APPENDIX D

Hydrology, Hydraulics, and Water Quality Technical Report

EIR Technical Appendix

Belcaro – Hydrology, Hydraulics, Water Quality

November 2025

Prepared For:

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PACE JN C323

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Appendix

Appendix A – Reference Reports

- Belcaro – Oak Springs Canyon Creek Preliminary Hydraulic Design Report, PACE 2025
- Hydrology Report – Belcaro at Sand Canyon, Alliance 2024
- LID Report – Belcaro at Sand Canyon, Alliance 2025

1 Introduction

The proposed Belcaro Project, in Santa Clarita, California, will develop 341 new homes on 194 acres east of Oak Springs Canyon Creek, and south of the Santa Clara River, in Santa Clarita, California. A vicinity map is shown in **Figure 1**. This report documents the regional hydrology, hydraulics, and impacts for the proposed project. This report serves as a technical appendix for the project specific EIR.

2 Relevant Authority and Guidance Documents

The project is within the incorporated city of Santa Clarita, In Los Angeles County. Project flood control, drainage, and water quality design are reviewed and approved by the City of Santa Clarita. The project stormwater discharges are permitted under the Los Angeles County MS4 Permit R4-2012-0175, and subsequent amendments. Water quality management for the Santa Clara River watershed is documented in the Enhanced Watershed Management Program, 2016, which lists the Water Body Pollutant Combinations subject to Total Maximum Daily Load, TMDL, values. The project water quality design follows the Los Angeles County Low Impact Development Standards Manual, 2014, which is utilized by the City of Santa Clarita for LID design guidance. Multiple reports and manuals were referenced for the Belcaro project, including the following:

- Enhanced Watershed Management Program, Upper Santa Clare River Watershed Management Study, February 2006
- City of Santa Clarita Urban Stormwater Mitigation Plan, 2013
- County of Los Angeles Low Impact Development Standards Manual, 2014
- Santa Clara River Valley East Groundwater Subbasin Groundwater Sustainability Plan, 2022
- LID Report, Belcaro at Sand Canyon Vesting Tentative Tract No. 084497, Alliance Land Planning & Engineering, August 2025 – Included in **Appendix A**
- Hydrology Report, Belcaro at Sand Canyon Vesting Tentative Tract No. 084497, Alliance Land Planning & Engineering, November 2024 – Included in **Appendix A**
- Low Impact Development Standards Manual, LADWP, February 2014
- FEMA Flood Insurance Study, Los Angeles County, June 2021
- Preliminary Hydraulic Design Report, Belcaro Oak Springs Canyon Creek, PACE, July 2025 – Included in **Appendix A**

3 Existing Drainage and Flow Patterns

The existing project property, shown on **Figure 2**, is relatively flat land on the plateau above the Santa Clara River. The property receives flow from tributary offsite watershed area to the east. The offsite flows and flows from the eastern two thirds of the project property drain north through three existing pipe culverts under the Metrolink Rail Line. The western third of the property drains directly to Oak Springs Canyon Creek.

The Santa Clara River, which borders the project on the north, drains more than 170 mi^2 upstream of the project and is subject to very large flows that are conveyed west through Ventura County to the Pacific Ocean.

Oak Springs Canyon Creek, which borders the project on the west, drains 5.8 mi^2 of watershed to the south and east of the project and flows to the Santa Clara River. Oak Springs Canyon Creek is generally dry and only flows during rainfall events. The effective FEMA 100-yr flowrate shown in the 2021 FIS, and used in the FEMA HEC-RAS model, is 1,140 cfs.

4 Proposed Drainage Components

The project does not encroach on Oak Springs Canyon Creek (OSCC), or on the Santa Clara River (SCR) with the development footprint, however, there are some crossings and some segments of rip rap erosion protection on OSCC and some rip rap aprons for tract drainage outlets on the overbank of the SCR.

4.1 Oak Springs Canyon Creek Drainage Components

The project development footprint does not encroach on Oak Springs Canyon Creek; however, the project does include crossings and some segments of rip rap erosion protection on Oak Springs Canyon Creek. The project utilizes two crossings, including an upgraded and extended culvert to replace the existing Oak Springs Canyon Road culvert and a new bridge for the eastward extension of Lost Canyon Road. There is a segment of rip rap channel lining in the area of the proposed Oak Springs Canyon Road culvert, and rip rap erosion protection about the Lost Canyon Road bridge abutments and piers. Summaries of the hydraulic design components are provided here, but the regional hydrology and hydraulic design are documented in detail in Belcaro – Oak Springs Canyon, Preliminary Hydraulic Design Report, PACE March 2025.

4.1.1 Proposed Oak Springs Canyon Road Culvert

The existing Oak Springs Canyon Road culvert will be replaced with a larger capacity culvert that extends farther downstream. The existing culvert consists of three 4-foot diameter barrels. Hydraulic modeling of the existing culvert shows that it is significantly undersized and overtops in a 10-year or greater storm, and the natural channel at the culvert outlet has experienced significant erosion. The proposed culvert will restore conveyance and sediment transport at Oak Springs Canyon Road.

The proposed culvert will be a three barrel, broken back box culvert, with each box having a 10-ft span and 10-ft rise. The upstream culvert segment is approximately 230 feet in length at a 0.052% slope, and the downstream segment is approximately 100 feet in length at a 0.001% slope. The plan and profile for the culvert are shown on **Figure 5.** A loose rock apron will be placed downstream of the culvert outlet for scour protection. 1-to rock is proposed for approximately 50 feet downstream of the culvert outlet, which will then transition to ½ ton rock for an additional 100 feet downstream. The configuration of the channel improvements and culvert are shown in **Figure 3**.

4.1.2 Proposed Lost Canyon Road Bridge

The existing Lost Canyon Road is a concrete road that crosses through the active channel of Oak Springs Canyon Creek approximately 550 feet downstream of the existing railroad bridge. Since this road will be a main access point to the Belcaro development, a new bridge is proposed to replace the existing crossing. The proposed bridge will have a 170-foot span with three 4-foot diameter piers in a single line. Rip rap

abutment protection is proposed to protect the bridge abutments from scour. Rip rap will extend from the abutments to the design scour depth. The proposed Lost Canyon Road abutment rip rap rock protection is detailed in **Figure 4**.

4.2 Santa Clara River Drainage and Water Quality Components

The project development footprint does not encroach on the Santa Clara River, however, all runoff generated onsite drains to the Santa Clara River, and two rip rap aprons are used to dissipate energy at the pipe outlets. The rip rap installations are placed the Santa Clara River overbank, outside of the FEMA 100-year floodplain.

4.3 Tract Drainage and Water Quality Components

The proposed project includes a stormwater drainage system that collects tributary offsite flows, and onsite runoff, and drains to two outlets on overbank of the Santa Clara River. No runoff from the tract drains to Oak Springs Canyon Creek. The drainage system can be seen on Sheet 2 and Sheet 3 of the Developed Condition Hydrology Exhibit from the Hydrology Report by Alliance Engineering and Land Planning, shown on **Figure 6** and **Figure 7**.

Debris basins on the east border of the project capture debris before offsite runoff enters the tract drainage system conveying the flow to the Santa Clara River. Two tract biofiltration water quality basins on the west side of the development treat stormwater flows generated onsite before discharging to the Santa Clara River. The two water quality basins are designed following the LA County LID Manual to treat the listed TMDL, the listed pollutants of concern, and pollutants typical of urban residential developments, as described in CASQA documentation and County of Los Angeles Low Impact Development Standards Manual. Any installed LID's will include certified full-capture trash removal units in compliance with Statewide Trash Control Requirements.

The water quality treatment system design is described in more detail in the LID Report. Following the LA County LID Manual, the tract will also utilize general LID design principles including source control measures such as community restrictions, signage, and landscaping management practices to limit urban pollutant generation

5 Project Hydrology

The hydrology for design and for impacts assessment is compiled from multiple sources, Including FEMA, USGS, and project reports by Alliance Land Planning & Engineering, and PACE

5.1 Oak Springs Canyon Creek Hydrology

Flowrates in Oak Springs Canyon Creek for the 10-year, 50-year, and 100-year events are published in the 2021 FEMA FIS and are utilized for impacts assessment. The flowrate for a 2-Year event was obtained using the USGS StreamStats online hydrology tool. The Oak Springs Canyon Creek flowrates, used for impacts assessment, are summarized in summarized in **Table 1.**

Table 1: Oak Springs Canyon Creek Hydrology

Return Storm	Flow Rate (cfs)	Data Source
2-year	115	USGS StreamStats
10-year	250	FEMA FIS
50-year	770	
100-year	1,140	

Note that PACE prepared a synthetic unit hydrograph analysis to develop a conservative 100-year flowrate used for hydraulic design of the rip rap and crossing structures. The calculated 100-year design flowrate is nearly three times the published FEMA 100-yr value and is only used for sizing hydraulic structures. The PACE design flowrate will not be used for FEMA floodplain mapping and is not used for impacts assessment.

5.2 Santa Clara River Hydrology

The project has no structural revisions in the Santa Clar River. Although the project onsite drainage outlets to the Santa Clara River, and has rip rap aprons for erosion protection, the outlets are on the overbank of the river. The outlets and rip rap aprons are outside of the floodplain limits shown on the 2021 FEMA FIRM. The flowrates for the Santa Clara River shown in the FIS are developed using the gross watershed hydrology. The hydrology includes all the tributary inflows for an anticipated developed watershed condition, including the Belcaro project property.

5.3 Belcaro Tract Onsite Hydrology

Onsite drainage is described in the tract Hydrology Report for existing conditions and proposed conditions.

6 Project Impacts Analysis

The Belcaro project is analyzed for project impacts and significance. The CEQA criteria for significance evaluate the project hydrology, hydraulics, and water quality effects on environmental resources by examining multiple conditions.

- The project will satisfy water quality standards and waste discharge requirements.
- The project will not substantially decrease groundwater supplies or impede groundwater recharge.
- The project will not result in substantial erosion or siltation.
- The project will increase surface runoff in a manner that causes flooding.
- The project will not contribute additional runoff that would exceed the capacity of current or future drainage systems.
- The project will not impede or alter the direction of flood flows.
- The project will not conflict with a water quality control plan or groundwater management plan.

The Belcaro project is analyzed for hydrology and hydraulic impacts to Oak Springs Canyon Creek and to the Santa Clara River, and for water quality impacts from the project.

6.1 Oak Springs Canyon Creek

Hydraulic analysis for Oak Springs Canyon Creek was performed using HEC-RAS 1D modeling. The FEMA effective model was revised using the latest topographic data to create a corrected effective model that is used for existing conditions analysis. The proposed project design was used to develop the proposed conditions model for proposed conditions analysis.

The hydraulics of Oak Springs Canyon Creek were analyzed in existing conditions, and in proposed conditions, for the 2-Year event, the 10-Year event, 50-Year event, and the 100-Year event. The flow depth and flow velocity were analyzed and differentials, proposed minus existing, were prepared.

The flow existing conditions flow depth, the existing conditions velocity, the proposed conditions flow depth, the proposed conditions velocity, and the flow depth and velocity differentials are shown, for each analyzed storm event, in **Figures 8 – 31**.

It can be seen in **Figures 8 – 31** that the flow depths and flow velocities are the same, almost everywhere, for all the modeled storm events. Impacts to depths and velocities, shown the depth and velocity differential exhibits are localized in the vicinity of the proposed project elements. Depth increases of approximately one-half foot or less occur around the proposed bridge piers, and in the vicinity of the proposed culvert and rip rap channel lining. Velocity increases and decreases, of approximately 2.5 ft/s or less occur in the vicinity of the proposed bridge, and in the vicinity of the proposed culvert and the short length of rip rap channel lining.

Almost the entire reach of Oak Springs Canyon Creek, from upstream of Oak Springs Canyon Road, to the Santa Clara River, shows no change to depths or velocities during any of the modeled storm events.

Impacts to depth and impacts to velocity in Oak Springs Canyon Creek are minor and localized to the areas of the proposed bridge, culvert, and rip rap. The rip rap protects the streambed from erosion and dissipates increases in energy so that the hydraulic flow conditions return to normal within the length of rip rap protection. The proposed crossings at Oak Springs Canyon Road and Lost Canyon Road are not anticipated to result in increased impacts.

The flowrate in Oak Springs Canyon Creek is minimally altered. There is no considerable addition of flow from the impervious surfaces of the proposed culvert and bridge, however, a portion of the project property that drains directly to Oak Springs Canyon Creek in existing conditions will be conveyed in the proposed tract drainage system, shown on the tract drainage exhibits. This will result in a small reduction of flow conveyed by the reach of Oak Springs Canyon Creek from approximately 2,000 feet upstream of Lost Canyon Road to the Santa Clara River. This alteration to area tributary to the creek is very small relative to watershed size, and represents a small fractional change.

Groundwater protection is the vicinity of the project is sustainably managed through the Santa Clara River Valley East Groundwater Subbasin Groundwater Sustainability Plan (SCV-GSA). The plan focuses on maintaining water supply for municipal, agricultural, and domestic uses, and to protect the groundwater from harm. This project aligns with the SCV-GSA plan by helping to maintain sufficient groundwater quality, since runoff is treated. Any wells within the project site will be protected and/or appropriately abandoned in place.

Impacts to hydrology and flow in Oak Springs Canyon Creek are minor and localized to an approximately 2,000 foot long reach along the downstream end of the project. The flowrate change will not cause measurable change in creek sediment transport, or natural erosion and aggradation processes.

6.2 Santa Clara River

Runoff from the tract flows through two outflow locations. The same tributary offsite area and tract area that flows to the Santa Clara River in existing conditions is drained through the tract drainage system. The western part of the tract property that drains to Oaks Springs Canyon Creek in existing conditions, is drained through the tract drainage system to the Santa Clara River in proposed conditions.

The outflows utilize rip rap aprons to dissipate energy and prevent erosion. The rip rap aprons are on the overbank of the Santa Clara River, so there is no effect on the floodplain. The drainage from the rip rap aprons, in proposed conditions, takes the same overland route as existing conditions flow.

There are no impacts to the flow and hydraulics of the Santa Clara River within the floodplain. Rip rap outlets on the overbank of the Santa Clara River dissipate energy in the flow from the tract before it flows from the outlets to the Santa Clara River floodplain.

The tract design is required to use basins and LID design to limit outflows in proposed conditions, which prevent peak hydrology impacts to the Santa Clara River.

The tract drainage uses LID design principles and has two biofiltration basins for water quality treatment, shown on the tract drainage plans, and will include source control measures. The tract water quality system is designed to manage the one TMDL pollutant, E. Coli, and the three pollutants of concern, Copper, Mercury, and Cyanide, listed in the Upper Santa Clara River Enhanced Watershed Management Program for the Santa Clara River. Additionally, the tract water quality system will manage and treat the common pollutants associated with urban developments, but not generally present in runoff from natural land, suspended solids, trash, oil and grease, metals, nutrients, BOD constituents, and toxic organics.

Because of the tract LID design and the proposed tract water quality basins, pollutants generated onsite will be minimized, and runoff generated onsite will be treated before discharging to the Santa Clara River. The tract water quality system will be designed to minimize and treat typical pollutants from urban developments are and to treat the specific TMDL and pollutants of concern in the Santa Clara River. As a result, water quality impacts to runoff from will be minimal and water quality impacts to the Santa Clara River will not be significant.

7 Project Impacts and Conclusions

The Belcaro project is designed to minimize or eliminate changes to flow and hydraulics in Oak Springs Canyon Creek and the Santa Clara River, and to runoff from the project development area. The proposed project impacts are assessed using CEQA significance conditions, which include:

a. Violation of any water quality standards or waste discharge requirements, or sizable degradation of water quality

b. Decrease in groundwater supplies or impediment to sustainable groundwater management

c. Substantial alteration to drainage patterns in a way that:
   i. causes substantial erosion or siltation
   ii. alters runoff causing flooding
   iii. increases runoff so that capacity of stormwater drainage system is exceeded or produces substantial additional pollutants
   iv. impedes or redirects flood flows

d. Conflict with implementation of water quality control plan and sustainable groundwater management plan

The tract implements low impact development design, as described in the tract LID report, included in **Appendix A**. The LID design includes source controls and treatment controls to manage standard urban pollutants, pollutants of concern and the listed TMDL for the Santa Clara River. The tract design complies with Los Angeles County MS4 Permit R4-2012-0175 and does not degrade water quality. Thus, the tract does not cause significant impacts under Criteria a.

As described in the tract LID report, the groundwater recharge is not significantly reduced. The increase in impervious surface is offset by the addition of the two infiltration water quality basins, and multiple debris basins which will all provide additional recharge in proposed conditions. The net effect is that the proposed tract will not cause significant impacts to groundwater recharge, or impede sustainable groundwater management under Criteria b.

The project does not cause any change in flowrate in the Santa Clara River. The project does not cause any change to the hydraulics or sediment transport in the Santa Clara River. As described in the tract LID report, there is a very minor reduction in flow to Oak Springs Canyon Creek, however this does not effect sediment transport capacity. Areas near the Oak Springs Canyon Road crossing are lined with rip rap to prevent erosion. Additional rock abutment protection is specified at Lost Canyon Road to prevent erosion. All proposed structures are sufficiently protected against scour.

Tract runoff has not increased. Flood flows maintain the original courses in Oak Springs Canyon Creek and in the Santa Clara River, with no net increase in flowrate and no substantial increase in pollutants. The tract drains to the Santa Clara River, which has a capital flow event in excess of 25,000 cfs, and so the project is exempt from hydromodification controls. Thus, the project does not cause significant impacts under Criteria c.

The project conforms with the City of Santa Clarita water quality control guidance, as documented in the tract LID report, which includes the City of Santa Clarita Urban Stormwater Mitigation Plan checklist. The project is covered, with the city, by the Los Angeles County MS4 Permit. The project is compatible with the city and county water quality and groundwater management, so the tract does not cause significant impacts under Criteria d.

The Belcaro project includes minor physical intrusion in Oak Springs Canyon Creek and minimal physical intrusion on the Santa Clara River overbank. The project creates very minor and localized changes to flow hydraulics in portions of Oak Springs Canyon Creek but includes rip rap as a protective measure to prevent

erosion. The tract utilizes LID design and water quality control measures to manage runoff and pollutants from the tract development. The tract does not create hydrology, hydraulics, or water quality impacts that are significant under any of the listed CEQA criteria.

PACE
Advanced Water Engineering

Figures

Legend

Stream Centerline

Soledad Canyon Rd

Norland Dr

Norland Dr

Soledad Canyon Rd

Soledad Canyon Rd

Soledad Canyon Rd

Santa Clara River

Santa Clara River

Mitchell Elementary School

Alder Peak Ave

Winterdale Dr

Kenroy Ave

Sand Canyon Rd

N Prairie Ln

Dune Ln

Ada St

Sam Pl

Marilyn Dr

Flowerpark Dr

Gladiolus Dr

Winterdale Dr

Sand Canyon Rd

Lost Canyon Rd

Arial Way

Zion Dr

Comet Way

Oak Spring Canyon Rd

Robinson Ranch Golf Course

Robinson Ranch Rd

Robinson Ranch Rd

Valley Ranch Rd

14

14

14

Edwards Air Force Base

Lancaster

Project Location

Palmdale

Santa Clarita

Santa Clara River

Simi Valley

Thousand Oaks

Pasadena

El Monte

Los Angeles

Inglewood

Downey

Norwalk

P:\C323\GIS\Projects\C323_Belcaro\C323_Belcaro.aprx - Vicinity Map

BELCARO

PROJECT VICINITY MAP

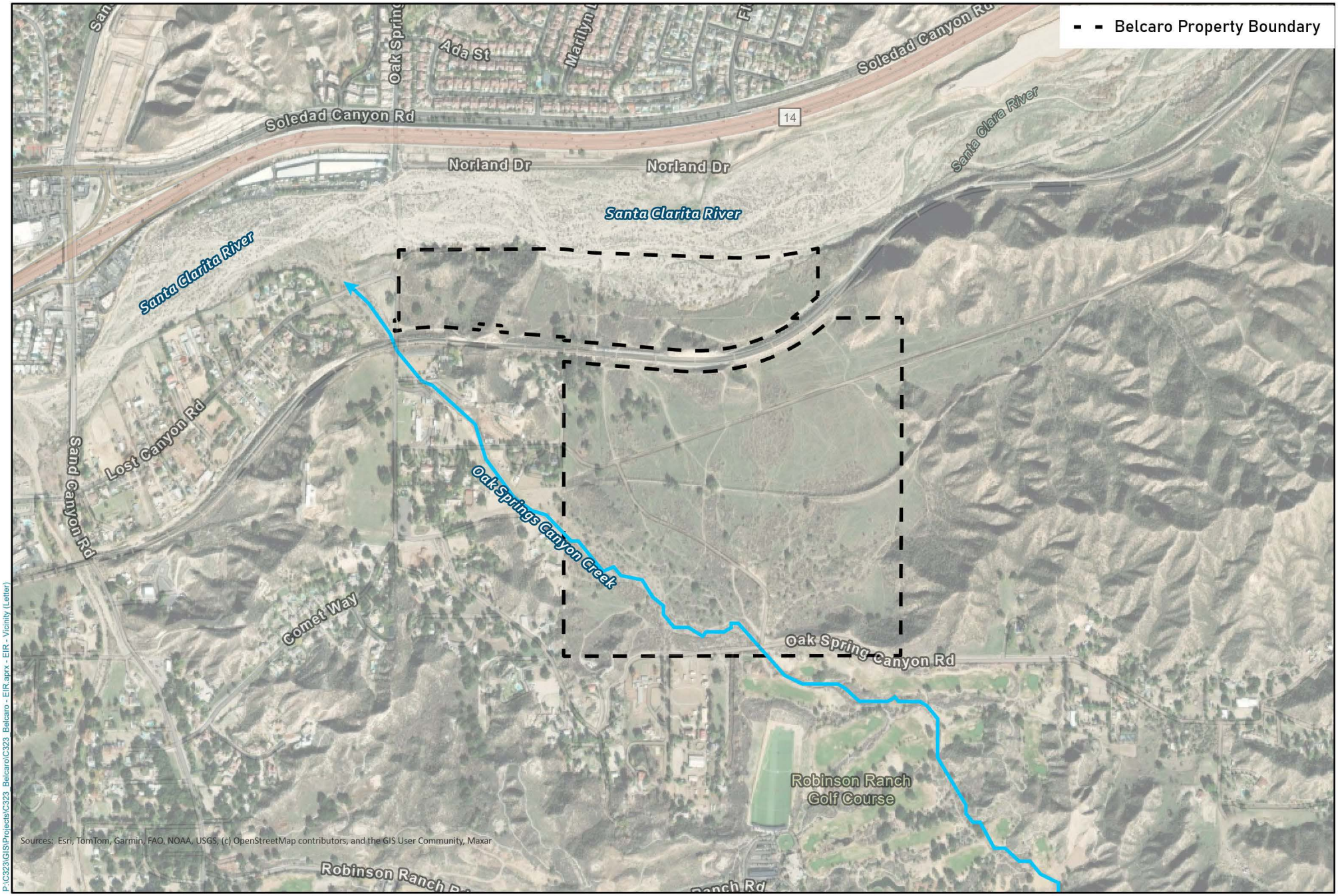
PACE Advanced Water Engineering

0 500 1,000 2,000 Feet

Date: 2025-11-19

Job Number: B323

Exhibit 1



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BELCARO

Existing Condition At Project Site

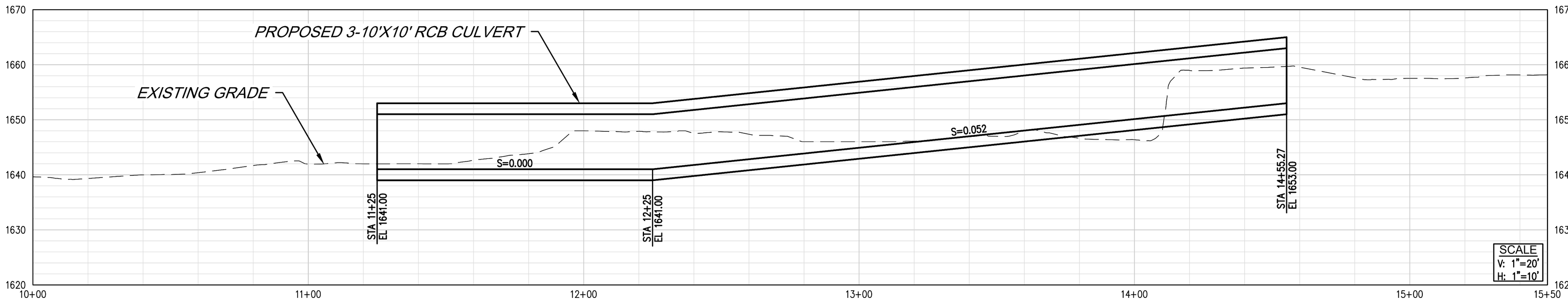
PACE Advanced Water Engineering

0 500 1,000 2,000 Feet

Date: 2025-07-29

Job Number: C323

Figure 2



PROFILE

PLAN

NO	BY	DATE	REVISIONS	DATE	APP.

PREPARED BY
EMR

R.C.E. NO. — # XXXX
EXP. xx/xx/xx

DRAWN
B.P.

DESIGNED
EMR

CHECKED
A.R.

SCALE

DATE
11/19/2025

TITLE
OAK SPRINGS CANYON CREEK CULVERT LAYOUT

JOB
BELCARO OAK SPRINGS
SANTA CLARITA CA

PACE
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P: (714) 481-7300 | www.pacewater.com

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P:\C323\Engineering\Global\Exhibits\GR_Exhibits\C323_Exhibit 3_CULVERT LAYOUT.dwg - Tab: 24x36 - by emreig on 11/19/25 at 2:55:35 PM

LOST CANYON ROAD

TOE OF ROCK SLOPE PROTECTION (BURIED)

TOE OF ROCK SLOPE PROTECTION (BURIED)

DAYLIGHT

DAYLIGHT

DAYLIGHT

DAYLIGHT

PROPERTY BOUNDARY

ACCESS ROAD

ACCESS ROAD

ACCESS ROAD

R=300'

R=750'

(PUB.)

NORTH

40 0 40 80

SCALE 1"=40'

NO	BY	DATE	REVISIONS	DATE	APP.

PREPARED BY
EMR

R.C.E. NO. — # XXXX
EXP. xx/xx/xx

DRAWN
B.P.

DESIGNED
EMR

CHECKED
A.R.

SCALE

DATE
11/19/2025

TITLE

LOST CANYON ROAD BRIDGE LAYOUT

JOB

BELCARO
OAK SPRINGS

SANTA CLARITA CA

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PROPOSED RIP-RAP

BEGIN ½-TON RIPRAP

END ½-TON RIPRAP

BEGIN 1-TON RIPRAP

10+00

11+00

12+00

13+00

14+00

15+00

15+50

STA 11+25.00

STA 12+25.00

STA 14+55.27

TRAIL

"J" STREET

CANYON ROAD

OAK SPRINGS

1656 PAD

1656 PAD

1654 PAD

1652 PAD

PROPOSED 3-10'X10' RCB CURLVERT

DAYLIGHT

DAYLIGHT

PROPERTY BOUNDARY

PROPERTY BOUNDARY

2:1

SD

1645

1650

1655

1660

1665

1670

NORTH

20 0 20 40

SCALE 1"=20'

NO	BY	DATE	REVISIONS	DATE	APP.

PREPARED BY
EMR

R.C.E. NO. ___ # XXXX
EXP. 9/xx/xx

DRAWN
B.P.

DESIGNED
EMR

CHECKED
A.R.

SCALE

DATE
XX/XX/98

TITLE
OAK SPRINGS CANYON ROAD BRIDGE AND "J" STREET CULVERT

JOB
BELCARO
OAK SPRINGS
WORKMAP

CA
SANTA CLARITA

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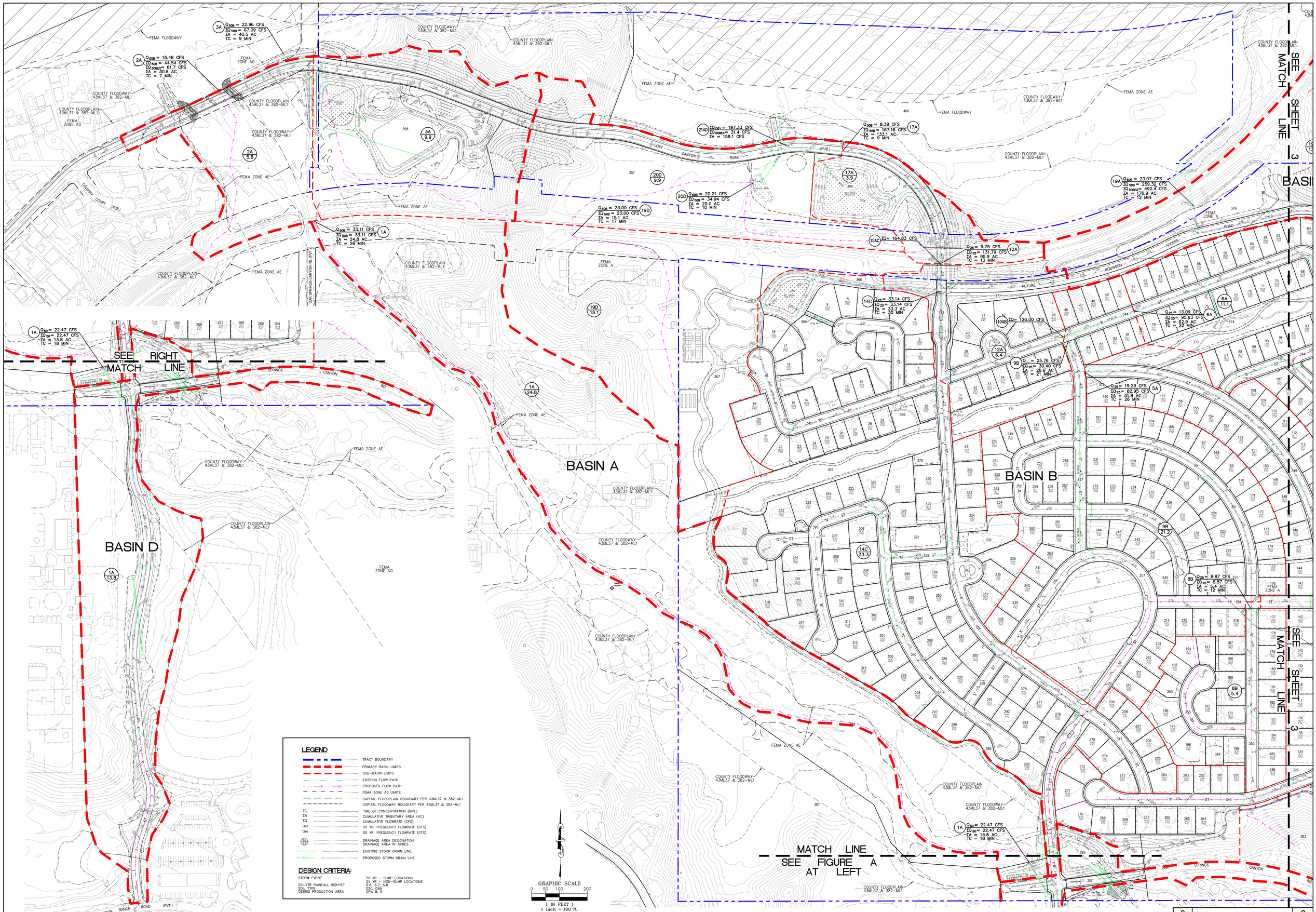

ALLIANCE LAND PLANNING & ENGINEERING INC.
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PLANS PREPARED BY:
ALLIANCE LAND PLANNING & ENGINEERING INC.
2248 FARADAY AVE. CARLSBAD, CA. 92008
(760) 431-9896

PLANS PREPARED UNDER THE DIRECTION OF:
CRAIG M. WHITTEKER R.C.E. 51929 — 11/8/24 DATE

REGISTERED PROFESSIONAL ENGINEER — CRAIG M. WHITTEKER — NO. 51929 — EXP 6-30-26 — CIVIL — STATE OF CALIFORNIA

PLAN PREPARED FOR:
NUWI-SAND CANYON, LLC
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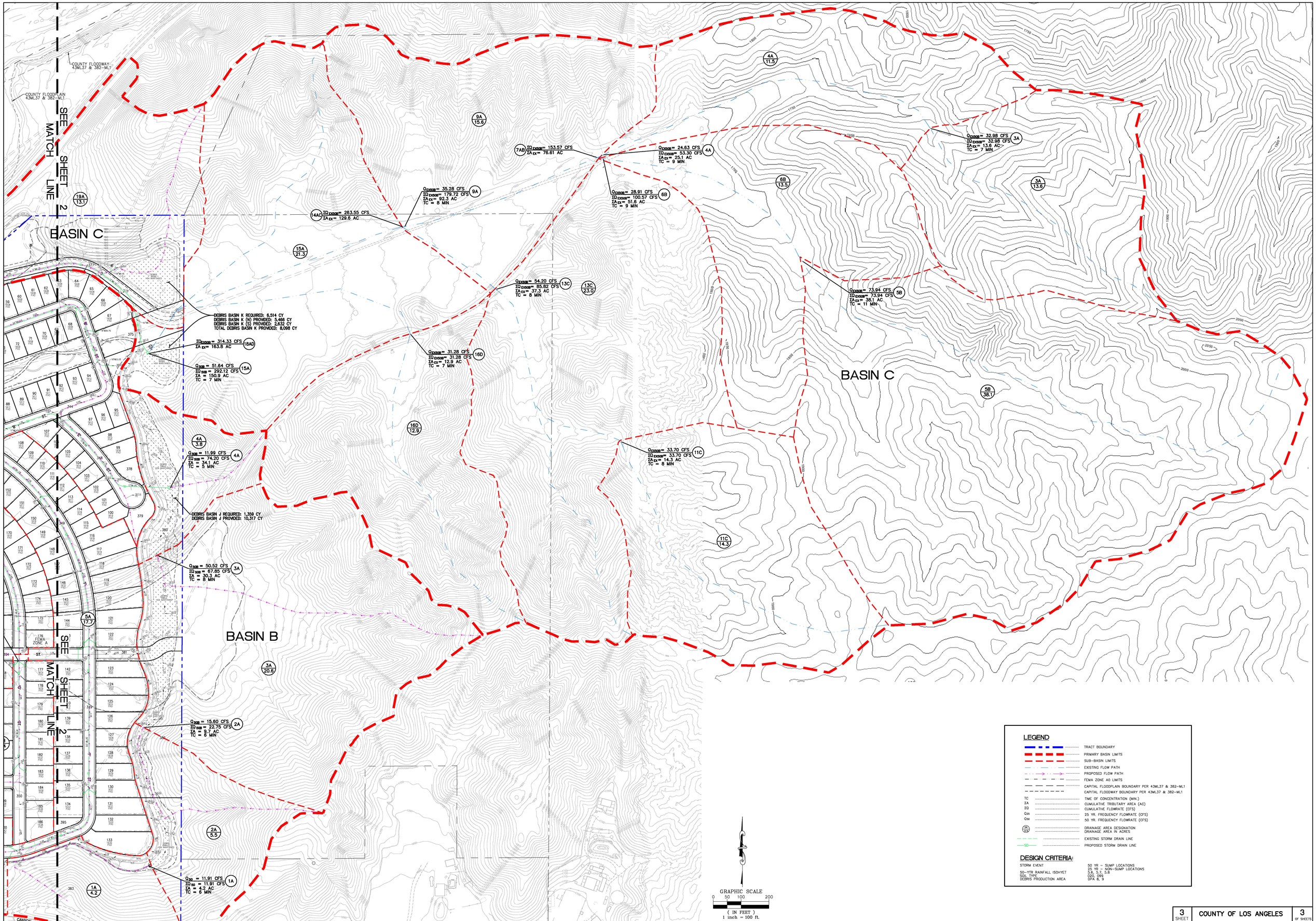
SANTA MONICA, CA 90403
TEL: (916) 717-8599
ATTN: COREY HARPOLE

NO.	DATE		BY	APPR

2 SHEET | COUNTY OF LOS ANGELES | 3 OF SHEETS

DEVELOPED CONDITION HYDROLOGY EXHIBIT
BELCARO AT SAND CANYON
VTTM 084497

I: \CAD\2330\HYDROLOGY\DEVELOPED CONDITION\2330_DEV_CONDITION_HYDROLOGY.dwg



GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 inch = 100 ft.

LEGEND

- TRACT BOUNDARY
- PRIMARY BASIN LIMITS
- SUB-BASIN LIMITS
- EXISTING FLOW PATH
- PROPOSED FLOW PATH
- FEMA ZONE AO LIMITS
- CAPITAL FLOODPLAIN BOUNDARY PER 43ML37 & 382-ML1
- CAPITAL FLOODWAY BOUNDARY PER 43ML37 & 382-ML1
- TC — TIME OF CONCENTRATION (MIN.)
- ΣA — CUMULATIVE TRIBUTARY AREA (AC)
- ΣQ — CUMULATIVE FLOWRATE (CFS)
- Q25 — 25 YR. FREQUENCY FLOWRATE (CFS)
- Q50 — 50 YR. FREQUENCY FLOWRATE (CFS)
- (A) 2.5 — DRAINAGE AREA DESIGNATION / DRAINAGE AREA IN ACRES
- EXISTING STORM DRAIN LINE
- SD — PROPOSED STORM DRAIN LINE

DESIGN CRITERIA:

STORM EVENT	50 YR – SUMP LOCATIONS 25 YR – NON-SUMP LOCATIONS
50-YR RAINFALL ISOHYET	5.6, 5.7, 5.8
SOIL TYPE	020, 069
DEBRIS PRODUCTION AREA	DPA 8, 9

ALLIANCE LAND PLANNING & ENGINEERING INC.
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27413 TOURNEY ROAD SUITE 120 VALENCIA, CA 91355
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CIVIL ENGINEERING • LAND PLANNING • HILLSIDE DESIGN • SURVEYING

PLANS PREPARED BY:
ALLIANCE LAND PLANNING & ENGINEERING INC.
2248 FARADAY AVE. CARLSBAD, CA. 92008
(760) 431-9896

PLANS PREPARED UNDER THE DIRECTION OF:
CRAIG M. WHITTEKER R.C.E. 51929 — 11/8/24 DATE

REGISTERED PROFESSIONAL ENGINEER — CRAIG M. WHITTEKER — NO. 51929 — EXP 6-30-26 — CIVIL — STATE OF CALIFORNIA

PLAN PREPARED FOR:
NUWI-SAND CANYON, LLC
2001 WILSHIRE BLVD. SUITE 401
SANTA MONICA, CA 90403
TEL: (916) 717-8599
ATTN: COREY HARPOLE

NO.	DATE		BY	APPR

3 SHEET | COUNTY OF LOS ANGELES | 3 OF SHEETS

DEVELOPED CONDITION HYDROLOGY EXHIBIT BELCARO AT SAND CANYON VTTM 084497

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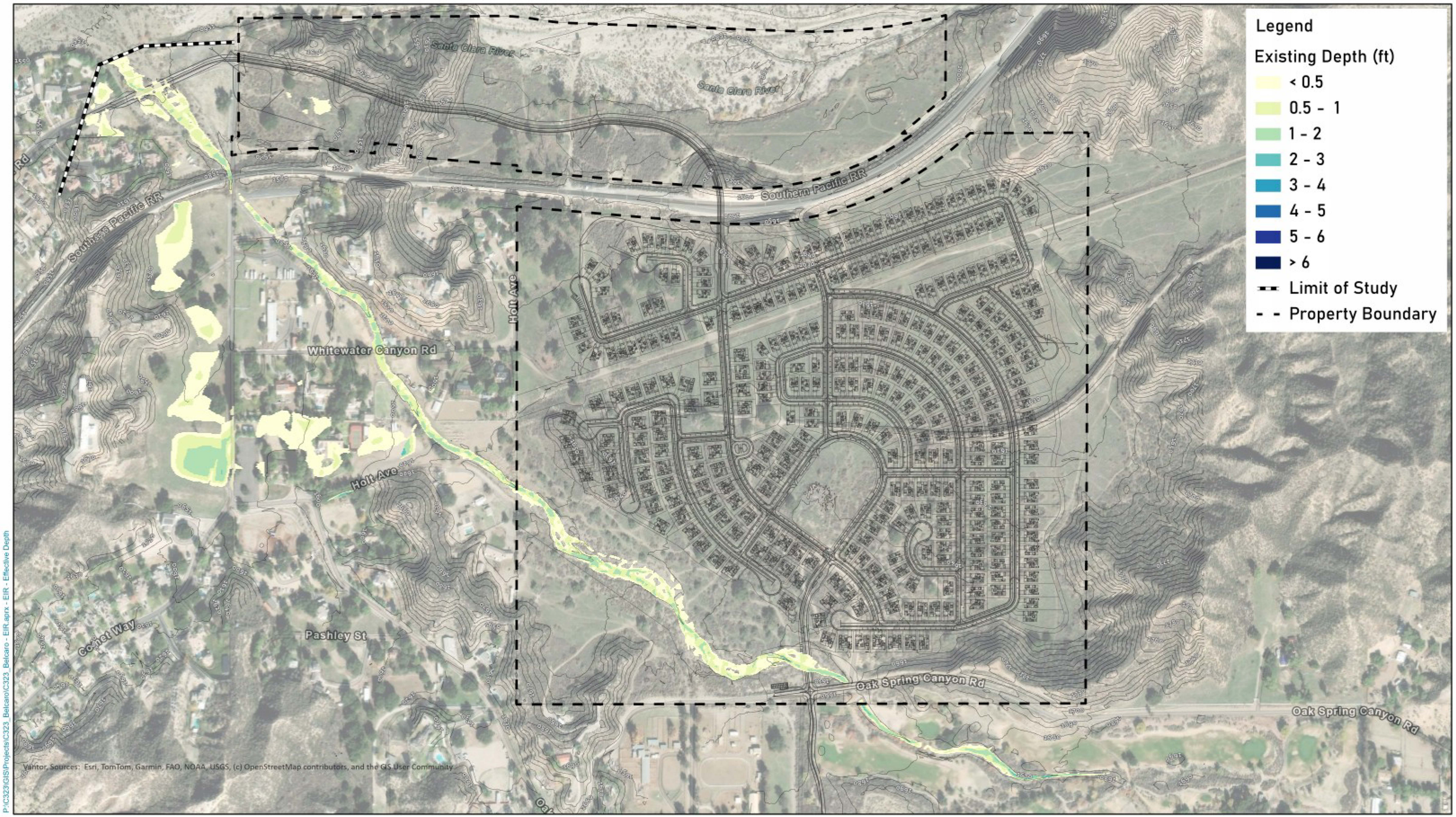

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BELCARO EIR

Existing Flood Depth 2-Year

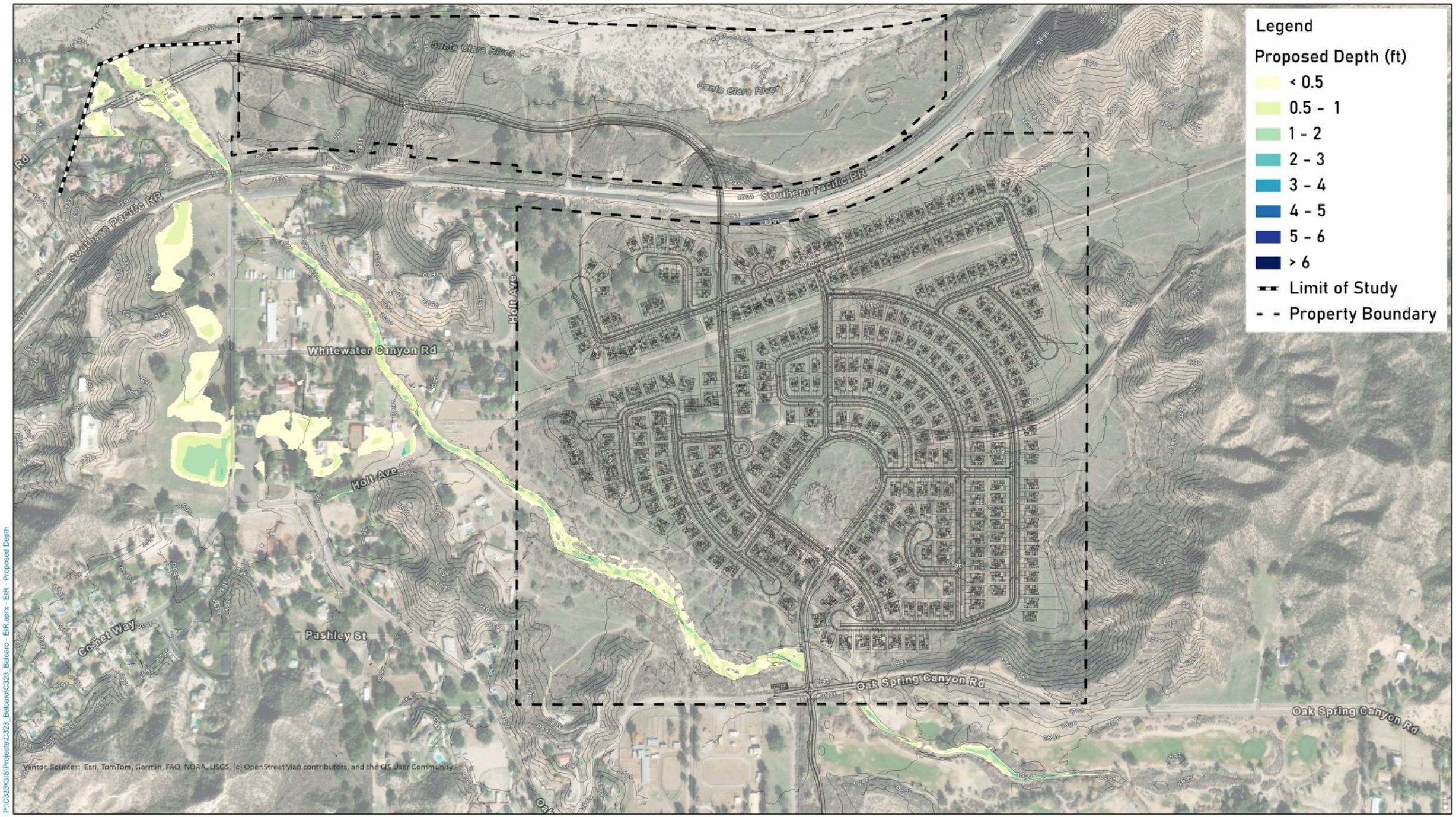
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 8



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BELCARO EIR

Proposed Flood Depth 2-Year

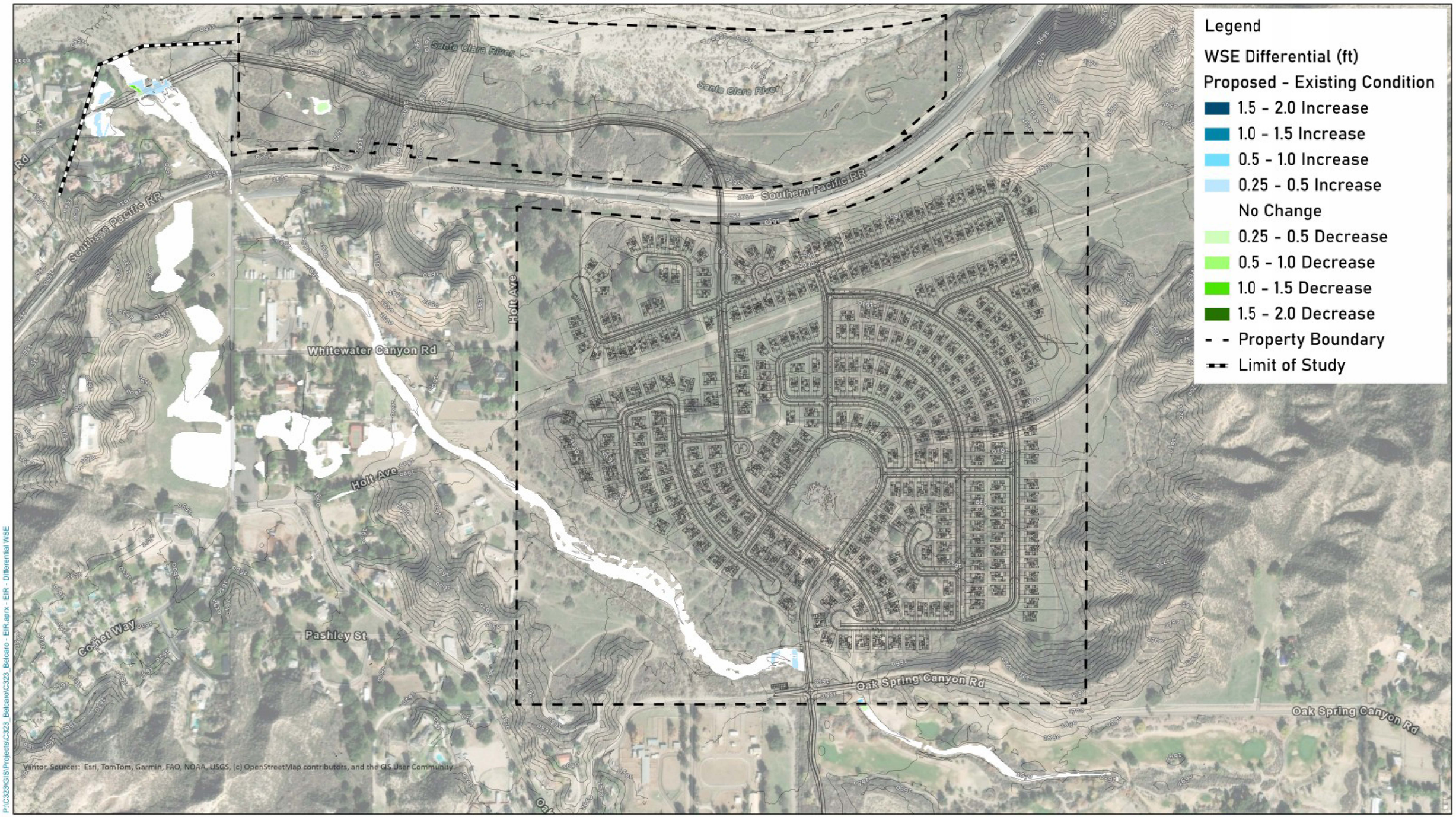
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 9



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BELCARO EIR

Water Surface Elevation Differential
2-Year

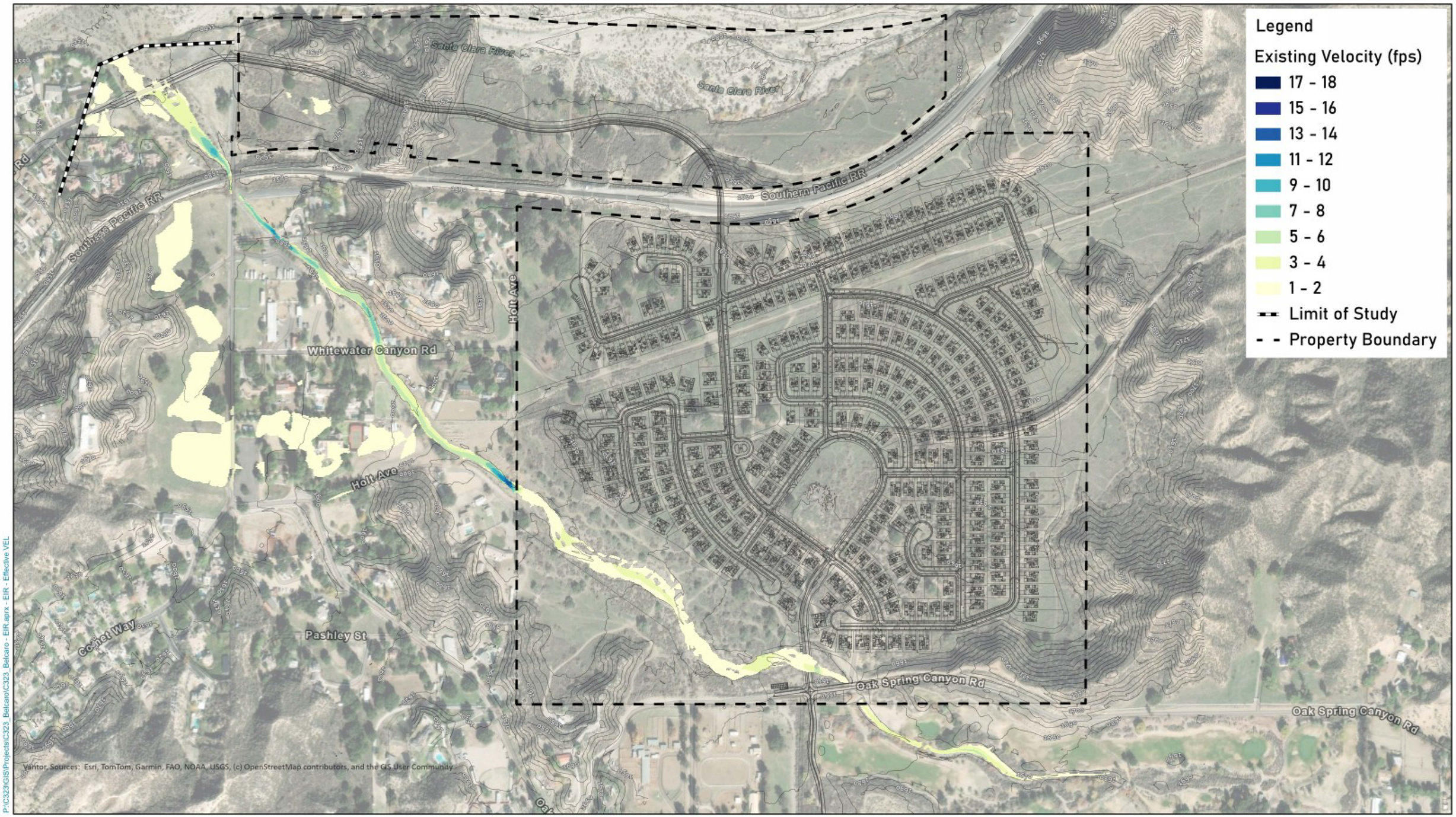
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 10



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BELCARO EIR

Existing Velocity 2-Year

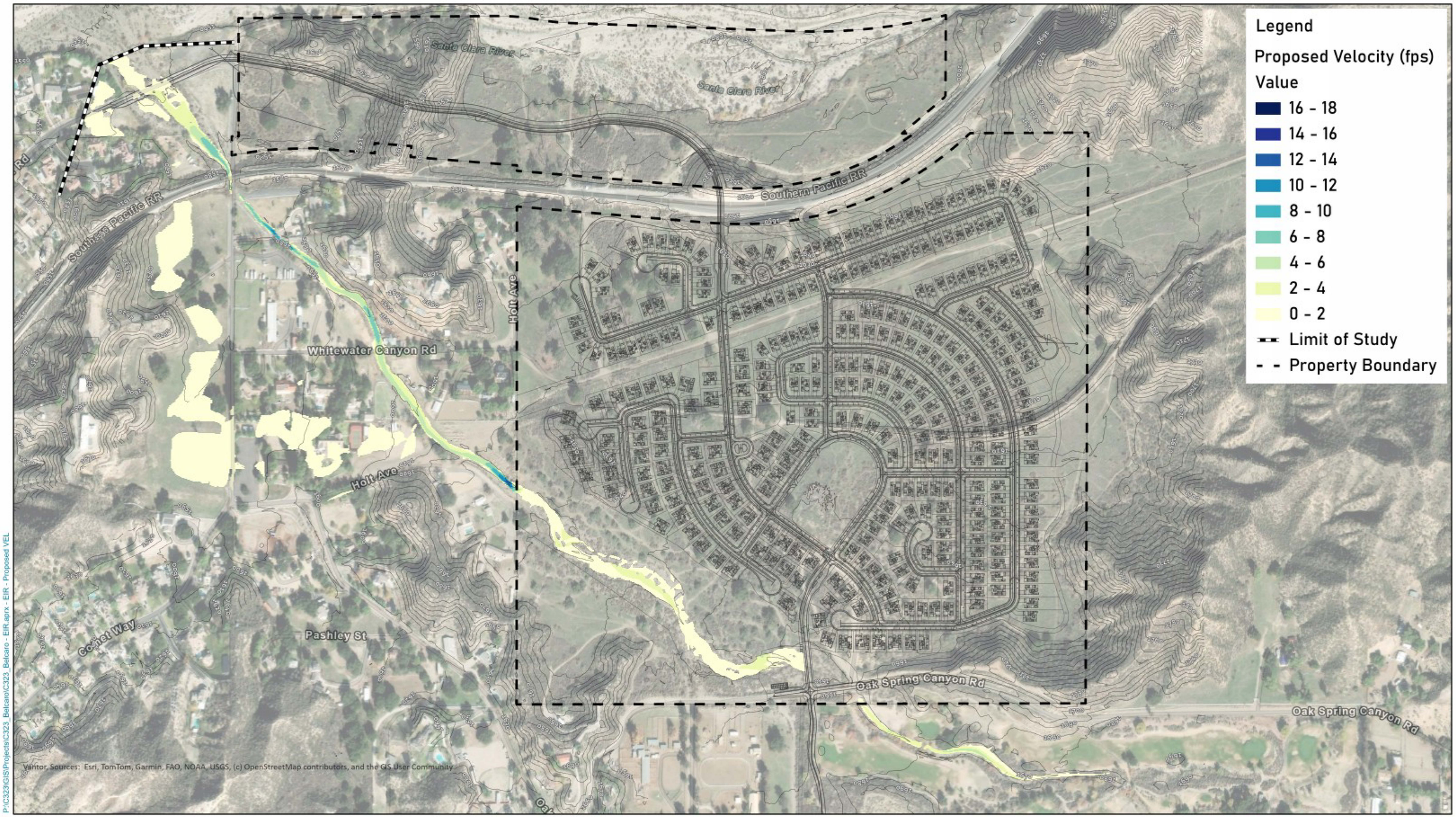
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 11



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BELCARO EIR

Proposed Velocity 2-Year

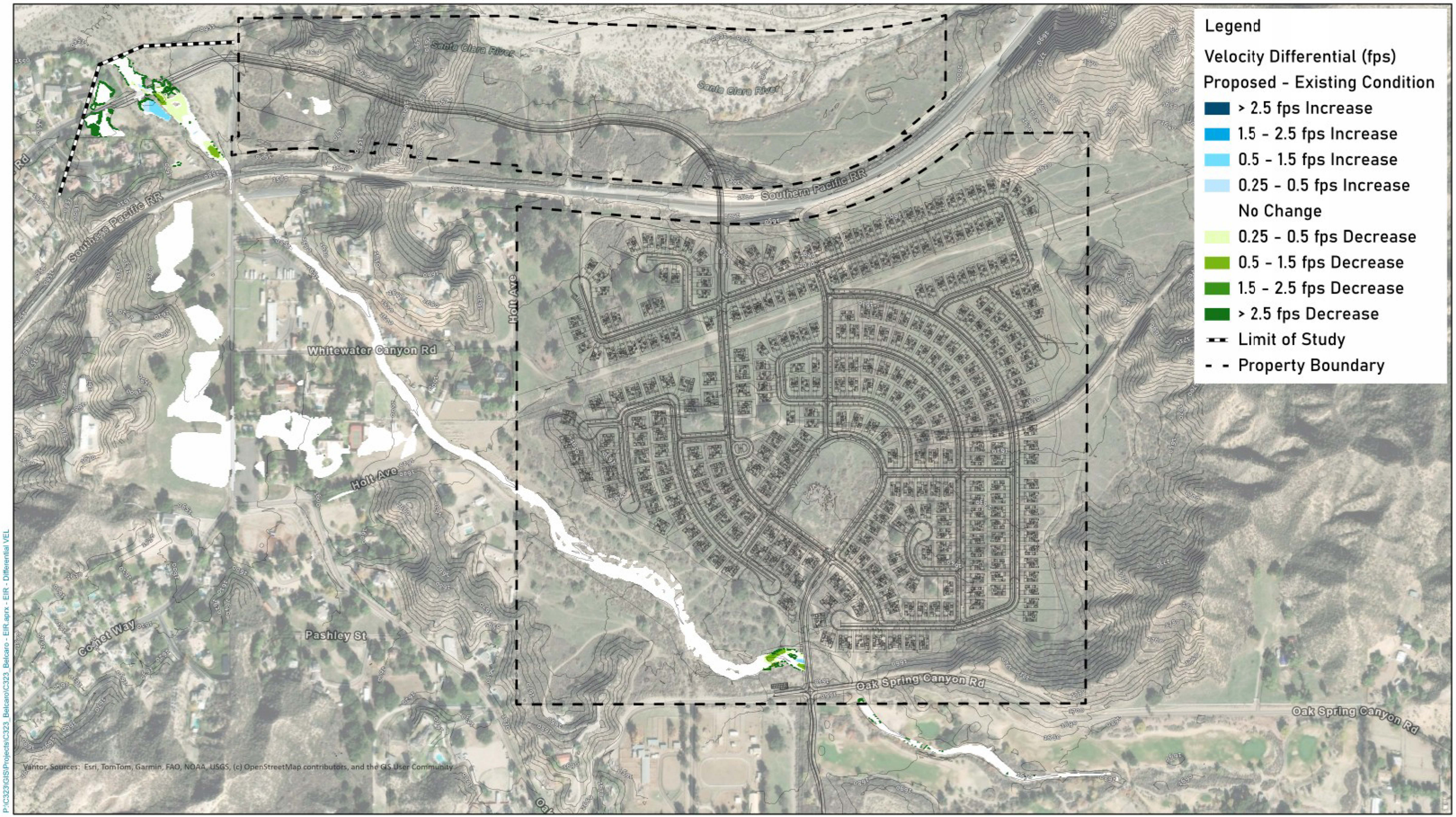
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 12



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BELCARO EIR

Velocity Differential 2-Year

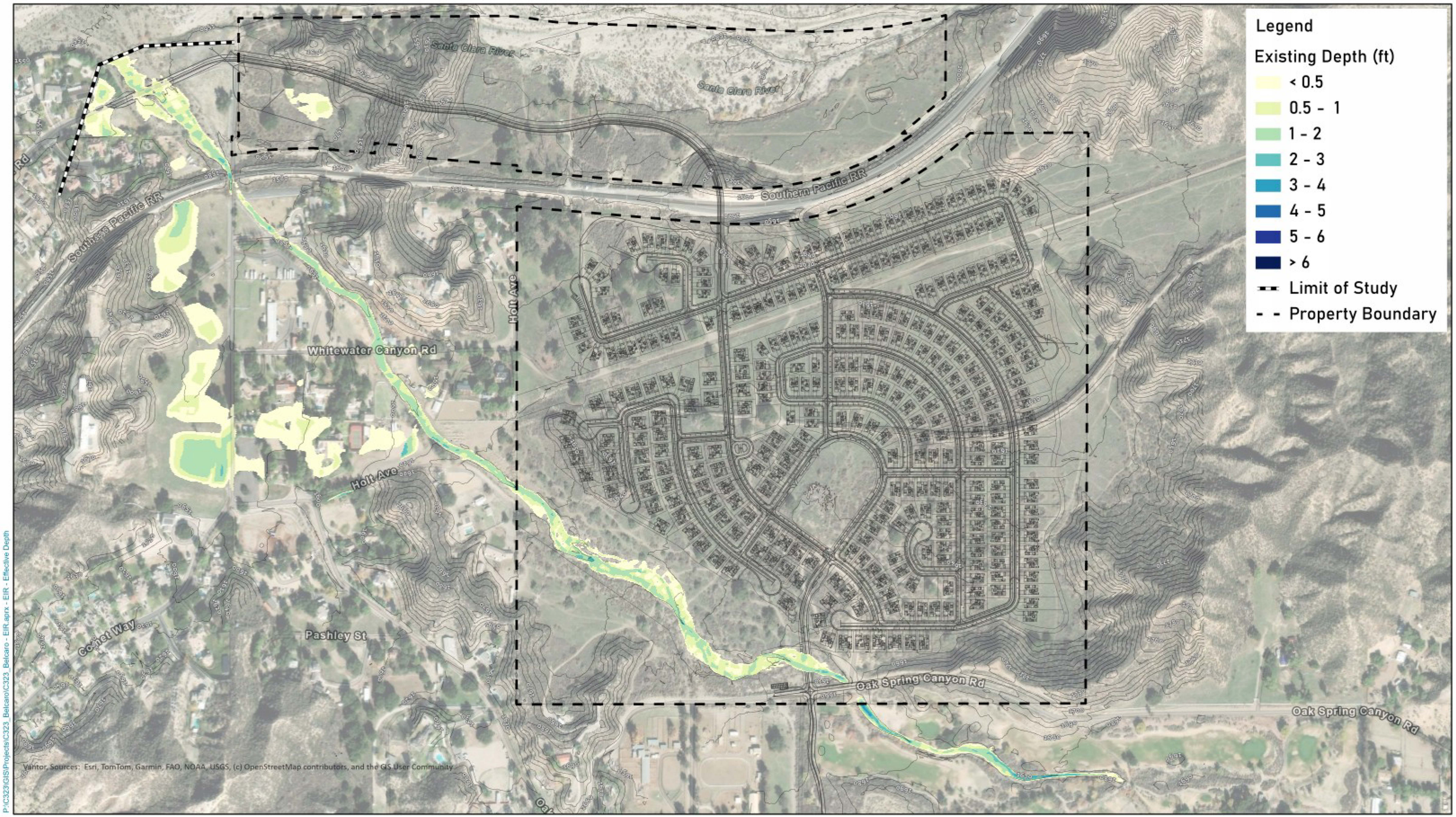
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 13



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BELCARO EIR

Existing Flood Depth 10-Year

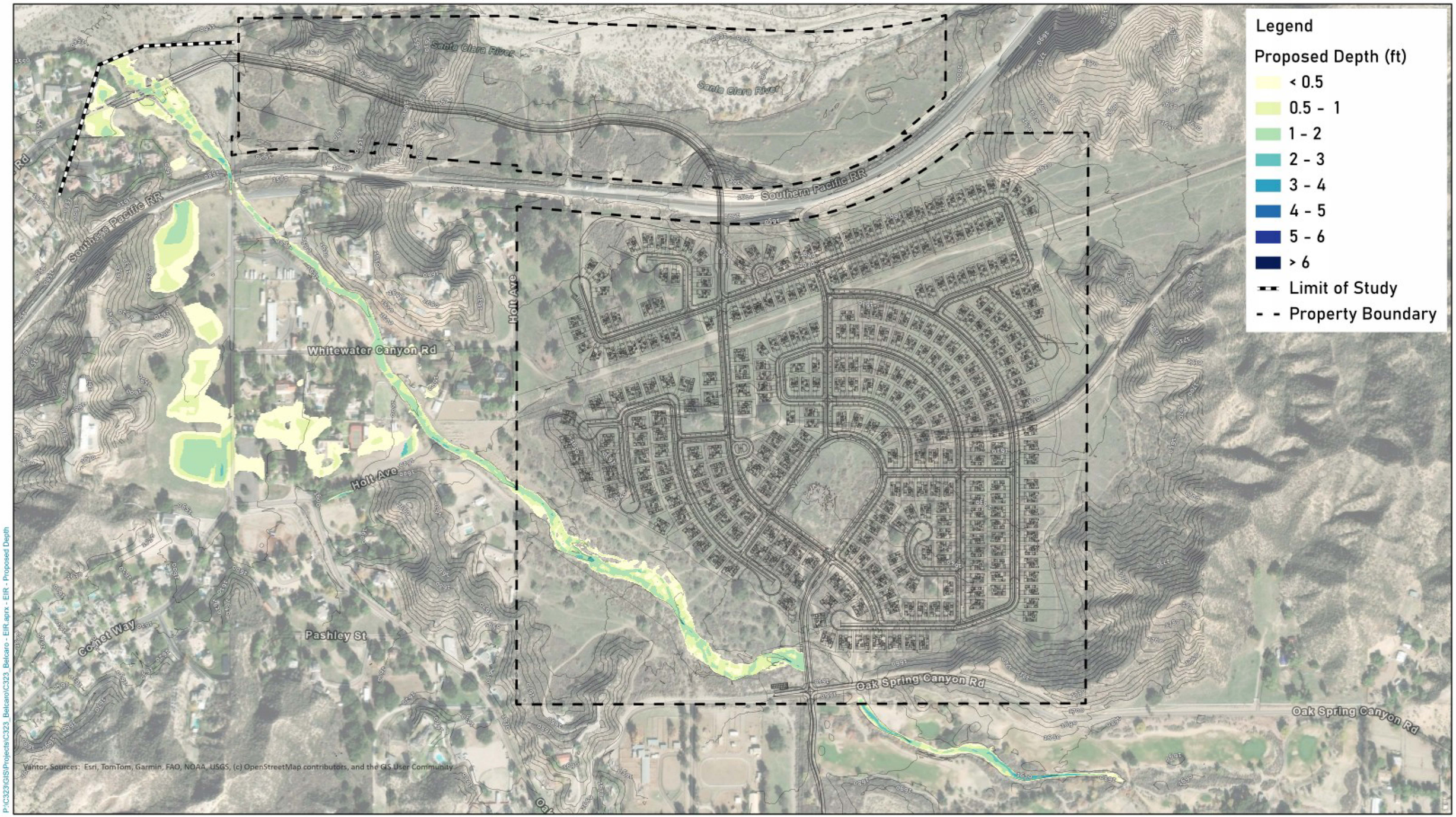
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 14



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BELCARO EIR

Proposed Flood Depth 10-Year

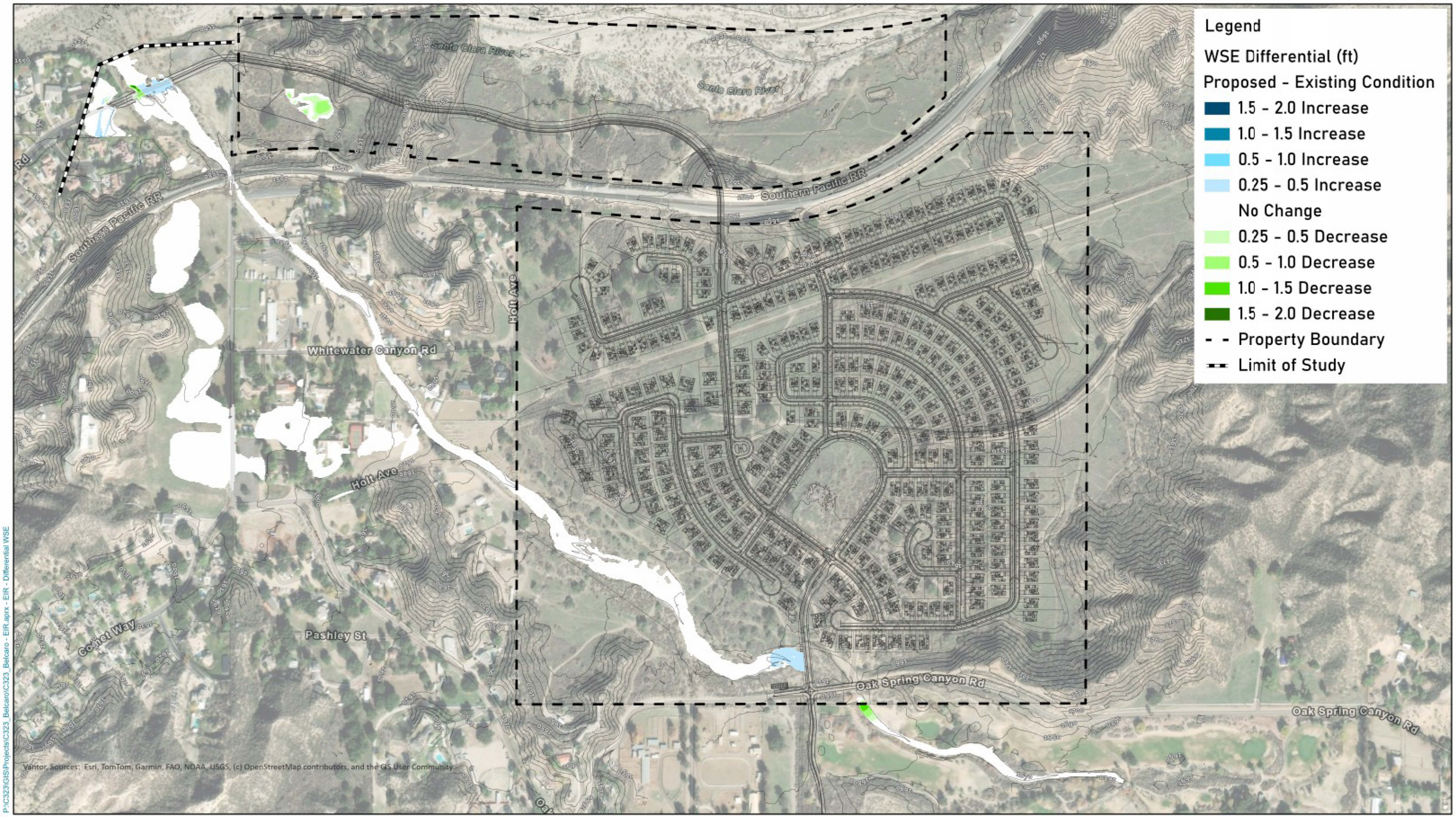
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 15



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BELCARO EIR

Water Surface Elevation Differential
10-Year

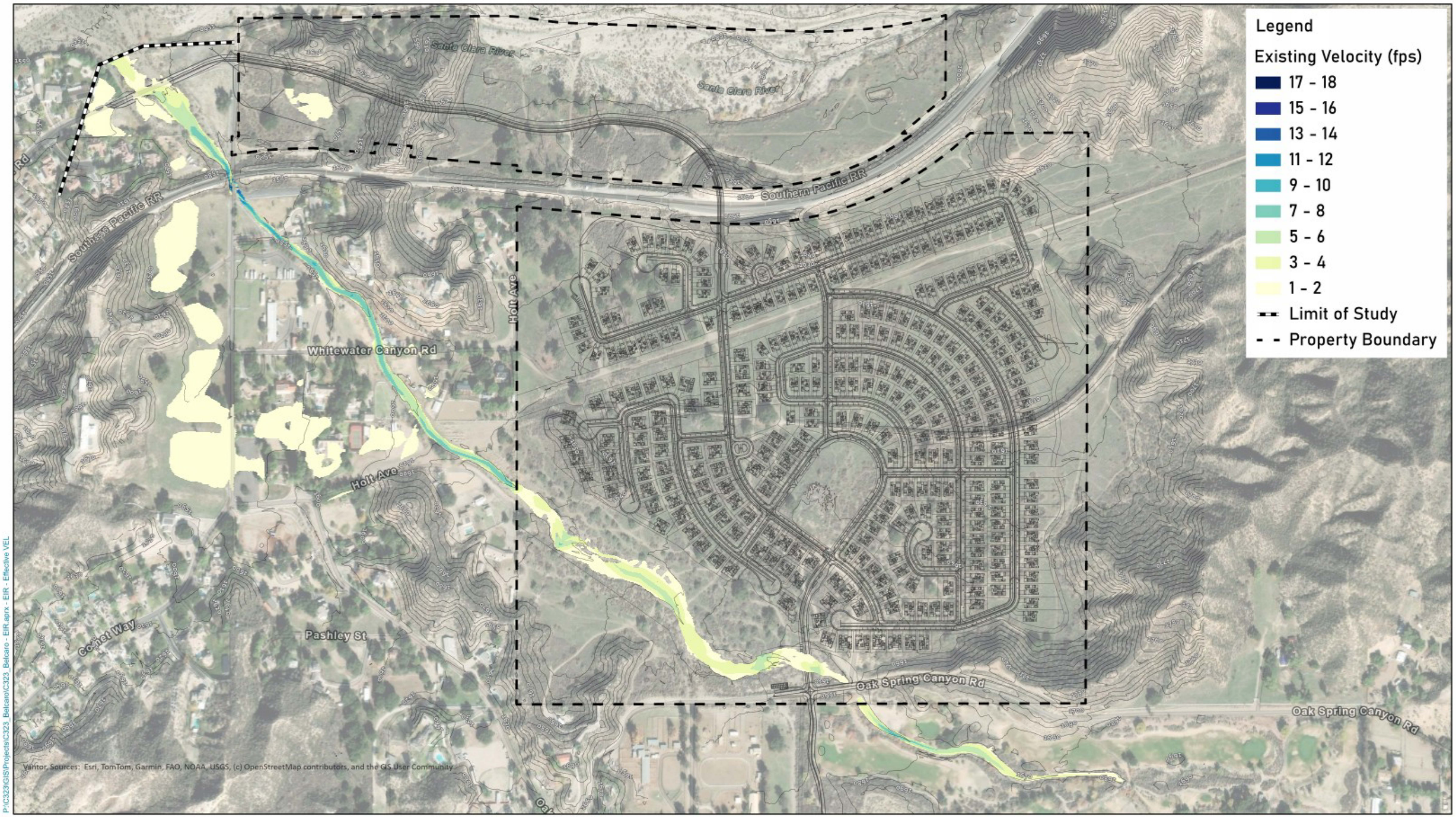
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 16



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BELCARO EIR

Existing Velocity 10-Year

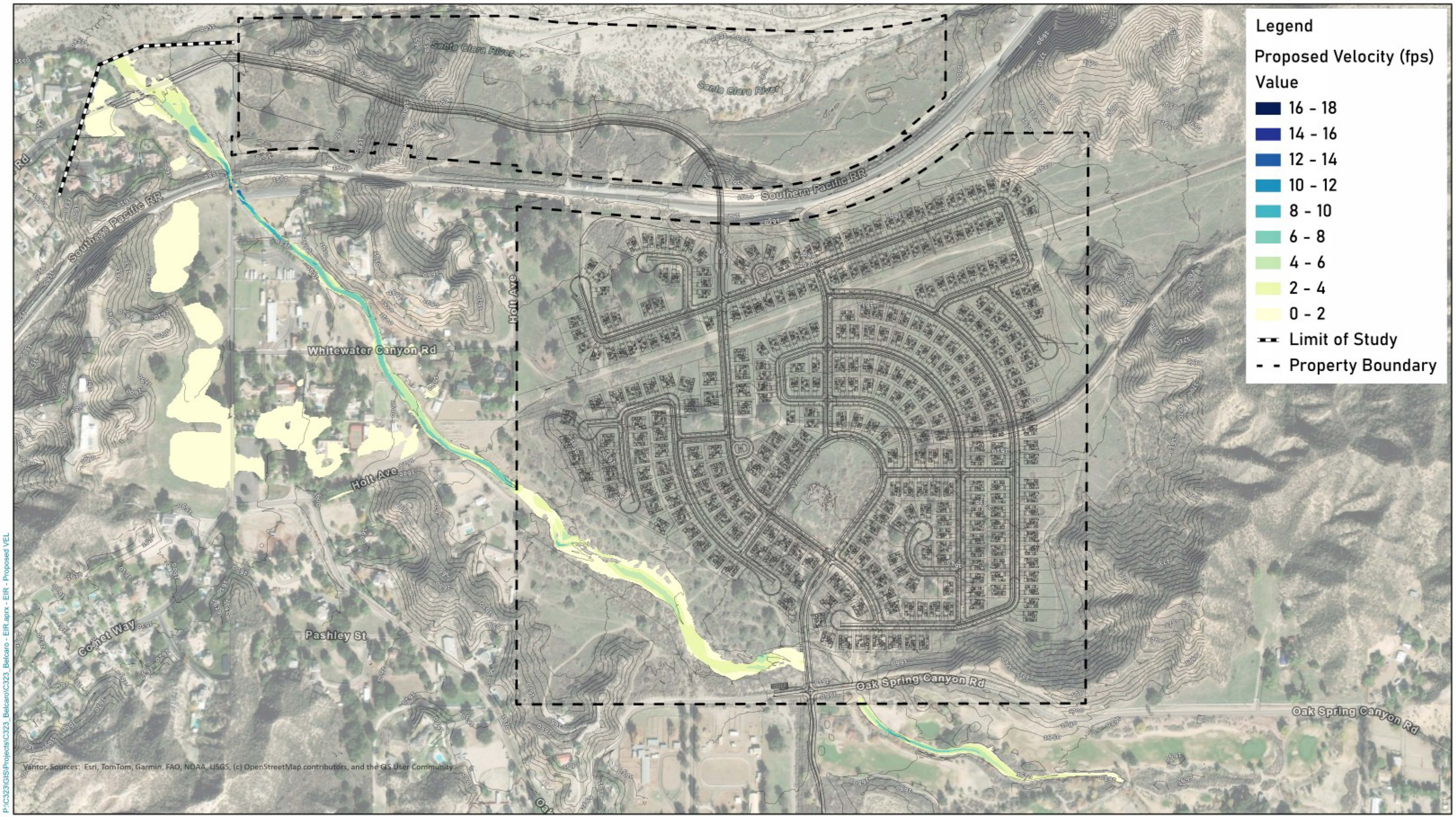
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 17



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BELCARO EIR

Proposed Velocity 10-Year

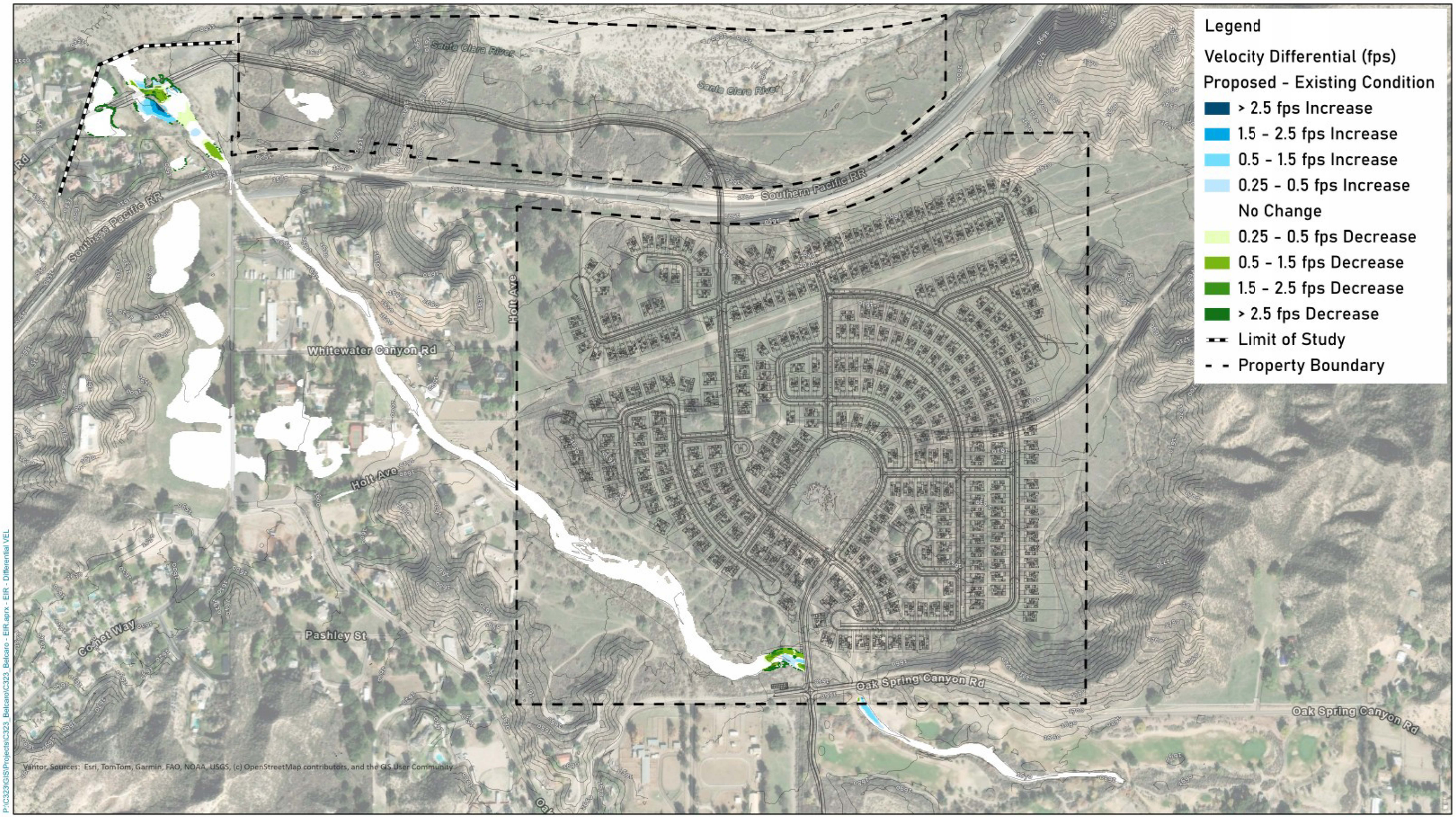
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 18



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BELCARO EIR

Velocity Differential 10-Year

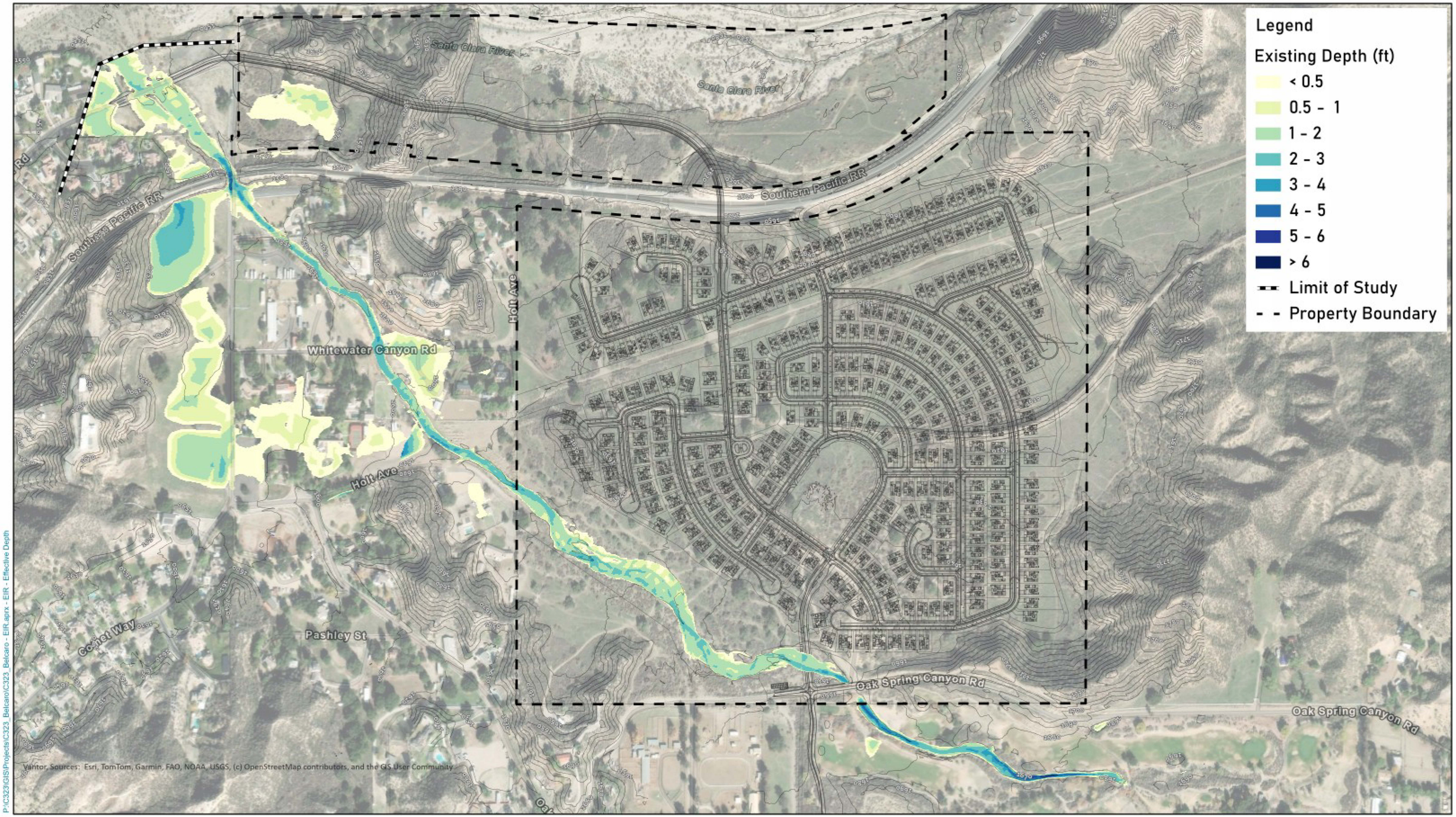
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 19



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BELCARO EIR

Existing Flood Depth
50-Year

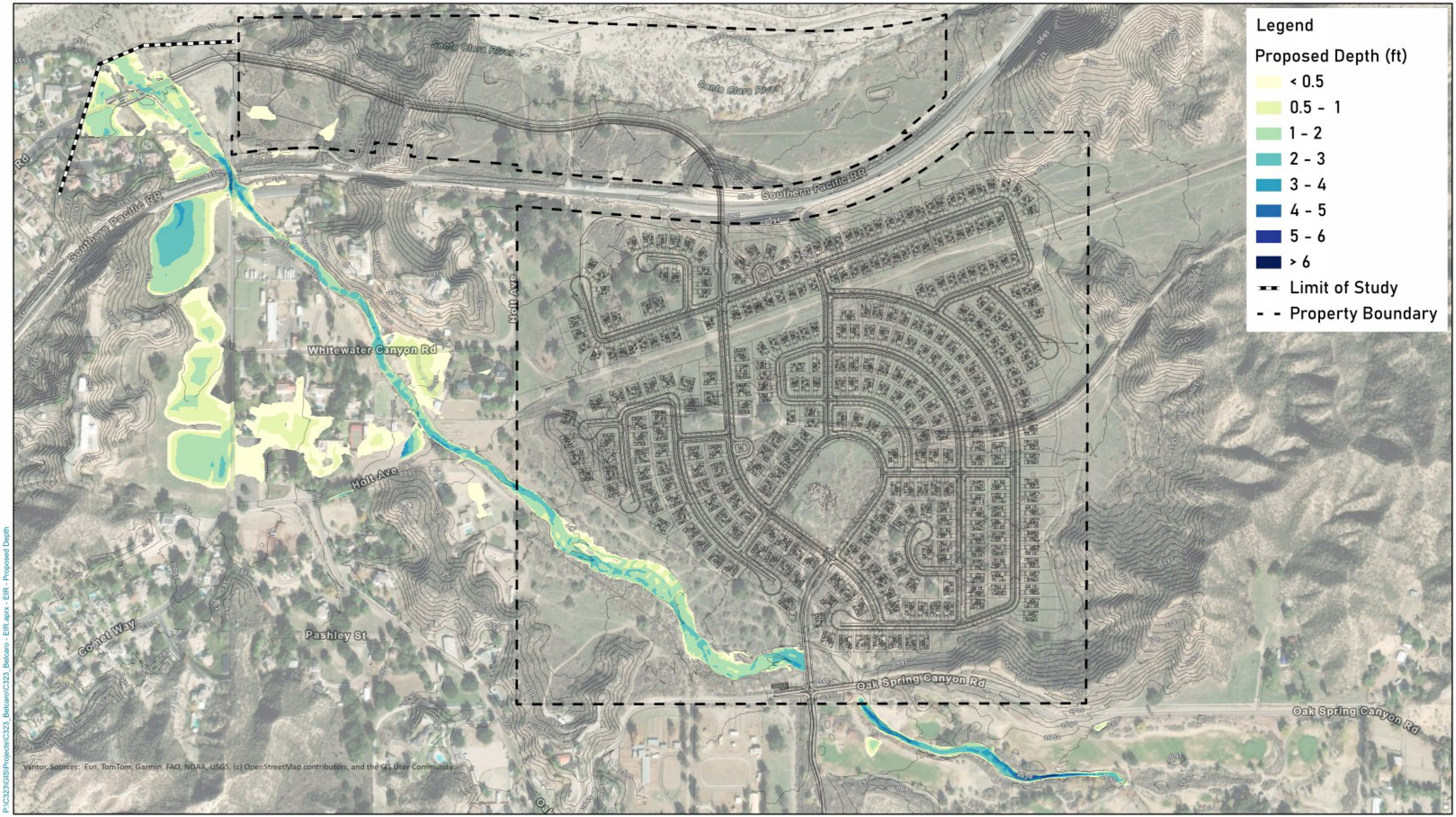
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 20



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BELCARO EIR

Proposed Flood Depth
50-Year

PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 21

P:\C323\GIS\Projects\C323_Belcaro\C323_Belcaro - EIR.aprx - EIR - Differential WSE

BELCARO EIR

Water Surface Elevation Differential 50-Year

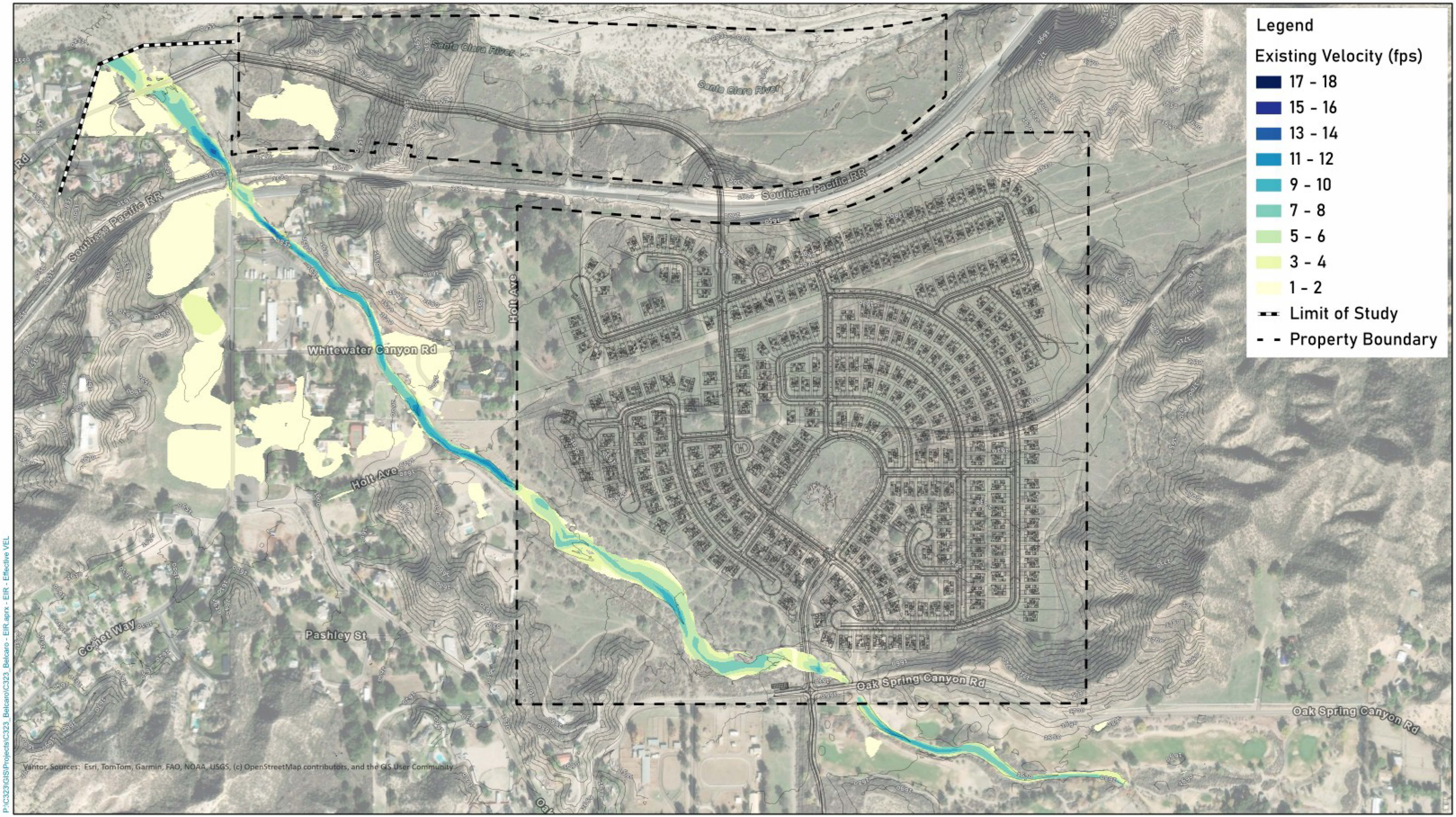
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 22



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BELCARO EIR

Existing Velocity 50-Year

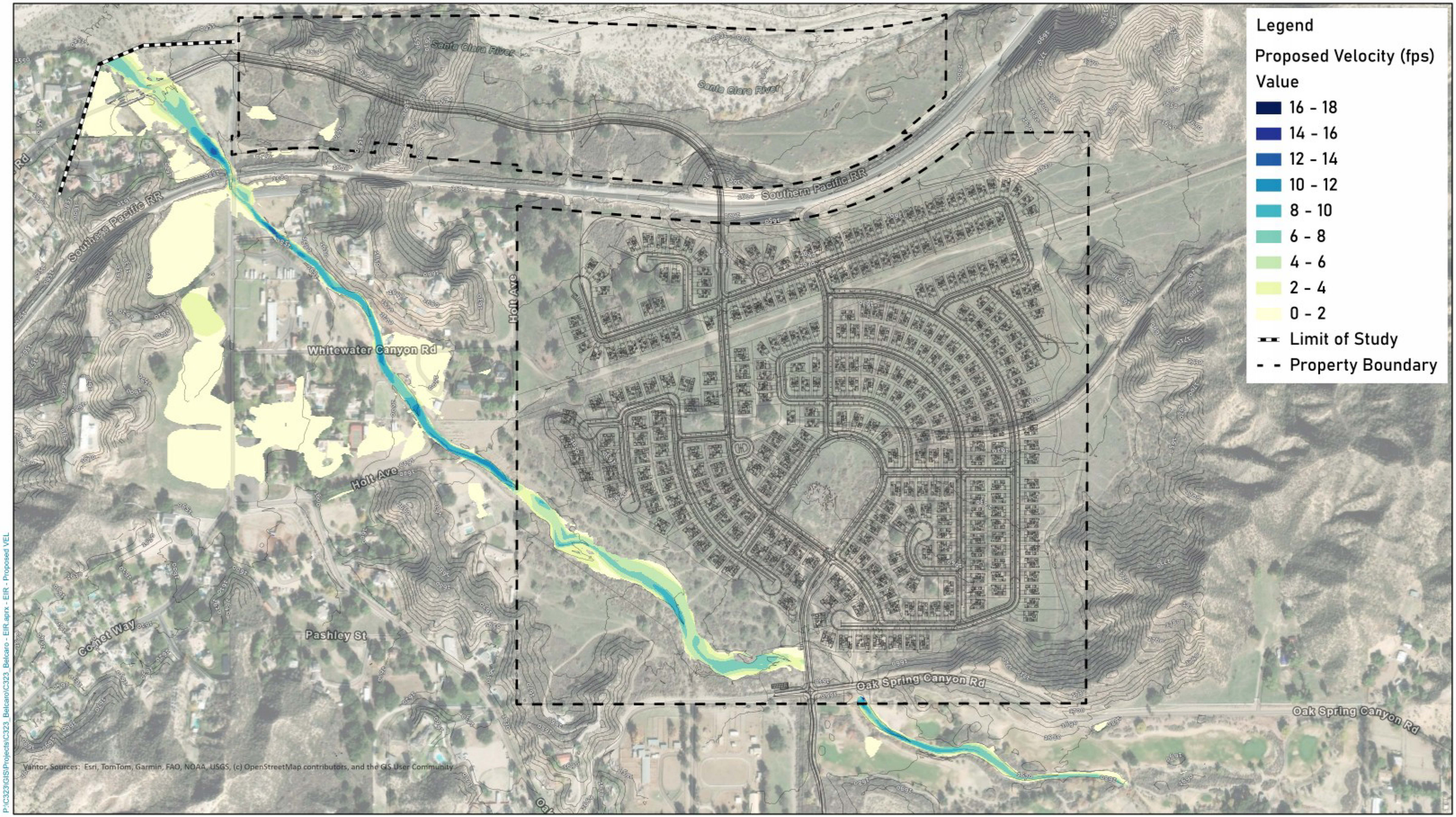
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 23



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BELCARO EIR

Proposed Velocity 50-Year

PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 24

P:\C323\GIS\Projects\C323_Belcaro\C323_Belcaro - EIR.aprx - EIR - Differential VEL

BELCARO EIR

Velocity Differential
50-Year

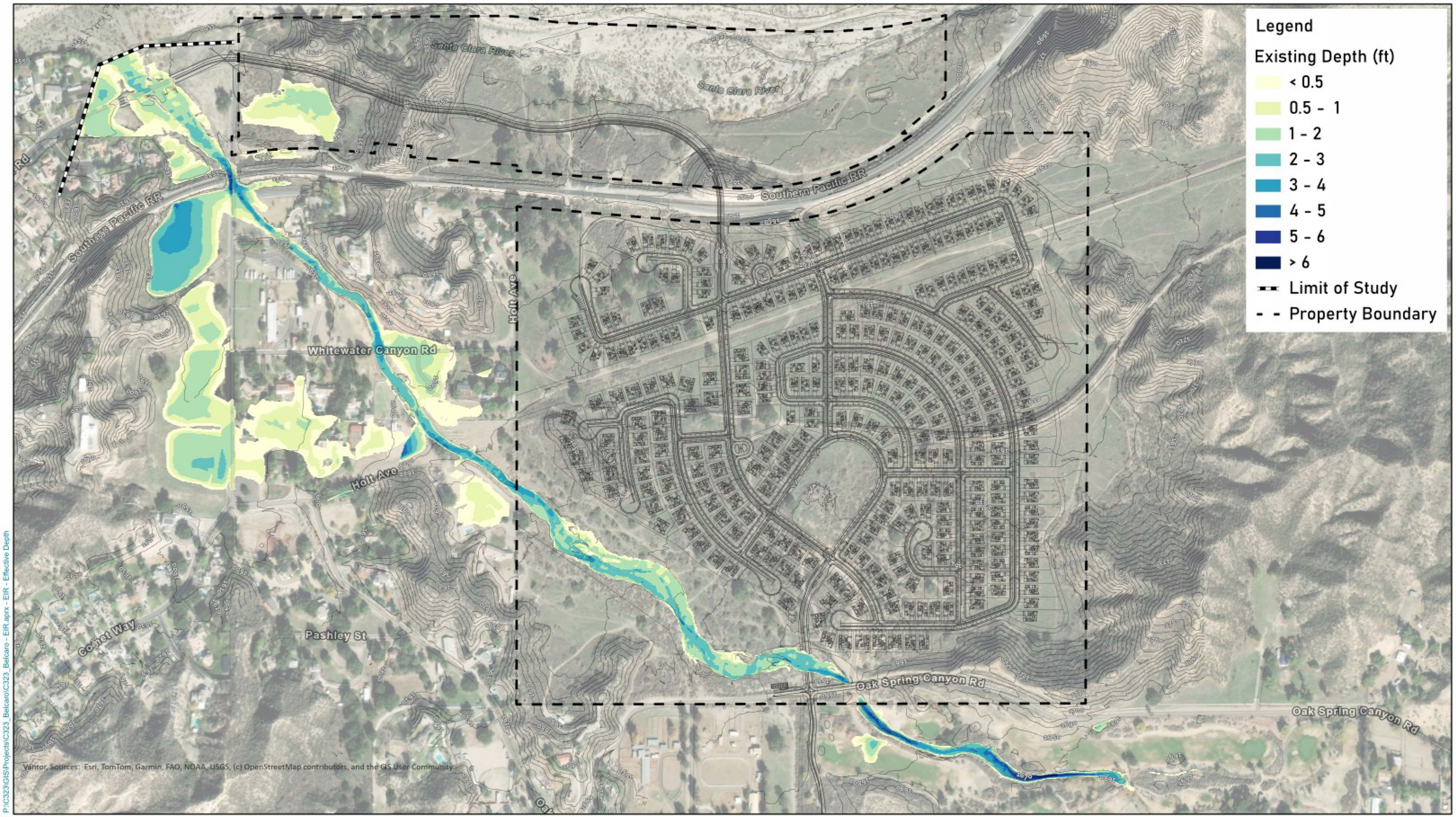
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 25



P:\C323\GIS\Projects\C323_Belcaro\C323_Belcaro - EIR.aprx - EIR - Effective Depth

BELCARO EIR

Existing Flood Depth
100-Year

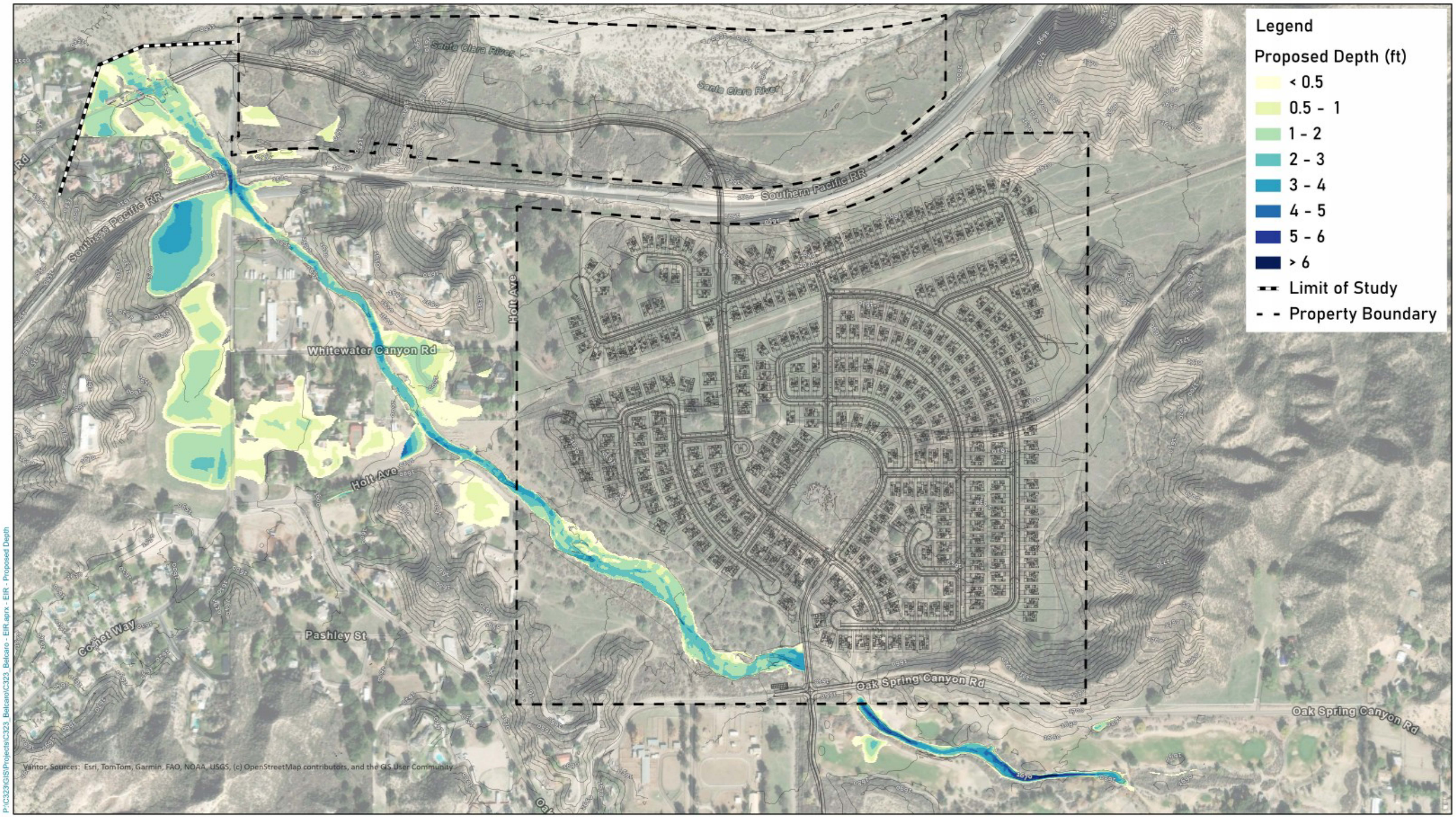
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 26



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BELCARO EIR

Proposed Flood Depth
100-Year

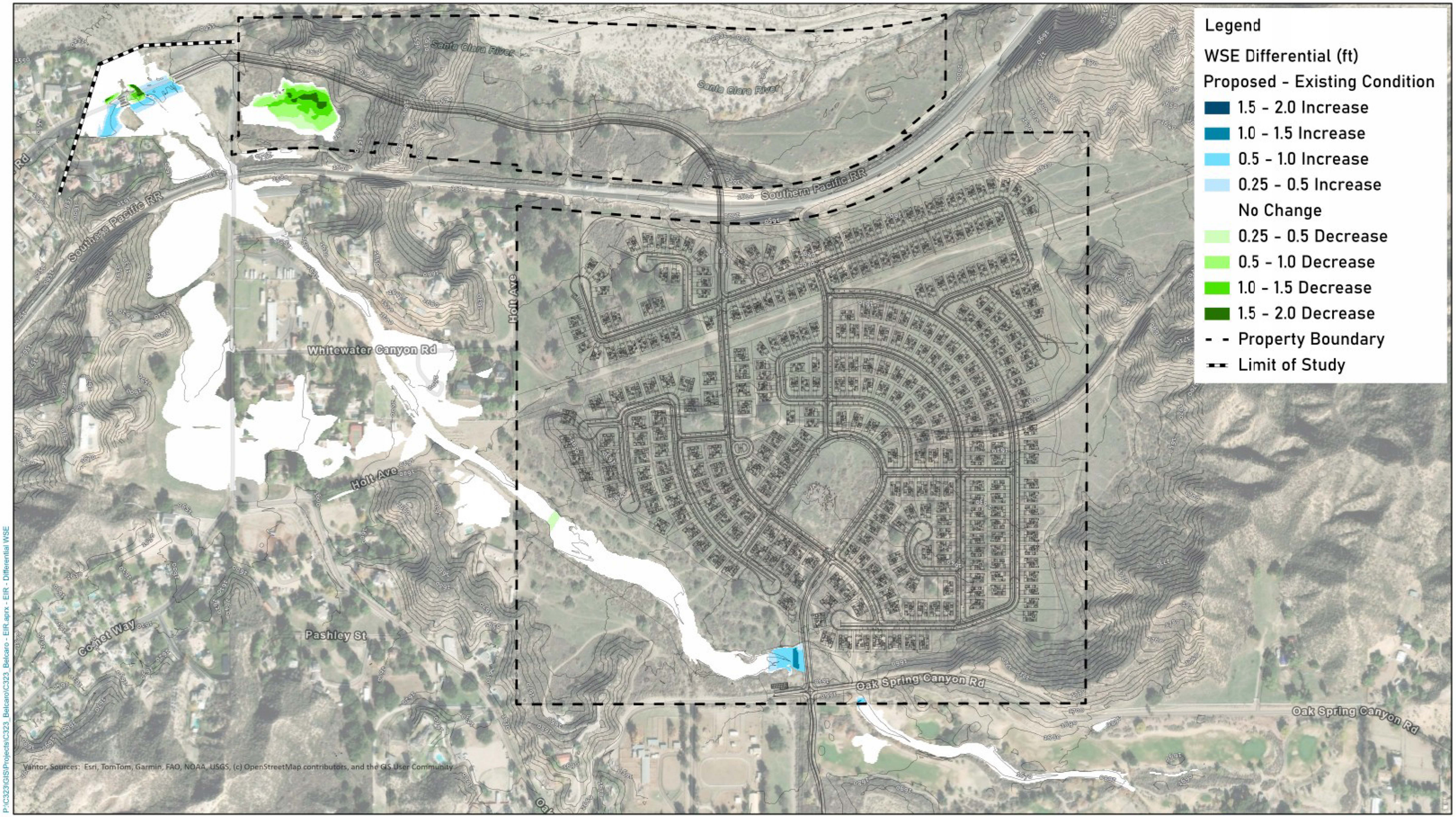
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 27



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BELCARO EIR

Water Surface Elevation Differential 100-Year

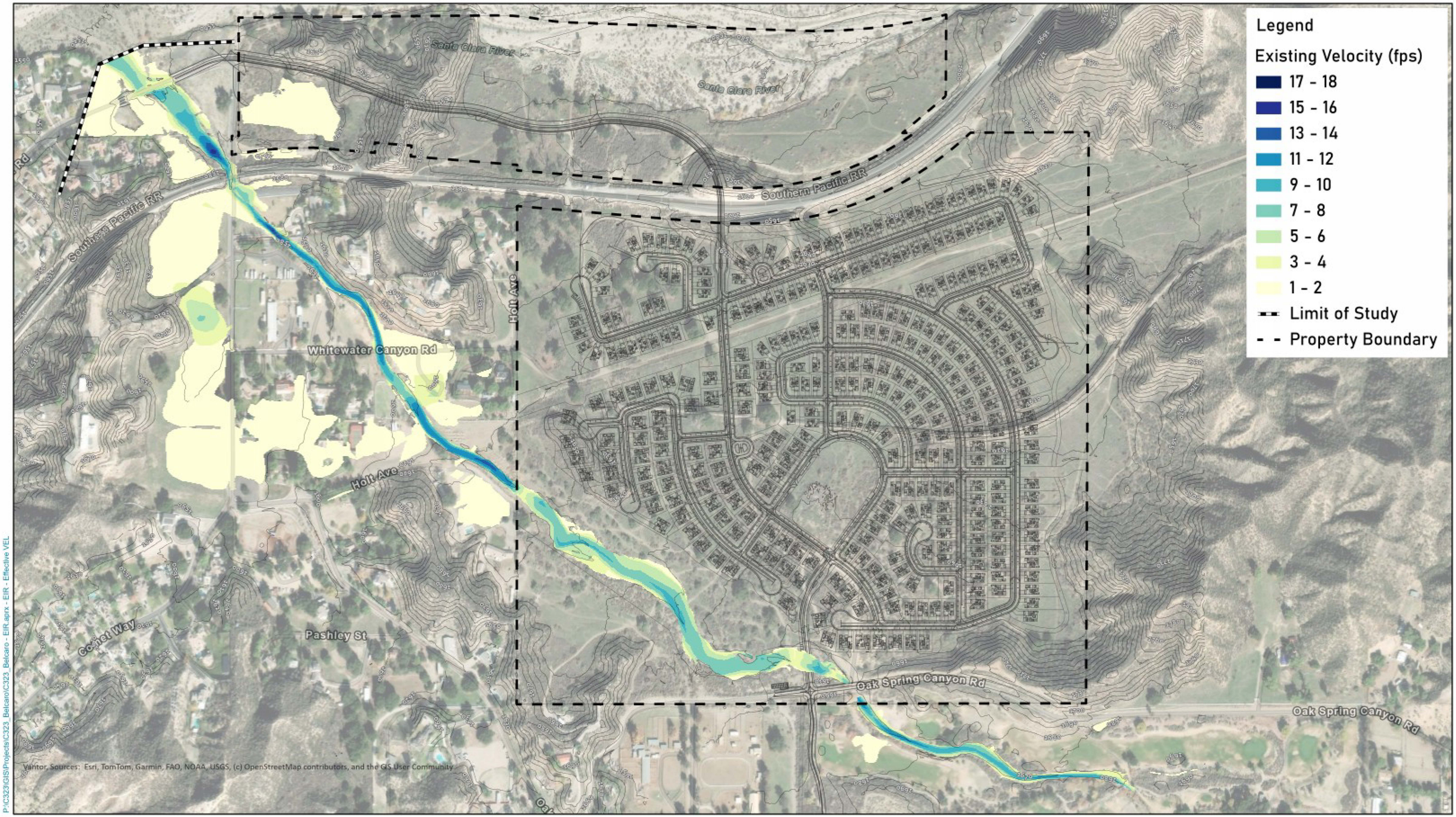
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 28



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BELCARO EIR

Existing Velocity
100-Year

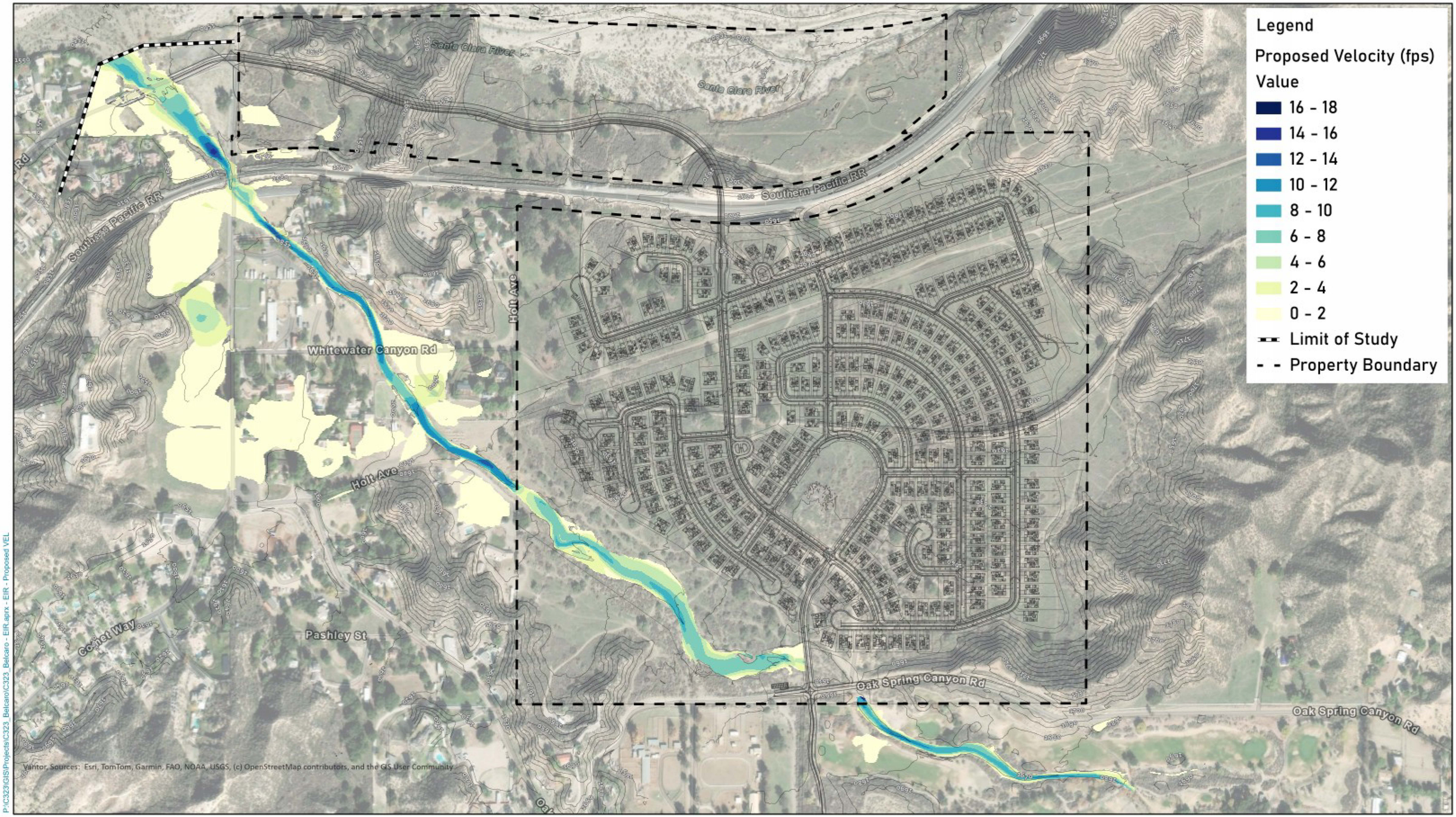
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 29



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BELCARO EIR

Proposed Velocity 100-Year

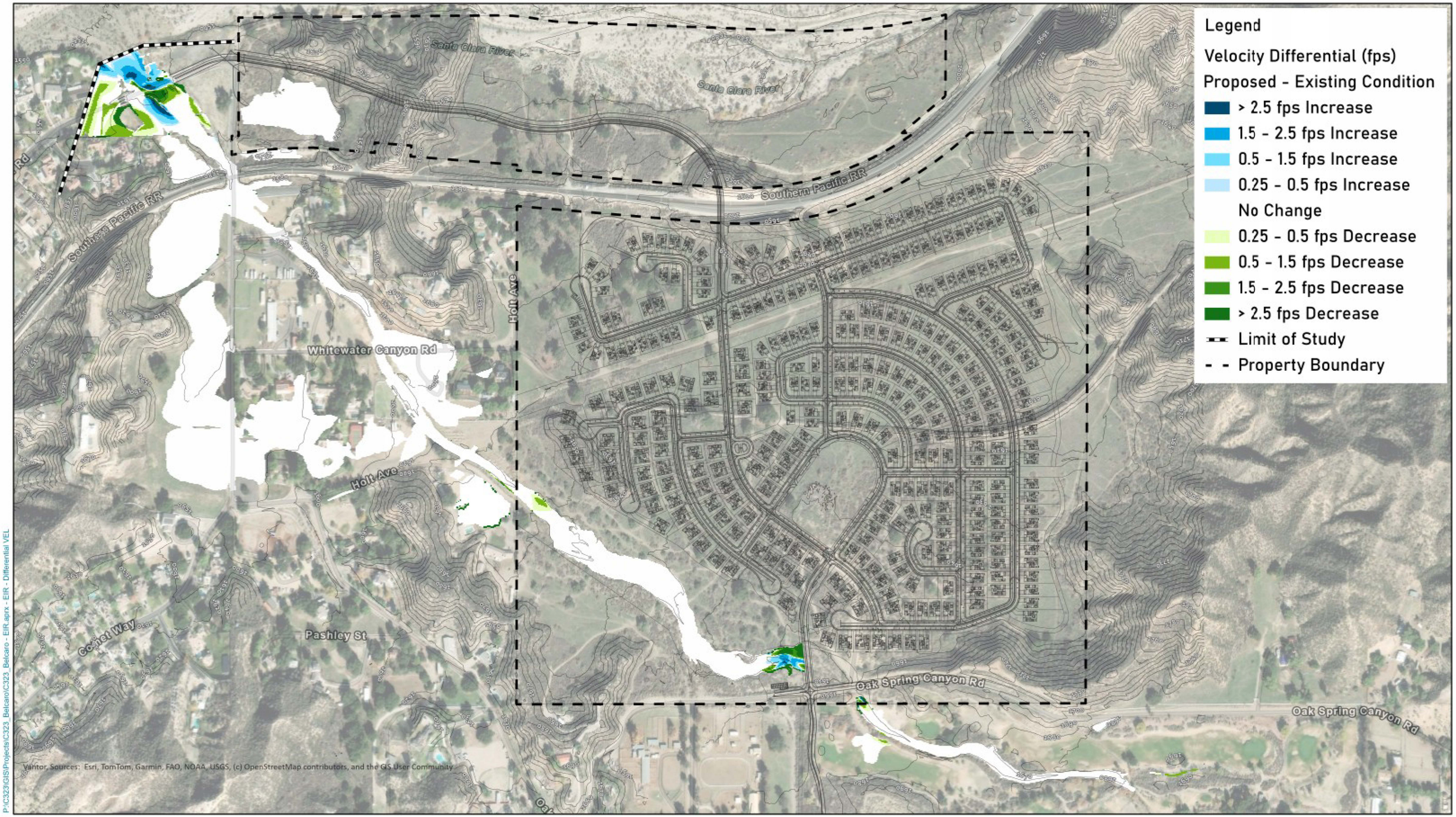
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 30



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BELCARO EIR

Velocity Differential
100-Year

PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 2025-11-19

Job Number: C323

Figure 31

PACE
Advanced Water Engineering

Appendix A – Reference Reports

Belcaro – Oak Springs Canyon Creek Preliminary Hydraulic Design Report, PACE 2025

Preliminary Hydraulic Design Report

Belcaro – Oak Springs Canyon Creek

July 2025
(March 2025 – Revised)
(December 2024 – Revised)

Prepared For:

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Santa Monica, CA 90403
661-305-7536

Prepared By:

Pacific Advanced Civil Engineering, Inc.
17520 Newhope Street, Suite 200
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Contact Person:

Andrew Ronnau PhD, PE
Emily Randig MS, EIT

PACE JN C323

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1 Introduction

Pacific Advanced Civil Engineering, Inc. (PACE) has been retained to prepare a Preliminary Hydraulic Design Report for the proposed crossings at the Belcaro development. The proposed improvements associated with the project include three crossings: the proposed Oak Springs Canyon Road Culvert, the proposed "J" Street Culvert, and the proposed Lost Canyon Road Bridge. Additional rock slope protection is also proposed around the "J" Street and Lost Canyon Road Culverts.

1.1 Project Description

The Belcaro development is situated in the city of Santa Clarita within Los Angeles County. A vicinity map for the project site is shown in **Exhibit 1**. The limits of the study area extend from 1,800 feet upstream of the existing Oak Springs Canyon Road Culvert to the confluence of Oak Springs Canyon Creek with the Santa Clara River. The proposed improvements along Oak Springs Canyon Creek include three proposed structures described below.

1.1.1 Proposed Oak Springs Canyon Road Culvert

The proposed Oak Springs Canyon Road culvert will replace the existing Oak Springs Canyon Road culvert. The existing culvert consists of three 4-foot diameter barrels. Hydraulic modeling of the existing culvert shows that it is significantly undersized and overtops in the 10-year, 50-year, 100-year, and 500-year return storms. In addition, the areas downstream of the culvert have experienced significant scour, while the areas upstream have experienced significant sedimentation. The proposed Oak Springs Canyon Road Culvert aims to correct these issues. The proposed culvert will be a rectangular configuration that is 48 feet wide and 12 feet tall and include a graded trapezoidal channel with 26 foot base width and 1:1 side slopes through it. A combination of grouted rock and concrete will be used through the invert of the culvert to allow for more controlled hydraulic flow through the structure.

1.1.2 Proposed "J" Street Culvert

A new street, "J" Street, has been proposed as a means of access to the Belcaro development. This street will cross Oak Springs Canyon Creek approximately 250 feet downstream of the proposed Oak Springs Canyon Road Bridge / existing Oak Springs Canyon Road culvert. The proposed "J" Street culvert consists of two arched barrels, each 18 feet wide and 12 feet tall. The creek banks between the proposed Oak Springs Canyons Road Bridge and proposed "J" Street culvert will be re-graded and rock protection will be added to the channel slopes for stability and erosion protection.

1.1.3 Proposed Lost Canyon Road Bridge

The existing Lost Canyon Road is a concrete road that crosses through the active channel of Oak Springs Canyon Creek approximately 550 feet downstream of the existing railroad bridge. Since this road will be a main access point to the Belcaro development, a new bridge is proposed to replace the existing crossing. The proposed bridge will have a 170-foot span with three 4-foot diameter piers in a single line.

2 Project Hydrology

2.1 Regional Oak Springs Canyon Creek Hydrology

The study reach is situated within the Oak Springs Canyon Creek Watershed, which encompasses approximately 5.8 square miles. The hydrology used for the hydraulic analysis was obtained from the Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS). The FEMA FIS has published maps and flow rates to designate flood hazard zones that are accepted as the floodplain boundaries for insurance purposes. FEMA has established the 10-year, 50-year,100-year, and 500-year flow rates for Oak Springs Canyon Creek, summarized in **Table 2-1** below.

The hydraulic analyses for scour require the use of a 2-year flow rate. Since FEMA has not established a 2-year flow rate as part of the FIS, the U.S. Geologic Survey (USGS) StreamStats tool was used to estimate the 2-year flow. The StreamStats tool uses regional data based on gauge stations and regression equations to estimate flow statistics for ungauged sites.

Table 2-1: Oak Springs Canyon Creek Hydrology

Return Storm	Flow Rate (cfs)	Data Source
2-year	115	USGS StreamStats
10-year	250	FEMA FIS
50-year	770	
100-year	1,140	
500-year	2,530	

The flowrates summarized in **Table 2-1** are used for floodplain mapping and for general scour calculations. For secure design, a single area hydrologic analysis of the Oak Springs Canyon watershed was performed to provide a comparative flowrate. The calculated 100-year flowrate, 3,535 cfs, is much larger than the published FEMA 500-year flowrate, and greatly exceeds the capacity of the channel for most of the project reach. The hydrologic calculations are provided in **Appendix D**.

The larger calculated flowrate was used to design erosion protection in the upper project reach in the vicinity of the proposed Oak Springs Canyon Road bridge and proposed “J” Street culvert, where the flow is contained in the channel. The larger calculated flowrate was also used to evaluate pier scour at the proposed Lost Hills Road bridge.

3 Hydraulic Modeling

3.1 Model Overview

Hydraulic modeling of Oak Springs Canyon Creek in the project vicinity was completed using the Hydraulic Engineering Center – River Analysis System (HEC-RAS), version 6.6. PACE developed HEC-RAS one-dimensional models in the study area based on hydraulic models obtained from FEMA, which were used to establish the Flood Insurance Rate Map (FIRM) floodplain limits. This FEMA model was clipped to the study reach and refined. A hydraulic workmap showing the extents of the refined model and proposed development is included in **Exhibits 7 and 8**.

PACE created five one-dimensional hydraulic models of the project reach, each with a different purpose. Each of these models features the same cross section geometry, with differences in flow regime, roughness, and downstream boundary conditions. The five hydraulic models are summarized in **Table 3-1**.

Table 3-1:Summary of HEC-RAS Models

Model	Steady or Unsteady	Flow Regime	Purpose
Existing Condition	Steady	Mixed	Floodplain Mapping
Proposed Condition	Steady	Mixed	Floodplain Mapping
Proposed Condition, 2-year Peak Flow	Steady	Mixed	Low-Flow Incisement Scour
Proposed Condition, n=0.025	Steady	Mixed	Bedform Scour, HEC-18 Local Scour, and Rock Sizing
Proposed Condition, n=0.085	Steady	Subcritical	Freeboard
Sediment Transport Model	Unsteady	Mixed	General Scour

3.2 Model Setup

The basis of the HEC-RAS model is a FEMA effective model for Oak Springs Canyon Creek dated June 2021. This model was updated with new topographic data, and cross section locations were modified to best fit the proposed improvements that are part of the Belcaro development.

3.2.1 Model Extents

The HEC-RAS model extends from approximately 1,800 feet upstream of the existing culvert over Oak Springs Canyon Road to the confluence of Oak Springs Canyon Creek with the Santa Clara River. Model extents are shown in **Exhibits 7 and 8.**

3.2.2 Model Inflow

With the exception of the proposed condition 2-year steady-state model, all steady state models were run with the two design flowrates, the FEMA Q_{100} flow rate of 1,140 cfs and the calculated flow rate of 3,535 cfs. The unsteady-state sediment transport model was run with a synthetic SCS hydrograph of the FEMA Q_{100} flow rate. A plot of the synthetic hydrograph is shown in **Figure 3-1**.

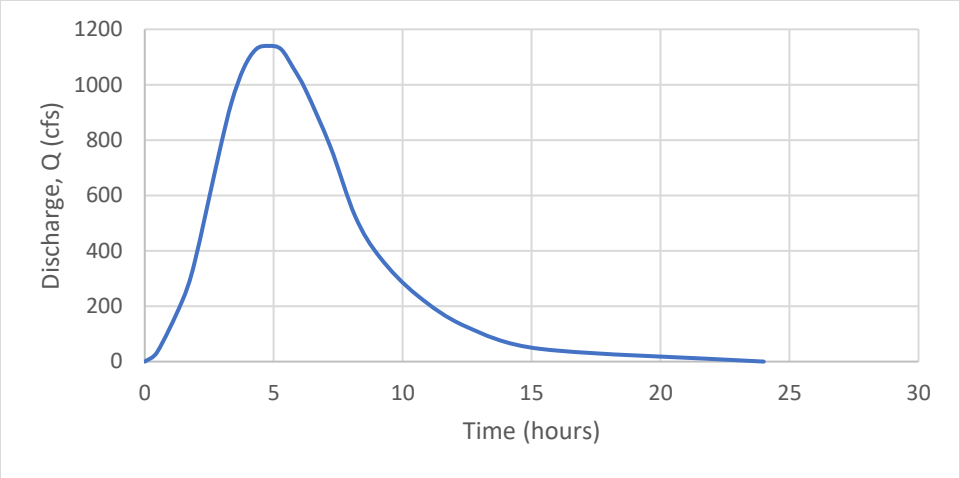


Figure 3-1: SCS Hydrograph, Q_{Peak} = 1,140 cfs

The 2-year steady-state model features a constant inflow of 115 cfs. This 2-year peak flow rate was calculated using StreamStats, see **Section 2.1**.

3.2.3 Flow Regime

The existing and proposed condition models for floodplain mapping were run in the mixed flow regime, which allows the program to solve for both subcritical and supercritical water surface elevation and velocity to assign the appropriate value to each cross section. This is the most appropriate option for the Oak Springs Canyon Creek study reach because it experiences both subcritical and supercritical flow.

The model with high Manning's roughness value used to calculate freeboard was run with a subcritical flow regime. The subcritical flow regime forces the program to solve for subcritical water surface elevations, which results in higher water surface elevations and thus more conservative floodplain limits.

3.2.4 Boundary Conditions

All steady-state models used a normal depth boundary condition for the upstream and downstream limits. The upstream boundary condition for these models was a normal depth boundary condition with a friction slope of 0.024 ft/ft, and the downstream boundary condition was a normal depth boundary condition with a friction slope of 0.02 ft/ft. These slopes generally represent the slope of the channel invert in this area.

The unsteady-state sediment transport model also used a normal depth downstream boundary condition, equal to the ground slope at the downstream end of the modeled reach (0.017 ft/ft).

3.2.5 Topographic Data

Topographic data within the study area is based on an aerial photogrammetric survey performed by Vertex on January 2, 2024. Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88). Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83). Cross sections use this terrain as the basis for their geometry. The provided topography did not extend to the upstream limits of the model, so sections 6472, 6665, and 6879 use the same cross section geometry as the effective FEMA model. Note that these sections are sufficiently far upstream and will not impact modeling of the proposed improvements.

3.2.6 Manning's Roughness

The hydraulic models incorporated various Manning's roughness values to simulate different vegetation conditions within the river:

- The models used for floodplain mapping used the Manning's roughness values established in the FEMA effective model for Oak Springs Canyon Creek. These values are generally 0.04 in the channel and range from 0.04–0.07 in the overbanks.

- The models used for scour analysis used a Manning's roughness value of 0.025 within the channel where no erosion countermeasures are present. This roughness represents a vegetation condition within the channel in which some of the existing vegetation within the channel is washed out during a large storm event. A mannings roughness of 0.025 is specified to be used for scour calculations in the Los Angeles County Department of Public Works Hydrology and Sedimentation Manual.

- The model used for freeboard analysis has a Manning's roughness value of 0.085 within the soft bottom portions of the Oak Springs Canyon Creek channel. This roughness represents a condition where vegetation has grown in the main channel enough to cause some obstructions to flow resulting in a higher water surface elevation.

3.2.7 Cross Section Spacing

Cross sections along the study reach are spaced approximately 100 – 300 feet apart. Cross section spacing is consistent with the FEMA effective model. Additional cross sections were added in the proposed condition model to simulate the proposed crossings at , "J" Street, and Lost Canyon Road. Cross sections spacing in the vicinity of these proposed structures follow HEC-RAS bridge modeling guidance. Cross sections are shown in **Exhibits 7 and 8**.

3.2.8 Ineffective Flow Markers

Ineffective flow markers used in the existing condition model are consistent with those used in the FEMA effective model. Flow markers are used in locations where flow is split between the main channel and the overbanks to denote the overbanks as ineffective flow areas. Ineffective flow markers are also used at the modeled hydraulic structures. Ineffective flow markers are used upstream and downstream of the bridges and culverts to mark flow as ineffective as it expands and contracts through the structure.

At the downstream end of the study reach, between the rail road bridge and Lost Canyon Road, ineffective flow markers are used to define a main flow channel within the topographically defined channel. Flows coming out of the Rail road bridge constriction do not have time to fully expand to the whole floodplain before contracting again to get through Lost Canyon Road.

3.2.9 Hydraulic Structures

There are five hydraulic structures associated with the HEC-RAS models:

- **Existing Oak Springs Canyon Road Culvert:** Located at HEC-RAS Section 5064; Culvert with three 4-foot diameter barrels

- **Existing Railroad Bridge:** Located at HEC-RAS Section 1126; Bridge with 120-foot opening with two 1-foot diameter piers

- **Proposed Oak Springs Canyon Road Culvert:** Located at HEC-RAS Section 5064, replaces the existing culvert; Culvert with 48-foot by 12-foot rectangular barrel

- **Proposed "J" Street Culvert:** Located at HEC-RAS Section 4806; Culvert with two 18-foot by 12-foot arched barrels

- **Proposed Lost Canyon Road Bridge:** Located at HEC-RAS Section 575; Bridge with 170-foot opening with a series of three 4-foot diameter piers in a single line

3.2.10 Sediment Transport Model Modifications

The existing condition steady-state hydraulic model was modified for the purposes of sediment transport modeling. The limits of the model were truncated to ensure model stability. The upstream limit of the sediment transport model begins at cross section 4744. This was chosen because there is a scour hole downstream of the existing Oak Springs Road culvert that causes a significant drop in terrain, which causes instability in the sediment transport unsteady flow.

The downstream limits of the model were also truncated to cross section 482. The downstream limit of the steady-state model is the confluence of Oak Springs Canyon Creek with the Santa Clara River. The downstream sections are very wide with shallow depths; these tend to cause instabilities in the unsteady flow computations, so the model was truncated to the point where the sediment transport model was able to run with no instabilities.

The existing Railroad Bridge was removed from the model. In order to account for the influence of the bridge piers on the sediment transport model, the cross section geometry for the bounding sections immediately upstream and downstream of the bridge was modified to artificially add back the piers into the sections. The overflow reach and lateral structures were also removed from the model. This is a conservative approach because all modeled flow will remain in the main channel of Oak Springs Canyon Creek, producing larger potential degradation or aggradation.

4 Hydraulic Modeling Results

4.1 Existing vs. Proposed Condition

Results of the hydraulic analysis for the existing and proposed conditions modeling are summarized in **Table 4-1**. Comparison of the existing and proposed hydraulic results indicate there are no off-site impacts due to the proposed structures and grading around Oak Springs Canyon Creek. The on-site changes to water surface elevation and velocity are centered around the three proposed structures. The existing Oak Springs Canyon Road culvert will be replaced with a larger and wider culvert, which raises water surface elevations by 0.2 feet directly upstream of the proposed culvert but lowers water surface elevations downstream of the proposed culvert. The largest on-site changes to water surface elevations occur just upstream of the proposed "J" Street culvert at cross sections 4902 and 4902. There is a maximum increase in water surface elevation of 1.8 feet and an increase in velocity of 2.8 feet per second. Lastly, the proposed Lost Canyon Road Bridge will raise water surface elevation by 0.7 feet upstream of the proposed structure.

Table 4-1: Existing vs Proposed Hydraulic Analysis (Q_{100} = 1,140 cfs)

HEC-RAS Cross Section	Existing Condition WSEL (ft)	Proposed Condition WSEL (ft)	Difference [Proposed - Existing] (ft)	Existing Condition Velocity (ft/s)	Proposed Condition Velocity (ft/s)	Difference [Proposed - Existing] (ft/s)
6879	1691.8	1691.8	0.0	12.0	12.0	0.0
6665	1685.6	1685.6	0.0	12.2	12.2	0.0
6472	1682.0	1682.0	0.0	7.7	7.7	0.0
6120	1675.4	1675.4	0.0	11.1	11.1	0.0
5780	1669.5	1669.5	0.0	7.0	7.0	0.0
5441	1665.1	1665.1	0.0	9.2	9.2	0.0
5353	1663.5	1663.5	0.0	9.9	9.8	-0.1
5238	1662.1	1662.0	0.0	6.4	6.5	0.1
5167	1660.5	1660.7	0.2	9.4	8.9	-0.5
5064	Existing/ Proposed Oak Springs Canyon Road Culvert					
5029	1650.1	1648.8	-1.3	9.7	4.3	-5.3
4965	1647.0	1648.8	1.8	12.8	3.3	-9.5
4902	1647.0	1648.7	1.7	8.7	2.9	-5.8
4838	1646.2	1646.4	0.2	7.2	10.0	2.8
4806	Proposed "J" Street Culvert					
4775	1644.2	1645.0	0.8	9.1	7.3	-1.8
4744	1642.3	1643.6	1.3	10.7	8.1	-2.6
4593	1641.3	1641.3	0.0	7.5	7.5	0.0
4418	1638.0	1638.0	0.0	7.0	7.0	0.0
4248	1635.4	1635.4	0.0	6.1	6.1	0.0
4143	1633.5	1633.5	0.0	7.5	7.5	0.0
4022	1631.3	1631.3	0.0	7.2	7.2	0.0
3789	1626.6	1626.6	0.0	5.7	5.7	0.0
3548	1622.3	1622.3	0.0	7.6	7.6	0.0
3457	1619.9	1619.9	0.0	7.2	7.2	0.0
3360	1617.6	1617.6	0.0	7.6	7.6	0.0
3260	1616.3	1616.3	0.0	7.2	7.2	0.0
3172	1615.3	1615.3	0.0	7.3	7.3	0.0
3094	1613.5	1613.5	0.0	9.8	9.8	0.0
2950	1609.9	1609.9	0.0	10.9	10.9	0.0
2734	1607.0	1607.0	0.0	9.7	9.7	0.0
2592	1603.8	1603.8	0.0	10.2	10.2	0.0
2529	1601.9	1601.9	0.0	10.4	10.4	0.0
2432	1600.7	1600.7	0.0	6.0	6.0	0.0
2254	1597.4	1597.4	0.0	9.4	9.4	0.0
2124	1595.0	1595.0	0.0	9.3	9.3	0.0
1911	1590.7	1590.7	0.0	9.7	9.7	0.0

HEC-RAS Cross Section	Existing Condition WSEL (ft)	Proposed Condition WSEL (ft)	Difference [Proposed - Existing] (ft)	Existing Condition Velocity (ft/s)	Proposed Condition Velocity (ft/s)	Difference [Proposed - Existing] (ft/s)
1824	1588.5	1588.5	0.0	9.9	9.9	0.0
1679	1585.8	1585.8	0.0	8.9	8.9	0.0
1609	1583.8	1583.8	0.0	10.0	10.0	0.0
1556	1583.2	1583.2	0.0	8.3	8.3	0.0
1438	1578.6	1578.6	0.0	12.3	12.3	0.0
1343	1577.2	1577.2	0.0	8.1	8.1	0.0
1173	1575.5	1575.5	0.0	5.5	5.5	0.0
1126	Existing Railroad Bridge over Oak Springs Canyon Road					
1058	1571.1	1571.1	0.0	8.8	8.8	0.0
979	1567.9	1567.9	0.0	11.7	11.7	0.0
856	1566.5	1566.5	0.0	7.5	7.5	0.0
786	1564.7	1564.7	0.0	8.6	8.6	0.0
672	1562.8	1562.8	0.0	7.4	7.4	0.0
604	1560.8	1561.5	0.7	8.3	4.6	-3.7
575	Proposed Lost Canyon Road Bridge					
543	1559.6	1559.8	0.2	6.6	7.1	0.5
482	1557.6	1557.4	-0.1	8.2	9.2	1.0
351	1555.0	1555.0	0.0	6.4	6.4	0.0

Note:

1. *Existing floodplain WSE and velocities are based on Q_{100} flow rate (see **Appendix A**)*
2. *Proposed floodplain WSE and velocities are based on Q_{100} flow rate (see **Appendix B**)*

5 Erosion Protection

Erosion protection is provided at critical areas within the project area, mainly at the upstream end of the study reach between Oak Springs Canyon Road and future "J" Street. The erosion protection will consist of channel embankment protection at the proposed Oak Springs Canyon Road culvert and channel lining from the Robinson Ranch Golf Course to downstream of the proposed "J" Street culvert. Erosion protection is designed based on the calculated 100-year flowrate, 3,535 cfs. This ensures that the proposed structures will be adequately protected in high flow events.

5.1 Grouted Riprap under Oak Springs Canyon Road

The existing channel profile drops approximately ten feet between the inlet to the existing culvert and the channel immediately downstream of the culvert. The proposed design will grade the channel to provide a more gentle bed slope and will include grouted rock lining, which is necessary because of the high flow velocity. The grouted rock will start at the proposed grading upstream of Oak Springs Canyon Road and continue under the bridge to the end of the wing-walls downstream of the bridge. The rock gradation was determined using the procedures outlined in USACE's *EM 1110-2-1601: Hydraulic Design of Flood Control Channels*, Section 3 (USACE, 1991). Equation 3-3 from the manual, which is defined below, is used to determine the D_{30} of the riprap:

$$D_{30} = \left(S_f C_s C_v C_T\right) d \left[\left(\frac{\gamma_w}{\gamma_s - \gamma_w}\right)^{\frac{1}{2}} \frac{V}{\sqrt{K_1 g d}}\right]^{2.5}$$

Where:

- S_f = Safety factor, set to 1.1.
- C_s = Stability coefficient for incipient failure, equal to 0.30 for angular rock.
- C_v = Velocity distribution coefficient, equal to 1.0 for straight channels and 1.25 downstream of concrete channels.
- C_t = Blanket thickness coefficient, set to 1.0.
- d = Local depth of flow, (ft).
- γ_w= unit weight of water (lb/ft^3).
- γ_s= unit weight of stone, taken as 165 lb/ft^3.
- V= local depth-averaged velocity (ft/s), equal to average channel velocity.
- g = Acceleration due to gravity, 32.2 ft/s^2.
- K_1 = Side Slope correction factor, based on the bank angle, θ = 26.56 for 2:1 side slopes. The side slope correction factor is obtained from Plate 39 of *EM 1110-2-1601*.

The D_{30} of the riprap is then converted to D_{50} using the ratio: $D_{50} = D_{30} * 1.25$

Additionally, the Los Angeles County Public Works (LACPW) Rip-Rap Rock for Levees Design Table F-32 was also used to size the rock protection.

The results of the rock sizing for the Oak Springs Canyon Creek culvert and its accompanying grading show that large loose rip rap would be required. The LACPW Rip-Rap table shows that grouted 1-ton riprap can be used instead of the required 2-ton and 4-ton loose riprap. 1-ton grouted riprap with a thickness of 68 inches is selected for erosion protection at and around the proposed Oak Springs Canyon Creek Culvert.

Table 5-1: Oak Springs Canyon Road Culvert Erosion Protection (Q_{100} = 3,535 cfs, n=0.025)

HEC-RAS Cross Section	Depth (ft)	Velocity (ft/s)	USACE D_{50} Rock Size		LACPW D_{50} Rock Size		Design Rock Size
			Calculated D_{50} (in)	Loose Riprap (in)	Loose Riprap (in)	Grouted Riprap (in)	
5140.5	5.5	17.1	41.2	43", 2-ton	54", 4-ton	34", 1-ton	34", 1-ton Grouted Rip-Rap
5114	10.0	5.6	2.2	10", 50-lb	10", 50-lb	NA	
5100.67 (U/S Bridge Section)	8.8	11.5	13.7	15", 150-lb	21", 1/4-ton	NA	
5054.71 (D/S Bridge Section)	6.2	16.4	35.9	43", 2-ton	43", 2-ton	34", 1-ton	
5041.86	4.8	19.5	47.4	54", 4-ton	54", 4-ton	34", 1-ton	
5029	10.6	4.7	1.4	10", 50-lb	10", 50-lb	NA	

5.1.1 Plunge Scour

The grading into the basin introduces a potential for additional scour, or plunge scour, at the toe of the proposed rock. The design toe of the rock is considered plunge scour. The Veronese (1937) method is an empirical equation commonly used to calculate scour at the toe of a drop structure. The present analysis used the Veronese equation, which defines scour depth measured from tailwater surface:

$$D = 0.202 \frac{q^{0.54} H^{0.225}}{d^{0.42}}$$

where,

D = Scour depth measured from tailwater surface
H = Difference between upstream and downstream water surface elevations
q = Discharge per unit width, taken as Y×V
Y = Depth of water at the crest of the drop
V = Velocity of water at the crest of the drop
d = mean sediment grain size, where d >5mm

Veronese's equation is sensitive to the grain size used in the equation. The National Engineering Handbook Technical Supplement 14 B, Scour Calculations (August 2007) suggests a mean sediment grainsize of 250 mm for beds made of rock material. This yields an unrealistic scour depth, so the d_{15}, d_{50}, and d_{85} for the average gradation (see Section 6-1) were investigated. The d_{15} and d_{50}, with values of 0.17mm and 0.91mm respectively, do not meet the minimum grain size requirement of 5mm, so the d_{85} was used for the plunge scour analysis. The resultant plunge scour is 7.6 ft, so the design cut off depth for the grouted rock is set at 8 feet below the existing ground.

5.2 Loose Riprap Protection

Downstream of the grouted riprap, the channel bed and embankments will be lined with loose rock. The rock will reduce flow energy and protect the basin embankments where the flow from Oak Springs Canyon Creek makes a sharp turn and transitions between the two proposed structures. Rock erosion protection measures will be continued downstream of the culvert to the point where the flow velocities return to existing conditions.

The USACE EM 1110-2-1601 and LACPW Rip-Rap Rock for Levees Design Table F-32 were used to size the rock protection. Additional interpolated cross sections were added downstream of the "J" Street culvert to provide more accurate velocity results in HEC-RAS. HEC-RAS uses the additional sections to better plot water surface elevation (WSE) and velocity in places of abrupt change within the creek. 1-ton rock with

thickness of 68 inches is selected up to interpolated cross section 4759.5, which then transitions to ½-ton loose rock with thickness of 54 inches.

Table 5-2: Basin and "J" Street Culvert Erosion Protection (Q_{100} = 3,535 cfs, n=0.025)

HEC-RAS Cross Section	Depth (ft)	Velocity (ft/s)	USACE D_{50} Rock Size		LACPW D_{50} Rock Size – Loose Riprap (in)	Design Rock Size
			Calculated D_{50} (in)	Loose Riprap (in)		
4965	10.6	3.7	0.7	10", 50-lb	10", 50-lb	34", 1-ton Loose Riprap
4902	11.5	3.3	0.6	10", 50-lb	10", 50-lb	
4838 (U/S Culvert Section)	10.0	10.9	11.7	12", 100lb	18", 300lb	
4775 (D/S Culvert Section)	6.2	13.6	22.7	27", 1/2-ton	34", 1-ton	
4759.5*	5.3	15.0	30.0	34", 1-ton	34", 1-ton	
4744	4.8	11.5	15.9	18", 300lb	21", 1/4-ton	
4668.5*	6.3	5.6	2.4	10", 50-lb	10", 50-lb	27", 1/2-ton Loose Riprap
4593	4.4	10.7	13.7	15", 150-lb	18", 300lb	

*Note: * Denotes interpolated cross section added to the HEC-RAS model to allow for finer computational spacing in HEC-RAS downstream of the "J" Street Culvert.*

The proposed configuration for the riprap erosion protection is shown in **Exhibit 5 and Exhibit 6**. The riprap protection is carried downstream of the culvert to the point where the structure no longer affects the channel hydraulics. As seen in **Table 4-1** the proposed "J" street culvert increases velocity at cross sections 4775 and 4744. After that, there are no differences between the existing and proposed conditions. The proposed riprap is carried to section 4593, sufficiently far enough from the structure to ensure for proper erosion protection.

5.2.1 Top of Rock

The top of the rock protection along the basin embankment is calculated based on a conservative water surface elevation within the basin. A HEC-RAS model with high mannings condition and subcritical flow regime was run to simulate a high-water condition. **Table 5-3** summarized the required top of riprap protection and the design top of rip rap for the basin between Oak Springs Canyon Creek Road and "J" Street.

Table 5-3: Top of Riprap Protection

Cross Section	Water Surface Elevation (Q_{100} = 3,535 cfs, n=0.085) (ft)	Freeboard (ft)	Minimum Top of Riprap Protection (ft)	Actual Top of Riprap (ft)
5029	1654.6	2	1656.6	1657
4965	1654.6	2	1656.6	1657
4902	1654.5	2	1656.5	1657
4838	1652.2	2	1654.2	1657

5.2.1.1 Adjacent Development Pad Elevations

The development pad elevations adjacent to Oak Springs Canyon Creek between Oak Springs Canyon Road and "J" Street have an elevation of 1656'. The design water surface elevation ranges from 1654.5' – 1654.6', so the pads are sufficiently above the design water surface. In addition, there is proposed grading for a pedestrian trail in between the development pads and the creek which have elevations up to 1665. The adjunct pads are sufficiently protected from the creek.

6 Scour Analysis

A scour analysis along the study area was completed using the results of the hydraulic models described in **Section 3.1**. Scour was calculated using a modified version of the Los Angeles (LA) County methodology, described in the LACPW Sedimentation Manual (2006). The following scour analysis is focused on the Lost Canyon Road Bridge area. Rock protection is proposed at the upstream structures ("J" Street and Oak Springs Canyon Road), so a scour analysis is only needed for the downstream study area around the Lost Canyon Road Bridge.

The scour methodology calculates an estimated scour depth at and around each proposed structure, which was used to establish a maximum design toe elevation for each proposed structure. Total scour is equal to the total of (1) general scour, (2) local scour, (3) long-term adjustment, (4) bend scour, (5) low flow incisement, and (6) bedform height. These scour components are discussed in detail below. Bend scour was not included in the analysis, as bend scour is not anticipated within the downstream study reach. Bend scour occurs when curves in an open channel lead to differential velocity gradients, and the project reach of Oak Springs Canyon Creek is fairly straight.

6.1 General Scour

General scour is the scour associated with a given, single flood event. General scour was evaluated for the Q_{100} event using an unsteady-state HEC-RAS sediment transport model. Model development, inputs, and results are discussed in the following section.

6.1.1 Sediment Gradation Data

The basis for the sediment transport model starts with sediment gradation data. LGC Valley, Inc. completed a Geotechnical Investigation Report for the Belcaro development in February 2025. Their analysis included collecting grainsize distributions on a series of four borings and five grab samples. Both the boring and grab samples were collected at various depths. The grainsize data for each sample was reviewed and plotted. The samples were then collated into two groups, downstream samples and upstream samples. Perceived outliers and samples with large variation in grainsize with depth were removed and an average for the upstream and downstream samples was created. Because the average of the two areas was very similar, an average for the creek was determined and used for the present analysis. The LGC Valley, Inc. sampling location map and laboratory data can be found in **Appendix C**, along with the gradation selection analysis completed by PACE. The gradation curve used in the sediment transport analysis is shown in **Figure 6-1**. The median grain size, D_{50}, is 0.91 millimeters (mm).

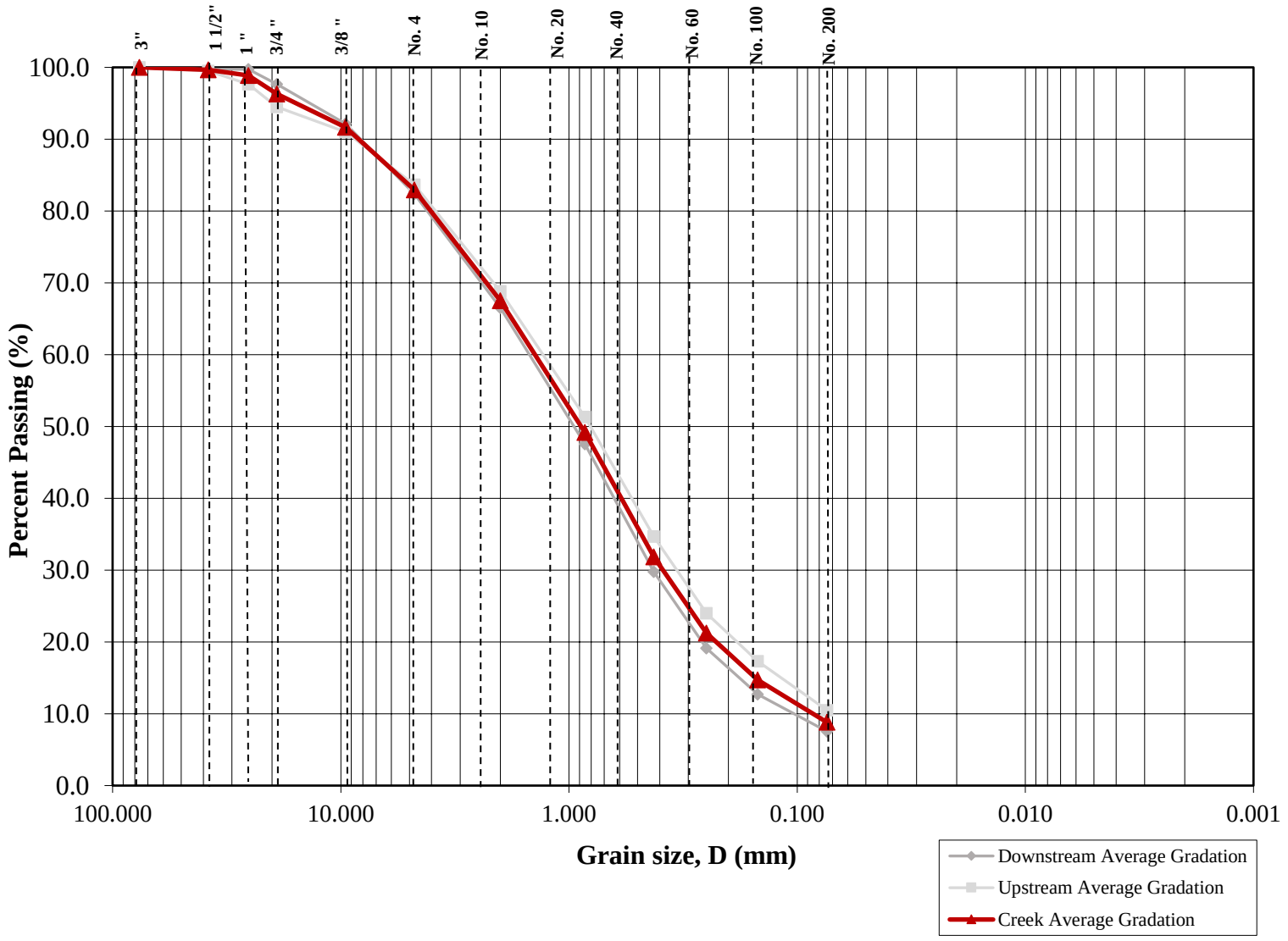


Figure 6-1: Sediment Transport Gradation Curve

6.1.2 Sediment Transport Model Development

6.1.2.1 Sediment Transport Function Selection

In order to select a transport equation to be used for the general scour analysis, both the SAMaid subroutine within SAMwin and the HEC-RAS Hydraulic Reference Manual were used. The SAMaid subroutine determines the most representative transport function by comparing sediment data (D_{50}) and hydraulic parameters (slope, velocity, width, and depth) with gauge data reported in 19 peer-reviewed sediment transport studies. The SAMaid subroutine then indicates the top three sediment transport functions for each field study, selected as the equations which resulted in the closest calculated sediment discharge to the measured sediment discharge. Results of the steady-state hydraulic modeling using the Q_{100} flow rate were used to determine the average hydraulic parameters for the study reach. These parameters were used as inputs to SAMaid along with the D_{50}. The results for the SAMaid subroutine indicated that the top three transport functions were Van Rijn, Yang, and Ackers-White.

HEC-RAS Hydraulic Reference Manual Table 12-8 reports the applicable range of input values for each sediment transport function. These input values include D_{50}, energy gradient, velocity, channel depth, channel width, and water temperature. Like with the SAMaid analysis, the results of the steady-state hydraulic modeling using the Q_{100} flow rate were used to determine the average hydraulic parameters of the study reach. A summary of the channel and sediment characteristics compared to the applicable ranges of each transport function is shown in **Table 6-1** below. Following the HEC-RAS Hydraulic Reference Manual, the transport function that best fits the Oak Springs Canyon Creek study reach is the Yang transport equation.

Table 6-1: Oak Springs Canyon Creek Reach Characteristics Compared to the Range of Input Values for Sediment Transport Functions

Sediment Samples and Channel Characteristics	Study Reach Input Value	Transport Functions in HEC-RAS											
		Ackers and White*		Engelund-Hansen*		Laursen-Copeland*		Meyer-Peter Muller*		Toffaleti*		Yang*	
Overall Particle Diameter (d), mm	0.79	0.04 - 7.0	Y	0.19 - 0.93	Y	0.08– 0.7	N	0.4 – 29	Y	0.095 - 0.76	N	0.15 – 1.7	Y
Energy Gradient (S)	0.02	0.00006 - 0.037	Y	0.000055 – 0.019	Y	0.0000021 - 0.0018	N	0.0004 - 0.02	N	0.000002 - 0.0011	N	0.000043 - 0.028	Y
Average Channel Velocity (V), fps	7.55	0.07 - 7.1	N	0.65 – 6.34	N	0.068 - 7.8	N	1.2 - 9.4	Y	0.7 - 7.8	N	0.8 - 6.4	N
Channel Depth (D), ft	2.98	0.01 - 1.4	N	0.19 – 1.33	N	0.67 - 54	Y	0.03 - 3.9	Y	NA	-	0.04 - 50	Y
Channel Width, (W) ft	195.44	0.23 - 4	N	NA	-	63 - 3640	Y	0.5 - 6.6	N	63 - 3640	Y	0.44 - 1750	Y
Water Temperature (°F)	60	46 - 89	Y	45 - 93	Y	32 - 93	Y	NA	-	32 - 93	Y	32 - 94	Y

**Note: Y/N denotes if the Oak Springs Canyon Creek reach characteristic/input value falls within the acceptable range of each transport function parameter.*

Given the results of the SAMaid subroutine and the sediment transport equation input comparison, three sediment transport equations were selected: Van Rijn, Yang, and Ackers-White. Of the matching sediment transport functions, only the Yang and Ackers-White functions are available for use in HEC-RAS. Thus, these functions were used to further develop the HEC-RAS sediment transport model.

Each function was tested in the sediment transport model for the study reach. The Ackers-White function resulted in aggradation of the study reach. The Yang transport function yielded the most consistent results and was therefore selected as the final transport function.

6.1.2.2 Sorting and Fall Velocity Methods

HEC-RAS currently has three sorting methods the user can select from: Thomas, Copeland, and Active Layer. The Thomas method was selected for the model because it uses a three-layer bed model that forms an independent coarse armor layer, which limits erosion of deeper layers. It is also the default method used in HEC-6.

There are five fall velocity methods specified in the HEC-RAS sediment transport interface. The Van Rijn method was selected as the fall velocity method because it was identified in the SAMaid analysis as an appropriate match for the hydraulic and sediment data. Alternate fall velocity methods were tested but did not significantly change results.

6.1.2.3 Sediment Control Volume and Bed Change Options

The sediment control volumes are dictated by specifying the maximum depth (or minimum elevation) as the bottom boundary of the control volume and the movable bed limits as the control volume width. Since no bedrock was noted within the boring logs, a deep maximum depth was used to set the bottom of the control volume to a distance of 20 feet below the original invert of the channel. A maximum depth of 10 feet was also tested, but the model results did not change, so the deep control volume distance of 20 feet was used in the final model. Movable bed limits constrain erosion and deposition to the cross section nodes between a specified right and left station. The movable bed limits were set at the toe of the existing low flow limits.

Veneer erosion and deposition are specified in the channel limits, and only Veneer deposition is specified for floodplain partition and floodplain distribution. Veneer deposition and erosion shift the entire inundated area of the cross section by a uniform amount at each time step. Of the available deposition and erosion methods, the Veneer method is the most applicable to existing channels.

6.1.2.4 Sediment Boundary Conditions

A sediment inflow rating curve was input as the upstream boundary condition for the HEC-RAS sediment transport model. An inflow rating curve correlates sediment loads with user-specified flow rates. SAM was used to develop the inflow conditions of the study reach. SAM is used to calculate sediment discharge based on hydraulic conditions and bed gradations.

Table 6-2: Supply and Design Reach Delineation

Reach	Start Section	End Section
Supply	6665	5238
Design	4744	482

For SAM modeling, a supply inflow reach was selected upstream of the study area, as outlined in **Table 6-2**. Rating curve inflow to the supply reach ranged from 250 cfs to 1,140 cfs. Supply reach HEC-RAS results for each flow rate supplied the inputs to calculate reach averages for each flow rate of the rating curve. The gradation data used in the sediment transport model was also used as the gradation for the SAM model with the transport function selected as the Yang function. The SAM model output includes the total sediment load (tons per day) per flow rate as well as the transport broken into each grain size class. The final sediment inflow rating curves are summarized in **Figure 6-2**.

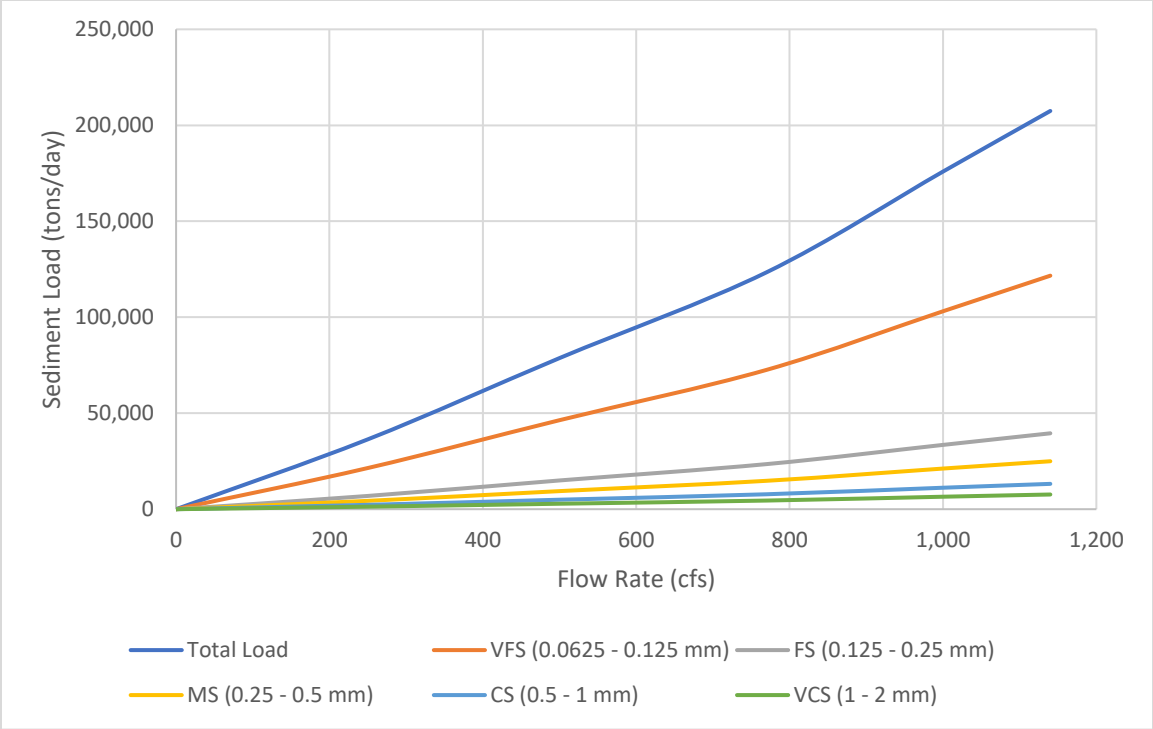


Figure 6-2: Sediment Loading Rate Curves

6.1.3 HEC-RAS Sediment Transport General Scour Results

The results of the unsteady-state sediment transport model reveal general scour ranging from aggrading up to 0.7 feet to degrading up to 1.9 feet. These results are summarized in **Table 6-3** and **Figure 6-3**. Note that general scour for aggrading areas was set to 0.0 feet for the total design scour.

Table 6-3: Summary of General Scour Results

HEC-RAS Cross Section	General Scour* (ft)
4744	0.1
4593	0.1
4418	0.1
4248	0.0
4143	0.1
4022	0.3
3789	0.2
3548	0.7
3457	0.0
3360	0.7
3260	-0.4
3172	-0.2
3094	0.0
2950	0.2
2734	0.3
2592	0.2
2529	0.3

HEC-RAS Cross Section	General Scour* (ft)
2432	0.1
2254	0.3
2124	0.5
1911	-0.2
1824	0.3
1679	-0.1
1609	0.5
1556	-0.2
1438	-0.1
1343	0.0
1258	-0.4
1173	-0.6
1126	Existing Railroad Bridge
1058	-0.1
979	0.3
856	0.1
786	0.5
672	0.1
604	0.5
575	Proposed Lost Canyon Road Bridge
543	0.1
482	-0.1

**Note: Positive values represent aggradation and negative values represent degradation.*

A general scour value for the project reach was selected as 0.6 feet which represents the max general scour along the analysis reach.

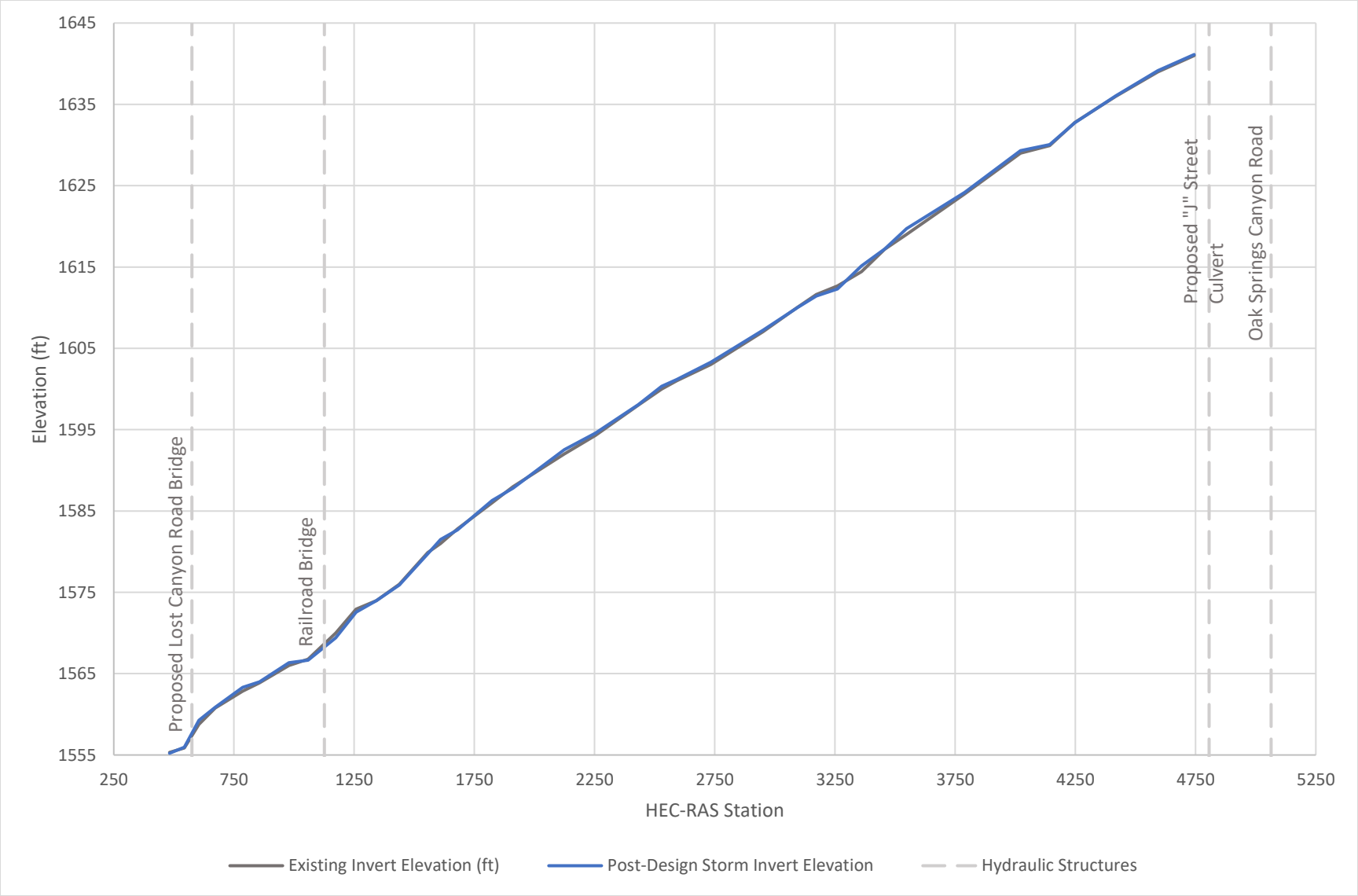


Figure 6-3: Initial and Final Bed Elevation for Oak Springs Canyon Creek HEC-RAS Sediment Transport General Adjustment

6.2 Long-Term Adjustment

Long-term adjustment accounts for fluvial processes that lead to long-term changes within the streambed over many rainy seasons. Long-term adjustment can represent changes in the riverbed that occur as the river aggrades or degrades toward its stable slope or fluctuations in the riverbed over time due to differences in rainy seasons. United States Geological Survey (USGS) historical topography was analyzed to determine trends in the bed elevation over time. The historical analysis considered the following USGS 7.5-minute quadrangle maps:

- 1961 map of Mint Canyon, California, with 40-foot topographic contours based on aerial photographs taken from 1954 to 1956
- 1999 map of Mint Canyon, California, with 40-foot topographic contours based on imagery taken in 1993
- 2012 map of Mint Canyon, California, with 40-foot topographic contours based on contours from the National Elevation Dataset dated 1999
- 2015 map of Mint Canyon, California, with 40-foot topographic contours based on contours from the National Elevation Dataset dated 1999
- 2018 map of Mint Canyon, California, with 40-foot topographic contours based on contours from the National Elevation Dataset dated 2018
- 2022 map of Mint Canyon, California, with 40-foot topographic contours based on contours from the National Elevation Dataset dated 2018

The invert elevations within the study reach of Oak Springs Canyon Creek were obtained from each USGS map and compared. The river stationing associated with each contour within the study reach of Oak Springs Canyon Creek was obtained by drawing a line perpendicular to the stream centerline used in the hydraulic modeling. The six USGS maps are shown in **Exhibits 11 to 16**, as well as the river stations and elevations along the channel invert.

In addition to the USGS historical topographic maps, light detection and ranging (LiDAR) and Digital Elevation Model (DEM) data was considered in the analysis. 2015 LiDAR data was downloaded from the National Oceanic and Atmospheric Administration (NOAA), and 2024 DEM data was downloaded from the USGS. In addition, Alliance provided topography dated 2024. Invert elevations along the study reach of Oak Springs Canyon Creek were obtained from these terrain surfaces at each cross section used in the hydraulic modeling.

The historical Oak Springs Canyon Creek bed profiles are shown in **Figure 6-4**, where the solid lines represent the riverbed profiles obtained from the USGS historical topographic maps. Elevations obtained from the USGS 1961 historical map, and 1995 historical map were converted from National Geodetic Vertical Datum of 1929 (NGVD29) to North American Vertical Datum of 1988 (NAVD88), with a shift of 2.72 feet.

The USGS maps show that the Oak Springs Canyon Creek channel is relatively stable in the downstream areas of the study reach. The plotted stream bed profiles do show some variation in the upstream areas of the study reach. The changes to the bed profiles are centered around the existing Oak Springs Canyon culvert. Between 1995 and 2012, the stream bed seems to be aggrading, and between 2015 and 2018 the bed seems to be degrading. Historical precipitation totals for the Los Angeles area also show that the area experienced an extremely wet winter storm season in the 2016-2017 water year that could have contributed to degradation around the existing culvert. Based on the upstream bed profiles, it seems that Oak Springs Canyon Creek oscillates through periods of aggradation and degradation. These changes to the stream bed seem to be on average between 4 to 8 feet. However, the contour elevations on the USGS topo maps are at 40-foot intervals, so some differences in results could be compounded.

The LiDAR, DEM, and 2024 survey data used to supplement the USGS topographic maps are plotted on **Figure 6-4** in dashed lines. The 2024 survey and DEM data seem to match up with the 2022 USGS data relatively well, while the 2015 USGS and LiDAR data shows differences in the channel stream bed of over

10 feet, especially at the upstream areas. Some of these differences may be attributed to the higher resolution of the LiDAR and survey data compared with the USGS maps, which only show 40-foot contours. The changes in the topographic survey and DEM also show that the existing Oak Springs Canyon culvert affected the stream bed profile. This is evident through the “dip” in channel stream bed elevation shown on the graph.

The final long-term scour value used is 4 feet since this is the average fluctuation noted in the Oak Springs Canyon Creek bed profile.

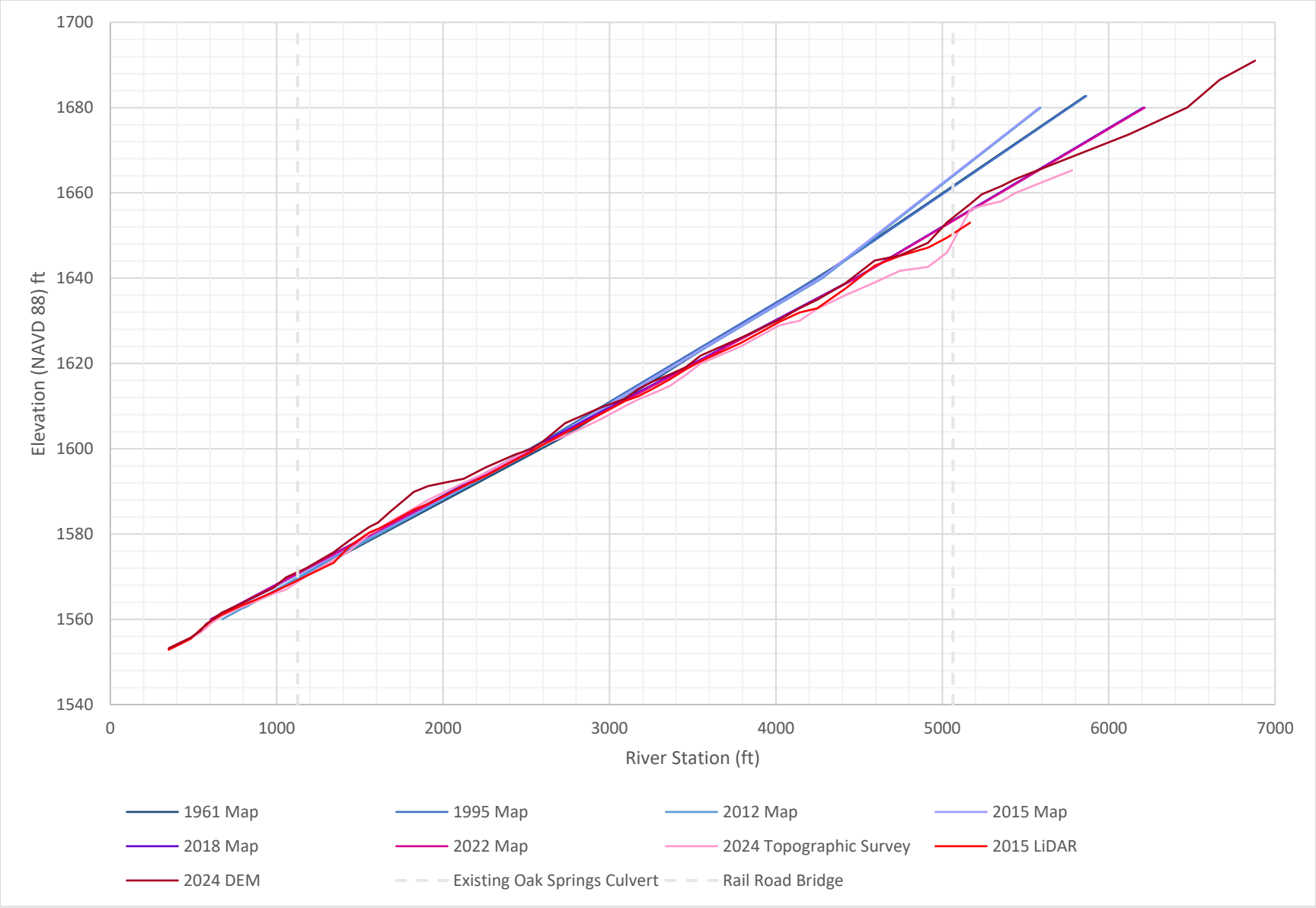


Figure 6-4: Historical Oak Springs Canyon Creek Bed Profiles

6.3 Low-Flow Incisement

The LACPW Sedimentation Manual states that low flow incisement is equal to the greater of the measured low flow depth or 2.0 feet. The low flow depth is associated with the 2-year flow rate and was obtained from the 2-year steady-state HEC-RAS model discussed in **Section 3.1**. The 2-year hydraulic results and the resulting low-flow incisement are shown in **Table 6-4.** The results show that the 2-year flow depth is below 2 feet; therefore, a value of 2 feet is used as the low flow incisement.

Table 6-4: Low Flow Incisement Results

Cross Section	Minimum Channel Elevation (ft)	2-yr Water Surface Elevation (ft)	Calculated Low Flow Depth (ft)	Low Flow Depth (ft)
1058	1567.0	1568.5	1.5	2.0
979	1566.0	1566.8	0.8	2.0
856	1563.9	1564.6	0.7	2.0
786	1562.8	1563.6	0.7	2.0
672	1560.8	1561.3	0.5	2.0
604	1559.0	1559.9	0.9	2.0
575	Lost Canyon Road Bridge			
543	1556.9	1557.9	1.0	2.0
482	1555.5	1556.3	0.8	2.0
351	1553.0	1553.7	0.7	2.0

6.4 Bedform Scour

Bedform scour is caused by dunes and anti-dunes that naturally form in the riverbed. The scour depth due to dunes and anti-dunes is assumed to be half the bedform height. Bedform scour was calculated using the following equation developed by Kennedy (1963), which was utilized by the USACE in the design of Levees 1 and 2 (USACE, 2021) and is the recommended methodology in LA County:

$$y_a = \frac{1}{2} * 0.14 * 4 * \pi * \left(\frac{V^2}{2g}\right)$$

Where:

- y_a= bedform scour (ft).
- V= average channel velocity (ft/s).
- g= gravitational constant (32.2 ft/s).

Average channel velocities for the bedform scour calculations were obtained from the proposed condition hydraulic model discussed in **Section 3.1**. Average channel velocities from this model are listed in **Table 6-5** along with the resulting scour values.

Table 6-5: Bedform Scour Results

Cross-Section	Channel Velocity (ft/s)	Bedform Scour (ft)
1058	8.8	1.1
979	11.7	1.9
856	7.5	0.8
786	8.7	1.0
672	6.5	0.6
604	3.1	0.1
575	**Lost Canyon Road Bridge**	
543	6.8	0.6
482	6.8	0.6
351	6.8	0.6

6.5 Local Scour

The local scour component at the Lost Canyon Road Bridge and Oak Springs Canyon Road Culvert was calculated using the hydraulic results of the proposed condition scour model discussed in **Section 3.1**. Local scour at bridges is made up of abutment scour, contraction scour, and bridge pier scour. Each scour component was calculated using HEC-18 methodology. Calculations were completed using the HEC-RAS HEC-18 local scour calculation tool during the peak flow rate of 1,140 cfs ($Q_{100, FEMA}$) and 3,535 cfs (Q_{100}). Sediment grain sizes, including D_{50} and D_{95}, were obtained from the sediment gradation curve established for the sediment transport calculations in **Section 6.1.1**.

Contraction scour occurs when the flow area in the river is reduced due to constriction by a bridge. There are two types of contraction scour: Type I, live-bed contraction scour, and Type II, clear-water contraction scour. Live-bed contraction scour occurs when the bed material is transported to the bridge from upstream of the contraction reach, whereas clear-water contraction scour occurs assuming no (or negligible) sediment supply to the bridge. HEC-RAS determines whether the mean channel velocity is larger than the critical velocity for beginning of motion using an equation developed by Laursen (1963), which relates the critical velocity in the channel to the D_{50} and depth of flow. If the critical velocity exceeds the mean channel velocity, Type II contraction scour is calculated; otherwise, Type I is calculated. The bridge scour tool within HEC-RAS calculates contraction scour following HEC-18 procedures given hydraulic results from the HEC-RAS model, a user-input D_{50} (0.91 mm), and a set water temperature (assumed to be 60°F).

Scour occurs at bridge piers due to acceleration of flow around the pier and formation of a horseshoe vortex. HEC-RAS calculates pier scour using the HEC-18 pier scour equation, which is based on the Colorado State University (CSU) method and is included below:

$$y_s = 2.0K_1K_2K_3K_4a^{0.65}y_1^{0.35}Fr_1^{0.43}$$

Where:

- y_s= Depth of scour (ft).
- K_1= Correction factor for pier nose shape, which was set to 1.0 to represent the cylindrical pier noses
- K_2= Correction factor for angle of attack, which was set to 0 degrees since the bridge piers are oriented parallel to the direction of flow.
- K_3= Correction factor for bed condition, which was set to 1.1 to represent small dunes. The height range for small dunes is defined as between 2 feet and 10 feet, which is consistent with the dune height calculated to determine bedform scour
- K_4= Correction factor for armoring bed materials, which decreases the scour depths accounting for armoring of scour holes. No correction factor was used (i.e., K_4 was set to 1.0), since the D_{50} is below the suggested grain size for which to apply the factor.
- a = Pier width (ft).
- y_1 = Flow depth directly upstream of the pier (ft), taken from the flow distribution output for the cross section immediately upstream of the bridge
- Fr_1= Froude number immediately upstream of the pier, taken from the flow distribution output for the cross section immediately upstream of the bridge

The HEC-18 subroutine within HEC-RAS was run to determine the local scour components at the Lost Canyon Road Bridge structure. The total local bridge scour calculated at the Lost Canyon Road Bridge is 9.19 feet for $Q_{100, FEMA}$ (1,140 cfs) and 10.78 feet for Q_{100} (3,535 cfs). Note, less abutment scour is calculated for the right abutment since it has less area inside of the limits of the floodplain due to the existing topography in the approach and bridge section geometries.

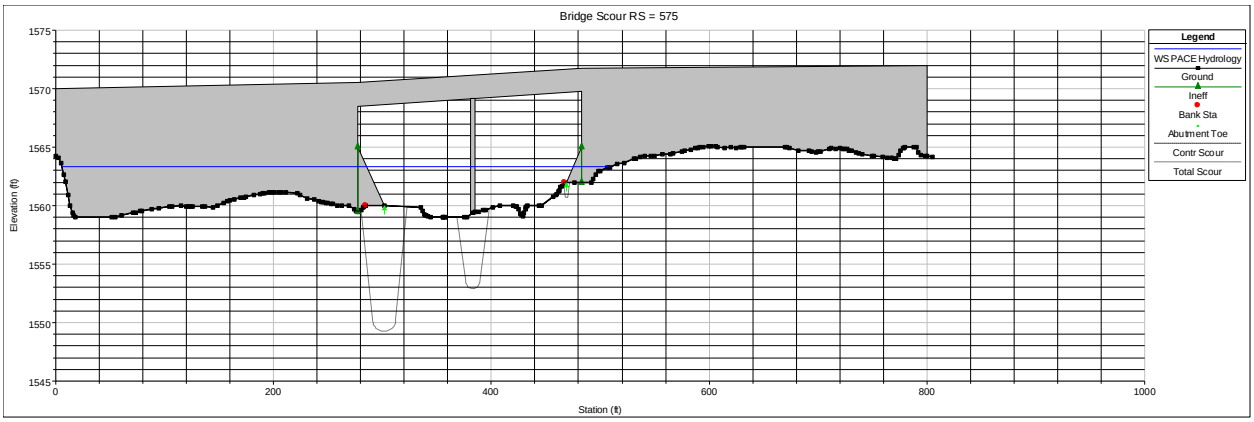


Figure 6-5: Lost Canyon Road Bridge Scour

6.6 Total Scour

The total scour at each HEC-RAS cross section within the vicinity of the proposed structures was determined by analyzing channel adjustments possible from long-term degradation, general scour, local scour, low-flow incisement, bend scour, and bedform scour. The total scour is summarized in **Table 6-6**.

$$Z_{Total} = Z_{Gerneral} + Z_{Local\ Scour} + Z_{Long\text{-}Term} + Z_{Low\ Flow\ incisement} + Z_{Bedform}$$

Table 6-6: Summary of Total Scour at Lost Canyon Road Bridge

HEC-RAS Cross Section	Invert Elevation (ft)	General Scour (ft)[1]	Long-Term Scour (ft)[2]	Low-Flow Incisement (ft)[3]	Bedform Scour (ft)[4]	Local Scour (ft)[5]	Total Scour (ft)
1058	1567	0.6	4	2.0	1.1		7.7
979	1566	0.6	4	2.0	1.9		8.5
856	1563.9	0.6	4	2.0	0.8		7.4
786	1562.8	0.6	4	2.0	1.0		7.6
672	1560.8	0.6	4	2.0	0.6		7.2
604	1559	0.6	4	2.0	0.1	10.8	17.5
575	Lost Canyon Road Bridge						
543	1557	0.6	4	2.0	0.6	10.8	18.0
482	1555.5	0.6	4	2.0	0.6		7.2
351	1553	0.6	4	2.0	0.6		7.2

Notes:
*[1]General Scour values from **Section 6.1***
*[2]Long-Term Scour values from **Section 6.2***
*[3]Low-Flow Incisement values from **Section 6.3***
*[4]Bedform Scour values from **Section 6.4***
*[5]Local Scour values from **Section 6.5***

7 Conclusion

This report presents the result of the Belcaro development preliminary hydraulic design in order to provide design guidelines for the proposed improvements and evaluate potential floodplain impacts along Oak Springs Canyon Creek in Santa Clarita, California. The project improvements include:

- Removing the existing Oak Springs Canyon Creek culvert and replacing it with a larger culvert
- Constructing a new proposed culvert crossing along future "J" Street
- Constructing a new proposed bridge crossing along existing Lost Canyon Road
- Implementation of erosion protection around the proposed Oak Springs Canyon Creek Bridge and "J" Street culvert

HEC-RAS was used to model the existing and proposed conditions and no off-site impacts were found. The existing and proposed floodplains are plotted on **Exhibit 8**.

Rock erosion protection is proposed around the proposed Oak Springs Canyon Creek Bridge and "J" Street. 1-ton grouted rock will be used at the Oak Springs Canyon Creek Bridge, 1-ton loose rock will be used as erosion protection in the basin and through the "J" Street Culvert, and ½-ton loose rock will be used downstream of the culvert. The proposed rock limits are shown in **Exhibit 5**.

A scour analysis was completed at the downstream limits of the study area around the proposed Lost Canyon Road Bridge. Total scour was estimated using LACPW methodology and showed scour values ranging from 7.2 to 8.5 feet upstream and downstream of the bridge and values up to 18 feet at the bridge.

A Conditional Letter of Map Revision (CLOMR) application will be prepared and submitted to FEMA, and upon completion of the project, a Letter of Map Revision (LOMR) will also be prepared and submitted to FEMA.

References

Federal Highway Administration (2001) Hydraulic Engineering Circular Number 18. May.

LGC Valley, Inc. “Geotechnical Investigation Report Proposed Residential Development Belcaro at Sand Canyon Vesting Tentative Tract Map 084497”, May 17, 2024.

Los Angeles County Department of Public Works Hydrology and Sedimentation Manual (LACH&SM) (December 1991)

Los Angeles County Flood Control District Hydraulic Design Manual (March 1982)

National Engineering Handbook, Technical Supplement 14B, Scour Calculations (210-VI-NEH) (August 2007)

US Army Corps of Engineers (ACOE) (September 2002) SAM Hydraulic Design Package for Channels.

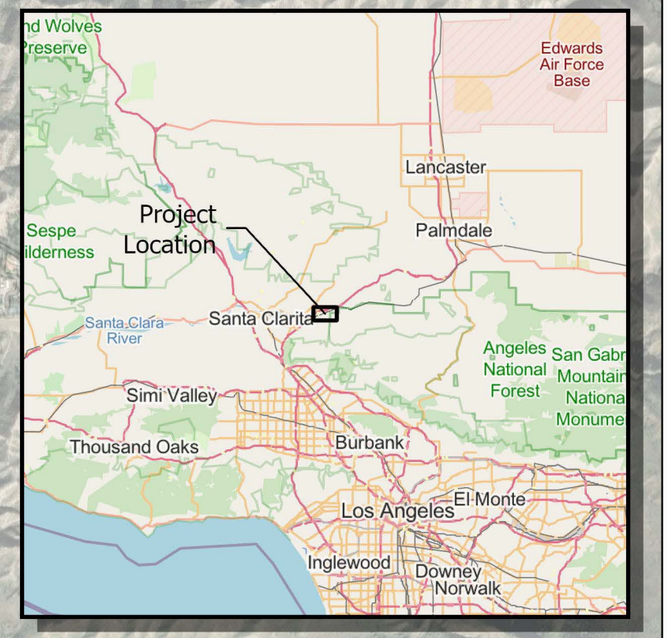
PACE
Advanced Water Engineering

Exhibits

Legend

- Property Boundary
- Stream Centerline

Soledad Canyon Rd
Norland Dr
Norland Dr
Soledad Canyon Rd
Soledad Canyon Rd
Soledad Canyon Rd
Santa Clara River
Santa Clara River
Sand Canyon Rd
Oak Spring Canyon Rd
Ada St
Sam Pl
Marilyn Dr
Flowerpark Dr
Gladiolus Dr
Yaglen Dr
Alder Peak Ave
Winterdale Dr
Winterdale Dr
Kenroy Ave
Mitchell Elementary School
Lost Canyon Rd
Sand Canyon Rd
Arial Way
Zion Dr
Grand Ln
Comet Way
English Ivy Ln
Oak Spring Canyon Rd
Robinson Ranch Golf Course
Robinson Ranch Rd
Robinson Ranch Rd
Valley Ranch Rd
14



P:\C323\GIS\Projects\C323_Belcaro\C323_Belcaro.aprx - Vicinity Map

BELCARO

PROJECT VICINITY MAP

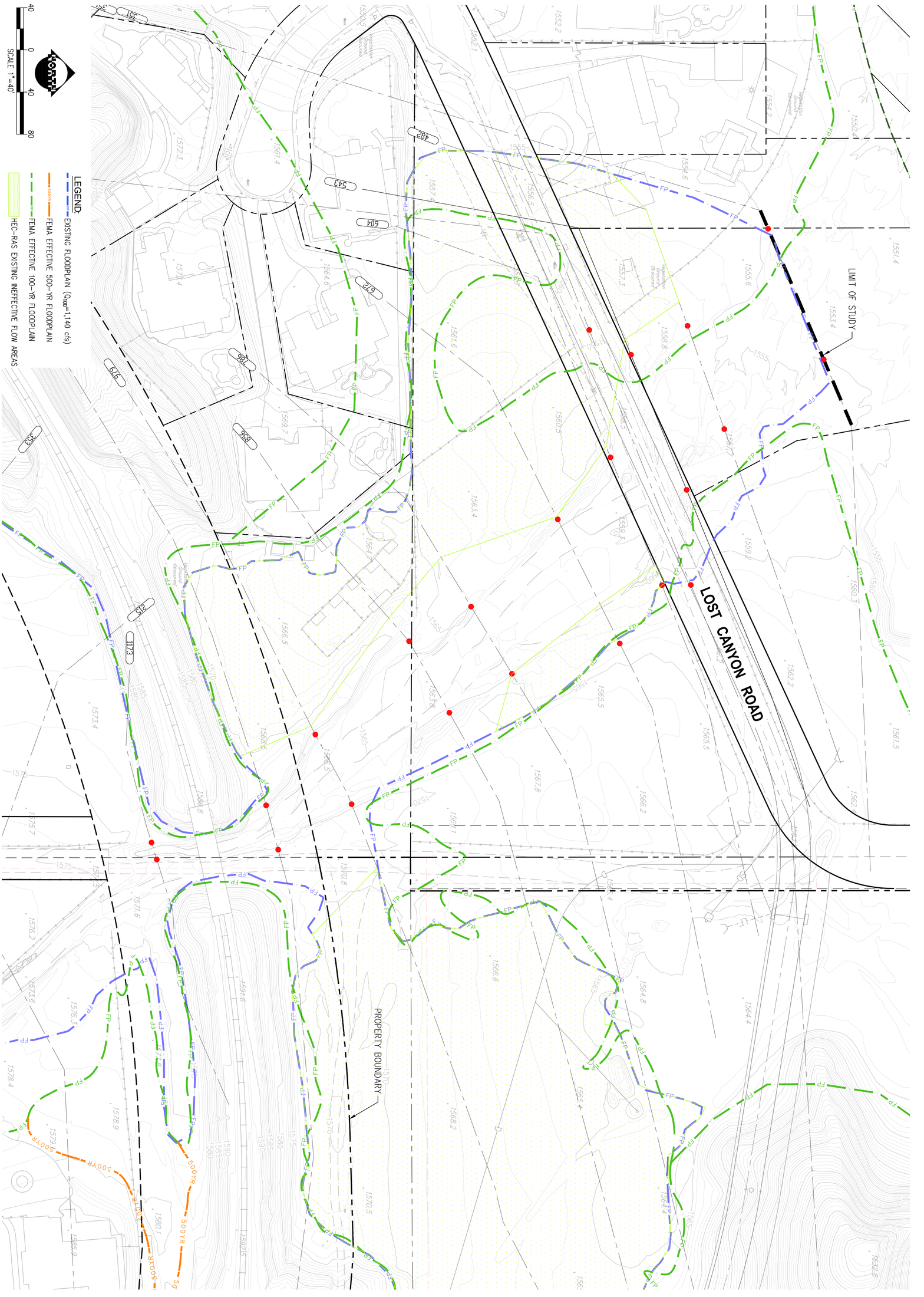
PACE Advanced Water Engineering

0 500 1,000 2,000 Feet

Date: 12/5/2024

Job Number: B323

Exhibit 1


SCALE 1"=40'
40
0
40
80
NORTH
LEGEND:
EXISTING FLOODPLAIN (Q100=1,140 cfs)
FEMA EFFECTIVE 500-YR FLOODPLAIN
FEMA EFFECTIVE 100-YR FLOODPLAIN
HEC-RAS EXISTING INEFFECTIVE FLOW AREAS
HEC-RAS EXISTING BANK STATIONS
LIMIT OF STUDY
LOST CANYON ROAD
PROPERTY BOUNDARY
500YR
500YR
500YR

LIMIT OF STUDY

TOE OF ROCK SLOPE PROTECTION (BURIED)

DAYLIGHT

LOST CANYON ROAD

TOE OF ROCK SLOPE PROTECTION (BURIED)

DAYLIGHT

DAYLIGHT

DAYLIGHT

PROPERTY BOUNDARY

Vegetation Ground Obscured

LEGEND:

- EXISTING FLOODPLAIN (Q_{100}=1,140 cfs)
- PROPOSED FLOODPLAIN (Q_{100}=1,140 CFS)
- HEC-RAS PROPOSED INEFFECTIVE FLOW AREAS
- HEC-RAS PROPOSED BANK STATIONS

NORTH

40 0 40 80

SCALE 1"=40'

NO	BY	DATE	REVISIONS	DATE	APP.

PREPARED BY
EMR

R.C.E. NO. — PROJECT ENGINEER
EXP. YY/YY — # XXXX

DRAWN
B.P.

SCALE

DESIGNED
EMR

CHECKED
A.R.

DATE
XX/XX/98

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TITLE

LOST CANYON ROAD BRIDGE PROPOSED CONDITION FLOODPLAIN MAPPING

JOB

BELCARO
OAK SPRINGS
HEC-RAS
WORKMAP

SANTA CLARITA CA

PACE
Advanced Water Engineering
17520 Newhope Street, Suite 200 | Fountain Valley
P: (714) 481-7300 | www.pacewater.com

EXHIBIT
03

JOB NO. C323

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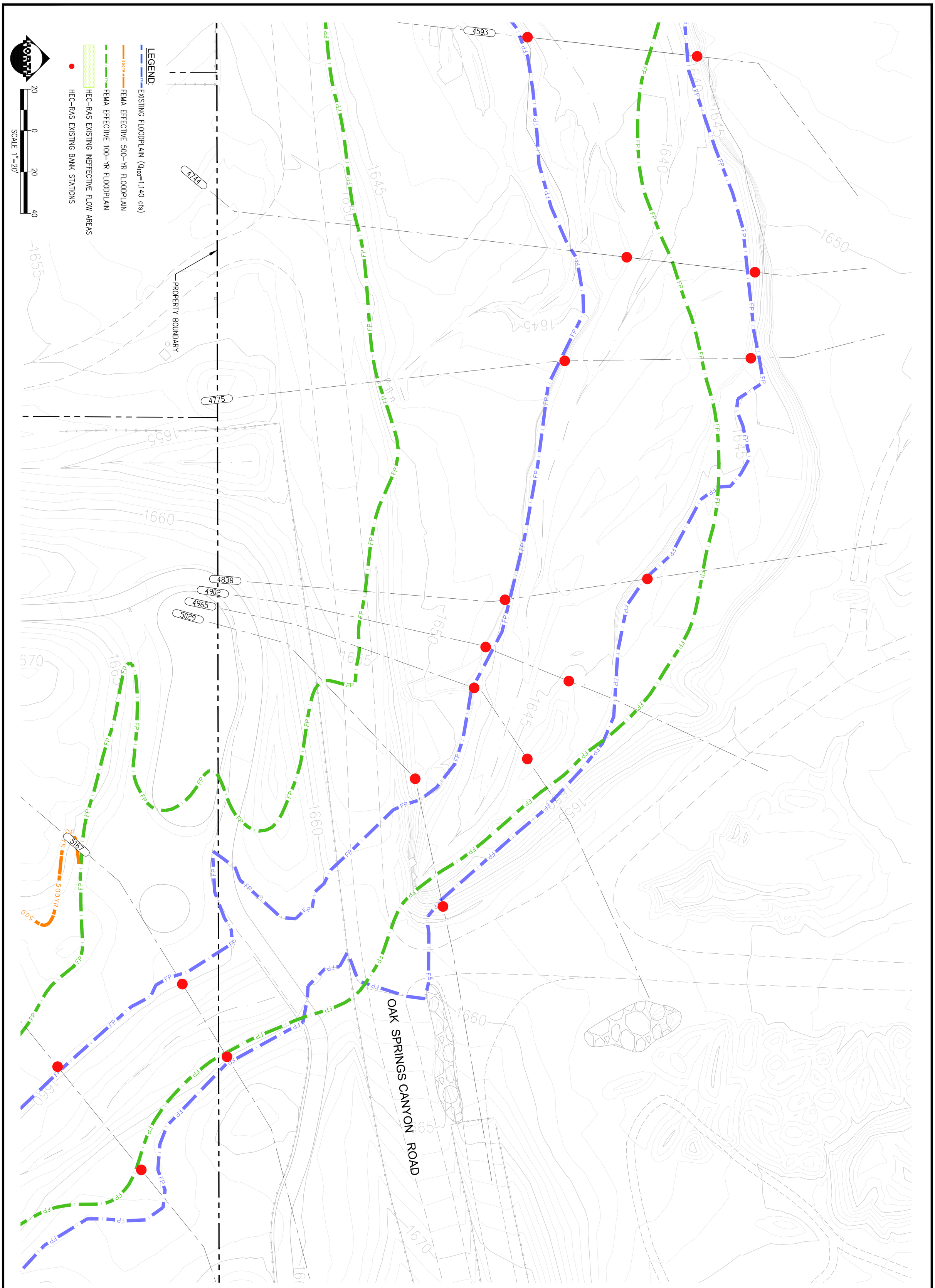

JOB NO. C323

EXHIBIT 04

PACE
Advanced Water Engineering
17520 Newhope Street, Suite 200 | Fountain Valley, CA 92708
P: (714) 481-7300 | www.pacewater.com

JOB
BELCARO
OAK SPRINGS
HEC-RAS
WORKMAP
SANTA CLARITA **CA**

TITLE
OAK SPRINGS CANYON ROAD AND "J" STREET EXISTING CONDITIONS FLOODPLAIN MAPPING

PREPARED BY	*EMR*
PROJECT ENGINEER R.C.E. NO. ——	*# XXXX*
EXP.	*x/xx/xx*
DRAWN	*B.P.*
SCALE	
DESIGNED	*EMR*
CHECKED	*A.R.*
DATE	*XX/XX/98*

NO	BY	DATE	REVISIONS	DATE	APP.

P:\C323\Engineering\GlobalExhibits\C323_Exhibit 4_JStreetRock_EffEx.dwg – Tab: 24x36 – by erandig on 07/11/25 at 4:09:16 PM

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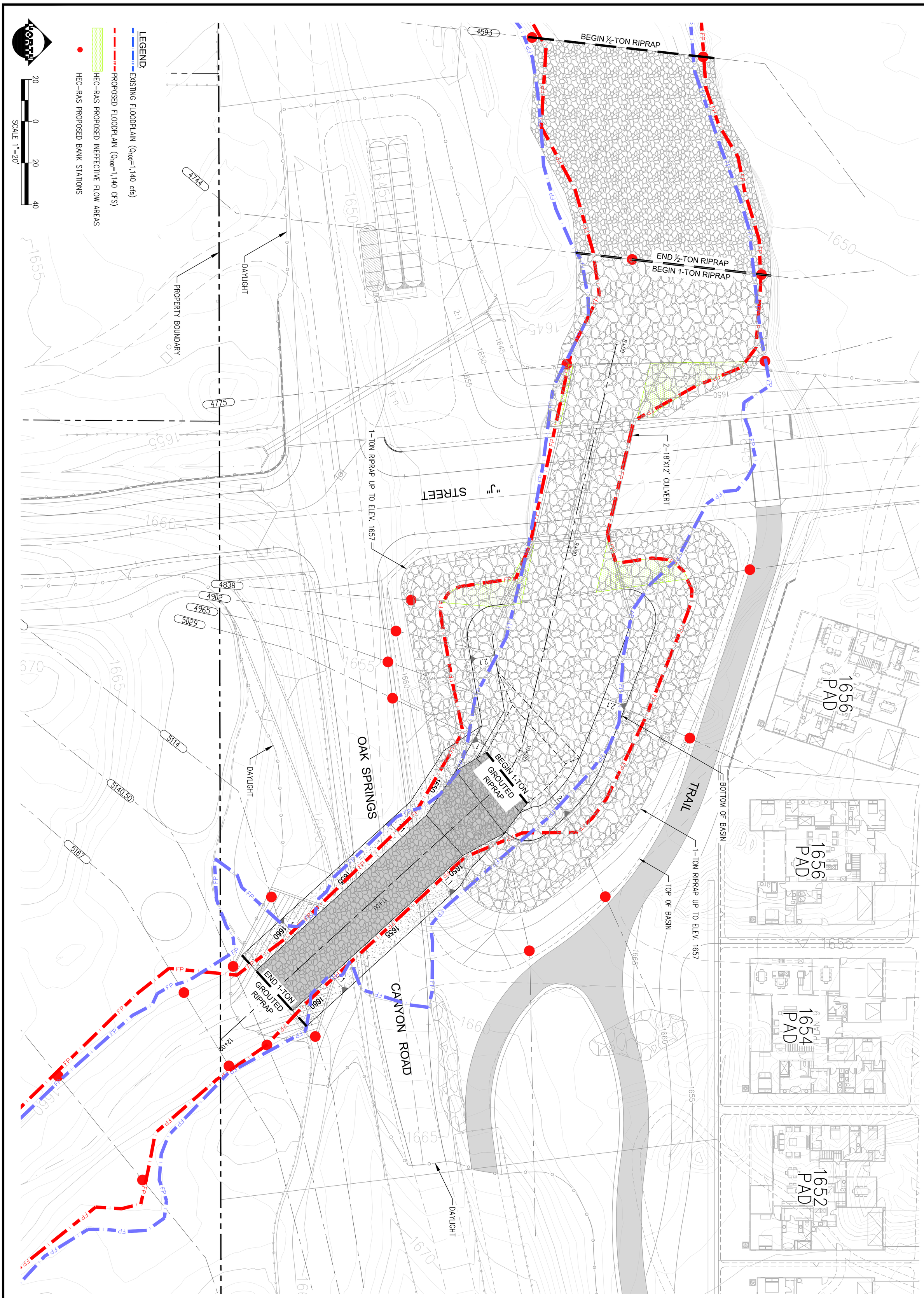

JOB NO. C323

EXHIBIT 05

PACE
Advanced Water Engineering
17520 Newhope Street, Suite 200 | Fountain Valley, CA 92708
P: (714) 481-7300 | www.pacewater.com

JOB
BELCARO
OAK SPRINGS
HEC-RAS WORKMAP
SANTA CLARITA **CA**

TITLE
OAK SPRINGS CANYON ROAD BRIDGE AND "J" STREET CULVERT FLOODPLAIN

PREPARED BY	*EMR*
PROJECT ENGINEER R.C.E. NO. ——	*# XXXX*
EXP.	*x/xx/xx*
DRAWN	*B.P.*
SCALE	
DESIGNED	*EMR*
CHECKED	*A.R.*
DATE	*XX/XX/98*

NO	BY	DATE	REVISIONS	DATE	APP.

P:\C323\Engineering\GlobalExhibits\C323_Exhibit 5_JStreetRock_ExPr.dwg – Tab: 24x36 – by erandig on 07/11/25 at 3:25:02 PM

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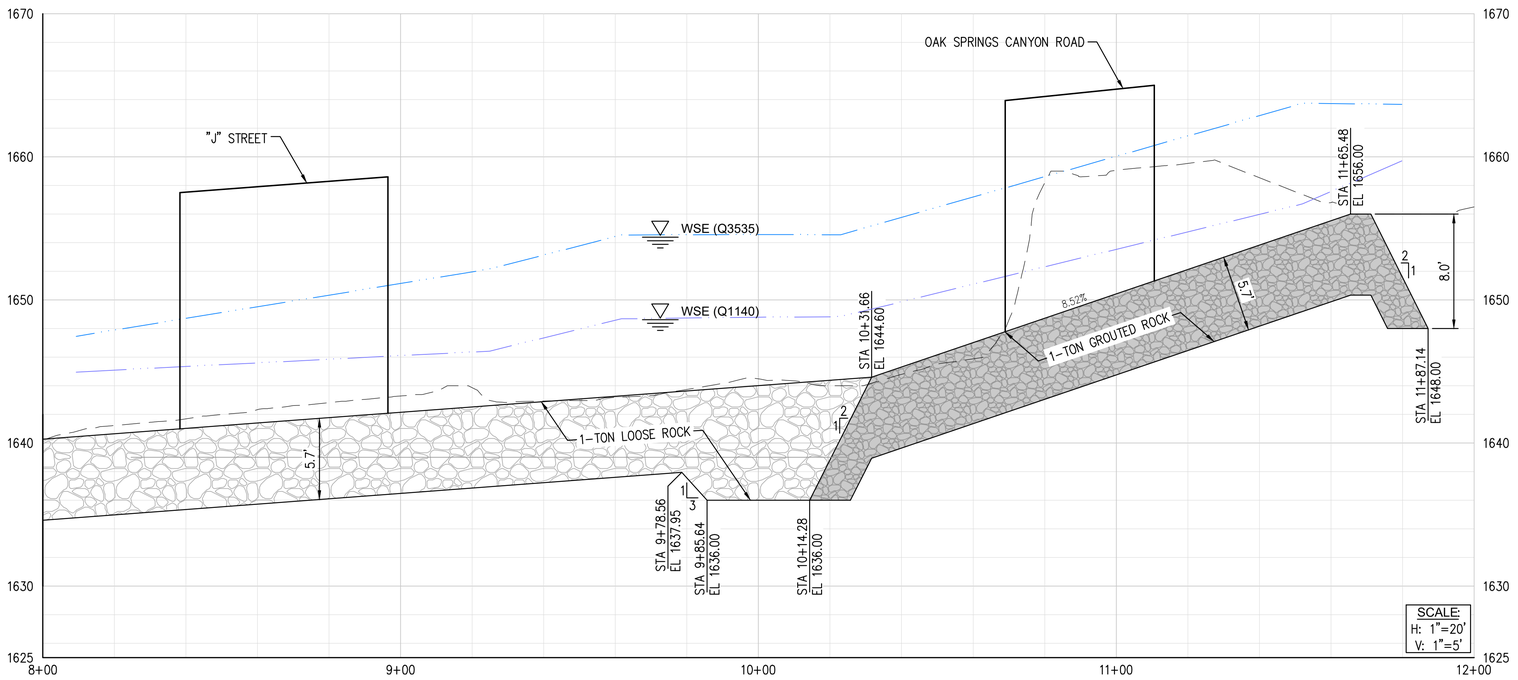

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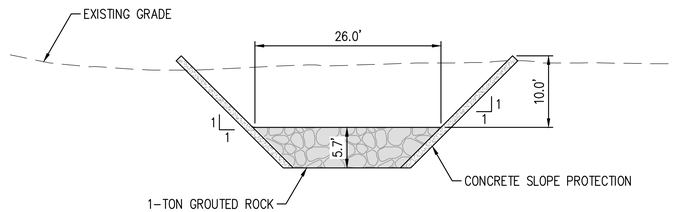

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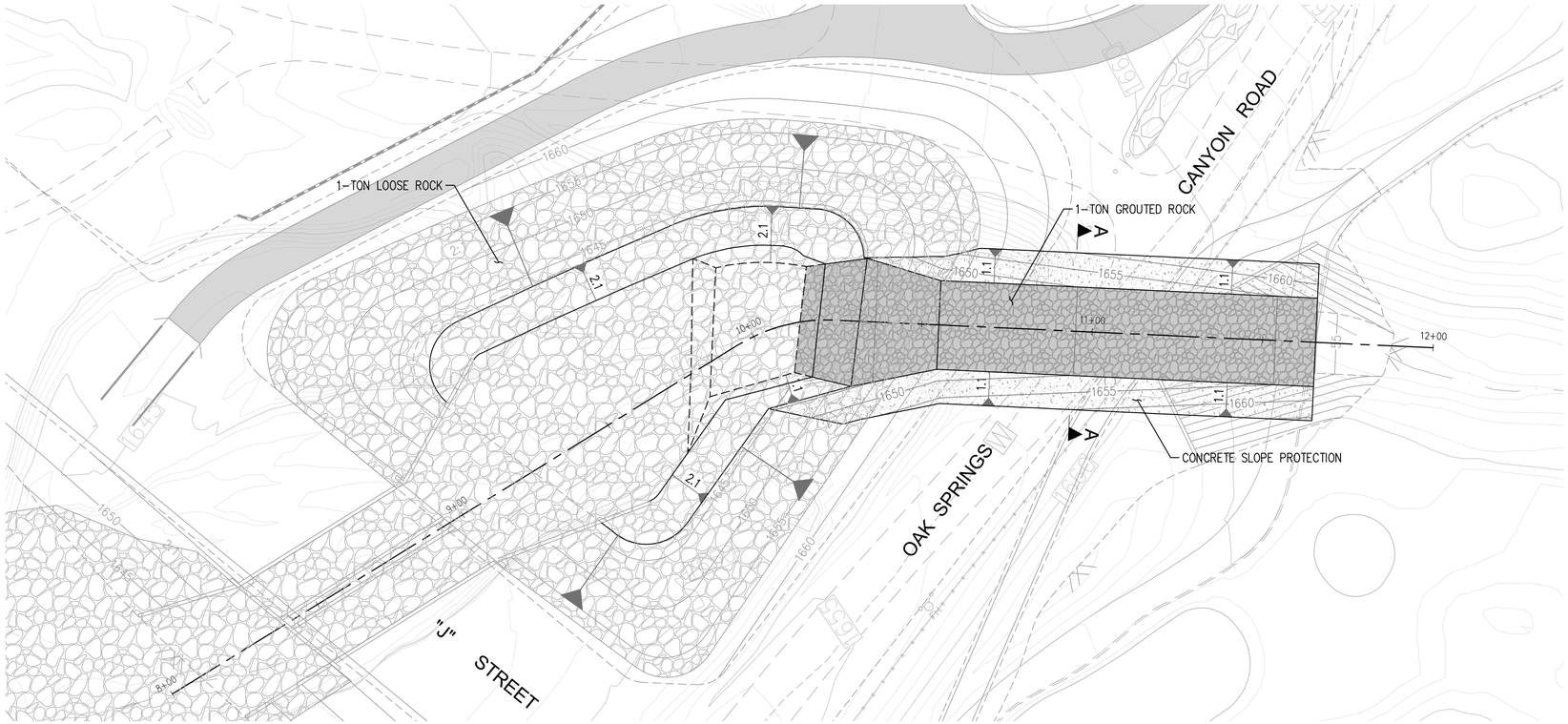


PLAN

PACE
Advanced Water Engineering
17520 Newhope Street, Suite 200 | Fountain Valley, CA 92708
P: (714) 481-7300 | www.pacewater.com

PREPARED	JOSE CRUZ
PROJECT ENGINEER	
R.C.E. NO.	72249
EXP.	06/30/20XX
DRAWN	BDP
SCALE	AS SHOWN
DESIGNED	ER
CHECKED	MEK
DATE	7/11/2025

TITLE

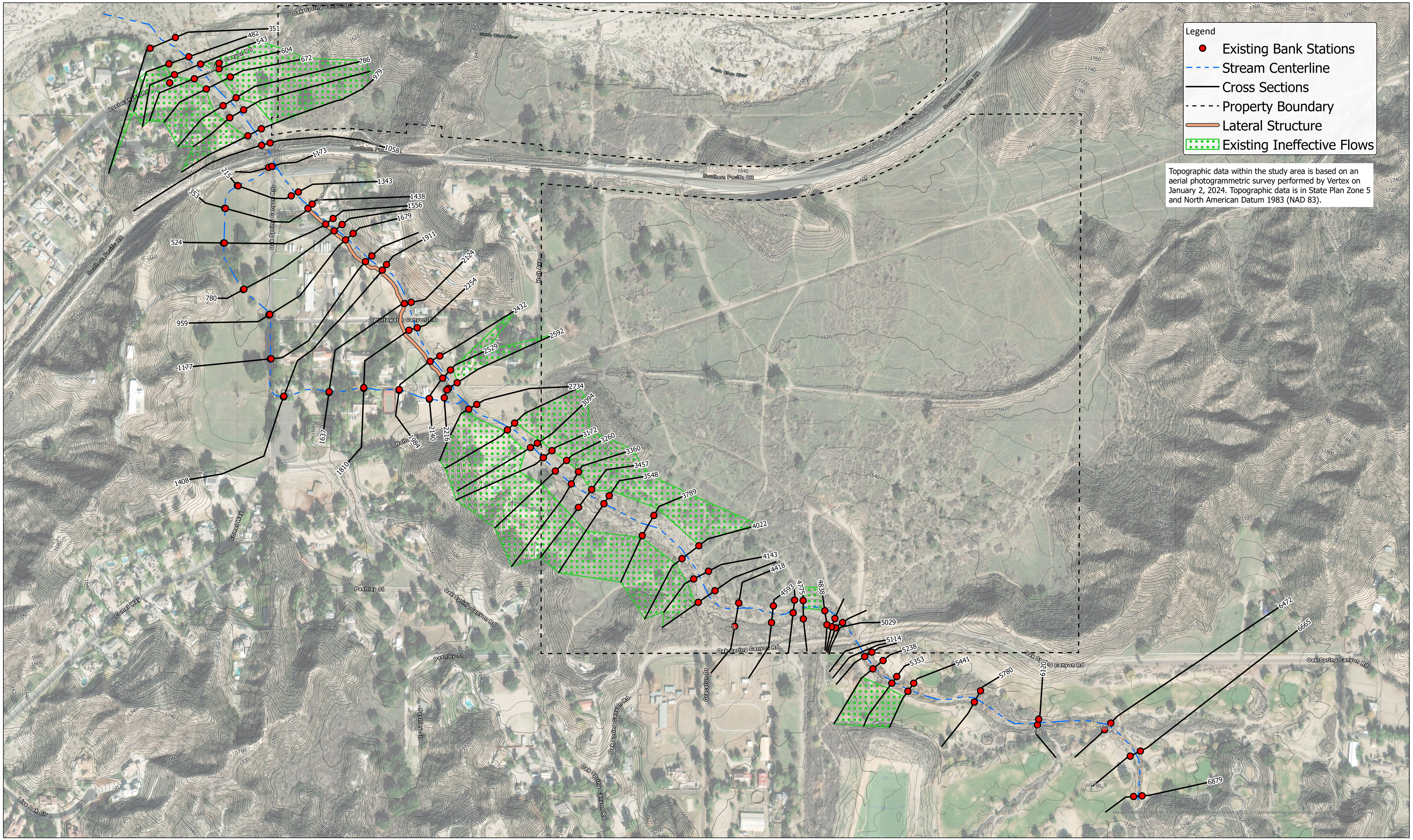
PROPOSED CHANNEL PLAN AND PROFILE

EIMP. XXXXXXXX

FIGURE 06

JOB NO. XXXX

P:\CS23\Engineering\GlobalExhibits\CS23 PROP CHANNEL EXHIBIT.dwg — Tab: 24x36 By: bphan on Jul. 11, 2025 at 03:06 pm



P:\C323\GIS\Projects\C323_Belcaro\C323_Belcaro.aprx - HEC-RAS Workmap Existing

BELCARO

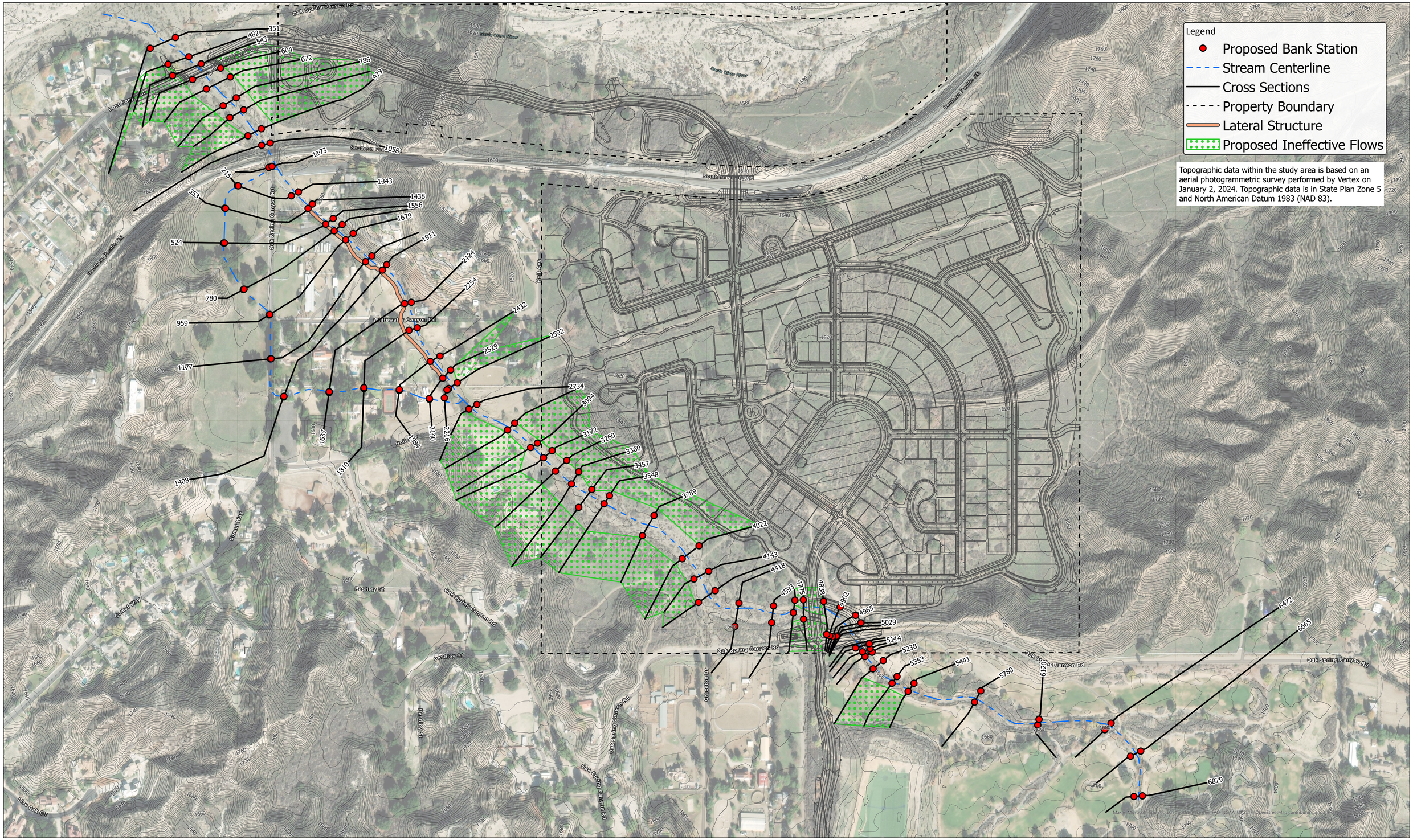
EXISTING CONDITION HEC-RAS WORKMAP

0 200 400 800 Feet

Date: 7/10/2025

Job Number: B323

Exhibit 7



P:\C323\GIS\Projects\C323_Belcaro\C323_Belcaro.aprx - HEC-RAS Workmap Proposed

BELCARO

PROPOSED CONDITION HEC-RAS WORKMAP

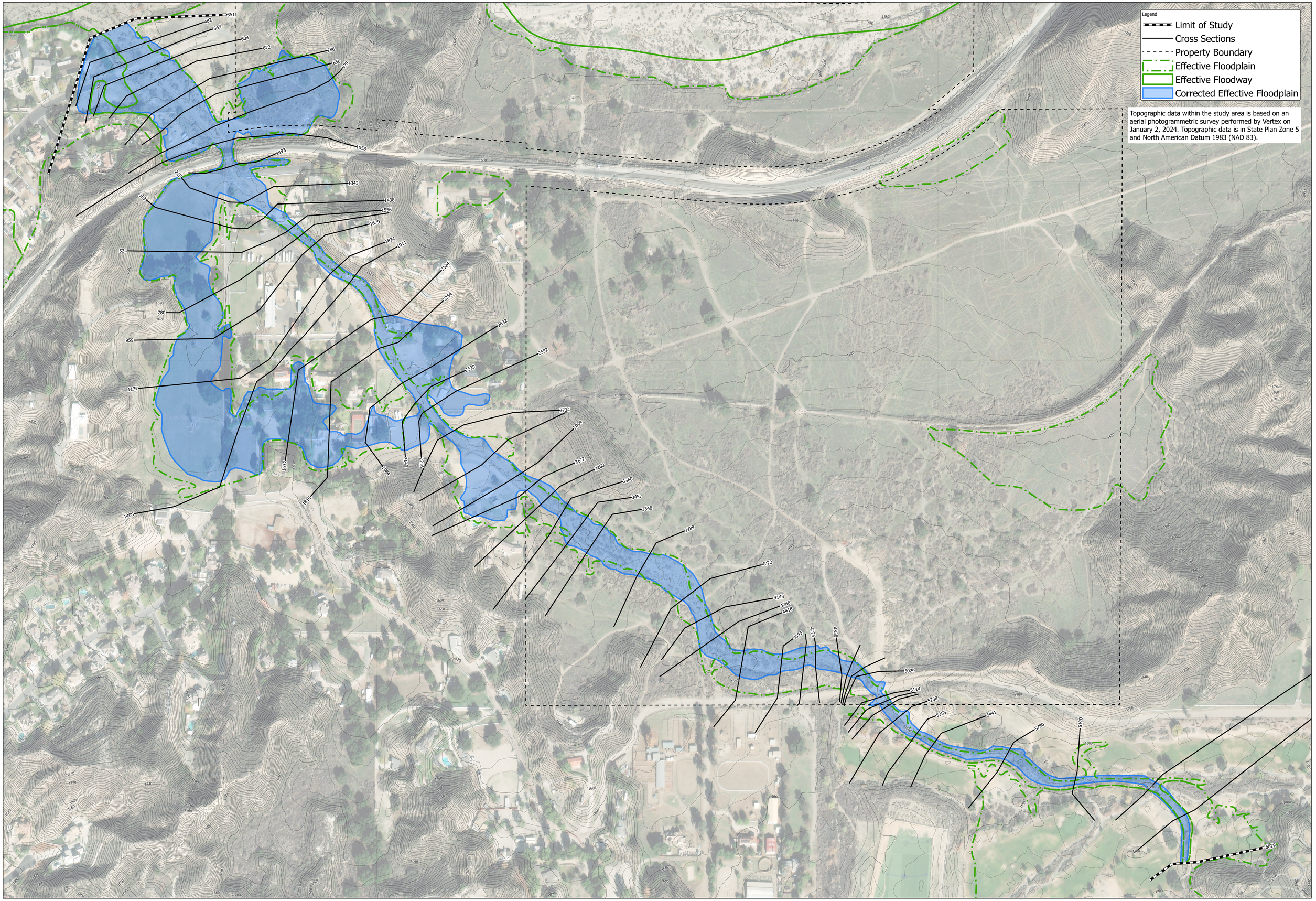
PACE Advanced Water Engineering

0 200 400 800 Feet

Date: 7/10/2025

Job Number: B323

Exhibit 8



P:\C323\GIS\Projects\C323_Belcaro\C323_Belcaro.aprx - Effective vs Corrected Effective Floodplain Workmap

BELCARO

EXISTING CONDITIONS FLOODPLAIN COMPARISON

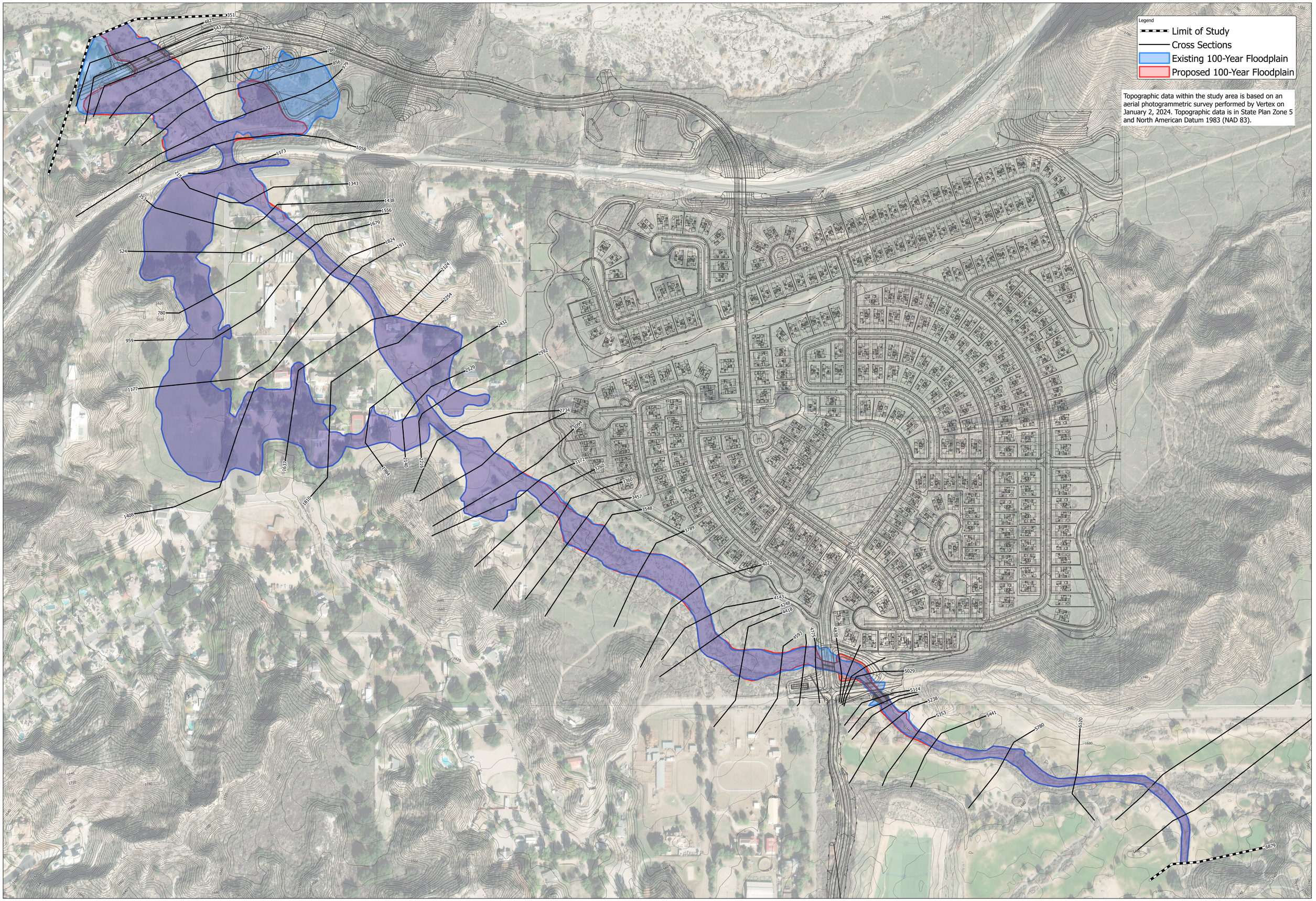
PACE Advanced Water Engineering

0 125 250 500 Feet

Date: 7/10/2025

Job Number: B323

Exhibit 9



P:\C323\GIS\Projects\C323_Belcaro\C323_Belcaro.aprx - Existing vs Proposed Floodplain Workmap

BELCARO

PROPOSED CONDITIONS FLOODPLAIN COMPARISON

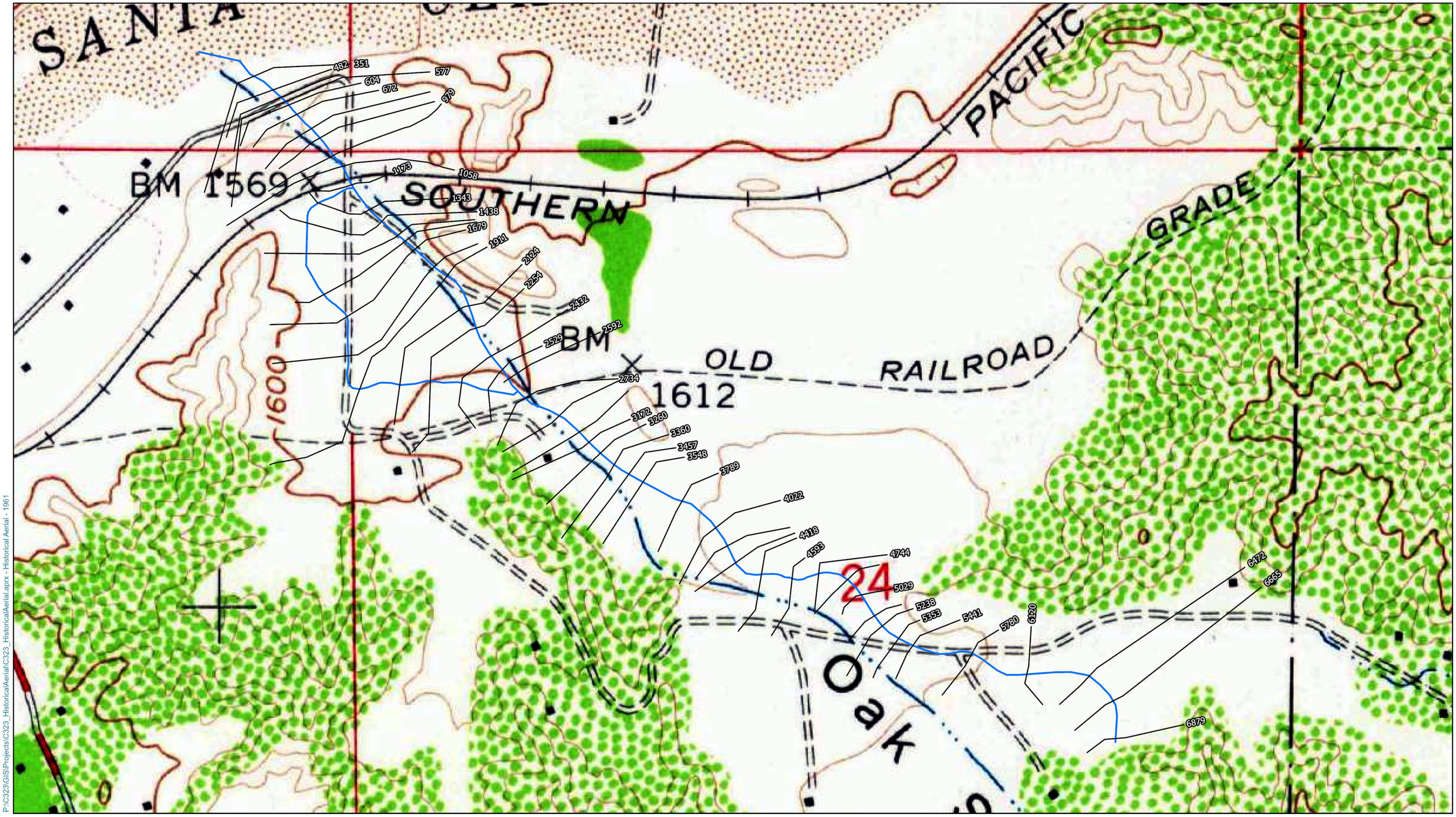
PACE Advanced Water Engineering

0 125 250 500 Feet

Date: 7/10/2025

Job Number: B323

Exhibit 10



P:\C323\GIS\Projects\C323_HistoricalAerial\C323_HistoricalAerial.aprx - Historical Aerial - 1961

BELCARO

HISTORIC TOPOGRAPHIC MAP, 1961

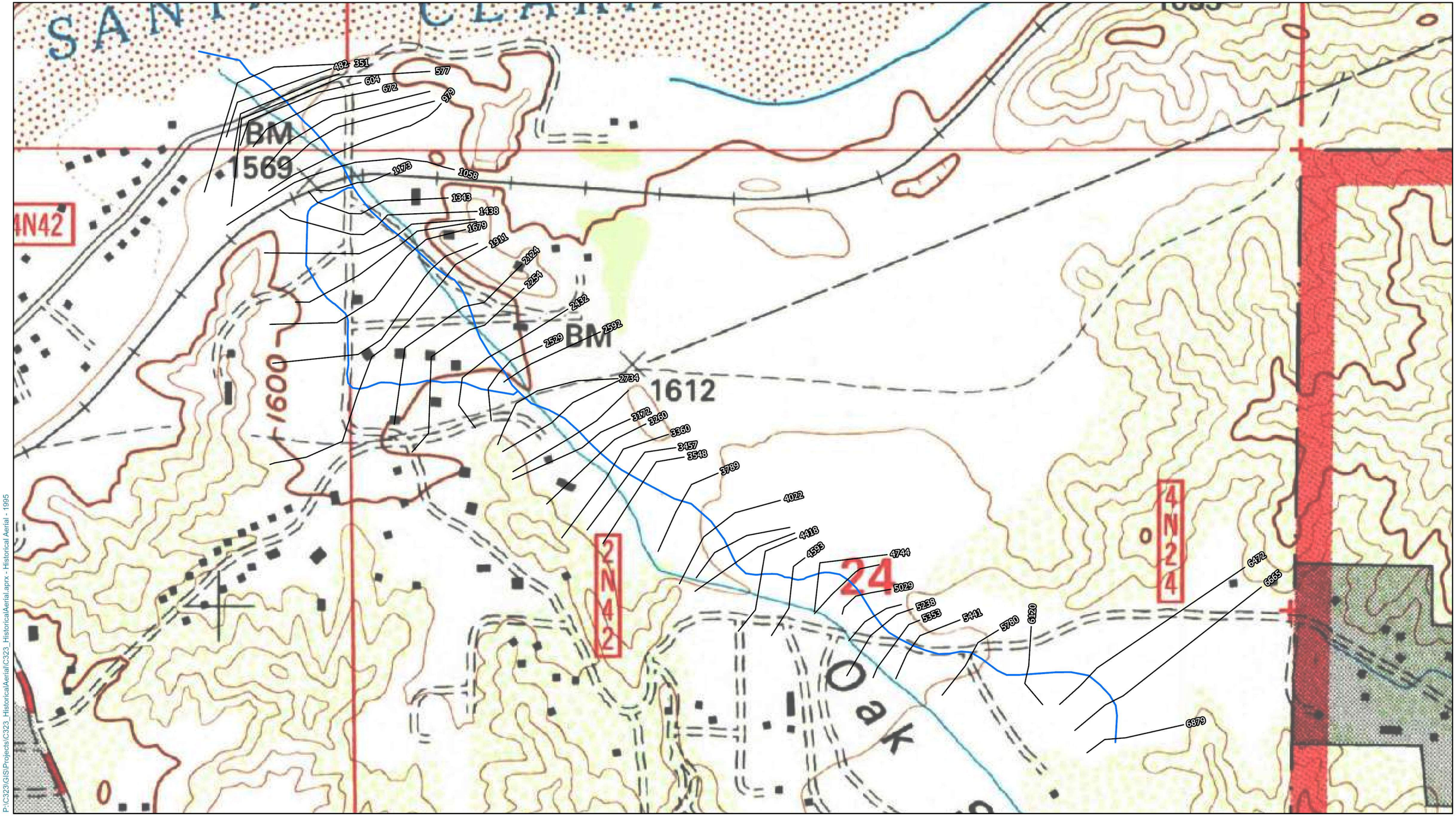
PACE Advanced Water Engineering

0 250 500 1,000 Feet

Date: 12/5/2024

Job Number: B323

Exhibit 11



P:\C323\GIS\Projects\C323_HistoricalAerial\C323_HistoricalAerial.aprx - Historical Aerial - 1995

BELCARO

Historic Topographic Map, 1995

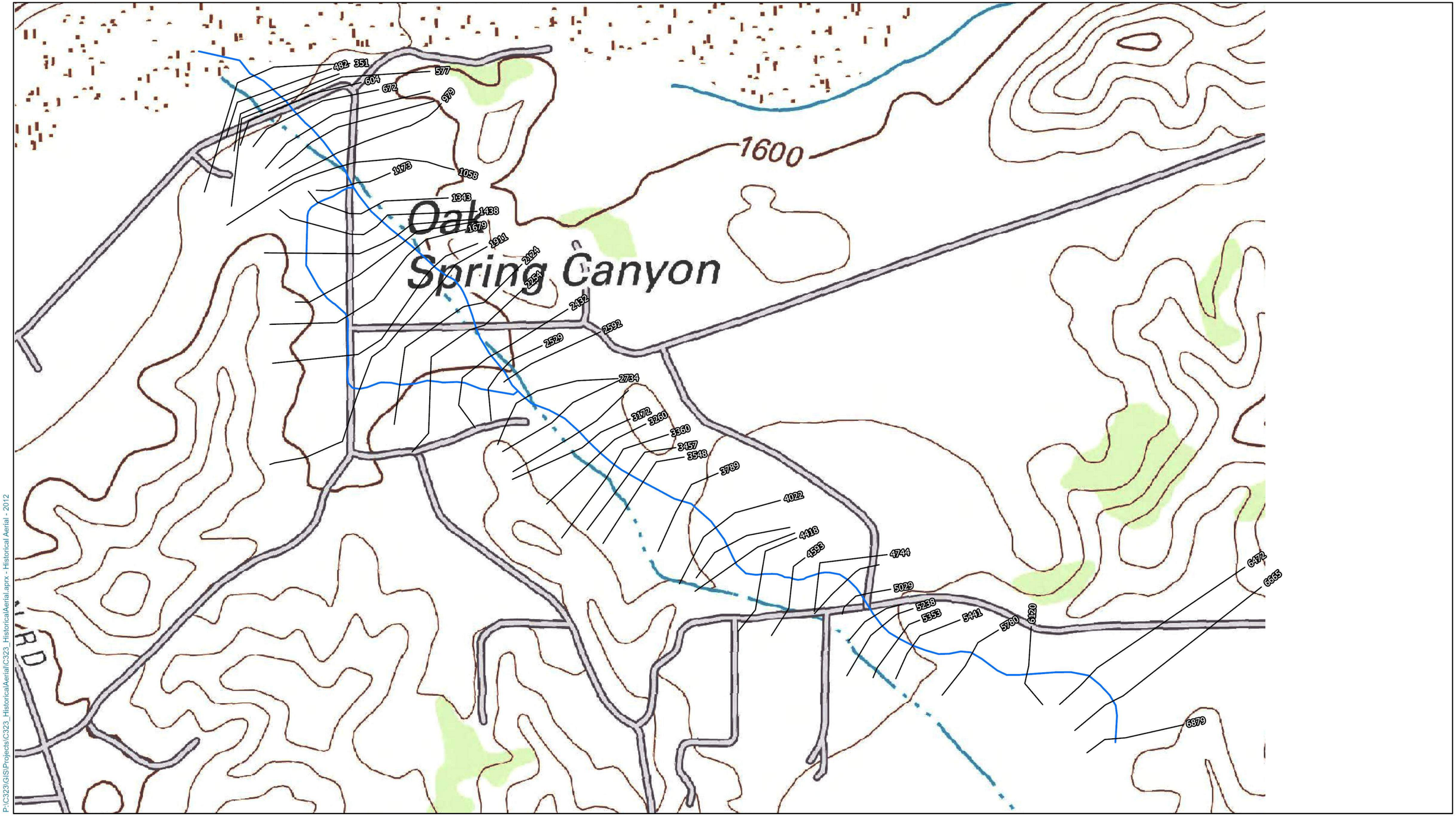
PACE Advanced Water Engineering

0 250 500 1,000 Feet

Date: 12/5/2024

Job Number: B323

Exhibit 12



P:\C323\GIS\Projects\C323_HistoricalAerial\C323_HistoricalAerial.aprx - Historical Aerial - 2012

BELCARO

HISTORIC TOPOGRAPHIC MAP, 2012

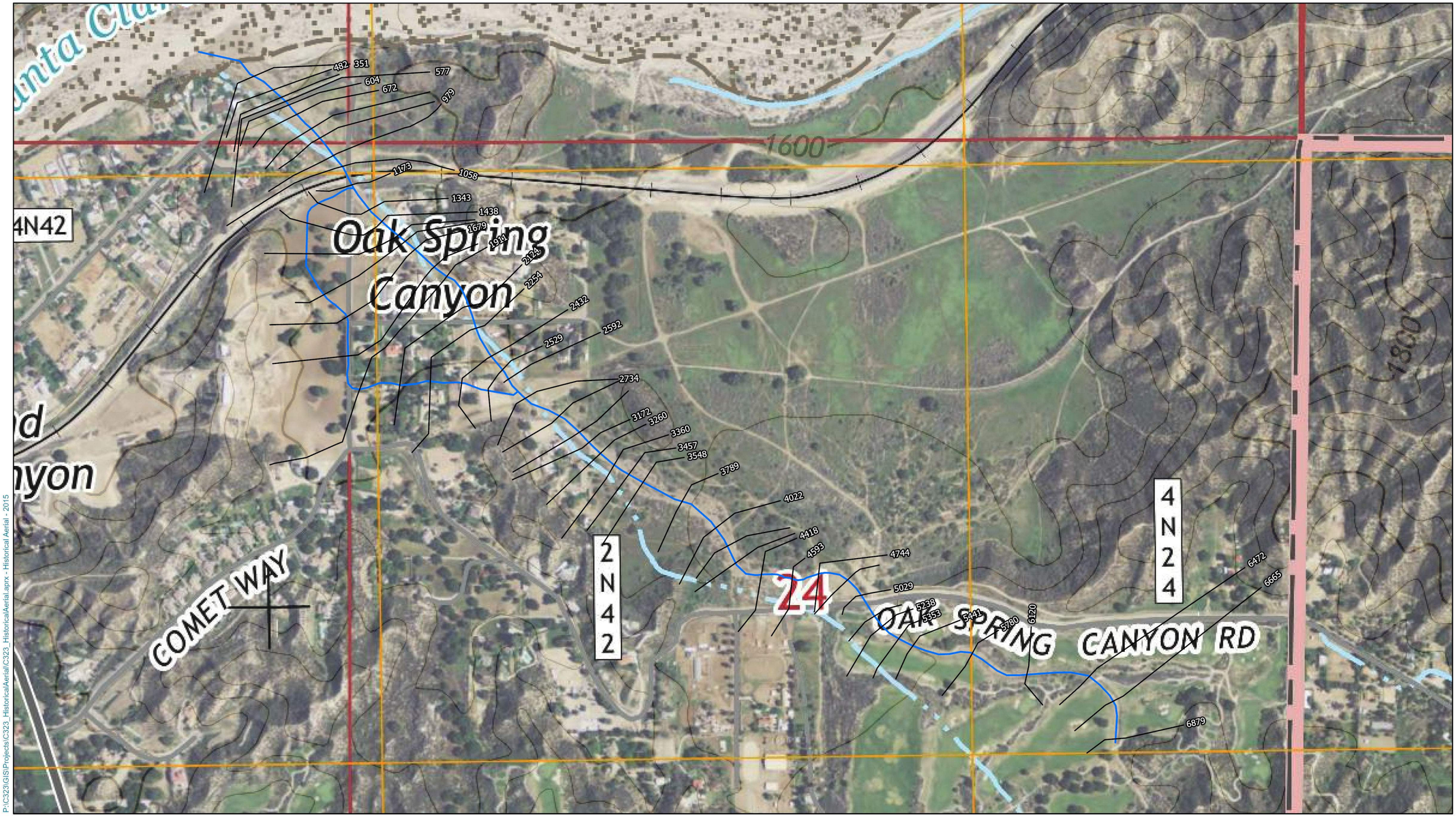
PACE Advanced Water Engineering

0 250 500 1,000 Feet

Date: 12/5/2024

Job Number: B323

Exhibit 13



P:\C323\GIS\Projects\C323_HistoricalAerial\C323_HistoricalAerial.aprx - Historical Aerial - 2015

BELCARO

HISTORIC TOPOGRAPHIC MAP, 2015

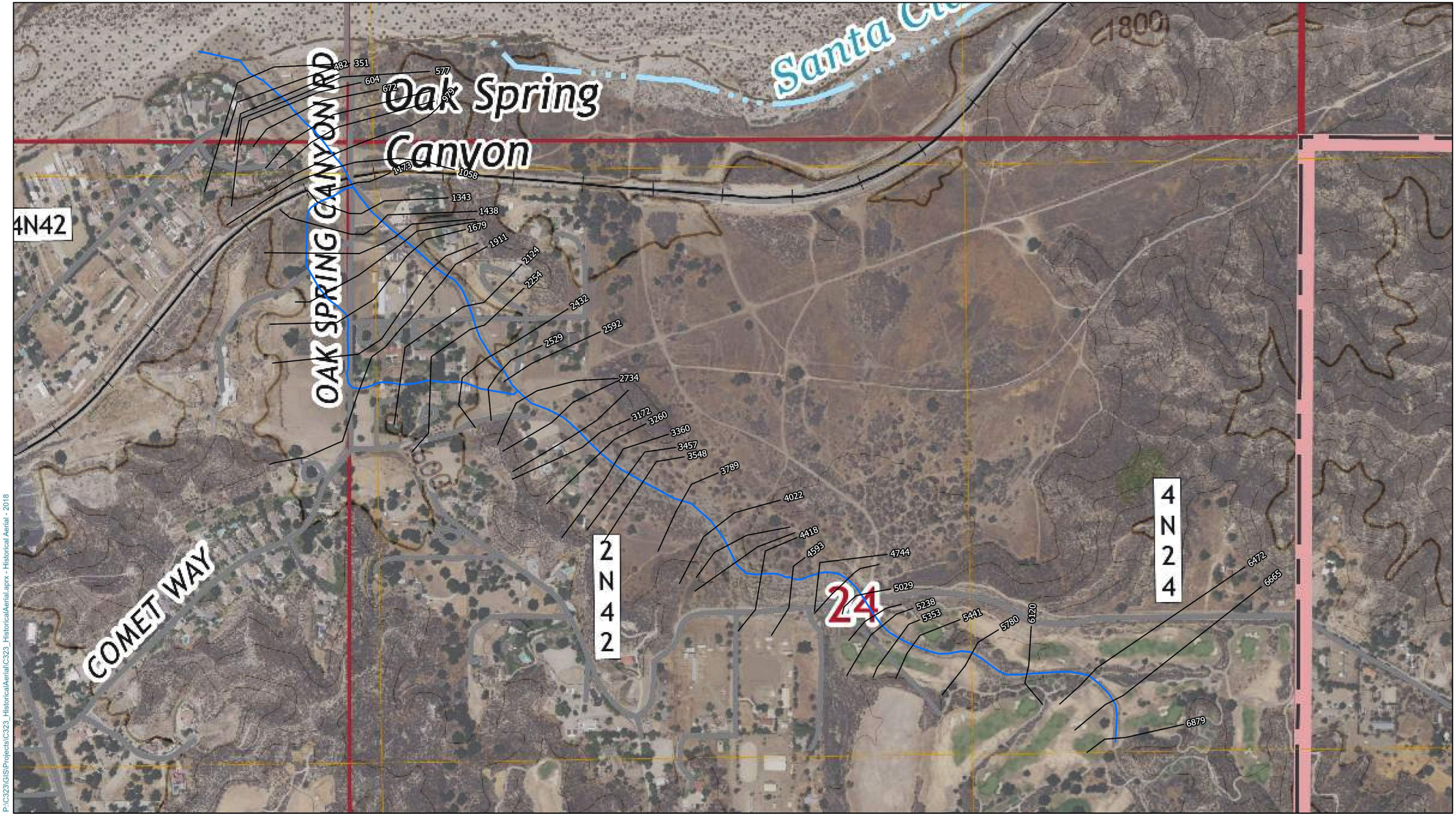
PACE Advanced Water Engineering

0 250 500 1,000 Feet

Date: 12/5/2024

Job Number: B323

Exhibit 14



P:\C323\GIS\Projects\C323_HistoricalAerial\C323_HistoricalAerial.aprx - HistoricalAerial - 2018

BELCARO

HISTORIC TOPOGRAPHIC MAP, 2018

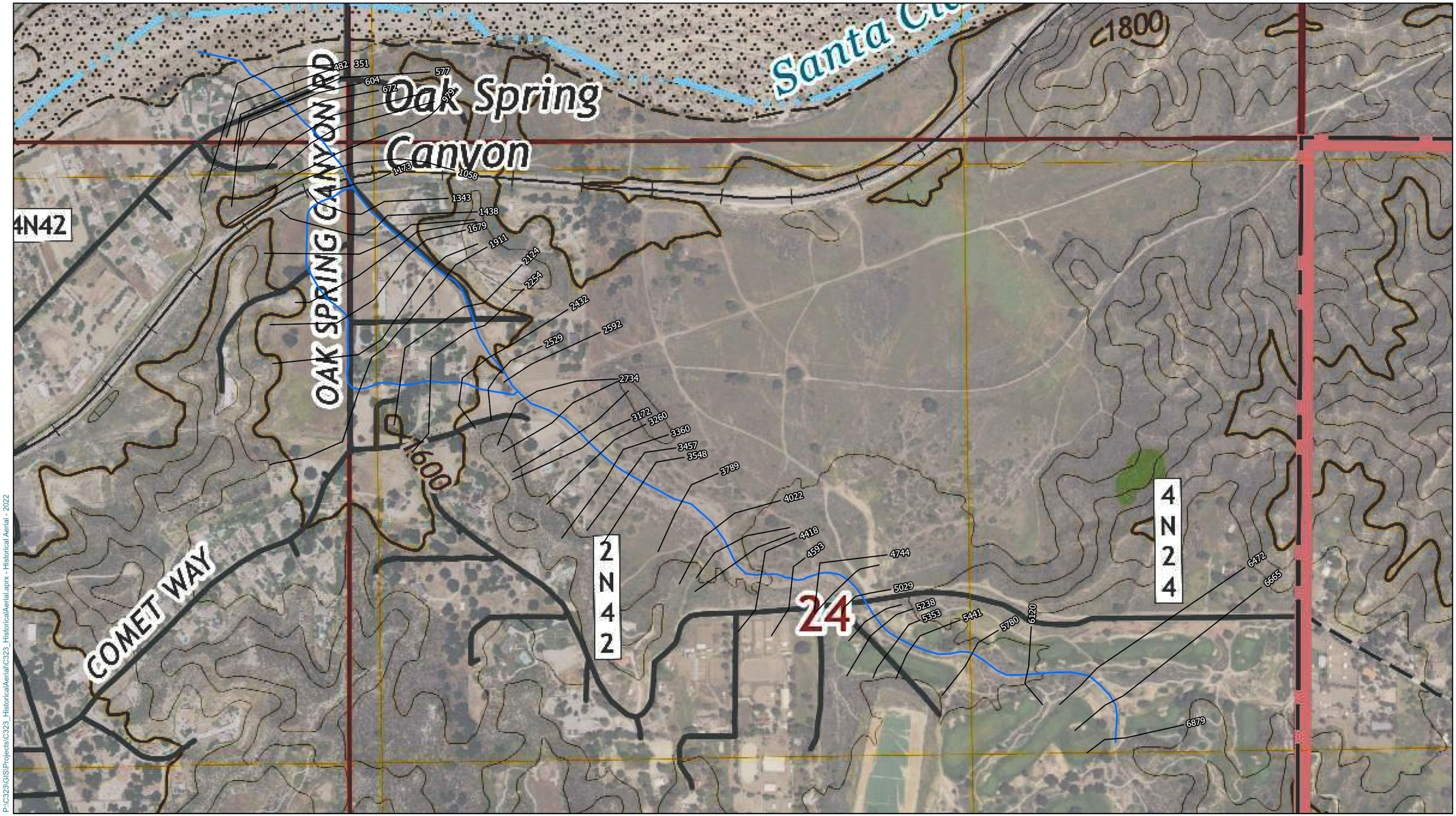
PACE Advanced Water Engineering

0 250 500 1,000 Feet

Date: 12/5/2024

Job Number: B323

Exhibit 15



P:\C323\GIS\Projects\C323_HistoricalAerial\C323_HistoricalAerial.aprx - HistoricalAerial - 2022

BELCARO

HISTORIC TOPOGRAPHIC MAP, 2022

PACE Advanced Water Engineering

0 250 500 1,000 Feet

Date: 12/5/2024

Job Number: B323

Exhibit 16

PACE
Advanced Water Engineering

Appendix A – Existing Condition HEC-RAS Output

HEC-RAS Plan: Corr_Eff_Existing Profile: 100-year

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
OS Overflow	OS Overflow	2216	100-year	10.00	1602.87	1603.16	1603.04	1603.17	0.013321	0.95	11.06	55.12	0.34
OS Overflow	OS Overflow	2140	100-year	10.00	1600.72	1600.86	1600.86	1600.91	0.119143	1.93	6.00	56.61	0.93
OS Overflow	OS Overflow	1984	100-year	22.23	1596.97	1596.91	1596.55	1596.91	0.003511		36.37	107.35	0.00
OS Overflow	OS Overflow	1810	100-year	54.34	1592.95	1593.16	1593.16	1593.23	0.128374	2.53	25.36	171.65	1.02
OS Overflow	OS Overflow	1637	100-year	330.25	1589.00	1589.78	1589.43	1589.81	0.008052	1.61	227.93	347.68	0.32
OS Overflow	OS Overflow	1408	100-year	330.25	1585.75	1585.53	1585.47	1585.66	0.061521		116.17	303.89	0.00
OS Overflow	OS Overflow	1177	100-year	330.28	1582.00	1581.41		1581.45	0.005639		213.82	224.13	0.00
OS Overflow	OS Overflow	959	100-year	330.28	1580.00	1580.24		1580.28	0.006357	0.65	210.49	249.49	0.24
OS Overflow	OS Overflow	780	100-year	330.28	1576.79	1577.51	1577.51	1577.79	0.085865	4.97	77.80	138.65	1.04
OS Overflow	OS Overflow	524	100-year	330.28	1573.57	1575.90	1573.98	1575.91	0.000318	0.66	523.57	250.60	0.08
OS Overflow	OS Overflow	353	100-year	437.91	1572.34	1575.86		1575.86	0.000243	0.76	702.30	282.72	0.07
OS Overflow	OS Overflow	215	100-year	437.91	1573.16	1575.77		1575.80	0.001320	1.45	349.31	188.38	0.16
Oak Springs	0	6879	100-year	1140.00	1686.40	1691.84	1692.23	1694.07	0.024003	11.98	95.19	93.94	1.16
Oak Springs	0	6665	100-year	1140.00	1681.94	1685.58	1686.20	1687.89	0.035375	12.17	93.64	39.11	1.39
Oak Springs	0	6472	100-year	1140.00	1676.37	1681.96	1681.15	1682.87	0.013539	7.67	148.54	42.41	0.72
Oak Springs	0	6120	100-year	1140.00	1669.00	1675.41	1675.41	1677.34	0.017739	11.14	102.31	26.31	1.00
Oak Springs	0	5780	100-year	1140.00	1665.31	1669.52	1668.94	1670.28	0.009524	6.99	163.05	59.88	0.75
Oak Springs	0	5441	100-year	1140.00	1660.00	1665.08	1664.85	1666.38	0.013758	9.15	124.54	39.34	0.91
Oak Springs	0	5353	100-year	1140.00	1658.01	1663.52	1663.52	1665.02	0.016857	9.85	116.17	165.23	0.99
Oak Springs	0	5238	100-year	1140.00	1657.00	1662.08	1661.19	1662.72	0.007770	6.39	180.57	82.73	0.68
Oak Springs	0	5167	100-year	1140.00	1656.00	1660.52	1660.52	1661.88	0.015678	9.39	124.63	54.07	0.97
Oak Springs	0	5064		Culvert									
Oak Springs	0	5029	100-year	1140.00	1646.00	1650.11	1650.11	1651.55	0.017194	9.65	118.10	40.87	1.00
Oak Springs	0	4965	100-year	1140.00	1644.00	1647.04	1647.84	1649.57	0.046414	12.77	90.14	60.64	1.57
Oak Springs	0	4902	100-year	1140.00	1643.00	1646.96	1646.95	1648.05	0.014748	8.72	146.08	68.17	0.93
Oak Springs	0	4838	100-year	1140.00	1642.18	1646.23	1645.88	1647.04	0.011530	7.22	157.90	66.92	0.80
Oak Springs	0	4775	100-year	1140.00	1641.00	1644.15	1644.15	1645.43	0.017042	9.09	125.67	92.52	0.99
Oak Springs	0	4744	100-year	1140.00	1640.00	1642.33	1642.85	1644.08	0.042842	10.74	114.37	87.84	1.47
Oak Springs	0	4593	100-year	1140.00	1639.00	1641.28	1641.22	1642.15	0.017746	7.49	152.15	80.82	0.96
Oak Springs	0	4418	100-year	1140.00	1636.00	1637.99	1637.99	1638.75	0.020744	7.00	162.77	107.99	1.01
Oak Springs	0	4248	100-year	1140.00	1632.79	1635.36	1635.07	1635.94	0.011837	6.11	186.60	99.78	0.79
Oak Springs	0	4143	100-year	1140.00	1630.00	1633.52	1633.48	1634.40	0.017768	7.54	151.11	79.51	0.96
Oak Springs	0	4022	100-year	1140.00	1629.00	1631.27	1631.27	1632.07	0.020382	7.16	159.14	100.66	1.00
Oak Springs	0	3789	100-year	1140.00	1624.00	1626.57	1626.25	1627.08	0.011225	5.71	199.69	113.30	0.76
Oak Springs	0	3548	100-year	1140.00	1620.00	1622.30	1622.17	1622.91	0.029868	7.58	193.29	144.07	1.17
Oak Springs	0	3457	100-year	1140.00	1617.24	1619.85	1619.85	1620.64	0.020806	7.15	159.44	118.94	1.01
Oak Springs	0	3360	100-year	1140.00	1614.67	1617.62	1617.42	1618.53	0.014019	7.64	149.24	64.27	0.88
Oak Springs	0	3260	100-year	1140.00	1613.00	1616.26	1616.09	1617.07	0.014480	7.22	157.98	75.92	0.88
Oak Springs	0	3172	100-year	1140.00	1611.57	1615.25	1615.03	1616.03	0.009697	7.25	187.80	273.39	0.75
Oak Springs	0	3094	100-year	1140.00	1610.00	1613.49	1613.49	1614.97	0.017369	9.77	116.77	240.44	1.00
Oak Springs	0	2950	100-year	1140.00	1607.00	1609.90	1610.31	1611.76	0.028840	10.92	104.42	80.56	1.26
Oak Springs	0	2734	100-year	1140.00	1603.00	1606.95	1606.95	1608.40	0.017170	9.66	117.97	40.27	1.00
Oak Springs	0	2592	100-year	1140.00	1601.00	1603.79	1604.12	1605.40	0.026236	10.18	113.09	155.38	1.20
Oak Springs	0	2591.9		Lat Struct									
Oak Springs	0	2529	100-year	1140.00	1600.00	1601.86	1602.26	1603.17	0.045670	10.37	151.40	183.61	1.49
Oak Springs	0	2528.9		Lat Struct									
Oak Springs	0	2432	100-year	1127.78	1598.00	1600.66	1600.60	1601.05	0.008937	5.98	301.70	314.46	0.70
Oak Springs	0	2431.9		Lat Struct									
Oak Springs	0	2254	100-year	1095.66	1594.30	1597.41	1597.41	1598.77	0.018069	9.35	117.26	192.79	0.99
Oak Springs	0	2253.9		Lat Struct									
Oak Springs	0	2124	100-year	819.75	1592.00	1595.04	1595.10	1596.39	0.018668	9.33	88.14	86.85	1.03
Oak Springs	0	2123.9		Lat Struct									
Oak Springs	0	1911	100-year	819.75	1588.00	1590.70	1590.84	1592.15	0.021275	9.66	85.75	36.81	1.08
Oak Springs	0	1910.9		Lat Struct									
Oak Springs	0	1824	100-year	819.72	1586.00	1588.46	1588.75	1589.93	0.031286	9.92	87.18	46.63	1.28
Oak Springs	0	1823.9		Lat Struct									
Oak Springs	0	1679	100-year	819.72	1582.83	1585.77	1585.77	1587.00	0.018486	8.88	92.32	38.20	1.01
Oak Springs	0	1678.9		Lat Struct									
Oak Springs	0	1609	100-year	819.72	1581.00	1583.79	1584.11	1585.36	0.029183	10.03	81.71	40.03	1.24
Oak Springs	0	1608.9		Lat Struct									
Oak Springs	0	1556	100-year	819.72	1580.00	1583.16	1583.16	1584.24	0.018518	8.32	98.70	47.11	1.00
Oak Springs	0	1555.9		Lat Struct									
Oak Springs	0	1438	100-year	712.09	1576.00	1578.61	1579.45	1580.91	0.047238	12.30	62.42	44.92	1.57
Oak Springs	0	1343	100-year	712.09	1573.97	1577.23	1577.31	1578.23	0.017176	8.09	96.08	68.73	0.96
Oak Springs	2	1173	100-year	1140.00	1570.00	1575.54	1574.04	1575.77	0.002902	5.46	378.64	247.25	0.44
Oak Springs	2	1126		Bridge									
Oak Springs	2	1058	100-year	1140.00	1567.00	1571.12	1571.12	1572.22	0.015294	8.79	154.03	460.44	0.94
Oak Springs	2	979	100-year	1140.00	1566.00	1567.85	1568.50	1569.98	0.060499	11.72	97.24	443.01	1.71
Oak Springs	2	856	100-year	1140.00	1563.88	1566.48	1566.48	1567.33	0.016808	7.47	160.02	555.81	0.94
Oak Springs	2	786	100-year	1140.00	1562.84	1564.72	1564.99	1565.82	0.027716	8.64	152.37	232.96	1.18
Oak Springs	2	672	100-year	1140.00	1560.77	1562.76	1562.76	1563.61	0.019456	7.41	153.92	307.43	1.00
Oak Springs	2	604	100-year	1140.00	1559.00	1560.77	1561.01	1561.83	0.036126	8.27	137.88	370.94	1.29
Oak Springs	2	577	100-year	1140.00	1558.00	1560.45	1559.65	1560.59	0.003610	2.97	383.55	467.87	0.42
Oak Springs	2	543	100-year	1140.00	1556.90	1559.61	1559.61	1560.28	0.022624	6.57	173.51	435.21	1.02
Oak Springs	2	482	100-year	1140.00	1555.52	1557.56	1557.84	1558.58	0.033323	8.18	145.27	421.89	1.25
Oak Springs	2	351	100-year	1140.00	1553.00	1554.97	1554.95	1555.60	0.020020	6.36	181.26	219.88	0.97

PACE
Advanced Water Engineering

Appendix B – Proposed Condition HEC-RAS Output

Proposed Condition, Q_{100} = 1,140 cfs

HEC-RAS Plan: Proposed Profile: 100-year

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
OS Overflow	OS Overflow	2216	100-year	10.00	1602.87	1603.16	1603.04	1603.17	0.013321	0.95	11.06	55.12	0.34
OS Overflow	OS Overflow	2140	100-year	10.00	1600.72	1600.86	1600.86	1600.91	0.119143	1.93	6.00	56.61	0.93
OS Overflow	OS Overflow	1984	100-year	22.22	1596.97	1596.91	1596.55	1596.92	0.003329		37.02	107.89	0.00
OS Overflow	OS Overflow	1810	100-year	54.18	1592.95	1593.15	1593.15	1593.23	0.147285	2.65	24.23	170.73	1.08
OS Overflow	OS Overflow	1637	100-year	330.28	1589.00	1589.78	1589.43	1589.81	0.008044	1.61	228.02	347.69	0.32
OS Overflow	OS Overflow	1408	100-year	330.28	1585.75	1585.53	1585.47	1585.66	0.061583		116.13	303.80	0.00
OS Overflow	OS Overflow	1177	100-year	330.31	1582.00	1581.41		1581.45	0.005640		213.82	224.13	0.00
OS Overflow	OS Overflow	959	100-year	330.31	1580.00	1580.24		1580.28	0.006361	0.65	210.46	249.49	0.24
OS Overflow	OS Overflow	780	100-year	330.31	1576.79	1577.51	1577.51	1577.79	0.085652	4.97	77.87	138.67	1.04
OS Overflow	OS Overflow	524	100-year	330.31	1573.57	1575.90	1573.98	1575.91	0.000318	0.66	523.76	250.61	0.08
OS Overflow	OS Overflow	353	100-year	438.13	1572.34	1575.86		1575.86	0.000243	0.76	702.55	282.74	0.07
OS Overflow	OS Overflow	215	100-year	438.13	1573.16	1575.77		1575.80	0.001319	1.45	349.47	188.41	0.16
Oak Springs	0	6879	100-year	1140.00	1686.40	1691.84	1692.23	1694.07	0.024003	11.98	95.19	93.94	1.16
Oak Springs	0	6665	100-year	1140.00	1681.94	1685.58	1686.20	1687.89	0.035375	12.17	93.64	39.11	1.39
Oak Springs	0	6472	100-year	1140.00	1676.37	1681.96	1681.15	1682.87	0.013539	7.67	148.54	42.41	0.72
Oak Springs	0	6120	100-year	1140.00	1669.00	1675.41	1675.41	1677.34	0.017739	11.14	102.31	26.31	1.00
Oak Springs	0	5780	100-year	1140.00	1665.31	1669.53	1668.94	1670.29	0.009439	6.97	163.59	59.97	0.74
Oak Springs	0	5441	100-year	1140.00	1660.00	1665.06	1664.85	1666.38	0.013950	9.20	123.88	39.23	0.91
Oak Springs	0	5353	100-year	1140.00	1658.01	1663.53	1663.53	1665.02	0.016610	9.79	116.90	166.00	0.99
Oak Springs	0	5238	100-year	1140.00	1657.00	1662.03	1661.19	1662.69	0.008355	6.53	175.81	80.03	0.70
Oak Springs	0	5167	100-year	1140.00	1656.00	1660.67	1660.52	1661.89	0.013220	8.91	132.85	57.73	0.90
Oak Springs	0	5140.50	100-year	1140.00	1656.00	1659.71	1659.71	1661.37	0.026554	10.33	110.35	33.43	1.00
Oak Springs	0	5131.67*	100-year	1140.00	1655.28	1658.30	1658.99	1660.93	0.056627	13.00	87.69	32.04	1.39
Oak Springs	0	5122.83*	100-year	1140.00	1654.57	1657.48	1658.28	1660.34	0.065187	13.57	84.03	31.82	1.47
Oak Springs	0	5114	100-year	1140.00	1653.85	1656.71	1657.57	1659.68	0.069277	13.82	82.49	31.72	1.51
Oak Springs	0	5107.34*	100-year	1140.00	1653.08	1655.88	1656.79	1658.99	0.074800	14.14	80.60	31.59	1.56
Oak Springs	0	5100.67	100-year	1140.00	1652.32	1655.09	1656.03	1658.28	0.078061	14.33	79.56	31.53	1.59
Oak Springs	0	5064		Bridge									
Oak Springs	0	5054.71	100-year	1140.00	1647.00	1649.61	1650.51	1652.66	0.081684	14.01	81.36	33.77	1.59
Oak Springs	0	5048.29*	100-year	1140.00	1646.25	1648.67	1649.60	1651.79	0.106481	14.18	80.38	35.69	1.67
Oak Springs	0	5041.86	100-year	1140.00	1645.50	1647.81	1648.70	1650.82	0.096902	13.92	81.89	37.78	1.67
Oak Springs	0	5035.43*	100-year	1140.00	1644.75	1646.93	1647.78	1649.75	0.125981	13.46	84.70	43.45	1.70
Oak Springs	0	5029	100-year	1140.00	1644.00	1648.83	1646.78	1649.12	0.005451	4.32	263.75	70.48	0.39
Oak Springs	0	4965	100-year	1140.00	1644.00	1648.79		1648.96	0.003198	3.29	346.52	94.32	0.30
Oak Springs	0	4902	100-year	1140.00	1643.00	1648.68		1648.81	0.002375	2.92	390.94	102.12	0.26
Oak Springs	0	4838	100-year	1140.00	1642.18	1646.42	1646.42	1647.98	0.036110	10.00	113.95	100.12	1.00
Oak Springs	0	4806		Culvert									
Oak Springs	0	4775	100-year	1140.00	1641.00	1644.96	1644.15	1645.77	0.016154	7.25	157.29	119.65	0.68
Oak Springs	0	4759.50*	100-year	1140.00	1640.50	1644.18	1643.88	1645.21	0.024473	8.21	142.02	105.61	0.82
Oak Springs	0	4744	100-year	1140.00	1640.00	1643.62	1643.32	1644.57	0.023286	8.13	151.84	94.70	0.80
Oak Springs	0	4668.50*	100-year	1140.00	1639.50	1642.51		1643.19	0.022702	6.61	174.15	79.10	0.76
Oak Springs	0	4593	100-year	1140.00	1639.00	1641.28	1641.22	1642.15	0.017746	7.49	152.15	80.82	0.96
Oak Springs	0	4418	100-year	1140.00	1636.00	1637.99	1637.99	1638.75	0.020744	7.00	162.77	107.99	1.01
Oak Springs	0	4248	100-year	1140.00	1632.79	1635.36	1635.07	1635.94	0.011837	6.11	186.60	99.78	0.79
Oak Springs	0	4143	100-year	1140.00	1630.00	1633.52	1633.48	1634.40	0.017768	7.54	151.11	79.51	0.96
Oak Springs	0	4022	100-year	1140.00	1629.00	1631.27	1631.27	1632.07	0.020382	7.16	159.14	100.66	1.00
Oak Springs	0	3789	100-year	1140.00	1624.00	1626.57	1626.25	1627.08	0.011225	5.71	199.69	113.30	0.76
Oak Springs	0	3548	100-year	1140.00	1620.00	1622.30	1622.17	1622.91	0.029868	7.58	193.29	144.07	1.17
Oak Springs	0	3457	100-year	1140.00	1617.24	1619.85	1619.85	1620.64	0.020806	7.15	159.44	118.94	1.01
Oak Springs	0	3360	100-year	1140.00	1614.67	1617.62	1617.42	1618.53	0.014019	7.64	149.24	64.27	0.88
Oak Springs	0	3260	100-year	1140.00	1613.00	1616.26	1616.09	1617.07	0.014480	7.22	157.98	75.92	0.88
Oak Springs	0	3172	100-year	1140.00	1611.57	1615.25	1615.03	1616.03	0.009697	7.25	187.80	273.39	0.75
Oak Springs	0	3094	100-year	1140.00	1610.00	1613.49	1613.49	1614.97	0.017369	9.77	116.77	240.44	1.00
Oak Springs	0	2950	100-year	1140.00	1607.00	1609.90	1610.31	1611.76	0.028840	10.92	104.42	80.56	1.26
Oak Springs	0	2734	100-year	1140.00	1603.00	1606.95	1606.95	1608.40	0.017170	9.66	117.97	40.27	1.00
Oak Springs	0	2592	100-year	1140.00	1601.00	1603.79	1604.12	1605.40	0.026236	10.18	113.09	155.38	1.20
Oak Springs	0	2591.9		Lat Struct									
Oak Springs	0	2529	100-year	1140.00	1600.00	1601.86	1602.26	1603.17	0.045670	10.37	151.40	183.61	1.49
Oak Springs	0	2528.9		Lat Struct									
Oak Springs	0	2432	100-year	1127.78	1598.00	1600.66	1600.60	1601.05	0.008932	5.98	301.78	314.49	0.70
Oak Springs	0	2431.9		Lat Struct									
Oak Springs	0	2254	100-year	1095.82	1594.30	1597.41	1597.41	1598.77	0.018075	9.35	117.26	192.79	0.99
Oak Springs	0	2253.9		Lat Struct									
Oak Springs	0	2124	100-year	819.72	1592.00	1595.04	1595.10	1596.39	0.018670	9.33	88.14	86.85	1.03
Oak Springs	0	2123.9		Lat Struct									
Oak Springs	0	1911	100-year	819.72	1588.00	1590.70	1590.84	1592.15	0.021273	9.66	85.75	36.81	1.08
Oak Springs	0	1910.9		Lat Struct									
Oak Springs	0	1824	100-year	819.69	1586.00	1588.46	1588.75	1589.93	0.031271	9.92	87.20	46.63	1.28
Oak Springs	0	1823.9		Lat Struct									
Oak Springs	0	1679	100-year	819.69	1582.83	1585.77	1585.77	1587.00	0.018487	8.88	92.32	38.20	1.01
Oak Springs	0	1678.9		Lat Struct									
Oak Springs	0	1609	100-year	819.69	1581.00	1583.79	1584.11	1585.36	0.029208	10.03	81.68	40.03	1.24
Oak Springs	0	1608.9		Lat Struct									
Oak Springs	0	1556	100-year	819.69	1580.00	1583.16	1583.16	1584.24	0.018524	8.32	98.69	47.11	1.00
Oak Springs	0	1555.9		Lat Struct									
Oak Springs	0	1438	100-year	711.87	1576.00	1578.61	1579.45	1580.91	0.047241	12.29	62.40	44.91	1.57
Oak Springs	0	1343	100-year	711.87	1573.97	1577.24	1577.31	1578.23	0.017127	8.08	96.18	68.73	0.96
Oak Springs	2	1173	100-year	1140.00	1570.00	1575.54	1574.04	1575.78	0.002898	5.45	378.80	247.28	0.44
Oak Springs	2	1126		Bridge									
Oak Springs	2	1058	100-year	1140.00	1567.00	1571.12	1571.12	1572.22	0.015294	8.79	154.03	460.44	0.94
Oak Springs	2	979	100-year	1140.00	1566.00	1567.85	1568.50	1569.98	0.060499	11.72	97.24	443.01	1.71
Oak Springs	2	856	100-year	1140.00	1563.88	1566.48	1566.48	1567.33	0.016808	7.47	160.02	555.81	0.94
Oak Springs	2	786	100-year	1140.00	1562.84	1564.72	1564.99	1565.82	0.027716	8.64	152.37	232.96	1.18
Oak Springs	2	672	100-year	1140.00	1560.77	1562.76	1562.76	1563.61	0.019456	7.41	153.92	307.43	1.00
Oak Springs	2	604	100-year	1140.00	1559.00	1561.51	1560.98	1561.83	0.006963	4.56	255.90	441.67	0.60
Oak Springs	2	575		Bridge									
Oak Springs	2	543	100-year	1140.00	1556.90	1559.84	1559.84	1560.57	0.020338	7.11	177.65	449.46	1.00

HEC-RAS Plan: Proposed Profile: 100-year (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Oak Springs	2	482	100-year	1140.00	1555.52	1557.42	1557.83	1558.72	0.046835	9.16	127.63	408.02	1.46
Oak Springs	2	351	100-year	1140.00	1553.00	1554.97	1554.95	1555.60	0.020020	6.36	181.26	219.88	0.97

Proposed Condition, Q_{100} = 3,535 cfs and n=0.025

HEC-RAS Plan: Proposed_0.025 Profile: PACE Hydrology

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
OS Overflow	OS Overflow	2216	PACE Hydrology	10.00	1602.87	1603.33	1603.04	1603.34	0.001818	0.50	22.25	72.28	0.14
OS Overflow	OS Overflow	2140	PACE Hydrology	59.99	1600.72	1601.08	1601.08	1601.21	0.106605	3.47	21.54	86.28	1.03
OS Overflow	OS Overflow	1984	PACE Hydrology	91.12	1596.97	1597.26	1596.84	1597.28	0.004062	0.60	105.97	225.68	0.19
OS Overflow	OS Overflow	1810	PACE Hydrology	211.76	1592.95	1593.37	1593.37	1593.54	0.107893	3.80	65.08	205.91	1.06
OS Overflow	OS Overflow	1637	PACE Hydrology	855.04	1589.00	1590.28	1589.70	1590.35	0.008531	2.31	408.17	371.80	0.36
OS Overflow	OS Overflow	1408	PACE Hydrology	855.04	1585.75	1585.85	1585.79	1586.06	0.059955	1.05	241.75	456.20	0.61
OS Overflow	OS Overflow	1177	PACE Hydrology	866.05	1582.00	1582.32		1582.37	0.004839	0.69	460.99	331.00	0.21
OS Overflow	OS Overflow	959	PACE Hydrology	867.35	1580.00	1580.46		1580.63	0.021309	1.85	266.60	257.89	0.48
OS Overflow	OS Overflow	780	PACE Hydrology	867.35	1576.79	1579.73		1579.78	0.002294	2.08	512.95	244.30	0.21
OS Overflow	OS Overflow	524	PACE Hydrology	867.42	1573.57	1579.71		1579.72	0.000062	0.56	1831.30	398.64	0.04
OS Overflow	OS Overflow	353	PACE Hydrology	1116.31	1572.34	1579.70		1579.71	0.000077	0.70	2061.64	429.93	0.05
OS Overflow	OS Overflow	215	PACE Hydrology	1116.31	1573.16	1579.68		1579.69	0.000148	0.90	1518.91	318.31	0.06
Oak Springs	0	6879	PACE Hydrology	3535.00	1686.40	1693.78	1695.96	1701.45	0.024045	22.22	159.11	151.32	1.93
Oak Springs	0	6665	PACE Hydrology	3535.00	1681.94	1686.93	1689.58	1695.23	0.034995	23.15	155.27	62.22	2.31
Oak Springs	0	6472	PACE Hydrology	3535.00	1676.37	1682.35	1684.52	1689.40	0.023294	21.32	167.52	53.75	1.92
Oak Springs	0	6120	PACE Hydrology	3535.00	1669.00	1678.27	1679.90	1683.71	0.010207	18.87	194.95	129.47	1.32
Oak Springs	0	5780	PACE Hydrology	3535.00	1665.31	1669.41	1671.83	1677.34	0.040025	22.58	156.55	58.84	2.44
Oak Springs	0	5441	PACE Hydrology	3535.00	1660.00	1667.32	1668.50	1670.60	0.008367	14.84	277.70	164.82	1.21
Oak Springs	0	5353	PACE Hydrology	3535.00	1658.01	1665.20	1666.31	1669.60	0.012355	17.48	226.51	229.34	1.45
Oak Springs	0	5238	PACE Hydrology	3535.00	1657.00	1662.25	1664.21	1667.59	0.023787	18.59	195.11	91.57	1.91
Oak Springs	0	5167	PACE Hydrology	3535.00	1656.00	1662.09	1663.33	1666.06	0.011169	16.87	257.54	125.81	1.40
Oak Springs	0	5140.50	PACE Hydrology	3535.00	1656.00	1661.49	1662.80	1665.54	0.040666	17.07	228.47	101.94	1.34
Oak Springs	0	5131.67*	PACE Hydrology	3535.00	1655.28	1661.49	1662.72	1665.08	0.029180	15.88	247.62	108.82	1.18
Oak Springs	0	5122.83*	PACE Hydrology	3535.00	1654.57	1663.73	1662.58	1664.24	0.002523	6.25	630.53	186.01	0.38
Oak Springs	0	5114	PACE Hydrology	3535.00	1653.85	1663.80	1662.54	1664.19	0.001761	5.58	726.34	211.85	0.33
Oak Springs	0	5107.34*	PACE Hydrology	3535.00	1653.08	1661.27	1661.27	1663.58	0.011471	12.34	299.51	72.33	0.82
Oak Springs	0	5100.67	PACE Hydrology	3535.00	1652.32	1661.08	1659.82	1663.11	0.009007	11.52	315.13	64.55	0.75
Oak Springs	0	5064		Bridge									
Oak Springs	0	5054.71	PACE Hydrology	3535.00	1647.00	1653.22	1654.14	1657.37	0.031505	16.35	216.16	40.98	1.26
Oak Springs	0	5048.29*	PACE Hydrology	3535.00	1646.25	1651.54	1653.16	1656.85	0.066955	18.49	191.17	41.44	1.52
Oak Springs	0	5041.86	PACE Hydrology	3535.00	1645.50	1650.29	1652.09	1656.18	0.067194	19.47	181.55	42.73	1.67
Oak Springs	0	5035.43*	PACE Hydrology	3535.00	1644.75	1654.31	1650.81	1655.05	0.006729	6.88	513.99	77.96	0.47
Oak Springs	0	5029	PACE Hydrology	3535.00	1644.00	1654.55		1654.89	0.002561	4.65	759.99	102.18	0.30
Oak Springs	0	4965	PACE Hydrology	3535.00	1644.00	1654.57		1654.78	0.001419	3.66	965.51	119.77	0.23
Oak Springs	0	4902	PACE Hydrology	3535.00	1643.00	1654.53		1654.70	0.001118	3.34	1059.91	126.46	0.20
Oak Springs	0	4838	PACE Hydrology	3535.00	1642.18	1652.16	1649.94	1654.03	0.010771	10.94	323.01	137.01	0.65
Oak Springs	0	4806		Culvert									
Oak Springs	0	4775	PACE Hydrology	3535.00	1641.00	1647.25	1647.25	1650.12	0.029190	13.61	259.71	132.59	1.00
Oak Springs	0	4759.50*	PACE Hydrology	3535.00	1640.50	1645.83	1646.53	1649.09	0.046402	14.99	250.08	118.62	1.21
Oak Springs	0	4744	PACE Hydrology	3535.00	1640.00	1644.78	1645.63	1648.14	0.030740	11.50	258.55	108.04	0.97
Oak Springs	0	4668.50*	PACE Hydrology	3535.00	1639.12	1645.40	1643.80	1645.88	0.006394	5.57	633.14	189.73	0.45
Oak Springs	0	4593	PACE Hydrology	3535.00	1639.00	1643.36	1643.36	1645.13	0.030888	10.73	332.36	97.01	0.95
Oak Springs	0	4418	PACE Hydrology	3535.00	1636.00	1639.03	1639.69	1641.52	0.014270	12.65	279.37	116.68	1.44
Oak Springs	0	4248	PACE Hydrology	3535.00	1632.79	1636.07	1636.98	1638.98	0.015193	13.69	260.18	117.93	1.50
Oak Springs	0	4143	PACE Hydrology	3535.00	1630.00	1634.96	1635.63	1637.62	0.010136	13.10	273.48	93.21	1.27
Oak Springs	0	4022	PACE Hydrology	3535.00	1629.00	1631.94	1633.13	1635.69	0.024476	15.55	227.52	106.01	1.86
Oak Springs	0	3789	PACE Hydrology	3535.00	1624.00	1626.98	1627.97	1630.20	0.021446	14.40	246.01	118.46	1.73
Oak Springs	0	3548	PACE Hydrology	3535.00	1620.00	1622.96	1623.56	1625.31	0.017214	12.12	292.70	158.45	1.53
Oak Springs	0	3457	PACE Hydrology	3535.00	1617.24	1620.54	1621.47	1623.54	0.020691	14.23	266.69	161.94	1.71
Oak Springs	0	3360	PACE Hydrology	3535.00	1614.67	1619.19	1619.85	1622.20	0.009926	13.91	254.18	69.15	1.28
Oak Springs	0	3260	PACE Hydrology	3535.00	1613.00	1617.19	1618.66	1620.89	0.015910	15.43	229.69	134.54	1.57
Oak Springs	0	3172	PACE Hydrology	3535.00	1611.57	1616.18	1616.18	1616.98	0.004303	9.02	583.20	378.94	0.83
Oak Springs	0	3094	PACE Hydrology	3535.00	1610.00	1614.85	1614.85	1615.60	0.003527	9.08	591.97	312.93	0.77
Oak Springs	0	2950	PACE Hydrology	3535.00	1607.00	1612.00	1612.00	1612.87	0.003703	9.17	544.38	405.55	0.79
Oak Springs	0	2734	PACE Hydrology	3535.00	1603.00	1609.03	1610.04	1611.58	0.007675	13.96	349.99	230.25	1.14
Oak Springs	0	2592	PACE Hydrology	3535.00	1601.00	1605.52	1605.52	1606.17	0.003353	8.43	655.57	402.86	0.75
Oak Springs	0	2591.9		Lat Struct									
Oak Springs	0	2529	PACE Hydrology	3485.01	1600.00	1602.47	1603.38	1605.46	0.028612	16.33	271.53	209.19	1.99
Oak Springs	0	2528.9		Lat Struct									
Oak Springs	0	2432	PACE Hydrology	3453.88	1598.00	1600.80	1601.56	1603.00	0.019298	14.64	346.43	324.27	1.67
Oak Springs	0	2431.9		Lat Struct									
Oak Springs	0	2254	PACE Hydrology	3333.24	1594.30	1598.36	1598.36	1599.18	0.004409	8.87	488.14	225.01	0.81
Oak Springs	0	2253.9		Lat Struct									
Oak Springs	0	2124	PACE Hydrology	2689.96	1592.00	1597.18	1597.33	1598.56	0.004403	10.85	323.07	132.26	0.88
Oak Springs	0	2123.9		Lat Struct									
Oak Springs	0	1911	PACE Hydrology	2689.96	1588.00	1592.83	1594.02	1596.91	0.010462	16.43	171.17	44.92	1.35
Oak Springs	0	1910.9		Lat Struct									
Oak Springs	0	1824	PACE Hydrology	2678.95	1586.00	1589.57	1591.28	1595.38	0.025885	19.67	139.90	48.73	2.01
Oak Springs	0	1823.9		Lat Struct									
Oak Springs	0	1679	PACE Hydrology	2677.65	1582.83	1587.25	1588.72	1592.05	0.017212	17.56	152.48	42.73	1.64
Oak Springs	0	1678.9		Lat Struct									
Oak Springs	0	1609	PACE Hydrology	2677.65	1581.00	1585.24	1586.90	1590.61	0.022649	18.60	143.93	45.94	1.85
Oak Springs	0	1608.9		Lat Struct									
Oak Springs	0	1556	PACE Hydrology	2677.58	1580.00	1584.13	1585.74	1589.38	0.022062	18.48	149.14	63.02	1.85
Oak Springs	0	1555.9		Lat Struct									
Oak Springs	0	1438	PACE Hydrology	2428.69	1576.00	1579.68	1581.22	1586.14	0.033104	22.13	137.76	96.99	2.26
Oak Springs	0	1343	PACE Hydrology	2428.69	1573.97	1577.86	1579.22	1582.89	0.026596	19.02	154.54	129.39	2.00
Oak Springs	2	1173	PACE Hydrology	3535.00	1570.00	1579.39	1576.19	1579.67	0.001876	6.51	1039.77	354.47	0.39
Oak Springs	2	1126		Bridge									
Oak Springs	2	1058	PACE Hydrology	3535.00	1567.00	1573.65	1573.65	1574.91	0.009254	10.61	536.61	684.15	0.82
Oak Springs	2	979	PACE Hydrology	3535.00	1566.00	1569.68	1570.89	1573.35	0.038688	15.38	231.72	660.94	1.55
Oak Springs	2	856	PACE Hydrology	3535.00	1563.88	1568.36	1568.38	1570.03	0.014324	10.81	389.70	730.26	0.98
Oak Springs	2	786	PACE Hydrology	3535.00	1562.84	1565.80	1566.56	1568.39	0.037807	14.08	329.82	511.90	1.50
Oak Springs	2	672	PACE Hydrology	3535.00	1560.77	1563.44	1563.48	1564.64	0.023356	9.54	437.89	381.03	1.14
Oak Springs	2	604	PACE Hydrology	3535.00	1559.00	1563.50	1562.00	1563.88	0.003182	5.02	730.82	509.03	0.46
Oak Springs	2	575		Bridge									
Oak Springs	2	543	PACE Hydrology	3535.00	1556.90	1560.07	1560.56	1561.88	0.043437	10.82	326.70	482.21	1.48

HEC-RAS Plan: Proposed_0.025 Profile: PACE Hydrology (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Oak Springs	2	482	PACE Hydrology	3535.00	1555.52	1558.13	1558.13	1558.49	0.013272	6.41	824.62	488.76	0.83
Oak Springs	2	351	PACE Hydrology	3535.00	1553.00	1556.21	1556.21	1556.72	0.009535	6.80	868.90	624.58	0.75

Proposed Condition, Q_2 = 115 cfs and n=0.025

HEC-RAS Plan: Proposed_0.025 Profile: 2-yr

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
OS Overflow	OS Overflow	2216	2-yr	10.00	1602.87	1603.16	1603.04	1603.17	0.013321	0.95	11.06	55.12	0.34
OS Overflow	OS Overflow	2140	2-yr	10.00	1600.72	1600.86	1600.86	1600.91	0.119143	1.93	6.00	56.61	0.93
OS Overflow	OS Overflow	1984	2-yr	10.00	1596.97	1596.64	1596.47	1596.64	0.008035		14.26	63.71	0.00
OS Overflow	OS Overflow	1810	2-yr	10.00	1592.95	1593.06	1593.06	1593.08	0.125655	1.50	8.62	150.05	0.89
OS Overflow	OS Overflow	1637	2-yr	10.10	1589.00	1589.11	1589.03	1589.11	0.006399	0.39	23.96	197.39	0.21
OS Overflow	OS Overflow	1408	2-yr	10.10	1585.75	1584.93	1584.93	1585.00	0.136800		4.79	34.47	0.00
OS Overflow	OS Overflow	1177	2-yr	10.10	1582.00	1580.31	1580.09	1580.31	0.002102		26.17	104.80	0.00
OS Overflow	OS Overflow	959	2-yr	10.10	1580.00	1579.08		1579.10	0.079212		9.13	114.54	0.00
OS Overflow	OS Overflow	780	2-yr	10.10	1576.79	1577.03		1577.04	0.005270	0.59	19.74	104.15	0.21
OS Overflow	OS Overflow	524	2-yr	10.10	1573.57	1573.31	1573.31	1573.35	0.111729		6.04	52.71	0.00
OS Overflow	OS Overflow	353	2-yr	10.10	1572.34	1572.91	1572.28	1572.91	0.000181	0.19	56.64	124.23	0.05
OS Overflow	OS Overflow	215	2-yr	10.10	1573.16	1572.73	1572.73	1572.80	0.133298		4.61	30.61	0.00
Oak Springs	0	6879	2-yr	115.00	1686.40	1688.08	1688.43	1689.19	0.024011	8.43	13.64	14.61	1.54
Oak Springs	0	6665	2-yr	115.00	1681.94	1683.28	1683.48	1683.99	0.023454	6.78	16.96	25.63	1.47
Oak Springs	0	6472	2-yr	115.00	1676.37	1677.86	1678.16	1678.87	0.029915	8.07	14.25	19.72	1.67
Oak Springs	0	6120	2-yr	115.00	1669.00	1670.63	1670.86	1671.61	0.015049	7.95	14.46	11.91	1.27
Oak Springs	0	5780	2-yr	115.00	1665.31	1666.70	1666.71	1667.07	0.011063	4.85	23.70	34.45	1.03
Oak Springs	0	5441	2-yr	115.00	1660.00	1661.39	1661.62	1662.20	0.018985	7.21	15.95	19.07	1.39
Oak Springs	0	5353	2-yr	115.00	1658.01	1659.58	1659.85	1660.53	0.018687	7.82	14.72	15.21	1.40
Oak Springs	0	5238	2-yr	115.00	1657.00	1658.23	1658.29	1658.76	0.011275	5.85	19.67	21.76	1.08
Oak Springs	0	5167	2-yr	115.00	1656.00	1657.41	1657.46	1657.98	0.010903	6.05	19.02	19.43	1.08
Oak Springs	0	5140.50	2-yr	115.00	1656.00	1656.93	1657.03	1657.50	0.078332	6.04	19.04	23.08	1.17
Oak Springs	0	5114	2-yr	115.00	1651.00	1653.33	1652.01	1653.42	0.003221	2.47	46.59	28.24	0.29
Oak Springs	0	5064		Bridge									
Oak Springs	0	5029	2-yr	115.00	1644.00	1645.91	1645.23	1646.08	0.009112	3.32	34.65	51.59	0.45
Oak Springs	0	4965	2-yr	115.00	1644.00	1645.60		1645.64	0.005861	1.69	68.06	80.37	0.32
Oak Springs	0	4902	2-yr	115.00	1643.00	1645.23		1645.28	0.008443	1.82	63.16	87.86	0.38
Oak Springs	0	4838	2-yr	115.00	1642.18	1643.71	1643.71	1644.23	0.052189	5.77	19.93	19.59	0.99
Oak Springs	0	4806		Culvert									
Oak Springs	0	4775	2-yr	115.00	1641.00	1642.19	1641.98	1642.37	0.024135	3.36	34.27	70.73	0.65
Oak Springs	0	4759.50*	2-yr	115.00	1640.50	1641.72	1641.53	1641.94	0.029441	3.69	31.14	67.62	0.73
Oak Springs	0	4744	2-yr	115.00	1640.00	1641.51	1641.05	1641.62	0.010772	2.72	42.34	61.17	0.46
Oak Springs	0	4668.50*	2-yr	115.00	1639.50	1640.90		1640.96	0.007032	1.97	58.36	63.01	0.36
Oak Springs	0	4593	2-yr	115.00	1639.00	1639.83	1639.71	1639.96	0.032817	2.93	39.26	74.23	0.71
Oak Springs	0	4418	2-yr	115.00	1636.00	1636.46	1636.46	1636.69	0.012001	3.80	30.26	67.76	1.00
Oak Springs	0	4248	2-yr	115.00	1632.79	1633.40	1633.51	1633.79	0.025666	4.96	23.18	61.42	1.42
Oak Springs	0	4143	2-yr	115.00	1630.00	1631.39	1631.47	1631.90	0.013133	5.75	20.00	25.62	1.15
Oak Springs	0	4022	2-yr	115.00	1629.00	1629.65	1629.75	1630.10	0.016522	5.37	21.41	36.18	1.23
Oak Springs	0	3789	2-yr	115.00	1624.00	1624.58	1624.76	1625.19	0.027632	6.27	18.34	36.16	1.55
Oak Springs	0	3548	2-yr	115.00	1620.00	1620.26	1620.32	1620.63	0.013335	2.55	24.23	44.65	0.94
Oak Springs	0	3457	2-yr	115.00	1617.24	1618.24	1618.39	1618.73	0.036000	5.64	20.38	57.44	1.67
Oak Springs	0	3360	2-yr	115.00	1614.67	1615.43	1615.54	1615.88	0.024293	5.38	21.39	48.32	1.42
Oak Springs	0	3260	2-yr	115.00	1613.00	1614.22	1614.22	1614.58	0.010066	4.81	23.92	32.78	0.99
Oak Springs	0	3172	2-yr	115.00	1611.57	1612.46	1612.66	1613.11	0.031490	6.45	17.84	37.26	1.64
Oak Springs	0	3094	2-yr	115.00	1610.00	1610.83	1610.95	1611.34	0.016393	5.71	20.15	30.91	1.25
Oak Springs	0	2950	2-yr	115.00	1607.00	1607.67	1607.89	1608.40	0.025613	6.87	16.74	27.06	1.54
Oak Springs	0	2734	2-yr	115.00	1603.00	1604.27	1604.30	1604.69	0.011806	5.16	22.29	30.77	1.07
Oak Springs	0	2592	2-yr	115.00	1601.00	1601.77	1601.95	1602.33	0.024532	6.01	19.13	36.79	1.47
Oak Springs	0	2591.9		Lat Struct									
Oak Springs	0	2529	2-yr	115.00	1600.00	1600.65	1600.73	1601.05	0.015942	5.10	22.55	40.18	1.20
Oak Springs	0	2528.9		Lat Struct									
Oak Springs	0	2432	2-yr	115.00	1598.00	1598.70	1598.83	1599.16	0.024178	5.43	21.19	46.94	1.42
Oak Springs	0	2431.9		Lat Struct									
Oak Springs	0	2254	2-yr	115.00	1594.30	1595.06	1595.16	1595.51	0.017655	5.36	21.47	38.00	1.26
Oak Springs	0	2253.9		Lat Struct									
Oak Springs	0	2124	2-yr	114.90	1592.00	1592.81	1592.92	1593.37	0.015318	5.99	19.19	25.84	1.22
Oak Springs	0	2123.9		Lat Struct									
Oak Springs	0	1911	2-yr	114.90	1588.00	1588.65	1588.83	1589.31	0.024105	6.55	17.55	29.00	1.48
Oak Springs	0	1910.9		Lat Struct									
Oak Springs	0	1824	2-yr	114.90	1586.00	1587.01	1587.10	1587.44	0.017929	5.02	22.20	42.46	1.25
Oak Springs	0	1823.9		Lat Struct									
Oak Springs	0	1679	2-yr	114.90	1582.83	1583.59	1583.79	1584.29	0.026354	6.71	17.12	29.36	1.55
Oak Springs	0	1678.9		Lat Struct									
Oak Springs	0	1609	2-yr	114.90	1581.00	1581.83	1582.05	1582.58	0.022613	6.95	16.53	23.93	1.47
Oak Springs	0	1608.9		Lat Struct									
Oak Springs	0	1556	2-yr	114.90	1580.00	1581.09	1581.18	1581.59	0.013728	5.68	20.22	27.20	1.16
Oak Springs	0	1555.9		Lat Struct									
Oak Springs	0	1438	2-yr	114.90	1576.00	1576.70	1577.19	1578.44	0.063992	10.57	10.87	18.29	2.42
Oak Springs	0	1343	2-yr	114.90	1573.97	1574.96	1575.08	1575.59	0.014409	6.34	18.13	21.36	1.21
Oak Springs	2	1173	2-yr	115.00	1570.00	1570.91	1571.83	1574.65	0.112049	15.50	7.42	10.46	3.25
Oak Springs	2	1126		Bridge									
Oak Springs	2	1058	2-yr	115.00	1567.00	1568.46	1568.46	1568.91	0.009960	5.37	21.41	24.55	1.01
Oak Springs	2	979	2-yr	115.00	1566.00	1566.44	1566.69	1567.28	0.058799	7.35	15.64	84.66	2.15
Oak Springs	2	856	2-yr	115.00	1563.88	1564.56	1564.56	1564.83	0.011232	4.20	27.36	50.15	1.00
Oak Springs	2	786	2-yr	115.00	1562.84	1563.34	1563.43	1563.69	0.025460	4.73	24.30	68.81	1.40
Oak Springs	2	672	2-yr	115.00	1560.77	1561.38	1561.39	1561.58	0.013590	3.58	32.14	169.71	1.04
Oak Springs	2	604	2-yr	115.00	1559.00	1559.88	1559.63	1559.98	0.003171	2.42	47.43	177.54	0.54
Oak Springs	2	575		Bridge									
Oak Springs	2	543	2-yr	115.00	1556.90	1558.28	1558.28	1558.54	0.010154	4.13	28.36	247.91	0.96
Oak Springs	2	482	2-yr	115.00	1555.52	1556.01	1556.26	1557.01	0.107729	8.04	14.31	200.47	2.75
Oak Springs	2	351	2-yr	115.00	1553.00	1553.65	1553.65	1553.85	0.012627	3.60	31.99	80.92	1.01

Proposed Condition, Q_{100} = 3,535 cfs and n=0.085

HEC-RAS Plan: Proposed-V6_Flared_0.085 Profile: PACE Hydrology

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth	Hydr Depth
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
OS Overflow	OS Overflow	2216	PACE Hydrology	10.00	1602.87	1603.51	1603.04	1603.51	0.000445	0.31	36.39	83.84	0.07	0.64	0.43
OS Overflow	OS Overflow	2140	PACE Hydrology	141.46	1600.72	1601.28	1601.28	1601.45	0.100907	4.51	43.20	129.11	1.08	0.58	0.33
OS Overflow	OS Overflow	1984	PACE Hydrology	405.83	1596.97	1597.89	1597.27	1597.93	0.005328	1.47	255.31	248.80	0.27	1.61	1.03
OS Overflow	OS Overflow	1810	PACE Hydrology	836.89	1592.95	1593.85	1593.85	1594.17	0.081515	5.57	186.34	294.78	1.05	0.94	0.63
OS Overflow	OS Overflow	1637	PACE Hydrology	1805.70	1589.00	1590.80	1590.07	1590.93	0.011139	3.32	623.84	429.41	0.44	1.91	1.45
OS Overflow	OS Overflow	1408	PACE Hydrology	1820.01	1585.75	1586.32	1586.13	1586.56	0.036001	2.72	468.43	509.18	0.64	1.65	0.92
OS Overflow	OS Overflow	1177	PACE Hydrology	1861.25	1582.00	1583.12		1583.23	0.005169	1.65	734.72	350.42	0.27	3.12	2.10
OS Overflow	OS Overflow	959	PACE Hydrology	2002.11	1580.00	1581.56		1581.75	0.011296	3.03	580.14	332.45	0.43	2.56	1.75
OS Overflow	OS Overflow	780	PACE Hydrology	2002.11	1576.79	1579.88		1580.09	0.009804	4.45	549.87	245.68	0.45	3.13	2.24
OS Overflow	OS Overflow	524	PACE Hydrology	2013.47	1573.57	1579.79		1579.81	0.000318	1.28	1860.96	399.38	0.09	6.67	4.66
OS Overflow	OS Overflow	353	PACE Hydrology	2371.89	1572.34	1579.73		1579.75	0.000342	1.48	2074.31	431.33	0.10	7.63	4.81
OS Overflow	OS Overflow	215	PACE Hydrology	2371.89	1573.16	1579.65		1579.69	0.000682	1.92	1507.99	318.25	0.13	7.13	4.74
Oak Springs	0	6879	PACE Hydrology	3535.00	1686.40	1695.96	1695.96	1696.27	0.011207	5.75	893.77	355.49	0.41	9.56	2.51
Oak Springs	0	6665	PACE Hydrology	3535.00	1681.94	1688.68	1689.58	1690.97	0.078554	12.78	327.09	151.75	1.07	6.74	2.16
Oak Springs	0	6472	PACE Hydrology	3535.00	1676.37	1687.65	1684.52	1687.99	0.006102	5.68	1060.46	527.97	0.33	11.28	2.01
Oak Springs	0	6120	PACE Hydrology	3535.00	1669.00	1679.90	1679.90	1682.97	0.050982	14.43	272.79	199.04	0.90	10.90	4.46
Oak Springs	0	5780	PACE Hydrology	3535.00	1665.31	1674.29	1671.83	1674.78	0.008892	6.15	754.34	252.39	0.40	8.98	2.99
Oak Springs	0	5441	PACE Hydrology	3535.00	1660.00	1668.50	1668.50	1669.66	0.029920	9.59	495.25	208.81	0.70	8.50	2.51
Oak Springs	0	5353	PACE Hydrology	3535.00	1658.01	1666.64	1666.31	1666.91	0.008306	5.08	904.05	255.13	0.37	8.63	3.54
Oak Springs	0	5238	PACE Hydrology	3535.00	1657.00	1665.83	1664.21	1666.07	0.006238	4.76	1027.16	308.98	0.33	8.83	3.32
Oak Springs	0	5167	PACE Hydrology	3535.00	1656.00	1664.85		1665.43	0.012204	7.14	643.57	187.06	0.47	8.85	3.44
Oak Springs	0	5140.50	PACE Hydrology	3535.00	1656.00	1663.41	1663.41	1665.01	0.011970	11.49	499.50	159.15	0.77	7.41	3.14
Oak Springs	0	5131.67*	PACE Hydrology	3535.00	1655.28	1662.82	1663.11	1664.85	0.013177	12.31	437.82	159.38	0.83	7.54	2.75
Oak Springs	0	5122.83*	PACE Hydrology	3535.00	1654.57	1662.21	1662.76	1664.67	0.014401	13.05	370.08	157.77	0.88	7.64	2.35
Oak Springs	0	5114	PACE Hydrology	3535.00	1653.85	1661.99	1661.99	1664.23	0.011492	12.28	368.40	138.90	0.81	8.14	2.65
Oak Springs	0	5107.34*	PACE Hydrology	3535.00	1653.08	1660.16	1660.65	1663.70	0.021620	15.09	234.53	44.04	1.10	7.08	5.33
Oak Springs	0	5100.67	PACE Hydrology	3535.00	1652.32	1658.77	1659.82	1663.20	0.031229	16.88	209.38	38.90	1.28	6.45	5.38
Oak Springs	0	5064		Bridge											
Oak Springs	0	5054.71	PACE Hydrology	3535.00	1647.00	1652.07	1654.14	1658.76	0.068806	20.75	170.34	38.68	1.74	5.07	4.40
Oak Springs	0	5048.29*	PACE Hydrology	3535.00	1646.25	1650.93	1653.15	1657.95	0.103178	21.26	166.28	40.22	1.84	4.68	4.13
Oak Springs	0	5041.86	PACE Hydrology	3535.00	1645.50	1649.89	1652.09	1657.03	0.092266	21.44	164.89	41.94	1.91	4.39	3.93
Oak Springs	0	5035.43*	PACE Hydrology	3535.00	1644.75	1654.31	1650.81	1655.05	0.006729	6.88	513.99	77.96	0.47	9.56	6.59
Oak Springs	0	5029	PACE Hydrology	3535.00	1644.00	1654.55		1654.89	0.002561	4.65	759.99	102.18	0.30	10.55	7.44
Oak Springs	0	4965	PACE Hydrology	3535.00	1644.00	1654.57		1654.78	0.001419	3.66	965.51	119.77	0.23	10.57	8.06
Oak Springs	0	4902	PACE Hydrology	3535.00	1643.00	1654.53		1654.70	0.001118	3.34	1059.91	126.46	0.20	11.53	8.38
Oak Springs	0	4838	PACE Hydrology	3535.00	1642.18	1652.16	1649.94	1654.03	0.010771	10.94	323.01	137.01	0.65	9.98	8.87
Oak Springs	0	4806		Culvert											
Oak Springs	0	4775	PACE Hydrology	3535.00	1641.00	1647.57	1647.25	1650.15	0.024347	12.89	274.24	133.66	0.92	6.57	6.12
Oak Springs	0	4759.50*	PACE Hydrology	3535.00	1640.50	1647.02	1646.77	1649.46	0.024832	12.72	284.22	124.54	0.92	6.52	5.68
Oak Springs	0	4744	PACE Hydrology	3535.00	1640.00	1646.31	1645.96	1648.49	0.046728	12.24	300.97	188.47	0.89	6.31	5.44
Oak Springs	0	4668.50*	PACE Hydrology	3535.00	1639.50	1645.85		1646.56	0.016962	7.23	572.85	157.88	0.53	6.35	3.63
Oak Springs	0	4593	PACE Hydrology	3535.00	1639.00	1644.57		1645.52	0.023898	7.97	485.27	156.59	0.62	5.57	3.10
Oak Springs	0	4418	PACE Hydrology	3535.00	1636.00	1641.25		1641.87	0.017400	6.36	592.99	182.32	0.52	5.25	3.25
Oak Springs	0	4248	PACE Hydrology	3535.00	1632.79	1639.07	1636.98	1639.53	0.010784	5.67	670.12	175.45	0.42	6.28	4.64
Oak Springs	0	4143	PACE Hydrology	3535.00	1630.00	1637.02	1635.63	1637.93	0.021682	7.79	485.53	250.36	0.59	7.02	3.83
Oak Springs	0	4022	PACE Hydrology	3535.00	1629.00	1633.83	1633.13	1634.77	0.032011	7.93	467.19	140.70	0.69	4.83	3.48
Oak Springs	0	3789	PACE Hydrology	3535.00	1624.00	1629.72	1627.97	1630.17	0.012634	5.63	775.31	398.43	0.45	5.72	1.95
Oak Springs	0	3548	PACE Hydrology	3535.00	1620.00	1624.34	1623.56	1624.95	0.037190	7.49	604.88	484.97	0.72	5.34	2.03
Oak Springs	0	3457	PACE Hydrology	3535.00	1617.24	1622.85	1621.47	1623.15	0.011256	5.01	982.88	521.26	0.42	5.61	1.89
Oak Springs	0	3360	PACE Hydrology	3535.00	1614.67	1621.26	1619.85	1621.84	0.015523	6.85	784.25	497.49	0.50	6.59	1.58
Oak Springs	0	3260	PACE Hydrology	3535.00	1613.00	1618.66	1618.66	1619.61	0.032890	8.52	562.19	342.99	0.71	5.66	1.64
Oak Springs	0	3172	PACE Hydrology	3535.00	1611.57	1617.06	1616.18	1617.34	0.013559	5.43	920.36	417.52	0.45	5.49	2.37
Oak Springs	0	3094	PACE Hydrology	3535.00	1610.00	1614.89	1614.85	1615.61	0.038132	8.84	605.65	313.08	0.75	4.89	1.93
Oak Springs	0	2950	PACE Hydrology	3535.00	1607.00	1613.34	1612.00	1613.51	0.006725	4.37	1224.94	536.50	0.33	6.34	2.28
Oak Springs	0	2734	PACE Hydrology	3535.00	1603.00	1610.04	1610.04	1610.87	0.026987	8.78	630.11	329.88	0.65	7.04	1.91
Oak Springs	0	2592	PACE Hydrology	3535.00	1601.00	1605.73	1605.52	1606.22	0.027616	7.37	740.92	410.10	0.64	4.72	1.81
Oak Springs	0	2591.9		Lat Struct											
Oak Springs	0	2529	PACE Hydrology	3403.54	1600.00	1604.03	1603.33	1604.50	0.025610	6.59	646.17	261.97	0.61	4.03	2.47
Oak Springs	0	2528.9		Lat Struct											
Oak Springs	0	2432	PACE Hydrology	3139.17	1598.00	1601.91	1601.24	1602.21	0.021785	5.89	784.67	446.75	0.55	3.90	1.76
Oak Springs	0	2431.9		Lat Struct											
Oak Springs	0	2254	PACE Hydrology	2708.11	1594.30	1599.35	1598.36	1599.59	0.010263	4.60	713.87	228.61	0.37	5.05	3.12
Oak Springs	0	2253.9		Lat Struct											
Oak Springs	0	2124	PACE Hydrology	1739.31	1592.00	1597.95	1596.56	1598.27	0.009940	5.31	427.15	137.20	0.40	5.95	3.11
Oak Springs	0	2123.9		Lat Struct											
Oak Springs	0	1911	PACE Hydrology	1724.99	1588.00	1593.48		1594.72	0.031175	9.11	201.76	49.46	0.70	5.48	4.08
Oak Springs	0	1910.9		Lat Struct											
Oak Springs	0	1824	PACE Hydrology	1683.75	1586.00	1591.78		1592.51	0.018361	7.06	252.07	52.71	0.55	5.78	4.78
Oak Springs	0	1823.9		Lat Struct											
Oak Springs	0	1679	PACE Hydrology	1542.89	1582.83	1588.51		1589.36	0.026315	7.41	208.34	46.46	0.61	5.68	4.48
Oak Springs	0	1678.9		Lat Struct											
Oak Springs	0	1609	PACE Hydrology	1542.89	1581.00	1586.84		1587.59	0.023634	6.95	222.86	53.93	0.58	5.84	4.13
Oak Springs	0	1608.9		Lat Struct											
Oak Springs	0	1556	PACE Hydrology	1531.53	1580.00	1584.69	1584.39	1585.85	0.045902	8.75	185.04	65.39	0.81	4.69	2.83
Oak Springs	0	1555.9		Lat Struct											
Oak Springs	0	1438	PACE Hydrology	1173.11	1576.00	1580.32	1580.16	1580.99	0.033590	7.48	207.63	116.76	0.69	4.32	1.78
Oak Springs	0	1343	PACE Hydrology	1173.11	1573.97	1579.53		1579.68	0.006262	3.70	449.01	214.94	0.31	5.56	2.09
Oak Springs	2	1173	PACE Hydrology	3535.00	1570.00	1579.39	1576.19	1579.67	0.001876	6.51	1039.77	354.47	0.39	9.39	5.20
Oak Springs	2	1126		Bridge											
Oak Springs	2	1058	PACE Hydrology	3535.00	1567.00	1573.65	1573.65	1574.91	0.009254	10.61	536.61	684.15	0.82	6.65	2.82
Oak Springs	2	979	PACE Hydrology	3535.00	1566.00	1569.68	1570.88	1573.35	0.038626	15.38	231.84	661.02	1.54	3.68	2.90
Oak Springs	2	856	PACE Hydrology	3535.00	1563.88	1568.36	1568.38	1570.03	0.014331	10.81	389.63	730.20	0.98	4.48	2.62
Oak Springs	2	786	PACE Hydrology	3535.00	1562.84	1566.00	1566.68	1568.50	0.032183	13.61	317.37	544.51	1.40	3.15	2.45
Oak Springs	2	672	PACE Hydrology	3535.00	1560.77	1564.77	1564.77	1565.04	0.003642	5.36	1029.41	455.10	0.49	4.00	3.00
Oak Springs	2	604	PACE Hydrology	3535.00	1559.00	1564.08	1562.45	1564.15	0.000762	2.67	1949.24	536.38	0.23	5.08	3.63
Oak Springs	2	575		Bridge											
Oak Springs	2	543	PACE Hydrology	3535.00	1556.90	1561.52	1561.52	1562.97	0.016058	10.14	397.00	529.24	1.00	4.62	2.94
Oak Springs	2	482	PACE Hydrology	3535.00	1555.52	1558.13	1558.13	1558.49	0.013272	6.41	824.62	488.76	0.83	2.61	1.69
Oak Springs	2	351	PACE Hydrology	3535.00	1553.00	1556.21	1556.21	1556.72	0.009535	6.80	868.90	624.58	0.75	3.21	1.39

Proposed Condition, HEC-RAS Hydraulic Design Function
Bridge Scour, Q_{100} = 3,535 cfs and n=0.025

Contraction Scour

		Left	Channel	Right
Input Data				
	Average Depth (ft):	2.09	2.18	0.37
	Approach Velocity (ft/s):	5.33	9.54	1.94
	Br Average Depth (ft):		3.38	0.82
	BR Opening Flow (cfs):		3526.81	8.19
	BR Top WD (ft):		178.07	7.59
	Grain Size D50 (mm):	0.91	0.91	0.91
	Approach Flow (cfs):	792.66	2738.58	3.76
	Approach Top WD (ft):	71.33	131.50	5.27
	K1 Coefficient:	0.690	0.690	0.640
Results				
	Scour Depth Ys (ft):		0.00	0.00
	Critical Velocity (ft/s):	1.91	1.84	1.36
	Equation:		Live	Live

Pier Scour

All piers have the same scour depth

Input Data

	Pier Shape:	Group of cylinders
	Pier Width (ft):	4.00
	Grain Size D50 (mm):	0.91000
	Depth Upstream (ft):	4.31
	Velocity Upstream (ft/s):	5.50
	K1 Nose Shape:	1.00
	Pier Angle:	0.00
	Pier Length (ft):	50.00
	K2 Angle Coef:	1.00
	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	15.51000
	K4 Armouring Coef:	1.00

Results

	Scour Depth Ys (ft):	6.51
	Froude #:	0.47
	Equation:	CSU equation

Abutment Scour

		Left	Right
Input Data			
	Station at Toe (ft):	301.89	469.38
	Toe Sta at appr (ft):	286.65	402.58
	Abutment Length (ft):	261.61	4.73
	Depth at Toe (ft):	3.50	1.50
	K1 Shape Coef:	0.55 - Spill-through abutment	
	Degree of Skew (degrees):	90.00	90.00
	K2 Skew Coef:	1.00	1.00
	Projected Length L' (ft):	261.61	4.73
	Avg Depth Obstructed Ya (ft):	1.55	0.37
	Flow Obstructed Qe (cfs):	1212.90	3.38
	Area Obstructed Ae (sq ft):	406.49	1.74
Results			
	Scour Depth Ys (ft):	10.78	1.34
	Qe/Ae = Ve:	0.00	1.94
	Froude #:	0.45	0.56
	Equation:	HIRE	Froehlich

Appendix C – Geotechnical Sampling Data

LGC Valley, Inc. Sampling Location Map

PACE

Zone AO 2

P1 -Grab sample, 3', 5' depths

B2 - Boring Sample 7.5

P2 - Grab sample, 3', 5' depths

B1 - Boring Sample, 3, 5, 10

Zone AO 2

Zone A

Zone A

Zone AE

P3 - Grab sample, 3', 5' depths

B5 - Boring Sample, 3, 5, 10

P4 - Grab sample, 3', 5' depths

B4 - Boring Sample, 3, 5, 10

P5 - Grab sample, 1', 3' depths

Zone A

Zone AO 2

City of Santa Clarita

Belcaro Property Boundary

FEMA XS

A

AE

AE FLOODWAY

X 0.2 PCT ANNUAL CHANCE FLOOD HAZARD

AO

PACE Advanced Water Engineering

0 100 200 400 600 Feet

Date: 7/9/2024

Job Number: C323

P:\C323\GIS\Projects\C323_Belcaro\C323_Belcaro aprx - C323 Tract Map (24x36) 200 Scale w Aerial

LGC Valley, Inc. 2-26-25

LGC Valley, Inc. Grainsize Data

PACE

Summary of Grainsize Analysis:

1) All LGC Valley sampling data (grab samples and boring data) is plotted

2) LGC Valley sampling data is separated into two zones, downstream (Samples P1, P2, B1, and B2) and upstream (Samples P3, P4, P5, B4, and B5)

   Both sets of sampling data are analyzed and any outliers are removed from the zones

   An average of the downstream gradation and the upstream gradation are plotted

3) The results of the average for the downstream and upstream gradations show they are very similar, so an average grainsize for the whole creek is created by combining the data for the upstream and downstream zones (with outliers excluded)

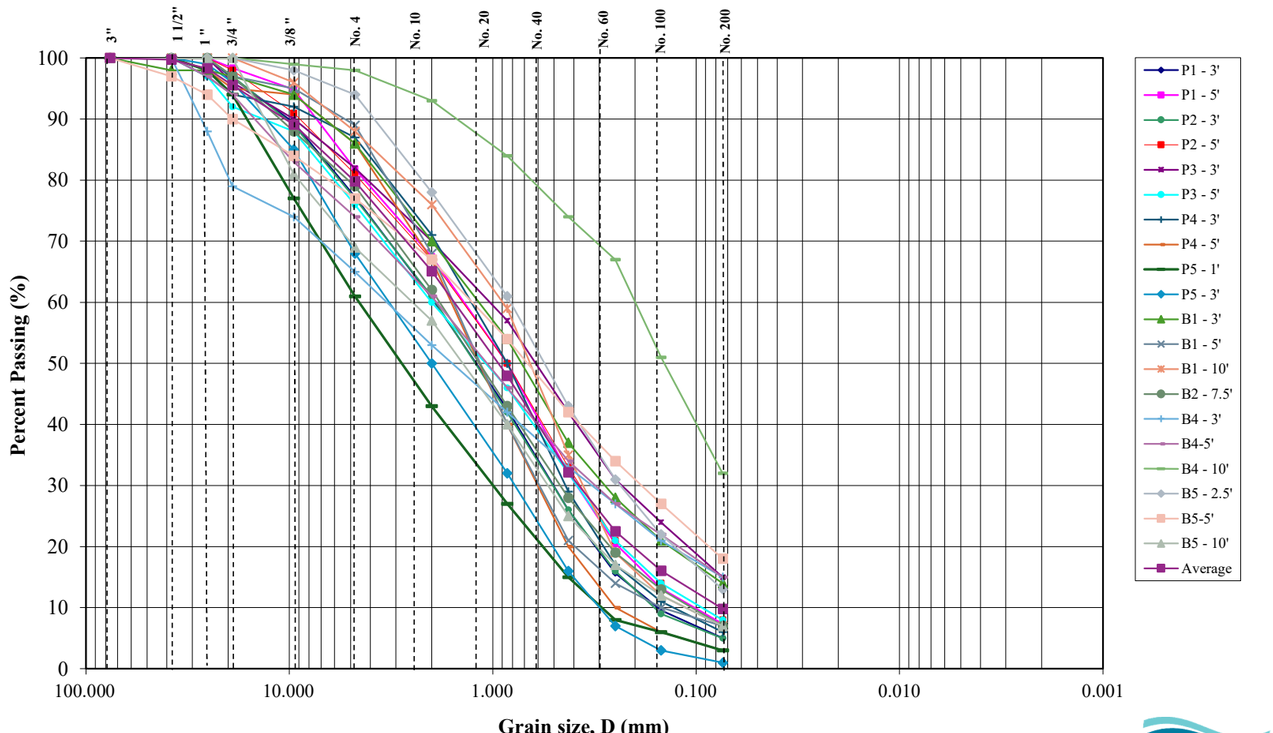
   The final average gradation is plotted.

All Sampling Data for Oak Springs Canyon Creek

Stream Gradation Samples - Oak Springs Canyon Creek

	Sieve No.	Sieve Opening (mm)	Percent Passing (%)																					
			P1		P2		P3		P4		P5		B1			B2	B4			B5			High	Average	Low
			P1 - 3'	P1 - 5'	P2 - 3'	P2 - 5'	P3 - 3'	P3 - 5'	P4 - 3'	P4 - 5'	P5 - 1'	P5 - 3'	B1 - 3'	B1 - 5'	B1 - 10'	B2 - 7.5'	B4 - 3'	B4-5'	B4 - 10'	B5 - 2.5'	B5-5'	B5 - 10'			
SC	3	76.200	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	**100.0**	100.0
VCG	1 1/2	38.100	100	100	100	100	100	100	100	100	100	100	98	100	100	100	100	100	100	100	97	100	100	**99.8**	97
CG	1	25.400	100	100	100	100	100	97	97	98	98	99	98	100	100	100	88	97	100	100	94	100	100	**98.3**	88
	3/4	19.050	97	98	97	98	96	92	94	95	94	96	97	97	100	97	79	94	100	100	90	100	100.0	**95.6**	79.0
MG	3/8	9.525	89	95	89	91	90	88	92	94	77	85	94	95	96	88	74	83	99	98	84	81	99.0	**89.1**	74.0
FG	4	4.760	77	82	77	81	82	76	87	86	61	68	86	89	88	79	65	74	98	94	77	69	98.0	**79.8**	61.0
VFG	10	2.000	61	67	61	67	70	60	71	67	43	50	70	68	76	62	53	61	93	78	67	57	93.0	**65.1**	43.0
CS	20	0.850	42	50	42	50	57	46	50	40	27	32	54	40	59	43	42	46	84	61	54	40	84.0	**48.0**	27.0
MS	40	0.425	26	32	26	33	42	32	29	20	15	16	37	21	35	28	33	34	74	43	42	25	74.0	**32.2**	15.0
FS	60	0.250	16	21	16	21	31	21	17	10	8	7	28	14	19	19	27	27	67	31	34	17	67.0	**22.5**	7.0
VFS	100	0.149	10	13	9	14	24	14	11	6	6	3	21	10	12	13	21	22	51	22	27	12	51.0	**16.0**	3.0
CM	200	0.074	5	7	5	8	15	8	6	3	3	1	14	7	7	7	15	15	32	13	18	7	32.0	**9.8**	1.0
d50			**1.21**	**0.85**	**1.22**	**0.85**	**0.54**	**1.09**	**0.85**	**1.17**	**2.80**	**2.00**	**0.72**	**1.15**	**0.66**	**1.17**	**1.58**	**1.07**	**0.14**	**0.56**	**0.67**	**1.41**	2.80	**1.08**	0.14
d15			0.24	0.17	0.23	0.16	0.07	0.16	0.21	0.33	0.43	0.40	0.08	0.27	0.19	0.18	0.07	0.07	0.04	0.09	0.06	0.20			
d85			7.40	5.63	7.56	6.28	6.17	8.01	4.27	4.55	13.20	9.53	4.51	4.04	3.83	7.56	23.08	10.80	0.93	2.92	10.69	11.02			
d95			16.15	9.80	16.02	14.15	16.97	22.64	20.97	19.05	20.47	17.89	12.00	9.53	8.73	16.33	32.18	20.97	2.83	5.66	29.08	15.87			

Oak Springs Canyon Creek Streambed Grain Size



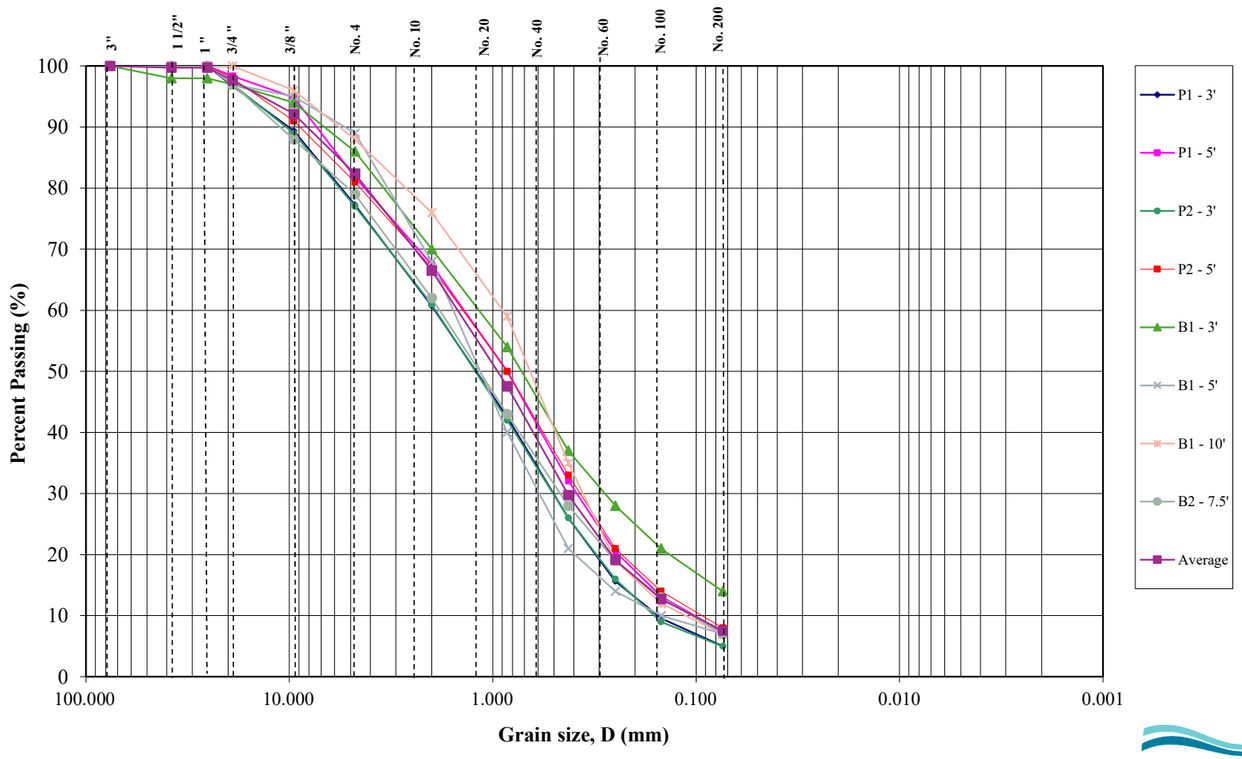
PACE
Advanced Water Engineering

Downstream Sampling Data for Oak Springs Canyon Creek

Stream Gradation Samples - Oak Springs Canyon Creek

	Sieve No.	Sieve Opening (mm)	Percent Passing (%)																					High	Average	Low
			P1		P2								B1			B2										
			P1 - 3'	P1 - 5'	P2 - 3'	P2 - 5'							B1 - 3'	B1 - 5'	B1 - 10'	B2 - 7.5'										
SC	3	76.200	100	100	100	100							100	100	100	100								100	**100.0**	100.0
VCG	1 1/2	38.100	100	100	100	100							98	100	100	100								100	**99.8**	98
CG	1	25.400	100	100	100	100							98	100	100	100								100	**99.8**	98
	3/4	19.050	97	98	97	98							97	97	100	97								100.0	**97.6**	96.8
MG	3/8	9.525	89	95	89	91							94	95	96	88								96.0	**92.2**	88.0
FG	4	4.760	77	82	77	81							86	89	88	79								89.0	**82.4**	77.0
VFG	10	2.000	61	67	61	67							70	68	76	62								76.0	**66.5**	60.7
CS	20	0.850	42	50	42	50							54	40	59	43								59.0	**47.6**	40.0
MS	40	0.425	26	32	26	33							37	21	35	28								37.0	**29.8**	21.0
FS	60	0.250	16	21	16	21							28	14	19	19								28.0	**19.1**	14.0
VFS	100	0.149	10	13	9	14							21	10	12	13								21.0	**12.7**	9.0
CM	200	0.074	5	7	5	8							14	7	7	7								14.0	**7.5**	5.0
	d50		**1.21**	**0.85**	**1.22**	**0.85**							**0.72**	**1.15**	**0.66**	**1.17**								1.22	**0.98**	0.66
	d15		0.24	0.17	0.23	0.16							0.08	0.27	0.19	0.18										
	d85		7.40	5.63	7.56	6.28							4.51	4.04	3.83	7.56										
	d95		16.15	9.80	16.02	14.15							12.00	9.53	8.73	16.33										

Oak Springs Canyon Creek Streambed Grain Size

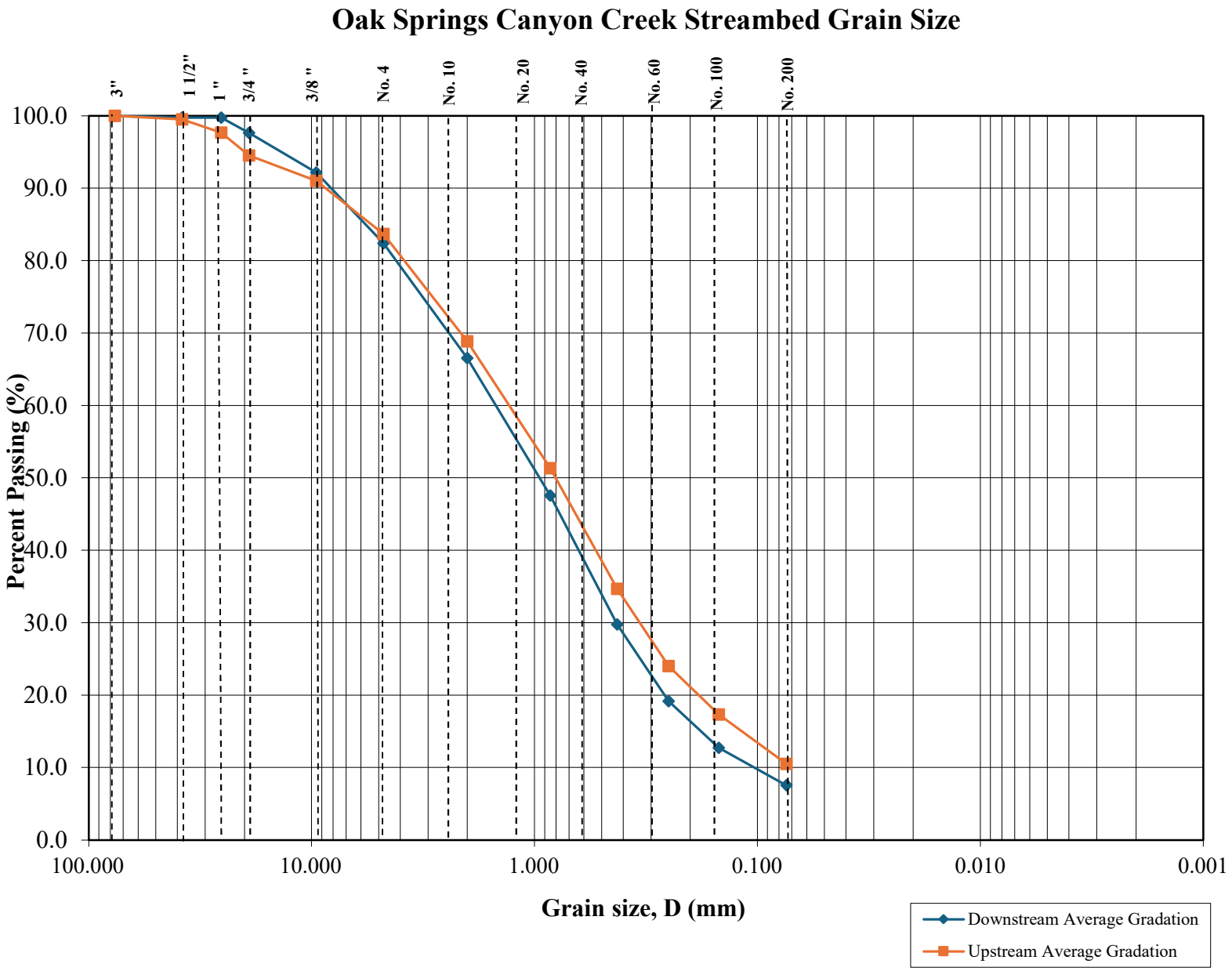


PACE
Advanced Water Engineering

Upstream Sampling Data for Oak Springs Canyon Creek

Stream Gradation Samples - Oak Springs Canyon Creek

| | Sieve No. | Sieve Opening (mm) | Percent Passing (%) | | |

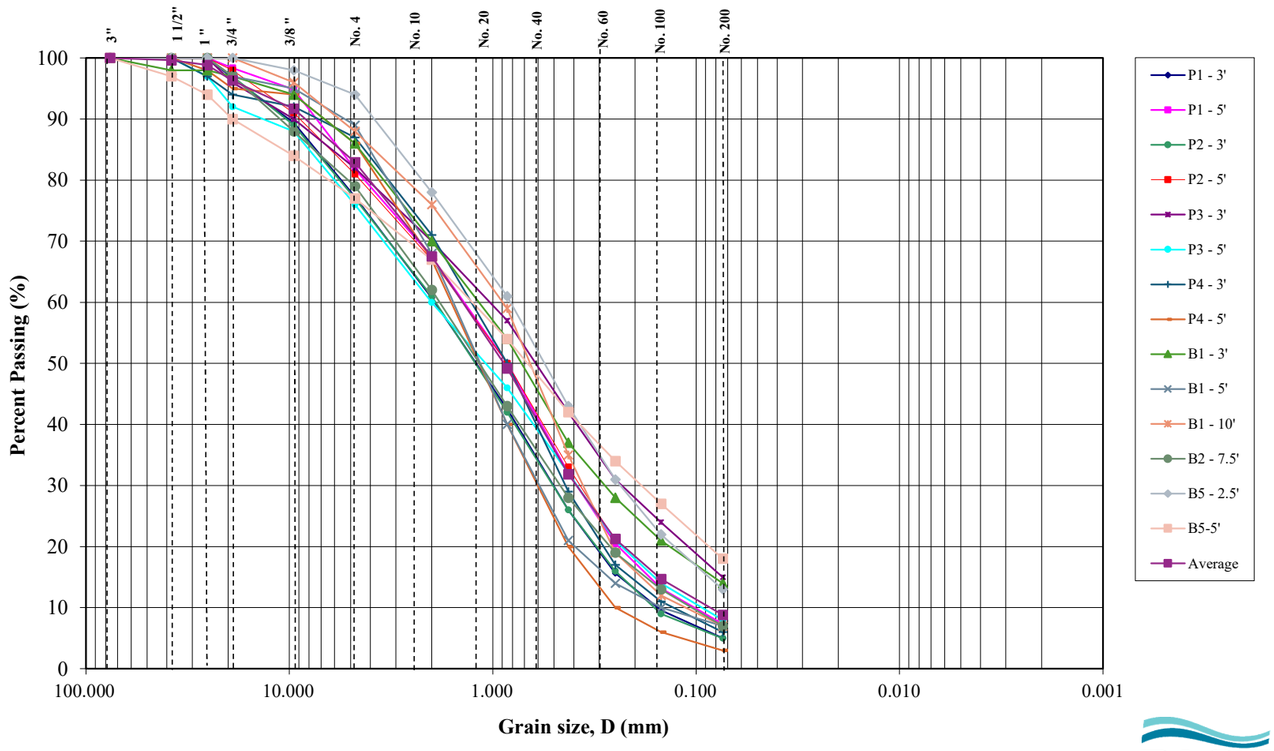

Oak Springs Canyon Creek Streambed Grain Size
3"
1 1/2"
1 "
3/4 "
3/8 "
No. 4
No. 10
No. 20
No. 40
No. 60
No. 100
No. 200
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Percent Passing (%)
100.000
10.000
1.000
0.100
0.010
0.001
Grain size, D (mm)
Downstream Average Gradation
Upstream Average Gradation

Combination Downstream and Upstream Sampling Data

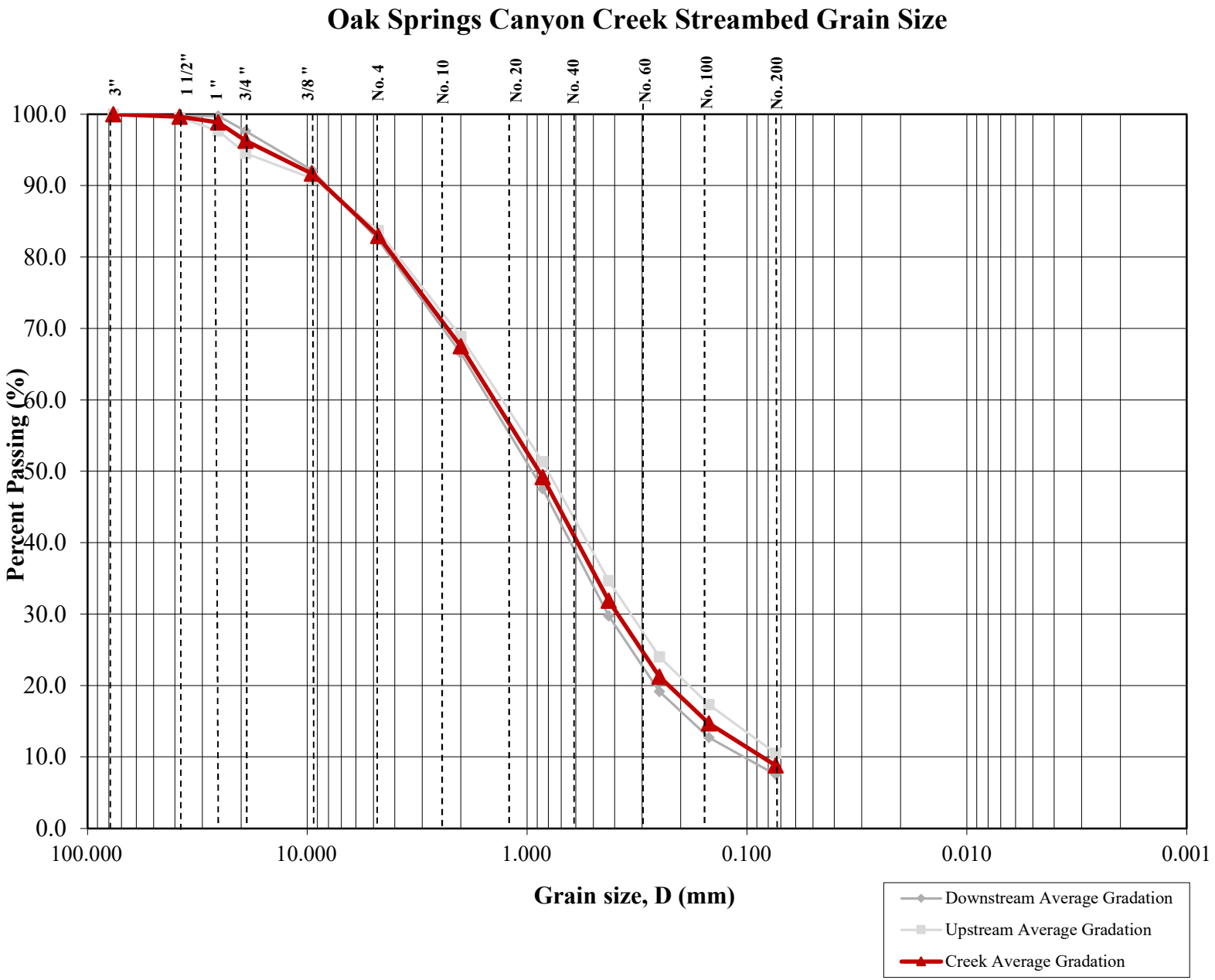
Stream Gradation Samples - Oak Springs Canyon Creek

	Sieve No.	Sieve Opening (mm)	Percent Passing (%)																									
			P1		P2		P3		P4				B1			B2				B5						High	Average	Low
			P1 - 3'	P1 - 5'	P2 - 3'	P2 - 5'	P3 - 3'	P3 - 5'	P4 - 3'	P4 - 5'			B1 - 3'	B1 - 5'	B1 - 10'	B2 - 7.5'				B5 - 2.5'	B5-5'							
SC	3	76.200	100	100	100	100	100	100	100	100			100	100	100	100				100	100					100	**100.0**	100.0
VCG	1 1/2	38.100	100	100	100	100	100	100	100	100			98	100	100	100				100	97					100	**99.6**	97
CG	1	25.400	100	100	100	100	100	97	97	98			98	100	100	100				100	94					100	**98.9**	94
	3/4	19.050	97	98	97	98	96	92	94	95			97	97	100	97				100	90					100.0	**96.3**	90.0
MG	3/8	9.525	89	95	89	91	90	88	92	94			94	95	96	88				98	84					98.0	**91.7**	84.0
FG	4	4.760	77	82	77	81	82	76	87	86			86	89	88	79				94	77					94.0	**82.9**	76.0
VFG	10	2.000	61	67	61	67	70	60	71	67			70	68	76	62				78	67					78.0	**67.5**	60.0
CS	20	0.850	42	50	42	50	57	46	50	40			54	40	59	43				61	54					61.0	**49.2**	40.0
MS	40	0.425	26	32	26	33	42	32	29	20			37	21	35	28				43	42					43.0	**31.9**	20.0
FS	60	0.250	16	21	16	21	31	21	17	10			28	14	19	19				31	34					34.0	**21.2**	10.0
VFS	100	0.149	10	13	9	14	24	14	11	6			21	10	12	13				22	27					27.0	**14.7**	6.0
CM	200	0.074	5	7	5	8	15	8	6	3			14	7	7	7				13	18					18.0	**8.8**	3.0
d50			**1.21**	**0.85**	**1.22**	**0.85**	**0.54**	**1.09**	**0.85**	**1.17**			**0.72**	**1.15**	**0.66**	**1.17**				**0.56**	**0.67**					1.22	**0.91**	0.54
d15			0.24	0.17	0.23	0.16	0.07	0.16	0.21	0.33			0.08	0.27	0.19	0.18				0.09	0.06							
d85			7.40	5.63	7.56	6.28	6.17	8.01	4.27	4.55			4.51	4.04	3.83	7.56				2.92	10.69							
d95			16.15	9.80	16.02	14.15	16.97	22.64	20.97	19.05			12.00	9.53	8.73	16.33				5.66	29.08							

Oak Springs Canyon Creek Streambed Grain Size



PACE
Advanced Water Engineering


Oak Springs Canyon Creek Streambed Grain Size
3"
1 1/2"
1 "
3/4 "
3/8 "
No. 4
No. 10
No. 20
No. 40
No. 60
No. 100
No. 200
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Percent Passing (%)
100.000
10.000
1.000
0.100
0.010
0.001
Grain size, D (mm)
Downstream Average Gradation
Upstream Average Gradation
Creek Average Gradation

Grainsize Analysis for Sediment Transport

PACE

SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	B-1	Small Bag 1	3.0	Bag	SM	N/A	N/A

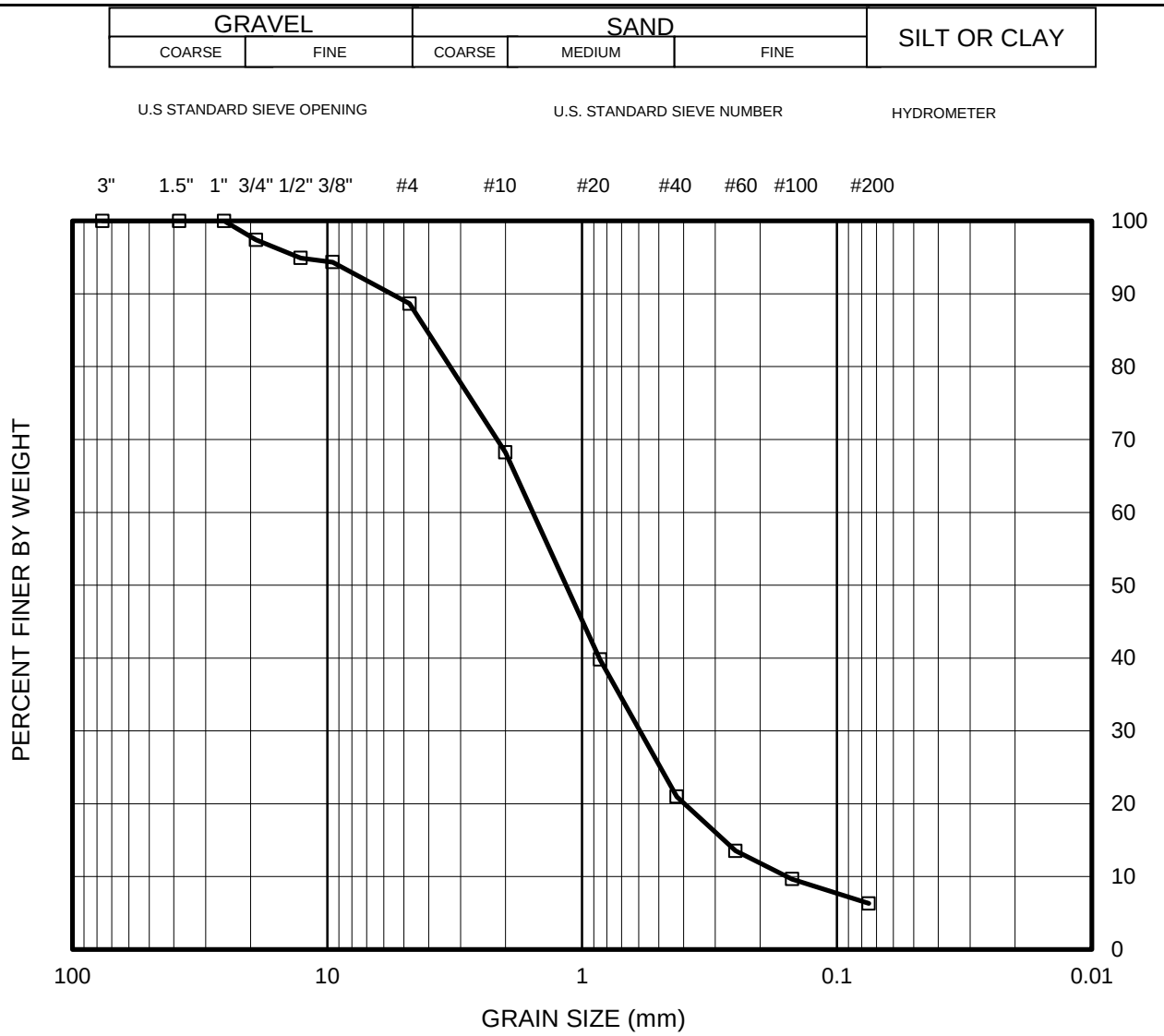
Gravel:	14.6%
Sand:	72.0%
Fine:	13.4%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	B-1	SPT-1	5.0	Bag	SW-SM	N/A	N/A

Gravel:	11.4%
Sand:	82.3%
Fine:	6.3%

EGLAB, INC.

Project Name: Belcaro

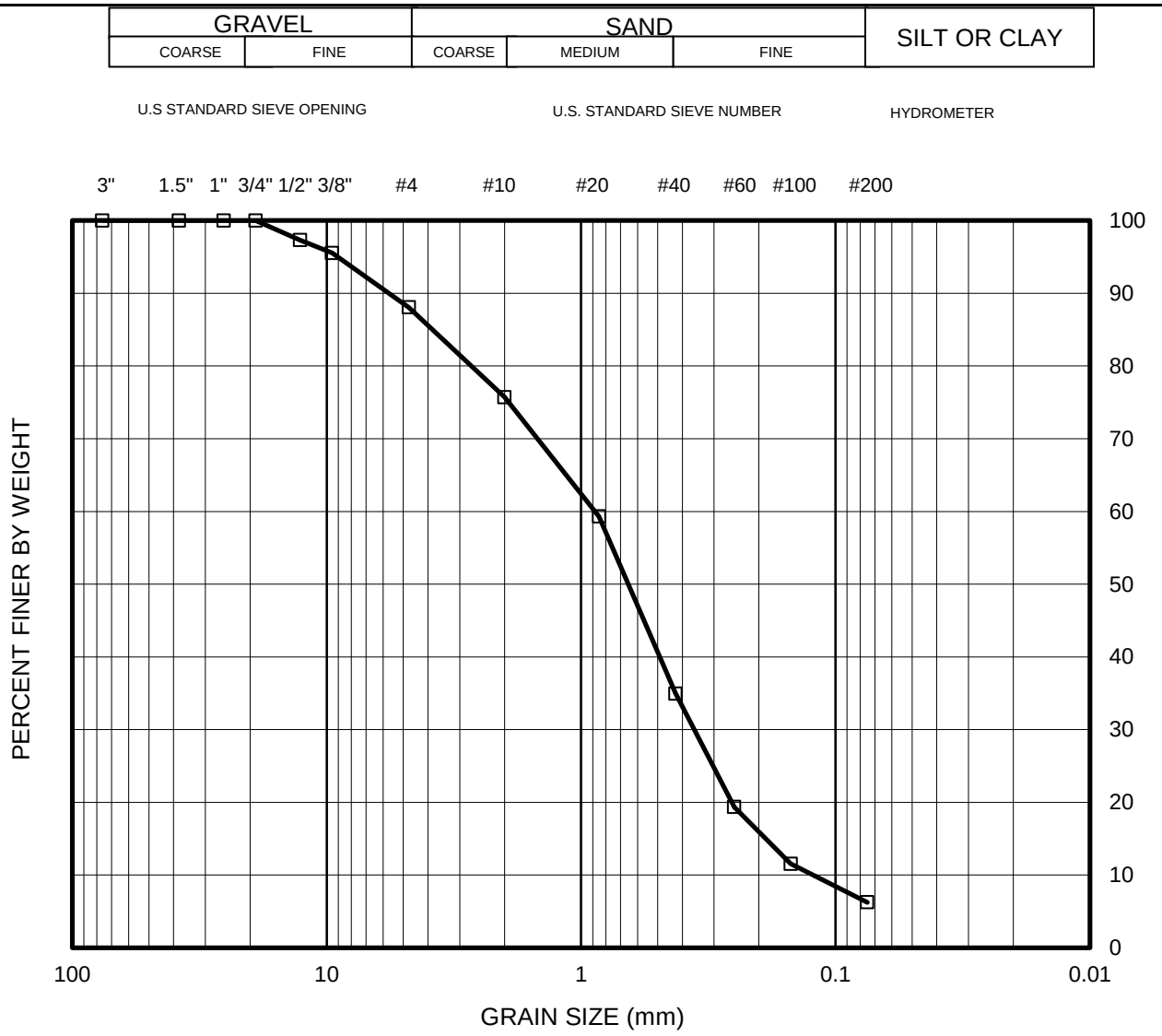
Client Job No.: 233012-01

Client Name: LGC Valley, Inc.

EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

01/16/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	B-1	SPT-2	10.0	Bag	SW-SM	N/A	N/A

Gravel:	11.9%
Sand:	81.8%
Fine:	6.3%

EGLAB, INC.

Project Name: Belcaro

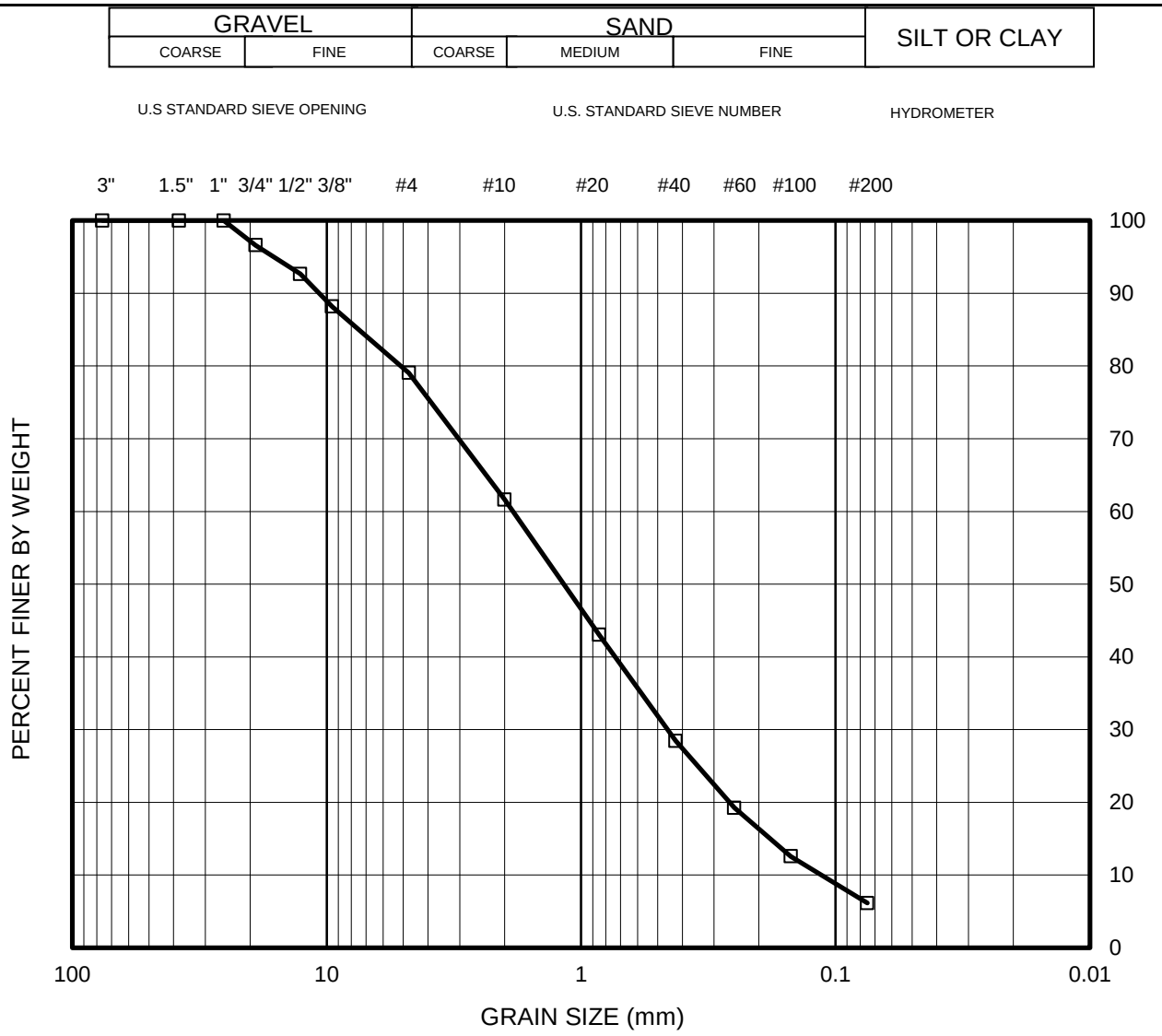
Client Job No.: 233012-01

Client Name: LGC Valley, Inc.

EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

01/16/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	B-2	SPT-1	7.5	Bag	SW-SM	N/A	N/A

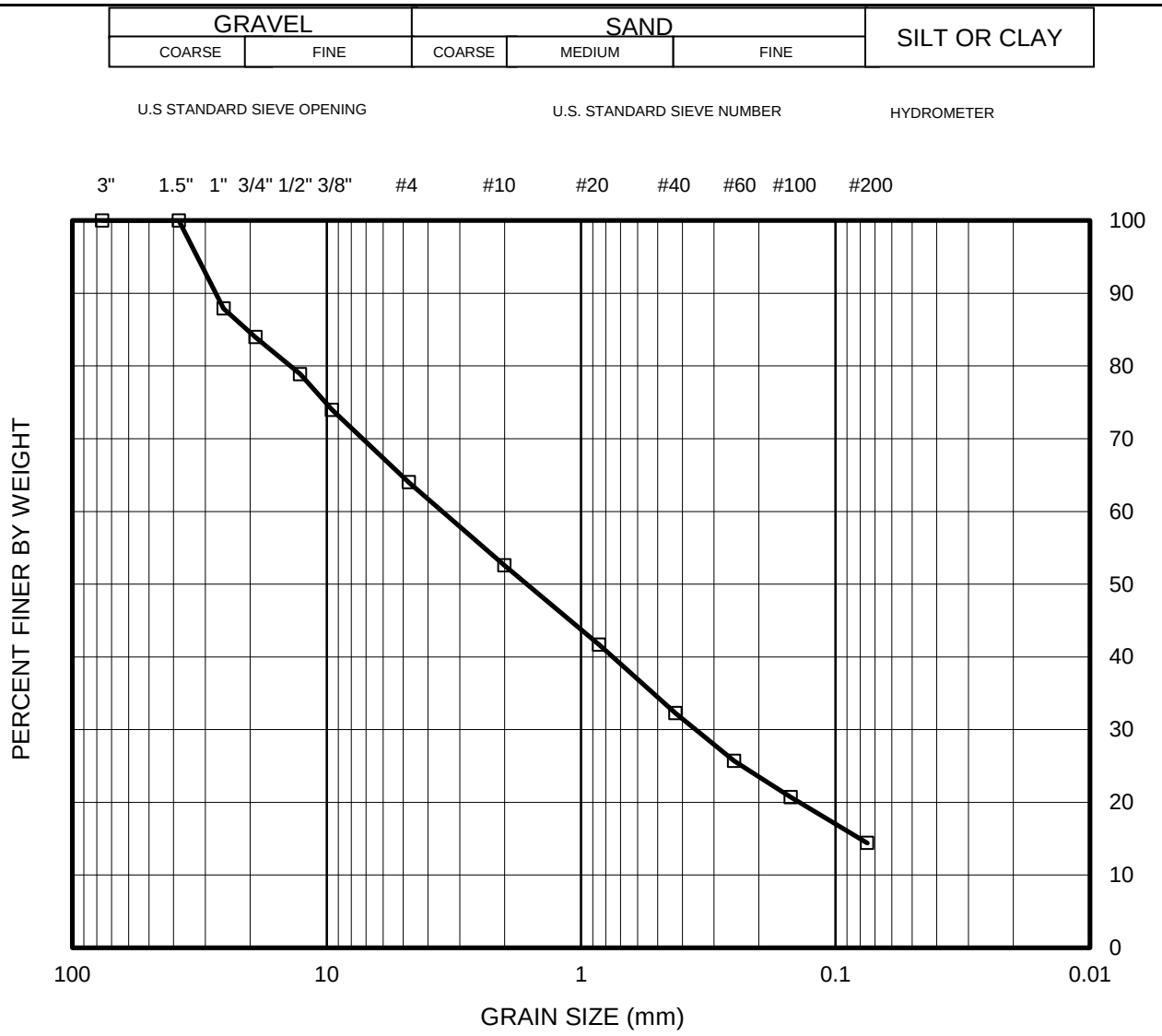
Gravel:	20.9%
Sand:	72.9%
Fine:	6.2%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

01/16/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	B-4	Small Bag 1	3.0	Bag	SM	N/A	N/A

Gravel:	36.0%
Sand:	49.6%
Fine:	14.4%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE

SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	B-4	Small Bag 2	5.0	Bag	SM	N/A	N/A

Gravel:	26.1%
Sand:	59.2%
Fine:	14.7%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE

SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	B-4	R-2	10.0	Ring	SM	N/A	N/A

Gravel:	2.3%
Sand:	65.5%
Fine:	32.2%

EGLAB, INC.

Project Name: Belcaro

Client Job No.: 233012-01

Client Name: LGC Valley, Inc.

EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE

SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	B-5	SPT-1	2.5	Bag	SM	N/A	N/A

Gravel:	6.9%
Sand:	81.0%
Fine:	12.1%

EGLAB, INC.

Project Name: Belcaro

Client Job No.: 233012-01

Client Name: LGC Valley, Inc.

EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE

SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	B-5	Small Bag 2	5.0	Bag	SM	N/A	N/A

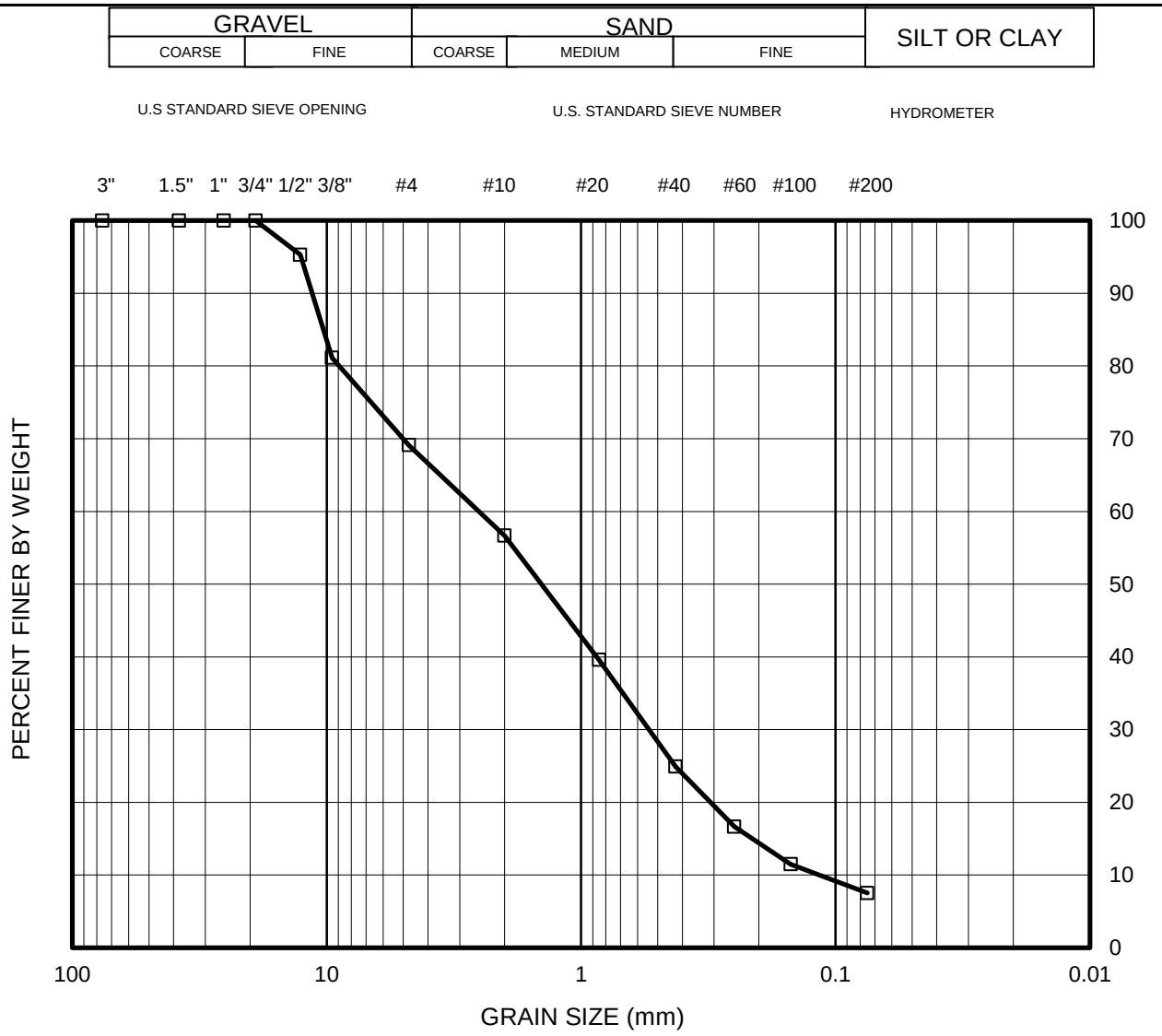
Gravel:	23.1%
Sand:	58.6%
Fine:	18.3%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	B-5	R-4	10.0	Ring	SW-SM	N/A	N/A

Gravel:	30.9%
Sand:	61.6%
Fine:	7.5%

EGLAB, INC.

Project Name: Belcaro

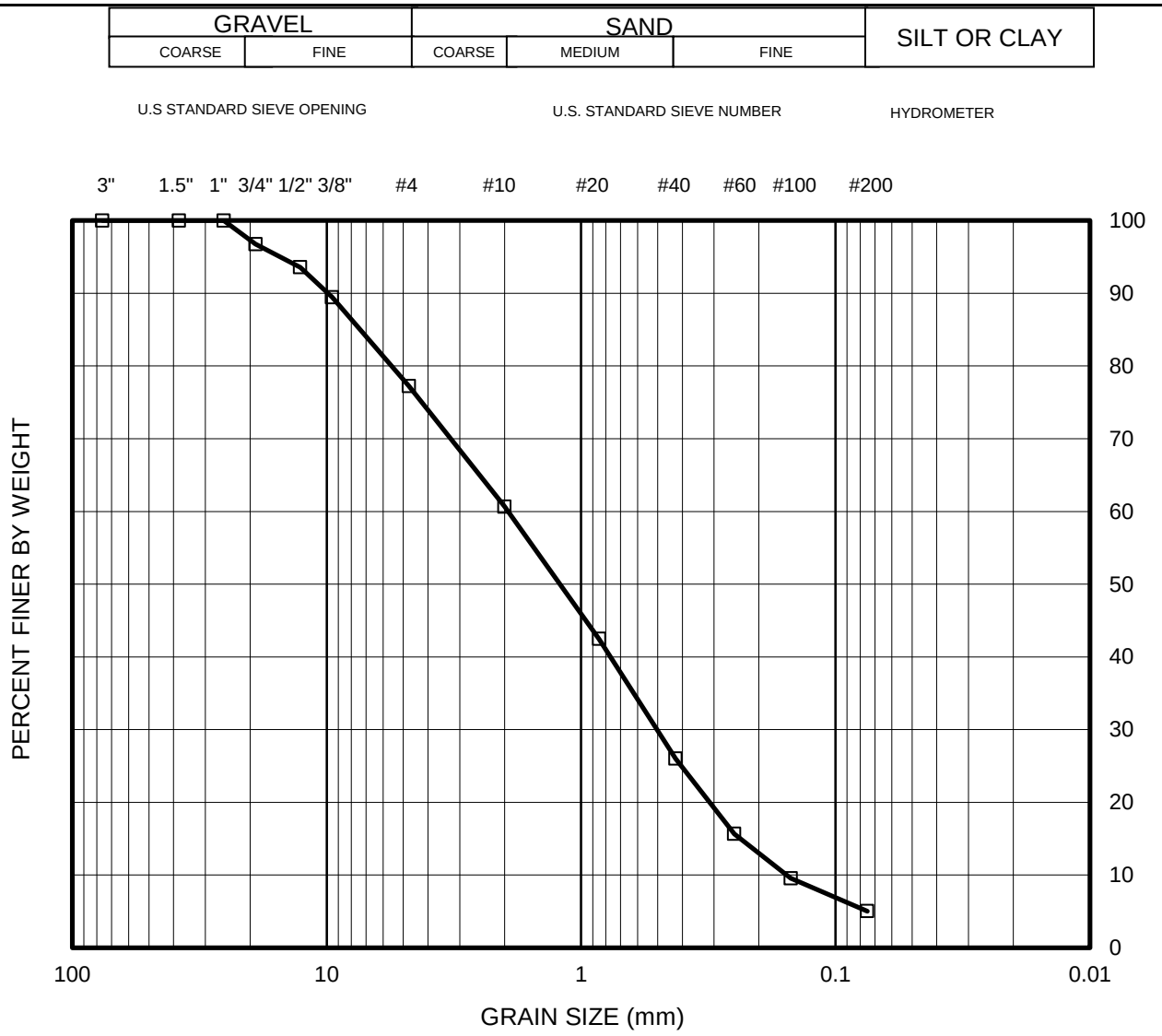
Client Job No.: 233012-01

Client Name: LGC Valley, Inc.

EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	P-1	1	3.0	Bag	SW-SM	N/A	N/A

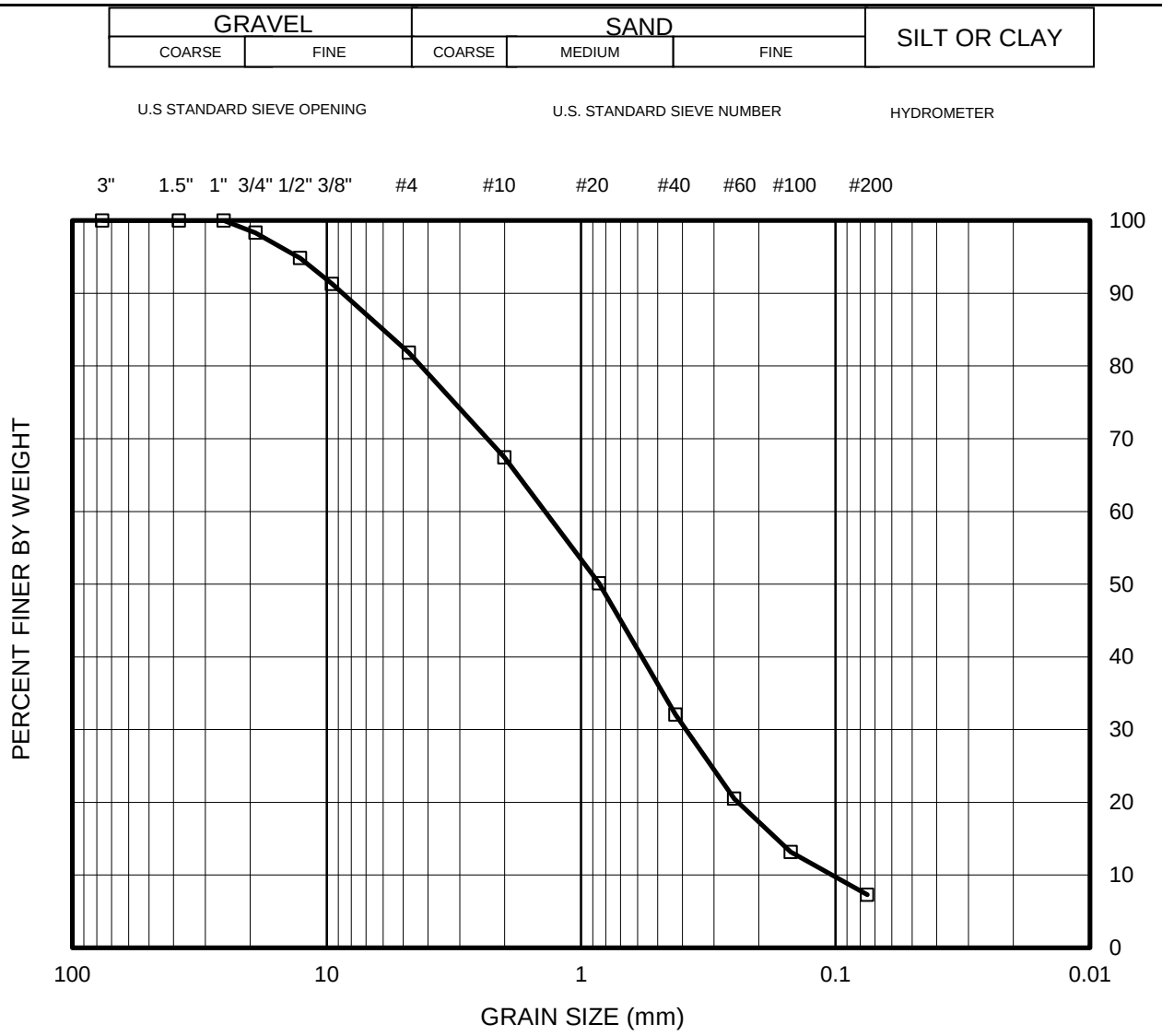
Gravel:	22.8%
Sand:	72.2%
Fine:	5.0%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/25/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	P-1	2	5.0	Bag	SW-SM	N/A	N/A

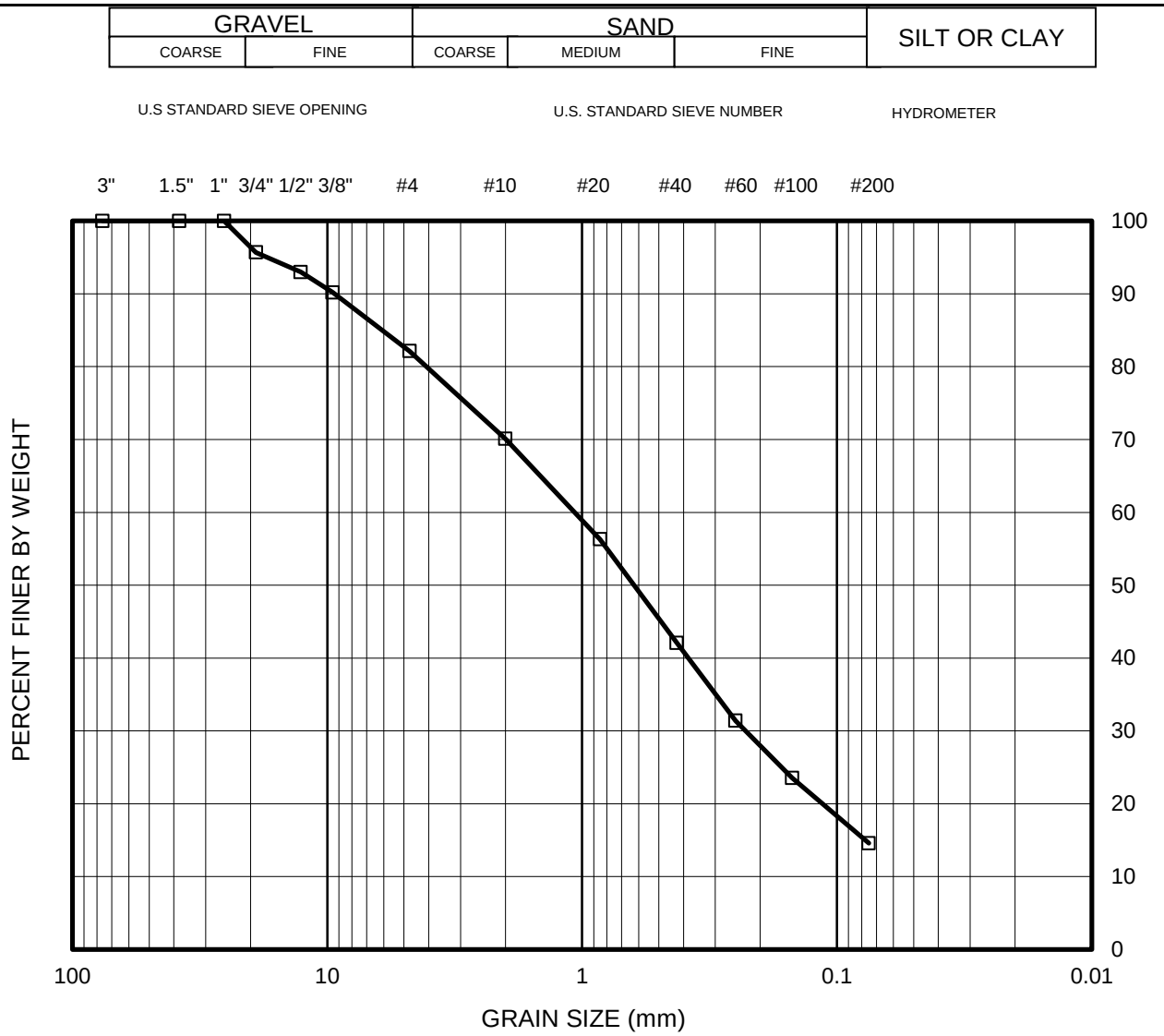
Gravel:	18.2%
Sand:	74.5%
Fine:	7.3%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/25/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	P-2	1	3.0	Bag	SM	N/A	N/A

Gravel:	17.9%
Sand:	67.5%
Fine:	14.6%

EGLAB, INC.

Project Name: Belcaro

Client Job No.: 233012-01

Client Name: LGC Valley, Inc.

EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE

SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	P-2	2	5.0	Bag	SW-SM	N/A	N/A

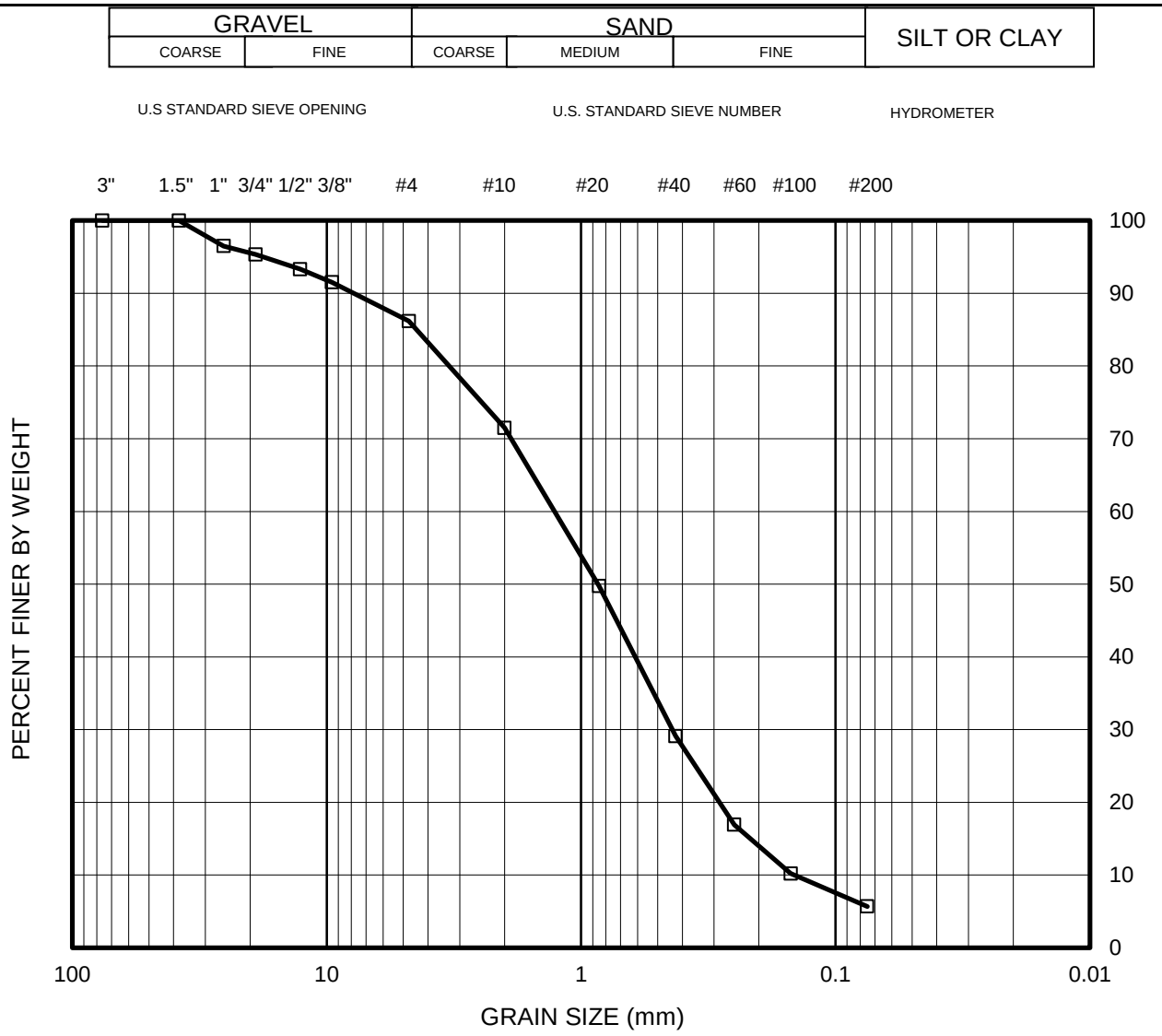
Gravel:	23.8%
Sand:	68.8%
Fine:	7.4%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	P-3	1	3.0	Bag	SW-SM	N/A	N/A

Gravel:	13.8%
Sand:	80.5%
Fine:	5.7%

EGLAB, INC.

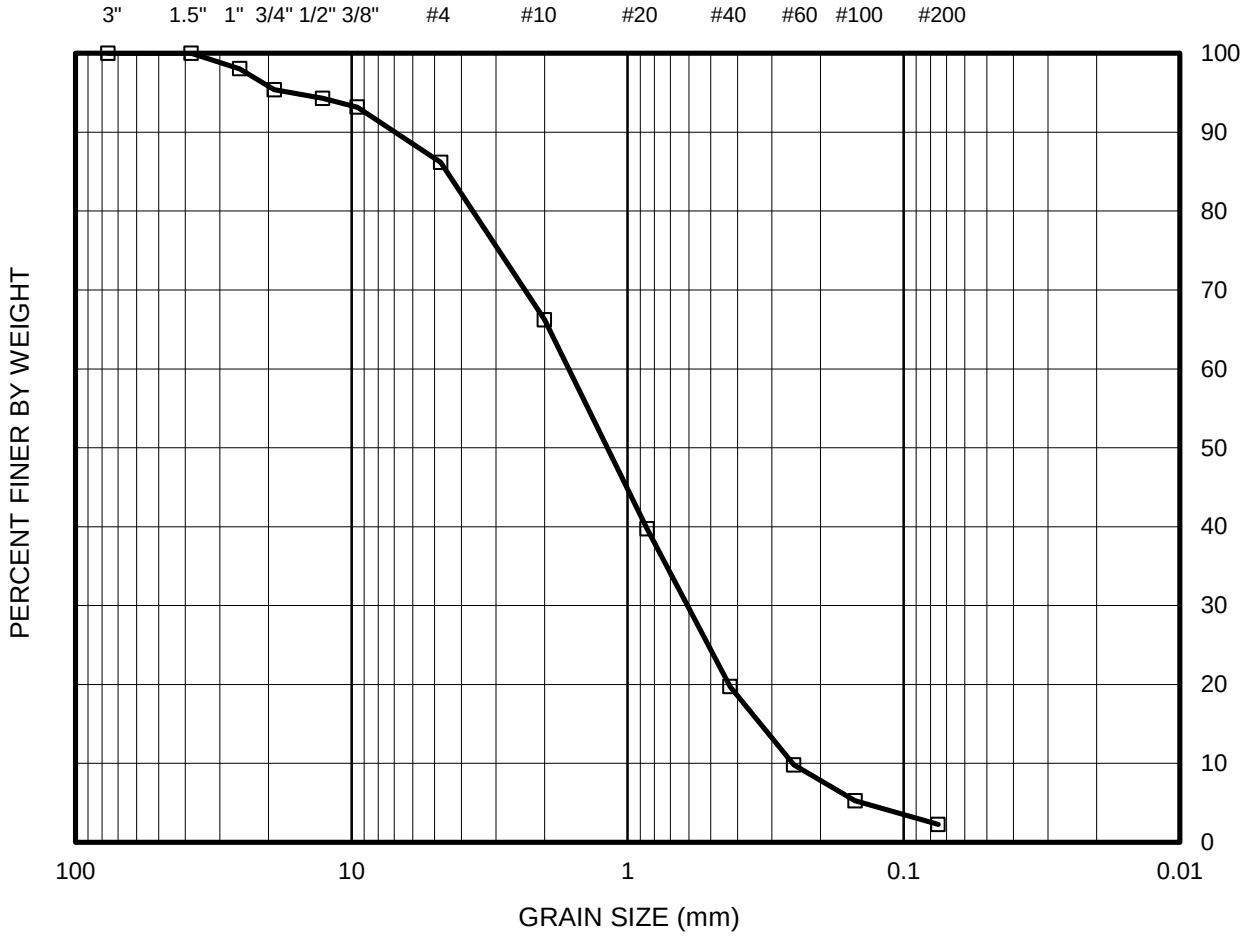
Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

U.S STANDARD SIEVE OPENING | U.S. STANDARD SIEVE NUMBER | HYDROMETER



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	P-3	2	5.0	Bag	SW	N/A	N/A

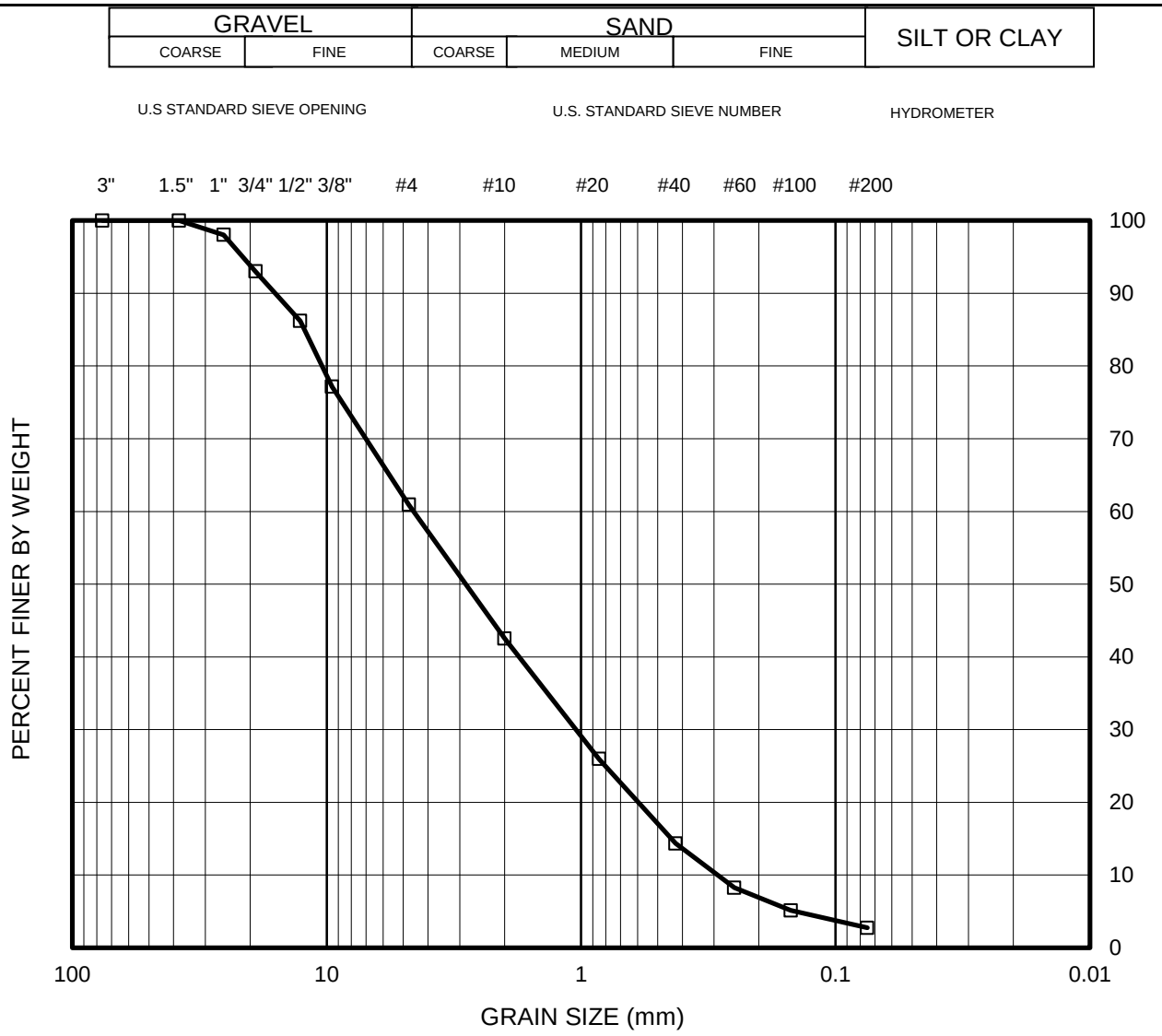
Gravel:	13.8%
Sand:	83.9%
Fine:	2.3%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	P-4	1	3.0	Bag	SW	N/A	N/A

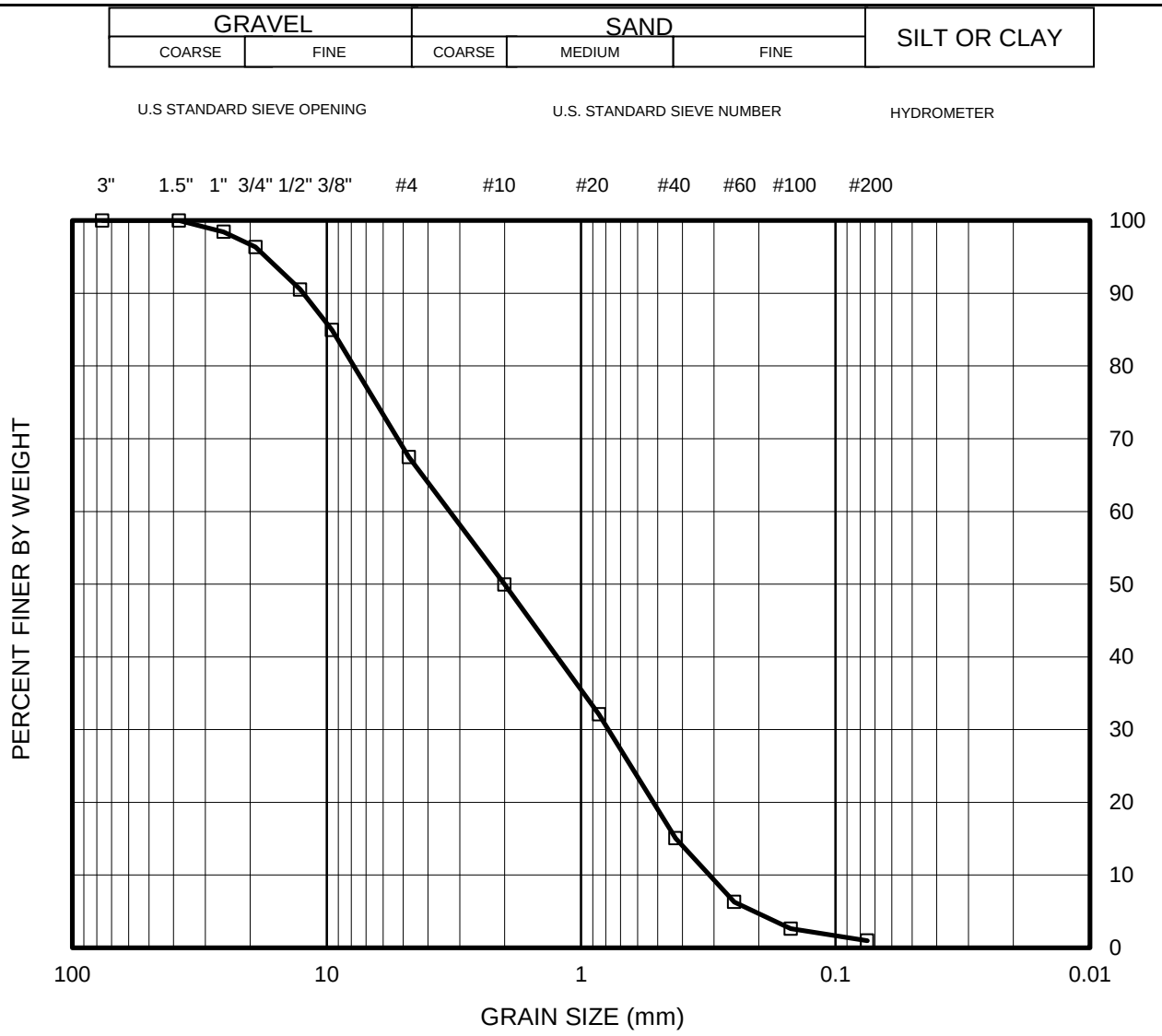
Gravel:	39.1%
Sand:	58.2%
Fine:	2.7%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	P-4	2	5.0	Bag	SW	N/A	N/A

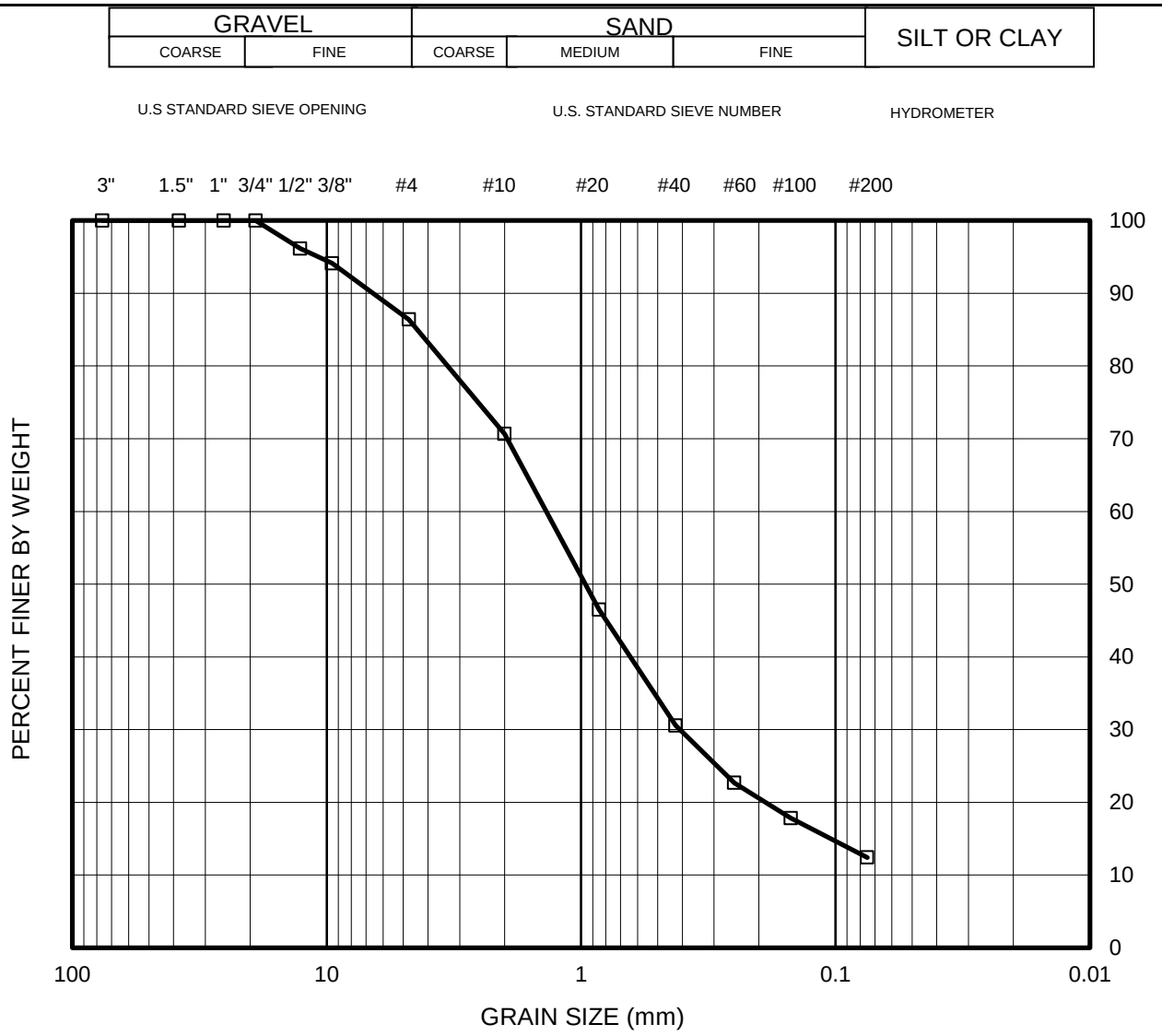
Gravel:	32.5%
Sand:	66.5%
Fine:	1.0%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	P-5	1	1.0	Bag	SM	N/A	N/A

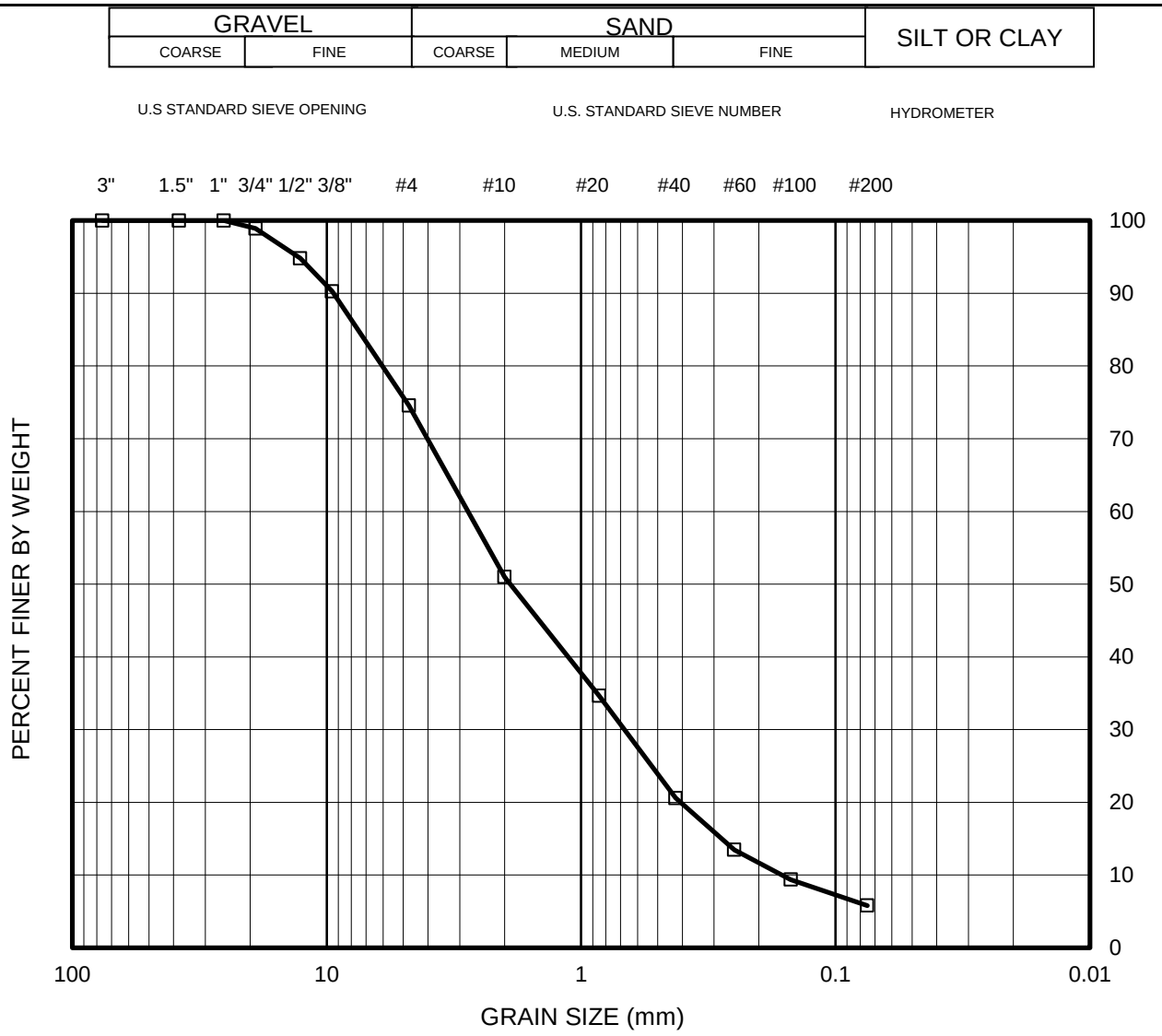
Gravel:	13.6%
Sand:	74.0%
Fine:	12.4%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
☐	P-5	2	3.0	Bag	SW-SM	N/A	N/A

Gravel:	25.4%
Sand:	68.8%
Fine:	5.8%

EGLAB, INC.

Project Name: Belcaro
Client Job No.: 233012-01
Client Name: LGC Valley, Inc.
EGLAB Project No.: 24-059-004

GRAIN SIZE DISTRIBUTION CURVE

02/26/25 (ASTM D422) FIGURE

PACE
Advanced Water Engineering

Appendix D – Oak Springs Canyon Creek Hydrology

PACE
Advanced Water Engineering

Technical Memorandum

Date: December 6, 2024

To: New Urban West

From: Andrew Ronnau, PhD, PE
Emily Randig, MS, EIT

Re: Oak Springs Canyon Creek Hydrology # C323

Introduction

Belcaro is a proposed residential development located to the south of the Santa Clara River, and east of Oak Springs Canyon Creek in Santa Clarita, California. PACE prepared offsite hydrology for the 100-yr, 24-hour flood event. The following memorandum presents hydrology of the Oak Springs Canyon Creek drainage system for the 24-hr, 100-yr storm event. Hydrology analyses were completed using HEC-HMS.

Hydrologic Model Inputs

Watershed Delineation

For this study the Oak Springs Canyon Creek watershed was delineated using GeoHEC-HMS and verified using USGS StreamStats. The delineated watershed covers approximately 5.8 square miles, consistent with the watershed areas presented in USGS StreamStats and the 2021 FEMA FIS. The watershed outlet is located at the confluence of Oak Springs Canyon Creek and the Santa Clara River.

Storm Event and Precipitation Data

Hydrologic modeling was completed using a Hypothetical Storm for the 100-yr, 24-hour event. The SCS Type-1 Hypothetical Storm pattern was used. The Type I storm represents Pacific climates with generally wet winters and dry summers and are generally used on the Pacific coast from Washington to California, plus Alaska and Hawaii. Precipitation data for the storm event was sources from NOAA Atlas 14, evaluated at the centroid of the watershed. Rainfall depth for the 100-yr, 24hour storm was used in the model. The 100-year, 24-hour rainfall depth was 9.37 inches.

Rainfall Loss Parameters

The SCS Curve Number method was used to calculate losses within the watershed. A composite curve number was calculated for the Oak Springs Canyon Creek watershed using GeoHEC-HMS.

$$CN_{composite} = \frac{\sum A_i CN_i}{\sum A_i}$$

Where:

$CN_{composite}$ = composite CN
i = index of watershed of uniform land use and soil type
CN = Curve Number
A = Area

GeoHEC-HMS bisects NLCD 2021 Land Cover and NRCS Soil Survey to calculate the areas of the watershed for each CN, then calculates the composite CN for the watershed. The calculated composite watershed curve number is 74.41. GeoHEC-HM was also used to calculate the watershed percent impervious area. GeoHEC-HMS uses the NLCD impervious land cover database from 2021. A percent impervious value of 1.91 % was calculated for the Oak Springs Canyon Creek watershed. An initial abstraction was not specified in the HEC-HMS model. The program assumes that:

$$I_a = 0.2 * S, where\ S = \frac{1000 - 10CN}{CN}$$

Where:

I_a = initial abstraction (in)
S = Storage (in)
CN = Curve Number

Lag Time

Lag time was calculated using the SCS lag equation.

$$t_L = \frac{HL^{0.8}(S+1)^{0.7}}{1900Y^{0.5}}$$

Where:

t_L = Lag Time (hr)
HL = watershed flow length (ft)
S = Storage (in)
Y = Slope (%)

The calculated lag time is 2.08 hours, which was used to develop the unit hydrograph.

Unit Hydrograph

Calculations utilized the SCS unit hydrograph developed with the SCS dimensionless mass curve shown in **Figure 1**.

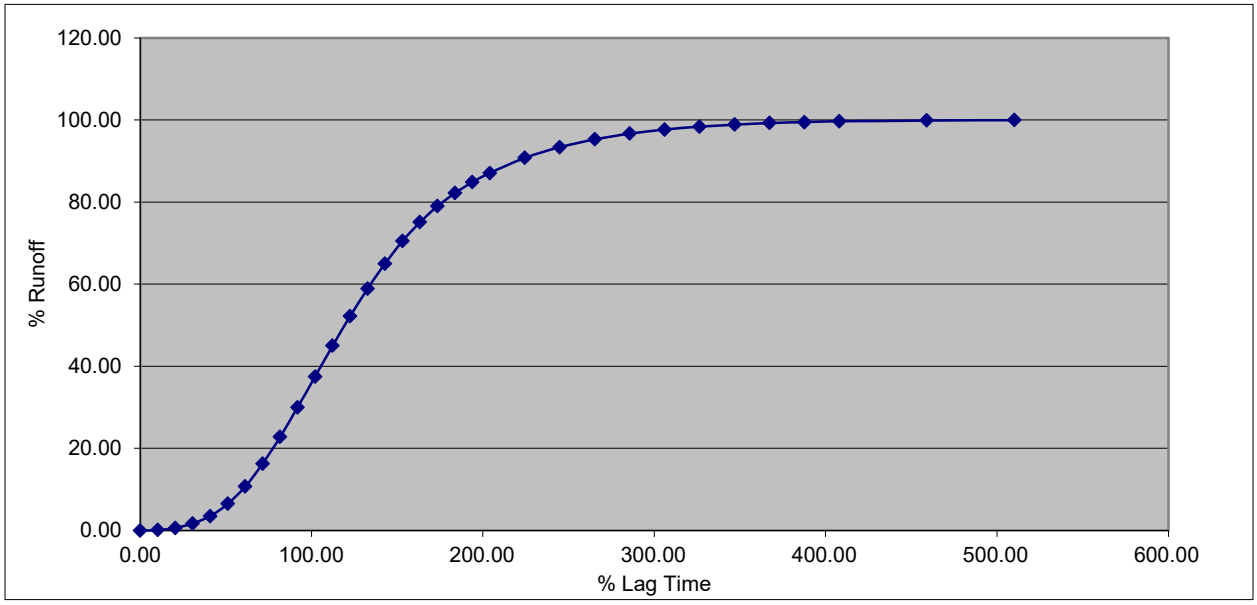


Figure 1: SCS Dimensionless S-Graph

Runoff Hydrograph

The output hydrograph from HEC-HMS is detailed in **Figure 2**. The 100-year runoff hydrograph has a peak flow of 3,535 cfs and runoff volume of 1,816 acre-feet.

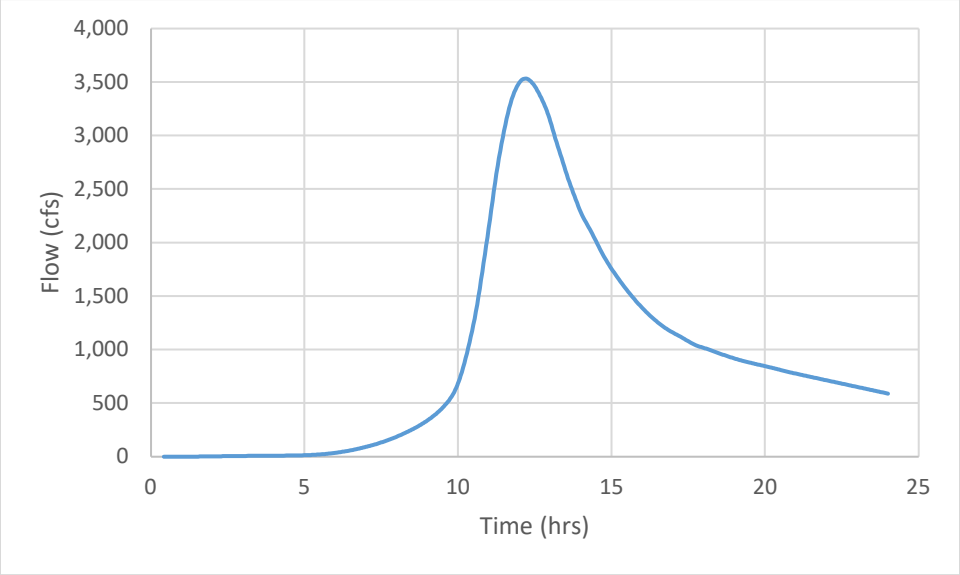
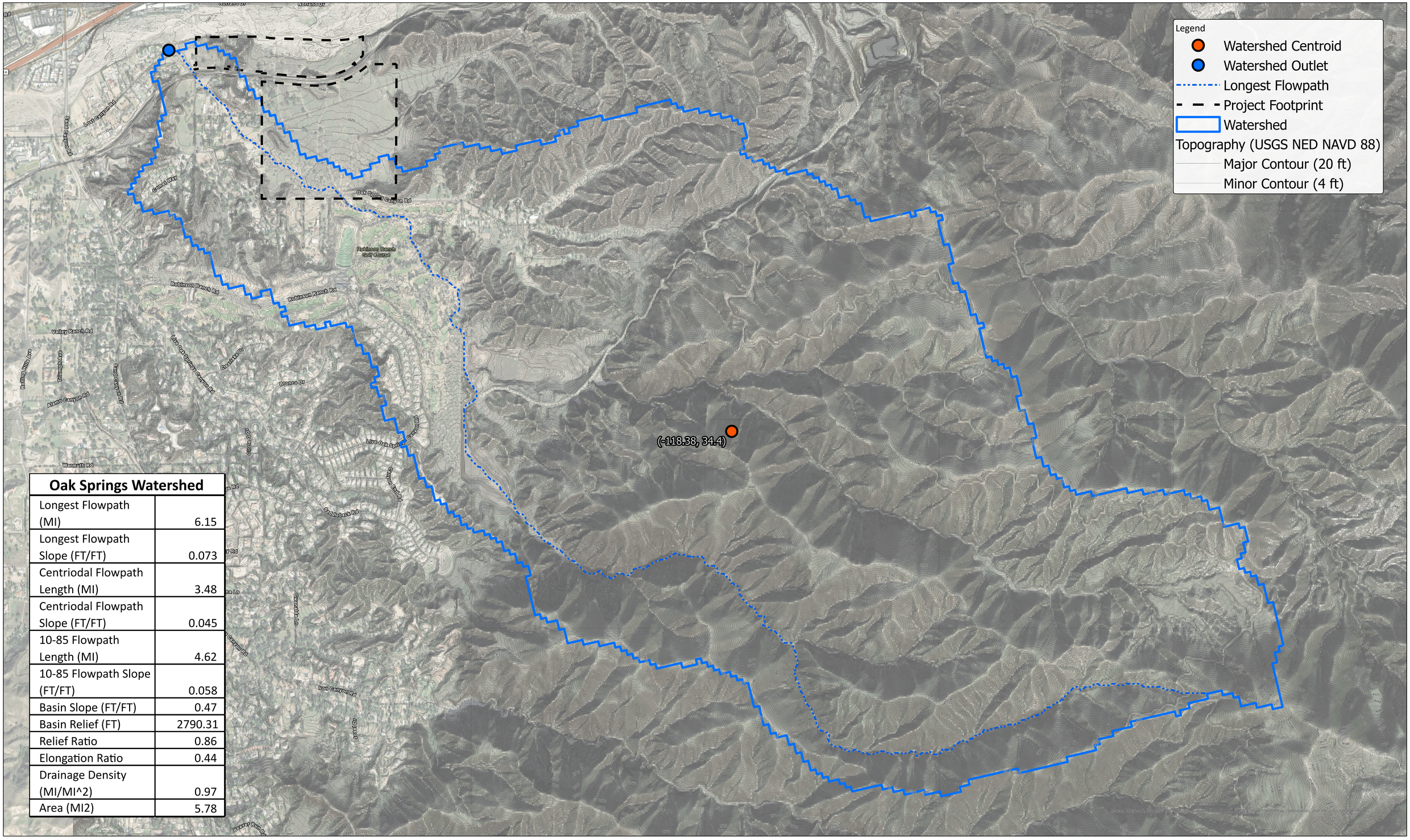


Figure 2: Oak springs Canyon Runoff Hydrograph



Oak Springs Watershed	
Longest Flowpath (MI)	6.15
Longest Flowpath Slope (FT/FT)	0.073
Centriodal Flowpath Length (MI)	3.48
Centriodal Flowpath Slope (FT/FT)	0.045
10-85 Flowpath Length (MI)	4.62
10-85 Flowpath Slope (FT/FT)	0.058
Basin Slope (FT/FT)	0.47
Basin Relief (FT)	2790.31
Relief Ratio	0.86
Elongation Ratio	0.44
Drainage Density (MI/MI^2)	0.97
Area (MI2)	5.78

P:\C323\GIS\Projects\C323_Belcaro\C323_Belcaro.aprx - Hydrology Workmap

BELCARO

HYDROLOGY WORKMAP

PACE Advanced Water Engineering

0 800 1,600 3,200 Feet

Date: 7/10/2025

Job Number: B323

Exhibit B

PACE
Advanced Water Engineering

Appendix E – Rock Sizing

Inputs

S_f	1.1	
Unit Weight	165	lb/cf
Angle of Repose	40	
Side Slope Angle	26.56	degrees
Channel Type	Natural Channel	
Rock Type	Angular Rock	
K1 Method	USACE	
K1 Method	0.72	

Cross-Section	Q_{100} = 3,535 cfs, n=0.025			Dss (ft)	EM 1110-2-1601				LACPW	
	Velocity Avg (ft)	Hydraulic Depth (ft)	Max Channel Depth(ft)		d30 (in)	d50 (in)	d50 (in)	Weight	d50 (in)	Weight
5353	17.48	2.94	7.19	2.35	32.71	40.88	43	2 ton	54	4 ton
5238	18.59	2.13	5.25	1.70	41.27	51.59	54	4 ton	54	4 ton
5167	16.87	2.05	6.09	1.64	31.20	38.99	43	2 ton	43	2 ton
5140.5	17.07	2.24	5.49	1.79	32.97	41.22	43	2 ton	54	4 ton
5131.67*	15.88	2.28	6.21	1.82	26.69	33.36	34	1 ton	43	2 ton
5122.83*	6.25	3.39	9.16	2.71	2.35	2.94	10	50 lb	10	50 lb
5114	5.58	3.43	9.95	2.74	1.74	2.17	10	50 lb	10	50 lb
5107.34*	12.34	4.14	8.19	3.31	13.26	16.57	18	300 lb	27	1/2 ton
5100.67	11.52	4.88	8.76	3.90	10.98	13.72	15	150 lb	21	1/4 ton
5064										
5054.71	16.35	5.27	6.22	4.22	28.70	35.87	43	2 ton	43	2 ton
5048.29*	18.49	4.61	5.29	3.69	40.64	50.80	54	4 ton	54	4 ton
5041.86	19.47	4.25	4.78	3.40	47.43	59.28	54	4 ton	54	4 ton
5035.43*	6.88	6.59	9.56	5.27	2.96	3.70	10	50 lb	10	50 lb
5029	4.65	7.44	10.55	5.95	1.08	1.36	10	50 lb	10	50 lb
4965	3.66	8.06	10.57	6.45	0.60	0.74	10	50 lb	10	50 lb
4902	3.34	8.38	11.53	6.70	0.46	0.58	10	50 lb	10	50 lb
4838	10.94	8.87	9.98	7.10	9.34	11.67	12	100 lb	18	300 lb
4806										
4775	13.61	5.8	6.24	4.64	18.13	22.66	27	1/2 ton	34	1 ton
4759.5*	14.99	4.15	5.33	3.32	24.00	30.01	34	1 ton	34	1 ton
4744	11.5	3.33	4.78	2.66	12.72	15.90	18	300 lb	21	1/4 ton
4668.5*	5.57	3.34	6.27	2.67	1.94	2.42	10	50 lb	10	50 lb
4593	10.73	3.43	4.36	2.74	10.94	13.68	15	150 lb	18	300 lb

PACE
Advanced Water Engineering

Appendix F – Plunge Scour Results

PLUNGE SCOUR CALCULATIONS

Veronese (1937)

Equations:

$$D = 0.202 \frac{(q^{0.54} H^{0.225})}{d^{0.42}} \qquad D_s = D - TW$$

Where:

D= Scour depth measured from the tailwater elevation (ft)

Ds= Depth of scour below river bed (ft)

H = Difference between upstream and downstream water surface elevations (ft)

q = Discharge per unit width, taken as Y*V (ft^3/s/ft)

Y= Depth of water at toe of drop structure (ft)

V= Water velocity at toe of drop structure (ft^3/s)

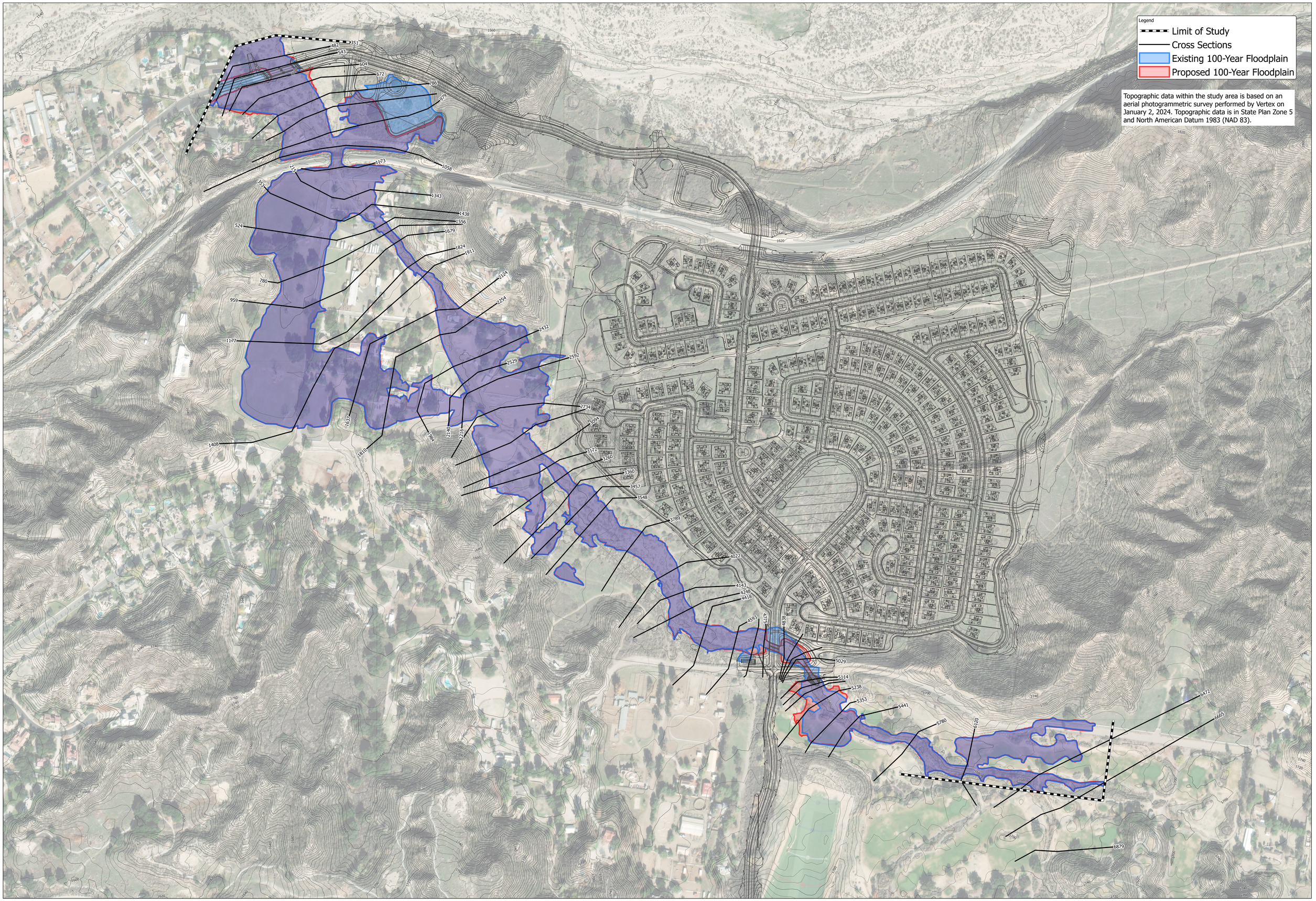
TW= Tailwater depth (ft)

d = Mean grain size of sediment (mm)

	D15 (mm) = 0.17	D50 (mm) = 0.91	D85 (mm) = 5.96	D (mm) = 250
H=	16.91	16.91	16.91	16.91
Q=	3535	3535	3535	3535
V=	4.69	4.69	4.69	4.69
Y=	5.30	5.30	5.30	5.30
q=	24.87	24.87	24.87	24.87
TW=	5.3	5.3	5.3	5.3
d=	5.6E-04	3.0E-03	2.0E-02	8.2E-01
D=	57.7	28.5	13.0	2.7
Ds=	**52.4**	**23.2**	**7.6**	**-2.6**

PACE
Advanced Water Engineering

Appendix G – Design Flow Rate Floodplain Comparison



P:\C323\GIS\Projects\C323_Belcaro\C323_Belcaro.aprx - Existing vs Proposed Floodplain Workmap Q = 3,535 cfs

BELCARO

PROPOSED CONDITIONS FLOODPLAIN COMPARISON
Q = 3,535 CFS

PACE Advanced Water Engineering

0 125 250 500 Feet

Date: 7/11/2025

Job Number: B323

Exhibit A

PACE
Advanced Water Engineering

Appendix H –Response to Comments

March 14, 2025

Hoon Hahn, PE
Engineering Manager
Rick Engineering
24501 Town Center Dr. #103
Valencia, CA 91355
Phone (661) 855-4001

Re: Belcaro – Oak Springs Canyon Creek
Response to PC #1 Comment Letter # C323

Dear Hoon,

Pacific Advanced Civil Engineering, Inc. (PACE) is pleased to provide the following responses to the Preliminary Hydraulic Design Report (dated December 2024) comments letter dated January 10, 2025. The responses from PACE are as follows:

1. *It is understood that this is not the final hydraulic analysis, and there may be updates based on the bridge design or other design refinements.*

   PACE RESPONSE: Noted.

2. *Please note that LA County Flood Control District has mapped a significant portion of the project area as within the capital flood plain boundary and/or a floodway boundary. These limits are mapped by Map 382-ML1 and provide calculated water surface elevations on the NGVD 29 datum calculated for the County's Capital Flood Hydrology (i.e. Capital Burn and Bulk Peak Flow Rates or "QCap,50") with 2% (50-year) chance of annual occurrence. How would the proposed development be protected from the Capital Flood hazard?*

   PACE RESPONSE: Project is located in the City of Santa Clarita. The city flood control ordinance does not reference the LA County Q_{cap} flowrate as a design requirement. Modeling for the project includes the FEMA 100-yr flow rate which will be used for floodplain mapping, and a higher flow rate, developed with new hydrology, used for design. Note that the PACE design flow rate (3,535 cfs) is higher than the FEMA 500-yr flow rate (2,530 cfs). Ultimately, the flow rate requirement will be set by the city.

3. *Please provide a copy of the effective FEMA model for reference.*

   PACE RESPONSE: PACE will provide a copy of the effective FEMA model in the next submittal.

4. *Page 7: Please provide the vertical datum of the project topography, and the datum conversion (if needed) relative to other vertical datums.*

   PACE RESPONSE: Datum data for the project topography has been added to the report in Section 3.2.5. It has also been added to the exhibits.

5. *Page 7: Section 3.2.3 references a model calculating freeboard that is run in subcritical flow regime. This is not tabulated with Table 3-1 or provided with the hydraulic model. Please provide a freeboard analysis in accordance with Section C-4 of the LACFCD Hydraulic Design Manual.*

PACE RESPONSE: A freeboard analysis for the areas between Oak Springs Canyon Road Bridge and the Proposed "J" Street culvert has been completed. The analysis has been added to the report in Section 5.2.1 and the HEC-RAS results have been added to Appendix B.

6. *Page 7: Please confirm how the analysis will determine the controlling water surface elevation to check freeboard with respect to the downstream Santa Clara River in accordance with Section B-2.1 of the LACFCD Hydraulic Design Manual.*

   PACE RESPONSE: Section B-2.1 of the Hydraulic Design Manual applies to closed conduit pipes and is not applicable to open channels. The boundary conditions for the HEC-RAS models are normal depth. These boundary conditions are significantly far enough upstream and downstream of the project improvements to not influence calculated water surface elevations in the improvement areas.

7. *Please indicate the entity who will be responsible for maintaining the hydraulic structures and slope protection.*

   PACE RESPONSE: The City of Santa Clarita will maintain the Lost Canyon Road Bridge. The Oak Springs Canyon Road Bridge and "J" Street Culverts will be city maintained through a DBAA, which satisfies FEMA requirements for maintenance.

8. *According to Table 10 of Volume 2 of the FIS for Los Angeles County the 100-year flow rate for Oak Springs Canyon Creek is 2,703 cfs at a location approximately 100 feet upstream of Union Pacific Railroad. Would this impact the design flow rate for the channel?*

   PACE RESPONSE: The FIS flowrate used by PACE in this analysis (1,140 cfs) is the flow rate used in the FEMA effective model. The row in the FIS discharge table, Oak Springs Canyon Creek location approximately 100 feet upstream of Union Pacific Railroad, may be an entry that was inadvertently left in the table from a previous FIS as it is not used in the effective model from FEMA.

   The design flow rate for bridge structures and erosion protection measures is Q_{100} = 3,535 cfs. This is a larger flow rate that both the effective flow rates mentioned in this comment (1,140 cfs and 2,703 cfs).

9. *Please clarify the design flow rates and level of flood protection provided for the site in the context of Chapter 4 of the Los Angeles County Hydrology Manual and Section 2.2 of the Los Angeles County Sedimentation Manual.*

   PACE RESPONSE: Please see the response to Comment #2. The level of protection for analysis and design will be dictated by the City of Santa Clarita.

10. *Page 8: The sediment transport model does not extend upstream of the proposed "J" Street and Oak Springs Canyon Road crossings. What will be the project impact to the aggradation and/or degradation trends upstream of Oak Spring Canyon Road?*

    PACE RESPONSE: The proposed improvements eliminate the backwater impacts upstream of Oak Springs Canyon Road, which contribute to aggradation upstream of the road andscour downstream of the road. The new crossing at Oak Springs Canyon Road provides a hard control point that maintains the bed elevation at the road and prevents head cutting and erosion from progressing upstream.

11. *Page 4: Please discuss the depths and configuration of the key in for the proposed rock slope protections.*

    PACE RESPONSE: PACE has provided additional details on the concept drawings. Additionally, a plan and profile exhibit of the rock chute has been prepared. See Exhibit 6.

12. *Page 8: Are there any locations in the modeled reach where there is grade control? If so, these should be considered by the sediment transport model and may impact the calculated scour depths.*

    PACE RESPONSE: There are locations that provide grade control. There is an existing Arizona crossing approximately 350 feet upstream of the existing railroad bridge, and there are hard bottoms in the culverts at "J" Street and Oak Springs Canyon Road, however, the hard bottom structures do not impact the sediment transport model or calculated scour depths.

13. *Page 11: If the calculated flowrate of 3,535 cfs is used to design erosion protection, why is a lesser Q_100 from Table 2-1 used for the sediment transport analyses?*

    PACE RESPONSE: The higher design flow is a conservative value for culvert design and for local scour. The calculated higher flow is not contained in the natural incised channel of Oak Springs Canyon Creek, and so it is not suitable for a sediment transport model, which requires channelized flow. The sediment transport calculations, which are a component of the scour depth analysis and design, were thus performed with the FEMA flow which is representative of the flow conveying sediment in the channel.

14. *Page 12: Are velocities non-erosive downstream of Section 4593?*

    PACE RESPONSE: The velocities are in the erosive range in existing conditions and in proposed conditions. Channel protection downstream of the culvert was continued to the point where the proposed conditions velocity is equal or less than existing conditions velocity. The project design ensures that the structures are protected and that there is no increase in the naturally occurring transport processes that occur in existing conditions.

15. *Page 22: It is unclear where the proposed bridges are located on Figure 6-4*

    PACE RESPONSE: Figure 6-4 has been revised to show the locations of the proposed bridge structures.

16. *Exhibit 2: Will additional slope protection be needed along Lost Canyon Road to protect against the Santa Clara River?*

    PACE RESPONSE: No additional slope protection is needed along Lost Canyon Road bridge to protect it against flooding from the Santa Clara River. The source of the floodplain downstream of the bridge is ponding from Oak Springs Canyon Creek. On the effective FIRM, this area is denoted as Zone AO with a depth of 2 feet. The Santa Clara River floodplain does not extend into this area.

    Two representative profile lines were drawn and sections cut directly upstream and downstream of Oak Springs Canyon Creek, see Figure 1. The cross sections were plotted with the effective BFE's for the Santa Clara River, see Figure's 2 and 3. The results show that the mapped flooding in this area is from Oak Springs Canyon Creek. The floodplain from the Santa Clara River will not reach the proposed development due to the natural topography of the site.

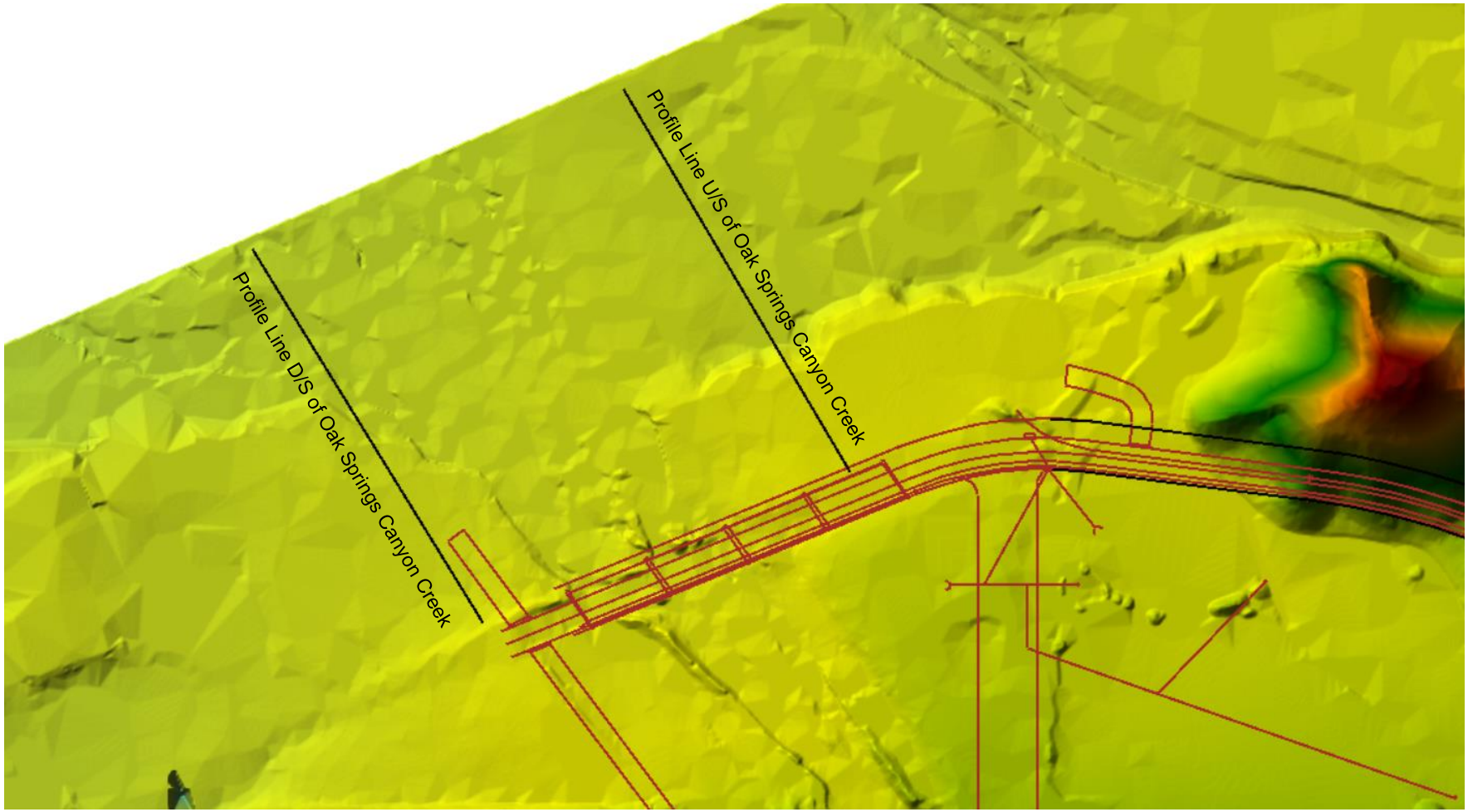


Figure 1: Profile Lines from Santa Clara River Upstream and Downstream of Oak Springs Canyon Creek

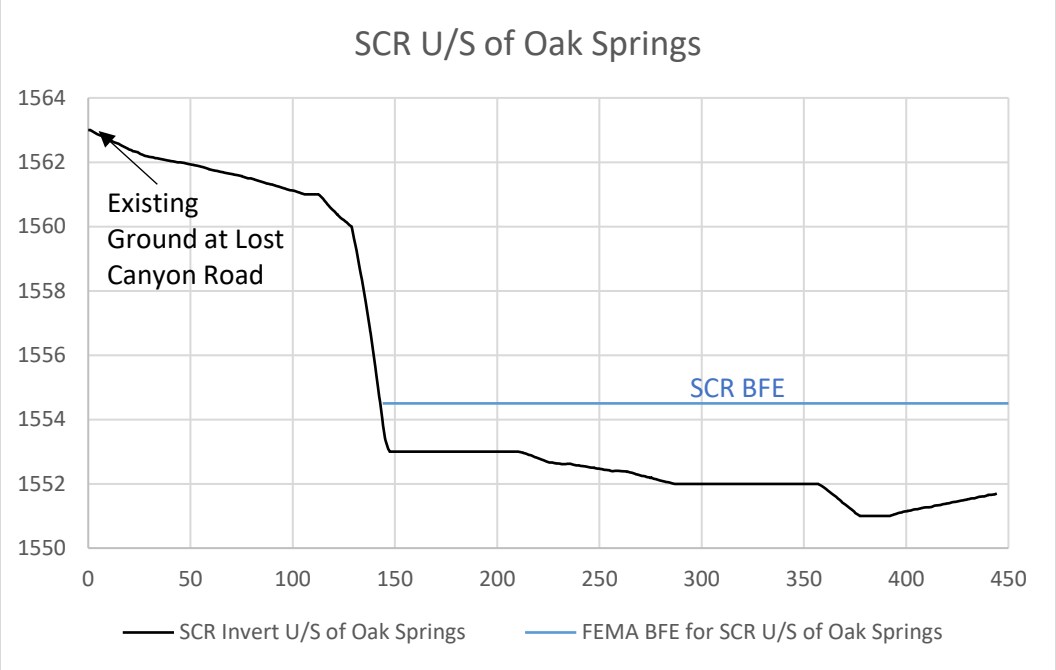


Figure 2: Cross section of SCR U/S of Oak Springs Canyon Creek

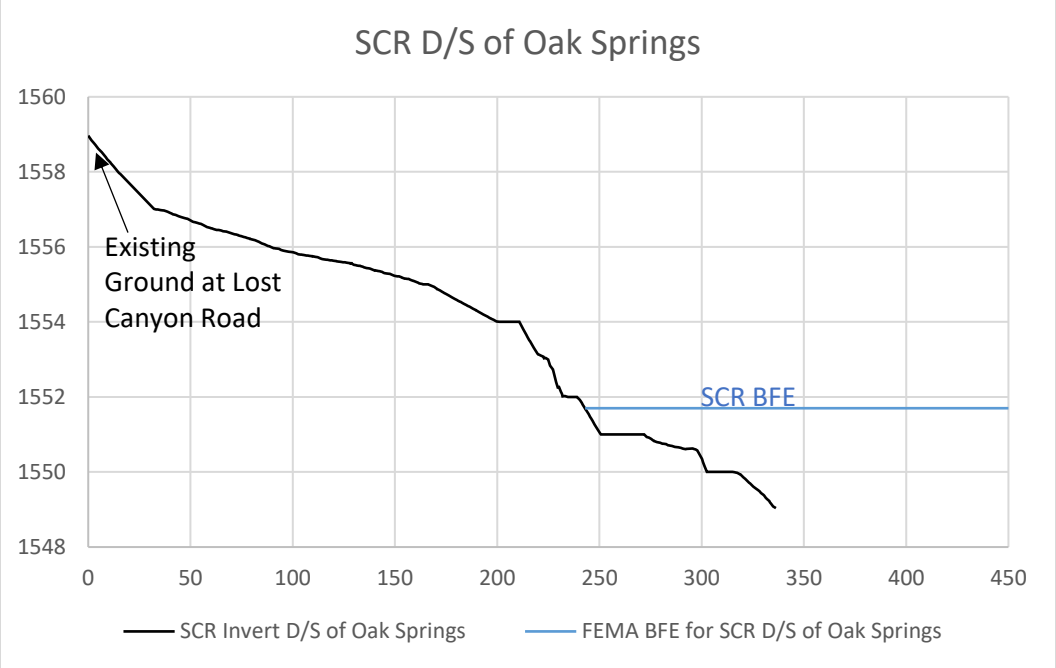


Figure 3: Cross section of SCR D/S of Oak Springs Canyon Creek

17. *Exhibit 2: How will the proposed erosion countermeasures protect the proposed bridge to the calculated depth of scour?*

    PACE RESPONSE: The rip rap along the abutments is extended below the surface to the calculated scour depth.

18. *Exhibit 2: Please provide additional information on the plan view to function as a HEC-RAS Workmap (i.e. ineffective flow area, bank stations, etc.)*

    PACE RESPONSE: Exhibit 2 has been separated into two exhibits, one that shows the information relevant on a HEC-RAS workmap, and one that compares the existing and proposed floodplains.

19. *Exhibit 3: Please provide additional information on the plan view to function as a HEC-RAS Workmap (i.e. ineffective flow area, bank stations, etc.)*

    PACE RESPONSE: Exhibit 3 has been separated into two exhibits, one that shows the information relevant on a HEC-RAS workmap, and one that compares the existing and proposed floodplains.

20. *Exhibit 4: Please provide additional information on the plan view to function as hydraulic workmap (i.e. topography, ineffective flow area, bank stations, lateral weir locations, and existing/proposed erosion protection)*

    PACE RESPONSE: Exhibit 4 has been revised to include topographic contours, ineffective flow areas, cross section bank stations, lateral weir locations, and labels for the proposed bank protection.

21. *Exhibit 5: Please show the effective floodplain and floodway limits for reference.*

    PACE RESPONSE: An additional exhibit has been added to the report. There is now an exhibit that compares the effective floodplain and the existing condition floodplain, and an exhibit that compares the existing condition floodplain and the proposed condition floodplain.

22. *Exhibit 5: It is understood per FIS Map 06037C0845G there are two locations of Zone A floodplain on the NE portion of the proposed development. How is the proposed site protected from these hazards?*

    PACE RESPONSE: FEMA established these Zone A areas based on anticipated sump conditions in the topography used for the mapping. Those areas will have positive drainage in the proposed conditions due to the development grading. The Zone A areas will be removed from the map as part of the CLOMR and LOMR process.

23. *Appendix C: It is noted that there is no geotechnical data available for the proposed Lost Canyon Road bridge.*

    PACE RESPONSE: The geotechnical sampling has been performed. The data has been included in the Report in Appendix C. The sediment transport model has been revised based on the new geotechnical data received and the report has been updated.

24. *Appendix C: The location used for the grain size distribution for scour efforts is outside of the existing channel. Can you confirm that it is a similar material as to what was encountered with stream bed explorations (i.e. BB-9)?*

PACE RESPONSE: The data, from samples outside of the creek, was available and used for the initial analysis. New geotechnical data within the creek was received and the scour analysis and design were updated appropriately using the new data.

25. *Page 54 Hydrology Workmap: Please provide additional information on the plan view for reference (i.e. topography source, contour labeling, project footprint, and delineation of the longest flow path and centroid location)*

    PACE RESPONSE: The hydrology workmap in Appendix D has been revised to include: topographic data source information, major contour labels, the project property footprint, the delineated longest flowpath, the watershed centroid, and the watershed centroid coordinates.

If you have any questions regarding the above responses, please feel free to give us a call at PACE.

Sincerely,

Andrew Ronnau, PhD, PE
Vice President / Stormwater Management Technical Director

AR/ch

Enclosures: Revised Preliminary Hydraulic Design Report for Belcaro – Oak Springs Canyon Creek

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PACE
Advanced Water Engineering

July 11, 2025

Hoon Hahn, PE
Engineering Manager
Rick Engineering
24501 Town Center Dr. #103
Valencia, CA 91355
Phone (661) 855-4001

Re: Belcaro – Oak Springs Canyon Creek
Response to PC #2 Comment Letter # C323

Dear Hoon,

Pacific Advanced Civil Engineering, Inc. (PACE) is pleased to provide the following responses to the Preliminary Hydraulic Design Report (dated March 2025) comments letter dated June 18, 2025. The responses from PACE are as follows:

Report Redlines and Comments:

Report Section 3-1:

Update as needed – Figure 3-1 Reference Error

PACE RESPONSE: The report has been updated to fix this "Reference Error."

Section 3-3:

Please discuss any other relevant modifications such as lateral structure removal and removal of overflow reach...

PACE RESPONSE: Section 3.2.9 of the report was edited to include more detail on the modifications made to the sediment transport HEC-RAS model.

Exhibits:

Exhibit 2 and 3 – Justify modeling of ineffective flow areas within the channel.

PACE RESPONSE: Additional text has been added to Chapter 3 of the report to describe the ineffective flow markers used in the analysis.

Exhibit 6 - What are velocities at this interface? Verify that 1-ton loose rock can hold up if supercritical flows extend beyond the grade break.

PACE RESPONSE: Velocities on the rock chute range from 16.4 – 19.5 feet per second. This is within the limits for velocity of grouted 1-ton rock according to the LACPW Rip-Rap Rock for Levees Design Table F-32. At the toe of the slope, velocities drop to under 5 feet per second. Due to the toe of the structure being just upstream of the "J" Street culvert, velocities at the toe are impacted by the backwater effect from "J" Street, which lowers velocity at the toe of the slope. 1-ton grouted rock is extremely sufficient for these anticipated velocities.

Exhibit 6 - Confirm? Section shows 5.7

PACE RESPONSE: The 1-ton grouted and ungrouted rock thickness is set to 68 inches, which corresponds to 5.7 feet. Exhibit 6 has been updated accordingly.

Appendix F:

Appendix F: Plunge Scour Results - really this low?; what are these units?

PACE RESPONSE: The velocity used in the plunge scour calculation is the water velocity at the toe of the structure. There is a backwater effect from the "J" Street culvert which lowers velocity at the toe of the slope. Units for each of the input parameters were added to the descriptions of each parameter and the Appendix was updated.

General Comments from Project Issue Checklist

1-7 *What is the vertical datum of the project topography? American Datum 1983 is provided in Section 3.2.5 but it is a horizontal control datum and is not relevant for vertical.*

PACE RESPONSE: Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88). Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83). Section 3.2.5 has been updated accordingly.

1-7 *Please include the maintenance entity information with the Hydraulic Design Report for reference. Per the City it is understood that Oak Springs Canyon Road Bridge and "J" Street Culvert are to be maintained by the HOA, not through a DBAA*

PACE RESPONSE: Maintenance will be funded and managed by the project as would be done with an HOA. However, FEMA requires that maintenance entities have public oversight and control which comes with a DBAA structure.

1-10 *Please reconcile the decreased velocity and increased WSE upstream of Oak Springs Canyon Rd, shown by Table 4-1, with the assertion that the backwater impact upstream of Oak Springs Canyon Road is eliminated.*

PACE RESPONSE: In the existing condition the current Oak Springs Canyon Creek Culvert is undersized. The existing culvert consists of three 4' barrels which are insufficient to carry project design flows. This causes a localized backwater effect onto the Golf course in lower return storms (i.e. the 10-yr and 50-yr) as water pools upstream of Oak Springs Canyon Road. In larger flows (i.e. the 100-yr and the design flow) most of the flow overtops the road, so the backwater effect is not as significant.

The proposed Oak Spring Canyon Creek Culvert is 48' wide and 12' tall. This is a huge increase in flow area through the structure which eliminates the backwater effect in the lower flow conditions.

Any structure within a natural watercourse will have some effect on water surface elevation and velocity. Table 4-1 shows a small increase of 0.2' at cross section 5167, just upstream of the structure. In addition there are small changes to velocity upstream of the structure, showing it both increases up to 0.1 fps and decreases up to 0.5 fps. Note that all these changes are within the property boundary of the proposed development and there are no offsite impacts.

1-12 Please include the information and approach regarding grade control structures with the report for reference. Has it been verified that hard bottom structures do not impact calculated scour depths? In my experience there can be additional scour downstream of a grade control structure as compared to an unreinforced thalweg.

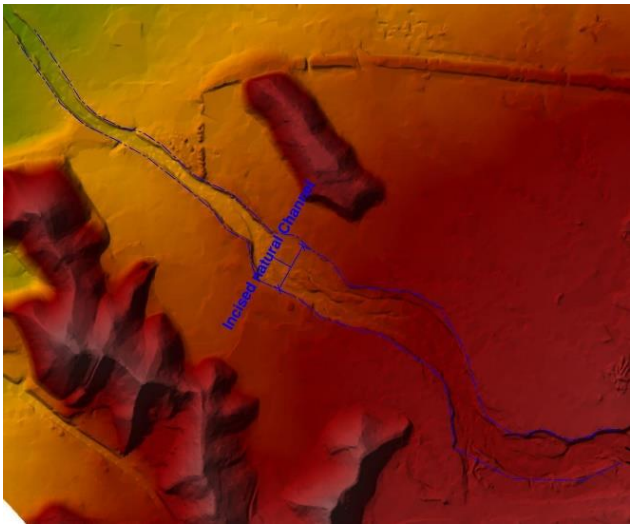
PACE RESPONSE: It should be clarified that there are no proposed grade control structures in the Belcaro project design. There are however, existing and proposed hardened structures in the creek. Rip rap on Oak Springs Canyon Creek, from approximately 150 feet downstream of future "J" Street to the upstream side of Oaks Springs Canyon Road, will prevent erosion.

An Arizona Crossing, approximately 350 feet upstream of the existing railroad bridge, is lined with concrete. The Arizona Crossing is privately owned, design drawings are not available, and it is uncertain if there is any toe down protection which would protect the structure and allow a bed elevation step to form in a degrading condition, so the Arizona Crossing was not included in the sediment transport model.

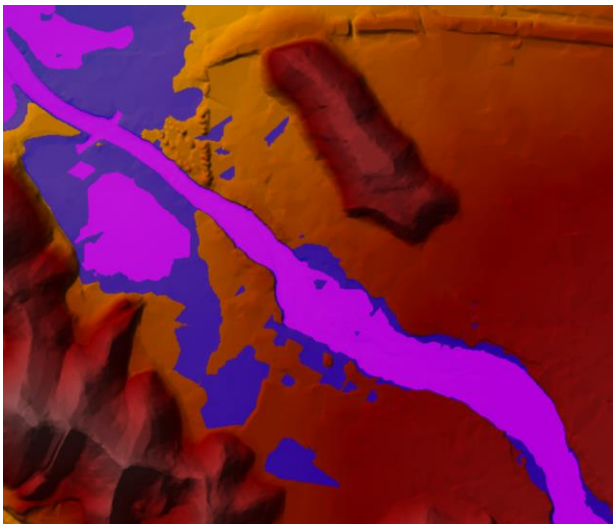
1-13 Please clarify where the higher flow is not contained by the incised channel. Based on the provided hydraulic information, the design flow rate is understood to be channelized for a distance of ~1,200 linear feet downstream of "J" Street. It is noted that the "OS Overflow" reach is removed from the sediment transport model. How is this anticipated to impact the findings of sediment transport at Lost Canyon Road? The report should document the design approach.

PACE RESPONSE: The figure below on the left depicts the surface with the Oak Springs Canyon Creek channel. The figure below on the right depicts the FEMA flow of 1,140 cfs in magenta and the design flow rate of 3,535 cfs in blue. The FEMA flow, in magenta, is generally confined to the channel. The design flow, in blue, has much more extensive breakout. Flow with extensive shallow breakout is does not produce reliable sediment transport calculations because the parameters important for transport calculation, such as depth, top width, velocity, are not reliable representations of the hydraulic conditions in those areas. Those conditions result in transport models that are unstable or not accurate. Sediment transport was, therefore, calculated using the FEMA flowrate, which generally stays within the channel.

The overflow reach was removed, which eliminated the shunting effect. All flow stays in the channel, which produces more conservative scour results. All flow rejoins the main channel upstream of the Lost Canyon Road Bridge. Channel modifications upstream of the bridge will have minimal impacts or no impacts to the calculated scour values.



Example of the "Incised" Natural Channel



Floodplain Comparison of the FEMA flow of 1,140 cfs in magenta and the design flow rate of 3,535 cfs in blue.

1-17 *Where is the intended extent of riprap shown or indicated with the report? The riprap limits shown on Exhibit 03 for Lost Canyon Road seem to end at the daylight line, while the total scour calculated at Lost Canyon Bridge is between 17 and 18 feet according to Table 6-6. Please add section detail(s) for clarity.*

PACE RESPONSE: The riprap below the daylight line, shown on Exhibit 3, to the design scour depths, 17.5 – 18.0 feet. The buried portion of the riprap can be added to the Exhibits, but is not presently shown.

2-1 *Please add the technical memorandum dated May 15, 2025 "Re: Oak Springs Canyon Creek Preliminary Hydraulic Design Report Comments" to the Appendices as a supporting document.*

PACE RESPONSE: Noted, the response to comments has been added to a new Appendix.

2-2 *Please clarify the proposed structural configuration for Oak Springs Canyon Road. The report states that the "proposed culvert will be 48 feet wide and 12 feet tall and include a graded trapezoidal channel through it." Will the culvert be arched or rectangular? What is the bottom width of the trapezoidal channel?*

PACE RESPONSE: The proposed configuration of the Oak Springs Canyon Road culvert is a rectangular culvert with a trapezoidal channel with bottom width of 26 feet and 1:1 side slopes running through it. Note the Oak Springs Canyon Road is a culvert, but functions hydraulically as a bridge by design, therefore it is modeled in HEC-RAS as a clear span bridge.

2-3 *Why are there WSE differences between the provided effective model and existing RAS results for sections 6472, 6665, and 6879 if they are using the same terrain as discussed by Section 3.2.5 of the report?*

PACE RESPONSE: The water surface elevations for the FEMA effective model and the existing condition model are different because the models are run with different flow regimes. The FEMA effective model is run in a subcritical flow regime, per FEMA mapping requirements, this produces the highest water surface elevation. The existing condition model is run in a mixed flow regime. This allows for subcritical and supercritical flow computations. The existing condition model upstream cross sections show that the flow is

supercritical, so the new HEC-RAS existing condition analysis calculates different water surface elevations than in the effective model which forces those sections to be subcritical.

HEC-RAS Cross Section	Effective FEMA Model WSE (ft)	Existing Condition WSE (ft)
6879	1692.43	1691.84
6665	1686.35	1685.58
6472	1682.86	1681.96

2-4 Have the extents of the grouted riprap vs. loose riprap been verified against the extents of hydraulic jumps for various flow events? As shown on Figure 6 the 8% slope is grouted but the portion of channel immediately downstream of the grade break is not grouted.

PACE RESPONSE: Hydraulic jump calculations were performed for the ~8% grouted rip rap slope, and the jump is weak and not well formed. Grouted riprap is used in locations where it is necessary to provide protection based on velocities. Ungrouted riprap provides suitable protection at the bottom of the basin. Ungrouted riprap provides extra energy dissipation because of the slight mobility of the rocks.

2-5 In addition to delineation of the existing and proposed floodplains utilizing the flow rate of 1,140 cfs, please also show the existing and proposed floodplains for the calculated design flowrate.

PACE RESPONSE: An exhibit comparing the Existing and Proposed floodplain extents for the design flow rate has been included in Appendix G.

2-7 Justify the manning's roughness values assigned for the modeled scenarios.

PACE RESPONSE: Additional text has been added to Section 3.2.6 to describe the Mannings roughness values used. Descriptions on the mannings for floodplain mapping, scour calculations, and freeboard calculations are all summarized.

2-8 Please verify the existing condition floodplain extents. According to the existing condition model provided with the first submittal, it is understood that existing flows would overtop Oak Springs Canyon Road which is understood to have a capacity of < 400 cfs.

PACE RESPONSE: The existing condition floodplain extents were checked and the floodplain delineation was revised to better match the topographic data.

2-9 Please provide proposed pad and FF elevations adjacent to the channel. Please also provide narrative in the report text as to how a levee condition is avoided in this portion of the project.

PACE RESPONSE: The pad elevations adjacent to Oak Springs Canyon Creek have been added to Exhibit 5. Additional text has been added to the report stating the pads are sufficiently above the design water surface elevations.

2-10 Grading lines between the culverts indicate a localized sump? If so, how will it drain and why do the proposed cross section flowlines not indicate a sump?

PACE RESPONSE: There is no sump condition in the basin. Incorrect linework on Exhibit 6 gave the appearance of a sump. The Exhibit has been revised.

2-11 What are the inundation limits and HGL's of the proposed condition flow profiles in relation to the proposed armoring?

PACE RESPONSE: The proposed condition flow profile has been added to Exhibit 6.

2-12 Please label major contours

PACE RESPONSE: The major contours have been added on Exhibits 7, 8, 9, and 10.

2-13 Please verify flowpath lengths and update dependent calculations as necessary. For example, the longest flow path is tabulated as 6.15 miles while the longest flowpath delineated by the exhibit measures as closer to 5 miles.

PACE RESPONSE: The basin parameters were calculated within HEC-HMS. The longest flowpath shown on the exhibit did not reflect the HMS flow path. The HMS flowpath has been exported and the Hydrology Workmap has been updated to reflect the 6.15 mi flowpath.

2-14 Please denote the flow rate and flow scenario used to calculate the presented hydraulic information.

PACE RESPONSE: Appendix E has been updated to note the flow rate and scenario used for rock sizing calculations.

If you have any questions regarding the above responses, please feel free to give us a call at PACE.

Sincerely,

Andrew Ronnau, PhD, PE
Vice President / Stormwater Management Technical Director

AR/ch

Enclosures: Revised Preliminary Hydraulic Design Report for Belcaro – Oak Springs Canyon Creek

P:\C323\4-Administrative\Letters\2025-06-25_Response to Hydrology Rpt Comments Letter_AR.docx

Hydrology Report – Belcaro at Sand Canyon, Alliance 2024

PACE

HYDROLOGY REPORT

City of Santa Clarita

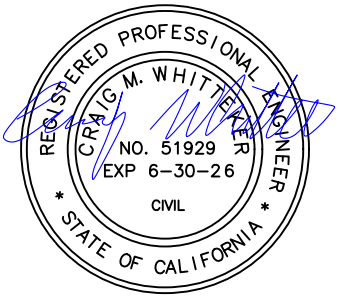
Belcaro At Sand Canyon
Vesting Tentative Tract Map No. 084497

JN 2330

Prepared For:
NUWI-Sand Canyon, LLC
2001 Wilshire Blvd, Ste 401
Santa Monica, CA 90403

Prepared By:
Alliance Land Planning & Engineering, Inc.
2248 Faraday Ave.
Carlsbad, CA 92008

November 8, 2024



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APPENDIX C…..……..……..**Hydrologic Model Input/Output (LAR04)**
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APPENDIX E…….....**Debris Production**
APPENDIX F……...…….....….....….**Approved SIKAND Hydrology Study**

PROJECT OVERVIEW

The Belcaro At Sand Canyon project, VTTM No. 084497, is an approximately 193.8 acre project located in the City of Santa Clarita, CA. The project is located immediately south of the Santa Clarita River, east of the present terminus of Lost Canyon Road at Oak Springs Canyon Road and north of the Robinson Ranch Golf Course. Undeveloped property is located east of the project site.

Proposed development consists of 400 total lots, of which 341 lots will become Active Adult Residential Single Family homes. The remaining lots are intended for recreation, open space and streets. The 341 residential lots cover a gross area of approximately 58.7 acres. A new bridge extending Lost Canyon Road into the project site will span across Oak Springs Canyon Creek. This extension of Lost Canyon Road will terminate at the Metrolink railroad tracks, where a new undercrossing will be built connecting to the northerly entrance ('A' Street) by the project. Prefabricated arch culverts will be constructed over Oak Springs Canyon Creek at the project's southerly boundary to allow for extension of the proposed 'J' Street and minor improvements of the existing Oak Springs Canyon Road. The proposed 'J' Street secondary access to the project will extend south through the Robinson Ranch Golf Course and then to Robinson Ranch Road.

EXISTING CONDITION DRAINAGE

The project site is predominately flat and undeveloped. Oak Springs Canyon Creek is the major drainage feature in the area and runs in a northwest direction through portions of the project site. Lost Canyon Road is presently an 'at grade' crossing with Oak Springs Canyon Creek and is flooded during major rain events.

The western third of the site drains into Oak Springs Canyon Creek. The creek is ephemeral, mostly undeveloped, and outlets into the Santa Clara River. Just south of the river, the creek runs beneath the Metrolink Rail line. This undercrossing is also the existing Oak Springs Canyon Road which is a dirt road used by local residents. Upstream of the project site, Oak Springs Canyon Creek runs through Robinson Ranch Golf Course. Portions of the creek through the golf course have been stabilized to protect against erosion and flooding. A small box culvert exists on the boundary between the project site and the golf course and acts as an overpass for Oak Springs Canyon Road at this location.

The eastern two thirds of the site drains northerly and drains under the Metrolink rail line via three existing pipe culverts. From the pipe culverts water sheet flows to the Santa Clara River.

DEVELOPED CONDITION DRAINAGE

Developed condition flow patterns remain mostly unchanged as compared to those of the existing condition. The flowpath and alignment of Oak Springs Canyon Creek will remain unchanged and continue to run northwesterly and out through the undercrossing of the Metrolink rail line. The golf course will continue to be the upstream source of flow for Oak Springs Creek and the Santa Clara River will continue to be the outlet. The project also includes the construction of the Lost Canyon Road bridge over the Oak Springs Canyon Creek, which will provide an all-weather access for the project and existing homes in the area.

Runoff from the eastern two-thirds of the project site will be treated and drain north through an existing culvert that is beneath the Metrolink tracks or via a new storm drain pipe that will run beneath the new Metrolink undercrossing within 'A' Street. The existing culvert will continue to handle offsite flow from the undeveloped property to the east. Conveyance of the onsite developed runoff will occur through a system of underground storm drains for the new development.

All developed flows that originate on-site will be routed through above ground water quality basins for treatment. These basins are discussed in detail in the USMP/LID Report which accompanies this report.

HYDROMODIFCATION

This project is considered exempt from hydromod requirements due to all developed project flows directly discharging into the Santa Clara River which has a LA County capital flood flowrate of greater than 25,000 cfs. Please see section on the 'Capital Flood Analysis' below for additional comment on this subject.

METHODOLOGY

Peak flowrates and runoff volumes for the La County capital flood event for both the existing and developed conditions have been analyzed using methods prescribed in the LA County Hydrology Manual. The following hydrologic parameters and software have been used during this analysis:

- Storm Event = 25-Yr, 50-Yr (sump) for onsite area
  50-Yr Burned for offsite natural area
- 50-year, 24-hour Rainfall Depth = 5.5", 5.6", 5.7"
- Soil Classification Area = 020, 099
- DPA Zone = 8, 9
- Time of concentration = HydroCalc software
- Flow rates and volumes = LAR04 software

The project's total tributary watershed is approximately 389.3 acres in size and has been divided into four (4) major drainage basins (A, B, C, & D). Each major drainage basin has been further subdivided into subareas. Existing and developed condition drainage basins have been delineated based upon topography of each respective condition and do not necessarily line up identically. However, outfall locations for each major drainage basin have been located at outlets and do line up relatively well across each condition.

Los Angeles County approved software was used to develop time of concentration (Tc), peak flowrates, and runoff volumes for all subareas in both the existing and developed condition.

Peak flowrate values for a burned event (Qb) have been calculated for all subareas on the site. A 25-year clear event flowrate is reported for developed onsite subareas while a 50-year burned event flowrate is reported for any undeveloped offsite subareas. Burned areas consist only of undeveloped area. Additionally, burned and bulked flowrates (Qbb) are reported at most undeveloped areas, at the upstream subareas of any development, and at detention basins that take on undeveloped flow.

Existing and developed condition hydrology maps can be found in the appendices of this report.

SIKAND HYDROLOGY STUDY/ALLIANCE HYDROLOGY STUDY

The existing condition drainage basins and subareas were largely duplicated from the Los Angeles County approved Hydrology Study for TR No. 063022 as performed by Sikand Engineering Associates in 2008. Existing drainage areas and flowpaths from the Sikand report were confirmed as accurate using current topographic data used in this current report by Alliance. This information was then modeled using current software versions to develop new existing and developed condition Time of Concentrations, peak flowrates, and runoff volumes. Relevant excerpts and exhibits of the Sikand report can be found in the appendices of this report.

HYDROLOGY RESULTS

Summary tables below are the results of hydrologic modeling for the existing and developed conditions performed using LAR04 software.

HYDROLOGIC RESULT SUMMARY TABLES

Existing Condition Peak Flows

Basin	Area	Design
	ac	cfs
A	266.8	492.4
B	21.7	31.4
C	44.7	52.9
D	13.6	19.8
E	37.1	61.7
TOTAL	383.9	658.1

Existing Condition Runoff Volume

Basin	Area	50-YEAR
	ac	ac-ft
A	266.8	49.9
B	21.7	4.4
C	44.7	8.4
D	13.6	2.9
E	37.1	7.69
TOTAL	383.9	73.23

Developed Condition Peak Flows

Basin	Area	Design
	ac	cfs
A	40.5	67.1
B	158.1	197.3
C	176.9	259.3
D	13.8	21.3
TOTAL	389.3	545.1

Developed Condition Runoff Volume

Basin	Area	50-YEAR
	ac	ac-ft
A	40.5	8.8
B	158.1	30.1
C	176.9	32.6
D	13.8	3.1
TOTAL	389.3	74.56

Peak Flow Comparison

Basin	Area	Design
	ac	cfs
Existing	383.9	658.1
Developed	389.3	545.1
Δ	5.4	-113.1

Runoff Volume Comparison

Basin	Area	50-YEAR
	ac	ac-ft
Existing	383.9	73.23
Developed	389.3	74.56
Δ	5.4	1.33

Despite an increase in imperviousness (roads, homes, etc.), the developed condition yields an overall net reduction in peak flowrate and runoff volume for the overall project. This is attributed to generally longer flowpaths, flatter slopes, and longer times of concentration.

CAPITAL FLOOD ANALYSIS

The results presented in the tables above are also attributed to the nature of the capital flood design event. The existing condition is comprised of undeveloped subareas which are subject to burning and the 50 year rainfall depth. The developed condition is comprised primarily of onsite developed subareas which are subject to no burning and only the 25-year clear rainfall depth. Since the receiving body of the Santa Clara river has a capital flood flowrate of greater than 25,000 cfs, this type of analysis is considered acceptable.

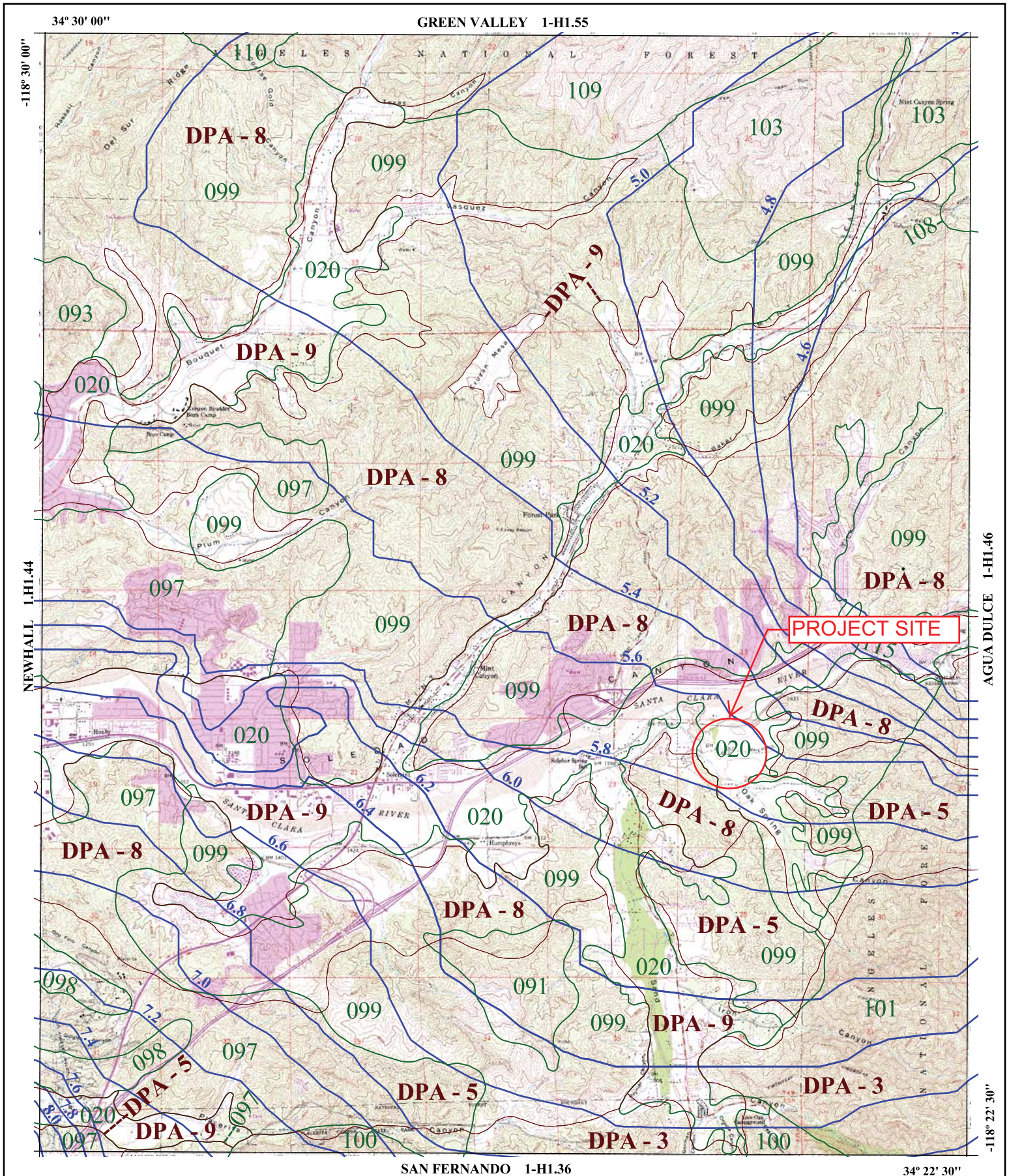
Please refer to the developed condition map to view the impacts at individual outlet points in the Santa Clara River.

CONCLUSION

The results provided above for the overall project net reduction of peak flowrate and runoff volume for the design event. The hydraulic study shows no significant impact to downstream or adjacent properties. Because of this, the Belcaro At Sand Canyon project is considered acceptable for development.

APPENDIX A

MAPS AND EXHIBITS



016 SOIL CLASSIFICATION AREA

7.2 INCHES OF RAINFALL

DPA - 6 DEBRIS POTENTIAL AREA

N W E S

1 0 1 2 Miles

25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714

MINT CANYON
50-YEAR 24-HOUR ISOHYET

1-H1.45

LOS ANGELES COUNTY PUBLIC WORKS Public Service That Works

SANTA CLARA RIVER

SANTA CLARA RIVER

SEE MATCH SHEET LINE 2

LOST CANYON ROAD

COLHARY CT.

OAK SPRINGS CANYON ROAD

OAK SPRINGS CANYON CREEK

OAK SPRINGS CANYON ROAD

SEE MATCH LINE 1A LOWER RIGHT

SEE MATCH LINE 1A FIGURE A

SEE MATCH SHEET LINE 2

BASIN A

BASIN B

BASIN C

BASIN D

BASIN E

5AB: Q_{EXSOB}= 61.7 CFS; ΣQ_{EXSOB}= 83.8 CFS; ΣA_{EX}= 37.1 AC

3A: Q_{EXSOB}= 11.4 CFS; ΣQ_{EXSOB}= 40.9 CFS; ΣA_{EX}= 27.1 AC; TC = 9 MIN

3A 5.8

4B: Q_{EXSOB}= 22.1 CFS; ΣQ_{EXSOB}= 22.1 CFS; ΣA_{EX}= 10.0 AC; TC = 10 MIN

4B 10.0

5B: ΣQ_{EXSOB}= 52.9 CFS; ΣQ_{EXSOB}= 71.9 CFS; ΣA_{EX}= 44.7 AC

5B 16.5

6A: ΣQ_{EXSOB}= 31.4 CFS; ΣQ_{EXSOB}= 42.7 CFS; ΣA_{EX}= 21.7 AC

6A 1.4

32AD: ΣQ_{EXSOB}= 492.4 CFS; ΣQ_{EXSOB}= 631.7 CFS; ΣA_{EX}= 266.8 AC

30AB: ΣQ_{EXSOB}= 461.5 CFS; ΣA_{EX}= 245.7 AC

19A: Q_{EXSOB}= 34.6 CFS; ΣQ_{EXSOB}= 337.1 CFS; ΣA_{EX}= 177.3 AC; TC = 9 MIN

2A: Q_{EXSOB}= 28.7 CFS; ΣQ_{EXSOB}= 31.2 CFS; ΣA_{EX}= 21.1 AC; TC = 15 MIN

2A 16.0

2B: Q_{EXSOB}= 25.2 CFS; ΣQ_{EXSOB}= 47.5 CFS; ΣA_{EX}= 37.2 AC; TC = 13 MIN

2B 16.5

3A: Q_{EXSOB}= 30.3 CFS; ΣQ_{EXSOB}= 30.3 CFS; ΣA_{EX}= 20.3 AC; TC = 12 MIN

3A 20.3

31D: Q_{EXSOB}= 35.3 CFS; ΣQ_{EXSOB}= 35.3 CFS; ΣQ_{EXSOB}= 48.0 CFS; ΣA_{EX}= 21.1 AC; TC = 11 MIN

31D 21.1

1B: Q_{EXSOB}= 31.7 CFS; ΣQ_{EXSOB}= 31.7 CFS; ΣA_{EX}= 20.7 AC; TC = 14 MIN

1B 20.7

1A: Q_{EXSOB}= 6.2 CFS; ΣQ_{EXSOB}= 6.2 CFS; ΣA_{EX}= 5.3 AC; TC = 22 MIN

1A 5.3

1A: Q_{EXSOB}= 19.8 CFS; ΣQ_{EXSOB}= 19.8 CFS; ΣQ_{EXSOB}= 26.9 CFS; ΣA_{EX}= 13.6 AC; TC = 16 MIN

1A 13.6

23B 14.2

21B

27BC

LEGEND

- TRACT BOUNDARY
- PRIMARY BASIN LIMITS
- SUB-BASIN LIMITS
- EXISTING FLOW PATH
- TC ..... TIME OF CONCENTRATION (MIN.)
- ΣA ..... CUMULATIVE TRIBUTARY AREA (AC)
- ΣQ ..... CUMULATIVE FLOWRATE (CFS)
- Q_{25} ..... 25 YR. FREQUENCY FLOWRATE (CFS)
- Q_{50} ..... 50 YR. FREQUENCY FLOWRATE (CFS)
- 3A 5.8 ..... DRAINAGE AREA DESIGNATION / DRAINAGE AREA IN ACRES
- EXISTING STORM DRAIN LINE
- SD PROPOSED STORM DRAIN LINE

DESIGN CRITERIA:

STORM EVENT	50 YR = SUMP LOCATIONS 25 YR = NON-SUMP LOCATIONS
50-YR RAINFALL ISOHYET	5.6, 5.7, 5.8
SOIL TYPE	020, 099
DEBRIS PRODUCTION AREA	DPA 8, 9

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)

1 inch = 100 ft.

FIGURE A

ALLIANCE
LAND PLANNING & ENGINEERING INC.

2248 FARADAY AVE.
CARLSBAD, CA 92008
TEL: (760) 431-9896
FAX: (760) 431-8802

27413 TOURNEY ROAD
SUITE 120
VALENCIA, CA 91355
TEL: (661) 799-2760

CIVIL ENGINEERING • LAND PLANNING • HILLSIDE DESIGN • SURVEYING

PLANS PREPARED BY:
ALLIANCE LAND PLANNING & ENGINEERING INC.
2248 FARADAY AVE. CARLSBAD, CA. 92008
(760) 431-9896

PLANS PREPARED UNDER THE DIRECTION OF:
CRAIG M. WHITTEKER R.C.E. 51929 — 10/29/24 DATE

REGISTERED PROFESSIONAL ENGINEER — CRAIG M. WHITTEKER — NO. 51929 — EXP 6-30-26 — CIVIL — STATE OF CALIFORNIA

PLAN PREPARED FOR:

NUWI-SAND CANYON, LLC
2001 WILSHIRE BLVD. SUITE 401
SANTA MONICA, CA 90403
TEL: (916) 717-8599
ATTN: COREY HARPOLE

NO.	DATE		BY	APPR

1 SHEET | COUNTY OF LOS ANGELES | 2 OF SHEETS

EXISTING CONDITION HYDROLOGY EXHIBIT
BELCARO AT SAND CANYON
VTTM 084497

I: \CAD\2330\HYDROLOGY\EXISTING CONDITION\2330_EX_CONDITION_HYDROLOGY.dwg

SEE MATCH SHEET LINE 1

SEE MATCH SHEET LINE 1

BASIN A

9A 15.6

15A 19.3

19A 15.5

Q_{D100}= 35.3 CFS
ΣD $_{D100}$= 179.7 CFS
ΣA $_{EX}$= 92.3 AC
TC = 8 MIN
9A

7AB ΣD $_{D100}$= 153.6 CFS
ΣA $_{EX}$= 76.7 AC

14AB ΣD $_{D100}$= 263.6 CFS
ΣA $_{EX}$= 129.6 AC

Q_{D100}= 24.6 CFS
ΣD $_{D100}$= 53.3 CFS
ΣA $_{EX}$= 25.1 AC
TC = 9 MIN
4A

4A 11.5

Q_{D100}= 28.9 CFS
ΣD $_{D100}$= 100.6 CFS
ΣA $_{EX}$= 51.6 AC
TC = 9 MIN
6B

6B 13.6

Q_{D100}= 33.0 CFS
ΣD $_{D100}$= 33.0 CFS
ΣA $_{EX}$= 13.6 AC
TC = 7 MIN
3A

3A 13.6

Q_{D100}= 461.5 CFS
ΣA $_{EX}$= 245.7 AC
50AB

19A

Q_{D100}= 34.6 CFS
ΣD $_{D100}$= 337.1 CFS
ΣA $_{EX}$= 177.3 AC
TC = 9 MIN

18AC ΣD $_{D100}$= 319.1 CFS
ΣA $_{EX}$= 161.8 AC

Q_{D100}= 46.8 CFS
ΣD $_{D100}$= 288.7 CFS
ΣD $_{D100}$= 377.3 CFS
ΣA $_{EX}$= 148.9 AC
TC = 7 MIN
15A

Q_{D100}= 54.2 CFS
ΣD $_{D100}$= 85.82 CFS
ΣA $_{EX}$= 37.3 AC
TC = 8 MIN
13B

13B 23.0

Q_{D100}= 73.9 CFS
ΣD $_{D100}$= 73.9 CFS
ΣA $_{EX}$= 38.1 AC
TC = 11 MIN
5B

5B 38.1

Q_{D100}= 28.6 CFS
ΣD $_{D100}$= 127.8 CFS
ΣA $_{EX}$= 68.4 AC
TC = 9 MIN
29B

29B 15.3

Q_{D100}= 32.5 CFS
ΣD $_{D100}$= 32.5 CFS
ΣA $_{EX}$= 12.9 AC
TC = 7 MIN
16C

16C 12.9

Q_{D100}= 33.7 CFS
ΣD $_{D100}$= 33.7 CFS
ΣA $_{EX}$= 14.3 AC
TC = 8 MIN
11B

11B 14.3

27B ΣD $_{D100}$= 105.0 CFS
ΣA $_{EX}$= 53.1 AC

Q_{D100}= 46.7 CFS
ΣD $_{D100}$= 46.7 CFS
ΣD $_{D100}$= 63.4 CFS
ΣA $_{EX}$= 18.8 AC
TC = 8 MIN
26C

23B Q_{D100}= 26.2 CFS
ΣD $_{D100}$= 59.6 CFS
ΣA $_{EX}$= 33.3 AC
TC = 10 MIN

23B 14.2

26C 19.8

21B Q_{D100}= 35.3 CFS
ΣD $_{D100}$= 35.3 CFS
ΣA $_{EX}$= 19.1 AC
TC = 10 MIN

21B 19.1

LEGEND

- TRACT BOUNDARY
- PRIMARY BASIN LIMITS
- SUB-BASIN LIMITS
- EXISTING FLOW PATH
- TC — TIME OF CONCENTRATION (MIN.)
- ΣA — CUMULATIVE TRIBUTARY AREA (AC)
- ΣQ — CUMULATIVE FLOWRATE (CFS)
- Q_{25} — 25 YR. FREQUENCY FLOWRATE (CFS)
- Q_{50} — 50 YR. FREQUENCY FLOWRATE (CFS)
- (AA / S.S) — DRAINAGE AREA DESIGNATION / DRAINAGE AREA IN ACRES
- EXISTING STORM DRAIN LINE
- —SD— PROPOSED STORM DRAIN LINE

DESIGN CRITERIA:

STORM EVENT	50 YR – SUMP LOCATIONS 25 YR – NON-SUMP LOCATIONS
50-YR RAINFALL ISOHYET	5.6, 5.7, 5.8
SOIL TYPE	D20, D99
DEBRIS PRODUCTION AREA	DPA 8, 9

GRAPHIC SCALE
100 0 50 100 200
(IN FEET)
1 inch = 100 ft.

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NO.	DATE		BY	APPR

2 SHEET | COUNTY OF LOS ANGELES | 2 OF SHEETS

EXISTING CONDITION HYDROLOGY EXHIBIT
BELCARO AT SAND CANYON
VTTM 084497

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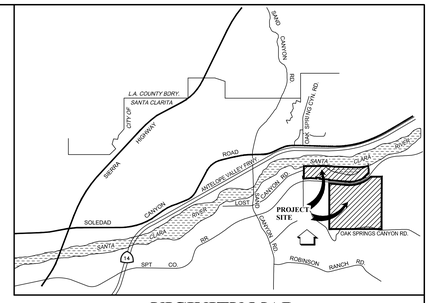
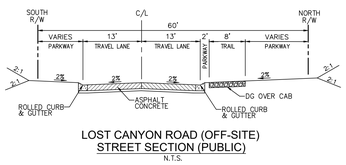
BELCARO AT SAND CANYON
DEVELOPED CONDITION
HYDROLOGY EXHIBIT
VTTM 084497



VICINITY MAP
NOT TO SCALE

TG 4552-D2
TG 4552-E2
TG 4552-E3



LOST CANYON ROAD (OFF-SITE)
STREET SECTION (PUBLIC)
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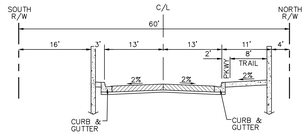

LOST CANYON ROAD BRIDGE SECTION (PUBLIC)
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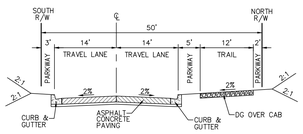
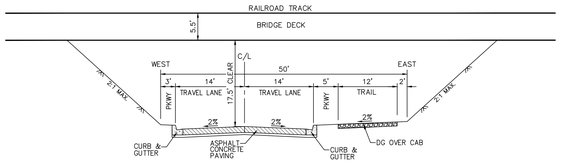
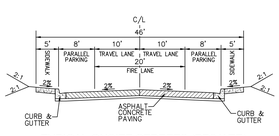


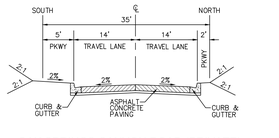
LOST CANYON ROAD (PUBLIC)
ONSITE STREET SECTION
N.T.S.



'A' STREET (PRIVATE)
RAILROAD UNDERCROSSING SECTION
NOT TO SCALE



TYPICAL ONSITE STREETS (PRIVATE)
N.T.S.



OAK SPRINGS CANYON ROAD (PRIVATE)
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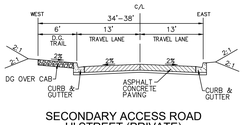
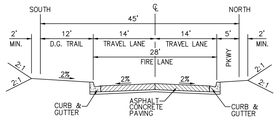
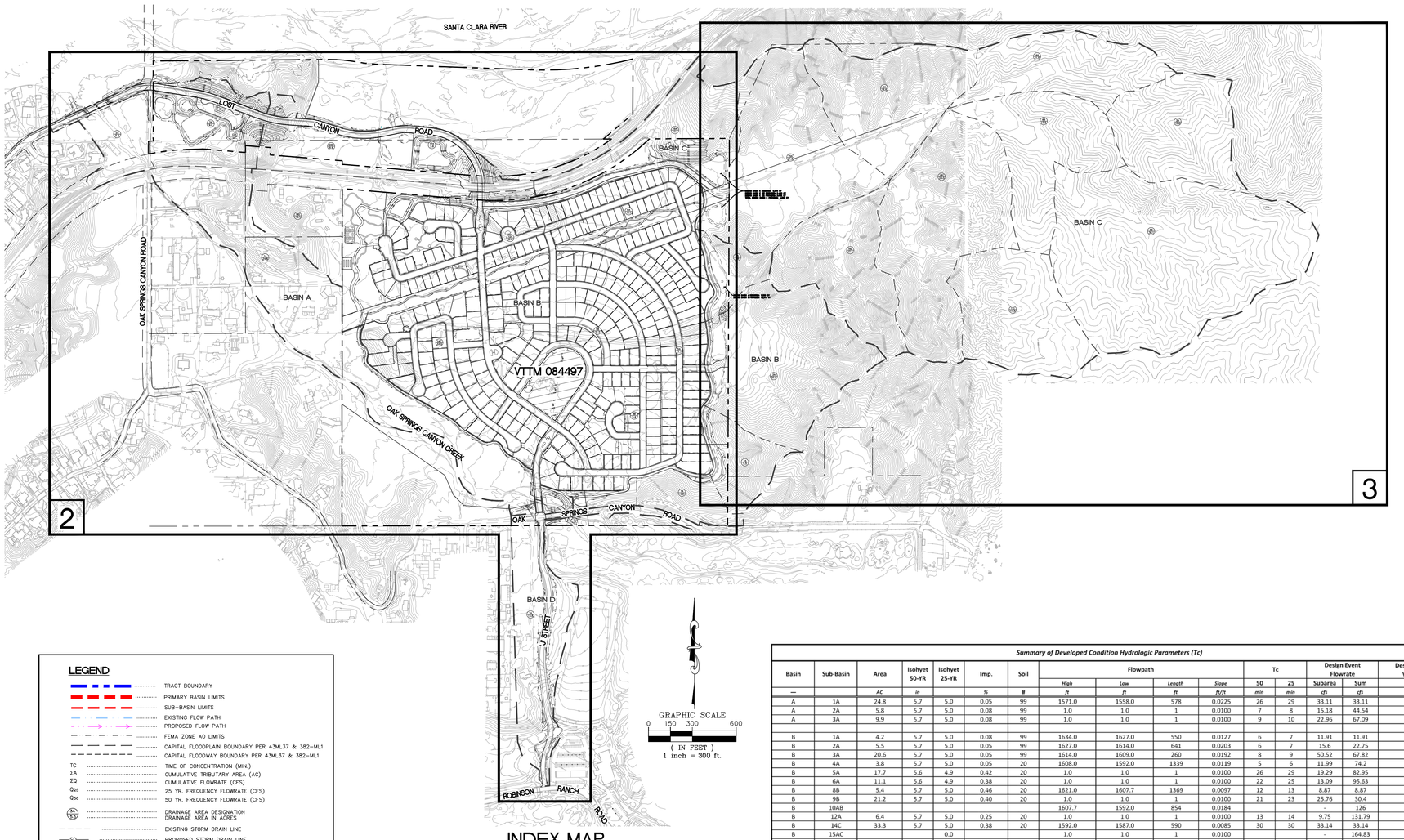


SECONDARY ACCESS ROAD
'J' STREET (PRIVATE)
N.T.S.



FUTURE ROBINSON ACCESS ROAD (PRIVATE)
N.T.S.



INDEX MAP
SCALE: 1"=300'

GRAPHIC SCALE
0 150 300 600
(IN FEET)
1 inch = 300 ft.

LEGEND

- TRACT BOUNDARY
- PRIMARY BASIN LIMITS
- SUB-BASIN LIMITS
- EXISTING FLOW PATH
- PROPOSED FLOW PATH
- FEMA ZONE AO LIMITS
- CAPITAL FLOODPLAIN BOUNDARY PER 43ML37 & 382-ML1
- CAPITAL FLOODWAY BOUNDARY PER 43ML37 & 382-ML1
- TC — TIME OF CONCENTRATION (MIN.)
- ΣA — CUMULATIVE TRIBUTARY AREA (AC)
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- DRAINAGE AREA DESIGNATION (A3) / DRAINAGE AREA IN ACRES
- EXISTING STORM DRAIN LINE
- SD — PROPOSED STORM DRAIN LINE

DESIGN CRITERIA:

STORM EVENT	50 YR – SUMP LOCATIONS 25 YR – NON-SUMP LOCATIONS
50-YTR RAINFALL ISOHYET	5,6, 5.7, 5.8
SOIL TYPE	020, 099
DEBRIS PRODUCTION AREA	DPA 8, 9

NOTES:

1. STREET DRAINAGE REQUIREMENTS SHALL BE COMPLIED WITH TO THE SATISFACTION OF THE DEPARTMENT OF PUBLIC WORKS.
2. NECESSARY EASEMENTS FOR THE STORM DRAIN SYSTEM SHALL BE DEDICATED APPROPRIATELY AND TO THE SATISFACTION OF THE DEPARTMENT OF PUBLIC WORKS.
3. VEHICULAR ACCESS SHALL BE PROVIDED AT ALL STORM DRAIN INLETS AND OUTLETS TO THE SATISFACTION OF THE COUNTY OF LOS ANGELES FLOOD CONTROL DISTRICT.
4. APPROVAL OF THIS HYDROLOGY PLAN DOES NOT CONSTITUTE DETERMINATION THAT THE OFFSITE IMPROVEMENTS ARE REQUIRED WITHIN THE MEANING OF GOVERNMENT CODE SECTION 664462.5.
5. AN OFFSITE DRAINAGE COVENANT FOR ACCEPTANCE OF DRAINAGE (AND DRAINAGE FACILITIES) MAY BE REQUIRED PER FLOOD CONTROL DISTRICT DISCRETION.
6. FLOOD HAZARD NOTES AND NATURAL DRAINAGE COURSES SHALL BE SHOWN PRIOR TO FINAL PLAN APPROVAL.
7. AN EASEMENT SHALL BE GRANTED TO THE LOS ANGELES FLOOD CONTROL DISTRICT ON THE FINAL MAP FOR STORM DRAIN INGRESS AND EGRESS AND MAINTENANCE OVER ALL PRIVATE STREETS.
8. A DRAINAGE BENEFIT ASSESSMENT AREA MAY BE REQUIRED FOR THE MAINTENANCE OF THE PROPOSED STORMDRAIN FACILITIES PER FLOOD CONTROL DISTRICT DISCRETION.
9. A FEMA APPROVED CLOMR WILL BE REQUIRED PRIOR TO APPROVAL OF STORM DRAIN PLANS

Summary of Developed Condition Hydrologic Parameters (Tc)

Basin	Sub-Basin	Area	Isohyet 50-YR	Isohyet 25-YR	Imp.	Soil	Flowpath				Tc		Design Event Flowrate		Design Event Volume
							High	Low	Length	Slope	50	25	Subarea	Sum	Sum
—		AC	in		%	#	ft	ft	ft	ft/ft	min	min	cfs	cfs	ac-ft
A	1A	24.8	5.7	5.0	0.05	99	1571.0	1558.0	578	0.0225	26	29	33.11	33.11	-
A	2A	5.8	5.7	5.0	0.08	99	1.0	1.0	1	0.0100	7	8	15.18	44.54	-
A	3A	9.9	5.7	5.0	0.08	99	1.0	1.0	1	0.0100	9	10	22.96	67.09	8.8
B	1A	4.2	5.7	5.0	0.08	99	1634.0	1627.0	550	0.0127	6	7	11.91	11.91	-
B	2A	5.5	5.7	5.0	0.05	99	1627.0	1614.0	641	0.0203	6	7	15.6	22.75	-
B	3A	20.6	5.7	5.0	0.05	99	1614.0	1609.0	260	0.0192	8	9	50.52	67.82	-
B	4A	3.8	5.7	5.0	0.05	20	1608.0	1592.0	1339	0.0119	5	6	11.99	74.2	-
B	5A	17.7	5.6	4.9	0.42	20	1.0	1.0	1	0.0100	26	29	19.29	82.95	-
B	6A	11.1	5.6	4.9	0.38	20	1.0	1.0	1	0.0100	22	25	13.09	95.63	-
B	8B	5.4	5.7	5.0	0.46	20	1621.0	1607.7	1369	0.0097	12	13	8.87	8.87	-
B	9B	21.2	5.7	5.0	0.40	20	1.0	1.0	1	0.0100	21	23	25.76	30.4	-
B	10AB						1607.7	1592.0	854	0.0184			-	126	-
B	12A	6.4	5.7	5.0	0.25	20	1.0	1.0	1	0.0100	13	14	9.75	131.79	-
B	14C	33.3	5.7	5.0	0.38	20	1592.0	1587.0	590	0.0085	30	30	33.14	33.14	-
B	15AC			0.0			1.0	1.0	1	0.0100				164.83	-
B	17A	3.9	5.7	5.0	0.12	20	1.0	1.0	1	0.0100	9	10	8.39	167.16	-
B	19D	15.1	5.7	5.0	0.08	20	1590.0	1582.0	940	0.0085	17	20	23	23	-
B	20D	9.9	5.7	5.0	0.09	20	1.0	1.0	1	0.0100	10	11	20.21	34.94	-
B	21AD			0.0			1580.0	1575.0	115	0.0435			-	197.33	30.1
C	3A	13.6	5.4	4.7	0.01	99			1000	0.1800	7	8	32.98	32.98	-
C	4A	11.5	5.4	4.7	0.01	99			1299	0.1174	9	11	24.63	53.3	-
C	5B	38.1	5.4	4.7	0.01	99			1800	0.1444	11	13	73.94	73.94	-
C	6B	13.5	5.4	4.7	0.01	99			844	0.0859	9	10	28.91	100.57	-
C	7AB								1	0.0100			-	153.57	-
C	9A	15.6	5.4	4.7	0.01	99			750	0.0347	8	9	35.28	179.72	-
C	11C	14.3	5.5	4.8	0.01	99			1310	0.1107	8	9	33.7	33.7	-
C	13C	23.0	5.5	4.8	0.01	99			787	0.3050	8	9	54.2	85.82	-
C	14AC								1	0.0100			-	263.55	-
C	15A	21.3	5.5	4.8	0.01	99			785	0.0338	7	8	51.64	292.12	-
C	16D	12.9	5.5	4.8	0.01	99			1	0.0100	7	8	31.28	31.28	-
C	18AD						1610.0	1600.0	915	0.0109			-	174.03	-
C	19A	13.1	5.6	4.9	0.05	20	1.0	1.0	1	0.0100	12	14	31.28	314.33	32.6
D	1A	13.8	5.8	5.1	0.11	20	1.0	1.0	1	0.0100	18	20	23.07	259.32	3.1

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ATTN: COREY HARPOLE

NO.	DATE		BY	APPR

1 SHEET | COUNTY OF LOS ANGELES | 3 OF SHEETS

DEVELOPED CONDITION
HYDROLOGY EXHIBIT
BELCARO AT SAND CANYON
VTTM 084497

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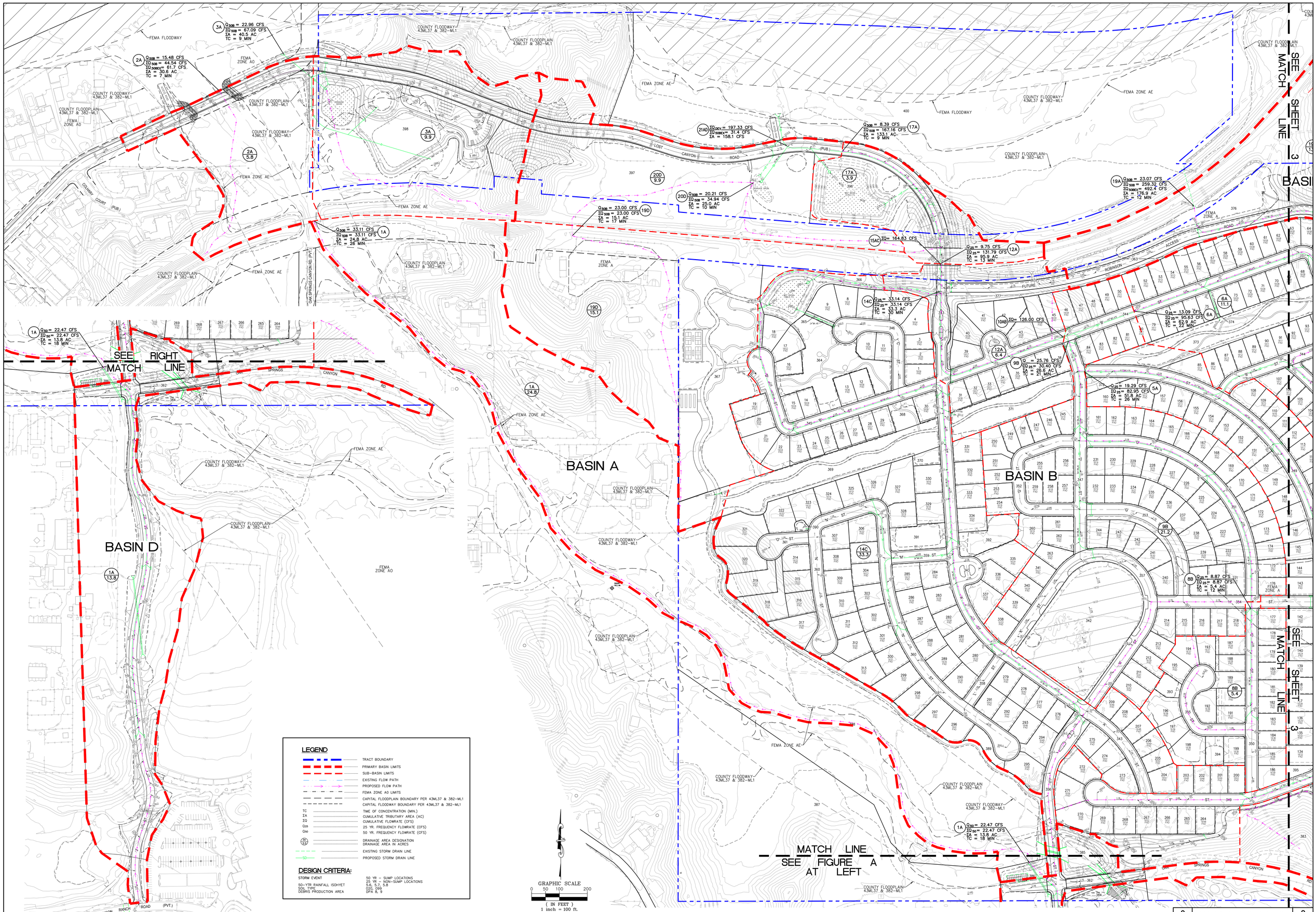

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DEVELOPED CONDITION HYDROLOGY EXHIBIT
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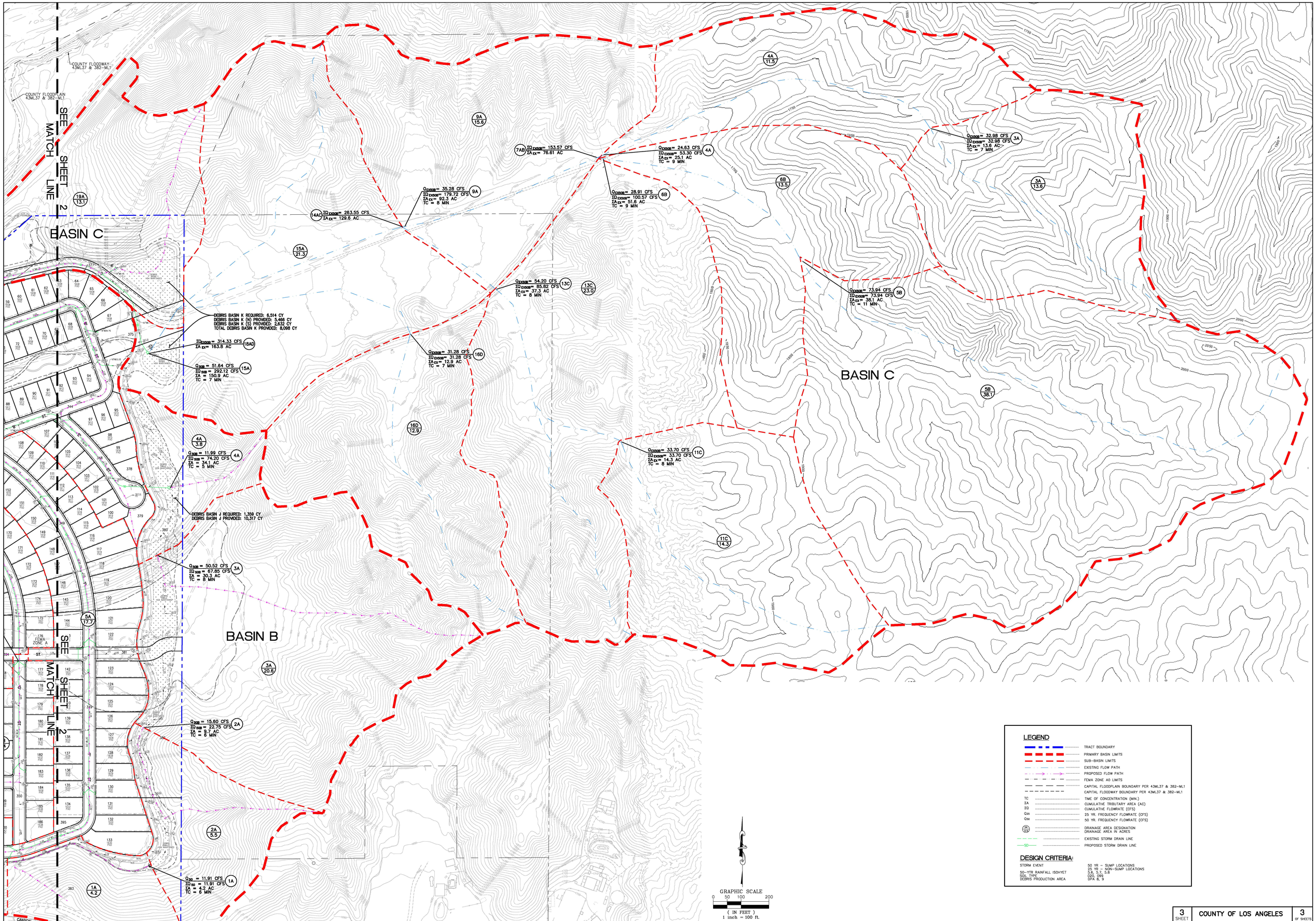

GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 inch = 100 ft.

LEGEND

- TRACT BOUNDARY
- PRIMARY BASIN LIMITS
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- EXISTING FLOW PATH
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- CAPITAL FLOODPLAIN BOUNDARY PER 43ML37 & 382-ML1
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- TC — TIME OF CONCENTRATION (MIN.)
- ΣA — CUMULATIVE TRIBUTARY AREA (AC)
- ΣQ — CUMULATIVE FLOWRATE (CFS)
- Q25 — 25 YR. FREQUENCY FLOWRATE (CFS)
- Q50 — 50 YR. FREQUENCY FLOWRATE (CFS)
- (A) 2.5 — DRAINAGE AREA DESIGNATION / DRAINAGE AREA IN ACRES
- EXISTING STORM DRAIN LINE
- SD — PROPOSED STORM DRAIN LINE

DESIGN CRITERIA:

STORM EVENT	50 YR – SUMP LOCATIONS 25 YR – NON-SUMP LOCATIONS
50-YR RAINFALL ISOHYET	5.6, 5.7, 5.8
SOIL TYPE	020, 069
DEBRIS PRODUCTION AREA	DPA 8, 9

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NO.	DATE		BY	APPR

3 SHEET | COUNTY OF LOS ANGELES | 3 OF SHEETS

DEVELOPED CONDITION HYDROLOGY EXHIBIT BELCARO AT SAND CANYON VTTM 084497

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APPENDIX B

HYDROLOGIC PARAMETERS

Tc SUMMARY TABLES

Belcaro

Summary of Existing Condition Hydrologic Parameters (Tc)

Basin	Sub-Basin	Area	Isohyet 50-YR	Imp.	Soil	DPA	Flowpath	Slope		Tc	
								Longest	Flowpath	50	25
—	—	AC	in	%	#	#	ft	ft/ft	ft/ft	min	min
A	3A	13.6	5.4	1	99	8	1000	0.1800	0.1800	7	8
A	4A	11.5	5.4	1	99	8	1299	0.1173	0.1174	9	11
A	5B	38.1	5.4	1	99	8	1800	0.1444	0.1444	11	13
A	6B	13.5	5.4	1	99	8	844	0.1420	0.0859	9	10
A	9A	15.6	5.4	1	99	8	750	0.1510	0.0347	8	9
A	11B	14.3	5.5	1	99	8	1310	0.1261	0.1107	8	9
A	13B	23.0	5.5	1	99	8	787	0.1920	0.3050	8	9
A	15A	19.3	5.5	1	99	8	785	0.2087	0.0338	7	8
A	16C	12.9	5.5	1	99	8	1050	0.2019	0.2019	7	8
A	19A	15.5	5.7	1	99	9	1250	0.1200	0.1200	9	10
A	21B	19.1	5.7	1	20	9	1050	0.1100	0.1100	10	12
A	23B	14.2	5.7	1	20	9	950	0.1000	0.1000	10	11
A	26C	19.8	5.6	1	99	8	1250	0.1730	0.1730	8	9
A	29B	15.3	5.6	1	20	9	900	0.1100	0.1100	9	11
A	31D	21.1	5.6	1	20	9	1250	0.1400	0.1400	11	13
B	3A	20.3	5.7	1	20	9	1250	0.1100	0.1100	12	14
B	5A	1.4	5.7	1	20	9	500	0.0800	0.0800	6	7
C	1B	20.7	5.7	5	20	9	1500	0.0900	0.0900	14	16
C	2B	16.5	5.7	5	20	9	1350	0.0800	0.0800	13	15
C	5B	7.5	5.7	5	20	9	650	0.1000	0.1000	7	9
D	1A	13.6	5.8	15	20	9	1863	0.0531	0.0531	16	18
E	1A	5.3	5.7	5	20	9	2071	0.0275	0.0275	22	26
E	2A	16.0	5.7	5	99	9	1755	0.0219	0.0219	15	17
E	3A	5.8	5.7	5	20	9	585	0.0385	0.0231	9	10
E	4B	10.0	5.7	5	99	9	904	0.0155	0.0155	10	11

Summary of Developed Condition Hydrologic Parameters (Tc)

Basin	Sub-Basin	Area	Isohyet 50-YR	Isohyet 25-YR	Imp.	Soil	Flowpath				Tc		Design Event Flowrate		Design Event Volume
							High	*Low*	*Length*	*Slope*	50	25	Subarea	Sum	Sum
—		*AC*	*in*		*%*	#	*ft*	*ft*	*ft*	*ft/ft*	*min*	*min*	*cfs*	*cfs*	*ac-ft*
A	1A	24.8	5.7	5.0	0.05	99	1571.0	1558.0	578	0.0225	26	29	33.11	33.11	-
A	2A	5.8	5.7	5.0	0.08	99	1.0	1.0	1	0.0100	7	8	15.18	44.54	-
A	3A	9.9	5.7	5.0	0.08	99	1.0	1.0	1	0.0100	9	10	22.96	67.09	8.8
B	1A	4.2	5.7	5.0	0.08	99	1634.0	1627.0	550	0.0127	6	7	11.91	11.91	-
B	2A	5.5	5.7	5.0	0.05	99	1627.0	1614.0	641	0.0203	6	7	15.6	22.75	-
B	3A	20.6	5.7	5.0	0.05	99	1614.0	1609.0	260	0.0192	8	9	50.52	67.82	-
B	4A	3.8	5.7	5.0	0.05	20	1608.0	1592.0	1339	0.0119	5	6	11.99	74.2	-
B	5A	17.7	5.6	4.9	0.42	20	1.0	1.0	1	0.0100	26	29	19.29	82.95	-
B	6A	11.1	5.6	4.9	0.38	20	1.0	1.0	1	0.0100	22	25	13.09	95.63	-
B	8B	5.4	5.7	5.0	0.46	20	1621.0	1607.7	1369	0.0097	12	13	8.87	8.87	-
B	9B	21.2	5.7	5.0	0.40	20	1.0	1.0	1	0.0100	21	23	25.76	30.4	-
B	10AB						1607.7	1592.0	854	0.0184			-	126	-
B	12A	6.4	5.7	5.0	0.25	20	1.0	1.0	1	0.0100	13	14	9.75	131.79	-
B	14C	33.3	5.7	5.0	0.38	20	1592.0	1587.0	590	0.0085	30	30	33.14	33.14	-
B	15AC			0.0			1.0	1.0	1	0.0100			-	164.83	-
B	17A	3.9	5.7	5.0	0.12	20	1.0	1.0	1	0.0100	9	10	8.39	167.16	-
B	19D	15.1	5.7	5.0	0.08	20	1590.0	1582.0	940	0.0085	17	20	23	23	-
B	20D	9.9	5.7	5.0	0.09	20	1.0	1.0	1	0.0100	10	11	20.21	34.94	-
B	21AD			0.0			1580.0	1575.0	115	0.0435			-	197.33	30.1
C	3A	13.6	5.4	4.7	0.01	99			1000	0.1800	7	8	32.98	32.98	-
C	4A	11.5	5.4	4.7	0.01	99			1299	0.1174	9	11	24.63	53.3	-
C	5B	38.1	5.4	4.7	0.01	99			1800	0.1444	11	13	73.94	73.94	-
C	6B	13.5	5.4	4.7	0.01	99			844	0.0859	9	10	28.91	100.57	-
C	7AB								1	0.0100			-	153.57	-
C	9A	15.6	5.4	4.7	0.01	99			750	0.0347	8	9	35.28	179.72	-
C	11C	14.3	5.5	4.8	0.01	99			1310	0.1107	8	9	33.7	33.7	-
C	13C	23.0	5.5	4.8	0.01	99			787	0.3050	8	9	54.2	85.82	-
C	14AC								1	0.0100			-	263.55	-
C	15A	21.3	5.5	4.8	0.01	99			785	0.0338	7	8	51.64	292.12	-
C	16D	12.9	5.5	4.8	0.01	99			1	0.0100	7	8	31.28	31.28	-
C	18AD						1610.0	1600.0	915	0.0109			-	174.03	-
C	19A	13.1	5.6	4.9	0.05	20	1.0	1.0	1	0.0100	12	14	31.28	314.33	32.6
D	1A	13.8	5.8	5.1	0.11	20	1.0	1.0	1	0.0100	18	20	23.07	259.32	3.1

APPENDIX C

HYDROLOGIC MODEL INPUT/OUTPUT

LAR04: .INL, .OUT, AND .HHD FILES

HYDROLOGIC RESULT SUMMARY TABLES

Existing Condition Peak Flows

Basin	Area	Design
	ac	cfs
A	266.8	492.4
B	21.7	31.4
C	44.7	52.9
D	13.6	19.8
E	37.1	61.7
TOTAL	383.9	658.1

Existing Condition Runoff Volume

Basin	Area	50-YEAR
	ac	ac-ft
A	266.8	49.9
B	21.7	4.4
C	44.7	8.4
D	13.6	2.9
E	37.1	7.69
TOTAL	383.9	73.23

Developed Condition Peak Flows

Basin	Area	Design
	ac	cfs
A	40.5	67.1
B	158.1	197.3
C	176.9	259.3
D	13.8	21.3
TOTAL	389.3	545.1

Developed Condition Runoff Volume

Basin	Area	50-YEAR
	ac	ac-ft
A	40.5	8.8
B	158.1	30.1
C	176.9	32.6
D	13.8	3.1
TOTAL	389.3	74.56

Peak Flow Comparison

Basin	Area	Design
	ac	cfs
Existing	383.9	658.1
Developed	389.3	545.1
Δ	5.4	-113.1

Runoff Volume Comparison

Basin	Area	50-YEAR
	ac	ac-ft
Existing	383.9	73.23
Developed	389.3	74.56
Δ	5.4	1.33

BELCARO AT SAND CANYON

LAR04: .INL, .OUT, AND .HHD FILES

EXISTING CONDITION

25-YR

```
006  1420    1A 299    0.099A27                          0  G1
006  1420    2A 299    0.099A27                          0
006  1420    3A 299 0113.608A272 137007290               0
006  1420    4A 299 0111.511A27                          0
006  1420    5B 299 0138.113A272  86105810               0
006  1420    6B 299 0113.510A27                          0
006  1420    7AB299         A272  73004000               0
006  1420    8A 299    0.099A27                          0
006  1420    9A 299 0115.609A27                          0
006  1420   10A 299    0.099A27                          0
006  1420   11B 299 0114.309A282  76007890               0
006  1420   12B 299    0.099A28                          0
006  1420   13B 299 0123.009A282  40005000               0
006  1420   14AB299         A282  69202600               0
006  1420   15A 299 0119.308A27                         0
006  1420   16C 299 0112.908A284  10003500               0
006  1420   17C 299    0.099A282  80003500               0
006  1420   18AC299         A282  96802780               0
006  1420   19A 299 0115.510A28                         0
006  1420   20A 299    0.099A28                         0
006  1420   21B 220 0119.112A292  49002650               0
006  1420   22B 220    0.099A29                         0
006  1420   23B 220 0114.211A29                         0
006  1420   24B 220    0.099A29                         0
006  1420   25B 220    0.099A29                         0
006  1420   26C 299 0119.809A28                         0
006  1420   27BC299         A284  12001660              0
006  1420   28B 299    0.099A282  83002890              0
006  1420   29B 220 0115.311A282  46002390              0
006  1420   30AB220         A28                         0
006  1420   31D 220 0121.113A28                         0
006  1420   32AD220         A282  14002000              02  2
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Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 25 SOIL DATA FILE: C:\civild\lasoilx.dat

EXIST BELCARO Q25B - BASIN A

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	STORM RAIN ZONE	DAY 4 PCT IMPV
1420	1A	.0	.00	.0	.00	0	0.	.00000	.00	.00	0.	299	99	A27	.00
1420	2A	.0	.00	.0	.00	0	0.	.00000	.00	.00	0.	299	99	A27	.00
1420	3A	13.6	26.64	13.6	26.64	2	1370.	.07290	.00	.00	0.	299	8	A27	.01
1420	4A	11.5	19.29	25.1	42.82	0	0.	.00000	.00	.00	0.	299	11	A27	.01
1420	5B	38.1	58.37	38.1	58.37	2	861.	.05810	.00	.00	0.	299	13	A27	.01
1420	6B	13.5	23.89	51.6	80.18	0	0.	.00000	.00	.00	0.	299	10	A27	.01
1420	7AB	51.6	80.18	76.7	122.89	2	730.	.04000	.00	.00	0.	299	0	A27	.00
1420	8A	.0	.00	76.7	121.72	0	0.	.00000	.00	.00	0.	299	99	A27	.00
1420	9A	15.6	28.92	92.3	146.06	0	0.	.00000	.00	.00	0.	299	9	A27	.01
1420	10A	.0	.00	92.3	146.06	0	0.	.00000	.00	.00	0.	299	99	A27	.00
1420	11B	14.3	27.65	14.3	27.65	2	760.	.07890	.00	.00	0.	299	9	A28	.01
1420	12B	.0	.00	14.3	27.05	0	0.	.00000	.00	.00	0.	299	99	A28	.00
1420	13B	23.0	44.47	37.3	70.22	2	400.	.05000	.00	.00	0.	299	9	A28	.01
1420	14AB	37.3	69.73	129.6	215.40	2	692.	.02600	.00	.00	0.	299	0	A28	.00
1420	15A	19.3	37.81	148.9	236.95	0	0.	.00000	.00	.00	0.	299	8	A27	.01
1420	16C	12.9	26.34	12.9	26.34	4	100.	.03500	2.00	.00	0.	299	8	A28	.01
1420	17C	.0	.00	12.9	26.27	2	800.	.03500	.00	.00	0.	299	99	A28	.00
1420	18AC	12.9	24.80	161.8	261.75	2	968.	.02780	.00	.00	0.	299	0	A28	.00
1420	19A	15.5	28.54	177.3	276.65	0	0.	.00000	.00	.00	0.	299	10	A28	.01
1420	20A	.0	.00	177.3	276.65	0	0.	.00000	.00	.00	0.	299	99	A28	.00
1420	21B	19.1	26.81	19.1	26.81	2	490.	.02650	.00	.00	0.	220	12	A29	.01
1420	22B	.0	.00	19.1	26.48	0	0.	.00000	.00	.00	0.	220	99	A29	.00
1420	23B	14.2	21.03	33.3	46.68	0	0.	.00000	.00	.00	0.	220	11	A29	.01
1420	24B	.0	.00	33.3	46.68	0	0.	.00000	.00	.00	0.	220	99	A29	.00
1420	25B	.0	.00	33.3	46.68	0	0.	.00000	.00	.00	0.	220	99	A29	.00
1420	26C	19.8	38.28	19.8	38.28	0	0.	.00000	.00	.00	0.	299	9	A28	.01
1420	27BC	19.8	38.28	53.1	83.72	4	120.	.01660	3.00	.00	0.	299	0	A28	.00
1420	28B	.0	.00	53.1	83.49	2	830.	.02890	.00	.00	0.	299	99	A28	.00
1420	29B	15.3	21.74	68.4	101.46	2	460.	.02390	.00	.00	0.	220	11	A28	.01
1420	30AB	68.4	100.50	245.7	377.15	0	0.	.00000	.00	.00	0.	220	0	A28	.00
1420	31D	21.1	27.11	21.1	27.11	0	0.	.00000	.00	.00	0.	220	13	A28	.01
1420	32AD	21.1	27.11	266.8	401.90	2	140.	.02000	.00	.00	0.	220	0	A28	.00

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 25 SOIL DATA FILE:
EXIST BELCARO Q25B - BASIN A
HYDROGRAPH AT 1420 32A STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	.00	100	9.47	200	9.82	300	10.34	400	10.90
500	11.63	600	12.47	700	13.55	800	15.03	900	17.19
1000	20.71	1050	27.24	1100	44.28	1110	54.74	1120	69.76
1130	88.29	1131	90.16	1132	92.06	1133	94.28	1134	96.31
1135	98.57	1136	100.90	1137	103.45	1138	106.16	1139	109.24
1140	112.43	1141	116.34	1142	120.44	1143	124.77	1144	129.49
1145	135.30	1146	141.50	1147	148.34	1148	155.67	1149	168.40
1150	183.30	1151	201.18	1152	223.32	1153	250.88	1154	279.38
1155	311.06	1156	343.13	1157	372.51	1158	393.61	1159	401.90
1160	400.05	1161	387.50	1162	363.50	1163	333.74	1164	303.70
1165	272.55	1166	242.73	1167	217.00	1168	194.11	1169	173.92
1170	156.07	1171	140.46	1172	126.71	1173	114.90	1174	104.50
1175	95.37	1176	87.63	1177	80.97	1178	75.23	1179	70.14
1180	65.79	1181	62.01	1182	58.65	1183	55.52	1184	52.82
1185	50.34	1186	48.11	1187	46.11	1188	44.22	1189	42.39
1190	40.79	1191	39.31	1192	37.86	1193	36.57	1194	35.26
1195	34.08	1196	32.88	1197	31.79	1198	30.82	1199	29.88
1200	28.94	1201	28.18	1202	27.47	1203	26.71	1204	26.12
1205	25.62	1206	25.07	1207	24.63	1208	24.17	1209	23.79
1210	23.41	1211	23.03	1212	22.74	1213	22.46	1214	22.16
1215	21.86	1216	21.69	1217	21.43	1218	21.21	1219	21.01
1220	20.80	1221	20.63	1222	20.42	1223	20.26	1224	20.11
1225	19.93	1226	19.76	1227	19.62	1228	19.49	1229	19.33
1230	19.14	1231	19.01	1232	18.88	1233	18.76	1234	18.65
1235	18.48	1236	18.36	1237	18.25	1238	18.09	1239	17.98
1240	17.85	1241	17.75	1242	17.65	1243	17.52	1244	17.43
1245	17.30	1246	17.20	1247	17.06	1248	17.02	1249	16.88
1250	16.83	1251	16.72	1252	16.59	1253	16.56	1254	16.43
1255	16.33	1256	16.28	1257	16.17	1258	16.07	1259	16.02
1260	15.92	1261	15.82	1262	15.74	1263	15.66	1264	15.59
1265	15.52	1266	15.40	1267	15.40	1268	15.33	1269	15.21
1270	15.15	1271	15.10	1272	15.01	1273	14.92	1274	14.86
1275	14.81	1276	14.77	1277	14.69	1278	14.65	1279	14.60
1280	14.52	1281	14.46	1282	14.41	1283	14.36	1284	14.31
1285	14.27	1286	14.19	1287	14.15	1288	14.11	1289	13.98
1290	13.93	1291	13.88	1292	13.83	1293	13.78	1294	13.73
1295	13.69	1296	13.64	1297	13.58	1298	13.47	1299	13.44
1300	13.39	1310	12.97	1320	12.63	1330	12.23	1340	11.80
1350	11.48	1360	11.30	1370	11.01	1380	10.83	1390	10.49
1400	10.34	1420	10.00	1440	9.66	1460	8.15	1500	8.15

TOTAL VOLUME THIS HYDROGRAPH = 42.56(Ac.Ft)

```
006  1420    1A 220    0.099A28                          0  G1
006  1420    2A 220    0.099A28                          0
006  1420    3A 220 0120.314A284   6705000               0
006  1420    4A 220    0.099A282  53005000               0
006  1420    5A 220 0101.407A28                          02  2
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Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 25 SOIL DATA FILE: C:\civild\lasoilx.dat

EXIST BELCARO Q25B - BASIN B

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	STORM RAIN ZONE	DAY 4 PCT IMPV
1420	1A	.0	.00	.0	.00	0	0.	.00000	.00	.00	0.	220	99	A28	.00
1420	2A	.0	.00	.0	.00	0	0.	.00000	.00	.00	0.	220	99	A28	.00
1420	3A	20.3	25.01	20.3	25.01	4	67.	.05000	2.00	.00	0.	220	14	A28	.01
1420	4A	.0	.00	20.3	25.01	2	530.	.05000	.00	.00	0.	220	99	A28	.00
1420	5A	1.4	2.55	21.7	26.78	0	0.	.00000	.00	.00	0.	220	7	A28	.01

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 25 SOIL DATA FILE:
EXIST BELCARO Q25B - BASIN B
HYDROGRAPH AT 1420 5A STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	.00	100	.79	200	.82	300	.86	400	.91
500	.97	600	1.04	700	1.13	800	1.26	900	1.44
1000	1.75	1050	2.19	1100	3.21	1110	3.91	1120	4.84
1130	6.04	1131	6.19	1132	6.33	1133	6.49	1134	6.67
1135	6.89	1136	7.11	1137	7.31	1138	7.51	1139	7.73
1140	7.94	1141	8.21	1142	8.51	1143	8.87	1144	9.26
1145	9.69	1146	10.20	1147	10.84	1148	11.47	1149	12.37
1150	13.85	1151	16.23	1152	19.01	1153	21.93	1154	24.54
1155	26.38	1156	26.78	1157	26.57	1158	26.06	1159	25.39
1160	24.52	1161	23.67	1162	22.74	1163	21.73	1164	20.14
1165	17.80	1166	15.27	1167	12.77	1168	10.41	1169	8.46
1170	7.14	1171	6.24	1172	5.60	1173	5.10	1174	4.71
1175	4.42	1176	4.18	1177	3.96	1178	3.78	1179	3.62
1180	3.46	1181	3.32	1182	3.20	1183	3.09	1184	2.99
1185	2.89	1186	2.80	1187	2.71	1188	2.63	1189	2.55
1190	2.47	1191	2.40	1192	2.34	1193	2.28	1194	2.22
1195	2.18	1196	2.14	1197	2.10	1198	2.07	1199	2.04
1200	2.01	1201	1.99	1202	1.96	1203	1.93	1204	1.91
1205	1.89	1206	1.87	1207	1.86	1208	1.84	1209	1.82
1210	1.80	1211	1.78	1212	1.76	1213	1.74	1214	1.72
1215	1.71	1216	1.69	1217	1.68	1218	1.67	1219	1.66
1220	1.65	1221	1.63	1222	1.62	1223	1.60	1224	1.59
1225	1.57	1226	1.56	1227	1.55	1228	1.54	1229	1.53
1230	1.52	1231	1.52	1232	1.51	1233	1.49	1234	1.48
1235	1.47	1236	1.47	1237	1.46	1238	1.45	1239	1.44
1240	1.43	1241	1.42	1242	1.42	1243	1.40	1244	1.39
1245	1.39	1246	1.38	1247	1.38	1248	1.37	1249	1.36
1250	1.35	1251	1.34	1252	1.34	1253	1.33	1254	1.32
1255	1.31	1256	1.31	1257	1.30	1258	1.29	1259	1.29
1260	1.28	1261	1.27	1262	1.27	1263	1.26	1264	1.25
1265	1.25	1266	1.24	1267	1.24	1268	1.23	1269	1.23
1270	1.23	1271	1.22	1272	1.22	1273	1.21	1274	1.20
1275	1.19	1276	1.19	1277	1.18	1278	1.18	1279	1.18
1280	1.18	1281	1.18	1282	1.18	1283	1.17	1284	1.16
1285	1.15	1286	1.15	1287	1.15	1288	1.15	1289	1.14
1290	1.14	1291	1.14	1292	1.13	1293	1.11	1294	1.11
1295	1.10	1296	1.10	1297	1.10	1298	1.09	1299	1.09
1300	1.09	1310	1.05	1320	1.03	1330	1.00	1340	.96
1350	.94	1360	.93	1370	.90	1380	.88	1390	.86
1400	.85	1420	.82	1440	.79	1460	.74	1500	.74

TOTAL VOLUME THIS HYDROGRAPH = 3.25(Ac.Ft)

```
006  1420    1B 220 0520.716A292 145501500                0  G1
006  1420    2B 220 0516.515A282   7005000                0
006  1420    3B 220    0.099A28                           0
006  1420    4B 220    0.099A284  55001200                0
006  1420    5B 220 0507.509A28                           02  2
```

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 25 SOIL DATA FILE: C:\civild\lasoilx.dat

EXIST BELCARO Q25B - BASIN C

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	STORM RAIN ZONE	DAY 4 PCT IMPV
1420	1B	20.7	24.98	20.7	24.98	2	1455.	.01500	.00	.00	0.	220	16	A29	.05
1420	2B	16.5	19.87	37.2	37.66	2	70.	.05000	.00	.00	0.	220	15	A28	.05
1420	3B	.0	.00	37.2	37.65	0	0.	.00000	.00	.00	0.	220	99	A28	.00
1420	4B	.0	.00	37.2	37.65	4	550.	.01200	2.50	.00	0.	220	99	A28	.00
1420	5B	7.5	12.07	44.7	42.69	0	0.	.00000	.00	.00	0.	220	9	A28	.05

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 25 SOIL DATA FILE:
EXIST BELCARO Q25B - BASIN C
HYDROGRAPH AT 1420 5B STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	.00	100	1.77	200	1.83	300	1.93	400	2.03
500	2.17	600	2.32	700	2.53	800	2.81	900	3.20
1000	3.86	1050	4.78	1100	6.86	1110	8.09	1120	9.60
1130	11.92	1131	12.15	1132	12.39	1133	12.70	1134	13.01
1135	13.37	1136	13.76	1137	14.16	1138	14.55	1139	14.98
1140	15.38	1141	15.93	1142	16.42	1143	17.02	1144	17.61
1145	18.41	1146	19.27	1147	20.26	1148	21.23	1149	23.44
1150	26.04	1151	29.38	1152	33.05	1153	36.85	1154	39.13
1155	40.80	1156	41.80	1157	42.69	1158	42.37	1159	42.09
1160	41.83	1161	41.18	1162	40.35	1163	40.19	1164	39.83
1165	38.84	1166	37.05	1167	34.92	1168	32.70	1169	30.51
1170	28.71	1171	27.25	1172	25.88	1173	24.42	1174	22.89
1175	21.31	1176	19.77	1177	18.27	1178	16.85	1179	15.58
1180	14.48	1181	13.50	1182	12.59	1183	11.80	1184	11.13
1185	10.49	1186	9.92	1187	9.43	1188	8.97	1189	8.54
1190	8.17	1191	7.82	1192	7.51	1193	7.23	1194	6.98
1195	6.74	1196	6.53	1197	6.34	1198	6.17	1199	5.99
1200	5.83	1201	5.69	1202	5.54	1203	5.40	1204	5.28
1205	5.18	1206	5.06	1207	4.97	1208	4.86	1209	4.79
1210	4.69	1211	4.60	1212	4.55	1213	4.47	1214	4.39
1215	4.33	1216	4.27	1217	4.22	1218	4.17	1219	4.12
1220	4.08	1221	4.02	1222	3.98	1223	3.94	1224	3.90
1225	3.85	1226	3.81	1227	3.78	1228	3.75	1229	3.72
1230	3.68	1231	3.66	1232	3.63	1233	3.59	1234	3.57
1235	3.53	1236	3.51	1237	3.49	1238	3.45	1239	3.44
1240	3.41	1241	3.38	1242	3.36	1243	3.32	1244	3.32
1245	3.28	1246	3.26	1247	3.25	1248	3.23	1249	3.21
1250	3.19	1251	3.16	1252	3.15	1253	3.13	1254	3.11
1255	3.08	1256	3.08	1257	3.05	1258	3.04	1259	3.02
1260	3.01	1261	3.00	1262	2.97	1263	2.97	1264	2.95
1265	2.93	1266	2.92	1267	2.92	1268	2.89	1269	2.88
1270	2.87	1271	2.86	1272	2.83	1273	2.82	1274	2.80
1275	2.79	1276	2.78	1277	2.76	1278	2.76	1279	2.75
1280	2.75	1281	2.73	1282	2.72	1283	2.71	1284	2.70
1285	2.67	1286	2.67	1287	2.66	1288	2.65	1289	2.63
1290	2.62	1291	2.61	1292	2.60	1293	2.59	1294	2.57
1295	2.56	1296	2.56	1297	2.55	1298	2.54	1299	2.54
1300	2.52	1310	2.43	1320	2.37	1330	2.29	1340	2.22
1350	2.16	1360	2.13	1370	2.05	1380	2.03	1390	1.96
1400	1.94	1420	1.85	1440	1.79	1460	1.48	1500	1.47

TOTAL VOLUME THIS HYDROGRAPH = 7.20(Ac.Ft)

```
006  1420    1A 220 1513.618A292  1.0001000                0  G1
006  1420    2A 220  0  .099A292  1.0001000                02  2
```

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 25 SOIL DATA FILE: C:\civild\lasoilx.dat

EXIST BELCARO Q25B - BASIN D

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	STORM RAIN ZONE	DAY 4 PCT IMPV
1420	1A	13.6	15.82	13.6	15.82	2	1.	.01000	.00	.00	0.	220	18	A29	.15
1420	2A	.0	.00	13.6	15.82	2	1.	.01000	.00	.00	0.	220	99	A29	.00

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 25 SOIL DATA FILE:
EXIST BELCARO Q25B - BASIN D
HYDROGRAPH AT 1420 2A STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	.00	100	.64	200	.67	300	.70	400	.74
500	.79	600	.85	700	.92	800	1.03	900	1.17
1000	1.42	1050	1.82	1100	2.57	1110	3.04	1120	3.74
1130	4.55	1131	4.65	1132	4.74	1133	4.87	1134	4.99
1135	5.12	1136	5.24	1137	5.43	1138	5.61	1139	5.74
1140	5.87	1141	6.08	1142	6.30	1143	6.51	1144	6.73
1145	7.09	1146	7.48	1147	7.87	1148	8.23	1149	9.64
1150	11.10	1151	12.46	1152	13.88	1153	15.35	1154	15.72
1155	15.81	1156	15.82	1157	15.75	1158	15.65	1159	15.41
1160	15.13	1161	14.82	1162	14.47	1163	13.99	1164	13.43
1165	12.91	1166	12.39	1167	10.77	1168	9.15	1169	7.64
1170	6.18	1171	4.73	1172	4.18	1173	3.85	1174	3.54
1175	3.33	1176	3.14	1177	3.00	1178	2.84	1179	2.75
1180	2.64	1181	2.55	1182	2.47	1183	2.38	1184	2.29
1185	2.26	1186	2.17	1187	2.13	1188	2.04	1189	2.01
1190	1.97	1191	1.91	1192	1.85	1193	1.83	1194	1.77
1195	1.73	1196	1.72	1197	1.68	1198	1.65	1199	1.63
1200	1.60	1201	1.60	1202	1.57	1203	1.55	1204	1.52
1205	1.51	1206	1.51	1207	1.48	1208	1.46	1209	1.47
1210	1.44	1211	1.43	1212	1.41	1213	1.42	1214	1.38
1215	1.37	1216	1.36	1217	1.35	1218	1.33	1219	1.33
1220	1.31	1221	1.32	1222	1.30	1223	1.28	1224	1.26
1225	1.27	1226	1.26	1227	1.25	1228	1.25	1229	1.24
1230	1.22	1231	1.20	1232	1.20	1233	1.20	1234	1.18
1235	1.19	1236	1.18	1237	1.17	1238	1.15	1239	1.15
1240	1.15	1241	1.15	1242	1.14	1243	1.14	1244	1.12
1245	1.10	1246	1.10	1247	1.09	1248	1.10	1249	1.11
1250	1.09	1251	1.09	1252	1.07	1253	1.07	1254	1.06
1255	1.06	1256	1.06	1257	1.06	1258	1.04	1259	1.02
1260	1.04	1261	1.02	1262	1.01	1263	1.02	1264	1.01
1265	1.01	1266	1.01	1267	.99	1268	.99	1269	.99
1270	.99	1271	.97	1272	.97	1273	.97	1274	.97
1275	.96	1276	.96	1277	.96	1278	.94	1279	.96
1280	.96	1281	.94	1282	.94	1283	.94	1284	.93
1285	.93	1286	.93	1287	.91	1288	.91	1289	.91
1290	.91	1291	.89	1292	.89	1293	.89	1294	.89
1295	.89	1296	.89	1297	.88	1298	.88	1299	.88
1300	.88	1310	.86	1320	.83	1330	.80	1340	.77
1350	.76	1360	.74	1370	.73	1380	.71	1390	.69
1400	.69	1420	.66	1440	.64	1460	.64	1500	.64

TOTAL VOLUME THIS HYDROGRAPH = 2.54(Ac.Ft)

```
006  1420    1A 220  5 5.326A292 1755002190                0  G1
006  1420    2A 299  516.017A292585.0002310                0
006  1420    3A 220  5 5.810A292  1.0001000                0
006  1420    4B 299  510.011A292  1.0001000                0
006  1420    5AB220         A292  1.0001000                02  2
```

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 25 SOIL DATA FILE: C:\civild\lasoilx.dat

EXIST BELCARO Q25B - BASIN E

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	STORM RAIN ZONE	DAY 4 PCT IMPV
1420	1A	5.3	4.79	5.3	4.79	2	1755.	.02190	.00	.00	0.	220	26	A29	.05
1420	2A	16.0	23.10	21.3	25.18	2	585.	.02310	.00	.00	0.	299	17	A29	.05
1420	3A	5.8	9.22	27.1	32.96	2	1.	.01000	.00	.00	0.	220	10	A29	.05
1420	4B	10.0	18.15	10.0	18.15	2	1.	.01000	.00	.00	0.	299	11	A29	.05
1420	5AB	10.0	18.15	37.1	50.13	2	1.	.01000	.00	.00	0.	220	0	A29	.00

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 25 SOIL DATA FILE:
EXIST BELCARO Q25B - BASIN E
HYDROGRAPH AT 1420 5A STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	.00	100	1.48	200	1.54	300	1.62	400	1.71
500	1.81	600	1.95	700	2.13	800	2.36	900	2.70
1000	3.26	1050	4.57	1100	7.22	1110	9.08	1120	11.01
1130	13.62	1131	13.94	1132	14.17	1133	14.47	1134	14.79
1135	15.13	1136	15.48	1137	15.97	1138	16.49	1139	17.02
1140	17.57	1141	18.27	1142	18.92	1143	19.58	1144	20.25
1145	21.26	1146	22.41	1147	23.60	1148	24.72	1149	28.18
1150	31.88	1151	35.91	1152	40.40	1153	45.11	1154	47.63
1155	49.40	1156	50.13	1157	50.09	1158	49.67	1159	48.15
1160	44.88	1161	41.50	1162	38.06	1163	34.66	1164	31.77
1165	30.42	1166	29.27	1167	27.92	1168	26.27	1169	24.21
1170	22.09	1171	19.93	1172	17.86	1173	16.22	1174	14.97
1175	14.03	1176	13.29	1177	12.68	1178	12.15	1179	11.68
1180	11.26	1181	10.90	1182	10.55	1183	10.20	1184	9.87
1185	9.54	1186	9.24	1187	8.90	1188	8.54	1189	8.23
1190	7.93	1191	7.57	1192	7.22	1193	6.94	1194	6.66
1195	6.36	1196	6.16	1197	5.89	1198	5.68	1199	5.50
1200	5.31	1201	5.12	1202	4.99	1203	4.81	1204	4.68
1205	4.54	1206	4.43	1207	4.28	1208	4.20	1209	4.12
1210	4.03	1211	3.96	1212	3.89	1213	3.83	1214	3.78
1215	3.70	1216	3.66	1217	3.59	1218	3.54	1219	3.50
1220	3.45	1221	3.39	1222	3.35	1223	3.31	1224	3.27
1225	3.23	1226	3.22	1227	3.17	1228	3.15	1229	3.12
1230	3.06	1231	3.03	1232	3.01	1233	2.99	1234	2.97
1235	2.95	1236	2.92	1237	2.89	1238	2.85	1239	2.83
1240	2.83	1241	2.83	1242	2.79	1243	2.77	1244	2.77
1245	2.72	1246	2.71	1247	2.67	1248	2.66	1249	2.67
1250	2.63	1251	2.62	1252	2.60	1253	2.60	1254	2.57
1255	2.56	1256	2.55	1257	2.54	1258	2.53	1259	2.49
1260	2.49	1261	2.47	1262	2.44	1263	2.45	1264	2.43
1265	2.40	1266	2.41	1267	2.39	1268	2.37	1269	2.38
1270	2.37	1271	2.34	1272	2.34	1273	2.34	1274	2.33
1275	2.31	1276	2.30	1277	2.27	1278	2.27	1279	2.28
1280	2.26	1281	2.25	1282	2.25	1283	2.23	1284	2.21
1285	2.20	1286	2.20	1287	2.19	1288	2.19	1289	2.17
1290	2.15	1291	2.14	1292	2.13	1293	2.12	1294	2.12
1295	2.11	1296	2.11	1297	2.10	1298	2.10	1299	2.09
1300	2.09	1310	2.02	1320	1.97	1330	1.90	1340	1.83
1350	1.80	1360	1.75	1370	1.72	1380	1.68	1390	1.62
1400	1.62	1420	1.55	1440	1.49	1460	1.48	1500	1.48

TOTAL VOLUME THIS HYDROGRAPH = 6.56(Ac.Ft)

BELCARO AT SAND CANYON

LAR04: .INL, .OUT, AND .HHD FILES

EXISTING CONDITION

50-YR

```
006  1420    1A 299    0.099A27                          0  G1
006  1420    2A 299    0.099A27                          0
006  1420    3A 299 0113.607A272 137007290               0
006  1420    4A 299 0111.509A27                          0
006  1420    5B 299 0138.111A272  86105810               0
006  1420    6B 299 0113.509A27                          0
006  1420    7AB299         A272  73004000               0
006  1420    8A 299    0.099A27                          0
006  1420    9A 299 0115.608A27                          0
006  1420   10A 299    0.099A27                          0
006  1420   11B 299 0114.308A282  76007890               0
006  1420   12B 299    0.099A28                          0
006  1420   13B 299 0123.008A282  40005000               0
006  1420   14AB299         A282  69202600               0
006  1420   15A 299 0119.307A27                         0
006  1420   16C 299 0112.907A284  10003500               0
006  1420   17C 299    0.099A282  80003500               0
006  1420   18AC299         A282  96802780               0
006  1420   19A 299 0115.509A28                         0
006  1420   20A 299    0.099A28                          0
006  1420   21B 220 0119.110A292  49002650               0
006  1420   22B 220    0.099A29                          0
006  1420   23B 220 0114.210A29                          0
006  1420   24B 220    0.099A29                          0
006  1420   25B 220    0.099A29                          0
006  1420   26C 299 0119.808A28                          0
006  1420   27BC299         A284  12001660               0
006  1420   28B 299    0.099A282  83002890               0
006  1420   29B 220 0115.309A282  46002390               0
006  1420   30AB220         A28                         0
006  1420   31D 220 0121.111A28                         0
006  1420   32AD220         A282  14002000              02  2
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Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE: C:\civild\lasoilx.dat

EXIST BELCARO Q50B - BASIN A

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	STORM RAIN ZONE	DAY 4 PCT IMPV
1420	1A	.0	.00	.0	.00	0	0.	.00000	.00	.00	0.	299	99	A27	.00
1420	2A	.0	.00	.0	.00	0	0.	.00000	.00	.00	0.	299	99	A27	.00
1420	3A	13.6	32.98	13.6	32.98	2	1370.	.07290	.00	.00	0.	299	7	A27	.01
1420	4A	11.5	24.63	25.1	53.30	0	0.	.00000	.00	.00	0.	299	9	A27	.01
1420	5B	38.1	73.94	38.1	73.94	2	861.	.05810	.00	.00	0.	299	11	A27	.01
1420	6B	13.5	28.91	51.6	100.57	0	0.	.00000	.00	.00	0.	299	9	A27	.01
1420	7AB	51.6	100.57	76.7	153.57	2	730.	.04000	.00	.00	0.	299	0	A27	.00
1420	8A	.0	.00	76.7	151.77	0	0.	.00000	.00	.00	0.	299	99	A27	.00
1420	9A	15.6	35.28	92.3	179.72	0	0.	.00000	.00	.00	0.	299	8	A27	.01
1420	10A	.0	.00	92.3	179.72	0	0.	.00000	.00	.00	0.	299	99	A27	.00
1420	11B	14.3	33.70	14.3	33.70	2	760.	.07890	.00	.00	0.	299	8	A28	.01
1420	12B	.0	.00	14.3	33.06	0	0.	.00000	.00	.00	0.	299	99	A28	.00
1420	13B	23.0	54.20	37.3	85.82	2	400.	.05000	.00	.00	0.	299	8	A28	.01
1420	14AB	37.3	85.31	129.6	263.55	2	692.	.02600	.00	.00	0.	299	0	A28	.00
1420	15A	19.3	46.80	148.9	288.67	0	0.	.00000	.00	.00	0.	299	7	A27	.01
1420	16C	12.9	32.46	12.9	32.46	4	100.	.03500	2.00	.00	0.	299	7	A28	.01
1420	17C	.0	.00	12.9	32.37	2	800.	.03500	.00	.00	0.	299	99	A28	.00
1420	18AC	12.9	30.45	161.8	319.12	2	968.	.02780	.00	.00	0.	299	0	A28	.00
1420	19A	15.5	34.60	177.3	337.08	0	0.	.00000	.00	.00	0.	299	9	A28	.01
1420	20A	.0	.00	177.3	337.08	0	0.	.00000	.00	.00	0.	299	99	A28	.00
1420	21B	19.1	35.28	19.1	35.28	2	490.	.02650	.00	.00	0.	220	10	A29	.01
1420	22B	.0	.00	19.1	34.41	0	0.	.00000	.00	.00	0.	220	99	A29	.00
1420	23B	14.2	26.23	33.3	59.57	0	0.	.00000	.00	.00	0.	220	10	A29	.01
1420	24B	.0	.00	33.3	59.57	0	0.	.00000	.00	.00	0.	220	99	A29	.00
1420	25B	.0	.00	33.3	59.57	0	0.	.00000	.00	.00	0.	220	99	A29	.00
1420	26C	19.8	46.66	19.8	46.66	0	0.	.00000	.00	.00	0.	299	8	A28	.01
1420	27BC	19.8	46.66	53.1	105.01	4	120.	.01660	3.25	.00	0.	299	0	A28	.00
1420	28B	.0	.00	53.1	104.59	2	830.	.02890	.00	.00	0.	299	99	A28	.00
1420	29B	15.3	28.59	68.4	127.81	2	460.	.02390	.00	.00	0.	220	9	A28	.01
1420	30AB	68.4	125.36	245.7	461.51	0	0.	.00000	.00	.00	0.	220	0	A28	.00
1420	31D	21.1	35.30	21.1	35.30	0	0.	.00000	.00	.00	0.	220	11	A28	.01
1420	32AD	21.1	35.30	266.8	492.36	2	140.	.02000	.00	.00	0.	220	0	A28	.00

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE:
EXIST BELCARO Q50B - BASIN A
HYDROGRAPH AT 1420 32A STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	.00	100	10.79	200	11.18	300	11.78	400	12.41
500	13.25	600	14.21	700	15.44	800	17.12	900	19.59
1000	23.73	1050	35.32	1100	56.76	1110	69.17	1120	87.00
1130	108.30	1131	110.48	1132	112.50	1133	114.94	1134	117.33
1135	120.04	1136	122.86	1137	126.02	1138	129.41	1139	133.30
1140	137.26	1141	142.24	1142	147.18	1143	152.71	1144	158.45
1145	165.88	1146	173.79	1147	182.59	1148	191.81	1149	208.30
1150	227.57	1151	251.72	1152	281.32	1153	318.65	1154	357.19
1155	399.82	1156	440.55	1157	474.22	1158	491.13	1159	492.36
1160	474.83	1161	443.89	1162	405.07	1163	364.72	1164	324.10
1165	288.10	1166	255.13	1167	225.85	1168	200.35	1169	178.43
1170	159.85	1171	143.63	1172	130.11	1173	118.65	1174	109.04
1175	100.65	1176	93.82	1177	87.84	1178	82.52	1179	77.93
1180	74.10	1181	70.46	1182	67.16	1183	64.27	1184	61.72
1185	59.15	1186	56.97	1187	54.96	1188	52.99	1189	51.14
1190	49.59	1191	47.86	1192	46.27	1193	44.90	1194	43.48
1195	42.04	1196	40.75	1197	39.52	1198	38.36	1199	37.28
1200	36.21	1201	35.27	1202	34.33	1203	33.44	1204	32.70
1205	32.00	1206	31.17	1207	30.48	1208	29.74	1209	29.11
1210	28.41	1211	27.78	1212	27.25	1213	26.64	1214	26.12
1215	25.62	1216	25.19	1217	24.82	1218	24.41	1219	24.11
1220	23.78	1221	23.49	1222	23.26	1223	23.00	1224	22.80
1225	22.58	1226	22.40	1227	22.19	1228	22.03	1229	21.87
1230	21.64	1231	21.50	1232	21.36	1233	21.21	1234	21.08
1235	20.88	1236	20.75	1237	20.63	1238	20.43	1239	20.35
1240	20.16	1241	20.09	1242	19.97	1243	19.79	1244	19.72
1245	19.54	1246	19.47	1247	19.33	1248	19.23	1249	19.14
1250	19.05	1251	18.93	1252	18.80	1253	18.71	1254	18.62
1255	18.47	1256	18.45	1257	18.29	1258	18.20	1259	18.11
1260	18.03	1261	17.91	1262	17.79	1263	17.78	1264	17.65
1265	17.55	1266	17.49	1267	17.44	1268	17.34	1269	17.27
1270	17.17	1271	17.11	1272	17.01	1273	16.94	1274	16.83
1275	16.76	1276	16.74	1277	16.68	1278	16.59	1279	16.53
1280	16.47	1281	16.42	1282	16.36	1283	16.31	1284	16.25
1285	16.17	1286	16.11	1287	16.02	1288	15.97	1289	15.85
1290	15.80	1291	15.74	1292	15.68	1293	15.62	1294	15.57
1295	15.51	1296	15.45	1297	15.38	1298	15.28	1299	15.23
1300	15.21	1310	14.76	1320	14.36	1330	13.90	1340	13.40
1350	13.04	1360	12.85	1370	12.51	1380	12.32	1390	11.91
1400	11.76	1420	11.38	1440	10.99	1460	9.28	1500	9.28

TOTAL VOLUME THIS HYDROGRAPH = 49.86(Ac.Ft)

```
006  1420    1A  20 70 0.099A28                          0  G1
006  1420    2A  20 70 0.099A28                          0
006  1420    3A  20 3820.312A284   6705000               0
006  1420    4B  20 70 0.099A282  53005000               0
006  1420    5AB 20          A272  73004000               0
006  1420    6A  20 5001.406A28                          02  2
```

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE: C:\civild\lasoilx.dat

EXIST BELCARO Q50B - BASIN B

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	STORM RAIN ZONE	DAY 4 PCT IMPV
1420	1A	.0	.00	.0	.00	0	0.	.00000	.00	.00	0.	20	99	A28	.70
1420	2A	.0	.00	.0	.00	0	0.	.00000	.00	.00	0.	20	99	A28	.70
1420	3A	20.3	30.33	20.3	30.33	4	67.	.05000	2.00	.00	0.	20	12	A28	.38
1420	4B	.0	.00	.0	.00	2	530.	.05000	.00	.00	0.	20	99	A28	.70
1420	5AB	.0	.00	20.3	30.32	2	730.	.04000	.00	.00	0.	20	0	A27	.00
1420	6A	1.4	3.20	21.7	31.40	0	0.	.00000	.00	.00	0.	20	6	A28	.50

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE:
EXIST BELCARO Q50B - BASIN B
HYDROGRAPH AT 1420 6A STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	.00	100	1.13	200	1.17	300	1.23	400	1.30
500	1.39	600	1.49	700	1.62	800	1.80	900	2.06
1000	2.49	1050	3.19	1100	4.34	1110	5.15	1120	6.26
1130	7.55	1131	7.70	1132	7.85	1133	8.03	1134	8.22
1135	8.42	1136	8.61	1137	8.81	1138	9.01	1139	9.23
1140	9.47	1141	9.78	1142	10.10	1143	10.47	1144	10.90
1145	11.40	1146	11.94	1147	12.54	1148	13.26	1149	14.41
1150	15.83	1151	17.94	1152	20.84	1153	24.19	1154	27.43
1155	29.81	1156	31.05	1157	31.40	1158	31.06	1159	30.21
1160	29.37	1161	28.40	1162	26.97	1163	24.69	1164	21.89
1165	18.94	1166	16.00	1167	13.30	1168	11.16	1169	9.65
1170	8.54	1171	7.72	1172	7.09	1173	6.58	1174	6.16
1175	5.80	1176	5.51	1177	5.26	1178	5.04	1179	4.83
1180	4.66	1181	4.51	1182	4.36	1183	4.24	1184	4.14
1185	4.03	1186	3.93	1187	3.84	1188	3.73	1189	3.64
1190	3.57	1191	3.50	1192	3.41	1193	3.35	1194	3.29
1195	3.22	1196	3.16	1197	3.11	1198	3.06	1199	3.00
1200	2.96	1201	2.91	1202	2.87	1203	2.82	1204	2.78
1205	2.74	1206	2.70	1207	2.67	1208	2.63	1209	2.61
1210	2.57	1211	2.54	1212	2.52	1213	2.49	1214	2.47
1215	2.45	1216	2.44	1217	2.41	1218	2.39	1219	2.37
1220	2.36	1221	2.34	1222	2.31	1223	2.29	1224	2.27
1225	2.26	1226	2.24	1227	2.23	1228	2.21	1229	2.20
1230	2.18	1231	2.17	1232	2.16	1233	2.14	1234	2.12
1235	2.11	1236	2.11	1237	2.10	1238	2.08	1239	2.07
1240	2.05	1241	2.04	1242	2.03	1243	2.00	1244	2.00
1245	1.99	1246	1.99	1247	1.97	1248	1.95	1249	1.94
1250	1.93	1251	1.92	1252	1.91	1253	1.91	1254	1.89
1255	1.88	1256	1.87	1257	1.86	1258	1.85	1259	1.84
1260	1.83	1261	1.82	1262	1.81	1263	1.81	1264	1.80
1265	1.78	1266	1.78	1267	1.78	1268	1.77	1269	1.76
1270	1.76	1271	1.75	1272	1.75	1273	1.73	1274	1.72
1275	1.71	1276	1.71	1277	1.70	1278	1.69	1279	1.69
1280	1.69	1281	1.69	1282	1.67	1283	1.67	1284	1.66
1285	1.65	1286	1.65	1287	1.65	1288	1.65	1289	1.64
1290	1.64	1291	1.63	1292	1.61	1293	1.59	1294	1.58
1295	1.58	1296	1.58	1297	1.57	1298	1.56	1299	1.56
1300	1.56	1310	1.52	1320	1.48	1330	1.43	1340	1.37
1350	1.34	1360	1.34	1370	1.29	1380	1.26	1390	1.23
1400	1.21	1420	1.17	1440	1.13	1460	1.04	1500	1.04

TOTAL VOLUME THIS HYDROGRAPH = 4.39(Ac.Ft)

```
006  1420    1B 220 0520.714A292 145501500                0  G1
006  1420    2B 220 0516.513A282   7005000                0
006  1420    3B 220    0.099A28                           0
006  1420    4B 220    0.099A284  55001200                0
006  1420    5B 220 0507.507A28                           02  2
```

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE: C:\civild\lasoilx.dat

EXIST BELCARO Q50B - BASIN C

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	STORM RAIN ZONE	DAY 4 PCT IMPV
1420	1B	20.7	31.69	20.7	31.69	2	1455.	.01500	.00	.00	0.	220	14	A29	.05
1420	2B	16.5	25.22	37.2	47.54	2	70.	.05000	.00	.00	0.	220	13	A28	.05
1420	3B	.0	.00	37.2	47.47	0	0.	.00000	.00	.00	0.	220	99	A28	.00
1420	4B	.0	.00	37.2	47.47	4	550.	.01200	2.50	.00	0.	220	99	A28	.00
1420	5B	7.5	16.10	44.7	52.89	0	0.	.00000	.00	.00	0.	220	7	A28	.05

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE:
EXIST BELCARO Q50B - BASIN C
HYDROGRAPH AT 1420 5B STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	.00	100	2.01	200	2.09	300	2.20	400	2.31
500	2.47	600	2.65	700	2.88	800	3.20	900	3.65
1000	4.40	1050	5.81	1100	8.31	1110	9.90	1120	11.86
1130	14.66	1131	14.96	1132	15.27	1133	15.68	1134	16.08
1135	16.53	1136	16.96	1137	17.43	1138	17.89	1139	18.43
1140	18.87	1141	19.57	1142	20.26	1143	21.03	1144	21.76
1145	22.82	1146	23.95	1147	25.29	1148	26.43	1149	29.49
1150	33.29	1151	37.99	1152	42.78	1153	47.67	1154	50.67
1155	52.89	1156	52.33	1157	51.61	1158	51.02	1159	50.30
1160	49.42	1161	49.75	1162	49.95	1163	49.39	1164	47.65
1165	44.96	1166	42.00	1167	38.96	1168	36.53	1169	34.58
1170	32.73	1171	30.67	1172	28.55	1173	26.40	1174	24.29
1175	22.26	1176	20.47	1177	18.87	1178	17.50	1179	16.26
1180	15.18	1181	14.22	1182	13.43	1183	12.67	1184	11.98
1185	11.36	1186	10.84	1187	10.33	1188	9.85	1189	9.42
1190	9.07	1191	8.71	1192	8.42	1193	8.15	1194	7.86
1195	7.63	1196	7.41	1197	7.17	1198	6.98	1199	6.80
1200	6.59	1201	6.43	1202	6.27	1203	6.12	1204	5.99
1205	5.87	1206	5.74	1207	5.66	1208	5.54	1209	5.45
1210	5.37	1211	5.26	1212	5.18	1213	5.10	1214	5.01
1215	4.94	1216	4.87	1217	4.81	1218	4.76	1219	4.68
1220	4.62	1221	4.57	1222	4.52	1223	4.44	1224	4.40
1225	4.35	1226	4.32	1227	4.28	1228	4.24	1229	4.21
1230	4.16	1231	4.12	1232	4.08	1233	4.05	1234	4.02
1235	3.98	1236	3.96	1237	3.95	1238	3.91	1239	3.88
1240	3.83	1241	3.80	1242	3.80	1243	3.75	1244	3.73
1245	3.71	1246	3.70	1247	3.67	1248	3.65	1249	3.61
1250	3.61	1251	3.57	1252	3.56	1253	3.54	1254	3.52
1255	3.48	1256	3.49	1257	3.44	1258	3.43	1259	3.43
1260	3.40	1261	3.38	1262	3.37	1263	3.35	1264	3.33
1265	3.32	1266	3.28	1267	3.29	1268	3.28	1269	3.27
1270	3.24	1271	3.23	1272	3.21	1273	3.20	1274	3.15
1275	3.14	1276	3.15	1277	3.14	1278	3.13	1279	3.12
1280	3.11	1281	3.10	1282	3.09	1283	3.05	1284	3.04
1285	3.03	1286	3.03	1287	3.02	1288	3.01	1289	2.99
1290	2.97	1291	2.95	1292	2.93	1293	2.92	1294	2.91
1295	2.90	1296	2.91	1297	2.91	1298	2.88	1299	2.87
1300	2.85	1310	2.75	1320	2.69	1330	2.60	1340	2.51
1350	2.46	1360	2.42	1370	2.33	1380	2.30	1390	2.23
1400	2.20	1420	2.11	1440	2.04	1460	1.68	1500	1.68

TOTAL VOLUME THIS HYDROGRAPH = 8.36(Ac.Ft)

```
006  1420    1A 220 1513.616A292  1.0001000                0  G1
006  1420    2A 220  0  .099A292  1.0001000                02  2
```

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE: C:\civild\lasoilx.dat

EXIST BELCARO Q50B - BASIN D

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	STORM RAIN ZONE	DAY 4 PCT IMPV
1420	1A	13.6	19.82	13.6	19.82	2	1.	.01000	.00	.00	0.	220	16	A29	.15
1420	2A	.0	.00	13.6	19.82	2	1.	.01000	.00	.00	0.	220	99	A29	.00

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE:
EXIST BELCARO Q50B - BASIN D
HYDROGRAPH AT 1420 2A STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	.00	100	.73	200	.76	300	.80	400	.84
500	.90	600	.97	700	1.05	800	1.17	900	1.34
1000	1.62	1050	2.19	1100	3.05	1110	3.70	1120	4.53
1130	5.49	1131	5.61	1132	5.73	1133	5.89	1134	6.05
1135	6.21	1136	6.38	1137	6.54	1138	6.70	1139	6.87
1140	7.03	1141	7.31	1142	7.58	1143	7.86	1144	8.14
1145	8.63	1146	9.19	1147	9.69	1148	10.16	1149	11.94
1150	13.76	1151	15.60	1152	17.51	1153	19.31	1154	19.70
1155	19.81	1156	19.82	1157	19.60	1158	19.33	1159	19.03
1160	18.67	1161	18.06	1162	17.35	1163	16.69	1164	15.98
1165	13.88	1166	11.81	1167	9.77	1168	7.77	1169	5.92
1170	5.25	1171	4.82	1172	4.43	1173	4.19	1174	3.90
1175	3.70	1176	3.49	1177	3.36	1178	3.22	1179	3.11
1180	2.99	1181	2.92	1182	2.80	1183	2.76	1184	2.65
1185	2.60	1186	2.52	1187	2.47	1188	2.39	1189	2.34
1190	2.30	1191	2.24	1192	2.17	1193	2.15	1194	2.10
1195	2.05	1196	2.04	1197	1.99	1198	1.94	1199	1.93
1200	1.88	1201	1.86	1202	1.82	1203	1.77	1204	1.75
1205	1.73	1206	1.69	1207	1.67	1208	1.66	1209	1.65
1210	1.62	1211	1.63	1212	1.58	1213	1.59	1214	1.56
1215	1.54	1216	1.54	1217	1.52	1218	1.49	1219	1.52
1220	1.50	1221	1.48	1222	1.45	1223	1.46	1224	1.43
1225	1.42	1226	1.43	1227	1.42	1228	1.41	1229	1.40
1230	1.37	1231	1.38	1232	1.35	1233	1.35	1234	1.35
1235	1.33	1236	1.33	1237	1.33	1238	1.31	1239	1.31
1240	1.31	1241	1.31	1242	1.27	1243	1.27	1244	1.27
1245	1.25	1246	1.27	1247	1.25	1248	1.25	1249	1.25
1250	1.23	1251	1.23	1252	1.21	1253	1.21	1254	1.21
1255	1.21	1256	1.19	1257	1.19	1258	1.19	1259	1.17
1260	1.16	1261	1.17	1262	1.14	1263	1.16	1264	1.14
1265	1.12	1266	1.14	1267	1.12	1268	1.12	1269	1.12
1270	1.12	1271	1.10	1272	1.10	1273	1.10	1274	1.10
1275	1.10	1276	1.08	1277	1.08	1278	1.08	1279	1.08
1280	1.08	1281	1.08	1282	1.06	1283	1.06	1284	1.06
1285	1.04	1286	1.04	1287	1.04	1288	1.04	1289	1.02
1290	1.02	1291	1.02	1292	1.02	1293	1.02	1294	1.02
1295	1.00	1296	1.00	1297	1.00	1298	1.00	1299	1.00
1300	1.00	1310	.98	1320	.94	1330	.91	1340	.88
1350	.87	1360	.84	1370	.83	1380	.81	1390	.78
1400	.79	1420	.75	1440	.73	1460	.73	1500	.73

TOTAL VOLUME THIS HYDROGRAPH = 2.93(Ac.Ft)

```
006  1420    1A 220  5 5.322A292 1755002190                0  G1
006  1420    2A 299  516.015A292585.0002310                 0
006  1420    3A 220  5 5.8 9A292  1.0001000                 0
006  1420    4B 299  510.010A292  1.0001000                 0
006  1420    5AB220         A292  1.0001000                 02  2
```

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE: C:\civild\lasoilx.dat

EXIST BELCARO Q50B - BASIN E

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	STORM RAIN ZONE	DAY 4 PCT IMPV
1420	1A	5.3	6.24	5.3	6.24	2	1755.	.02190	.00	.00	0.	220	22	A29	.05
1420	2A	16.0	28.67	21.3	31.18	2	585.	.02310	.00	.00	0.	299	15	A29	.05
1420	3A	5.8	11.38	27.1	40.88	2	1.	.01000	.00	.00	0.	220	9	A29	.05
1420	4B	10.0	22.10	10.0	22.10	2	1.	.01000	.00	.00	0.	299	10	A29	.05
1420	5AB	10.0	22.10	37.1	61.67	2	1.	.01000	.00	.00	0.	220	0	A29	.00

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE:
EXIST BELCARO Q50B - BASIN E
HYDROGRAPH AT 1420 5A STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	.00	100	1.68	200	1.75	300	1.85	400	1.94
500	2.07	600	2.23	700	2.42	800	2.69	900	3.07
1000	3.89	1050	5.87	1100	8.97	1110	11.28	1120	13.48
1130	16.52	1131	16.82	1132	17.10	1133	17.49	1134	17.90
1135	18.34	1136	18.80	1137	19.43	1138	20.06	1139	20.69
1140	21.30	1141	22.09	1142	22.89	1143	23.70	1144	24.56
1145	25.90	1146	27.32	1147	28.73	1148	30.14	1149	34.51
1150	39.17	1151	44.18	1152	49.98	1153	56.04	1154	59.08
1155	60.93	1156	61.67	1157	61.53	1158	59.78	1159	55.76
1160	51.59	1161	47.29	1162	42.78	1163	39.21	1164	37.41
1165	35.67	1166	33.35	1167	30.64	1168	27.88	1169	25.02
1170	22.38	1171	20.34	1172	18.81	1173	17.70	1174	16.83
1175	16.05	1176	15.44	1177	14.92	1178	14.33	1179	13.90
1180	13.40	1181	12.97	1182	12.52	1183	12.00	1184	11.56
1185	11.09	1186	10.63	1187	10.19	1188	9.74	1189	9.35
1190	9.01	1191	8.57	1192	8.23	1193	7.97	1194	7.65
1195	7.33	1196	7.14	1197	6.89	1198	6.70	1199	6.45
1200	6.24	1201	6.08	1202	5.92	1203	5.65	1204	5.52
1205	5.39	1206	5.21	1207	5.03	1208	4.93	1209	4.84
1210	4.69	1211	4.60	1212	4.49	1213	4.44	1214	4.32
1215	4.21	1216	4.15	1217	4.07	1218	3.98	1219	3.93
1220	3.88	1221	3.81	1222	3.77	1223	3.71	1224	3.68
1225	3.63	1226	3.61	1227	3.58	1228	3.54	1229	3.49
1230	3.44	1231	3.42	1232	3.40	1233	3.37	1234	3.35
1235	3.31	1236	3.28	1237	3.25	1238	3.20	1239	3.20
1240	3.21	1241	3.19	1242	3.15	1243	3.13	1244	3.12
1245	3.06	1246	3.05	1247	3.01	1248	3.02	1249	3.01
1250	2.96	1251	2.96	1252	2.94	1253	2.93	1254	2.90
1255	2.90	1256	2.88	1257	2.88	1258	2.84	1259	2.80
1260	2.82	1261	2.79	1262	2.77	1263	2.77	1264	2.75
1265	2.71	1266	2.73	1267	2.70	1268	2.69	1269	2.70
1270	2.67	1271	2.66	1272	2.64	1273	2.65	1274	2.64
1275	2.62	1276	2.59	1277	2.59	1278	2.57	1279	2.57
1280	2.57	1281	2.56	1282	2.54	1283	2.51	1284	2.51
1285	2.50	1286	2.50	1287	2.49	1288	2.47	1289	2.44
1290	2.43	1291	2.42	1292	2.42	1293	2.41	1294	2.40
1295	2.40	1296	2.39	1297	2.39	1298	2.38	1299	2.37
1300	2.37	1310	2.30	1320	2.23	1330	2.15	1340	2.08
1350	2.04	1360	1.98	1370	1.96	1380	1.90	1390	1.83
1400	1.85	1420	1.77	1440	1.69	1460	1.68	1500	1.68

TOTAL VOLUME THIS HYDROGRAPH = 7.69(Ac.Ft)

BELCARO AT SAND CANYON

LAR04: .INL, .OUT, AND .HHD FILES

DEVELOPED CONDITION

25-YR/50-YR DESIGN EVENT

```
006  2330    1A 299 0524.826A292 057802250                0  G1
006  2330    2A 299 08 5.807A292 1.0001000                0
006  2330    3A 299 08 9.909A292 1.0001000                02  2
```

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE: C:\civild\lasoilx.dat

DEV BELCARO Q50B - BASIN A STORM DAY 4

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	RAIN ZONE	PCT IMPV
2330	1A	24.8	33.11	24.8	33.11	2	578.	.02250	.00	.00	0.	299	26	A29	.05
2330	2A	5.8	15.18	30.6	44.54	2	1.	.01000	.00	.00	0.	299	7	A29	.08
2330	3A	9.9	22.96	40.5	67.09	2	1.	.01000	.00	.00	0.	299	9	A29	.08

```
006  2330    1A 299 08 4.2 6A292 055001270                0  G1
006  2330    2A 299 05 5.5 6A292 064102030                0
006  2330    3A 299 0520.6 8A292 026001920                0
006  2330    4A 299 05 3.8 5A292 133901190                0
006  2330    5A  99 4217.726A254 1.0001000                0
006  2330    6A  99 3811.122A254 1.0001000                0
006  2330    7A  99 01  .099A292 1.0001000                0
006  2330    8B  99 46 5.412A254 136900097                0
006  2330    9B  99 4021.221A254 1.0001000                0
006  2330   10AB 99         A254 085401840                0
006  2330   11A  99 01  .099A292 1.0001000                0
006  2330   12A  99 25 6.413A254 1.0001000                0
006  2330   13A  99 01  .099A292 1.0001000                0
006  2330   14C  99 3833.330A254 059000850                0
006  2330   15AC 99         A254 1.0001000                0
006  2330   16A  99 01  .099A292 1.0001000                0
006  2330   17A  99 12 3.9 9A294 1.0001000                0
006  2330   18A  99 01  .099A292 1.0001000                0
006  2330   19D  99 0815.117A292 094000850                0
006  2330   20D  99 09 9.910A294 1.0001000                0
006  2330   21AD 99         A294 011504350                02  2
```

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE: C:\civild\lasoilx.dat

DEV BELCARO Q50B/Q25 - BASIN B STORM DAY 4

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	RAIN ZONE	PCT IMPV
2330	1A	4.2	11.91	4.2	11.91	2	550.	.01270	.00	.00	0.	299	6	A29	.08
2330	2A	5.5	15.60	9.7	22.75	2	641.	.02030	.00	.00	0.	299	6	A29	.05
2330	3A	20.6	50.52	30.3	67.82	2	260.	.01920	.00	.00	0.	299	8	A29	.05
2330	4A	3.8	11.99	34.1	74.20	2	1339.	.01190	.00	.00	0.	299	5	A29	.05
2330	5A	17.7	19.29	51.8	82.95	4	1.	.01000	3.25	.00	0.	99	26	A25	.42
2330	6A	11.1	13.09	62.9	95.63	4	1.	.01000	3.50	.00	0.	99	22	A25	.38
2330	7A	.0	.00	62.9	95.62	2	1.	.01000	.00	.00	0.	99	99	A29	.01
2330	8B	5.4	8.87	5.4	8.87	4	1369.	.00097	2.25	.00	0.	99	12	A25	.46
2330	9B	21.2	25.76	26.6	30.40	4	1.	.01000	2.25	.00	0.	99	21	A25	.40
2330	10AB	26.6	30.40	89.5	126.00	4	854.	.01840	3.50	.00	0.	99	0	A25	.00
2330	11A	.0	.00	89.5	125.40	2	1.	.01000	.00	.00	0.	99	99	A29	.01
2330	12A	6.4	9.75	95.9	131.79	4	1.	.01000	4.00	.00	0.	99	13	A25	.25
2330	13A	.0	.00	95.9	131.79	2	1.	.01000	.00	.00	0.	99	99	A29	.01
2330	14C	33.3	33.14	33.3	33.14	4	590.	.00850	2.50	.00	0.	99	30	A25	.38
2330	15AC	33.3	33.08	129.2	164.83	4	1.	.01000	4.25	.00	0.	99	0	A25	.00
2330	16A	.0	.00	129.2	164.83	2	1.	.01000	.00	.00	0.	99	99	A29	.01
2330	17A	3.9	8.39	133.1	167.16	4	1.	.01000	4.25	.00	0.	99	9	A29	.12
2330	18A	.0	.00	133.1	167.16	2	1.	.01000	.00	.00	0.	99	99	A29	.01
2330	19D	15.1	23.00	15.1	23.00	2	940.	.00850	.00	.00	0.	99	17	A29	.08
2330	20D	9.9	20.21	25.0	34.94	4	1.	.01000	2.50	.00	0.	99	10	A29	.09
2330	21AD	25.0	34.94	158.1	197.33	4	115.	.04350	3.50	.00	0.	99	0	A29	.00

```
006  2330    1A 299    0.099A27                          0  G1
006  2330    2A 299    0.099A27                          0
006  2330    3A 299 0113.607A272 137007290               0
006  2330    4A 299 0111.509A27                          0
006  2330    5B 299 0138.111A272  86105810               0
006  2330    6B 299 0113.509A27                          0
006  2330    7AB299         A272  73004000               0
006  2330    8A 299    0.099A27                          0
006  2330    9A 299 0115.608A27                          0
006  2330   10A 299    0.099A27                          0
006  2330   11C 299 0114.308A282  76007890               0
006  2330   12C 299    0.099A28                          0
006  2330   13C 299 0123.008A282  40005000               0
006  2330   14AC299         A282  69202600               0
006  2330   15A 299 0121.307A272 1.0001000               0
006  2330   16D 299 0112.907A272 1.0001000               0
006  2330   17D 299    0.099A27                          0
006  2330   18AD299         A282 091500109               0
006  2330   19A  99 0513.112A284 1.0001000               02  2
```

Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE: C:\civild\lasoilx.dat

DEV BELCARO Q50B - BASIN C STORM DAY 4

LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	RAIN ZONE	PCT IMPV
2330	1A	.0	.00	.0	.00	0	0.	.00000	.00	.00	0.	299	99	A27	.00
2330	2A	.0	.00	.0	.00	0	0.	.00000	.00	.00	0.	299	99	A27	.00
2330	3A	13.6	32.98	13.6	32.98	2	1370.	.07290	.00	.00	0.	299	7	A27	.01
2330	4A	11.5	24.63	25.1	53.30	0	0.	.00000	.00	.00	0.	299	9	A27	.01
2330	5B	38.1	73.94	38.1	73.94	2	861.	.05810	.00	.00	0.	299	11	A27	.01
2330	6B	13.5	28.91	51.6	100.57	0	0.	.00000	.00	.00	0.	299	9	A27	.01
2330	7AB	51.6	100.57	76.7	153.57	2	730.	.04000	.00	.00	0.	299	0	A27	.00
2330	8A	.0	.00	76.7	151.77	0	0.	.00000	.00	.00	0.	299	99	A27	.00
2330	9A	15.6	35.28	92.3	179.72	0	0.	.00000	.00	.00	0.	299	8	A27	.01
2330	10A	.0	.00	92.3	179.72	0	0.	.00000	.00	.00	0.	299	99	A27	.00
2330	11C	14.3	33.70	14.3	33.70	2	760.	.07890	.00	.00	0.	299	8	A28	.01
2330	12C	.0	.00	14.3	33.06	0	0.	.00000	.00	.00	0.	299	99	A28	.00
2330	13C	23.0	54.20	37.3	85.82	2	400.	.05000	.00	.00	0.	299	8	A28	.01
2330	14AC	37.3	85.31	129.6	263.55	2	692.	.02600	.00	.00	0.	299	0	A28	.00
2330	15A	21.3	51.64	150.9	292.12	2	1.	.01000	.00	.00	0.	299	7	A27	.01
2330	16D	12.9	31.28	12.9	31.28	2	1.	.01000	.00	.00	0.	299	7	A27	.01
2330	17D	.0	.00	12.9	31.28	0	0.	.00000	.00	.00	0.	299	99	A27	.00
2330	18AD	12.9	31.28	163.8	314.33	2	915.	.00109	.00	.00	0.	299	0	A28	.00
2330	19A	13.1	23.07	176.9	259.32	4	1.	.01000	5.00	.00	0.	99	12	A28	.05

```
006  2330    1A 299 1113.818A292  1.0001000                0  G1
006  2330    2A 299  0  .099A292  1.0001000                02  2
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Version 11.3, MODIFIED RATIONAL METHOD HYDROLOGY - STORM YEAR = 50 SOIL DATA FILE: C:\civild\lasoilx.dat

DEV BELCARO Q50B - BASIN D STORM DAY 4

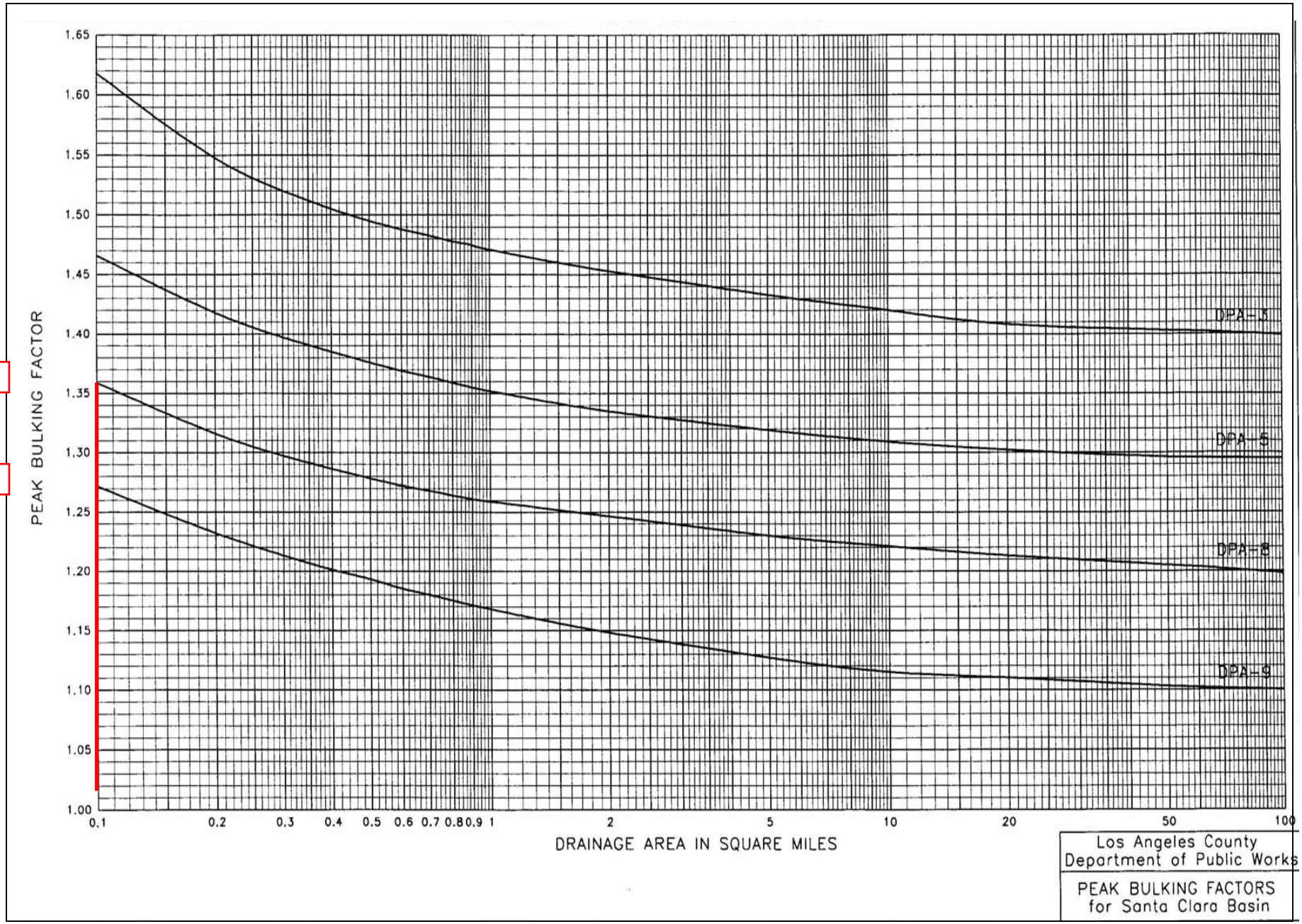
LOCATION		SUBAREA AREA(Ac)	SUBAREA Q(CFS)	TOTAL AREA(Ac)	TOTAL Q(CFS)	CONV TYPE	CONV LNGTH(Ft)	CONV SLOPE	CONV SIZE(Ft)	CONV Z	CONTROL Q(CFS)	SOIL NAME	TC	RAIN ZONE	PCT IMPV
2330	1A	13.8	22.47	13.8	22.47	2	1.	.01000	.00	.00	0.	299	18	A29	.11
2330	2A	.0	.00	13.8	22.47	2	1.	.01000	.00	.00	0.	299	99	A29	.00

APPENDIX D

BULKING CALCULATIONS

1.36

1.27


PEAK BULKING FACTOR
1.65
1.60
1.55
1.50
1.45
1.40
1.35
1.30
1.25
1.20
1.15
1.10
1.05
1.00
DPA-3
DPA-5
DPA-8
DPA-9
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2
5
10
20
50
100
DRAINAGE AREA IN SQUARE MILES
Los Angeles County
Department of Public Works
PEAK BULKING FACTORS
for Santa Clara Basin

APPENDIX E

DEBRIS PRODUCTION

DEBRIS PRODUCTION

DRAINAGE BASIN	SUBAREA	TRIBUTARY AREA		DPA ZONE	DPR	DEBRIS YIELD
		AC	SQ MI		CY/SQ MI	CY
B	4A	34.1	0.05	8	25,500	1,359
C	18AD	163.5	0.26	8	25,500	6,514

APPENDIX F

APPROVED SIKAND STUDY

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
CITY ENGINEER/SUPERINTENDENT OF STREET
LAND DEVELOPMENT DIVISION
SUBDIVISION PLAN CHECKING SECTION
DRAINAGE UNIT

To: SIKAND Engineering/Planning/Surveying DATE 01/09/2008

Attention: Doug Farmer

REVIEW OF HYDROLOGY STUDY/SUSMP & OFF-SITE HYDRAULICS

TR NO. 063022
MTD NO. Not Yet Assigned
CITY OF SANTA CLARITA
SUBMITTAL DATE 01/08/08

We have reviewed your Hydrology Study/SUSMP and Off-site Hydraulics.

[X] The Hydrology Study/SUSMP and Off-site Hydraulics are recommended for City approval for Area and Q only subject to the comments noted herein and on the returned map.

COMMENTS & CONDITIONS:

- Submit Hydrology Study/SUSMP to the City of Santa Clarita for final signature and approval. Return one set (signed) to LACDPW Land Development Division.
- Approval for location, span, and clearance for proposed bridges spanning the watercourses are recommended.
- Prior to the transfer of this MTD the City of Santa Clarita will finance the future ongoing maintenance and capital replacement of SUSMP devices/systems.
- A maintenance permit is required from the State Department of Fish and Game, the Corps of Engineers, and the State Water Resources Control Board for debris basins with a minimum capacity of 5,000 cubic yards. This is required to the satisfaction of the Department of Public Works prior to the filing of the final map.
- Notify the State Department of Fish and Game prior to commencement of work within any natural drainage course. If non-jurisdiction is established by the Department of Fish and Game, submit a letter of non-jurisdiction to Public Works (Land Development Division).
- Contact the State Water Resources Control Board to determine if a Notice of Intent (NOI) and a Storm Water Pollution Prevention Plan (SWPPP) are required to meet National Pollution Discharge Elimination System (NPDES) construction requirements for this site.

COMMENTS & CONDITIONS: (cont.)

- Contact the Corps of Engineers to determine if a permit is required for any proposed work within a watercourse. Provide a copy of the 404 Permit upon processing of the drainage plans. If non-jurisdiction is established by the Corps of Engineers, submit a letter of non-jurisdiction to Public Works (Land Development Division).

- This site is located in Zone "A" per the Federal Flood Insurance Rate Map. Public Works, Watershed Management Division (626) 458-4322, should be contacted to obtain procedures for revising the flood insurance rate map once the storm drain facilities are constructed. Encroachment into FEMA Zone "A" is not permitted prior to obtaining a Conditional Letter of Map Revision (CLOMR) from FEMA.

- Portions of the County Adopted Floodway Maps (43-ML37 and 382-ML1) must be rescinded and revised by the Board of Supervisors prior to recordation of the final map. The modifications to the floodplain and floodway will not extend beyond the project boundary since the hydraulic impacts are restricted to this tract.

- Prior to approval of any grading, storm drain, or other improvement plan and prior to recordation of any final map for this subdivision, notarized drainage covenants, in a form approved by Public Works, shall be obtained from all impacted offsite property owners, as determined by Public Works, and shall be recorded by the applicant. The number of offsite drainage covenants will be determined by Public Works based on hydrology and hydraulic studies which must be prepared by the applicant's consultants and submitted to Public Works for review and approval, in a format acceptable to Public Works. By acceptance of this condition, the applicant acknowledges and agrees that this condition does not require or otherwise involve the construction or installation of an offsite improvement, and that the offsite drainage covenants referenced above do not constitute an offsite easement, license, title or interest in favor of the County. Therefore, the applicant acknowledges and agrees that the provisions of Government Code Section 66462.5 do not apply to this condition and that the County shall have no duty or obligation to acquire by negotiation or by eminent domain any land or any interest in any land in connection with this condition.

REVIEWED BY _____

EJR

DIEGO G. RIVERA
(626) 458-4921

HYDROLOGY STUDY / SUSMP

FOR

MANCARA

TENTATIVE TRACT 063022

Prepared for:

ROBINSON RANCH RESIDENTIAL, LP

Prepared By:

SEAND ENGINEERING ASSOCIATES
15230 Burbank Blvd., Suite 100
Van Nuys, CA 91411
Telephone (818) 787-8550

Doug Farmer

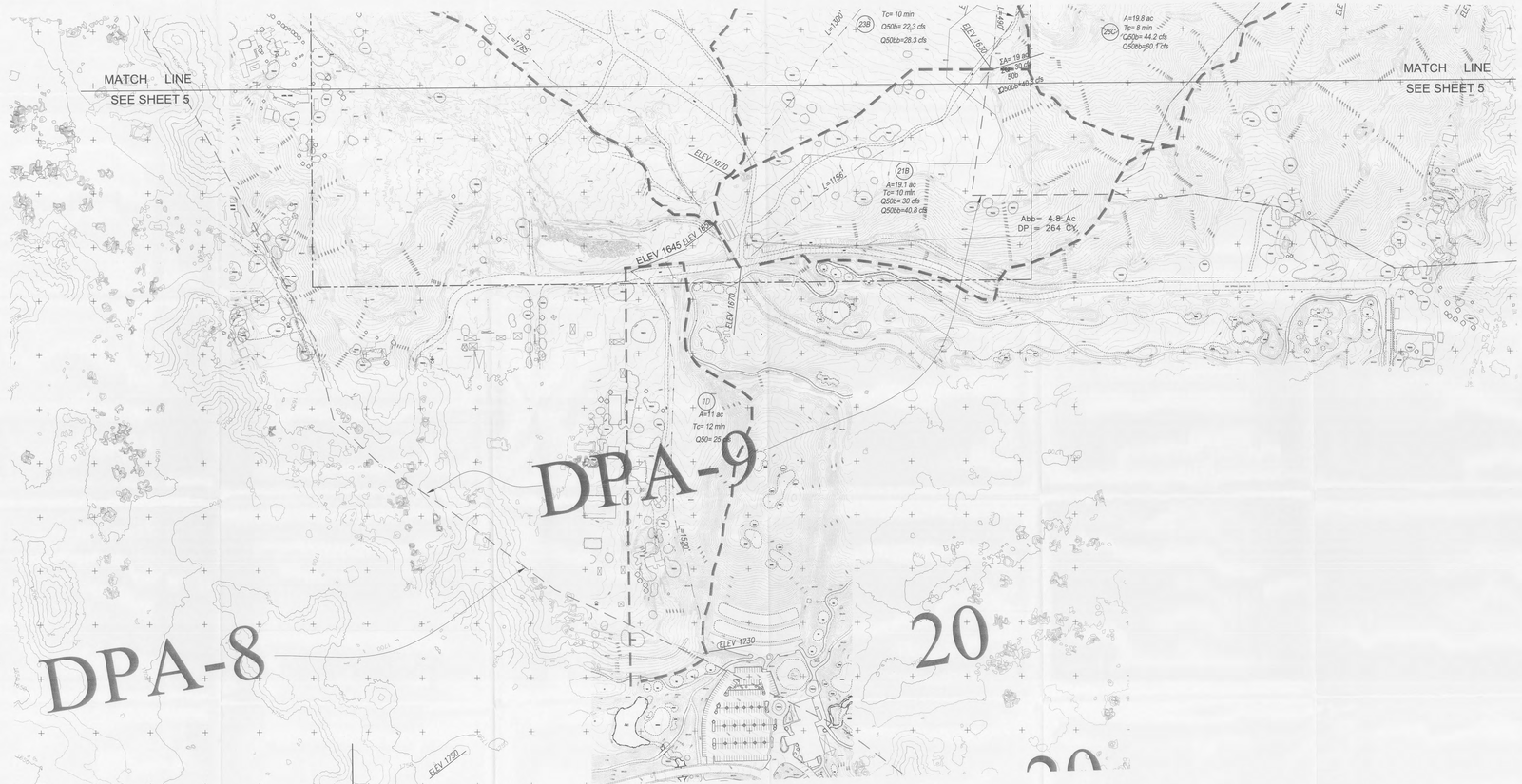
Doug Farmer, PE

W.O.: 5089-060-04

Date: January 07, 2008

HYDROLOGY STUDY / SUSMP
APPROVED FOR AREA AND Q ONLY
APPROVED BY: _____ RCE NO. 46872 DATE: 4-1-08

HYDROLOGY STUDY / SUSMP
MTD — CITY OF Santa Clarita
RECOMMENDED FOR CITY APPROVAL
RECOMMENDED BY: _____ RCE NO. 62550 DATE: 1/9/08
CHECKED BY: _____ DATE: 01/09/08
LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
LAND DEVELOPMENT DIVISION



HYDROLOGY CRITERIA

RAINFALL FREQUENCY: 50 YR UNDEVELOPED
DPA : 8, 9
50-YEAR 24-HOUR ISOHYET : 5.4 + 5.8 INCHES PER HOUR (SEE MAP)
SOIL TYPE : 020, 099
BULKING FACTOR : 1.36 (DPA-8 FOR 64 Ac. OR UNDER, FOR OVER 64 Ac. SEE LACDPW Fig. P-5)
BULKING FACTOR : 1.27 (DPA-9 FOR 64 Ac. OR UNDER, FOR OVER 64 Ac. SEE LACDPW Fig. P-5)
DEBRIS PRODUCTION RATE : 55.00 Cy/Ac (DPA-8 FOR 64 Ac. OR UNDER, FOR OVER 64 Ac. SEE ATTACHED LACDPW Fig. P-2)
DEBRIS PRODUCTION RATE : 25.80 Cy/Ac (DPA-9 FOR 64 Ac. OR UNDER, FOR OVER 64 Ac. SEE ATTACHED LACDPW Fig. P-2)

LEGEND

SCRAPER BOUNDARY
PROPERTY LINE
FLOODPLAIN LIMITS
FLOWLINE
ISOHYET — 5.2 —

ABBREVIATIONS

Q50b	CAPITAL FLOOD FLOW
Q50bb	BOOSTED 100-YR RELIEF FLOW
A und	AREA UNDEVELOPED
DV	DEBRIS VOLUME
EXIST.	EXISTING
ELEV. 1660	ELEVATION

HYDROLOGY STUDY
MTD ____ CITY OF ____
RECOMMENDED FOR CITY APPROVAL
RECOMMENDED BY: ____ RCE NO. ____ DATE: ____
CHECKED BY: ____ DATE: ____
CIVIL DEVELOPMENT DIVISION
LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

HYDROLOGY STUDY
APPROVED FOR AREA AND Q ONLY
APPROVED BY: ____ RCE NO. ____ DATE: ____

PREPARED FOR:
ROBINSON RANCH RESIDENTIAL, LP
8447 WILSHIRE BLVD, SUITE 100
BEVERLY HILLS, CA 90211
TEL: (323) 966-4989

SIKAND Engineering (Planning) Surveying
15230 Burbank Blvd,
Van Nuys, CA 91411
Tel: (818) 787-8550
Fax: (818) 901-7451
info@sikand.com

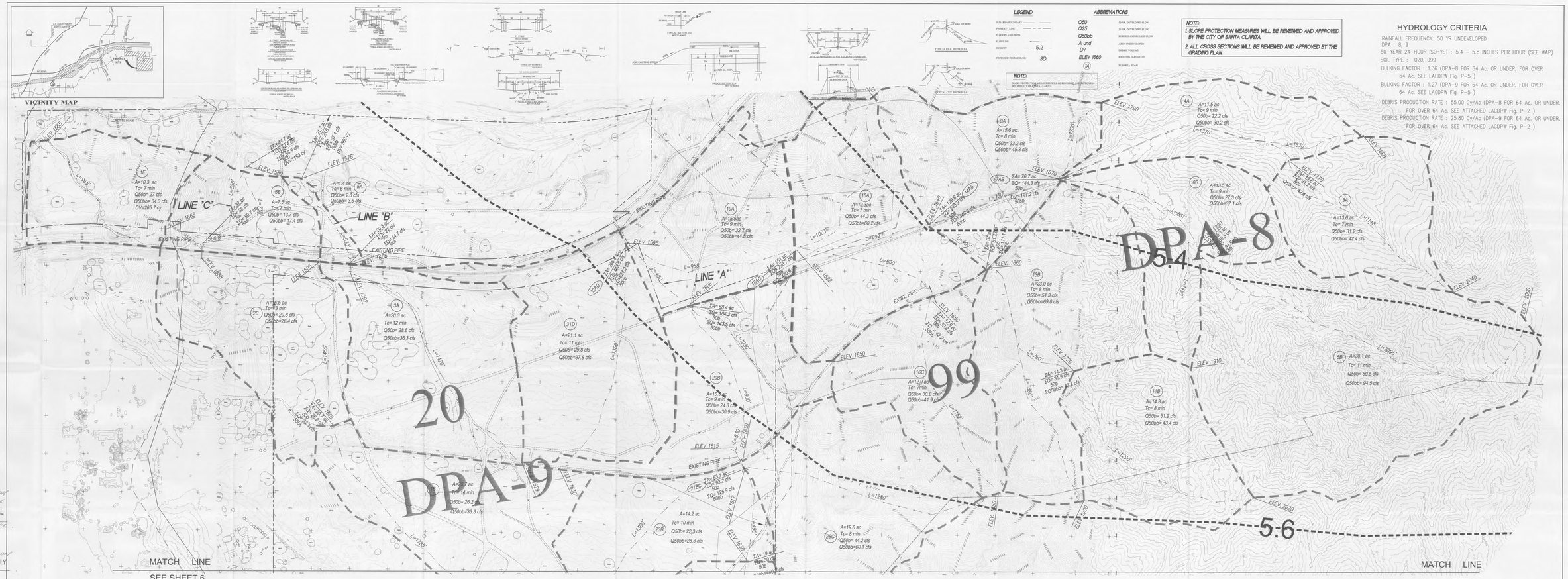
DATE	REVISION	BY	REVISION
SCALE: 1"=100'	DATE: BY: APPROVED: BY:	DATE: 12-20-07	JOB. NO. 5066-080-04

SHEET 6 OF 6

N

TENTATIVE TRACT NO. 063022
IN THE CITY OF SANTA CLARITA,
COUNTY OF LOS ANGELES

HYDROLOGY STUDY/SUSMP FOR TR 063022
EXISTING CONDITIONS



HYDROLOGY STUDY (signature)
MTD _____ CITY OF Santa Clarita
RECOMMENDED FOR CITY APPROVAL
RECOMMENDED BY: _____ RCE NO. _____ DATE: _____
REVIEWED BY: (signature) DATE: 12/19/07
LAND DEVELOPMENT DIVISION
LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

HYDROLOGY STUDY (signature)
APPROVED FOR AREA AND Q ONLY
APPROVED BY: _____ RCE NO. _____ DATE: _____

PREPARED FOR:
ROBINSON RANCH RESIDENTIAL, LP
8447 WILSHIRE BLVD., SUITE 100
BEVERLY HILLS, CA 90211
TEL: (323) 966-4989

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15230 Burbank Blvd,
Van Nuys, CA 91411
Tel: (818) 787-8550
Fax: (818) 901-7451
info@sikand.com

DATE	REVISION	BY	REVISION
SCALE: 1"=100'	DATE: 12-20-07	APPROVED BY:	JOB NO: 20080-060-04
			SHEET 5 OF 6

TENTATIVE TRACT NO. 063022
IN THE CITY OF SANTA CLARITA,
COUNTY OF LOS ANGELES

HYDROLOGY STUDY/SUSMP FOR TR 063022
EXISTING CONDITIONS

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

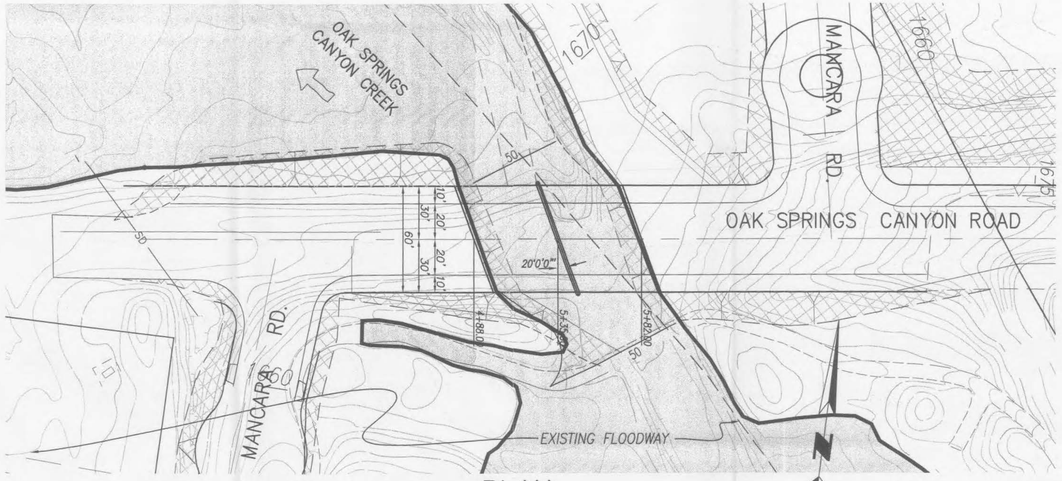
LOCATION, SPAN & CLEARANCE

FOR

OAK SPRINGS CANYON ROAD BRIDGE

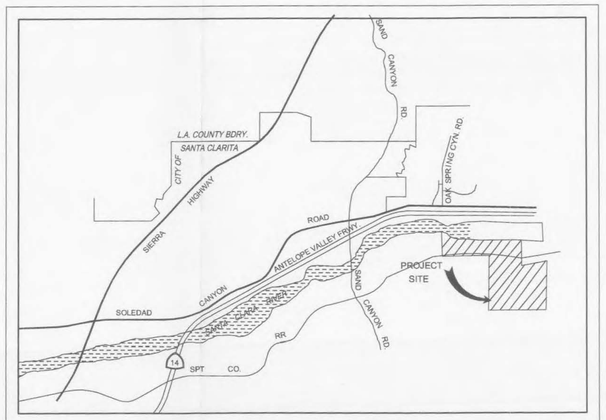
OVER

OAK SPRINGS CANYON CREEK



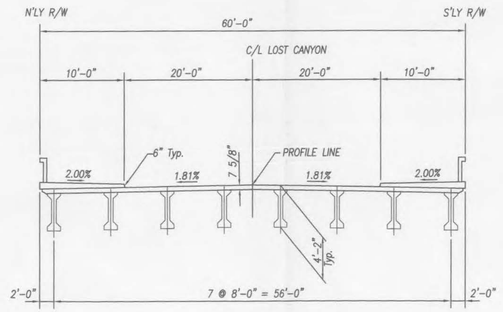
PLAN

SCALE: 1" = 40'



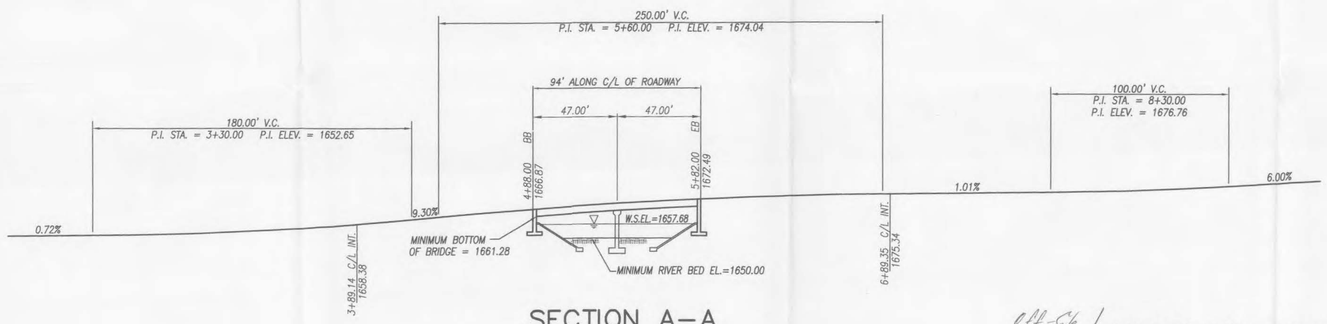
VICINITY MAP

NOT TO SCALE



SECTION B–B

SCALE: 1" = 10'



SECTION A–A

SCALE: 1" = 40'

Off-Site Hydraulics / HYDROLOGY STUDY / Bridge Clearance

APPROVED FOR AREA AND Q ONLY

APPROVED BY: [signature] RCE NO. 40872 DATE: 4-1-08

REGISTERED PROFESSIONAL ENGINEER
DOUG FARMER
No. 49041
Exp. 09-30-08
CIVIL
STATE OF CALIFORNIA

Off-Site Hydraulics / HYDROLOGY STUDY / Bridge Clearance

MTD — CITY OF Santa Clarita

RECOMMENDED FOR CITY APPROVAL

RECOMMENDED BY: [signature] RCE NO. 67550 DATE: 1/9/08

CHECKED BY: [signature] DATE: 01/09/08

LAND DEVELOPMENT DIVISION

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

SIKAND ENGINEERING ASSOCIATES CONSULTING ENGINEERS 15230 BURBANK BLVD., VAN NUYS, CALIFORNIA 91411 (818)787-8550	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS LOCATION, SPAN & CLEARANCE	
DESIGNED BY:	OAK SPRINGS CANYON ROAD BRIDGE OVER OAK SPRINGS CANYON CREEK	
DRAWN BY:		
PROJECT ENGINEER:	SUBMITTED: DIVISION ENGINEER DATE	BRIDGE NO.: PROJECT NO.:
	APPROVED: DONALD L. WOLFE, DIRECTOR OF PUBLIC WORKS BY: DEPUTY DIRECTOR DATE	SHT.: 2 OF: 2 DWG. NO.:

DRAWN | CHECKED | REVISIONS

X:\Sikand\2589-2601\04\Planning\Drawings\dwg\HYDROLOGY SH11.dwg, LSC_OAK SPRINGS, 12/19/07 17:07:19 by

ANTELOPE VALLEY FREEWAY

SANTA CLARA RIVER

ZONE A0 (DEPTH 3)

ZONE A

ZONE A0 (DEPTH 2)

ZONE A0 (DEPTH 1)

ZONE C

A0 1552.1

A1 1567.6

A2 1575.2

1579.2

A4 1582.7

OPEN SPACE FUTURE RECREATION AREA

5± AC PARK AREA

PARK AREA

RL

RVL

CITY CULVERT

Qbb=3906#S

Qbb=3906#S 309X

Qbb=3906#S 307X

Qbb=3906#S 304X

Qbb=3612#S 304XC

Qbb=3612#S 304X

Qbb=3612#S 304X

Qbb=3612#S 304X

LID Report – Belcaro at Sand Canyon, Alliance 2025

PACE

LID REPORT

City of Santa Clarita

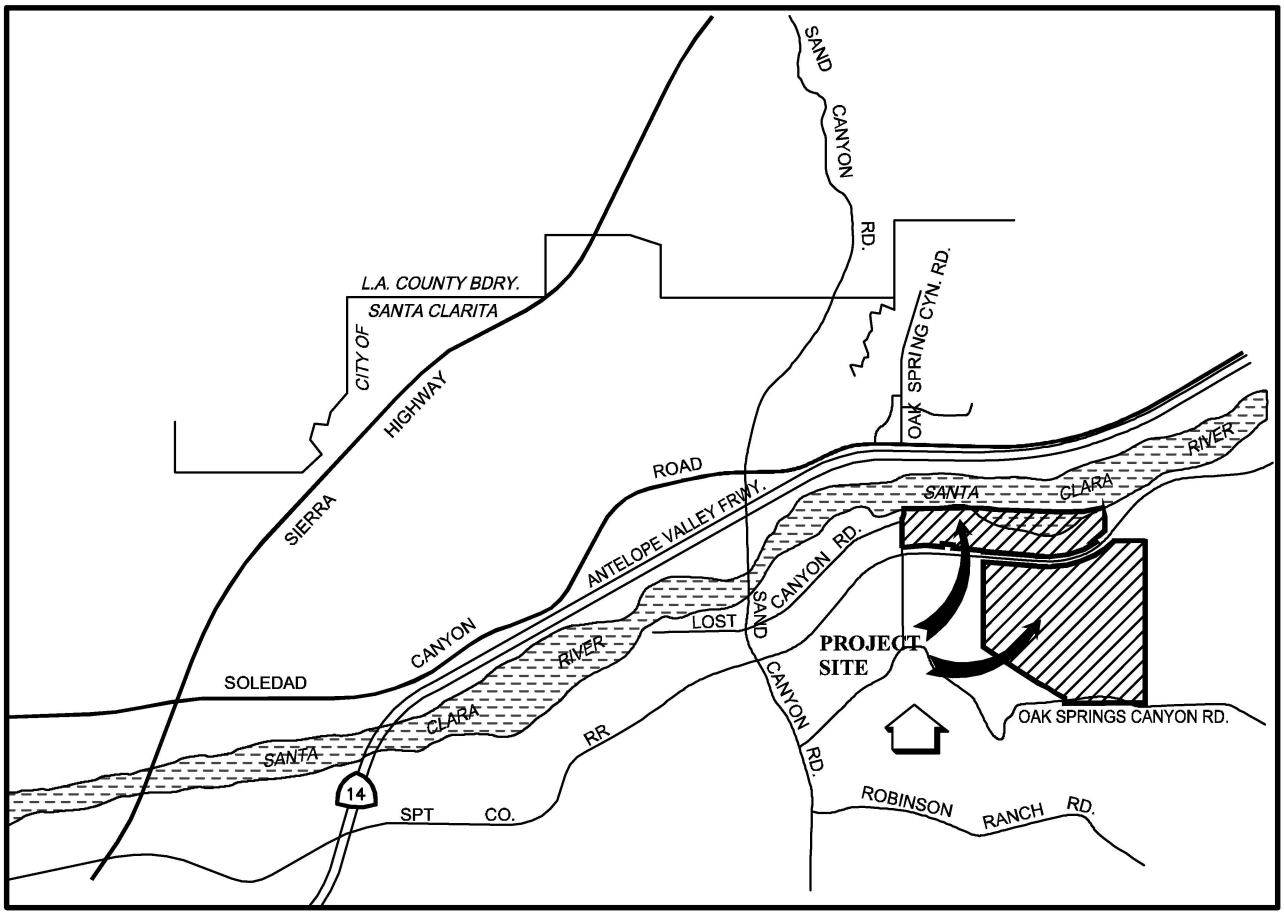
Belcaro At Sand Canyon
Vesting Tentative Tract No. 084497

JN 2330

Prepared For:
NUWI-Sand Canyon, LLC
2001 Wilshire Blvd, Ste 401
Santa Monica, CA 90403

Prepared By:
Alliance Land Planning & Engineering, Inc.
2248 Faraday Ave.
Carlsbad, CA 92008

August 5, 2025



VICINITY MAP

NOT TO SCALE

TG 4552-D2
TG 4552-E2
TG 4552-E3

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APPENDIX B - Water Quality Volume Summary Tables

APPENDIX C - LID Basin Design Calculations

APPENDIX D – Statement on Infiltration By Soils Engineer

APPENDIX E - Proprietary Contech Stormwater Detention Systems Info

APPENDIX F - BMP Master Covenant / Operations and Maintenance (O&M)

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Project Overview

The Belcaro at Sand Canyon project, VTTM No. 084497, is an approximately 193.8-acre project located in the City of Santa Clarita, CA. The project is located immediately south of the Santa Clarita River, east of the present terminus of Lost Canyon Road at Oak Springs Canyon Road and north of the Robinson Ranch Golf Course. Undeveloped property is located east of the project site.

Proposed development consists of 400 total lots, of which 341 lots will become Active Adult Residential Single-Family homes. The remaining lots are intended for recreation, open space and streets. The 341 residential lots cover a gross area of approximately 58.7 acres. A new bridge extending Lost Canyon Road into the project site will span across Oak Springs Canyon Creek. This extension of Lost Canyon Road will terminate at the Metrolink railroad tracks, where a new undercrossing will be built connecting to the northerly entrance ('A' Street) by the project. Prefabricated arch culverts will be constructed over Oak Springs Canyon Creek at the project's southerly boundary to allow for extension of the proposed 'J' Street and minor improvements of the existing Oak Springs Canyon Road. The proposed 'J' Street secondary access to the project will extend south through the Robinson Ranch Golf Course and then to Robinson Ranch Road.

Water quality features for this project will include above ground biofiltration basins as well as a single proprietary underground infiltration chamber (Contech).

Existing Condition Drainage

The project site is predominantly flat and undeveloped. Oak Springs Canyon Wash is the major drainage feature in the area and runs in a northwest direction through portions of the project site. Lost Canyon Road is presently an 'at grade' crossing with Oak Springs Canyon Wash and is flooded during major rain events.

The western third of the site drains into Oak Springs Canyon Wash. The Wash is ephemeral, mostly undeveloped, and outlets into the Santa Clara River. Just south of the River, the Wash runs beneath the Metrolink Rail line. This undercrossing also is also Oak Springs Canyon Road. Upstream of the project site, Oak Springs Canyon Wash runs through Robinson Ranch Golf Course. Portions of the wash through the golf course have been stabilized to protect against erosion and flooding. A small box culvert exists on the boundary between the project site and the golf course and acts as an overpass for Oak Springs Canyon Road at this location.

The eastern two thirds of the site drains northerly and drains under the Metrolink rail line via three existing pipe culverts. From the pipe culverts water sheet flows to the Santa Clara River.

Developed Condition Drainage

Developed condition flow patterns remain mostly unchanged as compared to those of the existing condition. The flow path and alignment of Oak Springs Canyon Wash will remain unchanged and continue to run northwesterly and out through the undercrossing of the Metrolink rail line. The golf course will continue to be the upstream source of flow for Oak Springs Wash and the Santa Clara River will continue to be the outlet. The project also includes the construction of the Lost Canyon Road bridge over the Oak Springs Canyon Wash, which will provide an all-weather access for the project and existing homes in the area.

Runoff from the eastern two-thirds of the project site will be treated and drain north through the new Metrolink rail line undercrossing and an existing levee culvert on eastern portion of the project site. The existing culvert will also continue to handle offsite flow from the undeveloped property to the east. Conveyance of the onsite developed runoff will occur through a system of underground storm drains and a drainage swale that bisects the project site. Above ground biofiltration basins and underground proprietary infiltration units (Contech) will be used to treat all water quality flows prior to discharge into the ultimate drainage outlet, the Santa Clara River.

Low Flow Routing

Low flows will be combined with high flows into standard storm drain catch basins and/or grated inlets where they will be separated by low-flow splitters which route water quality flows directly to their designated treatment location. High flows will bypass the low-flow splitter, designed to intercept only the water quality flowrate, where they will ultimately outlet at the Santa Clara River.

Storm drains equipped with splitter boxes placed in-line with high flow drain lines and will route low flows out of the main storm drain system after flow has already been captured at an upstream catch basin inlet. Each splitter box will be equipped with two outlet pipes; a low flow outlet pipe will be set with an invert at the bottom of the splitter box. A high flow outlet pipe will be set with an invert at the obvert of the low flow pipe. When flow exceeds the capacity of the low flow line, high flows will bypass through to the main storm drain line.

All above ground biofiltration basins and underground infiltration units will be offline from the main line storm drain system and will be equipped with overflow system piping if treatment unit capacity is ever exceeded.

Above Ground Biofiltration Basin Design

High ground water makes infiltration unsuitable at two (2) above ground basins (BMP B and at BMP C) located north of the railroad tracks near the River. Instead, biofiltration via engineered media, gravel, and underdrains will be used to mitigate storm water pollution at these basins. These basins have been designed to accommodate the 85th percentile volume multiplied by a factor of safety of 1.5.

The basins will be graded to the acreage that is reported in the following summary tables and what is shown on the LID map provided with this report. Water quality volumes will pass through 36” of engineered media, and an underdrain buried in 24” of 3/4” gravel. Each basin will be fully empty within 96 hours after any rainfall event. A maximum side slope of 2:1 will be used for grading along the banks of each basin. Both basins B and C are designed to pond at 1.5 feet deep with a minimum freeboard height of 1.0 feet.

Underground Infiltration Chamber (Contech CMP) Design

An Underground infiltration unit (BMP A) will be used where ground water is low for treatment of storm water runoff near the intersection of “J” Street and Oak Springs Canyon Road.

A statement on infiltration from the soils engineer concerning ground water at BMP A, BMP B, and BMP C is provided in Appendix D.

The underground unit will consist of 96" diameter pipes embedded in porous rock. No structures, walkways, or roadways are currently designed be constructed above this unit, the top of which will be 2.5 - 3.0 feet below finished ground. A minimum 10-foot setback will be maintained from the top of slope of any significant bank such as the rock erosion protection around the abutments of the "J" Street bridge over the Oak Springs stream channel.

This system will be completely offline from the adjacent onsite storm drain system that uses biofiltration.

Modeling and Methodology

Water quality flowrates and volumes for the 85th percentile rainfall event have been analyzed using methods prescribed in the LA County Low Impact Development Manual, 2014. The following hydrologic parameters and software have been used during this analysis:

- 85th % rainfall depth = 0.91 in
- 95th % rainfall depth = 1.73 in
- Soil Classification Area = 020, 099
- Time of concentration = HydroCalc software
- Flow rates and volumes = HydroCalc software

Only onsite drainage areas of the developed condition have been considered in this analysis.

Results

The above ground biofiltration basins and underground infiltration unit will be used treat water quality flows of the 85th percentile, 24-hr event. Table 1 and Table 2 below summarize the volume required and volume provided within each infiltration basin and underground unit as calculated per HydroCalc modeling software. Separate tables that summarize the required water quality flows tributary to each basin is provided in Appendix A.

Table 1 - Summary of Water Quality Basin Design

BASIN	INFILTRATION	TOP AREA	BOTTOM AREA	AVG AREA	DEPTH	VOLUME PROVIDED	
		sf	sf	sf	ft	cf	ac-ft
A	YES	2,496	2,496	2,496	9.0	16,043	0.37
B	NO	49,536	46,412	47,974	1.5	304,021	6.98
C	NO	12,902	11,597	12,250	1.5	76,362	1.75
					TOTAL	396,426	9.10

Table 2 - Summary of Water Quality Treatment Requirements

LID UNIT	VOLUME REQUIRED (x1.5 NON-INFILTRATION)		VOLUME PROVIDED		Δ
	cf	ac-ft	cf	ac-ft	ac-ft
A	15,761	0.36	16,043	0.37	0.01
B	300,992	6.91	304,021	6.98	0.07
C	18,664	0.43	76,362	1.75	1.32
TOTAL	335,417	7.70	396,426	9.10	1.40

LID Specific Requirements

The following list discusses additional aspects of the project's LID specific requirements:

Hydromodification

This project is considered exempt from hydromod requirements due to all developed project flows directly discharging into the Santa Clara River which has a LA County capital flood flowrate of greater than 25,000 cfs. Please see the section on the 'Capital Flood Analysis' below for additional comment on this subject.

Natural Areas

Natural undeveloped area comprises most of the existing condition site. To maintain the drainage condition of this natural area, the developed condition site will include significant amounts of landscaped or open space areas to encourage infiltration prior to entering the storm drain system. 5,000 to 7,000 square feet (sf) single family residential lots are estimated to be 75% or more landscaped or open space. A city/trailhead park site will also remain mostly landscaped or open space.

Stormwater Pollutants of Concern

The primary pollutants of concern anticipated for this project are associated with rooftops, private driveways, asphalt paved streets, and landscaped areas. These pollutants have been listed below for regions both on-site and downstream of the proposed development.

Pollutants of concern

Pathogens, nutrients, pesticides, organic compounds, oxygen demanding substances, trash and debris, hydrocarbons, oils and grease, sediments, and metals. No legacy pollutants are present.

Pollutants shall be removed through the treatment control BMP described above.

Pollutant Removal

Both above ground and below ground units will remove; trash and debris, total suspended solids (TSS), hydrocarbons, oil and grease, nitrogen, total phosphorus, iron, copper, lead, and zinc.

The infiltration unit includes an isolator row, where flow enters first. Here, treatment will remove trash and debris, hydrocarbons, oil and grease, and TSS, Similarly, biofiltration basins feature a splash pad that traps debris and slows water flow before passing through engineered media, gravel and an underdrain.

Slopes and Channels

Slopes exist at various locations around the perimeter of the graded residential lots and along roads. Residential pad slopes will be landscaped and maintained by the home owner. Slopes along roadways will be maintained by HOA. Where feasible, surface runoff generated from these slopes will drain to water quality treatment basins as delineated in the LID map.

One engineered channel bisects the developed site and runs north to south. This channel conveys offsite flows originating from the hillsides to the south of the site. Channel banks will be vegetated and maintained by HOA.

Storm Drain System Stenciling

Grated inlet storm drain catch basins and low flow grated inlet catch basins are proposed for this project. “NO DUMPING. DRAINS TO RIVER” stencils will be painted at each inlet location per directives shown on the LID Map. Since this project will contain rolled curbs, stencils shall be painted upon the concrete face of the rolled curb above the gutter flowline where practical.

Outdoor Material Storage Areas

No outdoor material storage areas are proposed for this project.

Properly Design Trash Storage Areas

No trash storage areas are proposed for the project.

BMP Maintenance (O&M)

Per BMP covenant in Appendix E of this report, it is the responsibility of the owner and/or future HOA to maintain the proposed above ground infiltration basins and underground units once the project is complete. Specialized Operations and Maintenance (O&M) Manuals are included with this report also in Appendix E.

Conclusion

Water quality modeling and Table 2 above show that the capacity of the proposed above ground biofiltration basins and underground infiltration chamber is adequate for treatment of all site runoff at Belcaro.

The Belcaro project is considered acceptable with regards to LID impacts to the City of Santa Clarita.

APPENDIX A

HYDROCALC MODEL OUTPUT

Peak Flow Hydrologic Analysis

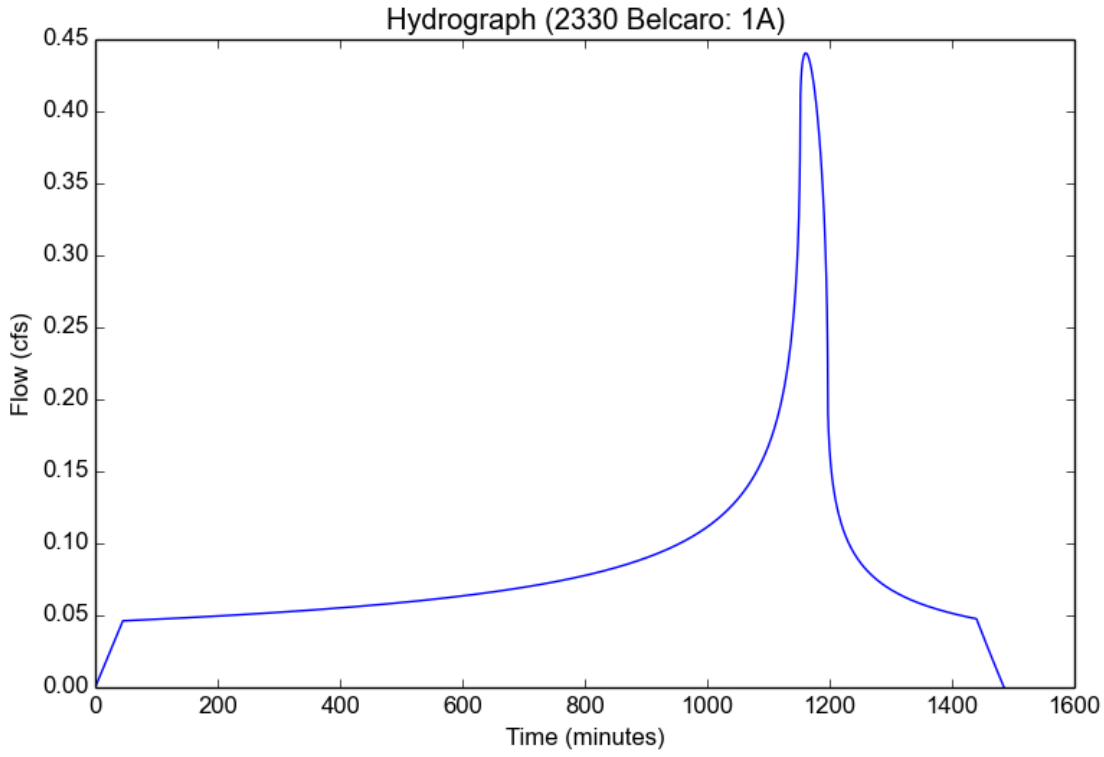
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	1A
Area (ac)	2.7
Flow Path Length (ft)	1815.0
Flow Path Slope (vft/hft)	0.048
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.93
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.1933
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.844
Time of Concentration (min)	45.0
Clear Peak Flow Rate (cfs)	0.4405
Burned Peak Flow Rate (cfs)	0.4405
24-Hr Clear Runoff Volume (ac-ft)	0.1714
24-Hr Clear Runoff Volume (cu-ft)	7465.5436



Peak Flow Hydrologic Analysis

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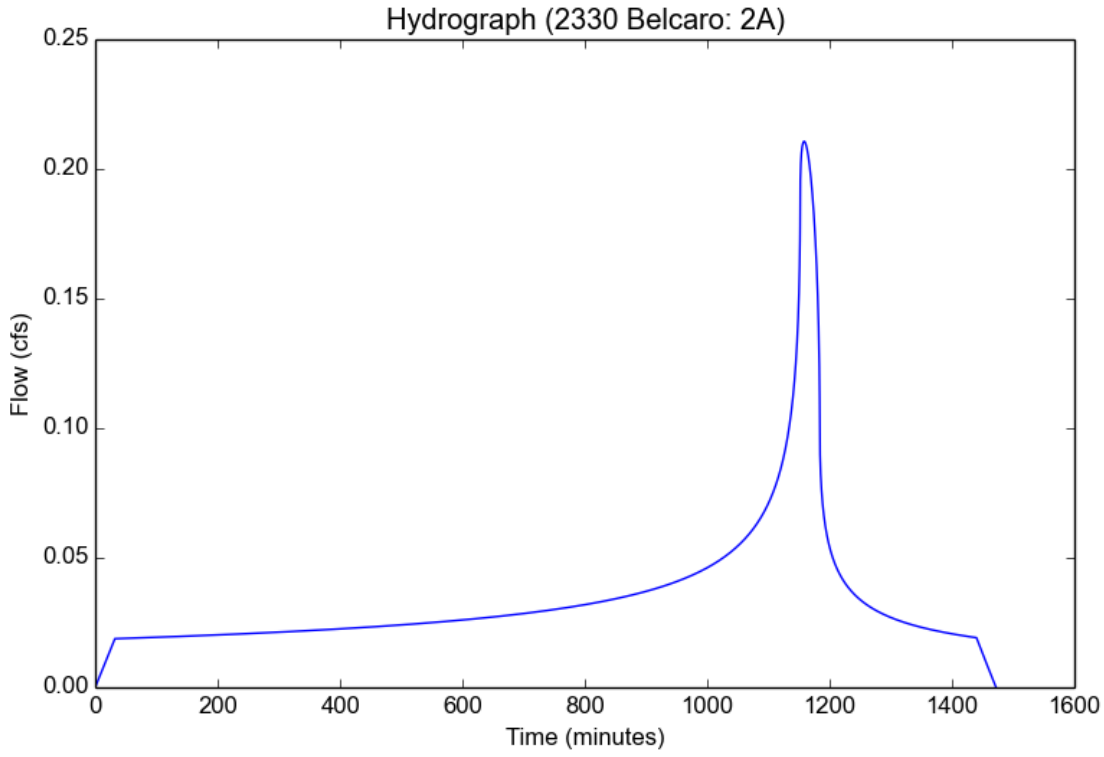
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	2A
Area (ac)	1.1
Flow Path Length (ft)	1035.0
Flow Path Slope (vft/hft)	0.04
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.93
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2269
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.844
Time of Concentration (min)	32.0
Clear Peak Flow Rate (cfs)	0.2107
Burned Peak Flow Rate (cfs)	0.2107
24-Hr Clear Runoff Volume (ac-ft)	0.0698
24-Hr Clear Runoff Volume (cu-ft)	3041.4782



Peak Flow Hydrologic Analysis

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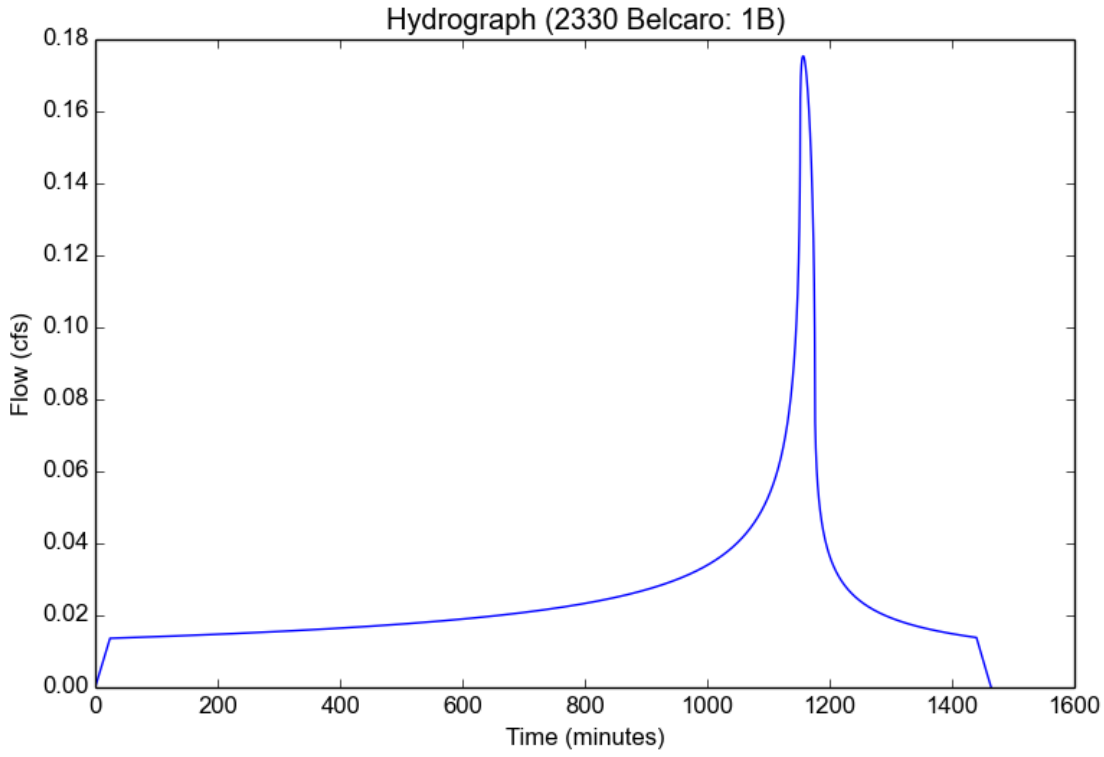
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	1B
Area (ac)	0.8
Flow Path Length (ft)	591.0
Flow Path Slope (vft/hft)	0.027
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.93
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2598
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.844
Time of Concentration (min)	24.0
Clear Peak Flow Rate (cfs)	0.1754
Burned Peak Flow Rate (cfs)	0.1754
24-Hr Clear Runoff Volume (ac-ft)	0.0508
24-Hr Clear Runoff Volume (cu-ft)	2211.9714



Peak Flow Hydrologic Analysis

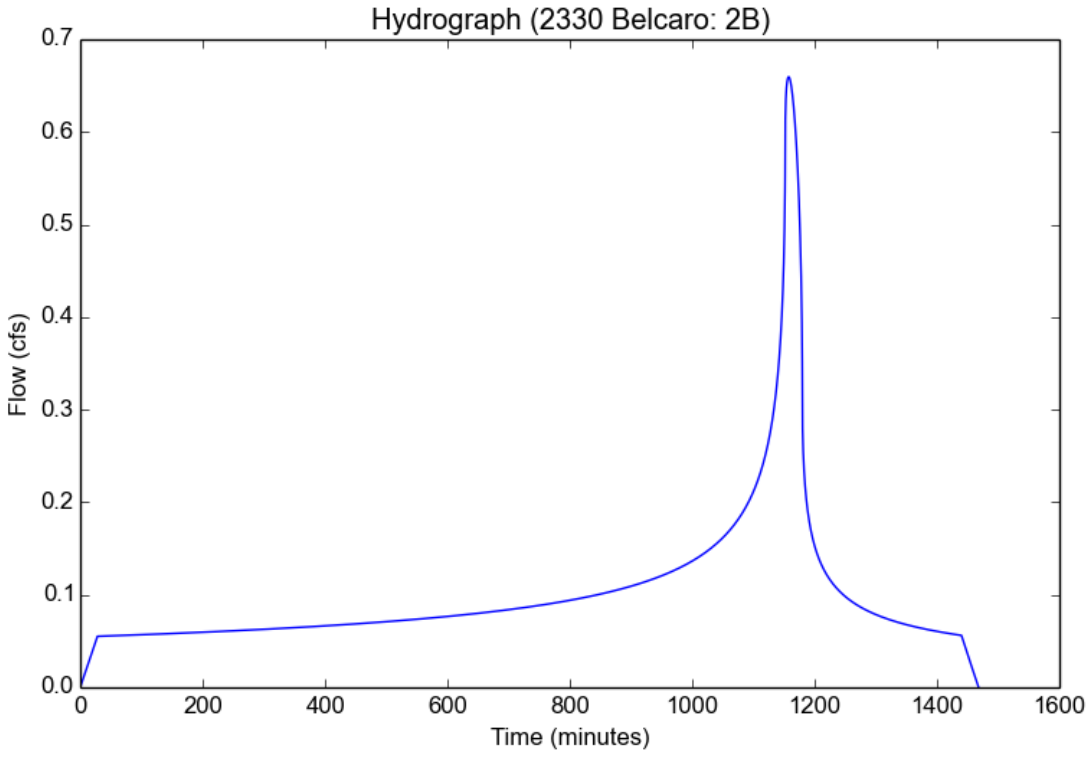
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	2B
Area (ac)	3.9
Flow Path Length (ft)	614.0
Flow Path Slope (vft/hft)	0.029
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2416
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	28.0
Clear Peak Flow Rate (cfs)	0.6596
Burned Peak Flow Rate (cfs)	0.6596
24-Hr Clear Runoff Volume (ac-ft)	0.2053
24-Hr Clear Runoff Volume (cu-ft)	8943.5693



Peak Flow Hydrologic Analysis

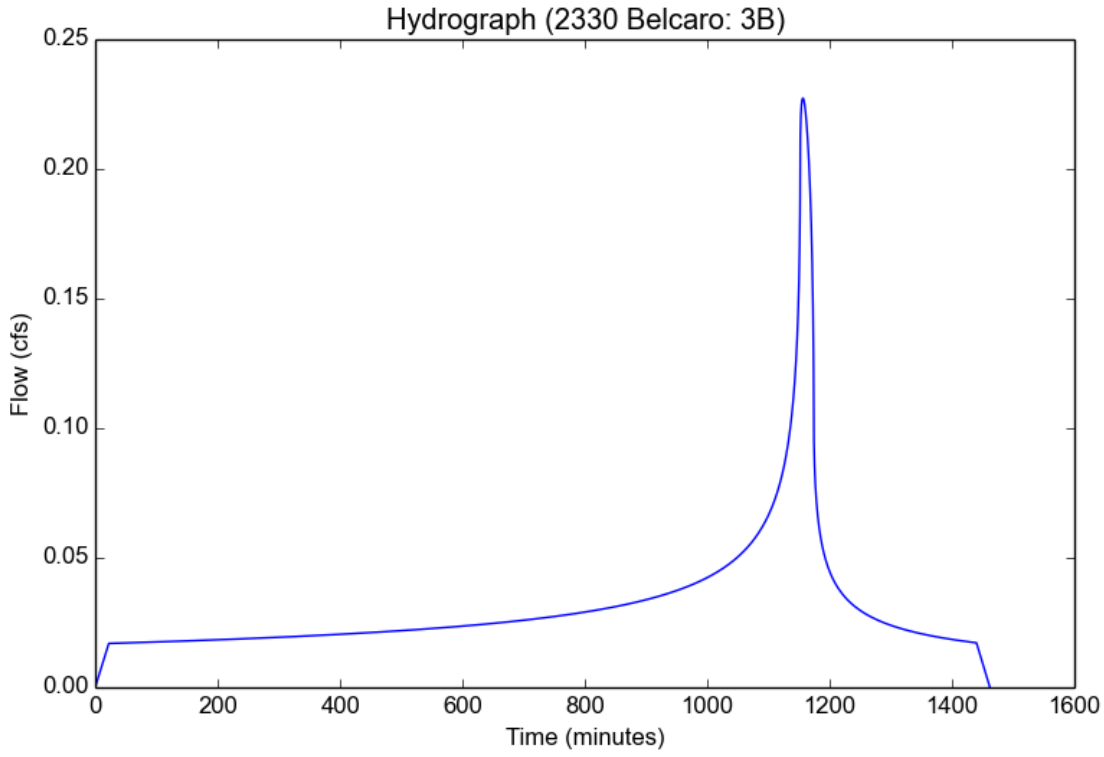
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	3B
Area (ac)	1.2
Flow Path Length (ft)	395.0
Flow Path Slope (vft/hft)	0.025
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2706
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	22.0
Clear Peak Flow Rate (cfs)	0.2273
Burned Peak Flow Rate (cfs)	0.2273
24-Hr Clear Runoff Volume (ac-ft)	0.0632
24-Hr Clear Runoff Volume (cu-ft)	2751.8569



Peak Flow Hydrologic Analysis

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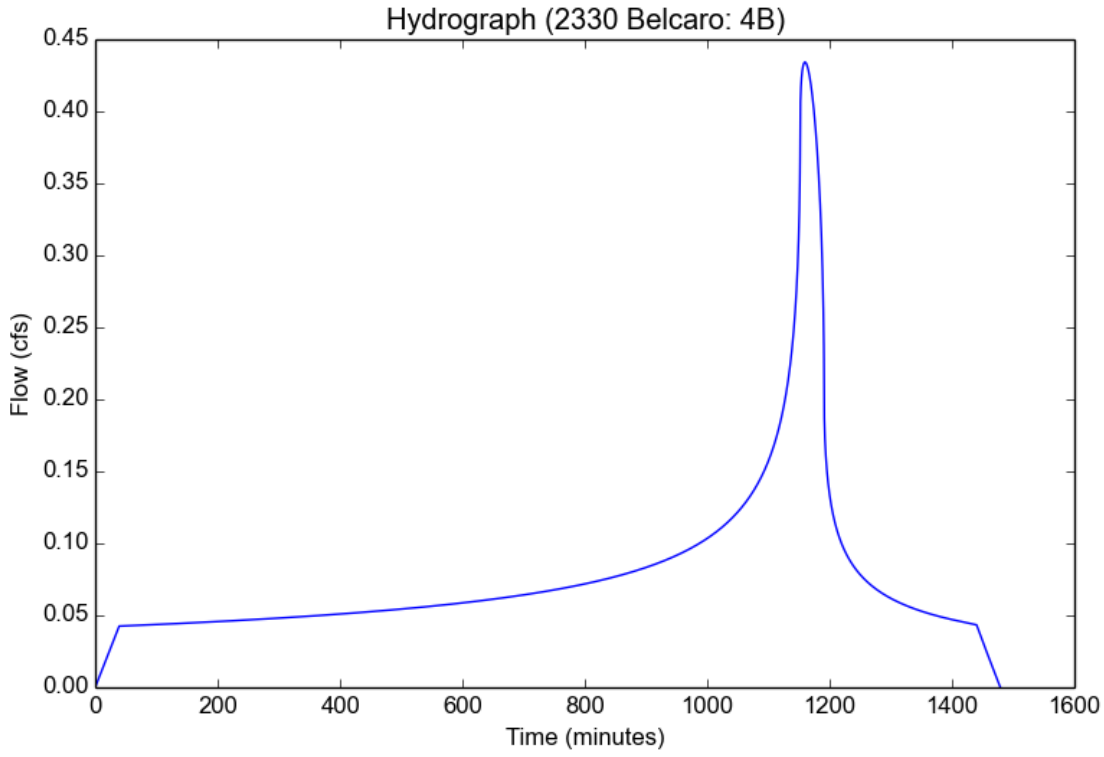
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	4B
Area (ac)	3.0
Flow Path Length (ft)	706.0
Flow Path Slope (vft/hft)	0.007
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2068
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	39.0
Clear Peak Flow Rate (cfs)	0.4342
Burned Peak Flow Rate (cfs)	0.4342
24-Hr Clear Runoff Volume (ac-ft)	0.1579
24-Hr Clear Runoff Volume (cu-ft)	6879.7343



Peak Flow Hydrologic Analysis

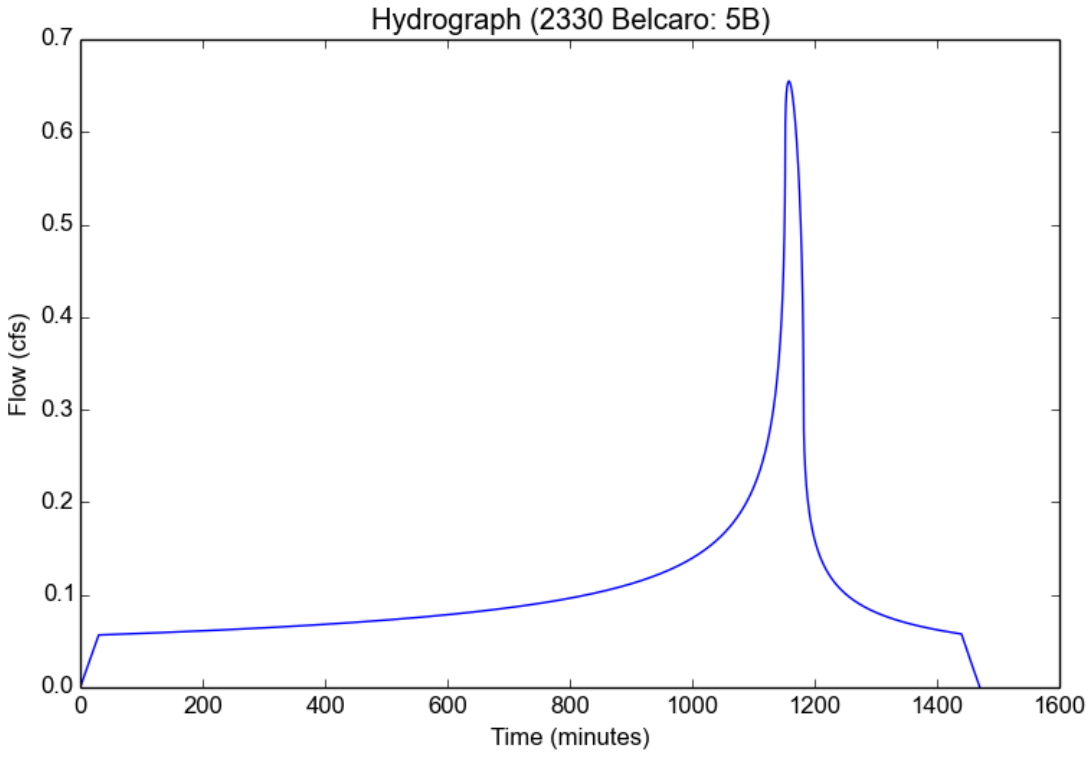
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	5B
Area (ac)	4.0
Flow Path Length (ft)	694.0
Flow Path Slope (vft/hft)	0.031
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2339
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	0.6549
Burned Peak Flow Rate (cfs)	0.6549
24-Hr Clear Runoff Volume (ac-ft)	0.2106
24-Hr Clear Runoff Volume (cu-ft)	9172.9053



Peak Flow Hydrologic Analysis

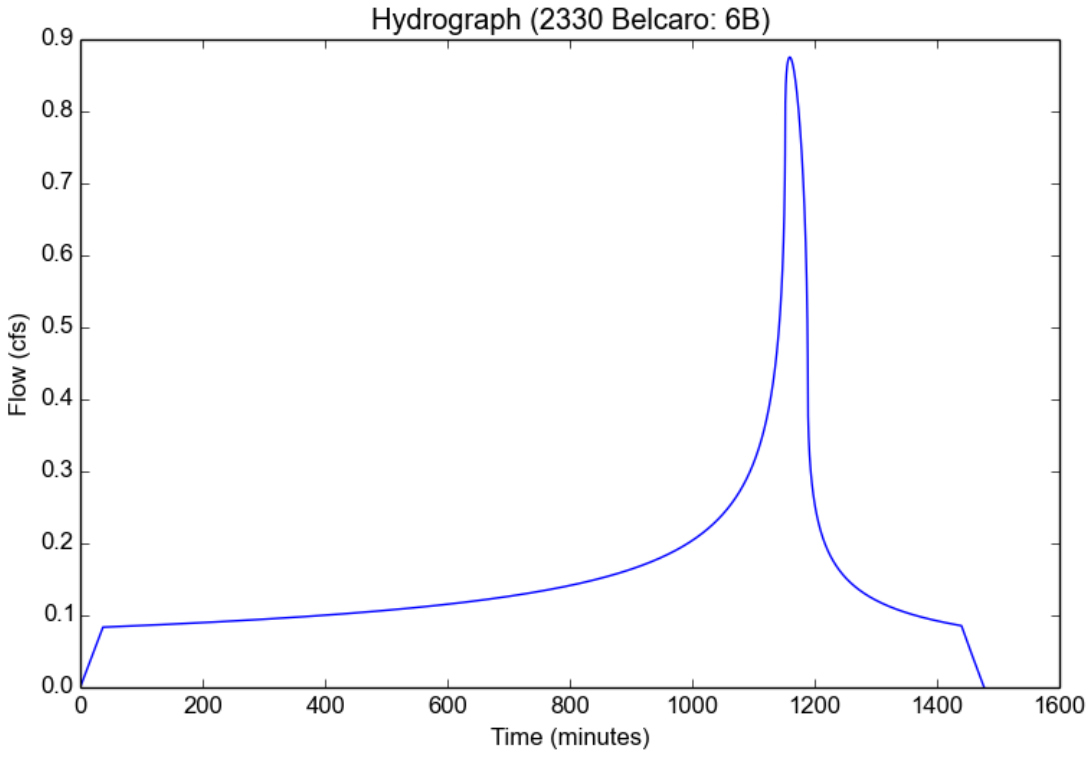
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	6B
Area (ac)	5.9
Flow Path Length (ft)	849.0
Flow Path Slope (vft/hft)	0.019
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2119
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	37.0
Clear Peak Flow Rate (cfs)	0.8753
Burned Peak Flow Rate (cfs)	0.8753
24-Hr Clear Runoff Volume (ac-ft)	0.3106
24-Hr Clear Runoff Volume (cu-ft)	13530.1174



Peak Flow Hydrologic Analysis

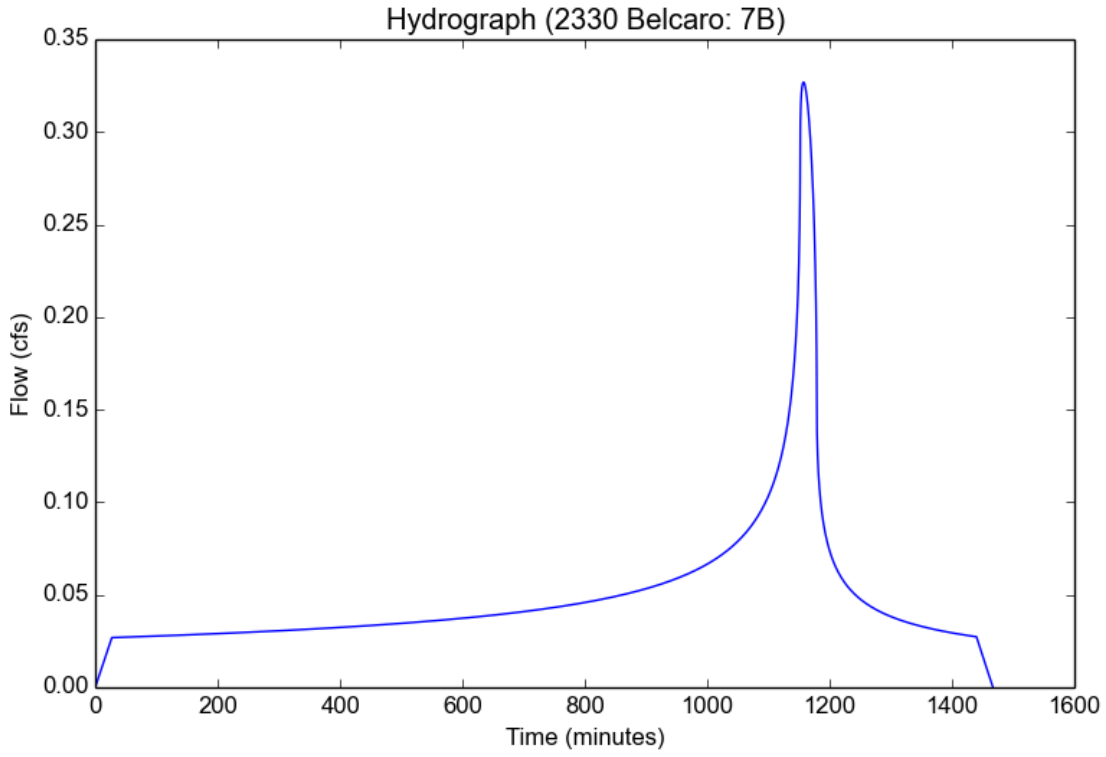
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	7B
Area (ac)	1.9
Flow Path Length (ft)	525.0
Flow Path Slope (vft/hft)	0.019
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2458
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	27.0
Clear Peak Flow Rate (cfs)	0.3269
Burned Peak Flow Rate (cfs)	0.3269
24-Hr Clear Runoff Volume (ac-ft)	0.1
24-Hr Clear Runoff Volume (cu-ft)	4357.1204



Peak Flow Hydrologic Analysis

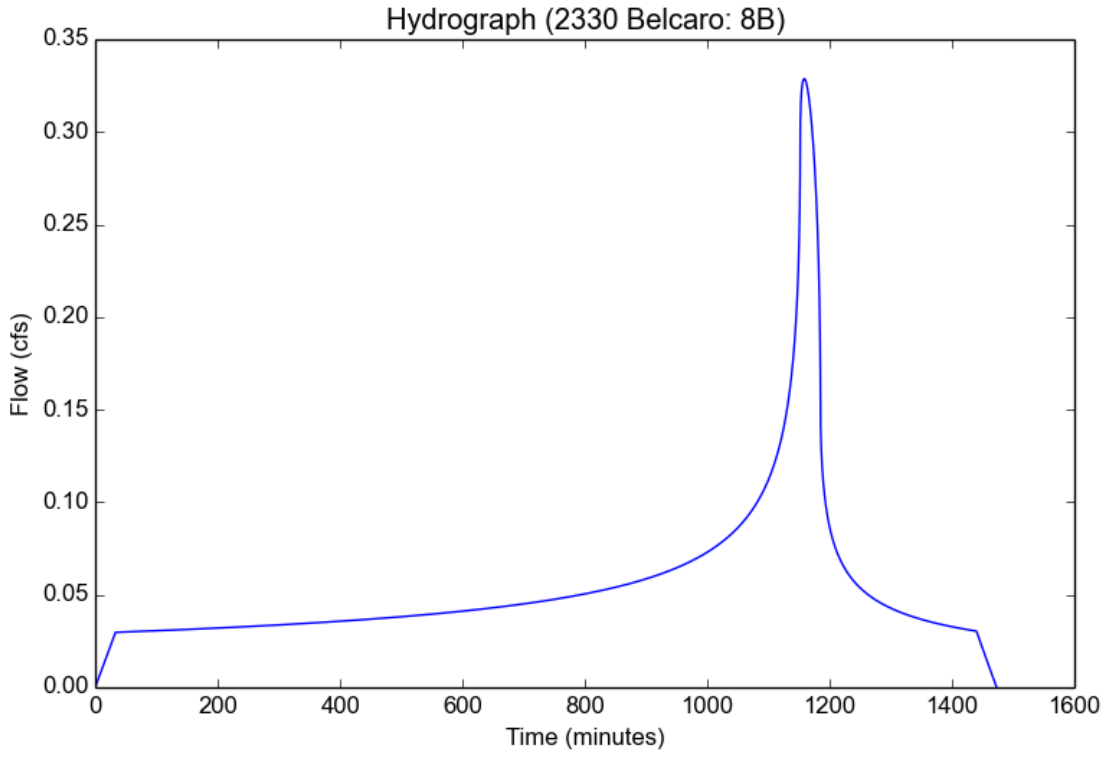
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	8B
Area (ac)	2.1
Flow Path Length (ft)	571.0
Flow Path Slope (vft/hft)	0.009
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2236
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	33.0
Clear Peak Flow Rate (cfs)	0.3288
Burned Peak Flow Rate (cfs)	0.3288
24-Hr Clear Runoff Volume (ac-ft)	0.1106
24-Hr Clear Runoff Volume (cu-ft)	4815.787



Peak Flow Hydrologic Analysis

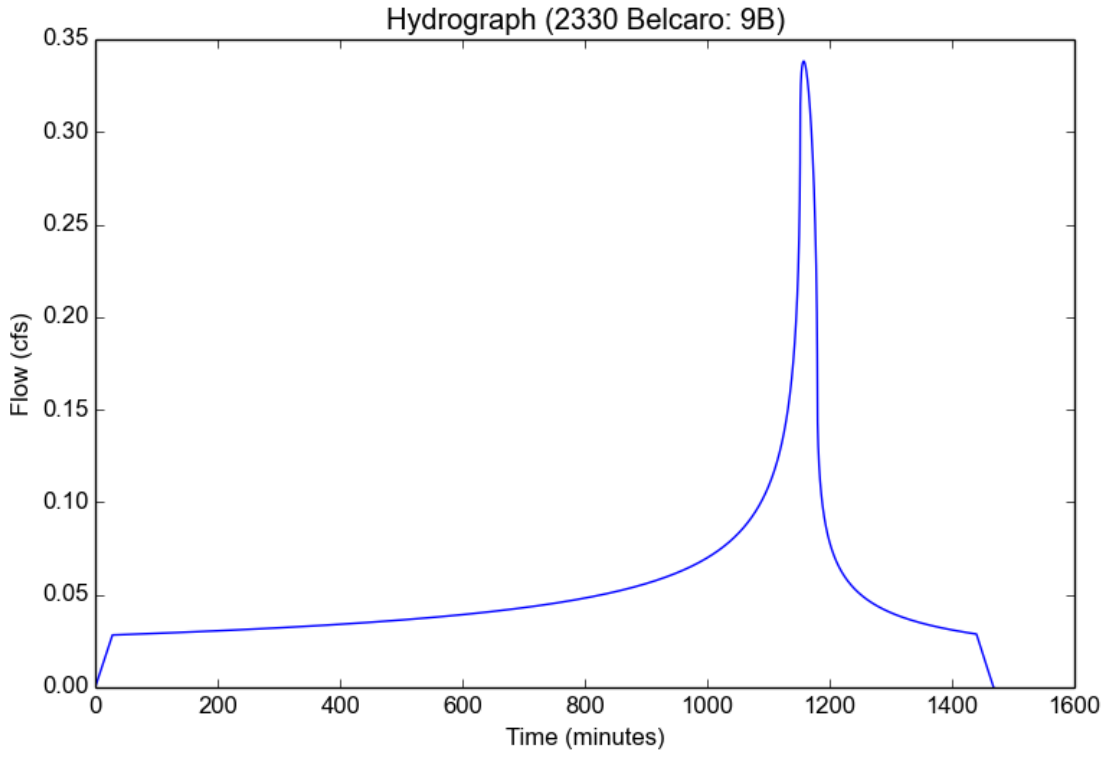
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	9B
Area (ac)	2.0
Flow Path Length (ft)	462.0
Flow Path Slope (vft/hft)	0.011
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2416
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	28.0
Clear Peak Flow Rate (cfs)	0.3382
Burned Peak Flow Rate (cfs)	0.3382
24-Hr Clear Runoff Volume (ac-ft)	0.1053
24-Hr Clear Runoff Volume (cu-ft)	4586.4458



Peak Flow Hydrologic Analysis

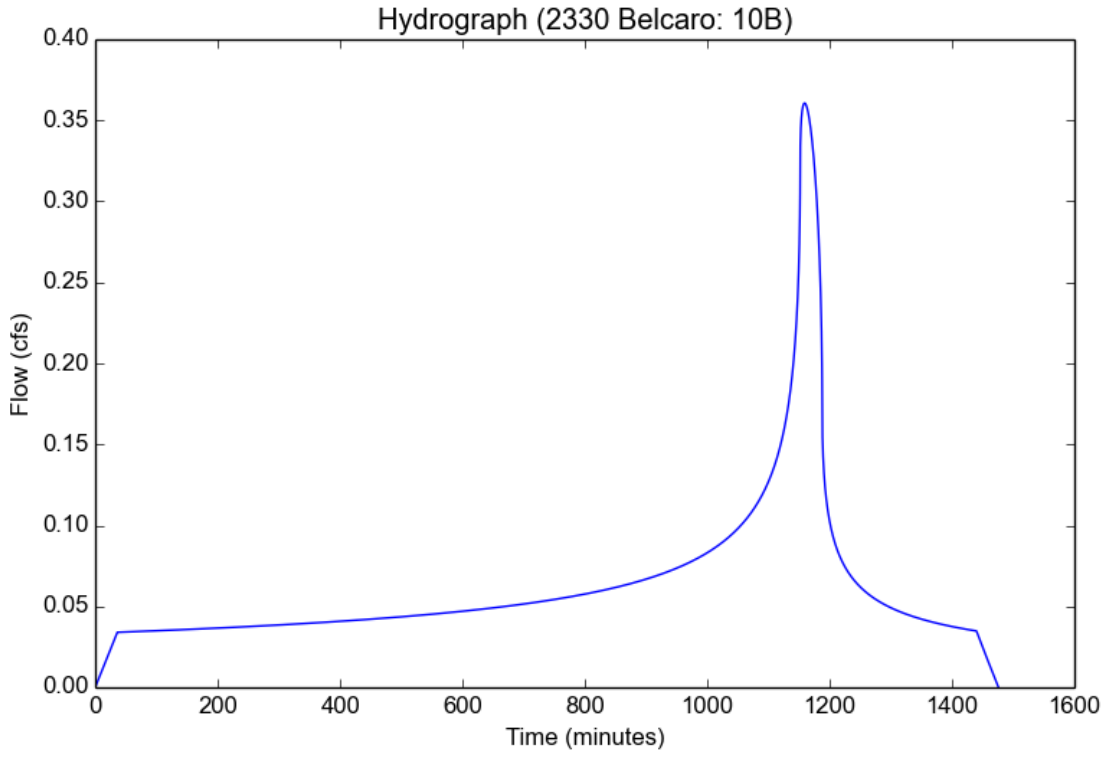
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	10B
Area (ac)	2.4
Flow Path Length (ft)	565.0
Flow Path Slope (vft/hft)	0.005
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2147
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	36.0
Clear Peak Flow Rate (cfs)	0.3607
Burned Peak Flow Rate (cfs)	0.3607
24-Hr Clear Runoff Volume (ac-ft)	0.1263
24-Hr Clear Runoff Volume (cu-ft)	5503.7714



Peak Flow Hydrologic Analysis

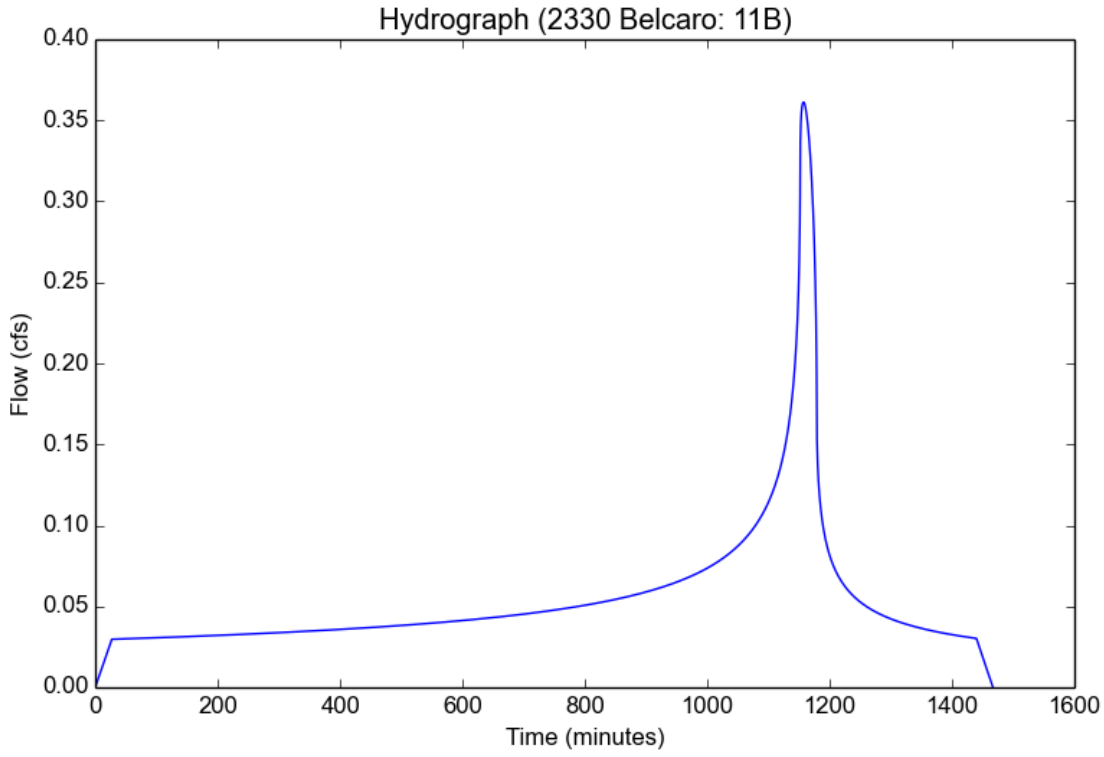
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	11B
Area (ac)	2.1
Flow Path Length (ft)	489.0
Flow Path Slope (vft/hft)	0.015
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2458
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	27.0
Clear Peak Flow Rate (cfs)	0.3613
Burned Peak Flow Rate (cfs)	0.3613
24-Hr Clear Runoff Volume (ac-ft)	0.1106
24-Hr Clear Runoff Volume (cu-ft)	4815.7647



Peak Flow Hydrologic Analysis

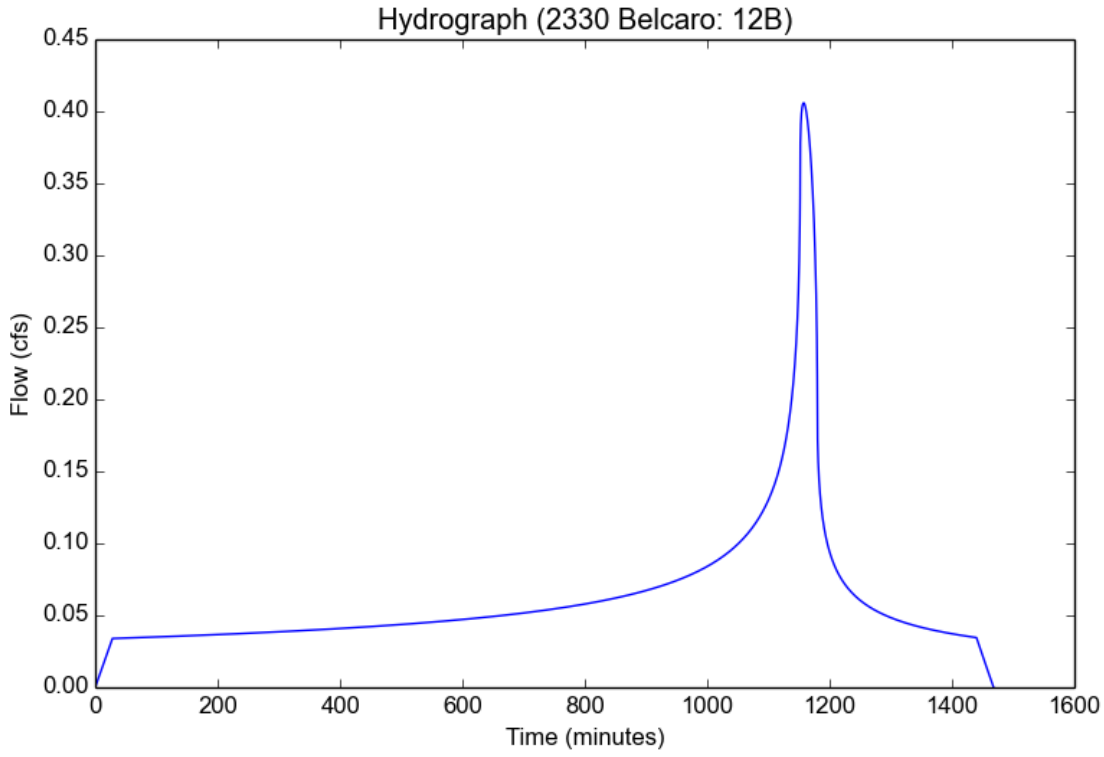
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	12B
Area (ac)	2.4
Flow Path Length (ft)	558.0
Flow Path Slope (vft/hft)	0.022
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2416
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	28.0
Clear Peak Flow Rate (cfs)	0.4059
Burned Peak Flow Rate (cfs)	0.4059
24-Hr Clear Runoff Volume (ac-ft)	0.1263
24-Hr Clear Runoff Volume (cu-ft)	5503.735



Peak Flow Hydrologic Analysis

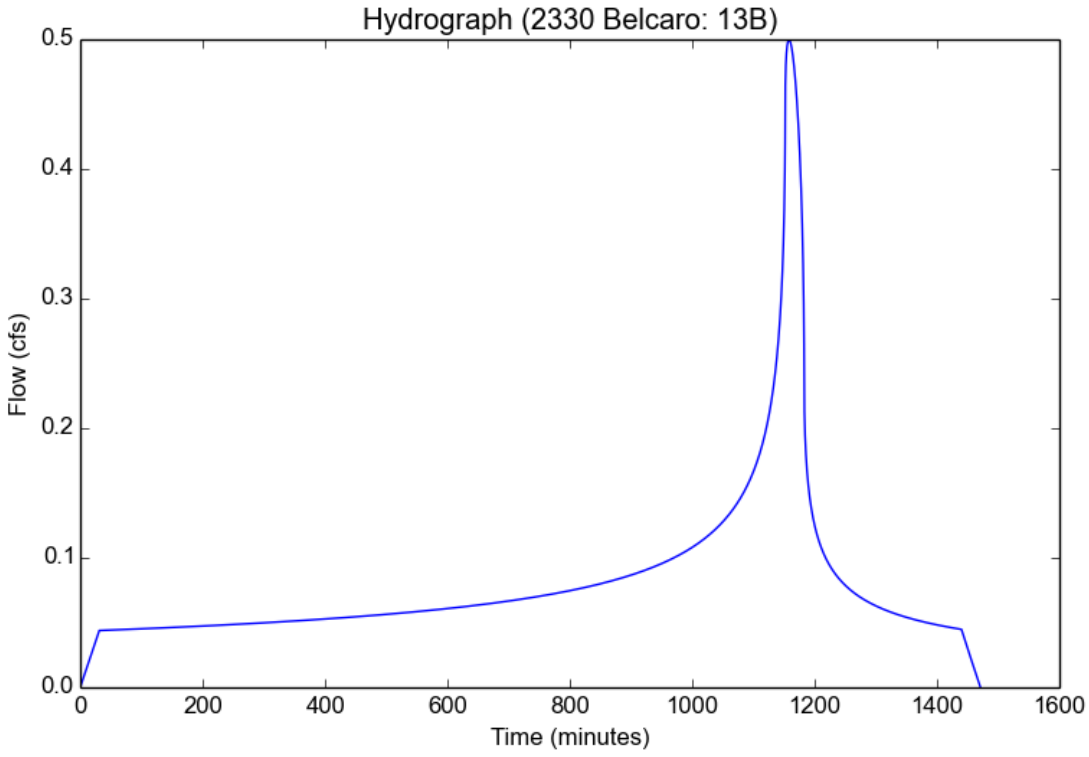
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	13B
Area (ac)	3.1
Flow Path Length (ft)	670.0
Flow Path Slope (vft/hft)	0.022
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2303
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	31.0
Clear Peak Flow Rate (cfs)	0.4998
Burned Peak Flow Rate (cfs)	0.4998
24-Hr Clear Runoff Volume (ac-ft)	0.1632
24-Hr Clear Runoff Volume (cu-ft)	7109.0072



Peak Flow Hydrologic Analysis

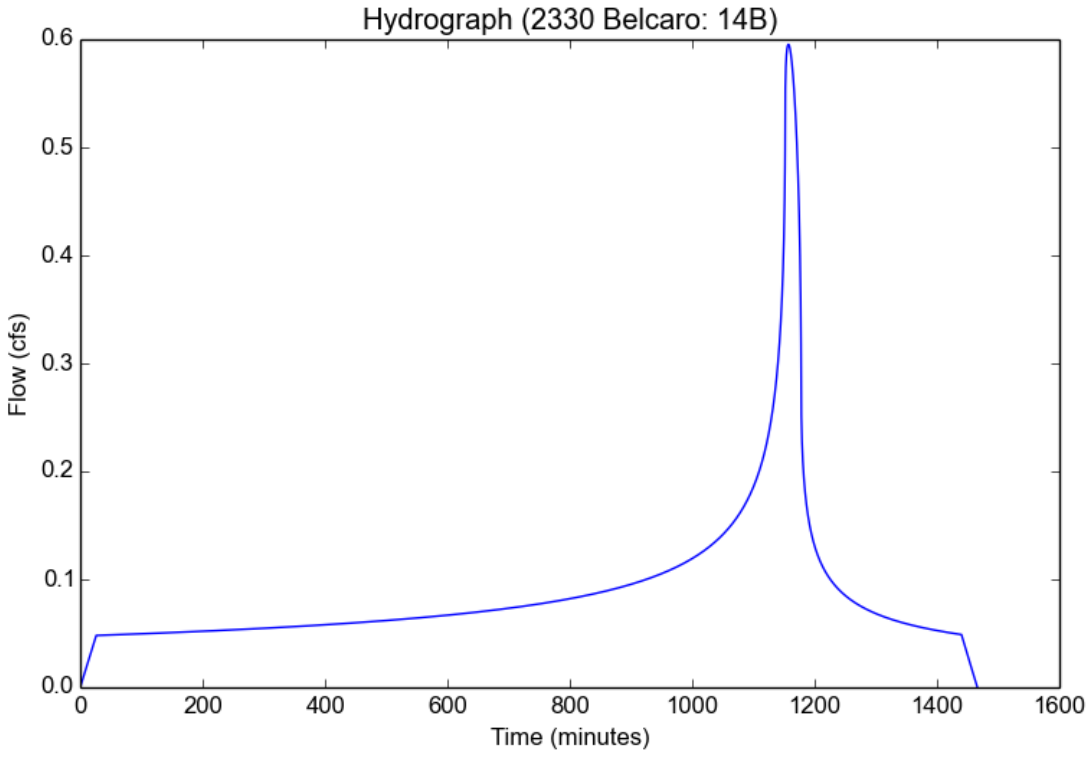
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	14B
Area (ac)	3.4
Flow Path Length (ft)	440.0
Flow Path Slope (vft/hft)	0.014
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2502
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	26.0
Clear Peak Flow Rate (cfs)	0.5954
Burned Peak Flow Rate (cfs)	0.5954
24-Hr Clear Runoff Volume (ac-ft)	0.179
24-Hr Clear Runoff Volume (cu-ft)	7796.9471



Peak Flow Hydrologic Analysis

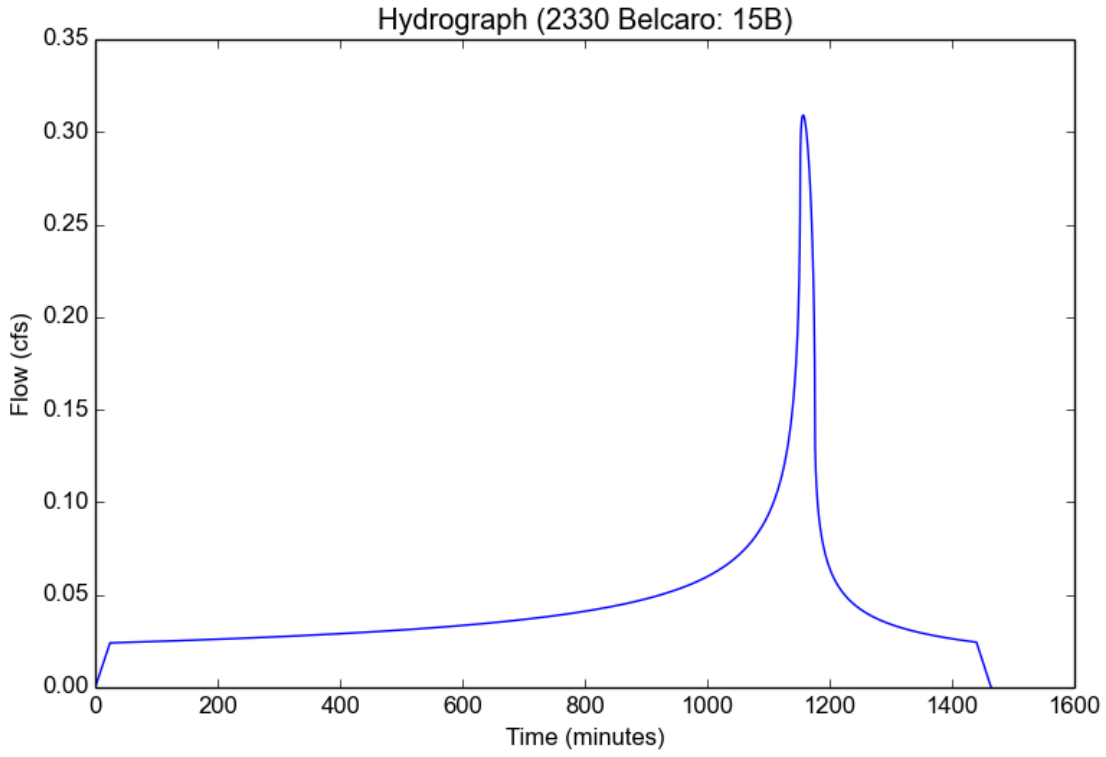
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	15B
Area (ac)	1.7
Flow Path Length (ft)	385.0
Flow Path Slope (vft/hft)	0.013
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2598
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	24.0
Clear Peak Flow Rate (cfs)	0.3091
Burned Peak Flow Rate (cfs)	0.3091
24-Hr Clear Runoff Volume (ac-ft)	0.0895
24-Hr Clear Runoff Volume (cu-ft)	3898.4685



Peak Flow Hydrologic Analysis

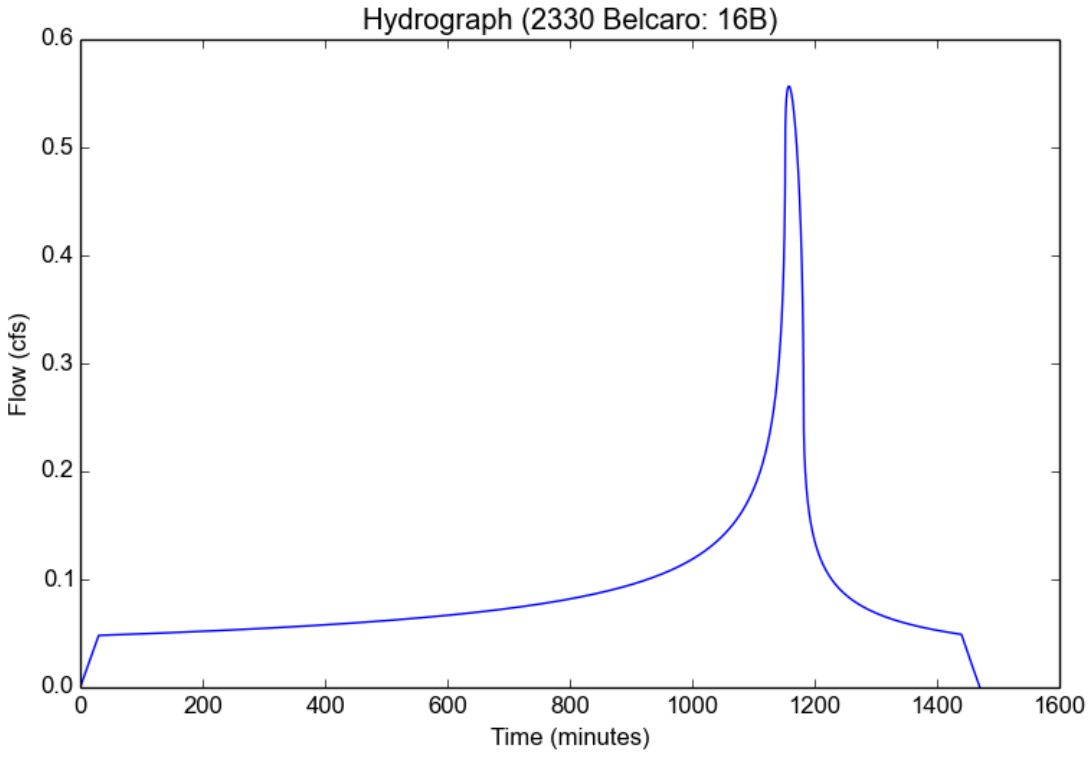
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	16B
Area (ac)	3.4
Flow Path Length (ft)	628.0
Flow Path Slope (vft/hft)	0.022
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2339
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	0.5567
Burned Peak Flow Rate (cfs)	0.5567
24-Hr Clear Runoff Volume (ac-ft)	0.179
24-Hr Clear Runoff Volume (cu-ft)	7796.9695



Peak Flow Hydrologic Analysis

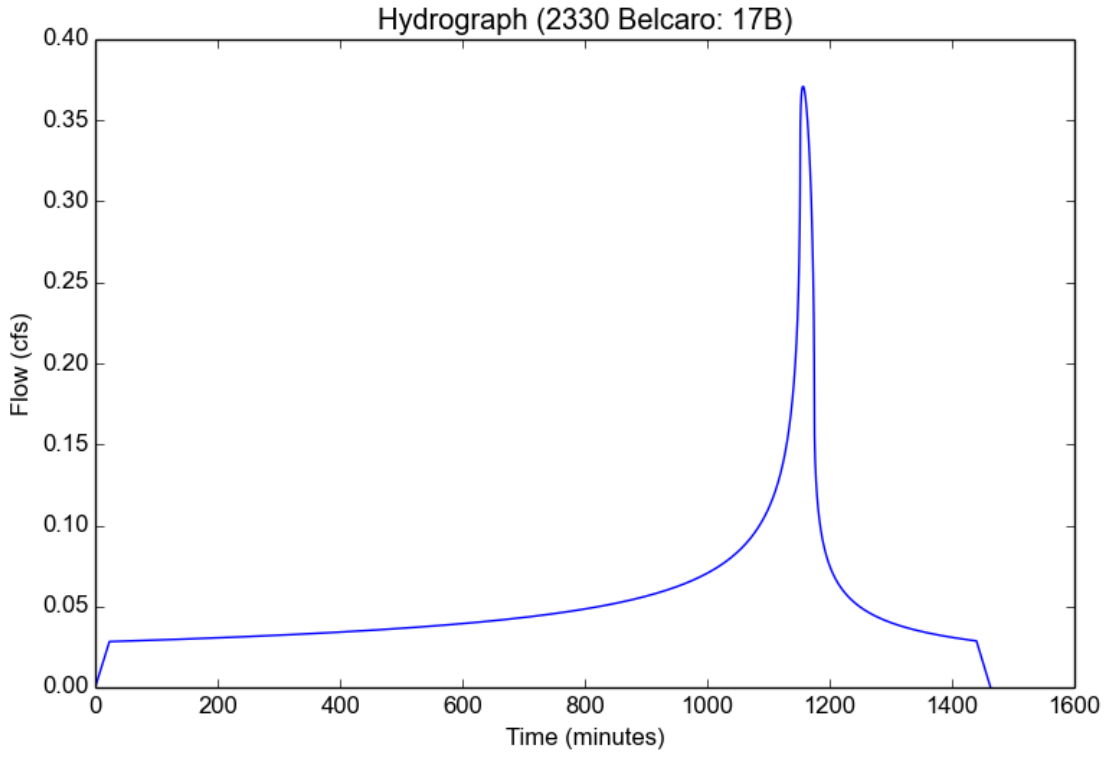
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	17B
Area (ac)	2.0
Flow Path Length (ft)	433.0
Flow Path Slope (vft/hft)	0.025
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.265
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	23.0
Clear Peak Flow Rate (cfs)	0.371
Burned Peak Flow Rate (cfs)	0.371
24-Hr Clear Runoff Volume (ac-ft)	0.1053
24-Hr Clear Runoff Volume (cu-ft)	4586.4308



Peak Flow Hydrologic Analysis

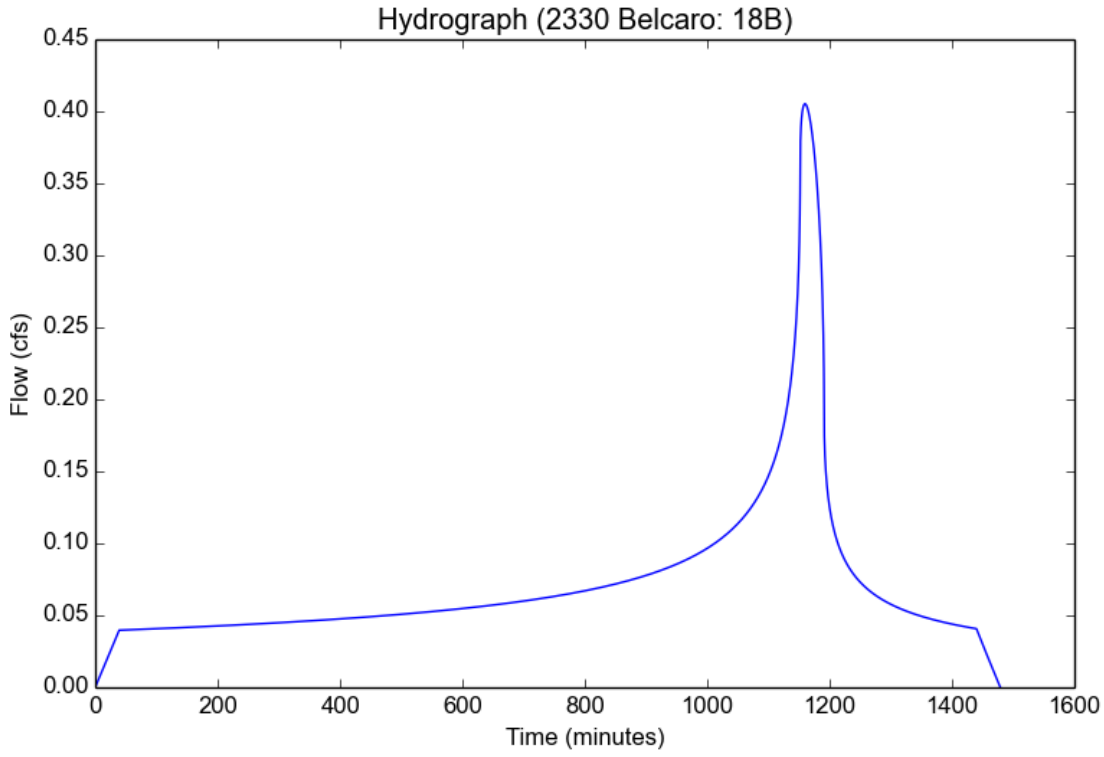
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report4.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	18B
Area (ac)	2.8
Flow Path Length (ft)	995.0
Flow Path Slope (vft/hft)	0.024
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2068
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	39.0
Clear Peak Flow Rate (cfs)	0.4052
Burned Peak Flow Rate (cfs)	0.4052
24-Hr Clear Runoff Volume (ac-ft)	0.1474
24-Hr Clear Runoff Volume (cu-ft)	6421.0853



Peak Flow Hydrologic Analysis

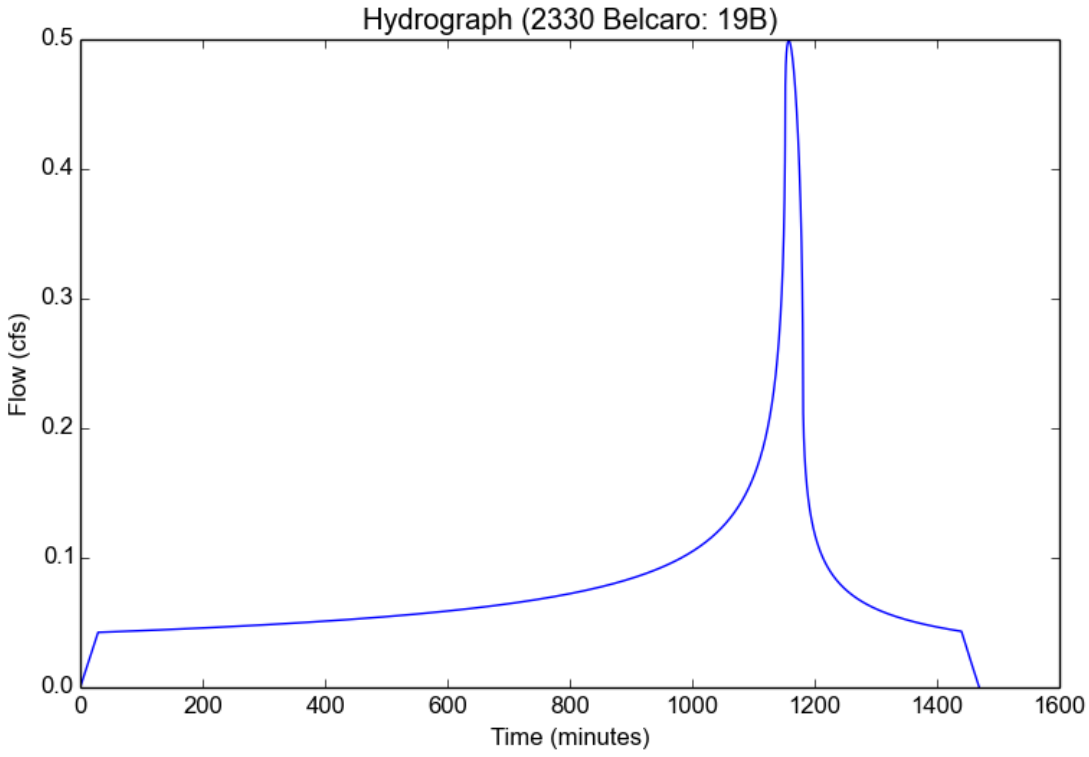
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	19B
Area (ac)	3.0
Flow Path Length (ft)	551.0
Flow Path Slope (vft/hft)	0.015
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2376
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	29.0
Clear Peak Flow Rate (cfs)	0.4991
Burned Peak Flow Rate (cfs)	0.4991
24-Hr Clear Runoff Volume (ac-ft)	0.1579
24-Hr Clear Runoff Volume (cu-ft)	6879.6738



Peak Flow Hydrologic Analysis

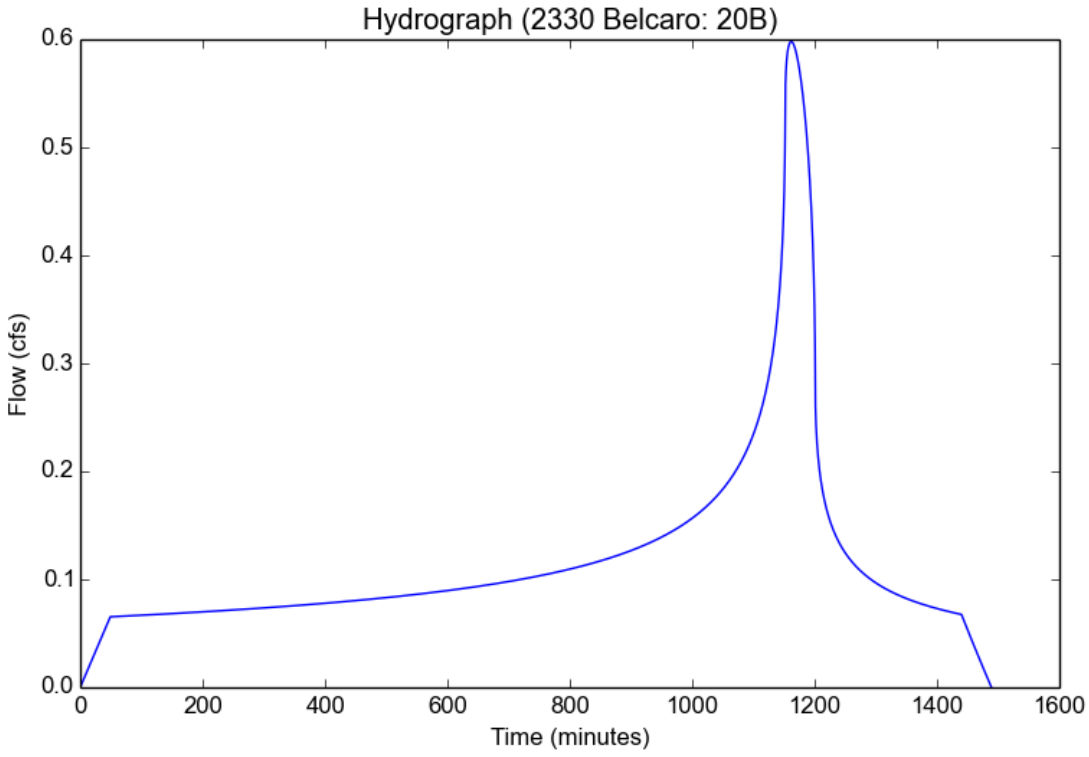
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	20B
Area (ac)	4.6
Flow Path Length (ft)	1271.0
Flow Path Slope (vft/hft)	0.016
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.1857
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	49.0
Clear Peak Flow Rate (cfs)	0.598
Burned Peak Flow Rate (cfs)	0.598
24-Hr Clear Runoff Volume (ac-ft)	0.2422
24-Hr Clear Runoff Volume (cu-ft)	10549.0472



Peak Flow Hydrologic Analysis

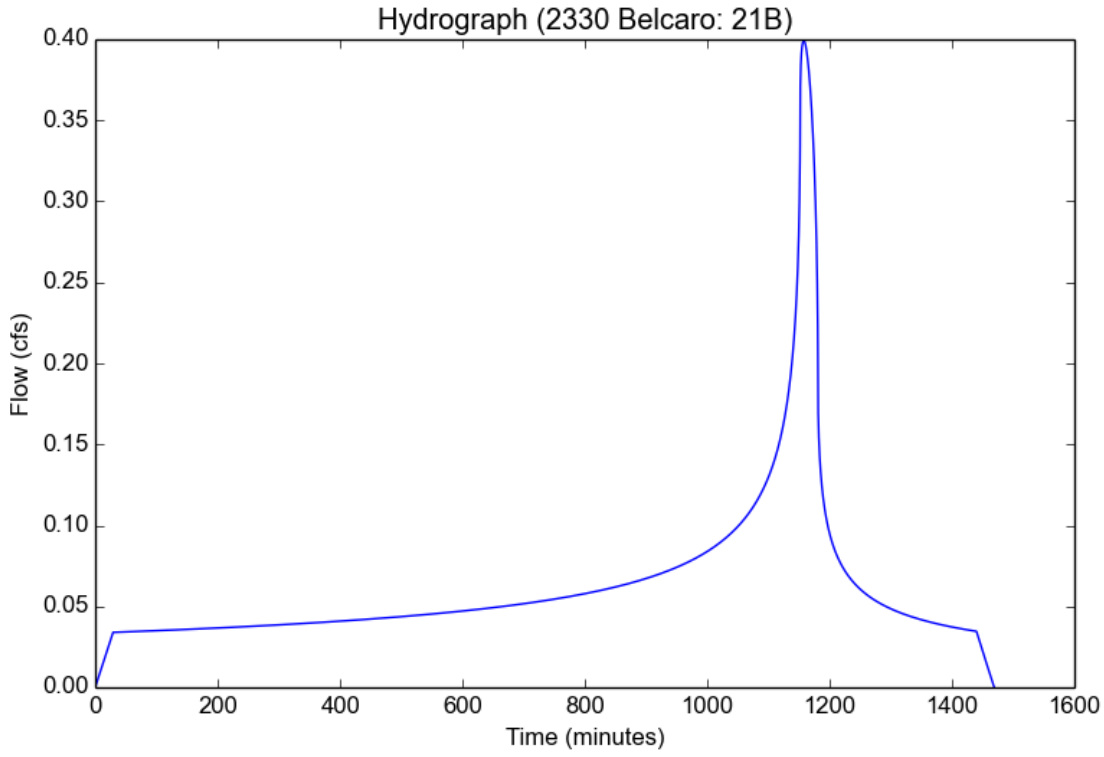
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	21B
Area (ac)	2.4
Flow Path Length (ft)	506.0
Flow Path Slope (vft/hft)	0.012
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2376
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	29.0
Clear Peak Flow Rate (cfs)	0.3992
Burned Peak Flow Rate (cfs)	0.3992
24-Hr Clear Runoff Volume (ac-ft)	0.1263
24-Hr Clear Runoff Volume (cu-ft)	5503.739



Peak Flow Hydrologic Analysis

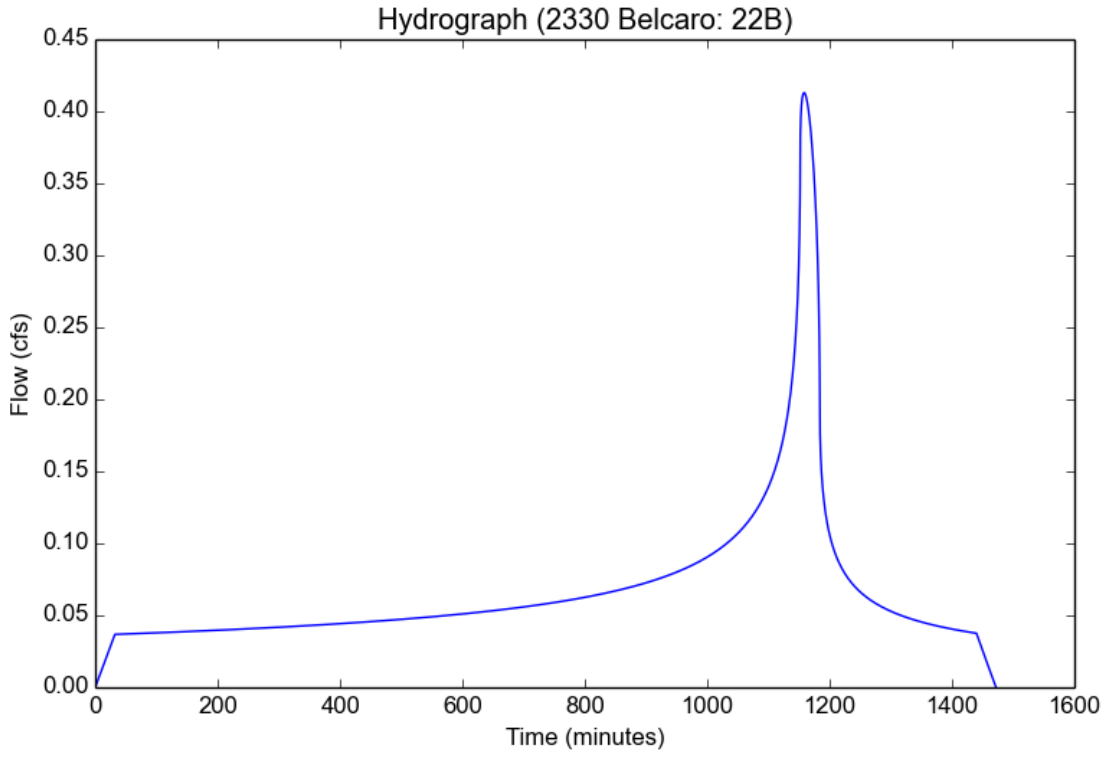
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	22B
Area (ac)	2.6
Flow Path Length (ft)	520.0
Flow Path Slope (vft/hft)	0.008
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2269
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	32.0
Clear Peak Flow Rate (cfs)	0.413
Burned Peak Flow Rate (cfs)	0.413
24-Hr Clear Runoff Volume (ac-ft)	0.1369
24-Hr Clear Runoff Volume (cu-ft)	5962.398



Peak Flow Hydrologic Analysis

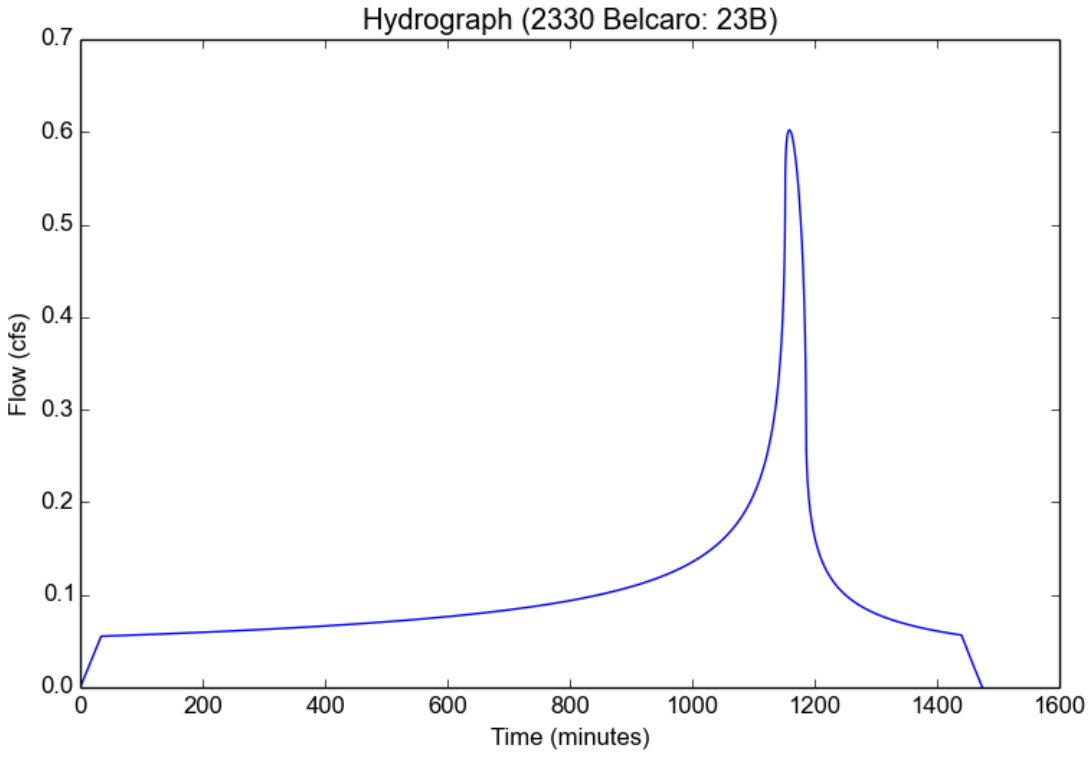
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	23B
Area (ac)	3.9
Flow Path Length (ft)	628.0
Flow Path Slope (vft/hft)	0.01
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2205
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	34.0
Clear Peak Flow Rate (cfs)	0.602
Burned Peak Flow Rate (cfs)	0.602
24-Hr Clear Runoff Volume (ac-ft)	0.2053
24-Hr Clear Runoff Volume (cu-ft)	8943.6122



Peak Flow Hydrologic Analysis

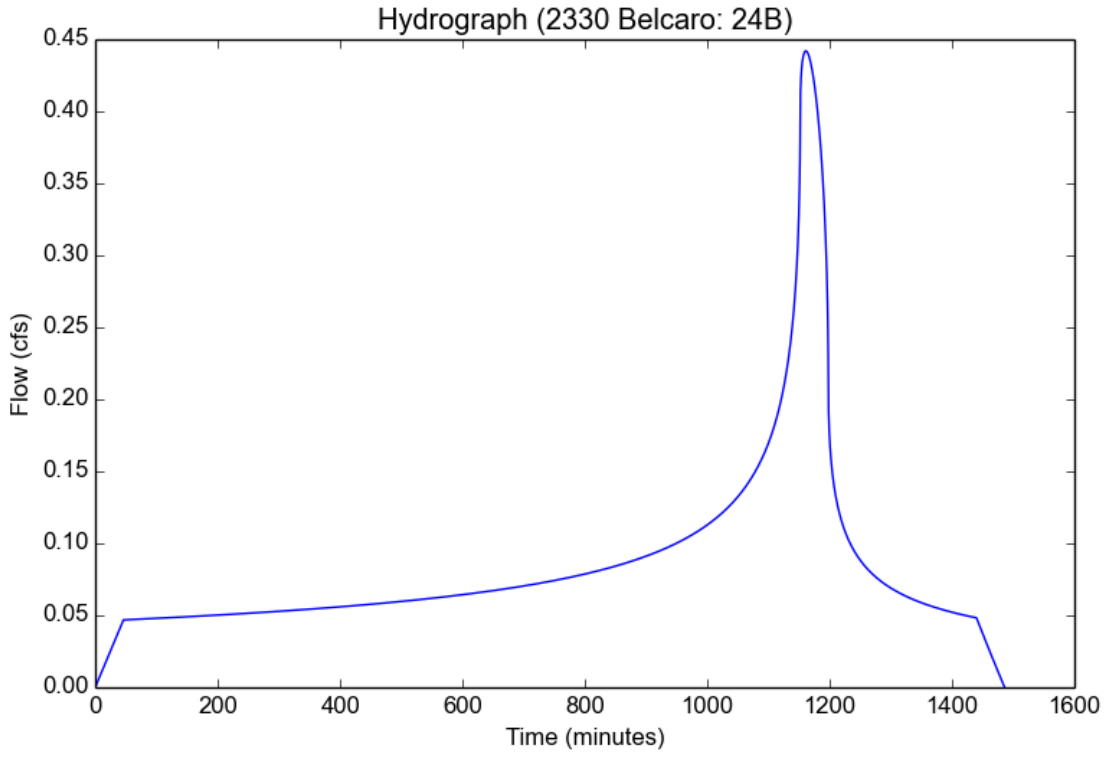
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	24B
Area (ac)	3.3
Flow Path Length (ft)	859.0
Flow Path Slope (vft/hft)	0.006
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.1913
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	46.0
Clear Peak Flow Rate (cfs)	0.442
Burned Peak Flow Rate (cfs)	0.442
24-Hr Clear Runoff Volume (ac-ft)	0.1737
24-Hr Clear Runoff Volume (cu-ft)	7567.7664



Peak Flow Hydrologic Analysis

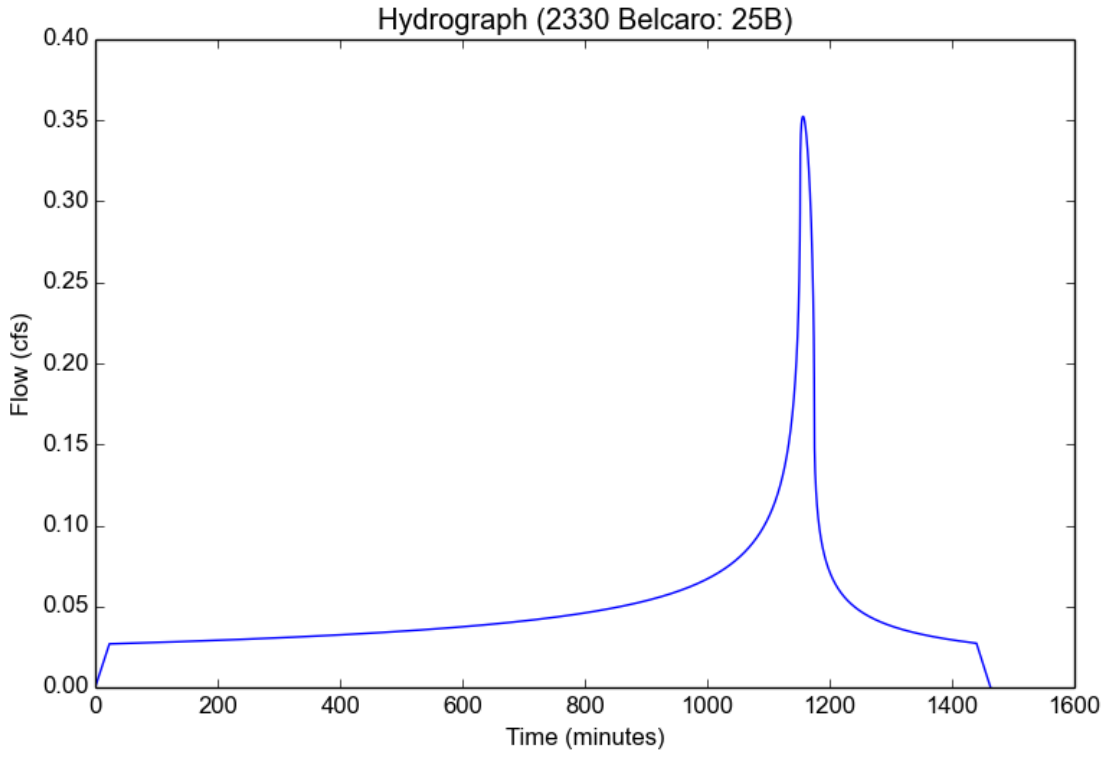
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	25B
Area (ac)	1.9
Flow Path Length (ft)	383.0
Flow Path Slope (vft/hft)	0.017
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.265
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	23.0
Clear Peak Flow Rate (cfs)	0.3525
Burned Peak Flow Rate (cfs)	0.3525
24-Hr Clear Runoff Volume (ac-ft)	0.1
24-Hr Clear Runoff Volume (cu-ft)	4357.1093



Peak Flow Hydrologic Analysis

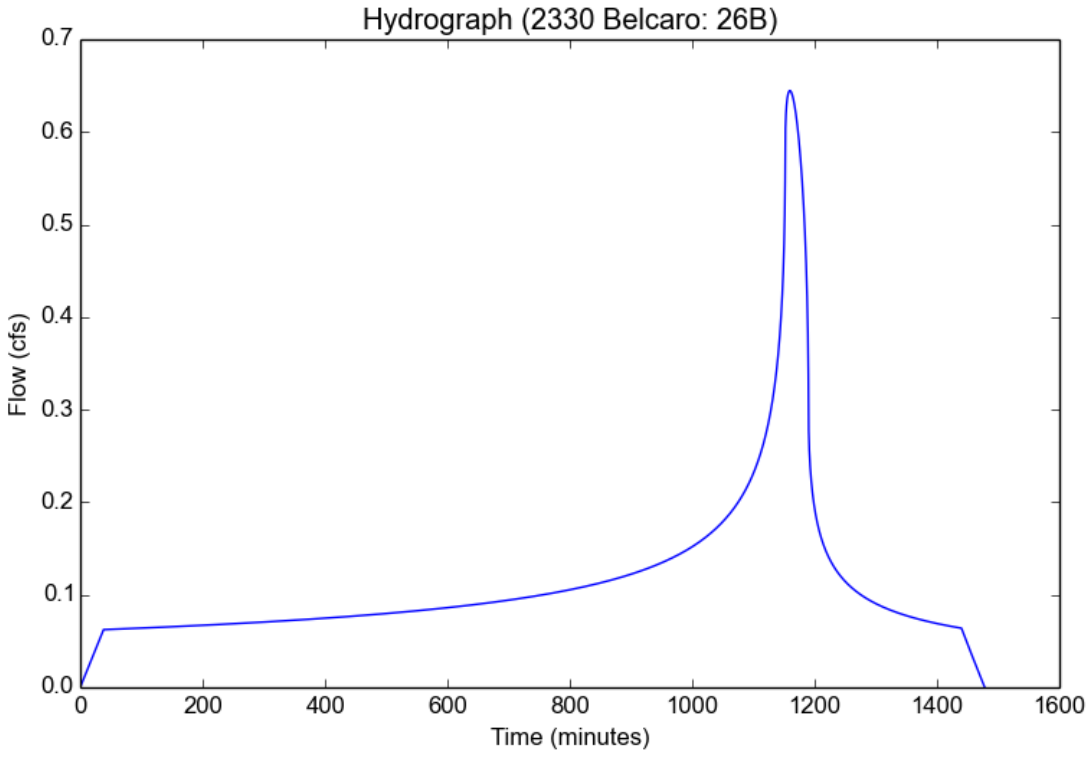
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	26B
Area (ac)	4.4
Flow Path Length (ft)	767.0
Flow Path Slope (vft/hft)	0.012
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2093
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	38.0
Clear Peak Flow Rate (cfs)	0.6446
Burned Peak Flow Rate (cfs)	0.6446
24-Hr Clear Runoff Volume (ac-ft)	0.2316
24-Hr Clear Runoff Volume (cu-ft)	10090.2668



Peak Flow Hydrologic Analysis

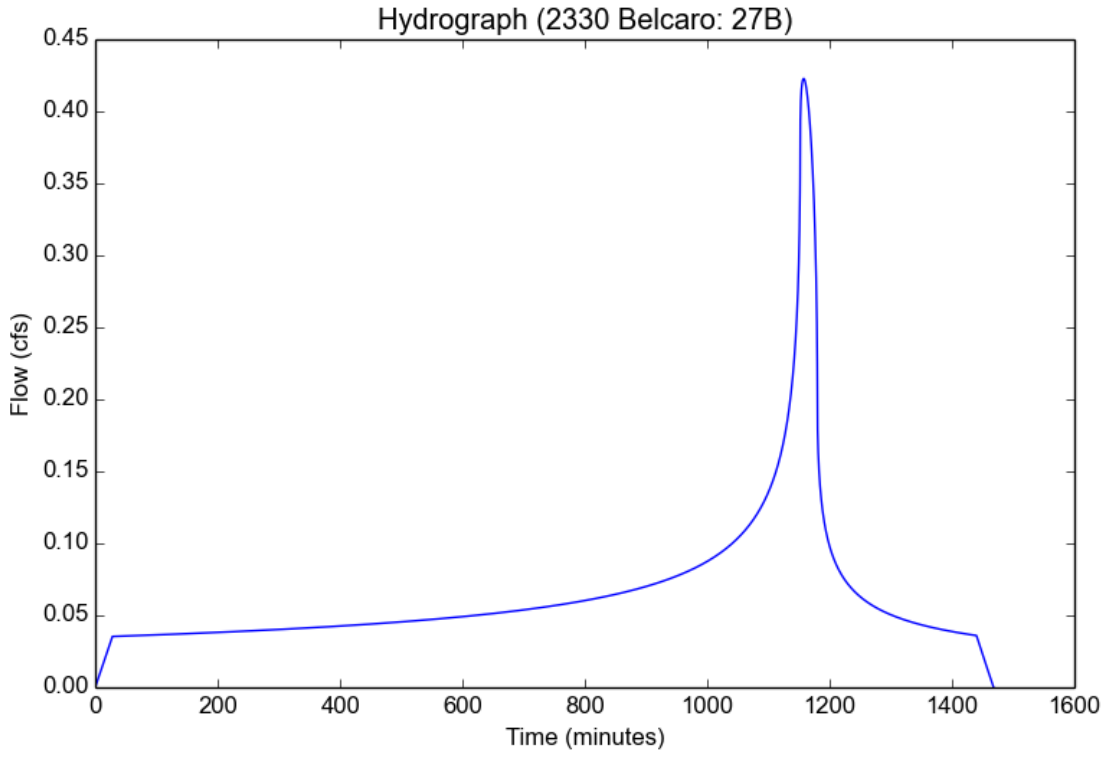
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	27B
Area (ac)	2.5
Flow Path Length (ft)	439.0
Flow Path Slope (vft/hft)	0.009
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2416
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	28.0
Clear Peak Flow Rate (cfs)	0.4228
Burned Peak Flow Rate (cfs)	0.4228
24-Hr Clear Runoff Volume (ac-ft)	0.1316
24-Hr Clear Runoff Volume (cu-ft)	5733.0573



Peak Flow Hydrologic Analysis

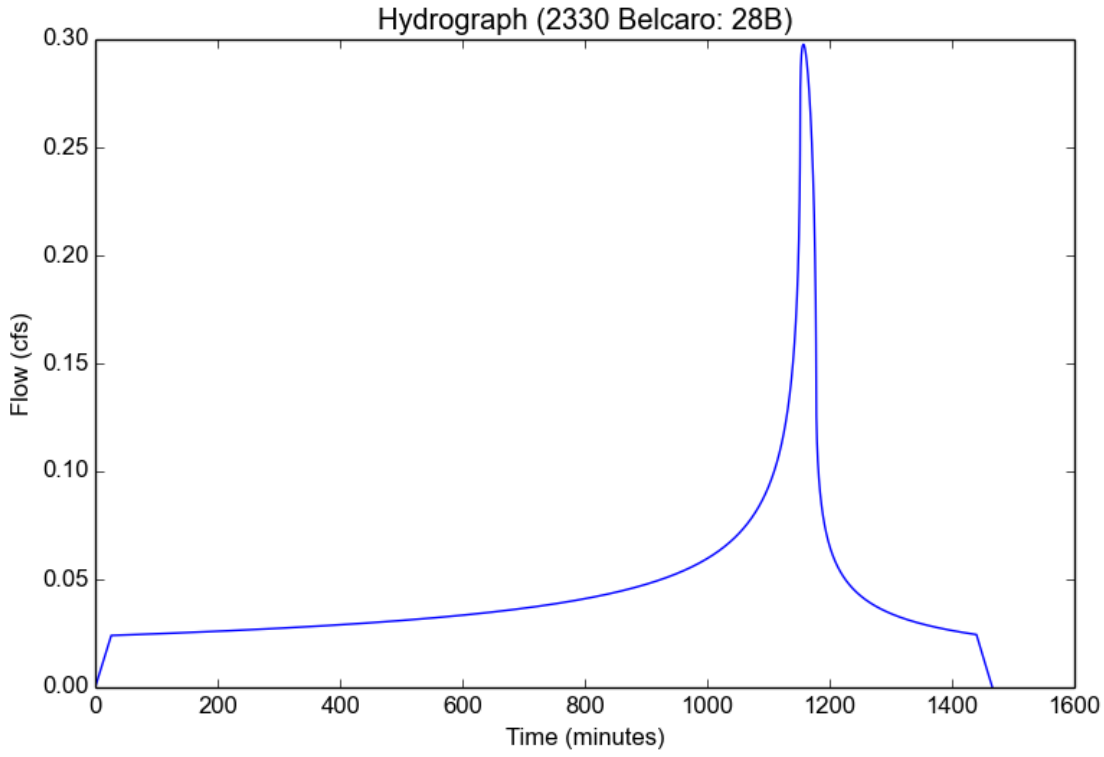
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	28B
Area (ac)	1.7
Flow Path Length (ft)	353.0
Flow Path Slope (vft/hft)	0.006
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2502
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	26.0
Clear Peak Flow Rate (cfs)	0.2977
Burned Peak Flow Rate (cfs)	0.2977
24-Hr Clear Runoff Volume (ac-ft)	0.0895
24-Hr Clear Runoff Volume (cu-ft)	3898.4735



Peak Flow Hydrologic Analysis

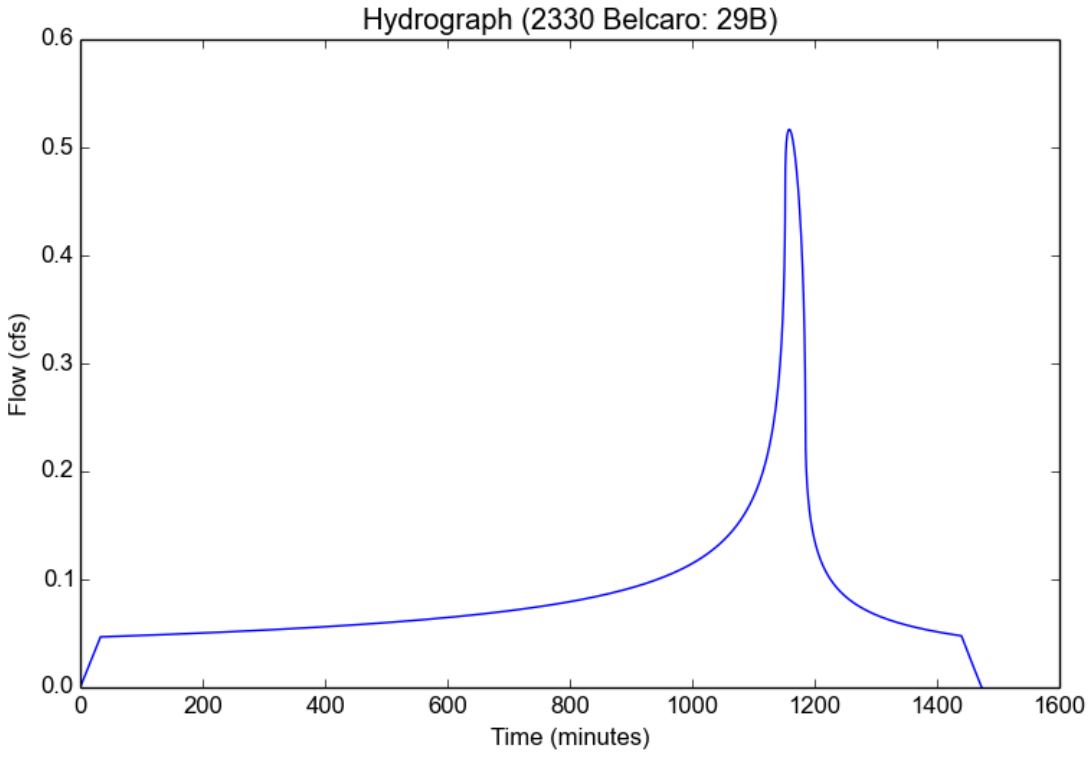
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	29B
Area (ac)	3.3
Flow Path Length (ft)	573.0
Flow Path Slope (vft/hft)	0.009
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2236
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	33.0
Clear Peak Flow Rate (cfs)	0.5166
Burned Peak Flow Rate (cfs)	0.5166
24-Hr Clear Runoff Volume (ac-ft)	0.1737
24-Hr Clear Runoff Volume (cu-ft)	7567.6653



Peak Flow Hydrologic Analysis

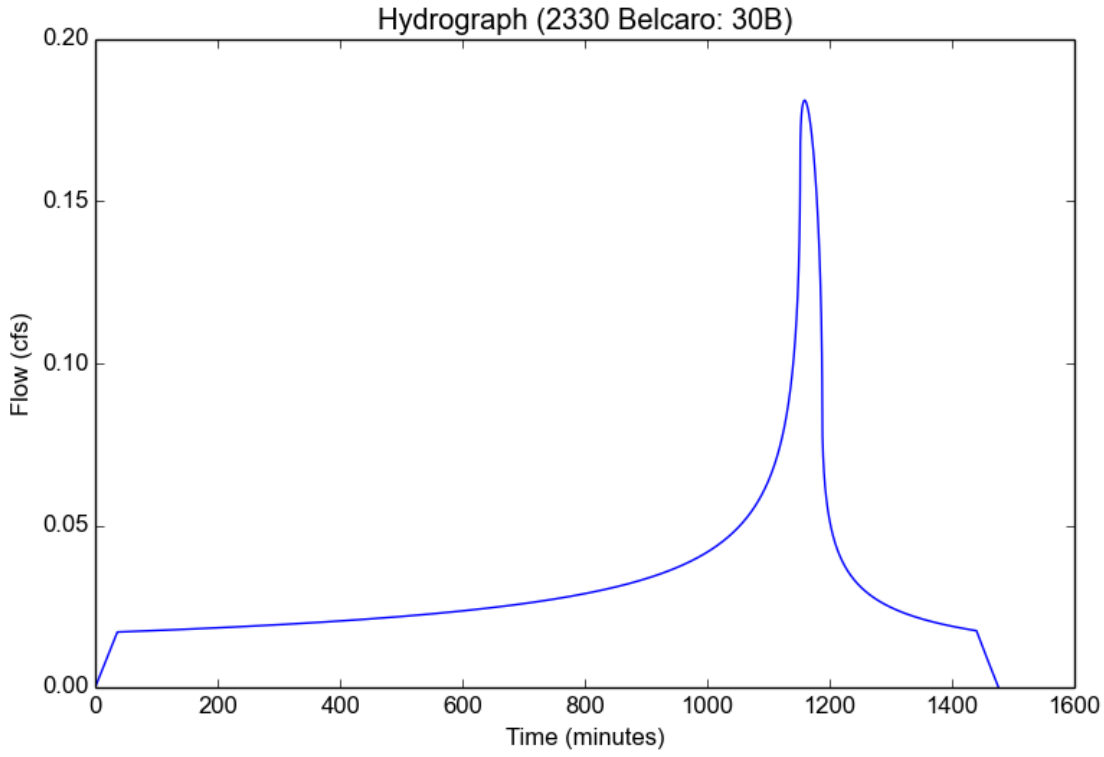
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	30B
Area (ac)	1.0
Flow Path Length (ft)	834.0
Flow Path Slope (vft/hft)	0.01
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.93
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2147
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.844
Time of Concentration (min)	36.0
Clear Peak Flow Rate (cfs)	0.1812
Burned Peak Flow Rate (cfs)	0.1812
24-Hr Clear Runoff Volume (ac-ft)	0.0635
24-Hr Clear Runoff Volume (cu-ft)	2764.9899



Peak Flow Hydrologic Analysis

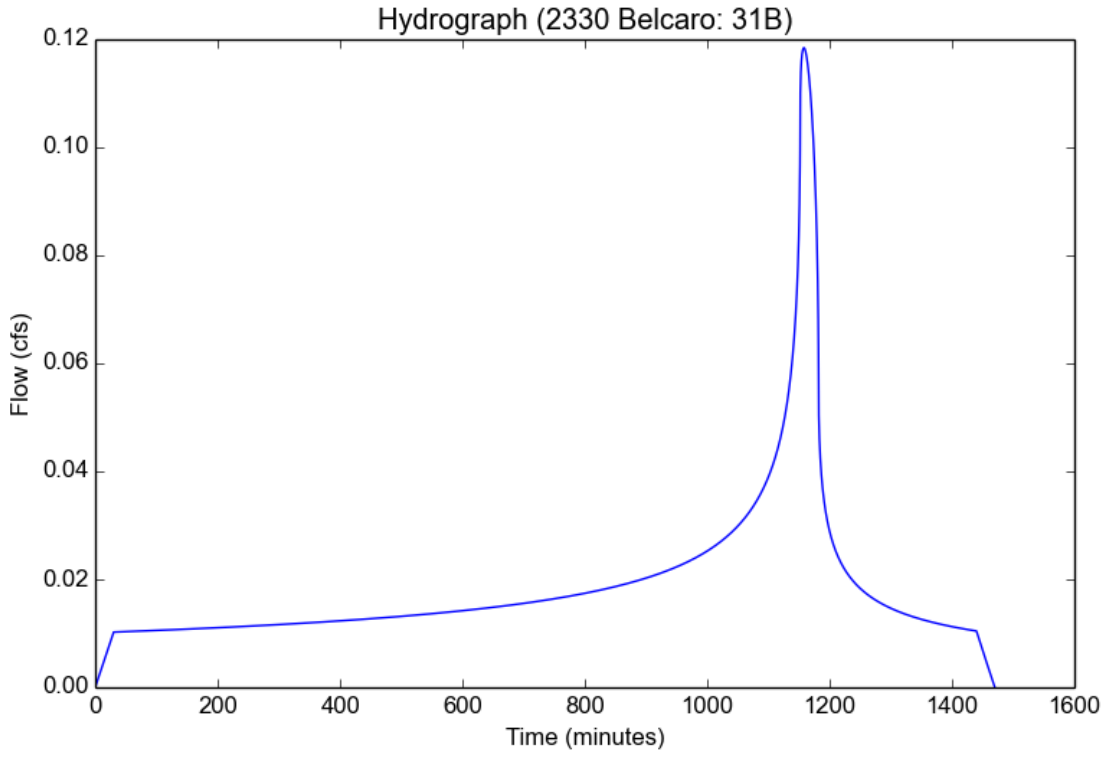
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	31B
Area (ac)	0.6
Flow Path Length (ft)	476.0
Flow Path Slope (vft/hft)	0.004
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.93
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2339
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.844
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	0.1184
Burned Peak Flow Rate (cfs)	0.1184
24-Hr Clear Runoff Volume (ac-ft)	0.0381
24-Hr Clear Runoff Volume (cu-ft)	1658.9854



Peak Flow Hydrologic Analysis

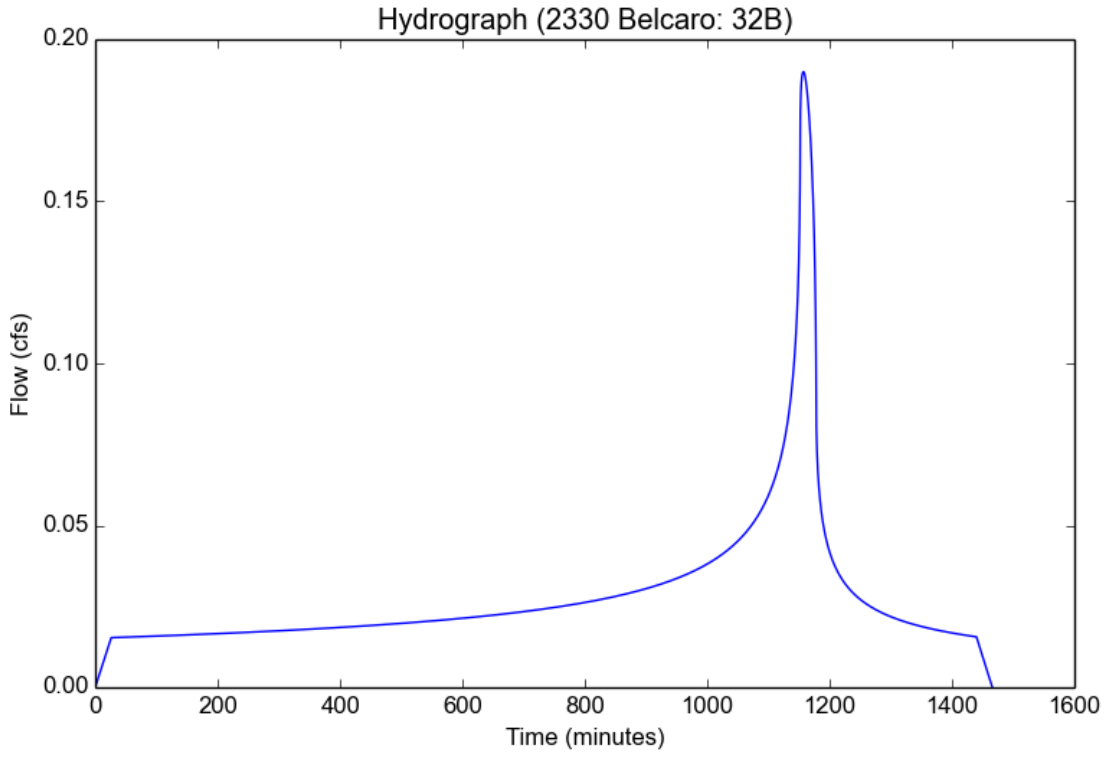
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	32B
Area (ac)	0.9
Flow Path Length (ft)	622.0
Flow Path Slope (vft/hft)	0.022
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.93
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2502
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.844
Time of Concentration (min)	26.0
Clear Peak Flow Rate (cfs)	0.19
Burned Peak Flow Rate (cfs)	0.19
24-Hr Clear Runoff Volume (ac-ft)	0.0571
24-Hr Clear Runoff Volume (cu-ft)	2488.471



Peak Flow Hydrologic Analysis

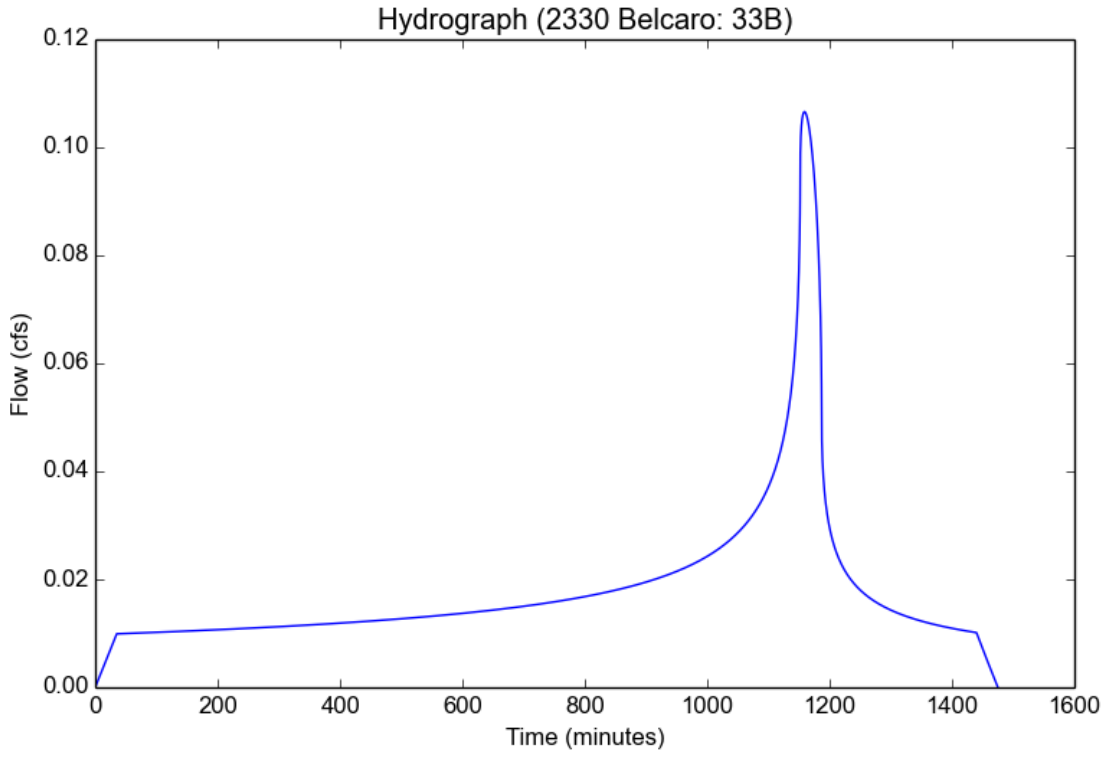
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	33B
Area (ac)	0.7
Flow Path Length (ft)	636.0
Flow Path Slope (vft/hft)	0.009
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2175
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	35.0
Clear Peak Flow Rate (cfs)	0.1066
Burned Peak Flow Rate (cfs)	0.1066
24-Hr Clear Runoff Volume (ac-ft)	0.0369
24-Hr Clear Runoff Volume (cu-ft)	1605.2652



Peak Flow Hydrologic Analysis

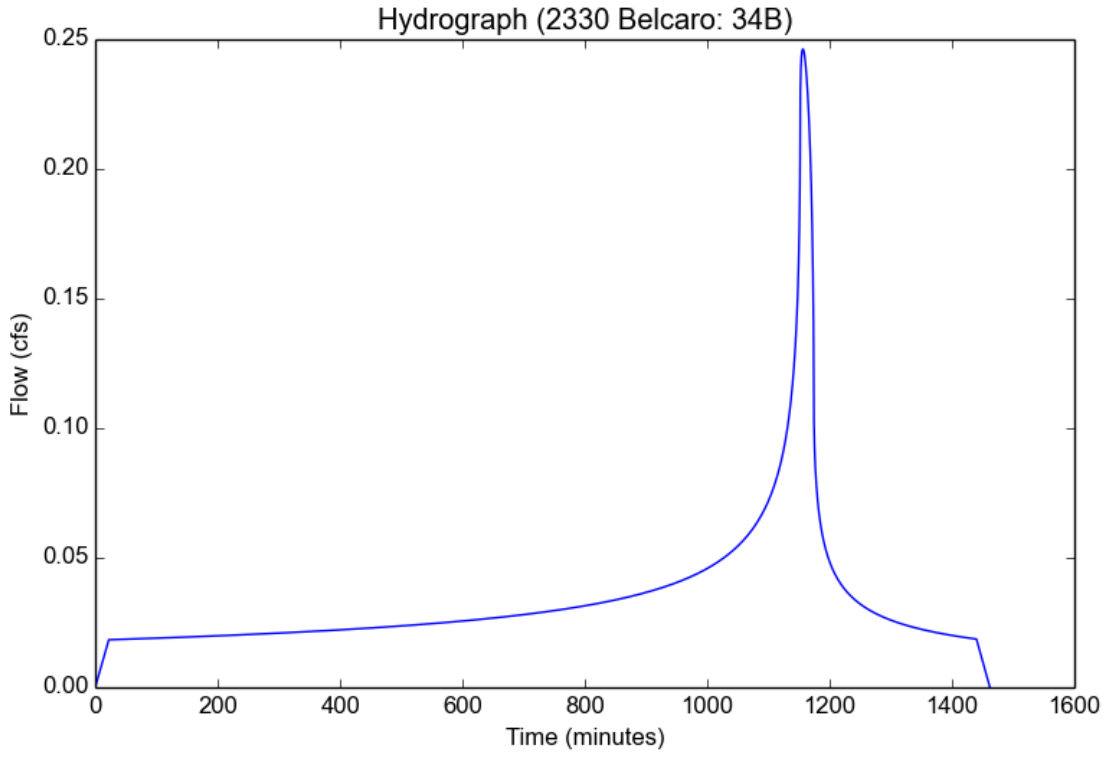
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	34B
Area (ac)	1.3
Flow Path Length (ft)	331.0
Flow Path Slope (vft/hft)	0.012
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.75
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2706
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7
Time of Concentration (min)	22.0
Clear Peak Flow Rate (cfs)	0.2462
Burned Peak Flow Rate (cfs)	0.2462
24-Hr Clear Runoff Volume (ac-ft)	0.0684
24-Hr Clear Runoff Volume (cu-ft)	2981.1783



Peak Flow Hydrologic Analysis

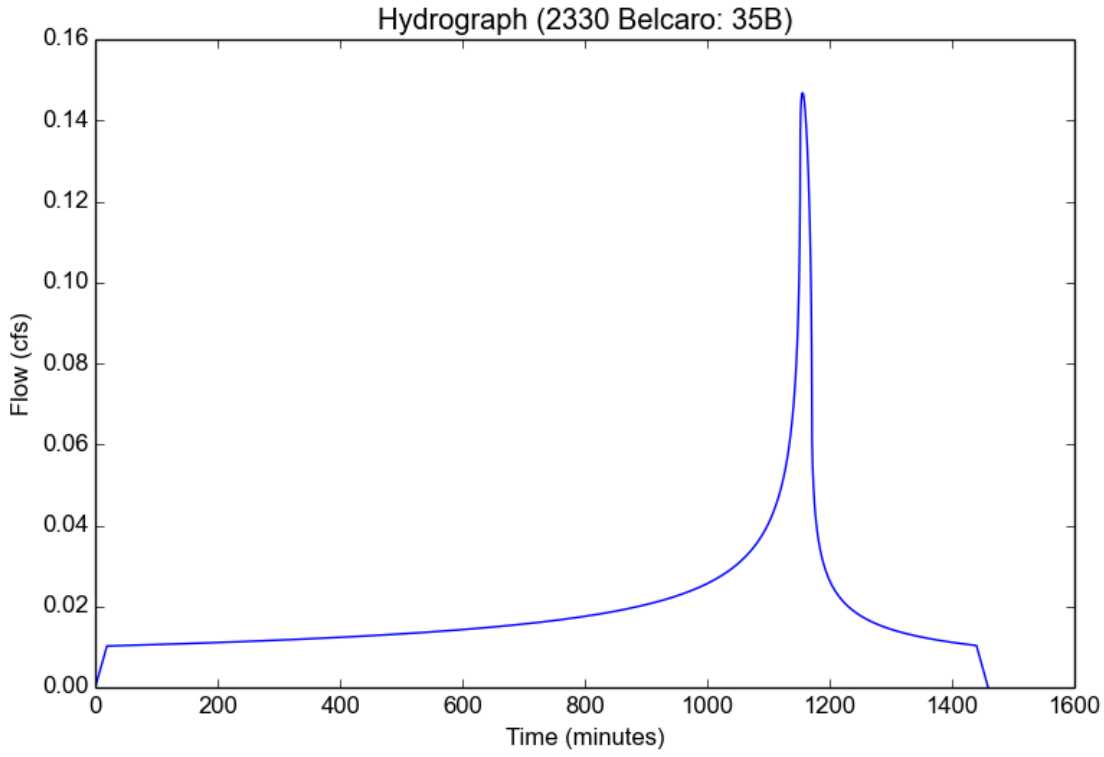
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	35B
Area (ac)	0.6
Flow Path Length (ft)	413.0
Flow Path Slope (vft/hft)	0.034
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.93
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2899
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.844
Time of Concentration (min)	19.0
Clear Peak Flow Rate (cfs)	0.1468
Burned Peak Flow Rate (cfs)	0.1468
24-Hr Clear Runoff Volume (ac-ft)	0.0381
24-Hr Clear Runoff Volume (cu-ft)	1658.974



Peak Flow Hydrologic Analysis

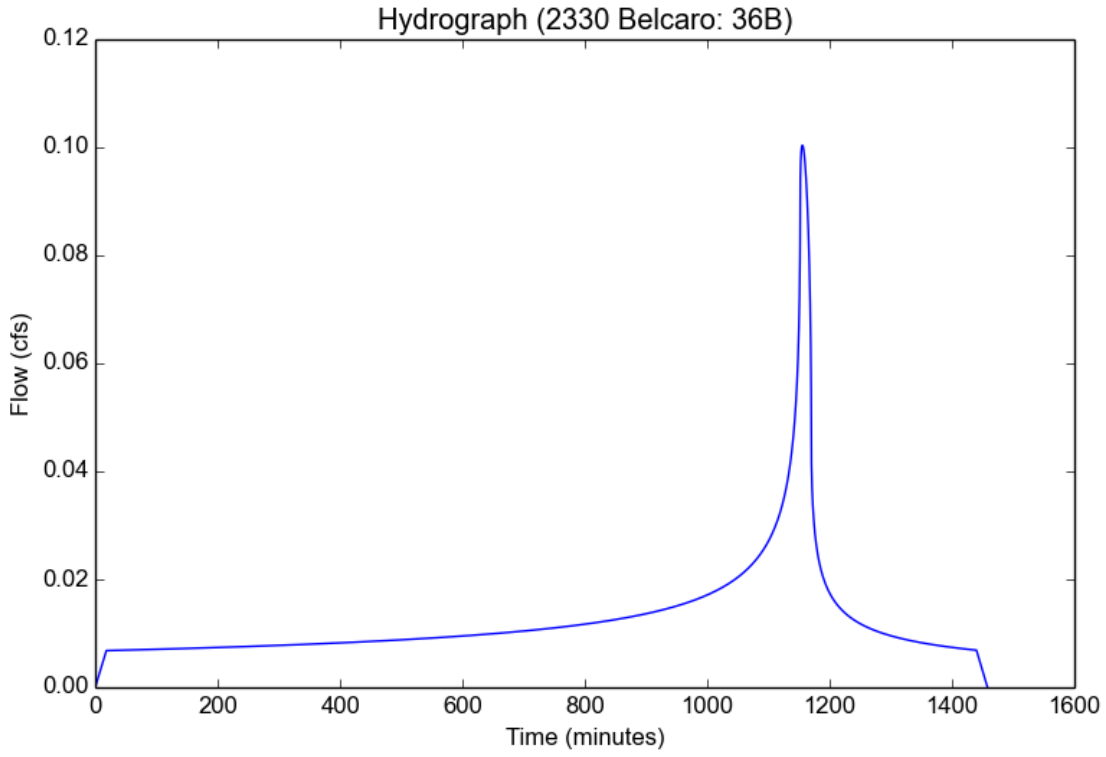
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	36B
Area (ac)	0.4
Flow Path Length (ft)	296.0
Flow Path Slope (vft/hft)	0.013
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.93
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2974
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.844
Time of Concentration (min)	18.0
Clear Peak Flow Rate (cfs)	0.1004
Burned Peak Flow Rate (cfs)	0.1004
24-Hr Clear Runoff Volume (ac-ft)	0.0254
24-Hr Clear Runoff Volume (cu-ft)	1105.9821



Peak Flow Hydrologic Analysis

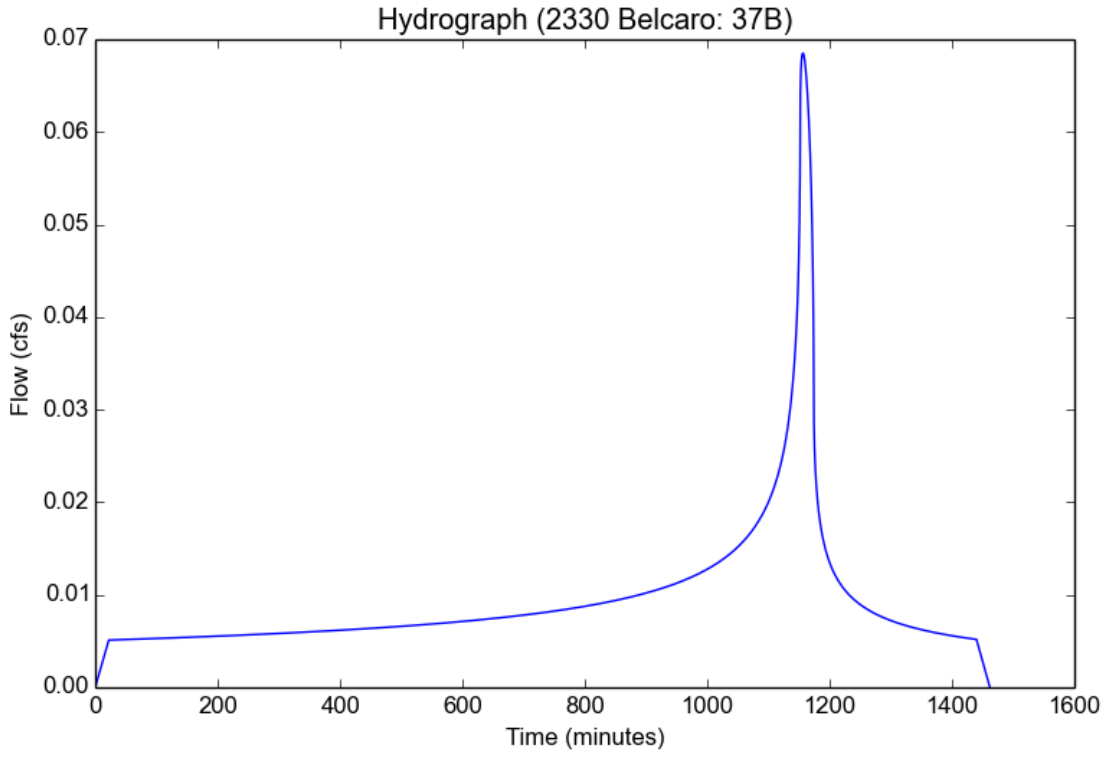
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	37B
Area (ac)	0.3
Flow Path Length (ft)	436.0
Flow Path Slope (vft/hft)	0.017201835
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.93
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2706
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.844
Time of Concentration (min)	22.0
Clear Peak Flow Rate (cfs)	0.0685
Burned Peak Flow Rate (cfs)	0.0685
24-Hr Clear Runoff Volume (ac-ft)	0.019
24-Hr Clear Runoff Volume (cu-ft)	829.4883



Peak Flow Hydrologic Analysis

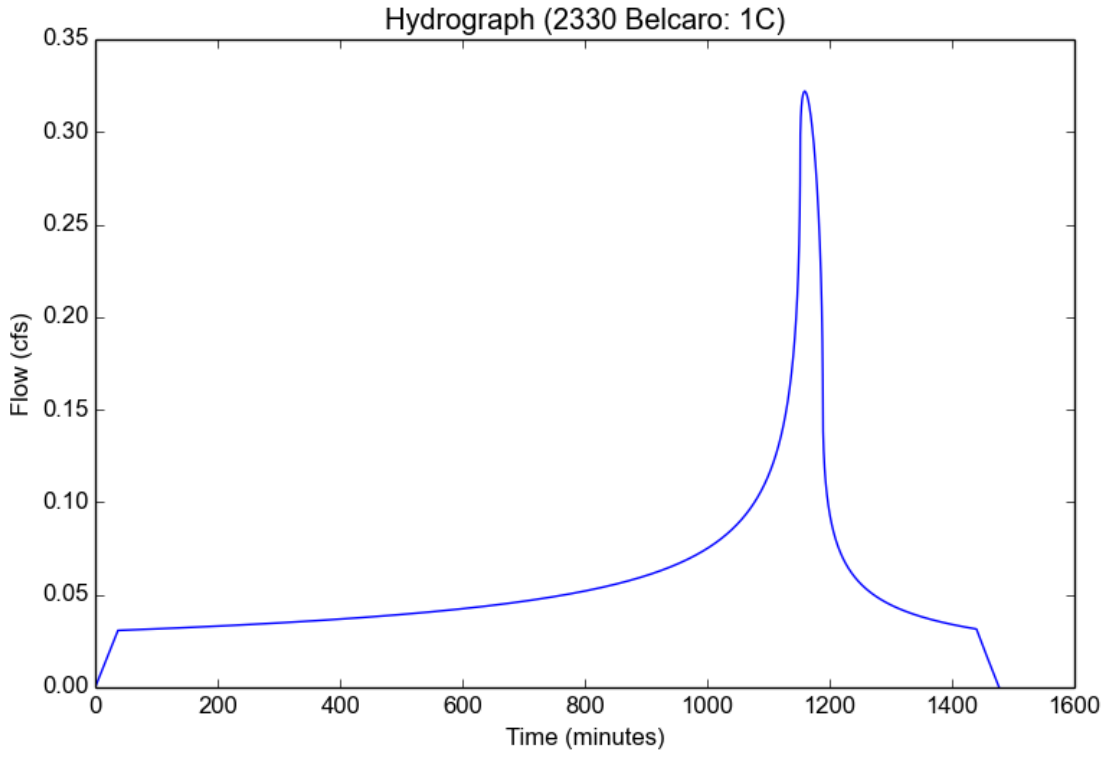
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	1C
Area (ac)	1.8
Flow Path Length (ft)	840.0
Flow Path Slope (vft/hft)	0.009
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.93
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2119
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.844
Time of Concentration (min)	37.0
Clear Peak Flow Rate (cfs)	0.322
Burned Peak Flow Rate (cfs)	0.322
24-Hr Clear Runoff Volume (ac-ft)	0.1143
24-Hr Clear Runoff Volume (cu-ft)	4976.9865



Peak Flow Hydrologic Analysis

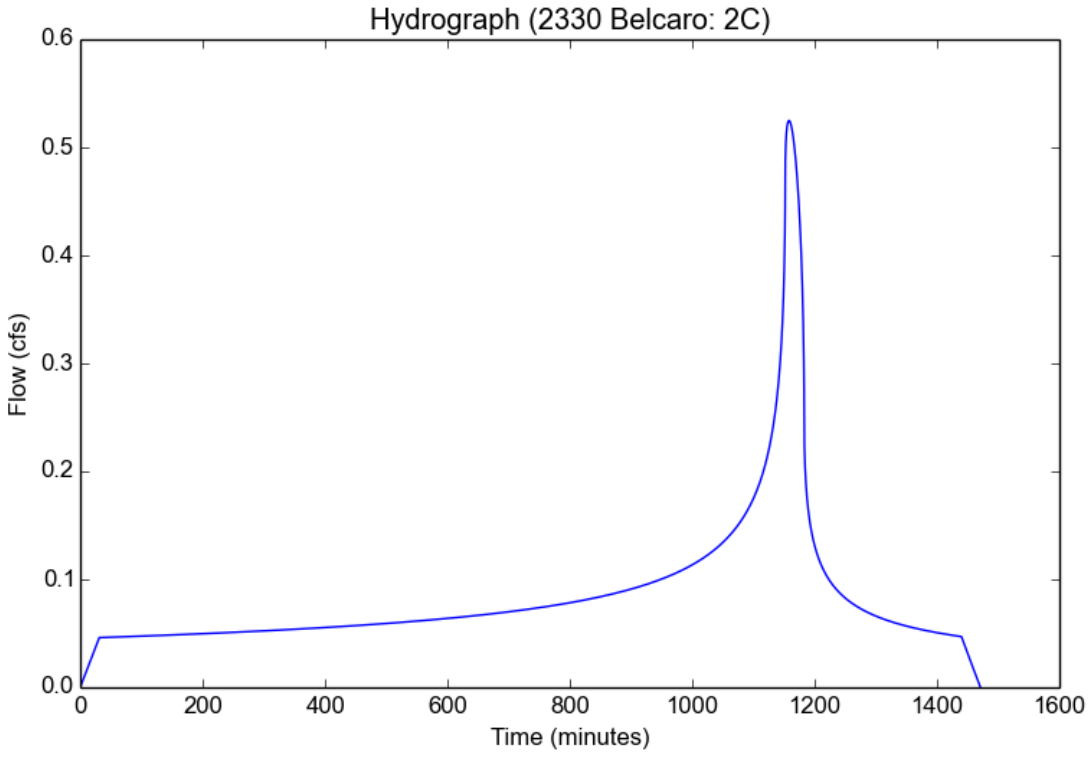
File location: I:/Project Files/2330 - BELCARO SAND CANYON/USMP/HYDROCALCS/2330 Belcaro Report5.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2330 Belcaro
Subarea ID	2C
Area (ac)	2.7
Flow Path Length (ft)	780.0
Flow Path Slope (vft/hft)	0.019
85th Percentile Rainfall Depth (in)	0.91
Percent Impervious	0.93
Soil Type	20
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.91
Peak Intensity (in/hr)	0.2303
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.844
Time of Concentration (min)	31.0
Clear Peak Flow Rate (cfs)	0.5248
Burned Peak Flow Rate (cfs)	0.5248
24-Hr Clear Runoff Volume (ac-ft)	0.1714
24-Hr Clear Runoff Volume (cu-ft)	7465.4404



APPENDIX B

WATER QUALITY VOLUME SUMMARY TABLES

WQT Basin A

DMA (WQT)	AREA	FLOWPATH LENGTH	SLOPE	85TH% RAINFALL DEPTH	% IMP.	SOIL TYPE	Q_{PM}	V_{LID}
	ac	*ft*	*ft/ft*	*in*			*cfs*	*cu-ft*
1A	2.7	1815	0.048	0.91	0.93	020	0.441	11,198
2A	1.1	1035	0.040	0.91	0.93	020	0.211	4,562
TOTAL	3.8						0.651	15,761
								0.36 ac-ft

WQT Basin B

DMA (WQT)	AREA	FLOWPATH LENGTH	SLOPE	85TH% RAINFALL DEPTH	% IMP.	SOIL TYPE	Q_{PM}	V_{LID}
	ac	*ft*	*ft/ft*	*in*			*cfs*	*cu-ft*
1B	0.8	591	0.027	0.91	0.93	020	0.175	3,318
2B	3.9	614	0.029	0.91	0.75	020	0.660	13,415
3B	1.2	395	0.025	0.91	0.75	020	0.227	4,128
4B	3	706	0.007	0.91	0.75	020	0.434	10,320
5B	4	694	0.031	0.91	0.75	020	0.655	13,759
6B	5.9	849	0.019	0.91	0.75	020	0.875	20,295
7B	1.9	525	0.019	0.91	0.75	020	0.327	6,536
8B	2.1	571	0.009	0.91	0.75	020	0.329	7,224
9B	2	462	0.011	0.91	0.75	020	0.338	6,880
10B	2.4	565	0.005	0.91	0.75	020	0.361	8,256
11B	2.1	489	0.015	0.91	0.75	020	0.361	7,224
12B	2.4	558	0.022	0.91	0.75	020	0.406	8,256
13B	3.1	670	0.022	0.91	0.75	020	0.500	10,662
14B	3.4	440	0.014	0.91	0.75	020	0.595	11,695
15B	1.7	385	0.013	0.91	0.75	020	0.309	2,599
16B	3.4	628	0.022	0.91	0.75	020	0.557	11,695
17B	2	433	0.025	0.91	0.75	020	0.371	6,880
18B	2.8	995	0.024	0.91	0.75	020	0.405	9,632
19B	3	551	0.015	0.91	0.75	020	0.499	10,320
20B	4.6	1271	0.016	0.91	0.75	020	0.598	15,824
21B	2.4	506	0.012	0.91	0.75	020	0.399	8,256
22B	2.6	520	0.008	0.91	0.75	020	0.413	8,944
23B	3.9	628	0.010	0.91	0.75	020	0.602	13,415
24B	3.3	859	0.006	0.91	0.75	020	0.442	11,352
25B	1.9	383	0.017	0.91	0.75	020	0.353	6,536
26B	4.4	767	0.012	0.91	0.75	020	0.645	15,135
27B	2.5	439	0.009	0.91	0.75	020	0.423	8,600
28B	1.7	353	0.006	0.91	0.75	020	0.298	5,848
29B	3.3	573	0.009	0.91	0.75	020	0.517	11,351
30B	1	834	0.010	0.91	0.93	020	0.181	4,147
31B	0.6	476	0.004	0.91	0.93	020	0.118	2,488
32B	0.9	622	0.022	0.91	0.93	020	0.190	3,733
33B	0.7	636	0.009	0.91	0.75	020	0.107	2,408
34B	1.3	331	0.012	0.91	0.75	020	0.246	4,472
35B	0.6	413	0.034	0.91	0.93	020	0.147	2,488
36B	0.4	296	0.013	0.91	0.93	020	0.100	1,659
37B	0.3	436	0.017	0.91	0.93	020	0.069	1,244
TOTAL	87.5						14.231	300,992
								6.91 ac-ft

WQT Basin C

DMA (WQT)	AREA	FLOWPATH LENGTH	SLOPE	85TH% RAINFALL DEPTH	% IMP.	SOIL TYPE	Q_{PM}	V_{LID}
	ac	*ft*	*ft/ft*	*in*			*cfs*	*cu-ft*
1C	1.8	840	0.008929	0.91	0.93	020	0.322	7,465
2C	2.7	780	0.01859	0.91	0.93	020	0.525	11,198
TOTAL	4.5						0.847	18,664
								0.43 ac-ft

BMP CAPACITY							
DMA	***FLOWRATE***	***VOL REQ***	***VOL REQ (x 1.5)***	***VOL REQ (Total)***	***VOL PROV***	***BMP***	***DELTA***
	cfs	***cf***	***cf***	***cf***	***cf***		***cf***
1A	0.441	7,466	11,198	15,761	16,043	A	282
2A	0.211	3,041	4,562				
1B	0.175	2,212	3,318	300,992	304,021	B	3,029
2B	0.660	8,944	13,415				
3B	0.227	2,752	4,128				
4B	0.434	6,880	10,320				
5B	0.655	9,173	13,759				
6B	0.875	13,530	20,295				
7B	0.327	4,357	6,536				
8B	0.329	4,816	7,224				
9B	0.338	4,586	6,880				
10B	0.361	5,504	8,256				
11B	0.361	4,816	7,224				
12B	0.406	5,504	8,256				
13B	0.500	7,108	10,662				
14B	0.595	7,797	11,695				
15B	0.309	3,898	2,599				
16B	0.557	7,797	11,695				
17B	0.371	4,586	6,880				
18B	0.405	6,421	9,632				
19B	0.499	6,880	10,320				
20B	0.598	10,549	15,824				
21B	0.399	5,504	8,256				
22B	0.413	5,962	8,944				
23B	0.602	8,944	13,415				
24B	0.442	7,568	11,352				
25B	0.353	4,357	6,536				
26B	0.645	10,090	15,135				
27B	0.423	5,733	8,600				
28B	0.298	3,898	5,848				
29B	0.517	7,568	11,351				
30B	0.181	2,765	4,147				
31B	0.118	1,659	2,488				
32B	0.190	2,488	3,733				
33B	0.107	1,605	2,408				
34B	0.246	2,981	4,472				
35B	0.147	1,659	2,488				
36B	0.100	1,106	1,659				
37B	0.069	829	1,244				
1C	0.322	4,977	7,465	18,664	27,995	C	9,331
2C	0.525	7,465	11,198				

APPENDIX C

LID BASIN DESIGN CALCULATIONS

BASIN A

DYODS™
Design Your Own Detention System

CONTECH CMP DETENTION SYSTEMS

CONTECH STORMWATER SOLUTIONS INC.

For design assistance, drawings,
and pricing send completed worksheet to:
dyods@contech-cpi.com

Project Summary

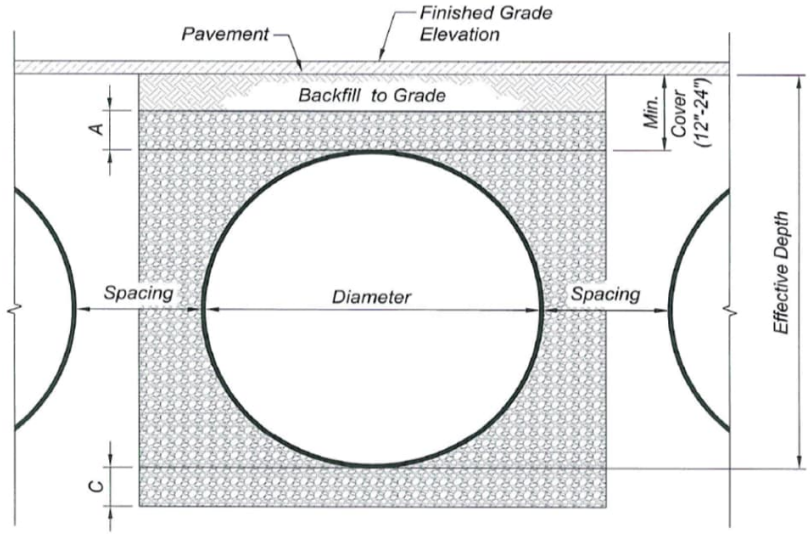
Date:	7/9/2025
Project Name:	2330-Belcaro At Sand Canyon
City / County:	Santa Clarita, Los Angeles
State:	California
Designed By:	Raed
Company:	Alliance Land Planning & Engineering
Telephone:	760-431-9876

Enter Information in Blue Cells

Corrugated Metal Pipe Calculator

Storage Volume Required (cf):	15,761
Limiting Width (ft):	38.00
Invert Depth Below Asphalt (ft):	11.00
Solid or Perforated Pipe:	Perforated
Shape Or Diameter (in):	96
Number Of Headers:	1
Spacing between Barrels (ft):	3.00
Stone Width Around Perimeter of System (ft):	1
Depth A: Porous Stone Above Pipe (in):	6
Depth C: Porous Stone Below Pipe (in):	6
Stone Porosity (0 to 40%):	40

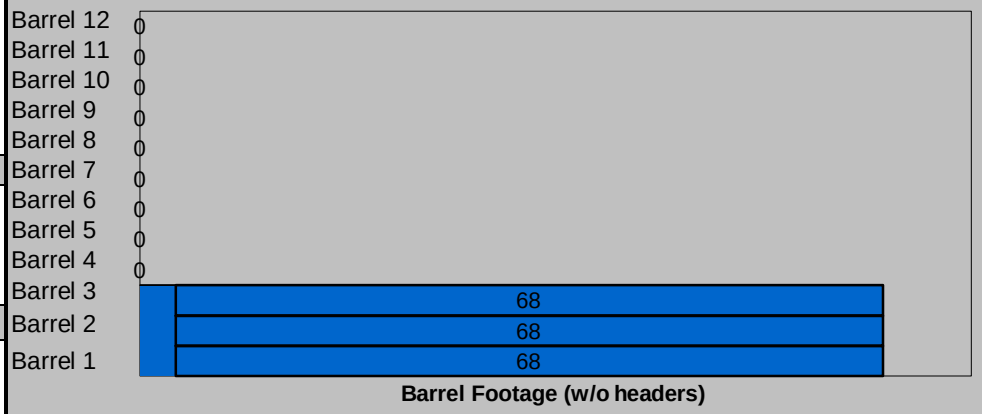
50.27 ft^2 Pipe Area



System Sizing

Pipe Storage:	11,762	cf	
Porous Stone Storage:	4,281	cf	
Total Storage Provided:	16,043	cf	101.8% Of Required Storage
Number of Barrels:	3	barrels	
Length per Barrel:	68.0	ft	
Length Per Header:	30.0	ft	
Rectangular Footprint (W x L):	32. ft x 78. ft		

System Layout



CONTECH Materials

Total CMP Footage:	234	ft
Approximate Total Pieces:	11	pcs
Approximate Coupling Bands:	10	bands
Approximate Truckloads:	6	trucks

Construction Quantities**

Total Excavation:	1017	cy
Porous Stone Backfill For Storage:	396	cy stone
Backfill to Grade Excluding Stone:	185	cy fill

***Construction quantities are approximate and should be verified upon final design*

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2330-BELCARO SAND CANYON
7/9/2025

BIOFILTRATION BASIN B
DESIGN WORKSHEET

Static Storage Calc		
Ponded Volume		
Area btm	46,412	sf
Area Top	49,536	sf
Avg Area	47,974	sf
Ponding Depth	1.5	ft
Ponding Vol	71,961	cf
Media Volume		
Area Btm	46,412	sf
Void Ratio	0.3	
Depth	2.0	ft
Media Volume	27,847	cf
Gravel Volume		
Area Btm	46,412	sf
Void Ratio	0.4	
Depth	1.0	ft
Gravel Volume	18,565	cf
Total Static Volume	**118,373**	**cf**

Flow Through Calc		
Btm Area	46,412	sf
Infil rate	8.0	in/hr
	0.667	ft/hr
Duration	6	hrs
Flow Thru Vol	**185,648**	**cf**

Treatment Summary		
Wqt per Hydrocalc	300,991	cf
factor of safety already applied		
Wqt Vol Required	**300,991**	**cf**
Total Vol Provided	**304,021**	**cf**
Delta	**3,030**	**cf**

2330-BELCARO SAND CANYON
7/9/2025

BIOFILTRATION BASIN C
DESIGN WORKSHEET

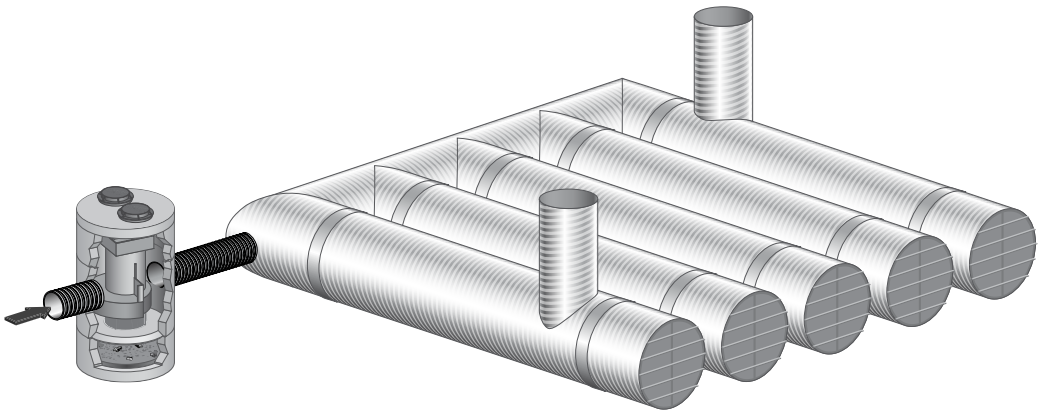
Static Storage Calc		
Ponded Volume		
Area btm	11,597	sf
Area Top	12,902	sf
Avg Area	12,250	sf
Ponding Depth	1.5	ft
Ponding Vol	18,375	cf
Media Volume		
Area Btm	11,597	sf
Void Ratio	0.3	
Depth	2.0	ft
Media Volume	6,958	cf
Gravel Volume		
Area Btm	11,597	sf
Void Ratio	0.4	
Depth	1.0	ft
Gravel Volume	4,639	cf
Total Static Volume	**29,972**	**cf**

Flow Through Calc		
Btm Area	11,597	sf
Infil rate	8.0	in/hr
	0.667	ft/hr
Duration	6	hrs
Flow Thru Vol	**46,390**	**cf**

Treatment Summary		
Wqt per Hydrocalc	18,663	cf
factor of safety already applied		
Wqt Vol Required	**18,663**	**cf**
Total Vol Provided	**76,362**	**cf**
Delta	**57,699**	**cf**

CONTECH®
ENGINEERED SOLUTIONS
A QUIKRETE® COMPANY

Corrugated Metal Pipe Detention Design Guide



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Design Tables 6

Pretreatment Options 11

Custom Fabrication and Fittings 12

CMP Detention System Bedding and Backfill..... 13

CMP Detention System Installation 13

CMP Detention System Design Tools

Design Your Own Detention System (DYODS®)

Contech's DYODS is an exclusive, online design tool that allows you to design your own detention or infiltration system. DYODS fully automates the layout process for stormwater detention and infiltration systems and produces CAD and PDF files that can be used for creating plans and specs, and for estimating total installed costs.
Features of the new tool include:

- Optimizes design and layout for cost efficiency
- "Drag and drop" feature allow users to customize layout
- Design multiple systems per project and save for future use
- Provides instant access to customized, project specific drawings
- CAD/PDF files provided for use in creating plans and specs
- Guides the selection of CMP material and coatings

The DYODS tool is available at www.conteches.com/design-center

Online Product Design Worksheet (PDW)

Our in-house team of engineers can support you through the entire permitting process. Just enter your information into the online form, and one of our in-house engineers will contact you with specific recommendations for your project.

The Detention Product Design Worksheet
is available at www.conteches.com/detentionpdw

Engineering Services & Support

Contech has regional engineering offices and local stormwater consultants trained to provide regulatory guidance and permitting assistance, preliminary standard details and/or site specific final drawings and specifications, Low Impact Development design assistance, engineering calculations for hydraulics/hydrology, buoyancy, and stage-storage, installation support, maintenance support and more.

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Guidelines for Designing CMP Detention Systems

Please follows these guidelines when designing a custom fabricated CMP detention system.

- No riser or stubs on a weld.
- Minimum distance from riser or stub to a weld joint is 12".
- Riser minimum distance to end of pipe is 24".
- Stub minimum distance to end of pipe is 12".
- Spacing between pipe runs up to /incl 24"diameter pipe is 12", 24" to 72" diameter pipe is equal to half the diameter of pipe, =>72" Diameter pipe is 3 ft standard spacing.
- Minimum depth of earth cover is 1' above crown of pipe up 96" diameter pipe, 102" diameter pipe and over is 18" min. earth cover.
- Standardized length of pipe is 24' but can vary from one region to another. Speak to your local Contech representative for additional information.
- Minimum length of pipe needs to be 4 feet greater than the diameter of the pipe.
- Any system should be outside the building's foundation zone of influence and any system beneath a structure should be evaluated on an individual basis.

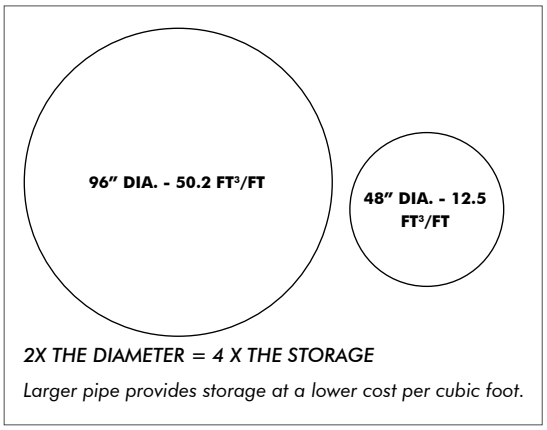
Cost-Effective Design and Layout

The three most important goals should be to shrink the footprint of the system by maximizing the storage volume within a given area, eliminate unnecessary welding and fabrication, and eliminate unnecessary structures.

Shrinking the Footprint

The goal of any CMP detention system should be to maximize the vertical space available to minimize the overall footprint, to reduce material, excavation, and backfill costs. To do this we recommend using the largest diameter pipe possible.

Increasing the depth of a CMP detention system allows for a smaller footprint while storing the same amount of water. For example, doubling the diameter of pipe yields four times as much storage volume per foot in the pipe. This provides significant cost savings per cubic foot of storage. Also, more vertical storage space means a smaller footprint equating to less excavation, less backfill and lower project costs.

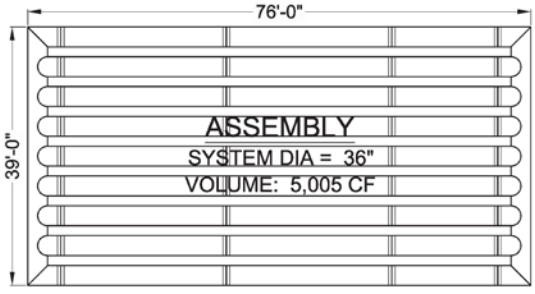


2X THE DIAMETER = 4 X THE STORAGE

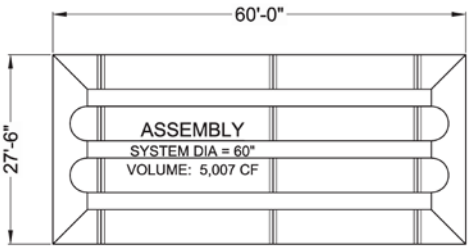
Larger pipe provides storage at a lower cost per cubic foot.

Consider the following example:

System 1 is made from 36" diameter pipe that provides 5,005 cubic feet of storage. System 2 is made from 60" diameter pipe that provides the same 5,005 cubic feet of storage. Both systems provide the same amount of storage, but System 2 is the most economical design as it reduces material costs, fabrication costs, excavation, and backfill costs. Having fewer runs of pipe will cut down on the number of welds and special fabrication requirements. Having fewer welds will also cut down on lead times. Lastly, System 2 has a footprint that is 1,300 square feet smaller than System 1, reducing excavation and backfill costs. The only instance, where System 2 may not be feasible, is when you do not have the available depth for the larger diameter pipe.



System 1

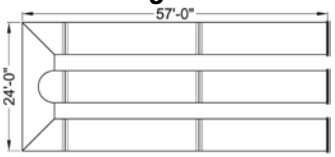


System 2

Eliminating Unnecessary Welds

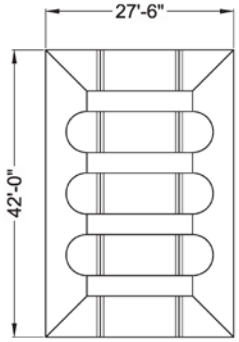
The rule of thumb is to use as much straight pipe as possible to reduce the number of tees and elbows in your design. Doing so will result in a more cost effective and efficient design, and will also reduce lead times. In the example below, both systems are designed with 72" diameter pipe and roughly the same storage volume. System 1 uses only two elbows and one tee and will be much more cost effective than System Two that uses four elbows and six tees.

Efficient Design



System 1

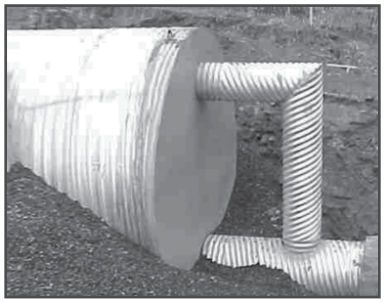
Inefficient Design



System 2

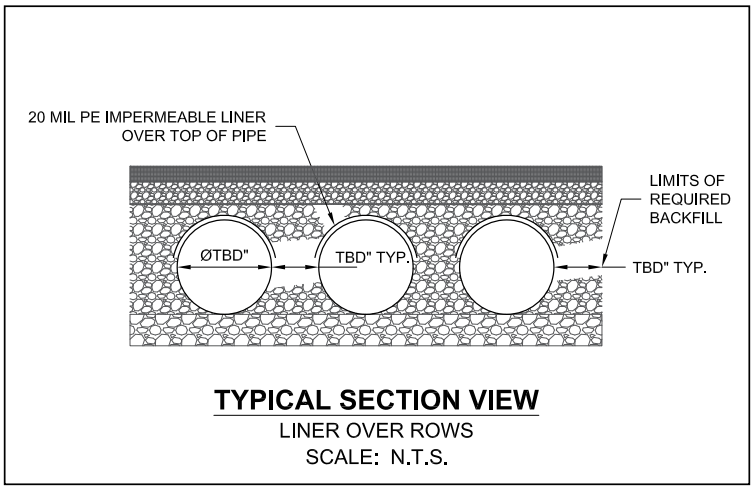
Eliminating Unnecessary Structures

Costs can also be reduced by eliminating concrete structures such as catch basins and outlet control structures by incorporating them into the CMP system. For example, a riser can be added to a system in the low point of a parking lot with a grated inlet to eliminate a concrete catch basin. Internal weir plates and multiple external outlet stubs can often be used to eliminate a separate concrete outlet control structure downstream. Such designs may seem a bit unusual for an engineer that is used to designing with concrete structures. Contech's team of stormwater design engineers have experience in this and can assist with the routing designs of CMP detention systems.



CMP Detention Systems and the Geomembrane Barrier

The resistivity of a project site may change over time due to the use of various salting, de-icing, and agricultural agents applied on or near the area. To mitigate the potential impact of these agents, an HDPE membrane liner will be installed on the crown of each pipe, creating an impermeable barrier. This measure is designed to protect the system from environmental changes that could lead to premature corrosion and reduce the overall service life.



Standard Liner Over Rows

Detention Pipe Selection

Durability Design Guide for CMP Detention Products

Proper design of detention systems requires structural, hydraulic and durability considerations. While most designers are comfortable with structural and hydraulic design, the mechanics of evaluating abrasion, corrosion and water chemistry to perform a durability design are not found in most civil engineering handbooks.

The durability and service life of a CMP detention installation is directly related to the environmental conditions encountered at the site and the type of materials and coatings from which the system is fabricated. Two principle causes of early failure for CMP are corrosion and abrasion.

Service life can be affected by the corrosive action of the backfill in contact with the outside of a CMP detention or occasionally by the corrosive and abrasive action of the flow in the invert of the CMP detention. The design life analysis should include a check for both the water side and soil side environments to determine which is more critical— or which governs service life.

Metal loss in the invert of a CMP detention due to abrasive flows is not typical as the hydraulic dynamics are different as compared to a culvert application. An estimate for potential abrasion is required at each pipe location in order to determine the appropriate material and gage. Typical Detention applications are considered to have an Abrasion Level 1, or non-abrasive.

This manual is intended to guide specifiers through the mechanics of selecting appropriate materials to meet service life requirements. The information contained in the following pages is a composite of several national guidelines.

Procedure for Selection of the Appropriate System

The choice of material, gage and product type can be extremely important to service life. The following steps describe the procedure for selecting the appropriate CMP detention material and gage to meet a specific service life requirement.

Design Sequence:

1. Select pipe or structure based on hydraulic and clearance requirements.

2. Use Height of Cover tables for the chosen pipe or structure to determine the material gage required for the specific loading condition.

3. Use Table 2 to select the appropriate material for the site-specific environmental conditions. There may be some instances where more than one material is appropriate for the project environmental conditions. Generally speaking, the metal material types increase in price as you move from top down on Table 2. Please contact your local Contech Representative for pricing.

4. Use Table 3 to determine which abrasion level most accurately describes site conditions. The expected stream velocity and associated abrasion conditions should be based on a typical flow and not a 10 or 50-year design flood. Abrasion Level 1 is typically an accepted value for detention and infiltration applications.

5. Use Table 4 to determine whether the structural gage for the selected material is sufficient for the design service life. If the structural gage is greater than or equal to the gage required for a particular abrasion condition and service life, use the structural gage. Conversely, if the structural gage is less than the gage required for a particular abrasion condition and service life, use the gage required by Table 4.

Note: *Corrosive environments, such as seawater and road/de-icing salt infiltration, and other environments with pH and resistivity outside of the recommended range may cause premature corrosion and reduce actual service life. See page 19 for additional information.*

Table 1 - AASHTO Reference Specifications

	Material Type	Material	Pipe	Design*	Installation*
Pipe & Pipe Arch	**CMP (1/2" or 1" deep corrugations)**				
	Galvanized (2 oz.)	M218	M36	Section 12	Section 26
	Asphalt Coated	M190	M36	Section 12	Section 26
	Asphalt Coated and Paved Invert	M190	M36	Section 12	Section 26
	Aluminized Type 2	M274	M36	Section 12	Section 26
	Polymer Coated	M246	M36 & M245	Section 12	Section 26
	Aluminum Alloy	M197	M196	Section 12	Section 26
	ULTRA FLO® (3/4" x 3/4" x 7-1/2" corrugation)				
	Galvanized (2 oz.)	M218	M36	Section 12	Section 26
	Aluminized Type 2	M274	M36	Section 12	Section 26
	Polymer Coated	M246	M36 & M245	Section 12	Section 26
	Aluminum Alloy	M197	M196	Section 12	Section 26
	Smooth Cor™				
	Polymer Coated	M246	M36 & M245	Section 12	Section 26

* *AASHTO LRFD Bridge Design Specification and AASHTO Standard Specification for Highway Bridges*

Table 2 — Recommended Environments

Material Type	Soil* and Water pH										Resistivity (ohm-cm)	
	3	4	5	6	7	8	9	10	11	12	Minimum	Maximum
Galvanized Steel*											2,000	10,000
Aluminized Steel Type 2											1,500	N/A
Polymer Coated											250	N/A
Aluminum Alloy											500	N/A

**Appropriate pH range for Galvanized Steel is 6.0 to 10*

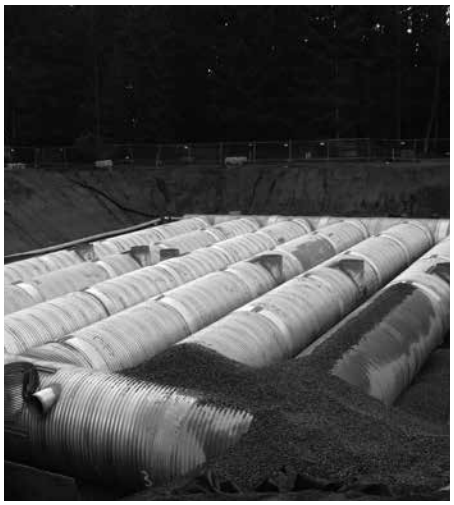


Table 3 — FHWA Abrasion Guidelines

Abrasion Level	Abrasion Condition	Bed Load	Flow Velocity (fps)
1*	Non-Abrasive	None	Minimal
2	Low Abrasion	Minor	< 5
3	Moderate Abrasion	Moderate	5 - 15
4	Severe Abrasion	Heavy	> 15

"Interim Direct Guidelines on CMP Drainage Alternative Selection." FHWA, 2005.

** Typical abrasion level for Detention and Infiltration applications is level 1.*

Table 4 – CMP Detention & Infiltration Typical Gage Recommendations

Design Service Life[1] Estimates Abrasion Level 1 & 2	25 Years	50 Years	75 Years	100 Years
Galvanized (2 oz.)[2]	16	12	10	8[5]
Aluminized Type 2[3]	16	16	16	14[6]
Polymer Coated[4]	16	16	16[7]	16[8]
Aluminum Alloy	16	16	16	16

"Interim Direct Guidelines on CMP Drainage Alternative Selection." FHWA, 2005.

1. All service life guidance is based on use in certain recommended environments only.
2. The National Corrugated Steel Pipe Association (NCSPA) provides service life guidance for galvanized materials, with service life guidance up to 97 years for 8 GA galvanized.
3. Aluminized Type 2 is the typical coating for most detention and infiltration applications. The NCSPA service life guidance of 75+ years for ALT2 in recommended environments, for pH 5-9 and resistivity > 1,500 ohm-cm.
4. The NCSPA provides service life guidance for polymer coated materials. Service life guidance of up to 75 years for polymer coated materials is based on a pH range of 4-9 and resistivity greater than 750 ohm-cm and of up to 100 years for polymer coated is based on a pH range of 5-9 and resistivity greater than 1,500 ohm-cm.
5. Design service life for 8 GA galvanized is 97 years.
6. NCSPA states that 14 GA ALT2 can achieve a 100 year service life when the environmental conditions have a pH of 5 to 9 and a resistivity greater than 1,500 ohm-cm.
7. 75 year service life for polymer-coated is based on a pH range of 4-9 and resistivity greater than 750 ohm-cm.
8. 100 year service life for polymer-coated is based on a pH range of 5-9 and resistivity greater than 1,500 ohm-cm.

CMP for Subsurface Infilitration

- CMP infiltration systems can be designed to meet HS 20 or greater load requirements with proper depths of cover.
- Protective pipe coatings such as Aluminized Type 2 (ALT2), Galvanized, and Polymer-Coated are matched to the pH and resistivity of the surrounding soil. See table 3 for additional information.
- CMP infiltration systems need to be surrounded by clean crushed stone to provide increased capacity utilizing storage in the void space. The system is then wrapped with fabric on the sides and top. The fabric is primarily used to keep native soils from filling stone voids and reducing long term storage capacity.

Storage Volumes for Corrugated Steel Pipe

Round Pipe - Hydraulic Storage per Linear Foot	
Diameter (Inches)	Hydraulic Storage (CF per FT)
12	0.8
15	1.2
18	1.8
21	2.4
24	3.1
30	4.9
36	7.1
42	9.6
48	12.6
54	15.9
60	19.6
66	23.8
72	28.3
78	33.2
84	38.5
90	44.2
96	50.3
102	56.7
108	63.6
114	70.9
120	78.5
126	86.6
132	95.0
138	103.9
144	113.1

Pipe Arch - Hydraulic Storage per Linear Foot		
2 2/3" x 1/2" Corrugated Steel Pipe		
Diameter (Inches)	Pipe Arch Equivalent Size (Inches)	Hydraulic Storage (CF per FT)
15	17 x 13	1.1
18	21 x 15	1.6
21	24 x 18	2.2
24	28 x 20	2.4
30	35 x 24	4.5
36	42 x 29	6.5
42	49 x 33	8.9
48	57 x 38	11.6
54	64 x 43	14.7
60	71 x 47	18.1
66	77 x 52	21.9
72	83 x 57	26.0

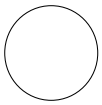
Pipe Arch - Hydraulic Storage per Linear Foot		
3" x 1" or 5" x 1" Corrugated Steel Pipe		
Diameter (Inches)	Pipe Arch Equivalent Size (Inches)	Hydraulic Storage (CF per FT)
54	60 x 46	15.6
60	66 x 51	19.3
66	73 x 55	23.2
72	81 x 59	27.4
78	87 x 63	32.1
84	95 x 67	37.0
90	103 x 71	42.4
96	112 x 75	48.0
102	117 x 79	54.2
108	128 x 83	60.5
114	137 x 87	67.4
120	142 x 91	74.5

Height of Cover and Weights Tables for HEL-COR® Corrugated Steel Pipe (CSP)

Heights of Cover Notes:

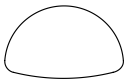
1. *These tables are for lock-seam or welded-seam construction. They are not for riveted construction. Consult your Contech Stormwater Consultant for Height of Cover tables on riveted pipe.*
2. *These values, where applicable, were calculated using a load factor of K=0.86 as adopted in the NCSPA CSP Design Manual, 2008.*
3. *The span and rise shown in these tables are nominal. Typically the actual rise that forms is greater than the specified nominal. This actual rise is within the tolerances as allowed by the AASHTO & ASTM specifications. The minimum covers shown are more conservative than required by the AASHTO and ASTM specifications to account for this anticipated increase in rise. Less cover height may be tolerated depending upon actual rise of supplied pipe arch.*
4. *H 20 and H 25 minimum cover is measured from top of pipe to bottom of flexible pavement or top of rigid pavement.*
5. *The H 20 and H 25 pipe-arch tables are based on 2 tons per square foot corner bearing pressures.*
6. *0.052" is 18 gage.*
   0.064" is 16 gage.
   0.079" is 14 gage.
   0.109" is 12 gage.
   0.138" is 10 gage.
   0.168" is 8 gage.
7. *For construction and firetruck loads, see Page 18.*
8. *1-1/2" x 1/4" corrugation. H 20, H 25 and E 80 loading.*
9. *Sewer gage (trench conditions) tables for corrugated steel pipe can be found in the AISI book "Modern Sewer Design," 4th Edition, 1999. These tables may reduce the minimum gage due to a higher flexibility factor allowed for a trench condition.*
10. *The haunch areas of a pipe-arch are the most critical zone for backfilling. Extra care should be taken to provide good material and compaction to a point above the spring line.*

Heights of Cover Limits – 2 2/3" x ½" HEL-COR CSP



H 20 and H 25 Live Loads

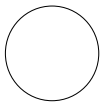
Diameter or Span, Inches	Minimum Cover, Inches	Maximum Cover, Feet					
		Specified Thickness, Inches					
		0.052	0.064	0.079	0.109	0.138	0.168
6[8]	12	388	486				
8[8]	12	291	365				
10[8]	12	233	392				
12	12	197	248	310			
15	12	158	198	248			
18	12	131	165	206			
21	12	113	141	177	248		
24	12	98	124	155	217		
30	12		99	124	173		
36	12		83	103	145	186	
42	12		71	88	124	159	195
48	12		62	77	108	139	171
54	12			67	94	122	150
60	12				80	104	128
66	12				68	88	109
72	12					75	93
78	12						79
84	12						66



H 20 and H 25 Live Loads, Pipe-Arch

Size		Minimum Structural Thickness, Inches	Minimum Cover, Inches	Maximum Cover, Feet
Round Equivalent, Inches	Span x Rise, Inches			2 Tons/Ft.² Corner Bearing Pressure
15	17 x 13	0.064	12	16
18	21 x 15	0.064	12	15
21	24 x 18	0.064	12	15
24	28 x 20	0.064	12	15
30	35 x 24	0.064	12	15
36	42 x 29	0.064	12	15
42	49 x 33	0.064*	12	15
48	57 x 38	0.064*	12	15
54	64 x 43	0.079*	12	15
60	71 x 47	0.109*	12	15
66	77 x 52	0.109*	12	15
72	83 x 57	0.138*	12	15

Heights of Cover Limits – 5" x 1" or 3" x 1" HEL-COR CSP



H 20 and H 25 Live Loads

Diameter or Span, Inches	Minimum Cover, Inches	Maximum Cover, Feet				
		Specified Thickness, Inches				
		0.064	0.079	0.109	0.138	0.168
54	12	56	70	98	127	155
60	12	50	63	88	114	139
66	12	46	57	80	103	127
72	12	42	52	74	95	116
78	12	39	48	68	87	107
84	12	36	45	63	81	99
90	12	33	42	59	76	93
96	12	31	39	55	71	87
102	18	29	37	52	67	82
108	18		35	49	63	77
114	18		32	45	58	72
120	18		30	42	54	66
126	18			39	50	61
132	18			36	46	58
138	18			33	43	53
144	18				39	49

Maximum cover heights shown are for 5" x 1".
To obtain maximum cover for 3" x 1", increase these values by 12%.

H 20 and H 25 Live Loads, Pipe-Arch

Size		Minimum Structural Thickness, Inches	Minimum Cover, Inches	Maximum Cover, Feet
Round Equivalent, Inches	Span x Rise, Inches			2 Tons/Ft.² Corner Bearing Pressure
72	81 x 59	0.109	18	21
78	87 x 63	0.109	18	20
84	95 x 67	0.109	18	20
90	103 x 71	0.109	18	20
96	112 x 75	0.109	21	20
102	117 x 79	0.109	21	19
108	128 x 83	0.109	24	19
114	137 x 87	0.109	24	19
120	142 x 91	0.138	24	19

Larger sizes are available in some areas of the United States. Check with your local Contech representative . Some minimum heights of cover for pipe-arches have been increased to take into account allowable "plus" tolerances on the manufactured rise.

Approximate Weight – Pounds/Foot
HEL-COR® CSP

(Estimated Average Weights—Not for Specification Use)

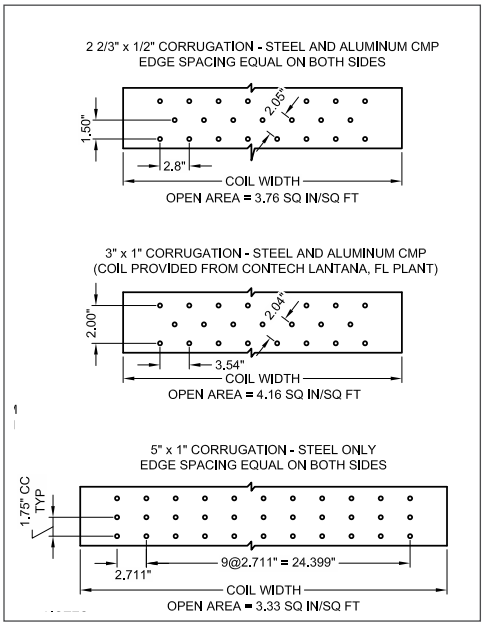
2 ²/₃" x ¹/₂" HEL-COR® CSP						
Inside Diameter, Inches	Weight (Pounds/Feet) Specified Thickness (Gage)					
	0.052	0.064	0.079	0.109	0.138	0.168
	18	16	14	12	10	8
12	8	10	12			
15	10	12	15			
18	12	15	18			
21	14	17	21	29		
24	15	19	24	33		
30		24	30	41		
36		29	36	49	62	
42		34	42	57	72	88
48		38	48	65	82	100
54			54	73	92	112
60				81	103	124
66				89	113	137
72					123	149
78						161
84						173

3" x 1" HEL-COR® CSP						
Inside Diameter, Inches	Weight (Pounds/Feet) Specified Thickness (Gage)					
	0.052	0.064	0.079	0.109	0.138	0.168
	18	16	14	12	10	8
54		50	61	83	106	129
60		55	67	92	118	143
66		60	74	101	129	157
72		66	81	110	140	171
78		71	87	119	152	185
84		77	94	128	164	199
90		82	100	137	175	213
96		87	107	147	188	228
102		93	114	155	198	241
108			120	165	211	256
114			127	174	222	271
120			134	183	234	284
126				195	247	299
132				204	259	259
138				213	270	328
144					282	344

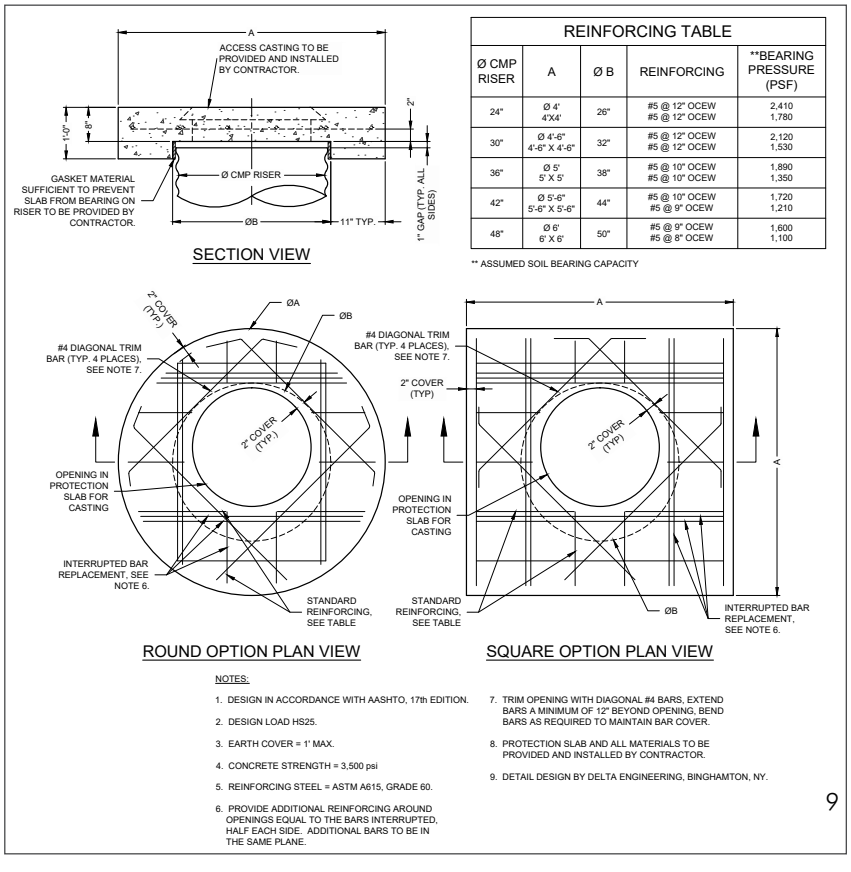
Notes::

1. *Weights shown apply to galvanized and aluminized type 2 (ALT2) CSP only. Weights for polymer coated CSP are 1% to 4% higher, varying by gage.*
2. *Please contact your Contech Stormwater Consultant.*
3. *Weights listed in the 3" x 1" or 5" x 1" table are for 3" x 1" pipe. Weights for 5" x 1" are approximately 12% less than those used in this table, for metallic coated pipe.*

CMP Perforation Details

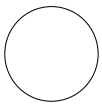


Manhole Cap Detail



Height of Cover and Weights Tables - CORLIX® Corrugated Aluminum Pipe (CAP)

Heights of Cover Limits – 2 ²/₃" x ½" CORLIX CAP



HL 93 Live Load

Diameter or Span, Inches	Minimum Cover, Inches	Maximum Cover, Feet[2] Specified Thickness (Gage) 18	16	14	12	10	8[5]
6[4]	12	197	247				
8[4]	12	147	185				
10[4]	12	119	148				
12	12		125	157			
15	12		100	125			
18	12		83	104			
21	12		71	89			
24	12		62	78	109		
27	12			69	97		
30	12			62	87		
36	12			51	73	94	
42	12				62	80	
48	12				54	70	85
54	15				48	62	76
60	15					52	64
66	18						52
72	18						43

HL 93 Live Load, Pipe-Arch

Round Pipe Dia. (Inches)	Size, Inches Span x Rise	Minimum Gage	Minimum[3] Cover (Inches)	Maximum Cover, (Ft.) Aluminum Pipe-Arch[2] 2 Tons/Ft.² for Corner Bearing Pressures
15	17 x 13	16	12	13
18	21 x 15	16	12	12
21	24 x 18	16	12	12
24	28 x 20	14	12	12
30	35 x 24	14	12	12
36	42 x 29	12	12	12
42	49 x 33	12	15	12
48	57 x 38	10	15	12
54	64 x 43	10	18	12
60	71 x 47	8[5]	18	12

Notes:

1. Height of cover is measured to top of rigid pavement or to bottom of flexible pavement.
2. Maximum cover meets AASHTO LRFD design criteria.
3. Minimum cover meets AASHTO and ASTM B 790 design criteria.
4. 1 1/2" x 1/4" corrugation.
5. 8-gage pipe has limited availability.
6. For construction loads, see page 18.

Approximate Weight – Pounds/Foot

CORLIX® CAP

(Estimated Average Weights—Not for Specification Use)

2 ²/₃" x ¹/₂" CORLIX® CAP

Diameter or Span, Inches	Weight (Pounds/Feet) Specified Thickness (Gage) 0.048 18	0.060 16	0.075 14	0.105 12	0.135 10	0.164 8[3]
6[4]	1.3	1.6				
8[4]	1.7	2.1				
10[4]	2.1	2.6				
12		3.2	4			
15		4	4.9			
18		4.8	5.9			
21		5.6	6.9			
24		6.3	7.9	10.8		
27			8.8	12.2		
30			9.8	13.5		
36			11.8	16.3	20.7	
42				19	24.2	
48				21.7	27.6	33.5
54				24.4	31.1	37.7
60					34.6	41.9
66						46
72						50.1

3" x 1" CORLIX® CAP

Diameter or Span, Inches	Weight (Pounds/Feet) Specified Thickness (Gage) 0.060 16	0.075 14	0.105 12	0.135 10	0.164 8[3]
30	9.3	11.5	15.8	20.2	
36	11.1	13.7	18.9	24.1	
42	12.9	16	22	28	
48	14.7	18.2	25.1	32	38.8
54	16.5	20.5	28.2	35.9	43.6
60	18.3	22.7	31.3	40	48.3
66	20.2	24.9	34.3	43.7	53
72	22	27.1	37.4	47.6	57.8
78		29.3	40.4	51.5	62.5
84			43.5	55.4	67.2
90			46.6	59.3	71.9
96			49.6	63.2	76.7
102				66.6	80.8
108				71	86.1
114					90.9
120					95.6

Notes:

1. Helical lockseam pipe only. Annular riveted pipe weights will be higher.
2. 1 ½" x ¼" Corrugation.
3. 8-gage pipe has limited availability.

Pretreatment Options

Regardless of infiltration material type and configuration, one of the most important components to consider is pretreatment. A pretreatment device prolongs the life of the infiltration system by removing debris and sediment that can collect on the invert and within the stone backfill voids. Pretreatment will maintain the efficiency of an infiltration system as well as extend the life cycle, therefore preventing a premature replacement. Pretreatment also offers these additional benefits:

- Pretreatment creates a single collection point which is easier to clean and maintain compared to the infiltration system alone.
- Cost savings due to the extended service life of the system.
- Removing trash and debris protects downstream outlet control structures from clogging.

Contech offers a number of pretreatment options, all of which will extend the life of subsurface infiltration systems and improve water quality. The type of system chosen will depend on a number of factors including footprint, soil conditions, local regulations, and the desired level of pretreatment.

Hydrodynamic Separation

Hydrodynamic Separation (HDS) provides a basic level of pretreatment by capturing and retaining trash and debris, sediment, and oil from stormwater runoff.

Cascade Separator™
The Cascade Separator™ is the latest innovation in hydrodynamic separation from Contech. The Cascade uses advanced sediment capture technology to provide the highest sediment removal efficiency of any Contech HDS product. Cascade also captures trash and hydrocarbons.

CDS®
The CDS® uses both swirl concentration and a nonblocking screen to capture and retain 100% of floatables and neutrally buoyant debris 4.7mm or larger.

Vortechs®
Vortechs combines swirl concentration and flow controls into a shallow treatment unit that traps and retains trash, debris, sediment, and hydrocarbons from stormwater runoff. Vortechs removes sediment down to 50 microns and is the ideal solution for projects that require a shallow treatment device due to groundwater, utility, or bedrock constraints.

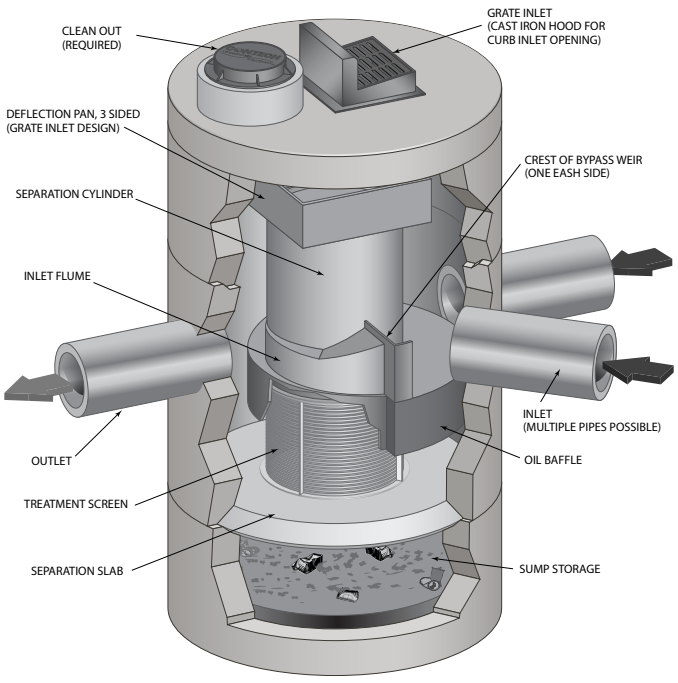
Filtration

Filtration provides a higher level of pretreatment and improved water quality by removing trash and debris, oil, fine solids, and dissolved pollutants such as metals, hydrocarbons, and nutrients.

Filterra® Bioretention System
Filterra is an engineered bioretention system that has been optimized for high volume/flow treatment and high pollutant removal.

The Stormwater Management StormFilter®
The StormFilter system is comprised of a structure that houses rechargeable, media-filled cartridges. The media can be customized to target site-specific pollutants.

Jellyfish® Filter
The Jellyfish filter uses membrane filtration in a compact footprint to remove a high level and a wide variety of stormwater pollutants such as fine particulates, oil, trash and debris, metals, and nutrients.



CDS® Hydrodynamic Separator

Custom Fabrication and Fittings

One of the benefits of CMP detention systems is its flexibility. With the addition of elbows, tees, stubs, and other components, CMP detention systems can be configured to meet sight specific constraints.

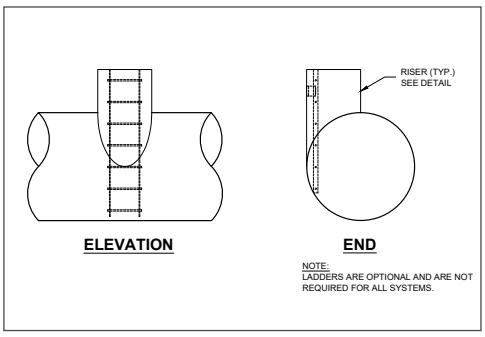
Benefits of Custom Fabrication

- More efficiently match site constraints
- System components are easy to install
- Provide maintenance ready structures - easily accessible
- Easily control influent and effluent
- Eliminate concrete structures such as junction boxes

CMP is also versatile enough for use for the entire stormwater system, including:

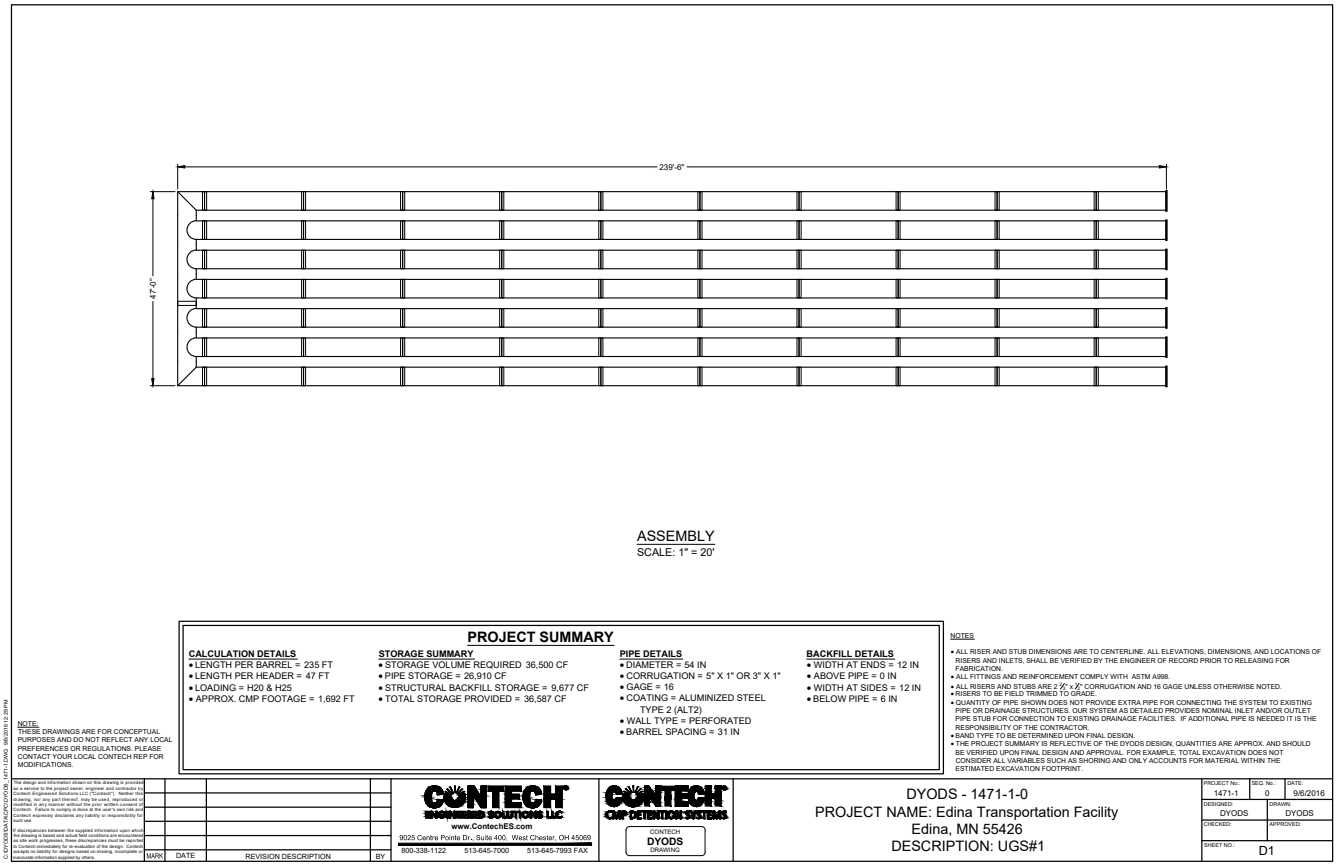
- Slotted drain pipe
- Storm sewer pipe
- Manholes / Inlet structures

Typical Riser Detail



One benefit to CMP detention systems is that we can integrate the manhole risers so you don't have to have an additional concrete junction box which can add cost to the project. Vertical risers can be used as manholes or inlets…or both, and ladders can be added so the opening can be used for access. We typically locate the manhole on the side of the pipe so that the ladder can be extend down the wall of the pipe to the invert.

Sample Proposal Drawing



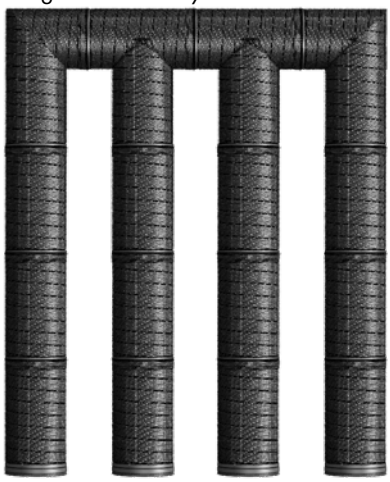
Note: Fittings will need to be structurally checked for reinforcements.

CMP Detention System Bedding and Backfill

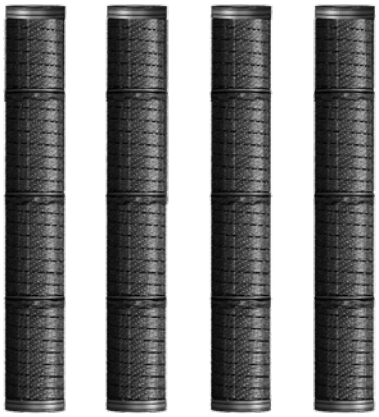
Please follow the guidelines below regarding pipe bedding and backfill.

1. Minimum trench width must allow room for proper compaction of haunch materials under pipe. min. width = (1.5 x diameter) + 12" (follow AASHTO Section 12 & 26).
    a. The minimum embankment width is 3 pipe diameters.
2. The foundation shall be well consolidated & stable.
3. The bedding material shall be a relatively loose material that is roughly shaped to fit the bottom of the pipe, 4" to 6" in depth.
4. Bedding material shall be a relatively loose material that is roughly shaped to fit the bottom of the pipe, and a minimum of twice the corrugation depth in thickness, with the maximum particle size of one-half of the corrugation depth (AASHTO Section 26.3.8.1, 26.5.3).
    a. Haunch zone material shall be hand shoveled or shovel sliced into place to allow for proper compaction.
5. H 20 and H 25 minimum cover is measured from top of pipe to bottom of flexible pavement or top of rigid pavement. Minimum cover is 12 inches for diameters up to and including 96", 18 inches for diameters ranging from 102" and greater.
6. Final backfill material selection and compaction requirements per the project plans, specifications, or engineer of record.
7. Geotextile shall be used as required to prevent soil migration.
8. Final backfill material selection and compaction requirements shall follow the project plans and specifications per the engineer of record (26.5.4.1).

Single Manifold System



No Manifold System



CMP Detention System Installation

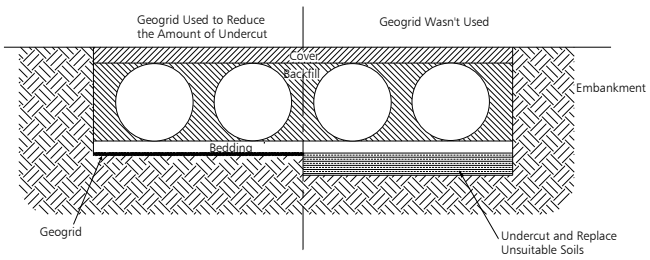
Overview

Proper installation of a flexible underground detention system will ensure long-term performance. The configuration of these systems often requires special construction practices that differ from conventional flexible pipe construction. Contech Engineered Solutions strongly suggests scheduling a pre-construction meeting with your local Sales Engineer to determine if additional measures, not covered in this guide, are appropriate for your site.

Foundation

Construct a foundation that can support the design loading applied by the pipe and adjacent backfill weight as well as maintain its integrity during construction.

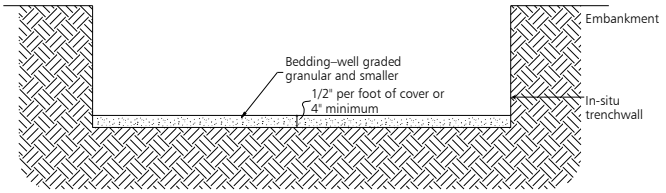
If soft or unsuitable soils are encountered, remove the poor soils down to a suitable depth and then build up to the appropriate elevation with a competent backfill material. The structural fill material gradation should not allow the migration of fines, which can cause settlement of the detention system or pavement above. If the structural fill material is not compatible with the underlying soils an engineering fabric should be used as a separator. In some cases, using a stiff reinforcing geogrid reduces over excavation and replacement fill quantities.



Grade the foundation subgrade to a uniform or slightly sloping grade. If the subgrade is clay or relatively non-porous and the construction sequence will last for an extended period of time, it is best to slope the grade to one end of the system. This will allow excess water to drain quickly, preventing saturation of the subgrade.

Bedding

A 4 to 6-inch thick, well-graded, granular material is the preferred pipe bedding. If construction equipment will operate for an extended period of time on the bedding, use either an engineering fabric or a stiff geogrid to ensure the base material maintains its integrity.

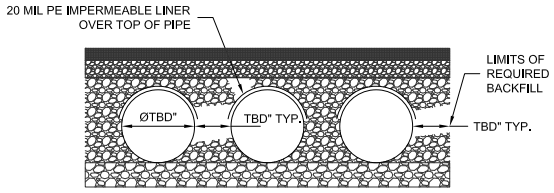


Using a relatively loose material, grade the base to a smooth, uniform grade to allow for the proper placement of the pipe. Using an open-graded bedding material is acceptable; however, an engineering fabric separator is required between the base and the subgrade.

Geomembrane Barrier

A site's resistivity may change over time when various types of salting agents are used, such as road salts for deicing purposes. If salting agents are used on or near the project site, a geomembrane barrier must be used with the system. The geomembrane liner is intended to help protect the system from the potential adverse effects that may result from the use of such salting agents including premature corrosion and reduced actual service life.

The project's Engineer of Record is to evaluate whether salting agents will be used on or near the project site, and use his/her best judgement to determine if any additional protective measures are required. Below is a typical detail showing the placement of a geomembrane barrier for projects where salting agents are used on or near the project site.



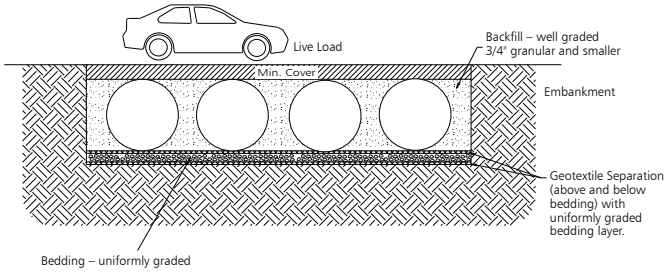
Standard Liner Over Rows

In-Situ Trench Wall

If excavation is required, the trench wall needs to be capable of supporting the load that the pipe sheds as the system is loaded. If soils are not capable of supporting these loads, the pipe can deflect. Perform a simple soil pressure check using the applied loads to determine the limits of excavation beyond the spring line of the outer most pipes. In most cases the requirements for a safe work environment and proper backfill placement and compaction take care of this concern.

Backfill Material

Typically, the best backfill material is an angular, well-graded, granular fill meeting the requirements of AASHTO A-1, A-2 or A-3. In some cases, it may be desirable to use a uniformly graded material for the first 18- to 24-inches. This type of material is easier to place under the haunches of the pipe and requires little compactive effort. Depending on the bedding material, a separation geotextile might be required above and below these initial lifts.

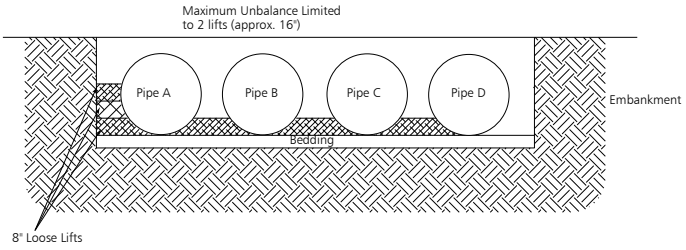


Open-graded fill is typically not used beyond the initial 18- to 24-inches because this type of fill often does not provide adequate confining restraint to the pipes. If a uniformly graded material (particles all one size) is used, install a geotextile separation fabric to prevent the migration of fines into the backfill.

Backfill using controlled low-strength material (CLSM or "flowable fill") when the spacing between the pipes will not allow for placement and adequate compaction of the backfill. Work closely with the local Contech Stormwater Consultant regarding the special installation techniques required when using CLSM.

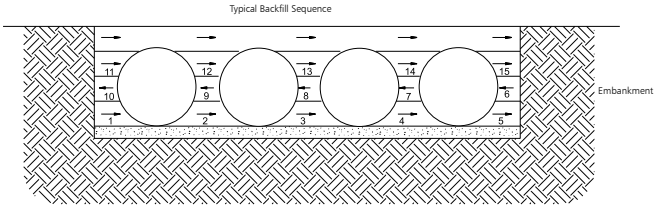
Backfill Placement

Place backfill in 8-inch loose lifts and compact to 90% AASHTO T99 standard proctor density. Material shall be worked into the pipe haunches by means of shovel-slicing, rodding, air tamper, vibratory rod, or other effective methods. If AASHTO T99 procedures are determined infeasible by the geotechnical engineer of record, compaction is considered adequate when no further yielding of the material is observed under the compactor, or under foot, and the geotechnical engineer of record (or representative thereof) is satisfied with the level of compaction.

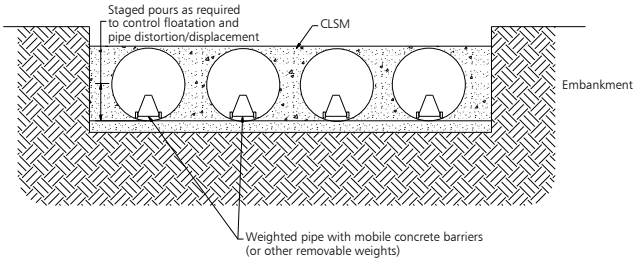


For large systems, conveyor systems, backhoes with long reaches or draglines with stone buckets may be used to place backfill.

Once minimum cover for construction loading across the entire width of the system is reached, advance the equipment to the end of the recently placed fill, and begin the sequence again until the system is completely backfilled. This type of construction sequence provides room for stockpiled backfill directly behind the backhoe, as well as the movement of construction traffic. Material stockpiles on top of the backfilled detention system should be limited to 8- to 10-feet high and must provide balanced loading across all barrels. To determine the proper cover over the pipes to allow the movement of construction equipment see Table 1, or contact your local Contech Stormwater Consultant.



When flowable fill is used, you must prevent pipe floatation. Typically, small lifts are placed between the pipes and then allowed to set-up prior to the placement of the next lift. The allowable thickness of the CLSM lift is a function of a proper balance between the uplift force of the CLSM, the opposing weight of the pipe, and the effect of other restraining measures. The pipe can carry limited fluid pressure without pipe distortion or displacement, which also affects the CLSM lift thickness. Your local Contech Stormwater Consultant can help determine the proper lift thickness.

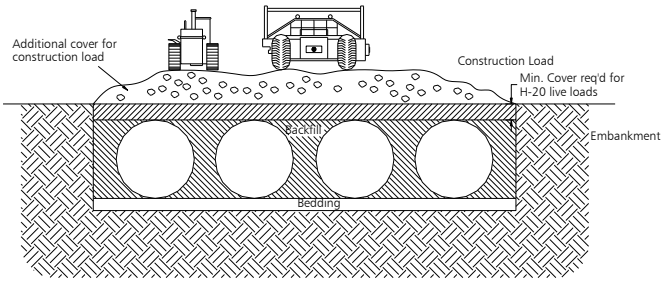


Construction Loading

Typically, the minimum cover specified for a project assumes H-20 live load. Because construction loads often exceed design live loads, increased temporary minimum cover requirements are necessary. Since construction equipment varies from job to job, it is best to address equipment specific minimum cover requirements with your local Contech Stormwater Consultant during your pre-construction meeting.

HEL-COR® CSP Minimum Height of Cover Requirements for Heavy Off-Road Construction Equipment

Pipe Span, Inches	Minimum Cover, Inches for Indicated Axle Loads (kips)			
	18-50	50-75	75-110	110-150
12 - 42	24	30	36	36
48-72	36	36	42	48
78-120	36	42	48	48
126 - 144	42	48	54	54



Firetruck Loading

Please use the table below for general guidance.

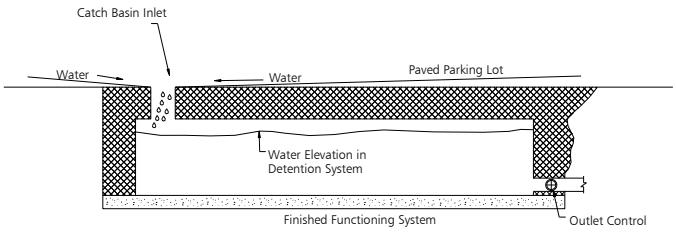
HEL-COR® CSP Minimum Height of Cover Requirements for Firetruck Loading[1]

Pipe Span, Inches	Corrugation Profile, Inches	Minimum Cover, Inches for Firetruck Outrigger Load (64 kips)[2,3]			
		16 GA	14 GA	12 GA	10 GA
		0.064	0.079	0.109	0.138
12 - 36	2 2/3 x ½	12	12	12	12
42 - 48	2 2/3 x ½	18	18	18	18
54 - 60	3 x 1 or 5 x 1	24	18		
72	3 x 1 or 5 x 1	30	24		
78 - 120	3 x 1 or 5 x 1		36	30	
126 - 144	3 x 1 or 5 x 1			42	36

1. *Minimum cover may vary depending on local conditions. The contractor must provide additional cover required to avoid damage to the pipe.* ***Minimum cover is measured from the top of the pipe to the top of the maintained construction roadway surface****.*
2. *Table is based on a typical 85,000 lb GVW firetruck with an outrigger load of 64,000 lbs. The 64,000 lb outrigger force is applied over a surface area of about 850.6 in2. The dimensions of the outrigger square pad are 25-7/8" x 32-7/8".*
3. *The outrigger load will be the heaviest load applied from the firetruck.*

Additional Considerations

Because most systems are constructed below-grade, rainfall can rapidly fill the excavation; potentially causing floatation and movement of the previously placed pipes. To help mitigate potential problems, it is best to start the installation at the downstream end with the outlet already constructed to allow a route for the water to escape. Temporary diversion measures may be required for high flows due to the restricted nature of the outlet pipe.



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APPENDIX D

STATEMENT ON INFILTRATION

BY SOILS ENGINEER

LGC Valley, Inc.
Geotechnical Consulting

July 31, 2025 Project No. 233012-01

Mr. Corey Harpole
New Urban West
2001 Wilshire Blvd, Ste 401
Santa Monica, CA 90403

Subject: ***Evaluation of the Depth to Groundwater for the Urban Stormwater Management Plan, Proposed Residential Development, Belcaro at Sand Canyon, Vesting Tentative Tract Map 084497, City of Santa Clarita, California***

Introduction

In accordance with your request, LGC Valley, Inc. (LGC) reviewed the latest Urban Stormwater Management Plan (USMP) Exhibit, dated July 10, 2025, for the Proposed Belcaro at Sand Canyon Development with respect the design groundwater elevations at the proposed BMP locations.

Urban Stormwater Management Plan

Based on our review of the USMP Exhibit dated July 10, 2025, there are three BMP locations proposed for the subject site. Two BMP locations (BMP B and C) are proposed in the northern portion of the site, north of the existing active railroad tracks and consist of an earthen biofiltration basins (with no infiltration). An additional BMP (BMP A) is located on the southern boundary of the site and consists of an Infiltration Chamber with proposed infiltration.

Groundwater

Based on our review of previous site investigations and reviews by others (Leighton on Associates, Inc, and RTF&A), groundwater levels across the site were reviewed and evaluated and determined to be within 10 feet of the existing ground surface north of the MTA railroad tracks and should be considered at an Elevation of 1,572 feet msl south of the MTA line. The following is the groundwater evaluation and discussion reiterated from RTF&A report dated February 24, 2017:

> "***GROUNDWATER***
> *Water well records from the Los Angeles County Department of Public Works (LACDPW) indicate one well located within the TTM 063022 boundaries (designated as Well No. 7197B) and six wells (designated as Well Nos. 7197, 7197A, 7197C, 7197E, 7197F, and 7197G) within 0.2 miles of TTM 063022. Well No. 7197B is located in the northwest corner of TTM 063022; the remaining six wells are all located to the north of TTM 063022, and north of the active stream channel of the Santa Clara River. Only Well No. 7197G is an active well. The approximate location of Well No. 7179B is shown on Figures 1.1 through 1.3; the remaining wells are located outside of the coverage of the Tentative Tract Map. Water levels in Well No. 7197B were measured from July 1948 through April 1976. During that period, the highest measured water*

level was 9.1 feet below ground surface, corresponding to a water surface elevation of 1571.4 feet above mean sea level (msl), recorded on April 21, 1969. The last measurement recorded in this well was 62 feet below ground surface (water surface elevation of 1518.5 feet msl) taken on April 9, 1976. Water levels in active Well No. 7197G have been recorded since October 15, 1972, with the last recorded water level measured on October 1, 2013. Within that time, the highest water level was measured at a depth of 14 feet below ground surface (water surface elevation of 1588.5 feet msl) on April 1, 1978 and again on May 1, 1978. The lowest recorded water level was 94 feet (water surface elevation of 1602.5 feet msl) measured on December 1, 1977.

Water level information presented in the 2013 Santa Clarita Valley Water Report (Luhdorff & Scalmanini Consulting Engineers, 2014) indicate groundwater elevations in Newhall County Water District well Pinetree 1, located approximately 500 feet north of the site within the Santa Clara River flood plain, have ranged from approximately 1,495 feet above msl to 1,570 feet above msl since 1985. The data indicates a 2013 water surface elevation in Pinetree 1 at approximately the historic recorded low of 1,495 feet msl, indicative of the drought conditions that have been occurring the last few years.

According to Leighton (2006) groundwater levels across the site vary appreciably, with the shallowest groundwater conditions in the northern portions of the site beneath the Santa Clara River flood plain. Leighton excavated numerous exploratory borings within or in close proximity to TTM 063022 during the period 1984 through 2006 and encountered the highest water level at a depth of 15 feet below existing ground surface in their borings B-4 and B-9. These two borings were excavated 200 feet and 500 feet, respectively, northwest of TTM 063022, and north of the MTA line. South of the MTA line, the highest water level was observed in Leighton boring B-11, at a depth of 30 feet below ground surface

Plate 1.2 of the State of California Seismic Hazard Maps for the Mint Canyon Quadrangle (CDMG, 1998) indicates that the historic high groundwater north of the existing MTA railroad tracks ranges from 5 to 25 feet and is greater than 25 feet south of the existing MTA railroad tracks.

It is recommended that a historic high groundwater depth for liquefaction calculations of 10 feet below existing ground surface be used north of the existing MTA railroad tracks and that a historic high groundwater depth corresponding to a groundwater elevation of 1,572 feet msl be used for the alluvial areas south of the active MTA right-of-way."

During previous site investigations completed for the entire site, for the proposed Oak Springs Bridge crossing, and the proposed J-Street crossing performed by LGC south of the MTA line, groundwater south of the existing MTA railroad line was encountered at depths ranging from 25 to 38 feet below the existing grades (Elevations ranging from 1,569 to 1,577 feet msl) near the MTA line and was encountered at depths ranging from 69 to 72.5 feet below the existing grades (Elevations ranging from 1,572 to 1,585.5 feet msl) near BMP A and the existing Oak Springs Road (along the southern boundary of the site). Groundwater is anticipated to fluctuate seasonally, likely by several tens of feet, which will be directly related to the recent and intensity of local storms. Historic high groundwater is greater than 25 feet (CGS, 1998) below the existing grades south of the active railroad tracks and approximately 10 feet below existing grades to the north of the active railroad

tracks. The groundwater elevations encountered in the recent LGC geotechnical borings are in agreement with the above design groundwater elevations and are confirmation of these results.

Conclusions

Based on the results of previous and current evaluations of the groundwater levels across the site, the encountered groundwater level was greater than 25 feet below the existing grades (corresponding to elevations of 1,569 to 1,585.5 feet msl) south of the active MTA railroad tracks and approximately 10 feet below existing grades to the north of the active MTA railroad tracks.

Based on our review of the USMP exhibit, the proposed bottom of BMP A is designed to be approximately 6 feet below the existing grades (at an approximate elevation of 1,639 feet msl) and based on the groundwater evaluation the groundwater level near BMP A is at an elevation ranging from 1,572 to 1,585.5 feet msl. Therefore, the historic high groundwater elevation is considered to be greater than 10 feet below the proposed BMP A bottom elevation and infiltration is acceptable.

Based on our review of the USMP exhibit, the proposed bottom of BMP B and C (which are north of the active MTA railroad tracks) is designed to be approximately 10 feet below the existing grades and based on the groundwater evaluation the groundwater level near BMP B and C is up to approximately 10 feet below the existing grades. Therefore, the historic high groundwater elevation is considered to be within 10 feet below the proposed BMP B and C bottom, and infiltration is not acceptable. It is our understanding that these basins are proposed to be biofiltration basins, with no design infiltration.

Should you have any questions regarding this letter, please contact us at your convenience.

Respectfully Submitted,

LGC Valley, Inc.

Basil Hattar, GE 2734
Principal Engineer

BIH

Distribution: (1) Addressee
(1) Alliance Land Planning & Engineering, Inc.

References

Alliance Land Planning & Engineering, Inc., 2025, Belcaro at Sand Canyon, Developed Condition USMP Exhibit, dated July 10, 2025

Leighton and Associates, December 5, 2006, Revised Geotechnical Assessment Report, Proposed Tentative Tract No. 063022, Robinson Ranch Development, Sulfur Springs, Santa Clarita, California, Project No. 061989-002.

LGC Valley, Inc., Geotechnical Investigation Report, Proposed Residential Development, Belcaro at Sand Canyon, Vesting Tentative Tract Map 084497, City of Santa Clarita, California, Project No. 233012-01, dated October 18, 2024.

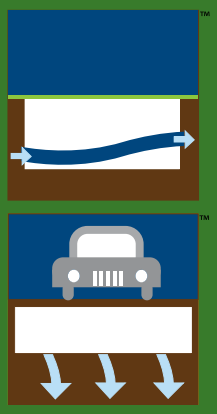
RT Frankian and Associates, February 24, 2017, 100-Scale Plan Review, Tentative Tract No. 063022, Mancara Development, Santa Clarita, California, Job No. 2014-024-021.

APPENDIX E

PROPRIETARY ADS STORMTECH INFO

UrbanGreen™

Metal Detention and Infiltration Products



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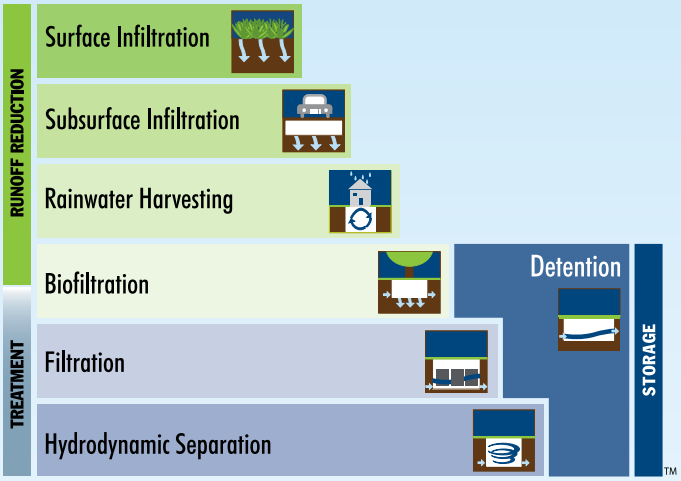
ENGINEERED SOLUTIONS

Corrugated Metal Pipe for Stormwater Detention and Infiltration

Selecting the right stormwater solution just got easier...

It's simple to choose the right low impact development (LID) solution to achieve your runoff reduction goals with the Contech UrbanGreen™ Staircase. First, select the runoff reduction practices that are most appropriate for your site, paying particular attention to pretreatment needs. If the entire design storm cannot be retained, select a treatment best management practice (BMP) for the balance. Finally, select a detention system to address any outstanding downstream erosion.



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Meet your stormwater quantity and runoff reduction requirements with ease.

Contech's corrugated metal pipe (CMP) underground detention/infiltration systems can be sized and shaped to meet your site-specific needs. The versatile material provides almost limitless opportunities to match individual site requirements while lowering site development costs.

Durable

- Proven service life – Exceeds 100-years with proper specification that meets all AASHTO and ASTM pipe specifications
- Handles fill heights in excess of 100 feet – steel combines strength with soil
- 100% traceable material – maintains performance even when recycled
- Homogenous material – eliminates failures due to stress cracks, shrinkage cracks and air voids
- Various coatings available with predictable service life
  - Aluminized Steel™ Type 2
  - Galvanized
  - CORLIX®
  - TRENCHCOAT®

Learn more about our available coatings at: www.ContechES.com/cmp

various coatings available

Versatile

- Wide range of shapes and sizes – round and pipe-arch in diameters from 6 to 144 inches
- Variety of layouts – rectangular, L-shape and staggered cells are frequently used
- Array of fittings – tees, wyes, elbow, saddle branches, manifolds, reducers and custom fabrication available

Sustainable

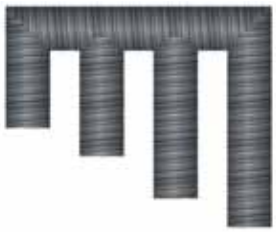
- World's most recycled content – can count towards LEED® credits
- Requires less energy and materials to produce – lowers carbon footprint

Learn how Contech products can help contribute to LEED credits at: www.ContechES.com/LEED

Easy to Install and Maintain

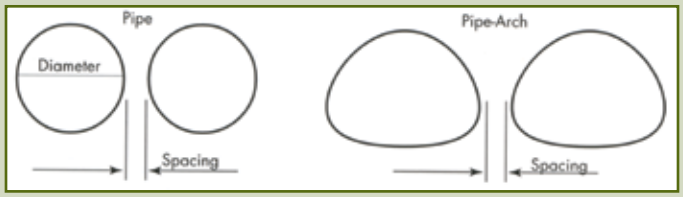
- Flexible and forgiving during installation
- Lightweight for easy handling
- Quick assembly shortens site development time
- Integrated outlet control structure eliminates need for downstream control structure
- Manhole riser sections, complete with ladders facilitate any access and scheduled maintenance

Tees, wyes, elbows, saddle branches, manifolds and reducers are available



Rectangular, L-shaped and staggered shapes are frequently used.

Typical Spacing for Multiple Barrels



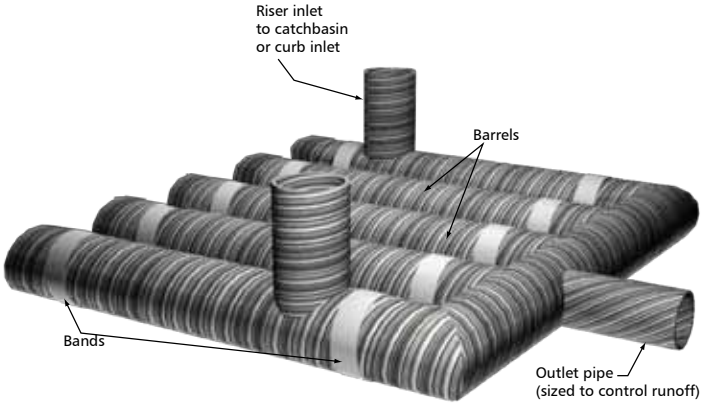
Diameter	Spacing*	Pipe-Arch Span	Spacing*
Up to 24"	12"	Up to 36"	12"
24" to 72"	1/2 Diameter of Pipe	36" to 108"	1/3 Span of Pipe-Arch
72" +	36"	108" to 189"	36"

* Spacing shown provides room for proper backfill to enable the structure to develop adequate side support. Spacing with AASHTO M-145, A-1, A-2, A-3 granular fill. Closer spacing is possible depending on quality of backfill and placing and compaction methods.

Applications

Detention

Contech CMP detention systems store stormwater runoff exceeding a site's allowable discharge rate and release it slowly over time. Installed belowgrade, the systems maximize property usage and meet your specific water quantity requirements. CMP detention systems are available in all AASHTO M-36 Types.



CMP detention system

High Volume Storage

Contech plate systems allow for high volume stormwater storage in small footprint areas. The systems are offered in a wide variety of shapes and sizes in both aluminum and galvanized steel. Full-pipe systems and three-sided structures with open bottoms can be used for infiltration.

Typically, Contech plate systems are used on high vertical rise applications or in areas where the smallest possible footprint is of the greatest concern. The systems are bolted together in the field, which reduces the number of freight loads. Remote sites or projects with challenging accessibility often utilize plate systems.

Plate system for high volume storage

Perforated CMP infiltration system

Infiltration

CMP pipe and pipe-arch is available fully or partially perforated to meet your Low Impact Development (LID) requirements. Subsurface perforated CMP infiltration systems store stormwater runoff in the pipe and surrounding stone during a storm until it can be slowly released into the surrounding native soil.

Stormwater runoff is stored in the pipe and surrounding stone.

Meet Your Low Impact Development Requirements

Pipe-arch for low profile application.

Low Profile

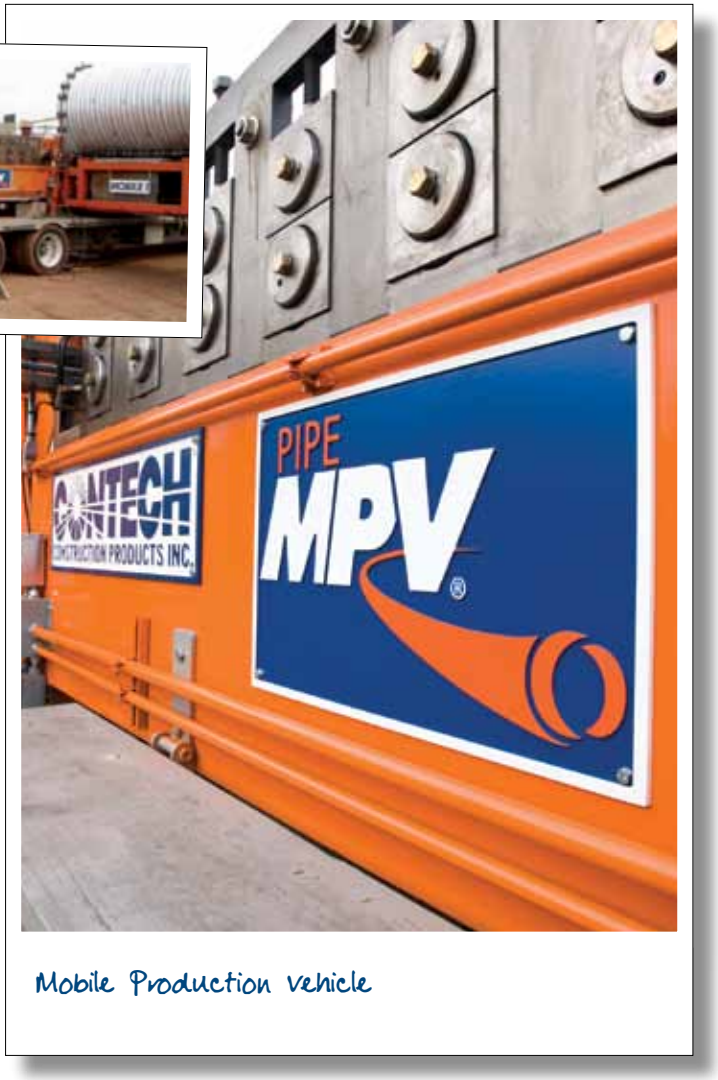
When vertical space must be maximized, the CMP can be utilized in a pipe-arch shape. The low, wide pipe-arch design allows for greater storage in a shallow profile than typical round pipe without losing any structural integrity. Like our round pipe, pipe arch is produced in six wall thicknesses including 18, 16, 14, 12, 10 and 8 gage, which are available with either helical or annular corrugations.

Applications

On-Site Manufacturing

If your job site is remote or you have limited storage space or restricted traffic patterns, take advantage of our Mobile Production Vehicle (MPV) for fast and cost effective on-site steel pipe manufacturing. The PIPE MPV® is designed to be a self-supporting factory that can be quickly deployed and put into production. Once on site, pipe manufacturing progresses quickly enough to allow pipe installation within four hours.

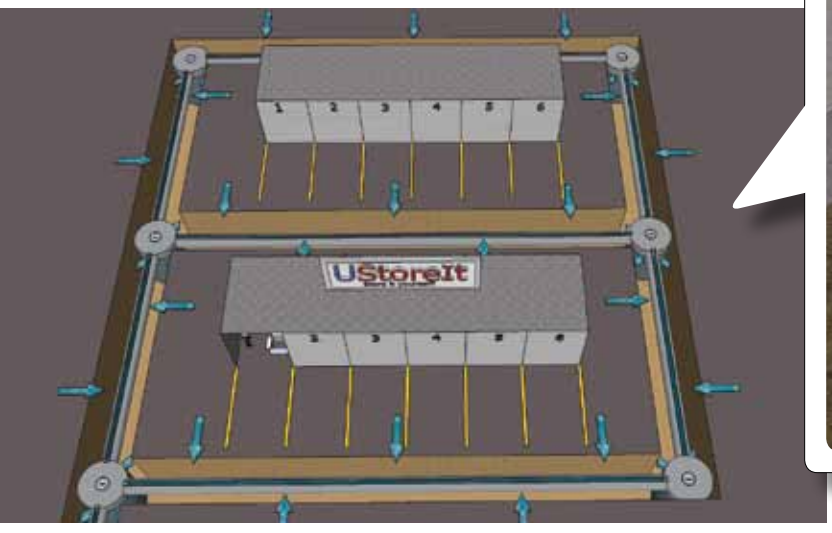
The PIPE MPV can produce corrugated metal pipe in a variety of sizes. Diameters from 36" – 192" and lengths up to 35' can be accommodated. This pipe meets the same levels of quality construction as does all Contech manufactured pipe, with high coil feedrate speeds and the same lock-seem edge process used in conventional pipe manufacturing.

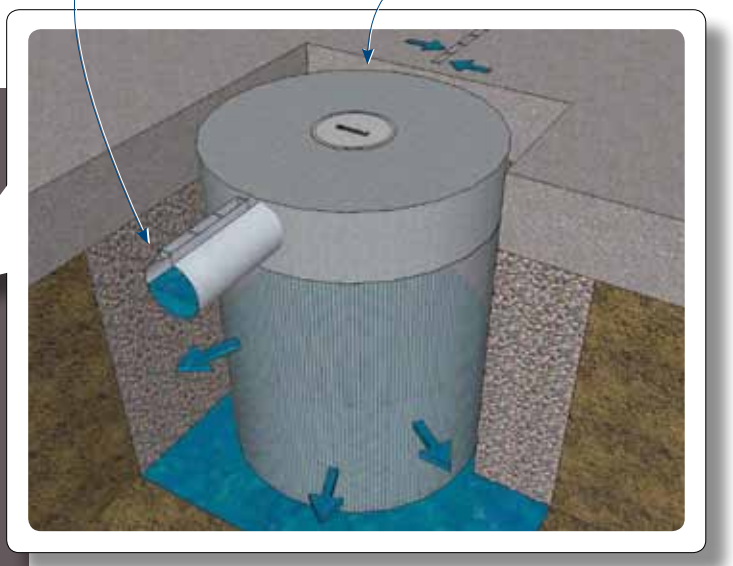


Mobile Production Vehicle

Innovative Solutions for Challenging Sites

The flexibility of CMP allows you to create innovative solutions when dealing with challenging sites. For example, when trying to meet runoff reduction requirements, your site may be mostly impervious or you may have a thin, shallow clay layer just below the surface, limiting the infiltration capacity of surface BMPs. One solution is to utilize CMP infiltration wells. First, collect the site runoff using our Slotted Drain™ around the perimeter of each drive isle. The Slotted Drain then directs water into vertical lengths of perforated CMP. The vertical perforated CMP is long enough to penetrate the clay layer and infiltrate the stormwater into a highly permeable alluvial layer about 12'-14' belowground. This allows the developer to meet the LID requirements and eliminate the need for the extended detention basin.





Sizing

Round Pipe - CMP and Plate (CMP → 12-in to 144-in; Plate → 60-in to 240-in)

Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height	Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height	Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height	Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height
12	.78	12″	60	19.6	12″	120	78.5	18″	180	176	24″
15	1.22	12″	66	23.7	12″	126	86.5	18″	186	188	24″
18	1.76	12″	72	28.2	12″	132	95.0	18″	192	201	24″
21	2.40	12″	78	33.1	12″	138	103.8	18″	198	213	30″
24	3.14	12″	84	38.4	12″	144	113.1	18″	204	227	30″
30	4.9	12″	90	44.1	12″	150	122	24″	210	240	30″
36	7.0	12″	96	50.2	12″	156	132	24″	216	254	30″
42	9.6	12″	102	56.7	18″	162	143	24″	222	268	30″
48	12.5	12″	108	63.6	18″	168	153	24″	228	283	30″
54	15.9	12″	114	70.8	18″	174	165	24″	234	298	30″

Pipe-Arch - CMP

1/2″ Deep Corrugations											
Shape (inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (inches)	Volume (ft^3/ft)	Min. Cover Height
17 x 13	1.1	12″	28 x 20	2.9	12″	49 x 33	8.9	12″	71 x 47	18.1	12″
21 x 15	1.6	12″	35 x 24	4.5	12″	57 x 38	11.6	12″	77 x 52	21.9	12″
24 x 18	2.2	12″	42 x 29	6.5	12″	64 x 43	14.7	12″	83 x 57	26.0	12″
1″ Deep Corrugations											
60 x 46	15.6	15″	81 x 59	27.4	18″	103 x 71	42.4	18″	128 x 83	60.5	24″
66 x 51	19.3	15″	87 x 63	32.1	18″	112 x 75	48.0	21″	137 x 87	67.4	24″
73 x 55	23.2	18″	95 x 67	37.0	18″	117 x 79	54.2	21″	142 x 91	74.5	24″

Pipe-Arch - MULTI-PLATE®

2″ Deep Corrugations												
	Shape (ft-in)	Volume (ft^3/ft)	Min. Cover Height	Shape (inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (inches)	Volume (ft^3/ft)	Min. Cover Height
18-in Corner Radius (Rc)	6-1 x 4-7	22	12″	8-7 x 5-11	41	18″	8-7 x 5-11	41	18″	14-1 x 8-9	97	24″
	6-4 x 4-9	24	12″	8-10 x 6-1	43	18″	8-10 x 6-1	43	18″	14-3 x 8-11	101	24″
	6-9 x 4-11	26	12″	9-4 x 6-3	46	18″	9-4 x 6-3	46	18″	14-10 x 9-1	105	24″
	7-0 x 5-1	29	12″	9-6 x 6-5	49	18″	9-6 x 6-5	49	18″	15-4 x 9-3	109	24″
	7-3 x 5-3	31	12″	9-9 x 6-7	52	18″	9-9 x 6-7	52	18″	15-6 x 9-5	114	24″
	7-8 x 5-5	33	12″	10-3 x 6-9	55	18″	10-3 x 6-9	55	18″	15-8 x 9-7	118	24″
	7-11 x 5-7	36	12″	10-8 x 6-11	58	18″	10-8 x 6-11	58	18″	15-10 x 9-10	122	24″
	8-2 x 5-9	38	18″	10-11 x 7-1	61	18″	10-11 x 7-1	61	18″	16-5 x 9-11	126	30″
							13-11 x 8-7	93	24″	16-7 x 10-1	131	30″
31-in Corner Radius (Rc)	13-3 x 9-4	98	24″	15-4 x 10-4	124	24″	17-2 x 11-4	153	30″	19-3 x 12-4	185	30″
	13-6 x 9-6	102	24″	15-7 x 10-6	129	24″	17-5 x 11-6	158	30″	19-6 x 12-6	191	30″
	14-0 x 9-8	106	24″	15-10 x 10-8	134	24″	17-11 x 11-8	163	30″	19-8 x 12-8	196	30″
	14-2 x 9-10	111	24″	16-3 x 10-10	138	30″	18-1 x 11-10	168	30″	19-11 x 12-10	202	30″
	14-5 x 10-0	115	24″	16-6 x 11-0	143	30″	18-7 x 12-0	174	30″	20-5 x 13-0	208	30″
	14-11 x 10-2	120	24″	17-0 x 11-2	148	30″	18-9 x 12-2	179	30″	20-7 x 13-2	214	36″

Next Steps

Learn more

Read our white paper, *Economic Optimization of Infiltration Systems*, to learn more. You'll receive free PDH credits for completing a quick quiz.

Available at www.ContechES.com/cmp

Quick Links:

- LEED information – www.ContechES.com/leed
- LID Application Guide – www.ContechES.com/lid
- Articles – www.ContechES.com/pdh

Connect with us

We're here to make your job easier – and that includes being able to get in touch with us when you need to. Search for your local rep at **www.ContechES.com**

While you're there, be sure to check out our upcoming seminar schedule or request an in-house technical presentation.

Links to Stormwater Tools:

To use the Design Your Own Detention System tool, visit: www.ContechES.com/dyods

To use the Land Value Calculator, visit: www.ContechES.com/lvc

(Please scroll to the bottom right to download the Land Value Calculator)

To use the Rain Water Harvesting Runoff Reduction Calculator tool, visit: www.ContechES.com/rwh-calculator

Start a Project

If you are ready to begin a project, contact your local representative to get started. Or you can check out our design toolbox for all our online resources at www.ContechES.com/designtoolbox.

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FSC

APPENDIX F

BMP MASTER COVENANT

OPERATIONS AND MAINTENANCE (O&M)

RECORDING REQUESTED BY:
Robinson Ranch Residential, LP
2780 Los Feliz Place, 2nd Floor
Los Angeles, CA 90039

WHEN RECORDED MAIL TO:
Mary Cusick, City Clerk
City of Santa Clarita
23920 Valencia Boulevard, Suite 120
Santa Clarita, CA 91355

Space above this line for Recorder's use

TITLE(S)

MAINTENANCE COVENANT FOR PARCELS SUBJECT TO STANDARD URBAN STORMWATER MITIGATION PROGRAM (SUSMP) REQUIREMENTS

RECORDING REQUESTED BY:
Robinson Ranch Residential, LP
2780 Los Feliz Place, 2nd Floor
Los Angeles, CA 90039

WHEN RECORDED MAIL TO:
Mary Cusick, City Clerk
City of Santa Clarita
23920 Valencia Boulevard, Suite 120
Santa Clarita, CA 91355

Recording Fee: _____ Space above this line for Recorder's use

Documentary Transfer Tax:

The property is located in the City of Santa Clarita.

MAINTENANCE COVENANT FOR PARCELS SUBJECT TO STANDARD URBAN STORMWATER MITIGATION PROGRAM (SUSMP) REQUIREMENTS

Pursuant to Section 17.95.110 of the Santa Clarita Municipal Code and Title 10, Chapter 10.04 of the Santa Clarita Municipal Code relating to the control of pollutants carried by storm water runoff, structural and/or treatment control Best Management Practices (BMPs) have been installed on the following property:

LEGAL DESCRIPTION

Assessor Parcel No(s): 2840-001-118, 2840-015-031, 2840-015-032, 2840-015-033, 2840-015-034, 2840-015-035, 2840-015-045, 2840-015-047

Tract/Parcel Map No.: 084497 Lot No.:____

Address: Lost Canyon Road
Santa Clarita, CA 91387

I/We, Robinson Ranch Residential, LP hereby certify that I/we am/are the legal owner(s) of property described above, and as such owners for the mutual benefit of future purchasers and transferees, their heirs, successors, and assigns (collectively "owner"), do hereby affix the following protective conditions to which their property, or portions thereof, shall be held, sold and/or conveyed:

1. That the owner(s) shall maintain the drainage devices such as paved swales, bench drains, inlets, catch basins, down-drains, pipes, and water quality devices on the property described above and as shown on plans submitted to the City of Santa Clarita, in a good and functional condition to safeguard the property and adjoining properties from damage and pollution.
2. That owner(s) shall conduct maintenance inspection of all Structural or Treatment Control BMPs on the property at least once a year and retain proof of the inspection. The annual maintenance inspections shall verify the legibility of all required stencils and signs and the owner shall repaint and label as necessary.
3. That owner(s) shall provide to new owner(s) with any conveyance of the property printed educational materials giving information on which storm water management facilities are present, the type(s) and location(s) of required maintenance signs, and required maintenance instructions.

NUWI-Sand Canyon, LLC

_____ Date:_____

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California

County of _____ }

On _____ before me, _____, Notary Public,
Date Name of Notary

personally appeared _____
Name(s) of Signer(s)

_____,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____
Signature of Notary Public

Place Notary Seal Above

---------- *OPTIONAL* ----------

Though the information below is not required by law, it may prove valuable to person relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document

Title or type of Document: _____

Document Date: _____ Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____
☐ Individual
☐ Corporate Officer --Title(s): _____
☐ Partner -- ☐ Limited ☐ General
☐ Attorney-in Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: _____

Signer Is Representing: _____

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Signer's Name: _____
☐ Individual
☐ Corporate Officer -- Title(s): _____
☐ Partner – ☐ Limited ☐ General
☐ Attorney-in Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: _____

Signer Is Representing: _____

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Bioretention Area[1] Maintenance Plan for

Belcaro At Sand Canyon
Vesting Tentative Tract No. 084497

Project Address and Cross Streets_____

Assessor's Parcel No.: _____

Property Owner: NUWI-Sand Canyon, LLC Phone No.:_____

Designated Contact: _____ Phone No.:_____

Mailing Address:_____

The property contains 8 5 bioretention basins as shown on the site plan attached.

I. Routine Maintenance Activities

The principal maintenance objective is to prevent sediment buildup and clogging, which reduces pollutant removal efficiency and may lead to bioretention area failure. Routine maintenance activities, and the frequency at which they will be conducted, are shown in Table 1.

Table 1
Routine Maintenance Activities for Bioretention Areas

No.	Maintenance Task	Frequency of Task
1	Remove obstructions, debris and trash from bioretention area and dispose of properly.	Monthly, or as needed after storm events
2	Inspect bioretention area to ensure that it drains between storms and within five days after rainfall.	Monthly, or as needed after storm events
3	Inspect inlets for channels, soil exposure or other evidence of erosion. Clear obstructions and remove sediment.	Monthly, or as needed after storm events
4	Remove and replace all dead and diseased vegetation.	Twice a year
5	Maintain vegetation and the irrigation system. Prune and weed to keep bioretention area neat and orderly in appearance.	Before wet season begins, or as needed
6	Check that mulch is at appropriate depth (3 inches per soil specifications) and replenish as necessary before wet season begins.	Monthly
7	Inspect bioretention area using the attached inspection checklist.	Monthly, or after large storm events, and after removal of accumulated debris or material

II. Prohibitions

The use of pesticides and quick release fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed:

1. Employ non-chemical controls (biological, physical and cultural controls) before using chemicals to treat a pest problem.

[1] Bioretention areas include linear treatment measures designed for water to filter through biotreatment soils. A bioretention area that is unlined and has a raised underdrain in the underlying rock layer to promote infiltration, as shown in Section 6.1, may also be called a "bioinfiltration area".
[2] Attached site plan must match the site plan exhibit to Maintenance Agreement.

2. Prune plants properly and at the appropriate time of year.
3. Provide adequate irrigation for landscape plants. Do not over water.
4. Limit fertilizer use unless soil testing indicates a deficiency. Slow-release or organic fertilizer is preferable. Check with municipality for specific requirements.
5. Pest control should avoid harming non-target organisms, or negatively affecting air and water quality and public health. Apply chemical controls only when monitoring indicates that preventative and non-chemical methods are not keeping pests below acceptable levels. When pesticides are required, apply the least toxic and the least persistent pesticide that will provide adequate pest control. Do not apply pesticides on a prescheduled basis.
6. Sweep up spilled fertilizer and pesticides. Do not wash away or bury such spills.
7. Do not over apply pesticide. Spray only where the infestation exists. Follow the manufacturer's instructions for mixing and applying materials.
8. Only licensed, trained pesticide applicators shall apply pesticides.
9. Apply pesticides at the appropriate time to maximize their effectiveness and minimize the likelihood of discharging pesticides into runoff. With the exception of pre-emergent pesticides, avoid application if rain is expected.
10. Unwanted/unused pesticides shall be disposed as hazardous waste.

Standing water shall not remain in the treatment measures for more than five days, to prevent mosquito generation. Should any mosquito issues arise, contact the Alameda County Mosquito Abatement District (ACMAD), as needed for assistance. In Albany, contact the Alameda County Vector Control Services District (ACVCSD). Mosquito larvicides shall be applied only when absolutely necessary, as indicated by the ACMAD or ACVCSD, and then only by a licensed professional or contractor. Contact information for ACMAD and ACVCSD is provided below.

III. Vector Control Contacts

LA County Vector Management
562-944-9656
http://www.glacvcd.org/

IV. Inspections

The attached Bioretention Area Inspection and Maintenance Checklist shall be used to conduct inspections monthly (or as needed), identify needed maintenance, and record maintenance that is conducted.

Bioretention Area

Inspection and Maintenance Checklist

Property Address: _____ Property Owner: _____

Treatment Measure No.: _____ Date of Inspection: _____ Type of Inspection: □ Monthly □ Pre-Wet Season
□ After heavy runoff □ End of Wet Season

Inspector(s): _____ □ Other:_____

Defect	**Conditions When Maintenance Is Needed**	**Maintenance Needed? (Y/N)**	**Comments** (Describe maintenance completed and if needed maintenance was not conducted, note when it will be done)	**Results Expected When Maintenance Is Performed**
1. Standing Water	When water stands in the bioretention area between storms and does not drain within five days after rainfall.			There should be no areas of standing water once inflow has ceased. Any of the following may apply: sediment or trash blockages removed, improved grade from head to foot of bioretention area, or added underdrains.
2. Trash and Debris Accumulation	Trash and debris accumulated in the bioretention area.			Trash and debris removed from bioretention area and disposed of properly.
3. Sediment	Evidence of sedimentation in bioretention area.			Material removed so that there is no clogging or blockage. Material is disposed of properly.
4. Erosion	Channels have formed around inlets, there are areas of bare soil, and/or other evidence of erosion.			Obstructions and sediment removed so that water flows freely and disperses over a wide area. Obstructions and sediment are disposed of properly.
5. Vegetation	Vegetation is dead, diseased and/or overgrown.			Vegetation is healthy and attractive in appearance.
6. Mulch	Mulch is missing or patchy in appearance. Areas of bare earth are exposed, or mulch layer is less than 3 inches in depth.			All bare earth is covered, except mulch is kept 6 inches away from trunks of trees and shrubs. Mulch is even in appearance, at a depth of 3 inches.
7. Miscellaneous	Any condition not covered above that needs attention in order for the bioretention area to function as designed.			Meet the design specifications.

Contech® CMP Detention Inspection and Maintenance Guide

Underground stormwater detention and infiltration systems must be inspected and maintained at regular intervals for purposes of performance and longevity.

Inspection

Inspection is the key to effective maintenance of CMP detention systems and is easily performed. Contech recommends ongoing, annual inspections. Sites with high trash load or small outlet control orifices may need more frequent inspections. The rate at which the system collects pollutants will depend more on-site specific activities rather than the size or configuration of the system.

Inspections should be performed more often in equipment washdown areas, in climates where sanding and/or salting operations take place, and in other various instances in which one would expect higher accumulations of sediment or abrasive/corrosive conditions. A record of each inspection is to be maintained for the life of the system.

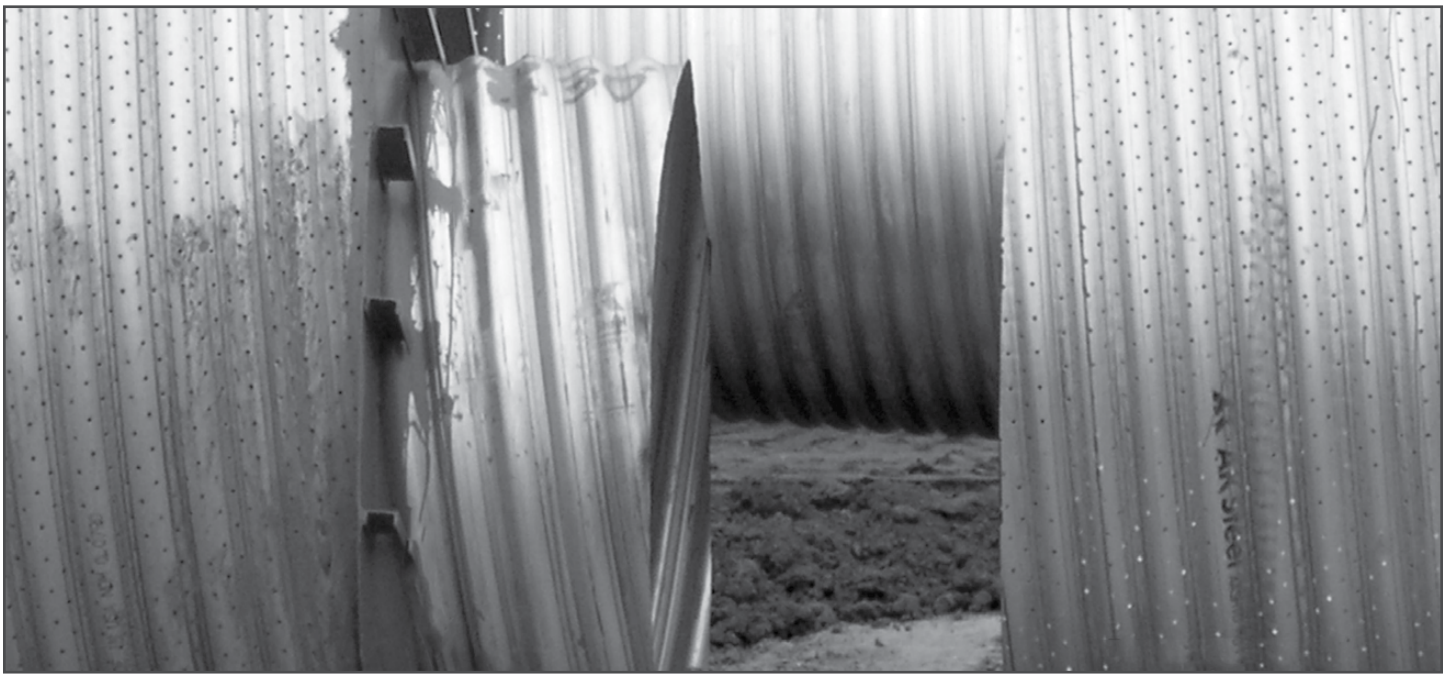
Maintenance

CMP detention systems should be cleaned when an inspection reveals accumulated sediment or trash is clogging the discharge orifice. Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities. Contech suggests that all systems be designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.

Annual inspections are best practice for all underground systems. During this inspection if evidence of salting/de-icing agents is observed within the system, it is best practice for the system to be rinsed, including above the spring line soon after the spring thaw as part of the maintenance program for the system.

Maintaining an underground detention or infiltration system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.

The foregoing inspection and maintenance efforts help ensure underground pipe systems used for stormwater storage continue to function as intended by identifying recommended regular inspection and maintenance practices. Inspection and maintenance related to the structural integrity of the pipe or the soundness of pipe joint connections is beyond the scope of this guide.



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CMP DETENTION SYSTEMS

CONTECH®
ENGINEERED SOLUTIONS

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Inspection & Maintenance Log Sample Template

Location:				
Date	**Depth of Sediment**	**Accumulated Trash**	**Name of Inspector**	**Maintenance Performed/Notes**

APPENDIX G

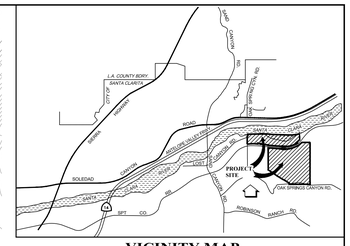
LID EXHIBIT

BELCARO AT SAND CANYON
DEVELOPED CONDITION USMP EXHIBIT
7/10/25

BMP C – BIOFILTRATION BASIN
$SQWD_{VOL}$ REQ=18,664 CU-FT
$SQWD_{VOL}$ PROV=76,362 CU-FT

BMP B – BIOFILTRATION BASIN
$SQWD_{VOL}$ REQ=300,992 CU-FT
$SQWD_{VOL}$ PROV=304,021 CU-FT

BMP A – INFILTRATION CHAMBER
$SQWD_{VOL}$ REQ=15,761 CU-FT
$SQWD_{VOL}$ PROV=16,043 CU-FT



VICINITY MAP
NOT TO SCALE

WQT Basin A

DMA (WQT)	AREA	FLOWPATH LENGTH	SLOPE	85TH% RAINFALL DEPTH	% IMP.	SOIL TYPE	Q_{PM}	V_{LID}
	ac	*ft*	*ft/ft*	*in*			*cfs*	*cu-ft*
1A	2.7	1815	0.048	0.91	0.93	020	0.441	11,198
2A	1.1	1035	0.040	0.91	0.93	020	0.211	4,562
TOTAL	3.8						0.651	15,761
								0.36 ac-ft

WQT Basin B

DMA (WQT)	AREA	FLOWPATH LENGTH	SLOPE	85TH% RAINFALL DEPTH	% IMP.	SOIL TYPE	Q_{PM}	V_{LID}
	ac	*ft*	*ft/ft*	*in*			*cfs*	*cu-ft*
1B	0.8	591	0.027	0.91	0.93	020	0.175	3,318
2B	3.9	614	0.029	0.91	0.75	020	0.660	13,415
3B	1.2	395	0.025	0.91	0.75	020	0.227	4,128
4B	3	706	0.007	0.91	0.75	020	0.434	10,320
5B	4	694	0.031	0.91	0.75	020	0.655	13,759
6B	5.9	849	0.019	0.91	0.75	020	0.875	20,295
7B	1.9	525	0.019	0.91	0.75	020	0.327	6,536
8B	2.1	571	0.009	0.91	0.75	020	0.329	7,224
9B	2	462	0.011	0.91	0.75	020	0.338	6,880
10B	2.4	565	0.005	0.91	0.75	020	0.361	8,256
11B	2.1	489	0.015	0.91	0.75	020	0.361	7,224
12B	2.4	558	0.022	0.91	0.75	020	0.406	8,256
13B	3.1	670	0.022	0.91	0.75	020	0.500	10,662
14B	3.4	440	0.014	0.91	0.75	020	0.595	11,695
15B	1.7	385	0.013	0.91	0.75	020	0.309	2,599
16B	3.4	628	0.022	0.91	0.75	020	0.557	11,695
17B	2	433	0.025	0.91	0.75	020	0.371	6,880
18B	2.8	995	0.024	0.91	0.75	020	0.405	9,632
19B	3	551	0.015	0.91	0.75	020	0.499	10,320
20B	4.6	1271	0.016	0.91	0.75	020	0.598	15,824
21B	2.4	506	0.012	0.91	0.75	020	0.399	8,256
22B	2.6	520	0.008	0.91	0.75	020	0.413	8,944
23B	3.9	628	0.010	0.91	0.75	020	0.602	13,415
24B	3.3	859	0.006	0.91	0.75	020	0.442	11,352
25B	1.9	383	0.017	0.91	0.75	020	0.353	6,536
26B	4.4	767	0.012	0.91	0.75	020	0.645	15,135
27B	2.5	439	0.009	0.91	0.75	020	0.423	8,600
28B	1.7	353	0.006	0.91	0.75	020	0.298	5,848
29B	3.3	573	0.009	0.91	0.75	020	0.517	11,351
30B	1	834	0.010	0.91	0.93	020	0.181	4,147
31B	0.6	476	0.004	0.91	0.93	020	0.118	2,488
32B	0.9	622	0.022	0.91	0.93	020	0.190	3,733
33B	0.7	636	0.009	0.91	0.75	020	0.107	2,408
34B	1.3	331	0.012	0.91	0.75	020	0.246	4,472
35B	0.6	413	0.034	0.91	0.93	020	0.147	2,488
36B	0.4	296	0.013	0.91	0.93	020	0.100	1,659
37B	0.3	436	0.017	0.91	0.93	020	0.069	1,244
TOTAL	87.5						14.231	300,992
								6.91 ac-ft

WQT Basin C

DMA (WQT)	AREA	FLOWPATH LENGTH	SLOPE	85TH% RAINFALL DEPTH	% IMP.	SOIL TYPE	Q_{PM}	V_{LID}
	ac	*ft*	*ft/ft*	*in*			*cfs*	*cu-ft*
1C	1.8	840	0.008929	0.91	0.93	020	0.322	7,465
2C	2.7	780	0.01859	0.91	0.93	020	0.525	11,198
TOTAL	4.5						0.847	18,664
								0.43 ac-ft

USMP NOTES:

ALL STRUCTURAL BMP'S SHALL BE ACCESSIBLE FOR INSPECTION AND MAINTENANCE AND SHALL BEAR A "NO DUMPING – DRAINS TO RIVER" SYMBOL IN TRAFFIC RATED PAINT PER DETAIL HEREIN.

CATCH BASIN STENCIL DETAIL:

ALL CATCH BASIN AND INLETS THAT DISCHARGE INTO AN EXISTING OR PROPOSED STORM DRAIN MUST BE STENCILED TO DISCOURAGE ILLEGAL DUMPING OF POLLUTANTS. STENCIL SHALL HAVE A MINIMUM DIAMETER OF 30 INCHES.

LEGEND:

- PROJECT BOUNDARY
- SUBAREA BOUNDARY
- EXISTING STORM DRAIN LINE
- SD — STORM DRAIN LINE (PVT)
- LF — LOW FLOW SD LINE (PVT)
- OVERLAND PATH
- XX / XX.X — SUBAREA
- SUBAREA ACREAGE
- WATER QUALITY TREATMENT BIOFILTRATION BASIN/CHAMBER
- WATER QUALITY TREATMENT BIOFILTRATION UNIT (*MWS OR APPROVED EQUAL)

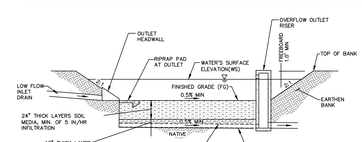
DESIGN CRITERIA:

85TH PERCENTILE DEPTH	0.91"
SOIL TYPE	020,099
DEBRIS PRODUCTION AREA	DPA X, DPA X

85th PERCENTILE STORM	0.91 IN
95th PERCENTILE STORM	1.73 IN
DISCHARGE TO NATURAL WATER BODY	YES
RECEIVING NATURAL WATER BODY, RIVER	SANTA CLARA
HYDROMOD DESIGN STORM	85th %
TOTAL DESIGN STORM VOLUME REQUIRED	335,417 CF
TOTAL STORAGE VOLUME PROVIDED	396,426 CF
% OF DESIGN STORM RETAINED ONSITE	100%

Table 1 - Summary of Water Quality Basin Design

BASIN	INFILTRATION	TOP AREA	BOTTOM AREA	AVG AREA	DEPTH	VOLUME PROVIDED	
		sf	sf	sf	ft	cf	ac-ft
A	YES	2,496	2,496	2,496	9.0	16,043	0.37
B	NO	49,536	46,412	47,974	1.5	304,021	6.98
C	NO	12,902	11,597	12,250	1.5	76,362	1.75
					TOTAL	**396,426**	**9.10**



EARTHEN BIOINFILTRATION BASIN
NOT TO SCALE

Table 2 - Summary of Water Quality Treatment Requirements

LID UNIT	VOLUME REQUIRED (x1.5 NON-INFILTRATION)		VOLUME PROVIDED		Δ
	cf	ac-ft	cf	ac-ft	ac-ft
A	15,761	0.36	16,043	0.37	0.01
B	300,992	6.91	304,021	6.98	0.07
C	18,664	0.43	76,362	1.75	1.32
TOTAL	**335,417**	**7.70**	**396,426**	**9.10**	**1.40**

NOT A PART

GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 inch = 100 ft.

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CIVIL ENGINEERING • LAND PLANNING • HILLSIDE DESIGN • SURVEYING

PLAN PREPARED FOR:
NUWI-SAND CANYON, LLC
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SANTA MONICA, CA 90403
TEL: (661) 305-7536
ATTN: COREY HARPOLE

PLANS PREPARED BY:
ALLIANCE LAND PLANNING & ENGINEERING INC.
2248 FARADAY AVE.
CARLSBAD, CA 92008
(760) 431-9896
PLANS PREPARED UNDER THE DIRECTION OF:
CRAIG M. WHITTEKER R.C.E. 51929 DATE 7/10/25
REGISTERED PROFESSIONAL ENGINEER CRAIG M. WHITTEKER NO. 51929 EXP 6-30-26 CIVIL STATE OF CALIFORNIA

NO.	DATE	REVISIONS	BY	APPR

SHEET 1 | COUNTY OF LOS ANGELES | 1 SHEETS

DEVELOPED CONDITION
USMP EXHIBIT
BELCARO AT SAND CANYON
VTTM 084497

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