Upper Truckee Marsh
Sewer Facilities Protection Project
Adaptive Management Plan
Closeout Report

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Final Report

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EXECUTIVE SUMMARY

The South Tahoe Public Utility District (District) implemented an Adaptive Management Plan (AMP) to protect existing sewer facilities in the Upper Truckee Marsh. District gravity and force main sewer pipelines, constructed in the 1960s, are located along the northern margin of the marsh in a 12-foot wide easement across property owned by the California Tahoe Conservancy (Conservancy) between Oakland Avenue and Bellevue Avenue. The primary focus of this project is the right overbank area of Trout Creek near the end of Bellevue Avenue where the District has a sewage pump station, and the easement upstream of the pump station for about 1200 feet along the northern side of the marsh, including the locations of five manholes on the gravity sewer pipeline, designated BV-18 to BV-22, herein referred to as the Bellevue project area. A second project area is located along a reach of inactive secondary distributary channel on the left bank of Trout Creek, situated about 0.6 miles south-southeast of the Bellevue project area near the north end of Rubicon Trail Road, referred to as the Rubicon project area. Between these two areas a section of abandoned road fill was removed and replaced with existing sod to the adjacent meadow grade. Figure 2-1 Figure 2-2 are maps of the study area showing the locations of the project areas discussed in this report.

The need for the AMP was initiated by a channel avulsion in Trout Creek upstream of the Bellevue Pump Station following a record snowmelt during a wet water year in 2011. The long-term objective of the plan was to reduce inundation of the sewer easement and improve access for the District's crews to perform regular maintenance and emergency services to the manholes within the easement. The project also aimed to reduce the short-term risk for stream channel development and erosion within the District's utility easement. The District's concern was the potential exposure and damage of the gravity sewer main from channeling within the easement. A second objective was to provide stability against future erosion over the pipelines in the longer term.

The development of the AMP is described in the Upper Truckee Marsh Sewer Facilities Adaptive Management Plan (NHC, 2014). Adaptive management work was completed in multiple construction seasons, as reported in the 2015, 2016, and 2017 Annual Reports (NHC, 2015, 2017, 2018). The AMP envisioned up to five years of implementation guided by annual monitoring, followed by two additional years of monitoring. No significant implementation of adaptive management measures has occurred since 2017.

Adaptive management measures have been successful at reducing risk to the pipelines and have met environmental objectives for maintaining or enhancing marsh habitat. However, stream and marsh conditions have significantly changed since development of the AMP, due in part to beaver activity in the area upstream of Bellevue Avenue. Hydrologic changes from beaver activity along Trout Creek have negatively impacted meeting operation and maintenance access objectives in the AMP. This Closeout Report summarizes the history of the project and implementation, describes challenges associated with beaver activity, and assesses overall effectiveness of the AMP activities.

Baseline conditions

In 2011, a section of the Trout Creek channel was entirely filled with sediment resulting in an avulsion event with increased flow over the right overbank of Trout Creek toward the Bellevue Pump Station and utility pipeline easement. Following this avulsion event the channel remained completely plugged and flows from Trout Creek continuously inundated the sewer easement near the Bellevue Pump Station.

Flooding of the sewer easement inhibits access to sewer manholes by District crews which significantly reduces the District's ability to remove potential obstructions formed within the gravity sewer main, increasing the potential for sewer surcharges directly to the Upper Truckee Marsh. After considering other more construction intensive options for relocating the pipelines or the stream, the District elected to pursue an adaptive management approach to improve long-term conditions for operations and maintenance of the sewer pipeline and reduce the risk of damage to the sewer pipeline from erosion.

As part of the permitting process, the jurisdictional wetland habitats were mapped in the project area. The mapping shows that nearly the entire project area lies within jurisdictional areas. A primary objective of the AMP was to maintain wetland habitat(s) while reducing inundation of the utility easement.

The District retained Tri-State Surveying to set survey control and produce a topographic survey of the area near the Bellevue project area. The survey included five cross sections previously surveyed by the Conservancy and nine new transects. The District installed four pressure transducers in the Bellevue project area to monitor surface water and groundwater elevations, and two YSI-6-Series Sondes for monitoring turbidity in Trout Creek upstream and downstream of the Bellevue project area.

Vegetation characteristics in the study area have been described in environmental documentation for the Upper Truckee River and Marsh Restoration Project (California Department of General Services and California Tahoe Conservancy, 2013). Wetland vegetation within the Bellevue project area is classified primarily as wet montane meadow with areas of avulsed channel and main channel. Areas of willow scrub-wet meadow were mapped in the study area, both upstream and downstream of the Bellevue project area, and within the Rubicon project t area. A wetland delineation was prepared for the project area that mapped nearly the entire study area as potential jurisdictional area (AECOM, 2014). Direct field observations and measurements were used to document baseline vegetation conditions in the Bellevue project area (Western Botanical Services, 2014).

Baseline information on wildlife and fish was primarily obtained from previously published environmental documentation associated with the Conservancy's Upper Truckee Marsh Restoration project (California Department of General Services and California Tahoe Conservancy, 2013).

AMP Actions and Monitoring

The AMP describes existing conditions, presents a set of adaptive management measures, provides plans for the first year of construction, and monitoring methods to be used to guide future actions (NHC, 2014). A supporting Mitigated Negative Declaration was prepared by AECOM (2014) and permits were obtained from the U.S. Army Corps of Engineers (USACOE), Lahontan Regional Water Quality Control Board (LRWQCB), California Department of Fish and Wildlife (CDFW), and Tahoe Regional Planning Agency (TRPA).

The District retained V&C Construction to construct planned improvements as approved by the regulatory oversight agencies developed over a three-year construction period for the AMP. AMP activities varied each year and were based on monitoring observations for measures installed in the previous years.

In 2014 (Year 1), V&C Construction constructed measures in accordance with the – Year 1 Construction Plans, focused on the Bellevue project area. The work included construction of three pilot channels (PC-1, PC-2, and PC-3), installation of vegetated hummocks and fill hummocks, minor excavation and coir log installation to encourage flow towards the left overbank and discourage flow to the right overbank, and planting to reduce inundation of the sewer utility easement. Removal of abandoned road fill downstream of the Bellevue project area was also completed during Year 1.

In 2015 (Year 2), V&C Construction constructed measures in accordance with the – Year 2 Construction Plans, including excavation of a pilot channel and clearing of obstructions and debris from about 500 lineal feet of the secondary channel in the Rubicon project area. Work also included the enlargement of portions of the pilot channels constructed in 2014, installation of an additional vegetated hummock and minor work along the right bank of Trout Creek to discourage right overbank flows in the Bellevue project area.

In 2016 (Year 3), V&C Construction constructed measures in accordance with the – Year 3 Construction Plans, including additional planting in the right overbank area, coir log placement to encourage flow into PC-1, installation of hummocks near Manholes BV-18, BV-19, BV-21, and BV-22, and additional hummocks west of BV-18 and between BV-21 and BV-22 in the Bellevue project area. A pond leveler designed to maintain an estimated 3 cfs minimum flow through the reactivated secondary distributary channel in the Rubicon project area was also installed. The pond leveler was installed to bypass a beaver dam formed at the head of the secondary channel following Year 2. All work performed during Year 3 was completed by hand crews with the exception of the installation of the pond leveler which required the use of low ground pressure equipment (New Holland E55BX Compact Excavator).

In 2017 (Year 4), AMP activities were limited to maintenance of channels - clearing channel obstructions and debris on the main channel near District Manhole BV-22 in the Bellevue project area and on the secondary channel in the Rubicon project area. All work performed during Year 4 was completed by hand crews. Construction work for implementation of the AMP has not occurred since the end of Year 4.

Monitoring of AMP improvements included continuous recording of water levels and turbidity, and annual observations of AMP features, flow distribution, and vegetation. Monitoring after each year of construction was used to develop AMP actions for subsequent years.

At the time the AMP was developed, beavers were present in the lower marsh, but were not observed along Trout Creek in the vicinity of the Bellevue and Rubicon project areas. After Year 1 construction, beaver activity was observed in a reach of Trout Creek between the Bellevue and Rubicon project areas, near District Manhole BV-22, and in the reactivated secondary distributary channel in the Rubicon project area. AMP activities in Years 2 through 4 were influenced by the presence of beavers, with the general objectives of reducing overbank flow directed to the easement area by beaver activity and encouraging deposition around District manholes upstream of the Bellevue project area. Under current conditions, the primary source of water in the easement during low stream flows is water spilling onto the right overbank near BV-22, in large part due to the network of primary and secondary beaver dams upstream of the Bellevue project area. The water entering the overbank makes its way downstream through the easement until it reaches existing drainages and returns overbank flows back into Trout Creek. General observations in the project area indicate an increase in overall wetness and vegetative vigor during the AMP period.

It should be noted that AMP implementation and monitoring has occurred over highly variable hydrologic conditions, from low runoff conditions during below normal water years in 2014 and 2015 (coinciding with the California statewide drought emergency), to very high runoff conditions during a historic wet water year in 2017, with over 300 percent of normal runoff in Trout Creek.

Summary of AMP Effectiveness

The right overbank area of Trout Creek within the Bellevue project area has been revegetated and raised slightly through a combination of hummock installation and deposition in the easement area, with an overbank return flow channel remaining just south of the easement. The flow path established by PC-3 to encourage main channel flows from Trout Creek toward the center of the marsh has persisted and enlarged since construction in 2014 and 2015. The immediate risk of channel development over the sewer pipelines situated within the easement has been mitigated by changes in flow patterns. Future risk is also believed to have been reduced by opening flow paths toward the center of the marsh and adding new vegetation to the easement area.

Vegetation

Vegetation monitoring generally indicates that vegetation establishment was successful in the Bellevue project area. Vegetation establishment occurred quickly in the abandoned road fill removal area and successful vegetation establishment of hummocks occurred over time. The AMP features are currently well vegetated, and the vegetation monitoring summary indicates a shift from some of the planted graminoid species to dominance by Northwest Territory sedge (*Carex utrichulata*), which is adapted to wet conditions and long periods of inundation.

Willows were not planted in the Bellevue project area due to adjacent property owners' preference for non-willow wetland species, but willows have established through natural recruitment on the sandy channel fill deposited in Trout Creek near Bellevue Avenue. Willows planted in the Rubicon project area did not initially meet performance standards, but sufficient survival occurred to result in vigorous growth over time, with willows now 5 to 8 feet tall in the limited areas with willow plantings.

Vegetation performance monitoring focused on areas planted by the project. Although more general vegetation conditions in the project vicinity were not monitored, visual observations indicate significant changes in general marsh conditions over the monitoring period. At the inception of the AMP, herbaceous vegetation in this portion of the marsh was generally lower in height and drier conditions existed in much of the study area. Current conditions are characterized by widespread inundation of the meadow and vigorous and dense wetland herbaceous vegetation 3 to 4 feet in height.

Easement Inundation

Due to the low topography along the northern margin of the marsh, the easement area remains a flow path during higher flows. Beaver activity increases flows along this flowpath during lower stream flows in the section of Trout Creek between the Bellevue and Rubicon project areas near District Manhole BV-22.

Low flow measurements during fall 2020 in the project area indicate that only about half the flow passing the upstream USGS Gage 10336780 is flowing to the project area. During higher flows the relative portion of flow going through the project area is unknown. Visual observations indicate that

beaver activity upstream of the project area is directing flow onto both the left and right overbanks and that a section of the historical main channel is entirely filled with sediment upstream of the beaver dams established along Trout Creek between the Bellevue and Rubicon project areas. Much of the overbank flow through the Rubicon project area is presently directed onto the left overbank toward the center of the marsh, while the remaining overbank flow is spread across the meadow in the direction of the Bellevue project area. While these conditions appear to be contributing to vigorous vegetation growth and general health of the marsh, overbank flow is problematic for access in the District's easement. Secondary dams constructed by beavers appears to increase right overbank flow near Manhole BV-22, which then flows down the easement toward the Bellevue pump station. Although flow rates may be quite low, a small amount of flow can result in significant inundation in the dense herbaceous vegetation. Return of this flow to the main channel of Trout Creek when flows recede is also impeded by natural levee deposits formed along the main channel.

Considerations for Future Management

Low gradient streams in delta marsh settings naturally form levees along distributary channels, conditions with channel banks slightly above the adjacent ground surface, which are prone to avulsion and lateral adjustment. Under present conditions, the reach of Trout Creek between the Bellevue and Rubicon project areas, has substantially aggraded since 2014 by stream deposition upstream of the beaver dams through this area. The highest present risk of avulsion may be upstream of this channel fill on the right overbank. Avulsion in this direction could form a new channel or reactivate an old distributary channel very close to the utility easement, just to the southwest of BV-22 and BV-23.

It should be noted that although risk of future avulsion is present, the AMP area remained stable during the 2017 water year when two large rain-on-snow events and a record annual runoff occurred. Recent construction of beaver dams in PC-3 and upstream of the Bellevue project area in Trout Creek increase overbank flow, which contributes to the increased potential risk of avulsion. The timing and extent of future channel changes is uncertain, and this uncertainty is compounded by the impacts of climate change.

Inundation due to overbank flooding caused by beaver activity has been regularly observed in the past few years even during relatively low flow conditions in Trout Creek and is considered the dominant source of inundation in the easement during late summer and fall. The measures developed in the AMP did not specifically target this source of inundation and a change in management appears to be needed to ensure access to the sewer line upstream of the Bellevue project area for maintenance.

Several options for addressing the risk of pipeline damage and lack of maintenance access were considered by the District as part of the initial planning for this project. These included relocating the sewer lines and raising the easement area. The relocation option would have required extensive collection system and pump station/force main relocations, new construction, and improvements, including residential pumping stations for properties along El Dorado Avenue. This option was considered excessively expensive and difficult to implement. Raising the easement was originally considered, but not selected by the District due to the size of the potential work area, potential effects on the wetland, probable mitigation requirements, and difficulty in ensuring that areas to the right (north) of the raised area, including private property, would drain by gravity. A third option of reconstructing the Trout Creek channel in a more favorable location, such as the current location of the secondary channel in the middle of the marsh, was considered very complex to permit and implement.

Although these options might be reconsidered, the complexities and uncertainties identified at the time that the AMP was developed remain. Planning and permitting for any of these approaches is outside the scope of the AMP.

An option that was developed as a contingency plan during implementation of the AMP is to develop access points from the right upland margin of the marsh to specific manholes. This option would potentially require crossing a wetland area with planned access routes to specific manholes, and therefore, would likely require small hydraulic structures (mini-bridge, culverts, etc.) to maintain drainage patterns. Potential routes from El Dorado Avenue to Manholes BV-19 and BV-20 across property owned by the Tahoe Conservancy would require minimal grading and little disturbance to vegetation, but another route partially on Conservancy land and partially on private property would shorten the distance of wet meadow that needs to be crossed and would provide access to Manhole BV-21. However, these routes are outside the project area defined for the AMP and would require a new planning and permitting process.

Given the AMP facilities in place, a potential future management activity directly related to overbank flooding from beaver activity would be to promote drainage of the right overbank back to the main channel during low flow periods. The water levels measured in the 2020 survey indicate that some gradient exists between water in the overbank and water levels in the creek, at least in the Bellevue project area. Swales from the overbank through the natural creek levee could help drain the overbank area in low flows, especially if water levels in the channel are managed by removing recently constructed beaver dams in the project area. This activity would also be compatible with the option of developing improved maintenance access from El Dorado Avenue.

The Conservancy has indicated an interest in continuing to engage with the STPUD on evaluating the site conditions and work on developing solutions to ensure STPUD infrastructure is protected. The potential alternative access is not within the AMP project area and any future management of beaver activities would need to consider objectives beyond the District's interests in a drier easement, such as reduction of impacts to private property and potential effects on channel behavior. The AMP does not directly address the topics most relevant to these potential future management actions, and it is recommended that the District close the AMP permit and explore potential cooperative agreements with the Conservancy for any future work within the Upper Truckee Marsh.

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1 INTRODUCTION

1.1 Background and Purpose of AMP

The South Tahoe Public Utility District (District) implemented an Adaptive Management Plan (AMP) in 2014 to protect existing sewer facilities in the Upper Truckee Marsh. Two District sewer pipelines are located along the northern margin of the marsh in an easement over property owned by the California Tahoe Conservancy. The need for the plan was initiated by a channel avulsion in the vicinity of the easement following the high snowmelt year of 2011. The primary long-term objective of the plan was to reduce inundation of the sewer easement and improve access for the District's underground sewer crews to perform regular maintenance and emergency services to the manholes lying within the inundated portions of the easement. The project also aimed to reduce the short-term risk for stream channel development and erosion that would expose or damage the sewer lines and potentially lead to a sewage spill into the marsh and subsequently Lake Tahoe, and to provide stability against future erosion over the pipelines in the longer term. The development of the plan is described in the Upper Truckee Marsh Sewer Facilities Adaptive Management Plan (NHC, 2014).

Adaptive management work has been completed since that time in multiple construction seasons, as reported in the 2015, 2016, and 2017 Annual Reports (NHC, 2015, 2017, 2018). The AMP envisioned up to 5 years of implementation guided by annual monitoring, followed by 2 additional years of monitoring. No significant implementation of adaptive management measures has occurred since 2017. The adaptive management measures have been successful at reducing risk to the pipelines and have met environmental objectives for maintaining or enhancing marsh habitat. However, stream and marsh conditions have significantly changed since development of the AMP due in part to beaver activity in the area upstream of Bellevue Avenue, and these changes have affected success in meeting operation and maintenance objectives in the AMP. This Closeout Report summarizes the history of the project and implementation, describes challenges associated with beaver activity and general changes in marsh vegetation and wetness, and assesses overall effectiveness of the AMP activities.

1.2 Summary of AMP Activities

Prior to starting construction, the District entered a three-year contract with V&C Construction to implement Construction Plans developed over the three-year construction period for the AMP (Appendix A). AMP activities varied each year and were based on monitoring observations for measures installed inthe previous year(s).

In 2014 (Year 1), V&C Construction constructed measures in accordance with the – Year 1 Construction Plans, focused on the area near Bellevue pump station. The work included construction of pilot channels, removal of an abandoned road fill, installation of vegetated hummocks and fill hummocks, minor excavation and coir log installation to encourage flow towards the left overbank and discourage flow to the right overbank, and planting to reduce inundation of the sewer utility easement.

In 2015 (Year 2), V&C Construction constructed measures in accordance with the – Year 2 Construction Plans including excavation of a pilot channel at the head of the secondary channel in the center of the marsh, clearing of obstructions and debris from about 500 lineal feet of the secondary channel, enlargement of portions of the pilot channels constructed in 2014, installation of an additional vegetated hummock, minor work along the right bank of Trout Creek to discourage right overbank flows, and planting.

In 2016 (Year 3), V&C Construction constructed measures in accordance with the – Year 3 Construction Plans, including additional planting in the right overbank area near the end of Bellevue Avenue, coir log placement to encourage flow into Pilot Channel 1, installation of hummocks near Manholes BV-18, BV-19, BV-21, and BV-22, and additional hummocks west of BV-18 and between BV-21 and 22. The District also installed a pond leveler at the head of the secondary channel near the Rubicon project area in the center of the marsh designed to maintain an estimated 3 cfs minimum flow through the channel. The purpose of the pond leveler was to reactivate flow from Trout Creek back into the secondary channel across an incipient beaver dam. With the exception of the installation of the pond leveler, Year 3 improvements required no heavy equipment access and no significant grading activities.

In 2017 (Year 4), AMP activities were limited to maintenance of channels - clearing channel obstructions and debris on the main channel near District Manhole BV-22 and on the secondary channel in the center of the marsh. No heavy equipment was required in 2017.

No AMP activities have occurred since 2017.

2 BASELINE CONDITIONS

The District retained Tri-State Surveying to set survey control and produce a topographic survey of the area near Bellevue Pump Station where the channel avulsion occurred and where the Year 1 activities were focused (see Appendix A for improvement activities). The survey included five cross sections previously surveyed by the California Tahoe Conservancy and nine new transects. Inundation of the sewer easement near Bellevue Avenue was mapped in October 2013 as part of the field survey and observed prior to Year 1 construction operations in the spring and summer of 2013 and 2014. In the baseline condition, a section of the main channel was entirely blocked in the 2011 channel avulsion, and essentially all of the creek flow was passing over the right overbank and sewer easement. Thus, regardless of flows in the creek or season, the sewer easement was continuously inundated in the area near Bellevue Pump Station.

NHC and the District installed three pressure transducers in the project area near Bellevue Avenue to record water level data on a set time interval. The baseline water level conditions reflect discontinuous channel conditions – the Trout Creek channel between the middle and downstream gages was completely filled with sediment and the entire flow was occurring on the right overbank. In addition to the transducers along the stream channel, the District installed a transducer in an existing monitoring well (MW-4) near the end of Bellevue Avenue in July 2014.

As part of the permitting process, the jurisdictional wetland habitats were mapped in the project area. The mapping shows that nearly the entire project area is in jurisdictional areas, and an objective of the AMP is to maintain the wetland habitat while reducing risk for the pipelines. Baseline vegetation transects were established on an abandoned road fill identified for removal and in locations where hummock features (slightly elevated planted areas) were to be constructed. Baseline data showed average vegetative cover to be 90% in the road fill area and 80% in the areas of the proposed hummocks. In both areas, very high percentages (greater than 90%) of the plants present were native species (see Section 2.3).

Baseline information on wildlife and fish was primarily obtained from previously published environmental documentation associated with the Conservancy's Upper Truckee Marsh Restoration project. Monitoring of wildlife and fish populations is not a part of the AMP monitoring plan, but several mitigation measures were identified in the AMP to minimize construction impacts to wildlife and fish.

2.1 Topography

The project area, as described in the AMP, is shown in Figure 2-1. The District retained Tri-State Surveying to set survey control and produce a topographic survey of the area near Bellevue Pump Station where the channel avulsion occurred and where the Year 1 improvements were focused (Tri-State Surveying, 2013). The survey included five cross sections previously surveyed by the California Tahoe Conservancy and ten new transects. The base map and cross section plots from the survey are included in Appendix C. In addition to the field survey, LiDAR-based mapping completed by Tahoe Regional Planning Agency (TRPA, 2010) provides general topographic information for the Upper Truckee Marsh. Figure 2-2 shows the LiDAR-based mapping. Note that this figure does not show topographic changes associated with the 2011 channel avulsion due to the date of the mapping. The in-channel topography was digitally smoothed to better represent the existing channel topography.

2.2 Inundation of Easement

Inundation of the sewer easement near Bellevue Avenue was mapped in October 2013 as part of the field survey and observed prior to Year 1 construction operations in the spring and summer of 2013 and 2014. Figure 2-3 shows the area inundated on the baseline survey date, which had a recorded flow of 11 cfs at the USGS Gage 10336780 Trout Creek at Tahoe Valley. In the baseline condition, a section of the main channel was entirely blocked as a result of the 2011 channel avulsion, and most all of the creek flow was passing over the right overbank and sewer easement. Thus, regardless of flows in the creek or season, the sewer easement was continuously inundated in the area near Bellevue Pump Station. Figure 2-4 shows a photo of inundation in the easement near Bellevue Avenue in May 2013 at a flow of approximately 40 cfs. Figure 2-5 shows a photo of inundation during April 2014 at a flow of approximately 20 cfs.

2.3 Vegetation and Wetland Characteristics

Vegetation characteristics in the study area have been described in environmental documentation for the Upper Truckee River and Marsh Restoration Project (California Department of General Services and California Tahoe Conservancy, 2013). A wetland delineation was prepared for the project by AECOM

(2014) and is shown in Figure 2-6. Wetland vegetation near the end of Bellevue Avenue, where the channel avulsion occurred, was classified primarily as wet montane meadow with areas of avulsed channel and main channel. Main channel mapping was discontinuous in the area of the avulsed channel. Areas of willow scrub-wet meadow were mapped in the study area, both upstream and downstream of the avulsed channel area, and along the secondary channel in the middle of the marsh. Nearly the entire study area was mapped as potential jurisdictional area.

The Baseline vegetation surveys in the area near the channel avulsion were conducted by Western Botanical Services in August 2014 and are summarized in a report provided in Appendix D. Three reference transects were established in the area proposed for abandoned road fill removal and three were established in areas proposed for hummock construction in Year 1. The transect locations are shown in Figure 2-7.

All transects were 100 feet long. Total cover, vegetative cover, and dominance by natives was determined by point-intercept method for the transects. Baseline vegetative cover varied from 84% to 98% (average 90%) in the road fill removal transects and from 58% to 98% (average 80%) in the proposed hummock area transects (Table 2-1). Cover by native plants averaged 86% and 80% in the road fill removal and proposed hummock area transects, respectively.

The baseline vegetation surveys focused on herbaceous vegetation in relatively undisturbed areas of the road fill and easement to establish a reference for post-construction revegetation. The area of channel avulsion was initially relatively bare (see Figure 2-5), with some willow regeneration in sandy areas of slightly higher ground between the previous channel location and the avulsed channel location.

Legend

- Stream Environment Zone
- State of California Property
- Project Area
- Bellevue Pump Station
- Sewer Easment
- Soft Coverage in Project Area

SCALE - 1:12,000

0 500 1,000 1,500 Feet

N

DATA SOURCES:
AECOM, ESRI, CTC

Job: 5006145

FEBRUARY 2021

Figure 2-1

Project Area and SEZ Boundaries

nhc
northwest hydraulic consultants

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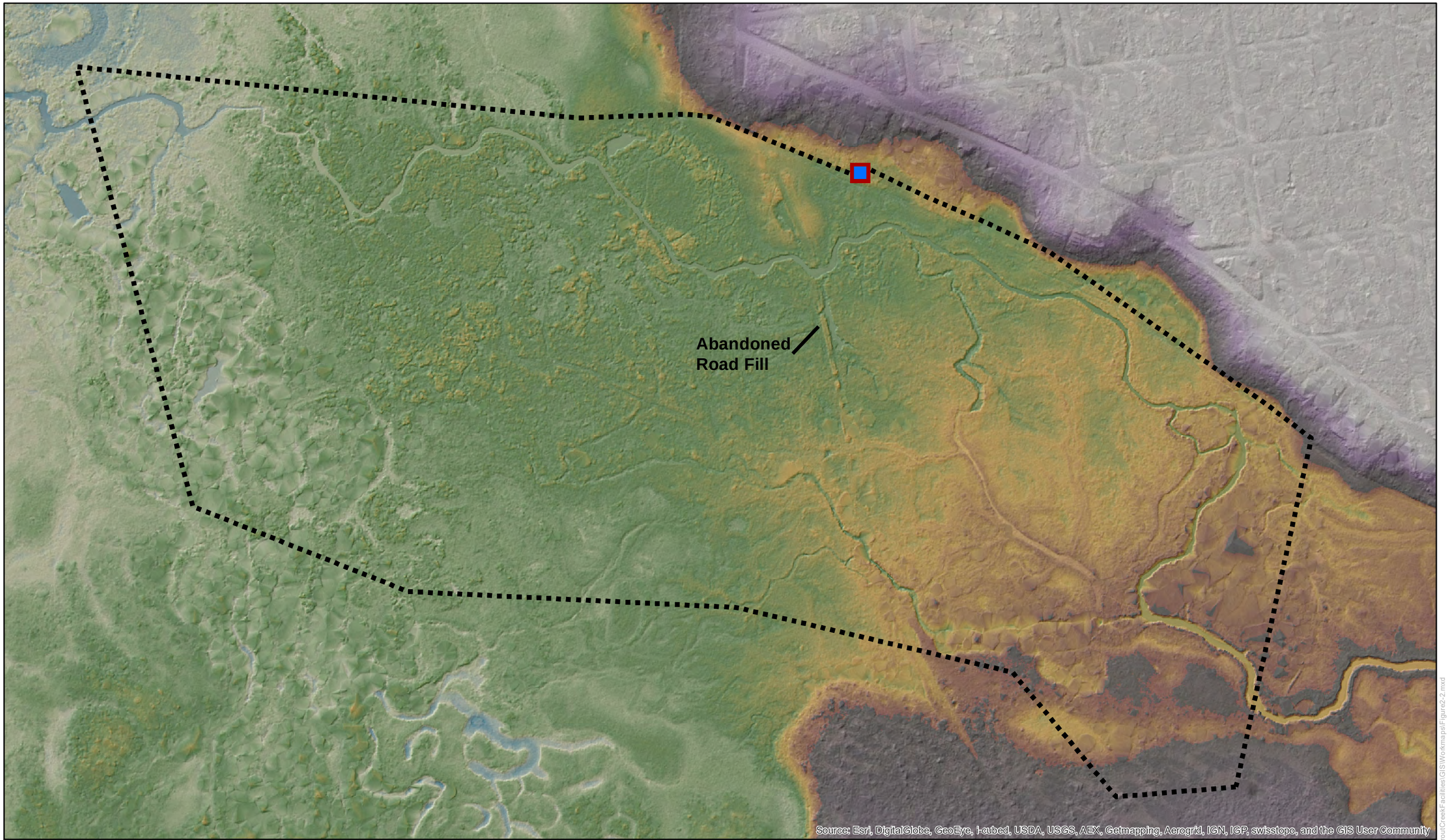


Legend

Bellevue Pump Station

Project Area

UT Marsh Topo [ft]

Value

High : 6238

Low : 6230

South Lake Tahoe [ft]

Value

High : 6260

Low : 6238

SCALE - 1:3,000

0 100 200 300 Feet

N

DATA SOURCES: Tahoe Regional Planning Agency

Job: 5006145

February 2020

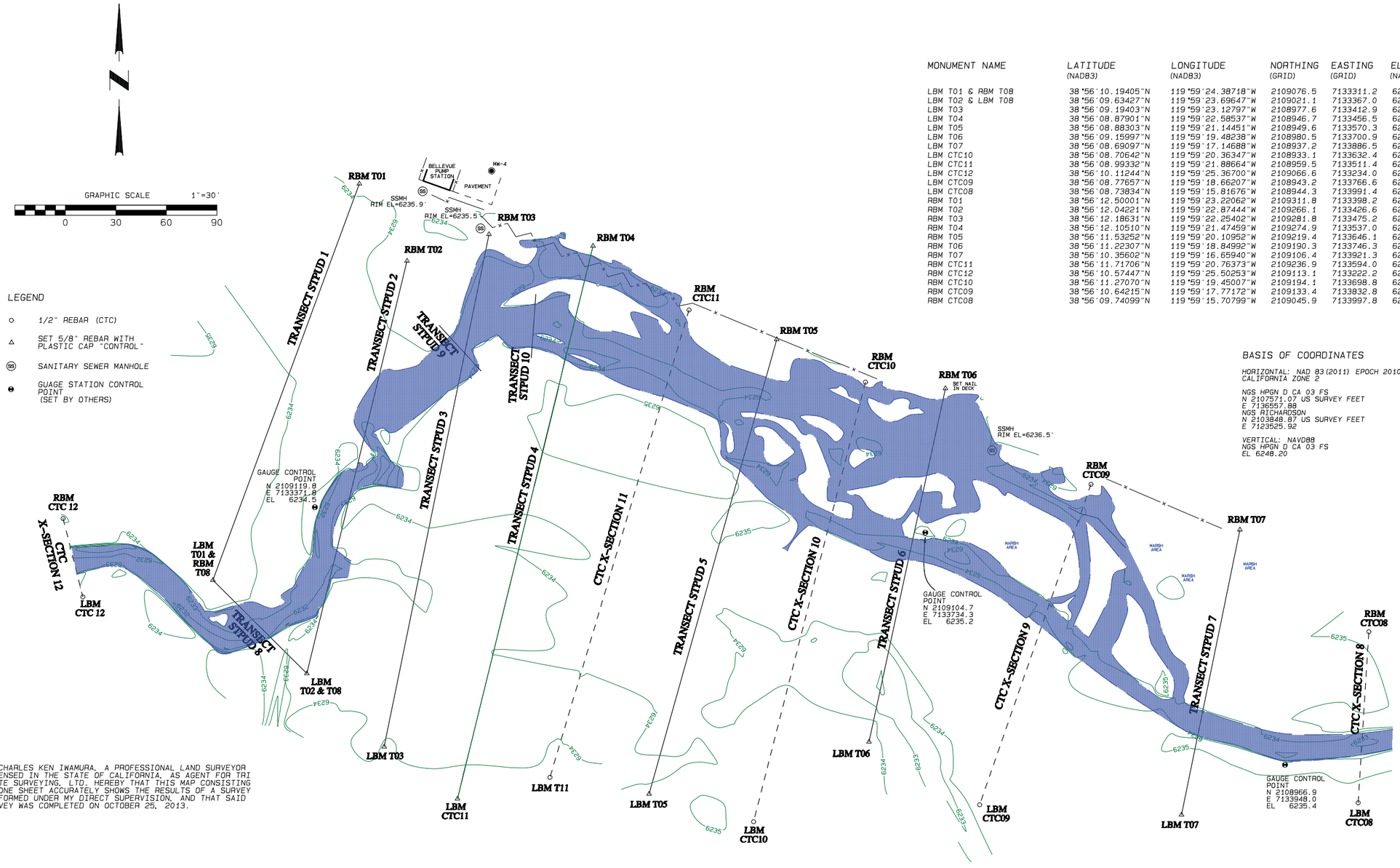
FIGURE 2-2

2010 LiDAR Topography

nhc northwest hydraulic consultants

ABC, L:\OldProj\600035_TroutCreekFacilities\GIS\Workmaps\Figure2-2.mxd

TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT FOR SOUTH TAHOE PUBLIC UTILTY DISTRICT



MONUMENT NAME	LATITUDE (NAD83)	LONGITUDE (NAD83)	NORTHING (GRID)	EASTING (GRID)	ELEV (NAVD88)	ELEV (NGVD29)
LBM T01 & RBM T08	38°56'10.19405"N	119°59'24.38718"W	2109076.5	7133311.2	6234.3	6230.3
LBM T02 & LBM T08	38°56'09.63427"N	119°59'23.69647"W	2109021.1	7133367.0	6233.9	6229.9
LBM T03	38°56'09.19403"N	119°59'23.12797"W	2108977.6	7133412.9	6234.2	6230.2
LBM T04	38°56'08.87901"N	119°59'22.58537"W	2108946.7	7133456.5	6234.4	6230.5
LBM T05	38°56'08.88303"N	119°59'21.14451"W	2108949.6	7133570.3	6234.2	6230.3
LBM T06	38°56'09.15997"N	119°59'19.48238"W	2108980.5	7133700.9	6234.6	6230.6
LBM T07	38°56'08.69097"N	119°59'17.14688"W	2108937.2	7133886.5	6234.5	6230.5
LBM CTC10	38°56'08.70642"N	119°59'20.36347"W	2108933.1	7133632.4	6234.6	6230.6
LBM CTC11	38°56'08.99332"N	119°59'21.88664"W	2108959.5	7133511.4	6234.4	6230.4
LBM CTC12	38°56'10.11244"N	119°59'25.36700"W	2109066.6	7133234.0	6233.9	6229.9
LBM CTC09	38°56'08.77657"N	119°59'18.66207"W	2108943.2	7133766.6	6235.2	6231.2
LBM CTC08	38°56'08.73834"N	119°59'15.81676"W	2108944.3	7133991.4	6234.9	6231.0
RBM T01	38°56'12.50001"N	119°59'23.22062"W	2109311.8	7133398.2	6234.3	6230.3
RBM T02	38°56'12.04221"N	119°59'22.87444"W	2109266.1	7133426.6	6234.4	6230.4
RBM T03	38°56'12.18631"N	119°59'22.25402"W	2109281.8	7133475.2	6234.4	6230.5
RBM T04	38°56'12.10510"N	119°59'21.47459"W	2109274.9	7133537.0	6234.3	6230.3
RBM T05	38°56'11.53252"N	119°59'20.10952"W	2109219.4	7133646.1	6235.0	6231.0
RBM T06	38°56'11.22307"N	119°59'18.84992"W	2109190.3	7133746.3	6236.5	6232.5
RBM T07	38°56'10.35602"N	119°59'16.65940"W	2109106.4	7133921.3	6234.9	6230.9
RBM CTC11	38°56'11.71706"N	119°59'20.76373"W	2109236.9	7133594.0	6235.2	6231.2
RBM CTC12	38°56'10.57447"N	119°59'25.50253"W	2109113.1	7133222.2	6234.3	6230.3
RBM CTC10	38°56'11.27070"N	119°59'19.45007"W	2109194.1	7133698.8	6235.1	6231.1
RBM CTC09	38°56'10.64215"N	119°59'17.77172"W	2109133.4	7133832.8	6235.0	6231.1
RBM CTC08	38°56'09.74099"N	119°59'15.70799"W	2109045.9	7133997.8	6235.6	6231.6

BASIS OF COORDINATES

HORIZONTAL: NAD 83(2011) EPOCH 2010.00
CALIFORNIA ZONE 2

NGS HPGN D CA 03 FS
N 2107571.07 US SURVEY FEET
E 7136557.88
NGS RICHARDSON
N 2103848.87 US SURVEY FEET
E 7123525.92

VERTICAL: NAVD88
NGS HPGN D CA 03 FS
EL 6248.20

I, CHARLES KEN IWAMURA, A PROFESSIONAL LAND SURVEYOR LICENSED IN THE STATE OF CALIFORNIA, AS AGENT FOR TRI STATE SURVEYING, LTD. HEREBY THAT THIS MAP CONSISTING OF ONE SHEET ACCURATELY SHOWS THE RESULTS OF A SURVEY PERFORMED UNDER MY DIRECT SUPERVISION, AND THAT SAID SURVEY WAS COMPLETED ON OCTOBER 25, 2013.

CHARLES KEN IWAMURA
PROFESSIONAL LAND SURVEYOR
CALIFORNIA CERTIFICATE NO. 8540

Figure 2-3. Baseline Topographic Survey near Bellevue Avenue (source: Tri-State Surveying)

TRI STATE SURVEYING, LTD
425 EAST LONG STREET
CARSON CITY, NEVADA 89706
(775) 887-9911 * FAX 887-9915

REVISIONS | NO. | DATE | MARK

BENCHMARK
DESIGNED BY
DRAWN BY CKI
CHECKED BY JS
DATE SURVEYED OCT 16, 2013
APPROVED BY

TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT
PORTIONS OF THE N 1/2 OF SECTION 4, TOWNSHIP 12 NORTH, RANGE 18 EAST, M.D.M.
EL DORADO COUNTY CALIFORNIA

JOB NO 13120.01.CM
DATE 11-5-13
SHEET 1 OF 3

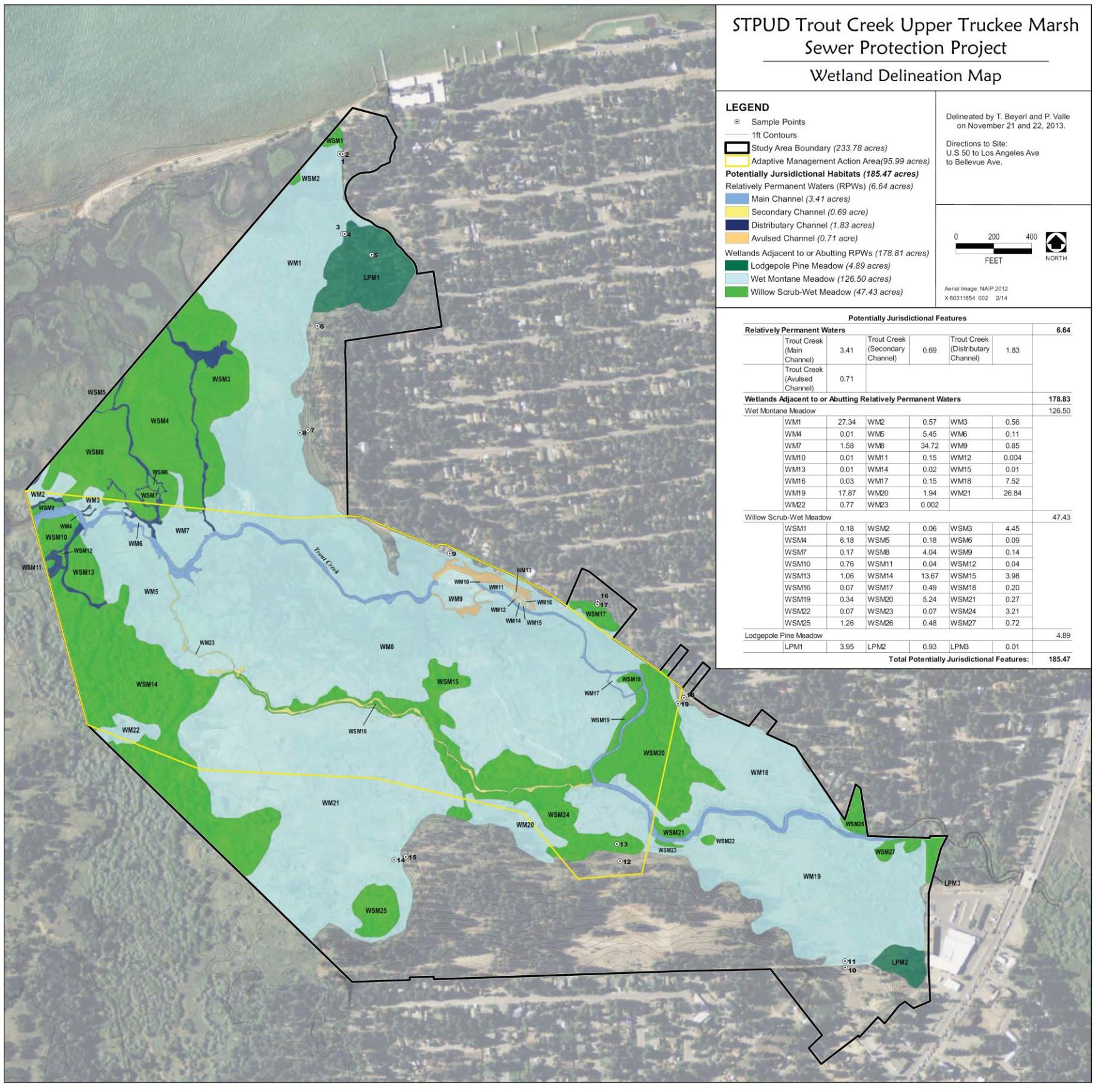
Figure 2-4. Inundation of the sewer easement near Bellevue Avenue at a flow of approximately 40 cfs, looking upstream, 20 May 2013.

Figure 2-5. Inundation of the sewer easement near Bellevue Avenue at a flow of approximately 20 cfs, looking upstream, 1 April 2014

Table 2-1. Cover in baseline vegetation transects.

Community at Road Fill	Transect 1	Transect 2	Transect 3	Average
Total Cover (including litter, gravel, rock)	100%	100%	100%	100%
Total Vegetative Cover	88%	98%	84%	90%
Vegetative Cover by Native Species	84%	90%	83%	85.7%

Community at Proposed Hummocks	Transect 1	Transect 2	Transect 3	Average
Total Cover (including litter, gravel, rock)	100%	61%	90%	83.7%
Total Vegetative Cover	95%	58%	88%	80.3%
Vegetative Cover by Native Species	93%	58%	88%	79.7%



Potentially Jurisdictional Features							
Relatively Permanent Waters							**6.64**
	Trout Creek (Main Channel)	3.41	Trout Creek (Secondary Channel)	0.69	Trout Creek (Distributary Channel)	1.83	
	Trout Creek (Avulsed Channel)	0.71					
Wetlands Adjacent to or Abutting Relatively Permanent Waters							**178.83**
Wet Montane Meadow							126.50
	WM1	27.34	WM2	0.57	WM3	0.56	
	WM4	0.01	WM5	5.45	WM6	0.11	
	WM7	1.58	WM8	34.72	WM9	0.85	
	WM10	0.01	WM11	0.15	WM12	0.004	
	WM13	0.01	WM14	0.02	WM15	0.01	
	WM16	0.03	WM17	0.15	WM18	7.52	
	WM19	17.87	WM20	1.94	WM21	26.84	
	WM22	0.77	WM23	0.002			
Willow Scrub-Wet Meadow							47.43
	WSM1	0.18	WSM2	0.06	WSM3	4.45	
	WSM4	6.18	WSM5	0.18	WSM6	0.09	
	WSM7	0.17	WSM8	4.04	WSM9	0.14	
	WSM10	0.76	WSM11	0.04	WSM12	0.04	
	WSM13	1.06	WSM14	13.67	WSM15	3.98	
	WSM16	0.07	WSM17	0.49	WSM18	0.20	
	WSM19	0.34	WSM20	5.24	WSM21	0.27	
	WSM22	0.07	WSM23	0.07	WSM24	3.21	
	WSM25	1.26	WSM26	0.48	WSM27	0.72	
Lodgepole Pine Meadow							4.89
	LPM1	3.95	LPM2	0.93	LPM3	0.01	
						Total Potentially Jurisdictional Features:	**185.47**

Figure 2-6. Wetland delineation map (AECOM, 2014).

.

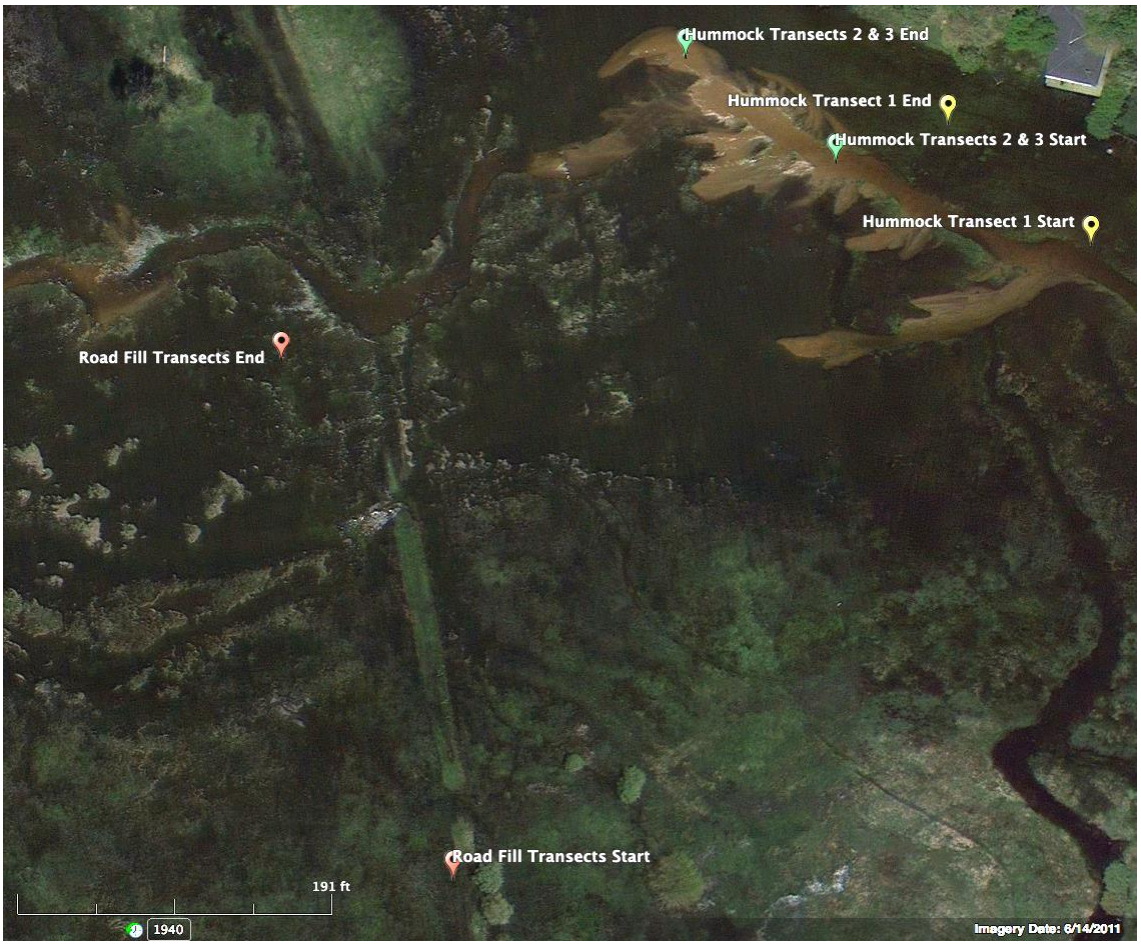


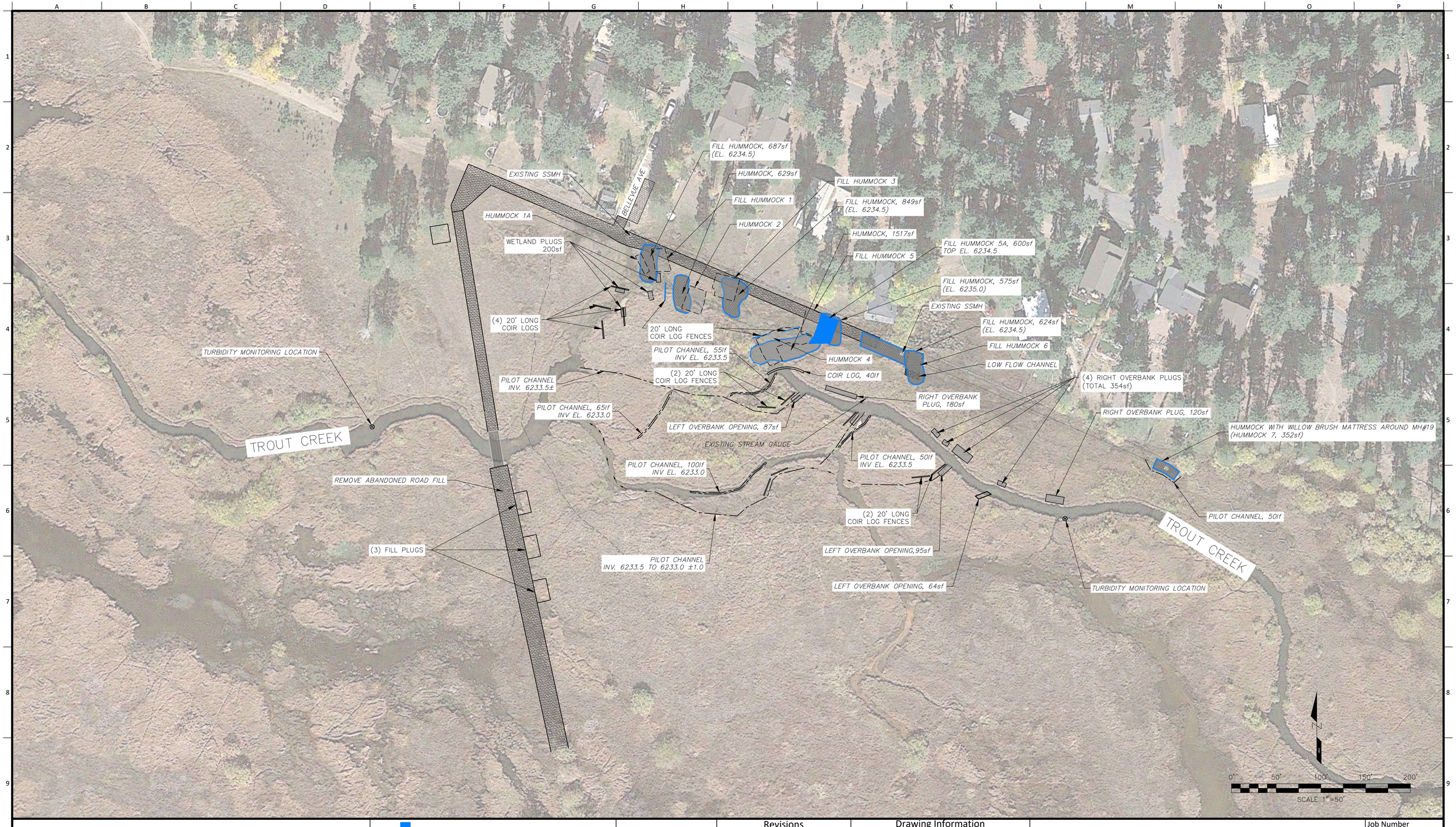
Figure 2-7. Baseline vegetation monitoring transect locations.

3 AMP ACTIONS

3.1 Types of Actions

Over the three-year period of construction there were numerous AMP actions taken to improve the District's access to the easement. These features are described below and are highlighted in Figure 3-1.

1. **Construction of pilot channels** off the left bank to divert some portion of routine flows to the south away from the easement;
2. **Opening of left bank overflow paths** to convey higher flow levels to the south;
3. **Planting of willow fences, stakes, poles, or wattles** along preferred channel alignments to encourage scour and increase in channel capacity;
4. **Removal of debris and fill** at the entrance to the pre-1968 channel alignment;
5. **Local widening or deepening** of desirable alternative flow paths to increase their capacity;
6. **Installation of hydraulic roughness elements** spanning the easement and adjacent low areas to break up flow lines, and reduce local velocities in order to prevent channel incision and encourage sedimentation;
7. **Placement of hummock fill**, to be vegetatively stabilized, over portions of the easement and adjacent low areas;
    a. **TYPES OF HUMMOCKS (hummocks, fill hummocks, double marsh mat hummocks, hummocks with will brush mattresses…)**
8. **Miscellaneous fill on the floodplain**, using existing vegetation and a biodegradable perimeter for stabilization;
9. **Installation of overbank flow plugs** along the right bank to reduce the amount of flow passing over or adjacent to the easement;
10. **Planting of willow fences, stakes, poles, or wattles** on unfavorable flow paths that currently contribute, or have the potential to contribute to inundation on the easement;
11. **Removal of abandoned road fill**, including salvaging and replacing existing sod, to the adjacent meadow grade; and
12. **Intermittent fill and revegetation** of the erosional depression upstream of the abandoned road fill.



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Revisions		
No.	Date	Description

Drawing Information	
Date	19 November 2021 (15:20)
Status	R1 Submittal
Designer	DJB
Drafter	CF
Checked	
File Name	TROUT CREEK FEATURE MAP
Plotted Scale	0 1/2 1 (15:08:38)

Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Years 1-3 Features Map

Figure 3-1

Job Number 5006145

Sheet Number G1

Sheet 1 of 2

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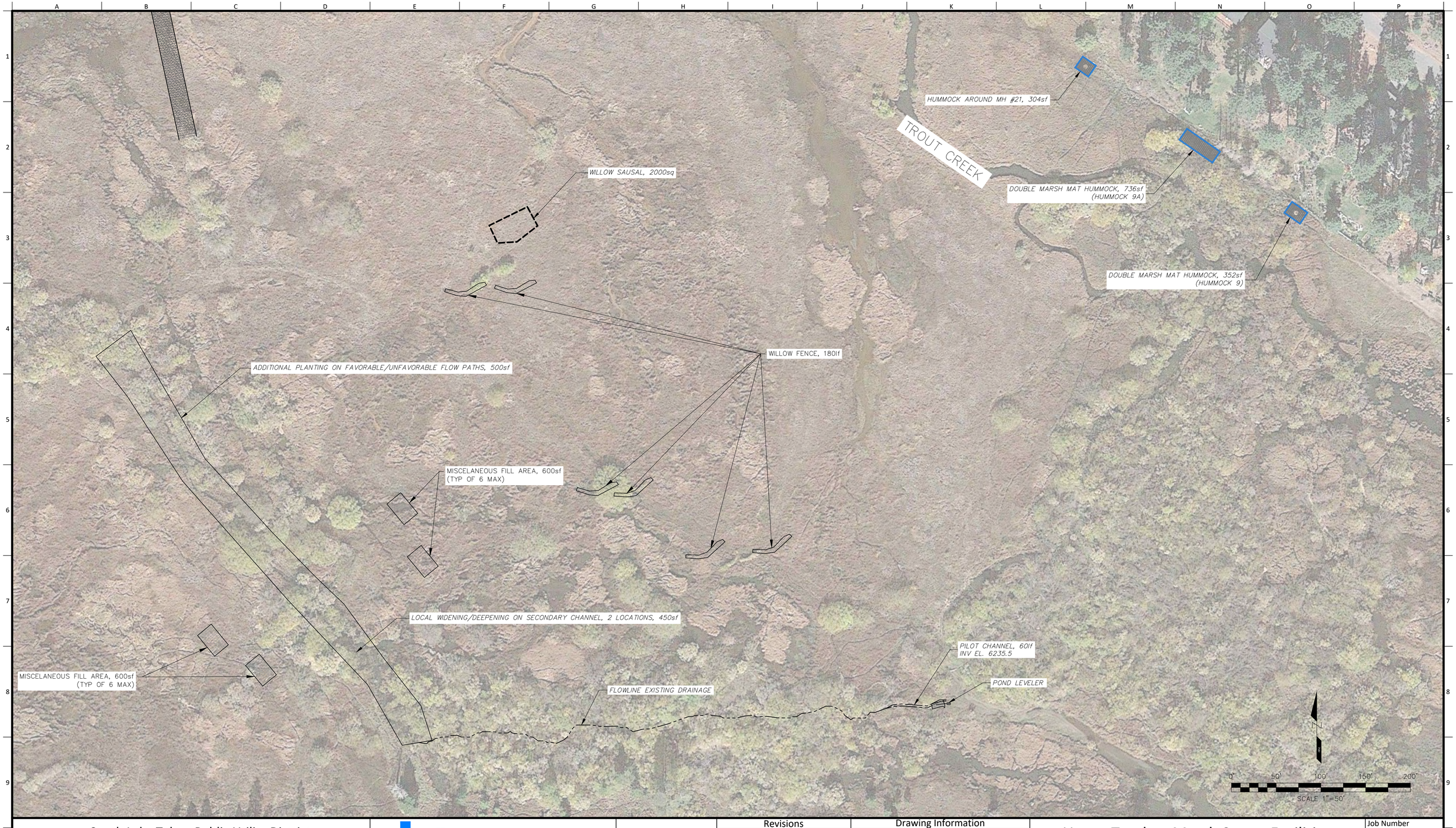
FILE LOCATION:P:\5006145 UTMSFPP AMP CLOSEOUT\96_CAD\01 DESIGNDRAWINGS\04_DESIGN\TROUT CREEK FEATURE MAP.DWG



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Date	19 November 2021 (15:21)
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File Name	TROUT CREEK FEATURE MAP
Plotted Scale	0 1/2 1

Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Years 1-3 Features Map

Figure 3-2

Job Number 5006145

Sheet Number

G2

Sheet 2 of 2

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FILE LOCATION:P:\5006145 UTMSFPP AMP CLOSEOUT\96_CAD\01 DESIGNDRAWINGS\04_DESIGN\TROUT CREEK FEATURE MAP.DWG

3.2 Summary by Year

Prior to starting construction, the District entered a 3-year contract with V&C Construction to implement Construction Plans developed over the three-year construction period for the AMP (Appendix A).

In 2014 (Year 1), V&C Construction constructed measures in accordance with the – Year 1 Construction Plans, including:

- Construction of three pilot channels to carry flow from the avulsed channel area into existing low ground and remnant channels south of the avulsed channel;
- Removal of approximately 7,000 square feet of abandoned road embankment crossing the meadow by removal of sod, shallow excavation, and replacement of sod to match the adjacent ground (excess soil was placed intermittently in a linear depression upstream of the road fill to discourage flow along the restored area);
- Installation of approximately 2,800 square feet of vegetated hummock (pre-grown coir marsh mats propagated by Nevada Division of Forestry (NDF) using bare root stock) and an equal quantity of vegetated fill hummock (pre-grown marsh mats installed over shallow fill intended to raise local depressions to no more than a few inches above adjacent ground);
- Excavation of two additional openings in the left bank (looking downstream) of Trout Creek to encourage flows to the adjacent low-lying area of the marsh and raising of six low areas in the right bank using a combination of coir logs and salvaged sod to discourage flow to the right overbank; and
- Planting of an additional 4,000 square feet of vegetation along other flow paths in the marsh upstream of the avulsion area, including willow fences using coir logs and closely spaced willow cuttings from the project area that were installed in areas of low existing vegetation density that could become flow paths towards the pipeline easement, and installation of a willow sausal (grove) near an area of remnant channels, also intended to encourage flow towards the center of the marsh rather than towards the easement on the right margin.

The primary purposes of the Year 1 work were to remove the road fill to eliminate the local restriction in overbank flow downstream of the avulsed area and thereby reduce potential backwater effects near Bellevue Pump Station in higher flows, to roughen (with vegetation) and slightly elevate areas immediately over the pipelines to encourage flow paths to the left (looking downstream) of the easement, and to encourage new channel establishment to the left of the existing main channel and avulsed channel area where low ground and remnant channels were present. Vegetation planted upstream of the avulsion area was intended to discourage flow paths toward the easement, recognizing that future changes in channel alignment and flow patterns were probable.

In 2015 (Year 2), adaptive management plans were developed based on observations of Year 1 performance and V&C constructed measures in accordance with the 2015 Year 2 Construction Plans, including:

- Excavation of approximately 120 lineal feet of pilot channel at the head of the secondary channel in the center of the marsh;
- Clearing of obstructions and debris from about 500 lineal feet of the secondary channel;
- Enlargement of portions (approximately 400 lineal feet) of the pilot channels constructed in 2014;
- Construction of an additional 600 square feet of vegetated fill hummock;
- Raising of an additional low area along the right bank of Trout Creek; and
- Installation of 80 lineal feet of planted coir log and an additional 45 wetland plugs.

The primary purposes of the Year 2 work were to promote flowin the secondary channel in the centerof the marsh, thereby reducing flow along the easement; mechanical enlargement of the pilot channels based on observations of very low natural erosion and channel development following Year 1 work; and slightly raising and revegetating additional area within the easement to manage low flows along a swale just to the south of the easement, including installation of coir logs and vegetation along this flow path to concentrate lower flows.

In 2016 (Year 3), adaptive management plans were again developed based on observations of Year 2 performance and V&C constructed measures in accordance with the 2016 Year 3 Construction Plans, including:

- Additional planting of wetland plugs in the right overbank near the end of Bellevue Avenue;
- Reinforcement and extension of an existing coir log at the head of Hummock H4 to encourage flow into Pilot Channel 1;
- Installation of a double marsh mat hummock near Manhole BV-18, downstream of Hummock H6 in the District's easement;
- Slight modification of coir logs around the south side of Hummock H6 to lower top elevations to the level of the adjacent marsh to allow free drainage of overbank flows and reduce ponding in the easement;
- Installation of a marsh mat and willow mattress hummock and short pilot channel near Manhole BV-19;
- Installation of a hummock near Manhole BV-21;
- Installation of a double marsh mat hummock between Manholes BV-21 and BV-22 in a low spot within the easement; and
- Installation of a double marsh mat hummock near Manhole BV-22.

The District also installed a pond leveler at the head of the secondary channel in the center of the marsh designed to maintain an estimated 3 cfs minimum flow through the channel. The purpose of the pond leveler was to reactivate flow from Trout Creek back into the secondary channel across an incipient

beaver dam. With the exception of the installation of the pond leveler, Year 3 improvements required no heavy equipment access and no significant grading activities. The purposes of the Year 3 activities were to make minor adjustments in topography and vegetation near Bellevue Avenue to reduce inundation in the easement and to install additional marsh mats with slightly varied designs from the Year 1 hummocks to encourage deposition of sediment and reduce depth of inundation in the easement upstream of Bellevue Avenue. In particular, marsh mats were placed in the vicinity of gravity main manholes to improve maintenance access and encourage flow around the manholes. The techniques used in Year 3 were selected to avoid the need to access the area with heavy equipment and were, at least partially, in response to observations of increasing inundation upstream of the Bellevue area due to increased beaver activity (see Section 4.5).

In 2017 (Year 4), AMP activities were limited to maintenance of channels - clearing channel obstructions and debris on the main channel near District Manhole BV-22 and on the secondary channel in the center of the marsh. No heavy equipment was required in 2017. No AMP activities have occurred since 2017.

4 MONITORING

4.1 Monitoring Plan

The scope of the monitoring includes flow conditions and water surface elevations (including flow outside the main channel in the sewer easement area); topographic changes; turbidity; and vegetation. The complete monitoring plan is included in the AMP (NHC, 2014) and is summarized in Table 4-1. The purpose of the Annual Report is to provide permitting agencies and other stakeholders with information related to the success of the project so that they may continue to be engaged in the adaptive management process, and to track the development of approved measures constructed during the project. The permits for the project cover the entire expected 5-year implementation period and thus there is no specific agency approval or action required in response to the Annual Report. Completion of Year 3 monitoring was delayed in 2017 due to inundation associated with beaver activity, which is described in more detail below.

Table 4-1. Monitoring plan summary.

Monitoring Component	Performance Standard	Frequency	Duration
Baseline Conditions			
Topography	Baseline 2014	Once	NA
Inundation of Easement	Baseline 2014	Once	NA
Trout Creek Water Levels	Baseline 2014	Continuous recorders installed 3 locations	NA
Groundwater Levels	Baseline 2014	Continuous recorder in well at end of Bellevue Ave	NA
Wetland Extent	Baseline 2014	Once	NA

Monitoring Component	Performance Standard	Frequency	Duration
Woody Riparian	Baseline 2014	Once	NA
Herbaceous Cover and Natives Composition	Baseline 2014	Once	NA
Pre-Construction and During Construction			
Willow Flycatcher Surveys	Establish buffers or other measures to avoid disturbance, if present	Annually, if construction within nesting season	NA
Yellow Warbler, Long-Eared Owl, Waterfowl, and Northern Harrier Surveys	Establish buffers or other measures to avoid disturbance, if present	Annually, if construction within nesting season	NA
Fisheries	Fish rescue and relocation as needed; reporting if endangered species present	During dewatering and in-channel operations	Years 1-7
Cultural Resources	Observations during ground disturbance; avoidance of unknown cultural resources	Daily during ground disturbance	Years 1-7
Sediment Discharge	Turbidity below 20 NTUs except temporary periods during in channel work and pilot channel activation	Periodic field measurements plus logging turbidimeter at 15 minute intervals	During construction operations
Trout Creek Turbidity	Turbidity below project area shall not exceed turbidity above project area by more than 10 percent except temporary periods during in channel work and pilot channel activation	Periodic field measurements plus logging turbidimeter at 15 minute intervals	During construction operations
Pilot Channel Width	NA	Twice per week	During construction operations
Post-Construction			
Topography	NA – Repeat of topographic surveys or cross sections for information	Annually	Years 2-7
Right Overbank Flows	No more than 10 percent over right overbank at flows less than bankfull	Up to 3 times during snowmelt season	Years 2-7
Inundation of Easement	No inundation of easement at flows less than 50 cfs	Annually in snowmelt season	Years 2-7
Pilot Channels and Left Bank Pathways	NA – Information on channel development	Annually	Years 2-7
Trout Creek Water Levels	NA – Information for inundation extents and channel behavior	Continuous, reported annually	Years 2-7

Monitoring Component	Performance Standard	Frequency	Duration
Groundwater	NA – Information for vegetation survival	Continuous, reported annually	Years 2-7
Planted Herbaceous Vegetation	70 percent of baseline cover after 2 years; 90 percent of baseline after three years; vigor comparable to surrounding marsh areas	Annually	Years 2-7
Planted Woody Vegetation	80 percent survival and exhibit good vigor	Annually	Years 2-7
Turbidity	Turbidity below project area shall not exceed turbidity above project area by more than 10 percent	Continuous, reported annually	Years 2-7
Photo Points	NA – Information to support channel and vegetation conditions	Annually	Years 1-7
Wetland Extent	No loss in jurisdictional wetland	Once	At completion
Final Topography	NA – for information	Once	At completion

4.2 Water Level Data

In November 2013, the District installed three pressure transducer data loggers along Trout Creek, as shown in Figure 4-1. In 2014 a pressure transducer data logger was also installed in monitoring well 4 (MW-4) next to the District's Bellevue Sewer Pump Station. Figure 4-2 shows the water level record collected by the District for these sensors through September 2020. Manual measurements were taken at the sensors to validate the data, and if needed to calibrate the loggers against drift (see symbols in Figure 4-2). The water levels are intended to supplement observations on easement inundation and pilot channel performance in conjunction with survey data.

Communication difficulty between the datalogger and the computer was noted in the 2016 annual report, and water levels for TC 001 after December 2015 were considered suspect. The water level data for 2016 and 2017 also appear to have some inaccuracies. For example, it is highly unlikely to have a water surface elevation at the mid-stream or down-stream sensors that is higher than the up-stream sensor. Water level data for TC 001 differ from manual measurements by up to 1 foot from late 2015 to June 2016 and then reasonably match manual measurements in June 2016 and August 2017. However, level data trends in the winter of 2016/2017 do not match flow trends. During the winter, ice build-up typically forms along the reach of Trout Creek in the project area and has been observed at TC-001 and TC 003. Ice accumulation can overpressure the sensor which may explain the discrepancies in the water level data recorded during the winter readings. Water level data for TC 002 appear to reasonably match manual measurements through 2017, after which these data appear suspect. Water level data for TC 003 differ from manual measurements by 0.5 to 1 foot in 2016 and 2017. Stages recorded at TC 003 varied about 2 feet in 2016 and 2017 and varied about 1.5 feet at TC 002.

After 2017, TC 002 logger data does not match manual measurements in values or trends, and this data is considered unusable. TC 001 data matched manual measurement in September 2018, but the logger was out of service after this date. Logger data for TC 003 and MW-4 reasonably match manual measurements in 2017 through 2020.

During the 2017 water year, winter brought significant snow to the Sierra Mountains (Figure 4-6), and runoff for the 2017 water year was high in terms of peaks flows, late summer flow duration, and annual runoff volume. Winter-time peaks of 409 cfs and 483 cfs occurred on January 9 and February 9, respectively, at USGS Gage 10336780 near Tahoe Valley upstream of the site. These flows were associated with peak flows on the Upper Truckee River and combined flows resulted in street flooding on the margins of the marsh. A snowmelt peak of 484 cfs also occurred on June 23. The snowmelt peak is the fourth largest flow in the historical record for the gage (1961 to present), and the other winter-time peaks were larger than all but seven of the annual peaks since 1961. Flows remained at or above 100 cfs for almost four months in April-July and the recession limb of the annual hydrograph never descended below about 28 cfs in late October; median flows in October are 15 cfs. The USGS reported average annual flow was 112 cfs, the largest in the historical record, exceeding even other large water years such as 1997 and 2011 by at least 50 percent. Due to the long duration of flows in excess of the channel capacity, much of the marsh, including the right overbank near Bellevue Avenue, remained inundated through the summer and fall months.

The 2017 water year was also a period of exceptional groundwater recharge resulting in above normal groundwater levels across the local groundwater basin (Bergsohn, 2018). An increase in water elevation at MW-4, for both the sensor data and the manual measurements (Figure 4-2) corresponds to the high recharge and coincident rise in Lake Tahoe water levels shown in Figure 4-4. From 2017 to 2019, lake levels were high during summer months, each year reaching a peak near elevation 6232 feet and the maximum legal limit for Lake Tahoe set by the 1915 legal decree. In 2020, the peak lake level was about 1 foot lower, and on the date of the 2020 field survey the lake was at approximately elevation 6228.8 feet, which is approximately 4 and 5 feet below water levels measured at TC 003 and MW-4, respectively. Comparison of MW-4 and TC 003 levels indicates a gradient towards the creek in the past few years (2017-2020), the reverse of relative water levels in the 2014 to early 2017 period. The period of losing streamflow from 2014 to early 2017 corresponds with very low runoff years on Trout Creek in 2014 and 2015 (41 and 32 percent of normal, respectively) and below normal runoff in 2016 (83% of normal), and statewide California drought conditions in 2012 to 2016. In contrast, Water Year 2017 produced over 300 percent of normal runoff on Trout Creek.

Water levels at TC 003 in the last few years generally follow the flow pattern recorded at USGS Gage 10336780. However, high lake levels also likely affect baseflow water levels at the site. As a broad comparison, lake water surface elevations have been between 6230 and 6232 ft over the past few years (Figure 4-4), which is only a few feet below the observed water surface elevations for the same time period (Figure 4-2). Beaver dams are known to exist downstream of the site on Trout Creek and may also affect water levels at the site.

MW-4

Stream Flow Cross Section #1

TC 003

TC 002

Down-Stream Turbidimeter

Up-Stream Turbidimeter

TC 001

Stream Flow Cross Section #2

TC 001 = Up-Stream Gage
TC 002 = Mid-Stream Gage
TC 003 = Down-Stream Gage

Pre-1968 Alignment
Crest Stage Gage

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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northwest hydraulic consultants

Legend

- Crest Stage Gauge
- Groundwater Elevation Gage
- Surface Water Elevation Gage
- Turbidimeter
- Streamflow Measurement Cross Sections

SCALE - 1:1,800
0 50 100 150 200 Feet
N

DATA SOURCES:
Google Earth

Job: 5006145

February 2020

Figure 4-1

Streamflow Measurement Sites

ABC, L:\OldProj\6000035_TroutCreekFacilities\GIS\Workmaps\Figure2-6.mxd

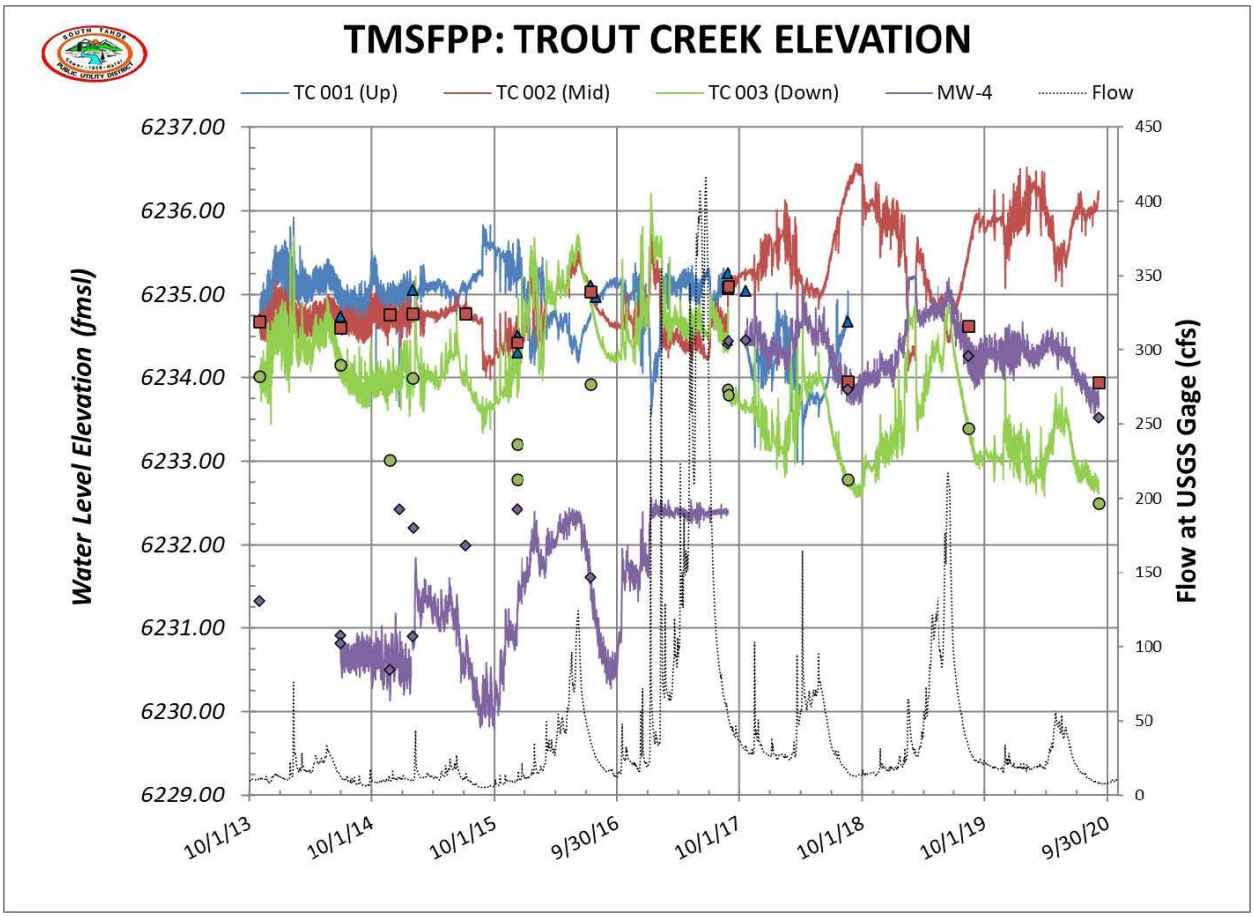


Figure 4-2. Water levels and USGS stream flow (at Gage 10336780) from fall 2013 through fall 2020. Manual hand readings are shown as symbols with matching color of corresponding sensor.

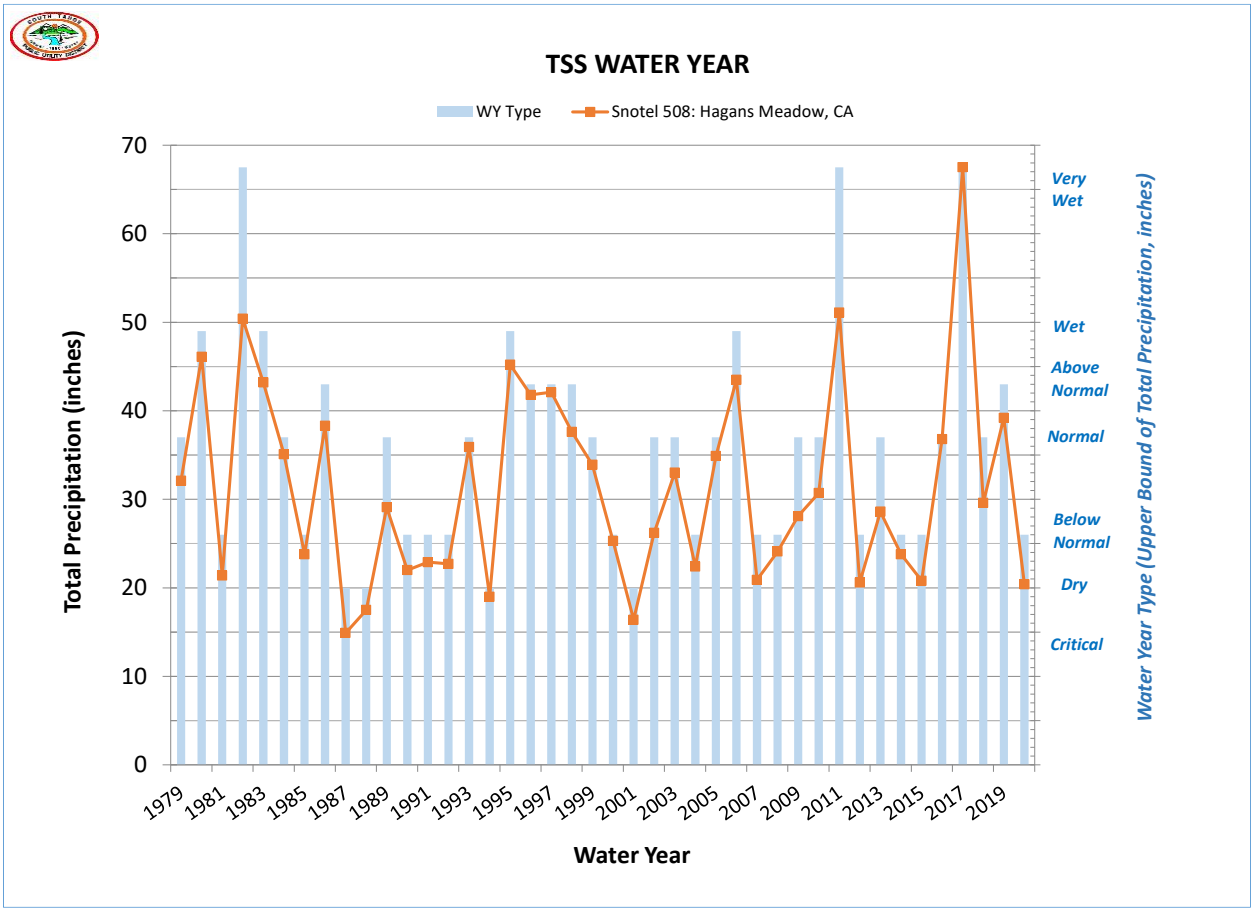


Figure 4-3. Total precipitation, as recorded at the Hagans Meadow Snotel, and corresponding water year type. Graph provided by STPUD.

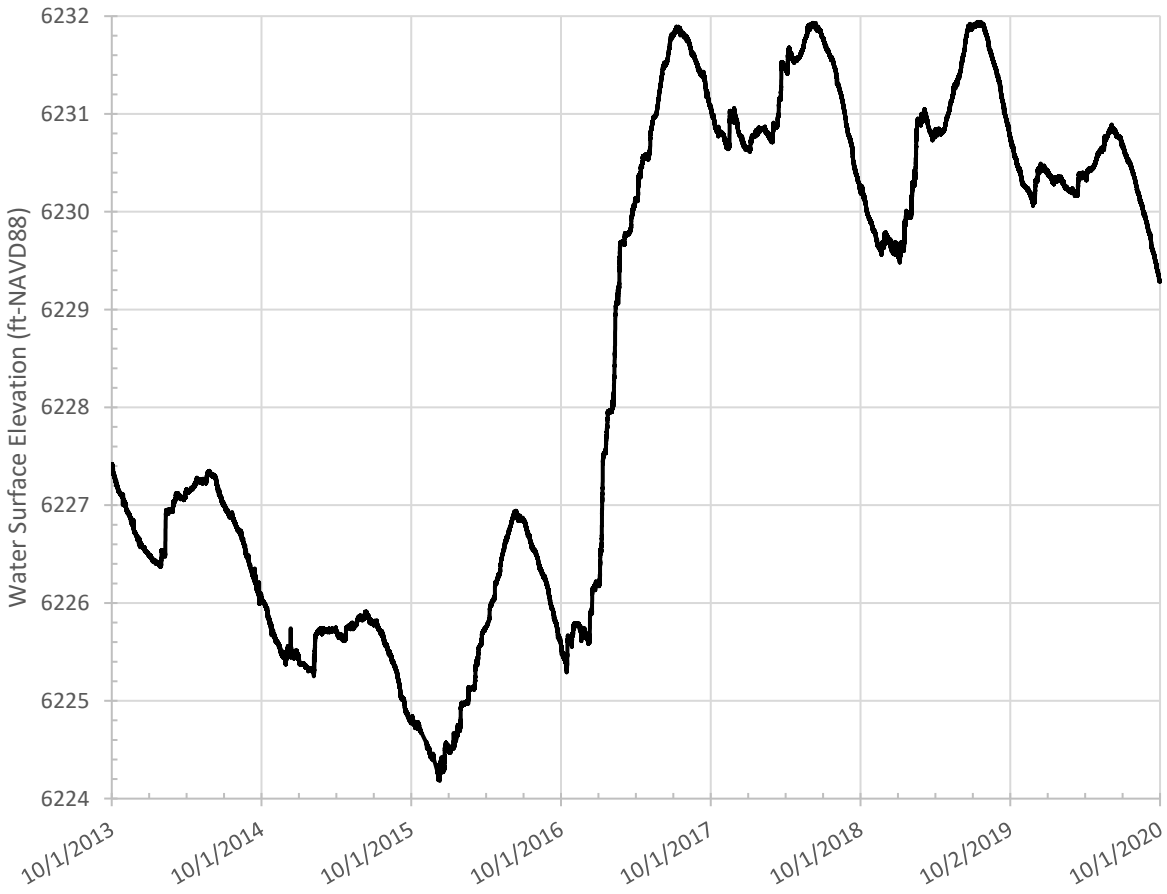


Figure 4-4. Lake Tahoe water surface elevations (USGS 10337000 gage).

4.3 Turbidity Data

Figure 4-5 shows the turbidity measurements upstream and downstream of the work area near Bellevue Avenue for the duration of the project from 2014 to 2020. The records indicate no long-term trend for elevated turbidity at the downstream gage compared to the upstream location. In addition, no temporary impacts associated with Year 3 construction in October 2017 are evident. Year 4 records are unfortunately intermittent and there is a gap during the period of maintenance activities in November 2017. Both Year 3 and Year 4 records show periods of spikes in downstream turbidity but the cause of these increases is unknown and does not correspond to periods of project activity. Although one purpose of the turbidity monitoring is to determine if the project activities from the previous year increase turbidity during high runoff periods, the observed spikes are not consistent with a general increase in erosion or sediment transport in the pilot channels. Turbidity in 2020 was similar to previous years, with perhaps a slight increase in turbidity (Figure 4-6). Outside of the periods with spikes in downstream turbidity, the plots generally show that turbidity is in the range of 2 to 10 NTUs, with a slight trend for higher levels during summer months.

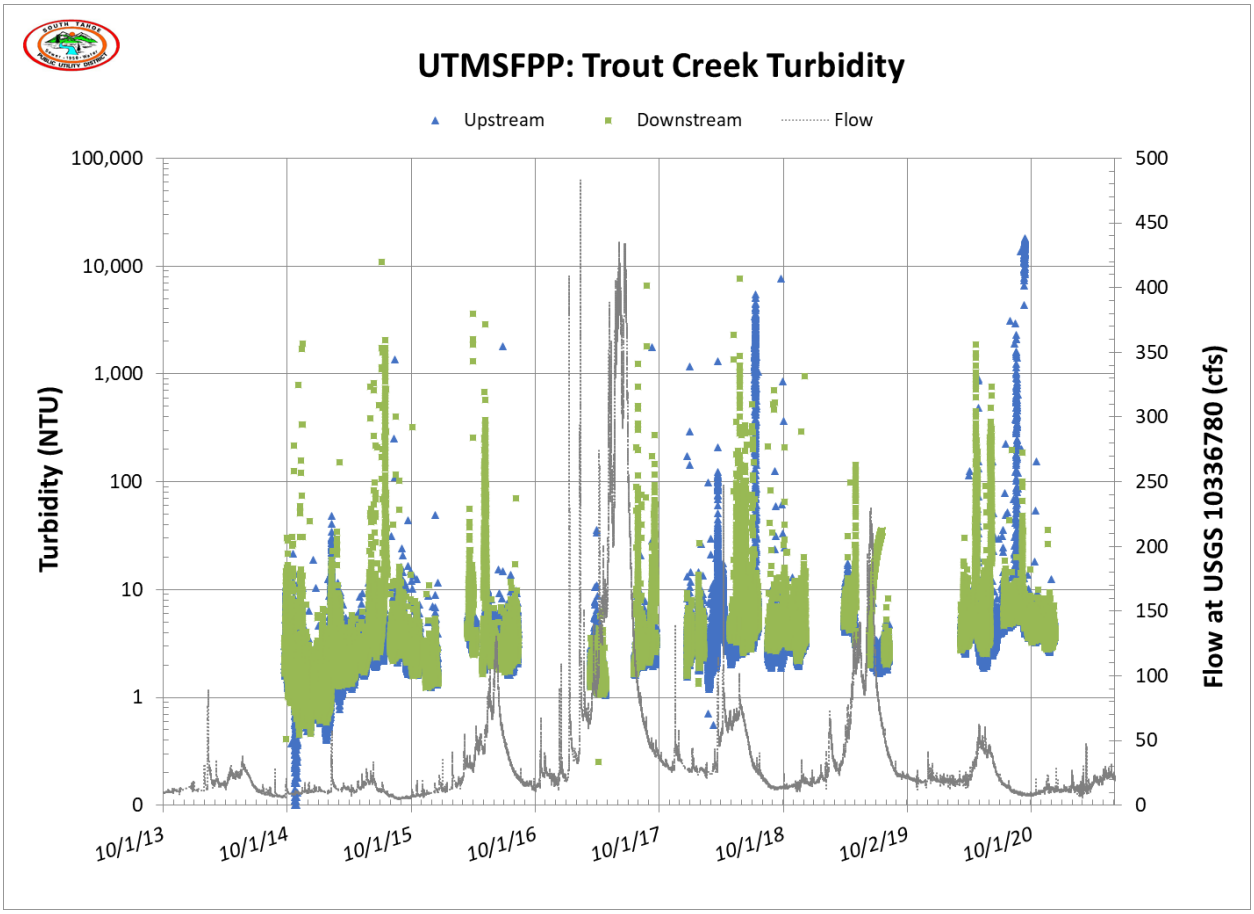


Figure 4-5. Turbidity upstream and downstream of work area near Bellevue Avenue.

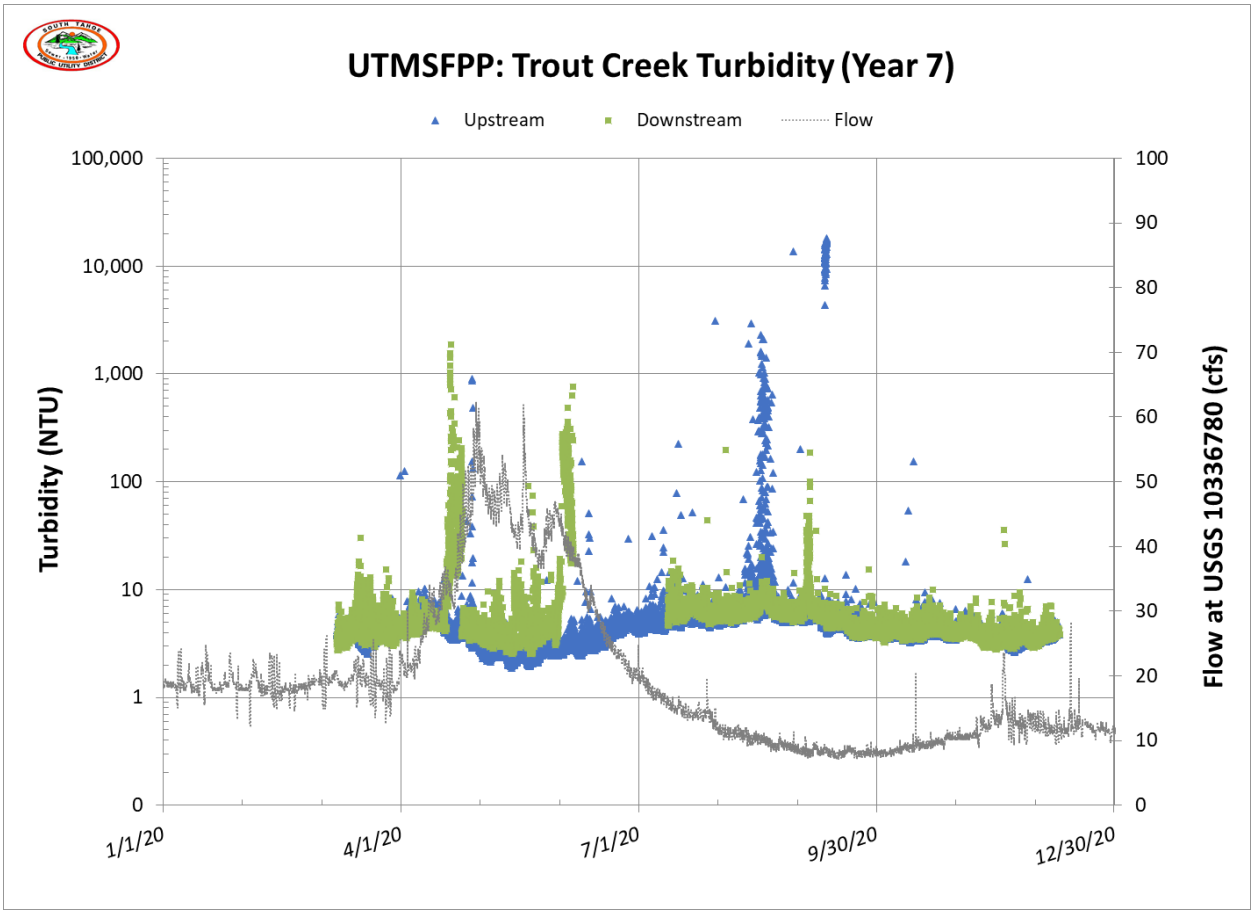


Figure 4-6. Turbidity upstream and downstream of work area near Bellevue Avenue in 2020.

4.4 Survey Data

Prior to implementation of any AMP activities, the District retained Tri-State Surveying to set survey control and produce a topographic survey of the area near Bellevue Pump Station (Tri-State Surveying, 2013). The survey included five cross sections previously surveyed by the California Tahoe Conservancy and ten new transects. In 2014 Lumos & Associates resurveyed these cross sections, and an additional seven cross sections on the pilot channels (Lumos & Associates, 2014). In 2015 Lumos & Associates again resurveyed all cross sections (Lumos & Associates, 2015). No topographic surveys were collected 2016 through 2019.

On 5 November 2020, NHC visited the Bellevue site and resurveyed the cross sections. This survey used a Trimble R8 and R10 RTK-GNSS system. The R8 (used as a base station) was setup over RBM T01 and additional benchmarks at the ends of cross sections were surveyed. Comparing eight of these other benchmarks it was determined that RBM T01 had lowered approximately 0.2 ft. All data were translated by the average difference of the northing, easting, and elevation of the eight other BMs. Channel thalweg and water surface elevations (WSEs) were also collected during this survey. These data were

verified for erroneous and/or mislabeled points. Photos were taken at previously established photo points along the right (north) overbank looking along six of the transects to the south (Appendix B).

A comparison of the repeat cross sections provides information on channel changes during the AMP period (see Appendix C for a comparison of the cross sections). The observed changes for the time series of cross sections are summarized in Table 4-2; these results are ordered roughly from upstream (CTC XS-8) to downstream (CTC XS-12) as denoted in Figure 4-7. Trout Creek and PC-3 have enlarged at nearly all cross sections, while treatment activities have, in general, led to aggradation of the overbank at TRANSECT STPUD 5, CTC XS-11, TRANSECT STPUD 4, TRANSECT STPUD 3, and PC XS1. Over time there has been an infilling of PC-1 and PC-2 at PC XS6, PC XS3, CTC XS-11, TRANSECT STPUD 4, and PC XS2. In addition to observations on topographic changes, Table 4-2 includes notes regarding surveyed water surfaces in the overbanks compared to water surfaces in the channel. Several cross sections show water levels that are higher in the right overbank than in the adjacent channel, indicating that high ground between the channel and overbank is limited the ability for surface water to return to the channel.

In addition to the NHC surveyed cross sections, 2010 Tahoe Regional Planning Agency LiDAR (TRPA, 2010) and 2018 Quantum Spatial Inc. LiDAR (QSI, 2018) was used to qualitatively understand geomorphic changes from 2010 to 2018 (Figure 4-8). Both datasets were collected with high resolution and accuracy, however, it should be noted that the 2018 LiDAR was collected using a green wavelength sensor, which is more capable of collecting topography below the water surface. The 2018 LiDAR may therefore be expected to show lower ground elevations in areas where inundation was present in 2010. For example, elevations appear to be slightly lower in the main Trout Creek channel through the Bellevue project area in the 2018 mapping. Elevations also appear to be lower in portions of the marsh downstream of Bellevue Avenue, near the center of the marsh, and in the overbank downstream of the road crossing in the 2018 mapping. The apparent channel elevations are influenced by flow at the time of the flights, and neither data set may accurately capture stream bed elevations. The marsh topography downstream of Bellevue Avenue is unlikely to have changed significantly during this period, and differences are probably due to lower levels of inundation or increased penetration of inundated areas in the 2018 topography. Evident from comparing the two LiDAR datasets is that beaver activity has led to aggradation of the channel upstream of Bellevue, near where the channel crosses the meadow from south to north (Figure 4-8). The 2018 LiDAR data also clearly illustrates the lower terrain at the north edge of the meadow and how the channel banks are slightly perched above adjacent areas of the meadow. The right overbank water levels higher than channel water levels noted in Table 4-3 indicate that water is trapped or flowing along this low-lying area even when creek water levels are lower.

Table 4-2. Summary of channel changes overtime from 2013 to 2020, ordered roughly from upstream to downstream.

Transect	Observations
CTC XS-8	Trout Creek slightly enlarged channel; right overbank WSE approximately 0.9' higher than channel WSE
TRANSECT STPUD 7	Trout Creek re-incision
CTC XS-9	Trout Creek slightly enlarged channel; right overbank WSE approximately 0.5' higher than channel WSE
PC XS7	PC-3 channel incision (just upstream of existing beaver dam)
TRANSECT STPUD 6	Beaver dam in PC-3; Trout Creek re-incision; right overbank WSE approximately 1.0' higher than PC-3 WSE, and approximately 0.7' higher than Trout Creek WSE
CTC XS-10	PC-3 slight lateral shift; Trout Creek re-incision; right overbank WSE approximately 1.3' higher than PC-3 WSE and 0.5' higher than Trout Creek WSE
PC XS6	PC-2 filling back in
TRANSECT STPUD 5	PC-3 slight incision; overbank deposition; PC-1 WSE approximately 0.8' higher than PC-3 WSE; right overbank WSE approximately 1.0' higher than PC-3 WSE
PC XS5	PC-3 channel incision
PC XS3	PC-1 slight channel shift
CTC XS-11	PC-3 slight channel widening; PC-1 mostly filled in; right overbank WSE approximately 0.9' higher than channel WSE; slight aggradation in right overbank
PC XS4	No discernable changes
TRANSECT STPUD 4	PC-3 slight channel enlargement; PC-2 filling back in; slight aggradation in right overbank; right overbank WSE approximately 0.6' higher than PC-3 WSE
PC XS2	PC-1 filling back in
TRANSECT STPUD 3	PC-3 slight channel enlargement; slight aggradation in right overbank; right overbank WSE approximately 0.8' higher than PC-3 WSE
PC XS1	Left overbank aggradation
TRANSECT STPUD 2	Slight channel shift at Trout Creek/PC-3 confluence; pool incision on Trout Creek remnant channel
TRANSECT STPUD 8	Trout Creek re-incision
TRANSECT STPUD 1	No discernable changes
CTC XS-12	Trout Creek channel enlargement

Figure 4-7. Repeat transect locations described in Table 3.

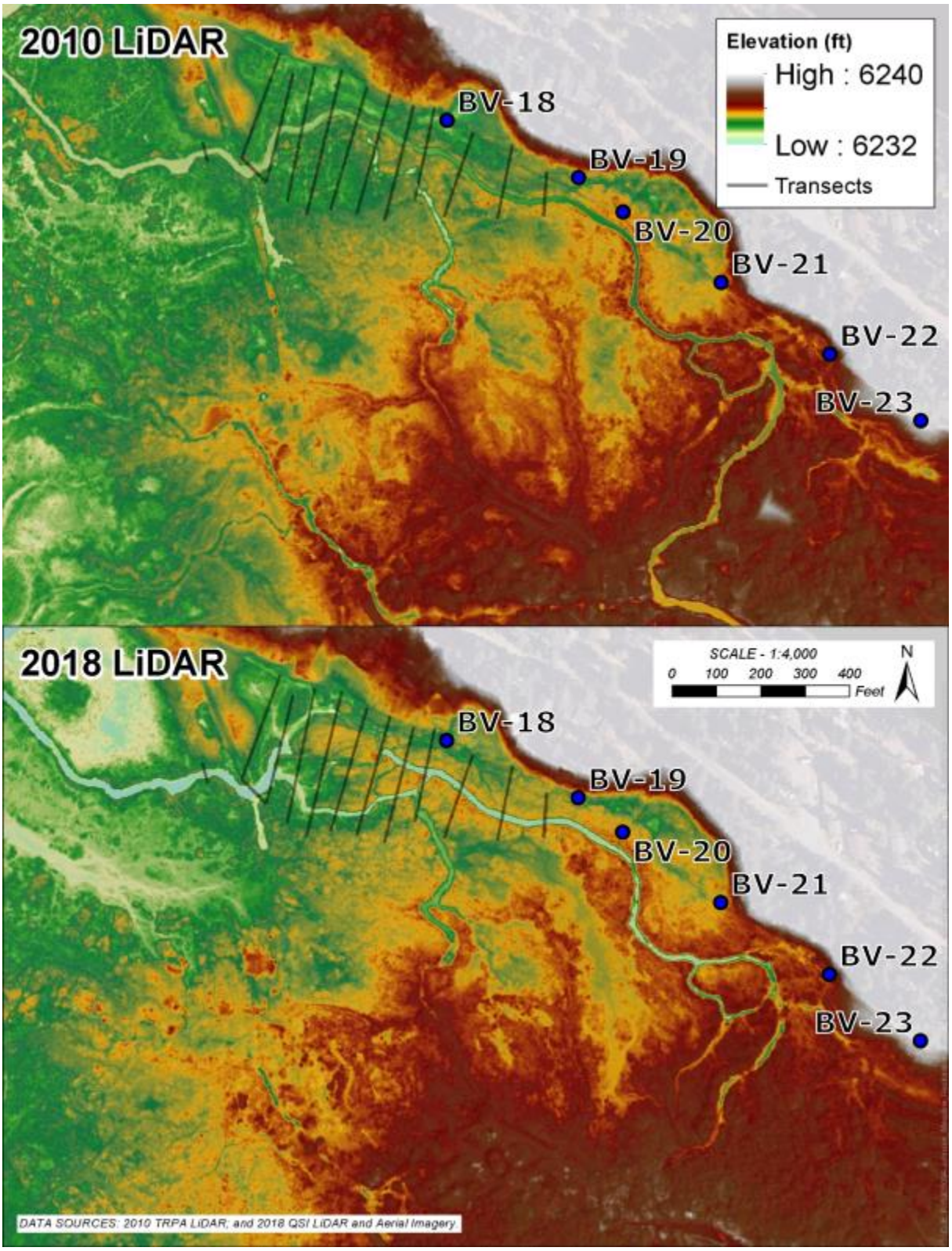


Figure 4-8. Topographic comparison of 2010 and 2018 LiDAR along the Bellevue easement.

4.5 Beaver Activity

Beaver activity upstream of the Bellevue work area began shortly after Year 1 improvements were constructed in 2014, and by 2015 overbank flooding had increased in the area upstream of Bellevue due to a beaver dam on the main Trout Creek channel in the area where the channel crosses the meadow from left to right approximately 1,300 feet upstream of Bellevue Avenue. Figure 4-9 shows the inundation of the left overbank and center of the marsh in April 2015. Since 2015, beaver activity has increased, with dams occurring on the main and secondary channels, as well as in the overbank.

The large snowmelt hydrograph in 2017 resulted in elevated flows and long duration overbank flooding of the District's easement and several of the manholes on the gravity sewer. The increase in flooding in 2017 appears to be at least partly related to construction of an extensive system of beaver dams on flow paths that would otherwise drain overbank flows to the main channel. The backwater caused by some of these dams led to overbank flows near District's Manhole BV-22, which continued down the lower elevation terrain along the north edge of the meadow and into the easement (Figure 4-8). Figure 4-10, an annotated aerial image, provides approximate beaver dam locations and flow paths in the vicinity of BV- 22 on 11 February 2017. Approximate dam locations and inundation, 13.8 acres as shown in Figure 4-11, illustrate the extent of valley inundation upstream from Bellevue during 2016-2018.

Inundation by beaver activity was a primary cause of flooding in the easement in the fall of 2016 and 2017, and effectively prevents typical maintenance access along the easement. Year 3 improvements were designed to slightly raise ground levels and plant vegetation in areas around the manholes and other low points, but were expected to provide limited benefits against inundation by beaver activity. Maintenance activities in Year 4 were designed to alleviate some of the flooding and temporarily restore channel capacity.

Field observations have indicated that beaver activity continued into fall 2020 (see Figure 4-12). Mapping of beaver dams and flow paths indicate that flows on the easement are due to overbank flows that originate around BV-22 (Figure 4-13). In addition, reconnaissance of the secondary channel in the center of the marsh (historical main channel location prior to 1969) in 2020 and 2021 indicates the presence of several beaver dams across the channel and auxiliary dams along the banks. It is recognized that beaver activity will likely continue inundating the easement and a more comprehensive solution to inundation is still needed.

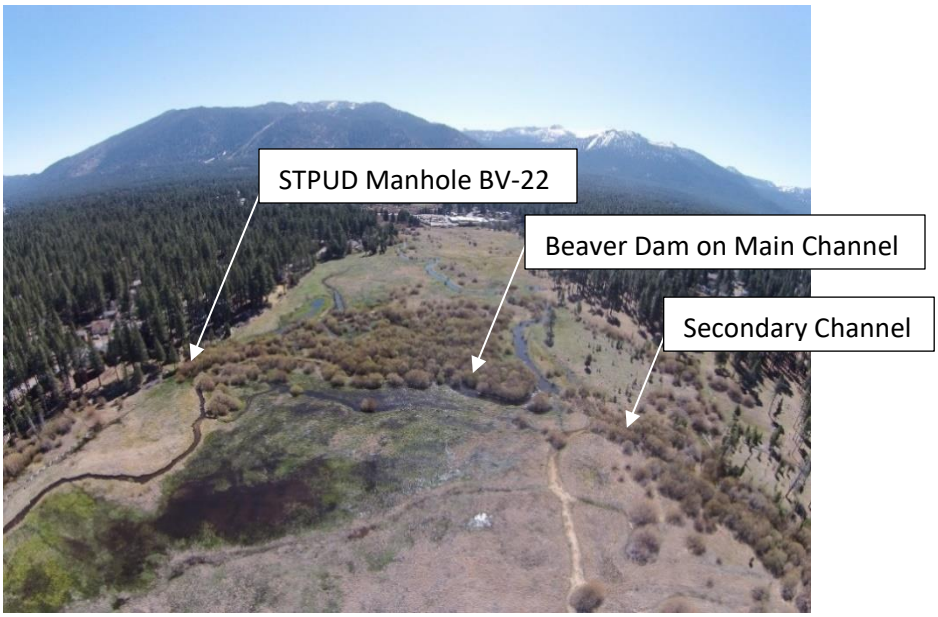


Figure 4-9. Inundation of meadow at low flow (approximately 25 cfs) due to beaver activity, as mapped in April 2015.

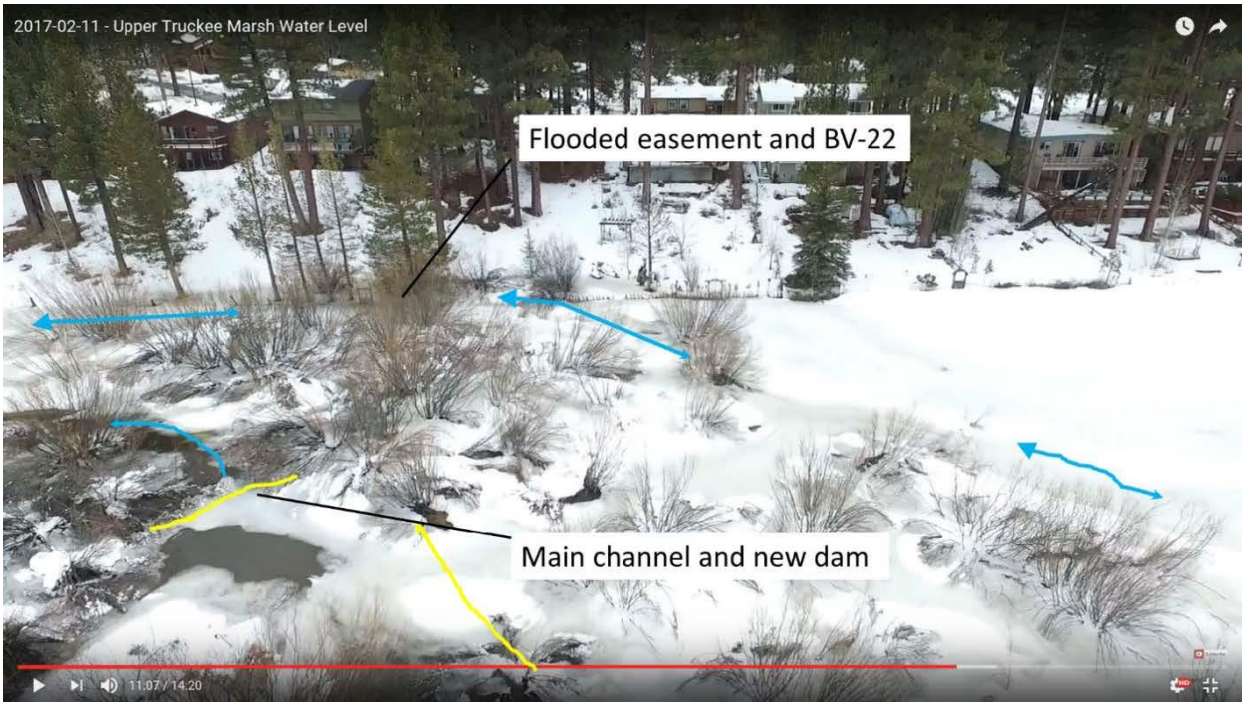


Figure 4-10. Aerial photo showing beaver dam locations and flow paths, February 2017. Yellow lines indicate dam locations and blue lines indicate flow paths.

Legend

- 2016 Inundation Areas
- Overbank flow path due to beaver activity, June 2018 (46 cfs at gage)
- 2018 additional ponding areas near easement

California Tahoe Conservancy Parcels

BV-18

BV-19

BV-20

Inundation continues toward Lake Tahoe (disconnected areas)

BV-21

BD#1

BD#2

BV-22

Disconnected inundation areas not delineated in this area

BV-23

BD#5

Beaver Inundation

BD#11
Inundation continues toward Lake Tahoe

Beaver Inundation

Additional beaver dams on secondary channel (2018)

BD#10

Secondary channel filled with sand (2018)

Main channel filled with sand (2018)

Beaver Inundation

Inundation continues toward US50

Note: BD#X calls out a recorded beaver dam from 2016 observations. The five shown on the map act as a primary blockages for flow in or returning to Trout Creek's main and secondary channels. Another seven were recorded as secondary inundation retainment structures and are located along channel banks.

Beaver dam locations and inundation areas observed in 2018 were similar to those shown in 2016, although maintenance activities in June 2017 had cleared the main and secondary channels

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Argonaut Ave
Bellevue Ave
Los Angeles Ave
Berkeley Ave
Fresno Ave
Stanford Ave
Sonoma Ave
Capistrano Ave
Nevada Ave
Paloma Ave
El Dorado Ave
Placer Ave
Tulare Ave
Sacramento Ave
Oakland Ave
Creekwood Dr
Springwood Dr
Mackinaw Rd

SCALE - 1:3,600
0 300 Feet
N

Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree

TMSFPP

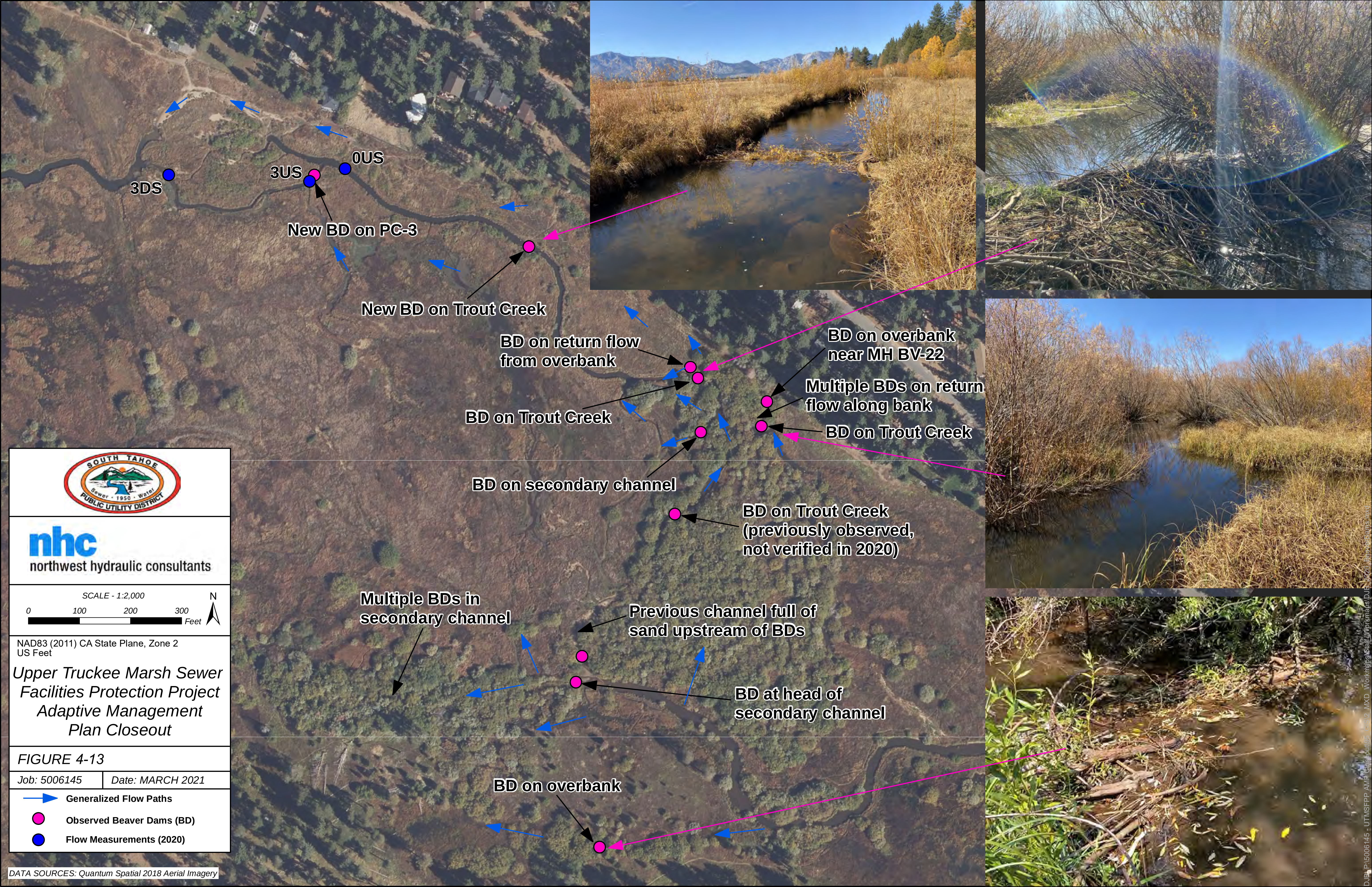
Beaver Related Structure Inundation Extents

FIGURE 4-11

Job: 5006145 | *Date: FEBRUARY 2020*

ABC: P:\600035_Truckee_Marsh\GIS\2_MXD_Workmaps\Report_Figure_Workmaps\AnnualReport2016_Figure4-2.mxd

Figure 4-12. Upstream view of Trout Creek and PC-3 in November 2020; note the beaver dam in the middle of PC-3 and a surveyor for scale.


0US
3US
3DS
New BD on PC-3
New BD on Trout Creek
BD on return flow from overbank
BD on overbank near MH BV-22
Multiple BDs on return flow along bank
BD on Trout Creek
BD on Trout Creek
BD on secondary channel
BD on Trout Creek (previously observed, not verified in 2020)
Multiple BDs in secondary channel
Previous channel full of sand upstream of BDs
BD at head of secondary channel
BD on overbank
SOUTH TAHOE PUBLIC UTILITY DISTRICT
Sewer · 1950 · Water
nhc
northwest hydraulic consultants
SCALE - 1:2,000
0 100 200 300 Feet
N
NAD83 (2011) CA State Plane, Zone 2
US Feet
Upper Truckee Marsh Sewer Facilities Protection Project Adaptive Management Plan Closeout
FIGURE 4-13
Job: 5006145
Date: MARCH 2021
Generalized Flow Paths
Observed Beaver Dams (BD)
Flow Measurements (2020)
DATA SOURCES: Quantum Spatial 2018 Aerial Imagery

4.6 Flow Estimates

Flow estimates on PC-3 and on Trout Creek upstream of PC-3 were made during field observations on 5 November 2020. The flow measurements were made using a Sontek Flow Tracker handheld acoustic doppler velocity probe and top-setting wading rod. Table 4-3 summarizes the flow data collected. At the time of the flow measurements on the site, flow was recorded to be approximately 10.5 cfs at USGS Gage 10336780, upstream on Trout Creek.

Flow in PC-3 near the downstream outlet to the Trout Creek channel was 7 to 7.5 cubic feet per second (cfs) and flow at the upstream end of PC-3 was about 3.5 cfs. Very low to no flow was observed in PC-1 and PC-2, and concentrated inflow below the PC-3 flow measurement was not observed. Some inflow may have been occurring in a side channel near the head of PC-3, which was observed to be inundated but no velocity was evident. Additional flow may have been entering through seepage and minor inflows from both the left and right banks of PC-3. Flow in Trout Creek upstream of the PC-3 diversion was measured at approximately 4.5 cfs. A small amount of flow was observed returning to the channel from the right overbank near Bellevue Pump Station. This flow was too shallow to measure and was estimated to be less than 0.5 cfs.

Comparison of the field flow observations on November 5 and the flow at USGS Gage 10336780 indicates that only approximately one third of the upstream flow was occurring through the Trout Creek channel along the north side of the marsh in the project area. Figure 4-13 qualitatively illustrates flow patterns and distribution of flows to the overbanks upstream of the project based on field observations. Overbank flows were largely due to the influence of beaver dams, including infilling of the channel behind beaver dams where it crosses the marsh from south to north, as described below.

Table 4-3. Flow measurements on 5 November 2020.

Site ID	Location	Flow Area, sf	Wetted Perimeter, ft	Core Velocity, ft/s	Discharge, cfs	Estimated Uncertainty, IVO (FT software)
3DS	Appox. 50’ upstream of PC-3 return confluence with Trout Creek	4.78	9.98	1.5-2.0	7.77	6%
3DS	Appox. 50’ upstream of PC-3 return confluence with Trout Creek (repeat)	5.42	9.97	1.5-2.0	6.91	6%
3US	Downstream of beaver dam on PC-3, approx. 40’ downstream of Trout Creek	8.14	7.91	0.4-0.7	3.45	9%
0US	Trout Creek upstream of PC-3	31.56	19.5	0.15-0.2	4.52	6%

Notes:

1. Flows were measured using a Sontek FlowTracker2 hand-held acoustic doppler probe with top setting wading rod and dividing the stream cross section into segments of width perpendicular to flow direction. Depth and velocity are measured at each segment and integrated to compute flow area and total flow.
2. The Flow Tracker software also computes wetted perimeter and measurement uncertainty based on the variation of instantaneous velocities and flow direction detected over a measurement period of approximately one minute.
3. Core velocities shown are based on the velocity measurements in the central stream segments, disregarding margins where shallow depth, bank irregularities, and overhanging vegetation produce low velocities. Core velocities may be a better indication of sediment transport capability than cross section average velocity in some cross sections.

4.7 Yearly Summary

4.7.1 Year 2 (2015)

Following Year 1 construction, the District surveyed the work area near Bellevue Avenue and the head of the secondary channel in the center of the meadow, including resurvey of the fourteen cross sections established in the Bellevue Avenue work area by the baseline survey, establishment of seven monumented cross sections on the pilot channels, and general topography and eight cross sections along the secondary channel (historical main channel alignment) in the center of the marsh. Comparison of the 2013 and 2014 surveys indicated little change in the extent of overbank flooding in the sewer easement area near Bellevue Avenue but confirmed increased left overbank flow paths associated with the pilot channels.

Pilot channel flows were measured on 2 February 2015. Right overbank flows in the easement area were too shallow to measure on this date and were estimated to be less than 1 cfs. The mean daily flow at USGS Gage 10336780 for 2 February was approximately 11 cfs. A site visit on 12 February 2015 followed a small peak in runoff of approximately 60 cfs (annual peak for 2013/2014 water year). On 12 February, the flow at USGS Gage 10336780 was approximately 18 cfs. On this date, it was estimated that approximately 75 percent of the flow was passing through the pilot channels and left overbank and 25 percent through the right overbank/easement. These measurements indicate that although the extent of inundation was changed only slightly following Year 1 construction, flow through the easement was significantly reduced. The relative distribution of flows to the pilot channels was higher at lower flows (up to 90%), and lower at higher flows. This was because the area near Hummocks 4 (H-4) and 5 (H-5) in Year 1 construction function as a weir – at higher flows, distribution to the right overbank increases relatively rapidly as the stage on the weir increases. Flows were measured again prior to Year 2 construction on 20 August 2015 with a flow of 8 cfs at USGS Gage 10336780. Approximately 4 cfs was estimated to be passing through the three pilot channels with less than one cfs on the right overbank. These results indicate that the pilot channels serve to divert low flows, but natural enlargement of the pilot channels (as envisioned in the AMP) would be necessary to achieve the desired reduction of flows in the easement.

Pilot channels were observed periodically after construction and minor local scour was observed between November and May 2015. However, no significant increase in pilot channel size was observed and bed materials were observed to be cohesive and resistant to erosion, although relatively high velocities (2-4 fps) were observed in the downstream portions of the channels. In some areas, remaining root mass from vegetation appeared to contribute to stability. In August 2015, PCXS3, PCX6, and PCXS7 were measured as part of flow measurements. These measurements indicated no expansion in pilot channel area and observations between May and August indicated a trend for reduction in effective flow area due to vigorous growth of vegetation on the pilot channel banks. A profile survey was also conducted for the pilot channels which indicated no general increase in depth or changes in slope since construction.

The pressure transducers continued to operate following Year 1 construction and the data indicate that water levels at the middle and upper stations on Trout Creek have remained relatively constant since the baseline period. The lower station was below the channel avulsion area and stages vary more with

flow than for the other two stations. Groundwater levels remained relatively constant with a slight increase during the spring that may correlate to to seasonal changes in groundwater recharge and lake level elevation. In the data collected to date, groundwater levels were not well correlated to stream stage and were below the stream levels. This suggests that Trout Creek may be a losing ("influent") stream along its reach near the Bellevue Pump Station.

Planted vegetation was surveyed in July 2015 by Western Botanical Services. Herbaceous vegetation was monitored on the six transects established for baseline conditions on the road fill removal and hummock areas. Vegetative cover averaged 96% in the road fill removal area transects and 34% in the hummock transects. Vegetative cover by native species, primarily native perennial graminoids, was greater than 90% of vegetative cover for both locations and vigor was very good to excellent.

The performance standard for herbaceous vegetation established in the AMP is 70 percent of baseline cover after 2 years; 90 percent of baseline after three years; and vigor comparable to surrounding marsh areas. The data for the road fill removal area indicate that the performance standards were met in Year 1. The performance standards were not met in the hummock transects (Transect 2 and 3), where baseline vegetative cover averaged about 80% among the three transects. The pre-planted marsh mats for Year 1 were delivered with much lower-than-expected vegetative growth due to a combination of shipping, weather, and construction timing problems. The revegetation monitoring report notes that, in spite of the planting problems, the hummocks were growing well and were expected to meet cover standards over time.

Willow stake counts were made for the willow sausal and the willow fences. Survival was 13% for the willow sausal and 40% for the willow fence, not meeting the performance standard of 80% survival. The vegetation monitoring report attributes the low success to improper planting methods, but notes that the survival rate was sufficient for the features to serve their intended function if the material continues to grow.

Turbidity measurements in the period following construction and through the subsequent snowmelt season were intended to provide a means for assessing whether channel development was proceeding too rapidly or erosion was occurring as a result of project features. As noted above, pilot channel development did not progress as rapidly as expected, and project features were visually observed to be stable during the highest seasonal flows in February 2015. The turbidity measurements upstream and downstream of the work area near Bellevue Avenue for the period during and after Year 1 construction through June 2015 show turbidity levels to be similar at the two stations and to generally be less than about 5 NTUs.

Photos were collected at photo points identified in the AMP and are included in Appendix B of this report. Additional ground photos were collected to document conditions, and these were previously provided. In addition to ground photos, the District collected aerial views of the work area on 24 Oct 2014 and 17 Apr 2015 using a small unmanned aerial vehicle (UAV). The additional ground photos and UAV photos are available from the District's files on request.

In February 2015, shortly after construction, beaver activity was observed upstream of the Bellevue Avenue work area in portions of the stream where beavers had not previously been present. A primary

dam was noted in the main channel of Trout Creek just downstream of the location of the secondary channel in the center of the meadow, and several auxiliary dams were noted blocking flow from returning. Widespread flooding of the meadow resulted at very low flows through this area upstream (south) of the Bellevue project area, impinging on the District's utility easement through the meadow, east of the main beaver dam.

4.7.2 Year 3 (2016)

Pre-construction monitoring included surveys for avian species, establishment of a buffer for the single mourning dove nest site identified, and rescue and relocation of fish (speckled dace and brown trout) in the work area. Water level and turbidity monitoring continued through the construction period and showed occasional turbidity in excess of 20 NTUs during the construction period, but no prolonged periods of elevated turbidity. The large deviations of these individual measurements from the trend of the data indicate that they may be local disturbance spikes (e.g., humans or animals crossing the channel). These data indicate that the performance standard for sediment discharge and turbidity was met during construction.

Post-construction monitoring included resurveying established cross sections and topographic mapping, continued water level and turbidity measurements, and revegetation monitoring. The surveying in October 2015 showed little change in topography (refer to Appendix C for cross section), although recent deposition was evident in some areas of the project features. Changes in channel geometry were primarily associated with constructed expansion of the pilot channels, indicating that the project area continued to be stable (as can be seen in Figure 4-14).

Flow measurements in the pilot channels and right overbank indicate an increase in the capacity of the pilot channel system and a reduction in right overbank flows during moderate flow events. Combined flows in the pilot channels near Bellevue were estimated at approximately 25 cfs in April 2016, with approximately 8.5 cfs on the right overbank. In the area near Bellevue Avenue, flows in the right overbank were primarily located along the outboard edge of the hummocks, and little or no flow occurs in the sewer easement in this area at flows up to about 35 cfs. During this site observation, flows in Trout Creek (measured at 42 cfs at USGS Gage 10336780 upstream of the project area) were out of bank both upstream and downstream of the project work area. The total pilot channel capacity of 25 cfs was estimated to be close to the existing Trout Creek channel capacity upstream of the Bellevue work area. In addition to higher flow capacity, active bed load transport and bed form development (scour, ripples, dunes) were evident for bed load material comprised of sand and small gravel. The main pilot channel beds were observed to have little vegetative growth and were characterized by sand in gradual transport along the bed. The peak flow during WY 2016 at USGS Gage 10336780 was approximately 130 cfs. Deposition of sand in overbanks along the pilot channel system and on the hummocks were noted during site observations conducted in August 2016, and are visible in aerial imagery from November 2016 (Figure 4-15). Water level and turbidity measurements continued post-construction. Measurements from turbidimeters upstream and downstream of the Bellevue work area showed that that turbidity levels were not substantially affected by the project area, indicating that the work area was not a significant source of fine sediment during higher flow periods.

Despite increased capacity in the pilot channel system and reduction of overbank flows near Bellevue Avenue, inundation of the sewer easement during relatively low flows persisted upstream of the Bellevue work area. This was primarily attributed to beaver activities in the segment of channel that runs perpendicular to the dominant meadow slope about 1,300 feet upstream of Bellevue Avenue. Stream flows that were pushed overbank by a beaver dam in the main channel were prevented from returning to the channel by a number of auxiliary dams on the return flow paths, and a portion of this flow continues down the right overbank in the District's easement, which was also the location of a pedestrian trail.

In late October 2016 the District installed a Pond Leveler (beaver dam flow maintenance device) at the head of the secondary channel in the center of the marsh was installed to maintain flows through the channel. A compact excavator was used for installation, otherwise all other construction was completed using hand-tools.

Vegetation transects performed in Year 1 on hummocks were repeated in Year 2 monitoring (2016). The three transects all showed an increase in total and native vegetation cover. The average of the three transects met the performance standard for establishment of cover at 85% of baseline cover in Year 2. The standard for 90% of cover by native species, primarily Nebraska sedge (*Carex nebrascensis*), was not quite achieved in Year 2, but native cover increased for Year 2 and was expected to be achieved in Year 3 without any additional planting. Vigor was rated as good to excellent for the plantings.

Figure 4-14. Upstream of Bellevue work area looking west, 14 Nov 2016 (with pilot channels diverting flow to left). District utility easement was inundated in area of BV-18 within overbank area right of the main channel of Trout Creek.

Figure 4-15. Easement and avulsed channel area looking west, 14 Nov 2016 (hummocks in easement along fence on right side of photo).

4.7.3 Year 4 (2017)

The 2017 water year was an exceptionally high water year in terms of peaks flows, late summer flow duration, and annual runoff volume. Winter-time peaks of 409 cfs and 483 cfs occurred on January 9 and February 9, respectively, at USGS Gage 10336780 near Tahoe Valley upstream of the site. Flows remained at or above 100 cfs for almost four months in April-July and the recession limb of the annual hydrograph never descended below about 28 cfs in late October. The channel capacity prior to the 2011 avulsion was believed to range between 25 and 50 cfs. The USGS reported average annual flow was 112 cfs, the largest in the historical record, exceeding even other large water years such as 1997 and 2011 by at least 50 percent. No calculations have been performed for sediment transport for the year, but flow characteristics suggest that WY 2017 was likely one of the largest years, and possibly the largest year, on record for transport of sediment. Due to the long duration of flows in excess of the channel capacity and the influence of beaver activity, much of the marsh, including the right overbank near Bellevue Avenue, remained inundated through the summer and fall months.

No significant topographic or channel changes were made in Year 3 construction, and topographic monitoring was limited to measurement of pilot channel geometry and visual observations. Visual observations in the Bellevue Avenue in August and October 2017 indicated that sediment had accumulated in the vicinity of the coir logs placed in Year 2 construction and the active portion of the overbank flow had narrowed due to increased vegetation. Minor accumulation of sediment was also noted in the hummocks placed in Year 1 and 2 construction, especially deposition of sand at Hummock

3. During the snowmelt period, the District implemented a management measure to encourage flow into the upstream end of one of the pilot channels (Pilot Channel 3, PC-3) for the purpose of encouraging further natural development of pilot channel capacity (Figure 4-16 and Figure 4-17). Pilot channels were observed in March, August, and October 2017. In March, all of the pilot channels were flowing over their banks and sand deposits were noted in several areas due to overflow of the channels in vegetated areas (Figure 4-17). Approximately 30 cfs was estimated to be passing through the pilot channel system, with 10-15 cfs on the right overbank. In August, approximately 25 cfs was estimated to be passing through the pilot channel system with about 3 cfs on the right overbank. Flows were generally contained in the channel banks. In October, flows in the pilot channel system were estimated at about 15 cfs with almost no flow in the right overbank. Flows at the USGS gage upstream of the site were about 85, 75, and 30 cfs for the March, August, and October observation dates, respectively.

Pilot Channel 3 was observed to carry the majority of the flow in all three observations. Measurements of the pilot channel geometry indicated that the outlet channel for the pilot channel system and Pilot Channel 3 expanded slightly in width and in depth since Year 2 measurements. Pilot Channels 1 and 2 remained active, but were not increasing in capacity.

Despite increased capacity in PC-3, inundation of the overbank area continued through the fall of 2017. This inundation can partly be attributed to higher than normal flows and overflow of the main channel upstream of Bellevue Avenue due to beaver dams in the main channel. In addition to higher flow capacity, active bed load transport and bed form development (scour, ripples, dunes) were evident in the pilot channel system. The main pilot channel beds were observed to have little vegetative growth and were observed to have sand in transport along the bed.

The pressure transducers installed at the beginning of the project continued to operate following Year 3 construction. The water levels are intended to supplement observations on easement inundation and pilot channel performance in conjunction with survey data. The water level data for 2016 and 2017 appear to have some inaccuracies which may be attributed to overpressure of the pressure transducers during ice build-up in Trout Creek. Manual measurements were used to identify potential problems with the sensors and verify collected data. Stages recorded at the pressure sensors varied 1.5 to 2 feet.

Vegetation replanted on the road fill removal area and planted in the hummocks was surveyed in September 2015 by Western Botanical Services and results were reported in the 2015 Annual Report (NHC, 2015). Vegetation on the road fill removal met success criteria in the first year and has not been resurveyed, but was observed in 2016 to be in good condition with nearly 100% cover. Hummock transects surveyed in 2015 were resurveyed in 2016, and results showed that percent cover criteria were met and native plant criteria were nearly met. The 2016 annual report noted that native cover criteria were expected to be met in the following year, but inundation during the summer prevented resurveying the transects. Similarly, vegetation planted in Year 3 could not be accurately observed or surveyed. In observations from previous years, lowest establishment rates were associated with areas that had long inundation.

Turbidity measurements continued to be made upstream and downstream of the work area near Bellevue Avenue for Years 3 and 4. There were considerable gaps in operation of the turbidity sondes, and the available records generally do not correspond to periods of project activity. Both Year 3 and

Year 4 records show periods of spikes in downstream turbidity but the cause of these increases was unknown and they do not correspond to dates of project activity. One purpose of the turbidity monitoring was to determine if the project activities from the previous year increase turbidity during high runoff periods, the observed spikes were not consistent with a general increase in erosion or sediment transport in the pilot channels. Outside of the periods with spikes in downstream turbidity, the plots do not show a general increase in turbidity from upstream to downstream and may be more indicative of a decrease in turbidity from upstream to downstream under typical conditions. The turbidimeter equipment was repaired by the District for re-deployment in fall 2017.

Beaver activity upstream of the Bellevue work area increased in 2017, resulting in long duration overbank flooding of the District's easement and several of the manholes on the gravity sewer. The increase in flooding in 2017 appears to be related to construction of an extensive system of auxiliary beaver dams on flow paths that would otherwise return overbank flows to the main channel. The blockage of these return flows causes overbank flows near the District's Manhole BV-22 to continue down the right overbank and flood other manholes in the easement. Several areas of ponded water were evident in this area in August 2017, including areas near Manholes 18, 19, 21, and 22. Beaver activity in the main channel resulted in sediment deposition in the main channel upstream and at the location of the Pond Leveler installed in October 2016. Sediment deposition upstream of the pond leveler reduced main channel capacity and increases left and right overbank flows. Right overbank flows generally accumulated near the District's manhole BV-22 because auxiliary beaver dams along the banks of the channel limit flows from re-entering the main channel. A second dam on the main channel was also noted in 2017, close to BV-22.

Inundation by beaver activity was a primary cause of flooding in the easement in the fall of 2016 and 2017, and effectively prevents typical maintenance access along the easement. Year 3 improvements were designed to slightly raise ground levels and plant vegetation in areas around the manholes and other low points, but were expected to provide limited benefits against inundation by beaver activity.

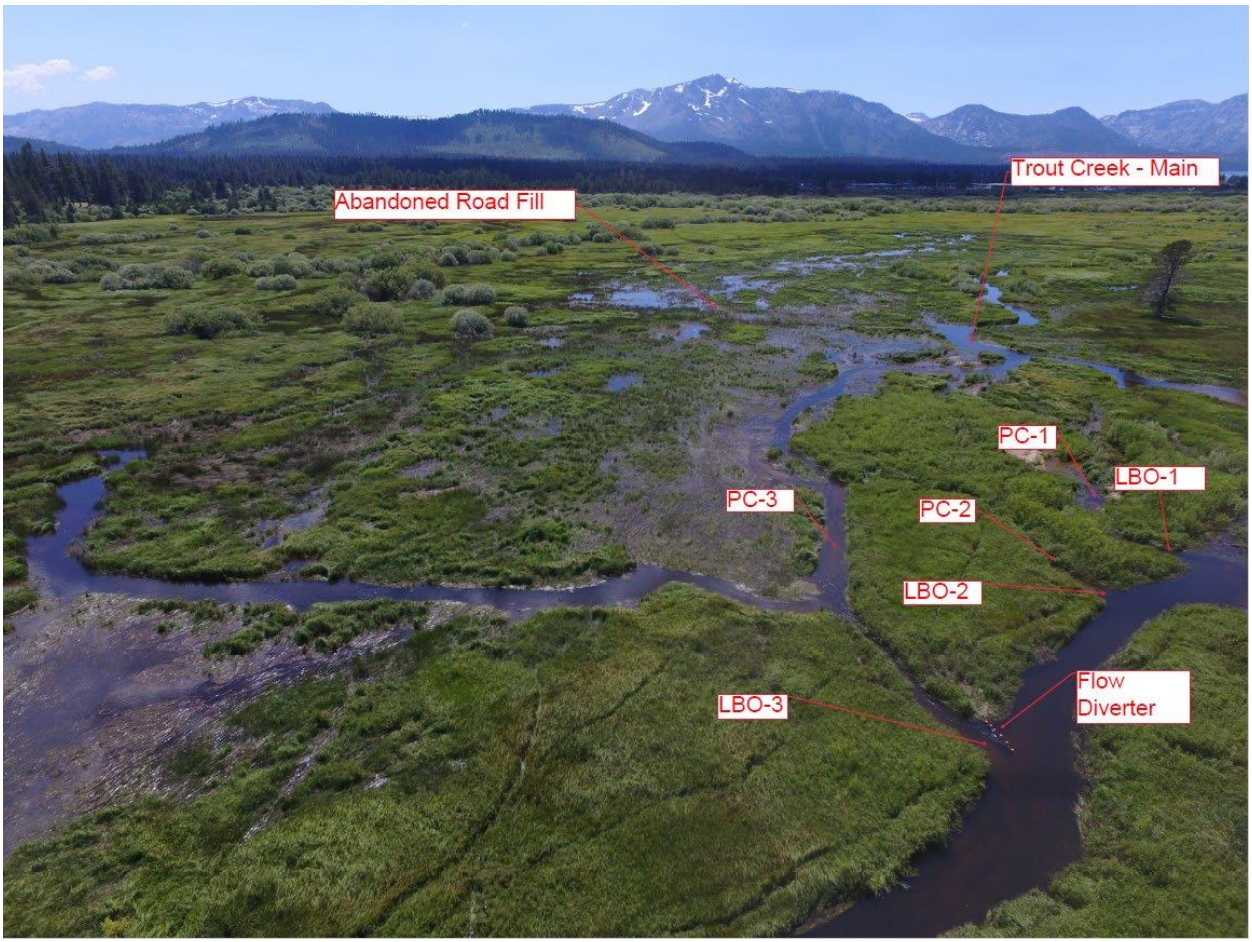


Figure 4-16. Annotated aerial imagery looking downstream across project site, photo taken 28 July 2017 (STPUD image).

Figure 4-17. Annotated aerial imagery looking south across project site, photo taken 28 July 2017 (STPUD image).

4.7.4 Year 5 (2018)

A field review of conditions was conducted in June 2018 and pilot channels were found to generally be operating as expected, with an estimated 30 cfs passing through the system. A flow of approximately 47 cfs was recorded at USGS Gage 10336780 at the time of the field visit. A small flow of less than 1 cfs was estimated in the right overbank near Bellevue with only a fraction of that amount in the easement area. Gradient through the pilot channel system remains higher than the average gradient for the adjacent stream reaches, indicating that some incision and increase in capacity in the pilot channels may occur over time. Upstream of the Bellevue area, inundation on the right overbank and in the District's easement persisted although the creek channel was flowing at or below bankfull in some areas. The inundation was likely due to a combination of hydraulic control at the pilot channels and beaver activity. Hydraulic controls at the pilot channels were related to the size of the channels and inlet conditions. Although Pilot Channel 3 continues to slowly enlarge, the other two pilot channels have relatively low capacity due to a combination of channel size and vegetative growth. The combined capacity of the pilot channels remains less than the upstream main channel, resulting in backwater effects. Stages near

bankfull in the main channel were slightly higher than ground elevations in some areas of the District's easement (i.e., channel was slightly perched), and thus ponding in these areas appears to persist well after overbank flow ceases. Overbank flows at higher discharges earlier in the year and a water table near the surface of the marsh result in ponding and very low flows in and through topographic depressions. Flows on the right overbank were directly influenced by beaver activity near and upstream of BV-22.

4.7.5 Year 6 (2019)

Reconnaissance of the site was conducted on 24 June 2019 (flow of about 150 cfs at USGS 10336780) and 9 August 2019 (flow of about 38 cfs at USGS 10336780), but no field measurements or specific site observations were made in Year 5 (2019). General observations from June included very wet conditions in the marsh in general and wet conditions and some flow through the easement near Bellevue. Nearly continuous inundation and flow was observed along the northern margin of the marsh between Bellevue Avenue and Manhole BV-22, including flow on private property adjacent to the marsh. In August, wet conditions persisted in the easement but overbank flow near Bellevue Avenue was primarily through the swale just south of the easement.

4.7.6 Year 7 (2020)

In November 2020, NHC staff resurveyed cross sections, collected repeat photographs and flow measurements, and made general monitoring observations of the Bellevue site per the monitoring plan (Table 4-1). Initial impressions included increased vegetative growth (willow and herbaceous; Figure 4-18) and an almost completely inundated easement (Figure 4-19). The vegetation monitoring summary (Appendix D) indicates that vegetation establishment has been successful in the abandoned road fill and the AMP features. Northwest Territory sedge (*Carex utrichulata*) dominate much of the area and planted willow stakes (noted in 2015 monitoring to not meet construction performance requirements) are now 5 to 8 feet tall. The WSEs in the easement were generally about one foot higher than the WSEs along the primary flow path down Trout Creek and PC-3 (Figure 4-20). The primary source of water in the easement flows from upstream, where water is spilling onto the floodplain near BV-22, which is in part due to the network of primary and secondary beaver dams upstream of the Bellevue project area. Given the elevated groundwater levels since 2017, it is possible that some of the water on the easement comes from seepage into the marsh from adjacent upland areas, as anecdotally suggested by the water level being higher at MW-4 than the adjacent downstream water level at TC 001, and in some cases higher than the mid-stream water level at TC 002 (Figure 4-2). The water entering the overbank makes its way downstream through the easement until it reaches the previous Trout Creek alignment and flows back into Trout Creek (refer to Figure 4-13). The 2018 LiDAR micro-dendritic pattern of flow paths in the overbank as opposed to the 2010 LiDAR, which perhaps suggests that flows are being concentrated along the easement (Figure 4-8), however, significant concentration of flows was not observed in the field.

Review of the survey data (Appendix C) and a comparison of the 2010 LiDAR with the more recent 2018 LiDAR (Figure 4-8), it appears that minimal aggradation has occurred along the near-channel overbank (i.e., levee deposits). Elevation changes are noted along Trout Creek at CTC XS-9 and CTC XS-10 and along the pilot channels at TRANSECT STPUD 6, CTC XS-10, and TRANSECT STPUD 5. Additional

deposition can be noted in the far overbank at CTC XS-11, TRANSECT STPUD 3, and TRANSECT STPUD 3. Deposition is generally on the order of 0.1-0.2 feet. Part of this increase in elevation can be attributed to the AMP activities (e.g., placement of coir logs, wetland plugs and hummocks, and marsh mats), while some increase in elevation may be attributed to deposition caused by the increased roughness of the overbank. This suggests that the AMP activities are performing as expected, albeit the process of aggrading enough sediment to alleviate flooding on the easement is slow. An effect of the higher near-channel terrain is that water flowing down the easement is essentially trapped until it reaches the low point near the Bellevue pump station. Over the previous few years, it is noted that the main Trout Creek and PC-3 have enlarged. Infilling has occurred in PC-1 and PC-2, which was initially considered a possibility. At the time of this field visit there was a beaver dam located on PC-3. At the conception of the AMP, beavers were not anticipated to be an influence that the AMP would have to address.

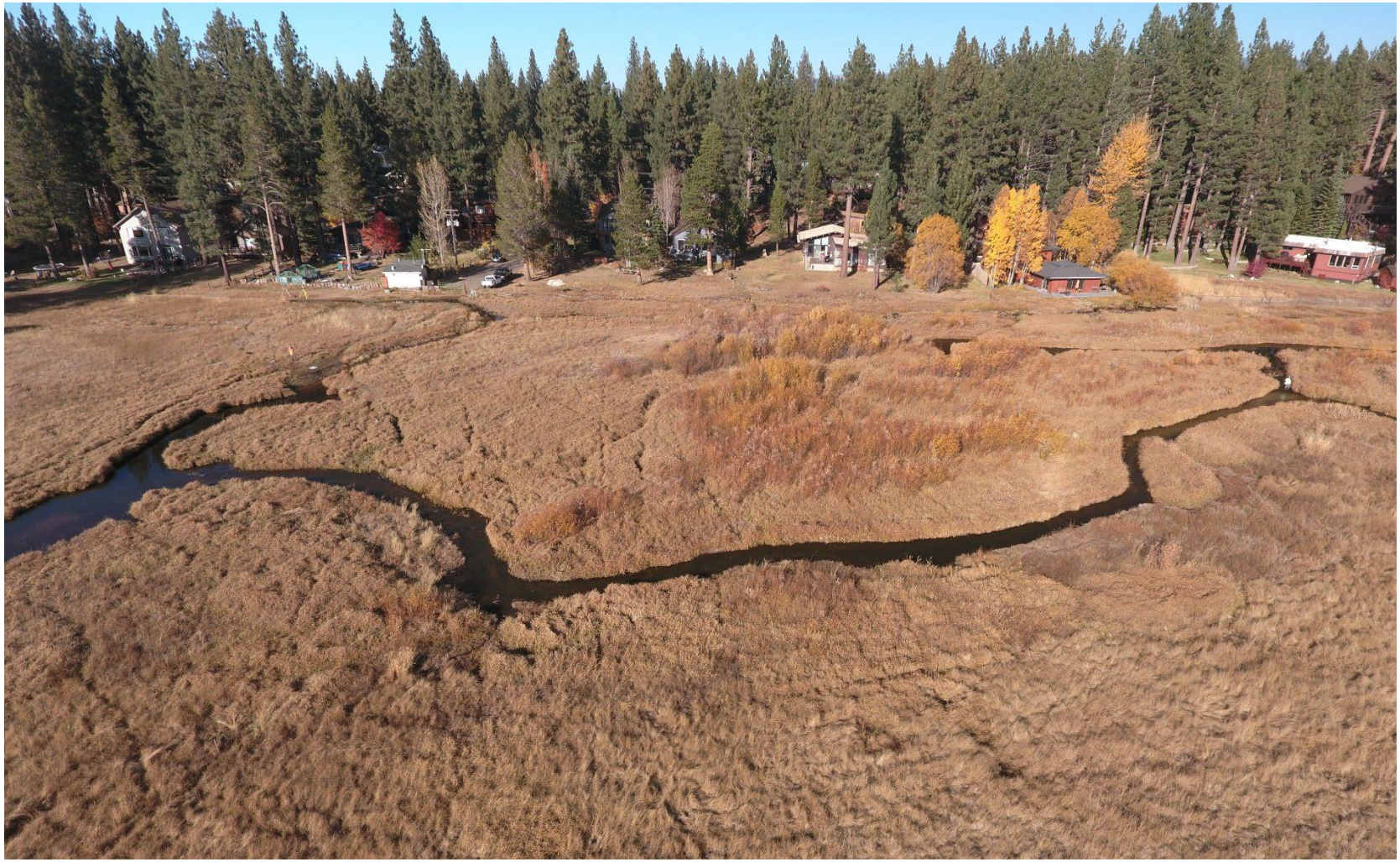


Figure 4-18. Oblique aerial image looking north across the project site, photo taken 5 November 2020.

2020 WSE (elevations in feet)

Transects

Approx. Open Water

Approx. Inundated Overbank

DATA SOURCES:
2020 nhc survey;
2018 Quantum Spatial Aerial Imagery
ESRI Cities, Roads, and Waterbodies, 2012.

SCALE - 1:600

0 20 40 60 80 Feet

N

NAD 1983 (2011) CA SPC Zone 2
Unit: Foot US

Job: 5006145

Date: FEBRUARY 2021

FIGURE 4-19

TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT

FALL 2020 INUNDATION

nhc
northwest hydraulic consultants

DJB, P:\5006145 - UTM\SFPP AMP Closeout\95_GIS\2_MXD_Workmaps\Staff_Workmaps\DJB_Flood_Inundation.mxd

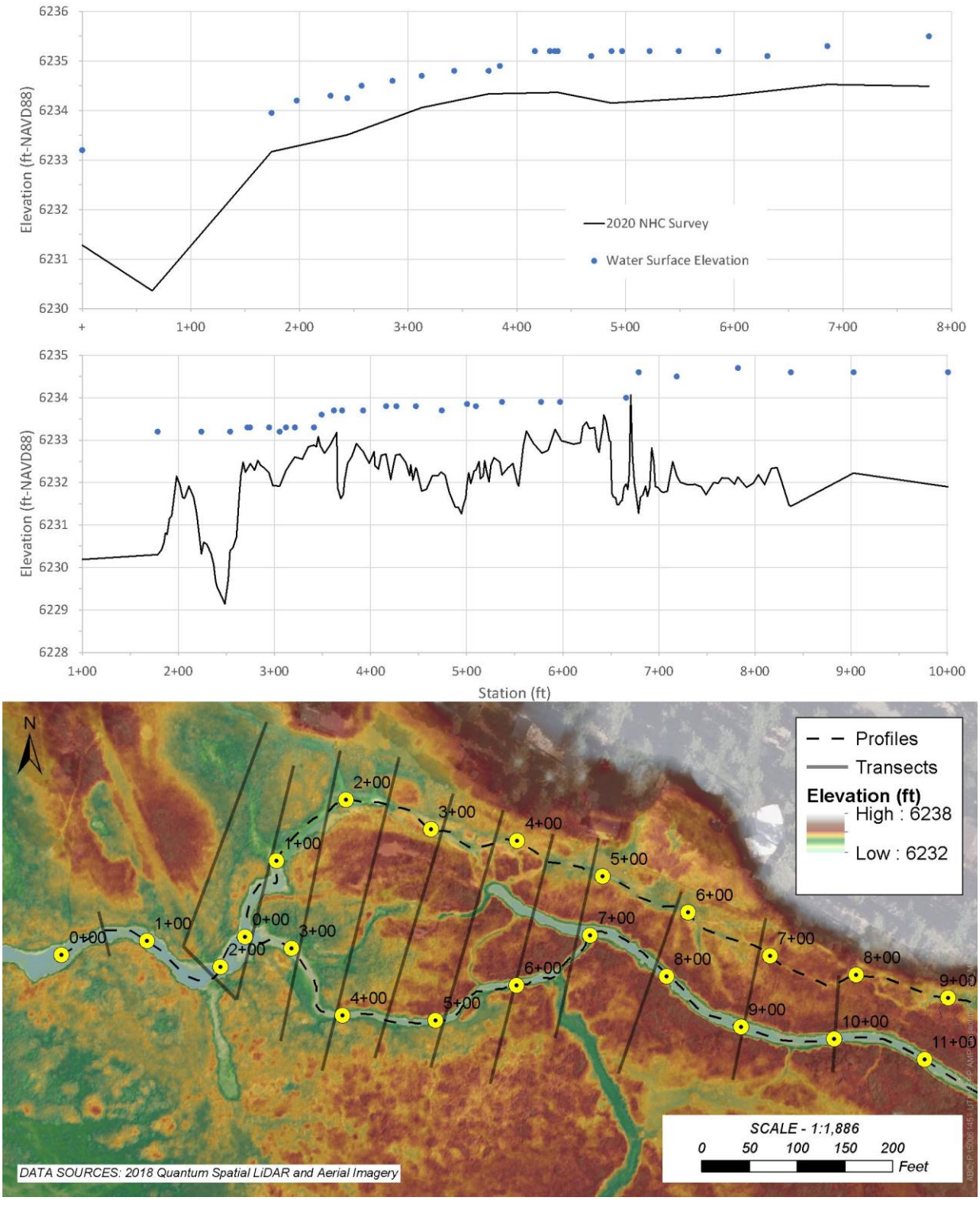


Figure 4-20. Longitudinal profile and water surface elevation comparison between the easement (top) and in-channel thalweg (middle), as surveyed in 2020. The bottom shows the location and stationing of the profiles above.

5 SUMMARY OF AMP EFFECTIVENESS

5.1 Channel Avulsion

The 2011 channel avulsion area near Bellevue has been revegetated and raised slightly through a combination of hummock installation and deposition in the easement area, with an overbank flow channel remaining just south of the easement. At the beginning of the AMP period the left branch of the main flow path was directly over the utility easement, preventing access to sewer manholes. Sewer force and gravity main pipelines lying within the easement were also believed to be threatened by erosion and potential channel incision. The immediate threat to the pipelines that existed at the start of the AMP has thus been mitigated, however, persistent inundation of the easement is still inhibiting District crew access to BV-18, BV-19, BV-21 and BV-22. The flow path established by PC-3 to encourage main channel flows from Trout Creek toward the center of the marsh has persisted and enlarged since construction in 2014 and 2015. Due to the low topography along the northern margin of the marsh, the easement area remains a flow path during higher flows. Flow is increased along this path during lower streamflows by beaver activity in the section of channel that crosses the marsh from south to north and near the bend back to the left along the northern margin of the marsh near Manhole BV-22.

Low gradient channels in marsh and deltaic settings naturally produce topographic conditions with channel banks slightly above the adjacent ground due to deposition as the flow passes overbank (i.e., levee and crevasse-splay deposition), and they are also prone to avulsion and lateral adjustment. The Trout Creek channel in the project area has avulsed at least twice in the last 50 to 80 years, and some risk remains of future avulsion that could threaten the pipelines. Under present conditions, the channel segment that crosses the marsh from south to north (itself the product of an avulsion) has substantially filled-in since 2014 by deposition upstream of beaver dams. Upstream of this channel segment the floodplain has also experienced dense willow growth, likely due to germination in the sand deposits from the avulsion. The highest present risk of avulsion may be upstream of this channel fill on the right overbank where old channel traces are visible and overbank flow is presently occurring at relatively low flows. Avulsion in this direction could form a new channel or reoccupy an old channel very close to the utility easement, just to the southwest of BV-22 and BV-23.

Although avulsion in the right overbank appears probable, qualitative observations in 2019 and 2020 indicate that a large portion of the flow is presently being carried in the left overbank, beginning upstream of the bend to the right across the marsh. This water flows straight along the southern margin of the marsh and disperses into the center of the marsh. An avulsion in this area would not threaten the pipeline or adjacent properties.

It should be noted that although risk of future avulsion is present, the AMP area remained stable in the 2017 water year when two large rain-on-snow events and a record annual runoff occurred. Recent construction of beaver dams in PC-3 and upstream in Trout Creek increase overbank flow, which help attenuate flood impacts and store sediment, but also contributes to the increased potential risk of avulsion. Much uncertainty exists of when and where these changes will happen, and this uncertainty is compounded by the impacts of climate change.

5.2 Vegetation Establishment and Wetland Characteristics

Vegetation monitoring was conducted for 2014 baseline conditions (Western Botanical Services, 2014), following Year 1 construction (Western Botanical Services, 2015) and Year 2 construction (Western Botanical Services, 2016), and are provided in Appendix D. A vegetation monitoring summary for 2020 is also provided in Appendix D. The monitoring summary generally indicates that successful vegetation establishment in the abandoned road fill occurred quickly after construction and establishment in the hummock areas occurred over time. The AMP features are currently well vegetated, with many of the reinforcing features such as marsh mat netting and coir logs no longer visible due to vegetation growth and biodegradation. In addition, the vegetation monitoring summary indicates a shift from some of the planted graminoid species to dominance by Northwest Territory sedge (*Carex utrichulata*), which is adapted to wet conditions and long periods of inundation. The appendix includes a list of 29 species present in the project area in 2020.

Willows planted as part of the project did not initially meet performance standards, but sufficient survival occurred to result in vigorous growth over time, with willows now 5 to 8 feet tall in the limited areas with willow plantings. The easement area was planted with primarily herbaceous species (no willows) at the request of the adjacent property owners, but willows have established on the sandy avulsion deposits near Bellevue Avenue. This may influence future channel behavior but presently appears compatible with the PC-3 flow path.

Vegetation performance monitoring focused on areas planted by the project. Although more general vegetation conditions were not monitored, visual observations indicate significant changes in general marsh conditions over the monitoring period. At the inception of the AMP, herbaceous vegetation was generally lower in height and drier conditions existed in much of the project area (Figure 5-1 top). Current conditions are characterized by widespread inundation of the meadow and vigorous and dense wetland herbaceous vegetation 3 to 4 feet in height (Figure 5-1 bottom). Pedestrian use of the marsh in the project area is notably less due to wet conditions, and trails that were evident early in the period are no longer visible.

Figure 5-1. Easement conditions near Bellevue Avenue in May 2014 (top) and August 2019 (bottom), view looking upstream.

5.3 Easement Inundation

Flow measurements in the project area indicate that only about a third of the flow passing USGS Gage 10336780 is flowing to the project area. Although a reduction in flow might be considered a benefit in reducing potential inundation, the channel flow is associated with overbank flow primarily attributable to beaver activity. While these conditions appear to be contributing to vigorous vegetation growth and general health of the marsh, overbank flow is problematic for access in the District's easement. In particular, beaver activity appears to contribute to right overbank flow near Manhole BV-22, which then remains in the easement downstream to Bellevue Avenue. Although flow rates may be quite low (flow velocity is not evident in most areas of the overbank), a small amount of flow can result in significant inundation in the dense herbaceous vegetation. Return of this flow to the channel when flows recede is impeded by natural deposition (levee deposits) along the channel, and in some cases by beaver dams.

The area of the project where the avulsion occurred and where the most intensive work was conducted near Bellevue Avenue is drier than much of the easement upstream but is still subject to inundation at relatively low flows. Inundation farther upstream prevents the effects of the project near Bellevue Avenue from being effective for conducting pipeline maintenance in the way that it was performed in the past – access along the entire easement was used to access multiple manholes.

5.4 Considerations for Future Management

Conditions in the project area may change as lake levels vary and beaver activity changes. However, inundation of the right overbank by beaver activity is expected to continue and may change in location or severity from time to time. Beaver activity has also caused the main Trout Creek channel to fill with sand near the upstream end of the project area, increasing the probability for a new avulsion and increased overland flow across the Upper Truckee Marsh. The increased water levels in the channels due to beaver activity may also contribute to generally higher groundwater levels, filling topographic depressions in and near the easement. Groundwater may also seep into the margin of the marsh along the easement, especially during wet years or during spring conditions, but inundation due to overbank flooding caused by beaver activity has been regularly observed in the past few years even during relatively low flow conditions in Trout Creek and is considered the dominant source of current inundation in the easement. Inundation during summer and fall months precludes even periodic maintenance that could otherwise be scheduled during the lowest water level conditions. The measures developed in the Adaptive Management Plan did not specifically target this source of inundation and a change in management appears to be needed to ensure access to the sewer line upstream of Bellevue for maintenance.

Several options for addressing the risk of pipeline damage and lack of maintenance access were considered by the District after the 2011 avulsion. These included relocating the sewer lines and raising the easement area. The relocation option would have required extensive collection system and pump station/force main relocations, new construction, and improvements, and may have required residential pumping stations for properties along El Dorado. This option was considered excessively expensive and difficult to implement. Raising the easement was originally considered but not selected by the District due to the size of the potential work area, potential effects on the wetland, probable mitigation requirements, and difficulty in ensuring that areas to the right (north) of the raised area, including

private property, would drain by gravity. A third option of reconstructing the Trout Creek channel in a more favorable location, such as the current location of the secondary channel in the middle of the marsh (close to the historical alignment of the main channel) was considered very complex to permit and implement.

An option that was developed as a contingency plan during implementation of the AMP is to develop access points from the right upland margin of the marsh to specific manholes (i.e, not every manhole would have maintenance access). This option would potentially require crossing a wetland area with planned access routes to specific manholes, and therefore, would likely require small hydraulic structures (mini-bridge, culverts, etc.) to maintain drainage patterns. Routes exist to Manholes BV-19 and BV-20 on property owned by the Tahoe Conservancy that would require minimal grading and little disturbance to vegetation, but another route partially on Conservancy land and partially on private property would shorten the distance of wet meadow that needs to be crossed and would provide access to Manhole BV-21. However, this area is outside the project area defined for the AMP and would require a new planning and permitting process.

Given the AMP facilities in place, a potential future management activity directly related to overbank flooding from beaver activity would be to attempt to improve conditions by promoting drainage of the overbank back to the main channel (see Figure 5-2). The water levels measured in the 2020 survey indicate that some gradient exists between water in the overbank and water levels in the creek, at least in the Bellevue Avenue area. Swales from the overbank through the natural creek levee could help drain the overbank area in low flows, especially if water levels in the channel are managed by recently constructed beaver dams in the project area. This work could feasibly be done by hand crews, although larger and wider swales cut by equipment would be more effective and less prone to blockage by beaver dams. A challenge in cutting larger swales is disposal of excavated materials – access for excavation is relatively simple, but access for hauling equipment requires more intensive measures to protect the marsh vegetation and soils. Potential measures may include low ground pressure (LGP) hauling equipment and locating the swales in areas where the material could be used at the head of the swales near manholes to locally raise the terrain, but not above levels that support typical marsh vegetation. These swales would potentially allow more flow into the right overbank in some flow conditions but would promote drainage during low flows and creek water levels. This activity would also be compatible with the option of developing improved maintenance access from El Dorado Avenue, potentially developing and using the permanent maintenance access route as construction access to the work area. Figure 5-2 shows a conceptual plan for the types of features that could be considered.

The Conservancy has indicated an interest in continuing to engage with the STPUD on evaluating the site conditions and work on developing solutions to ensure STPUD infrastructure is protected. The potential alternative access is not within the AMP project area and any future management of beaver activities would need to consider objectives beyond the District's interests in a drier easement, such as reduction of impacts to private property and potential effects on channel behavior. The AMP does not directly address the topics most relevant to these potential future management actions, and it is recommended that the District close the AMP permit and explore potential cooperative agreements with the Conservancy for any future work within the Upper Truckee Marsh.

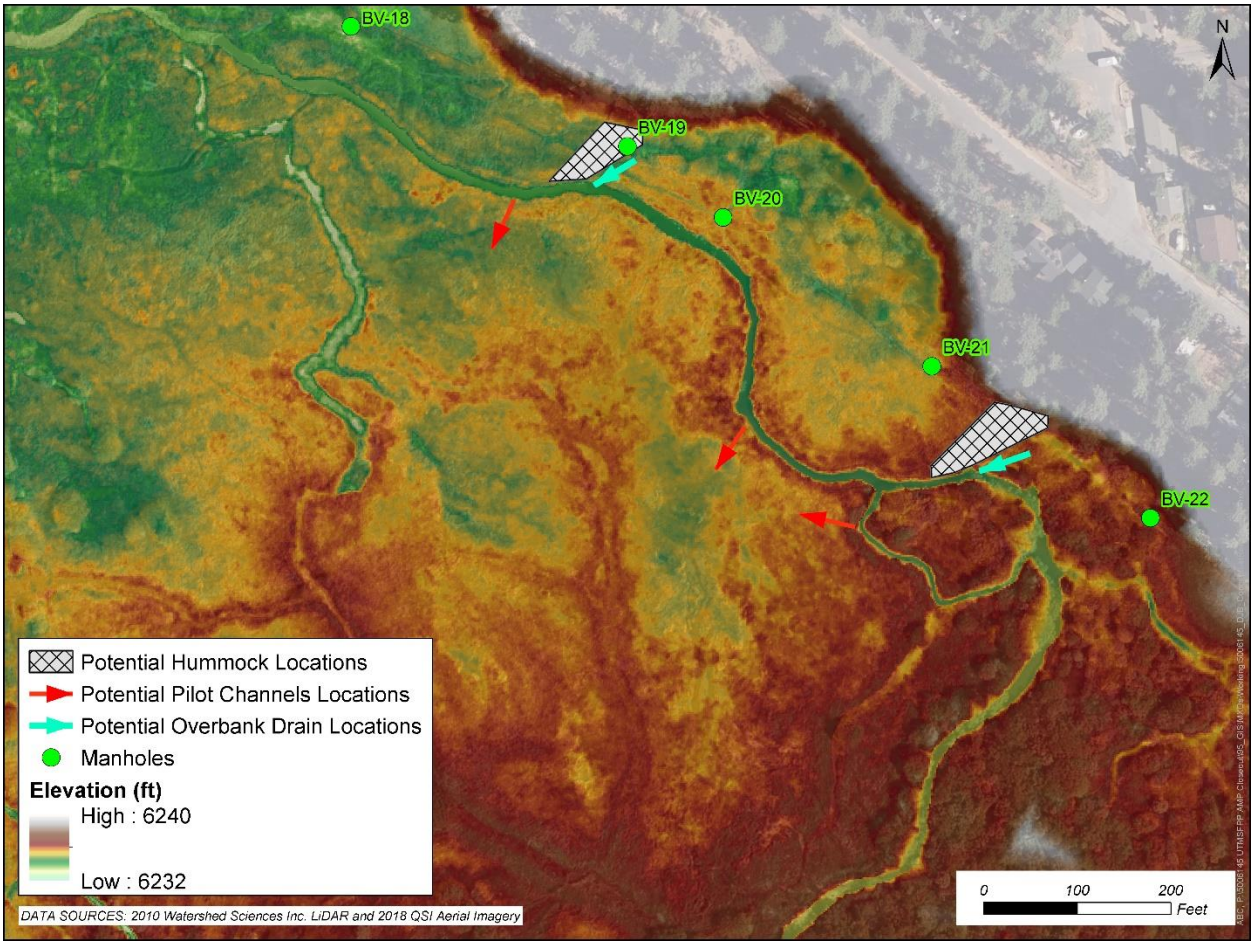


Figure 5-2. Conceptual potential remediation options for alleviating some inundation on the District's easement.

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APPENDIX A

CONSTRUCTION AND MAINTENANCE INFORMATION

SHEET INDEX

South Tahoe Public Utility District

CONSTRUCTION PLANS FOR

Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan - Year 1 Improvements

JANUARY 2014

PROJECT MANAGER

Ivo Bergsohn
South Tahoe Public Utility District
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South Lake Tahoe, California 96150

APPROVED BY:

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xxxxxxxxxxxx, title *(date)*

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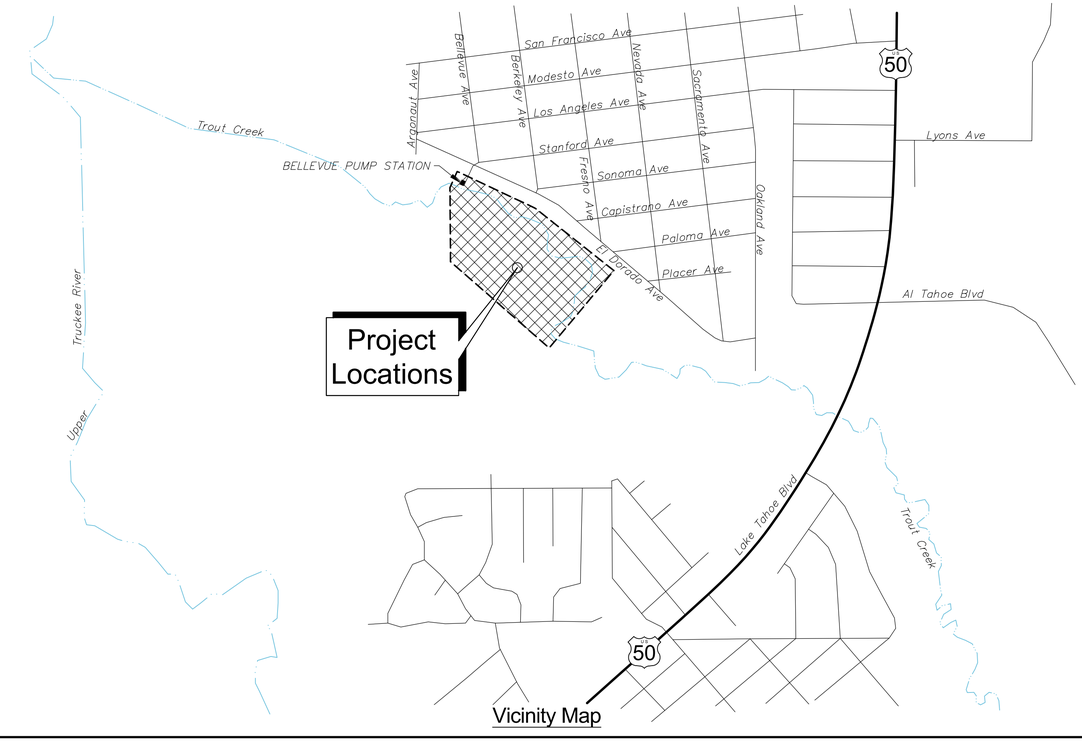
STATE OF CALIFORNIA

PRELIMINARY
NOT FOR CONSTRUCTION

Edward E. Wallace *(date)*
CALIFORNIA REGISTERED
PROFESSIONAL ENGINEER NO. # 32301
northwest hydraulic consultants



Vicinity Map

Project Location Map

Drawing Name UT MARSH COVER P:\600035_Truckee_Marsh\AC-600035\dwg\YR1			Date 3 April 2014	
Drawing Status 60% Submittal	Designer eew	Drafter tvs	Checked eew	Job Number 600035
Sheet 1 of 9				Sheet Number T1

GENERAL NOTES

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING UTILITY COMPANIES TO DETERMINE THE LOCATION OF UNDERGROUND FACILITIES. THE LOCATION OF KNOWN EXISTING FACILITIES IN THE WORK AREA ARE SHOWN, BUT NO GUARANTEE IS MADE AS TO THE ACCURACY OF THIS INFORMATION.
2. THE CONTRACTOR SHALL PROTECT EXISTING SURVEY CONTROL POINTS AND SHALL BE RESPONSIBLE FOR CONSTRUCTION STAKING. IF EXISTING MONUMENT(S) MUST BE DISTURBED TO PERFORM THE WORK, THE CONTRACTOR SHALL NOTIFY THE DISTRICT FOR RELOCATION OF THE MONUMENT PRIOR TO BEGINNING TO WORK.
3. EXCESS MATERIAL IS TO BE REMOVED FROM THE SITE AND DISPOSED OF AT AN APPROVED SITE.
4. THE ENGINEER MAY MAKE MINOR CHANGES TO THE CONFIGURATION AND DESIGN GRADES OF PROJECT FEATURES AND TO REVEGETATION LAYOUTS TO SUIT FIELD CONDITIONS.
5. THE CONTRACTOR SHALL CONTACT THE DISTRICT IMMEDIATELY IF FIELD CONDITIONS ARE FOUND THAT CONFLICT WITH THESE PLANS. FIELD ADJUSTMENTS MUST BE APPROVED BY THE DISTRICT PRIOR TO CONSTRUCTION.
6. IF ANY ARTIFACTS OR OTHER MATERIALS ARE FOUND INDICATING POTENTIAL ARCHAEOLOGICAL OR HISTORICAL RESOURCES, WORK SHALL BE HALTED IMMEDIATELY AND THE CONTRACTOR SHALL CONTACT THE DISTRICT.

AREAS & QUANTITIES

DISTURBANCE AREAS AND APPROXIMATE CUT/FILL QUANTITIES

COMPONENT	SURFACE AREA, SF	CUT (−)/FILL(+) CY
ACCESS ROUTES	11,000	0
PILOT CHANNELS	1,350	−37
LEFT BANK OVERFLOWS	350	−6
LOCAL WIDENING/DEEPING ON FAVORABLE FLOW PATHS	450	−22
HUMMOCKS (VEGETATION ONLY)	2,800	0
FILL HUMMOCKS	2,850	+91
MISCELLANEOUS FILL	3,600	+22
RIGHT BANK PLUGS	600	+12
ABANDONED ROAD FILL REMOVAL	7,000	−390
INTERMITTENT FILL IN EROSIONAL DEPRESSION	1,150	+65
PLANTING AND VEGETATION MANAGEMENT AREAS–FAVORABLE AND UNFAVORABLE FLOW PATHS	4,900	0
TOTALS	36,050 GRADING–17,350[1]	−455/+190 −265 NET

[1]EXCLUDES AREAS WHERE ONLY PLANTING OCCURS

SURVEY
TOPOGRAPHY BASED ON FIELD SURVEY, 25 OCTOBER 2013.

HORIZONTAL: NAD 83(2011) EPOCH 2010.00
CALIFORNIA STATE PLANE ZONE II, US SURVEY FEET

NGS HPGN D CA 03 FS
N 2107571.07 US SURVEY FEET–GRID
E 7136557.88

NGS RICHARDSON
N 2103848.87 US SURVEY FEET – GRID
E 7123525.92 GRID

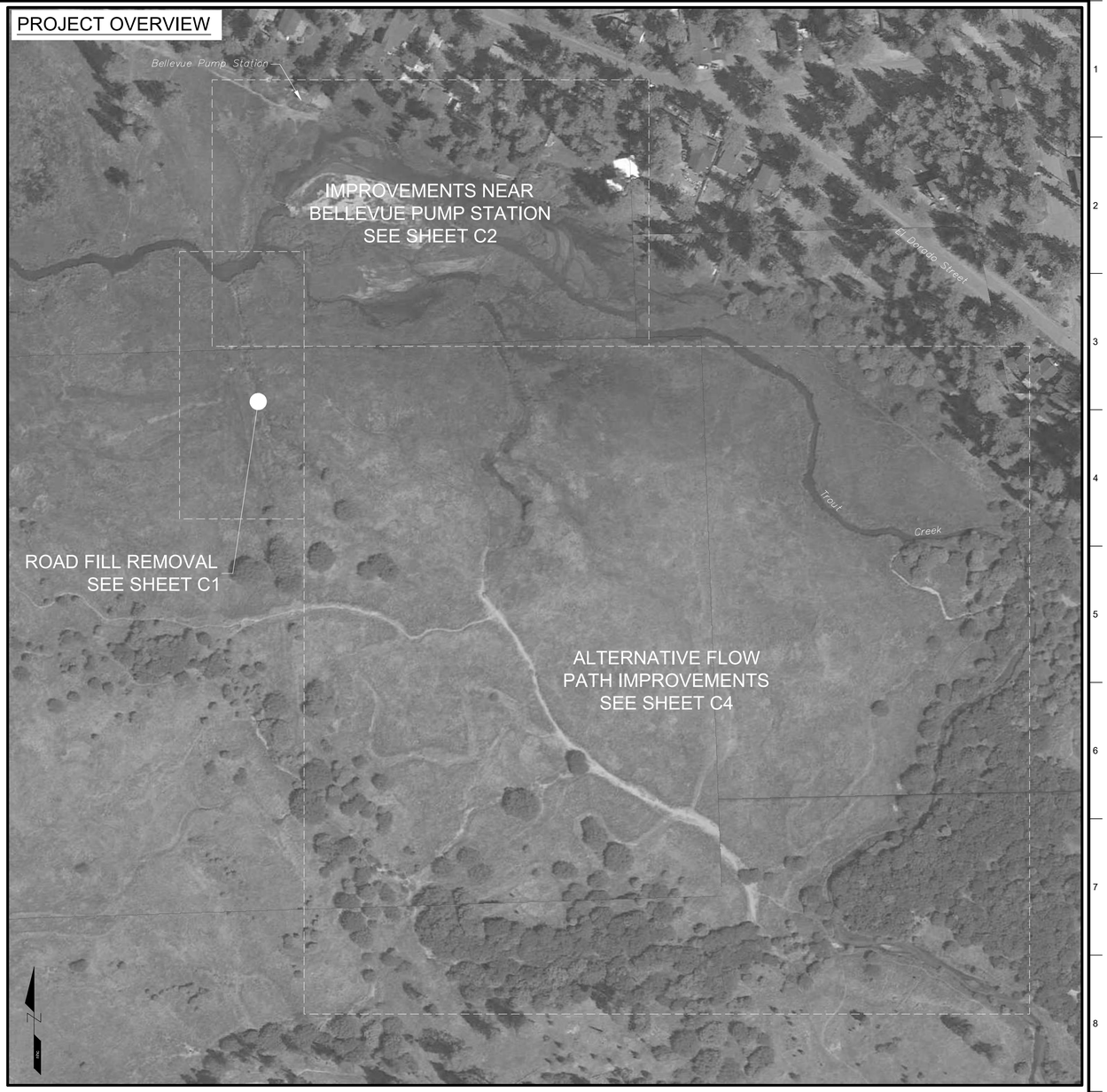
VERTICAL: NAVD88
NGS HPGN D CA 03 FS
EL 6248.20

MONUMENT NAME	LATITUDE (NAD83)	LONGITUDE (NAD83)	NORTHING (GRID)	EASTING (GRID)	ELEV (NAVD88)
LBM T01 & RBM T08	38.936165015'N	119.990107549'W	2109076.5	7133311.2	6234.3	6230.3
LBM T02 & LBM T08	38.936009520'N	119.989915687'W	2109021.1	7133367.0	6233.9	6229.9
LBM T03	38.935887231'N	119.989757770'W	2108977.6	7133412.9	6234.2	6230.2
LBM T04	38.935799724'N	119.989607047'W	2108946.7	7133456.5	6234.4	6230.5
LBM T05	38.935800843'N	119.989206809'W	2108949.6	7133570.3	6234.2	6230.3
LBM T06	38.935877770'N	119.988745105'W	2108980.5	7133700.9	6234.6	6230.6
LBM T07	38.935747492'N	119.988096356'W	2108937.2	7133886.5	6234.5	6230.5
LBM CTC08	38.935760651'N	119.987726877'W	2108944.3	7133991.4	6234.9	6231.0
LBM CTC09	38.935771271'N	119.988517241'W	2108943.2	7133766.6	6235.2	6231.2
LBM CTC10	38.935751784'N	119.988989853'W	2108933.1	7133632.4	6234.6	6230.6
LBM CTC11	38.935831478'N	119.989412956'W	2108959.5	7133511.4	6234.4	6230.4
LBM CTC12	38.936142345'N	119.990379722'W	2109066.6	7133234.0	6233.9	6229.9
RBM T01	38.936805560'N	119.989783506'W	2109311.8	7133398.2	6234.3	6230.3
RBM T02	38.936678391'N	119.989687343'W	2109266.1	7133426.6	6234.4	6230.4
RBM T03	38.936718421'N	119.989515004'W	2109281.8	7133475.2	6234.4	6230.5
RBM T04	38.936695860'N	119.989298498'W	2109274.9	7133537.0	6234.3	6230.3
RBM T05	38.936536812'N	119.988919311'W	2109219.4	7133646.1	6235.0	6231.0
RBM T06	38.936450851'N	119.988569421'W	2109190.3	7133746.3	6236.5	6232.5
RBM T07	38.936210006'N	119.987960945'W	2109106.4	7133921.3	6234.9	6230.9
RBM CTC08	38.936039165'N	119.987696663'W	2109045.9	7133997.8	6235.6	6231.6
RBM CTC09	38.936289485'N	119.988269921'W	2109133.4	7133832.8	6235.0	6231.1
RBM CTC10	38.936464082'N	119.988736129'W	2109194.1	7133698.8	6235.1	6231.1
RBM CTC11	38.936588072'N	119.989101037'W	2109236.9	7133594.0	6235.2	6231.2
RBM CTC12	38.936270686'N	119.990417368'W	2109113.1	7133222.2	6234.3	6230.3

LEGEND

- EXISTING TREES
- EXISTING EDGE OF PAVED ROAD
- EXISTING TRAIL
- EXISTING CONTOURS (MAJOR) — 60
- EXISTING CONTOURS (MINOR) — 61
- EXISTING FENCE
- EXISTING EDGE OF WATER (10/25/13)
- EXISTING BUILDINGS & STRUCTURES
- SURVEY CONTROL POINT
- PROPOSED SLOPE
- CONSTRUCTION BASELINE — 1+00
- COIR LOG AND STEEL STAKE SEDIMENT BARRIER
- PRESERVATION FENCE WITH SILT BARRIER
- PROPOSED CONTOURS (MAJOR) — 80
- PROPOSED CONTOURS (MINOR) — 79
- PROPOSED SPOT ELEVATIONS — 83.2
- TYPE 1 UPPER BANK REVEGETATION
- TYPE 2 UPPER BANK REVEGETATION
- DIVERSION DAM
- STAGING AREA
- PEDESTRIAN SIGN

PROJECT OVERVIEW



PROJECT OVERVIEW
SCALE: 1"=100'

South Tahoe Public Utility District
1275 Meadow Crest Drive
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PRELIMINARY
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Revisions		
No.	Date	Description

Drawing Information	
Date	3 April 2014
Status	60% Submittal
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Checked	eew
File Name	UT MARSH COVER
Plotted Scale	0 1/2 1

Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 1 Improvements
Legend & Notes Sheet

Job Number 600035
Sheet Number G1
Sheet 2 of 9

NOTES

1. ACCESS ROUTE AREA 'A' WILL BE USED FOR LGP EQUIPMENT AND FOOT TRAFFIC ONLY AND SHALL BE PROTECTED WITH CONSTRUCTION MATS OR PLATES. ACCESS ROUTE 'B' WILL BE USED FOR TRUCK AND LGP EQUIPMENT TRAFFIC AND SHALL BE PROTECTED WITH WOOD CHIPS, SUPPLEMENTED BY PLATES OR MATS AS NEEDED TO PREVENT RUTS. ACCESS ROUTE 'C' WILL BE USED FOR TRUCKS AND LGP EQUIPMENT AND WILL BE PROTECTED WITH A LAYER OF WOOD CHIPS AND PLATES OR MATS SUITABLE FOR TRUCK LOADS. SEE SPECIFICATIONS FOR DETAILS ON PROTECTION AND RESTORATION OF THE THREE AREAS.

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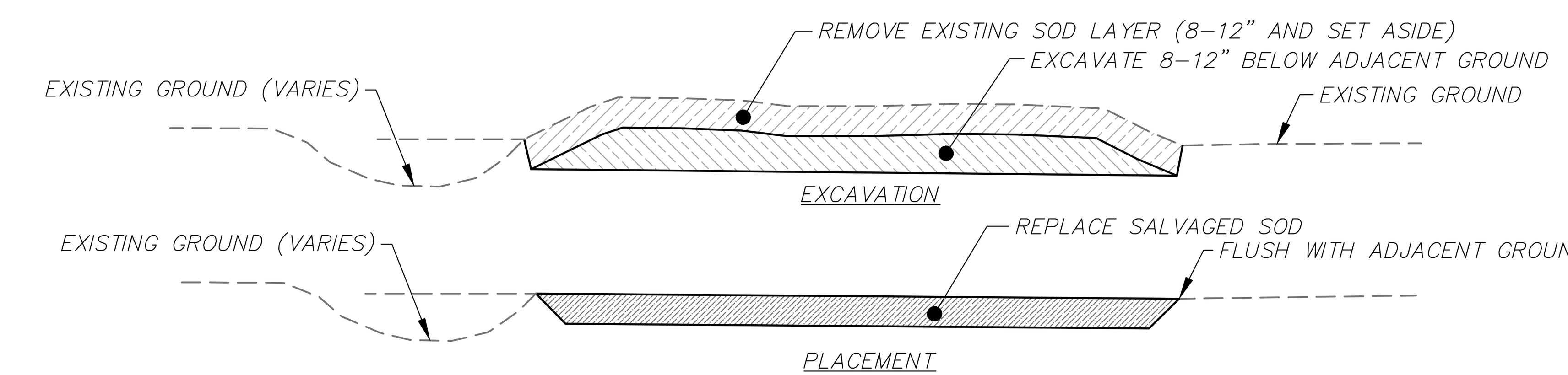
Plotted Scale	0 1/2 1

Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 1 Improvements
Aerial & Staging Plan Sheet

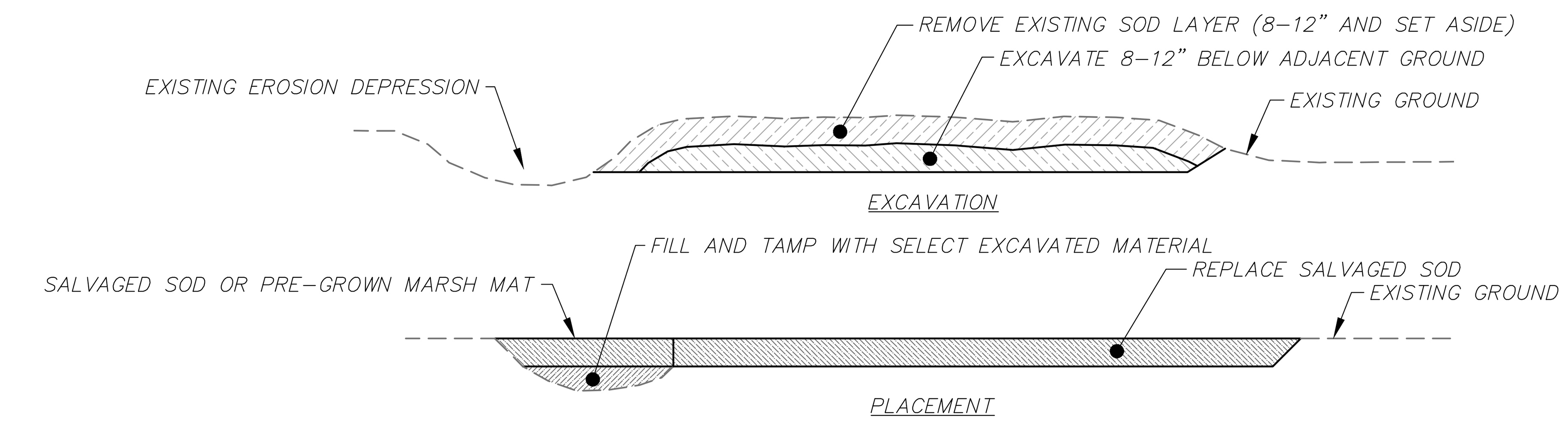
Job Number 600035

Sheet Number G2

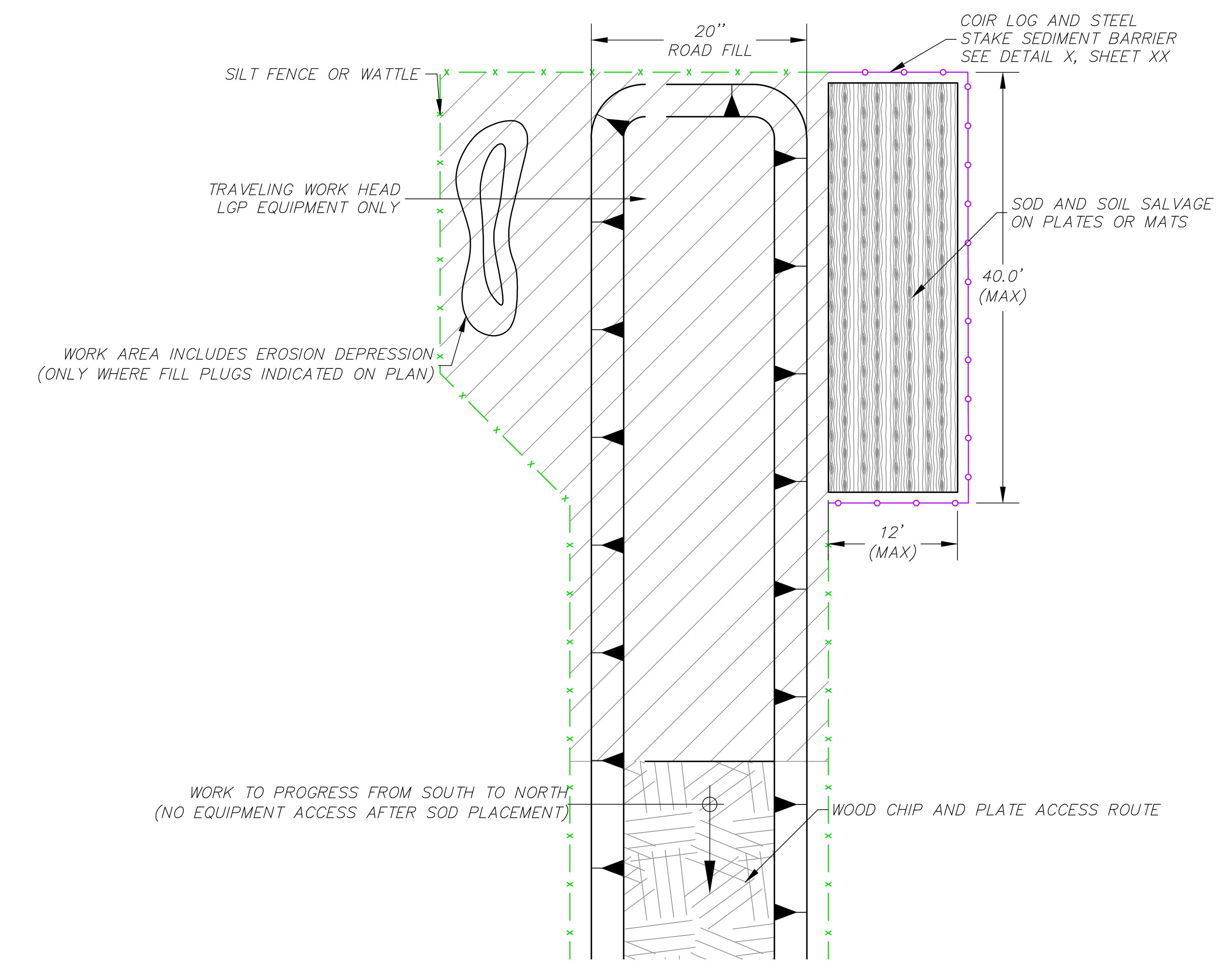
Sheet 3 of 9



A SECTION
SCALE: 1"=5'



B SECTION
SCALE: 1"=5'



TRAVELING WORK HEAD FOR ROAD FILL REMOVAL
SCALE: 1"=10'

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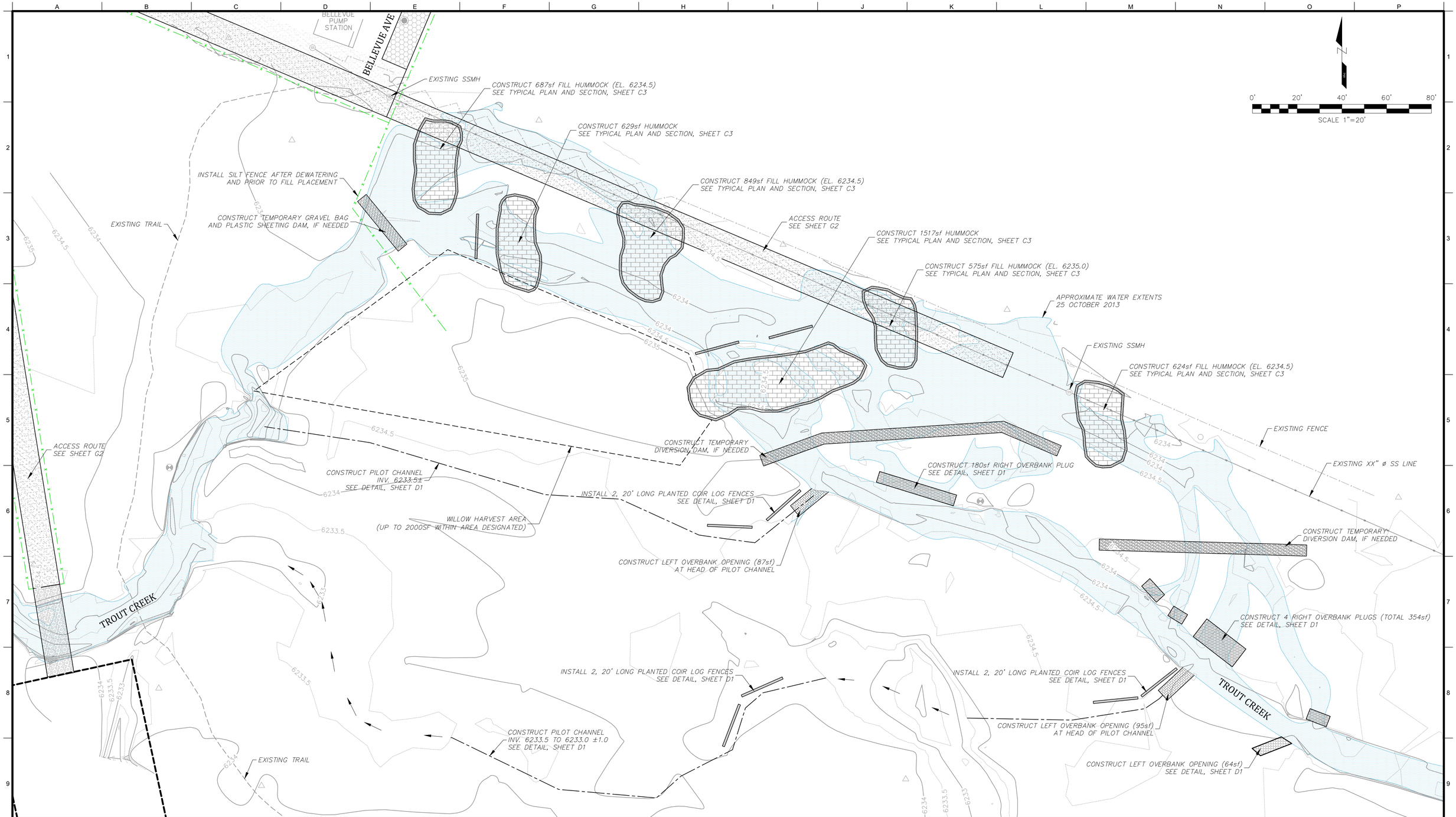
File Name	UT MARSH ROAD FILL
Plotted Scale	0 1/2 1

Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 1 Improvements
Road Fill Removal Sheet

Job Number
600035

Sheet Number
C1



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File Name	UT MARSH
Plotted Scale	0 1/2 1

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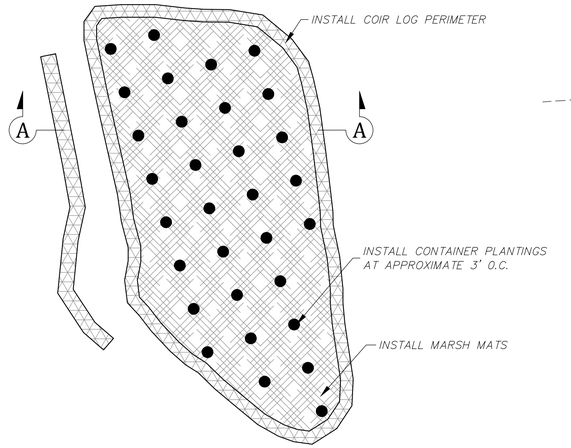
Upper Truckee Marsh Sewer Facilities Adaptive Management Plan Year 1 Improvements

Plan Sheet

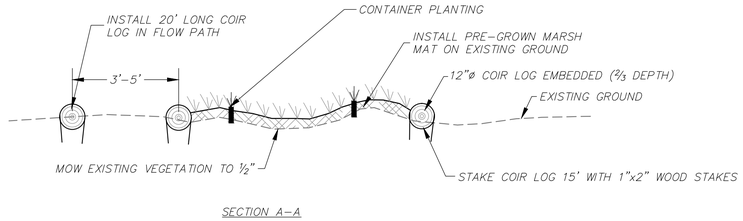
Job Number 600035

Sheet Number C2

Sheet 5 of 9



PLAN VIEW

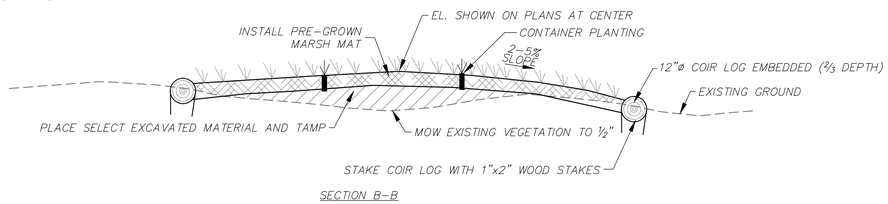


SECTION A-A

HUMMOCK DETAIL

Not to Scale

PLAN VIEW



SECTION B-B

FILL HUMMOCK DETAIL

Not to Scale

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File Name	UT MARSH
Plotted Scale	0 1/2 1

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Upper Truckee Marsh Sewer Facilities Adaptive Management Plan Year 1 Improvements

Typical Cross Sections Sheet

Job Number 600035

Sheet Number C3

Sheet 6 of 9

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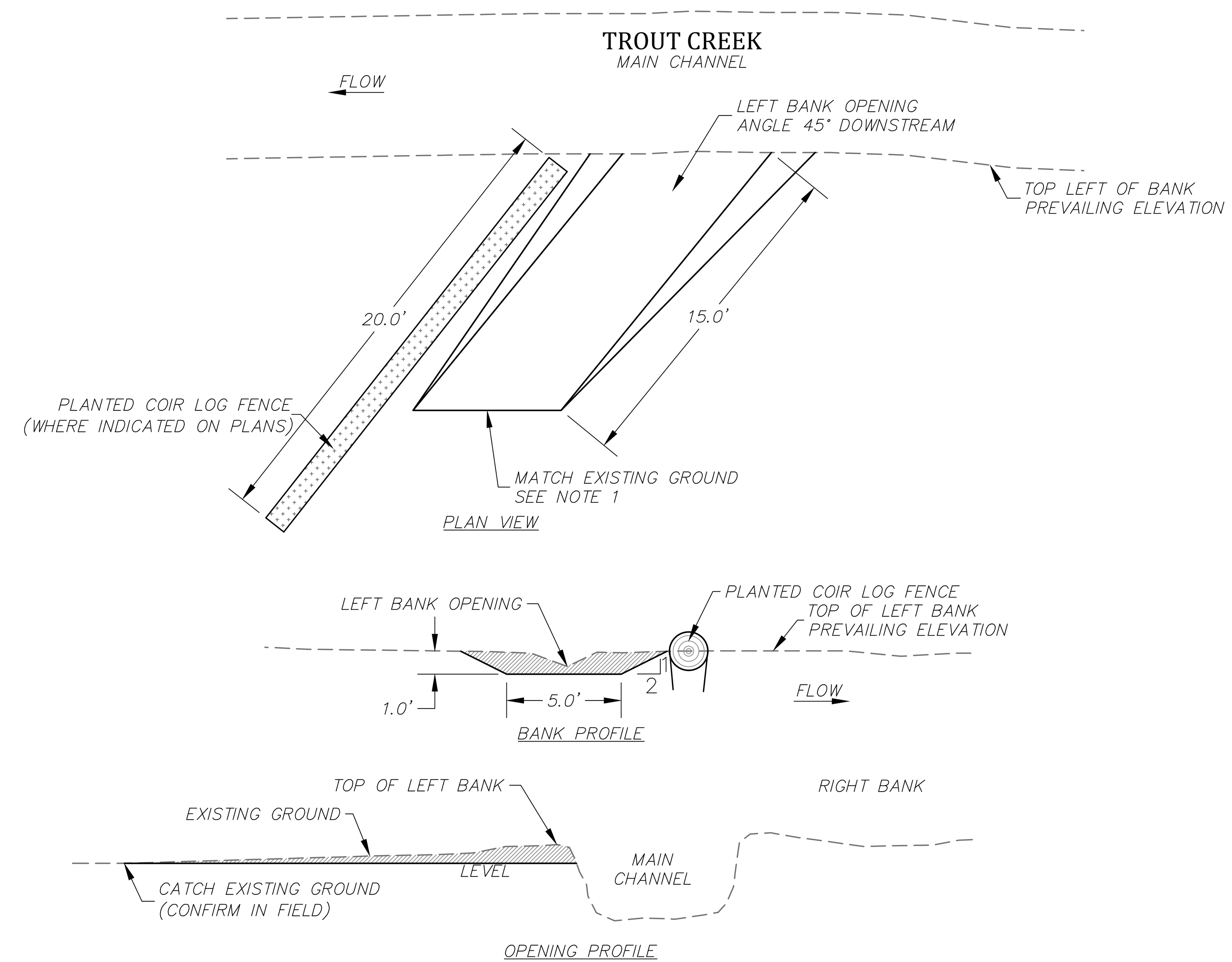
Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 1 Improvements
Alternative Flow Path Improvements
Plan Sheet

Job Number
600035

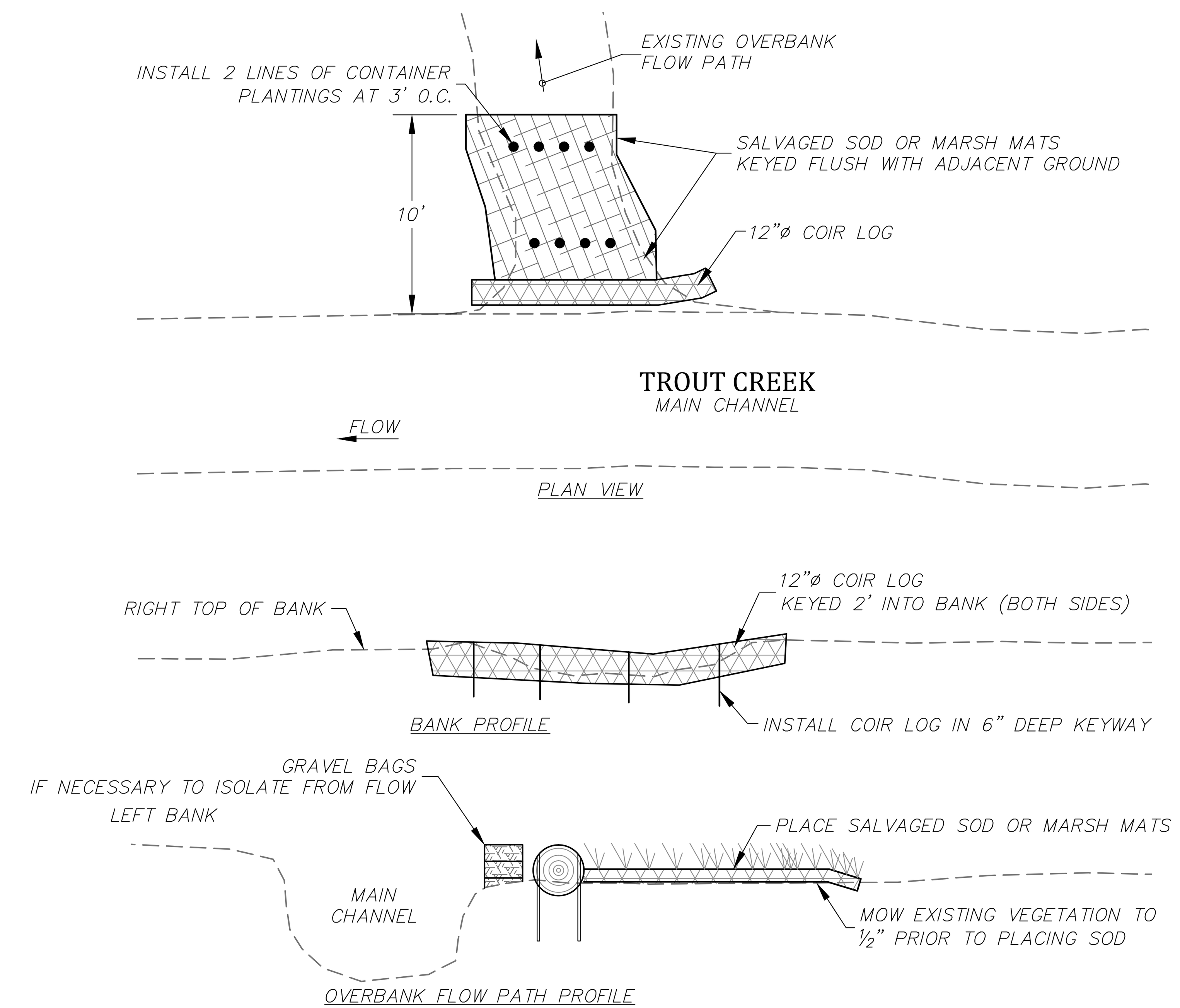
Sheet Number
C4

Sheet 7 of 9

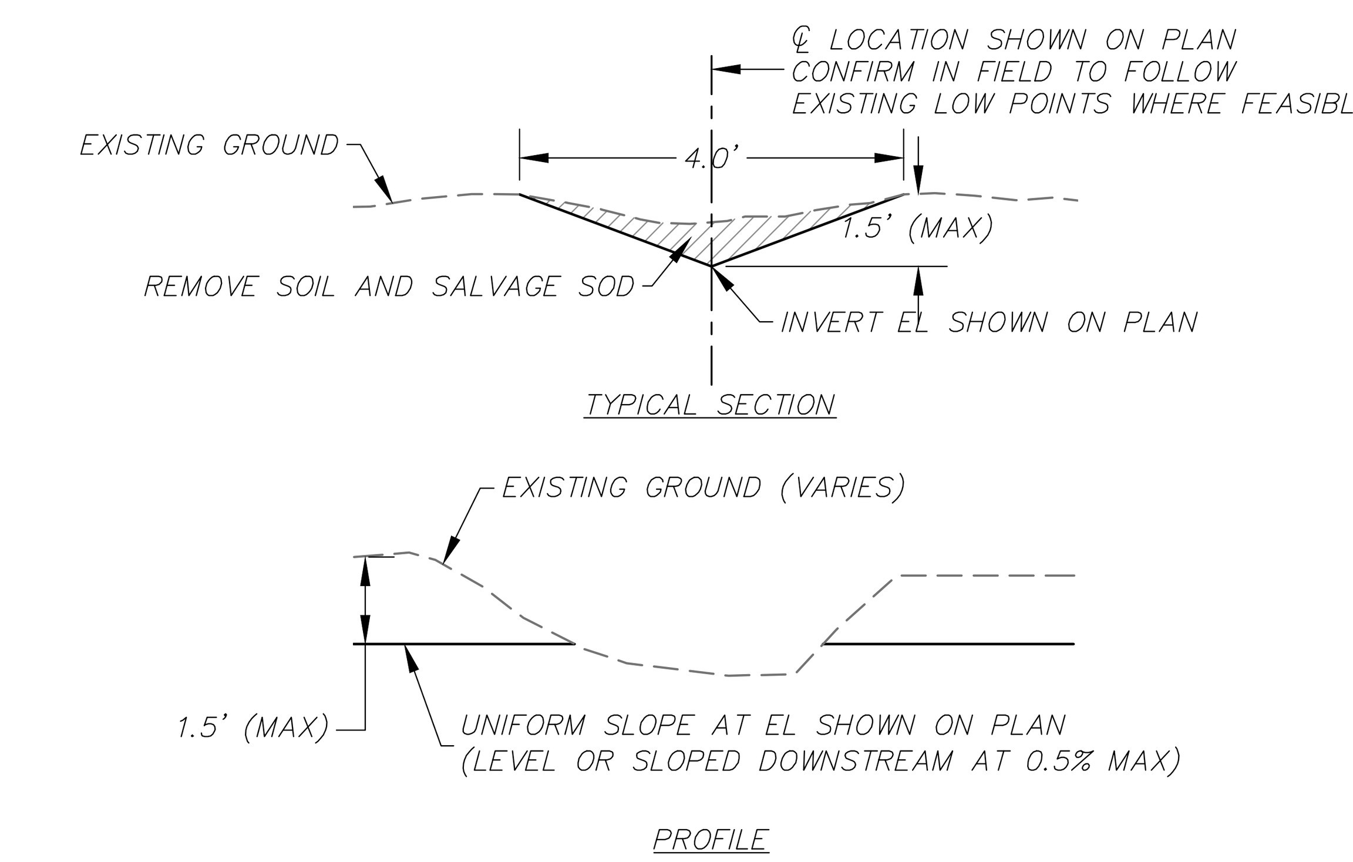


LEFT OVERBANK OPENING
Not to Scale

NOTES:
1. WHERE LEFT BANK OPENING CONNECTS TO PILOT CHANNEL, CONFORM DOWNSTREAM END TO TYPICAL PILOT CHANNEL SECTION

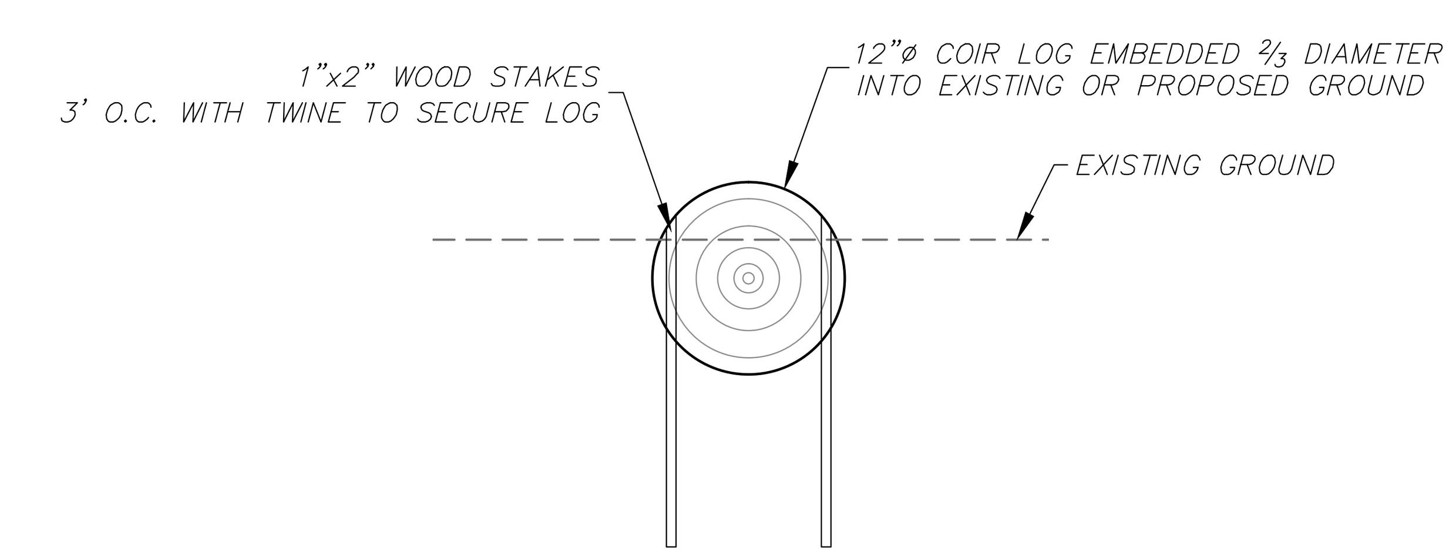


RIGHT OVERBANK PLUG
Not to Scale

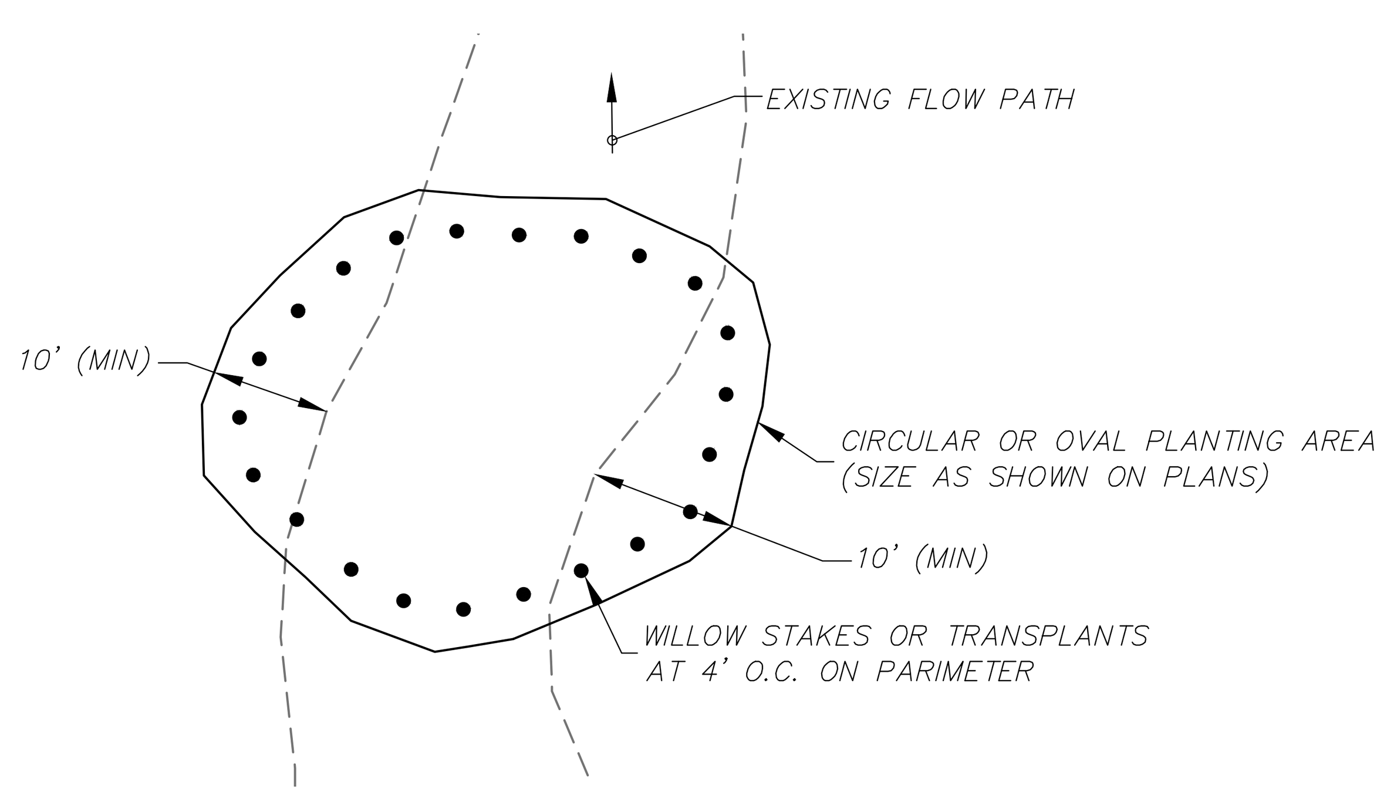


PILOT CHANNEL
Not to Scale

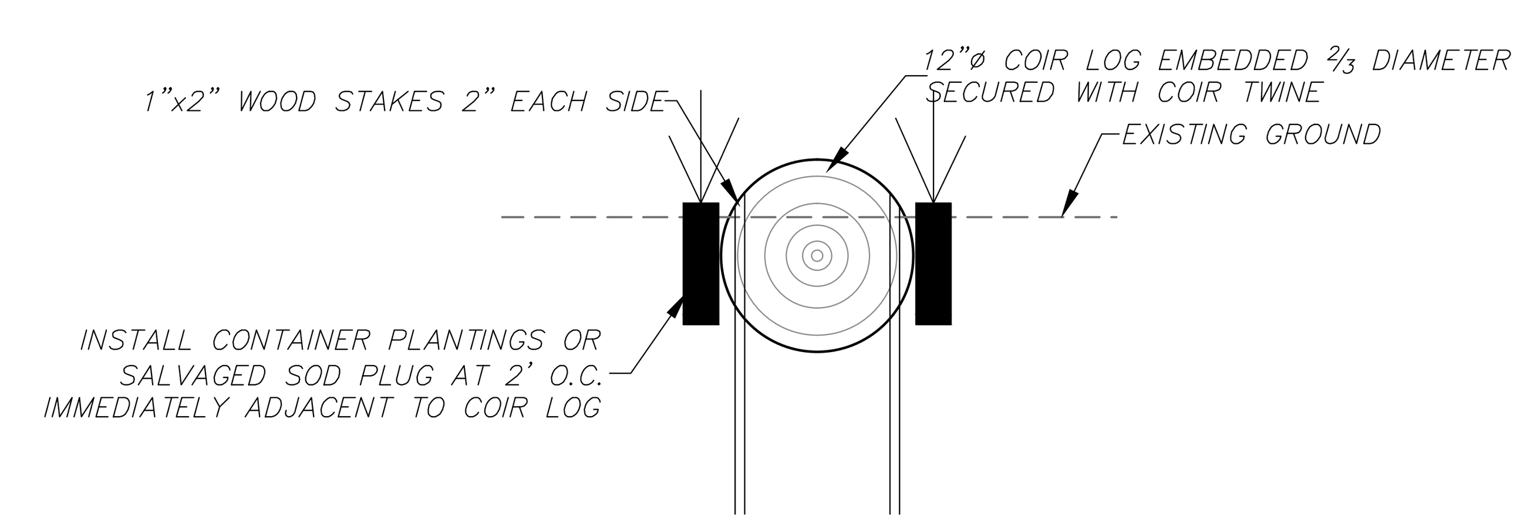
NOTES:
1. AT 40' INTERVALS ON PILOT CHANNEL, SALVAGE AND REPLACE SOD FLUSH WITH CHANNEL SHAPE TO FORM A 5' WIDE VEGETATED SILL. INSTALL ONE SILL AT OUTLET TO MAIN CHANNEL.



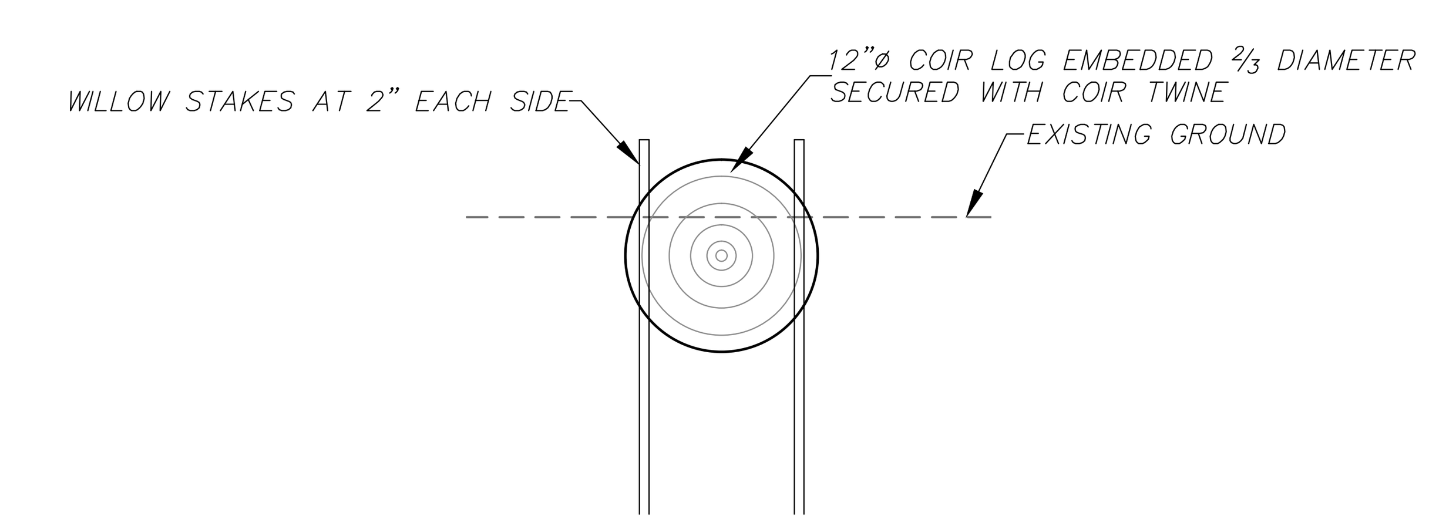
COIR LOG INSTALLATION
Scale: 1"=5'



WILLOW SAUSAL
Not to Scale



PLANTED COIR LOG
Not to Scale



WILLOW FENCE
Not to Scale

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Revisions		
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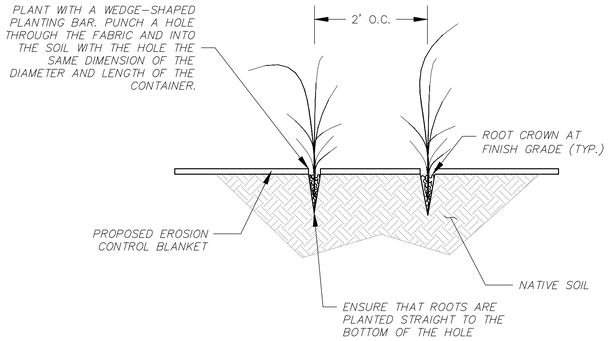
File Name	UT MARSH DETAILS
Plotted Scale	0 1/2 1

Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 1 Improvements
Details Sheet

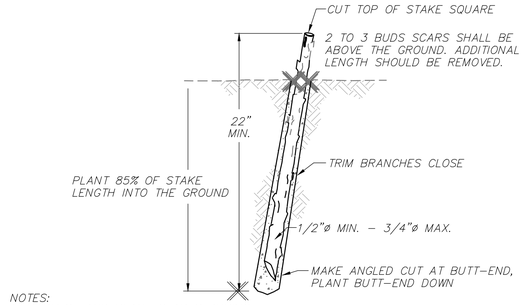
Job Number 600035

Sheet Number D1



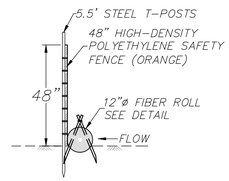
NOTES:
1. PULL NETTING APART PRIOR TO DIGGING THE PLANTING HOLE TO MINIMIZE THE NEED TO CUT THE FABRIC.
2. WETLAND PLUGS SHALL BE CAREX NEBRASCENSIS AND JUNCUS BALTICUS.
3. WETLAND PLUGS SHALL BE SUPERCELL 1.5 INCH WIDE AND 8 INCHES DEEP OR DEEPOTS (10-INCH DEPTH).

WETLAND PLUG PLANTING
Not to Scale

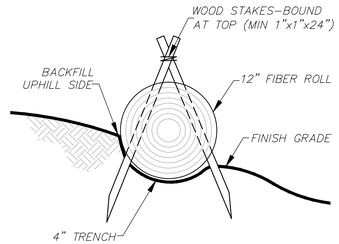


NOTES:
1. HARVEST AND PLANT STAKES DURING THE DORMANT SEASON.
2. USE HEALTHY, STRAIGHT AND LIVE WOOD AT LEAST 1 YEAR OLD.
3. MAKE CLEAN CUTS AND DO NOT DAMAGE STAKES OR SPLIT ENDS DURING INSTALLATION, USE A PILOT BAR IN FIRM SOILS.
4. SOAK CUTTINGS FOR 24 HOURS (MIN.) PRIOR TO INSTALLATION.
5. TAMP THE SOIL AROUND THE STAKE.
6. USE SALIX SPP. FROM PROJECT AREA.
7. PLANT AT 4' O.C. BOTH SIDES OF CHANNEL.

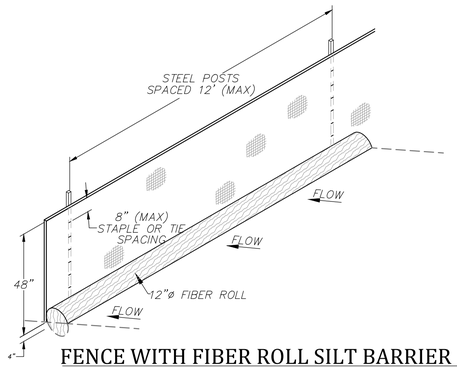
WILLOW LIVE STAKING
Not to Scale



SECTION
FIBER ROLL SILT BARRIER AT SAFETY FENCE

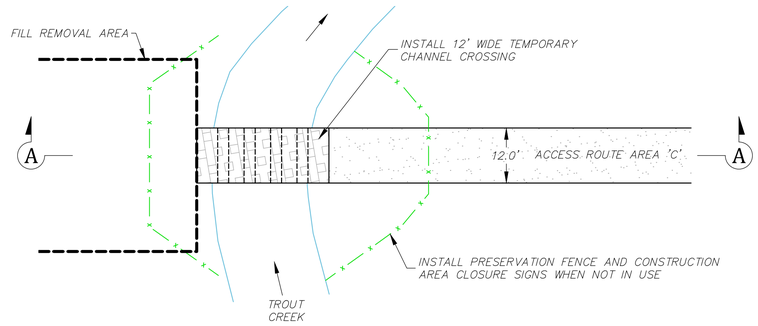


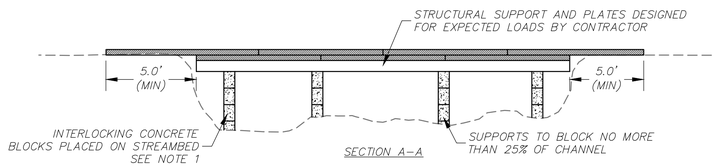
SECTION
FIBER ROLL SILT BARRIER



FENCE WITH FIBER ROLL SILT BARRIER
Not to Scale

NOTES:
1. FIBER ROLL SHALL BE MADE FROM 100% MATTRESS GRADE COCONUT FIBER AND BOUND BY HIGH STRENGTH COIR NETTING, AND HAVE A MINIMUM WEIGHT OF 5 LBS PER LINEAL FOOT.
2. ORANGE SAFETY FENCE SHALL BE HIGH DENSITY POLYETHYLENE WITH A MESH OPENING OF APPROXIMATELY 1 INCH BY 4 INCHES AND A MINIMUM HEIGHT OF 4 FEET.
3. FIBER ROLL SILT BARRIER SHALL BE INSTALLED ALONG CONTOUR AND ON SLOPES 5H:1V OR FLATTER UNLESS OTHERWISE APPROVED BY TRPA.
4. THE INSTALLATION CONFIGURATION SHALL PREVENT RUNOFF FROM LEAVING THE SITE OR ENTERING A WATERCOURSE WITHOUT PASSING THROUGH A SILT BARRIER.
5. THE MAXIMUM LENGTH OF SLOPE DRAINING TO THE SILT BARRIER SHALL BE 100 FEET.
6. FIBER ROLL SHALL BE INSTALLED BY SHAPING A 4 INCH DEEP FURROW TO MATCH THE SHAPE OF THE LOG, SECURING IN FURROW WITH WOOD STAKES, AND TAMPING THE GROUND AROUND THE FIBER ROLL TO FILL VOIDS BETWEEN THE LOG AND THE GROUND.
7. TRPA BMP-517

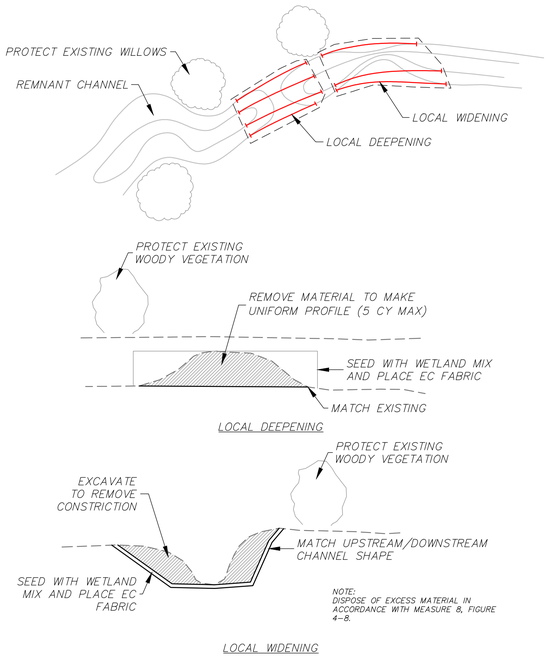




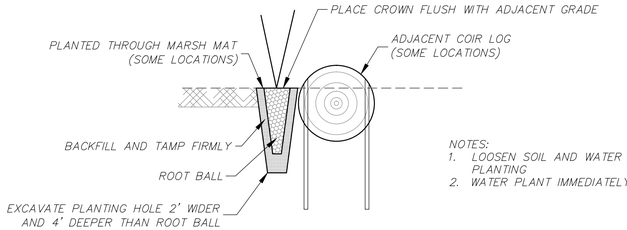
SECTION A-A

NOTES:
1. THE CONTRACTOR MAY PROPOSE ALTERNATIVE CROSSING DESIGNS AS DESCRIBED IN THE SPECIFICATIONS.
2. CONTRACTOR SHALL DESIGN CROSSING FOR EXPECTED EQUIPMENT AND TRUCK LOADS.
3. IF STREAMBANK DEFORMATION OCCURS OPERATIONS TO CEASE UNTIL CROSSING IS SUITABLY MODIFIED.

TEMPORARY CHANNEL CROSSING
Not to Scale



LOCAL WIDENING AND/OR DEEPENING OF DESIRABLE FLOW PATHS
Not to Scale



NOTES:
1. LOOSEN SOIL AND WATER HOLE PRIOR TO PLANTING.
2. WATER PLANT IMMEDIATELY AFTER PLANTING

CONTAINER PLANTING
Not to Scale

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Plotted Scale	0 1/2 1

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Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 1 Improvements
Details Sheet

Job Number 600035
Sheet Number D2
Sheet 9 of 9

SHEET INDEX

South Tahoe Public Utility District

CONSTRUCTION PLANS FOR

Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan - Year 2 Improvements

JULY 2015

PROJECT MANAGER

Ivo Bergsohn, Hydrogeologist
South Tahoe Public Utility District
1275 Meadow Crest Road
South Lake Tahoe, California 96150

APPROVED BY:

Shannon Cotulla, PE, Assistant General Manager *(date)*
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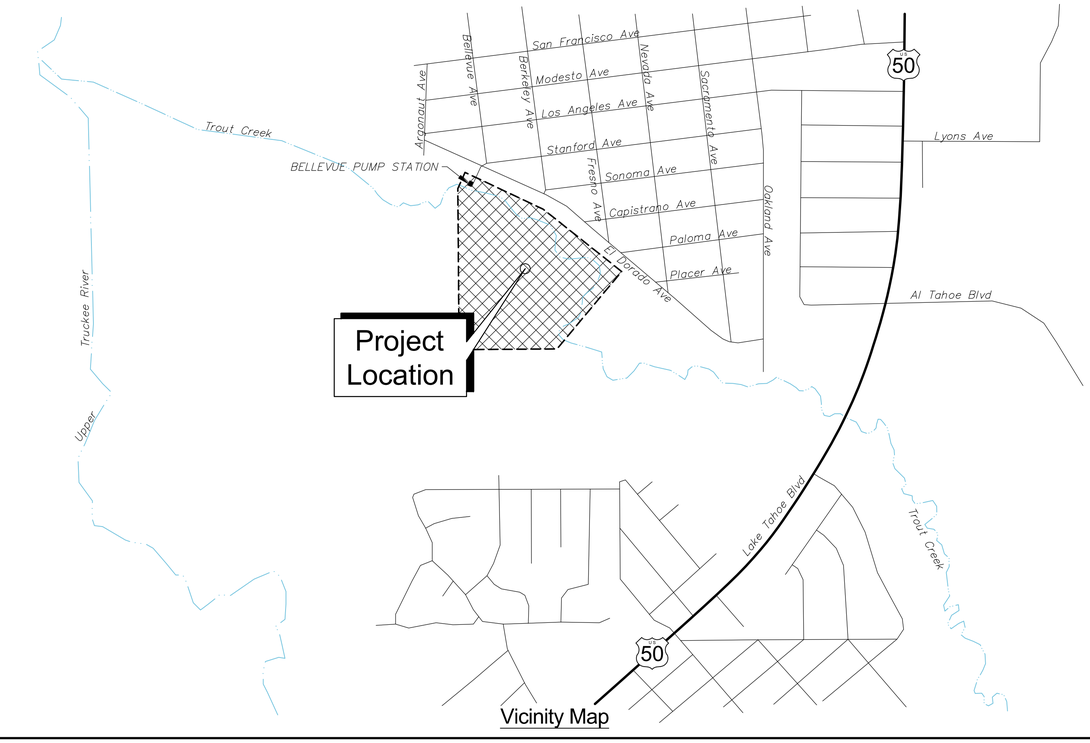
REGISTERED PROFESSIONAL ENGINEER
EDWARD E. WALLACE
No. 32301
Exp: 12/31/16
CIVIL
STATE OF CALIFORNIA

Edward E Wallace — 08 JULY 2015

Edward E. Wallace *(date)*
CALIFORNIA REGISTERED
PROFESSIONAL ENGINEER NO. # 32301
northwest hydraulic consultants



Vicinity Map

Project Location Map

Drawing Name UT MARSH YR2 COVER P:\6000145-Upper Truckee Monitoring\AC-6000145\dwg			Date 8 July 2015 14:03	
Drawing Status Final	Designer tvs	Drafter tvs	Checked eew	Job Number 6000145
Sheet 1 of 8				Sheet Number T1

GENERAL NOTES

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING UTILITY COMPANIES TO DETERMINE THE LOCATION OF UNDERGROUND FACILITIES. THE LOCATION OF KNOWN EXISTING FACILITIES IN THE WORK AREA ARE SHOWN, BUT NO GUARANTEE IS MADE AS TO THE ACCURACY OF THIS INFORMATION.
2. THE CONTRACTOR SHALL PROTECT EXISTING SURVEY CONTROL POINTS AND SHALL BE RESPONSIBLE FOR CONSTRUCTION STAKING. IF EXISTING MONUMENT(S) MUST BE DISTURBED TO PERFORM THE WORK, THE CONTRACTOR SHALL NOTIFY THE DISTRICT FOR RELOCATION OF THE MONUMENT PRIOR TO BEGINNING TO WORK.
3. THE ENGINEER MAY MAKE MINOR CHANGES TO THE CONFIGURATION AND DESIGN GRADES OF PROJECT FEATURES AND TO REVEGETATION LAYOUTS TO SUIT FIELD CONDITIONS.
4. THE CONTRACTOR SHALL CONTACT THE DISTRICT IMMEDIATELY IF FIELD CONDITIONS ARE FOUND THAT CONFLICT WITH THESE PLANS. FIELD ADJUSTMENTS MUST BE APPROVED BY THE DISTRICT PRIOR TO CONSTRUCTION.
5. IF ANY ARTIFACTS OR OTHER MATERIALS ARE FOUND INDICATING POTENTIAL ARCHAEOLOGICAL OR HISTORICAL RESOURCES, WORK SHALL BE HALTED IMMEDIATELY AND THE CONTRACTOR SHALL CONTACT THE DISTRICT.
6. NO TREES ARE DESIGNATED FOR REMOVAL. IF FIELD CONDITIONS INDICATE THE NEED FOR TREE REMOVAL, PRIOR APPROVAL FROM THE DISTRICT AND TRPA IS REQUIRED.
7. NO GRADING SHALL OCCUR PRIOR TO INSTALLATION OF CONSTRUCTION BMPs AND APPROVAL BY TRPA AT A PRE-GRADE INSPECTION. BMPs TO BE INSTALLED PRIOR TO EQUIPMENT OR TRUCK USE OF ACCESS ROUTES IN PROJECT AREA.
8. WORK TO BE PERFORMED IS PART OF A MULTI-YEAR ADAPTIVE MANAGEMENT PLAN(AMP). PERMIT CONDITIONS FOR THE AMP APPLY TO THE PROJECT.
9. ON-SITE WORK SHALL BE PERFORMED FROM 8AM TO 6PM, MONDAY THROUGH FRIDAY. WORK OUTSIDE THESE HOURS MUST BE APPROVED BY THE DISTRICT A MINIMUM OF 48 HOURS BEFORE THE ABNORMAL WORKING HOURS ARE SCHEDULED TO BEGIN.
10. EXCESS MATERIAL SHALL BE DISPOSED OF OFFSITE AT A LOCATION APPROVED BY THE DISTRICT.

AREAS & QUANTITIES - YEAR 2 IMPROVEMENTS

DISTURBANCE AREAS AND APPROXIMATE CUT/FILL QUANTITIES

COMPONENT	SURFACE AREA, SF	CUT (-)/FILL(+) CY
ACCESS ROUTES	28183.0	
PILOT CHANNELS	300.0	-7
PILOT CHANNEL DEEPENING	540.0	-15
HUMMOCKS (FILL)	600.0	10
RIGHT BANK PLUGS	120.0	3
PLANTED COIR LOGS	80.0	-3
WETLAND PLUG PLANTING	180.0	0
TOTALS	30,003	-12

[1]EXCLUDES AREAS WHERE ONLY PLANTING OCCURS

SEQUENCE OF WORK

1. INSTALL BMPs AND ACCESS ROUTES
2. DEWATER AND CONSTRUCT PILOT CHANNEL ON SECONDARY CHANNEL; INSTALL FLOW CONTROL BARRIER AT HEAD OF CHANNEL; OPEN CHANNEL TO FLOW
3. DEWATER PILOT CHANNEL PC-3 IN BELLEVUE AREA AND DEEPEN PILOT CHANNEL; OPEN TO FLOW
4. IF DETERMINED NEEDED BY DISTRICT, DEWATER PILOT CHANNEL PC-1 AND DEEPEN PILOT CHANNEL; OPEN TO FLOW
5. INSTALL DEWATERING BARRIERS 8 & 9. IF NEEDED TO PREVENT FLOW IN OVERBANK DOWNSTREAM OF PC-1. PUMP, IF NEEDED TO DEWATER FILL HUMMOCK 5A WORK AREA.
6. INSTALL FILL HUMMOCK 5A, PLANTED COIR LOGS, RIGHT OVERBANK PLUG, AND WETLAND PLUG PLANTINGS.
7. MANAGE FLOWS AT SECONDARY CHANNEL TO PROVIDE MAXIMUM FLOW IN PC-1 AND PC-3 WITHOUT OVERBANK FLOW
8. DECOMMISSION ACCESS ROUTES
9. CONDUCT VEGETATION MAINTENANCE AND IRRIGATION

MONUMENT LOCATIONS

NAME	LATITUDE (NAD83)	LONGITUDE (NAD83)	NORTHING (GRID)	EASTING (GRID)	ELEVATION (NAVD88)
RBM T01	38.936805560'N	119.989783506'W	2109311.8	7133398.2	6234.3
RBM T02	38.936678391'N	119.989687343'W	2109266.1	7133426.6	6234.4
RBM T04	38.936695860'N	119.989298498'W	2109274.9	7135537.0	6234.3
RBM T05	38.936536812'N	119.988919311'W	2109219.4	7133646.1	6235.0
RBM T07	38.936210006'N	119.987960945'W	2109106.4	7133921.3	6234.9

LEGEND

- EXISTING TREES
- EXISTING EDGE OF PAVED ROAD
- EXISTING TRAIL
- EXISTING CONTOURS (MAJOR) — 60
- EXISTING CONTOURS (MINOR) — 61
- EXISTING FENCE
- EXISTING EDGE OF WATER (10/25/13)
- EXISTING BUILDINGS & STRUCTURES
- SURVEY CONTROL POINT
- PROPOSED SLOPE
- CONSTRUCTION BASELINE — 1+00
- SILT BARRIER
- SAFETY PRESERVATION FENCE WITH SILT BARRIER
- PROPOSED CONTOURS (MAJOR) — 80
- PROPOSED CONTOURS (MINOR) — 79
- PROPOSED SPOT ELEVATIONS — 83.2
- HUMMOCK
- DIVERSION DAM
- STAGING AREA

SURVEY
TOPOGRAPHY BASED ON FIELD SURVEY, 25 & 26 NOVEMBER 2014, BY LUMOS & ASSOCIATES.

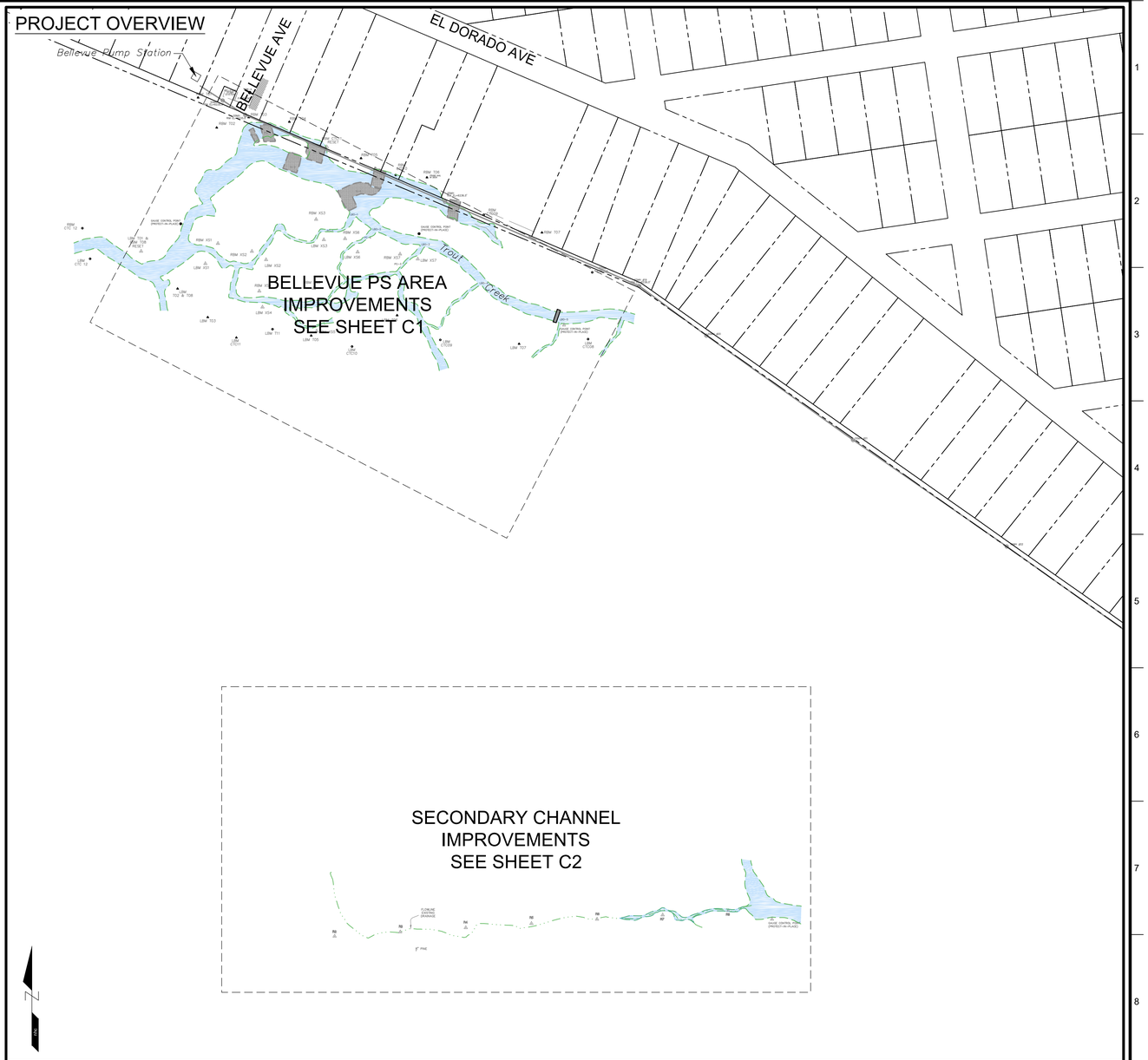
HORIZONTAL: NAD 83(2011) EPOCH 2010.00 CALIFORNIA ZONE 2

NGS HPGN D CA 03 FS
N 2107571.07 US SURVEY FEET- GRID
E 7136557.88

NGS RICHARDSON
N 2103848.87 US SURVEY FEET - GRID
E 7123525.92 GRID

VERTICAL: NAVD88
NGS HPGN D CA 03 FS
EL = 6248.20

PROJECT OVERVIEW



PROJECT OVERVIEW
SCALE: 1"=100'

South Tahoe Public Utility District
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Revisions		
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Drafter	tvs
Checked	eew
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Plotted Scale	0 1/2 1

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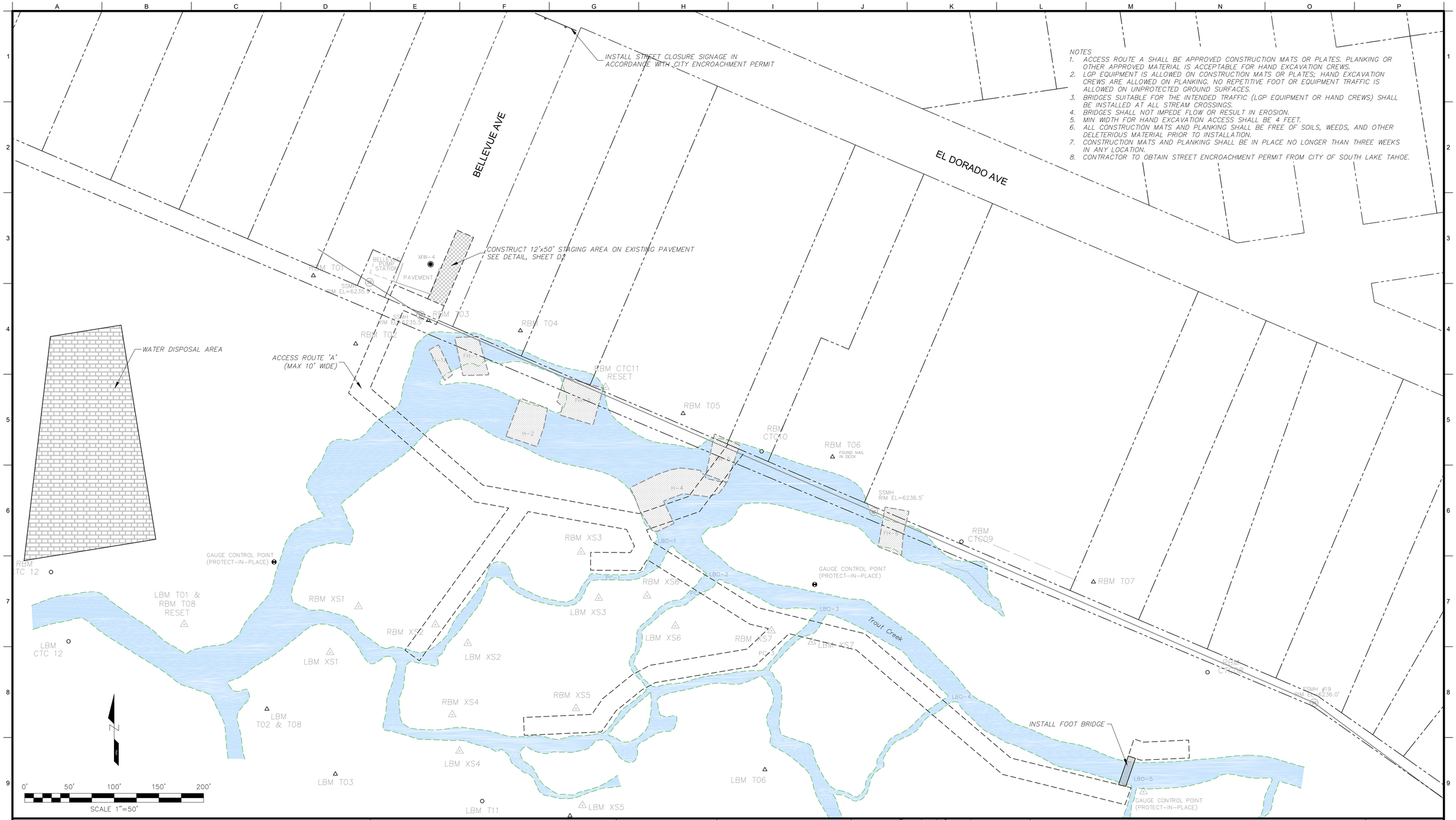
Upper Truckee Marsh Sewer Facilities Adaptive Management Plan Year 2 Improvements

Legend & Notes Sheet

Job Number 6000145

Sheet Number G1

Sheet 2 of 8



NOTES
1. ACCESS ROUTE A SHALL BE APPROVED CONSTRUCTION MATS OR PLATES. PLANKING OR OTHER APPROVED MATERIAL IS ACCEPTABLE FOR HAND EXCAVATION CREWS.
2. LGP EQUIPMENT IS ALLOWED ON CONSTRUCTION MATS OR PLATES; HAND EXCAVATION CREWS ARE ALLOWED ON PLANKING. NO REPETITIVE FOOT OR EQUIPMENT TRAFFIC IS ALLOWED ON UNPROTECTED GROUND SURFACES.
3. BRIDGES SUITABLE FOR THE INTENDED TRAFFIC (LGP EQUIPMENT OR HAND CREWS) SHALL BE INSTALLED AT ALL STREAM CROSSINGS.
4. BRIDGES SHALL NOT IMPEDE FLOW OR RESULT IN EROSION.
5. MIN WIDTH FOR HAND EXCAVATION ACCESS SHALL BE 4 FEET.
6. ALL CONSTRUCTION MATS AND PLANKING SHALL BE FREE OF SOILS, WEEDS, AND OTHER DELETERIOUS MATERIAL PRIOR TO INSTALLATION.
7. CONSTRUCTION MATS AND PLANKING SHALL BE IN PLACE NO LONGER THAN THREE WEEKS IN ANY LOCATION.
8. CONTRACTOR TO OBTAIN STREET ENCROACHMENT PERMIT FROM CITY OF SOUTH LAKE TAHOE.

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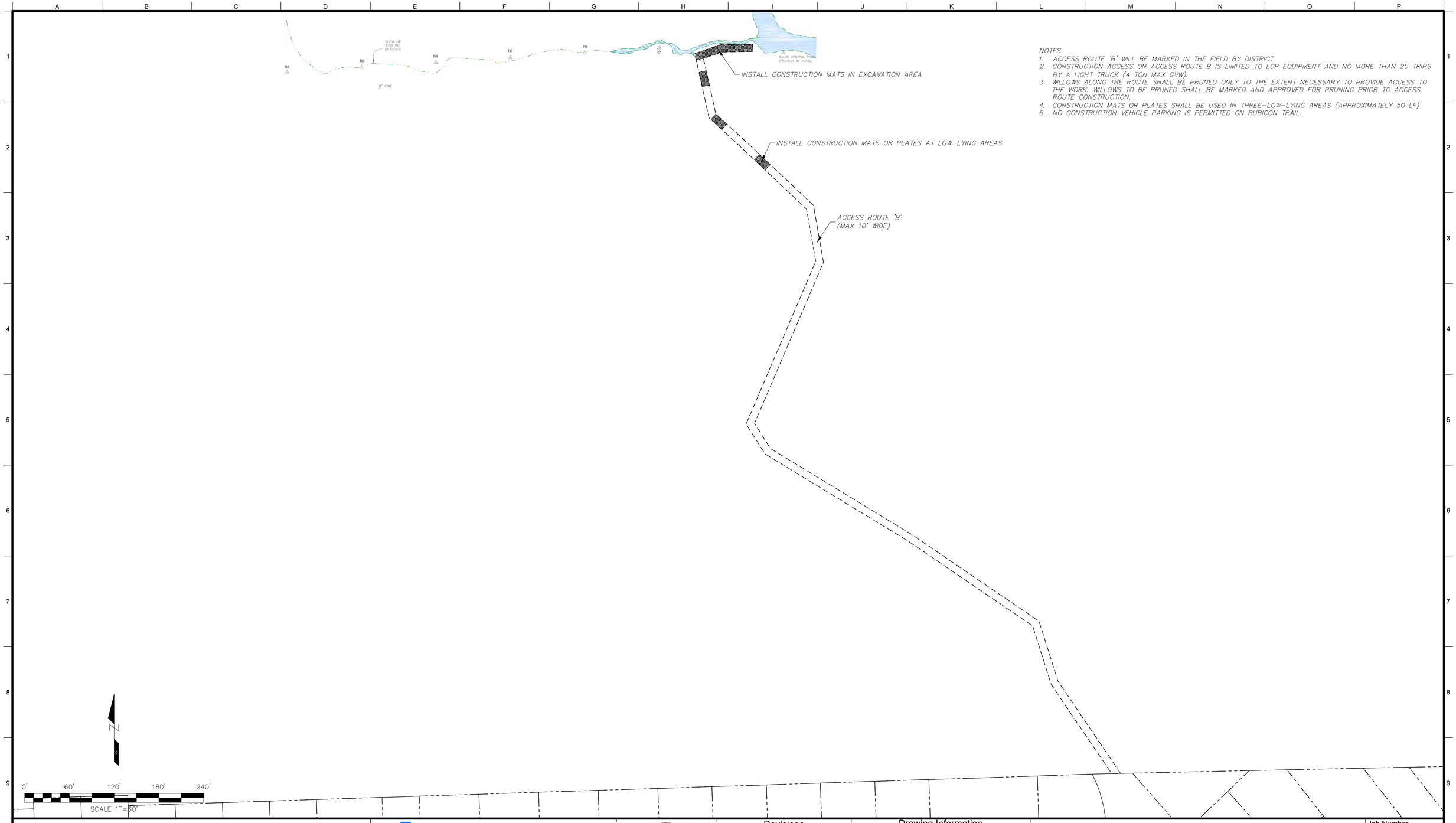
Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 2 Improvements
Bellevue PS Area Improvements
Access Sheet

Job Number 6000145

Sheet Number G2



NOTES
1. ACCESS ROUTE 'B' WILL BE MARKED IN THE FIELD BY DISTRICT.
2. CONSTRUCTION ACCESS ON ACCESS ROUTE B IS LIMITED TO LGP EQUIPMENT AND NO MORE THAN 25 TRIPS BY A LIGHT TRUCK (4 TON MAX GVW).
3. WILLOWS ALONG THE ROUTE SHALL BE PRUNED ONLY TO THE EXTENT NECESSARY TO PROVIDE ACCESS TO THE WORK. WILLOWS TO BE PRUNED SHALL BE MARKED AND APPROVED FOR PRUNING PRIOR TO ACCESS ROUTE CONSTRUCTION.
4. CONSTRUCTION MATS OR PLATES SHALL BE USED IN THREE-LOW-LYING AREAS (APPROXIMATELY 50 LF)
5. NO CONSTRUCTION VEHICLE PARKING IS PERMITTED ON RUBICON TRAIL.

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Plotted Scale	0 1/2 1

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Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 2 Improvements
Secondary Channel Improvements
Access Sheet

Job Number 6000145

Sheet Number

G3


EL DORADO AVE
BELLEVUE PUMP STATION
MW-4
PAVEMENT
RBM T01
SSMH RIM EL=6235.2'
SSMH RIM EL=6235.5'
RBM T03
RBM T02
RBM T04
WATER DISPOSAL AREA
INSTALL x4 20'-LONG PLANTED COIR LOGS
RBM CTC11 RESET
RBM T05
CONSTRUCT FILL HUMMOCK 5A (600sf) TOP EL. 6234.5 SEE DETAIL, SHEET D1
RBM CTC10
RBM T06
FOUND NAIL IN DECK
INSTALL PUMP, IF NEEDED, TO DEWATER FILL HUMMOCK 5A
INSTALL DEWATERING BARRIERS 8 & 9
SSMH RIM EL=6236.5'
INSTALL DEWATERING SHEET PILE BARRIERS 2 TO 4 PRIOR TO PILOT CHANNEL DEEPENING SEE SHEET G1 FOR SEQUENCE OF WORK
DEEPEN 55lf PILOT CHANNEL INV EL. 6233.5 SEE DETAIL, SHEET D1
RBM XS3
RBM CTC09
RBM CTC 12
GAUGE CONTROL POINT (PROTECT-IN-PLACE)
LBM T01 & RBM T08 RESET
RBM XS1
RBM XS6
LBO-2
GAUGE CONTROL POINT (PROTECT-IN-PLACE)
RBM T07
LBM CTC 12
DEEPEN 65lf PILOT CHANNEL INV EL. 6233.0 SEE DETAIL, SHEET D1
LBM XS3
DEEPEN 50lf PILOT CHANNEL INV EL. 6233.5 SEE DETAIL, SHEET D1
LBO-3
RBM XS2
LBM XS6
RBM XS7
LBM XS7
LBM XS1
LBM XS2
INSTALL SUMP PUMP FOR DEWATERING, IF NEEDED, TO PREVENT FLOW IN PILOT CHANNEL
INSTALL DEWATERING BARRIERS (6 & 7) AND SUMP PUMPS, IF NEEDED, DURING PILOT CHANNEL EXCAVATION TO CONTROL TURBID DISCHARGE
DEEPEN 100lf PILOT CHANNEL INV EL. 6233.0 SEE DETAIL, SHEET D1
RBM XS4
RBM XS5
RBM CTC08
SSMH #19 RIM EL=6236.0'
LBM T02 & T08
CONSTRUCT RIGHT OVERBANK PLUG 120sf SEE DETAIL, SHEET C4
LBM XS4
LBM T03
LBM T06
LBO-5
GAUGE CONTROL POINT (PROTECT-IN-PLACE)
LBM T11
LBM XS5
LBM T05
LBM CTC11
LBM CTC10
LBM CTC09
LBM T07
LBM CTC08
N
0' 40' 80' 120' 160'
SCALE 1"=40'

NOTES:
1. WATER DISPOSAL AREA TO BE USED TO SPREAD OR SPRAY AND INFILTRATE WATER DISCHARGED FROM PUMPS, AS NEEDED.
2. NO SURFACE RUNOFF OR DISCHARGE OF TURBID WATER IS PERMITTED FROM WATER DISPOSAL AREA.

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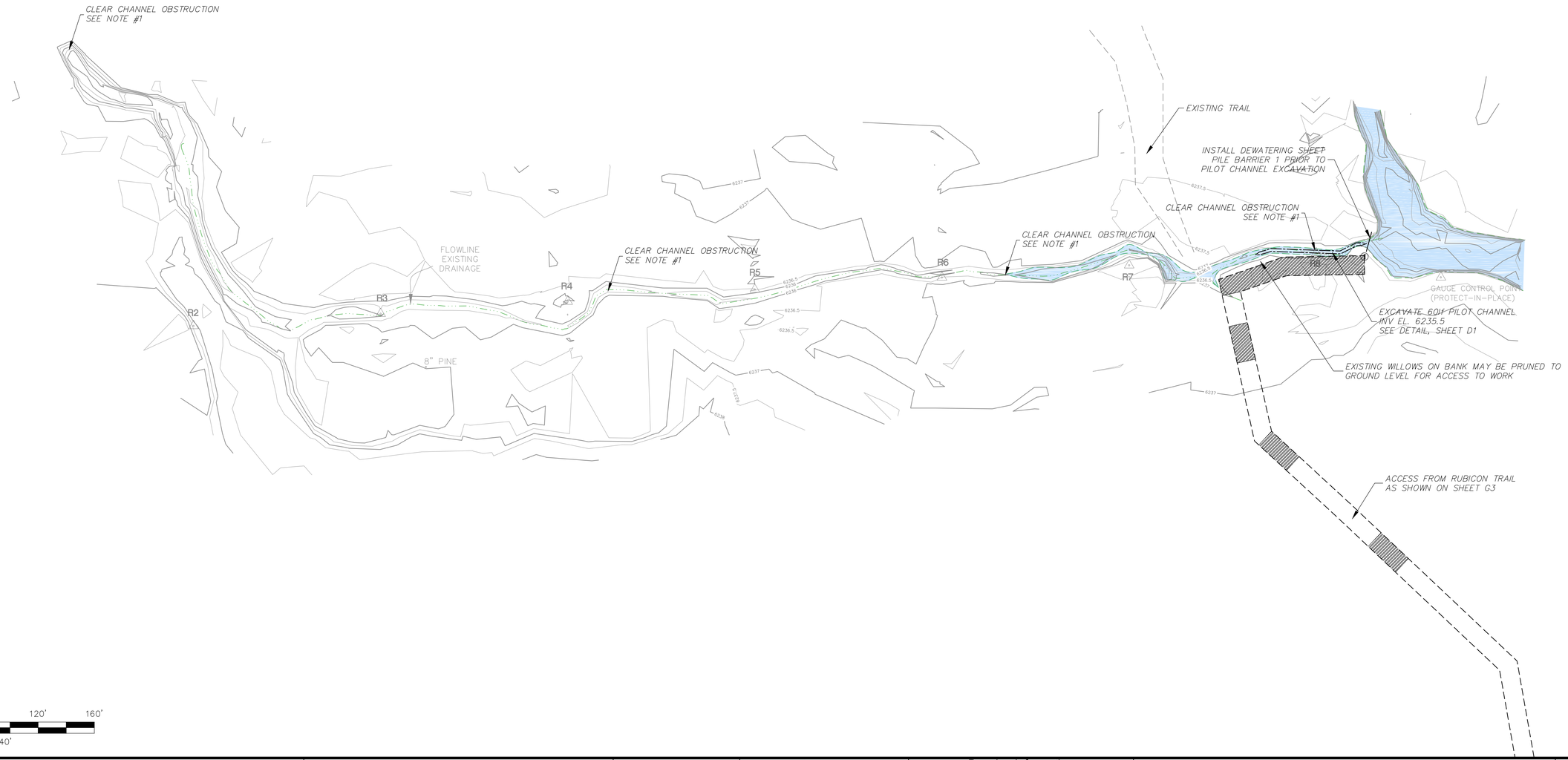
Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 2 Improvements
Bellevue PS Area Improvements
Plan Sheet

Job Number 6000145

Sheet Number C1

Sheet 5 of 8

NOTE:
1. FOUR CHANNEL OBSTRUCTION LOCATIONS, UP TO 1CY OF DEBRIS IN EACH LOCATION. SPECIFIC LOCATION(S) TO BE IDENTIFIED IN FIELD BY ENGINEER. NO MECHANIZED ACCESS.



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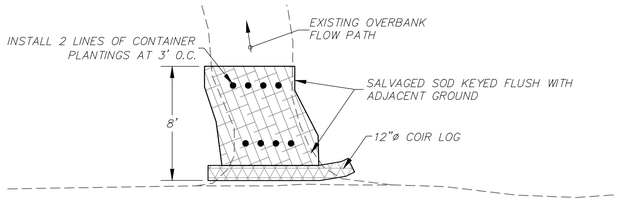
Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 2 Improvements
Secondary Channel Improvements
Plan Sheet

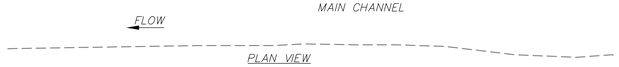
Job Number 6000145

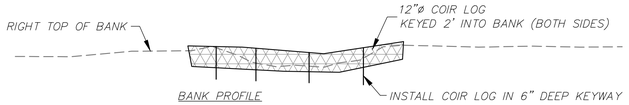
Sheet Number C2

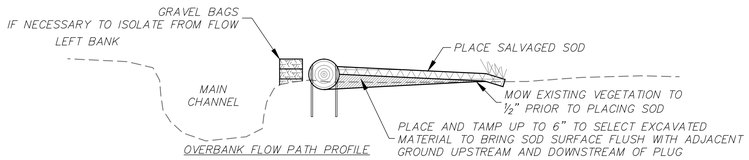
Sheet 6 of 8



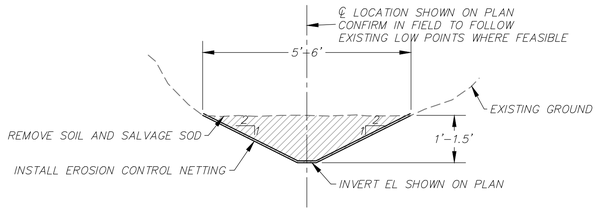
TROUT CREEK
MAIN CHANNEL







RIGHT OVERBANK PLUG
Not to Scale



PILOT CHANNEL
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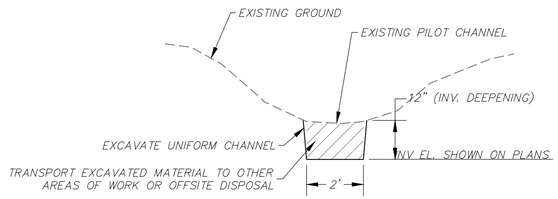
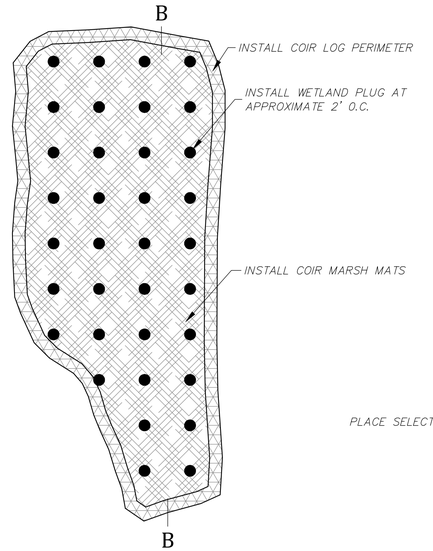
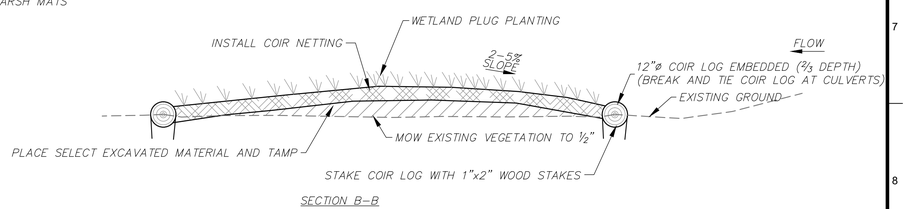


PILOT CHANNEL DEEPENING
Not to Scale

HUMMOCK DETAIL
Not to Scale





FILL HUMMOCK DETAIL
Not to Scale

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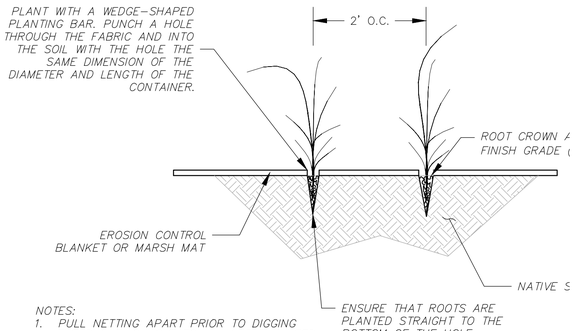
Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 2 Improvements

Details Sheet

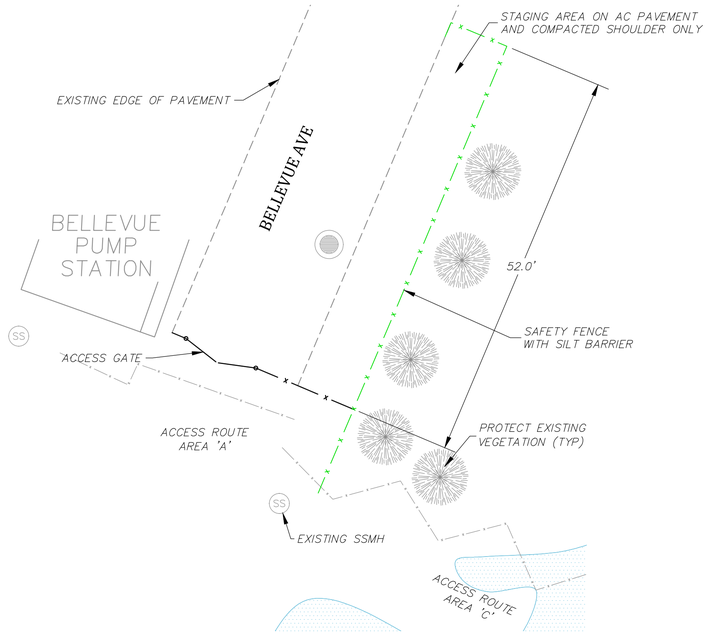
Job Number 6000145

Sheet Number D1



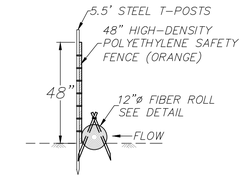
NOTES:
1. PULL NETTING APART PRIOR TO DIGGING THE PLANTING HOLE TO MINIMIZE THE NEED TO CUT THE FABRIC.
2. WETLAND PLUGS SHALL BE CAREX NEBRASCENSIS AND JUNCUS BALTICUS.
3. WETLAND PLUGS SHALL BE SUPERCELL 1.5 INCH WIDE AND 8 INCHES DEEP OR DEEPOTS (10-INCH DEPTH).
4. UP TO 45 WETLAND PLUGS WILL BE PLANTED AT LOCATIONS DIRECTED BY THE DISTRICT (NOT SHOWN ON PLANS)

WETLAND PLUG PLANTING
Not to Scale

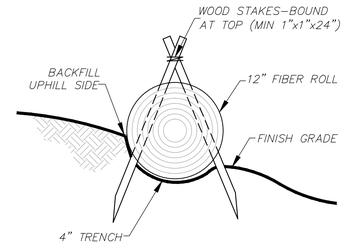


STAGING AREA BMPs
Not to Scale

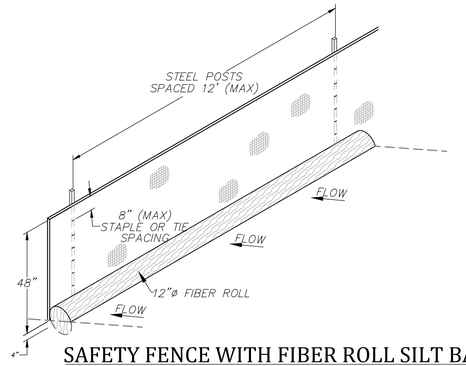
STAGING AREA BMP NOTES:
1. STAGING AREA TO BE MAINTAINED IN A CLEAN CONDITION
.
2. CONTRACTOR IS RESPONSIBLE TO MAINTAIN OR RESTORE EXISTING AC PAVEMENT TO A PRE-PROJECT CONDITION.



SECTION
FIBER ROLL SILT BARRIER AT SAFETY FENCE



FIBER ROLL SILT BARRIER
Not to Scale



SAFETY FENCE WITH FIBER ROLL SILT BARRIER
Not to Scale

NOTES:
1. FIBER ROLL SHALL BE MADE FROM 100% MATTRESS GRADE COCONUT FIBER AND BOUND BY HIGH STRENGTH COIR NETTING, AND HAVE A MINIMUM WEIGHT OF 5 LBS PER LINEAL FOOT.
2. ORANGE SAFETY FENCE SHALL BE HIGH DENSITY POLYETHYLENE WITH A MESH OPENING OF APPROXIMATELY 1 INCH BY 4 INCHES AND A MINIMUM HEIGHT OF 4 FEET.
3. FIBER ROLL SILT BARRIER SHALL BE INSTALLED ALONG CONTOUR AND ON SLOPES 5H:1V OR FLATTER UNLESS OTHERWISE APPROVED BY TRPA.
4. THE INSTALLATION CONFIGURATION SHALL PREVENT RUNOFF FROM LEAVING THE SITE OR ENTERING A WATERCOURSE WITHOUT PASSING THROUGH A SILT BARRIER.
5. THE MAXIMUM LENGTH OF SLOPE DRAINING TO THE SILT BARRIER SHALL BE 100 FEET.
6. FIBER ROLL SHALL BE INSTALLED BY SHAPING A 4 INCH DEEP FURROW TO MATCH THE SHAPE OF THE LOG, SECURING IN FURROW WITH WOOD STAKES, AND TAMPING THE GROUND AROUND THE FIBER ROLL TO FILL VOIDS BETWEEN THE LOG AND THE GROUND.
7. TRPA BMP-517

PLANTED COIR LOG
Not to Scale

COIR LOG INSTALLATION
Scale: 1"=5'

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EDWARD E. WALLACE
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Revisions		
No.	Date	Description

Drawing Information	
Date	8 July 2015 (01:56)
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Drafter	tvs
Checked	eew
File Name	UT MARSH YR2 DETAILS
Plotted Scale	0 1/2 1 (15:56:02)

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Upper Truckee Marsh Sewer Facilities Adaptive Management Plan Year 2 Improvements

Details Sheet

Job Number 6000145

Sheet Number D2

Sheet 8 of 8

SHEET INDEX

South Tahoe Public Utility District

CONSTRUCTION PLANS FOR

Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan - Year 3 Improvements

OCTOBER 2016

PROJECT MANAGER

Ivo Bergsohn, Hydrogeologist
South Tahoe Public Utility District
1275 Meadow Crest Road
South Lake Tahoe, California 96150

APPROVED BY:

Shannon Catulla, Assistant General Manager *(date)*
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REGISTERED PROFESSIONAL ENGINEER — EDWARD E. WALLACE — No. 32301 — Exp: 12/31/16 CIVIL — STATE OF CALIFORNIA

4 oct 2016

Edward E. Wallace *(date)*
CALIFORNIA REGISTERED
PROFESSIONAL ENGINEER NO. # 32301
northwest hydraulic consultants

Vicinity Map

Project Location Map

Drawing Name: UT MARSH COVER YR3 (P:\600035_Truckee_Marsh\AC-600035\dwg\YR3)			Date: 4 OCTOBER 2016	
Drawing Status: Final Construction Documents	Designer: eew	Drafter: tvs	Checked: eew	Job Number: 6001103
Sheet 1 of 7				Sheet Number: T1

GENERAL NOTES

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING UTILITY COMPANIES TO DETERMINE THE LOCATION OF UNDERGROUND FACILITIES. THE LOCATION OF KNOWN EXISTING FACILITIES IN THE WORK AREA ARE SHOWN, BUT NO GUARANTEE IS MADE AS TO THE ACCURACY OF THIS INFORMATION.
2. THE CONTRACTOR SHALL PROTECT EXISTING SURVEY CONTROL POINTS AND SHALL BE RESPONSIBLE FOR CONSTRUCTION STAKING. IF EXISTING MONUMENT(S) MUST BE DISTURBED TO PERFORM THE WORK, THE CONTRACTOR SHALL NOTIFY THE DISTRICT FOR RELOCATION OF THE MONUMENT PRIOR TO BEGINNING TO WORK.
3. EXCESS MATERIAL IS TO BE REMOVED FROM THE SITE AND DISPOSED OF AT AN APPROVED SITE.
4. THE ENGINEER MAY MAKE MINOR CHANGES TO THE CONFIGURATION AND DESIGN GRADES OF PROJECT FEATURES AND TO REVEGETATION LAYOUTS TO SUIT FIELD CONDITIONS.
5. THE CONTRACTOR SHALL CONTACT THE DISTRICT IMMEDIATELY IF FIELD CONDITIONS ARE FOUND THAT CONFLICT WITH THESE PLANS. FIELD ADJUSTMENTS MUST BE APPROVED BY THE DISTRICT PRIOR TO CONSTRUCTION.
6. IF ANY ARTIFACTS OR OTHER MATERIALS ARE FOUND INDICATING POTENTIAL ARCHAEOLOGICAL OR HISTORICAL RESOURCES, WORK SHALL BE HALTED IMMEDIATELY AND THE CONTRACTOR SHALL CONTACT THE DISTRICT.
7. NO TREES ARE DESIGNATED FOR REMOVAL. IF FIELD CONDITIONS INDICATE THE NEED FOR TREE REMOVAL, PRIOR APPROVAL FROM THE DISTRICT AND TRPA IS REQUIRED.
8. NO GRADING SHALL OCCUR PRIOR TO INSTALLATION OF CONSTRUCTION BMPs AND APPROVAL BY TRPA AT A PRE–GRADE INSPECTION. BMPs TO BE INSTALLED PRIOR TO EQUIPMENT OR TRUCK USE OF ACCESS ROUTES IN PROJECT AREA.
9. WORK TO BE PERFORMED IS PART OF A MULTI–YEAR ADAPTIVE MANAGEMENT PLAN(AMP). PERMIT CONDITIONS FOR THE AMP APPLY TO THE PROJECT.
10. ON–SITE WORK SHALL BE PERFORMED FROM 8AM TO 6PM, MONDAY THROUGH FRIDAY. WORK OUTSIDE THESE HOURS MUST BE APPROVED BY THE DISTRICT A MINIMUM OF 48 HOURS BEFORE THE ABNORMAL WORKING HOURS ARE SCHEDULED TO BEGIN.
11. VEHICLE ACCESS RESTRICTED TO LOW GROUND PRESSURE UTILITY ATV (E.G., MULE), MAX WEIGHT 2000 LBS. ACCESS RESTRICTED TO MINIMUM NUMBER OF TRIPS REQUIRED FOR DELIVERY OF MATERIALS. AREAS OF WET GROUND TO BE PROTECTED, IF NEEDED TO AVOID RUTS OR OTHER DISTURBANCE OF THE MEADOW SURFACE.
12. CONTRACTOR TO PROVIDE SERVICES AS DIRECTED BY DISTRICT TO REMOVE DEBRIS AND MAINTAIN DRAINAGE IN EXISTING SECONDARY FLOW ROUTES FOR DEWATERING AND WATER MANAGEMENT AT THE SITE. CONTRACTOR TO DOCUMENT SERVICES PERFORMED ON A DAILY BASIS AND PROVIDE REPORTS TO THE DISTRICT WEEKLY.

AREAS & QUANTITIES - YEAR 3 IMPROVEMENTS

DISTURBANCE AREAS AND APPROXIMATE CUT/FILL QUANTITIES

COMPONENT	SURFACE AREA, SF	CUT (–)/FILL(+) CY
ACCESS ROUTES	14,200	0
PILOT CHANNELS	200	–5
DOUBLE MARSH MAT HUMMOCKS	1968	+5
MARSH MAT HUMMOCKS WITH WILLOW MATTRESS	352	0
PLANTED COIR LOGS	40	0
WETLAND PLUG PLANTINGS	200	0
HUMMOCKS	304	0
TOTALS	3078.2	0

[1]EXCLUDES AREAS WHERE ONLY PLANTING OCCURS

MONUMENT LOCATIONS

NAME	LATITUDE (NAD83)	LONGITUDE (NAD83)	NORTHING (GRID)	EASTING (GRID)	ELEVATION (NAVD88)
RBM T01	38.936805560°N	119.989783506°W	2109311.8	7133398.2	6234.3
RBM T02	38.936678391°N	119.989687343°W	2109266.1	7133426.6	6234.4
RBM T04	38.936695860°N	119.989298498°W	2109274.9	713537.0	6234.3
RBM T05	38.936536812°N	119.988919311°W	2109219.4	7133646.1	6235.0
RBM T07	38.936210006°N	119.987960945°W	2109106.4	7133921.3	6234.9

LEGEND

EXISTING TREES	
EXISTING EDGE OF PAVED ROAD	
EXISTING TRAIL	
EXISTING CONTOURS (MAJOR)	60
EXISTING CONTOURS (MINOR)	61
EXISTING FENCE	
EXISTING EDGE OF WATER (10/25/13)	
EXISTING BUILDINGS & STRUCTURES	
SURVEY CONTROL POINT	△
PROPOSED SLOPE	
CONSTRUCTION BASELINE	1+00
SILT BARRIER	
SAFETY PRESERVATION FENCE WITH SILT BARRIER	
PROPOSED CONTOURS (MAJOR)	80
PROPOSED CONTOURS (MINOR)	79
PROPOSED SPOT ELEVATIONS	83.2
HUMMOCK	
DIVERSION DAM	
STAGING AREA	

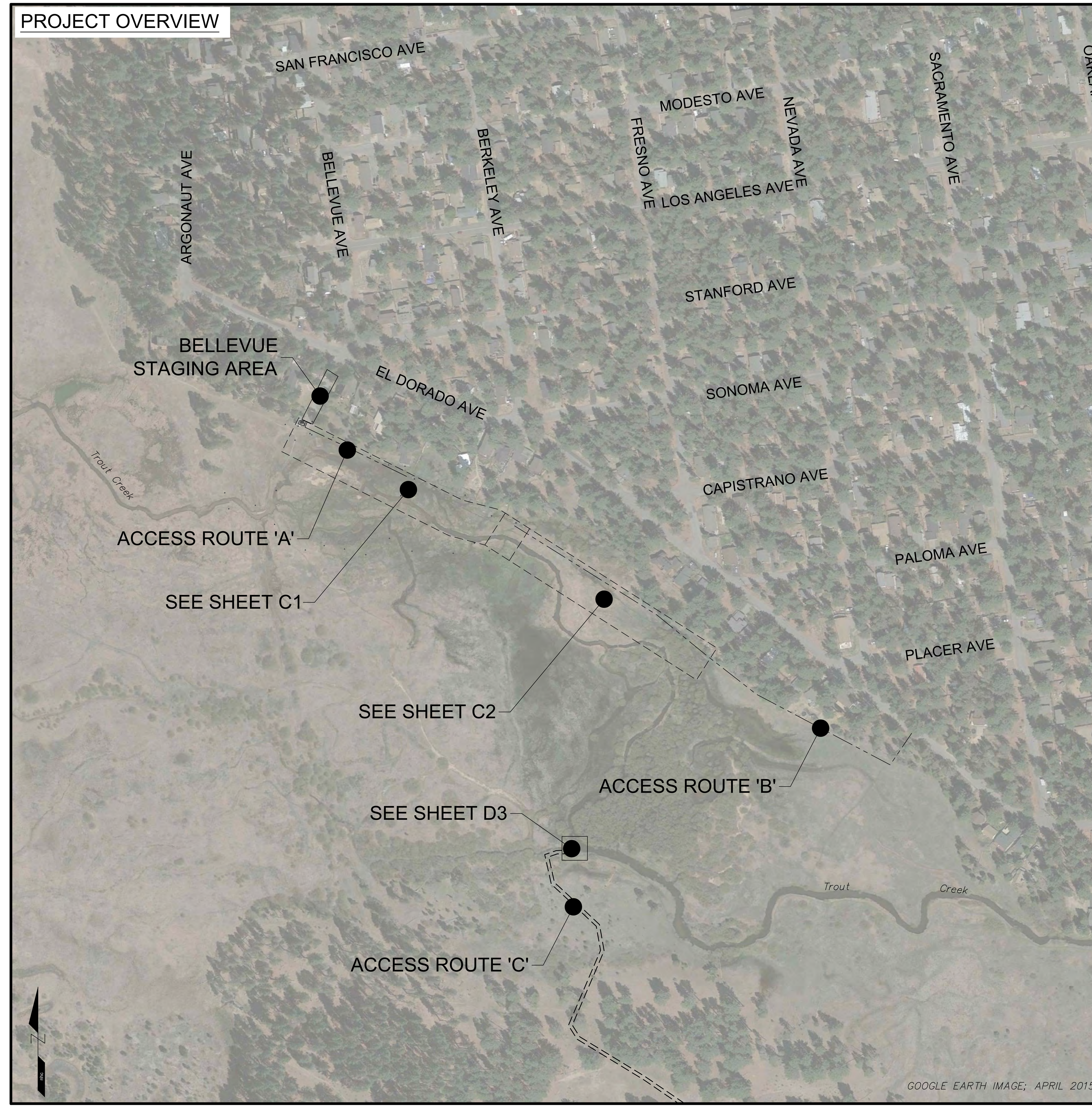
SURVEY
TOPOGRAPHY BASED ON FIELD SURVEY, 3 NOVEMBER 2013, BY TRI–STATE SURVEYING, LTD., AND 20 JANUARY 2015 AND NOVEMBER 2015 LUMOS & ASSOCIATES.

HORIZONTAL: NAD 83(2011) EPOCH 2010.00
CALIFORNIA STATE PLANE ZONE II, US SURVEY FEET

NGS HPGN D CA 03 FS
N 2107571.07 US SURVEY FEET–GRID
E 7136557.88

NGS RICHARDSON
N 2103848.87 US SURVEY FEET – GRID
E 7123525.92 GRID

VERTICAL: NAVD88
NGS HPGN D CA 03 FS
EL 6248.20



PROJECT OVERVIEW
SCALE: 1"=200'

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Revisions		
No.	Date	Description

Drawing Information	
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Status	Final Construction Documents
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Drafter	
Checked	
File Name	UT MARSH COVER YR3
Plotted Scale	0 1/2 1

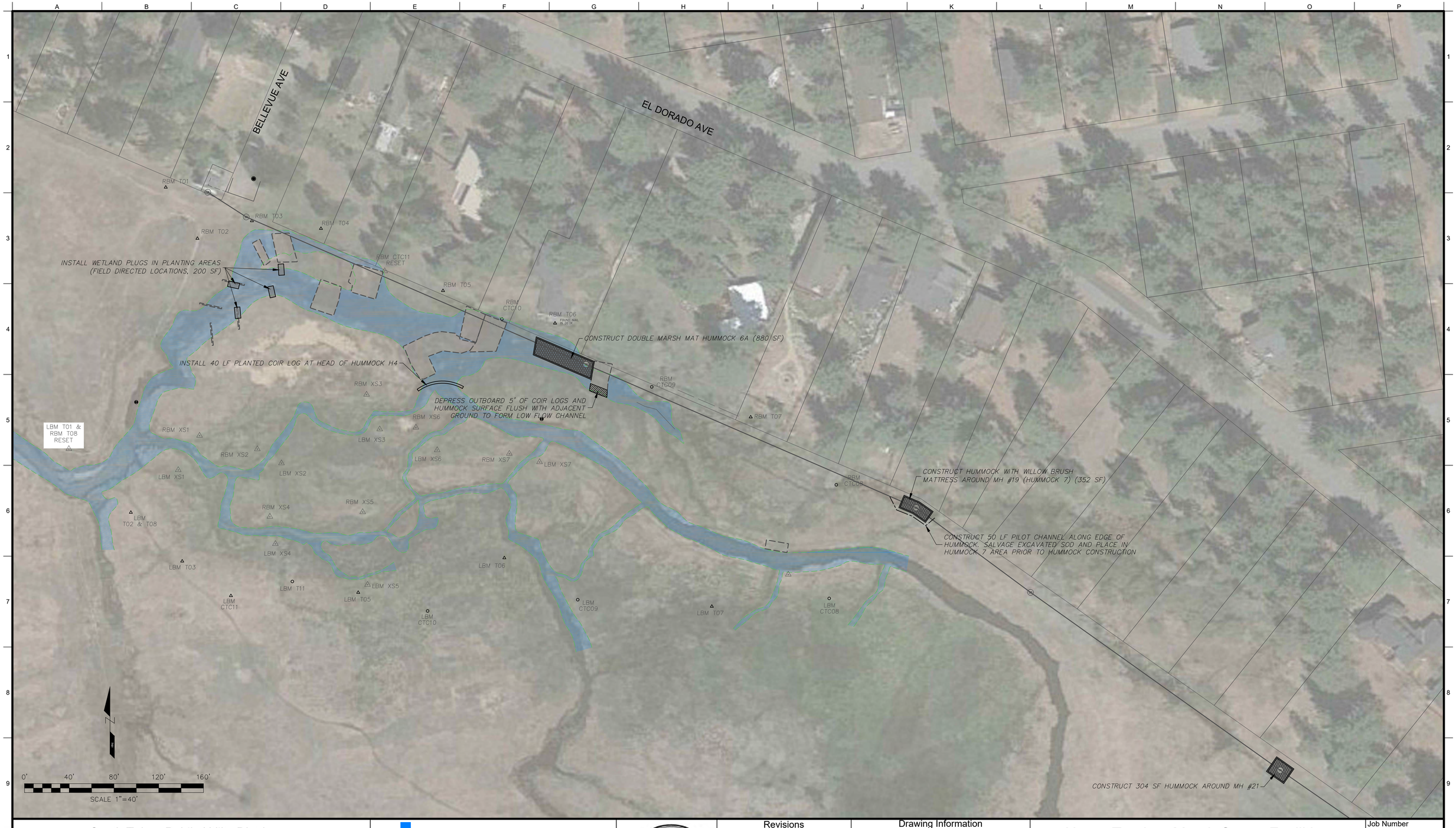
Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Years 2-5 Improvements

General Notes

Job Number
6001103

Sheet Number
G1

Sheet 2 of 7



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Drawing Information	
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Checked	eew
File Name	UT MARSH YR3
Plotted Scale	0 1/2 1

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Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Years 2-5 Improvements

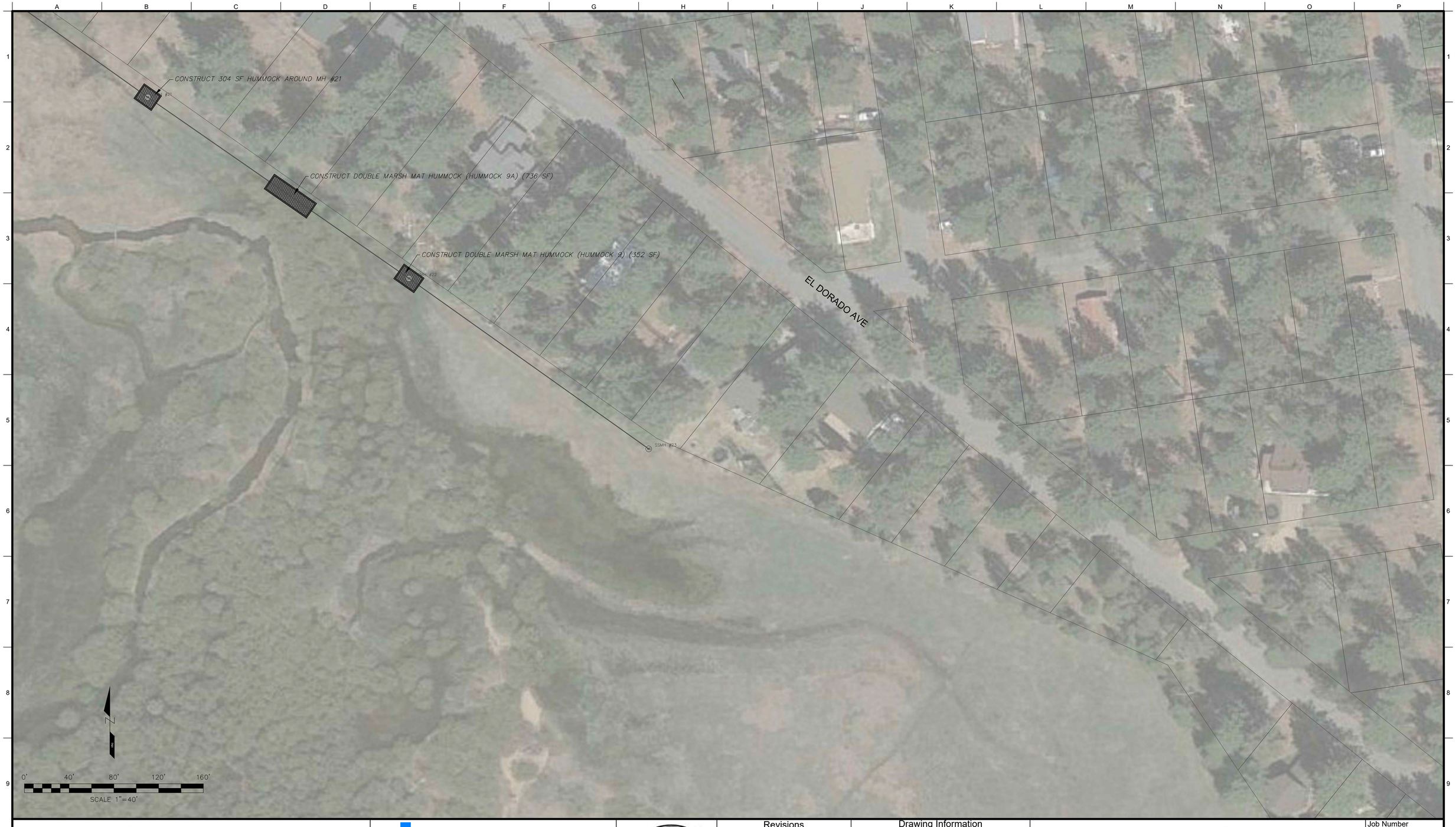
Plan Sheet

Job Number 6001103

Sheet Number

C1

Sheet 3 of 7



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File Name	UT MARSH YR3
Plotted Scale	0 1/2 1

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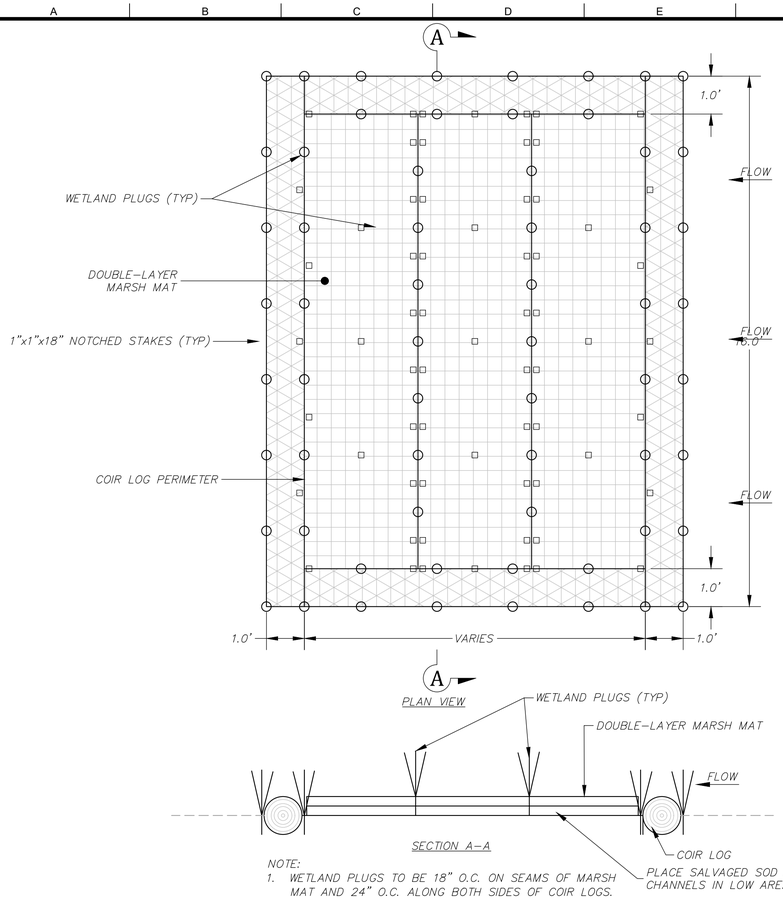
Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Years 2-5 Improvements

Plan Sheet

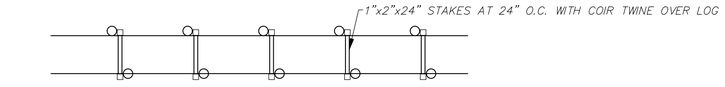
Job Number
6001103

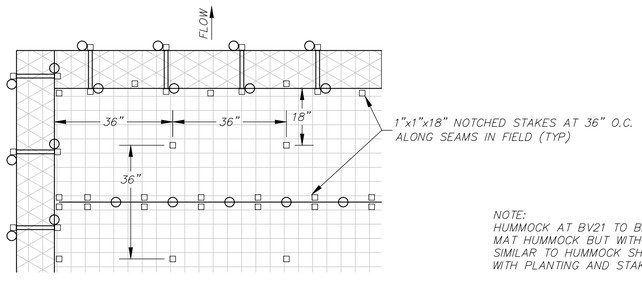
Sheet Number
C2



NOTE:
1. WETLAND PLUGS TO BE 18" O.C. ON SEAMS OF MARSH MAT AND 24" O.C. ALONG BOTH SIDES OF COIR LOGS.

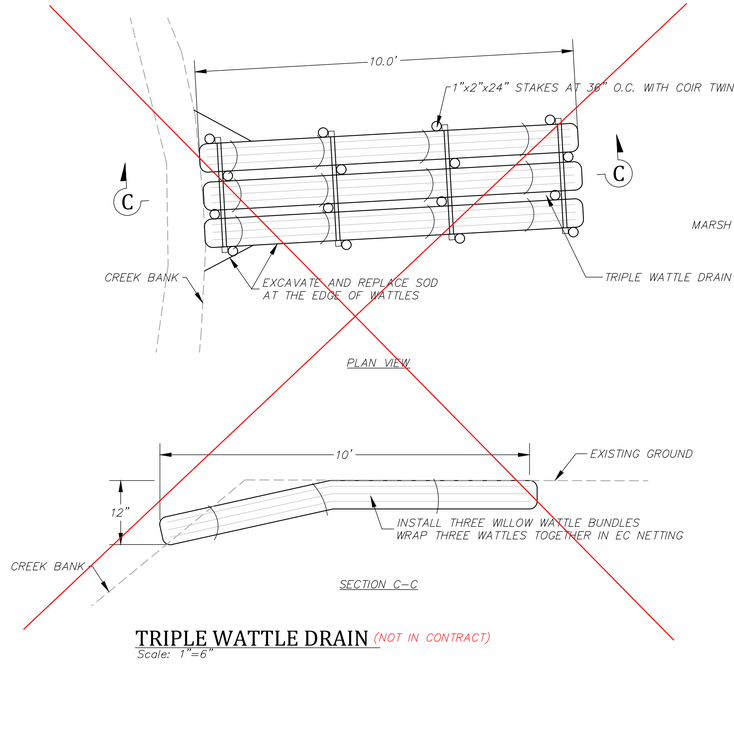
PLACE SALVAGED SOD FROM PILOT CHANNELS IN LOW AREAS OF SUBGRADE



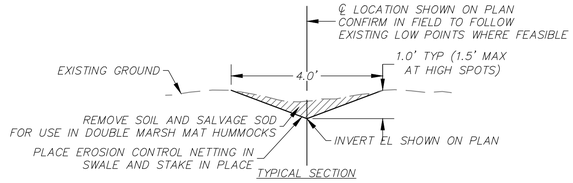


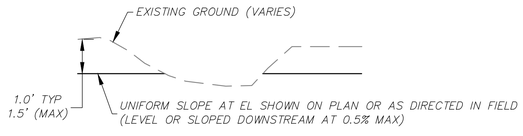
DOUBLE MARSH MAT
Scale: 1"=6"

NOTE:
HUMMOCK AT BV21 TO BE SIMILAR TO DOUBLE MARSH MAT HUMMOCK BUT WITH ONE LAYER OF MARSH MAT. SIMILAR TO HUMMOCK SHOWN ON Y2 PLAN SET BUT WITH PLANTING AND STAKING PER THIS SHEET.

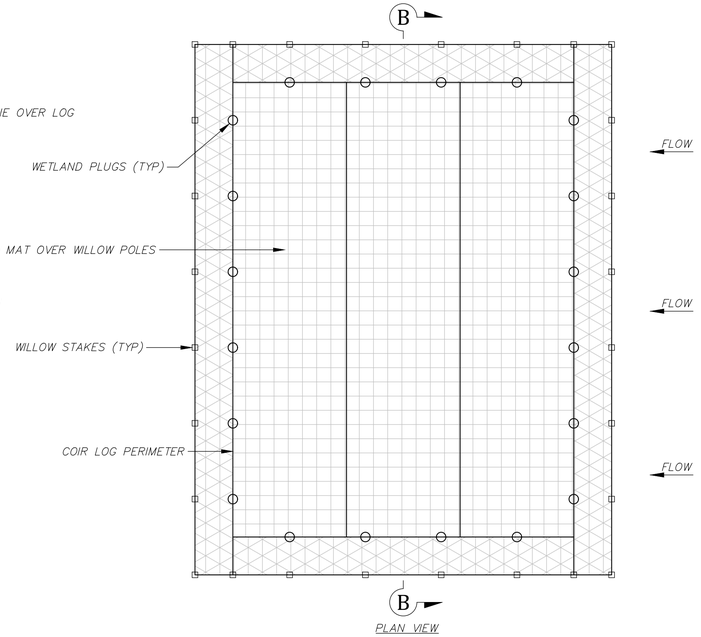


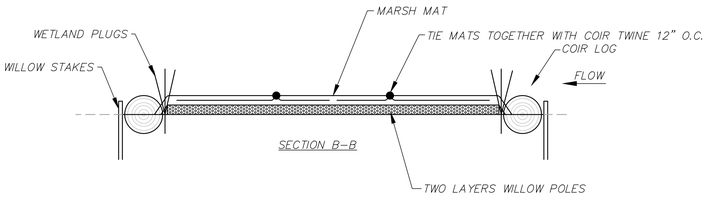
TRIPLE WATTLE DRAIN (NOT IN CONTRACT)
Scale: 1"=6"





PILOT CHANNEL
Not to Scale





HUMMOCK WITH WILLOW BRUSH MATTRESS
Scale: 1"=6"

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Revisions		
No.	Date	Description

Drawing Information	
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Plotted Scale	0 1/2 1

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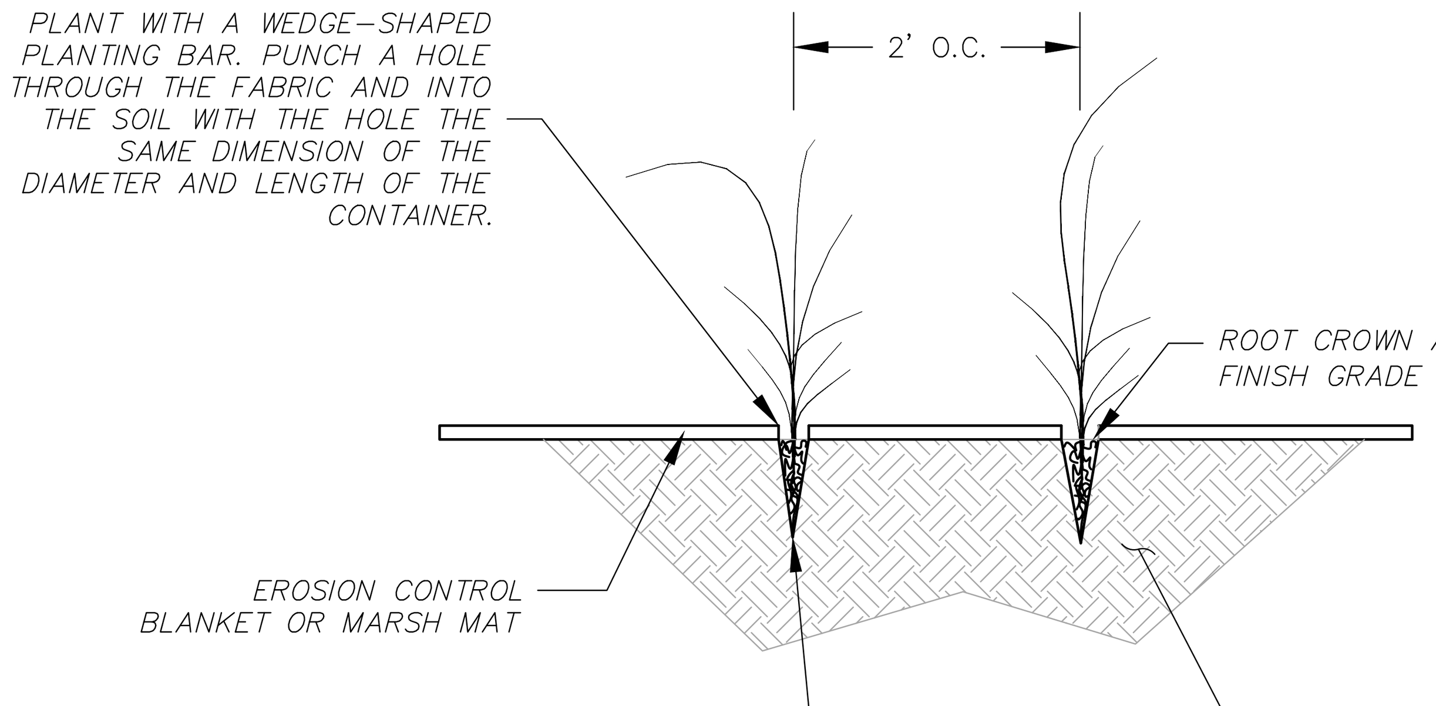
Upper Truckee Marsh Sewer Facilities Adaptive Management Plan Years 2-5 Improvements

Details Sheet

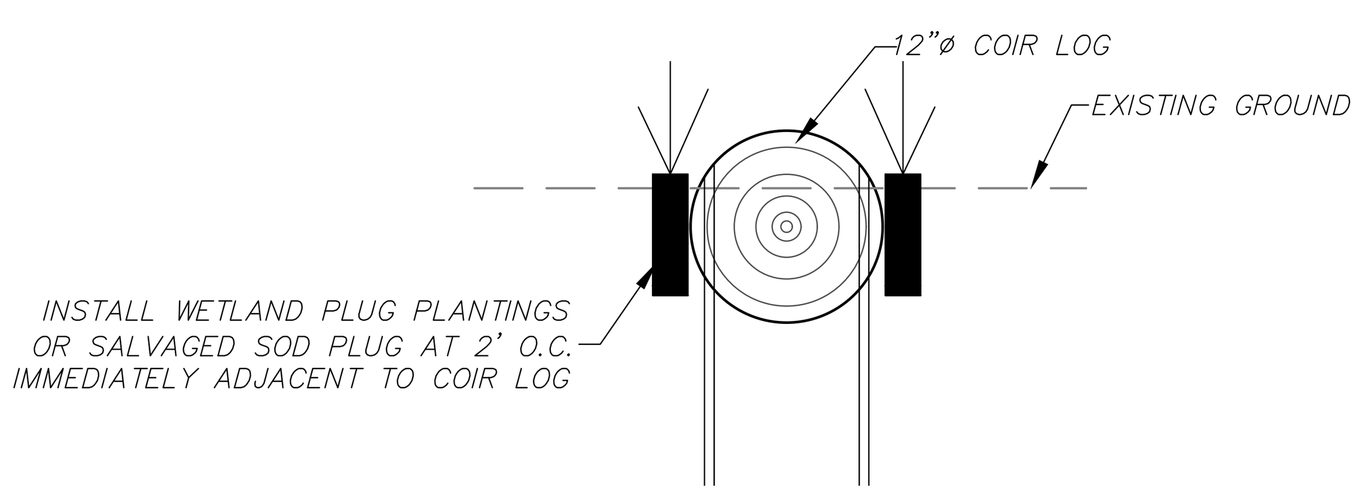
Job Number 6001103

Sheet Number D1

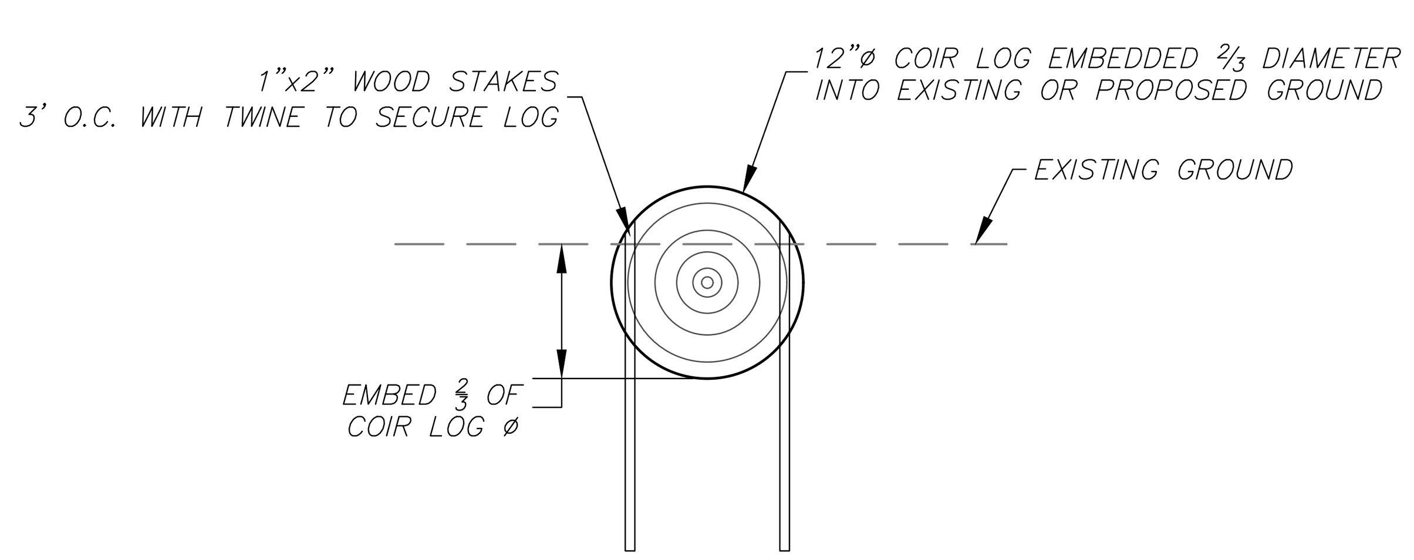


NOTES:
1. PULL NETTING APART PRIOR TO DIGGING THE PLANTING HOLE TO MINIMIZE THE NEED TO CUT THE FABRIC.
2. WETLAND PLUGS SHALL BE CAREX NEBRASCENSIS AND JUNCUS BALTICUS.
3. WETLAND PLUGS SHALL BE SUPERCELL 1.5 INCH WIDE AND 8 INCHES DEEP OR DEEPOTS (10-INCH DEPTH).
4. UP TO 45 WETLAND PLUGS WILL BE PLANTED AT LOCATIONS DIRECTED BY THE DISTRICT (NOT SHOWN ON PLANS)

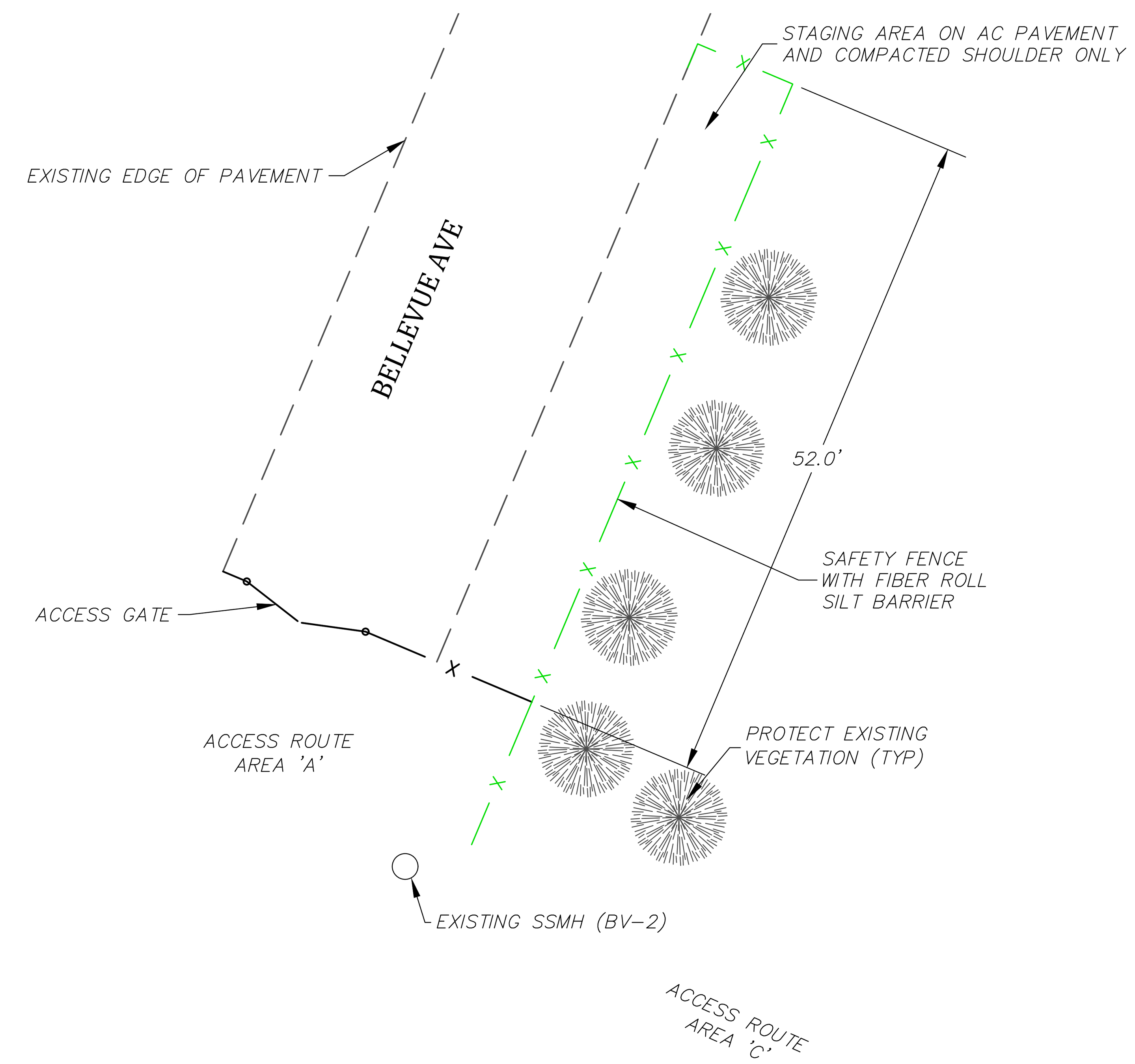
WETLAND PLUG PLANTING
Not to Scale



PLANTED COIR LOG
Not to Scale

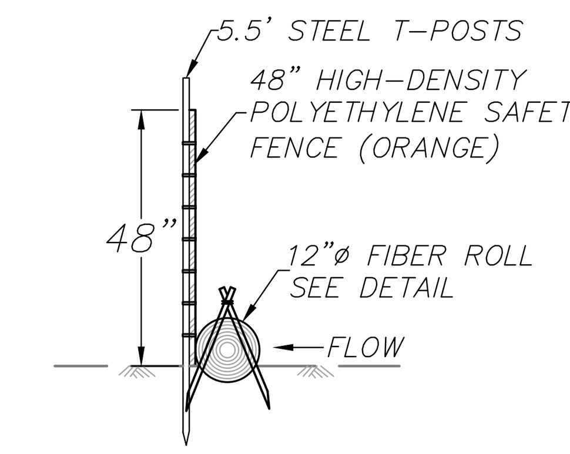


COIR LOG INSTALLATION
Scale: 1"=5'

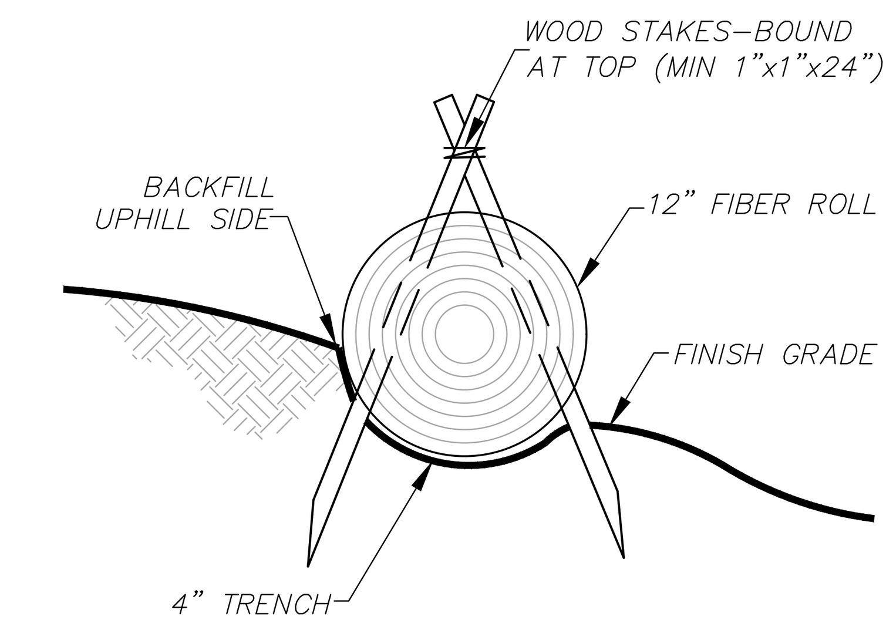


STAGING AREA BMPs
Not to Scale

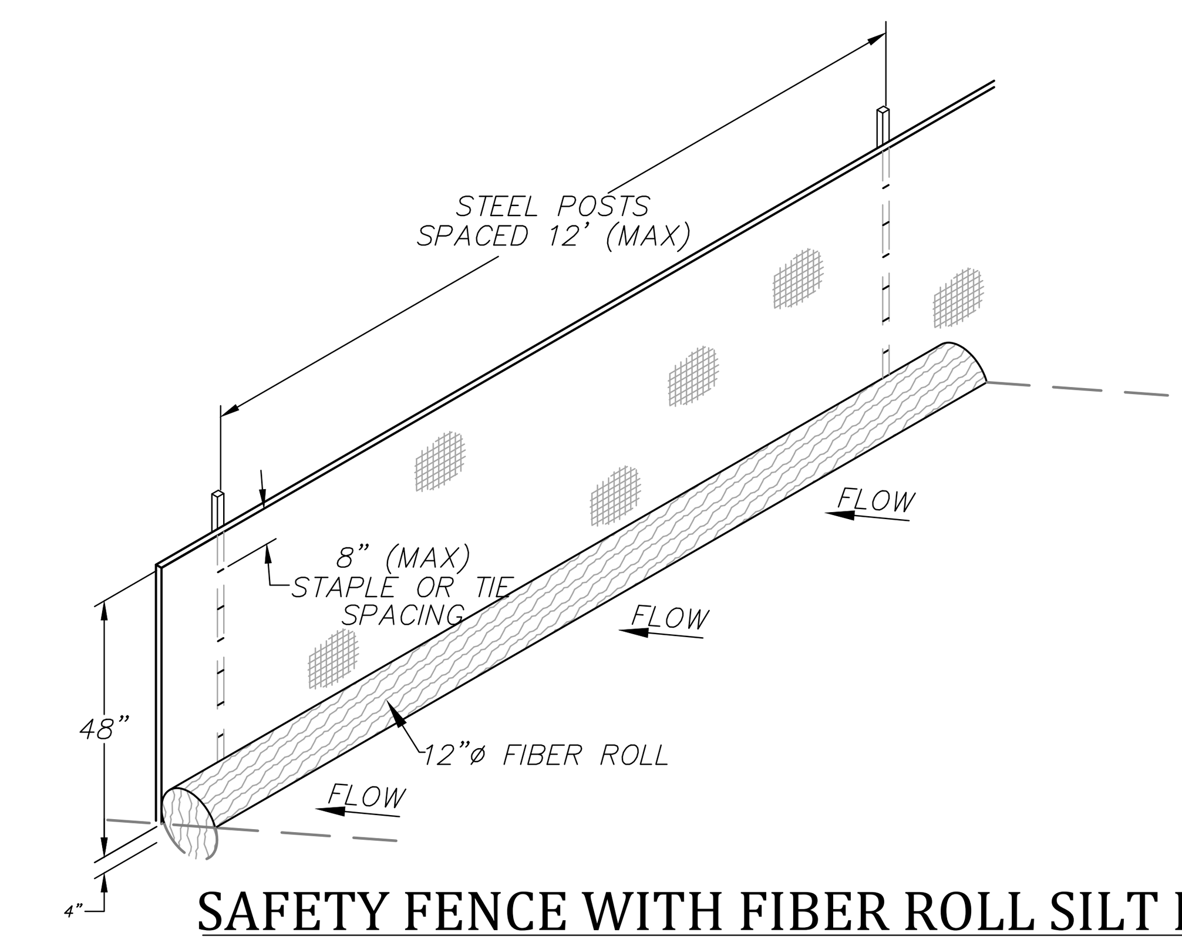
STAGING AREA BMP NOTES:
1. STAGING AREA TO BE MAINTAINED IN A CLEAN CONDITION
2. CONTRACTOR IS RESPONSIBLE TO MAINTAIN OR RESTORE EXISTING AC PAVEMENT TO A PRE-PROJECT CONDITION.



SECTION
FIBER ROLL SILT BARRIER AT SAFETY FENCE



FIBER ROLL SILT BARRIER
Not to Scale



SAFETY FENCE WITH FIBER ROLL SILT BARRIER
Not to Scale

NOTES:
1. FIBER ROLL SHALL BE MADE FROM 100% MATTRESS GRADE COCONUT FIBER AND BOUND BY HIGH STRENGTH COIR NETTING, AND HAVE A MINIMUM WEIGHT OF 5 LBS PER LINEAL FOOT.
2. ORANGE SAFETY FENCE SHALL BE HIGH DENSITY POLYETHYLENE WITH A MESH OPENING OF APPROXIMATELY 1 INCH BY 4 INCHES AND A MINIMUM HEIGHT OF 4 FEET.
3. FIBER ROLL SILT BARRIER SHALL BE INSTALLED ALONG CONTOUR AND ON SLOPES 5H:1V OR FLATTER UNLESS OTHERWISE APPROVED BY TRPA.
4. THE INSTALLATION CONFIGURATION SHALL PREVENT RUNOFF FROM LEAVING THE SITE OR ENTERING A WATERCOURSE WITHOUT PASSING THROUGH A SILT BARRIER.
5. THE MAXIMUM LENGTH OF SLOPE DRAINING TO THE SILT BARRIER SHALL BE 100 FEET.
6. FIBER ROLL SHALL BE INSTALLED BY SHAPING A 4 INCH DEEP FURROW TO MATCH THE SHAPE OF THE LOG, SECURING IN FURROW WITH WOOD STAKES, AND TAMPING THE GROUND AROUND THE FIBER ROLL TO FILL VOIDS BETWEEN THE LOG AND THE GROUND.
7. TRPA BMP-517

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Revisions

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Drawing Information

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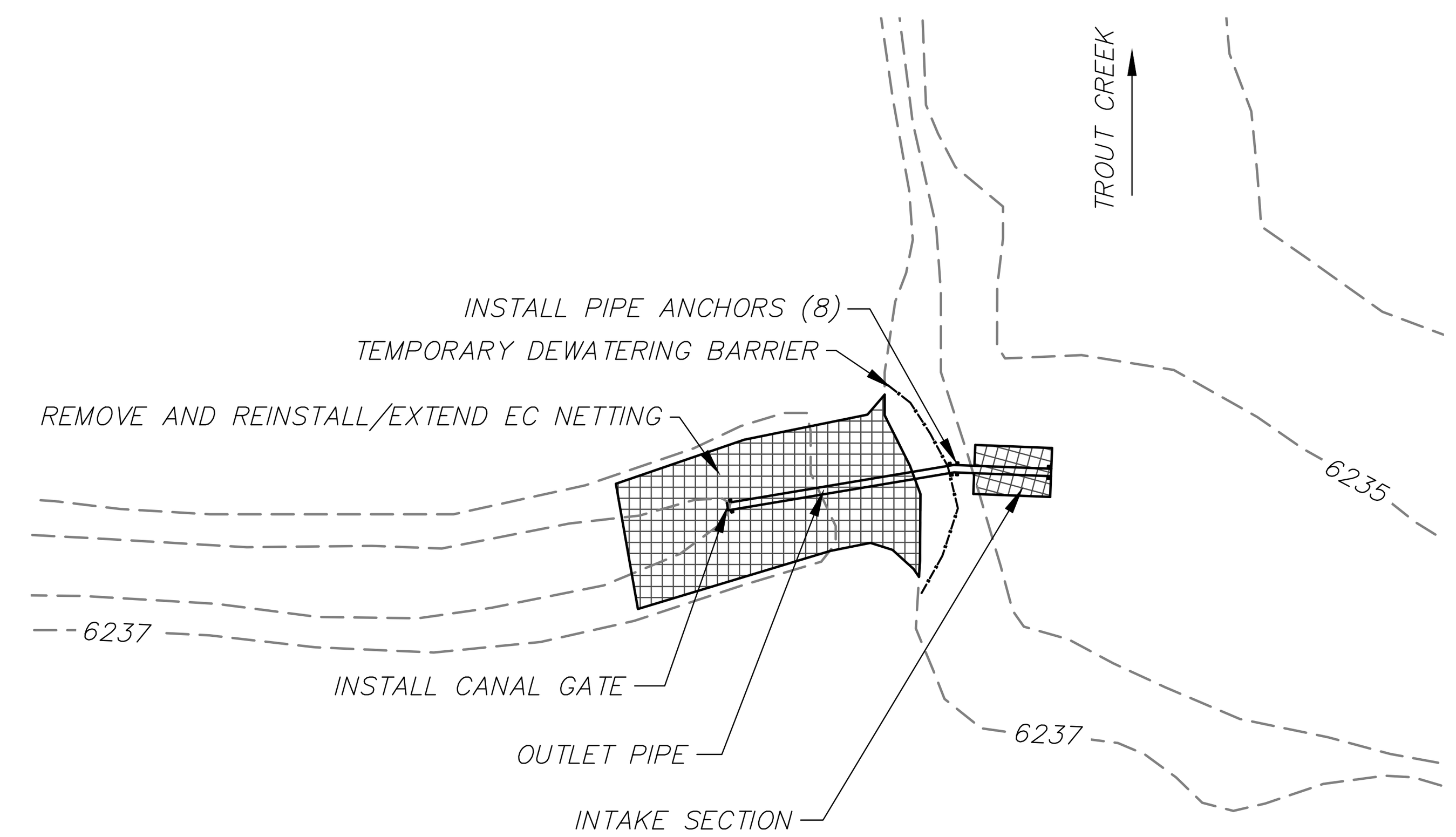
Plotted Scale	0 1/2 1

Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Years 2-5 Improvements
Details Sheet

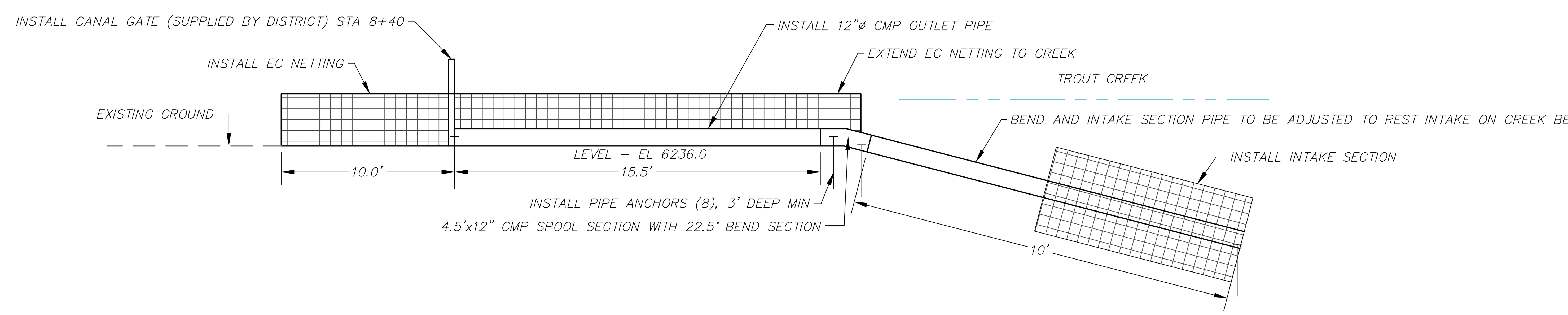
Job Number
6001103

Sheet Number
D2

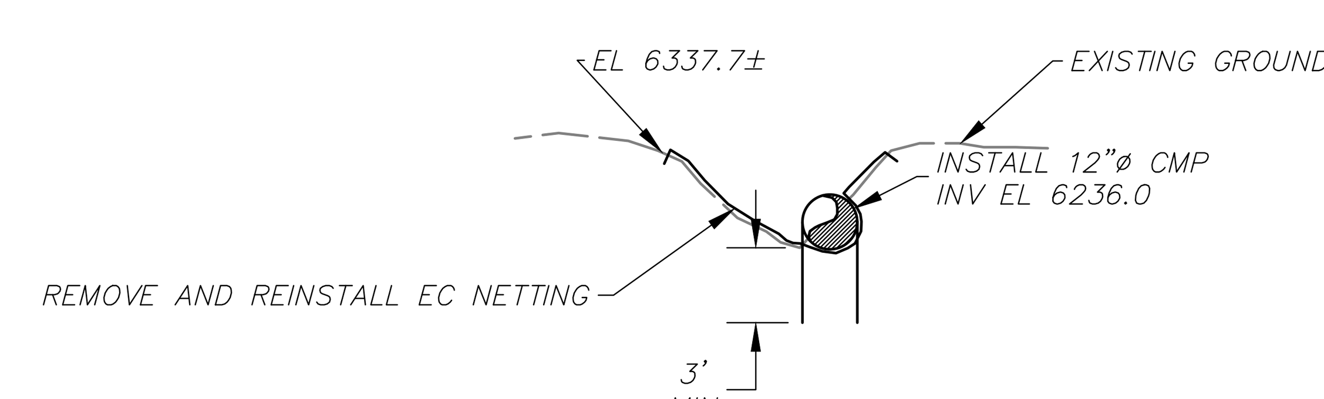


NOTES:
POND LEVELER TO BE INSTALLED IN THE FOLLOWING STEPS:
1. INSTALL TEMPORARY DEWATERING BARRIER AT HEAD OF SECONDARY CHANNEL TO STOP FLOW INTO SECONDARY CHANNEL
2. REMOVE EXISTING EROSION CONTROL FABRIC
3. EXCAVATE FOR PIPE BEDDING
4. REINSTALL AND EXTEND EROSION CONTROL FABRIC
5. INSTALL OUTLET PIPE AND CANAL GATE
6. REMOVE TEMPORARY DEWATERING BARRIER
7. INSTALL INTAKE SECTION IN TROUT CREEK

PIPE ANCHORS TO BE ¾" GALVANIZED PIPE WITH A TEE FITTING AT TOP AND ⅜" POLYESTER ROPE STRAPS, TIGHTENED TO HOLD PIPE TO GROUND.



NOTES:
1. CONTRACTOR TO SCHEDULE DELIVERY OF POND LEVELER TO PROJECT SITE BY DISTRICT.
2. SECONDARY CHANNEL TO BE DEWATERED FOR INSTALLATION OF OUTLET PIPE. INSTALLATION AND CONNECTION OF INTAKE SECTION SHALL BE MADE IN THE WATER (TROUT CREEK).
3. OUTLET PIPE TO BE INSTALLED LEVEL AT EL 6236.0
4. BEND CONNECTION BETWEEN OUTLET PIPE AND INTAKE SECTION TO BE ADJUSTED TO REST INTAKE SECTION ON BED OF CREEK CHANNEL
5. EROSION CONTROL NETTING TO BE 0.3" 100% COIR NETTING WITH 50% OPEN AREA (70 OR 700 SERIES PRODUCT)
6. OUTLET PIPE TO BE INSTALLED ALONG RIGHT BANK (LOOKING DOWNSTREAM) OF SECONDARY CHANNEL AND BACKFILLED ALONG THE BANK WITH SOD SALVAGED AT LOCATIONS IDENTIFIED IN THE FIELD BY ENGINEER



LONGITUDINAL SECTION

POND LEVELER

Not to Scale

South Tahoe Public Utility District
1275 Meadow Crest Drive
South Lake Tahoe, California 96150
(530) 544-6474
www.stpud.us

nhc
northwest hydraulic consultants
80 south lake avenue, suite 800
pasadena, california 91101
phone: (626) 440–0080
fax: (626) 440–1881
www.nhcweb.com

REGISTERED PROFESSIONAL ENGINEER
EDWARD E. WALLACE
No. 32301
Exp: 12/31/16
CIVIL
STATE OF CALIFORNIA

Revisions		
No.	Date	Description

Drawing Information	
Date	4 October 2016 (09:11)
Status	Final Construction Documents
Designer	eew
Drafter	tvs
Checked	eew
File Name	UT MARSH DETAIL YR3
Plotted Scale	0 1/2 1

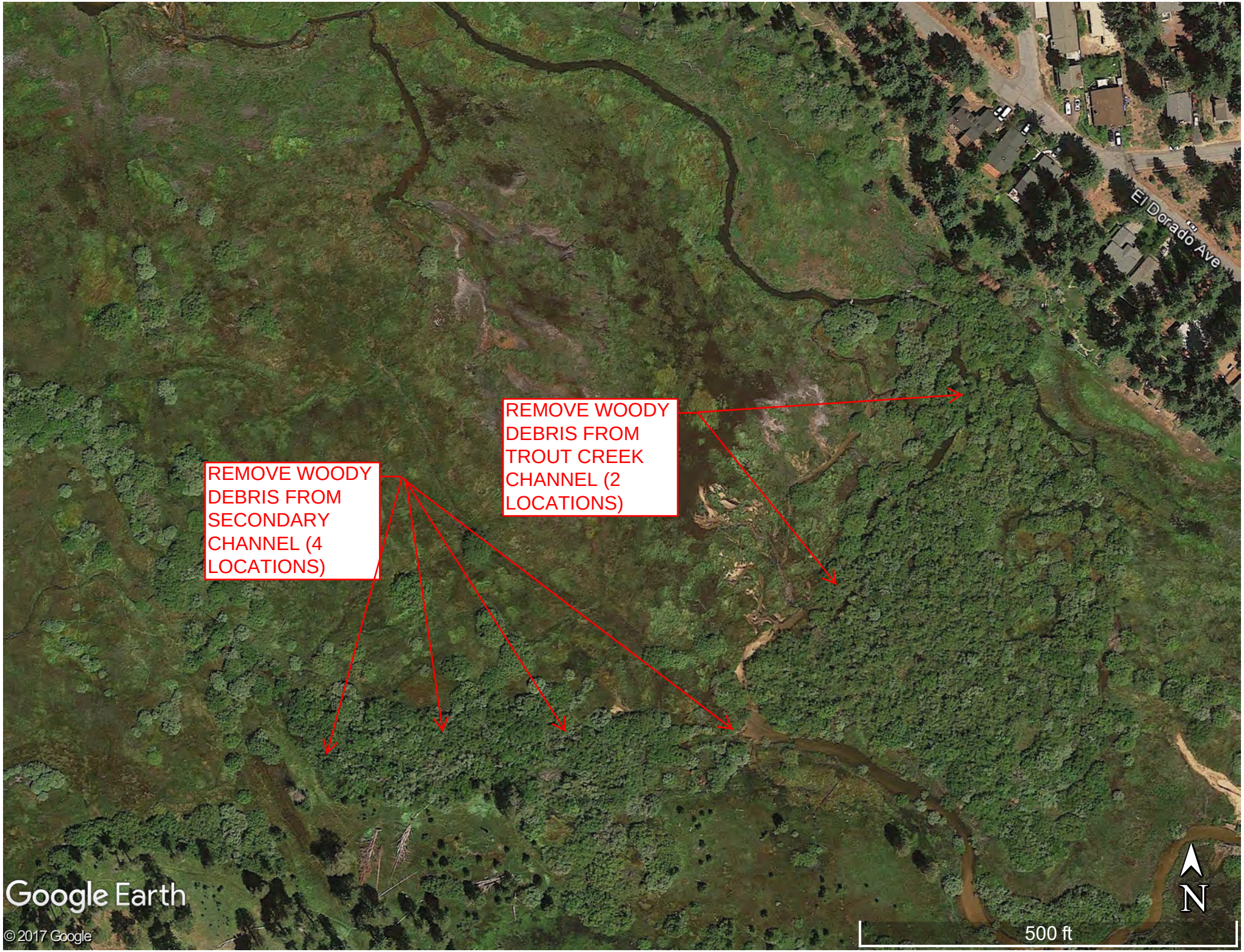
Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Years 2-5 Improvements

Details Sheet

Job Number
6001103

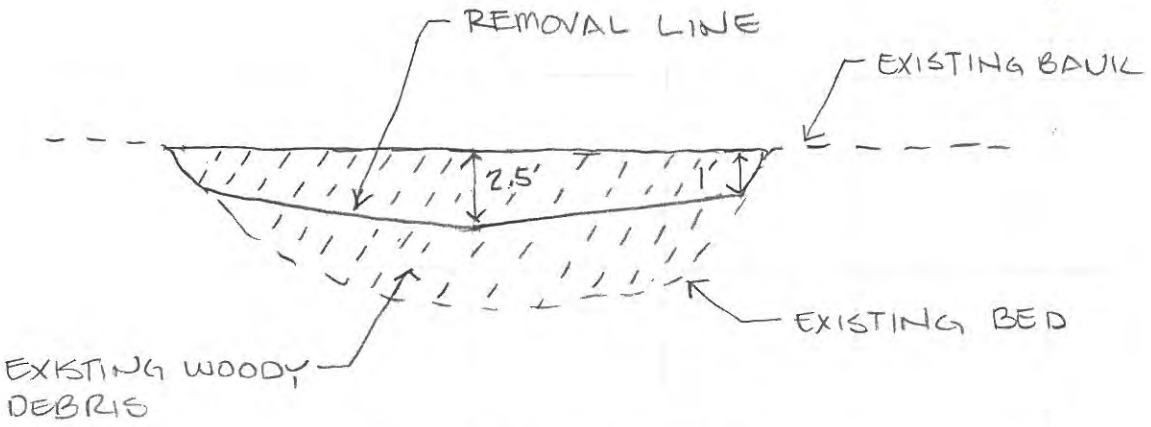
Sheet Number

D3

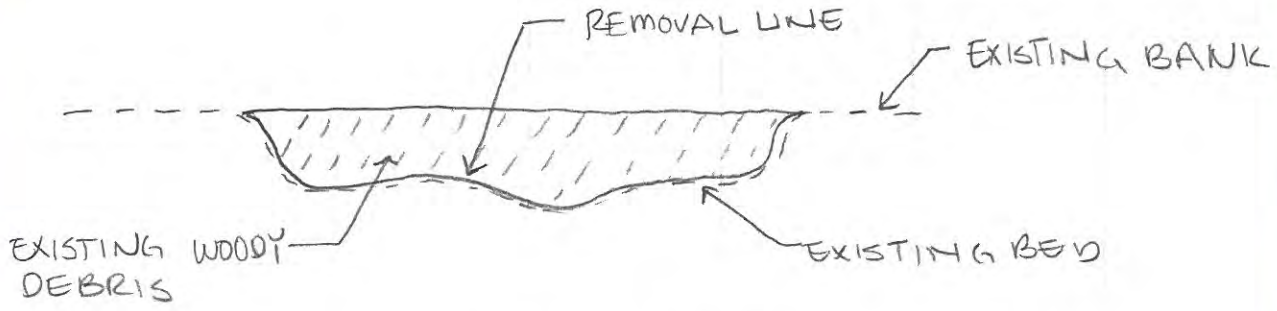

REMOVE WOODY DEBRIS FROM SECONDARY CHANNEL (4 LOCATIONS)
REMOVE WOODY DEBRIS FROM TROUT CREEK CHANNEL (2 LOCATIONS)
El Dorado Ave
Google Earth
© 2017 Google
N
500 ft

northwest hydraulic consultants inc.	DATE:	BY:	CHK:
PROJECT:		JOB NUMBER:	
SUBJECT:			SCALE:

NOTES:
1. DEBRIS WILL BE PARTIALLY REMOVED FROM OBSTRUCTIONS ON TROUT CREEK AND FULLY REMOVED ON SECONDARY CHANNEL
2. DISPOSE OF WOODY DEBRIS BY SCATTERING ON FLOODPLAIN
3. WORK TO BE PERFORMED BY HAND CREWS - NO EQUIPMENT ACCESS



TYPICAL SECTION
WOODY DEBRIS REMOVAL
TROUT CREEK CHANNEL
(NTS)



TYPICAL SECTION
WOODY DEBRIS REMOVAL
SECONDARY CHANNEL
(NTS)

APPENDIX B

PHOTO POINTS AND SUPPLEMENTAL PHOTOS

SOUTH FORK PUBLIC UTILITY DISTRICT

nhc
northwest hydraulic consultants

Legend

Photo Monitoring Stations

Survey Cross Sections

SCALE - 1:800

0 25 50 75 100 ft

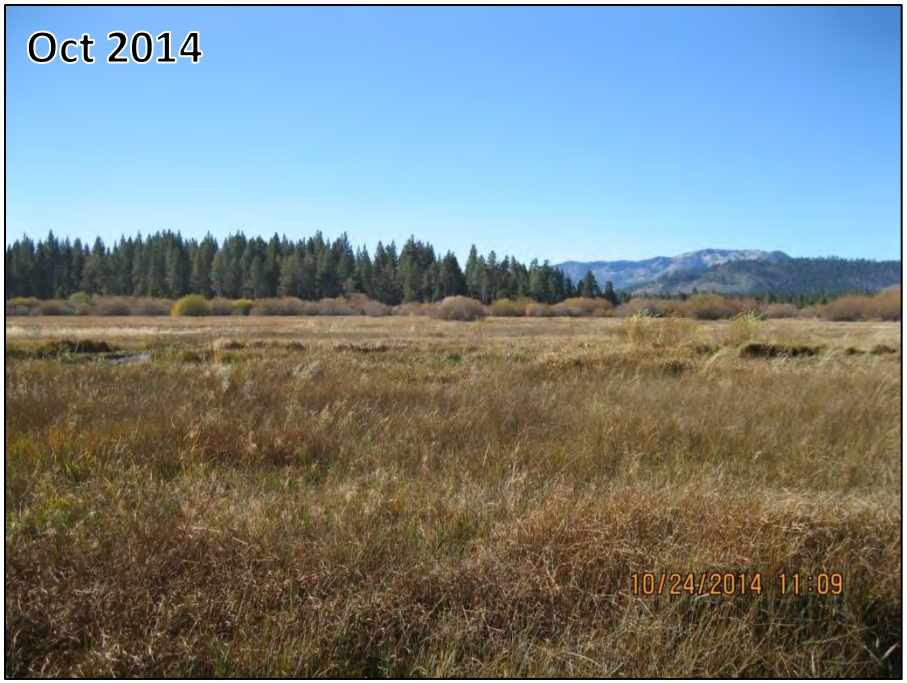
N

DATA SOURCES:
Google Earth

Job: 600035

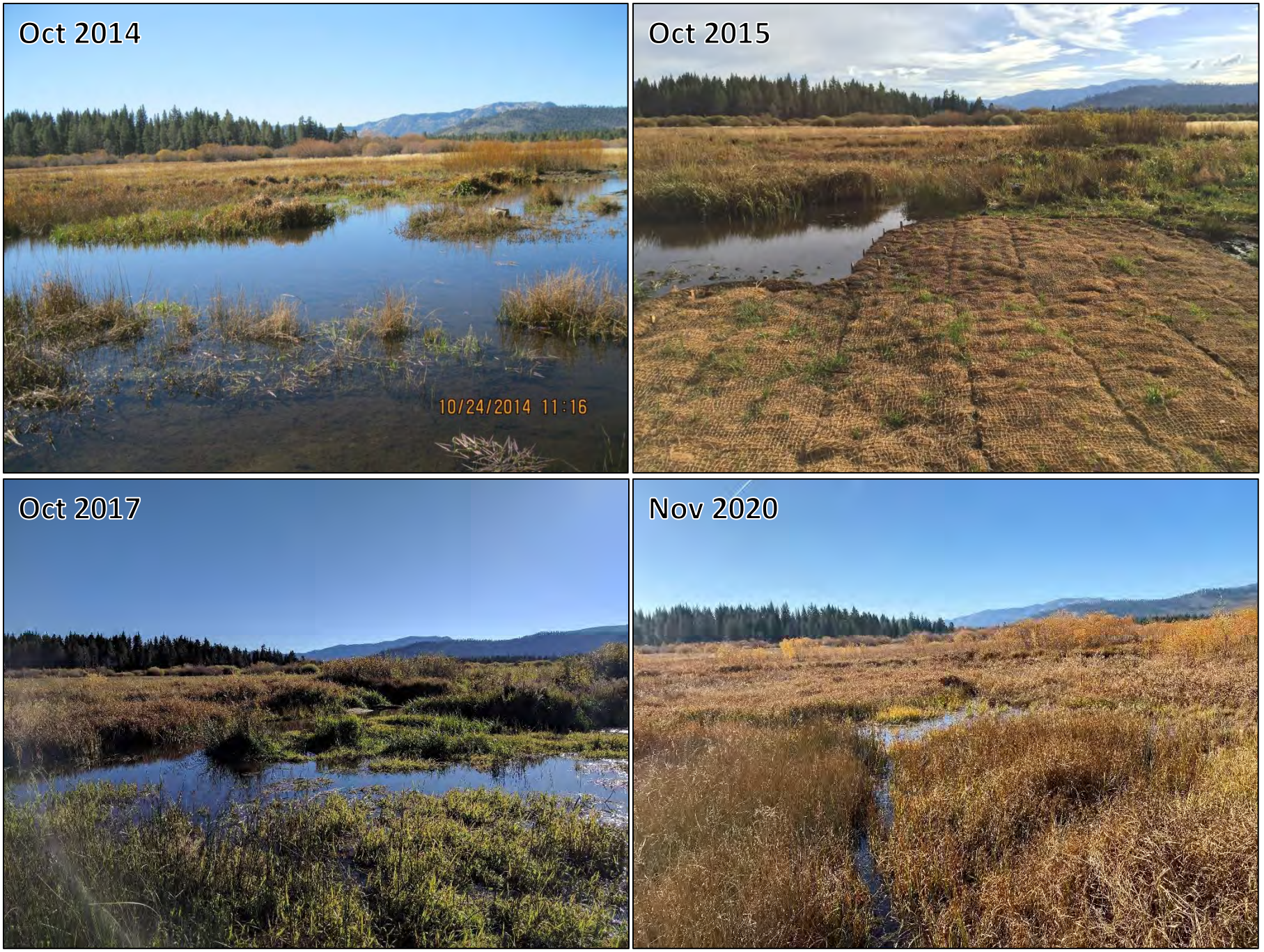
JANUARY 2014

Locations of Photo Points



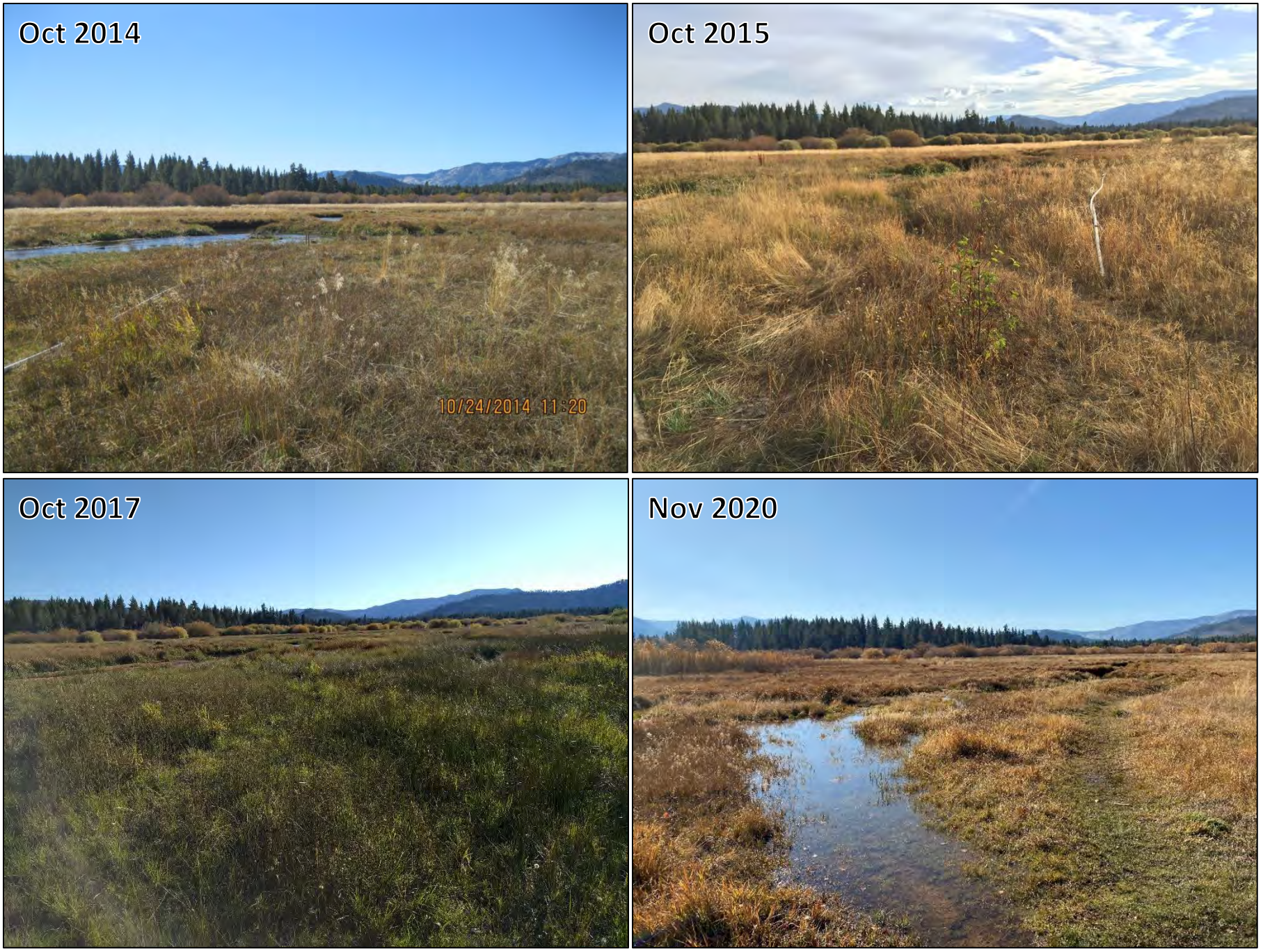
TMSFPP AMP Closeout – Photo Point 1 – Looking southwest across right overbank

TMSFPP AMP Closeout – Photo Point 2 – Looking southwest across right overbank

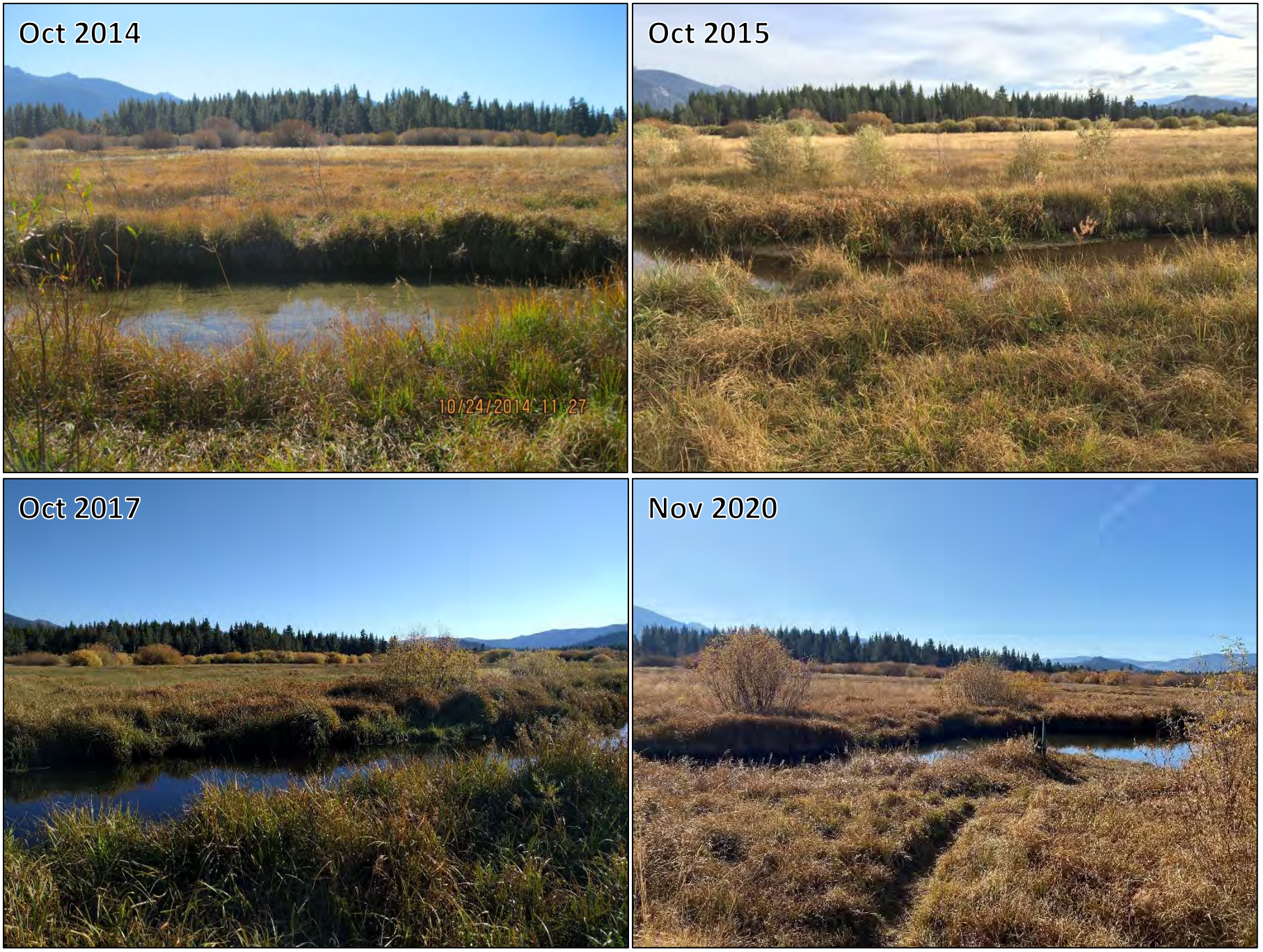


TMSFPP AMP Closeout – Photo Point 3 – Looking southwest across right overbank in avulsion area; LBO-1 at middle far right of view, FH5A in foreground

TMSFPP AMP Closeout – Photo Point 4 – Looking southwest across right overbank in avulsion area; FH-3 at lower right

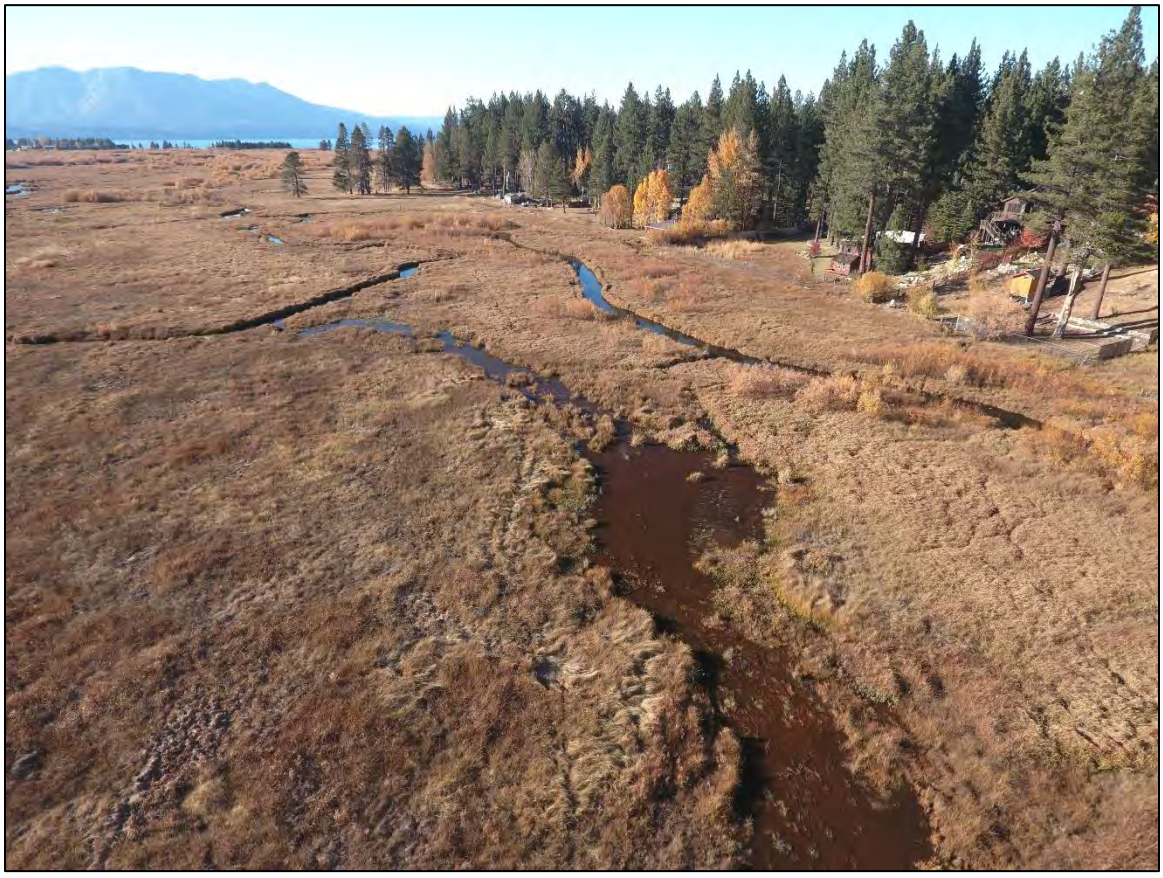


TMSFPP AMP Closeout – Photo Point 5 – Looking southwest across right overbank at downstream end of avulsion area



TMSFPP AMP Closeout – Photo Point 6 – Looking southwest across marsh towards Trout Creek near downstream end of Bellevue Avenue project area

Oblique view looking downstream



Oblique view looking downstream from upstream end of Bellevue Avenue project area

Oblique view looking upstream from downstream end of Bellevue Avenue project area

View upstream of flow deflector – note surveyor standing at downstream end of beaver dam for scale

Oblique downstream view (1 of 8)

Oblique downstream view (2 of 8)

Oblique downstream view (3 of 8)

Oblique downstream view (4 of 8)

Oblique downstream view (5 of 8) – note surveyor for scale

Oblique downstream view (6 of 8)

Oblique downstream view (7 of 8)

Oblique downstream view (8 of 8) – note surveyor for scale

APPENDIX C

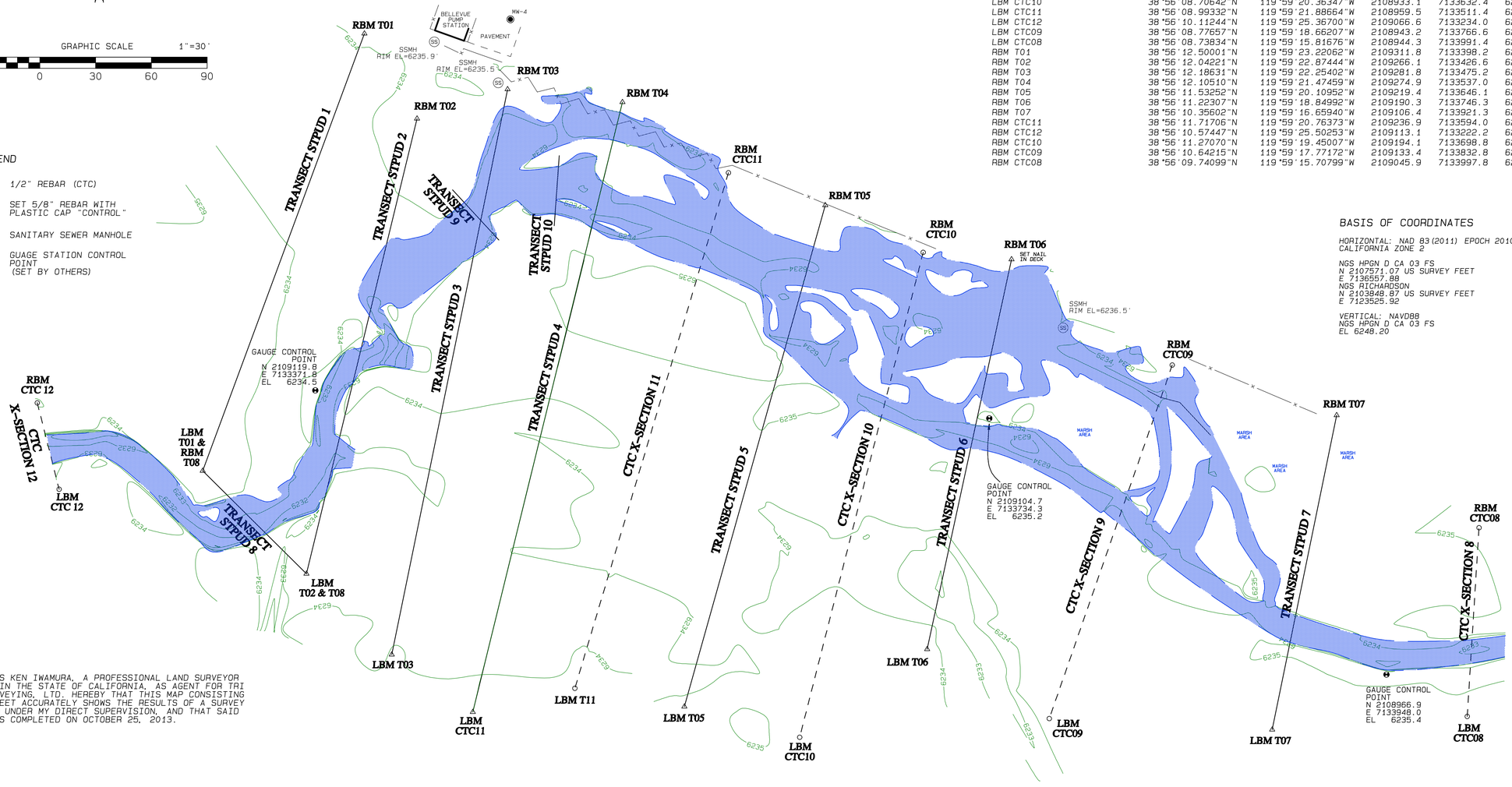
SURVEY DATA

TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT FOR SOUTH TAHOE PUBLIC UTILTY DISTRICT

GRAPHIC SCALE 1"=30'
0 30 60 90

LEGEND

- ○ 1/2" REBAR (CTC)
- △ SET 5/8" REBAR WITH PLASTIC CAP "CONTROL"
- (SS) SANITARY SEWER MANHOLE
- GUAGE STATION CONTROL POINT (SET BY OTHERS)



MONUMENT NAME	LATITUDE (NAD83)	LONGITUDE (NAD83)	NORTHING (GRID)	EASTING (GRID)	ELEV (NAVD88)	ELEV (NGVD29)
LBM T01 & RBM T08	38°56'10.19405"N	119°59'24.38718"W	2109076.5	7133311.2	6234.3	6230.3
LBM T02 & LBM T08	38°56'09.63427"N	119°59'23.69647"W	2109021.1	7133367.0	6233.9	6229.9
LBM T03	38°56'09.19403"N	119°59'23.12797"W	2108977.6	7133412.9	6234.2	6230.2
LBM T04	38°56'08.87901"N	119°59'22.58537"W	2108946.7	7133456.5	6234.4	6230.5
LBM T05	38°56'08.88303"N	119°59'21.14451"W	2108949.6	7133570.3	6234.2	6230.3
LBM T06	38°56'09.15997"N	119°59'19.48238"W	2108980.5	7133700.9	6234.6	6230.6
LBM T07	38°56'08.69097"N	119°59'17.14688"W	2108937.2	7133886.5	6234.5	6230.5
LBM CTC10	38°56'08.70642"N	119°59'20.36347"W	2108933.1	7133632.4	6234.6	6230.6
LBM CTC11	38°56'08.99332"N	119°59'21.88664"W	2108959.5	7133511.4	6234.4	6230.4
LBM CTC12	38°56'10.11244"N	119°59'25.36700"W	2109066.6	7133234.0	6233.9	6229.9
LBM CTC09	38°56'08.77657"N	119°59'18.66207"W	2108943.2	7133766.6	6235.2	6231.2
LBM CTC08	38°56'08.73834"N	119°59'15.81676"W	2108944.3	7133991.4	6234.9	6231.0
RBM T01	38°56'12.50001"N	119°59'23.22062"W	2109311.8	7133398.2	6234.3	6230.3
RBM T02	38°56'12.04221"N	119°59'22.87444"W	2109266.1	7133426.6	6234.4	6230.4
RBM T03	38°56'12.18631"N	119°59'22.25402"W	2109281.8	7133475.2	6234.4	6230.5
RBM T04	38°56'12.10510"N	119°59'21.47459"W	2109274.9	7133537.0	6234.3	6230.3
RBM T05	38°56'11.53252"N	119°59'20.10952"W	2109219.4	7133646.1	6235.0	6231.0
RBM T06	38°56'11.22307"N	119°59'18.84992"W	2109190.3	7133746.3	6236.5	6232.5
RBM T07	38°56'10.35602"N	119°59'16.65940"W	2109106.4	7133921.3	6234.9	6230.9
RBM CTC11	38°56'11.71706"N	119°59'20.76373"W	2109236.9	7133594.0	6235.2	6231.2
RBM CTC12	38°56'10.57447"N	119°59'25.50253"W	2109113.1	7133222.2	6234.3	6230.3
RBM CTC10	38°56'11.27070"N	119°59'19.45007"W	2109194.1	7133698.8	6235.1	6231.1
RBM CTC09	38°56'10.64215"N	119°59'17.77172"W	2109133.4	7133832.8	6235.0	6231.1
RBM CTC08	38°56'09.74099"N	119°59'15.70799"W	2109045.9	7133997.8	6235.6	6231.6

BASIS OF COORDINATES

HORIZONTAL: NAD 83(2011) EPOCH 2010.00
CALIFORNIA ZONE 2

NGS HPGN D CA 03 FS
N 2107571.07 US SURVEY FEET
E 7136557.88
NGS RICHARDSON
N 2103848.87 US SURVEY FEET
E 7123525.92

VERTICAL: NAVD88
NGS HPGN D CA 03 FS
EL 6248.20

I, CHARLES KEN IWAMURA, A PROFESSIONAL LAND SURVEYOR LICENSED IN THE STATE OF CALIFORNIA, AS AGENT FOR TRI STATE SURVEYING, LTD. HEREBY THAT THIS MAP CONSISTING OF ONE SHEET ACCURATELY SHOWS THE RESULTS OF A SURVEY PERFORMED UNDER MY DIRECT SUPERVISION, AND THAT SAID SURVEY WAS COMPLETED ON OCTOBER 25, 2013.

CHARLES KEN IWAMURA
PROFESSIONAL LAND SURVEYOR
CALIFORNIA CERTIFICATE NO. 8540

TRI STATE SURVEYING, LTD
425 EAST LONG STREET
CARSON CITY, NEVADA 89706
(775) 887-9911 * FAX 887-9915

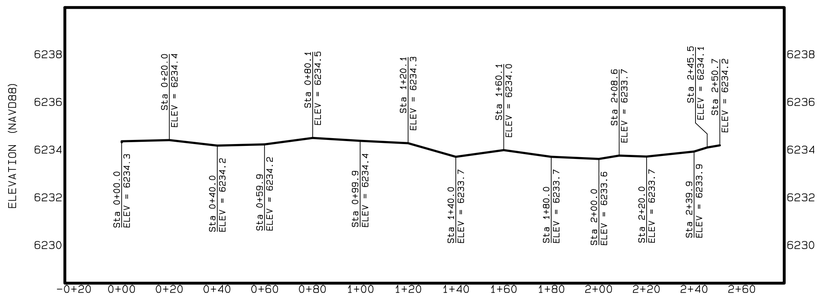
REVISIONS | NO. | DATE | MARK

BENCHMARK
DESIGNED BY
DRAWN BY CKI
CHECKED BY JS
DATE SURVEYED OCT 16, 2013
APPROVED BY

TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT
PORTIONS OF THE N 1/2 OF SECTION 4, TOWNSHIP 12 NORTH, RANGE 18 EAST, M.D.M.
EL DORADO COUNTY CALIFORNIA

JOB NO 13120.01.CM
DATE 11-5-13
SHEET 1 OF 3

TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT FOR SOUTH TAHOE PUBLIC UTILTY DISTRICT



TRANSECT STPUD 1

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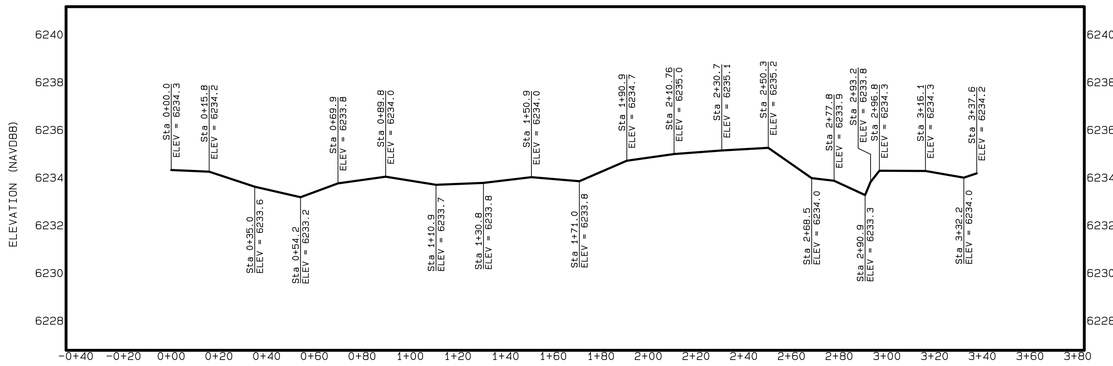
VERTICAL SCALE: 1"=3'



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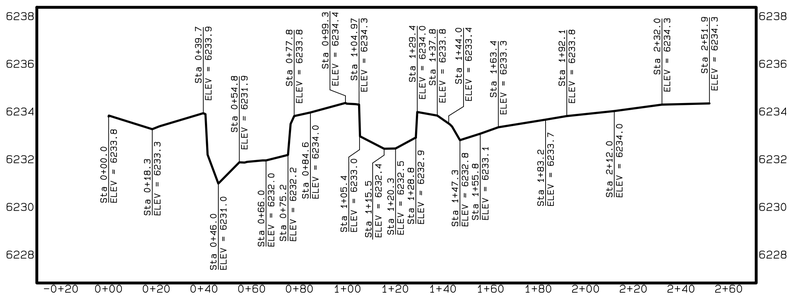

TRANSECT STPUD 2

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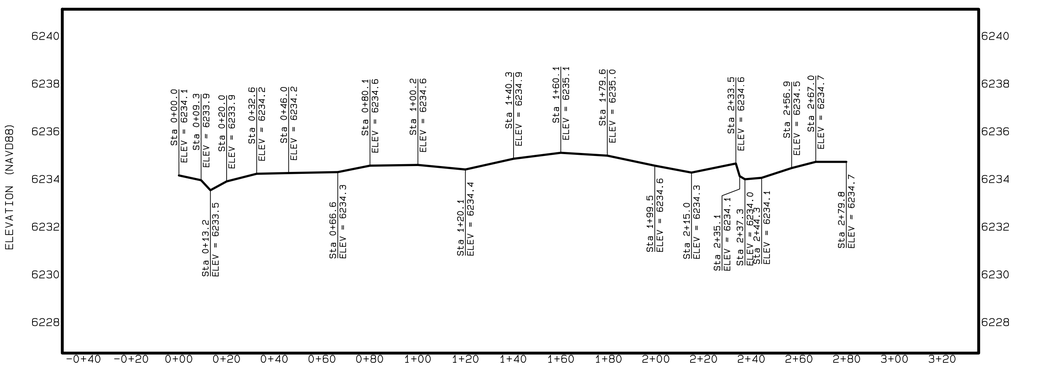

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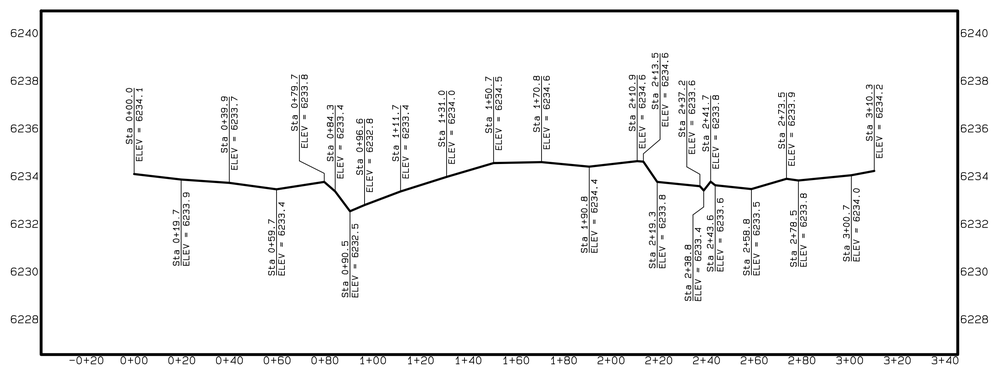


TRANSECT STPUD 6

HORIZONTAL SCALE: 1"=30'
VERTICAL SCALE: 1"=3'

TRANSECT STPUD 3

HORIZONTAL SCALE: 1"=30'
VERTICAL SCALE: 1"=3'

TRI STATE SURVEYING, LTD
425 EAST LONG STREET
CARSON CITY, NEVADA 89706
(775) 887-9911 * FAX 887-9915

REVISIONS		
MARK	DATE	NO.

BENCHMARK

DESIGNED BY

DRAWN BY CKI

CHECKED BY JS

DATE SURVEYED OCT 16, 2013

APPROVED BY

TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT

PORTIONS OF THE N 1/2 OF SECTION 4, TOWNSHIP 12 NORTH, RANGE 18 EAST, M.D.M.

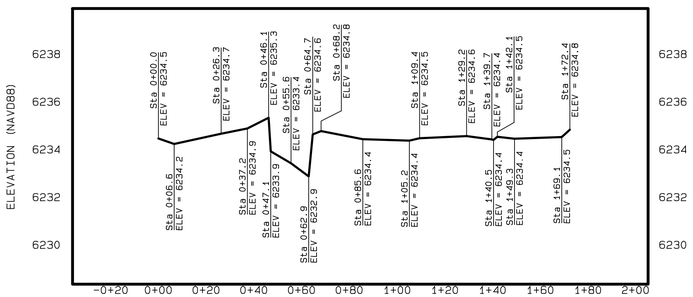
EL DORADO COUNTY *CALIFORNIA*

JOB NO 13120.01.CM

DATE 11-5-13

SHEET 2 OF 3

TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT FOR SOUTH TAHOE PUBLIC UTILTY DISTRICT



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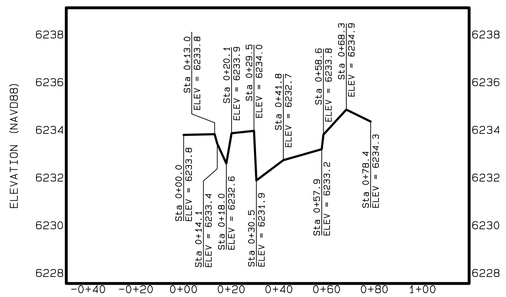

TRANSECT STPUD 8

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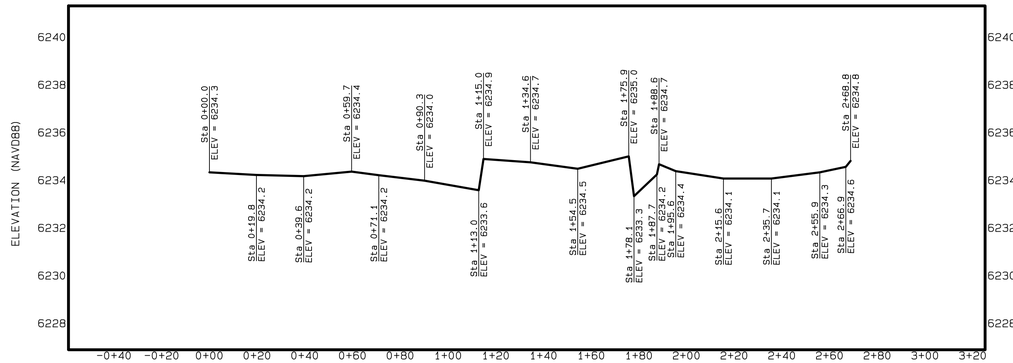

CTC X-SECTION 10

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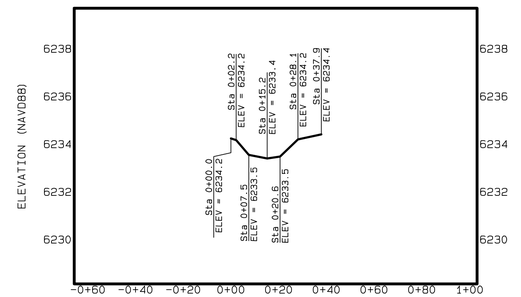
VERTICAL SCALE: 1"=3'



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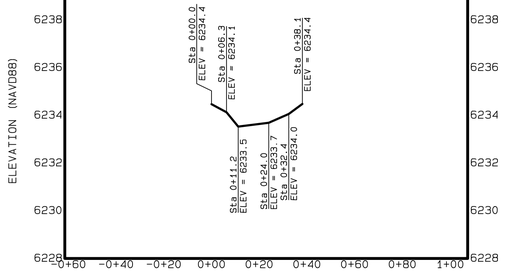

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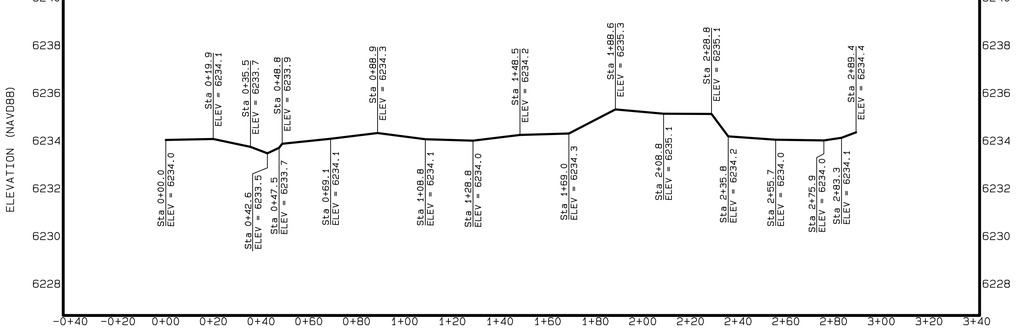

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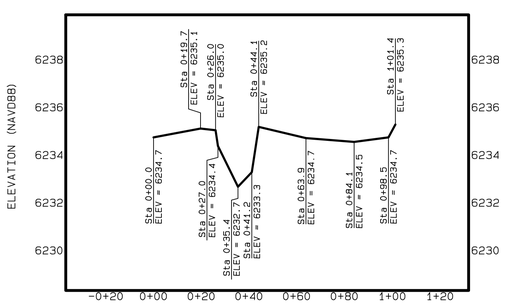

CTC X-SECTION 8

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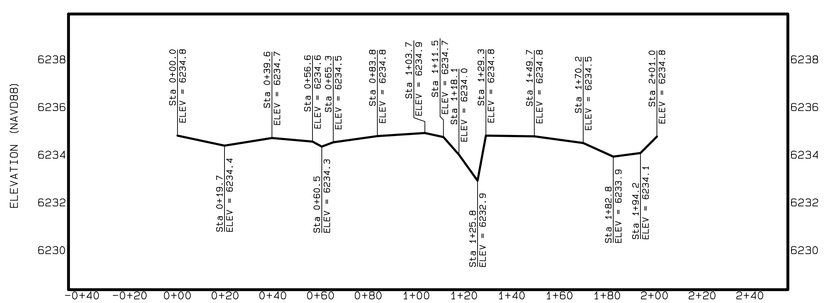

CTC X-SECTION 9

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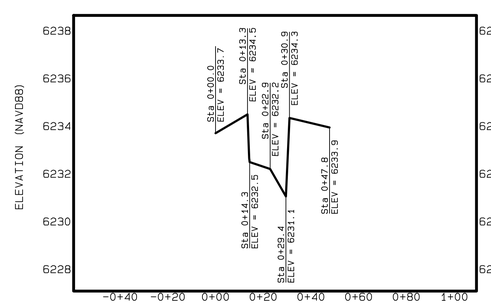
VERTICAL SCALE: 1"=3'



CTC X-SECTION 12

HORIZONTAL SCALE: 1"=30'
VERTICAL SCALE: 1"=3'

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425 EAST LONG STREET
CARSON CITY, NEVADA 89706
(775) 887-9911 * FAX 887-9915

REVISIONS

MARK	DATE	NO.

BENCHMARK

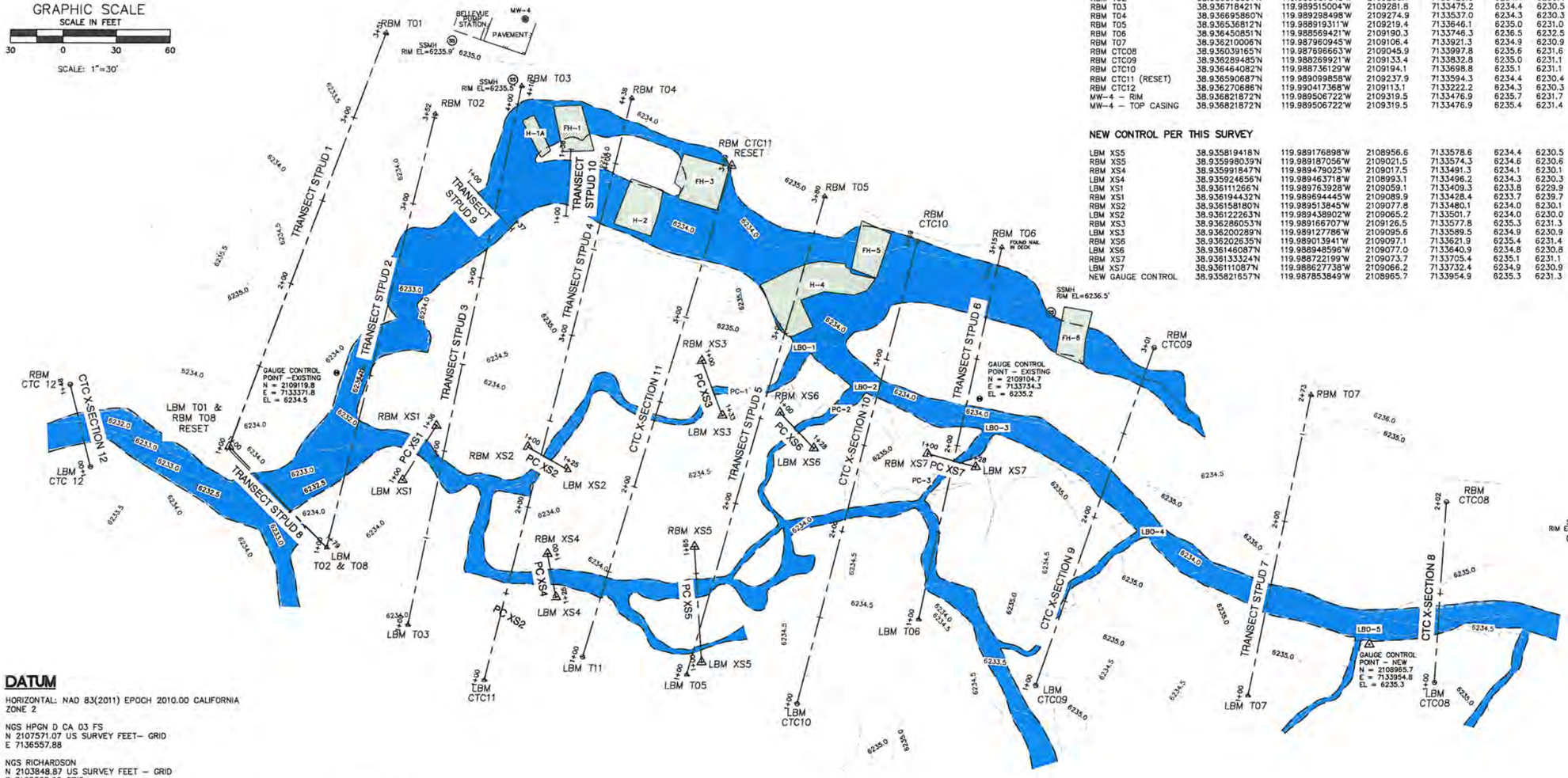
DESIGNED BY
DRAWN BY CKI
CHECKED BY JS
DATE SURVEYED OCT 16, 2013
APPROVED BY

TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT
PORTIONS OF THE N 1/2 OF SECTION 4, TOWNSHIP 12 NORTH, RANGE 18 EAST, M.D.M.
EL DORADO COUNTY *CALIFORNIA*

JOB NO 13120.01.CM
DATE 11-5-13
SHEET 3 OF 3

TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT - AS BUILT FOR SOUTH TAHOE PUBLIC UTILITY DISTRICT

GRAPHIC SCALE
SCALE IN FEET
30 0 30 60
SCALE: 1"=30'



DATUM

HORIZONTAL: NAD 83(2011) EPOCH 2010.00 CALIFORNIA ZONE 2

NGS HPGN D CA 03 FS
N 2107571.07 US SURVEY FEET- GRID
E 7136557.88

NGS RICHARDSON
N 2103848.87 US SURVEY FEET – GRID
E 7123525.92 GRID

VERTICAL: NAVD88
NGS HPGN D CA 03 FS
EL = 6248.20

PER CONTROL SURVEY PROVIDED BY S.T.P.U.D., PREPARED BY TRI STATE SURVEYING, LTD., DATED 11-05-13

LEGEND:

△ SET 5/8" REBAR AND CAP "LUMOS CONTROL"
▲ FOUND 5/8" REBAR AND CAP "TR-STATE CONTROL" – UNLESS OTHERWISE NOTED
○ FOUND 1/2" REBAR W/ NO CAP (CTC)

NOTE:

FIELD SURVEY CONDUCTED ON NOVEMBER 25 & 26, 2014.

EXISTING CONTROL PROVIDED BY S.T.P.U.D.

MONUMENT NAME	LATITUDE NAD83	LONGITUDE NAD83	NORTHING SPC GRID	EASTING SPC GRID	ELEV. NAVD88	ELEV. NGVD29
LBM T01 & RBM T08 (RESET)	38.936168894'N	119.990106106'W	2109078.0	7133311.6	6234.3	6230.3
LBM T02 & LBM T08	38.936009520'N	119.989915687'W	2109021.1	7133367.0	6233.9	6229.9
LBM T0	38.935887231'N	119.989757770'W	2108977.6	7133412.9	6234.2	6230.2
LBM T04	38.935799724'N	119.989607047'W	2108946.7	7133456.5	6234.4	6230.5
LBM T05	38.935808643'N	119.989206809'W	2108949.6	7133570.3	6234.2	6230.3
LBM T06	38.935877770'N	119.988745105'W	2108980.5	7133700.9	6234.6	6230.6
LBM T07	38.935747492'N	119.988096356'W	2108937.2	7133886.5	6234.5	6230.5
LBM CTC08	38.935760651'N	119.987726877'W	2108944.3	7133991.4	6234.9	6231.0
LBM CTC09	38.935771271'N	119.9885172411'W	2108943.2	7133766.6	6235.2	6231.2
LBM CTC10	38.935751784'N	119.988989853'W	2108933.1	7133632.4	6234.6	6230.6
LBM CTC11	38.935831478'N	119.989412956'W	2108959.5	7133511.4	6234.4	6230.4
LBM CTC12	38.936142345'N	119.990379722'W	2109066.6	7133234.0	6233.9	6229.9
RBM T01	38.936805560'N	119.989783506'W	2109311.8	7133398.2	6234.3	6230.3
RBM T02	38.936678391'N	119.989687343'W	2109266.1	7133426.6	6234.4	6230.4
RBM T03	38.936718421'N	119.989515004'W	2109281.8	7133475.2	6234.4	6230.5
RBM T04	38.936695860'N	119.989298498'W	2109274.9	7133537.0	6234.3	6230.3
RBM T05	38.936536812'N	119.988919311'W	2109219.4	7133646.1	6235.0	6231.0
RBM T06	38.936450851'N	119.988569421'W	2109190.3	7133746.3	6236.5	6232.5
RBM T07	38.936210006'N	119.987960945'W	2109106.4	7133921.3	6234.9	6230.9
RBM CTC08	38.936039165'N	119.987696663'W	2109045.9	7133997.8	6235.5	6231.6
RBM CTC09	38.936289485'N	119.988269921'W	2109133.4	7133832.8	6235.0	6231.1
RBM CTC10	38.936464082'N	119.988736129'W	2109194.1	7133698.8	6235.1	6231.1
RBM CTC11 (RESET)	38.936590687'N	119.989099858'W	2109237.9	7133594.3	6234.4	6230.4
RBM CTC12	38.936270686'N	119.990417368'W	2109113.1	7133222.2	6234.3	6230.3
MW-4 – RIM	38.936821872'N	119.989506722'W	2109319.5	7133476.9	6235.7	6231.7
MW-4 – TOP CASING	38.936821872'N	119.989506722'W	2109319.5	7133476.9	6235.4	6231.4

NEW CONTROL PER THIS SURVEY

LBM XS5	38.935819418'N	119.989176898'W	2108956.6	7133578.6	6234.4	6230.5
RBM XS5	38.935998039'N	119.989187056'W	2109021.5	7133574.3	6234.6	6230.6
RBM XS4	38.935991847'N	119.989479025'W	2109017.5	7133491.3	6234.1	6230.1
LBM XS4	38.935924656'N	119.989463718'W	2108993.1	7133496.2	6234.3	6230.3
LBM XS1	38.936111266'N	119.989763928'W	2109059.1	7133409.3	6233.8	6229.9
RBM XS1	38.936194432'N	119.989694445'W	2109089.9	7133428.4	6233.7	6239.7
RBM XS2	38.936158180'N	119.989513845'W	2109077.8	7133480.1	6234.0	6230.1
LBM XS2	38.936122263'N	119.989438902'W	2109065.2	7133501.7	6234.0	6230.0
RBM XS3	38.936286053'N	119.989166707'W	2109126.5	7133577.8	6235.3	6231.3
LBM XS3	38.936200289'N	119.989127786'W	2109095.6	7133589.5	6234.9	6230.9
RBM XS6	38.936202635'N	119.989013941'W	2109097.1	7133621.9	6235.4	6231.4
LBM XS6	38.936146087'N	119.988948596'W	2109077.0	7133640.9	6234.8	6230.8
RBM XS7	38.936133324'N	119.988722199'W	2109073.7	7133705.4	6235.1	6231.1
LBM XS7	38.936111087'N	119.988627738'W	2109066.2	7133732.4	6234.9	6230.9
NEW GAUGE CONTROL	38.935821657'N	119.987853849'W	2108965.7	7133954.9	6235.3	6231.3

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PROFESSIONAL LAND SURVEYOR GREGORY S. PHILLIPS NO. 7936 EXP. 12/31/15 STATE OF CALIFORNIA

SOUTH TAHOE PUBLIC UTILITY DISTRICT

UPPER TRUCKEE MARSH - BELLEVUE AREA
A PORTION OF THE NORTH 1/2 OF
SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

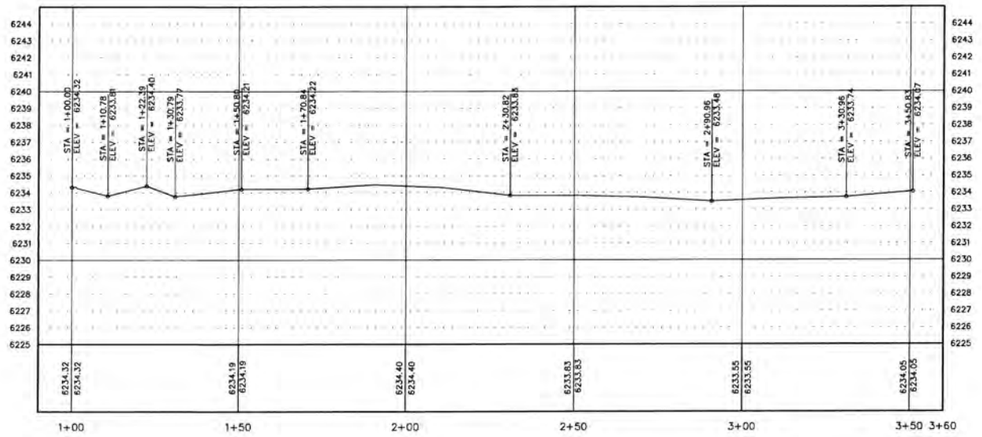
B1

DATE: JANUARY 2015
DRAWN BY: KLN
DESIGNED BY: GP
CHECKED BY: GP
JOB NO.: 8688.000

L:\Active\8688.000 - Upper Truckee Marsh\Survey\DWG\8688000 Upper Truckee Marsh plotfiles.dwg,B1 OVERALL, 01/10/2015 10:06 am, gphillips

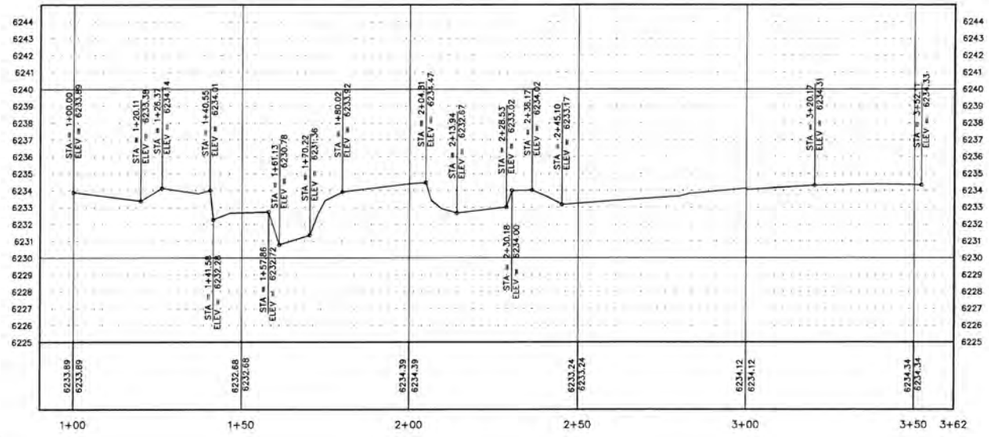
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 1 – STA: 0+90 TO STA: 3+60



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 2 – STA: 0+90 TO STA: 3+62



SCALE:
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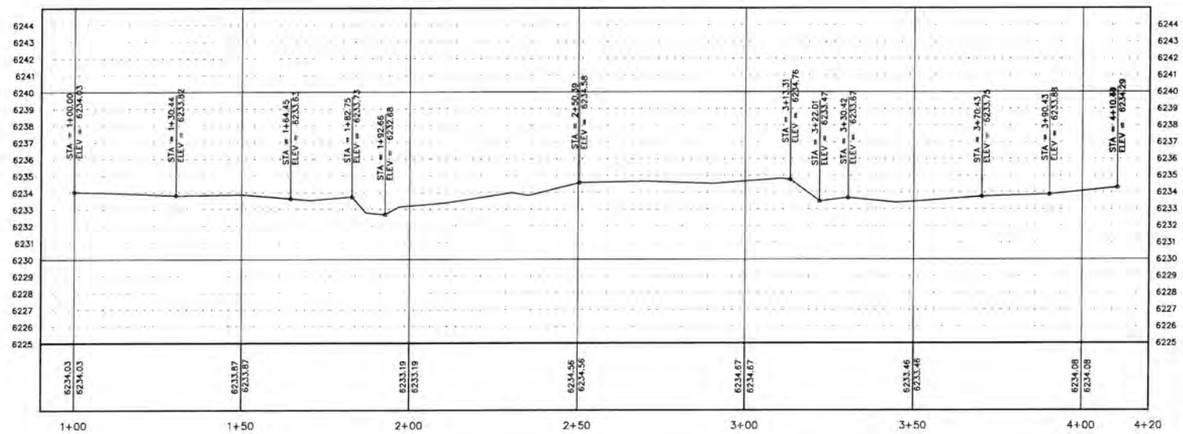
TRANSECT STPUD 3 – STA: 0+90 TO STA: 4+20



SCALE:
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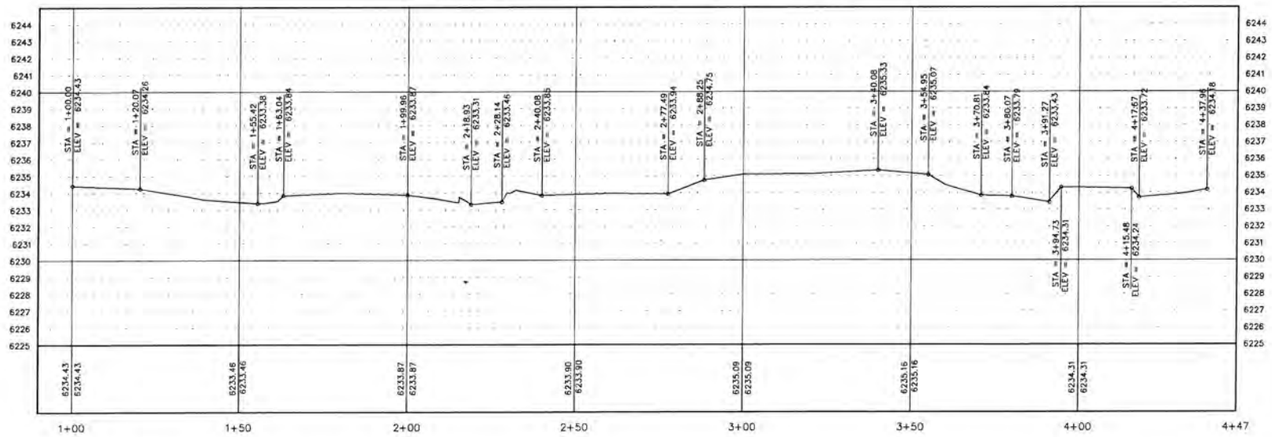
TRANSECT STPUD 4 – STA: 0+90 TO STA: 4+47



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A PORTION OF THE NORTH 1/2 OF SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

B2

DATE: JANUARY 2015
DRAWN BY: KLN
DESIGNED BY: GP
CHECKED BY: GP
JOB NO.: 8688.000

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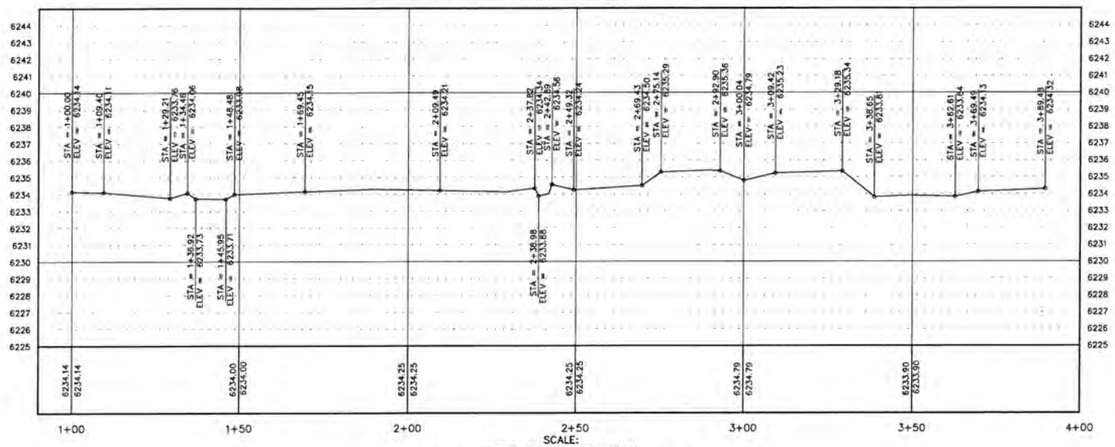
01/06/2015 01:35 pm khunes

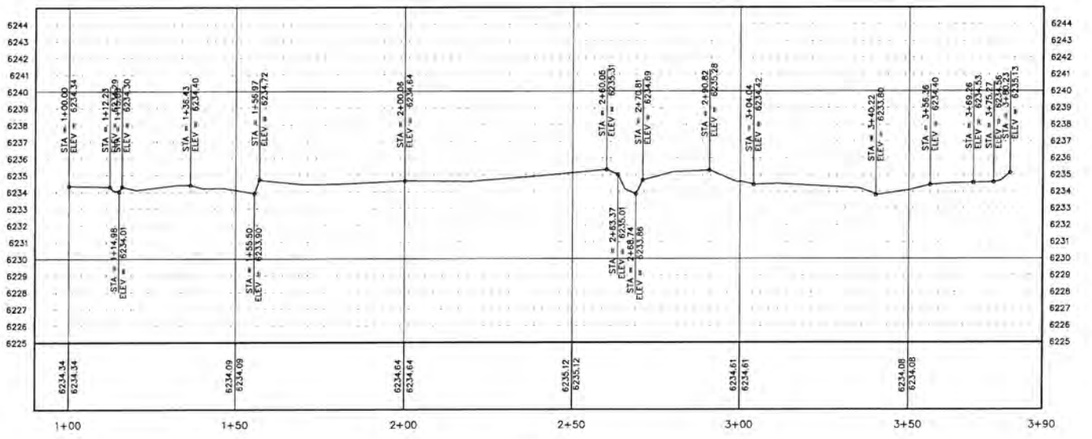
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

CTC X-SECTION 11 – STA: 0+90 TO STA: 4+00



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 5 – STA: 0+90 TO STA: 3+90



SCALE:
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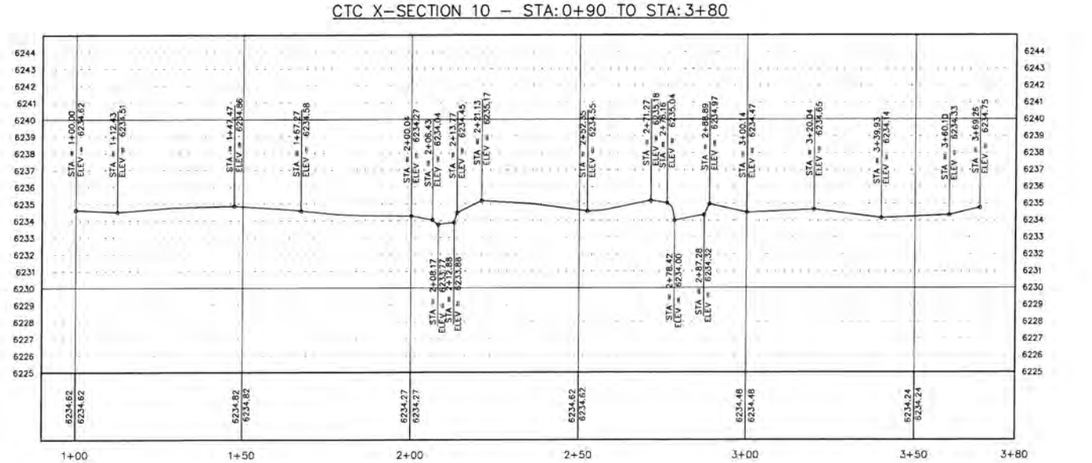
CTC X-SECTION 10 – STA: 0+90 TO STA: 3+80



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A PORTION OF THE NORTH 1/2 OF SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

B3

DATE: JANUARY 2015
DRAWN BY: KLN
DESIGNED BY: GP
CHECKED BY: GP
JOB NO.: 8688.000

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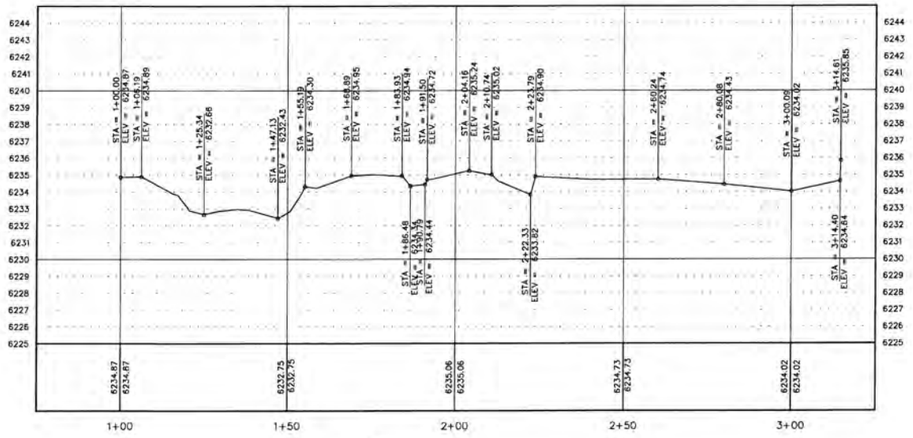
01/06/2015 01:35 pm krounes

SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 6 – STA: 0+75 TO STA: 3+25



SCALE:
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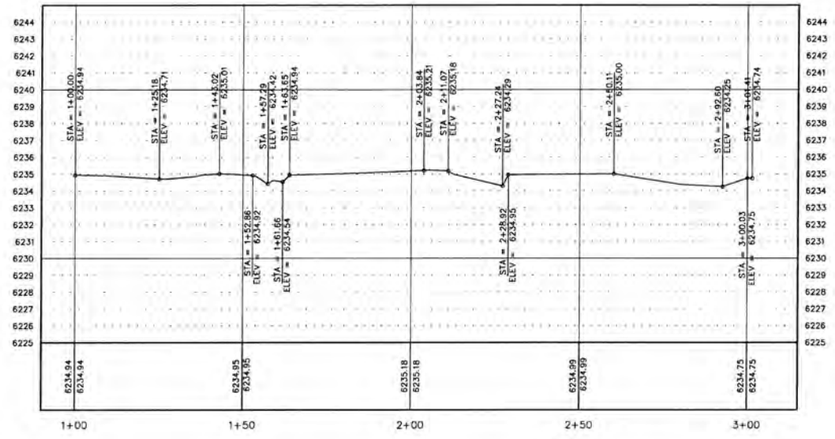
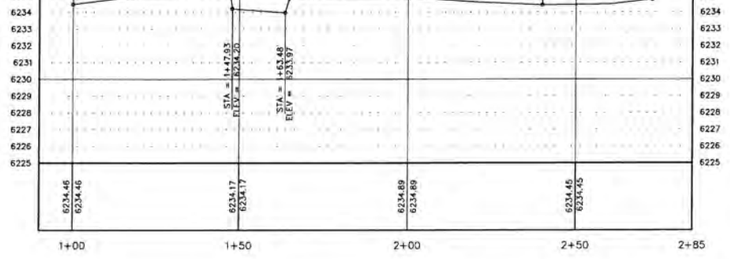
CTC X-SECTION 9 – STA: 0+90 TO STA: 3+15



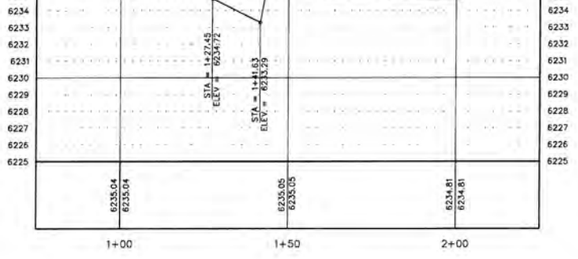
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 7 – STA: 0+90 TO STA: 2+85



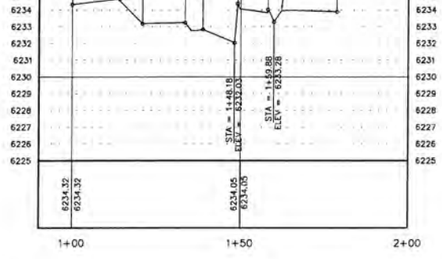
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

CTC X-SECTION 8 – STA: 0+75 TO STA: 2+25



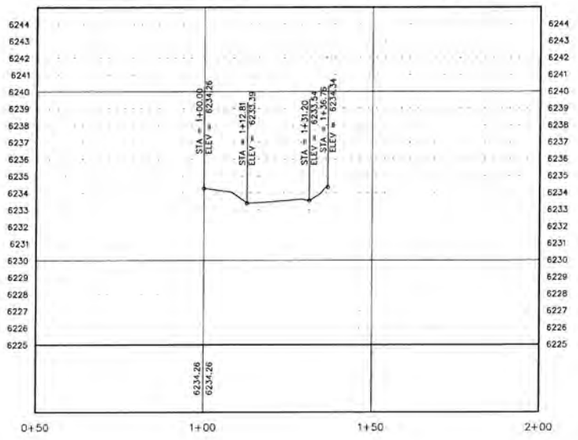
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 8 – STA: 0+90 TO STA: 2+00



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 9 – STA: 0+50 TO STA: 2+00



SCALE:
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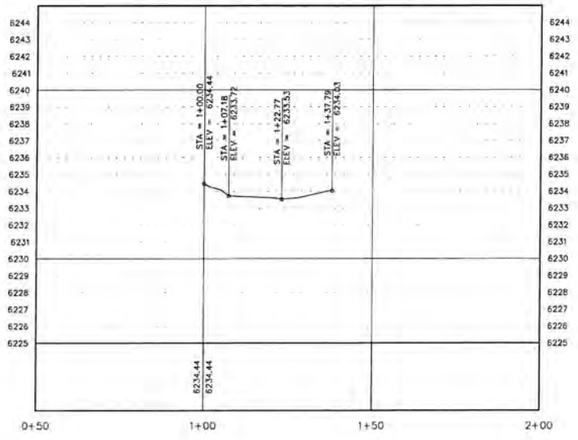
TRANSECT STPUD 10 – STA: 0+50 TO STA: 2+00



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UPPER TRUCKEE MARSH - BELLEVUE AREA

A PORTION OF THE NORTH 1/2 OF
SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

B4

DATE:	JANUARY 2015
DRAWN BY:	KLN
DESIGNED BY:	GP
CHECKED BY:	GP
JOB NO.:	8688.000

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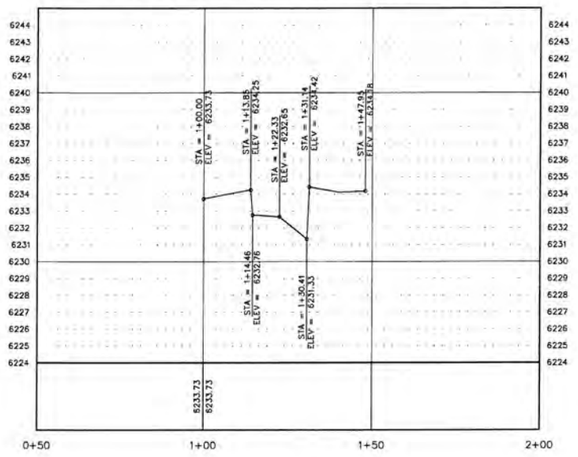
01/08/2015 01:36 pm knunes

SCALE:
HORIZ. 1"=20', VERT. 1"=2'

CTC X-SECTION 2 – STA: 0+50 TO STA: 2+00



SCALE:
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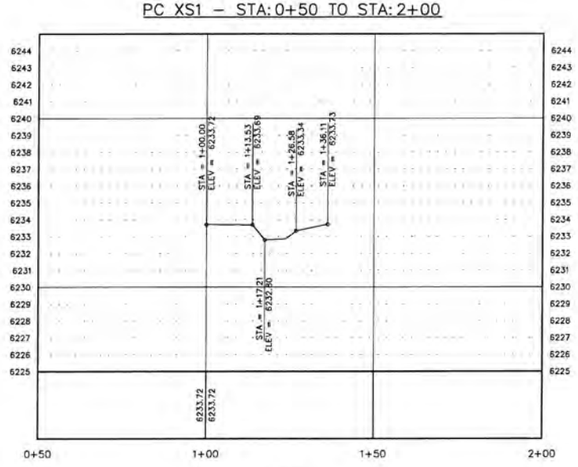
PC XS1 – STA: 0+50 TO STA: 2+00



SCALE:
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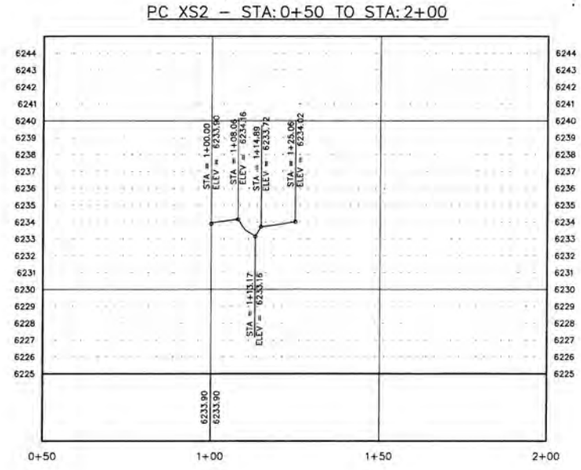
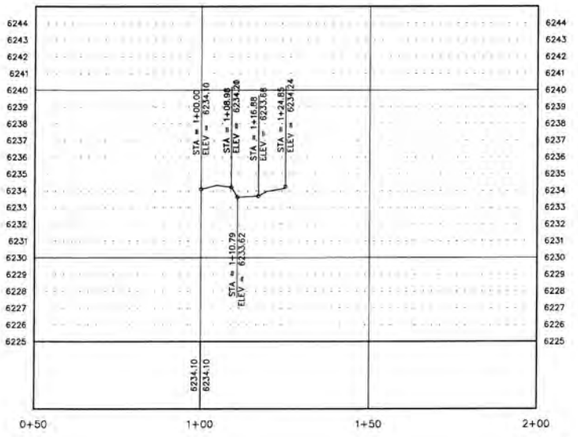
PC XS2 – STA: 0+50 TO STA: 2+00



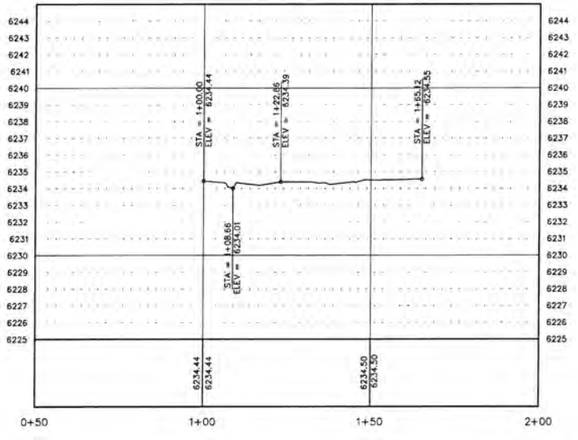
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC XS4 – STA: 0+50 TO STA: 2+00



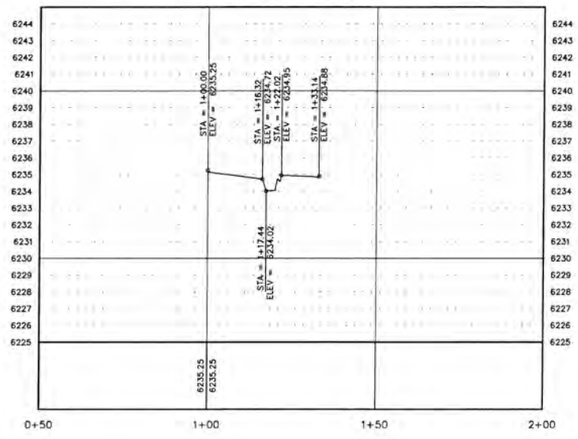
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC XS5 – STA: 0+50 TO STA: 2+00



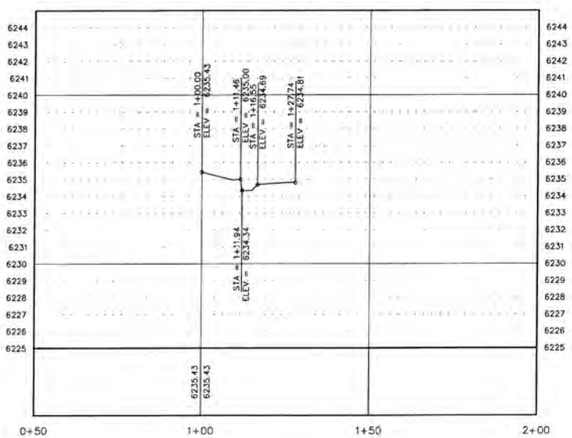
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC XS3 – STA: 0+50 TO STA: 2+00



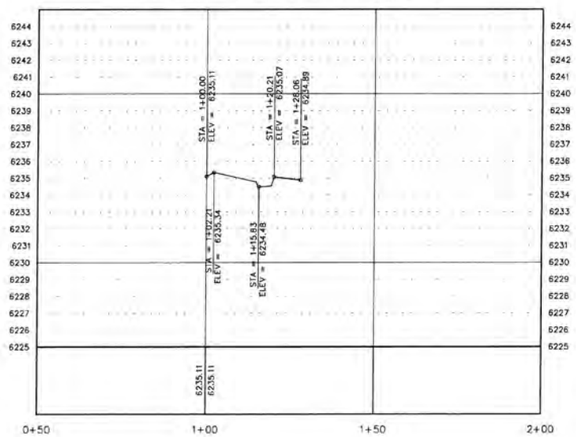
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC XS6 – STA: 0+50 TO STA: 2+00



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC XS7 – STA: 0+50 TO STA: 2+00



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SOUTH TAHOE PUBLIC UTILITY DISTRICT

UPPER TRUCKEE MARSH - BELLEVUE AREA

A PORTION OF THE NORTH 1/2 OF
SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

B5

DATE: JANUARY 2015
DRAWN BY: KLN
DESIGNED BY: GP
CHECKED BY: GP
JOB NO.: 8388.000

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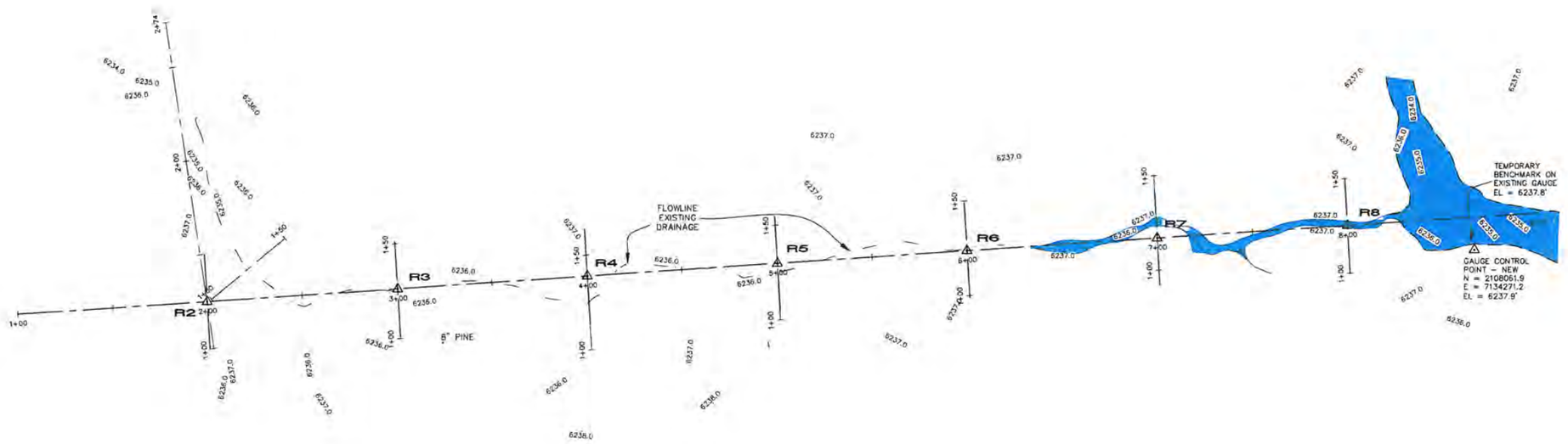
TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT FOR SOUTH TAHOE PUBLIC UTILITY DISTRICT

GRAPHIC SCALE
SCALE IN FEET
30 0 30 60
SCALE: 1"=30'



NEW CONTROL PER THIS SURVEY

MONUMENT NAME	LATITUDE NAD83	LONGITUDE NAD83	NORTHING SPC GRID	EASTING SPC GRID	ELEV. NAVD88	ELEV. NGVD29
R2	38.933290737'N	119.989152495'W	2108036.0	7133605.9	6236.7	6232.7
R3	38.933302389'N	119.988801138'W	2108042.5	7133705.8	6235.1	6231.1
R4	38.933314115'N	119.988450170'W	2108049.0	7133805.5	6236.2	6232.3
R5	38.933325686'N	119.988098854'W	2108055.4	7133905.3	6236.4	6232.4
R6	38.933337426'N	119.987747632'W	2108061.9	7134005.1	6236.5	6232.5
R7	38.933349104'N	119.987396289'W	2108068.3	7134104.9	6237.8	6233.8
R8	38.933360888'N	119.987045069'W	2108074.8	7134204.7	6236.7	6232.7
RUBICON GAUGE	38.933321287'N	119.986812431'W	2108061.9	7134271.2	6237.9	6234.0

DATUM

HORIZONTAL: NAD 83(2011) EPOCH 2010.00 CALIFORNIA ZONE 2

NGS HPGN D CA 03 FS
N 2107571.07 US SURVEY FEET - GRID
E 7136557.88

NGS RICHARDSON
N 2103848.87 US SURVEY FEET - GRID
E 7123525.92 GRID

VERTICAL: NAVD88
NGS HPGN D CA 03 FS
EL = 6248.20

PER CONTROL SURVEY PROVIDED BY S.T.P.U.D., PREPARED BY TRI STATE SURVEYING, LTD., DATED 11-05-13

LEGEND:

- △ SET 5/8" REBAR AND CAP "LUMOS CONTROL"
- ▲ FOUND 5/8" REBAR AND CAP "TR-STATE CONTROL" - UNLESS OTHERWISE NOTED
- ○ FOUND 1/2" REBAR W/ NO CAP (CTC)

NOTE:

FIELD SURVEY CONDUCTED BETWEEN 11/25/14 AND 12/09/14

01/12/2015 10:32 dm cphillips

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PROFESSIONAL LAND SURVEYOR
GREGORY S. PHILLIPS
NO. 7836
EXP. 12/31/15
STATE OF CALIFORNIA

SOUTH TAHOE PUBLIC UTILITY DISTRICT

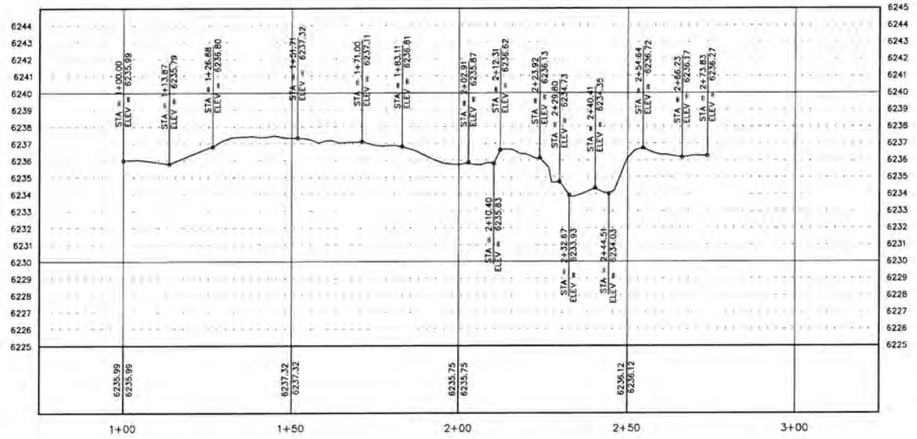
UPPER TRUCKEE MARSH - RUBICON TRAIL AREA
A PORTION OF THE NORTH 1/2 OF
SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

REV	DATE	DESCRIPTION	BY
R1			

DATE: JANUARY 2(
DRAWN BY: K
DESIGNED BY:
CHECKED BY:
JOB NO. 8668.

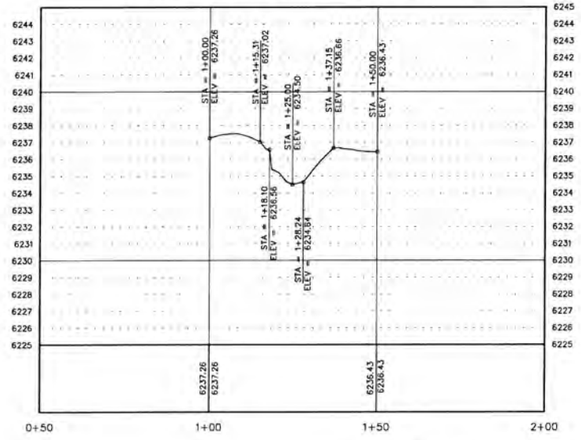
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 2+00 – STA: 0+75 TO STA: 3+25



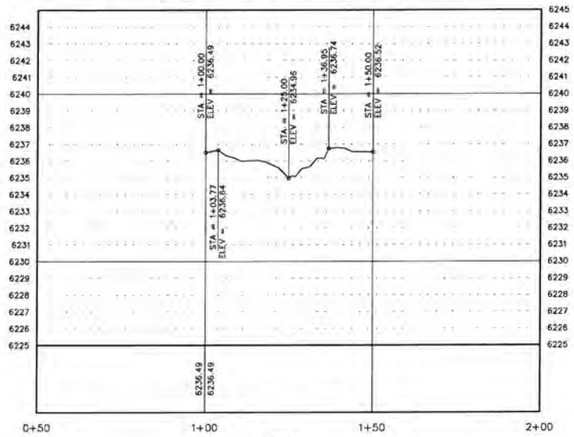
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 2+25 – STA: 0+50 TO STA: 2+00



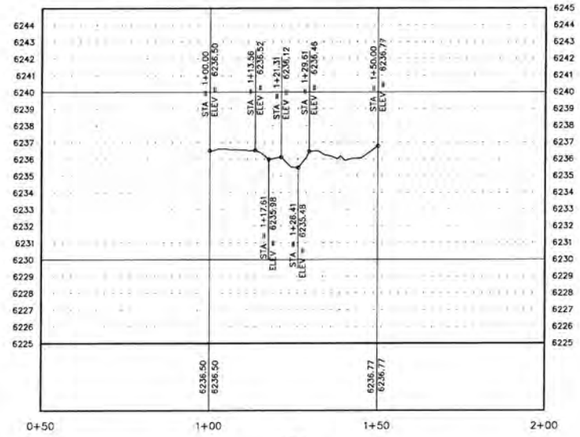
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 3+00 – STA: 0+50 TO STA: 2+00



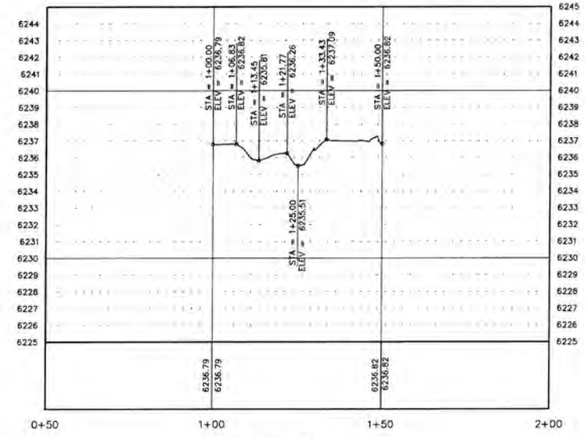
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 4+00 – STA: 0+50 TO STA: 2+00



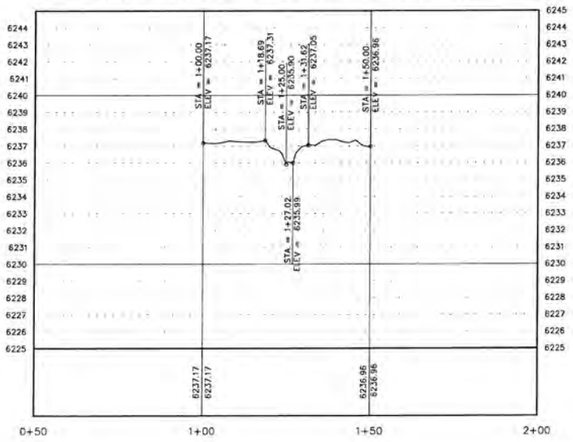
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 5+00 – STA: 0+50 TO STA: 2+00



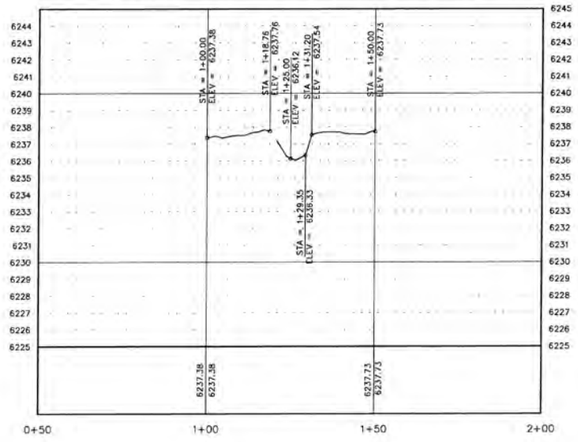
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 6+00 – STA: 0+50 TO STA: 2+00



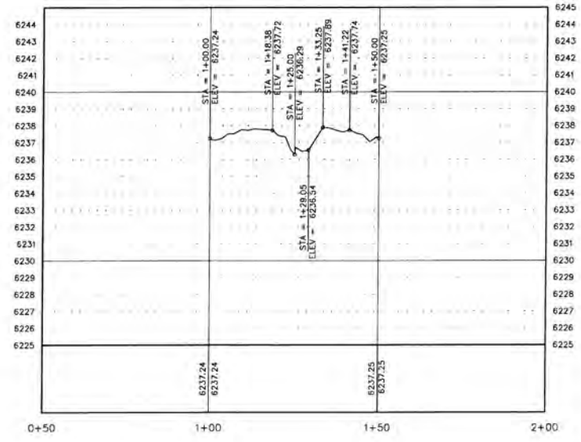
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 7+00 – STA: 0+50 TO STA: 2+00



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 8+00 – STA: 0+50 TO STA: 2+00



LUMOS & ASSOCIATES

800 E. COLLEGE PARKWAY
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MATERIALS TESTING

SOUTH TAHOE PUBLIC UTILITY DISTRICT

UPPER TRUCKEE MARSH - RUBICON TRAIL AREA

A PORTION OF THE NORTH 1/2 OF
SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

R2

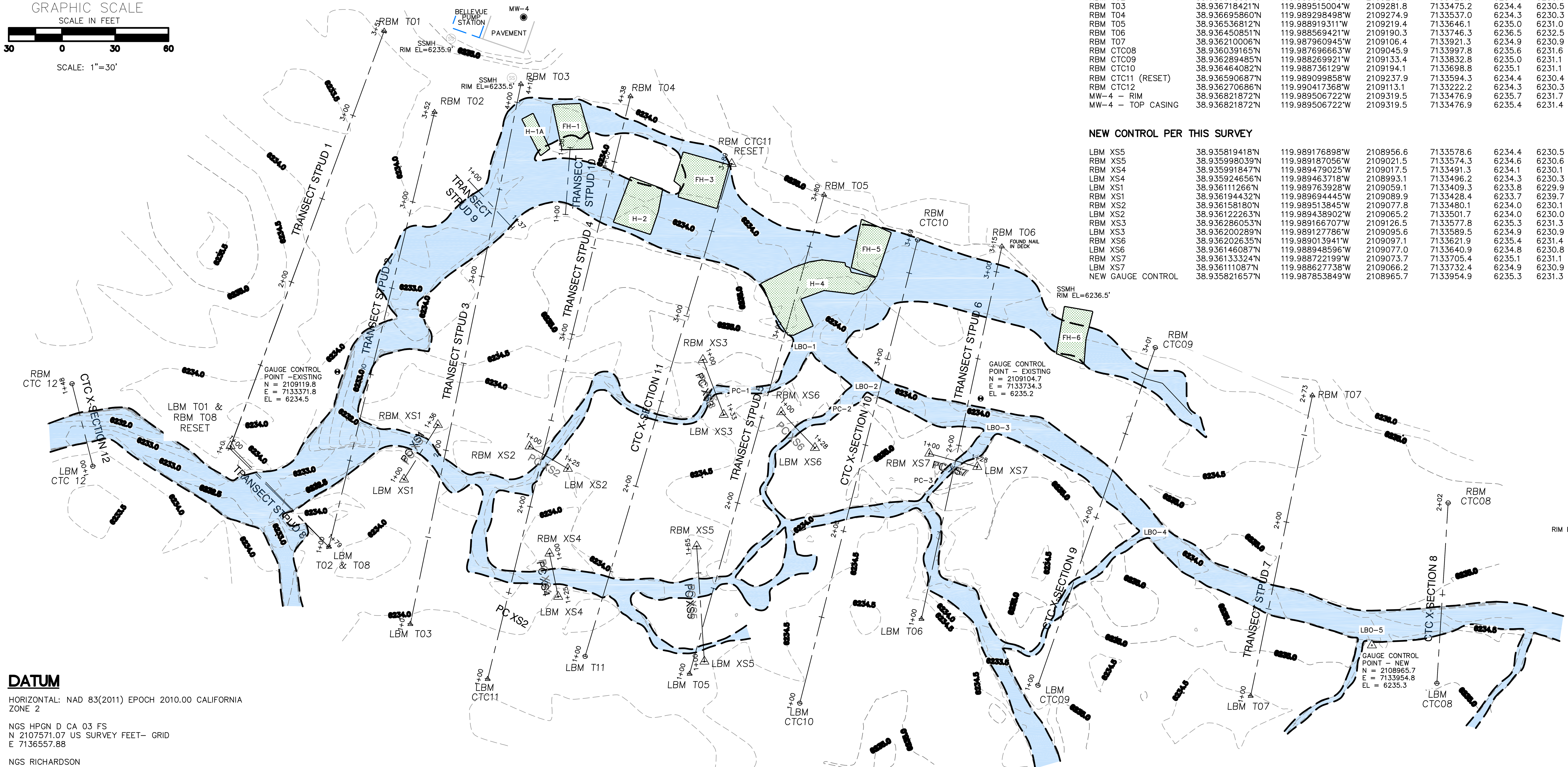
DATE:	JANUARY 2015
DRAWN BY:	KLN
DESIGNED BY:	GP
CHECKED BY:	GP
JOB NO.:	8688.000

L:\LAP-tb\8688.000 - Upper Truckee Marsh\Survey\DWG\8688000 Upper Truckee Marsh profiles.dwg#2 PROFILES, 01/08/2015 01:37 pm, knunes

TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT - AS BUILT FOR SOUTH TAHOE PUBLIC UTILITY DISTRICT

Comparison of Baseline and 2014 Cross Sections, Sheets 2-5

GRAPHIC SCALE
SCALE IN FEET
30 0 30 60
SCALE: 1"=30'



EXISTING CONTROL PROVIDED BY S.T.P.U.D.

MONUMENT NAME	LATITUDE NAD83	LONGITUDE NAD83	NORTHING SPC GRID	EASTING SPC GRID	ELEV. NAVD88	ELEV. NGVD29
LBM T01 & RBM T08 (RESET)	38.936168894°N	119.990106106°W	2109078.0	7133311.6	6234.3	6230.3
LBM T02 & LBM T08	38.936009520°N	119.989915687°W	2109021.1	7133367.0	6233.9	6229.9
LBM T0	38.935887231°N	119.989757770°W	2108977.6	7133412.9	6234.2	6230.2
LBM T04	38.935799724°N	119.989607047°W	2108946.7	7133456.5	6234.4	6230.5
LBM T05	38.935800843°N	119.989206809°W	2108949.6	7133570.3	6234.2	6230.3
LBM T06	38.935877770°N	119.988745105°W	2108980.5	7133700.9	6234.6	6230.6
LBM T07	38.935747492°N	119.988096356°W	2108937.2	7133886.5	6234.5	6230.5
LBM CTC08	38.935760651°N	119.987726877°W	2108944.3	7133991.4	6234.9	6231.0
LBM CTC09	38.935771271°N	119.988517241°W	2108943.2	7133766.6	6235.2	6231.2
LBM CTC10	38.935751784°N	119.988989853°W	2108933.1	7133632.4	6234.6	6230.6
LBM CTC11	38.935831478°N	119.989412956°W	2108959.5	7133511.4	6234.4	6230.4
LBM CTC12	38.936142345°N	119.990379722°W	2109066.6	7133234.0	6233.9	6229.9
RBM T01	38.936805560°N	119.989783506°W	2109311.8	7133398.2	6234.3	6230.3
RBM T02	38.936678391°N	119.989687343°W	2109266.1	7133426.6	6234.4	6230.4
RBM T03	38.936718421°N	119.989515004°W	2109281.8	7133475.2	6234.4	6230.5
RBM T04	38.936695860°N	119.989298498°W	2109274.9	7133537.0	6234.3	6230.3
RBM T05	38.936536812°N	119.988919311°W	2109219.4	7133646.1	6235.0	6231.0
RBM T06	38.936450851°N	119.988569421°W	2109190.3	7133746.3	6236.5	6232.5
RBM T07	38.936210006°N	119.987960945°W	2109106.4	7133921.3	6234.9	6230.9
RBM CTC08	38.936039165°N	119.987696663°W	2109045.9	7133997.8	6235.6	6231.6
RBM CTC09	38.936289485°N	119.988269921°W	2109133.4	7133832.8	6235.0	6231.1
RBM CTC10	38.936464082°N	119.988736129°W	2109194.1	7133698.8	6235.1	6231.1
RBM CTC11 (RESET)	38.936590687°N	119.989099858°W	2109237.9	7133594.3	6234.4	6230.4
RBM CTC12	38.936270686°N	119.990417368°W	2109113.1	7133222.2	6234.3	6230.3
MW-4 - RIM	38.936821872°N	119.989506722°W	2109319.5	7133476.9	6235.7	6231.7
MW-4 - TOP CASING	38.936821872°N	119.989506722°W	2109319.5	7133476.9	6235.4	6231.4

NEW CONTROL PER THIS SURVEY

LBM XS5	38.935819418°N	119.989176898°W	2108956.6	7133578.6	6234.4	6230.5
RBM XS5	38.935998039°N	119.989187056°W	2109021.5	7133574.3	6234.6	6230.6
RBM XS4	38.935991847°N	119.989479025°W	2109017.5	7133491.3	6234.1	6230.1
LBM XS4	38.935924656°N	119.989463718°W	2108993.1	7133496.2	6234.3	6230.3
LBM XS1	38.936111266°N	119.989763928°W	2109059.1	7133409.3	6233.8	6229.9
RBM XS1	38.936194432°N	119.989694445°W	2109089.9	7133428.4	6233.7	6239.7
RBM XS2	38.936158180°N	119.989513845°W	2109077.8	7133480.1	6234.0	6230.1
LBM XS2	38.936122263°N	119.989438902°W	2109065.2	7133501.7	6234.0	6230.0
RBM XS3	38.936286053°N	119.989166707°W	2109126.5	7133577.8	6235.3	6231.3
LBM XS3	38.936200289°N	119.989127786°W	2109095.6	7133589.5	6234.9	6230.9
RBM XS6	38.936202635°N	119.989013941°W	2109097.1	7133621.9	6235.4	6231.4
LBM XS6	38.936146087°N	119.988948596°W	2109077.0	7133640.9	6234.8	6230.8
RBM XS7	38.936133324°N	119.988722199°W	2109073.7	7133705.4	6235.1	6231.1
LBM XS7	38.936111087°N	119.988627738°W	2109066.2	7133732.4	6234.9	6230.9
NEW GAUGE CONTROL	38.935821657°N	119.987853849°W	2108965.7	7133954.9	6235.3	6231.3

DATUM

HORIZONTAL: NAD 83(2011) EPOCH 2010.00 CALIFORNIA ZONE 2

NGS HPGN D CA 03 FS
N 2107571.07 US SURVEY FEET- GRID
E 7136557.88

NGS RICHARDSON
N 2103848.87 US SURVEY FEET - GRID
E 7123525.92 GRID

VERTICAL: NAVD88
NGS HPGN D CA 03 FS
EL = 6248.20

PER CONTROL SURVEY PROVIDED BY S.T.P.U.D., PREPARED BY TRI STATE SURVEYING, LTD., DATED 11-05-13

LEGEND:

- △ SET 5/8" REBAR AND CAP "LUMOS CONTROL"
- △ FOUND 5/8" REBAR AND CAP "TR-STATE CONTROL" - UNLESS OTHERWISE NOTED
- ○ FOUND 1/2" REBAR W/ NO CAP (CTC)

NOTE:

FIELD SURVEY CONDUCTED ON NOVEMBER 25 & 26, 2014.

LUMOS & ASSOCIATES
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SOUTH TAHOE PUBLIC UTILITY DISTRICT

UPPER TRUCKEE MARSH - BELLEVUE AREA
A PORTION OF THE NORTH 1/2 OF
SECTION 4, T.12N., R18E., M.D.M., A.P.N. 026-200-11

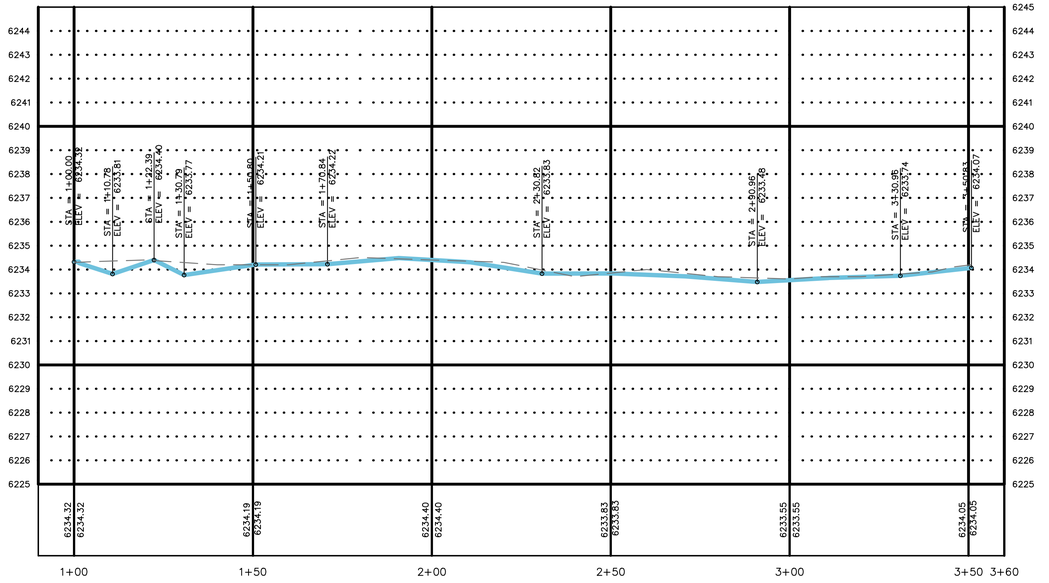
EL DORADO COUNTY
CALIFORNIA

REV	DATE	DESCRIPTION	BY

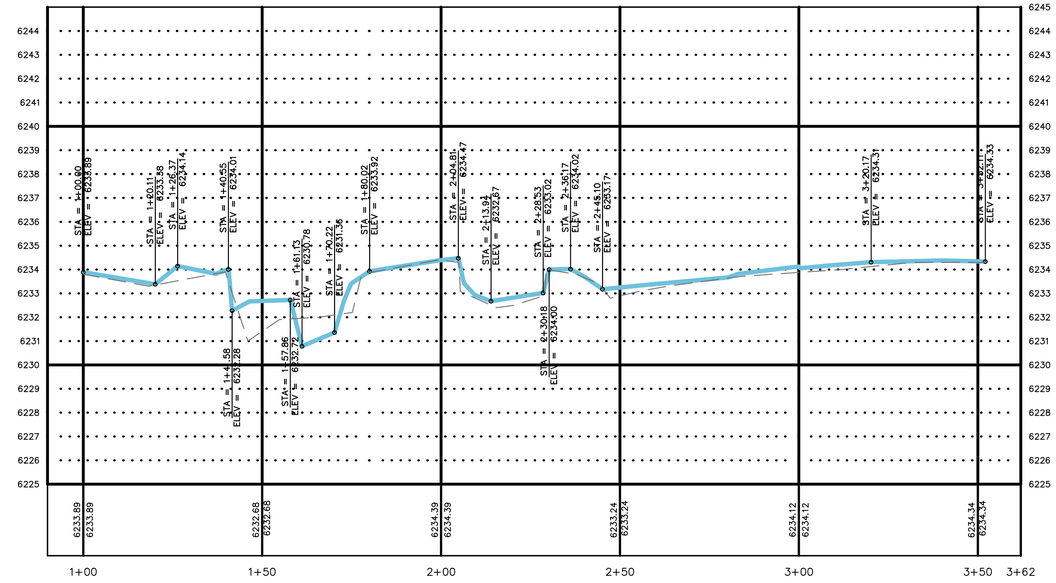
B1

DATE:	JANUARY 2015
DRAWN BY:	KLN
DESIGNED BY:	GP
CHECKED BY:	GP
JOB NO.:	8688.000

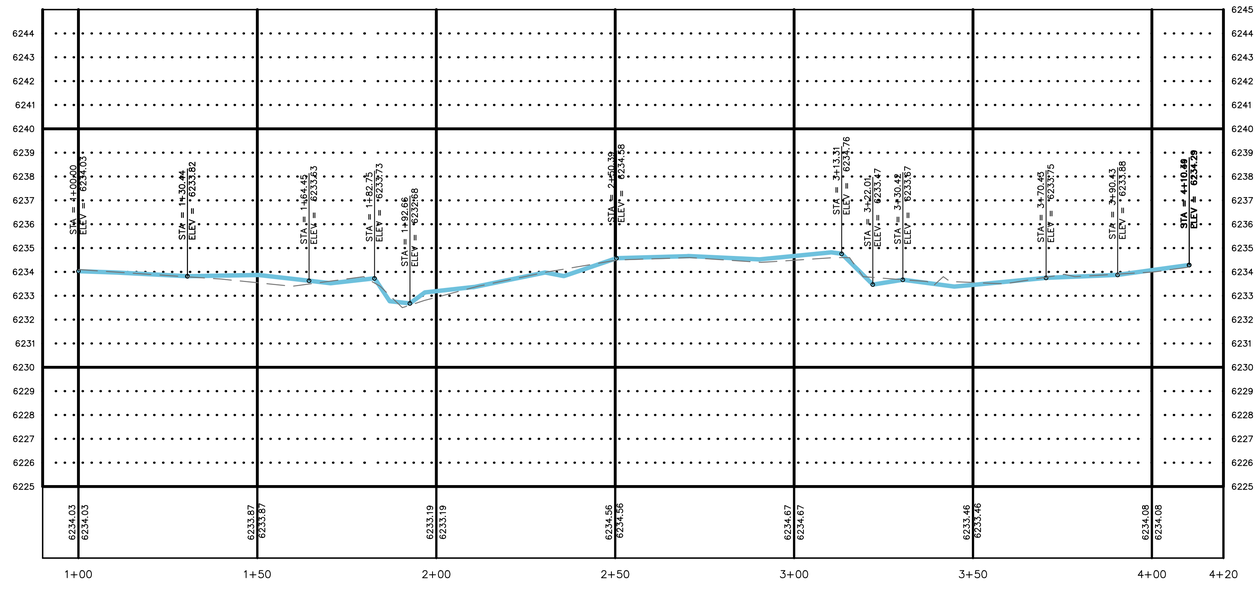
TRANSECT STPUD 1 – STA: 0+90 TO STA: 3+60



TRANSECT STPUD 2 – STA: 0+90 TO STA: 3+62



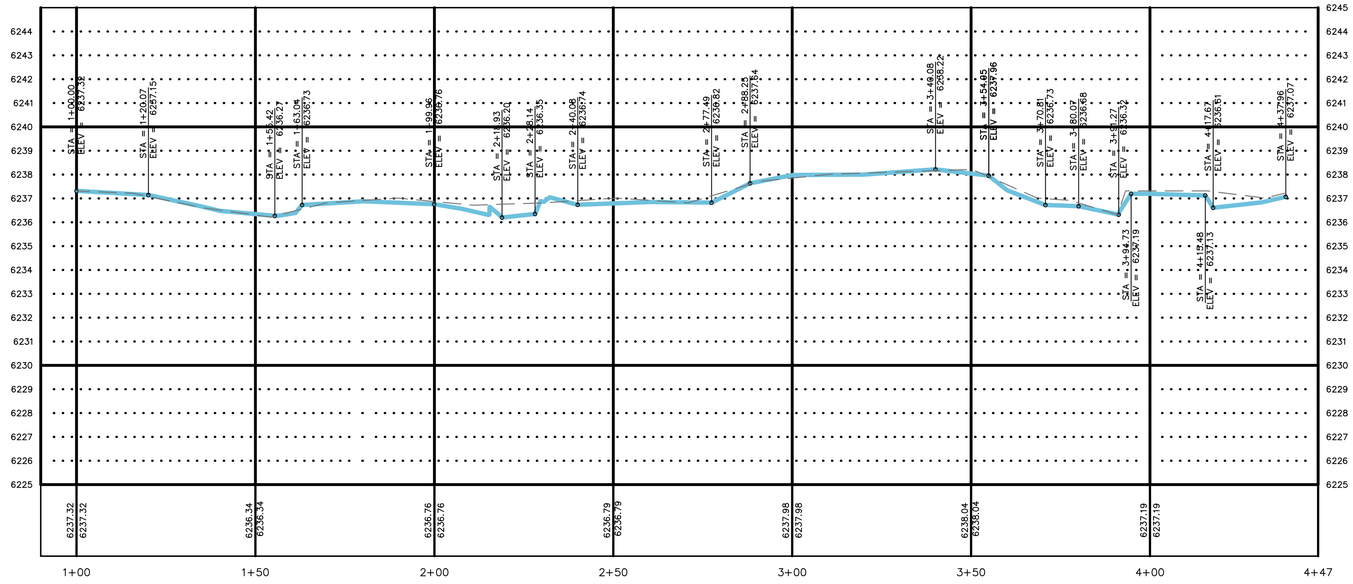
TRANSECT STPUD 3 – STA: 0+90 TO STA: 4+20



Baseline survey represented by dashed lines.
2014 resurvey represented by blue lines.

SCALE H:1"=20 V:1"=3'

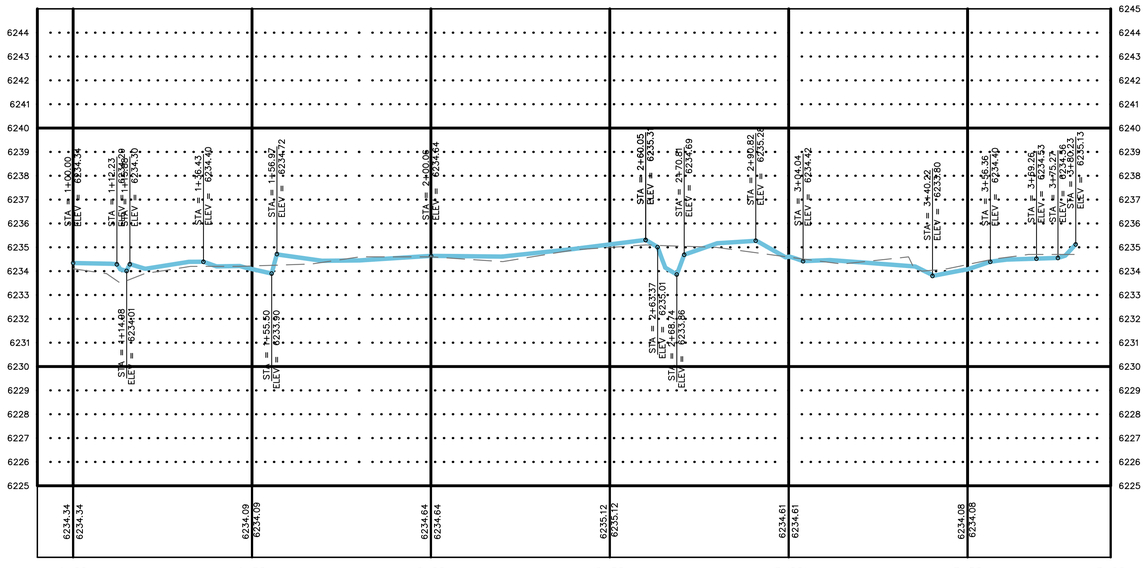
TRANSECT STPUD 4 – STA: 0+90 TO STA: 4+47



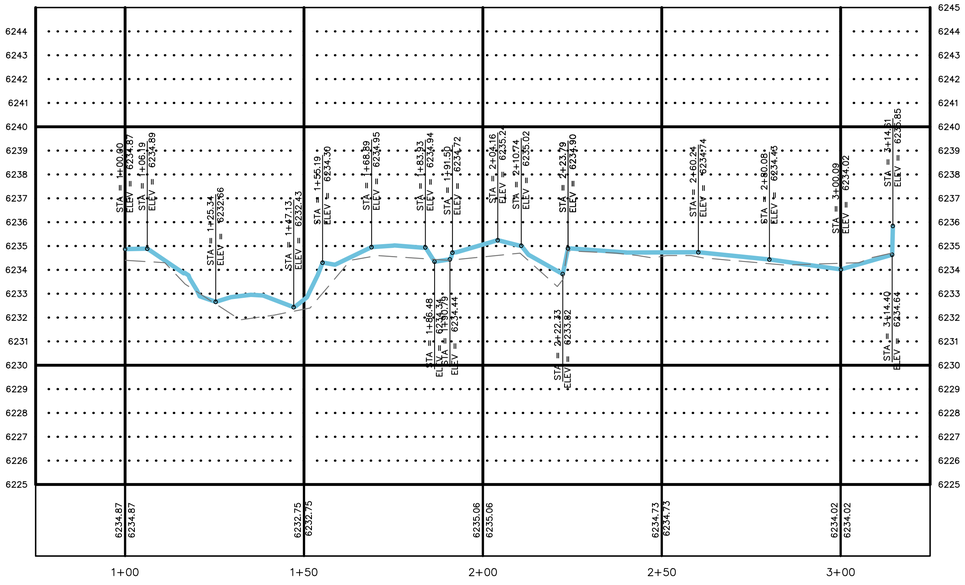
SCALE H: 1"=20 V: 1"=3'

Baseline survey represented by dashed lines.
2014 resurvey represented by blue lines.

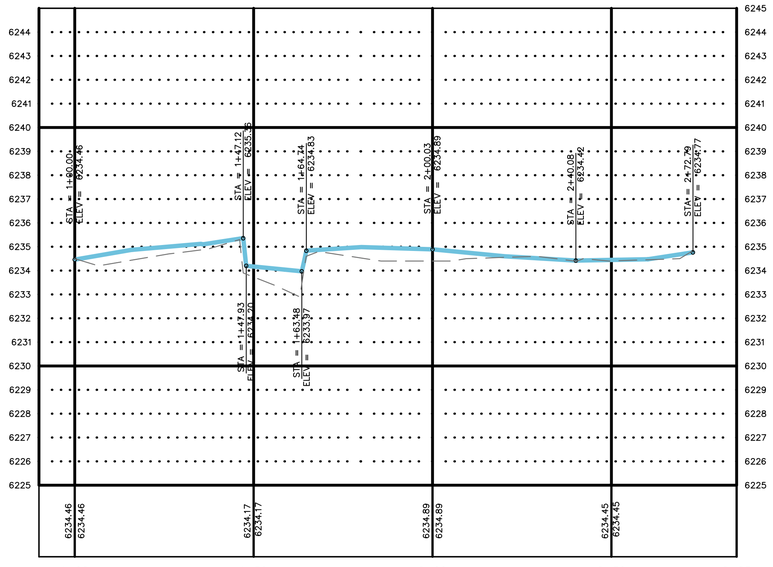
TRANSECT STPUD 5 – STA: 0+90 TO STA: 3+90



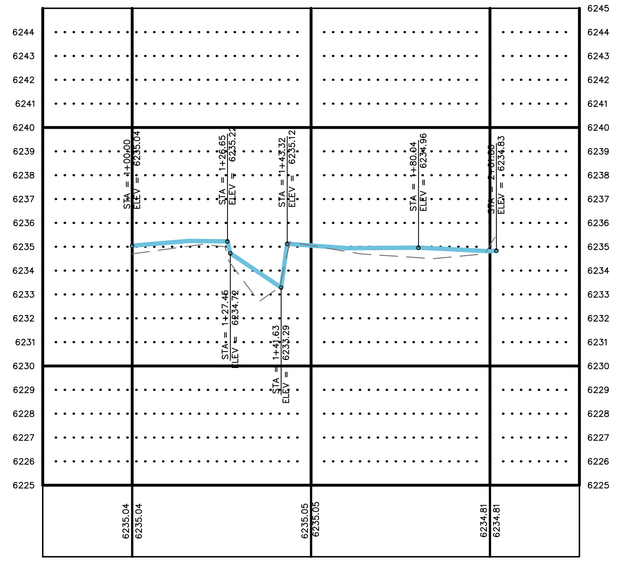
TRANSECT STPUD 6 – STA: 0+75 TO STA: 3+25



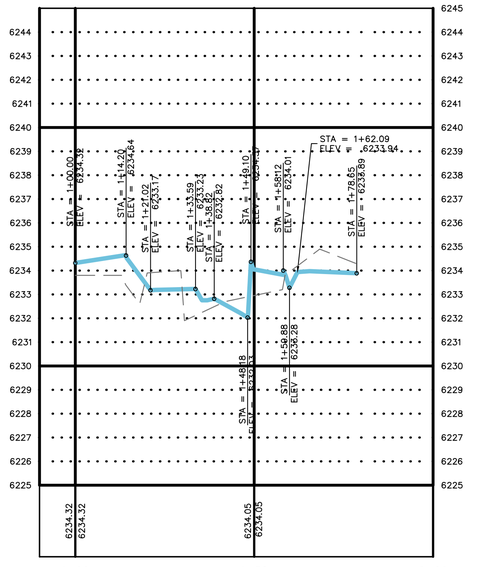
TRANSECT STPUD 7 – STA: 0+90 TO STA: 2+85



CTC X–SECTION 8 – STA: 0+75 TO STA: 2+25



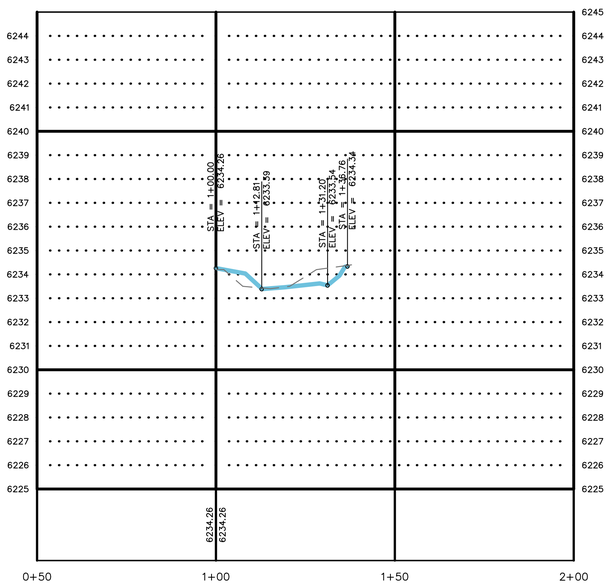
TRANSECT STPUD 8 – STA: 0+90 TO STA: 2+00



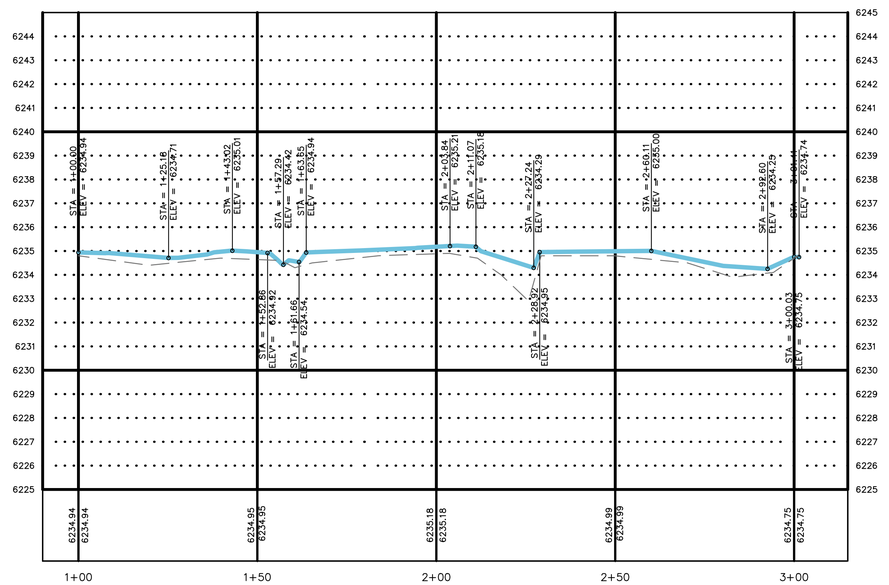
SCALE H:1"=20 V:1"=3'

Baseline survey represented by dashed lines.
2014 resurvey represented by blue lines.

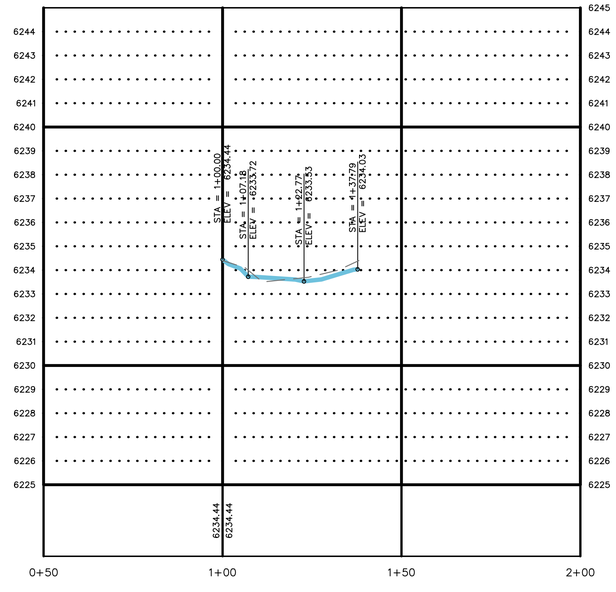
TRANSECT STPUD 9 – STA: 0+50 TO STA: 2+00



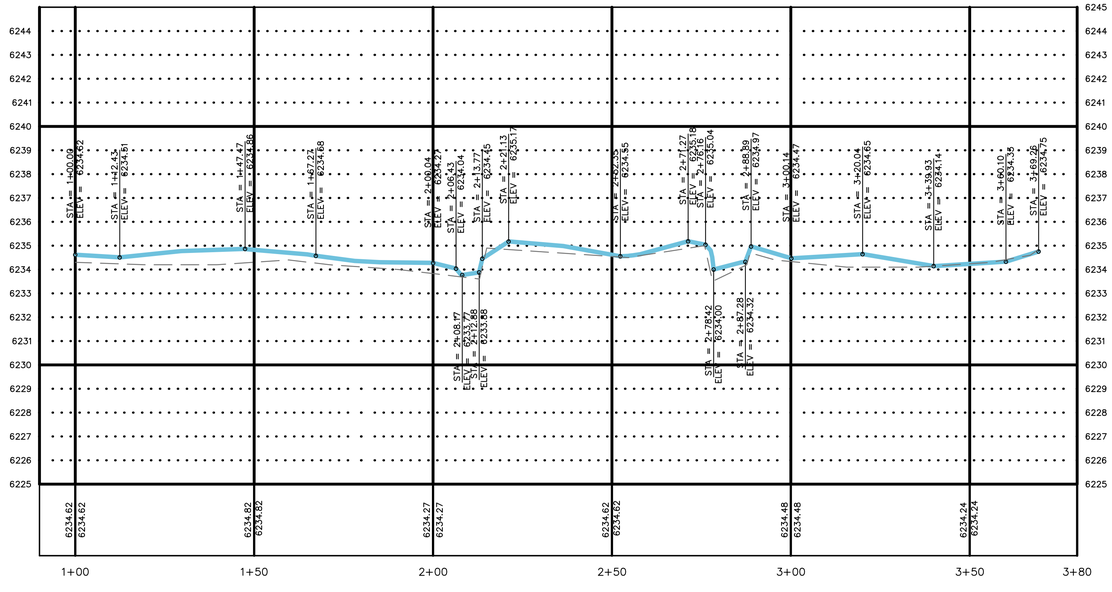
CTC X–SECTION 9 – STA: 0+90 TO STA: 3+15



TRANSECT STPUD 10 – STA: 0+50 TO STA: 2+00

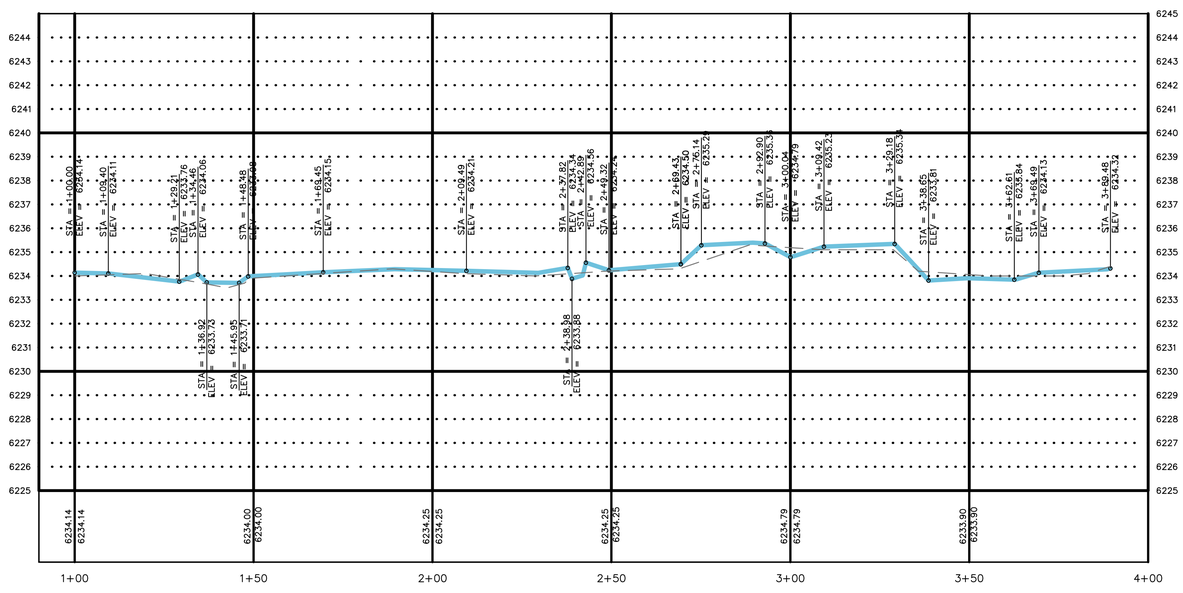


CTC X–SECTION 10 – STA: 0+90 TO STA: 3+80

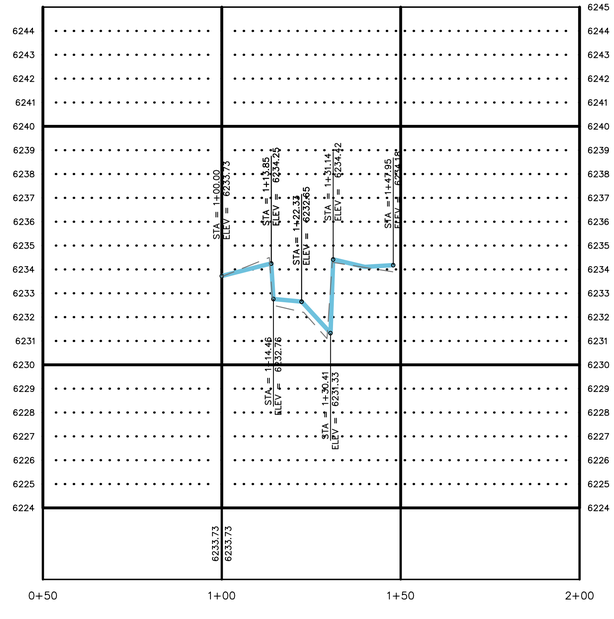


SCALE H: 1"=20 V: 1"=3'

CTC X–SECTION 11 – STA: 0+90 TO STA: 4+00



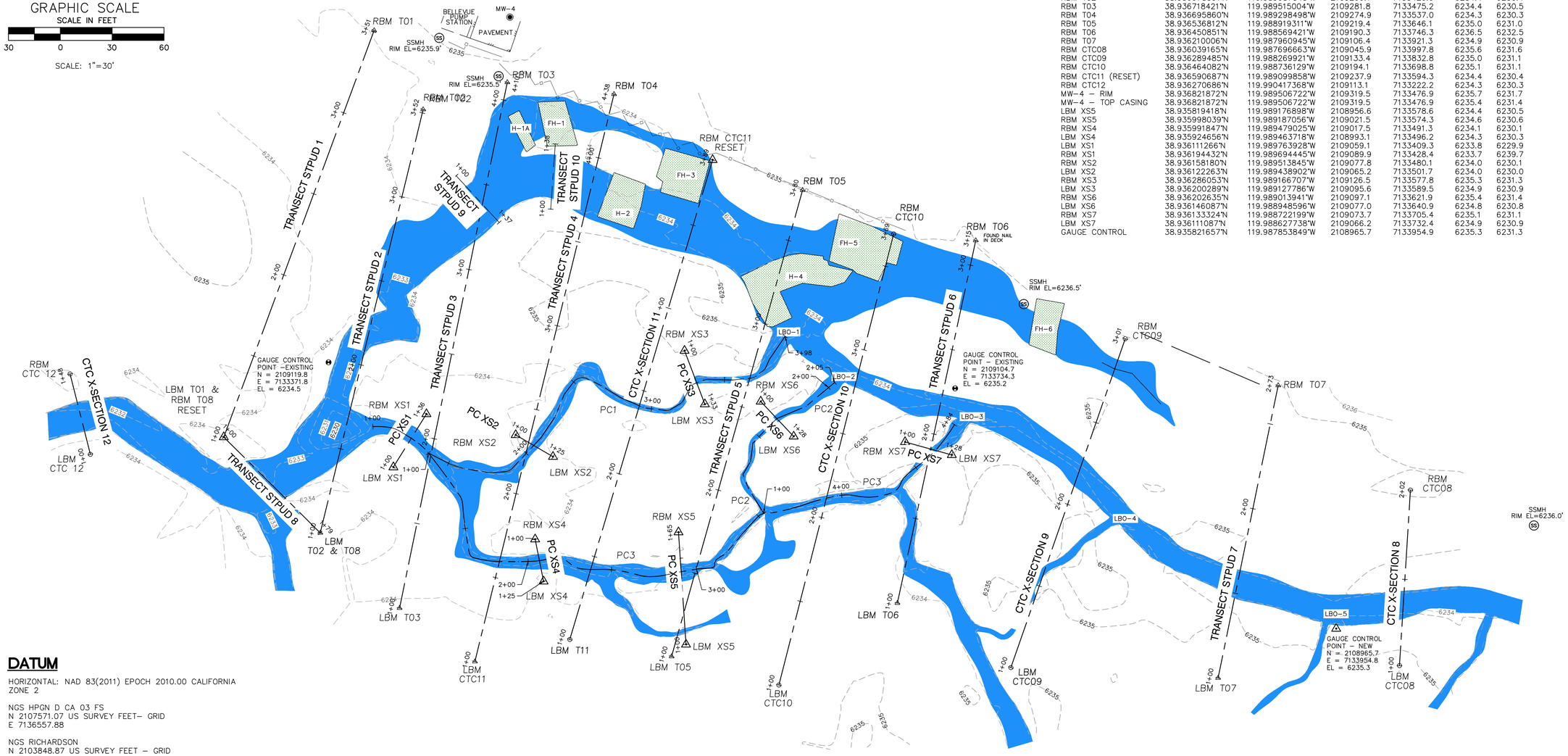
CTC X–SECTION 12 – STA: 0+50 TO STA: 2+00



Baseline survey represented by dashed lines.
2014 resurvey represented by blue lines.

TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT - AS BUILT FOR SOUTH TAHOE PUBLIC UTILITY DISTRICT

GRAPHIC SCALE
SCALE IN FEET
30 0 30 60
SCALE: 1"=30'



PROJECT CONTROL

MONUMENT NAME	LATITUDE NAD83	LONGITUDE NAD83	NORTHING SPC GRID	EASTING SPC GRID	ELEV. NAVD88	ELEV. NGVD29
LBM T01 & RBM T08 (RESET)	38.936168894"N	119.990106106"W	2109078.0	7133311.6	6234.3	6230.3
LBM T02 & LBM T08	38.936009520"N	119.989915687"W	2109021.1	7133367.0	6233.9	6229.9
LBM T0	38.935887231"N	119.989757770"W	2108977.6	7133412.9	6234.2	6230.2
LBM T04	38.935799724"N	119.989607047"W	2108946.7	7133456.5	6234.4	6230.5
LBM T05	38.935800843"N	119.989206809"W	2108949.6	7133570.3	6234.2	6230.3
LBM T06	38.935877770"N	119.988745105"W	2108980.5	7133700.9	6234.6	6230.6
LBM T07	38.935747492"N	119.988096356"W	2108937.2	7133886.5	6234.5	6230.5
LBM CTC08	38.935760651"N	119.987726877"W	2108944.3	7133991.4	6234.9	6231.0
LBM CTC09	38.935771271"N	119.988517241"W	2108943.2	7133766.6	6235.2	6231.2
LBM CTC10	38.935751784"N	119.988989853"W	2108933.1	7133632.4	6234.6	6230.6
LBM CTC11	38.935831478"N	119.989412956"W	2108959.5	7133511.4	6234.4	6230.4
LBM CTC12	38.936142345"N	119.990379722"W	2109066.6	7133234.0	6233.9	6229.9
RBM T01	38.936805560"N	119.989783506"W	2109311.8	7133398.2	6234.3	6230.3
RBM T02	38.936678391"N	119.989687343"W	2109266.1	7133426.6	6234.4	6230.4
RBM T03	38.936718421"N	119.989515004"W	2109281.8	7133475.2	6234.4	6230.5
RBM T04	38.936695860"N	119.989298498"W	2109274.9	7133537.0	6234.3	6230.3
RBM T05	38.936536812"N	119.988919311"W	2109219.4	7133646.1	6235.0	6231.0
RBM T06	38.936450851"N	119.988569421"W	2109190.3	7133746.3	6236.5	6232.5
RBM T07	38.936210006"N	119.987960945"W	2109106.4	7133921.3	6234.9	6230.9
RBM CTC08	38.936039165"N	119.987696663"W	2109045.9	7133997.8	6235.6	6231.6
RBM CTC09	38.936289485"N	119.988269921"W	2109133.4	7133832.8	6235.0	6231.1
RBM CTC10	38.936464082"N	119.988736129"W	2109194.1	7133698.8	6235.1	6231.1
RBM CTC11 (RESET)	38.936590687"N	119.989099858"W	2109237.9	7133594.3	6234.4	6230.4
RBM CTC12	38.936270686"N	119.990417368"W	2109113.1	7133222.2	6234.3	6230.3
MW-4 – RIM	38.936821872"N	119.989506722"W	2109319.5	7133476.9	6235.7	6231.7
MW-4 – TOP CASING	38.936821872"N	119.989506722"W	2109319.5	7133476.9	6235.4	6231.4
LBM XS5	38.935819418"N	119.989176898"W	2108956.6	7133578.6	6234.4	6230.5
RBM XS5	38.935998039"N	119.989187056"W	2109021.5	7133574.3	6234.6	6230.6
RBM XS4	38.935991847"N	119.989479025"W	2109017.5	7133491.3	6234.1	6230.1
LBM XS4	38.935924656"N	119.989463718"W	2108993.1	7133496.2	6234.3	6230.3
LBM XS1	38.936111266"N	119.989763928"W	2109059.1	7133409.3	6233.8	6229.9
RBM XS1	38.936194432"N	119.989694445"W	2109089.9	7133428.4	6233.7	6239.7
RBM XS2	38.936158180"N	119.989513845"W	2109077.8	7133480.1	6234.0	6230.1
LBM XS2	38.936122263"N	119.989438902"W	2109065.2	7133501.7	6234.0	6230.0
RBM XS3	38.936286053"N	119.989166707"W	2109126.5	7133577.8	6235.3	6231.3
LBM XS3	38.936200289"N	119.989127786"W	2109095.6	7133589.5	6234.9	6230.9
RBM XS6	38.936202635"N	119.989013941"W	2109097.1	7133621.9	6235.4	6231.4
LBM XS6	38.936146087"N	119.988948596"W	2109077.0	7133640.9	6234.8	6230.8
RBM XS7	38.936133324"N	119.988722199"W	2109073.7	7133705.4	6235.1	6231.1
LBM XS7	38.936111087"N	119.988627738"W	2109066.2	7133732.4	6234.9	6230.9
GAUGE CONTROL	38.935821657"N	119.987853849"W	2108965.7	7133954.9	6235.3	6231.3

DATUM

HORIZONTAL: NAD 83(2011) EPOCH 2010.00 CALIFORNIA ZONE 2

NGS HPGN D CA 03 FS
N 2107571.07 US SURVEY FEET– GRID
E 7136557.88

NGS RICHARDSON
N 2103848.87 US SURVEY FEET – GRID
E 7123525.92 GRID

VERTICAL: NAVD88
NGS HPGN D CA 03 FS
EL = 6248.20

PER CONTROL SURVEY PROVIDED BY S.T.P.U.D., PREPARED BY TRI STATE SURVEYING, LTD., DATED 11–05–13

LEGEND:

- ⚠ FOUND 5/8" REBAR AND CAP "LUMOS CONTROL"
- △ FOUND 5/8" REBAR AND CAP "TR–STATE CONTROL" – UNLESS OTHERWISE NOTED
- ○ FOUND 1/2" REBAR W/ NO CAP (CTC)

NOTE:

FIELD SURVEY CONDUCTED ON OCTOBER 22 & 30, 2015.

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PROFESSIONAL LAND SURVEYOR GREGORY S. PHILLIPS NO. 7936 EXP. 12/31/17 STATE OF CALIFORNIA

12/15/15

SOUTH TAHOE PUBLIC UTILITY DISTRICT

UPPER TRUCKEE MARSH - BELLEVUE AREA
A PORTION OF THE NORTH 1/2 OF
SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

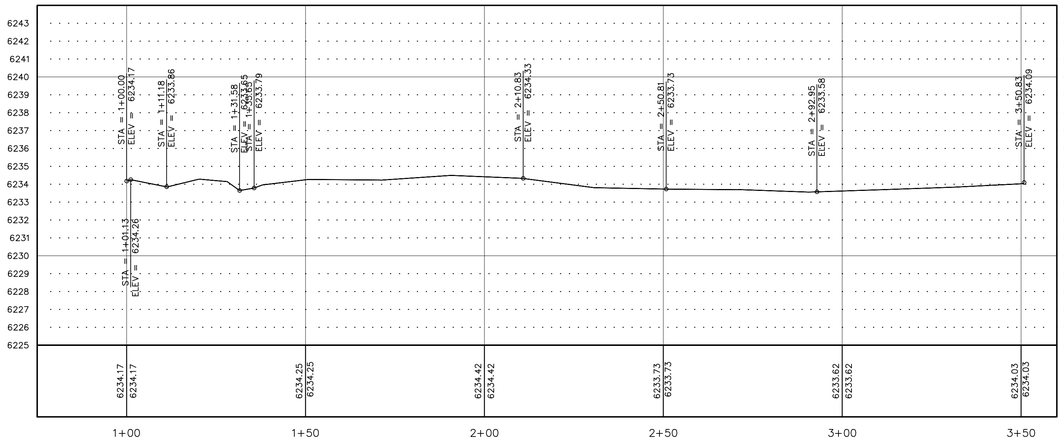
B1

DATE: NOVEMBER 2015
DRAWN BY: KLN
DESIGNED BY: GP
CHECKED BY: GP
JOB NO.: 8688.001

L:\LAP(x)\8688.001 – Upper Truckee Marsh As Built– 2015\Survey\Dwg\8688001 Upper Truckee Marsh profiles.dwg,B1 OVERALL, 12/15/2015 04:14 pm, dgillings

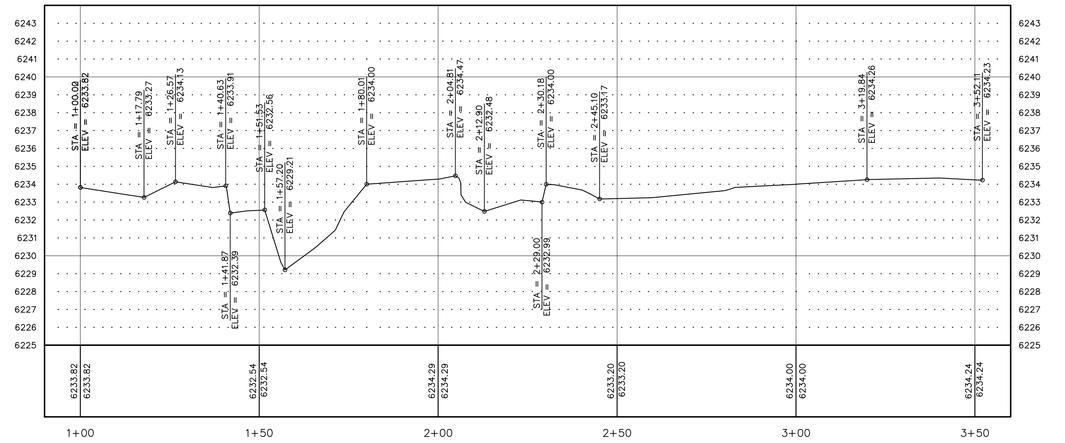
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 1 – STA: 0+75 TO STA: 3+60



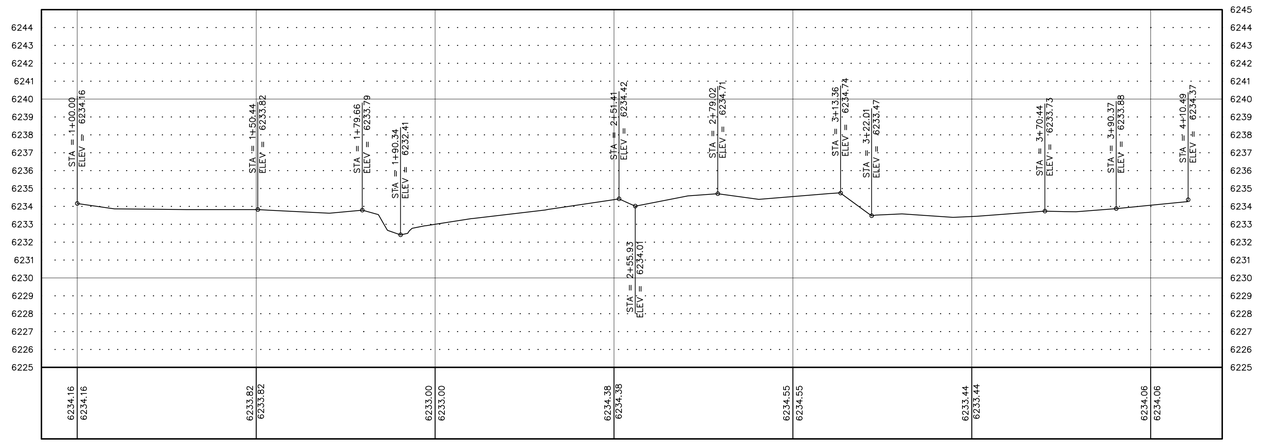
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 2 – STA: 0+90 TO STA: 3+60



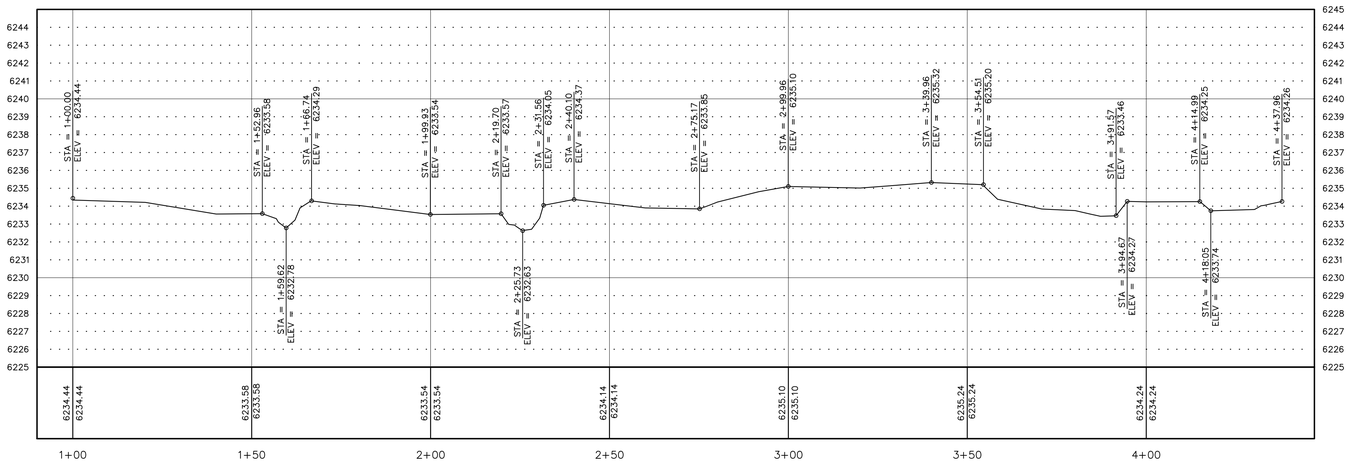
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 3 – STA: 0+90 TO STA: 4+20



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 4 – STA: 0+90 TO STA: 4+47



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EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

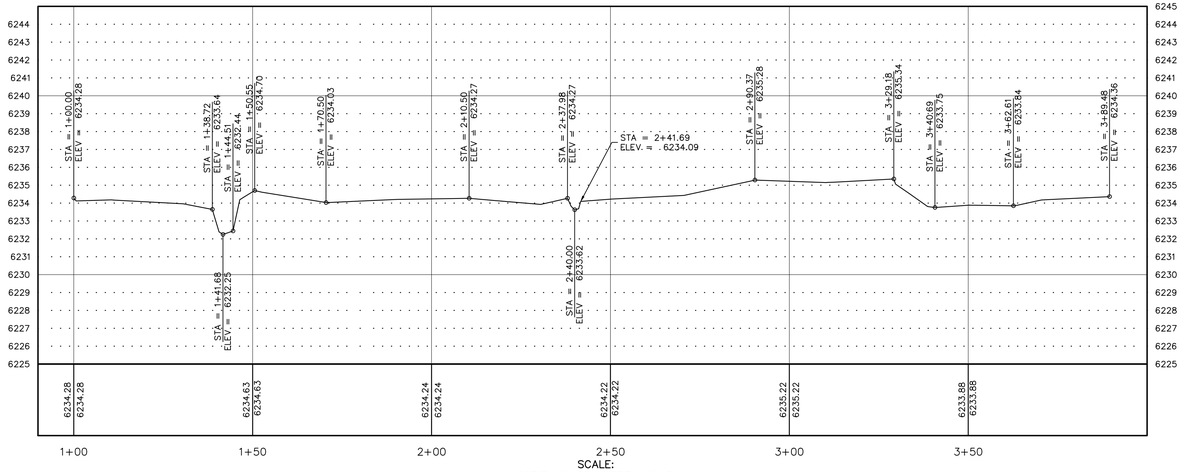
B2

DATE: NOVEMBER 2015
DRAWN BY: KLN
DESIGNED BY: GP
CHECKED BY: GP
JOB NO.: 8688.001

L:\APro\8688.001 – Upper Truckee Marsh As Built– 2015\Survey\Dwg\8688001 Upper Truckee Marsh profiles.dwg,B2 PROFILES,
12/15/2015 04:14 pm dphillips

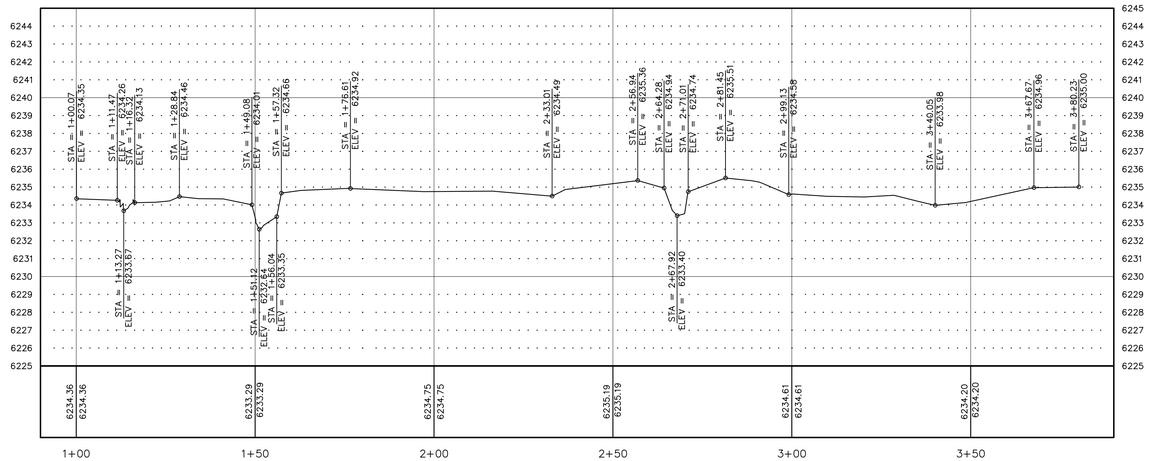
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

CTC X-SECTION 11 – STA: 0+90 TO STA: 4+00



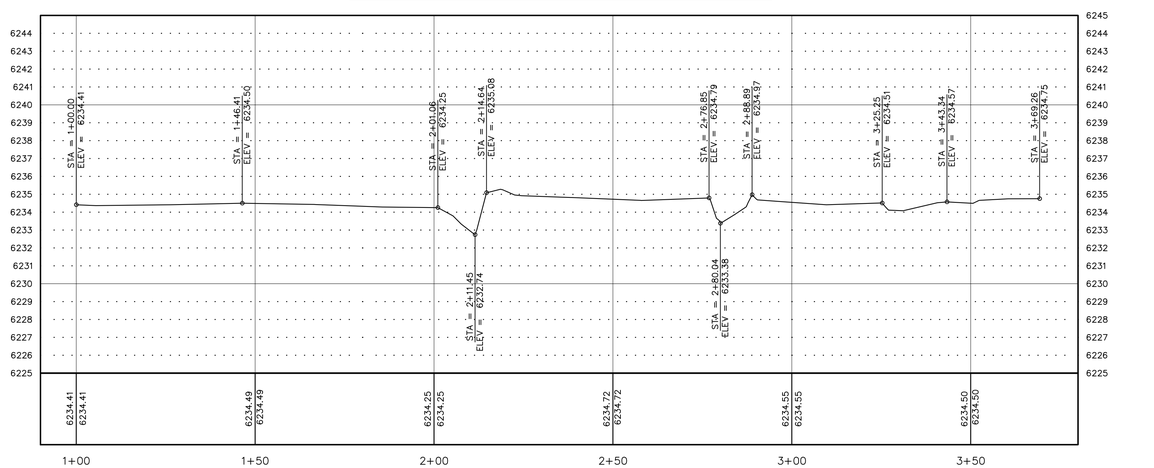
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 5 – STA: 0+90 TO STA: 3+90



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

CTC X-SECTION 10 – STA: 0+90 TO STA: 3+80



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SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

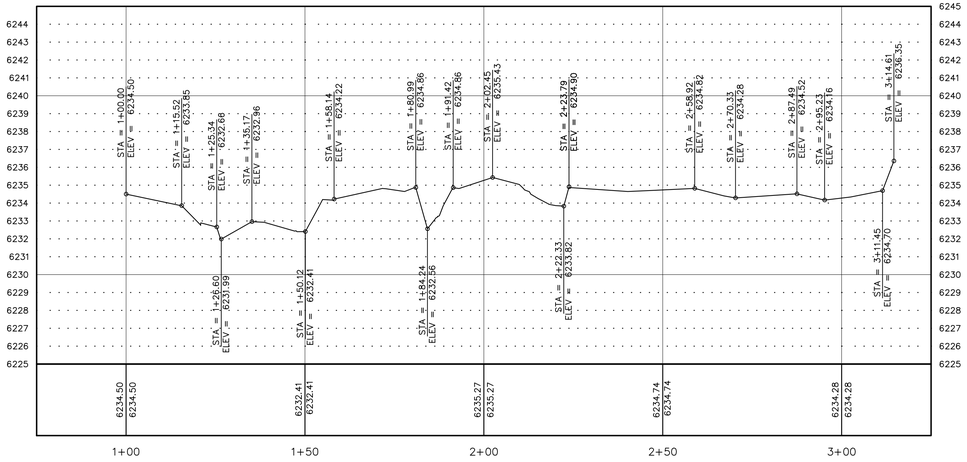
B3

DATE: NOVEMBER 2015
DRAWN BY: KLN
DESIGNED BY: GP
CHECKED BY: GP
JOB NO.: 8688.001

L:\LAPro\8688.001 – Upper Truckee Marsh As Built– 2015\Survey\Dwg\8688001 Upper Truckee Marsh profiles.dwg,B3 PROFILES, 12/15/2015 04:14 pm dphillips

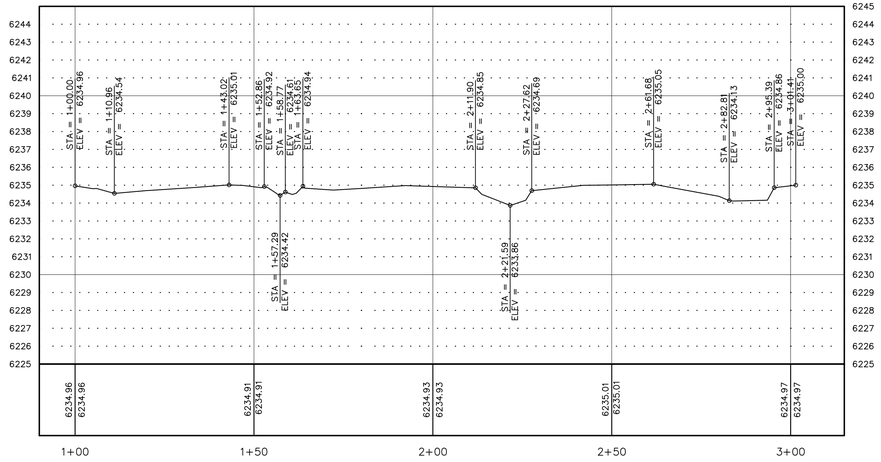
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 6 – STA: 0+75 TO STA: 3+25



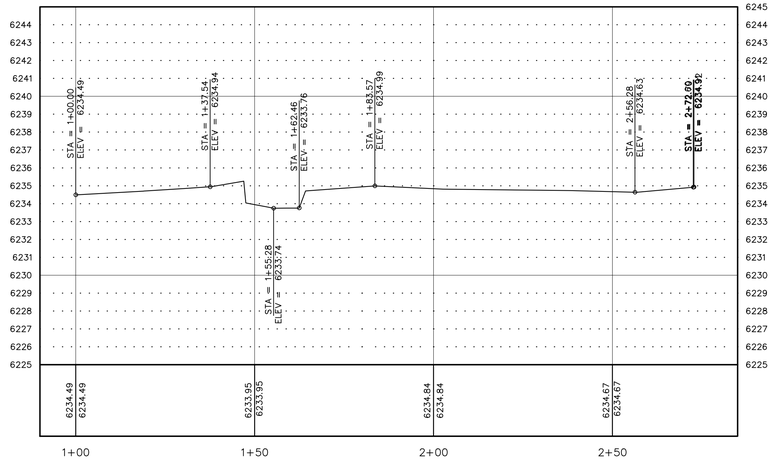
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

CTC X-SECTION 9 – STA: 0+90 TO STA: 3+15



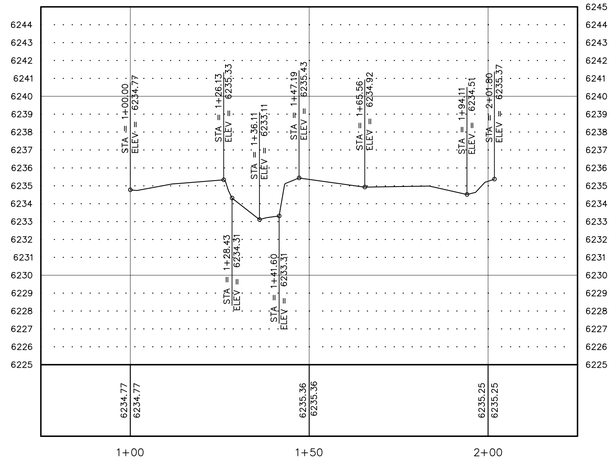
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 7 – STA: 0+90 TO STA: 2+85



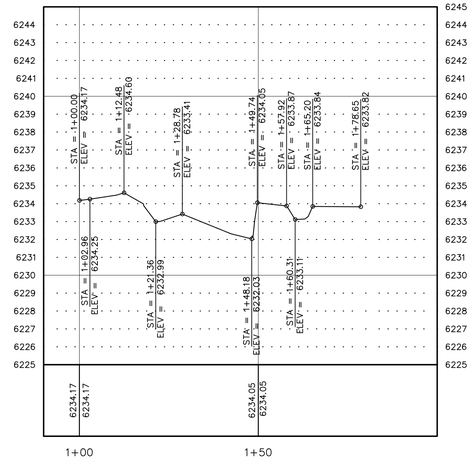
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

CTC X-SECTION 8 – STA: 0+75 TO STA: 2+25



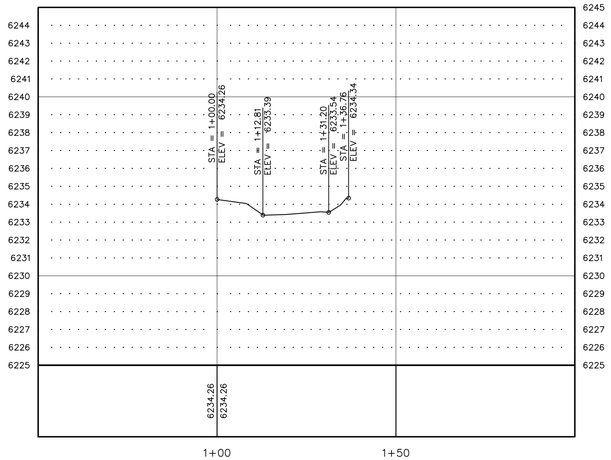
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 8 – STA: 0+90 TO STA: 2+00



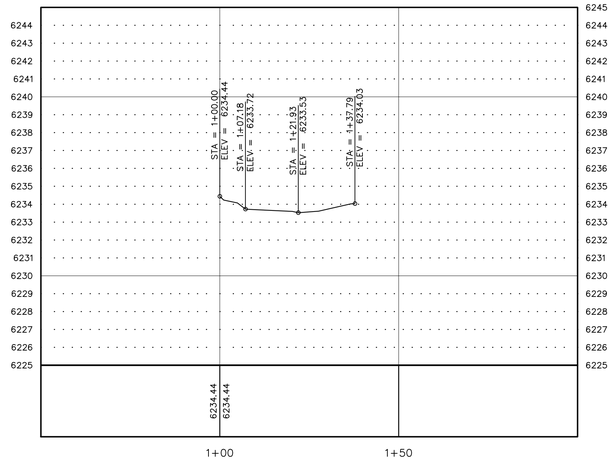
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 9 – STA: 0+50 TO STA: 2+00



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

TRANSECT STPUD 10 – STA: 0+50 TO STA: 2+00



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SOUTH TAHOE PUBLIC UTILITY DISTRICT

UPPER TRUCKEE MARSH - BELLEVUE AREA

A PORTION OF THE NORTH 1/2 OF
SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

B4

DATE: NOVEMBER 2015
DRAWN BY: KLN
DESIGNED BY: GP
CHECKED BY: GP
JOB NO.: 8688.001

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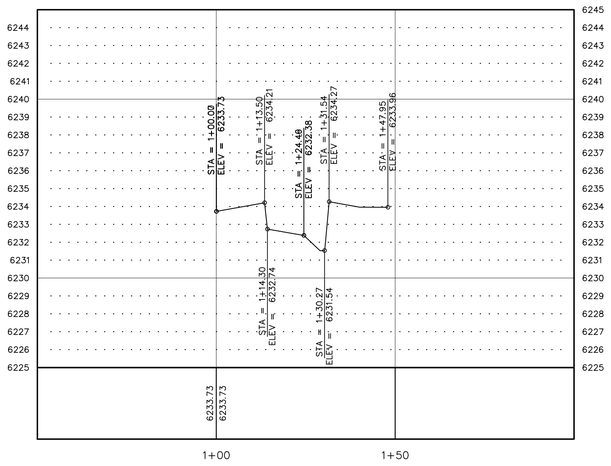
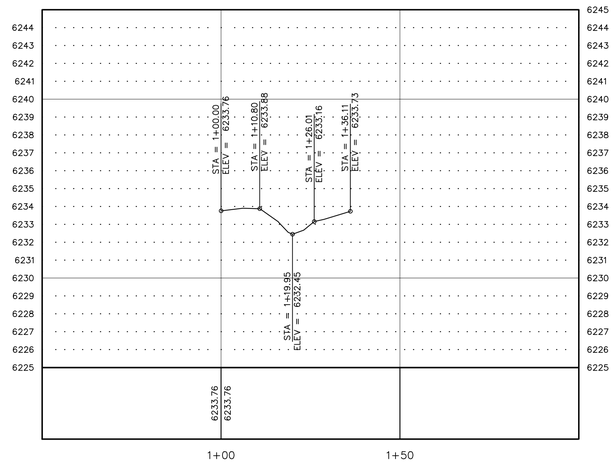
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

CTC X-SECTION 12 – STA: 0+50 TO STA: 2+00



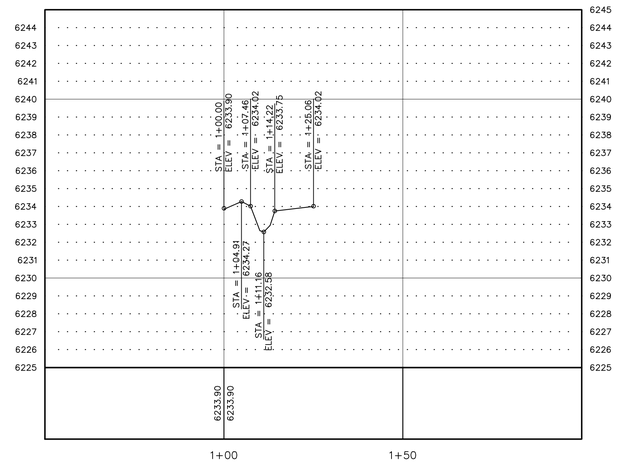
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC XS1 – STA: 0+50 TO STA: 2+00



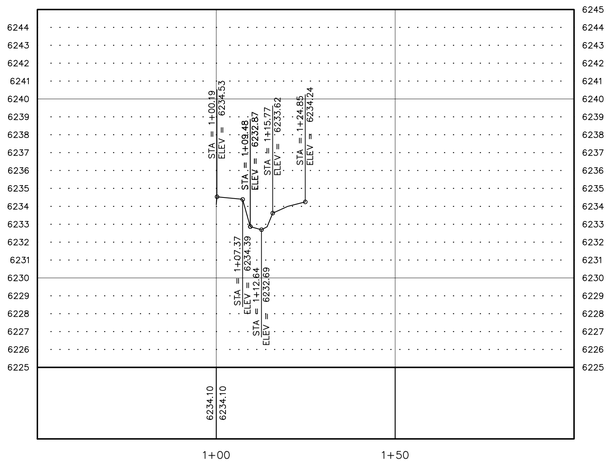
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC XS2 – STA: 0+50 TO STA: 2+00



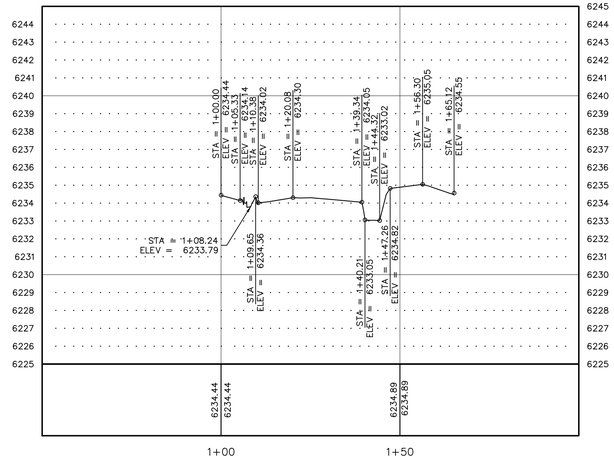
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC XS4 – STA: 0+50 TO STA: 2+00



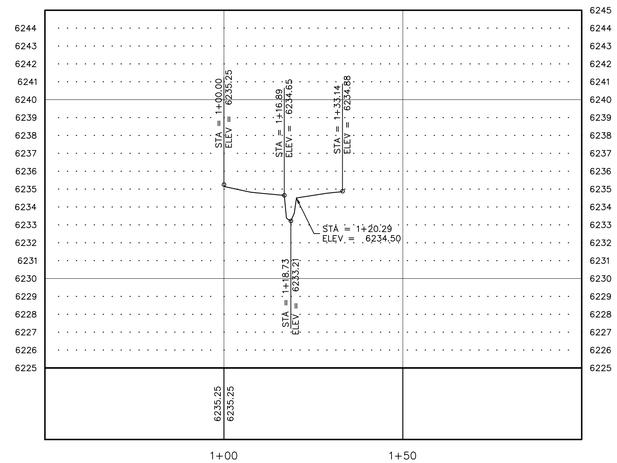
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC XS5 – STA: 0+50 TO STA: 2+00



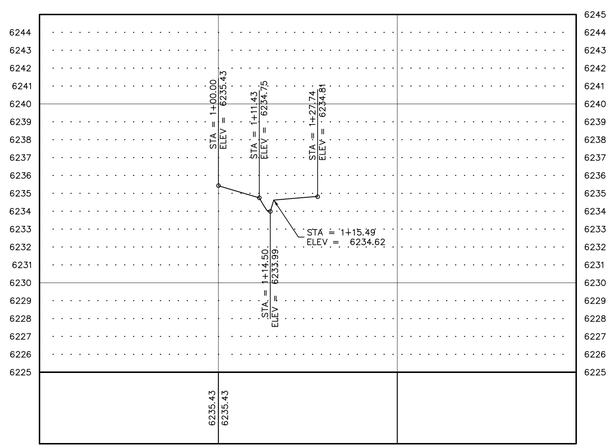
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC XS3 – STA: 0+50 TO STA: 2+00



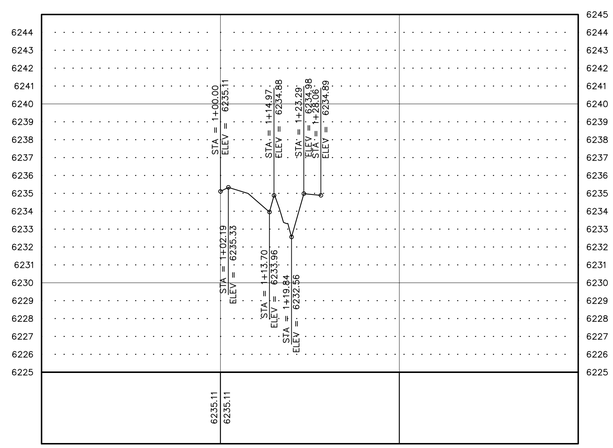
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC XS6 – STA: 0+50 TO STA: 2+00



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC XS7 – STA: 0+50 TO STA: 2+00



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EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

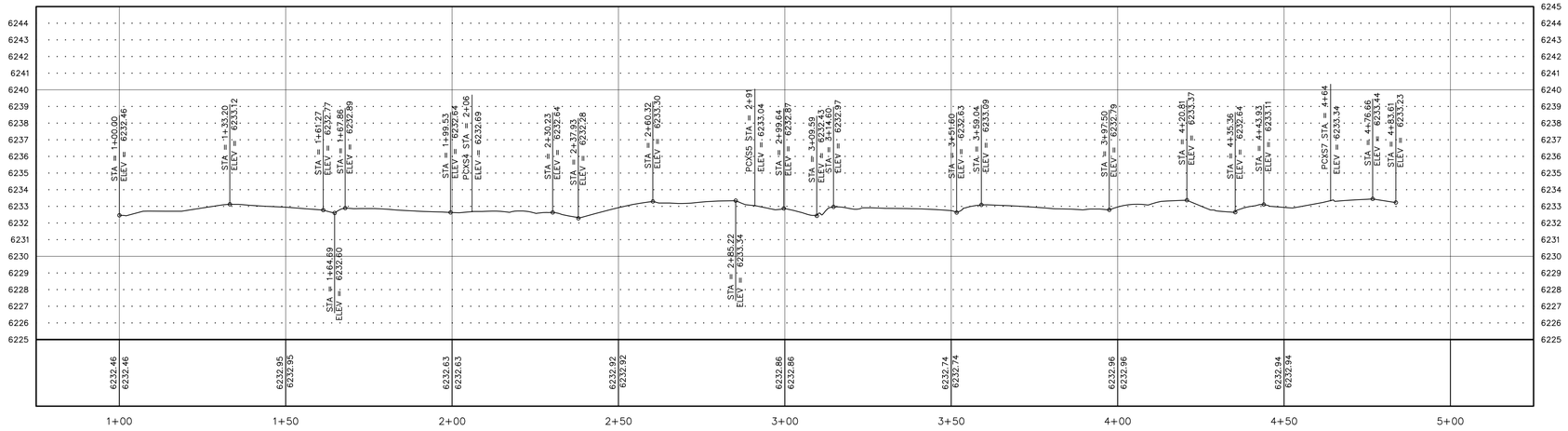
B5

DATE:	NOVEMBER 2015
DRAWN BY:	KLN
DESIGNED BY:	GP
CHECKED BY:	GP
JOB NO.:	8688.001

L:\LAPro\8688.001 – Upper Truckee Marsh As Built– 2015\Survey\Dwg\8688001 Upper Truckee Marsh profiles.dwg,B5 PROFILES,
12/15/2015 04:14 pm tphillips

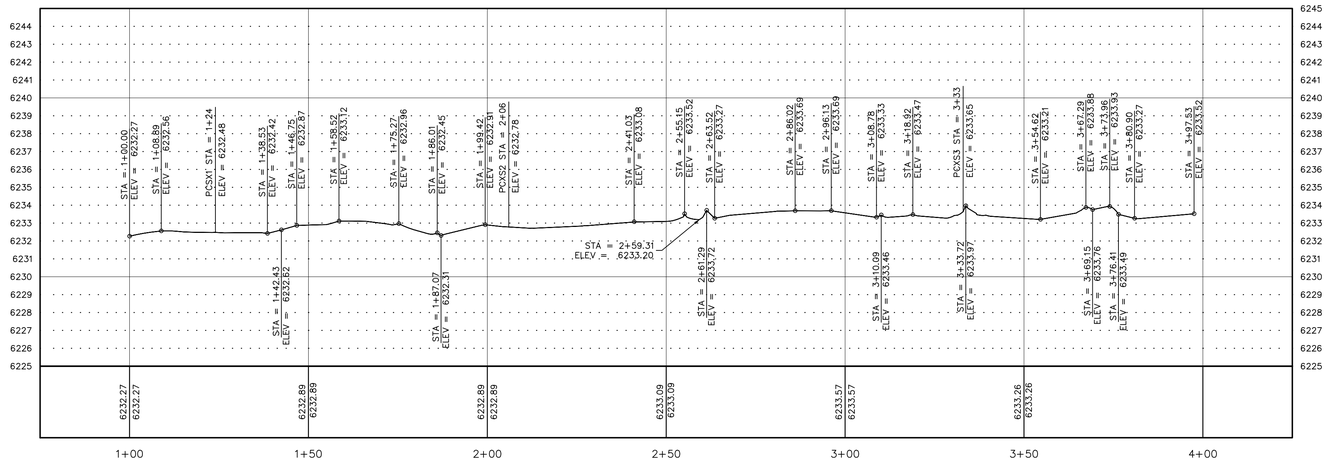
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC3 – STA: 0+75 TO STA: 5+25



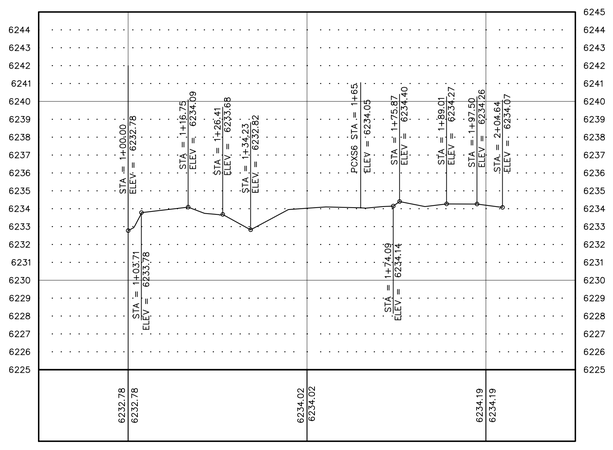
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC1 – STA: 0+75 TO STA: 4+25



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

PC2 – STA: 0+75 TO STA: 2+25



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EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

B6

DATE: NOVEMBER 2015
DRAWN BY: KLN
DESIGNED BY: GP
CHECKED BY: GP
JOB NO.: 8688.001

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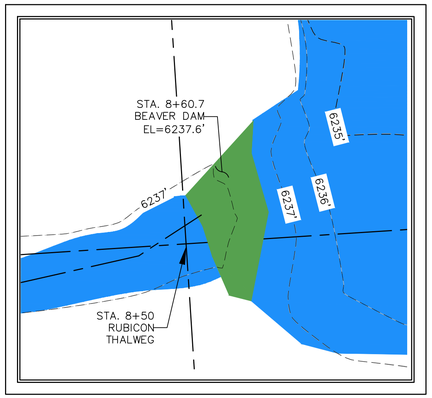
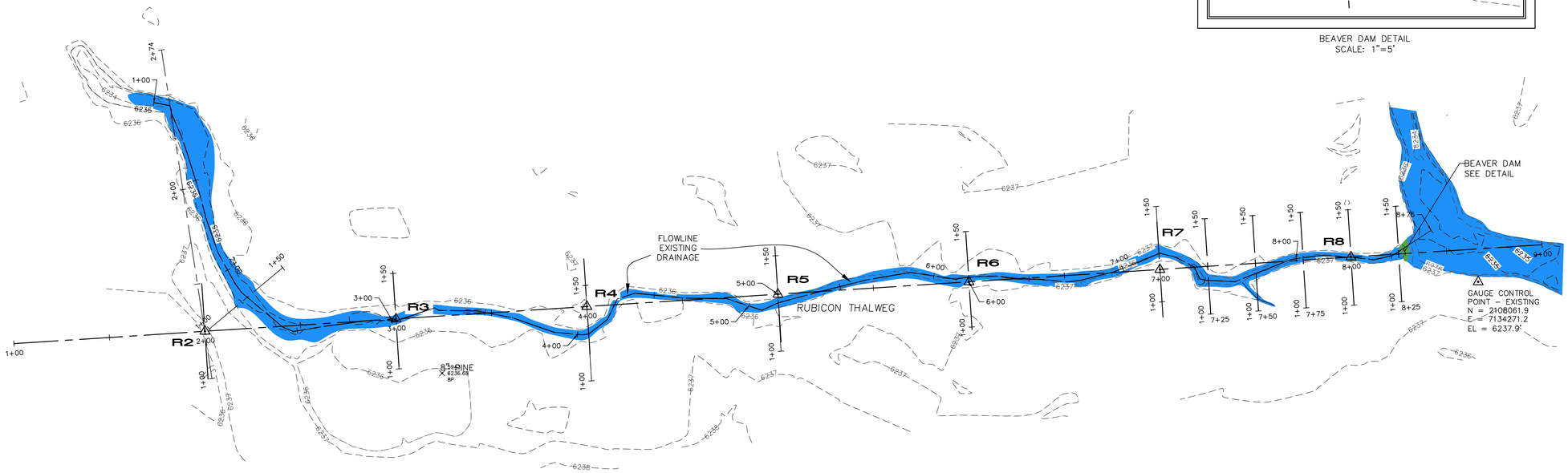
TRUCKEE MARSH SEWER FACILITIES PROTECTION PROJECT FOR SOUTH TAHOE PUBLIC UTILITY DISTRICT

GRAPHIC SCALE
SCALE IN FEET
30 0 30 60
SCALE: 1"=30'



BEAVER DAM DETAIL
SCALE: 1"=5'



PROJECT CONTROL

MONUMENT NAME	LATITUDE NAD83	LONGITUDE NAD83	NORTHING SPC GRID	EASTING SPC GRID	ELEV. NAVD88	ELEV. NGVD29
R2	38.933290737"N	119.989152495"W	2108036.0	7133605.9	6236.7	6232.7
R3	38.933302389"N	119.988801138"W	2108042.5	7133705.8	6235.1	6231.1
R4	38.933314115"N	119.988450170"W	2108049.0	7133805.5	6236.2	6232.3
R5	38.933325686"N	119.988098854"W	2108055.4	7133905.3	6236.4	6232.4
R6	38.933337426"N	119.987747632"W	2108061.9	7134005.1	6236.5	6232.5
R7	38.933349104"N	119.987396289"W	2108068.3	7134104.9	6237.8	6233.8
R8	38.933360888"N	119.987045069"W	2108074.8	7134204.7	6236.7	6232.7
RUBICON GAUGE	38.933321287"N	119.986812431"W	2108061.9	7134271.2	6237.9	6234.0

DATUM

HORIZONTAL: NAD 83(2011) EPOCH 2010.00 CALIFORNIA ZONE 2

NGS HPGN D CA 03 FS
N 2107571.07 US SURVEY FEET– GRID
E 7136557.88

NGS RICHARDSON
N 2103848.87 US SURVEY FEET – GRID
E 7123525.92 GRID

VERTICAL: NAVD88
NGS HPGN D CA 03 FS
EL = 6248.20

PER CONTROL SURVEY PROVIDED BY S.T.P.U.D., PREPARED BY TRI STATE SURVEYING, LTD., DATED 11–05–13

LEGEND:

- ⚠ FOUND 5/8" REBAR AND CAP "LUMOS CONTROL"
- △ FOUND 5/8" REBAR AND CAP "TR–STATE CONTROL" – UNLESS OTHERWISE NOTED
- ○ FOUND 1/2" REBAR W/ NO CAP (CTC)

NOTE:

FIELD SURVEY CONDUCTED BETWEEN OCTOBER 22 & 30, 2015

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PROFESSIONAL LAND SURVEYOR
GREGORY S. PHILLIPS
NO. 7936
EXP. 12/31/17
STATE OF CALIFORNIA

12/15/15

SOUTH TAHOE PUBLIC UTILITY DISTRICT

UPPER TRUCKEE MARSH - RUBICON TRAIL AREA
A PORTION OF THE NORTH 1/2 OF
SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

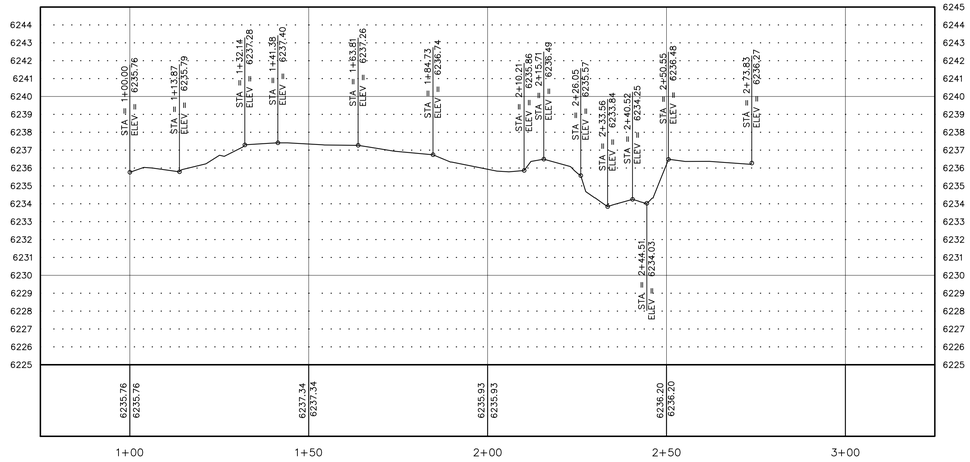
R1

DATE: NOVEMBER 2015
DRAWN BY: KLN
DESIGNED BY: GP
CHECKED BY: GP
JOB NO.: 8688.001

L:\LAP\o)\8688.001 – Upper Truckee Marsh As Built– 2015\Survey\Dwg\8688001 Upper Truckee Marsh profiles.dwg,R1 OVERALL, 12/15/2015 04:14 pm sphillips

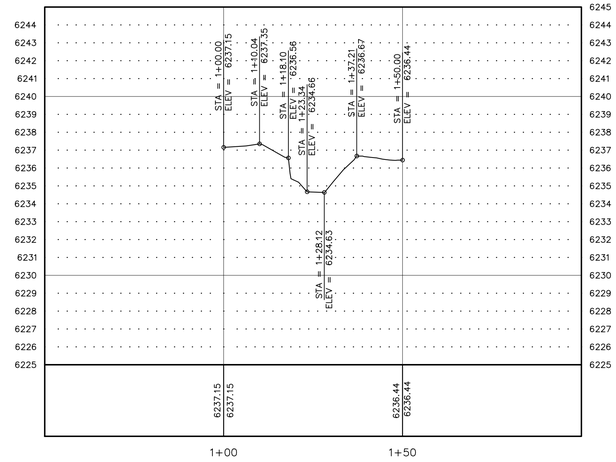
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 2+00 – STA: 0+75 TO STA: 3+25



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 2+25 – STA: 0+50 TO STA: 2+00



SCALE:
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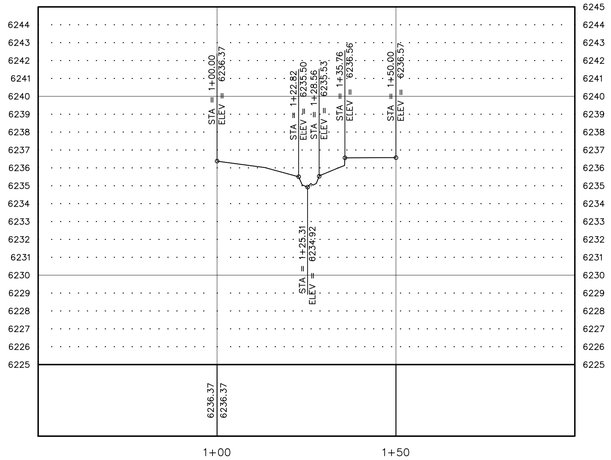
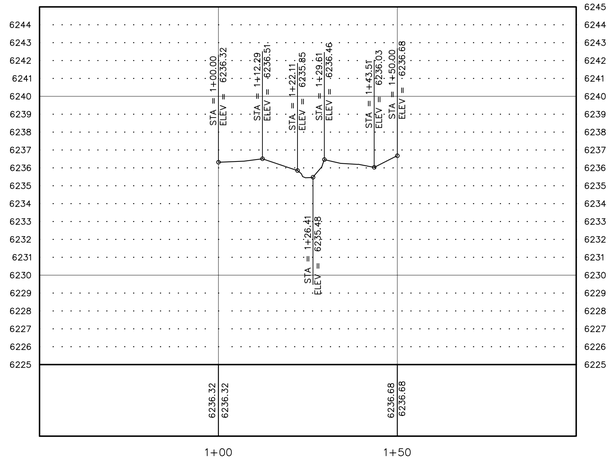
RUBICON 3+00 – STA: 0+50 TO STA: 2+00



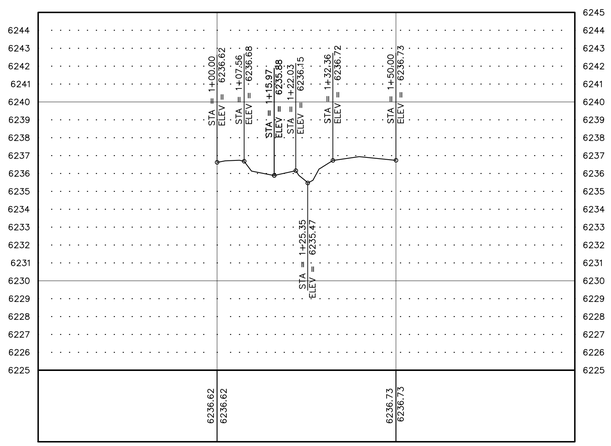
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 4+00 – STA: 0+50 TO STA: 2+00



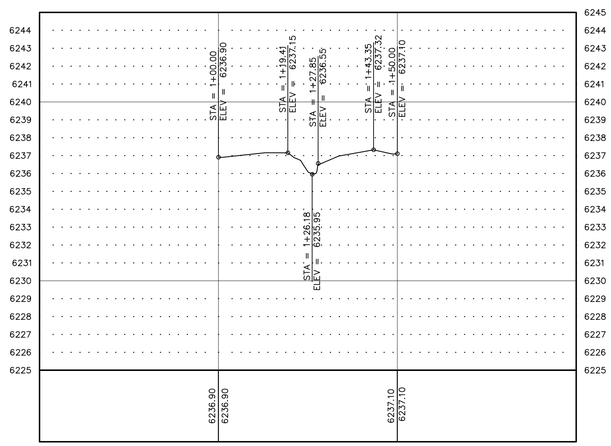
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 5+00 – STA: 0+50 TO STA: 2+00



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 6+00 – STA: 0+50 TO STA: 2+00



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A PORTION OF THE NORTH 1/2 OF
SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

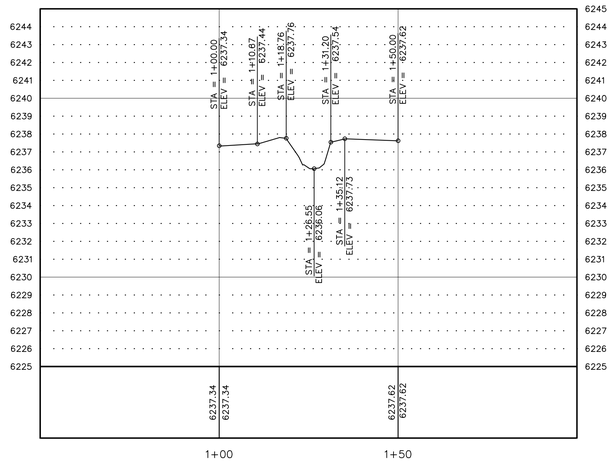
R2

DATE:	NOVEMBER 2015
DRAWN BY:	KLN
DESIGNED BY:	GP
CHECKED BY:	GP
JOB NO.:	8688.001

L:\LAPro\8688.001 – Upper Truckee Marsh As Built– 2015\Survey\Dwg\8688001 Upper Truckee Marsh profiles.dwg,R2 PROFILES,
12/15/2015 04:14 pm tphillips

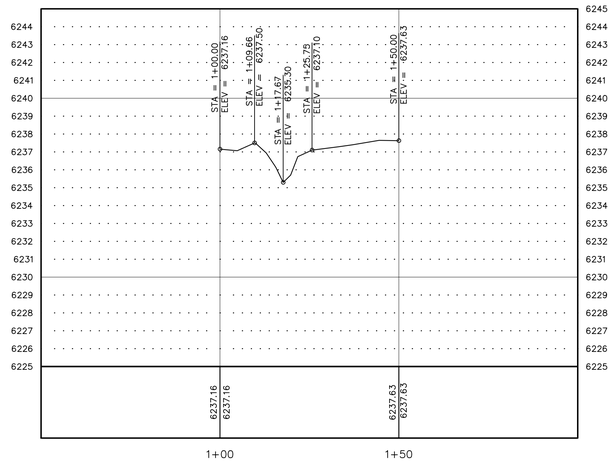
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 7+00 – STA: 0+50 TO STA: 2+00



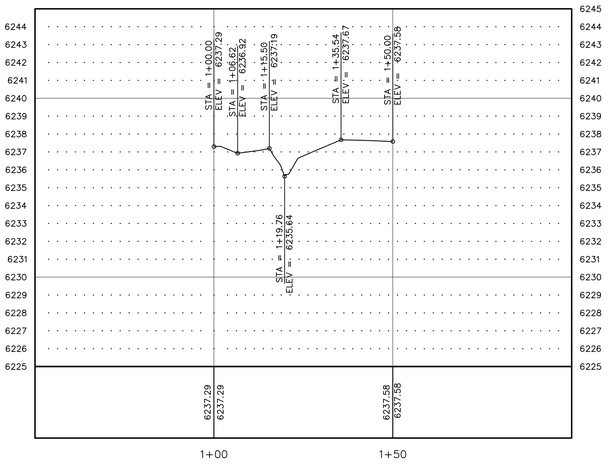
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 7+25 – STA: 0+50 TO STA: 2+00



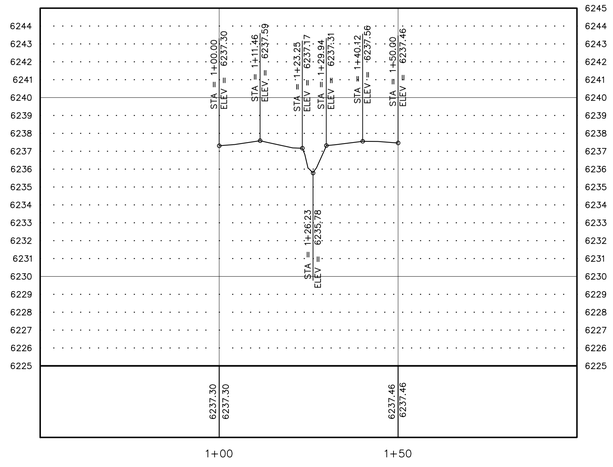
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 7+50 – STA: 0+50 TO STA: 2+00



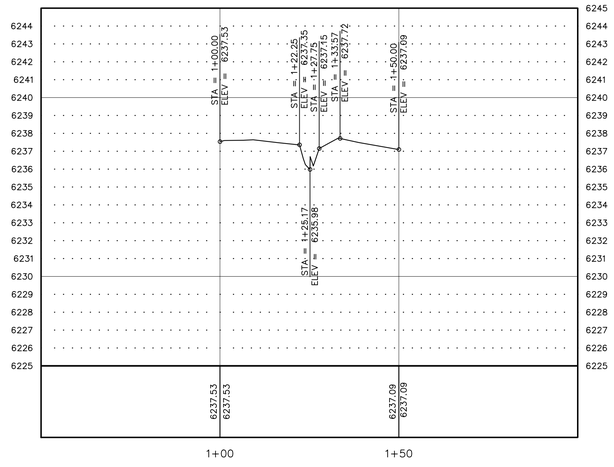
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 7+75 – STA: 0+50 TO STA: 2+00



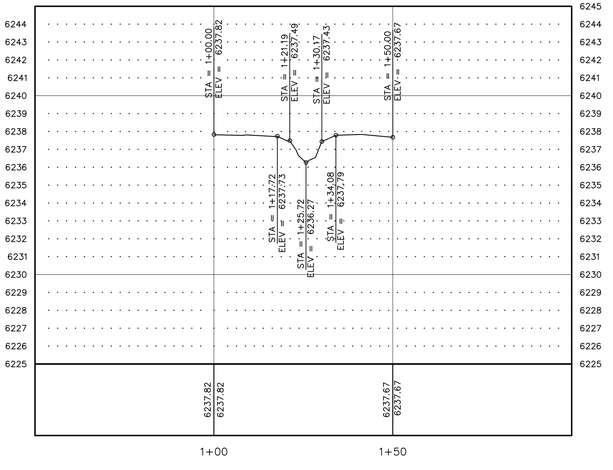
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 8+00 – STA: 0+50 TO STA: 2+00



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

RUBICON 8+25 – STA: 0+50 TO STA: 2+00



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EL DORADO COUNTY CALIFORNIA

REV	DATE	DESCRIPTION	BY

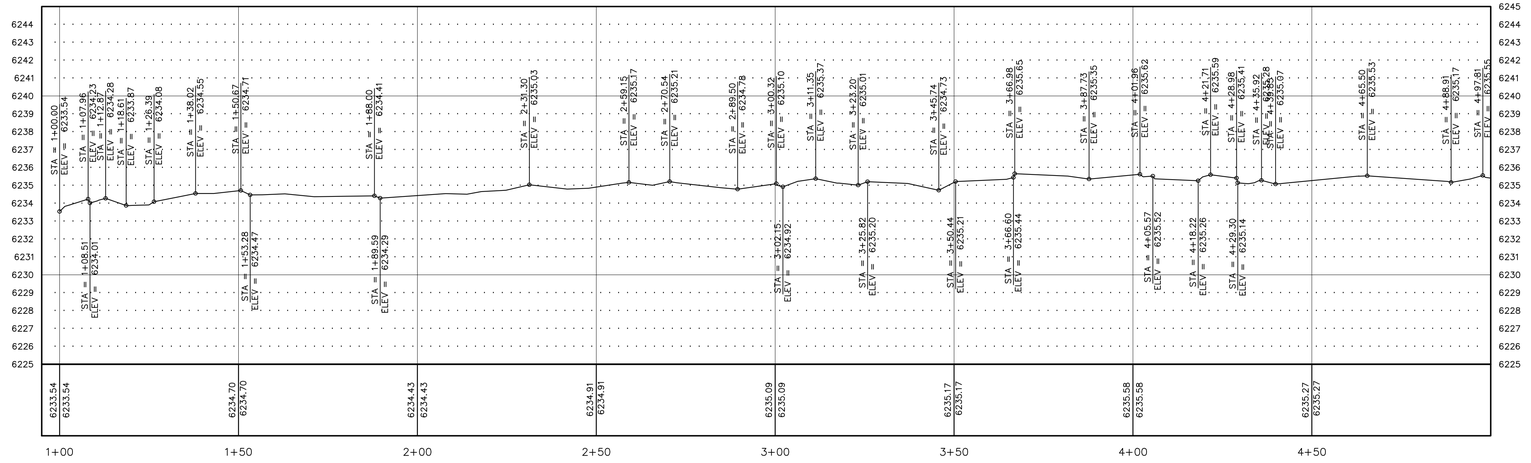
R3

DATE: NOVEMBER 2015
DRAWN BY: KLN
DESIGNED BY: GP
CHECKED BY: GP
JOB NO.: 8688.001

L:\APro\8688.001 – Upper Truckee Marsh As Built– 2015\Survey\Dwg\8688001 Upper Truckee Marsh profiles.dwg,R3 PROFILES, 12/15/2015 04:14 pm tphillips

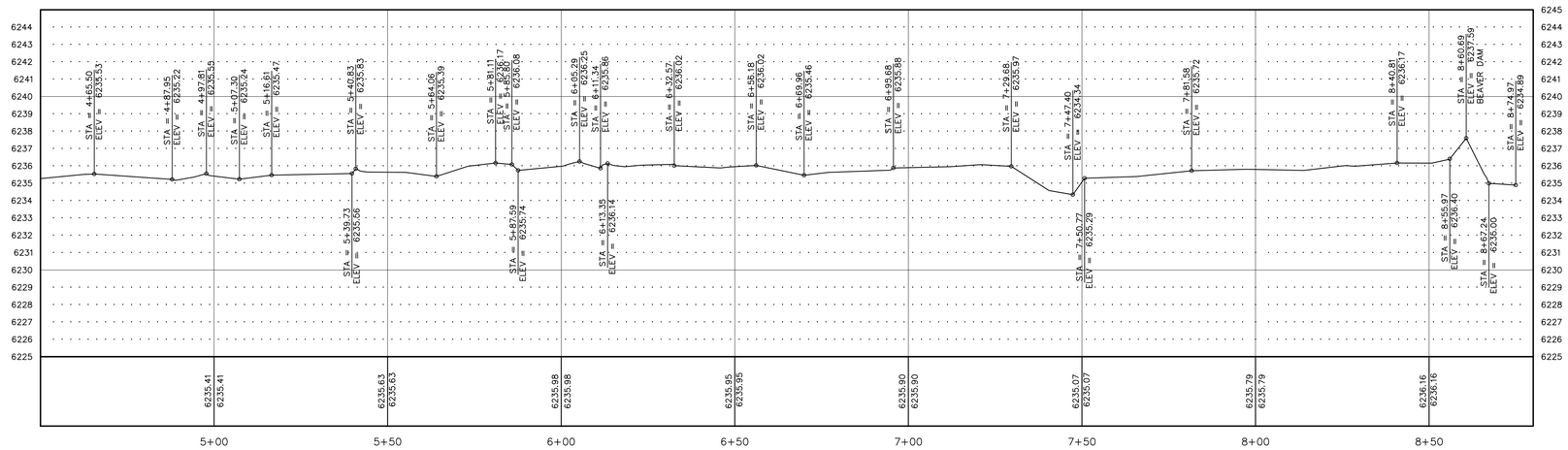
SCALE:
HORIZ. 1"=20', VERT. 1"=2'

Rubicon Thalweg – STA: 0+95 TO STA: 5+00



SCALE:
HORIZ. 1"=20', VERT. 1"=2'

Rubicon Thalweg – STA: 4+50 TO STA: 8+80



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A PORTION OF THE NORTH 1/2 OF
SECTION 4, T.12N., R18E., M.D.M, A.P.N. 026-200-11

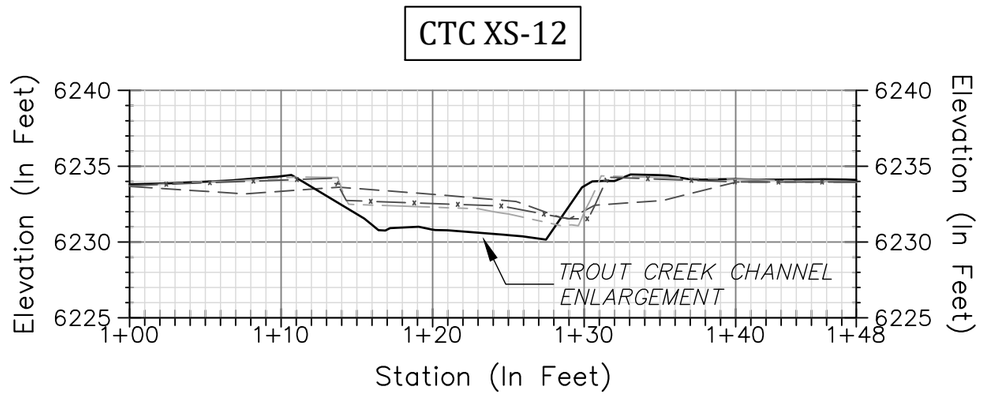
REV	DATE	DESCRIPTION	BY

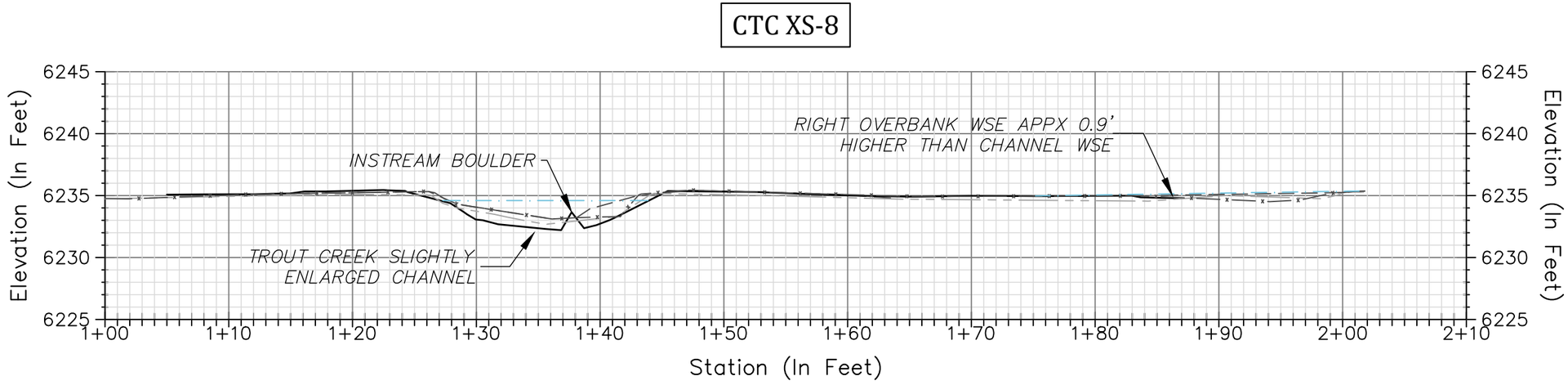
R4

DATE: NOVEMBER 2(
DRAWN BY: K
DESIGNED BY:
CHECKED BY:
JOB NO.: 8688.(

12/15/2015 04:27 pm Gphillips

LEGEND
2020 nhc SURVEY
2015 LUMOS SURVEY
2014 LUMOS SURVEY
2013 TRI-STATE SURVEY
WSEL





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FILE LOCATION: P:\5006145 - UTMSFPP AMP CLOSEOUT\96_CAD\02 DESIGNPRODUCTION\0100_CURRENT\TROUT CREEK TRANSECT COMPARISON_DJB.DWG

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fax: (916) 371-7475

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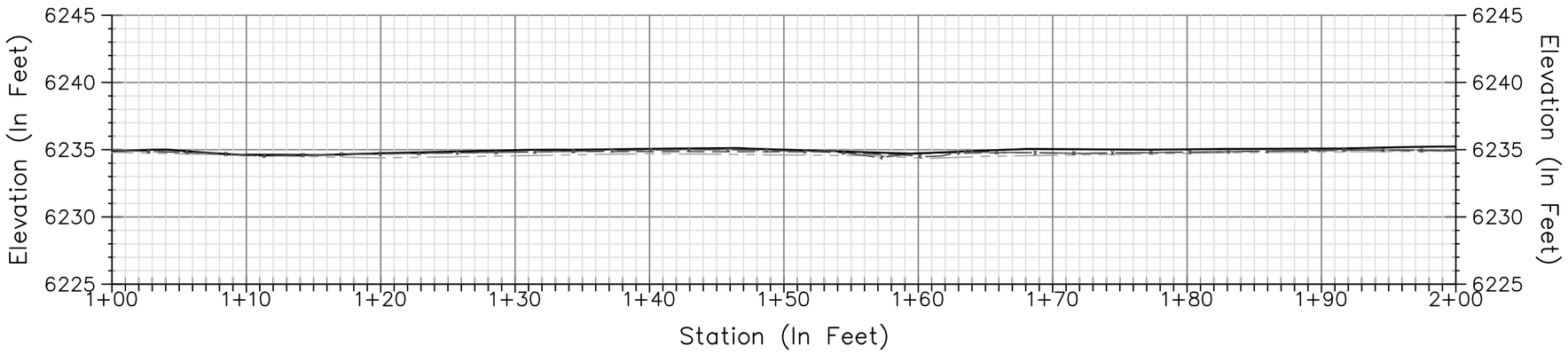
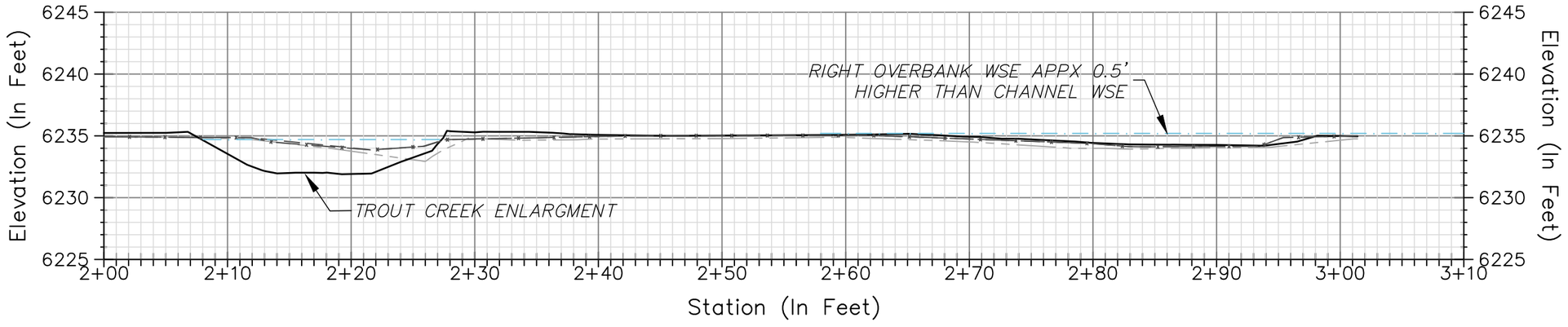
Date: 26Feb21	

LEGEND
2020 nhc SURVEY
2015 LUMOS SURVEY
2014 LUMOS SURVEY
2013 TRI-STATE SURVEY
WSEL

CTC XS-9



CTC XS-9



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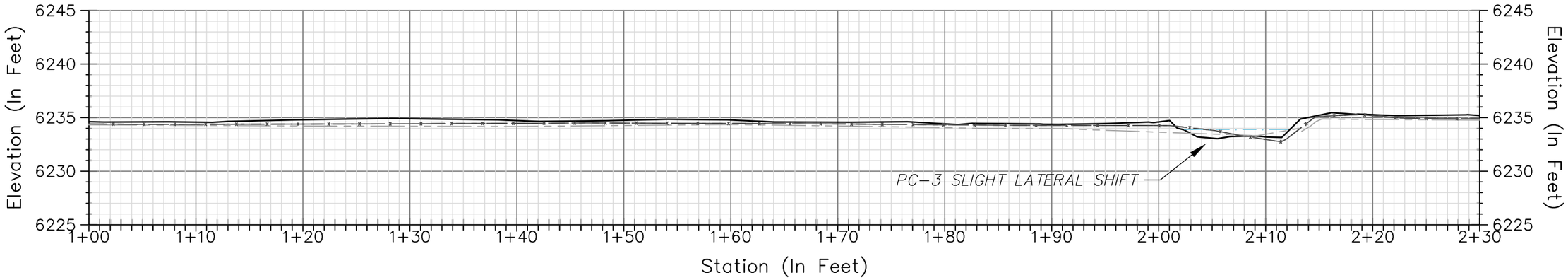
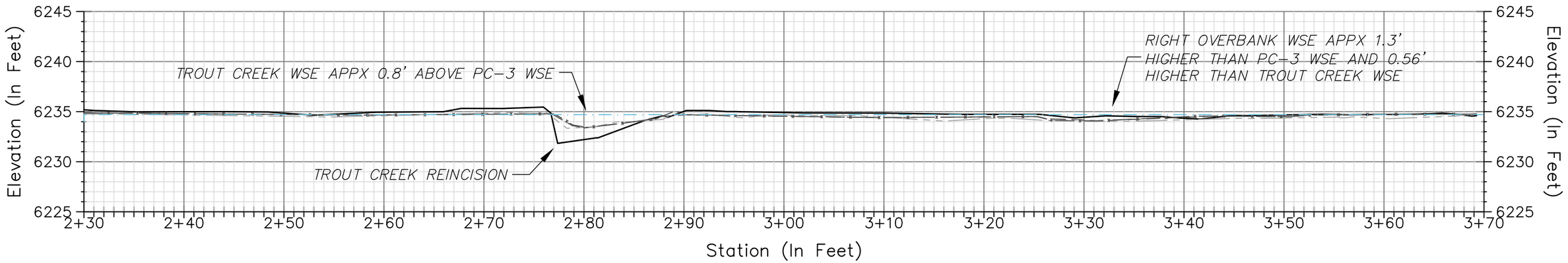
Chkd:	
Date: 26Feb21	

CTC XS-10



LEGEND
2020 nhc SURVEY
2015 LUMOS SURVEY
2014 LUMOS SURVEY
2013 TRI-STATE SURVEY
WSEL

CTC XS-10



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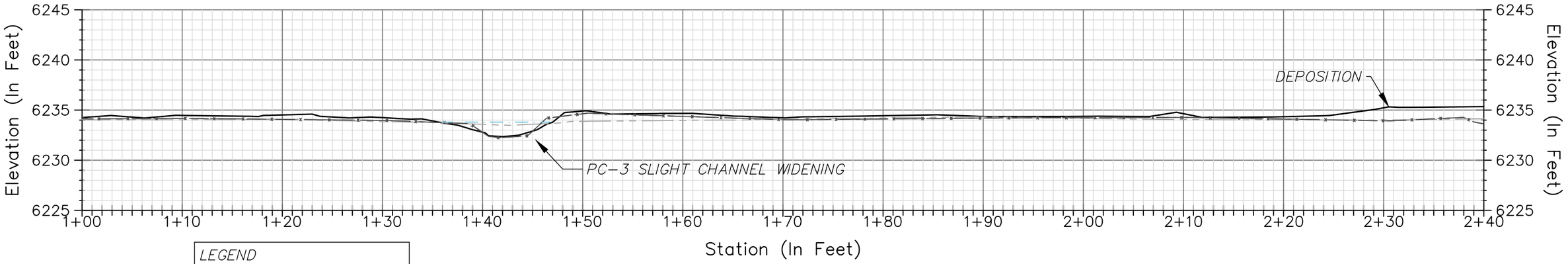
Date: 26Feb21	

CTC XS-11



LEGEND
2020 nhc SURVEY
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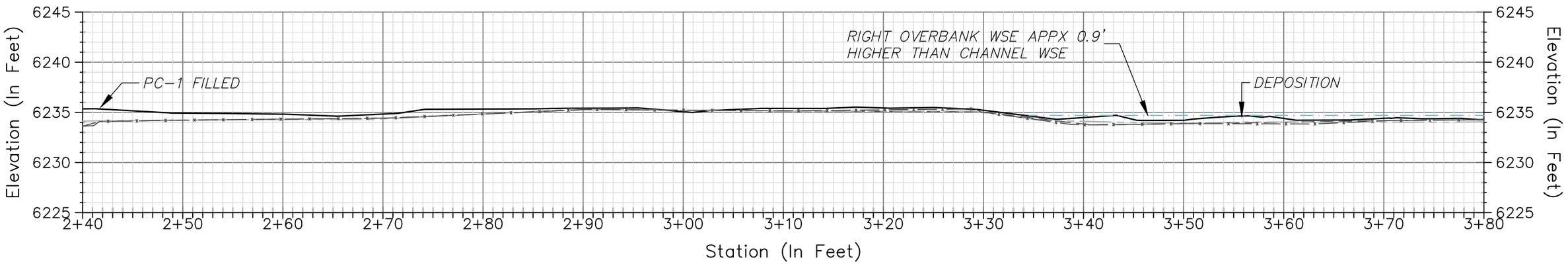
2014 LUMOS SURVEY
2013 TRI–STATE SURVEY
WSEL

CTC XS-11



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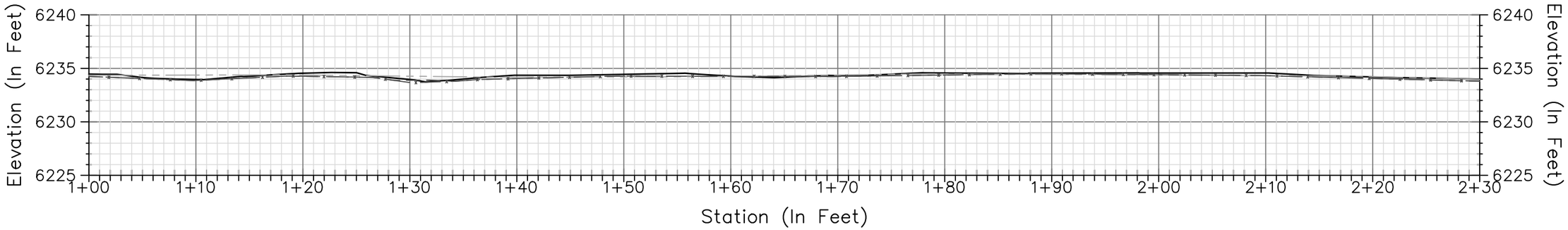
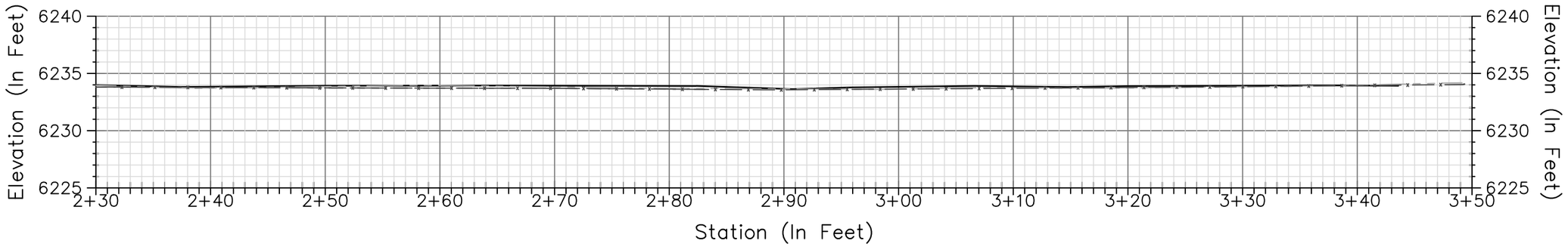
Chkd:	
Date: 26Feb21	

T01 TRANSECT



LEGEND
2020 nhc SURVEY
2015 LUMOS SURVEY
2014 LUMOS SURVEY
2013 TRI-STATE SURVEY
WSEL

T01 TRANSECT



LAST SAVED BY: dbrogan LAST DATE SAVED: 02/26/2021 08:40
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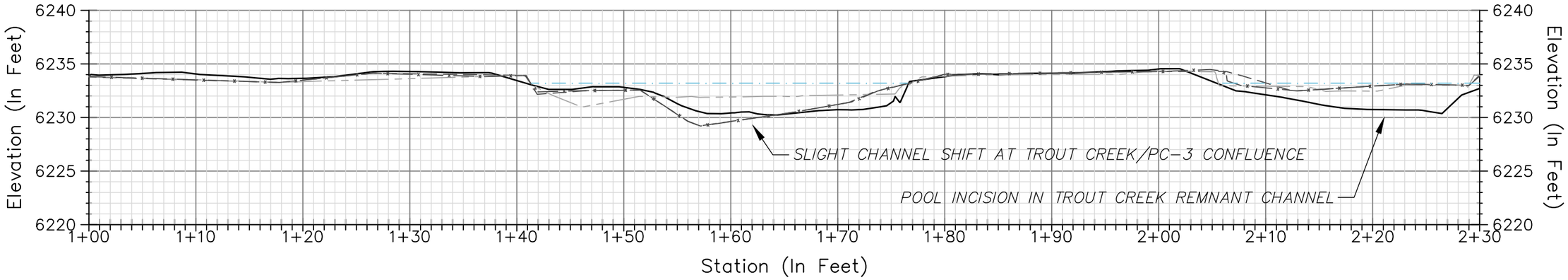
fax: (916) 371-7475

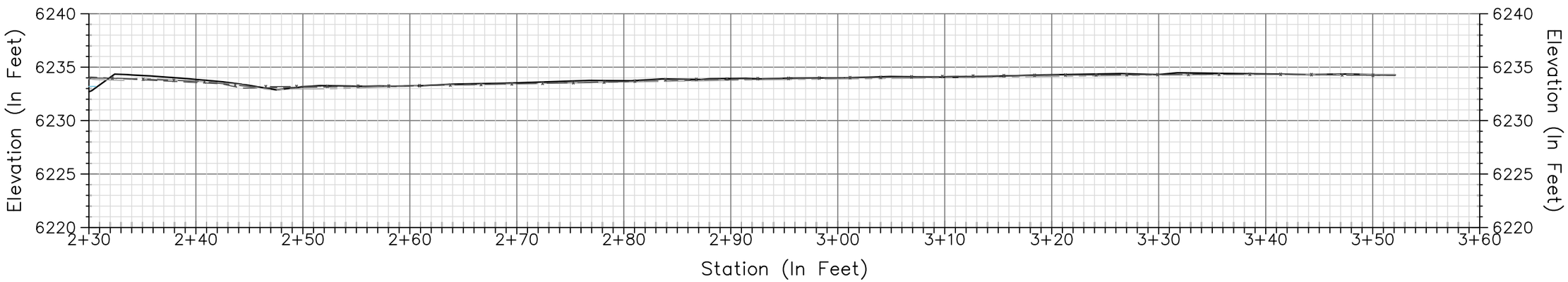
Job:	
Rev:	
Drft:	
Chkd:	
Date: 26Feb21	

T02 TRANSECT



LEGEND
2020 nhc SURVEY
2015 LUMOS SURVEY
2014 LUMOS SURVEY
2013 TRI-STATE SURVEY
WSEL

T02 TRANSECT



LAST SAVED BY: dbrogan LAST DATE SAVED: 02/26/2021 08:40
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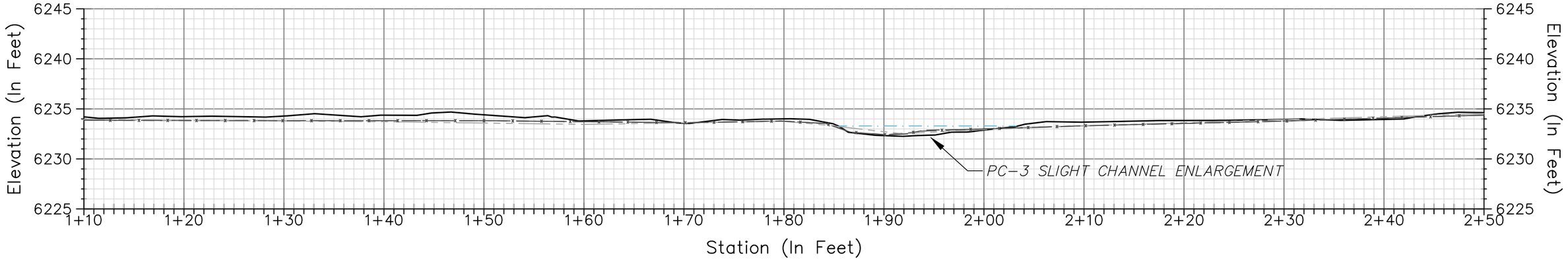
fax: (916) 371-7475

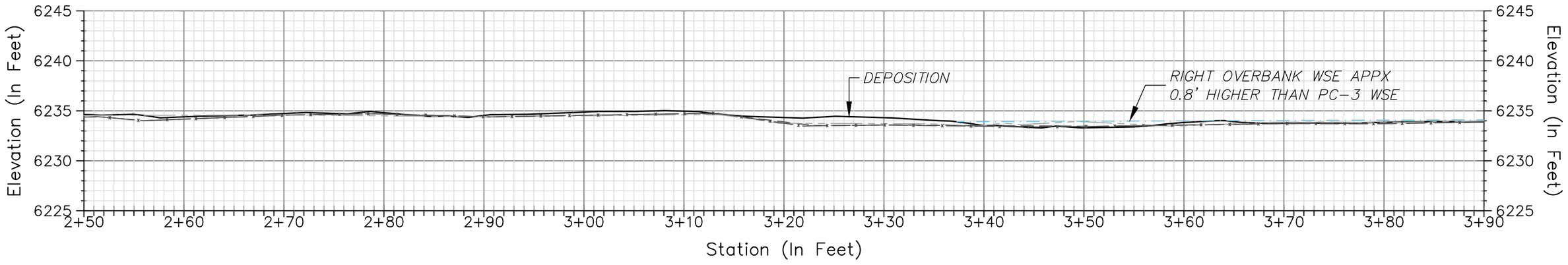
Job:	
Rev:	
Drft:	
Chkd:	
Date: 26Feb21	

T03 TRANSECT



LEGEND
2020 nhc SURVEY
2015 LUMOS SURVEY
2014 LUMOS SURVEY
2013 TRI-STATE SURVEY
WSEL

T03 TRANSECT



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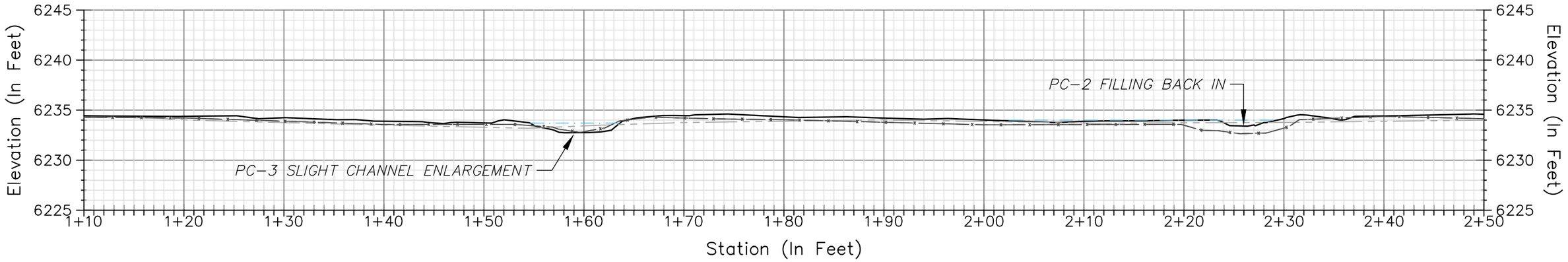
fax: (916) 371-7475

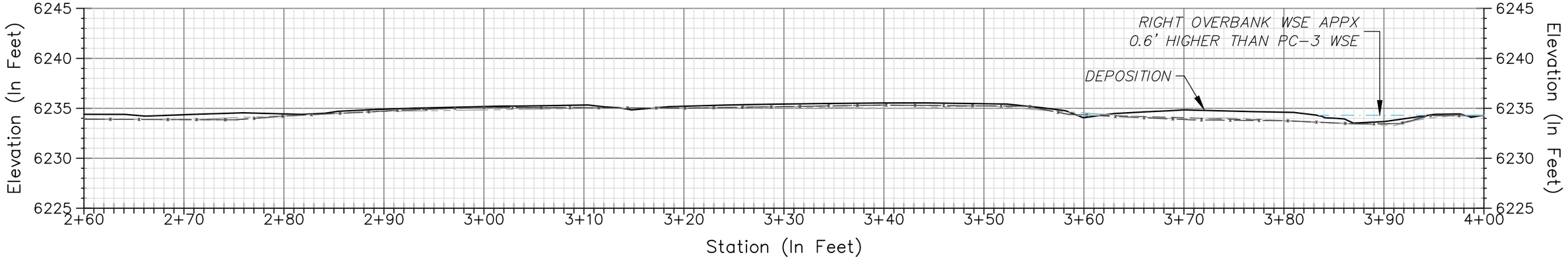
Job:	
Rev:	
Drft:	
Chkd:	
Date: 26Feb21	

T04 TRANSECT



LEGEND
2020 nhc SURVEY
2015 LUMOS SURVEY
2014 LUMOS SURVEY
2013 TRI–STATE SURVEY
WSEL

T04 TRANSECT



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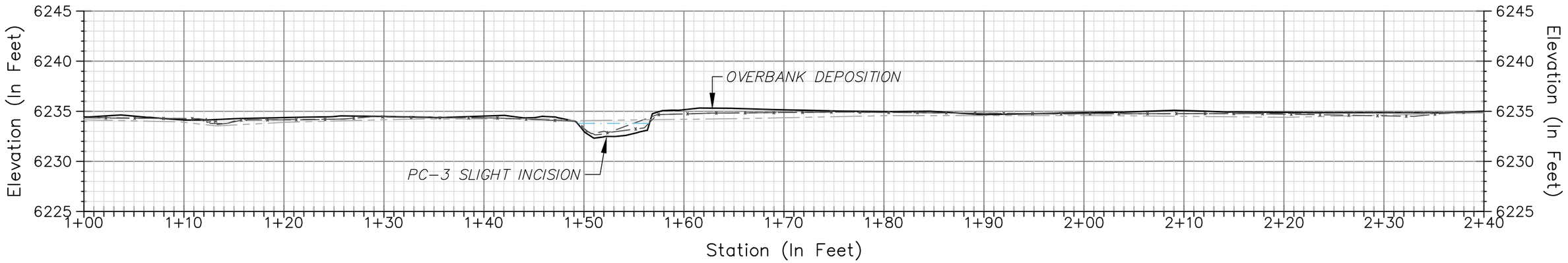

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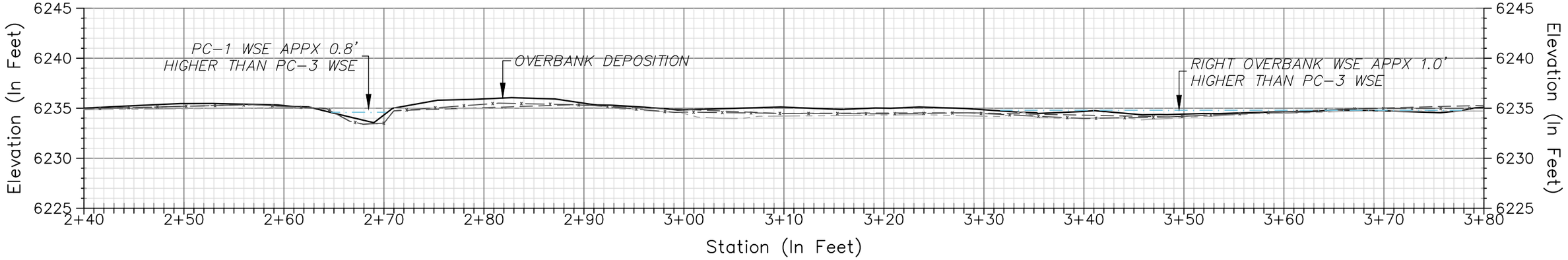

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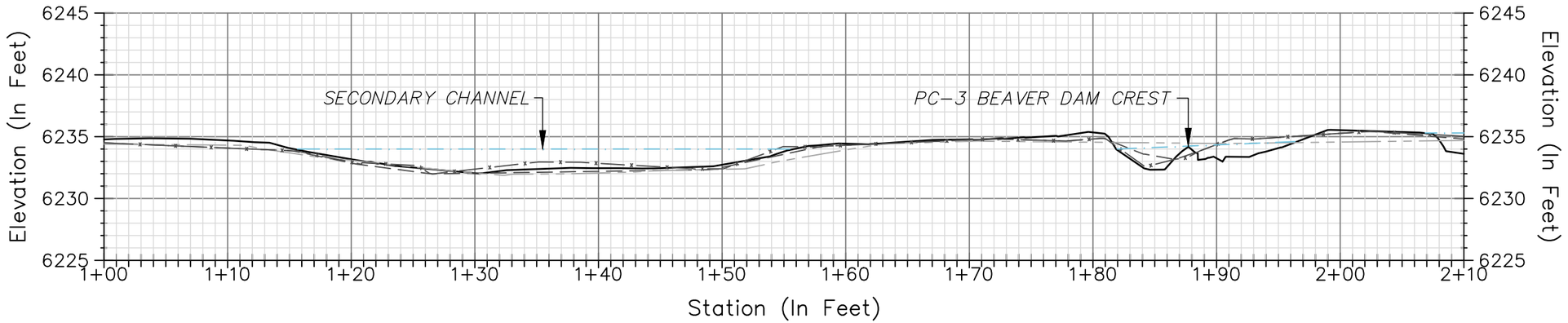

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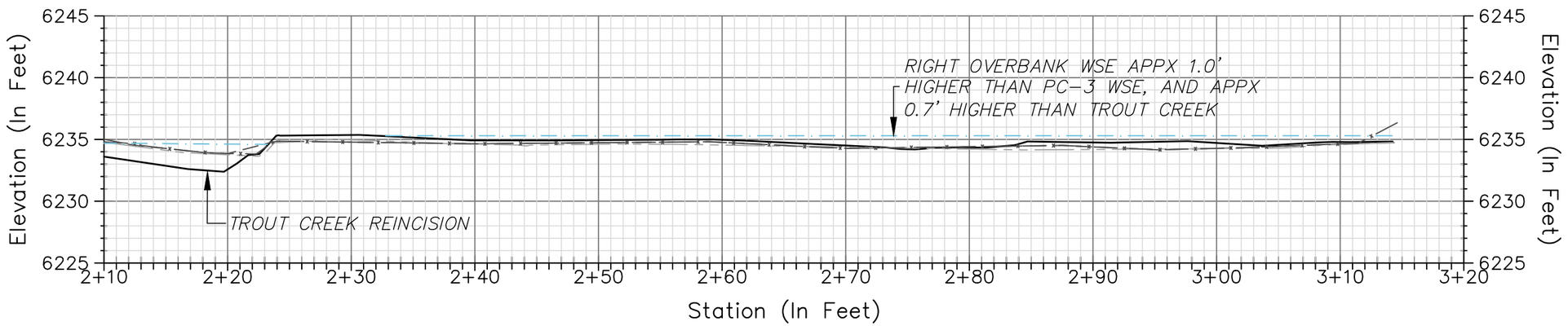

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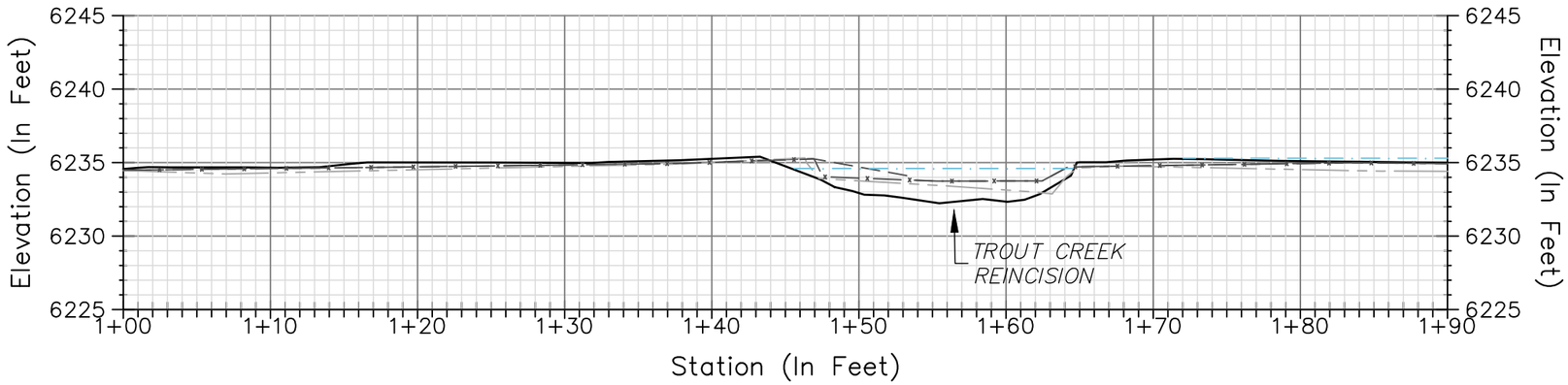

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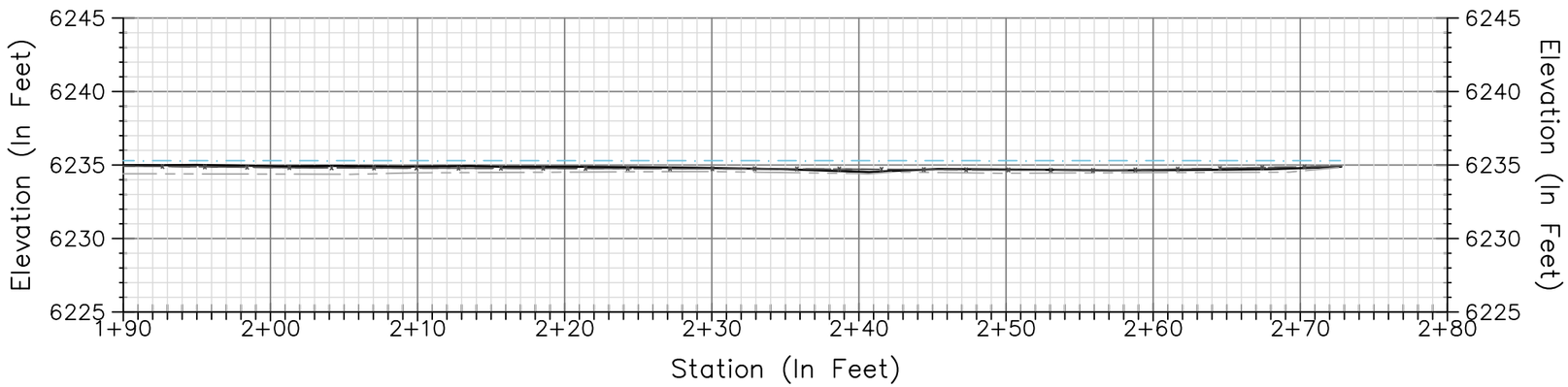

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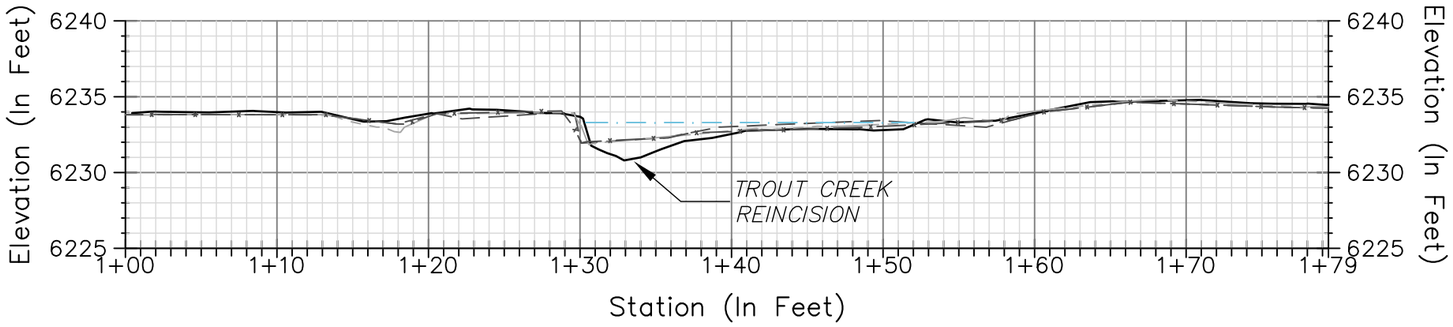

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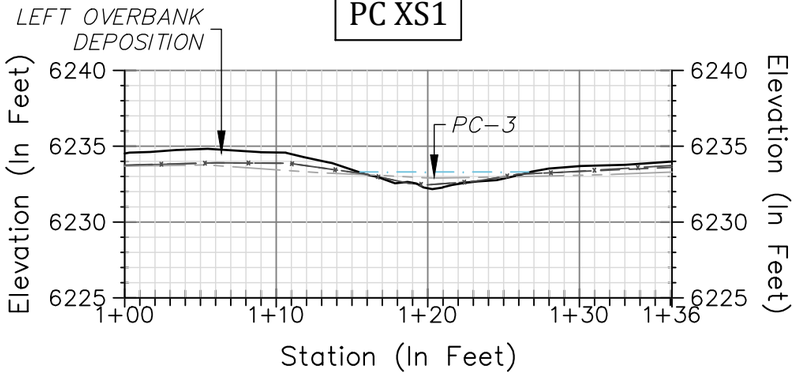

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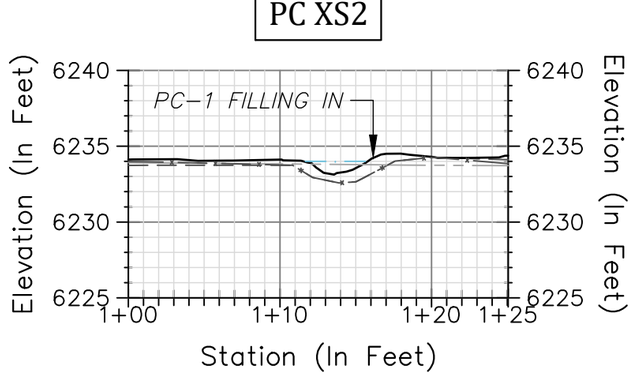

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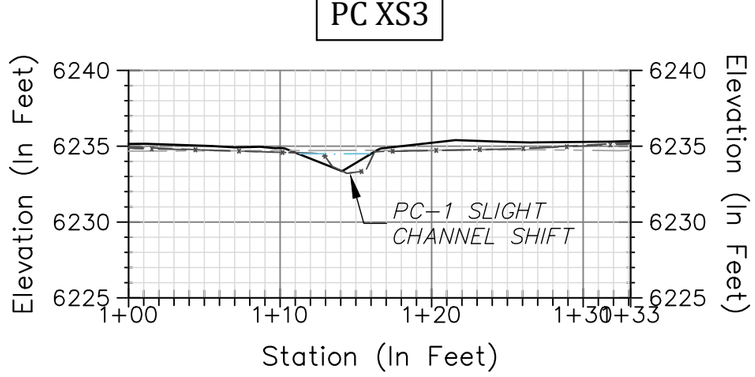

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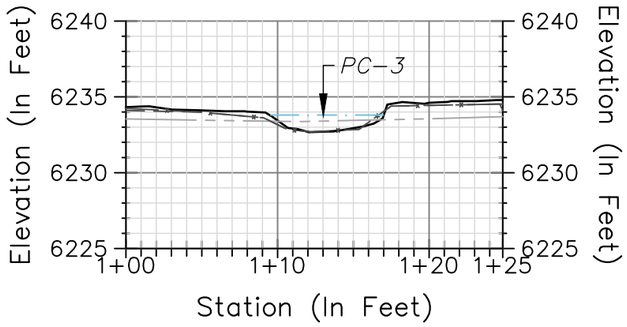

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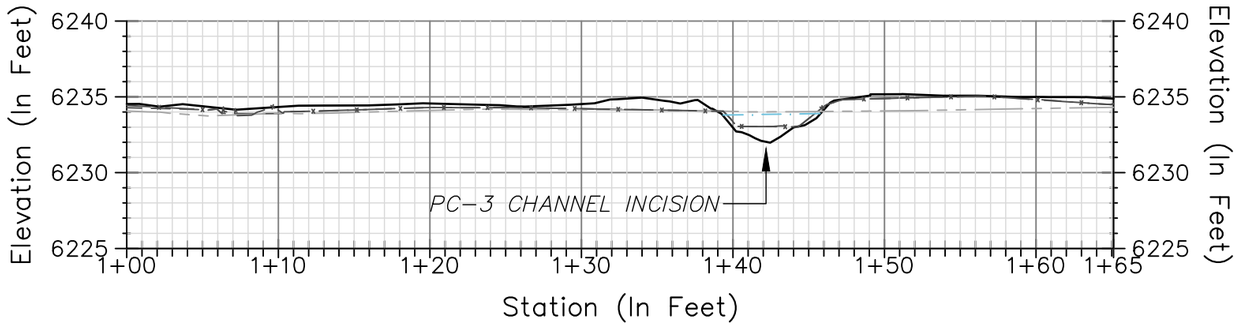

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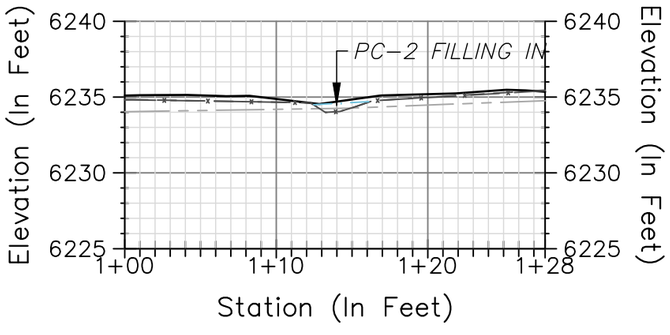

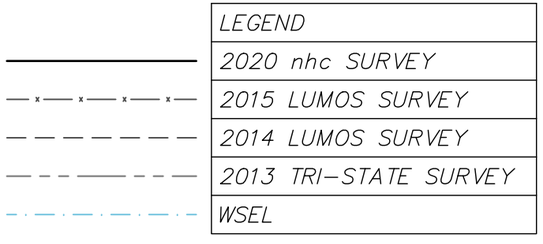

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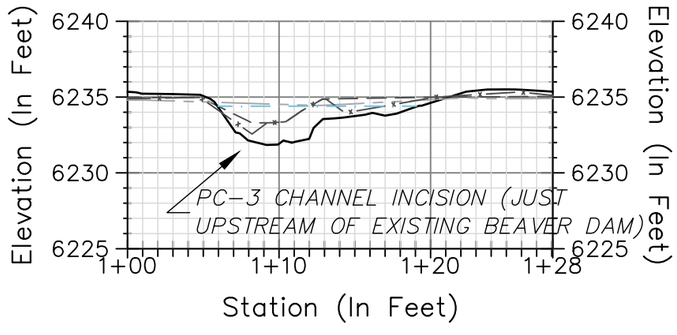

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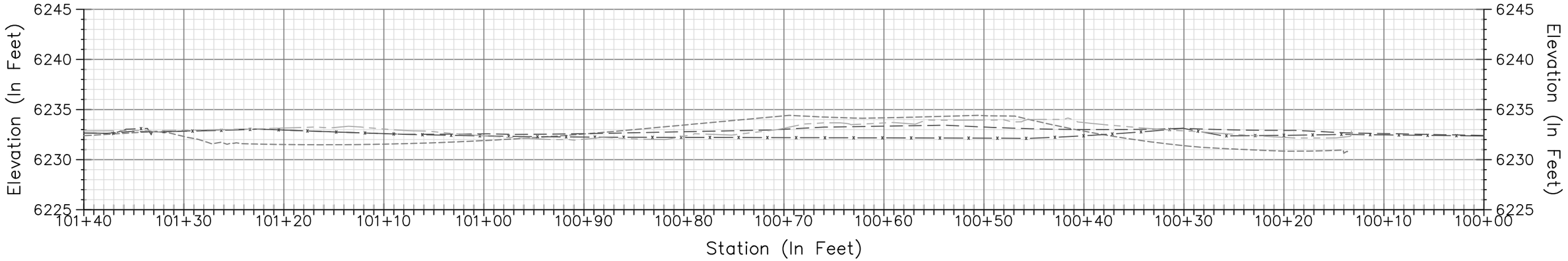

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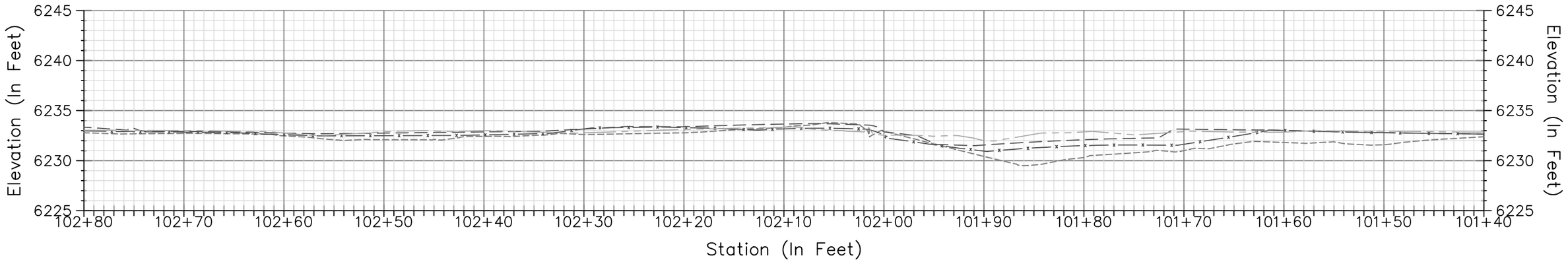

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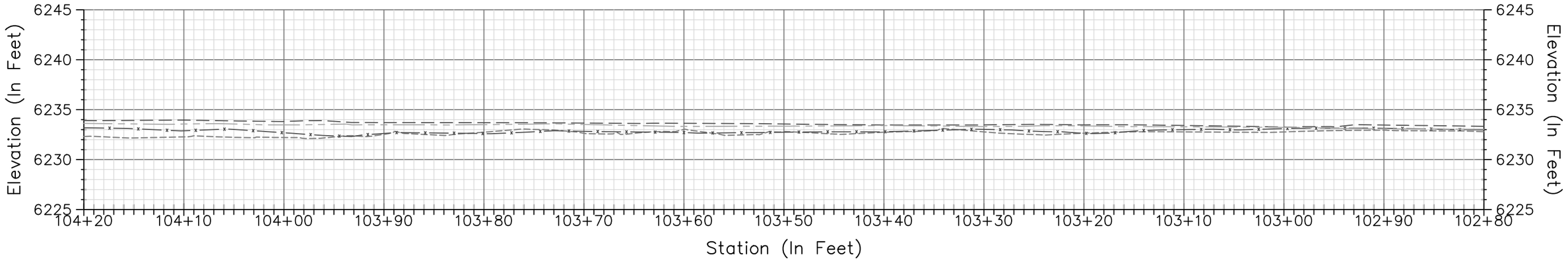

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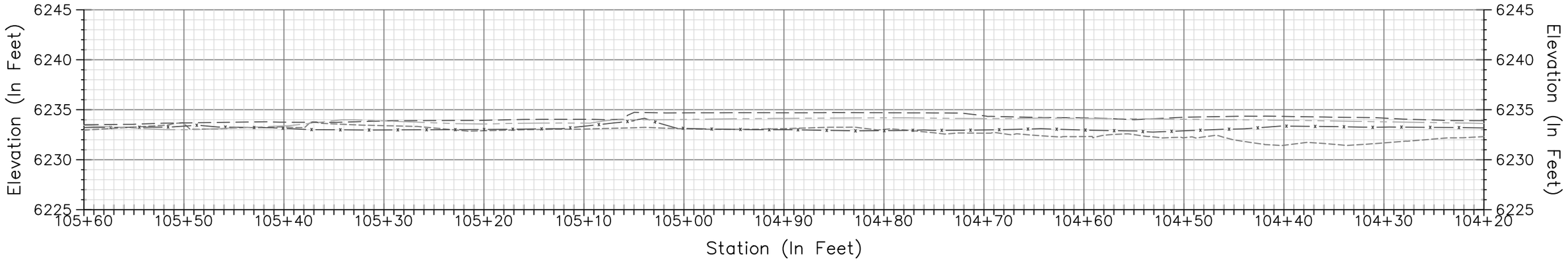

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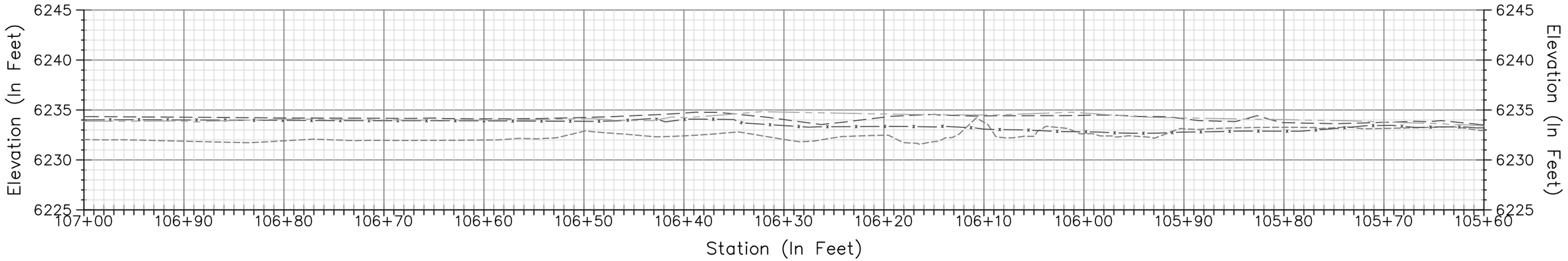

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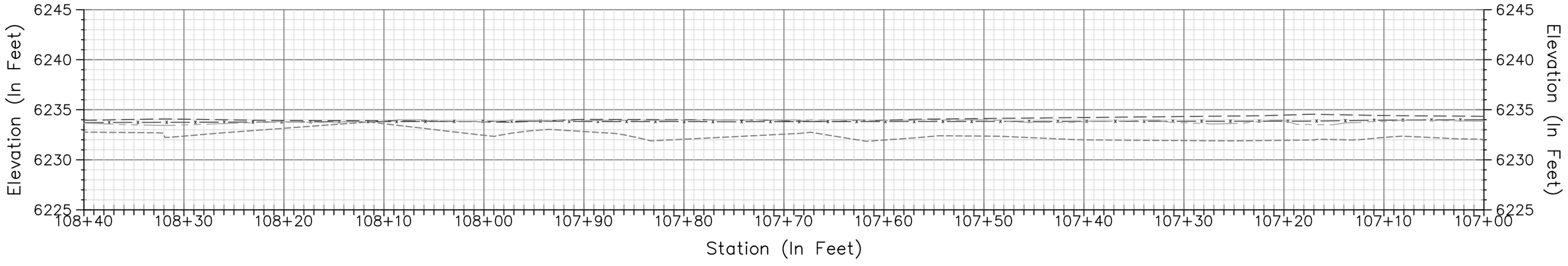

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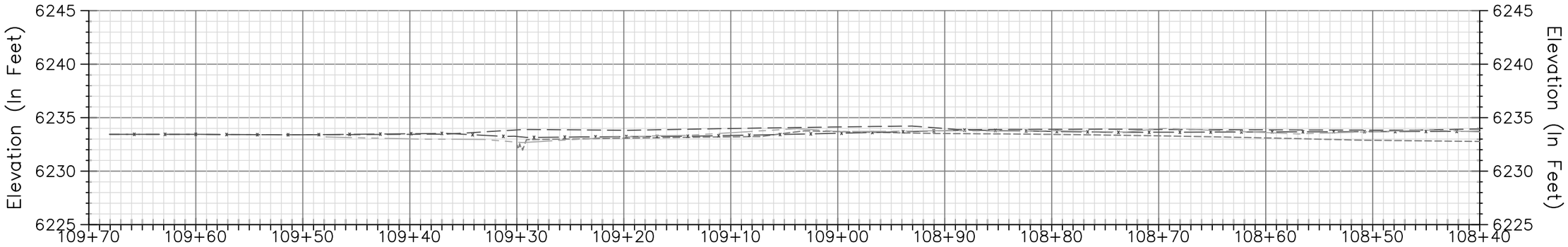

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APPENDIX D

VEGETATION MONITORING REPORTS

REFERENCE VEGETATION MEMORANDUM!

UPPER TRUCKEE MARSH SEWER FACILITIES

SOUTH LAKE TAHOE, CA

Prepared for:

nhc
80 South Lake Avenue, Suite 800
Pasadena, California 91101

September 2, 2014

Western Botanical Services, Inc.
5859 Mt. Rose Highway / Reno, NV 89511

Table of Contents

Appendices

1 Introduction

This report evaluates revegetation conditions at the Upper Truckee Marsh Sewer Facilities site in South Lake Tahoe, CA. It also presents the results of the revegetation baseline surveys conducted by Western Botanical Services, Inc. (WBS) within two distinct plant communities that will be disturbed during the course of the project in the road fill and hummocks. The survey results document reference conditions that will be used to measure progress toward meeting performance criteria goals. The survey was conducted on July 21st, 2014.

2 Methodology

Cover was determined using the point-intercept sampling method. All plants intercepted along transects were identified to the lowest possible taxonomic level. One-hundred 'hits' were obtained per transect, taken every foot. This methodology measures absolute and species-specific foliar cover. A laser point sampler device (Synergy Resource Solutions, Inc., www.countgrass.com) was lined up with the tape at a level 90-degree angle at each foot along the tape. All plant species and non-plant elements (bare ground, rock, litter) intercepted by the projected laser 'dot' were recorded. Field data sheets are included in Appendix C.

Although this sampling technique does not in itself evaluate root type or degree of plant or community development, the data has been organized by growth form (annual, perennial forb, grass, etc.), which in turn gives an indication of plant succession and community structure. Data were also organized by native status. A broader species list was developed for the project area to identify those species not intercepted by transects. This list is included in Appendix B.

Percent litter, rock, and bare areas are calculated separately. Total cover includes vegetation, standing dead, fine gravel (4–8 mm), coarse gravel (8-32 mm), rock (>32 mm) and litter. Litter refers to material detached from growing vegetation older than one year and includes decomposing vegetation, animal waste, and garbage. Total vegetative cover refers only to live vegetation. Frequency was calculated by determining the number transects in which a species was intercepted.

Three consecutive 100-ft. transects were surveyed in the road fill area, and three transects (two of which were adjacent and parallel) in the hummock community (Figure 1). The hummock transects 2 and 3 appear to be over water in Figure 1 because the background Google Earth image is from 2011, but the water has receded since then. Each transect was sampled for quantitative cover data using the point-intercept method. All vegetation was identified to the lowest taxonomic group possible. The Theodolite iPad app was used to record the location of each transect (Appendix A).

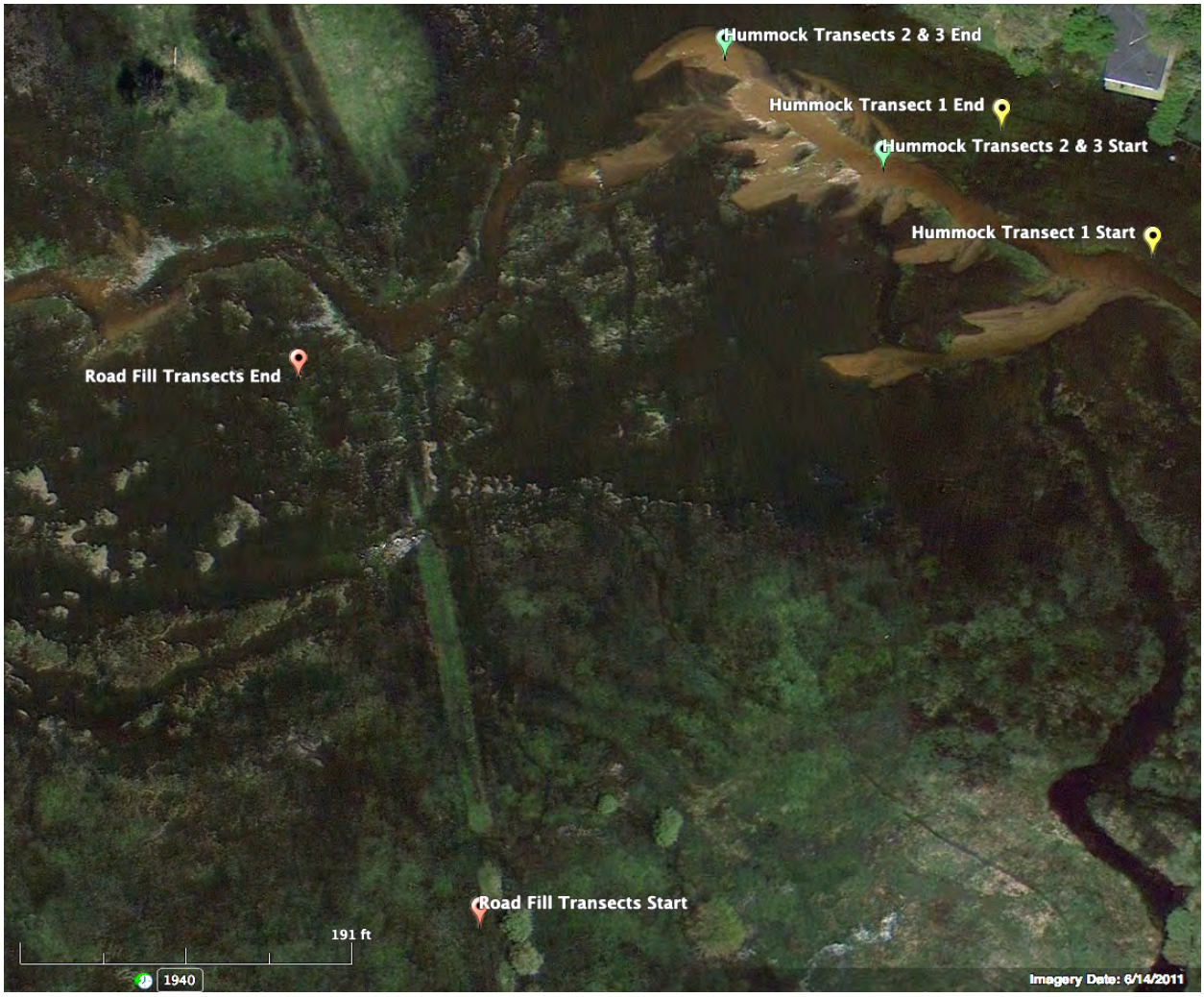

Figure 1. Locations of Transects

3 Results and Discussion

3.1 Road Fill Plant Community Cover

Data for total cover, vegetative cover, and dominance by natives are presented in Table 1. Detailed cover calculations are included in Appendix C. Total cover in the road fill community averaged 100%, while total vegetative cover averaged 90% with a range between 84% (Transect 3) and 98% (Transect 2). Relative cover by native species averaged 85.7% with a range between 83% (Transect 3) and 90% (Transect 2). Vegetative cover was dominated by native perennial graminoids, (esp. Baltic rush).

Table 1. Road Fill Cover Summary

	Transect 1	Transect 2	Transect 3	Average
Total Cover (including litter, gravel, and rock)	100%	100%	100%	100%
Total Vegetative Cover	88%	98%	84%	90%
Vegetative Cover By Native Species	84%	90%	83%	85.7%

3.2 Hummock Plant Community

Data for total cover, vegetative cover, and dominance by natives are presented in Table 2. Detailed cover calculations are included in Appendix C. Total cover in the hummock community averaged 83.7%, while total vegetative cover averaged 80.3% with a range between 58% (Transect 2) and 95% (Transect 1). Relative cover by native species averaged 79.7% with a range between 58% (Transect 2) and 93% (Transect 1). Vegetative cover was dominated by native perennial graminoids and forbs. Several non-native pasture grasses species were either intercepted or identified off-transects. These grasses may be remnants from prior grazing activities before the California Tahoe Conservancy (CTC) took ownership in 2001.

Table 2. Hummock Community Cover Summary

	Transect 1	Transect 2	Transect 3	Average
Total Cover (including litter, gravel, and rock)	100%	61%	90%	83.7%
Total Vegetative Cover	95%	58%	88%	80.3%
Vegetative Cover By Native Species	93%	58%	88%	79.7%

4 References

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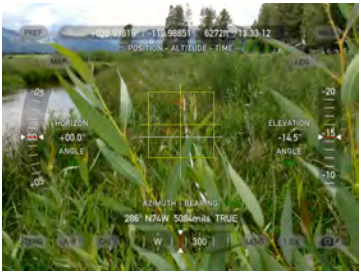
Appendix(A!

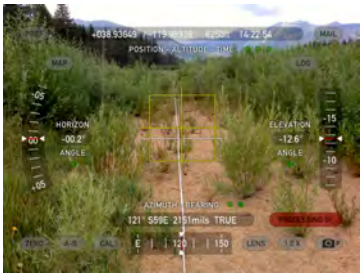
Transect Photos and Locations



Hummock Transect 1 Begin

Hummock Transect 1 End

Hummock Transect 2 Begin



Hummock Transect 2 End

Hummock Transect 3 Begin

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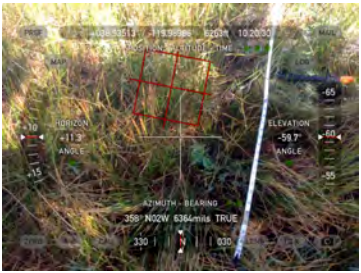

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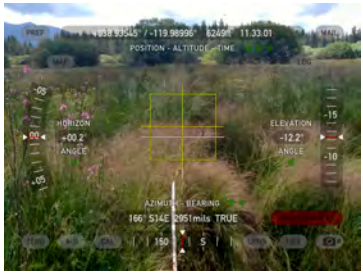

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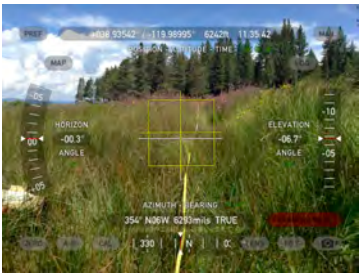

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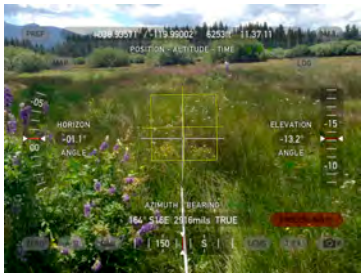

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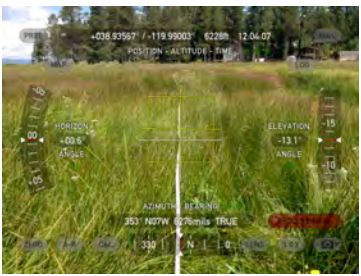

Road Fill Transect 3 Begin

Road Fill Transect 3 End

Appendix(B!

Reference Species List

Upper Truckee Marsh Species List!

FAMILY	SCIENTIFIC NAME	COMMON NAME	HYD STATUS[1]
ASTERACEAE	*Achillea millefolium*	Yarrow	FACU
	Arnica chamissonis	Chamisso arnica	FACW
	Solidago Canadensis	Canada goldenrod	FACU
	Symphyotrichum spathulatum var yosemitanum	Western aster	FAC
CYPERACEAE	*Carex aqualtilis*	Water sedge	OBL
	Carex athrostachya	Slenderbeak sedge	FACW
	Carex lanuginosa	Wooly sedge	OBL
	Carex nebrascensis	Nebraska sedge	OBL
	Carex utriculata	Beaked sedge	OBL
	Scirpus microcarpus	Panicled bulrush	OBL
FABACEAE	*Lupinus polyphyllus*	Tahoe lupine	FAC
IRIDACEAE	*Iris missouriensis*	Rocky mtn. Iris	FACW
JUNCACEAE	*Juncus balticus*	Baltic rush	FACW
	Juncus ensifolius	Equitant rush	OBL
	Juncus nevadensis	Nevada rush	FACW
MALVACEAE	*Sidalcea oregana*	Oregon checkerbloom	FACW
ONAGRACEAE	*Eplilobium ciliatum*	Fringed willowherb	FACW
POACEAE	*Alopecurus aequalis*	Shortawn foxtail	OBL
	Alopecurus pratensis	Meadow foxtail	FAC
	Agrostis exarata	Spike bentgrass	FACW
	Agrostis scabra	Rough bentgrass	FAC

FAMILY	SCIENTIFIC NAME	COMMON NAME	HYD STATUS[1]
	Agrosits stolonifera	Creeping bentgrass	FAC
	Deschampsia danthonoides	Annual hairgrass	FACW
	Phleum pratense	Timothy	FAC
	Poa palustris	Fowl bluegrass	FAC
	Poa pratensis	Kentucky bluegrass	FAC
	Torreyochloa pallida	Pale false mannagrass	OBL
POLYGONACEAE	*Rumex acetosella*	Common sheep sorrel	FACU
	Rumex crispus	Curly dock	FAC
ROSACEAE	*Fragaria virginiana*	Strawberry	FACU
	Geum macrophyllum	Big-leaved avens	FAC
	Potentilla glandulosa	Sticky cinquefoil	FACU
	Potentilla gracilis	Cinquefoil	FAC
RUBAIACEAE	*Galium trifidum*	Bedstraw	FACW
SALICACEAE	*Salix exigua*	Sandbar willow	OBL
	Salix lemmonii	Lemmon's willow	OBL
	Salix lucida ssp lasiandra	Pacific willow	FACW
SCROPHULAREACEAE	*Mimulus guttatus*	Seep monkeyflower	OBL
	Mimulus primuloides	Primrose monkeyflower	OBL
	Veronica americana	America brooklime	OBL

[1] Army Corps of Engineers; Western Mountains, Valleys, and Coast
N/A = Not Applicable
OBL = Obligate
FACW = Facultative Wetland
FAC = Facultative
FACU = Facultative Upland

* = Non-native species

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Appendix(C!

Point-Intercept Cover Data Calculations

POINT INTERCEPT COVER DATA ANALYSIS

SAMPLING AREA: Hummock Transects

COVER TYPE	POINT HITS (#) BY TRANSECT NUMBER			FREQUENCY	VEGETATIVE COVER	TOTAL COVER
	1	2	3			
Native Perennial Forbs						
Mimulus guttatus (Seep monkeyflower)	1	-	-	33%	0.4%	0.4%
Epilobium ciliatum (fringed willowherb)	-	1	-	33%	0.4%	0.4%
Lupinus polyphyllus (Tahoe lupine)	-	17	12	66%	12.0%	11.6%
Veronica americana (American brooklime)	3	-	-	33%	1.2%	1.2%
Symphyotrichum spathulatum (western mountain aster)	-	-	1	33%	0.4%	0.4%
Sidalcea oregana (Oregon checkerbloom)	-	1	-	33%	0.4%	0.4%
Total Native Perennial Forbs	4	19	13	100%	14.9%	14.3%
Introduced Perennial Grasses						
Phleum pratense (timothy)	2	-	-	33%	0.8%	0.8%
Total Intro. Perennial Grasses	2	0	0	33%	0.8%	0.8%
Native Perennial Graminoids						
Carex nebrascensis (Nebraska sedge)	6	1	16	100%	9.5%	9.2%
Juncus balticus (Baltic rush)	3	1	-	66%	1.7%	1.6%
Deschampsia caespitosa (hairgrass)	1	2	1	100%	1.7%	1.6%
Poa pratensis (Kentucky bluegrass)	1	-	-	33%	0.4%	0.4%
Poa palustris (fowl bluegrass)	1	-	-	33%	0.4%	0.4%
Juncus nevadensis (Nevada rush)	2	-	-	33%	0.8%	0.8%
Agrostis scabra (rough bentgrass)	2	19	10	100%	12.9%	12.4%
Alopecurus aequalis (shortawn foxtail)	-	-	1	33%	0.4%	0.4%
Scirpus microcarpus (panicled bulrush)	47	-	1	66%	19.9%	19.1%
Carex utriculata (beaked sedge)	8	2	26	100%	14.9%	14.3%
Juncus ensifolius	-	2	-	33%	0.8%	0.8%
Glyceria	1	-	-	33%	0.4%	0.4%
Total Native Perennial Grasses	72	27	55	100%	63.9%	61.4%
Native Shrubs and Subshrubs						
Salix lucida ssp. Lasiandra (Pacific willow)	10	7	20	100%	15.4%	14.7%
Salix exigua (sandbar willow)	-	1	-	33%	0.4%	0.4%
Salix lemmonii (Lemmon's willow)	4	4	-	66%	3.3%	3.2%
Salix geyeriana (Geyer willow)	3	-	-	33%	1.2%	1.2%
Total Nat. Shrubs & Subshrubs	17	12	20	100%	20.3%	19.5%

POINT INTERCEPT COVER DATA ANALYSIS

COVER TYPE	POINT HITS (#) BY TRANSECT NUMBER			FREQUENCY	VEGETATIVE COVER	TOTAL COVER
	1	2	3			
NATIVE VEGETATIVE COVER	93	58	88	n/a	99.2%	95.2%
NON-NATIVE VEGETATIVE COVER	2	0	0	n/a	0.8%	0.8%
TOTAL VEGETATIVE COVER	95	58	88	n/a	100.0%	96.0%
Bare Soil	0	39	8	n/a	n/a	n/a
Litter	5	3	2	n/a	n/a	4.0%
TOTAL COVER	100	61	90	n/a	n/a	100.0%
TOTAL OVER ALL (300) SAMPLING POINTS		ALL COVER:	83.7%	NON-NATIVE:	0.7%	
		VEGETATIVE COVER:	80.3%	NATIVE:	79.7%	

POINT INTERCEPT COVER DATA ANALYSIS

SAMPLING AREA: Road Fill Transects

COVER TYPE	POINT HITS (#) BY TRANSECT NUMBER			FREQUENCY	VEGETATIVE COVER	TOTAL COVER
	1	2	3			
Native Annual & Biennial Forbs						
Galium sp. (bedstraw)	-	2	2	66.0%	1.5%	1.3%
Total Native Ann. & Bien. Forbs	0	2	2	66.0%	1.5%	1.3%
Introduced Annual & Biennial Forbs						
Cirsium vulgare (bull thistle)	-	-	1	33.0%	0.4%	0.3%
Total Introduced Ann. & Bien. Forbs	0	0	1	33.0%	0.4%	0.3%
Native Perennial Forbs						
Solidago canadensis (Canada goldenrod)	12	-	-	33.0%	4.4%	4.0%
Fragaria virginiana (Virginia strawberry)	8	5	-	66.0%	4.8%	4.3%
Epilobium ciliatum (fringed willowherb)	-	-	2	33.0%	0.7%	0.7%
Mimulus primuloides (primrose monkeyflower)	-	1	9	66.0%	3.7%	3.3%
Lupinus polyphyllus (Tahoe lupine)	-	-	1	33.0%	0.4%	0.3%
Veronica americana (American brooklime)	-	-	3	33.0%	1.1%	1.0%
Achillea millefolium (yarrow)	-	3	3	66.0%	2.2%	2.0%
Arnica chamissonis (Chamisso arnica)	-	-	4	33.0%	1.5%	1.3%
Symphyotrichumspathulatum (western mountain aster)	3	10	3	100.0%	5.9%	5.3%
Sidalcea oregana (Oregon checkerbloom)	1	13	-	66.0%	5.2%	4.7%
Potentilla gracilis (cinquefoil)	6	10	1	100.0%	6.3%	5.7%
Total Native Perennial Forbs	30	42	26	100.0%	36.3%	32.7%
Introduced Perennial Forbs						
Rumex acetosella (common sheep sorrel)	1	8	-	66.0%	3.3%	3.0%
Rumes crispus (curly dock)	2	-	-	33.0%	0.7%	0.7%
Total Intro. Perennial Forbs	3	8	0	66.0%	4.1%	3.7%
Introduced Perennial Grasses						
Phleum pratense (timothy)	1	-	-	33.0%	0.4%	0.3%
Total Intro. Perennial Grasses	1	0	0	33.0%	0.4%	0.3%

POINT INTERCEPT COVER DATA ANALYSIS

COVER TYPE	POINT HITS (#) BY TRANSECT NUMBER			FREQUENCY	VEGETATIVE COVER	TOTAL COVER
	1	2	3			
Native Perennial Graminoids						
Carex nebrascensis (Nebraska sedge)	1	1	1	100.0%	1.1%	1.0%
Juncus balticus (Baltic rush)	37	22	25	100.0%	31.1%	28.0%
Deschampsia caespitosa (hairgrass)	4	-	7	66.0%	4.1%	3.7%
Poa pratensis (Kentucky bluegrass)	6	19	8	100.0%	12.2%	11.0%
Eleocharis macrostachya (pale spikerush)	-	-	5	33.0%	1.9%	1.7%
Agrostis scabra (rough bentgrass)	6	4	7	100.0%	6.3%	5.7%
Carex utriculata (beaked sedge)	-	-	2	33.0%	0.7%	0.7%
Total Native Perennial Grasses	54	46	55	100.0%	57.4%	51.7%
NATIVE VEGETATIVE COVER	84	90	83	n/a	95.2%	85.7%
NON-NATIVE VEGETATIVE COVER	4	8	1	n/a	4.8%	4.3%
TOTAL VEGETATIVE COVER	88	98	84	n/a	100.0%	90.0%
Litter	12	2	16	n/a	n/a	10.0%
TOTAL COVER	100	100	100	n/a	n/a	100.0%
TOTAL OVER ALL (300) SAMPLING POINTS		ALL COVER:	100.0%	NON-NATIVE:	4.3%	
		VEGETATIVE COVER:	90.0%	NATIVE:	85.7%	

REVEGETATION MONITORING MEMORANDUM!

UPPER TRUCKEE MARSH SEWER FACILITIES

SOUTH LAKE TAHOE, CA

Prepared for:

nhc
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October 2, 2015

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Table of Contents

Appendices

1 Introduction

This report evaluates revegetation conditions at the Upper Truckee Marsh Sewer Facilities site in South Lake Tahoe, CA. It also presents the results of the revegetation monitoring surveys conducted by Western Botanical Services, Inc. (WBS) within two distinct plant communities that were disturbed during the course of the project in the road fill and hummocks. The survey was conducted on July 14 and 30, 2015.

The survey results compare revegetation success to reference conditions in 2014 to measure progress toward meeting performance criteria goals. The goals were established in the "Upper Truckee Marsh Sewer Facilities Adaptive Management Plan" (Plan), (Section 32 90 00 Restoration, Revegetation, and Erosion Control 3.03), and are as follows:

- "Planted wetland herbaceous vegetation and sod established at 80 percent of baseline cover after 1 year and 85 percent of baseline cover after 2 years and exhibiting good vigor. Native species established at 90 percent of baseline after 1 year and 95 percent of baseline after 2 years. Wetland species, combining obligate and facultative species, established equal to or exceeding baseline after 2 years. Planted woody vegetation established at 80 percent survival and exhibit good vigor."

- "Survival 80% of willow stakes and willow transplants, and minimum of two sprouts per lineal foot of willow wattles, one year following the completion date of the work. If contractor fails to meet the warranty requirements the warranty period will be extended by a year until they are met."

2 Methodology

2.1 Vegetation Cover

Cover was determined using the point-intercept sampling method. All plants intercepted along transects were identified to the lowest possible taxonomic level. One hundred 'hits' were obtained per transect, taken every foot. This methodology measures absolute and species-specific foliar cover. A laser point sampler device (Synergy Resource Solutions, Inc., www.countgrass.com) was lined up with the tape at a level 90-degree angle at each foot along the tape. All plant species and non-plant elements (bare ground, rock, litter) intercepted by the projected laser 'dot' were recorded.

Although this sampling technique does not in itself evaluate root type or degree of plant or community development, the data has been organized by growth form (annual, perennial forb, grass, etc.), which in turn gives an indication of plant succession and community structure. Data were also organized by native status. A broader species list was developed for the project area to identify those species not intercepted by transects. This list is included in Appendix A.

Percent litter, rock, water, erosion control mat, and bare areas are calculated separately. Total cover includes vegetation, standing dead, fine gravel (4–8 mm), coarse gravel (8-32 mm), rock

(>32 mm) and litter. Litter refers to material detached from growing vegetation older than one year and includes decomposing vegetation, animal waste, and garbage. Total vegetative cover refers only to live vegetation. Frequency was calculated by determining the number transects in which a species was intercepted.

Three consecutive 100-ft. transects were surveyed in the road fill area. Three hummocks were surveyed with transects of varying lengths, but totaling 100 ft. per hummock. Each transect was sampled for quantitative cover data using the point-intercept method. All vegetation was identified to the lowest taxonomic group possible. The Theodolite iPad app was used to record the location of each transect (Appendix B).

2.2 Willow Survival

The numbers of dead and live willow stakes were counted in each of the willow wattles and the willow sausal.

2.3 Vigor of Herbaceous Vegetation and Willows

Vigor is a qualitative observation that can vary among observers but should be consistent on a project basis. It refers to the relative size and health of the individual without reference to its reproductive success (vitality). It is usually determined in a scale of 1-5 plant and as a function of both typical growth for the species in question as well as favorableness and suitability of the environment with 1=poor, 2=fair, 3=good, 4=very good, and 5=excellent.

3 Results and Discussion

3.1 Road Fill Plant Community Cover and Vigor

2014 reference data for total cover, vegetative cover, and dominance by natives are presented in Table 1. 2015 revegetation cover data for the same transects are presented in Table 2. Detailed cover calculations are included in Appendix C.

Total cover in the road fill community averaged 100%, while total vegetative cover averaged 96% with a range between 95% (Transect 3) and 97% (Transects 1, 2). Relative cover by native species averaged 90% with a range between 88% (Transect 3) and 92% (Transect 1.) Vegetative cover was dominated by native perennial graminoids.

The performance criteria established in the Plan was 80% of baseline vegetative cover after one year. The average vegetative cover was 96%, therefore the performance criteria is met for year one post construction. The performance criteria established in the Plan was 90% of native species baseline cover after one year. The average cover by native species was 90%, therefore the performance criteria is met for year one post construction.

Fill removal and lowering the elevation to match the surrounding meadow and hydrology was most likely the cause for an increase in vegetative cover.

Table 1. 2014 Road Fill Reference Cover Summary

Cover Type	Transect 1	Transect 2	Transect 3	Average
Total Cover (including litter, gravel, and rock)	100%	100%	100%	100%
Total Vegetative Cover	88%	98%	84%	90%
Vegetative Cover By Native Species	84%	90%	83%	86%

Table 2. 2015 Road Fill Revegetation Cover Summary

Cover Type	Transect 1	Transect 2	Transect 3	Average
Total Cover (including litter, gravel, and rock)	100%	100%	100%	100%
Total Vegetative Cover	97%	97%	95%	96%
Vegetative Cover By Native Species	92%	89%	88%	90%

Vigor for this pant community was rated 5. It has responded to improved hydrology, and the dominant species blend into the surrounding mature sedge-dominated plant community. Younger plants also tend to be more vigorous compared to well established climax plant communities.

3.2 Hummock Plant Community Cover and Vigor

2014 reference data for total cover, vegetative cover, and dominance by natives are presented in Table 3. 2015 revegetation cover data for the same transects are presented in Table 4. Detailed cover calculations are included in Appendix C.

Total cover in the hummock community averaged 83.7%, while total vegetative cover averaged 80.3% with a range between 58% (Transect 2) and 95% (Transect 1). Relative cover by native species averaged 79.7% with a range between 58% (Transect 2) and 93% (Transect 1).

The performance criteria established in the Plan was 80% of baseline vegetative cover after one year, which would be 64%. The average vegetative cover was 34%, therefore the performance criteria was not met for year one post construction. The performance criteria established in the Plan was 90% of native species baseline cover after one year, which would be 72%. The average cover by native species was 34%, therefore the performance criteria is not met for year one post construction.

However, the hummocks, (with perhaps the exception of Hummock 1 on the south end which is largely under water), are performing as designed. The hummocks were installed late in the season and have had less than one growing season. They are expected to fill in over the next few years and should ultimately meet the design criteria.

Table 3. 2014 Hummock Reference Cover Summary

Cover Type	Transect 1	Transect 2	Transect 3	Average
Total Cover (including litter, gravel, and rock)	100%	61%	90%	84%
Total Vegetative Cover	95%	58%	88%	80%
Vegetative Cover By Native Species	93%	58%	88%	80%

Table 4. 2015 Hummock Revegetation Cover Summary

Cover Type	Transect 1	Transect 2	Transect 3	Average
Total Cover (including litter, gravel, and rock)	68%	85%	62%	72%
Total Vegetative Cover	37%	35%	31%	34%
Vegetative Cover By Native Species	36%	35%	31%	34%

Vigor for these plants was rated 3.5 - 4, based on a comparison to the vigorous growth of the surrounding mature plant community. Plants established last year are more vigorous that the younger plants, as anticipated, and as reflected in the cover photo. Species composition and vigor, however, will change with hydrology now that the ROW is substantially drier, with no surface flow. This response should also manifest in the adjacent community.

3.3 Willow Survival and Vigor

The results of the willow stake count is presented in Table 5. The performance criteria established in the Plan was 80% willow stake survival for both treatment types. Willow stake survival was 40% for the wattles and 13% for the sausal. Therefore, the performance criteria are not met.

Willows in the sausal was not done to spec, with many of the stakes branched (Photo 1), and not planted to the optimum depth. However, the three live stakes are coincidentally located in strategic areas and if they continue to grow, as expected, they should serve their purpose (Photo 2). Similarly, although the willow brush fence did not meet the performance criteria, the surviving stakes, along with the coir log, will serve as intended (Photos 3, 4).

Table 5. 2015 Willow Survival Count

Willow Structure	Live	Dead	Survival %
Willow!Brush!Fence!	587!	866!	40!
Sausal!	3!	20!	13!

Photo 1. Improper material used for sausal.

Photo 2. Surviving stake in sausal.

Vigor was considered 2.5, based on the substandard material and methods used. However, once the willows become well established, vigor and growth are expected to improve. Increased flows into Trout Creek in the vicinity of the willow work should result in more rapid growth as they respond to the improved growing conditions.

4 Recommendations

The new hummock should be installed as soon as possible to maximize growth for this year. Additional willows are not necessary are the present time.

Photo 3. Willow brush fence

Photo 4. Willow brush fence

5 References

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Appendix(A!

Species List

Upper Truckee Marsh Species List!

FAMILY	SCIENTIFIC NAME	COMMON NAME	HYD STATUS[1]
ASTERACEAE	*Achillea millefolium*	Yarrow	FACU
	Arnica chamissonis	Chamisso arnica	FACW
	Solidago Canadensis	Canada goldenrod	FACU
	Symphyotrichum spathulatum var yosemitanum	Western aster	FAC
CYPERACEAE	*Carex aqualtilis*	Water sedge	OBL
	Carex athrostachya	Slenderbeak sedge	FACW
	Carex lanuginosa	Wooly sedge	OBL
	Carex nebrascensis	Nebraska sedge	OBL
	Carex utriculata	Beaked sedge	OBL
	Scirpus microcarpus	Panicled bulrush	OBL
FABACEAE	*Lupinus polyphyllus*	Tahoe lupine	FAC
HIPPURIDACEAE	*Hippuris vulgaris*	Mare's tail	OBL
IRIDACEAE	*Iris missouriensis*	Rocky mtn. Iris	FACW
JUNCACEAE	*Juncus balticus*	Baltic rush	FACW
	Juncus ensifolius	Equitant rush	OBL
	Juncus nevadensis	Nevada rush	FACW
LAMIACEAE	*Mentha arvensis*	Wild mint	FACW
MALVACEAE	*Sidalcea oregana*	Oregon checkerbloom	FACW
ONAGRACEAE	*Eplilobium ciliatum*	Fringed willowherb	FACW
POACEAE	*Alopecurus aequalis*	Shortawn foxtail	OBL
	Alopecurus pratensis	Meadow foxtail	FAC

FAMILY	SCIENTIFIC NAME	COMMON NAME	HYD STATUS[1]
	Agrostis exarata	Spike bentgrass	FACW
	Agrostis scabra	Rough bentgrass	FAC
	Agrosits stolonifera	Creeping bentgrass	FAC
	Deschampsia danthonoides	Annual hairgrass	FACW
	Phleum pratense	Timothy	FAC
	Poa palustris	Fowl bluegrass	FAC
	Poa pratensis	Kentucky bluegrass	FAC
	Torreyochloa pallida	Pale false mannagrass	OBL
POLYGONACEAE	*Rumex acetosella*	Common sheep sorrel	FACU
	Rumex crispus	Curly dock	FAC
ROSACEAE	*Fragaria virginiana*	Strawberry	FACU
	Geum macrophyllum	Big-leaved avens	FAC
	Potentilla glandulosa	Sticky cinquefoil	FACU
	Potentilla gracilis	Cinquefoil	FAC
RUBAIACEAE	*Galium trifidum*	Bedstraw	FACW
SALICACEAE	*Salix exigua*	Sandbar willow	OBL
	Salix lemmonii	Lemmon's willow	OBL
	Salix lucida ssp lasiandra	Pacific willow	FACW
SCROPHULAREACEAE	*Veronica anagallis-aquatica*	Water speedwell	OBL
	Mimulus guttatus	Seep monkeyflower	OBL
	Mimulus primuloides	Primrose monkeyflower	OBL
	Veronica americana	America brooklime	OBL

FAMILY	SCIENTIFIC NAME	COMMON NAME	HYD STATUS[1]
SPARGANIACEAE	*Sparganium angustifolium*	Bur-reed	OBL

[1] Army Corps of Engineers; Western Mountains, Valleys, and Coast
N/A = Not Applicable
OBL = Obligate
FACW = Facultative Wetland
FAC = Facultative
FACU = Facultative Upland
* = Non-native species

Appendix(B!

Transect Photos

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Road Fill 1 Begin

Road Fill 1 End

Road Fill 2 Begin

Road Fill 2 End

Road Fill 3 Begin

Road Fill 3 End

Hummock 1

Hummock 1

Hummock 2

Hummock 2

Hummock 3

Hummock 3

Appendix(C!

Point-Intercept Cover Data Calculations

POINT INTERCEPT COVER DATA ANALYSIS
Revegetation Monitoring 2015

SAMPLING AREA: Hummock Transects

COVER TYPE	POINT HITS (#) BY TRANSECT NUMBER			FREQUENCY	VEGETATIVE COVER	TOTAL COVER
	1	2	3			
Native Perennial Forbs						
Mimulus guttatus (Seep monkeyflower)	0	0	1	33%	1.0%	0.5%
Epilobium ciliatum (fringed willowherb)	0	1	1	66%	1.9%	0.9%
Plagiobothrhys sp. (popcornflower)	0	0	2	33%		
Rorippa curvisiliqua (curvepod yellow cress)	0	1	0	33%	1.0%	0.5%
Veronica anagallis-aquatica (water speedwell)	1	1	4	33%	5.8%	2.8%
Arnica chamissonis (Chamiso arnica)	0	1	0	33%	1.0%	0.5%
Total Native Perennial Forbs	1	4	8	100%	12.6%	6.0%
Introduced Perennial Grasses						
Agrostis stolonifera (creeping bentgrass)	1	0	0	33%	1.0%	0.5%
Total Intro. Perennial Grasses	1	0	0	33%	1.0%	0.5%
Native Perennial Graminoids						
Carex nebrascensis (Nebraska sedge)	6	9	10	100%	24.3%	11.6%
Juncus balticus (Baltic rush)	7	3	1	100%	10.7%	5.1%
Deschampsia caespitosa (hairgrass)	1	0	0	33%	1.0%	0.5%
Scirpus microcarpus (panicled bulrush)	3	5	4	100%	11.7%	5.6%
Eleocharis macrostachya (creeping spikerush)	4	5	0	66%	8.7%	4.2%
Agrostis scabra (rough bentgrass)	0	0	1	33%	1.0%	0.5%
Glyceria elata (fowl mannagrass)	13	9	5	100%	26.2%	12.6%
Alopecurus aequalis (shortawn foxtail)	0	0	1	33%	1.0%	0.5%
Carex athrostachya (beaked sedge)	1	0	0	33%	1.0%	0.5%
Carex utriculata (beaked sedge)	0	0	1	33%	1.0%	0.5%
Total Native Perennial Grasses	35	31	23	100%	86.4%	41.4%
NATIVE VEGETATIVE COVER	36	35	31	n/a	99.0%	47.4%
NON-NATIVE VEGETATIVE COVER	1	0	0	n/a	1.0%	0.5%
TOTAL VEGETATIVE COVER	37	35	31	n/a	100.0%	47.9%
Water	32	15	38	100%	n/a	n/a
Erosion Control Mat	30	50	30	100%	n/a	51.2%
Litter	1	0	1	66%	n/a	0.9%
TOTAL COVER	68	85	62	n/a	n/a	100.0%
TOTAL OVER ALL (300) SAMPLING POINTS		ALL COVER:	71.7%	NON-NATIVE:	0.3%	
		VEGETATIVE COVER:	34.3%	NATIVE:	34.0%	

POINT INTERCEPT COVER DATA ANALYSIS
Revegetation Monitoring 2015

SAMPLING AREA: Road Fill Transects

COVER TYPE	POINT HITS (#) BY TRANSECT NUMBER			FREQUENCY	VEGETATIVE COVER	TOTAL COVER
	1	2	3			
Native Annual & Biennial Forbs						
Galium odoratum (bedstraw)	1	0	0	33.0%	0.3%	0.3%
Lotus purshianus (bird's foot trefoil)	1	0	0	33.0%	0.3%	0.3%
Total Native Ann. & Bien. Forbs	2	0	0	33.0%	0.7%	0.7%
Native Perennial Forbs						
Solidago canadensis (Canada goldenrod)	10	0	0	33.0%	3.5%	3.3%
Fragaria virginiana (Virginia strawberry)	3	2	2	100.0%	2.4%	2.3%
Epilobium ciliatum (fringed willowherb)	2	2	1	100.0%	1.7%	1.7%
Arnica chamissonis (Chamiso arnica)	0	0	1	33.0%	0.3%	0.3%
Mentha arvensis (American wild mint)	0	0	2	33.0%	0.7%	0.7%
Lupinus polyphyllus (big leaf lupine)	0	0	4	33.0%	1.4%	1.3%
Penstemon rydbergii (Rydberg's pentstemon)	0	0	1	33.0%	0.3%	0.3%
Plagiobothrhys sp. (popcornflower)	0	0	1	33.0%	0.3%	0.3%
Veronica americana (American speedwell)	0	2	6	66.0%	2.8%	2.7%
Achillea millefolium (yarrow)	2	3	1	100.0%	2.1%	2.0%
Stellaria longipes (chickweed)	1	0	0	33.0%	0.3%	0.3%
Symphyotrichumspathulatum (western mountain aster)	7	5	1	100.0%	4.5%	4.3%
Sidalcea oregana (Oregon checkerbloom)	1	4	0	66.0%	1.7%	1.7%
Potentilla gracilis (cinquefoil)	9	4	0	66.0%	4.5%	4.3%
Total Native Perennial Forbs	35	22	20	100.0%	26.6%	25.7%
Introduced Perennial Forbs						
Taraxacum officinale (common dandelion)	1	0	0	33.0%	0.3%	0.3%
Rumex acetosella (sheep sorrel)	1	3	4	100.0%	2.8%	2.7%
Rumes crispus (curly dock)	1	1	0	66.0%	0.7%	0.7%
Total Intro. Perennial Forbs	3	4	4	66.0%	3.8%	3.7%
Introduced Perennial Grasses						
Festuca rubra (red fescue)	2	0	0	33.0%	0.7%	0.7%
Agrostis stolonifera (creeping bentgrass)	0	4	3	66.0%	2.4%	2.3%
Total Intro. Perennial Grasses	2	4	3	33.0%	3.1%	3.0%

POINT INTERCEPT COVER DATA ANALYSIS
Revegetation Monitoring 2015

COVER TYPE	POINT HITS (#) BY TRANSECT NUMBER			FREQUENCY	VEGETATIVE COVER	TOTAL COVER
	1	2	3			
Native Perennial Graminoids						
Carex nebrascensis (Nebraska sedge)	0	10	0	33.0%	3.5%	3.3%
Carex utriculata (beaked sedge)	0	0	9	33.0%		
Juncus balticus (Baltic rush)	21	25	8	100.0%	18.7%	18.0%
Juncus encifolius (sword leaved rush)	0	2	0	33.0%		
Eleocharis macrostachya (creeping spikerush)	0	1	0	33.0%		
Deschampsia cespitosa (Calfornia hairgrass)	0	6	12	66.0%		
Hordeum brachyantherum (meadow barley)	3	0	2	66.0%	1.7%	1.7%
Poa pratensis (Kentucky bluegrass)	23	9	9	100.0%	14.2%	13.7%
Alopecurus aequalis (short-awned foxtail)	1	1	3	100.0%	1.7%	1.7%
Agrostis scabra (rough bentgrass)	7	13	25	100.0%	15.6%	15.0%
Total Native Perennial Grasses	55	67	68	100.0%	65.7%	63.3%
NATIVE VEGETATIVE COVER	92	89	88	n/a	93.1%	89.7%
NON-NATIVE VEGETATIVE COVER	5	8	7	n/a	6.9%	6.7%
TOTAL VEGETATIVE COVER	97	97	95	n/a	100.0%	96.3%
Litter	3	3	5	n/a	n/a	3.7%
TOTAL COVER	100	100	100	n/a	n/a	100.0%
TOTAL OVER ALL (300) SAMPLING POINTS		ALL COVER:	100.0%	NON-NATIVE:	6.7%	
		VEGETATIVE COVER:	96.3%	NATIVE:	89.7%	

REVEGETATION MONITORING MEMORANDUM

UPPER TRUCKEE MARSH SEWER FACILITIES

SOUTH LAKE TAHOE, CA

Prepared for:

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September 13, 2016

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Appendices

1 Introduction

This report evaluates revegetation conditions at the Upper Truckee Marsh Sewer Facilities site in South Lake Tahoe, CA. It also presents the results of the revegetation monitoring surveys conducted by Western Botanical Services, Inc. (WBS) within the hummock plant communities. The survey was conducted on August 9, 2016.

The survey results compare revegetation success to reference conditions in 2014 to measure progress toward meeting performance criteria goals in the constructed hummocks. The embankment restoration met the goals in 2015 and measurements were not repeated in 2016.

The goals for herbaceous vegetation were established in the "Upper Truckee Marsh Sewer Facilities Adaptive Management Plan" (Plan), (Section 32 90 00 Restoration, Revegetation, and Erosion Control 3.03), and are as follows:

> "*Planted wetland herbaceous vegetation and sod established at 80 percent of baseline cover after 1 year and 85 percent of baseline cover after 2 years and exhibiting good vigor. Native species established at 90 percent of baseline after 1 year and 95 percent of baseline after 2 years. Wetland species, combining obligate and facultative species, established equal to or exceeding baseline after 2 years. Planted woody vegetation established at 80 percent survival and exhibit good vigor*."

2 Methodology

2.1 Vegetation Cover

The methodology employed in 2016 was identical to what was conducted in 2014 and 2015. Cover was determined using the point-intercept sampling method. All plants intercepted along transects were identified to the lowest possible taxonomic level. All plant species and non-plant elements (bare ground, rock, litter) intercepted by the projected laser 'dot' were recorded. A broader species list was developed for the project area to identify those species not intercepted by transects (Appendix A).

Percent litter, rock, water, erosion control mat, and bare areas are calculated separately. Total cover includes vegetation, standing dead, fine gravel (4–8 mm), coarse gravel (8-32 mm), rock (>32 mm) and litter. Litter refers to material detached from growing vegetation older than one year and includes decomposing vegetation, animal waste, and garbage. Total vegetative cover refers only to live vegetation. Frequency was calculated by determining the number transects in which a species was intercepted.

The three hummocks surveyed in 2015 were re-surveyed with transects of varying lengths, but totaling 100 ft. per hummock. The Theodolite iPad app was used to record the location of each transect (Appendix B).

2.2 Willow Survival and Vigor

An assessment of willow survival and vigor was not conducted in 2016. Although 2015 data indicated that the willow work was not in compliance with specified goals, it was agreed that the net results none-the-less achieved the desired effect.

2.3 Vigor of Herbaceous Vegetation

Vigor is a qualitative observation that can vary among observers but should be consistent on a project basis. It refers to the relative size and health of the individual without reference to its reproductive success (vitality). It is usually determined in a scale of 1-5 plant and as a function of both typical growth for the species in question as well as favorableness and suitability of the environment with 1=poor, 2=fair, 3=good, 4=very good, and 5=excellent.

3 Results and Discussion

2014 reference data for total cover, vegetative cover, and dominance by natives are presented in Table 1. 2015 revegetation cover data for the same transects are presented in Table 2. The results of the 2016 survey are presented in Table 3. Detailed cover calculations for 2016 are included in Appendix C.

Total cover in 2016 in the hummock community averaged 84%, versus 83.7% in 2015, while total vegetative cover averaged 76.6% in 2016 as opposed to 34% in 2015, with a range from 95% (Transect 1) to 52% (Transect 3). Transect 3 was largely under water (L-shaped hummock #4). Relative cover by native species averaged 72.3% with a range between 88% (Transect 1) and 52% (Transect 3).

The performance criteria established in the Plan for year 2 was 85% of baseline vegetative, which would be 68%. Since the average vegetative cover was 76.6% the performance criteria was met for year two post construction, in spite of transect #3. The performance criteria established in the Plan was 95% of native species baseline cover after one year, which would be 76%. The average cover by native species was 72.3% therefore the performance criteria was not met for year two post construction, albeit close.

The hummocks, (with perhaps the exception of the L-shaped hummock #4 which was largely under water), are performing as designed. Although the hummocks were installed late in the season of 2015 and were mostly inundated by water throughout the summer of 2016, by early August they were for the creating surface roughness leading to sediment deposition by sand. They are expected to continue to perform as designed, assuming there are no radical unanticipated changes in hydrology.

Vigor for these plants was rated 4.5 - 5, based on a comparison to the vigorous growth of the surrounding mature plant community.

Table 1. 2014 Hummock Reference Cover Summary

Cover Type	Transect 1	Transect 2	Transect 3	Average
Total Cover (including litter, gravel, and rock)	100%	61%	90%	84%
Total Vegetative Cover	95%	58%	88%	80%
Vegetative Cover By Native Species	93%	58%	88%	80%

Table 2. 2015 Hummock Revegetation Cover Summary

Cover Type	Transect 1	Transect 2	Transect 3	Average
Total Cover (including litter, gravel, and rock)	68%	85%	62%	72%
Total Vegetative Cover	37%	35%	31%	34%
Vegetative Cover By Native Species	36%	35%	31%	34%

Table 3. 2016 Hummock Revegetation Cover Summary

Cover Type	Transect 1	Transect 2	Transect 3	Average
Total Cover (including litter, gravel, and rock)	96%	94%	62%	84%
Total Vegetative Cover	95%	83%	52%	76.6%
Vegetative Cover By Native Species	88%	77%	52%	72.3%

It is anticipated that species composition and cover will change with the changing dynamics of a natural ecosystem. The current species diversity can accommodate changes in hydrology, the dominant factor in vegetation community structure. Whatever responses occur within the project area should also be manifest in the adjacent vegetation community.

4 Recommendations

The performance criteria for vegetation cover on the hummocks was achieved in 2016. The performance criteria for cover by native species was not achieved by a narrow margin (-3.7%). However, cover by natives is expected to increase and it is reasonable to assume that the performance criteria will be met next year.

Although the design has been for the most part very effective, there are still some areas along the right of way that are were inundated during the growing season (due to beaver activity) and would benefit from additional biotechnical installations to effectively raise elevations and further protect infrastructure.

5 References

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Appendix A

Species List

2016 Upper Truckee Marsh Species List

FAMILY	SCIENTIFIC NAME	COMMON NAME	HYD STATUS[1]
ASTERACEAE	*Achillea millefolium*	Yarrow	FACU
	Arnica chamissonis	Chamisso arnica	FACW
	Solidago Canadensis	Canada goldenrod	FACU
	Symphyotrichum spathulatum var yosemitanum	Western aster	FAC
CYPERACEAE	*Carex aqualtilis*	Water sedge	OBL
	Carex athrostachya	Slenderbeak sedge	FACW
	Carex lanuginosa	Wooly sedge	OBL
	Carex nebrascensis	Nebraska sedge	OBL
	Carex utriculata	Beaked sedge	OBL
	Scirpus microcarpus	Panicled bulrush	OBL
FABACEAE	*Lupinus polyphyllus*	Tahoe lupine	FAC
HIPPURIDACEAE	*Hippuris vulgaris*	Mare's tail	OBL
IRIDACEAE	*Iris missouriensis*	Rocky mtn. Iris	FACW
JUNCACEAE	*Juncus balticus*	Baltic rush	FACW
	Juncus ensifolius	Equitant rush	OBL
	Juncus nevadensis	Nevada rush	FACW
LAMIACEAE	*Mentha arvensis*	Wild mint	FACW
MALVACEAE	*Sidalcea oregana*	Oregon checkerbloom	FACW
ONAGRACEAE	*Eplilobium ciliatum*	Fringed willowherb	FACW
POACEAE	*Alopecurus aequalis*	Shortawn foxtail	OBL
	*Alopecurus pratensis**	Meadow foxtail	FAC

FAMILY	SCIENTIFIC NAME	COMMON NAME	HYD STATUS[1]
	Agrostis exarata	Spike bentgrass	FACW
	Agrostis scabra	Rough bentgrass	FAC
	*Agrosits stolonifera**	Creeping bentgrass	FAC
	Deschampsia danthonoides	Annual hairgrass	FACW
	Phleum pratense	Timothy	FAC
	*Poa palustris**	Fowl bluegrass	FAC
	Poa pratensis	Kentucky bluegrass	FAC
	Torreyochloa pallida	Pale false mannagrass	OBL
POLYGONACEAE	*Rumex acetosella*	Common sheep sorrel	FACU
	*Rumex crispus**	Curly dock	FAC
ROSACEAE	*Fragaria virginiana*	Strawberry	FACU
	Geum macrophyllum	Big-leaved avens	FAC
	Potentilla glandulosa	Sticky cinquefoil	FACU
	Potentilla gracilis	Cinquefoil	FAC
RUBAIACEAE	*Galium trifidum*	Bedstraw	FACW
SALICACEAE	*Salix exigua*	Sandbar willow	OBL
	Salix lemmonii	Lemmon's willow	OBL
	Salix lucida ssp lasiandra	Pacific willow	FACW
SCROPHULAREACEAE	*Veronica anagallis-aquatica*	Water speedwell	OBL
	Mimulus guttatus	Seep monkeyflower	OBL
	Mimulus primuloides	Primrose monkeyflower	OBL
	Veronica americana	America brooklime	OBL

FAMILY	SCIENTIFIC NAME	COMMON NAME	HYD STATUS[1]
SPARGANIACEAE	*Sparganium angustifolium*	Bur-reed	OBL

[1] Army Corps of Engineers 2012; Western Mountains, Valleys, and Coast

N/A = Not Applicable

OBL = Obligate

FACW = Facultative Wetland

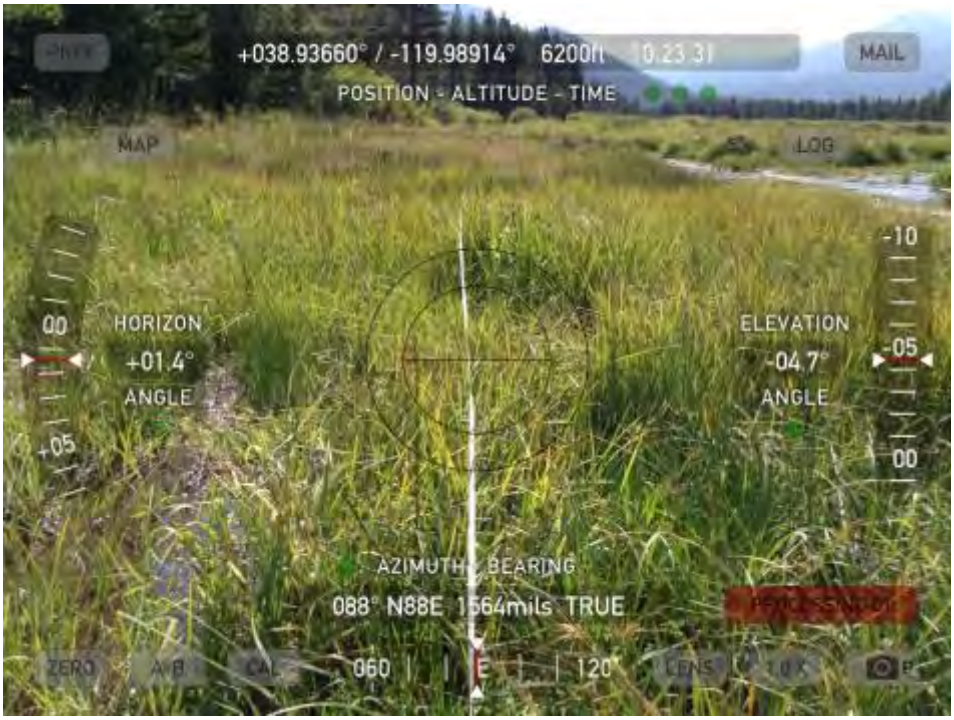
FAC = Facultative

FACU = Facultative Upland

* = Non-native species

Appendix B

Transect Photos



TRANSECT 1: BEGIN

Date & Time: Tue Aug 9 10:23:32 PDT 2016
Position: +038.93660° / -119.98914°
Altitude: 6200ft
Datum: WGS-84
Azimuth/Bearing: 088° N88E 1564mils (True)
Elevation Angle: -04.4°
Horizon Angle: +01.5°
Zoom: 1X

TRANSECT 1: END

Date & Time: Tue Aug 9 10:56:10 PDT 2016
Position: +038.93650° / -119.98884°
Altitude: 6193ft
Datum: WGS-84
Azimuth/Bearing: 320° N40W 5689mils (True)
Elevation Angle: -03.4°
Horizon Angle: -00.4°
Zoom: 1X

TRANSECT 2: BEGIN

Date & Time: Tue Aug 9 11:15:23 PDT 2016
Position: +038.93661° / -119.98936°
Altitude: 6207ft
Datum: WGS-84
Azimuth/Bearing: 347° N13W 6169mils (True)
Elevation Angle: -04.8°
Horizon Angle: -00.1°
Zoom: 1X

TRANSECT 2: END

Date & Time: Tue Aug 9 11:29:07 PDT 2016
Position: +038.93673° / -119.98945°
Altitude: 6192ft
Datum: WGS-84
Azimuth/Bearing: 147° S33E 2613mils (True)
Elevation Angle: -02.6°
Horizon Angle: +02.2°
Zoom: 1X

TRANSECT 3: BEGIN

Date & Time: Tue Aug 9 11:56:34 PDT 2016
Position: +038.93639° / -119.98906°
Altitude: 6202ft
Datum: WGS-84
Azimuth/Bearing: 043° N43E 0764mils (True)
Elevation Angle: -06.6°
Horizon Angle: -02.1°
Zoom: 1X

TRANSECT 3: END

Date & Time: Tue Aug 9 12:19:49 PDT 2016
Position: +038.93658° / -119.98887°
Altitude: 6252ft
Datum: WGS-84
Azimuth/Bearing: 090° N90E 1600mils (True)
Elevation Angle: -05.2°
Horizon Angle: -01.2°
Zoom: 1X

Appendix C

Point-Intercept Cover Data Calculations

SAMPLING AREA: Hummock Transects 2016

COVER TYPE	POINT HITS (#) BY TRANSECT NUMBER			FREQUENCY	VEGETATIVE COVER	TOTAL COVER
	1	2	3			
Native Perennial Forbs						
Epilobium ciliatum (fringed willowherb)	5	0	1	67%	2.6%	2.4%
Galium trifidum (bedstraw)	1	0	0	33%	0.4%	0.4%
Veronica anagallis-aquatica (water speedwell)	1	0	1	67%	0.9%	0.8%
Arnica chamissonis (Chamiso arnica)	2	0	0	33%	0.9%	0.8%
Total Native Perennial Forbs	9	0	2	67%	4.8%	4.4%
Native Shrubs						
Rosa woodsii (Wood's rose)	2	0	0	33%	0.9%	0.8%
Total Native Shrubs	2	0	0	33%	0.9%	0.8%
Introduced Perennial Grasses						
Poa palustris (fowl bluegrass)	1	0	0	33%	0.4%	0.4%
Agrostis stolonifera (creeping bentgrass)	6	6	0	66%	5.2%	4.8%
Total Intro. Perennial Grasses	7	6	0	33%	5.7%	5.2%
Native Perennial Graminoids						
Carex nebrascensis (Nebraska sedge)	32	37	9	100%	33.9%	31.0%
Juncus balticus (Baltic rush)	6	9	0	67%	6.5%	6.0%
Juncus nevadensis (Sierra rush)	7	0	0	33%	3.0%	2.8%
Scirpus microcarpus (panicled bulrush)	7	14	15	100%	15.7%	14.3%
Eleocharis palustris (common spikerush)	11	9	2	100%	9.6%	8.7%
Glyceria elata (fowl mannagrass)	6	4	23	100%	14.3%	13.1%
Phalaris arundinacea (reed canarygrass)	4	3	1	100%	3.5%	3.2%
Carex athrostachya (beaked sedge)	4	1	0	67%	2.2%	2.0%
Total Native Perennial Grasses	77	77	50	100%	88.7%	81.0%
NATIVE VEGETATIVE COVER	88	77	52	n/a	94.3%	86.1%
NON-NATIVE VEGETATIVE COVER	7	6	0	n/a	5.7%	5.2%
TOTAL VEGETATIVE COVER	95	83	52	n/a	100.0%	91.3%
Coarse gravel (> 5mm)	0	0	3	33%	n/a	1.2%
Fine gravel (< 5mm)	0	0	7	33%	n/a	2.8%
Litter	0	1	0	33%	n/a	0.4%
Erosion control mat	0	10	0	33%	n/a	4.0%
Moss	1	0	0	33%	n/a	0.4%
Water	3	6	36	100%	n/a	n/a
Bare	1	0	2	67%	n/a	n/a
TOTAL COVER	96	94	62	n/a	n/a	100.0%
TOTAL OVER ALL (300) SAMPLING POINTS	ALL COVER:		84.0%	NON-NATIVE:	4.3%	
	VEGETATIVE COVER:		76.7%	NATIVE:	72.3%	

Summary Technical Memorandum: Revegetation Monitoring Results 2020

Upper Truckee Marsh Sewer Facilities Improvement Project

South Lake Tahoe, CA

Prepared for:

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November 10, 2020

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Appendices

1 Introduction

This report evaluates the results of the revegetation monitoring surveys conducted by Western Botanical Services, Inc. (WBS) summarized in the Technical Memorandum from March 20, 2018 and updated here. The focus of the recent surveys was the biotechnical work conducted over three years, starting in 2014 and concluding in 2016, including the coir mats used to build the hummocks, coir logs, planting of wetland plugs, willow stakes, and revegetation of a graded berm.

1.1 Survey History

Post construction monitoring surveys were conducted on July 14 and 30 in 2015, and on August 9, 2016. Detailed results were summarized in the 2015 and 2016 reports (*Revegetation Monitoring Memorandum*, October 2, 2015; *Revegetation Monitoring Memorandum*, September 13, 2016 and *Summary Revegetation Monitoring Memorandum 2015-2017,* March 20, 2018*.* Sites were surveyed again in 2020 on September 11th, September 25th, and October 29th. The surveys were conducted at a suboptimum time for maximum species identification.

The most recent surveys did not include quantitative measurements of vegetative cover, frequency, or survival. The primary purposes were to evaluate the success of treatments in achieving project goals by directing flows back into Trout creek, and reducing open water to allow access to the sewer line for maintenance with biotechnical treatments. Plant community structure along the pipeline ROW was expected to change with the installation of the coir mat hummocks and wetland plugs which raised the surface elevation, acting as a type of organic fill. They were also intended to trap coarse sediment due to their surface roughness, contributing to aggradation. We examined all the original treatments, those installed in 2015 (including four coir logs) as well as hummocks 6A and 7 and the four coir logs installed in late October of 2016 as part of the last phase of implementation of this Adaptive Management Plan.

The willow work installed in 2014, the first year of construction, had not been surveyed since 2015, when we reported 40% willow stake survival in the wattles and and 13% for the sausals.

No surveys were conducted in either 2018 or 2019.

1.2 Performance Criteria

Performance goals were established in the "Upper Truckee Marsh Sewer Facilities Adaptive Management Plan" (Plan), (Section 32 90 00 Restoration, Revegetation, and Erosion Control 3.03), and are as follows:

- Planted wetland herbaceous vegetation and sod established at 80 percent of baseline cover after 1 year and 85 percent of baseline cover after 2 years and exhibiting good vigor. Native species established at 90 percent of baseline after 1 year and 95 percent of baseline after 2 years. Wetland species, combining obligate and facultative species, established equal to or exceeding baseline after 2 years. Planted woody vegetation established at 80 percent survival and exhibit good vigor.

- Survival 80% of willow stakes and willow transplants, and minimum of two sprouts per lineal foot of willow wattles, one year following the completion date of the work. If

contractor fails to meet the warranty requirements, the warranty period will be extended by a year until they are met.

2 Results and Discussion

2.1 Road Fill Plant Cover

The performance criteria established in the Plan was 80% of baseline vegetative cover after one year. The average vegetative cover was 96%, therefore the performance criteria was met in 2015 and measurements were unnecessary in 2016.The performance criteria established in the Plan was 90% of native species baseline cover after one year. The average cover by native species was 90%, therefore the performance criteria was met in 2015. No additional data has been obtained from this site.

2.2 Hummocks and Coir logs: Cover, Species Composition, and Function

2.2.1 Cover

The performance criteria established in the Plan was 80% of baseline vegetative cover after one year, or 64%. The average vegetative cover was 34%, therefore the performance criteria was not met in 2015. For native species, the performance criteria established in the Plan was 72%. The average cover by native species was 34%, therefore the performance criteria was not met year one post construction.

The performance criteria established in the Plan for year 2 was 85% of baseline vegetative cover, or 68%. Since the average vegetative cover was 77% the performance criteria were met year two post construction. The performance criteria established in the Plan was 95% of native species baseline cover after two years, or 76%. For native species, cover measured 72% in 2016; therefore, the performance criteria were not met for year two post construction, albeit close.

We presume this requirement was met in 2020.

2.2.2 Species Composition

Species composition has changed over time as the active, open water channel is largely gone along with associated species (American brooklime [*Veronica americana*], water speedwell [*Veronica anagallis-aquatica*]), and standing water remains in much of the treatment areas. This was not unexpected.

Also anticipated was colonization by willows on coarse depositions of sand and the establishment of cattails (*Typha latifolia*) in standing water, which has indeed occurred. The species composition of the hummocks has also changed from the original plantings of Nebraska sedge/Baltic rush (*Carex nebrascensis/Juncus balticus*), which are still visible, to the dominance of Northwest Territory sedge (*Carex utriculalta*), which prefers saturated soils for a long duration. *Carex nebrascensis* and *Juncus balticus* were selected for this project since they are ubiquitous, common in this marsh, tolerant of a variety of growing conditions, and commonly available.

Plantings of *Rosa woodsii* along the fence line have largely persisted, in spite of standing water and competition from herbaceous species.

At Hummock 7, the plant community was dominated by the introduced pasture grass meadow foxtail (*Alopecurus pratensis*), a historical remnant from past grazing activities.

A list of plant species in the project area is included in Appendix A.

2.2.3 Function

The hummocks for the most part have functioned as intended. The coir mats used to build the hummocks have become densely vegetated and were difficult to locate, particularly the original installations. We measured a six-inch difference from the hummock surface to the surface of the open channel at Hummock 6. We were only able to locate the coir mats and coir logs by finding the anchoring stakes. The coir logs were very well vegetated.

Hummock 6A was not accessible as it was totally inundated. Hummock 7 was accessible with the coil mat and coir logs still visible, and much drier since the initial installation. None of the willows in the willow mattress at Hummock 7 survived; this was not unexpected as the site was inundated at the time of construction. However, the willows helped to achieve the design finish grade.

We observed deposition by coarse sand in numerous locations.

2.3 Willow Coir Log with Willow Stakes and Willow Sausals

The performance criteria established in the Plan was 80% willow stake survival for both treatment types, willow stakes with coir logs, and willow stakes alone planted in a semi-circle. In 2015 willow stake survival was 40% for the coir logs and 13% for the sausal and the performance criteria were not met. The willows in the sausal were not planted as specified (not deep enough). However, plantings were vigorous and it was concluded that the remaining willows, along with the coir log, were at that time performing as intended. No new plantings occurred in 2015, and no measurements were obtained in 2016.

In 2020 we were able to relocate the treatments, although we could no longer differentiate between them and we failed to locate the coir fiber rolls as they had either biodegraded or were overgrown. Willow growth varied between five and up to eight feet and were very vigorous.

3 Conclusions and Recommendations

It appears that the biotechnical treatments were largely successful as designed, but the objective of obtaining vehicular access to the sewer line for periodic maintenance will continue to problematic and dictated by complex and interacting sites conditions, including lake level, snow melt, drought, and beaver activity, although Hummock 7 (Manhole 21) was accessible at the time of our 2020 survey.

Coir mats and logs, along with plug plantings, were very effective in achieving the desired results. The propagated mat initially installed in 2014 was planted too late in the growing season to develop vigorous root growth at the time of installation, and were planted too late to warrant their

cost. Five and six years after installation the mats and logs were well vegetated and difficult to locate. Although the willows planted with the coir logs and in the sausals were not installed as specified and initially did not meet the required performance standards, the remaining plants were well established and effective by 2020. Clearing of two channels was also effective in re-directing flows into Trout Creek.

We could have considered doubling the thickness of the coir mats (e.g. two layers) but that would have complicated the wetland plug plantings. Willow plantings may also have helped achieve direr site conditions, and would not have prohibited site access as they can be mowed/pruned.

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Appendix A

Species List

Upper Truckee Marsh Species List

FAMILY	SCIENTIFIC NAME	COMMON NAME	HYDROPHYTIC STATUS[1]	2016	2020
ASTERACEAE	*Achillea millefolium*	Yarrow	FACU	✓	-
	Arnica chamissonis	Chamisso arnica	FACW	✓	-
	Solidago Canadensis	Canada goldenrod	FACU	✓	-
	Symphyotrichum spathulatum var yosemitanum	Western aster	FAC	✓	✓
CYPERACEAE	*Carex aqualtilis*	Water sedge	OBL	✓	-
	Carex athrostachya	Slenderbeak sedge	FACW	✓	-
	Carex lanuginosa	Wooly sedge	OBL	✓	-
	Carex nebrascensis	Nebraska sedge	OBL	✓	✓
	Carex utriculata	Beaked sedge	OBL	✓	✓
	Elecocharis macrostachya	Creeping spikerush	OBL	✓	✓
	Scirpus microcarpus	Panicled bulrush	OBL	✓	✓
FABACEAE	*Lupinus polyphyllus*	Tahoe lupine	FAC	✓	✓
HIPPURIDACEAE	*Hippuris vulgaris*	Mare's tail	OBL	✓	-
IRIDACEAE	*Iris missouriensis*	Rocky mtn. Iris	FACW	✓	-
JUNCACEAE	*Juncus balticus*	Baltic rush	FACW	✓	✓
	Juncus ensifolius	Equitant rush	OBL	✓	✓
	Juncus nevadensis	Nevada rush	FACW	✓	✓

FAMILY	SCIENTIFIC NAME	COMMON NAME	HYDROPHYTIC STATUS[1]	2016	2020
LAMIACEAE	*Mentha arvensis*	Wild mint	FACW	✓	✓
MALVACEAE	*Sidalcea oregana*	Oregon checkerbloom	FACW	✓	✓
ONAGRACEAE	*Eplilobium ciliatum*	Fringed willowherb	FACW	✓	✓
POACEAE	*Alopecurus aequalis*	Shortawn foxtail	OBL	✓	-
	Alopecurus pratensis	Meadow foxtail	FAC	✓	✓
	Agrostis exarata	Spike bentgrass	FACW	✓	✓
	Agrostis scabra	Rough bentgrass	FAC	✓	✓
	Agrosits stolonifera	Creeping bentgrass	FAC	✓	✓
	Deschampsia cespitosa	Tufted hairgrass	FACW	-	✓
	Deschampsia danthonoides	Annual hairgrass	FACW	✓	-
	Phalaris arundinacea	Reed canarygrass	FACW	-	✓
	Phleum pratense	Timothy	FAC	✓	✓
	Poa palustris	Fowl bluegrass	FAC	✓	
	Poa pratensis	Kentucky bluegrass	FAC	✓	✓
	Torreyochloa pallida	Pale false mannagrass	OBL	✓	✓
POLYGONACEAE	*Rumex acetosella*	Common sheep sorrel	FACU	✓	-

FAMILY	SCIENTIFIC NAME	COMMON NAME	HYDROPHYTIC STATUS[1]	2016	2020
	Rumex crispus	Curly dock	FAC	✓	✓
ROSACEAE	*Fragaria virginiana*	Strawberry	FACU	✓	-
	Geum macrophyllum	Big-leaved avens	FAC	✓	-
	Potentilla glandulosa	Sticky cinquefoil	FACU	✓	-
	Potentilla gracilis	Cinquefoil	FAC	✓	-
	Rosa woodsii	Woods' rose	FSCU	✓	✓
RUBIACEAE	*Galium trifidum*	Bedstraw	FACW	✓	-
SALICACEAE	*Salix exigua*	Sandbar willow	OBL	✓	✓
	Salix lemmonii	Lemmon's willow	OBL	✓	✓
	Salix lucida var lasiandra	Pacific willow	FACW	✓	✓
SCROPHULAREACEAE	*Mimulus guttatus*	Seep monkeyflower	OBL	✓	✓
	Mimulus primuloides	Primrose monkeyflower	OBL	✓	✓
	Veronica americana	America brooklime	OBL	✓	-
	Veronica anagallis-aquatica	Water speedwell	OBL	✓	-
SPARGANIACEAE	*Sparganium angustifolium*	Bur-reed	OBL	✓	-
TYPHACEAE	*Typha latifolia*	Cat-tail	OBL	-	✓

[1] Army Corps of Engineers; Western Mountains, Valleys, and Coast

Indicator Categories

OBL	Obligate Wetland	Occurs almost always (estimated probability 99%) under natural conditions in wetlands.
FACW	Facultative Wetland	Usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands.
FAC	Facultative	Equally likely to occur in wetlands or non-wetlands (est. probability 34%-66%).
FACU	Facultative Upland	Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%).
UPL	Obligate Upland	Occurs in wetlands in another region but occurs almost always (estimated probability 99%) under natural conditions in non-wetlands in the regions specified. If a species does not occur in wetlands in any region, it is not on the National List.
NA	No agreement	The regional panel was not able to reach a unanimous decision on this species.
NI	No indicator	Insufficient information was available to determine an indicator status.
NO	No occurrence	The species does not occur in that region.

Appendix B

Photo Log

Hummock Evolution (view from Bellevue) 2014-2020

Photo 1. Construction of Hummock 4 looking south, October 6, 2014

Photo 2. May 4, 2015

Hummock Evolution (view from Bellevue) 2014-2020

Photo 3. June 23, 2105

Photo 4. June 23, 2015

Hummock Evolution (view from Bellevue) 2014-2020

Photo 5. July 14, 2014

Photo 6. April 28, 2016

Hummock Evolution (view from Bellevue) 2014-2020

Photo 7. November 2, 2017

Photo 8. May 2, 2018

Hummock Evolution (view from Bellevue) 2014-2020

Photo 9. May 31, 2018

Photo 10. Hummock 1, September 25, 2020

Hummock 6A and 7, Construction 2016 and Current Condition 2020

Photo 11. Hummock 6A, October 26, 2016

Photo 12. Hummock 6A, inundated, September 11, 2020

Hummock 6A and 7, Construction 2016 and Current Condition 2020

Photo 13. Hummock 7, September 11, 2020

Sausals and Willow Cuttings

Photo 14. July 17, 2015

Photo 15. October 29, 2020

Sausals and Willow Cuttings

Photo 16. October 29, 2020

Channel Clearing

Photo 17. August 25, 2015 following clearing of Trout Creek, west side of marsh

Photo 18. August 27, 2015. Hand clearing vegetation at Trout Creek to direct flows away from the pipeline ROW. Bare soils were seeded

Coir Log Evolution

Photo 19. Coir log installed at Hummock 4 November 2, 2016

Photo 20. Well-vegetated coir log at Hummock 4, September 11, 2020

Coir Log Evolution

Photo 21. Coir log install year 2, September 17, 2015 near Hummock 1

Photo 22. October 26, 2016

Coir Log Evolution

Photo 23. Vegetated coir log near Hummock 1, September 11, 2020

Species Composition Change Over Time

Photo 24. Colonizing cat tails, September 11, 2020

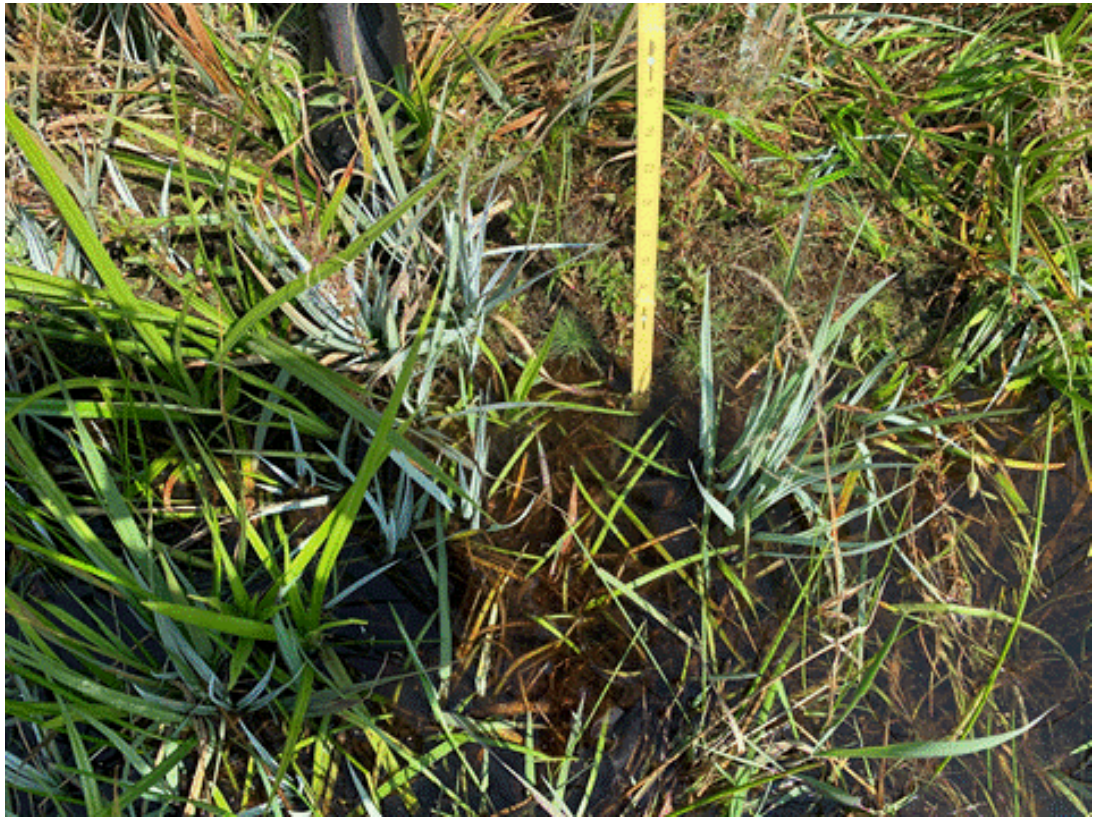

Photo 25. Six-inch depth from surface of hummock to surface of open water, September 11, 2020. Note persistence of planted *Carex nebrascensis* (blue) and establishment of *Carex utriculata*

Sedimentation

Photo 26. Coarse sediment deposition, September 11, 2020