APPENDIX B

GRADING AND DRAINAGE ANALYSIS

GRADING AND DRAINAGE FEASIBILITY STUDY

For

YOCHA DEHE WINTUN NATION

"FEE TO TRUST" CONVERSION

Assessor's Parcel Numbers:

047-020-01, 048-230-01, 060-020-19, 060-020-20,

060-030-16 & 060-030-17

JOB No. 2303-15-H-2

FEBRUARY 2011

REGISTERED PROFESSIONAL ENGINEER
BRYAN P. BONINO
No. 41804
CIVIL
STATE OF CALIFORNIA

Prepared by:

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Table of Contents

Tables:

Figures:

Appendices

1.0 Introduction

Laugenour and Meikle has been retained to prepare this Grading and Drainage Feasibility Study for the "Fee-To-Trust" Conversion by the Yocha Dehe Wintun Nation. This Study will be used to support the Environmental Assessment (EA) being prepared by Analytic Environmental Services (AES) for the project. The scope of this Study includes site background and field investigations, an evaluation of facility requirements, and a preliminary assessment of grading and drainage requirements.

1.1 Background

The project is located at County Road 75A and State Highway 16, approximately 1.2 miles north of Brooks, a small, unincorporated community in western Yolo County and 2 miles north of the existing Cache Creek Casino Resort. The project boundary would be contiguous with the existing Community Trust Property at County Road 75A. A Vicinity Map is shown in Figure 1-1.

1.2 Project Description

Two alternative designs, along with a no-action alternative, are being considered for this project: Alternative "A" – 853± acre trust acquisition and development of 25 residences for Tribal members, plus three (3) cultural/educational facilities, Tribal school, domestic water storage tank, and a wastewater treatment plant and supporting infrastructure; Alternative "B" – 751± acre trust acquisition would be same development as Alternative A; and Alternative "C" – No Federal action as described in the EA.

The EA parcels included in the proposed Fee-to-Trust conversion with corresponding Assessor's Parcel Number (APN) and acreage for each parcel are shown in Table 1-1. Each parcels existing and proposed land use is shown in Figure 1-2, Location & Use Map. The projected development of the parcels is shown in Figure 1-3, Project Use Map.

Table 1-1 EA Parcels

EA Parcel	APN	Area	EA Parcel	APN	Area	EA Parcel	APN	Area
1	060-030-16	55.92 ac	6	060-020-18	17.82 ac	11	060-010-01	4.49 ac
2	060-030-17	92.14 ac	7	060-020-19	19.76 ac	12	060-013-01	2.30 ac
3	060-030-01	17.69 ac	8	060-020-20	153.70 ac	13	060-014-01	1.55 ac
4	060-030-08	26.32 ac	9	048-230-01	316.41 ac	14	060-020-11	10.41 ac
5	060-030-09	16.02 ac	10	047-020-01	113.09 ac	15	060-020-14	5.28 ac

Although all of the parcels listed above are included in the proposed Fee-to-Trust conversion, this study only evaluates Parcels 1, 2, 7, 8, 9, and 10 since they are the only parcels currently identified as sites for potential infrastructure improvements. The remaining parcels (Parcel 3-6 and 11-15) will continue to be used as agricultural land with no new improvements currently under consideration.

1.3 Hydrologic Analysis

The project site was analyzed for both existing and proposed conditions to determine potential impacts of the development. The hydrology method used in this analysis was the Soils Conservation Service (SCS) Type II Hydrograph method developed by the Natural Resources Conservation Service. The SCS Type II method uses rainfall distributions developed by the SCS for the TR-55 model to generate a runoff hydrograph routed through a drainage basin with a lag time equal to the basin's time of concentration.

The modeling software used for the hydrologic analysis was version 3.4 of the Hydrologic Engineering Corps-Hydrologic Modeling System (HEC-HMS) developed by the Army Corp of Engineers. Input parameters for the SCS Type II method include precipitation data, contributing drainage area, soil curve numbers, and lag time.

The annual precipitation for the Capay Valley ranges from 20 inches to 28 inches per year. A mean annual precipitation of 25 inches has been selected for this model. Table 1-2 lists the 24-hour duration rainfall amounts for the 100-year and 200-year storm events. FEMA has had discussions about utilizing 200-year storm events for levee certifications. Although there are no levees within the project areas, due to the nature of the steep confined water sheds in the Cache Creek area, the 200-year storm event will be considered for design.

Table 1-2 Precipitation Data

STORM EVENT	DURATION	PRECIPITATION	MEAN ANNUAL PRECIPITATION
100-Year	24-Hours	6.28 inches	25 inches
200-Year	24-hours	6.81 inches	25 inches

1.3.1 Soil Characteristics and Land Cover Description:

Soil characteristics are used to develop curve numbers (CN) for each sub-basin. The soil types identified in the project area include the Balcom silty clay loam (BaE2, BaF2), Corning gravelly loam (CtD2), Dibble clay loam (DaF2), Dibble-Millsholm complex (DbG2), Millsholm rocky loam (MrG2), Rock land (RoG), Clear Lake clay (Ck), Riverwash (Rh), Tehama Loam (TaA, TaB) and Yolo silt loam (Ya). All soils are of soils type C and D. A Soil Map of the project area is shown in Figure 1-4. Curve numbers identified for the project area are shown in Table 1-3.

Table 1-3 SCS Curve Number and Description

SCS CURVE NUMBER (CN)	COVER TYPE	SOIL TYPE
57	Oak-Aspen-Mountain Brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	C
63	Oak-Aspen-Mountain Brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	D
77	Brush- brush-weed-grass mixture with brush the major element	D
81	Row Crops-Contoured and Terraced	D
89	Straight row Crops	D
89	Herbaceous-mixture of grass, weeds, and low-growing brush, with brush the minor element	D

1.3.2 Time of Concentration:

The times of concentration, T_c, in the watersheds were calculated using the CN method which is based on the average slope of the watershed. The method follows the TR-55 procedure for sheet flow and shallow concentrated flows. In addition, the travel time in the natural creeks were approximated with the Muskingum-Cunge routing method in HEC-HMS.

1.3.3 Drainage Areas:

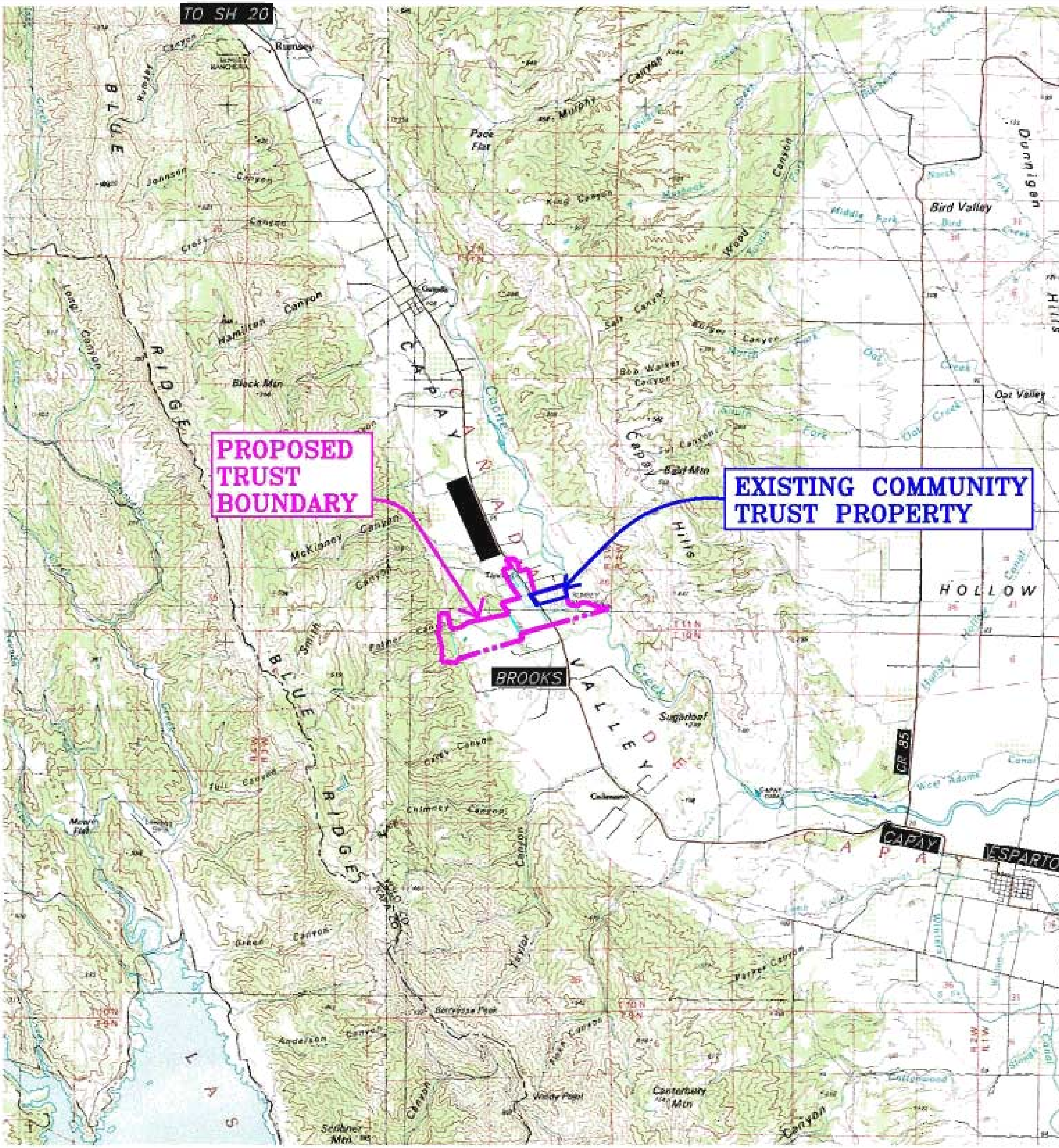
Contributing drainage basins for the subject properties were delineated using the Brooks, California 7.5-minute Topographic Quadrangle (USGS 1959) and the Esparto, California 7.5-minute Topographic Quadrangle (USGS REV 1993) and enhanced with the site specific topographic survey data for the EA parcels.

1.4 Objectives

The goal of this Study is to identify and evaluate the grading and drainage requirements, on a preliminary design level, for those parcels that will have a different land use after the Fee-to-Trust conversion, which are:

- EA Parcel 1 (APN 060-030-16).
- EA Parcel 2 (APN 060-030-17).
- EA Parcel 7 (APN 060-020-19).
- EA Parcel 8 (APN 060-020-20).
- EA Parcel 9 (APN 048-230-01).
- EA Parcel 10 (APN 047-020-01).

The proposed improvements and their impacts would be the same regardless of which project alternative is selected. Therefore, the findings of this report are appropriate for Alternative "A" and Alternative "B".



0 3,750 7,500 15,000

SCALE: 1"=7,500

VICINITY MAP
FOR
FEE TO TRUST EA
YOCHA DEHE WINTUN NATION

FIGURE 1-1

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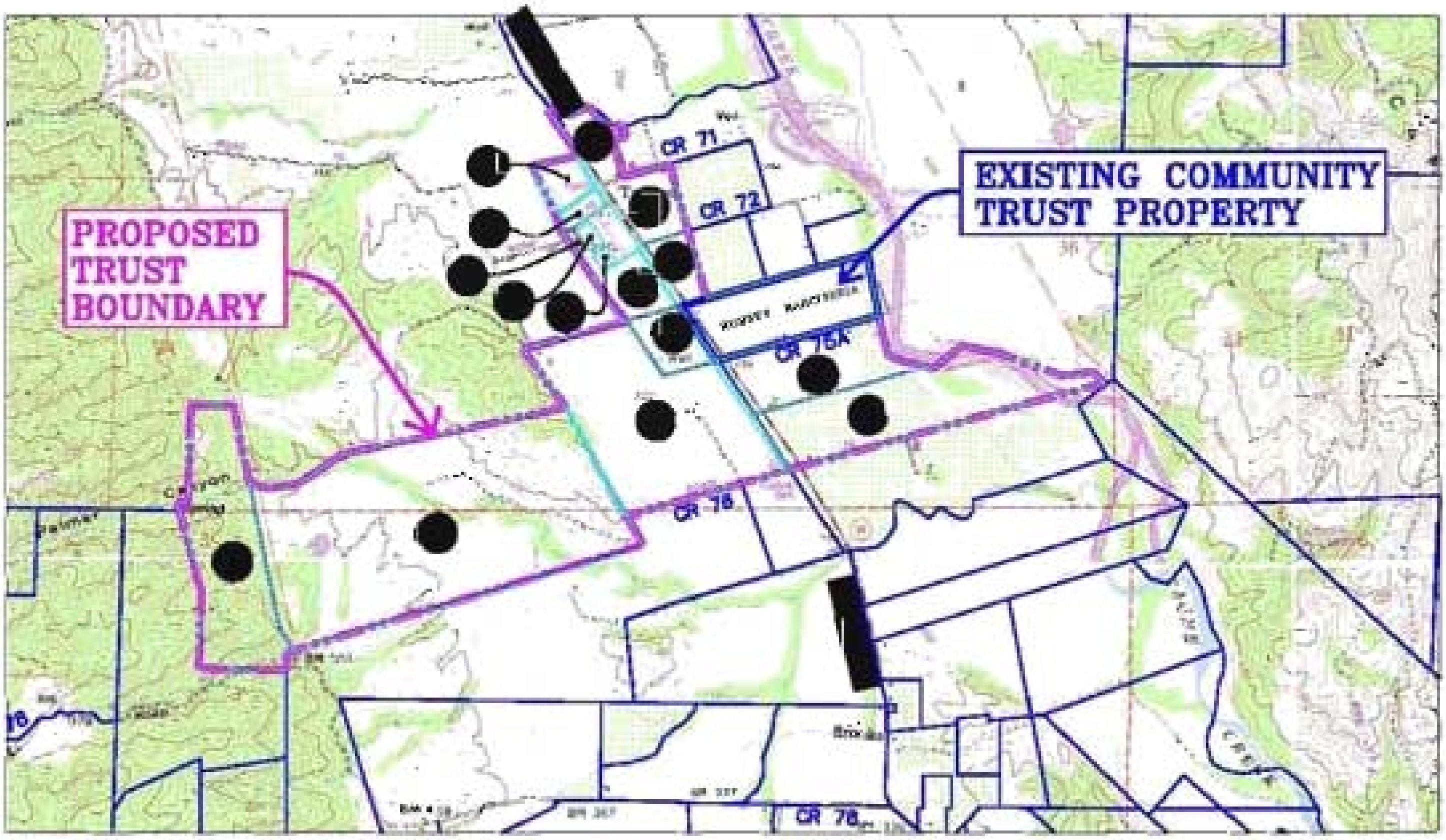
X:\Land Projects\2303-15-H-2\dwg\2303-15-H-2_Fig_1-1_G&W_Vicinity Map



EIS PARCEL IDENTIFICATION	ASSESSOR PARCEL NUMBER	ACREAGE	EXISTING USE	PROPOSED USE
1	060-030-018	55.92	CULTURAL EDUCATION FACILITIES & AGRICULTURE	84,600 SF OF SUPPORT FACILITIES AND AGRICULTURE
2	060-030-017	92.14	AGRICULTURE	CULTURAL RESOURCE CENTER AND AGRICULTURE
3	060-030-001	17.69	AGRICULTURE	AGRICULTURE
4	060-030-008	26.32	AGRICULTURE	AGRICULTURE
5	060-030-009	16.02	AGRICULTURE	AGRICULTURE
6	060-020-018	17.82	AGRICULTURE	AGRICULTURE
7	060-020-019	19.76	AGRICULTURE	AGRICULTURE
8	060-020-020	153.70	AGRICULTURE	AGRICULTURE WITH RANCH HOUSE
9	048-230-001	316.41	AGRICULTURE	23 HOMES, SUPPORT INFRASTRUCTURE & AGRICULTURE
10	047-020-001	113.09	NONE	2 HOMES, SUPPORT INFRASTRUCTURE
11	060-010-001	4.49	AGRICULTURE	AGRICULTURE
12	060-013-001	2.30	AGRICULTURE	AGRICULTURE
13	060-014-001	1.55	AGRICULTURE	AGRICULTURE
14	060-020-011	10.41	AGRICULTURE	AGRICULTURE
15	060-020-014	5.28	AGRICULTURE	AGRICULTURE

0 1500 3000 6000

LM

SCALE: 1"=3000'

LEGEND

● *EA PARCEL (TYP.)*

LOCATION & USE MAP

FOR

FEE TO TRUST EA
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FIGURE 1-2

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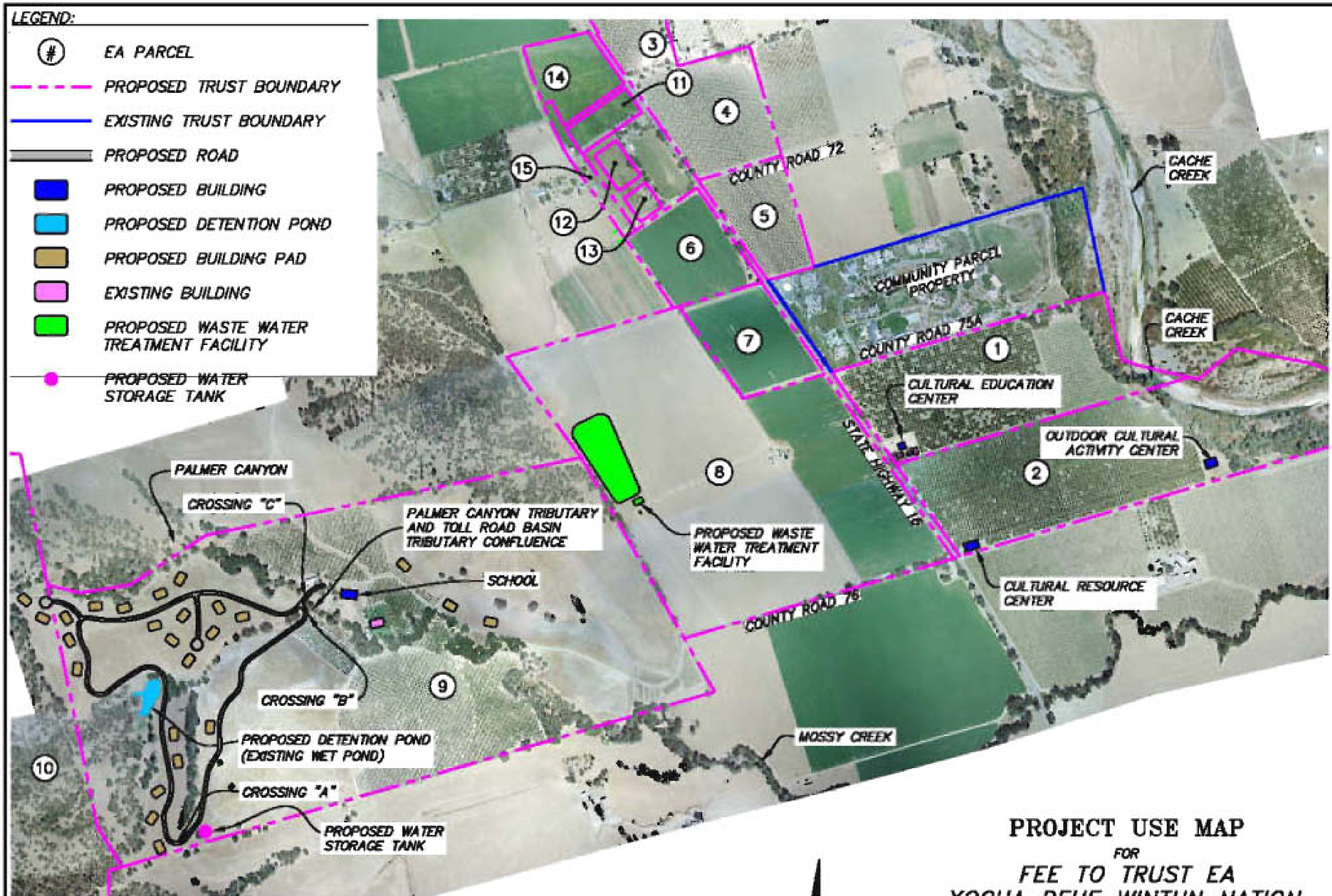

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0 600 1200 2400
SCALE: 1"=1200'

PROJECT USE MAP
FOR
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FIGURE 1–3

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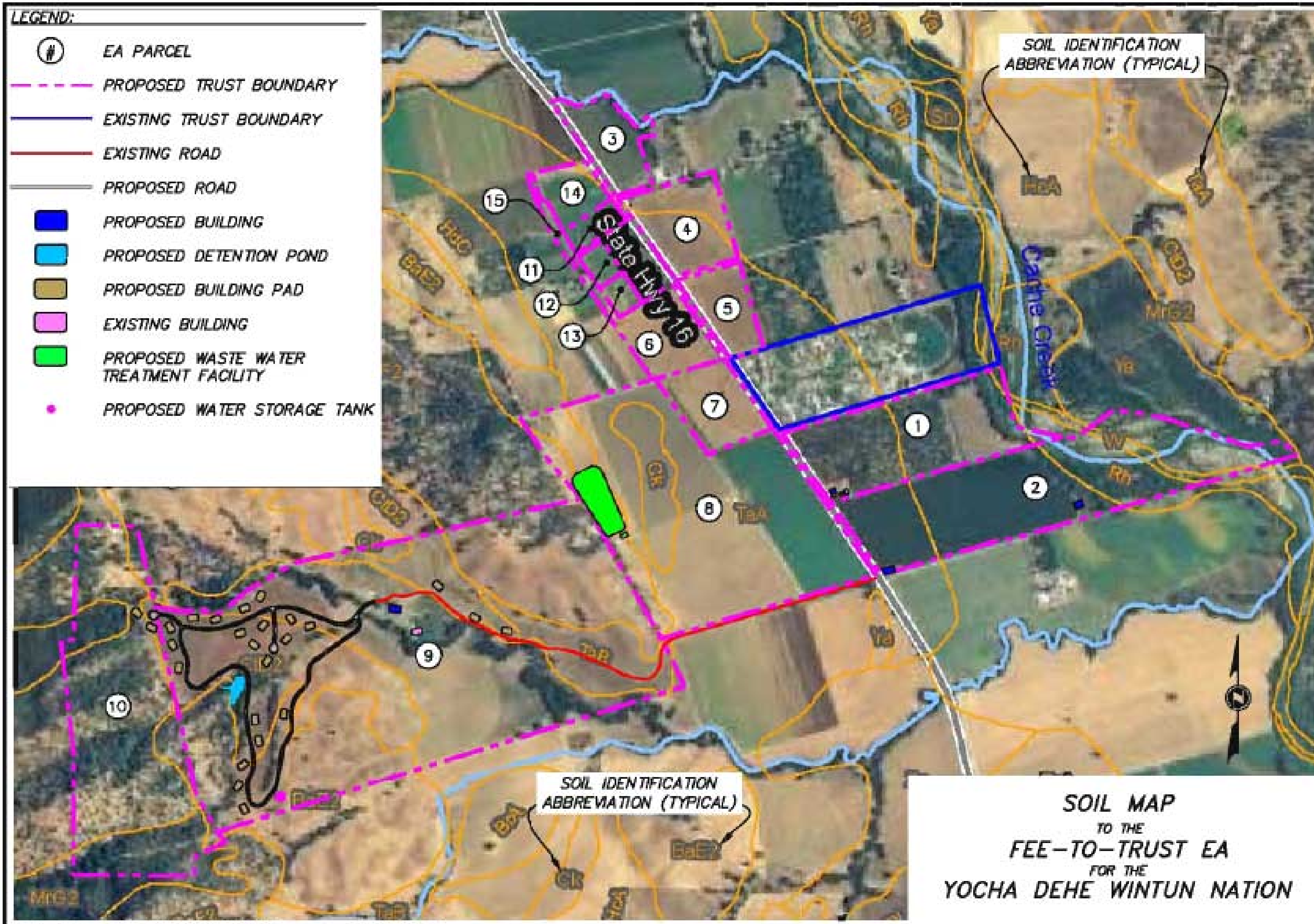
X:\Land Projects\2303-15-H-2\dwg\2303-15-H-2_Fig_1-3_G&W_Project Use Map



SOIL MAP
TO THE
FEE-TO-TRUST EA
FOR THE
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FIGURE 1-4

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2.0 EA Parcel 1 & EA Parcel 2

2.1 Existing Site Conditions

EA Parcel 1 consists of approximately 55.92 acres of orchard and is bounded by State Highway 16 to the west, County Road 75A and the existing Community Trust Property to the north, agriculture to the south, and Cache Creek to the east. EA Parcel 2 consists of approximately 92.14 acres of orchard and is also bounded by State Highway 16 to the west, County Road 76 to the south, EA Parcel 1 to the north and Cache Creek to the east. The existing topography is relatively flat sloping from west to east where drainage is generally directed towards Cache Creek. Elevations range from approximately 295 feet above mean sea level on the west portion of the property to approximately 286 feet above mean sea level in the southwest portion of the property, adjacent to the banks of Cache Creek.

2.2 Floodplain

2.2.1 Effective FEMA Designation

Parcel 1 lies within potential flood-prone areas as designated on the Flood Insurance Rate Map entitled "Yolo County, California and Unincorporated Areas, Map Number 06113C 0225G", dated June 18, 2010. The eastern portion of Parcel 1 is located within Zone A. The map defines Zone A as: "Areas of 100-year flood; base flood elevations and flood hazard factors not determined." A Partial FEMA Map showing the parcel with the effective FEMA designation is shown in Figure 2-1.

2.2.2 Additional Studies

Two hydraulic models were recently assembled to determine the extent of flood water inundation in the vicinity of the existing Community Trust Property (Rumsey Rancheria) to the north of Parcel 1. "Rumsey Rancheria Flood Inundation, Technical Memorandum" by Eric W. Larsen, Department of Environmental Design, University of California, Davis dated February 1, 2009 (Appendix A), and "Base Flood Elevation Study of Yocha De-He Existing Community Trust Parcel." By Bryan P. Bonino, Laugenour and Meikle Civil Engineers, dated December 9, 2010 (Appendix B). In comparison, the base flood elevations between the two studies yield differentials of 0.5'-1.0±. The model assembled by Laugenour and Meikle is pending future stage-flood survey to calibrate the model. The 200-year base flood elevations were determined in the above mentioned memorandums and are considered in this Study for the proposed grading and drainage for EA Parcel 1 and EA Parcel 2. The topography with the existing 200-year base flood elevations is shown in Appendix B.

2.3 Site Layout

A preliminary site layout was provided by AES and consists of a new Cultural Education Center Building. On Parcel 1, the existing residence and associated outbuildings are located at the southwest corner of the parcel. The proposed Cultural Education Center would be housed in the vicinity of the existing residence and associated outbuildings. The development is not situated within the 200-year floodplain limit.

On Parcel 2, the placement of nonpermanent structures representative of a historic Tribal village would be developed as the Outdoor Cultural Activity Center. The third cultural/education facility, phased at a later date, is situated near the southwesterly corner of Parcel 2. The Outdoor Cultural Activity Center is situated in an identified 200-year floodplain limit, while the cultural/education facility is outside the 200-year floodplain limit.

Parcels 1 & 2 Site Layout is shown in Figure 2-2.

2.4 Hydrology

Parcel 1 pre-development hydrologic conditions and post-development hydrologic conditions are shown in Tables 2-1 and 2-2, respectively. The Parcel 1 Pre-Development Hydrograph is shown in Figure 2-3.

Table 2-1 Parcel 1 Pre-Development Hydrology

Storm Event (SCS Type II Distribution)	Area Improved (ac)	SCS CN Improved	Area Unimproved (ac)	SCS CN Unimproved	Total Area (ac)	Composite SCS CN	Q_{peak} (cfs)	Total Volume (ac-ft)
10-Year, 24-hour	0	0	55.92	82	55.92	82	61.6	12.0
100-Year, 24-hour	0	0	55.92	82	55.92	82	103.2	20.0
200-Year, 24-hour	0	0	55.92	82	55.92	82	115.0	22.4

Table 2-2 Parcel 1 Post-Development Hydrology

Storm Event (SCS Type II Distribution)	Area Improved (ac)	SCS CN Improved	Area Unimproved (ac)	SCS CN Unimproved	Total Area (ac)	Composite SCS CN	Q_{peak}[1] (cfs)	Total Volume (ac-ft)
10-Year, 24-hour	1.2	98	54.72	82	55.92	82.3	88.1	12.0
100-Year, 24-hour	1.2	98	54.72	82	55.92	82.3	146.5	20.0
200-Year, 24-hour	1.2	98	54.72	82	55.92	82.3	163.1	22.4
[1] The maximum Q_{peak} from Parcel 1 developments will be limited to 90% of the 10-year, pre-developed peak discharge.								

Table 2-3 Parcel 2 Pre-Development Hydrology

Storm Event (SCS Type II Distribution)	Area Improved (ac)	SCS CN Improved	Area Unimproved (ac)	SCS CN Unimproved	Total Area (ac)	Composite SCS CN	Q_{peak} (cfs)	Total Volume (ac-ft)
10-Year, 24-hour	0	0	92.14	82	92.14	82	100.5	19.5
100-Year, 24-hour	0	0	92.14	82	92.14	82	168.3	32.7
200-Year, 24-hour	0	0	92.14	82	92.14	82	187.6	36.5

Table 2-4 Parcel 2 Post-Development Hydrology

Storm Event (SCS Type II Distribution)	Area Improved (ac)	SCS CN Improved	Area Unimproved (ac)	SCS CN Unimproved	Total Area (ac)	Composite SCS CN	Q_{peak} (cfs)	Total Volume (ac-ft)
10-Year, 24-hour	1.92	98	90.22	82	92.14	82.33	144.8	19.6
100-Year, 24-hour	1.92	98	90.22	82	92.14	82.33	240.8	32.7
200-Year, 24-hour	1.92	98	90.22	82	92.14	82.33	268.0	36.5

2.5 Stormwater Detention

2.5.1 EA Parcel 1:

A channel is proposed to mitigate increased runoff generated from the increased impervious development. Approximately 2,220 cubic feet and 2,000 cubic-feet of increased impervious runoff (Difference between the Post-Development Volume and Pre-Development Volume) would be generated during a 100-year storm event, 24-hour duration and a 200-year storm event, 24-hour duration, respectively. The channel would be installed with check-dams to increase the time-of-concentration of the post development runoff. This design would greatly reduce downstream impacts in Cache Creek.

Excavated volume from the channel would be used to fill the development site, no import or export is expected.

2.5.2 EA Parcel 2:

A channel is also proposed to mitigate increased runoff generated from the increased impervious area. Approximately 1,650 cubic feet and 1,005 cubic-feet of increased impervious runoff (Difference between the Post-Development Volume and Pre-Development Volume) would be generated during the 100-year storm event, 24-hour duration and the 200-year storm event, 24-hour duration. The channel would be also installed with check-dams to increase the time-of-concentration of the post development runoff. This design would greatly reduce downstream impacts in Cache Creek.

Excavated fill from the channel volume would be used to fill the development site, no import or export is expected.

2.6 Storm Drainage Improvements

Roadside swales in the proposed development will convey stormwater runoff to the easterly intersection at County Road 75A. The preliminary design criteria for the drainage ditch, adjacent to County Road 75A on Parcel 1 to the proposed detention pond, is shown in Table 2-3. Check dams will be used to reduce the velocities and increase the time-of-concentration.

Table 2-5 Drainage Channels for EA Parcels 1 & 2

EA Parcel #	Storm Event (SCS Type II Distribution)	Improved Area (ac)	Q_{peak} (cfs)	Bottom (ft)	Side Slope	Longitudinal Slope (ft/ft)	Depth (ft)
1	100-Year, 24-hour	1.2	146.5	3.00	2:1	0.0075	4.00
2	100-Year, 24-hour	1.92	168.3	3.00	2:1	0.0075	4.00

2.7 Street Design

No additional streets are required for the development of these projects. Each project will have an access from existing streets.

2.8 Preliminary Grading

Each project is outside of the 200-year base flood overlay. The pad elevations would most likely be filled a minimum of 1 foot above the building's most upstream 200-year base flood contour. The grading of the sites will be analyzed as each site plan is developed.

2.9 Best Management Practices

To minimize the amount of pollutants discharged to existing waterways, Best Management Practice (BMPs) will be implemented during and after construction in accordance with the California Stormwater Quality Association's "Stormwater Best Management Practice Handbook". Improvement plans will incorporate erosion and sediment control measures, and a Stormwater Pollution Prevention Plan (SWPPP) will be prepared either during design or by the construction contractor prior to construction.

BMP's for Parcels 1 & 2 would include, but not limited to:

- Vegetation Preservation.
- Straw wattle placement on cut and fill slopes.
- Straw wattle check dams installed within drainage swales.
- Rip-rap energy dissipaters installed at the point of release of concentrated flows.

- Hydroseeding of disturbed areas.
- Bioswales installed to reduce sediment transport in storm water runoff.
- Washout stations and other controls at construction entrances that would minimize spreading of pollutants offsite.

2.10 Summary

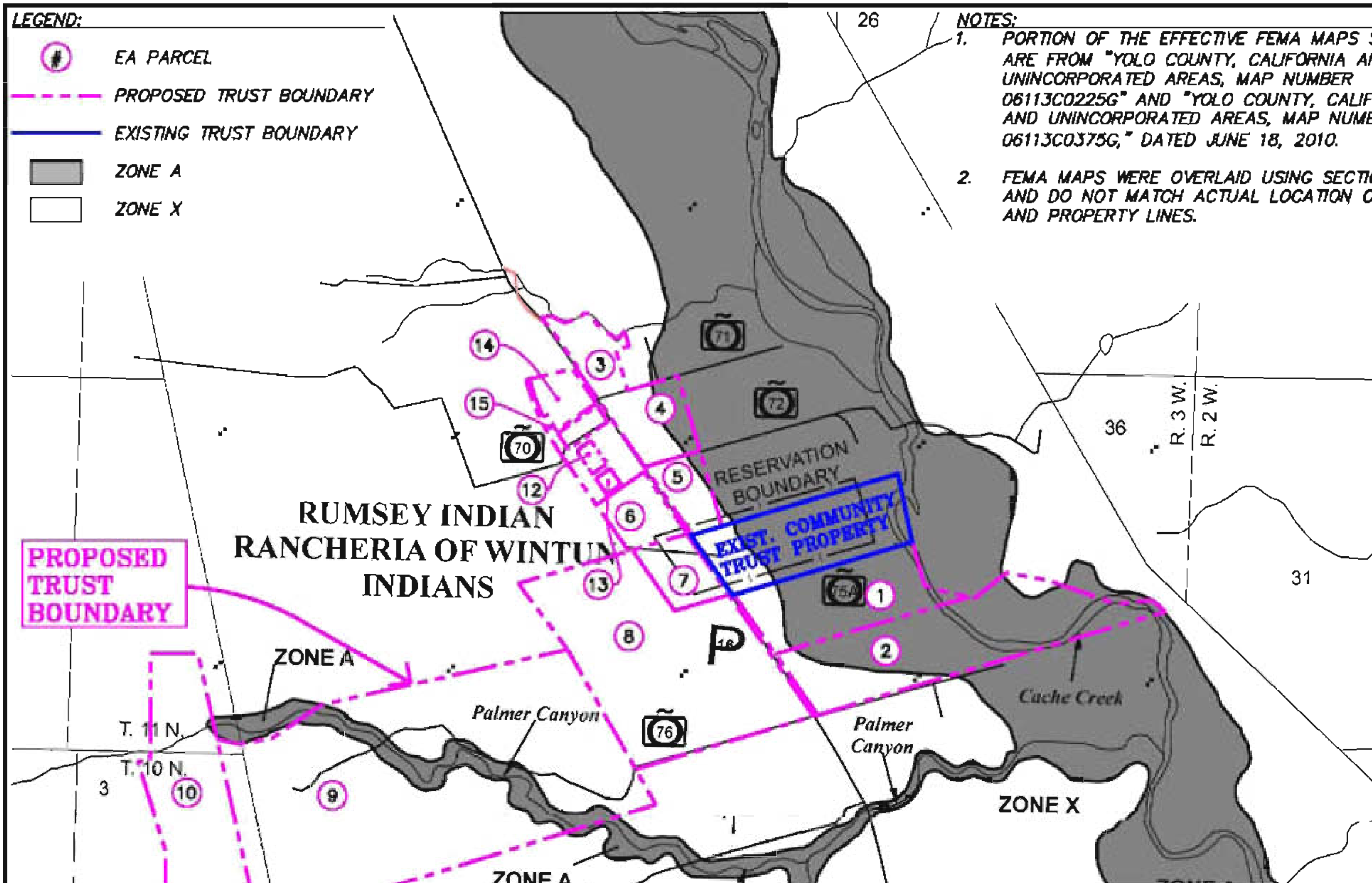
Fill would be required to build the pads above the 200-year base flood elevation. The fill is expected from excavation of drainage channels for the proposed improvements. The check-dams and BMPs that would be specified in during design development would most likely minimize impacts of the floodplain and Cache Creek. No import or export of material is anticipated for this project.

LEGEND:

- EA PARCEL
- PROPOSED TRUST BOUNDARY
- EXISTING TRUST BOUNDARY
- ZONE A
- ZONE X

NOTES:

1. PORTION OF THE EFFECTIVE FEMA MAPS SHOWN ARE FROM "YOLO COUNTY, CALIFORNIA AND UNINCORPORATED AREAS, MAP NUMBER 06113C0225G" AND "YOLO COUNTY, CALIFORNIA AND UNINCORPORATED AREAS, MAP NUMBER 06113C0375G," DATED JUNE 18, 2010.
2. FEMA MAPS WERE OVERLAID USING SECTION LINES AND DO NOT MATCH ACTUAL LOCATION OF ROADS AND PROPERTY LINES.



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PARTIAL FEMA MAP

FOR

FEE TO TRUST EA

YOCHA DEHE WINTUN NATION

FIGURE 2-1

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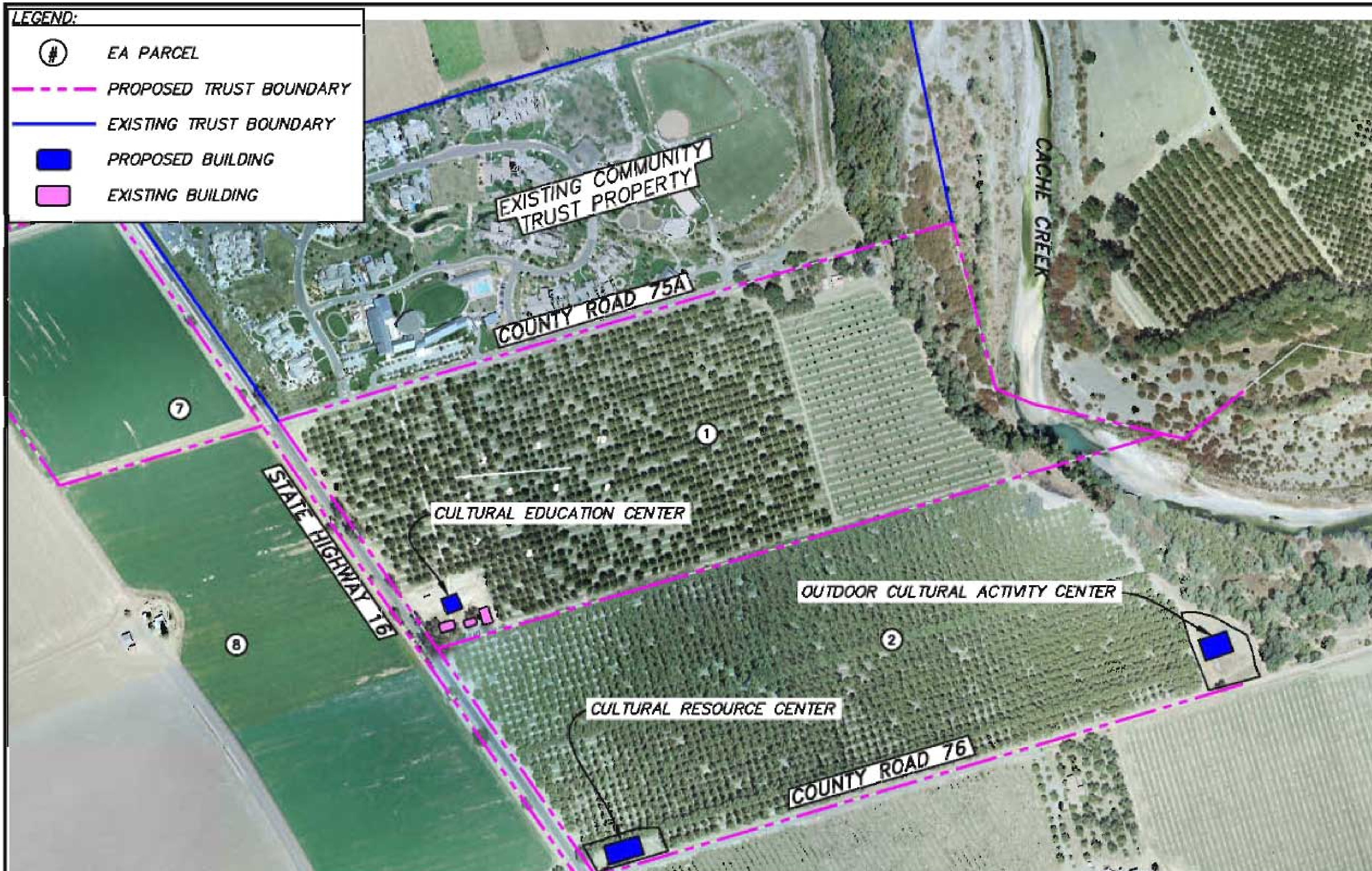

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FIGURE 2-2
SITE LAYOUT
FOR
PARCELS 1 & 2
YOCHA DEHE WINTUN NATION
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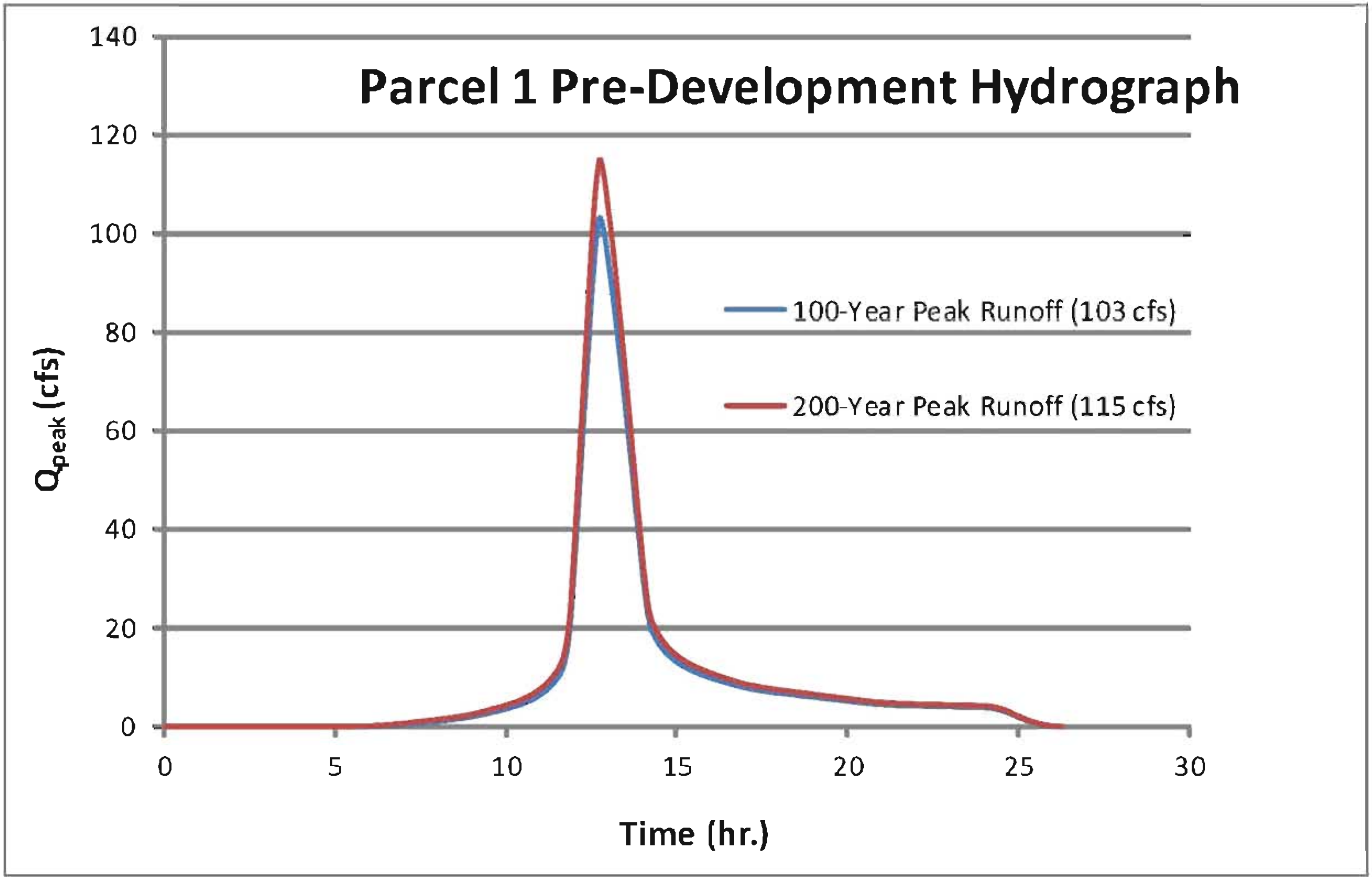
X:\Land Projects\2303-15-H-2\dwg\2303-15-H-2_Fig_2-2_G_Site Plan-Parcel 1



PARCEL 1 PRE-DEVELOPMENT HYDROGRAPH
FOR
FEE TO TRUST EA
YOCHA DEHE WINTUN NATION

FIGURE 2-3

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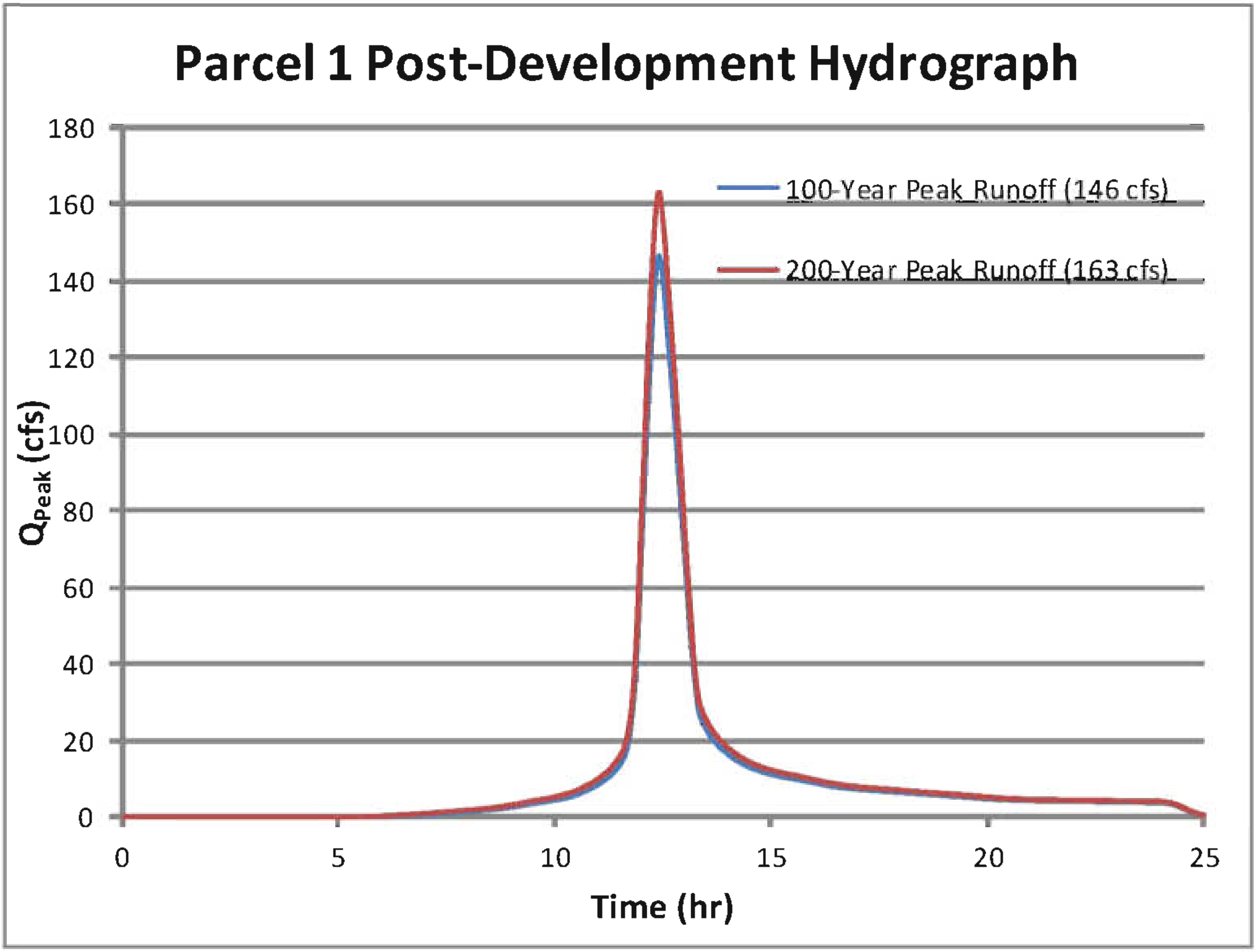

PARCEL 1 POST-DEVELOPMENT HYDROGRAPH
FOR
FEE TO TRUST EA
YOCHA DEHE WINTUN NATION

FIGURE 2-4

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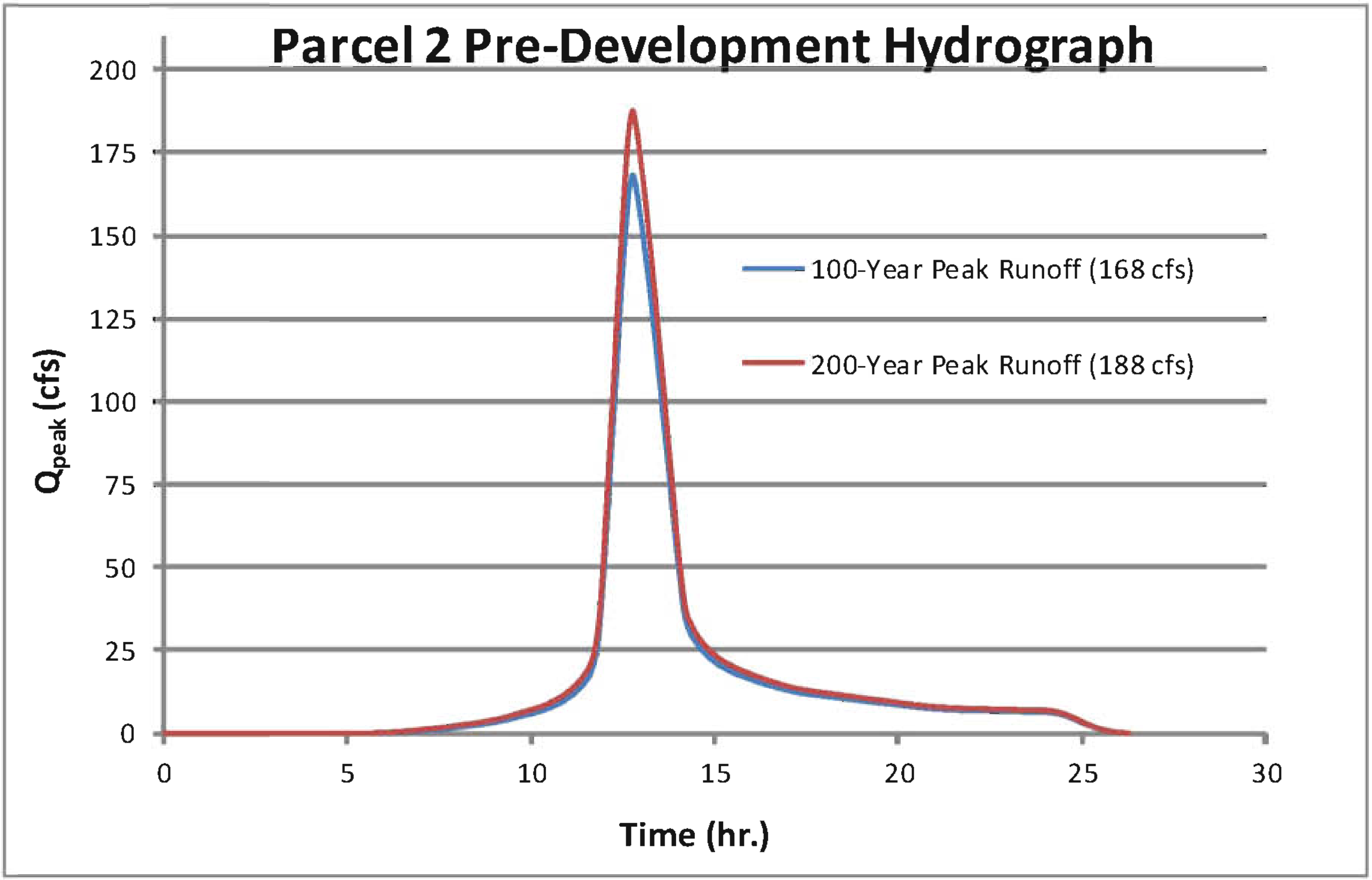

PARCEL 2 PRE–DEVELOPMENT HYDROGRAPH

FOR

FEE TO TRUST EA

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FIGURE 2–5

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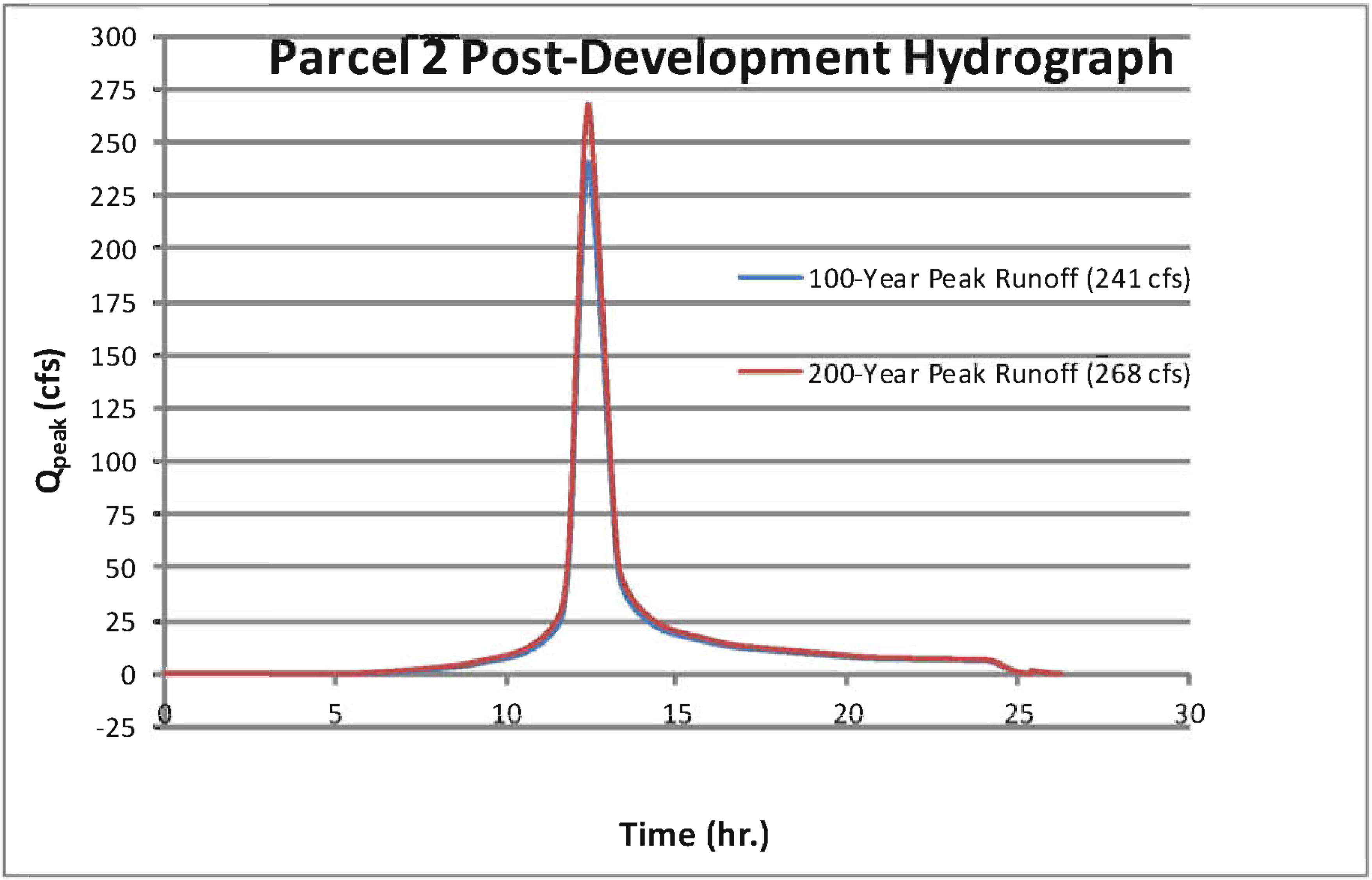

PARCEL 2 POST-DEVELOPMENT HYDROGRAPH

FOR

FEE TO TRUST EA
YOCHA DEHE WINTUN NATION

FIGURE 2-6

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3.0 EA Parcel 9 & EA Parcel 10

3.1 Existing Site Conditions

Parcel 9 consists of approximately 316.41 acres on mostly undeveloped, open field and hilly terrain. County Road 76 terminates at the southeast corner of the parcel with a private access road continuing through to the middle of the parcel within a small valley. Two (2) existing structures are located on the parcel with access roads to County Road 76. The elevation ranges from 344 feet to 569 feet. Drainage is collected through Palmer Canyon, in a normally dry creek bed, which traverses through the center of Parcel 9 in a west to east trend. A delineated tributary basin referred to as "Toll Road Basin" in this Report is collected in an existing stock pond east of the private access road on Parcel 9 as shown in the Existing Shed Exhibit (Figure 3-1). The existing pond does not have the capacity to contain minor storm events (i.e. 10-year storm event, 24-hour duration), and once full from early seasonal rainfall accumulation, would not provide any detention or reduce peak discharge. As water level increases in the stock pond, storm water would overspill the road and drain toward the confluence with Palmer Canyon unimpeded.

Parcel 10 consists of approximately 113.09 acres on mostly undeveloped, hilly, and sparsely dense oak woodland and oak savannah. No structures are identified on Parcel 10. A majority of Parcel 10 is a sub-shed to the stock pond on Parcel 9, with the exception of the northerly portion being a sub-shed to Palmer Canyon.

3.2 Floodplain

3.2.1 Effective FEMA Designation

The majority of Parcel 9 is located within Zone X, with a small portion in the valley of Palmer Canyon within Zone A, as designated on the Flood Insurance Rate Map (FIRM) entitled "Yolo County, California and Unincorporated Areas, Map Number 06113C 0225G", dated June 18, 2010. This map defines Zone A as: "Areas of 100-year flood; base flood elevations and flood hazard factors not determined" and Zone X as: "Areas determined to be outside the 0.2% annual chance flood plain." A Partial FEMA Map showing the parcel with the effective FEMA designation is shown in Figure 2-1.

No floodplain is identified on Parcel 10.

3.2.2 Additional Studies

A hydraulic model was developed to estimate base flood elevations on the valley floor of Palmer Canyon within Parcel 9. The base flood elevation estimates would assist in establishing minimum building pad elevations during a 200-year flood event. The floodplain is delineated with approximate base flood elevations on Figure 3-2.

Table 3-1 Peak Flows in Parcel 9’s Hydraulic Model

Flood Event	Watercourse/ Feature	Location	Peak Flow
100-Year	Palmer Canyon	Immediately Upstream of EA Parcel 9	1843.6 CFS
	Stock Pond	Immediately Downstream of Stock Pond	407.5 CFS
	Mossy Creek	Immediately Downstream of EA Parcel 9	2200.4 CFS
200-Year	Palmer Canyon	Immediately Upstream of EA Parcel 9	2147.5 CFS
	Stock Pond	Immediately Downstream of Stock Pond	467.4 CFS
	Mossy Creek	Immediately Downstream of EA Parcel 9	2576.6 CFS

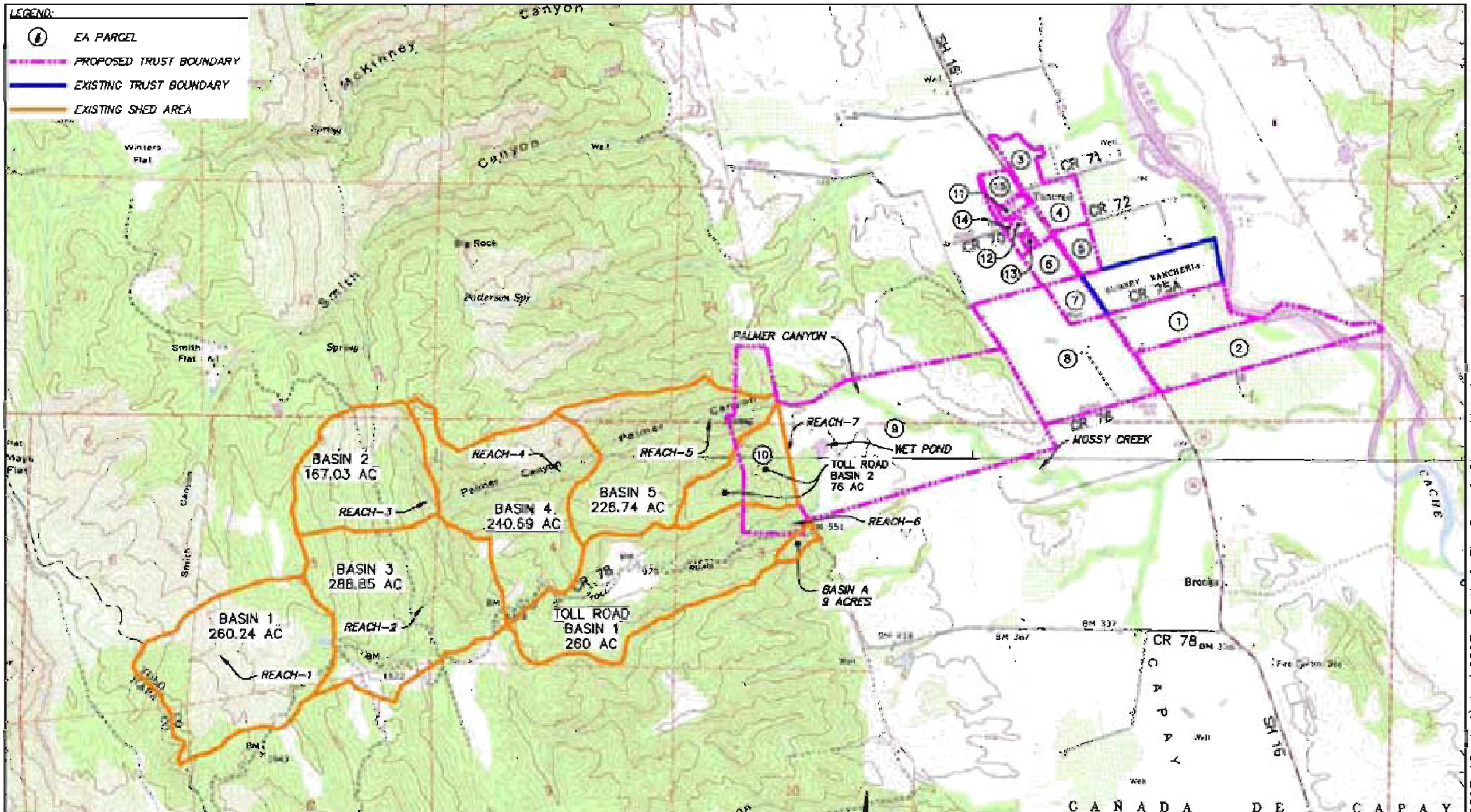

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FIGURE 3-1
EXISTING SHED EXHIBIT
FOR
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YOLO COUNTY, CALIFORNIA
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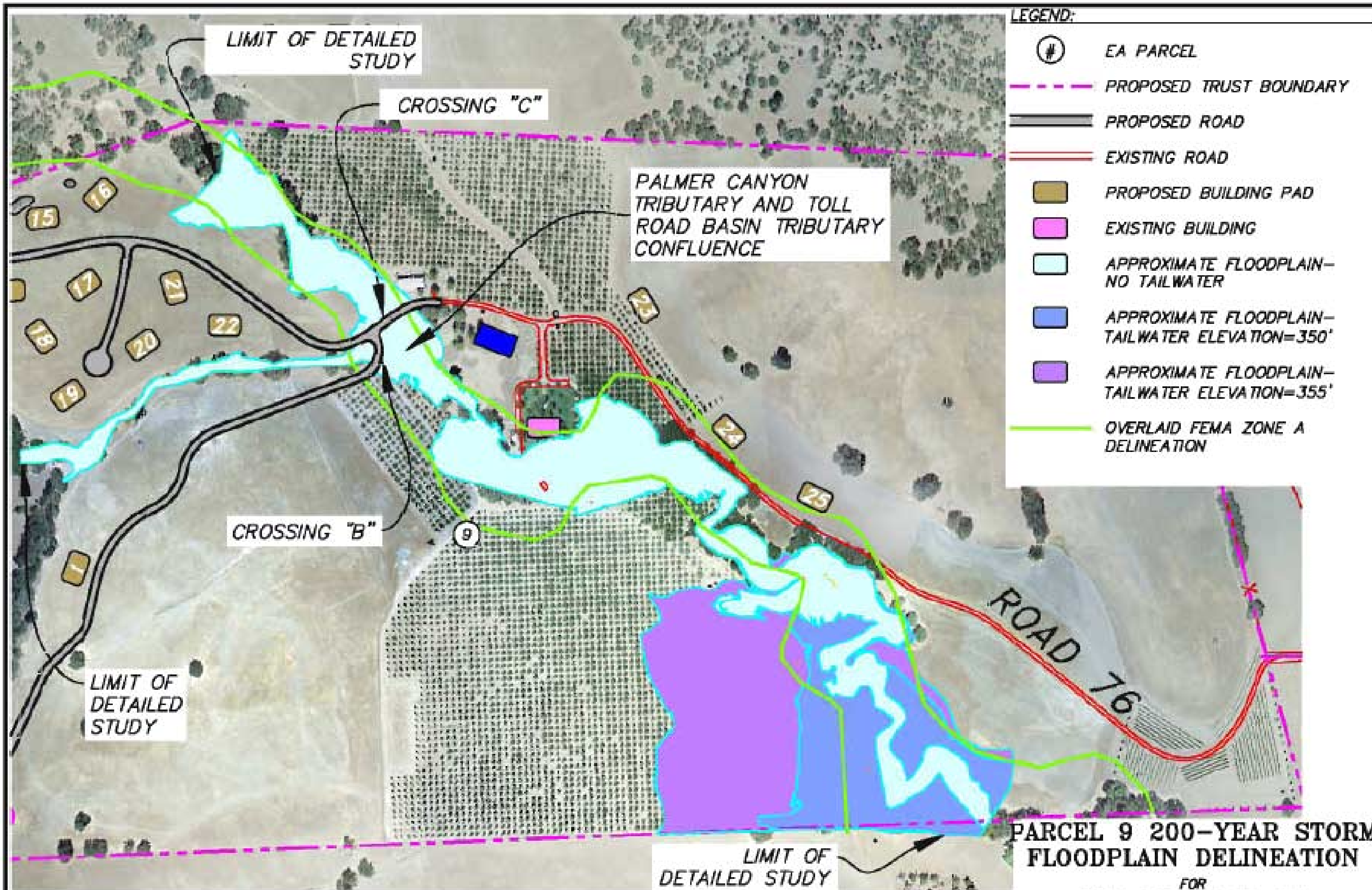

PARCEL 9 200–YEAR STORM FLOODPLAIN DELINEATION

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FIGURE 3–2

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3.3 Site Layout

A preliminary site layout was established based on minimizing grading and land disturbances. Parcel 9 consists of 23 single-family homes with a looped, paved access road. Parcel 10 consists of 2 single-family homes with a cul-de-sac access road. The roadways and building pad locations were adjusted through several iterations to fit the site terrain. Proposed grading features and drainage facilities are presented with conceptual planning level detail, and some refinements and modifications to this preliminary design are anticipated during development of the final design. Parcels 9 & 10 Site Layout is shown in Figure 3-3.

3.4 Hydrology

EA Parcel 9 and EA Parcel 10 pre-development hydrologic conditions and post-development hydrologic conditions are shown in Table 3-2 through Table 3-3. The flows presented consider Parcel 9 and Parcel 10 only, and does not include flows from the Palmer Canyon Basin and Toll Road Basin tributaries. The EA Parcel 9 and EA Parcel 10 Pre-Development and Post-Development hydrographs are shown from Figures 3-4 to Figure 3-7.

3.4.1 Discussion

The increase of peak flows for the post-development hydrology shows a less than 3% increase, almost no change in volume. This occurrence is the result of a matching pre and post CN for a watershed with the same area. The composite post CN is not affected by the amount of imperviousness proposed. Furthermore, the only difference between pre- and post- characteristics are the reduced time-of-concentration for a post-developed shed. With that said, however, reductions in existing flow rates as they enter Parcel 9 are being proposed to reduce to over peak loading for the project and downstream properties.

Table 3-2 Parcel 9 Pre-Development Hydrology

Storm Event (SCS Type II Distribution)	Area Improved (ac)	SCS CN Improved	Area Unimproved (ac)	SCS CN Unimproved	Total Area (ac)	Composite SCS CN	Q_{peak} (cfs)	Total Volume (cubic-ft)
10-Year, 24-hour	0	0	316.41	89	316.41	89	749.27	3,664,917
100-Year, 24-hour	0	0	316.41	89	316.41	89	1155.9	5,750,896
200-Year, 24-hour	0	0	316.41	89	316.41	89	1269.3	6,432,006

Table 3-3 Parcel 9 Post-Development Hydrology

Storm Event (SCS Type II Distribution)	Area Improved (ac)	SCS CN Improved	Area Unimproved (ac)	SCS CN Unimproved	Total Area (ac)	Composite SCS CN	Q_{peak} (cfs)	Total Volume (cubic-ft)
10-Year, 24-hour	12.69	98	303.72	89	316.41	89.4	804.4	3,731,557
100-Year, 24-hour	12.69	98	303.72	89	316.41	89.4	1235.4	5,835,155
200-Year, 24-hour	12.69	98	303.72	89	316.41	89.4	1355.6	6,432,006

Table 3-4 Parcel 10 Pre-Development Hydrology

Storm Event (SCS Type II Distribution	Area Improved (ac)	SCS CN Improved	Area Unimproved (ac)	SCS CN Unimproved	Total Area (ac)	Composite SCS Curve Number	Q_{peak} (cfs)	Total Volume (cubic ft)
10-Year, 24-hour	0	0	113.09	57	113.09	57	115.0	332,730
100-Year, 24-hour	0	0	113.09	57	113.09	57	307.4	772,397
200-Year, 24-hour	0	0	113.09	57	113.09	57	368.5	914,183

Table 3-5 Parcel 10 Post-Development Hydrology

Storm Event (SCS Type II Distribution	Area Improved (ac)	SCS CN Improved	Area Unimproved (ac)	SCS CN Unimproved	Total Area (ac)	Composite SCS Curve Number	Qpeak (cfs)	Total Volume (cubic ft)
10-Year, 24-hour	0.67	98	112.42	57	113.09	57.2	117.2	337,141
100-Year, 24-hour	0.67	98	112.42	57	113.09	57.2	310.7	779,480
200-Year, 24-hour	0.67	98	112.42	57	113.09	57.2	372.0	921,941

Table 3-6 lists the drainage areas, loss characteristics, and descriptions of the routes individual basins take to reach Parcel 9. The Existing Shed Exhibit, Figure 3-1, shows the delineated drainage basins for the project and tributary areas, the boundary of the site, and the outlet locations.

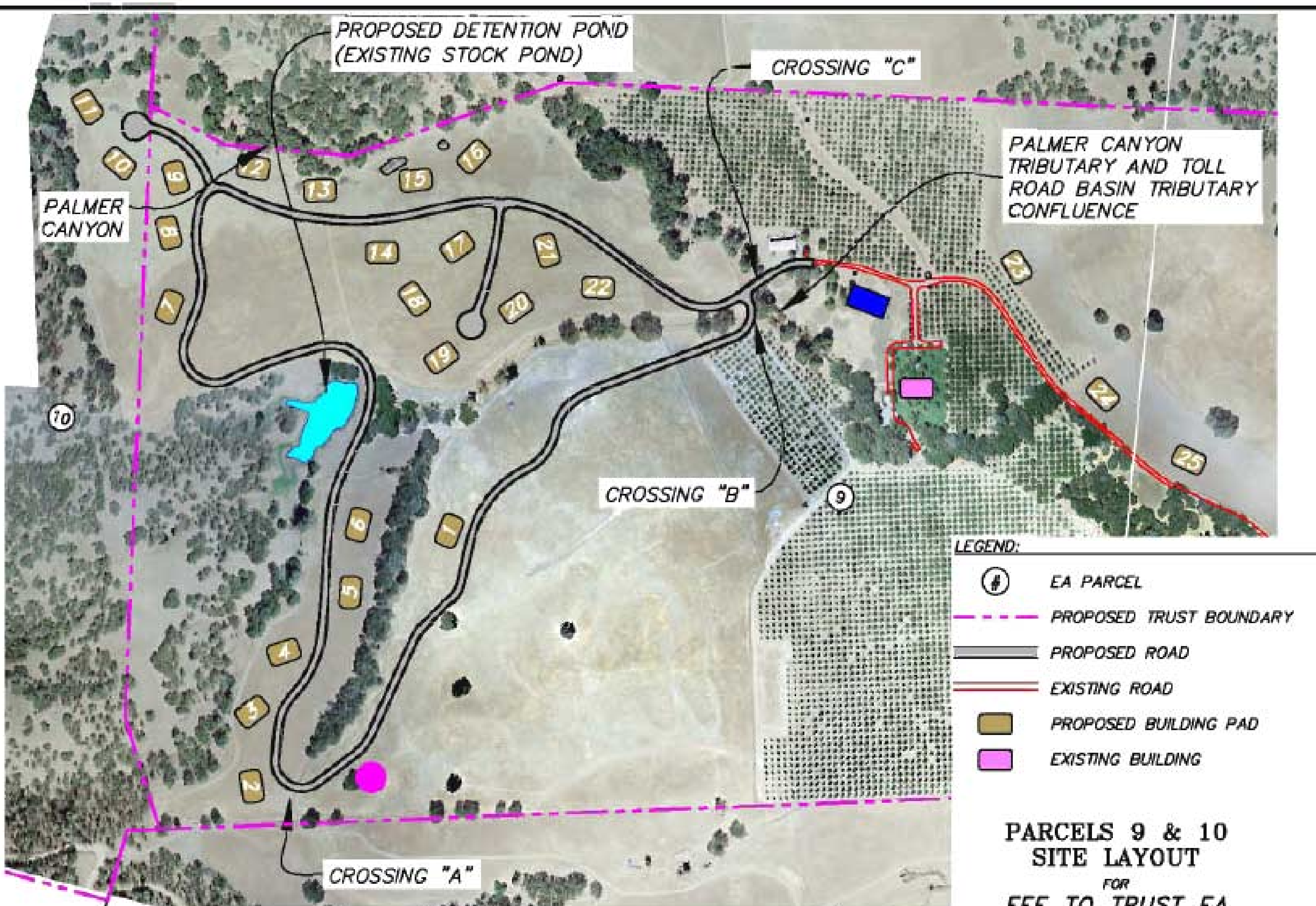
Table 3-6 Existing Tributary Drainage Sheds Through Parcels 9 & 10

WATERSHED BASIN	Total Area (ac)	SCS CN	Outlet	Q_{peak} (cfs) (100-year)	Total Volume (ac-ft) (100-year)	Q_{peak} (cfs) (200-year)	Total Volume (ac-ft) (200-year)
Palmer Canyon Basin 1	260.2	57	Reach-1 to Basin 3	404.9	40.0	480.7	47.8
Palmer Canyon Basin 2	167.0	63	Reach-3 to Basin 3	277.9	32.60	322.0	38.3
Palmer Canyon Basin 3	288.9	63	Reach-2 to Basin 4	515.4	56.5	596.9	66.3
Palmer Canyon Basin 4	240.7	63	Reach-4 to Junction 5	349.0	47.5	405.7	56.0
Palmer Canyon Basin 5	226.7	60	Reach-5 to Palmer Canyon	340.9	38.9	399.7	46.1
Palmer Canyon Basin 1-5	1183.5	--	Immediately Upstream of Parcel 9	1843.6	214.6	2147.5	254.6
Toll Road Basin 1	260.0	57	Reach-6 to Parcel 9	407.5	54.1	467.4	84.8
Toll Road Basin 2	76.0	57	Overland into Parcel 9				
Basin A	9.0	63	Overland into Parcel 9	21.0	1.8	24.1	2.1

In Parcel 9, two unnamed watercourses traverse easterly and join at a confluence near the center of Parcel 9. The two tributary basins for these two watercourses are Palmer Canyon Basin and Toll Road Basin. Downstream of the confluence at the southerly property line of Parcel 9 is Mossy Creek. Mossy Creek meanders to the southeast corner of the parcel where the drainage exits the parcel towards State Highway 16, then ultimately to Cache Creek.

The Toll Road Basin concentrates surface flows into two unnamed watercourses that flow to an existing stock pond located on the western portion of Parcel 9. During dry seasons, the water level in the stock pond remains low and stagnant. During wet seasons, the service road acts as spillways with two depressed sections to release water. The north spillway is approximately 125-feet in length with an approximate 1-foot depression. The south spillway is approximately 45-feet in length with an approximate 2-foot depression.

Palmer Canyon Basin channelizes into Palmer Canyon and traverses southeasterly towards EA Parcel 9's northerly property line. Palmer Canyon reaches an identified floodplain in Parcel 9 during a 100-year flood event.



PARCELS 9 & 10
SITE LAYOUT
FOR
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FIGURE 3-3

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SCALE: 1"=500'

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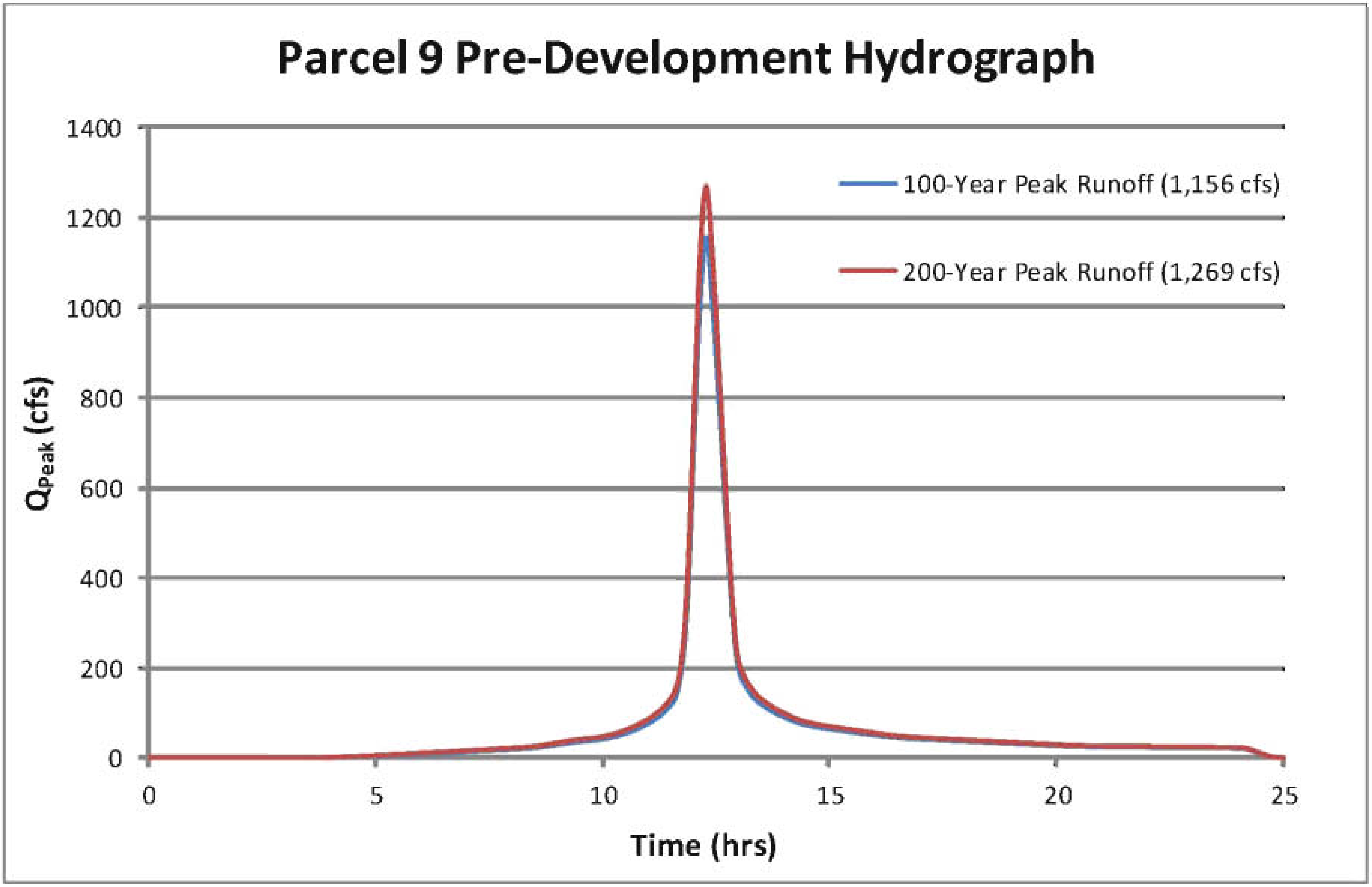

PARCEL 9 PRE-DEVELOPMENT HYDROGRAPH

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FIGURE 3-4

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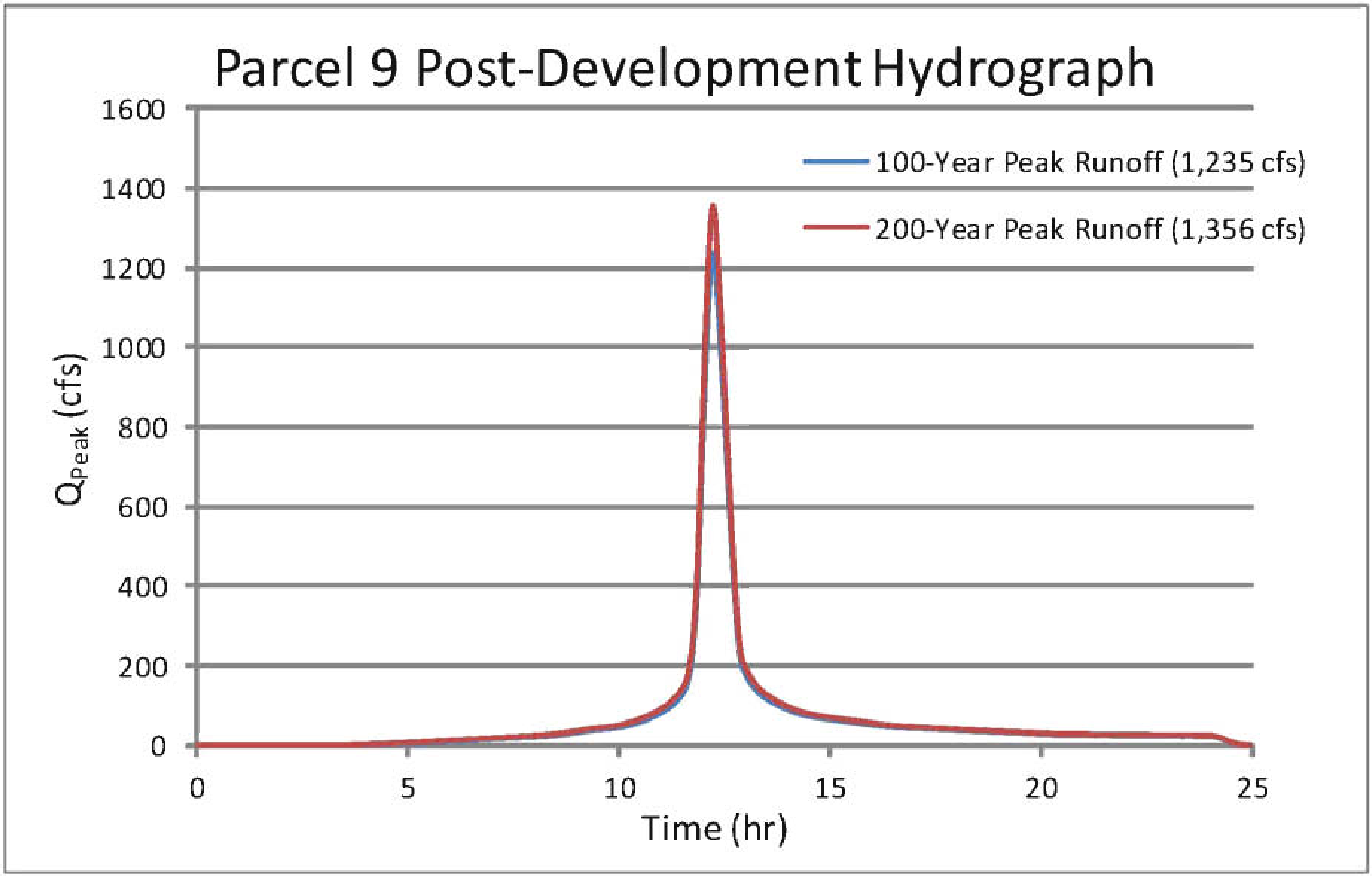

PARCEL 9 POST-DEVELOPMENT HYDROGRAPH

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FIGURE 3-5

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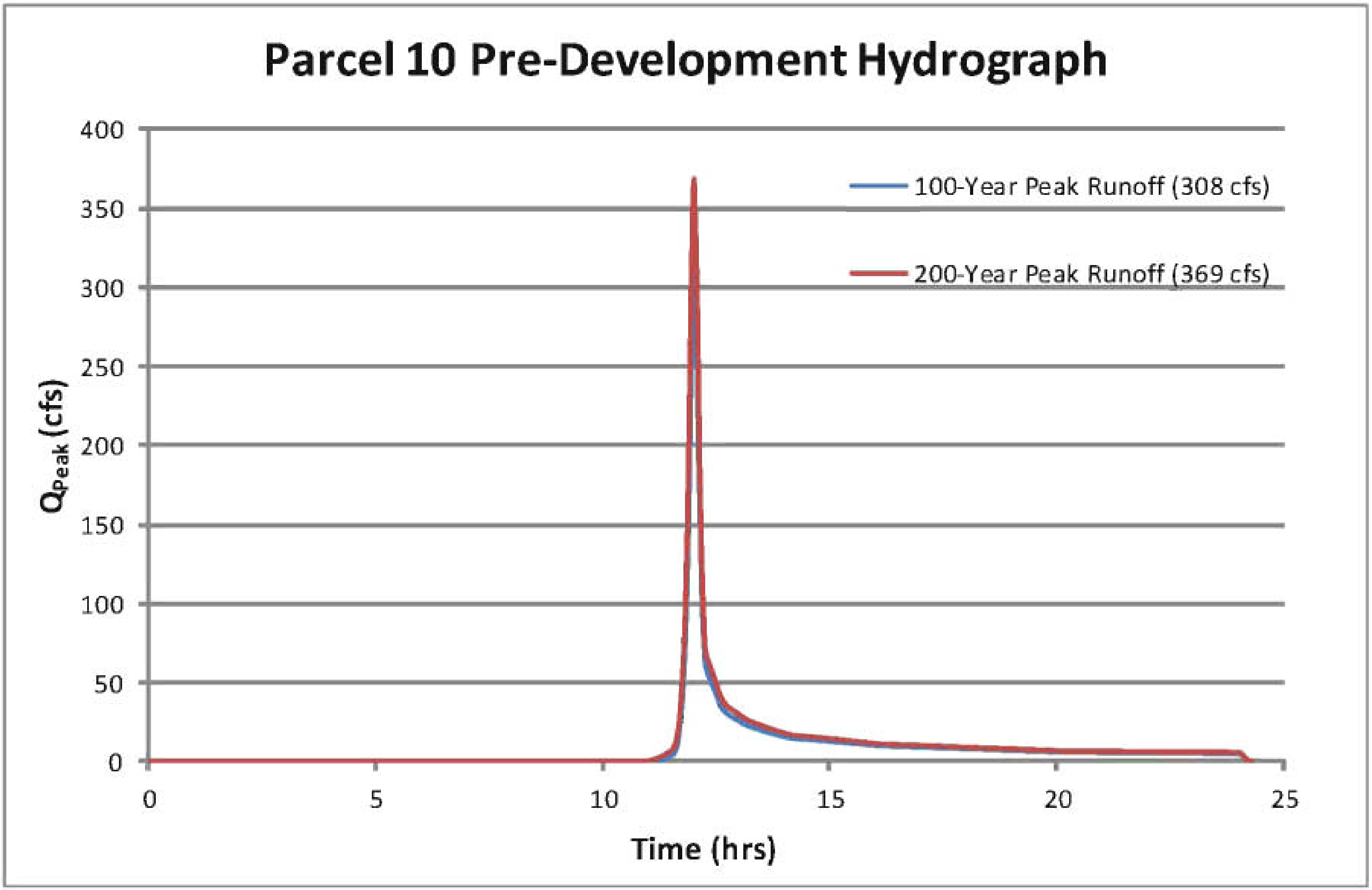

PARCEL 10 PRE-DEVELOPMENT HYDROGRAPH
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FIGURE 3-6

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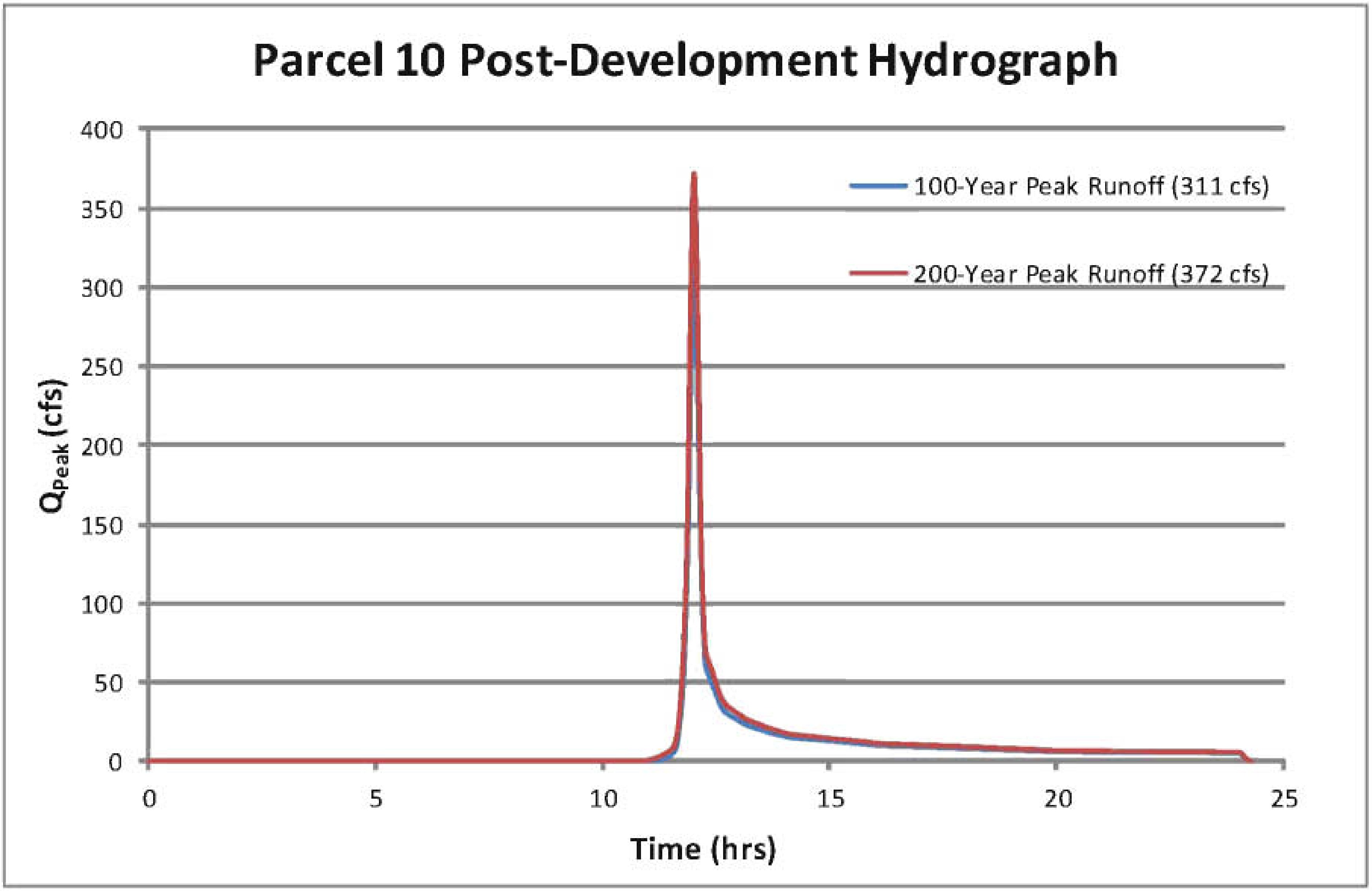

PARCEL 10 POST–DEVELOPMENT HYDROGRAPH
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FIGURE 3–7

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3.5 Stormwater Detention

3.5.1 Existing Stock Pond Condition:

The existing stock pond would not have the storage capacity to contain the runoff volume generated by Toll Road Basin during a 10-year flood event and would overtop the existing Private Access Road at a discharge rate of approximately 133 cfs (existing 10-year discharge). Once full, the stock pond would have no detention capacity and would allow full discharge of the next storm event to pass through the spillways.

3.5.2 Improvements to Existing Stock Pond:

The existing stock pond would be improved to provide detention volume for peak flows not exceeding the 100-year, 24-hour flood event. A 48-inch culvert will be installed at the bottom of the pond, designed to discharge at a rate not to exceed the existing pond's spillway discharge rate (133 cfs, Table 3-6). The 48-inch culvert allows the pond to drain and provide detention for every runoff event. Arch culverts are proposed along the existing pond's spillway to allow drainage through the improved Private Access Road during storm events exceeding an intensity of a 100-year storm event, 24-hour duration. The proposed detention pond would discharge with the conditions presented in Table 3-7.

Table 3-7 Existing and Proposed Stock Pond Conditions

STORM EVENT	10-YEAR, 24-HOUR STORM DURATION	100-YEAR, 24-HOUR STORM DURATION	200-YEAR, 24-HOUR STORM DURATION	CULVERT SLOPES
Existing Spillway	133 CFS	385 CFS	--[1]	0.80%
Proposed Spillway Arch Culverts	0 CFS	0 CFS	0 CFS	1%
Proposed 48 Inch Culvert	90 CFS	178 CFS	196.7 CFS	2%

[1]Impractical to determine due to major overtopping of nearly entire circumference of the existing pond

3.5.3 Pond Culvert Sizing and Design Discharge:

The hydrologic interaction between the existing stock pond and Toll Road Basin would require a hydrology study performed at an extended duration. The study would involve the phenomenon of evaporation, percolations, groundwater recharge, precipitation, and other losses considerable to the alteration of the volume of the stock pond. With intent to maintain existing ecological habitat in the stock pond, while improving potential drainage issues downstream, a 48-inch culvert would be installed "near" the bottom of the pond. The size of the culvert is limited in discharge to a 10-year, 24-hour duration flood event. The invert elevation would be determined by the volume of stagnant water required for the beneficial use of the existing ecological habitat. This determination would be recommended by consulting environmental professionals and/or biologists.

3.5.4 Parcels 9 & 10 Storm Water Detention:

In EA Parcel 9 and EA Parcel 10, the area of existing imperviousness compared with the proposed imperviousness is presented in Table 3-8 below.

Table 3-8 Impervious Areas

EA Parcel #	CONDITION	IMPERVIOUS AREA	PERVIOUS AREA
9	Existing	0 acres	316.41 acres
	Proposed	12.69 acres	303.72 acres
10	Existing	0 acres	113.09 acres
	Proposed	0.67 acres	112.42 acres

The proposed development on EA Parcel 9 and EA Parcel 10 presents only a 3% increase in imperviousness. These parcels consist of hill gradients that generate time-of-concentrations not less than time-of-concentrations of impervious land cover. Since the change in pervious area is minimal, the increase in peak flows in Parcel 9 would be considered insignificant. Although peak flow attenuation and detention is not required, the project does propose the conversion of the stock pond to a detention pond to reduce existing peak flows. This would offset any increased peak flows due to the development. Check-dams would also be used to increase the sub-shed's time-of-concentrations, which ultimately reduces flow velocities.

3.6 Storm Drainage Improvements

The proposed access road crosses existing drainage courses; therefore, culverts would be constructed to assure that drainage is not impeded. Due to considerably large watersheds with watercourses traversing through EA Parcel 9 and EA Parcel 10, culvert crossings will be sized to allow a 200-year, 24-hour storm event to drain without creating backwater or overtopping of existing and proposed roads. The following flow rates have been estimated through each crossing (Table 3-9):

Table 3-9 Flow Rates at Culvert Crossings

CULVERT CROSSING	100-YEAR, 24-HOUR STORM DURATION FLOW	200-YEAR, 24-HOUR STORM DURATION FLOW	CULVERT TYPE	QUANTITY	GEOMETRY	CULVERT SLOPES
A	21 CFS	24 CFS	PIPE	1	36"	1%
B	397.5 CFS	477.1 CFS	BOX CULVERT	2	16' SPAN 4'3" RISE	12%
C	1844 CFS	2147.5 CFS	BOX CULVERT	4	21' 7" SPAN 4'11" RISE	10%
NORTH SPILLWAY	407.5 CFS	--	ARCH CULVERT	4	17' 9" SPAN 3' 10" RISE	1%
SOUTH SPILLWAY		--	ARCH CULVERT	1	15' 10" SPAN 3' 6" RISE	0.5%

These flow rates would be verified and refined during the design phase, and arch culverts or pipe would be detailed.

3.7 Street Design

The roadway is 24-feet wide with 4-foot gravel shoulders. The profiles of the roadway were designed in conformance with the latest Yolo County Improvement Standards, with a minimum grade of 0.5% and a maximum of 15%. Vertical curves are proposed at locations where the grade differential is greater than 2.0% with a minimum vertical curve length of 100-feet. A structural section of 0.34-feet of asphalt concrete over 1.00-foot of Class II aggregate base is the minimum base on Yolo County Improvement Standards and will be used in this Report for earthwork calculations. The final structural section design shall be based on the projects Geotechnical Report.

3.8 Preliminary Grading

The alignment of the proposed road has been designed to follow the existing terrain to minimize the cut and fill needed to construct the road. Roadside swales are provided at areas where there is substantial cut required for the road. Daylight slopes along the road are no steeper than 2:1. One pad size has been examined with the pad sloped at 1% and daylight slopes to the road and natural ground are no steeper than 3:1. The pad is approximately 80-feet by 120-feet, were placed in flatter terrain areas. In areas with steeper terrain, pads were placed to minimize the grading impacts. The pad size can be refined during the design process to fit the final house and lot requirements. The Preliminary Grading Plan for Parcels 9 & 10 is included in Appendix C.

Assessment of approximate cut and fill volumes were developed by comparing the existing ground surface with the grading required to support the proposed roadways and building pads. A grading shrinking factor of 20% was applied to fill volumes to account for compaction activities during construction. The shrinkage factor shall be verified by the contractor prior to start of earthwork activities. Preliminary Earthwork Quantities are shown in Table 3-10.

Booster pumps for the building's fire-sprinkler system would likely be required for Homes on Pads 2 thru 4 to provide minimum water pressures during fire-suppression and/or domestic use. Pad locations and elevations could be adjusted and/or relocated for the water system to offer gravity service throughout the development. These designs could be refined during design development. Refer to the water and wastewater report.

Table 3-10 Preliminary Earthwork Quantities

ITEM	CUT	FILL	NET
Roadway	4,242 CY	1,974 CY	2,268 CY (Cut)
Pad 1	326 CY	11 CY	315 CY (Cut)
Pad 2	943 CY	0 CY	943 CY (Cut)
Pad 3	37 CY	1,070 CY	1,033 CY (Fill)
Pad 4	0 CY	1,224 CY	1,224 CY (Fill)
Pad 5	341 CY	35 CY	306 CY (Cut)
Pad 6	530 CY	30 CY	500 CY (Cut)
Pad 7	566 CY	100 CY	466 CY (Cut)
Pad 8	943 CY	19 CY	924 CY (Cut)
Pad 9	600 CY	0 CY	600 CY (Cut)
Pad 10	1,182 CY	0 CY	1,182 CY (Cut)
Pad 11	245 CY	5 CY	240 CY (Cut)
Pad 12	55 CY	260 CY	205 CY (Fill)
Pad 13	222 CY	49 CY	173 CY (Cut)
Pad 14	59 CY	77 CY	18 CY (Fill)
Pad 15	90 CY	140 CY	50 CY (Fill)
Pad 16	79 CY	14 CY	65 CY (Cut)
Pad 17	137 CY	56 CY	81 CY (Cut)
ITEM	**CUT**	**FILL**	**NET**
Pad 18	232 CY	23 CY	209 CY (Cut)
Pad 19	61 CY	68 CY	7 CY (Fill)
Pad 20	18 CY	439 CY	421 CY (Fill)
Pad 21	75 CY	0 CY	75 CY (Cut)
Pad 22	78 CY	61 CY	17 CY (Cut)
Pad 23	4,530 CY	0 CY	4,530 CY (Cut)
Pad 24	1,279 CY	0 CY	1,279 CY (Cut)
Pad 25	1,062 CY	0 CY	1,062 CY (Cut)
Total	**17,932 CY**	**5,655 CY**	**12,277 CY (Cut)**

3.9 Best Management Practices

To minimize the amount of pollutants discharged to existing waterways, Best Management Practices (BMPs) will be implemented during and after construction in accordance with the California Stormwater Quality Association's "Stormwater Best Management Practice Handbook". Improvement plans will incorporate erosion and sediment control measures, and a Stormwater Pollution Prevention Plan (SWPPP) will be prepared either during design or by the construction contractor prior to construction.

BMP's for this project would include, but not limited to:

- Vegetation preservation.
- Straw wattle placement on cut and fill slopes.
- Straw wattle check dams installed within drainage swales.
- Rip-rap energy dissipaters installed at the point of release of concentrated flows.
- Hydroseeding of disturbed areas.
- Bioswales installed to reduce sediment transport in storm water runoff.
- Washout stations and other controls at construction entrances that would minimize spreading of pollutants offsite.

3.10 Summary

The minimal impacts due to the increase in storm runoff do not necessarily require a detention pond to be built for this development; however, the conversion of the stock pond to a detention pond to reduce existing peak flows that enter the property and reduce them significantly for the downstream conveyance system will offset any development impacts. All downstream property along the Creek frontage will benefit from the reduced peak flows from larger storm events. The check dams within the road ditches should adequately mitigate for any impacts due to the locally increased runoff. No import or export of material is anticipated for this project.

The grading analyzed in this report is preliminary and may require deviations to accommodate actual building footprints, final building locations and utility service constraints.

4.0 EA Parcel 7 & EA Parcel 8

4.1 Existing Site Conditions

EA Parcel 7 consists of approximately 19.76 acres on mostly undeveloped open agricultural field. Parcel 7 is bounded by State Highway 16 to the east, and agriculture to the north, south, and west. EA Parcel 8 consists of approximately 153.7 acres on mostly undeveloped open agricultural field. EA Parcel 8 is bounded by State Highway 16 to the east, EA Parcel 7 to the northeast, agriculture to the north and south, and foothills to the west. The existing topography is relatively flat sloping from southwest to northeast where drainage is directed towards State Highway 16 culvert crossings and into Cache Creek. Elevations range from approximately 303 feet above mean sea level on the westerly portion of EA Parcel 8 to approximately 294 feet above mean sea level in the easterly portion of the property.

4.2 Floodplain

EA Parcel 7 and EA Parcel 8 are not identified in a floodplain by FEMA. However, during a 200-year flood event, the floodplain limit would overlay near the northeasterly portion of Parcel 7. No buildings or above grade infrastructure is proposed on Parcel 7.

4.3 Site Layout

A preliminary site layout was provided by AES and consists of a new Wastewater Treatment Plant (WWTP) on EA Parcel 8. The WWTP is one option for wastewater treatment and recycled water storage. EA Parcel 7 would likely consist of pipelines for the WWTP and related infrastructure. The EA Parcel 7 and EA Parcel 8 Site Layout are shown in Figure 1-3.

4.4 Hydrology

The development nature of Parcel 7 is insignificant for a hydrologic evaluation. Ground disturbances on EA Parcel 7 from trenching and utility work would most likely be restored to pre-existing conditions. EA Parcel 8 pre-development hydrologic conditions and post-development hydrologic conditions are shown in Tables 4-1 thru 4-2.

Table 4-1 Parcel 8 Pre-Development Hydrology

Storm Event (SCS Type II Distribution)	Area Improved (ac)	SCS CN Improved	Area Unimproved (ac)	SCS CN Unimproved	Total Area (ac)	Composite SCS CN	Q_{peak} (cfs)	Total Volume (ac-ft)
10-Year, 24-hour	0	0	153.7	89	153.7	89	269.2	41.0
100-Year, 24-hour	0	0	153.7	89	153.7	89	416.3	64.3
200-Year, 24-hour	0	0	153.7	89	153.7	89	457.4	71.0

Table 4-2 Parcel 8 Post-Development Hydrology

Storm Event (SCS Type II Distribution)	Area Improved (ac)	SCS CN Improved	Area Unimproved (ac)	SCS CN Unimproved	Total Area (ac)	Composite SCS CN	Q_{peak} (cfs)	Total Volume (ac-ft)
10-Year, 24-hour	0.11	98	147.59	89	147.7[1]	89.01	275.1	39.4
100-Year, 24-hour	0.11	98	147.59	89	147.7[1]	89.01	425.1	61.9
200-Year, 24-hour	0.11	98	147.59	89	147.7[1]	89.01	467.0	68.3

Note: [1]"Total Area" does not reflect Pre-Existing "Total Area." The ~6 acre pond would be designed for self-containment and/or zero discharge.

4.5 Potential Development

4.5.1 Preliminary Grading:

Earthwork on Parcel 8 would consist of excavation and berming to construct the wastewater treatment ponds, recycled water reservoir, and facilities along with access road construction. Balance cut/fill construction would be used for the wastewater ponds, reservoirs, and accompanying facilities for the WWTP. No import or export of soil is expected on this parcel.

4.5.2 Existing Drainage:

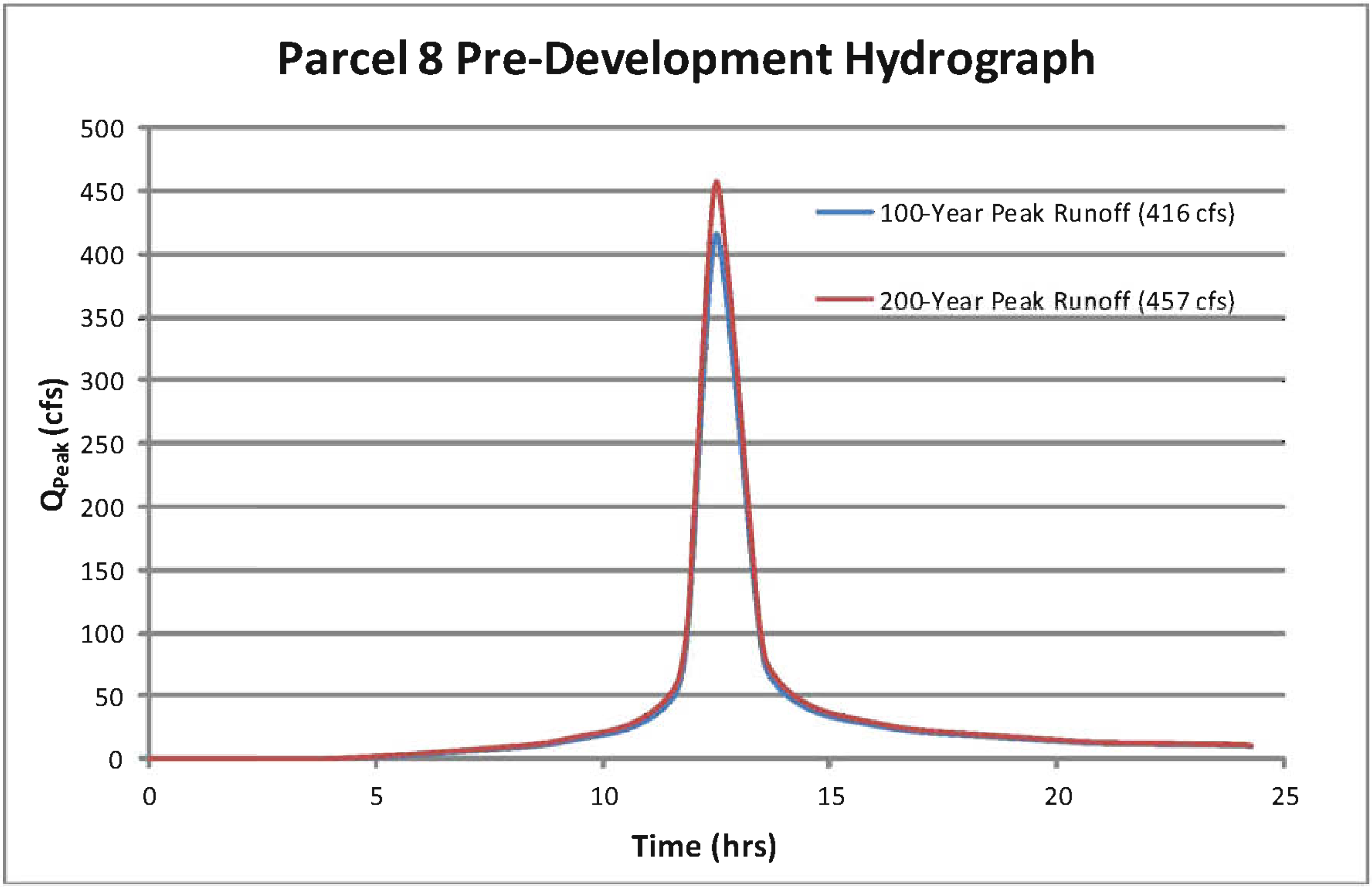
Parcel 7 overland flows northeast into an existing ditch along the northerly property line. The ditch conveys drainage towards a culvert that crosses State Highway 16. Downstream of the culvert, on the east side of State Highway 16 is an existing ditch that drains along the northerly property line of the Existing Community Trust Property towards Cache Creek.

Parcel 7 is not within the 100-year base flood overlay.

The WWTP would be designed as a zero discharge facility, thus, the area of the ponds will reduce the drainage shed acreage and offset any increase of impervious surfaces associated with the development of Parcel 7. Drainage improvements will be recommended as needed during the design phase of the project.

4.6 Summary

The development of a wastewater treatment facility on EA Parcel 8 would require minor drainage improvements depending on the final design layout of the wastewater treatment plant. All drainage improvements would be designed to allow proper setbacks from wastewater facilities. Furthermore, reduction in post-developed imperviousness is anticipated as a result of self-containment of the recycled water pond.



PARCEL 8 PRE-DEVELOPMENT HYDROGRAPH
FOR
FEE TO TRUST EA
YOCHA DEHE WINTUN NATION

FIGURE 4-1

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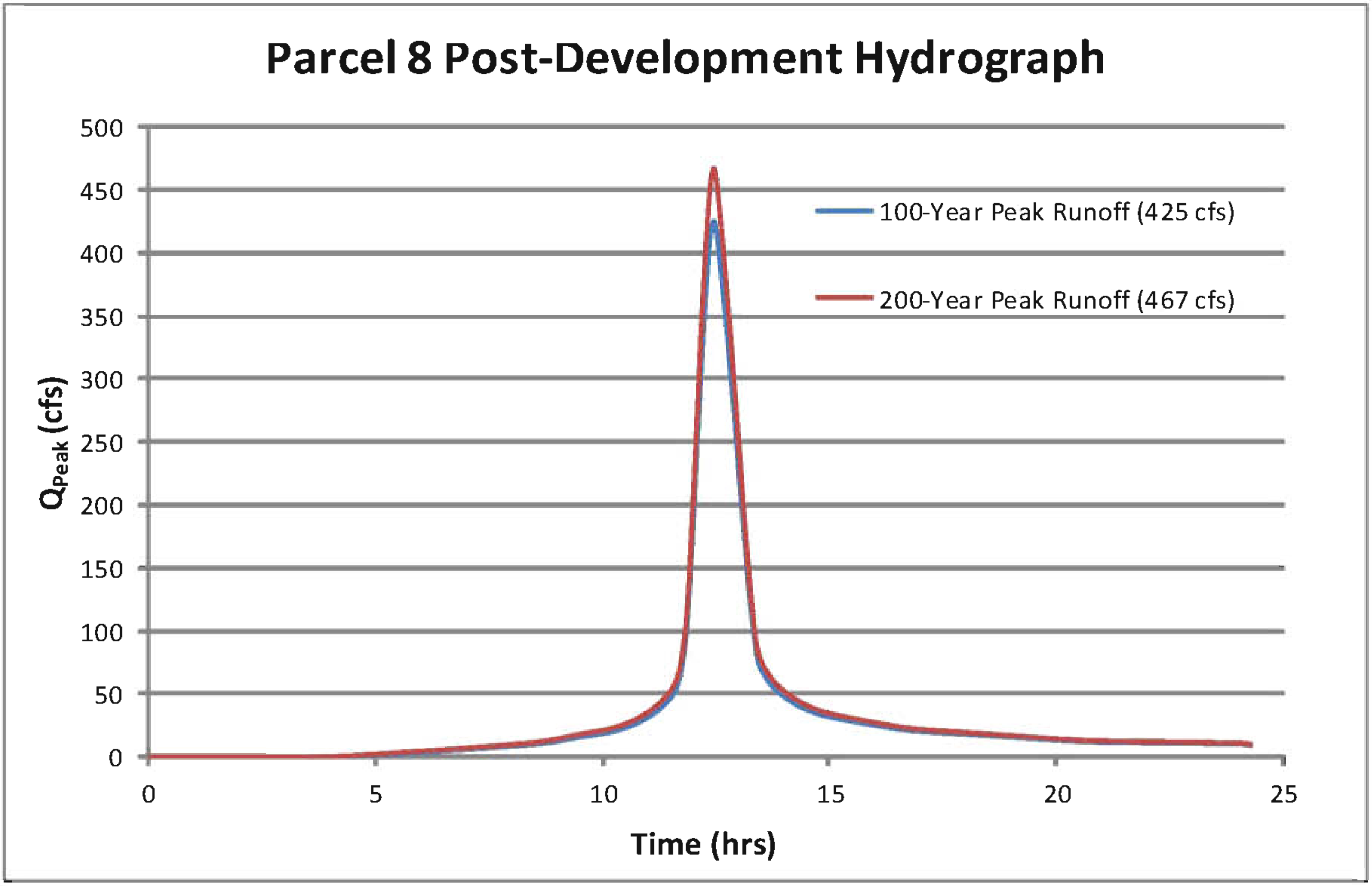

PARCEL 8 POST-DEVELOPMENT HYDROGRAPH

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FIGURE 4-2

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REVIEW DRAFT

Rumsey Rancheria Flood Inundation

Technical Memorandum

Prepared for
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and
Rumsey Tribe

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February 1, 2009

Contents

List of figures

List of tables

Executive Summary

Hydraulic modeling was used to determine the extent of flood water inundation in the vicinity of the Rumsey Rancheria near Cache Creek. HEC RAS (Hydrologic Engineering Center River Analysis System) and HEC GeoRAS (used with ARCGIS software) hydraulic models were used to estimate the areal extent of the 100, 200, and 500 year recurrence interval flooding. This report documents the data used, the calibration, and provides maps of the extent of the water in the chosen floods.

The model was calibrated using water surface elevations from USGS (United States Geological Survey) cross sections which show the water surface elevation at 26,000 cfs, which is approximately the 5-year recurrence interval flow. The 100, 200, and 500-year flood levels were then estimated based on the calibrated model. The extent of flooding for the 100, 200, and 500-year flood levels is very similar, with a large percentage of the Rancheria being inundated by all of these flows. The inundation patterns are similar because the flows, as estimated by the US Army Corps of Engineers, are relatively similar. Because the differences between 100 and 500 year inundations are relatively small, one could estimate that any variance due to different calibrations might be small, and that the levels of flooding can be used to consider land use planning at the Rancheria. For comparison purposes, the 50-year recurrence interval flow was also modeled. The difference in water surface elevations near the Rancheria buildings between flows (50 to 100, 100 to 200, and 200 to 500) was less than 6 inches for each interval. Because of the small difference in water surface elevations between flood events, it is expected that the level of uncertainty in modeling would not make a large difference in water surface elevations for planning purposes at the Rancheria.

Introduction

Rumsey Rancheria is doing building design and construction. Adjacent to the Rancheria property is Cache Creek. Some of the buildings and area lie within the potential flood-prone areas of the Rancheria property. The Rumsey Tribe working with Architect Jim Zanetto requires flood inundation levels in order to design floor surface elevations for structures.

HEC RAS and HEC GeoRAS are US Army Corps of Engineers hydraulic models that allow one to model the flow of water in a river, and to estimate the extent of overbank flooding in flood events. The model can be used with best engineering judgment, and not calibrated, or can be calibrated to known flows. In the case of the current modeling, calibration was done with data from 1984 cross sections which show the water surface elevation at a flow of 26,000 cfs, which is approximately a 5-year recurrence interval flow. There was reasonable agreement between observed 26,000 flows and modeled 26,000 flows.

Based on the calibrated values in the HEC RAS program, estimations were made for the 100, 200, and 500 year recurrence interval flows, and flood inundation maps were prepared for each flow, as well as maps which showed comparisons between the flows. In addition, a table of water surface elevations near the Rancheria was prepared for the various floods.

Methods

Site description

The Rumsey Rancheria is located on Cache Creek in Yolo County, upstream from the Capay Diversion Dam. Figure nnn [ADD FIGURE] shows the site of the modeling with the extent of the hydraulic model shown in red.

Flood inundation mapping

Flood inundation mapping requires that the flow of storm water be modeled to understand what elevations the water surface reaches in floods of different magnitudes. The standard method for modeling those flows is the US Army Corps of Engineers (USACOE) HEC RAS[1] hydrologic model. HEC RAS uses mathematical modeling of river flow and known calibration data to predict the level of water that various flood events will reach.

HEC RAS predicts the water surface elevation that will fill chosen cross sections, which located across the landscape. In order to extend this information to a 2-dimensional area, HECGeoRAS is an add-on to ARCGIS that allows areas of flood inundation to be delineated.

Input Data for HEC Geo RAS and HEC RAS

Aerial photography

The area of concern is visualized using digitized and ortho-rectified aerial photography. These aerial photos are also used, in conjunction with the digital terrain model (DTM) to draw the centerline of the channel and the location of the channel cross sections. Two aerial photos were

[1] Hydrologic Engineering Center River Analysis System

used for these purposes, a 2005 photo, with complete coverage, and a set of 2007 photos, which were used for digitization, but not for visualization, because some of the corners were missing.

Digital terrain model

A digital terrain model was used, which was developed from LIDAR data that was gathered by Yolo County in 2007.[2]

Landuse map

A GIS coverage of vegetation type along Cache Creek[3] was used to determine the land use in the vicinity of the Rancheria. Each land use was assigned a Manning roughness coefficient for the purposes of modeling the flows. The HEC RAS model was calibrated so that the observed water surface elevations matched the modeled water surface elevations at 26,000 cfs. The roughness coefficients required for that calibration are shown in Appendix 1 Land use categories and Manning n values).

Flow data

Flow data are available for Cache Creek from the Technical Report, which summarize various studies that have been done to establish a flood recurrence interval analysis. Values used in the modeling were taken from the US Army Corps of Engineers flood recurrence interval analysis reported in the Tech. Report. Figure 1shows the recurrence interval analysis up to the 100 year flood as summarized by Kamman Engineering and Technology. Table 1 shows the discharge values used in this study. This table also shows a comparison of the relative magnitude of the flood discharges as a percentage of the 100-year flow.

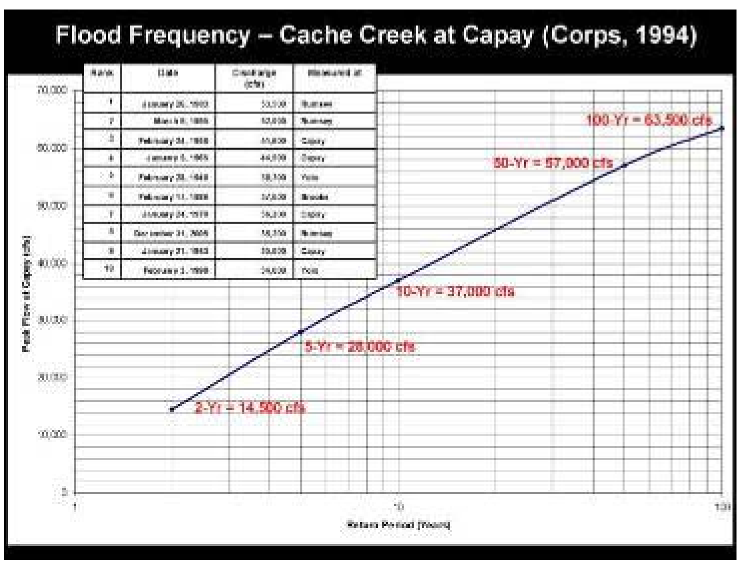


Figure 1 Recurrence interval graph for flows up to 100 cfs

[2] Kamman Hydrology and Engineering. Greg Kammon and Shawn Higgins, pers. Com 2009.
[3] KHE, 2009.

Recurrence interval	Discharge (cfs)	Percentage of 100-yr flow	Notes
5	28,000	44%	From KHE/USACOE
50	57,000	90%	From KHE/USACOE
100	63,500	100%	From KHE/USACOE
200	69,000	109%	Estimate (this study)
500	75,000	118%	From table 6[4] Rumsey gage

Table 1 Flood flow discharges used in the study

Results

Based on the HEC RAS flow modeling, the flood inundation maps were prepared for the chosen flows. Figure 2 and Figure 3 show the flood inundation maps for the 5, 100, 200, and 500 year recurrence interval flows. The colored areas represent the areas inundated at the specified flows. Figure 2 shows that the 100, 200, and 500 year flows inundate most of the Rancheria property, with certain buildings perched out of the floodplain. The 5-year flow, which was used for calibration, does not reach the Rancheria where the buildings are located. The black lines in the two figures are cross section “cut lines”, which are the location of the cross section profiles that were used in the HEC RAS modeling.

Note that in the maps there are some areas that are show as not in the flood areas that are, in fact, in the flood zones. This discrepancy is due to flaws in the original LIDAR data that failed to map certain areas. All of the areas where this occurs are not critical to flood evaluation at the Rancheria. The two rectangular fields that are located north of the Rancheria building properties, and certain small areas in the channel of Cache Creek show on the maps as if they are out of the flood zones. This is not the case, but is the result of the faulty LIDAR data.

Nnn shows the same inundation mapping in a close up view that shows the building area of the Rancheria. There are select buildings that are not inundated, even at the 500 year flood. The figure shows areas in light green that are inundated at the 200 flow and in red that are inundated at the 100 flow. Although there are slight differences in the patterns, the difference in the extent of inundation is slight. This is because the discharges for the various flood levels do not differ in a large extent. Table 1 shows that the difference between the 100 flow and the 500 year flow is only 18%.

Table 2 gives the water surface elevations for the cross sections on the maps. The water surface elevations are tabulated in two different geographic datum references, North American Datum (NAD) 83 and NAD 27. The original analysis was done in the NAD 83 datum, and the results were also tabulated in the NAD 27 datum because the Rancheria property surveys are done in the NAD 27 datum.

[4] Cache Creek Technical Studies, section 6, Hydrology

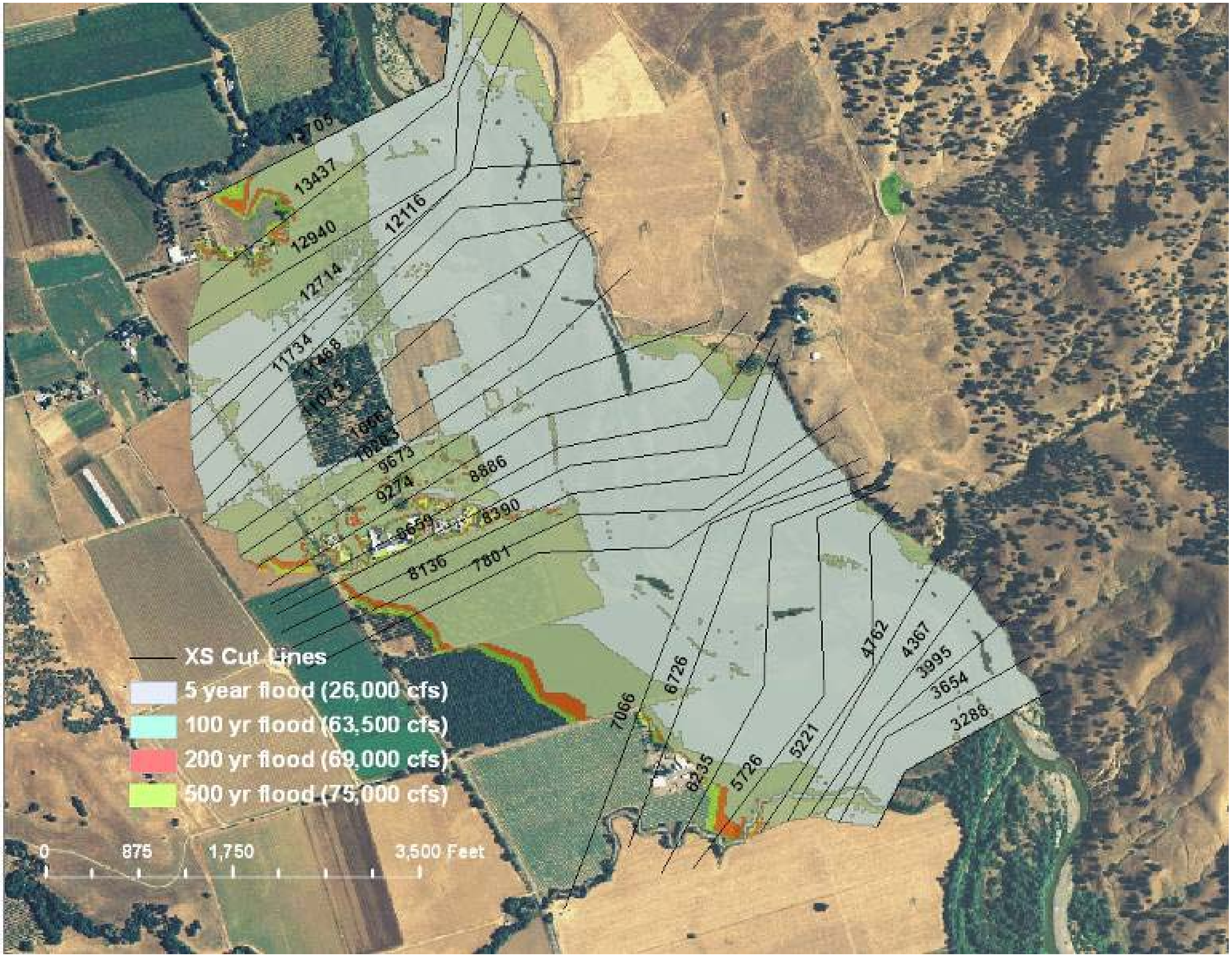


Figure 2 Flood inundation maps for the 5, 100, 200, and 500 year recurrence interval flows

Figure 3 Flood inundation maps (close up) for the study flows

Figure 4 Flood inundation map 100 and 500 year recurrence interval flows compared

Table 2 Water surface elevations of flood flows in the vicinity of the Rancheria

River Sta	Profile	Q Total	W.S. Elev (ft)	W.S. Elev (ft)
		(cfs)	(NAD 83)	(NAD 27)
10661	5-yr flow	26000	294.67	291.97
10661	50-yr flow	57000	297.62	294.92
10661	100-yr flow	63500	298.06	295.36
10661	200-yr flow	69000	298.41	295.71
10661	500-yr flow	75000	298.77	296.07
10203	5-yr flow	26000	293.82	291.12
10203	50-yr flow	57000	296.91	294.21
10203	100-yr flow	63500	297.36	294.66
10203	200-yr flow	69000	297.72	295.02
10203	500-yr flow	75000	298.08	295.38
9673	5-yr flow	26000	292.51	289.81
9673	50-yr flow	57000	295.41	292.71
9673	100-yr flow	63500	295.88	293.18
9673	200-yr flow	69000	296.25	293.55
9673	500-yr flow	75000	296.64	293.94
9274	5-yr flow	26000	291.84	289.14
9274	50-yr flow	57000	294.63	291.93
9274	100-yr flow	63500	295.09	292.39
9274	200-yr flow	69000	295.46	292.76
9274	500-yr flow	75000	295.85	293.15
8886	5-yr flow	26000	291.14	288.44
8886	50-yr flow	57000	293.86	291.16
8886	100-yr flow	63500	294.32	291.62
8886	200-yr flow	69000	294.69	291.99
8886	500-yr flow	75000	295.09	292.39
8659	5-yr flow	26000	290.75	288.05
8659	50-yr flow	57000	293.49	290.79
8659	100-yr flow	63500	293.95	291.25
8659	200-yr flow	69000	294.33	291.63
8659	500-yr flow	75000	294.74	292.04
8390	5-yr flow	26000	290.27	287.57
8390	50-yr flow	57000	293.08	290.38
8390	100-yr flow	63500	293.55	290.85
8390	200-yr flow	69000	293.95	291.25
8390	500-yr flow	75000	294.36	291.66
8136	5-yr flow	26000	289.72	287.02
8136	50-yr flow	57000	292.60	289.90
8136	100-yr flow	63500	293.09	290.39
8136	200-yr flow	69000	293.50	290.80
8136	500-yr flow	75000	293.94	291.24

Discussion

One of the most important questions in this flood inundation study is to consider the level of uncertainty of the results. In the vicinity of the Rancheria (Cross sections 8136 to 10661) the average difference in water surface elevations between the various flows is about 5 inches (Table 3). Because of the small difference in water surface elevations between flood events, it is expected that the level of uncertainty in modeling would not make a large difference in water surface elevations for planning purposes at the Rancheria.

Average difference in flood levels near the Rancheria	
Years	Inches
50 to 100	5.6
100 to 200	4.6
200 to 500	4.8

Table 3 Average difference in flood levels near the Rancheria

References

Appendices

Appendix 1 Land use categories and Manning n values

Vegetation classification	N_value
Barren - Gravel and Sand Bars	0.060
Blue Oak Alliance	0.075
California Annual Grasslands Alliance	0.070
Deciduous Fruits/Nuts	0.075
Eucalyptus Alliance	0.090
Field Crops	0.080
Fremont Cottonwood - Valley Oak - Willow (Ash - S*	0.090
Giant Reed Series	0.090
Grain/Hay Crops	0.080
Intermittently Flooded to Saturated Deciduous Shr*	0.080
Mixed Fremont Cottonwood - Willow spp. NFD Allian*	0.080
Mixed Willow Super Alliance	0.080
Pasture	0.070
Tamarisk Alliance	0.090
Truck/Nursery/Berry Crops	0.090
Upland Annual Grasslands & Forbs Formation	0.070
Urban or Built-up	0.100
Valley Oak Alliance	0.075
Valley Oak Alliance - Riparian	0.075
Water	0.060

Table 4 Land use categories and Manning n values

Appendix 2 Calibration of HEC RAS model

Adjusting cross sections with USGS data

The LIDAR data was not able to penetrate the water surface, and therefore, the bed topography was not documented. The LIDAR, and therefore the DTM data from which the cross sections were made, record the water surface as a line from one bank to the other. In order to get a sense of the bed topography, cross sections on the HEC RAS model were compared with measured cross sections from USGS measured data (ref).

The cross sections on the HEC RAS model that correspond with USGS cross sections are given in Table 5Table 5.

HEC RAS cross section number	USGS cross section number	Datum adjustment Add 2.7 ft to USGS value	WSE USGS	Our datum	Calibrated WSE in HEC RAS
3288	12		281.0	283.7	283.3
8136	13	Add 2.7 ft to USGS value	284.5	287.2	289.72
9673	14	Add 2.7 ft to USGS value	290	292.7	292.51

Table 5 Calibration data for the water surface elevations at the calibrated cross sections

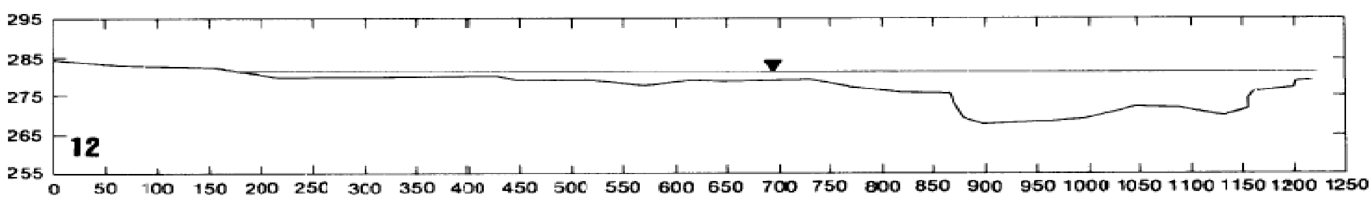


Figure 5 USGS 1984 cross section number 12 used for model calibration

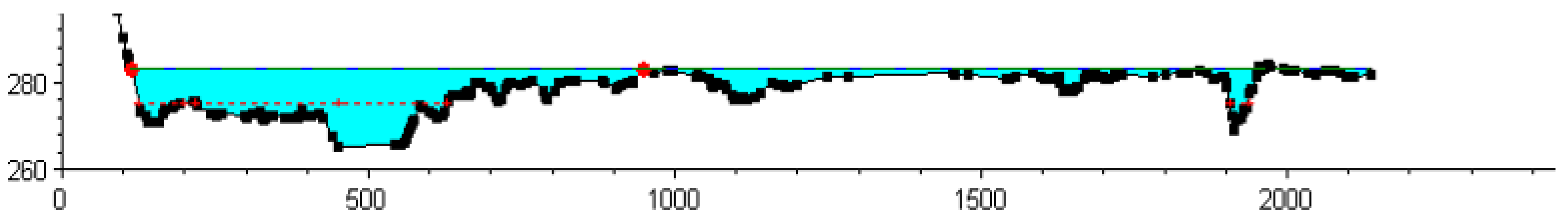


Figure 6 HEC RAS cross section number 3288 used for model calibration

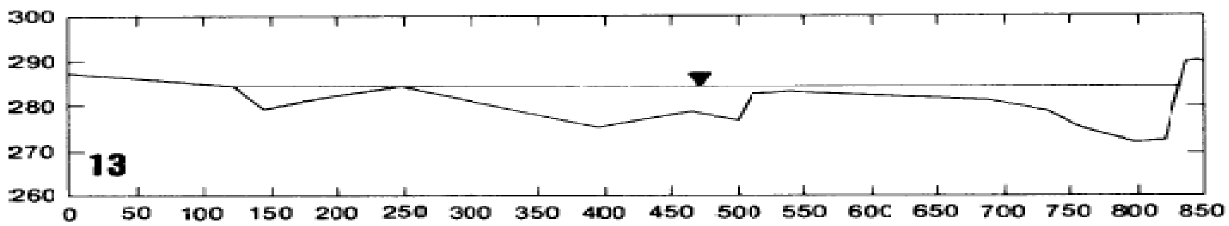


Figure 7 USGS 1984 cross section number 13 used for model calibration

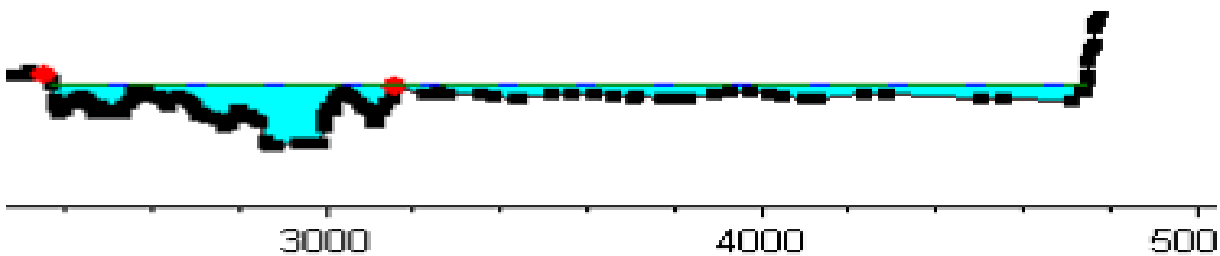


Figure 8 HEC RAS cross section number 8136 used for model calibration

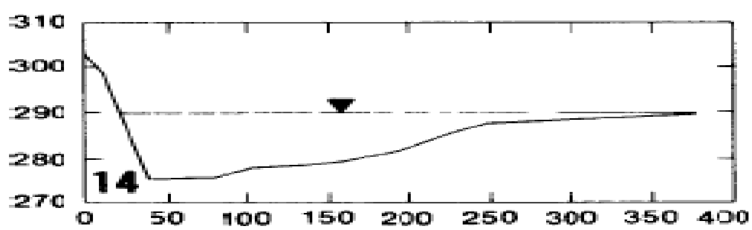


Figure 9 USGS 1984 cross section number 14 used for model calibration

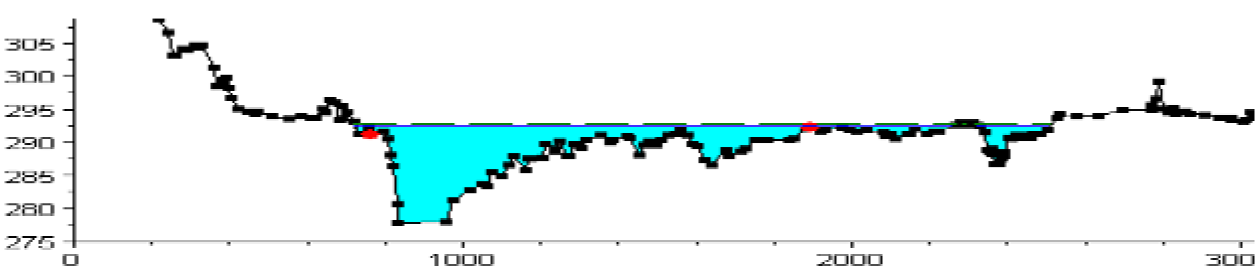


Figure 10 HEC RAS cross section number 9673 used for model calibration

Appendix 2 Flood inundation maps

100 year maps

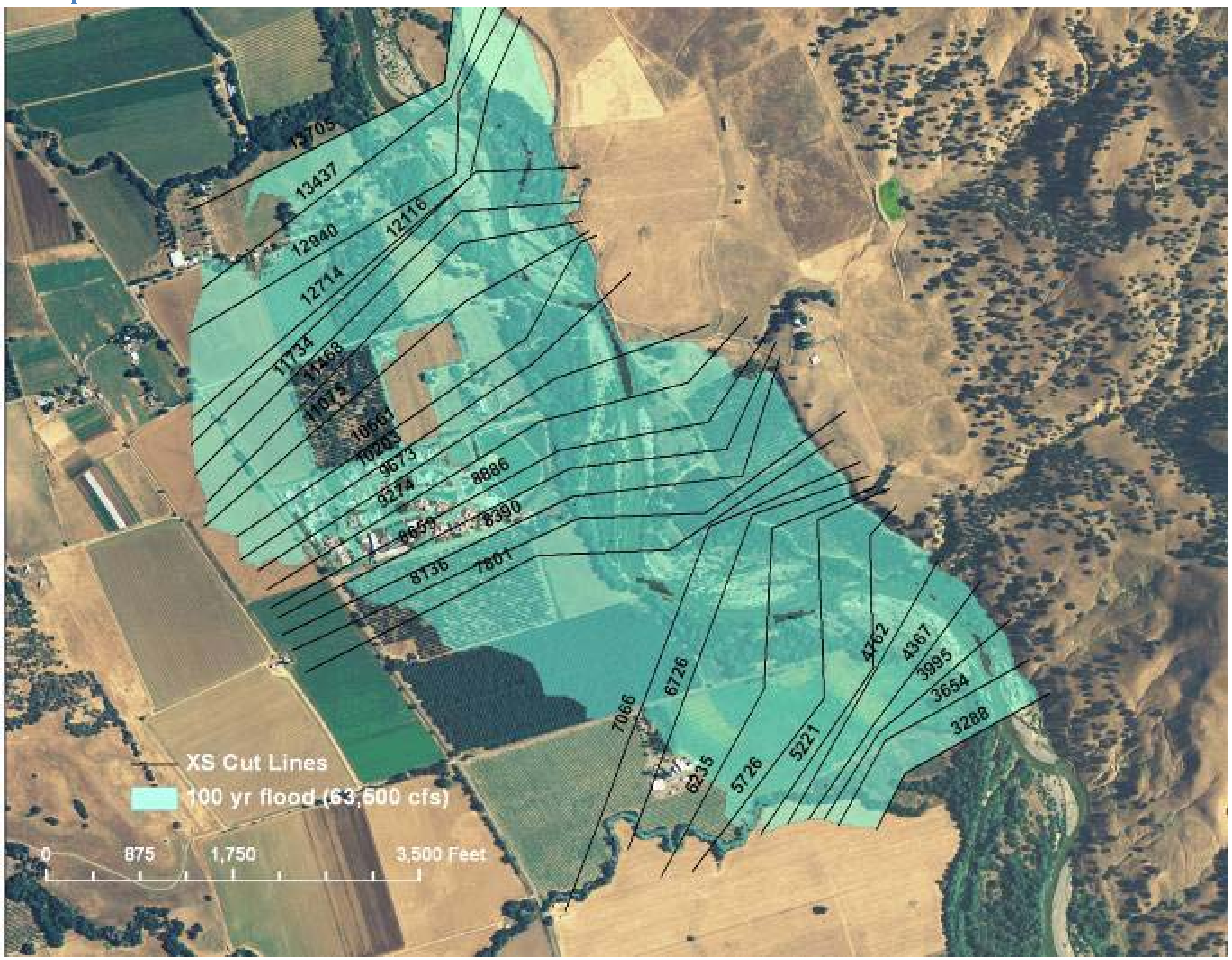


Figure 11 100 year flood inundation level in the vicinity of the Rancheria

Figure 12 100 year flood inundation level in the vicinity of the Rancheria

200 year

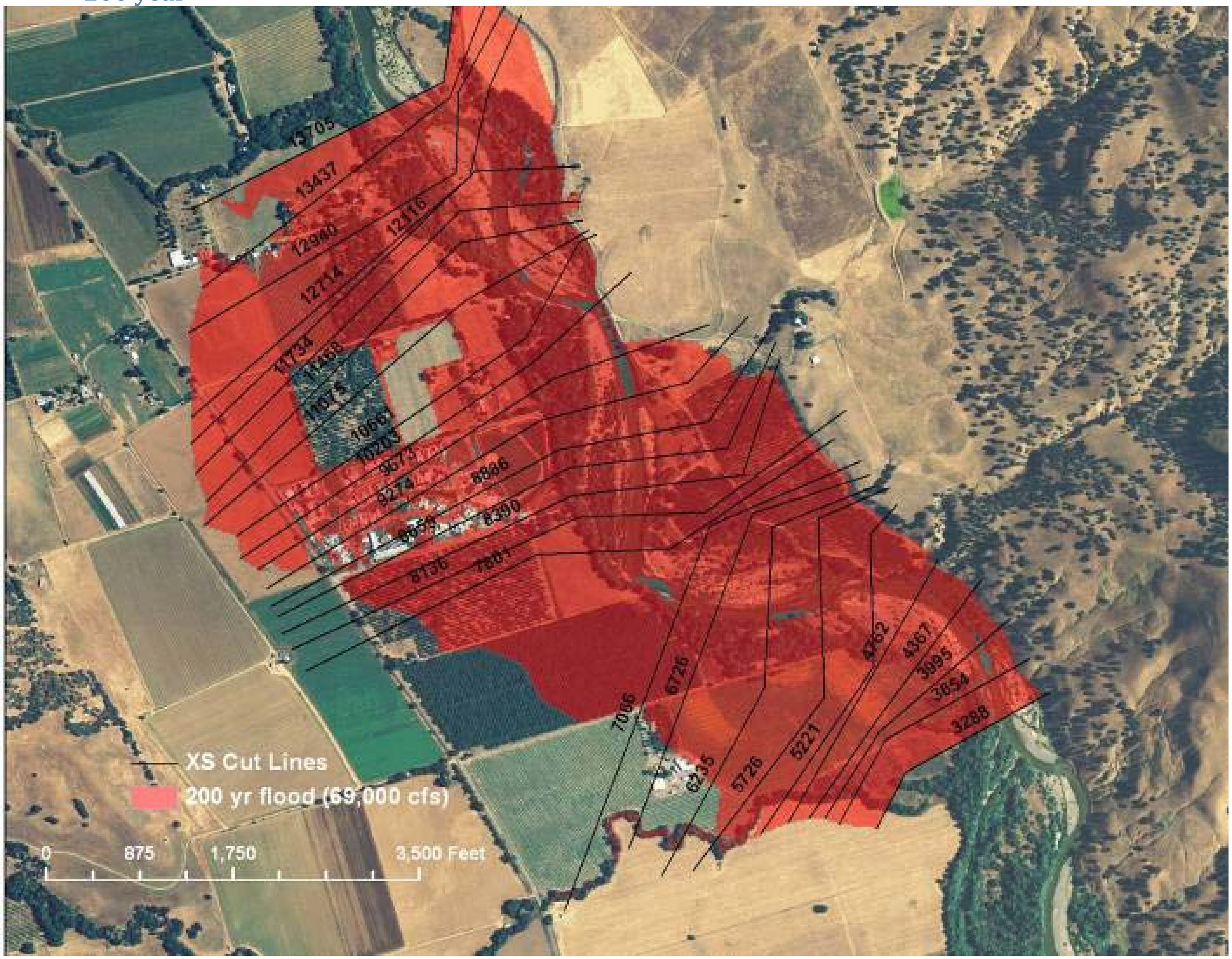


Figure 13 100 year flood inundation level in the vicinity of the Rancheria

Figure 14 100 year flood inundation level in the vicinity of the Rancheria

500 year

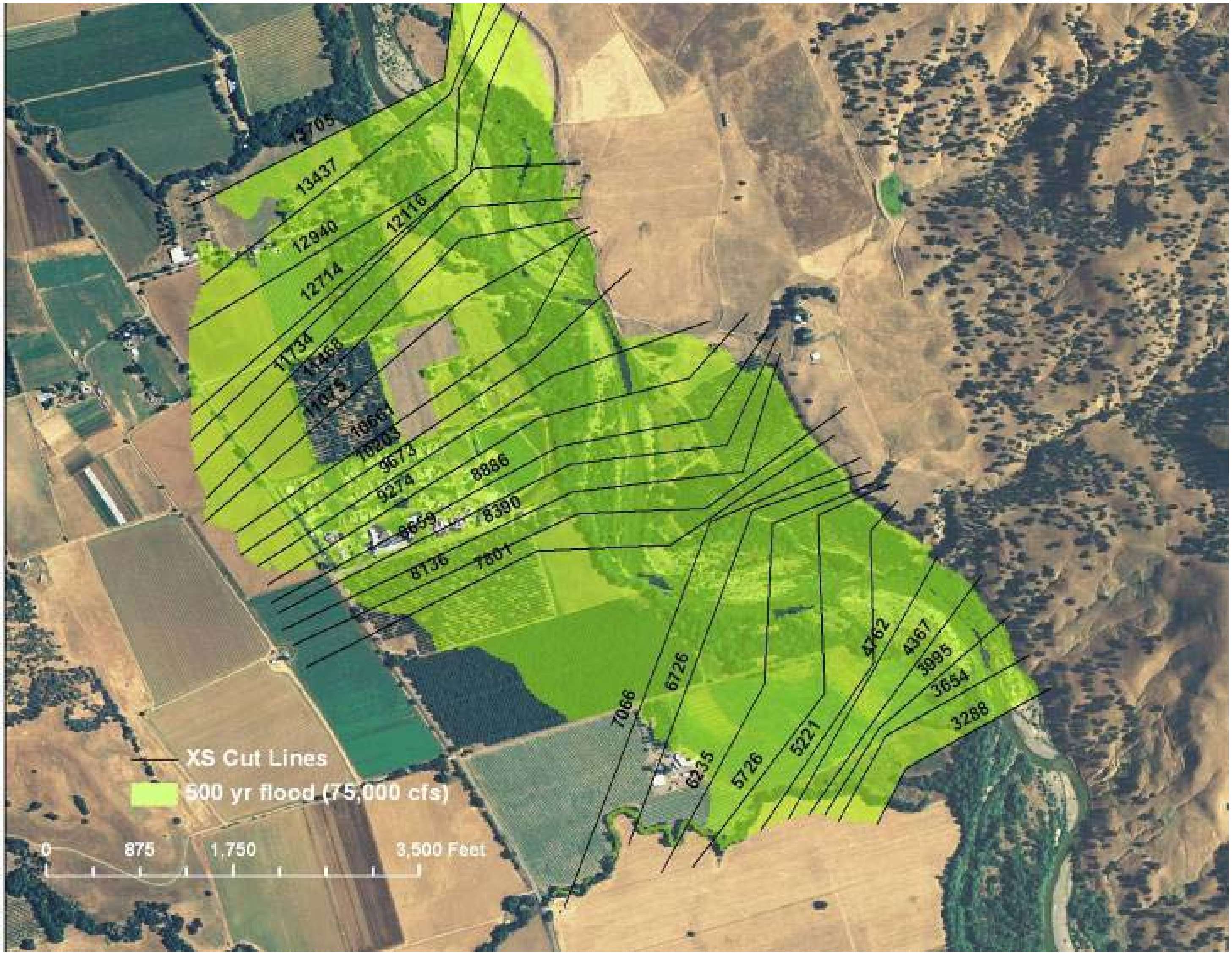
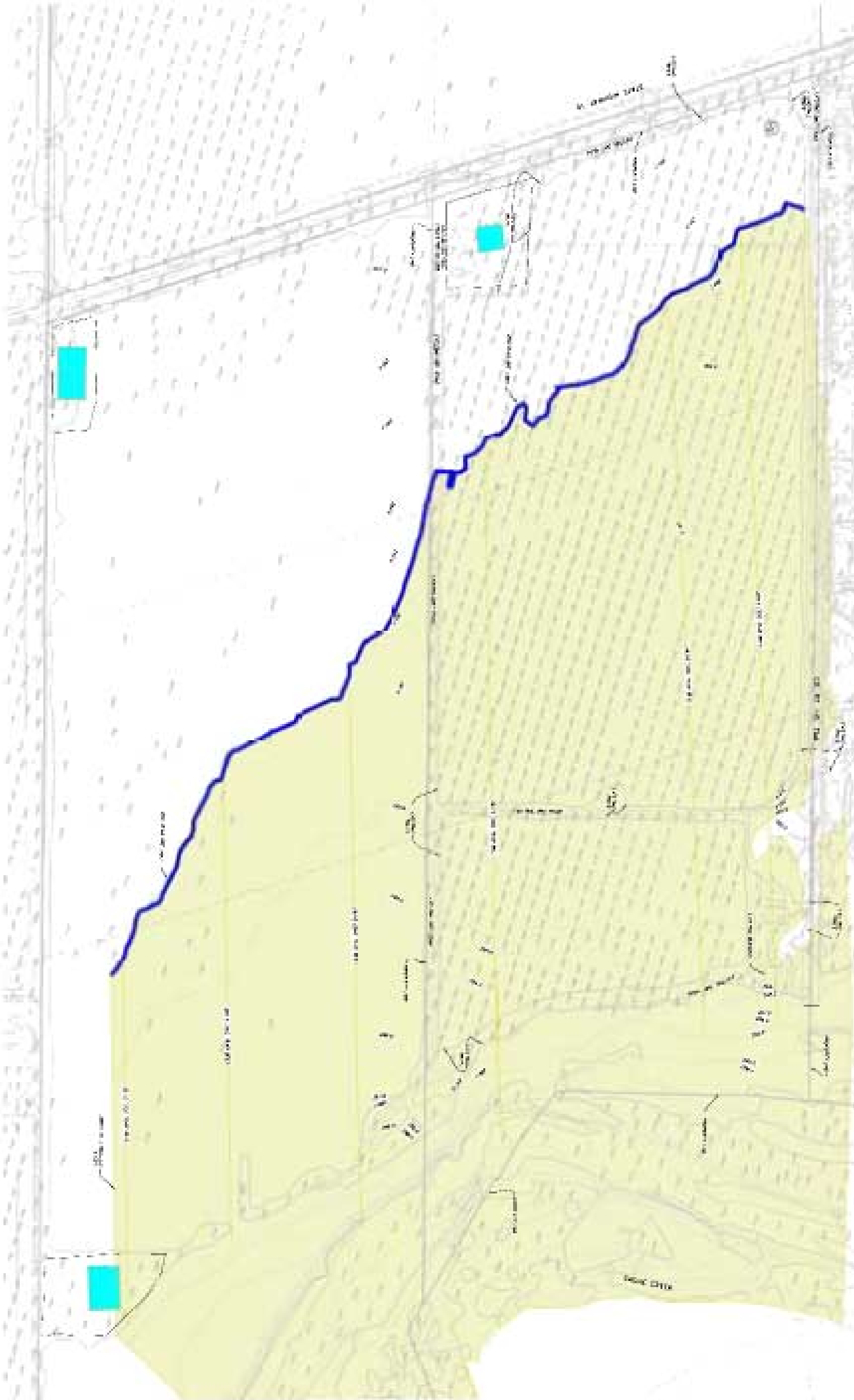


Figure 15 100 year flood inundation level close up of the Rancheria

Figure 16 100 year flood inundation level close up of the Rancher



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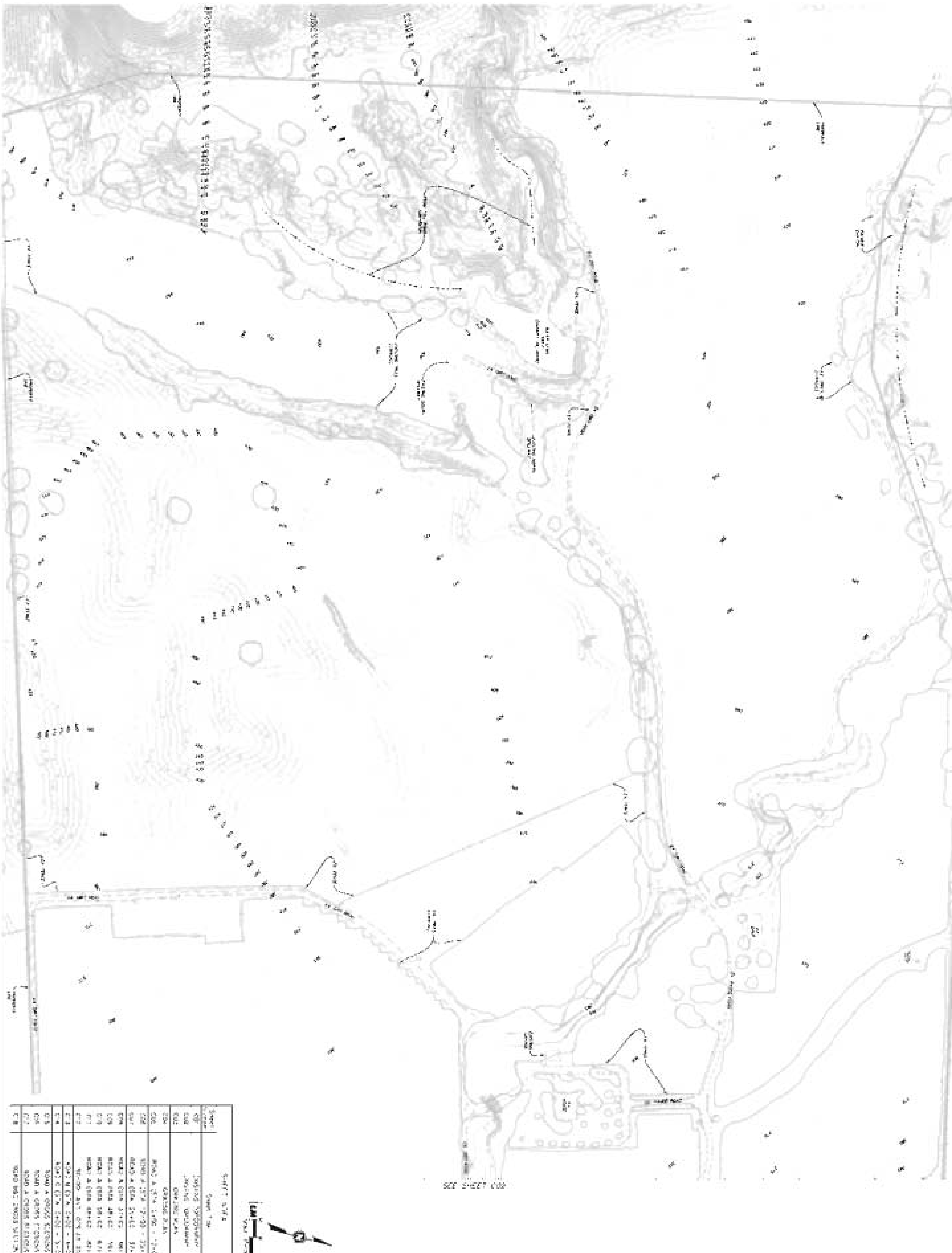

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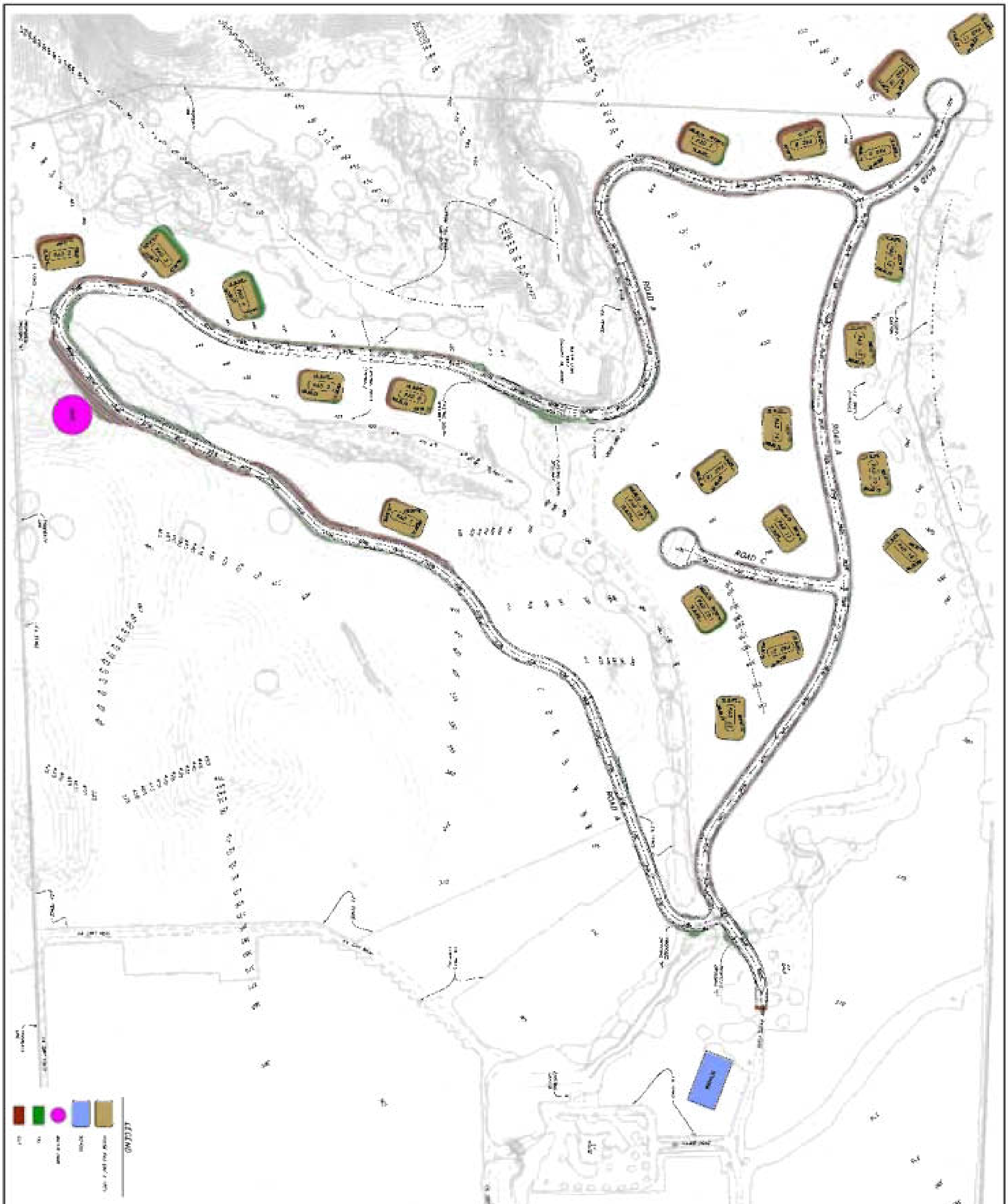

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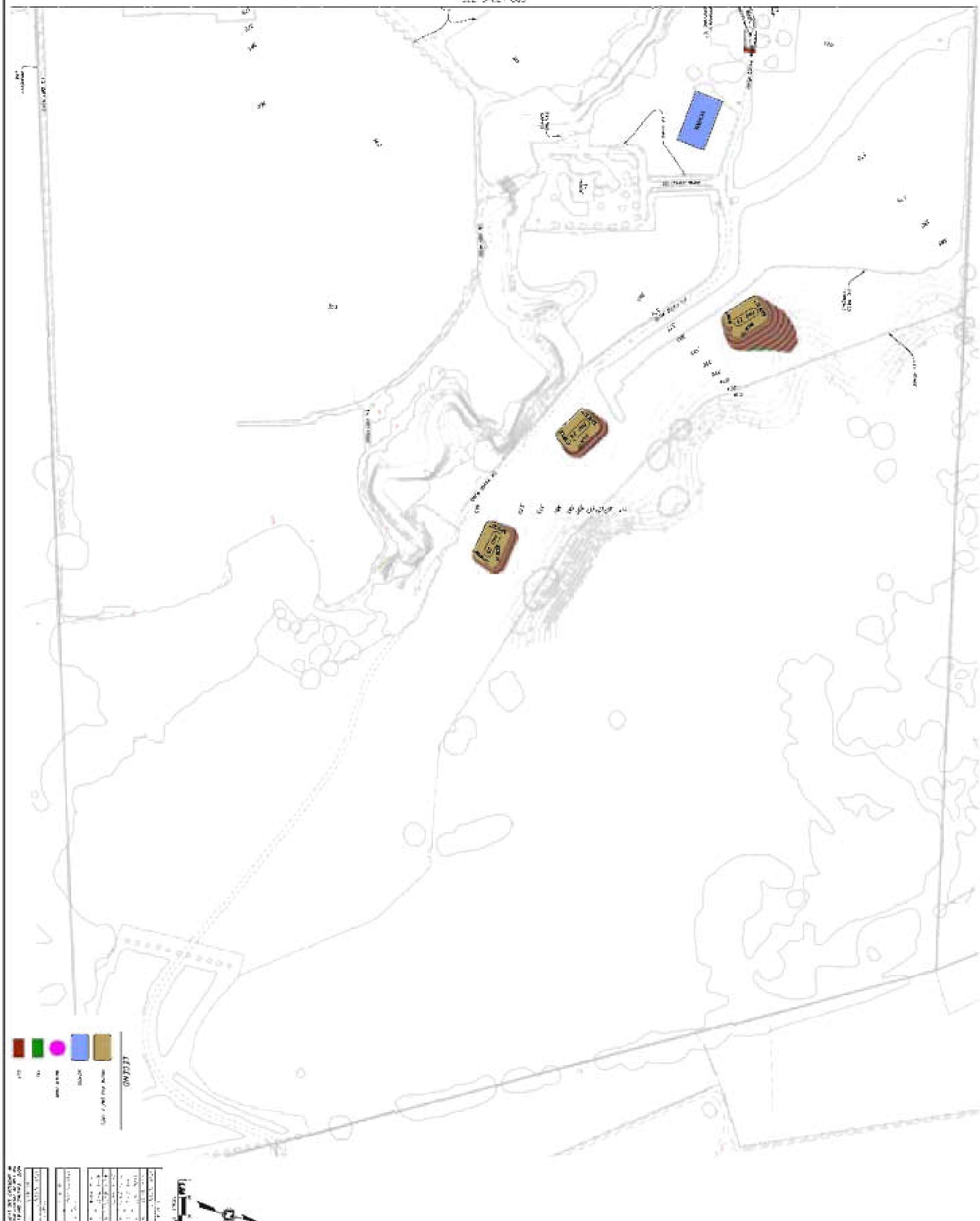

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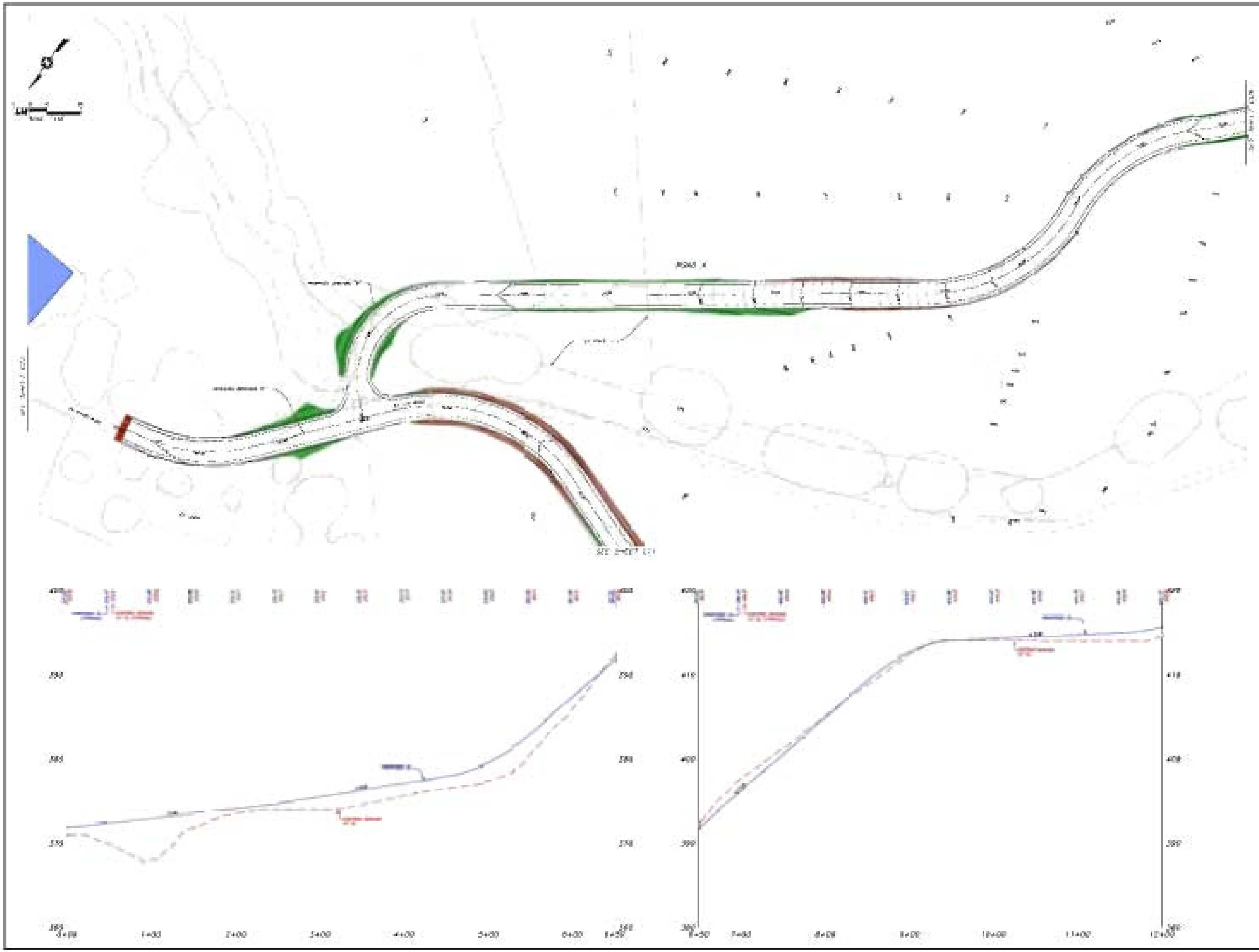

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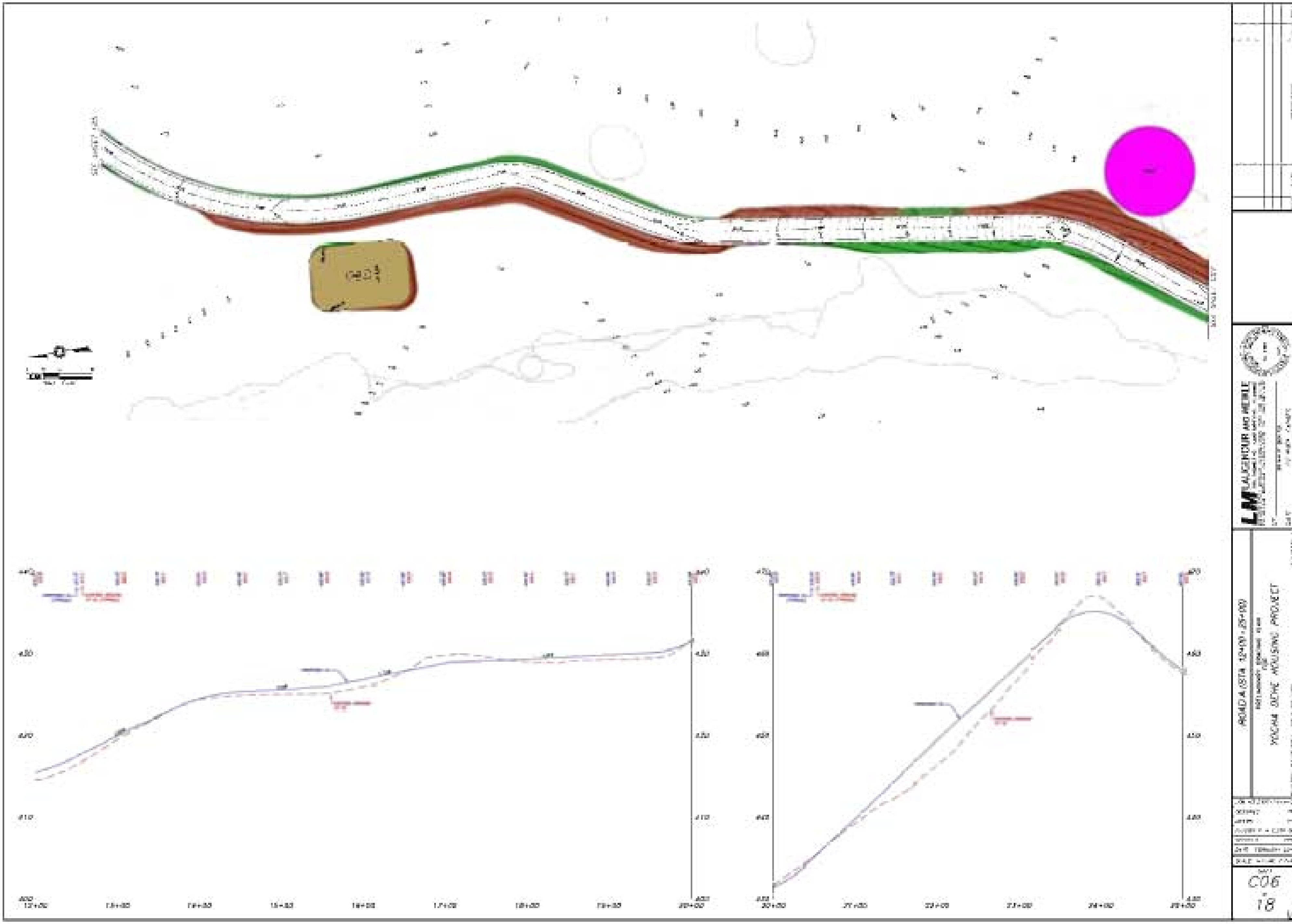
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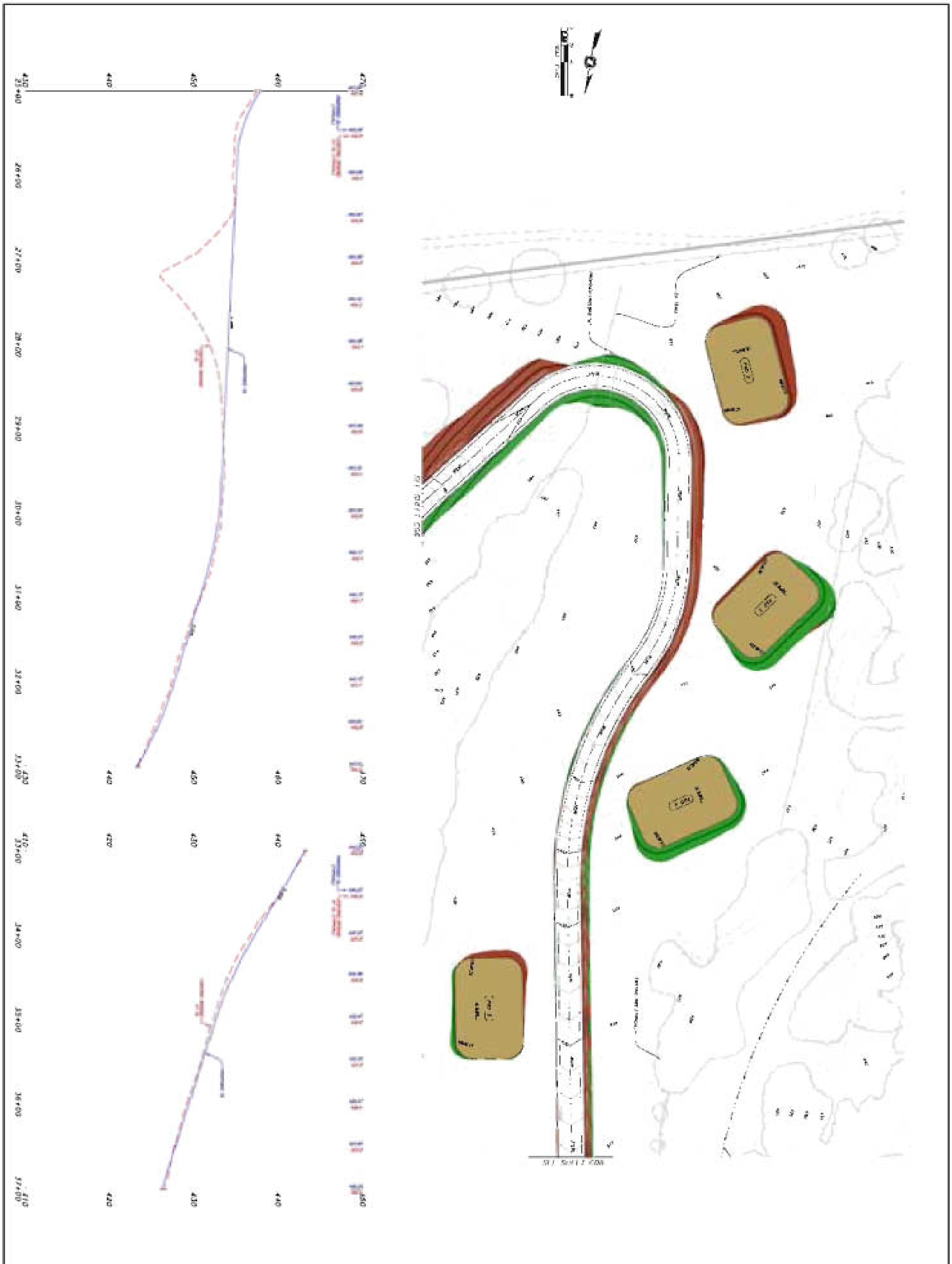

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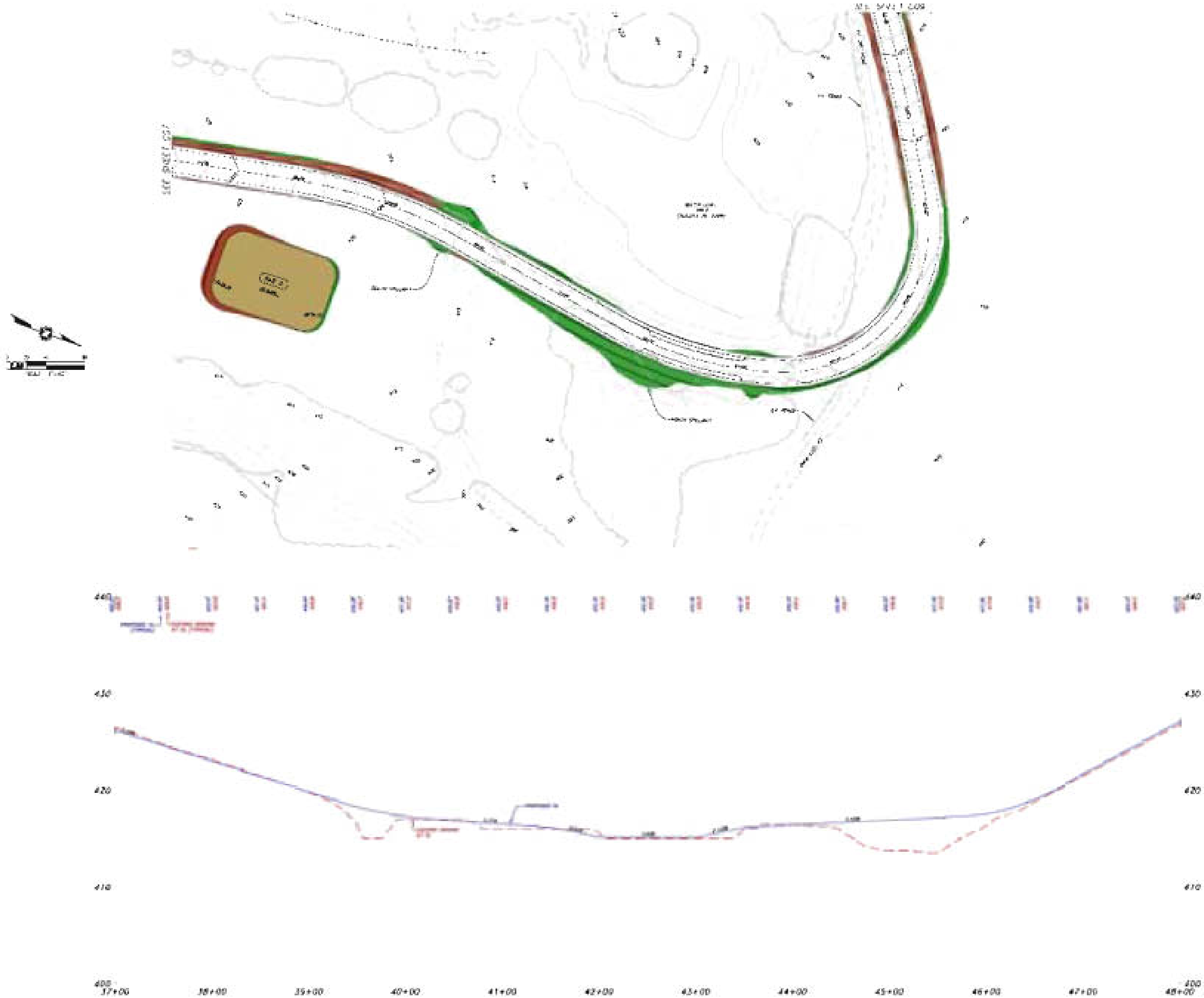

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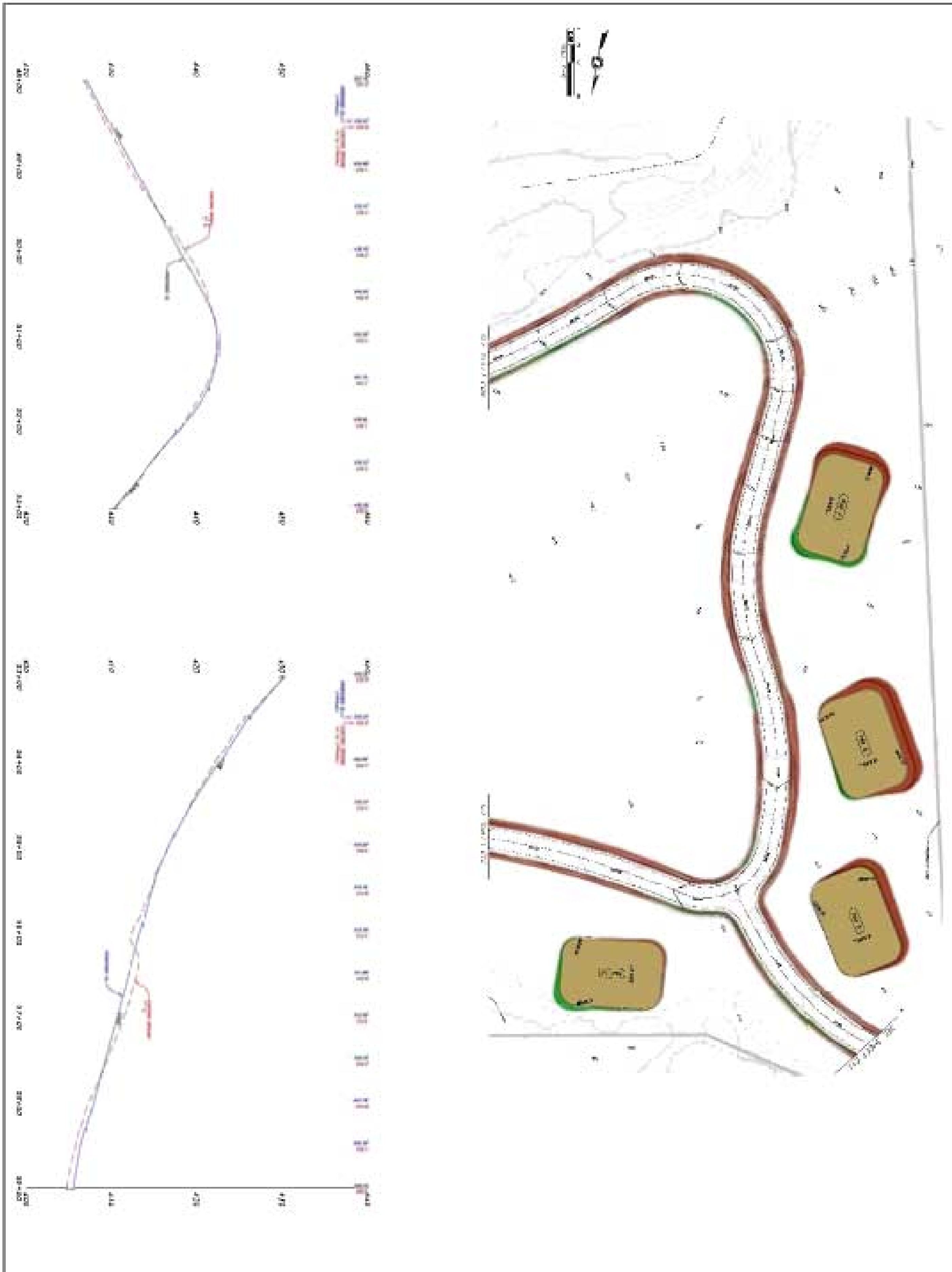

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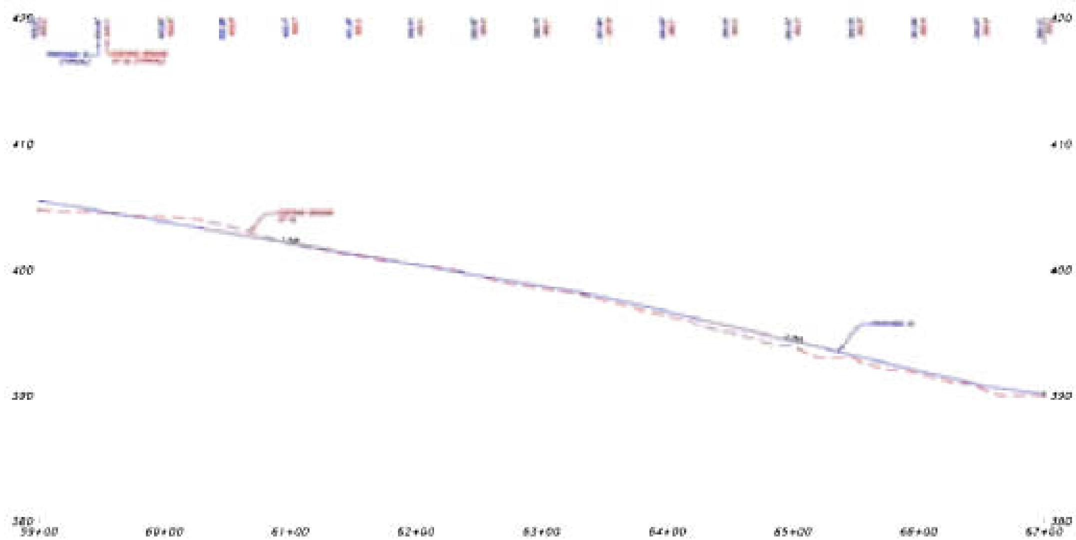

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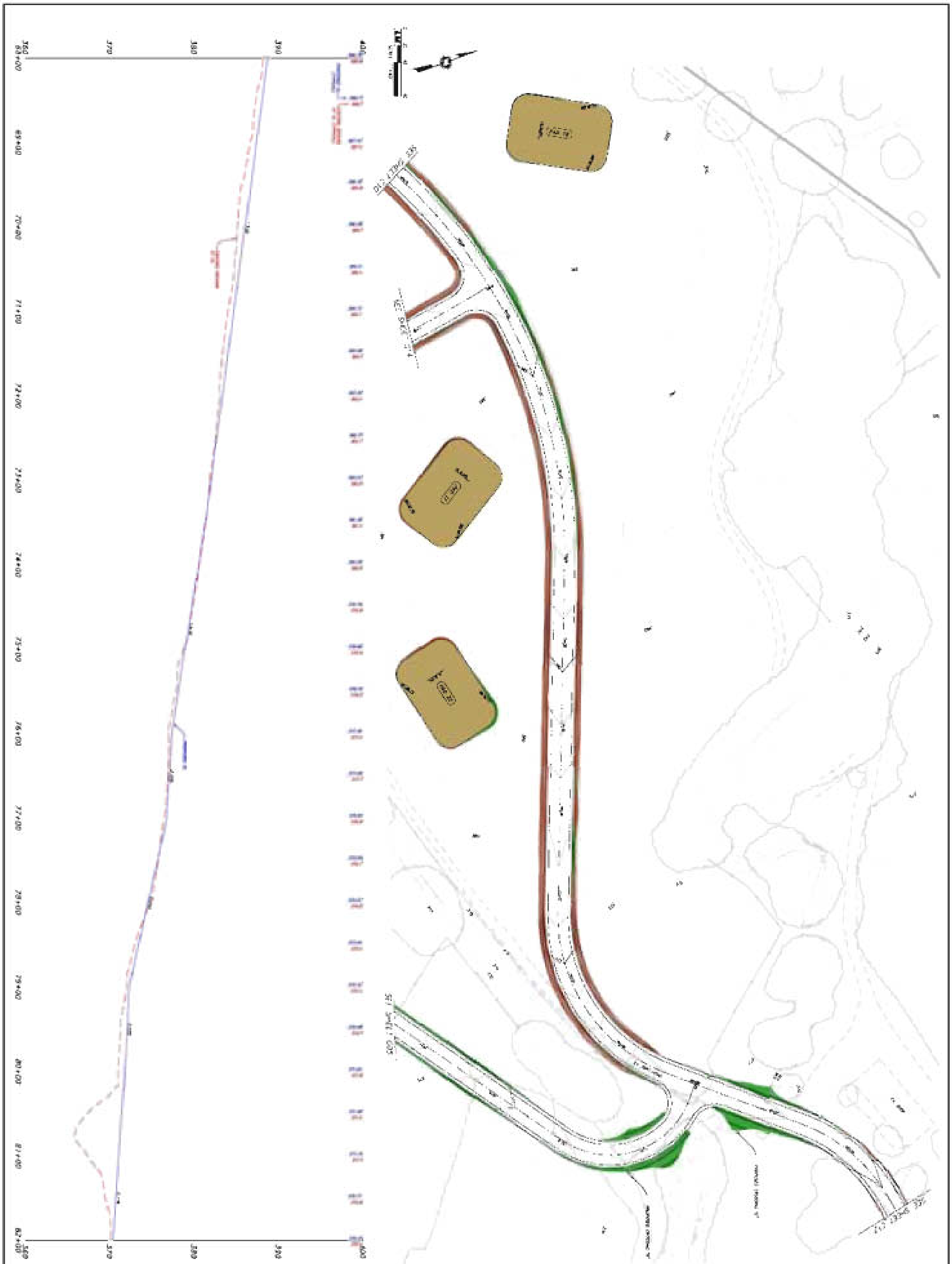

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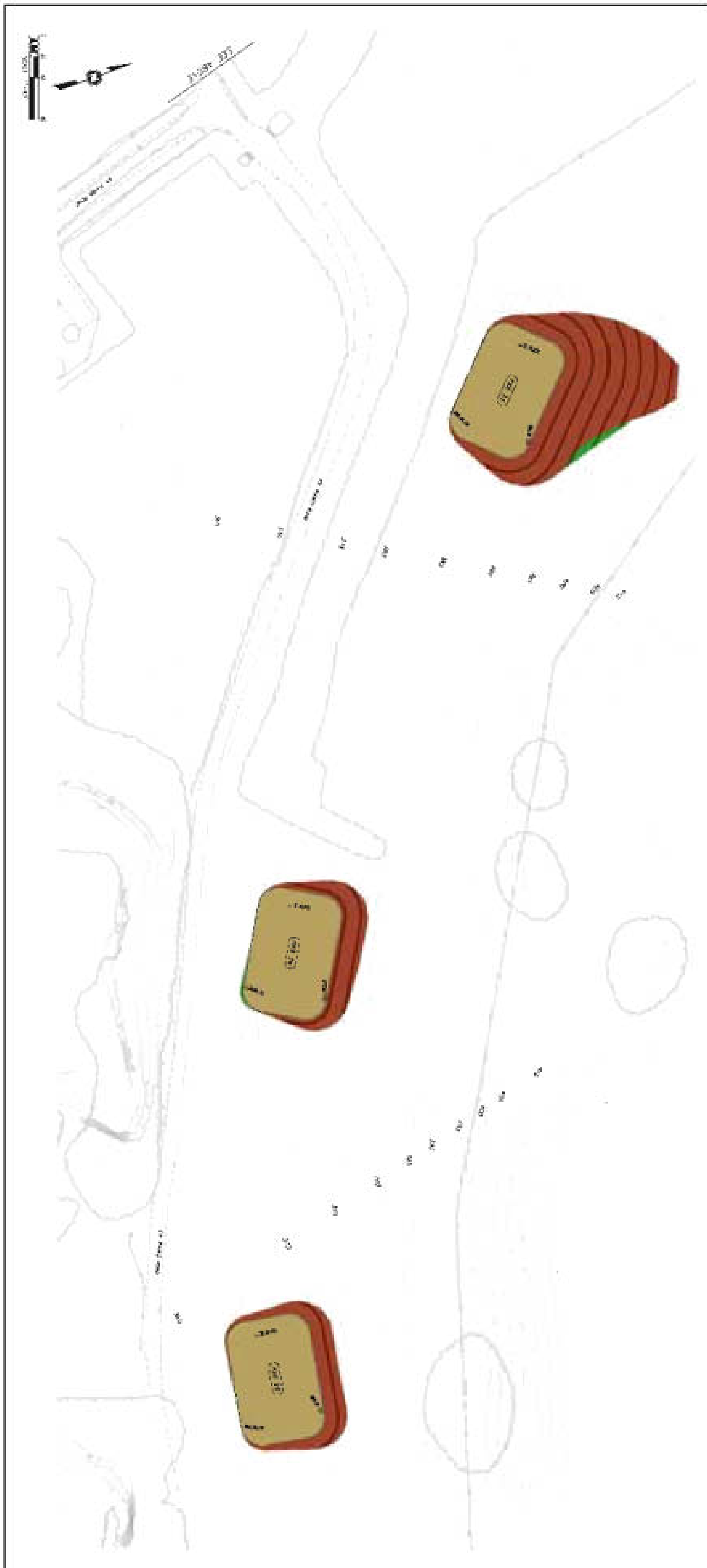
SHEET C11 OF 18

REV	DATE	DESCRIPTION	BY APPD



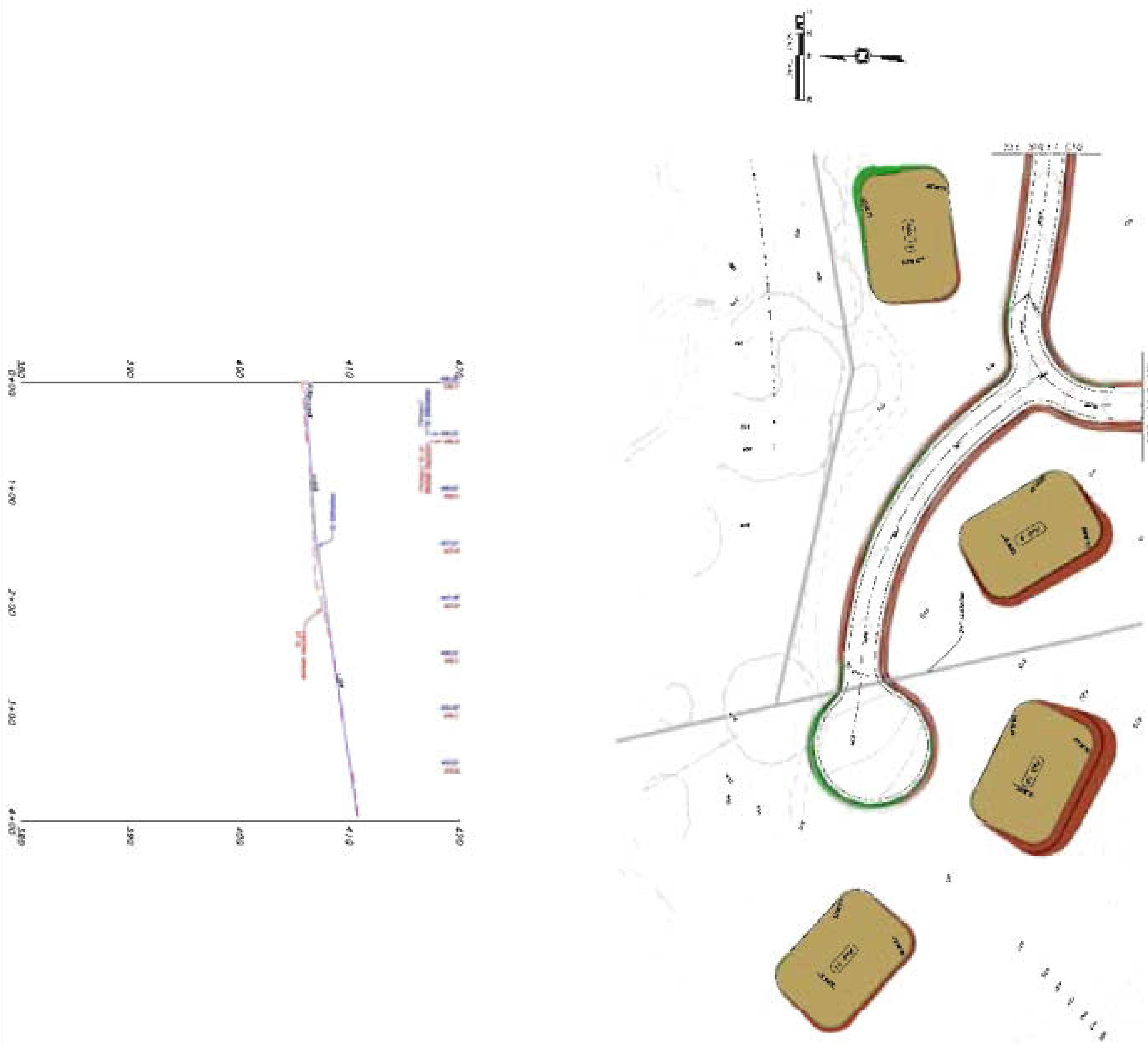
SCHOOL AND LOTS 23-25

PRELIMINARY GRADING PLAN
FOR
YOCHA DEHE HOUSING PROJECT

RUMSEY RANCHERIA, YOLO COUNTY CALIFORNIA

LM LAUGENOUR AND MEIKLE

SHEET C12 OF 18



ROAD B (STA. 0+00 - 4+00)

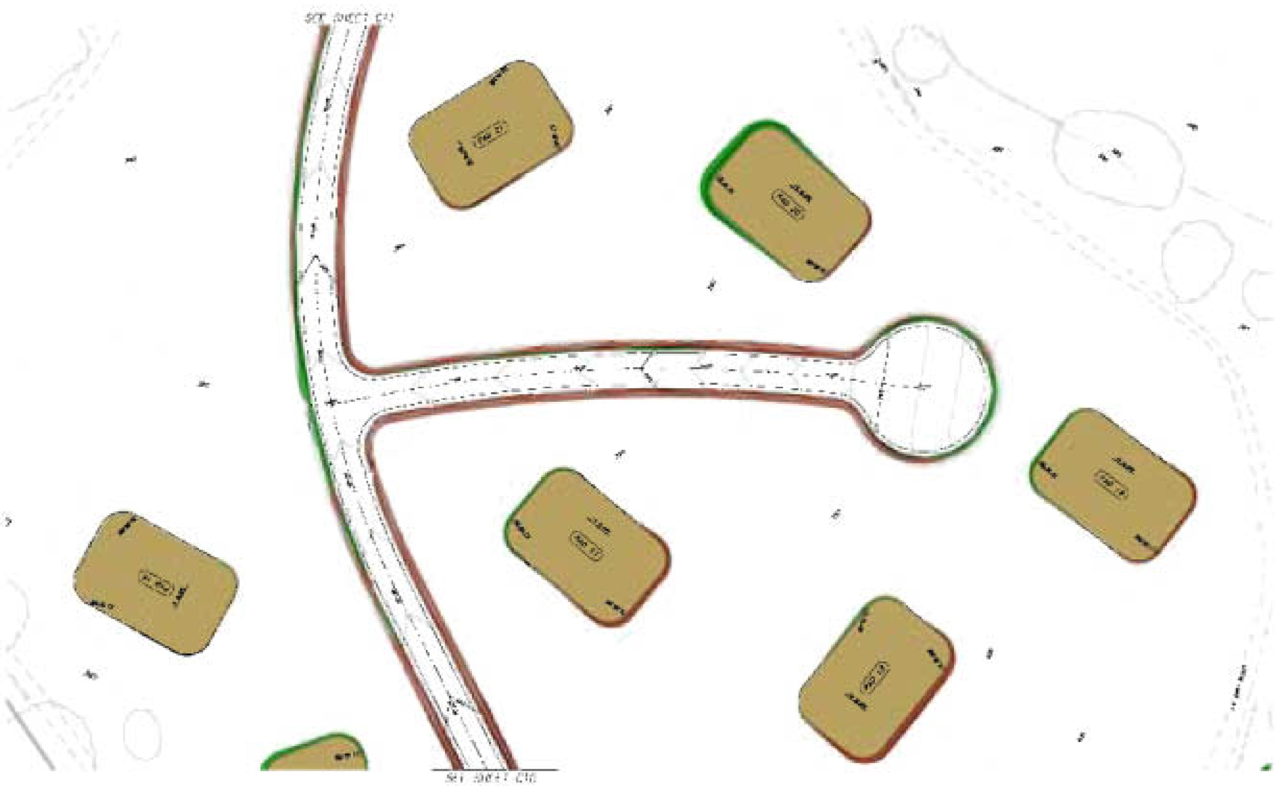
PRELIMINARY GRADING PLAN
FOR
YOCHA DEHE HOUSING PROJECT

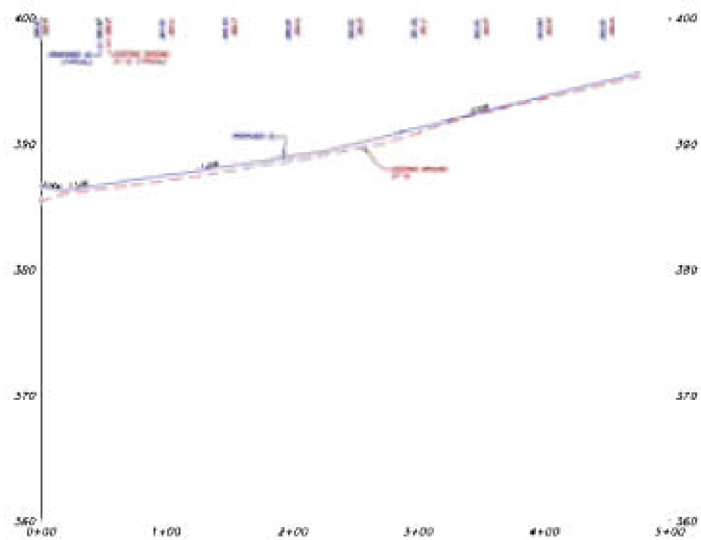
RUMSEY RANCHERIA, YOLO COUNTY CALIFORNIA

LM LAUGENOUR AND MEIKLE

C13
18

REV	DATE	DESCRIPTION	BY APPR





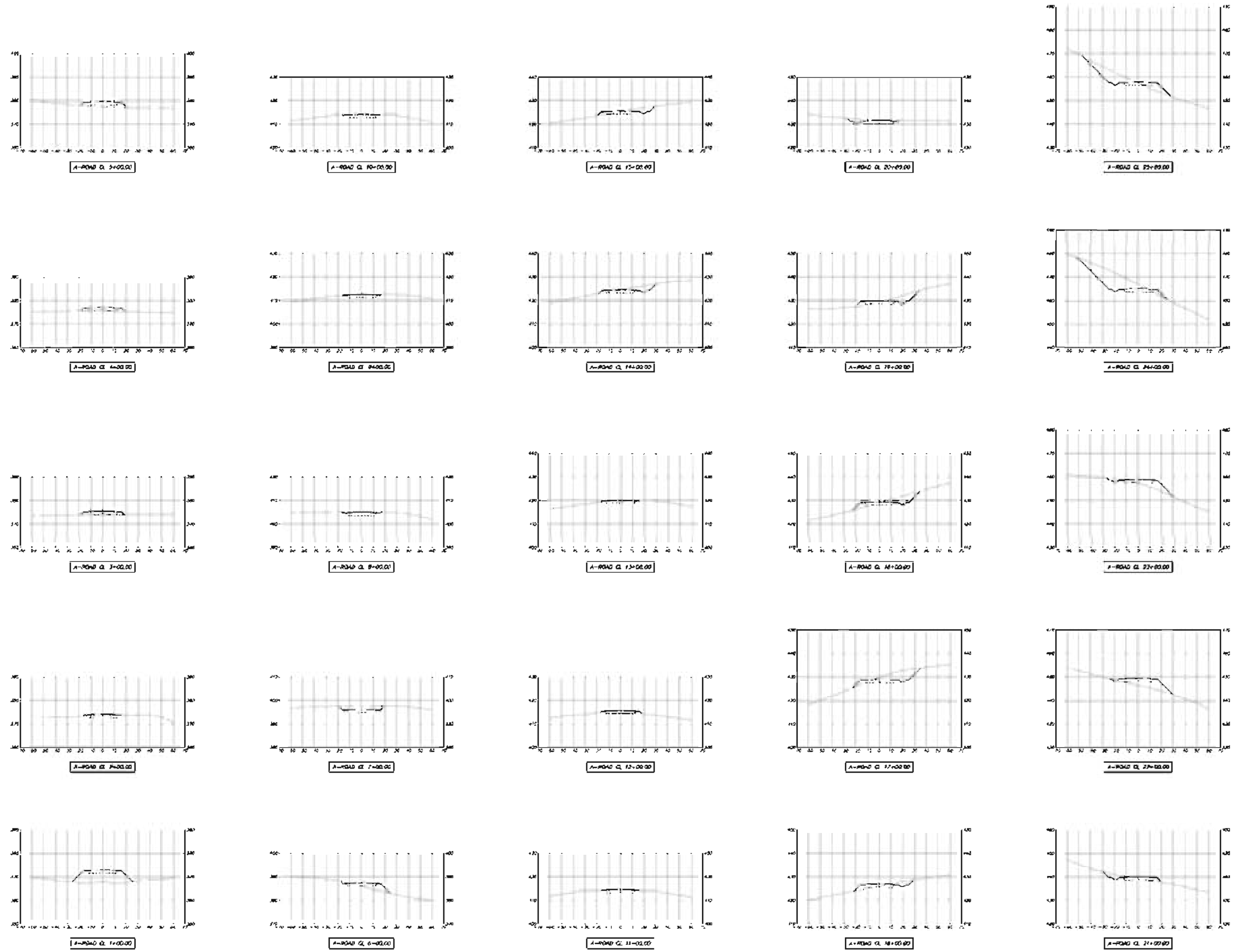
ROAD C (STA. 0+00 - 5+00)

PRELIMINARY GRADING PLAN FOR

YOCHA DEHE HOUSING PROJECT

LM LAUGENOUR AND MEIKLE

C14 of 18



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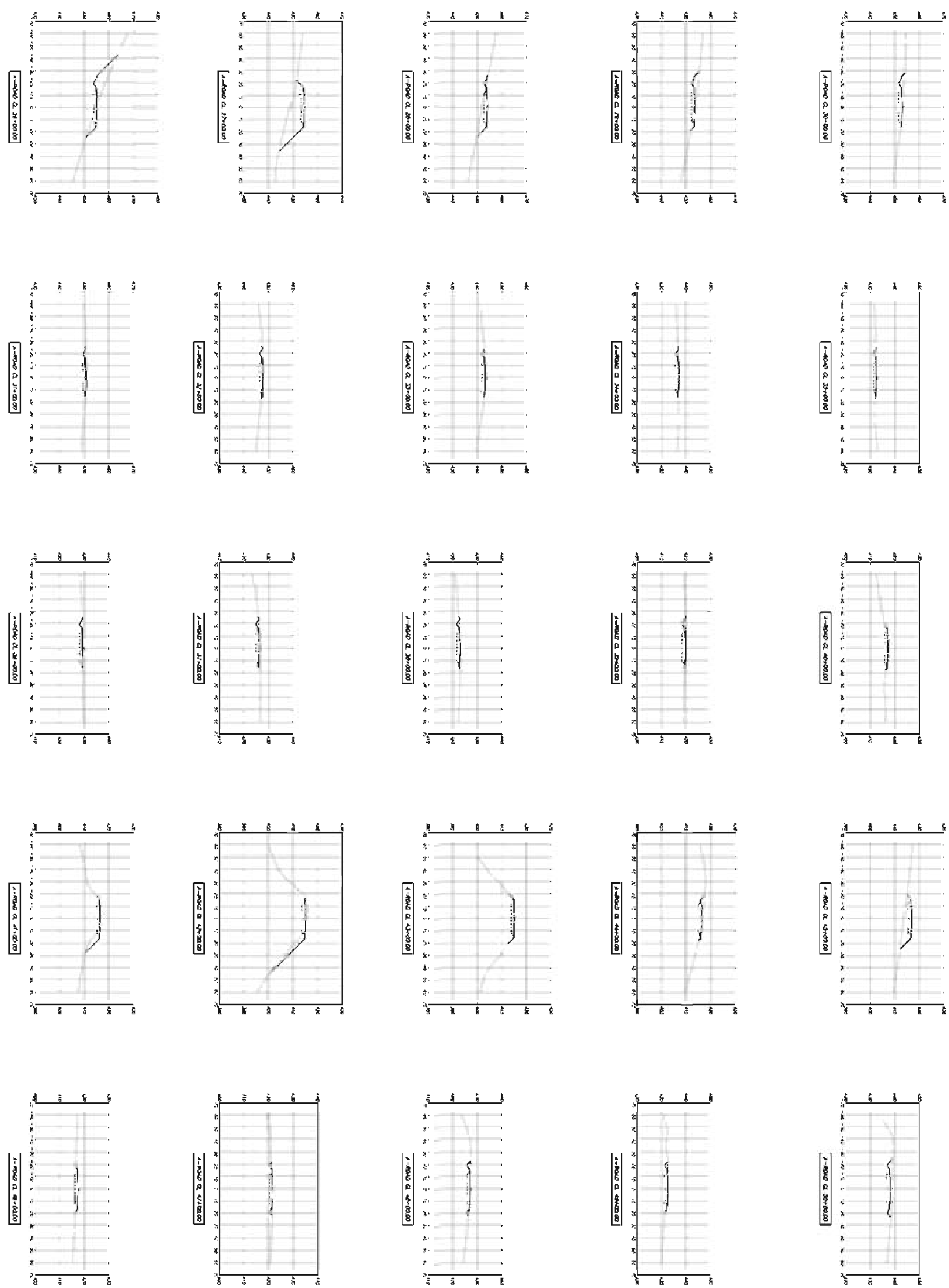
ROAD A CROSS SECTIONS

PRELIMINARY GRADING PLAN
FOR
YOCHA DEHE HOUSING PROJECT

SHEET C15 OF 18



ROAD A CROSS SECTIONS

PRELIMINARY GRADING PLAN
FOR
YOCHA DEHE HOUSING PROJECT

RUMSEY RANCHERIA, YOLO COUNTY | CALIFORNIA

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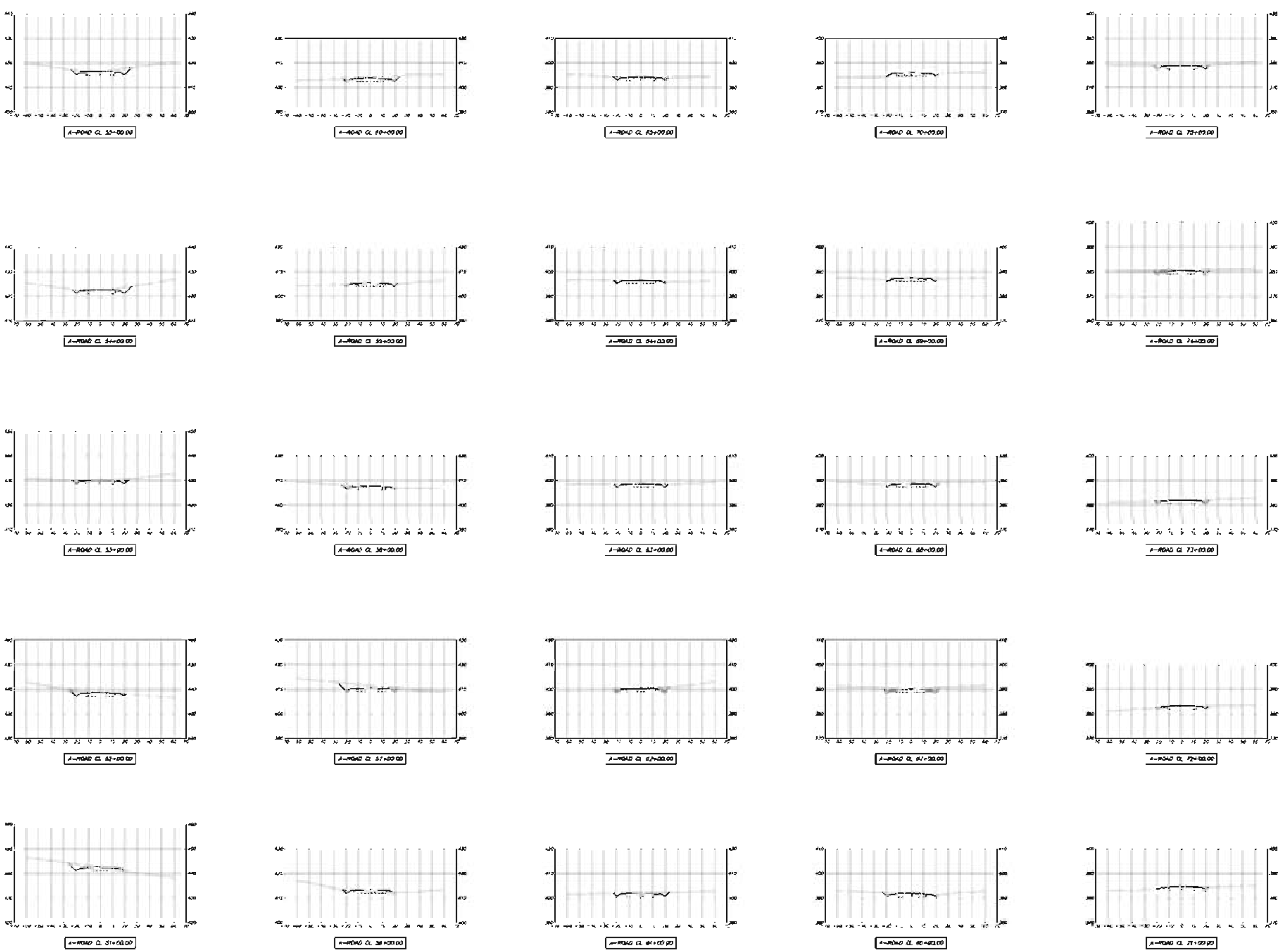
SHEET C16 OF 18

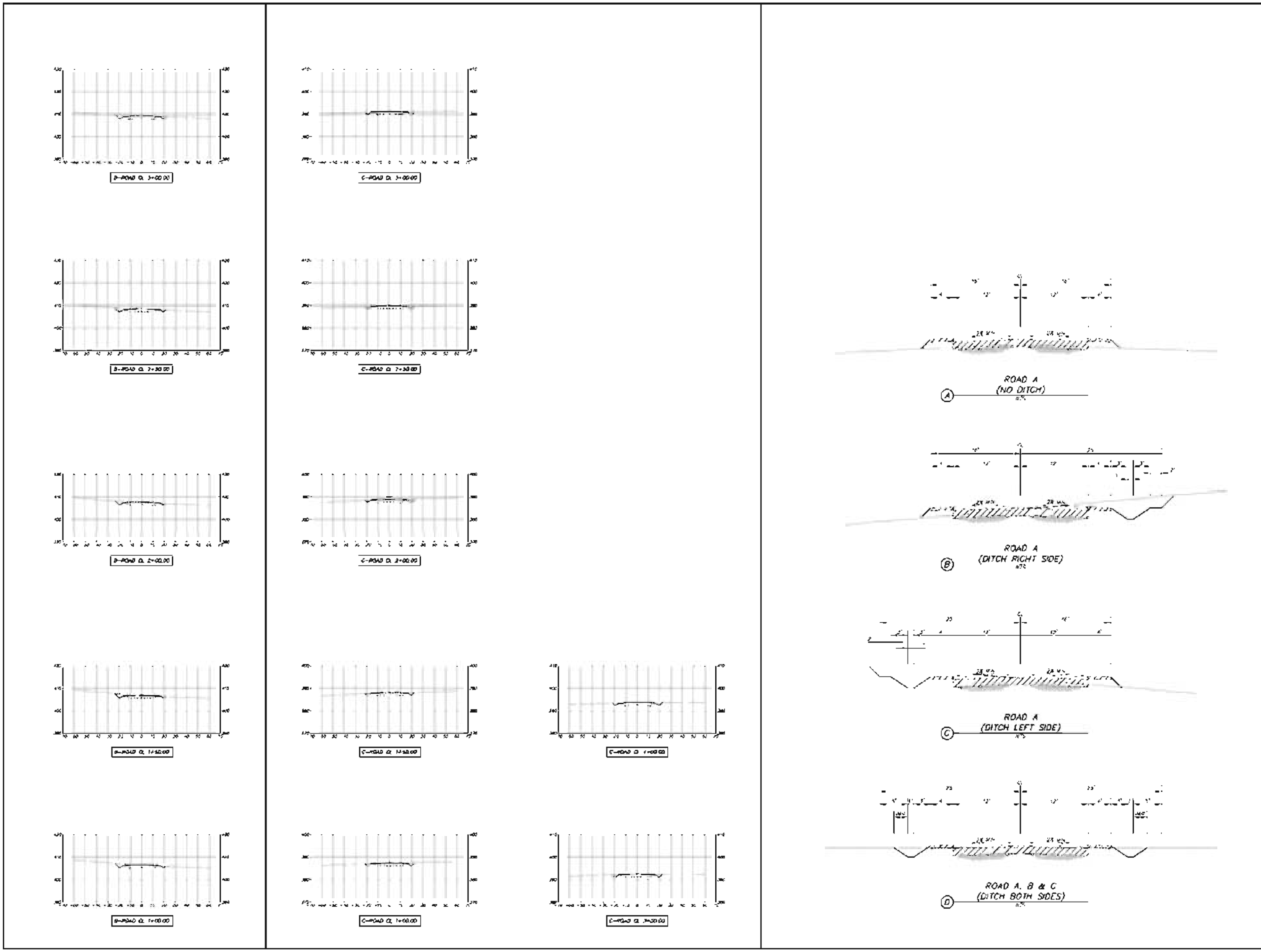


LM LAUGENOUR AND MEIKLE

ROAD A CROSS SECTIONS

PRELIMINARY GRADING PLAN
FOR
YOCHA DEHE HOUSING PROJECT

SHEET C17 of 18



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ROAD B&C CROSS SECTIONS

PRELIMINARY GRADING PLAN FOR

YOCHA DEHE HOUSING PROJECT

SHEET C18 OF 18