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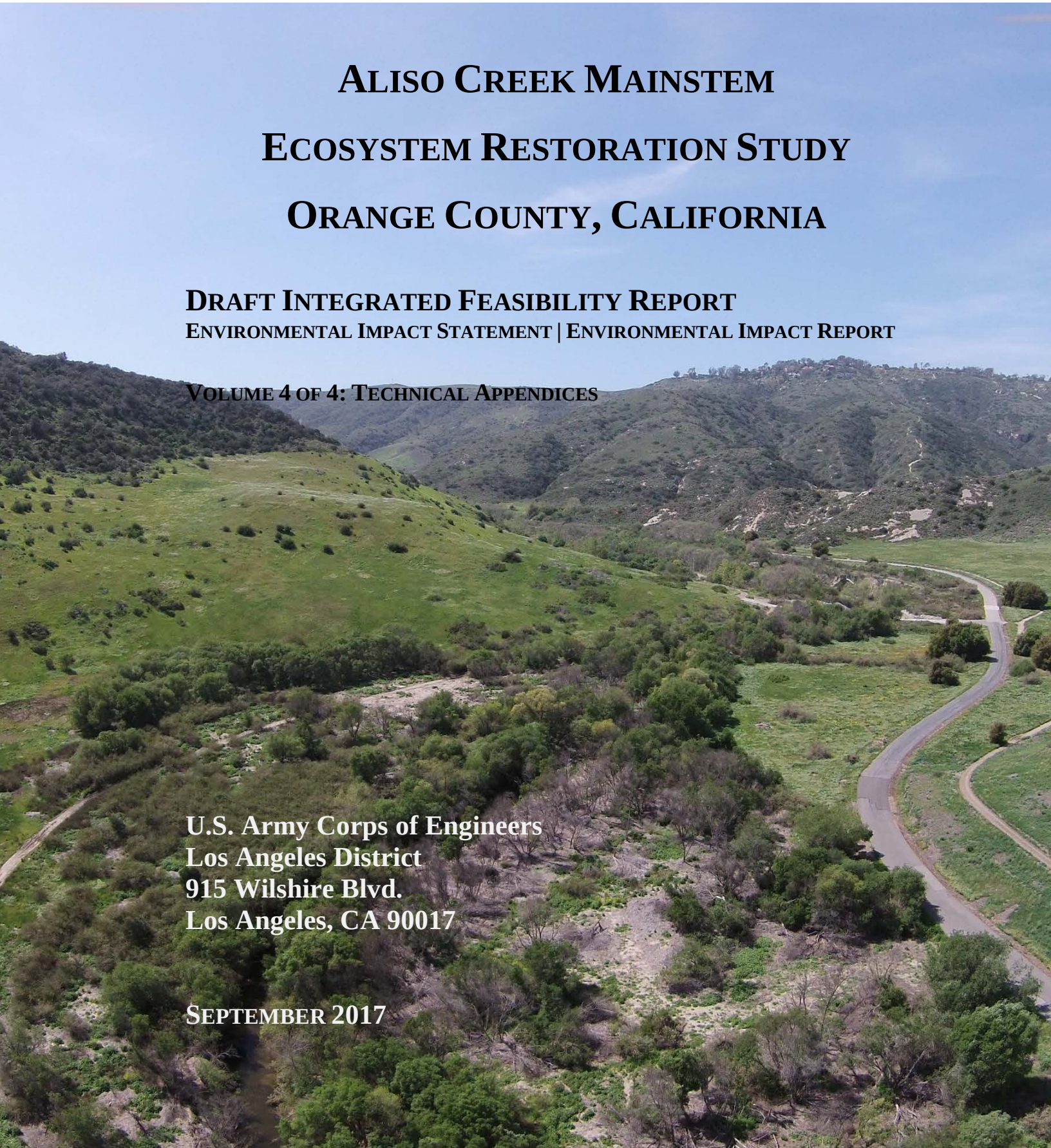

ALISO CREEK MAINSTEM ECOSYSTEM RESTORATION STUDY ORANGE COUNTY, CALIFORNIA

DRAFT INTEGRATED FEASIBILITY REPORT
ENVIRONMENTAL IMPACT STATEMENT | ENVIRONMENTAL IMPACT REPORT

VOLUME 4 OF 4: TECHNICAL APPENDICES

U.S. Army Corps of Engineers
Los Angeles District
915 Wilshire Blvd.
Los Angeles, CA 90017

SEPTEMBER 2017

USACE. 2017. Aliso Creek Mainstem Ecosystem Restoration Study. Draft Integrated Feasibility Report Environmental Impact Statement Environmental Impact Report. Orange County, California. Volume 4 of 4: Technical Appendices. U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, California. September.

Volume 4

Appendix C: Economics

Appendix D: Real Estate

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DRAFT INTEGRATED FEASIBILITY REPORT ENVIRONMENTAL IMPACT STATEMENT / ENVIRONMENTAL IMPACT REPORT (EIS/EIR)

APPENDIX C: ECONOMICS

ALISO CREEK MAINSTEM
ECOSYSTEM RESTORATION STUDY
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Contents

1.0 Purpose

The purpose of this appendix is to document the socioeconomic resources, regional economic development considerations and the economic evaluation of the benefits and costs associated with ecosystem restoration and compatible recreation features along the Aliso Creek within Orange County, California.

1.1 Guidance

The principal controlling guidance of the analysis comes from the U. S. Army Corps of Engineer's (USACE) ER 1105-2-100, *Planning Guidance Notebook*, with specific guidance from Appendix D – Economic and Social Considerations. This economic appendix provides a description of the existing and future without-project economic conditions, as well as benefits and costs of proposed alternatives. Both the comparison and the analysis of economic and social impacts of potential project alternatives will be included as part of this feasibility study. Guidance and policy documents referenced for this analysis include the following: For topics related to the cost effectiveness and incremental cost analysis, IWR Report #95-R-1, *Evaluation of Environmental Investments Procedures Manual – Interim: Cost Effectiveness and Incremental Cost Analyses* (May 1995); Damages, benefits and costs are expressed as annual values and calculated utilizing the FY17 discount rate of 2.875 percent with a period of analysis of 50 years. All damages and costs are expressed at an FY16 price level, except for the flood inundation damage analysis that was completed for the Aliso Creek Watershed Report dated October 2002.

1.2 Study Area

1.2.1 Watershed Description and Location

The study area is located within the Aliso Creek watershed which is located in southern Orange County, California. The creek flows nearly 20 miles from its headwaters at approximately 2,400 feet above sea level in Cleveland National Forest's Santiago Hills to its outlet at the Pacific Ocean near South Laguna Beach. The headwaters begins in a natural and rugged mountain environment, which transitions to more level floodplain in the middle reaches, and on through a narrow coastal canyon on the way to its ocean inlet. In particular, the Proposed Project area encompasses about a five (5)-mile stretch of Aliso Creek mainstem river system from the Pacific Park Drive area downstream to the SOCWA Coastal Treatment Plant (CTP) bridge, located about 1.2 miles upstream of the ocean outlet.

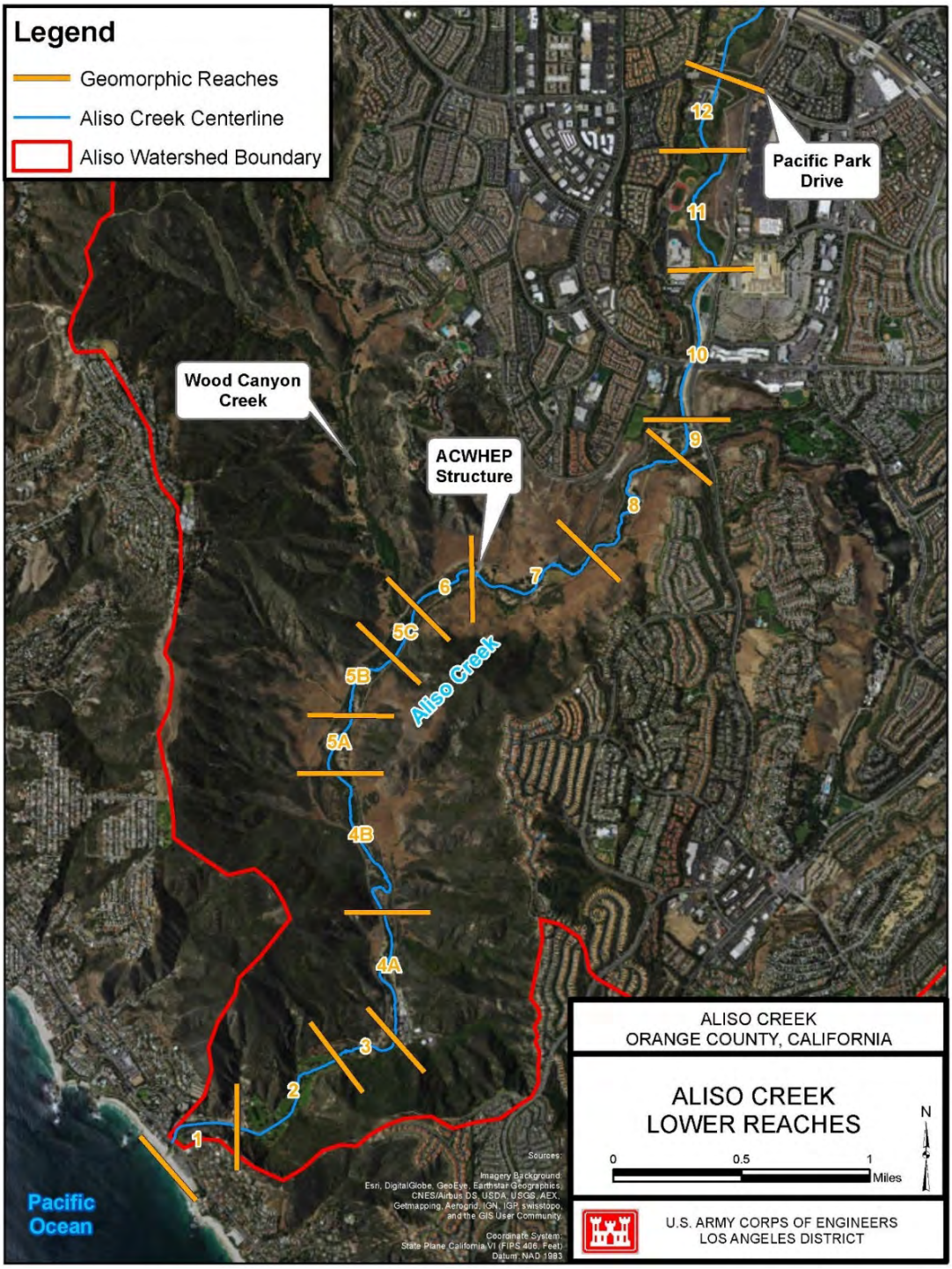
Communities within the watershed area include Portola Hills, Mission Viejo, Lake Forest, El Toro, Laguna Hills, Laguna Woods (Leisure World), Aliso Viejo, Laguna Niguel, and Laguna Beach. Major tributaries to Aliso Creek include English Canyon, Sulphur Creek, and Wood Canyon.

1.2.2 Study Reaches

Seventeen reaches were delineated along Aliso Creek for this study (Figure C1). The goal of the delineations was to establish reaches, each with similar hydraulics within itself, that adequately represent the geomorphic conditions along the creek. Channel slope, existing

hydraulic and bed controls, geologic features, sediment supply, and hydraulic parameters were considered. General features for each reach are presented below. Some reaches were divided into sub-reaches to further differentiate localized geomorphic conditions, or boundaries of the Wilderness Park. The downstream limit of the proposed project area extends through Reach 4, while the upstream limit is Reach 12.

Figure C1 Aliso Creek Restoration Project Reaches



Reach 1: Pacific Ocean outlet to the first pedestrian bridge of the golf course at the Ranch at Laguna

Reach 1 extends from the Pacific Ocean outlet to the first pedestrian bridge of the golf course at the Ranch at Laguna Beach property. Due to the outlet collecting littoral sediment drift and from tidal influence, the bridge crossing at the Pacific Coast Highway (PCH) was used as a downstream boundary for modeling purposes. Above the PCH Bridge, the reach is an improved earthen channel 1,570 feet long with concrete side slopes through the Ranch at Laguna Beach. The overall slope is 0.12 percent (0.0012 feet/ft), and the bottom width varies from 25 to 65 feet. Bank heights range from approximately 10 to 15 feet. The east overbank is occupied by a County parking lot and the west overbank includes the access road to the privately-owned Ranch at Laguna Beach and some maintenance buildings for the South Coast Water District. Man-made and geologic constraints limit the ability of the channel to self-adjust in this reach.

Reach 2: 2,620 feet of channel through the golf course

Reach 2 encompasses 2,620 feet of channel through the golf course property, which includes some riprap-protected banks. The main channel is at a slope of 0.35 percent, and is 10 to 50 feet wide, shallow and sandy, and includes some exposed gravel bars. Bank heights range from 10 to 15 feet. Several pedestrian golf course bridges span this reach. Both overbanks are broad and flat and are occupied by the golf course. Man-made constraints and channelization through this reach limit the ability of the channel to self-adjust.

Reach 3: Upper end of the golf course to the SOCWA Coastal Treatment Plant (CTP) Bridge.

Reach 3 extends from the upper end of the golf course property to the SOCWA CTP Bridge. The 1,150 feet channel in this reach is natural and unmaintained. It passes through a narrow portion of Aliso Canyon that separates the Wilderness Park from the Ranch at Laguna Beach and has a channel slope of 0.46 percent. The bottom is 23 to 60 feet wide and overbanks are well vegetated. An unnamed road follows the right (looking downstream) overbank and connects to the downstream end of AWMA Road. Bank heights are 9 feet on average and consistent within the reach. This reach has achieved a quasi-equilibrium state.

Reach 4A: 2,720 feet upstream from the CTP Bridge to the downstream end of the S-bend.

Reach 4A extends 2,720 feet upstream from the CTP Bridge to the downstream end of the S-bend. The SOCWA treatment plant is located at the lower end of this reach on the east side. The plant discharges treated effluent through a 36-inch concrete pipe that extends underground from the plant through Reaches 1, 2, and 3 to an outfall in the ocean. Buried utility lines are routed upstream from the plant through Reach 9 (after which pipeline easement is routed eastward away from Aliso Creek) and include a 36-inch raw effluent transmission pipeline, two 4-inch force main sludge pipelines and a Moulton Niguel Water District 18-inch raw effluent pipeline. Within Reach 4A, some riprap is present on the east overbank from past efforts to protect the adjacent utility lines from erosion. The reach has a slope of 0.30 percent and includes some natural grade control structures such as gravel/cobble plugs and exposed bedrock. The bottom

width ranges from 8 to 46 feet and consists of sandy bed material in pools upstream of coarse material plugs. Bank heights range from 8 to 20 feet. This reach is vertically stable but erosion and slumping of bank material continues as the channel attempts to achieve equilibrium.

Reach 4B: S-bend upstream to a weathered sandstone outcrop that acts as grade control near the upstream end of the abandoned oxbow

Reach 4B follows the S-bend upstream to a weathered sandstone outcrop at streambed grade that acts as grade control near the upstream end of the abandoned oxbow. The 3,260 foot reach has a slope of 0.35 percent with bottom widths ranging from 5 to 40 feet. Some sandy material is present in the reach while the majority of the substrate is coarse gravel and cobble. Bank heights from the S-bend to the downstream end of the oxbow are approximately 15 feet followed by a noticeable increase to 20 feet at the oxbow site. A clay-rich and relatively erosion resistant deposit is prevalent in the lower elevations of the overlying very steep channel slopes of valley fill, and also makes up some of the streambed substrate materials. This reach is vertically stable but erosion and slumping of geotechnically unstable banks continue as the channel attempts to achieve equilibrium.

Reach 5A: Upstream from the weathered sandstone boundary of Reach 4B to a thick clay-layer and lower banks of the creek

Reach 5A extends upstream from the weathered sandstone boundary of Reach 4B to a thick clay-layer in the streambed and lower banks of the creek. This 1,480-foot long reach, which ranges from 11 to 45 feet in width, is slowly incising into the clayey substrate material. The valley fill bank materials are of higher cohesion with heights of 20 to 25 feet. Streambed materials are predominately coarse gravels and cobbles, though sand-rich wedges are also found. The average channel slope is 0.30 percent. This reach is expected to continue some further vertical incision, accompanied by additional channel widening due to erosion and slumping of bank materials.

Reach 5B: 1,810 feet upstream to exposed bedrock, a geologic grade control

Reach 5B extends for 1,810 feet to exposed bedrock, a geologic grade control. The reach is densely vegetated with an average slope of 0.46 percent, and is associated with several riffle areas. Channel widths range from 8 to 60 feet. Bank heights range from 20 to 25 feet and include some riprap to provide localized protection of AWMA road to the west and adjacent buried utility lines to the east. This reach is vertically stable, however localized slumping of steepened and high channel banks will continue, especially where flows impinge and erode side slopes.

Reach 5C: 1,080 feet upstream to the confluence of Wood Canyon Creek

Reach 5C extends 1,080 feet upstream to the confluence of Wood Canyon Creek. This reach contains an abundance of sandy bed material, and is the flattest of all reaches with an average slope of 0.04 percent (0.0004 feet/ft). Channel bottom widths range from 17 to 37 feet and bank heights are relatively consistent at 25 feet. Bank slopes are less steep than downstream reaches with more established vegetation. This reach is stable both vertically and horizontally. Localized erosion is expected where the channel impinges on the toe of the disconnected floodplain terrace.

Reach 6: upstream from the Wood Canyon Creek confluence 1,300 feet to the downstream end of the ACHWEP drop structure

Reach 6 continues upstream from the Wood Canyon Creek confluence 1,300 feet to the downstream end of the ACHWEP drop structure. The channel slope of the reach is 0.55 percent, and the bottom widths vary from 16 to 26 feet. The scoured area downstream of the structure is approximately 175 feet wide. The ACWHEP drop structure is approximately 25 feet high. Bank heights in the reach range from 25 to 30 feet and include some areas of riprap stone to protect adjacent utility lines within the east bank. Multiple cobble-boulder riffles occur in this reach, and riprap, likely displaced from the ACWHEP structure or failed bank protection, are present at various streambed locations. The bed elevation in this reach appears to be relatively stabilized. Channel banks are generally vegetated and appear to have stabilized except in the immediate vicinity of the drop structure, where flood flows are directed at the geotechnically unstable banks.

Reach 7: Crest of the ACWHEP structure 2,750 feet upstream to a channel bend where the bank height transitions to 15 feet.

Reach 7 extends from the crest of the ACWHEP structure 2,750 feet upstream to a channel bend where the bank height transitions to 15 feet. Throughout this reach, the grade control appears to arrest the down-cutting, except at its upper end. The average channel slope is 0.25 percent. The banks at the lower end of the reach are comprised of alluvium and generally 4 feet high; gradually increasing to 10 feet high as the banks transition to valley fill materials. The channel bottom is generally 12 to 37 feet wide. This reach exhibits higher sinuosity than other reaches of the creek. The ACWHEP structure at the downstream end of the reach acts as a sediment trap which provides vertical stability. The bed material is primarily depositional sand and small gravel although coarse gravel and cobble riffles are also present. This reach is both vertically and laterally stable.

Reach 8: 3,110 feet upstream to the confluence with Sulphur Creek

Reach 8 extends 3,110 feet upstream to the confluence with Sulphur Creek. The channel slope is 0.27 percent, and the bottom width varies from 10 to 28 feet. The incision is well pronounced with bank heights of valley fill materials in excess of 30 feet at the upstream end. A thick clay layer lies at the toe of the banks. Reach 8 exhibits sinuosity, the greatest in the watershed, with the bed material switching between gravel and cobble riffles to sand and small gravel in the intervening pools. The outside of a bend has moved laterally and is threatening AWMA Road. Sections of pavement have been lost, and concrete barriers were placed to prevent vehicles from going over the edge. This reach is vertically stable but additional channel widening is expected.

Reach 9: 360 feet upstream of the Sulphur Creek confluence to the AWMA Road Bridge crossing which marks a transition to an engineered channel.

This reach includes the Wilderness Park Ranger Station, park restrooms, a parking lot for visitors, and access to the park from Alicia Parkway. The creek has a bottom width that varies from 8 to 18 feet. The area under the AWMA Road Bridge is protected by concrete and includes

a sloped grouted stone 3-foot drop. The overall channel slope is 1.00 percent with bank heights of 25 to 30 feet. Though the streambed is vertically stable, erosion and slumping of bank material continues to widen the channel through this reach.

Reach 10: 3,240 feet of engineered channel from AWMA Road Bridge, under the Aliso Creek Road, and continuing upstream past the Laguna Niguel Skateboard and Soccer Park

Reach 10 is a 3,240-foot stretch of engineered channel from AWMA Road Bridge, passing under the Aliso Creek Road, and continuing upstream past the Laguna Niguel Skateboard and Soccer Park. The realignment was done in 1969 to accommodate the construction of the Chet Holifield Federal Building and Alicia Parkway. Due to the channel straightening and steepness of the grade, two 10-foot high concrete drop structures were constructed. The side slopes of the channel are laid back at 2H:1V, and are protected with riprap for a distance of about 700 feet downstream of Aliso Creek Road Bridge. The overall average channel slope is 1.00 percent (0.01 feet/ft), although the bed slope between the two drop structures is 0.31% (0.0031 feet/ft). The bottom width ranges from 25 to 60 feet and bank heights range from 10 to 15 feet. The engineered channel design precludes assessment of equilibrium within the reach.

Reach 11: 2,670 feet upstream of the engineered channel to the major riprap grade control structure where the Joint Regional Water Supply System (JRWSS) pipeline crosses the creek

Reach 11 extends 2,670 feet upstream of the engineered channel to the major riprap grade control structure where the Joint Regional Water Supply System (JRWSS) pipeline crosses the creek. Several segments of the west bank are subject to scour and protected with riprap. One segment is fortified with steel piling to protect a portion of the JRWSS alignment. The channel slope is roughly 0.38 percent. The low-flow thalweg shows a consistent bottom width of 30 feet but the entire bottom width, which is heavily overgrown with giant reed (*Arundo donax)* and varies in width up to 150 feet. A thick clay layer is present in the bed and toe of the banks. A series of cattail covered coarse gravel plugs are present along the reach, with interspaced sandy pools. The reach exhibits higher sinuosity relative to other reaches. The west overbank is occupied by the Aliso Niguel High School and athletic grounds and the east overbank is a broad paved area that is a remnant of a previous road and development. Bank heights range from 10 to 20 feet. The reach is expected to further incise and widen.

Reach 12: From the riprap drop structure upstream 1,270 feet to the downstream end of the Pacific Park Drive outlet structure

Reach 12 extends from the riprap drop structure upstream 1,270 feet to the downstream end of the Pacific Park Drive outlet structure (triple barrel concrete box culverts, 8 ft H x 10 ft W). The reach has a slope of 0.51 percent and a bottom width of 27 to 55 feet. The uppermost 250 feet of the reach is engineered and lined with riprap protection. A bike path/maintenance road runs along the top of the west bank, which is protected in places with riprap and subject to further scour erosion where left unprotected. The banks heights no greater than 10 feet. The left and right overbanks in this reach are up to 500 feet wide, but are no longer inundated except during

extreme events (>500-year) due to the peak discharge reduction at the Pacific Park basin. Coarse gravel plugs/riffles are present along the streambed with intervening stretches of sandy substrate. With a mix of some engineered channel sections and natural grade control provided by plugs, this reach presents a quasi-equilibrium state.

Reach 13: Pacific Park Detention Basin upstream under the San Joaquin Hills Transportation Corridor Bridge, upstream about 4,150 feet

Reach 13 includes the Pacific Park Detention Basin and extends upstream, passing under the San Joaquin Hills Transportation Corridor bridge, up to a tributary inlet about 4,150 feet upstream across from the Aliso Viejo Middle School. The Pacific Park culvert reduces the flow conveyance under the Pacific Park Drive roadway, creating a backwater upstream in the basin. The reach has a slope of 0.5%, with a bottom width up to 150 feet wide and a consistent low flow thalweg of about 30 feet up to the Corridor Bridge. Upstream of the bridge the creek width varies between 25 and 35 feet.

Reach 14: From the tributary inlet in Reach 13 to the start of the channel bend 1,800 feet downstream of Moulton Parkway Bridge crossing

Reach 14 extends from the tributary inlet in Reach 13 to the start of the channel bend at about 1,800 feet downstream of Moulton Parkway Bridge crossing. The 3,180-foot long reach has a slope of 0.77 percent. The low flow channel is incised 3 to 10 feet within a floodplain that is up to 300 feet wide.

Reach 15: A length of 2,700 feet from 1,870 feet downstream of Moulton Parkway Bridge to a 3-foot concrete drop structure just downstream of Laguna Hills Drive Bridge

Reach 15 extends from 1,870 feet downstream of Moulton Parkway bridge to a 3-foot concrete drop structure just downstream of Laguna Hills Drive bridge for a total length of 2,700 feet. The channel slope is 1.0%. In the portion of the reach downstream of Moulton Parkway (Subreach 15A, which defines the upstream boundary of the Wilderness Park), the channel is much like the previous reach, and is incised about 10 feet within a floodplain of up to 400 feet wide. In the 830-foot section between Moulton Parkway and Laguna Hills Drive (Subreach 15B, which is Sheep Hills Park in the City of Laguna Hills), the channel has a width of about 50 feet within a floodplain of about 160 feet.

Reach 16: 3,200 feet from just downstream of Laguna Hills Drive to just upstream of the Avenida Sevilla Bridge

Reach 16 extends for 3,200 feet from Laguna Hills Drive to just upstream of the Avenida Sevilla Bridge. This reach has been modified with graded side slopes of 2.5H:1V and some riprap stone protection; the channel bottom varies between 20 and 65 feet wide. The channel is soft-bottom with an overall slope of 0.86%. The lower 1,200 feet of the reach (Subreach 16A) is County-owned and maintained for flood control. Marsh vegetation is currently cleared twice a year. The upstream 2,000 feet of the reach (Subreach 16B) is within the City of Laguna Woods which has a 16-acre conservation easement within the Laguna Woods Community preserving Aliso Creek as a natural riparian stream and freshwater marsh habitat.

Reach 17: 5,370 feet from just upstream of Avenida Sevilla to the San Diego Freeway

Reach 17 extends about 5,370 feet from just upstream of Avenida Sevilla to the San Diego Freeway. It crosses under a bridge at Paseo De Valencia, and has an overall slope of 0.98%. In the 2,000 feet between Avenida Sevilla and Paseo de Valencia, a 15 to 30-foot wide modified channel splits a narrow floodplain. The channel bottom is sandy and the side slopes are protected in stretches by riprap. This stretch of the reach (Subreach 17A) is within the Laguna Woods Community conservation easement. Between Paseo de Valencia and the San Diego Freeway, the channel (Subreach 17B) is within County–owned land and natural, with a meandering low-flow thalweg from 10 to 20 feet wide within a 160 to 260-foot wide floodplain. The banks and overbanks are largely vegetated, but include riprap and concrete protection near the freeway.

2.0 Problem & Opportunities

2.1 Environmental Resources

The quantity and quality of environmental resources within the Aliso Creek watershed has been reduced dramatically over the last few decades. Much of the change is related to the increasing development in the watershed, which has caused changes in hydrologic and hydraulic conditions, which in turn have adversely affected riparian, floodplain, and wetland habitat in the watershed.

Historically, Aliso Creek was a natural perennial stream with dry-weather flows no higher than a few cubic feet per second. With the advent of agriculture in the watershed in the late 1800's and the associated diversion of surface water, pumping of groundwater, and other factors, Aliso Creek became ephemeral. Since the water distribution system was connected to the Metropolitan Water District's transmission line, development intensified and urban runoff from excess landscape irrigation, wastewater reclamation plant discharges, and other activities in concert with structural modifications to Aliso Creek, produced year-round stream flows.

Urbanization of the Aliso Creek watershed has degraded the biological resources, compromised its ecological capacity, and impaired the goals of the Orange County Central Coastal Natural Community Conservation Planning Habitat Conservation Plan

During the early to mid-1900's, agricultural practices dominated the landscape, reducing native plant communities significantly and increasing stormwater runoff and erosion to a smaller extent. Prior to the 1930s, the Aliso Creek Watershed was primarily underdeveloped with the primary land use being for agricultural production. By the end of the 1930's the 35 square-mile watershed was merely 1% developed. Development slowly increased to 15% by the early 1970's. Development doubled over the decade to 33% by 1981. By 1990 the watershed development had increased to nearly 60%. By 2005, the 22,110-acre watershed is approximately 75% (16,580 acres) developed, but only 900 acres of the remaining vacant land is open to urban development. The estimates of urban development within the watershed was developed by an engineering consultant (Tetra Tech Inc.) almost twenty years ago for the Aliso

Creek Watershed Study (October 1998). After the completion of the Aliso Creek Watershed Study, the consultant provided an update of the percentage of urban development within the watershed for the year of 2005.

As the watershed has become more urbanized, the quantity and quality of water have been more significantly affected. The drainage system for urban areas in the watershed has been designed to speed water quickly out of the built environment into stream channels which lead ultimately to the ocean. The increase in volume and velocity during storm events has caused significant erosion and loss of the riverine vegetation type including cottonwood- willow mulufat association as well as freshwater marsh, and more quickly transports pollutants into the stream channels and ocean. The loss of floodplain and wetland areas have reduced groundwater recharge and further reduced native plant communities. Invasive non-native plants, such as giant reed, eucalyptus, pampas grass, castor bean, among others have invaded the study site over hundreds of years due to the continual disturbance and land practices that have occurred. Giant reed has infested greater than 85% of the study site and in most places in dense stands.

In order to show the current urban development within the watershed since the assessment completed in 2005, this document provides a comparison of the current population estimates with the population estimates for the year 2005. Hence the current population estimates should be an indicator of the current watershed development. The comparison of the current population estimates with the population estimate for the year of 2005 reflects the net change in urban development since the year of 2005.

Based on current and future population projections, it expected that total populations within the watershed will be either equal or slightly higher than the population estimates calculated for the year of 2005. The remaining buildable land for new development is becoming scarce within the watershed. The majority of vacant land in the watershed is related to the land area located within the Cleveland National Forest. Table C2 provides the current population estimate and the projections of population for the years 2020 and 2035 and for all cities in the watershed. The population estimates for the future years are compared with population estimate for the year of 2005, for the purpose of comparing percentage change in the population from the year of 2005. The cities Aliso Viejo and Lake Forest are only two cities showing an increase in population from the population estimate for the year of 2005. Other four cities in the watershed are showing little or no increase in the population from the year of 2005. Hence the amount of current and future projection of urbanization of the watershed is similar to the year of 2005.

Table C1 Percentage of Watershed Developed

Year	Percent Developed
1938	1%
1959	4%
1968	8%
1972	15%
1981	33%
1986	47%
1990	59%
1998	74%
2005	75%

Table C2 Comparison of Current Population and Future Population Projections with 2005 Estimate

Cities	2005	2016	% of 2005	2020	% of 2005	2035	% of 2005
Aliso Viejo	45,302	50,509	111.49%	51,500	113.68%	51,000	112.58%
Laguna Beach	23,497	23,617	100.51%	23,500	100.01%	23,400	99.59%
Laguna Hills	31,421	30,681	97.64%	32,100	102.16%	32,000	101.84%
Laguna Niguel	63,310	66,142	104.47%	65,700	103.78%	65,200	102.99%
Laguna Woods	16,998	16,213	95.38%	17,000	100.01%	16,900	99.42%
Lake Forest	76,635	83,910	109.49%	88,100	114.96%	87,400	114.05%

* Current Population Estimate 2016 Department Finance E-1_2016_InternetVersion.xls

*Projected Population Estimates for 2020 and 2035 Southern California Association of Governments: 2012AdoptedGrowthForecast.xls

The Aliso Creek watershed exhibits diverse topography and land forms resulting in a wide range of habitat types and biological diversity. The Aliso Creek ecosystem supports aquatic, wetland and riparian, as well as adjacent upland terrestrial habitats. The aquatic habitats of freshwater marsh and riparian habitats include riparian herb community, southern willow scrub, mulefat scrub, southern sycamore woodland, southern coast live oak, southern arroyo willow, southern black willow forest, and canyon live oak ravine forest. The upland terrestria1 habitats include coastal sage scrub, chaparral, grassland, and woodland. Historically, the wildlife inhabiting the Aliso Creek ecosystem was highly diverse due to the wide range of topographic relief ranging from sea level to several hundred feet above sea level.

A natural environment will experience disturbances from processes such as flooding and channel migration. In fact, disturbances in a riverine system often lead to a healthier, more diverse ecosystem. So the native plant and animal taxa are adapted to the processes of period river scour.

However, these are not the same set of disturbances experienced in an urbanized environment, which may have a permanent effect on the spatial distribution, density, and diversity of the native species and habitats. In some sites within the Aliso Creek watershed, the ecosystem has been severely impaired and riverine plant and animal assemblages may be below the natural distribution and carrying capacity. Nonetheless, some locale within the riverine ecosystem appear to be thriving, such as freshwater marsh and in some locales, verdant stands of southern willow scrub, mulefat scrub southern arroyo willow, southern black willow forest, and cottonwood-mulefat woodlands.

Historically, the wildlife inhabiting the Aliso Creek watershed was probably highly diverse due to the topographic relief ranging from sea level to approximately 2,400 feet above sea level. Within the watershed are ocean beaches, relatively flat valleys, rolling hills, and steep mountains, supporting the habitats described above. The relatively flat valleys and rolling hills and their associated habitats and streams have nearly been eliminated as a result of residential and commercial development, flood control facilities, and highways. Therefore the species diversity or species richness has decreased over time.

The ecological health of Aliso Creek is degraded. However, there is potential to recover some of the lost ecological functional capacity and equally important, prevent further loss of ecological functional capacity. There is a cause and effect relationship between development and the ecologically degraded condition of the Aliso Creek ecosystem and its congruent floodplain.

Adverse impacts of environmental degradation are not limited to plant and animal communities. Human health risks associated with impaired water quality and economic losses due to changing channel conditions are also of significant concern.

2.2 Flooding and Erosion Impacts

While most development within the study area for the Aliso Creek Mainstem Ecosystem Restoration Study is safely outside the FEMA 1% ACE (100-yr event) floodplain, those private and public developments that are within the creek's floodplain experience repeated damages flood inundation. In addition, the dramatic scale of the Aliso Creek Watershed's urbanization has contributed to increases in the peak discharge rates for a given amount of rainfall due to the increase of impervious areas, elimination of temporary depression storage, and increases in the efficiency of drainage.

With development have come investments in transportation and utility infrastructure within the study area that have suffered damage from instability of the creek channel. Channel migration as well as widening and deepening of the channel have historically caused repeated damages to transportation investments (road and bridges) and to water and sewer utilities serving the developed portions of the watershed and surrounding communities.

Channel instability and flooding within the study area have resulted in a wide range of economic costs – both national and regional in scope. Historic economic damages in the watershed have resulted from flood inundation of structures and their contents, inundation of golf courses and

public parks, and erosion resulting from channel instability (lateral stream bank erosion and migration, and/or vertical streambed down cutting). Channel instability has contributed to damages to utility and transportation infrastructure, with wide-ranging economic effects, including public health and safety costs, regulatory/legal costs, and costs associated with the closure of recreation facilities. Table C3 details the flood and erosion damages that have occurred since 1969.

Flooding and erosion damages are not new to the structures and infrastructure within the study area. The Corps of Engineers Los Angeles District prepared a Floodplain Information Report on Aliso Creek in 1973 documenting the damaging floods in the Aliso Creek Watershed for the years 1916, 1927, 1937, and 1969. While no dollar estimates of damages are available for the early floods (1916-1937), documentation shows that bridges spanning the creek were the primary source of damages.

Dollar estimates of flooding and erosion damages within the Aliso Creek Watershed (records do not differentiate the two) resulting from two storms in 1969 amounted to $7,681,000. The first storm, occurring in January caused damages of $2,745,000, while damages from a second storm in February amounted to $4,936,000. The February 1969 storm event flooded the hotel, The Ranch at Laguna Beach, located in reach 2, where 78 guests were evacuated by the fire department without injury. Mud stood three feet deep in most guestrooms at the hotel destroying most of the rooms' contents. Additional damaging storms occurred in 1992, 1995, and during the recent El Nino storm events in the winter of 1997-1998.

In 1992, the dollar estimates of flooding and erosion damages within the study area totaled $6,035,000. The storm flooded 47 rooms attached to the Ranch at Laguna Beach. As mentioned in the previous discussion on reach descriptions, the hotel has been significantly remodeled and re-named as The Ranch at Laguna Beach. The flooding in 1992 washed out the access bridge to the SOCWA Treatment Facility. Without the bridge, staff was unable to service and maintain the plant. Fortunately the U.S. Marines were available to fly in a temporary bridge until a new bridge could be constructed; averting what would otherwise have been a major spill of untreated sewage into Aliso Creek and then the Pacific Ocean. The depreciated replacement cost and cost of the temporary bridge totaled $373,000.

A series of damaging El Nino driven storm events occurred in the winter of 1997-98. Dollar estimates of flooding and erosion damages that occurred within the Aliso Creek Watershed due to El Nino storms were estimated at $8,871,000. The portion of the total watershed damages that occurred to commercial- property and infrastructure within the study area was estimated at $8,723,000 ($6,467,000 in flood damage, $2,256,000 in erosion damage). Two of these El Nino events again flooded the hotel, The Ranch at Laguna Beach, and Ben Brown Golf Course causing $5,550,000 in damages including $2,018,000 of damages to the Ben Brown Golf Course, $1,514,000 to structures and contents, and $2,018,000 in lost income.

The El Nino storm events during the winter of 1998-99 destabilized the embankments on Sulphur Creek and Aliso Creek located near the AWMA Road. The destabilized embankment caused damages to a 36" effluent pipeline and two 4" sludge pipelines serving SOCWA, and 18"

sewer line owned by Moulton Niguel Water District. The two agencies spent $555,000 in repairing these damages in the winter 1998-99.

In 2006, the storm events from January through March, destabilized the west embankment of Aliso Creek resulting in the collapse of AWMA Road into Aliso Creek. The AWMA Road was repaired by SOCWA and repair costs totaled $372,000.

In addition to the direct costs associated with storm damages, general instability and unpredictability of the Aliso Creek Channel cause recurring unanticipated operation and maintenance expenditures for the repair and protection of utility infrastructure due to steady long-term erosion of the Aliso Creek channel.

South Coast Water District (SCWD) has spent $76,000 to $84,000 per year on bank protection along Aliso Creek during the period of 1983 to 1998. In 1992 the SCED spent $469,000 for bank control protection along the access through Aliso and Wood Canyons Wilderness Park.

The South Orange County Wastewater Authority (SOCWA) spent approximately $5.9 million during the period of 1979 to 1994, or an average of $392,000/year repairing erosion damages along the creek. In 2003, SOCWA repaired a pipeline after steady erosion damaged the encasement for effluent pipeline. SOCWA considers all repairs along Aliso Creek temporary due to instability of the creek, stating "Until Aliso Creek is stabilized, anything SOCWA does in and along its banks should be considered temporary".

In 2008, the U.S. Army of Corps of Engineers partnered with SOCWA in constructing a bank protection project for protecting the access bridge to SOCWA Treatment Facility located in Aliso Woods Canyon Wilderness Park. The total cost for the project was $763,000.

Table C3 Historical Flood and Erosion Damages

Historical Flood and Erosion Damages are based on FY 2016 Price Level	
Year	Damages
1969	$7,681,000
1979	$392,000
1980	$392,000
1981	$392,000
1982	$392,000
1983	$476,000
1984	$476,000
1985	$476,000
1986	$476,000
1987	$476,000
1988	$476,000
1989	$476,000
1990	$476,000
1991	$476,000
1992	$6,035,000
1993	$1,041,000
1994	$476,000
1995	$1,246,000
1996	$84,000
1997	$84,000
1998	$8,871,000
1999	$555,000
2003	$315,000
2006	$372,000
2008	$763,000
Total Damages	$33,375,000

2.3 Recreation

Aliso Creek is a popular Orange County recreation destination, offering a variety of recreation opportunities including, hiking, walking, biking, mountain biking, and nature appreciation. Aliso Creek offers unique natural recreation opportunities in the increasingly developed region. A February 1996 article in Los Angeles Times cited the Aliso and Wood Canyon Regional Park as one of Orange County's three best parks, recommending "Make your way to this 3,400 acre park for an idea of what the County looked like before the invention of concrete – abundant hiking and biking trails."

Aliso Creek provides a range of unique environmental resources and recreation experiences in an increasingly developed region. The freshwater marsh and riparian communities found along Aliso Creek have been degraded and are at risk of further declines due to poor water quality and channel instability. The popular recreation activities provided along the creek are repeatedly closed to the pubic due to public health and safety risks associated with water quality and threatened/damaged roads, paths, and tails.

3.0 Without Project Conditions

3.1 Development & Land Use

Existing Land Use

A significant portion of the study area is located within the boundaries of the Aliso and Wood Canyons Wilderness Park. The park has approximately 4,500 acres of wilderness and natural open space, which includes mature oaks, sycamores and elderberry trees, and over 30 miles of hiking trails. The land uses surrounding Aliso and Wood Canyons Wilderness Park include the communities of Aliso Viejo, Laguna Niguel, Laguna Niguel, Laguna Hills, Laguna Woods, and Laguna Beach. These communities are densely populated with residential and commercial development. In addition, the land uses in the study area include the following recreational areas: Moulton Meadows Park, Laguna Niguel Regional Park, Acorn Park, Grand Park, Laguna Wilderness Park, Aliso Viejo Community Park, Laguna Niguel Skate & Soccer, Woodfield Park, Foxorough Park, Crown Valley Park, Hillview Park, Ben Brown Golf Course, and Aliso Beach.

3.2 Population

Orange County, California spans over 948 square miles and has over nearly three million residents in 2016. It is the smallest county in Southern California. The County is famous for its tourism with Disneyland, Knott's Berry Farm, as well as the sunny beaches along its 40 mile coastline. Thirty-four incorporated cities are located in Orange County. The County has a very diverse population according to the Census Bureau's 2014 American Community Survey with 41.8% white Non-Hispanic, 34.3% Hispanic, 19.2% Asian-Pacific Islander, 1.5% African American, 0.2% Native American, .1% from other races and 2.8% Two or more races.

The tables below show respective populations and geographic sizes for the County and cities in the watershed.

Table C4 Population Data for Cities within the Watershed

Demographics								
Area - Square Miles	Entity	Date of Incorporation	Population 2016	2010	2000	1990	1980	1970
948	Orange County	3/11/1889	3,183,011	3,010,232	2,846,289	2,410,556	1,932,709	1,421,233
10.2	Aliso Viejo	1-Jul-2001	50,509	47,823	40,225	7,612	N/A	N/A
6.5	Dana Point	1-Jan-1989	33,415	33,351	35,110	31,896	N/A	N/A
9.7	Laguna Beach	29-Jun-1927	23,617	22,723	23,317	23,170	N/A	N/A
6.4	Laguna Hills	5-Mar-1991	30,681	30,344	31,178	27,445	N/A	N/A
14.7	Laguna Niguel	1-Dec-1989	66,142	62,979	61,963	44,400	N/A	N/A
3.2	Laguna Woods (1)	24-Mar-1999	16,213	16,192	16,252	N/A	N/A	N/A
12.6	Lake Forest	20-Dec-1991	83,910	77,264	58,806	N/A	N/A	N/A
	(1) formally Leisure World Laguna Hills							
Source: US Census Bureau, California Department of Finance								

Except for the City of Laguna Beach all the cities in the Aliso Creek Watershed are relatively newly incorporated cities. The table above shows the growth rate of the population from 1990 to 2016 in the Watershed was greater than the County as a whole.

The California Department of Finance forecasts that the average annual rate of growth of the population of Orange County will continue its current downward trend over the course of the next forty years, and that the population will increase slowly through 2050. After the year of 2050, the projection of population growth is expected to be negative. Future growth for the cities in the study area will be limited to the few areas where developable land still exists.

Table C5 Population Forecast-Orange County

Population Forecast - Orange County			
Year	**Population**	**% Change**	**Average Annual % Change**
2010	3,014,996	NA	NA
2016	3,183,011	NA	NA
2020	3,243,261	7.57%	0.73%
2030	3,361,556	3.65%	0.36%
2040	3,449,498	2.62%	0.26%
2050	3,481,613	0.93%	0.09%
2060	3,464,374	-0.50%	-0.05%
Source: California Department of Finance, Demographic Research Unit			

3.3 Economic Profile

The table below shows some of the basic economic indicators at the county level, comparing Orange County to cities in the Aliso Creek Watershed. As the following table below shows, median household income in Orange County was $75,988 in 2014. All the cities in the Watershed have higher household income with the exception of Laguna Woods which is a retirement community.

Table C6 Economic Indicators for Orange County and Cities for Watershed

Economic Indicators					
	Median Age 2014	Median Household Income 2014	2014 Percent Owner-Occupied	Median Home Price Aug 2016	2014 Percent with Security Income
Orange County	36.7	$75,998	58.2	$657,100	24.9%
Aliso Viejo	36.1	$102,325	62.1	$562,900	11.6%
Laguna Beach	50.1	$97,881	61.5	$1,890,000	28.4%
Laguna Hills	41.7	$91,460	70.2	$696,000	26.3%
Laguna Niguel	43.4	$98,957	71.8	$776,100	22.9%
Laguna Woods	74.5	$36,708	73.8	$330,300	79.4%
Lake Forest	38.2	$92,781	70.3	$639,100	18.7%
Source for Age, Income, Percent Owner Occupied -US Census					
Source For Aug 2016 Median Home Price-Zillow Website					

Laguna Woods formally known as Leisure World, is a retirement community. Accordingly, housing sizes are smaller and incomes are lower than the surrounding communities. As a whole the communities in and around the Aliso Creek Watershed are more affluent than the County and State as a whole.

3.4 Without Project Flood and Erosion Damages

In October 2002, the Aliso Creek Watershed Management Study was completed for the purpose of identifying solutions to environmental and economic problems in the Aliso Creek Watershed. The report summarizes a damage assessment that analyzed the expected flood and erosion damages in the watershed.

Maintaining the existing level of flood protection is a critical constraint of any potential ecosystem restoration project, and all potential alternatives will be formulated in a way that improves the quantity and quality of habitat along the creek, while at the same time not adversely impacting the ability of the creek to protect the people and property along its banks. The damage assessment presented in Aliso Creek Watershed Management Study was not updated for this

report since the primary purpose of this report is to identify measures that improve the quantity and quality of habitat along the creek.

3.4.1 Flood Risk

Expected annual flood damages to structures and their contents in the Aliso Creek watershed were estimated to provide a baseline forecast of anticipated future damages without the implementation of any new management measures within the study area. A complete survey of structures within the Aliso Creek regulatory floodplain was conducted in 1998 to estimate expected annual flood inundation damages. This survey identified 20 structures at risk of flood inundation. These structures, all located within the current study area, included the pump house for the SOCWA Treatment Facility located in Aliso &Wood Canyons Regional Park, 17 structures of the hotel named "The Ranch at Laguna Beach" and Ben Brown Golf Course, and two maintenance facilities belonging to the SOCWA and Orange County near the Pacific Coast Highway. The damage assessment analysis for flood inundation was based on 1998 price levels and a discount rate of 6.875%. Average annual flood inundation damages to structures and contents within the study area were estimated at $35,100.

In addition to the damages to structures and contents in the study area, potential damages exist at the 9-hole golf course at the hotel named "The Ranch at Laguna Beach". Frequency-based future damages to the Ben Brown Golf Course were estimated by overlaying the flood overflow maps generated in the Watershed Study's hydrologic and hydraulic analyses together with golf course layouts to determine depth-damage relationships for storm events of varying magnitude. A damage estimate of $123,000 per hole inundated was used for forecasting future damages. The damage assessment was based on 1998 price levels and a discount rate of 6.875%. Average annual golf course damages within the study area were estimated at $105,000.

Because of the limited amount of flood risks within the study area, flood risk reduction was not included as an objective for this feasibility study.

3.4.2 Erosion Risk

Streambank erosion throughout the Aliso Creek Watershed has contributed to recurring damages to utility, transportation, and recreation infrastructure over time. At-risk utility infrastructure includes pipelines for the transmission of water supplies, raw sewage, treated effluent, reclaimed water, and gas. These pipelines run alongside and cross under the Aliso Creek channel. Ruptured mains incur a variety of costs including emergency repair costs, public health and safety costs, legal costs associated with regulatory fines and penalties, and costs associated with service interruptions to homes and businesses.

The frequency of erosion related damages in the study area can to some extent be attributed to the fact that the creek channel is allowed to migrate more freely – especially through the Aliso and Wood Canyons Wilderness Park. The encroachment of development in the upper watershed has led to more channelized and bank protected reaches that are safer from damages due to the degradation of the creek channel. Hydrologic, hydraulic, and sedimentation studies conducted as part of the watershed study have indicated that the instability in the lower reaches is likely a

natural response in part to the hydraulic modifications upstream. These studies found the creek to be highly unstable and unpredictable through study area.

Much of the Proposed Project area for the feasibility study is within the Aliso and Wood Canyons Wilderness Park. A public utility, the South Orange County Wastewater Authority (SOCWA) Coastal Treatment Plant, is situated in Aliso Canyon within an isolated lower parcel surrounded by the Wilderness Park. The facility is located on the east side of Aliso Creek and is approximately 1.2 miles upstream from the Pacific Ocean. The Coastal Treatment Plant has a design capacity of 6.7 million gallons per day and serves the City of Laguna Beach, Emerald Bay Services District, South Coast Water District, and Moulton Niguel Water District for a population of 40,000. An easement for buried sludge conveyance force mains (two- 4 inch) and raw effluent (18-inch and 36-inch) pipelines runs along the east side of Aliso Creek In particular, the 18- inch raw effluent pipeline, which is owned by Moulton Niguel Water District, follows an alignment that is closer to the creek bank than other three pipelines. The three other pipelines (36-inch effluent pipeline and two 4-inch sludge lines) follow same route as 18-inch pipeline (owned Moulton Niguel Water District). The 4-inch and 36-inch pipelines are generally in close proximity, however their distance to the 18-inch alignment can vary from a few feet up to approximately 100 feet.

Treated effluent is discharged to the Pacific Ocean through the Aliso Creek Ocean Outfall. Some limited amount of treated effluent is also utilized for recycled water. The facility is accessible by way of the SOCWA bridge, by way of a private access road (AWMA Road) that parallels to the west of Aliso Creek through the Wilderness Park. County staff and the recreational users of Wood Canyon trail share a portion of AWMA Road for Wilderness Park access. SOCWA also has an unimproved (dirt) service road on the east side of Aliso Creek.

The on-going erosion of the Aliso Creek channel poses a threat to the SOCWA pipeline infrastructure. SOCWA has spent millions of dollars repairing erosion damages along Aliso Creek and the agency considers all repairs along Aliso Creek temporary due to instability of the channel. Based on recent SOCWA study, *Lower Aliso Creek Erosion Assessment Study* (Tetra Tech, dated April 2012), the geomorphic instabilities of the channel poses risks to the infrastructure (i.e. AWMA Road and wastewater pipelines) located along both banks of Aliso Creek. The assessment included the identification and evaluation of locations where erosion of the banks could lead to exposure/undermining of the existing pipelines or AWMA Road located throughout the study reaches. The results of this study established various segments ("risk locations") of both channel banks that are at risk to incur significant impacts to the facilities from erosion. For the without-project conditions, these risk locations were identified as being more susceptible to damages than other areas (eg. along outside bends of the alignment). The without-project conditions also helped to establish the risk areas for with-project as the latter's alignment is relatively similar and hence lead to the development of the required bank protection features.

In order to evaluate the expected future erosion damages in the study area, the PDT developed an erosion model. The model is a "life-cycle" simulation spreadsheet that developed with Microsoft Excel software and Palisade @Risk software. The following provides a summary of the erosion model. A detailed discussion of the erosion model can be reviewed in the document titled, "Aliso Creek Erosion Model Appendix". In particular, the Aliso Creek Erosion Model Appendix is addendum to the Aliso Creek Economic Appendix.

The purpose of the economic model is to quantify the erosion damages within the Proposed Project area due to streambank erosion and the corresponding benefits that can be realized with the implementation of streambank erosion protection measures. Bank protection features are required for the proposed ecosystem restoration alternatives, but also provide incidental erosion damage reduction benefits. Hence, the total reduction of future erosion damages to the pipelines and AWMA road are classified as incidental benefits associated with the TSP ecosystem restoration plan.

The purpose of this section is to provide a clear and concise description of how the erosion model calculates the corresponding erosion damages and the damages reduced by the proposed bank protection measures. The model description details the steps of how model calculates the erosion damages for the without project and with project conditions. In particular, the with project conditions is referring to the future condition that includes the construction of a bank protection measure that was designed for all ecosystem restoration alternatives.

Step 1. Identify the Setback Information for Each Risk Location

In order for the economic model to calculate the total erosion damages and damages reduced, the model focuses on those channel locations where infrastructure is most at risk and the setback distance between the top of bank of Aliso Creek and the 18-inch pipeline (east bank) or AWMA road (west bank). This location and setback information is detailed in the following worksheets: *AWMA RD Risk Locations* and *SOCWA Risk Locations*.

Step 2. Identify the Yearly Erosion Event Occurring at Each Risk Location

Secondly, the model randomly generates a separate yearly erosion event for the east and the west bank. *SOCWA* and *AWMA RD Erosion Worksheets* provide a single random erosion event/value for each year identified in the model.

Step 3. Calculate the Remaining Setback Distance between the Top of Bank and the Infrastructure

The third step for the economic model is to account for the remaining setback distance at each of the risk locations after the yearly erosion rate is generated in the Erosion Worksheet. The *SOCWA* and *AWMA RD Remaining Setback Worksheet* accounts for the remaining setback distance at each risk location accounting for cumulative erosion in prior years.

Step 4. Identify the Year of Construction of the Initial Protective Measure (Rip-rap) Based on Remaining Setback Distance

The *SOCWA* and *AWMA Rd Armor Worksheets* account for the fourth step for the economic model by determining the year that the remaining setback distance for the pipeline or AWMA Road reaches the assumed distance that would trigger the construction of protective measures (rip-rap) due to the threat of damages to this infrastructure.

Step 5 Calculate the Costs of the Construction of Initial Protective Measure (Rip-rap)

After the *Armor* worksheets determines the year of the armoring, the fifth step for the model is to account for total costs of implementing the initial rip-rap measure. The total costs of the initial (non-engineered) rip-rap measure is accounted for in the *SOCWA* and *AWMA Rd Initial Cost Worksheets*.

Step 6 Calculate the Future Residual Damages after Construction of Initial Protective Measure (Rip-rap)

Since the without project condition includes a design of a rip-rap measure that is non-engineered, it is assumed that the rip-rap would be vulnerable to subsequent storm events which have a probability of less than a 10% annual chance of exceedance (ACE) (10-year event). Non-engineered rip-rap is defined as stone simply dumped during emergency operations; it is typically not sized or sorted to withstand a specific level storm flow event, and as a result of the manner in which it was placed, does not constitute a well-nested mass of interlocking stone. The sixth step of the model accounts for the damages to the non-engineered rip-rap features after they are assumed to be in place due to storm events less probable than 10% ACE event (10- year event); the calculations for these damages are detailed in the *SOCWA* and *AWMA Rd WO Residual Damage Worksheets*. Without project damages include the cost of the protective measures and the residual damages to the pipeline and the road, as well as downstream recreation impacts from a potential pipeline break after the protective measures are put in place.

Step 7 Calculate the Residual Damages with Implementation of USACE Project or With Project Features.

To quantify the reduction in erosion damages, the last step of the model is to account for the residual damages assumed to occur with implementation of With Project erosion protection features (rip-rap measures). The *SOCWA* and *AWMA Rd Res Damage With Project Worksheets* account for residual damages to the pipeline and road, as well as recreation losses, that are projected to occur with the implementation of these With Project features.

The calculation of the residual damages described in Step 7 is assuming that a proposed alternative is constructed before the base year of 2026. Hence, the calculation of erosion damages in Step 7 is evaluating all storm events that will cause damages to the project erosion protection features. If storm event randomly selected in the Annual Event Probabilities has probability event less frequent than 1% (100-year event) then residual damages can occur to the erosion protection measure.

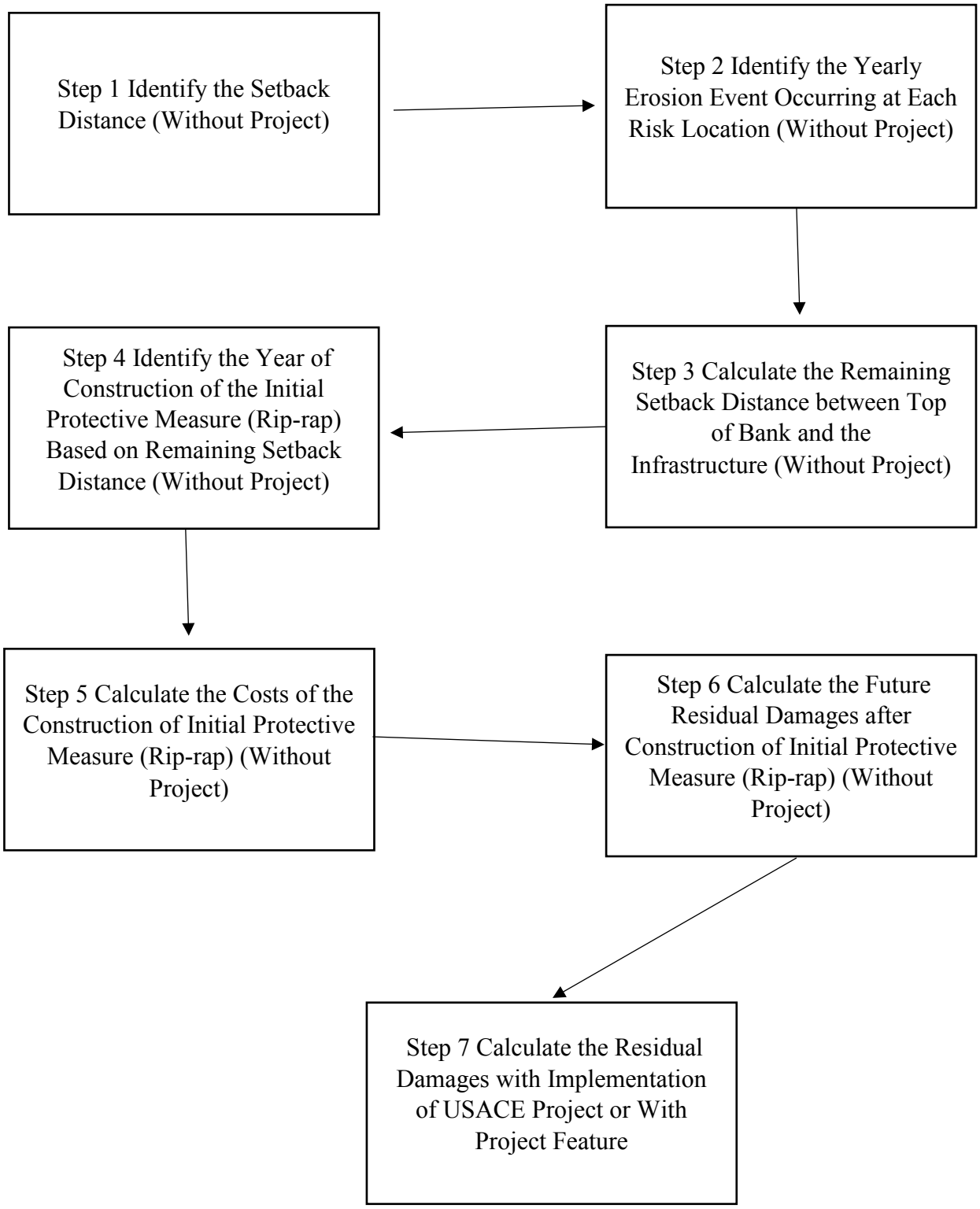
The calculations of Step 7 damages assume that the storm events with a probability of less than 0.5% ACE (200 year event) result in 80% of the total replacement costs for the engineered rip-rap. For storm events less probable than the 1% ACE event (100 year event) but more probable than the 0.5% ACE (200 year event), these storm events are assumed to cause 50% damage to the engineered rip-rap features. The damage estimates for the engineered (with-project) rip-rap features were based on a cost estimate of $1,150 per linear foot. This methodology is applied for both the east and west bank.
The following table provides a summary of the type of cost and the expected costs that are estimated for each cost type. In developing the risk model that incorporates Monte Carlo

simulations, the model was coded with triangular distributions for each type of costs to account for uncertainty of the actual costs. The table provides the cost figures that are incorporated into the Risk Triangle Distribution.

Table C7 Table of Costs Applied to the Erosion Damage Model

Category Costs	Type of Costs	Min cost	Most Likely Cost	Max cost
W/O Protective Measure				
	Protective Measure Costs per linear foot	$580	$650	$710
With Project Protective Measure				
	Protective Measure Costs per linear foot	$1,040	$1,150	$1,270
	Sulphur Creek Measure Costs per Installation per linear foot	$3,190	$3,550	$3,900
Compensated Costs for Protective Measure Costs				
	Processing Gov Doc. Initial Placement Rip-rap per Installation	$75,000	$87,500	$100,000
	Minimization of Environmental Impact for Gov Doc Replacement Rip-rap per Installation	$50,000	$67,500	$75,000
	Least Bell Vireo Minimization Costs for Rip-rap per Installation	$1,730,700	$1,923,000	$2,115,300
Cost of Damaged Pipeline				
	Pipeline Repair 18-inch, 32-inch and two 4-inch per Repair	$477,800	$530,800	$584,000
	Pipeline Repair 18-inch pipline per Repair	$371,700	$413,000	$454,000
Costs for Closure of Aliso Creek Beach				
	Closure of Aliso Creek Beach per Sewage Spill	$115,100	$1,279,000	$1,407,000
Costs for Damaged AWMA Road				
	Costs Repair Road AWMA per Repair	$36,000	$40,000	$44,000

The following figure provides a visual diagram of the seven steps that show the model logic for the calculation of the erosion damages occurring during the without project conditions and the residual damages with the implementation of a USACE Project.


Step 1 Identify the Setback Distance (Without Project)
Step 2 Identify the Yearly Erosion Event Occurring at Each Risk Location (Without Project)
Step 3 Calculate the Remaining Setback Distance between Top of Bank and the Infrastructure (Without Project)
Step 4 Identify the Year of Construction of the Initial Protective Measure (Rip-rap) Based on Remaining Setback Distance (Without Project)
Step 5 Calculate the Costs of the Construction of Initial Protective Measure (Rip-rap) (Without Project)
Step 6 Calculate the Future Residual Damages after Construction of Initial Protective Measure (Rip-rap) (Without Project)
Step 7 Calculate the Residual Damages with Implementation of USACE Project or With Project Feature

- A delineation of facilities at risk and hydraulic/hydrologic characteristics were provided by LA District Engineering Division. Facilities at risk includes the sewage line/sludge line and AWMA road. For each location for facilities at risk (risk location), the model includes the baseline setback distance or lateral distance between the location of sewage line/sludge line or AWMA road and the creek bank. The measurement of the setback distance for each risk location was based on the actual distance between the 18-inch pipeline or AWMA road and the top of bank line for Aliso Creek.

- Engineering Division provided location-specific erosion rate assumptions. These erosion rates are in the form of average annual rates with uncertainty. The source for the annual erosion rates and the lognormal distributions applied in the model are detailed in the Draft Hydrology and Hydraulics Appendix for the Aliso Creek Ecosystem Restoration Feasibility Study. The discussion of the erosion rates is detailed in section 9 of the Draft Hydrology and Hydraulics Appendix. Table C8 below provides a list of erosion rates used in the model. The information in Table C8 shows the mean and standard deviation applied to the lognormal distribution for the three risks groups for SOCWA impact areas and three risk groups for AWMA impact areas.

Table C8 Erosion Rates for Aliso Creek

Risk Group	Mean Value	5% Percentile	95% Percentile
Risk Group A	0.25	0.01	0.91
Risk Group B	0.16	0.01	0.61
Risk Group C	0.18	0.01	0.68
Risk Group D	2.66	0.23	8.93
Risk Group E	1.63	0.14	5.48
Risk Group F	1.09	0.09	3.70

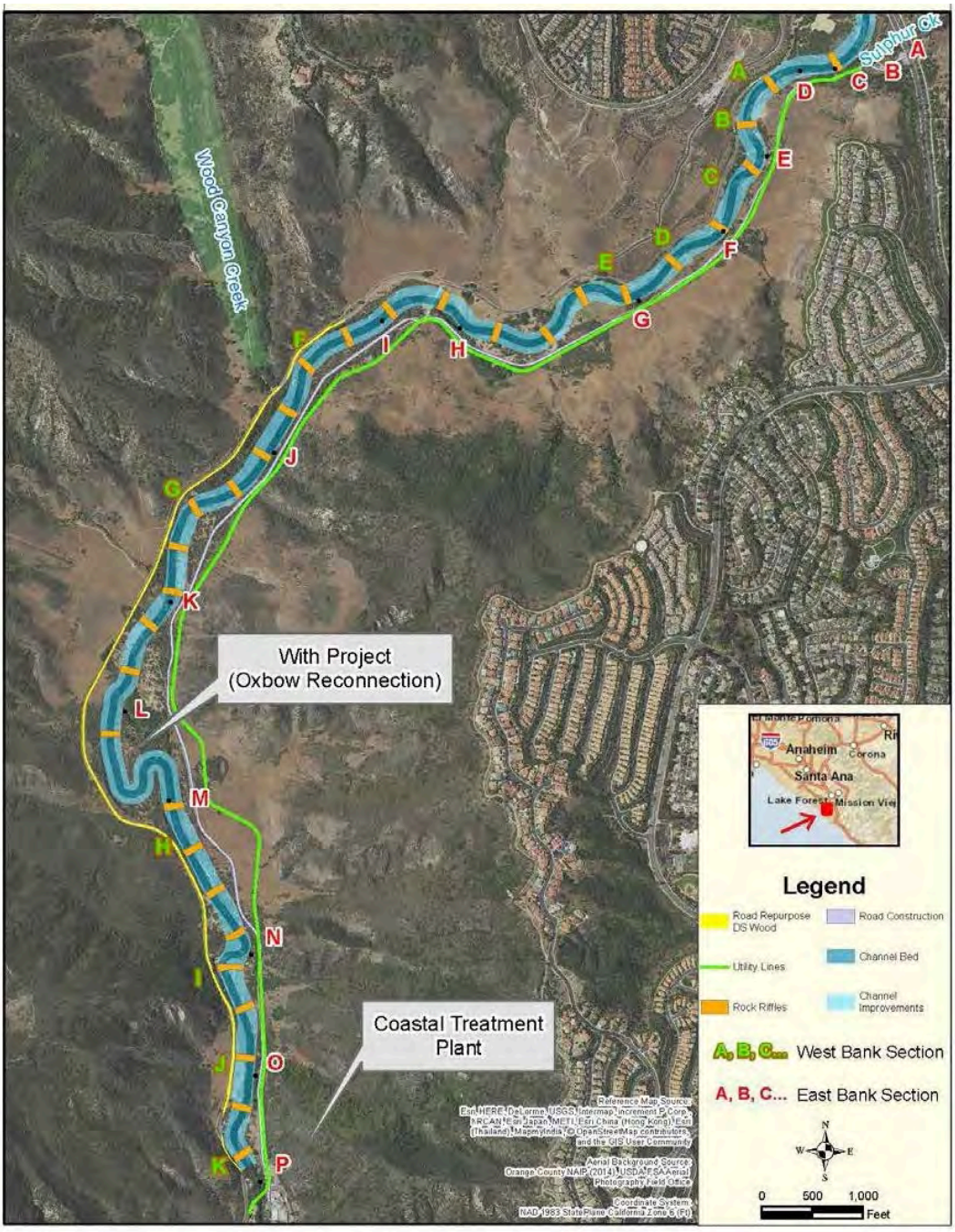
- The model identifies the minimum lateral distance (in feet), or "setback distance", that lies between the creek's top of bank and infrastructure facilities (pipelines on east bank; or AWMA Road on west bank). For the east bank, as the 18-inch line is closest to the creek (and hence the shortest setback distance of the four pipelines), it would be chosen as the first facility to require bank protection. For the west bank, the edge of AWMA Road was chosen was chosen as the setback distance.

  The model is a simple "life-cycle" analysis spreadsheet, which tracks the change in the setback distance at the locations of the facilities at risk, accounting for cumulative erosion in prior years. The Palisade @Risk software was utilized in conjunction with Microsoft Excel to randomly derive annual erosion amounts based upon the functions provided by Engineering Division, and, once erosion reaches the setback trigger for potential damages/costs, such costs are quantified for that specific year. The @Risk software is utilized to perform Monte Carlo simulations of expected annual damages over the 50-

year period of analysis. Such damages are based upon the annualized net present value of damages/costs accounting for the amount and timing of damages based upon the simulations, which account for uncertainty in both erosion rates and damages/costs.

The risk locations in the SOCWA worksheet are segmented into 17 locations that are labeled from “A” to “Q”. The risk locations in AWMA worksheet are segmented into 11 locations that are labeled from “A” to “K”. For each risk location the without-project erosion rate for the section is based on the level of risk associated with each risk location. It should be noted that the same erosion rate is assigned to each risk location of the same risk level. The future potential erosion rate is based on average erosion rates derived from historical topographic information for each level of risk group (A-F). Figure C2 shows the locations for risk locations for east and west banks.

Figure C2 Aliso Creek Risk Locations



After running the "life-cycle" analysis spreadsheet over 100,000 iterations, the model generated results that show the average results at each impact area. Table C9 shows the results by impact area and total erosion damages for the impact areas located on the east bank or SOCWA worksheets. Based on the model results, the total without project damages occurring to the impact areas on the east bank or SOCWA impact areas shows a total average annual damages of

about $416,000. This result includes the costs of installing the initial rip-rap measure and the subsequent repairs to the rip-rap measure that are needed due to future storm events.

Table C10 shows the model results for the impact areas located on the west bank or AWMA Road impacts areas. According to the results in Table C10, the total average annual damages occurring in the without project conditions is about $325,000 for AWMA Road impact areas.

Table C9 SOCWA Impact Areas Erosion Damages
Without Project Conditions (FY16 Price Level/FY17 Discount Rate 2.875%)

Impact Area	Risk Assessment	Initial Rip-Rap Measure Annual Costs	Repairs Rip-Rap Measure Annual Costs	Total Annual Damages
Impact Area A	Group A	$39	$23,423	$23,462
Impact Area B	Group C	$21,748	$20,847	$42,595
Impact Area C	Group B	$22,805	$16,227	$39,032
Impact Area D	Group C	$499	$19,338	$19,837
Impact Area E	Group A	$2,463	$28,136	$30,599
Impact Area F	Group C	$35,821	$6,309	$42,130
Impact Area G	Group C	$2,405	$303	$2,708
Impact Area H	Group C	$11,012	$1,253	$12,265
Impact Area I	Group C	$2,276	$306	$2,582
Impact Area J	Group A	$13,849	$49,831	$63,680
Impact Area K	Group C	$37,784	$21,434	$59,218
Impact Area L	Group B	$10,673	$1,043	$11,716
Impact Area M	Group C	$26,994	$23,540	$50,534
Impact Area N	Group A	$1,865	$204	$2,069
Impact Area O	Group A	$11,523	$1,875	$13,398
Impact Area P	Group B	$471	$69	$540
Totals		$202,227	$214,138	$416,365

Table C10 AWMA Road Impact Areas Erosion Damages
Without Project Conditions (FY16 Price Level/FY17 Discount 2.875%)

Impact Area	Risk Assessment	Initial Rip-Rap Measure Annual Costs	Repairs Rip-Rap Measure Annual Costs	Total Annual Damages
Impact Area A	Group F	$0	$21,732	$21,732
Impact Area B	Group F	$85	$13,730	$13,815
Impact Area C	Group F	$24,996	$16,312	$41,308
Impact Area D	Group F	$10,853	$20,468	$31,321
Impact Area E	Group F	$50,961	$6,722	$57,683
Impact Area F	Group E	$1,237	$26,150	$27,387
Impact Area G	Group D	$1,105	$20,823	$21,928
Impact Area H	Group D	$3,284	$25,036	$28,320
Impact Area I	Group E	$354	$14,438	$14,792
Impact Area J	Group F	$43,469	$7,391	$50,860
Impact Area K	Group D	$57	$15,508	$15,565
Totals		$136,401	$188,310	$324,711

3.4.3 Erosion Risks of Joint Regional Water Supply System

The Joint Regional Water Supply System (JRWSS) is a water supply transmission line, owned by the public utility South Coast Water District, which provides a primary source of drinking water for southern Orange County communities. The JRWSS provides water transmission over a 26 mile service area to approximately 200,000 residents of communities of south Orange County. Two locations of the Joint Transmission Main, one in parallel, and one crossing under the creek, are threatened. Both risk locations are located in reach 11 or immediately downstream of Pacific Park Drive.

Reach 11 was identified by the geomorphic analysis for the study to be an unstable reach, subject to continued incision up to 3 to 4 feet. The JTM pipeline passes to the west of Aliso Creek approximately 2,200 feet downstream of Pacific Park Drive. At this location, the west bank of the creek is fortified by a steel piling retaining wall designed to protect the JTM pipeline from erosion and migration of the creek. Since the time of sheetpiling driving (circa 1990), there has been about 6 feet of streambed incision (scour) at this location. An evaluation conducted for South Coast Water District (HDR, 2008), concluded that additional scour at this location would threaten undermining of the sheet piling. The second location is approximately 1,200 feet

downstream of Pacific Park Drive. The JTM pipeline at this location passes under Aliso Creek and is encased in concrete and protected by riprap overlain by exposed grouted stone. There is a driven sheetpile on the upstream side of the crossing. Undercutting on the downstream side is evident, and a 7 to 8-foot deep scour hole has formed. The 2008 evaluation concluded that the pipeline is at risk of being undercut by potential additional scour.

The potential erosion risk and corresponding consequences to the JTM pipeline was not modeled in the Erosion Model. The consequences of the failure of the JTM pipeline would include the costs of the repair of pipeline that would cost over several million dollars and temporary loss of water supply to the residents of South Orange County.

3. 5 Environmental Resources

In order to measure the current and future environmental quality of Aliso Creek for the CHAP study area, the study team used the Combined Habitat Assessment Protocols (CHAP) model to evaluate the environmental quality for the without project conditions and with project conditions.

3.5.1 CHAP Evaluation

USACE guidance requires that the ecosystem related benefits of proposed alternatives be subjected to detailed economic analysis, allowing an explicit comparison of the costs and benefits associated with the alternatives. Consequently, it is necessary that the environmental benefits of the alternatives be based on some quantifiable unit of value. Since restoration value is difficult to monetize, instead of calculating benefits in monetary terms, USACE ecosystem restoration projects calculate the value and benefits of restored habitat using established habitat assessment methodologies. Comparing the alternatives in this manner facilitates the determination of the most cost-effective restoration alternative that meets restoration goals.

For this study, benefits (or outputs) have been quantified using the CHAP approach for the existing, future without project, and future with project conditions. Detailed information regarding the CHAP analysis is provided in Appendices B-2a through B-2c.

The future without project conditions related to biological resources was assessed by Northwest Habitat Institute (NHI). To undertake this assessment, several projections, predictions and assumptions were made to assess habitats over the 50-year time period, based on the current condition trends and climate change. These are detailed in Appendix B-2a. To determine future conditions, the CHAP method was used to determine changes in species, habitat, and functions from the baseline condition at 2020, and estimate future conditions at 25 years (2045) and 50 years (2070). A complete description of the methodology used for this analysis is provided in Appendix B-2b.

An overall baseline CHAP assessment was originally performed for an analysis area extending 8.5 miles from the SOCWA CTP to Interstate 5 as shown in Figure C3. The CHAP analysis area encompasses 691 acres and includes California Wildlife Habitat Types such as Valley Foothill Riparian, Riverine (Open Water), Coastal Scrub, Annual Grassland, and Urban. The baseline existing condition assessment calculated these acres to have a CHAP value of 8,916.2 habitat

units (HUs). The CHAP evaluation calculated the future projections HUs for 25 years (8,346.3 HUs) and 50 years (6,862.3 HUs). The calculated average annual HUs is 8,117.8.

Figure C3 Aliso Creek CHAP Project Area

3.6 Recreation Resources

3.6.1 Without-Project Recreation Use Analysis

The primary recreation resources in the study area are Aliso and Wood Canyons Wilderness Park and Aliso Creek Beach. For the baseline assessment of recreation opportunities at these facilities, the expected recreation market area is assumed to be Orange County, California. This assumption is based upon discussions with local experts from the Orange County Department of Harbors, Beaches, and Parks. Both recreational areas offer unique recreation experiences that are enjoyed by residents throughout the County. Although Aliso Creek recreation opportunities do attract some visitors from outside the Orange County, for example from Riverside and San Bernardino Counties, their numbers are small enough relative to Orange County visitors to make their effect on this recreation analysis insignificant. Growth in attendance is based upon in the population rate for the market area. In particular, the communities in close proximity of the

Aliso Creek, which have a total population over 300,000, will benefit by any improvement in the recreational opportunities at Aliso and Wood Canyons Wilderness Park..

According to population projections by the California Department of Finance, the population estimates for Orange County changed by a total percentage of 1% between the years of 2015 and 2016. Yet, the future estimates for population in Orange County is showing declining annual growth rate for population. According to the data in Table C5, the population estimates by California Department of Finance are showing the annual growth rate for county declining from .7% in 2020 to negative population annual growth rate in 2060. Therefore, the recreational analysis used a factor of .5% to determine yearly increase in attendance between the years of 2026 and 2040. The attendance projections after the year 2040 were held equal to the attendance projection for 2040.

3.6.2 Valuing Potential Future Recreational Resources

The valuation of recreational resources is not an assessment of the economic value of the site in terms of employment, income, or tourism. It is simply an estimate, based on well-established national parameters developed by federal water resource agencies, of users willingness to pay for recreational experiences at the site. USACE Principles and Guidelines describe three techniques which have been developed to estimate recreation demand and value. The three method are: 1) Travel Cost; 2) Contingent Valuation; and 3) Unit Day. Because of its simplicity and general acceptability, and because the focus of the study is ecosystem restoration, the Unit Day method (Unit Day Value, or UDV) was selected for use in this analysis.

Unlike the Travel Cost method, the UDV method does not attempt to account for the impact of price on visitations to a recreation site. Instead, an assigned user day value is applied to the total number of estimated visitors. User day values are simulated market values derived form a range of values agreed to by Federal water resource agencies. It is intended to represent a typical user's average willingness to pay for a full day of recreation activity at the site when considering key characteristics such as the range of possible activities, the accessibility of the site, and the overall quality of the recreation experience. When a property formulated unit day value is applied to estimated use, an approximation of the area under the site demand curve is obtained, which is used in estimating recreation value at a site as well as the net recreation benefits of a proposed project.

3.6.3 Aliso and Wood Canyons Wilderness Park Recreation Analysis

Aliso and Wood Canyons Wilderness Park offers unique recreational opportunities for the residents of Orange County. The park is located in highly urban area, but offers the opportunities of the wilderness park. In addition to the recreation opportunities, the park is interesting classroom for students interested in geological formations and archaeological and paleontological sites. Finally, the park is part of the 20,000- acre South Coast Wilderness Area.

In 1968, James Dilley helped to organize the local organization Citizens for Greenbelt, which two years later was incorporated as Laguna Greenbelt, Inc. The incorporation of Laguna

Greenbelt helped in the creation of the parks: Laguna Wilderness Park, Crystal Cove State Park, and Aliso and Wood Canyons Wilderness Park.

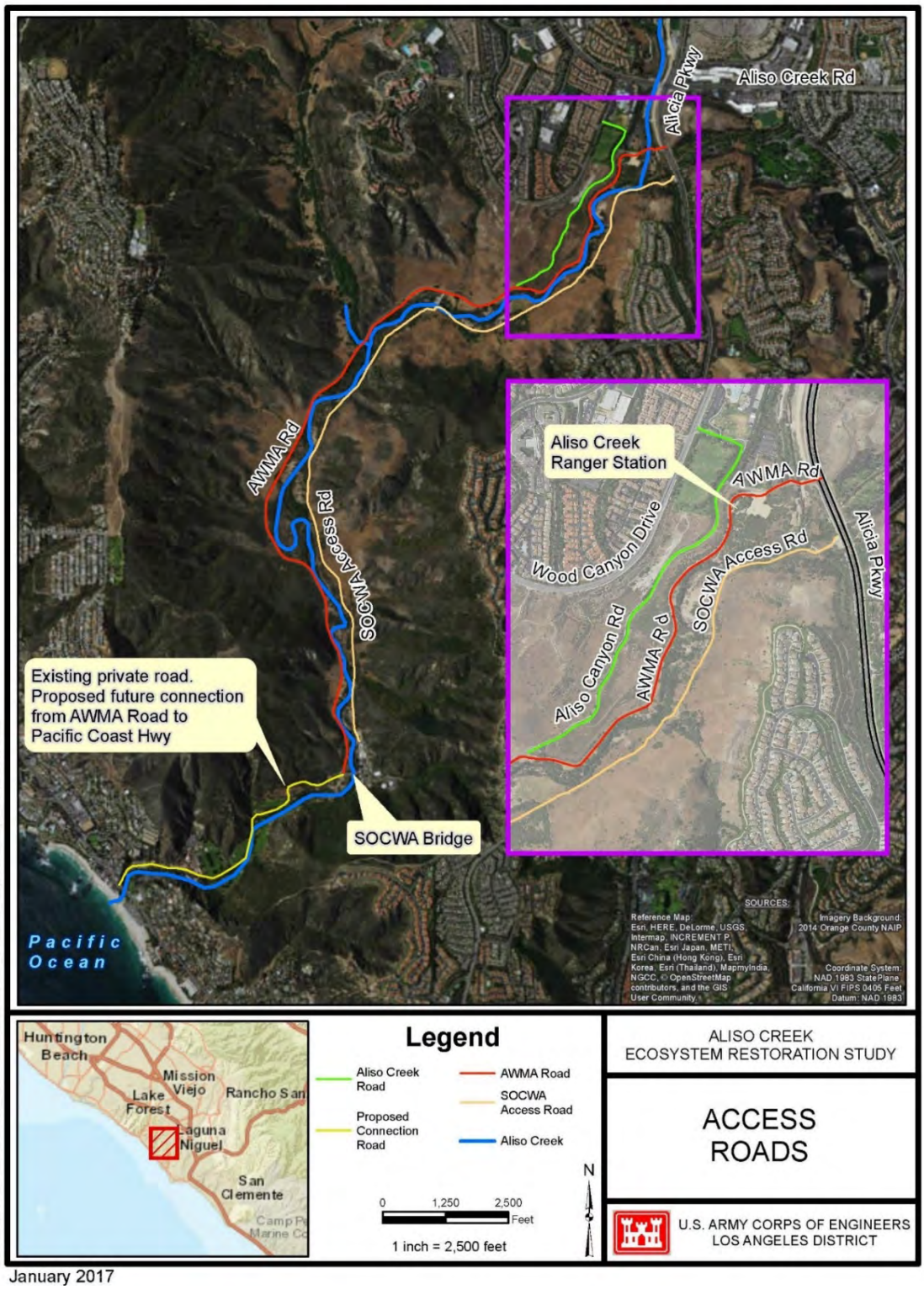
An interesting natural landmark located within the park is Dripping Cave. This cave is also known as "Robbers" cave and is the park's largest rock-shelter. The cave was once used as a temporary refuge by Native American hunter-gathers, and later the shelter was reportedly used by the infamous Juan Flores "gang" as a hide-out from which to rob the San Diego and Los Angeles stagecoach.

Recreational facilities within Aliso and Wood Canyons Wilderness Park are managed by the Orange County Department of Harbors, Beaches, & Parks. The park offers a wide-range of recreational activities that include the following: equestrian trails for horse riding activities, picnic facilities for picnicking activities, hiking trails for mountain biking and walking activities. The following description is a brief summary of the park amenities: the park offers 30 miles of hiking trials, 8 picnic tables, 8 scenic overlook spots, two parking lots, 15 access gates, and five restrooms. The park offers over 80 parking spaces for cars and trucks and about 20 spaces for horse trailers at the parking lot located next to Alicia Parkway. The park charges $3 daily or $55 annual pass for parking vehicles. In addition, the park has 15 access points that allow park visitors to either enter the park through the bike trail along Aliso Creek or walk from the nearby housing tracts.

Based on the county maps (County Website) of the park and Google Earth Maps, the users of the park have a choice of 15 access points to enter into the park. In particular, the maps show two significant access points that offer access to a parking lot and the ranger station. These access points are shown on the maps to be located at the intersection of Alicia Parkway and AWMA Road and the intersection of Wood Canyon Drive and Aliso Canyon Road.

Figure C4 shows a map that details the access roads for Aliso and Wood Canyons Wilderness Park. In particular, the map shows a detailed public access point at Wood Canyon Drive and Alicia Parkway. At these two access points, the users have two options to reach unique natural landmarks, facilities, or the park's trails, by either using the Aliso Canyon Road or AWMA Road. At the access point located at Alicia Parkway, AWMA Road merges with Old AWMA Road. Old AWMA Road is narrow concrete road owned by the park that is dedicated to the recreational users of the park.

Figure C4 Map of Aliso and Wood Canyons Wilderness Park



January 2017

The access point at Wood Canyon Drive is connected with Aliso Canyon Road. Aliso Canyon Road is owned by SOCWA for the purpose of allowing trucks and employees access to SOCWA

treatment plant. The Old AWMA Road and Aliso Canyon Road merge with AWMA Road, which allows recreational users to reach the south boundary of the park.

In the development of the plan formulation for the proposed alternatives, the PDT developed ecosystem restoration measures that will provide recreational benefits to the users using the immediate areas surrounding Aliso Creek. Hence, the ecosystem restoration measures will mainly benefit the park users using AWMA Road instead of the users that use the trails on the uplands. Therefore, the recreational analysis for the without project condition will separate the park attendees by the users of AWMA Road and Old AWMA Road and by the users of the upland trails.

According to the park ranger, the roads of AWMA Road and Old AWMA Road on the east bank of the creek are being used by 75% of park attendees for biking and walking activities. Hence, this study will be assuming that 75% of the future yearly attendance after the base year of 2026 will account for the users that are using either AWMA Road and Old AWMA Road for the recreational purpose of running, walking, nature hikes, and biking.

The following table shows the annual attendance at the park from 1991 through 2015. Park rangers have no set rules on how to count the number of people in the park. The park has 15 locations where people could enter. Hence, the availability of multiple access points affects the uncertainty of the annual attendance and may result in under reporting the actual attendance at the park. The park's Chief Ranger estimates park attendance monthly. While parking is limited, many park users park along nearby roads or enter the park by bike by foot from the surrounding developments and trails. Special events have been held at the park with 10,000 people in attendance.

Table C11 Annual Attendance at Aliso and Wood Canyons Wilderness Park

Year	Historical Annual Attendance	AWMA Road Attendance	Non-AWMA Attendance
1991	35,139	26,354	8,785
1992	57,473	43,105	14,368
1993	126,949	95,212	31,737
1994	153,494	115,121	38,374
1995	149,759	112,319	37,440
1996	117,752	88,314	29,438
1997	81,115	60,836	20,279
1998	25,930	19,448	6,483
1999	179,774	134,831	44,944
2000	109,964	82,473	27,491
2001	116,475	87,356	29,119
2002	115,046	86,285	28,762
2003	108,995	81,746	27,249
2004	67,507	50,630	16,877
2005	101,195	75,896	25,299
2006	124,692	93,519	31,173
2007	115,337	86,503	28,834
2008	113,057	84,793	28,264
2009	104,320	78,240	26,080
2010	111,791	83,843	27,948
2011	152,269	114,202	38,067
2012	168,739	126,554	42,185
2013	179,219	134,414	44,805
2014	187,541	140,656	46,885
2015	129,437	97,078	32,359

The attendance estimates for 1998 is estimate from Jan to Sept.

Over the 10-year period ending in 2015, average annual park attendance was about 138,640. Based on park ranger estimates of 75% of park attendees using Old AWMA Road and AWMA Road, in the year of 2016 it is expected that these roads were used by 104,000 attendees of the park.

According to Orange County Department of Harbors, Beaches, & Parks, the park has lost up to 100 acres of land for recreational use from the degradation of the stream banks. In addition, SOCWA roads and sewage lines running through the park have been damaged by streambed degradation and bank erosion. The AWMA Road, running through the park, is severely threatened near the entrance to the park and could cause a park closure when any further failure occurs to protect human health and safety.

The value of existing and future without project general recreation at Aliso and Wood Canyons Wilderness Park was calculated using a user day value and annual visitation estimates for years 2026-2075. The next table shows the judgement factors and point values that were used to calculate the unit day value for general recreation.

The following paragraph provides explanation of how the judgment factors were selected for each criterion. The recreation experience was calculated to be 7 on scale of 0 to 30, because the park offers several general activities: horse backing, nature study, hiking, bicycling, and walking. The calculation for the availability of opportunity at the park was determined to be 3 on scale of 0 to 18, because three wilderness parks are within thirty minutes of driving time (Ronald W. Casper Regional Park, Laguna Wilderness Park, and Thomas S. Riley Wilderness Park). Aliso and Wood Canyons Wilderness Park carrying capacity was calculated to be 8 on scale of 0 to 14, because the park offers adequate facilities for hiking and bicycling activities. The calculation for the accessibility to the park is 12 on scale of 0 to 18, because of parking facilities as well as the ability of citizens in surrounding communities to enter the park by foot or bike through many corridors. The environmental value at the park was calculated to be 5 on scale of 0 to 20, because while the park is intended to offer a pristine environment for people, the environment is degraded due to continue degradation of the channel.

Table C12 Wilderness Park W/O Calculation of the Unit Day Value General Recreation

Aliso and Wood Canyons Wilderness Park

Calculations of the Unit Day Value General Recreation

Recreation Criteria	Range of Values	Judgement Value
Recreation Experience	0 to 30	7
Availability of Opportunity	0 to 18	3
Carrying Capacity	0 to 14	8
Accessibility	0 to 18	12
Environmental	0 to 20	5
	Total	35
	Conversion of Points to Dollar Value	$6.69

The table above provides a summary of the unit day value ratings for Aliso and Wood Canyons Wilderness Park. The ratings total to 35 points, which correspond to a dollar value of $6.69 based upon the Economic Guidance Memorandum 17-03, Unit Day Values for Recreation, Fiscal Year 2017.

Before any project is completed at Aliso and Wood Canyons Wilderness Park, AWMA Road is expected to be extended to Aliso Creek Beach or Pacific Coast Highway, for the reasons described below. Figure C4 highlights the extension of AWMA Road to Aliso Creek Beach. The road is being extended by agreement between California Coastal Commission and property owner of the hotel located directly between the park and Aliso Creek Beach.

The Ranch at Laguna Beach (formerly Aliso Creek Inn), luxury hotel resort, was recently awarded a permit from the California Coastal Commission. The permit allows the hotel to complete renovations to the hotel. As part of the Coastal Commission approval, the hotel agreed to pay $250,000 to a consultant to design a pedestrian and bicycle trail that will help link inland property to the coastline. Hence, the expanded trail will offer more recreational opportunities by

allowing users of the trail to access Aliso Beach. By extending AWMA Road to Aliso Beach or Pacific Coast Highway, users of the road will have additional access point to Aliso and Wood Canyons Wilderness Park. Therefore, the number of users using AWMA Road is expected to increase after the completion of the extension. It is estimated that future demand for the AWMA Road will increase by at least 25%. Applying this increase, annual visitation in 2026 is projected at 136,000 attendees. In addition, base year (2026) attendance by those not utilizing AWMA Road is projected at 36,400 visitors.

To calculate the expected annual recreation value of Aliso and Wood Canyons Wilderness Park, attendance projections were calculated for years 2026 through 2075. Based on the previous assumptions on future attendance at Aliso and Wood Canyons Wilderness Park the total future attendance is expected to be 172,400 in the year 2026 and expected reach 184,900 by the year 2040.

The future yearly attendance projections were then multiplied by the unit day value of $6.69 to arrive at a total recreation value for each year in the period of analysis. Table C13 provides a summary of total recreational value for the years of 2026 and 2040 and the equivalent annual recreation value for the period analysis.

Table C13 Projection of Annual Attendance/Recreational Value Wilderness Park

FY17 UDV and FY17 Discount Rate of 2.875%

Year	AWMA Road Attendance	Non-AWMA Road Attendance	Total Attendance	Total Recreational Value
2026	136,000	36,400	172,400	$1,153,200
2040	145,800	39,100	184,900	$1,236,600
[redacted]		Equivalent Average Annual Value		$1,215,900

It should be noted that this analysis does not incorporate any decline in recreation value or attendance that could result from continued channel and ecosystem degradation that could occur under the future without project conditions.

3.6.4 Aliso Beach Recreation Analysis

The next table shows the annual visitation at Aliso Beach from 1990 thru 2015. The Annual visitation figures were obtained from the Orange County Department of Harbors, Beaches and Parks.

Table C14- Annual Attendance Aliso Creek Beach

Annual Attendance Aliso Beach	
Year	Annual Attendance
1990	1,989,050
1991	2,137,900
1992	2,111,970
1993	1,851,500
1994	2,361,513
1995	3,477,369
1996	965,961
1997	1,027,484
1998 (January-July)	846,812
1999	NA
2000	1,022,184
2001	983,074
2002	1,045,982
2003	1,023,430
2004	912,437
2005	1,099,983
2006	1,150,144
2007	1,113,123
2008	1,031,396
2009	1,421,393
2010	1,190,768
2011	1,253,306
2012	1,377,910
2013	1,355,613
2014	1,469,901
2015	1,473,657

The attendance projection was starting with a base attendance value for 2016, and then increasing it annually by 0.5%, commensurate with the projected population growth rate in the recreation market area. The base attendance value for 2016 was derived by averaging the annual attendance from the most recent ten years that had complete attendance records (2006-2015). The ten year average was calculated to be 1,283,700. The ten year average is realistic to show current overall attendance because it incorporates years with different weather patterns.

The following are the assumptions used to estimate the unit day value for Aliso Beach recreation. The recreation experience was calculated to be 7 on scale of 0 to 30, because the beach offers only general activities: surfing, picnicking, sunbathing and walking. The calculation for the beach availability of opportunity was determined to be 1 on scale of 0 to 18, because several other beaches with similar facilities are within one hour of driving time (Huntington Beach and San Clemente). Aliso Beach carrying capacity was calculated to be 7 on scale of 0 to 14,

because the beach offers adequate facilities for beach activities. The calculation for the accessibility to the beach is 12 on scale of 0 to 18, because the beach is located off Pacific Coast Highway. The environmental value at the beach was calculated to be 5 on scale of 0 to 20, because of recurring sewage spills have resulted in beach closures and contributed to a reputation associating Aliso Beach with poor water quality and human health and safety risks.

Table C15 Aliso Creek Beach Calculation of the Unit Day Value General Recreation

Aliso Beach

Calculations of the Unit Day Value General Recreation

Recreation Criteria	Range of Values	Judgement Value
Recreation Experience	0 to 30	7
Availability of Opportunity	0 to 18	1
Carrying Capacity	0 to 14	7
Accessibility	0 to 18	12
Environmental	0 to 20	8
	Total	35
	Conversion of Points to Dollar Value	$6.69

The recreation analysis for the future without–project condition is based on a period analysis of 50 years and a base year of 2026 (2026 thru 2075). The attendance projections were then multiplied by the unit day value of $6.69 to arrive at a total recreation value each year in the period of analysis. Table C16 shows the projections of future attendance at Aliso Beach and the Equivalent Average Annual Value over the period analysis

Table C16 Projection of Annual Attendance at Aliso Creek Beach/Average Annual Recreation Value

FY17 UDV and FY17 Discount Rate 2.875%

Year	Total Attendance	Total Recreational Value
2026	1,349,400	$9,027,300
2075	1,447,000	$9,680,200
Equivalent Average Annual Value		$9,518,100

4.0 Ecosystem Restoration Alternatives

The plan formulation for the proposed ecosystem restoration alternatives is described in detail in Chapter 3 of the Draft Integrated Feasibility Report. That section describes how each of the alternative plans were developed and evaluated at each step in the process, and ultimately included or excluded from the array of plans being considered. This appendix mentions briefly

some of the plan formulation processes, evaluation criteria and array of plans that were considered. It does not describe these processes or information in detail. For a more detailed description the reader should refer to Section 3.7 Focused Array of Alternatives of the Draft Integrated Feasibility Report.

Ecosystem restoration is one of the primary missions of the Corps of Engineers Civil Works program. The Corps objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). Contributions to NER are increases in the net quantity and/or quality of desired ecosystem resources. Measurement of NER is based on changes in ecological resource quality and a function of improvement in habitat quality and/or quantity and expressed quantitatively in physical units or indexes (but not monetary units). These net changes are measured in the planning area and in the rest of the nation. Thus, single purpose ecosystem restoration plans shall be formulated and evaluated in terms of their net contributions to increases in ecosystem value (NER outputs) expressed in non-monetary units (habitat units).

For ecosystem restoration projects in general, a plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, shall be identified as the NER Plan. The NER plan must be shown to be a cost effective plan for achieving the desired level of output and economically justified (determined to be worth its investment cost). This formulation, evaluation, and selection process is described below.

4.1 Methodology to Formulate Focused Array

The focused array of alternatives was formulated from the screened preliminary alternatives presented below, with integration of the considerations described in Table C17. Formulation of the focused array consisted of establishing *base* alternatives and then adding combinable measures. The process of adding combinable measures was evaluated through Cost Effectiveness/ Incremental Cost Analysis (CE/ICA).

Description of Base Alternatives

Alternative 1 No Action Alternative

Base Alternative 2: Maintain Similar Streambed Elevation within Incised Channel Margins

The improvement for Base Alternative 2 was designed to provide a geomorphically stable channel within the incised channel margins from the SOCWA CTP bridge at the downstream limit to the ACWHEP structure at the upstream limit. These limits comprise reaches 4A and 6.

The channel alignment would generally follow the existing channel alignment, and will utilize a single trapezoidal configuration with a 50-foot-wide bottom. Over-steepened and unstable bank slopes would be re-contoured to a stable 3H:1V slope. Existing terraces would be maintained as much possible. An equilibrium streambed slope of 0.4% would be utilized.

The riparian corridor along the creek banks would be restored with appropriate riverine vegetation types (Salix-Populus Forest/Woodland Alliance, Salix-Baccharis Forest Alliance, and Baccharis Shrubland Alliance). Freshwater marsh (Typha herbaceous alliance) habitat would establish naturally, and once established could be monitored and adapted in preferred areas

through an adaptive management program. All exotic/invasive plants would be eradicated over time where present within the Proposed Project area, as necessary, specifically giant reed and salt cedar. The riparian and aquatic corridor vegetation along Aliso Creek would remain segmented by the significant elevation discontinuities at the ACWCEP structure and at the confluence with Wood Canyon Creek tributary. Aquatic wildlife connectivity would not be established to Wood Canyon, or upstream of ACWHEP. With a geomorphically stable channel, the "S: bend would remain intact.

Base Alternative 3: Raise Streambed Elevation to Reconnect to Historic Floodplain

The extent of the proposed improvements for Base Alternative 3 starts at the SOCWA CTP bridge of the downstream end and continues to the AWMA Road bridge at the upstream limit. These limits comprise reaches 4A and 9.

Base Alternative 3 would raise the existing streambed to approach the pre-incised stream elevation (circa 1967) to improve hydrologic reconnection with the historic floodplain. An intermediate floodplain would also be constructed within the raised channel margin. Raising of the streambed would be phased, starting from upstream of the SOCWA CTP bridge (Subreach 4a) and continuing upstream to reestablish connection at an elevation close to that of the ACWHEP structure (Reach 7). Upstream of ACWHEP, some additional streambed raising would occur along the remaining reaches to the AWMA Road Bridge. This alternative would re-establish connectivity for aquatic wildlife movement across the ACWHEP structure, which would be removed. Aquatic wildlife passage however at Wood Canyon cannot be fully restored due to the AWMA Road crossing, which includes two small culverts. Streambed riprap protection would be provided at the confluence transition to preclude scouring.

The channel would be constructed to have a compound trapezoidal configuration with a bottom width of 76 feet, flanked by 2-year flow floodplain terraces (benches). All sides would be a stable 3H:1V.

The riparian corridor along the recontoured creek banks in Reaches 4A through 9 would be restored with appropriate riverine vegetation types (Salix-Populus Forest/Woodland Alliance, Salix-Baccharis Forest Alliance, and Baccharis Shrubland Alliance). Freshwater marsh (Typa Herbaceous Alliance) habitat would establish naturally, and once established could be monitored and adapted in preferred areas through an adaptive management program. All exotic/invasive plants would be eradicated over time where present within the Proposed Project area, as necessary, specifically, giant reed and salt cedar.

Rifffle structures acting as grade control stabilizers, consisting of buried large boulders, would be placed in a series transverse to the channel and spaced at intervals required to support a projected equilibrium slope along the creek alignment. The riffle structures would promote pool and riffle habitat and allow fish passage. With a geomorphically stable channel, the "S" bend would remain intact.

Screens would be placed on the upstream side of the culvert at Alicia Parkway to prevent the entry of exotic aquatic wildlife from upstream Sulphur Creek and reservoir.

Base Alternative 4: Raise Streambed Elevation and Establish Intermediate Floodplain Connection

The extent of the proposed improvements for Base Alternative 4 starts at the SOCWA CTP bridge on the downstream end and continues to the AWMA Road bridge at the upstream limit. These limits comprise reaches 4A and 9.

Base Alternative 4 would raise the existing streambed to an intermediate elevation between the current and the historic streambed, and construct an associated floodplain within the raised channel margin. Raising of the streambed would be transitioned, starting from upstream of the SOCWA bridge (Subreach 4a) and continuing upstream to the ACHWEP structure (Reach 7). The elevation at the ACHWEP structure would be lowered to establish connection with the raised streambed downstream. The ACHWEP structure would be removed. Upstream of the ACHWEP structure, the streambed elevation would be lowered within Reach 7 to transition to the downstream elevation. Alternative 4 would re-establish connectivity for aquatic wildlife movement upstream of the ACWHEP structure. Streambed riprap protection would be provided at the confluence transition to preclude scouring.

The channel would be constructed to have a compound trapezoidal configuration with a bottom width of 76 feet, flanked by 2-year flow floodplain terraces (benches). All side slopes would be a stable 3H:1V.

The riparian corridor along the recontoured creek banks in Reaches 4A through 9 would be restored with appropriate riverine vegetation types (Salix-Populus Forest/Woodland Alliance, Salix-Baccharis Forest Alliance, and Baccharis Shrubland Alliance). Freshwater marsh (Typha Herbaceous Allisance) habitat would establish naturally, and once established could be maintained in designated areas through an adaptive management program. All exotic/invasive plants would be eradicated over time where present within the project area, as necessary, specially, giant reed and salt cedar.

Riffle structures acting as grade control stabilizers, consisting of buried large boulders, would be placed in a series transverse to the channel and spaced at intervals required to support a projected equilibrium slope along the creek alignment. The riffle structures would promote and riffle habitat and allow fish passage. With a geomorphically stable channel, the "S" bend would remain intact.

Screens would be placed on the upstream side of the culvert at Alicia Parkway to prevent the entry of exotic aquatic wildlife from upstream Sulphur Creek and reservoir.

<u>Refinement of Ecosystem Restoration Measures</u>

Ecosystem restoration measures have been developed which provide additional ecosystem restoration benefits and can be added to the Base Alternatives. All the measures in this table could be combinable with either the base measure for alternative 2, for alternative 3 or for alternative 4. The measures are presented in following table.

Table C17 Aliso Creek Ecosystem Restoration Measures

Proposed Aliso Creek Measures		
Proposed Measure	**Abbreviation of Measure Name**	**Description of Measure**
Reconnection of abandoned oxbow	Reconnect Oxbow	An abandon oxbow (upper reach 4B and 5A) would be reconnected to become the main active channel through the area, based on the historical channel alignment, to restore riparian habitat in the oxbow.
Sinuosity downstream of Wood Canyon Creek Confluence	Sinuosity d/s Wood Canyon	The channel alignment would be lengthened in this subreach to provide more sinuosity at this location
Wood Canyon Trailhead Realignment	Wood Cyn Trailhead Realignment	An 800-foot length of Wood Canyon trailhead would be realigned to the southwest to create more riparian habitat area upstream of the confluence and the AWMA Road crossing.
Wood Canyon Landscape Reconnection	Wood Cyn Landscape Reconnect	A small vehicular bridge (Wood Canyon Bridge) would replace the small culverts at the AWMA Road crossing over Wood Canyon Creek tributary to improve flow conveyance, eliminate the vegetation overgrowth, and improve aquatic access between the tributary and mainstem for aquatic species.
Removal of two 10-foot-high vertical drop structures; Widening in the vicintiy of the Aliso Creek Road Bridge; Re-contour existing channel from 1,400 feet u/s of the Aliso Road Bridge ot Pacific Park Drive	Widen Channel and Recontour Channel	**Removal of Two 10-foot-high vertical drop structures:** The existing two 10-foot-high vertical drop structures in the vicinity of Aliso Creek Road Bridge (Reach 10) would be removed and replaced with a series of rock riffle structures to enable aquatic wildlife connectivity. **Widening in vicinity of the Aliso Creek Road Bridge:** The east bank for approximately 2,000 ft in the vicinity of Aliso Creek Road Bridge (reach 10) would be widened, using a sheetpile wall. Some streambed raising and rock riffles will be incorporated. The widened area will be used to provide a riparian habitat corridor which is currently non-existent due to engineered channel. Some raising of creek elevation is needed. **Re-contour existing channel from 1,400 feet u/s of the Aliso Road Bridge to Pacific Park Drive:** The existing channel (reach 11 and 12) would be raised recontoured and widened to include terracing and a series of riffle structures. This feature would also improve flow dynamics
Re-contour existing channel from 1,400 feet u/s of the Aliso Road Bridge to Pacific Park Drive	Widen Channel and Recontour Channel	The existing channel (reach 11 and 12) would be raised, recontoured and widened to include terracing and a series of riffle structures. This feature will also improve flow dynamics downstream of Pacific Drive and will improve habitat quality.
Sinuosity downstream of Pacific Park, Drive	Sinuosity d/s Pacific Park Drive	The channel alignment would be lengthened along the subreach to provide more sinuosity
Construction of Newbury Riffle Structures	Newbury Riffle Weir Structure	Newbury Riffle Weir Structures would be constructed along the channel streambed to create shallow pools
Pacific Park Drive Bypass	Pacific Park Drive Bypass Channel	Introduction of Pacific Park Drive Bypass channel to provide aquatic wildlife connectivity at Pacific Park Drive embankment crossing. Utilizes pump system at upstream end to capture a portion of incoming flows into bypass

4.2 CHAP Analysis

For this study, benefits (or outputs) have been quantified using the CHAP approach. The CHAP analysis is an accounting and appraisal method that utilizes species-habitat-functions to derive current unit values, which are annualized over the period of analysis to create the average annual habitat units (AAHUs). To determine a change in these values over time, projections are needed to account for impacts to either the species, habitat, or function parameters. Details pertaining to the CHAP analysis methods and results are found within Appendix B-2c CHAP Alternative Conditions.

Table C18 Average Annual CHAP Units for the Proposed Measures

Base Alts/Measures [incl. CE/ICA letter codes]	**AAHU**	**Combinable Base Plan**
Alt 2 Base [A]	569.9	Alt 2 Base
Sinuosity (Stream Lengthen) downstrem Wood Canyon [B]	19.5	Alt 2 Base
Newbury Riffle Weir [C]	12.6	Alt 2 Base
Alt 3 Base [D]	2847.2	Alt 3 Base
Reconnect Oxbow [E]	177.2	Alt 3 Base
Sinuosity (Stream Lengthen) downstream Wood Canyon [F]	7.9	Alt 3 Base
Wood Cyn Realign Trail [G]	56.4	Alt 3 Base
Widen Channel and Recontour Channel [H]	451.5	Alt 3 Base
Sinuosity (Stream Lengthen) downstream Pacific Park Drive [I]	59.8	Alt 3 Base
Wood Cyn Landscape Reconnect [J]	1029.7	Alt 3 Base
Pacific park Drive Bypass Channel [K]	1212.6	Alt 3 Base
Alt 4 Base [L]	2153.6	Alt 4 Base
Reconnect Oxbow [M]	193.5	Alt 4 Base
Sinuosity (Stream Lengthen) downstream Wood Canyon [N]	10.4	Alt 4 Base
Widen Channel and Recontour Channel [O]	450.7	Alt 4 Base
Sinuosity (Stream Lengthen) downstream Pacific Park Drive [P]	59.8	Alt 4 Base
Pacific park Drive Bypass Channel [Q]	1212.6	Alt 4 Base

4.3 Cost Estimates

Cost estimates have been developed for the base alternatives as well as additional measures that can be added to the base alternatives. All cost are presented at FY16 price levels. Supporting cost information can be found in Appendix A-3: Cost Estimate.

The supporting cost information in Appendix A-3: Cost Estimate includes number of measures that were not included in the final array of measures that were not inputted into IWR-Plan. The screening of the measures to determine which measures should be inputted into IWR-Plan was discussed in Section 3.7 Focus Array of Alternatives of the Draft Integrated Feasibility Report.

The calculation of the Interest During Construction (IDC) for all the measures in following cost tables did not include the costs for real estate. The local sponsor already owns majority of the real estate that will needed for the implementation of the NER plan/TSP. Hence, the local sponsor is expected to incur short timeline and small amount of costs in acquiring the parcels for the NER plan/TSP.

Table C19 Cost Estimates for Alternative 2 Measures

FY16 Price Level and FY17 Discount Rate 2.875%

Cost Category	Alt 2 BASE	Alt 2 Sinuosity (Stream Lengthen) downstrem WC	Alt 2 Newbury Riffles
Real Estate	$7,787,156	$192,027	NA
Construction	$15,484,274	$896,611	$205,436
PED (incl EDC)	$2,400,063	$138,975	$31,843
Construction Mgt (S&A)	$1,006,478	$58,280	$13,353
Monitoring	$284,363	$21,877	$5,013
Adaptive Management	$426,545	$32,816	$7,519
Cultural Resources	$142,182	$10,939	NA
Test Holes	$0	$0	$0
Total Construction Costs	$19,743,905	$1,159,497	$263,164
Total First Costs	$27,531,061	$1,351,524	$263,164
IDC	$863,764	$1,371	$153
Total Gross Investment	$28,394,825	$1,352,895	$263,317
Total Annual Costs of Gross Investment	$1,077,529	$51,340	$9,992
Annual OM	$81,857	$1,642	$376
Total Aver. Annual Costs	$1,159,386	$52,982	$10,368
Construction Duration	3 years	1 month	15 days

Table C20 Cost Estimates for Alternative 3 Measures

FY16 Price Level and FY17 Discount Rate 2.875%

Cost Category	Alt 3 BASE	Alt 3 Reconnect Oxbow	Alt 3 Sinuosity (Stream Lengthen) downstream Wood Canyon	Alt 3 Wood Cyn Realign Trail	Alt 3 Widen Channel and Recontour Channel
Real Estate	$12,972,687	$863,287	$111,877	$23,000	$3,036,531
Construction	$42,109,330	$2,964,996	$247,210	$13,229	$15,162,613
PED (incl EDC)	$6,526,946	$459,574	$38,318	$2,050	2,350,205
Construction Mgt. (S&A)	$2,737,106	$192,725	$16,069	$860	985,570
Monitoring	$934,792	$72,346	$6,032	$323	369,968
Adaptive Management	$1,402,189	$108,519	$9,048	$484	554,952
Cultural Resources	$467,396	$36,173	$3,016	$161	184,984
Test Holes	$0	$500,000	$0	$0	$0
Total Construction Costs	$54,177,760	$4,334,333	$319,692	$17,108	$19,608,291
Total First Costs	$67,150,447	$5,197,620	$431,569	$40,108	$22,644,822
IDC Costs	$3,190,745	$10,256	$378	9	$46,398
Total Gross Investment	$70,341,192	$5,207,876	$431,947	$40,117	$22,691,220
Total Annual Costs of Gross Investment	$2,669,314	$197,629	$16,392	$1,522	$861,088
Annual OM	$146,315	$9,114	$660	$250	$40,456
Total Aver. Annual Costs	$2,815,629	$206,743	$17,052	$1,772	$901,544
Construction Duration	4 years	2 months	1 month	2 weeks	2 months

Table C21 Cost Estimates for Alternative 3 Measures
FY16 Price Level and FY17 Discount Rate 2.875%

Cost Category	Alt 3 Sinuosity (Stream lengthen) downstream Pacific Park Drive	Alt 3 Wood Cyn Landscape Reconnect	Alt 3 Pacific Park Drive Bypass Channel
Real Estate	$672,095	$26,717	$192,862
Construction	$961,418	$736,062	$467,936
PED (incl EDC)	$149,020	$114,090	$72,530
Construction Mgt. (S&A)	$62,492	$47,844	$30,416
Monitoring	$23,459	$17,960	$11,418
Adaptive Management	$35,188	$26,940	$17,126
Cultural Resources	$11,729	$8,980	$5,709
Test Holes	$0	$0	$0
Total Construction Costs	$1,243,306	$951,875	$605,135
Total First Costs	$1,915,401	$978,592	$797,997
IDC Costs	$2,942	$519	$716
Total Gross Investment	$1,918,343	$979,111	$798,713
Total Annual Costs of Gross Investment	$72,797	$37,155	$30,310
Annual OM	$1,330	$175	$250
Total Average Annual Costs	$74,127	$37,330	$30,560
Construction Duration	2 months	2 weeks	1 month

Table C22 Cost Estimates for Alternative 4 Measures

FY16 Price Level and FY17 Discount Rate 2.875%

Cost Category	Alt 4 BASE	Alt 4 Reconnect Oxbow	Alt 4 Sinuosity (Stream Lengthen) downstream Wood Canyon	Alt 4 Widen Channel and Recontour Channel	Alt 4 Sinuosity (Stream lengthen) downstream Pacific Park Drive	Alt 4 Pacific Park Drive Bypass Channel
Real Estate	$12,972,687	$863,287	$111,877	$3,036,531	$672,095	$192,862
Construction	$48,988,572	$2,158,395	$174,746	$15,019,044	$959,891	$467,193
PED (incl EDC)	$7,593,229	$334,551	$27,086	$2,327,952	$148,783	$72,415
Construction Mgt. (S&A)	$3,184,257	$140,296	$11,358	$976,238	$62,393	$30,368
Monitoring	$1,102,793	$52,665	$4,264	$366,465	$23,421	$11,400
Adaptive Management	$1,654,190	$78,997	$6,396	$549,697	$35,132	$17,099
Cultural Resources [1]	$551,397	$26,332	$2,132	$183,232	$11,711	$5,700
Test Holes	$0	$500,000	$0	$0	$0	$0
Total Construction Costs	$63,074,437	$3,291,236	$225,981	$19,422,628	$1,241,331	$604,174
Total First Costs	$76,047,124	$4,154,523	$337,858	$22,459,159	$1,913,426	$797,036
IDC Costs	$3,714,705	$7,788	$267	$45,958	$2,937	$714
Total Gross Investment	$79,761,829	$4,162,311	$338,125	$22,505,117	$1,916,363	$797,750
Total Annual Costs of Gross Investment	$3,026,809	$157,952	$12,831	$854,026	$72,722	$30,273
Annual OMRR&R	$145,195	$5,885	$394	$34,155	$1,123	$250
Total Avg. Annual Costs	$3,172,004	$163,837	$13,225	$888,181	$73,845	$30,523
Construction Duration	4 years	2 months	1 month	2 months	2 months	1 month

[1] Cultural Resources – Data Recovery.

4.4 CE/ICA

Cost-effectiveness and incremental cost analysis were performed using IWR-PLAN using the certified IWR Planning Suite software version 2.0.6.0. The CE/ICA is an evaluation tool which considers and identifies the relationship between changes in cost and changes in quantified, but not monetized, habitat benefits. The evaluation is used to identify the most cost-effective alternative plans to reach various levels of restoration output and to provide information about whether increasing levels of restoration are worth the successively added costs.

4.5 Cost Effectiveness Analysis

When there is no monetary measure of benefits but project outcomes can be described and quantified in some dimension, cost effectiveness analysis can be used to assist on the decision making progress. Cost effectiveness analysis seeks to answer the question: given an adequately described objective, what is the least-costly way of attaining the objective? A plan is considered cost effective if it provides a given level of output for the least cost. Cost effectiveness analysis was used to identify the least cost solution for each level of environmental output being considered.

The cost effectiveness analysis is the first step in the CE/ICA, and compares the Average Annual Habitat Units (AAHUs) potentially achieved by each alternative to the cost of each alternative to generate a "cost per AAHU." This cost provides a means to compare the cost-effectiveness of each plan. The three criteria used for identifying non-cost effective plans or combinations include (1) the same level of output could be produced by another plan at less cost; (2) a larger output level could be produced at the same cost; or (3) a larger output level could be produced at less cost. Cost-effectiveness is one of the criteria by which all plans are judged and plays a role in the selection of the National Ecosystem Restoration (NER) Plan. Non-cost effective combinations of plans are generally dropped from further consideration.

4.6 Incremental Cost Analysis

Incremental cost analysis compares the additional costs to the additional output of an alternative. It is a tool that can assist in the plan formulation and evaluation process, rather than a dictum that drives the process. The analysis consists of examining increments of plans or project features to determine their incremental costs and incremental benefits. Increments of plans continue to be added and evaluated as long as the incremental benefits exceed the incremental costs. When the incremental costs exceed the incremental benefits, no further increments are added. Incremental analysis helps to identify and display variations in costs among different increments of restoration measures and alternative plans. Thus, it helps decision makers determine the most desirable level of output relative to costs and other decision criteria.

The incremental cost analysis portion of the CE/ICA compares the incremental costs for each additional unit of output from the one cost effective plan to the next to identify "best buy" plans. The first step in developing "best buy" plans is to determine the incremental cost per unit. The plan with the lowest incremental cost per unit over the No Action Alternative is the first incremental best buy plan. Plans that have a higher incremental cost per unit for a lower level of output are eliminated. The next step is to recalculate the incremental cost per unit for the

remaining plans. This process is reiterated until the lowest incremental cost per unit for next level of output is determined. The intent of the incremental analysis is to identify successively larger plans with the smallest incremental cost per unit of incremental output.

4.7 Selection Considerations

For ecosystem restoration, the recommended plan should be the justified alternative and scale having the maximum excess of monetary and non-monetary beneficial effects over monetary and nonmonetary costs. This plan occurs where the incremental beneficial effects just equal the incremental costs, or alternatively stated, where the extra environmental value is just worth the extra costs. A plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, is identified as the National Ecosystem Restoration (NER) Plan. The selected plan should be costs effective and justified in achieving the desired level of output. Thus, the NER plan is selected from the suite of cost effective plans identified in the CE/ICA. While the NER plan is not required to be a best buy plan, this is often the case. The results of the CE/ICA do not result in a discrete decision, but rather they offer tools to help inform a decision.

4.8 Input to CE/ICA

The first step is primarily concerned with plan formulation, specifically with generating all possible alternative plans from the three base alternatives (2, 3, and 4) and additional measures under consideration. Descriptions of these alternatives and measures were identified previously in the document.

It should be noted that the with-project conditions analysis was conducted on a smaller subset of the baseline CHAP analysis area established for without-project conditions. The CHAP with-project analysis area for each restoration alternative is based on the footprint of the design (the spatial extent to which the landscape is being affected). The overall baseline CHAP study area encompasses all areas being evaluated in the alternatives analysis (and beyond), therefore a comparison between the alternative (or measure) and the baseline was attained by clipping the Geographic Information Systems (GIS) layer for the baseline to the exact extent of each alternative (or measure). Once the individual acreages of each base alternative and additional measure are established, the acreages are multiplied by the per-acre value to obtain habitat units. The HUs were calculated for existing, year 5, year 25, and year 50.

Table C23 groups each base alternative with the relevant array of measures which can be added to it to generate additional restoration output. Additional details on this process can be found in Chapter 4 of the main report. For each base alternative and measure, the table shows the monetary cost and the environment output. Costs include both total cost and average annual costs. The IWR Plan software was used to compute interest during construction and average annual costs based upon the first cost of the project and estimated periods of construction for each measure. The environmental output results were calculated from the CHAP model and are expressed in terms of Average Annual Habitat Units (AAHUs). The annualized AAHUs were

calculated using IWR Plan's Annualizer feature and based on linear interpolation of the future values.

Table C23 Total Average Annual Costs and Average Annual HUs by Measure

FY16 Price Level and FY17 Discount Rate 2.875%

Base Alts/Measures [incl. CE/ICA letter codes][2]	Total Costs[3]	Total Average Annual Costs[4]	AAHUs	AAC/AAHU
Alt 2 Base [A]	$27,531,062	$1,159,386	569.9	$2,034
Sinuosity (Stream Lengthen) downstream Wood Canyon [B]	$1,351,524	$52,982	19.5	$2,723
Newbury Riffle [C]	$263,164	$10,368	12.6	$823
Alt 3 Base [D]	$67,150,447	$2,815,629	2847.2	$989
Reconnect Oxbow [E]	$5,197,620	$206,743	177.2	$1,167
Sinuosity (Stream Lengthen) downstream Wood Canyon [F]	$431,569	$17,052	7.9	$2,146
Wood Cyn Realign Trail [G]	$40,108	$1,772	56.4	$31
Widen Channel and Recontour Channel [H][5]	$22,644,822	$901,544	451.5	$1,997
Sinuosity (Stream Lengthen) downstream Pacific Park Drive [I]	$1,915,401	$74,127	59.8	$1,239
Wood Cyn Landscape Reconnect [J]	$978,592	$37,330	1029.7	$36
Pacific park Drive Bypass Channel [K]	$797,997	$30,560	1212.6	$25
Alt 4 Base [L]	$76,047,124	$3,172,004	2153.6	$1,473
Reconnect Oxbow [M]	$4,154,523	$163,837	193.5	$847
Sinuosity (Stream Lengthen) downstream Wood Canyon [N]	$337,858	$13,225	10.4	$1,269
Widen Channel and Recontour Channel [Q]	$22,459,159	$888,181	450.7	$1,971
Sinuosity (Stream Lengthen) downstream Pacific Park Drive [P]	$1,913,426	$73,845	59.8	$1,235
Pacific park Drive Bypass Channel [O]	$797,036	$30,523	1212.6	$25

[2] CE/ICA letter codes are not the same codes identified for 'additional measures" in the following technical appendices: Design Hydrology and Hydraulics and Cost.

[3] Total Costs do not include Interest During Construction (IDC) costs. Average Annual Costs (AACE) include IDC costs.

[4] The cost effectiveness and incremental cost analysis was conducted before an update of the real estate cost for this project was completed. In Table C23, the average annual costs includes the most current updated real estate costs and the updated real estate costs are slightly higher than real estate costs applied in the cost effectivenss and incremental cost analysis. Hence, the data tables and figures describing the results of cost effectiveness and incremental cost anlaysis include the total average annual costs that exclude the slight increase in the real estate costs.

[5] Widen Channel-Widening in the vicinity of the Aliso Creek Road Bridge, includes removal of two 10-ft drop structures and planting of riparian corridor. Recontour Channel – Re-contouring of the existing channel from 1,400 feet upstream the Aliso Creek Road Bridge to Pacific Park Drive.

Combinability and Dependencies

All measures that are combinable with each base alternative will establish an associated array of completed alternatives. Combinability and dependency relationships and described below.

Alternative 2

Minimum Alternative: Base.
Combinability: No Combinable Limitation
Dependencies: None.

Alternative 3

Minimum Alternative: Base.
Combinability/Dependencies:

1. Base cannot be combined solely with Pacific Park Drive Bypass Channel (PPDBC)(K).
2. If PPDBC(K) is present: need Widen Channel and Reconfigure Channel(H); or need Widen Channel and Reconfigure Channel(H) and Sinuosity Downstream of Pacific Park Drive (I).
3. If Sinuosity Downstream of Pacific Park Drive is present, then need Widen Channel and Reconfigure Channel (I).

Alternative 4

Minimum alternative and combinability/dependencies are similar to Alternative 3.

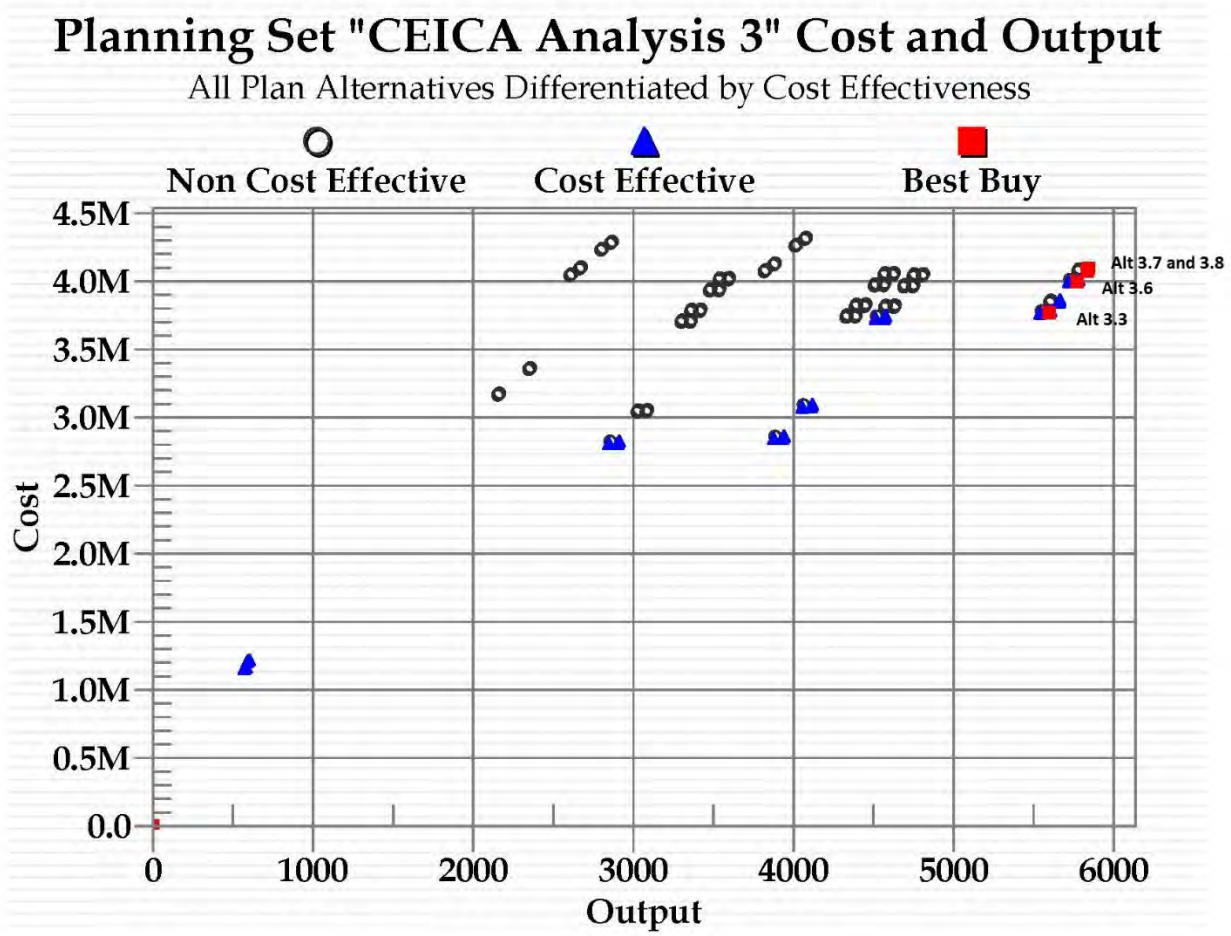
4.9 Results of the Cost Effective Analysis

After inputting all the costs and output for proposed measures into IWR Plan as well as the combinability and dependencies of measures established by the PDT, the software calculated 105 possible combinations (including No Action).

Figure E5[6] is a scatterplot of the restoration measure combinations generated by IWR Plan. The costs and outputs (AAHUs) shown in the figures and tables of the CE/ICA are in average annual terms.

[6] The following data tables showing the cost effectivenss and incremental analysis exclude the update of real etate costs.

Figure C5 Graph of Cost Effective Alternatives



After all possible plan combinations are identified, the next step is to identify those plans that are cost effective. As noted previously, "Cost effective" means that, for a given level of non-monetary output, no other plan costs less, and no other plan yields more output for less money. Table C24 shows those plans that were screened as cost effective. The table shows that 27 plans were identified as cost effective plans. Note that the corresponding lettering output generated by IWR Plan shown in Table C24 corresponds to the letter codes associated with each base alternative and measure as presented Table C23. (In Table C24, the numeral "1" that follows each letter indicates that the base/measure is activated, whereas a "0" (not included in the table) would indicate non-activation of the base/measure). The plans generated by CE/ICA include only combinations with either Base Alternatives 2 or 3. There were no cost effective plans associated with Base Alternative 4.

Table C24 Cost Effective Alternatives

Plan No.	Name	Cost (AAC)	Output (AAHUs)	AAC/AAHU	Alt
1	No Action Plan	$0	0.0	$0	
2	A1	$1,157,547	569.9	$2,031	Alternative 2
3	A1C1	$1,167,916	582.5	$2,005	
4	A1B1	$1,210,529	589.3	$2,054	
5	A1B1C1	$1,220,898	601.9	$2,028	
6	D1	$2,805,831	2,847.2	$985	Alternative 3
7	D1G1	$2,807,603	2,903.5	$967	
8	D1F1G1	$2,824,655	2,911.5	$970	
9	D1J1	$2,843,161	3,876.9	$733	
10	D1G1J1	$2,844,933	3,933.2	$723	
11	D1F1G1J1	$2,861,985	3,941.2	$726	
12	D1E1J1	$3,049,904	4,054.1	$752	
13	D1E1G1J1	$3,051,676	4,110.4	$742	
14	D1E1F1G1J1	$3,068,728	4,118.4	$745	
15	D1H1K1	$3,725,261	4,511.3	$826	
16	D1G1H1K1	$3,727,033	4,567.7	$816	
17	D1F1G1H1K1	$3,744,085	4,575.6	$818	
18	D1H1J1K1	$3,762,591	5,541.0	$679	
19	D1G1H1J1K1	$3,764,363	5,597.4	$673	
20	D1F1G1H1J1K1	$3,781,415	5,605.3	$675	
21	D1G1H1I1J1K1	$3,838,490	5,657.2	$679	
22	D1F1G1H1I1J1K1	$3,855,542	5,665.2	$681	
23	D1E1H1J1K1	$3,969,334	5,718.2	$694	
24	D1E1G1H1J1K1	$3,971,106	5,774.6	$688	
25	D1E1F1G1H1J1K1	$3,988,158	5,782.5	$690	
26	D1E1G1H1I1J1K1	$4,045,233	5,834.4	$693	
27	D1E1F1G1H1I1J1K1	$4,062,285	5,842.4	$695	

4.10 Incremental Analysis Results

Incremental cost analysis is used as a tool to compare the additional costs to the additional outputs of an alternative, or measure (feature). The analysis consists of examining increments of plans or project features to determine their incremental costs and incremental benefits. Increments of plans continue to be added and evaluated as long as the incremental benefits exceed the incremental costs. When the incremental costs exceed the incremental benefits, no further increments are added. Incremental analysis helps to identify and display variations in costs among different increments of restoration measures and alternative plans. The incremental

cost analysis compares the incremental costs for each additional unit of output from one cost effective plan to the next to identify "best buy" plans.

According to Table C25, the first Best Buy Plan (D1G1H1J1K1) has the lowest incremental cost per unit of output over the No Action Plan. Per letter code convention in Table C23 this plan corresponds to:

- Base Alternative 3 (Letter "D")
- Wood Canyon Trailhead Realignment (Letter "G")
- Widen Channel and Recontour (Letter "H")
- Wood Canyon Landscape Reconnection (Letter "J")
- Pacific Park Drive Bypass Channel (Letter "K")

This plan corresponds to Final Array Alternative 3.3 as described in the Main Report.

Table C25 First Best Buy Alternative

Plan No.	Name	Cost (AAC)	Output (AAHUs)	AAC/AAHU	Alt
1	No Action Plan	$0	0.0	$0	
2	A1	$1,157,547	569.9	$2,031	
3	A1C1	$1,167,916	582.5	$2,005	
4	A1B1	$1,210,529	589.3	$2,054	
5	A1B1C1	$1,220,898	601.9	$2,028	
6	D1	$2,805,831	2,847.2	$985	
7	D1G1	$2,807,603	2,903.5	$967	
8	D1F1G1	$2,824,655	2,911.5	$970	
9	D1J1	$2,843,161	3,876.9	$733	
10	D1G1J1	$2,844,933	3,933.2	$723	
11	D1F1G1J1	$2,861,985	3,941.2	$726	
12	D1E1J1	$3,049,904	4,054.1	$752	
13	D1E1G1J1	$3,051,676	4,110.4	$742	
14	D1E1F1G1J1	$3,068,728	4,118.4	$745	
15	D1H1K1	$3,725,261	4,511.3	$826	
16	D1G1H1K1	$3,727,033	4,567.7	$816	
17	D1F1G1H1K1	$3,744,085	4,575.6	$818	
18	D1H1J1K1	$3,762,591	5,541.0	$679	
19	D1G1H1J1K1	$3,764,363	5,597.4	$673	**Alt 3.3**
20	D1F1G1H1J1K1	$3,781,415	5,605.3	$675	
21	D1G1H1I1J1K1	$3,838,490	5,657.2	$679	
22	D1F1G1H1I1J1K1	$3,855,542	5,665.2	$681	
23	D1E1H1J1K1	$3,969,334	5,718.2	$694	
24	D1E1G1H1J1K1	$3,971,106	5,774.6	$688	
25	D1E1F1G1H1J1K1	$3,988,158	5,782.5	$690	
26	D1E1G1H1I1J1K1	$4,045,233	5,834.4	$693	
27	D1E1F1G1H1I1J1K1	$4,062,285	5,842.4	$695	

According to Table C26, the second Best Buy Plan (D1G1H1J1K1) has the lowest incremental cost per unit of output over the Alternative 3.3. Per letter code convention in Table C23 this plan corresponds to:

- Base Alternative 3 (Letter “D”)
- Reconnect Oxbow (Letter “E”)
- +Wood Canyon Trailhead Realignment (Letter “G”)
- Widen Channel and Recontour (Letter “H”)
- Wood Canyon Landscape Reconnection (Letter “J”)

- Pacific Park Drive Bypass Channel (Letter “K”)

This plan corresponds to Final Array Alternative 3.6 as described in the Main Report. Relative to Alternative 3.3, Alternative 3.6 adds the feature Reconnect Oxbow, which adds 177 AAHUs at an incremental average annual cost of about $206,743. The incremental AAC/AAHU for Alternative 3.6 of $1,167 is about 73% greater than the incremental AAC/AAHU for Alternative 3.3.

Table C26 Second Best Buy Alternative

Plan No.	Name	Incr. AAC	Incr. HUs	Incr. AAC/HUs	Alt
20	D1F1G1H1J1K1	$17,052	7.9	$2,145	
21	D1G1H1I1J1K1	$74,127	59.8	$1,239	
22	D1F1G1H1I1J1K1	$91,179	67.8	$1,345	
23	D1E1H1J1K1	$204,971	120.9	$1,696	
24	D1E1G1H1J1K1	$206,743	177.2	$1,167	**Alt 3.6**
25	D1E1F1G1H1J1K1	$223,795	185.2	$1,209	
26	D1E1G1H1I1J1K1	$280,870	237.1	$1,185	
27	D1E1F1G1H1I1J1K1	$297,922	245.0	$1,216	

Incremental costs and AAHUs are compared to Alternative 3.3

According to Table C27, the third Best Buy Plan (D1E1G1H1I1J1K1) has the lowest incremental cost per unit of output over the Alternative 3.6. Per letter code convention in Table C23 this plan corresponds to:

- Base Alternative 3 (Letter “D”)
- Reconnect Oxbow (Letter “E”)
- Wood Canyon Trailhead Realignment (Letter “G”)
- Widen Channel and Recontour (Letter “H”)
- Sinuosity (Stream Lengthen) downstream Pacific Park Drive (Letter “I”)
- Wood Canyon Landscape Reconnection (Letter “J”)
- Pacific Park Drive Bypass Channel (Letter “K”)

This plan corresponds to Final Array Alternative 3.7 as described in the Main Report. Relative to Alternative 3.6, Alternative 3.7 adds the feature Sinuosity (Stream Lengthening) Downstream of Pacific Park Drive, which adds about 60 AAHUs at an incremental average annual cost of about $74,127. The incremental AAC/AAHU for Alternative 3.7 of $1,239 is only about 6% greater than the incremental AAC/AAHU for Alternative 3.6.

Table C27 Third Best Buy Alternative

Plan No.	Name	Incr. AAC	Incr. HUs	Incr. AAC/HUs	Alt
25	D1E1F1G1H1J1K1	$17,052	7.9	$2,145	
26	D1E1G1H1I1J1K1	$74,127	59.8	$1,239	**Alt 3.7**
27	D1E1F1G1H1I1J1K1	$91,179	67.8	$1,345	

Incremental costs and AAHUs are compared to Alternative 3.6

According to Table C28, the Fourth Best Buy Plan (D1E1F1G1H1I1J1K1) has the lowest incremental cost per unit of output over the Alternative 3.7. Per letter code convention in Table C23 this plan corresponds to:

- Base Alternative 3 (Letter "D")
- Reconnect Oxbow (Letter "E")
- Sinuosity (Stream Lengthen) downstream Wood Canyon Creek (Letter "F")
- Wood Canyon Trailhead Realignment (Letter "G")
- Widen Channel and Recontour (Letter "H")
- Sinuosity (Stream Lengthen) downstream Pacific Park Drive (Letter "I")
- Wood Canyon Landscape Reconnection (Letter "J")
- Pacific Park Drive Bypass Channel (Letter "K")

This plan corresponds to Final Array Alternative 3.8 as described in the Main Report. Relative to Alternative 3.7, this Best Buy alternative adds the feature Sinuosity (Stream Lengthening) Downstream of Wood Canyon Creek, which adds about 8 AAHUs at an incremental average annual cost of about $17,052. The incremental AAC/AAHU for Alternative 3.8 of $2,145 is 73% greater than the incremental AAC/AAHU for Alternative 3.7.

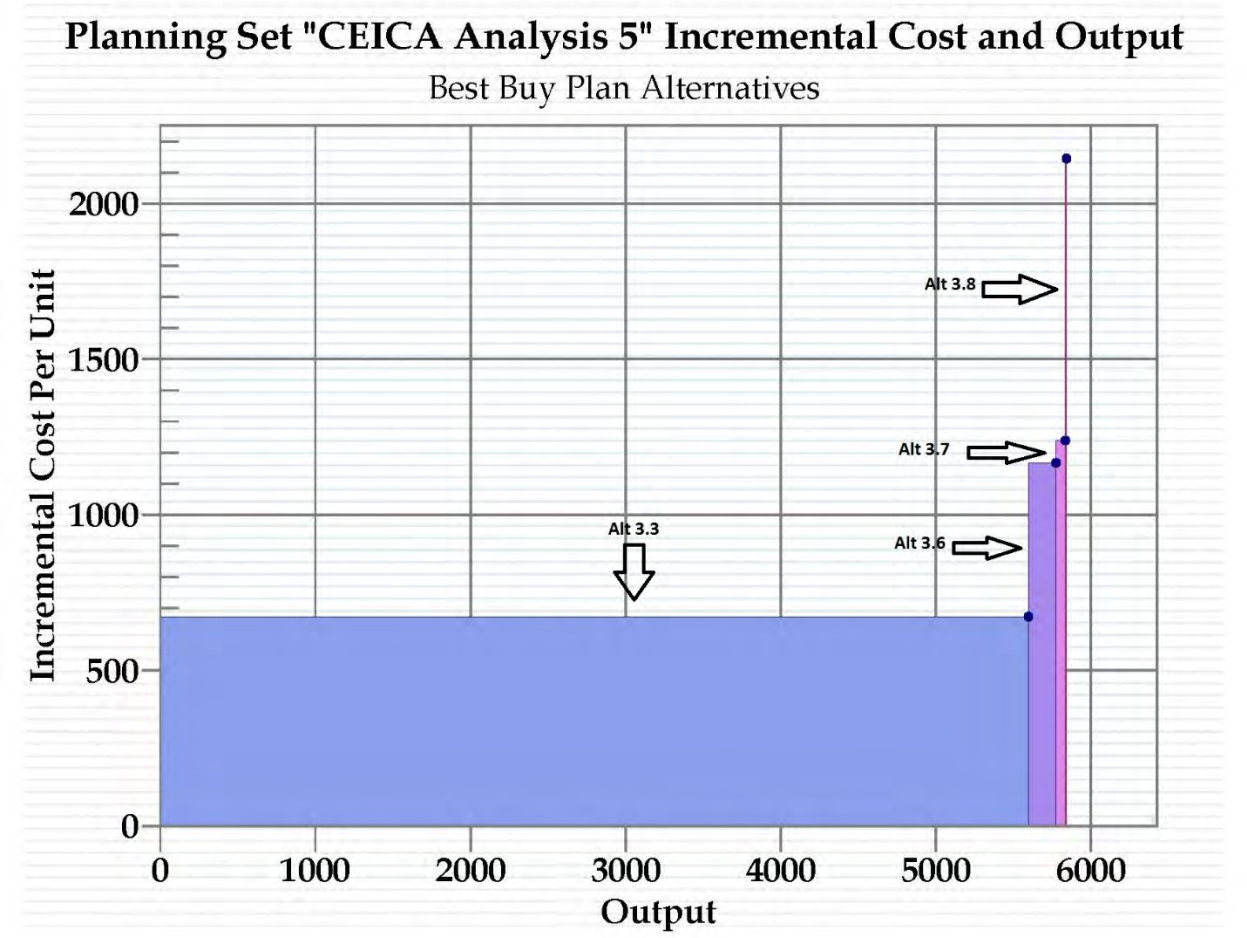
Table C28 Fourth Best Buy Alternative

Plan No.	Name	Incr. AAC	Incr. HUs	Incr. AAC/HUs	Alt
27	D1E1F1G1H1I1J1K1	$17,052	7.9	$2,145	**Alt 3.8**

Incremental costs and AAHUs are compared to Alternative 3.7

Figure C6 shows a box plot of the incremental average annual cost per incremental gain in output for the four Best Buy Action Plans. Of particular note for this graph is that the incremental cost per output for the largest Best Buy Plan is significantly higher than that of the smaller Best Buy Plans.

Figure C6 Graph of Best Buy Alternatives



4.11 National Ecosystem Restoration (NER) Plan

As part of the planning process the U.S Army Corps of Engineers (USACE) and the Non-Federal Sponsor identify the National Ecosystem Restoration (NER) Plan. As described in the USACE planning guidance, the NER Plan is the alternative and scale having the maximum monetary and non-monetary and non-monetary beneficial effects over monetary and nonmonetary costs. This plan occurs where the incremental beneficial effects just equal the incremental costs, or alternatively stated, where the extra environmental value is just work the extra costs. Alternative 3.6 has been identified as the NER Plan and Tentatively Selected Plan (TSP) as it reasonably maximizes net NER benefits. Please refer to the Main Report for a discussion of the criteria applied to determine that Alternative 3.6 is the NER Plan. The table below shows the costs and output for each of the best-buy alternatives.

Table C29 Costs and Output for the Best-Buy Alternatives

FY16 Price Level and FY17 Discount Rate 2.875%

Cost Category	Alt 3.3	Alt 3.6	Alt 3.7	Alt 3.8
Real Estate	$16,251,797	$17,115,084	$17,787,179	$17,899,056
Construction	$58,489,170	$61,454,166	$62,415,584	$62,662,794
PED (incl EDC)	$9,065,821	$9,525,396	$9,674,415	$9,712,733
Construction Mgt (S&A)	$3,801,796	$3,994,521	$4,057,013	$4,073,082
Monitoring	$1,334,461	$1,406,806	$1,430,265	$1,436,297
Adaptive Management	$2,001,691	$2,110,210	$2,145,398	$2,154,445
Cultural Resources [7]	$667,230	$703,403	$715,133	$718,148
Test Holes	$0	$500,000	$500,000	$500,000
Total Construction Costs	$75,360,168	$79,694,501	$80,937,807	$81,257,499
Total First Costs	$91,611,965	$96,809,585	$98,724,986	$99,156,555
IDC Costs	$3,238,387	$3,248,643	$3,251,585	$3,251,963
Total Gross Investment	$94,850,352	$100,058,228	$101,976,571	$102,408,518
Total Annual Costs of Gross Investment	$3,599,389	$3,797,018	$3,869,816	$3,886,207
Annual OMRR&R	$187,446	$196,560	$197,890	$198,550
Total Avg. Annual Costs	$3,786,835	$3,993,578	$4,067,706	$4,084,757
Net Increase AAHU	5,597	5,775	5,834	5,842

[7] Cultural Resource – Data Recovery.

As mentioned in footnote for Table C23, the cost effectiveness and incremental cost analysis was conducted before an update of the real estate costs for the proposed measures was completed. Hence, the real estate costs that were included in the cost effectiveness and incremental cost anlaysis were slightly less than the real estate cost displayed in Table C29 for the final array of alternatives. The total net change in real estate costs after the update was completed was $592,139 for each of the final arrary of alternatives. In Table C30 shows that the net change in total average annual costs and percentage difference due to update of the real estate costs. Based on the results in the table, the net percentage change in the total average annual costs is less than 1% due to the update of the real estate costs.

Table C30 Comparison of Real Estate Costs Applied for CE/ICA and Final Real Estate Costs

FY16 Price Level and FY17 Discount Rate 2.875%

Real Estate Costs Totals	Alt 3.3	Alt 3.6	Alt 3.7	Alt 3.8
Total AA Costs After Update	$3,786,835	$3,993,578	$4,067,706	$4,084,757
Total AA Costs Before Update	$3,764,365	$3,971,108	$4,045,235	$4,062,287
Difference in Costs	$22,471	$22,471	$22,471	$22,471
% Difference in Costs	0.6%	0.6%	0.6%	0.6%

5.0 Recreation Plan Benefits Analysis

The non-Federal sponsor and USACE Los Angeles District cooperatively formulated a recreation plan with features that would be compatible with the TSP; however, the economic justification of the recreation features are evaluated as separable components of the plan. The features of the recreation plan are designed to capitalize on the areas where substantial ecosystem restoration is proposed. As such, it assumed that the ecosystem restoration will have taken place when considering the effects of the recreation plan features. Recreation development at ecosystem restoration projects is intended to be compatible with, but also enhance the visitation experience by taking advantage of natural values. The recreation experience is intended to build upon ecosystem restoration and take advantage of restored values and not detract from them as described by Engineer Pamphlet 1162-2-502 (USACE 1999). The formulation of recreation plans were informed by that guiding principle and designed with the intent to be operated in a manner consistent with the primary project purpose or ecosystem restoration.

The formulation for recreation is conducted ancillary to ecosystem restoration at an appropriate scope and scale compatible with the restoration features. As a function of the formulation process, a corresponding recreation plan was formulated after identification of the final array and in the case of this study, after the identification of the NER Plan and Tentatively Selected Plan. The recreation plan developed for the NER/TSP is commensurate with the scope and scale of the proposed restoration plan in a manner that does not impair the restoration outputs.

The recreation plan features include the construction of five kiosks that are located within the Proposed Project Area. The construction of the five kiosks is expected to provide increased

public understanding and appreciation of the restoration features of the TSP, which enhances the ecosystem within Aliso and Wood Canyon Wilderness Park.

The kiosks would be constructed in the following locations:

- One kiosk located in the vicinity of Pacific Park Drive and Aliso Creek.
- One kiosk located in the vicinity of Ranger Station at the park entrance at Alicia Parkway.
- Three kiosks located along the re-built AWMA road between the Ranger Station and SOCWA CTP.

The evaluation of the recreation plan acknowledges the recreation benefits generated by the features of the ecosystem restoration features of the TSP that provide an enhanced environmental setting for recreation activities. Hence the recreation benefit analysis accounts for the increase in recreation benefits due to the construction of TSP ecosystem restoration project.

Consistent with the without project evaluation of recreation values in the Proposed Project Area the PDT conducted the evaluation of recreation benefits using a unit day value (UDV) method.

The value of existing and future with project general recreation at Aliso and Wood Canyons Wilderness Park was calculated using the UDV and annual visitation estimates for years 2026-2075. The following table shows the judgement factors and point values that were used to calculate the UDV for general recreation with the completion of the NER/TSP plan.

Table C31 Aliso and Wood Canyons Wilderness UDV (with NER Plan/TSP)

Aliso and Wood Canyons Wilderness Park

Calculations of the Unit Day Value General Recreation

Recreation Criteria	Range of Values	Judgement Value
Recreation Experience	0 to 30	9
Availability of Opportunity	0 to 18	3
Carrying Capacity	0 to 14	9
Accessibility	0 to 18	14
Environmental	0 to 20	15
	Total	50
Conversion of Points to Dollar Value		$8.42

The following paragraph provides explanation how the judgment factors were selected for each UDV point value criteria.

The recreation experience was increased to a point value of 9 from point value of 7 under without project conditions because the restoration features of the NER/TSP will enhance the user recreation experience. The restoration measures would increase riparian habitat that could

present a recreation resource through attractive and aesthetic features both within and along Aliso Creek. The restoration measures would occur in areas that could connect with existing recreational areas upstream and downstream of the Wilderness Park.

In addition, the Wilderness Park carrying capacity was raised from point value of 8 to point value of 9, because the NER/TSP plan offers features that will provide an improved Old AWMA road for park users. The design plans for the improved Old AWMA road will fix the damaged sections of the road that were damaged in previous storm events.

The calculation for the accessibility to the park is raised from point value of 12 to a point value of 14 on scale of 0 to 18, because the NER/TSP plan will enhance the road network in the park due to enhancements to the Old AWMA road..

The environmental value at the park was raised from point value of 5 to point value of 15 on scale of 0 to 20, because NER/TSP Plan will enhance recreational users experience with the biological resources within the park. The NER/TSP plan would increase the amount of wildlife habitat; provide greater ecological/biological benefits; aid in linking isolated habitats; help increase the amount of open space; and help expand species diversity. These impacts would be beneficial from a regional perspective since they would benefit wildlife species that may migrate outside of the study area. The enhanced environmental setting will enhance the overall recreation experience for visitors.

In addition, the completion of the ecosystem restoration feature of the NER/TSP plan is expected to be popular with Orange County residents that have an interest in activities that involve birdwatching and residents that enjoy the outdoors with a passion in naturalism. The PDT expected that usage of the trail will increase by 5% after the completion of ecosystem restoration feature.

The table above provides a summary of the unit day value ratings for Aliso and Wood Canyons Wilderness Park after the completion of the NER/TSP plan. The ratings total to 50 points, which corresponds with a dollar value of $8.42 based upon the Economic Guidance Memorandum 17-03, Unit Day Values for Recreation, Fiscal Year 2017.

Table C32 shows the judgement factors and point values that were used to calculate the unit day value for general recreation with the completion of the recreation plan that incorporates the construction of five kiosks. The construction of the kiosks will enhance the users experience by enhancing their knowledge of the restoration projects. The Wilderness Park carrying capacity was raised from point value of 9 to point value of 10, because the recreation plan offers kiosks that provide more critical information of parks trails for parks users.

Table C32 Aliso and Wood Canyons Wilderness Recreation Plan UDV

Aliso and Wood Canyons Wilderness Park Calculations of the Unit Day Value General Recreation		
Recreation Criteria	**Range of Values**	**Judgement Value**
Recreation Experience	0 to 30	10
Availability of Opportunity	0 to 18	3
Carrying Capacity	0 to 14	9
Accessibility	0 to 18	14
Environmental	0 to 20	15
	Total	51
	Conversion of Points to Dollar Value	$8.49

The table above provides a summary of the unit day value ratings for Aliso and Wood Canyons Wilderness Park after the completion of the NER plan. The ratings total to 51 points, which correspond to a dollar value of $8.49 based upon the Economic Guidance Memorandum 17-03, Unit Day Values for Recreation, Fiscal Year 2017.

Table C33 Aliso and Wood Canyons Wilderness Recreation Benefits
FY17 UDV and FY17 Discount Rate 2.875%

Project Condition	Unit Day Value	Base Year Attendance (2020)	Future Year Attendance (2069)	Total Equivalent Annual Recreation Value
Without Project Conditions (Entire Park)	$6.69	172,400	184,900	$1,215,900
Without Project Conditions (Existing AWMA Road)	$6.69	136,000	145,800	$958,900
Ecosystem Restoration (Rebuilding Portion of AWMA Road)	$8.42	142,800	153,100	$1,267,200
Recreation Feature (Kiosks)	$8.49	142,800	153,100	$1,277,800

As shown above, implementation of the TSP ecosystem restoration features is anticipated to provide approximately $308,000 in incidental equivalent annual recreation benefits. Recreation features, limited to construction of five kiosks, is estimated to provide incremental equivalent annual benefits of approximately $11,000.

According to costs estimates from previous USACE projects, the kiosks are expected to cost approximately $5,000 each. Based on the construction of five kiosks, the total cost of recreation plan features is estimated at about $25,000, corresponding with an annual cost of about $1,000 based on discount rate of 2.875% and fifty year period of analysis. Therefore, the recreation plan has benefit to cost ratio of 11 and net benefits of $10,000.

6.0 Incidental Erosion Damage Reduction Benefits

In addition to the average annual damages occurring under the without project conditions, the Erosion Model generates the average annual damage occurring after implementation of the NER plan/TSP for the impact areas located on the east bank or SOCWA impact areas. Table C33 shows the results of average annual damages occurring after the implementation of the NER plan/TSP and the net reduction in damages between the without project conditions and with project conditions. Based on the results in the table for SOCWA impact areas, the total average annual damages occurring in the with project condition is $68,000 and the net reduction in average annual damages after the implementation of TSP is about $348,000.

As shown on Table C34, four of the sixteen impact areas have slightly higher damages with implementation of the NER plan/TSP relative to without project conditions. This is due to: 1) based upon the risk based analysis, without project average annual damages/costs are minimal in these areas because there is a very low probability of erosion triggering the placement of rip-rap (resulting in without project costs) in the first half of the period analysis; and 2) under with-project conditions, more costly lateral protection included in the NER Plan/TSP (relative to the cost of rip rap assumed under the without project condition) is subject to potential damages throughout the period of analysis. However, it should be noted that the combined increase in damages for these four impact areas is very minor (only $6,500) and is insignificant relative to the overall reduction in erosion damages throughout the SOCWA reaches of $348,000.

In addition, it is also important to note that the without project damages are likely underestimated since the erosion rates only account for fluvial forces and not channel bank slumping due to geotechnical instabilities. This additional erosion factor was not included in the analysis due to the significant cost of incorporating such analysis, especially given the relatively small cost of bank protection relative to other restoration features.

Table C35 shows the model results for the impact areas located on the west bank or AWMA Road impacts areas. According to the results in Table C35, the total average annual damages occurring in the with project conditions is $27,000 for AWMA Road impact areas. In addition, Table C35 shows the net reduction of average annual damages of about $297,000 with the implementation of the TSP.

Hence, the results for erosion model is showing a net reduction of average annual damages of $646,000 for the impact areas in the TSP project area. This net reduction of average annual damages is attributable to the bank stabilization features included in the TSP ecosystem restoration plan. Since the features are required for ecosystem restoration purposes, the erosion damage reduction benefits are considered incidental.

Table C34 SOCWA Impact Areas Average Annual Damages TSP/Net Reduction Damages FY16 Price Level and FY17 Discount Rate 2.875%

Impact Area	Total Without Project Annual Damages	Total With Project Annual Damages	Net Reduction Annual Damages
Impact Area A	$23,462	$8,416	$15,046
Impact Area B	$42,595	$7,839	$34,756
Impact Area C	$39,032	$1,575	$37,457
Impact Area D	$19,837	$1,875	$17,962
Impact Area E	$30,599	$3,749	$26,850
Impact Area F	$42,130	$2,250	$39,880
Impact Area G	$2,708	$3,374	-$666
Impact Area H	$12,265	$2,625	$9,640
Impact Area I	$2,582	$3,749	-$1,167
Impact Area J	$63,680	$8,998	$54,682
Impact Area K	$59,218	$3,749	$55,469
Impact Area L	$11,716	$1,875	$9,841
Impact Area M	$50,534	$3,749	$46,785
Impact Area N	$2,069	$3,749	-$1,680
Impact Area O	$13,398	$6,749	$6,649
Impact Area P	$540	$3,562	-$3,022
Totals	$416,365	$67,883	$348,482

Table C35 AWMA Impact Areas Average Annual Damages TSP Net Reduction Damages FY16 Price Level and FY17 Discount Rate 2.875%

Impact Area	Total Without Project Annual Damages	Total With Project Annual Damages	Net Reduction Annual Damages
Impact Area A	$21,732	$3,187	$18,545
Impact Area B	$13,815	$1,500	$12,315
Impact Area C	$41,308	$2,250	$39,058
Impact Area D	$31,321	$2,999	$28,322
Impact Area E	$57,683	$0	$57,683
Impact Area F	$27,387	$4,124	$23,263
Impact Area G	$21,928	$2,999	$18,929
Impact Area H	$28,320	$3,899	$24,421
Impact Area I	$14,792	$1,650	$13,142
Impact Area J	$50,860	$3,007	$47,853
Impact Area K	$15,565	$1,875	$13,690
Totals	$324,711	$27,490	$297,221

6.1 Incidental Erosion Damage Reduction Benefits – Joint Transmission Main (JTM) Pipeline.

The ecosystem restoration in Reach 11 (for NER/TSP) would be raising the creek bed by about 7 feet, terracing for riparian establishment, and providing a riffle structure at the JTM pipeline crossing to facilitate aquatic passage. As the threat to the JTM pipeline would be significantly diminished as an outcome of the ecosystem restoration feature, this would be considered incidental erosion damage reduction benefits for the construction of the project.

7.0 Other Social Effects

The Other Social Effects (OSE) account describes the potential effects of the proposed project alternatives in areas that are not dealt with explicitly in the NER accounts presented above. ER 1105-2-409 states, "Any alternative plan may be selected and recommended for implementation if it has, on balance, net beneficial effects after considering all plan effects, beneficial and adverse in the four Principles and Guidelines evaluation accounts," of which the OSE is one. The Principles and Guidelines state that the OSE, when included in U.S. Army Corps of Engineers documents, should "display plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others."

This OSE describes the potential effects of NER Plan construction and the effects after construction is completed. The OSE account explores the following categories of effects from the implementation of the NER plan.

- Displacement/impacts to population
- Public health and safety
- Displacement/impacts to minorities and special interest groups
- Displacement/impacts to business
- Displacement/impacts to recreational areas
- Community growth
- Project Impacts and Connectivity of the Community

For the analysis of the region of influence (ROI) for direct social effects is defined as Orange County. This ROI area definition extends beyond the potential construction impact area and was chosen based on the assumption that all direct social effects, if any, associated with a project of this type would be confined to this area. The selection of County of Orange as the ROI for the project was also based on the assumption that the county is the market area for the users of Aliso and Wood Canyons Wilderness Park.

7.1 Displacement/Impacts to Population

The TSP will be constructed in a non-populated location within the Aliso and Wood Canyons Wilderness Park. The direct effects of construction are not likely to result in any displacement or impacts to population beyond the health and safety concerns outlined below. Indirect construction effects are also anticipated to be minimal, since the current population of Orange County is over three million. It is generally assumed the project will need between 30 to 50 workers from Orange County to complete the project. Therefore, the construction-related employment is not likely to increase the population to any significant degree within the ROI.

After the construction of the NER/TSP plan, the project long-term impacts are expected have minimal impacts on the county labor force. The project features that are related to ecosystem restoration and recreation will generate minor positive impacts on local tourism industry. Any increase in tourism will be minimal to the overall tourism industry in Orange County. Also, the project long-term impacts may include positive impacts on quality of life for the residents of Orange County that may help attract some local business activity.

7.2 Public health and safety.

The analysis of effects to public health and safety includes environmental effects related to noise and air quality and the possible effects to the populace in regard to access to emergency services.

Construction of the NER/TSP plan is expected to produce temporary adverse effects in regard, for example, to noise level, air quality and water quality in the construction area, as well as other adverse effects as described in Chapter 5 of the Main Report. The construction of TSP will incorporate measures to minimize these impacts during the construction of the TSP.

As the implementation of the restoration measures and other reasonably foreseeable recreation amenities would increase the opportunities for the public to interact with the Creek, the cumulative risk of water-related injury could increase. This cumulative risk would be greatest with the development of recreational activities with direct access to the creek. This risk would be greatest during and following seasonal flooding events. Under the No Action Alternative or with the implementation of any of the construction alternatives, this risk would be similar. Flood events would be contained within the proposed re-configuration of the historic floodplain. Some overbanking would occur in designated areas with a greater than a 1% ACE. Since the Wilderness Park is uninhabited, there is little chance of risk of life and property damage as in an urban area. None of the proposed alternatives would increase exposure of people or structures to flooding hazards. Existing public health and safety agencies providing emergency services would be utilized to address any cumulative impacts to public health and safety.

Historically, the Aliso Beach has experienced recurring sewage spills that have resulted in beach closures and contributed to a reputation associating Aliso Beach with poor water quality and human health and safety risks. As mentioned previously in the document the on-going erosion of the Aliso Creek channel poses a threat to the SOCWA pipeline infrastructure. In particular, the SOCWA Coastal Treatment Plant has a design capacity of 6.7 million gallons per day and serves the City of Laguna Beach, Emerald Bay Services District, South Coast Water District, and Moulton Niguel Water District for a population of 40,000. Hence, the threat of on-going erosion damages to SOCWA pipelines threatens the well-being of the users of Aliso Beach and discourages use at the beach. The NER/TSP plan (Alternative 3.6) is designed with protection measures that are expected to greatly reduce occurrences of potential sewage spills due to pipeline breaks which affect the water quality at Aliso Beach. Therefore, the public health and recreation usage at Aliso Beach should improve with the construction of TSP plan (Alternative 3.6).

7.3 Displacement/Impacts to minorities and special interest groups.

As discussed above, displacements or relocations related to the construction efforts surrounding the project are unlikely. The construction footprint being in a public park and the small workforce required for construction indicated an unlikelihood for impacts.

The NER/TSP plan is expected to have minimal beneficial impacts to minorities and special interest groups. The local communities surrounding the park have median income over $90,000 and have low percentage of population that are classified as minorities.

7.4 Displacement /Impacts to businesses

During the construction of TSP, displacement or relocations to businesses are not expected. Some businesses may incur slight increase sales in gas and food purchases by the temporary labor force. As mentioned in the previous section, the TSP may increase tourism in the local area.

7.5 Displacement/impacts to recreational areas

Implementation of the NER/TSP plan would contribute to cumulative beneficial recreation impacts for the residents surrounding the study area. The restoration measures would increase riparian habitats that could present a recreation resource through attractive and aesthetic features both within and along Aliso Creek. Communities surrounding the study area have documented the need for more parks and open space in general plans and in various community plans. The restoration measures would occur in areas that could connect with existing recreational areas upstream and downstream of the Wilderness Park.

While there would be limited access during construction which could cause an increase in other regional parks with similar trail and nature amenities, these impacts would be lifted once construction was completed, adding beneficial amenities to the Wilderness Park. See the Main Report, Chapter 5, section 5.15 for more details.

7.6 Community Growth

Generally, a project is expected to promote growth if it contributes substantially to the population or economics of the area. The NER/TSP plan is expected to provide temporary positive regional economic impacts during the construction phase of the project. The NER/TSP is not expected to contribute to any rise in area population, directly or indirectly, during the construction or after the completion of the project.

7.7 Connectivity and Community Cohesion

A sustainable restored ecosystem would provide future generations with the opportunity to have a higher quality experience to appreciate the restored environment, while maintaining responsibility of environmental stewardship. Restoration would entice more users of the educational and passive recreational nature of the park, which in turn leads to increased community value of the park. Sustainable ecosystems also result in ongoing high quality of life for park visitors and area residents. However, restored habitats must also be managed long-term through an adaptive management program, for example, to insure success given the predictions of climate change and other factors.

8.0 Regional Economic Development Benefits

"The regional economic development (RED) account registers changes in the distribution of regional economic activity that result from each alternative plan. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output and population."[8] The RED account displays information not analyzed in other accounts in the feasibility report that could have a "material bearing on the decision-making process."[9]

[8] *Economic and Environmental Principles for Water and Related Land Resources Implementation Studies*, 1983
[9] Ibid

The RED account is born out of the difference in perspectives between the Federal government and local communities directly impacted by water resource planning. The Federal objective in water resource planning is contributing to national economic development and the Federal perspective is the nation as a whole. Local communities and regions directly impacted by water resource planning may consider impacts at the state, regional, or local level a more relevant measure. From the Federal perspective transferring employment opportunities and resources from one region of the nation to another to construct a water resource project does not in itself constitute national economic development and therefore regional economic impacts may not be fully captured in the NER account. However, from a regional or local perspective the transfer of employment opportunities and resources to construct a project in that region, as opposed to some other region of the United States, can be a significant benefit to the local economy in terms of more local employment, more local spending, and more local production. This is why the different perspectives between the Federal government and local communities impacted by water resource projects are addressed in different accounts. The Federal perspective is addressed principally in the NER account while the regional or local perspective is addressed principally in the RED account.

8.1 Process

To perform an economic analysis from the regional perspective (RED account), several different impacts from constructing the water resource project have to be analyzed. These impacts are termed direct, indirect, and induced effects.

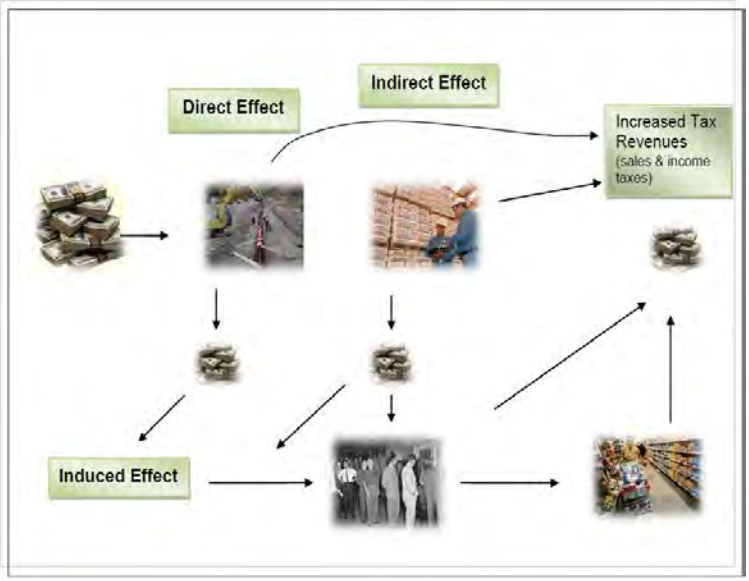
a. *Direct effects* are "immediate effects associated with the change in total sales for a particular industry. In other words…the proportion of the expenditure in each industry that flows to material and service providers in that region."[10] Stated simply, these are the direct impacts to employment and income due to the demand for goods and services to complete construction (e.g. construction equipment and labor). The region is typically defined by political rather than economic or geographic boundaries. Political boundaries are broken down to state and county or metropolitan area for analysis.
b. *Indirect Effects* are changes in inter-industry purchases in response to new demand from the directly affected industries. In other words the supply of materials and services to meet the needs of the companies or individuals directly engaged in constructing the project (e.g. concrete suppliers).
c. *Induced effects* are "changes in spending patterns [from] increases in income to directly and indirectly affected industries."[11] Stated simply, this is the increased spending on local goods and services such as restaurants, grocery stores, hotels, and gas stations due to the direct and indirect effects of the project.

The impact from spending to construct the project is shown in Figure C7. First the direct effects from hiring a construction firm to complete the project are experienced, then that firm

[10] *Regional Economic Development (RED) Procedures Handbook* 2011-RPT-01, March 2011
[11] Ibid

purchases supplies and services from other firms to complete the project causing indirect effects.

Figure C7 Process to Evaluate Regional Economic Development



Finally, both direct and indirect effects contribute to induced spending at local retailers, restaurants, convenience stores, etc. This leads local retailers, restaurants, convenience stores, and so on to purchase more goods and services and perhaps hire additional workers. At the same time all this cycling of dollars also leads to increased tax revenue. This cycle continues until the additional dollars are no longer in circulation in the regional economy due to leakages. Leakages occur when goods and services with value added outside of the region are purchased (e.g. purchased clothing that was manufactured in Asia or consulting services from a firm located and engaged in business activity primarily outside the region). The graphic above illustrates the concepts of direct, indirect, and induced effects.

The direct, indirect, and induced effects are estimated through multipliers, which can be thought of, figuratively, as money multiplying throughout the regional economy. A portion of the money spent on construction equipment and labor (direct effect) gets re-spent on construction supplies (indirect effect) and a portion of the money from both is re-spent on local restaurants and gas stations (induced effect). Economists have used regression analysis on historical spending data to estimate how much spending and re-spending varies when there is an economic stimulus to the region through various construction projects. This produces the "multipliers" that are applied to the initial construction spending (i.e. cost of constructing the project) to estimate the direct, indirect, and induced effects of the project studied in this feasibility report.

In addition to the regional benefits from direct, indirect, and induced spending on constructing the project there are also benefits from increased recreation demand from non-locals and tax benefits to the local and state economy from preserving property tax receipts since episodic erosion events causing property loss would be markedly reduced once the project is constructed. These are called forward linkages since they link the construction project to the regional

"consumers" of the outputs from the NER/TSP which are decreased land loss resulting in the preservation of property tax receipts as well as increased recreational opportunities resulting in more tourist spending. This contrasts with backward linkages from the construction firm to its suppliers captured in the "money multipliers" described earlier and analyzed in this section.

8.2 Analysis

The RECONS model was used to estimate the direct, indirect, and induced effects of the TSP based on construction cost estimates. This model generates regional construction multipliers based on the USACE business lines (navigation, flood mitigation, water storage & supply, etc). Each business line is subdivided into numerous work activities, which improves the accuracy of the estimates for regional and national job creation, and retention and other economic measures such as income, value added, and sales. For this analysis the business line is Environmental Stewardship and the work activity is construction of ecosystem and habitat improvement. Table C29 shows that the first costs for the TSP (Alternative 3.6) is approximately $97 million which includes real estate costs. According to the discussion in section 4.3 Cost Estimates, the local sponsor owns most of the real estate that will be needed for the implementation of the TSP. Hence the local sponsor will incur some expenses and incur timeline in acquiring the parcels for the TSP. The total direct expenditures for TSP is $80 million instead $97 million due to the local sponsor ownership of the real estate.

8.3 Results

Results are presented for the region, state, and nation. The region consists of Orange County which includes the Aliso Creek study area. This means regional impacts that have been measured accrue within Metropolitan Area Generic Model. The state-level impacts are for California and the national impacts are for the contiguous United States.

Direct impacts (effects) to employment and income are due to the demand for goods and services. These contribute to additional output, additional demand for jobs, and increased value-added to goods and services within Metropolitan area, and the state of California, and the nation as shown in Table C36.

Based on these estimated impacts we expect about 658 full-time equivalent (FTE) jobs to be created from direct employment from constructing the NER Plan over the period analysis in local region. The NER Plan is projected to create an additional 451 additional FTE jobs, by indirect and induced effects that support or compliment that construction effort. The regional capture rate, which is the region's direct output as a share of total spending, is around 79%. Since much of the labor and equipment comes from within the region, we expect the capture rate to be high as shown.

Overall, the NER Plan should lead to $73.5 million in gross regional product (GRP) and about 1109 additional job opportunities within the region. The impact to the state would be of greater magnitude although less relative importance due to the large size of the California economy. Approximately $105 million in GRP and about 1,410 jobs would be created state-wide.

Table C36 NER RED Overall Summary Economic Impacts

Impact Areas / Impacts		Regional	State	National
Total Spending		$79,694,500	$79,694,500	$79,694,500
Direct Impact				
	Output	$63,102,692	$77,408,377	$79,494,578
	Job	658	797	822
	Labor Income	$34,582,208	$43,421,049	$44,403,123
	GRP	$41,486,026	$51,563,514	$52,737,414
Total Impact				
	Output	$116,355,549	$167,076,878	$213,624,762
	Job	1109	1410	1744
	Labor Income	$53,444,090	$74,437,785	$88,638,927
	GRP	$73,548,262	$105,477,637	$129,096,718

9.0 Overall Benefits of TSP

The following table provides a summary of the benefits of implementing the TSP.

Table C37 Summary of the Overal Benefits for the TSP

Item	Amount
NER First Cost	
Real Estate	$17,115,000
Construction	$61,454,200
PED (incl EDC)	$9,525,400
Contruction Management (S&A)	$3,994,500
Montoring and Adaptive Management	$3,517,000
Cultural Resources	$703,400
Test Holes	$500,000
Total NER First Costs	$96,809,500
NER Average Annual Costs	
Annual Cost to Total Gross Investment	$3,797,000
Annual OMRR&R	$196,600
Total Avg. Annual Costs	$3,993,600
Total Average Annual Cost per AAHU	$692
NER Average Annual Benefits	
Net Avg Annual Habitat Units (AAHU)	5,775
Incidental Streambank Erosion Protection (Wastewater Conveyance)	$646,000
Incidental streambank Erosion Protection (Water Supply Conveyance)	Not quantified. Protects water supply for more than 200,000 residents
Recreation	
Recreation Cost	$25,000
Average Annual Cost	$1,000
Average Annual Benefit	$11,000
Benefit to Cost Ratio	11
Incidential Annual Recreation Benefits (NER)	$308,000
Total Project First Cost	$96,834,500

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APPENDIX C-1: Aliso Creek Erosion Model

ALISO CREEK MAINSTEM
ECOSYSTEM RESTORATION STUDY
Orange County, California

September 2017

US Army Corps
of Engineers

Orange County Public Works
Environmental Resources
Department

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Contents

Appendix A

1. Model Documentation

This appendix, which supports the Aliso Creek Ecosystem Restoration Feasibility Study, describes the model software, structure, approach and assumptions for an economic model developed to evaluate the National Economic Development (NED) benefits for reducing streambank erosion damages in the study area of Aliso Creek, Orange County, California. The economic analysis is performed in a probabilistic economic model built with the @Risk software add-in to Microsoft Excel.

The Aliso Creek watershed is located in southern Orange County, California and encompasses an area of approximately 35 square miles. Aliso Creek flows nearly 19.5 miles from its headwaters at approximately 2,400 feet above sea level in the Santiago Hills (foothills of the Santa Ana Mountains and within the boundaries of the Cleveland National Forest) to its outlet at the Pacific Ocean in south Laguna Beach. The Aliso Creek outlet is approximately 50 miles south of Los Angeles and approximately 65 miles north of San Diego.

One of the objectives of the Aliso Creek Feasibility Study is to address flood and erosion damages to the infrastructure in the study Area. Therefore, the purpose of the economic model is to determine the expected annual damages and costs to this infrastructure under without project conditions (non-engineered rip-rap measure, placed during emergency actions), as well as the potential benefits from the proposed with-project (engineered rip-rap measures). In particular the model was designed to focus on the NED damages that occurs to the sewage line and sludge line on east bank and AWMA road on west bank of Aliso Creek and costs for implementing protective measures to avoid such damages. The pipelines and AWMA road are subject to potential damages by erosion or degradation of the channel due the future storm events. The model will be used for the approximately 3.5 mile of Aliso Creek from the SOCWA Coastal Treatment Plant to the confluence with Sulphur Creek.

The lower reach (study area) of the watershed was identified in the *Aliso Creek Watershed Management Feasibility Study* (USACE, 2002) as having the most significant issues associated with ecosystem and stream degradation, infrastructure threat, and water quality impairment. Much of the proposed project area for the current study is within the Aliso and Wood Canyons Wilderness Park. A public utility, the South Orange County Wastewater Authority (SOCWA) Coastal Treatment Plant, is situated in Aliso Canyon within an isolated lower parcel surrounded by the Wilderness Park. The facility is located on the east side of Aliso Creek and is approximately 1.2 miles upstream from the Pacific Ocean. The Coastal Treatment Plant has a design capacity of 6.7 million gallons per day and serves the City of Laguna Beach, Emerald Bay Services District, South Coast Water District, and Moulton Niguel Water District for a population of 40,000. An easement for buried sludge conveyance force mains (two- 4 inch) and

raw effluent (18-inch and 36-inch) pipelines runs along the east side of Aliso Creek In particular, the 18- inch raw effluent pipeline, which is owned by Moulton Niguel Water District, follows an alignment that is closer to the creek bank than other three pipelines. The three other pipelines (36-inch effluent pipeline and two 4-inch sludge lines) follow same route as 18-inch pipeline (owned Moulton Niguel Water District). The 4-inch and 36-inch pipelines are generally in close proximity, however their distance to the 18-inch alignment can vary from a few feet up to approximately 100 feet.

Treated effluent is discharged to the Pacific Ocean through the Aliso Creek Ocean Outfall. Some limited amount of treated effluent is also utilized for recycled water. The facility is accessible by way of the SOCWA bridge, by way of a private access road (AWMA Road) that parallels to the west of Aliso Creek through the Wilderness Park. County staff and the recreational users of Wood Canyon trail share a portion of AWMA Road for Wilderness Park access. SOCWA also has an unimproved (dirt) service road on the east side of Aliso Creek.

The on-going erosion of the Aliso Creek channel poses a threat to the SOCWA pipeline infrastructure. SOCWA has spent millions of dollars repairing erosion damages along Aliso Creek and the agency considers all repairs along Aliso Creek temporary due to instability of the channel. Based on recent SOCWA study, *Lower Aliso Creek Erosion Assessment Study* (Tetra Tech, dated April 2012), the geomorphic instabilities of the channel poses risks to the infrastructure (i.e. AWMA Road and wastewater pipelines) located along both banks of Aliso Creek. The assessment included the identification and evaluation of locations where erosion of the banks could lead to exposure/undermining of the existing pipelines or AWMA Road located throughout the study reaches. The results of this study established various segments ("risk locations") of both channel banks that are at risk to incur significant impacts to the facilities from erosion. For the without-project conditions, these risk locations were identified as being more susceptible to damages than other areas (eg. along outside bends of the alignment). The without-project conditions also helped to establish the risk areas for with-project as the latter's alignment is relatively similar and hence lead to the development of the required bank protection features.

The model quantifies all NED damages from erosion over the period of analysis under without project conditions and with project conditions.

- A delineation of facilities at risk and hydraulic/hydrologic characteristics were provided by LA District Engineering Division. Facilities at risk includes the sewage line/sludge line and AWMA road. For each location for facilities at risk (risk location), the model includes the baseline setback distance or lateral distance between the location of sewage line/sludge line or AWMA road and the creek bank. The measurement of the setback distance for each risk location was based on the actual distance between the 18-inch pipeline or AWMA road and the top of bank line for Aliso Creek.
- Engineering Division provided location-specific erosion rate assumptions. These erosion rates are in the form of average annual rates with uncertainty.
- The model identifies the minimum lateral distance (in feet), or "setback distance", that lies between the creek's top of bank and infrastructure facilities (pipelines on east bank; or AWMA Road on west bank). For the east bank, as the 18-inch line is closest to the creek (and hence the shortest setback distance of the four pipelines), it would be chosen

as the first facility to require bank protection. For the west bank, the edge of AWMA Road was chosen was chosen as the setback distance.

- The model is a simple "life-cycle" analysis spreadsheet, which tracks the change in the setback distance at the locations of the facilities at risk, accounting for cumulative erosion in prior years. The Palisade @Risk software was utilized in conjunction with Microsoft Excel to randomly derive annual erosion amounts based upon the functions provided by Engineering Division, and, once erosion reaches the setback trigger for potential damages/costs, such costs are quantified for that specific year.

  The @Risk software is utilized to perform Monte Carlo simulations of expected annual damages over the 50-year period of analysis. Such damages are based upon the annualized net present value of damages/costs accounting for the amount and timing of damages based upon the simulations, which account for uncertainty in both erosion rates and damages/costs.

For this analysis, input variables defined with uncertainty included annual erosion rates and the installation costs for bank protection measures. Supporting details of the uncertainty modeled for the annual erosion rates are documented in the Aliso Creek Ecosystem Restoration Feasibility Study TSP Draft Hydrology and Hydraulics Appendix (November 2014). The Appendix provides a summary of how the annual rates were developed for different risk levels (high, medium, low) for the west bank and the east bank of the channel. In addition, the Appendix documents the mean and standard deviation for the annual erosion rates for each level of risk). It should be noted that an evaluation of the statistical distributions for the different risk levels did not show a significant difference in mean erosion rates, in particular for the east bank. For this reason, this appendix will refer to the groups with similar risks as Groups A-F, rather than high/medium/low.

The cost data for without project conditions that was applied to the model was obtained from SOCWA and consultants hired by SOCWA or USACE. This cost data that was used to determine the costs that the agency will incur in repairing the damaged section of sewer line and sludge line and the costs of adding some protective armoring over the damaged sections to avoid future damages to the section.

2. @Risk Software

@Risk is a risk analysis software add-in for Microsoft Excel that allows the evaluation of uncertainty in a spreadsheet environment. Using @Risk, cells in Excel can take on probability distributions, rather than deterministic values. Other cells and formulas in the model can then be dependent on the probability distributions. @Risk runs a simulation by sampling values from all of the probability distributions in the model, and updating the workbook calculations many times with each update called an "iteration." For this analysis, @Risk is set to run 100,000 iterations for a simulation. For each iteration, @Risk stores the sampled variables, as well as the result values of user defined outputs. The distributions of the input and output values during the simulation can then be presented and examined statistically with the @Risk interface.

3. Model Structure

The purpose of the economic model is to quantify the NED damages within the Study Area due to streambank erosion and the corresponding benefits that can be realized with the implementation of streambank erosion protection measures. The purpose of this appendix is to provide the reader with clear and concise description how the model calculates the corresponding NED damages and the damages reduced by the proposed measures to address lateral erosion. Therefore, the following text provides a model description that sequentially details how that model calculates the NED damages for the without project conditions and with project conditions.

Step 1. Identify the Setback Information for Each Risk Location

In order for the economic model to calculate the total NED damages and damages reduced, the model focuses on those channel locations where infrastructure is most at risk and the setback distance between the top of bank of Aliso Creek and the 18-inch pipeline (east bank) or AWMA road (west bank). This location and setback information is detailed in the following worksheets: *AWMA RD Risk Locations* and *SOCWA Risk Locations*.

Step 2. Generate Estimates of Yearly Erosion Occurring at Each Risk Location

Secondly, the model randomly generates a separate yearly erosion estimate for the east and the west bank. *SOCWA* and *AWMA RD Erosion Worksheets* provide a single random erosion event/value for each year identified in the model.

Step 3. Calculate the Remaining Setback Distance between the Top of Bank and the Infrastructure

The third step for the economic model is to account for the remaining setback distance at each of the risk locations after the yearly erosion rate is generated in the Erosion Worksheet. The *SOCWA* and *AWMA RD Remaining Setback Worksheet* accounts for the remaining setback distance at each risk location accounting for cumulative erosion in prior years.

Step 4. Identify the Year of Construction of the Initial Protective Measure (Rip-rap) Based on Remaining Setback Distance

The *SOCWA* and *AWMA Rd Armor Worksheets* account for the fourth step for the economic model by determining the year that the remaining setback distance for the pipeline or AWMA Road reaches the assumed distance that would trigger the construction of protective measures (rip-rap) due to the threat of damages to this infrastructure.

Step 5 Calculate the Costs of the Construction of Initial Protective Measure (Rip-rap)

After the *Armor* worksheets determines the year of the armoring, the fifth step for the model is to account for total costs of implementing the initial rip-rap measure. The total costs of the initial (non-engineered) rip-rap measure is accounted for in the *SOCWA* and *AWMA Rd Initial Cost Worksheets*.

Step 6 Calculate the Future Residual Damages after Construction of Initial Protective Measure (Rip-rap)

Since the without project condition includes a design of a rip-rap measure that is non-engineered, it is assumed that the rip-rap would be vulnerable to storm events which have a probability of less than a 10% annual chance of exceedance (ACE) (10-year event). Non-engineered rip-rap is defined as stone simply dumped during emergency operations; it is typically not sized or sorted to withstand a specific level storm flow event, and as a result of the manner in which it was placed, does not constitute a well-nested mass of interlocking stone. The sixth step of the model accounts for the damages to the non-engineered rip-rap features after they are assumed to be in place due to storm events less probable than 10% ACE event (10- year event); the calculations for these damages are detailed in the *SOCWA* and *AWMA Rd WO Residual Damage Worksheets*. Without project damages include the cost of the protective measures and the residual damages to the pipeline and the road, as well as downstream recreation impacts from a potential pipeline break after the protective measures are put in place.

Step 7 Calculate the Residual Damages with Implementation of USACE Project or With Project Features.

To quantify the reduction in NED damages, the last step of the model is to account for the residual damages assumed to occur with implementation of With Project erosion protection features (rip-rap measures). The *SOCWA* and *AWMA Rd Res Damage With Project Worksheets* account for residual damages to the pipeline and road, as well as recreation losses, that are projected to occur with the implementation of these With Project features.

The calculation of the residual damages described in Step 7 is assuming that a USACE Project is constructed before the base year. Hence, the calculation of NED damages in Step 7 is evaluating all storm events that will cause damages to the USACE Project. If a storm event randomly selected in the Annual Event Probabilities has a probability of less than 1% then residual damages can occur to the erosion protection measure. Note that Step 7 does not follow or use any information from the previous six steps for the calculation of the damages for the without project conditions.

The following table provides a summary of the types of costs and the expected costs that are estimated by the model. This Monte Carlo simulation model, incorporates risk triangle distributions for each type of cost to account for uncertainty of the actual costs. The table below provides the cost assumptions/parameters incorporated into the Risk Triangle distributions.

Table 1: Costs Applied in the Model & Probability Distributions

Category Costs	Type of Costs	Min cost	Most Likely Cost	Max cost
W/O Protective Measure				
	Protective Measure Costs per linear foot	$580	$650	$710
With Project Protective Measure				
	Protective Measure Costs per linear foot	$1,040	$1,150	$1,270
	Sulphur Creek Measure Costs per Installation per linear foot	$3,190	$3,550	$3,900
Mitigation Costs for Protective Measure Costs				
	Processing Gov Doc. Initial Placement Rip-rap per Installation	$75,000	$87,500	$100,000
	Mitigation Costs for Gov Doc Replacement Rip-rap per Installation	$50,000	$67,500	$75,000
	Least Bell Vireo Mitigation Costs for Rip-rap per Installation	$1,730,700	$1,923,000	$2,115,300
Cost of Damaged Pipeline				
	Pipeline Repair 18-inch, 32-inch and two 4-inch per Repair	$477,800	$530,800	$584,000
	Pipeline Repair 18-inch pipline per Repair	$371,700	$413,000	$454,000
Costs for Closure of Aliso Creek Beach				
	Closure of Aliso Creek Beach per Sewage Spill	$115,100	$1,279,000	$1,407,000
Costs for Damaged AWMA Road				
	Costs Repair Road AWMA per Repair	$36,000	$40,000	$44,000

The table below lists the categories of costs that apply to Steps 5 thru 7 of model calculations. A summary is also provided after the table to describe the sources for these costs.

Table 2: Costs Applied by Step

Category Costs	Type of Costs	Step 5	Step 6	Step 7
W/O Protective Measure				
	Protective Measure Costs	YES	Yes	No
With Project Protective Measure				
	Protective Measure Costs	No	No	Yes
	Sulphur Creek Measure Costs	No	No	Yes
Mitigation Costs for Protective Measure Costs				
	Processing Gov Doc. Initial Placement Rip-rap	Yes	No	No
	Mitigation Costs for Gov Doc Replacement Rip_Rap	No	Yes	No
	Least Bell Vireo Mitigation Costs for Rip_Rap	Yes	No	No
Cost of Damaged Pipeline				
	Pipeline Repair 18-inch, 32-inch and two 4-inch	Yes	Yes	No
	Pipeline Repair 18-inch pipline	Yes	Yes	No
Costs for Closure of Aliso Creek Beach				
	Closure of Aliso Creek Beach	Yes	yes	No
Costs for Damaged AWMA Road				
	Costs Repair Road AWMA	Yes	Yes	No

- Protective Measure Costs-Without Project Conditions: The source for these costs are based on best professional judgement (USACE Los Angeles District – Design Engineering Section).

- Protective Measure Costs –With Project Condition: The source for these costs are based on the cost estimates by feature for the project.

- Sulphur Creek Measure Costs – With Project Condition: The source for these costs are based on the cost estimates by feature for the project.

- Mitigation Costs for Initial Placement Rip-rap - The source for these costs is based on best professional judgement. (USACE Los Angeles District Planning Division, Environmental Resources Branch)

- Mitigation costs for Replacement Rip-rap - The source for these costs is based on best professional judgement. (USACE L.A. District Planning Division, Environmental Resources Branch)

- Least Bell Vireo Mitigation Costs for Rip-rap – The source for these cost is based on the following engineering document: *Buried Utility protection along Aliso Creek Phase 1, June 2014,* Tetra Tech, Inc.

- Pipeline Repair 18-inch, 32-inch, and two 4-inch –Cost of Damaged Pipeline- The source for these costs is based on following engineering document: *Sulphur and Aliso Creek Stabilization Project (SOCWA) dated February 2013.*

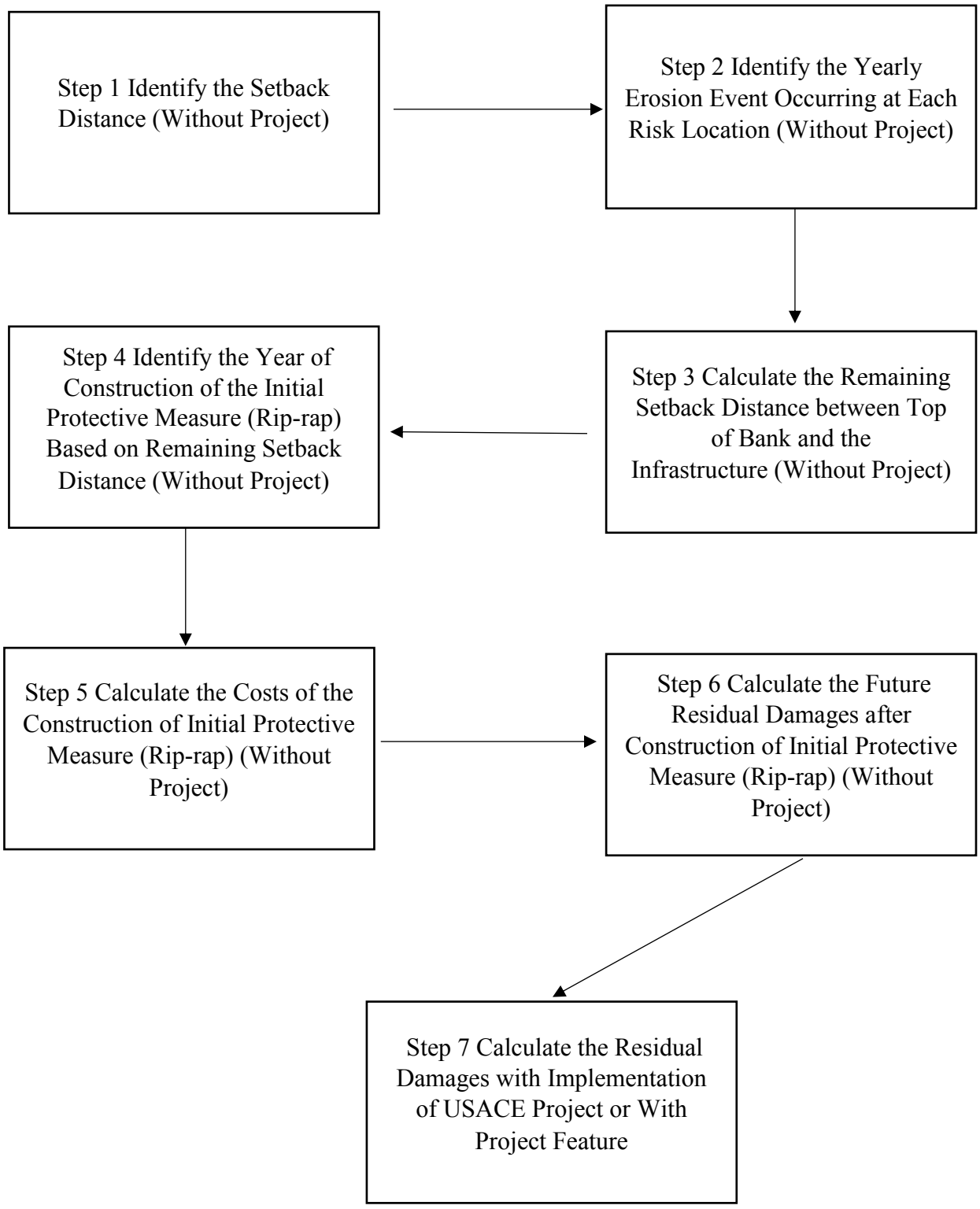
- Pipeline Repair 18-inch –Cost of Damaged Pipeline- The source for these costs is based on following engineering document: *Sulphur and Aliso Creek Stabilization Project (SOCWA) dated February 2013.*

- Cost for Closure of Aliso Beach – Closure of Aliso Creek Beach –Closure of Aliso Creek Beach- The source for these costs is based on the following engineering document: *Sulphur and Aliso Creek Stabilization Project (SOCWA) dated February 2013*.

- Costs for Damaged AWMA Road – Road Repair Costs - The source for these costs is based on best professional judgement. (USACE Los Angeles District, Engineering Division).

The following flow diagram depicts the seven steps applied by the model to derive estimates of NED damages occurring during the without project conditions and the residual damages with the implementation of a USACE project that addresses erosion in the areas evaluated.

Figure 1: Model Flow Diagram



As noted above, the data and calculations of the economic model were organized into separate worksheets within a Microsoft Excel workbook. The general types of worksheets are described below.

Simulation Settings – This worksheet contains the high-level parameters and decision variables relevant to the simulation as a whole. These include:

- Financial parameters – Includes the federal discount rate. The default discount rate for the model is set to the Fiscal Year 2017 federal discount rate of 2.875 percent.

- Period Analysis – Identifies the Base Year (2020) and period of analysis of 50 years.

- Costs for Protection Measures Without-Project Conditions – The costs (per linear foot) of installing non-engineered rip-rap to protect the pipelines (east bank) or AWMA Road (west bank).

- Costs for Protection Measure With-Project Conditions – The costs (per linear foot) of installing the Federal Project erosion protection features.

- Mitigation Costs for Installation of Rip-Rap Measure – The environmental mitigation costs related to the installation of rip-rap measures for both east and west banks. In particular these mitigation costs will be applied only to the installation of non-engineered rip-rap and the repairs of non-engineered rip-rap after significant storm events. These mitigation costs include the costs for processing federal and state permits and the cost for mitigating impacts to the Least Bell's vireo. Furthermore, these mitigation costs are expected to occur for only the without project conditions.

- Costs for Damage Pipeline East Bank – The incurred repair costs of pipeline if the pipeline is damaged by erosion. The future repair costs for the damaged pipeline are expected to occur for only the without project conditions. The repair costs represent damages for two scenarios: 1) damages to only the 18-inch pipeline; and 2) damages to all four pipelines.

- Repair Costs for AWMA Road - The incurred repair costs of AWMA road if the road is damaged by erosion. The future repair costs for the AWMA road are expected to occur for only the without project conditions.

- Recreation Loss at Aliso Creek Beach Due to Breach at Unprotected Location – If erosion of the channel breaches the pipelines at unprotected location on east bank (two sludge conveyance pipelines and two effluent pipelines), then a sewage spill is highly probable and the sewage will most likely flow downstream to the ocean. Aliso Creek Beach is located downstream of the sewage spill and the beach will probably be closed until local government agencies determine the water quality is safe for body contact. Also, the future recreational losses from sewage spills are expected to occur for only the unprotected areas in the without project conditions. This recreation loss scenario is calculated in the Initial Cost Worksheet.

- Recreation Loss at Aliso Creek Beach Due to Breach at Initial Protected Location – Based on best professional judgment of Engineering the impact of storm events that are less probable than .5% ACE (200-year flood event) are expected to cause significant lateral erosion (20 to 30 feet). This scenario is expected to result in breaching of the non-engineered rip-rap and consequent breaching in 18-, 36- and two 4-inch pipelines with ensuing sewage spills. The sewage spills will cause the closure Aliso Creek Beach for the without project conditions. This recreation loss scenario is further described in this document and calculated in the WO Residual Damage Worksheet.

- Erosion Rates East Bank – The annual erosion rate for areas with similar levels of risk (Group A, Group B, Group C) for locations on east bank. The annual rates are based on a lognormal distribution.

- Erosion Rates West Bank – The annual erosion rate for areas with similar levels of risk (Group D, Group E, Group F) for locations on west bank. The annual rates are based on a lognormal distribution.

- Setback Trigger- The model was formulated with a setback trigger (based on lognormal distribution) for each bank (west bank and east bank) that will determine the timing of the implementation of the protection measures. Once the cumulative amount of erosion surpasses the setback trigger, the model will calculate the costs that local agencies (Orange County Parks or SOCWA) will incur in protecting the facilities.

Model Summary Worksheet – This worksheet presents the outputs of the analysis, including the present value of the total costs/damages and annual cost/damage estimates. Furthermore, the summary categorizes all costs/damages for both the without-project conditions and for with-project conditions. For with-project, the costs are categorized as those associated with the placement of protective measures associated with the FRM design and which generate FRM benefits, and also those associated with FRM incidental benefits resulting from damages prevented as an outcome of implementation of the ecosystem restoration project.

Erosion Worksheets ("SOCWA" and "AWMA") – First, this worksheet randomly selects an annual erosion rate for the risk group that applies to that location based on the lognormal distribution. An erosion rate from the lognormal distribution is randomly selected for each year from year 2016 to year 2076 for the applicable risk group. Also, the worksheet shows the risk locations that are determined to have the potential for erosion impacts to the pipeline (east bank) or AWMA road (west bank). The risk locations in the SOCWA worksheet are segmented into 17 locations that are labeled from "A" to "Q". The risk locations in AWMA worksheet are segmented into 11 locations that are labeled from "A" to "K". For each risk location the without-project erosion rate for the section is based on the applicable risk group for that location. It should be noted that the same erosion rate is assigned to risk locations of the same risk level. The future potential erosion rate is based on average erosion rates derived from historical topographic information for each level of risk group (Risk Groups A-F).

Figure 2 (page 12) shows the risk locations for the west bank and the east bank.

The source for the annual erosion rates and the lognormal distributions applied in the model are detailed in the Draft Hydrology and Hydraulics Appendix for the Aliso Creek Ecosystem Restoration Feasibility Study. The discussion of the erosion rates is detailed in section 9 of the appendix. Table 3 below provides a list of erosion rates used in the model. The information in Table 3 shows the mean and standard deviation applied to the lognormal distribution for the six risk groups that were described in the Draft Hydrology and Hydraulic Appendix. The information for the six risk groups in this appendix described the engineering assessment that developed the lognormal distributions. Thus, the discussion in the Draft Hydrology and Hydraulic Appendix provides a descriptive narrative how the lognormal distribution for each risk group was developed. In particular, the erosion characteristics in each risk group included the location of the bank (east or west) and the engineering assessment of the erosion risks in each risk group. The evaluation of erosion risks in specific locations is based on the risk categories developed in the SOCWA study, *Lower Aliso Creek Erosion Assessment Study* (Tetra Tech, dated April 2012) As noted, while the SOCWA study reported on three risk categories (High, Medium, Low) for the east and west bank, this appendix refers to the areas with similar risks as Groups A-F, rather than as high/medium/low. In section 4.0 Probability Distributions of SOCWA study, this section of the report includes the maps that show the risk locations that were identified to a specific risk group.

Table 3 Erosion Rates (Mean & Standard Deviation) Based on Lognormal Distribution

Risk Group	Mean (ft/year)	Standard Deviation
A Risk Group East Bank	0.25	0.53
B Risk Group East Bank	0.16	0.43
C Risk Group East Bank	0.18	0.49
D Risk Group West Bank	2.66	4.16
E Risk Group West Bank	1.63	2.56
F Risk Group West Bank	1.09	1.76

Remaining Setback Worksheets ("SOCWA" and "AWMA") The yearly erosion rate selected in the Erosion Worksheet is subtracted from the previous year setback distance to determine the remaining setback distance for each risk location. The modeling for the initial setback distance was based on USGS LiDAR (2011) and recent aerial images (2015) to verify that the initial setback distance calculated for the year 2011 has not altered substantively through 2015 due to the persistent drought conditions that occurred since 2011.

Armor Worksheet ("SOCWA" and "AWMA") For each year evaluated in the model, this worksheet compares the remaining setback distance listed in the *Remaining Setback* worksheet with the selected setback trigger that is identified in the simulation worksheet. If the remaining setback distance is less than the setback trigger, then the worksheet identifies the risk location to be armored. If the setback distance is less than the trigger (simulation worksheet), then cells for the risk location will be coded with "yes" to account for armoring.

Figure 2 - Rip Rap Locations

Initial Cost Worksheet ("SOCWA" and "AWMA") The Cost Worksheet determines the total costs of the initial armoring of the risk location. According to the *Armoring* worksheet, the initial armoring costs are incurred the first year the setback distance is less than the setback trigger, provided the setback distance has not become negative, which would signify damage to the pipeline. Based on the length of the risk location and cost per linear foot identified in the *SOCWA Section* or *AWMA Rd Section* worksheets, the worksheet shows the total costs of implementing the initial armoring for each of the risk locations. The initial armoring costs are based on best professional judgment of $649 per linear foot.

Also, the initial armoring costs include the cost of environmental mitigation for the impacts for habitat loss for the federal endangered species (least Bell Vireo) and associated analysis and reporting due to implementation of future actions of armoring the risk locations. The environmental mitigation cost for the least Bell Vireo was estimated at $1,923,000 per risk location based on an engineering document for the SOCWA pipeline. (*Buried Utility protection along Aliso Creek Phase 1*, June 2014, Tetra Tech) In addition, the modeling includes the costs for processing federal and state documents. In particular, the costs include the following: environmental mitigation costs include obtaining U.S Army Corps of Engineers Section 404 Nation-wide permit, California Department of Fish and Wildlife Section 1602 Streambed Alteration Agreement, and the Regional Water Quality Control Board Section 401 Water Quality Certification and documents for the California Environmental Quality Act (CEQA). The model uses a triangular distribution with a minimum cost of $75,000, most likely estimate of $87,500 and maximum costs of $100,000. These costs are relevant to both the east and west banks.

For the east bank specifically, if the simulated setback distance becomes less than zero, then initial costs include damages to the pipelines (two 4 inch sludge pipelines and two effluent conveyance) and recreational losses at Aliso Creek Beach from sewage reaching and causing closure of the beach downstream.

The 18-inch effluent pipeline is periodically used by Moulton Niguel Water District for conveying raw sewage to SOCWA Coastal Treatment Plant. The 36-inch pipeline is regularly operated by SOCWA to convey raw sewage to SOCWA Coastal Treatment Plant. Also, there is two 4-inch force main pipelines that is regularly operated by SOCWA to convey sludge to upstream processing plants.

Based on an assessment provided by the Los Angeles District Engineering Division, there is high likelihood for breaching of the 36-inch effluent pipeline or two 4-inch sludge pipelines should the 18-inch effluent pipeline be breached in cases where the 36- and 4-in pipelines are within 10 feet of the 18-pipeline. This is the result of a "scalloping failure" mode occurring in the fill behind the 18-inch pipeline. Hence, each risk location was evaluated to determine if the 36-inch effluent pipeline or two 4-inch sludge pipelines are within 10 feet of the 18-inch effluent pipeline. If this is the case, then the column for the risk location in this worksheet includes a "yes" on row 5 to identify the risks for pipelines.

Aliso Creek Beach is sandy beach downstream of the study area that has an average annual attendance of 1.1 million. Historically, the events that caused damages to SOCWA pipelines

have impacted water quality at Aliso Creek Beach and caused the beach to close, or postings. The modeling for the lost recreation at Aliso Creek Beach is accounted for in cell C42 (*Stimulation Setting* worksheet) which has a probability function (triangular distribution with minimum costs of $1,253,491, most likely estimate of $1,392,768, and maximum costs of $1,532,045) that accounts for the uncertainty in the amount of recreation that is lost due to closure of Aliso Creek Beach. The consequence of closing the beach at Aliso Creek assumed that 14% of the annual beach attendance will be lost due to sewage spill and closing the beach. The total cost of the recreational loss is $1,392,800 which is based on assumption that annual attendance drops by 14%. The assumptions for the loss in recreation value is based on information presented in the document titled *Sulphur and Aliso Creek Stabilization Project* (SOCWA), dated February 2013. The damages to the pipelines (18-inch, 36-inch, and two 4-inch pipelines) are based on repair costs detailed in the document for the Sulphur and Aliso Creek Stabilization Project (SOCWA),dated February 2013, which estimated repairs to cost about $530,845 per risk (triangular distribution with minimum costs of $477,761, most likely estimate of $530,845, and maximum costs of $583,930) location. If the distance between the 18-inch effluent pipeline and other pipelines is more than 10 feet, then estimated repairs for 18-inch effluent pipeline is to cost about $413,021 (triangular distribution with minimum costs of $371,719, most likely estimate $413,021, and maximum costs of $454,323) per risk location.

The worksheet is setup to identify all the costs for mitigation, repairs, and recreational loss due to negative setback distance or positive setback distance for the year of implementation of non-engineered rip-rap measure. The total costs for negative setback distance is listed on row 6 and for positive setback distance on row 7 of the worksheet.

If the simulated setback distance is less than zero occurred for the west bank or AWMA Road Costs worksheet, then damages to AWMA Road would occur with most likely repair costs of $40,000 would be incurred by the responsible parties. According to an estimate of repair costs for AWMA Road from Los Angeles District Engineering Division, the most likely costs is $40,000 (triangular distribution with minimum $36,000, most likely estimate $40,000, and maximum costs of $44,000) per risk location.

WO Residual Damage Worksheet ("SOCWA" and "AWMA") After the risk location is armored with the initial rip-rap measure (without project conditions), this worksheet will evaluate the future damages to the rip-rap due to large storm events. Based on best professional judgement, the PDT engineers have estimated the percent damages to the rip-rap features due to a large scale future storm event. For example, if the project area is affected by a storm event with a probability of less than 0.5% ACE (200-year event), it is assumed the erosion will cause 100% damage to the rip-rap and will also result in environmental mitigation costs. These costs will occur on the east and west bank.

The erosion modeling for the east bank has shown that storm event with a probability of less than 0.5% ACE (200-year event) can produce lateral erosion of 20 to 30 feet. This worksheet includes an assessment that determines if each risk location has a setback distance for SOCWA 36-inch effluent pipeline and two 4-inch sludge pipelines within 30 feet. If the setback distance for these pipelines is within 30 feet then "yes" is marked in row 5 for each risk location.

Also, if the 36-inch and two- 4 inch pipelines are damaged by erosion (setback is less than 30 feet) then the model accounts for repair costs for the pipelines and lost recreational attendance/value at Aliso Creek Beach that were discussed for the initial rip-rap measure. The total pipeline repair costs for each risk location is calculated in row 6 which accounts for the repair costs if the 36-inch and 4-inch pipelines are within 30 feet of Aliso Creek Channel. If these pipelines are further than 30 feet, then the repair costs apply to only the 18-inch pipeline.

The modeling for the lost recreational value at Aliso Creek Beach was slightly modified from the Initial Cost Worksheet to account for the scenario where the breakage could occur at any risk location. The model assumes that breakage of pipeline could occur in multiple locations with a storm event with a probability that is less than the 0.5% ACE (200 year event). With a multiple breach scenario, recreational loss would still result as a one-time occurrence. The recreational loss is identified for each risk location and was displayed on row 7. To ensure that the recreational loss does not exceed the costs identified in cell C42 in the Stimulation Setting Worksheet, the recreational loss is divided by number of locations that are armored and have 36-inch and 4-inch pipelines within 30 feet setback distance of top of bank.

The environmental mitigation costs include the federal and state compliance documents discussed for the initial rip-rap measure. The model includes a triangular distribution with a minimum costs of $50,000, most likely estimate of $67,500 and maximum costs of $75,000. These costs pertain to both the east and west banks.

The erosion modeling for the west bank has shown that storm event with a probability of less than 0.5% ACE (200-year event) can produce lateral erosion of 85 to 170 feet. As mentioned in the previous worksheet, the total damages to AWMA Road would be $40,000.

Based on professional judgment storm events between a 0.5% ACE (200 year event) and 1% ACE (100 year event) are assumed to cause 100% damage to the non-engineered rip-rap measure and incur environmental costs for processing federal and state compliance documents. Storm events between 0.1% ACE (10 year event) and 1% ACE (100 year event) are estimated to cause about 50% damage to rip-rap measures and also incur environmental costs for processing federal and state documents. These costs pertain to both the east and west banks.

Res Damage With Project Worksheet ("SOCWA" and "AWMA") After completion of the with-project erosion protection features, which constructs engineered rip-rap features, it is assumed that the risk locations will have protection for storm events with the probability greater than the 1% ACE (100 year event) in magnitude. Hence, the USACE engineered rip-rap will be vulnerable to be damages for storm events less probable than the 1% ACE (100 year event). Therefore, the *Res Damage With Project* worksheet estimates the residual future damages after the completion of the with-project engineered rip-rap features. The modeling for calculating damages assumes that the storm events with a probability of less than 0.5% ACE (200 year event) result in 80% of the total replacement costs for the engineered rip-rap. For storm events less probable than the 1% ACE event (100 year event) but more probable than the 0.5% ACE (200 year event), these storm events are assumed to cause 50% damage to the engineered rip-rap features. The damage estimates for the engineered (with-project) rip-rap features were based on a

cost estimate of $1,150 per linear foot. This methodology is applied for both the east and west bank.

AWMA Rd Risk Location Worksheet. This worksheet provides list of the vulnerable risk locations located on the west bank of Aliso Creek. In particular, the AWMA road follows the contours of the west bank. The worksheet has identified eleven risk locations, labeled alphabetically from A to K. For each risk location, the worksheet provides the following information: the length of the risk location (feet), the current shortest setback distance within the risk location, the cost of non-engineering rip-rap measures, if the risk location would be protected by proposed with-project engineered rip-rap features, and if the benefit from the with-project engineered rip-rap features are direct or incidental. The incidental benefits that are identified for the west bank are based on the rerouting the AWMA road into a safer location than the current route for the road. In particular, the rerouting of the road was based on the changes in design plans that accounted for the reconfiguration of the channel which moved the channel closer to the AWMA Road. The safer location for the AWMA Road will reduce the probability that this road will be closed due to breach of the road.

The direct NED benefits are based on reducing the erosion damages to AWMA Road. In particular, the design incorporates the engineered rip rap features in risk locations that have been assessed in engineering studies to be extremely, moderately, or slightly vulnerable to erosion and degradation of the creek channels. The corresponding reduction in damages to the AWMA Road are classified as NED benefits. However, there are instances where there are incidental benefits to FRM in cases where the ecosystem restoration project necessitates relocating AWMA Road further away from the channel alignment, and consequently removing the erosion threat to the road.

SOCWA Risk Location Worksheet. This worksheet provides list of the vulnerable risk locations located on the east bank of Aliso Creek. In particular, 18-, 36- and 4-inch pipelines are located on the east bank. The worksheet has identified seventeen risk locations and the risk locations were labeled alphabetically from A to Q. For each risk locations, the worksheet provides the following information: the length of the risk locations (feet), the current shortest setback distance within the risk locations, the cost of non-engineered rip-rap features if the risk locations are protected by the with-project engineered rip-rap features, and if the benefit from the with-project rip-rap feature is direct or incidental. The incidental benefits that are identified for the east bank are based on reducing the risk of erosion damages and sewage spills due to relocating the channel alignment to a safer location for ecosystem restoration purposes. In particular, the realignment of the channel configuration was based on design plans that will reduce the probability of the risks of erosion or degradation causing breach of the pipeline.

The direct NED benefits are based on reducing erosion damages to pipelines. In particular, the design incorporates the engineered rip rap features in risk locations that have been assessed in engineering studies to be extremely, moderately, or slightly vulnerable to erosion and degradation of the creek channels. The corresponding reduction in damages to the pipelines are classified NED benefits. There are instances where there are incidental benefits to FRM in cases where the ecosystem restoration project necessitates moving the channel alignment away from the pipeline alignment, and consequently removing the pipeline vulnerability threat.

The identification of the risk areas that are listed in AWMA Rd Location (11 risk areas) and SOCWA Location (17 risk areas) worksheets were identified by reviewing the engineering designs plans for the Aliso Creek Restoration project. The engineering designs plans for the proposed alternatives proposes to construct lateral bank protection measures at different risk locations along Aliso Creek to avoid future NED damages and proposes lateral protection measures to offset the adverse erosion impacts due to construction of the new channel for the Aliso Creek Restoration Project. Figure 2 shows the locations of the risk areas identified in the two worksheets. The @risk model evaluates the net change in NED damages/costs at each of the proposed risk areas to determine the overall economic justification at each risk location.

The length of the risk locations were from measurements identified in the engineering design plans. The shortest setback distance listed for the risk location was based on ARC-GIS measurement using LiDAR data from USGS (2011).

Annual Event Probabilities Events Worksheet. This worksheet provides a function for selecting a random storm event probability for the model simulations.

4 Probability Distributions

The probability distributions used in the analysis are described below. See the @Risk software documentation for more information on the distributions and parameters.

- **Erosion Rates Probability Distributions**

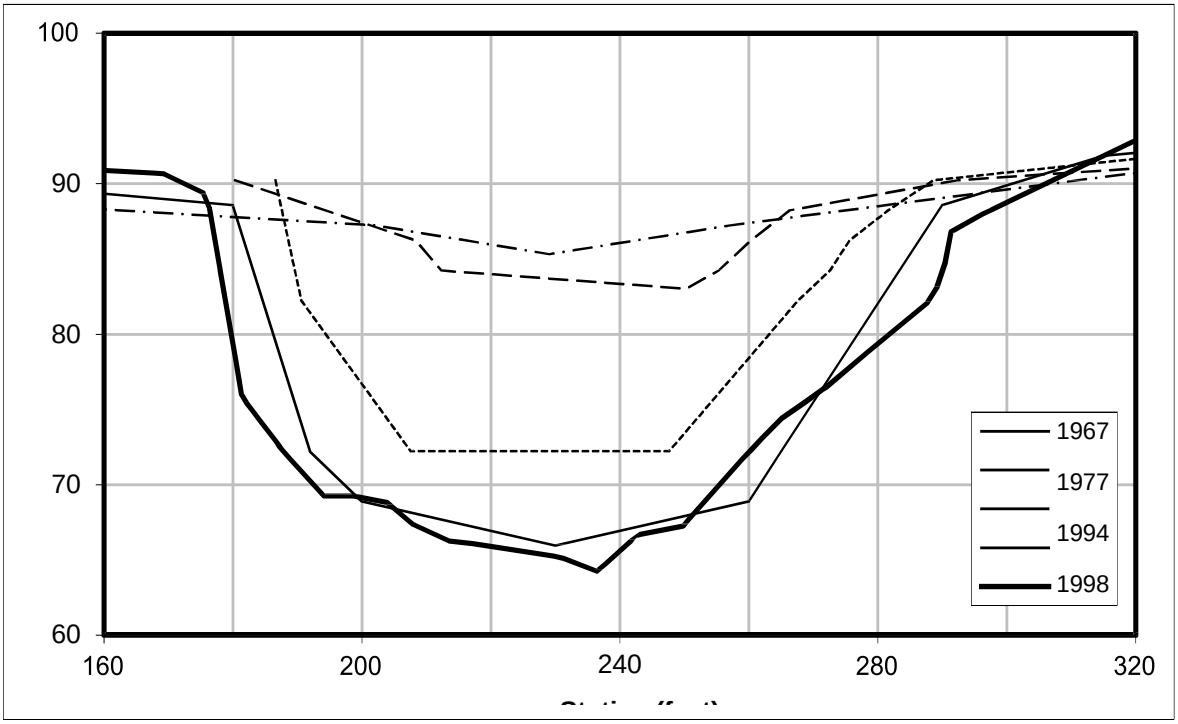
The uncertainty in the long-term yearly erosion rate requires a probability distribution that accounts for the physical factors that affects the amount of erosion that can occur in any given year. The probability distribution for erosion rates that were developed for each risk group and incorporated into the model are discussed in the TSP Draft Hydrology and Hydraulics Appendix for the Aliso Creek Ecosystem Restoration Feasibility Study. According to the discussion in the appendix:

Based on previous work performed by Tetra Tech for the USACE in the Aliso Creek F4 Geomorphic Assessment (January 2014), historical lateral erosion was investigated for the period in which historical topographic information was available. This period covered 1967 through 2006. Lateral erosion seen in the earlier part of the period was, in general, larger than seen in the latter part of the period when hydraulically driven incision was a primary driver. The following figure, shows a representative cross section displaying this trend. It was concluded that as the invert of the channel stabilizes, the rate of lateral erosion has decreased, shifting from hydraulic incision to more geotechnical bank failings due to the steep bank slopes. Therefore, to predict future lateral erosion, the most recent historical rate of erosion (i.e. 1998-2006) would be the most representative and likely somewhat conservative as future potential is considered.

An evaluation of the erosion rates indicates that more significant erosion has occurred on the west bank as compared to the east bank. Based on the hillside constraints on the east bank and the general curvature of the river to the west, difference in erosion rates for each bank are appropriate and the report recommended the erosion rates for use in the economic model.

As part of work performed for South Orange County Wastewater Authority (SOCWA) in the report Lower Aliso Creek Erosion Assessment (Tetra Tech, April 2012), the potential for erosion risk to the proposed pipeline was assessed downstream of AWMA road. The potential was categorized as high (H), medium (M), or low (L) based on the bank energy index (BEI) which considers channel hydraulics and radii of curvature in channel bends. For this Erosion Model, the erosion rates were grouped into risk groups that are labeled into letters A thru F, instead of labeling the areas as High, or Medium, or Low.

Figure 3 Cross Section of Trend of Lateral Erosion



The erosion rates determined in each cross section from the historical topographic information were averaged on each bank for each group riskrisk (A,B,C,D,E,F), to determine average rates of erosion at these previously identified locations. The following process was used to determine the erosion rates for each cross section:

1. 108 cross sections from the 1998 and 2006 topographic mapping were evaluated.

2. These cross sections were compared to determine the extent of erosion that has been experienced at each location in the evaluation period.

3. An average annual erosion distance was developed for each cross section group for the west and east bank. Table 1 provides the average annual erosion rates and the annual minimum/maximum rates over the analyzed time frame for each cross section group.

The estimated erosion rates were plotted to determine the most adequate distribution to be applied to the data. A simple triangular distribution, using the minimum, maximum, and most likely value, does not necessarily reflect the data accurately, as this distribution will push the mean disproportionally higher than what would be expected. Therefore, it was determined that a lognormal distribution is the most appropriate for this data. Lognormal distributions are generally used in situations where values are positively skewed, and most of the values occur near the minimum value.

The following tables show the results of model for the erosion rates according to the mean, 5% percentile and 95% percentile for each risk group.

Table 4 Erosion Rates for East Bank

Annual Erosion Rate	Risk Group	5% Percentile feet/year	Mean feet/year	95% Percentile feet/year
High Annual Erosion Rate	A	0.01	0.25	0.91
Medium Annual Erosion Rate	B	0.01	0.16	0.61
Low Annual Erosion Rate	C	0.01	0.18	0.68

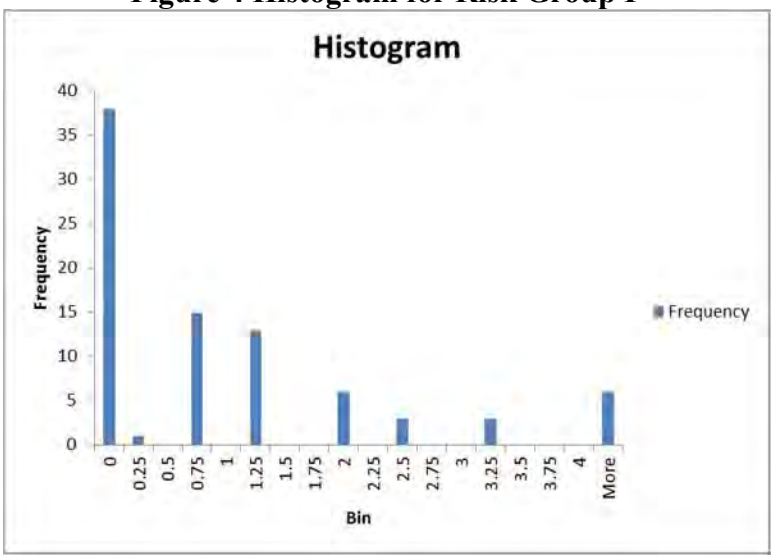
Table 5 Erosion Rates for West Bank

Annual Erosion Rate	Risk Group	5% Percentile feet/year	Mean feet/year	95% Percentile feet/year
High Annual Erosion Rate	D	0.23	2.66	8.93
Medium Annual Erosion Rate	E	0.14	1.63	5.48
Low Annual Erosion Rate	F	0.09	1.09	3.70

4. The estimated erosion rates were plotted to determine the most adequate distribution to be applied to the data. A simple triangular distribution, using the minimum, maximum, and most likely value, does not necessarily reflect the data accurately, as this distribution will push the mean disproportionally higher than what would be expected. Therefore, it was determined that a lognormal distribution is the most appropriate for this data. Lognormal distributions are generally used in situations where values are positively skewed, and most of the values occur near the minimum value. For example, Figure 4

illustrates the data for the cross sections in risk group F and how the data tends to reflect these lognormal parameters.

Figure 4 Histogram for Risk Group F



In order to develop the lognormal distributions, several pieces of information are required. These items are the location, mean, and standard deviation of the data. The following tables 6 and 7 provide the necessary data inputs for each cross sectional group. A sample distribution graph calculated from the input parameters for risk group F is shown in Figure 5.

As stated previously, to predict future lateral erosion the most recent historical rate of erosion (i.e. 1998 – 2006) would be the most representative and likely somewhat conservative as future potential is considered.

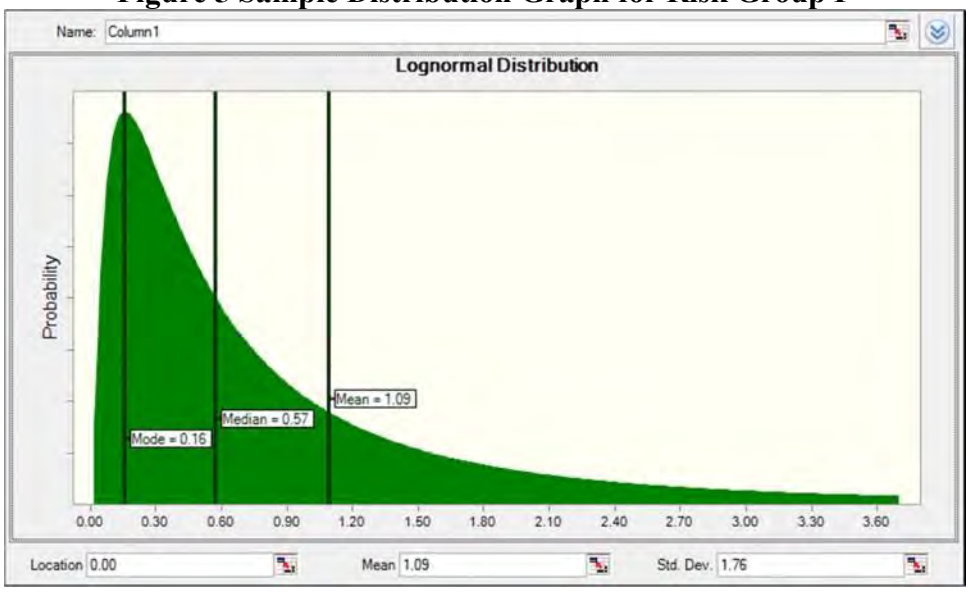
Table 6 Erosion Rates for East Bank

Risk Group	Mean (ft)	Standard Deviation (ft)
A	0.25	0.53
B	0.16	0.43
C	0.18	0.49

Table 7 Erosion Rates for West Bank

Risk Group	Mean (ft)	Standard Deviation (ft)
D	2.66	4.16
E	1.63	2.56
F	1.09	1.76

Figure 5 Sample Distribution Graph for Risk Group F



- **Setback Probability Distribution**

In order to predict the timing of the construction of non-engineered rip-rap measure for without project conditions, the model needs to include a trigger that corresponds with the assumed initiation of construction of the rip-rap feature.

Generally, a setback trigger should be based on historical setbacks distances when actions have been taken. However, in this case local agencies do not have proper record keeping of historical setback distances when protective measures for any of the risk areas in the study area have been implemented. Therefore, the development of probability distributions of setback triggers was based on the range of current setback distances and the mean erosion rates for the three levels of risk.

The following is the probability distribution function for ***east bank*** setback trigger:

- **@RiskTriang (1,4,8)**

The minimum value of 1 ft was selected since the smallest setback distance among the 17 risk locations are Section A (2.2 ft) and Section D (2.4 ft). Each are slightly above 2 feet. Hence, these two sections have no current rip-rap protection and it is reasonable to assume the setback trigger should be less than 2 feet. Therefore, the selection of one foot for the minimum setback trigger accounts for the existing section A and B setback distances.

The maximum distance for the setback trigger of 8 feet is based on comparing the amount of erosion that could occur for a low probability storm event with the number of years that local agencies would determine the pipelines would be safe without protective measures. Since the mean erosion rate is .16 ft/yr, (risk group B) the mean erosion rate would not impact the

pipelines for almost fifty years if the setback distance is 8 feet. The highest mean erosion rate of .25 ft/yr (Risk Group A) would not reach the pipelines within thirty years if the setback distance is 8 feet. In addition, according to the comparison of statistical data in Table 6, the 95% percentile for Risk Group A is only 0.91 ft/yr. Hence, the probability of selecting an erosion rate larger than 1 foot is quite rare based on data in Table 6. Therefore, it is reasonable to assume the pipeline agency would assume that the pipeline is not threatened based upon mean erosion rates if the setback distance is 8 feet.

The most likely setback distance that triggers construction of protective rip-rap features was determined to be 4 feet for east bank. The selection of 4 feet was selected as the approximate midpoint between the minimum and maximum setback distance for local agency take action.

The following is the probability distribution function for ***west bank*** setback trigger:

- **@RiskTriang (1,11.5,23)**

The minimal value of 1 was selected since the smallest setback distance among the 11 risk section is Section A (3 ft). Hence, Section A has no current rip-rap measure, it will be conservative estimate to assume the setback trigger should be less than 3 feet. Therefore, the selection of one foot for the minimal setback trigger accounts for section A minimal setback distance.

The maximum distance of 23 feet is based on comparing the amount of erosion that could occur within number of years that local agencies would determine the pipelines would be safe without the rip-rap measure. Since the mean erosion rates for west bank are more aggressive than east, the park will need to action with a larger setback distance than east bank. Since the lowest mean erosion rate along the west bank is 1.09 ft/yr (Risk Group F) would not impact the pipelines for almost twenty years if the setback distance is 23 feet. In addition, according to the comparison of statistical data in Table 6, the 95% percentile for risk group with the highest erosion rate (west bank) (Risk Group D) is only showing 8.93 ft/yr. Hence, the probability of selecting an erosion rate larger than 9 feet is quite rare based on data in Table 6. Also, only two risk sections among eleven risk sections on west bank are over 23 feet, therefore, it will be unlikely the responsible agency would have larger maximum setback distance to trigger the construction of rip-rap measure if majority of risk locations have setback distance less than the maximum setback distance.

The most likely setback distance that initiates the rip-rap measure was determined to be 11.5 feet for west bank trigger. The selection of 11.5 feet was based on assumption the 11.5 feet was midpoint between the minimal and maximum setback distance for the local agency take action.

Table 8
Statistical Comparison of Erosion Rates

Risk Group	Mean Value	5% Percentile	95% Percentile
Risk Group A	0.25	0.01	0.91
Risk Group B	0.16	0.01	0.61
Risk Group C	0.18	0.01	0.68
Risk Group D	2.66	0.23	8.93
Risk Group E	1.63	0.14	5.48
Risk Group F	1.09	0.09	3.70

- **Uncertainty for Environmental Mitigation Costs for Initial Placement of Rip-Rap**

The following is the probability distribution function for Environmental Mitigation Costs for Initial Placement of Rip-Rap Measure:

@RiskTriang ($75,000, $87,500, $100,000)

As mentioned previously in this appendix, the model included a probability distribution to account for the range of possible costs for processing federal and state documents that account for the impacts of the rip-rap measures. The probability distribution is triangular with a minimum value $75,000, most likely value $87,500 and maximum value $100,000. As mentioned in the section titled "Model Structure", the mitigation costs for initial placement of rip-rap that was discussed for this probability distribution was applied exclusively to the without project conditions.

- **Uncertainty for Environmental Mitigation Costs for Replacment of Rip-Rap**

The following is the probability distribution function for Environmental Mitigation Costs for Replacement Rip-Rap Measure:

@RiskTriang ($50,000, $67,500, $75,000)

As mentioned previously in this appendix, the model included a probability distribution to account for the range of possible costs for processing federal and state documents that account for the impacts of replacing rip-rap measures. The probability distribution is triangular with minimal value $50,000, most likely value $67,500 and maximum value $75,000. As mentioned in the section titled "Model Structure", the mitigation costs for replacement of rip-rap that was

discussed for this probability distribution was applied exclusively to the without project conditions.

- **Uncertainty for Least Bell Vireo Mitigation Costs for Non-engineered Rip-Rap**

The following is the probability distribution function for the Mitigation Costs for impacts to Least Bell Vireo due to construction of non-engineered rip-rap measure.

@Risk Triang ($1,730,700, $1,923,000, $2,115,300)

According to the discussion in the *Initial Costs Worksheets,* the initial armoring costs include the cost of environmental mitigation for the impacts for habitat loss for the federal endangered species (least Bell Vireo) and associated analysis and reporting due to implementation of future actions of armoring the risk locations. The environmental mitigation cost for the least Bell Vireo was estimated at $1,923,000 per risk location based on an engineering document for the SOCWA pipeline. (*Buried Utility protection along Aliso Creek Phase 1*, June 2014, Tetra Tech)

- **Uncertainty for Pipeline Repair Costs for 18-inch effluent, 36-inch effluent, and two 4-inch sludge Pipelines or only 18-inch effluent Pipeline**

The following is the probability distribution function for the Repairs for 18-inch Effluent, 36-inch Effluent and two 4-inch Sludge Pipelines

@Risk Triang ($477,761, $530,848, $583,930)

If the Repairs to only 18-inch Effluent Pipeline

@Risk Triang ($371,719, $413,021, $454,323)

The damages to the pipelines (18-inch, 36-inch, and two 4-inch pipelines) are based on repair costs detailed in the document for the Sulphur and Aliso Creek Stabilization Project (SOCWA), dated February 2013, which estimated repairs to cost about $530,845 per risk (triangular distribution with minimum costs of $477,761, most likely estimate of $530,845, and maximum costs of $583,930) location. If the distance between the 18-inch effluent pipeline and other pipelines is more than 10 feet, then estimated repairs for 18-inch effluent pipeline is to cost about $413,021 (triangular distribution with minimum costs of $371,719, most likely estimate $413,021, and maximum costs of $454,323) per risk location.

- **Uncertainty for Lost Recreational Value Due to Closure of Beach**

The following is the probability distribution function for the loss of recreational value due to closure of Aliso Creek Beach resulting from an erosion-induced break in the pipeline.

@Risk Triang ($1,253,491, $1,392,768, $1,532,045)

As mentioned in the description for the *"Initial Cost Worksheet",* historical storm events have caused damages to the pipelines and spillage of sewage into Aliso Creek. The sewage spills from pipelines owned by SOCWA and Moulton Niguel Water District have caused beach closure at Aliso Creek Beach. The sewage spills are due to two effluent conveyance pipelines (36-inch and 18 inch) and two sludge pipelines (4-inch) that are located at different setback distances from the top of bank of Aliso Creek. Figure 2 provides a map showing the location of the pipelines along Aliso Creek. Although not shown on the map, the 18 inch effluent pipeline is located closer to the top of bank than the 36-inch effluent pipeline and two 4-inch sludge pipelines. Also, the map does not show the route of the four pipelines and how routes of the two pipelines vary in the separation between the two sludge pipelines.

The use of the 18-inch sludge pipeline by Moulton Niguel Water District has been limited due to operational requirements for Moulton Niguel Water District. Hence, the breach of 18-inch sludge pipeline has a low chance that the pipeline has sewage and will cause beach closure at Aliso Creek Beach. However, the 36-inch effluent pipeline and 4-inch sludge pipeline are heavily used by SOCWA to transport sewage and sludge; therefore, a breach of this pipeline has a high probability of causing a closure of Aliso Creek Beach.

The modeling for the lost recreation at Aliso Creek Beach is accounted for in cell C42 (*Stimulation Setting* worksheet) which has a probability function (triangular distribution with minimum costs of $1,253,491, most likely estimate of $1,392,768, and maximum costs of $1,532,045) that accounts for the uncertainty in the amount of recreation that is lost due to closure of Aliso Creek Beach. The consequence of closing the beach at Aliso Creek assumed that 14% of the annual beach attendance will be lost due to sewage spill and closing the beach. The total cost of the recreational loss is $1,392,800 which is based on assumption that annual attendance drops by 14%. The assumptions for the loss in recreation value is based on information presented in the document titled *Sulphur and Aliso Creek Stabilization Project* (SOCWA), dated February 2013.

- ## Uncertainty for Repairs AWMA Road

  The following is the probability distribution function for the Repairs for AWMA Road due to erosion and degradation of the channel.

@Risk Triang ($36,000, $40,000, $44,000)

If the simulated setback distance is less than zero occurred for the west bank or AWMA Road Costs worksheet, then damages to AWMA Road would occur with most likely repair costs of $40,000 would be incurred by the owners of the road. According to an estimate of repair costs for AWMA Road from Los Angeles District Engineering Division, the most likely costs is $40,000 (triangular distribution with minimum $36,000, most likely estimate $40,000, and maximum costs of $44,000) per risk location.

Addendum

Model User's Guide

This Addendum describes the basic steps to run the Aliso Creek Erosion Damages Economic Model. The economic analysis is performed in a probabilistic economic model built with Microsoft Excel as a platform and using the @Risk software. @Risk is a risk analysis Microsoft Excel add-in developed by Palisade Corporation.

Before You Begin

Load @Risk Software: Aliso Creek Erosion Damages Economic Model was built on the Microsoft Excel platform but uses @Risk to perform the model simulation calculations. All model outputs are also produced using @Risk.

Opening the Model: @Risk needs to be opened before opening the model. To open the @Risk tool: Go to Start>Programs> Palisades Decision Tool >@Risk for Excel. Once the @Risk tool is open, the user can open the model from Excel.

Model Components

The Aliso Creek Erosion Damages Economic Model spreadsheet has 17 separate tabs or worksheets, including worksheets that contain information used as databases within the model, and worksheets that perform calculations. The worksheets are set up in a user friendly and logical sequence. See Appendix A for details on each worksheet.

The "Simulation Settings" and "Model Summary" worksheets are the two most important worksheets in the model from a user point of view.

The Simulation Settings worksheet contains all the high-level input parameters and decision variables relevant to the simulation as a whole. The user should make any necessary changes to model parameters in this tab.

The Model Summary worksheet presents the key output from the analysis. The user can refer to the subsequent worksheets for more detailed understanding of the summary calculations in the Model Summary tab.

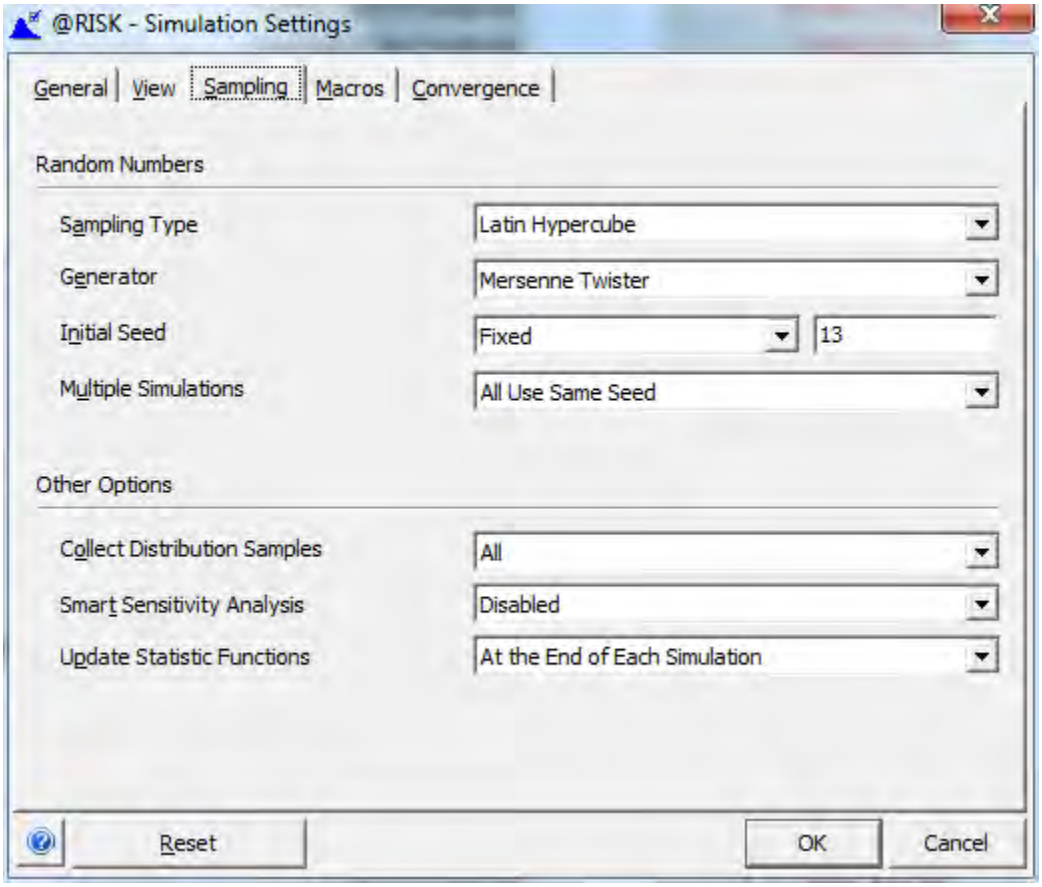
Running the Model

@Risk runs a simulation by sampling values from all of the probability distributions (probability density functions called PDFs) in the model and updating the workbook calculations many times,

with each update called an ”iteration”. For this analysis, @Risk is set to run 100,000 iterations for a simulation.

Running the model requires the user to run an @Risk simulation (100,000 iterations) by going to the @Risk interface/tab in the model. According to Figure 3, the sampling type is Latin Hypercube with an initial seed is 13 and the seed is fixed.

Figure 6 Sampling Type



DRAFT INTEGRATED FEASIBILITY REPORT ENVIRONMENTAL IMPACT STATEMENT / ENVIRONMENTAL IMPACT REPORT (EIS/EIR)

APPENDIX D: REAL ESTATE

ALISO CREEK MAINSTEM
ECOSYSTEM RESTORATION STUDY
Orange County, California

September 2017

US Army Corps of Engineers

Orange County Public Works
Environmental Resources Department

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Aliso Creek Ecosystem Feasibility Study

TSP (Alternative 3.6) Real Estate Plan

Orange County, California

Real Estate Plan

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TABLE OF CONTENTS

EXHIBITS/TABLES

1.0 Statement of Purpose

This appendix is prepared in accordance with Engineering Regulation (ER) 405-1-12, 12-16, Real Estate Plan (REP), and presents the real estate requirements for the Aliso Creek Main stem Ecosystem Restoration Tentatively Selected Plan (TSP) described below. The Orange County Public Works (OCPW), Environmental Resources Department, is the non-Federal sponsor (NFS) for the Study.

This REP is an appendix to the Integrated Feasibility Report. The REP will describe the lands, easements, rights of way, relocations, and disposal areas (LERRD) required for construction, operation, and maintenance of the Proposed Project, including the number of parcels, acreage, estates, ownerships, and estimated value. The REP includes other relevant information on non-Federal sponsor ownership of land, proposed non-standard estates, existing federal projects and ownership, relocations under the Uniform Relocation Assistance and Real Property Acquisition Policies Act (P.L. 91-626, as amended) ("the Uniform Act"), presence of contaminants, facility/utility relocations, a baseline cost estimate, a schedule for real estate activities, and other issues as required by ER 405-1-12.

This REP is written to the same level of detail as the Integrated Feasibility Report it supports. This REP is tentative in nature and is to be used for planning purposes only, both the final real estate acquisition lines and the estimate of value are subject to change even after approval of the report.

1.1 Project Purpose/Objective

The purpose of the Proposed Project as considered in paragraph 1.5.1 of the Draft Integrated Feasibility Report is to increase habitat function and value associated with aquatic and riparian ecosystem resources along approximately five (5) miles of lower Aliso Creek that have been adversely affected by urbanization-induced changes. Ecosystem restoration would be supported by protecting critical wastewater infrastructure from creek erosion and instability. Long term increases in habitat function and value would also provide passive recreational enhancement compatible with the primary purpose of ecosystem restoration. To diminish the adverse effects of manmade alterations affecting the lower Aliso Creek riverine system to support a healthy aquatic and riparian community, and to improve connectivity for wildlife species between the Aliso and Wood Canyons Wilderness Park and the broader South Coast Wilderness area, as well as with the Cleveland National Forest.

Planning for Federal water resources projects constructed by the Corps is based on the *Economic and Environmental Principles and Guidelines for Water and Land Related Resources Implementation Studies* adopted by the Water Resources Council (U.S. Water Resources Council 1983). This guidance states the primary purpose of Federal objective of water and related land resources project planning is to contribute to national economic development (NED) consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. The Corps' objective in ecosystem restoration planning is to contribute to National Ecosystem Restoration (NER). Contributions to NER outputs are increases in the net quantity and/or quality of desired ecosystem resources. Contributions to national economic development (NED), typically apply to projects such as flood risk management or streambank erosion protection that result in increases in the net value of the national output of goods and services expressed in monetary

units. Regional Economic Development benefits (RED) and Other Social Effects (OSE) were also be assessed as part of plan selection.

USACE national planning objectives are general statements and not specific enough for direct use in plan formulation. Specific Plan formulation objectives resulted in the following study objectives for the five-mile reach of the Aliso Creek extending from Pacific Park Drive to the SOCWA CTP Bridge, including the confluence areas of Wood Canyon Creek and Sulphur Creek:

- Improve the degraded aquatic and riparian habitat ecosystem function and structure, increase plant and animal biodiversity for the Aliso Creek main stem and tributary confluences within the Aliso and Wood Canyons Wilderness Park. Promote in-stream connectivity (longitudinal, lateral, and vertical) to facilitate the reproductive viability of aquatic species.
- Improve the hydrologic and hydraulic regime to increase floodplain function and channel stability for the Aliso Creek system within the Aliso and Woods Canyon Wilderness Park throughout the period of analysis.
- Enhance the passive recreational experience that is compatible with the Proposed Project within the Aliso and Wood Canyons Wilderness Park throughout the period of analysis.

1. 2 Study Authority

Corps engagement began by resolution of the Committee on Public Works, House of Representatives, adopted May 8, 1964, for the Santa Ana River Basin and Area Streams, Orange County, California:

*"*Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports on (a) San Gabriel River and Tributaries, published as House Document No. 838, 76th Congress, 3d Session; (b) Santa Ana River and Tributaries, published as House Document No. 135, 81st Congress, 1st Session; and (c) the project authorized by the Flood Control Act of 1936 for the protection of the metropolitan area in Orange County, with a view to determining the advisability of modification of the authorized projects in the interest of flood control and related purposes."

Additionally, the Water Resources Development Act (WRDA) of 2007 includes the following authority under Section 4015, Aliso Creek, California:

*"*The Secretary shall conduct a study to determine the feasibility of carrying out a project for streambank protection and environmental restoration along Aliso Creek, California*".*

1.3 Study Area

The study area is generally the Aliso Creek watershed located in southern Orange County, California and covering an area of approximately 35 square miles (Exhibit A-1). Aliso Creek flows nearly 19.5 miles from headwaters at approximately 2,400 feet above sea level in the Santa Ana Mountains within the Cleveland National Forest, through a somewhat level valley in

the middle reaches, and finally through a narrow and more steep coastal canyon along the downstream-most reaches to its outlet at the Pacific Ocean at Aliso Beach in south Laguna Beach, California. The Aliso Creek outlet is approximately 50 miles south of Los Angeles and approximately 65 miles north of San Diego. The creek is joined by six major tributaries; four in the middle watershed (Munger Creek, English Canyon, Diary Fork, and Aliso Hills Channel), and two in the lower watershed (Sulphur Creek and Wood Canyon Creek).
Within the lower portion of the Aliso Creek watershed is the 4,200-acre Aliso and Wood Canyons Wilderness Park, a significant largely undeveloped natural resource in southern California. The Aliso and Wood Canyons Wilderness Park is a coastal canyon ecosystem with significant biodiverse value, provides several important wildlife corridors that link wildlife habitat within protected open space in the region.
The Aliso and Wood Canyons Wilderness Park is part of the broader 20,000-acre South Coast Wilderness area within the coastal San Joaquin Hills, which includes, contiguously the Aliso Creek watershed, the Laguna Coast Wilderness Park, Irvine Open Space Preserve, and Crystal Cove State Park.
Lower Aliso Creek watershed links two regionally significant ecosystems: the terrestrial greenbelt formed by the natural habitat of the South Coast Wilderness area, and the blue belt of the coastal and offshore Laguna Beach State Marine Reserve/Conservation Area, recently established by the Marine Life Protection Act. The Aliso Creek Regional Riding and Hiking Trail was designated a National Recreation Trail by the Secretary of the Interior in 2012. The 15-mile trail, popular for hiking, cycling, walking, running, equestrian, and birdwatching, links the Santa Ana Mountains to the Aliso and Wood Canyons Wilderness Park.

Presently, about 75 percent of the Aliso Creek watershed has been developed; the most intensive development has occurred in the broad middle section comprised of the cities of Lake Forest, Aliso Viejo, Mission Viejo, Laguna Niguel, Laguna Hills, and Laguna Woods. Development has consisted of medium to high density residential areas interspersed with commercial and industrial developments. Of the undeveloped 25 percent of the watershed, the Cleveland National Forest in the extreme upper portion and the Aliso and Wood Canyons Wilderness Park (Wilderness Park) in the lower portion are protected public lands. Urbanization has had a significant impact on the natural drainage system of the watershed. The highly developed middle areas of the watershed, the tributaries and main stem of Aliso Creek have been subject to confinement by urban development and by physical alterations. Alterations include various channel straightening efforts and inclusion of flood flow management features, such as drop structures, retention basins and channel bank and streambed armoring. Of the six major tributaries joining Aliso Creek two are located in the lower watershed Sulphur Creek and Wood Canyon Creek; only Wood Canyon Creek has avoided major alterations. Existing alterations are due to creek and trail crossings associated with the Wilderness Park trail system; erosion protection modifications at the headwaters and sub tributaries in response to urban drainage from residential housing development along the northern and eastern ridge rims of the sub watershed. Human activities have caused degradation of riverine (aquatic and riparian) habitat quality as a result of changes to hydrology, floodplain function loss, channel modifications, loss in contributing sediment sources, channel instability, and introduction and spreading of non-native plant species Riparian ecosystems are dependent on perennial, ephemeral, or intermittent surface or near-surface water. Many species of wildlife rely on riverine ecosystems during their life cycles. Within the Wilderness Park, the quality of aquatic, riparian and floodplain habitat biodiversity has been adversely affected by channel incision and instability, loss of hydrologic floodplain connection, competition with invasive vegetation species, and habitat type conversion. Riverine corridors function as linkages for wildlife movement between habitat areas. Vegetation and habitat connectivity maintain and support migratory

animals, provide corridors for gene flow, allow wildlife and plant dispersal to new areas, and provide movement corridors at both the local and regional level.

Within the Aliso Creek watershed habitat,species numbers and diversity have declined due to the loss of connectivity between habitats. Aquatic linkages, especially, have been impaired by manmade channel modifications; such linkages are critical for supporting multiple populations of species to assure continual exchange of genes within populations, which in turn help to sustain genetic diversity. Within the Wilderness Park, linkages for aquatic species along a 5-mile stretch of Aliso Creek, including its connection to its major tributary (Wood Canyon Creek), are severely fragmented by manmade changes. Despite the watershed fragmentation, terrestrial wildlife corridors are still intact between the Wilderness Park and the other portions of the South Coast Wilderness Area to the west. The 19.5 miles of Aliso Creek still serves as a northerly wildlife corridor to the Cleveland National Forest, despite some short stretches where some modified channel sections and narrow channel easements exist. Migratory birds that may rely on riparian habitat, face population declines due to losses of this type of habitat. Biological diversity in Aliso Creek has also been impacted by the introduction of non-native species. Exotic predators, such as bullfrogs, have decimated populations of native fish and aquatic wildlife.

Regional wastewater infrastructure is susceptible to erosion-driven damage from Aliso Creek. Channel degradation. Large flow events have caused infrastructure damage in recent years exceeding $5 million in the lower watershed. Threatened wastewater infrastructure vulnerable to bank erosion poses a significant threat to human health and a measurable impact to the environment, valued beach recreation, and the local economy from potential major sewer line failure. Due to the instabilities in the creek, the South Orange County Wastewater Authority (SOCWA), a public utility, must routinely perform temporary emergency protective actions to their facilities. Ecosystem restoration project alternatives would not be sustainable without a solution to the infrastructure threat within the Proposed Project area. Failure of wastewater infrastructure would cause undesired impacts to any restoration effort.

The purpose of the Proposed Project is to increase habitat function and value associated with aquatic and riparian ecosystem resources on approximately five (5) miles of the lower Aliso Creek watershed (See Exhibit A1; Reaches 4A to Reach 12) that have been adversely affected by urbanization-induced changes. Ecosystem restoration will also be supported by protecting critical wastewater infrastructure from creek erosion and instability. Long term increases in habitat function and value will provide passive recreational enhancement compatible with the purpose of ecosystem restoration. The need exists to diminish the adverse effects of manmade alterations affecting the lower Aliso Creek riverine system to support a healthy aquatic and riparian community, and to improve connectivity for wildlife species between the Aliso and Wood Canyons Wilderness Park and the broader South Coast Wilderness area, as well as with the Cleveland National Forest. Proposed Plan Alternative will protect critical wastewater infrastructure from streambank erosion and stream instability that would otherwise compromise ecosystem restoration benefits.

1.2 **Tentatively Selected Plan (TSP)**

TSP Alternative 3.6 would raise the streambed elevation of Aliso Creek to historic levels (circa 1967) between the SOCWA Coastal Treatment Plant (CTP) Bridge and the Aliso Water Management Agency (AWMA) Road Bridge and provide channel improvements between

AWMA Road and Pacific Park Drive (see Exhibit A1 Overview Map). Under this alternative, a multi-terrace, trapezoidal channel geometry will be used in conjunction with in-stream riffle structures to provide a geomorphically stable channel for Reaches 4A through 9. The raised terrace channel design will contain the 10% Annual Chance Event (ACE) (10-year) flood and elevate the groundwater table to benefit riparian habitat. This alternative includes hydraulic reconnection with the Wood Canyon tributary. The existing AWMA Road culvert crossing will be replaced with a bridge and the confluence of Wood Canyon and Aliso Creeks will be graded to provide a stable transition. The adjacent Wood Canyon trail will be re-routed several hundred feet to the south where it will connect to AWMA Road outside the existing riparian corridor. The previous trail alignment will be allowed to develop into additional riparian habitat.

To protect existing and expanded habitat in Aliso Canyon, screens will be placed on the upstream side of the culvert at Alicia Parkway to prevent the entry of exotic aquatic wildlife from upstream Sulphur Creek and reservoir. Longitudinal connectivity of Aliso Creek upstream from the SOCWA CTP to Pacific Park drive will be improved by the removal of the ACWHEP structure and two 10-foot drop structures immediately upstream and downstream of Aliso Creek Road. The engineered channel upstream of Alicia Parkway will be raised slightly, widened at Aliso Creek Road, and incorporate riffle grade control structures to promote channel stability. The recontouring of the channel in these upper reaches will improve flow dynamics to improve habitat function and provide protection against erosion. TSP 3.6 includes reconnection of the abandoned oxbow to add channel length and sinuosity in lower Aliso Creek. The total 5.0 mile restoration footprint stretches from the SOCWA STP to Pacific Park Drive. The lower 3.6 miles of the Proposed Project area (i.e. downstream of AWMA Road Bridge) lies within a narrow coastal canyon that varies in width between approximately 400 and 1,400 feet; the upper 1.4 miles lies within the existing channel width where the channel has been modified for flood control purposes, but extends out to about a width of 200 feet wide where prior improvements have not occurred. The Proposed Project area includes approximately 700 feet of Wood Canyon Creek, and also 600 feet of Sulphur Creek to Alicia Parkway, from their respective confluence with Aliso Creek. The trailhead area of the Wood Canyon Creek trail is also within the Proposed Project area. The Proposed Project area will also include adjacent areas to the riverine corridor for temporary staging areas, access routes and entry points to the site during construction, and permanent road access for operations and maintenance."

The recreation plan formulated for Alternative 3.6 includes the construction of five interpretive kiosks within the Proposed Project at key locations. The kiosks will be located along points of recreational access for the public which includes the Aliso Creek Bikeway and AWMA Road, both paralleling the west side of Aliso Creek within the Wilderness Park.

The majority of the land required for the project footprint is owned by the non-Federal Sponsor, County of Orange, California, and is managed by Orange County Public Works Department (OCPWD). Additional lands will be required from public and private entities as indicated in Table 1 - Summary of Land Ownership. Road easements will be required in order to provide access to SOCWA CTP from the east side of Aliso Creek; and to AWMA road on the west side of the creek. Permanent access for operations, maintenance, repair, rehabilitation, and replacement (OMRRR) of the project footprint between Reach 4A and 9 will be provided on the west side by AWMA Road and the east side by a new access road. The east road will follow the alignment of the existing unpaved road. In addition to OMRRR, the non-Federal sponsor intends to utilize the east access road for use by SOCWA. For the east road, paving of the existing dirt access road between Reaches 4A to 9 will be provided to protect the usability and integrity of the road pursuant to any overbank flood events that could potentially affect various segments associated with the restoration project. Depths of overflow would in general be

remain fairly shallow as sheet flow, with flows returning to the channel as streamflow elevations subside, likely within minutes to an hour. No flooding impacts would occur to the Coastal Treatment Plant facility. The AWMA Road (west side) would be solely dedicated for use by OC Parks (OMRRR and Ranger operations) and the park recreational users (pedestrian and cyclists). For Reaches 10 through the lower portion of Reach 13, OMRRR activities will be carried out utilizing the existing paved Aliso Creek Bikeway and the unpaved Aliso Creek Trail to the west and east side, respectively, of Aliso Creek. The CTP pipeline will be left in place and protected by buried rip rap placement adjacent to the pipeline. Orange County owns over 97 percent of the lands required to build the proposed project and will receive LERRD Credit for the fair market value of all lands provided for project use. Land value is estimated to be approximately 17% of the total project cost.

2.0 Real Estate Requirements – Description of Lands, Easements and Rights-of-Way Required for the Project

The most significant land interests required will be Fee lands and Permanent Road Easements, other land interests will be Temporary Road Easements and Temporary Work Area Easements. The lands, easements, and rights of way (LER) required for the TSP Alternative 3.6 are described in this report under each respective legal estates required. Table 1; Summary of Land Ownership; lists the proposed land tracts that will required for project construction. Table 1 indicates the map exhibit page number (see Exhibits B-K), ownership name, assessor's parcel number (APN), type of estate required and number of acres to be provided for each estate. Detailed description of the proposed construction details and schedule is available in the IFR. All of the LER required to build the proposed project is indicated in the Summary of Land Ownership (Table 1) and is shown on Exhibit Maps B-K. Permanent and temporary roads, construction staging areas, habitat areas, disposal sites and recreational features such as kiosks are incorporated within the lands required to build the TSP 3.6 footprint. No additional lands are required for recreational features.

2.1 Fee Estate Description

Construction of TSP Alternative 3.6 will require the NFS to provide approximately 174.16 acres of land to be used for ecosystem restoration to be used for construction of channel enhancements, streambank protection features and disposal of excess material. Disposal of material removed from the channel improvement is discussed in Section 2.4 (Disposal Sites). The NFS owns over 97 percent of the land required for Alternative 3.6. and will provide approximately 172.01 fee acres of land the project. In addition, the NFS will be responsible for acquiring 2.15 acres of additional fee land for the project from five (5) private and public land ownerships including the Aliso Viejo Community Association, Aliso Viejo Company, City of Aliso Viejo, Aliso Water Management Agency, and Laguna Nigel Community Services Department. (See Table 1 Breakdown of Land Ownership)

Fee Estate

The fee simple title to (the land described in Schedule A) (Tracts Nos. _____, _____ and _____), Subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

2.2 Permanent Road Easement Description

Approximately 21.37 acres of Permanent Road Easement will be required to build Alternative 3.6. Acquisition of Permanent Road Easement (Standard Estate #11) will be required on both sides of Aliso Creek to allow access for project OMRRR activities from Reach 4A to the project termination in Reach 13. For Reaches 4A to 9, Proposed Project operation will utilize AWMA Road (west side of creek) for OC Parks, Ranger and recreational visitor use. The AWMA road will be an exclusive Permanent road easement to the project; and used for OMRRR and recreational uses. On the east side, the existing SOCWA dirt access road will be paved; and utilized by OC Parks and by SOCWA. For Reaches 10 through 12, OMRRR activities will be carried out utilizing the existing paved Aliso Creek Bikeway and the unpaved Aliso Creek Trail to the west and east side, respectively, of Aliso Creek. The NFS currently owns 20.26 acres of land required for proposed road easements and will be required to provide 1.11 acres of permanent road easement to be acquired from public and private entities; including the Aliso Water Management Agency (Tract # 1), Aliso Viejo Community Association (Tracts # 9 and 23), Church of LDS (Tract # 16), Laguna Nigel Community Services Department (Tract # 19); see Exhibits B-K. The NFS will be entitled to receive fair market value LERRD credit for land they provide for permanent road easements.

2.3 Temporary Road Easement Description

Approximately 2.08 acres are required for temporary 4 year road easements proposed for Alternative 3.6. The NFS owns 0.4 acres of the required lands and will be required to acquire approximately 2.08 acres from two (2) private landowners (Tract # 9 and 11 Aliso Viejo Community Association and Tract # 12 Aliso Viejo Company see Exhibits G & H). The road will provide temporary construction access during the AWMA road (east access road to the AWMA/SOCWA facility) improvements; and will also provide construction access to the Aliso Creek main stem construction on the west side of Aliso Creek between approximate Stations 204+00 and 252+00; shown on tract numbers 9; 11; 12 and 14; and on Exhibits G and H. The temporary access road will be replaced by AWMA Road after construction is complete. The NFS will be entitled to receive fair market value LERRD credit for land provided for temporary road easement.

Road Easement Estate

A (perpetual [exclusive] (non-exclusive]and assignable) (temporary) easement and right-of-way in, on, over and across (the land described in schedule A) Tracts Nos _____, _____ and _____) for the location, construction, operation, maintenance, alteration replacement of (a) road(s) and appurtenances thereto: together with the right to maintain, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving. however, to the owners. their heirs and assigns)the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B); subject however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

2.4 Temporary Work Area Easements Description

Temporary work area easements totaling 28.08 acres are required for staging and habitat reservation areas. Eight staging areas which contain approximately 19.08 acres and 2 temporary habitat reservation areas containing approximately 9.0 acres are proposed for

Alternative 3.6. The staging areas are indicated in red crosshatch on map Exhibits B through K; the temporary habitat reservations are indicated in blue crosshatch on the Exhibit G and H. The temporary work areas will be used to store equipment and materials; and to maintain equipment during the construction phases. Approximately 9.0 acres of the total temporary work area easements will be used for habitat reservation during the construction process. The habitat reservations will temporarily relocate native plant species and wildlife that would otherwise be displaced from the construction site. The NFS owns approximately 27.80 acres of land required for Temporary Work Area Easements and will be responsible for obtaining 0.28 acres of private land from one land owner; Tract # 1 Aliso Water Management Agency; see Exhibit B. The sponsor will be entitled to receive fair market value LER credit for the temporary work area lands provided for the project.

Temporary Work Area Easement Estate

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____) for a period not to exceed _____, beginning with date possession of the land is granted to the United States for use by the United States, its representatives, agents. and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move. store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the _____Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation. Structures or obstacles within the limits of the right-of-way: reserving, however, to the landowners their heirs and assigns all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired: subject, however, to existing easements for public roads and highways, public utilities railroads and pipelines.

2.5 Disposal Sites

Two disposal sites totaling 24.12 acres of fee land are proposed (cross hatched in green and indicated on Exhibit D as DS1 and Exhibit F as D2) as material disposal area sites. Alternative 3.6 will require excavation and removal of approximately 300,000 cubic yards of material from the TSP 3.6 Proposed Project footprint. The disposal sites are situated adjacent to the proposed construction areas and will support the economic disposal of large quantities of excess material; in lieu of trucking the material. The Project Delivery Team requested fee lands to use for disposal of excess materials. Both of the proposed disposal sites are currently owned by the NFS. There are no proposed borrow sites on project alternative TSP 3.6.

2.6 Ingress/Egress – Staging areas and Construction Access

For construction access downstream of the AWMA Road Bridge, the points of project entrance and exit would be located at either the east trail parking lot off Alicia Parkway just south of Sulphur Creek, which leads to the existing dirt access road, or the main entrance of the Wilderness Park at the AWMA Road Bridge, which leads to the paved AWMA Road along the west bank of Aliso Creek; see Ingress / Egress on Exhibit A1. Potential staging open space areas are located parallel to the east bank; see Red Cross hatched staging areas on Exhibits B –K. The potential staging areas were selected on the basis of factors such as presence of a relatively flat and uniform ground slope (~2 percent), and avoidance of sensitive vegetation

habitat or potential archeological sites. For construction of the Phase 0 area upstream of the AWMA Road Bridge, the points of project entrance and exit would be located at the maintenance access at the bridge, which leads to a dirt access road along the east bank of Aliso Creek; see Exhibit A1 AWMA Road Bridge. Other potential staging areas include flat open spaces on the east bank upstream of the skate park. It is anticipated that transfers of excavated material between the Phase 0 reaches to downstream areas (including the two disposal areas) will be needed. Because of the limited height underneath Aliso Creek Road Bridge, vehicles hauling the material may be required to drive on Alicia Parkway, for a short distance, which would require frequent traffic control. Access points have been identified on the Project Phases Map Exhibit A1) If additional ingress/egress is required after final design is approved; the required lands will be provided by the NFS to the project; as Permanent or Temporary Road Easement (Standard Estate #11) or Temporary Work Area Easement (Standard Estate #15).

TABLE 1- Summary of Land Ownership (as indicated in Exhibits B to K)

Exhibit Map (EX); Map Section (S) Map Tract # (TR) and Ownership Name	**Assessor's Parcel Number (APN)**	**Estate Interest to be provided/ acquired; and Standard Estate Number**	**Acres to be provided; and type of estate**
EX B; S 3; **TR #1** Aliso Water Management Agency (AWMA)	120-191-79	Fee Estate (F) (standard estate #1); Permanent Road Easement (PRE) #11, Temporary Work Area Easement (TWAE) #15	1.08 acres, F 0.22 acres, PRE 0.28 acres, TWAE (Staging Area A)
EX B & C; S 3 & 4; **TR # 2,** County of Orange	120-191-80	Fee Estate (F) (standard estate #1); Permanent Road Easement (PRE) #11; Temporary Work Area Easement (TWAE), #15	17.72 acres, F 3.17 acres, PRE 1.13 acres, TWAE (Staging Area A)
EX C, D & E S , 4; 5 & 6 **TR #3,** County of Orange	655-051-04	FEE Estate (F) #1; Permanent Road Easement (PRE) #11; Temporary Work Area Easement (TWAE), #15	37.75 acres, F 6.05 acres, PRE 1.57 acres, TWAE (Staging Area B)
EX D; S 5**; TR #4,** County of Orange	655-051-05 (TR # 4)	Fee Estate (F) #1 Permanent Road Easement (PRE) #11	13.08 Acres F - (Disposal Area 1) 0.17 acres, PRE
EX E; S 5; **TR #4A,** County of Orange	655-051-03 (TR # 4A)	Fee Estate (F) #1 Permanent Road Easement (PRE) #11	0.61 acres, F 0.17 acres, PRE

EX E, F & G S 6, 7 & 8; **TR #5,** County of Orange	639-021-05 (TR # 5)	Fee Estate (F) #1 Permanent Road Easement (PRE) # 11 Temporary Work Area Easement (TWAE), #15	10.50 acres, F 11.04 acres F; (Disposal area 2) 2.37 acres, PRE 0.61areas, TWAE (Staging Area C (part of)
EX E & F S 6 & 7; **TR #6,** R. Harmelink	639-011-07 (TR # 6)	Place holder only no lands required. Staging Area C - moved off of this private ownership and onto TR# 5 and TR # 7	
EX F & G; S 7 & 8; **TR #7**, County of Orange	639-011-20	Fee Estate (F) standard estate # 1 Permanent Road Easement (PRE) #11; Temporary Work Area Easement (TWAE), #15	12.94 acres, F 1.84 acres, PRE 10.32 areas, TWAE Plus (Staging Area C 4.15 AC; & Staging Area D 2.23 AC part of Habitat 1)
EX G; S 8**;** **TR #8**, County of Orange	639-011-22	Permanent Road Easement (PRE) #11	0.20 acres, PRE
EX G & H; S 8 &9; **TR #9,** Aliso Viejo Comm. Assoc. (AVCA)	639-161-11	Fee Estate (F) standard estate # 1 Permanent Road Easement (PRE); standard estate #11; Temporary Road Easement (TRE); standard estate #11	0.60 acres, F 0.36 acres, PRE 1.89 acres TRE; (W construction access road)
EX G & H; S 8 & 9; **TR #10,** County of Orange	639-011-18	Fee Estate (F) standard estate # 1 Permanent Road Easement (PRE) #11; Temporary Work Area Easement (TWAE), #15	15.33 acres, F 1.92 acres, PRE 6.53 acres TWAE (Habitat 2, 3.5 ac. & Staging Area E 3.03 ac.)
EX H; S 9; **TR #11,** Aliso Viejo Comm. Assoc. (AVCA)	639-161-09	Fee Estate (F) standard estate # 1 Temporary Road Easement (TRE) standard estate #11	0.15 acres; F 0.13 acres ; TRE Acres; TRE (W construction access road)

EX H; S 9; **TR #12,** Aliso Viejo Company (ACVO) on EX H map)	639-011-17	Fee Estate (F) standard estate # 1; Permanent Road Easement (PRE) #11; Temporary Road Easement (PRE) #11	0.01 acres; F 0.08 acres; PRE 0.06 acres; TRE (W construction access road)
EX H; S 9; **TR #13,** County of Orange	639-011-16	Fee Estate (F) standard estate # 1	0.17 acres; F
EX H & I; S 9&10; **TR #14,** County of Orange	639-011-08	Fee estate (F) ;standard estate 1; Permanent Road Easement (PRE); #11; Temporary Work Area PRE) #15	12.60 acres; F 0.78 acres; PRE 0.09 acres; TRE; (West construction access road) 1.34 acres; TWAE (Part of Staging F)
EX H & I ; S 9 &10; **TR #15,** County of Orange	639-011-25	Fee estate (F) standard estate 1; Permanent Road Easement (PRE) #11	0.59 acres; F 0.11 acres; PRE
EX I; S 10; **TR #16**, LDS Church (LDS)	639-011-09	Permanent Road Easement (PRE) #11	0.32 acres; PRE
EX I; S 10; **TR #17,** County of Orange	634-052-06	Fee estate (F) standard estate 1; Permanent Road Easement; (PRE) standard estate # 11(PRE) #11	0.44 acres; F 0.15 acres; PRE
EX I & J S 10 & 11; **TR #18,** County of Orange	634-052-09	Fee estate (F) standard estate 1; Permanent Road Easement (PRE) standard estate # 11)	8.10 acres; F 0.43 acres; PRE
EX J &K; S 11 &12; **TR #19**, Laguna Nigel Community Services (LNCSD) on Ex. J map	634-031-03	Fee estate (F) standard estate 1 Permanent Road Easement; (PRE) estate # 15 (PRE) #11	0.05 acres; F 0.07 acres; PRE
EX J & K; S 11& 12; **TR #20**;	634-021-09	Fee estate (F) standard estate # 1; Permanent Road Easement	33.09 acres; F 2.94 acres; PRE 3.19 acres; TWAE

County of Orange		(PRE) estate #11; Temporary Work Area Easement (TWAE), estate #15	(Stage Area G)
EX K; S 12; **TR #21**, County of Orange	634-342-03	Fee estate (F) standard estate # 1; Permanent Road Easement (PRE); standard estate # 11 Temporary Work Area PRE) #15	0.02 acres; F 0.13 acres; PRE
EX K; S 12; **TR #22** County of Orange	634-342-06	Fee estate (F) standard estate # 1 Permanent Road Easement (PRE) standard estate #11	0.10 acres; F 0.11acres; PRE
EX K; S12; **TR #23** Aliso Viejo Community Association (AVCA)	634-351-01	Fee estate (F) standard estate # 1; Permanent Road Easement (PRE) #11	0.25 acres; F 0.14 acres; PRE
EX K; S 12; **TR #24**, City of Aliso Viejo (shown on map as AVCity)	634-341-02	Fee estate (F) standard estate #	0.01 acres; F
EX J; S 12; **TR #25** County of Orange	634-341-01	Fee Estate; (F) standard estate # 1; Permanent Road Easement (PRE) #11	0.10 acres; F 0.03 acres; PRE
EX K; S 12; **TR #26**, County of Orange	634-012-09	Fee Estate; (F) standard estate # 1; Permanent Road Easement (PRE) #11	1.42 acres; F 0.03 acres; PRE

Table 2 Summary of Land Provided for TSP 3.6

- Fee estate - 174.16 acres required; 172.01 acres to be provided by the NFS and 2.15 acres to be acquired from private landowners. The NFS owns over 97 percent of the required Fee land. The Aliso Water Management Agency, also known as South Orange County Water Authority (SOCWA), owns the largest single tract of fee land to be acquired (1.08 acres) and is one of the oldest project stakeholders.

- Permanent road easement – 21.37 acres required; 20.26 acres to be provided by the NFS and 1.11 acres to be acquired from private landowners.
- Temporary road easement – 2.08 acres required; .04 to be provided by the NFS and 2.04 to be acquired from private landowners.
- Temporary work area including habitat area – 28.08 acres required; 27.80 acres to be provided by the NFS and 0.28 acres to be acquired from one private landowner.

3.0 Sponsor Owned LERRD

The NFS owns approximately 172.01 acres required for Fee land; 19.94 acres required for Permanent road easement; .04 acres for Temporary road easement and 27.9 acres required for Temporary work area. Approximately 97 percent of the land required to build the Alternative 3.6 is owned by the NFS. The NFS interests appear to be sufficient to convey the required estates (Fee Estate, Permanent Road Easements, Temporary Road Easements and Temporary Work Area Easements) to the Proposed Project. The County will receive LERRD Credit for the fair market value of all lands and easement provided to the project.

4.0 Non – Standard Estates

Nonstandard estates are not required for the proposed project. The NFS will provide the necessary lands to construct the project using Standard Estates. If it is determined that non-standard estates are necessary, a request for approval of the non-standard estate will be submitted for approval through South Pacific Division.

5.0 Existing Federal Project

The Project Delivery Team has determined there are no existing Federal projects that are fully or partially within the LER required for the proposed Alternative 3.6 footprint.

6.0 Federally – Owned Land

There is no federally owned land within the LERRD required for the Proposed Project.

7.0 Navigational Servitude

Exercise of the navigational servitude is not applicable to this Proposed Project and is not being invoked.

8.0 Project Map

See Project Real Estate Maps Exhibits B through K (ten map sheets) for a delineated area of the project study footprint. The project mapping indicates Alternative 3.6 design.

9.0 Potential Flooding Induced by Construction, Operation or Maintenance of Project

The Draft Integrated Feasibility Report indicates that the TSP 3.6 will induce some limited flooding to the west and east access roads that are part of the project, and also to some limited open space that is not part of land interests necessary for the project. The east and west access roads will be utilized for project OMRRR. The non-Federal sponsor also intends to utilize the west road for park ranger operations and for park recreational users (pedestrian and cyclists). The east access road will be also utilized for park ranger operations and by SOCWA operations.

The increase to the length of access road inundation over the No Action alternative is about 15% over the total road length from SOCWA CTP to AWMA Road Bridge. Frequency of flooding would result from flows much greater than the 10-year event (i.e. likely 25 to 50-year); although there is a 2,000-foot segment along the east access road in the vicinity of Wood Canyon Creek that is subject to flooding with the 10-year event. In general, depths of inundation would be remain fairly shallow as sheet flow, with flows returning to the channel as peak flows subside, likely within minutes to an hour. Open space outside of the project boundary may be subject to some of these flows. These lands are within the Wilderness Park and are not utilized for recreational or other purposes. No flood easements will be necessary. Clean up costs related to debris removal on segments of the access roads subject to overbanking following a large storm event is included under OMRRR costs.

10.0 Real Estate Baseline Cost Estimate

The Baseline Cost Estimate for Real Estate (BCERE) for the TSP Alternative 3.6 is presented below. In accordance with Engineering Regulation (ER) 405-1-12 Chapter 12 and Real Estate Policy Guidance Letter (RPG) No. 31, for projects in which the value of real estate does not exceed 30 percent of total project costs, a brief gross appraisal for land cost estimate is acceptable for planning purposes at the TSP feasibility phase. The Project Team consulted with the Orange County, Chief Appraiser, and relied on research of local public records to estimate the land cost. Most of the required land (footprint) is open space. Open space land is valued according to classification as passive or active use. Active recreational open space is considered to be assessable and suitable for hiking, biking and other public land uses, while passive open space is typically rough, steep and less accessible. The project footprint of Alternative 3.6 surrounds Aliso Creek which flows through areas of mixed steep terrain (canyons) and areas of recreational trails and bike paths. The project lands are a mixture of active and passive recreational open space.

The real estate cost estimates indicated in Table 3 as LERD; P.L. 91-646 and 01 Account costs are based on land estimates furnished by the Chief Appraiser of Orange County. The land costs were developed after review of land sales of active/passive open space. The land cost values in Table 3 below are Draft Feasibility Report estimates. In accordance with PGL No 31 guidance pre-acquisition appraisals will be obtained after the PED is approved and the Project Program Agreement is signed.

Real estate soft costs (non-federal administrative costs; 01 Account) reflect real estate activities performed by the Sponsor to administer and complete the real estate acquisition processes. Examples of NFS real estate activities are acquisition of tract title documents, preparation of tract appraisals, landowner negotiations and payments made for incidental closing costs, LER crediting and administration of real estate records associated with tract acquisition.

LER required for Aliso Creek Alternative 3.6 project footprint will be provided by the non-Federal sponsor. A contingency of 25 percent has been added to the LER cost estimate, due to factors – such as project schedule -- that cannot be evaluated in this Feasibility Report. Such factors

are affected by federal appropriations, changes to the PED design, escalation of land costs and increased relocation costs.

Table 3 Real Estate Baseline Cost Estimate

Non-Federal Sponsor Cost (TSP Alternative 3.6)	**ACRES**	**COST**
Lands, Easements, Relocation and Disposals (LERD) (P.L. 91-646) (01 Account) 174.16 acres in fee ownership 21.37 acres permanent easements 30.16 acres temporary easements 225.69 acres total	225.69	**$12,397,409**
Incremental RE Costs (25% contingency) (01 Account)		**$ 3,099,352**
Facility/Utility Relocations (02 Account) No utility relocations identified (See section 16).		**$ 0**
Incremental RE Costs (15% contingency) (02 Account)		**$ 0**
Subtotal LERRDs (01 and 02 accounts)		**$ 15,496,761**
*Non Federal Administrative Costs (01 Account) Estimated at 10% of LER costs		**$ 1,549,676**
Total Non-Federal Sponsor LERRDs		**$ 17,046,437**
Federal Cost		
Federal Administrative Costs (01 Account Non Fed Sponsor oversight; RE Crediting)		**$ 65,000**
Total Real Estate Costs		**$ 17,111,437**

11.0 P.L.91-646 Relocation Assistance Benefits

The non-Federal sponsor is aware of the requirements of the Uniform Act (P.L. 91-646). If relocations are required, the non-Federal sponsor will proceed in accordance with the Act. No residential or business relocation assistance entitlements have been identified in the Alternative 3.6 footprint.

12.0 Mineral/Timber Activity

There is no known mineral/timber activity currently occurring inside the proposed project foot print. A pre-acquisition title search will disclose any unknown mineral/timber rights which might exist.

13.0 Non-Federal Sponsor's Legal and Professional Capability and Experience to Acquire and provide LERRD

An assessment of the non-Federal Sponsor's (Orange County) legal and professional capability and experience to acquire, provide and perform LERRDs was initially completed and received from the sponsor; however, the original NFS Real Estate Capability form is not included in this report because it does not accurately represent revised project mapping of the real estate lines. The Project Development Team (PDT) requested a revised real estate Assessment of Non-Federal Sponsors Real Estate Acquisition Capability from the NFS in mid-August 2017 based on revised mapping of the real estate lines which indicate; the NFS will be required to acquire land from private landholders. The NFS has a dedicated legal and real estate staff and has condemnation authority. Orange County already owns over 97 percent of the required project lands; the NSF has provided similar LERRD for many other recent projects (Santa Anna River etc.). Therefore, the non-Federal sponsor is considered to be fully capable of acquiring and providing LERRD required for Alternative 3.6.

14.0 Application or Enactment of Zoning Ordinances

Application of zoning ordinances are not proposed in lieu of, or to facilitate, acquisition in connection with this project.

15.0 Real Estate Acquisition Schedule

The acquisition of lands needed for the TSP will be accomplished over several years, with the certification of all the real property required for each respective project contract phase completed in advance of contracting for construction. Currently, at the feasibility level of project planning, the proposed project construction is anticipated to be implemented in phases. Construction will begin at the downstream end of the project footprint and progress upstream (See Table 4). However, because the Proposed Project is at feasibility design stage, the construction sequence phases may change. The acquisition of Rights of Entry for Construction, Fee lands and the various easements required for Alternative 3.6 will be accomplished in accordance with the priority and resources provided. Real estate certification typically requires an 18 month lead time before Certification of project lands for BCOE. Further details and refinement of the acquisition schedule will be established during the PED phase.

Table 4 Real Estate Schedule

Phase; Other Areas	Construction Calendar Year	LEERDS Real Estate Acquisition (months)
Phase 0; Phase 1; Disposal Site downstream of Wood Canyon Creek; Temporary Habitat Easement; Staging areas A- H; Road easements	January 2020- January 2021	12 Months Begin January 2019
Phase 2; Disposal Site upstream of Wood Canyon Creek	January 2021- January 2022	12 Months Begin January 2020

Phase 3	January 2022- January 2023	12 Months, begin January 2021
Phase 4	January 2023- January 2024	12 Months; begin January 2022

16.0 FACILITY/UTILITY RELOCATIONS

A preliminary assessment of utilities and facilities within the Alternative 3.6 footprint has been completed using guidance set forth in Real Estate Policy Guidance Letter (PGL) No. 31. In accordance with PGL No. 31, the District Real Estate Office performed a real estate assessment to identify utility/facilities, and if they are generally of the type eligible for Compensation under the substitute facilities doctrine, consulting data or evidence that demonstrates that a property owner has a compensable interest in the affected property. Table 3 summarizes utility structures located in the Proposed Project footprint and describes the type of utility, location, ownership, and Proposed Project action to taken. Alternative 3.6 proposed utility actions are to protect in place, remove as abandoned; and protect in place and modify.

The Project Team has not identified utility/facilities that are generally of the type eligible for compensation under the substitute facilities doctrine, consulting data or evidence that demonstrates that a property owner has a compensable interest in the affected property. At the time of this Real Estate Feasibility Report, no utility relocations have been identified. Abandoned irrigation lines and pipes belonging to Orange County will be removed from Station 118+00 to approximately 182+00. Water, sewer and storm drains belonging to SOCWA and, Moulton Niguel Water District (MNWD) will be protected in place with armor or pilings. A gas pipeline belonging to SOCWA located between Station 247+00 and 249+00; and a SOCWA wastewater line located between Station 328+00 and 332+00 will be protected in place. No utility relocations requiring an Attorney Opinion of Compensability have been identified by the project team; no Attorney Opinion of Compensability have been requested.

Table 5 Aliso Creek Utility Summary

Begin Station	End Station	Bank	Utility Type	Ownership	Required Action	Reach
70+00	n/a	East/West	Various (water, sewer, storm drain, etc.)	SOCWA	Protect in Place	4A
70+00	250+00	East	Utility Pipe	SOCWA/Moulton Niguel Water District (MNWD)	Protect in Place	4A - 9
75+00	77+00	East/West	Various (sewer, Storm Drain)	SOCWA	Protect in Place	4A
82+00	n/a	West	Storm Drain	Orange County	Protect in Place	4A
115+50	117+40	West	Irrigation Line	Orange County	Remove, as abandoned	4B
118+00	126+00	East and West	Irrigation Line	Orange County	Remove, as abandoned	4B

133+00	186+80	West	Irrigation Line	Orange County	Remove, as abandoned	5A - 7
152+00	157+00	West	LTP287-Irrigation	Orange County	Remove, as abandoned	5B
154+00	159+00	West	LTP287- Irrigation	Orange County	Remove, as abandoned	5B -5C
157+00	n/a	In channel	Pipe Above Ground	Orange County	Remove, as abandoned	5B
160+00	167+00	West	LTP287- Irrigation	Orange County	Remove, as abandoned	5C
171+00	182+00	West	LTP287- Irrigation	Orange County	Remove, as abandoned	6
184+00	n/a	in channel	Pipe Above Ground	Orange County	Remove, as abandoned	6
205+00	209+00	West	Existing Storm Drain/Culvert	Orange County	Protect in Place (Modify outlet)	7
217+00	n/a	West	Existing Storm Drain/Culvert	Orange County	Protect in Place (Modify outlet)	8
232+00	n/a	West	Existing Storm Drain/Culvert	Orange County	Protect in Place (Modify outlet)	8
236+00	n/a	West	Existing Storm Drain/Culvert	Orange County	Protect in Place (Modify outlet)	8
238+50	241+00	West	Existing Storm Drain/Culvert	Orange County	Protect in Place (Modify outlet)	8
247+00	249+00	East	Various (i.e. Sludge/Utility Pipe, Gas)	SOCWA	Protect in Place	Sulphur
247+00	251+00	East	Various (i.e. Sludge/Water)	SOCWA	Protect in Place	Sulphur
252+50	n/a	West/East	Storm Drain, Water, Sewer	MNWD	Protect in Place	9
263+00	n/a	W and E	Storm Drain	MNWD	Protect in Place (Modify outlet)	10
266+00	n/a	W and E	Storm Drain, Water, Sewer	MNWD	Protect in Place	10
269+00	n/a	W and E	Storm Drain	Orange County	Protect in Place (Modify outlet)	10
273+00	n/a	W and E	Storm Drain	Orange County	Protect in Place (Modify outlet)	10
287+00	n/a	East	Storm Drain	Orange County	Protect in Place (Modify outlet)	11

289+00	292+70	West	Storm Drain	Aliso Viejo	Protect in Place (Modify outlet)	11
301+00	n/a	West	Storm Drain	Aliso Viejo	Protect in Place (Modify outlet)	11
316+00	321+20	W and E	Joint Regional Water Supply	South Coast Water District	Protect in Place	12
319+00	n/a	West	Storm Drain	Aliso Viejo	Protect in Place (Modify outlet)	12
328+00	332+00	NE/SW	Wastewater	Moulton Niguel Water District (MNWD)	Protect in Place	12
328+00	332+00	NE/SW	Wastewater	SOCWA	Protect in Place	12
333+00	n/a	NE/SW	Storm Drain	Aliso Viejo	Protect in Place (Modify outlet)	13

ANY CONCLUSION OR CATEGORIZATION CONTAINED IN THIS REPORT THAT AN ITEM IS A UTILITY OR FACILITY RELOCATION TO BE PERFORMED BY THE NON-FEDERAL SPONSOR AS PART OF ITS LER RESPONSIBILITIES IS PRELIMINARY ONLY. THE GOVERNMENT WILL MAKE A FINAL A DETERMINATION OF THE RELOCATIONS NECESSARY FOR THE CONSTRUCTION, OPERATION, OR MAINTENANCE OF THE PROJECT AFTER FURTHER ANLYSIS AND COMPLETION AND APPROVAL OF FINAL ATTORNEY'S OPINIONS OF COMPENSABILTY FOR EACH OF THE IMPACTED UTILITIES AND FACILITIES.

17.0 Impact on Real Estate Acquisition and LER Value Estimates Due to Suspected or Known Contaminants

The project footprint is predominantly situated within the boundaries of the Aliso and Wood Canyon Wilderness Park, lands that historically were part of the Rancho Niguel granted in 1812. The park lands are currently undeveloped. A Phase I Environmental Site Assessment (ESA) was completed by the Los Angeles District. The ESA did not identify any HTRW hazards within the Proposed Project footprint, other than the surface water quality problems including urban runoff and non-point source pollution. The Aliso Creek Watershed has been designated as a target watershed for priority water quality enhancement efforts. There are no known "Superfund" sites or sites presently under CERCLA remediation or response orders identified in the proposed project area. The LERRD estimate is predicated on the assumption that all lands and properties are clean and require no remediation.

18.0 Support /Opposition for the Project

The Proposed Project enjoys support by the South Orange County Wastewater Authority (SOCWA), the Orange County Public Works Environmental Resources Department, and many stakeholders in the surrounding communities. Alternative 3.6 proposes to improve riverine ecosystem structure and function, reestablish channel stability, and improve recreation access and opportunities. Approximately 97percent of land required for the Proposed Project footprint is owned by the NFS (Orange County). The major concerns from the community have focused on alteration and changes to local traffic patterns during the construction process.

19.0 NON-FEDERAL SPONSOR NOTIFICATION OF RISKS OF PRE- PPA ACQUISITION

The non-Federal sponsor has been provided the Real Estate Risk Letter and has been advised in writing of the risks associated with acquiring land prior to the execution of the Project Partnership Agreement. A copy of this letter is posted as Exhibit L.

Exhibit A

ALISO CREEK MAINSTEM
ECOSYSTEM RESTORATION STUDY - ALTERNATIVE 3
SOCWA CTP BRIDGE TO PACIFIC PARK DRIVE
ORANGE COUNTY, CALIFORNIA

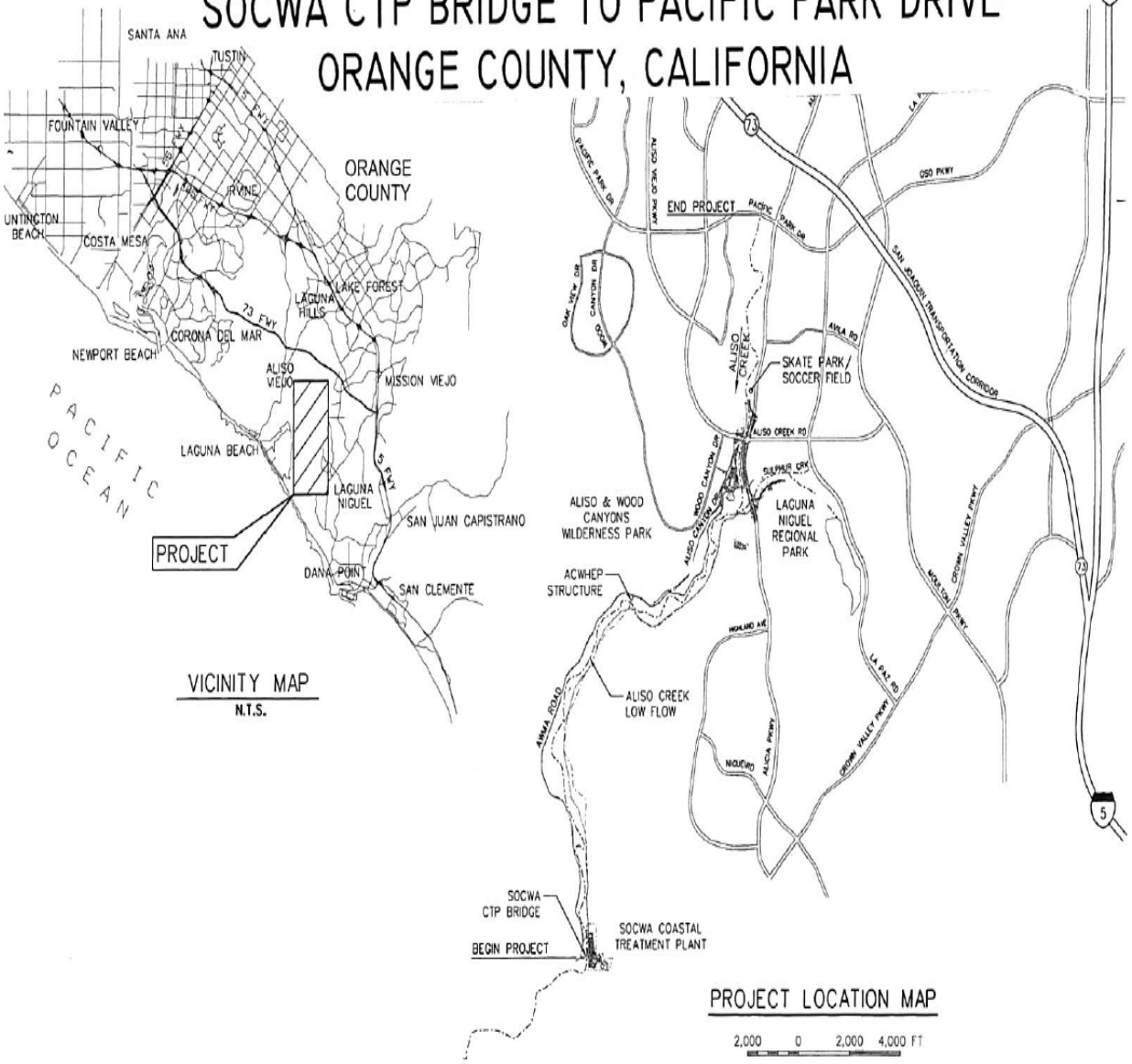


EXHIBIT A1

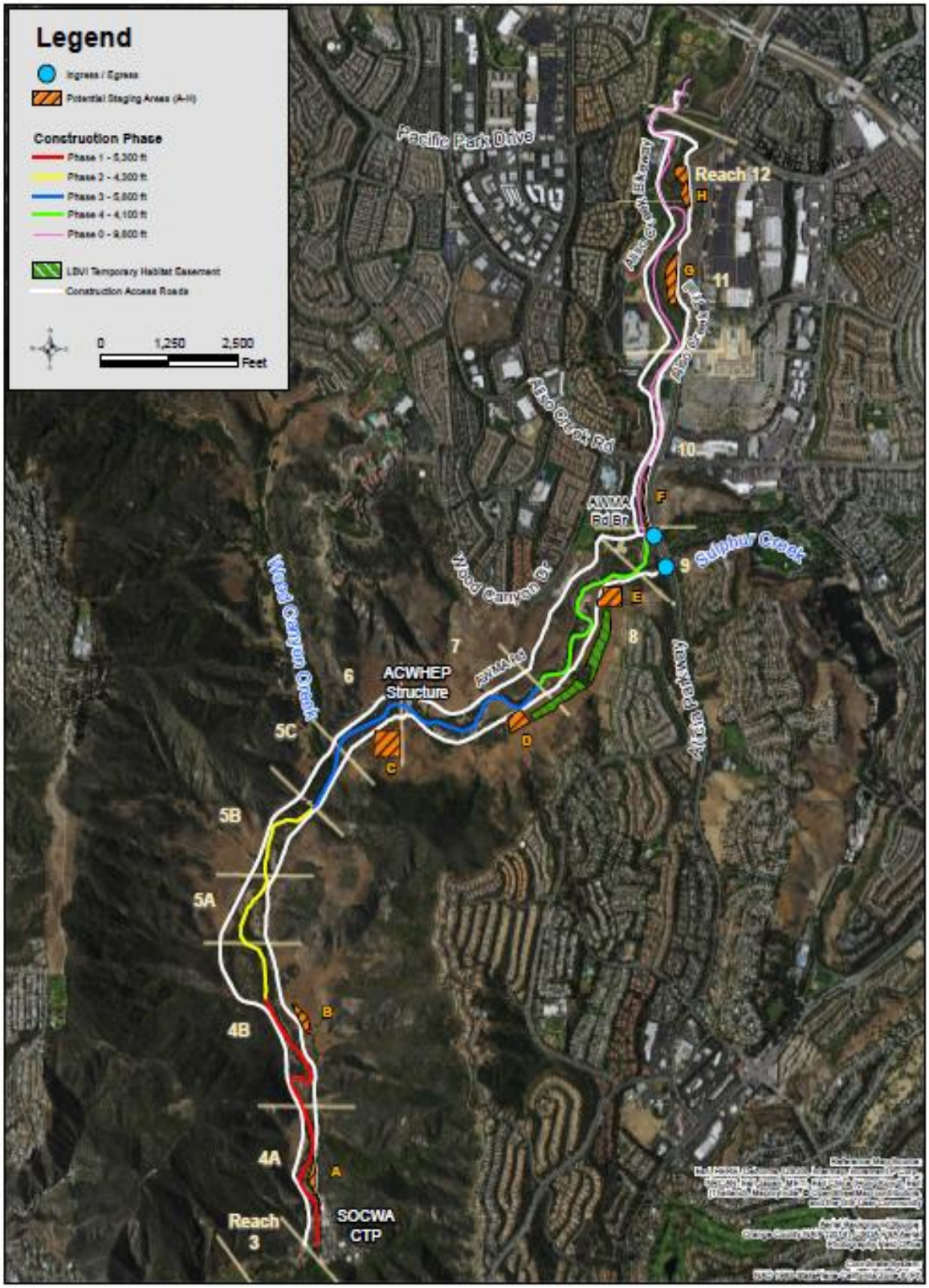
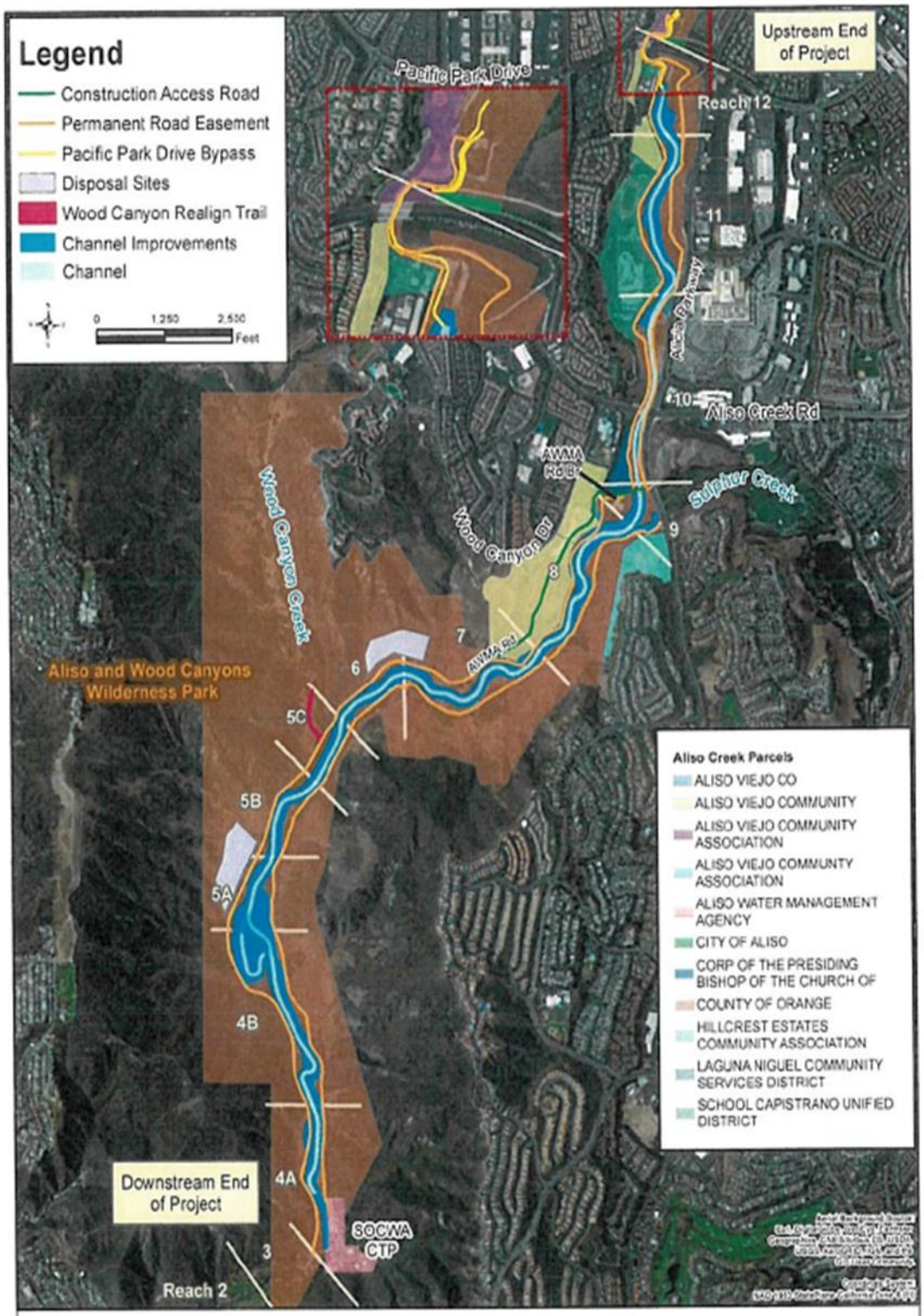

Legend
Ingress / Egress
Potential Staging Areas (A-H)
Construction Phase
Phase 1 - 5,300 ft
Phase 2 - 4,300 ft
Phase 3 - 5,800 ft
Phase 4 - 4,100 ft
Phase 0 - 9,800 ft
LBVI Temporary Habitat Easement
Construction Access Roads
0
1,250
2,500
Feet
Pacific Park Drive
Reach 12
H
G
11
Aliso Creek Rd
10
AWMA Fd Br
F
9
Sulphur Creek
Wood Canyon Dr
E
8
7
6
ACWHEP Structure
Wood Canyon Creek
5C
C
D
Aliso Creek
5B
5A
4B
B
4A
A
Reach 3
SOCWA CTP

Exhibit A2

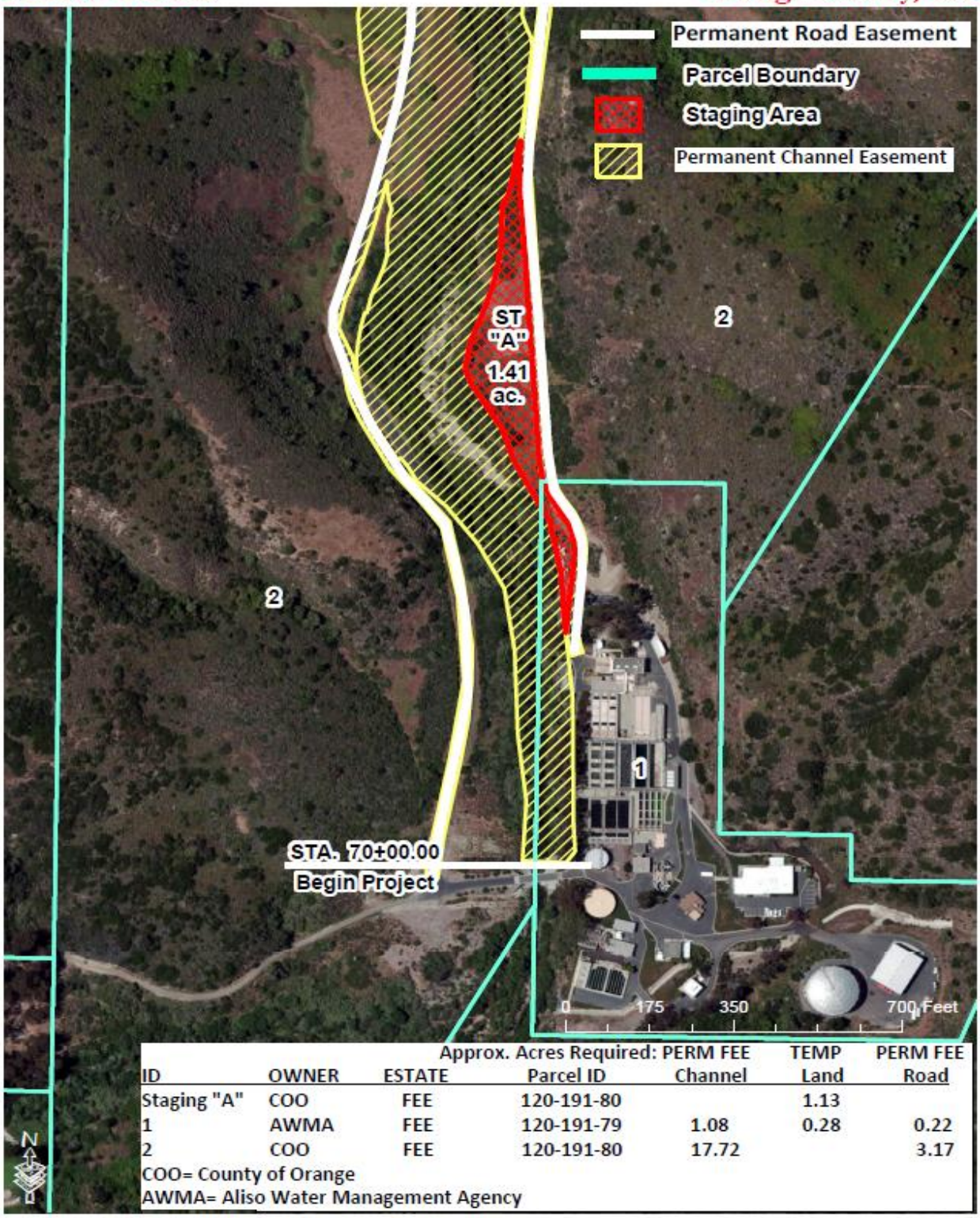


Real Estate Overview Map

EXHIBIT B

Aliso Creek

Orange County, CA



ID	OWNER	ESTATE	Approx. Acres Required: Parcel ID	PERM FEE Channel	TEMP Land	PERM FEE Road
Staging "A"	COO	FEE	120-191-80		1.13	
1	AWMA	FEE	120-191-79	1.08	0.28	0.22
2	COO	FEE	120-191-80	17.72		3.17

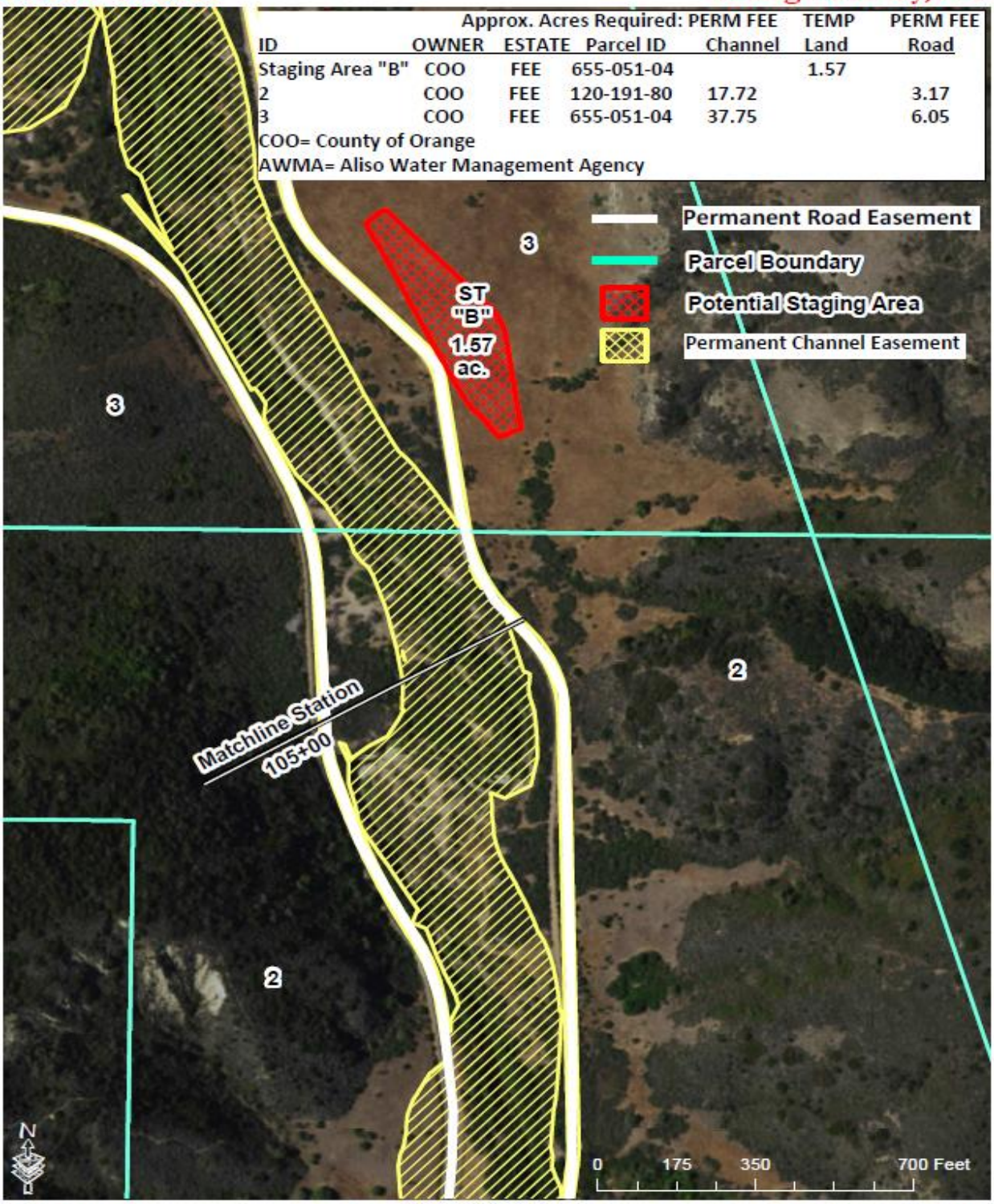
COO= County of Orange
AWMA= Aliso Water Management Agency

Section 3

Alternative 3.6

EXHIBIT C

Aliso Creek — Orange County, CA



Section 4 — Alternative 3.6

EXHIBIT D

Aliso Creek

Orange County, CA

Approx. Acres Required:				PERM FEE	TEMP	PERM FEE
ID	OWNER	ESTATE	Parcel ID	Channel	Land	Road
DS 1	COO	FEE	655-051-05		13.08	
3	COO	FEE	655-051-04	37.75		6.05
4	COO	FEE	655-051-05			

COO= County of Orange

Section 5

Alternative 3.6

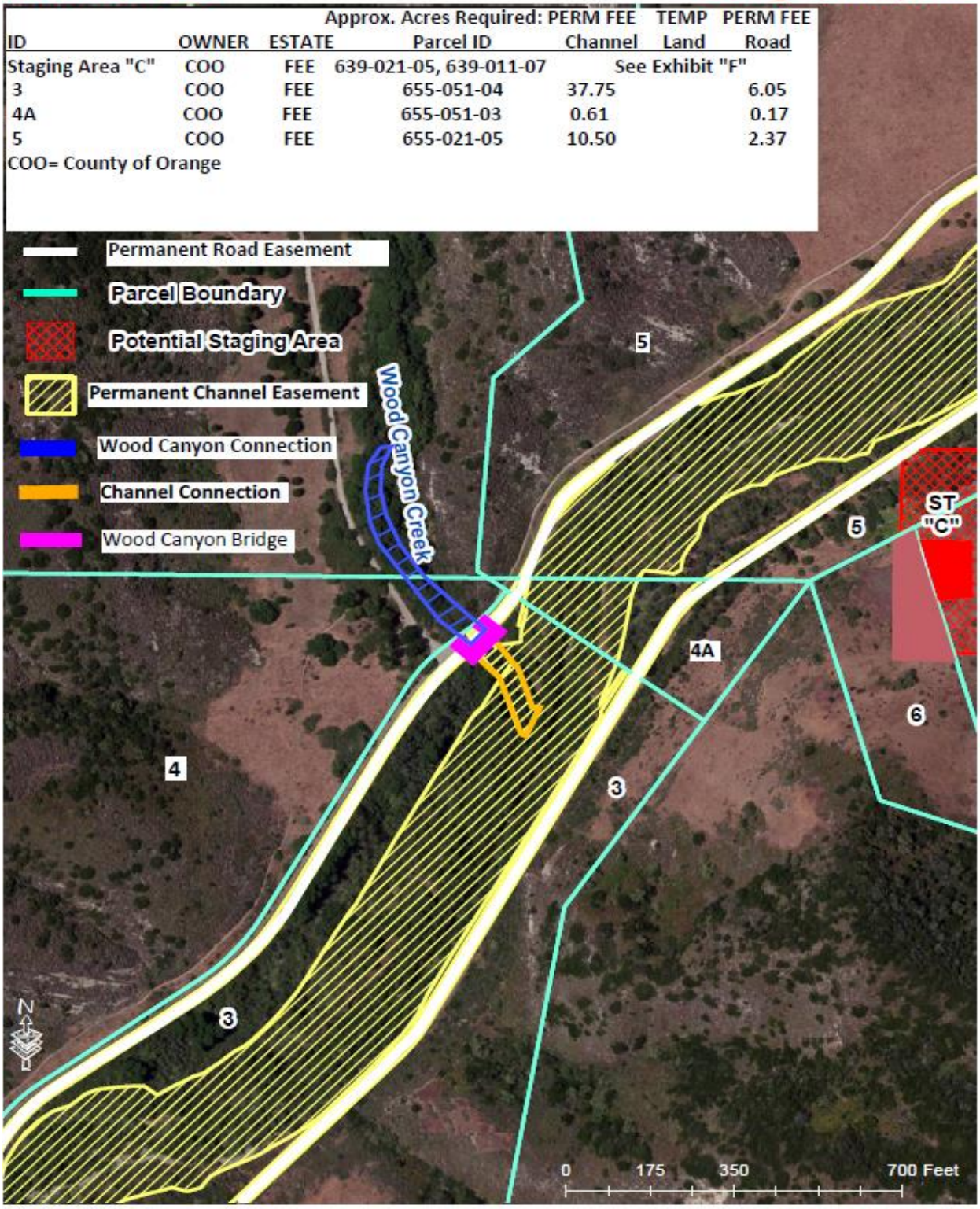
EXHIBIT E

Aliso Creek

Orange County, CA

ID	OWNER	ESTATE	Parcel ID	Approx. Acres Required: PERM FEE Channel	TEMP Land	PERM FEE Road
Staging Area "C"	COO	FEE	639-021-05, 639-011-07	See Exhibit "F"		
3	COO	FEE	655-051-04	37.75		6.05
4A	COO	FEE	655-051-03	0.61		0.17
5	COO	FEE	655-021-05	10.50		2.37

COO= County of Orange



Section 6

Alternative 3.6

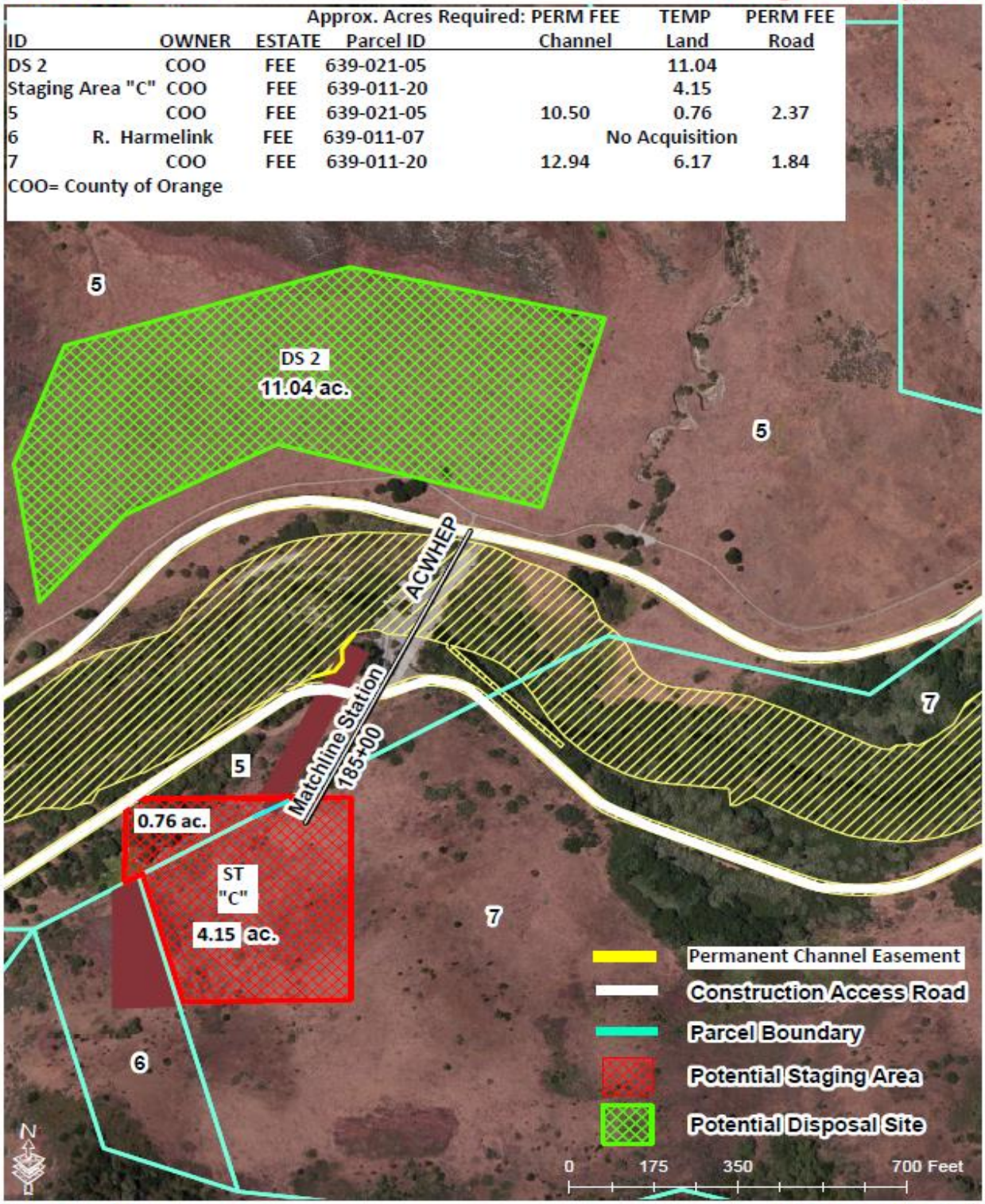
EXHIBIT F

Aliso Creek

Orange County, CA

ID	OWNER	ESTATE	Parcel ID	Approx. Acres Required: PERM FEE Channel	TEMP Land	PERM FEE Road
DS 2	COO	FEE	639-021-05		11.04	
Staging Area "C"	COO	FEE	639-011-20		4.15	
5	COO	FEE	639-021-05	10.50	0.76	2.37
6	R. Harmelink	FEE	639-011-07		No Acquisition	
7	COO	FEE	639-011-20	12.94	6.17	1.84

COO= County of Orange



Section 7

Alternative 3.6

EXHIBIT G

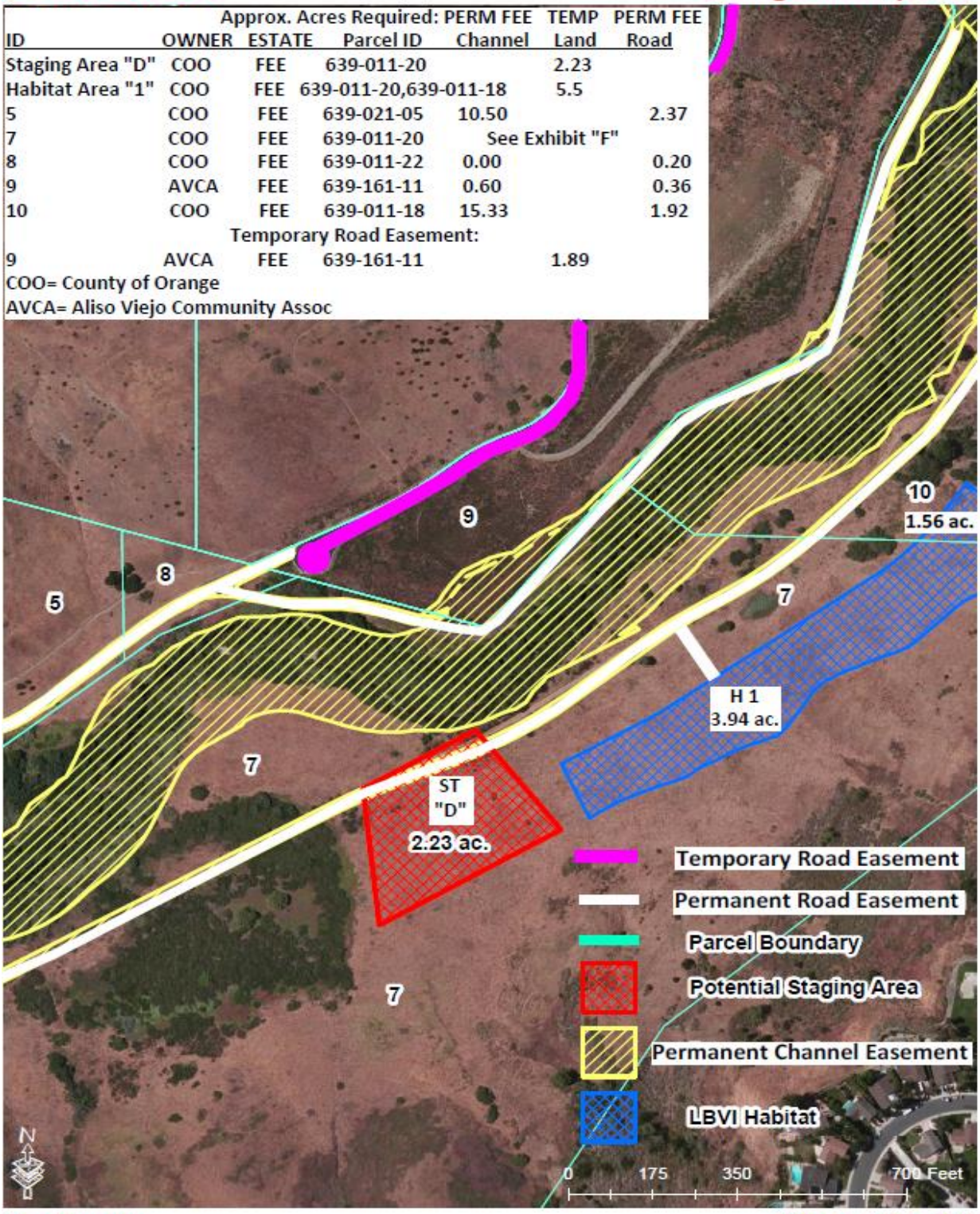
Aliso Creek

Orange County, CA

ID	OWNER	ESTATE	Parcel ID	Approx. Acres Required: PERM FEE Channel	TEMP Land	PERM FEE Road
Staging Area "D"	COO	FEE	639-011-20		2.23	
Habitat Area "1"	COO	FEE	639-011-20,639-011-18		5.5	
5	COO	FEE	639-021-05	10.50		2.37
7	COO	FEE	639-011-20	See Exhibit "F"		
8	COO	FEE	639-011-22	0.00		0.20
9	AVCA	FEE	639-161-11	0.60		0.36
10	COO	FEE	639-011-18	15.33		1.92
			Temporary Road Easement:			
9	AVCA	FEE	639-161-11		1.89	

COO= County of Orange

AVCA= Aliso Viejo Community Assoc

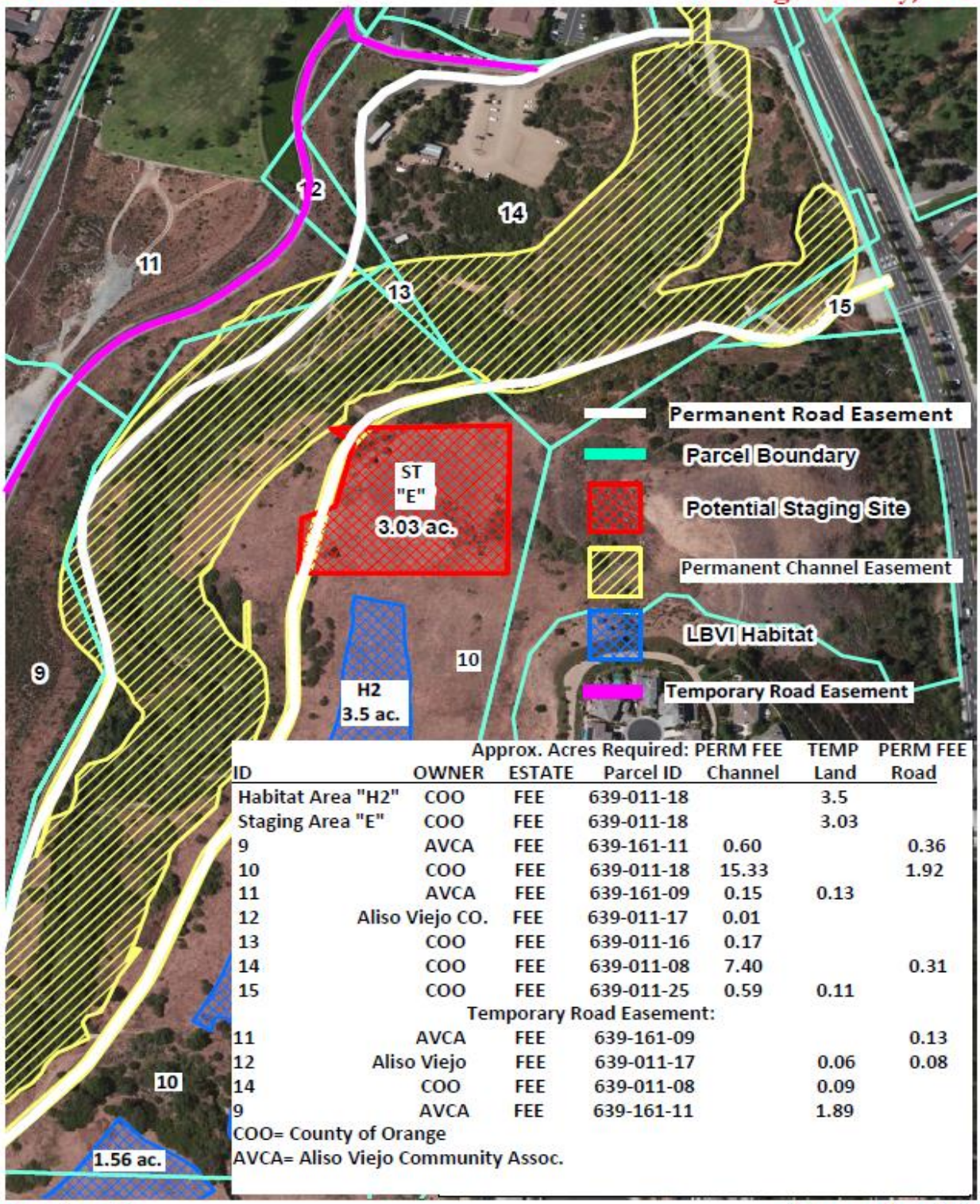


Section 8

Alternative 3.6

EXHIBIT H

Aliso Creek — Orange County, CA



ID	OWNER	ESTATE	Parcel ID	Approx. Acres Required: PERM FEE Channel	TEMP Land	PERM FEE Road
Habitat Area "H2"	COO	FEE	639-011-18		3.5	
Staging Area "E"	COO	FEE	639-011-18		3.03	
9	AVCA	FEE	639-161-11	0.60		0.36
10	COO	FEE	639-011-18	15.33		1.92
11	AVCA	FEE	639-161-09	0.15	0.13	
12	Aliso Viejo CO.	FEE	639-011-17	0.01		
13	COO	FEE	639-011-16	0.17		
14	COO	FEE	639-011-08	7.40		0.31
15	COO	FEE	639-011-25	0.59	0.11	
			Temporary Road Easement:			
11	AVCA	FEE	639-161-09			0.13
12	Aliso Viejo	FEE	639-011-17		0.06	0.08
14	COO	FEE	639-011-08		0.09	
9	AVCA	FEE	639-161-11		1.89	

COO= County of Orange
AVCA= Aliso Viejo Community Assoc.

Section 9 — Alternative 3.6

EXHIBIT I

Aliso Creek — Orange County, CA

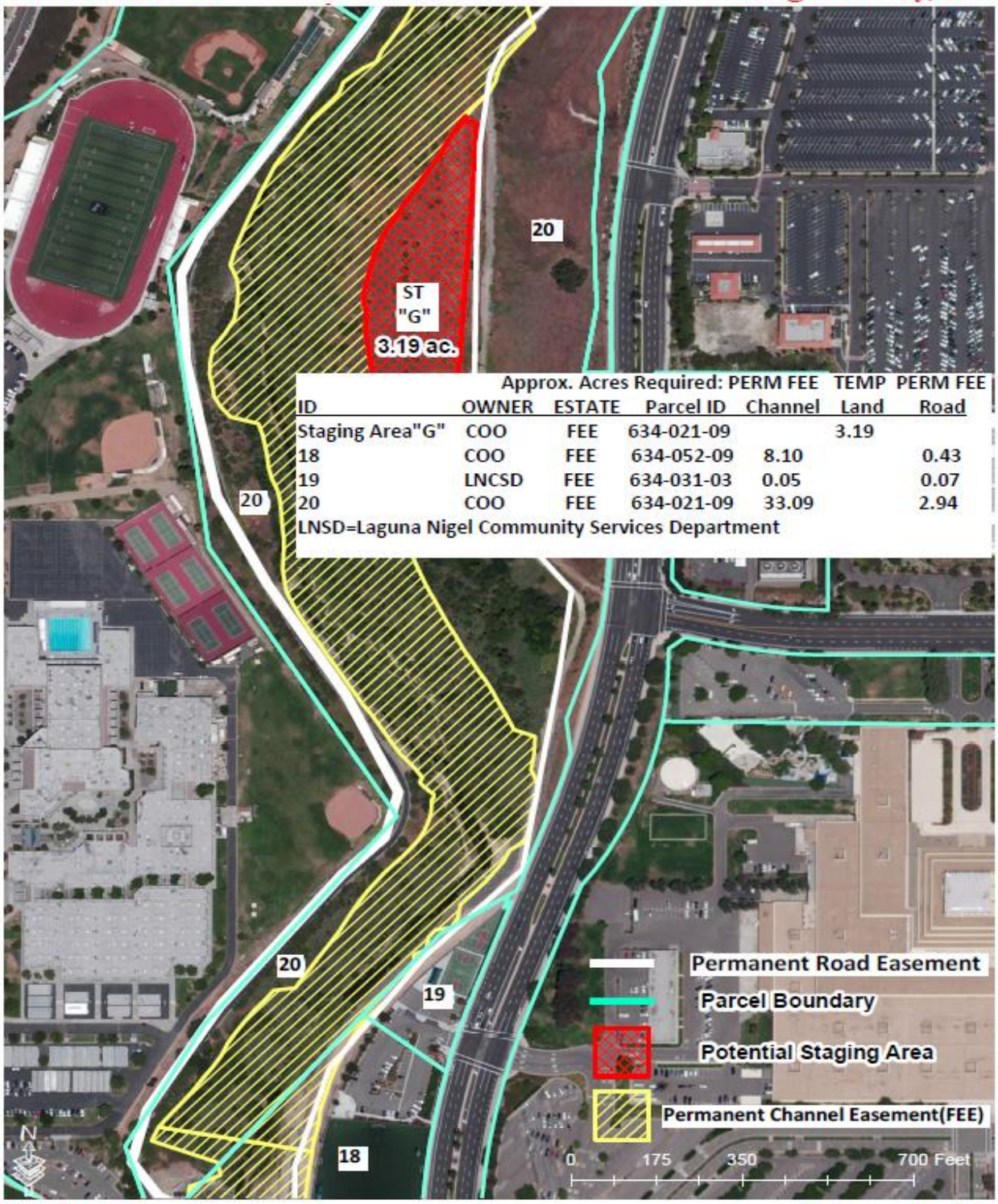
ID	OWNER	ESTATE	Parcel ID	Approx. Acres Required: PERM FEE Channel	TEMP Land	PERM FEE Road
Staging Area "F"	COO	FEE	639-011-08		1.34	
14	COO	FEE	639-011-08	5.20		0.47
16	LDS Church	FEE	639-011-09	0.00		0.32
17	COO	FEE	634-052-06	0.44		0.15
18	COO	FEE	634-052-09	8.10		0.43

COO= County of Orange
LDS Church= Church of Ladder Day Saints

Section 10 — Alternative 3.6

EXHIBIT J

Aliso Creek — Orange County, CA



ID	OWNER	ESTATE	Parcel ID	Approx. Acres Required: PERM FEE Channel	TEMP Land	PERM FEE Road
Staging Area"G"	COO	FEE	634-021-09		3.19	
18	COO	FEE	634-052-09	8.10		0.43
19	LNCSD	FEE	634-031-03	0.05		0.07
20	COO	FEE	634-021-09	33.09		2.94

LNSD=Laguna Nigel Community Services Department

Section 11 — Alternative 3.6

Aliso Creek

EXHIBIT K

Orange County, CA

ID	OWNER	ESTATE	Parcel ID	Approx. Acres Required: PERM FEE Channel	TEMP Land	PERM FEE Road
Staging Area "H"	COO	FEE	634-021-09		2.40	
20	COO	FEE	634-021-09	33.09		2.94
21	COO	FEE	634-342-03	0.02		0.13
22	COO	FEE	634-342-06	0.10		0.11
23	AVCA	FEE	634-351-01	0.25		0.14
24	AV City	FEE	634-341-02	0.01		0.00
25	COO	FEE	634-341-01	0.10		0.03
26	COO	FEE	634-012-09	1.42		0.03

AV CITY= City of Aliso Viejo
AVCA= Aliso Viejo Community Association

Section 12

Alternative 3.6

Exhibit L

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
AZ /NV ASSET MANAGEMENT OFFICE
3636 N CENTRAL AVE, SUITE 900
PHOENIX, AZ 85012-1939

MAY 17, 2017

Asset Management Division

SUBJECT: Aliso Creek Ecosystem Restoration Study Real Estate Acquisition

Marilyn Thoms
Manager, Watershed Management Division
OC Environmental Resources
2301 N. Glassell Street
Orange, CA 92865

Dear Ms. Thoms:

The intent of this letter is to formally advise the subject Non-Federal Sponsor, Orange County, of the risk associated with beginning land acquisition prior to the execution of the Project Partnership Agreement (PPA); and or prior to the receipt of the Federal Sponsor (Government's) formal notice to proceed with acquisition. If the Non-Federal Sponsor begins land acquisition prior to receipt of the executed Project Partnership Agreement (PPA); for whatever reason, the Non-Federal Sponsor will assume full and sole responsibility for any and all costs, or liability arising out of the acquisition effort.

Generally, these risks include but may not be limited to, the following:

a. Congress may not appropriate funds to construct the proposed project;

b. The proposed project may otherwise not be funded or approved for construction;

c. A PPA which is mutually agreeable to the Non-Federal Sponsor and the Federal Government Sponsor may not be executed and implemented;

d. The Non-Federal Sponsor may incur liability and expense by virtue of ownership of contaminated lands, or interests therein, whether such liability should arise out of local, state, or Federal laws including liability arising out of CERCLA, as amended;

e. The Non-Federal Sponsor may acquire interests or estates that are later determined (due to engineering design change revision) by the Federal Government Sponsor to be inappropriate, insufficient, or otherwise not required for the project.

f. The Non-Federal Sponsor may initially acquire insufficient or excessive Lands, Easements, Right-of-Way, Relocations and Disposals (LERRDS); which have not been authorized by the Federal Government Sponsor. Unauthorized LERRDS may result in additional unrequired acquisition expense and/or benefit payments made by the Non-Federal Sponsor. Unauthorized real property acquisitions can be avoided by delaying acquisition until after the PPA is executed. The Non-Federal sponsor is advised not to begin land acquisition until after the PPA has been signed; and it has received a formal Notice to Proceed Acquisition from the Federal Sponsor.

g. The Non-Federal Sponsor will incur costs or expenses connected with the acquisition of LERRD. If LERRD work was performed before the PPA is executed and before the Federal Sponsor Notice to Proceed was received by the Non Federal Sponsor; the Federal Sponsor may not reimburse the Non Federal Sponsor if it is determined that the LERRD work was not necessary; because of project design changes. In accordance with Public Law 91-646 the costs will be considered non creditable expenses and the Non-Federal sponsor will not be reimbursed by the Sponsor.

We appreciate the many contributions Orange County has made to the Aliso Creek Ecosystem Restoration Project; and want to be certain that the LERRD crediting procedures for Non Federal Sponsor reimbursement are explained. Should you have questions or concerns pertaining to this letter please feel free to contact Mr. Miles Pillars at (602) 230-6965 or by email at miles.d.pillars@usace.army.mil.

Sincerely,

Joseph M. Gatti
Chief AZ/NV Asset Management Office

Exhibit M

ASSESMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY

PROJECT NAME: Aliso Creek Ecosystem Restoration
NON-FEDERAL SPONSOR: County of Orange, CA

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes?

b. Does the sponsor have the power of eminent domain for this project?

c. Does the sponsor have a "quick-take" authority for this project?

d. Are any of the lands/interests in land required for the project located outside the sponsor's Political boundary?

e. Are any of the lands and interests in land required for the project owned by an entity who's Property the sponsor cannot condemn?

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate Requirements of Federal projects including P.L. 91-646, as amended?

b. If the answer to II a. is yes, has a reasonable plan been developed to provide such training?

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project?

d. Is the sponsor's projected in-house staffing level sufficient considering its other work load if any, and the project schedule?

e. Can the sponsor obtain contractor support, if required, in a timely fashion?

f. Will the sponsor likely request USACE assistance in acquiring real estate?

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site?

b. Has the sponsor approved the project/real estate schedule/milestones?

IV. Overall Assessment: (Blue are Sponsors answers, Black are Corps answers)

a. Has the sponsor performed satisfactorily on other USACE projects?

b. With regard to this project, the sponsor is anticipated to be:

V. Coordination:

a. Has this assessment been coordinated with the sponsor?

b. Does the sponsor concur with this assessment?

Authorized Signature for the Sponsor: _____

_____
(Print Name, Title and Date)

Date: _____

Prepared by: Miles Pillars, Realty Specialist

Reviewed and Approved by: _____
Joe Gatti, Chief AZ/Nevada Field Office