RIFLE RANGE CREEK:
Hydrology Report
Restoration Plan
Preliminary Creek Protection Plan

Oak Knoll Mixed Use Community Development Project
Oak Knoll Venture Acquisition LLC

Prepared by

ESA

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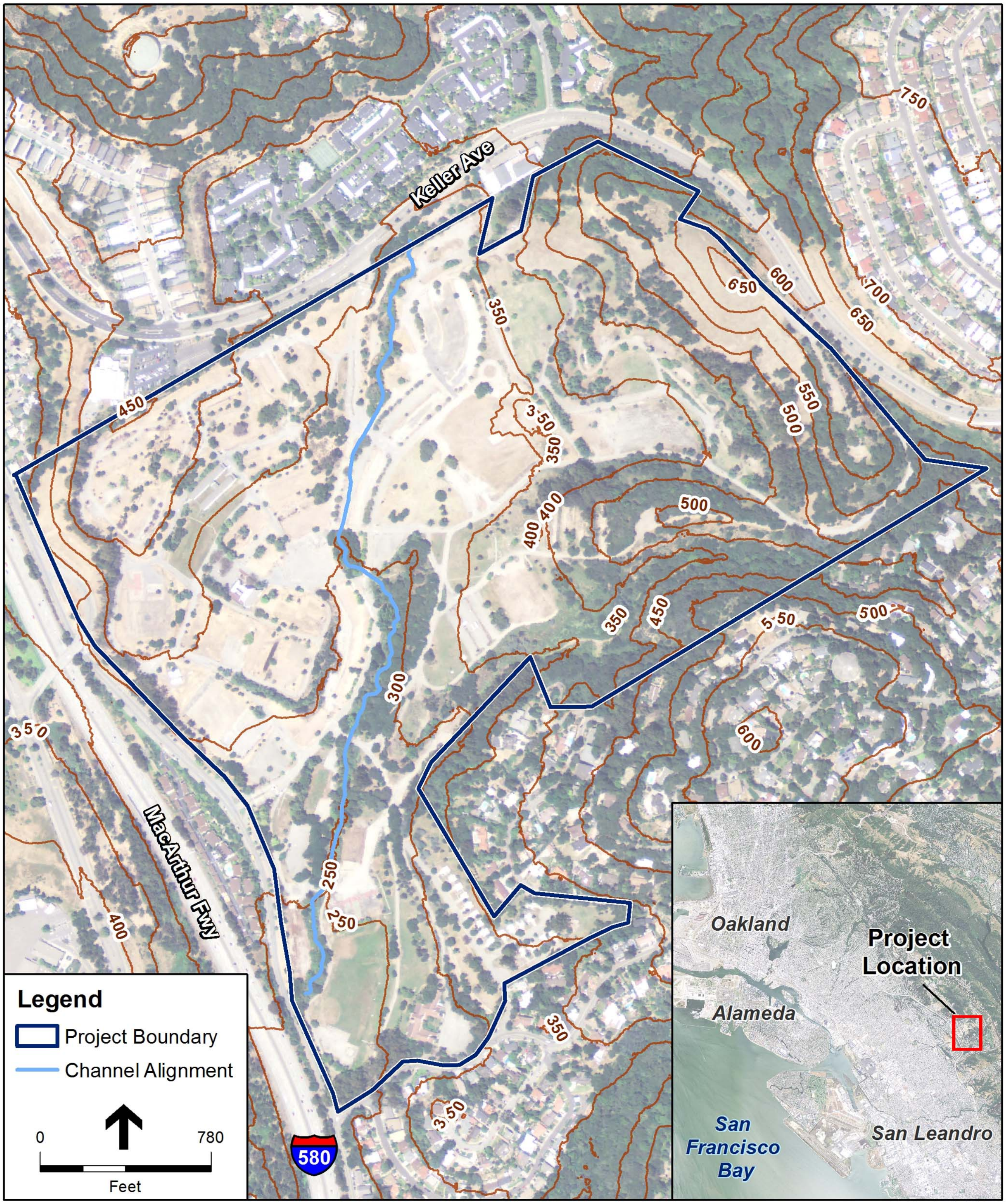
1. INTRODUCTION

The Oak Knoll Mixed Use Community Development Project ("Project") site consists of the former Naval Medical Center Oakland (NMCO) property at Oak Knoll and an adjacent parcel to the southeast. It is located approximately seven miles southeast of downtown Oakland and is bounded by Mountain Boulevard and Interstate 580 to the west, Keller Avenue to the north and east, and Sequoyah Road to the south. A location map is provided in Figure 1.

The NMCO facility was decommissioned in 1996 and has been unoccupied since that time, with the exception of continued operations at two privately owned inholdings: the Sea West Federal Coast Guard Credit Union and the Seneca Center for Children and Families. Rifle Range Creek, a tributary of Arroyo Viejo, flows from north to south across the project site and is one of its most prominent natural features.

The proposed development includes multiple land uses including single-family and multi-family residential as well as mixed use parcels. Appendix 1 is a site plan that shows existing and proposed topography for the site as well as proposed parcel boundaries and land use designations. The project also includes restoration and enhancement of Rifle Range Creek. This report summarizes Rifle Range Creek hydrology and hydraulic analyses, describes the restoration plan for the creek (including 60% complete design plans), and presents a preliminary creek protection plan. A tree removal impact and mitigation plan is provided in Appendix 2.



SOURCE: Aerial (NAIP 2014), Topo (USGS 2006)

Oak Knoll . D140419

Figure 1

Location Map

2. SETTING

The project site covers approximately 187 acres on the western flank of the Oakland Hills, east of Highway 580 and south of Keller Avenue. The Rifle Range Branch of Arroyo Viejo, also known as Rifle Range Creek, flows from north to south across the project site.

Rifle Range Creek is the largest and northernmost of three tributaries to Arroyo Viejo that originate in the Oakland hills. At the point where it leaves the Oak Knoll site, the creek drains a watershed area of approximately 920 acres (including the project area). The headwaters and upper watershed are located in the Leona Canyon Open Space Preserve; the remainder of the watershed contains a mix of residential development and open space. An in-line detention basin, owned and maintained by the Alameda County Flood Control and Water Conservation District (ACFCWCD), is located at the downstream end of the Leona Canyon Open Space Preserve. The basin is approximately 4.5 acres in area and 20-30 feet deep. The basin and outlet structure regulate flood flows to the creek and also trap sediment from the upper watershed area.

Rifle Range Creek flows in an enclosed culvert for approximately 1000 feet from the detention basin to an outfall just south of Keller Avenue near the project site boundary. From there, the creek flows southward across the project site through a series of open channel and culverted sections, including several road crossings. Surface drainage from the majority of the project site is delivered to the creek channel by an underground storm drain system with outfalls occurring at various intervals along the channel. However the drainage system has not been maintained since the closure of the NMCO and many elements are damaged, blocked or failing.

Two tributary channels enter the creek from the east. The northern tributary ("Hospital Creek"), which appears to drain the area of the former hospital building, is culverted on the project site except for a channel fragment near the confluence with Rifle Range Creek. The open channel fragment is approximately 300 feet long, starting from a storm drain outfall at the southern edge of the main hospital parking lot. The historic watershed of the southern tributary ("Power House Creek") encompassed the southeastern portion of the project site and surrounding hillsides.

As with other East Bay creeks, Rifle Range Creek has been influenced by a pattern of grazing, urbanization and hydrologic modifications in the watershed. Earliest records of the project site show it was part of the 1820 Spanish land grant Rancho San Antonio, and was used for cattle ranching and timber extraction. USGS topographic maps and aerial photos from 1897 to 1939 (**Error! Reference source not found.**) show no urban development in the watershed prior to the construction of the Oakland Naval Hospital. The 1939 aerial photo shows the site undeveloped but suggests it was heavily grazed. A 1947 aerial photo (**Error! Reference source not found.**) shows two subdivisions east and west of the hospital.

Figure 2
1939 Aerial photo

Oak Knoll. D140419
Figure 3
1947 Aerial photo

The Oakland Naval Hospital was constructed on the project site in 1942. As part of construction of the hospital, over 1,000 feet of Rifle Range Creek channel was culverted and covered. Hospital creek and much of Power House creek were also culverted and covered. Between 1946 and 1968, subdivisions expanded north east of the project site and between 1980 and 1987 the remaining watershed northwest of the site was developed to its current limit at the Leona Canyon Open Space Preserve. During the same period, a detention basin was constructed at the foot of Leona Canyon and the channel between the Leona Canyon and the project site was culverted.

The two tributaries, Hospital Creek and Powerhouse Creek, were culverted and filled to their current condition by the time of the 1947 aerial photo. Sections of Powerhouse Creek upstream of its confluence with Rifle Ranch Creek were culverted, with the remaining channel upstream left open. Field observations suggest that the upstream watershed was subsequently routed to the storm drainage system with the development of the hillsides to the south and east. As a result, it appears the historic Powerhouse Creek channel upstream of the culverted section has been dewatered except for local slope runoff.

3. STORMWATER

A Preliminary Storm Drainage Master Plan, prepared for the project by BKF Engineers, is provided in Appendix 3. This plan describes the on-site drainage and stormwater management facilities that will treat, retain and convey runoff from the project. The Preliminary Plan provides general concepts and guidelines that will be followed in developing more detailed design as the project moves forward. It describes long term, post-construction strategies to treat stormwater runoff consistent with Alameda Countywide Clean Water Program guidance.

As described in the Preliminary Plan, the storm drainage system will include street curb and gutter systems, ditches, underground storm drain lines, stormwater treatment facilities and multiple outfalls to Rifle Range Creek. Low impact development stormwater Best Management Practices (BMPs) such as bioretention areas and grass swales will be used to treat storm drainage flow before discharging to the creek. Where feasible, runoff from self-treating areas such as open spaces and landscape areas will be intercepted to bypass treatment basins. Appendix 4 provides a preliminary "C.3 Plan" summarizing the storm drainage pattern and treatment areas for the project site.

4. HYDROLOGY

HEC HMS rainfall / runoff modeling software, developed by the U.S. Army Corps of Engineers, was used to estimate Rifle Range Creek flows watershed using Alameda County Flood Control and Water Conservation District (ACFCD) guidelines (ACFCD, 2003). HEC HMS simulates watershed runoff based on rainfall depths, watershed characteristics, and other parameters entered by the user. The model generates an outflow hydrograph (time series of flow rates) for each model computation point. Computation points are typically the downstream end of each watershed or subwatershed identified by the user. HEC HMS modeling methods and results are described in the following sections.

The HEC HMS model was configured to simulate runoff from extreme events and does not reflect the detailed configuration of the proposed on-site stormwater management system. Analysis of the on-site storm drainage system was performed using different methods as described in the Appendix 3 Preliminary Storm Drainage Master Plan.

4.1 DESIGN RAINSTORMS

Rainfall time series for 5-, 10-, 15-, 25-, and 100-year recurrence intervals events were developed using ACFCD methods. A 6-hour storm duration was selected for all scenarios based on watershed size (watersheds with areas between 1- and 20- square miles). Total storm depths, summarized in Table 1, were calculated based on County isohyetals and distributed temporally using the ACFCD design hyetograph.

Table 1. Total Precipitation Depths for Design Storm Events

Return Period (yrs)	Storm Depth (in)
5	1.8
10	2.2
15	2.4
25	2.6
100	3.3

4.2 DETENTION BASIN

The Leona Canyon detention facility is located upstream of the project area and provides peak flood attenuation for large events. It was created by placing fill across the floodplain to impound water. An outlet structure, built into the fill, regulate outflows to the downstream storm drain system through three grated inlet structures at different elevations. The basin invert is approximately two feet below the lowest outlet invert, resulting in ponded water even during dry periods.

A topographic map of the detention basin, provided by ACFCD, was used to estimate the storage volume of the basin corresponding to a given water surface elevation. A discharge rating curve (the rate of outflow from the basin as function of water depth) was developed by assuming fully-pressurized orifice flow (inlet controlled) through the outfall pipe. The stage-storage and outfall rating curve were used to develop the basin storage-discharge relationship shown in Table 4.8. This relationship is reflected in the HEC HMS model setup for the Leona Canyon watershed subbasin.

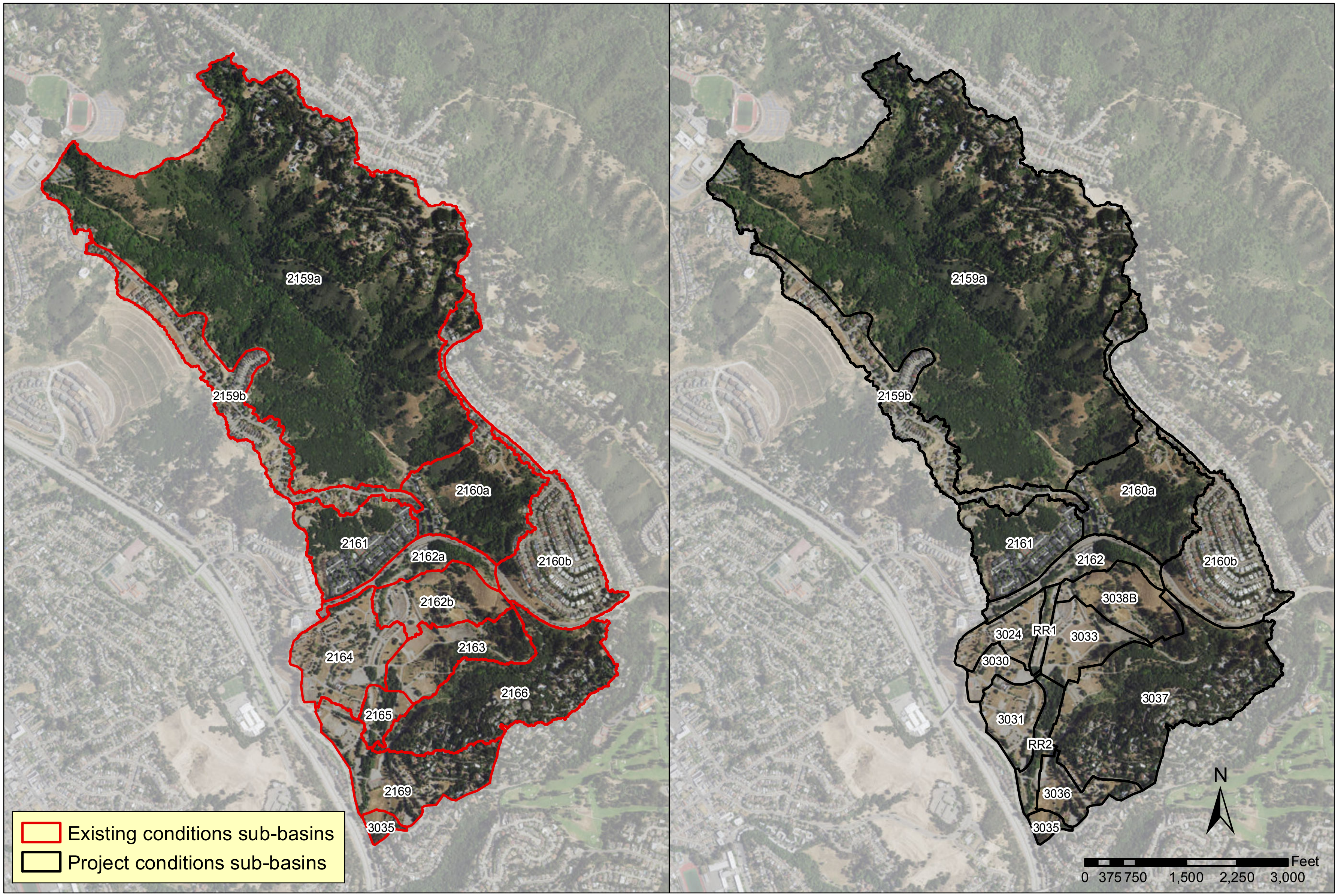
Table 2. Leona Canyon detention basin elevation-storage-discharge relationship

Elevation (ft)	Storage (ac-ft)	Discharge (cfs)
393*	0	0
394	2	60.5
396	5.9	104.8
398	9.9	135.3
400	13.9	160.1
402	20.2	181.5
404	26.6	200.7
406	33	218.2
408	39.3	234.3
410	45.7	249.5
412	54.9	263.7
414	64.2	277.3
416	73.4	290.2
418	82.7	302.5
420	92.1	314.4

* Lowest grate elevation is at 393 ft (NAVD)

4.3 WATERSHED PARAMETERS

The Rifle Range Creek watershed, including both upstream and on-site areas, was divided into sub-basins to model runoff for a range of storm events under existing and post-project conditions. Sub-basin delineations are shown in Figure 4. The existing conditions sub-basins were delineated using ArcHydro, a GIS tool used to characterize spatial data and convert this into the hydrologic parameters required as input to the rainfall-runoff model. The topography used to delineate the subbasins was from a 2006 LiDAR dataset collected by the USGS and obtained through the



SOURCE: ESRI World Imagery - NAIP (06/08/2014)

Oak Knoll III. 140419.00

Figure 4

Existing and proposed hydrologic model sub-basins

NOAA Coastal LiDAR viewer (coast.noaa.gov/dataviewer/#). Topographic subbasins in the upper watershed were modified slightly to reflect the City of Oakland's storm drainage master plan (CH2MHill, 2006). For the project site, sub-basins delineations were developed by BKF Engineers for project storm drainage planning and design (Appendix 3 Preliminary Storm Drainage Master Plan). Appendix 5 provides a table that summarizes watershed parameters by sub-basin.

The constant loss rate due to soil infiltration for each subwatershed is based on a composite average of the basin soils and land use characteristics. To compute the uniform loss rate for each catchment, the hydrologic soil map of the area was superimposed on the land use map and the drainage area map. The soil data used was the USDA's Soil Survey Geographic Database (SSURGO) dataset (USDA, accessed January 2014). The 2011 National Land Cover Dataset (Homer *et al*, 2015) and the 2011 NLCD percent imperviousness dataset (Xian *et al*, 2011) were used to define landuse and impervious percentages respectively. The NLCD categories were associated with a corresponding category from the ACFCD categories for infiltration. A composite map was developed and the appropriate loss rates based on Table 3 was assigned to each area (ACFCD, 2003). Finally, an area-weighted average of the uniform loss rate was computed for each sub-basin. Soil type and land use distribution by sub-basin for the existing conditions scenario are summarized in Table 4. Land use and soil type distributions for the post-development scenario are summarized in Table 5 respectively.

Table 3. Uniform Loss Rates (inches/hour) for the Synthetic Unit Hydrograph Method (ACFCD, 2003)

ACFCD category	NLCD 2011 category	Hydrologic Soil Group			
		A	B	C	D
		Infiltration rates (in/hr)			
Rural	Evergreen Forest	0.45	0.35	0.14	0.05
	Herbaceuous	0.45	0.35	0.14	0.05
	Mixed Forest	0.45	0.35	0.14	0.05
	Shrub/Scrub	0.45	0.35	0.14	0.05
New Urban	Developed, Open Space	0.45	0.37	0.19	0.07
Existing Urban	Developed, Medium Intensity	0.45	0.4	0.25	0.09
	Developed, Low Intensity	0.45	0.4	0.25	0.09

Table 4. Landuse, soil type, percent impervious, and infiltration rate for existing conditons sub-basins

Basin	Total area (ac)	Landcover area (ac)																												% Impervious	Infiltration rate (in/hr)
		Rural																New Urban				Existing Urban									
		Evergreen Forest				Herbaceuous				Mixed Forest				Shrub/Scrub				Developed, Open Space				Developed, Medium Intensity				Developed, Low Intensity					
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D		
2159a	487.3	0.0	0.0	0.0	13.6	0.0	0.0	0.0	7.2	0.0	0.0	0.0	272.6	0.0	0.0	0.0	41.6	0.0	0.0	0.0	136.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.1	3%	0.06
2159b	54.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	2.5	0.0	0.0	0.0	1.3	0.0	0.0	0.0	22.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	25.5	22%	0.08
2160a	67.4	0.0	0.0	0.0	3.3	0.0	0.0	0.0	2.2	0.0	0.0	0.0	19.2	0.0	0.0	0.0	4.7	0.0	0.0	1.8	19.0	0.0	0.0	0.8	1.8	0.0	0.0	0.9	13.7	12%	0.07
2160b	56.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	17.3	0.0	0.0	0.0	34.3	43%	0.09
2161	40.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	1.1	0.0	0.0	0.0	16.7	0.0	0.0	0.0	18.0	0.0	0.0	0.0	3.4	31%	0.08
2162a	19.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	6.6	30%	0.08
2162b	31.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.2	0.0	0.0	0.0	7.0	0.0	0.0	0.0	6.8	40%	0.08
2163	35.4	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	16.8	0.0	0.0	0.0	4.7	0.0	0.0	0.0	9.0	39%	0.08
2164	43.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	19.5	0.0	0.0	0.0	18.2	65%	0.09
2165	10.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	4.8	0.0	0.0	0.0	2.6	0.0	0.5	0.0	1.8	50%	0.10
2166	81.9	0.0	0.0	4.2	1.8	0.0	0.0	0.0	0.0	0.0	0.0	5.2	1.8	0.0	0.0	0.0	0.0	0.0	0.1	26.0	27.0	0.0	0.0	0.0	0.3	0.0	0.6	10.9	4.1	14%	0.14
2169	49.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	4.1	2.1	0.7	0.0	1.4	0.0	7.4	0.0	2.8	2.6	4.5	65%	0.21
3035	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.9	0.0	0.0	0.5	0.0	0.0	0.0	0.3	0.7	0.0	47%	0.25

Table 5. Landuse, soil type, percent impervious, and infiltration rate for project conditons sub-basins

Basin	Total area (ac)	Landcover area (ac)																												% Impervious	Infiltration rate (in/hr)
		Rural																New Urban				Existing Urban									
		Evergreen Forest				Herbaceuous				Mixed Forest				Shrub/Scrub				Developed, Open Space				Developed, Medium Intensity				Developed, Low Intensity					
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D		
2159a	487.3	0.0	0.0	0.0	13.6	0.0	0.0	0.0	7.2	0.0	0.0	0.0	272.6	0.0	0.0	0.0	41.6	0.0	0.0	0.0	136.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.1	3%	0.06
2159b	54.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	2.5	0.0	0.0	0.0	1.3	0.0	0.0	0.0	22.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	25.5	22%	0.08
2160a	67.4	0.0	0.0	0.0	3.3	0.0	0.0	0.0	2.2	0.0	0.0	0.0	19.2	0.0	0.0	0.0	4.7	0.0	0.0	1.8	19.0	0.0	0.0	0.8	1.8	0.0	0.0	0.9	13.7	12%	0.07
2160b	56.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0	0.0	0.0	17.2	0.0	0.0	0.0	34.2	42%	0.09
2161	40.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	1.1	0.0	0.0	0.0	16.7	0.0	0.0	0.0	18.0	0.0	0.0	0.0	3.4	31%	0.08
2162	21.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6	0.0	0.0	0.0	4.8	0.0	0.0	0.0	7.3	21%	0.08
3034	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	6.4	0.0	0.0	0.0	9.8	54%	0.07
3037	116.8	0.0	0.0	4.2	3.2	0.0	0.0	0.0	0.0	0.0	0.0	5.7	1.8	0.0	0.0	0.0	1.9	0.0	0.0	35.0	38.2	0.0	0.0	0.0	2.7	0.0	0.2	17.4	6.5	22%	0.07
3030	9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	4.1	0.0	0.0	0.0	3.9	36%	0.07
3031	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	11.6	0.0	0.0	0.0	8.0	67%	0.07
3033	24.2	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2	0.0	0.0	0.0	9.2	0.0	0.0	0.0	7.1	58%	0.30
3035	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.9	0.0	0.0	0.5	0.0	0.0	0.0	0.3	0.7	0.0	47%	0.25
3036	16.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	3.2	0.0	0.0	0.5	0.4	0.0	0.0	1.5	7.6	0.0	48%	0.14
3038B	27.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	18.9	0.0	0.0	0.0	1.5	0.0	0.0	0.0	5.5	22%	0.07
RR1	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0	1.2	0%	0.09
RR2	12.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	4.7	0.0	0.9	0.0	1.1	0.0	2.3	0.0	1.7	5%	0.20

4.4 RESULTS

The parameterized model was used to estimate peak flow rates through the Rifle Range Creek reaches for existing and project conditions. Upstream (entering the project site) and downstream (leaving the project site) peak flow rates for the 5-year, 10-year, 25-year, and 100-year design event are shown for existing and proposed conditions in Table 6.

Table 6. Existing and proposed discharge at downstream end of project site

	Peak flow (cfs)			
	Upstream end of project reach	Downstream end of project reach		
		Existing	Proposed	% change
5-year	222	369	357	-3.2%
10-year	284	496	477	-3.7%
25-year	360	630	614	-2.6%
100-year	470	821	800	-2.5%

Model results show reductions in peak flow for all storm events modeled. Reductions in modeled peak flow result from 1) a reduction in total impervious area relative to existing conditions, which increases modeled infiltration rates and reduces runoff, and 2) changes in runoff timing for on-site sub-basins relative to the Rifle Range peak flow from the upper watershed.

5. HYDRAULICS AND FLOOD MANAGEMENT

A one-dimensional, steady-state HEC RAS hydraulic model of Rifle Range Creek was used to evaluate creek hydraulics for flood hazard assessment and to support design development. Model setup and results are described in this section. Modeling was conducted using methods that are consistent with ACFCD and FEMA guidelines.

5.1 STUDY REACH

The HEC RAS model extent covers Rifle Range Creek between the box culvert inlet at Mountain Boulevard and the upstream culvert outfall at Keller Avenue.

5.2 MODEL GEOMETRY

Station 0+00 was assigned to the downstream-most surveyed cross-section, located at the face of the box culvert inlet, and channel stationing proceeds upstream along the flow line to the property boundary. Stationing differs slightly between existing and project conditions due to changes in creek alignment.

5.2.1 Existing Conditions

Model geometry for existing conditions was developed from ground surveys performed by BKF (2015). The data was converted into a topographic surface in CAD and cross-sections were cut from the surface in GIS using the HEC-GeoRAS toolbar which enables facilitation of data between GIS and HEC-RAS. There are five existing road and culvert crossings on the site. Existing culvert dimensions were measured in the field and are summarized in Table 7.

Table 7. Existing conditions culvert dimensions on Rifle Range Creek

HEC-RAS Station	Manning's n	Shape	Dimensions		Invert elevation (ft NAVD)	
					Upstream	Downstream
3855.5	0.016	Circular	Diameter (ft)	5.5	319.9	319.6
2803.5	0.014			5	300.0	277.7
2277.5	0.016			6	274.5	270.1
1353.5	0.014			5.5	250.1	248.3
602.5	0.02	Ellipse	Span (ft)	7.2	233.1	228.3
			Rise (ft)	6.1		

Channel roughness was observed during the field reconnaissance and assigned an appropriate Manning's "n" value for the model. The low flow channel (which is generally open in the lower channel reaches) was assigned an n=0.04 and the vegetated overbanks were specified as: n=0.08 for most of the reach. Expansion and contraction coefficients are set to normal 0.1 and 0.3, respectively, with the exception of the inlet and outlet of the existing culverts, where they were increased to 0.3 and 0.5, respectively based on HEC guidance (USACE, 2010).

5.2.2 Post-project conditions

Post-project model geometry reflects the 60% channel restoration design and community development project as of November, 2015. Model results will be used to inform design refinements for future submittals. The hydraulic model will be updated if needed to reflect future design refinements.

A Manning's roughness coefficient of 0.045 was used to represent the future composite of the low flow channel, sinuosity, and in-stream vegetation. The overbank values were set at 0.09 to represent denser bank vegetation than the existing condition.

5.3 BOUNDARY CONDITIONS

The project reach for the existing conditions hydraulic model begins at an existing box culvert, located near the downstream property boundary bordering Mountain Boulevard. The model assumes the existing 6.0' wide by 7.0' tall box culvert will function under inlet control conditions for all events modeled. The downstream boundary condition (starting water surface elevation) was estimated from an inlet control nomograph for box culverts (FHWA, 1965). The starting water surface elevation for each flow profile is shown in Table 8.

Table 8. Starting Water Surface Elevations for Existing Conditions and Proposed Conditions

	Flow rate (cfs)		Water surface elevation (ft NAVD)	
Profile	**Existing**	**Proposed**	**Existing**	**Proposed**
5-year	376	402	220.6	220.7
10-year	488	520.7	223.42	223.35
25-year	625	662.4	226.50	226.36
100-year	823.8	857.4	233.57	233.50

5.3.1 Hydrology

Modeled flow rates and flow change locations are based on hydrologic modeling described above.

5.4 RESULTS

The hydraulic model was used to estimate peak water surface elevations for existing and proposed conditions. The model was run in subcritical flow conditions which is typical for flood analyses. The model results show some locations where the Froude number reaches 1.0 indicating that flow may go supercritical at these locations. Supercritical flow generates high velocity and high scour potential and is feasible under current conditions given the steepness and confinement of the existing channel. Under project conditions, the channel is designed to reduce velocities and increase stability compared to the existing channel conditions by removing constrictions, reducing channel slope between grade controls, and increasing hydraulic roughness. The model results for the 100-year event are summarized in Table 9 for existing conditions and Table 10 for project conditions. Figure 5 shows water surface elevation profiles for the 100-year event.

Table 9. Hydraulic model results for existing conditions 100-year discharge

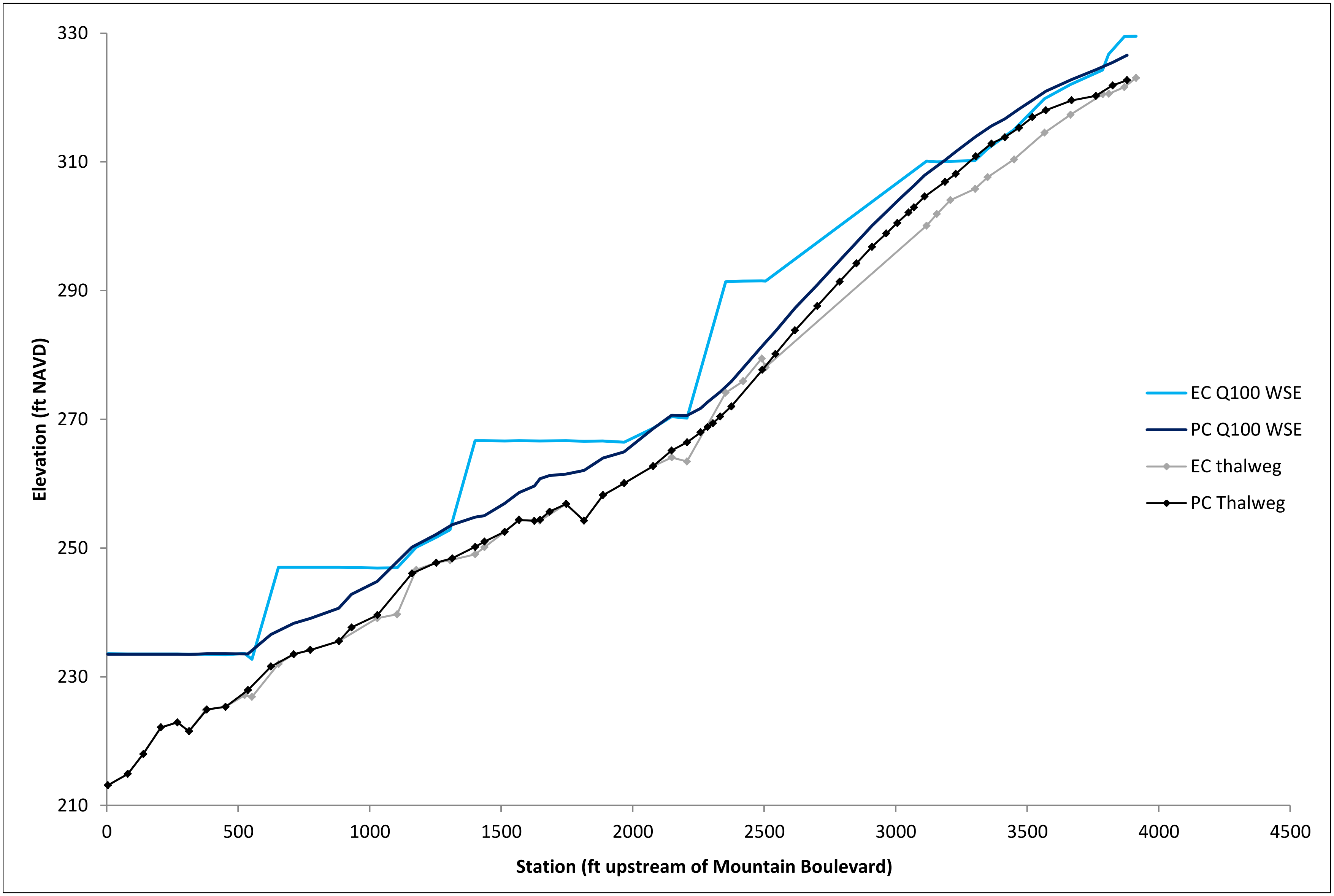
River station	Flow (cfs)	Water surface elevation (ft NAVD)	Velocity (ft/s)	Depth (ft)	Top width (ft)	Froude #
3934	470	329.54	2.04	6.48	81.67	0.23
3886	470	329.51	2.03	7.89	85	0.21
3855.5	5.5' diameter culvert					
3825	470	326.74	13.25	6.16	34.58	1
3800	470	324.28	8.06	3.77	29.44	1
3638	470	322.04	5.4	4.7	63.58	0.68
3537	470	319.83	9.1	5.3	20.96	0.96
3437	470	315.01	9.53	4.63	17.76	1.01
3356	470	312.01	9.51	4.41	18.24	1
3293	470	310.21	8.46	4.4	22.03	0.94
3199	470	310.11	4.84	6.05	29.05	0.45
3144	514.3	310.02	4.16	8.13	31.87	0.35
3106	514.3	310.13	2.41	10.04	50.62	0.22
2803.5	5.0' diameter culvert					
2501	514.3	291.5	1.78	13.41	36.29	0.11
2486	514.3	291.51	1.52	12.06	41.24	0.1
2412	514.3	291.49	1.27	15.58	54.68	0.11
2346	514.3	291.36	3.21	17.22	43.39	0.14
2277.5	6.0' diameter culvert					
2208	514.3	270.19	10.64	6.74	14.51	0.97
2148	514.3	270.43	6.1	6.36	20.49	0.52
2077	620.3	268.6	10.39	5.88	18.34	0.97
1967	620.3	266.46	7.41	6.39	19.77	0.61
1887	620.3	266.63	3.87	8.42	31.08	0.32
1815	620.3	266.59	3.61	12.35	34.03	0.26
1747	620.3	266.68	2.09	9.83	48.24	0.16
1646	620.3	266.64	2.04	12.4	40.9	0.16
1568	620.3	266.68	1.27	12.26	64.04	0.09
1513	620.3	266.62	1.79	14.11	45.57	0.12
1401	620.3	266.66	0.83	17.64	78.47	0.04
1353.5	5.5' diameter culvert					

River station	Flow (cfs)	Water surface elevation (ft NAVD)	Velocity (ft/s)	Depth (ft)	Top width (ft)	Froude #
1306	637.9	252.91	10.33	4.81	19.31	0.98
1253	637.9	251.71	9.45	4	25.38	0.99
1177	637.9	250.12	8.76	3.51	31.93	1.01
1104	637.9	246.94	6.78	7.24	20.99	0.54
1029	761.4	246.9	4.88	7.81	31.47	0.4
883	761.4	247.01	2.81	11.48	39.54	0.2
774	761.4	247.02	2.3	12.86	44.15	0.15
711	761.4	247.03	1.87	13.53	54.36	0.12
653	761.4	247.02	1.73	15.03	62.26	0.11
602.5	7.2' x 6.1' culvert					
552	761.4	232.76	12.97	5.9	29.72	1
524	761.4	233.6	5.87	6.48	31.88	0.49
451	761.4	233.42	5.18	8.1	31.38	0.43
376	761.4	233.5	3.6	8.67	38.72	0.28
313	761.4	233.49	2.72	11.96	44.05	0.22
269	761.4	233.54	2.27	10.63	51.82	0.17
206	761.4	233.54	1.95	11.42	59.07	0.14
139	761.4	233.56	1.19	15.58	103.57	0.1
80	761.4	233.56	0.96	18.65	124.83	0.09
4	823.8	233.57	0.83	20.44	124.33	0.08
0	6' x 7' reinforced box culvert					

Table 10. Hydraulic model results for project conditions, 100-year discharge

River station	Flow (cfs)	Water surface elevation (ft NAVD)	Velocity (ft/s)	Depth (ft)	Top width (ft)	Froude #
3880	470	326.60	5.2	3.9	54.26	0.75
3825	470	325.43	7.08	3.55	35.77	0.91
3761	470	324.31	3.01	4.06	74.69	0.51
3669	470	322.80	5.37	3.25	53.24	0.91
3571	470	320.98	4.28	2.95	79.57	0.9
3520	470	319.58	4.26	2.64	81.45	0.93
3469	470	318.21	4.19	2.91	82.6	0.9
3415	470	316.69	4.08	2.87	89.33	0.91
3364	470	315.56	4.32	2.71	80.82	0.96
3304	470	313.91	4.41	3.05	74.41	0.89
3228	502.4	311.56	5.2	3.42	57.59	0.89
3188	502.4	310.29	5.41	3.38	52.99	0.91
3110	502.4	307.95	5.72	3.34	48.75	0.92
3069	502.4	306.29	5.71	3.36	48.18	0.93
3049	502.4	305.54	5.71	3.4	47.67	0.92
3006	502.4	303.88	5.66	3.36	49.05	0.93
2964	502.4	302.22	5.83	3.36	46.58	0.93
2910	502.4	300.08	5.29	3.27	55.85	0.92
2851	502.4	297.50	5.1	3.26	59.07	0.91
2787	502.4	294.67	5.15	3.27	58.02	0.91
2702	502.4	290.90	5.74	3.29	48.1	0.94
2617	502.4	287.28	6.12	3.46	42.22	0.93
2543	502.4	283.69	6.56	3.53	37.56	0.94
2493	561.9	281.43	7.13	3.78	34.31	0.95
2375	574.5	275.88	7.47	3.89	32.27	0.95
2333	574.5	274.27	7.54	3.87	31.68	0.95
2305	574.5	273.32	7.62	3.93	31.54	0.95
2285	574.5	272.69	7.13	3.89	35.26	0.94
2258	574.5	271.72	6.56	3.75	40.64	0.93
2207	574.5	270.62	4.95	4.18	49.4	0.71
2148	574.5	270.66	2.77	5.51	70.89	0.38
2077	574.5	268.54	8.61	5.82	21.5	0.93
1967	574.5	264.93	8.26	4.86	24.6	0.92
1887	574.5	263.98	5.51	5.77	32.63	0.59
1815	574.5	262.05	7.85	7.81	24.46	0.83

River station	Flow (cfs)	Water surface elevation (ft NAVD)	Velocity (ft/s)	Depth (ft)	Top width (ft)	Froude #
1747	574.5	261.49	6.73	4.64	29.64	0.69
1684	574.5	261.25	4.11	5.59	43.03	0.55
1648	574.5	260.77	5.2	6.36	35.93	0.6
1626	574.5	259.65	8.75	5.42	25.78	0.94
1568	574.5	258.63	5.95	4.27	39.34	0.65
1513	574.5	256.93	9.38	4.06	23.4	0.98
1436	574.5	255.01	8.7	4.03	28.89	0.99
1401	574.5	254.80	6.14	4.64	34.25	0.64
1314	574.5	253.63	6.77	5.23	27.11	0.68
1253	574.5	252.13	7.35	4.42	27.65	1.04
1161	574.5	250.13	8.28	4.08	30.78	0.96
1029	732.7	244.80	8.44	5.24	32.69	0.89
931	732.7	242.80	9.31	5.14	28.37	0.96
883	732.7	240.64	7.64	5.12	35.96	0.89
774	732.7	239.05	6.35	4.89	45.95	0.83
711	732.7	238.32	6.04	4.82	48.18	0.78
624	732.7	236.56	8.45	4.98	36.49	0.93
537	732.7	233.56	4.07	5.88	61.75	0.49
452	732.7	233.59	2.24	8.26	78.23	0.28
381	732.7	233.58	1.73	8.67	86.04	0.2
313	732.7	233.46	2.11	11.93	64.48	0.2
269	732.7	233.49	1.91	10.58	66.08	0.15
206	732.7	233.49	1.6	11.37	71.77	0.13
139	732.7	233.52	0.8	15.54	118.09	0.08
80	732.7	233.52	0.69	18.61	124.09	0.06
4	799.7	233.50	0.74	20.37	124.15	0.07



Oak Knoll Redevelopment .
D140419.00 **Figure 5**
Existing and proposed 100-year water surface elevation profiles

6. RIFLE RANGE CREEK

On the project site, Rifle Range Creek consist of approximately 2300 linear feet of open channel, 750 feet of gabion-lined channel, and 960 linear feet of culverts. Open channel segments are deeply incised relative to adjacent site grades, resulting in high, steep banks. They generally support a mixture of riffle-pool and plane bed morphology, with steeper segments transitioning to step-pools. Bed materials include boulder, cobble, gravel, cohesive alluvial sediment, bedrock, and rubble. The gabion-lined channel was constructed by the Navy in the 1980s**.** Table 11 provides a summary of the existing culverts, numbered from downstream to upstream. According to Navy records, Culvert 4 is made up of numerous segments that do not follow a straight line between the inlet and the outfall; the length shown on Table 11 is an estimate based on best available information regarding the alignment of culvert segments.

Table 11. Rifle Range Creek - existing culverts

	Description	Length (ft)
Culvert 1	Road crossing	77
Culvert 2	Road crossing	89
Culvert 3	Road crossing	122
Culvert 4	Parking lot	631*
Culvert 5	Road crossing	45
total		*964*

* estimated

6.1 EXISTING CONDITIONS

Four channel reaches are described in the following sections and shown in Figure 6. Average reach slope is between 2% and 3% except for Reach 4b which is contained in a culvert. Within the open reaches, local channel gradient varies greatly from 0.6 – 4.5%. Table 12 summarizes existing average channel slope by reach.

Table 12. Existing Channel Slope – average by reach

Reach	Length (feet)	Slope
1	566	2.7%
2	742	2.5%
3	909	2.2%
4a	310	3.0%
4b	631*	3.6%
4c	868	2.7%

* estimated culvert length

Figure 6
Rifle Ranch Creek – Existing Conditions

6.1.1 Reach 1

Reach 1 consists of the downstream portion of Rifle Range Creek, from the box culvert inlet at Mountain Road to the downstream-most culverted road crossing. The reach has an average gradient of 2.7%. Width-depth ratios vary from 3:1 at the downstream end (deeply confined) to 6:1 at the upstream end (considered the boundary between confined and unconfined, e.g. Rosgen, 1996).

The existing channel appears to be slightly incising and actively widening. Evidence for this comes from the series of small knickpoints and active bank slumps. The slopes adjacent to the creek have become unstable in places, as evident by recent and historic slope failure scars (e.g. landslides, slumps and earthflows). Downcutting has been temporarily arrested in at least one location by a quasi-stable knickpoint feature supported by tree roots. However, numerous small vertical knickpoints along the channel indicate that the channel has the potential to downcut further.

6.1.2 Reach 2

Reach 2 consists of the portion of the Rifle Range Creek from the downstream side of the existing tennis court road crossing (Culvert 1) to the downstream side of the existing Pool Street road crossing (Culvert 2), and incorporating the confluence with Power House Creek. The reach has an average gradient of 2.5%.

The downstream portion of this reach lies within Culvert 1. The next 235 feet is deeply incised (width-depth ratio of 2:1) and has steep banks that are actively failing. The local slope is low (0.9%), as the channel has adjusted to the grade control function of the culvert. The bed steepens to the confluence with Power House Creek and becomes more sharply incised with a 6 foot knickpoint just upstream of the Power House Creek confluence. The knickpoint has halted at a large pile of concrete blocks that have been placed in the channel, but an avulsion is starting to form around the obstruction. A remnant floodplain terrace feature can be observed slightly downstream of the confluence with Power House Creek. This feature is over 9 feet above the existing channel bottom, implying that about 6-7 feet of down-cutting has occurred at this location.

6.1.3 Reach 3

Reach 3 extends from the downstream side of the Pool Street crossing (Culvert 2) to the downstream side of the Blackwood Street crossing (Culvert 3) and contains the confluence with Hospital Creek; it has an average gradient of 2.2%.

The downstream portion the reach lies in Culvert 2. Immediately upstream of the culvert is a relatively flat reach that terminates in a 3 foot knickpoint. Upstream of the knickpoint, the channel is moderately sinuous across a floodplain that is approximately 40 feet in width. Bedrock outcroppings suggest bedrock control of the channel gradient in this area. The channel and floodplain are well connected, implying that the channel has been relatively stable for some time.

The width-depth ratio of 4:1 shows that the reach is about averagely entrenched for the project site.

6.1.4 Reach 4

Reach 4 extends from the Blackwood Street culvert (Culvert 3) to the upstream project boundary at Keller Avenue. The length is 1,809 feet and the average gradient is 3.1%. This reach has been broken into three sub-reaches for existing conditions.

Reach 4a includes the culverted road crossing at Blackwood Street (Culvert 3) and a section of open channel terminating at the culvert outfall at Crowley Street (Culvert 4). It has an average gradient of 3.0%. The open portion of the reach is deeply incised with actively failing banks and a width-depth ratio of 3:1, which is highly unstable.

Reach 4b is the culverted parking lot reach (Culvert 4). The culvert is approximately 631 feet long and has an average slope of approximately 3.6%, based on best available information regarding the culvert alignment.

Reach 4c extends from the upstream end of Culvert 4 upstream to the property boundary. The reach has an average gradient of 2.7%. The majority of Reach 4c was constructed from gabions (rock-filled wire baskets) in the 1980s. According to Navy design plans, the channel was excavated to a trapezoidal section in a modified alignment, and then lined with gabion baskets. In some places, the wire baskets have failed and channel erosion is evident. Reach 4c includes a culverted road crossing (Culvert 5) upstream of the gabion section, and a fragment of open channel between Culvert 5 and the upstream project boundary.

6.2 CREEK DESIGN

This section describes the geomorphic and engineering design approach to stabilize and enhance Rifle Range Creek. A preliminary riparian restoration and monitoring plan is provided in Appendix 6.

6.2.1 Geotechnical Stabilization

Significant demolition and earthwork will be performed throughout the site in preparation for the redevelopment project. Mass grading will include construction of engineered keyways along much of the creek corridor to meet geotechnical requirements. To facilitate revegetation of graded slopes as well as integration with proposed creek work, engineered slopes will be 2:1 or flatter where they interface with the creek corridor, and will be constructed with a layer of native soils (stockpiled during construction) at the surface. Engineering design of the keyways and engineered slopes will be included in the civil design plans for the project and constructed as part of mass site grading. Finished grades for engineered slopes are reflected in the creek plans to the extent they are adjacent to and integral with the proposed creek work.

6.2.2 Creek Design

The proposed creek design is reflected in the 60% complete design plans provided in Appendix 7. The design approach for each reach is summarized below, followed by a description of the design basis for individual design elements. Channel gradients are summarized by reach in Table 13. The upstream channel station for each reach is provided in Table 13 to facilitate cross-referencing with the 60% design plans. Channel stationing is based on centerline distance from the Mountain Boulevard inlet.

Table 13. Existing and Design Channel Slope

	Existing		Design		
Reach	Length (feet)	Slope	Length (feet)	Slope	Upstream Station
1	566	2.7%	566	2.7%	05+66
2	742	2.5%	742	2.5%	13+08
3	909	2.2%	909	2.2%	22+17
4a	310	3.0%	888	3.6%	31+05
4b	631*	3.6%			
4c	868	2.7%	868	2.7%	39+73

* estimated culvert length

For Reaches 1-3, the design approach is to preserve the bankfull channel within the existing, incised creek corridor. Average reach slope and channel length are therefore unchanged from existing conditions. Existing headcuts and oversteepened segments will be stabilized in place and biotechnical bank stabilization methods will be applied where needed to limit bank erosion. Two culverts (Culvert 1 and Culvert 2) will be daylighted. For the 60% design, bankfull channel dimensions for daylighted reaches were estimated using Regional Hydraulic Geometry Curves (Table 14); daylighted channel dimensions will be refined for the final (100% complete) design based on hydraulic modeling results.

Table 14. Estimated bankfull channel dimensions from Regional Hydraulic Geometry curves (Collins and Leventhal, 2013)

	Watershed area (acres)	Estimated Bankfull Channel Width (feet)	Estimated Bankfull Channel Depth (feet)
Reach 1-3	793	14.2	1.1
Reach 4	707	13.5	1.1

Reaches 4a and 4b consist of two culverts (Culverts 3 and 4) totaling over 750 linear feet, separated by approximately 190 linear feet of open channel. The design approach for the combined Reach 4a + 4b is to daylight the culverts and create a continuous open channel with a stable slope and step-pool morphology. The boulder step pool design and approach for step-pools spacing are described below (6.2.2.4 Step Pools).

In Reach 4c, the design approach is to remove 750 feet of gabion channel lining and daylight Culvert 5 and create a continuous naturalized channel with plane bed morphology. The channel alignment will be modified (relative to the existing gabion channel) to accommodate design requirements for the entry road from Keller Avenue; however, the realigned channel will have the same length and slope as the existing channel.

6.2.2.1 Biotechnical stabilization

Biotechnical methods are applied throughout the design as needed to stabilize the creek corridor up to the 10-year water surface elevation. Biotechnical treatments were selected using the method described by Fischenich and summarized below (Fischenich, 2001).

- The average channel boundary shear stress and velocity were evaluated for design conditions using a HEC RAS hydraulic model.
- Adjustments were made to account for outside bend curvature and instantaneous velocity and shear stress per Fischenich, 2001
- Bank treatments were selected based on shear and velocity results for each cross section using the values summarized in Table 15.
- The selected bank treatments were applied to the design with minor adjustments to consolidate treatments and smooth bank transitions.

Table 15. Selected Biotechnical Bank Treatments (Fischenich, 2001)

Permissible shear stress (lb/ft^2)	Permissible velocity (ft/sec)	Treatment
<1.7	< 4	Native grasses or similar
< 4	< 8	Brush mattress (willow)
< 6	< 9.5	Vegetated soil lift
> 6	> 9.5	Planted rock

6.2.2.2 Habitat structures

Log structures and boulder piles are included throughout the design as habitat elements to increase channel roughness and complexity. Log structures will be constructed from trees that are removed during construction. They will be anchored according to standard techniques but are not designed to provide a specific grade control or stability function. Structure dimensions and details will be refined for the final (100% complete) design.

6.2.2.3 Roughened channels

Roughened channel segments are used in Reaches 1 – 3 to stabilize major knickpoints and locally steep channel segments. They are designed based on guidance from the California Salmonid Stream Habitat Restoration Manual Volume 2 Part 12 (California Department of Fish and Game, 2009). These channel segments tie in to the existing channel upstream and downstream with the minimum practical change in gradient while minimizing disturbance to existing stable channel areas. The bankfull channel dimensions within the roughened channel were estimated using hydraulic geometry relationships and are designed to tie into the upstream and downstream channel bankfull width. Channel sizing, rock sizing and structure dimensions will be refined for the final (100% complete) design.

6.2.2.4 Step pools

Boulder step pools are used in Reach 1-3 to stabilize smaller existing knickpoints in place, and in Reach 4a + 4b to create step-pool channel morphology for the reconstructed, daylighted channel. In Reach 4c, Steps are limited to 1-2 feet in height. The pool width spans the active channel, with buried rock cutoff wings integrated into the bank to prevent outflanking. Pool lengths were designed to be 1-2 times channel width. Toe-downs at the up-and downstream end of the structure are designed to accommodate slope adjustments without being undercut. Rock sizing and structure dimensions will be refined for the final (100% complete) design.

To determine the step pool spacing for Reach 4a + 4b, the channel was first laid out in plan form. The plan form alignment generally follows the existing culvert/channel alignment, with some adjustments to accommodate site design constraints including geotechnical grading and bridge/road alignments required for access to existing land uses on the project site. The design channel alignment resulted in an average reach slope of 4.2%, which falls in the step-pool gradient spectrum according to the Montgomery-Buffington classification of channels by gradient (Montgomery and Buffington, 1977). The design profile was therefore developed based on step-pool morphology.

The following bullet points summarize the steps used to develop the plan and profile channel design for Reach 4.

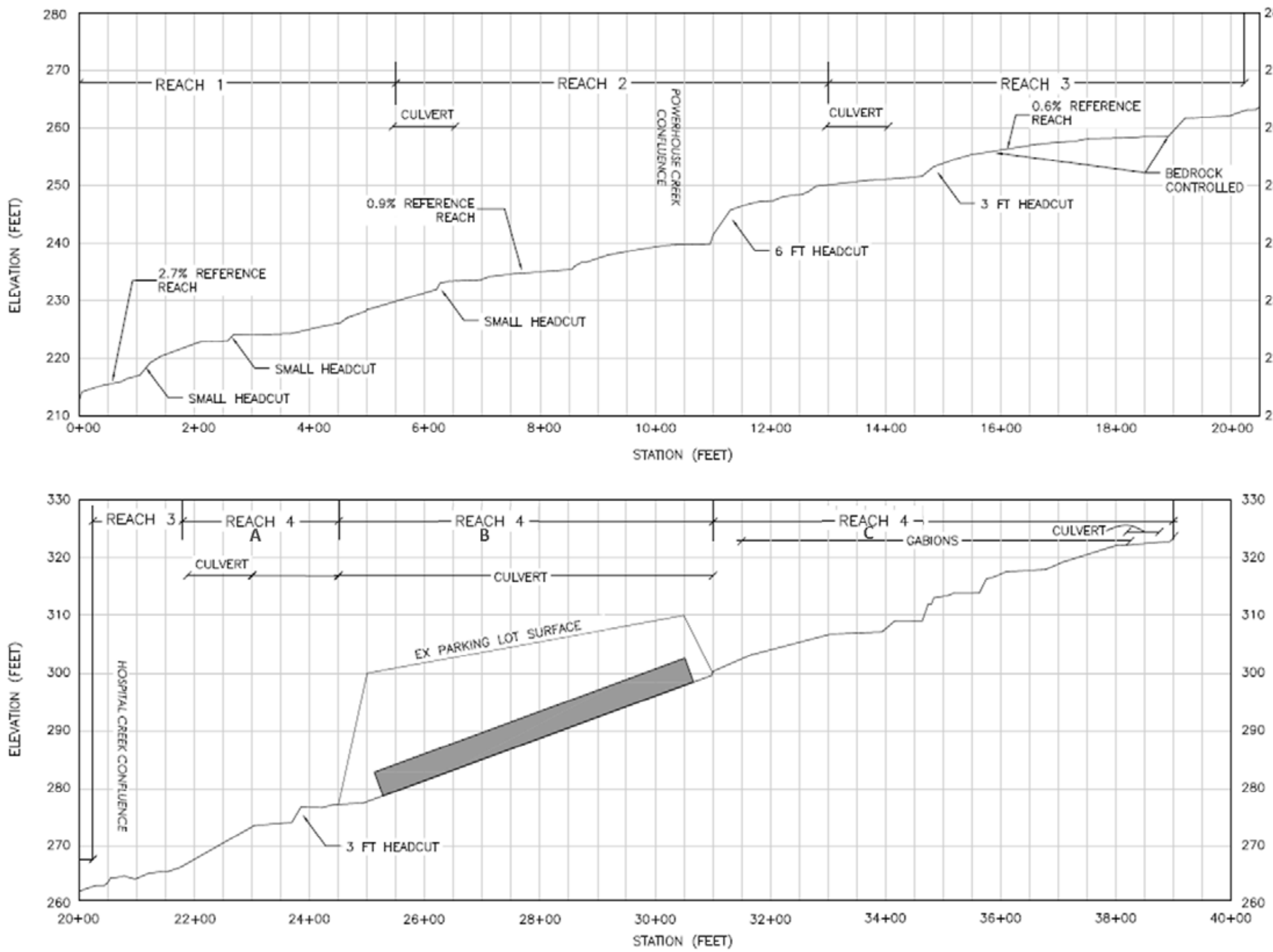
- Lay out channel plan form
- Calculate the difference in elevation between the two ends of the reach
- Estimate a range of equilibrium channel slopes
- Apply the average estimated equilibrium slope to the planform channel
- Estimate the number of 1 and 2 foot high steps needed to take up any remaining elevation difference between the two ends of the reach
- Space the steps approximately evenly, but with some variation to create heterogeneity
- Design steps and pools to accommodate slope adjustment

6.2.2.5 Equilibrium Slope

Equilibrium slope is the channel gradient where sediment transport is in balance with creek hydrology, such that the channel profile persists in dynamic equilibrium (neither aggrading nor eroding significantly) over time. The method above uses an estimate of equilibrium channel slope to determine the remaining vertical distance to be taken up by stabilized steps and pools. Given the changes in watershed hydrology and sediment supply, the current equilibrium channel slope is likely to be different from the historic average slope of approximately 2.6%. Therefore three other reference subreaches were surveyed within the project area to estimate current equilibrium gradient. Selected subreaches were at least 100 feet long and had a grade control (hard substrate or structure) at the downstream end (Figure 7). Channel slope for the three reference subreaches was variable, ranging from 0.6% to 2.7% with a mean value of 1.5%.

For comparison, a relationship between watershed area and slope developed for stable creeks in Contra Costa County was also consulted. The Contra Costa County creeks had different levels of development, but were mostly for rural watersheds with some suburban housing. According to this relationship, stable slope for creeks with a 1.5 square mile watershed is between 1 and 2% which is consistent with the observed range for Rifle Range Creek. In the absence of more definitive data, we assumed that the equilibrium gradient lies between 1 and 2% for Reach 4. Therefore, the step pool reach was designed so that the natural channel between steps has a slope of 1-2% and the remaining vertical distance is taken up by step pools. The resulting average channel slope (including steps) is 3.4%.

Because of the uncertainty in estimating equilibrium slope, the step pool structures were designed to tolerate adjustment of the channel slope between structures. Buried rock toes at the downstream end of each pool are designed to accommodate as little as zero channel slope without undercutting, while the wing walls are designed to accommodate up to a 3% channel slope without lateral channel migration.



NOTE: stationing may differ from 60% plan stationing

Oak Knoll. D140419

Figure 7

Rifle Range Creek longitudinal profile

7. PRELIMINARY CREEK PROTECTION PLAN

This section describes measures that will be used to protect Rifle Range Creek during and after project construction. Additional detail will be provided based on the resource agency permitting process, which is currently underway.

7.1 CONSTRUCTION PERIOD CREEK PROTECTION

Standard construction period practices will be followed to protect the creek during the construction period. Detailed construction period creek protection plans will be provided with subsequent submittals when creek restoration construction plans are further developed. Creek protection measures will be incorporated into a Water Control Plan, a Storm Water Pollution Prevention Plan, and other documents produced as part of the final creek restoration design plan.

7.1.1 Water Control Plan

A dewatering and flow bypass system will be required during construction for creek restoration. A water control plan detailing methods to be used by the contractor will be prepared following guidelines published by the US Fish and Wildlife Service and incorporating specific requirements of resource agency permits for the project. The plan will specify methods and locations for water for water diversion as well as other guidelines related to managing creek flows during construction.

7.1.2 Storm Water Pollution Prevention Plan (SWPPP)

A project specific Storm Water Pollution Prevention Plan (SWPPP) will be developed to limit and control impacts to the creek from erosion and sedimentation during construction. At a minimum the plan shall:

- Define objectives, Best Management Practices (BMPs) and methods for erosion control and protection through all phases of construction.
- Identify water quality and erosion protection BMPs consistent with the California Stormwater Quality Association requirements shall be identified to:
    - Minimize Disturbed Areas: Limit clearing and grubbing activities to those that will be under construction.
    - Stabilize Disturbed Areas: Provide temporary stabilization of disturbed areas and active construction zones. Provide long-term/ permanent stabilization elements.
    - Protect Slopes and the Creek Channel: Convey runoff from top of slope, dissipate any water diverted within the project and returned to the active channel
    - Control Perimeter of the Project Site: Contractor shall provide all necessary construction fencing, silt fences and other measures to control and protect the site.
    - Retain Sediment and Control Dust

- All disturbed areas in the creek corridor shall be protected against potential erosion, runoff and soil transport to the creek. Appropriate BMPs (defined by the contractor and approved by the owner or owner's representative) shall be followed throughout the construction period of the creek stabilization and enhancement elements.
- All construction activities shall conform with the Storm Water Pollution and Prevention Plan (SWPPP) as required by the local jurisdiction including:
  - Contractor activities such as project staging, equipment storage, cleaning and maintenance areas and activities. Contractor employees and workers on the site will be provided with information and requirements for all activities in and around the creek.
  - Construction access such as ingress and egress
  - Material loading and unloading, segregation of construction materials
  - Site maintenance and 'good 'house-keeping'. The contractor shall be responsible for maintaining a clean project site including cleaning up and controlling all debris and deleterious materials at the end of each working day.
  - Identification of equipment that may come in contact with stormwater
  - Contingency Plans for clean-up of accidental spills, wet/ inclement weather, etc.
    - Describe physical conditions and forces of the project site. The SWPP will provide a project layout showing project limits and features. Supplemental materials such as hydrology reports, soils report and grading/ drainage plans shall be prepared.
    - Existing vegetation and critical physical features.

7.2 POST CONSTRUCTION CREEK PROTECTION

Post construction creek protection measures include site design, creek restoration, and stormwater management elements which are described below.

7.2.1 Site Design Measures

The site plan provides separation between developed areas and the restored creek corridor. The restored creek corridor will be defined by an open space parcel that is a minimum of 100 feet wide, with a minimum of 50 feet between the creek flow line and the boundary of the parcel. In the central part of the site, the creek corridor is up to 250 feet wide and includes an existing oak woodland habitat that will be preserved adjacent to the creek. Buildings and paved areas are set back a minimum of 15 feet from the parcel boundary throughout the site. On the north side of the creek, Creekside Parkway parallels the open space parcel and provides a continuous buffer between the creek corridor and developed areas to the northwest. Much of the restored creek corridor will provide habitat mitigation for resource agency permitting purposes. As such, resource agency permits will include additional creek protections. The resource permitting process is currently underway.

The site design incorporates low impact development approaches including separation of runoff from self-treating areas such as open space and landscaping (Appendix 3).

7.2.2 Creek Restoration

The creek restoration plan described above will stabilize the creek channel and banks, arresting ongoing erosion and proving a stable substrate for revegetation with native plants. The restoration plan has been designed to protect and enhance habitat, water quality and flood conveyance functions of the creek, including daylighting of hundreds of feet of creek currently contained in culverts and removal of extensive debris and failed infrastructure from the creek corridor.

7.2.3 Post Construction Stormwater Management

The Appendix 3 Preliminary Storm Drainage Master Plan describes long term, post construction stormwater management strategies for the project site and Appendix 4 provides a preliminary project C.3 Plan. Runoff from all structures and paved areas will pass through post-construction BMPs that will provide water quality treatment and slow runoff before discharge to the creek. Rifle Range Creek outfalls have been designed to incorporate energy dissipation structures and biotechnical stabilization techniques to prevent erosion from concentrated stormwater discharges. Wherever possible, outfalls are located where grade control or other stabilization structures are being constructed as part of the restoration design.

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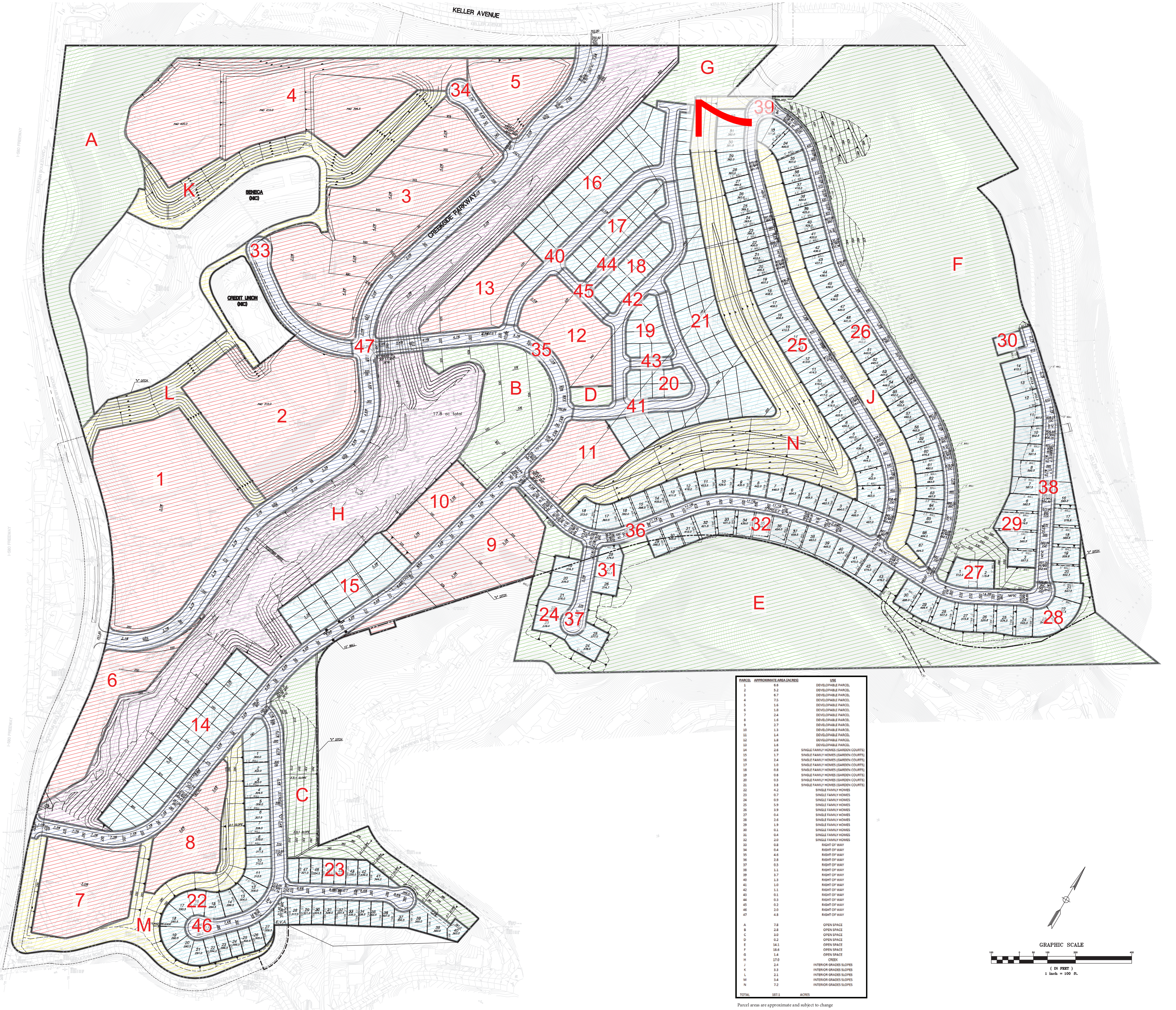
Appendix 1
Site Plan



PARCEL	APPROXIMATE AREA (ACRES)	USE
1	6.6	DEVELOPABLE PARCEL
2	5.2	DEVELOPABLE PARCEL
3	6.7	DEVELOPABLE PARCEL
4	7.5	DEVELOPABLE PARCEL
5	1.6	DEVELOPABLE PARCEL
6	1.8	DEVELOPABLE PARCEL
7	2.4	DEVELOPABLE PARCEL
8	1.6	DEVELOPABLE PARCEL
9	2.7	DEVELOPABLE PARCEL
10	1.3	DEVELOPABLE PARCEL
11	1.4	DEVELOPABLE PARCEL
12	1.8	DEVELOPABLE PARCEL
13	1.6	DEVELOPABLE PARCEL
14	2.6	SINGLE FAMILY HOMES (GARDEN COURTS)
15	1.7	SINGLE FAMILY HOMES (GARDEN COURTS)
16	2.4	SINGLE FAMILY HOMES (GARDEN COURTS)
17	1.0	SINGLE FAMILY HOMES (GARDEN COURTS)
18	0.8	SINGLE FAMILY HOMES (GARDEN COURTS)
19	0.6	SINGLE FAMILY HOMES (GARDEN COURTS)
20	0.5	SINGLE FAMILY HOMES (GARDEN COURTS)
21	3.8	SINGLE FAMILY HOMES (GARDEN COURTS)
22	4.2	SINGLE FAMILY HOMES
23	0.7	SINGLE FAMILY HOMES
24	0.9	SINGLE FAMILY HOMES
25	5.9	SINGLE FAMILY HOMES
26	3.9	SINGLE FAMILY HOMES
27	0.4	SINGLE FAMILY HOMES
28	2.6	SINGLE FAMILY HOMES
29	1.9	SINGLE FAMILY HOMES
30	0.1	SINGLE FAMILY HOMES
31	0.4	SINGLE FAMILY HOMES
32	2.0	SINGLE FAMILY HOMES
33	0.8	RIGHT OF WAY
34	0.4	RIGHT OF WAY
35	4.6	RIGHT OF WAY
36	2.8	RIGHT OF WAY
37	0.5	RIGHT OF WAY
38	1.1	RIGHT OF WAY
39	3.7	RIGHT OF WAY
40	1.3	RIGHT OF WAY
41	1.0	RIGHT OF WAY
42	1.1	RIGHT OF WAY
43	0.1	RIGHT OF WAY
44	0.3	RIGHT OF WAY
45	0.2	RIGHT OF WAY
46	2.0	RIGHT OF WAY
47	4.8	RIGHT OF WAY
A	7.8	OPEN SPACE
B	2.8	OPEN SPACE
C	3.0	OPEN SPACE
D	0.2	OPEN SPACE
E	14.1	OPEN SPACE
F	18.6	OPEN SPACE
G	1.4	OPEN SPACE
H	17.0	CREEK
J	2.4	INTERIOR GRADES SLOPES
K	3.3	INTERIOR GRADES SLOPES
L	2.1	INTERIOR GRADES SLOPES
M	3.4	INTERIOR GRADES SLOPES
N	7.2	INTERIOR GRADES SLOPES
TOTAL	187.1	ACRES

Parcel areas are approximate and subject to change

Appendix 2
Tree Impact Memo

(available upon request)

Appendix 3
Preliminary Storm Drainage Master Plan

(available upon request)

Appendix 4
Preliminary Stormwater Treatment Plan (C.3 plan)

(available upon request)

Appendix 5
Watershed Parameter Tables

Table A5.1 Uniform Loss Rates (inches/hour) for the Synthetic Unit Hydrograph Method (ACFC&WCD, 2003)

Hydrologic Soil Group	Rural	New Urban	Existing Urban
A	0.45	0.45	0.45
B	0.35	0.37	0.40
C	0.14	0.19	0.25
D	0.05	0.07	0.09

Table A5.2 Directly Connecting Impervious Areas for Typical Land Uses in Alameda County

Land Use Type	Directly Connecting Impervious Area
Older Residential 1/8 Ac.	24%
1980 and Newer Residential 1/8 Ac.	50%
Older Residential 1/4 Ac.	22%
1980 and Newer Residential 1/4 Ac.	40%
Residential Zero Lot Line 3600 SF Lots	51%
Residential Duets 4500 SF	69%
Commercial/Industrial	85%
Townhouse	68%
Apartment	89%
Rural Housing	11%
Freeway	100%

Source: ACFC&WCD 2003

Table A5.3 Land Use and Soil Type Distribution by Sub-basin for Existing Conditions

Sub-basin #	Total Area	Hyd. Grp B (%)	Hyd. Grp C (%)	Hyd. Grp D (%)	Forest land (%)	Infrastructure (%)	Rangeland (%)	Residential (%)	Urban Open Space (%)	Sparsely Vegetated Land (%)	Military (%)	Unclassified Impervious (%)	Composite Impervious Area (%)
					15	85	25		25	25	85	100	I
2159		1	0	99	22	0	18	32	25	3	0	0	27
2160		45	5	50	3	0	11	51	34	0	0	1	35
2161		11	0	89	7	0	8	63	20	1	0	0	26
2162		3	0	97	0	0	0	21	0	0	42	37	80
2163		0	0	100	0	0	0	0	0	0	78	22	88
2164		75	0	25	0	0	0	4	0	0	54	42	90
2165		4	0	96	0	0	0	0	0	0	65	35	91
2166		21	13	66	0	0	0	55	9	0	31	5	46
2167		50	0	50	0	0	0	0	0	0	53	47	92
2169		58	0	42	0	0	0	15	0	0	47	38	80

Table A5.4 Proposed Land-use by Sub-basin

Sub-basin #		Employment Area	Forestland	Infrastructure	Rangeland	Residential	Urban Open	Sparsely Vegetated Land	Apts with Struct Park	Civic	Mixed Use Residential	Small Lot Single Family	Standard Townhomes	Traditional Single Family	Tuck Under Residential
	Area														
72		0	0	0	0	58	38	0	0	0	0	0	0	4	0
141		7	0	8	0	54	17	0	0	3	0	0	3	9	0
142		33	0	25	0	16	18	0	0	0	3	0	3	3	0
143		0	0	0	0	1	61	0	0	0	0	11	4	23	0
144		0	0	6	0	10	41	0	5	0	8	7	9	10	3
145		0	0	1	0	30	55	0	0	0	0	0	0	14	0
2159		0	23	0	20	28	24	5	0	0	0	0	0	0	0
2160		0	4	0	12	42	41	0	0	0	0	0	0	0	0
2161		0	1	0	6	57	35	1	0	0	0	0	0	0	0

Table A5.5 Distribution of Hydric Soil Types by Sub-basin for Post-Development Conditions

Sub-basin #	Within Project Area (Y/N)	Hyd. Grp B	Hyd. Grp C	Hyd.Grp D
72	Y	0	0	100
141	Y	18	0	82
142	Y	72	0	28
143	Y	1	0	99
144	Y	68	0	32
145	Y	8	17	75
2159	N	1	0	99
2160	N	44	5	51
2161	N	11	0	89

Table A5.6 Routing Parameters

Reach	Method	Length (ft)	Slope (ft/ft)	Manning's n	Shape	Lag (min)	Width	Side Slope (H:V)
1	Lag					10		
2	Muskingum	740	0.0267	0.05	Trapezoid		8	2
3	Lag					5		
4	Muskingum	750	0.02	0.05	Trapezoid		10	1
5	Muskingum	670	0.022	0.05	Trapezoid		10	1
6	Muskingum	520	0.048	0.05	Trapezoid		10	1

Table A5.7 Parameters Used to Configure HEC-HMS Model

Existing Conditions										
Sub-basin #	**Within Project Area (Y/N)**	**Area (sq.mi)**	**Impervious Area (%)**	**Initial Loss (in)**	**Constant Loss Rate (in/hr)**	**Snyder TL (hr)**	**Snyder Cp**	**Longest Flowpath (mi)**	**Length to Centroid (mi)**	**Slope (ft/mi)**
2159	N	0.866	27	0.8	0.08	0.65	0.6	1.74	0.74	245
2160	N	0.112	35	0.8	0.23	0.12	0.85	0.49	0.29	577
2161	N	0.066	26	0.8	0.12	0.11	0.6	0.4	0.17	160
2162	Y	0.065	80	0.8	0.09	0.09	0.85	0.26	0.2	395
2163	Y	0.063	88	0.8	0.09	0.07	0.85	0.34	0.17	1136
2164	Y	0.057	90	0.8	0.31	0.08	0.85	0.27	0.16	404
2165	Y	0.022	91	0.8	0.1	0.06	0.85	0.26	0.09	860
2166	Y	0.15	46	0.8	0.17	0.35	0.85	0.91	0.42	1070
2167	Y	0.019	92	0.8	0.23	0.05	0.85	0.22	0.08	624
2169	Y	0.014	80	0.8	0.26	0.06	0.85	0.22	0.12	518
Post-development Conditions										
Sub-basin #	**Within Project Area (Y/N)**	**Area (sq.mi)**	**Impervious Area (%)**	**Initial Loss (in)**	**Constant Loss Rate (in/hr)**	**Snyder TL (hr)**	**Snyder Cp**	**Longest Flowpath (mi)**	**Length to Centroid (mi)**	**Slope (ft/mi)**
72	Y	0.024	46	0.8	0.09	0.111	0.85	0.48	0.23	707
141	Y	0.068	60	0.8	0.14	0.183	0.85	0.46	0.21	1136
142	Y	(offsite)								
143	Y	0.109	56	0.8	0.09	0.175	0.85	0.68	0.33	860
144	Y	0.078	70	0.8	0.29	0.155	0.85	0.65	0.38	1070
145	Y	0.15	51	0.8	0.14	0.113	0.85	0.81	0.39	624
2159	N	0.866	21	0.8	0.08	0.65	0.6	1.74	0.74	245
2160	N	0.112	22	0.8	0.23	0.12	0.85	0.49	0.29	577
2161	N	0.066	23	0.8	0.12	0.11	0.6	0.4	0.17	160

Appendix 6
Preliminary Riparian Restoration and Monitoring Plan

Rifle Range Creek Riparian Restoration and Monitoring Plan

OAK KNOLL MIXED-USE COMMUNITY DEVELOPMENT PROJECT
OAKLAND, ALAMEDA COUNTY, CALIFORNIA

Prepared For:
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Date:

March 2015

ENVIRONMENTAL CONSULTANTS

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APPENDICES

1.0 INTRODUCTION

On behalf of Oak Knoll Venture Acquisition, LLC, WRA, Inc. (WRA) prepared this Riparian Restoration and Monitoring Plan (Restoration Plan) for the Rifle Range Creek corridor (Restoration Area) in conjunction with the redevelopment of the former Oak Knoll Naval Medical Center (Project Area) in Oakland, California. The primary objectives of the Restoration Plan are to: (1) describe the restoration activities designed to restore riparian habitat along Rifle Range Creek and portions of its tributaries, Powerhouse Creek and Hospital Creek; (2) describe restoration engineering and planting schemes; and (3) describe the performance standards and monitoring plan for the Restoration Area. The Restoration Plan calls for restoring 3,820 linear feet of Rifle Range Creek and its associated riparian habitat, significantly increasing its biological habitat value. In addition, limited restoration activities will occur along 201 linear feet of Powerhouse Creek and 299 linear feet of Hospital Creek, for a total of 4,320 linear feet of creek and riparian restoration. The Project will also create an additional 13 linear feet of creek by realigning the existing channel, yielding a post-restoration total of 4,333 linear feet of restored creek and riparian habitats. Figures showing the proposed restoration discussed in this Plan are included in Appendix A.

Responsible Parties

The applicant is:

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The preparer of this plan is:

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2.0 RESTORATION PROJECT

2.1 Location of Project

Oak Knoll is a Master Planned Residential Community Development Project ("Project") consisting of the approximately 167 acre former Naval Medical Center Oakland (NMCO) property at Oak Knoll, two parcels owned by the public agency and an adjacent 15-acre parcel (known as the "Hardenstine parcel"). The Project Area is located approximately seven miles southeast of downtown Oakland and is bounded by Mountain Boulevard and Interstate 580 to the west, Keller Avenue to the north and east, and Sequoyah Road to the south (Figure 1). In general, topography in the Project Area is downsloping toward the south west, from a prominent ridge at the eastern side of the property. Rifle Range Creek, a tributary of Arroyo Viejo, flows from north to south across the Project Area and is one of the site's most prominent natural features. Surrounding land uses are primarily residential development, small local commercial centers, and regional open space.

2.2 Brief Summary of Overall Project

The NMCO facility was decommissioned in 1996 and has been unoccupied since that time, with the exception of continued operations at two privately owned inholdings: the Sea West Federal Coast Guard Credit Union and the Seneca Center for Children and Families. All structures within the NMCO, except the Club Knoll structure, were demolished between 2010 and 2011. The currently proposed Project would develop up to 935 residential units comprised of a range of single-family housing types, townhomes, and multifamily units that would be developed throughout the Project Area (Figure 2). A Village Center would provide a variety of neighborhood-serving retail of approximately 72,000 square feet of locally serving commercial uses and the highest density housing. The Project would also create approximately 75 to 85 acres of open space comprising an extensive network of parks, trails, and walkways that would weave through the Project Area, connecting various neighborhoods within the Project Area with adjacent open space areas and neighborhoods.

A key component of the Oak Knoll project is the enhancement and restoration of Rifle Range Creek and its tributaries. Rifle Range Creek has experienced severe incision which has lowered the channel elevation relative to the surrounding landscape and has resulted in an unstable and eroding channel and banks. Rifle Range Creek includes a mix of open and culverted sections of drainage (Figure 3). Open sections show evidence of active erosion in the creek channel and along the banks, leading to unstable conditions in most areas. Creek restoration activities include removing or replacing the existing degraded storm drain network, removing existing roadway crossings and in-channel culverts, and daylighting the longest culverted reach (636 linear feet). The Oak Knoll project presents an opportunity to address some of the large-scale impacts to the creek that have occurred as a result of development and hydrological modification in the watershed, and invasion by non-native plant species. Through a combination of re-alignment, grading, and planting, the flow capacity, stability, and habitat quality of Rifle Range Creek and its tributaries will be improved.

3.0 EXISTING CONDITIONS WITHIN THE PROJECT AREA

The Project Area consists of the approximately 167-acre abandoned NMCO facility as well as the adjacent 15-acre Hardenstine parcel. The NMCO facility was decommissioned in 1996 and has been unoccupied since that time. All structures within the NMCO, except the Club Knoll structure, were demolished between 2010 and 2011. The Project Area still contains remnants of infrastructure installed by the United States Navy while the facility was operational including roads, parking lots, building foundations, in-stream utilities, channel protection structures, and a storm drain network. Many of the structures in the Project Area are in deteriorated condition and/or have been vandalized. Rifle Ranch Creek flows across the Project Area, entering and exiting the property via culverts that run under adjacent urban development (Figure 3). The Project Area is dominated by developed and landscaped areas; however, fragments of disturbed native habitat are scattered throughout the former NMCO site. Additionally, the Hardenstine parcel consists of mostly native habitats.

3.1 Hydrology

Rifle Range Creek flows from north to south through the central portion of the Project Area and is a notable natural feature on the site (Figure 3). The creek is the largest and northernmost of three tributaries to Arroyo Viejo that originate in the Oakland hills. Rifle Range Creek and its tributaries are the only Section 404 jurisdictional Waters of the United States located in the Project Area (Figure 4). The principal hydrologic sources for the Project Area are direct precipitation and surface runoff.

3.2 Soils

The Alameda County Soil Survey (USDA 1981) indicates that the Project Area has six native soil types (Figure 5):

A.Botella loam, 0 to 2 percent slopes
B.Climara clay, 30 to 50 percent slopes
C.Los-Osos-Millsholm complex, 50 to 75 percent slopes
D.Millsholm silt loam, 50 to 75 percent slopes
E.Xerorthents-Millsholm complex, 30 to 50 percent slopes
F.Xerorthents-Millsholm complex, 50 to 75 percent slopes.

Of these soil types, only (A) and (E) are found within the Restoration Area. These soil types are described in detail in section 4.3.2.

3.3 Vegetation

The Project Area is dominated by urban development, including the remnants of building foundations, parking lots, and roads. The associated infrastructure for this former development resulted in widespread ground disturbance. Introduced landscape plants are found throughout the Project Area, and include trees such as blue gum eucalyptus (*Eucalyptus globulus*), Bailey's acacia (*Acacia baileyana)*, and Monterey pine (*Pinus radiata*). Non-native plant communities in the Project Area include areas dominated by French broom (*Genista monspessulana*), blue gum eucalyptus, Monterey pine, and non-native annual grasses. In addition, five native plant communities were identified within the Project Area including coast live oak riparian forest, coast live oak woodland, Valley needlegrass grassland, coyote brush scrub, and chamise chaparral. Coast live oak riparian forest, coast live oak woodland, and non-native plant communities are found within the Restoration Area and are described in detail in 4.3.3.

3.4 Special-Status Species

Several special-status plant and animal species have been documented to occur, or potentially occur, in the vicinity of the Project Area. However, a search of the California Department of Fish and Wildlife Natural Diversity Database (CNDDB 2015) found no documented occurrences of special-status species within the Project Area. Surveys for Alameda whipsnake (*Masticophis lateralis euryxanthus*) in 2006 yielded negative results. According to the Biological Resource Assessment Report (WRA 2006a), three special-status wildlife species have a high to moderate potential of occurring in the Oak Knoll Project Area: Cooper's Hawk (*Accipiter cooperi*), Allen's Hummingbird (*Selasphorous sasin*), and Yuma myotis (*Myotis yumanensis*). One special-status plant species, Oakland star tulip (*Calochortus umbellatus*), is known to occur within the Project Area (outside of the Restoration Area). No other special-status plants are expected to occur in the Project Area due to the site's disturbance history, lack of suitable habitat, and negative results during 2006 rare plant surveys (WRA 2006b).

4.0 THE RESTORATION AREA

To develop the Restoration Plan, WRA first analyzed existing conditions within the Project Area, focusing on the Restoration Area. WRA then considered the opportunities and constraints at the site, regional habitat goals, and economically/logistically feasible alternatives. The Restoration Plan focuses on the following objectives: (1) retaining the existing creek alignment and preserving high-quality trees where possible, (2) removing existing culverts and gabions, (3) reducing channel gradients, (4) creating a compound channel, and (5) stabilizing the creek banks. Public educational displays and passive recreational opportunities adjacent to the creek may also be included in the overall design to enhance the creek's education and recreational value.

Rifle Range Creek flows across the Project Area, entering and exiting the property via culverts that run under urban development (Figure 3 and 4). Rifle Range Creek has two tributaries, Powerhouse Creek and Hospital Creek. Rifle Range Creek flows west from the Oakland hills and is part of the Arroyo Viejo watershed. Upstream of the Project Area, an in-stream Alameda County flood control detention basin regulates stormwater flows and has altered sediment transport into the downstream reaches of the creek.

The aboveground portions of Rifle Range Creek within the Project Area total approximately 2,779 linear feet, and have been divided into several reaches as shown on the delineation map (Figure 3). The reaches are numbered 1 through 6 starting downstream and moving upstream. Reach 5 and portions of other reach have been culverted and are indicated with a solid line on Figure 3. Each reach consists of a mix of riffles, runs, and pools. Patches of wetland vegetation are present within some reaches, but the creek channel is primarily unvegetated perennial stream habitat.

The existing creek banks range from vertical to three to one slopes, and are highest, steepest, and most unstable where the channel is deeply incised relative to the adjacent land. Channel incision is most dramatic in the central portions of the creek (Reach 3 and Reach 4). In these areas, the channel has eroded as much as 25 feet below the top-of-bank. In other areas (e.g. small sections of Reach 3), although the channel is incised, the bank slopes are more stable and are supported by riparian vegetation. Immediately upstream of structures that stabilize the channel grade, such as road crossings or rip-rap, channel incision is limited and small inset floodplain areas have developed, which have supported a slight channel meander. In Reach 6, the bed and banks have been stabilized with gabions and are less incised relative to the surrounding area, although the gabions are undercut and failing. Much of the creek bed in this reach has been lined with crushed rock approximately 6 to12 inches in diameter, held in place by chain-link fence material staked flat against the rocks. This technique was used to minimize erosion and shifting of the channel, but has reduced functions and values of the reach and will ultimately fail. Trees and other vegetation form a canopy over most of the creek and its tributaries. A more detailed reach-by-reach description is provided in Appendix B.

The unculverted portion of Hospital Creek extends approximately 299 linear feet upstream from its confluence with Rifle Range Creek. The banks of Hospital Creek are heavily overgrown with non-native species. However, the upland hillslope to the south of the channel is stable, steep, and well vegetated with mature oaks.

The unculverted portion of Powerhouse Creek extends approximately 201 linear feet upstream from its confluence with Rifle Range Creek, and is deeply incised into the surrounding landscape. Several concrete block structures create channel steps in the creek to increase bank stability.

A wetland delineation of the Project Area was conducted by WRA on May 30 and 31, and June 21 and 28, 2006 and a jurisdictional determination was issued by the Corps on December 4, 2007 (Corps File No. 4002405) (WRA 2007). A total of 2,779 linear feet of free-flowing Waters of the United States and 1,041 linear feet of culverted Waters of the United States from Rifle Range Creek, 201 linear feet of Waters of the United States from Powerhouse Creek, and 299 linear feet of Waters of the United States from Hospital Creek were identified within the Project Area (Figure 4). The delineation was later re-verified by the Corps on May 16, 2013.

4.1 Location

As shown in Figure 3, the Restoration Area has a north-south alignment through the center of the Project Area. The Restoration Area includes Rifle Range Creek and short portions of two tributaries, associated riparian habitat, and adjacent upland areas that will be restored along with the riparian habitat to serve to broaden the restored riparian corridor.

4.2 Ownership Status

The owner of the site, including the Restoration Area, is Oak Knoll Venture Acquisition, LLC.

4.3 Existing Conditions within the Restoration Area

4.3.1 Hydrology

The principal hydrologic sources within the Restoration Area are direct precipitation, surface runoff, and storm drain flows.

4.3.2 Soils

The soils within the Restoration Area include two of the five soil types found within the Project Area: Xerorthents-Millsholm complex, 30 to 50 percent slopes, and Botella Loam, 0 to 2 percent slopes.

Botella loam, 0 to 2 percent slopes. The Botella series consists of very deep, well-drained soils that formed in alluvium that derived mainly from sedimentary rock sources. Botella soils are on low terraces and alluvial fans and have slopes ranging from 0 to 2 percent. Surface runoff is slow, and the hazard of erosion is slight. In most areas this soil is used for urban development. In some areas it is used for vegetable crops. Inclusions of this soil are listed as hydric when they occur in floodplains (USDA-NRCS 1992).

Xerothents-Millsholm complex, 30 to 50 percent slopes. The soils in this complex are roughly 70 percent loamy Xerothents and 20 percent Millsholm loam. Included in mapping, and making up 10 percent of the complex, are small areas of Maymen loam and Los Gatos loam. The Xerothents in this complex are well drained to somewhat excessively drained. They consist of soil material that has been altered by cutting or filling for urban development; as a result, they have variable soil characteristics. Runoff is rapid, and the hazard of erosion is high. The Millsholm soil is shallow and well drained. It formed in residuum of shale and fine-grained sandstone. This soil makes up most of the undisturbed areas in this complex. Runoff is rapid, and the hazard of erosion is high. Areas of this complex are used primarily as sites for residential developments. This soil type is not listed as a hydric soil (USDA-NRCS 1992).

4.3.3 Vegetation

Restoration activities will impact portions of existing riparian vegetation, non-native grassland, and landscaped areas dominated by blue gum eucalyptus and Monterey pine trees. Riparian areas occur along the entire length of Rifle Range Creek and its tributaries with the exception of some of the culverted reaches of Rifle Range Creek. Approximately 4.19 acres of riparian habitat along Rifle Range Creek and its tributaries will be removed and replanted. An additional 2.66 acres of riparian habitat will be preserved and enhanced (Figures 6a–6e). Existing vegetation within the Restoration Area includes coast live oak riparian forest, coast live oak woodland, and non-native plant communities.

Coast live oak riparian forest on the site is dominated by coast live oak (*Quercus agrifolia*), willow (*Salix* spp.), horsetail (*Equisetum* sp.), California blackberry (*Rubus ursinus*), poison oak (*Toxicodendron diversilobum*), and sedge (*Carex* sp.). Non-native species present in coast live oak riparian forest include: Himalayan blackberry (*Rubus armeniacus*), periwinkle (*Vinca major*), and western hemlock (*Tsuga heterophylla*). This habitat type is restricted to a narrow, fragmented strip along Rifle Range Creek.

Coast live oak woodland is dominated by coast live oak with an understory of non-native annual grasses. This community is located primarily adjacent to Reach 3 within the Restoration Area. Monterey pine and eucalyptus are present in some areas, as well as native species such as Pacific madrone (*Arbutus menziesii*) and California poppy (*Eschscholzia californica*).

Non-native communities in the Restoration Area are categorized together in Figure 3, and are characterized by scattered pockets of disturbed habitat dominated by varying mixes of non-native trees, shrubs, grasses, and forbs. Dominant species include eucalyptus, Monterey pine, scotch broom (*Cytisus scoparius*), slender wild oat (*Avena barbata*), rip-gut brome (*Bromus diandrus*), perennial mustard (*Hirschfeldia incana*), yellow star thistle (*Centaurea solstitialis*), and purple star thistle (*Centaurea calcitrapa*).

4.4 Proposed Impacts within the Restoration Area

4.4.1 Creek Impacts

Many portions of Rifle Range Creek currently exhibit signs of active erosion, are devoid of vegetation, and/or have undercut gabions. Restoration and enhancement efforts along Rifle Range Creek and its tributaries would temporarily impact 3,279 linear feet of unculverted waters of the United States due to temporary dewatering and stream diversion during construction. In addition, 1,041 linear feet of culverted waters along Rifle Range Creek will be temporarily impacted, of which 1,010 linear feet will be daylighted (Table 1).

Approximately 450 linear feet of existing channel would be realigned laterally and restored, and a 40-foot wide clear span bridge would be added over one of the realigned sections. Fill material would consist of clean cobbles, gravels, and soil excavated from the channel banks as well as logs and boulders for grade control.

Additional restoration-related activities, including bank stabilization, invasive species removal, and replanting of the riparian habitat using native trees, shrubs, and grasses will occur along Rifle Range Creek and its tributaries. Additional fill would be required between the ordinary high water mark and the top-of-bank to create the floodplain terraces and stabilize creek banks.

Table 1. Impacts to Waters of the United States (below ordinary high water)

Jurisdictional Area	Temporary Impacts[1]		Permanent Impacts[2]		
	Linear Feet	**Acres**	**Linear Feet**	**Acres**	**Cubic Yards**
Rifle Range Creek (includes 0.02 acre of in-stream wetland)	1,395	0.22	1,384	0.21	415
Powerhouse Creek	147	0.02	54	0.01	14
Hospital Creek Waters of the United States (includes 0.01 acre of in-stream wetland)	289	0.04	10	<0.01	7
Total Waters of the United States	**1,831**	**0.28**	**1,448**	**0.22**	**436**
Culverted Waters	1,041	0.11	n/a	n/a	n/a
Total Jurisdictional Waters	**2,872**	**0.39**	**1,448**	**0.22**	**436**

[1]Temporary impacts include the following activities: (1) temporary dewatering/water diversion during construction; and (2) temporary re-grading where the channel will be returned to its existing elevation and alignment.
[2]Permanent impacts include the following activities: (1) fill for channel realignment; (2) installation of rock step pools and logs for grade control and erosion protection; and (3) channel roughening for grade control.

Table 2. Impacts to Waters of the State (below top of bank)

Jurisdictional Area	Temporary Impacts[1]		Permanent Impacts[2]		
	Linear Feet	**Acres**	**Linear Feet**	**Acres**	**Cubic Yards**
Unculverted Waters	1,831	0.28	1,448	0.22	436
Culverted Waters	1,041	0.11	n/a	n/a	n/a
Riparian Stream Banks	n/a	2.13	n/a	0.25	3,638
Total Impacts to Waters of the State	**2,872**	**2.52**	**1,448**	**0.47**	**4,074**

[1]Temporary impacts include the following activities: (1) temporary dewatering/water diversion during construction; (2) temporary re-grading where the channel will be returned to its existing elevation and alignment; and (3) re-grading of the stream banks to support the restoration and enhancement of the riparian corridor.
[2]Permanent impacts include the following activities: (1) fill for channel realignment; (2) installation of rock step pools and logs for grade control and erosion protection; and (3) channel roughening for grade control.

4.4.2 Tree Impacts

Tree removal would be required to facilitate restoration activities including bank stabilization. A comprehensive tree survey of the Project Area and Restoration Area was conducted in 2006 and will be updated in 2015. The following data was collected for each tree:

- Each tree was identified to species
- Each tree was permanently tagged with a unique identification number and its location was mapped with GPS
- The diameter of each tree was measured at a point 54" above grade.
- The health and structural condition was rated using a 0-5 scale.
- The suitability for preservation was evaluated based on a combination of variables including health, age, and structural condition of the tree.

The highest quality trees were identified early in the restoration planning process and were avoided to the maximum extent practicable while still achieving the goals of the Project. Table 3 provides a preliminary list of all protected trees under the City of Oakland Tree Ordinance that would be removed in the Restoration Area, based on the 2006 tree survey. The City of Oakland Tree Ordinance defines protected trees to include all oak trees 4" or greater in diameter at breast height (DBH) and other species (excluding Monterey pine and blue gum) that are 9" or greater in DBH. Based on 2006 tree survey data, a total of 251 trees (217 of which are native trees) protected trees will be removed (Table 3): 120 trees greater than nine inches diameter at breast height (DBH) and 131 coast live oaks with DBH greater than four inches. This list will be updated in 2015 and all tree impacts will be mitigated for in accordance with the City of Oakland Tree Ordinance and other applicable regulations. Based on preliminary analysis, we anticipate the number of trees impacted will be up to 15% greater than was estimated using 2006 data due to tree growth and recruitment.

Table 3. Preliminary List of Trees to be Removed within the Restoration Area

Common Name	Scientific Name	Number of Trees to be Removed	Trunk DBH Range (inches)
Native Species			
California bay	*Umbellularia californica*	1	15
California buckeye	*Aesculus californica*	2	17
Coast live oak	*Quercus agrifolia*	131	4-43
Coast redwood	*Sequoia sempervirens*	2	16-25
Blue elderberry	*Sambucus mexicana*	5	6-15
White alder	*Alnus rhombifolia*	27	7-36
Willow	*Salix spp.*	49	6-44
Non-native Species			
Bailey's acacia	*Acacia baileyana*	1	5-18
Blackwood acacia	*Acacia melanoxylon*	13	18-2
Blue gum	*Eucalyptus globulus*	2	32-48
Lombardy poplar	*Populus nigra*	8	7-25
London plane	*Platanus hybrida*	4	18-30
Plum	*Prunus sp.*	2	7-8
Spruce	*Picea sp.*	1	9
Victorian box	*Pittosporum undulatum*	3	9-11
		251	

Note: Tree impacts are based on 2006 tree survey data and need to be re-calculated based on 2015 tree survey data when available.

4.4.3 Functions and Values of the Jurisdictional Areas to be Restored

Typical functions and values attributed to Waters of the United States and associated riparian habitat include attenuating flood flows, sediment, nutrient, and toxicant retention/transformation, erosion control, habitat for wildlife, and recreation. The functions and values of the jurisdictional areas proposed to be impacted within the Restoration Area are generally rated low to moderate because of their poor quality, small size, and surrounding land uses (Table 4).

Table 4. Existing Functions and Values within the Restoration Area

Function or Value	Rating of Function or Value	Rationale
Store and/or convey flood water	Low	The current incised and degraded nature of Rifle Range Creek results in less efficient flow conduction and increased rates of erosion.
Buffer storm surges	Low	The current incised and degraded nature of Rifle Range Creek makes the drainage less efficient at directing and containing storm surge flows.
Sediment and toxicant retention and stabilization	Low	The current incised nature of many areas of the drainage result in inadequate retention and stabilization of sediments and toxins.
Production export	Low	Most banks immediately adjacent to the drainage contain little vegetation and are heavily disturbed.
Uniqueness heritage	Moderate	Although currently of poor quality, Rifle Range Creek is the largest of three tributaries draining the Oakland hills watershed to Arroyo Viejo.
Nutrient removal/transformation	Low	Nutrient input is low due to the degraded state of surrounding habitat; also minimal vegetation in the small in-stream wetland areas does not adequately trap nutrients.
Wildlife diversity/abundance	Moderate	Although small and highly disturbed, Rifle Range Creek provides wildlife habitat in an otherwise urban surrounding; substantial presence of non-native vegetation in riparian corridor.
Aquatic diversity/abundance	Low	The current disturbed state of the drainage provides little habitat for aquatic life.
Recreational opportunities	Low	The site is currently fenced and unavailable for use by the public.

4.5 Present and Historical Uses of Restoration Area

During the Navy's tenure on the site, channel and bank erosion problems were treated by introducing rock and concrete rubble into the channel in various forms; some of these materials have provided a haphazard form of grade control. Despite these erosion control efforts, Rifle Range Creek and its tributaries have experienced channel incision as a result of increased runoff and more rapid concentration of peak flows from the urbanization of both on-site areas and off-site areas upstream of the Project Area.

4.6 Present and Proposed Uses of Adjacent Areas

Areas immediately surrounding the Restoration Area are characterized by decommissioned naval hospital and base facilities, including roads, parking lots, and landscaped areas. Areas adjacent to the riparian corridor will be developed into housing and commercial uses as part of the Oak Knoll Mixed Use Community Development Project. Once restored, Rifle Range Creek will provide a natural, continuous corridor through the larger Project Area.

5.0 PROPOSED CONDITIONS OF RESTORATION AREA

Implementation of the restoration program described in this Plan will result in the daylighting of a majority of the culverted portions of Rifle Range Creek, repair and reconstruction of most of the creek channel, and enhancement and expansion of degraded riparian habitat in the Restoration Area. Unculverted waters on the site will increase from 3,279 linear feet to 4,289 linear feet. The total acreage of riparian habitat and associated native upland vegetation will increase from 6.85 acres to 15.97 acres.

5.1 Restored Riparian Corridor Description

Rifle Range Creek and its tributaries within the Restoration Area have been impacted by upstream watershed development, as well as the Oak Knoll Naval Hospital development and infrastructure. Typical of many East Bay creeks, there is evidence of active erosion in the creek channel and along the banks, leading to unstable conditions in some areas. Despite the impacts of urbanization, the creek has largely maintained its original alignment and supports a corridor of riparian vegetation along the open channel reaches. Restoration activities will lead to a substantial increase in linear feet of unculverted Waters of the United States, as well as a significant increase in the acreage of the riparian corridor (Table 5). By restoring and enhancing Rifle Range Creek and its tributaries, project proponents aim to enhance the riparian habitat value, stabilize the creek channel and banks, accommodate stormwater flows, provide aesthetic amenities, allow for limited public access, and remove non-native species.

Table 5. Existing Proposed Habitats

Habitat	Pre-Restoration (Existing)	Post Restoration (Proposed)
Waters of the United States (unculverted)	3,279 linear feet; 0.50 acre	4,302 Linear feet; 1.19 acres
Waters of the United States (culverted)	1,921 linear feet; 0.21 acre	911 linear feet; 0.11 acre
Total Waters	5,200 linear feet; 0.72 acre	5,213 linear feet; 1.30 acres
Riparian Habitat (including riparian edge)	8.04 acres	15.97 acres

5.1.1 Structural Restoration Activities and Grading Plan

The Restoration Project Area comprises six reaches of Rifle Range Creek and two associated tributaries, Powerhouse Creek and Hospital Creek (Figures 3-5). In addition, three in-stream wetlands are present within Rifle Range Creek. The six reaches of Rifle Range Creek have been numbered from 1 to 6 starting at the downstream end. Currently, Rifle Range Creek is composed of both open channel sections and culverted sections. Active erosion is evident in the creek channel and along both banks. Channel incision has resulted in a deepened channel with over-steepened banks. The channel has an average grade of approximately three percent within the Project Area.

The overall restoration approach is to daylight all four of the culverts in the project reach; remove non-native vegetation and replant with native plants; remove existing obsolete infrastructure (e.g. stormdrain outfalls), trash and construction debris from the channel and banks; stabilize headcuts in two deeply incised reaches that threaten upstream areas; and use a combination of grading and biotechnical methods to stabilize actively eroding bank areas that are too steep to support riparian vegetation. A total of 1,010 feet of culverted channel would be daylighted and restored, approximately 450 feet of existing channel would be realigned laterally and restored, and a 40-foot wide clear span bridge would be added over one of the realigned sections. Overall, the Project would result in a net increase of both jurisdictional other waters and riparian habitats (Figures 6a–6j).

Earthwork and grading activities are proposed to reduce bank slopes, reduce the channel gradient, and stabilize the creek banks. A total of 436 cubic yards of fill covering 0.22 acre would be placed within the Ordinary High Water Mark (OHWM) of the creek to re-align and stabilize the channel, and to reduce the channel gradient. Fill material would consist of clean cobbles and gravels as well as logs and boulders for grade control. Additional fill would be required above the OHWM to create the floodplain terraces and stabilize creek banks.

Grading would be required to reduce channel slopes and to establish suitable conditions for the installation of stabilization structures and plantings. Grading activities would include re-profiling the creek banks, and roughening the channel to stabilize major knick points and provide continuity of the channel gradient (Figures 6a–6j). The existing and proposed creek profile is shown in Figure 7 and the typical creek channel cross-section that would result from these activities is shown in Figure 8. The newly restored channel would typically consist of a 12-foot-wide low flow channel, a floodplain terrace up to 40-feet-wide, and channel banks at between 1.5:1 and 3:1 slopes. Appropriate native vegetation would be selected based on slope characteristics and proximity to the creek (Figure 9).

In order to reduce the channel gradient and the associated stresses placed on the channel bed, the restoration project would include the installation of a series of steps as grade controls in selected locations along the length of the channel, including log drops and boulder step pools. These steps would be primarily located in daylight reaches where the steepness of the culvert to be removed necessitates grade control to create a stable slope (Figures 6a–6j and Figures 10a–10d). Approximately 20 to 40 log drops and ungrouted boulder step pools would be installed in Reaches 4, 5, and 6. The gradient of Reach 3 is primarily bedrock controlled, but a roughened channel section is proposed in the southern portion to stabilize an existing headcut. This roughened channel would extend into the northern and central portions of Reach 2. Reach 1 would be stabilized with grade control structures and log drops.

Excavation work is proposed along Reach 5. This portion of the creek is currently piped underground through a 636-foot-long culvert. Reach 5 would be daylighted by reconstructing an open channel. Culverts and fill material associated with road crossings would also be removed from this reach. The creek would be reconstructed and a bridge with a 60-foot span over the channel would be installed at the downstream end of Reach 5 (Figures 6f and 11).

5.2 Anticipated Functions and Values of the Restoration Area

The riparian and aquatic habitat created on the site would provide increased functions and values as outlined in Table 6.

Table 6. Anticipated Functions and Values for the Restoration Area

Function or Value	**Rating of Function or Value**	**Rationale**
Store and/or convey flood water	High	Stabilizing the channel banks, raising the channel bottom, and expanding the floodplain within Rifle Range Creek will result in improved storage and conveyance of floodwaters. The restored creek will safely accommodate storm flows.
Buffer storm surges	High	The increased width of the floodplain within restored Rifle Range Creek will provide additional area to accommodate storm surges.
Sediment and toxicant retention and stabilization	High	The increased vegetation cover and width of the drainage, and resultant decreased flow rate, will greatly enhance the retention and stabilization of sediments and toxins.
Production export	High	The planting plan for the restored riparian corridor will increase vegetation and biomass production in the riparian corridor.
Uniqueness heritage	High	Rifle Range Creek enters and exits the Restoration Area through culverts, which then flow under urban development. The restored creek and associated riparian and buffer habitats, will form a continuous corridor with high biological habitat value in an otherwise largely urban area.
Nutrient removal/transformation	High	Nutrient removal and transformation processes will be improved within the restored Rifle Range Creek and its tributaries as a result of increased vegetation along creek banks.
Wildlife diversity/abundance	High	Wildlife diversity and abundance will increase after the restoration due to increased quality and size of the drainage and riparian areas, and a continuous vegetated corridor.
Aquatic diversity/abundance	High	Aquatic diversity and abundance will increase after the restoration due to increased habitat quality, increased habitat diversity, and reduction in water flow rate as a result of increased riparian vegetation and widening the floodplain.
Recreational opportunities	High	The restored riparian areas will provide birdwatching and educational opportunities. A recreational path will be located within the riparian edge/buffer adjacent to the restored riparian habitat.

5.3 Impact Avoidance Measures

In order to minimize impacts, the following measures shall be implemented:

- Silt fences will be erected around the perimeter of the riparian corridor during excavation to prevent sediment runoff.
- Soil stockpiles will be covered and surrounded by berms or gravel bags.
- The construction limit of disturbance will be clearly identified in the field.
- All disturbed areas will be protected from erosion by top hydroseeding and mulching, soil binders, or erosion control matting after final grading.
- All soil erosion and sediment control measures will be kept in place until construction is complete and/or the disturbed area is stabilized.
- Prohibit excavation, grading, drainage, and leveling within the dripline of any preserved tree unless approved by the project consulting arborist.
- Prohibit disposal or depositing of oil, gasoline, chemicals, or other harmful materials within the root protection zone of preserved trees or in drainage channels, swales, or areas that may lead to the dripline.
- Exclusionary fencing will be installed as necessary in areas where proposed public access, including streets and trails, are immediately adjacent to riparian areas. Such fencing will be designed to limit public access to 'riparian edge' areas, and to allow for unimpeded passage of wildlife along and across the riparian corridor.

5.4 Planting Plan

The restored habitat will have three planting zones depending on elevation from the creek, and the plant species used in each zone will vary by location along creek. The three zones are: riparian floodplain zone, riparian upper bank, and riparian edge/buffer zone (Table 7). Plant species used in habitat restoration will be native riparian species currently found in the Project Area (Table 8).

Specifically tailored planting plans will be applied to the unique grading and slope conditions associated with the four different bank treatment types, with each plan incorporating the three riparian and riparian edge/buffer planting zones (Figure 9). All plantings will occur in specified planting areas (Figures 6a-6j). The bank treatment types are referred to as (1) bank grading; (2) preserve existing bank; (3) biotechnical stabilization; and (3) tree protection. Schematic drawings are included in Figure 9 and each bank treatment type is described below. Planting lists in each bank treatment type description below focus on upper bank planting. The riparian edge will be planted with oaks and native shrubs that can tolerate drier conditions, and species composition of the riparian edge will vary slightly between the four bank treatment types to fit in with existing preserved native habitat and soil and slope conditions.

Table 7. Proposed Plantings and Other Treatments within Each Planting

Riparian Habitat Zone	Elevation	Proposed Vegetation	Erosion Control
1. Riparian Floodplain	one to three feet above stream thalweg	Primary: willow and alder Secondary: blue elderberry and creek dogwood at densities typical of riparian environments.	Use of natural materials, such as rocks, boulders, and logs as appropriate in the final design to create in-stream habitat and to control erosion
2. Riparian Upper Bank	three to 10 feet above stream thalweg	coast live oak, California buckeye, California bay, willow at densities typical of riparian environments. Understory: California blackberry, California rose, snowberry, and native grasses.	Use of bank erosion materials to control erosion until vegetative cover is established.
3. Riparian Edge/Buffer	greater than 10 feet above stream thalweg	Native grasses, shrubs, oak woodland species at densities typical of 'riparian edge' environments.	Use of slope erosion materials where necessary to control erosion until vegetation cover is established.

Table 8. Proposed Plant Palette for Riparian and Buffer Planting Areas

Botanical Name	Common Name
Aesculus californica	California buckeye
Alnus rhombifolia	white alder
Baccharis pilularis	coyote brush
Cornus sericea	creek dogwood
Heteromeles arbutifolia	toyon
Quercus agrifolia	coast live oak
Rhamnus californica	coffeeberry
Rosa californica	California rose
Rubus ursinus	California blackberry
Salix laevigata	red willow
Salix lasiolepis	arroyo willow
Sambucus mexicana	blue elderberry
Symphoricarpos albus	snowberry
Umbellularia californica	California bay laurel

Bank Grading

The bank grading treatment will be located on banks with slopes three to one or flatter. Approximately 275 trees per acre and 400 shrubs per acre will be planted in restored areas with this treatment. The upper bank will be planted with a diversity of overstory trees and a dense understory of native shrubs. The primary plants in this bank treatment include California buckeye, white alder, toyon, willow species, and California bay.

Preserve Existing Bank

The "preserve existing bank" treatment will be located on banks where no grading is proposed. Approximately 50 trees per acre and 400 shrubs per acre will be planted in restored areas with this treatment. Existing native trees and shrubs will be preserved, and existing non-native understory will be removed and replaced with native shrubs. The primary plants in this bank treatment include California buckeye, California rose, snowberry, and coyote brush.

Biotechnical Stabilization

The biotechnical stabilization treatment will be applied on banks with slopes of approximately two to one to three to one. Approximately 150 trees per acre, 400 shrubs per acre, and 350 pole cuttings will be planted in restored areas with this treatment. To supplement adjacent stabilization measures, native trees and shrubs will be planted on the upper bank. Willows, alders, and dogwood will be planted along the low flow channel and terrace for additional stabilization. Additional species included in this bank treatment are coyote brush, coast live oak, coffeeberry, and California rose.

Tree Protection

The tree protection treatment will be applied on banks with slopes of two to one to three to one. Approximately 150 trees per acre and 400 shrubs per acre will be planted in restored areas with this treatment. Under this treatment, signature native trees are to be preserved, potentially with reinforced support from a retaining wall and with supplemental plantings of native shrubs and trees. Native plant species in this bank treatment include white alder, California rose, coast live oak, and elderberry.

5.5 Non-Native Vegetation Removal

Ruderal vegetation, including pampas grass, fennel, broom, and other non-native grasses and weedy species are present throughout the riparian corridor and most abundant in disturbed areas. Removal of all of this non-native vegetation is desirable to establish and maintain a native plant community after restoration and to reduce competition with planted vegetation. During restoration work, all non-native vegetation will be removed from the riparian corridor and adjacent areas.

5.6 Irrigation

Planted trees and shrubs will receive irrigation during the dry season for a minimum of two years, and longer as needed. The restored areas shall be inspected after the second year to determine if irrigation should continue for an additional year. Visual observations of tree health and testing with soil probes can help to determine if further irrigation will be necessary. Irrigation water will be applied in a manner that encourages deep rooting, such as less frequent, but high volume watering. This will ensure the establishment of these plants, lessen the need for continued irrigation, and reduce the need for replacement plantings.

5.7 Implementation Schedule

Planting in a given reach of the riparian corridor will begin after grading activities within that reach of the creek corridor have been completed. To reduce temporal impacts associated with riparian vegetation removal, the completion of plant and irrigation installation will occur within six months of ground disturbance in any given reach of the Restoration Area.

5.8 Construction Drawings

Construction drawings are included in Appendix A (Figures 6a-6j through Figure 12). Prior to construction, final versions of these documents will be submitted to the Corps, Regional Water Quality Control Board (RWQCB), and California Department of Fish and Wildlife (CDFW) in order for agency staff to confirm that the final design is in compliance with the spirit and intention of the design drawings contained herein.

5.9 As-Built Conditions

A letter report and plans outlining the as-built conditions of the restored riparian corridor will be prepared and submitted to the Corps, RWQCB, and CDFW within three months of completing the construction and planting of the Restoration Area.

6.0 MAINTENANCE ACTIVITIES

6.1 Maintenance Plan

The purpose of the maintenance program is to ensure the restored riparian corridor and adjacent areas function effectively and that the ecological values are not compromised by human disturbance, pest species invasions, or erosion. A maintenance schedule for the ten-year monitoring period is included in Table 9. Changes to maintenance activities and additional inspections may be recommended in the annual monitoring report.

6.1.1 Debris Removal

Trash and other refuse shall be removed from the restored riparian corridor on an ongoing basis. Inspections and trash removal shall be conducted at least four times each year.

6.1.2 Sign Inspection

All educational signs posted in the Restoration Area shall be inspected annually. If the signs become illegible, they shall be cleaned. Damaged signs shall be repaired and missing signs replaced.

6.1.3 Erosion Control

Visual monitoring for structural integrity of the restored riparian corridor including creek banks and slopes shall be conducted following storm events. In the event that large flow volumes cause excessive erosion or accretion, the impacted area will be repaired and revegetated immediately.

6.1.4 Non-Native Plants

Maintenance of the Restoration Area will include removal of problematic non-native plant species twice each year. Removal of non-native species may be conducted by a qualified biologist or by maintenance personnel as directed by a qualified biologist.

6.1.5 Trail Maintenance and Access

Trail corridors and any necessary exclusionary fencing within the Restoration Area shall be assessed following large storm events. Recreational trails will be located within the riparian edge/buffer areas with limited crossings into the riparian area. If site access is hindered or trail conditions deteriorate, repairs will be made immediately.

6.2 Property Ownership

Oak Knoll Venture Acquisition, LLC currently owns the proposed Restoration Area. As a result, Oak Knoll Venture Acquisition, LLC will be responsible for maintaining the restored creek corridor. In the event that ownership of the Restoration Area is transferred to another party, responsibility for maintenance activities may be transferred concurrently under agreement between Oak Knoll Venture Acquisition, LLC and the new owner.

Table 9. Restoration Area Maintenance Schedule

Tasks	**Riparian Corridor**	**Riparian Edge/ Buffer**	**Schedule**
Inspect for and remove debris (dead vegetation and trash)	**X**	**X**	Minimum: four times per year
Inspect signs to ensure legibility and presence	**X**	**X**	Minimum: annually
Inspect for erosion on banks and on upland slopes	**X**	**X**	Minimum: after all major storm events
Assess need to remove non-native species	**X**	**X**	Minimum: twice annually in spring and summer
Site access and trail maintenance	**X (limited areas)**	**X**	Minimum: after all major storm events
Retain all records of inspection and maintenance	**X**	**X**	Annually

7.0 MONITORING AND SUCCESS CRITERIA FOR THE RIPARIAN CORRIDOR

Monitoring will be performed in order to determine whether the Restoration Area has achieved proposed success criteria. Monitoring will be conducted in the summer of each year. Survival, health, and relative size of all planted tree and shrub species within the riparian restoration areas will be assessed. Success will be evaluated based on achieving the target canopy coverage of trees and shrubs presented in this Plan, as well as survival of the planted trees and shrubs.

7.1 Restoration Success Criteria

Success criteria for trees and shrubs installed in the planting areas will be based on survival rates, plant growth, and plant vigor assessed by visual observation during the ten-year monitoring period. Plant growth and vigor will be assessed as either "good, fair, poor, or dead". Percent cover and species diversity estimates will be made in areas planted with grasses and forbs. Because of shading effects, it is expected that grass cover will decrease during the monitoring period. The criteria that will be used to determine the success of the Restoration Area are shown in Table 10.

Table 10. Success Criteria for Restoration Areas

YEAR	1	2	3	4	5	6	7	8	9	10
Water quality will resemble that of the upstream and downstream reaches	x	x	x	x	x	x	x	x	x	x
Survival of planted riparian trees and shrubs will exceed 90 percent	x									
Survival of planted riparian trees and shrubs will exceed 85 percent		x	x							
Survival of planted riparian trees and shrubs will exceed 80 percent				x	x					
Survival of planted riparian trees and shrubs will exceed 70 percent						x	x	x	x	x
Invasive plants on the California Invasive Plant Council (Cal-IPC) High list will not exceed five percent cover within the riparian area or re-grade bank.	x	x	x	x	x	x	x	x	x	x
The re-graded portion of the bank will be stabilized by native vegetation and not show signs of significant erosion.	x	x	x	x	x	x	x	x	x	x
The restored reach will have a habitat assessment value greater than the pre-existing reach based on the CDFW California Stream Bioassessment Procedure.	x	x	x	x	x	x	x	x		
The restored reach will have a habitat assessment value at least fifty percent greater than the pre-existing value, and all parameters shall meet suboptimal conditions based on the CDFW California Stream Bioassessment Procedure.									x	x

7.2 Monitoring Methods

An annual monitoring program will be conducted for the restored riparian corridor for ten years. Vegetation monitoring efforts will focus on the success of plant establishment. During each monitoring visit, plant losses and/or damage to other restoration features will be noted, and arrangements will be made for their replacement and/or repair. The survival of trees and shrubs will be determined by counting and assessing the health of plants in the Restoration Area. The first monitoring visit will take place in the late summer after plant installation, and then annually thereafter for a total of ten years. Survival will be based on the number of plants originally installed, and the possibility for greater than 100 percent survival exists if natural regeneration of riparian species occurs in the Restoration Area during the ten-year monitoring period. Plant growth and vigor also will be assessed and rated as good, fair, or poor. Concurrent with the annual vegetation monitoring visit, restored areas of Rifle Range Creek and its tributaries will be visually inspected for signs of excessive erosion.

Photographs of monitored restoration sites will be taken at established photo points during the annual monitoring to document the conditions of restoration plantings. Once a photo point is established, photographs will be taken from that point each year. In addition, annual visual estimates of grass and forb percent cover will be made in planted open areas (i.e., areas within the riparian zone where tree canopy is not expected) beginning six months after initial planting. Estimates of relative abundance for each grass and forb species identified will be recorded.

7.3 Annual Reports to Agencies

Annual reports that discuss monitoring methodology and results will be submitted to the Corps, RWQCB, and CDFW. A qualified biologist with experience in vegetation monitoring will supervise the report preparation. These reports will assess progress in meeting success criteria and identify any problems with flooding, sedimentation, vandalism, and/or other general causes of poor survival or degradation. If necessary, recommendations to improve success in achieving criteria will be made. After ten years, a final report describing the success of the restoration project in meeting the success criteria will be prepared and submitted to the Corps, RWQCB, and CDFW along with an evaluation of the success of any necessary corrective measures undertaken.

8.0 CONTINGENCY MEASURES

If annual or final success criteria are not met, the applicant will prepare an analysis of the cause(s) of failure and, if determined necessary by the Corps, RWQCB, CDFW, propose remedial action for approval. The applicant will be responsible at that time for reasonably funding the contingency procedures necessary for completion of the restoration project.

9.0 COMPLETION OF RESTORATION

9.1 Notification of Completion

Upon completion of ten years of monitoring a final report will be sent to the Corps, RWQCB, and CDFW that details the results of the final year of monitoring. In addition, a Notice of Completion will be prepared, signed by the applicant, and submitted to the Corps, RWQCB, and CDFW to confirm successful completion of the restoration effort.

9.2 Corps Confirmation

The Corps may require a site visit to confirm successful completion of the restoration effort. They may wish to review the restoration areas to determine if all success criteria have been met. If a site visit is requested, the Corps shall contact the Applicant prior to visiting the site.

10.0 REFERENCES

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Reed, P.B., Jr. 1988. National list of plant species that occur in wetlands: California (Region 0). United States Fish and Wildlife Service Biological Report 88(26.10).

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WRA, Inc. 2006. Rare Plant Report. Prepared for SunCal Oak Knoll, LLC.

Appendix A. Project Figures

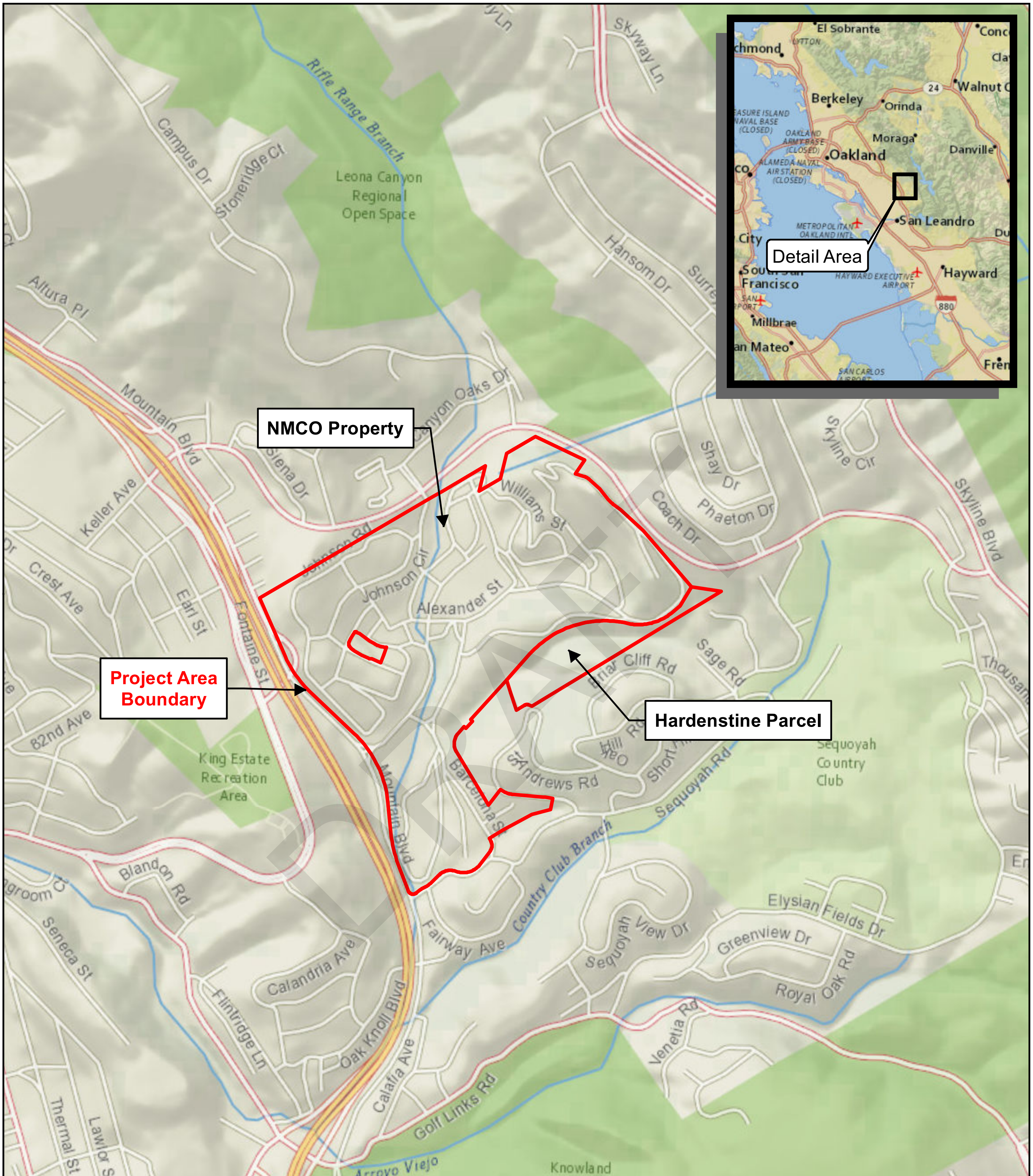

Figure 1. Location Map

Oak Knoll Development
Alameda County, California

Oak Knoll Venture Acquisition LLC
2392 Morse Avenue
Irvine, CA 92614
Contact: Mike Turner
mturner@argentmanagementllc.com

0 1,000 2,000
Feet

ENVIRONMENTAL CONSULTANTS

Map Prepared Date: 2/17/2015
Map Prepared By: czumwalt
Base Source: Esri, National Geographic
Data Source(s): WRA

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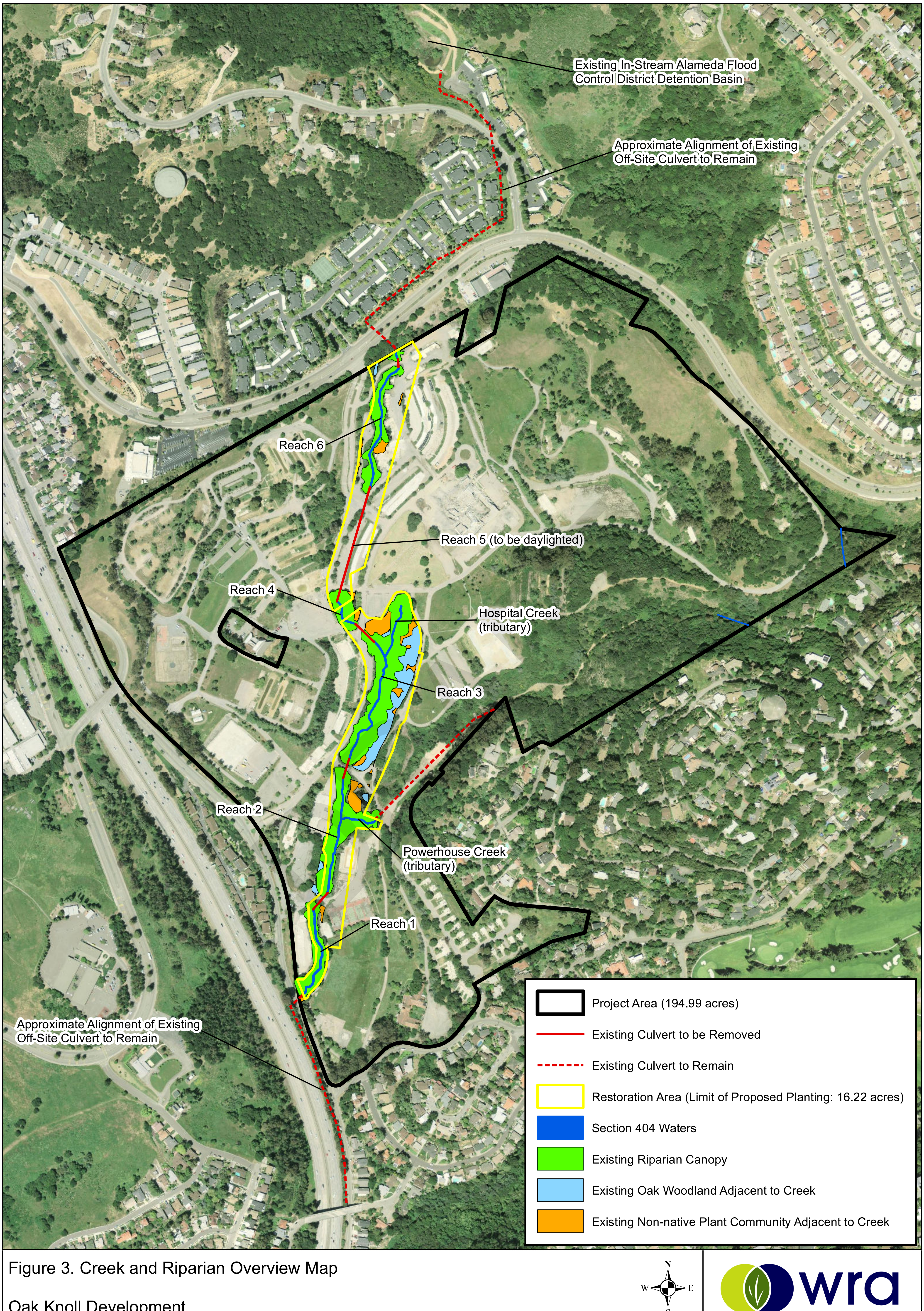

Figure 3. Creek and Riparian Overview Map

Oak Knoll Development
Alameda County, California

Oak Knoll Venture Acquisition LLC
2392 Morse Avenue
Irvine, CA 92614
Contact: Mike Turner
mturner@argentmanagementllc.com

wra ENVIRONMENTAL CONSULTANTS

Map Prepared Date: 3/17/2015
Map Prepared By: czumwalt
Base Source: USGS EROS 2013
Data Source(s): WRA

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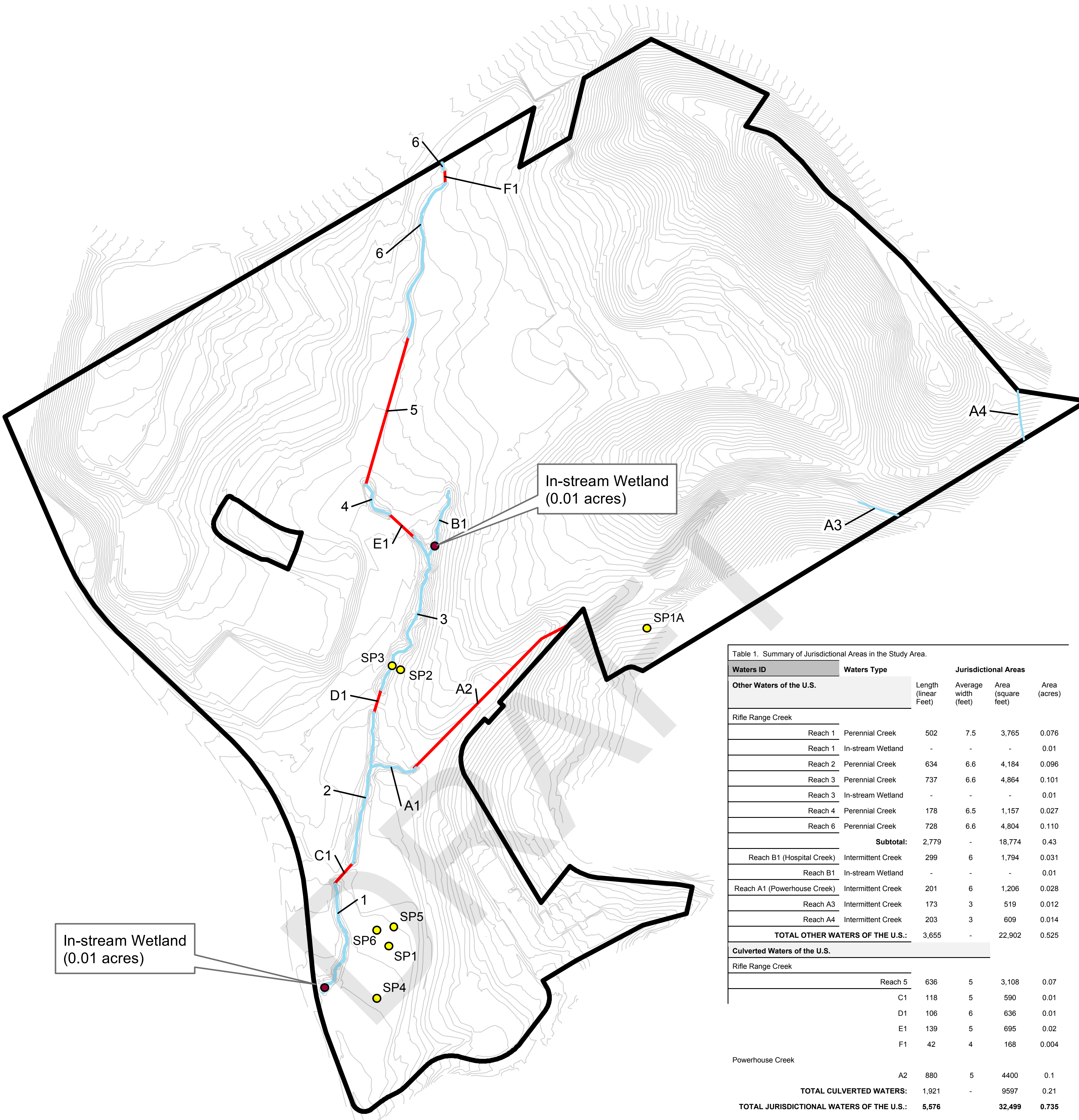

Table 1. Summary of Jurisdictional Areas in the Study Area.

Waters ID	Waters Type	Length (linear Feet)	Average width (feet)	Area (square feet)	Area (acres)
Other Waters of the U.S.					
Rifle Range Creek					
Reach 1	Perennial Creek	502	7.5	3,765	0.076
Reach 1	In-stream Wetland	-	-	-	0.01
Reach 2	Perennial Creek	634	6.6	4,184	0.096
Reach 3	Perennial Creek	737	6.6	4,864	0.101
Reach 3	In-stream Wetland	-	-	-	0.01
Reach 4	Perennial Creek	178	6.5	1,157	0.027
Reach 6	Perennial Creek	728	6.6	4,804	0.110
	Subtotal:	2,779	-	18,774	0.43
Reach B1 (Hospital Creek)	Intermittent Creek	299	6	1,794	0.031
Reach B1	In-stream Wetland	-	-	-	0.01
Reach A1 (Powerhouse Creek)	Intermittent Creek	201	6	1,206	0.028
Reach A3	Intermittent Creek	173	3	519	0.012
Reach A4	Intermittent Creek	203	3	609	0.014
TOTAL OTHER WATERS OF THE U.S.:		3,655	-	22,902	0.525
Culverted Waters of the U.S.					
Rifle Range Creek					
	Reach 5	636	5	3,108	0.07
	C1	118	5	590	0.01
	D1	106	6	636	0.01
	E1	139	5	695	0.02
	F1	42	4	168	0.004
Powerhouse Creek					
	A2	880	5	4400	0.1
TOTAL CULVERTED WATERS:		1,921	-	9597	0.21
TOTAL JURISDICTIONAL WATERS OF THE U.S.:		**5,576**		**32,499**	**0.735**

Legend

- In-stream Wetland
- Sample Point
- Section 404 Waters
- Section 404 Waters in Culvert
- Study Area Boundary

Figure 4. Jurisdictional Wetlands and Waters of the U.S.

Oak Knoll Development
Alameda County, California

N

Feet
0 250 500

ENVIRONMENTAL CONSULTANTS

Date: March 2015
Map By: Derek Chan
Data: WRA, Inc.

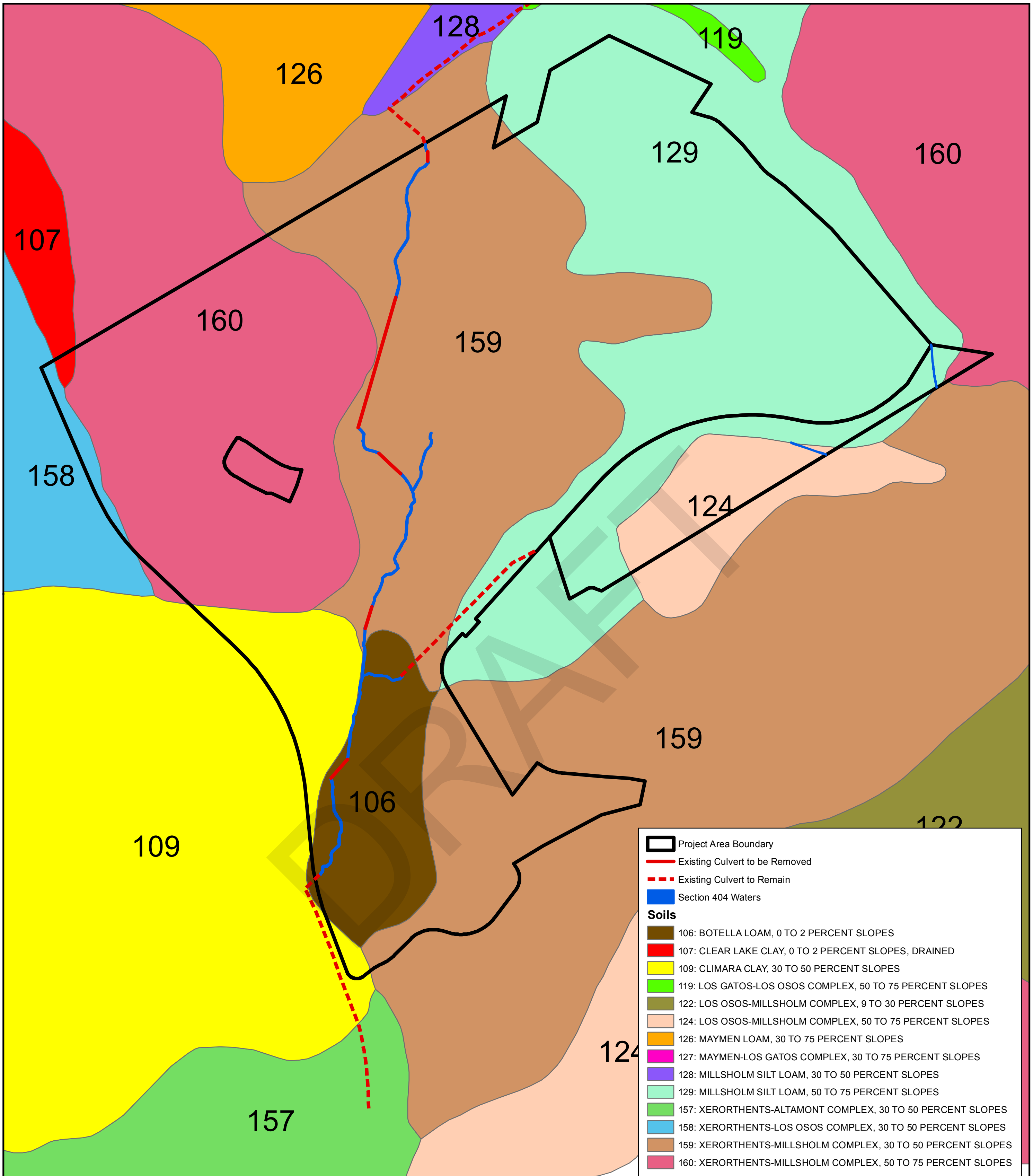

Figure 5. Soils Map

Oak Knoll Development
Alameda County, California

Oak Knoll Venture Acquisition LLC
2392 Morse Avenue
Irvine, CA 92614
Contact: Mike Turner
mturner@argentmanagementllc.com

N W E S

0 300 600 900
Feet

wra ENVIRONMENTAL CONSULTANTS

Map Prepared Date: 3/17/2015
Map Prepared By: czumwalt
Base Source: Esri, National Geographic
Data Source(s): WRA; SSURGO soil survey

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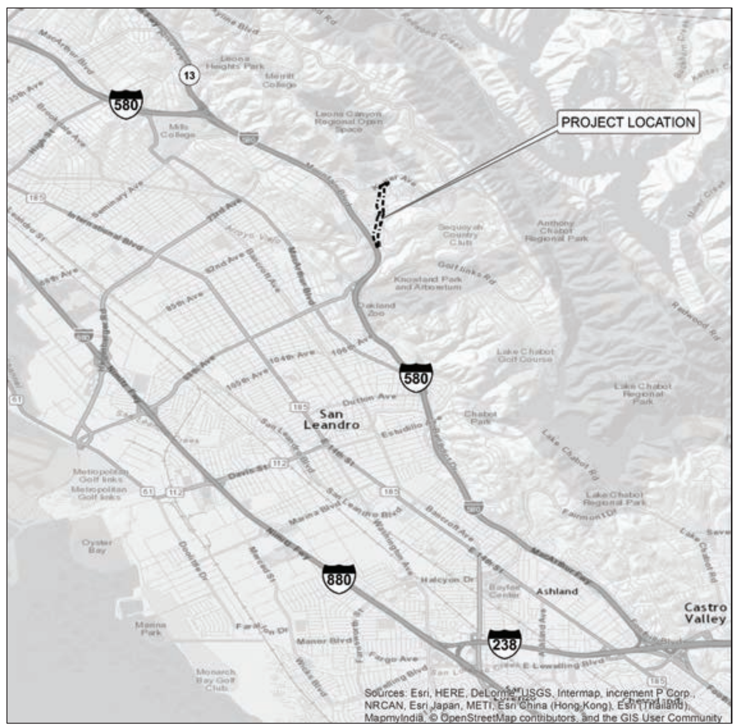
Appendix 7

Rifle Range Creek Channel Improvements - 60% Draft

OAK KNOLL MIXED USE COMMUNITY DEVELOPMENT

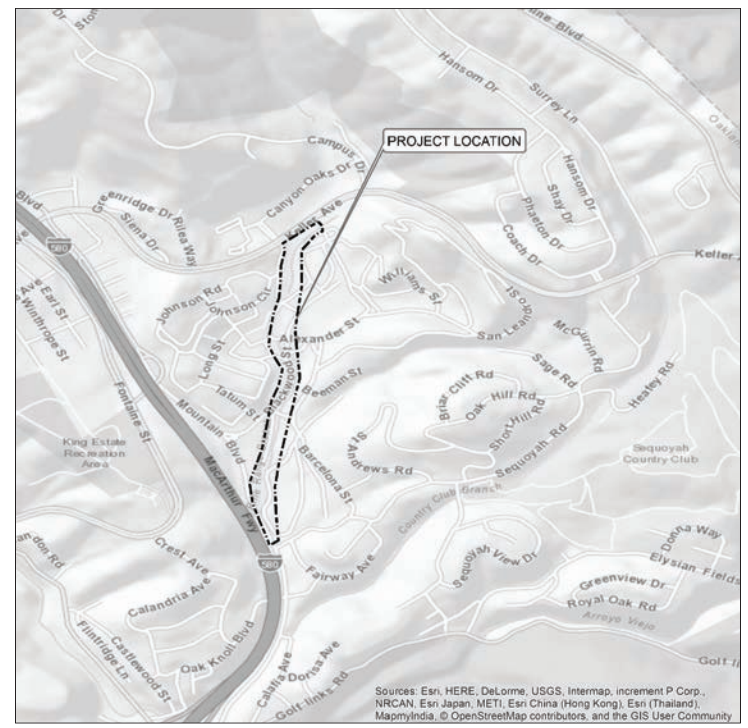
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

OAKLAND, CA



VICINITY MAP

NTS



LOCATION MAP

NTS

SHEET TITLE	SHEET
TITLE SHEET	G0-01
GENERAL NOTES, LEGEND, AND ABBREVIATIONS	G0-02
SHEET KEY	G0-03
PLAN AND PROFILE STA 0+00 TO 5+00	C1-01
PLAN AND PROFILE STA 5+00 TO 8+50	C1-02
PLAN AND PROFILE STA 8+50 TO 12+50	C1-03
PLAN AND PROFILE STA 12+50 TO 16+50	C1-04
PLAN AND PROFILE STA 16+50 TO 21+00	C1-05
PLAN AND PROFILE STA 21+00 TO 26+00	C1-06
PLAN AND PROFILE STA 26+00 TO 31+00	C1-07
PLAN AND PROFILE STA 31+00 TO 35+00	C1-08
PLAN AND PROFILE STA 35+00 TO 39+73	C1-09
POWERHOUSE CREEK GRADING PLAN AND PROFILE	C1-10
HOSPITAL CREEK GRADING PLAN AND PROFILE	C1-11
GRADING SECTIONS STA 0+00 TO 5+00	C3-01
GRADING SECTIONS STA 5+00 TO 8+50	C3-02
GRADING SECTIONS STA 8+50 TO 12+50	C3-03
GRADING SECTIONS STA 12+50 TO 16+50	C3-04
GRADING SECTIONS STA 16+50 TO 21+00	C3-05
GRADING SECTIONS STA 21+00 TO 25+50	C3-06
GRADING SECTIONS STA 26+00 TO 30+50	C3-07
GRADING SECTIONS STA 31+00 TO 35+00	C3-08
GRADING SECTIONS STA 35+50 TO 39+73	C3-09
POWERHOUSE CREEK GRADING SECTIONS	C3-10
HOSPITAL CREEK GRADING SECTIONS	C3-11
BANK TREATMENT SCHEDULE	C5-01
BIOTECHNICAL BANK STABILIZATION	C5-02
STEP POOL STRUCTURE	C5-03
ROUGHENED CHANNEL	C5-04
ROCK CLUSTER AND LOG STRUCTURE DETAILS	C5-05
BURIED GRADE CONTROL STRUCTURE & TYPICAL UPSTREAM SECTION	C5-06

VERIFY SCALE
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

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PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

TITLE SHEET

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED

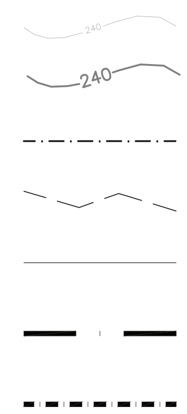
DESIGNED	ESA
DRAWN	M CARTER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	G0-01

1 OF 31

ABBREVIATIONS

DIA	DIAMETER
(E)	EXISTING
EL	ELEVATION
FG	FINISH GRADE
FT	FEET
(N)	NEW
NTS	NOT TO SCALE
LF	LINEAR FEET
MIN	MINIMUM
MAX	MAXIMUM
OC	ON CENTER
RC	RELATIVE COMPACTION
SHT	SHEET
SPECS	SPECIFICATIONS
STA	STATION
TYP	TYPICAL
VAR	VARIES
VSL	VEGETATED SOIL LIFTS

LEGEND



EXISTING CONTOURS

MASS GRADING CONTOURS

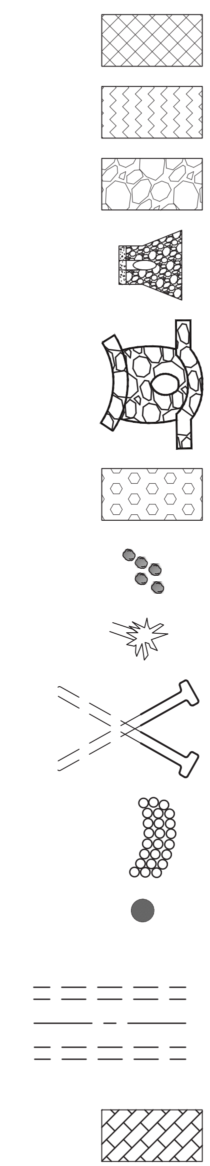
NEW CHANNEL CENTERLINE

EXISTING GRADE (PROFILE AND SECTION)

DESIGN GRADE (PROFILE AND SECTION)

MATCHLINE

GRADING/PROJECT LIMIT



BRUSH MAT

VEGETATED SOIL LIFTS (VSL)

PLANTED ROCK

STORM DRAIN OUTFALL

STEP POOL

ROUGHENED CHANNEL

VEGETATED BOULDER CLUSTER

FLOODPLAIN LARGE WOOD - TYPE I

FLOODPLAIN LARGE WOOD - TYPE II

BURIED GRADE CONTROL

4-TON ROCK BOULDER

NEW CHANNEL GRADING

EMERGENCY SPILLWAY

VERIFY SCALE

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GENERAL NOTES, LEGEND, AND ABBREVIATIONS

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:

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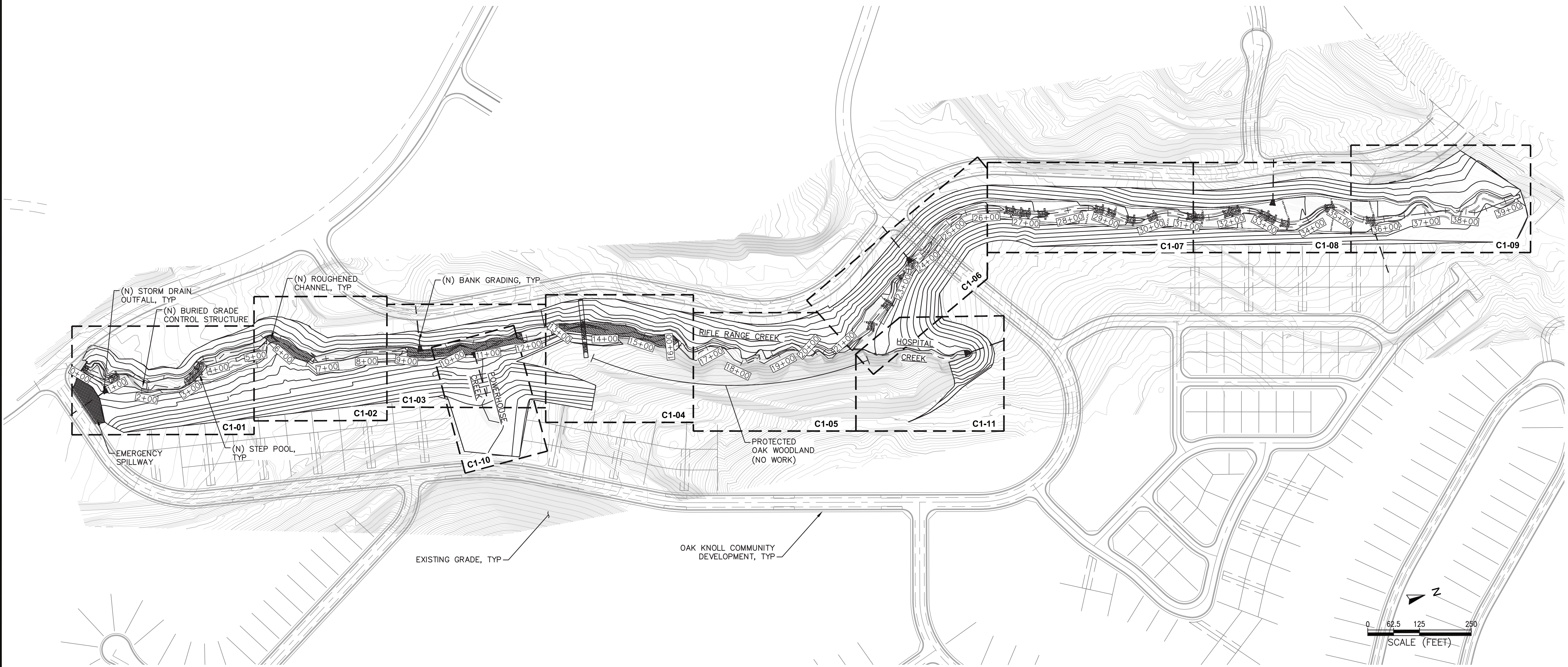
SHEET	G0-02



SHEET NOTES

1. BANK TREATMENTS ARE NOT SHOWN FOR CLARITY. SCHEDULE OF BANK TREATMENTS IS ON SHEET C5-01.
2. CULVERT REMOVAL AND CHANNEL DAYLIGHTING OCCURS FROM STA 5+65 TO 6+42 (77 LF); 13+08 TO 13+98 (89 LF); 22+35 TO 23+50 (115 LF); 25+05 TO 31+05 (600 LF); 38+25 TO 38+65 (40 LF).
3. ALL EXISTING INFRASTRUCTURE WITHIN RIPARIAN CORRIDOR WILL BE REMOVED UNDER SEPARATE CONTRACT PRIOR TO CREEK ENHANCEMENT WORK.
4. EXISTING GRADE SURVEY FOR RIPARIAN CORRIDOR CONDUCTED BY BKF ENGINEERS MAY 2015. HORIZONTAL COORDINATE SYSTEM: CA STATE PLANE ZONE 3. VERTICAL DATUM IS CITY OF OAKLAND (COO).

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SHEET KEY

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
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Irvine, CA 92614

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STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	M CARTER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	G0-03

3 OF 31

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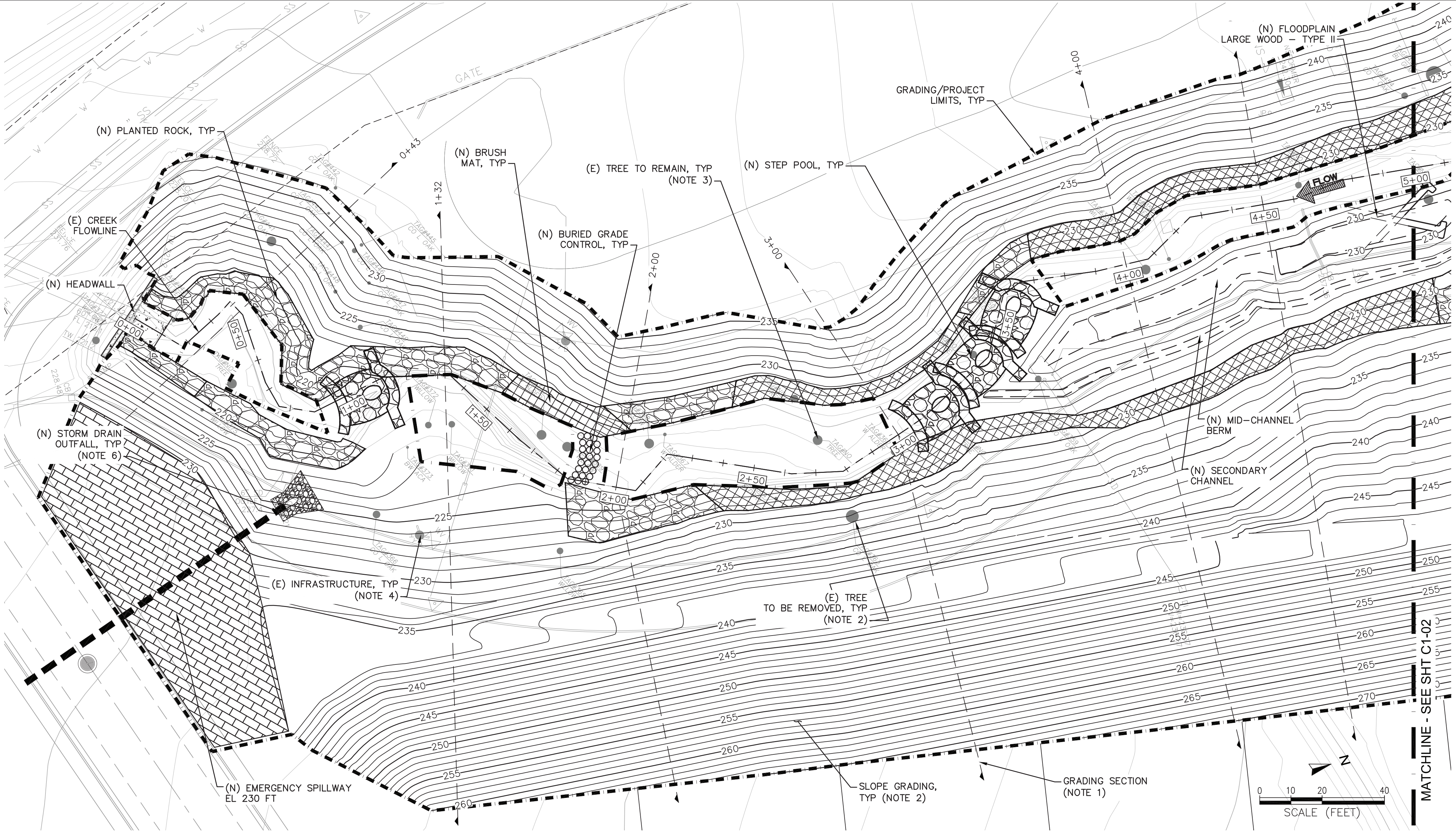

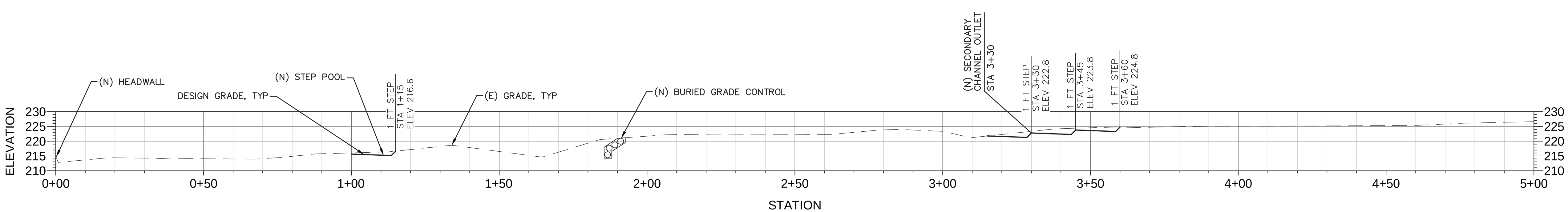

SHEET NOTES

1. GRADING SECTIONS ARE SHOWN ON SHEET C3-01.
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE FROM BELOW CHANNEL INVERT IN LIFTS WITH GEO-GRID AND STABILITY BENCHES. ALL TREES WITHIN GRADING LIMIT WILL BE REMOVED DURING SLOPE GRADING PRIOR TO CREEK ENHANCEMENT WORK.
3. TREES OUTSIDE OF GRADING LIMIT TO BE PRESERVED TO EXTENT POSSIBLE.
4. ALL EXISTING INFRASTRUCTURE WITHIN THE RIPARIAN CORRIDOR WILL BE REMOVED UNDER SEPARATE CONTRACT PRIOR TO BEGINNING THE CREEK ENHANCEMENT WORK.
5. SEE SHEET C5-01 FOR SCHEDULE OF BANK TREATMENT MEASURES. EXTENTS SHOWN ON THIS SHEET.
6. STORM DRAIN PIPE TO BE CONSTRUCTED UNDER SEPARATE CONTRACT BY OTHERS.

LEGEND

	BRUSH MAT	1 / C5-02
	VEGETATED SOIL LIFTS (VSL)	2 / C5-02
	PLANTED ROCK	3 / C5-02
	STORM DRAIN OUTFALL	5 / C5-02
	STEP POOL	1 / C5-03
	FLOODPLAIN LARGE WOOD - TYPE II	3 / C5-05
	BURIED GRADE CONTROL	1 / C5-06

PREPARED BY:

ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

PLAN AND PROFILE
STA 0+00 TO 5+00

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:

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CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	M CARTER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C1-01
	4 OF 31

VERIFY SCALE
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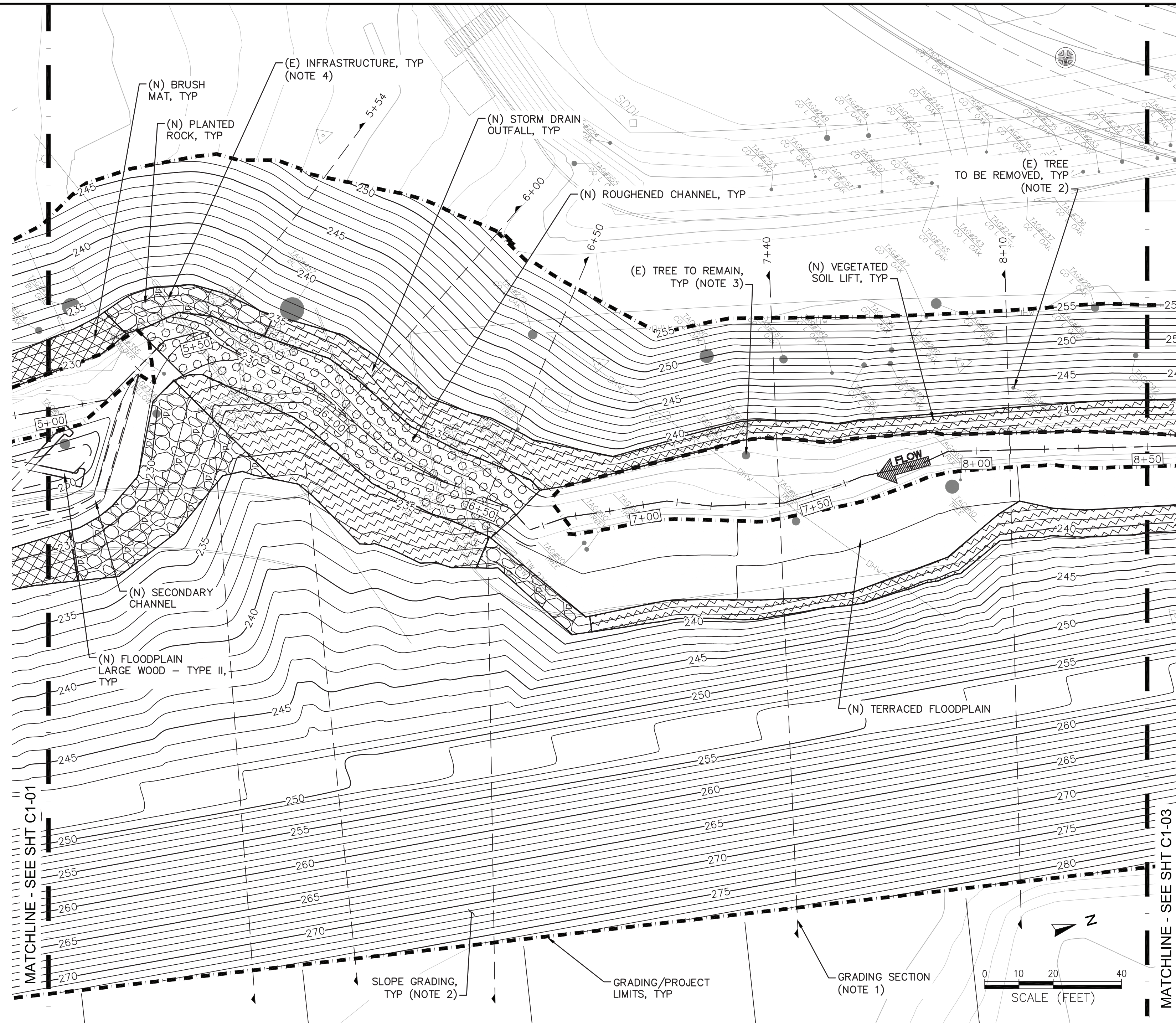

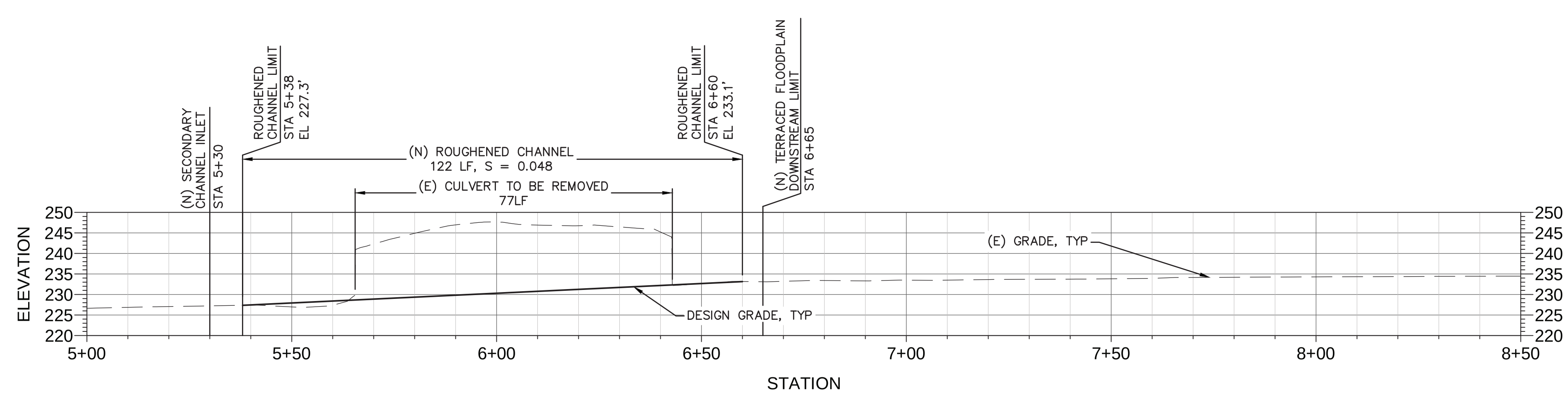

SHEET NOTES

1. GRADING SECTIONS ARE SHOWN ON SHEET C3-02.
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE FROM BELOW CHANNEL INVERT IN LIFTS WITH GEO-GRID AND STABILITY BENCHES. ALL TREES WITHIN GRADING LIMIT WILL BE REMOVED DURING SLOPE GRADING PRIOR TO CREEK ENHANCEMENT WORK.
3. TREES OUTSIDE OF GRADING LIMIT TO BE PRESERVED TO EXTENT POSSIBLE.
4. ALL EXISTING INFRASTRUCTURE WITHIN THE RIPARIAN CORRIDOR WILL BE REMOVED UNDER SEPARATE CONTRACT PRIOR TO BEGINNING THE CREEK ENHANCEMENT WORK.
5. SEE SHEET C5-01 FOR SCHEDULE OF BANK TREATMENT MEASURES. EXTENTS SHOWN ON THIS SHEET.

LEGEND

BRUSH MAT	1 / C5-02
VEGETATED SOIL LIFTS (VSL)	2 / C5-02
PLANTED ROCK	3 / C5-02
STORM DRAIN OUTFALL	5 / C5-02
ROUGHENED CHANNEL	1 / C5-04
FLOODPLAIN LARGE WOOD - TYPE II	3 / C5-05

PREPARED BY:

ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

PLAN AND PROFILE
STA 5+00 TO 8+50

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:

OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	M CARTER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C1-02

5 OF 31

VERIFY SCALE
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

60% DRAFT
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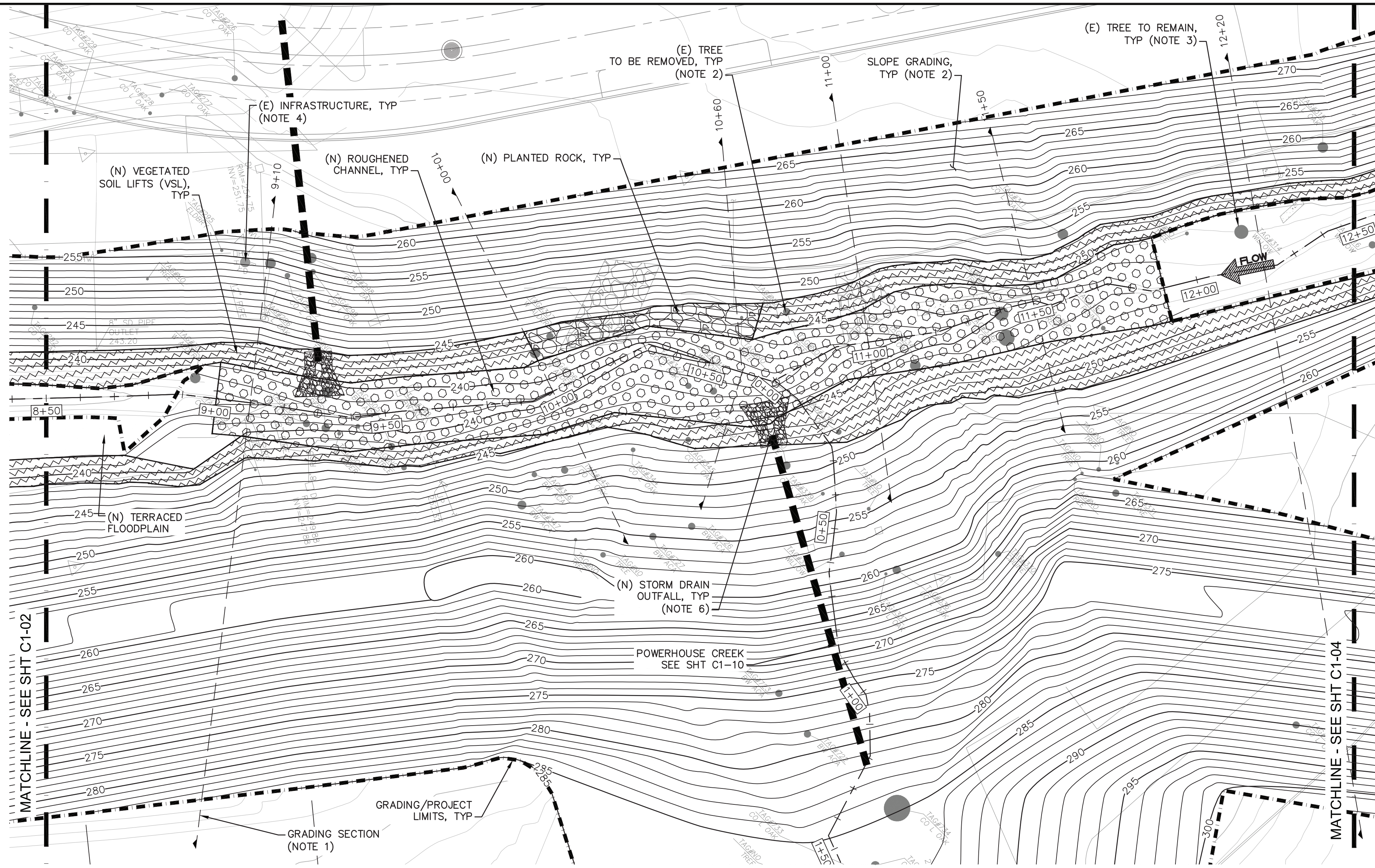

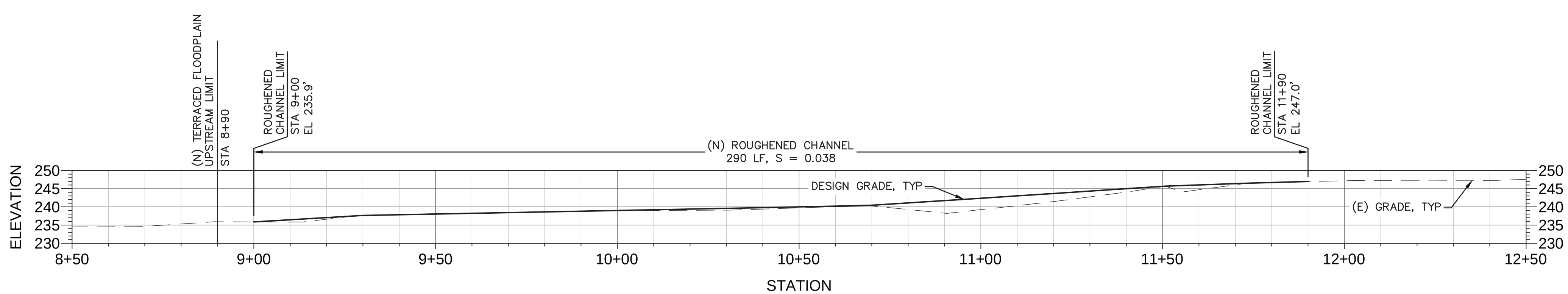

SHEET NOTES

1. GRADING SECTIONS ARE SHOWN ON SHEET C3-03.
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE FROM BELOW CHANNEL INVERT IN LIFTS WITH GEO-GRID AND STABILITY BENCHES. ALL TREES WITHIN GRADING LIMIT WILL BE REMOVED DURING SLOPE GRADING PRIOR TO CREEK ENHANCEMENT WORK.
3. TREES OUTSIDE OF GRADING LIMIT TO BE PRESERVED TO EXTENT POSSIBLE.
4. ALL EXISTING INFRASTRUCTURE WITHIN THE RIPARIAN CORRIDOR WILL BE REMOVED UNDER SEPARATE CONTRACT PRIOR TO BEGINNING THE CREEK ENHANCEMENT WORK.
5. SEE SHEET C5-01 FOR SCHEDULE OF BANK TREATMENT MEASURES. EXTENTS SHOWN ON THIS SHEET.
6. STORM DRAIN PIPE TO BE CONSTRUCTED UNDER SEPARATE CONTRACT BY OTHERS.

LEGEND

VEGETATED SOIL LIFTS (VSL)	2 / C5-02
PLANTED ROCK	3 / C5-02
STORM DRAIN OUTFALL	5 / C5-02
ROUGHENED CHANNEL	1 / C5-04

PREPARED BY:

ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

PLAN AND PROFILE
STA 8+50 TO 12+50

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:

OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	M CARTER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C1-03

6 OF 31

VERIFY SCALE
0 1"
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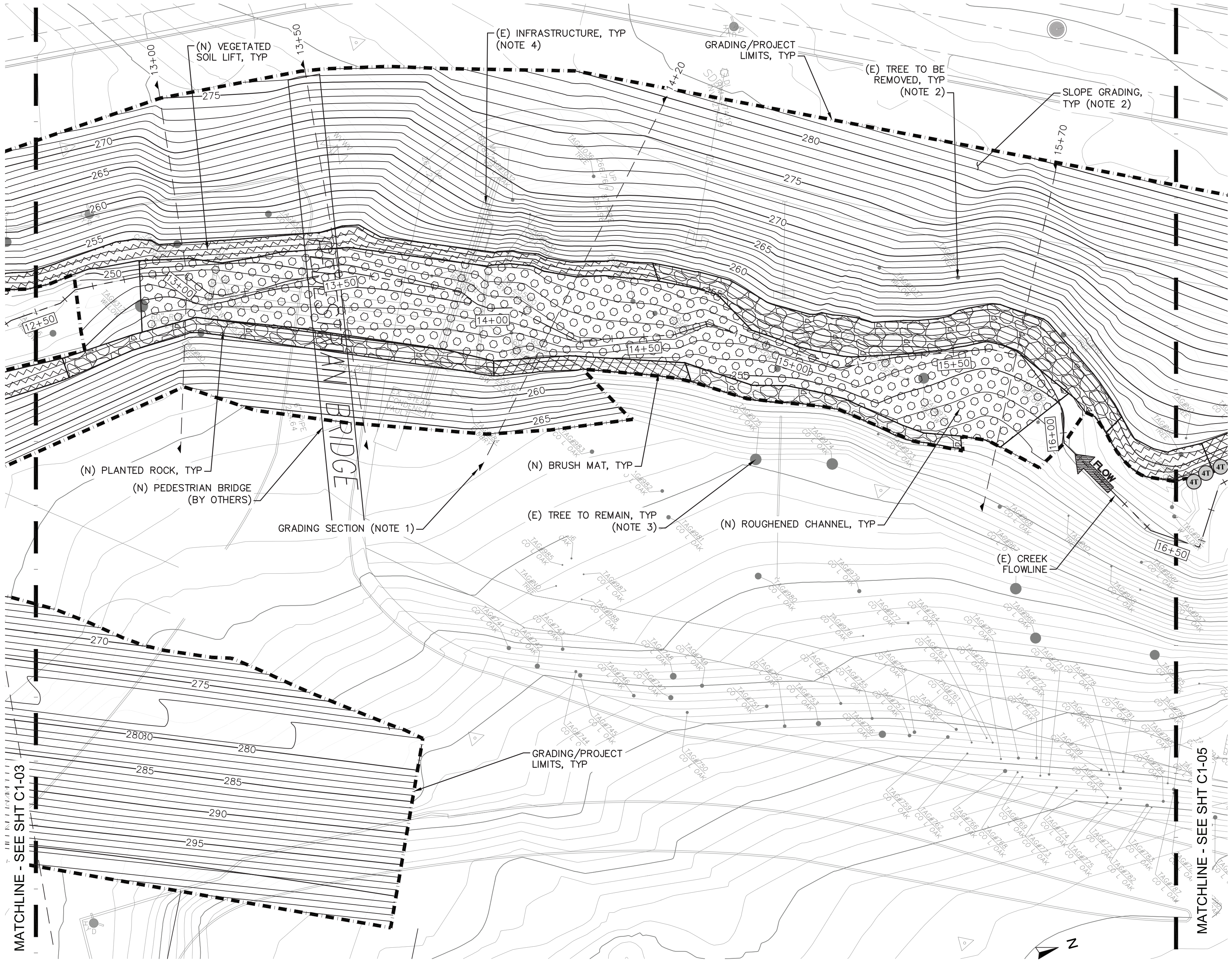

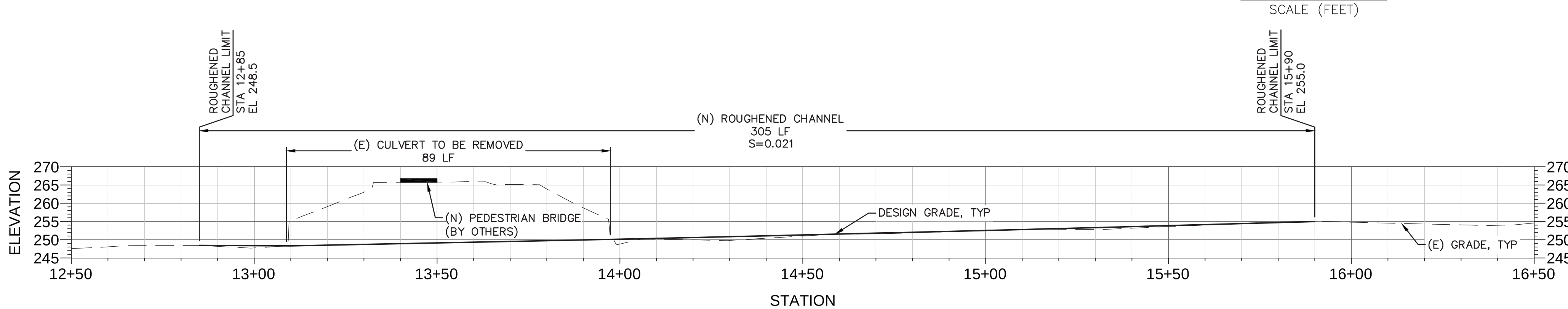

SHEET NOTES

1. GRADING SECTIONS ARE SHOWN ON SHEET C3-04.
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE FROM BELOW CHANNEL INVERT IN LIFTS WITH GEO-GRID AND STABILITY BENCHES. ALL TREES WITHIN GRADING LIMIT WILL BE REMOVED DURING SLOPE GRADING PRIOR TO CREEK ENHANCEMENT WORK
3. TREES OUTSIDE OF GRADING LIMIT TO BE PRESERVED TO EXTENT POSSIBLE.
4. ALL EXISTING INFRASTRUCTURE WITHIN THE RIPARIAN CORRIDOR WILL BE REMOVED UNDER SEPARATE CONTRACT PRIOR TO BEGINNING THE CREEK ENHANCEMENT WORK.
5. SEE SHEET C5-01 FOR SCHEDULE OF BANK TREATMENT MEASURES. EXTENTS SHOWN ON THIS SHEET.

LEGEND

	BRUSH MAT	1 / C5-02
	VEGETATED SOIL LIFTS (VSL)	2 / C5-02
	PLANTED ROCK	3 / C5-02
4T	4-TON ROCK BOULDER	2 / C5-06

VERIFY SCALE
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

60% DRAFT
NOT FOR CONSTRUCTION

PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

PLAN AND PROFILE
STA 12+50 TO 16+50

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	B TANAKA
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C1-04

7 OF 31

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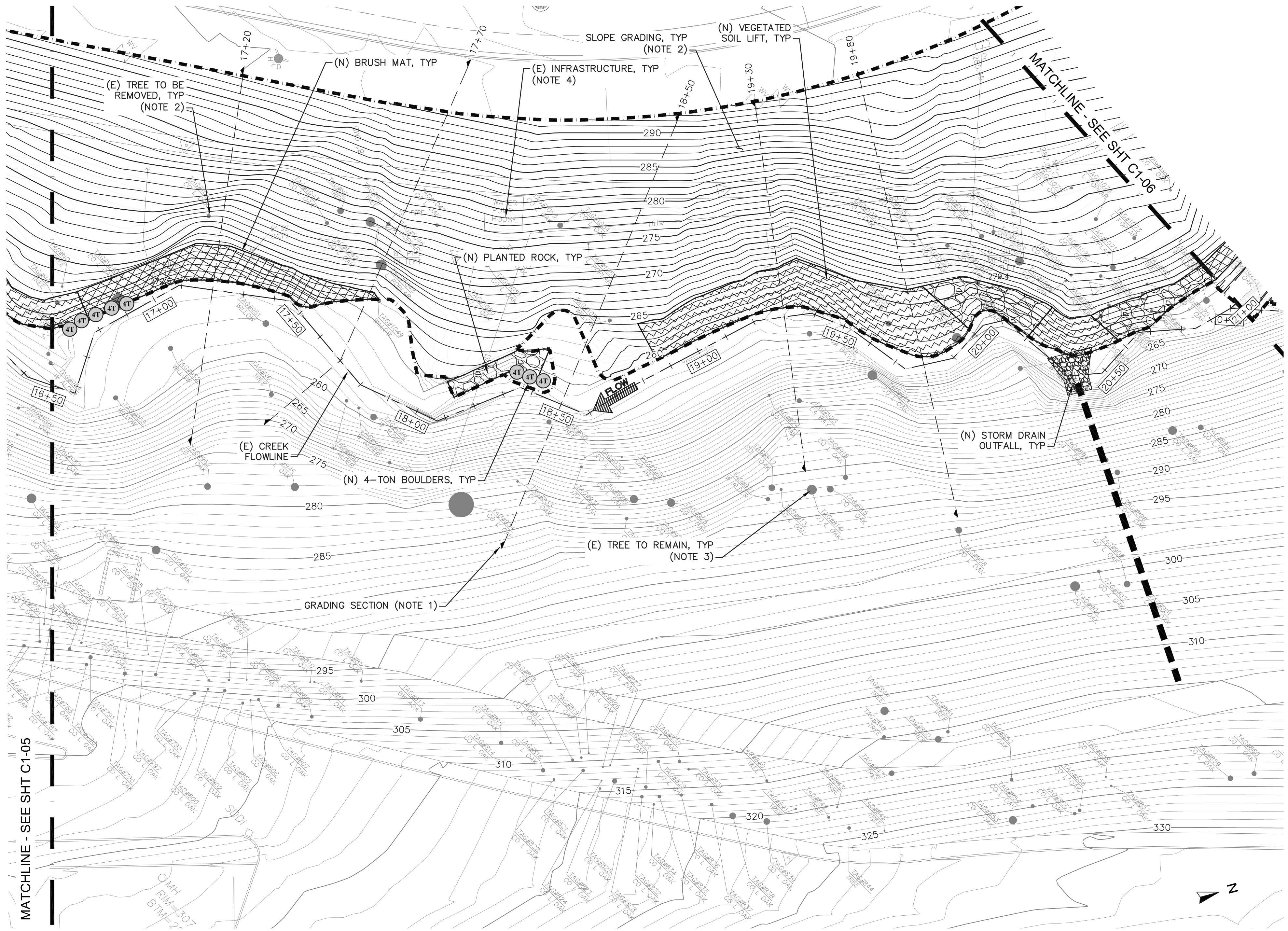

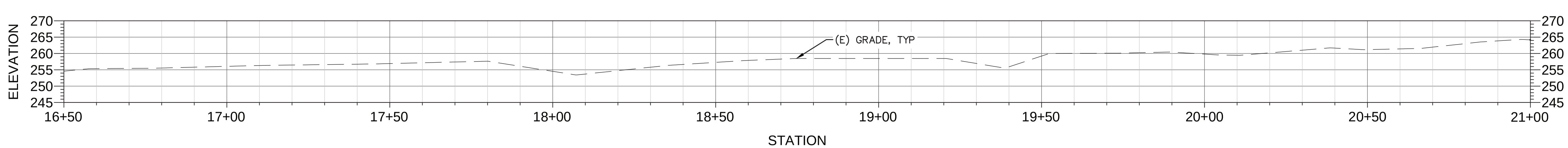

SHEET NOTES

1. GRADING SECTIONS ARE SHOWN ON SHEET C3-05.
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE FROM BELOW CHANNEL INVERT IN LIFTS WITH GEO-GRID AND STABILITY BENCHES. ALL TREES WITHIN GRADING LIMIT WILL BE REMOVED DURING SLOPE GRADING PRIOR TO CREEK ENHANCEMENT WORK.
3. ALL TREES WITHIN GRADING FOOTPRINT TO BE REMOVED.
4. ALL EXISTING INFRASTRUCTURE WITHIN THE RIPARIAN CORRIDOR WILL BE REMOVED UNDER SEPARATE CONTRACT PRIOR TO BEGINNING THE CREEK ENHANCEMENT WORK.
5. SEE SHEET C5-01 FOR SCHEDULE OF BANK TREATMENT MEASURES. EXTENTS SHOWN ON THIS SHEET.

LEGEND

BRUSH MAT	1 / C5-02
VEGETATED SOIL LIFTS (VSL)	2 / C5-02
PLANTED ROCK	3 / C5-02
STORM DRAIN OUTFALL	5 / C5-02
4T 4-TON ROCK BOULDER	2 / C5-06

PREPARED BY:

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San Francisco, CA 94108
415.262.2300 phone

PLAN AND PROFILE STA 16+50 TO 21+00

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:

OAK KNOLL VENTURE ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	B TANAKA
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C1-05
	8 OF 31

VERIFY SCALE
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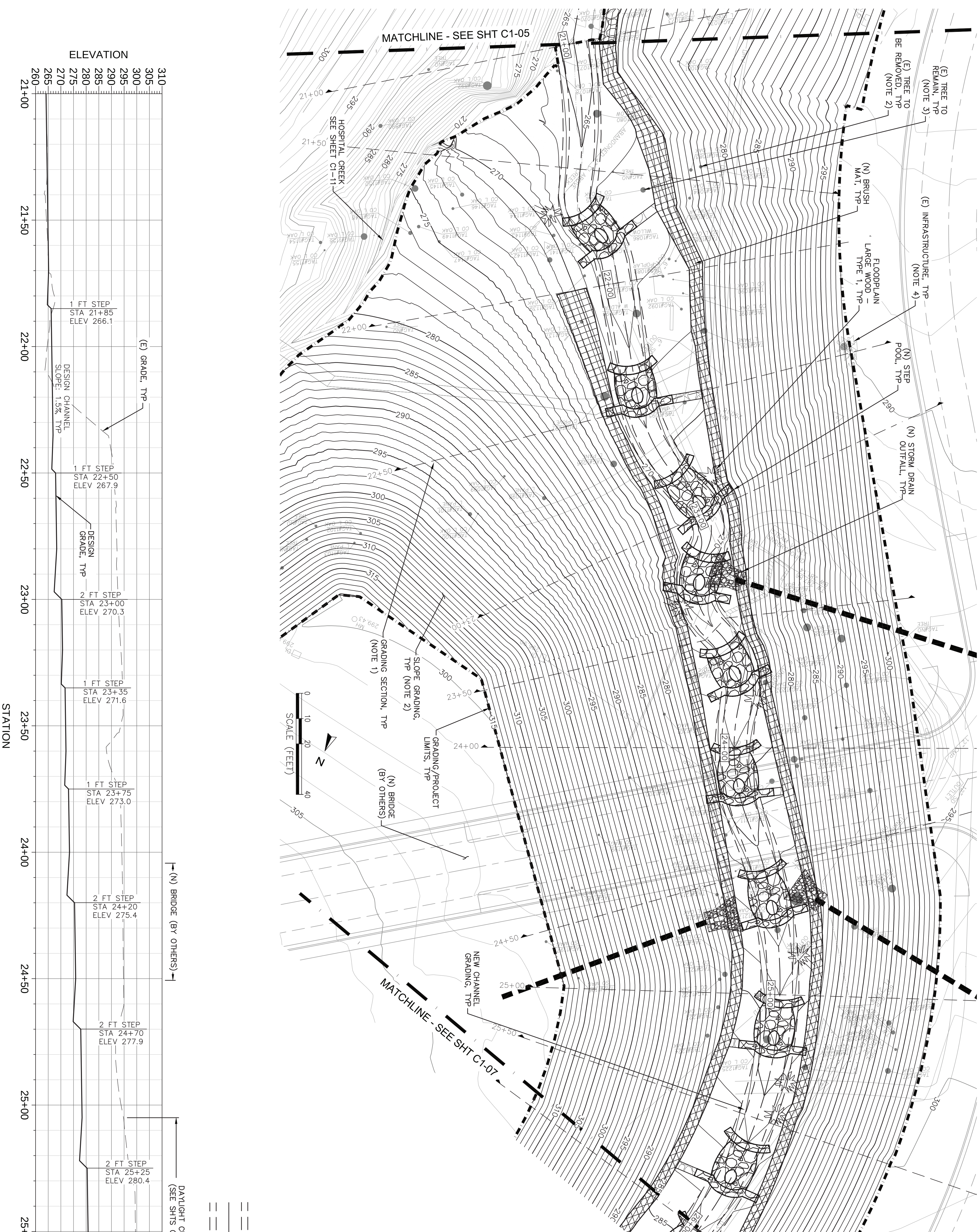

SHEET NOTES

1. GRADING SECTIONS ARE SHOWN ON SHEET C3-06.
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE FROM BELOW CHANNEL INVERT IN LIFTS WITH GEO-GRID AND STABILITY BENCHES. ALL TREES WITHIN GRADING LIMIT WILL BE REMOVED DURING SLOPE GRADING PRIOR TO CREEK ENHANCEMENT WORK.
3. TREES OUTSIDE OF GRADING LIMIT TO BE PRESERVED TO EXTENT POSSIBLE.
4. ALL EXISTING INFRASTRUCTURE WITHIN THE RIPARIAN CORRIDOR WILL BE REMOVED UNDER SEPARATE CONTRACT PRIOR TO BEGINNING THE CREEK ENHANCEMENT WORK.
5. SEE SHEET C5-01 FOR SCHEDULE OF BANK TREATMENT MEASURES. EXTENTS SHOWN ON SHEET.

LEGEND

BRUSH MAT	1 / C5-02
PLANTED ROCK	3 / C5-02
STORM DRAIN OUTFALL	5 / C5-02
STEP POOL	1 / C5-03
FLOODPLAIN LARGE WOOD - TYPE I	2 / C5-05
NEW CHANNEL GRADING	2 / C5-06

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APPROVED	
DESIGNED	ESA
DRAWN	S.STOLLER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C1-06

9 OF 31

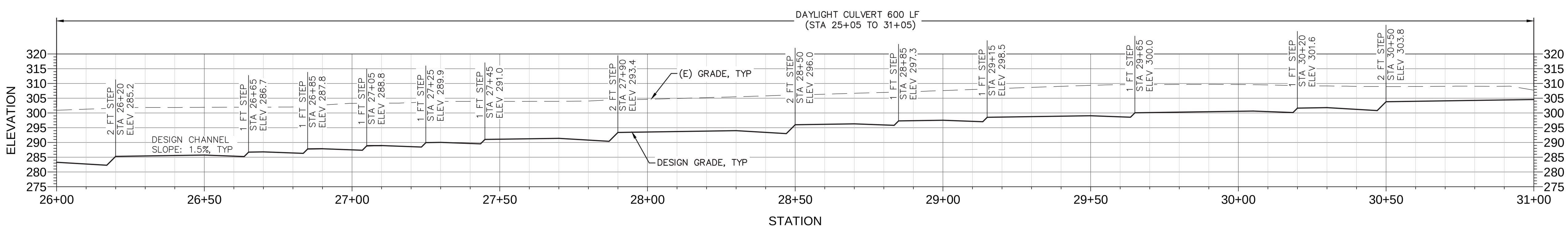
REGISTERED PROFESSIONAL ENGINEER SCOTT L. STOLLER 71728 CIVIL STATE OF CALIFORNIA

PREPARED FOR:
OAK KNOLL VENTURE ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

PLAN AND PROFILE
STA 21+00 TO 26+00

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone



SHEET NOTES

1. GRADING SECTIONS ARE SHOWN ON SHEET C3-07.
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE FROM BELOW CHANNEL INVERT IN LIFTS WITH GEO-GRID AND STABILITY BENCHES. ALL TREES WITHIN GRADING LIMIT WILL BE REMOVED DURING SLOPE GRADING PRIOR TO CREEK ENHANCEMENT WORK.
3. TREES OUTSIDE OF GRADING LIMIT TO BE PRESERVED TO EXTENT POSSIBLE.
4. ALL EXISTING INFRASTRUCTURE WITHIN THE RIPARIAN CORRIDOR WILL BE REMOVED UNDER SEPARATE CONTRACT PRIOR TO BEGINNING THE CREEK ENHANCEMENT WORK.
5. SEE SHEET C5-01 FOR SCHEDULE OF BANK TREATMENT MEASURES. EXTENTS SHOWN ON SHEET.

LEGEND

BRUSH MAT	1 / C5-02
STORM DRAIN OUTFALL	5 / C5-02
STEP POOL	1 / C5-03
VEGETATED BOULDER CLUSTER	1 / C5-05
FLOODPLAIN LARGE WOOD - TYPE I	2 / C5-05
FLOODPLAIN LARGE WOOD - TYPE II	3 / C5-05
NEW CHANNEL GRADING	2 / C5-06

VERIFY SCALE
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60% DRAFT
NOT FOR CONSTRUCTION

PREPARED BY:
ESA
550 KEARNY STREET
SUITE 800
SAN FRANCISCO, CA 94108
415.262.2300 PHONE

PLAN AND PROFILE
STA 26+00 TO 31+00

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	S STOLLER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C1-07

10 OF 31

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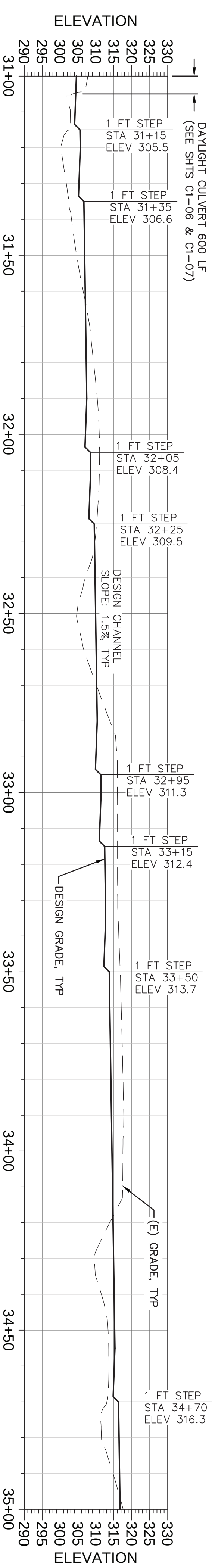
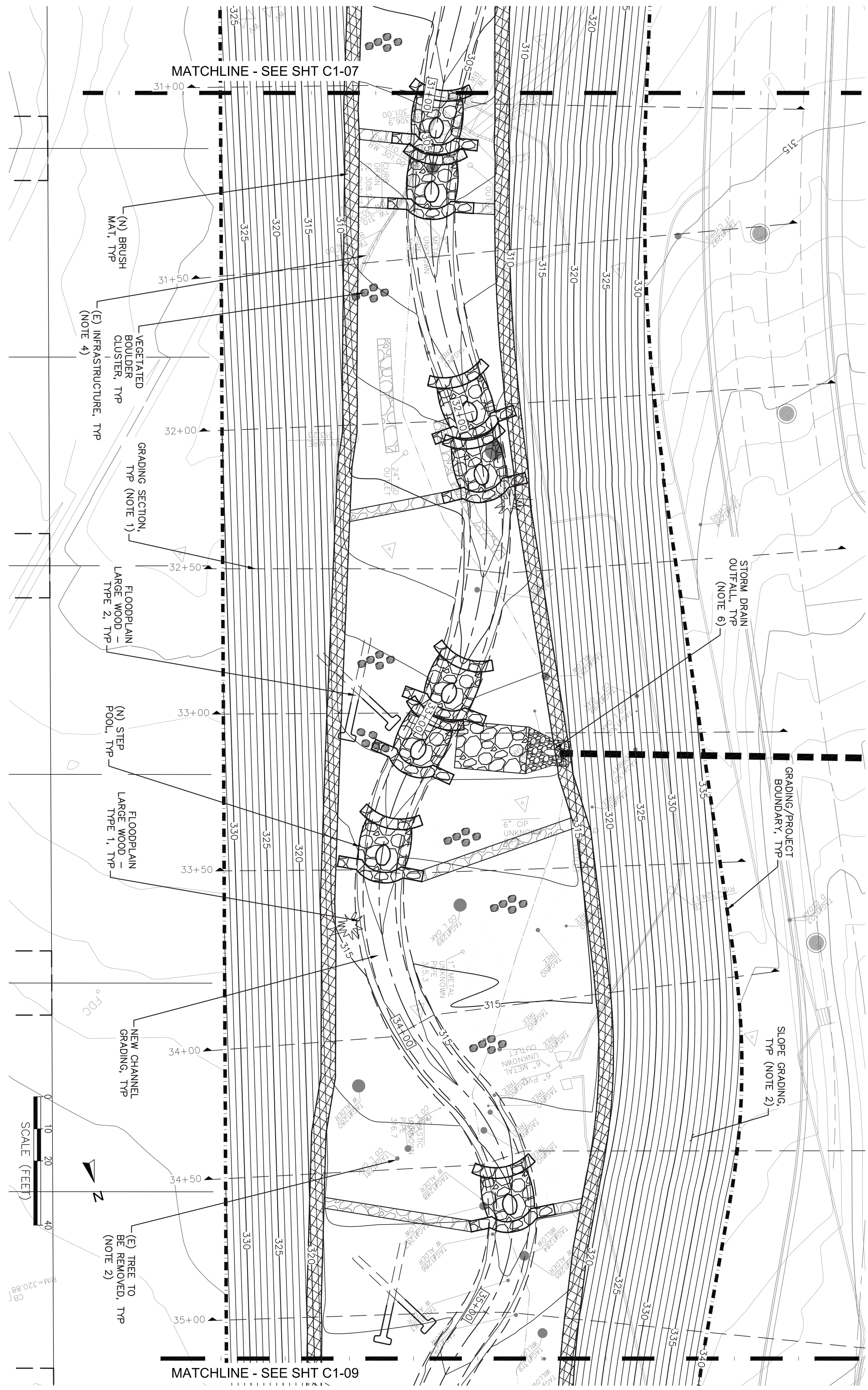
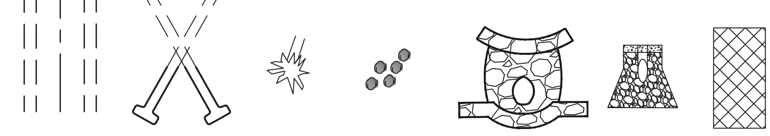




SHEET NOTES

1. GRADING SECTIONS ARE SHOWN ON SHEET C3-08.
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE FROM BELOW CHANNEL INVERT IN LIFTS WITH GEO-GRID AND STABILITY BENCHES. ALL TREES WITHIN GRADING LIMIT WILL BE REMOVED DURING SLOPE GRADING PRIOR TO CREEK ENHANCEMENT WORK.
3. TREES OUTSIDE OF GRADING LIMIT TO BE PRESERVED TO EXTENT POSSIBLE.
4. ALL EXISTING INFRASTRUCTURE WITHIN THE RIPARIAN CORRIDOR WILL BE REMOVED UNDER SEPARATE CONTRACT PRIOR TO BEGINNING THE CREEK ENHANCEMENT WORK.
5. SEE SHEET C5-01 FOR SCHEDULE OF BANK TREATMENT MEASURES. EXTENTS SHOWN ON SHEET.
6. STORM DRAIN PIPE TO BE CONSTRUCTED UNDER SEPARATE CONTRACT BY OTHERS.

LEGEND



BRUSH MAT	1 / C5-02
STORM DRAIN OUTFALL	5 / C5-02
STEP POOL	1 / C5-03
VEGETATED BOULDER CLUSTER	1 / C5-05
FLOODPLAIN LARGE WOOD - TYPE I	2 / C5-05
FLOODPLAIN LARGE WOOD - TYPE II	3 / C5-05
NEW CHANNEL GRADING	2 / C5-06

60% DRAFT
NOT FOR CONSTRUCTION

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SHEET	C1-08 — 11 OF 31
DATE	02-03-2016
SCALE	AS NOTED
INCHARGE	S.STOLLER 71728
DRAWN	S.STOLLER
DESIGNED	ESA
APPROVED	

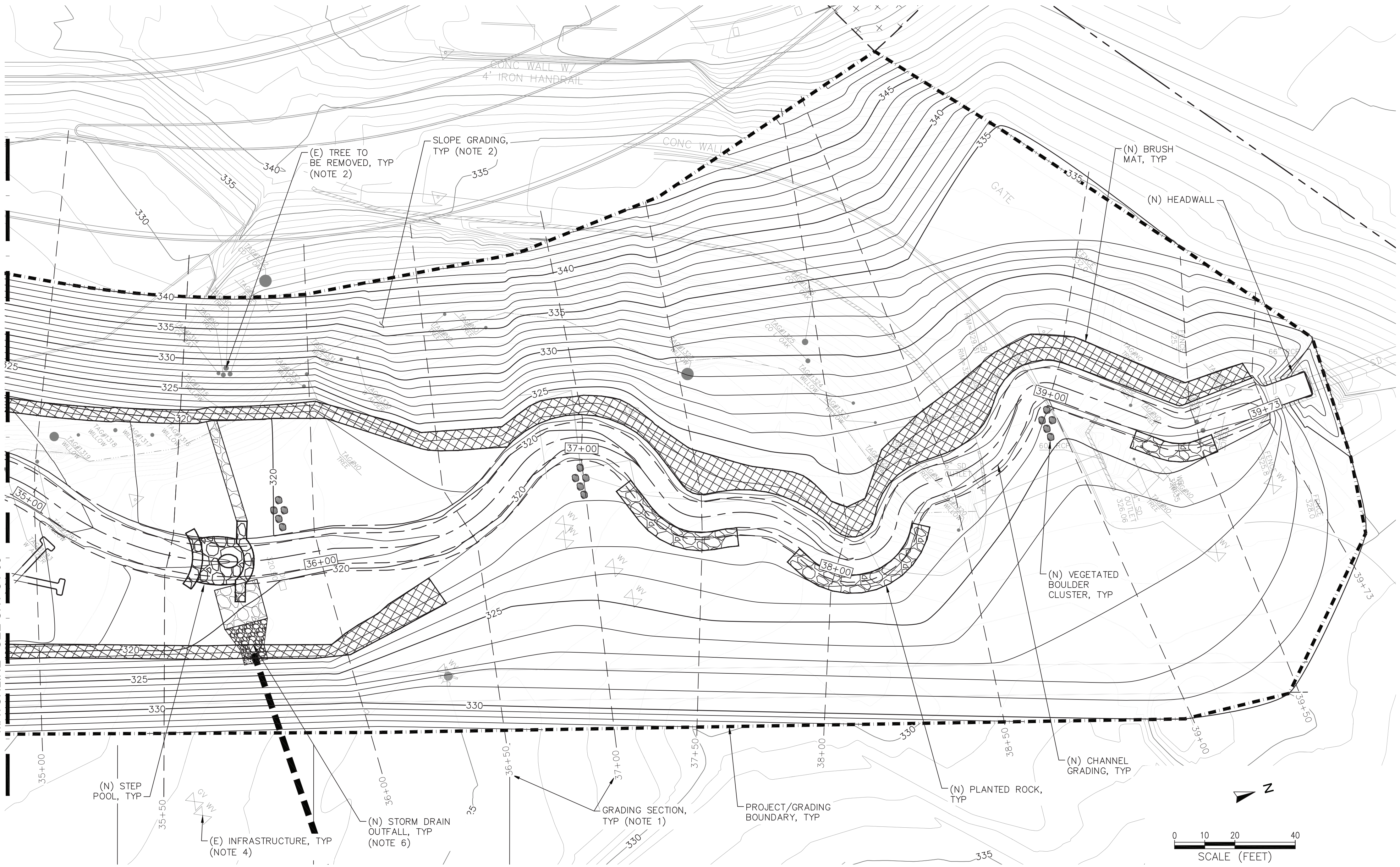
REGISTERED PROFESSIONAL ENGINEER ★ SCOTT L. STOLLER ★ 71728 ★ CIVIL ★ STATE OF CALIFORNIA

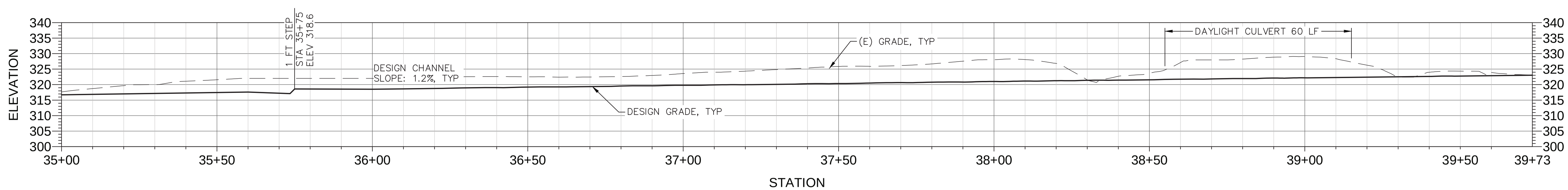
PREPARED FOR:
OAK KNOLL VENTURE ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

PLAN AND PROFILE
STA 31+00 TO 35+00

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone





SHEET NOTES

1. GRADING SECTIONS ARE SHOWN ON SHEET C3-09.
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE FROM BELOW CHANNEL INVERT IN LIFTS WITH GEO-GRID AND STABILITY BENCHES. ALL TREES WITHIN GRADING LIMIT WILL BE REMOVED DURING SLOPE GRADING PRIOR TO CREEK ENHANCEMENT WORK.
3. TREES OUTSIDE OF GRADING LIMIT TO BE PRESERVED TO EXTENT POSSIBLE.
4. ALL EXISTING INFRASTRUCTURE WITHIN THE RIPARIAN CORRIDOR WILL BE REMOVED UNDER SEPARATE CONTRACT PRIOR TO BEGINNING THE CREEK ENHANCEMENT WORK.
5. SEE SHEET C5-01 FOR SCHEDULE OF BANK TREATMENT MEASURES. EXTENTS SHOWN ON SHEET.
6. STORM DRAIN PIPE TO BE CONSTRUCTED UNDER SEPARATE CONTRACT BY OTHERS.

LEGEND

BRUSH MAT	1 / C5-02
PLANTED ROCK	3 / C5-02
STORM DRAIN OUTFALL	5 / C5-02
STEP POOL	1 / C5-03
VEGETATED BOULDER CLUSTER	1 / C5-05
NEW CHANNEL GRADING	2 / C5-06

VERIFY SCALE
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PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

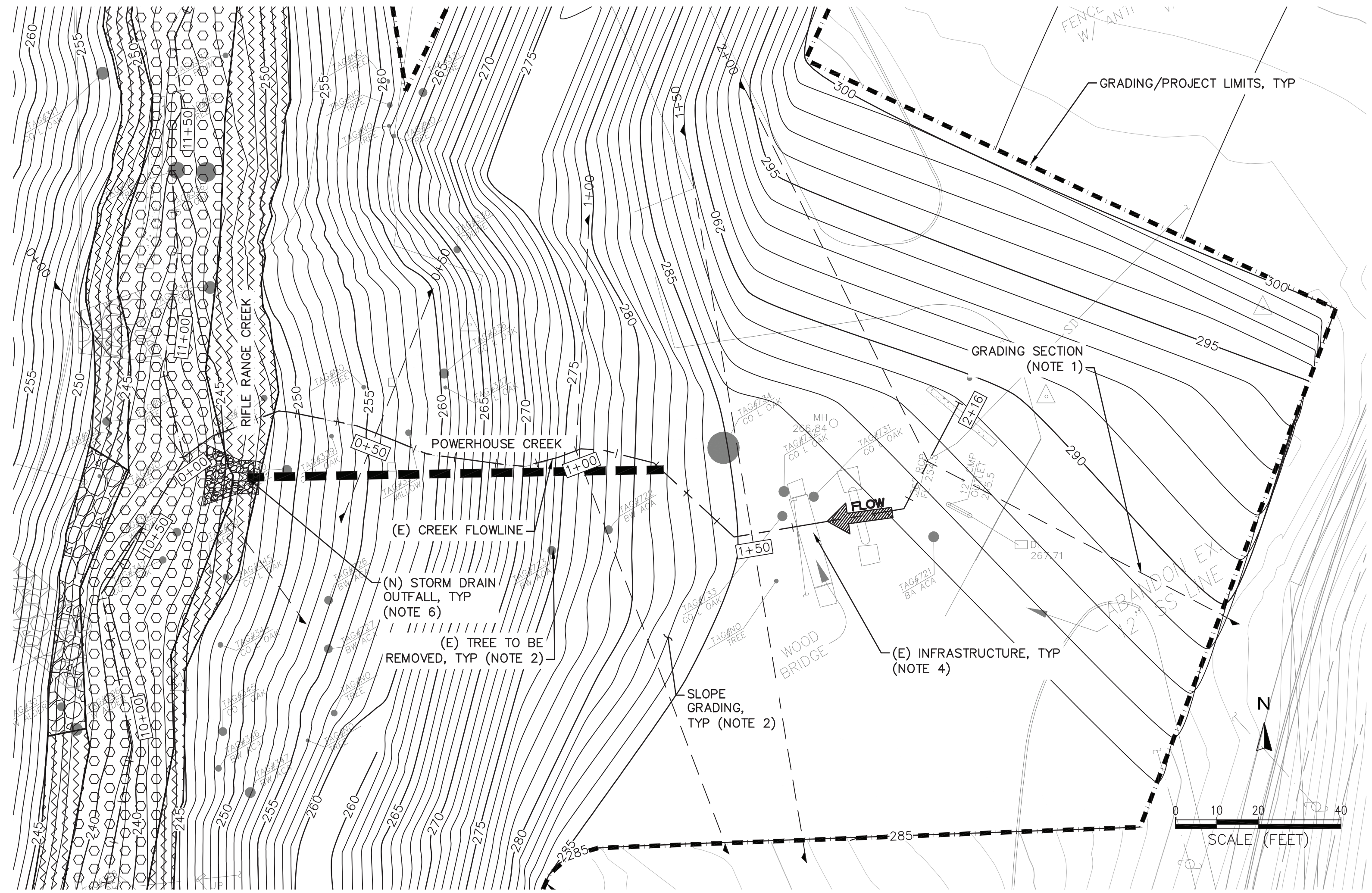
PLAN AND PROFILE
STA 35+00 TO 39+73

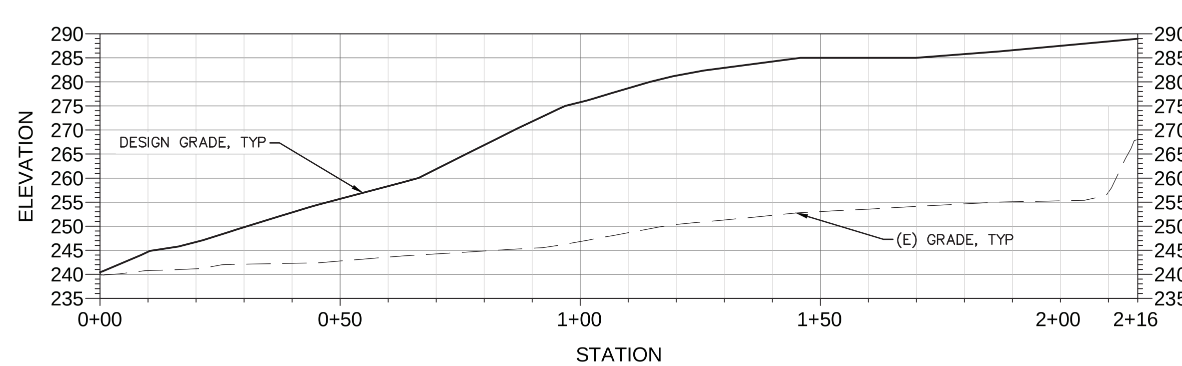
OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	S STOLLER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C1-09





SHEET NOTES

1. GRADING SECTIONS ARE SHOWN ON SHEET C3-10.
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE FROM BELOW CHANNEL INVERT IN LIFTS WITH GEO-GRID AND STABILITY BENCHES. ALL TREES WITHIN GRADING LIMIT WILL BE REMOVED DURING SLOPE GRADING PRIOR TO CREEK ENHANCEMENT WORK.
3. TREES OUTSIDE OF GRADING LIMIT TO BE PRESERVED TO EXTENT POSSIBLE.
4. ALL EXISTING INFRASTRUCTURE WITHIN THE RIPARIAN CORRIDOR WILL BE REMOVED UNDER SEPARATE CONTRACT PRIOR TO BEGINNING THE CREEK ENHANCEMENT WORK.
5. WORK SHOWN ON THIS SHEET PERTAINS ONLY TO POWERHOUSE CREEK. FEATURES SHOWN ON RIFLE RANGE CREEK ARE FOR REFERENCE ONLY.
6. STORM DRAIN PIPE TO BE CONSTRUCTED UNDER SEPARATE CONTRACT BY OTHERS.

LEGEND

	STORM DRAIN OUTFALL	5 C5-02

VERIFY SCALE
0 1"
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60% DRAFT
NOT FOR CONSTRUCTION

PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

POWERHOUSE CREEK
GRADING PLAN AND PROFILE

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	MCARTER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C1-10

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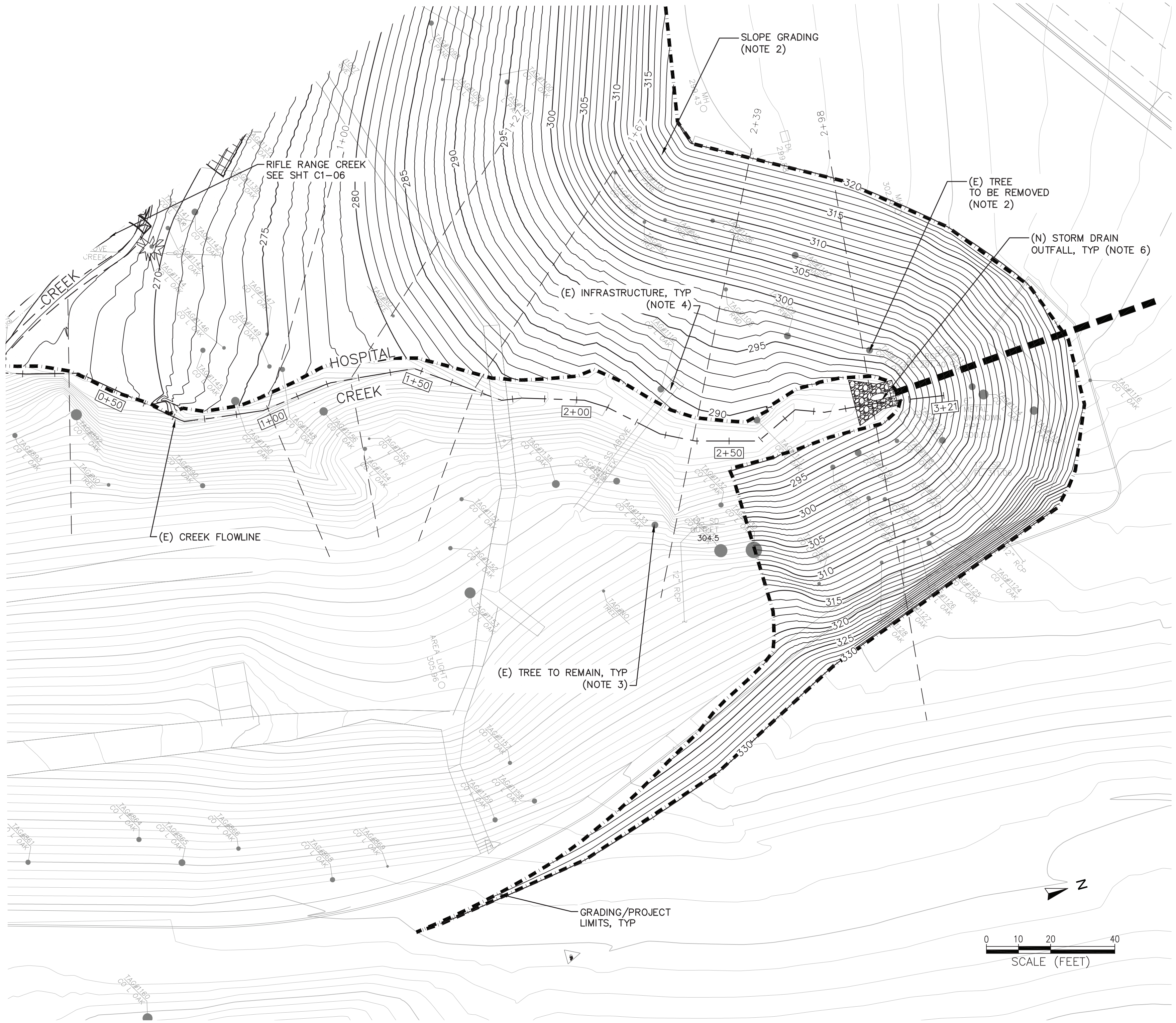

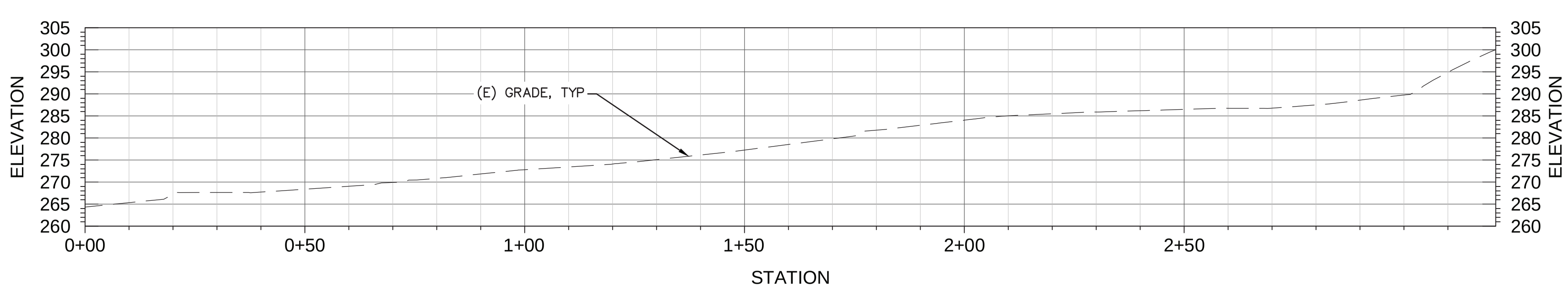

SHEET NOTES

1. GRADING SECTIONS ARE SHOWN ON SHEET C3-11.
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE FROM BELOW CHANNEL INVERT IN LIFTS WITH GEO-GRID AND STABILITY BENCHES. ALL TREES WITHIN GRADING LIMIT WILL BE REMOVED DURING SLOPE GRADING PRIOR TO CREEK ENHANCEMENT WORK.
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4. ALL EXISTING INFRASTRUCTURE WILL BE REMOVED UNDER SEPARATE CONTRACT PRIOR TO BEGINNING CREEK ENHANCEMENT WORK.
5. SEE SHEET C5-01 FOR SCHEDULE OF BANK TREATMENT MEASURES.EXTENTS SHOWN ON THIS SHEET.
6. STORM DRAIN PIPE TO BE CONSTRUCTED UNDER SEPARATE CONTRACT BY OTHERS.
7. WORK SHOWN ON THIS SHEET PERTAINS ONLY TO HOSPITAL CREEK. FEATURES SHOWN ON RIFLE RANGE CREEK ARE FOR REFERENCE ONLY.

VERIFY SCALE
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Suite 800
San Francisco, CA 94108
415.262.2300 phone

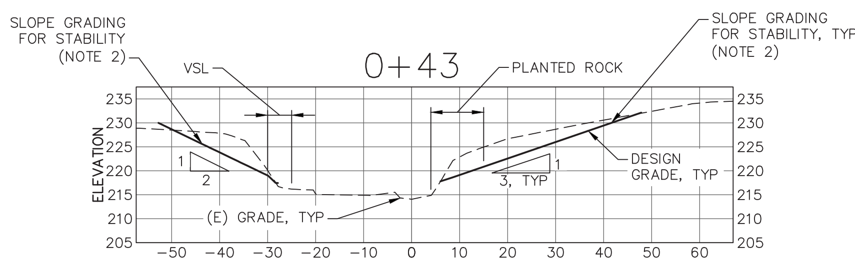
HOSPITAL CREEK GRADING PLAN AND PROFILE

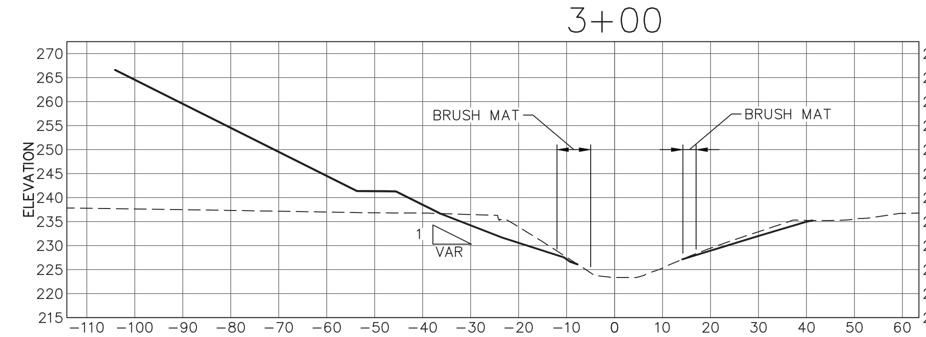
OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

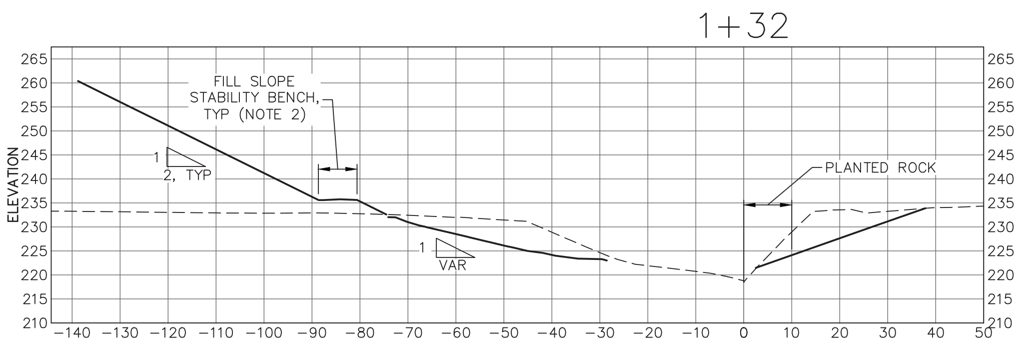
PREPARED FOR:
OAK KNOLL VENTURE ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

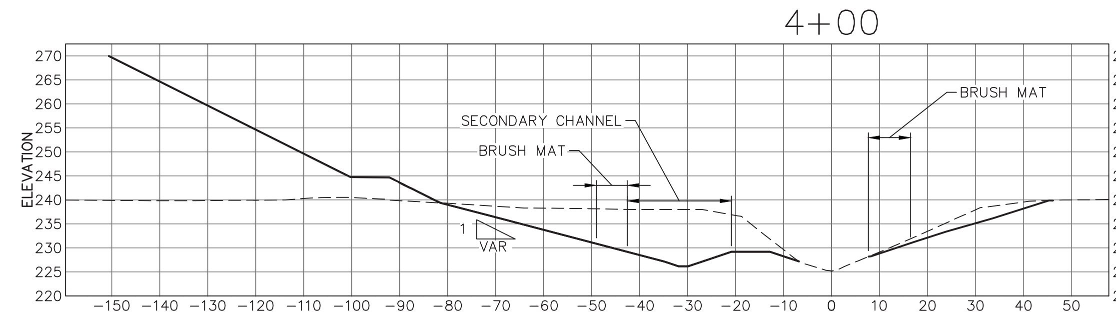
REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

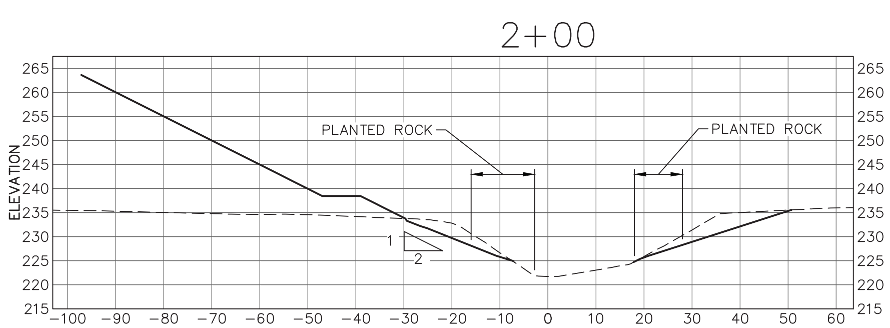
APPROVED	
DESIGNED	ESA
DRAWN	B TANAKA
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C1-11

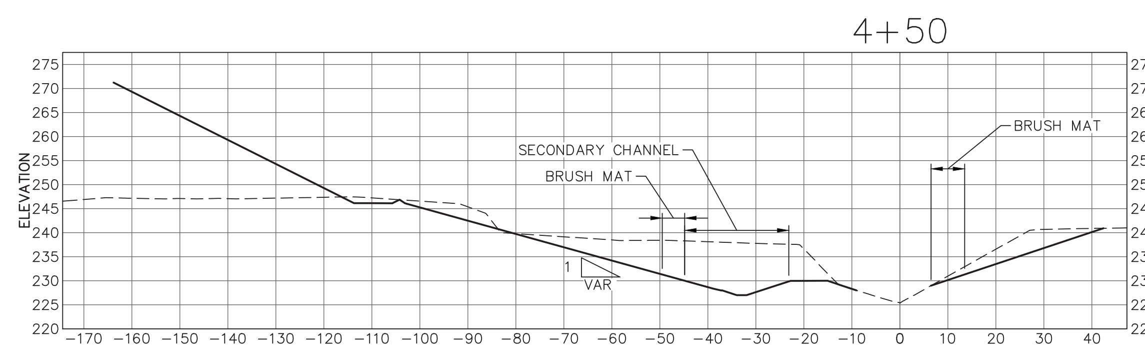












SHEET NOTES

1. SECTIONS ARE SHOWN LOOKING DOWNSTREAM
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE IN LIFTS WITH GEO-GRID (NOT SHOWN) AND STABILITY BENCHES.

VERIFY SCALE
0 1"
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60% DRAFT
NOT FOR CONSTRUCTION

PREPARED BY: ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

GRADING SECTIONS
STA 0+00 TO 5+00

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

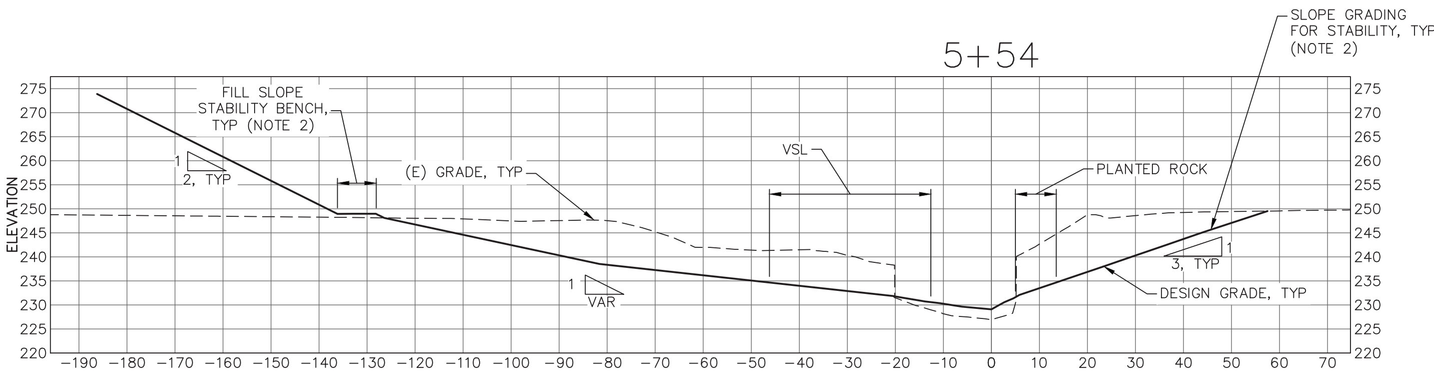
PREPARED FOR:
OAK KNOLL VENTURE ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	M CARTER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	01-29-2016
SHEET	C3-01

15 OF 31

5+54



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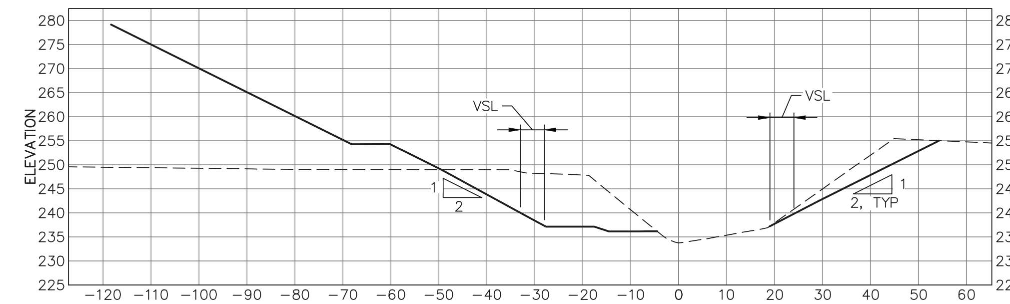
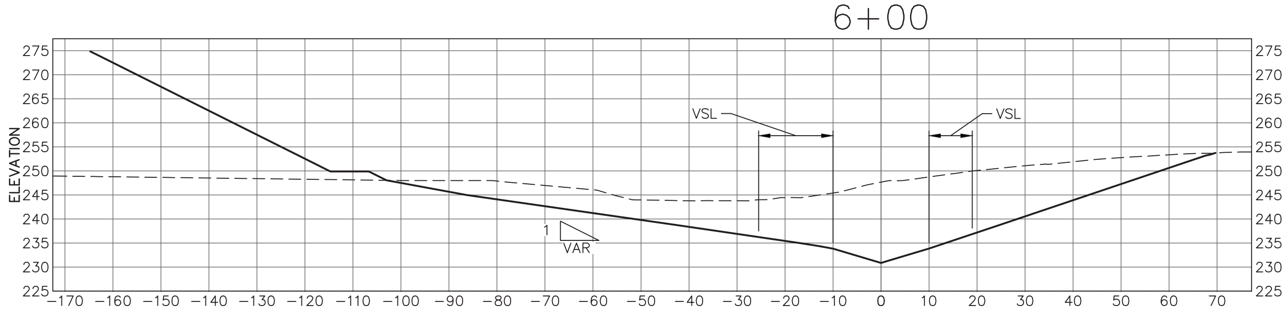
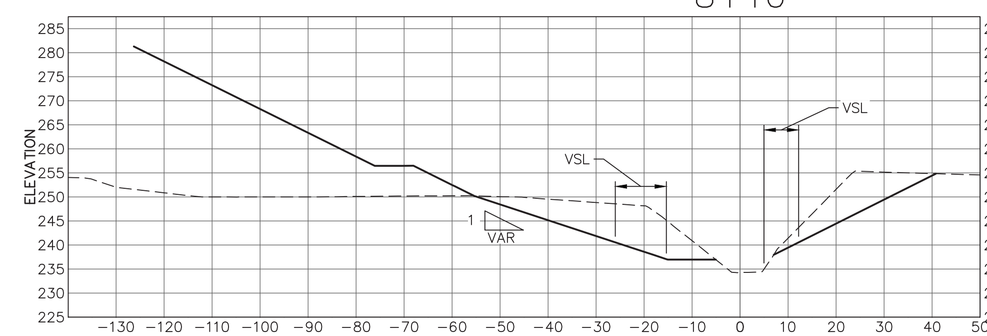


6+00



8+10



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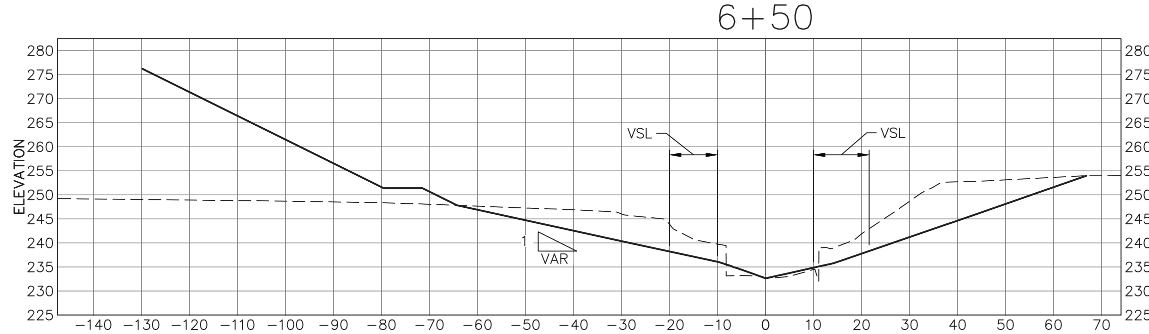

SHEET NOTES

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PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

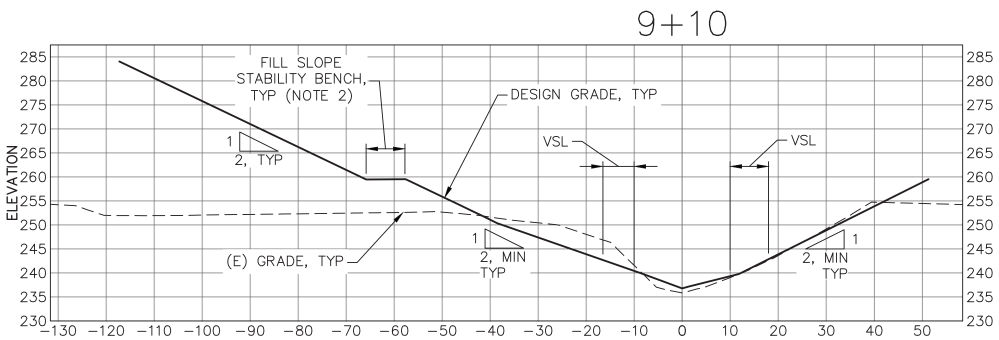
GRADING SECTIONS
STA 5+00 TO 8+50

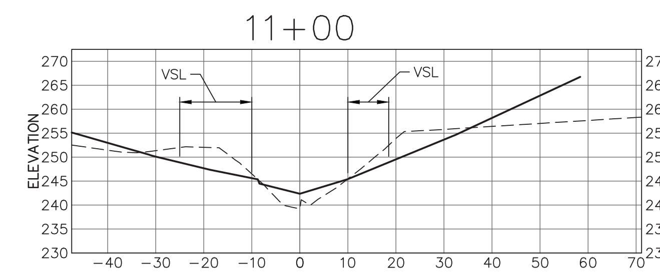
OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

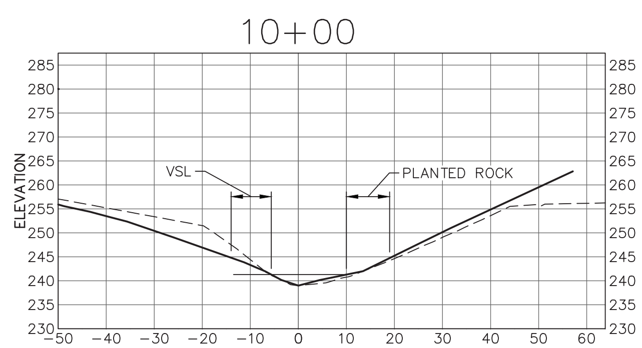
PREPARED FOR:
OAK KNOLL VENTURE ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

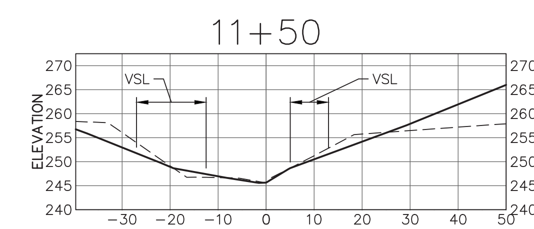
REGISTERED PROFESSIONAL ENGINEER SCOTT L. STOLLER 71728 CIVIL STATE OF CALIFORNIA

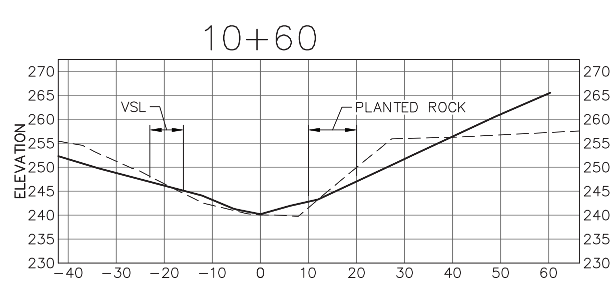
APPROVED	
DESIGNED	ESA
DRAWN	M CARTER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	01-29-2016
SHEET	C3-02

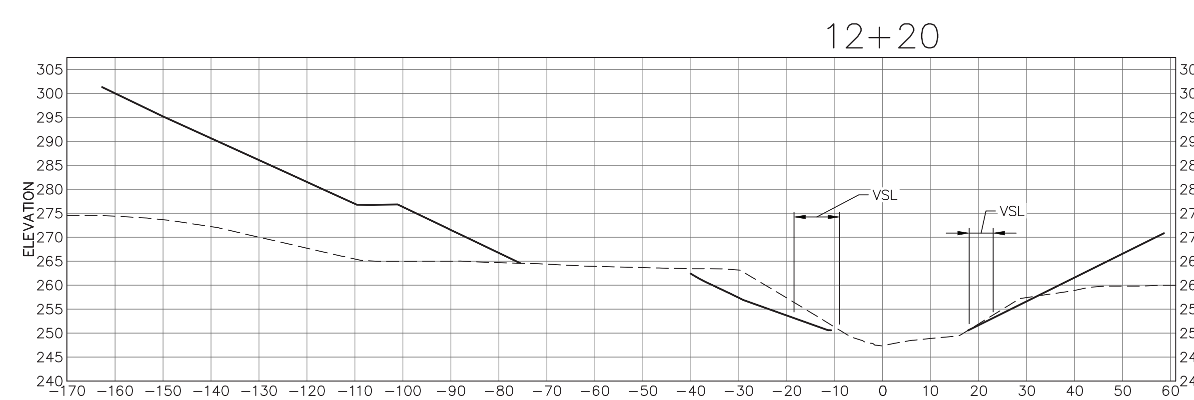












SHEET NOTES

1. SECTIONS ARE SHOWN LOOKING DOWNSTREAM
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE IN LIFTS WITH GEO-GRID (NOT SHOWN) AND STABILITY BENCHES.

VERIFY SCALE
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PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

GRADING SECTIONS
STA 8+50 TO 12+50

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

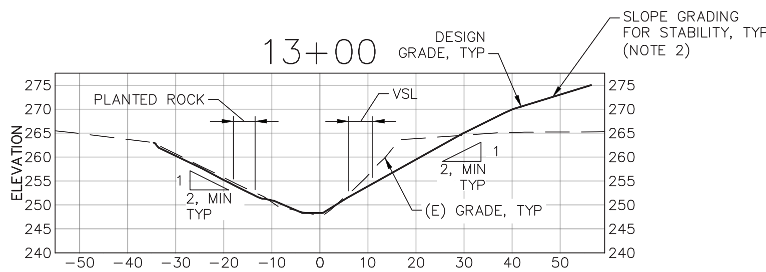
PREPARED FOR:
OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	M CARTER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C3-03

17 OF 31

13+00



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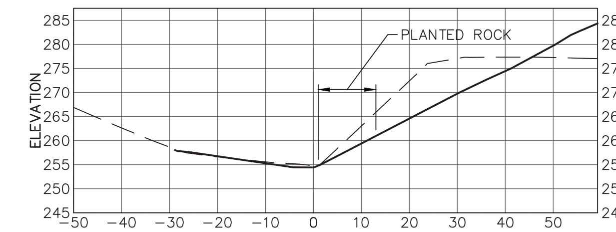
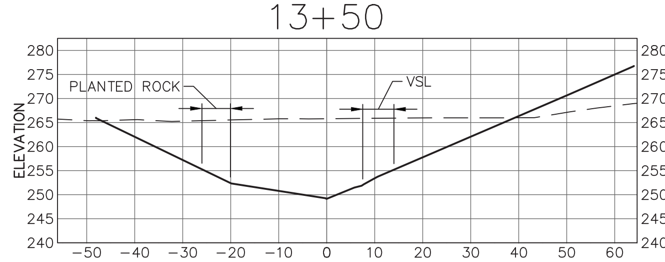
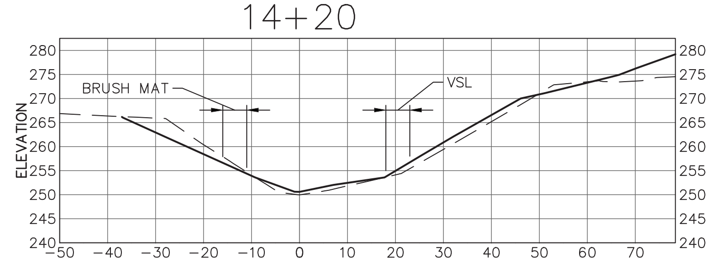


13+50



14+20



SHEET NOTES

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PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

GRADING SECTIONS
STA 12+50 TO 16+50

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	B TANAKA
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C3-04

18 OF 31

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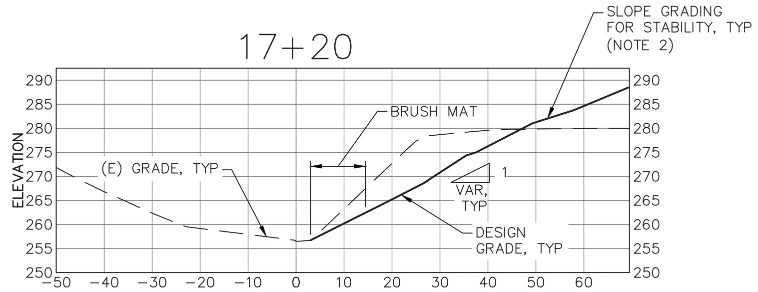

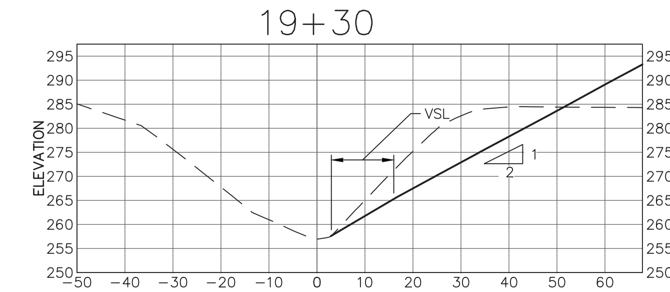

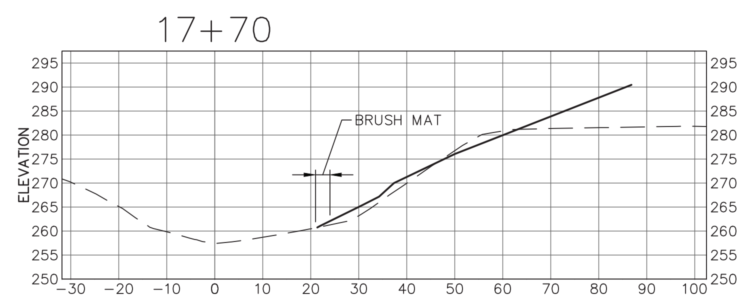

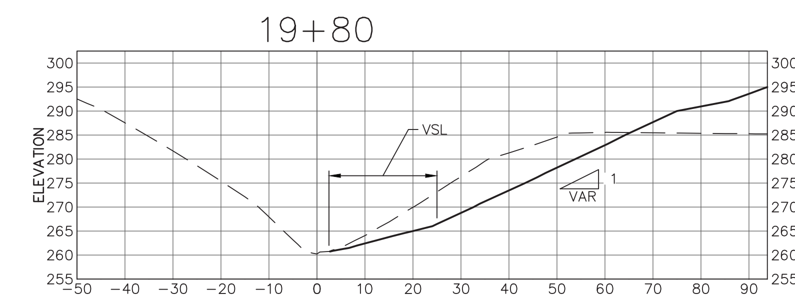

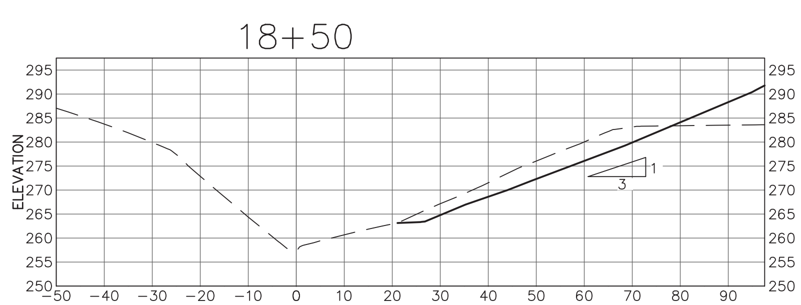

SHEET NOTES

1. SECTIONS ARE SHOWN LOOKING DOWNSTREAM
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE IN LIFTS WITH GEO-GRID (NOT SHOWN) AND STABILITY BENCHES.

VERIFY SCALE
0 1"
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PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

GRADING SECTIONS
STA 16+50 TO 21+00

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

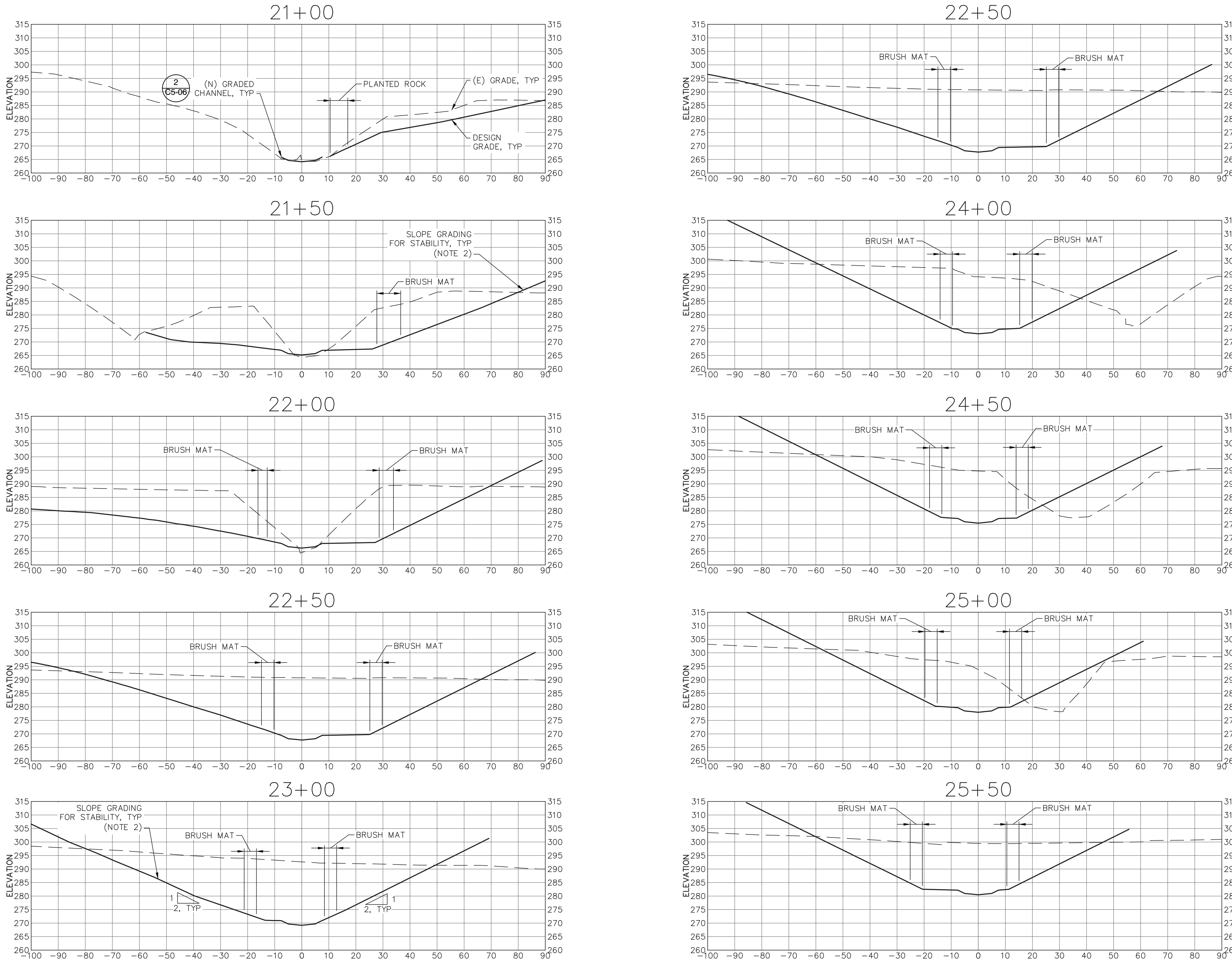
PREPARED FOR:
OAK KNOLL VENTURE ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED

DESIGNED	ESA
DRAWN	B TANAKA
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	01-29-2016
SHEET	C3-05

19 OF 31



SHEET NOTES

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2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE IN LIFTS WITH GEO-GRID (NOT SHOWN) AND STABILITY BENCHES.

VERIFY SCALE
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PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

GRADING SECTIONS
STA 21+00 TO 25+50

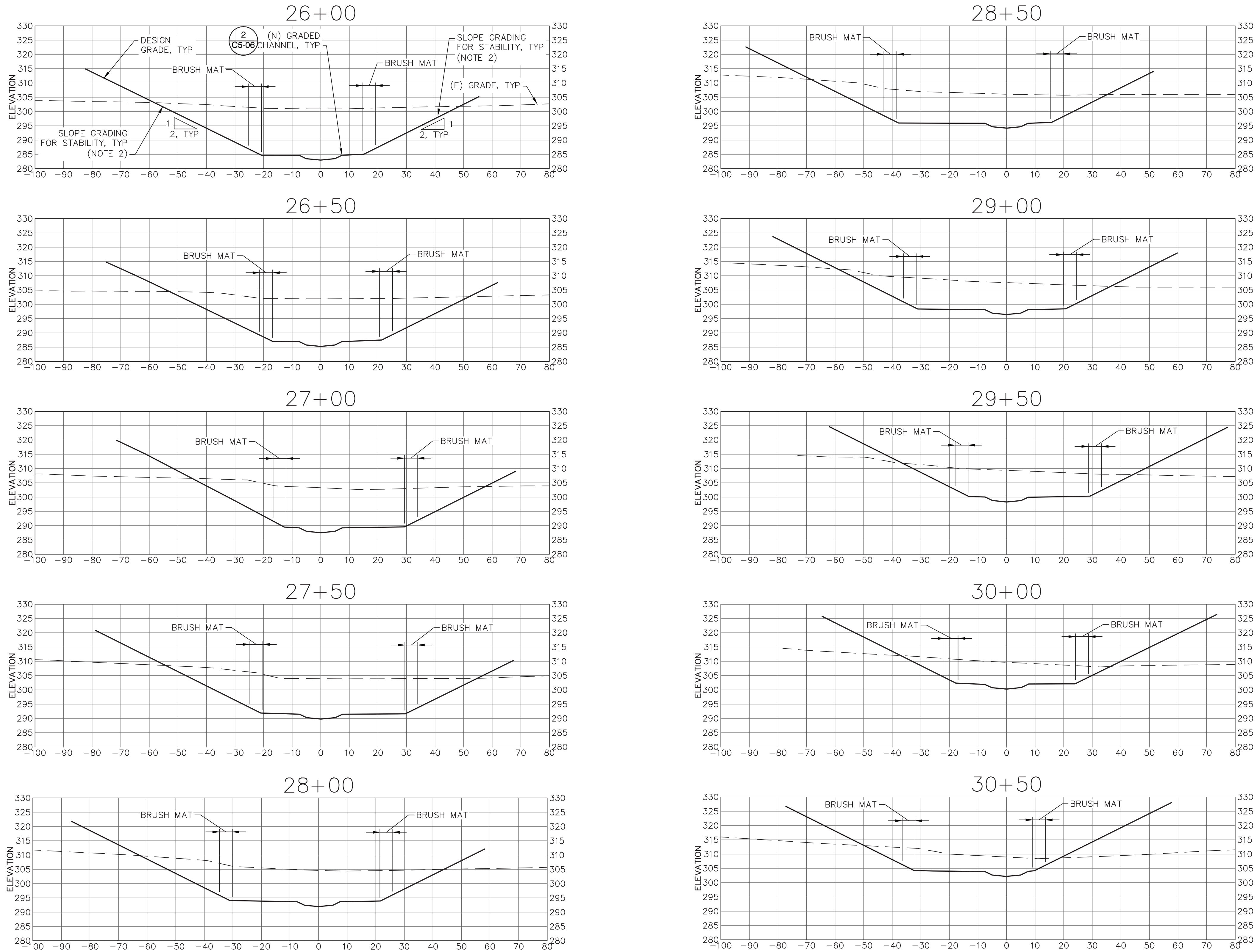
OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	S STOLLER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	01-29-2016
SHEET	C3-06

K:\projects_2014\D140419.00 - Oak Knoll III\09 CAD\Dwgs\D140419_1.1_XS_2100-3900.dwg 2-02-16 03:55:52 PM mmc



SHEET NOTES

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2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE IN LIFTS WITH GEO-GRID (NOT SHOWN) AND STABILITY BENCHES.

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PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

GRADING SECTIONS
STA 26+00 TO 30+50

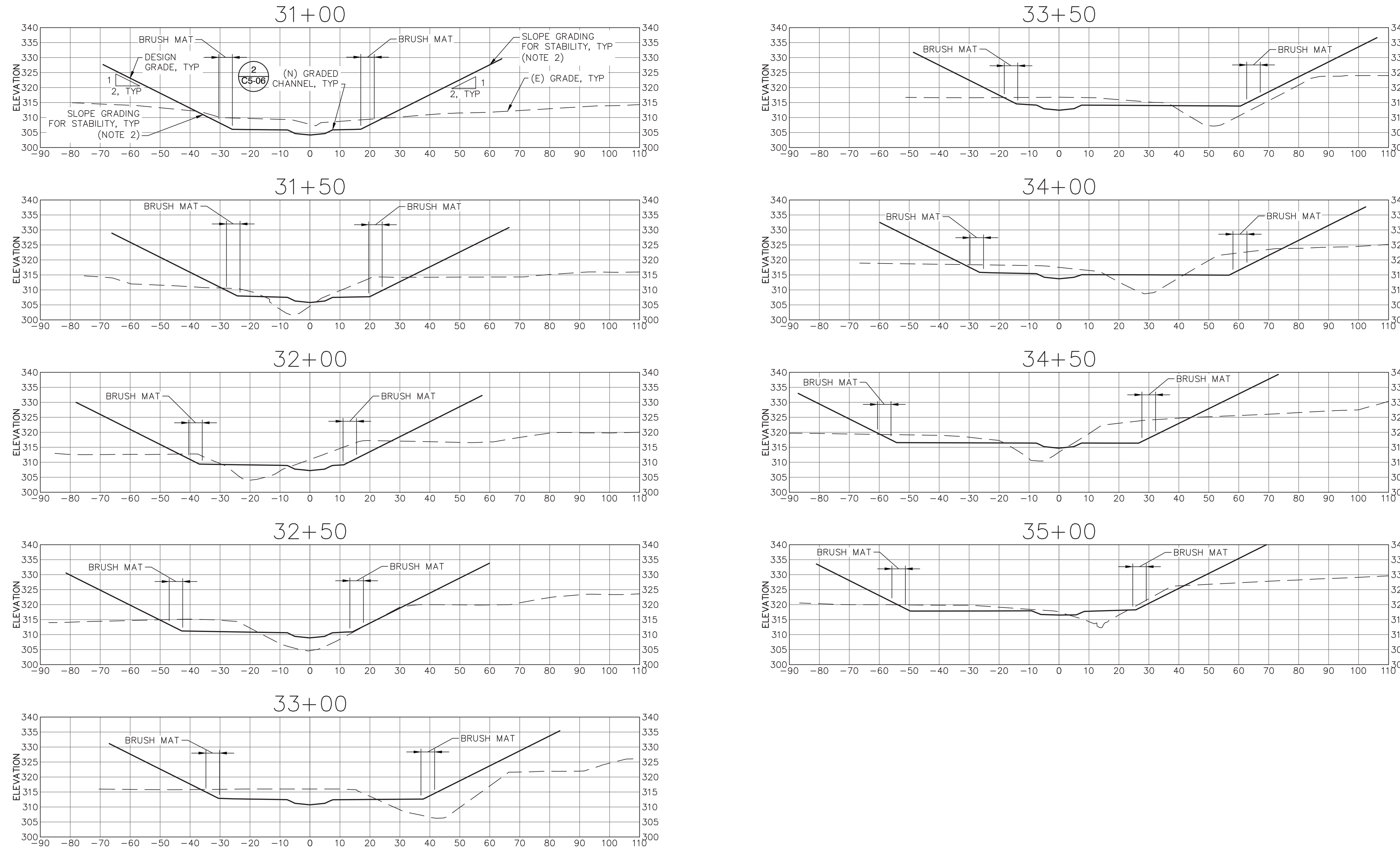
OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	S STOLLER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	01-29-2016
SHEET	C3-07

21 OF 31



SHEET NOTES

1. SECTIONS ARE SHOWN LOOKING DOWNSTREAM
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE IN LIFTS WITH GEO-GRID (NOT SHOWN) AND STABILITY BENCHES.

VERIFY SCALE
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PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

GRADING SECTIONS
STA 31+00 TO 35+00

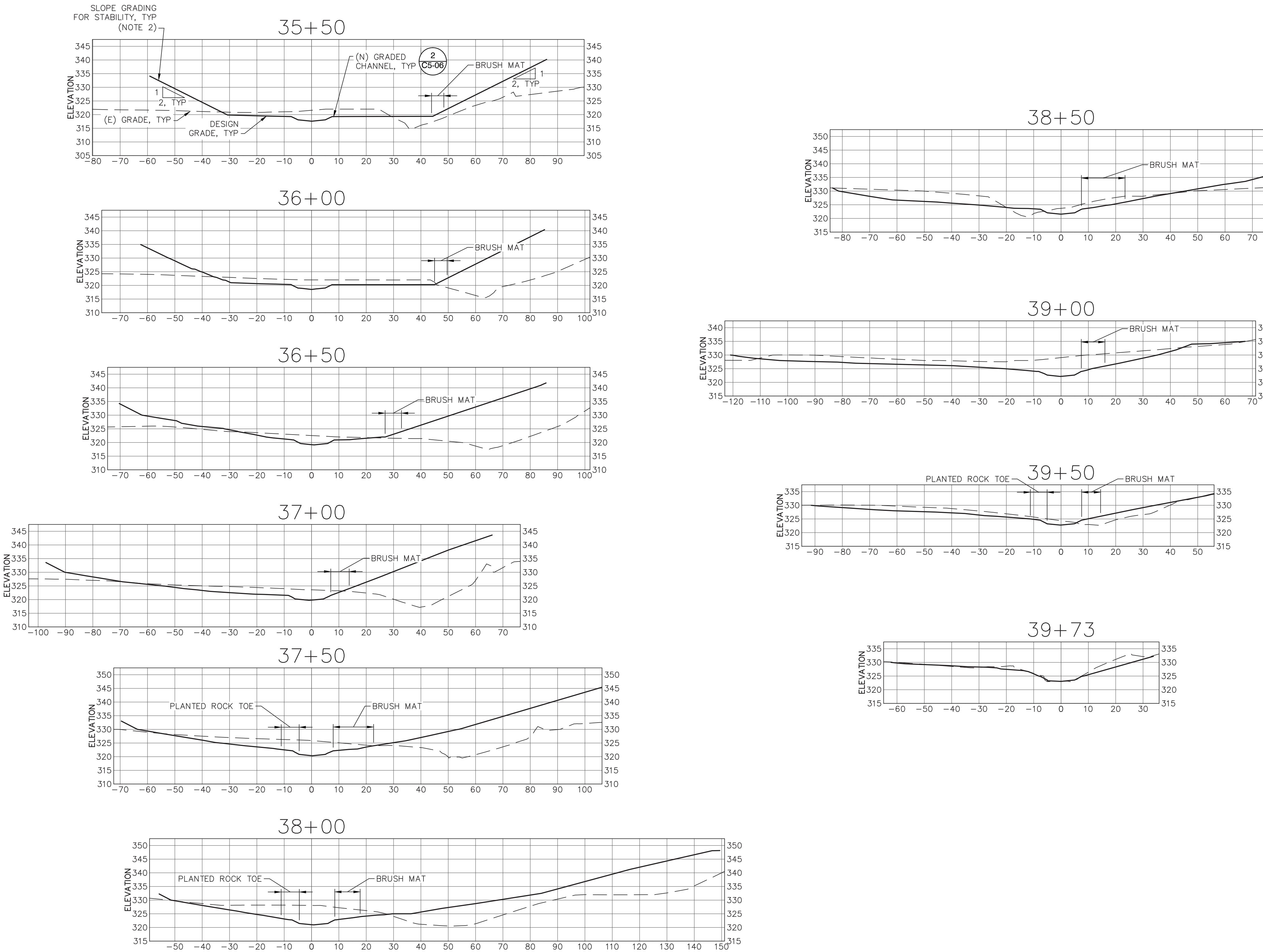
OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	S STOLLER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	01-29-2016
SHEET	C3-08

22 OF 31



SHEET NOTES

1. SECTIONS ARE SHOWN LOOKING DOWNSTREAM
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE IN LIFTS WITH GEO-GRID (NOT SHOWN) AND STABILITY BENCHES.

SCALE (FEET) 0 10 20 40

VERIFY SCALE 0 1"

BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

60% DRAFT
NOT FOR CONSTRUCTION

PREPARED BY:

ESA

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Suite 800
San Francisco, CA 94108
415.262.2300 phone

GRADING SECTIONS
STA 35+50 TO 39+73

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:

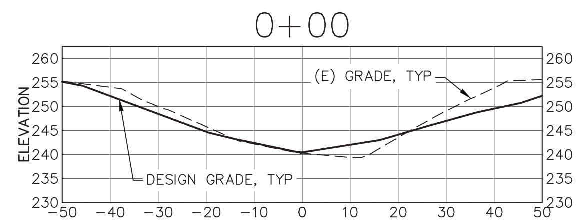
OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	S STOLLER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C3-09

23 OF 31

0+00



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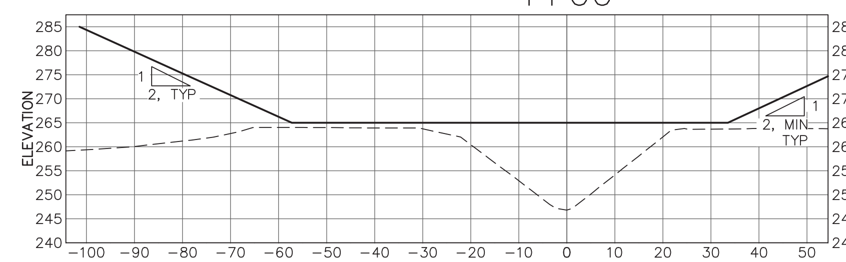

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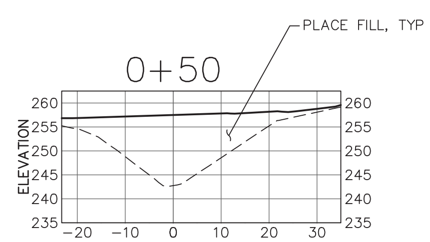

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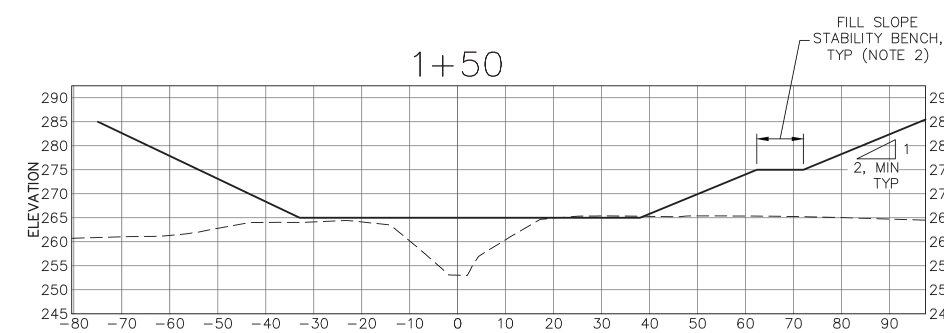
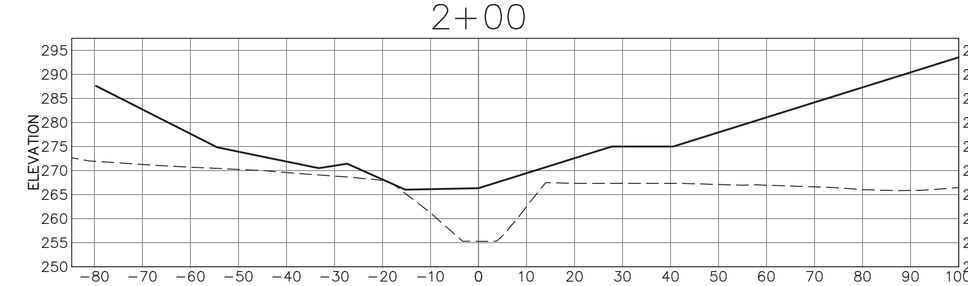


2+00



SHEET NOTES

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2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE IN LIFTS WITH GEO-GRID (NOT SHOWN) AND STABILITY BENCHES.

VERIFY SCALE
0 1"
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60% DRAFT
NOT FOR CONSTRUCTION

PREPARED BY:
ESA
550 Kearny Street
Suite 800
San Francisco, CA 94108
415.262.2300 phone

POWERHOUSE CREEK
GRADING SECTIONS

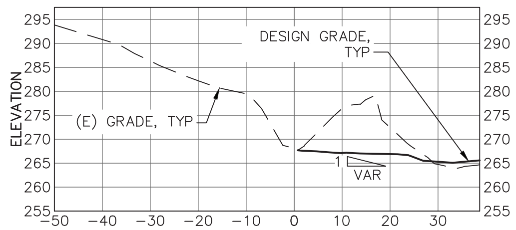
OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
71728
CIVIL
STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	M CARTER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	01-29-2016
SHEET	C3-10

0+34



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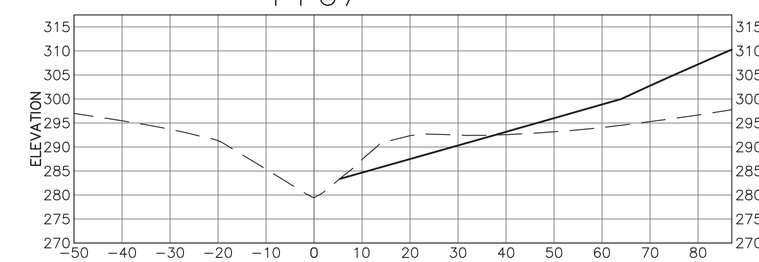

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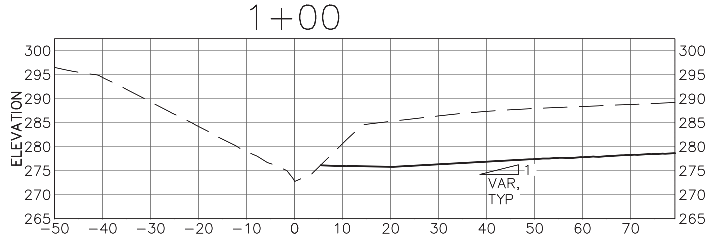
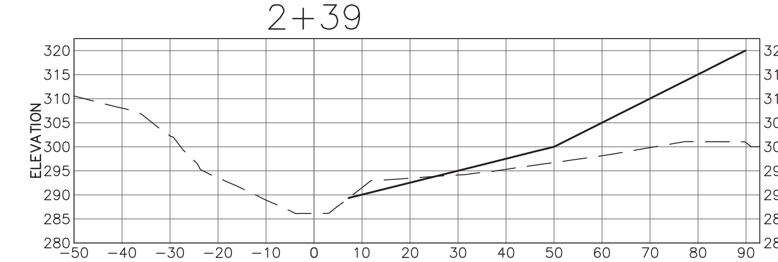


2+39



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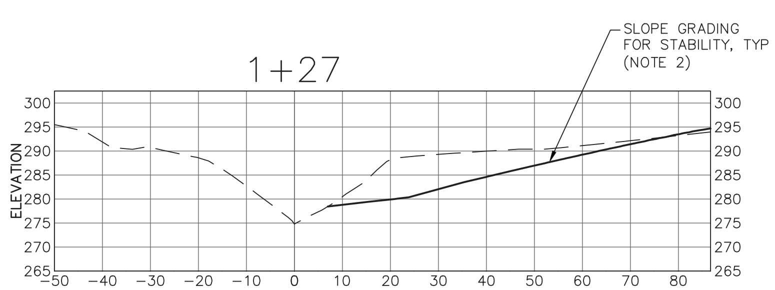

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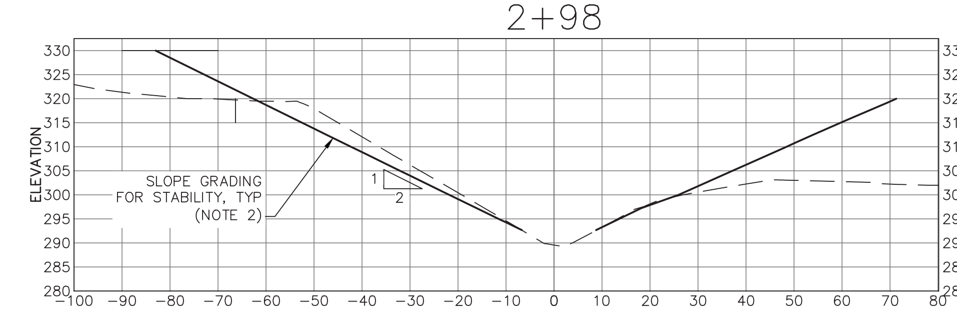

SHEET NOTES

1. SECTIONS ARE SHOWN LOOKING DOWNSTREAM
2. SLOPE GRADING FOR STABILITY IS BASED ON GEOTECHNICAL RECOMMENDATIONS AND INCLUDES REBUILDING SLOPE IN LIFTS WITH GEO-GRID (NOT SHOWN) AND STABILITY BENCHES.

VERIFY SCALE
0 1"
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HOSPITAL CREEK GRADING SECTIONS

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE
ACQUISITION LLC
2392 Morse Avenue
Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER ★ SCOTT L. STOLLER ★ 71728 CIVIL STATE OF CALIFORNIA

APPROVED	
DESIGNED	ESA
DRAWN	B. TANAKA
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	01-29-2016
SHEET	C3-11

BANK PROTECTION TREATMENT SCHEDULE

	LEFT BANK	RIGHT BANK
STATION	TREATMENT TYPE	TREATMENT TYPE
39+73	-	**BEGIN BRUSH MAT**
39+54	**BEGIN PLANTED ROCK**	BRUSH MAT
39+31	**END PLANTED ROCK**	BRUSH MAT
38+26	**BEGIN PLANTED ROCK**	BRUSH MAT
37+88	**END PLANTED ROCK**	BRUSH MAT
37+61	**BEGIN PLANTED ROCK**	BRUSH MAT
37+24	**END PLANTED ROCK**	BRUSH MAT
36+32	**BEGIN BRUSH MAT**	BRUSH MAT
22+00	**END BRUSH MAT**	BRUSH MAT
21+00	-	**BEGIN PLANTED ROCK**
20+85	-	PLANTED ROCK
20+77	-	PLANTED ROCK
20+60	-	**BEGIN VSL**
20+30	-	VSL
20+20	-	**BEGIN PLANTED ROCK**
20+00	-	**BEGIN VSL**
19+67	-	VSL
19+60	-	VSL
19+10	-	VSL
18+87	-	VSL
18+75	-	VSL
18+40	-	**BEGIN PLANTED ROCK**
18+35	-	PLANTED ROCK
18+15	-	**BEGIN BRUSH MAT**
17+80	-	BRUSH MAT
17+47	-	BRUSH MAT
16+84	-	BRUSH MAT
16+78	-	**BEGIN VSL**
16+60	-	VSL
16+48	-	VSL
16+40	-	VSL
16+26	-	VSL
16+10	-	**BEGIN PLANTED ROCK**
16+00	-	PLANTED ROCK
15+68	-	PLANTED ROCK
15+50	**BEGIN PLANTED ROCK**	PLANTED ROCK
15+30	PLANTED ROCK	PLANTED ROCK
15+13	PLANTED ROCK	PLANTED ROCK
15+00	PLANTED ROCK	PLANTED ROCK
14+80	PLANTED ROCK	PLANTED ROCK
14+60	**BEGIN BRUSH MAT**	**BEGIN VSL**
14+40	BRUSH MAT	VSL

BANK PROTECTION TREATMENT SCHEDULE

	LEFT BANK	RIGHT BANK
STATION	TREATMENT TYPE	TREATMENT TYPE
14+36	BRUSH MAT	VSL
14+20	BRUSH MAT	VSL
14+01	**BEGIN PLANTED ROCK**	VSL
13+30	PLANTED ROCK	VSL
13+14	PLANTED ROCK	VSL
13+00	PLANTED ROCK	VSL
12+53	**BEGIN VSL**	VSL
11+61	VSL	VSL
10+60	VSL	**BEGIN PLANTED ROCK**
10+29	VSL	PLANTED ROCK
10+00	VSL	**BEGIN VSL**
9+31	VSL	VSL
8+83	VSL	VSL
7+74	VSL	VSL
7+11	VSL	VSL
6+80	**BEGIN PLANTED ROCK**	VSL
6+55	**BEGIN VSL**	VSL
6+24	VSL	VSL
5+70	VSL	**BEGIN PLANTED ROCK**
5+37	VSL	PLANTED ROCK
5+35	**BEGIN BRUSH MAT**	**BEGIN BRUSH MAT**
5+00	BRUSH MAT	BRUSH MAT
4+52	BRUSH MAT	BRUSH MAT
4+20	BRUSH MAT	BRUSH MAT
3+90	BRUSH MAT	BRUSH MAT
3+81	BRUSH MAT	BRUSH MAT
3+70	BRUSH MAT	**BEGIN PLANTED ROCK**
3+50	BRUSH MAT	**BEGIN BRUSH MAT**
3+13	BRUSH MAT	BRUSH MAT
2+69	BRUSH MAT	BRUSH MAT
2+40	BRUSH MAT	**BEGIN PLANTED ROCK**
2+20	**BEGIN PLANTED ROCK**	**BEGIN BRUSH MAT**
2+06	PLANTED ROCK	BRUSH MAT
1+70	**END PLANTED ROCK**	BRUSH MAT
1+50	-	**BEGIN PLANTED ROCK**
1+39	-	PLANTED ROCK
1+10	-	PLANTED ROCK
0+97	**BEGIN PLANTED ROCK**	PLANTED ROCK
0+50	PLANTED ROCK	PLANTED ROCK
0+30	PLANTED ROCK	PLANTED ROCK
0+04	PLANTED ROCK	PLANTED ROCK
0+00	**END PLANTED ROCK**	**END PLANTED ROCK**

STEP POOL SCHEDULE

CONTROL POINT STA	ELEVATION (FT)	STEP HEIGHT (FT)
1+15	216.6	1
3+30	222.8	1
3+45	223.8	1
3+60	224.8	1
22+03	266.2	1
22+68	267.9	1
23+18	270.4	2
23+53	271.7	1
23+93	273.1	1
24+38	275.4	2
24+88	277.9	2
25+43	280.4	2
25+98	282.9	2
26+38	285.2	2
26+83	286.7	1
27+03	287.8	1
27+23	288.8	1
27+43	289.9	1
27+63	291	1
28+08	293.4	2
28+68	296	2
29+03	297.3	1
29+33	298.5	1
29+83	300	1
30+38	301.6	1
30+68	303.8	2
31+33	305.5	1
31+53	306.6	1
32+23	308.4	1
32+43	309.5	1
33+13	311.3	1
33+33	312.4	1
33+68	313.7	1
34+88	316.3	1
35+75	318.6	1

SHEET NOTES

1. SEE SHEETS C1-01 TO C1-09 FOR AREAL EXTENT OF BANK TREATMENTS.
2. BANK DESIGNATIONS ARE SHOWN LOOKING DOWNSTREAM.

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BANK TREATMENT SCHEDULE

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE ACQUISITION LLC
2392 Morse Avenue
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REGISTERED PROFESSIONAL ENGINEER
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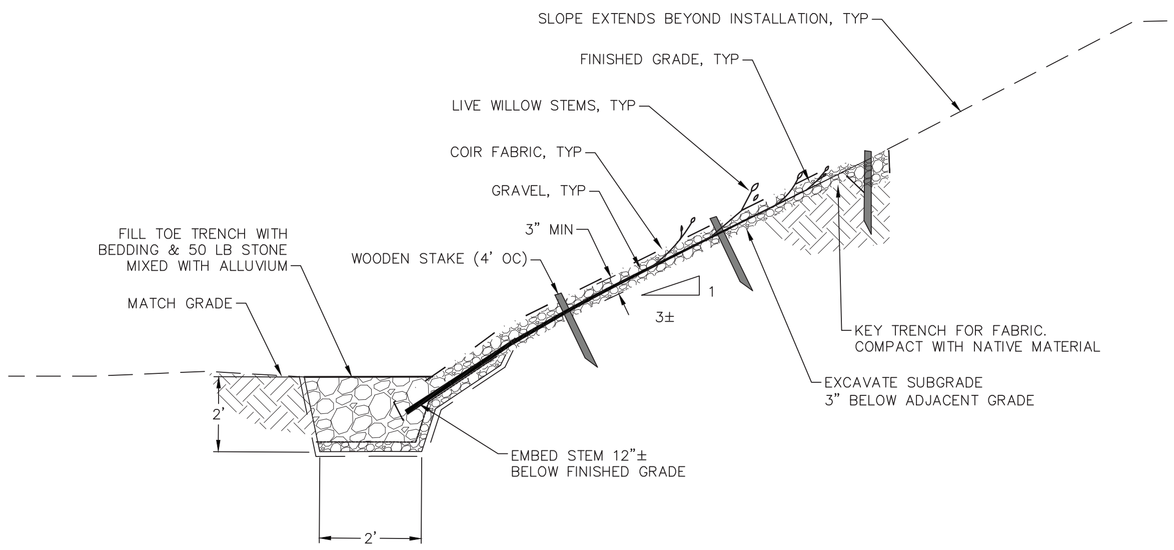
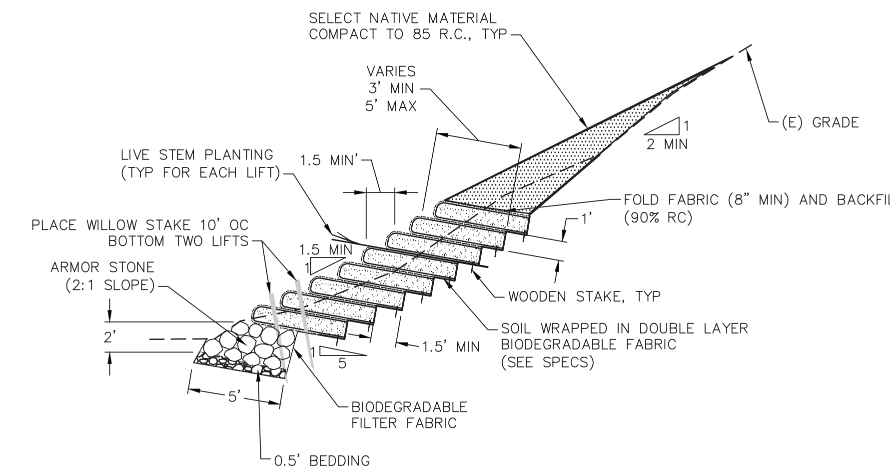
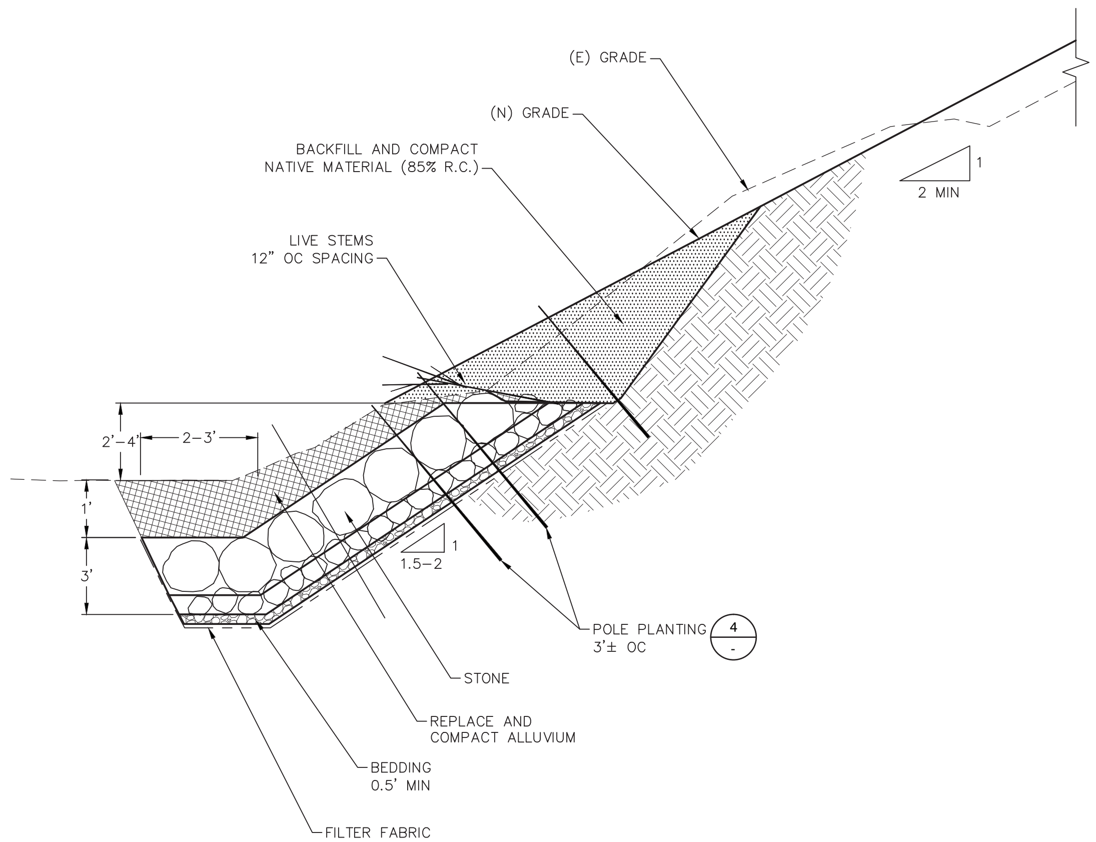
DESIGNED	ESA
DRAWN	M CARTER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C5-01



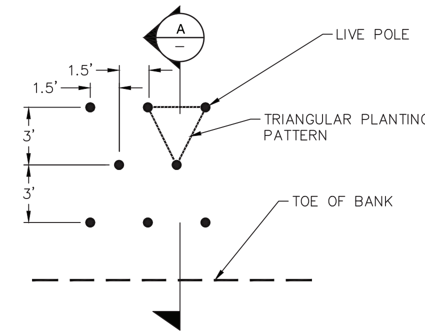
1 - BRUSH MAT
TYPICAL SECTION
SCALE: NTS



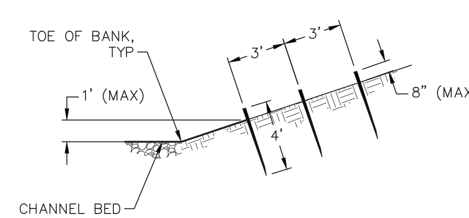
2 - VEGETATED SOIL LIFTS
SECTION
SCALE: 1" = 5'



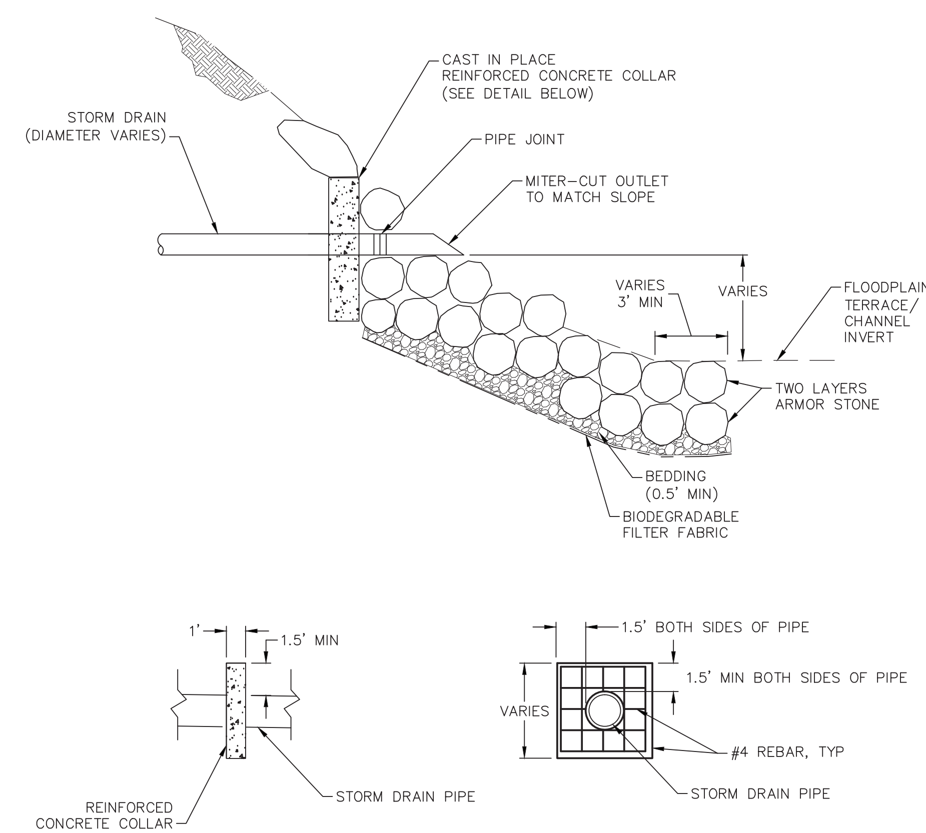
3 - PLANTED ROCK TOE
TYPICAL SECTION
SCALE: NOT TO SCALE



4 - LIVE POLE PLANTING
PLAN
SCALE: 1" = 5'



A - - LIVE POLE PLANTING
SECTION
1" = 5'



5 - STORM DRAIN OUTFALL
DETAIL
SCALE: 1" = 5'

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BIOTECHNICAL BANK STABILIZATION

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
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SCALE	AS NOTED
DATE	02-03-2016
SHEET	C5-02

27 OF 31

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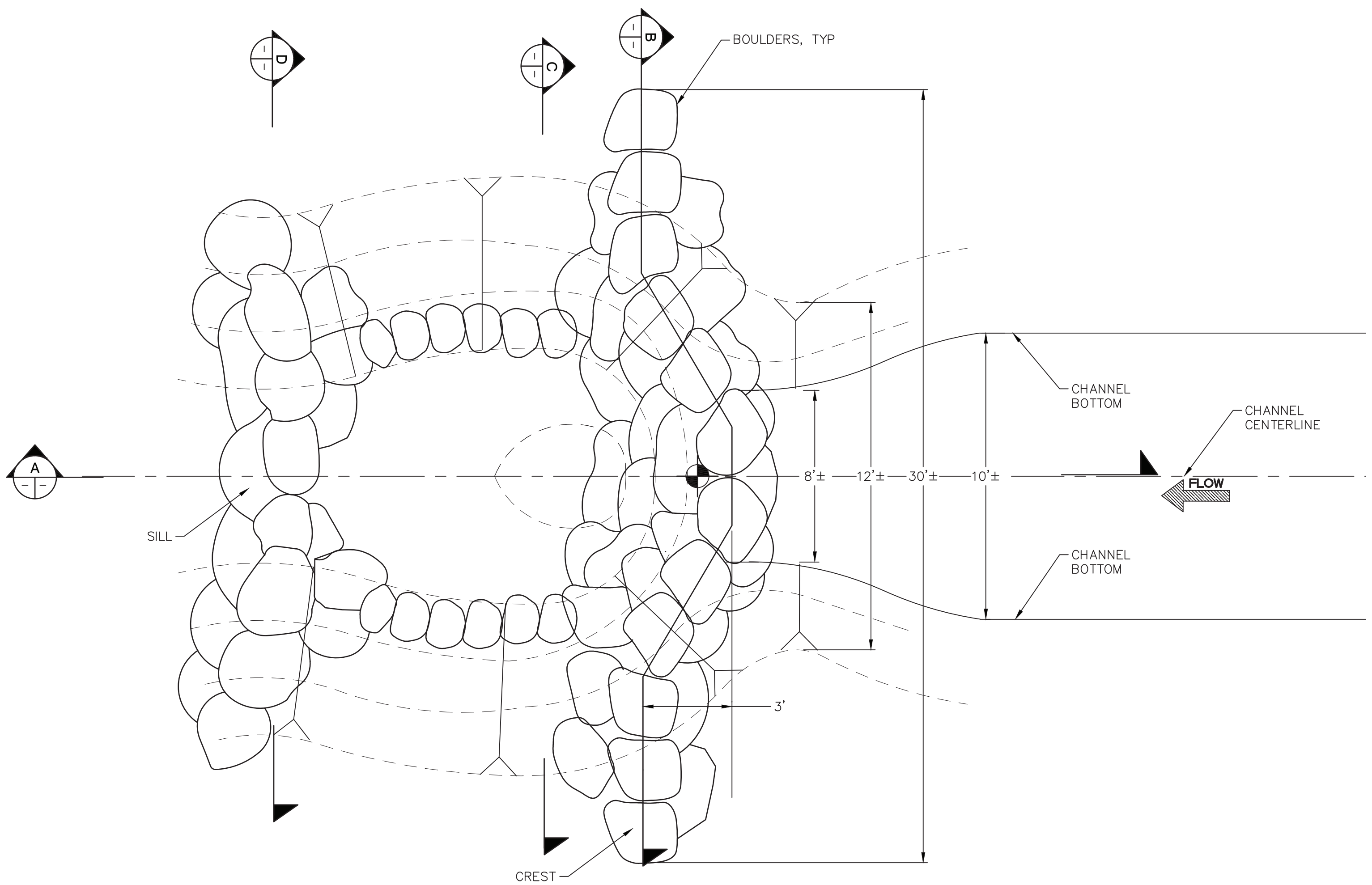
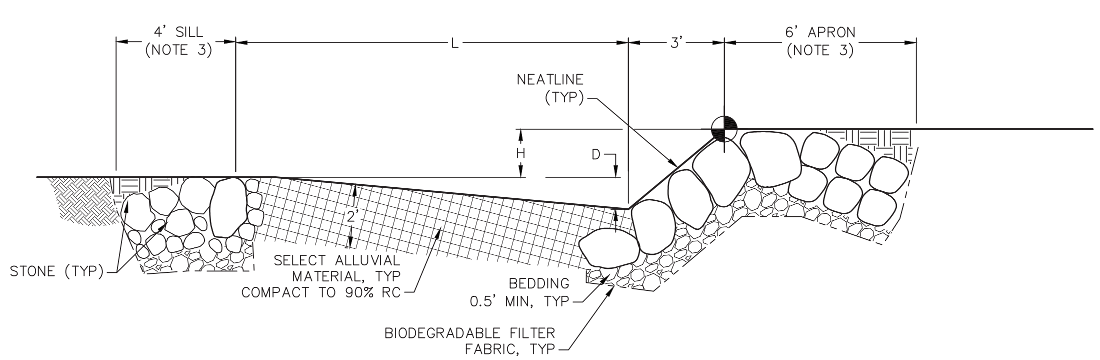
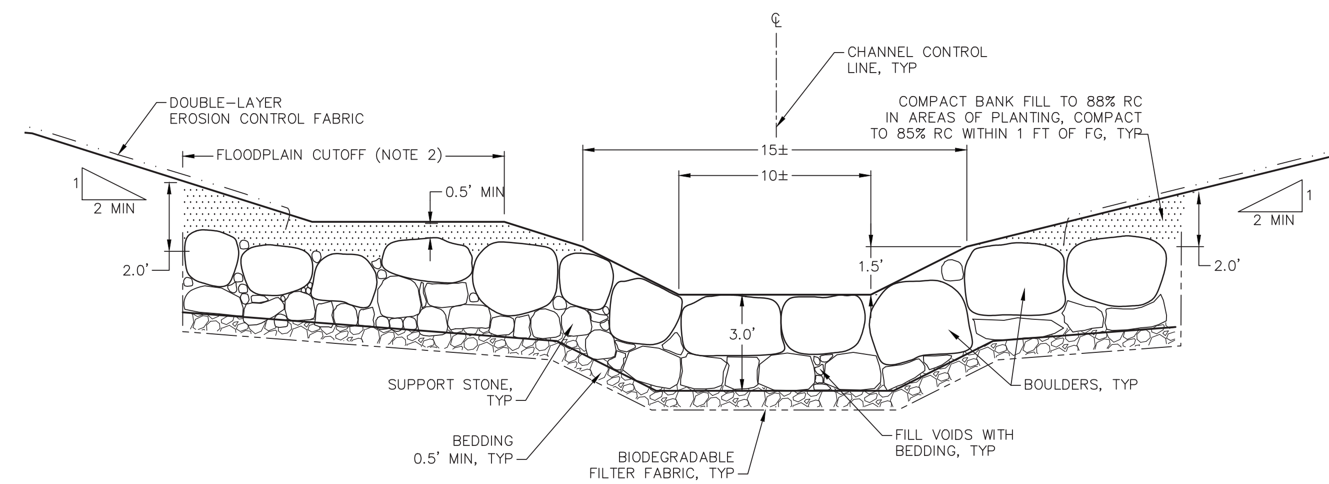


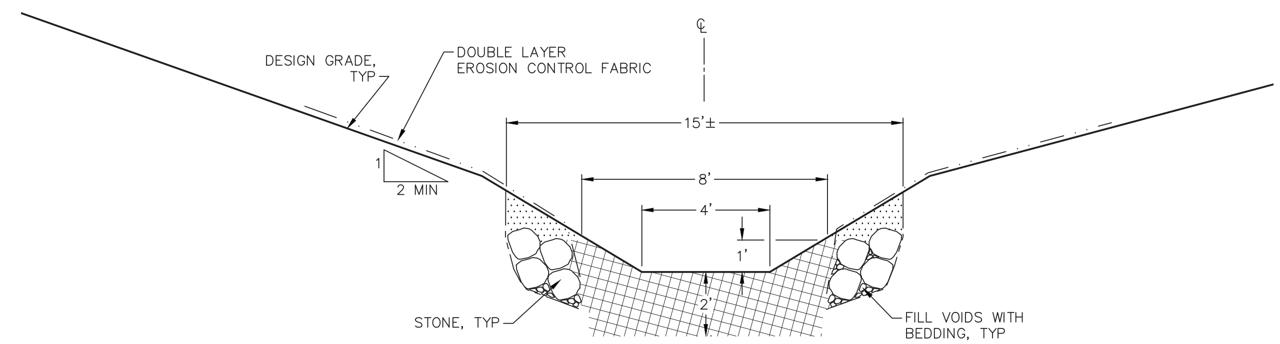
1 STEP POOL TYPICAL PLAN NTS



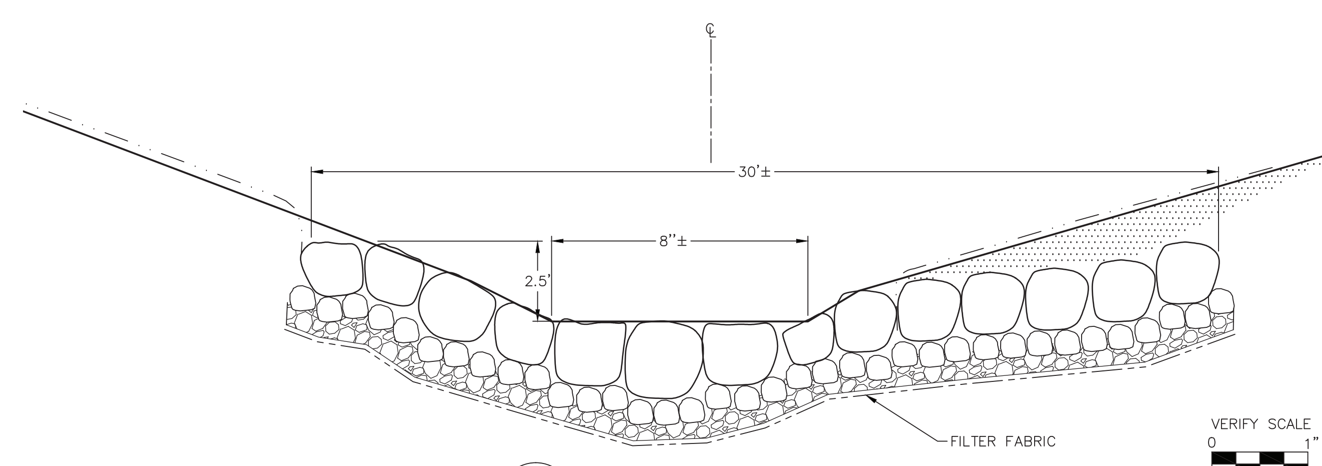
A STEP POOL PROFILE NTS



B STEP POOL CREST SECTION NTS



C STEP POOL POOL SECTION NTS



D STEP POOL SILL SECTION NTS

SHEET NOTES

1. SEE STEP POOL SCHEDULE, SHEET C5-01, FOR LOCATIONS AND STEP HEIGHTS FOR ALL STEP POOLS.
2. FLOODPLAIN CUTOFF TO PREVENT CHANNEL AVULSION. LENGTH VARIES, SEE PLAN.
3. UPSTREAM APRONS AND DOWNSTREAM SILLS TO EXTEND TO SUFFICIENT DEPTH TO ACCOMMODATE SCOUR TO A FLAT EQUILIBRIUM SLOPE (0.0%0

SCHEDULE OF DIMENSIONS (NOTE 1)

STEP HEIGHT	LENGTH (L)	HEIGHT OF STEP (H)	DEPTH OF POOL (D)
1 FT	15 FT	1 FT	0.5 FT
2 FT	20 FT	2 FT	1.0 FT

VERIFY SCALE 0 1"

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STEP POOL STRUCTURE

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
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REGISTERED PROFESSIONAL ENGINEER SCOTT L. STOLLER 71728 CIVIL STATE OF CALIFORNIA

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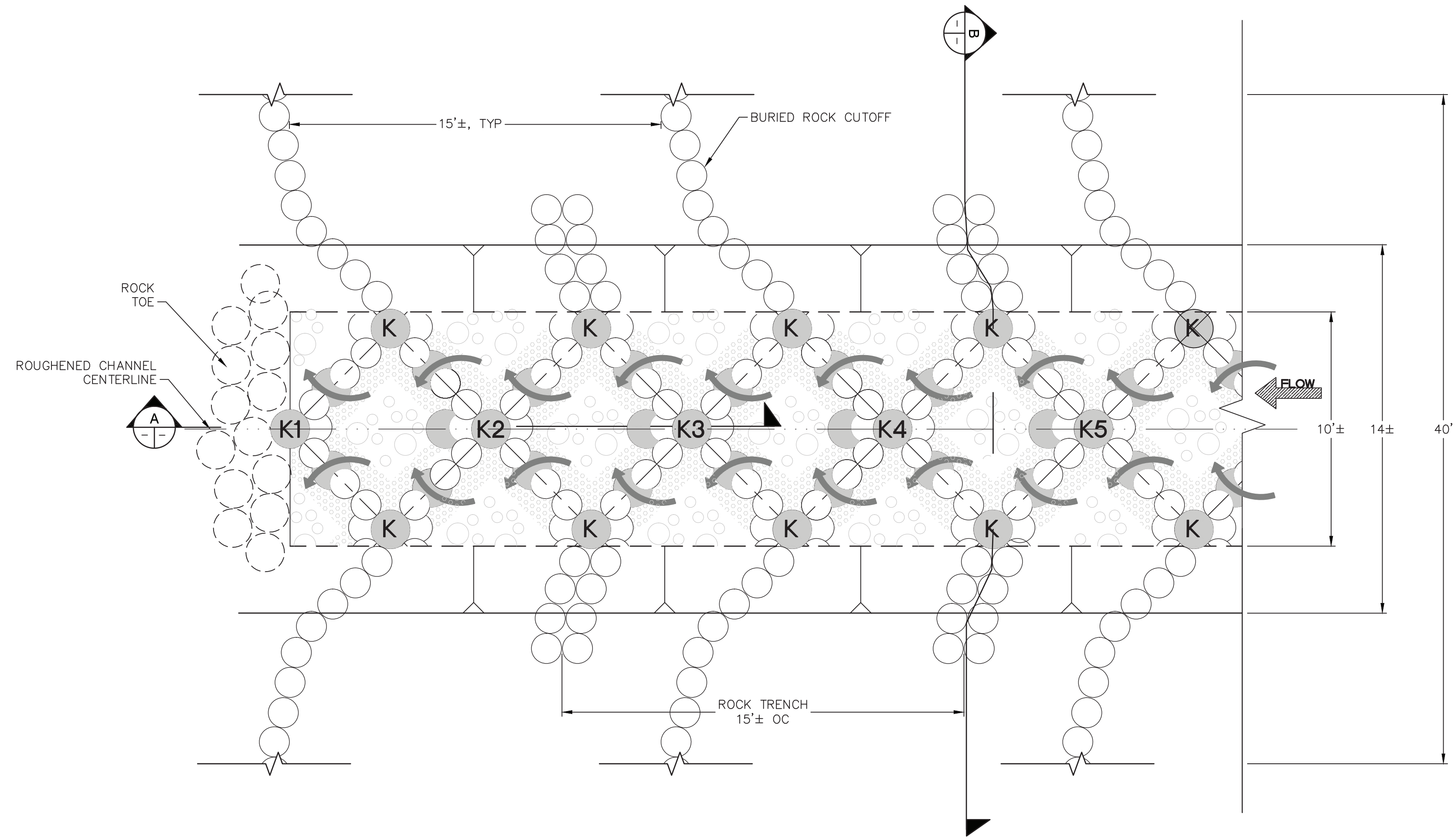
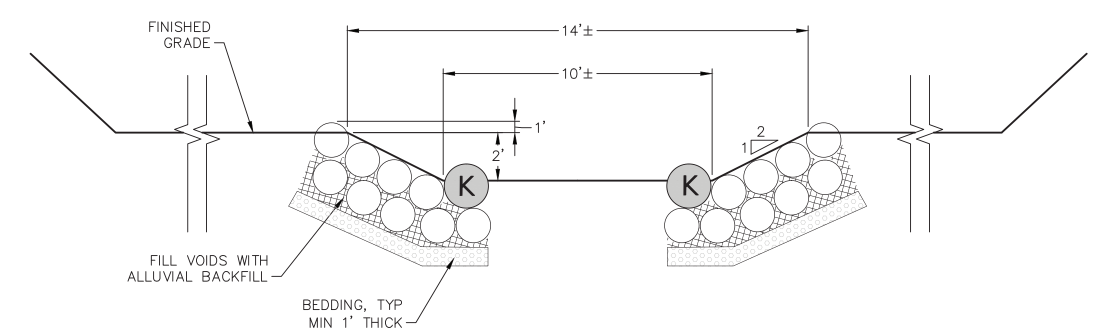
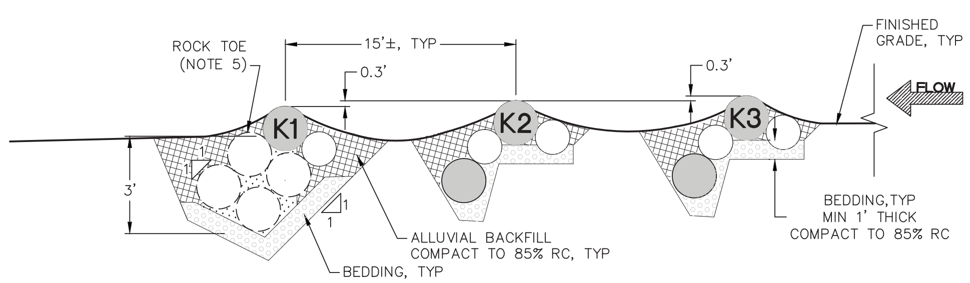
DESIGNED	ESA
DRAWN	S STOLLER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	01-29-2016
SHEET	C5-03



1 - ROUGHENED CHANNEL
PARTIAL PLAN (NOTES 2, 3, 4) NTS



B - ROUGHENED CHANNEL & ROCK TRENCH
TYPICAL SECTION NTS



A - ROUGHENED CHANNEL
PARTIAL PROFILE - CENTERLINE NTS

LEGEND

- K KEY STONE
- CREST STONE
- ROCK TOE

SHEET NOTES

1. CONTRACTOR SHALL ANTICIPATE FLOW DIVERSION AND/OR DEWATERING IS REQUIRED FOR INSTALLATION. COMPLY WITH ALL PERMIT REQUIREMENTS – SEE SPECS.
2. NATURAL BED MATERIAL (ALLUVIUM) FORMS CELLS WITHIN ROUGHENED CHANNEL MATRIX. EXCAVATE OR FILL WITH ALLUVIUM TO REACH DESIGN GRADE, COMPACT 85% R.C.
3. CENTERLINE KEYSTONE ELEVATIONS WILL BE PROVIDED IN FUTURE SUBMITTAL.
4. KEY STONES AND CREST STONES SHALL BE PLACED INDIVIDUALLY (CALTRANS METHOD A PLACEMENT). THE CONTRACTOR SHALL SELECT ROCK SIZE, ROTATE ITS PLACEMENT AND/OR EMBED IN THE BEDDING MATERIAL (6 INCHES MAXIMUM) AS NEEDED TO ACHIEVE THE DESIGN GRADES. ROCKS SHALL BE PLACED SUCH THAT THE LONG AXIS IS PARALLEL TO FLOW.
5. ROCK TOE TO BE CONSTRUCTED ON DOWNSTREAM END OF ROUGHENED CHANNEL.

VERIFY SCALE
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ROUGHENED CHANNEL

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

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DRAWN	S STOLLER
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C5-04

29 OF 31

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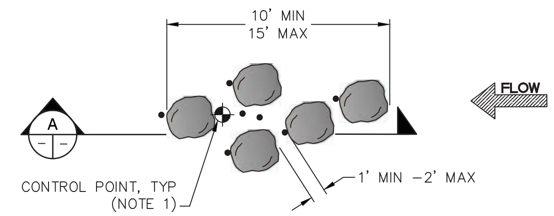
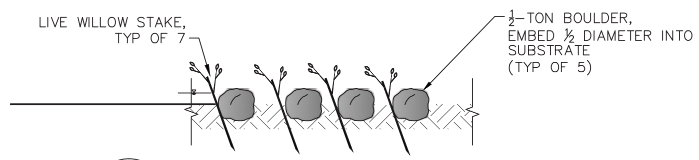
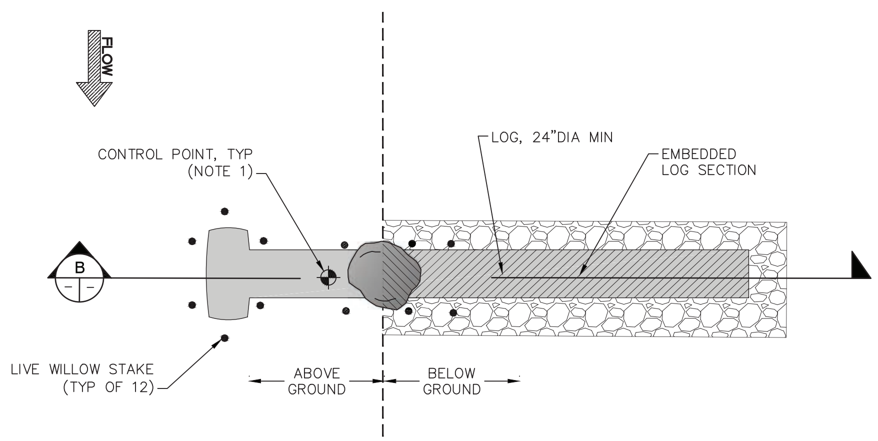


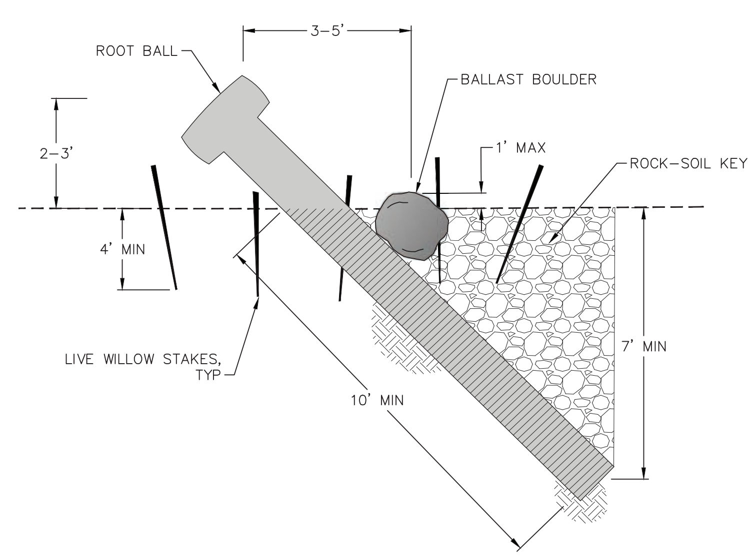
1 VEGETATED BOULDER CLUSTER
DETAIL PLAN
SCALE: 1" = 5'



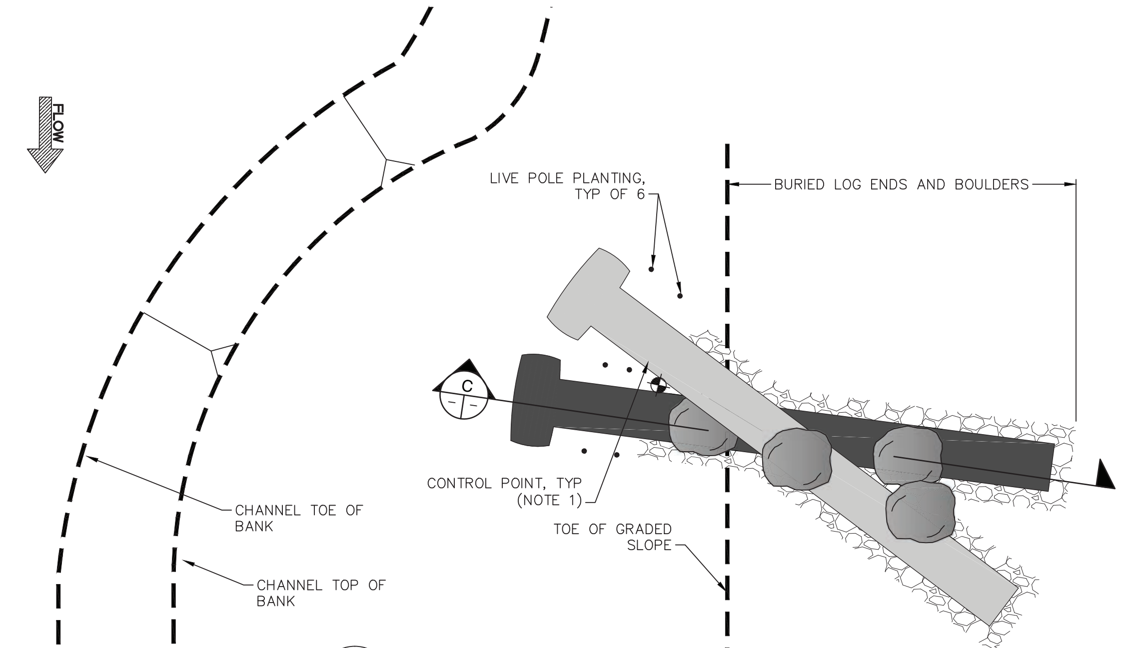
A VEGETATED BOULDER CLUSTER
DETAIL PROFILE
SCALE: 1" = 5'



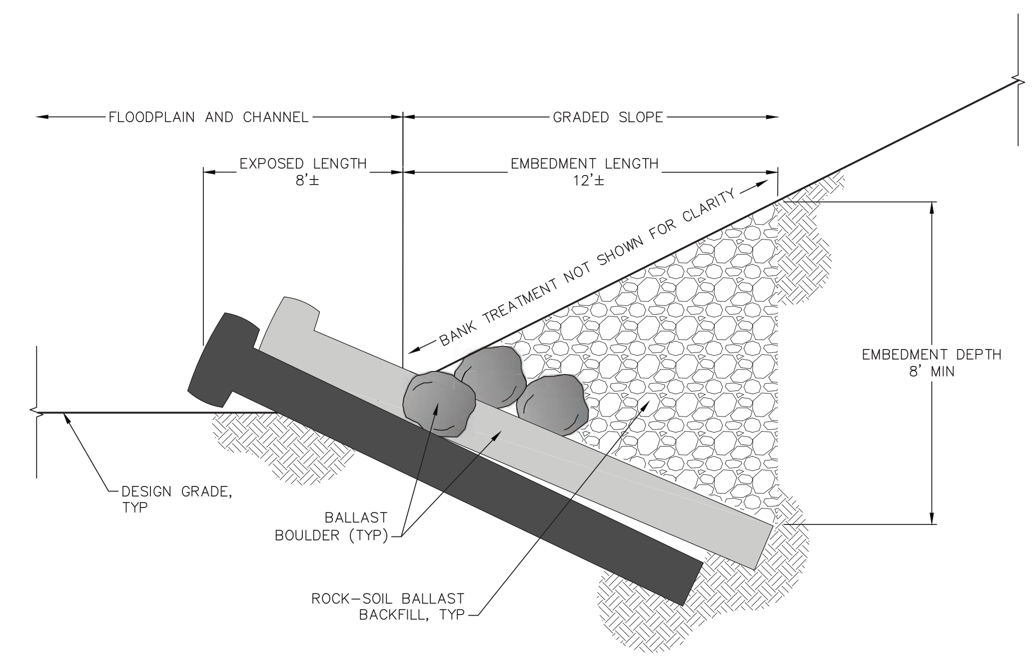
2 FLOODPLAIN LARGE WOOD - TYPE I
DETAIL PLAN
SCALE: 1" = 5'



B FLOODPLAIN LARGE WOOD - TYPE I
DETAIL SECTION (NOTE 2)
SCALE: 1" = 5'



3 FLOODPLAIN LARGE WOOD - TYPE II
DETAIL PLAN
SCALE: 1" = 5'



C FLOODPLAIN LARGE WOOD - TYPE II
DETAIL SECTION (NOTE 2)
SCALE: 1" = 5'

SHEET NOTES

1. CONTRACTOR SHALL STAKE CONTROL POINT LOCATIONS AND INDICATE STATION AND STRUCTURE TYPE. PLACE TWO STAKES PER CONTROL POINT. CONTRACTOR SHALL ANTICIPATE AND ALLOW 3 WORKING DAYS FOR RESTORATION ENGINEER TO REVIEW AND FIELD ADJUST STAKES.
2. DETAIL SECTION IS SHOWN LOOKING UPSTREAM

VERIFY SCALE
0 1"
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ROCK CLUSTER AND LOG STRUCTURE
DETAILS

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
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ACQUISITION LLC
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Irvine, CA 92614

REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
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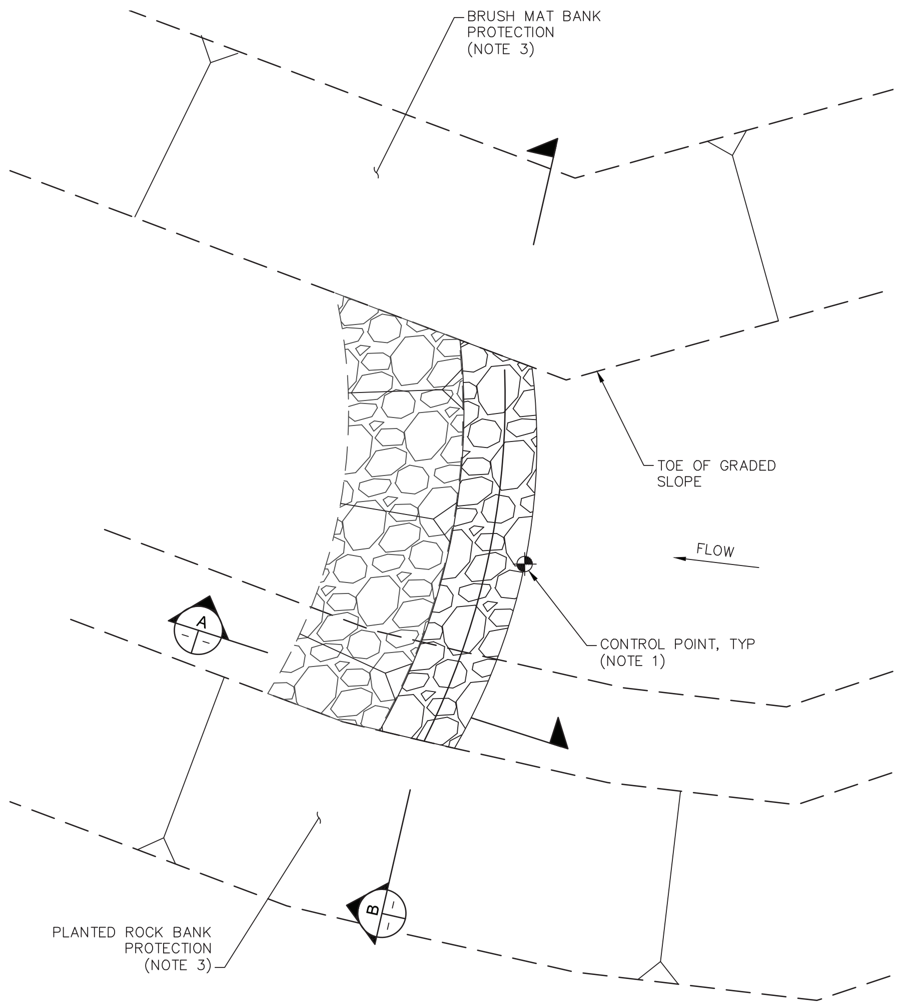
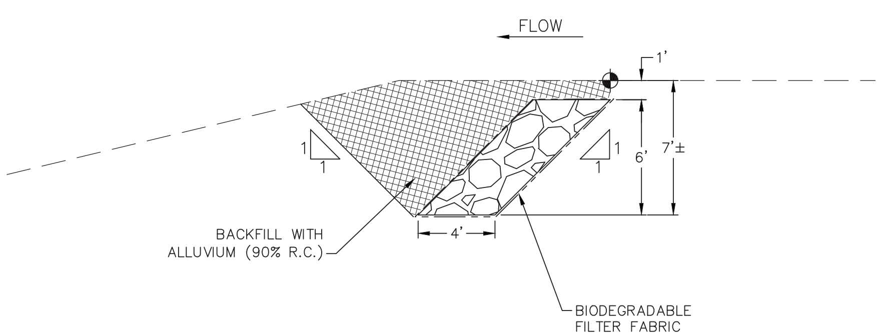
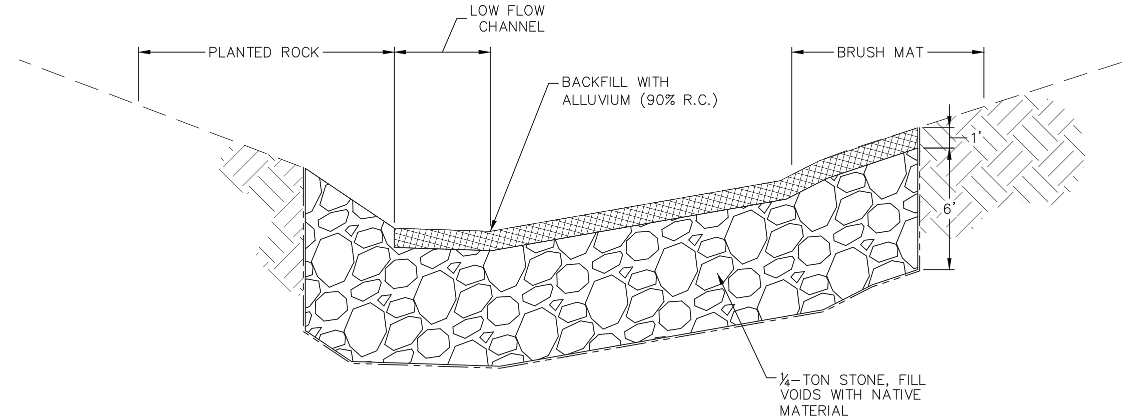
DRAWN	B TANAKA
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C5-05
	30 OF 31



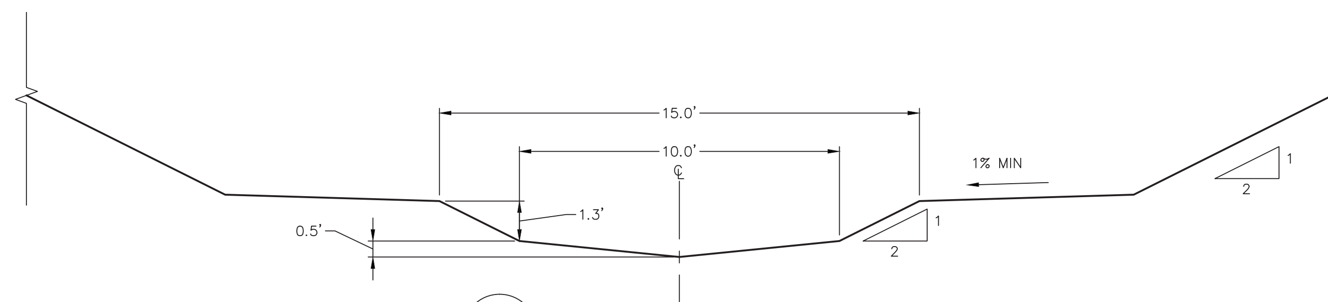
1 - BURIED GRADE CONTROL STRUCTURE
DETAIL PLAN
SCALE: 1" = 5'



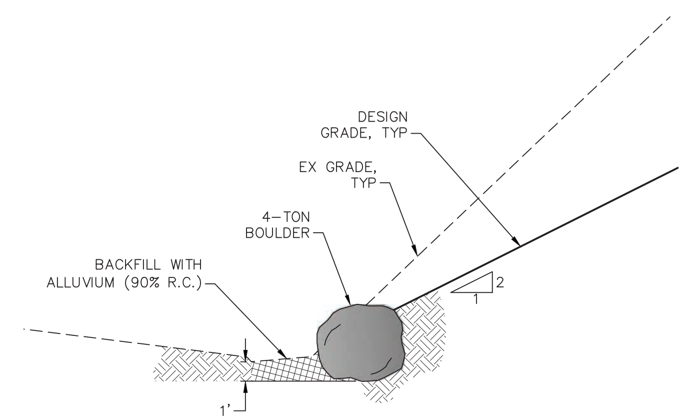
A - BURIED GRADE CONTROL STRUCTURE
PROFILE
SCALE: 1" = 5'



B - BURIED GRADE CONTROL STRUCTURE
ELEVATION (NOTE 2)
SCALE: 1" = 5'



2 - NEW CHANNEL
TYPICAL GRADING SECTION
SCALE: 1" = 3'



3 - 4 - TON BOULDER
DETAIL SECTION
SCALE: 1" = 5'

SHEET NOTES

1. CONTRACTOR SHALL STAKES CONTROL POINT LOCATIONS AND INDICATE STATION AND STRUCTURE TYPE. PLACE TWO STAKES PER CONTROL POINT. CONTRACTOR SHALL ANTICIPATE AND ALLOW 3 WORKING DAYS FOR RESTORATION ENGINEER TO REVIEW AND FIELD ADJUST STAKES.
2. DETAIL ELEVATION IS SHOWN LOOKING DOWNSTREAM
3. INTEGRATE BURIED GRADE CONTROL STRUCTURE WITH ADJACENT BANK PROTECTION

VERIFY SCALE
0 1"
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BURIED GRADE CONTROL STRUCTURE
& TYPICAL UPSTREAM SECTION

OAK KNOLL COMMUNITY DEVELOPMENT
RIFLE RANGE CREEK
CHANNEL IMPROVEMENTS

PREPARED FOR:
OAK KNOLL VENTURE
ACQUISITION LLC
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REGISTERED PROFESSIONAL ENGINEER
SCOTT L. STOLLER
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STATE OF CALIFORNIA

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DESIGNED	ESA
DRAWN	B TANAKA
INCHARGE	S.STOLLER 71728
SCALE	AS NOTED
DATE	02-03-2016
SHEET	C5-06
	31 OF 31