UPPER TRUCKEE MARSH SEWER FACILITIES ADAPTIVE MANAGEMENT PLAN

DRAFT

South Tahoe Public Utility District

7 April 2014

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northwest hydraulic consultants
water resource specialists

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Prepared for:
South Tahoe Public Utility District

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Executive Summary

Project Data

Location:	City of South Lake Tahoe, El Dorado County
APNs:	026-200-011 (construction expected); 026-210-31, 026-210-37 (in project area, potential for construction, but none identified at this time)
Property Owner:	California Tahoe Conservancy
Total Project Area:	96 acres
Land Disturbance:	Year 1: 0.83 acre total (including temporary access); 0.40 acre grading; 455 cubic yards excavation; 190 cubic yards fill
Years 1-5 (full AMP):	1.65 acre total (including temporary access); 0.65 acre grading; 523 cubic yards excavation; 279 cubic yards fill.

Management Measures:

Pilot channels and left bank openings;

Planting of vegetation to encourage favorable flow paths and discourage unfavorable flow paths;

Removal of fill and debris on pre-1968 channel in center of meadow;

Local widening and deepening on favorable flow paths;

Planting vegetation for hydraulic roughness in right overbank;

Placement of fill hummocks to discourage flow from occurring in the easement;

Miscellaneous fill (thin soil spreading on the floodplain) in vegetated areas;

Installation of right overbank flow plugs;

Removal of abandoned road fill in the SEZ and intermittent fill of an erosional depression on its upstream side.

Success Criteria: Majority of creek flow near Bellevue Pump Station restored to channel locations that existed in 2011 or further south, with not more than 10 percent of the flow in the sewer easement when channel is at bankfull stage upstream; and no flow in easement area when flows are less than 50 cfs at the Tahoe Valley gage.

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.

Hummock fills maintain functional wetland characteristics for vegetation and periodic inundation, continuing to meet criteria as jurisdictional wetlands.

Purpose of Project

The South Tahoe Public Utility District (District) owns and operates sewer facilities along the northern margin of the Upper Truckee Marsh in South Lake Tahoe. The facilities include Bellevue Pump Station, a 8-inch diameter gravity main, and a 10-inch diameter force main. The pipelines are located in a 12-foot wide easement between Oakland Avenue and Bellevue Avenue along the northeastern boundary of property owned by the California Tahoe Conservancy (Conservancy).

During the record snowmelt year of 2011, the Trout Creek channel near the Bellevue Pump Station completely filled with the bed material in transport (sand and gravel) causing flows to go over the right bank (looking downstream) and inundate the District's easement. Following this event the channel has remained completely plugged and the deposition process is continuing upstream such that overflow pathways are developing over an approximately 300 foot long reach.

Under current conditions the District no longer has access to the easement, including manholes on the gravity sewer. Surface inundation of the easement persisted through the summer and fall months of 2013, preventing access for routine maintenance. This condition poses a risk to the facilities and to water quality because: 1) manholes are subject to constant inundation, increasing potential infiltration and inflow to the pump station and the risk of overloading the station; 2) manholes are subject to increased potential for damage due to debris impacts during flood events; 3) access for routine maintenance is restricted, increasing the probability of a plug; and 4) access for emergency operations is restricted, increasing the probability of overflow in case of a plug or other problem. Formation of a new channel in the easement area would directly threaten exposure of the pipelines and operation of the pump station. An overflow due to inundation of the pump station, a plug in the gravity line, or a break in either of the lines could result in raw sewage discharge to Trout Creek, the Upper Truckee Marsh, and Lake Tahoe.

The District investigated several alternatives to address the risk to the sewer facilities, including excavation to restore the pre-2011 channel, relocation of the Trout Creek channel, raising and protecting the easement, and relocation of the sewer lines. All of these alternatives have significant cost and environmental constraints. Because a new channel has not yet formed, the District has an opportunity to develop less intensive measures that encourage initial channel formation away from the easement, and to implement similar measures over a longer period to reduce the risk of future channel

encroachment on the easement. The District therefore proposes to implement an Adaptive Management Plan (AMP) to protect the sewer infrastructure from flooding and reduce the risk of sewage discharges.

The adaptive management approach has the support of the Conservancy and provides an opportunity to work with adjacent landowners to protect the sewer facilities that serve their residences while preserving the environmental values of the Upper Truckee Marsh. Implementation of the AMP is expected to occur over a 3 to 5 year time frame, depending on success in meeting project objectives. By nature, the AMP includes a monitoring component to define existing conditions, protect resources during implementation, and assess success in meeting objectives. Monitoring is expected to continue for two years after the final implementation phase.

An Initial Study/Mitigated Negative Declaration to comply with California and TRPA regulations is being prepared under separate cover. Anticipated permits include a Nationwide Permit under Section 404 of the Clean Water Act (USACE permit) with Section 401 Water Quality Certification (Lahontan Regional Water Quality Control Board); a Streambed Alteration Agreement under Section 1600 of the California Fish and Game Code, and a TRPA grading permit.

Desired Outcomes and Proposed Management Measures

The primary goal of the AMP is to reduce risk to the sewer facilities while protecting resources in the Upper Truckee Marsh. To achieve that goal the AMP defines more specific objectives related to inundation of the easement area, formation of new channels, enhancement of vegetation to encourage favorable flow paths, and improved flow distribution across the marsh. The following measures may be implemented as part of the AMP to achieve these objectives:

1. Construction of pilot channels to divert low 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 vegetation along preferred channel alignments;
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 vegetative hydraulic roughness elements spanning the utility 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 fill hummocks, to be vegetatively stabilized, over portions of the easement and adjacent low areas;
8. Miscellaneous fill (thin soil spreading) on the floodplain, using existing vegetation and a biodegradable perimeter for stabilization;
9. Installation of overbank flow plugs to reduce flow passing over or adjacent to the easement;
10. Planting of vegetation in channels which currently contribute, or have the potential to contribute to inundation on the easement;
11. Removal of abandoned road fill and replacing existing sod to the adjacent meadow grade;
12. Intermittent fill and revegetation of the depression upstream of the abandoned road fill.

A fundamental tenet of the adaptive management approach is that measures will be implemented over a period of several years and adjusted according to stream response to the measures and normal hydrologic variability.

Construction Methods and Environmental Protection

The AMP measures are intended to minimize disturbance to existing marsh resources, and many will be implemented by hand crews rather than equipment. Equipment will be used to remove the abandoned road fill and to supply marsh mat material to the easement area. Where equipment is to be used on the floodplain or marsh surface, only low ground pressure equipment will be permitted, and construction monitoring will be performed to avoid compaction or rutting in meadow soils.

Construction will generally occur between 1 September and 15 October, although some planting may occur outside of this window. This period corresponds to minimum flows in the creek and also occurs after migratory bird nesting season and the spawning season for Lahontan cutthroat trout and other fish species.

The primary construction access for most AMP measures will be via Bellevue Avenue. Truck traffic is expected only in Year 1 of construction when the abandoned road fill will be removed, and is expected to last approximately 10 working days and generate less than 100 trips. Pedestrian access to the marsh through Bellevue Avenue will be temporarily closed or restricted to protect public safety during construction in Year 1, and possibly in subsequent implementation years.

Dewatering of the work area near the sewer lines will be accomplished through construction of the pilot channels off the left bank of Trout Creek. Water quality will be protected through a combination of "seasoning" the pilot channel features prior to activation and pumping any remnant water in the easement area to a sedimentation basin and then to a flood or spray irrigated infiltration area on an unsaturated area of the marsh. Temporary increases in creek turbidity are likely unavoidable during certain construction operations such as installation of a temporary bridge to remove the road fill and activation of the pilot channels, but water pollution control measures will limit the magnitude and duration of these increases.

Adaptive Management and Monitoring

Monitoring will be conducted to establish baseline conditions, protect water quality and other resources during construction, assess annual performance of the measures, guide implementation of measures in subsequent years, and document achievement of project objectives and compliance with permit conditions. Monitoring data will include surveys, photo points, flow measurements, turbidity measurements, and vegetation establishment monitoring.

An annual report will be prepared that summarizes AMP measures implemented in the past year; describes flow conditions and water surface elevations including flow outside the channel in the

easement area; topographic changes; turbidity data and evaluation of whether any remedial measures are needed to reduce turbidity; vegetation monitoring results; and plans for the coming year of implementation. The Annual Report will be submitted to the permitting agencies and the Conservancy in July of each year. Permitting for the project will cover the entire AMP implementation period and no action is required on an annual basis by the agencies. However, the annual report provides an opportunity to review and comment on AMP progress if the agencies feel it is appropriate.

In addition to the annual reports, a Final Report will be prepared that includes an assessment of the project with respect to stated goals and success criteria, an assessment of the trajectory of ongoing channel processes; comparison of baseline to final conditions, and recommendations, if any, for future monitoring.

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1.0 Background and Purpose

The South Tahoe Public Utility District (District) owns and operates sewer facilities along the northern margin of the Upper Truckee Marsh in South Lake Tahoe. The facilities include Bellevue Pump Station, an 8-inch diameter gravity main, and a 10-inch diameter force main. The pipelines are located in a 12-foot wide easement between Oakland Avenue and Bellevue Avenue along the northeastern boundary of property owned by the California Tahoe Conservancy (Conservancy). The force main is generally about four feet below the ground surface, and the gravity main lies below the force main and has numerous laterals which enter from the private properties along the north side of the meadow. Figure 1-1 shows the project area and Figure 1-2 shows the District's affected facilities in the vicinity of Bellevue Avenue. The Bellevue Pump Station and associated force main serves approximately 640 residential units and an estimated flow of about 223,000 gallons per day. The 8-inch gravity main serves approximately 150 units and has an estimated flow of approximately 47,000 gallons per day.

During the record snowmelt year of 2011, the Trout Creek channel near the Bellevue Pump Station completely filled with the sand and gravel in transport, causing flows to go over the right bank (looking downstream)and inundate the District's easement. Following this event the channel has remained completely plugged and the process is continuing upstream such that overflow pathways are developing over an approximately 300 foot long reach. During 2013, even low flows in summer and fall were diverted out of the main channel onto the meadow surface, and more defined flow paths developed over and adjacent to the District's easement.

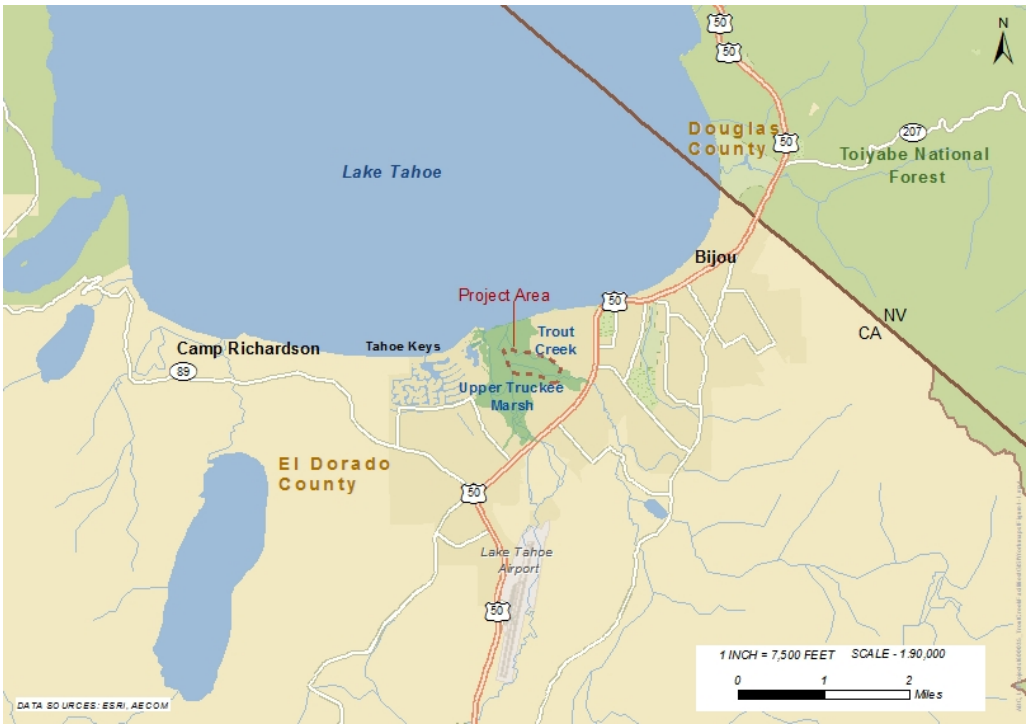

Figure 1-1. Project Location

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Legend

- Sanitary Sewer Manholes
- Bellevue Pump Station
- STPUD 12' Easment
- 10" Force Main
- 8" GravitySewer

SCALE - 1:600

0 25 50 75 Feet

N

DATA SOURCES:
Google Earth,
CaliforniaTahoe Conservancy

Job: 600035

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FIGURE 1-2

Upper Truckee Marsh
Sewer Facilities

Figure 1-3 shows a photograph of the easement looking west toward the Bellevue Pump Station in July 2013. Under current conditions the District no longer has access to the easement, including manholes on the gravity sewer. Surface inundation of the easement persisted through the summer and fall months of 2013, preventing access for routine maintenance. This condition poses a risk to the facilities and to water quality because: 1) manholes are subject to constant inundation, increasing potential infiltration and inflow to the pump station and the risk of overloading the station; 2) manholes are subject to increased potential for damage due to debris impacts during flood events; 3) access for routine maintenance is restricted, increasing the probability of a plug; and 4) access for emergency operations is restricted, increasing the probability of overflow in case of a plug or other problem.

Figure 1-3. Looking west toward Bellevue Pump Station, July 2013.

In the future, if the channel filling and overflow process is not arrested, flows are expected to incise a new channel in the easement, which will threaten exposure of the District’s sewer lines. The proximity of a new channel to the Bellevue Pump station also presents a direct threat to the operation of the pump station due to potential erosion damage to the intake structure in the meadow and subsequent flooding and catastrophic failure of the pump station. Exposure of the sewer lines and local flooding could result in a break in either the gravity or force main and could also disrupt pumping operations. Any of these conditions could result in discharge of raw sewage into Trout Creek, the Upper Truckee Marsh, and Lake Tahoe.

The District developed several preliminary alternatives for protection of the facilities and reviewed them with the landowner (Conservancy). The alternatives considered included relocation of the lines, excavation to replace or relocate the channel, and filling the easement area. All of these options have significant cost or environmental disadvantages. The facilities have been operated by the District since 1960, and until 2011 were subject to only periodic shallow inundation during high flows. Access to the easement has occurred during dry periods to protect sensitive Stream Environment Zone (SEZ) resources while performing required inspection and maintenance. The District has successfully operated the facilities within an SEZ for over 50 years, and return to pre-2011 conditions, although not ideal, would be an acceptable condition for operation of the facilities.

Because a new channel has not yet formed, the District has an opportunity to develop less intensive measures that encourage initial channel formation away from the easement. Similar measures could be implemented over a longer period to reduce the risk of future channel encroachment on the easement. The District therefore proposes to implement an Adaptive Management Plan (AMP) to protect its existing force and gravity sewer mains along with its Bellevue Pump Station facility. The goal of the project is to protect the sewer infrastructure from flooding and reduce the risk of sewage discharges. The AMP is a set of measures designed to be implemented and monitored over time that will encourage channel formation in a more favorable location, raise the easement area slightly and increase its hydraulic roughness to make it more resistant to any future channel avulsions, and potentially improve flood conveyance and sediment transport. The AMP approach is designed to use natural processes to the extent practical to accomplish the project objectives over time and to implement measures incrementally so that the impact at any point in time is held to a minimum. Each phase will consist of measures that minimize excavation and fill, and that can be implemented largely by hand crews. The stabilization measures anticipated primarily involve minor earthwork and vegetation. No structural stabilization (e.g., riprap, rock refusals, etc.) measures are proposed.

The AMP approach has the support of the Conservancy and provides an opportunity to work with adjacent landowners to protect the sewer facilities that serve their residences while preserving the environmental values of the Upper Truckee Marsh.

Implementation of the AMP is expected to occur over a 3 to 5 year time frame, depending on success in meeting project objectives. By nature, the AMP includes a monitoring component to define existing conditions, protect resources during implementation, and assess success in meeting objectives. Monitoring is expected to continue for two years after the final implementation phase.

The purposes of this AMP are to:

- Define desired outcomes and performance metrics;
- Describe management measures to be implemented, recognizing that flexibility and adjustment are required under the adaptive management approach;
- Describe the overall adaptive management strategy for phased implementation, decision making, and reporting;

- Identify potential temporary impacts and protective measures associated with AMP implementation; and
- Provide a detailed design for the initial actions to be taken in 2014 (Year 1 Plan).

This document will serve as the technical basis for environmental compliance and permitting for the AMP. A separate document has been prepared to comply with the California Environmental Quality Act (CEQA) and Tahoe Regional Planning Agency (TRPA) environmental review requirements (STPUD, 2014). Monitoring associated with permit requirements has been incorporated directly into the AMP and is described in this document. A description of the monitoring program is provided in Section 7, and protocols are included in Appendix E.

2.0 Project Setting

This section describes key land use, hydrologic, geomorphic, vegetation, and wildlife and fisheries characteristics of the project area. The sewer facilities are located in the area known as the Upper Truckee Marsh, a broad meadow/marsh complex formed at the shore of Lake Tahoe by the confluence of the Upper Truckee River and Trout Creek. The marsh provides regionally important ecological, water quality, aesthetic, and recreational values. Human activities have adversely affected these important resources and the Conservancy is implementing a major restoration project in the Upper Truckee Marsh (Conservancy, et al. 2013). While most of the restoration in the Conservancy's project involves riverine and marsh areas more directly related to the Upper Truckee River, the environmental analysis for the project provides useful background and baseline information for the District's AMP.

2.1 Land Use and Topography

The marsh is classified under the TRPA Land Capability Classification system as Land Capability District 1b, Stream Environment Zone (SEZ). Figure 2-1 shows the project area and the SEZ boundaries. For the purpose of defining areas in which management measures might be adaptively implemented under the AMP, a relatively large project area is delineated in Figure 2-1, although the majority of the management measures would likely be implemented in the vicinity of the Bellevue Pump Station. Figure 2-1 includes the location of user-created trails that are mapped as "soft" coverage within the SEZ. Land use in the easement area and adjacent meadow to the south is primarily recreational, and the Conservancy manages this use to protect marsh resources.

To the north of the sewer easement, the adjacent residential area is mostly located in Land Capability Districts 6 and 7. The dominant land use is single family residential. The back yards of residences along the easement are at or near the meadow elevation and some are subject to inundation during high flows or, under current conditions (post-2011 avulsion), during the entire year. Elevations increase rapidly to the north of the easement and elevations along El Dorado Avenue are 15 to 20 feet above the elevations in the easement. Figure 2-2 shows topography in the project area generated from a TRPA Light Detection and Ranging (LiDAR) dataset (TRPA, 2010), and illustrates the low relief in the SEZ and rapidly rising ground to the north. The figure represents 2010 conditions, and does not include recent changes in the vicinity of Bellevue Pump Station due to the Trout Creek channel avulsion. A distinctive linear feature in the Figure 2-2 topography is an abandoned road fill that shows as a northwest-southeast trending alignment crossing the meadow surface west and downstream of Bellevue Pump Station. Figure 2-3 shows topography in the vicinity of Bellevue Pump Station based on field survey in August 2013.

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: 600035

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Figure 2-1

Project Area and SEZ Boundaries

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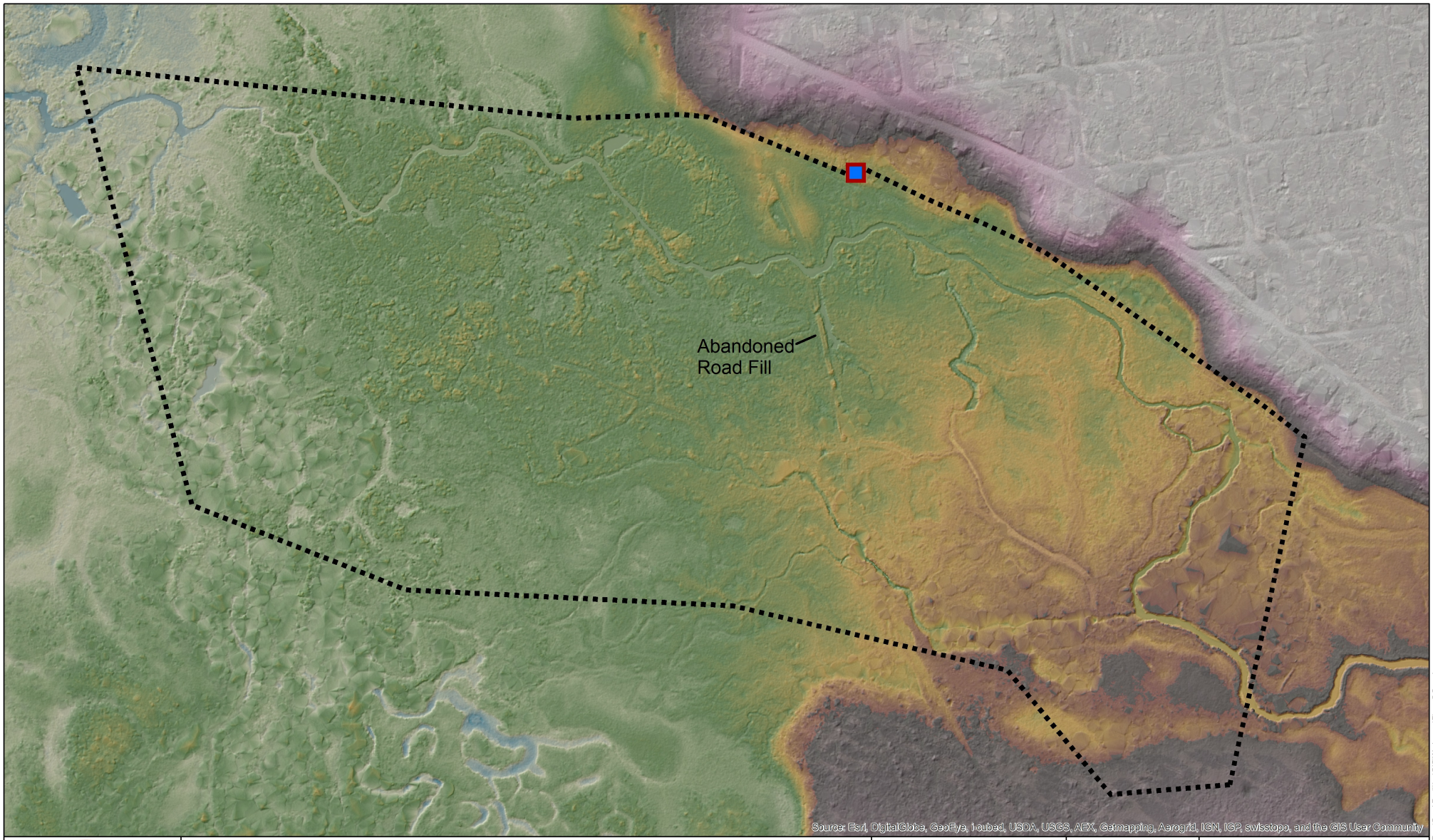

nhc
northwest hydraulic consultants

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: 600035

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FIGURE 2-2

20120 LiDAR Topography

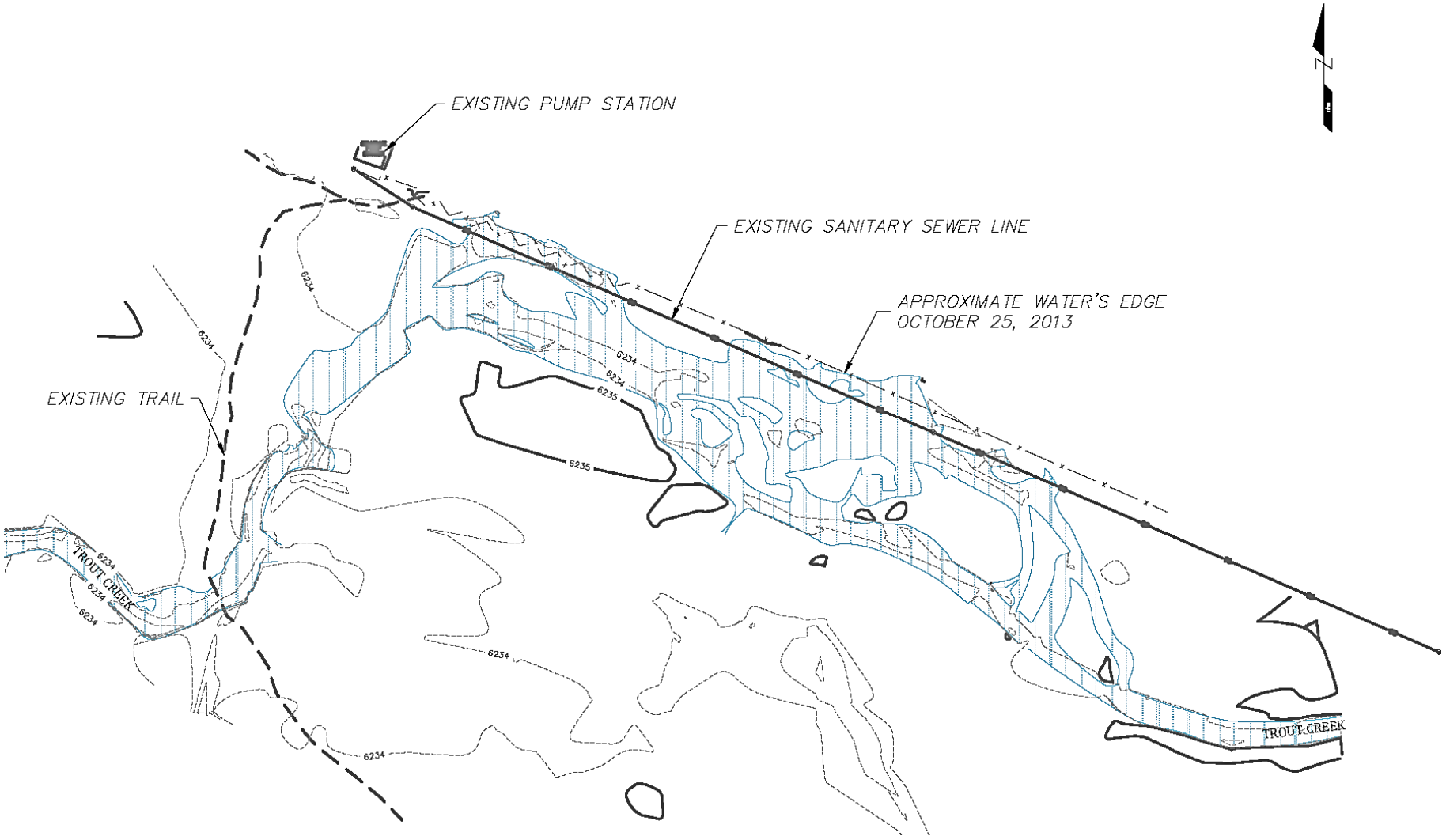


Figure 2-3. Topographic mapping in vicinity of Bellevue Pump Station.

Source: Tri-State Surveying, Ltd. 2013

2.2 Hydrology

Streamflow data has historically been collected at four gages on Trout Creek. The US Geological Survey gage at Tahoe Valley (USGS 10336780) has the longest period of record and is the closest to the project site of the three gages that remain in operation. NHC conducted flow frequency and flow duration analyses using flow data from this gage for the 1961 to 2012 water years. The flow frequency analysis was conducted using the procedures recommended in "Guidelines for Determining Flood Flow Frequency, Bulletin 17B" (Interagency Advisory Committee on Water Data, 1982). Figures 2-4 shows the annual flood peaks for the Tahoe Valley gage and Figures 2-5 through 2-7 summarize the flow frequency and flow duration results. A description of the analysis is provided in Appendix B. The tributary area at the gage is 36.7 square miles and the tributary area at the site is approximately 41 square miles. Because annual peak flows are typically generated by snowmelt from the upper watershed, the flood frequency relationship for the gage is considered generally applicable to the project site. The flow duration analysis for the gage may slightly underestimate lower flows due to urban contributions, but is also considered reasonably representative for application to project planning. Monitoring will be conducted as part of the AMP to verify or refine these assumptions.

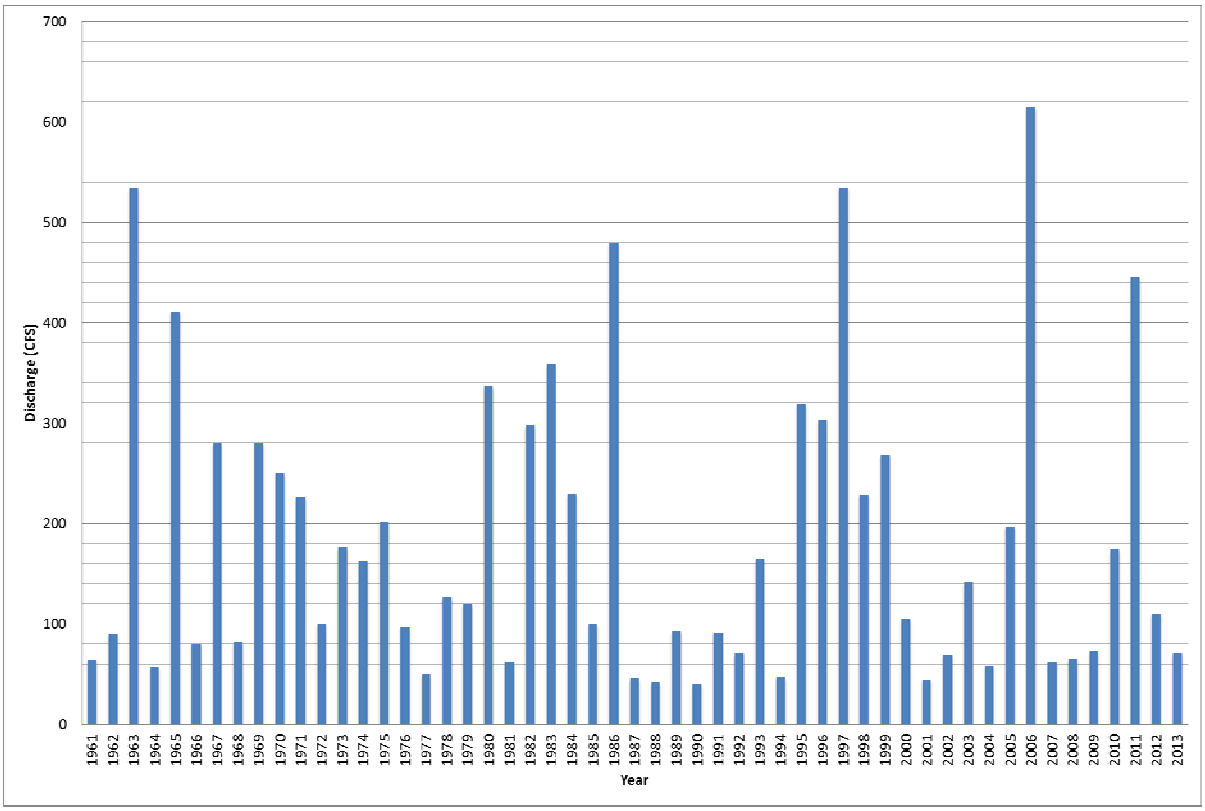


Figure 2-4. Annual peaks at USGS 10336780, Trout Creek at Tahoe Valley.

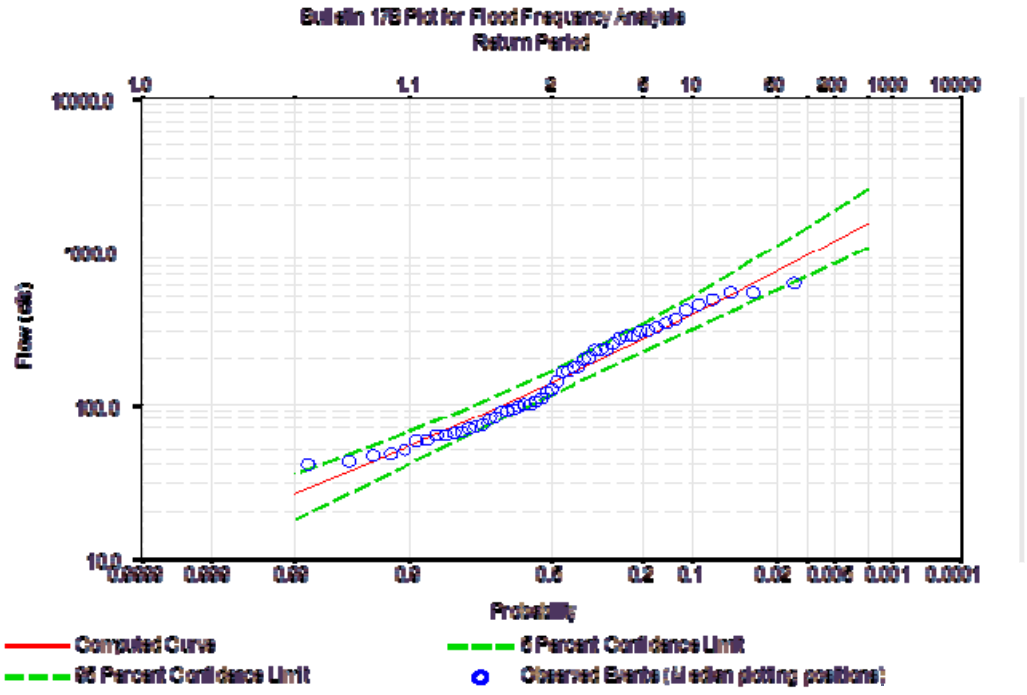


Figure 2-5. Flood frequency analysis results using Bulletin 17B procedures with computed station skew.

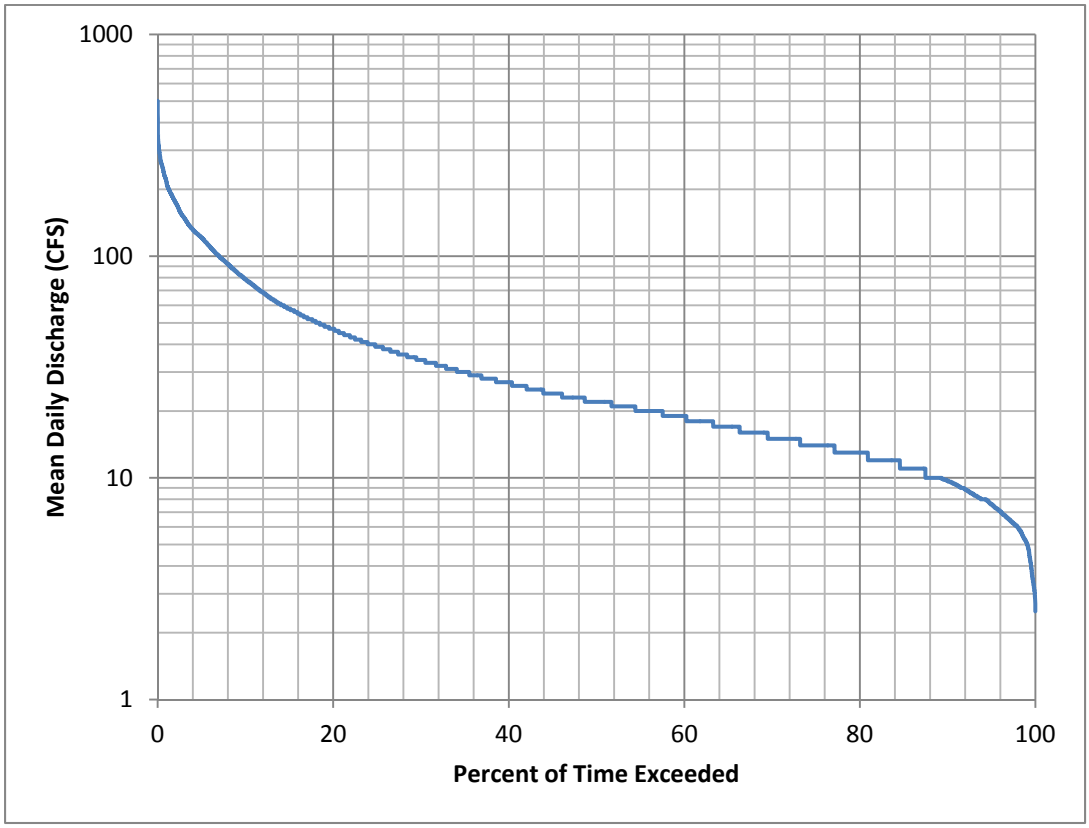


Figure 2-6. Flow duration for mean daily flows at USGS 10336780, Trout Creek at Tahoe Valley.

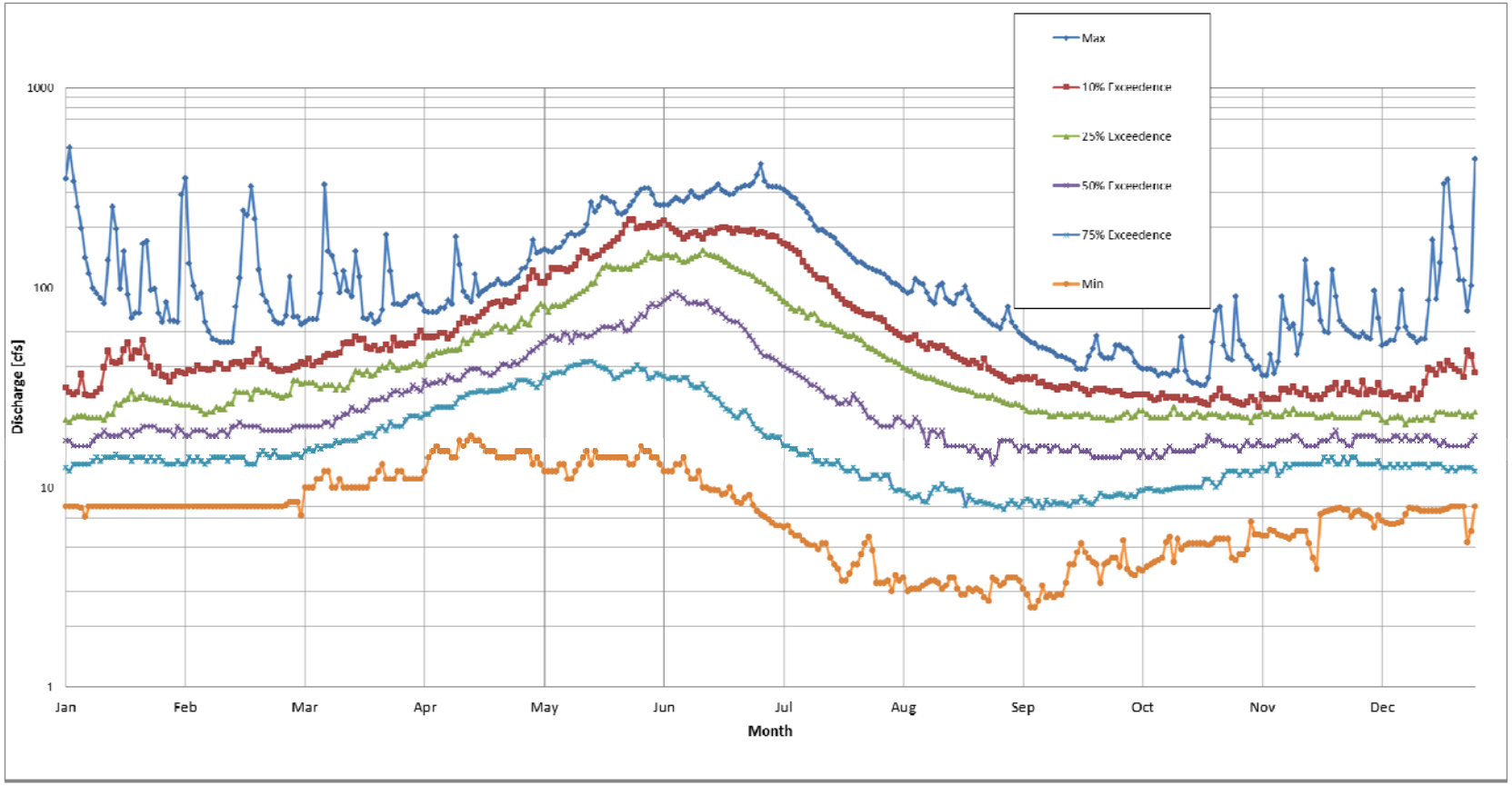


Figure 2-7. Summary hydrographs for Trout Creek.

The flood frequency analysis provides results that are consistent with the previous analyses for the Upper Truckee Marsh Restoration Project. Table 2-1 lists estimates of peak flows for recurrence intervals between 1.5 and 100 years. These values are within 5% of those reported in the Upper Truckee Marsh Restoration Project Draft EIR/EIS (Conservancy, et al, 2013).

Table 2-1. Flood Frequencies for Trout Creek.,

Recurrence Interval, years	Peak Discharge, cfs
1.5	100
2	138
5	270
10	385
100	940

A striking feature from the flow duration analysis is that flows remain at or above 10 cubic feet per second (cfs) about 90 percent of the time, consistent with previous evaluations noting that Trout Creek has a strong base flow component. The 10 percent exceedence value is approximately 80 cfs, which is similar to channel capacity estimates (see Hydraulics below).

2.3 Geomorphology

The geomorphic characteristics of Trout Creek below Highway 50 are described in *Upper Truckee River and Wetland Restoration Project Processes and Functions of the Upper Truckee Marsh* (Conservancy and DGS, 2003). The evaluation defined three reaches of Trout Creek. In the project area (Reach 2), Trout Creek was characterized as a split channel with the main channel along the north side of meadow and a secondary channel in the center of the meadow. The upstream reach (Reach 1) extends about 3000 feet downstream of Highway 50 to a sharp bend to the right where the secondary channel splits off (about 1800 feet upstream of Bellevue Pump Station), and was characterized as a single thread channel . Reach 3 was defined as beginning about 2000 feet downstream of Bellevue Pump Station and continuing to Lake Tahoe, and was characterized as a main channel and distributary channels in the lagoon area. Figure 2-8 shows the location of the Trout Creek reaches.

The Reach 2 channel was estimated to have a slope of approximately 0.001 and a sinuosity of approximately 1.48. Channel dimensions at the upstream and downstream ends of the STPUD October 2013 survey area indicate flow areas of approximately 25 and 35 square feet at the top of bank, respectively. Mean depths and width to depth ratios vary considerably, and may be affected by channel filling at the upstream sections. At the deeper cross sections both upstream and downstream of the avulsion, mean depths are 2 to 3 feet and top width to mean depth ratios are 6 to 8. In the project area the main channel has a characteristic top width of 15 to 20 feet. These values are generally consistent with those reported in 2003.

The Reach 1 channel is somewhat larger in size, with a top width of 25 to 30 feet and a flow area of 50 to 100 square feet according to the 2003 evaluation. The Reach 3 channel is distributary, and thus channel geometry is not directly comparable to the upstream reaches.

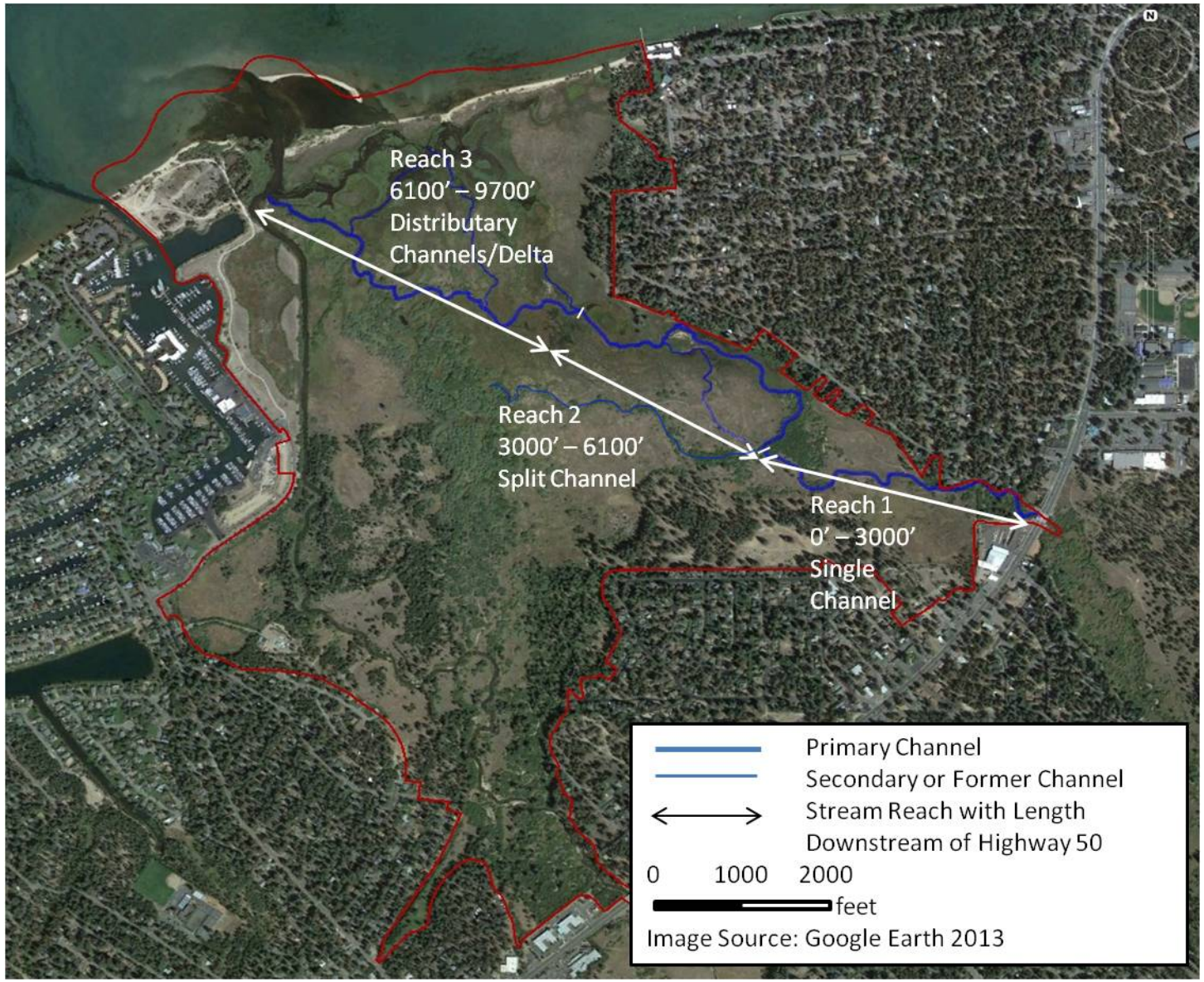


Figure 2-8. Trout Creek reaches (after CTC and DGS, 2003).

The Trout Creek channel has varied substantially in location over time, as summarized in Figure 2-9. Appendix C provides a summary of channel observations based on historical aerial photographs. Changes in channel location appear to be due to a combination of human influences and natural processes, including channel avulsions that occurred prior to the 2011 event. A key influence on historical channel morphology appears to be the road across the meadow that is evident in the earliest aerial photos. The channel pattern upstream of the road is distinctly more sinuous than other areas in these photos, indicating that the road may have created a constriction in the main channel and/or floodplain capacity. This would have contributed to overbank sediment deposition as well as increased channel sinuosity, increasing elevations in the center of the meadow and lowering channel slope. In these early photos, the main channel of Trout Creek is nearer the center of the meadow than its present location. A major avulsion occurred in the 1960s upstream of the now abandoned road fill.

A distinctive feature of the current channel pattern is the sharp bend to the right near the upstream end of the project area and about 3000 feet downstream of Highway 50 (Reach 1/Reach 2 break in 2003 *Processes and Functions* evaluation). The section of channel downstream of the bend runs from the center of the meadow to near the northern edge of the meadow and the District's easement. This channel section is approximately transverse to the general valley slope and developed after the 1960s era channel avulsion. Unlike most of the channel downstream, this section of channel is heavily vegetated with willows.

The bend at the head of the secondary channel is reinforced by debris and non-native materials (timber, logs). The secondary channel is presently seasonally dry but typically occupied by high flows in the snowmelt season (S. Carroll, pers. comm.). However, the *Processes and Functions* evaluation notes that it was occupied by low flows as recently as 2002. The upstream portion (50 to 100 feet) of this channel near the bend on the main channel is shallower than the downstream portion, potentially indicating that the channel was filled and the bend revetted to discourage this flow path.

Bed material in the project reach is primarily coarse sand with some small gravel, and bank material is primarily sandy silt and clay with a highly organic surface layer. Banks are reinforced by meadow sod (sedges, rushes, wetland grasses). With the exception of the transverse section of channel noted above, woody bank vegetation is generally limited, but a relatively dense stand of young willow is present on recent sand deposits in the area of the 2011 avulsion. The current channel has an approximately 400 foot long section that is revetted with rock, with its downstream end located approximately 600 feet upstream of Bellevue Pump Station.

The abandoned road fill is located downstream of Bellevue Pump Station and may restrict flood flows on both meadow overbanks. On the left overbank, this is a relatively narrow (20 to 25 feet) prism of fill that is now vegetated with meadow sod. On the right bank, a broader area of slightly higher ground exists (see Figure 2-2), a portion of which is vegetated with pines.

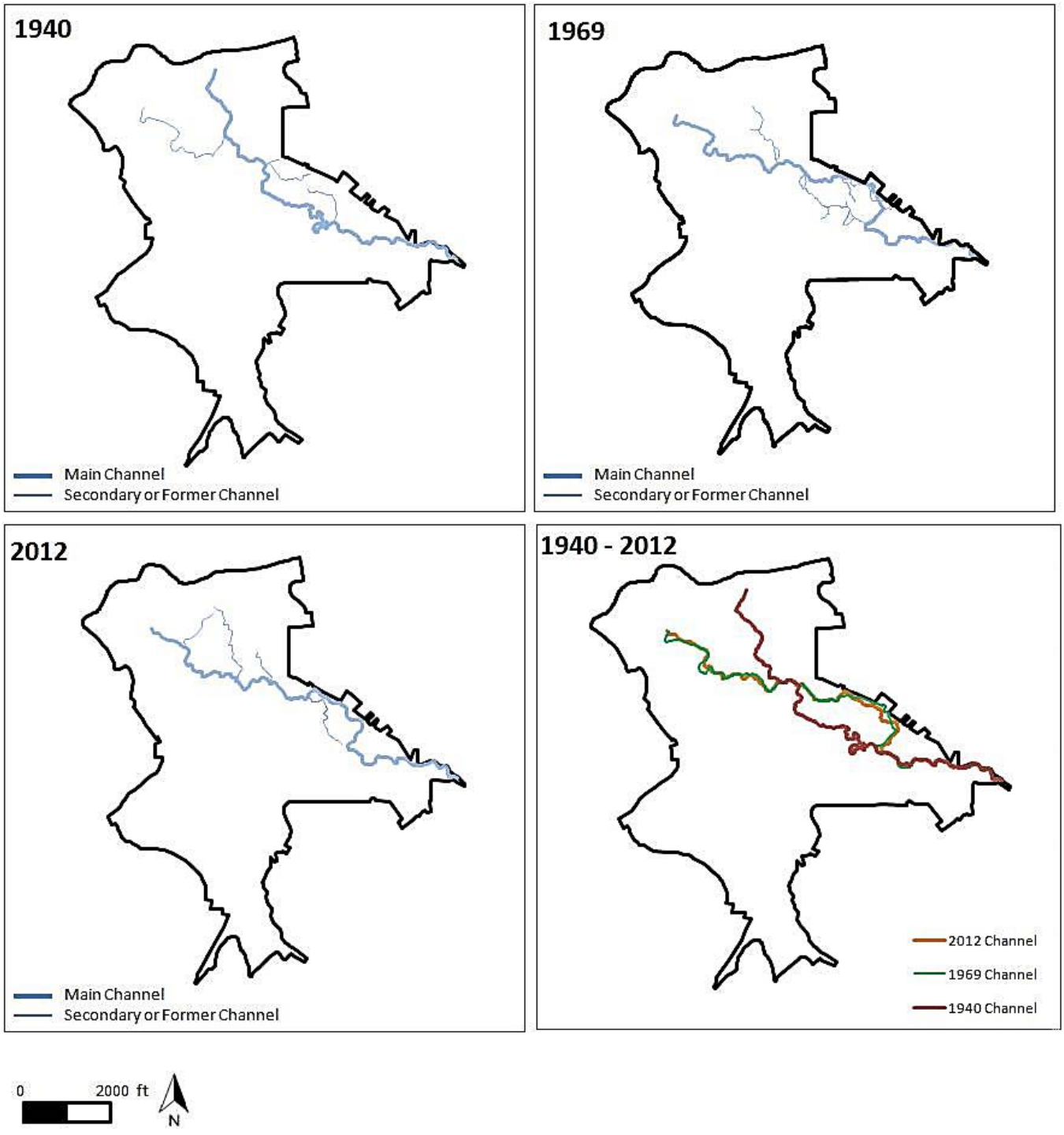


Figure 2-9. Historical channel locations.

The channel downstream of the Bellevue Pump Station is similar to the upstream channel, but in site visits in summer 2013 the overbanks were observed to become progressively more saturated and composed of organic material downstream of the road fill. This may in part be due to more distributary channel patterns in the lower marsh, but also may be influenced by beaver activity observed near the downstream end of the project area. The water surface elevation was observed to increase approximately 1 foot with respect to the top of bank elevation in about 800 feet downstream of the road fill.

Elevations at the project site are generally in the range of 6234 feet to 6236 feet (NAVD 88), and the channel bed elevation is approximately Elevation 6231 to 6233. Bellevue Pump Station is approximately 3,800 feet upstream of Lake Tahoe, which has a maximum legal elevation of 6232.1 NAVD88 (6229.1 USBR). Thus maximum lake elevations are likely to induce backwater effects in the vicinity of Bellevue Pump Station, and a surcharge of about 2 feet above the legal limit would inundate ground elevations near the station. Lake levels increased approximately 4 feet between January 2011 and August 2011, reaching a maximum of 6231.4 feet NAVD88 (6228.4 feet USBR) in late July and early August. Streamflow in 2011 peaked near the end of June at over 400 cfs (with the lake at Elev. 6230.5) and receded through July and August. At the end of July, streamflow was about 100 cfs with the lake at its maximum. The relatively high lake levels in this unusually high runoff volume year may have been a contributing factor in the channel avulsion. High lake levels can be expected to influence channel behavior and sediment transport at the project site in the future.

2.4 Hydraulics

A detailed hydraulic evaluation has not been performed for the project site, and previous modeling for the Upper Truckee Marsh Restoration project focused on the Upper Truckee River. The Conservancy plans to prepare a hydraulic model for the Trout Creek channel as part of that project (S. Carroll, pers. comm.). Review of FEMA mapping provided in the Draft EIR/EIS indicates that the stream channel alignment used in the mapping is not the current alignment and that the floodway is designated near the center of the marsh rather than along the current channel location in the vicinity of Bellevue Pump Station.

Based on the October 2013 survey data, hydraulic calculations were performed to estimate the channel capacity upstream and downstream of the avulsion area. These calculations indicate a channel capacity of approximately 50 cfs at the upstream cross sections (which may be affected by channel filling upstream of the avulsion section) and 75 cfs at the downstream sections. Channel capacity for Reach 2 was not estimated in the 2003 evaluation, but capacity in Reach 1 was estimated at 150 to 200 cfs.

Under present conditions, the previous channel near Bellevue Pump Station is completely filled and all flows are carried on the overbanks beginning about 200 feet upstream of Bellevue Pump Station. Sediment transport in the system is largely interrupted, although site observations indicate that some sand is moving in the shallow overbank flows. Because transport is interrupted, channel filling is in progress upstream of the avulsion area.

For flows greater than about 80 cfs, the abandoned road fill downstream of Bellevue Pump Station affects conveyance on the floodplain. Preliminary hydraulic calculations indicate that reduced velocities may occur in the area near Bellevue Pump Station for moderate flood flows (100 to 500 cfs) compared to upstream and downstream reaches, potentially affecting sediment transport and increasing risk of channel avulsion.

2.5 Vegetation

Vegetation types in the study area have been previously described and mapped in technical reports prepared for the Upper Truckee River and Marsh Restoration Project DEIR/DEIS/DEIS (AECOM and Cardno ENTRIX, 2013). The project area is comprised of montane meadow and willow scrub-wet meadow plant communities. Vegetation in the marsh and project vicinity is dominated by wetland graminoids, in particular the genera *Carex* (sedges) and *Juncus* (rushes). Dominant species include the wide spread *Carex nebrascensis* (Nebraska sedge) and *Juncus balticus* (Baltic rush). Species are largely sorted by elevation and hydrology, with *Carex utriculata* (beaked sedge), *Juncus nevadensis* (Nevada rush) and *Juncus ensifloius* (Iris-leaved rush) occurring in the most saturated soils, while Nebraska sedge and Baltic rush generally occur on drier sites. Grasses are also present but do not comprise a dominant component in the project area because conditions are too wet. The willow scrub–wet meadow community occurs primarily in association with the stream channel and as scattered patches within the floodplain. Willows, primarily *Salix lemmonii* (Lemmons' willow), are mostly restricted to depositional areas because they typically establish on disturbed surfaces and do not readily encroach on dense stands of rhizomatous graminoids.

Rorripa subumbellata (Tahoe yellow cress), is legally protected in California (Endangered) and Nevada (Fully Protected) and is a federally listed candidate species (United States Fish and Wildlife Service). Tahoe yellow cress occurs along Cove East and Barton beaches on the shores of Lake Tahoe to the north of the project area. It does not occur within the project area and there is no suitable habitat. Proposed actions in this AMP will have no impacts on the existing Tahoe yellow cress populations. During AECOM's special-status plant survey of the study area conducted in 2007 (Appendix G of the UTR and Marsh Restoration Project DEIR/DEIS/DEIS), American mannagrass was found in one location growing on a low mud bench within one of the active channels of Trout Creek just above the water surface. American mannagrass is on California Native Plant Society (CNPS) List 2 (plants that are rare, threatened, or endangered in California but more common elsewhere) (CNPS 2010). This population is northwest of the project area and would not be impacted by project activities.

AECOM conducted field surveys in 2013 and prepared a habitat map as part of a delineation of Waters of the United States (also see Appendix A). The habitat map is shown in Figure 2-10. Habitat types mapped in the project area include:

- Wet Montane Meadow - an herbaceous plant-dominated community of sedges, rushes and grasses including several *Juncus* and *Carex* species;
- Willow Scrub-Wet Meadow – a woody riparian community including Lemmon's willow, Geyer's willow, and shining willow (dense to open canopy, with a montane meadow understory in the areas of relatively open canopy);

- Open Water – the areas occupied by the primary and secondary channels of Trout Creek; and
- Jeffrey Pine Forest – drier and relatively well drained areas dominated by Jeffrey pine with an understory of shrubs and herbaceous species.

Measures for protection of vegetation, including special status species, are described in Section 5.

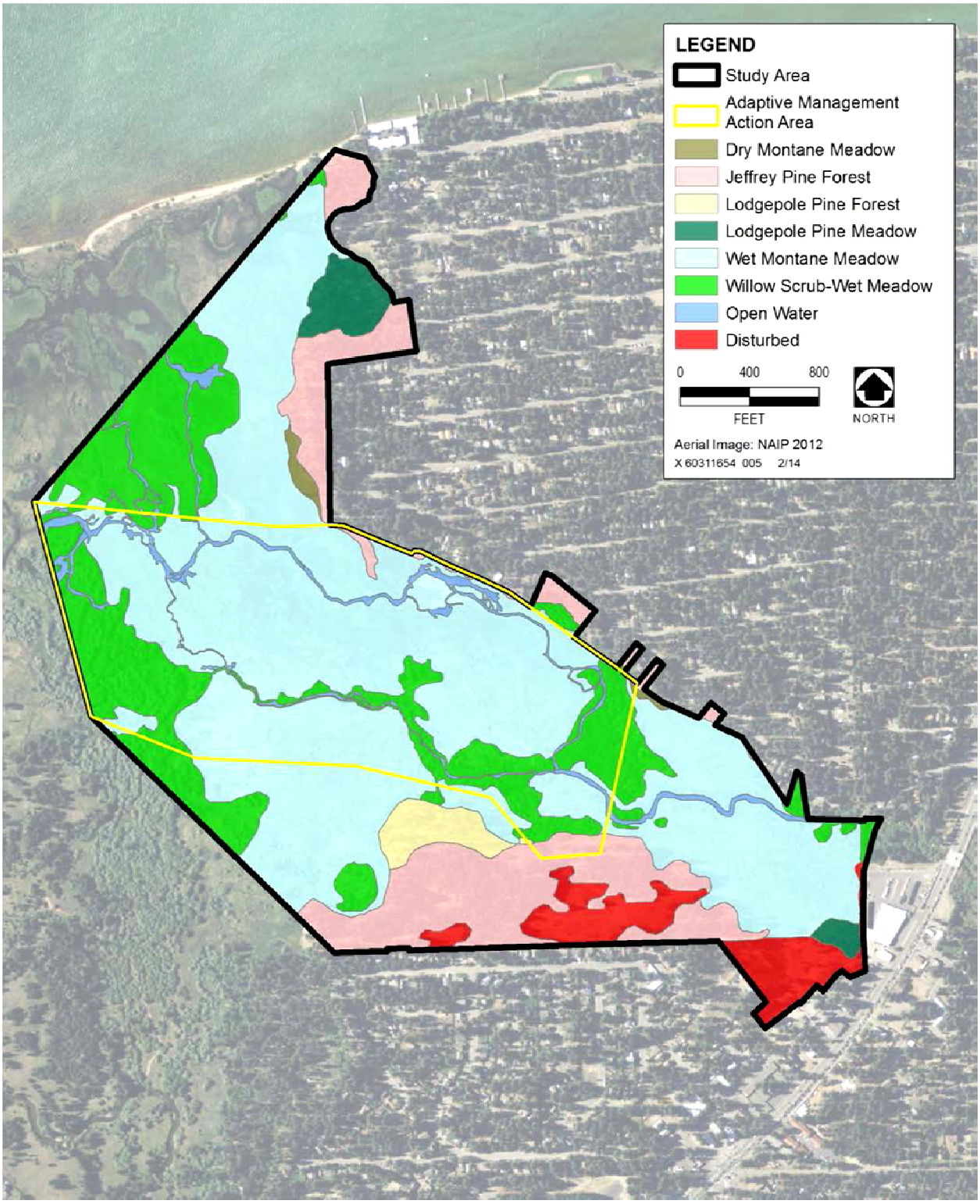


Figure 2-10. Habitat Map (Source: AECOM Draft Wetland Delineation, 2013)

2.6 Wildlife and Fisheries

The project area is primarily composed of montane meadow, with a small component of willow scrub-wet meadow. Information on wildlife and fish was obtained primarily from the "Upper Truckee River and Marsh Restoration Project" EIS/EIS/EIR (California Department of General Services and California Tahoe Conservancy 2013). Although this document is primarily focused on the Upper Truckee River, the area studied includes Trout Creek and the entire area of this project. The EIS/EIR is developed from a compilation of other sources and surveys. The Upper Truckee River marsh provides habitat for approximately 200 amphibian, reptile, bird, and mammal species.

The montane meadow habitat provides resident habitat for small mammals, such as voles, shrews, and mice, with voles being the most abundant, depending on the height of the water table because a near surface water table restricts the establishment of burrows. The habitat serves as foraging and refuge habitat for larger mammals such as coyotes and bears. Beavers and muskrats use the stream/meadow interface. It can provide nesting habitat for ground nesting birds. Waterfowl and shore birds may use the stream interface, while raptors and bats use the meadow primarily for foraging.

The willow scrub-wet meadow provides cover and foraging habitat for songbirds, including flycatchers, warblers and sparrows. In wetter areas, it may serve as habitat for the Pacific Tree frog, and within fish-free ponds as habitat for the long-toed salamander.

Within the entire marsh, 12 special status species have a high to moderate likelihood of occurrence. Of these, eight have been observed within the marsh. However, with the exception of the Yellow Warbler, they are all raptors and bats, which forage over wide areas.

Trout Creek, because of its lack of riffles and predominance of a uniform coarse sand bed, does not generally provide resident habitat for salmonids or most other species of fish. However, Trout Creek within the project area provides migratory habitat for rainbow and brown trout, and may also provide temporary migratory habitat for Paiute Sculpin, Tahoe sucker, mountain sucker, Lahontan redside, Lahontan tui chub, and mountain whitefish. California Department of Fish and Wildlife (CDFW) species of special concern include the Tahoe sucker, Lahontan Lake tui chub, and Lahontan redside, which have some potential for occurrence. Additionally, the Lahontan cutthroat trout is a federally listed threatened species which has the potential to use the project reach for migration. In 2011, two hatchery-raised Lahontan cutthroat were observed in the Upper Truckee River during a fisheries survey conducted by the U.S. Forest Service.

Measures for protection of fish and wildlife, including special status species, are described in Section 5.

2.7 Conditions Contributing to Risk

The current conditions that contribute to risk of damage to the sewer facilities include:

- Potential for channel formation in or adjacent to the easement (near term);

- Proximity of channel to the sewer easement and lack of woody vegetation or structure to prevent migration to the northern edge of the meadow;
- Topographic low over the sewer mains upstream of Bellevue Pump Station;
- Loss of capacity or active nature of historical flood paths in other parts of the meadow;
- Inundation downstream or possibly at the Pump Station during high lake stands;
- Floodplain constriction formed by the road fill; and
- Potential for beaver activity to reduce channel capacity downstream of the Pump Station.

In total, these factors pose both a significant near and long term risk to the sewer facilities.

3.0 Desired Outcomes

The primary goal of the AMP is to reduce risk to the sewer facilities while protecting resources in the Upper Truckee Marsh. To meet that goal, the AMP defines the following desired outcomes:

1. Inundation on the marsh surface in the vicinity of Bellevue Pump Station becomes similar in timing and duration to areas upstream and downstream where a defined channel currently exists;
2. Topography along the north edge of the marsh in the vicinity of the sewer line is more variable and the highest points are raised slightly compared to existing topography, discouraging future channel formation over the sewer lines;
3. Any new channel that forms in the vicinity of the District's facilities is no closer than the Trout Creek channel as it existed prior to 2011 (approximately 60 feet from easement);
4. Channel flow paths that encourage flows towards the center of the marsh become more active and those that encourage flow to the edge of the marsh and Bellevue Pump Station become less active such that more flooding during short recurrence interval events occurs in the center of the marsh ;
5. Vegetation, including some woody species, is increased in the vicinity of the sewer lines in a configuration that discourages future channel formation over or along the sewer lines ;
6. Herbaceous vegetation in areas affected by the project has similar species composition and vigor as the surrounding marsh.
7. Natural stream flow and sediment distribution across the marsh is improved through the selective removal of artificial impediments (abandoned road fill; relict excavations) presently crossing Trout Creek.

These outcomes will be achieved through implementation of the Management Measures described in Section 4.

4.0 Management Measures

This section describes the management measures that may be implemented over the term of the AMP and how they function to achieve the AMP objectives. Phasing and monitoring of the phased implementation are described in Section 6.The following measures may be implemented as part of the AMP.

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;
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;
12. Intermittent fill and revegetation of the erosional depression upstream of the abandoned road fill.

Each of these measures is described in additional detail below, and several are included in the Year 1 Plan that is presented in more detail in Section 7 and Appendix C.

Measures 1 through 5 focus on channel formation and maintenance of channels in favorable locations:

1. **Construction of pilot channels off the left bank.** This measure establishes low flow paths from the filled channel to the channel downstream of the avulsion. Depending on location, pilot channels may either connect to the main channel or to a remnant channel that connects to the main channel. One or more of the pilot channels is expected to expand over time to become the main flow path. Pilot channel geometry will necessarily vary with topography to maintain a gravity flow path, but excavation is expected to be no more than 4 feet wide and 1.5 foot deep below the existing ground. At intervals of approximately 40 feet, a salvaged sod lining will be

installed as a sill in the typical section (flush with excavated surface) to resist expansion of the channel under low flows. These sills are expected to erode under higher flows. This measure is needed in Year 1 to dewater the right overbank under low flows. This measure is an initial step to enhance stream function because it will encourage a continuous main channel, providing aquatic habitat and aquatic organism passage. Typical sections for pilot channels are shown in Figure 4-1. The junction of the pilot channel with the existing channel will be slightly larger, as given in Measure 2.

2. **Opening of left bank overflow paths.** This measure is similar to Measure 1 but excavation would be limited to the immediate area of left bank of the channel. The locations of left bank overflow paths would be selected based on existing low points or proximity to remnant channels in the left overbank. Openings are expected to have a top width of no more than 9 feet, a depth of approximately 1 foot below the existing ground and be no more than 20 feet long. Typical details for the left bank overflow paths are shown in Figure 4-2.

3. **Planting on favorable flow paths, including willow fences and staking.** Willow fences are intended to reinforce channel banks and encourage favorable channel morphology for sediment transport and habitat on preferred channel alignments. Willow fences in the vicinity of Bellevue Pump Station will be used only in the left overbank of the channel (more than 100 feet from the north property line) and will be focused at the left bank openings to reinforce the desired flow paths. In other locations in the project area, willow fences may be used along the channel banks and at bends or splits in the main or secondary channels. Typical details for willow fences are shown in Figure 4-3. Other types of willow planting may be performed, including willow staking of coir logs and live staking in areas where the density provided by a willow fence is not needed.

4. **Removal of debris and fill at the entrance to the pre-1968 channel alignment.** This measure is intended to ensure that the split se**c**ondary channel **i**n the project reach remains active and is a potential alignment for the main channel as it changes course in the future. The measure will remove artificial debris and fill at the head of the channel above the summer water surface elevation. Typical details for debris and fill removal are shown in Figure 4-4. This work will occur after evaluation of flow patterns and topography at the head of the channel in spring and summer of 2014. In Year 1 (late summer and fall 2014) construction, Measures 3, 5, and 10 will be used to enhance the alternative flow paths in the center of the meadow prior to removal of fill and debris at the head of the channel. Additional survey information will be collected to determine the limits of fill removal, and an access plan will be developed based on the level of fill removal required. Measures for removal of fill are presently anticipated to be similar to Measures 1 and 2, as shown in Figures 4-1 and 4-2. Fill disposal would be in accordance with Measures 7 or 8.

5. **Local widening or deepening of desirable alternative flow paths.** This measure is intended to remove constrictions, natural or artificial, that might restrict flows along favorable alternative flow paths and thereby limit the chance that the creek will re-occupy flow paths which put sewer facilities at risk. This measure might also be applied to previously constructed pilot

channels or left bank openings. Excavation is expected to be at a scale that can be accomplished by hand crews, and would be revegetated with native graminoid and/or woody riparian species consistent with the setting. This measure is illustrated schematically in Figure 4-5, but would be adjusted to fit local conditions. Disposal of excavated material would be in accordance with Measures 7 or 8.

Measures 6 through 10 focus on roughening and filling/accreting the floodplain. These measures would primarily be applied in the right overbank/floodplain in the area of the avulsion to reduce low flow inundation, encourage main channel formation away from the sewer and make the sewer easement area less susceptible to inundation or erosion in future channel avulsions. However, Measures 8 and 10 may be applied in other areas of the marsh in to discourage unfavorable flow paths.

6. **Installation of hummocks and hydraulic roughness elements**. This measure is intended initially to roughen and slightly raise the right bank floodplain to encourage the channel to re-form away from the sewer facilities. Over the course of the AMP implementation, this measure would promote sediment accretion along the northeast margin of the meadow to make it less subject to inundation during low to moderate flows, and to make it more robust in resisting inundation and channel erosion in the future, including any future channel avulsion events. The measure will result in hummocks, less than one foot above the existing surface, and increased hydraulic roughness due to herbaceous and woody vegetation. A variety of construction techniques may be used**,** including:

    a. pre-grown marsh mats;
    b. planted and unplanted coir logs;
    c. sedge and rush plug planting;
    d. sod salvage and placement;
    e. woody riparian container plantings (e.g., Woods' rose)
    f. willow staking in various configurations, including fences and sausals (groves).

    Initially, the most frequently used method to create a hummock will be through the use of pre-grown marsh mats with half-buried coir logs forming the perimeter (Figure 4-6). These hummocks are distinct from "fill hummocks," Measure 7, in that they are comprised solely of vegetation and biodegradable mats, logs, fabric or netting. Pre-grown marsh mats will use a biodegradable coir mat as the planting medium for sedge and rush species. Growing time requirements are about four months prior to installation. The marsh mats provide rooted vegetation in a sod-like mat that can be sized for handling by hand or low ground pressure (LGP) equipment. The mats can be installed on existing ground or on shallow fills. Coir log perimeters may be used where fill is placed to provide a resistant edge and containment for the fill materials.

    Planted and unplanted coir logs will be used to break up overbank flow paths, add hydraulic roughness, and promote sediment deposition. Coir logs may be planted with native graminoid

or woody species appropriate to the setting. Coir logs will typically be installed partially buried into existing ground and staked with wood stakes. Sedge and rush plug planting may be used in small areas where the marsh mats are not practical or where field adjustment is needed to revegetate edges or transitions in treatment measures. Plug planting areas exposed to high velocities will be protected with biodegradable erosion control fabric or netting. Container planting may be used in the perimeter coir logs or in the center of the hummocks to increase hydraulic resistance. To address adjacent property owner preferences, willows will not be used in the right overbank areas unless determined necessary as part of project monitoring. Sod salvage in the right overbank is less likely to be used than in other areas of the project because the existing meadow sod is deteriorating after a long duration of inundation, and because elevations in this area generally need to be raised. Placement of marsh mats is therefore anticipated to be the main planting method for sedges and rushes, but where healthy sod must be removed for some other purpose it will be salvaged where practical and re-used.

This measure is an enhancement in marsh/wetland and floodplain functional value because it adds habitat diversity with wetland hummocks and woody riparian vegetation. Typical drawings for this measure are shown in Figure 4-6.

7. **Placement of fill hummocks.** This measure is distinct from Measure 6 in that shallow fill is placed prior to the construction of the hummock. It involves placement of shallow fill areas in the right bank to raise elevations slightly, disrupt overbank flow paths that could lead to channel formation, and reduce inundation duration in the easement area. Fill will be placed to create irregular hummocks rather than as a continuous or uniform raised berm. These shallow fills will typically be overlaid with marsh mats and bounded by coir logs the same as described above in Measure 6, such that once constructed, they will be indistinguishable from marsh mat hummocks. Fill hummocks will increase diversity in the wetland and will be low enough to maintain the existing vegetation types. Fill material will be borrowed from onsite sources such as the abandoned road fill. Source materials will be examined in the field to determine that they are consistent with native soils in the area prior to placement. A maximum fill height in any implementation year of 0.5 feet is expected, and a maximum height over the full implementation period of 1.5 feet (may be placed in existing low areas; no more than 1.0 feet above prevailing marsh surface). This ensures that the constructed hummock fills will be consistent with natural variation in the marsh and will support the vegetation types present under existing conditions. LGP equipment may be used to place fill after suitable protection of access routes (see Section 5). This measure enhances wetland habitat by increasing diversity associated with subtle wetland elevation variability. Typical drawings for fill hummocks are shown in Figure 4-7.

8. **Miscellaneous fill placement (soil spreading) on floodplain.** This measure is not independent, but facilitates other measures that require small amounts of excavation in areas where access for removal of excavated material would be disruptive. This measure involves placement and confinement of very shallow fill in vegetated areas, such that the excavated material is stabilized and incorporated into the existing vegetated surface. Excess excavated material will be placed

by spreading a thin layer of soil no deeper than 2 inches in areas of healthy existing graminoid vegetation at least 6 inches in height and lightly raked into the vegetation, such that the vegetation protrudes through the spread soil. The filled area will be entirely surrounded by a coir log perimeter, buried to half depth. Fill areas will be no larger than 600 square feet and will be located at least 30 feet from the bank of any active channel. The areas for soil spreading will be selected to blend into existing topography, including placement in shallow closed depressions where feasible. This measure is shown in Figure 4-8.

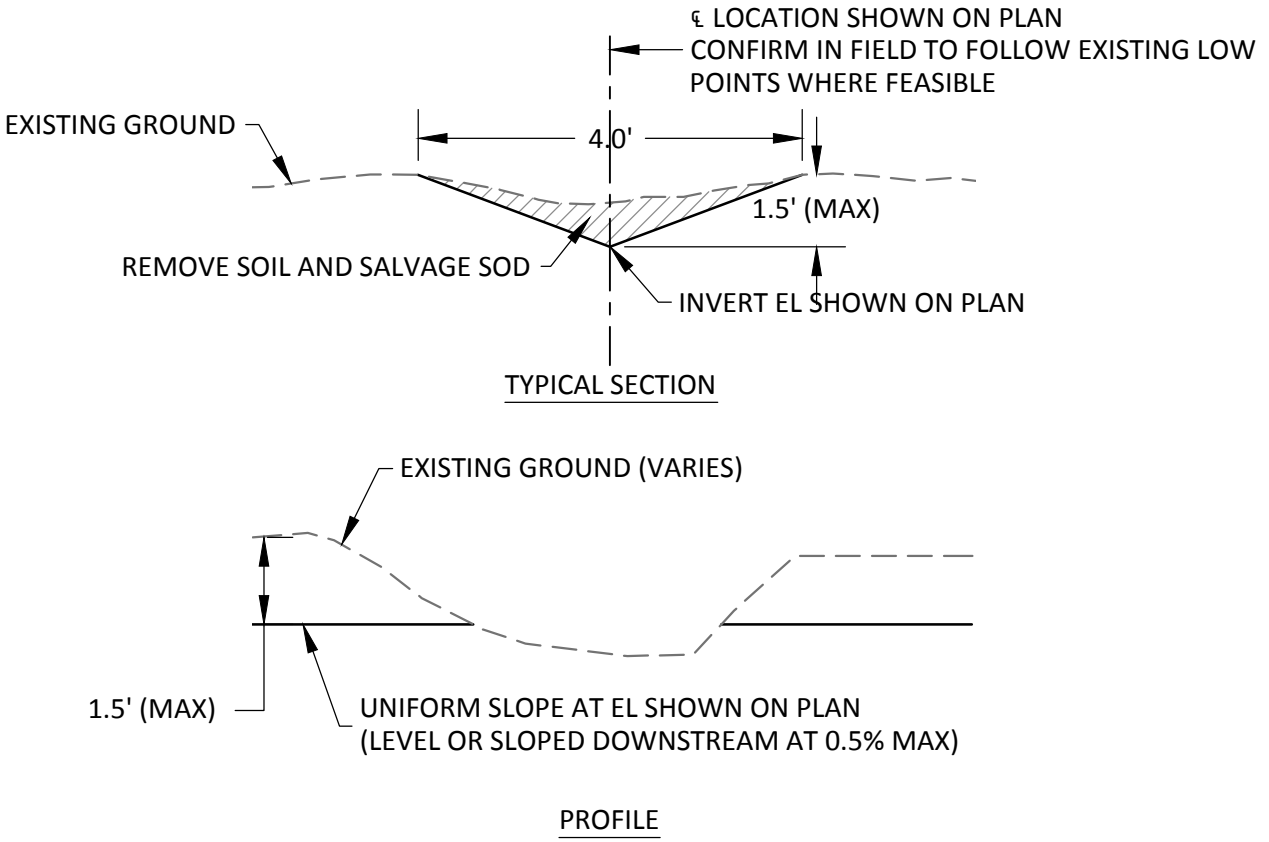
9. **Installation of overbank flow plugs along the right bank.** This measure is intended to reduce the amount of flow passing over or adjacent to the easement by roughening or blocking existing right bank overflow paths. This measure will also encourage flow on the left overbank initiated by Measures 1 and 2. The existing right bank overflow points are relatively minor low points in the right top of bank and thus require little structure to accomplish the objective. They will consist of planted coir logs with sod or marsh mats placed on the north side to reduce leakage and provide for a gentle transition back to the existing downslope grade. Typical details are shown in Figure 4-9. Minor low spots along the right bank may be treated with hydraulic roughness elements.

10. **Planting and vegetation management on unfavorable flow paths**. This measure will primarily plant willow stakes in configurations designed to form resistance or barriers to re-occupation or enlargement of flow paths that would increase risk to the sewer facilities. Willows will be planted in relatively dense clusters or rows to block flow paths. Multiple blocks may be constructed on a flow path to make it discontinuous and distribute flows onto the meadow surface. This measure enhances habitat diversity and sediment trapping. Where vegetation establishment by natural recruitment creates potentially unfavorable flow paths, vegetation will be removed or salvaged for use in other areas. An example of this measure is removal of willow saplings presently establishing on the sand bar formed in the 2011 avulsion. Willows in this area will be removed by hand excavation and any significant soil disturbance backfilled with sod clumps to prevent a willow grove from forming that could force flow to the north onto the right overbank and the District's easement.

11. **Removal of abandoned road fill.** This measure is intended to restore floodplain function and hydrologic connectivity by removing artificial fill. With respect to channel behavior in the project area, the fill restricts flood flows and potentially creates backwater conditions near Bellevue Pump Station that reduces sediment transport capacity and increases risk of avulsion. The fill also appears to have intercepted a secondary flow path and concentrated flows along the upstream face of the fill, resulting in scour along the toe of the fill and erosion of the meadow. In addition, the road fill is breached in at least one location, resulting in a scour hole and erosion on the downstream side of the fill. The portion of the existing road to the south of the channel will be removed. The road fill north of the channel is less distinct as a fill prism and may have some benefit for protection of the sewer facilities in preventing channel alignments to the north of its present location. The existing road is well vegetated with the graminoid species found on the adjacent meadow surface. The existing vegetation will be removed as sod, set

aside, and replaced after the road fill is excavated to a subgrade elevation that accommodates sod replacement at the adjacent meadow elevation. This measure is a significant enhancement in marsh/wetland and floodplain functional value because it restores natural hydrologic variability, increases diversity, reduces erosion potential, increases sediment trapping capacity, and restores floodplain hydraulic function. Measures 11 and 12 are illustrated in Figure 4-10. In addition, plan and typical section drawings for the road fill removal are included in the Year 1 plans in Appendix D.

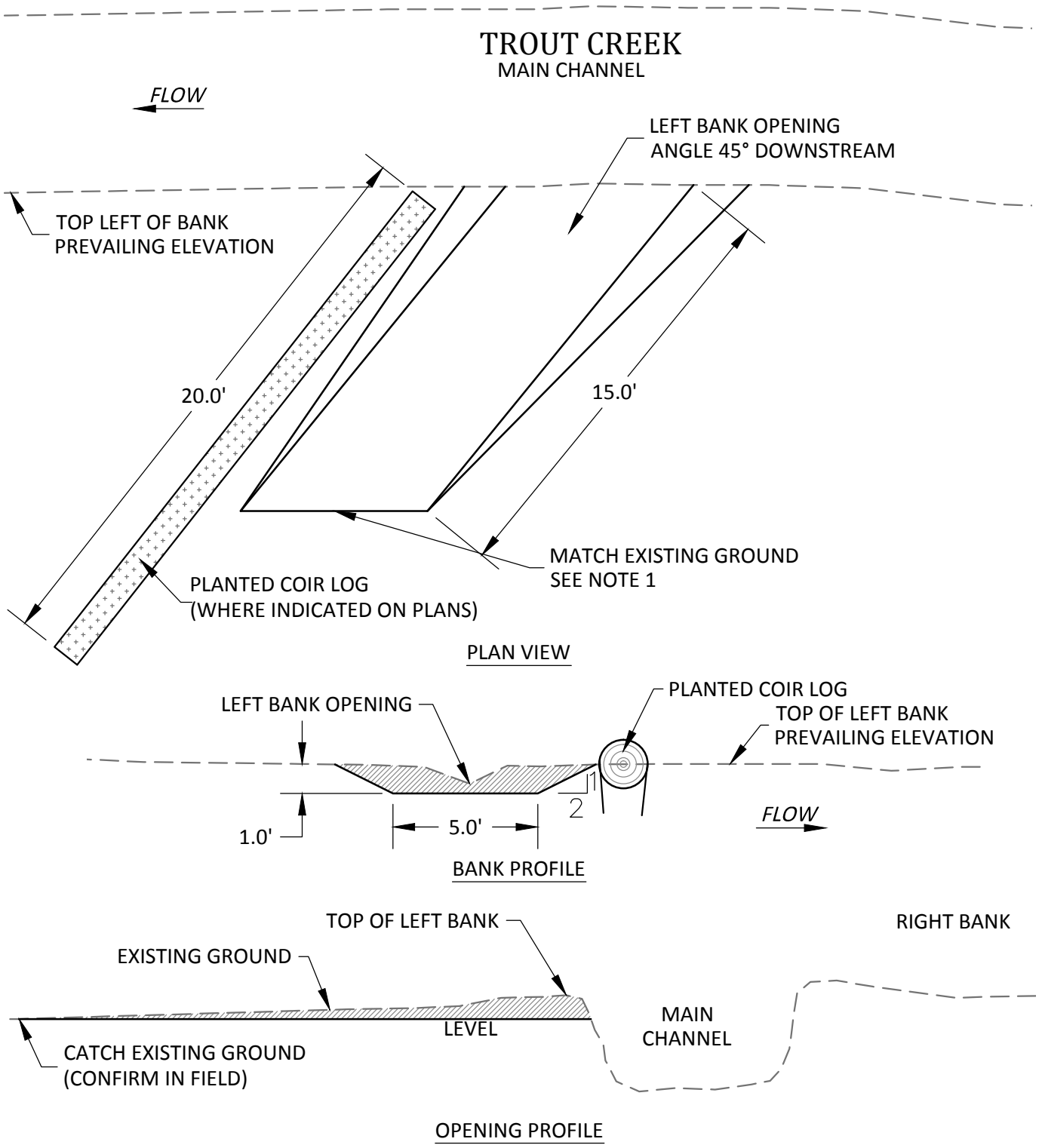
12. **Intermittent fill of erosional depression at road fill**. As noted above, an existing erosional depression is formed along the road fill due to interception of a secondary flow path. Portions of this depression will be filled to plug the eroded flow path, and revegetated using pre-grown marsh mats or by plug planting and protection with biodegradable erosion control blanket. The depression will be plugged intermittently rather than completely filled in order to retain some closed depressions and diversity in marsh elevations to enhance wildlife habitat. This measure prevents further erosion, provides increased potential for sediment trapping, and enhances wildlife value. Plan and typical section drawings for the intermittent fill are included in Appendix D.



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.

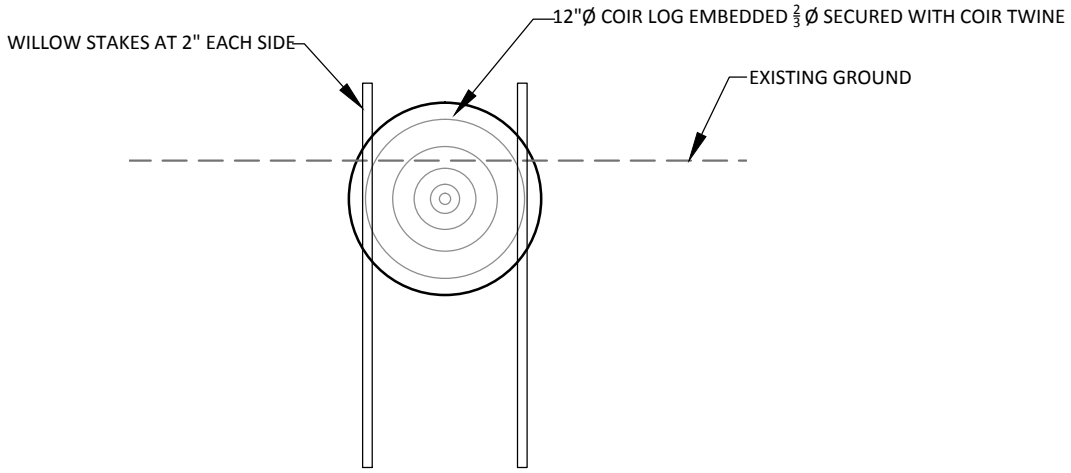
Figure 4-1. Pilot Channels Off the Left Bank (Measure 1)



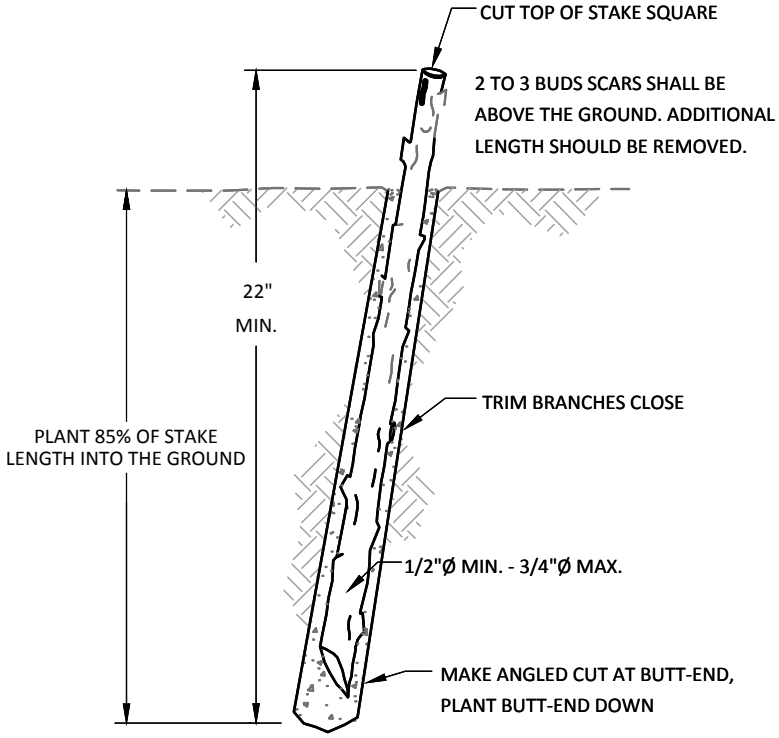
NOTE:

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

Figure 4-2. Left Bank Overflow Openings (Measure 2)



WILLOW FENCE



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. 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

Figure 4-3. Willow Fences and Live Staking (Measure 3)

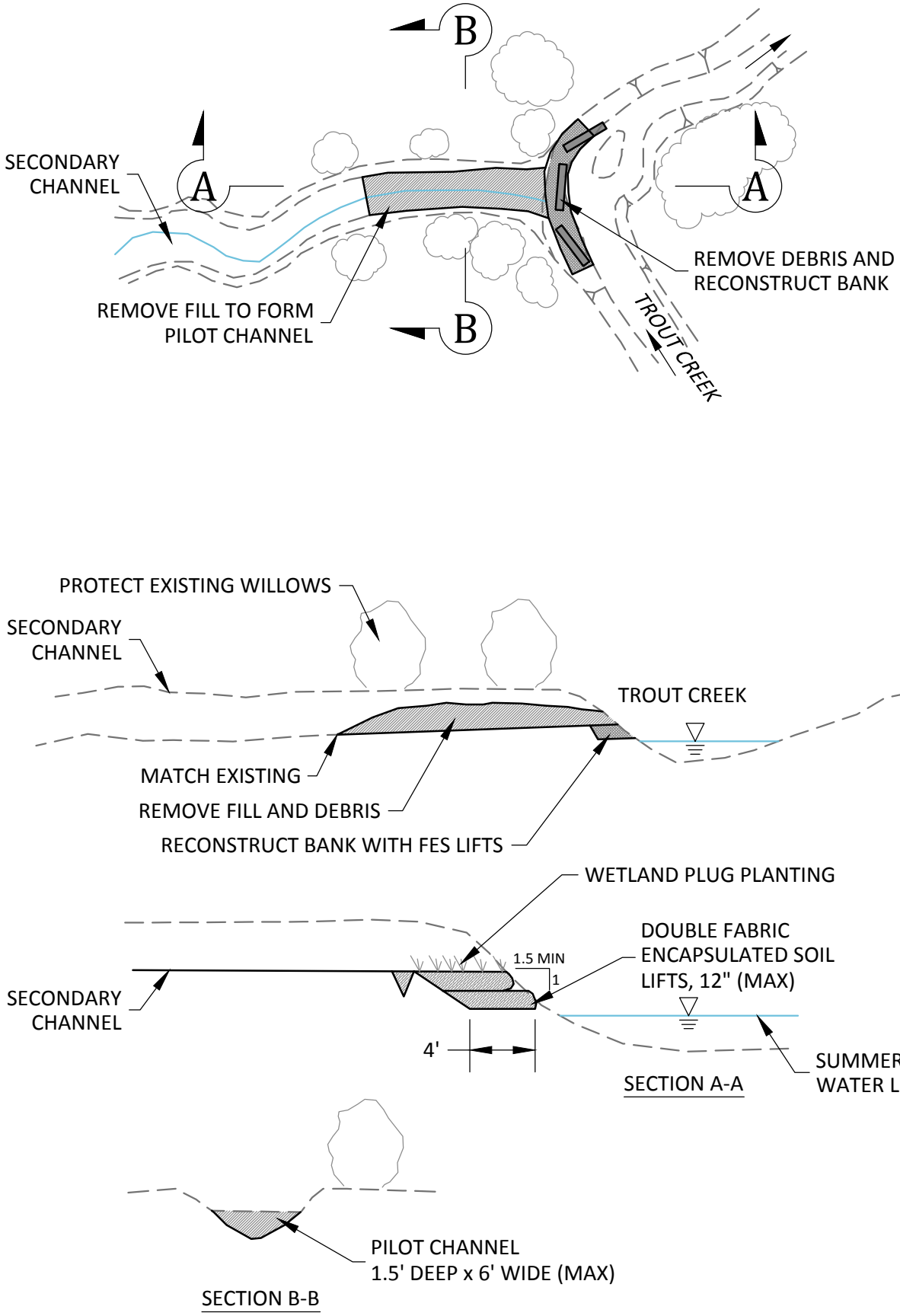


Figure 4-4. Debris and Fill Removal at Head of pre-1968 Channel (Measure 4)

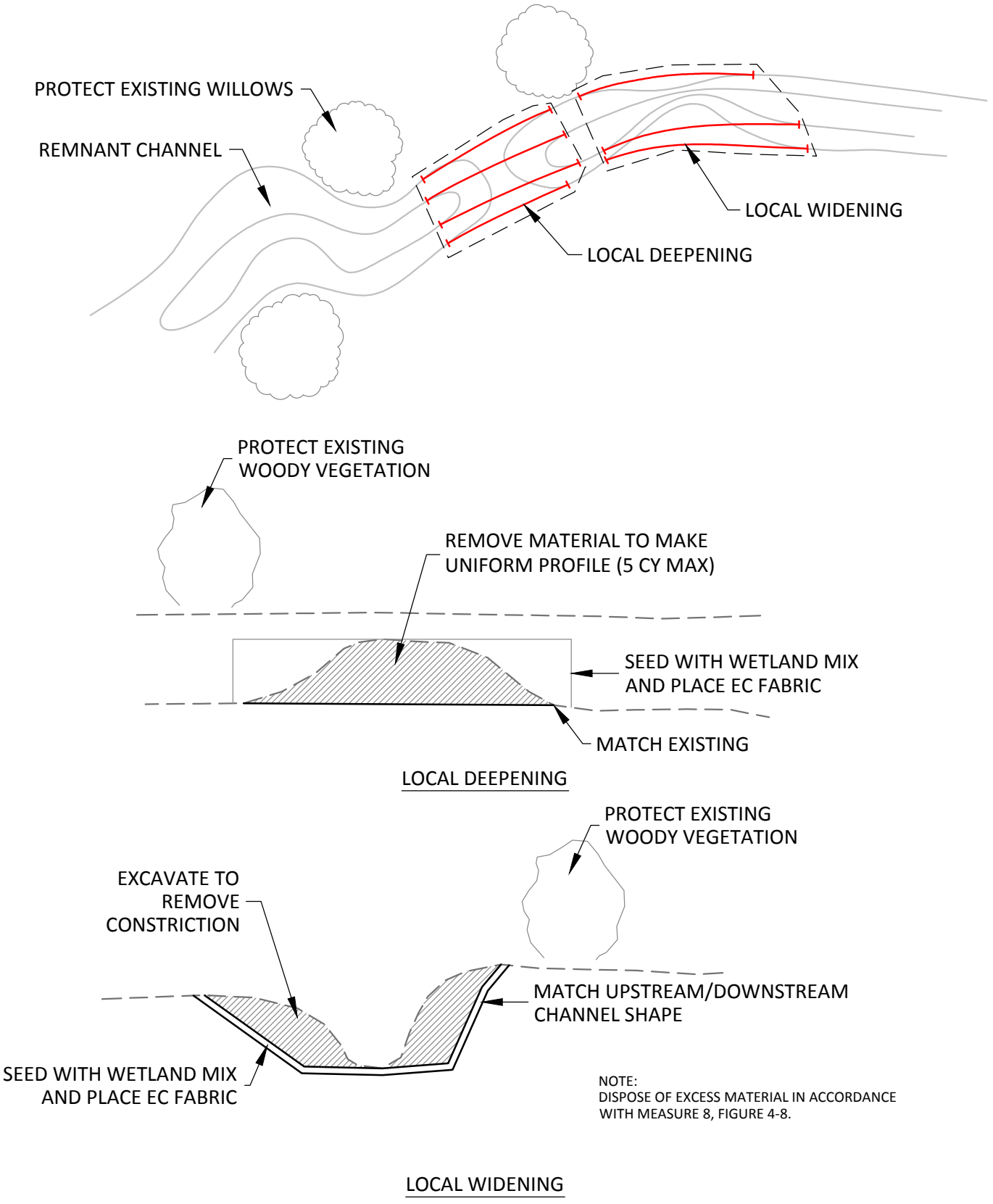


Figure 4-5. Local Widening and/or Deepening of Desirable Flow Paths (Measure 5)

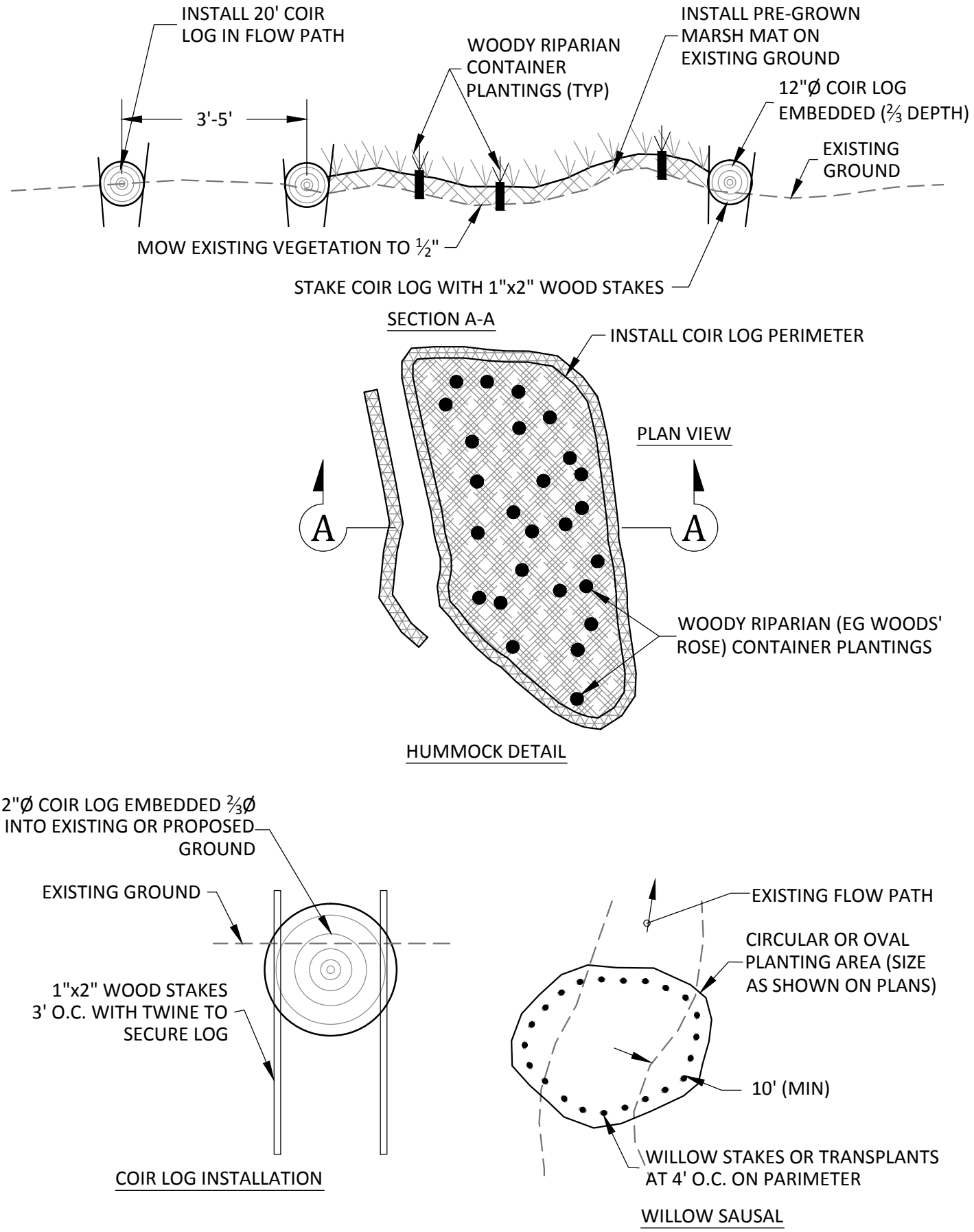


Figure 4-6. Hummocks and Hydraulic Roughness Elemetns (Measure 6)

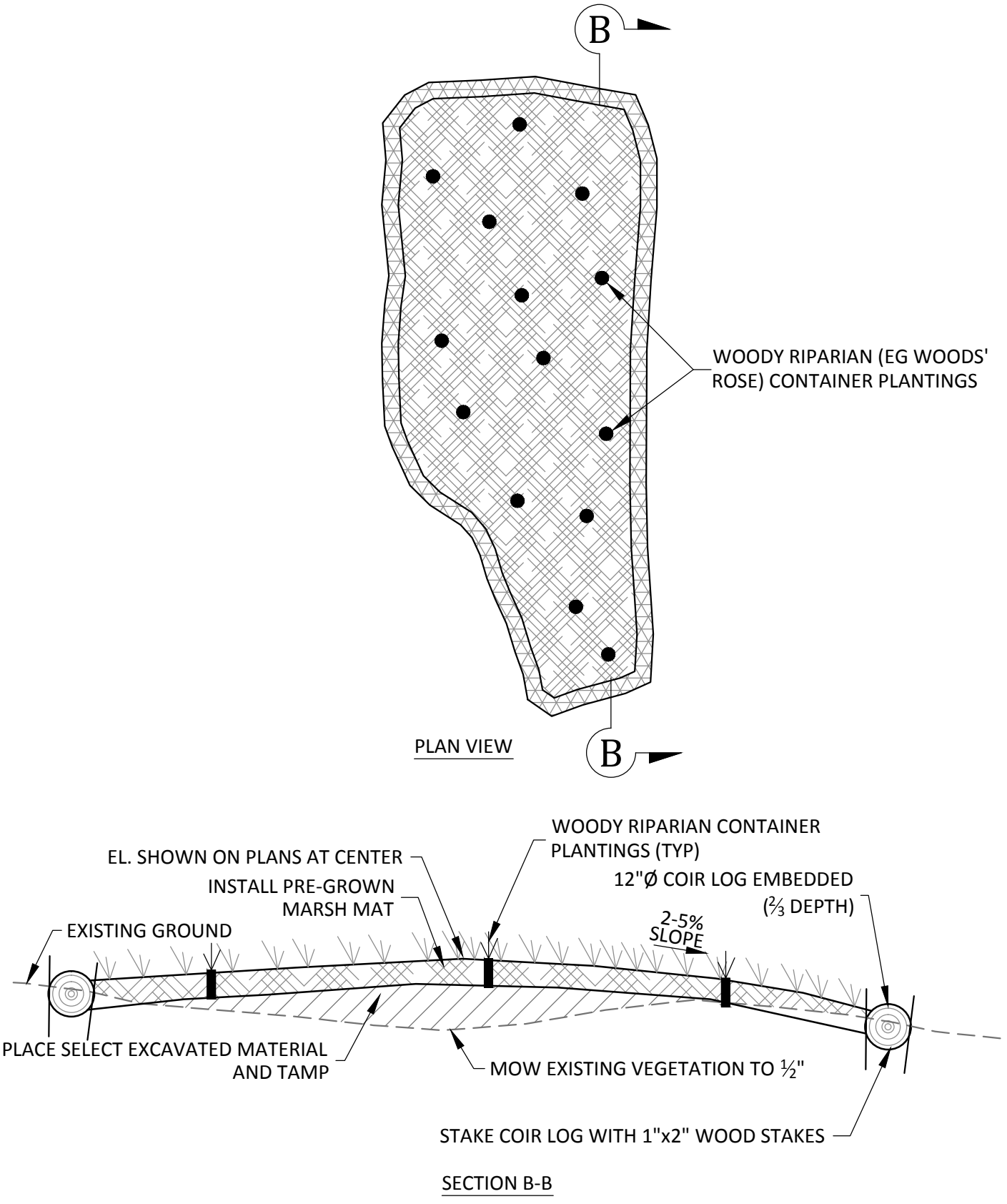


Figure 4-7. Fill Hummocks (Measure 7)

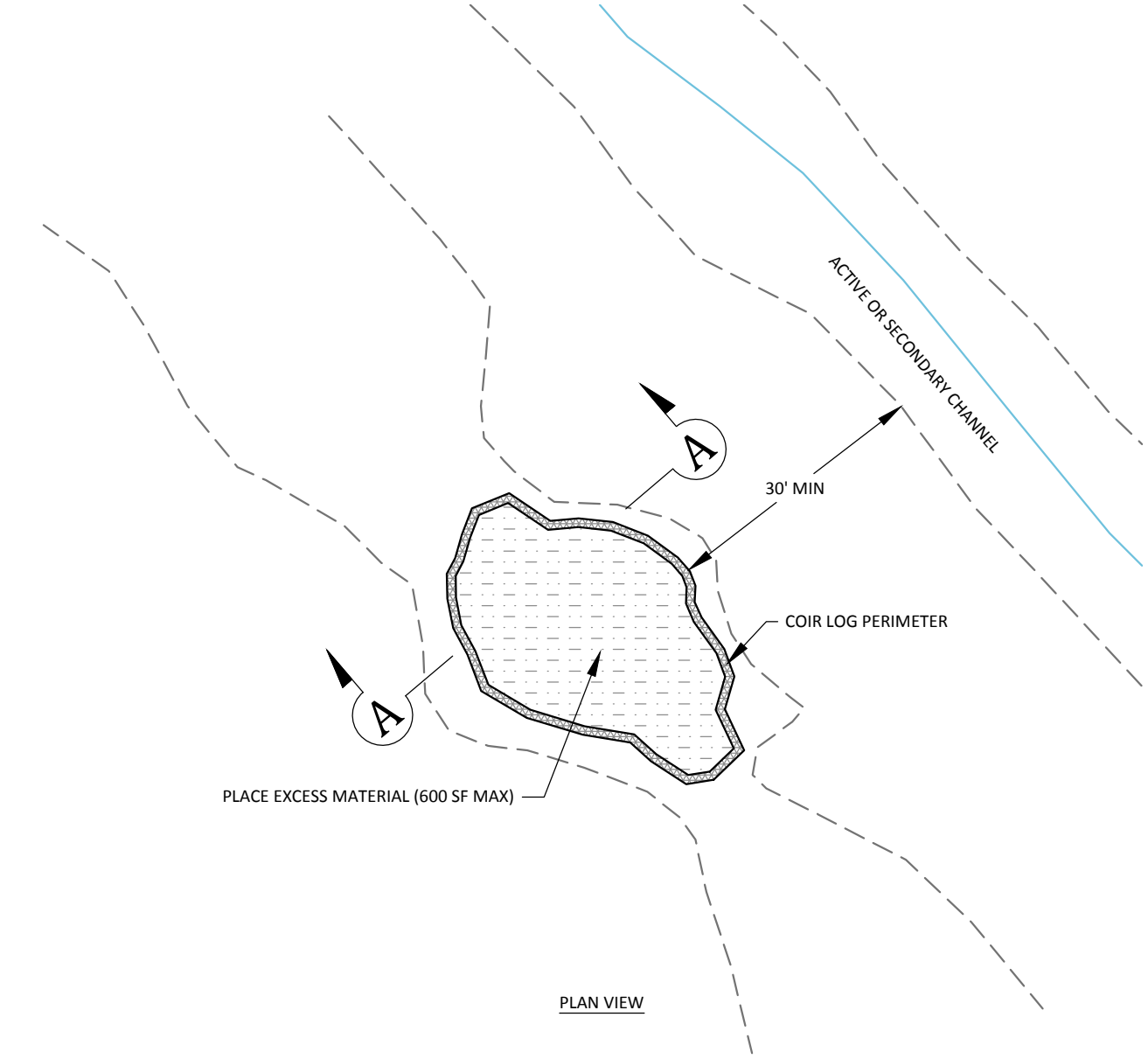


Figure 4-8. Miscellaneous Fill on Floodplain (Measure 8)

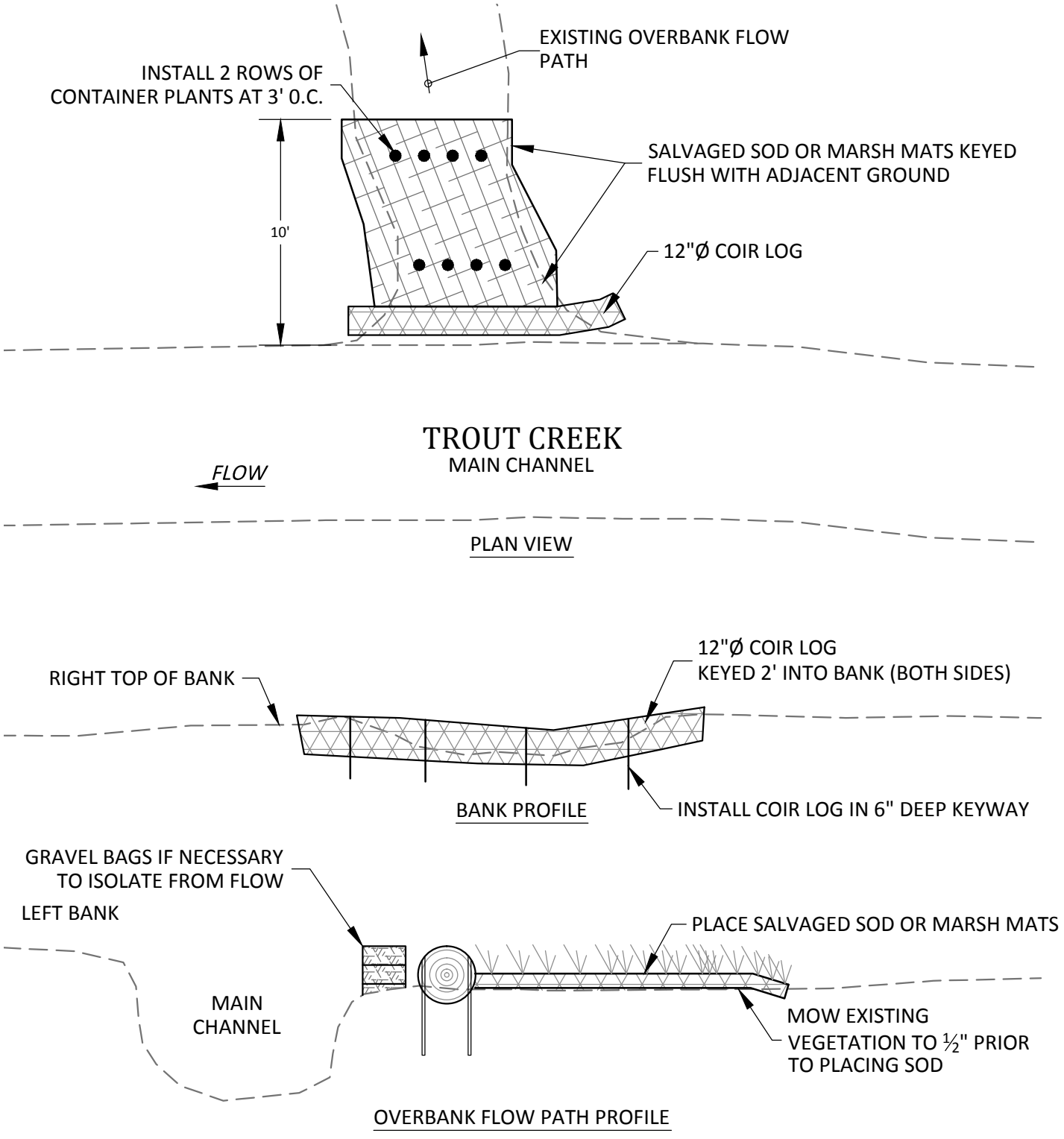
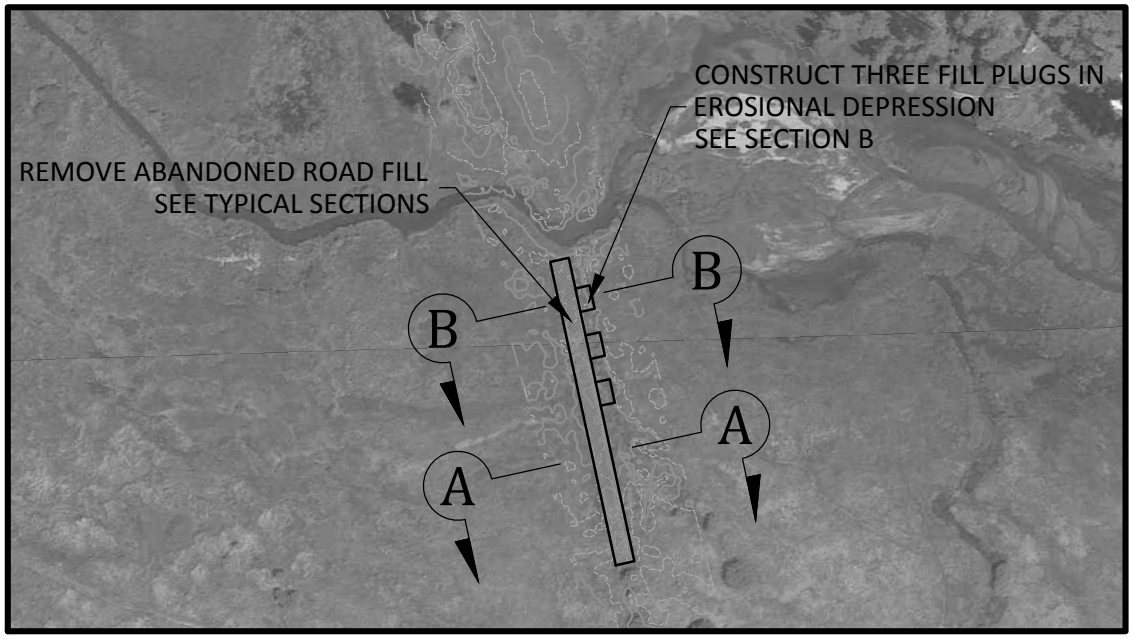


Figure 4-9. Right Bank Overlow Plugs (Measure 9)



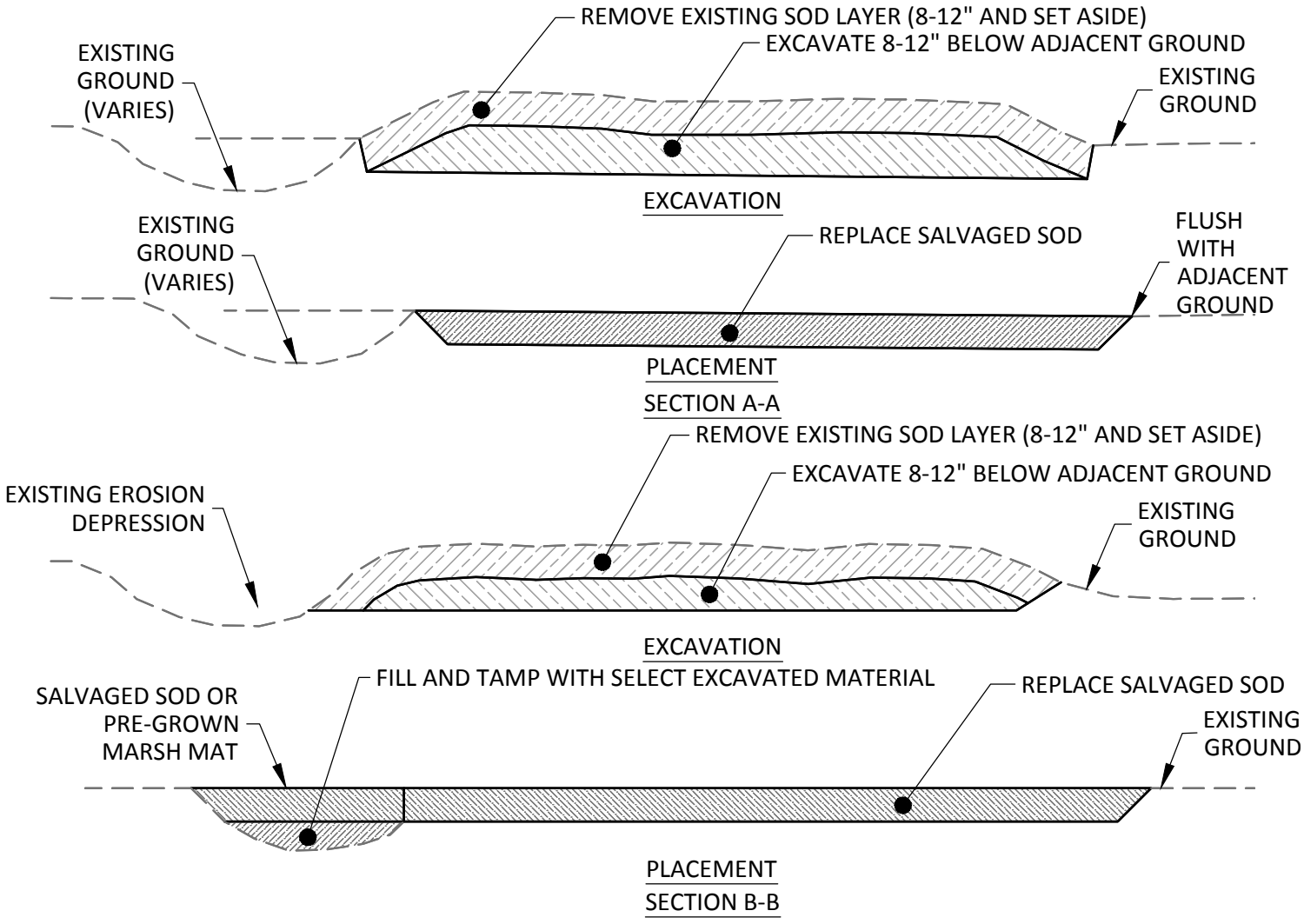


Figure 4-10. Road Fill Removal and Intermittent Fill of Adjacent Depression (Measures 10 & 11)

5.0 Construction Methods

This section describes the **g**eneral construction methods that will be used for the AMP, including pre-construction surveys and other activities for protection of plants and wildlife. Details for each phase (year) of construction will be developed in plans and specifications or prescriptions for that particular phase. The District expects to solicit bids for construction of Year 1 improvements. Subsequent years may either be bid or constructed by District forces. Construction related details for Year 1 are described in Section 7.

5.1 Pre-Construction Plant and Wildlife Protective Measures

The management measures are planned to be implemented during the late summer and fall of each implementation year because this timing coincides with the lowest flows in the channel and is after the bird nesting season and spawning migration season for various fish species.

Lahontan cutthroat trout, Paiute Sculpin, Tahoe sucker, mountain sucker, Lahontan redside, Lahontan tui chub, and mountain whitefish are potentially present in the study area. Lahontan cutthroat trout is a federally listed threatened species and Lahontan tui chub and Tahoe sucker are listed as species of special concern by the California Department of Fish and Wildlife (CDFW). Little construction activity in the main channel of Trout Creek is envisaged under the AMP, but creek flows are currently carried in the right overbank in the area of the 2011 avulsion. Construction activities affecting areas of flowing water (in the channel or overbank in the area of the avulsion) will be preceded by a fish relocation conducted by the District in the areas to be dewatered or directly affected by construction. Appendix A includes a Biological Assessment for Lahontan cutthroat trout and Appendix F describes a typical fish relocation plan to be implemented where applicable to AMP construction activities.

In addition to protection of fish species, the project will implement pre-construction measures to protect bird species and American Mannagrass, as described below.

Yellow Warbler, Long-Eared Owl, Waterfowl, and Northern Harrier

For construction activities that would occur within suitable habitat during the nesting season (approximately March 1–August 31, depending on weather), a qualified wildlife biologist will conduct pre-construction surveys for active nest sites of yellow warbler, long-eared owl, waterfowl, and northern harrier within 10 days before construction activities. In general, no breeding bird activity is anticipated to occur after August 31, however because the Sierra Nevada and Upper Truckee Marsh can experience wide hydrologic and climatic variation on an annual basis, it is possible that during an unusually wet and cold spring and early summer some breeding activity may extend into September. If construction takes place in a year with relatively wet and cold conditions, pre-construction surveys might extend into September and would be implemented prior to any construction activity.

The biologist conducting the surveys will be experienced with Sierra Nevada birds and capable of making species identifications of Sierra Nevada bird species audibly and visually. The pre-construction survey for nests will be conducted using a nest-searching technique appropriate for the species (e.g., first

conducting observations in suitable habitat to determine occupancy, followed by nest searching if the species is present). If a nest is located, CDFW shall be notified. Construction shall be prohibited within a distance directed by the appropriate regulatory agency to avoid disturbance until the nest is no longer active.

If any special-status wildlife species are detected incidentally in the study area during preconstruction surveys or otherwise, the Conservancy and TRPA, CDFW, and/or USFWS shall be notified, as appropriate. If necessary, measures to minimize or avoid disturbances to individuals or breeding activities (e.g., limiting operating periods during sensitive breeding periods) shall be developed and implemented in consultation with the appropriate agencies.

Willow Flycatcher

To determine potential willow flycatcher (WIFL) occupancy of the Study Area and the vicinity of the Study Area within the Upper Truckee Marsh, yearly surveys will be conducted according to the standardized WILF survey protocol (Bombay et al 2003) prior to construction in any year in which mechanized equipment will be used . To determine presence/absence of territorial WIFLs, survey transects will be established within potentially suitable habitat within and in the vicinity of the Study Area. Broadcast stations will be established using GIS and adjusted on the ground, and will be surveyed in accordance with the Bombay et al. (2003) survey guidelines.

The biologist conducting the surveys will be experienced with WIFLs and other Sierra Nevada birds, and will be capable of making species identifications of Sierra Nevada bird species audibly and visually. If territorial WIFLs are observed, construction will be prohibited within a distance directed by the appropriate regulatory agency to avoid disturbance.

American Mannagrass

Prior to any ground disturbance, surveys for American Mannagrass will be conducted to coincide with the blooming period of the target species. Surveys will follow established field techniques to ensure thorough coverage of potential impact areas, and all plants encountered during the surveys will be identified to the highest taxonomic level necessary for rare plant determination.

If American Mannagrass is identified within the Study Area or construction footprint, the Conservancy and TRPA, CDFW, and/or USFWS shall be notified, as appropriate. If necessary, measures to avoid disturbance (fencing, exclusion) shall be developed and implemented in consultation with the appropriate agencies. If avoidance is unavoidable, a translocation plan shall be developed and implemented in consultation with the appropriate agencies.

5.2 Dewatering and Diversion

Dewatering through the 5-year implementation period will be performed commensurate with the ground disturbance potential of the activity being performed. Dewatering plans will be developed separately each time ground-disturbing operations are proposed following the guidance provided below. Principals for development of specific dewatering plans include isolation of the work area through installation of biodegradable silt fencing or wattles and possibly a temporary dam installed across the channel at the downstream end of the project area, minimizing work in wet conditions,

provisions for pumping any water that must be removed from the work area and application of temporary Best Management Practices to control sediment discharge to active or remnant channel areas.

It is expected that most dewatering of the right overbank area will be accomplished through implementation of specific management measures in the Year 1 Plan and that the dewatering is integral to achieving one of the goals of the project, which is to reduce the depth and duration of inundation on the easement. As such, the right overbank dewatering activities are permanent measures, as opposed to temporary measures to be used during periods where construction activities may be taking place.

During Year 1 areas of disturbance will first be isolated using biodegradable silt fence or wattles and the installation of a temporary dam across the downstream end of the project area to ensure that no residual turbid water is discharged. Construction will only proceed when flows are less than 20 cfs as measured at the USGS Tahoe Valley gage. The pilot channels (Measure 1) will then be constructed by hand crews in the area between the upstream bank opening and the downstream outlet. The pilot channels will be seasoned and opened to flow in a sequence of steps to protect water quality, as described in Section 5.7 below. It is expected that the flow presently occupying the right overbank will be diverted through the pilot channels. Additional left bank flow paths (Measure 2) will be opened through hand excavation, although these may not divert flow except during higher flow periods. A third permanent measure will consist of installing overbank flow plugs along the right bank (Measure 8) which may be temporarily reinforced with gravel bags. Low temporary dams constructed using gravel bags, water-filled barriers, or similar methods will be used as needed to control water in the right overbank, and some of these measures may be left in place for the first runoff season following construction.

The above measures will result in progressive dewatering of the right overbank during the construction period. Depending on the effectiveness of these measures, a temporary diversion dam may also be installed to force any residual flow exiting the right bank into the pilot channels. With all of the above measures in place, there will be only residual ponded water in the easement area and right overbank during summer/fall low flows. Any residual non-turbid water will be diverted to the pilot channels or main channel, or pumped to a designated irrigation disposal area in an unsaturated area of the meadow. If there is residual continual flow or leakage, some minor excavation (lined with plastic) may be required to collect it at a centralized location from which it can also be pumped into the disposal area. Because implementation of these initial measures will be performed with hand crews, it is not anticipated that water exceeding 20 NTUs in turbidity will be generated. Should that not be the case, waters in excess of 20 NTUs shall be disposed as described in Section 5.7. During construction, turbidity will be field checked using laboratory prepared visual standards (20 NTU) and creek turbidity upstream and downstream of the work area near Bellevue Pump Station will be continually monitored using turbidimeters in accordance with the monitoring plan (Appendix E). Although the right overbank area will be dewatered as described above, soft or wet soil conditions may persist because of high groundwater levels. Transport of materials and operation of equipment within the dewatered area has the potential to generate turbid residual water. During construction operations, wet conditions will be acceptable as long as incipient rutting does not occur and features can be acceptably constructed. Under these conditions construction may proceed with no removal of residual water. If removal of residual water is

needed, only occasional disposal is expected because of the limited operations which will take place and the measures used to minimize ground disturbance. Only low ground pressure (LGP) equipment (less than 5 pounds per square inch loaded) will be used, the easement (which will be the primary equipment access and have the highest number of trips) will be protected with mats, and most of the remaining operations in the right overbank area will be performed with hand crews. Section 5.7 describes how any turbid nuisance water within the work area will be disposed if incipient rutting occurs or if other residual water must be removed to facilitate construction or prevent discharge of turbid waters to the creek.

5.3 Staging and Access

All equipment entering the study area will be cleaned of all attached soil or plant parts before being allowed into the study area. All motorized and non-motorized equipment that will come into contact with flowing water will be thoroughly cleaned and sanitized prior to use with a dilute quaternary disinfectant solution (or the equivalent) and allowed to dry before being used. Equipment access and material delivery will primarily be via Bellevue Avenue, which terminates at the District's pump station. The nearest residential driveway is approximately 120 feet away from the entrance to the pump station. A limited staging area is required due to the small amount of equipment and materials needed for the work. A portion of the roadway and shoulder (estimated at 600 square feet) near Bellevue Pump Station will be used for staging after installation of BMPs. All refueling of the equipment would be performed on the street in the area used by the District for pump station parking. For safety, pedestrian access to the meadow from Bellevue Avenue may be restricted or closed during construction. An access plan for the Year 1 measures has been prepared and is included in Appendix D. Similar plans will be prepared to show access for AMP activities in each year of construction.

Access to the project site will be via Highway 50 and local City of South Lake Tahoe streets. The most direct route to the work area near Bellevue Pump Station from Highway 50 would be via Los Angeles Avenue thence to Bellevue Avenue to its terminus at the pumping station. Equipment access may be required in Years 2-5 to the area at the head of the pre-1968 channel in the center of the meadow. Access to this area would be from Highway 50 via Rubicon Trail. No staging area is anticipated for this access route because no significant material quantities will be imported or exported.

Access into the principal area of operations near Bellevue Pump Station will be through the Bellevue Avenue gate. Except for the road fill removal, equipment use will be limited to small LGP equipment. The easement itself will be protected with temporary mats or plates and will be the primary route used to transport materials into the right overbank area. Elsewhere, when needed for equipment or foot traffic access for multiple trips that would cause rutting temporary road/walkway mats or steel plates will be laid down to minimize ground disturbance. Where rutting is not a threat, LGP equipment will be used to transport sod, marsh mats, coir logs, and other materials.

Equipment for road fill removal will likely include a full size excavator and dump trucks for fill transport. Access onto the old roadway for fill removal will be along the north boundary of the meadow west of Bellevue Avenue for approximately 240 feet. This area will be protected with wood chips, and if needed, plates or mats. The access will then follow the existing vegetated roadway fill to the north edge

of the channel. This zone will be protected with wood chips overlain with plates or mats should rutting begin to occur. In order to gain access to the southern portion of the old roadway, a temporary creek crossing will be needed. This creek crossing is anticipated to be constructed using structural elements placed parallel to flow in the channel (logs, barrier rail), surfaced with steel plates. Temporary disturbance of the channel bed to install the crossing is unavoidable and will be minimized by the use of clean, pre-fabricated structural elements that can be placed directly on top of the stream bed without the need for significant excavation. The installation will occur after 1 September and when flows are less than 20 cfs, and will be removed prior to October 15. Temporary discharge of some sediment associated with installation and removal of the crossing is unavoidable, but is expected to be short in duration (2 hours or less). For the area south of the creek, wood chips and plates will be used to protect the zone where excavated material will be loaded into trucks. Excavation will begin at the southern terminus of the fill removal and proceed backward towards the channel. Any equipment used directly on the meadow surface along the abandoned roadway will be LGP equipment to avoid excessive compaction of meadow soils. Wood chips and plates will be removed as construction proceeds on the fill removal south of the creek and at the completion of fill removal on the north side of the creek. Chips will be removed to the extent this is feasible without damage to the meadow surface – some chips will likely remain at the completion of construction.

Traffic expected to result from the Year 1 fill removal is described in Section 7.

The need for equipment access to the head of the pre-1968 channel for removal of debris and construction of a pilot channel will be assessed after observing spring runoff and collecting topographic information in 2014. If feasible, this work will be performed by hand crews. If equipment is determined necessary it will be limited to small LGP equipment. Disposal of excavated material will be done using Measure 8 so that truck access is not needed. One-time access for LGP equipment would be made via Highway 50 and Rubicon Trail and existing pedestrian access routes. A detailed description of access and equipment staging for this work will be included in the construction documents for Year 2 or subsequent improvements.

5.4 Grading

There will be no grading performed using equipment except for removal of the abandoned road fill back to the prevailing meadow grade as described in Section 4. All other excavation and fill will be performed by hand crews. All excavated sod will be salvaged and used as sod plugs, placed in existing low areas, or incorporated into the overbank plugs. Excess soil material excavated on or south of the left bank will be transported to the right overbank area and incorporated into fill hummocks. Fill placement will primarily occur for construction of fill hummocks (Section 4 – Measure 7). The fill will be hand tamped to consolidate the material but will not require mechanical compaction. The fill will be composed of material removed from the abandoned roadway or excavated from the left bank area that is suitable for planting. Excess fill material will be transported off site.

5.5 Installation of Vegetative Measures and Coir Logs

Section 4 describes various vegetative treatments, which may be used independently or as a part of another treatment. All vegetative measures will be installed by hand, although as previously described

transport of some materials (for example marsh mats) to their location may be performed through the use of LPG equipment.

Marsh mats will be placed as hydraulic roughness elements or as caps on hummock fills. They are also called vegetated coir mats, green mats, or bog mats and have been used on a variety of projects in the Lake Tahoe Basin over the last 18 years for vegetated channel outfalls (Fox Clean Water Project) and channels (Angora Creek, Snow Creek Steam and Wetland Restoration Project, Trout Creek Restoration Project), using a variety of fabrics and plant materials depending on the setting and purpose. Coir (coconut fiber) has been used to propagate vegetation in all these projects, and is currently the most suitable material for this purpose. For this project BioD Plant-Bed (Ro-Lanka) is the probable growth medium. Material will be grown hydroponically in lined plant beds. Plant plugs, rather than seed, will be planted on 6-inch or 12-inch centers, and will consist almost exclusively of Nebraska sedge (*Carex nebrascensis*) and Baltic rush (*Juncus balticus*), as these are rhizomatous species that grow rapidly and vigorously and are the dominant wetland graminoids in the marsh. Based on past experience it is anticipated that four months will be required to achieve dense growth and vigorous roots. If installed by late August or early September new growth and anchoring is expected. Size and weight of the mats is critical since they will be placed by hand but will be transported where needed by LGP equipment.

Coir logs will be used as overbank flow plugs (Measure 9), willow fences (Measures 3 and 10) and as part of hummocks and fill hummocks (Measures 6 and 7, respectively). They will be keyed in to half depth by salvaging the existing sod and incorporating any excavated soil into fill hummocks.

Sod plugs would be generated through sod removed in the formation of pilot channels, left overbank flow paths, right overbank plugs, or widening of alternative flow paths. These would be used to fill in gaps between/around marsh mats, be incorporated into hummock fills, or be used in right overbank plugs. Only vigorous and contiguous rhizomatous material will be used. Propagated wetland plugs may be also used if needed to fill in local areas, and a wetland seed mix will be applied to any remaining disturbed surfaces, such as local disturbance along access routes.

5.6 Erosion Control and Minimization of Ground Disturbance

Because of the scope and nature of proposed activities, there will be limited need for specific erosion control measures. No bare soil will be exposed at completion of any phase of construction. Measures that will limit the potential for erosion and the introduction of sediment into Trout Creek include:

1. Construction will generally occur between 1 September and 15 October, when creek flows are lowest and the meadow surface is driest. Planting activities that do not require ground disturbance may extend beyond October 15, weather permitting.
2. All excavation, with the exception of fill removal from the abandoned road, will be performed with hand crews.
3. Sod excavated by hand crews will be salvaged and used elsewhere. Material excavated from left bank areas will be transported to the right bank area and incorporated into hummock fills. Sod excavated off the old road alignment will be replaced in-situ. Salvaged sod will be re-planted as

soon after removal as feasible and handling will be minimized – temporary storage, if required, will be on mats or sheeting on the project site.

4. Dewatering measures will limit the generation of turbid water.
5. A temporary bridge will be used to cross Trout Creek to access the abandoned road. Structural support for the crossing will be placed on coarse bed material without excavation of the channel or meadow.
6. Fill placement will be vegetatively stabilized. Marsh mats will be the preferred method to cover any placed fill. Locally, fill may be stabilized with erosion control fabric planted with sod or plugs.
7. The meadow soils will be protected from compaction through the use of LPG equipment.
8. Access routes used repeatedly will be protected using temporary measures such as wood chips, alone or in combination with steel plates, and temporary mats or walkways where LPG equipment or wheel barrows make repeated trips.

5.7 Water Pollution Control

Several construction measures to protect water quality are discussed above, including protecting access routes, minimizing ground disturbance through the use of hand crews and limited use of LPG equipment, minimizing the discharge of turbid water during construction, and stabilization to prevent erosion and discharge of turbid runoff or floodwaters after the completion of construction activities.

However, construction in wet conditions is expected for some of the measures in and around active flow paths, and this has the potential to generate some discharge of sediment. In addition, the adaptive management approach of this project, which relies on natural processes to achieve project objectives, will result in the pilot channels or other flow paths gaining flow capacity over time by expansion into active main channels. This process will be most active during non-construction period peak flows, but control measures for this potential source are also included in this section.

In addition to the general measures described in the sections above, the District will minimize the duration, extent, and potential effects of sediment discharges through monitoring, control of any turbid water, staged activation of new flow paths, designs to encourage expansion of favorable flow paths primarily during periods of high flows, and temporary and remedial erosion control measures.

Monitoring during Construction

Turbidity monitoring is described in detail in Appendix E, and includes methods both during construction periods and in non-construction periods over the AMP implementation term. Construction monitoring will include: 1) visual monitoring by construction and District personnel referenced to index vials; 2) field turbidimeter measurements in response to visual indications; 3) logging turbidimeter installations above and below the work area upstream of Bellevue Pump Station with daily checks and weekly downloads. The turbidimeters are located in the area where the majority of the work will be performed and where work in and around active flow areas has the highest potential to generate sediment discharges. During construction the turbidimeters will use a 15 minute logging interval and monitoring will be used to confirm that turbidity at the downstream station is controlled to less than 20 NTU as a 1-hour rolling average, or if the upstream station turbidity exceeds 20 NTU that the downstream turbidity is less than

110% of the upstream station. Turbidimeter installation and logging at the "construction period" interval will begin at least 10 days prior to initiating construction and will continue for at least 15 days following completion of all grading or other activities with the potential to generate sediment.

Control of Turbid Water During Construction Operations

The following controls will be implemented during Year 1 and any other year when similar grading or dewatering operations are proposed.

Nuisance (residual) water on the right overbank area may require disposal if incipient rutting occurs as a result of equipment operations or if needed to facilitate construction of the measures. Prior to any disposal, the turbidity of the residual water will be measured using a field turbidimeter. Water will be pumped and discharged into a non-saturated area via spray or flood irrigation for infiltration into the meadow surface. If turbidity of the nuisance water is less than 20 NTUs it will be discharged directly to the meadow surface through gated irrigation pipe or hose system, or pumped from a temporary receiver basin through spray nozzles. The discharge area will be bounded with coir logs, wattles, or geotextile barrier to prevent surface runoff from leaving the discharge area. If turbidity of the nuisance water is greater than 20 NTUs it will be passed through a chitosan sock into a temporary lined sediment basin, then discharged on the meadow surface as described above. The discharge will be controlled to prevent surface runoff, erosion, or excessive accumulation of sediment. If needed, the pumping rates, basin size, or other system elements will be modified to meet these criteria.

The procedures described above are expected to control turbidity and prevent risk of discharge of turbid water to Trout Creek. However, as a contingency during Year 1 construction, a temporary 4,000 gallon tank will be provided on the site. If the measures described above do not provide sufficient capacity or water pollution control, nuisance water will be pumped through a chitosan sock to the tank for initial settling and then discharged to the gravity sewer.

Disposal operations for residual or nuisance water, if required, are expected to occur intermittently over a period of not more than three weeks during the construction season, and any sediment deposited in the discharge area will be raked into the existing vegetated surface at the completion of the operation at a depth less than two inches. Any sediment that accumulates in lined temporary basins will be removed from the site, incorporated into the fill hummocks (Measure 7), or spread on the meadow surface as described in Measure 8.

During the period when nuisance water is discharged, a field turbidimeter will be utilized in combination with the recording turbidimeters. All observations will be recorded and provided to the Lahontan Regional Water Quality Control Board (Lahontan) on a weekly basis, as described in Appendix E.

Staged Activation of New Flow Paths

Some AMP measures, such as pilot channels and left bank overflow paths, will open new flow paths and are therefore potentially subject to some erosion and generation of turbidity. Pilot channels in the work area upstream of Bellevue Pump Station are part of the dewatering strategy and may be particularly sensitive to initial flows. To minimize potential generation of turbidity, the pilot channels will be "seasoned" to reduce the initial flush of turbidity by installing gravel bag dams at the upstream and

downstream ends during construction and prior to activation. The upstream dam will then be used to introduce a small amount of flow into the channel. The water trapped in the channel by the downstream dam will be pumped and discharged using the same method as described for nuisance or residual water, including the same turbidity criteria. After 10 repetitions, the gravel bag dams will be gradually removed over a period of one hour and after a period of 24 hours turbidity at the downstream end of the pilot channel will be measured. If turbidity exceeds 20 NTUs, the channel will be partially restricted with gravel bags and the turbidity re-measured after 2 hours. Additional gravel bags will be added to the restriction until the turbidity falls below 20 NTU. The restriction shall remain in place for 24 hours at which point the gravel bags will again be removed for a period of 24 hours. This process will continue until, with the channels unrestricted, the downstream turbidity is less than 20 NTU after 24 hours. After a period of 5 days following this process, turbidity in the creek channel will be measured to verify that turbidity continues to decrease toward background levels, and after 10 days that turbidity has decreased to less than 10 NTU, or if turbidity at the upstream station exceeds 10 NTU, to not more than 110% of the upstream station.

During the seasoning period, a field turbidimeter will be utilized in combination with the recording turbidimeters. All observations will be recorded and provided to the Lahontan Regional Water Quality Control Board (Lahontan) on a weekly basis, as described in Appendix E.

Designs to Encourage Channel Expansion Primarily During High Flows

The pilot channels are intended to be stable during low flow periods but to allow channel expansion during high flows. The designs will incorporate vegetative grade controls or temporary erosion control measures to provide stability at low flows. Enlargement of the pilot channel is expected over time, primarily during spring snowmelt and individual storms. Similarly, constructed left bank overflow points may experience some erosion during high flows. Some turbidity will be generated during active widening of the channels. This process will decrease over time and are expected to cease once the channel conveyance approaches that of the upstream and downstream channels. During high flow periods background (upstream) turbidity is elevated and increases due to the project are expected to be consistent with natural processes associated with channel changes in other locations of the Upper Truckee Marsh and in upstream reaches of Trout Creek. The level and duration of increases cannot be precisely predicted. However, even if an increase occurs there will be storage and treatment within the Upper Truckee Marsh downstream of the project that will ameliorate any marginal increase prior to discharge to Lake Tahoe. In no case is it expected that the project would result in a significant increase in turbidity discharged to Lake Tahoe.

Non-Construction Period Monitoring

Routine turbidity monitoring will continue at the recording turbidimeters located above and below the Bellevue Pump Station work area. In non-construction periods the turbidimeters will log data at hour-intervals during the period of November 1 to June 30 (see Appendix E). District personnel will download turbidity data after the recession of peak flows when the turbidimeters can be safely accessed. Provided that access is feasible, quarterly data will be provided to Lahontan no later than 10 working days after the beginning of the following quarter, or as soon thereafter as feasible if access is

restricted by flows. Some increases in turbidity in the project area are expected during expansion of the left bank flow paths. The data will primarily be evaluated to determine whether any increases in turbidity decrease as expected as flows recede. If the data indicate that turbidity levels in excess of 10 NTU persists for more than a day at the downstream turbidimeter after flows recede below 15 cfs (approximately the 50% exceedence probability flow after September 1), or if downstream turbidimeter readings are persistently more than 110% of the upstream readings at flows below 15 cfs, remedial measures will be incorporated in the subsequent year's work to reduce sediment generation during low flows. Remedial measures may include temporary measures such as installation of gravel bags or erosion control fabric, or installation of vegetative measures such as sod bank or bed stabilization. These measures will be designed to meet the 10 NTU/10% increase objectives during low flows, but to allow channel expansion during high flows up to the desired channel capacity.

At the end of the full AMP implementation period, monitoring data will be provided to Lahontan to demonstrate that turbidity is increased by no more than 10% through the project area at flows up to the target channel capacity described in Section 6.

6.0 Adaptive Management Strategy

This section describes the overall phasing, monitoring, and reporting strategy for the AMP.

6.1 Phasing

The AMP strategy is to implement the project in phases followed by monitoring to assess the needs, if any, for additional action. The methods used to attain project objectives rely on natural processes, including development of new flow paths and distributaries, along with sedimentation in the marsh along the current alignment. The rate and extent that these processes will occur is uncertain due to the difficulties inherent in predicting stream behavior and the natural hydrologic and sedimentation variability of the creek and marsh. As a result, an AMP is needed to incrementally work toward the desired outcome, reduce the risk of unintended consequences of the measures, and to provide flexibility to respond to natural hydraulic, erosion, and sedimentation processes as they occur. Monitoring will be used to determine if sufficient progress is being made towards achieving the performance objectives to complete implementation within a 5 year period.

The Year 1 Plan is presented in Section 7. It is expected that several of the measures performed during Year 1 will be one-time measures. These include:

- Activating left bank pilot channel(s);
- Opening left bank overflow paths;
- Installing right bank overflow plugs;
- Removing abandoned road fill and installing plugs in adjacent erosional depression.

Some of the Year 1 measures may be implemented again in Years 2-5. Table 6-1 indicates which measures are expected to be unique to Year 1, and which may be implemented or repeated in subsequent years contingent upon monitoring results. Year 1 corresponds to the 2014 construction season (September-October 2014) and Year 5 to the 2018 construction season. No implementation measures are planned beyond 2018.

The District conducted a neighborhood meeting on 10 March 2014 to advise nearby residents on project planning and the preliminary designs. The overwhelming concern expressed by the residents was an increase in the willow population in the meadow due to the project, and associated effects on fire hazards, habitat, security, and views of the meadow. Following this meeting, the District revised the AMP and preliminary plans to eliminate the use of willows in the work area near Bellevue Pump Station in Year 1. Woods' rose will be used as an alternative to willows for woody riparian plantings in the hummocks. The success of Woods' rose in establishing hydraulic roughness consistent with AMP objectives and its success in terms of plant survival, growth, and vigor will be evaluated in the first two years of AMP monitoring. If considered necessary to meet AMP objectives, use of willows in this area will be phased in during later years of AMP implementation. Willows will be used in all years in the work areas closer to the center of the meadow.

Table 6-1. Implementation of measures by phase.

Year 1 Only	Years 1-5
Measure 1. Pilot channels off left bank near Bellevue Pump Station	Measure 2. Opening of left bank overflow paths (expected primarily in Years 1 and 2)
Measure 11. Removal of abandoned road fill	Measure 3. Planting of favorable flow paths
Measure 12. Intermittent fill of depression along abandoned road	Measure 4. Removal of debris and fill at pre-1968 channel entrance (not in Year 1)
	Measure 5. Local widening/deepening of preferred flow paths
	Measure 6. Installation of hummocks and hydraulic roughness on right overbank (expected primarily in Years 1 and 2)
	Measure 7. Placement of fill hummocks (expected primarily in Years 1 and 2)
	Measure 8. Miscellaneous fill (soil spreading) on floodplain
	Measure 9. Placement of right overbank flow plugs (expected primarily in Years 1 and 2)
	Measure 10. Planting and vegetation management on undesirable flow paths

6.2 Treatment Surface Area, Cut/Fill Volumes

Table 6-2 shows the maximum area over which excavation or fill will occur as a result of this project. These represent conservative estimates of surface area and volume over the full implementation period.

Table 6-2. Total expected cut/fill and surface area alteration.

Component	Dimension Totals (feet)	Surface Area (square. feet)	Cut(-)/ Fill (+)Volume (cubic yards)
Access Routes	Varies, typically 10-12' wide	29,000	0
Pilot Channel	0.5-1.5' x 2-4' x 748'	2200	-50
Left Bank Overflows	0-1'x 5'-9' x 60'	450	-8
Debris and Fill removal at pre-1968 Channel	Bank – 1-2' x4-8' x 40-50' Channel – 0-1.5' x 6' x 50'	1000	-30/+15
Local Widening and Deepening on Favorable Flow Paths	Varies, typically 1-2' x 5' x 20'	1000	-45
Hummocks (Vegetation Only)	Varies, typically 20-30' x 40-70'	4750	0
Fill Hummocks	Varies, typically 0-1' x	4750	+122

Component	Dimension Totals (feet)	Surface Area (square. feet)	Cut(-)/ Fill (+)Volume (cubic yards)
	20-30' x 30-40'		
Miscellaneous Fill	Varies, typically 1-2" x 20-30' x 20-30'	9800	+60
Right Bank Plugs	0.5-1.0' x 5-10' x 120'	900	+17
Abandoned Road Fill Removal	1-2'x 20'x 350'	7,000	-390
Intermittent Fill in Erosional Depression	1-2' x 15' x 75'	1,150	+65
Planting Areas – Favorable and Unfavorable Flow Paths	Varies	10,000	0
Totals =	N/A	72,000 Grading – 28,250[1]	-523/+279 -244 net

[1]Excludes access routes and areas with vegetation planting only

6.3 Performance Metrics

Performance metrics are oriented to two different themes: 1) achieving the District's goals in protecting its facilities, and; 2) increasing the function and values of the marsh adjoining its easement. The actions to be taken under this AMP are expected to result in subtle shifts in the physical and biological attributes of the project area. For example, the easement itself will not be filled to the extent that it is no longer inundated during normal snowmelt peaks, nor will the fill hummocks result in the creation of upland habitat on the easement. Similarly, Trout Creek, although it may occupy a new alignment south of the easement, is expected to flood at the approximately the same discharge as it does currently in other areas of the marsh and will transport approximately the current quantity of bedload.

The California Rapid Assessment Methodology (CRAM, http://www.cramwetlands.org/documents) was evaluated to determine if it could be used directly as tool by which to evaluate the condition of various attributes of the marsh, and thereby serve as the basis of the adaptive management approach. Using that approach a target CRAM score could be established as a goal, and unacceptably slow progress in attaining that score would serve as a trigger for additional actions. The currently available CRAM modules were evaluated and found to be too broad for application to this project. CRAM currently lacks a montane meadow module. Both the Depressional Wetland and Riverine modules were evaluated, but these lack sufficient sensitivity to provide scoring to serve as the monitoring mechanism for success of the project. The fundamental problem is that CRAM is more suited to gross characterization of the wetland, and in particular, where wetlands are affected by various anthropogenic stressors (e.g., diversions, drainage ditches, low connectivity due to road crossings, etc.). Review of the available modules raised concerns that the expected results of the project would be too subtle to produce a measurable or significant change in the CRAM score. However, several of the CRAM wetland attributes are useful in defining expected shifts, or "lifts", in wetland function expected as a result of the project. Table 6-3 illustrates these expected shifts in riverine wetland CRAM attributes.

Table 6-3. Expected riverine CRAM Wetland Attribute shifts.

Wetland Attribute	Expected Shift	Explanation
Physical Connectivity	→	Not altered by project
Buffer Condition	↑	Willow plantings off easement discourages human intrusion
Water Source	→	Not altered by project
Channel Stability	→	Deltaic rather than riverine setting, channel stability should be low
Hydrologic Connectivity	↑	Stream alignment moves to marsh center, creation of overflow distributaries, removal of abandoned road fill.
Structural Patch Richness	↑	Minor benefit from willow plantings, minor benefit from hummock fills, but no conversion to different habitat type.
Topographic Complexity	↑	Minor shift from hummock fills > +1 ft. over prevailing meadow surface
Plant Community Composition	↑	Willow plantings will increase horizontal interspersion, and vertical layering

In order to increase the resolution through which the project can be evaluated, the following project-specific performance metrics will be used.

1. Flow reduction on right overbank (aggradation/degradation)
2. Extent of inundation during low flows
3. Cover and vigor of planted wetland vegetation

Based on the above, the following success criteria are established:

1. At approximately bankfull stage, as measured at a point 700 feet upstream from the Bellevue Pump Station, not less than 90 percent of the flow shall pass through new pathways off the left bank, i.e., not more that 10 percent of the flow shall remain in the existing channel downstream of the left bank pathways. At flows of approximately 50 cfs as measured at the Tahoe Valley gage, corresponding to the 80 percent exceedence flow, there shall be no standing or flowing water on the easement. This discharge is equivalent to the mean discharge in late June, and flows for the remainder of the summer and fall are typically lower (see Figure 2-7).
2. Planted wetland herbaceous vegetation and sod shall be established at 80 percent of baseline cover after 1 year and 85 percent of baseline cover after 2 years and shall exhibit good vigor. Planted woody vegetation shall be established at 80 percent survival and exhibit good vigor. Willows in willow fences shall be established to provide a continuous flow barrier over 100 percent of the planted length. Wetland herbaceous native species composition shall be 90 percent of baseline after 1 year and 95 percent of baseline after 2 years. Wetland species, combining species classified as obligate and facultative, shall equal or exceed baseline after 2 years.

3. Hummock Fills. The hummock fills will maintain functional wetland characteristics for vegetation and periodic inundation, continuing to meet criteria as jurisdictional wetlands.

6.4 Success Criteria Monitoring

The District has established 13 monumented cross sections in the vicinity of Bellevue Pump Station, three stage recorders on the existing channel, and one stage recorder in a groundwater well in Bellevue Avenue near the Pump Station. Continuous stage records, annual surveys, and semi-annual photo monitoring will be conducted using these established locations. In addition, flow measurements and site observations will be made to evaluate progress towards success criteria. A monitoring plan has been developed and is included as Appendix E.

Monitoring will be performed to assess the progress toward meeting each success criterion as follows. Monitoring will be conducted annually, continuing for two years after the final implementation phase (maximum of six years after the Year 1 Plan is implemented).

1. Right overbank flow reduction. Monitoring will consist of measuring streamflow at bankfull stage at a point approximately 700 feet upstream of the Bellevue Pump Station and at a point within the existing right overbank near the pump station.

2. Absence of inundation. The streamflow record from the Tahoe Valley gage will be used to document the date on which 50 cfs is first observed following the snowmelt recession. The stage recorders will then be queried to determine the water surface elevation on that date. Those elevations will be used, in conjunction with an annually updated survey at the 13 established cross sections, to map topographic changes and inundation on the easement. This information will be supplemented by photos from 6 established photo points in summer and late fall of each year.

3. Vegetation cover, vigor, and growth. Vegetative cover and vigor will be monitored using transects, site observations, and photos. Monitoring will be based primarily on visual observations for each of the implemented features, but will be supplemented by transects for the abandoned road fill removal and hummocks. Transects will be monitored for baseline and constructed conditions. Three transects will be established in the road fill removal area and three will be established across constructed fill hummocks. Transect information will be supplemented by 6 established photo points in summer and late fall of each year. Willows will be observed, counted, and measured for mean height at each project feature. Willow observations will be supplemented by photo documentation.

6.5 Thresholds for Development and Implementation of Year 2 to5 Plans

Based on monitoring, additional measures will be implemented in Years 2 to 5 the area to ensure the project meets its objectives within the seven year period. Thresholds to initiate additional action are given below.

Year 2

1. Less than a 60 percent reduction in right overbank flows at bankfull stage.
2. Inundation of more than 30 percent of the length of the easement at 50 cfs.
3. Evidence of headcut migration toward pump station.
4. Significant erosion at any location on the existing channel right bank floodplain.
5. Trends suggesting potential failure to meet criteria for planted vegetation within two years.

Year 3

1. Less than an 80 percent reduction in right overbank flows at bankfull stage.
2. Inundation of more than 20 percent of the length of the easement at 50 cfs.
3. Evidence of headcut migration toward pump station.
4. Significant erosion at any location on the existing channel right bank floodplain.
5. Trends suggesting potential failure to meet criteria for planted vegetation within two years.

Years 4 and 5

1. Less than a 90 percent reduction in overbank bankfull channel capacity.
2. Inundation of the easement at flows less than 50 cfs (as measured at Tahoe Valley gage).
3. Trends suggesting potential failure to meet criteria for planted vegetation within two years.

To ensure long-term project success, the District may elect to implement additional actions even if the thresholds above do not occur, provided the scope of the actions is within that described in this AMP., Other minor actions may be performed at any time using hand crews to repair or enhance installed measures, maintain plantings, and remove debris.

6.6 Other Monitoring

Additional monitoring will be performed during to document baseline conditions, to ensure protection of resources during construction, and to document conditions throughout the project area over the monitoring period.

Baseline Monitoring

1. Document existing topography .
2. Map extent of inundation at Tahoe Valley discharge of 50 cfs
3. Establish permanent photo points and document existing conditions.
4. Map occurrence and condition (approximate age and height) of woody riparian vegetation within the project area.
5. Measure baseline cover on wetland transects in road fill and proposed hummock areas.
6. Monitor stream turbidity to ascertain the normal range of background turbidity in the project area.

Construction Monitoring

1. Automated turbidity monitoring above and below project area.
2. Pilot channel width measured at 5 points every 3 days while crews are operating.

Post Implementation: Years 2 to 7

1. Turbidity monitoring above and below work area near Bellevue pump station.
2. Photo documentation at all photo points each year taken on three dates, depending on flow conditions (50 cfs on recession, August 15, October 15).
3. Continuous operation of three stream stage recorders (relocation may be necessary depending on channel behavior) and groundwater stage recorder.
4. Mapping of flow paths established after Year 1 Implementation and cross-section measurements taken at monumented cross-sections.
5. Topographic mapping and generation of digital surfaces to quantify aggradation and degradation on the right overbank.
6. Transect measurements in road fill removal and hummocks.
7. Willow survival and growth measurements at each project feature.
8. Photo documentation at photo points for wetland vegetation and at project features for woody riparian vegetation.

6.7 Reporting

Reporting is intended to confirm that the District is in conformance with permits issued for the project and to identify approved measures to be implemented in Years 2 to 5. Monitoring reports will include proposed work plans for measures to be implemented later in the reporting year and a brief rationale for their selection.

Each annual monitoring report will measure the progress of the project toward meeting the success criteria stated above and will also provide information on channel aggradation or erosion within the confines of the area mapped during the baseline topographic survey, including results from recording turbidimeters.

Annual reports will be submitted to permitting agencies by no later than July 20 during Years 2-5. Although the 50 cfs index flow corresponds approximately to a July 1 mean, that flow may not be met until considerably later during wet years. As a result, some extrapolation of the inundated area based on higher stream stages may be necessary. For post-construction years (Years 6 and 7 if implementation requires 5 years) the annual report will be submitted by December 1.

6.8 Review of Year 2 through 5 Implementation Work Plans

The AMP defines measures to be implemented over the full period and permitting for the project is based on this term. Information provided in the annual reports is to ensure that regulatory agencies and the Conservancy, as landowner, are provided regular progress updates and could intervene if actions are inconsistent with permits or are considered a risk to protected resources. Unless the measures to be implemented are changed significantly from those described in this AMP, no formal

approval process for Year 2 to 5 plans is required. If deviations from proposed measures, access routes, or dewatering methods are required, the annual report will clearly identify the deviations.

Any deviations in the staging, access, or dewatering plans from the AMP shall be identified.

If for any reason a permitting agency considers a subsequent plan not to be in conformance with this AMP, then it shall provide its findings to the District no later than August 20. The District shall then make modifications as needed to bring the plan into conformance with this AMP and shall not implement the plan sooner than 15 days following re-submittal.

7.0 Year 1 Plan

The primary objective of the Year 1 Plan is to prevent Trout Creek from establishing a new main channel in or very near the easement, with secondary objectives consistent with the long term goals of the project to reduce inundation on the easement and reduce risk in future channel changes and avulsions. The current site topography was surveyed in October 2013. The layout of the Year 1 measures described is approximate, based on the current topography, and location and extent may be adjusted to match topography at the time of implementation in summer 2014. Preliminary plans for Year 1 Improvements are provided in Appendix D.

7.1 Basis of Design

The basis of the Year 1 design is to encourage natural erosional and depositional processes that will promote channel formation south of the avulsion area and easement using minimal excavation and fill. The general approach is to reduce resistance to flow in the left overbank in the area of the avulsion and increase resistance in the right overbank and easement area. To reduce the chances that a new channel will form immediately adjacent to the southern edge of the right overbank features and encourage channel locations further away from the easement, the right overbank measures constructed in Year 1 will be very nearly at existing grades. As noted in Section 6, depending on channel behavior and floodplain deposition in response to the Year 1 measures, additional work is likely in the easement area in subsequent years.

Year 1 measures include:

1. Opening alternate flow paths to the south in the area of the channel avulsion using pilot channels and left overbank openings;
2. Increase in resistance to flows in the right overbank using constructed hummocks and plugging of right overbank flow paths;
3. Removal of the road fill and plugging of the erosional depression upstream of the fill;
4. Local widening and deepening on favorable flow paths, most likely on the pre-1968 channel in the center of the meadow;;
5. Willow planting on secondary flow paths and remnant channels to encourage favorable flow paths and discourage unfavorable paths.

Year 1 Improvements result in the following disturbance, excavation, and fill quantities shown in Table 7-1.

Table 7-1. Year 1 disturbance areas, cuts, and fills.

Component	Surface Area, square feet	Cut (-)/Fill(+) Volume, cubic yards
Access routes	11,000	0
Pilot Channels	1,350	-37
Left Bank Overflows	350	-6
Local Widening/Deepening on Favorable Flow Paths	450	-22
Hummocks (Vegetation Only)	2800	0
Fill Hummocks	2850	+91
Miscellaneous Fill	3600	+22
Right Bank Plugs	600	+12
Abandoned Road Fill Removal	7,000	-390
Intermittent Fill in Erosional Depression	1,150	+65
Planting Areas – Favorable and Unfavorable Flow Paths	4,900	0
Totals	36,050 Grading – 17,350[1]	-455/+190 -265 net

[1]Excludes access routes and areas where only planting occurs; equipment grading required for road fill removal – 7,000 square feet

Year 1 Improvements will be constructed in the late summer and fall of 2014. Construction is anticipated to begin after 1 Sep 2014 and grading activities will conclude on or before 15 October. Planting activities are expected to conclude by 15 December 2014.

Year 1 activities will have two separate focal points; removal of fill from the abandoned road and installation of the measures described above along the right overbank east of the pumping station. They can largely be conducted independently of each other and it is expected that there will be a minimum of interaction between crews and equipment assigned to each area with the exception of transporting fill from the road fill removal area over to the right overbank area for use there in building hummock fills.

For the fill removal, a full-sized excavator will likely be employed as the primary and perhaps sole piece of equipment operating there. An LGP loader might also operate there to assist in moving sod and batching fill for load-out into the trucks. Non-LGP equipment will be limited to the protected access route or an extension protected with plates or mats. LGP equipment will be allowed on the excavated surface provided that this does not result in compaction of the subgrade. Given the limited turning radius onto the abandoned road, it is reasonable to expect that 10-yard dump trucks, with a capacity of 6-8 cubic yards of earth will be utilized to transport the fill off-site. As a worst case, if all of the material

excavated were trucked off site (390 cubic yards, as opposed to the 265 net yards given in Table 7-1), with none of the fill used to construct hummock fills, then 62 round trips would be needed to remove the entire abandoned road fill. Truck trips are expected to be directly related to excavation production rates on the road fill removal to minimize the need for double handling excavated material. This gives an estimate that truck trips per day will be in the range of 8 to 15, with trucks moving into and out of the site within a range of 4 to 10 working days. During the fill removal, some fill will be transported to the right overbank area upstream of the pump station. This may require a small temporary stockpile site along Bellevue Avenue near the gate. Fill will then be transported along a designated access route onto the right overbank area for fill hummock construction using LPG equipment, such as a Caterpillar 247B or 259B loader.

The loader would be used to transport fill to the fill hummocks and to transport protective mats, coir logs, marsh mats and other materials. Additional operations off the access route might include transporting coir logs, moving excavated sod, and transporting fill generated during pilot channel excavation and delivered to the right bank of the channel. Equipment access outside the access route or footprint of the fill hummocks will be allowed only to the extent that it does not result in compaction or rutting of the meadow surface.

For the work area upstream of the pump station, the most likely crew size will be 5 to 10 people, including equipment operators. The crew might temporarily be larger during excavation of the pilot channels as all of the excavation there must be performed by hand crews. Initial operations will involve excavation of the pilot channels and other dewatering measures, including construction of the right bank plugs. Once the site is dewatered, mats or plates will be installed on the access route, and stockpiling of materials can commence. It is reasonable to expect that operations will proceed from south to north so as not to impede access to the right bank plug sites and hummocks. Once all measures south and east of the access route are complete, the hummock fills would be constructed. Although this description is a reasonable expectation, the contractor will be allowed to develop alternative construction sequences, with the exception that all dewatering measures must be in place prior to any operation of equipment.

The time required to complete fill removal is not expected to exceed 10 working days and could require as little as four days. Because operations at each area are largely independent of each other the contractor may conduct operations simultaneously. At the work area upstream of the pump station, the entire available construction window from September 1 to October 15 may be utilized. It is reasonable to expect that up to a week would be required to prepare the site, install protective fencing and install wood chips and mats, with a similar length of time required after operations are complete for clean-up. Based on this, active operations will probably require 2 to 4 weeks with a maximum crew of approximately 20 people when both principal operations are in progress, decreasing to 5 to 10 people once the road fill removal is complete.

In addition to the possible maximum of 62 truck trips required for fill removal, it is anticipated that an additional 30 trips might be required to import wood chips, travel mats, marsh mats and other materials, and to transport equipment into and out of the site.

8.0 References

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APPENDIX A - PERMITTING DOCUMENTS

UPPER TRUCKEE MARSH SEWER FACILITIES

ADAPTIVE MANAGEMENT PLAN

(To be Completed)

APPENDIX B - HYDROLOGY

UPPER TRUCKEE MARSH SEWER FACILITIES

ADAPTIVE MANAGEMENT PLAN

This appendix provides back-up information of flood frequency and flow duration analyses conducted using USGS Gage 10336780, Trout Creek at Tahoe Valley, approximately 1.5 miles upstream of the project site, with a tributary area of 36.7 square miles. Because much of the runoff at the gage is generated by snowmelt from the upper watershed and because the tributary area at the site is only about 10% larger than the tributary area at the gage, values recorded at the gage are considered reasonably representative of peak flow and flow duration conditions at the site. However, some effects of urban runoff from the intervening tributary area to the site are not represented in the gage record.

Bulletin 17B Frequency Analysis

Analysis Name: Flood Frequency Analysis
Description: Flood Frequency Analysis of Trout Creek at Tahoe Valley USGS gage 10336780 using HEC-SSP software by the United States Army Corps of Engineers

Data Set Name: Peak Annual Flows

Start Date: June 14, 1961
End Date: January 21, 2012

Skew Option: Use Station Skew
Regional Skew: 0.24
Regional Skew MSE: 0.203

Plotting Position Type: Median

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Display ordinate values using 1 digits in fraction part of value

<< Low Outlier Test >>
Based on 51 events, 10 percent outlier test deviate K(N) = 2.775
Computed low outlier test value = 16.57
0 low outlier(s) identified below test value of 16.57

<< High Outlier Test >>
Based on 51 events, 10 percent outlier test deviate K(N) = 2.775
Computed high outlier test value = 1,205.07
0 high outlier(s) identified above test value of 1,205.07

--- Bulletin 17B Frequency Analysis Results ---

<< Plotting Positions >>
Peak Annual Flows

Events Analyzed				Ordered Events				
	FLOW				Water	FLOW	Median	
Day	Mon	Year	CFS	Rank	Year	CFS	Plot Pos	
14	Jun	1961	64	1	2006	615	1.36	
15	Jun	1962	90	2	1997	535	3.31	
1	Feb	1963	535	3	1963	535	5.25	
15	Nov	1963	57	4	1986	480	7.2	
24	Dec	1964	411	5	2011	445	9.14	
10	May	1966	80	6	1965	411	11.09	
1	Jul	1967	280	7	1983	358	13.04	
20	Feb	1968	82	8	1980	337	14.98	
6	Jun	1969	280	9	1995	319	16.93	
21	Jan	1970	250	10	1996	303	18.87	
27	Jun	1971	226	11	1982	298	20.82	
7	Jun	1972	100	12	1969	280	22.76	
31	May	1973	176	13	1967	280	24.71	
7	Jun	1974	163	14	1999	269	26.65	
7	Jun	1975	202	15	1970	250	28.6	
26	Oct	1975	97	16	1984	230	30.54	
29	May	1977	50	17	1998	229	32.49	
9	Jun	1978	26	18	1971	226	34.44	
27	May	1979	120	19	1975	202	36.38	
13	Jan	1980	337	20	2005	197	38.33	
30	Apr	1981	62	21	1973	176	40.27	
16	Feb	1982	298	22	2010	174	42.22	
18	Jun	1983	358	23	1993	165	44.16	
31	May	1984	230	24	1974	163	46.11	
15	Apr	1985	100	25	2003	142	48.05	
8	Mar	1986	480	26	1978	126	50	
29	Apr	1987	46	27	1979	120	51.95	
24	Mar	1988	42	28	2012	110	53.89	
3	Jun	1989	93	29	2000	105	55.84	
16	Apr	1990	40	30	1985	100	57.78	
4	Mar	1991	91	31	1972	100	59.73	
26	Oct	1991	71	32	1976	97	61.67	
31	May	1993	165	33	1989	93	63.62	
20	Apr	1994	47	34	1991	91	65.56	
26	Jun	1995	319	35	1962	90	67.51	
16	May	1996	303	36	1968	82	69.46	

2	Jan	1997	535	37	1966	80	71.4
22	Jun	1998	229	38	2009	73	73.35
29	May	1999	269	39	1992	71	75.29
14	Feb	2000	105	40	2002	69	77.24
15	Apr	2002	69	41	2008	65	79.18
30	May	2003	142	42	1961	64	81.13
6	May	2004	58	43	2007	62	83.07
29	May	2005	197	44	1981	62	85.02
31	Dec	2005	615	45	2004	58	86.96
14	Nov	2006	62	46	1964	57	88.91
18	May	2008	65	47	1977	50	90.86
19	May	2009	73	48	1994	47	92.8
7	Jun	2010	174	49	1987	46	94.75
28	Jun	2011	445	50	1988	42	96.69
20	Jan	2012	110	51	1990	40	98.64

<< Skew Weighting >>

Based on 51 events, mean-square error of station skew = 0.113

Mean-square error of regional skew = 0.203

<< Frequency Curve >>

Peak Annual Flows

Computed Curve FLOW, CFS	Expected Probability	Percent Chance Exceedance	Confidence Limits 0.05 FLOW, CFS	0.95
1,538.9	---	0.2	2,559.0	1,056.9
1,173.0	---	0.5	1,857.3	833.4
940.7	---	1.0	1,432.3	686.5
741.6	---	2.0	1,083.7	556.5
522.5	---	5.0	720.8	407.4
385.3	---	10.0	507.5	309.3
268.7	---	20.0	337.6	221.6
138.2	---	50.0	165.4	115.3
73.4	---	80.0	89.0	58.3
53.3	---	90.0	66.3	40.7
41.3	---	95.0	52.5	30.3
25.9	---	99.0	34.7	17.6

<< Systematic Statistics >>
Peak Annual Flows

Log Transform:	
FLOW, CFS	Number of Events
Mean 2.150	Historic Events 0
Standard Dev 0.335	High Outliers 0
Station Skew 0.175	Low Outliers 0
Regional Skew 0.240	Zero Events 0
Weighted Skew 0.198	Missing Events 0
Adopted Skew 0.175	Systematic Events 51

--- End of Analytical Frequency Curve ---

Summary Hydrograph

Analysis Name: Summary Hydrograph
Description: Summary Hydrograph Analysis of Trout Creek at Tahoe Valley USGS gage 10336780

Data Set Name: Mean Daily Flows

Start Date: October 1, 1960
End Date: October 1, 2013

The Summary Hydrograph displays mean daily flow exceedence values for each day of the year. This record of over 50 years provides statistically reliable streamflow characteristics. Using a daily data set the data are sorted by month, day and flow. Exceedence percentiles are calculated using the flow duration percentile equation, given as:

$$P = 100 * [1 - \left(\frac{m}{n+1}\right)]$$

where P is the exceedence probability, m is the ranking from highest to lowest of daily mean flows for each day, and n is the total number of daily mean flow records for each day. Displayed exceedence percentiles are interpolated linearly to the nearest 1 percent from the nearest calculated percentiles. For the summary hydrograph high flows are assigned high percentiles and low flows are assigned low percentiles, as opposed to the exceedence probabilities in the flow duration analysis.

Flow Duration Analysis

Analysis Name: Flow Duration Analysis
Description: Flow Duration Analysis of Trout Creek at Tahoe Valley USGS gage 10336780

Data Set Name: Mean Daily Flows

Start Date: October 1, 1960
End Date: June 5, 2013

The flow duration curve shows the percentage of time that flow in Trout Creek is likely to meet or exceed any specified flow value. Similar to the summary hydrograph, this curve is calculated as follows:

$$P = 100 * (\frac{m}{n+1})$$

where P is the exceedence probability, m is the ranking from highest to lowest of daily mean flows for each day, and n is the total number of daily mean flows. The curve is a plot of discharge vs. percent of time exceeded. The y-axis is displayed in log 10 scale.

Appendix C - Historical Channel Locations

UPPER TRUCKEE MARSH SEWER FACILITIES

ADAPTIVE MANAGEMENT PLAN

This appendix provides basic information on historical Trout Creek channel locations using the aerial photographic record available through *Google earth* ©. Figure C1 shows a graphical summary of the primary and secondary channel locations derived from the aerial photos and Figures C2 to C5 show selected historical aerial photos to illustrate key changes in channel pattern over time.

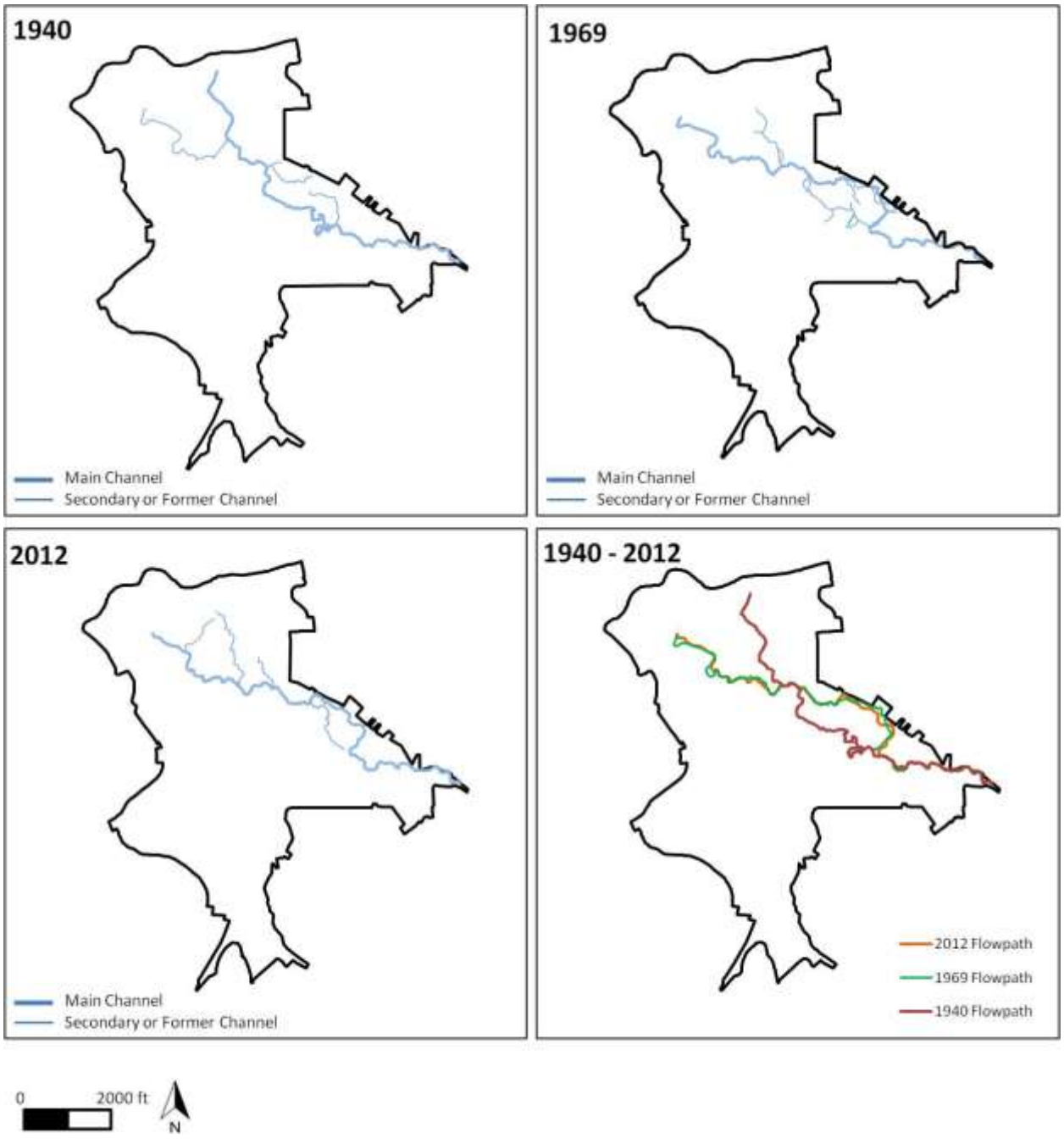

Figure C1. Summary of Historical Channel Locations

Figure C2. 1940 Aerial Photo (Source: GoogleEarth) showing dominant Trout Creek channel in center of marsh and sinuous meander pattern upstream of road

Figure C2. 1969 Aerial Photo (Source: GoogleEarth) showing Trout Creek avulsion or rerouting to north side of meadow

Figure C3. 1987 Aerial Photo (Source: GoogleEarth) showing dominant Trout Creek channel along northern edge of meadow and active secondary channel in center of meadow

Figure C4. 2009 Aerial Photo (Source: GoogleEarth) showing dominant channel prior to the 2011 avulsion near Bellevue Pump Station and remnant secondary channels in center of meadow

Figure C5. 2012 Aerial Photo (Source: GoogleEarth) showing Trout Creek channel pattern after the 2011 avulsion near Bellevue Pump Station

APPENDIX D – YEAR 1 PLANS

UPPER TRUCKEE MARSH SEWER FACILITIES

ADAPTIVE MANAGEMENT PLAN

SHEET INDEX

COVER	T1
LEGEND & NOTES	G1
ACCESS & STAGING PLAN	G2
ROAD FILL REMOVAL	C1
IMPROVEMENTS NEAR BELLEVUE PUMP STATION	C2
TYPICAL SECTIONS	C3
ALTERNATIVE FLOW PATH IMPROVEMENTS	C4
DETAILS	D1
DETAILS	D2

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
1275 Meadow Crest Road
South Lake Tahoe, California 96150

APPROVED BY:

xxxxxxxxxxxx, title *(date)*

xxxxxxxxxxxx, title *(date)*

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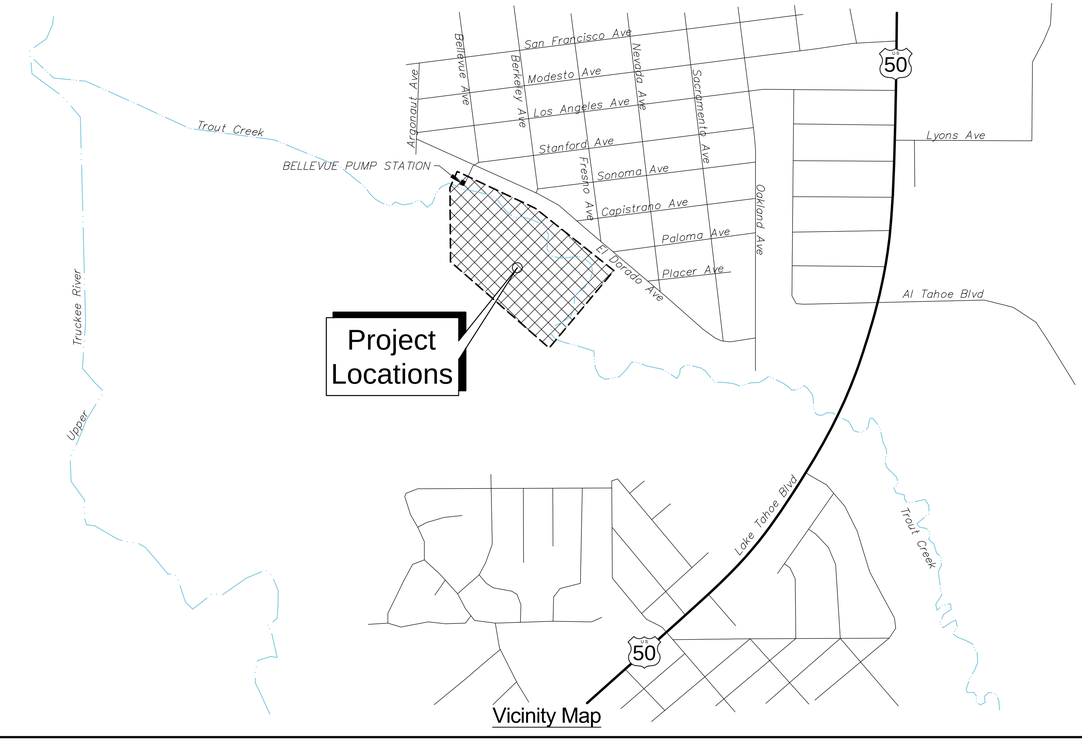
Reno, Nevada 89511
(775) 849–3223
www.wbsinc.us

REGISTERED PROFESSIONAL ENGINEER
EDWARD E. WALLACE
No. 32301
Exp: 12/31/14
CIVIL
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

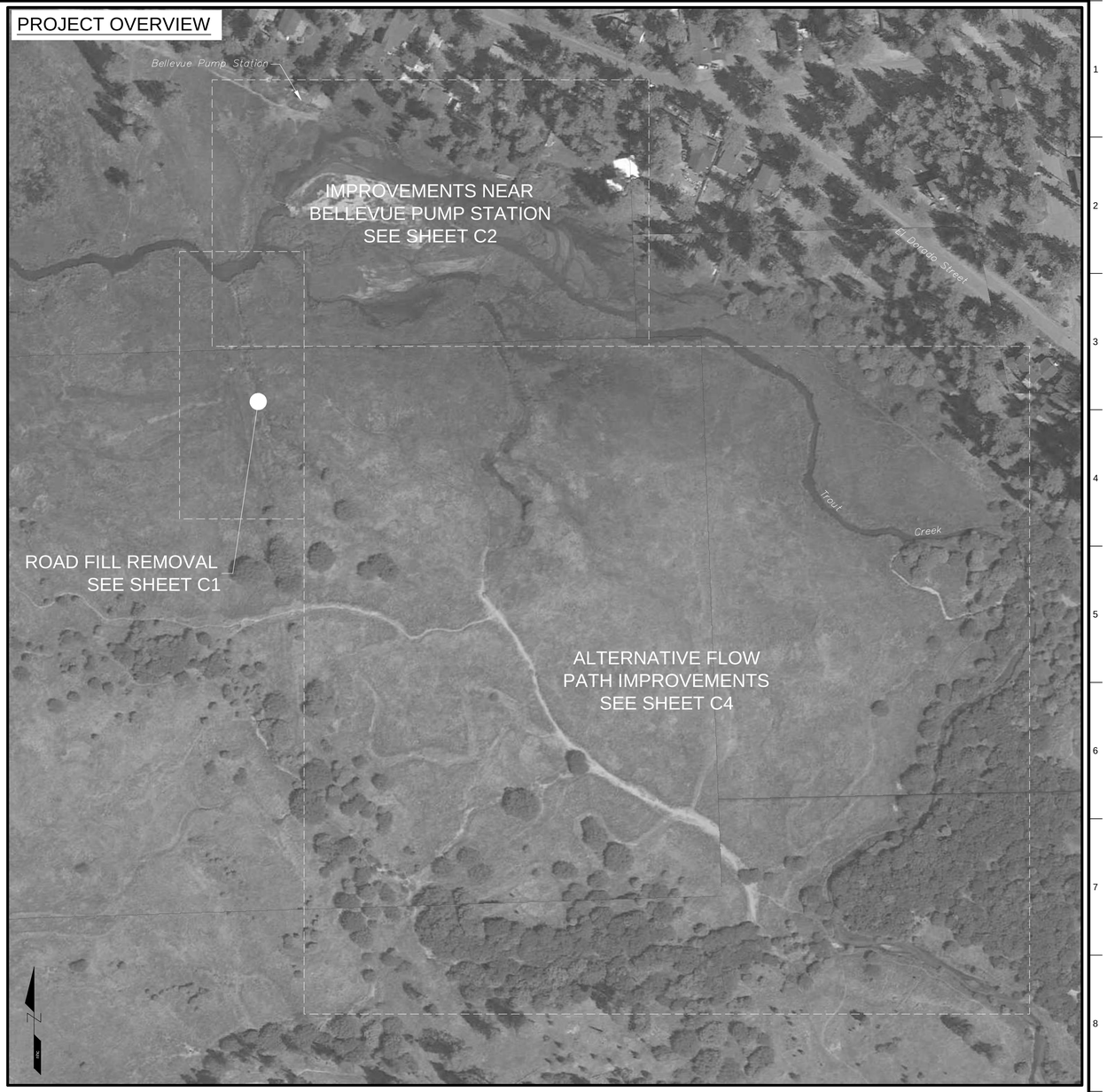
VERTICAL: NAVD88
NGS HPGN D CA 03 FS
EL 6248.20

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
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Revisions		
No.	Date	Description

Drawing Information	
Date	3 April 2014
Status	60% Submittal
Designer	eew
Drafter	tvs
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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Revisions		
No.	Date	Description

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

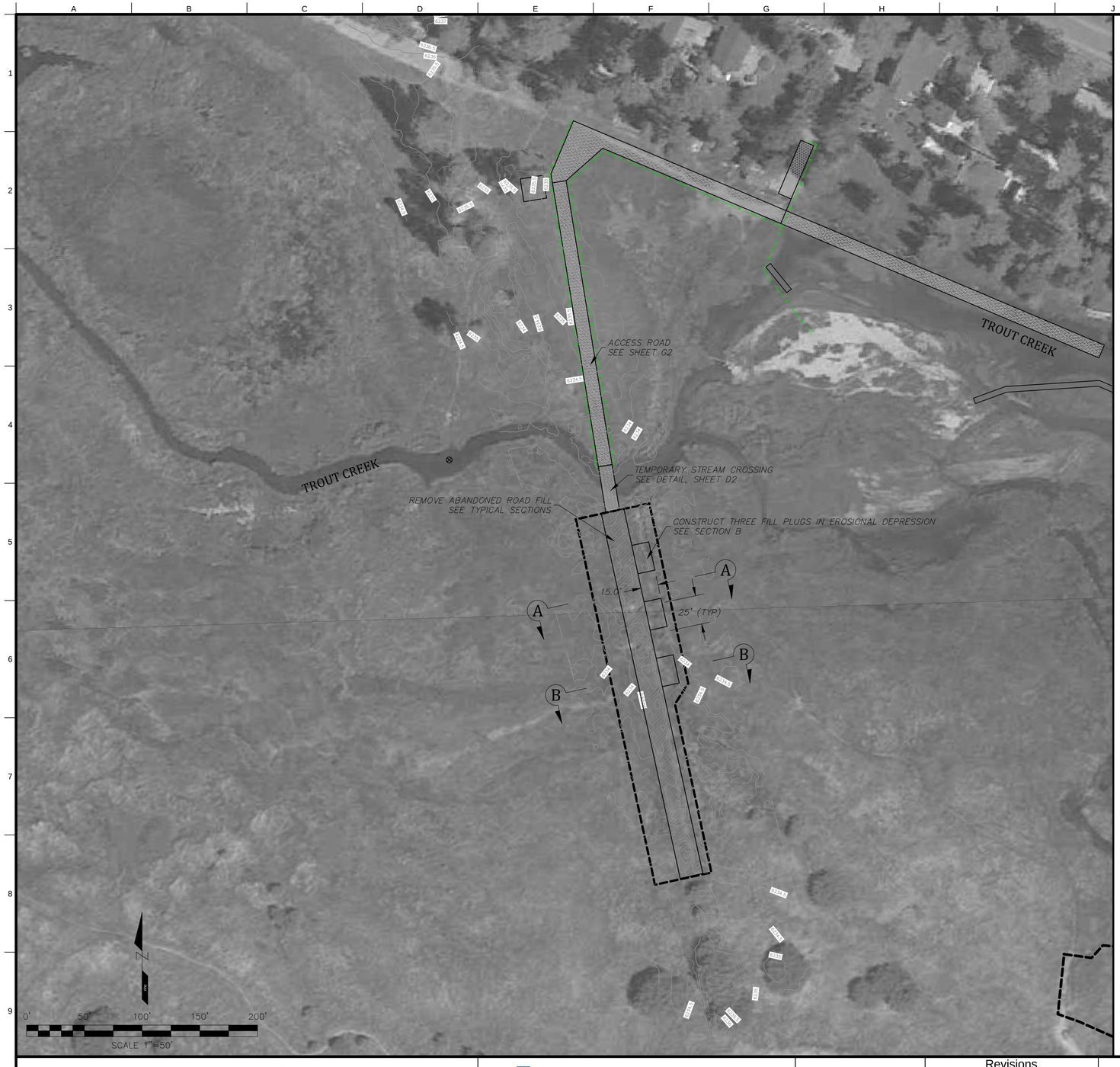
Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 1 Improvements
Aerial & Staging Plan Sheet

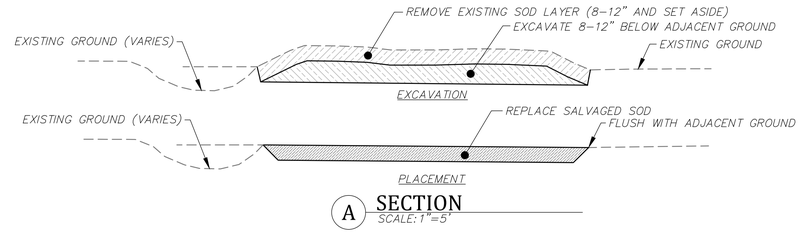
Job Number 600035

Sheet Number

G2

Sheet 3 of 9





A SECTION
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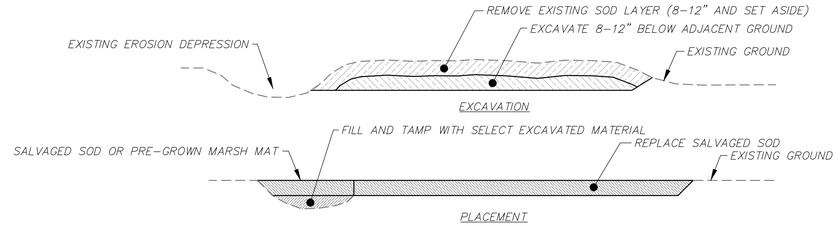

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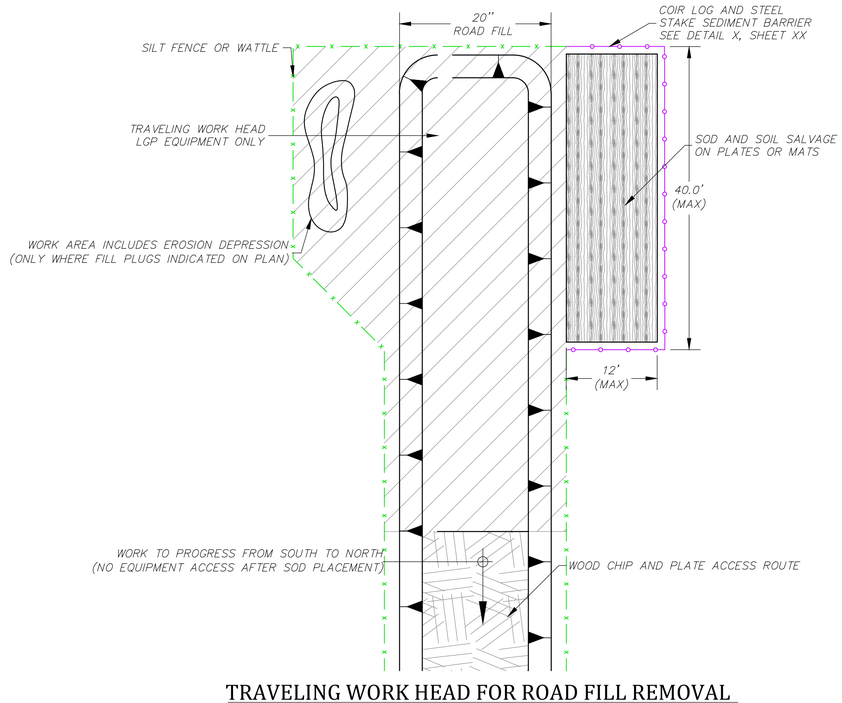

TRAVELING WORK HEAD FOR ROAD FILL REMOVAL
SCALE: 1"=10'

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Revisions		
No.	Date	Description

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Drafter	tvs
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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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No.	Date	Description

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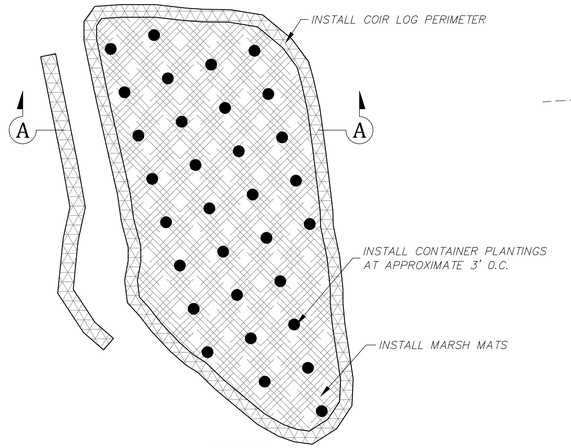
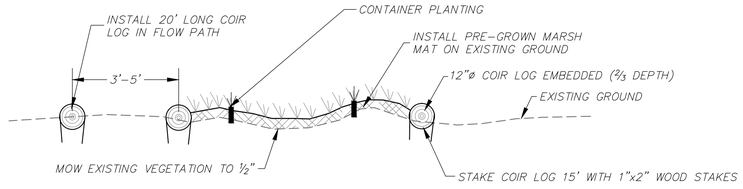
File Name	UT MARSH
Plotted Scale	0 1/2 1

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

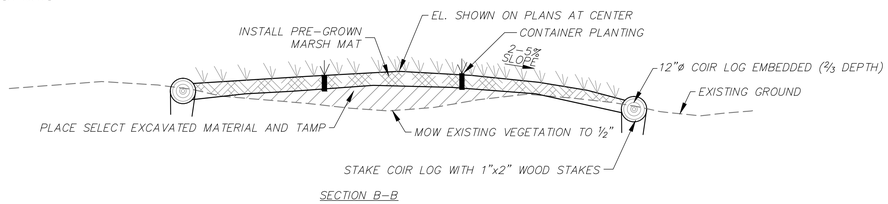


SECTION A-A

HUMMOCK DETAIL

Not to Scale

PLAN VIEW



SECTION B-B

FILL HUMMOCK DETAIL

Not to Scale

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No.	Date	Description

Drawing Information	
Date	3 April 2014
Status	60% Submittal
Designer	eew
Drafter	tvs
Checked	eew
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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Revisions		
No.	Date	Description

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

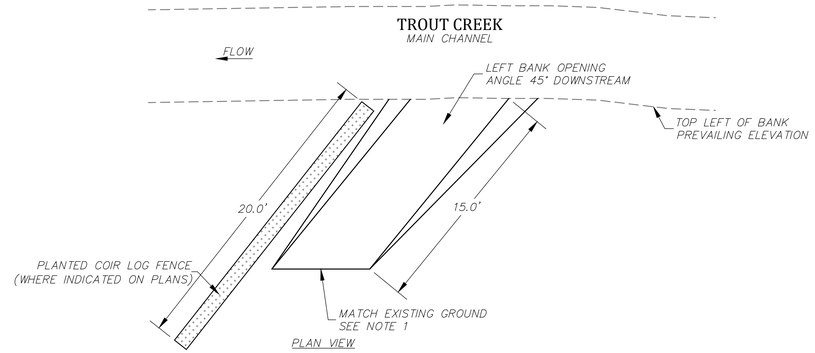
Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 1 Improvements
Alternative Flow Path Improvements
Plan Sheet

Job Number
600035

Sheet Number

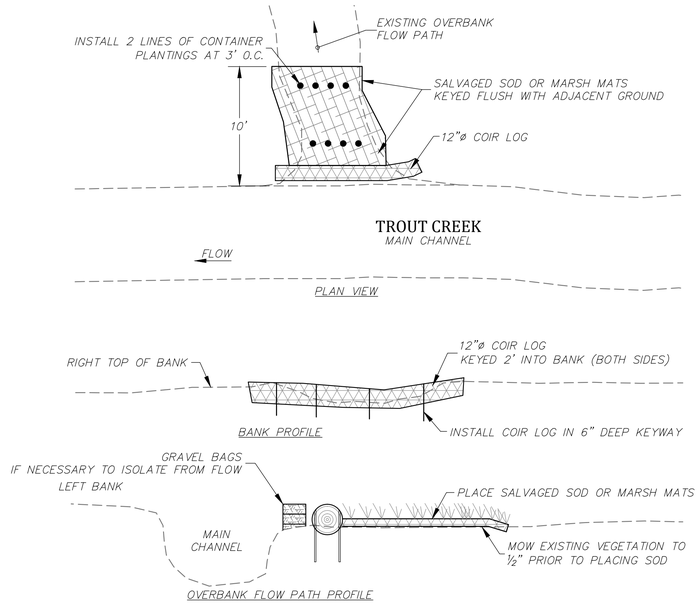
C4

Sheet 7 of 9

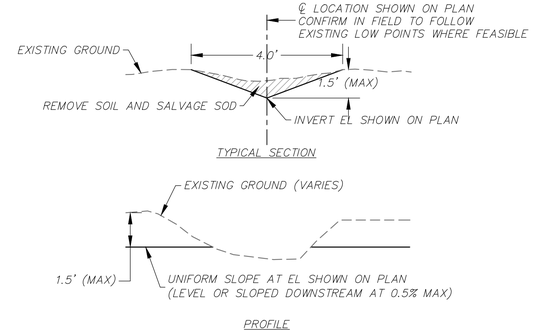


LEFT OVERBANK OPENING
Not to Scale

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

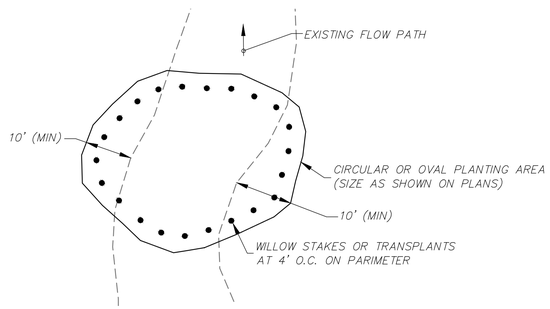


RIGHT OVERBANK PLUG
Not to Scale

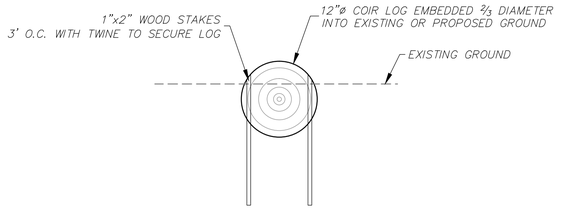


PILOT CHANNEL
Not to Scale

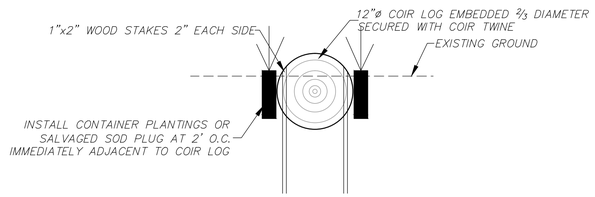
NOTES:
1. AT 40' INTERVALS ON PILOT CHANNEL, SALVAGE AND REPLACE SOD FLUSH WITH CHANNEL SHAPE TO FORM A 5' WIDE VEGETATED SILL. INSTALL ONE SILL AT OUTLET TO MAIN CHANNEL.



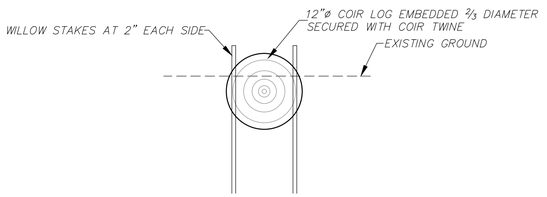
WILLOW SAUSAL
Not to Scale



COIR LOG INSTALLATION
Scale: 1"=5'



PLANTED COIR LOG
Not to Scale



WILLOW FENCE
Not to Scale

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Revisions		
No.	Date	Description

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

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Upper Truckee Marsh Sewer Facilities
Adaptive Management Plan
Year 1 Improvements

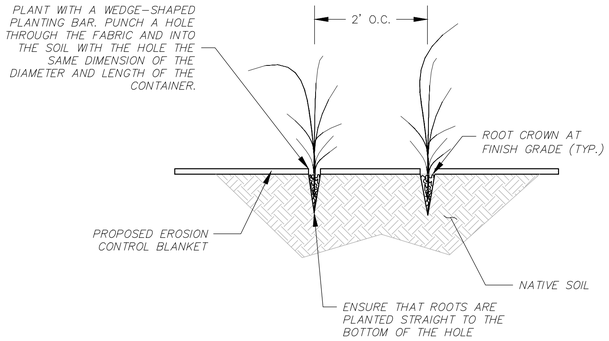
Details Sheet

Job Number 600035

Sheet Number

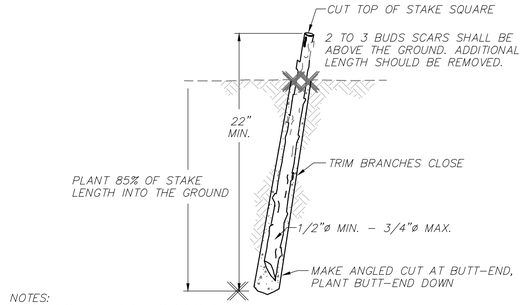
D1

Sheet 8 of 9



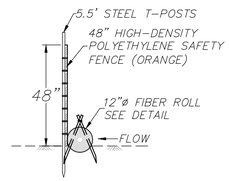
NOTES:
1. PULL NETTING APART PRIOR TO DIGGING THE PLANTING HOLE TO MINIMIZE THE NEED TO CUT THE FABRIC.
2. WETLAND PLUGS SHALL BE CAREX NEBRASCENSIS AND JUNCUS BALTICUS.
3. WETLAND PLUGS SHALL BE SUPERCELL 1.5 INCH WIDE AND 8 INCHES DEEP OR DEEPOTS (10-INCH DEPTH).

WETLAND PLUG PLANTING
Not to Scale

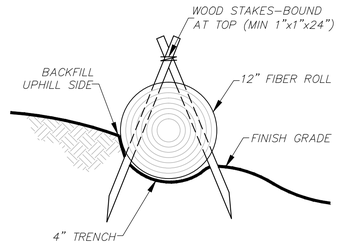


NOTES:
1. HARVEST AND PLANT STAKES DURING THE DORMANT SEASON.
2. USE HEALTHY, STRAIGHT AND LIVE WOOD AT LEAST 1 YEAR OLD.
3. MAKE CLEAN CUTS AND DO NOT DAMAGE STAKES OR SPLIT ENDS DURING INSTALLATION, USE A PILOT BAR IN FIRM SOILS.
4. SOAK CUTTINGS FOR 24 HOURS (MIN.) PRIOR TO INSTALLATION.
5. TAMP THE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

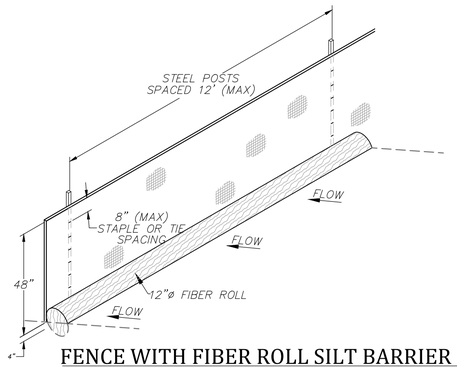
WILLOW LIVE STAKING
Not to Scale



SECTION
FIBER ROLL SILT BARRIER AT SAFETY FENCE

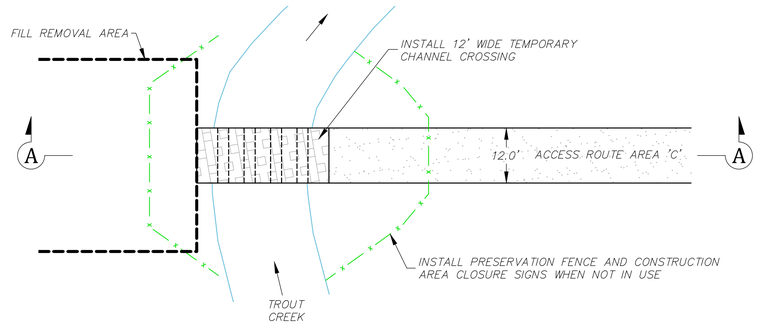


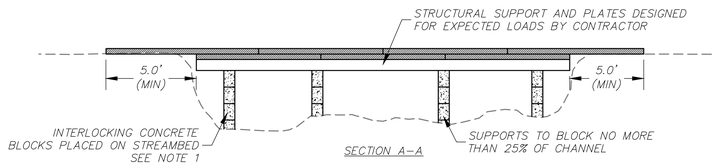
SECTION
FIBER ROLL SILT BARRIER



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

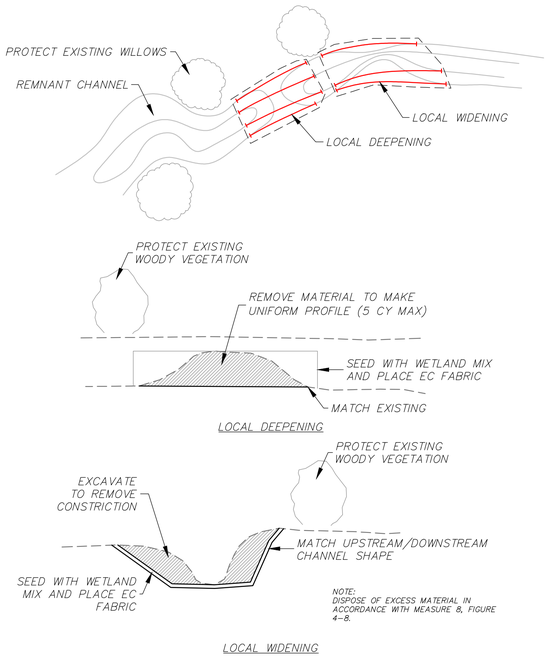




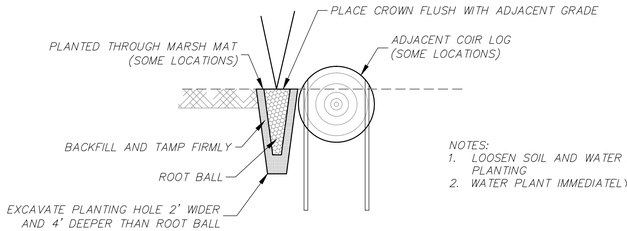
SECTION A-A

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

South Tahoe Public Utility District
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PRELIMINARY
NOT FOR CONSTRUCTION

Revisions		
No.	Date	Description

Drawing Information	
Date	3 April 2014
Status	60% Submittal
Designer	eew
Drafter	tvs
Checked	eew
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 D2

Sheet 9 of 9

APPENDIX E – MONITORING PLAN

UPPER TRUCKEE MARSH SEWER FACILITIES

ADAPTIVE MANAGEMENT PLAN

Introduction

This plan supplements Sections 6.4 to 6.6 of the AMP to provide additional details for monitoring protocols and reporting. It is intended to serve as the SEZ and Wetland Monitoring Plan required by the Lahontan Regional Water Quality Control Board and US Army Corps of Engineers permits. The overall objective is to assess and report on the progress of the project in achieving the stated success criteria.

The AMP specifies four specific success criteria:

1. At approximately bankfull stage, as measured at a point 700 feet upstream from the Bellevue Pump Station (Stream Cross Section # 2), not less than 90 percent of the flow shall pass through new pathways off the left bank, i.e., not more that 10 percent of the flow shall remain in the existing channel downstream of the left bank pathways.

2. At flows of approximately 50 cfs as measured at the Tahoe Valley gage, corresponding approximately to the 20 percent exceedence flow, there shall be no standing or flowing water on the easement. This discharge is equivalent to the mean discharge on July 1, and mean flows for the remainder of the field season are less.

3. Planted wetland herbaceous vegetation and vegetation established in the marsh mats shall be established at 70 percent of baseline over after two years and 90 percent of baseline cover after three years and shall exhibit good vigor. Species composition must be dominated by naitves, and match the percent natives in the baseline data. Willows shall be established at 80 percent survival and exhibit good vigor. Willows in willow fences shall be established to provide a continuous flow barrier over 100 percent of the planted length.

4. Functional wetland meeting USACE jurisdictional criteria is maintained within the boundaries of all hummock fills.

Monitoring is proposed to assess the degree to which the success criteria are achieved. Monitoring results will be used to adaptively manage and define implementation measures. Additional monitoring is proposed to assess the overall effect of the project on the portion of the Upper Truckee River Marsh affected by the project.

Monitoring Components

Table E1 summarizes monitoring proposed for the AMP. The entries are organized by sequence through the entire monitoring period; baseline, during operations, and post-operations. The monitoring period is defined as the implementation period plus two years, or a maximum of seven years.

Table E1. Monitoring Components

Monitoring Component	Performance Standard	Method	Frequency	Duration
Baseline Monitoring				
Baseline Topography	None	Topographic survey of existing area subject to inundation	Once, already completed	N/A
Baseline Inundation at50 cfs	None	Use stage recorders in conjunction with monumented cross-sections to delineate extent of inundation on the easement. Photo points taken at flow of approximately 50 cfs	Once, prior to Year One operations	N/A
Baseline Vegetation	Project will not result in the conversion of jurisdictional wetland to upland	Wetland Delineation	Once, already completed	N/A
Baseline Woody Riparian (Willows)	None	Mapped using GPS and entered on baseline map, applicable photo points	Year One, prior to operations	N/A
Baseline Herbaceous Composition and Vigor	None	Photo points, 3 transects on road fill removal area, 3 transects where hummock fills will be placed, co-located with surveyed cross-sections	Prior to initiation of Year One Operations	N/A
Operations/Construction Monitoring				
Sediment Discharge During Construction Operations	Discharges shall not exceed 20 NTUs. 20 NTUs may be exceeded temporarily for installation of temporary crossing.	See "Turbidity Monitoring" following table.	See "Turbidity Monitoring" following Table	Daily, during construction
Sediment Discharge, Pilot Channels	Turbidity below project area shall not exceed turbidity above project area by more than 10 percent	See "Turbidity Monitoring" following table	See "Turbidity Monitoring" following Table	See "Turbidity Monitoring" following table

Monitoring Component	Performance Standard	Method	Frequency	Duration
Pilot Channel Width During Operations	None	A minimum of 5 transects shall be monumented. Channel dimensions shall be recorded to the nearest 0.1 feet.	Twice per week after pilot channel excavation until Year One operations cease	Year 1 construction operations
Post-Operations/Construction Monitoring				
Right Overbank Flows	Not more than 10 percent of the streamflow shall remain in the right overbank at flows less than bankfull	Bankfull discharge shall be determined using direct flow measurement or indirectly using HECRAS. Streamflow measurements shall be made at points shown in Figure A1. Streamflow shall be measured using appropriate means to account for possible low flow depths at downstream station. Alternatively, measurement may be made on left bank pathways and right overbank flow determined by subtraction.	Not to exceed 3 times during snowmelt runoff season.	Years 2-7
Inundation of Right Overbank	No inundation of easement at flows of less than 50 cfs	The streamflow record from the Tahoe Valley gage shall be used to document the date on which 50 cfs is first observed following the snowmelt recession. Stage recorders will then be queried to determine the water surface elevation on that date. Those elevations will then be used, in conjunction with the 13 established cross sections, to map inundation extents and depth on the right overbank. This information will be supplemented by photos from 6 established photo points	Annually, photo point documentation in summer and fall	Years 2-7
Sedimentation, Erosion	None	Resurvey of established cross-sections. Inspection of existing channel and photo documentation of incision or headcut migration if occurring. Photo documentation of areas of evident deposition.	Annually	Years 2-7
Left Bank Pathways Cross-Section and Extent	None	Measure pilot channel width at monumented points. If other pathways develop, establish permanent cross-sections and measure width. Map extent of channels as evidenced by lack of vegetation on channel invert.	Annually, prior to August 15	Years 2-7
Groundwater Monitoring	None. Used to supplement vegetation monitoring and	Pressure transducer installed in shallow well near pump station.	Annually, installation	Years 1-7

Monitoring Component	Performance Standard	Method	Frequency	Duration
	determine SEZ limits		completed	
Herbaceous Composition and Vigor	Planted wetland herbaceous vegetation and transplanted sod shall be established at 70 percent of baseline cover after 2 years and 90 percent of baseline cover after 3 years and shall exhibit good vigor equal to surrounding vegetation	Vegetative cover and vigor will be monitored using transects, site observations, and photos. Monitoring will be based primarily on visual observations for each of the implemented features, but will be supplemented by transects for the abandoned road fill removal and hummocks. Three transects will be established in the road fill removal area and three will be established across constructed fill hummocks.	Annually	During Years 2-7 until all seeded, planted, or transplanted vegetation has met success criterion for three consecutive years.
Woody Vegetation Survival and Vigor	Planted woody vegetation shall be established at 80 percent survival and exhibit good vigor	Observations, counts, photo documentation and estimation of mean height of woody riparian planted areas.	Annually	During Years 2-7 until all planted or transplanted vegetation has met success criterion for three consecutive years.
Willow Fences	80 percent survival along 100 percent of length	Inspection and photo documentation	Annually	During Years 2-7 until all planted or transplanted vegetation has met success criterion for three consecutive years.
Wetland Extent	The project shall not result in the loss of jurisdiction wetland	The entire right bank area shall be inspected, with emphasis on hummock fills to determine if any portion of the area has been converted to upland	Once	Year 7
Final Topography	None	The right bank area within the limits of the original survey shall be re-surveyed, along with pilot channels and other created left bank flow paths	Once	Year 7

Monitoring Component	Performance Standard	Method	Frequency	Duration
Flow Occurrence in Pre-1968 Channel	None	Install crest stage gauge on channel bank at limit of any fill removal. Record high water elevation. Photo documentation of other high water marks and channel condition	By August 1 annually, and following flood peaks of > 150 cfs	Years 2-7

Turbidity Monitoring

Turbdity monitoring will occur during construction periods to verify that turbidity levels in Trout Creek generally remain below 20 NTU during construction activities. Turbidity monitoring during non-construction periods is intended to provide data on water quality during anticipated natural processes that are part of the AMP, such as expansion of favorable flow paths. Because short duration increases in turbidity are expected during high flows, this data will primarily be used to assess whether any remedial action is needed in subsequent years to arrest accelerated or persistent sediment generation that could affect beneficial uses downstream.

Construction Activity Turbidity Monitoring

Construction period turbidity monitoring is intended to confirm that discharges of sediment to Trout creek do not occur due to construction activities. Monitoring will include:

1) Visual observations of water in the construction area using reference vials at 20 NTU;
2) Periodic field turbidimeter measurements and systematic measurements at any time that a potential for discharge of water in excess of 20 NTU is identified visually;
3) Logging turbidimeter measurements at 15 minute intervals at the locations shown in Figure E1.

Pre-deployment preparation of the reference vials and calibration of the turbidimeters will be done by the District's laboratory.

The reference vials and field turbidimeter will be used to monitor turbidity in the creek channel at locations other than the logging turbidimeters, and to measure potential sources of turbidity in the pilot channels and overbank areas. The logging turbidimeters will provide a near-continuous record of creek water quality during construction. The turbidimeters will be checked daily during the first week of construction. After the turbidimeters are considered to be logging data correctly they will be checked weekly. Data will be downloaded weekly during construction.

Normal Conditions are defined as creek turbidity at both stations less than 20 NTUs. Under Normal Conditions, logging turbidimeter data will be provided to Lahontan weekly. Visual or field turbidimeter measurements will be used to identify conditions that require an elevated level of monitoring.

For sources of sediment, Corrective Action conditions are defined as situations in which sources greater than 20 NTU discharge or will potentially discharge to the creek channel. Sources of turbid water identified on the overbanks may be addressed by changes in construction methods, or restricted by barriers or by pumping to prevent discharge to the creek. In the event that sources over 20 NTUs are identified with potential for discharge to the creek, a systematic series of field turbidimeter measurements will be made to track the source, estimate any discharges to the creek channel, and provide a record of corrective measures. For any discharge greater than 20 NTUs that occurs, the District will collect duplicate samples for analysis in the laboratory. The source, measurements, and corrective measures will be recorded in a field log, and logging turbidimeter measurements for the period of the Corrective Action will be downloaded. Logs for Corrective Actions and associated turbidimeter measurements will be provided to Lahontan within 48 hours of the action.

For the creek channel, Corrective Action Conditions are defined as levels of turbidity at the downstream station greater than 20 NTU for a period of more than 2 hours; or if the upstream station turbidity is greater than 20 NTU, greater than 110% of the upstream station. If the source of elevated turbidity is associated with the construction for the project, operations will be immediately stopped or modified to correct the problem. Lahontan will be notified within 2 hours following a Corrective Action Condition for the creek channel. The nature of the problem, measurements, and corrective measures will be recorded in a field log, and logging turbidimeter measurements for the period of the Corrective Action will be downloaded. Logs for Corrective Actions and associated turbidimeter measurements will be provided to Lahontan within 48 hours of the action.

Non-Construction Period Monitoring

The non-construction period is generally expected to be from November 1 to August 31 each year, but could be longer if no work is planned in the vicinity of the turbidimeters in a particular year. During this period, the turbidimeters will be set to log at hourly intervals. The non-construction period measurements will provide a record of water quality during higher flows, including periods in which pilot channels or other favorable left bank flow paths enlarge or become more active. Elevated levels of turbidity are expected during these processes, but turbidity is expected to decrease following passage of higher flows to near background (upstream) levels. Access to the turbidimeters will be restricted during high flow periods. Assuming access is feasible and safe for monitoring personnel the District will download the data monthly, November through August, and provide the data within 7 days to Lahontan. The turbidimeters will be checked at the time the data is downloaded. If access at these times is not feasible, the District will download the data as soon as practical and safe. The data will be used to evaluate whether any remedial measures are needed in the following year to address elevated levels of sediment production based primarily on the measurements obtained for the recession of snowmelt or individual storm hydrographs, as described in AMP Section 5.7.

Instrumentation and Baseline Survey

Figure E1 shows the proposed locations of the streamflow measurement sites, turbidimeters, stage recorders, observation well and the location of the pre-1968 channel crest stage gauge.

The locations of all instruments and cross-section end points of pilot and left bank overflow pathways will be surveyed and added to the baseline topographic map. The elevation of the zero point of the transducer of the stage recorders and observation well, as well as the pin elevation of the crest stage gauge shall be established through a level survey or equivalent.

Stage recorders will be operated to log the current stage at 15-minute intervals and will be downloaded at least annually and more frequently as needed to assist in the documentation of the stage at 50 cfs. The groundwater observation well transducer shall log at no less than one hour intervals. Stage recorders are *Solinst Levelogger* programmable pressure transducers with internal data storage and capable of field downloads to a laptop computer.

Field turbidimeters will be Hach 2100Q portable turbidimeters or equivalent instrument by other manufacturers.

Logging turbidimeters will log at 15 minute intervals during construction periods and 60 minute intervals during the non-construction periods. Non-construction periods are generally expected to be November 1 to July 31, but could be extended if no work is proposed in the vicinity of the turbidimeters in a particular year. Turbidimeters will be YSI EXO-2 sondes with optical turbidity sensor and temperature and conductivity probes.

During Years 2-5, all data will be downloaded for inclusion in the annual report by July 1. For Years 5-7, data shall be down loaded by September 30.

Figure E2 shows the baseline survey of the area NEAR Bellevue Pump Station as performed in October 2013. The map displays depressional and inundated areas and also shows the locations of the permanent cross-sections.

Figure E3 shows the location and orientation of photo points.

Analysis and Reporting

While the primary goal of reporting is to validate that the District is in conformance with all permits issued for the project, reporting is also the vehicle by which the need for supplementary implementation of AMP measures will be identified. As a result, monitoring reports will serve as the basis for the generation of any work plans required beyond the Year One plan.

Each annual monitoring report will measure the progress of the project toward meeting the success criteria stated above and will also provide information on channel aggradation or erosion within the confines of the area mapped during the baseline topographic survey, the evolution of left bank pathways, and flow occurrences in the pre-1968 channel.

Annual reports will be submitted to permitting agencies and the Conservancy by no later than July 20 during Years 2-5. Although the 50 cfs index flow corresponds approximately to the July 1 mean, that flow may not be met until considerably later during wet years. As a result, some extrapolation of the inundated area based on higher stream stages may be necessary. For Years 6 and 7 the annual report shall be submitted by December 1.

nhc
northwest hydraulic consultants

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

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

DATA SOURCES: Google Earth

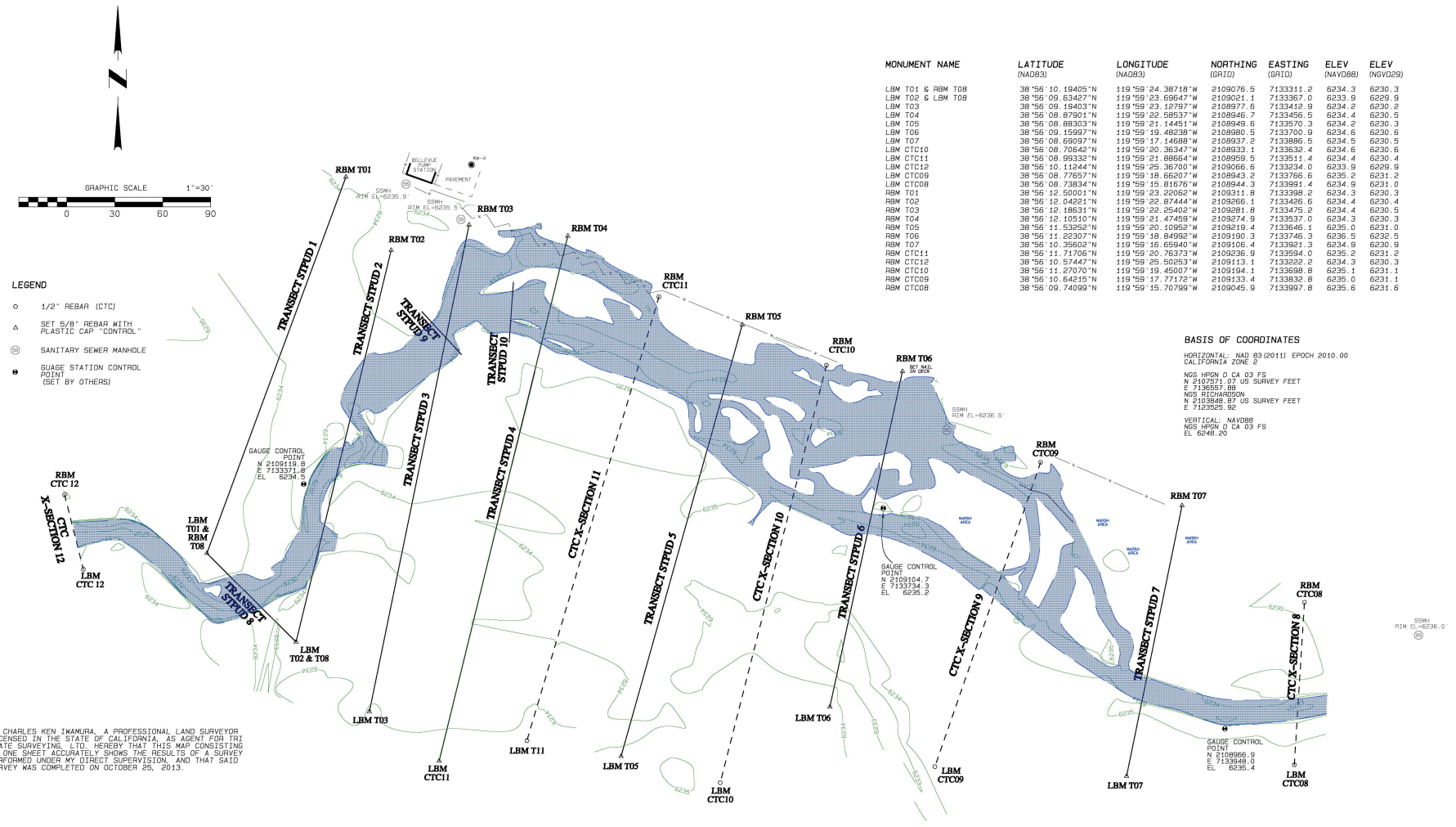
Job: 600035

JANUARY 2014

DRAFT

FIGURE E1
Streamflow Measurement Sites

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°59'15.81675"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 89706
CARSON CITY, NEVADA
(775) 887-9911 * FAX 887-9915

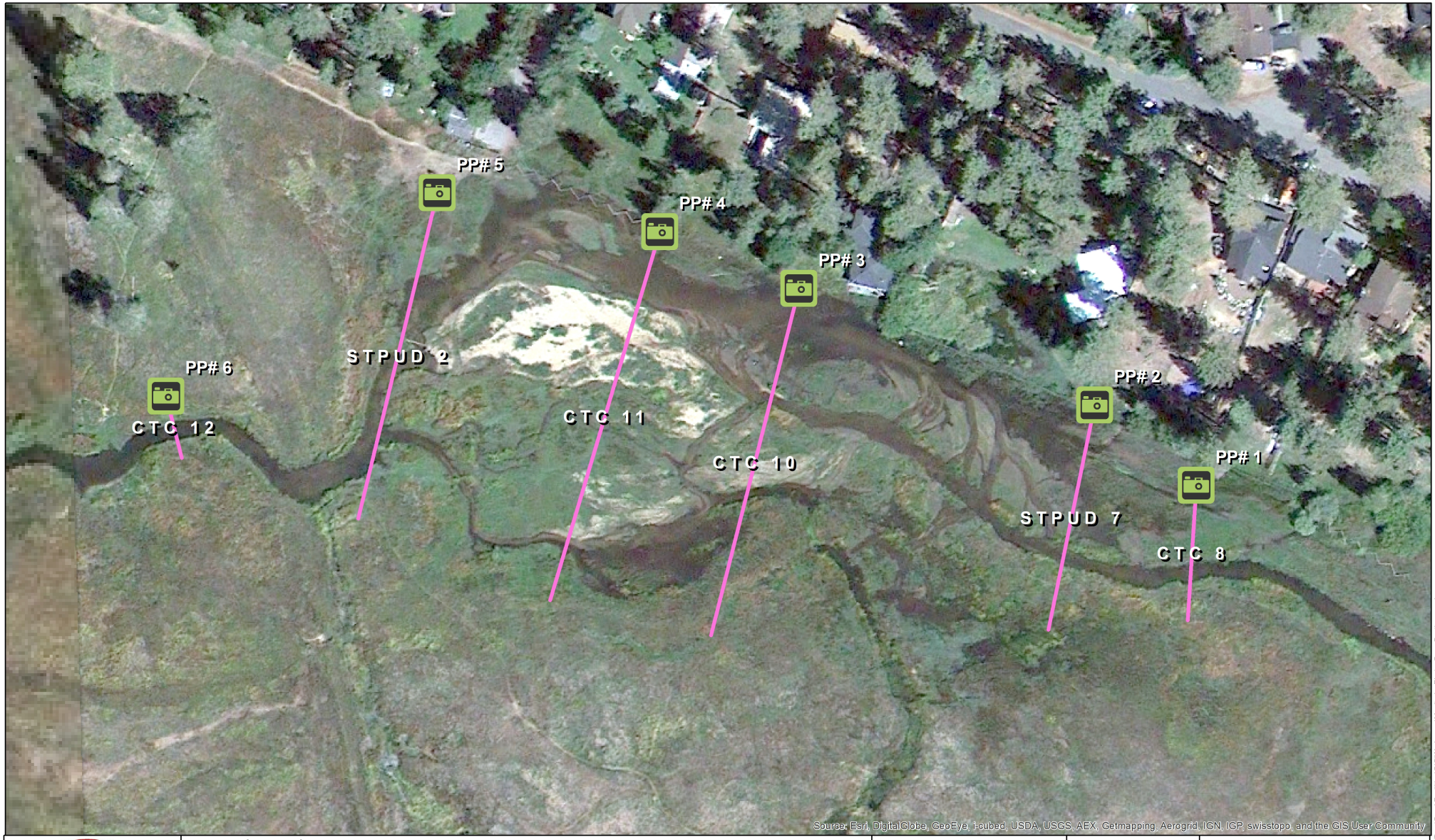
REVISIONS | MARK | DATE | NO.

BENCHMARK
DRAWN BY: CKT
DESIGNED BY: CKT
CHECKED BY: JS
APPROVED BY:
DATE: OCT 25, 2013

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.DM
DATE 11-5-13
SHEET 1 OF 3

Figure E2. Baseline Survey from October 2013



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

DRAFT

FIGURE E3

Locations of Photo Points

Annual Report

Each annual report will contain:

- A summary of any new actions taken in accordance with the AMP and a map showing their locations, along with a discussion of landscape irrigation performed the previous field season and what is proposed for the next field season.
- A summary of flow conditions over the previous year.
- Charts showing the water surface elevation at the three stage recorders along with the groundwater elevation over the previous year and a comparison to previous years.
- Flow measurement results comparing upstream/downstream flows along with the estimated upstream bankfull flow, along with the degree to which the current year condition meets the success criterion.
- Updated baseline survey showing extent of inundation within the bounds of the established cross sections at a flow of approximately 50 cfs, along with a computation of the percent of the easement which is inundated at that discharge, including photo documentation.
- Summary of turbidity monitoring during operations.
- Summary of turbidity monitoring during non-construction periods and an evaluation of whether any remedial measures are needed. If needed, a description of potential remedial measures will be included.
- Graph of discharge as measured at the Tahoe Valley gauge along with the graphs of turbidity recorded at the upstream and downstream turbidimeters.
- An analysis of the change in width of pilot channels and other new left bank overflow pathways in comparison to the duration of any occurrences of downstream turbidity exceeding upstream turbidity by more than 10 percent. A map of any change in channel length will be included.
- A summary of peak stage observations at the head of the pre-1968 channel, along with photo documentation and discussion of the duration and extent of flows there.
- Observations of any evidence of headcut migration into the project area, and, if previously documented, a map showing the location of any headcut as measured annually during the summer low flow period.
- Observations of any channel incision along existing (2013) flow paths in the right overbank near Bellevue Pump Station, including photo documentation and a map showing approximate limits of incision.
- Results of vegetation monitoring of hummocks, hummock fills, abandoned road fill sod replacement, willow fences, and any other locations where willows were planted at existing grade. Discussion of herbaceous plant cover and percent survival, vigor, and mean gain in height of willows will be reported along with recommendations for additional treatment.
- Plans and specifications for any new proposed actions

Final Report

In addition to the items contained in the annual report, the final (Year 7 or last implementation year plus 2 years), report will contain:

- An assessment of the project with respect to the stated goals and success criteria, including the results of the final wetland extent to determine that no jurisdictional upland was created as a result of the project.
- An assessment of the trajectory of any ongoing processes likely to continue in the future, such as new channel development.
- An analysis of the final topographic survey with respect to gains in elevation associated with sedimentation.
- A comparison of baseline versus final conditions at permanent photo points.
- A summary and discussion of turbidity monitoring results.
- Recommendations, if any, for further operations or monitoring.

Appendix F – Fish Rescue and Relocation Plan

UPPER TRUCKEE MARSH SEWER FACILITIES

ADAPTIVE MANAGEMENT PLAN

Introduction

This Fish Rescue and Relocation Plan describes the methods that will be used to capture and relocate fish from in-water work areas prior to dewatering. The plan will be implemented prior to all construction activities in the Trout Creek channel and in areas where active creek flows presently occur outside of the channel (e.g., right overbank upstream of Bellevue Pump Station). The plan is intended to minimize harm, harassment, and mortality of fish which may be present in the construction area. All species of fish and will be rescued and native species will be relocated prior to dewatering activities. Rescue efforts will focus on protecting Lahontan cutthroat trout, if found to be present, and any other fish species listed under Federal and California Endangered Species Acts (ESA and CESA) and/or fish species with protected habitat designations.

The construction time period for completing the work within the creek and creek flow areas will be restricted to periods of low stream flow after 1 September and prior to 15 October, after the spawning season for fish species expected to be present has passed.

Monitoring and Reporting

Fish rescue operations will be implemented under the direct supervision of a qualified fisheries biologist, approved by U. S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) and in possession of a valid California Department of Fish and Game (DFG) Scientific Collection Permit. The fisheries biologist will be present onsite to monitor the progress of dewatering and initial fish rescue prior to completely closing any cofferdam and as deemed additionally necessary to ensure compliance with this Fish Rescue Plan. USFWS, NMFS, and DFG will be notified at least 48 hours prior to commencing fish rescue activities. A Draft Fish Salvage Operation Report will be prepared and submitted to USFWS, NMFS, and DFG no later than one month following implementation of any fish rescue activities. The Draft Fish Salvage Operation Report will document the fish rescue and salvage operation, including the estimated number of fish by species salvaged. The Draft Fish Salvage Operation Report will be reviewed by designated USFWS, NMFS, and DFG biologists, and comments, if any, will be submitted to the South Tahoe Public Utility District. A Final Fish Salvage Operation Report will be issued after any comments have been satisfactorily addressed.

Fish Handling and Relocating Procedures

USFWS, NMFS, and DFG standard protocols for handling fish that are threatened, endangered, or otherwise protected under ESA and CESA will be followed during fish capture and relocation. Captured fish will first be placed in clean 5-gallon buckets and/or coolers filled with water from the creek where fish capture is occurring. A live car will be used to hold fish temporarily until processed and released,

and will be filled with water from the rescue location and will be equipped with an aeration device. Chemical additives (e.g., Stress Coat) may be used in the holding buckets and/or live car to reduce stress. Captured fish will be moved from the live car via clean 5-gallon buckets filled with local water and released at an appropriate location in the creek. Handling of fish will be minimized during all fish rescue activities. For reporting purposes, captured fish will be enumerated by species and total length estimated; captured fish will not be measured to reduce handling stress.

In the event listed or protected fish species suffer mortality during fish rescue operations, despite all precautions, they will be preserved (frozen or placed in a solution of formalin), photographed, and data will be recorded on the time and location of mortality, likely cause of mortality, environmental conditions (e.g., water temperature), and any other information relevant to the mortality event. All mortalities will be reported to USFWS, NMFS, and DFG and the preserved specimens held for pickup by these agencies. This documentation will be included in the Fish Salvage Operation Report described above.

Fish Rescue Methods

Prior to conducting fish rescue and relocation efforts, a fisheries biologists will coordinate with the District and appropriate resource agencies to determine the direction for the handling and release and/or disposal of different nonnative species (e.g., warm water invasive species). Release locations will be identified during a reconnaissance visit, and will be in viable and comparable habitats in the vicinity that will not be directly impacted by future construction activities (i,e., not in a construction footprint). The following work plan identifies step-by-step activities that will be followed during fish relocation and salvage at the project location.

1. Block nets with 1/8-inch mesh will be placed above (i.e., upstream) and below (i.e., downstream) the designated construction area to isolate fish movement and prevent fish from entering the site. For this project, the construction area affecting creek flows is expected to extend from the temporary stream crossing for road fill removal to a point near Streamflow Measurement Cross Section #2 identified in Appendix E. Because the AMP is adaptive and work locations cannot be predicted precisely at the outset, the area where fish rescue will occur will be identified each year. The upstream block net will be placed across the channel approximately 100-feet above the designated construction area. The downstream block net will be placed across the channel just downstream of the temporary stream crossing location in Year 1, and downstream of the construction area affecting creek flows in subsequent years. Additional block nets will be used to sub-divide the reach to be dewatered, if needed, into smaller reaches that can be fished more efficiently. Sub-reaches identified during site reconnaissance will be fished in a step-wise fashion from the downstream to the upstream limit of the construction area.

2. Once the stream reaches have been isolated, multiple passes utilizing backpack electrofishers with an output of approximately 1.5 amps will be employed throughout the entire length of the reach to safely and effectively capture and remove fish. (AECOM fisheries biologists utilize state of the art Smith-Root LR-24 backpack electrofishers with advanced technology that minimizes injury and mortality for all fish surveys and relocation activities.) Electrofisher passes will continue until a diminishing return on fish captured per pass is reached (i.e., numbers of fish captured per pass are reduced to a level where effectiveness has substantially decreased). The on-site fisheries biologist will determine when a diminishing return on fish captured has been reached.

3. Once a substantially diminished return has been reached, a biologists will coordinate with the construction contractors to initiate a partial reduction in flows (through incremental diversion of flows) to slowly reduce the wetted channel area and condense any remaining fish. Additional electrofisher passes will be made as necessary until it has been reasonably determined by the on-site fisheries biologist that all fish have been removed from the site that practicably can be removed.

4. Captured fish from electrofishing (Step 3) will be placed in 5-gallon buckets with fresh, clear water and transported to release sites identified during the site reconnaissance. Buckets containing fish will be moved to the release sites frequently, with no more than 200 fish in a bucket at one time and for no longer than 15 minutes. All fish species will be released in pools or slow moving currents (i.e., glides) and will be allowed to gently swim out of the buckets. Nonnative invasive fish and other nonnative aquatic species (e.g., bullfrog tadpoles) will be destroyed (as directed by resource agencies). Representative samples of the captured fish will be enumerated by species and will be measured for total length (millimeters) prior to release in suitable locations identified. Any potential fish mortalities will also be noted.

5. Once all fish have been captured, transported, and released, the on-site fisheries biologist will clear the site for dewatering. During the stream diversion and dewatering phase, the on-site fisheries biologist and a minimum of three assistants will monitor the reach (with fish removal and transporting equipment) for any stranded fish that may have been missed during steps 3 and 4. The stream diversion and subsequent wetting of one channel and dewatering of the other will take place incrementally (i.e., diverting a portion of the total flow and allowing the water to recede slowly in one channel while minimizing erosion potential and turbidity in the other channel). Any stranded fish will be immediately captured, transported, and released into suitable habitats as described above. Manual capture will also include removal of native fish that are hiding under banks in the dewatered channel. To the extent practicable, once all stranded fish have been removed, transported, and released, the site will be thoroughly inspected for any potential stranded fish. If the site is deemed to be absent of fish to the extent practicable after inspection, the on-site fisheries biologist, in consultation with construction crews, will clear the site for continued construction operations.

6. The District will notify the resource agencies two days prior to the expected date that the rescue and relocation will begin.