Coyote Valley Band of Pomo Indians

WaterSMART Drought Response Program: Drought Resiliency Projects for Fiscal Year 2017 (Funding Group 1)

West Fork Russian River Bank Stabilization and Habitat Restoration

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Executive Summary

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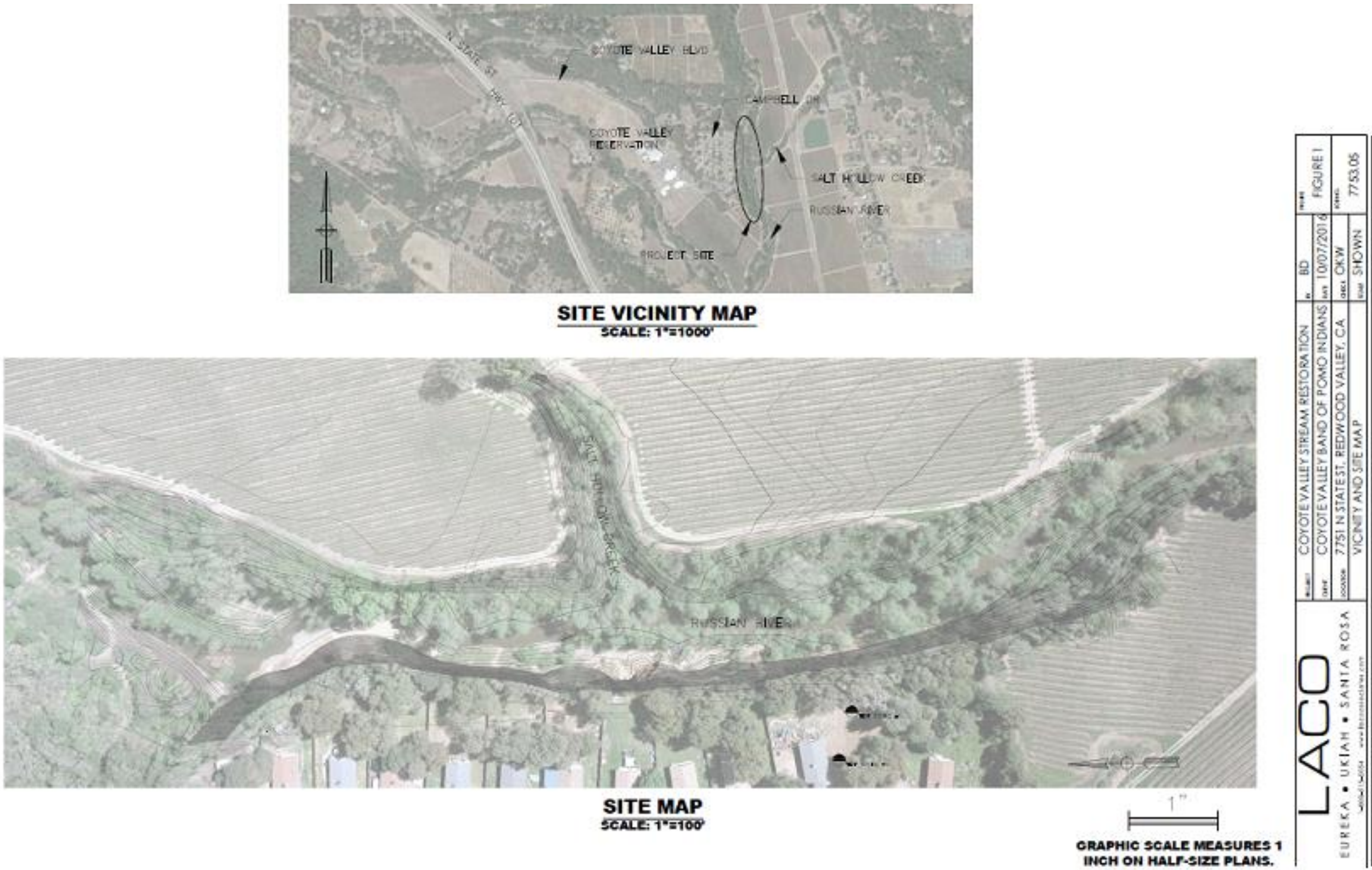
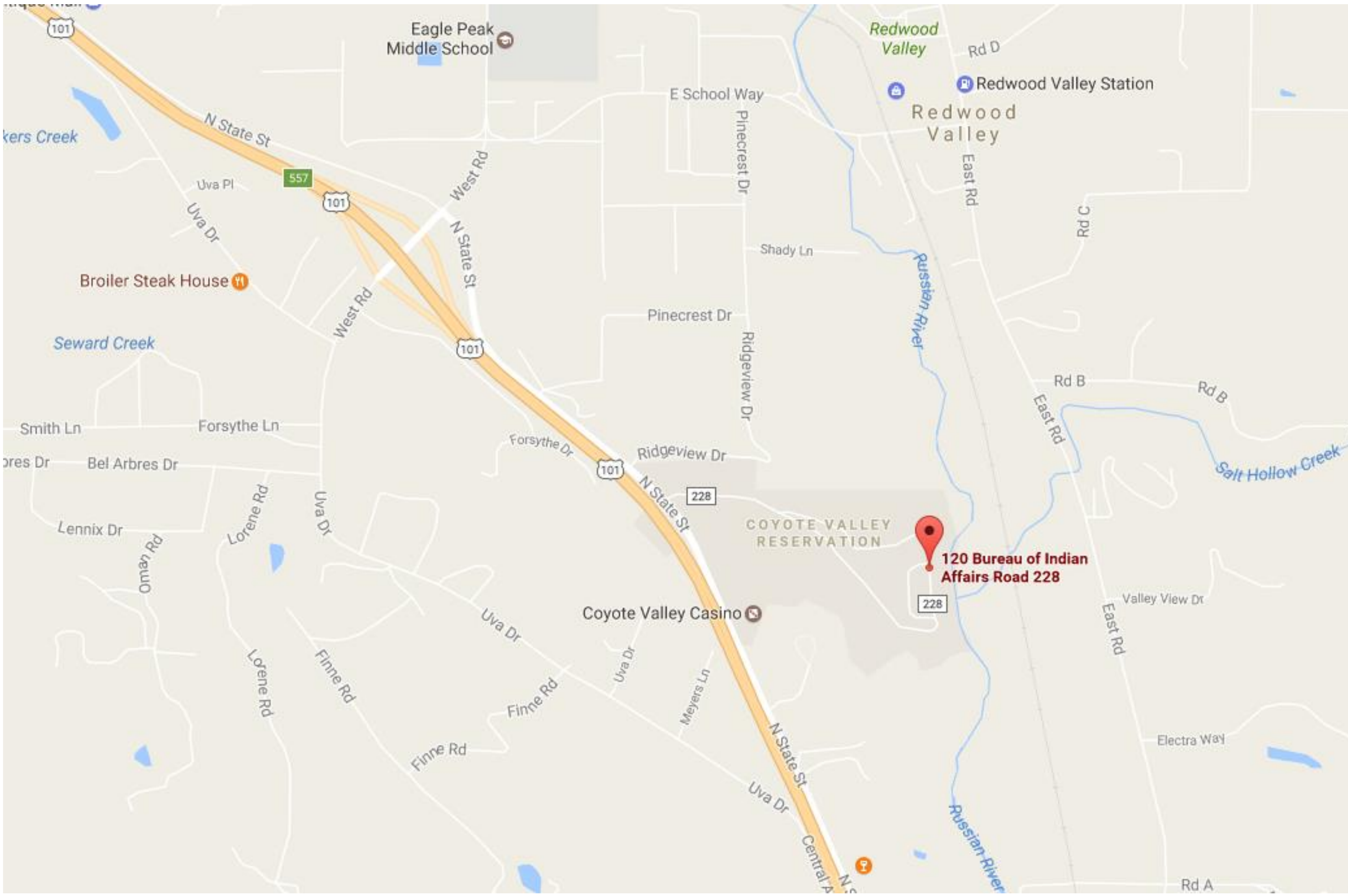
Coyote Valley Band of Pomo Indians
Redwood Valley, Mendocino County, California

This project addresses Section 3.1 Task 3 "Providing benefits for fish and wildlife and the environment" It will fall under sample project area: "Improving habitat, including restoring habitat to pre-drought conditions." It will be active in, "Restoring stream banks, managing and enhancing native vegetation, and installing stream flow deflectors in order to enhance pool and riffle benefits." One of the greatest benefits of the project is to reduce siltation in the West Fork Russian River (WFR), which is the biggest Nonpoint Source Pollution issue in the watershed and a major impediment to a healthy salmonid population. However, there are numerous benefits to this project including human health and safety. The drought has worsened the conditions in the stream significantly and has made the need to address this issue immediate. There is a 900 foot long destabilized and steep 60-foot bluff on the WFR impacting Coyote Valley Reservation (CVR). The section is long on the west bank of the WFR running from CVR northeastern boundary and continues until just before the southern boundary. It is 65 to 200 feet east of Coyote Valley Boulevard, the main housing road. This is endangering the housing and river habitat. The risk has increased due to the extended California drought. Capillary forces holding the soil together were lost during the prolonged drought causing increased sloughing and collapse. Recent heavy rainfall on destabilized soil is causing large areas of collapse. Porous areas of water coming from the bank due to the changes in soil stability have only been seen post drought and are causing more collapse. Wildlife fed on already drought-distressed vegetation and made new paths to remaining water holes, which further destabilized the riparian zone. Distressed trees and vegetation are now dying from disease. The channel overgrew with thick pockets of opportunistic invasive species that took over for drought stressed vegetation. They are much thicker than native species preventing the water from spreading out on the floodplain. The lack of floodplain forced the thalweg to move further over increasingly undercutting the bank and causing channelization. Climate change is amplifying and expediting destabilization with extreme precipitation events and extended drought years. Each year 10,000 cubic feet of sediment go in to WFR from this site. This grant will complete stabilization of the toe of the bank at the upstream entrance to the Reservation through grading, riprap and planting of native vegetation. This will reduce risks of catastrophic failure, significantly reduce sediment loading, create more pools and riffles, decrease water temperature and increase dissolved oxygen providing better habitat for fish and wildlife. Coyote Valley Band of Pomo Indians (CVBPI) is working with the Mendocino County Resource Conservation District (RCD) to assist with best management practices, quality control and compliance with the Russian River Watershed Management Plan (RRWMP), and providing and outreach. The bioengineering, riprap, excavation, and woody debris that will funding through this project will improve the health of the Russian River Watershed and restored habitats and bank stabilization to pre-drought levels. This project mitigates drought impacts and builds greater drought resiliency for the future.

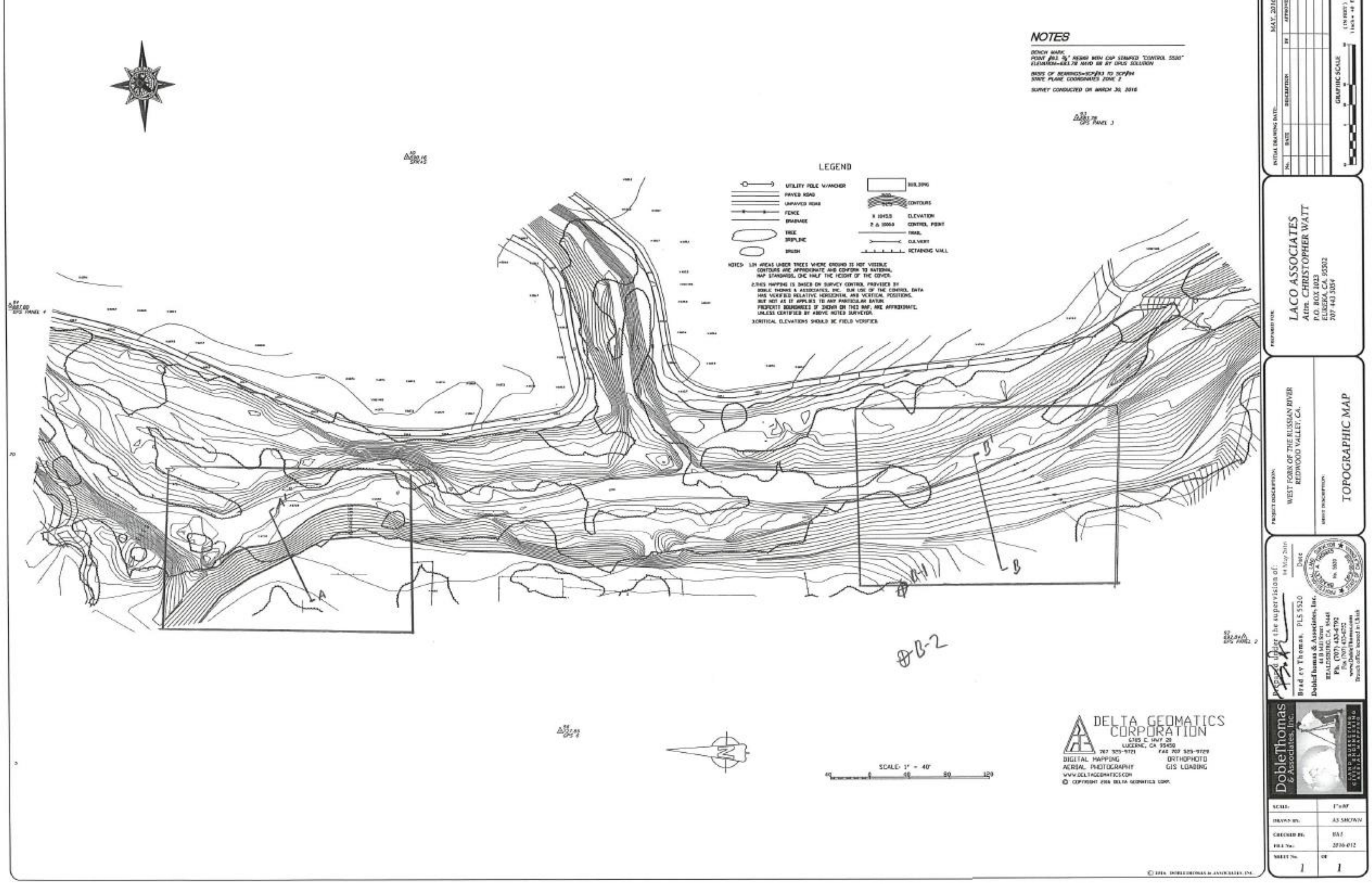
The project will be complete within the two-year grant period and is located on Federal Trust Land, Coyote Valley Reservation.

Background Data





Map detailing location of the Reservation and project site in relation to the nearest town, Redwood Valley.



Topographic map of the project site.

Coyote Valley Reservation is located approximately 10 miles north of Ukiah, Mendocino County, California. The address falls within the postal district of Redwood Valley, CA, which can be seen to the north east of the Reservation on the map. The land base is approximately 78 acres of Federal Trust Land with an exterior boundary to the south by Forsythe Creek with some sections of the creek having Reservation land on both sides, and the exterior boundary to the East is the West Fork of the Russian River (WFR) with a small section where both banks lie within the Reservation. The embankment on the WFR lying within the Reservation boundaries is the focus of this proposal.

The Russian River has many water uses ranging from drinking water to agriculture fishing and traditional uses. The River System runs through Mendocino and Sonoma Counties. CVR is located on the West Fork Russian River near the headwaters. The upper River water is used for agriculture, primarily grapes, and drinking water with the City of Ukiah and Lake Mendocino being the nearest drinking water uptakes. On the Reservation, water is used for fishing, tribal traditional uses, and fish and wildlife habitat. Cultural connection to the water is important for the Tribe and a healthy salmonid habitat is central to that. The waterways are also used for other traditional purposes such as the collection of basketry materials that were also impacted by the drought. These materials are not only culturally important, but provide habitat and root systems, which help to stabilize the riparian zone. The water flow is year round traditionally. Although, with the recent drought there were portions of River which stopped flowing, and other portions pools were connected by minimal flow. The pool riffle system was not functional and many pools were filled in with silt from the eroding bank. The last time a drought this severe occurred was in 1976-1977. The area is likely to experience more future droughts with climate change and this project is an important part of building long term drought resilience.

This is the Tribe’s first application with the BOR outside of Tribal Assistance. We have been working with Kevin Clancy since December 2015 on our need for assistance with this project. We have been pledged $200,000 in technical assistance funding over the next two years, which should be released this spring, and we have put in an emergency drought funding application should funds become available. This is a large project that we have broken in to many phases for different grants in able to complete the entire stretch of bank stabilization. This proposal will address the most critical section.

Project Description

This project will stabilize the most critically drought impacted portions of the River bank on the Reservation. This section is putting the housing and river habitat at risk. Climate change is amplifying and expediting destabilization with extreme precipitation events and extended drought years. CVBPI is working with the Mendocino County Resource Conservation District (RCD) to assist with best management practices, quality control and compliance with the Russian River Watershed Management Plan (RRWMP). The work proposed addresses nonpoint source pollution impairments and threats. Some impairments are as follows: streambank destabilization, sedimentation from erosion, channelization and channel incision, high temperatures and low dissolved oxygen as well as removal of riparian vegetation and increases in noxious weeds. Chinook and Steelhead, both on the threatened species list, are seen on the Reservation. Their numbers have been dwindling due to habitat loss because of the bank and other drought impacts. Sedimentation from bank collapse is a major impact on their ability to thrive in the River. The largest threat to their habitat is siltation with increased water temperature and decreased dissolved oxygen close behind. Ideal temperatures for spawning are 5.6-12.8 degrees C. The river is often above that and reaches near impairment levels for adults. Dissolved Oxygen (DO) should be around 11 mg/L for healthy hatching of eggs; even adults will avoid water below 5mg/L. We have seen readings in the range of 4 mg/L. Siltation caused by bank erosion affects all of these through filling of pools and loss of riffles. Filling of deep pools raises the temperature and decreases the riffles between pools that are necessary to increase DO. Siltation of gravel bottoms decreases spawning sites. Stabilizing the bank will reduce sediment loading, create new habitat, deeper pools, more riffles for oxygen and vegetative cover for cooler to temperatures to increase drought resilience for many years to come. As the vegetation grows on the project drought resilience will continue to increase.

Natural Resources Conservation Service (NRCS) and LACO Associates have measured the bank with a height ranging from 44 to 60 feet. Recent scours show a few inches to 1-3 feet inward sloughing. New scours appear after every significant storm. Scour widths vary in height, but are generally range from 20-30 feet in height at the bottom portion of the bluff. There is also serious undercutting in places up to several feet inward and up to the majority of bank height and various feet in width. Some of this has taken the form of voids going in to the face of the bluff. The largest of these recent voids is 15 by 15 at feet on the face. Several people could stand inside these at one time if it were stable enough to be safe. In one storm, last spring nearly 10 feet of undercutting occurred in one backyard. This seriously endangered several homes. It required backyard reduction and fence installation 20 feet closer to the home. This is not the first fencing move that has occurred at this location. The area of greatest concern is a 650-foot stretch of the bank and a smaller section in the middle near the home experiencing undercutting. This section in recent events alone has contributed around 100 tons of sediment to the Russian River. Unfortunately, during periods with high levels of turbidity we have been unable to test the levels in the water due to access issues during high water. During storms, active erosion is clearly visible on the face. This occurs as undercutting and as mud running down the face. During the summer, raveling of the slope is continual, and results in pelting with debris when working near the slope. It is clear that this is a significant source of NPS pollution in the form of sediment loading and is a safety risk. A local United States Geological Survey Geologist evaluated the site and was concerned that it could potentially collapse up to over 100 feet inward. A geologist and engineer from LACO Associates came and looked at the site with us before and during the major storms in December 2014 and 2015 and have confirmed our concerns that it is an extreme risk and needs to be stabilized as soon as possible. The section of the bank where the full force of the water hits the toe just as the River enters the Reservation on the northern boundary is the area which will be addressed with these funds.

Hydraulic modeling shows that 5 year flows are 2,000 cfs and 100 year flows are around 10,000 cfs. Velocity in a five-year event ranges from 4.5-9 feet per second and from 5.5 to 10 feet per second in a 50-year event. Recent storm events alone have contributed around 100 tons of sediment. This is due to considerable bank collapse and incision. Major flood years would only increase this sediment load. A major collapse could prove catastrophic for River health and fisheries. The Russian River has major flood years recorded for 1914, 1937, 1940, 1955, 1964, and 1986. Additionally, there are many other minor flood incidents including 2006, December 11, 2014, and January 2017 which have created increased active erosion. This project (all phases) will stabilize and restore native vegetation to reduce current sediment loading from the site at least in half and increase long term drought resilience to prevent this level of destabilization when drought occurs in the future.

Some of the project will be completed prior to the release of these funds. Some portions have already been completed such as the Basis of Design report, which is attached. The environmental compliance work is currently beginning. This will be available for review by Reclamation. After funding award, this project will go out for an implementation RFP to contractors. The Tribe will closely oversee the project both through the Environmental Protection Department, and through cultural monitors. Additionally, oversight will occur from the Resource Conservation District and their specialists. The area of soil that is quickly eroding and destabilizing and channelizing the water will be excavated to allow more flood plain and slower velocity coming in to the bank. This will be used to fill in some areas where native plants will be installed. Large riprap will be placed at the toe of the bank to prevent undercutting. Large woody debris and native plants will be installed around this to help with pool and riffle formation, decrease water temperatures, increase dissolved oxygen content and to help uptake nutrients and reduce eutrophication. The amounts of each of the materials being used are described in more detail in the budget section.

Photographs and maps of this area are included but do not adequately show the scale of the cliff face or the level of destabilization. The Environmental Protection Department can be contacted for any further information on this project at epddir@coyotevalley-nsn.gov, 707-485-8723 x2260 or 707-671-5842.

Work Plan /Performance Measures and Evaluation

Component/ Commitment	Performance measures and evaluation
1.Contract project	
1.1 Draft project RFP. Review proposals. Get contract in place for stabilization work.	A contract will be entered and work will be completed as set forth in the budget.
2.1 RCD Contract Administration	Copies of financials will be available
2.2 Coordination with watershed coordinator/ fisheries biologist on watershed plan, BMPs, project implementation oversight	Information on the link to the watershed plan will be available and the project will proceed in accordance with BMPs and watershed wide planning.
2.3 Contractor will provide initial plans and tentative schedule	Plans and comments will be available
3. Implementation of drought resiliency project	
3.1 Excavation will occur near the northern Reservation boundary	Photos of work will be taken, the Tribe will oversee the project with a project manager, cultural monitor and fisheries biologist from RCD to ensure that habitat is restored with the least impacts possible.
3.2 Placing of large rip rap at base of river bank at first point of contact with the current	This will reduce at least a quarter of the sediment loaded produced from the site and will be able to be measured through reduced rate of retreat and reduced numbers of scarps. Oversight listed above will be there throughout all of the implementation and photos of the work will document it.
3.3 Placing of large woody debris	See above
3.4 Planting of native vegetation	See above This combined with the work above will restore the habitat and increase drought resilience for plants and animals in the area as well as geologically by assisting with soil stabilization.

Evaluation Criteria

Project Benefits: This project will not make additional water supplies available, but will protect water from evaporation and maintain pools for habitat throughout the summer months through reduced siltation and design with riprap, woody debris, and native plants.

Long term resilience to the drought will be built through habitat restoration, revegetation and soil stabilization preventing major siltation and collapse in the future and providing long lasting habitat which will improve over time as the vegetation grows.

The project will benefit fish wildlife and the environment by reducing or eliminating most impairments to this reach of the river and further downstream. It will provide adequate habitat for fish to increase spawning in the stream and help revive two threatened species. It will assist in restoring 900 feet of river, and will dramatically reduce impairments in at least one mile of the river. It will improve habitat for two threatened species and will help many species of plant and animals thrive with improved habitat conditions and drought resilience.

Steelhead and Chinook have been severely impacted by the drought here because of the increased erosion and siltation of spawning areas and pool. This has led to increased temperatures and decreased dissolved oxygen as well as more concentrated nutrient loads leading to eutrophication. The species are both subject to recovery plans, with NOAA as the lead agency and we have consulted with them on this project. They concur on its importance.

Both threatened species are dependent upon enough water supply for pools with lower temperatures in the summer. It is also important to maintain a riffle network which will provide dissolved oxygen and assist with spawning habitat.

This section of the River traditionally is able to provide more vegetative cover over the narrower channel allowing for deep, cool pools to provide over summer habitat. This project would restore that habitat, which would improve the status of the species.

Resource Conservation District has said that it will directly improve the water management not just of the 900 foot stretch on the Reservation, but for at least one to two miles downstream and will assist in improving the overall impairments on the River as a whole. The River flows through two counties with numerous uses, many users, and high importance.

Drought Planning and Preparadness: This area is part of our long term climate change planning which accounts for both the risk of extended drought and of flood increasing. The project will mitigate the loss of capillary forces by stabilizing the soil and it will replace vegetation lost through the drought and increase pools to sustain that vegetation in future drought. The restoration of pool riffle systems, which was lost due to drought related sedimentation, will reduce river impairments. The stabilization and will prevent these problems from reoccurring on this scale. A copy of the relevant section of the climate change plan is included.

Severity of Actual or Potential Drought Impacts: Currently there are impacts, as noted previously in this proposal, to the River system because of the drought. Potential impacts if the situation is not stabilized are more severe. A large collapse could decimate low income minority housing, pose a great risk to human safety and be catastrophic for the River and neighboring properties. There has already been an issue with a person falling from the bluff and we have found animal bones on top of collapsed sections. The risks would increase exponentially with a catastrophic failure which could occur without stabilization. If this problem is not addressed the threatened salmonid species may not be able to continue to live in or spawn in this area of the river system. California has experienced four years of exceptional drought as can be seen in the California Drought Monitor and is well publicized. We have the potential for future droughts as severe or more so as climate change progresses.

Project Implementation: The proposed work will occur over two summers. No implementation work can occur during high water levels, spawning times or when fry are hatching. The first summer will conclude the excavation and major riprap installation. If water levels remain low enough long enough, then large woody debris and planting will occur. The timeline is highly dependent upon water levels and fish passage. By the end of summer 2017 the site should be excavated and the first layer or riprap installed at the least. By the end of the summer 2018 the portion of this project included in this proposal will be complete.

Permitting has been discussed further in other sections of this proposal. It is in progress and being included in the RFP for the environmental assessment, but the Tribe has already been in contact with the relevant agencies and they are aware of the project and have been working with us.

Design and engineering work is included in the report and further design will be contracted after the Environmental Assessment is complete taking in to consideration any comments and suggestions which come from that process.

Nexus to Reclamation: The proposed project will work on the site of a Reclamation technical assistance project and will meet a trust responsibility to the Tribe.

Environmental and Cultural Resources Compliance: The project will have some impacts during construction to the surrounding environment. There will be work that grades and excavates areas on the bank and heavy equipment will enter the channel in order to excavate and place stabilizing features such as the rip rap. There is currently an RPF for an EA to complete a full NEPA/ CEQA assessment for the entire project in all of its phases. Any recommendations made in there for minimization and mitigation will be completed. The channel will not be entered during high water or fish passage periods. Care will be taken to disturb only what needs to be disturbed and the end result will be much improved habitat and viable salmonid rearing areas.

Steelhead and Chinook are both in the River and are on the threatened species list. There is no designated critical habitat within the protection area because of the current impairments. They are listed jointly through NOAA and USFWS. Fish and Wildlife said that the primary point of contact for these species is NOAA. We spoke with Tom Daugherty at the Ukiah Field Office, who has been on a site visit, and he believes the project will be highly beneficial for habitat improvement. The current condition of the site is recognized as an impediment to healthy habitat for these species and the project may have some minor influences on them during construction that are currently unpredicted but will produce improved habitat for them both on the Reservation and downstream. Any impacts will be mitigated according to recommendations.

The surface water of the project is under base level Clean Water Act 106 & 319 funding as well as competitive 319. The long term impacts to this waterway by the project are projected to be extremely positive. The area has had site visits from both the water division at EPA Region 9 and Headquarters who approve of the project and have funded a phase currently in process.

This project does not pertain to a water delivery system. It is restoring habitat to pre-drought conditions on a River.

The project will not have any direct impact on an irrigation system. However, reduced turbidity will be an improvement for irrigation and drinking water uptakes that must shut down during times of high sedimentation. This will improve water use for drinking water and irrigation uptakes downstream including the City of Ukiah.

No historical register buildings will be impacted by this project.

There are no known archaeological sites in the project area. However, a full NEPA and CEQA review are being conducted and a cultural monitor will be present for ground disturbing activities.

The project will be beneficial to a low income minority community by preventing low income housing from becoming critically endangered by the collapsing bank. Additionally, it will improve habitat for their cultural practices. No adverse impacts will occur for a low income or minority population.

This is a Tribal project, which will improve access and use of the water for ceremonial and traditional uses and will not inhibit it in any way.

This project will be removing invasive species and replacing them with important native plants and will not contribute to the spread of noxious weeds.

$150.00 per cubic yard totaling $105, 000. Placement of 1,400 tons of rip rap at the toe of the bluff at $140.00 a ton totals $196,000., with an additional $74,214 in matching funds from our BOR 638 for technical assistance which will lay 530.1 tons in the second level. Revegetation with native plants will occur at approximately $500 each section placing 45 sections totaling $22,500. Large woody debris will be placed at $150.00 a cubic yard and approximately 50 cubic yards will be placed totaling $7,500. The costs of the existing contracts was negotiated through the RFP process with companies bidding for the contracts. This same process will be used for future contracts. The prices used as estimates are derived for the Basin of Design Report provided by LACO and included in the attachments.

Environmental and Regulatory Compliance Costs: These costs are detailed above in the contract which is currently out for RFP for in which the contractor will complete an Environmental Assessment which complies with NEPA and CEQA and works with all agencies for approval and permitting of the project. Currently BIA is the lead agency on this project for NEPA because they were the first to provide funding. The total cost available for this RFP provides $84,000.

Indirect Costs: We have a federally negotiated Indirect Cost Agreement, which is included in supporting attachments. The current IDC rate is 18.81% the costs included in this rate are itemized in the agreement and no costs covered by the agreement are listed anywhere else in the budget.

System for Award Management: Coyote Valley Band of Pomo Indians is registered in the SAM system and our DUNS number is 149723157.

Total Costs: Requested from Reclamation: $300,000; provided in match through 638 contracts $300,000. Total Costs: $600,000.

<u>Supporting Attachments</u>

1. Photographs, and maps	**pp. 19-32**
2. Water quality data graphs	**pp. 33-34**
3. Basis of Design Report and modeling	**Electronic attachment**
4. SF 424 and other federal forms	**Electronic**
5. IDC agreement	**Electronic attachment**
6. Resolution from Tribal Council	**Electronic attachment**
7. Letters of Support and Commitment	**Electronic Attachment**

This view is looking downstream from the upstream end of the erosion during low water. Scarps and voids in the bank are visible. This photo on the left was taken in February 2015. The photo on the right is slightly more close up view of the same area in May 2016.

By April 2016 the top above the void has collapsed in by over three feet and much of the void collapsed during one April storm as seen above. On the right is what remains of the void after a major collapse in May 2016.

Just upstream of the bank January 11, 2017 (18 hours past storm crest)


January 11, 2017 (18 hours post crest) new voids visible on the face, active erosion

January 12, 2017 upstream of bank (38 hours post crest) on left. On right new voids and scarps are clearly as visible as far as can be seen down the face where it was previously covered by storm water.

The April 2016 storm caused a large collapse just downstream of the void completely filling in another void. Most of the sedmiment was washed away, but these are the piles that remained when the water receded.

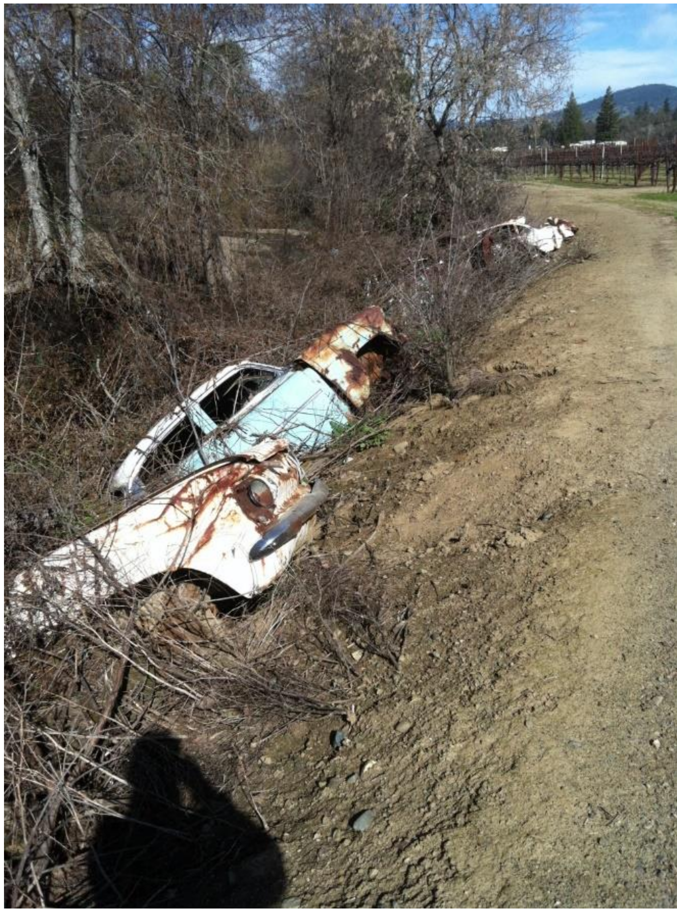
Left January 2017 Right December 2016

Russian River just upstream of the bank during December 2014 storm event a couple of hours past cresting.

The area of most immediate concern during December 2014 storm event, past crest on the left. Same area during low water February 2015 on the right.

Post December storm event with person in photo on right for scale.


Much smaller storm event, past crest, February 6, 2015.

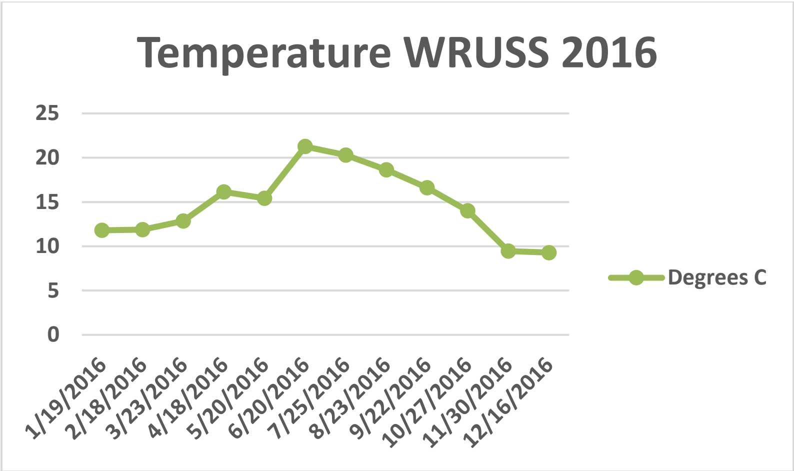


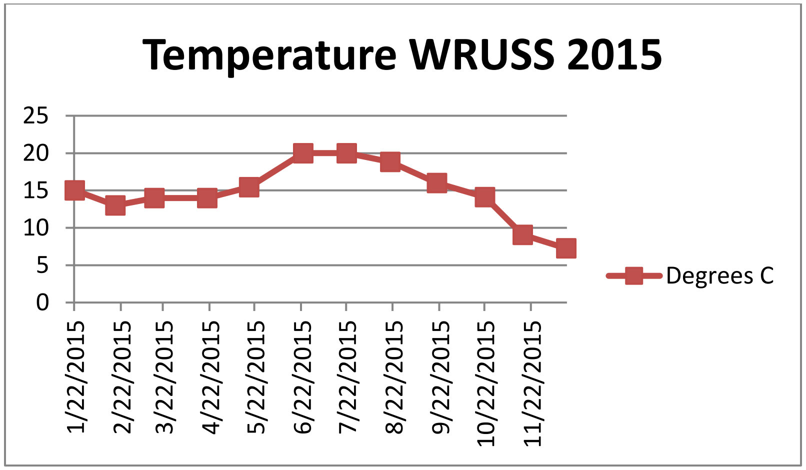
The photo on the left shows an example of the historical armoring of the opposite bank at the vineyard which is still in situ. The photo on the right is a view of the bank from the vineyard on the eastern bank.

The road showing endangered structures on top of the bank.

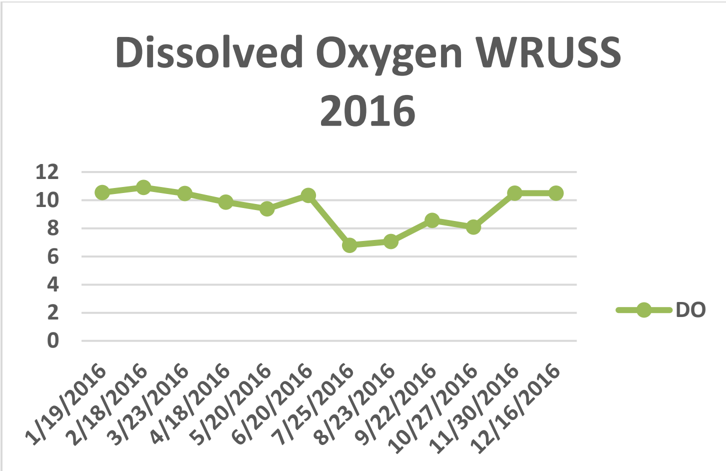
January 7, 2016 2 days past crest (moderate storm)

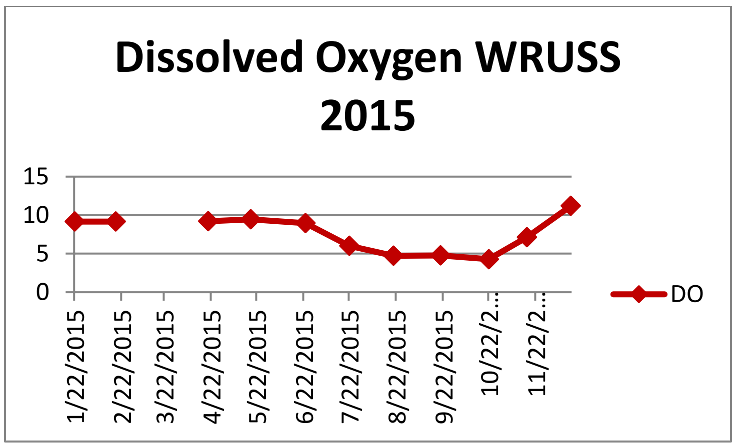
January 7, 2016 2 days past crest (moderate storm) **January 7, 2016 2 days past crest (moderate storm)**





This shows that the temperatures are reaching near impaired status and are frequently above the ideal temperatures for salmonids particularly for spawning, eggs, and juveniles and during the times of year they are in the water. 5.6- 12.8 degrees C is the ideal temperature for spawning Chinook.





Dissolved Oxygen levels should be at or above 11mg/L for healthy hatching of salmonids. For healthy juveniles it needs to be at or 8 mg/L and at or above 6.5 mg/L for ideal adult conditions. Adults will begin avoiding waters when the dissolved oxygen content is less than 5 mg/L. As you can see the only time the dissolved oxygen reaches levels for healthy hatching is immediately after a winter storm. There are many times when it is below even acceptable levels for adults. This problem will only increase if the erosion and siltation are not mitigated.

Relevant sections from draft Climate Change Adaptation and Mitigation Plan

Social Environment

Loss and decline of traditional species has a major social impact on the Tribe. This includes plant species in the riparian zone used for basket \ making such as sedge, dogbane and willow to medicinal species like angelica and dog bane to species used for multiple purposes like elderberry, California Bay Laurel, oaks and buckeye. Many plants and fungi have numerous important uses such as: soap root, miners' lettuce, nettle, manzanita, madrone, many mushrooms, black raspberries, wild gooseberry, wild rose, salmon berries, native thistles, bunch grasses, reeds, pine trees, fir trees and many more. Animals traditionally hunted and fished which are important parts of diet and culture are also at risk from decline, change in range or extinction. The decline of salmonid species is one of the most notable climate change impacts currently impacting the Tribe socially. Because they are a species which spawn in our waterways and are fished here as well as being fished in the ocean they are susceptible to impacts in the marine and inland environments. There has been a notable decline in these species in California since 1970 (Beamish, Riddell, Lange, Farley, Kang, Nagasawa, Radchencko, Temnkh & Urawa). The decline on the Reservation has accelerated with the drought. The changes in the times of rainfall also impacts traditional harvesting events. Extreme heat and other weather events can make cultural events and harvesting events to be cancelled or pose more health risks to hold.

Natural Environment

The ecosystem here has had many disruptions over the years due to many factors including climate, population density changes in the area, land use changes, introduction of species and many other issues. Although there are many causes to changes seen in the area, climate change has a very real impact on its own and exacerbates the changes created by other impacts.

There are already changes occurring to the predominant species in the area and health of Native Species. While climate change has not introduced invasive plant species to the area it has stressed native vegetation. This has made the environment opportune for previously introduced species to thrive and become invasive. This heightens the need to monitor introduced species and their impacts in order to be able to stop rapid and detrimental spread early.

Issues with erosion and bank destabilization are not caused by climate change, but are greatly impacted by it. There are a number of historical factors which lead to these including gravel mining, bank armoring, fault uplift, down cutting upstream due to a dam on the other fork, development, invasive species build up in the channel, and so forth. The extreme events that occur with climate change are already significantly impacting the bank and worsening erosion and destabilization along all of the waterways. The exceptional and extended drought was followed by heavy rains this year, both extreme events linked to climate change, have both significantly increased the erosion and destabilization of the bank. The extreme dry period saw the soils dry out to the point that capillary forces were lost and it became very unstable on all the waterway banks, road embankments and by the retaining wall. Additionally, the drought stressed vegetation which then died or became diseases and vegetation along the top and the bottom of the bank was lost due to the drought and the benefits of the root structure for stabilization have been lost. In their place we have had issues with overgrowth of invasive species, most notably Himalayan blackberry, which are significantly denser than the native vegetation and have channelized the water and moved the thalweg closer to the bank because the water cannot spread out on to what was previously the floodplain. There has also been some impact from animals wearing new trails down and opening up areas for erosion. This has occurred because only the deepest pools have maintained water for them to drink during the drought. Many feet have been lost at a time during recent storms on the Russian River bank, elevating the emergency status of the situation. Please see the before and after photographs. This continues to pose a greater risk as the result of climate change.

Erosion and landslides are an issue for the Reservation outside of the waterways as well. There is an area which is already having land slip issues over a failing retaining wall which threatens the main access road and water main. A risk assessment and modeling were conducted on it. It is impacted both by potential heavy rains causing soil slippage and by drought because of the loss of capillary force. There are other areas on the Reservation which have traditionally had slippage and erosion issues and the slope and soil type in the area create a high risk for landslides. This is also an issue for the Tribe not only on the reservation but because there are major issues with landslides which frequently impact the main access highway that goes past the Reservation and can interrupt emergency services to the area, particularly during severe storms when they may be the most needed. Landslides are expected to increase with climate change, but research into their geology has thus far been done independent of hydroclimatic research (Istanbulluoglu &Strauch). However, Istanbulluogulu of the University of Washington is working on a modeling project which will incorporate both of these aspects and will be useful to the Tribe in the future. It is important to remember that landslides and erosion are at the greatest risk in heavy rains after extreme dry and these situations will increase with the progression of climate change.

Decline of salmonid species is a huge climate change concern for the Tribe. The decline of the species has been noted for several decades along the Pacific Northwest Coast, but Tribal Members who fish the waterways regularly have noticed a particularly marked decline on the Reservation within the last five years. The effects of climate change on both freshwater and marine ecosystems in the area are playing a huge role in the decline of these species due to the stresses that occur on them through a number of environmental factors including water levels, water temperature, upwelling, acidification and hypoxia (Beamish, et al). There are many oceanic climate change impacts which are contributing to this decline as mentioned in the off Reservation impacts, but there are also inland climate change factors. We see this with the decline of snow melt (Beamish et al), which contributes to stream temperatures, water levels during spawning and juvenile growth, dissolved oxygen levels and pH. On the Reservation the largest contributing factor is the drought because it has lowered water levels, decreased vegetation and pool cover and this has in turn increased water temperatures. Eutrophication has also increased due to low water levels, nutrient loading concentration and the loss of vegetation to denitrify the water. Eurtrophication, low water levels and loss of capillary forces causing siltation have all contributed to lower dissolved oxygen levels. The siltation has caused pools and riffles to be lost because of pool siltation. This has caused lower water levels, loss of dissolved oxygen and higher water temperatures. The fines have decreased the ability of salmonids to spawn and have decreased available habitat for their entire in stream lifespan.

Built Environment

The built environment on the Reservation faces impacts from Climate Change that are real and current threats. The most notable is that the severe erosion and destabilization of the West Fork Russian River threatens Tribal Housing. The Tribe is currently working with BIA, BOR, USEPA, Army Corps of Engineers, Department of Water Resources, Bureau of Reclamation, Federal Emergency Management Agency and others on finding and funding a stabilization solution. Damage already done cannot be reversed and other damages can be slowed down, but ultimately may not be able to be stopped in the face of climate change. Stabilization and replanting the area will assist with long term resilience to drought, extreme rain events and other impacts of climate change.

The lower elevation areas of the Reservation are at greater risk from extreme events in the future due to higher flood levels expected with yearly precipitation predicted to fall in fewer events with more precipitation per events. Floods can impact roads and buildings on the lower part of the reservation as well as threaten other infrastructure with landslides from high rainfall. This includes the potential for impacting the water main running down the hill on to the Reservation.

Extreme events with higher winds threaten communication and power lines as well as road access and built infrastructure and facilities with the potential for downed trees or direct wind damage.

Thunder storms with greater severity create a security threat to the entire built environment through fire danger. They may also interrupt communication and power lines. While the Reservation has not lost any homes to wildfire, recent nearby fires have shown the risk of losing a whole area to drought fueled wildfire. Climate change has increased fire season by an average of 78 days every year and has seen the number of acres burned every year doubled from 1980 (USDA).

Environmental/ Native Ecosystem:

Many environmental protections and adaptations need to occur on an ecosystem scale so it is important to collaborate with other partners and projects and to continually review new research. University of Washington does a lot of applied climate change research so it is a good resource to keep in mind. Habitat connectivity is an important aspect of climate change adaptation because it allows species to move within an ecosystem as conditions warrant and larger chunks of habitat are more resilient especially when faced with diseases and invasive species. Creating ecosystem connectivity is listed as the number one climate change adaptation for species yet there are few areas which have worked out plans on enacting this so far (Krosby). It is important to keep an eye on research that is being done to look at genetic adaptations in native plants and animals. Genetics cannot keep pace with the speed of climate change, but genetic markers are being monitored in some species to look for beneficial adaptations that may be able to be propagated. There are only a few trial species, but the University of Washington study is looking at gene mapping for Douglas Fir (*Pseudotsuga menziesii*). They are including gene tip technologies and genomics to look at the spatial range of adaptations and look at the ability of those adaptations to survive in different areas over time with climate change (Shirk).

Some environmental mitigations and adaptations can be done on a localized scale and one of the most important things that can be done on the Reservation at this time is to stabilize and restore riparian zones. The first and most critical area of restoration is the Russian River Bank. This is the first priority for stabilization and restoration. This is critical to stop current damage and to create resiliency in the future.

Housing and other structures:

The first priority in planning and action is to find funding for and stabilize the river bank. Then move the houses most at risk away from the bank if the restoration does not mitigate safety concerns for all homes. The future stability of other homes there an anywhere there may be a landslide risk will then be evaluated. All new construction will be completed with flood risks and extreme events in mind and construction completed in the flood plain area will be elevated. In light of climate change extreme event predictions it should be elevated beyond current recommendations for the flood zone to prepare for these changes. Structures will be built with insulation and energy efficiency in mind to mitigate further expediting of climate impacts and to make them more resilient to extreme events.

Traditional Practices:

Traditional practices and sites are threatened through climate change. It is important to have Tribal members who harvest for traditional purposes to keep a log of changes noted so that mitigation and adaptation measures can be better planned for. As timings for harvest change due to the changes in climate patterns this will also assist in the ability to predict and continue traditional harvests on a different time schedule. There may be areas in which traditional plants need to be planted where they can be tended to for survival because the climate may no longer be as hospitable for them to grow wildly. Prioritization of the plants will be done by Tribal members and reviewed at least biannually unless there is a specific need or concern which arises prior to this. Priority lists for the protection of plants, animals, and cultural sites on and off the Reservation are included below and can be updated. There may also be the need to form partnerships for harvesting plants and animals outside of traditional territories as they move due to climate change. In our area this would most likely mean the need to move further north for harvesting. Restoration of River and Creek habitats to preserve as many of the species as possible on the Reservation is an immediate priority beginning with the stabilization and restoration of the Russian River bank.

Relevant section from the draft Predisaster Hazard Mitigation Plan

1.1.1 Landslide/ Erosion/ Bank Collapse

Risk: Extremely High

This is a problem that is already being experienced and is rapidly becoming worse. All three of these are related and pose numerous hazard issues, however, the bank collapse is our area of greatest concern currently which will have the biggest consequences to the environment and human safety. Bank collapse, erosion and landslides are risk issues in many areas of the Reservation. The greatest risk and most immediate concern is the West Fork Russian River bank behind the houses on Coyote Valley Boulevard. Hydrogeological modeling for this area has been completed and there is a significant amount of data on this problem some of which will be included in the appendices. Please see the basis of design report. We have also had a separate risk assessment conducted on the retaining wall above the main access road which is already failing and land is sliding above it. Erosion is a continual problem on the Reservation particularly along the waterways during high flows following drought when soil cohesion has dropped due to the extreme drying diminishing capillary forces. There have also been additional contributing factors with the drought such as build up of gravel bars and extremely dense invasive species pushing the force of the water in to the River Bank. Dead and dying native vegetation stressed by drought and additional animal tracks to find water have all aided in erosion issues across the Reservation since the drought. All known risk areas for severe erosion, landslide and bank collapse should be mitigated as soon as funding becomes available. The West Fork Russian River bank is the first priority for mitigation due to the risks is poses to human health and safety as well as environmental health of the River system.

LACO

January 27, 2017

7753.05

Coyote Valley Band of Pomo Indians
PO Box 39
Redwood Valley, California 95470

Attention: Emily Luscombe

Subject: Basis of Design Report
Coyote Valley Stream Restoration

Dear Ms. Luscombe:

Enclosed, please find a Basis of Design Report describing several potential design alternatives for improving a section of the Russian River on the Coyote Valley Reservation, as described in the Scope of Work included in our Proposal to Provide Hydrologic and Hydraulic Assessment and Modeling dated December 10, 2015.

Please do not hesitate to contact us at 707-462-0222 should you have any questions or concerns regarding this report.

Sincerely,
LACO Associates

Christopher J. Watt, C.E.G.
Principal Engineering Geologist

PROFESSIONAL GEOLOGIST
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STATE OF CALIFORNIA

OKW/JER/RLW: jc

P: 7700\7753 Coyote Valley Band of Pomo Indians\7753.05 Stream Restoration\01 Proposal Documents\7753.05 Design Memo Tech Report 20160722.docx

Basis of Design Report

Coyote Valley Band of Pomo Indians Stream Restoration

February 01, 2017

Prepared For:
Coyote Valley Band of Pomo Indians

Prepared By:
LACO Associates, Inc.
21 W. 4th Street
Eureka, California 95501
707 443-5054

Project No. 7753.05

LACO

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Christopher J. Watt, CEG

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1.0 INTRODUCTION

This document has been prepared for the Coyote Valley Band of Pomo Indians (the Tribe) by LACO Associates (LACO) to present the results of our evaluation of alternatives to address river bank instability along a reach of the West Fork of the Russian River passing through Tribal land in Redwood Valley near Ukiah, California. The location of subject project is presented on Figure 1.

The project area is approximately 800 feet long and is situated on the west bank of the West Fork Russian River. It is eroding a nearly vertical cliff, 40-50 feet high, with numerous scarps and large areas of notable wear caused by high flows in the river (see Figure 2 – Topographic Map). Tribal Housing is located on the top of this bank, and is becoming incrementally closer to the edge as bank collapses continue to occur. This erosion is contributing a significant amount of sedimentation to the Russian River system and the undercutting of the steep river bank is destabilizing the soil. The Tribe is concerned about further undercutting and erosion causing major bank collapse and ultimately threatening tribal homes and tribal members' safety. Given the above described circumstance, the Tribe sought out this assessment and hydraulic modeling as an important step in a project to stabilize the bank, and protect the housing and the water quality of the Russian River.

This area along the Russian River has been subject to several consequential events:

- Previous upstream gravel mining;
- Bank armoring on the opposite river bank;
- Drought induced changes in riparian vegetation, overgrowth, and channel restriction;
- The channel narrowing along the subject stretch; and
- Tectonic uplift coupled with down cutting in the main stem.

Our alternatives evaluation included a geotechnical survey, a topographic survey, a channel roughness evaluation, and a biological and botanical survey previously completed by the tribe. A hydrologic and hydraulic analysis was subsequently performed to evaluate existing conditions in the subject reach and provide a basis for developing and evaluating project design alternatives.

2.0 HISTORIC BLUFF RETREAT EVALUATION

2.1 Discussion and Methodology

A review of available historic aerial photography of the site was conducted to help evaluate the distribution, history and timing of past bluff retreat at the site. Our review was performed using five sets of aerial photographs obtained from the NRCS covering approximately 64 years between 1952 and 2016. In addition Google Earth photo imagery taken in 1993, 2004, 2004, 2006, 2007, 2009, 2010, 2011, 2013 and 2014 were reviewed to aid in the evaluation. A summary of the results are presented in table 1 below:

Table 1: Review of Site Specific Aerial Photography

Year	Description
1952	The area of the present day Campbell Drive, Coyote Valley Boulevard, tribal residential development is located within an undeveloped portion of the uplifted Russian River terrace covered with brush and scattered mature oak. At this time Highway 101 to the west of the site, as well as East Road and the North Pacific Railroad lines to the east are presence in their current orientations. No other surface streets are present. As this time, with the exception of tree lined riparian areas adjacent to Forsythe, and Salt Hollow Creeks, much of the land to the south and east is developed as farm fields and orchards with scattered farm houses connected via dirt driveways to Highway 101 and East Street. At this time much of the Russian River banks are obscured by mature trees and brush. The alluvial gravel bars visible in present day aerial photography, particularly to the east of the north end of the Study area appear more heavily vegetated, with only the immediate channel visible.
1972	Land use patterns around the Study area have changed only a little since the 1952 photos. By this time a strip of rural residential properties have been developed along East Road to the east of the Russian River. More of the farm land to the south and west, adjacent to Forsythe Creek have been planted as orchards. The uplifted alluvial terrace including and to the north of the study area is still undeveloped brush and oak forest. In this photo the Russian River, Salt Hollow Creek, and Forsythe Creek channels are all noticeably less vegetated with exposed gravel bars clearly visible in the bed of the Russian River. The river bars and channel location appear to be in approximately the present day configuration with channel impinging on the western river bank at the north end of the study area where the river turns gently east before following the eastern bank. At this time, and at this scale no signs of recent slope failure of the western Russian River bank within the Study area were observed.
1981	A new farm house has been built at the base of the slope off the opposite side of a dirt road in approximately the position of Coyote Valley Boulevard from the future position of the Casino Complex. A network of dirt roads now appear on the vegetated terrace adjacent to the subject bluff.
1988	Coyote Valley Boulevard, Campbell Drive, and the associated residential housing development are present in approximately their current configurations. Much of the river flats adjacent to Forsythe Creek to the south and west are still developed as orchards, with an area at approximately the location of the future Casino Complex cleared for a softball field. The quality of this image is too poor to clearly make out signs of river bank erosion or slope instability.
1996	The Casino Complex an associated parking areas are present in approximately there current configurations. Due to the westerly sun orientation much of the base of the Russian River channel and western bank is obscured by shadows. No features associated with river bank erosion or slope instability were noted.

Year	Description
2016	These aerial photographs are highly detailed with a near vertical sun orientation making both the Russian River channel base and western bank clearly visible. East of the northern intersection between Campbell Drive and Coyote Valley Boulevard the Russian River channel makes an approximately 30 degree eastward turning. At this point the river channel impinges on the western river bank carving an approximately 60 foot high cliff. The slope at and over an approximately 100 foot stretch south of this point shows evidence of recent erosion and slope failure. The slope is unvegetated and a debris field is exposed on the gravel bar below the slope. There is also evidence of either active seepage, or surface drainage over this section of slope, in the form of wet areas and erosional riling of the lower slopes and debris field. Another area of recent slope failure is visible approximately 250 feet south opposite the confluence of the Salt Hollow Creek. In this area two shallow embayments appear to have been carved into the western bank. An unvegetated debris field is visible at the base of this slope with signs of seepage from the slope and erosional rilling of the lower slopes and debris. Other portions of the slope appear to be partially vegetated. Subhorizontal bedding is visible across much of the exposed cliff faces.

Based on our review of Google Earth images it appears the Casino Complex was constructed between 1993 and 1996, with the addition of a community center and swimming pool before 2003. Between 2005 and 2007 vegetation appears to have been largely scoured from Russian River channel gravel bars within the study area. Portions of the lower slopes forming the western bank, particularly an approximately 250 foot wide stretch opposite the Salt Hallow Creek confluence have been stripped of vegetation during this period. Signs of recent instability are visible in the 2007 photos in this area as yellowish brown terrace deposits extending as debris field out onto the grayish cobbles of the channel bars. By 2010 signs of revegetation of these areas is visible. In 2011 the quality of aerial imagery improves significantly, but the westerly sun orientation in the 2011, 2013 and 2014 photos obscures much of the western river bank in shade.

Copies of aerial photographs reviewed have been included in Attachment 1.

2.2 Bluff Retreat Rate Analysis

A combination of poor photo quality, adverse sun orientation, and vegetative cover made a precise delineation of the top of the river bank impossible in many of the sets of aerial photographs reviewed as part of this report. Three sets of aerial photographs from 1972, 2007, and 2016, where portions of the top of the river bank could be distinguished were imported into Google Earth Pro and geo-rectified using common topographic markers. The river bank edge in the vicinity of the site was drawn onto each of the historical photographs and the geo-rectified results overlain. The results are presented in Figure 3.

Based on this analysis two areas of high bank erosion were identified and their rate of retreat estimated. An approximately 100 foot long section of the western river bank adjacent to the northern end of the site, where the river makes an approximately 30 degree eastward turn, appears to have retreated by as much as 50 feet since 1972 with much of this retreat having occurred prior to 2007. An approximately 300 foot section of the western river bank opposite the confluence of the Salt Hollow Creek appears to have retreated by as much as 30 feet since 1972 with approximately half of this retreat occurring since 2007.

Based on our aerial photographic review the observed river bank retreat appears to be episodic and associated with events that also de-vegetate adjacent gravel bars.

3.0 SLOPE STABILITY ANALYSIS

To better evaluate the conditions contributing to the observed bluff retreat LACO performed a quantitative slope stability analysis. This analysis was performed using the computer program Slide 7.0. The analysis utilized the Modified Bishop method to search for the critical failure surface and calculate the factor of safety against sliding. The critical failure surface is defined as the surface with the lowest calculated factor of safety. In general, factors of safety greater than 1.0 indicate stable conditions, while factors of safety less than 1.0 indicated an unstable condition. The slope stability model was generated using slope configuration obtained from a topographic survey and geologic material properties and distribution obtained from a subsurface exploration.

3.1 Subsurface Exploration

On March 30, 2016, LACO explored subsurface conditions in the vicinity of the bluff by directing the drilling of two borings, approximately 55 feet deep, at the approximate locations shown on Figure 1. The drilling was performed by Pearson Drilling Company utilizing hollow stem auger equipment. Our geologist logged the borings and obtained samples of the soil and rock materials encountered. Logs of borings are presented in Attachment 2. At the completion of drilling, the borings were converted to piezometers to allow groundwater level measurements to be monitored over time. Boring Logs and Piezometer construction details are presented in Attachment 2.

The borings encountered dense to very dense sandy gravel with varying amounts of silt and clay, interbedded with stiff/dense sandy clay/clayey sand up to 10 feet thick to the depths explored (55 feet below ground surface). Measurements obtained from our piezometers yielded depths to groundwater in borings B1 and B2 of 41.85 feet and 47.87 feet, respectively.

3.2 Slope Stability Model

A worst case scenario cross-section was generated from a detailed topographic survey of the retreating section of bluff and combined with subsurface data to create a geologic cross-section for the analysis. Soil strength and density parameters used in the analysis were estimated from soil type and SPT penetration resistance (Hatanaka and Uchida, 1996, Empirical Correlation Between Penetration Resistance and Phi Angle of Sandy Soils, Soils and Foundations 36(4): 1-9). Depth to groundwater was changed to model different slope condition and river flow scenarios.

The results of our analysis are presented in Attachment 3. Normal river flow and no groundwater models produced similar results with a critical failure surface (the surface with the lowest factor of safety) extends through the slope from a point approximately 20 feet behind the bluff face, with a toe surfacing at the bluff base, with static factors of safety of approximately 1.0. A model approximating a post flood, ground water configuration was also produced. This model produced a critical failure surface extending from a point approximately 10 feet behind the bluff face, with a factor of safety of approximately 0.35. These results suggest that, in addition to over steepening of the slopes due to erosion, the increased driving forces on the slope due to elevated groundwater conditions after flood waters recede is an important factor in the observed slope instability.

4.0 TOPOGRAPHIC SURVEY

A detailed topographic survey of the project site was performed by Doble Thomas and Associates in May of 2016, and the field data was used to develop a topographic map with one-foot contour intervals. LACO in turn used the topographic information to generate five cross sections of the project area.

5.0 HYDROLOGIC AND HYDRAULIC EVALUATIONS

Hydrologic and hydraulic evaluations were performed by O'Connor Environmental for the reach of the West Fork Russian River adjacent to the Coyote Valley Reservation for both the 5-year rainfall event and the 50-year rainfall event (see Attachment 4). This analysis was performed to determine how the river channel is affected by the stormwater runoff from these rainfall events. More specifically, these storms were characterized both hydrologically to determine the quantity of flow and hydraulically to determine how that quantity of flow in the river effected the flood extents, water depths, and velocities. The hydraulic modeling was performed for both storm events and for both the existing river channel conditions and the proposed river channel using the restoration and wall armoring outlined in this memorandum. A summary of the analyses performed are presented in the following sections.

5.1 Existing Conditions

A hydrologic and hydraulic analysis was performed to characterize existing conditions in the project reach and provide a basis for developing and evaluating project design. The purpose of the project is to stabilize and reduce erosion of the near-vertical west bank of the river. The results of these analyses are summarized in the following section and detailed results are presented in Attachment 4.

5.1.1 Results Summary

For the 5-year event, within the reach with near-vertical western banks, water surface elevations were 9 to 11 feet above the base of the cliff face. Rapid dewatering of the cliff face is hypothesized as a mechanism for bank failure, and the water level results indicate that water levels against the bank recede fairly quickly dropping by about 6 feet over an eight hour period following the peak flow (0.75 ft/hr).

During the 50-year event, maximum water depths in the channel generally ranged from 14 to 16 feet with depths as high as 19.0 feet in deeper pools. The extent of inundation is only slightly larger than the extent during the 5-year event, as most of the additional flow was accommodated through increases in depth within the active floodway.

Maximum simulated velocities generally ranged from 4.5 to 9 feet/second during the 5-year event and from 5.5 to 10 feet/second during the 50-year event. Velocities were generally highest within the deepest portions of the channel with lower velocities along the channel margins. In a few areas, however, the region of highest velocities extended laterally up against the western bank of the river. This occurred in portions of the reach with near-vertical banks (vicinity of cross sections B and C in Figure 9 of Attachment 4), where maximum velocities against the cliff face reached as high as 9 feet/second during the 5-year event and 16 feet/second during the 50-year event.

5.2 Proposed Restored Conditions

Using the results of existing conditions evaluations (Attachment 4, restoration alternatives were analyzed to evaluate their benefits in increasing west bank stability and reducing erosion. For the modeling efforts performed, restoration includes re-grading and re-vegetating portions of the west bank and is intended to stabilize and reduce erosion of the near-vertical west bank of the river. The analyses performed evaluated flood extents, water depths, and velocities under proposed restored conditions. The results of these analyses are summarized in the following section; detailed results are presented in Attachment 4.

5.2.1 Results Summary

The restoration design results in the edge of flooding moving 5 to 10 feet away from the banks during the 5-year event and 10 to 20 feet away from the banks during the 50 year event. Minor increases in inundation extent along the edge of the vineyard on the east bank adjacent to the upstream restoration area occurred during the 50-year event. Water surface elevations increase slightly (0.1 to 0.2 ft) in the vicinity of the restoration areas during the 5-year event and increase more significantly (0.2 to 0.5 ft) during the 50-year event. The restoration design results in significant increases in in-channel velocities adjacent to the upstream restoration area during the 5-year event. Relatively high velocities occur along the edge of the re-graded banks in portions of the restoration areas, reaching as high as 12 to 16 feet/second during the 50-year event. The re-graded banks extend at least 5 to 6 feet higher than the 50-year water surface elevations in these areas.

6.0 SLOPE REPAIR ALTERNATIVES

Using the results of hydrologic and hydraulic evaluations, LACO evaluated several alternatives for stabilizing the west bank of the project area. The no-action alternative was ruled out because it will not address the progressive erosion and undercutting of the bluff that has resulted in a historical retreat of the bluff. We concluded that regrading/reshaping of certain areas along the channel needed to be performed to prevent river flow from slamming into sections of the west bank and bluff (referred to as Repair Areas 1 and 2) oriented at approximate right angles to the flow direction. To protect the Repair Areas and the remaining sections of the bluff from erosion and under-cutting, slope protection is proposed. There are many slope protection alternatives, including sheet piles, Gabion structures, conventional cantilever retaining walls, soldier pile walls, synthetic slope protections, and rip rap. On the basis of our evaluations, we conclude that rock rip rap placed over the Repair Areas and a shot-crete soil nail wall constructed along the entire project area is the most suitable slope protection alternative. It is effective, easily implementable, and relatively low cost.

7.0 PREFERRED ALTERNATIVE

Our evaluations indicate that the following stream restoration approach described above is the most suitable alternative to address slope stability and erosion control. The preferred alternative is shown in Attachment 5 and a preliminary cost estimate for designing and implementing the preferred alternative is also presented in Attachment 5.

We recommend this alternative be implemented in phases as follows:

Phase 1. **Environmental, Permitting and Funding –** Obtain funding for the environmental review, permitting and construction of the project. If funding is available for the environmental review and permitting then those two elements could be considered Phase 1. It may be a more systematic and efficient approach to obtain this type of funding first and focus all efforts on the regulatory requirements. This funding could potentially pay for engineering design services as well, which would be an additional benefit to the Tribe. The funding for the construction phases of the project would likely be more attainable if a more detailed and refined construction design alternative is completed. The primary goal of Phase 1 is to explore all potential permitting or regulatory requirements to ensure that the construction phases of the project aren't subject to unnecessary delays.

Phase 2. **Bioengineering –** Regrade and reshape the west river bank within Restoration Areas 1 and 2. This will require improving the access to the river channel adjacent to Restoration Area 1 so that heavy equipment and dump trucks can access the restoration areas. With this phase there will be the removal of a quantity of existing material to allow for larger riprap to be placed and the new channel geometry formed. The larger material will protect the base of the river bank at the northern end of the project extents as well as on the west bank of the Russian River at its confluence with Salt Hollow Creek. The existing material at the north end of the project isn't likely to be suitable material and will have to be hauled off to a suitable disposal location.

Phase 3. **Stabilization –** Construct a soil nail wall that will extend from below the scour zone to a height above the 50-year flood high water elevation. The soil nail wall will consist of soil nails (approximately 10 feet long and 6-foot, center-to-center spacing) tied to welded wire mesh and covered with shotcrete. The preliminary recommended alternative includes approximately 850 feet of the soil nail wall spanning from Restoration Area 1 to approximately 150 feet south or downstream of Restoration Area 2. In the restoration areas the soil nail wall will be above the riprap installed as part of Phase 2. The same access for heavy equipment and truck will be required for Phase 3 that was required for Phase 2. Construction of Phase 2 and Phase 3 concurrently will be optimal if funding allows.

Phase 4. **Revegetation –** Revegetate disturbed areas along with treatment up the upper 35 feet of the steep bank section by hydroseeding. Considering the soils types and the steep slope to which the hydroseed is to be applied, the Tribe should enlist the help of a qualitied botanist. This person can work closely with the Tribe to determine the best seed mix that incorporates specific plant species desired by the Tribe.

Phase 5. **Redirect drainage –** This effort includes ensuring that all roof drains on the houses with lots backing on the river are directed towards the road in front of the homes. The drainage on that road and any Tribal land adjacent to the area of concern should be evaluated and surveyed if necessary to determine the direction of runoff. If any of these facilities are found to be concentrating stormwater runoff and affecting the area of concern then measures to correct these problems should be taken. This could include regrading shoulder or open areas adjacent to the river, installing new drainage facilities along the roadway or in back yards, or installing energy dissipating facilities/structures to help protect the river bank from erosion.

Phase 6. **Move Threatened Homes –** This is a consideration if the circumstance arises prior to construction or if Phase 1 through Phase 5 proves to be too costly or too time consuming. The moving of homes is possible but is considered a last resort. In order to move a house the Tribe would first need to identify the new location for the house. Then the site would have to be prepared for the number of houses to be moved and that would include grading, drainage, all infrastructure and utilities necessary.

8.0 NEXT STEPS

When funding is obtained and the Tribe is ready to move forward with implementation of the preferred alternative. This would include development of refined design concepts for review and approval by the Tribe. Once a design concept is selected by the Tribe, construction drawings and specifications can be prepared based on the following steps:

Preliminary Design:

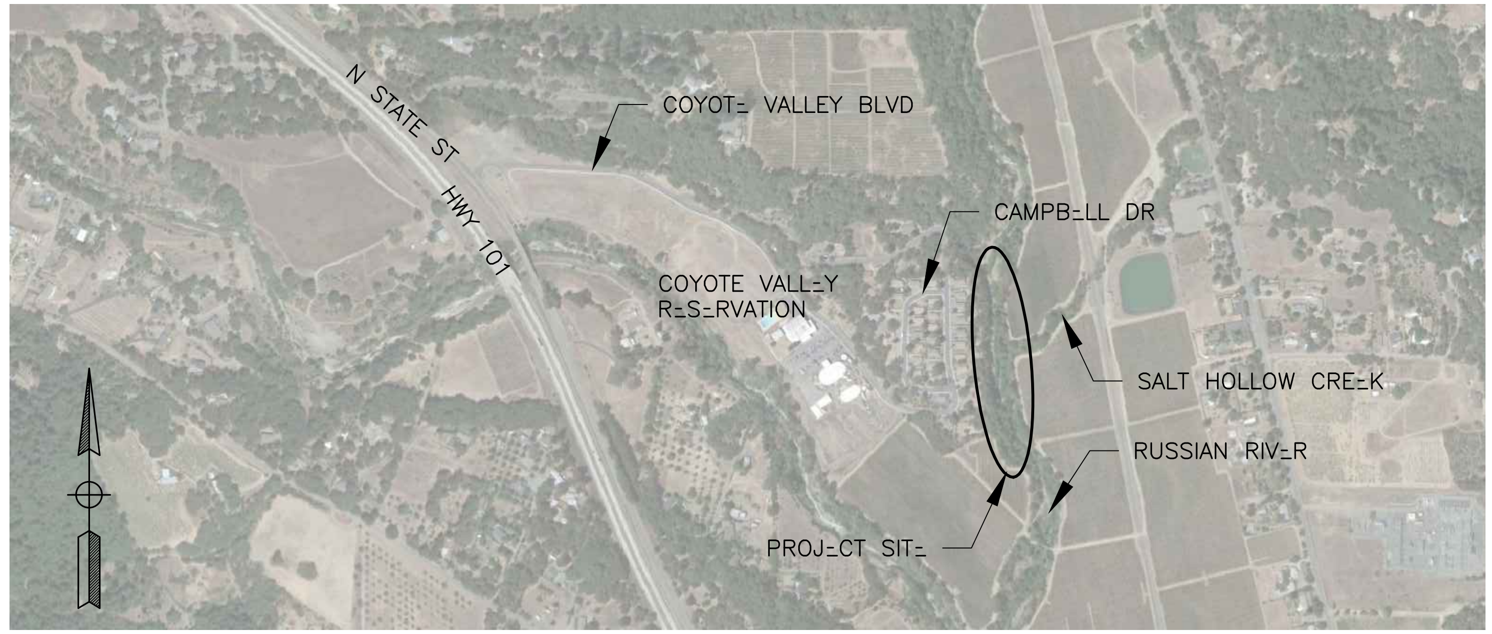
- Prepare 30 percent design of preferred alternative;
- Tribe reviews of 30 percent design; and
- Develop detailed cost estimate based on approved 30 percent design drawings and specifications.

Final Design:

- Prepare 90 percent design for Tribe's Review;
- Finalize design; and
- Solicit and receive bids for construction.

FIGURES

R=US= O =NTS: This documen- and -he ideas and design incorpora- d herein, as an ins-rumen - pro- ional service, is -he proper - -CO Associa- and shall no- be reused in whole or par - r any o-her projec- i-hou- -CO Associa- xpress wri- n au-horiza-ion.



SITE VICINITY MAP
SCALE: 1"=1000'

SITE MAP
SCALE: 1"=100'

1"

GRAPHIC SCALE MEASURES 1 INCH ON HALF-SIZE PLANS.

DRAFT

PROJECT	COYOTE VALLEY STREAM RESTORATION
CLIENT	COYOTE VALLEY BAND OF POMO INDIANS
LOCATION	7751 N STATE ST, REDWOOD VALLEY, CA
	VICINITY AND SITE MAP
BY	BD
DATE	10/07/2016
CHECK	OKW
SCALE	SHOWN
FIGURE	FIGURE 1
JOB NO.	7753.05

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T:\Cad-iles\7700\7753.05 COYOTE VALLEY STREAM RESTORATION\DWG\ 7753.05 FIGURE 1 SITE MAP.dwg
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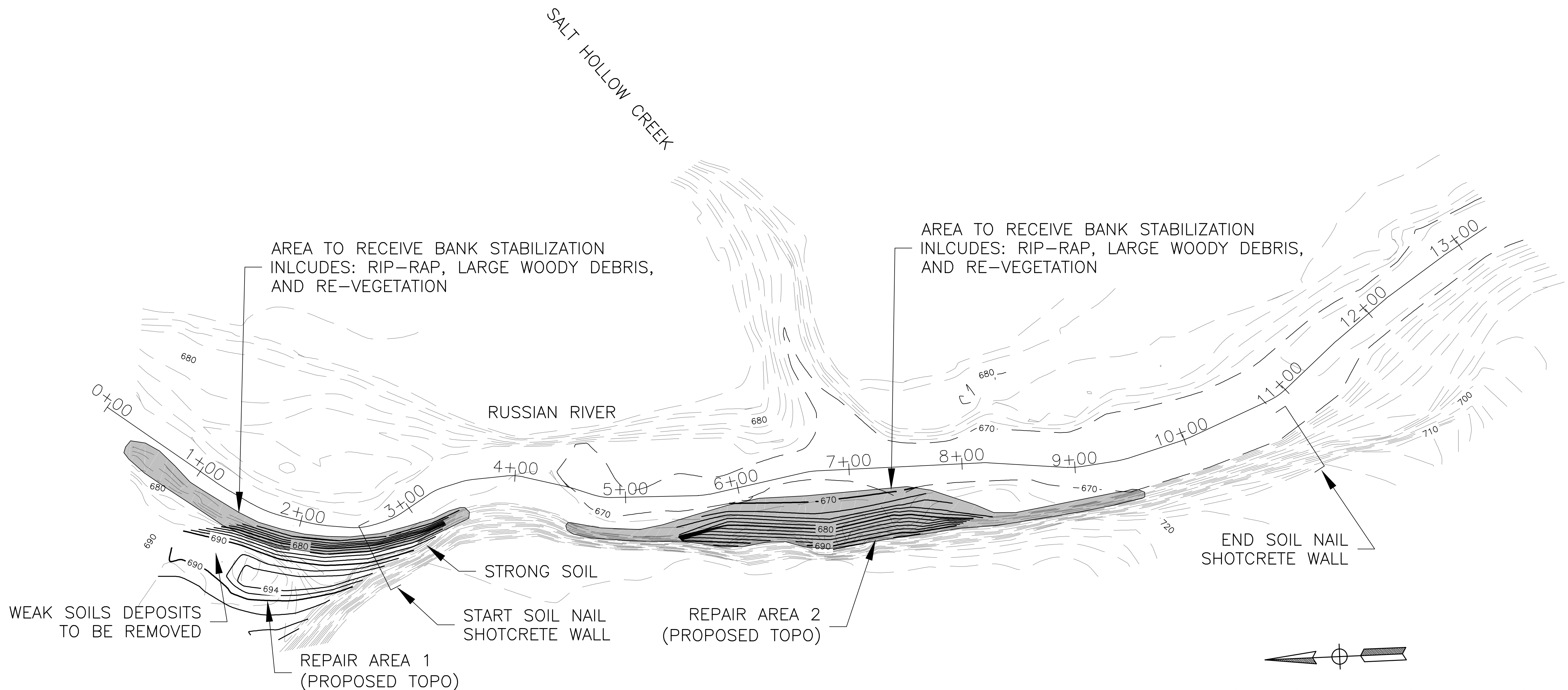

SITE PLAN

SCALE: 1"=100'

0 50' 100' 200' 300'

SCALE: 1"=100'

1"

GRAPHIC SCALE MEASURES 1 INCH ON FULL-SIZE PLANS.

NOTES:

ADDITIONAL STABILIZATION MEASURES INCLUDE BUT MAY NOT BE LIMITED TO:

1. KEYWAY 850 FEET LONG TO BE CONSTRUCTED AT BOTTOM OF RIVER BANK
2. SOIL NAIL SHOTCRETE WALL APPROXIMATELY 850 FEET LONG AND EXTENDING 20 FEET ABOVE BOTTOM OF RIVER BANK
3. HYDROSEED UPPER 35 FEET OF RIVER BANK
4. TERRACE RE-PLANTING
5. REDIRECT RUNOFF FROM ADJACENT ROADWAY AND HOMES
6. RE-LOCATE ADJACENT HOMES

PROJECT	COYOTE VALLEY STREAM RESTORATION
CLIENT	COYOTE VALLEY BAND OF POMO INDIANS
LOCATION	7751 N STATE ST, REDWOOD VALLEY, CA
	RIVER BANK REPAIR PLAN
BY	BD
DATE	10/11/2016
CHECK	JER
SCALE	SHOWN
FIGURE	FIGURE 2
JOB NO.	7753.05

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T:\Cadfiles\7700\7753.05 COYOTE VALLEY STREAM RESTORATION\DWG\ 7753.05 FIGURE 2 TOPO.dwg
Oct –9:32am

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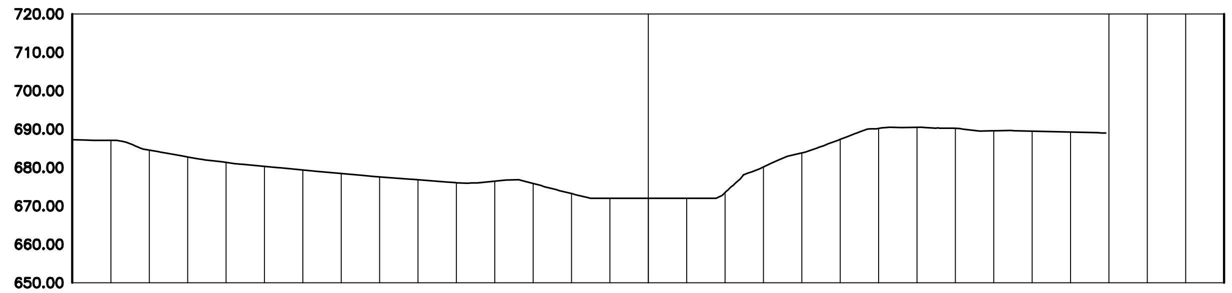

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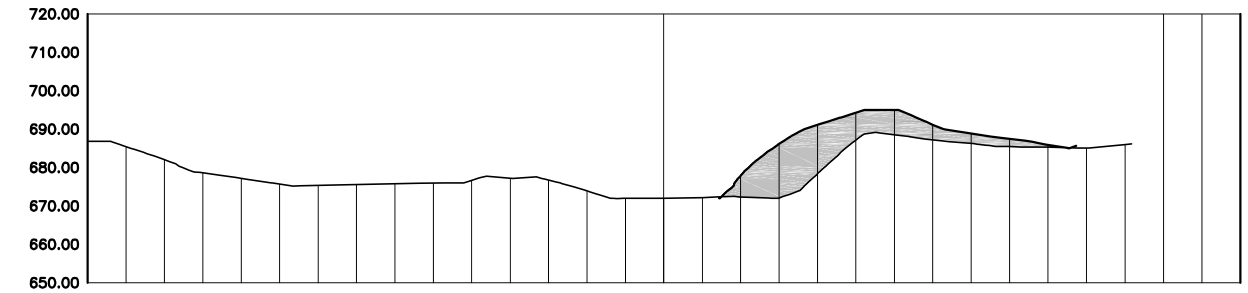

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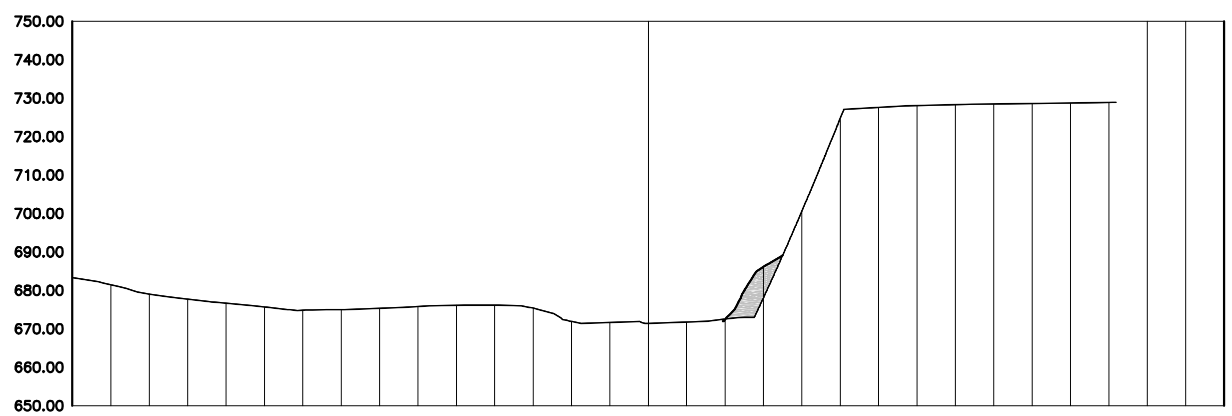

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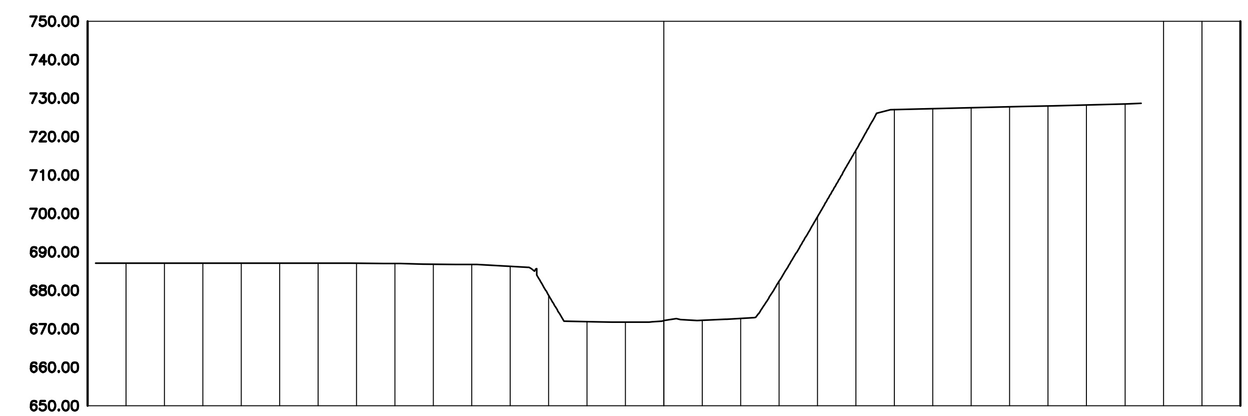

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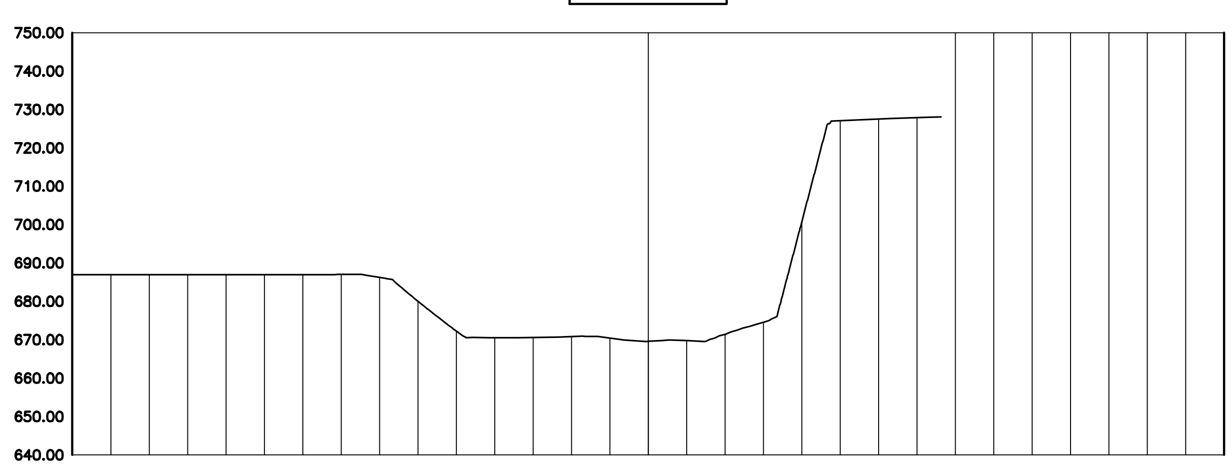

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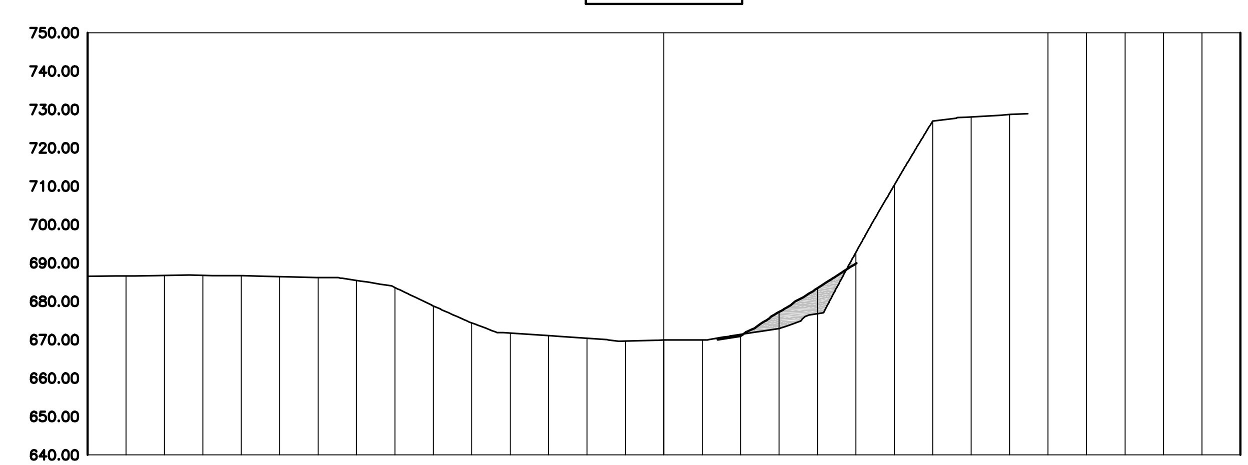

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PROJECT	COYOTE VALLEY STREAM RESTORATION
CLIENT	COYOTE VALLEY BAND OF POMO INDIANS
LOCATION	7751 N STATE ST, REDWOOD VALLEY, CA
	CROSS SECTIONS: STA 1+00 TO STA 6+00
BY	BD
DATE	10/11/2016
CHECK	JER
SCALE	SHOWN
FIGURE	FIGURE 2A
JOB NO.	7753.05

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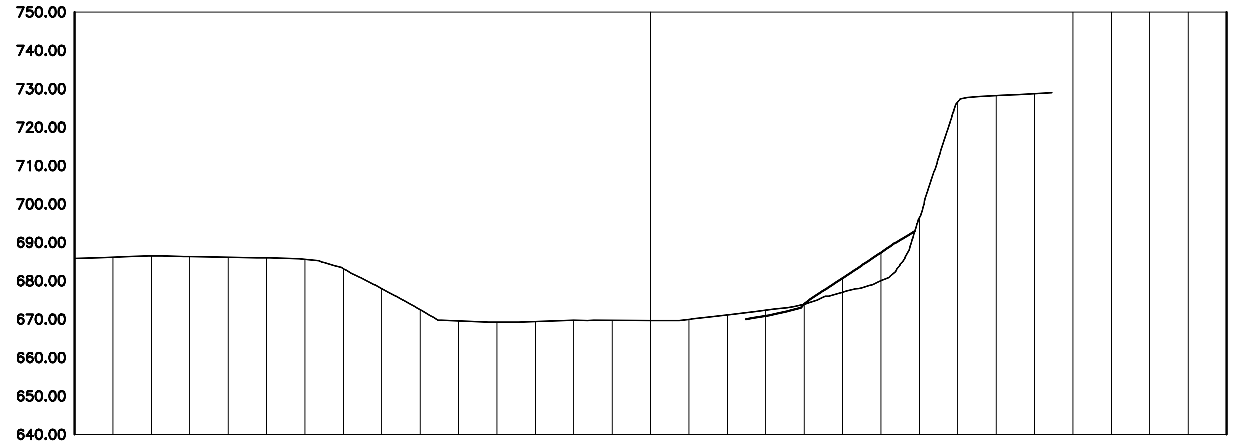
Oct 9:32am

7+00.0



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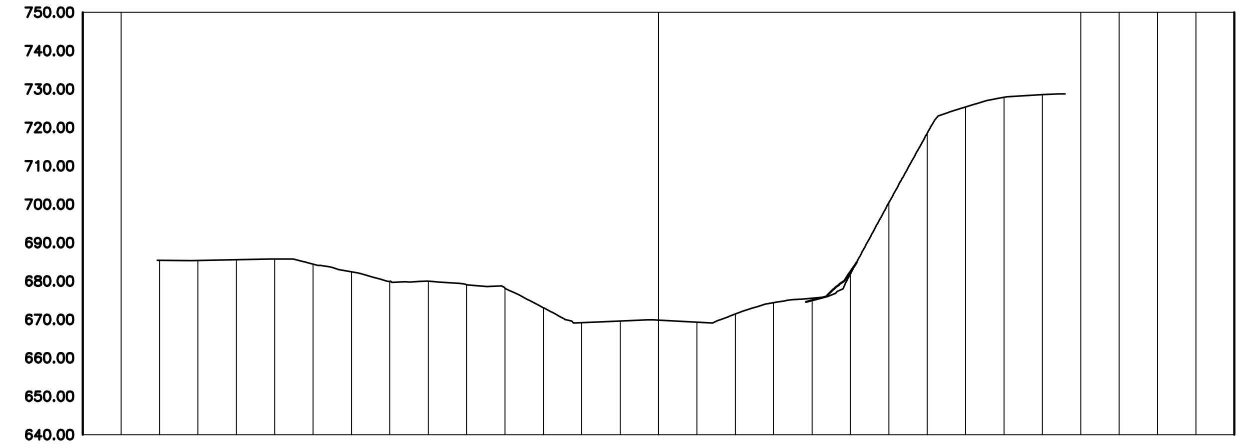

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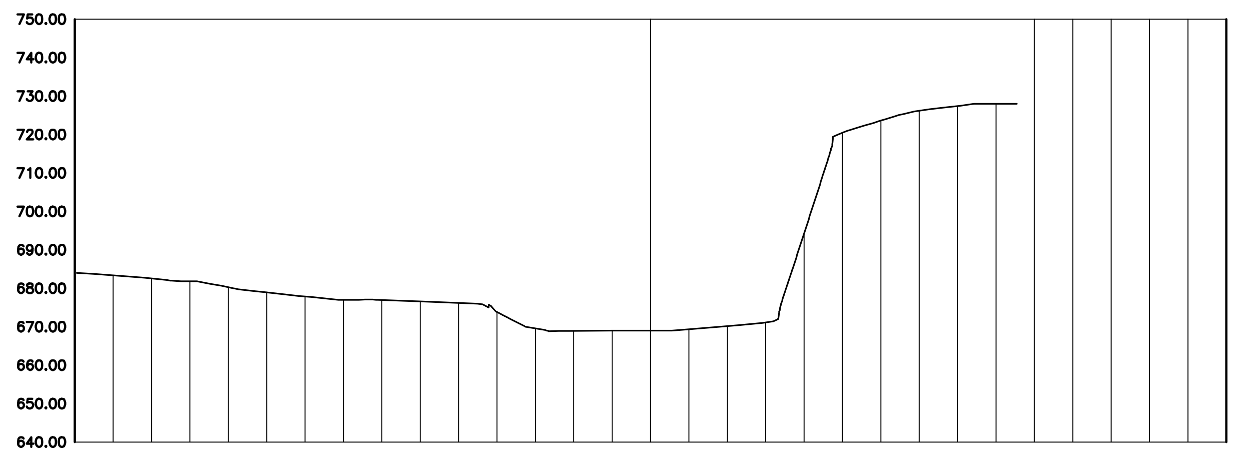

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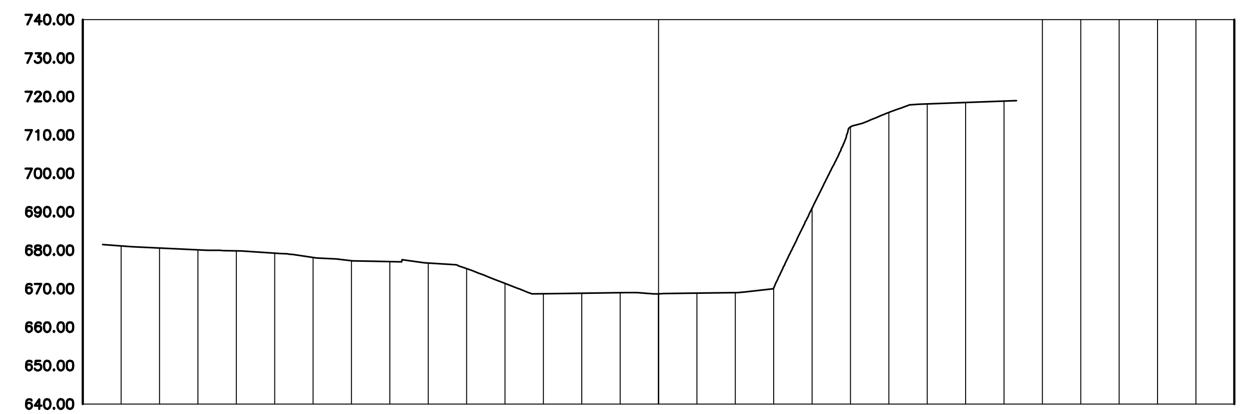

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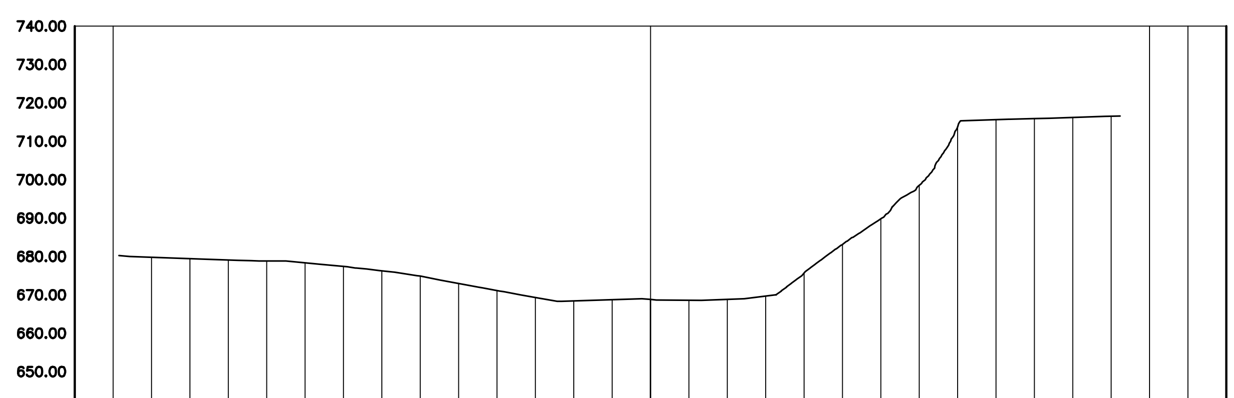

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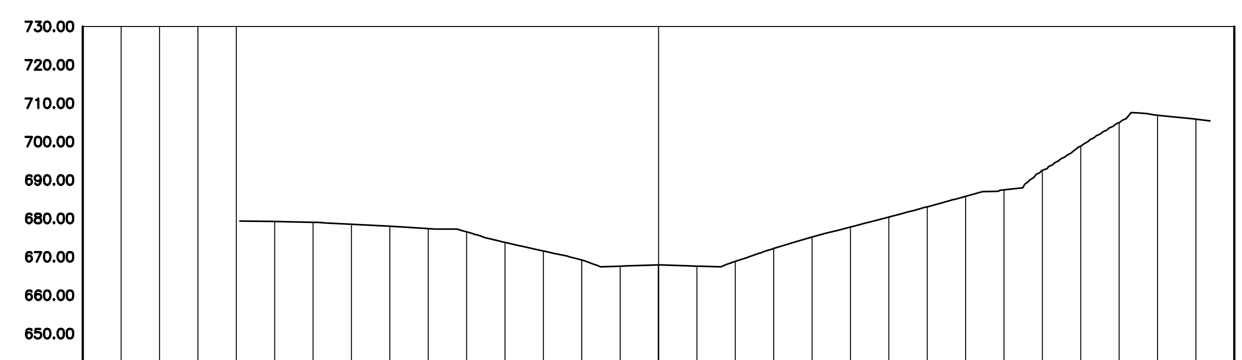

T:\Cadfiles\7700\7753.05 COYOTE VALLEY STREAM RESTORATION\DWG\7753.05 FIGURE 2 TOPO.dwg
Oct –9:33am

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PROJECT	COYOTE VALLEY STREAM RESTORATION
CLIENT	COYOTE VALLEY BAND OF POMO INDIANS
LOCATION	7751 N STATE ST, REDWOOD VALLEY, CA
	CROSS SECTIONS: STA 7+00 TO STA 12+00
BY	BD
DATE	10/11/2016
CHECK	JER
SCALE	SHOWN
FIGURE	FIGURE 2B
JOB NO.	7753.05

Historic Bluff Retreat

2007 and 2016 Photo Overlay

ATTACHMENT 1

Aerial Photographs


JULY 1952
CVN 12K-17


JUNE 1972
MEND 2-32


JUNE 1981
81-12-29


MAY 1988
WAC 88CA 14-161


MARCH 1996
MAC MENDOCINO 4-178

JULY 2016


JULY 1993
Google Earth Aerial Photo
Google earth
Image U.S. Geological Survey
N
1000 ft


JULY 2003
Google Earth Aerial Photo
Google earth
Image USDA Farm Service Agency
1000 ft
N


JULY 2004
Google Earth Aerial Photo
Google earth
Image USDA Farm Service Agency
1000 ft
N


August 2005
Google Earth Aerial Photo
Google earth
Image © 2016 DigitalGlobe
1000 ft
N


December 2005
Google Earth Aerial Photo
N
1000 ft
Google earth


MAY 2007
Google Earth Aerial Photo
Google earth
Image © 2016 DigitalGlobe
N
1000 ft


MARCH 2008
Google Earth Aerial Photo
Google earth
Image © 2016 DigitalGlobe
1000 ft
N


JUNE 2009
Google Earth Aerial Photo
Google earth
Image USDA Farm Service Agency
1000 ft
N

SEPTEMBER 2010
Google Earth Aerial Photo
Google earth
Image USDA Farm Service Agency
1000 ft
N


AUGUST 2011
Google Earth Aerial Photo
N
1000 ft
Google earth


AUGUST 2013
Google Earth Aerial Photo
Google earth
1000 ft
N


SEPTEMBER 2014
Google Earth Aerial Photo
Google earth
Image © 2016 DigitalGlobe
1000 ft
N

ATTACHMENT 2

Boring Logs and Piezometer Completion Details

Table A. Monitoring Well Construction Details

<table>
<tr><th>Monitoring Well Designation</th><th>Total Depth (feet bgs)</th><th>Casing Material and Diameter</th><th>Screen Interval of 0.20 slot PVC (feet)</th><th>Installation Method</th><th colspan="2">Filter Pack and Interval (feet bgs)</th><th colspan="2">Seal Material and Interval (feet bgs)</th></tr>
<tr><td rowspan="2">B1</td><td rowspan="2">55</td><td rowspan="2">2 inch PVC</td><td rowspan="2">40 - 55</td><td rowspan="4">8 inch outside diameter hollow stem auger</td><td rowspan="2">55 to 38</td><td rowspan="4">#3 Sand</td><td>Cement Slurry</td><td>24 to 0</td></tr>
<tr><td>Bentonite</td><td>38 to 24</td></tr>
<tr><td rowspan="2">B2</td><td rowspan="2">55</td><td rowspan="2">2 inch PVC</td><td rowspan="2">35 - 55</td><td rowspan="2">55 to 33</td><td>cement Slurry</td><td>25 to 0</td></tr>
<tr><td>Bentonite</td><td>33 to 25</td></tr>
</table>

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KEY TO SYMBOLS

CLIENT Coyote Valley Band of Pomo Indians
PROJECT NAME Coyote Valley: Stream Restoration
PROJECT NUMBER 7753.05
PROJECT LOCATION Coyote Valley Reservation

LITHOLOGIC SYMBOLS - (Unified Soil Classification System) -

- CH: USCS High Plasticity Clay
- CL: USCS Low Plasticity Clay
- GM: USCS Silty Gravel
- GW: USCS Well-graded Gravel
- SC: USCS Clayey Sand
- SC-SM: USCS Clayey Sand
- SM: USCS Silty Sand
- SP-SC: USCS Poorly-graded Sand with Clay

SAMPLER SYMBOLS

- Grab Sample

WELL CONSTRUCTION SYMBOLS

- Bentonite Seal: 1 pipe group, 1 pipe
- Blank section
- Capped Riser: 1 pipe group
- Cement Seal: 1 pipe group, 1 pipe
- Filter Pack: 1 pipe group, 1 pipe
- Slotted Pipe: 1 pipe group, 1 pipe

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)

TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION
▽ Water Level at Time Drilling, or as Shown
▼ Water Level at End of Drilling, or as Shown
▽ Water Level After 24 Hours, or as Shown

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WELL NUMBER B1

CLIENT Coyote Valley Band of Pomo Indians
PROJECT NAME Coyote Valley: Stream Restoration
PROJECT NUMBER 7753.05
PROJECT LOCATION Coyote Valley Reservation
DATE STARTED 3/30/16 **COMPLETED** 4/6/16
GROUND ELEVATION 725 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR Clear Heart Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY KRM **CHECKED BY** JER
AT END OF DRILLING 50.00 ft / Elev 675.00 ft
NOTES Ground elevation estimated from topo
AFTER DRILLING 47.00 ft / Elev 678.00 ft

DEPTH (ft)	SAMPLE TYPE NUMBER -	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0			GM		(GM) Silty Gravel with Sand, moderate brown, medium dense, estimated 20% fines, 20% fine-coarse sand, 60% subangular-angular gravel	Christy Box
5	GB	17-13-9 (22)				
10	GB	14-14-24/0"			no recovery from 10-11.5'	Cement Slurry
15	GB	13-19-24 (43)			Some sand lenses	
19.5			CL-ML		(CL-ML) Gravelly Silt with Sand, brown, stiff, moist-wet, estimated 55% fines, 40% sand, <5% gravel	705.5
20	GB	3-10-20 (30)				2" PVC Blank
20.5			SC-SM		(SC-SM) Silty, Clayey Sand with Gravel, dark brown, medium dense, moist, estimated 40% fines, 55% fine-medium sand, <5% fine gravel	704.5
25						

(Continued Next Page)

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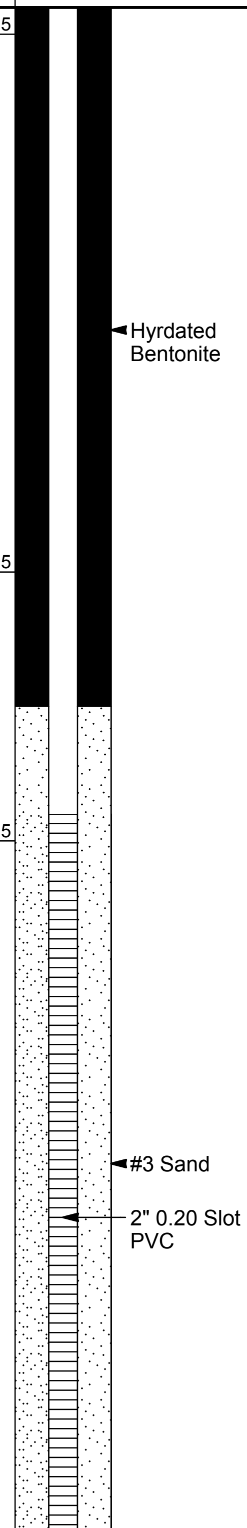
WELL NUMBER B1

CLIENT Coyote Valley Band of Pomo Indians
PROJECT NAME Coyote Valley: Stream Restoration
PROJECT NUMBER 7753.05
PROJECT LOCATION Coyote Valley Reservation

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	MATERIAL DESCRIPTION
25	GB	20-30	GM	25.5 — 699.5 (GM) Well-Graded Gravel with Sand, light brown, dense, moist, estimated 15% fines, 25% fine-coarse sand, 60% fine subrounded-subangular gravel Refusal with SPT at 26-26.5'
30	GB	20-27	GM	Refusal with SPT at 31-31.5'
35	GB	13-43	SC	35.5 — 689.5 (SC) Clayey Sand with Gravel, brown, very dense, moist, estimated 40% fines, 35% fine-coarse sand, 25% fine subrounded gravel Refusal with SPT at 36-36.5'
40	GB	36-24/3"	GW	40.5 — 684.5 (GW) Well Graded Gavel with Sand, light brown to medium brown, very dense, moist, estimated 10% fines, 20% fine-coarse sand, 70% fine to 2" subangular-subrounded gravel Refusal with SPT at 40.75'
45	GB	50	GW	Refusal at 45.5' with SPT
50	GB	50	GW	Saturated Refusal at 50.5' with SPT

WELL DIAGRAM



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CLIENT Coyote Valley Band of Pomo Indians
PROJECT NAME Coyote Valley: Stream Restoration
PROJECT NUMBER 7753.05
PROJECT LOCATION Coyote Valley Reservation

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
55			GW		(GW) Well Graded Gavel with Sand, light brown to medium brown, very dense, moist, estimated 10% fines, 20% fine-coarse sand, 70% fine to 2" subangular-subrounded gravel *(continued)* No recovery with SPT 56.0 669.0	

Bottom of borehole at 56.0 feet.

WELL NUMBER B2

LACO
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CLIENT Coyote Valley Band of Pomo Indians
PROJECT NAME Coyote Valley: Stream Restoration
PROJECT NUMBER 7753.05
PROJECT LOCATION Coyote Valley Reservation
DATE STARTED 3/30/16 **COMPLETED** 4/6/16
GROUND ELEVATION 725 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR Clear Heart Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 47.00 ft / Elev 678.00 ft
LOGGED BY KRM **CHECKED BY** JER
▼ **AT END OF DRILLING** 50.00 ft / Elev 675.00 ft
NOTES Ground elevation estimated from topo
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0			SM		(SM) Silty Sand with Gravel, dark brown, medium dense, moist, estimated 45% fines, 40% fine-medium sand, 15% fine to 1" subrounded-subangular gravel. Some trash/debris, may be fill.	Christy Box
4.0					721.0	
5	GB	5-6-11 (17)	GM		(GM) Silty Gravel with Sand, moderate brown, medium dense, moist, estimated 20% fines, 20% fine-coarse sand, 60% gravel	
	GB	22-16-16 (32)			Becomes dense	
10	GB	18-30-35 (65)			Becomes dense to very dense. Gravel is fine to 3" subrounded-subangular	
						Cement Slurry
15						
15.5	GB	25-22-18 (40)	SC-SM		709.5 (SC-SM) Silty Sand to Clayey Sand with Gravel, brown, dense, moist, estimated 40% fines, 45% fine-medium sand, 15% fine to 3/4 inch subrounded to subangular gravel	2" PVC Blank
20	GB	50			Refusal at 20.5' with SPT	
25 / 25.0					700.0	

(Continued Next Page)

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CLIENT Coyote Valley Band of Pomo Indians
PROJECT NAME Coyote Valley: Stream Restoration
PROJECT NUMBER 7753.05
PROJECT LOCATION Coyote Valley Reservation

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	MATERIAL DESCRIPTION	WELL DIAGRAM
25	GB	32-19/3"	GM	(GM) Well-Graded Gravel with Sand, light brown, very dense, moist, estimated 15% fines, 25% fine-coarse sand, 60% fine to 3/4" subrounded-subangular gravel Refusal at 25.75' with SPT	Hyrdated Bentonite
30	GB	59		Some SC lenses that are brown, very dense, moist, estimated 40% fines, 35% fine-coarse, 25% fine-subrounded gravel. Refusal at 30.5' with SPT	
35	GB	55		Refusal at 35.5' with SPT	
40	GB	24-17-19 (36)		41.0	684.0
			CH	(CH) Sandy Clay, brown, very stiff, moist, estimated 80% fines, 20% fine sand, estimated medium to high plasticity	#3 Sand
45				45.0	680.0
	GB	25-27-27 (54)	SP-SC	(SP-SC) Poorly Graded Sand with Clayey Sand, brown, very dense, saturated, estimated 15% fines, 85% fine-medium sand, estimated medium to high plasticity, becomes sandier with depth	2" 0.20 Slot PVC
50	GB	2-2-2 (4)		52.0	673.0
			GW	(GW) Well Graded Gavel with Sand, light brown, very dense, saturated, estimated 15% fines, 25% fine-coarse sand, 60% fine to 1.5" subrounded to subangular gravel	

(Continued Next Page)

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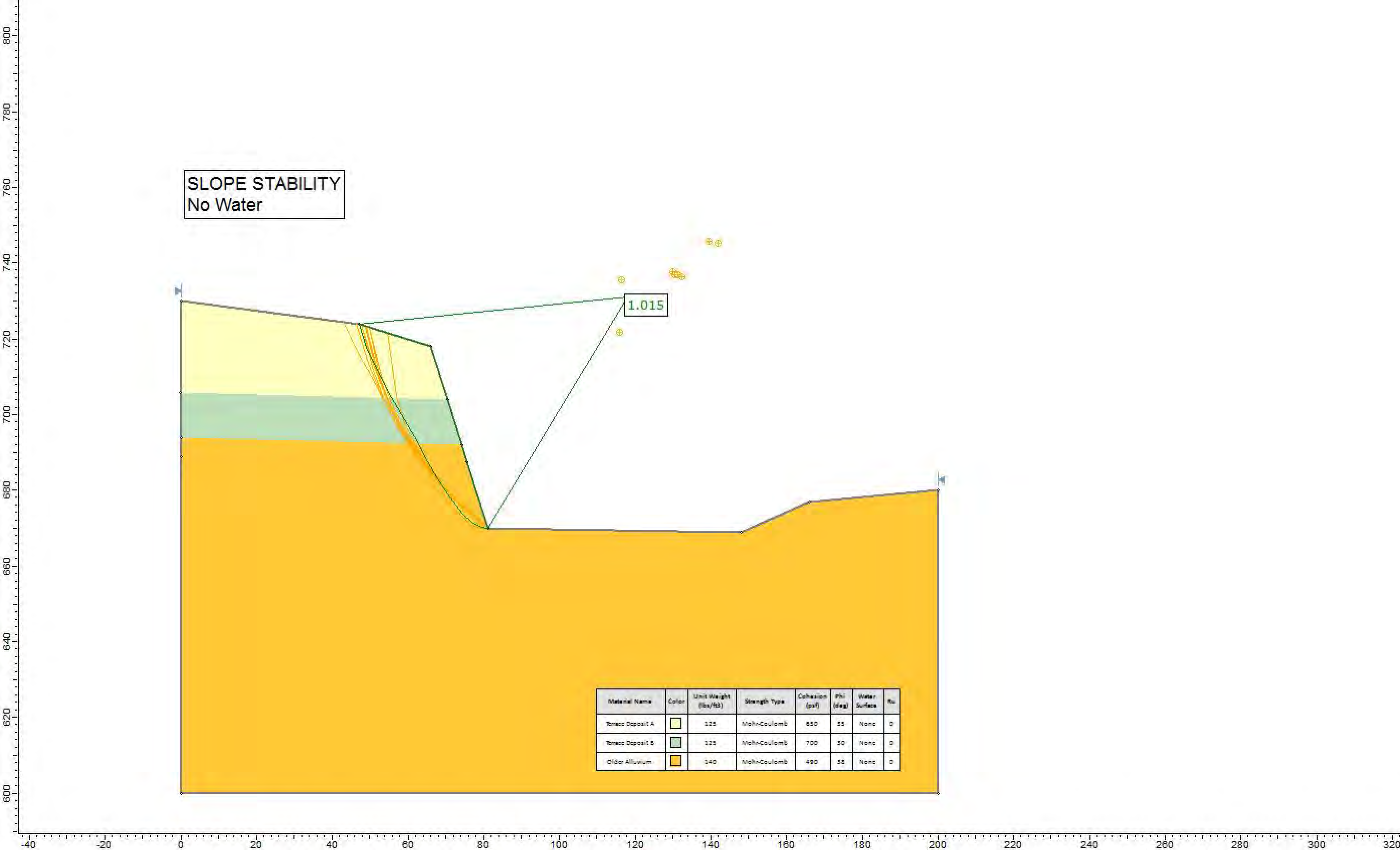
CLIENT Coyote Valley Band of Pomo Indians
PROJECT NAME Coyote Valley: Stream Restoration
PROJECT NUMBER 7753.05
PROJECT LOCATION Coyote Valley Reservation

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
55	GB	56	GW		(GW) Well Graded Gavel with Sand, light brown, very dense, saturated, estimated 15% fines, 25% fine-coarse sand, 60% fine to 1.5" subrounded to subangular gravel *(continued)*	
				55.5	669.5	

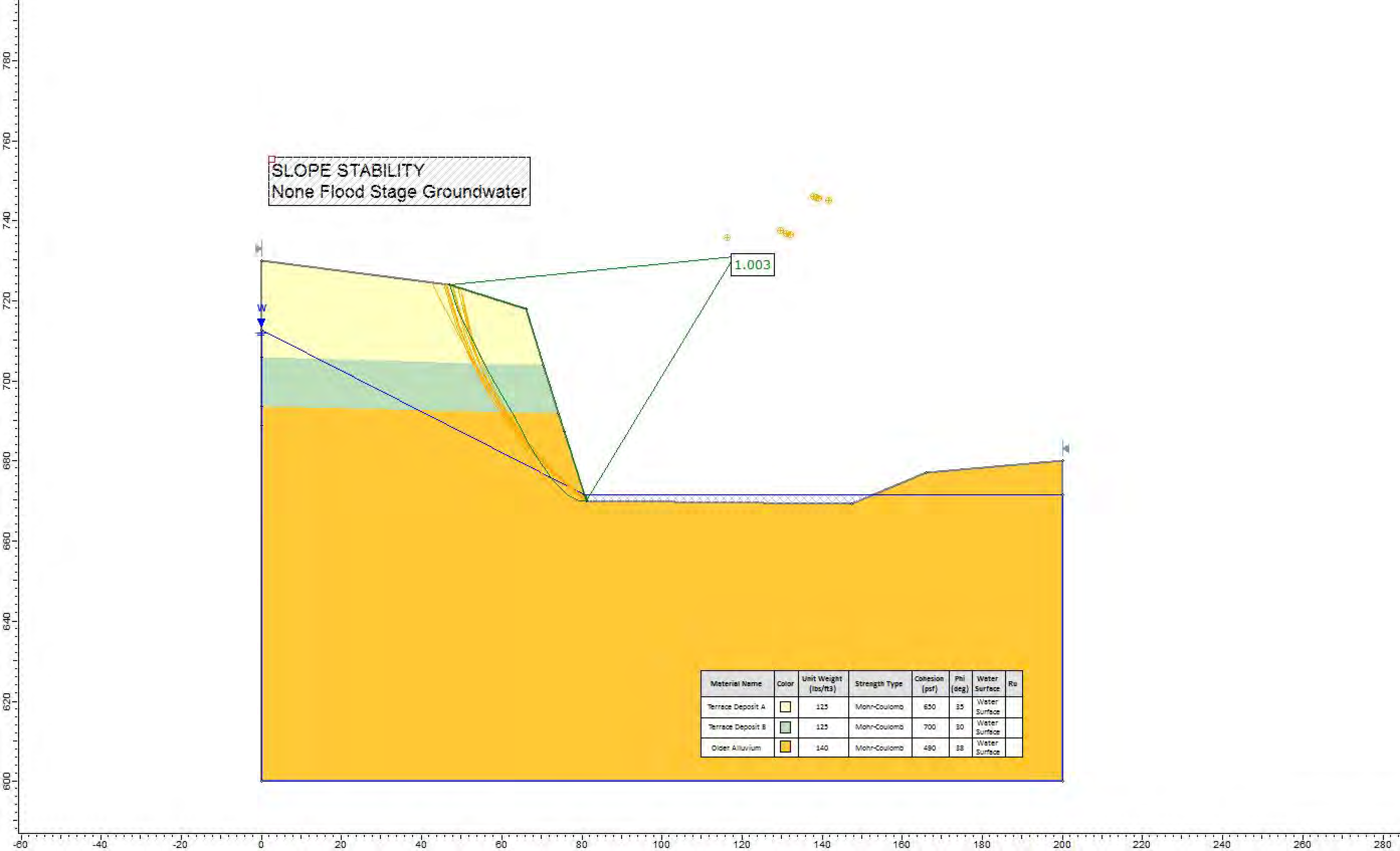
Refusal at 55.5' with SPT
Bottom of borehole at 55.5 feet.

ATTACHMENT 3

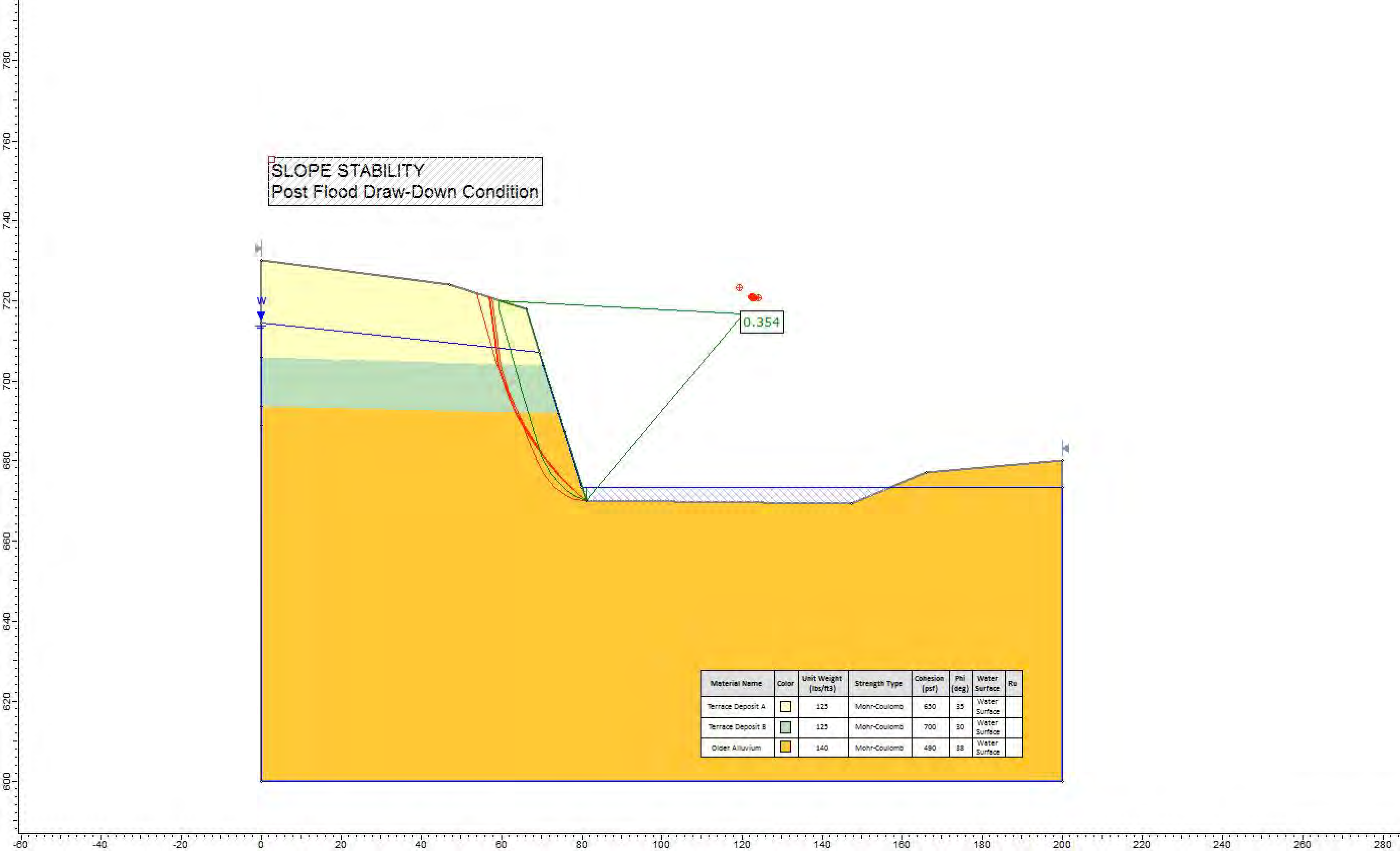
Slope Stability Analysis Results



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Terrace Deposit A		125	Mohr-Coulomb	650	35	None	0
Terrace Deposit B		125	Mohr-Coulomb	700	30	None	0
Older Alluvium		140	Mohr-Coulomb	490	38	None	0



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Terrace Deposit A		125	Mohr-Coulomb	630	35	Water Surface	
Terrace Deposit B		125	Mohr-Coulomb	700	30	Water Surface	
Older Alluvium		140	Mohr-Coulomb	490	38	Water Surface	



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Terrace Deposit A		125	Mohr-Coulomb	630	35	Water Surface	
Terrace Deposit B		125	Mohr-Coulomb	700	30	Water Surface	
Older Alluvium		140	Mohr-Coulomb	490	38	Water Surface	

ATTACHMENT 4

Hydrologic and Hydraulic Evaluations – Proposed Conditions

September 28, 2016

TO: Chris Watt, LACO Associates

FROM: Jeremy Kobor, CFM
Senior Hydrologist, O'Connor Environmental, Inc.

Matt O'Connor, PhD, CEG #2449
President, O'Connor Environmental, Inc

Hydrologic and Hydraulic Analysis of Proposed Stream Restoration - West Fork Russian River, Coyote Valley Reservation, Redwood Valley, CA

Overview

A hydrologic and hydraulic analysis was performed for the reach of the West Fork Russian River adjacent to the Coyote Valley Reservation in Redwood Valley, CA. This analysis was performed to characterize flood extents, water depths, and velocities under existing and proposed restored conditions. The proposed restoration design involves re-grading and re-vegetating portions of the west bank and is intended to stabilize and reduce erosion of the near-vertical west bank of the river.

Hydrologic Analysis

The Russian River Near Ukiah U.S. Geological Survey gauging station (Station ID #11461000) is located on the West Fork Russian River just upstream of the confluence with the East Fork Russian River, about four miles downstream of the project reach. This station has a nearly continuous streamflow record from 1953 to present plus some additional data from 1912-1913. A flood frequency analysis was performed on the 65 years of annual peak flow data available for the gauging site using the PeakFQ software which implements the U.S. Geological Survey's Bulletin 17B flood frequency analysis methodology (USGS, 1981).

Several large tributaries including Forsythe Creek and York Creek enter the river between the project reach and the gauge site, and the drainage area at the upstream edge of the project reach is about 30.5% of the drainage area at the gauge site. Annual peak flows at the gauge site were scaled down by a factor of 0.305 to account for the differences in drainage areas between the project site and the gauge site (Figure 1). The flood frequency analysis produced estimates of peak discharges associated with floods of various recurrence intervals ranging from 1,591 cfs for a 1.25-yr event to 8,579 cfs for a 500-yr event (Table 1 and Figure 2).

Based on the results of a preliminary hydraulic analysis, it was determined that the 50-yr event represents the threshold discharge above which flows begin to spread laterally onto the floodplain occupied by vineyard to the east. This event was selected for the hydraulic analysis to represent the maximum anticipated water surface elevations adjacent to the near-vertical west bank. The 5-yr event was also selected to represent a more frequent flood event with significant water depths adjacent to the near-vertical bank.

The 5-yr peak discharge estimate is 3,664 cfs and the 50-yr peak discharge estimate is 6,228 cfs (Table 1). Salt Hollow Creek enters the river from the east within the project reach. The drainage area of Salt Hollow Creek is about 3.8% of the drainage area at the gauge site. Estimates of peak flows for Salt Hollow Creek were obtained in a similar fashion to those for the main stem by scaling down the peak flows at the gauge site by a factor of 0.038. This exercise produced estimates of the peak discharges for Salt Hollow Creek of 460 cfs for the 5-yr event and 781 cfs for the 50-yr event (Table 1). This estimate of peak flow contributions from Salt Hollow Creek does not account for the effects of on-stream impoundments that would likely reduce peak flows.

The flow record at the gauge site was examined and two historical events were selected to represent the 5-yr and 50-yr floods. An event from December 2nd, 2012 produced a peak discharge of 3,267 cfs after scaling by drainage area. Flow data for this event was scaled up by a factor of 1.122 such that the peak flow matched the estimate of the 5-yr peak discharge. An event from December 30th, 2005 (the largest flood on record) produced a peak discharge of 6,900 cfs after scaling by drainage area. Flow data for this event was scaled down by a factor of 0.903 such that the peak flow matched the estimate of the 50-yr peak discharge. These scaled historical events provided the inflow boundary conditions for the hydraulic model described below (Figure 3).

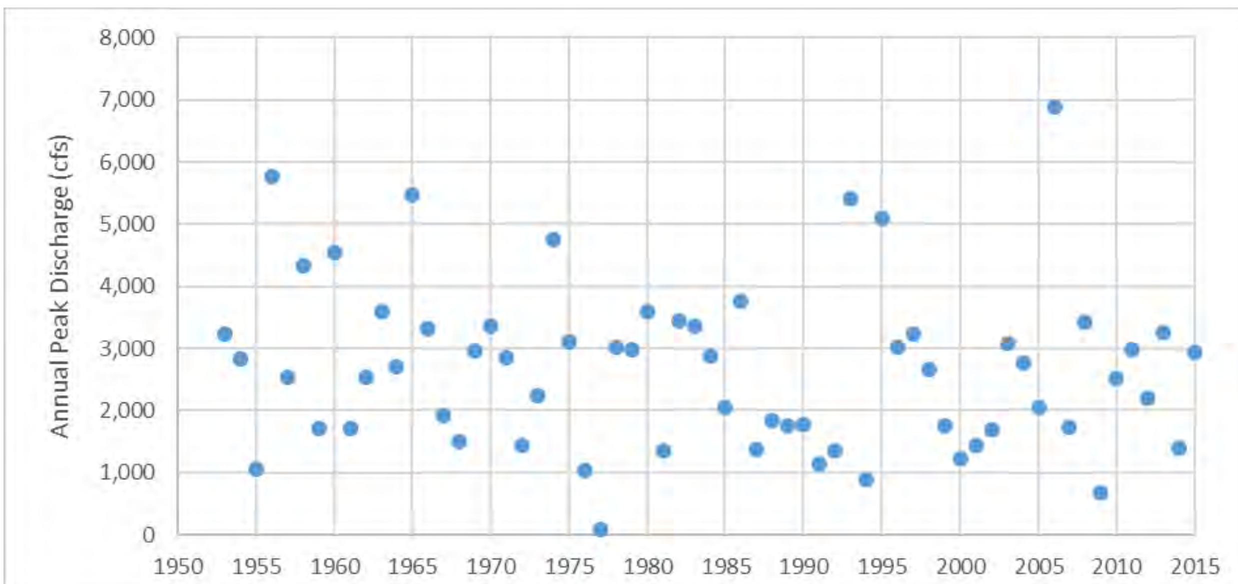


Figure 1: Annual peak flows at the project site from 1953 to 2015 based on drainage area scaled data from the USGS Russian River Near Ukiah gauging station.

Table 1: Tabular flood frequency analysis results for the project site based on the Bulletin 17B methodology applied to the drainage area scaled data from the USGS Russian River Near Ukiah gauging station.

Recurrence Interval (yrs)	Discharge (cfs)
1.25	1,591
1.5	1,975
2	2,458
2.33	2,684
5	3,664
10	4,488
25	5,495
50	6,228
100	6,930
200	7,633
500	8,579

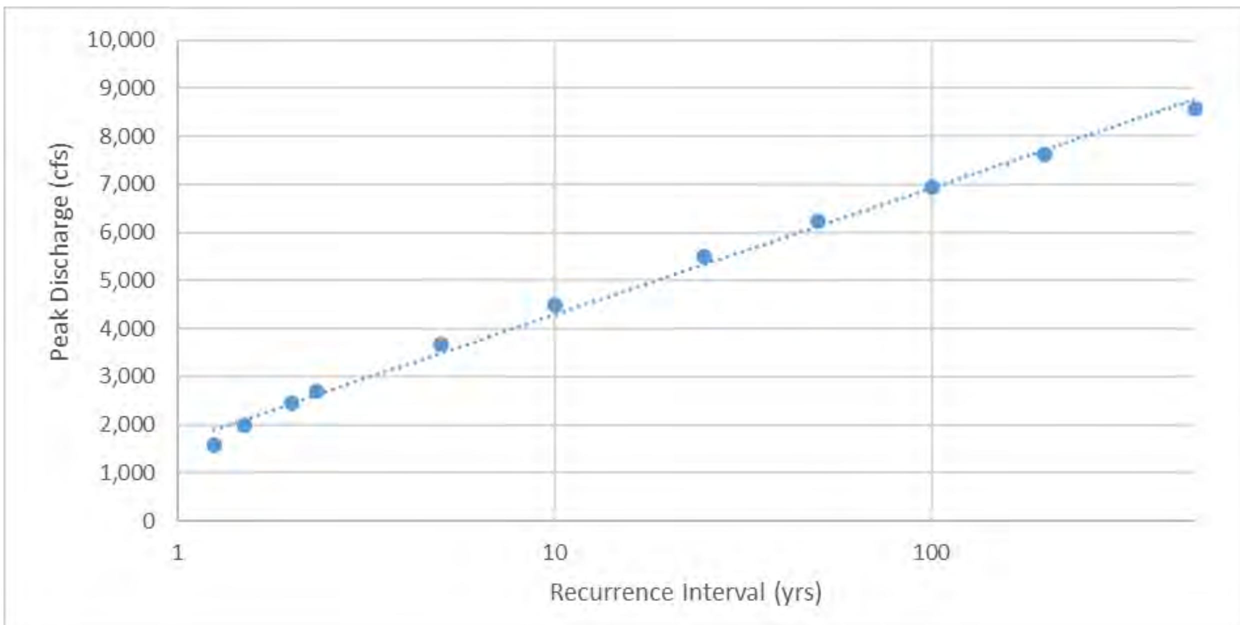


Figure 2: Graphical flood frequency analysis results for the project site based on the Bulletin 17B methodology applied to the drainage area scaled data from the USGS Russian River Near Ukiah gauging station.

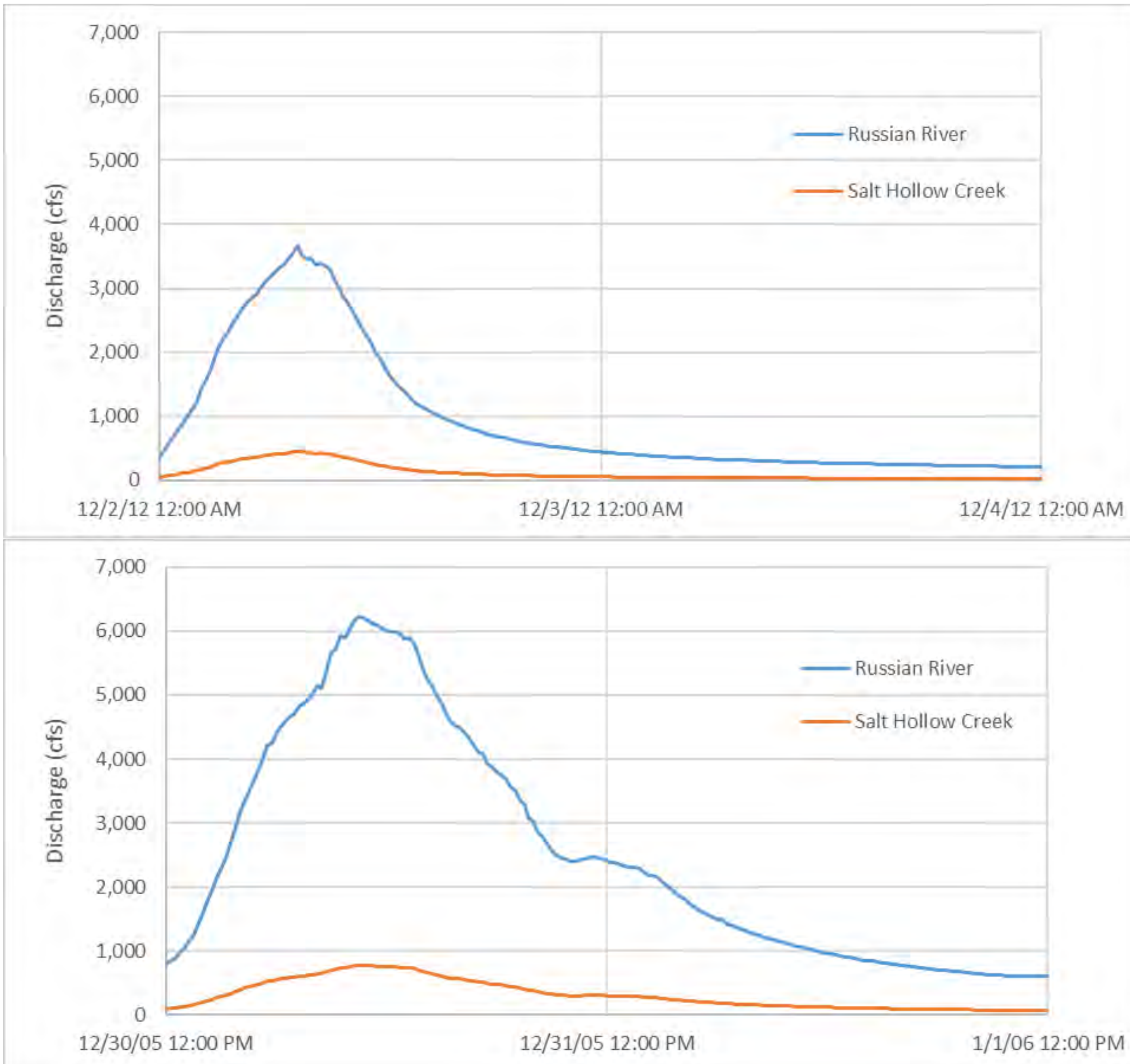


Figure 3: Inflow boundary conditions for the 5-yr (top) and 50-yr (bottom) flood events.

Hydraulic Analysis

Model Development

The MIKE 21 hydraulic model was used to simulate the existing conditions hydraulics at the project site. MIKE 21 is a 2-dimensional hydraulic model which simulates flows across a continuous topographic surface representing the project reach. The channel and floodplain topography within the project reach are represented by a series of grid cells, and open channel flow equations are solved to produce estimates of water depths and velocities at each grid cell (DHI, 2016). Velocity estimates from the simulation model are depth-averaged flow velocity.

A detailed topographic survey of the project site was completed by Doble Thomas and Associates in May 2016 and used to produce a 1-ft contour interval topographic map. The topographic map was converted to a 2.5-ft resolution Digital Elevation Model (DEM) for input in the hydraulic model (Figure 4). The model extent is equivalent to the extent of the topographic survey and it covers a 1,365-ft reach of the West Fork Russian River from 220-ft upstream of where the reach with near-vertical banks begins to 280-ft downstream of the southern end of the Reservation subdivision (Figure 4). The model also includes the lowest 270-ft of Salt Hollow Creek which enters the river from the east near the center of the study reach. Laterally, the model extends ~300 to 400-ft east of the river onto the vineyard and to the top of the near-vertical west bank so as to include the full extent of expected inundation (Figure 4).

Field observations of channel morphology, bed materials, and the extent of riparian vegetation provided the basis for developing estimates of channel roughness (Manning's n) for various reaches of the channel and portions of the floodplain. Field mapping in combination with interpretation of aerial photography and examination of the project DEM were used to delineate polygons with similar roughness characteristics. Manning's n values were assigned to each polygon and a roughness map was produced for the model (Figure 5). Manning's n values within the active channel range from 0.035 to 0.05. Floodplain values range from 0.025 along vineyard avenues to 0.12 in areas of dense blackberry and willow (Figure 5).

Implementing the proposed restoration design in the model involved modifying the model topography and roughness distributions as described below. A 1-ft contour interval topographic map of proposed restored conditions was provided by LACO Associates. The proposed contours were blended with the existing contours outside of the restoration areas in order to develop a DEM representing proposed conditions (Figure 6 & Figure 12 sections A and D). The DEM resolution and extent for proposed conditions was set to conform to the existing conditions DEM. Manning's n values for proposed conditions were modified within the restoration areas to account for the anticipated changes in roughness distributions associated with the project design. An n value of 0.06 was assumed for the restored bank areas and a value of 0.08 was assumed for the restored terrace (Figure 7). These values are intended to represent conditions several years after the project has been completed when riparian vegetation has been fully re-established within the restoration areas.

Inflow boundary conditions for the West Fork Russian River and Salt Hollow Creek for the 5-yr and 50-yr flood events (as described under Hydrologic Analysis and in Figure 3) were input in the model at the locations shown in Figure 4. A water-level boundary condition was developed for each event by solving Manning's Equation for a cross section extracted from the project DEM at the downstream end of the model for a variety of discharges in order to develop a rating equation (Figure 8). The rating equation was used in conjunction with the inflow boundary time series to develop time series of water levels as downstream boundary conditions for the model (Figure 9). Boundary conditions for existing and proposed conditions were identical.

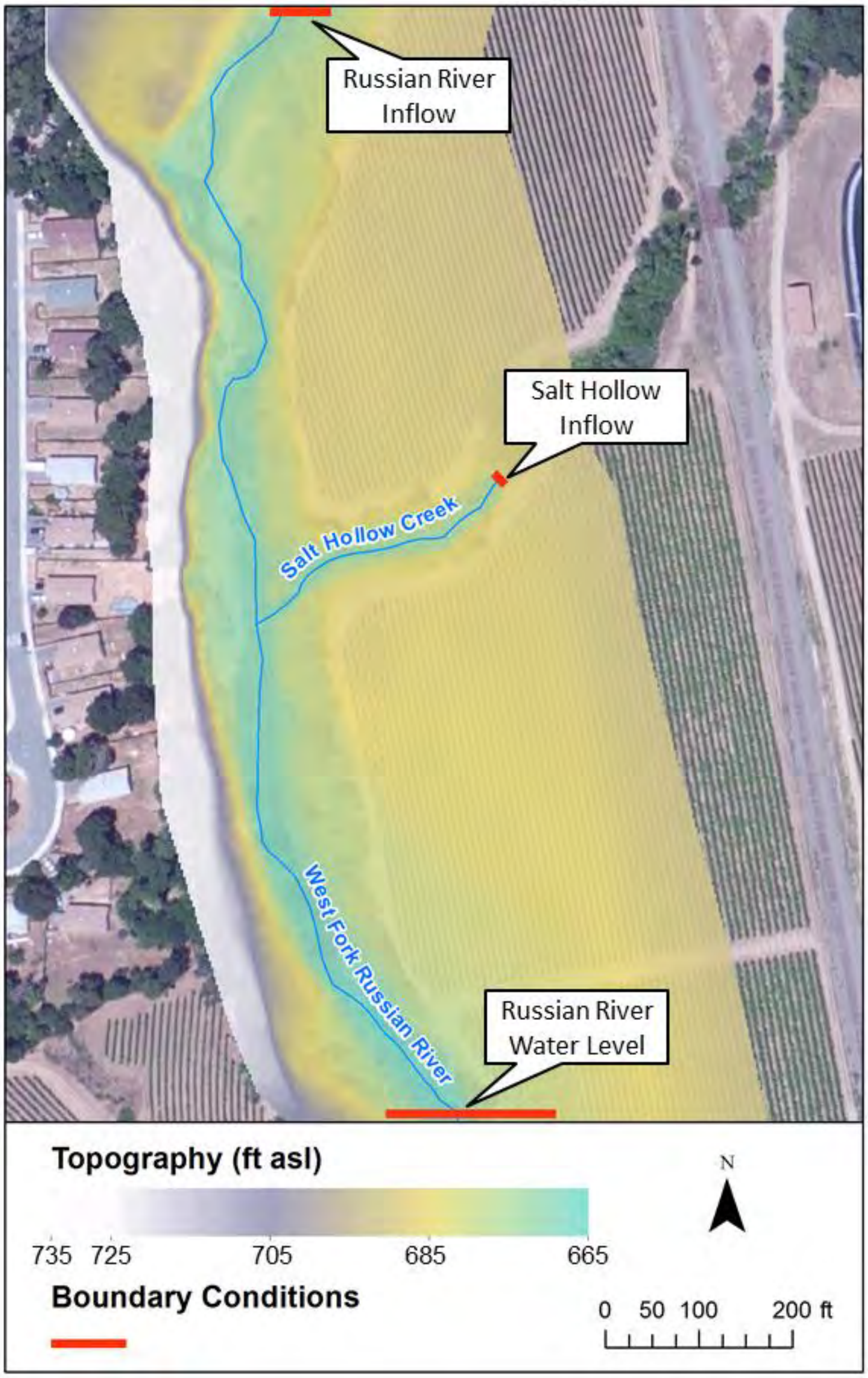


Figure 4: Extent of the hydraulic model domain, existing conditions model topography, and locations of boundary conditions.

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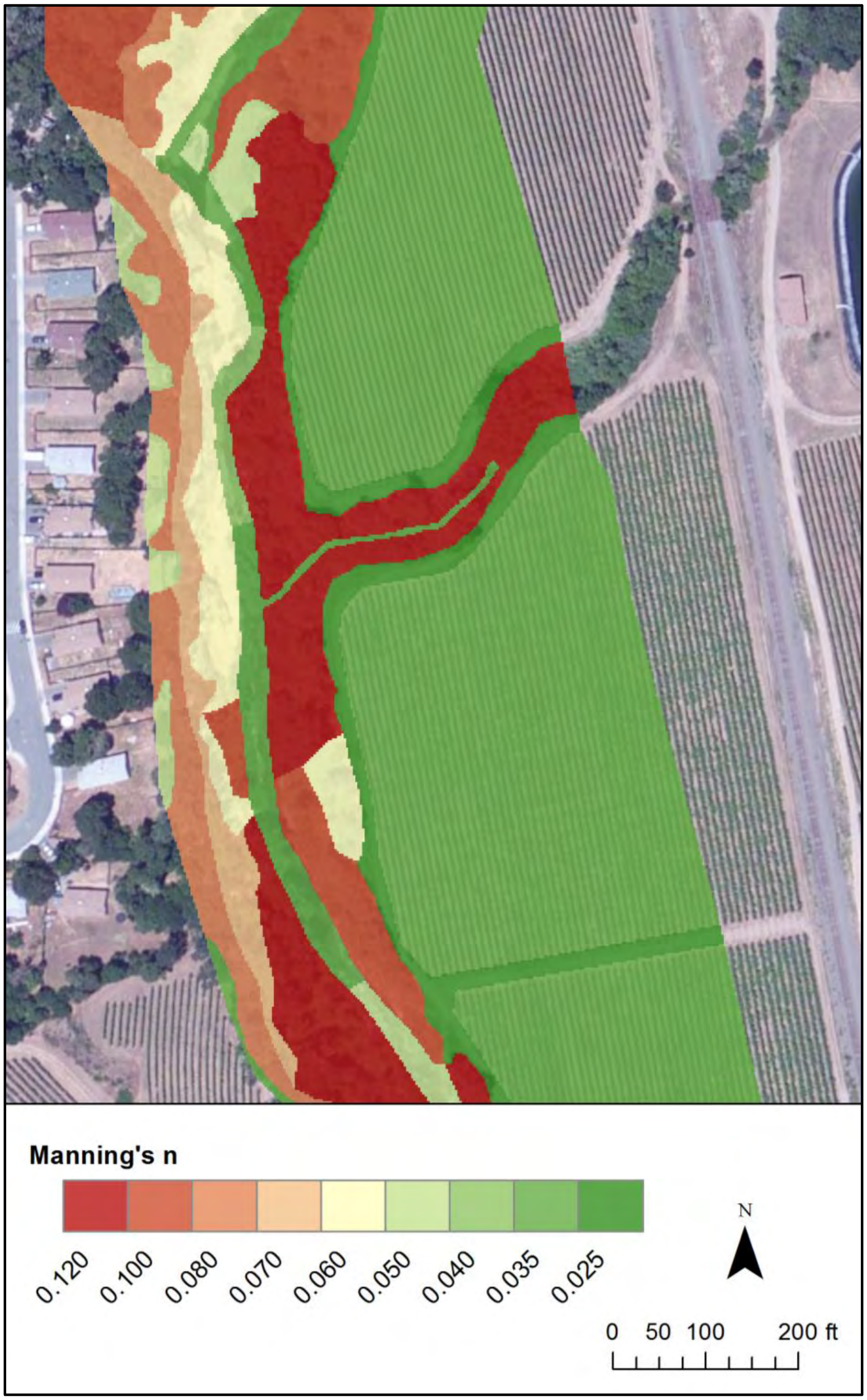

Figure 5: Distribution of Manning's n values used in the existing conditions hydraulic model.

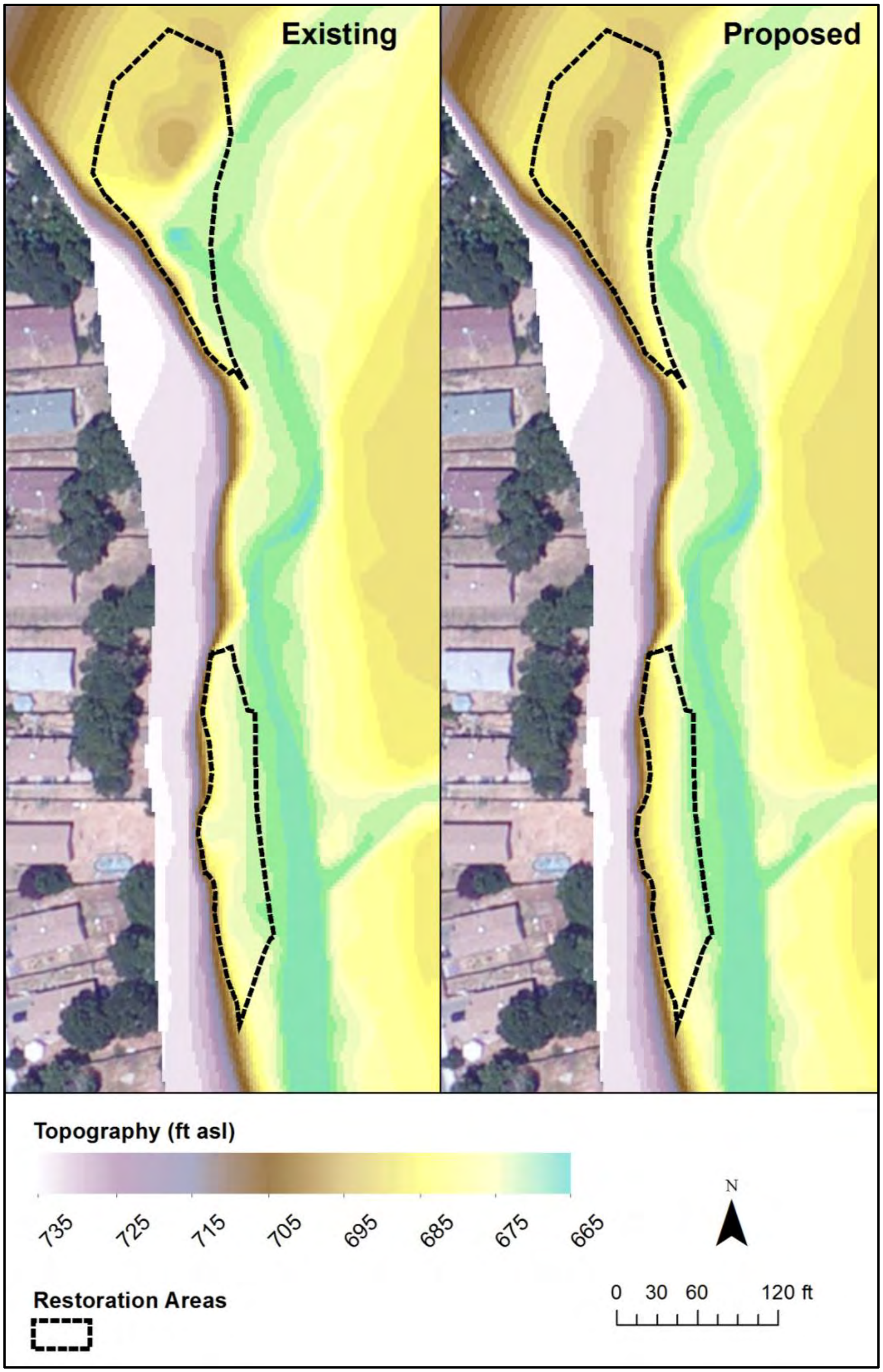

Figure 6: Comparison of existing and proposed conditions topography used in the hydraulic model.

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Figure 7: Comparison of existing and proposed conditions Manning's n values used in the hydraulic model.

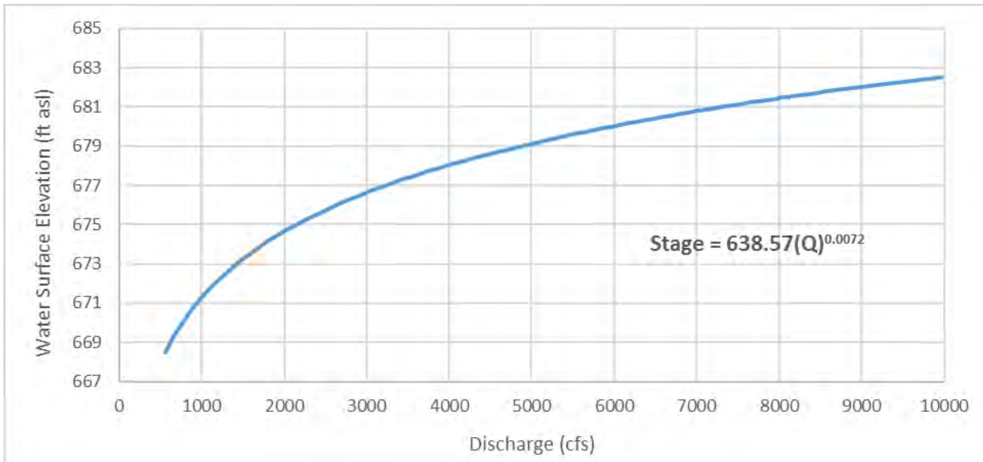

Figure 8: Rating curve developed for a cross section at the downstream edge of the model domain and used to generate the water level boundary conditions shown in Figure 9.

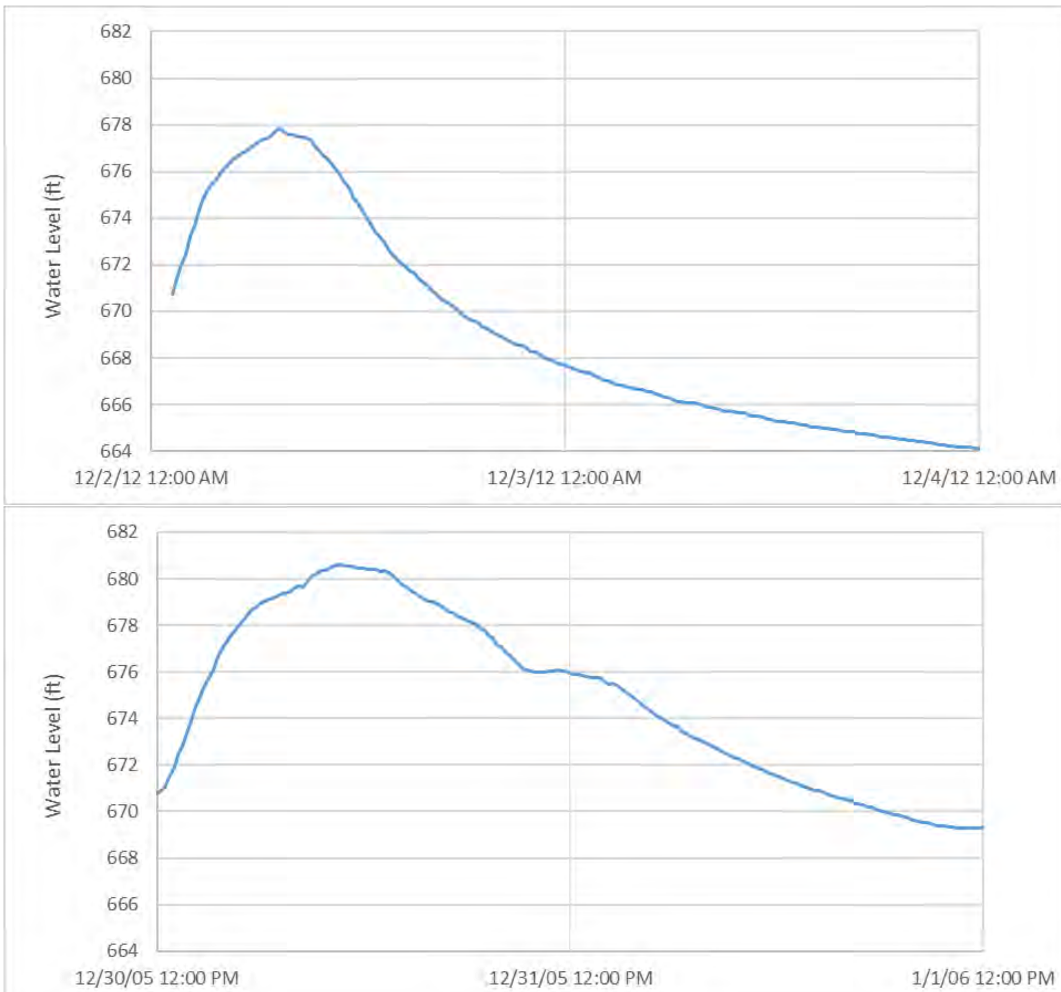

Figure 9: Water level boundary conditions for the 5-yr (top) and 50-yr (bottom) flood events.

Model Results

5-yr Water Depths and Inundation Extents

Maximum simulated water depths for the 5-yr event generally ranged from 11.0 to 12.5-ft within the channel with depths as high as 15.5-ft in deeper pools (Figure 10). Flows were contained within the active floodway for the most part with the exception of the lowest reach where water levels exceeded elevations along the east bank and inundated a small portion of the lower vineyard. Within the reach with near-vertical western banks, water surface elevations were 9 to 11-ft above the base of the cliff face (Figure 12). Rapid dewatering of the cliff face is hypothesized as a mechanism for bank failure, and the water level results indicate that water levels against the bank recede fairly quickly dropping by about 6-ft over an eight hour period following the peak flow (0.75-ft/hr).

The proposed grading associated with the restoration design results in a significant decrease in the inundated width within the upstream restoration area as a result of elevating the west-bank terrace above the 5-yr floodplain (Figure 11). Slight increases in water surface elevations occurred throughout the restored reach. These increases are generally less than 0.1-ft but reach as high as 0.2-ft in the upstream portions of the upstream restoration area (Figure 13). The increases are a local phenomenon and they do not extend downstream of the downstream restoration area. Along the face of the near-vertical west bank within the restoration areas, the restoration design results in a reduction in inundation width of 10- to 20-ft (away from the banks) and water levels that are ~9-ft below the top of the newly-graded banks (Figures 11 & 12).

50-yr Water Depths and Inundation Extents

During the 50-yr event, maximum water depths in the channel generally ranged from 14 to 16-ft with depths as high as 19.0-ft in deeper pools (Figure 14). The extent of inundation is only slightly larger than the extent during the 5-yr event, as most of the additional flow is accommodated through increases in depth within the active floodway. Water levels are at or very close to bank elevations along all of the eastern bank with minor inundation of the vineyard avenue in the upper portion of the study reach and inundation in the lower portion of the study reach extending as far as 100-ft into the lower portions of the vineyard (Figures 12 & 14). These water levels are in agreement with observations of high water marks made by the vineyard landowner following the December 2005 flood which show water levels in the upper reach at the elevation of the vineyard avenue and minor inundation along the edges of the vineyard in the lower portions of the study reach. Within the reach with near-vertical western banks, peak water surface elevations were 12 to 15-ft above the base of the cliff face (Figure 12). Water levels receded more slowly than during the 5-yr event, decreasing by about 4.5-ft over an eleven hour period (0.4-ft/hr).

The proposed grading associated with the restoration design results in a significant decrease in the inundated width within the upstream restoration area as a result of elevating the west-bank terrace above the 50-yr floodplain (Figure 15). The reduction in inundation on the west bank was accompanied by minor increases in inundation extent on the east bank along the edge of the vineyard adjacent to the upstream restoration area (Figure 15). Moderate increases in water surface elevations (0.4 to 0.5-ft) occurred throughout the reach adjacent to the upstream restoration area and the reach between the two restoration areas (Figure 13). Adjacent to the downstream restoration area, the increases were smaller (0.1 to 0.2-ft). Slight (~0.1-ft) increases in water surface elevations also occurred throughout the downstream reaches of the model area (Figure 13). Along the face of the near-vertical west bank within the restoration areas, the restoration design results in a reduction in inundation width of 5- to 10-ft (away from the banks) and water levels that are ~6-ft below the top of the newly-graded banks (Figures 12 & 15).

Velocities

Maximum simulated velocities generally ranged from 4.5 to 9 ft/sec during the 5-yr event and from 5.5 to 10 ft/sec during the 50-yr event (Figures 16 & 17). Velocities were generally highest within the deepest portions of the channel with lower velocities along the channel margins. In a few areas, however, the region of highest velocities extended laterally up against the western bank of the river. This occurred in portions of the reach with near-vertical banks (vicinity of cross sections B and C in Figure 12), where maximum velocities against the cliff face reached as high as 9 ft/sec during the 5-yr event and 16 ft/sec during the 50-yr event (Figures 16 & 17).

During the 5-yr event, the proposed grading associated with the restoration design results in a significant increase in velocities within the channel adjacent to the upstream restoration area. Velocities in this area increased from 4 to 5 ft/sec under existing conditions to 8 to 9 ft/sec under proposed conditions (Figure 18). Increases in in-channel velocities were much smaller (~1 ft/sec higher) downstream of the upstream restoration area. In contrast to the 5-yr event, in-channel velocities generally decreased slightly during the 50-yr event (Figure 19). Within the areas discussed above where very high velocities occurred against the cliff face (vicinity of cross sections B and C in Figure 12), the proposed grading did not have a significant effect on velocities (Figure 19). High velocity conditions occurred along the edge of the re-graded banks in portions of both restoration areas. These velocities were as high as 12 ft/sec in the upstream restoration area and as high as 16 ft/sec in the downstream restoration area (Figure 19).

Summary

A hydrologic and hydraulic analysis was performed for the reach of the West Fork Russian River adjacent to the Coyote Valley Reservation in Redwood Valley, CA. This analysis characterized flood extents, water depths, and velocities under existing and proposed restored conditions during 5-yr and 50-yr recurrence interval storm events.

The restoration design results in the edge of flooding moving 5- to 10-ft away from the banks during the 5-yr event and 10- to 20-ft away from the banks during the 50-yr event. Minor increases in inundation extent along the edge of the vineyard on the east bank adjacent to the upstream restoration area occurred during the 50-yr event. Water surface elevations increase slightly (0.1 to 0.2-ft) in the vicinity of the restoration areas during the 5-yr event and increase more significantly (0.2 to 0.5-ft) during the 50-yr event. The restoration design results in significant increases in in-channel velocities adjacent to the upstream restoration area during the 5-yr event. Relatively high velocities occur along the edge of the re-graded banks in portions of the restoration areas, reaching as high as 12 to 16 ft/sec during the 50-yr event. The re-graded banks extend at least 5 to 6-ft higher than the 50-yr water surface elevations in these areas.

By shifting the edge of flooding away from the near-vertical west bank within the two restoration areas and by developing more stable lower banks that extend well above the 50-yr water surface elevation, the restoration design is expected to improve bank stability and reduce bank erosion of the western bank of the river. The design effectively reduces channel widths in the restored areas which has the effect of increasing in-channel velocities during the 5-yr event and increasing water surface elevations, particularly during the 50-yr event. The channel can be expected to adjust to the decrease in width over time and some short-term increases in bed and/or bank erosion will likely occur within the restored reach. Relatively high velocities occur along the margins of portions of the newly-graded banks indicating the need to protect these areas with rock and vegetation as is planned as part of the design. The zone of highest simulated bank velocity on the western banks occurs in the central portion of the reach between the upstream and downstream restoration areas under both existing and proposed conditions.

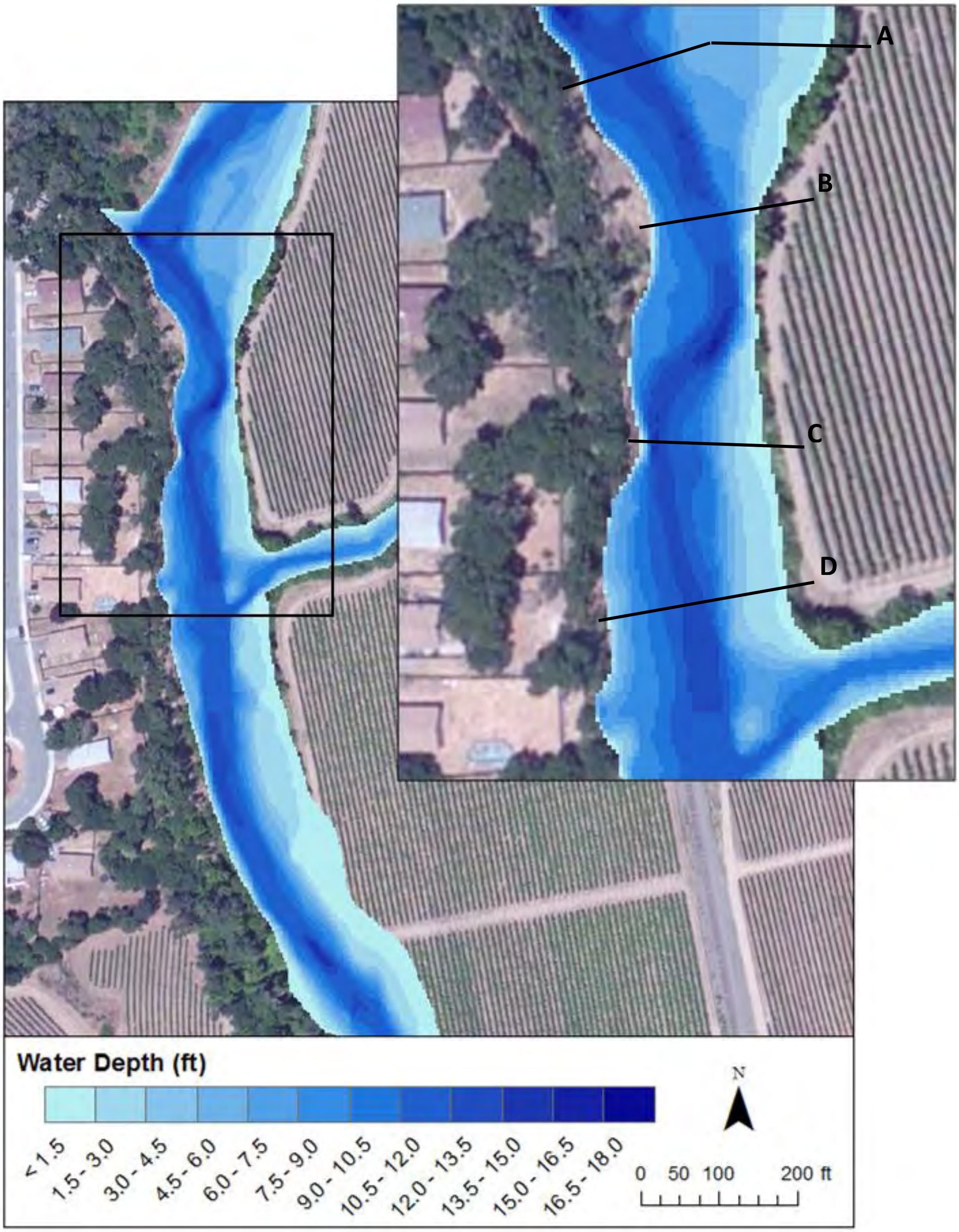

Figure 10: Maximum simulated water depths for existing conditions during the 5-yr flood event and locations of cross sections A through D as shown in Figure 12.

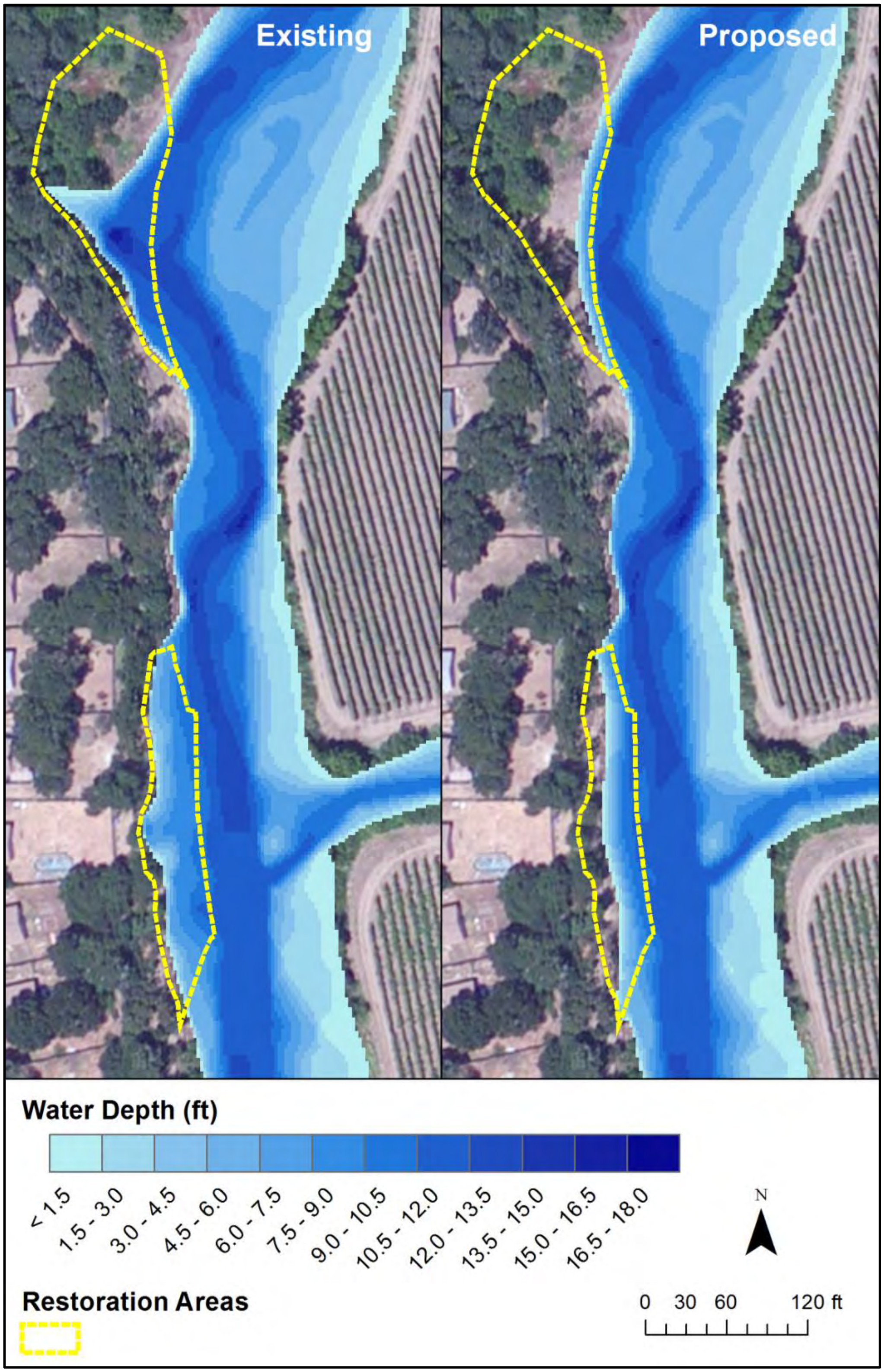

Figure 11: Comparison of maximum simulated water depths between existing and proposed conditions during the 5-yr flood event.

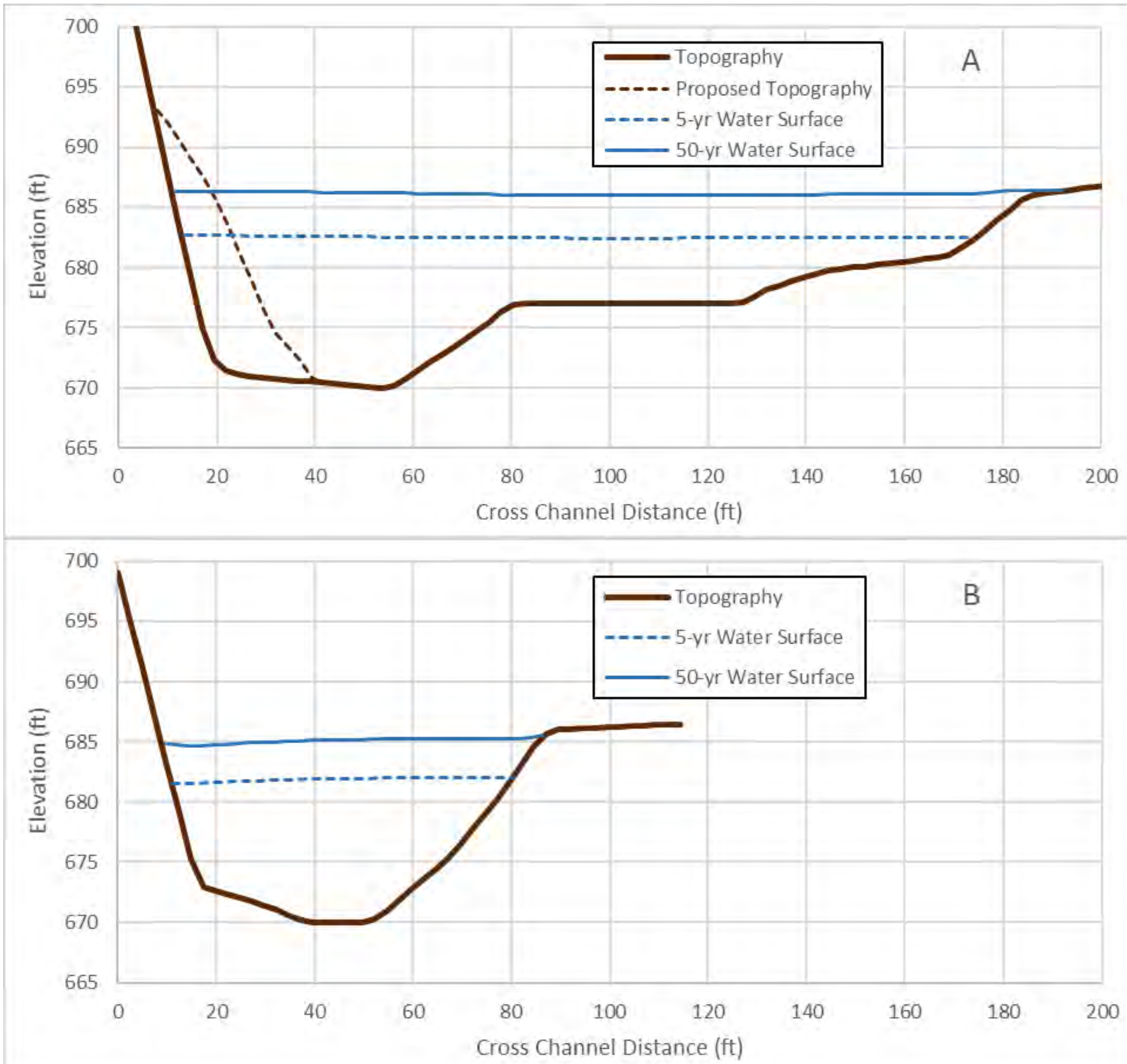

Figure 12: Channel cross sections showing the 5-yr and 50-yr water surface elevations. Sections A and D also show the proposed changes in channel topography in the upstream and downstream restoration areas respectively (see Figure 8 for locations).

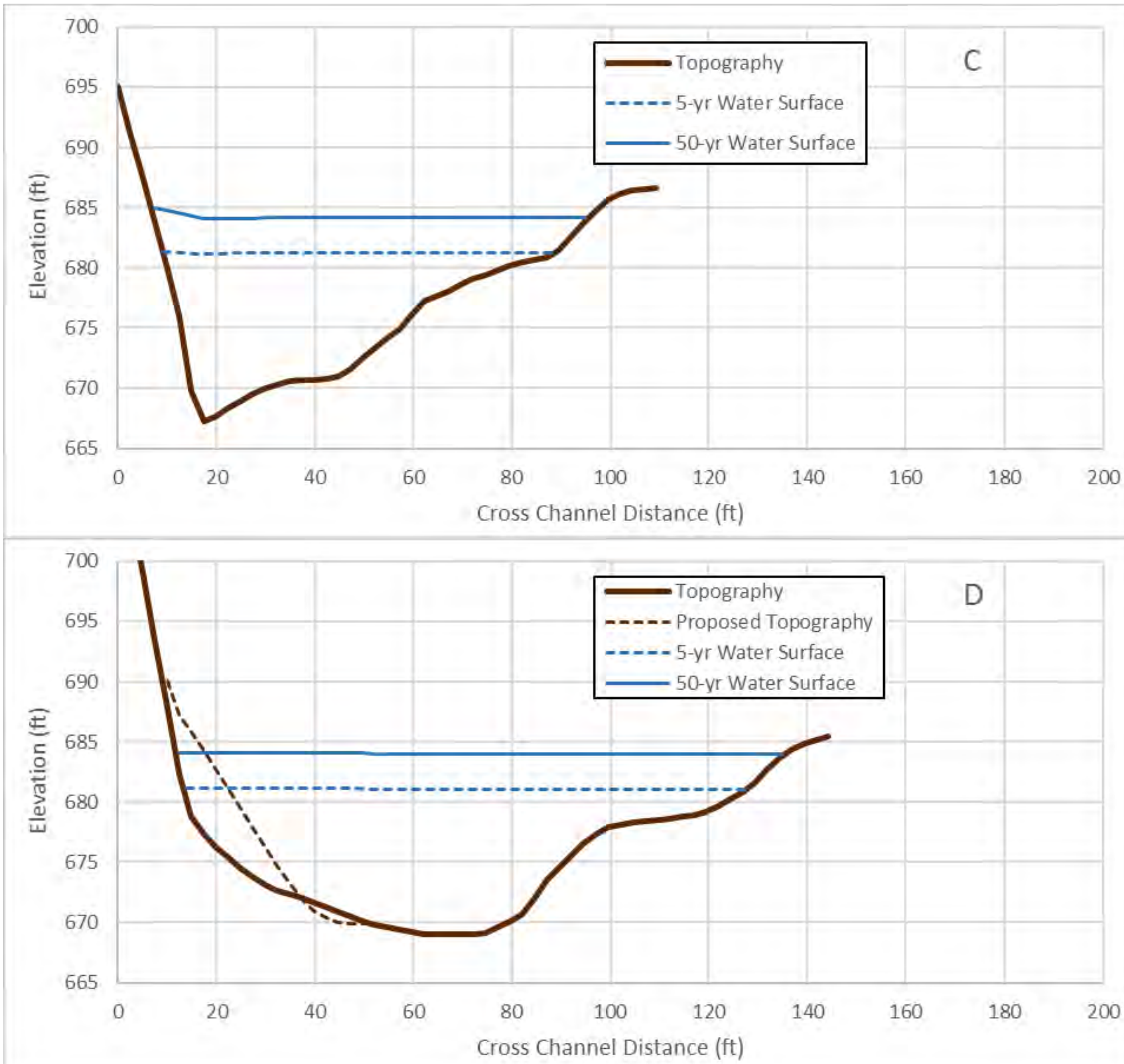

Figure 12 (continued)

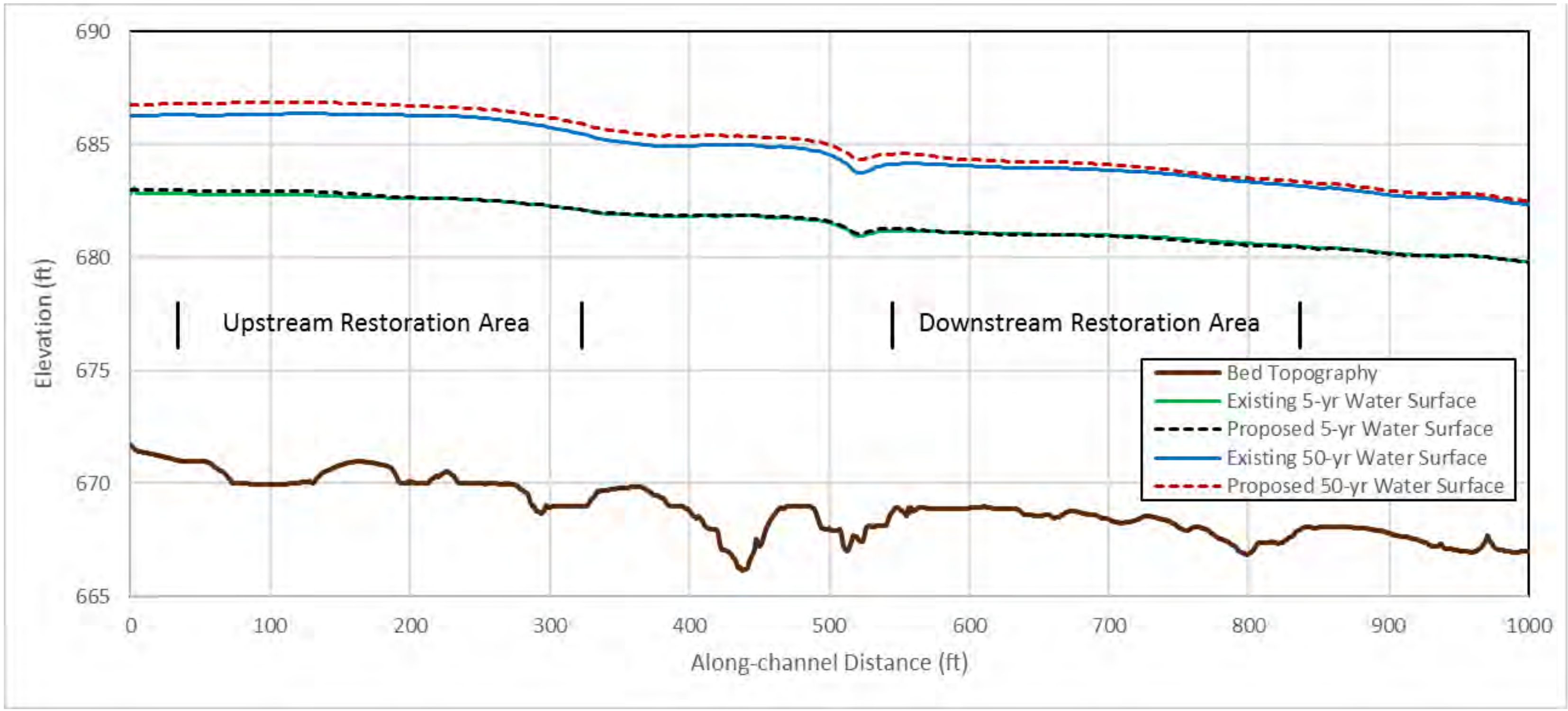

Figure 13: Longitudinal profile showing existing and proposed 5-yr and 50-yr water surface elevations.

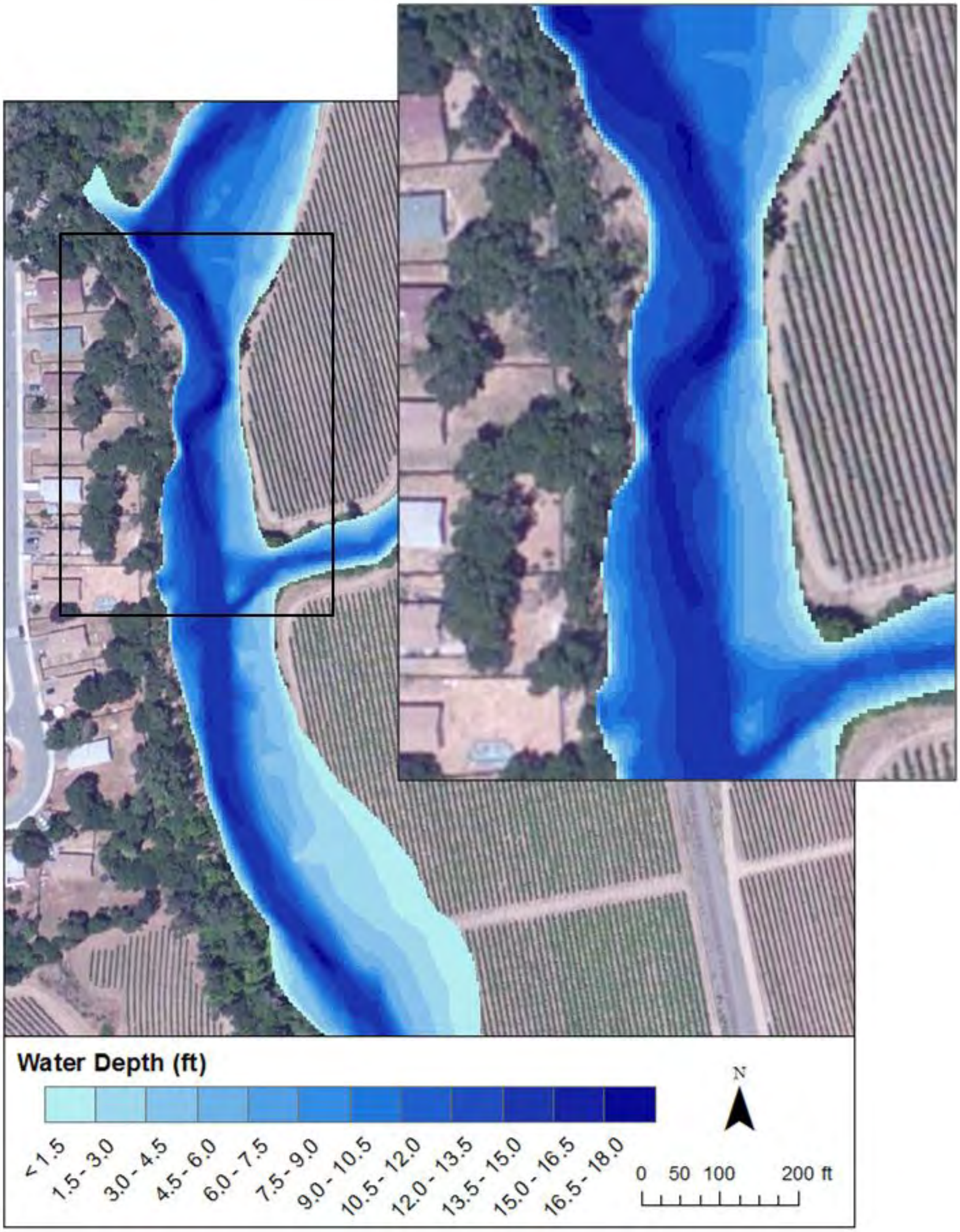
Water Depth (ft)
<1.5
1.5 - 3.0
3.0 - 4.5
4.5 - 6.0
6.0 - 7.5
7.5 - 9.0
9.0 - 10.5
10.5 - 12.0
12.0 - 13.5
13.5 - 15.0
15.0 - 16.5
16.5 - 18.0
N
0 50 100 200 ft

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Figure 14: Maximum simulated water depths during the 50-yr flood event.

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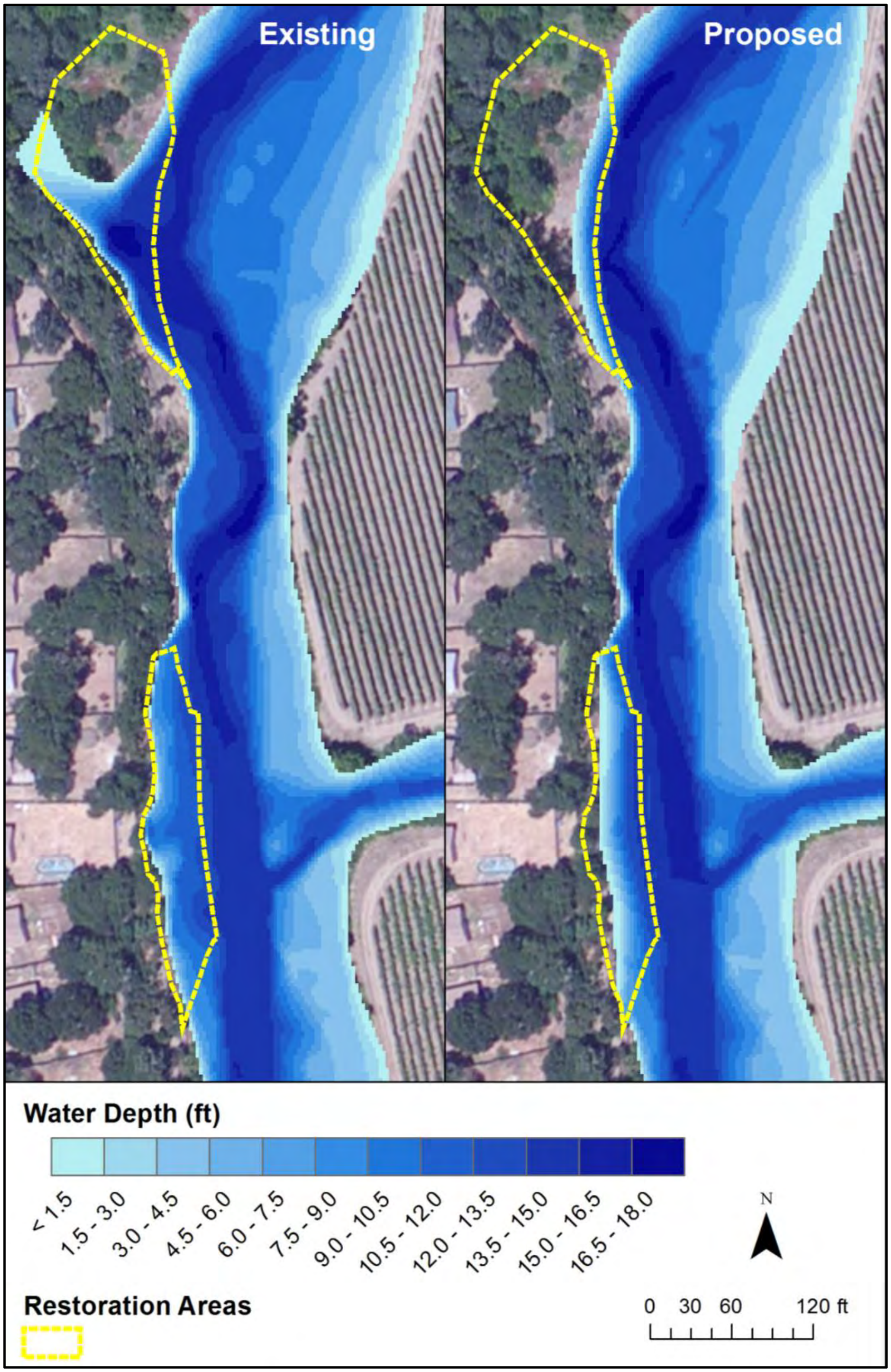

Figure 15: Comparison of maximum simulated water depths between existing and proposed conditions during the 50-yr flood event.

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Figure 16: Maximum simulated velocities during the 5-yr flood event.

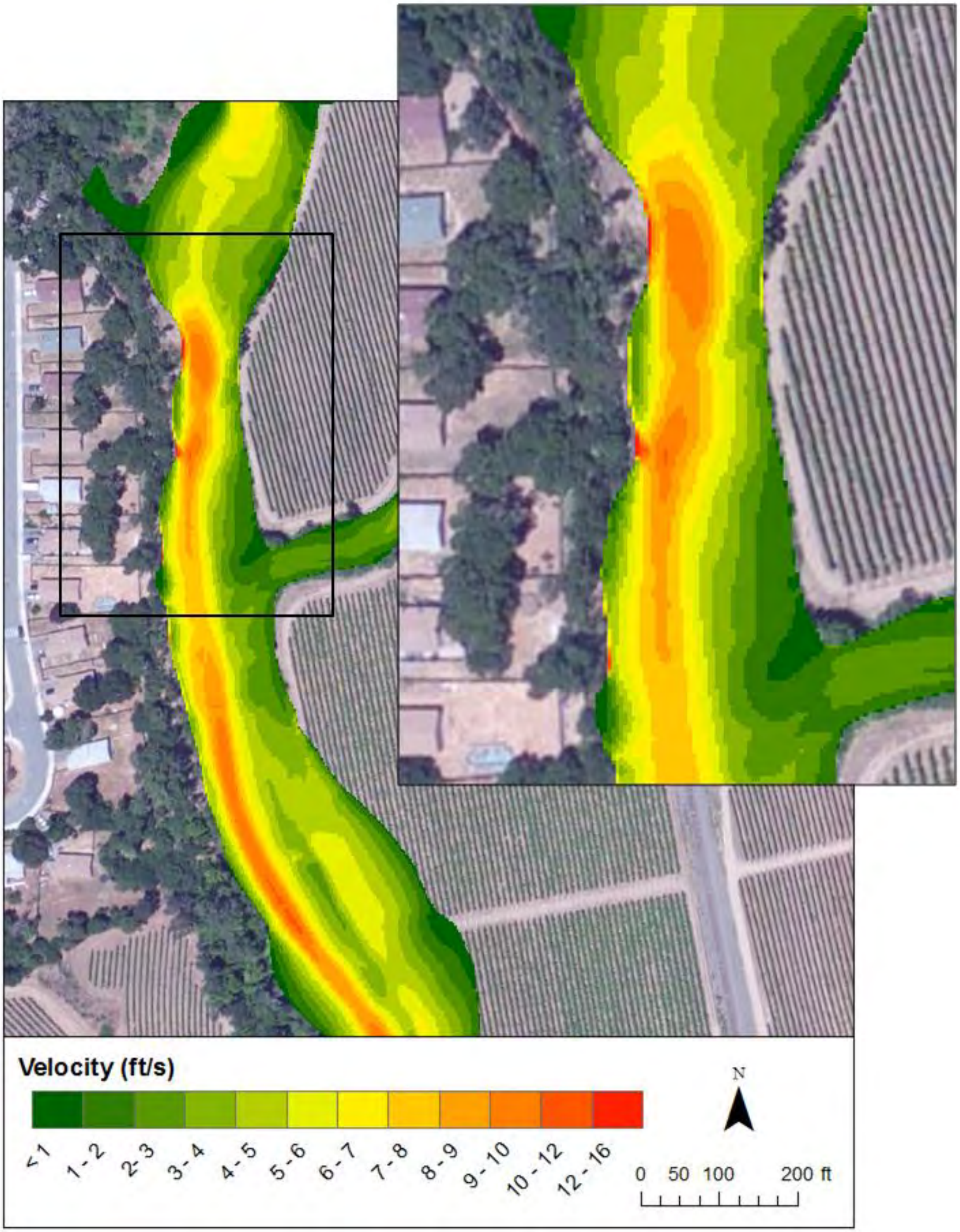

Figure 17: Maximum simulated velocities during the 50-yr flood event.

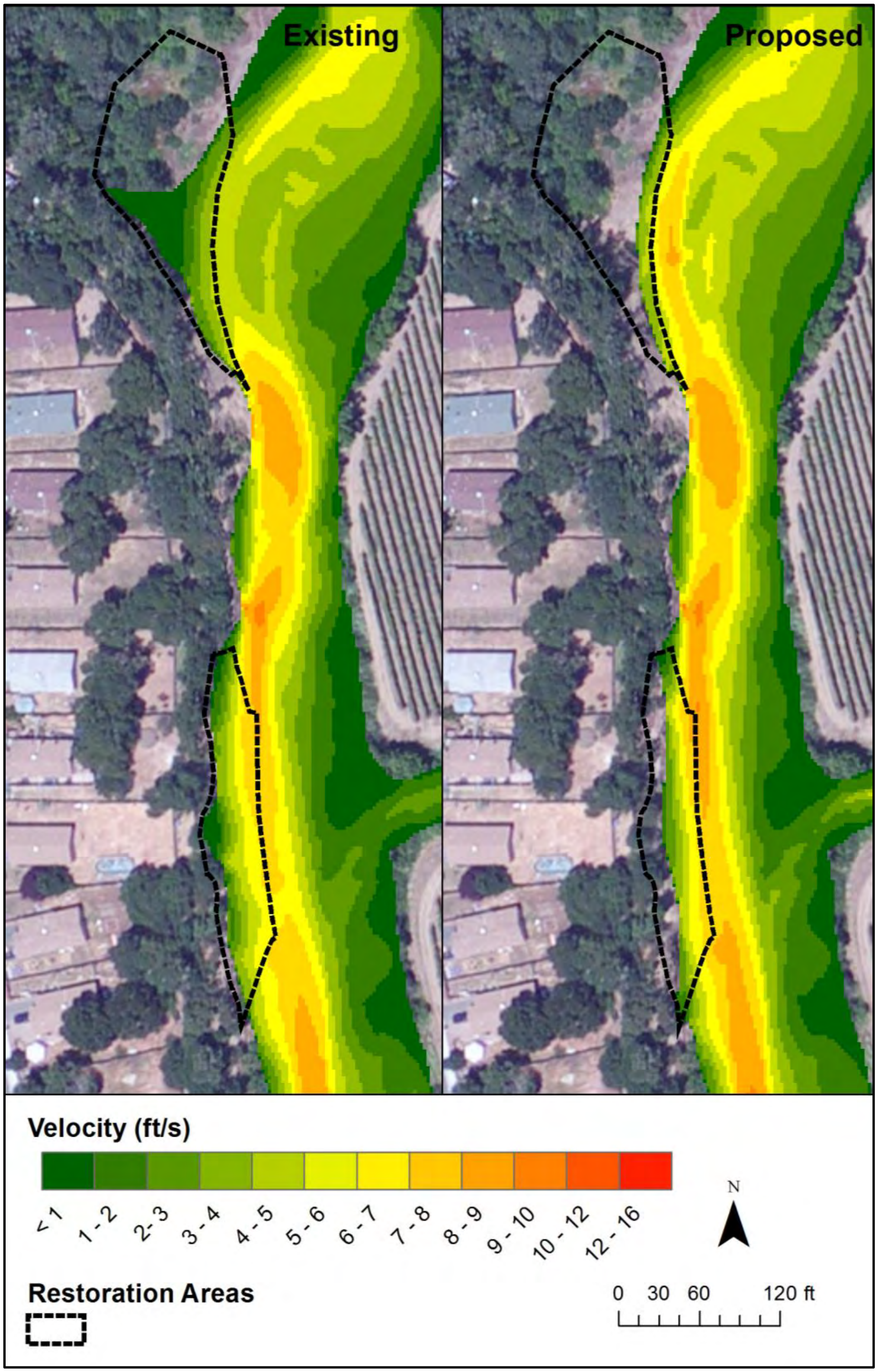

Figure 18: Comparison of maximum simulated water velocities between existing and proposed conditions during the 5-yr flood event.

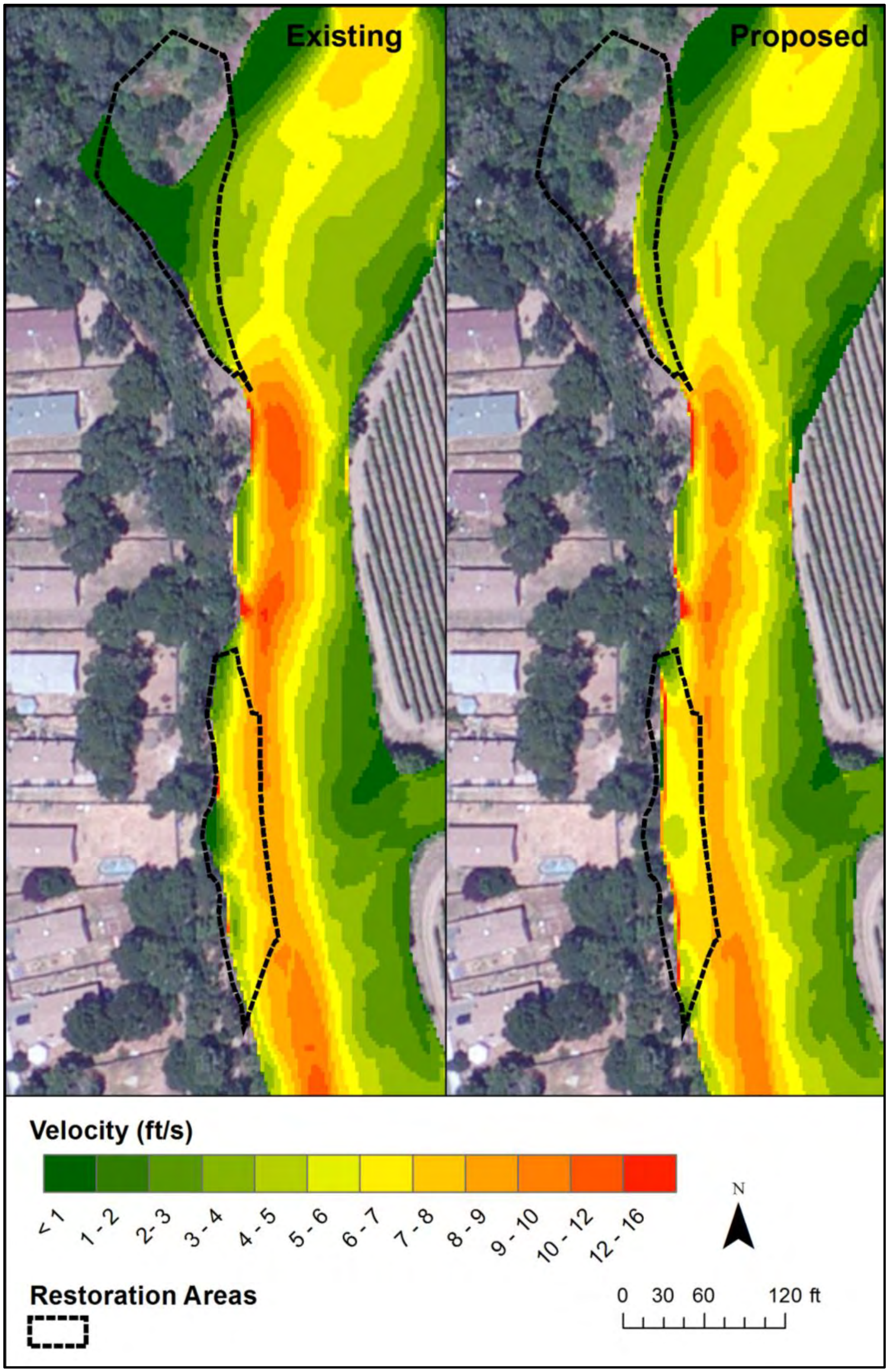

Figure 19: Comparison of maximum simulated water velocities between existing and proposed conditions during the 50-yr flood event.

July 6, 2016

TO: Chris Watt, LACO Associates

FROM: Jeremy Kobor, CFM
Senior Hydrologist, O'Connor Environmental, Inc.

Matt O'Connor, PhD, CEG #2449
President, O'Connor Environmental, Inc

Hydrologic and Hydraulic Analysis of Existing Conditions - West Fork Russian River on the Coyote Valley Reservation, Redwood Valley, CA

Overview

A hydrologic and hydraulic analysis was performed for the reach of the West Fork Russian River adjacent to the Coyote Valley Reservation in Redwood Valley, CA. This analysis was performed to characterize existing conditions in the project reach and provide a basis for developing and evaluating project design alternatives to stabilize and reduce erosion of the near-vertical west bank of the river. Development and evaluation of design alternatives will be described in a subsequent memorandum.

Hydrologic Analysis

The Russian River Near Ukiah U.S. Geological Survey gauging station (Station ID #11461000) is located on the West Fork Russian River just upstream of the confluence with the East Fork Russian River, about four miles downstream of the project reach. This station has a nearly continuous streamflow record from 1953 to present plus some additional data from 1912-1913. A flood frequency analysis was performed on the 65 years of annual peak flow data available for the gauging site using the PeakFQ software which implements the U.S. Geological Survey's Bulletin 17B flood frequency analysis methodology (USGS, 1981).

Several large tributaries including Forsythe Creek and York Creek enter the river between the project reach and the gauge site, and the drainage area at the upstream edge of the project reach is about 30.5% of the drainage area at the gauge site. Annual peak flows at the gauge site were scaled down by a factor of 0.305 to account for the differences in drainage areas between the project site and the gauge site (Figure 1). The flood frequency analysis produced estimates of peak discharges associated with floods of various recurrence intervals ranging from 1,591 cfs for a 1.25-yr event to 8,579 cfs for a 500-yr event (Table 1 and Figure 2).

Based on the results of a preliminary hydraulic analysis, it was determined that the 50-yr event represents the threshold discharge above which flows begin to spread laterally onto the floodplain occupied by vineyard to the east. This event was selected for the hydraulic analysis to represent the maximum anticipated water surface elevations adjacent to the near-vertical west bank. The 5-yr event was also selected to represent a more frequent flood event with significant water depths adjacent to the near-vertical bank.

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The 5-yr peak discharge estimate is 3,664 cfs and the 50-yr peak discharge estimate is 6,228 cfs (Table 1). Salt Hollow Creek enters the river from the east within the project reach. The drainage area of Salt Hollow Creek is about 3.8% of the drainage area at the gauge site. Estimates of peak flows for Salt Hollow Creek were obtained in a similar fashion to those for the main stem by scaling down the peak flows at the gauge site by a factor of 0.038. This exercise produced estimates of the peak discharges for Salt Hollow Creek of 460 cfs for the 5-yr event and 781 cfs for the 50-yr event (Table 1).

The flow record at the gauge site was examined and two historical events were selected to represent the 5-yr and 50-yr floods. An event from December 2nd, 2012 produced a peak discharge of 3,267 cfs after scaling by drainage area. Flow data for this event was scaled up by a factor of 1.122 such that the peak flow matched the estimate of the 5-yr peak discharge. An event from December 30th, 2005 (the largest flood on record) produced a peak discharge of 6,900 cfs after scaling by drainage area. Flow data for this event was scaled down by a factor of 0.903 such that the peak flow matched the estimate of the 50-yr peak discharge. These scaled historical events provided the inflow boundary conditions for the hydraulic model described below (Figure 3).

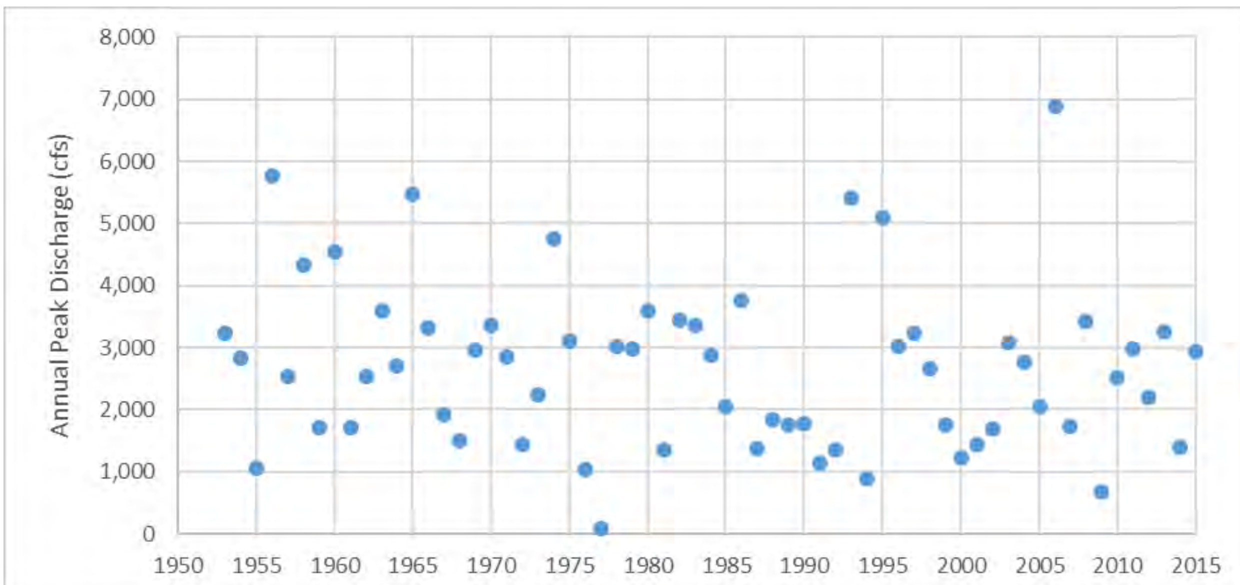

Figure 1: Annual peak flows at the project site from 1953 to 2015 based on drainage area scaled data from the USGS Russian River Near Ukiah gauging station.

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Table 1: Tabular flood frequency analysis results for the project site based on the Bulletin 17B methodology applied to the drainage area scaled data from the USGS Russian River Near Ukiah gauging station.

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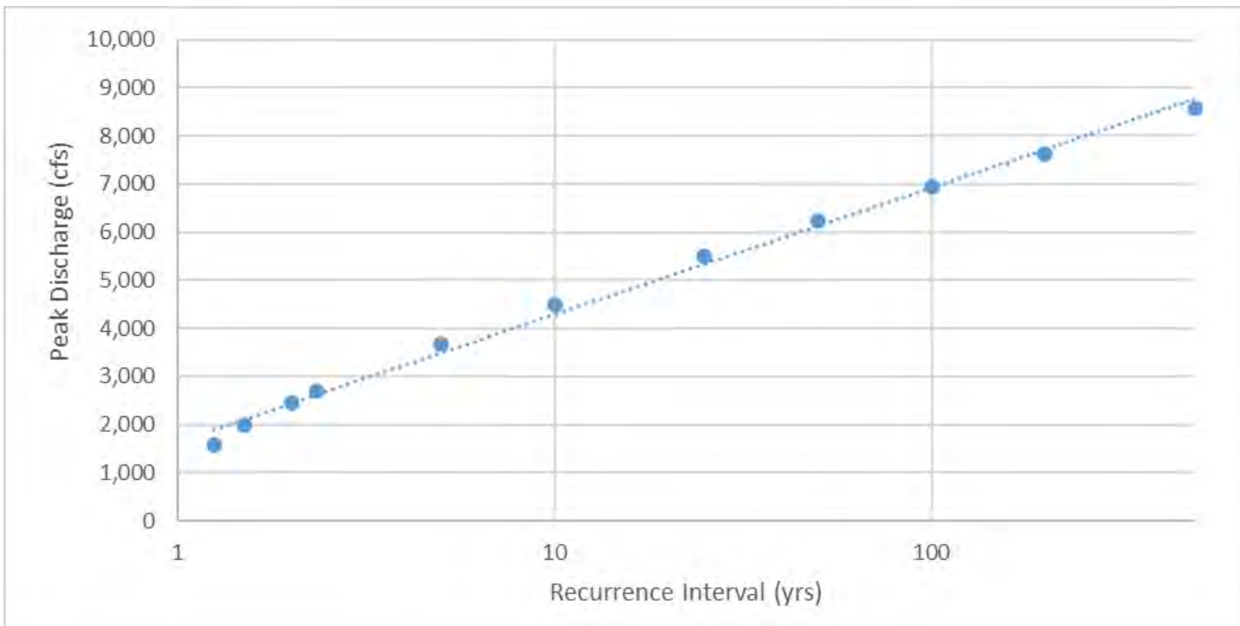

Figure 2: Graphical flood frequency analysis results for the project site based on the Bulletin 17B methodology applied to the drainage area scaled data from the USGS Russian River Near Ukiah gauging station.

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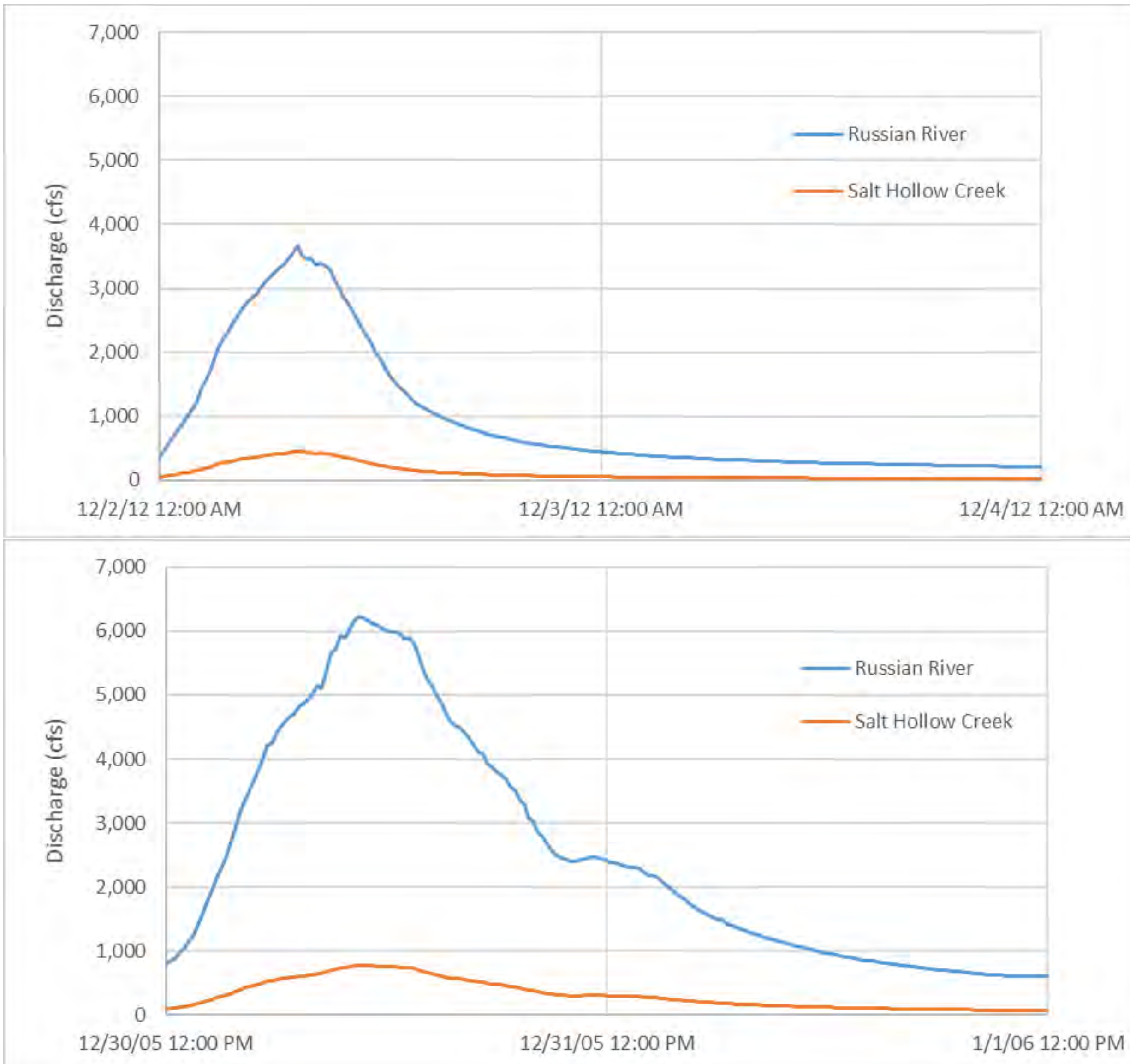

Figure 3: Inflow boundary conditions for the 5-yr (top) and 50-yr (bottom) flood events.

Hydraulic Analysis

Model Development

The MIKE 21 hydraulic model was used to simulate the existing conditions hydraulics at the project site. MIKE 21 is a 2-dimensional hydraulic model which simulates flows across a continuous topographic surface representing the project reach. The channel and floodplain topography within the project reach are represented by a series of grid cells, and open channel flow equations are solved to produce estimates of water depths and velocities at each grid cell (DHI, 2016). Velocity estimates from the simulation model are depth-averaged flow velocity.

A detailed topographic survey of the project site was completed by Doble Thomas and Associates in May 2016 and used to produce a 1-ft contour interval topographic map. The topographic map was converted to a 2.5-ft resolution Digital Elevation Model (DEM) for input in the hydraulic model (Figure 4). The model extent is equivalent to the extent of the topographic survey and it covers a 1,365-ft reach of the West Fork Russian River from 220-ft upstream of where the reach with near-vertical banks begins to 280-ft downstream of the southern end of the Reservation subdivision (Figure 4). The model also includes the lowest 270-ft of Salt Hollow Creek which enters the river from the east near the center of the study reach. Laterally, the model extends ~300 to 400-ft east of the river onto the vineyard and to the top of the near-vertical west bank so as to include the full extent of expected inundation (Figure 4).

Field observations of channel morphology, bed materials, and the extent of riparian vegetation provided the basis for developing estimates of channel roughness (Manning's n) for various reaches of the channel and portions of the floodplain. Field mapping in combination with interpretation of aerial photography and examination of the project DEM were used to delineate polygons with similar roughness characteristics. Manning's n values were assigned to each polygon and a roughness map was produced for the model (Figure 5). Manning's n values within the active channel range from 0.035 to 0.05. Floodplain values range from 0.025 along vineyard avenues to 0.12 in areas of dense blackberry and willow (Figure 5). The spatial distribution of roughness is constant in the simulation.

Inflow boundary conditions for the West Fork Russian River and Salt Hollow Creek for the 5-yr and 50-yr flood events (as described under Hydrologic Analysis and in Figure 3) were input in the model at the locations shown in Figure 4. A water-level boundary condition was developed for each event by solving Manning's Equation for a cross section extracted from the project DEM at the downstream end of the model for a variety of discharges in order to develop a rating equation (Figure 6). The rating equation was used in conjunction with the inflow boundary time series to develop time series of water levels as downstream boundary conditions for the model (Figure 7).

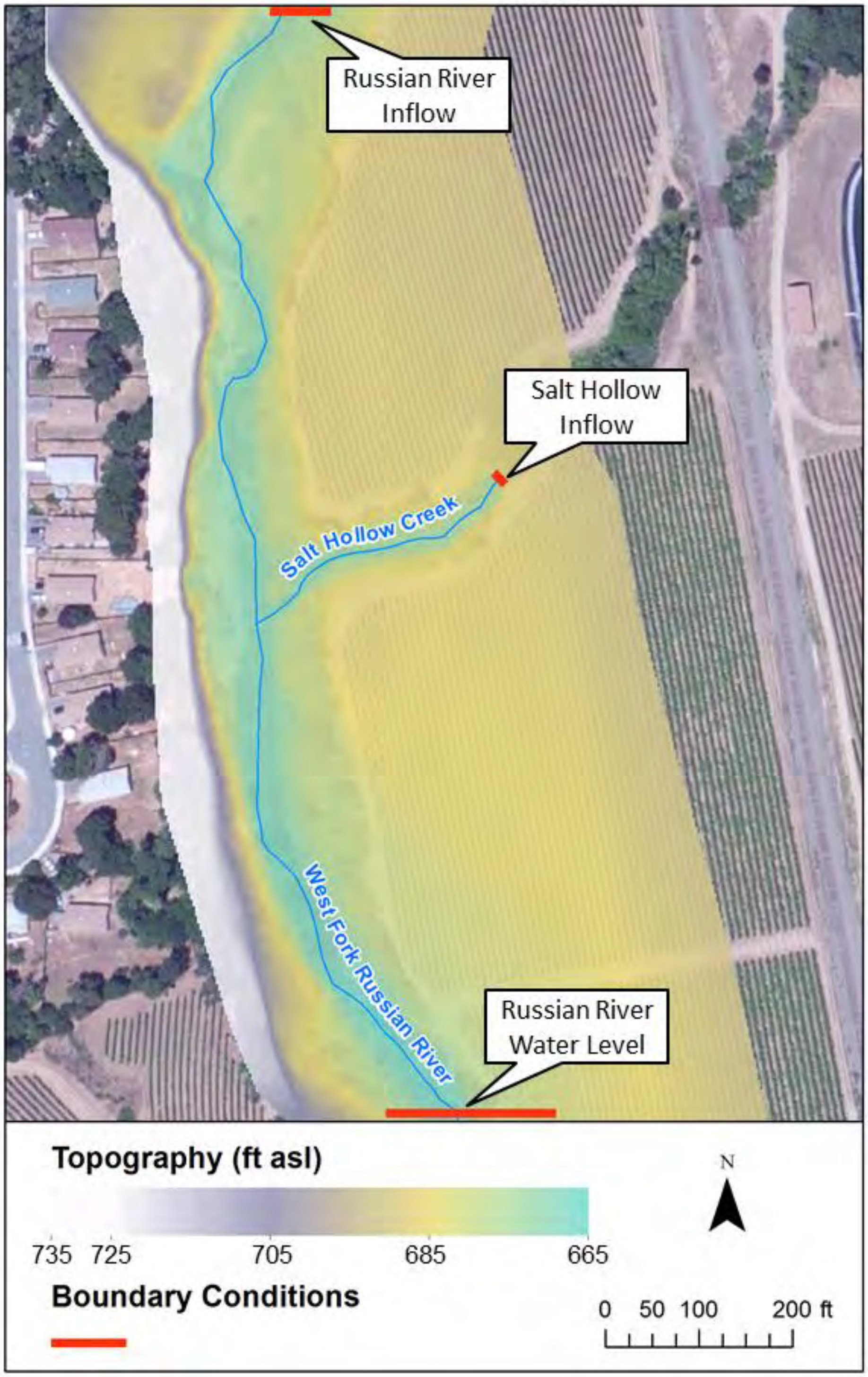

Figure 4: Extent of the hydraulic model domain, model topography, and locations of boundary conditions.

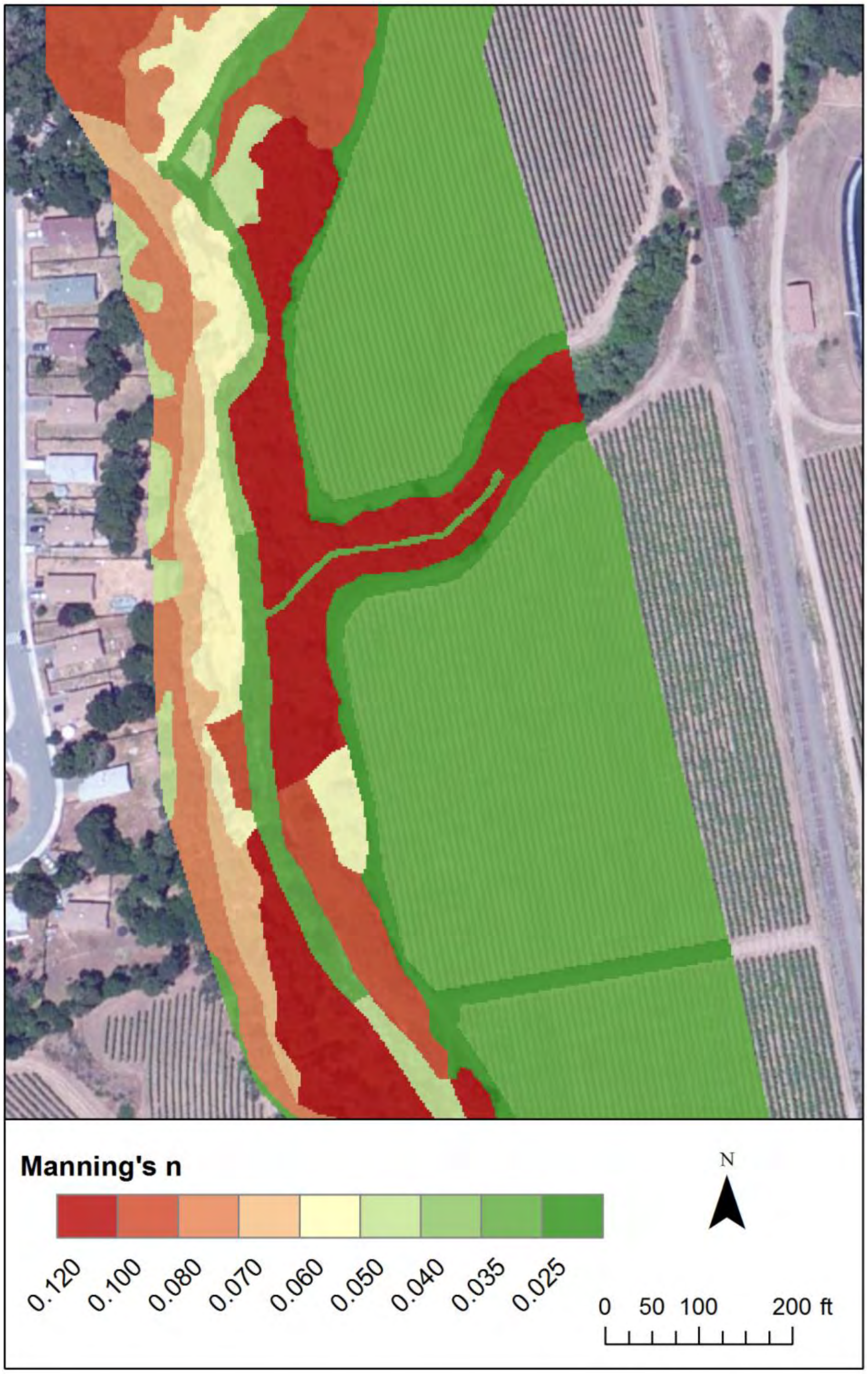

Figure 5: Distribution of Manning's n values used in the hydraulic model.

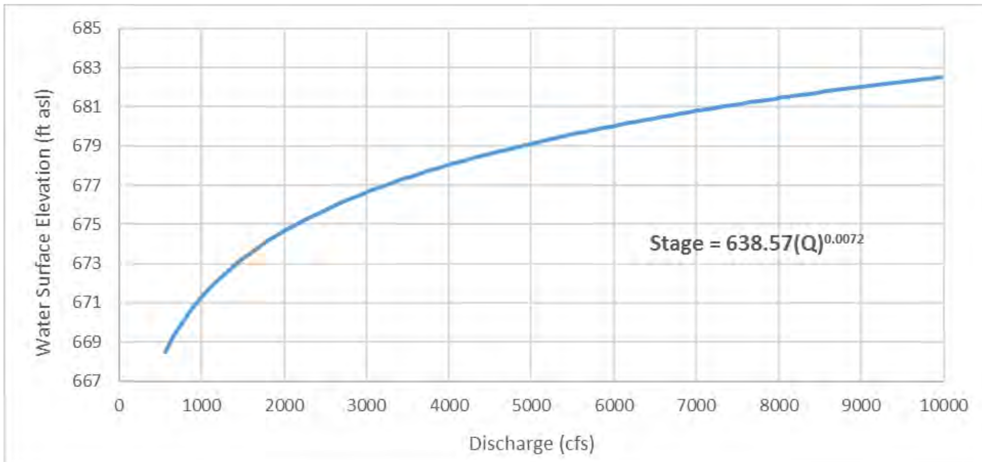

Figure 6: Rating curve developed for a cross section at the downstream edge of the model domain and used to generate the water level boundary conditions shown in Figure 7.

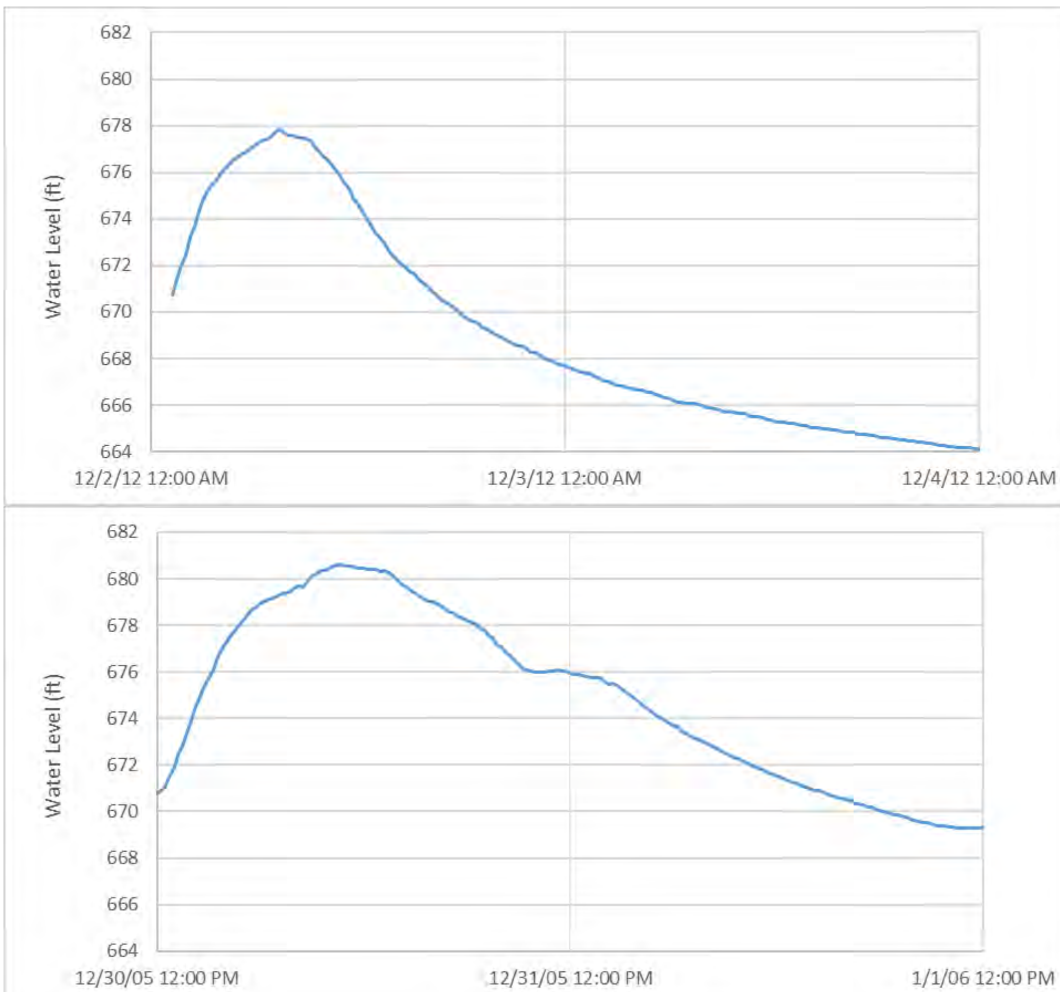

Figure 7: Water level boundary conditions for the 5-yr (top) and 50-yr (bottom) flood events.

Model Results

Maximum simulated water depths for the 5-yr event generally ranged from 11.0 to 12.5-ft within the channel with depths as high as 15.5-ft in deeper pools (Figure 8). Flows were contained within the active floodway for the most part with the exception of the lowest reach where water levels exceeded elevations along the east bank and inundated a small portion of the lower vineyard. Within the reach with near-vertical western banks, water surface elevations were 9 to 11-ft above the base of the cliff face (Figure 9). Rapid dewatering of the cliff face is hypothesized as a mechanism for bank failure, and the water level results indicate that water levels against the bank recede fairly quickly dropping by about 6-ft over an eight hour period following the peak flow (0.75-ft/hr).

During the 50-yr event, maximum water depths in the channel generally ranged from 14 to 16-ft with depths as high as 19.0-ft in deeper pools (Figure 10). The extent of inundation is only slightly larger than the extent during the 5-yr event, as most of the additional flow was accommodated through increases in depth within the active floodway. Water levels are at or very close to bank elevations along all of the eastern bank with minor inundation of the vineyard avenue in the upper portion of the study reach and inundation in the lower portion of the study reach extending as far as 100-ft into the lower portions of the vineyard (Figures 9 & 10). These water levels are in agreement with observations of high water marks made by the vineyard landowner following the December 2005 flood which show water levels in the upper reach at the elevation of the vineyard avenue and minor inundation along the edges of the vineyard in the lower portions of the study reach. Within the reach with near-vertical western banks, peak water surface elevations were 12 to 15-ft above the base of the cliff face (Figure 9). Water levels receded more slowly than during the 5-yr event, decreasing by about 4.5-ft over an eleven hour period (0.4-ft/hr).

Maximum simulated velocities generally ranged from 4.5 to 9 ft/s (Figure 11) during the 5-yr event and from 5.5 to 10 ft/s during the 50-yr event (Figures 11 & 12). Velocities were generally highest within the deepest portions of the channel with lower velocities along the channel margins. In a few areas, however, the region of highest velocities extended laterally up against the western bank of the river. This occured in portions of the reach with near-vertical banks (vicinity of cross sections B and C in Figure 9), where maximum velocities against the cliff face reached as high as 9 ft/s during the 5-yr event and 16 ft/s during the 50-yr event (Figures 11 & 12).

DRAFT

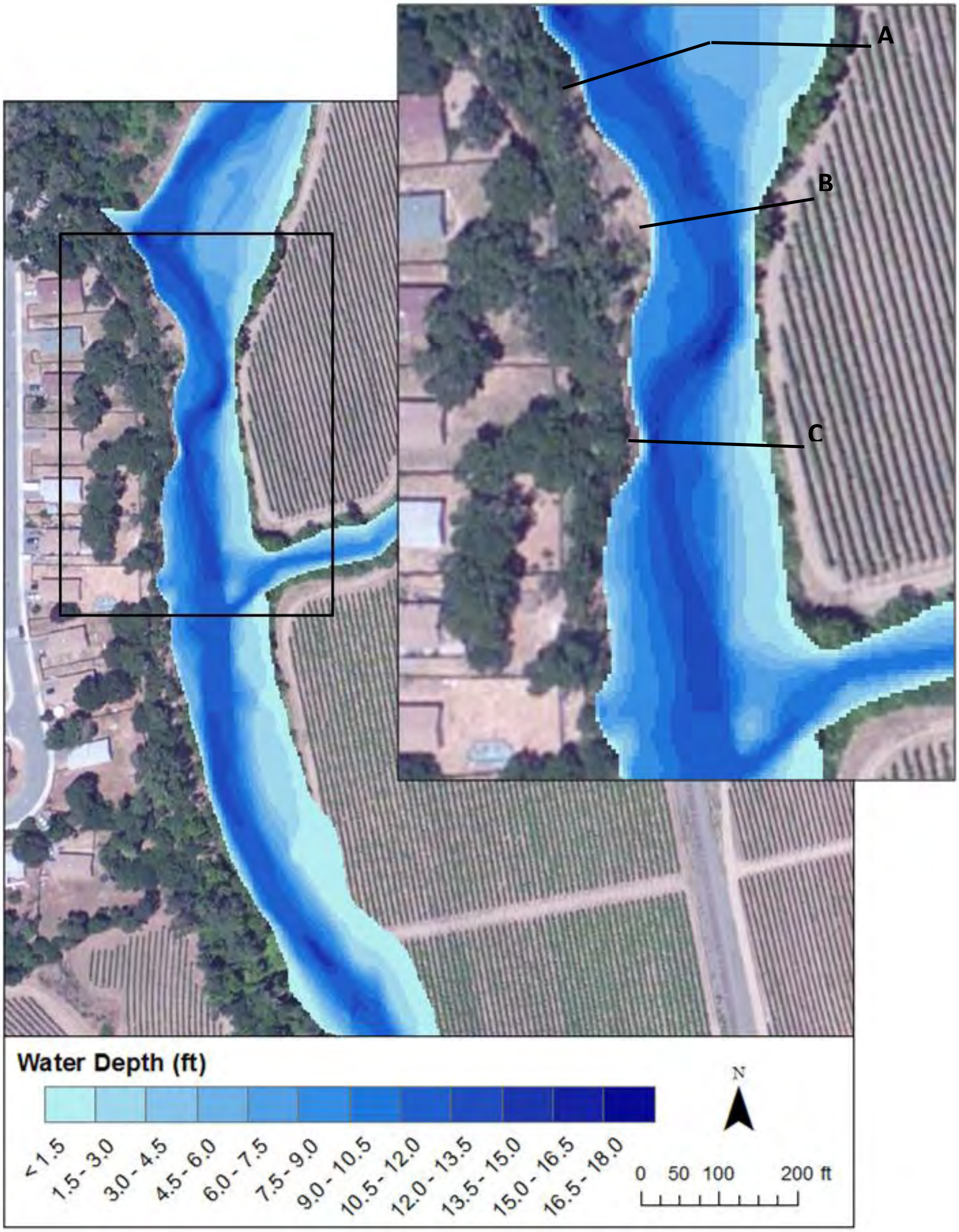

Figure 8: Maximum simulated water depths during the 5-yr flood event and locations of cross sections A through C as shown in Figure 9.

DRAFT

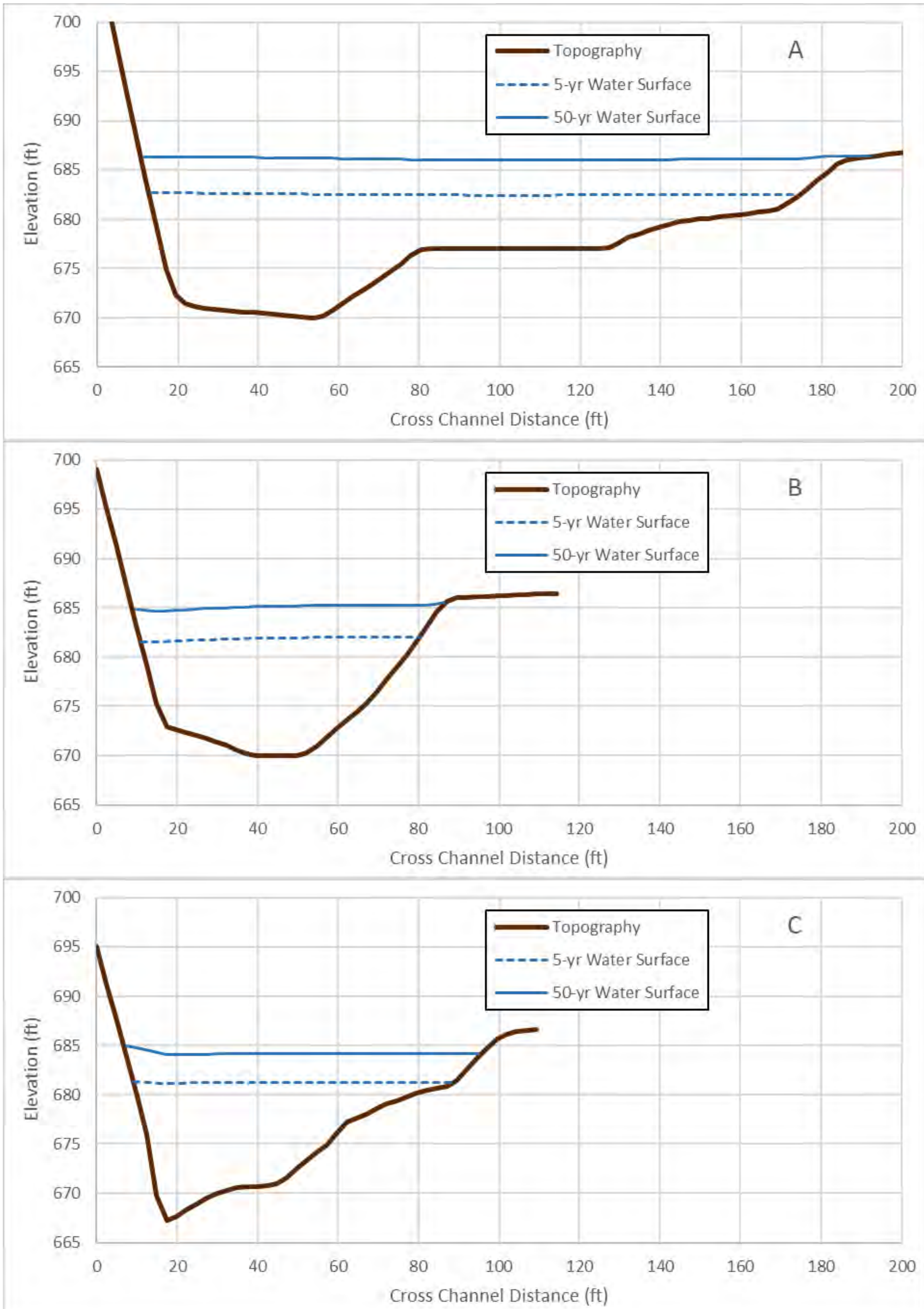

Figure 9: Channel cross sections showing the 5-yr and 50-yr water surface elevations (see Figure 8 for locations).

DRAFT

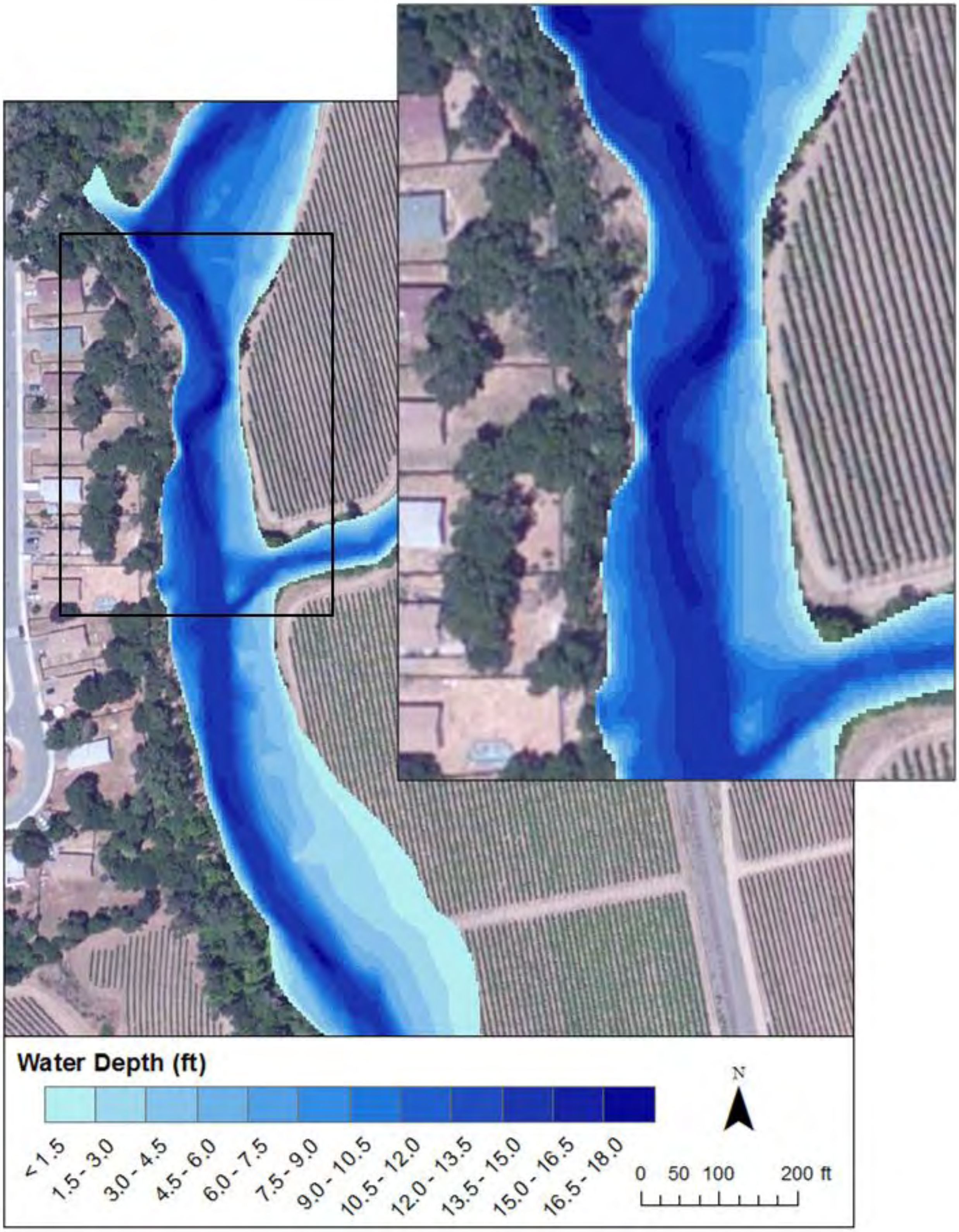

Figure 10: Maximum simulated water depths during the 50-yr flood event.

DRAFT

Figure 11: Maximum simulated velocities during the 5-yr flood event.

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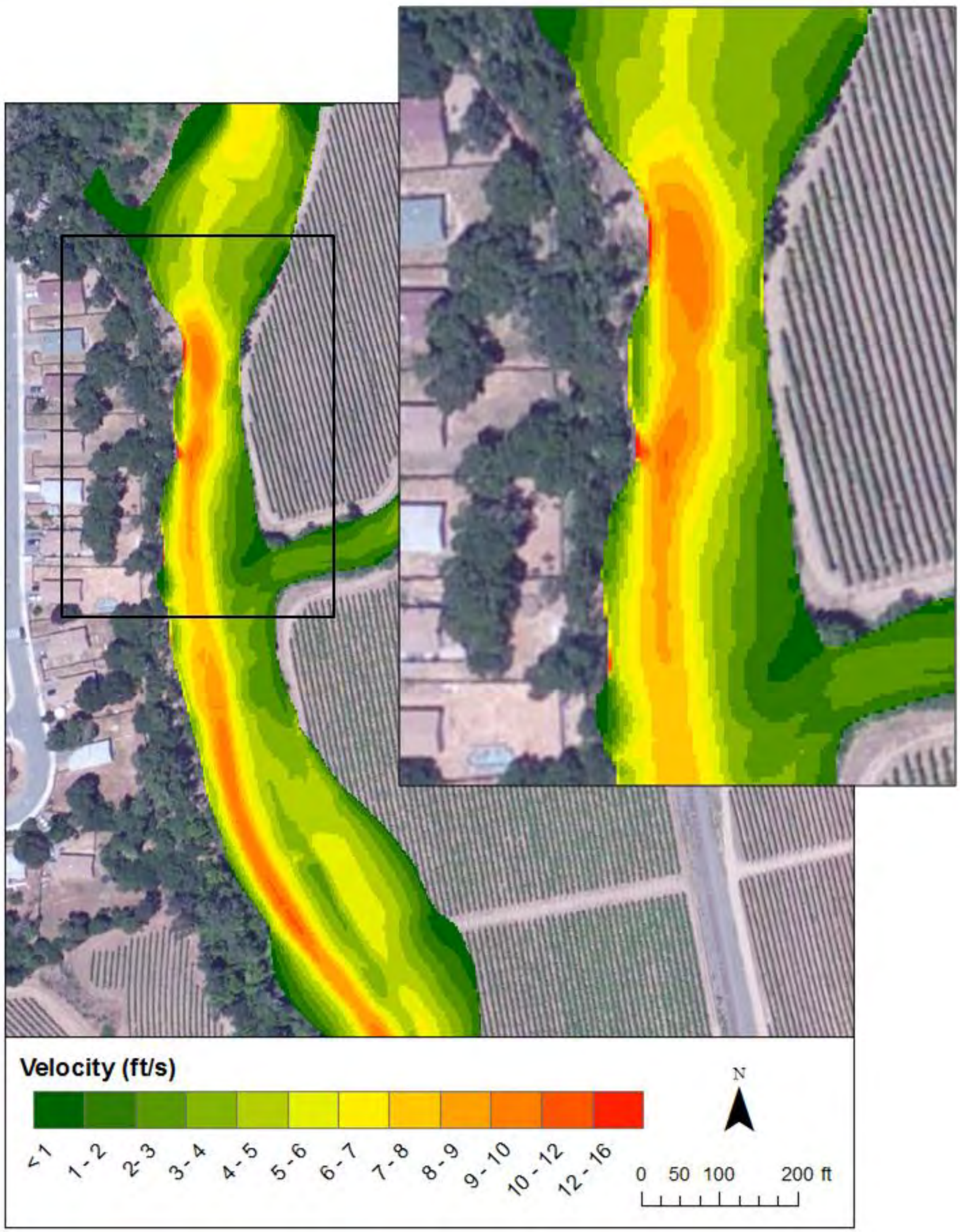


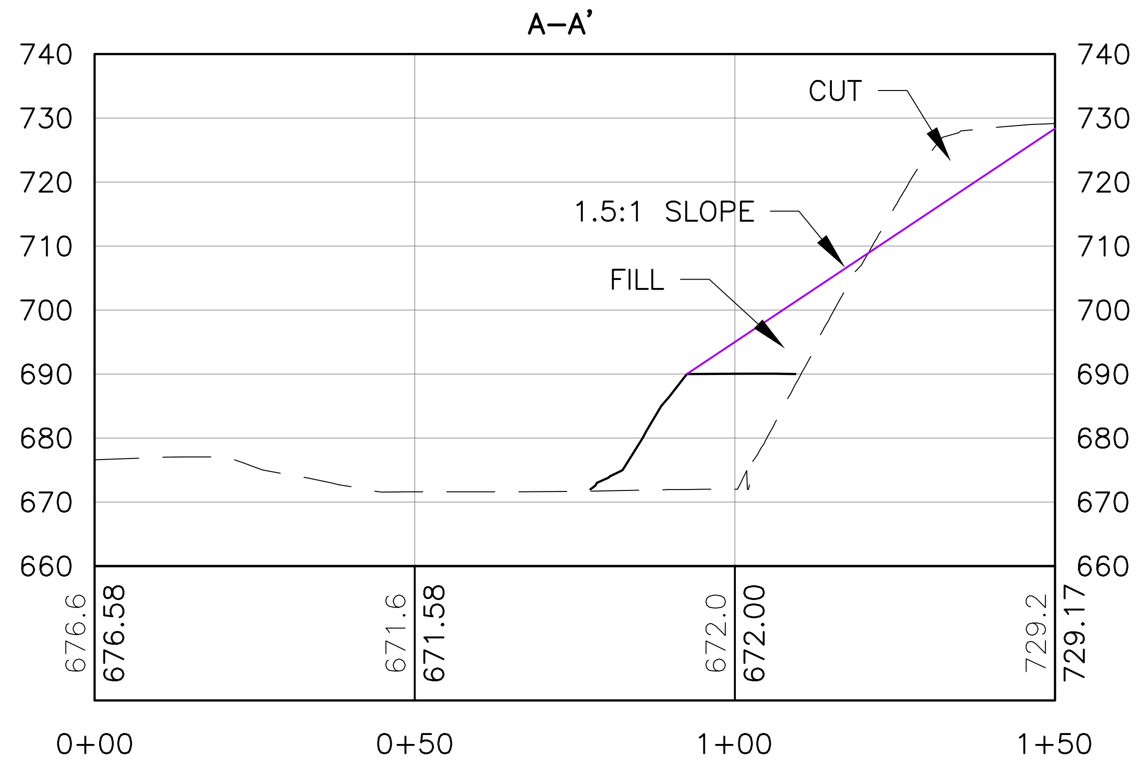
Figure 12: Maximum simulated velocities during the 50-yr flood event.

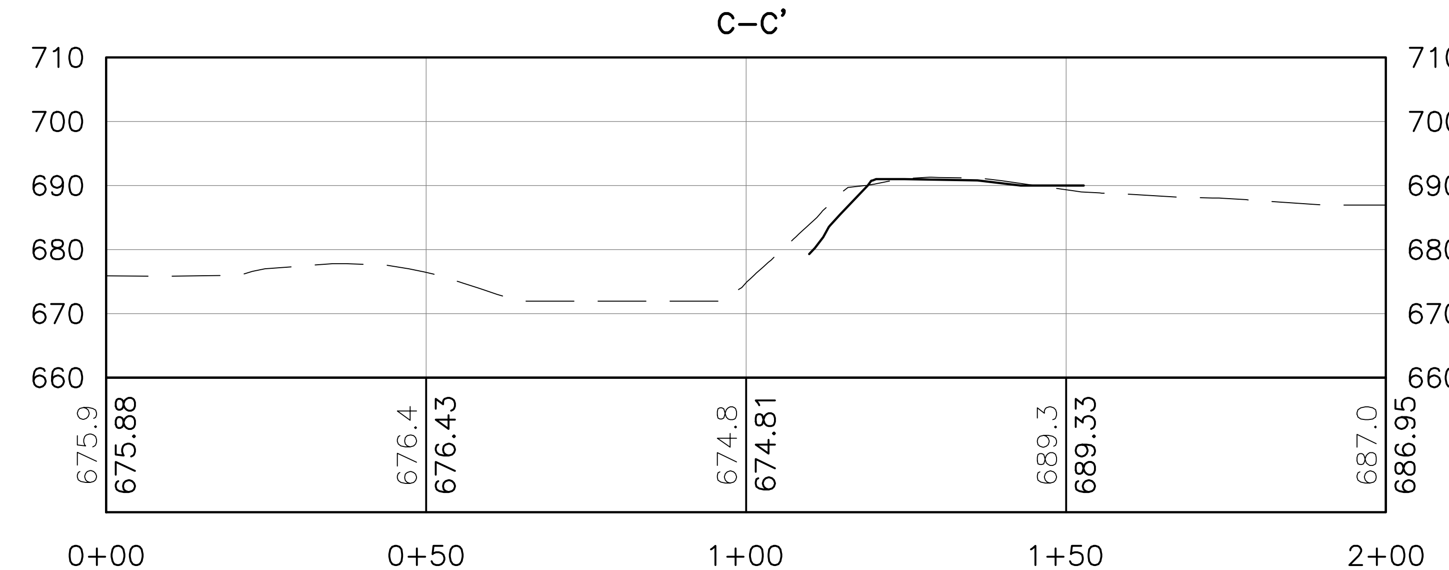
ATTACHMENT 5

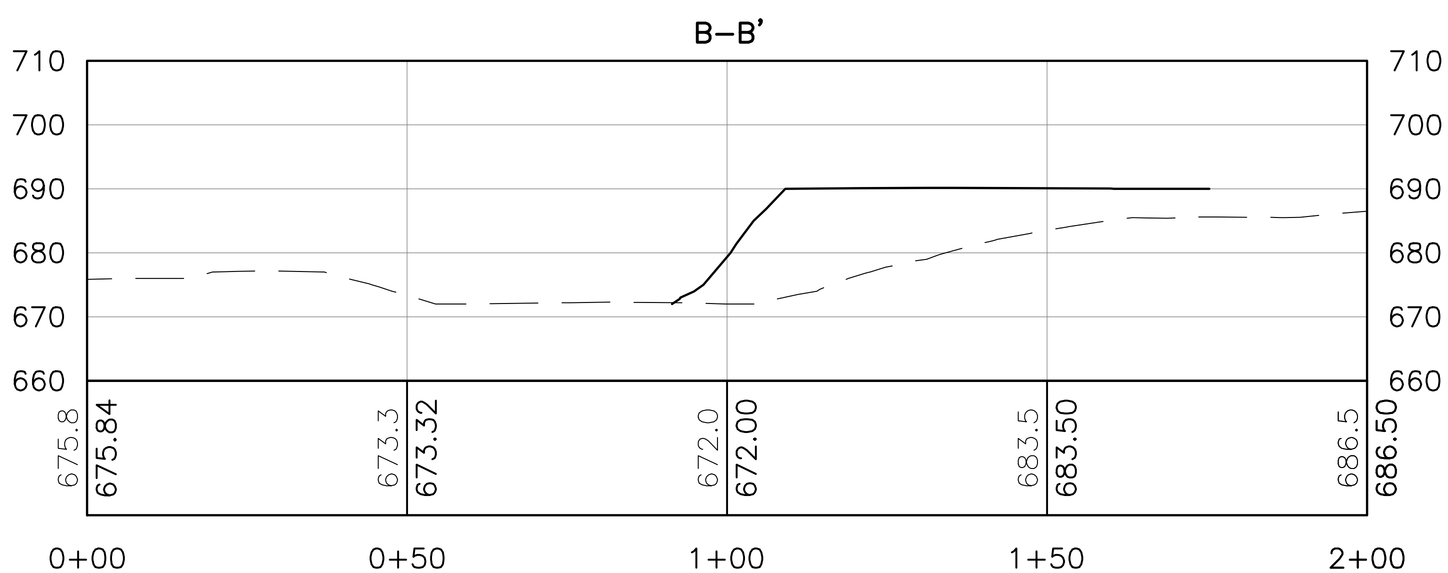
Preferred Alternative, Drawings & Estimate

LACO


AREA TO BE SCARIFIED 6"
ADD ROCK RIP-RAP
TO RIVER BANK
D
0+00
C
0+00
B
0+00
A
0+00
1+00
D'
1+50
PROPOSED
GRADING
MATCH PROPOSED GRADING
TO EXISTING RIVER BANK
KEY AND BENCH
WEAK SOIL
DEPOSITS
TO BE REMOVED
C'
2+00
B'
2+00
A'
1+50
STRONG SOIL
0 15' 30' 60' 90'
SCALE: 1"=30'


A–A'
CUT
1.5:1 SLOPE
FILL
740
730
720
710
700
690
680
670
660
676.6
676.58
671.6
671.58
672.0
672.00
729.2
729.17
0+00
0+50
1+00
1+50


C–C'
710
700
690
680
670
660
675.9
675.88
676.4
676.43
674.8
674.81
689.3
689.33
687.0
686.95
0+00
0+50
1+00
1+50
2+00


B–B'
710
700
690
680
670
660
675.8
675.84
673.3
673.32
672.0
672.00
683.5
683.50
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686.50
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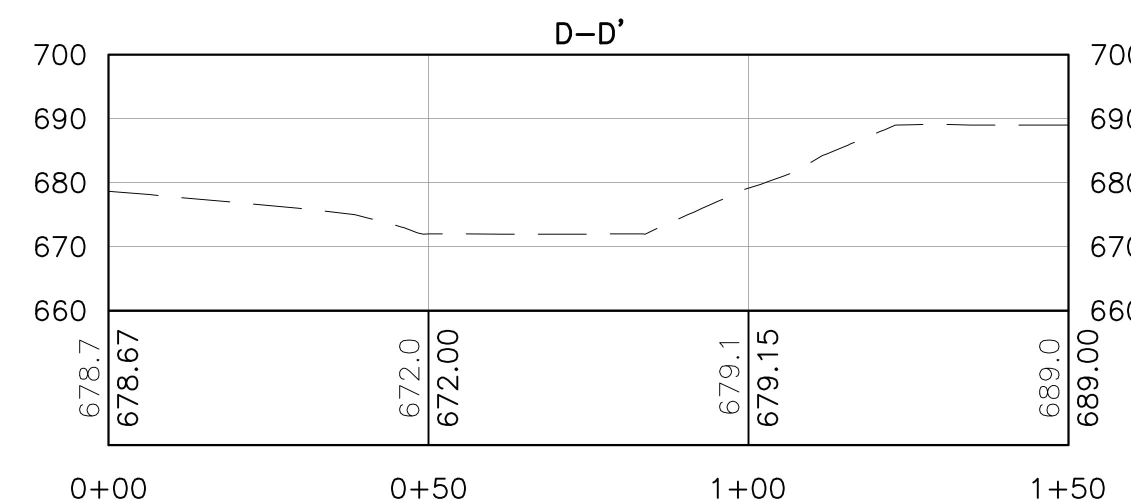
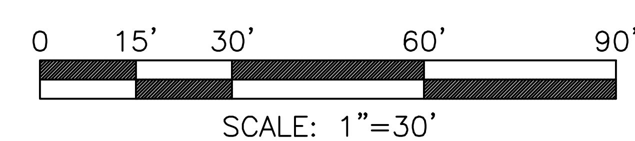
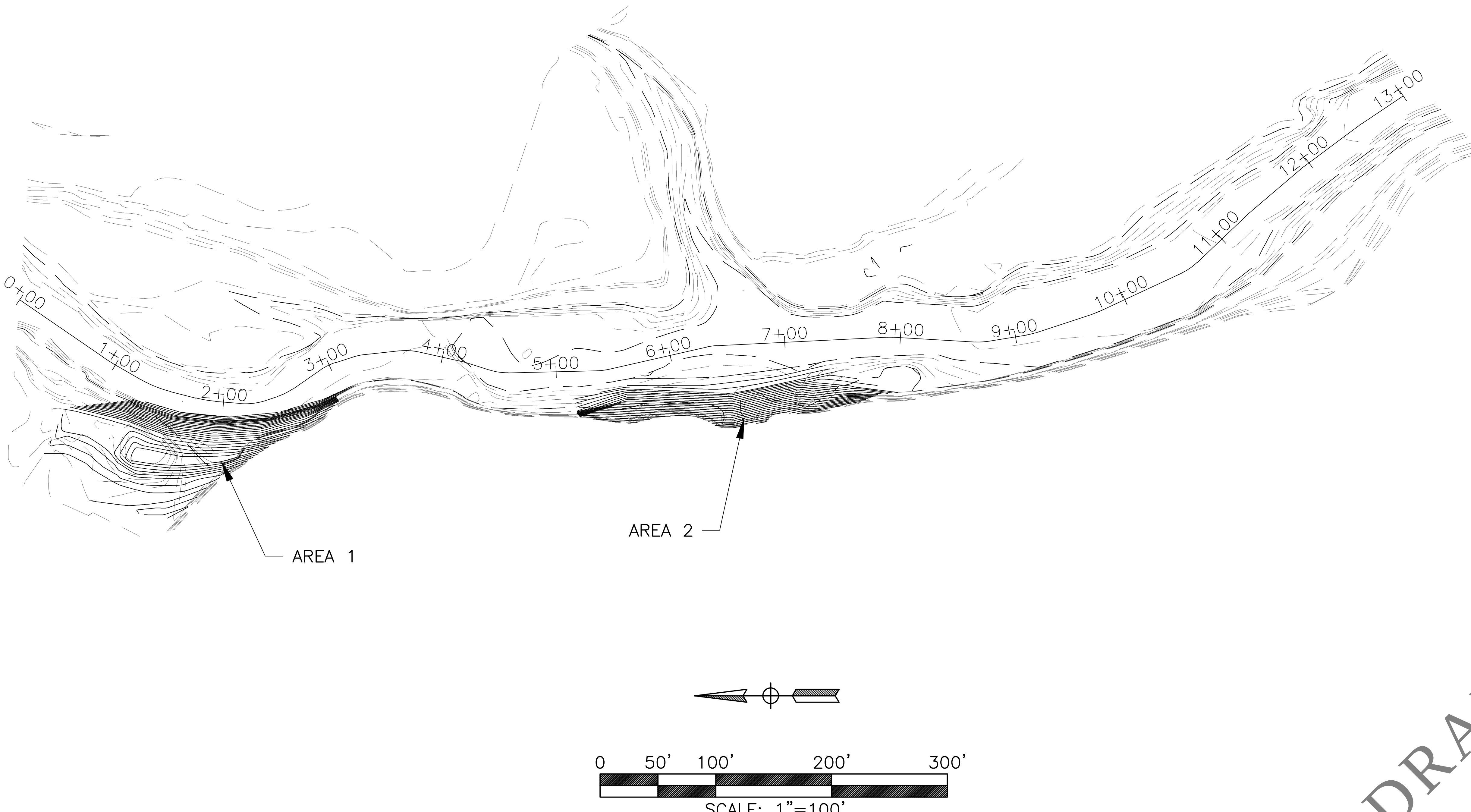
0+50
1+00
1+50
2+00


D–D'
700
690
680
670
660
678.7
678.67
672.0
672.00
679.1
679.15
689.0
689.00
0+00
0+50
1+00
1+50


0
15'
30'
60'
90'
SCALE: 1"=30'

R:US: 0 :NTS: This documen- and -he ideas and design incorpora- d herein, as an ins-rumen - pro- ional service, is -he proper - -CO Associa- and shall no- be reused in whole or par - r any o-her projec- i-hou- -CO Associa- xpress wri- n au-horiza-ion.



DRAFT

LACO
EUREKA • UKIAH • SANTA ROSA
1-800-515-5054 www.lacoassociates.com

NO.	HISTORY / REVISION	BY	CHK.	DATE

TITLE
SHEET TITLE

CLIENT NAME
CLIENT ADDRESS

DRAWN	X
CHECK	X
APPROVED	X
DATE	X
JOB NUMBER	X
SHEET X	OF X

Sep 21,2016-1:22pm
T:\Cad-iles\7700\7753.05 COYOTE VALLEY STREAM RESTORATION\DWG\ 7753.05 STREAM FIGURE - WORKING.dwg

MENDOCINO COUNTY
RESOURCE CONSERVATION DISTRICT

Conserving Wild and Working Landscapes since 1945

February 3, 2017

Bureau of Reclamation

RE: WaterSMART Drought Response Program: Drought Resiliency Projects

Dear Review Panel:

The Mendocino County Resource Conservation District (MCRCD) strongly supports the Coyote Valley Band of Pomo Indians' Environmental Protection Department on their grant application to implement the next phase of the West Fork Russian River Bank Stabilization and Habitat Restoration Project. The MCRCD has a long-standing working relationship with the Coyote Valley Tribe on watershed related projects, and we continue to work together to achieve the goals of restoring and preserving ecological processes and water resources.

This reach of the West Fork has been severely impacted by the last four years of drought, and extreme degradation is likely to occur unless the project is installed as designed. This section of the West Fork lies directly below several homes owned by members of the Coyote Valley Tribe. The chronic erosion of the bluff has been a concern to them for several years, but the accelerated erosion that has been documented over the last four years has created a safety issue.

The Russian River watershed is listed as impaired for temperature and sediment by the State Water Resource Control Board, and treatment of this site will be beneficial for both attributes, especially during summer low flow conditions. In addition, the West Fork Russian River hosts annual runs of Chinook salmon and steelhead trout, both of which are listed as threatened with extinction. This project will eliminate a chronic and potentially catastrophic sediment source, which impacts spawning gravels and invertebrate productivity that are so important to the life cycles of these native fish species.

I hope you will consider funding this proposal in full.

Sincerely,

Patricia Hickey
Executive Director

410 Jones Street, Suite C-3, Ukiah, CA ❖ (707) 462-3664 ❖ Fax (707) 462-5549 ❖ www.mcrcd.org

BioEngineering Associates, Inc.

Live Building Systems
AN ENGINEERING CONTRACTOR SPECIALIZING IN WATERSHED RESTORATION
California Class A License # 599522
Oregon Commercial General Contractor Level 1, License Number: 19244

To whom it may concern,

BioEngineering Associates supports the proposed project to stabilize 800 feet of actively eroding streambank along the West Fork Russian River. The streambank is 40 – 60 feet tall, and is contributing large amounts of fine sediment into the river. The issue with droughts is that during drought years, there is not enough flow to clear the gravel bars of vegetation. With 4 years of drought, the gravel bars have grown stronger as the vegetation grows more and more each year. The result is that what used to be a mobile gravel bar, is now a fixed obstacle to the rivers flow that directs the flow of the river into the eroding riverbanks, thus increasing riverbank erosion. This effect can be observed on almost any Northern California stream or river.

Stabilizing this enormous eroding riverbank has not only the obvious benefits of halting an eroding riverbank from taking out the houses located on the top of bank, but it also has many benefits to the riparian environment both on and off the reservation. Chief among them is stopping fine sediment from dropping out into the river. This fine sediment clogs the interstices between spawning gravels, preventing the endangered salmon from successfully spawning. Another benefit to stabilizing the eroding bank is that a bioengineered stabilization structure will improve habitat conditions along this reach of river. The bioengineering stabilization structure will provide overhanging vegetation to shade and cool the water and will also provide resting habitat for migrating salmonids during high flows.

Drought conditions have increased riverbank erosion where the gravel bars have grown large and immovable. Increased streambank erosion is problematic to both the people living at the top of bank and to the plants and animals living in the river.

Evan Engber

Evan Engber
President

Philip Buehler
Associate Engineer

P.O. Box 1554 Laytonville, CA 95454 Tele 707-984-6774 evan@bioengineers.com
695 W. 25th Ave Eugene, OR 97405 Tele 541-808-8322 www.bioengineers.com

United States Department of the Interior

BUREAU OF RECLAMATION
Mid-Pacific Regional Office
2800 Cottage Way
Sacramento, CA 95825-1898

IN REPLY REFER TO:

MP-400
PRJ.28.00

MEMORANDUM

To: WaterSMART Drought Response Program

From: Kevin Clancy, Native American Affairs Program Manager, Mid-Pacific Region KC

Subject: Pledged Funds For The Riverbank Stabilization Project

The Bureau of Reclamation's (Bureau) Mid-Pacific Region has been working with the Coyote Valley Band of Pomo Indians (Coyote Valley), a federally recognized tribe, on their Riverbank Stabilization project.

I have visited the project site and observed firsthand the damage that is occurring, bank erosion and channel incising. This project will stabilize the bank and restore native vegetation, helping to protect human health and safety as well as reservation housing. In addition, it will improve the aquatic habitat and health of the river. This is an important project.

There are many funding agencies and programs that are committing resources to this project. The Bureau's Mid-Pacific Region's Native American Affairs Technical Assistance Program is in the process of obligating a two-year, P.L. 93-638 agreement to fund a portion of this project. This two-year agreement will be funded with $100,000 for each year, and is expected to be in place before the end of FY 2017. It is my understanding that these funds may also be used to help Coyote Valley meet their cost share requirement.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

February 9, 2017

United States Bureau of Reclamation
Mid-Pacific Regional Office
Federal Office Building
2800 Cottage Way
Sacramento, CA 95825-1898

Subject: US EPA Clean Water Act Funding for Coyote Valley Band of Pomo Indians Erosion Control/Restoration on West Fork of the Russian River

To Whom It May Concern:

I am writing to inform you that the Coyote Valley Band of Pomo Indians currently receives a grant from the U.S. Environmental Protection Agency under the Clean Water Act (CWA) Section 319 Competitive Grant Program for a watershed restoration project within their reservation. Coyote Valley was selected from a pool of national applicants to receive up to $100,000 of federal funding for nonpoint source pollution control in FY2016. They are using this funding to address a severe erosion problem on the West Fork of the Russian River. In addition to this competitive project, Coyote Valley receives CWA Section 106 and 319 base funding annually and is in good standing regarding grant deliverables and project progress.

If you have any questions about these grants, please contact me at Pinkerton.kate@epa.gov or at (415) 972-3662.

Sincerely,

Kate Pinkerton

Clean Water Act Grant Project Officer
Water Division: Tribal Water Section

United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Central California Agency
650 Capitol Mall, Suite 8-500
Sacramento, CA 95814-4710

IN REPLY REFER TO

FEB 13 2017

Bureau of Reclamation
Water Resources and Planning
Attn: Mr. Darion Mayhom
Mail Code: 84-510000
Post Office Box 25007
Denver, CO 80225

RE: Matching Funds with other Federal Agencies

Dear Mr. Mayhom:

The Coyote Valley Band of Pomo Indians of California has requesting from the Bureau of Indian Affairs information that the Tribe can legally use federal funds from the Bureau of Indian Affairs to match other federal funds. The Tribe has been awarded $213,700.00 through Contract A14AV00574, under the provisions of Public Law 93-638, as amended, for the purpose of stabilization of the banks of the Russian River to protect Tribal property. The contract objectives are two fold, "1) To obtain permits from the Fish and Wildlife and Army Corps of Engineer, and 2) to design by contractor for the stabilization of the first phase of implementation." The terms of this Contract period is from January 01, 2014 through December 31, 2017, and can be extended. The Tribe is also searching for additional funds to assist with this overall project. Pursuant to Public Law 93-638, as amended, Section 106 (25 U.S.C. 450 j-1) 1(j), revised to Section 25:5325(j). Contract funding and indirect costs: reads as follows – 5325(j) – Use of funds for matching or cost participation requirements: "Notwithstanding any other provision of law, a tribal organization may use funds provided under a self-determination contract to meet matching or cost participation requirements under other Federal and non-Federal programs." Therefore, the Tribe can use funding from contract A14AV00574 as a match for any Bureau of Reclamation funding.

If you have any questions in regards to this provision of law or the contract, please contact Joseph C. Saulque, Indian Self-Determination Specialist and Awarding Official, at (916) 930-3778, or by E-mail joseph.saulque@bia.gov. The Indian Self-Determination Officer for Central California Agency, Tina Fourkiller-Ramirez, can also be at (916) 930-3742 or by E-mail tina.fourkiller@bia.gov.

Sincerely,

Joseph C Saulque

Joseph C. Saulque
Awarding Official
BIA-2014-L1-00101

COYOTE VALLEY
Band of Pomo Indians

COYOTE VALLEY BAND OF POMO INDIANS TRIBAL COUNCIL

RESOLUTION NO. CV-TC-02-09-17-01

RESOLUTION TO SUBMIT AN APPLICATION FOR THE BUREAU OF RECLAMATION WATERSMART DROUGHT RESPONSE PROGRAM: DROUGHT RESILIENCY PROJECTS FOR FISCAL YEAR 2017 (BOR-DO-17-F010)

WHEREAS, the Coyote Valley Band of Pomo Indians of California ("Tribe") is a federally recognized Indian Tribe, recognized by the United States of America through the Secretary of the Interior as a sovereign Indian Tribe possessed with inherent power of Tribal Self-Government; and

WHEREAS, among the powers of inherent sovereignty vested in the Coyote Valley Band of Pomo Indians General Council is the power to determine its own form of government, interpret its own laws and be governed by those laws; and

WHEREAS, on October 4, 1980, the General Council enacted the Document Embodying the Laws, Customs and Traditions of the Coyote Valley Band of Pomo Indians ("Tribal Constitution") to serve as the governing document of the Tribe; and

WHEREAS, the Tribal Council exercises, concurrently with the General Council, all powers delegated to it by the General Council in Article VII of the Tribal Constitution and otherwise vested in the Tribal Council and the Tribal Constitution; and

TO APPROVE and support the application for the Bureau of Reclamation WaterSMART Drought Response Program: Drought Resiliency Projects for Fiscal Year 2017.

WHEREAS, the Tribal Council is able to meet the match funds for this project through existing funding set forth in two Bureau of Indian Affairs 630 Contracts from the water resources division for assessments and permitting totaling $194,786 and using $105,214 in funds pledged from the Bureau of Reclamation Technical Assistance Program through at 638 contract. These funds will total the $300,000 funding match.

WHEREAS, Coyote Valley Band of Pomo Indians will work with the Bureau of Reclamation to meet established deadlines for entering into a grant or cooperative agreement.

NOW THEREFORE BE IT RESOLVED AND ENACTED, that the Tribal Council hereby approves the execution of all necessary action to submit the proposal for the Bureau of Reclamation WaterSMART Drought Response Program: Drought Resiliency Projects for Fiscal Year 2017 and that match funding is available and the Tribe will work with the Bureau of Reclamation on meeting deadlines.

CERTIFICATION

This is to certify that the foregoing resolution and action was approved by the Coyote Valley Band of Pomo Indians Tribal Council at a duly noticed and convened meeting held on February 9,2017, and was approved by a vote of 6 For 0 Against with 0 Abstaining, and that this resolution has not been amended or rescinded in any way.

Michael Hunter, Chairman
Coyote Valley Tribal Council

Candace Gonzalez, Secretary
Coyote Valley Tribal Council

United States Department of the Interior
INTERIOR BUSINESS CENTER
Indirect Cost Services
2180 Harvard Street, Suite 430
Sacramento, CA 95815

June 20, 2016

Ms. Ghazal Mahdavian, Tribal Administrator
Coyote Valley Band of Pomo Indians
P.O. Box 39
Redwood Valley, CA 95470-0039

Dear Ms. Mahdavian:

Enclosed is the signed original Negotiated Indirect Cost Rate Agreement that was processed by our office. If you have any questions concerning this agreement, please refer to the signature page for the name and contact number of the negotiator.

As a recipient of federal funds, the regulations require you to maintain a current indirect cost rate agreement. For provisional/final indirect cost rates, Indirect Cost Proposals should be submitted on an annual basis, and they are due within six (6) months after the close of your fiscal year. For predetermined rates and approved rate extensions, proposals are due in our office six (6) months prior to the expiration of your current rate agreement. Please note that proposals are processed on a first-in, first-out basis.

Common fiscal year end dates and proposal due dates are listed below:

Fiscal Year End Date	Proposal Due Date
September 30th	March 31st
December 31st	June 30th
June 30th	December 31st

Please visit our website for guidance and updates on submitting future indirect cost proposals. The website includes helpful tools such as a completeness checklist, indirect cost and lobbying certificates, sample proposals, Excel worksheet templates, and links to other websites.

Sincerely,

Deborah A. Moberly

Deborah A. Moberly
Office Chief

Enclosure

cc: Self-Determination Specialist, Pacific Regional Office, Bureau of Indian Affairs
Director, Self-Determination Services, Indian Health Services, HQE

Ref: J:\Native Americans\Pacific (Sacramento SA)\Coyote Valley Band of Pomo Indians (Cvtcw153)\FY 2016\Issue.ltr.docx

Phone: (916) 566-7111
Fax: (916)566-7110
Email: ICS@ibc.doi.gov
Website: http://www.doi.gov/ibc/services/finance/Indirect-Cost-Services

Indian Organizations
Indirect Cost Negotiation Agreement

EIN: 94-2375679

Organization:

Coyote Valley Band of Pomo Indians
P.O. Box 39
Redwood Valley, CA 95470-0039

Date: June 20, 2016

Report No(s).: 16-A-0964

Filing Ref.:
Last Negotiation Agreement
dated October 19, 2015

The indirect cost rate contained herein is for use on grants, contracts, and other agreements with the Federal Government to which Public Law 93-638 and 2 CFR Part 200 apply for fiscal years beginning on or after December 26, 2014 subject to the limitations contained in 25 CFR 900 and Section II.A. of this agreement. Applicable OMB Circulars and the regulations at 2 CFR 225 will continue to apply to federal funds awarded prior to December 26, 2014. The rate was negotiated by the U.S. Department of the Interior, Interior Business Center, and the subject organization in accordance with the authority contained in applicable regulations.

Section I: Rate

Type	Effective Period From	Effective Period To	Rate*	Locations	Applicable To
Fixed Carryforward	01/01/16	12/31/16	18.81%	All	All Programs

***Base:** Modified total direct costs: Total direct costs, less capital expenditures and passthrough funds. Passthrough funds are normally defined as payments to participants, stipends to eligible recipients, or subawards, all of which normally require minimal administrative effort.

Treatment of fringe benefits: Fringe benefits applicable to direct salaries and wages are treated as direct costs; fringe benefits applicable to indirect salaries and wages are treated as indirect costs.

Section II: General

A. **Limitations:** Use of the rate(s) contained in this agreement is subject to any applicable statutory limitations. Acceptance of the rate(s) agreed to herein is predicated upon these conditions: (1) no costs other than those incurred by the subject organization were included in its indirect cost rate proposal, (2) all such costs are the legal obligations of the grantee/contractor, (3) similar types of costs have been accorded consistent treatment, and (4) the same costs that have been treated as indirect costs have not been claimed as direct costs (for example, supplies can be charged directly to a program or activity as long as these costs are not part of the supply costs included in the indirect cost pool for central administration).

B. **Audit:** All costs (direct and indirect, federal and non-federal) are subject to audit. Adjustments to amounts resulting from audit of the cost allocation plan or indirect cost rate proposal upon which the negotiation of this agreement was based will be compensated for in a subsequent negotiation.

H. **Use of Other Rates:** If any federal programs are reimbursing indirect costs to this grantee/contractor by a measure other than the approved rate(s) in this agreement, the grantee/contractor should credit such costs to the affected programs, and the approved rate(s) should be used to identify the maximum amount of indirect cost allocable to these programs.

I. **Other:**
1. The purpose of an indirect cost rate is to facilitate the allocation and billing of indirect costs. Approval of the indirect cost rate does not mean that an organization can recover more than the actual costs of a particular program or activity.

2. Programs received or initiated by the organization subsequent to the negotiation of this agreement are subject to the approved indirect cost rate(s) if the programs receive administrative support from the indirect cost pool. It should be noted that this could result in an adjustment to a future rate.

3. Each Indian tribal government desiring reimbursement of indirect costs must submit its indirect cost proposal to our office within six (6) months after the close of the Tribe's fiscal year, unless an exception is approved.

Section III: Acceptance

Listed below are the signatures of acceptance for this agreement:

By the Indian Organization:

Coyote Valley Band of Pomo Indians
Tribal Government

[signature] /s/
Signature

Michael Hunter
Name (Type or Print)

Chairman
Title

6/20/16
Date

By the Cognizant Federal Government Agency:

U.S. Department of the Interior
Interior Business Center
Agency

Deborah A. Moberly /s/
Signature

Deborah A. Moberly
Name

Office Chief
Office of Indirect Cost Services
Title

JUN 20 2016
Date

Negotiated by Christopher D. Swain
Telephone (916) 566-7104

SUPPLEMENTAL INFORMATION
PLEASE KEEP FOR YOUR RECORDS

Coyote Valley Band of Pomo Indians
FY 2014 Carryforward and FY 2016 Rate Computation

Supplement 1

Program	FY 2014 Actual Direct Cost Base	% of Total	FY 2014 Indirect Cost Pool	Indirect Rate at 17.37%	Indirect Cost Collections	Underfunded Indirect	Overfunded Indirect	Carryforward
BIA (638)	$173,935	7.21%	$29,784	$30,213	$30,213	$0	$0	-$429
IHS (638)	339,367	14.07%	58,122	58,948	58,948	0	0	-826
HHS (Non-638)	6,785	0.28%	1,157	1,179	1,179	0	0	-22
Agriculture	11,824	0.49%	2,024	2,054	2,054	0	0	-30
EPA	164,784	6.83%	28,214	28,623	34,938	0	6,315	-409
HUD	250,886	10.40%	42,962	43,579	54,649	0	11,070	-617
IMLS	10,097	0.42%	1,735	1,754	0	1,735	0	0
Justice	179,361	7.43%	30,692	31,155	33,524	0	2,369	-463
Tribal	1,275,683	52.87%	218,402	221,586				1/
Totals	$2,412,722	100.00%	$413,092	$419,091	$215,505	$1,735	$19,754	-$2,796
	2/		3/		4/	5/	5/	

Accepted FY 2016 Indirect Costs	$496,209
FY 2014 Overrecovery Carryforward to FY 2016	-2,796
Accepted FY 2016 Indirect Cost Pool	$493,413
Accepted FY 2016 Direct Cost Base	$2,623,228
Accepted FY 2016 Indirect Cost Rate	18.81%

1/ Funding of indirect costs for tribal activities is an internal process and is not included in the carryforward computation.

2/ The FY 2014 direct cost base is adjusted to include general government costs inadvertently included in the FY 2014 indirect cost pool.

3/ The FY 2014 indirect cost pool includes the previously negotiated FY 2012 overrecovery carryforward of $80,888. The pool is also adjusted to transfer general government costs to the FY 2014 direct cost base.

4/ The amount of "Indirect Cost Collections" need not include direct funds (including direct program funds, direct CSC, or indirect CSC funds lawfully redirected to pay for unfunded direct CSC), private funds, or tribal funds diverted to pay indirect costs in the pool, provided that the amount listed is consistent with the tribal contractors' audited financial statements or post-audit statements, pursuant to Section III.B.1 (a) and (b) of PSA III.

5/ Underfunded indirect should be reported to the respective granting agencies. Underfunded amounts may be, but are not necessarily, due to shortfalls in appropriations. The presence of an amount in either of these columns does not constitute a determination or admission that either the government or the contractor is liable to the other for any amount.

Note: The amount shown as Indirect Cost Collections is based on the Band's audited financial statements.