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San Geronimo Creek Habitat Enhancement Project—Basis of Design Report

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Cover photo: San Geronimo Creek upstream of Creamery Road

I hereby state that all work described in this Basis of Design Report follows accepted engineering practice and was completed under my direction. The project includes engineered design plans for three habitat enhancement/erosion control sites located along mainstem San Geronimo Creek and one site located on a small tributary draining to Woodacre Creek (tributary to San Geronimo Creek).

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Table of Contents

Tables

Figures

Appendices

1 INTRODUCTION

The Marin County Department of Public Works contracted Stillwater Sciences to prepare engineered design plans for three habitat enhancement/erosion control sites located along mainstem San Geronimo Creek and one site located on a small tributary draining to Woodacre Creek (tributary to San Geronimo Creek). The four sites include the: (1) Synder-Stranger Project, (2) McGuinn-Newman Project, (3) Watson Project, and (4) Freund Stables Project. Design Plans have been prepared for each site based on the analyses presented in this design report.

2 PROBLEM STATEMENT

San Geronimo Creek is a California Coastal stream where coho salmon (*Oncorhynchus kisutch*) and steelhead (*O. mykiss*) once occurred in abundance. Salmonid populations in California and throughout the Pacific Northwest have experienced significant declines as compared with historical data, as result of multiple factors including widespread expansion of land and water uses, disease, ocean harvest, and predation (Nehlsen et al. 1991). Coho salmon, in particular, no longer occupy many of the streams in California where they used to occur (Hassler et al.1991) and state-wide estimates indicate that coho salmon populations are currently less than 6% of 1940 numbers (Brown et al. 1994). Coho in the southern part of the species' range appear to have shown the greatest declines, with few coho occupying coastal streams near or south of San Francisco Bay. Despite these declines, the Lagunitas Creek watershed population of coho salmon, including fish spawning in the tributary stream of San Geronimo Creek, is the largest and most stable population south of the Noyo River within the Central California Coast Evolutionarily Significant Unit (ESU) (Ketcham et al. 2004). While accurate steelhead adult population size estimates for Bay Area watersheds are not available, in general the stocks have also declined substantially throughout California since the mid-1960s (McEwan and Jackson 1996).

The San Geronimo Valley Salmon Enhancement Plan identified Lower San Geronimo Creek (location of three of the four sites) as one of the reaches in greatest need of rehabilitation. Specifically, limited high-flow refugia for winter rearing was identified as an instream condition that directly affects fish (Stillwater Sciences 2009). In addition, landowners within the project reaches are concerned with risks associated with bank erosion. The objective of this project is to enhance salmonid habitat by improving the impaired conditions where feasible, while also reducing the potential for damage to adjacent infrastructure associated with flooding and erosion.

Design elements of this project include large wood structures and floodplain enhancement that decrease water velocities during high winter flows, and increase scour to create deep pools with cover during summer low-flows. During the winter, many of the structures will provide refuge for salmonids so that they are not flushed out of the system. During the summer, some of the structures will increase the frequency of deep pools with cover to provide summer rearing habitat in the vicinity of winter refuge habitat (aka habitat connectivity).

Within the project reach complete re-connectivity to the floodplain is not feasible, due to funding and landowner constraints. Therefore, work will take place within the incised channel. However, where topographic opportunities occur (Snyder-Stanger project site), off-channel habitat will be enhanced through lowering of floodplain terraces and/or adding complexity. These off-channel habitat features were designed to provide winter velocity refuge and winter rearing habitat. Design of all enhancement features were guided by natural habitat features previously observed in other watersheds with analogous channel morphology, and with documented high rearing densities and survival of both coho salmon and steelhead.

A critical aspect of this project design was ensuring that the projects do not significantly increase flood risk on properties adjacent to where the structures are located, and to reduce the potential for bank erosion. Preventing bank erosion also provides the dual-benefit of reducing fine sediment delivery (identified as a high priority in the San Geronimo Valley Habitat Enhancement Plan). In addition, all enhancement features will be durable and stable to maximize longevity of benefits to habitat, while minimizing the risk to downstream infrastructure. Landowner and environmental concerns have been balanced in these designs to achieve the objectives of all stakeholders. As described below, hydraulic modeling of existing and proposed conditions were used to analyze and balance the size and extent of in-channel structures with flooding and erosion constraints.

3 SITE DESCRIPTION

San Geronimo Creek is located in western Marin County. In total, it drains an area of approximately 6,000 acres (ac). The watershed headwaters originate on White Hill, at an elevation of 1,430 feet (ft) above sea level, and generally drain to the North Fork San Geronimo Creek east of the community of Woodacre. Multiple small, low-gradient tributaries drain into San Geronimo Creek. The four major tributaries to San Geronimo Creek are Woodacre, Larsen, Montezuma, and the Arroyo/El Cerrito/Barranca complex of creeks. As with other nearby coastal California watersheds, the south-facing drainages of San Geronimo Creek are characterized by low-moderate relief slopes supporting California bay laurel forests, shrubs, and grassland species, and steep, north-facing slopes which tend to support dense conifer growth. Mainstem San Geronimo Creek flows 4.5 miles (mi) from its origination point at the eastern headwaters of White Hill until it reaches Lagunitas Creek to the west. The watershed encompasses the residential communities of Woodacre, San Geronimo, Forest Knolls, and Lagunitas. In addition, four Open Space Preserves have been designated in the watershed. Sir Francis Drake Blvd. runs relatively parallel to San Geronimo Creek. Per Figure 1, the four project sites from west to east are: (1) Snyder-Stanger Habitat Enhancement, (2) McGuinn-Newman Bank Rehabilitation, (3) Watson Bank Rehabilitation, and (4) Freund Stables Stormwater Management.

4 GEOLOGY AND SOILS

4.1 Watershed Geology and Tectonics

The San Geronimo Creek watershed lies to the east of the San Andreas Fault Rift Zone, a geologically active area of strike-slip (transverse) movement between the Pacific and North American tectonic plates. The main trace of the San Andreas Fault Zone lies approximately 2.8 mi to the west of the western-most watershed boundary. In general, the watershed is predominantly underlain by mélange of the Central terrane, Franciscan complex (Wentworth et al. 1997, Blake et al. 2000), with basalt and pillow lava (Nicasio Reservoir terrane), sandstones and shales (San Bruno Mountain terrane), and alluvium deposits also present. The Franciscan mélange is a sheared and deformed mixture composed mainly of greywacke, sandstone, shale, chert, greenstone, and metamorphic rocks integrated with lesser amounts of serpentine and silica-carbonate rocks as shown on Figure 2.

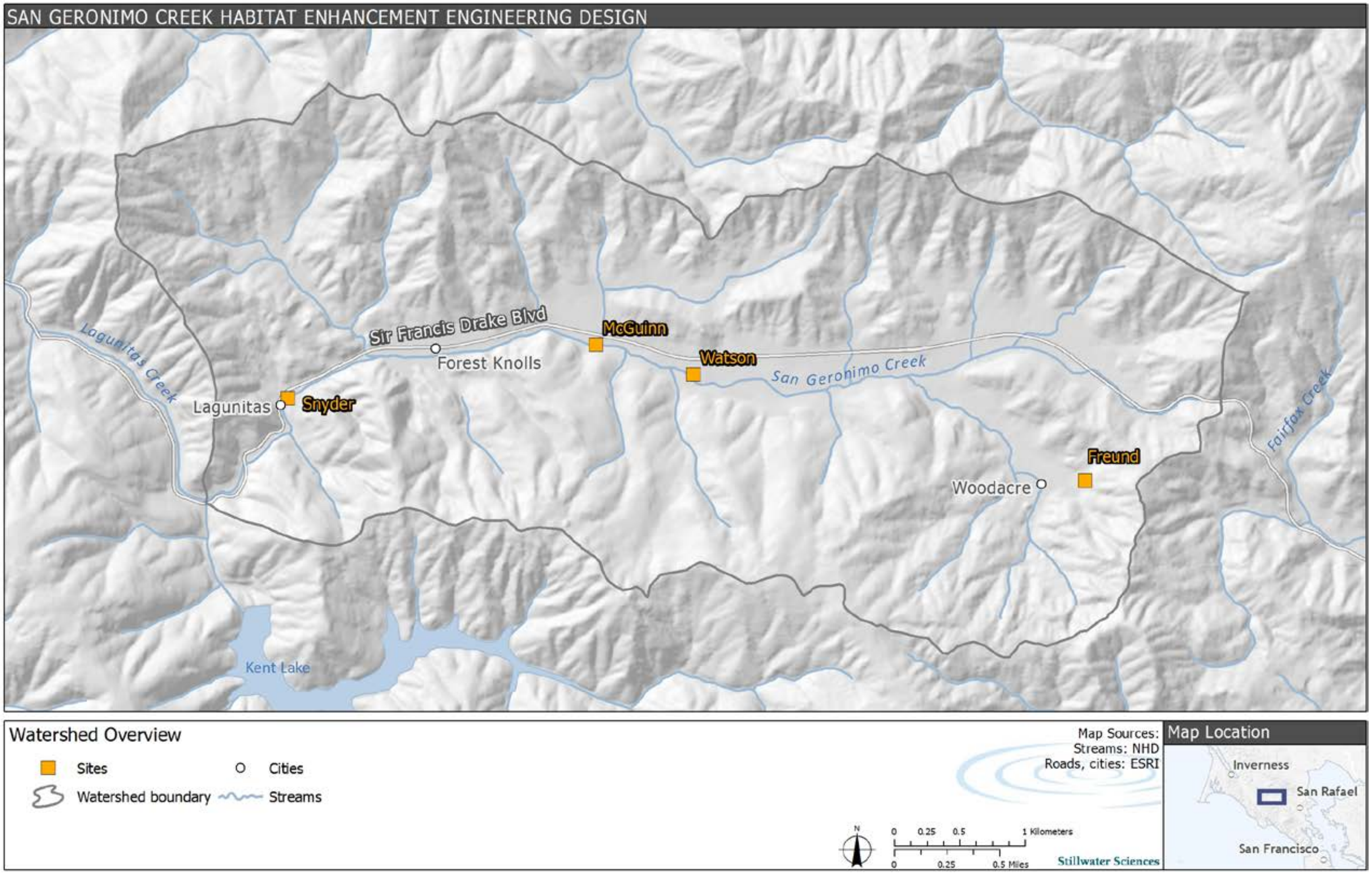

Figure 1. Vicinity and project site map.

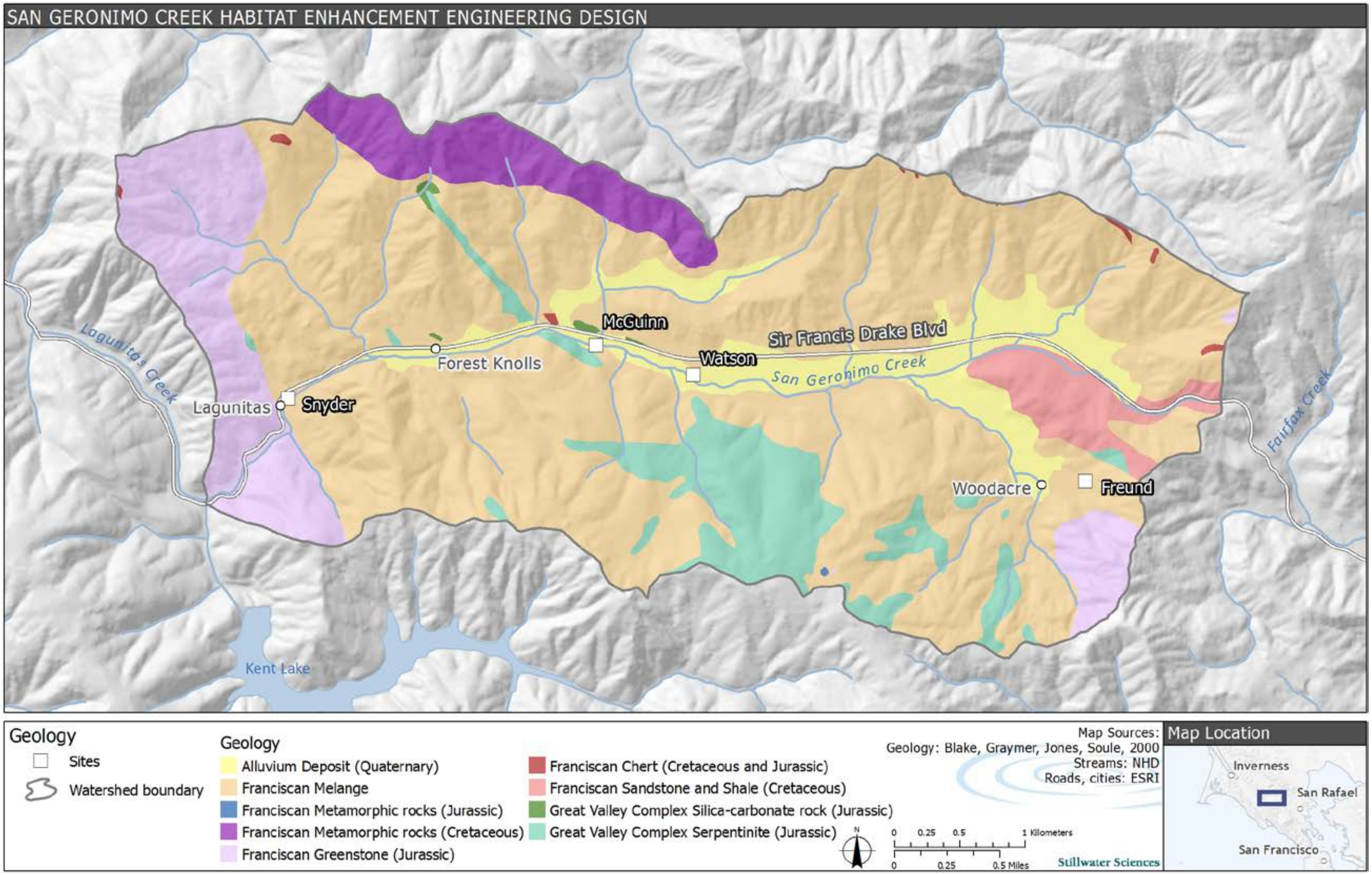

Figure 2. Watershed geologic map.

4.2 Project Vicinity Soils

The hillslopes adjacent to the project sites are mostly capped with clay-rich soils derived from the highly weathered Franciscan mélange discussed in Section 4.1 which supports a wide variety of land use types (e.g., agricultural, single-family residential, open space). As shown on Figure 3, the Snyder-Stanger and Freund Stables sites are composed of gravelly loams, the McGuinn-Newman site is composed of alluvium to the north and gravelly loams to the south, and the Watson site is composed of alluvium. It is important to note that the areas within the sites experiencing the most bank erosion (McGuinn-Newman north stream bank and Watson both stream banks) are composed of alluvium.

5 GEOMORPHOLOGY

In general, San Geronimo Creek is a predominately alluvial channel as shown on Figures 2 and 3. The mainstem channel banks are predominantly composed of Quaternary alluvium, or sediment that has been deposited over the past 1.8 million years, containing gravel- and cobble-sized material within a matrix of fine sediment. Bedrock along San Geronimo Creek at several locations has resulted in flow constriction which leads to localized zones of sediment deposition and channel widening upstream and sediment depletion and channel incision downstream of these constrictions. This process can be seen at the downstream extents of the McGuinn-Newman and Watson sites.

Mainstem San Geronimo Creek is a deeply incised channel that is disconnected from its historical floodplain (Nolte 1965). Increases in logging and agriculture in combination with several wet years during the first impact period in the Lagunitas Creek watershed (1850–1918) are thought to have started a phase of rapid channel incision that contributed in large measure to current channel conditions. Although San Geronimo Creek is a predominately alluvial channel, its gradient and geomorphic form is strongly bedrock-controlled. Overall, the channel has a relatively low gradient, with a reach-average channel slope of 0.7% (Stillwater Sciences 2009b) and the majority of the channel has a local channel gradient between 0.25% and 1%. Areas of local increases in channel slope occur downstream of forced and natural channel constrictions, including downstream of Roy's Pools and downstream of the sharp bend at the Lagunitas Road bridge crossing (Stillwater Sciences 2009b). San Geronimo Creek generally has localized plane-bed morphology where local channel gradient is relatively steep, with a pool-riffle morphology where local channel gradient is relatively low (see Montgomery and Buffington 1997 for more information on channel morphologic classification).

A preliminary analysis of habitat mapping information collected during summer 2006 (Stillwater Sciences under contract to MMWD) indicates that average pool spacing in mainstem San Geronimo is approximately 0.17 pools/channel widths (where the term "channel widths" is defined as representative channel length normalized by average bankfull channel width) or 28 pools/mi of mainstem channel (n=4 based on reach-scale preliminary estimates of pool frequency in Sections 4.2.3 and 4.3.4). Research in a coho- and Chinook-bearing Pacific Northwest watershed suggests that a pool frequency of 0.17 pools/channel widths is on the low end of the range of values associated with substantial spawning activity (i.e., > 10 redds/km of channel) (see Montgomery et al. 1999), where a higher value of pools/channel widths indicates a higher occurrence of pool tail-outs, or preferred salmonid spawning habitat. This is consistent with NMFS (1996) standard for "properly functioning streams" less than 50 ft wide at

26 pools/mi, but would correspond to a "poor" rating using the Johnston and Slaney (1996) standard (<0.25 pools/channel widths) for channels less than 50 ft wide.

Inset floodplains, including surfaces with mature riparian vegetation above the 'bankfull' channel and newly-vegetated gravel bars within the 'bankfull' channel, are present at a few locations along the mainstem. These features primarily exist in localized areas along several reaches of the mainstem San Geronimo with relatively high w/d ratio (w/d ratio > 10:1) and modest channel gradient (local slope ≤ 1%). Inset floodplains are expected to provide vital high-flow refugia for salmonids and the relatively low occurrence of these channel features at sites sampled during summer 2008 is likely a further indication of the general lack of salmonid rearing habitat in mainstem San Geronimo Creek.

The mainstem channel transports bedload sediment ranging in size from fine sand (< 0.08 in) to coarse cobble (<2.5 in) and has a bed dominated by gravel-sized sediment along the entire length of San Geronimo Creek, with localized depositional areas of finer (sand-sized) and coarser (cobble- and boulder-sized) sediment along with frequent exposure of bedrock in the channel. Sizable deposits of finer sediment (sand and fine gravel) occur primarily where the local channel gradient decreases, such as in the depositional zone upstream of Roy's Pools.

Specific to this project, the stream channel at the Snyder project site has an extensive bedrock grade control at the downstream extent of the site with the upstream channel composed primarily of course cobble and the banks composed of sand and gravel. There are three distinct types of channel bed composition at the Mcguinn project site: (1) bedrock and boulders at the upstream and downstream extents of the site, (2) a left bank point bar consisting of sediments ranging from sand to small cobble adjacent to the primary area of right bank failure, and (3) a cobble dominated channel along the upstream reach. The eroding stream banks throughout this reach are composed of silt, sand, and fine gravel and along the right bank upstream from the Larsen Creek confluence, concrete rubble has been placed to provide bank protection. The stream channel at the Watson project site is composed primarily of sand and gravel with the Creamery Road Bridge and bedrock in the channel at the downstream extent of the site acting to slow water and form a deposition zone for finer sediment. Both streambanks are composed of fine and generally unconsolidated material which are very susceptible to erosion, but a soft bedrock shelf on the right bank that has prevented further undercutting of the toe of the bank.

Exposed bedrock is associated with higher gradient reaches that are supply-limited; however, there are also bedrock exposures at several other locations along San Geronimo Creek with moderate gradient suggesting that overall in the mainstem bedrock currently sets channel slope and limits the rate of overall bed lowering. Accordingly, estimated channel incision rates for alluvial portions of the mainstem channel since 1982 (year of a channel re-setting flood event) are on the order of 0.05 ft/yr (Stillwater Sciences 2007b) and 0.04 ft/yr (Stetson Engineers Inc. 2002).

The San Geronimo Creek watershed accounts for the greatest sediment yield of all major sub-basins within the Lagunitas Creek watershed (Stillwater Sciences 2010), accounting for 46.5% of the total 20,135 ta^{-1} (metric tons/annum). The tributary and hillslope sediment yield of the San Geronimo Creek watershed accounts for 7,688 ta^{-1}, the majority (82%) of total sediment yield. In turn, the mainstem only contributes 1,668 ta^{-1}, for a total yield of 9,356 ta^{-1}. Tributary bank erosion is the greatest contributing factor to sediment delivery, generating 29.9% of the total sediment yield of the watershed, followed by hillslope slides and gullies (19.6%), roads and trails (16.8%), mainstem bed incision (15.6%), and tributary bed incision (15%). Soil creep and mainstem bank erosion make up the remaining 3.1%.

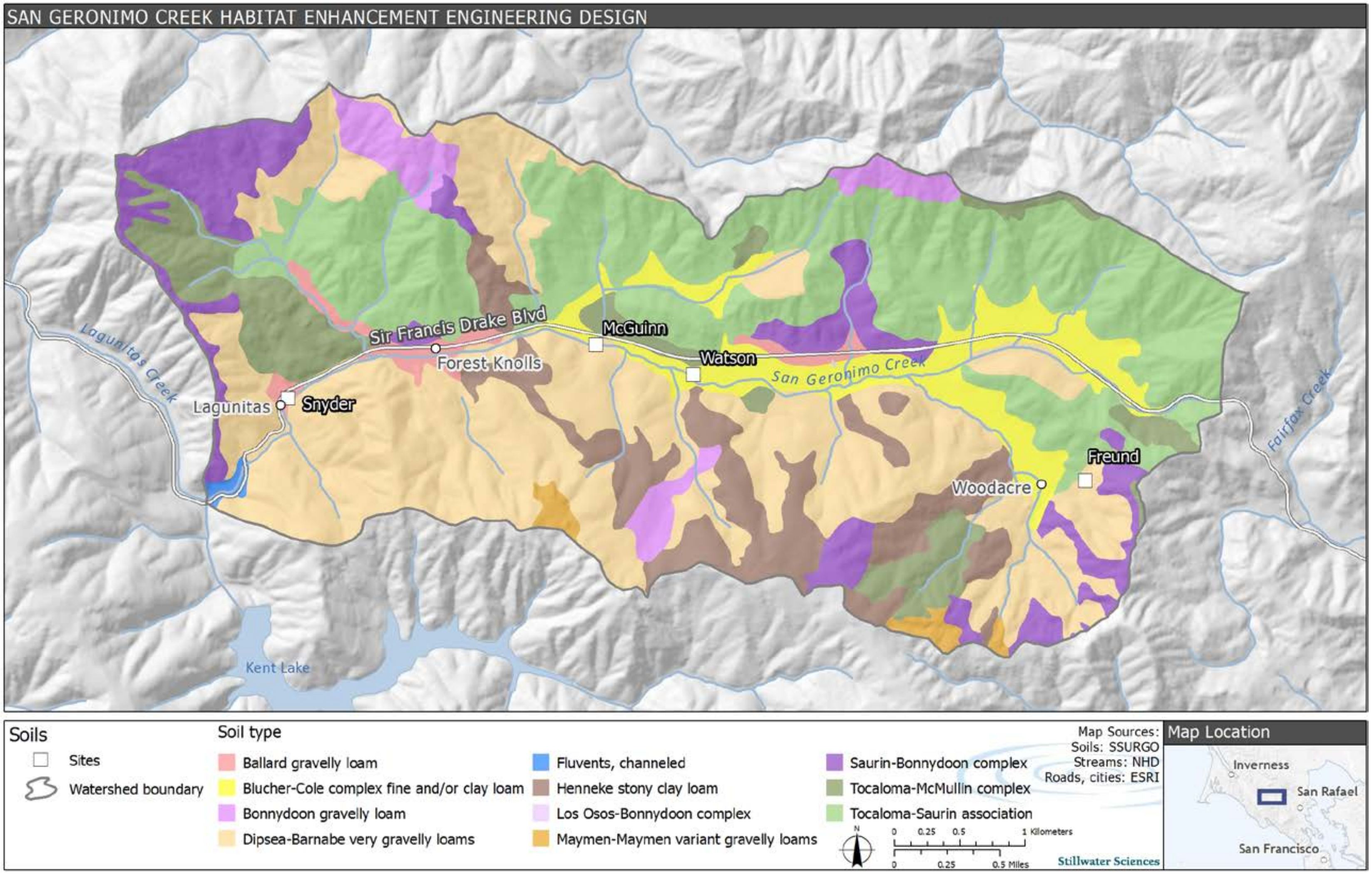

Figure 3. Project vicinity soils map.

6 EXISTING CONDITIONS ASSESSMENT

6.1 Field Survey

Stillwater staff performed new field surveys using a Total Station at the Snyder, McGuinn, and Watson project sites. Topographic information from the new surveys was merged with existing survey data provided by the County of Marin to Stillwater. The primary purposes of the field survey were to: (1) survey cross sections along the channel thalweg to be used for hydraulic modeling; (2) obtain additional topographic data in areas where habitat enhancement activities are likely to occur; and (3) survey existing features including buildings, trees, roads, fences, etc. Existing control points (previously set in a local coordinate system) were used at the Watson and Snyder site and new local control points were set at the McGuinn site (also in a local coordinate system). Survey results including the existing ground surface and control points are shown in Appendix A on the Existing Conditions Sheets for each project site. No topographic survey was conducted at the Freund site because the existing survey data provided sufficient information for design purposes.

6.2 Field Observations

In addition to collecting topographic data, Stillwater staff made general observations regarding site conditions and fluvial geomorphology to help identify target areas for habitat enhancement and to estimate channel and floodplain roughness coefficients to be used in the hydraulic models. Specific observations included channel banks with active erosion, gravel bars, pools, evidence of incision/scour, and existing woody debris. These features are included on the Design Plan Existing Conditions Sheets (Appendix A).

7 HYDROLOGY AND HYDRAULIC ANALYSIS

7.1 Hydrologic Data Analyses

7.1.1 Hydrologic data analysis at Snyder, McGuinn, and Watson sites

The primary hydrologic data sets analyzed for this project were flood frequency flows (also known as recurrence interval flows) which represent higher flows that are expected to occur at a specific frequency; i.e., a 100-year flow would be expected to occur every 100 years on average. These flood frequency flows, especially those from half of "bankfull" to 2-year discharges, are biologically significant because they occur during most winters and are swift enough to flush salmonids out of the system and/or cause mortality if insufficient low-velocity habitat is available at such flows. For this analysis, 1.5-year recurrence interval flows are considered to be synonymous with "bankfull" flows. In addition, it is critical to analyze flows from larger events ranging from 2- to 100-year to determine erosion potential and flooding hazards for adjacent property and infrastructure.

Flood frequency discharges for the Snyder, McGuinn, and Watson project sites were determined based on flow data from the Marin Municipal Water District (MMWD) gage located at Lagunitas Bridge measured during the period of 1980–2010. Note that this gage is located just downstream from the Snyder project site. With this record, a Log-Pearson Type III distribution was used to calculate the magnitude of peak flows for specific storm events. Then these flows were prorated by drainage area to determine peak flows for the other three project sites.

Typically, hydrologic analyses will also involve looking at Federal Emergency Management Agency (FEMA) flood insurance studies, and USGS Streamstats data found at: (http://water.usgs.gov/osw/streamstats/california.html) which uses a geographic information system (GIS) and flow regression equations to calculate storm discharges at any point along watercourses. However, for these three project sites, no detailed hydraulic analyses were completed by FEMA. In addition, the discharges generated by Streamstats were much lower (~50%) than the MMWD gage data so they were determined to be unsuitable for use in this analyses.

As such, using the MMWD gage data is the best option for calculating the hydrology at each site and the resulting discharges, which are used in the San Gregorio Creek hydraulic model, are shown in Table 1. These values have been rounded to two significant digits to reflect the uncertainty of these estimates. It should be noted that, because the drainage area of the Freund site is less than 320 ac, the Rational Method was used to determine flood frequency discharge estimates for this site in Section 7.1.2.

Table 1. Flood frequency discharge estimates for the three San Geronimo Creek project sites.

Discharge location	100-yr discharge (CFS)	50-yr discharge (CFS)	10-yr discharge (CFS)	5-yr discharge (CFS)	2-yr discharge (CFS)	1.5-yr discharge (CFS)
Snyder site (drainage area 8.96 sq mi)	4,510	3,990	3,450	2,710	2,110	1,240
McGuinn site (drainage area 5.74 sq mi)	2,890	2,550	2,210	1,740	1,350	790
Watson site (drainage area 4.21 sq mi)	2,120	1,880	1,620	1,270	990	580

In addition to the flood frequency flows, additional low and moderate flows have also been modeled in HEC-RAS which correspond to average summer and winter flows. These flows have biological significance for restoration, especially related to spring and summer rearing as well as over-wintering habitat for salmonids. The low to moderate flows used for this analysis are shown in Table 2.

Table 2. Additional discharge estimates used for the San Geronimo Creek hydraulic model.

	0.5 Bankfull discharge (CFS)	Average winter discharge (CFS)[1]	Average summer discharge (CFS)[2]
Snyder site (drainage area 8.96 sq mi)	460	40	0.37
McGuinn site (drainage area 5.74 sq mi)	290	26	0.24
Watson site (drainage area 4.21 sq mi)	220	19	0.17

[1] Prorated for the project sites based on December, January, February, and March flows measured at the MMWD gage located at Lagunitas Bridge for the period of 1980–2010.

[2] Prorated for the project site based July, August, and September flows measured at the MMWD gage located at Lagunitas Bridge for the period of 1980–2010.

7.1.2 Hydrologic analysis at the Freund stables site

7.1.2.1 The Rational Method

Rather than prorating flow data from the Marin Municipal Water District (MMWD) gage, located at Lagunitas Bridge, we used The Rational Method (also known as the Rational Formula) to calculate storm event design flows at the Freund Site. According to the California Department of Transportation Highway Design Manual (Caltrans HDM) Section 819.2 (Caltrans 2014), the Rational Method is more appropriate for determining flow rates for relatively small drainage areas of less than 320 ac. The Rational Formula incorporates a combination of rainfall intensity, drainage area and runoff coefficient to estimate maximum flows and is defined as follows:

$$Q = CIA$$

Where:

Q = Flow Discharge
C = Runoff Coefficient
I = Rainfall Intensity
A = Area

7.1.2.2 Determining storm duration

For the Rational Method analysis, the total drainage area for the Freund Site was determined to be approximately 9.6 ac or 0.015 sq mi based on analyses of a USGS topographic map. The drainage area is relatively steep with an average slope of ~38.6%. The longest flow path was determined to be approximately 1,530 ft. Velocities were estimated using the velocity-slope relationships published in the Caltrans HDM (Figure 4). Subsequently, these velocities were used to determine the "Time to Concentration" for the site based on the time it takes runoff to travel along the longest flow path within the contributing watershed and arrive at the site location. The time-to-concentration was determined to be approximately 15.9 minutes. This information is summarized in Table 3.

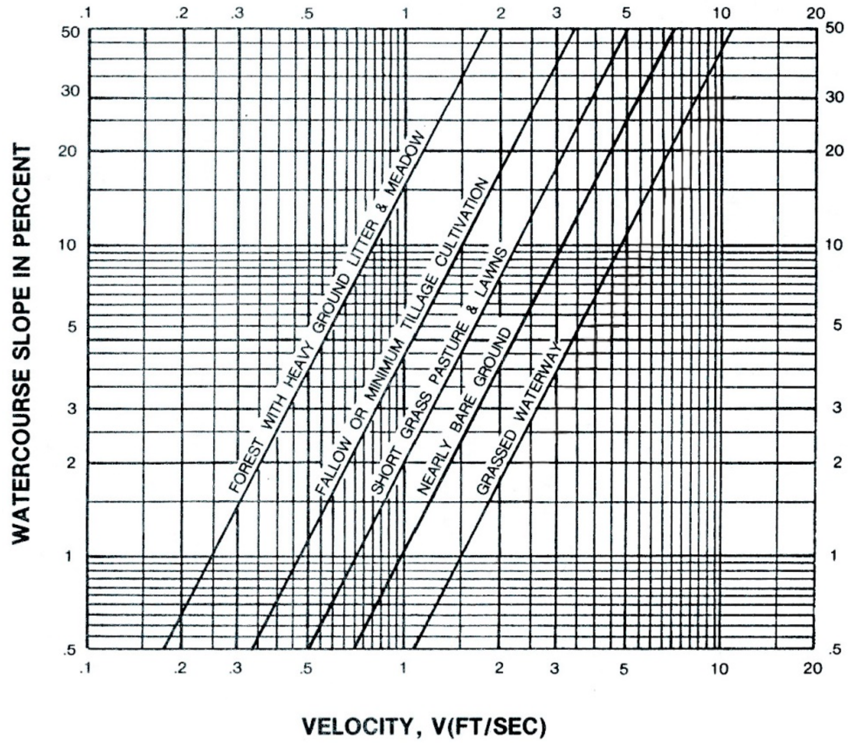

Figure 4. Velocities for upland method of estimating travel time for shallow concentrated flow (adopted from Figure 816.6 of the Caltrans HDM [2014]).

Table 3. Summary of time-to-concentration analyses for Freund site.

Drainage area (sq mi)	Longest flow patkh (ft)	Maximum elevation change (ft)	Slope (%)	Velocity (Figure 816.6 Caltrans HDM) (ft/s)	Time (min)	Relief	Soil infiltration	Vegetal cover	Surface storage	Runoff coefficient (Figure 819.2A Caltrans HDM)
0.015	1530	590	38.6%	1.6	15.9	0.28	0.06	0.06	0.10	0.50

7.1.2.3 Runoff coefficients

The runoff coefficient used in the Rational Formula was determined using the method for un-developed areas in the Caltrans HDM (Figure 5). For this analysis, the site was considered to have extreme relief, normal soil infiltration, fair to good vegetation cover, and negligible surface storage, resulting in a runoff coefficient of 0.50.

Watershed Types

	Extreme	High	Normal	Low
Relief	.28 -.35 Steep, rugged terrain with average slopes above 30%	.20 -.28 Hilly, with average slopes of 10 to 30%	.14 -.20 Rolling, with average slopes of 5 to 10%	.08 -.14 Relatively flat land, with average slopes of 0 to 5%
Soil Infiltration	.12 -.16 No effective soil cover, either rock or thin soil mantle of negligible infiltration capacity	.08 -.12 Slow to take up water, clay or shallow loam soils of low infiltration capacity, imperfectly or poorly drained	.06 -.08 Normal; well drained light or medium textured soils, sandy loams, silt and silt loams	.04 -.06 High; deep sand or other soil that takes up water readily, very light well drained soils
Vegetal Cover	.12 -.16 No effective plant cover, bare or very sparse cover	.08 -.12 Poor to fair; clean cultivation crops, or poor natural cover, less than 20% of drainage area over good cover	.06 -.08 Fair to good; about 50% of area in good grassland or woodland, not more than 50% of area in cultivated crops	.04 -.06 Good to excellent; about 90% of drainage area in good grassland, woodland or equivalent cover
Surface Storage	.10 -.12 Negligible surface depression few and shallow; drainageways steep and small, no marshes	.08 -.10 Low; well defined system of small drainageways; no ponds or marshes	.06 -.08 Normal; considerable surface depression storage; lakes and pond marshes	.04 -.06 High; surface storage, high; drainage system not sharply defined; large floodplain storage or large number of ponds or marshes

Figure 5. Runoff coefficients for undeveloped areas (adopted from Figure 819.2A of the Caltrans HDM [2014]).

7.1.2.4 Precipitation data and storm discharges

The intensity-duration-frequency (IDF) curve used for this Rational Method analysis came from NOAA's National Weather Service Hydrometeorological Design Studies Center Precipitation Frequency Data Server (PFDS).[3] Rainfall intensity was determined from the IDF storm event curves with 15.9-minute durations, which is equivalent to the "Time to Concentration" for the project site. The rainfall intensity for each storm event is shown in Table 4, below.

The final calculated flow discharges resulting from the Rational Method for each storm event for the Freund Stables site can be seen in Table 4 below:

[3] http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

Table 4. Flood frequency discharge estimates for the Freund Stables project site.

Recurrence interval precipitation event	100-yr	50-yr	10-yr	5-yr	2-yr	1.5-yr
Depth-interpolated NOAA PFDS (in)	0.84	0.74	0.53	0.45	0.36	0.32
Rainfall intensity (in/hr)	3.2	2.8	2.0	1.7	1.3	1.2
Rational Method flow Q=CIA (cfs)	15.4	13.5	9.7	8.2	6.5	5.9

7.2 Hydraulic Modeling

To understand channel dynamics and estimate flooding potential adjacent to the San Geronimo Creek project sites, flow hydraulics were modeled using the US Army Corps of Engineers' *Hydrologic Engineering Center's River Analysis System (*HEC-RAS). HEC-RAS is a one-dimensional hydraulic model that is widely used for floodplain mapping and estimating general flow characteristics. However, as a one-dimensional model, it is built on simplified hydraulic assumptions, such as: (1) flow in one direction only, (2) constant velocity distribution within the channel and floodplain portion of each cross section, and (3) flow is modeled based on channel cross section only (no effects of channel topography between cross sections is considered). Therefore, it is important that these limitations are closely considered during the hydraulic model setup, calibration and application.

7.2.1 Existing conditions hydraulic models (Snyder, McGuinn, and Watson)

The models were developed using the field-surveyed channel cross-sections as shown on Figures 6 to 8. The HEC-RAS cross sections were exported from CAD based on the new Digital Elevation Models (DEMs) created by combining the new and existing field survey data. At each of the three sites, a Manning's n value of 0.045 was used for the channel roughness based on the HEC-RAS Reference Manual recommendations for "Clean and winding natural streams with some pools, shoals, weeds and stones". A Manning's n value of 0.055 was used for floodplains roughness based on a slightly conservative value from the HEC-RAS Reference Manual recommendations for "Flood plains with light brush and trees in winter".

As the HEC-RAS model for each site was being developed, two steps were conducted to insure that the Manning's n values being used were appropriate. First, sensitivity analyses were conducted by running the model with different Manning's n values and comparing the results. These analyses showed that increasing "n" values by 0.01 resulted in water surface elevations throughout the reach generally increasing by 0.25 to 0.5 feet for any given flow. The second step used to test “n” values was comparing water surface elevations predicted by the model with field observations such as indicators of the bankfull channel dimensions. Overall, the “n” values recommended by the HEC-RAS Manual resulted in modeled flow depths that were consistent with field observations. Furthermore, although the model outputs are somewhat sensitive to changing “n” values, water surface elevations of +/- 0.5 feet fall within the range of precision expected for field observations of bankfull channel indicators. Therefore, we feel confident that the “n” values selected for these projects are appropriate.

Additional HEC-RAS model input parameters included selection of a subcritical flow regime with normal depth upstream and downstream boundary conditions. The floodplain extents resulting from the existing conditions hydraulic model are shown on Figures 6 to 8 for the Snyder, McGuinn, and Watson sites. Also, the mean total stream velocity and shear values taken from the HEC-RAS model for each site are tabulated in Table 5, below. A more simplistic modeling approach has been taken for the Freund site that includes only three cross sections that define the appropriate channel cross section and shear forces that act on the bed material.

Table 5. Bankfull width, mean total stream velocity, and shear values.

Site	Bankful width range	Velocity/Shear	100-yr	10-yr	Bankfull (1.5 yr)
Snyder	35–60 ft at Mainstem	Total Velocity (ft/s)	11.2	9.5	6.5
		Total Shear (lb/sq ft)	3.3	2.7	1.7
McGuinn	20–40 ft	Total Velocity (ft/s)	8.2	7.6	5.7
		Total Shear (lb/sq ft)	2.2	2.0	1.5
Watson	20–50ft	Total Velocity (ft/s)	7.2	6.6	5.0
		Total Shear (lb/sq ft)	1.6	1.5	1.1

Figure 6. Approximate floodplain extents at various flows for the Snyder project site.

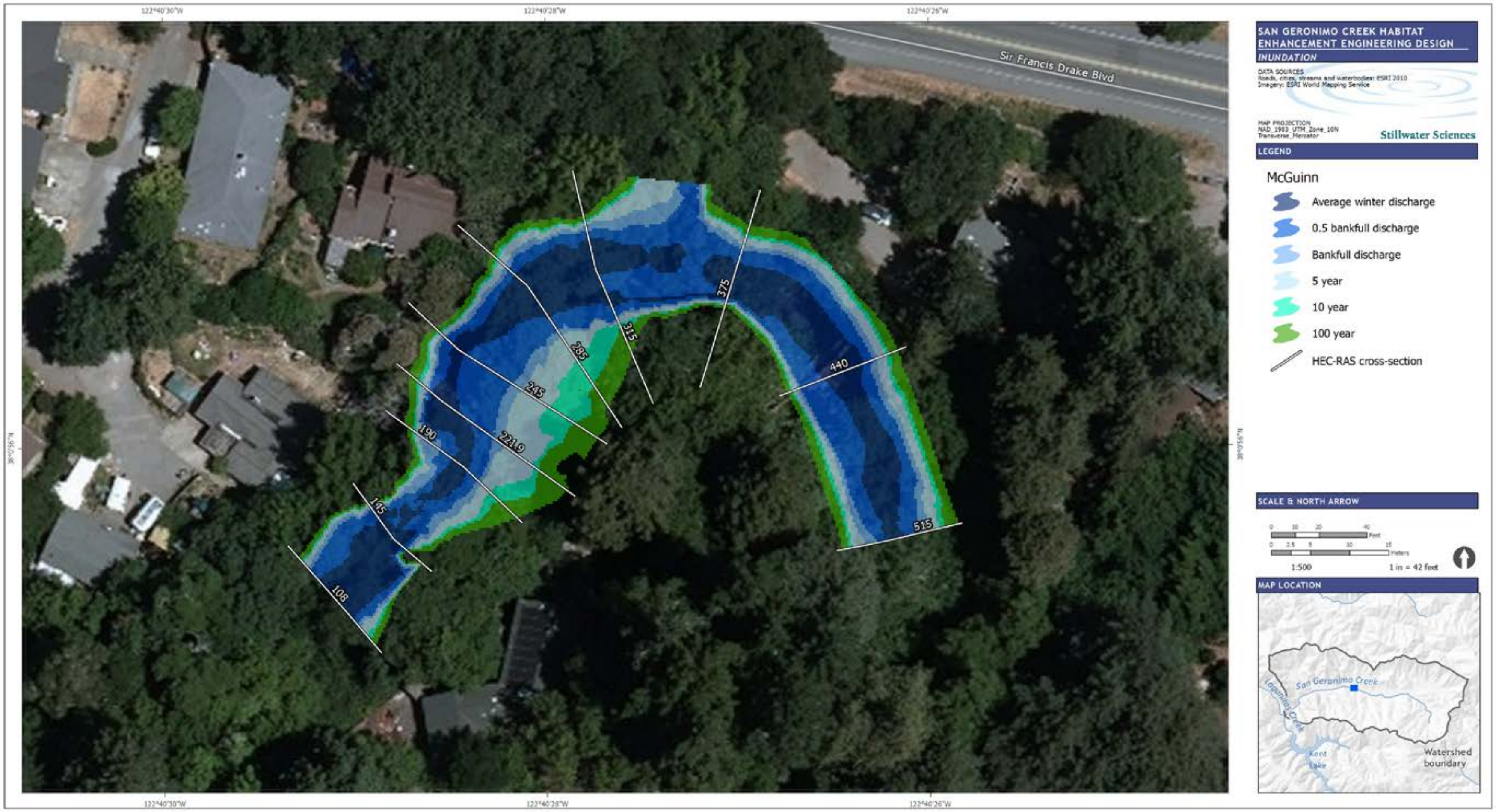

Figure 7. Approximate floodplain extents at various flows for the McGuinn project site.

Figure 8. Approximate floodplain extents at various flows for the Watson project site.

7.2.2 Proposed conditions hydraulic models (Snyder, McGuinn, and Watson)

Proposed site conditions that include the habitat enhancement treatments shown on the Design Plans in Appendix A were modeled in HEC-RAS. Proposed conditions modeling was conducted by adjusting the geometry of the channel cross sections based on proposed grading of the banks and increasing channel roughness from 0.045 to 0.055 and/or bank roughness from 0.055 to 0.65 based on the location of proposed wood structures. Using a one-dimensional model to determine the hydraulic response resulting from the installation of complex wood structures is not an exact science. As such, we have relied on professional judgment and common sense to adjust model parameters to mimic the proposed flow conditions. We believe that the increased roughness in the proposed conditions model accounts for some racking of new woody debris in the proposed structures, although extensive racking can block large portions of the channel, effectively changing the channel cross section dimension, and this analyses has not accounted for that degree of racking. If a high degree of large wood racking occurs, we recommend post-project maintenance to remove some of the racked material.

The existing and proposed conditions water surface elevations (WSEs) for the 100-, 10-, and 2-year storm events are shown on Figures 9 to 11. HEC-RAS output tables for existing and proposed conditions are included in Appendix C describing flow velocity and shear forces for a variety of flows at each project site.

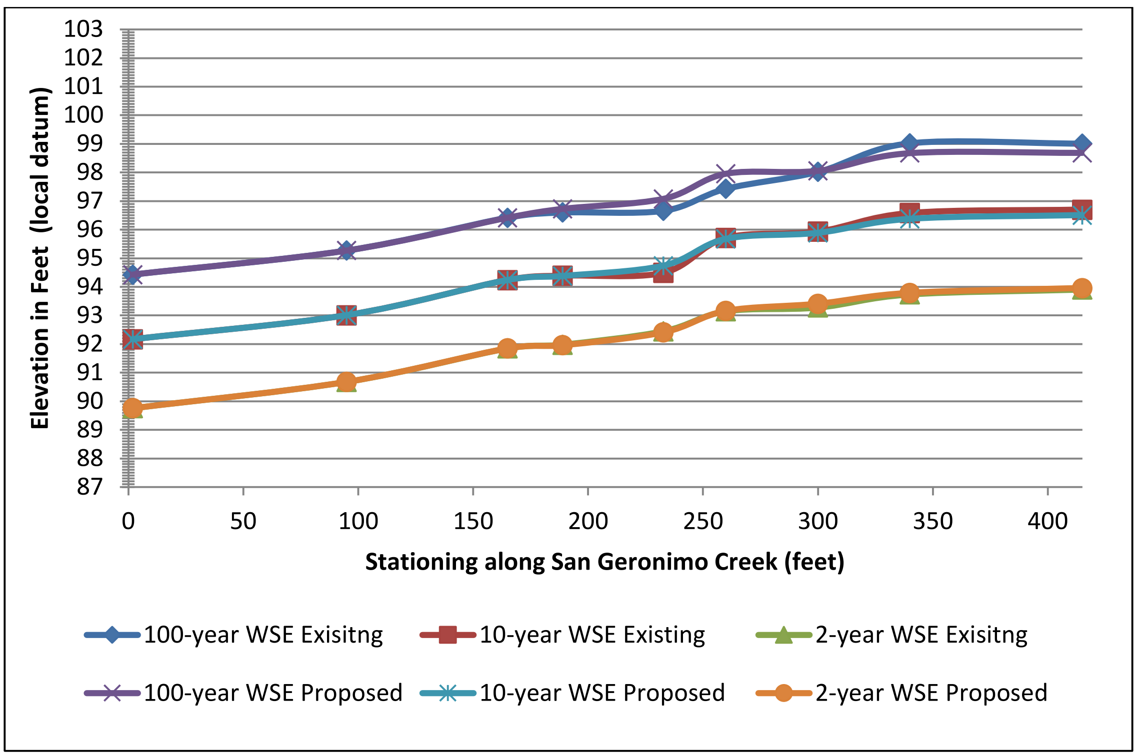

Figure 9. Existing and proposed water surface elevations for Snyder site estimated by HEC-RAS.

The figure above shows that the proposed Snyder project will result in minor increases in WSEs (less than 0.5 feet) within the immediate vicinity of channel widening and wood placement, based on HEC-RAS model outputs. The channel widening and increased roughness at Stations 232 and 260 will result in slower water velocities and thereby increase WSEs slightly according to the model. However, WSEs upstream of the project site will decrease because the proposed project is effectively widening a pinch point that was causing upstream flow to back up. The predicted increase in localized water surface elevation during the 100-year event will not increase risk to any adjacent infrastructure.

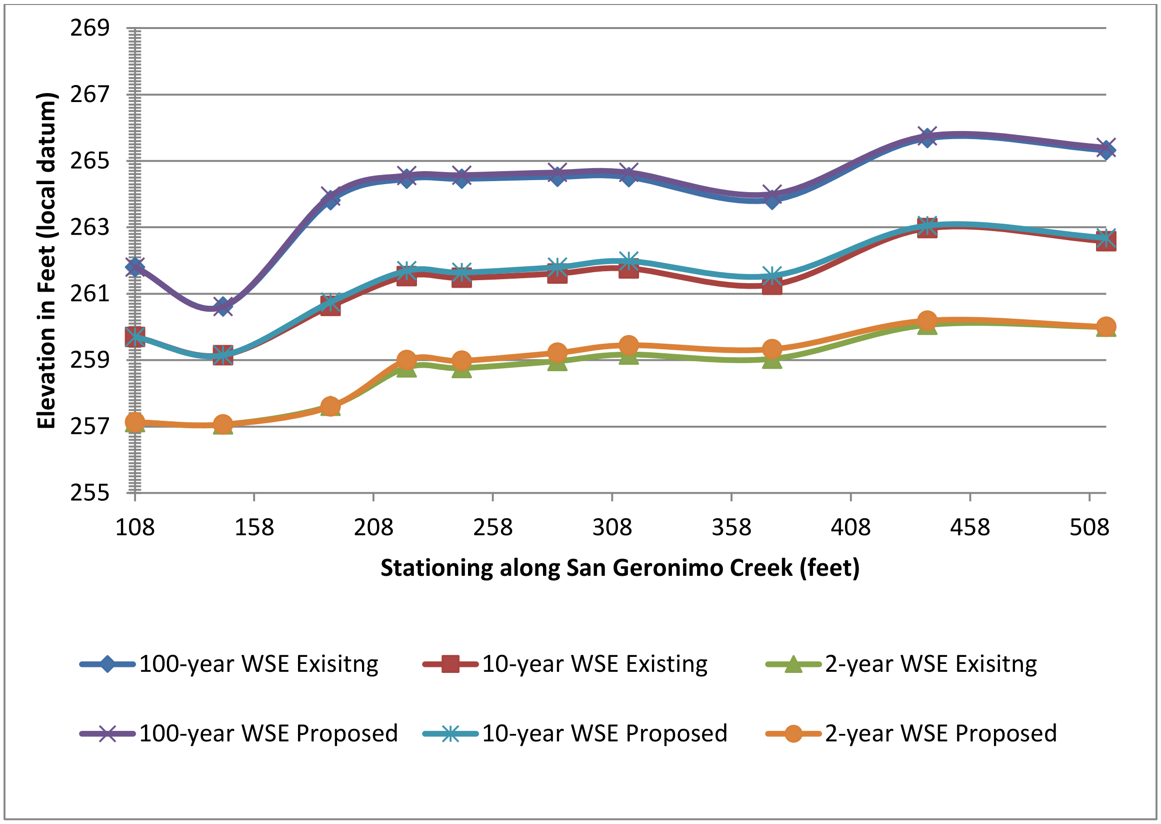

Figure 10. Existing and proposed water surface elevations for McGuinn site estimated by HEC-RAS

The figure above shows that the proposed McGuinn project will result in very minor increases to WSEs within the immediate vicinity of the boulder and wood placement ranging from approximately 3 inches during the 2-year event to 1 inch during the 100-year event. These WSE increases dissipate farther upstream. These minor increases are due to the rock and wood structures which result in minor decreases to the channel cross sectional area and increase roughness.

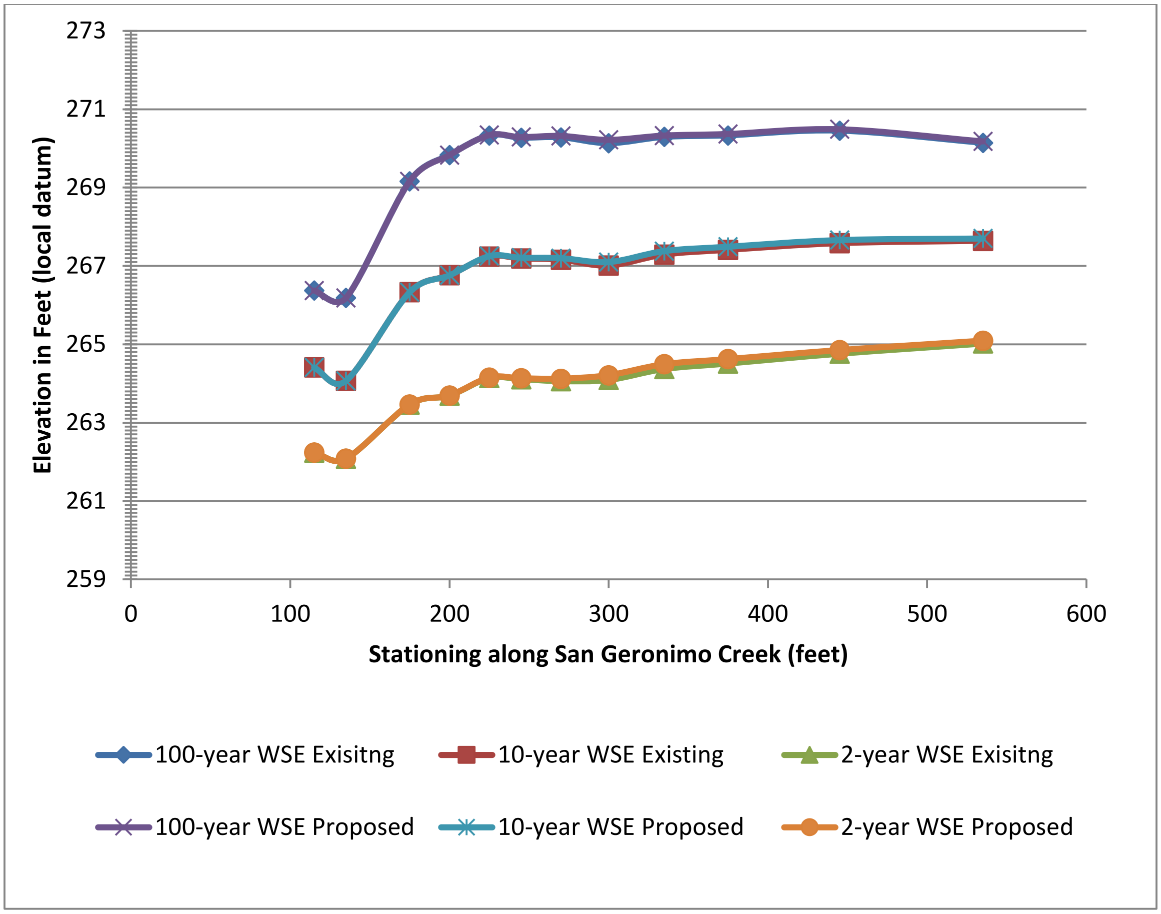

Figure 11. Existing and proposed water surface elevations for Watson site estimated by HEC-RAS.

The figure above shows that the proposed Watson project will result in very minor increases to WSEs within the immediate vicinity of the boulder and wood placement of approximately 1 inch during all storm events. These WSE increases dissipate farther upstream. These minor increases are due to the rock and wood structures which result in increased channel roughness.

7.2.3 Freund hydraulic model

A more simplistic approach was used for the Freund site that included hydraulic modeling of four cross sections. Modeling results define the channel cross section dimensions needed to contain flows up to the 100-year event of 8 cfs as well as the bed material that will be needed to withstand flow velocities ranging from 3 to 5 ft/sec during the 100-year event. As shown on the Plans, a channel width of 6 ft and depth of 1.5 ft is recommended and a mixture of gravel to large cobble is needed to withstand the expected flow velocities.

7.3 Summary of Hydraulic Modeling Results

One of the main goals of this project is to enhance winter habitat for salmonids through decreasing high flow velocities and an expected consequence of this type of project is higher WSEs. However, in the case of the proposed project, the increased WSEs are small and localized and do not increase flooding hazards for existing infrastructure such as houses, roads, or bridges. Therefore, we believe that the proposed designs achieve a fair compromise between salmonid habitat enhancement and flooding concerns.

8 HABITAT ENHANCEMENT DESIGNS

8.1 Snyder-Stanger Project

8.1.1 Project information

This project is located on property owned by Michael Snyder and Carol Stanger (APN#: 170-021-16; Address: 7303 Sir Francis Drake Boulevard, Lagunitas) at the confluence of San Geronimo and Cintura Creeks, across from the Lagunitas Store. A portion of the proposed work is also located on the adjacent upstream right bank property and the landowner has expressed willingness to participate in the project. We are currently working with this landowner to secure access and expect to have full landowner permission in place by January 29, 2016.

8.1.2 Project objectives

The San Geronimo Creek Salmon Enhancement Plan identified Lower San Geronimo Creek as one of the reaches in greatest need of rehabilitation. Specifically, limited high-flow refugia for salmonid winter rearing was identified as an instream condition that directly affects fish (Stillwater Sciences 2009). Our approach for habitat enhancement at this site is based on conditions observed in habitat units with the greatest retention of juvenile coho salmon and steelhead from fall to winter during intensive research on other portions of the Lagunitas Creek Watershed with similarly incised channels (Stillwater Sciences 2008), as well as PIT tag monitoring of juvenile salmonids during winter flow events (Bell 2001). The primary objective of this project is to create high flow refugia/winter rearing habitat for coho salmon through creation of contiguous rearing habitat from low winter base flows to storm event flows, allowing fish to migrate as flows increase, as demonstrated in Figure 12. In addition, this project will also enhance summer rearing habitat by increasing pool depth, cover, and complexity.

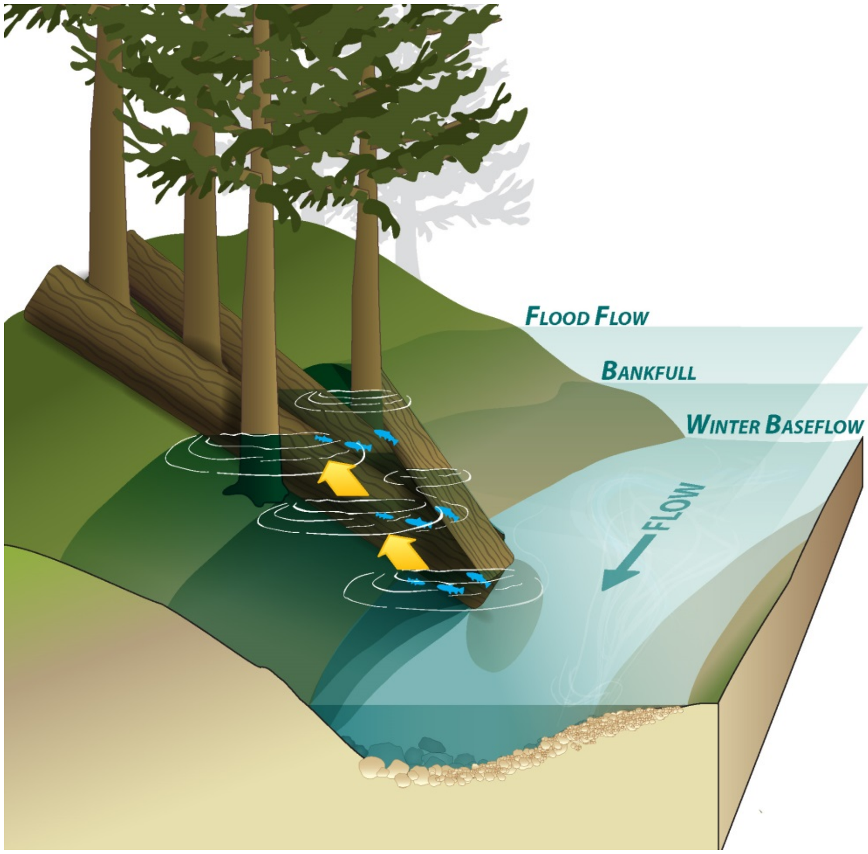

Figure 12. Conceptual design of simple 3-piece large wood structure.

8.1.3 Snyder design

The Design Plans for this project are located on Sheets 2–6 in Appendix A. Overall the channel slope ranges from 1.5% to .4%, and this site has unique potential for habitat enhancement due to the complexity provided by the Cintura Creek tributary confluence and due to the localized low channel slope (0.4%) at this location resulting from the downstream bedrock that controls channel gradient. Channel banks within the project area have slopes ranging from 35% to 45% adjacent to the creek with flatter terraces ranging in slope from 20% to nearly flat located at an elevation of 7–10 ft above the channel. Topographic constraints limit the amount of floodplain habitat that can be constructed cost-effectively on the right bank where landowner access is secured. Therefore, we are proposing opportunistic grading activities that work around well-established riparian vegetation and lay back steep channel banks to a 2:1 slope. In combination with the grading, anchored log and rootwad structures will be installed that provide contiguous habitat from low flows to storm flows as demonstrated on Design Plan Sheet 4. Work will be focused around the Cintura Creek confluence with additional structures and grading upstream and downstream. All disturbed areas will be re-vegetated with native riparian plants (Figure 13).

We believe that this project could be constructed without dewatering the channel considering that all of the proposed excavation will occur above the low-flow water level and there is easy heavy equipment access to the right channel bank. If needed, a turbidity curtain could be used at some locations to control sedimentation.

Figure 13. Photo of Cintura Creek Confluence looking upstream (photo courtesy of PCI).

8.1.4 Changes from PCI design

In comparison with the PCI conceptual plans developed for this site (Appendix B), Stillwater's Design Plans has scaled back the amount of grading and wood placement upstream from the Cintura Creek confluence and extended proposed grading and wood placement activities to downstream areas. We were concerned that the floodplain habitat proposed in the PCI conceptual plans would be filled with sediment relatively rapidly considering that Cintura Creek carries high sediment loads, and there would not be an obvious mechanism for maintaining the newly created habitat over time. The new conceptual designs have a much lower likelihood of sedimentation because no excavation is occurring within the Cintura creek channel, and the newly excavated areas adjacent to San Geronimo Creek are more likely to be maintained by the floodplain processes of San Geronimo Creek. In addition, the new conceptual design enhances habitat over a longer reach of San Geronimo Creek and also provides summer rearing habitat for salmonids in the form of pool cover, in close proximity to the high-flow rearing habitat.

8.1.5 Additional details related to off-channel habitat/floodplain enhancement

The Snyder-Stanger project involves off-channel floodplain creation/enhancement. As required to be considered for funding from the CA Department of Fish and Wildlife's Fisheries Restoration Grants Program (2015 Drought PSN Part V-27 to Part V–30), we are including additional details related to this activity below. This project will improve hydrologic connectivity between approximately 600 square feet of floodplain and the main channel. The goal of this project is to create conditions that allow the floodplain to inundate at lower discharges than under existing conditions. Currently, there is minimal active floodplain at the project site and the goal of the project is to create inset floodplains that inundates at flows between the winter baseflow to the bankfull event. This will be achieved through excavation of the channel banks as shown on the plans, and installation of wood structures that will direct water onto the floodplains. There is no infrastructure risk associated with this portion of the project because the area proposed for enhancement treatments is small, and there are no houses or other structures adjacent to the site. As shown on Figure 9, there will be some localized increases in post-project WSEs, but the project will decrease upstream WSEs. It is anticipated that the new floodplain will maintain itself over time due to the large wood structures and location along a gentle outside bend in the creek, although there will likely be localized areas of aggradation and degradation.

8.1.5.1 Biological evaluation

The Snyder-Stanger project is designed to provide velocity refuge for salmonids during a range of winter flows that currently exists in the project reach. As described earlier in this report, lack of winter refuge limits salmon populations in San Geronimo Creek. In addition, analyses of the San Geronimo Creek watershed have determined that widespread channel incision has largely been driven by anthropogenic factors. Therefore, these proposed floodplain enhancement activities are justified. Due to the fact that the proposed floodplain enhancement reach is relatively short and will not include any off-channel pools, there is minimal risk of fish stranding.

8.1.5.2 Site hydrology and hydraulics

As previously discussed, the floodplain enhancement component of the Snyder-Stanger project is designed for winter habitat only and will be designed to begin to be partially inundated by San Geronimo Creek at winter base flows. Given the proposed function and location of this feature, there is no need to analyze groundwater or tidal influence. Figure 9 shows the existing conditions HEC-RAS modeling results at the site which shows the general lack of floodplain within the project reach.

8.1.5.3 Site physiography

Currently, there are only a few small high-elevation floodplains within the project reach that are composed of a mix of gravel, silt and sand and stabilized by tree roots. The area where the primary floodplain habitat enhancement is being proposed upstream of Cintura Creek is composed of a nearly vertical bank. The geology, hydrology, and geomorphology of the site are described earlier in this document. Substantial large wood and boulder structures are proposed along the right bank throughout the site to minimize the risk of avulsion. As discussed earlier, San Geronimo Creek carries a significant sediment load and there is potential for aggradation of the enhanced floodplain. For this reason, we are proposing large wood features both in the main channel and along the floodplain to promote some scour at high flows. We expect that the floodplain enhancement component of this project will have a minimum design life of 10 years. (Note that the large wood structures are expected to have a design life of 20+ years). Even if some aggradation does occur such that the floodplain is not beginning to be inundated at winter baseflow, the project will still have a benefit at higher flows due to the new features installed on the floodplain that add complexity. This project does not reestablish stream flow through disconnected water bodies so no assessment of the existing habitat value is necessary.

8.1.5.4 Engineering and implementation

As previously mentioned, detailed topography for this portion of the project has been obtained. Approximately 360 cubic yards of material will be excavated and hauled offsite. Ultimately, the construction contractor selected to implement the project will be responsible for the off-hauled material, but should consult with Marin County Public Works to identify an appropriate nearby site that can result in a cost saving to the project. Wood and boulder structures will be incorporated into the design as shown on the plans to direct water into the floodplain area and protect the adjacent banks. All floodplain enhancement work will occur outside of the wetted channel and above groundwater levels so no flow management is necessary during construction.

8.2 McGuinn-Newman Project

8.2.1 Project information

The proposed project is located on property owned by Allan Newman and Donna McGuinn (APN#: 169-071-20; 6355 Sir Francis Drake Boulevard, San Geronimo) on the mainstem San Geronimo Creek immediately downstream of the confluence with Larsen Creek. A significant portion of the proposed project is also located on the adjacent upstream property which has recently transferred ownership. We are currently working with the new landowner to secure access.

8.2.2 Project objectives

The primary objective of this project is to reduce bank erosion adjacent to the McGuinn-Newman residence. To protect their house, a sheet pile wall was constructed as shown on Design Plan Sheet 10, Cross Section 2+85 of the design plans. The sheet pile wall is completely buried in the ground and extends down to an elevation below the channel depth (personnel communication with landowner). The proposed design will stabilize the stream banks with the installation of willow-planted boulder and wood structures that direct the stream's erosive forces away from the toe of the bank. Through these features and additional bioengineered bank stabilization treatments as shown on the plans, native riparian vegetation will become established thereby preventing bank erosion, eventual exposure of the sheet pile wall and further loss of property.

A second project objective is preventing channel incision from migrating upstream along San Geronimo Creek. There is evidence of approximately 2 ft of incision in the form of exposed roots in the channel reach downstream from the proposed project. Currently, the 100-ft stream reach located adjacent to the toe of the eroding bank has a steeper gradient than adjacent stream reaches accounting for approximately 1.5 ft of elevation change (see longitudinal profile on Design Plan Sheet 9). If this gradient is lost and incision migrates upstream, aquatic habitat would be further degraded and bank erosion would be exacerbated. The conceptual design includes two large wood and boulder structures designed to maintain channel gradient (and turn flows away from the toe of the bank).

Consistent with the objectives described for the Snyder-Stranger Project, a third objective of the McGuinn-Newman Project is creating summer and winter rearing habitat for salmonids throughout the project reach by opportunistically incorporating large wood structures into the design as demonstrated on Design Plan Sheet 9.

8.2.3 McGuinn design

The Design Plans for this project can be found on Sheets 7–11 in Appendix A. We are proposing four right-bank structures with the upstream and downstream structures designed to enhance summer rearing habitat and provide minor bank stability benefits and the two middle structures designed primarily to promote bank stability and control channel gradient (Figure 14). The localized channel slope ranges between of 0.3% and 1.4%. Channel banks within the project area have slopes ranging from 215% to 22% adjacent to the creek with flatter terraces ranging in slope from 15% to nearly flat, located at an elevation of 11ft to 13ft above the channel.

It should be noted that the type of boulder cluster structures proposed for this site are naturally occurring in adjacent reaches of San Geronimo Creek (left bank at Station 1+45). All four right bank structures will enhance slow-water edge habitat at low to moderate winter flows. In addition, a fifth structure proposed for the left bank at the downstream extent of the project is designed to provide contiguous rearing habitat from low winter base flows to storm event flows. All disturbed areas and oversteepened streambanks will be re-vegetated with native riparian plants.

An additional three large wood and boulder structures are also proposed upstream from the Larsen Creek confluence designed to enhance existing pool habitat and protect the toe of the bank from long-term scour and undercutting. It is possible, that these new structures could result in minor increases in erosion rates along the left bank between Stations 3+50 and 4+50 where the oversteepened bank is shown on Sheet 7 of the Design Plans. During a field visit with the landowner, we discussed this scenario and considering the infrastructure on the right bank and lack thereof on the left bank, this was a tradeoff that the landowner was comfortable with. Considering that the oversteepened bank lays along the inside of a sharp bend, significant long-term erosion is not expected to occur.

This project will require heavy equipment access within the San Geronimo Creek channel and associated dewatering activities because there is no equipment access to the top-of-right-bank and two of the proposed structures require channel excavation within the low flow thalweg. We are currently working with the landowner to secure equipment access.

Figure 14. Photo of eroding right bank adjacent to McGuinn-Newman residence taken looking downstream.

8.2.4 Changes from PCI design

The current Design Plans now include three additional downstream structures (the PCI design only included two structures). Due to the sharp bend in the creek and high erosion potential along the entire extent of the bend, we believe that it is important to treat the entire bend. In addition, we are proposing the use of large wood turning structures instead of a boulder vane and are proposing the installation of additional willow-planted boulder clusters along the eroding bank to provide the toe protection that is required for permanent riparian vegetation to become established.

8.3 Watson Project

8.3.1 Project information

The proposed project is located on property owned by Robin Watson (APN#: 169-111-48; Address: 585 San Geronimo Valley Drive, San Geronimo) on mainstem San Geronimo Creek immediately upstream of the Creamery Road bridge. A significant portion of the proposed project is also located on the adjacent left bank property which is owned by Larry Klein who has also expressed support for the project.

8.3.2 Project objectives

The objective of this project is to reduce bank erosion adjacent to the Watson backyard patio/pool and the Klein house, while improving habitat conditions for salmonids with enhancement of summer rearing and winter refuge habitat (as described in detail for Snyder-Stranger Project).

8.3.3 Watson design

The Design Plans for this project can be found on Sheets 12–16 in Appendix A. The localized channel slope ranges between of 0.5% and 1.7%. Channel banks within the project area have slopes ranging from 175% to 30% adjacent to the creek, with nearly vertical slopes at the down and upstream ends of the culvert with flatter terraces ranging in slope from 9% to nearly flat, located at an elevation of 11 ft to 13 ft above the channel (Figure 15). We are proposing two large wood and boulder structure on the left bank that will provide contiguous habitat from summer to winter flows and also stabilize the toe of the bank. For the right bank, we are proposing a willow-planted rock toe and boulder cluster with large wood incorporated to provide winter refuge during flows up to the bankfull event. The close proximity of the swimming pool at the top-of-bank constrains the proposed design on the right bank. We are proposing a rock toe consisting of two layers of large boulders precisely stacked to provide a stable 0.75:1 (H:V) slope for the lower 5 ft of bank. The upper 5 ft of bank will be laid back at a 2:1 slope, covered with erosion fabric and planted with native shrubs and trees.

A shallow toe trench is sufficient for this site because there is a bedrock outcropping with a top elevation of approximately 200 ft (local datum) that will prevent further incision and scour along the base of the eroding right bank. However, above this elevation, the bank consists of unconsolidated gravels, sand, and silt which are being eroded during high flows and will be protected by the proposed willow-planted rock slope protection.

To minimize channel disturbance, we recommend that some of the work on both sides of the creek takes place from the top-of-bank and believe that this will be feasible with experienced contractors and the use of the proper types of equipment.

Figure 15. Photo of oversteepened right bank adjacent to Klein residence taken looking upstream from Creamery Road.

8.3.4 Changes from PCI design

The current Design Plans has eliminated the retaining wall from the right bank which was prescribed in the PCI conceptual design. Aside from the removal of the wall and some other minor differences, the plans are very similar.

8.4 Freund Project

8.4.1 Project information

The proposed project is located on property owned by Alane Freund (APN#: 172-122-20; Address: 17 Laurel Ave., Woodacre) along a small gully draining to Woodacre Creek that was created by road construction and an associated ditch relief culvert drainage.

8.4.2 Project objectives

The objective of this project is to reduce sediment and nutrient delivery to Woodacre Creek which in turn drains into San Geronimo Creek. In addition, the project will harvest rainwater to provide summer irrigation for an existing garden.

8.4.3 Freund design

The Design Plans for this project is shown on Sheets 17 and 19 in Appendix A. We are proposing to construct a cobble roughened channel to dissipate energy and limit soil erosion within the small gully (Figure 16). An existing trail will be moved away from channel to provide space for a vegetated buffer strip along the channel to filter sediment and nutrients from the hillslope. In addition, a roofwater harvesting system is proposed for the barn.

Figure 16. Photo of eroding drainage on Freund property taken near footbridge looking downstream (photo courtesy of PCI).

8.4.4 Changes from PCI design

The current Design Plans is nearly identical to the PCI conceptual design. The one difference is that we have included a runoff management component at the upstream extent of the project site to control runoff from the parking area.

9 WOOD STRUCTURE STABILITY ANALYSES

9.1 Stability Analyses Overview

The large wood structure stability analysis used to develop this project design was generally based on the methodology presented in Castro and Sampson (2001). The constants, freebody diagram and equations from Castro and Sampson are included in Appendix D as well as a spreadsheet that describes the stability calculations for each specific wood structure and diagrams identifying each piece of wood and structure name. In summary, this method uses a basic force balanceapproach in the vertical and horizontal directions to insure that each wood structure will be stable during a specific flow regime. The calculation process begins with a sum of vertical forces to determine the boulder weight that is necessary to give each structure a factor of safety of 1.5 for buoyancy. Then based on these boulder weights, the factor of safety for momentum was calculated and in the case of every structure, it was determined to be 2.0 or greater.

9.1.1 Stability analyses parameters

Below is a list of assumptions that went into these calculations:

- Analysis was performed under 100-year flow regime
- All boulders submerged at 100-year flows
- Rootwad dimensions: 4 ft diameter x 5 ft length with porosity = 0.3
- Channel bed and banks composed of medium gravel: Friction angle = 40 degrees, which results in coefficient of friction for bed of 0.84 (Castro and Sampson)
- All wood is calculated as dry Douglas Fir: density = 33.7 lb/ft^3 (Castro and Sampson)
- Anchor to live tree is assumed to be equivalent to 4 tons of ballast and 4 tons of momentum-resisting force
- Boulders required for each feature are calculated based on a Factor of Safety = 1.5 for buoyancy
- Avg 100-year velocity for each project reach from HEC-RAS outputs:
    - Snyder = 11.3 ft/s
    - McGuinn = 6.1 ft/s
    - Watson = 4.8 ft/s
- For flow force calculation on multi-log structures located along the stream bank, calculations assume a shadow effect, i.e. flow only acts on upstream log
- For single rootwad structures on Watson property, assume flow force acts on 1/3 of the rootwad area
- ϴ (angle from rootwad face to vertical) = 0

9.1.2 Stability analyses results

Overall, the Factor of Safety for buoyancy/lift governs stability for all wood structures. Table 6 summarizes the results of the full calculations presented in Appendix D.

Table 6. Wood structure stability overview.

Site	Feature #	Number of Pieces of Wood	Weight of Boulder Required (tons)	Factor of Safety (Buoyancy/ Lift)	Factor of Safety (Momentum)
Snyder	1	2.0	13.6	1.5	2.0
	2	2.0	4.9	1.5	3.1
	3	4.0	14.0	1.5	2.3
	4	6.0	18.1	1.5	2.4
	5	2.0	3.4	1.5	2.1
	6	2.0	3.0	1.5	2.7
McGuinn	7	2.0	0.0	1.5	13.0
	8	3.0	2.9	1.5	5.2
	9	3.0	14.3	1.5	3.5
	10	3.0	14.3	1.5	3.5
	11	1.0	2.2	1.5	4.4
	18	2.0	0.0	1.5	4.7
	19	2.0	3.6	1.5	4.0
	20	2.0	0.0	1.5	5.8
Watson	12	6.0	21.9	1.5	7.8
	13	2.0	6.8	1.5	15.1
	14	1.0	2.3	1.5	3.0
	15	1.0	2.3	1.5	3.0
	16	1.0	2.3	1.5	3.0
	17	2.0	4.2	1.5	4.1

9.1.3 Stability analyses uncertainties and factors of safety

There are several areas of uncertainty associated with this stability analyses as discussed below. However, we are confident that the structures will be stable for the long-term due to the Factors of Safety built into this analysis and engineering judgement that has guided the layout of the structures (based on design, installation and monitoring of 50+ similar wood structures by the engineer). In addition, long-term stability will be guaranteed through proper installation as described in the plans and specifications, and guided by technical oversight.

The first area of uncertainty is that average flow velocities through each project reach (determined by HEC-RAS) are used for the stability analyses. In reality, water velocities vary greatly both laterally across the channel cross section and with depth. However, we believe that using average velocities is a conservative estimate because the highest velocities generally occur in the middle of the channel and all of the proposed structures are located along the streambanks. However, in some cases, especially along outside bends, velocities along the banks can be as high or higher than velocities in the middle of the channel. In these areas, structures will be designed with greater Factors of Safety considering the higher shear forces that may act against them, especially related to sliding stability (momentum). As seen in Table 6, most structure have a very high momentum Factor of Safety which implies that they could withstand much higher flow velocities then those used in this analyses, and still stay in place.

A second area of uncertainty is the possibility that the position of the wood structures may adjust due to scour. Most of the structures are built off of the bank with strong anchor points to existing trees or new boulders and in many cases the structures have been designed so that the force of the flow will hold them in place. In the case of these structures, minor scour and settling may actually help the structure stay in place because it will increase resistant forces via wedging. However, there is one structure (Structure 1, Snyder Project) that has potential to rotate if significant scour were to occur. For this structure, it is recommended that the two boulders anchoring the upstream portion of this structure are keyed deeply into the channel bed and bank and that the engineer is onsite as this structure is being constructed to insure proper installation.

A third area of uncertainty is the possibility of contractor error or faulty materials (wood or rock with insufficient strength) leading to failure of one or more of the anchoring connections. As such, we have included a significant amount of redundancy in the anchoring of each structure and will consider adding more redundancy prior to finalizing the Design Plans. To further insure the quality of anchoring, we strongly recommend that a contractor is selected that has previous experience with implementation of large wood projects. Also, it is recommended that the engineer is onsite during large wood placement and anchoring to insure proper installation.

Finally, to insure long-term durability of the structures, we recommend that the engineer performs post-storm inspections for the Snyder, McGuinn and Watson sites and identifies any areas where post-project maintenance is required to insure long-term stability of the structures.

10 IMPLEMENTATION

10.1 Cost Estimate

Tables 7 to 10 provide engineer's cost estimates for each project site. These costs are based on the assumption that the projects will be permitted through the FRGP process.

Table 7. Snyder engineer's cost estimate.

No.	Item	Unit Cost	Quantity	Units	Total cost
1	Mobilization and Site Protection	$10,000.00	1	LS	$10,000.00
2	Grading	$25.00	360	CY	$9,000.00
3	Offhaul	$25.00	360	CY	$9,000.00
4	Large Wood—Placed and Anchored	$2,500.00	20	each	$50,000.00
5	Boulders—Placed and Anchored	$200.00	40	CY	$8,000.00

6	Coir Log	$15.00	40	LF	$600.00
7	Bioswale	$1,500.00	1	LS	$1,500.00
8	Seeding/mulch/planting	$3,500.00	1	LS	$3,500.00
9	Irrigation/Rainwater Catchment	$15,000.00	1	LS	$15,000.00
10	Permits (DFW 1600 and Marin Creek Permit)	$5,000.00	1	LS	$5,000.00
11	Engineering - Bid support, construction oversight, As-builts	$15,000.00	1	LS	$15,000.00
12	Monitoring	$3,000.00	1	LS	$3,000.00
Total construction cost:					**$129,600.00**

Table 8. McGuinn engineer's cost estimate.

No.	Item	Unit Cost	Quantity	Units	Total cost
1	Mobilization and Site Protection	$10,000.00	1	LS	$10,000.00
2	Temporary Access	$5,000.00	1	LS	$5,000.00
3	Dewatering	$5,000.00	1	LS	$5,000.00
4	Large Wood—Placed and Anchored	$2,500.00	18	each	$45,000.00
5	Boulders—Placed and Anchored	$200.00	90	CY	$18,000.00
6	Coir/Willow Fence Structures	$30.00	300	LF	$9,000.00
7	Seeding/mulch/planting	$3,000.00	1	LS	$3,000.00
8	Irrigation	$1,500.00	1	LS	$1,500.00
9	Permits (DFW 1600 and Marin Creek Permit)	$5,000.00	1	LS	$5,000.00

10	Engineering - Bid support, construction oversight, As-builts	$15,000.00	1	LS	$15,000.00
Total construction cost:					**$116,500.00**

Table 9. Watson engineer's cost estimate.

No.	Item	Unit Cost	Quantity	Units	Total cost
1	Mobilization and Site Protection	$10,000.00	1	LS	$10,000.00
2	Temporary Access	$5,000.00	1	LS	$5,000.00
3	Dewatering	$5,000.00	1	LS	$5,000.00
4	Grading	$40.00	120	CY	$4,800.00
5	Offhaul	$40.00	120	CY	$4,800.00
6	Large Wood—Placed and Anchored	$2,500.00	12	each	$30,000.00
7	Boulders—Placed and Anchored	$250.00	80	CY	$20,000.00
8	Coir/Willow Fence Structures	$25.00	100	LF	$2,500.00
9	Seeding/mulch/planting	$3,000.00	1	LS	$3,000.00
10	Irrigation	$3,000.00	1	LS	$3,000.00
11	Rebuild Fence	$10.00	120	LF	$1,200.00
12	Permits (DFW 1600 and Marin Creek Permit)	$5,000.00	1	LS	$5,000.00
13	Engineering - Bid support, construction oversight, As-builts	$15,000.00	1	LS	$15,000.00
Total construction cost:					**$109,300.00**

Table 10. Freund engineer's cost estimate.

No.	Item	Unit Cost	Quantity	Units	Total cost
1	Mobilization	$5,000.00	1	LS	$5,000.00
2	Grading (cut/fill)	$50.00	20	CY	$1,000.00
3	Cobble—Placed	$250.00	25	tons	$6,250.00
4	Trail	$2,000.00	1	LS	$2,000.00
5	Surface runoff management	$7,500.00	1	LS	$7,500.00
6	Seeding/mulch/planting	$2,500.00	1	LS	$2,500.00
7	Irrigation/Rainwater Catchment	$15,000.00	1	LS	$15,000.00
8	Rebuild Fence/bridge	$2,500.00	1	LS	$2,500.00
9	Permits (DFW 1600)	$1,000.00	1	LS	$1,000.00
10	Engineering - Bid support, construction oversight, As-builts	$10,000.00	1	LS	$10,000.00
Total construction cost:					**$52,750.00**

10.2 Recommended Heavy Equipment Type

Each of the four sites pose challenges in terms of constructability due to tight working spaces and difficult equipment access. Choosing the type of equipment and developing a specific workplan will be the responsibility of the contractor who is selected to implement the projects. However, below are recommendations:

<u>Snyder Stanger</u>: It is recommended that the contractor use a large excavator (Cat 320 size class or equivalent) on the north side of Cintura Creek and use a rubber tracked skid steer (Takeuchi TL10 or similar) and small rubber tracked excavator (Takeuchi TB180 or similar) to construct the habitat enhancement features on the south side of Cintura Creek. Rubber-tracked equipment will help to protect Snyder-Stanger's landscaping.

<u>McGuinn-Newman</u>: It is recommended that the contractor use a large excavator (Cat 320 size class or equivalent) for primary site construction and use a rubber tracked skid steer (Takeuchi TL10 or similar) to shuttle materials to the project site along the temporary access road.

Watson: It is recommended that the contractor use a large excavator (Cat 320 size class or equivalent) positioned on Creamery Road to construct a portion of the large wood structure located on the left bank. For the right bank work adjacent to Watson's pool, a small rubber tracked excavator (Takeuchi TB180 or similar) working in combination with a rubber tracked skid steer (Takeuchi TL10 or similar) should be used. The excavator would be used to excavate the bank and set the rock and wood features and the skid steer would be used to shuttle material.

Freund Stables: It is recommended that the contractor use a small rubber-tracked excavator (Takeuchi TB180 or similar) and skid steer (Takeuchi TL10 or similar).

10.3 Large Wood Structures

10.3.1 Anchoring Techniques for Large Wood Structures

The general anchoring techniques used for this project will follow procedures listed in the CDFW Restoration Manual with log to log and log to tree connections made with threaded rebar. However, as shown on Design Plan Sheet 20 of the design plans, 7/8-in diameter threaded rebar, cast eyenuts, and ¾-in diameter quick links will be used for log to rock anchoring. This will provide clean and durable connections and eliminates the need for cable which is more likely to rust and break down over time. A similar technique has recently been used successfully in Scotts Creek. As discussed previously, post-storm inspections are recommended for the Snyder, McGuinn, and Watson sites.

10.3.2 Large Wood Dimensions

All pieces of large wood and rootwads used for the project should meet DFW's definition of Large Woody Debris which is >1 foot diameter measured anywhere along the log and >6 feet in length (Flosi et al, 2010). All logs without rootwads should be >1 foot diameter measured anywhere along the log and >20 length to fit into DFW's LWD Length Category 2 (Flosi et al., 2010). Specific dimensions for each piece of wood are shown in Appendix D and Sheet 23 of the Design Plans.

10.4 Riparian Planting

Planting of native riparian species is an important aspect of this project. Project-specific planting species, zones, quantities, and/or spacing are described on the Planting Sheets of the Design Plans. The purpose of the riparian planting is to provide long-term bank stability and shade for the riparian corridor while also providing a diverse riparian ecosystem. The contractor and/or landowners should follow instructions listed in the Planting and Revegetation section in the Special Specifications for planting and plant maintenance activities.

10.5 Avoiding Invasive Species

Implementation of this project will be conducted with a strong commitment to avoid the spread of aquatic invasive species (AIS), most notably New Zealand mudsnail, quagga mussels, and zebra mussels. No AIS have been documented to occur within the San Geronimo Creek watershed at this time (New Zealand mudsnail are documented in nearby Abbotts Lagoon). Protocols will be used consistent with CDFW (2013) to decontaminate all gear (e.g., waders, boots, etc.) and equipment (e.g., survey rods, excavators, block nets, etc.) prior to entering the project reach to ensure protection from AIS.

10.6 Changing Site Conditions

Due to the dynamic nature of the instream projects, significant changes to the project sites could occur between the date that design plans are finalized and construction. To address these potential changes, it is strongly recommended that the restoration engineer and DFW staff is closely involved in the final construction planning process including a site visit to determine if site conditions have changed since the Design Plans were finalized. If changes did occur at any of the sites, modifications to the designs may be necessary and should be completed by the engineer with input from DFW, the landowner, and Marin County.

11 POST-CONSTRUCTION MONITORING AND MAINTENANCE

It is recommended that post-construction monitoring and/or maintenance is conducted in relation to four specific areas.

11.1 Implementation Effectiveness Monitoring

Following project completion, As-built Design Plans should be created so that the actual constructed project can be compared to the proposed project for each of the four sites. In addition, restoration effectiveness monitoring at each site should be conducted using protocols described in the California Department of Fish and Wildlife's Fisheries Restoration Grants Program Manual or other similar approaches. The purpose of these activities is to insure that specific habitat enhancement goals were met as described in the design plans.

11.2 Large Wood Structures Monitoring and Maintenance

Following storm events with bankfull or greater flow discharges, it is recommended that field monitoring is conducted at the Snyder, McGuinn, and Watson sites to insure that the large wood structures are functioning as designed. Field photos and observations should document any evidence of the following conditions:

- Scour beyond expected pool formation that could undermine the structure or cause extensive bank erosion.
- Significant shifting of a structure.
- Failure or potential failure of anchoring hardware.
- Racking of new large wood on the structure.

Based on monitoring results, maintenance activities may be recommended such as removing excess racked wood or installing new anchoring hardware. Note that racking of new wood is general considered to be a positive project outcome, and this wood should only be modified or removed if the engineer determines that the racked wood may lead to instability of the large wood structure, excessive erosion, or flooding of adjacent infrastructure.

11.3 Off-channel Habitat Monitoring

The Marin County RCD will work with local California Department of Fish and Wildlife (CDFW) biologists to develop a monitoring plan for the floodplain enhancement component of the Snyder project that will include surveys of water depths and estimated flow velocities within the enhanced floodplain during a range of winter flows.

11.4 Riparian Plant Maintenance

It is recommended that a "one-year plant maintenance and replacement" clause is included in the contract with the landscape contractor who is hired to perform the project revegetation, as described in the project specifications. After the landscape contractor has maintained the plans for the first year, the RCD should train each landowner to maintain and operate the irrigation system and perform weeding and/or other maintenance activities that may be required to promote healthy long-term growth of the new riparian plants.

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Appendices

Appendix A

Design Plans

SAN GERONIMO CREEK HABITAT ENHANCEMENT PROJECT

MARIN COUNTY, CA

GENERAL NOTES, TERMS, & CONDITIONS:

1. **DESIGN INTENT.** THESE DRAWINGS REPRESENT THE GENERAL DESIGN INTENT TO BE IMPLEMENTED AND CONTRACTOR IS RESPONSIBLE FOR ALL ITEMS SHOWN ON THESE PLANS. CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING THE PROJECT MANAGER FOR ANY CLARIFICATIONS OR FURTHER DETAILS NECESSARY TO ACCOMMODATE ACTUAL SITE CONDITIONS. ANY DEVIATION FROM THESE PLANS WITHOUT THE RCD'S REPRESENTATIVE APPROVAL ARE AT THE CONTRACTOR'S OWN RISK AND EXPENSE. NOTIFY PROJECT MANAGER IMMEDIATELY OF ANY UNEXPECTED AND CHANGED CONDITIONS, SAFETY HAZARDS, AND ENVIRONMENTAL PROBLEMS ENCOUNTERED.

2. **JOB SITE CONDITIONS AND CONTRACTOR RESPONSIBILITY.** CONTRACTOR SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR SITE CONDITIONS DURING THE COURSE OF THE CONSTRUCTION OF THIS PROJECT, INCLUDING THE SAFETY OF ALL PERSONS AND PROPERTY, AND ALL ENVIRONMENTAL PROTECTION ELEMENTS, WHETHER SHOWN ON THESE DRAWINGS OR NOT. CONTRACTOR SHALL FOLLOW ALL APPLICABLE CONSTRUCTION AND SAFETY REGULATIONS. THESE REQUIREMENTS SHALL APPLY CONTINUOUSLY AND WILL NOT BE LIMITED TO NORMAL WORKING HOURS. THE CONTRACTOR SHALL DEFEND, INDEMNIFY, AND HOLD THE RCD OR THE ENGINEER (STILLWATER SCIENCES) HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPT FROM LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF THE RCD OR ENGINEER.

3. **DAMAGE.** CONTRACTOR SHALL EXERCISE CARE TO AVOID DAMAGE TO EXISTING PUBLIC AND PRIVATE PROPERTY, INCLUDING NATIVE TREES AND SHRUBS, AND OTHER PROPERTY IMPROVEMENTS. IF CONTRACTOR CAUSES DAMAGES TO SUCH ITEMS, HE SHALL BE RESPONSIBLE FOR REPAIR OR REPLACEMENT IN LIKE NUMBER, KIND, CONDITION, AND SIZE. ANY SUCH COST MAY BE DEDUCTED BY RCD FROM MONIES DUE CONTRACTOR UNDER THIS CONTRACT.

4. **LIMITS OF WORK, ACCESS, STAGING AND MOBILIZATION AREAS.** EXACT LIMITS OF WORK, POINTS OF INGRESS-EGRESS, CREEK CHANNEL ACCESS, MOBILIZATION, STAGING, AND WORK AREAS WILL BE IDENTIFIED IN THE FIELD BY THE RCD AND/OR ENGINEER. EQUIPMENT MAINTENANCE AND FUELING MUST OCCUR OUTSIDE OF THE CHANNEL AREA AS DESCRIBED IN THE ENVIRONMENTAL PERMITS FOR THE PROJECT.

5. **WORK IN STREAM CHANNELS AND STREAM DIVERSIONS.** ALL WORK INVOLVING USE OF HEAVY EQUIPMENT MUST BE COMPLETED FROM TOP OF BANK UNLESS A SPECIFIC POINT OF CREEK CHANNEL ACCESS HAS BEEN APPROVED AND IS SHOWN ON THE PLANS, AND THEN ONLY IN NON-LIVE WATER AS DEFINED BY CDFW. THE CONTRACTOR SHALL BE RESPONSIBLE FOR IMPLEMENTING THE DEWATERING PLAN DEPICTED IN THIS PLAN SET.

 5.1. CONTRACTOR IS RESPONSIBLE FOR REMOVAL AND DISPOSING OF ALL WATER CONTROL STRUCTURES AND EQUIPMENT.

 5.2. THE CONTRACTOR SHALL FURNISH, INSTALL, AND OPERATE ALL OTHER NECESSARY MACHINERY, APPLIANCES, AND EQUIPMENT TO DIVERT FLOWING WATER AROUND WORK AREAS, AND TO KEEP EXCAVATIONS AND TRENCHES REASONABLY FREE FROM WATER DURING CONSTRUCTION. CONTRACTOR SHALL DISPOSE OF THE WATER SO AS NOT TO CAUSE INJURY TO PUBLIC OR PRIVATE PROPERTY, OR TO CAUSE A NUISANCE OR A MENACE TO THE PUBLIC, OR TO DEGRADE WATER QUALITY. HE SHALL AT ALL TIMES HAVE ON HAND SUFFICIENT PUMPING EQUIPMENT AND MACHINERY IN GOOD WORKING CONDITION FOR ALL ORDINARY EMERGENCIES AND SHALL HAVE AVAILABLE AT ALL TIMES COMPETENT MECHANICS FOR THE OPERATION OF ALL PUMPING EQUIPMENT. IF THE CONTRACTOR CHOOSES TO USE A PUMPING SYSTEM FOR ANY PORTION OF THE WATER CONTROL WORK, HE SHALL HAVE ADEQUATE BACK-UP EQUIPMENT TO INSURE THE CONTINUOUS OPERATION OF THE EQUIPMENT.

 5.3. THE CONTRACTOR SHALL AT ALL TIMES PROVIDE FOR THE ADEQUATE RETURN FLOW OF DIVERSIONS BELOW THE PROJECT SITE. THE CONTRACTOR MAY TEMPORARILY DIVERT WATER DURING CONSTRUCTION, AS OUTLINED IN THE APPROVED STREAM DIVERSION AND WATER CONTROL PLAN. THIS MAY INCLUDE FOR INSTANCE, VISQUEEN AND STRAW BALE OR SAND BAG DIVERSION DIKES AND PIPING SYSTEMS. RETURN FLOW SHALL BE FILTERED THROUGH FILTER CLOTH, STRAW BALES AND/OR THROUGH A SERIES OF STILLING BASINS WHEN REQUIRED.

 5.4. TURBID DEWATERING FLOWS SHALL BE PUMPED INTO A HOLDING FACILITY OR SPRAYED OVER A LARGE AREA OUTSIDE THE STREAM CHANNEL TO ALLOW FOR NATURAL FILTRATION OF SEDIMENTS. AT NO TIME SHALL TURBID WATER FROM THE HOLDING FACILITY BE ALLOWED BACK INTO THE STREAM CHANNEL UNTIL WATER IS CLEAR OF SILT. SUCH PRACTICE SHOULD NOT SUPERCEDE IMPORTANCE OF MAINTAINING BYPASS FLOWS.

 5.5. ALL HEAVY EQUIPMENT MUST HAVE A SUPPLY OF SORBENT PADS AVAILABLE TO CLEAN-UP GREASE, OIL, OR FUEL THAT DRIPS OR SPILLS INTO THE STREAM CHANNEL. SORBENT BOOMS MUST BE PLACED DOWNSTREAM FROM LOCATIONS WHERE MACHINERY IS EXPECTED TO CROSS THE STREAM CHANNEL. USED PADS AND BOOMS ARE TO BE DISPOSED OF PROPERLY AT CONTRACTOR'S EXPENSE.

6. **EARTHWORK QUANTITIES.** CONTRACTOR IS RESPONSIBLE FOR ALL EARTHWORK, INCLUDING GRADING, PROVISION AND PLACEMENT OF ROCK MEETING SIZE LIMITS, AS SHOWN ON DRAWINGS, AND DISPOSAL OF ALL EXCESS SOIL AND RUBBLE. EARTHWORK QUANTITIES, INCLUDING GRADING, PLACED ROCK RIP-RAP QUANTITY ESTIMATES PROVIDED BY THE ENGINEER ARE ESTIMATES ONLY. RCD AND ENGINEER DO NOT, EXPRESSLY OR OTHERWISE BY IMPLICATION, EXTEND ANY WARRANTY TO EARTHWORK CALCULATIONS.

7. **THE FOLLOWING PERMITS** ARE REQUIRED FOR THIS PROJECT, THE CONTRACTOR SHALL BE GIVEN COPIES OF ALL THE PERMITS, SHALL BECOME FAMILIAR WITH THE PERMIT REQUIREMENTS, AND SHALL BE RESPONSIBLE FOR ADHERENCE TO AND CONFORMANCE WITH ALL PERMIT CONDITIONS.
 SEC. 404 PERMIT ISSUED BY US ARMY CORPS OF ENGINEERS
 1601/1603 STREAMBED ALTERATION AGREEMENT ISSUED BY CA DEPT. FISH & WILDLIFE
 WATER QUALITY CERTIFICATION, BY NORTH COAST REGIONAL WATER QUALITY CONTROL BOARD
 US FISH AND WILDLIFE SERVICE CONSULTATION AND IMPLEMENTATION RECOMMENDATIONS
 NATIONAL MARINE FISHERIES SERVICE CONSULTATION AND IMPLEMENTATION RECOMMENDATIONS.

8. AREAS TO BE GRADED SHALL BE CLEARED OF ALL VEGETATION INCLUDING ROOTS AND OTHER UNSUITABLE MATERIAL FOR A STRUCTURAL FILL, THEN SCARIFIED TO A DEPTH OF 6 INCHES PRIOR TO PLACING OF ANY FILL.

9. AREAS WITH EXISTING SLOPES WHICH ARE TO RECEIVE FILL MATERIAL SHALL BE KEYED AND BENCHED.

10. FILL MATERIAL SHALL BE SPREAD IN LIFTS NOT EXCEEDING 12 INCHES IN COMPACTED THICKNESS, MOISTENED OR DRIED AS NECESSARY TO NEAR OPTIMUM MOISTURE CONTENT AND COMPACTED BY AN APPROVED METHOD. FILL MATERIAL SHALL BE COMPACTED TO A MINIMUM OF 90% MAXIMUM DENSITY AS DETERMINED BY 1957 ASTM D - 1557 - 91 MODIFIED PROCTOR (AASHO) TEST OR SIMILAR APPROVED METHODS.

11. CUT AND FILL SLOPES SHALL NOT EXCEED A GRADE OF 2 HORIZONTAL TO 1 VERTICAL. ALL DISTURBED GROUND SHALL BE PLANTED WITH NATIVE GRASS SEED AND MULCHED.

12. BEST MANAGEMENT PRACTICES FOR CONSTRUCTION ACTIVITIES: ERODED SEDIMENTS AND OTHER POLLUTANTS MUST BE RETAINED ONSITE AND MAY NOT BE TRANSPORTED FROM THE SITE VIA SHEET FLOW, SWALES, AREA DRAINS, NATURAL DRAINAGE COURSES, OR WIND. STOCKPILES OF EARTH AND OTHER CONSTRUCTION RELATED MATERIALS MUST BE PROTECTED FROM BEING TRANSPORTED FROM THE SITE BY THE FORCES OF WIND OR WATER. FUELS, OILS, SOLVENTS, AND OTHER TOXIC MATERIALS MUST BE STORED IN ACCORDANCE WITH THEIR LISTING AND ARE NOT TO CONTAMINATE THE SOIL AND SURFACE WATERS. ALL APPROVED STORAGE CONTAINERS ARE TO BE PROTECTED FROM THE WEATHER. SPILLS MAY NOT BE WASHED INTO THE DRAINAGE SYSTEM. EXCESS OR WASTE CONCRETE MAY NOT BE WASHED INTO PUBLIC WAY OR ANY OTHER DRAINAGE SYSTEM.TRASH AND CONSTRUCTION RELATED SOLID WASTE MUST BE DEPOSITED INTO A COVERED WASTE RECEPTACLE TO PREVENT CONTAMINATION OF RAINWATER AND DISPERSAL BY WIND. SEDIMENTS AND OTHER MATERIAL MAY NOT BE TRACKED FROM TO THE SITE BY VEHICLE TRAFFIC.

13. BRUSH, LIMBS AND TOPS OF TREES GENERATED FROM WOOD HARVESTED ONSITE SHOULD BE USED IN THE CONSTRUCTION OF THE HABITAT ENHANCEMENT FEATURES AS DIRECTED IN THE FIELD BY THE RCD OR ENGINEER.

14. CONTRACTOR SHALL REFER TO PROJECT SPECIFICATIONS FOR ANY ITEMS NOT ADDRESSED ON THESE PLANS. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ITEMS SHOWN ON PROJECT SPECIFICATIONS. CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING THE PROJECT MANAGER AND/OR ENGINEER FOR ANY CLARIFICATIONS OR FURTHER DETAILS NECESSARY TO ACCOMMODATE ACTUAL SITE CONDITIONS. ANY DEVIATION FROM THESE SPECIFICATIONS WITHOUT THE RCD'S REPRESENTATIVE APPROVAL ARE AT THE CONTRACTOR'S OWN RISK AND EXPENSE.

15. CONTRACTOR MUST CALL MARK AREA AND CALL 811 A MINIMUM OF 48 HOURS PRIOR TO ANY GROUND DISTURBANCE ACTIVITIES.

SHEET INDEX:

ABBREVIATIONS AND SYMBOLS:

(E) = EXISTING

(N) = NEW OR PROPOSED

X DETAIL
X SHEET

X+XX **SITE-SPECIFIC SECTIONS SHOWN ON SHEETS 5, 10, 15, & 18**

EARTHWORK ESTIMATES:

San Geronimo Earthwork and Material Quantities

	Snyder	McGuinn	Watson	Freund
Earthwork Cut (CY)	360	0	120	15
Earthwork Fill (CY)	0	0	0	20
Export (CY)	360	0	120	0
Import Riprap (CY)	40	90	80	25
Import AB (CY)	0	0	0	30
Import Drain Rock (CY)	0	0	0	5
Import Bioswale mix (CY)	10	0	0	0
Import Large Wood (#)	20	18	12	0

PROJECT LOCATION MAP:

100% DESIGN APPROVED FOR CONSTRUCTION

SAN GERONIMO CREEK
HABITAT ENHANCEMENT PROJECT
MARIN COUNTY DEPARTMENT OF PUBLIC WORKS
MARIN COUNTY, CA

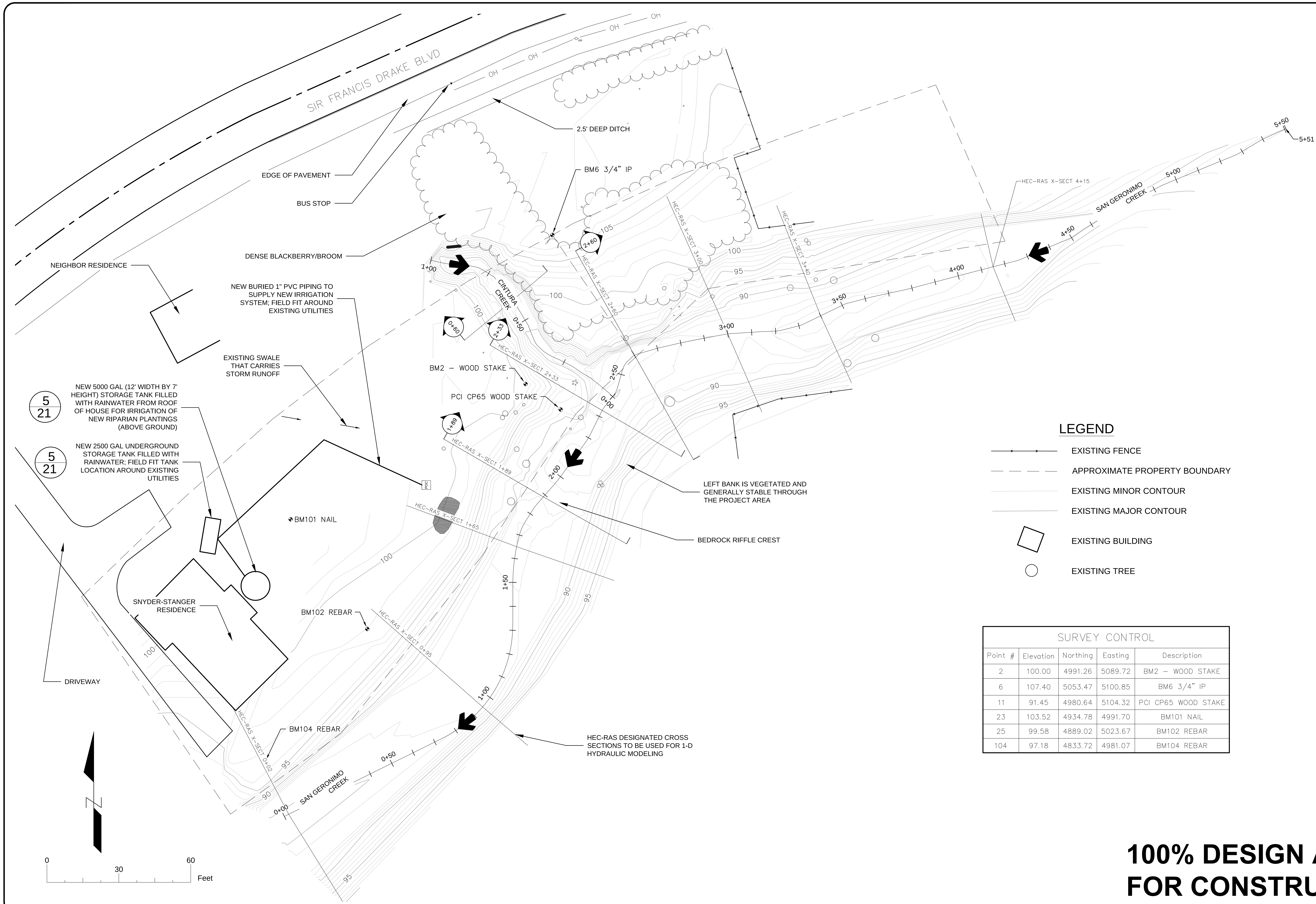
Stillwater Sciences
www.stillwatersci.com

No. 79688
9-30-16
EXPIRES

Design: JM
Drawn: JM
Checked: EB
Appr'd:

TITLE SHEET

Size: D
Project: 597.00
Scale: AS NOTED
Date: 2-23-2016
Sheet: 1 OF 24



SURVEY CONTROL

Point #	Elevation	Northing	Easting	Description
2	100.00	4991.26	5089.72	BM2 – WOOD STAKE
6	107.40	5053.47	5100.85	BM6 3/4" IP
11	91.45	4980.64	5104.32	PCI CP65 WOOD STAKE
23	103.52	4934.78	4991.70	BM101 NAIL
25	99.58	4889.02	5023.67	BM102 REBAR
104	97.18	4833.72	4981.07	BM104 REBAR

100% DESIGN APPROVED FOR CONSTRUCTION

IF BAR DOES NOT MEASURE 1" DRAWING IS NOT TO SCALE - ADJUST ACCORDINGLY

LAST SAVED: 2/25/2016 PLOT DATE: 2/25/2016 PLOT STYLE: -----

SAN GERONIMO CREEK HABITAT ENHANCEMENT PROJECT

MARIN COUNTY DEPARTMENT OF PUBLIC WORKS
MARIN COUNTY, CA

Stillwater Sciences
www.stillwatersci.com

REGISTERED PROFESSIONAL ENGINEER No. 79688 EXPIRES 9-30-16 CIVIL STATE OF CALIFORNIA

Design: JM
Drawn: JM
Checked: EB
Appr'd:

SNYDER-STANGER HABITAT ENHANCEMENT
EXISTING CONDITIONS & RAINWATER CATCHMENT

Size: D
Project: 597.00
Scale: AS NOTED
Date: 2-23-2016
Sheet: 2 OF 24

NOTE: NO DEWATERING REQUIRED

100% DESIGN APPROVED FOR CONSTRUCTION

SAN GERONIMO CREEK
HABITAT ENHANCEMENT PROJECT
MARIN COUNTY DEPARTMENT OF PUBLIC WORKS
MARIN COUNTY, CA

Stillwater Sciences
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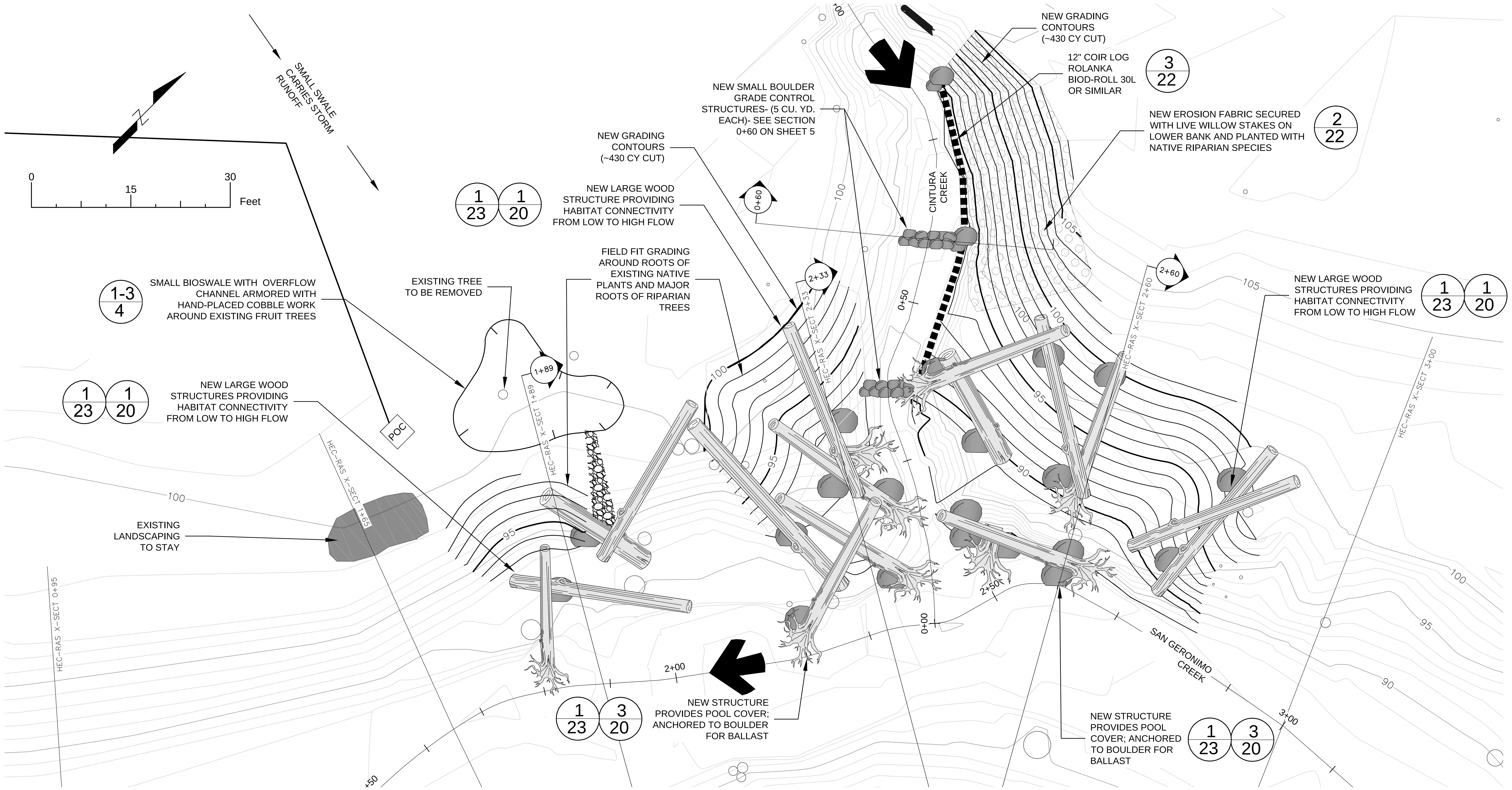
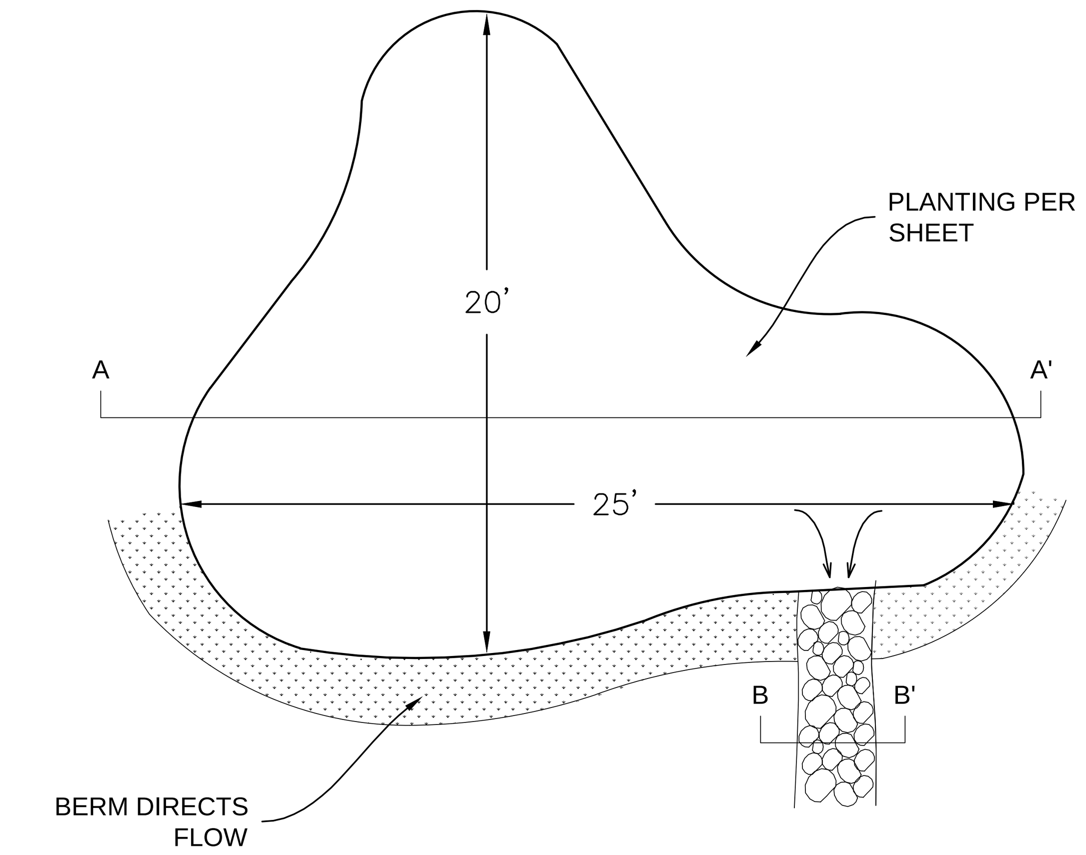
Design: JM
Drawn: JM
Checked: EB
Appr'd:

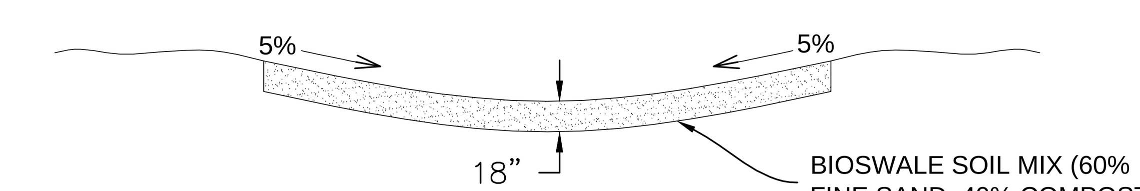
SNYDER-STANGER HABITAT ENHANCEMENT
STAGING, ACCESS & SITE PROTECTION

Size	Project
D	597.00
Scale:	AS NOTED
Date:	2-23-2016
Sheet:	3 OF 24

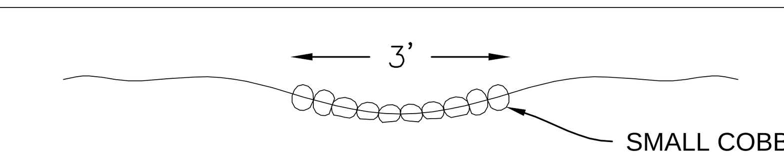




1 **BIOSWALE ZOOM**
NTS

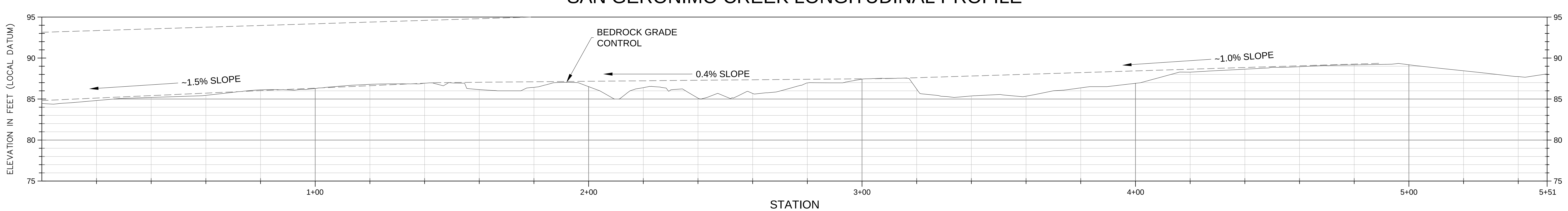


2 **BIOSWALE SECTION A-A'**
NTS



3 **BIOSWALE SECTION B-B'**
NTS

SAN GERONIMO CREEK LONGITUDINAL PROFILE



PROFILE NOTES:
1. LONGITUDINAL PROFILE HAS 3X VERTICAL EXAGGERATION
2. DASHED LINES REPRESENT APPROXIMATE CHANNEL GRADIENT MEASURED BETWEEN RIFFLE CRESTS

100% DESIGN APPROVED FOR CONSTRUCTION

SAN GERONIMO CREEK HABITAT ENHANCEMENT PROJECT

MARIN COUNTY DEPARTMENT OF PUBLIC WORKS
MARIN COUNTY, CA

Stillwater Sciences
www.stillwatersci.com

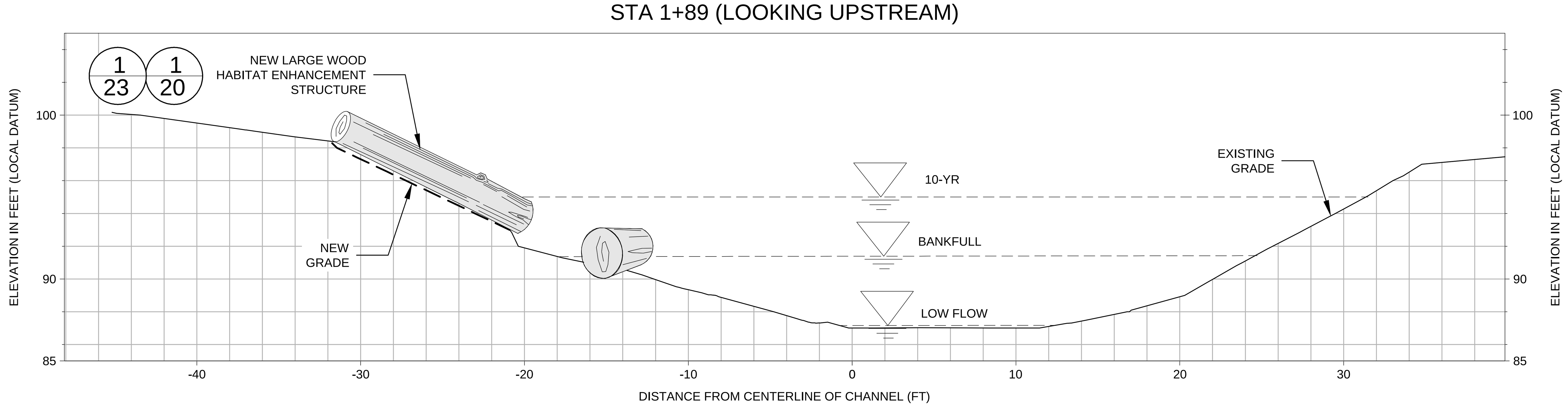
Design:	JM
Drawn:	JM
Checked:	EB
Appr'd:	

SNYDER-STANGER HABITAT ENHANCEMENT PLAN AND PROFILE

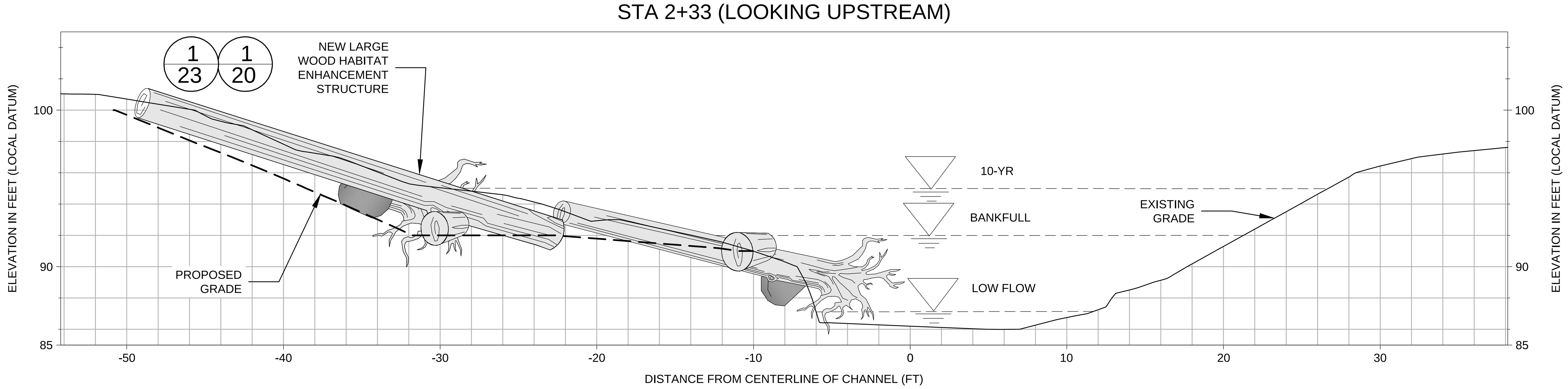
Size	D
Project	597.00
Scale:	AS NOTED
Date:	2-23-2016
Sheet:	4 OF 24

LAST SAVED: 2/25/2016 PLOT DATE: 2/25/2016 PLOT STYLE: ----
IF BAR DOES NOT MEASURE 1" DRAWING IS NOT TO SCALE - ADJUST ACCORDINGLY

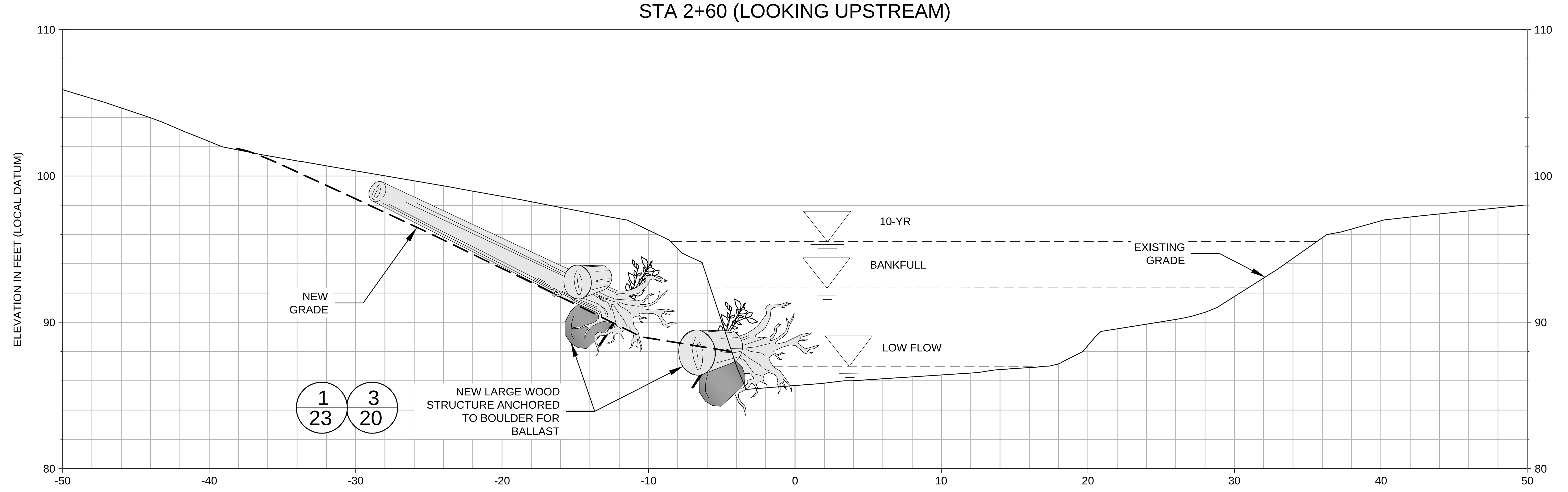
STA 1+89 (LOOKING UPSTREAM)



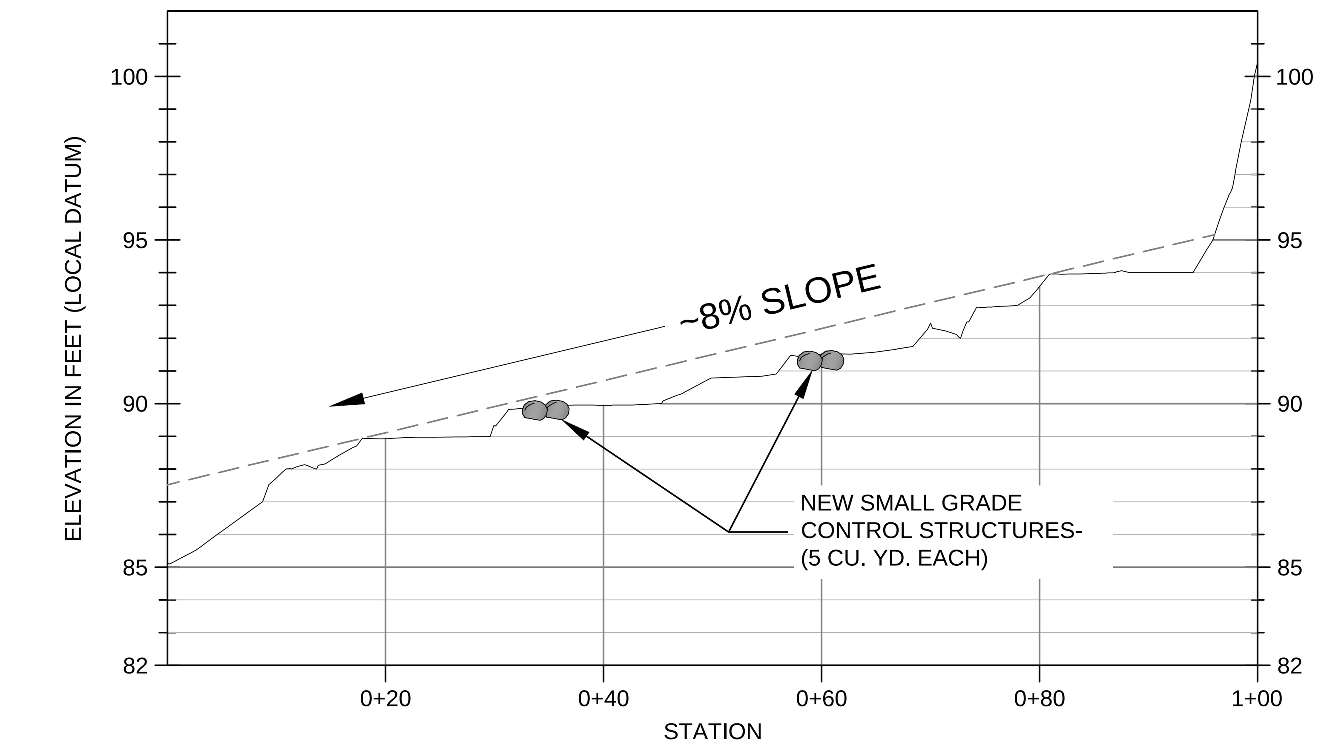
STA 2+33 (LOOKING UPSTREAM)



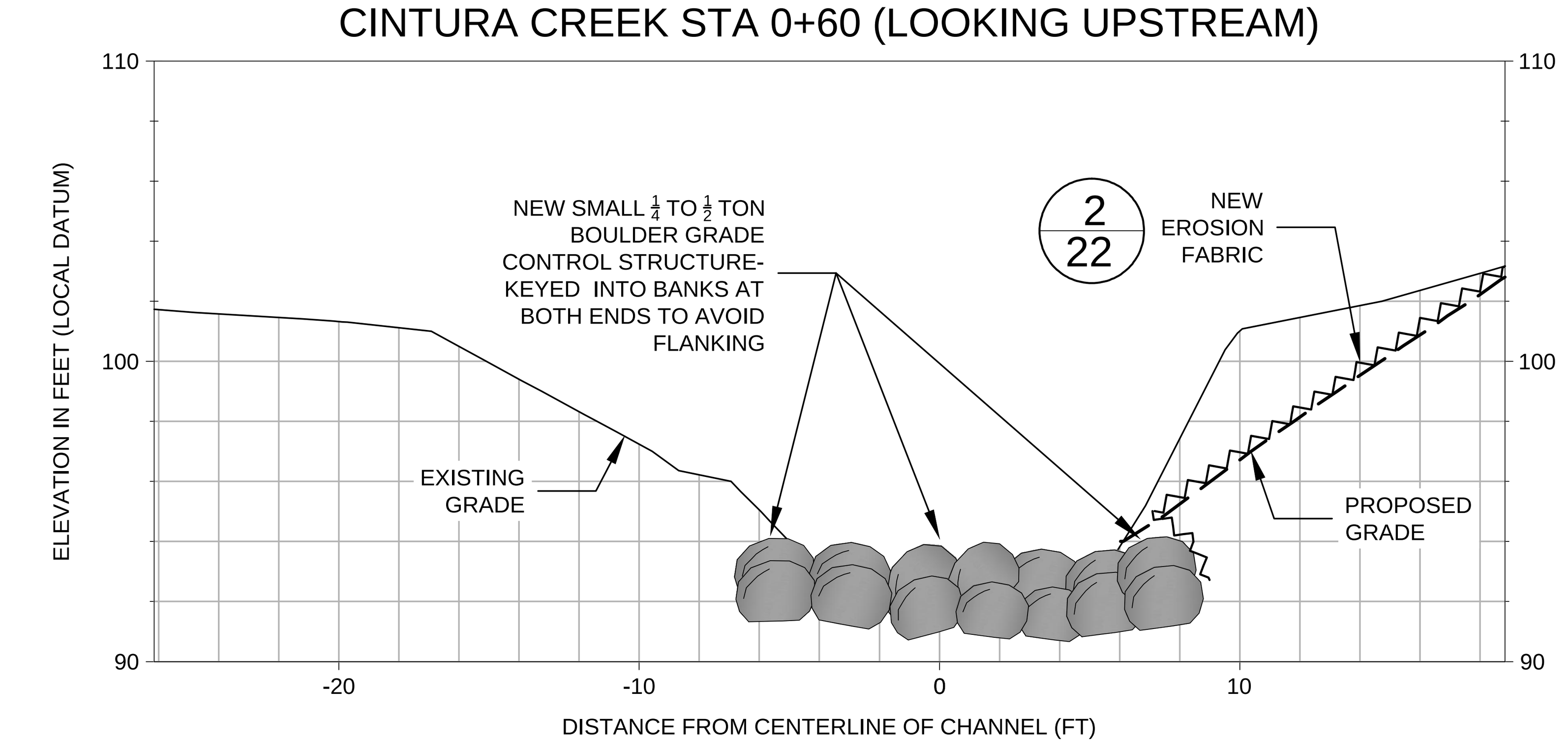
STA 2+60 (LOOKING UPSTREAM)



CINTURA CREEK LONGITUDINAL PROFILE



CINTURA CREEK STA 0+60 (LOOKING UPSTREAM)



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SAN GERONIMO CREEK HABITAT ENHANCEMENT PROJECT

MARIN COUNTY DEPARTMENT OF PUBLIC WORKS
MARIN COUNTY, CA

Stillwater Sciences
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PROFESSIONAL ENGINEER No. 79688 EXPIRES 9-30-16 CIVIL STATE OF CALIFORNIA

Design:	JM
Drawn:	JM
Checked:	EB
Appr'd:	

SNYDER-STANGER HABITAT ENHANCEMENT CROSS SECTIONS

Size	D
Project	597.00
Scale:	AS NOTED
Date:	2-23-2016
Sheet:	5 OF 24

SEEDING AND PLANTING PALLET:

PLANTING TYPE: RIPARIAN NATIVE GRASS AND HERB EROSION CONTROL SEED MIX; AREA = ~0.5 ACRE

Planting Zone	Scientific Name	Common Name	Life Form	Qty (lbs)
ALL DISTURBED AND/OR BARE GROUND WITHIN PROJECT AREA	*Agrostis exarata*	spike bent grass	Perennial grass	0.05 (0.8 oz)
	Anthoxanthum occidentale	California sweet grass	Perennial grass	0.5
	Danthonia californica	California oat grass	Perennial grass	1
	Deschampsia cespitosa subsp. *holciformis*	coastal tufted hair grass	Perennial grass	0.1 (1.6 oz)
	Deschampsia elongata	slender hair grass	Perennial grass	0.25
	Elymus triticoides	beardless wild rye	Perennial grass	2.5
	Festuca californica	California fescue	Perennial grass	0.5
	Hordeum brachyantherum subsp. *californicum*	California barley	Perennial grass	2.5
	Juncus bufonius var. *bufonius*	toad rush	Annual grasslike herb	0.005 (2.25 g)
			Total	7.405

PLANTING TYPE: RE-GRADED UPPER RIPARIAN BANK; AREA = 0.04 ACRE

Legend	Scientific Name	Common Name	Life Form	Container	Spacing	% Cover	# Plants
+ + +	*Acer macrophyllum*	big-leaf maple	Tree	treeband	20 ft	70	3
	Frangula californica	California coffeeberry	Shrub	deepot 16	12 ft	50	6
	Rosa californica	California wild rose	Shrub	TB9	5 ft	25	17
	Rubus ursinus	California blackberry	Vine	deepot 16	12 ft	50	6
						Total	32

PLANTING TYPE: RE-GRADED LOWER RIPARIAN BANK; AREA = 0.02 ACRE

Legend	Scientific Name	Common Name	Life Form	Container	Spacing	% Cover	# Plants
	Carex densa	dense sedge	Perennial grasslike herb	plugs	6 ft	60	15
	Juncus patens	spreading rush	Perennial grasslike herb	plugs	6 ft	60	15
	Acer negundo	box elder	Small tree	treeband	12 ft	30	2
	Alnus rhombifolia	white alder	Tree	treeband	20 ft	70	2
	Alnus rubra	red alder	Small tree	treeband	12 ft	45	3
	Cornus sericea	red-osier dogwood	Shrub	deepot 16	12 ft	60	4
	Fraxinus latifolia	Oregon ash	Tree	deepot 16	20 ft	25	1
						Total	42

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SAN GERONIMO CREEK
HABITAT ENHANCEMENT PROJECT

MARIN COUNTY DEPARTMENT OF PUBLIC WORKS
MARIN COUNTY, CA

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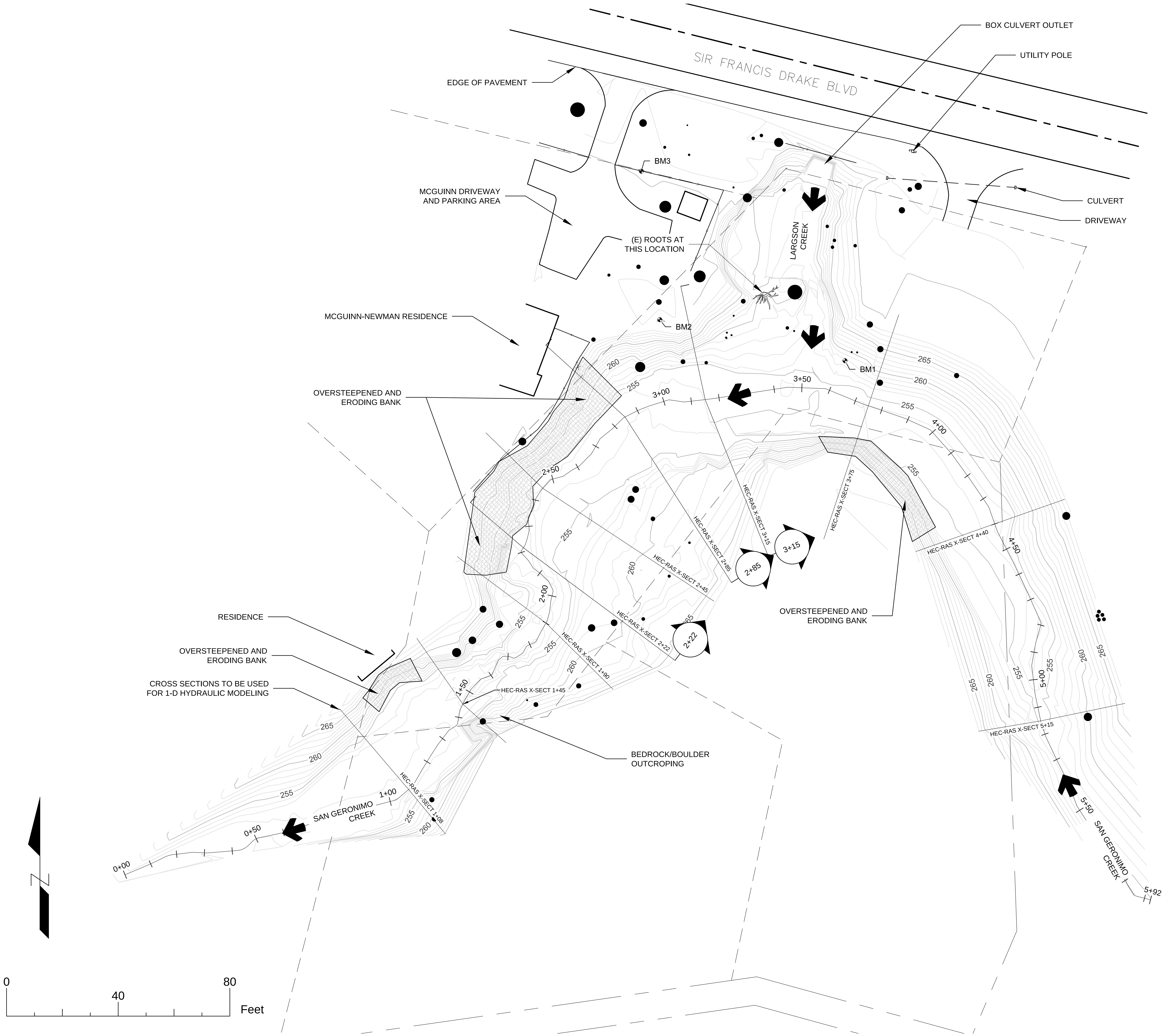
Drawn:	JM
Checked:	EB
Appr'd:	

SNYDER-STANGER HABITAT ENHANCEMENT
PLANTING PLAN

Size	D
Project	597.00
Scale:	AS NOTED
Date:	2-23-2016
Sheet:	6 OF 24



LEGEND

- EXISTING FENCE
- APPROXIMATE PROPERTY BOUNDARY
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING BUILDING
- EXISTING TREE

CONTROL POINTS

Point #	Elevation	Northing	Easting	Description
1	257.54	49113.30	40493.56	BM1
2	270.10	49128.03	40427.21	BM2
3	270.07	49181.21	40420.61	BM3

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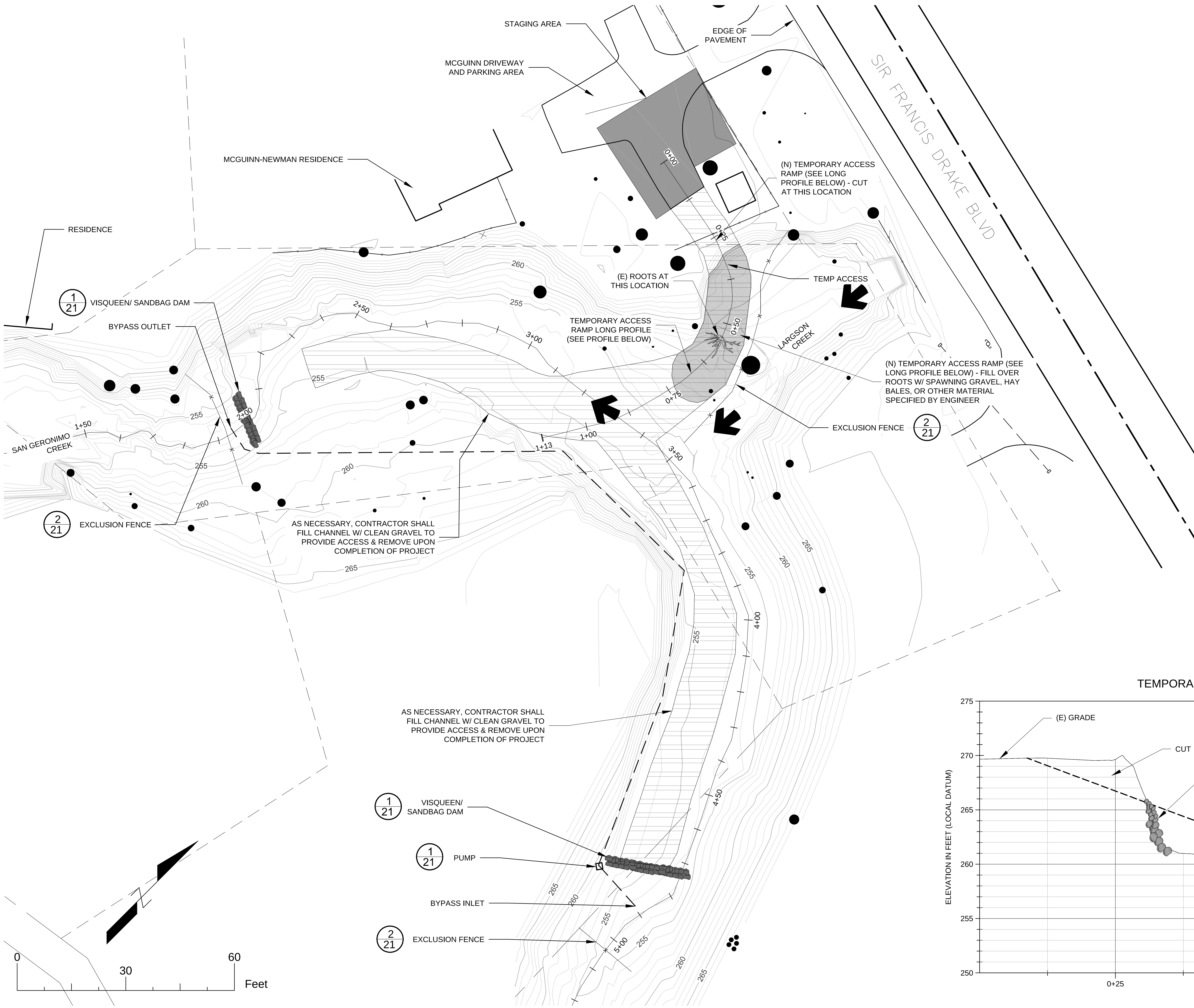
Appr'd:

MCGUINN-NEWMAN BANK REHABILITATION EXISTING CONDITIONS

Size: D
Project: 597.00
Scale: AS NOTED
Date: 2-23-2016
Sheet: 7 OF 24



LEGEND

- EXISTING FENCE
- APPROXIMATE PROPERTY BOUNDARY
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING BUILDING
- EXISTING TREE

NOTE:

ONSITE STAGING AREA SPACE EXTREMELY LIMITED; CONTRACTOR MUST STAGE OFFSITE WHENEVER POSSIBLE

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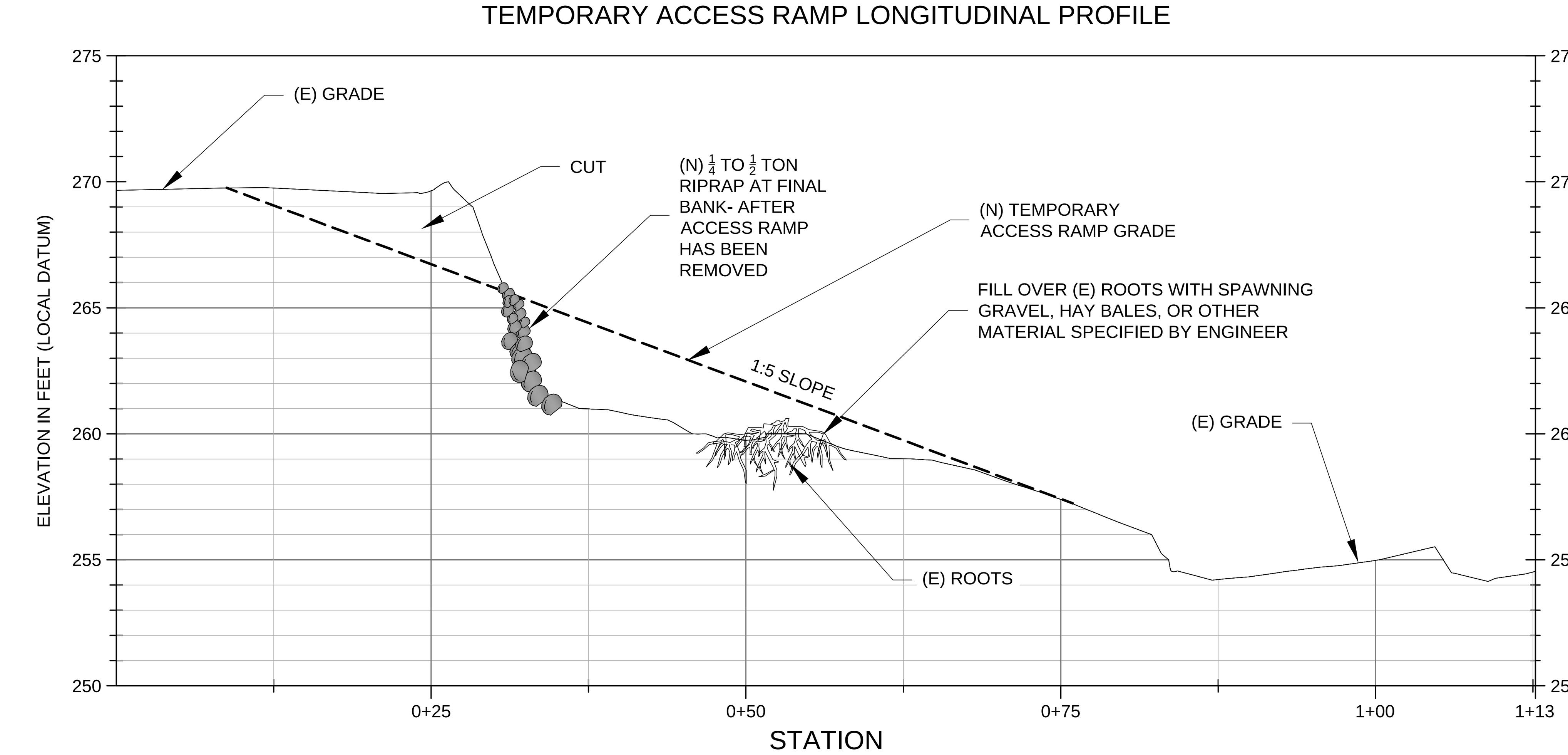
TEMPORARY ACCESS RAMP LONGITUDINAL PROFILE



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MCGUINN-NEWMAN BANK REHABILITATION
DEWATERING ACCESS & SITE PROTECTION

Size: D	Project: 597.00
Scale:	AS NOTED
Date:	2-23-2016
Sheet:	8 OF 24

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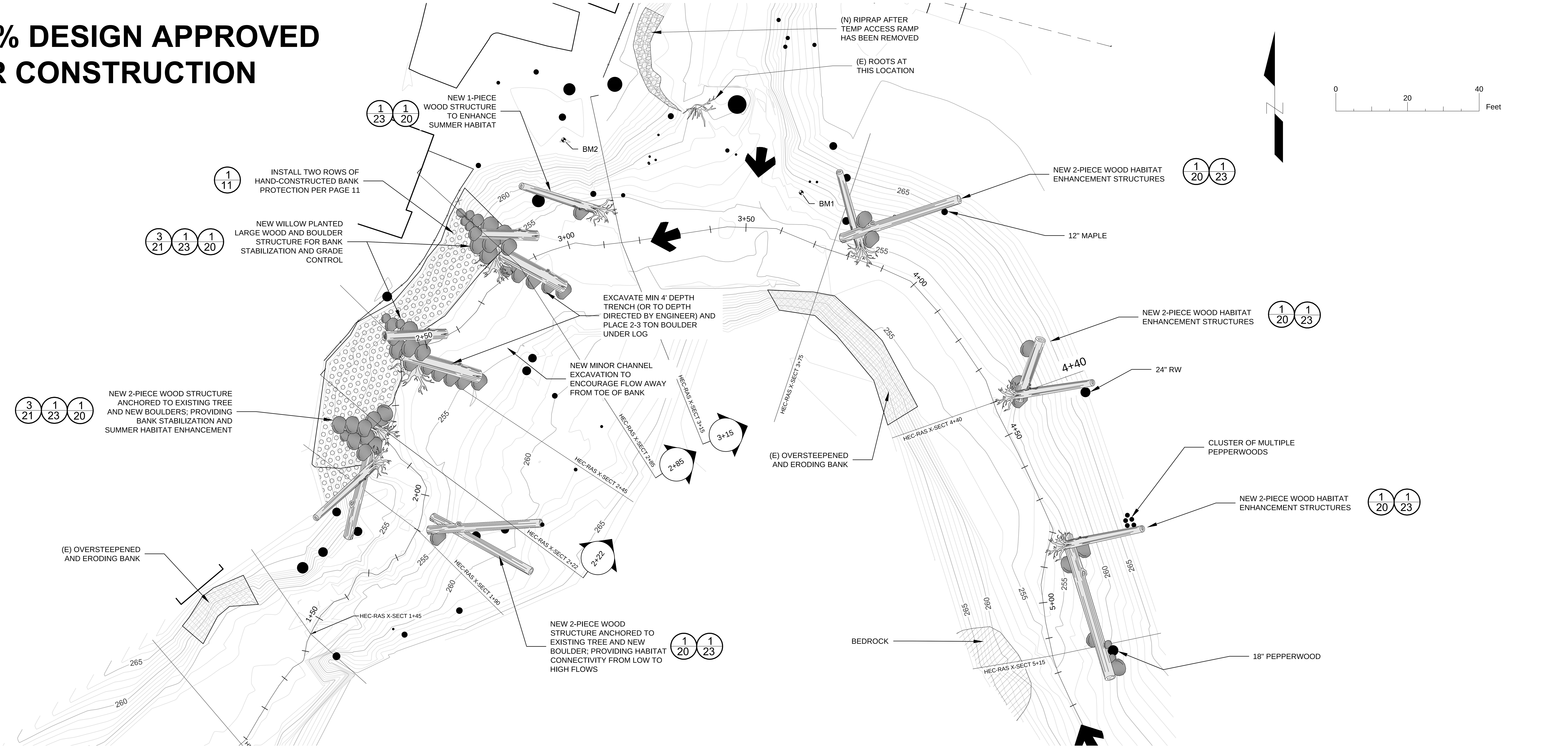

SAN GERONIMO CREEK LONGITUDINAL PROFILE

PROFILE NOTES:
1. LONGITUDINAL PROFILE HAS 3X VERTICAL EXAGGERATION
2. DASHED LINES REPRESENT APPROXIMATE CHANNEL GRADIENT MEASURED BETWEEN RIFFLE CRESTS

SAN GERONIMO CREEK HABITAT ENHANCEMENT PROJECT

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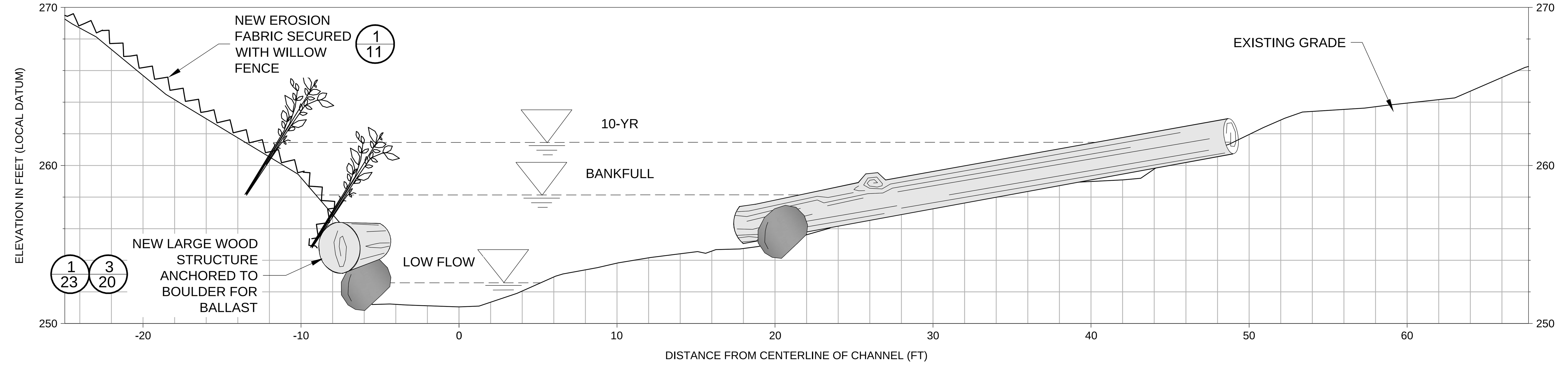
MCGUINN-NEWMAN BANK REHABILITATION PLAN AND PROFILE

Size: D
Project: 597.00
Scale: AS NOTED
Date: 2-23-2016
Sheet: 9 OF 24

STA 2+22 (LOOKING UPSTREAM)



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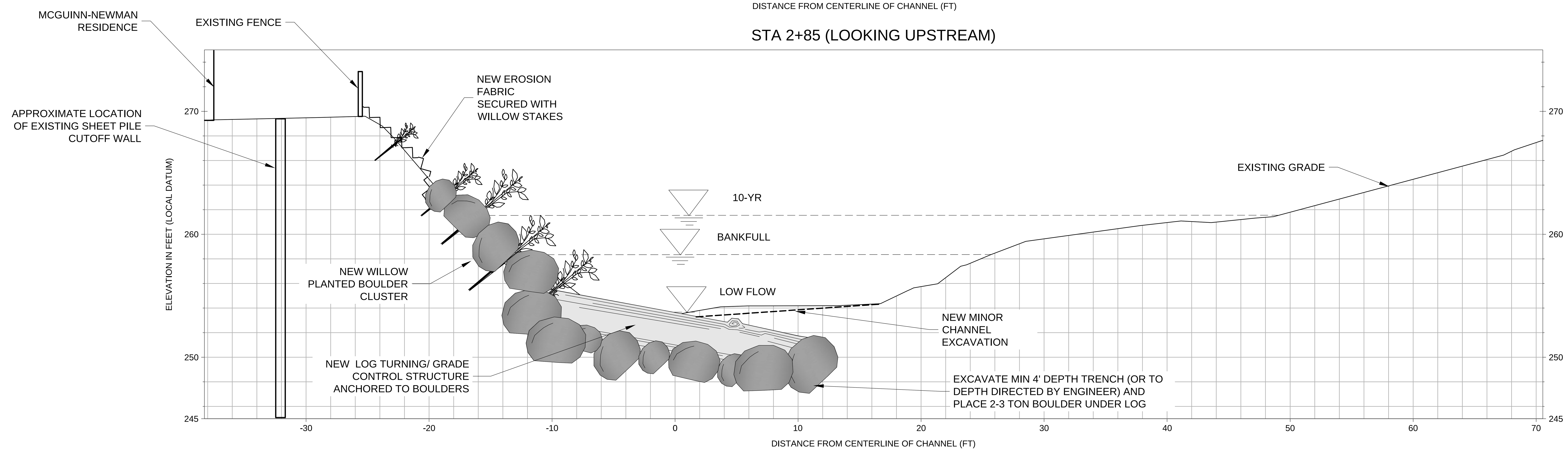
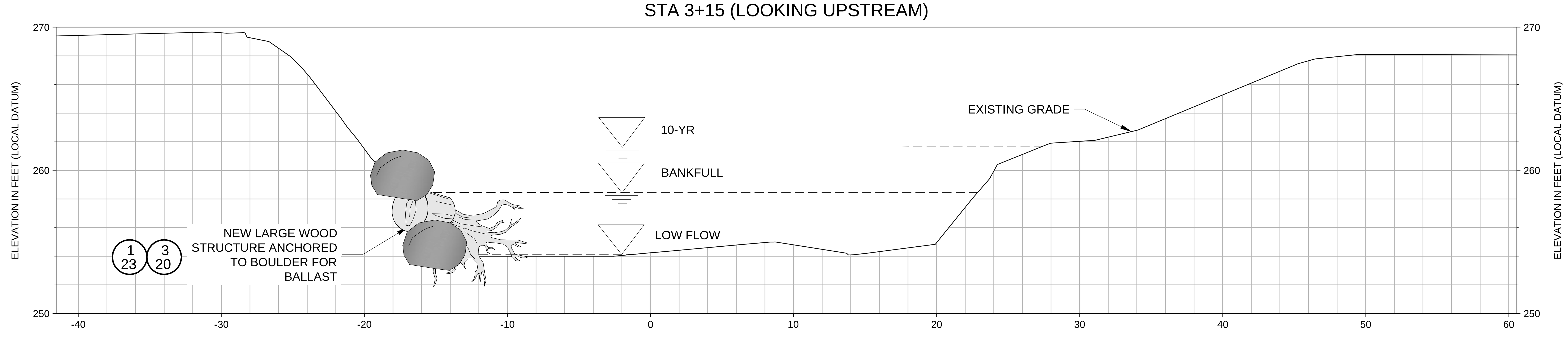


STA 3+15 (LOOKING UPSTREAM)



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HABITAT ENHANCEMENT PROJECT

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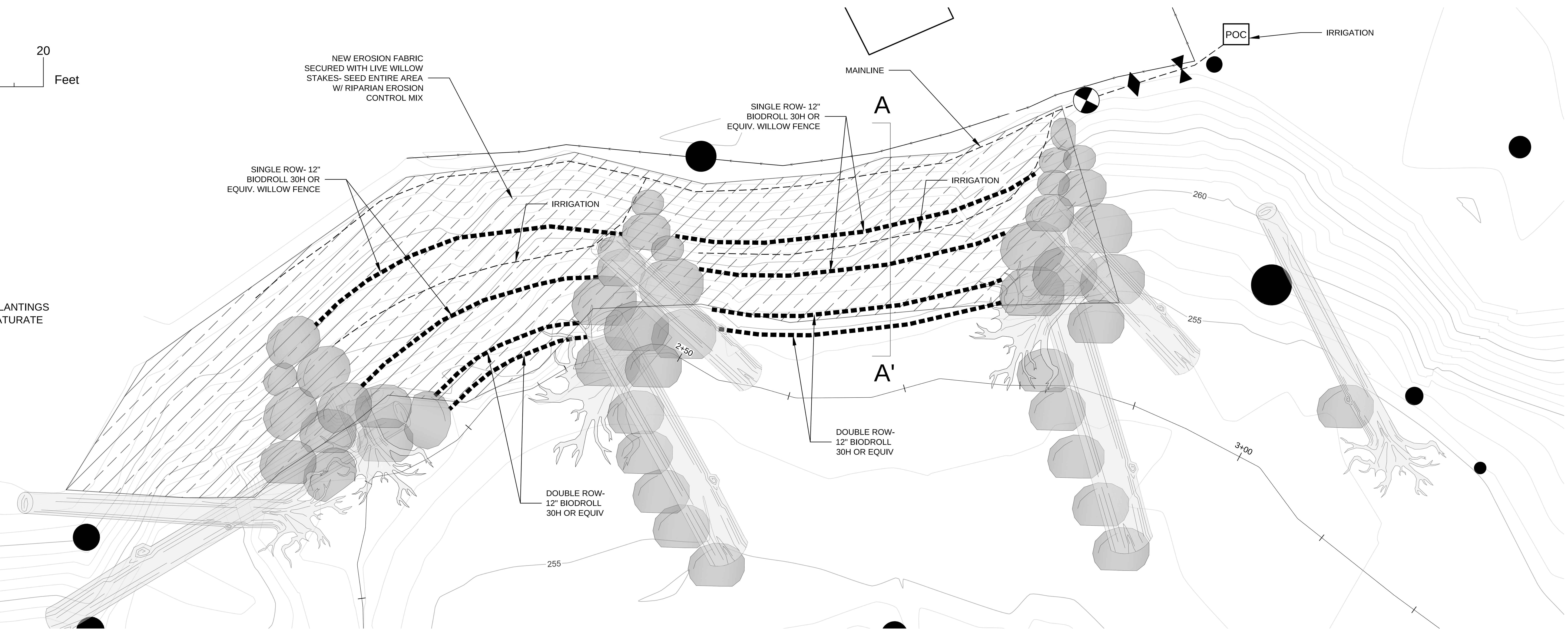
MCGUINN-NEWMAN BANK REHABILITATION
CROSS SECTIONS

Size	Project
D	597.00
Scale:	AS NOTED
Date:	2-23-2016
Sheet:	10 OF 24

0 10 20 Feet

IRRIGATION NOTE:

WATERING SHALL OCCUR FOR MINIMUM DURATION NECESSARY TO KEEP NEW PLANTINGS HEALTHY. BE CAREFUL NOT TO OVERSATURATE STREAM BANK.



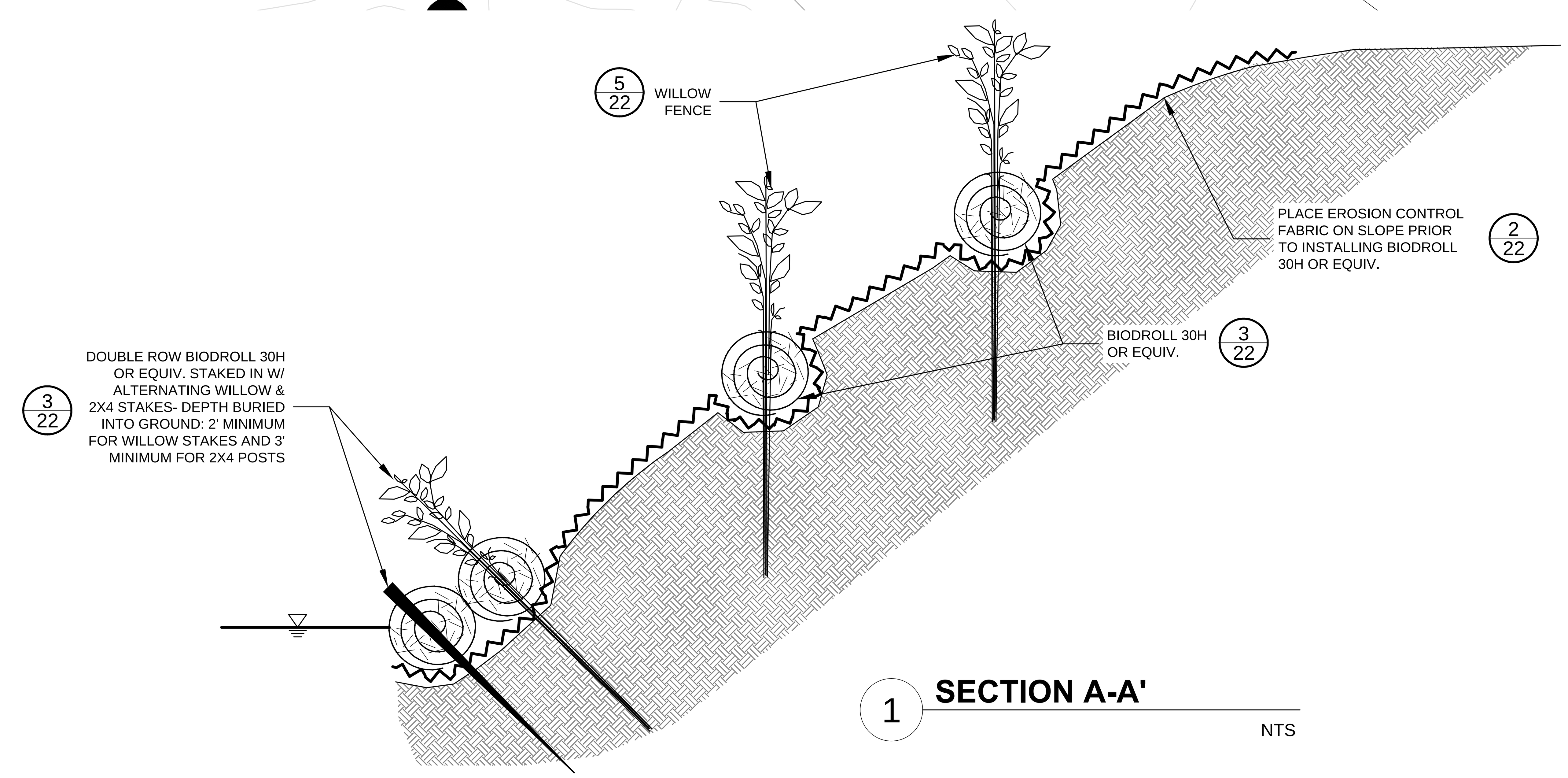
SEEDING AND PLANTING PALLET:

PLANTING TYPE: RIPARIAN NATIVE GRASS AND HERB EROSION CONTROL SEED MIX; AREA = ~0.5 ACRE

Planting Zone	Scientific Name	Common Name	Life Form	Qty (lbs)
ALL DISTURBED AND/OR BARE GROUND WITHIN PROJECT AREA	*Agrostis exarata*	spike bent grass	Perennial grass	0.05 (0.8 oz)
	Anthoxanthum occidentale	California sweet grass	Perennial grass	0.5
	Danthonia californica	California oat grass	Perennial grass	1
	Deschampsia cespitosa subsp. *holciformis*	coastal tufted hair grass	Perennial grass	0.1 (1.6 oz)
	Deschampsia elongata	slender hair grass	Perennial grass	0.25
	Elymus triticoides	beardless wild rye	Perennial grass	2.5
	Festuca californica	California fescue	Perennial grass	0.5
	Hordeum brachyantherum subsp. *californicum*	California barley	Perennial grass	2.5
	Juncus bufonius var. *bufonius*	toad rush	Annual grasslike herb	0.005 (2.25 g)
			Total	**7.405**

PLANTING TYPE: GENERALLY UNDISTURBED OVERSTEEPENED BANK PLANTING; AREA = ~0.01 ACRE

Planting Zone	Scientific Name	Common Name	Life Form	Container	Spacing	% Cover	# Plants
	Alnus rubra	red alder	Shrub/tree	treeband	12 ft	85	3
	Cornus sericea	red-osier dogwood	Shrub	deepot 16	12 ft	85	3
	Fraxinus latifolia	Oregon ash	Tree	deepot 16	20 ft	100	2
	Marah fabacea	California man-root	Vine	deepot 16	12 ft	85	3
	Rubus ursinus	California blackberry	Vine	deepot 16	12 ft	85	3
						Total	14



1 **SECTION A-A'**

NTS

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\\STILLWATERSCI.COM\DFS\GISSTORAGE\GIS\DATA\597.00_SANGER_ENG\ACAD\100%_DESIGNS\MCGUINN_100%DESIGN TITLE & DETS.DWG LAST SAVED: 2/25/2016 PLOT DATE: 2/25/2016 PLOT STYLE:------

IF BAR DOES NOT MEASURE 1" DRAWING IS NOT TO SCALE — ADJUST ACCORDINGLY

SAN GERONIMO CREEK
HABITAT ENHANCEMENT PROJECT

MARIN COUNTY DEPARTMENT OF PUBLIC WORKS
MARIN COUNTY, CA

Stillwater Sciences
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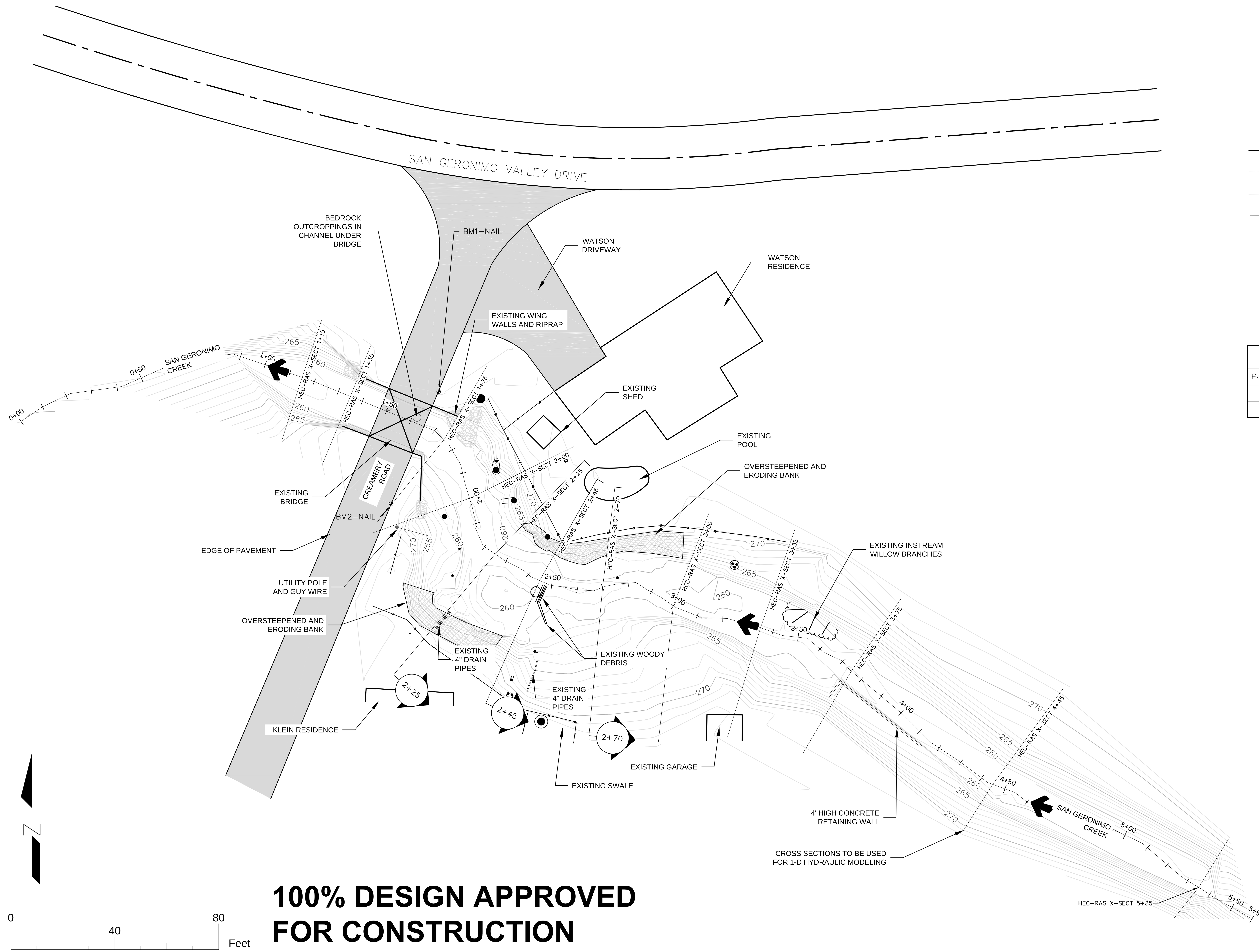
MCGUINN-NEWMAN BANK REHABILITATION
PLANTING PLAN

Size: D
Project: 597.00
Scale: AS NOTED
Date: 2-23-2016
Sheet: 11 OF 24



LEGEND

- EXISTING FENCE
- APPROXIMATE PROPERTY BOUNDARY
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING BUILDING
- EXISTING TREE

SURVEY CONTROL

Point #	Elevation	Northing	Easting	Description
1	274.23	5068.39	4966.70	BM1–NAIL
2	272.96	5025.28	4948.44	BM2–NAIL

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HABITAT ENHANCEMENT PROJECT

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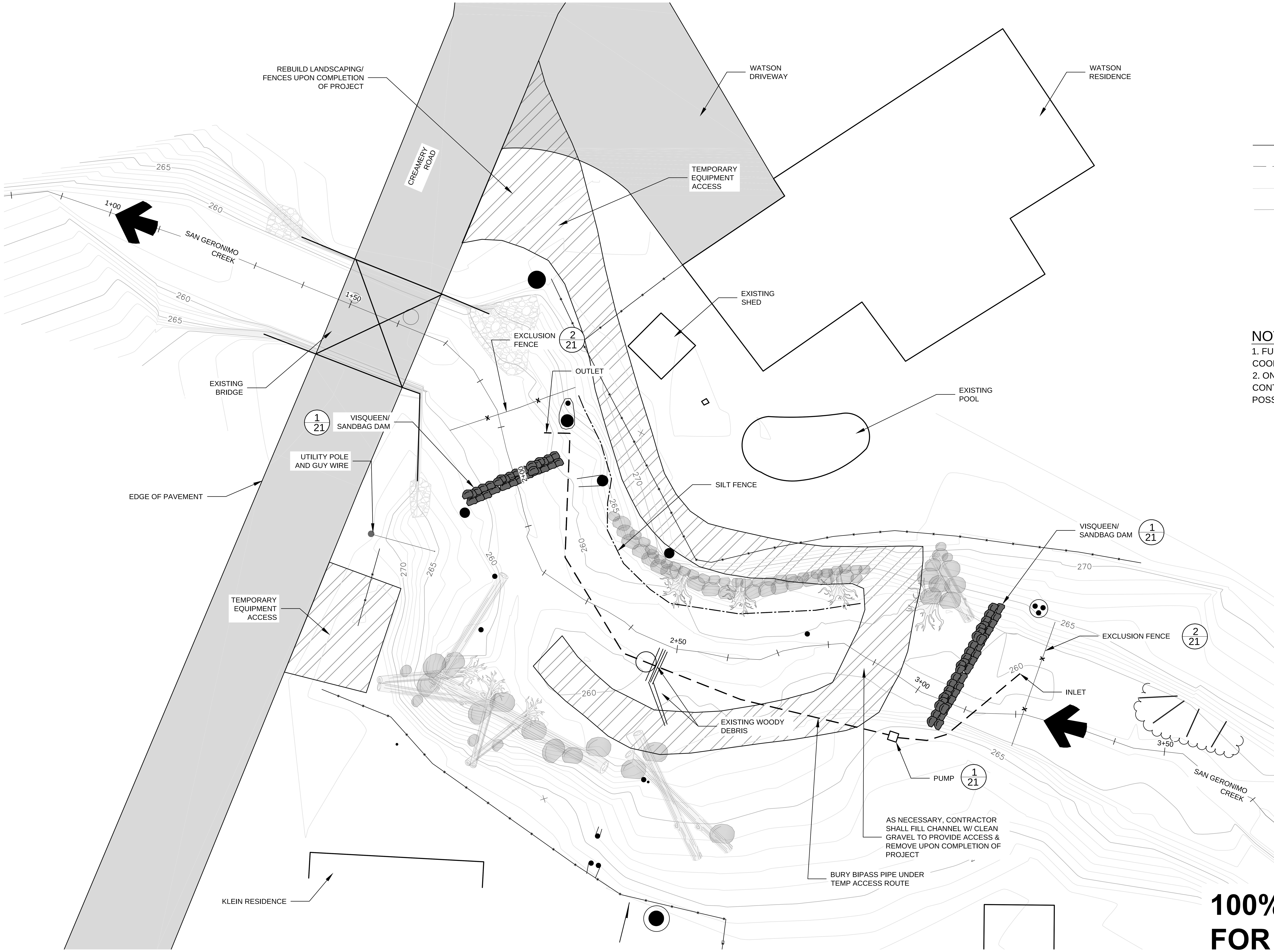
WATSON BANK REHABILITATION
EXISTING CONDITIONS

Size: D
Project: 597.00
Scale: AS NOTED
Date: 2-23-2016
Sheet: 12 OF 24



LEGEND

- EXISTING FENCE
- APPROXIMATE PROPERTY BOUNDARY
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING BUILDING
- EXISTING TREE

NOTES:

1. FULL DEWATERING MAY NOT BE NECESSARY- COORDINATE W/ DFW
2. ONSITE STAGING AREA SPACE EXTREMELY LIMITED; CONTRACTOR MUST STAGE OFFSITE WHENEVER POSSIBLE

N

0 10 20 Feet

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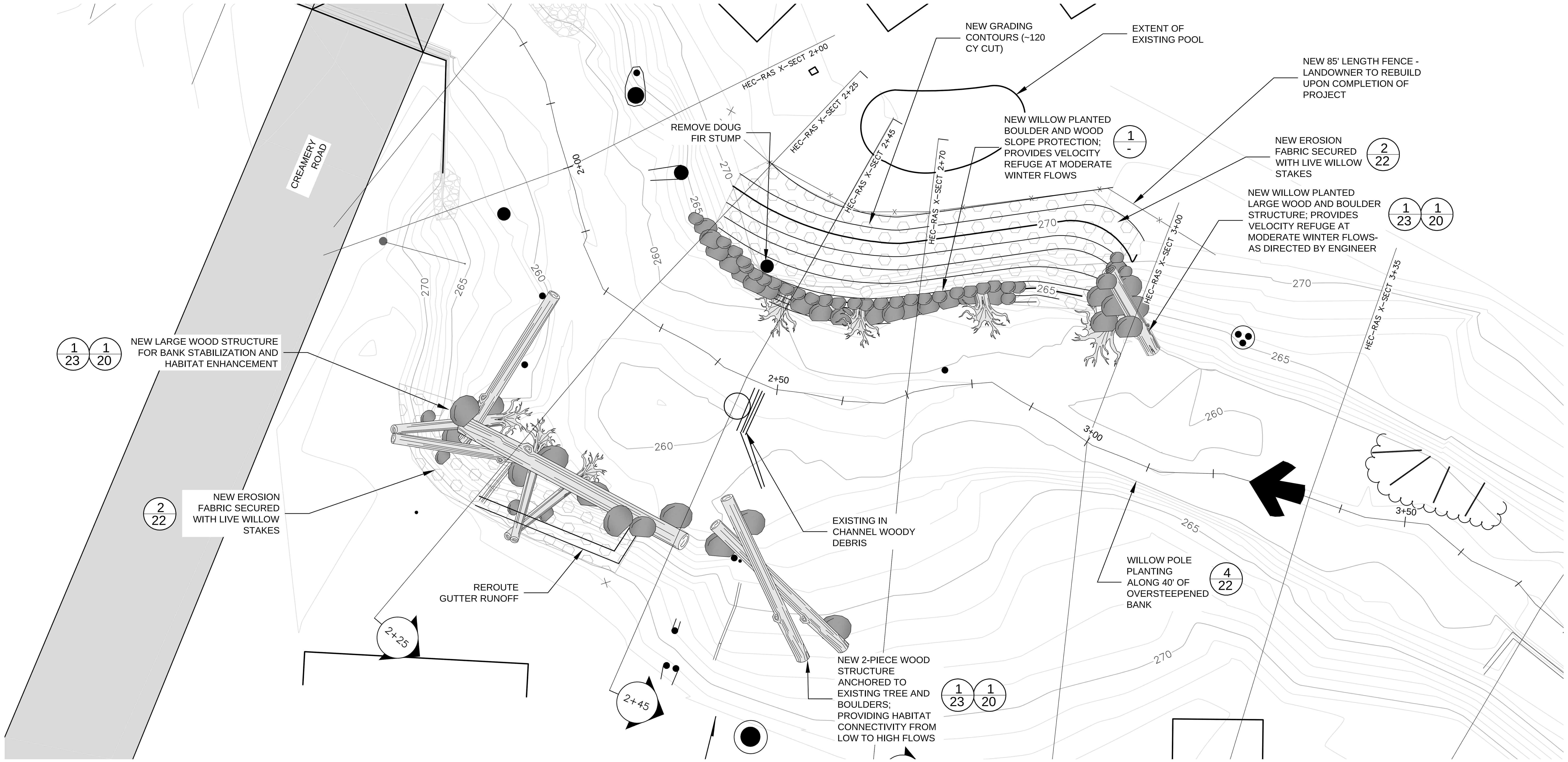
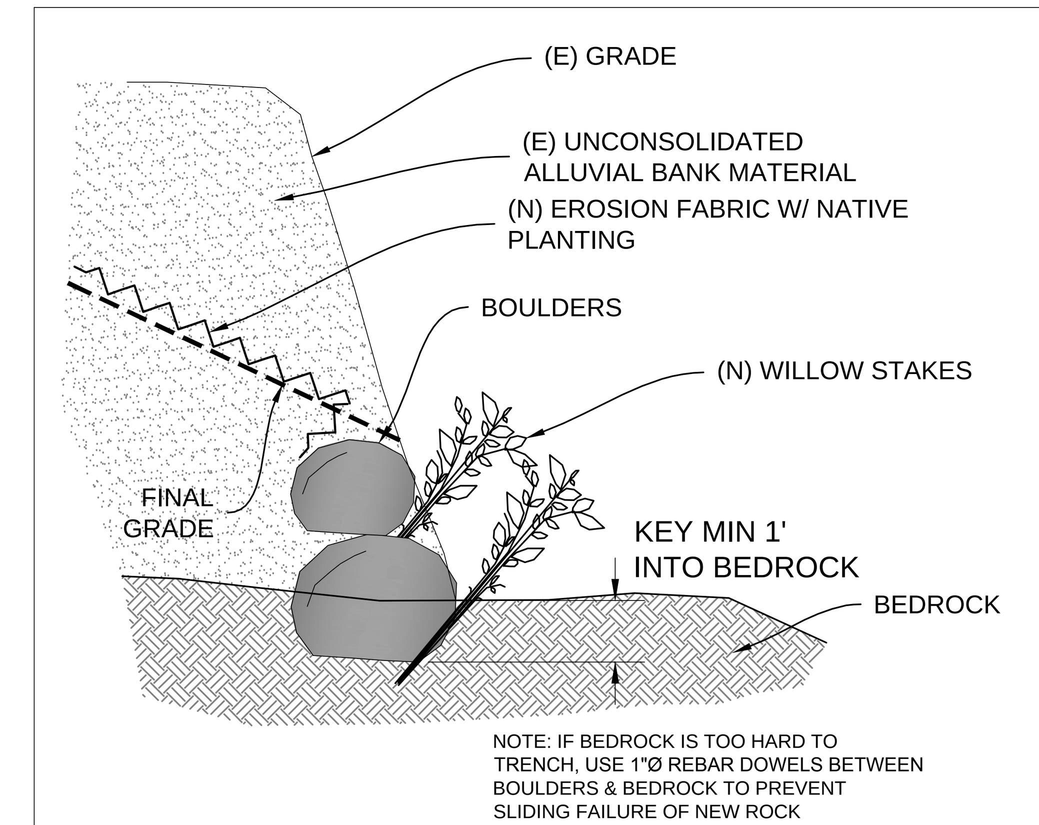
WATSON BANK REHABILITATION
DEWATERING, ACCESS, & SITE PROTECTION

Size	D
Project	597.00
Scale:	AS NOTED
Date:	2-23-2016
Sheet:	13 OF 24

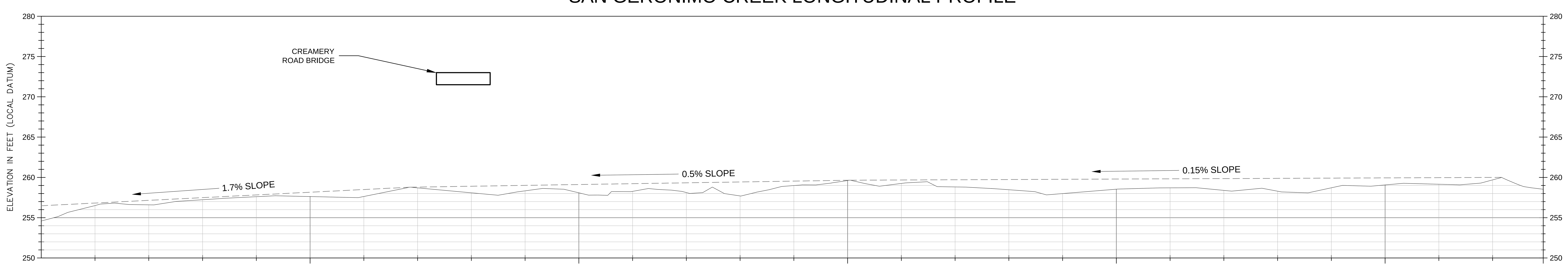




1 **BOULDER SLOPE PROTECTION**

NTS

SAN GERONIMO CREEK LONGITUDINAL PROFILE



PROFILE NOTES:

1. LONGITUDINAL PROFILE HAS 3X VERTICAL EXAGGERATION
2. DASHED LINES REPRESENT APPROXIMATE CHANNEL GRADIENT MEASURED BETWEEN RIFFLE CRESTS

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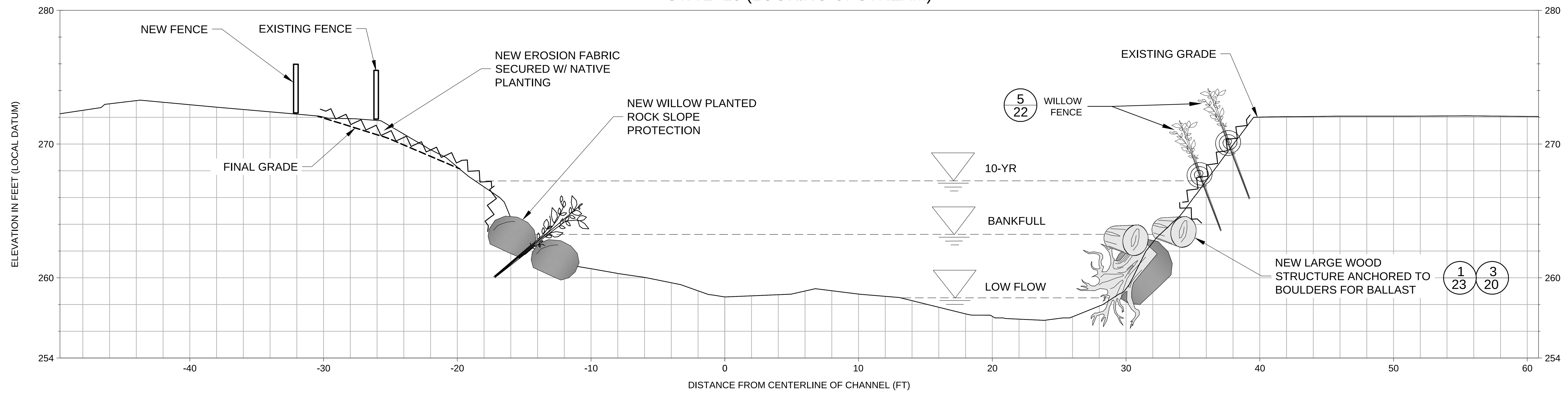
WATSON BANK REHABILITATION PLAN & PROFILE

Size: D | Project: 597.00
Scale: AS NOTED
Date: 2-23-2016
Sheet: 14 OF 24

STA 2+25 (LOOKING UPSTREAM)



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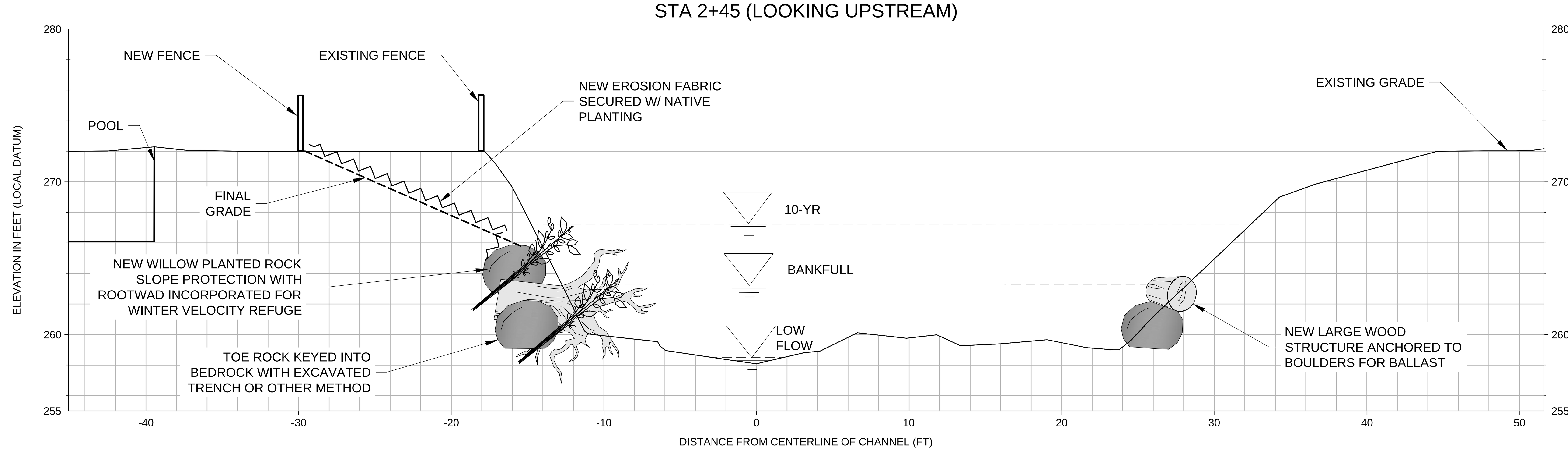
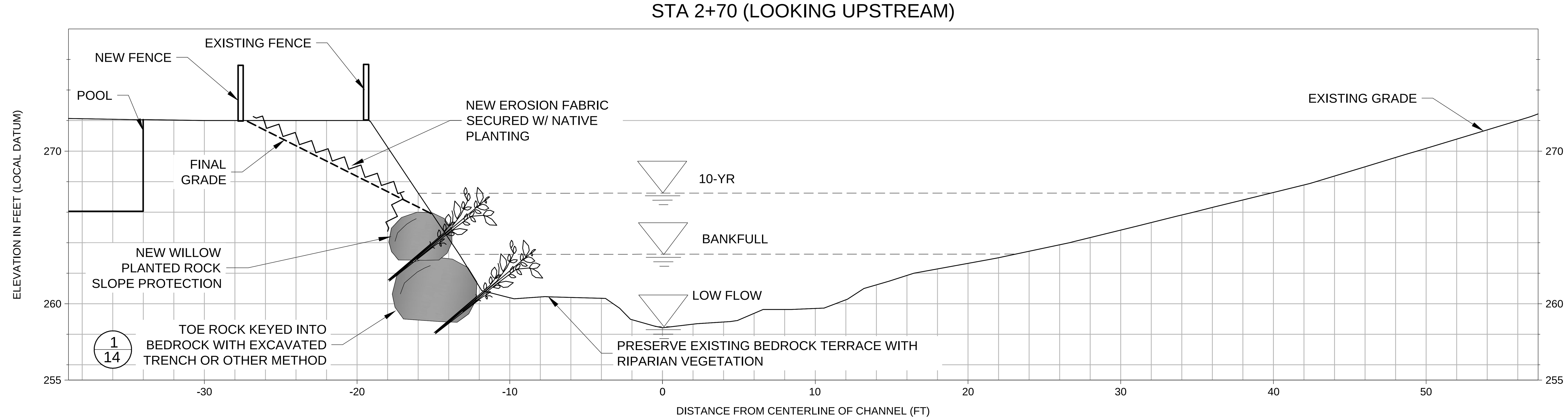


STA 2+70 (LOOKING UPSTREAM)



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9-30-16
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Drawn: JM
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WATSON BANK REHABILITATION CROSS SECTIONS

Size: D
Project: 597.00
Scale: AS NOTED
Date: 2-23-2016
Sheet: 15 OF 24

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SEEDING AND PLANTING PALLET:

PLANTING TYPE: RIPARIAN NATIVE GRASS AND HERB EROSION CONTROL SEED MIX; AREA = ~0.5 ACRE

Planting Zone	Scientific Name	Common Name	Life Form	Qty (lbs)
ALL DISTURBED AND/OR BARE GROUND WITHIN PROJECT AREA	*Agrostis exarata*	spike bent grass	Perennial grass	0.05 (0.8 oz)
	Anthoxanthum occidentale	California sweet grass	Perennial grass	0.5
	Danthonia californica	California oat grass	Perennial grass	1
	Deschampsia cespitosa subsp. *holciformis*	coastal tufted hair grass	Perennial grass	0.1 (1.6 oz)
	Deschampsia elongata	slender hair grass	Perennial grass	0.25
	Elymus triticoides	beardless wild rye	Perennial grass	2.5
	Festuca californica	California fescue	Perennial grass	0.5
	Hordeum brachyantherum subsp. *californicum*	California barley	Perennial grass	2.5
	Juncus bufonius var. *bufoniu*	toad rush	Annual grasslike herb	0.005 (2.25 g)
			Total	**7.405**

PLANTING TYPE: RE-GRADED UPPER RIPARIAN BANK; AREA = 0.01 ACRE

Planting Legend	Scientific Name	Common Name	Life Form	Container	Spacing	% Cover	# Plants
	Acer macrophyllum	big-leaf maple	Tree	treeband	20 ft	70	1
	Frangula californica	California coffeeberry	Shrub	deepot 16	12 ft	50	2
	Rosa californica	California wild rose	Shrub	TB9	5 ft	25	4
	Rubus ursinus	California blackberry	Vine	deepot 16	12 ft	50	2
						Total	**9**

PLANTING TYPE: RE-GRADED LOWER RIPARIAN BANK; AREA = 0.01 ACRE

Planting Legend	Scientific Name	Common Name	Life Form	Container	Spacing	% Cover	# Plants
	Carex densa	dense sedge	Perennial grasslike herb	plugs	6 ft	60	7
	Juncus patens	spreading rush	Perennial grasslike herb	plugs	6 ft	60	7
	Acer negundo	box elder	Small tree	treeband	12 ft	30	1
	Alnus rhombifolia	white alder	Tree	treeband	20 ft	70	1
	Alnus rubra	red alder	Small tree	treeband	12 ft	45	1
	Cornus sericea	red-osier dogwood	Shrub	deepot 16	12 ft	60	2
	Fraxinus latifolia	Oregon ash	Tree	deepot 16	20 ft	50	1
						Total	**20**

PLANTING TYPE: GENERALLY UNDISTURBED OVERSTEEPENED BANK PLANTING; AREA = ~0.01 ACRE

Planting Legend	Scientific Name	Common Name	Life Form	Container	Spacing	% Cover	# Plants
	Alnus rubra	red alder	Shrub/tree	treeband	12 ft	85	3
	Cornus sericea	red-osier dogwood	Shrub	deepot 16	12 ft	85	3
	Fraxinus latifolia	Oregon ash	Tree	deepot 16	20 ft	100	2
	Marah fabacea	California man-root	Vine	deepot 16	12 ft	85	3
	Rubus ursinus	California blackberry	Vine	deepot 16	12 ft	85	3
						Total	**14**

SAN GERONIMO CREEK
HABITAT ENHANCEMENT PROJECT

MARIN COUNTY DEPARTMENT OF PUBLIC WORKS
MARIN COUNTY, CA

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Checked: EB
Appr'd:

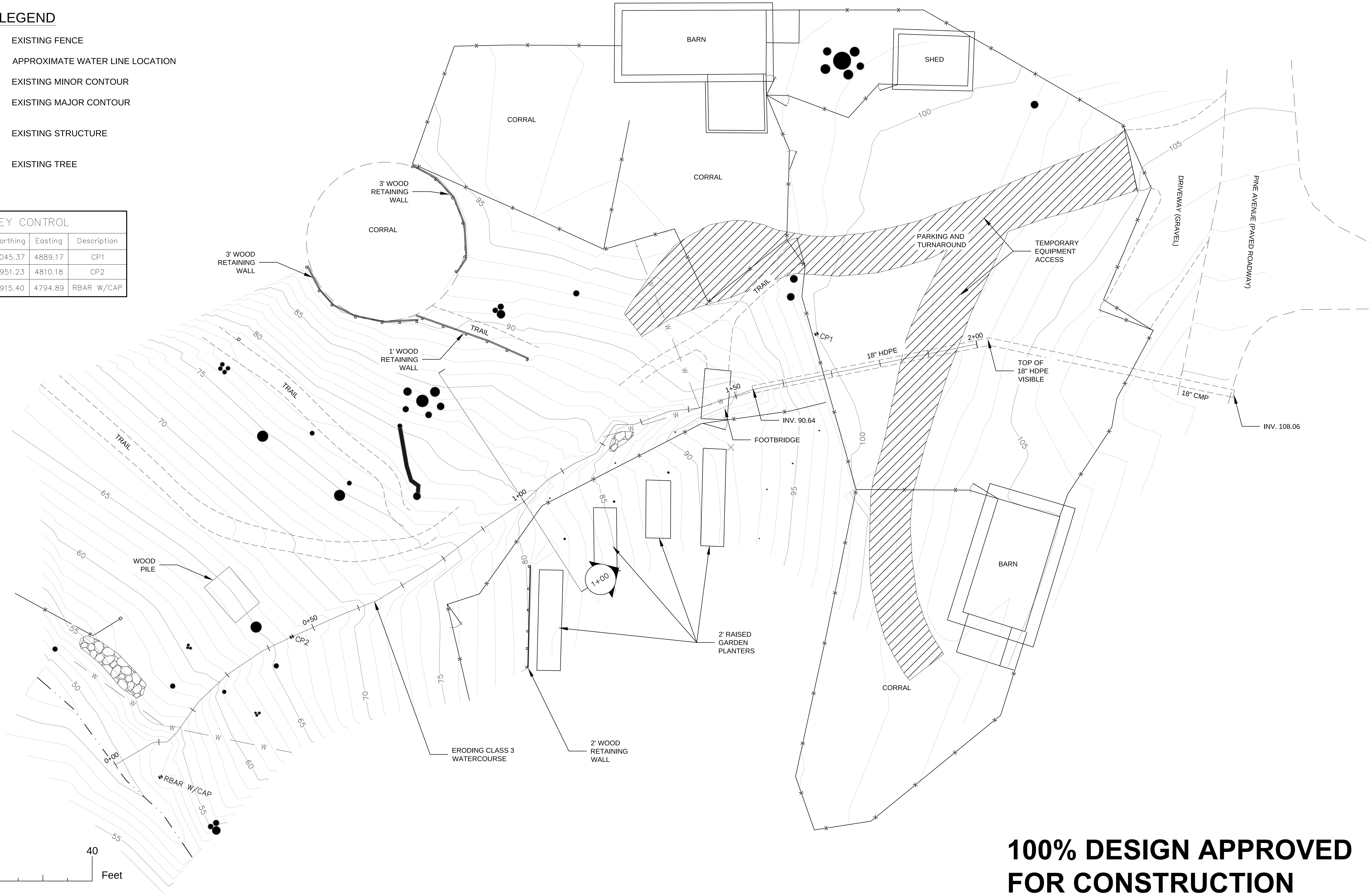
WATSON BANK REHABILITATION
PLANTING PLAN

Size: D
Project: 597.00
Scale: AS NOTED
Date: 2-23-2016
Sheet: 16 OF 24

LEGEND

- EXISTING FENCE
- APPROXIMATE WATER LINE LOCATION
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING STRUCTURE
- EXISTING TREE

SURVEY CONTROL				
Point #	Elevation	Northing	Easting	Description
1	100.00	5045.37	4889.17	CP1
2	66.34	4951.23	4810.18	CP2
3	52.60	4915.40	4794.89	RBAR W/CAP



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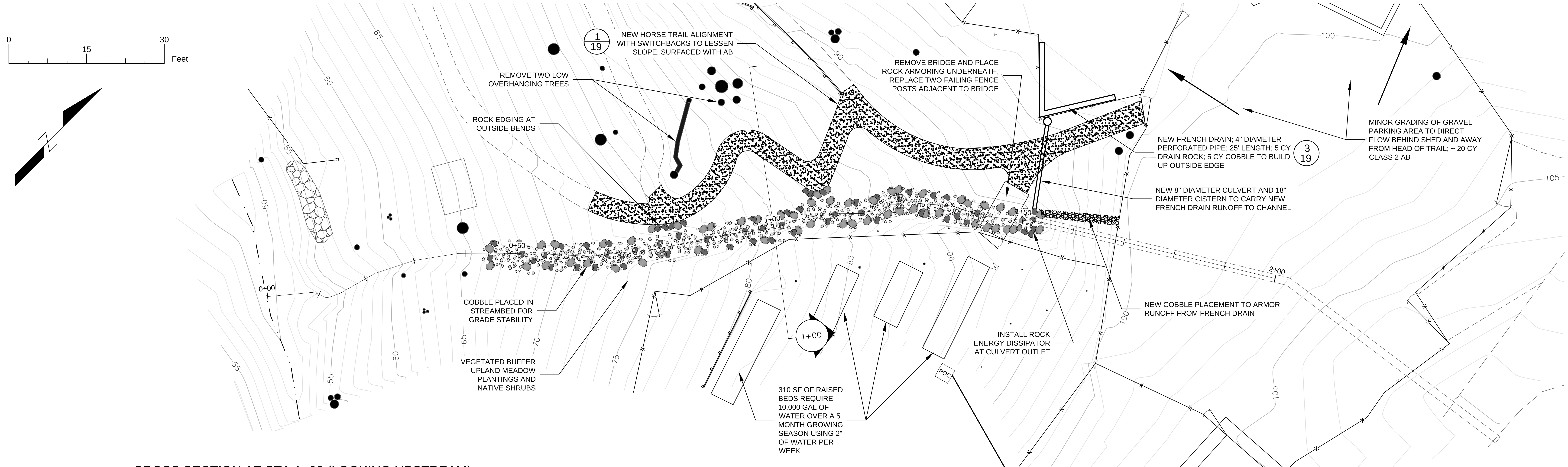
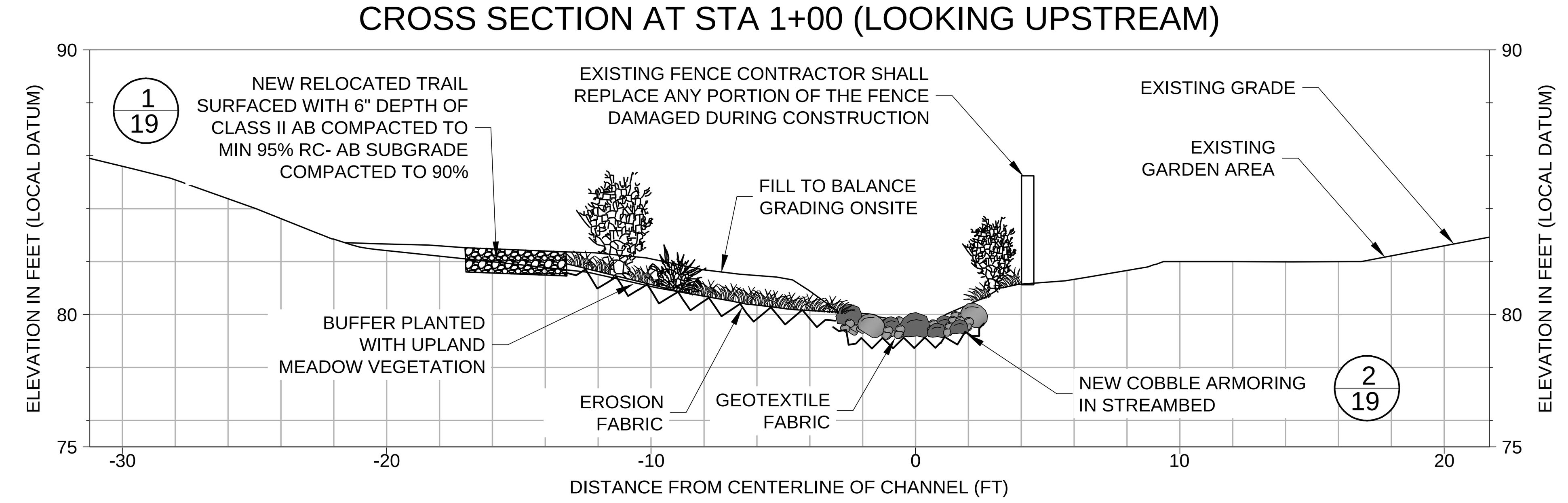
Drawn:	JM
Checked:	EB
Appr'd:	

FREUND STABLES STORMWATER MANAGEMENT EXISTING CONDITIONS AND ACCESS

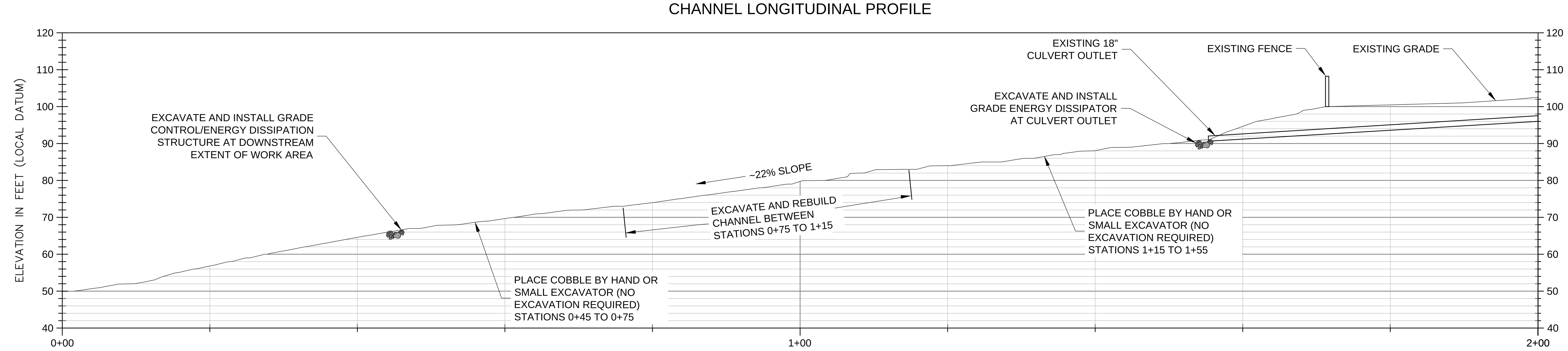
Size	D
Project	597.00
Scale:	AS NOTED
Date:	2-23-2016
Sheet:	17 OF 24



CROSS SECTION AT STA 1+00 (LOOKING UPSTREAM)



CHANNEL LONGITUDINAL PROFILE



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SAN GERONIMO CREEK HABITAT ENHANCEMENT PROJECT MARIN COUNTY DEPARTMENT OF PUBLIC WORKS MARIN COUNTY, CA	Stillwater Sciences www.stillwatersci.com	Design: JM Drawn: JM Checked: EB Appr'd:	**FREUND STABLES STORMWATER MANAGEMENT PLAN, PROFILE, AND SECTIONS**

Size	Project
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Scale:	AS NOTED
Date:	2-23-2016
Sheet:	18 OF 24

SEEDING AND PLANTING PALLET:

PLANTING TYPE: UPLAND NATIVE GRASS AND HERB EROSION CONTROL SEED MIX; AREA = ~0.5 ACRE

Planting Zone	Scientific Name	Common Name	Life Form	Qty (lbs)
ALL DISTURBED AND/OR BARE GROUND WITHIN PROJECT AREA	*Anthoxanthum occidentale*	California sweet grass	Perennial grass	0.5
	Danthonia californica	California oat grass	Perennial grass	1
	Elymus glaucus	blue wild-rye	Perennial grass	1
	Festuca californica	California fescue	Perennial grass	0.5
	Festuca idahoensis	Idaho fescue	Perennial grass	0.5
	Melica californica	California melic	Perennial grass	1
	Poa secunda subsp. *secunda*	one-sided blue grass	Perennial grass	0.5
	Eschscholzia californica	California poppy	Annual herb	0.25
	Lupinus bicolor	miniature lupine	Annual herb	0.5
			Total	**5.75**

PLANTING TYPE: UPLAND MEADOW PLANTING; AREA = ~0.25 ACRE

Planting Zone	Scientific Name	Common Name	Life Form	Container	Spacing	% Cover	# Plants
	Baccharis pilularis	coyote brush	Shrub	deepot 16	12 ft	5	4
	Rosa californica	California wild rose	Shrub	TB9	5 ft	2	10
	Elymus triticoides	beardless wild rye	Perennial grass	plug	3 ft	5	61
	Stipa pulchra	purple needle grass	Perennial grass	plug	5 ft	10	44
	Achillea millefolium	yarrow	Perennial herb	deepot 16	3 ft	3	36
						Total	**155**

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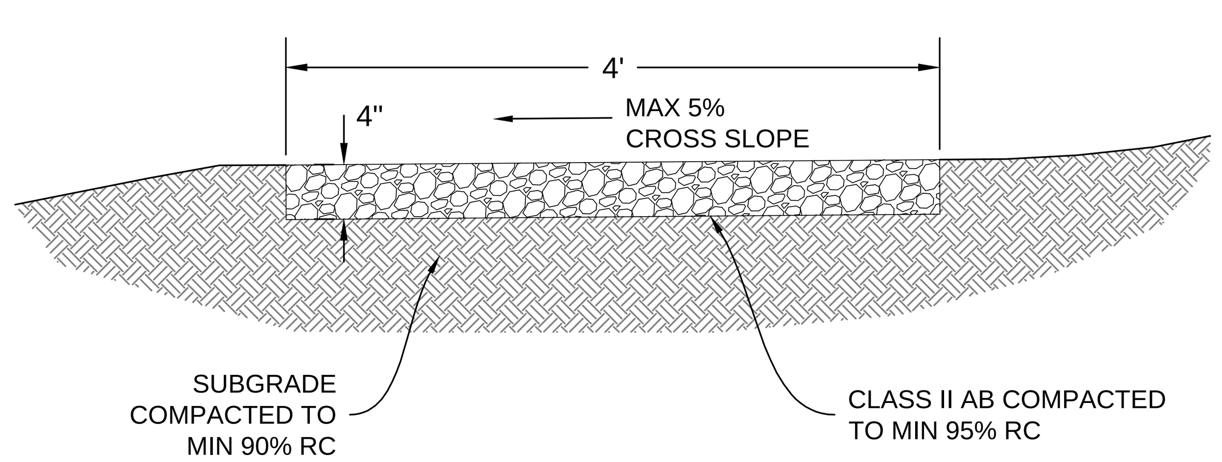
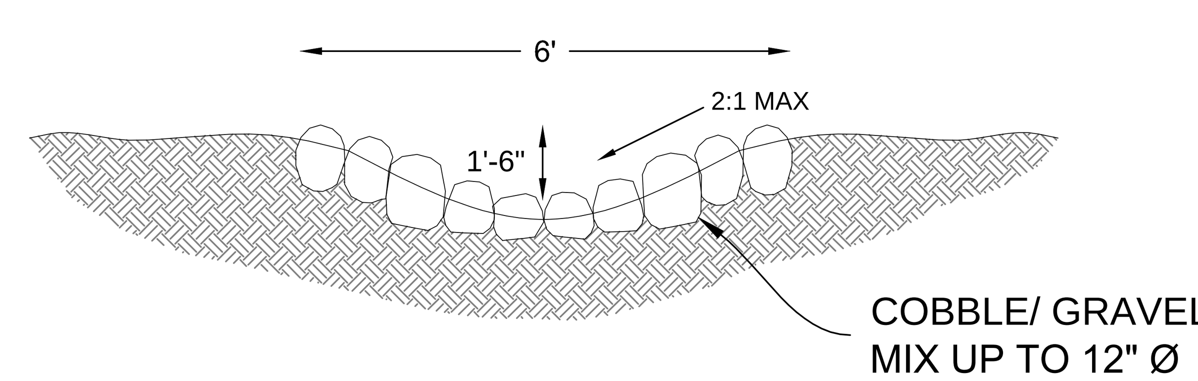


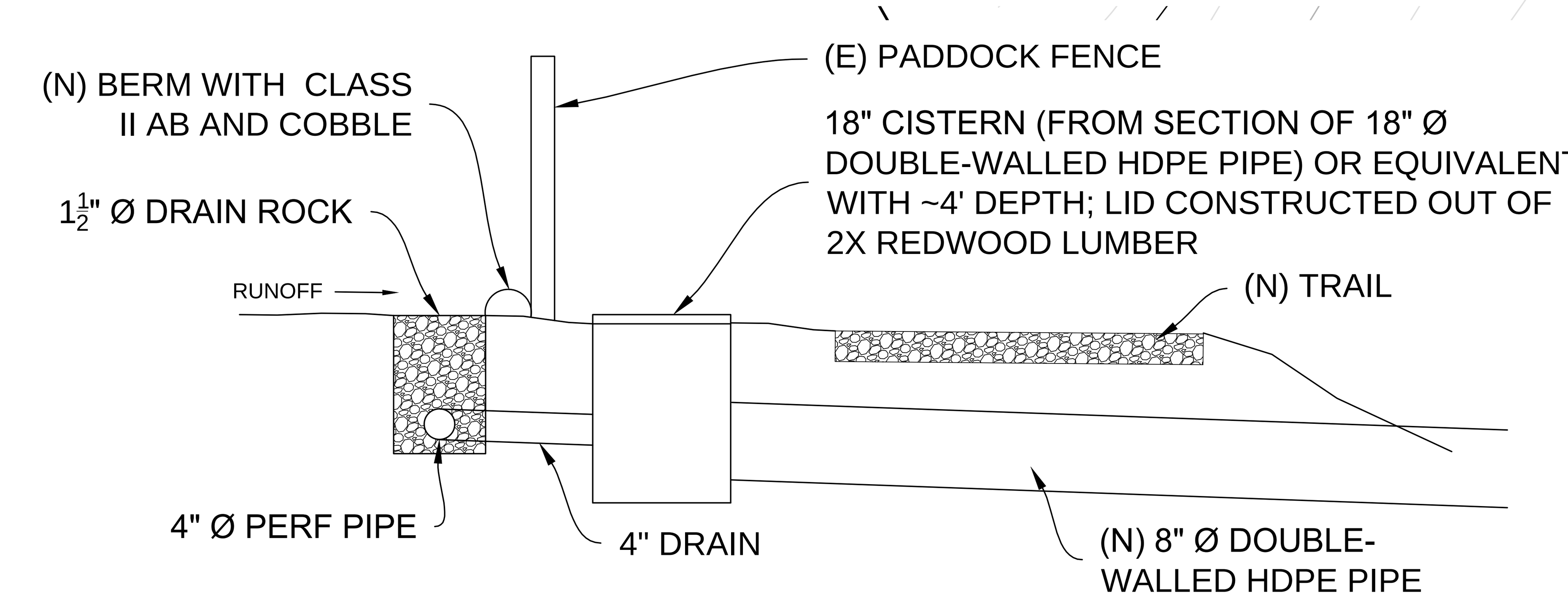
1 **TRAIL SECTION DETAIL**

NTS



2 **CHANNEL SECTION DETAIL**

NTS



3 **FRENCH DRAIN DETAIL**

NTS

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FREUND STABLES STORMWATER MANAGEMENT PLANTING PLAN

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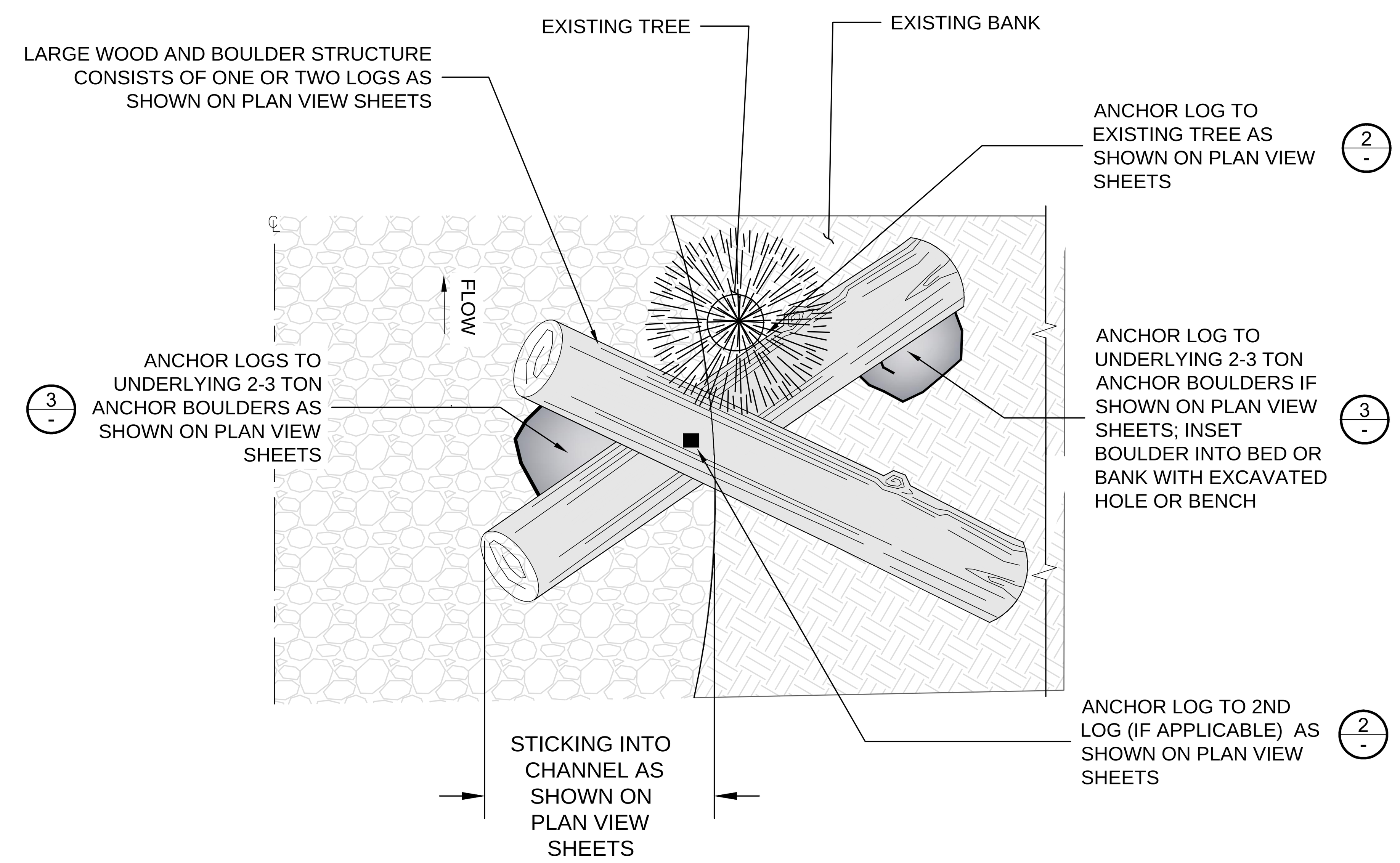
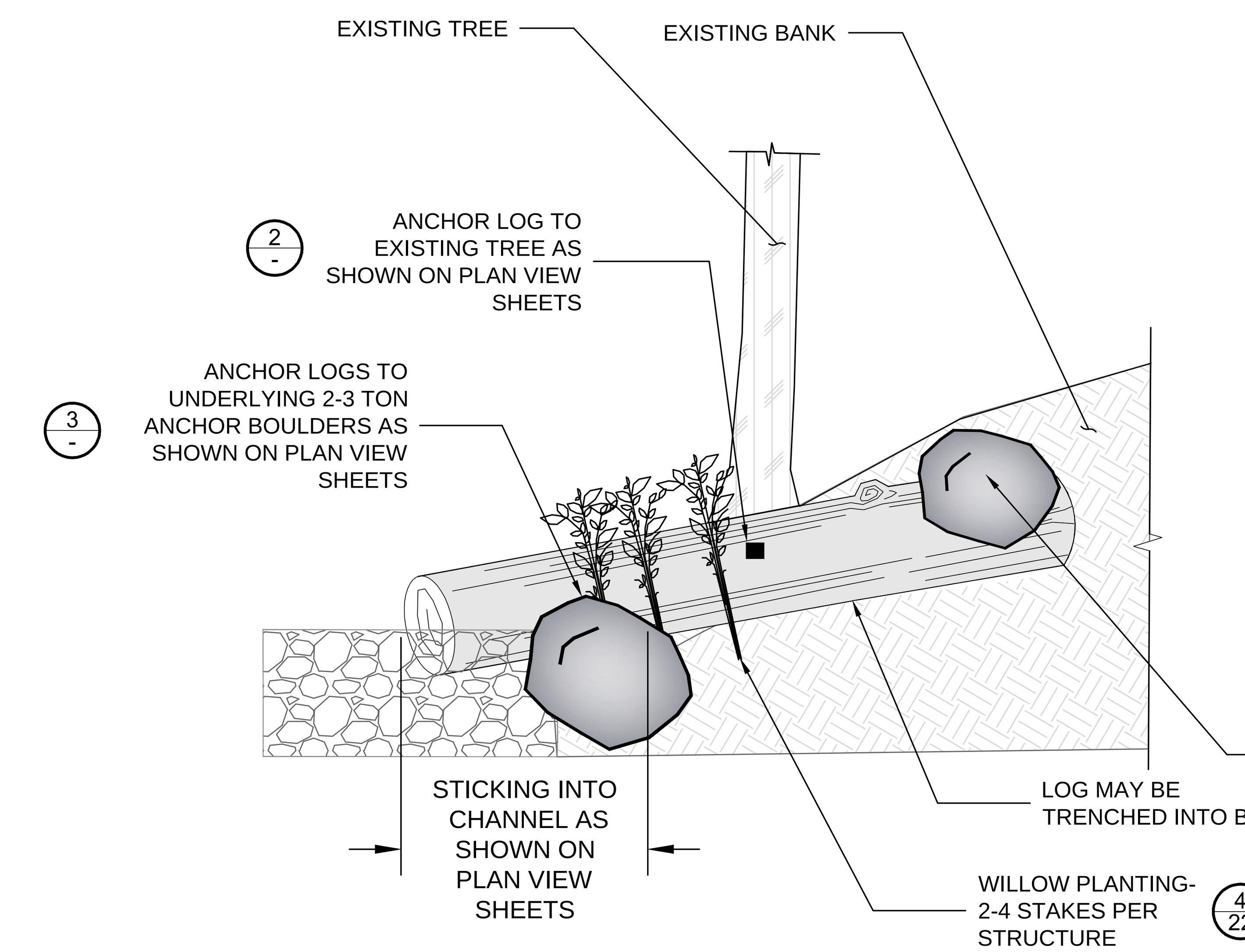
Sheet: 19 OF 24



PLAN VIEW



ANCHOR LOG TO UNDERLYING 2-3 TON ANCHOR BOULDERS IF SHOWN ON PLAN VIEW SHEETS; INSET BOULDER INTO BED OR BANK WITH EXCAVATED HOLE OR BENCH (3/-)

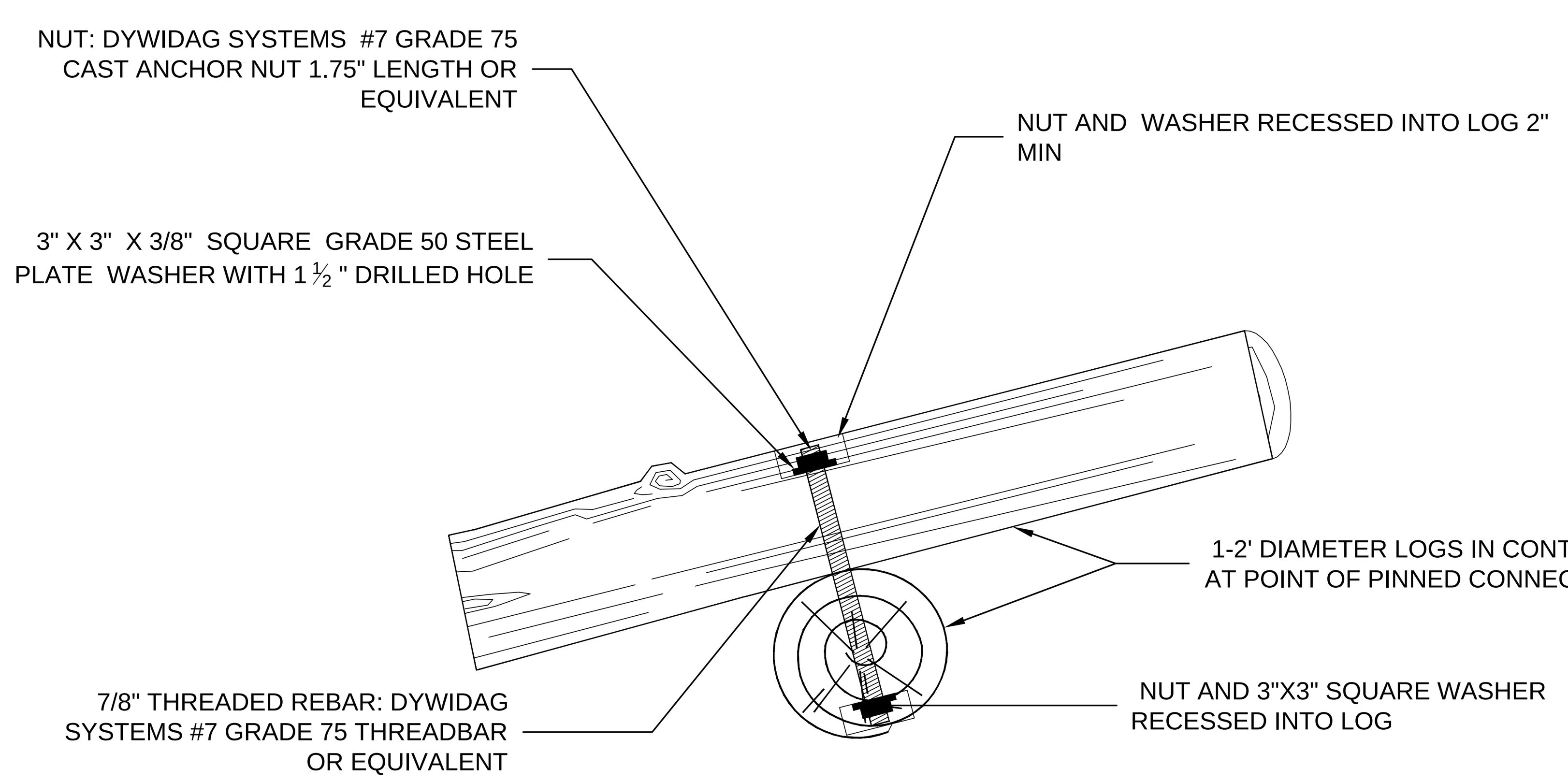
SECTION VIEW

NOTES:

1. LOG STRUCTURES SHALL BE INSTALLED AS SHOWN ON PLAN VIEW SHEETS
2. WHERE BANKS ARE STEEP, LOG STRUCTURES MAY BE TRENCHED INTO THE BANK TO ALLOW FOR A LOWER ANGLE AND PROVIDE MORE WOOD VOLUME IN THE ACTIVE CHANNEL
3. HOLE OR BENCH FOR BOULDERS SHOULD BE EXCAVATED INTO CHANNEL BANK OR BED TO INCREASE STABILITY OF STRUCTURE TO A MINIMUM DEPTH OF HALF OF THE BOULDER THICKNESS
4. BOULDER SHOULD BE PLACED WITH THE LARGEST FLAT SIDE DOWN FOR MAXIMUM STABILITY
5. LOG STRUCTURE CONSTRUCTION DETAILS MAY BE MODIFIED IN THE FIELD AS APPROVED BY THE PROJECT MANAGER AND ENGINEER
6. REDUNDANT ANCHORING SHALL BE CONDUCTED AS DIRECTED BY THE ENGINEER

1 1- AND 2-PIECE WOOD STRUCTURE DETAILS

NTS

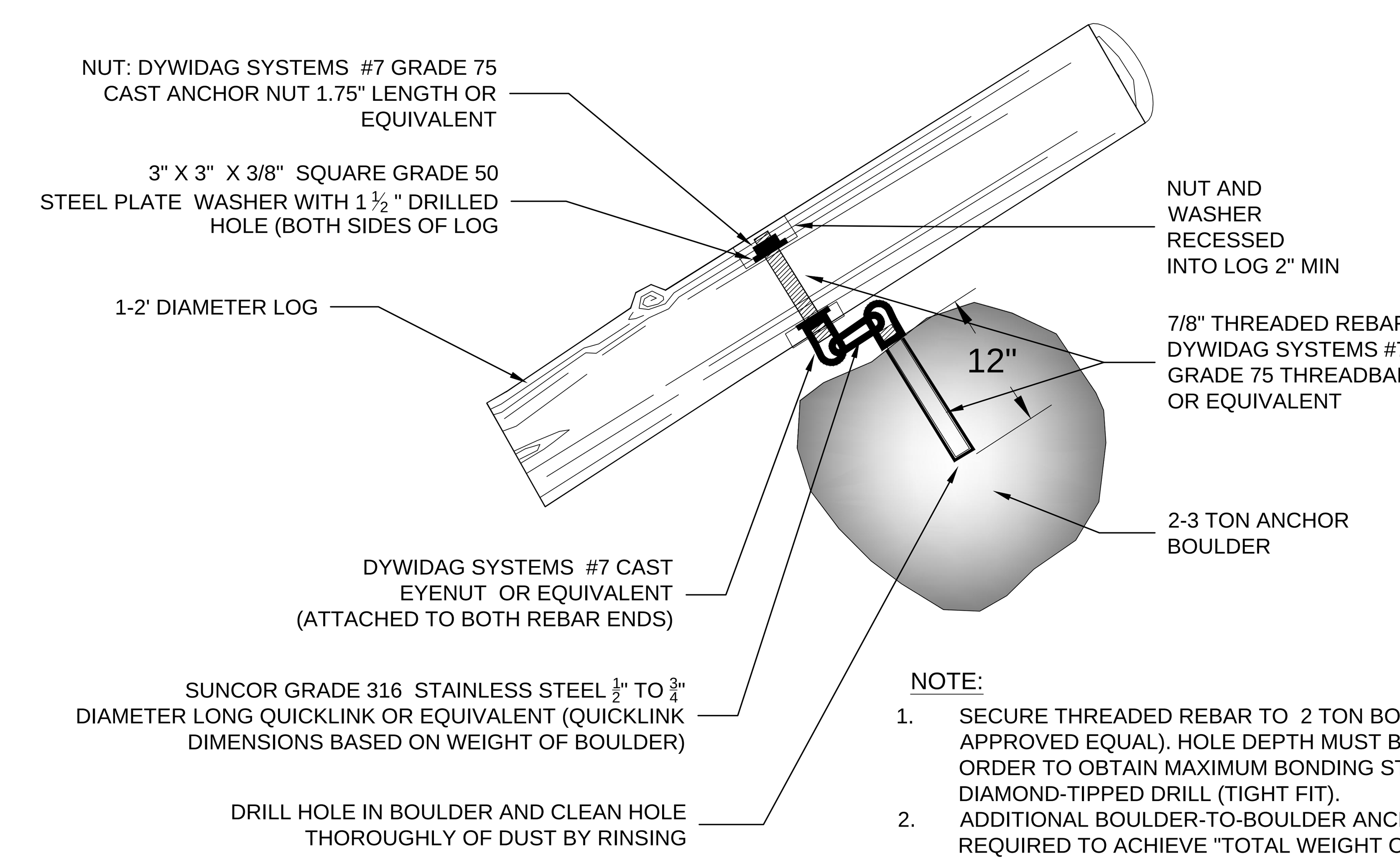


NOTE:

1. NOTCHING NOT REQUIRED ON LIVE TREES TO REDUCE IMPACTS TO TREE HEALTH

2 LOG-LOG OR LOG-TREE ANCHORING

NTS



NOTE:

1. SECURE THREADED REBAR TO 2 TON BOULDER USING EPOXY ADHESIVE (HILTI C-10 EPOXY CARTRIDGES, OR APPROVED EQUAL). HOLE DEPTH MUST BE SUFFICIENT TO REACH COMPETENT, UN-FRACTURED ROCK IN ORDER TO OBTAIN MAXIMUM BONDING STRENGTH. A MINIMUM OF 12 INCHES IS RECOMMENDED; 1" DIAMOND-TIPPED DRILL (TIGHT FIT).
2. ADDITIONAL BOULDER-TO-BOULDER ANCHORING (USING TECHNIQUE DESCRIBED IN DETAIL 3) MAY BE REQUIRED TO ACHIEVE "TOTAL WEIGHT OF BOULDERS REQUIRED" SHOWN ON DETAIL 1 ON SHEET 23.
3. REDUNDANT ANCHORING SHALL BE CONDUCTED AS DIRECTED BY THE ENGINEER TO REDUCE THE RISK OF FAILURE OF THE LARGE WOOD STRUCTURES

3 LOG-BOULDER ANCHORING

NTS

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IF BAR DOES NOT MEASURE 1" DRAWING IS NOT TO SCALE - ADJUST ACCORDINGLY

\\STILLWATERSCI.COM\DFS\GISSTORAGE\GIS\DATA\597.00_SANGER_ENG\ACAD\100%_DESIGNS\MCGUNN_100%DESIGN TITLE & DETS.DWG LAST SAVED: 2/25/2016 PLOT DATE: 2/25/2016 PLOT STYLE: ----

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MARIN COUNTY, CA

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CONSTRUCTION DETAILS
WOOD ANCHORING

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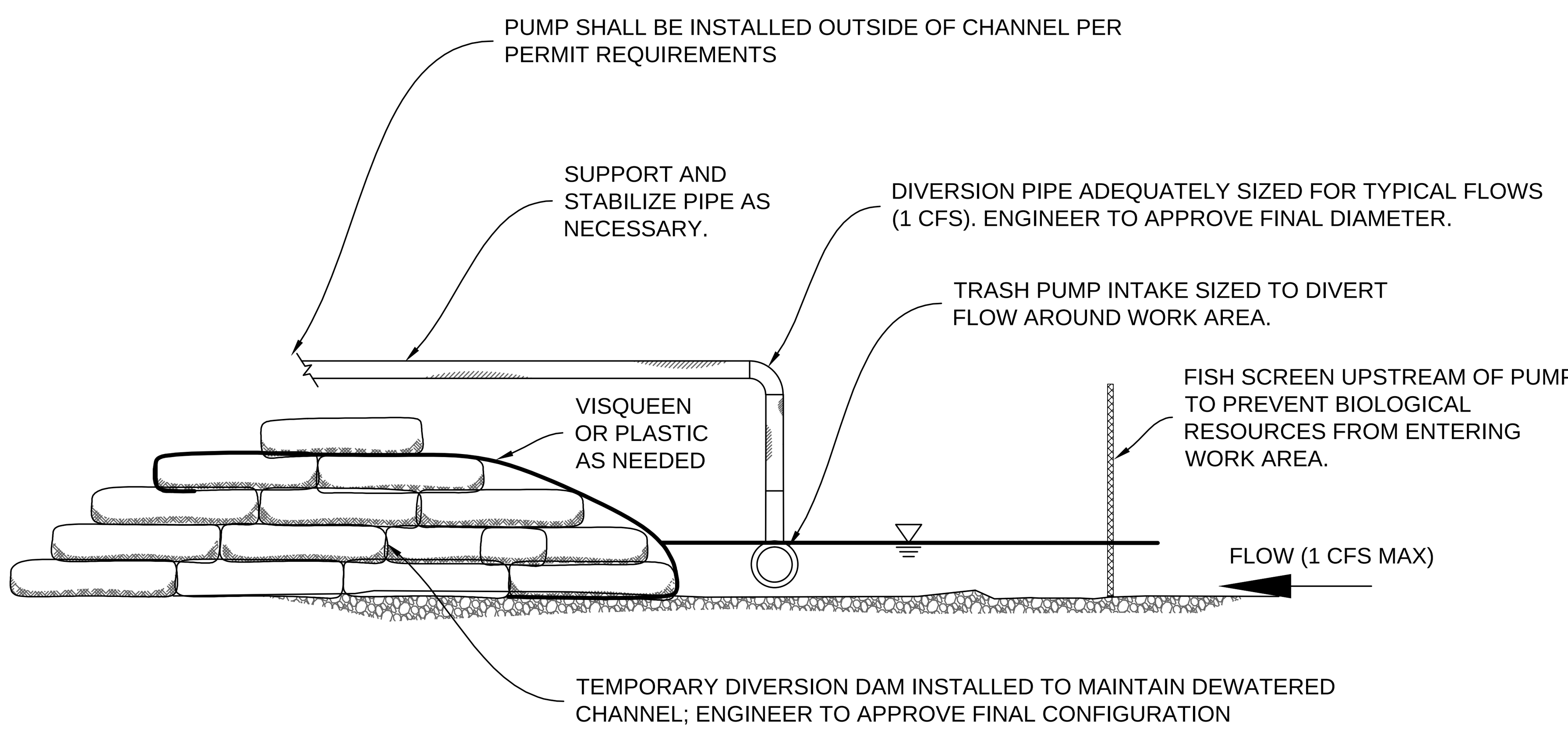
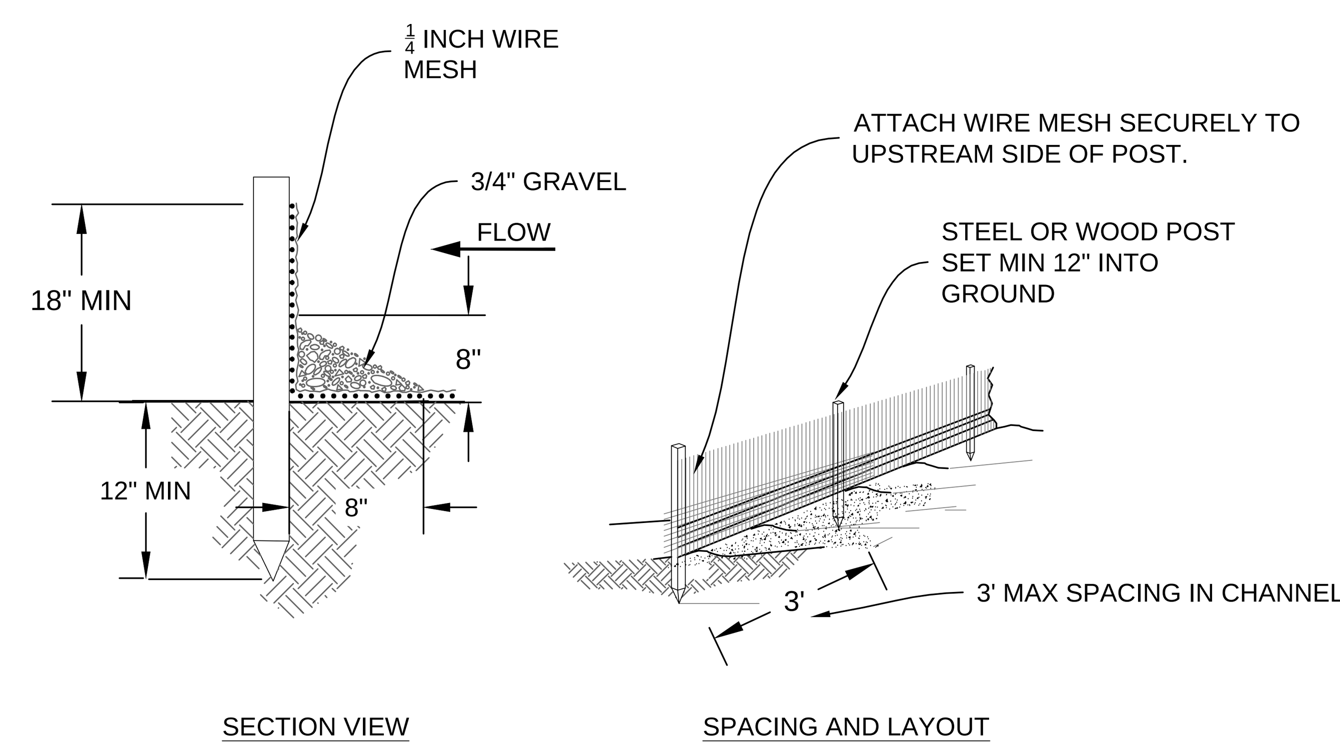
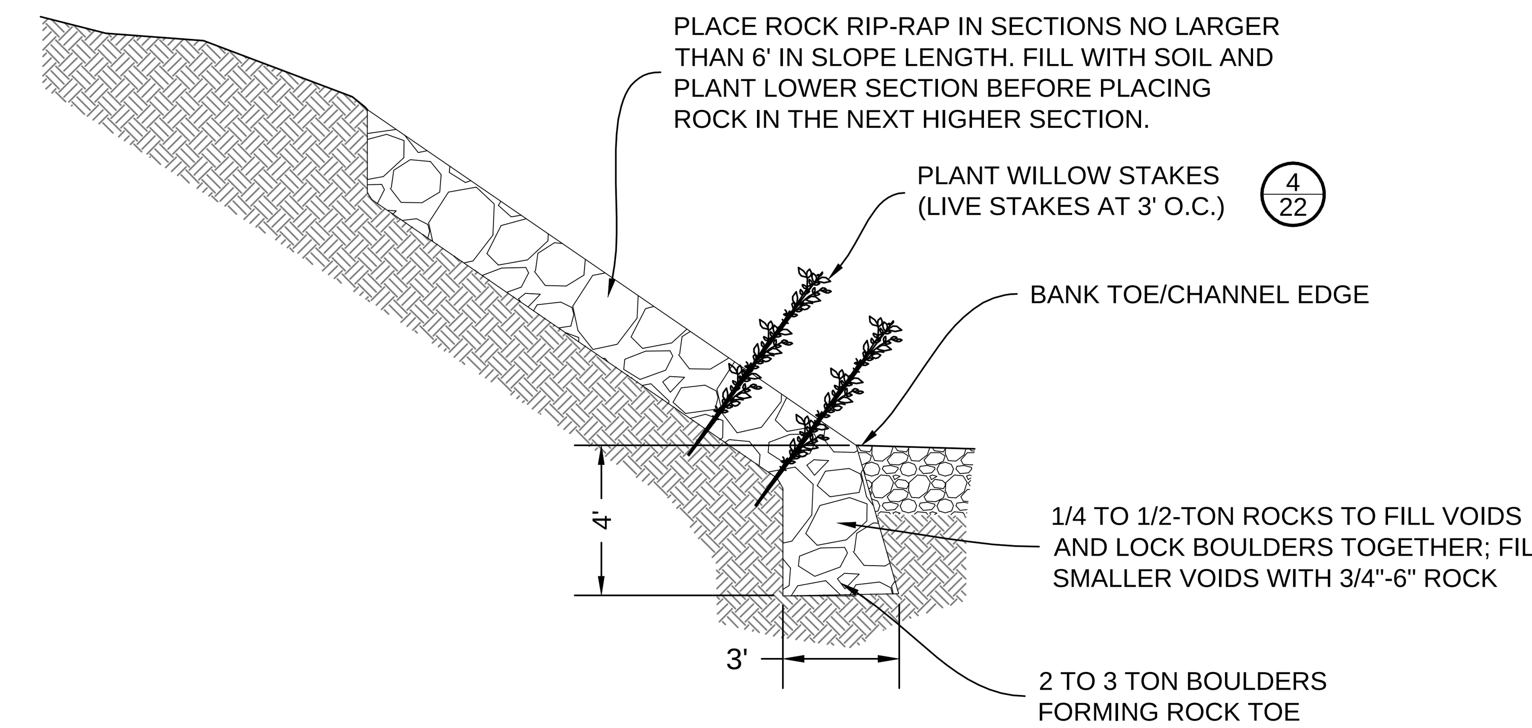
Sheet:	20 OF 24



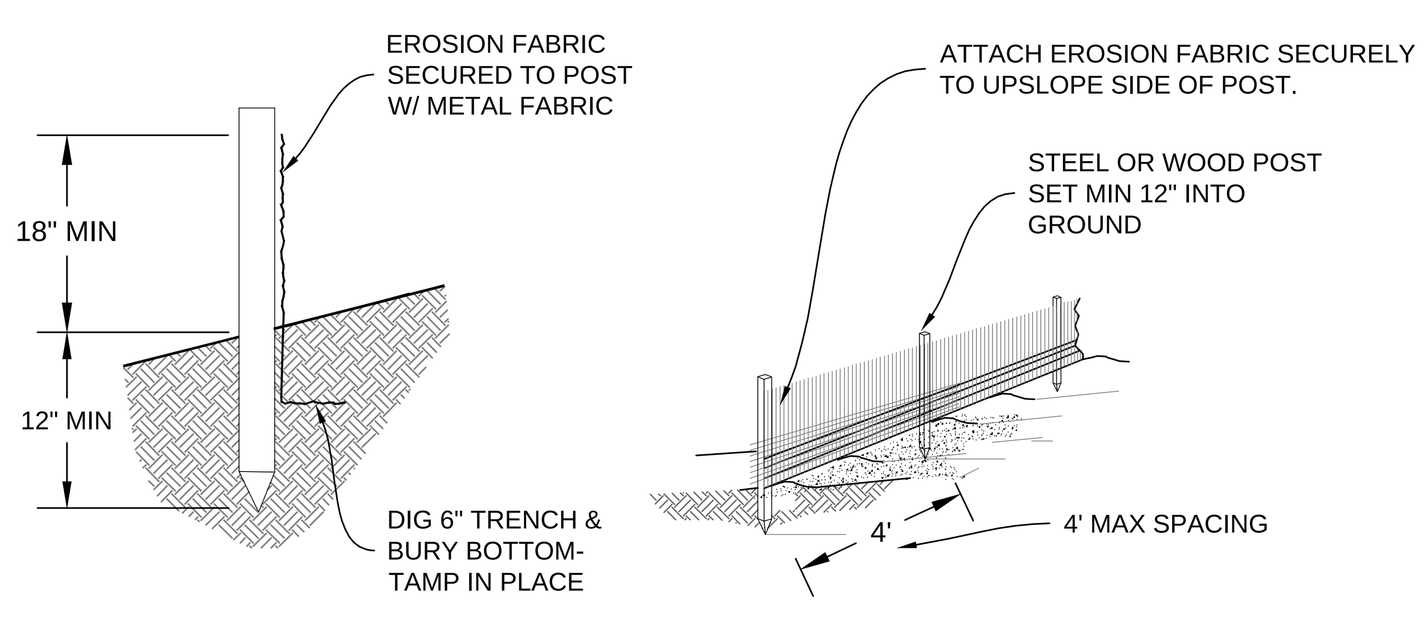
1 **COFFER DAM AND PUMP INTAKE**
NTS



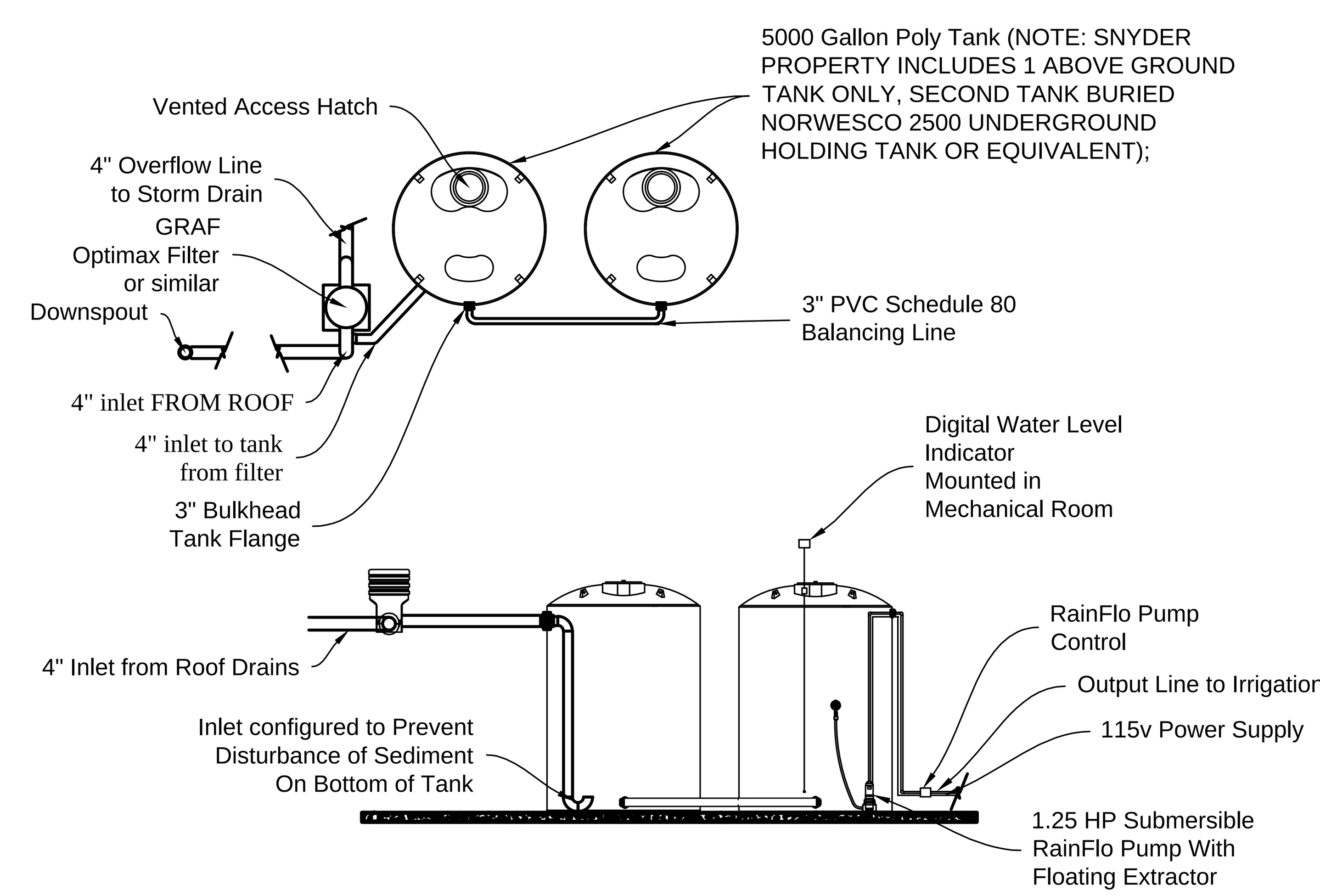
2 FISH EXLUSIONARY FENCING
NTS



3 **WILLOW PLANTED BOULDER PLACEMENT**
NTS



4 **SILT FENCING**
NTS



5 **RAINWATER CATCHMENT**
NTS

STANDARD SYMBOL	DESCRIPTION	MANUFACTURER	MODEL # (if applicable)	COMMENTS	DETAIL (see sheet 24)
- - - - - - -	Irrigation Trench - Mainline	Sch. 40 PVC for line 1" & smaller		18" below fin. grade	1
= = = = = = =	Sleeves	Class 315 PVC		24"/18" below fin. grade	1
◆	Quick-Coupling Valve (in box)	Rainbird	44LRC - 1" key	May substitute for normal faucet based on landowner input	4
	Quick-Coupling Valve Box	Carson	910 Lockable	10" Round box w/ lid	4
	Emitters*	Rainbird	Xeri-Bug 10-32 Threaded Inlet XB-20PC-1032	Two per plant	2
—— · ——	Dripline Tubing	Rainbird	Black Stripe Tubing; 1/2" polyethylene pipe	Extend from lateral PVC and connect to emitter	2
⋈	Gate Valve (in box)	Nibco	T-113		3
	Gate Valve Box	Carson	910 Lockable		3
◐	Remote Control Valve (in box)	Rainbird	XCZ-100-PRB-COM		5
	Remote Control Valve Box	Rainbird	Valve box with cover : Rainbird VB-STD		5

*Emitters not shown on plan

POC POINT OF CONNECTION

6 **IRRIGATION SYMBOLOGY AND MATERIALS**
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CONSTRUCTION DETAILS DEWATERING AND OTHER

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Sheet: 21 OF 24

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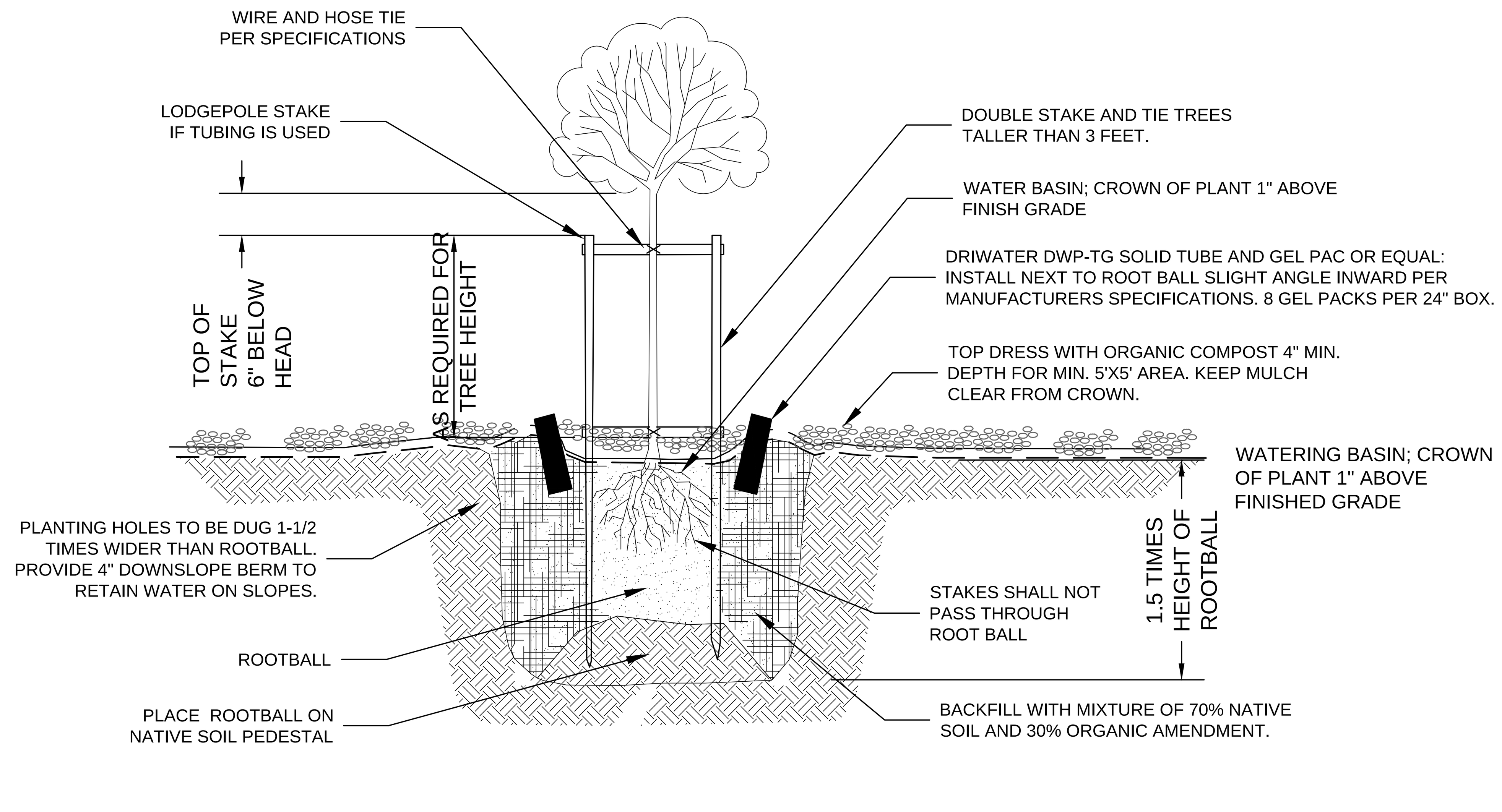
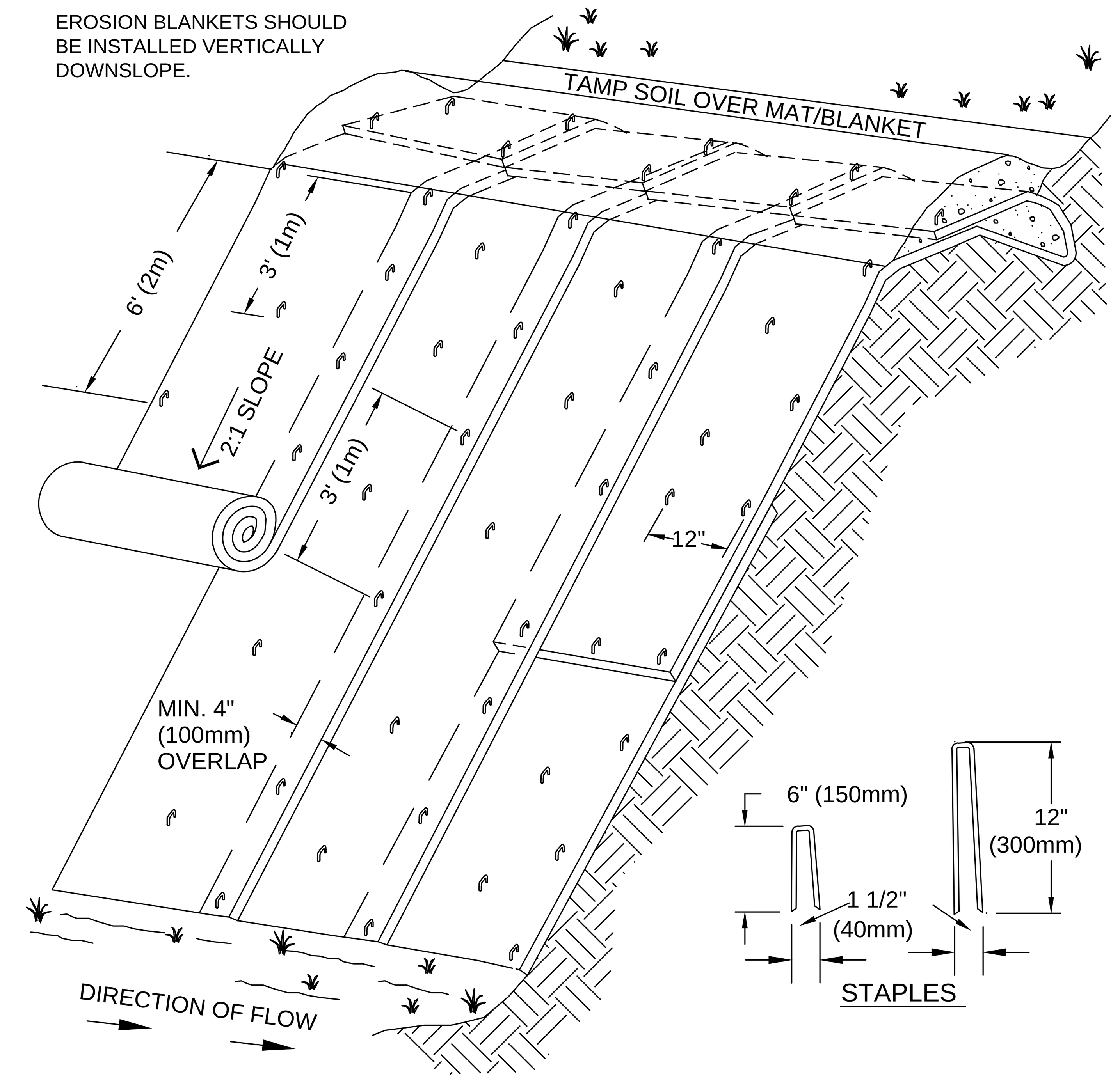
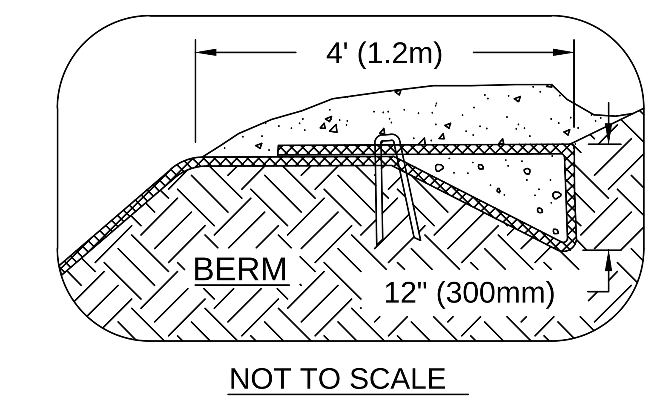


1 **TREE PLANTING**
TREE POTS
NTS

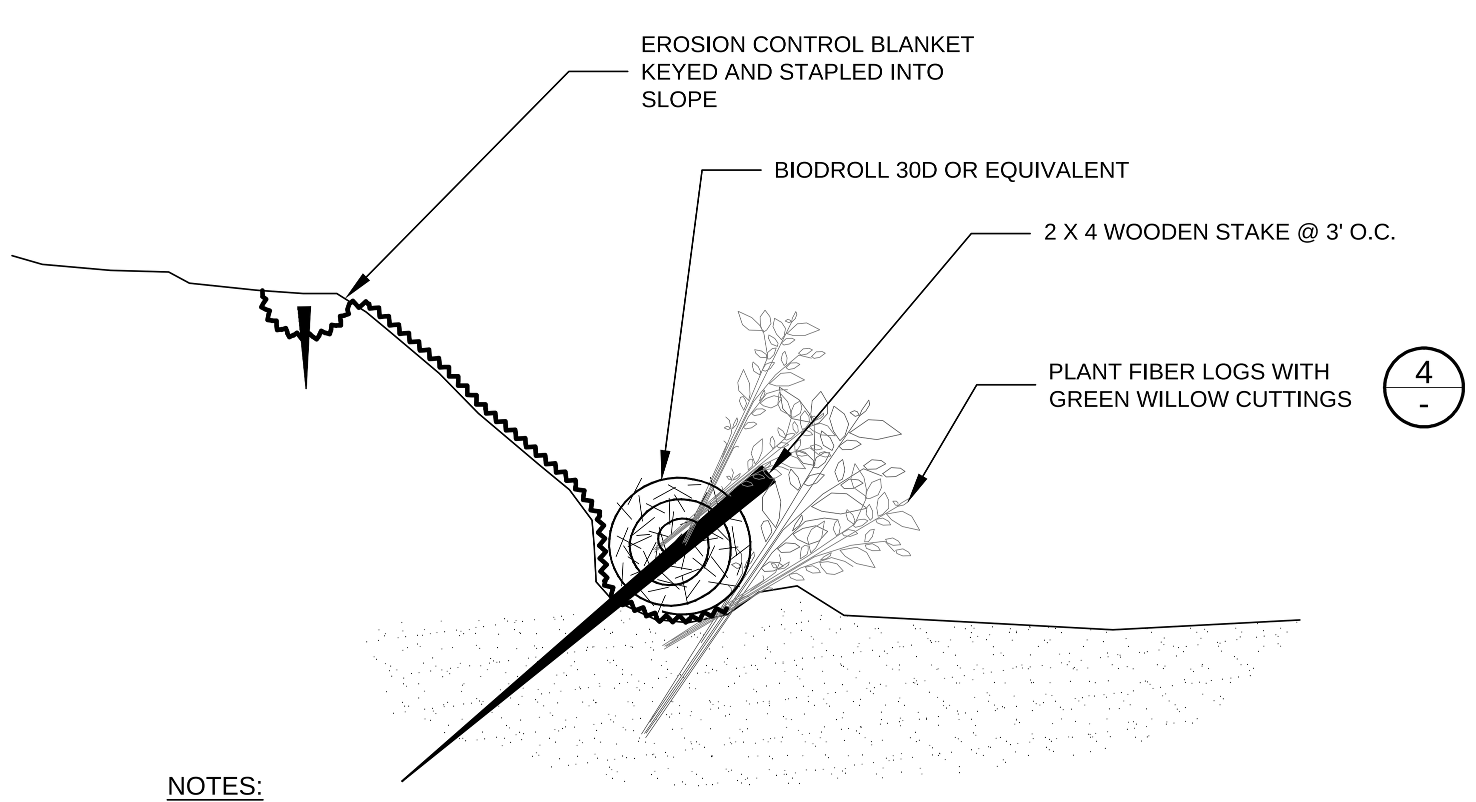




NOTES:

1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS. MATS/ BLANKETS SHALL HAVE GOOD SOIL CONTACT.
2. APPLY PERMANENT SEEDING BEFORE PLACING BLANKETS.
3. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH THE SOIL. DO NOT STRETCH.

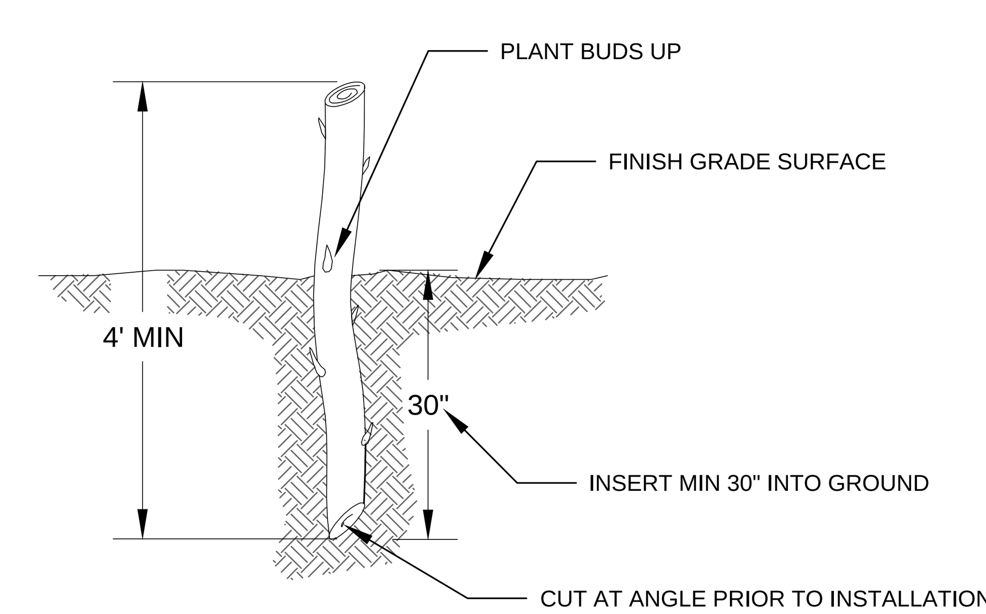
2 **EROSION CONTROL FABRIC**
NTS



NOTES:

1. PLANT GREEN WILLOW AT 3-FT O.C.
2. USE LIVE WILLOW STAKES 0.5 TO 2-INCHES THICK AND ± 5-FT LONG.

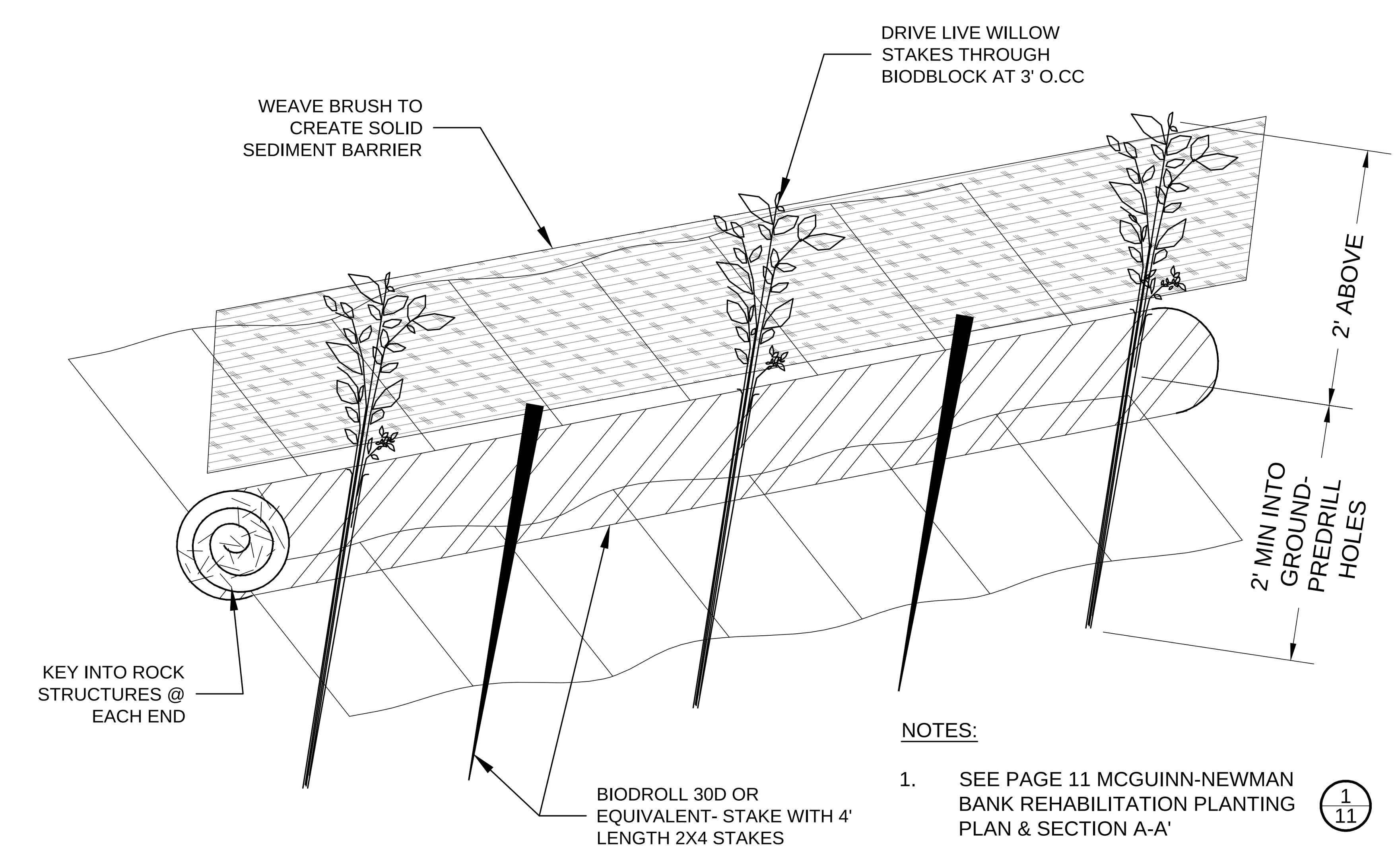
3 **BIOLOG STAKING**
NTS



NOTES:

1. WILLOW STAKE SPECIES SHALL BE A MIX OF SPECIES PRESENT AT AND ADJACENT TO THE WORK SITE INCLUDING: SALIX LASIANDRA, VAR. LASIANDRA (PACIFIC WILLOW), SALIX LASIOLEPIS (ARROYO WILLOW), AND SALIX SITCHENSIS (SITKA WILLOW).
2. EACH STAKE SHALL BE 1" - 3" THICK AT THE BOTTOM TO FACILITATE ROOT GROWTH AFTER TREATMENT WITH ROOTING HORMONE
3. INSERT MIN 30" INTO GROUND
4. INSTALL STAKES CONCURRENTLY WITH ROCK AND LOG STRUCTURES AND THEN BACKFILL WITH NATIVE SOIL TO PROMOTE ROOTING

4 **WILLOW STAKE PLANTING**
NTS



NOTES:

1. SEE PAGE 11 MCGUINN-NEWMAN BANK REHABILITATION PLANTING PLAN & SECTION A-A' (1/11)

5 **WILLOW FENCE DETAIL**
NTS

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Date:	2-23-2016
Sheet:	22 OF 24

SNYDER-STANGER HABITAT ENHANCEMENT FEATURES

Feature Number	Total Pieces of Wood (#)	Individual Pieces of Wood Reference Number	Length (ft)	Width (ft)	Tree with Rootwad	Total Weight of Boulder Required (tons)
1	2	1A	25	2	Yes	13.6
		1B	Rootwad		N/A	
2	2	2A	30	2	No	4.9
		2B	30	2	No	
3	4	3A	20	2	Yes	14.0
		3B	30	2	No	
		3C	20	2	Yes	
		3D	20	2	No	
4	6	4A	25	2	Yes	18.1
		4B	25	2	Yes	
		4C	40	2	No	
		4D	25	2	Yes	
		4E	Rootwad		N/A	
		4F	30	2	No	
5	2	5A	25	2	Yes	3.4
		5B	30	2	No	
6	2	6A	30	2	No	3.0
		6B	20	2	No	
Total	18					57.0

NOTES:

1. FOR PLAN VIEW LAYOUT OF FEATURES, SEE DET 2/-
2. EVERY WOOD COMPONENT WITHIN EACH FEATURE SHALL BE ANCHORED TO THE REST OF THE FEATURE AND TO THE TOTAL WEIGHT OF BOULDERS REQUIRED AS LISTED IN TABLES ABOVE SO THAT CONTINUITY OF ANCHORAGE WITHIN EACH FEATURE IS ACHIEVED AND ENTIRE FEATURE WILL RESIST MOVEMENT AS ONE UNIT.

MCGUINN-NEWMAN BANK REHABILITATION FEATURES

Feature Number	Total Pieces of Wood (#)	Individual Pieces of Wood Reference Number	Length (ft)	Width (ft)	Tree with Rootwad	Total Weight of Boulder Required (tons)
7	2	7A	40	2	No	0.0
		7B	40	2	No	
8	3	8A	40	2	No	2.9
		8B	35	2	Yes	
		8C	rootwad		N/A	
9	3	9A	25	3	No	14.3
		9B	20	1.5	Yes	
		9C	rootwad		N/A	
10	3	10A	25	3	No	14.3
		10B	20	1.5	Yes	
		10C	rootwad		N/A	
11	1	11A	35	2	Yes	2.2
18	2	18A	30	2	Yes	0.0
		18B	40	2	No	
19	2	19A	25	2	No	3.6
		19B	30	2	Yes	
20	2	20A	30	2	Yes	0.0
		20B	40	2	No	
Total	18					37.3

NOTES:

1. FOR PLAN VIEW LAYOUT OF FEATURES, SEE DET 3-4/-
2. EVERY WOOD COMPONENT WITHIN EACH FEATURE SHALL BE ANCHORED TO THE REST OF THE FEATURE AND TO THE TOTAL WEIGHT OF BOULDERS REQUIRED AS LISTED IN TABLES ABOVE SO THAT CONTINUITY OF ANCHORAGE WITHIN EACH FEATURE IS ACHIEVED AND ENTIRE FEATURE WILL RESIST MOVEMENT AS ONE UNIT.

WATSON BANK REHABILITATION FEATURES

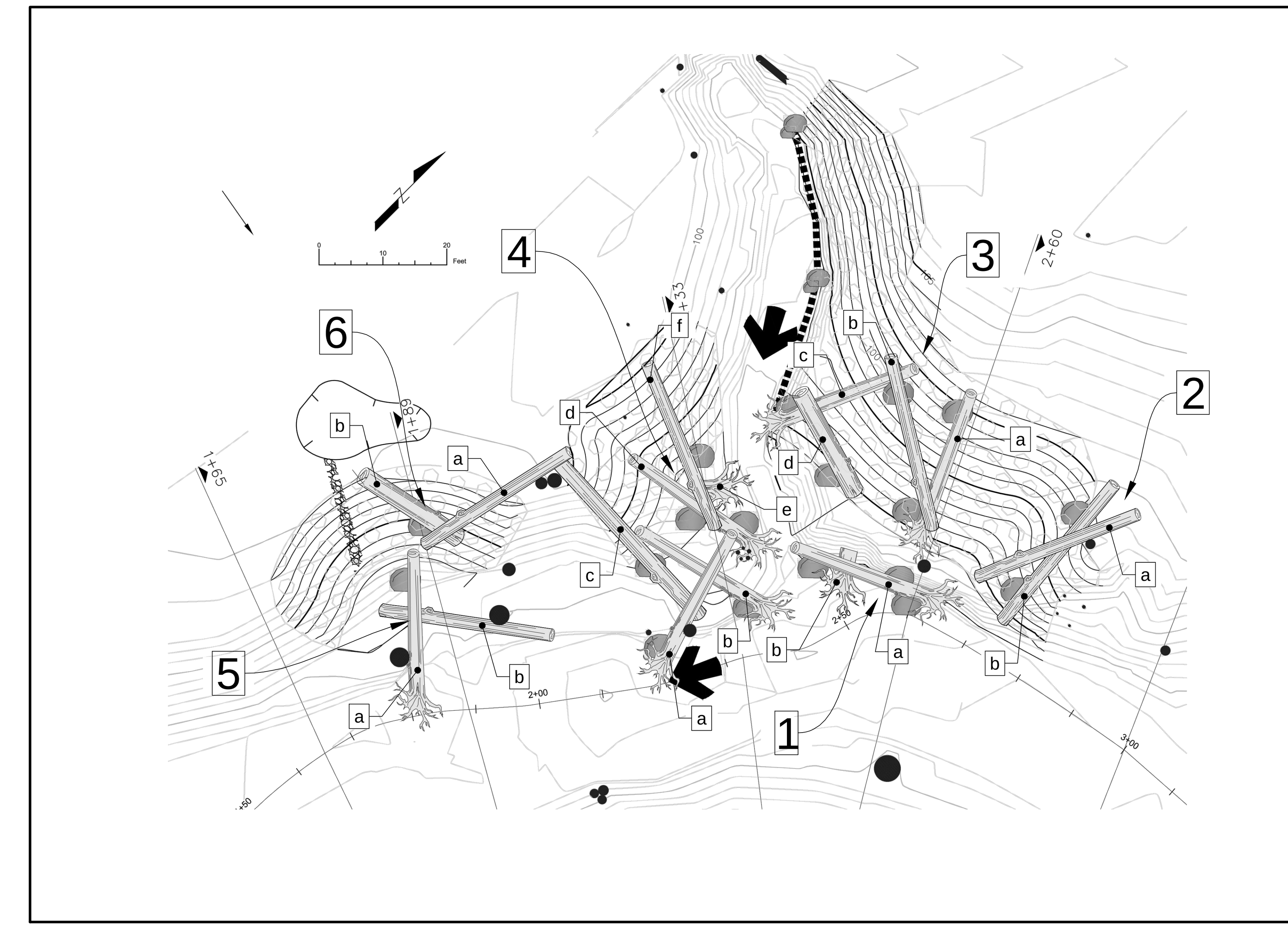
Feature Number	Total Pieces of Wood (#)	Individual Pieces of Wood Reference Number	Length (ft)	Width (ft)	Tree with Rootwad	Total Weight of Boulder Required (tons)
12	6	12A	30	2	No	21.9
		12B	40	2	No	
		12C	25	2	Yes	
		12D	25	2	Yes	
		12E	25	2	Yes	
		12F	25	2	Yes	
13	2	13A	35	2	No	6.8
		13B	35	2	No	
14	1	14A	Rootwad		N/A	2.3
15	1	15A	Rootwad		N/A	2.3
16	1	16A	Rootwad		N/A	2.3
17	2	17A	20	1.5	No	4.2
		17B	Rootwad		N/A	
Total	13					40.0

NOTES:

1. FOR PLAN VIEW LAYOUT OF FEATURES, SEE DET 5/-
2. EVERY WOOD COMPONENT WITHIN EACH FEATURE SHALL BE ANCHORED TO THE REST OF THE FEATURE AND TO THE TOTAL WEIGHT OF BOULDERS REQUIRED AS LISTED IN TABLES ABOVE SO THAT CONTINUITY OF ANCHORAGE WITHIN EACH FEATURE IS ACHIEVED AND ENTIRE FEATURE WILL RESIST MOVEMENT AS ONE UNIT.

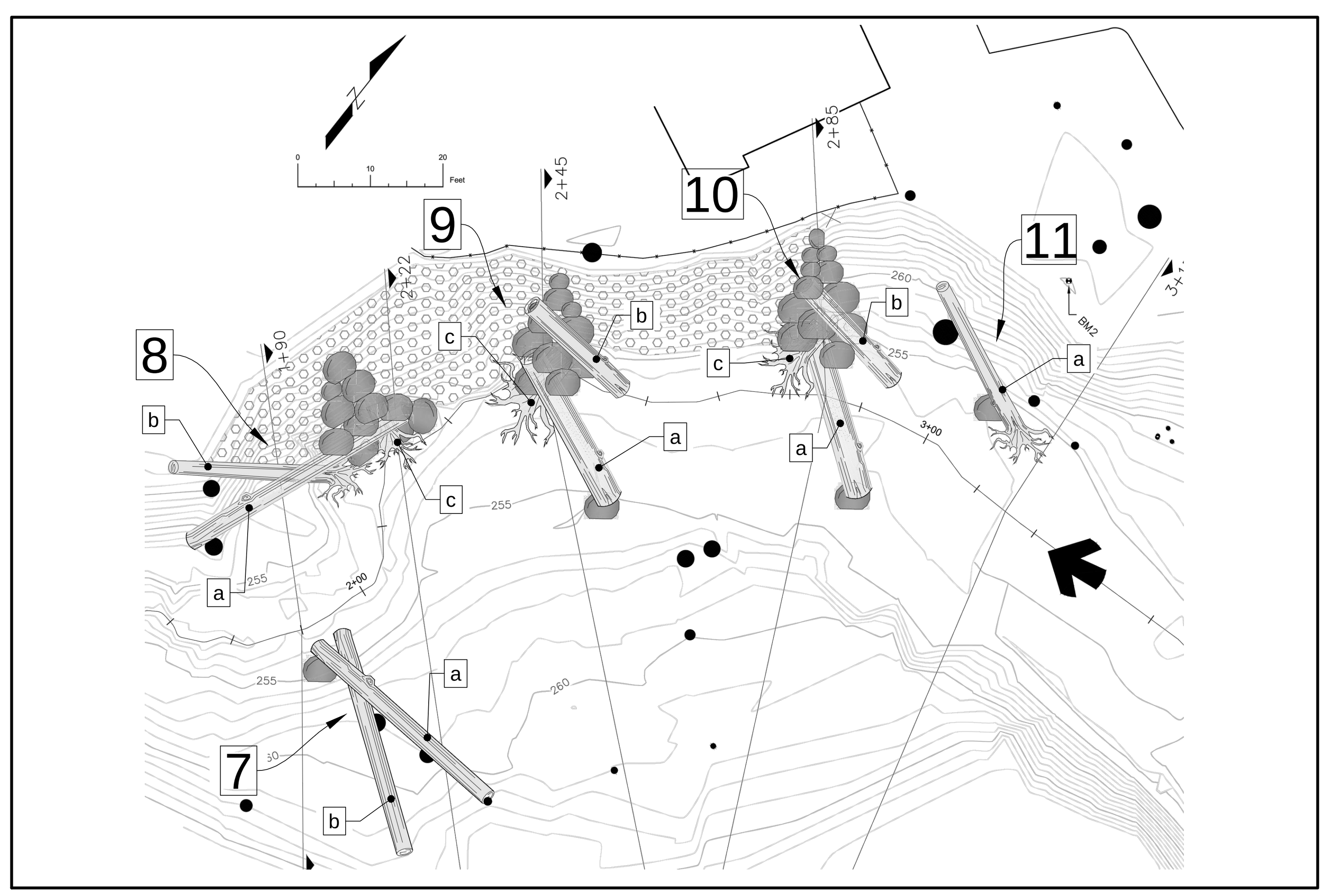
1 WOOD AND BOULDER FEATURE TABLES

NTS



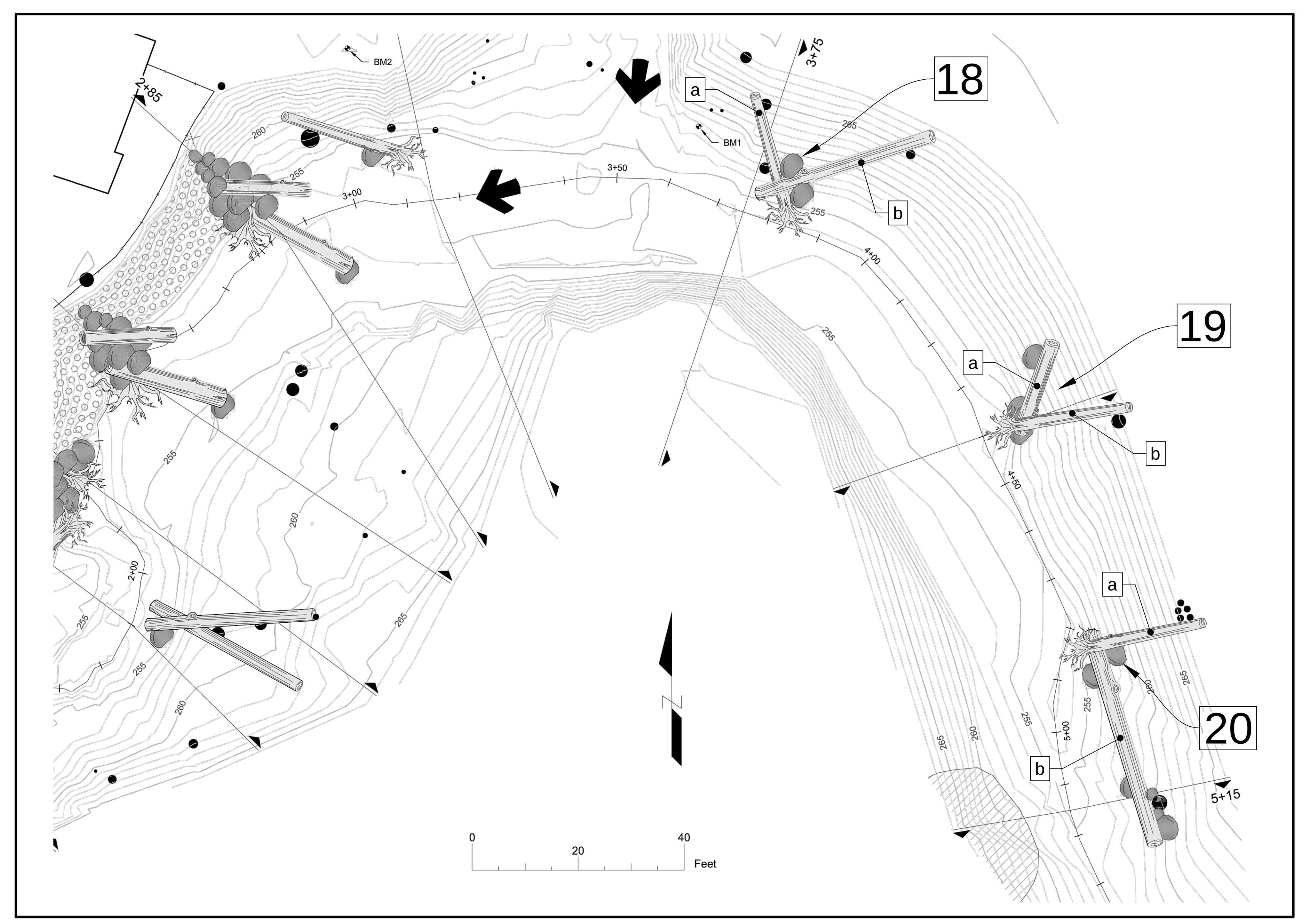
2 SNYDER-STANGER FEATURE OVERVIEW

NTS



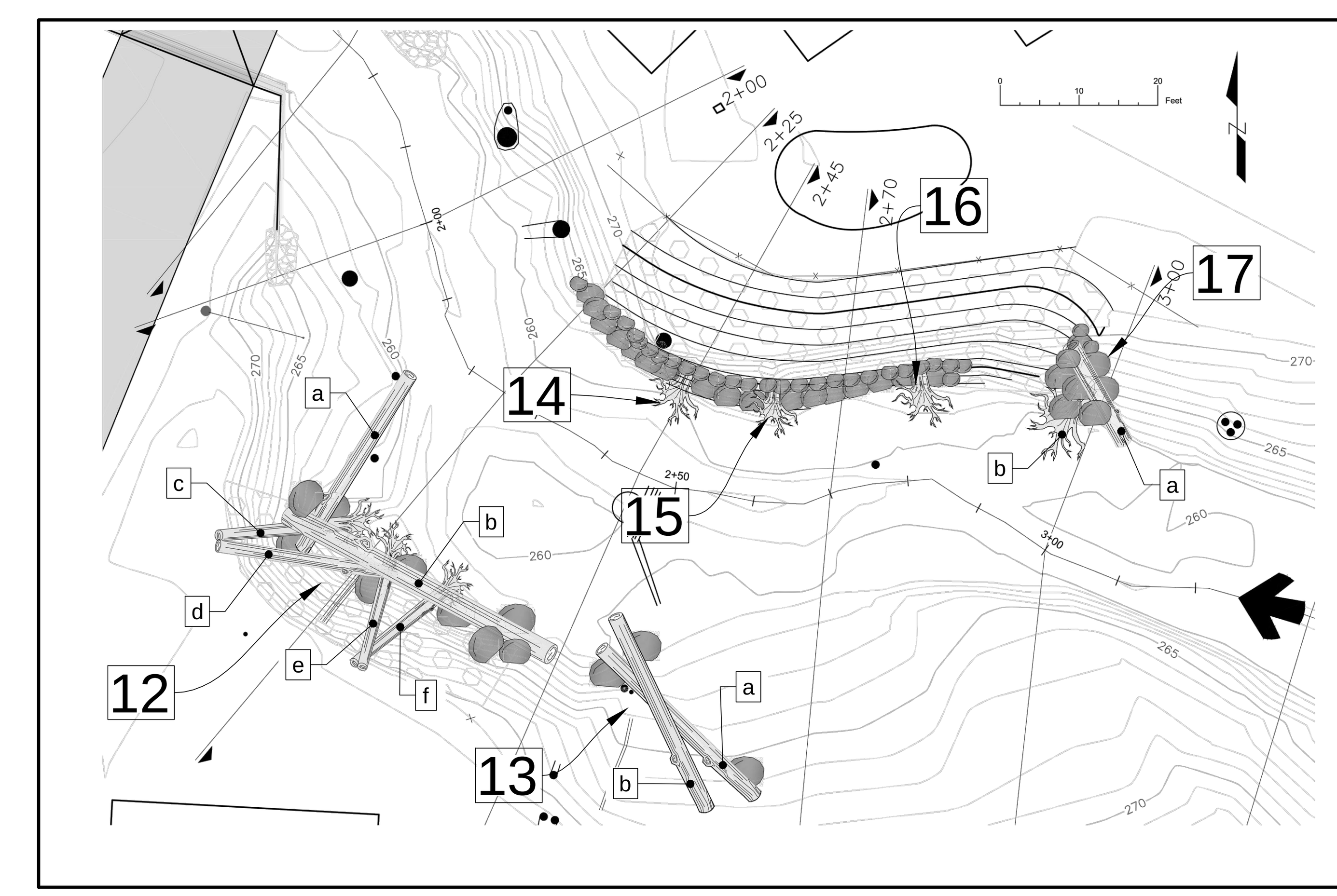
3 MCGUINN-NEWMAN FEATURE OVERVIEW

NTS



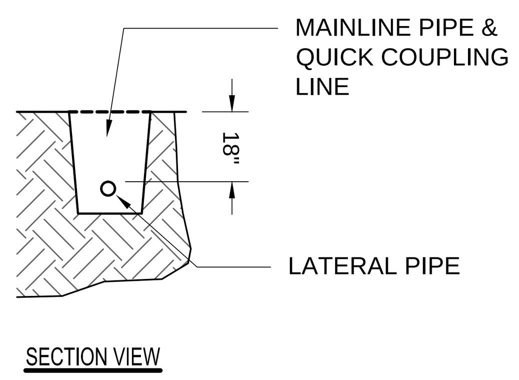
4 MCGUINN-NEWMAN UPSTREAM FEATURE OVERVIEW

NTS



5 WATSON FEATURE OVERVIEW

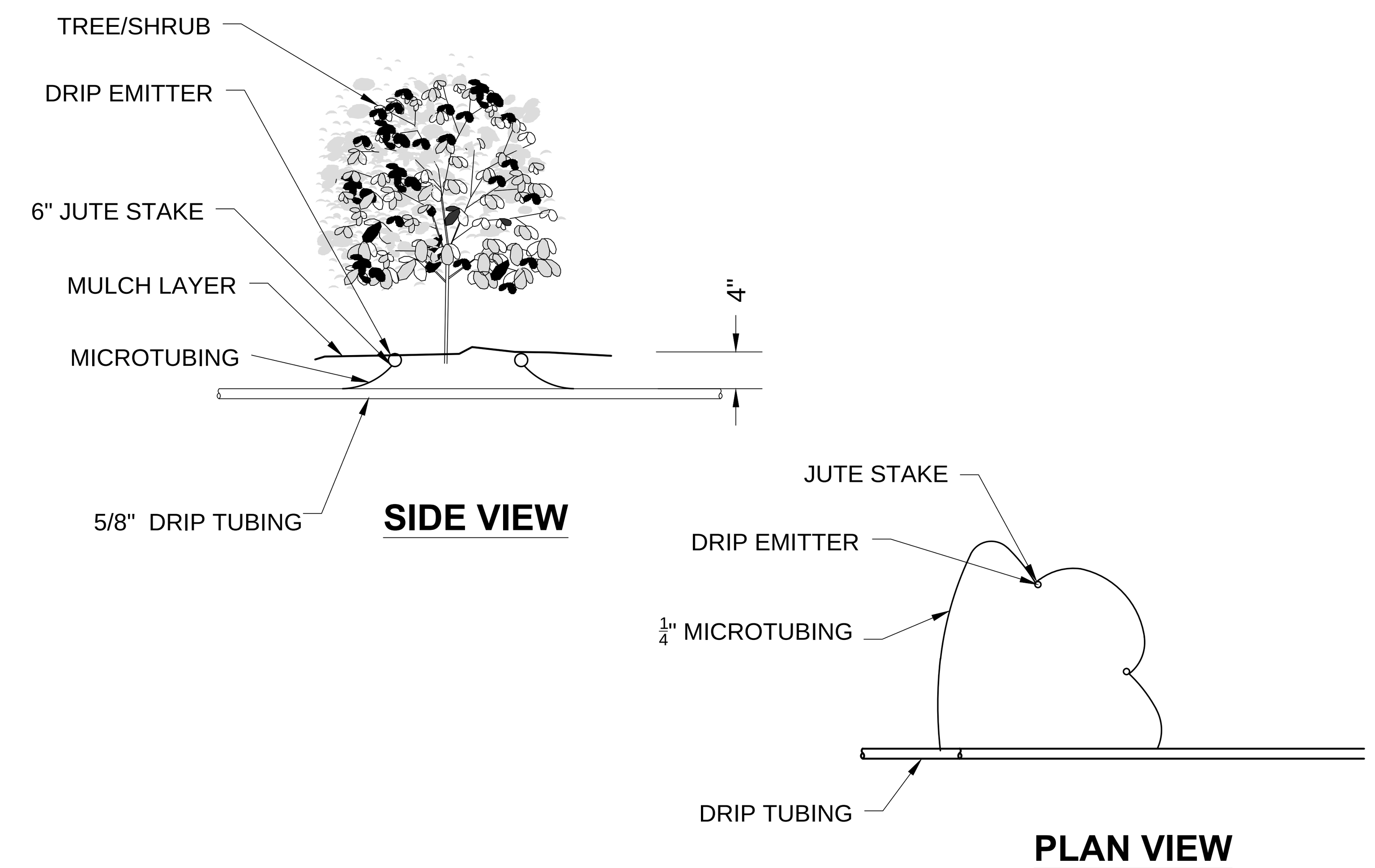
NTS



NOTES:
1. FOR PIPE AND WIRE BURIAL DEPTHS, SEE SPECIFICATIONS.
2. SCH 40 PVC FOR MAINLINE 2 INCHES OR SMALLER.
3. SCH 40 PVC FOR QUICK COUPLING LINE 1 INCH MIN. TO 2 INCH MAXIMUM
4. TRENCH BACKFILL SHALL BE NATIVE MATERIAL, COMPACT TO 90% MINIMUM, RELATIVE COMPACTION.

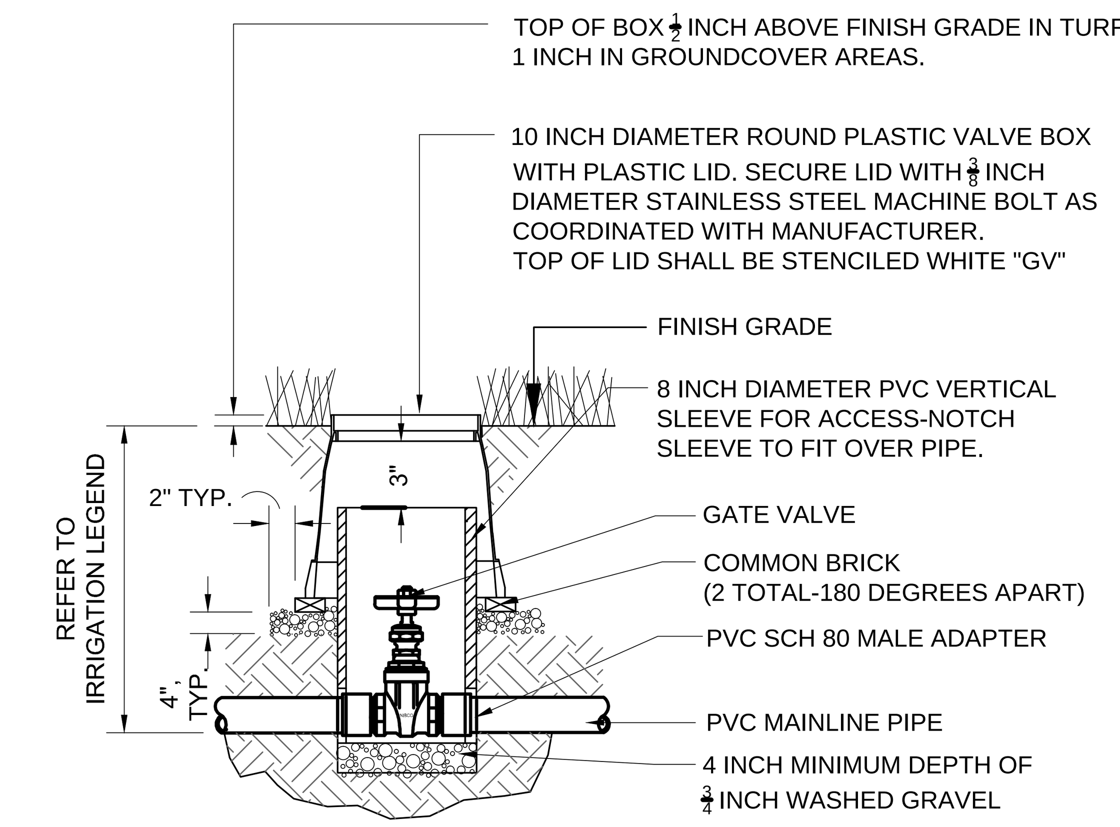
1 TRENCHING DETAILS

NTS



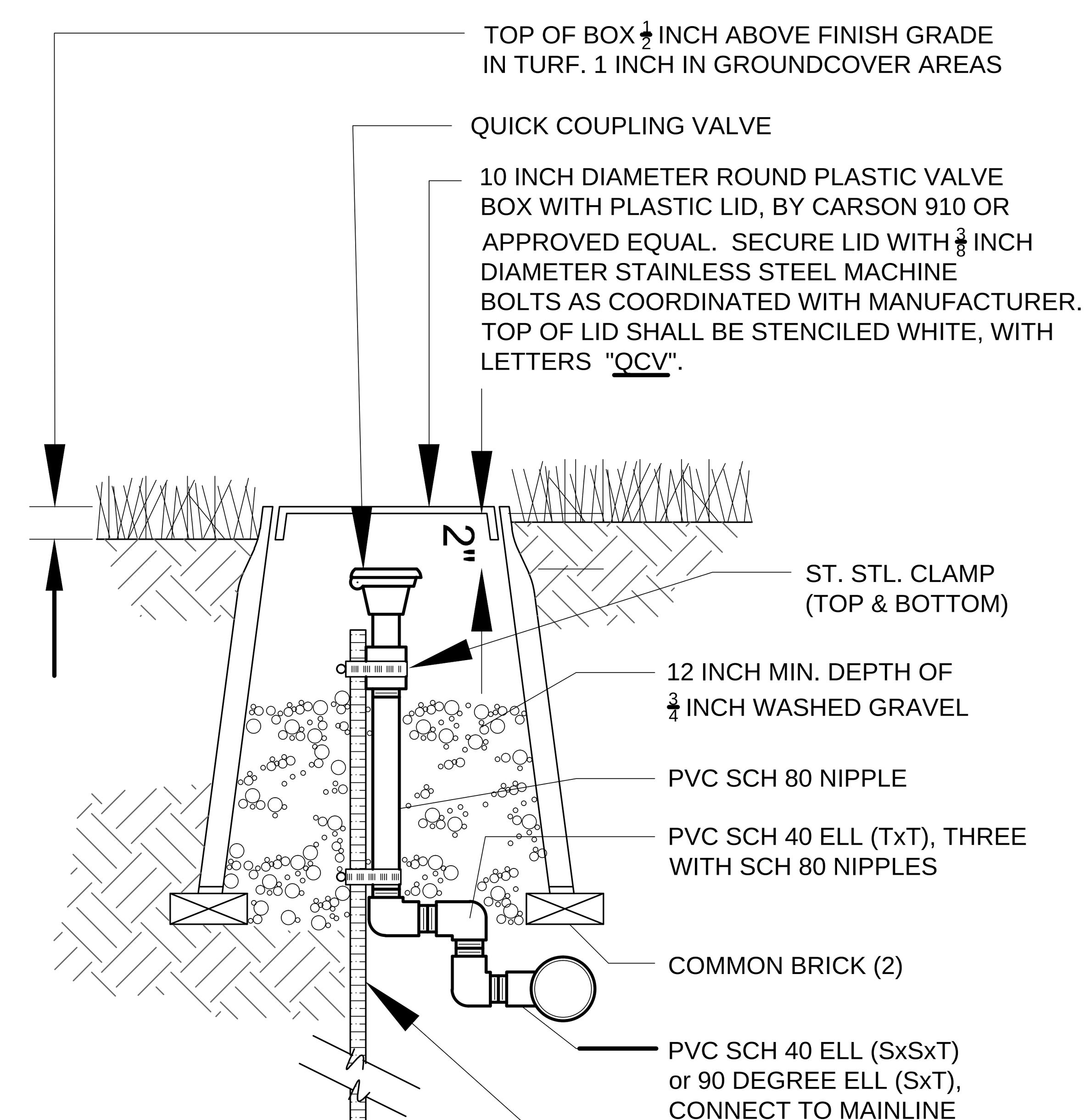
2 DRIP IRRIGATION

NTS



3 GATE VALVE DETAIL

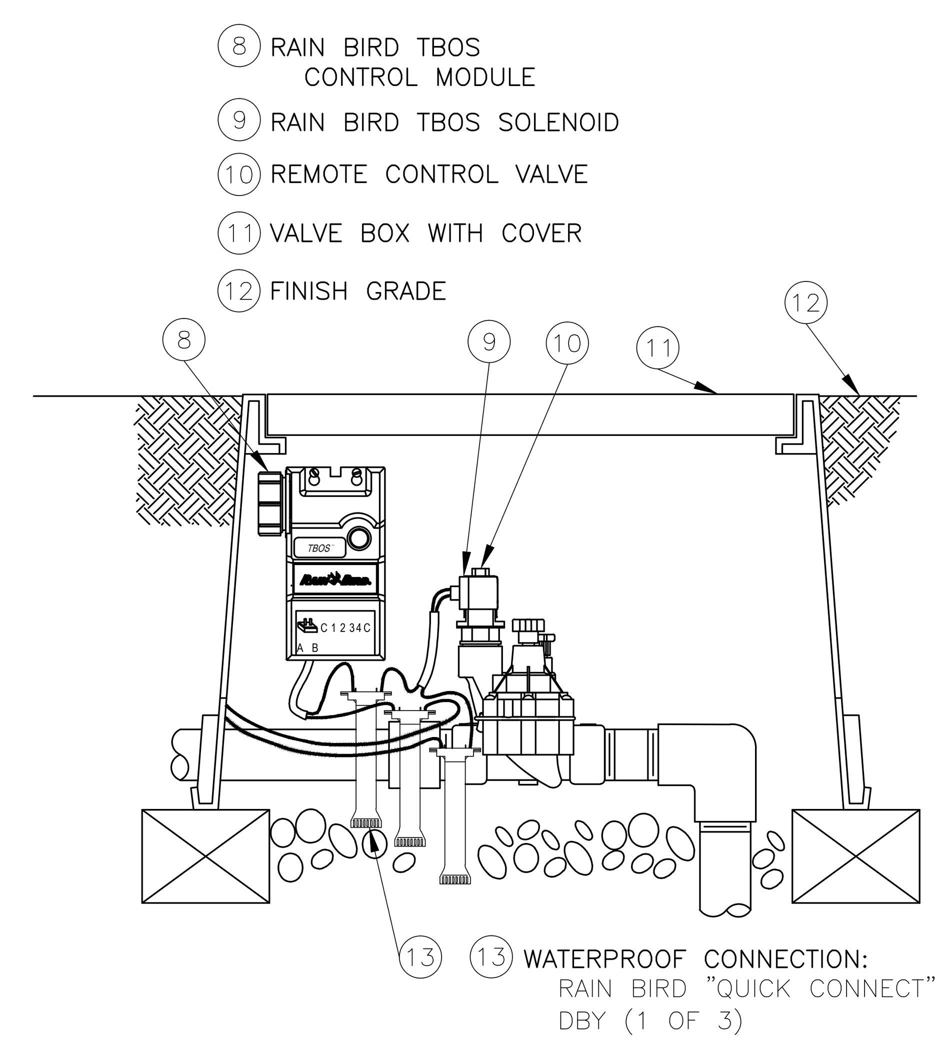
NTS



NOTE:
1. CONTRACTOR SHALL PROVIDE:
   (2) VALVE KEYS
   (2) SWIVEL HOSE-ELLS
2. ALL BOXES SHALL BE OFFSET 12 INCHES FROM ANY SIDEWALK, CURB OR HEADER.
3. REFER TO CITY STANDARD DETAIL LSD-14 FOR ALL MATERIALS

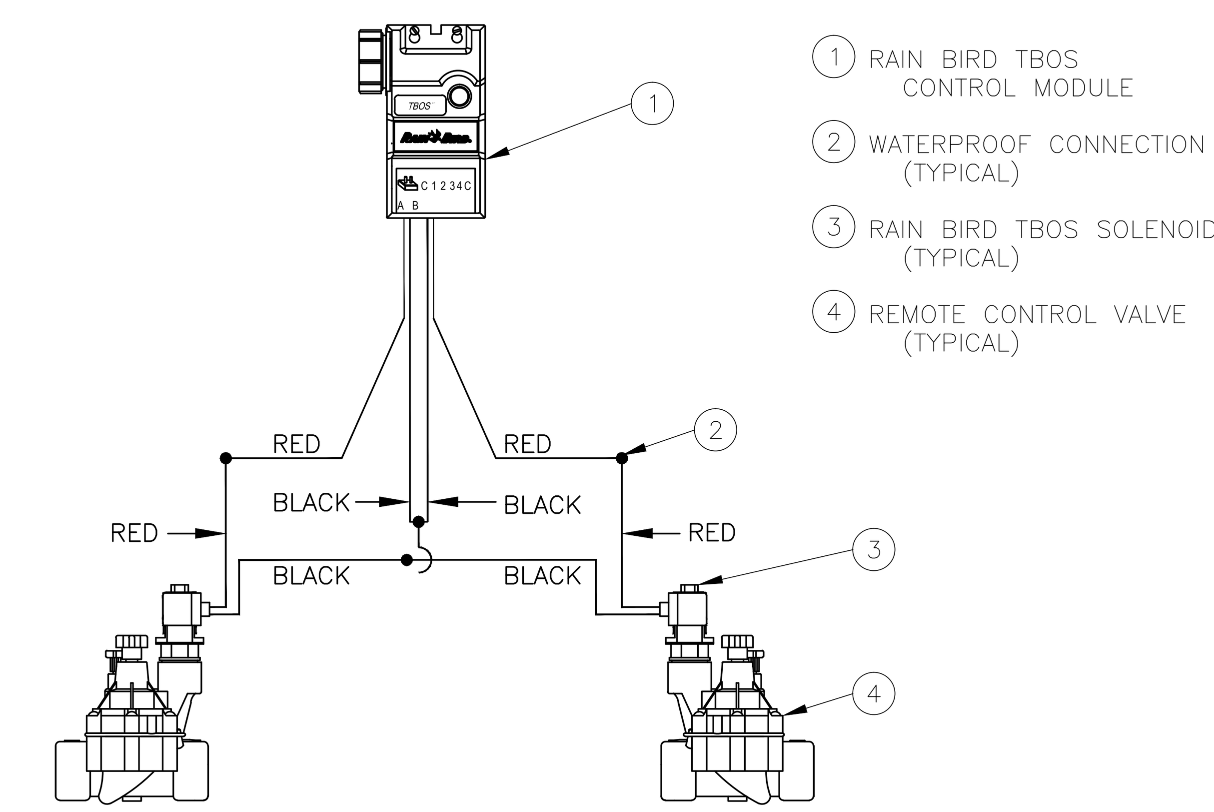
4 QUICK CONNECT FAUCET AND VALVE

NTS



5 THREE PROGRAM BATTERY OPERATED CONTROLLER

NTS



6 CONTROLLER WIRING

NTS

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IRRIGATION DETAILS

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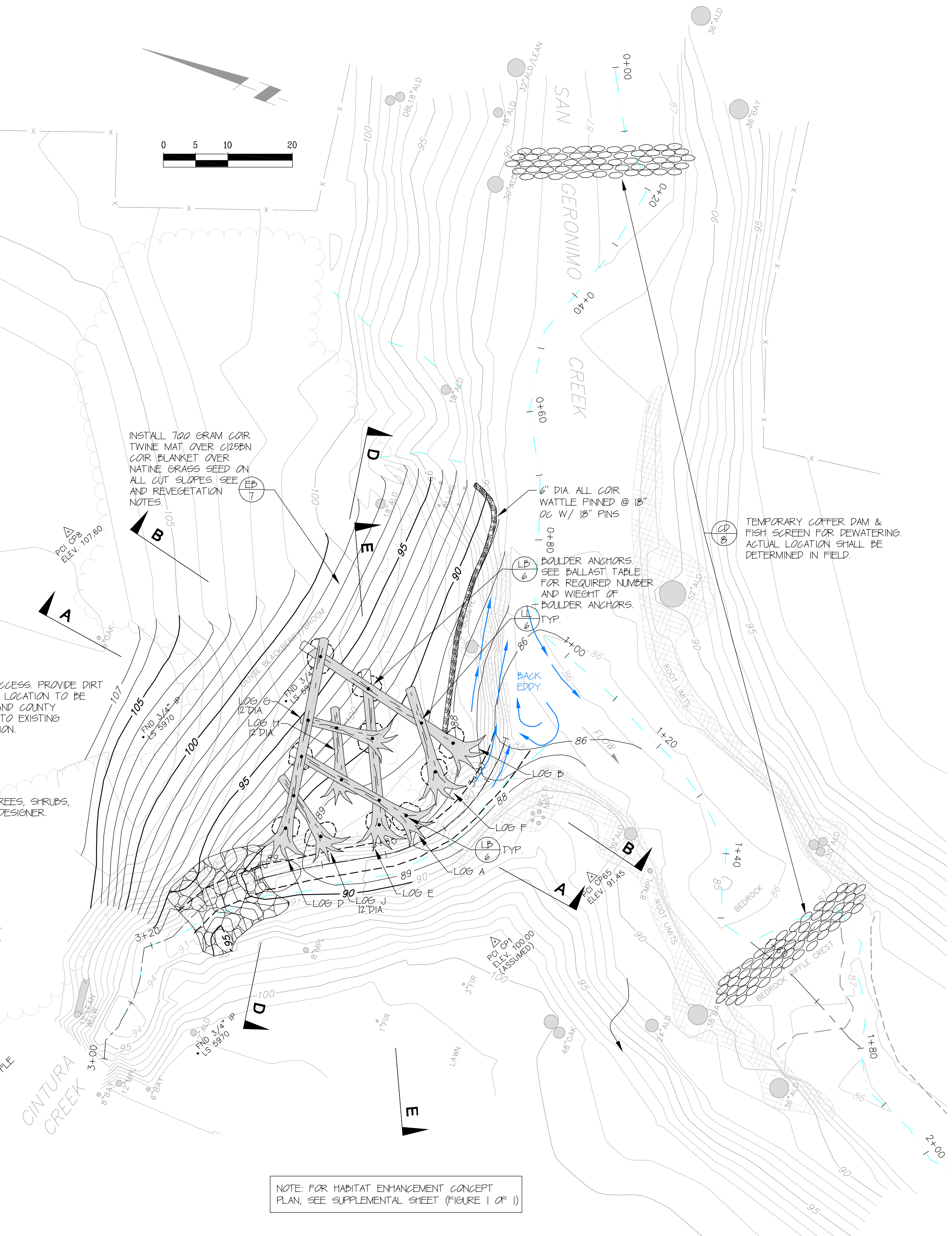
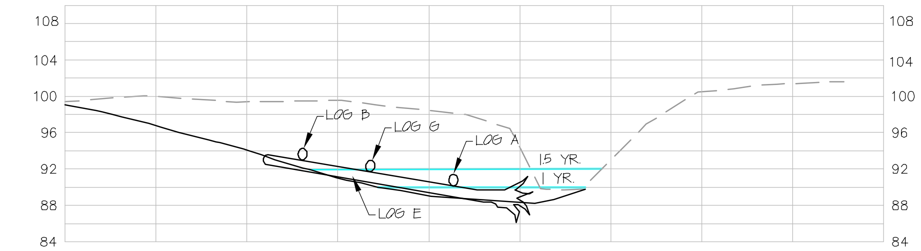
Project: 597.00
Scale: AS NOTED
Date: 2-23-2016
Sheet: 24 OF 24

Appendix B

PCI Conceptual Designs





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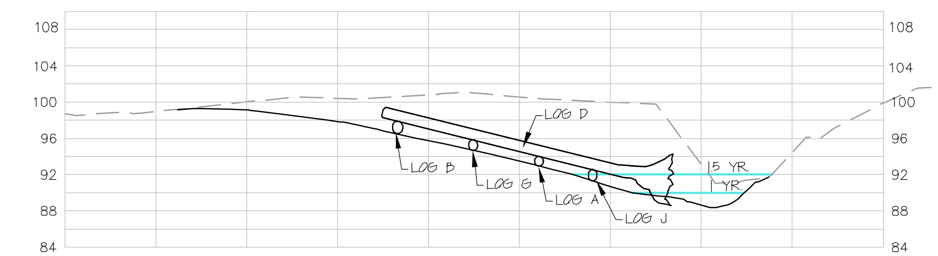

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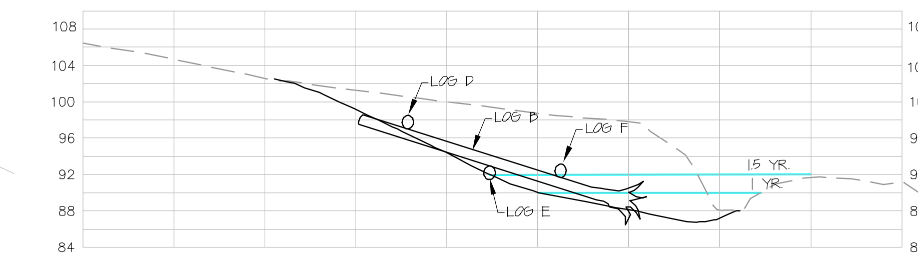

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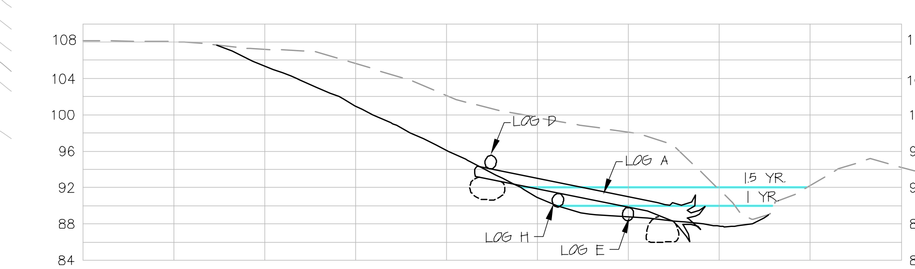
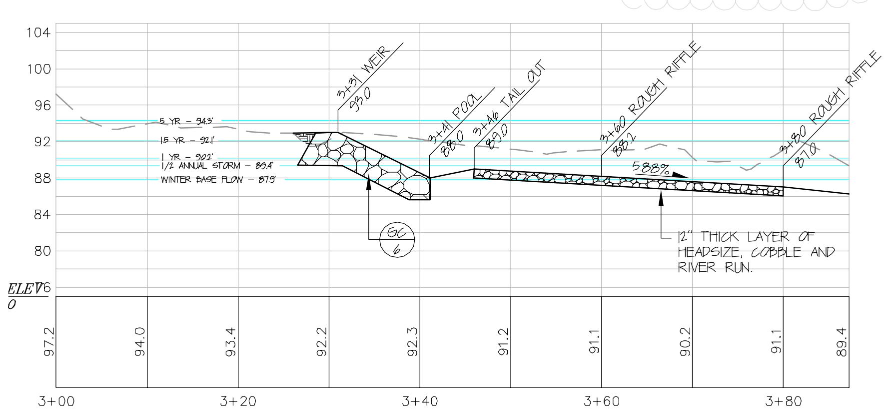


SECTION A-A

NOTE: LOG DIMENSIONS (LENGTH AND DIAMETER) SHOWN ARE APPROXIMATE. CONTRACTOR TO VERIFY ACTUAL LENGTH REQUIRED. IT IS RECOMMENDED TO ACQUIRE LOGS W/ A MIN OF 2 FEET EXTRA LENGTH TO CUT FOR FIELD FIT.



CINTURA CREEK PROFILE

INTERMEDIATE PLAN SET
FOR STUDY PURPOSES ONLY
NOT FOR CONSTRUCTION

VERIFY SCALES
ONE INCH

PRUNUSKE CHATHAM, INC.
400 MORRIS STREET, SUITE G
SEBASTOPOL, CA 95472
(707) 824-4600

DATE: MARCH 15, 2012
SCALE: AS SHOWN
DESIGNED BY: MJ, LH, SC
DRAFTED BY: JP
CHECKED BY: MJ

REVISIONS	DATE	BY

PREPARED FOR:
MARIN RESOURCE CONSERVATION DISTRICT
AND
PARTICIPATING LANDOWNERS

SAN GERONIMO VALLEY
LANDOWNER ASSISTANCE PROGRAM
SALMONID HABITAT PROJECT IMPLEMENTATION
SNYDER - PLAN. PROFILE AND SECTIONS

SHEET
3
OF 9

PROJECT GOALS:

Provide winter high flow refugia and slow water edge habitat downstream of Larsen Creek confluence. Redirect flow away from steep, eroding right bank to reduce chronic erosion.

FOR STUDY PURPOSES ONLY
NOT FOR CONSTRUCTION

VERIFY SCALES
ONE INCH

PRUNUSKE CHATHAM, INC.
400 MORRIS STREET, SUITE G
SEBASTOPOL, CA 95472
(707) 824-4600

PREPARED FOR:
MARIN COUNTY PUBLIC WORKS
SAN GERONIMO VALLEY
LANDOWNER ASSISTANCE PROGRAM

REVISIONS	DATE	BY

DATE: 12/31/12
SCALE: 1"=10'
DESIGNED BY: MJ
DRAFTED BY: MJ
CHECKED BY: LH

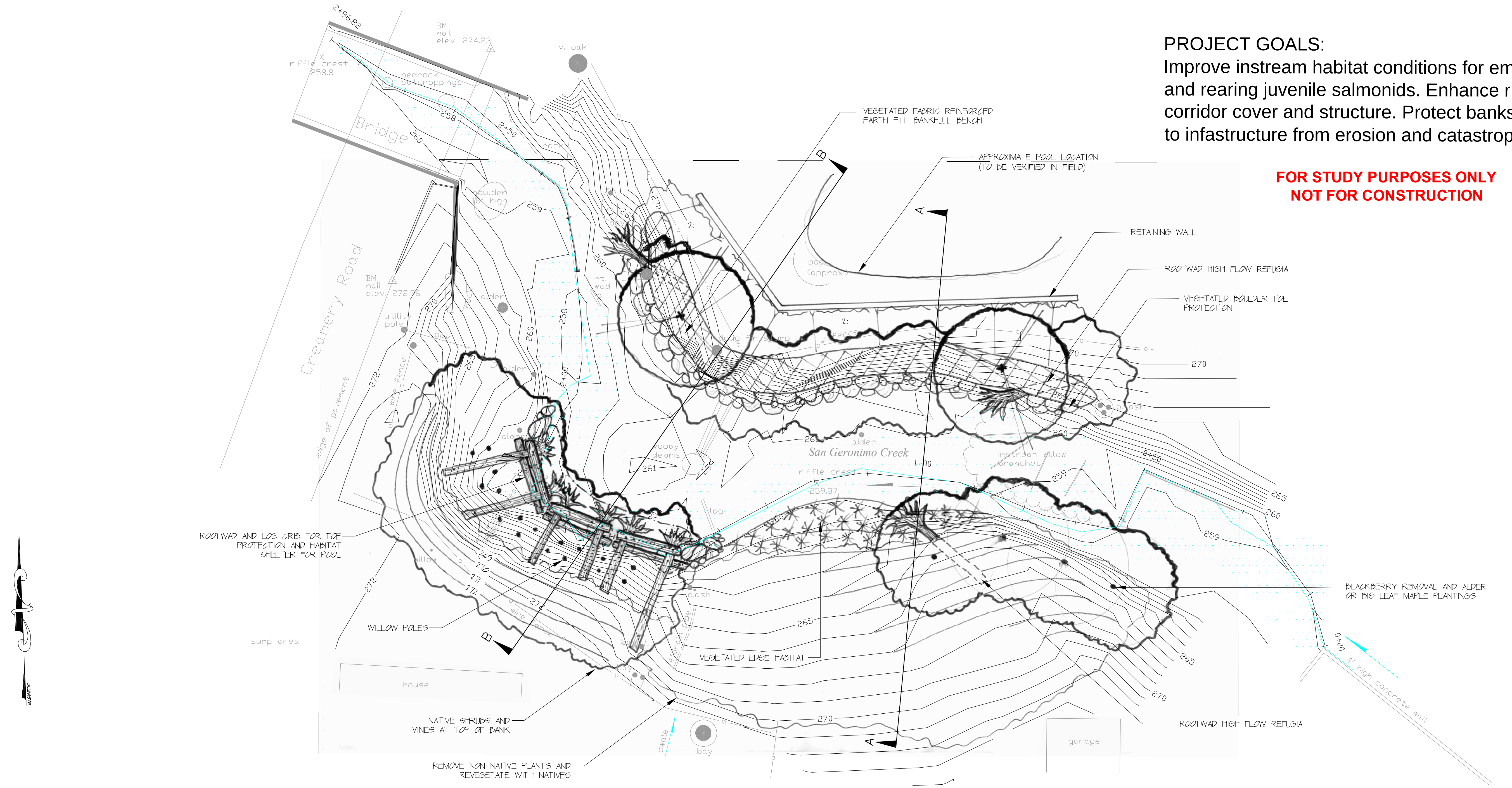
NEWMAN/MCGUIN RESIDENCE
6355 SIR FRANCIS DRAKE, SAN GERONIMO
INSTREAM HABITAT ENHANCEMENT
CONCEPTUAL DESIGN

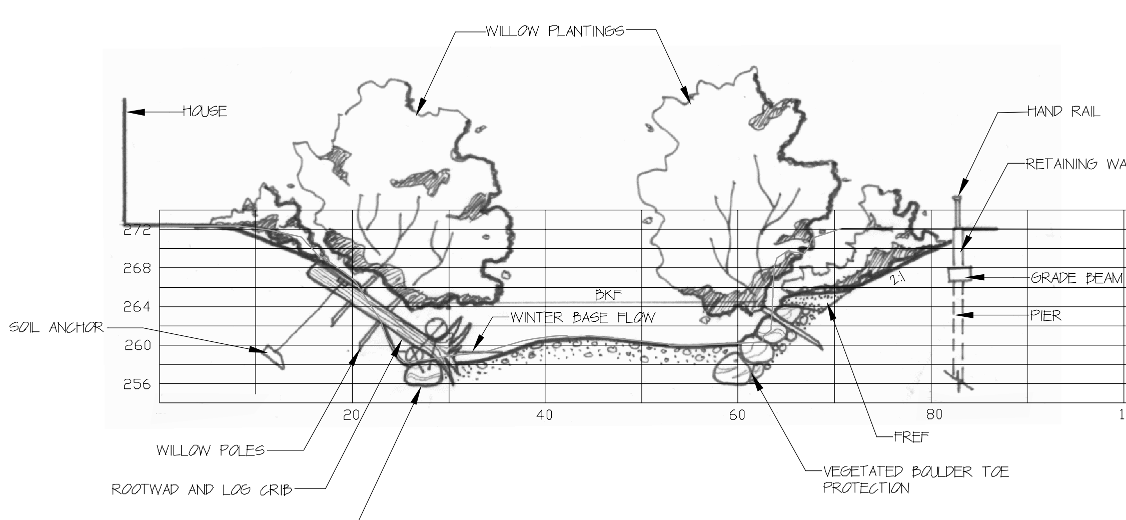
SHEET
1
OF 1

PROJECT GOALS:

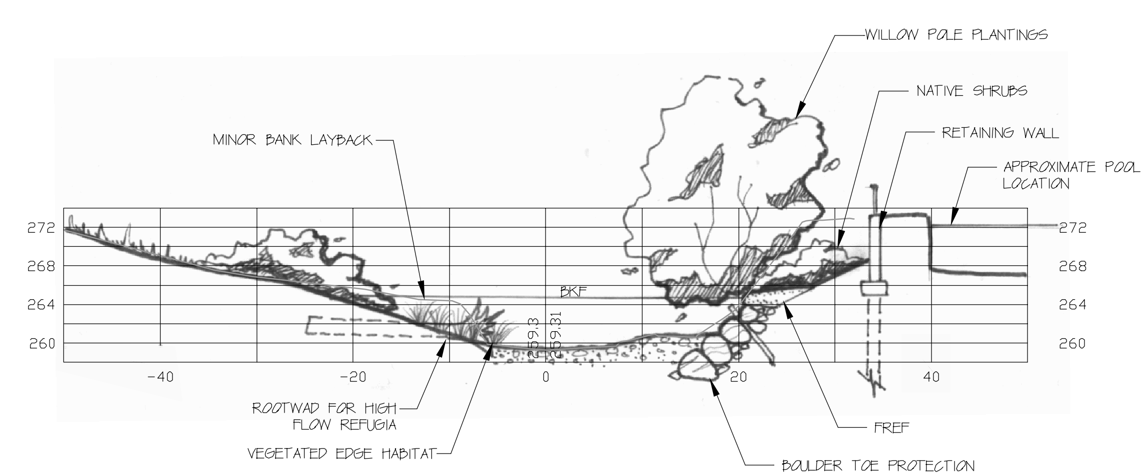
Improve instream habitat conditions for emergent and rearing juvenile salmonids. Enhance riparian corridor cover and structure. Protect banks adjacent to infastructure from erosion and catastrophic failure.

FOR STUDY PURPOSES ONLY
NOT FOR CONSTRUCTION





SECTION B



SECTION A

VERIFY SCALES
ONE INCH

PRUNUSKE CHATHAM, INC.
400 MORRIS STREET, SUITE G
SEBASTOPOL, CA 95472
(707) 824-4600

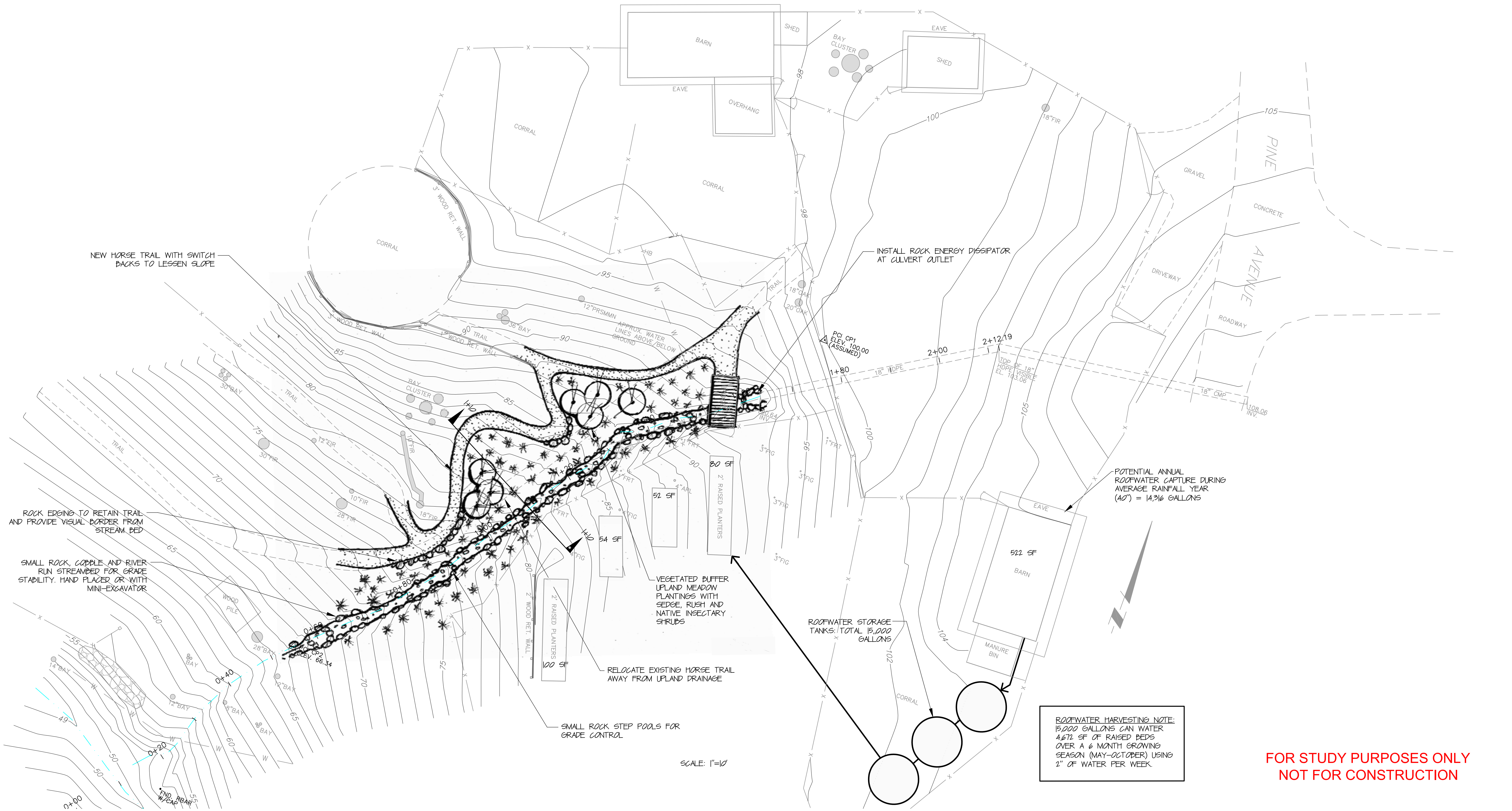
PREPARED FOR:
MARIN COUNTY PUBLIC WORKS
SAN GERONIMO VALLEY
LANDOWNER ASSISTANCE PROGRAM

REVISIONS	DATE	BY

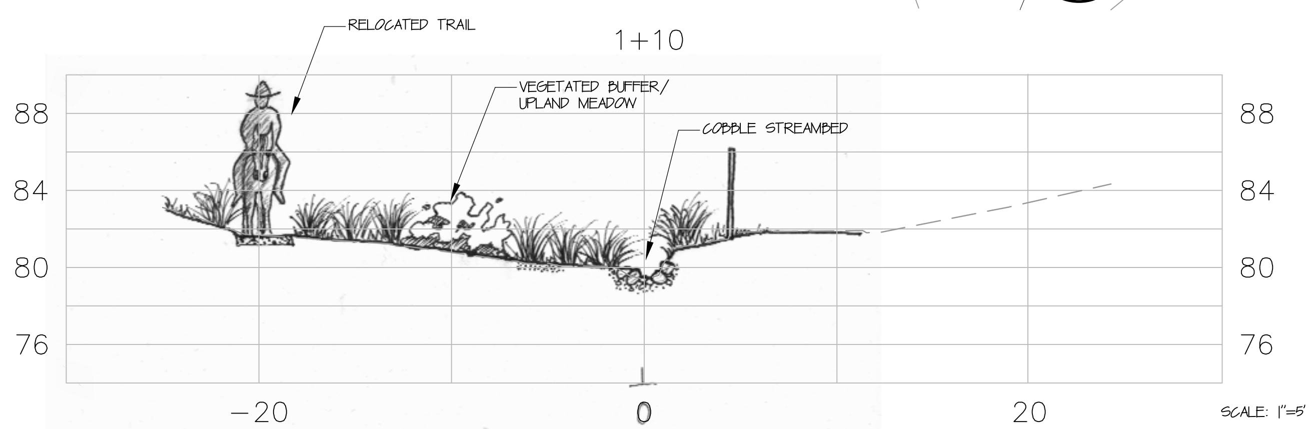
DATE: 12/31/12
SCALE: 1"=10'
DESIGNED BY: MJ
DRAFTED BY: MJ
CHECKED BY: LH

WATSON RESIDENCE
585 SAN GERONIMO VALLEY DR, SAN GERONIMO
RIPARIAN ENHANCEMENT & BANK PROTECTION
CONCEPTUAL DESIGN

SHEET
1
OF 1



FOR STUDY PURPOSES ONLY
NOT FOR CONSTRUCTION



PROJECT GOALS:

Reduce sediment and nutrient delivery to Woodacre Creek. Develop an alternative water supply for irrigation needs. Illustrate stormwater and nutrient management techniques for upland, first-order channels.

VERIFY SCALES
ONE INCH

PRUNUSKE CHATHAM, INC.
400 MORRIS STREET, SUITE G
SEBASTOPOL, CA 95472
(707) 824-4600

PREPARED FOR:
MARIN COUNTY PUBLIC WORKS
SAN GERONIMO VALLEY
LANDOWNER ASSISTANCE PROGRAM

REVISIONS	DATE	BY

DATE: 12/31/12
SCALE: AS SHOWN
DESIGNED BY: MJ
DRAFTED BY: MJ
CHECKED BY: LH

FREUND STABLES
17 LAUREL AVE, WOODACRE
STORMWATER MANAGEMENT
CONCEPTUAL DESIGN

SHEET
1
OF 1

[AutoCAD file name: G:\ACAD Drawings\MCPW San Geronimo 2011-12\Freund Site v2008\dwg\Freund-concept.dwg] [Plot Date: Jan 10, 2013 12:26pm]
[Xref files: Freund-tp] [Image files: Freund Horse Plan; Freund Horse Section; Freund Plan; Freund section; Horse Plan2; PCI_logo_for_plans.jpeg;]

Appendix C

HEC-RAS Hydraulic Model Outputs

HEC-RAS Plan: Existing River: San Geronimo Reach: Snyder

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Snyder	415	100-YR	99.01		100.89	0.007477	11.03	10.93	0.52		3.33	412.53	47.16	0.65
Snyder	415	50-YR	98.41		100.11	0.007270	10.46	10.39	0.45		3.08	384.17	47.16	0.64
Snyder	415	25-YR	97.74		99.24	0.007067	9.84	9.79	0.36		2.81	352.49	47.16	0.62
Snyder	415	10-YR	96.70		97.94	0.006871	8.94	8.93	0.14		2.46	303.61	46.42	0.61
Snyder	415	5-YR	95.69		96.73	0.006805	8.18	8.18			2.21	257.97	43.92	0.59
Snyder	415	2-YR	93.91		94.62	0.006224	6.75	6.75			1.62	183.62	39.74	0.55
Snyder	415	BANKFULL	93.10		93.67	0.005899	6.04	6.04			1.35	152.34	37.85	0.53
Snyder	415	1/2 BF	91.48		91.85	0.006212	4.90	4.90			1.00	93.91	34.06	0.52
Snyder	415	WINTER	88.79	88.79	88.99	0.041283	3.66	3.66			1.04	10.93	26.86	1.01
Snyder	415	SUMMER	88.26	88.26	88.29	0.130301	1.50	1.50			0.36	0.25	5.48	1.25
Snyder	340	100-YR	99.02		100.33	0.003893	9.40	8.55	0.65	0.77	1.78	527.62	64.74	0.51
Snyder	340	50-YR	98.38		99.57	0.003834	8.94	8.21	0.55	0.68	1.66	486.22	63.74	0.50
Snyder	340	25-YR	97.66		98.73	0.003764	8.43	7.82	0.45	0.58	1.52	441.10	62.35	0.49
Snyder	340	10-YR	96.58		97.47	0.003636	7.62	7.21	0.34	0.41	1.34	375.95	58.49	0.47
Snyder	340	5-YR	95.54		96.27	0.003584	6.90	6.66	0.24	0.27	1.20	316.83	54.58	0.46
Snyder	340	2-YR	93.74		94.21	0.003409	5.52	5.49	0.07	0.08	0.96	225.76	46.39	0.43
Snyder	340	BANKFULL	92.92		93.29	0.003281	4.86	4.86			0.84	189.42	42.69	0.41
Snyder	340	1/2 BF	91.32		91.53	0.002404	3.63	3.63			0.50	126.87	35.22	0.34
Snyder	340	WINTER	88.65		88.66	0.000252	0.82	0.82			0.03	49.05	23.89	0.10
Snyder	340	SUMMER	87.49		87.49	0.000000	0.02	0.02			0.00	24.06	19.41	0.00
Snyder	300	100-YR	98.02		100.05	0.007011	11.62	10.75	0.60	0.99	2.70	419.49	62.22	0.68
Snyder	300	50-YR	97.49		99.31	0.006739	10.95	10.26	0.69	0.85	2.61	388.96	57.07	0.66
Snyder	300	25-YR	96.88		98.48	0.006540	10.27	9.73	0.60	0.70	2.42	354.53	54.50	0.64
Snyder	300	10-YR	95.93		97.24	0.006235	9.23	8.89	0.44	0.51	2.13	304.76	50.89	0.61
Snyder	300	5-YR	94.97		96.05	0.006213	8.36	8.19	0.30	0.36	1.93	257.74	47.46	0.59
Snyder	300	2-YR	93.28		94.00	0.006357	6.82	6.81	0.09	0.08	1.59	182.05	42.22	0.57
Snyder	300	BANKFULL	92.50		93.09	0.006511	6.13	6.13			1.42	149.96	40.31	0.56
Snyder	300	1/2 BF	90.94		91.35	0.007674	5.12	5.12			1.13	89.76	36.63	0.58
Snyder	300	WINTER	88.36	88.36	88.60	0.041495	3.89	3.89			1.14	10.28	23.03	1.03
Snyder	300	SUMMER	87.43	87.43	87.48	0.063677	1.90	1.90			0.43	0.19	1.71	1.00
Snyder	260.04	100-YR	97.43		99.71	0.008640	12.22	11.53	0.75	0.63	3.11	391.00	58.01	0.70
Snyder	260.04	50-YR	97.05		99.00	0.007804	11.30	10.79	0.71	0.58	2.90	369.68	52.31	0.66
Snyder	260.04	25-YR	96.54		98.20	0.007098	10.38	10.02	0.60	0.46	2.60	344.33	49.05	0.62
Snyder	260.04	10-YR	95.71		96.98	0.006191	9.07	8.87	0.48	0.30	2.20	305.51	44.44	0.57
Snyder	260.04	5-YR	94.79		95.79	0.005727	8.03	7.94	0.31	0.12	1.87	265.76	42.23	0.54
Snyder	260.04	2-YR	93.15		93.75	0.004742	6.19	6.19	0.06		1.31	200.32	38.13	0.47
Snyder	260.04	BANKFULL	92.39		92.84	0.004166	5.35	5.35			1.03	171.95	36.78	0.44
Snyder	260.04	1/2 BF	90.88		91.11	0.003119	3.89	3.89			0.60	118.37	33.76	0.37
Snyder	260.04	WINTER	88.12		88.13	0.000436	0.95	0.95			0.04	42.26	24.10	0.13
Snyder	260.04	SUMMER	87.06		87.06	0.000001	0.02	0.02			0.00	17.93	21.21	0.00
Snyder	232.77	100-YR	96.66	96.48	99.39	0.011816	13.84	11.87	1.28	1.80	3.63	379.82	70.89	0.83
Snyder	232.77	50-YR	96.07	95.73	98.67	0.012239	13.42	11.77	1.24	1.65	3.64	338.94	65.07	0.84
Snyder	232.77	25-YR	95.42	95.21	97.87	0.012620	12.88	11.54	1.17	1.39	3.54	298.85	60.68	0.84
Snyder	232.77	10-YR	94.49	93.99	96.65	0.013072	11.97	11.11	0.88	0.89	3.26	244.01	55.62	0.83

HEC-RAS Plan: Existing River: San Geronimo Reach: Snyder (Continued)

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Snyder	232.77	5-YR	93.73	93.11	95.49	0.012416	10.72	10.27	0.58	0.69	3.02	205.52	47.44	0.80
Snyder	232.77	2-YR	92.45		93.51	0.010498	8.29	8.26	0.13	0.14	2.34	150.08	37.29	0.70
Snyder	232.77	BANKFULL	91.85		92.64	0.009118	7.13	7.13			1.93	129.08	33.54	0.64
Snyder	232.77	1/2 BF	90.59		90.98	0.005551	5.06	5.06			1.02	90.94	26.93	0.49
Snyder	232.77	WINTER	88.10		88.12	0.000675	1.17	1.17			0.07	34.25	19.66	0.16
Snyder	232.77	SUMMER	87.06		87.06	0.000001	0.03	0.03			0.00	14.40	18.62	0.01
Snyder	188.95	100-YR	96.60		98.78	0.008740	12.02	11.34	1.17	0.87	3.34	397.85	60.42	0.75
Snyder	188.95	50-YR	96.02		98.04	0.008914	11.54	10.98	1.06	0.75	3.22	363.28	58.50	0.75
Snyder	188.95	25-YR	95.36		97.22	0.009198	11.02	10.59	0.92	0.62	3.10	325.65	56.47	0.75
Snyder	188.95	10-YR	94.39		95.99	0.009722	10.21	9.96	0.70	0.42	2.92	272.09	53.30	0.75
Snyder	188.95	5-YR	93.50		94.88	0.010394	9.44	9.33	0.49	0.23	2.76	226.21	50.37	0.75
Snyder	188.95	2-YR	91.98		93.00	0.012606	8.11	8.11	0.06		2.53	152.98	45.94	0.78
Snyder	188.95	BANKFULL	91.28		92.16	0.013034	7.52	7.52			2.29	122.42	42.03	0.78
Snyder	188.95	1/2 BF	90.04		90.62	0.012461	6.10	6.10			1.66	75.41	34.45	0.73
Snyder	188.95	WINTER	87.93		88.04	0.009174	2.56	2.56			0.42	15.60	21.13	0.53
Snyder	188.95	SUMMER	87.04	87.04	87.06	0.106110	1.04	1.04			0.20	0.36	11.95	1.06
Snyder	165	100-YR	96.42		98.57	0.008175	11.98	11.18	1.11	1.07	3.21	403.30	59.02	0.72
Snyder	165	50-YR	95.84		97.82	0.008193	11.45	10.79	0.98	0.94	3.05	369.95	57.17	0.72
Snyder	165	25-YR	95.20		96.99	0.008232	10.85	10.33	0.84	0.80	2.88	334.02	55.16	0.71
Snyder	165	10-YR	94.24		95.75	0.008316	9.92	9.60	0.62	0.60	2.62	282.40	51.93	0.70
Snyder	165	5-YR	93.36		94.62	0.008424	9.03	8.86	0.43	0.42	2.39	238.07	48.95	0.68
Snyder	165	2-YR	91.85		92.70	0.008729	7.40	7.39	0.08	0.09	1.96	167.78	43.97	0.66
Snyder	165	BANKFULL	91.17		91.85	0.008732	6.64	6.64			1.72	138.56	41.67	0.64
Snyder	165	1/2 BF	89.92		90.33	0.008139	5.17	5.17			1.16	89.03	37.45	0.59
Snyder	165	WINTER	87.83		87.89	0.003858	1.83	1.83			0.20	21.90	25.47	0.35
Snyder	165	SUMMER	86.47		86.47	0.000533	0.27	0.27			0.01	1.35	6.12	0.10
Snyder	95	100-YR	95.27	94.55	97.84	0.012109	13.05	12.46		1.76	4.49	361.90	55.07	0.84
Snyder	95	50-YR	94.66	94.00	97.08	0.012409	12.64	12.14		1.59	4.34	328.78	53.23	0.84
Snyder	95	25-YR	93.99		96.24	0.012744	12.15	11.74		1.40	4.16	293.92	51.22	0.84
Snyder	95	10-YR	93.01		94.98	0.013261	11.33	11.06		1.09	3.86	245.05	48.25	0.84
Snyder	95	5-YR	92.14		93.84	0.013709	10.49	10.33		0.79	3.54	204.22	45.63	0.84
Snyder	95	2-YR	90.68		91.89	0.014482	8.80	8.78		0.25	2.90	141.16	41.25	0.83
Snyder	95	BANKFULL	90.04		91.03	0.015098	7.99	7.99			2.60	115.19	39.31	0.82
Snyder	95	1/2 BF	88.85		89.51	0.016797	6.52	6.52			1.97	70.55	35.91	0.82
Snyder	95	WINTER	87.08	87.06	87.26	0.035661	3.41	3.41			0.90	11.74	28.62	0.94
Snyder	95	SUMMER	86.30	86.30	86.34	0.054325	1.48	1.48			0.29	0.25	2.89	0.89
Snyder	2	100-YR	94.43	93.16	96.74	0.010007	12.31	11.92	1.30		4.01	378.45	52.07	0.76
Snyder	2	50-YR	93.82	92.58	95.96	0.010008	11.81	11.48	1.15		3.80	347.44	50.73	0.76
Snyder	2	25-YR	93.16	91.95	95.10	0.010004	11.23	10.98	0.97		3.56	314.25	49.25	0.75
Snyder	2	10-YR	92.17	91.05	93.81	0.010013	10.33	10.17	0.72		3.19	266.47	47.05	0.74
Snyder	2	5-YR	91.28	90.24	92.66	0.010002	9.44	9.36	0.49		2.85	225.45	45.07	0.72
Snyder	2	2-YR	89.76	88.88	90.70	0.010011	7.77	7.77	0.09		2.22	159.62	41.70	0.70
Snyder	2	BANKFULL	89.07	88.25	89.83	0.010003	7.00	7.00			1.93	131.40	39.94	0.68
Snyder	2	1/2 BF	87.79	87.18	88.27	0.010003	5.56	5.56			1.36	82.80	36.26	0.65

HEC-RAS Plan: Existing   River: San Geronimo   Reach: Snyder (Continued)

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Snyder	2	WINTER	85.55	85.22	85.65	0.010004	2.64	2.64			0.45	15.16	21.02	0.55
Snyder	2	SUMMER	84.40	84.35	84.41	0.010014	0.66	0.66			0.06	0.56	6.22	0.39

HEC-RAS Plan: Proposed   River: San Geronimo   Reach: Snyder

Reach	River Sta	Profile	W.S. US.	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Snyder	415	100-YR	98.87		100.82	0.007847	11.20	11.11	0.53		3.45	406.04	47.16	0.66
Snyder	415	50-YR	98.26		100.02	0.007681	10.65	10.58	0.46		3.21	377.29	47.16	0.65
Snyder	415	25-YR	97.58		99.15	0.007539	10.04	10.00	0.35		2.95	345.12	47.16	0.64
Snyder	415	10-YR	96.55		97.85	0.007383	9.15	9.14	0.12		2.61	296.54	46.04	0.63
Snyder	415	5-YR	95.58		96.66	0.007162	8.33	8.33			2.30	253.37	43.68	0.61
Snyder	415	2-YR	93.87		94.59	0.006398	6.82	6.82			1.66	181.87	39.64	0.56
Snyder	415	BANKFULL	93.07		93.64	0.006064	6.10	6.10			1.38	150.91	37.76	0.54
Snyder	415	1/2 BF	91.46		91.84	0.006353	4.93	4.93			1.02	93.22	34.01	0.53
Snyder	415	WINTER	88.79	88.79	88.99	0.041283	3.66	3.66			1.04	10.93	26.86	1.01
Snyder	415	SUMMER	88.26	88.26	88.29	0.130301	1.50	1.50			0.36	0.25	5.48	1.25
Snyder	340	100-YR	98.88		100.22	0.004098	9.55	8.71	0.66	0.79	1.85	518.06	64.51	0.52
Snyder	340	50-YR	98.22		99.46	0.004068	9.11	8.38	0.56	0.70	1.73	476.09	63.51	0.52
Snyder	340	25-YR	97.49		98.61	0.004028	8.61	8.01	0.46	0.59	1.61	430.48	61.67	0.51
Snyder	340	10-YR	96.41		97.34	0.003922	7.80	7.40	0.35	0.41	1.42	366.01	57.98	0.49
Snyder	340	5-YR	95.42		96.18	0.003802	7.02	6.80	0.24	0.27	1.26	310.38	54.03	0.47
Snyder	340	2-YR	93.69		94.17	0.003525	5.58	5.55	0.06	0.07	0.99	223.35	46.16	0.43
Snyder	340	BANKFULL	92.88		93.25	0.003372	4.91	4.91			0.86	187.52	42.50	0.41
Snyder	340	1/2 BF	91.30		91.51	0.002445	3.65	3.65			0.51	126.04	35.09	0.34
Snyder	340	WINTER	88.65		88.66	0.000252	0.82	0.82			0.03	49.05	23.89	0.10
Snyder	340	SUMMER	87.49		87.49	0.000000	0.02	0.02			0.00	24.06	19.41	0.00
Snyder	300	100-YR	97.78		99.92	0.007676	11.94	11.13	0.84	1.03	3.04	405.31	58.14	0.70
Snyder	300	50-YR	97.22		99.17	0.007562	11.35	10.69	0.75	0.89	2.88	373.25	55.82	0.69
Snyder	300	25-YR	96.59		98.33	0.007406	10.67	10.17	0.63	0.74	2.68	339.38	53.39	0.67
Snyder	300	10-YR	95.66		97.08	0.007117	9.61	9.30	0.45	0.54	2.37	291.29	49.86	0.65
Snyder	300	5-YR	94.79		95.94	0.006877	8.63	8.47	0.31	0.36	2.10	249.22	46.84	0.62
Snyder	300	2-YR	93.20		93.95	0.006747	6.95	6.94	0.09	0.07	1.67	178.73	42.00	0.59
Snyder	300	BANKFULL	92.43		93.04	0.006875	6.25	6.25			1.48	147.26	40.16	0.57
Snyder	300	1/2 BF	90.90		91.32	0.008064	5.21	5.21			1.17	88.27	36.48	0.59
Snyder	300	WINTER	88.36	88.36	88.60	0.041495	3.89	3.89			1.14	10.28	23.03	1.03
Snyder	300	SUMMER	87.43	87.43	87.48	0.063677	1.90	1.90			0.43	0.19	1.71	1.00
Snyder	260.04	100-YR	98.39		99.39	0.003062	8.17	7.49	0.37	0.52	1.31	602.46	80.40	0.45
Snyder	260.04	50-YR	97.76		98.67	0.003030	7.79	7.23	0.27	0.46	1.22	551.65	78.78	0.44
Snyder	260.04	25-YR	97.06		97.87	0.002948	7.31	6.90	0.27	0.39	1.19	499.78	70.89	0.43
Snyder	260.04	10-YR	96.03		96.68	0.002797	6.55	6.31	0.24	0.29	1.07	429.66	64.27	0.41
Snyder	260.04	5-YR	95.07		95.59	0.002651	5.85	5.71	0.16	0.20	0.92	369.70	60.87	0.39
Snyder	260.04	2-YR	93.34		93.67	0.002422	4.61	4.59	0.04	0.07	0.68	269.91	54.96	0.36
Snyder	260.04	BANKFULL	92.53		92.79	0.002351	4.07	4.07		0.01	0.59	226.30	52.16	0.34
Snyder	260.04	1/2 BF	90.95		91.09	0.002051	3.10	3.10			0.38	148.28	46.28	0.31
Snyder	260.04	WINTER	88.12		88.13	0.000499	0.94	0.94			0.04	42.69	27.79	0.13
Snyder	260.04	SUMMER	87.06		87.06	0.000001	0.02	0.02			0.00	17.88	21.17	0.00
Snyder	232.77	100-YR	97.08		99.16	0.008775	12.61	9.90	0.99	2.25	2.99	455.71	77.06	0.72
Snyder	232.77	50-YR	96.43		98.43	0.009160	12.28	9.80	0.96	2.11	2.97	407.13	72.26	0.73
Snyder	232.77	25-YR	95.74		97.63	0.009489	11.83	9.61	0.94	1.91	2.89	358.89	67.64	0.73
Snyder	232.77	10-YR	94.74	94.05	96.45	0.009880	11.05	9.22	0.73	1.56	2.64	293.82	63.07	0.73

HEC-RAS Plan: Proposed River: San Geronimo Reach: Snyder (Continued)

Reach	River Sta	Profile	W.S. US.	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Snyder	232.77	5-YR	93.86	93.24	95.37	0.010138	10.24	8.80	0.51	1.17	2.36	239.73	59.18	0.73
Snyder	232.77	2-YR	92.41		93.48	0.009738	8.39	7.82	0.11	0.43	1.74	158.67	50.87	0.68
Snyder	232.77	BANKFULL	91.82		92.62	0.008495	7.22	7.01		0.22	1.51	131.27	41.64	0.62
Snyder	232.77	1/2 BF	90.59		90.98	0.005551	5.06	5.06			1.02	90.94	26.93	0.49
Snyder	232.77	WINTER	88.10		88.12	0.000675	1.17	1.17			0.07	34.25	19.66	0.16
Snyder	232.77	SUMMER	87.06		87.06	0.000001	0.03	0.03			0.00	14.40	18.62	0.01
Snyder	188.95	100-YR	96.73		98.78	0.008043	11.84	10.59	1.11	1.51	3.03	425.83	66.53	0.72
Snyder	188.95	50-YR	96.07		98.03	0.008459	11.50	10.41	1.02	1.40	2.99	383.13	64.15	0.73
Snyder	188.95	25-YR	95.38		97.21	0.008884	11.06	10.16	0.89	1.26	2.90	339.61	61.72	0.74
Snyder	188.95	10-YR	94.38		95.99	0.009552	10.34	9.70	0.68	0.99	2.74	279.29	58.08	0.75
Snyder	188.95	5-YR	93.47		94.89	0.010353	9.63	9.25	0.48	0.69	2.59	228.10	54.62	0.76
Snyder	188.95	2-YR	91.96		93.00	0.012045	8.19	8.15	0.05	0.25	2.40	152.18	45.89	0.77
Snyder	188.95	BANKFULL	91.28		92.16	0.012953	7.51	7.51			2.28	122.55	42.04	0.77
Snyder	188.95	1/2 BF	90.04		90.62	0.012462	6.10	6.10			1.66	75.41	34.45	0.73
Snyder	188.95	WINTER	87.93		88.04	0.009174	2.56	2.56			0.42	15.60	21.13	0.53
Snyder	188.95	SUMMER	87.04	87.04	87.06	0.106110	1.04	1.04			0.20	0.36	11.95	1.06
Snyder	165	100-YR	96.42		98.57	0.008175	11.98	11.18	1.11	1.07	3.21	403.30	59.02	0.72
Snyder	165	50-YR	95.84		97.82	0.008193	11.45	10.79	0.98	0.94	3.05	369.95	57.17	0.72
Snyder	165	25-YR	95.20		96.99	0.008232	10.85	10.33	0.84	0.80	2.88	334.02	55.16	0.71
Snyder	165	10-YR	94.24		95.75	0.008316	9.92	9.60	0.62	0.60	2.62	282.40	51.93	0.70
Snyder	165	5-YR	93.36		94.62	0.008424	9.03	8.86	0.43	0.42	2.39	238.07	48.95	0.68
Snyder	165	2-YR	91.85		92.70	0.008729	7.40	7.39	0.08	0.09	1.96	167.78	43.97	0.66
Snyder	165	BANKFULL	91.17		91.85	0.008732	6.64	6.64			1.72	138.56	41.67	0.64
Snyder	165	1/2 BF	89.92		90.33	0.008139	5.17	5.17			1.16	89.03	37.45	0.59
Snyder	165	WINTER	87.83		87.89	0.003858	1.83	1.83			0.20	21.90	25.47	0.35
Snyder	165	SUMMER	86.47		86.47	0.000533	0.27	0.27			0.01	1.35	6.12	0.10
Snyder	95	100-YR	95.27	94.55	97.84	0.012109	13.05	12.46		1.76	4.49	361.90	55.07	0.84
Snyder	95	50-YR	94.66	94.00	97.08	0.012409	12.64	12.14		1.59	4.34	328.78	53.23	0.84
Snyder	95	25-YR	93.99		96.24	0.012744	12.15	11.74		1.40	4.16	293.92	51.22	0.84
Snyder	95	10-YR	93.01		94.98	0.013261	11.33	11.06		1.09	3.86	245.05	48.25	0.84
Snyder	95	5-YR	92.14		93.84	0.013709	10.49	10.33		0.79	3.54	204.22	45.63	0.84
Snyder	95	2-YR	90.68		91.89	0.014482	8.80	8.78		0.25	2.90	141.16	41.25	0.83
Snyder	95	BANKFULL	90.04		91.03	0.015098	7.99	7.99			2.60	115.19	39.31	0.82
Snyder	95	1/2 BF	88.85		89.51	0.016797	6.52	6.52			1.97	70.55	35.91	0.82
Snyder	95	WINTER	87.08	87.06	87.26	0.035661	3.41	3.41			0.90	11.74	28.62	0.94
Snyder	95	SUMMER	86.30	86.30	86.34	0.054325	1.48	1.48			0.29	0.25	2.89	0.89
Snyder	2	100-YR	94.43	93.16	96.74	0.010007	12.31	11.92	1.30		4.01	378.45	52.07	0.76
Snyder	2	50-YR	93.82	92.58	95.96	0.010008	11.81	11.48	1.15		3.80	347.44	50.73	0.76
Snyder	2	25-YR	93.16	91.95	95.10	0.010004	11.23	10.98	0.97		3.56	314.25	49.25	0.75
Snyder	2	10-YR	92.17	91.05	93.81	0.010013	10.33	10.17	0.72		3.19	266.47	47.05	0.74
Snyder	2	5-YR	91.28	90.24	92.66	0.010002	9.44	9.36	0.49		2.85	225.45	45.07	0.72
Snyder	2	2-YR	89.76	88.88	90.70	0.010011	7.77	7.77	0.09		2.22	159.62	41.70	0.70
Snyder	2	BANKFULL	89.07	88.25	89.83	0.010003	7.00	7.00			1.93	131.40	39.94	0.68
Snyder	2	1/2 BF	87.79	87.18	88.27	0.010003	5.56	5.56			1.36	82.80	36.26	0.65

HEC-RAS Plan: Proposed   River: San Geronimo   Reach: Snyder (Continued)

Reach	River Sta	Profile	W.S. US.	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Snyder	2	WINTER	85.55	85.22	85.65	0.010004	2.64	2.64			0.45	15.16	21.02	0.55
Snyder	2	SUMMER	84.40	84.35	84.41	0.010014	0.66	0.66			0.06	0.56	6.22	0.39

HEC-RAS Plan: Existing   River: San Geronimo   Reach: McGuinn

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
McGuinn	515	100-YR	265.32	263.84	267.04	0.007442	10.82	9.76	1.01	1.09	2.55	296.04	48.80	0.68
McGuinn	515	50-YR	264.56	263.32	266.26	0.008327	10.70	9.81	0.98	1.04	2.64	259.88	46.32	0.70
McGuinn	515	25-YR	263.76	262.77	265.44	0.009538	10.59	9.88	0.93	0.97	2.77	223.76	43.70	0.74
McGuinn	515	10-YR	262.58	262.00	264.24	0.012103	10.41	9.97	0.83	0.82	3.03	174.46	39.85	0.80
McGuinn	515	5-YR	261.44	261.23	263.14	0.016968	10.47	10.28	0.65	0.56	3.56	131.27	36.15	0.91
McGuinn	515	2-YR	260.00	260.00	261.40	0.023173	9.50	9.50			3.76	83.19	29.77	1.00
McGuinn	515	BANKFULL	259.36	259.36	260.63	0.024542	9.05	9.05			3.54	65.20	26.14	1.01
McGuinn	515	1/2 BF	258.08	258.08	259.06	0.026934	7.95	7.95			2.99	36.49	18.96	1.01
McGuinn	515	WINTER	255.72	255.72	256.06	0.037027	4.68	4.68			1.46	5.56	8.35	1.01
McGuinn	515	SUMMER	254.84	254.84	254.88	0.071149	1.56	1.56			0.33	0.15	2.04	1.00
McGuinn	440	100-YR	265.68		266.42	0.002857	6.88	6.83		0.17	1.29	423.03	49.34	0.40
McGuinn	440	50-YR	264.93		265.61	0.002901	6.62	6.60		0.11	1.25	386.49	47.75	0.40
McGuinn	440	25-YR	264.13		264.76	0.002955	6.34	6.33		0.06	1.20	349.11	46.06	0.40
McGuinn	440	10-YR	262.97		263.50	0.002963	5.86	5.86			1.09	296.83	43.57	0.40
McGuinn	440	5-YR	261.88		262.33	0.002864	5.38	5.38			0.95	250.80	41.24	0.38
McGuinn	440	2-YR	260.06	257.28	260.36	0.002555	4.41	4.41			0.68	179.21	37.31	0.35
McGuinn	440	BANKFULL	259.27	256.77	259.51	0.002356	3.92	3.92			0.56	150.60	35.62	0.34
McGuinn	440	1/2 BF	257.75	255.78	257.88	0.001945	2.93	2.93			0.35	98.90	32.03	0.29
McGuinn	440	WINTER	255.19	253.88	255.21	0.000655	0.97	0.97			0.05	26.81	21.03	0.15
McGuinn	440	SUMMER	254.13	253.04	254.13	0.000001	0.03	0.03			0.00	8.70	12.62	0.01
McGuinn	375	100-YR	263.82		265.95	0.011436	11.71	11.60	0.54		3.98	249.21	35.98	0.77
McGuinn	375	50-YR	263.07		265.13	0.012221	11.53	11.45	0.46		4.00	222.70	34.41	0.79
McGuinn	375	25-YR	262.28		264.27	0.013159	11.31	11.26	0.35		4.02	196.21	32.76	0.80
McGuinn	375	10-YR	261.27		263.02	0.013624	10.61	10.59	0.19		3.77	164.25	30.65	0.80
McGuinn	375	5-YR	260.39		261.88	0.013674	9.78	9.78	0.03		3.42	138.02	28.81	0.79
McGuinn	375	2-YR	259.04		259.99	0.011282	7.82	7.82			2.35	101.01	25.98	0.70
McGuinn	375	BANKFULL	258.46		259.19	0.009811	6.83	6.83			1.85	86.35	24.77	0.64
McGuinn	375	1/2 BF	257.24		257.63	0.007607	5.04	5.04			1.10	57.58	22.20	0.55
McGuinn	375	WINTER	255.08		255.12	0.003140	1.71	1.71			0.17	15.16	16.17	0.31
McGuinn	375	SUMMER	254.13		254.13	0.000426	0.16	0.16			0.00	1.48	12.59	0.08
McGuinn	315	100-YR	264.51		265.25	0.002521	6.99	6.51	0.32	0.25	1.01	443.78	60.47	0.40
McGuinn	315	50-YR	263.72		264.43	0.002673	6.79	6.42	0.26	0.22	1.01	396.96	57.95	0.40
McGuinn	315	25-YR	262.89		263.55	0.002862	6.57	6.32	0.19	0.19	1.00	349.59	55.33	0.41
McGuinn	315	10-YR	261.76		262.33	0.003003	6.08	5.98	0.13	0.14	1.00	290.91	47.81	0.41
McGuinn	315	5-YR	260.75		261.23	0.003106	5.55	5.52	0.06	0.09	0.94	244.35	44.53	0.41
McGuinn	315	2-YR	259.17		259.48	0.003070	4.48	4.48		0.01	0.73	176.28	41.84	0.38
McGuinn	315	BANKFULL	258.51		258.75	0.002870	3.96	3.96			0.60	149.04	40.87	0.37
McGuinn	315	1/2 BF	257.17		257.31	0.002580	3.01	3.01			0.39	96.29	37.40	0.33
McGuinn	315	WINTER	254.80		254.85	0.007044	1.76	1.76			0.22	14.77	28.56	0.43
McGuinn	315	SUMMER	254.03	254.03	254.04	0.125270	1.00	1.00			0.19	0.24	9.69	1.11
McGuinn	285	100-YR	264.52		265.15	0.002254	6.71	5.69	0.45	0.30	0.83	508.30	80.22	0.38
McGuinn	285	50-YR	263.70		264.33	0.002507	6.66	5.74	0.42	0.29	0.85	443.87	76.45	0.40
McGuinn	285	25-YR	262.82		263.46	0.002850	6.61	5.84	0.37	0.27	0.87	378.74	72.43	0.42
McGuinn	285	10-YR	261.61		262.23	0.003368	6.42	5.91	0.25	0.21	0.87	294.54	66.89	0.44

HEC-RAS Plan: Existing River: San Geronimo Reach: McGuinn (Continued)

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
McGuinn	285	5-YR	260.56		261.12	0.003795	6.06	5.85	0.20	0.12	0.97	230.80	52.90	0.46
McGuinn	285	2-YR	258.97		259.37	0.004017	5.03	5.02	0.07		0.90	157.51	41.11	0.44
McGuinn	285	BANKFULL	258.34		258.65	0.003816	4.46	4.46			0.77	132.24	38.36	0.42
McGuinn	285	1/2 BF	257.04		257.22	0.003166	3.37	3.37			0.48	85.98	33.29	0.37
McGuinn	285	WINTER	254.66		254.70	0.003838	1.56	1.56			0.16	16.66	24.51	0.33
McGuinn	285	SUMMER	253.61	253.53	253.61	0.004386	0.45	0.45			0.03	0.54	5.81	0.26
McGuinn	245	100-YR	264.46		265.05	0.002161	6.57	5.49	0.48	0.26	0.80	526.16	81.92	0.38
McGuinn	245	50-YR	263.62		264.22	0.002447	6.57	5.57	0.44	0.25	0.81	458.20	79.82	0.39
McGuinn	245	25-YR	262.73		263.34	0.002803	6.54	5.67	0.41	0.24	0.85	389.88	74.61	0.41
McGuinn	245	10-YR	261.48		262.10	0.003416	6.43	5.79	0.31	0.22	0.88	300.73	68.52	0.44
McGuinn	245	5-YR	260.40		260.97	0.003968	6.13	5.79	0.31	0.17	0.99	233.16	54.48	0.46
McGuinn	245	2-YR	258.76		259.19	0.004766	5.28	5.24	0.08	0.06	0.93	150.76	44.87	0.48
McGuinn	245	BANKFULL	258.12		258.47	0.004822	4.74	4.74			0.90	124.38	39.03	0.47
McGuinn	245	1/2 BF	256.86		257.07	0.004391	3.69	3.69			0.60	78.70	34.12	0.43
McGuinn	245	WINTER	254.02	254.02	254.31	0.037759	4.37	4.37			1.32	5.96	10.26	1.01
McGuinn	245	SUMMER	253.13	253.13	253.16	0.071795	1.50	1.50			0.31	0.16	2.26	0.99
McGuinn	221.9	100-YR	264.46		264.98	0.001882	6.05	5.28	0.35	0.25	0.71	547.30	81.92	0.34
McGuinn	221.9	50-YR	263.63		264.14	0.002022	5.92	5.29	0.35	0.23	0.73	482.39	74.45	0.35
McGuinn	221.9	25-YR	262.76		263.24	0.002175	5.74	5.24	0.37	0.19	0.76	421.56	67.41	0.35
McGuinn	221.9	10-YR	261.53		261.98	0.002428	5.45	5.09	0.30	0.14	0.74	341.86	62.78	0.36
McGuinn	221.9	5-YR	260.44		260.84	0.002673	5.11	4.89	0.22	0.07	0.71	276.08	57.50	0.37
McGuinn	221.9	2-YR	258.78		259.06	0.002781	4.23	4.23	0.02		0.63	186.82	45.54	0.36
McGuinn	221.9	BANKFULL	258.14		258.35	0.002423	3.70	3.70			0.52	159.52	40.68	0.33
McGuinn	221.9	1/2 BF	256.88		256.98	0.001483	2.58	2.58			0.27	112.47	33.89	0.25
McGuinn	221.9	WINTER	253.96	251.85	253.97	0.000314	0.81	0.81			0.03	32.21	17.53	0.10
McGuinn	221.9	SUMMER	252.62	251.14	252.62	0.000000	0.02	0.02			0.00	13.70	11.26	0.00
McGuinn	190	100-YR	263.81		264.85	0.004094	8.49	7.44	0.75	0.55	1.45	388.67	61.52	0.51
McGuinn	190	50-YR	262.93		263.99	0.004766	8.54	7.60	0.67	0.57	1.53	335.34	58.82	0.54
McGuinn	190	25-YR	261.96		263.07	0.005828	8.65	7.89	0.58	0.61	1.67	280.12	55.46	0.58
McGuinn	190	10-YR	260.63		261.78	0.007775	8.67	8.26	0.41	0.59	1.94	210.70	47.71	0.65
McGuinn	190	5-YR	259.47		260.62	0.010409	8.60	8.44	0.27	0.52	2.32	160.01	40.59	0.72
McGuinn	190	2-YR	257.62	257.48	258.78	0.020519	8.66	8.65		0.19	3.13	91.32	34.35	0.93
McGuinn	190	BANKFULL	256.97	256.97	258.08	0.026193	8.45	8.45			3.25	69.82	32.46	1.02
McGuinn	190	1/2 BF	255.86	255.86	256.78	0.026341	7.69	7.69			2.83	37.70	19.81	0.98
McGuinn	190	WINTER	253.57	253.57	253.90	0.040958	4.62	4.62			1.47	5.63	8.83	1.02
McGuinn	190	SUMMER	252.56	252.56	252.62	0.082313	2.00	2.00			0.50	0.12	0.97	1.00
McGuinn	145	100-YR	260.61	260.61	264.21	0.026263	15.23	15.23			7.87	189.73	26.42	1.00
McGuinn	145	50-YR	260.01	259.99	263.34	0.026079	14.65	14.65			7.42	174.04	25.99	1.00
McGuinn	145	25-YR	259.74	259.34	262.46	0.022014	13.23	13.23			6.10	167.01	25.79	0.92
McGuinn	145	10-YR	259.15		261.18	0.017866	11.45	11.45			4.66	151.93	25.36	0.82
McGuinn	145	5-YR	258.41		260.00	0.015583	10.11	10.11			3.74	133.53	24.83	0.77
McGuinn	145	2-YR	257.06		258.02	0.012179	7.85	7.85			2.40	100.65	23.86	0.67
McGuinn	145	BANKFULL	256.40	255.42	257.15	0.011244	6.95	6.95			1.96	84.94	23.38	0.64
McGuinn	145	1/2 BF	255.07	254.26	255.51	0.010380	5.32	5.32			1.29	54.49	22.14	0.60

HEC-RAS Plan: Existing River: San Geronimo Reach: McGuinn (Continued)

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
McGuinn	145	WINTER	252.98	252.27	253.03	0.004462	1.83	1.83			0.21	14.24	15.49	0.34
McGuinn	145	SUMMER	251.81	251.13	251.81	0.000033	0.10	0.10			0.00	2.49	5.37	0.03
McGuinn	108	100-YR	261.80	259.09	262.98	0.005002	8.75	8.48	0.31	0.49	1.92	340.67	48.05	0.54
McGuinn	108	50-YR	261.23	258.60	262.30	0.005006	8.33	8.13	0.23	0.43	1.82	313.58	46.79	0.54
McGuinn	108	25-YR	260.63	258.07	261.58	0.005005	7.87	7.74	0.14	0.37	1.72	285.68	45.45	0.53
McGuinn	108	10-YR	259.70	257.32	260.50	0.005001	7.19	7.12		0.28	1.58	244.53	42.52	0.52
McGuinn	108	5-YR	258.75	256.61	259.43	0.005000	6.61	6.57		0.19	1.42	205.42	40.14	0.51
McGuinn	108	2-YR	257.13	255.32	257.60	0.005001	5.50	5.50		0.03	1.12	143.59	36.16	0.49
McGuinn	108	BANKFULL	256.38	254.80	256.77	0.005000	5.03	5.03			0.99	117.41	33.72	0.47
McGuinn	108	1/2 BF	254.94	253.84	255.19	0.005002	4.02	4.02			0.71	72.14	29.43	0.45
McGuinn	108	WINTER	252.81	252.46	252.86	0.005002	1.72	1.72			0.20	15.12	22.91	0.37
McGuinn	108	SUMMER	251.80	251.68	251.80	0.005001	0.58	0.58			0.04	0.42	3.18	0.28

HEC-RAS Plan: Proposed   River: San Geronimo   Reach: McGuinn

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
McGuinn	515	100-YR	265.40	263.84	267.08	0.007196	10.70	9.64	0.99	1.07	2.48	299.66	49.04	0.67
McGuinn	515	50-YR	264.64	263.32	266.30	0.008016	10.58	9.68	0.96	1.02	2.56	263.43	46.57	0.69
McGuinn	515	25-YR	263.84	262.77	265.48	0.009140	10.45	9.73	0.91	0.95	2.68	227.14	43.95	0.72
McGuinn	515	10-YR	262.68	262.00	264.27	0.011310	10.20	9.74	0.80	0.80	2.87	178.57	40.19	0.78
McGuinn	515	5-YR	261.58	261.23	263.16	0.015163	10.12	9.91	0.64	0.57	3.25	136.25	36.60	0.87
McGuinn	515	2-YR	260.00	260.00	261.40	0.023173	9.50	9.50			3.76	83.19	29.77	1.00
McGuinn	515	BANKFULL	259.36	259.36	260.63	0.024542	9.05	9.05			3.54	65.20	26.14	1.01
McGuinn	515	1/2 BF	258.08	258.08	259.06	0.026896	7.94	7.94			2.98	36.51	18.97	1.01
McGuinn	515	WINTER	255.72	255.72	256.06	0.037027	4.68	4.68			1.46	5.56	8.35	1.01
McGuinn	515	SUMMER	254.84	254.84	254.88	0.071149	1.56	1.56			0.33	0.15	2.04	1.00
McGuinn	440	100-YR	265.75		266.47	0.002796	6.83	6.78		0.17	1.27	426.15	49.48	0.40
McGuinn	440	50-YR	265.00		265.66	0.002834	6.57	6.55		0.11	1.22	389.56	47.88	0.40
McGuinn	440	25-YR	264.20		264.81	0.002881	6.28	6.28		0.06	1.17	352.06	46.20	0.40
McGuinn	440	10-YR	263.05		263.57	0.002868	5.79	5.79			1.06	300.30	43.75	0.39
McGuinn	440	5-YR	261.98		262.41	0.002743	5.30	5.30			0.92	254.66	41.44	0.38
McGuinn	440	2-YR	260.19	257.28	260.48	0.002364	4.29	4.29			0.64	184.09	37.59	0.34
McGuinn	440	BANKFULL	259.39	256.77	259.62	0.002174	3.81	3.81			0.53	154.84	35.88	0.32
McGuinn	440	1/2 BF	257.82	255.78	257.95	0.001816	2.86	2.86			0.33	101.23	32.21	0.28
McGuinn	440	WINTER	255.23	253.88	255.24	0.000612	0.95	0.95			0.05	27.50	21.28	0.15
McGuinn	440	SUMMER	254.13	253.04	254.13	0.000001	0.03	0.03			0.00	8.75	12.66	0.01
McGuinn	375	100-YR	264.00		266.02	0.010648	11.42	11.30	0.53		3.75	255.64	36.35	0.75
McGuinn	375	50-YR	263.27		265.21	0.011213	11.19	11.11	0.45		3.73	229.59	34.82	0.76
McGuinn	375	25-YR	262.50		264.35	0.011850	10.91	10.86	0.35		3.69	203.54	33.23	0.77
McGuinn	375	10-YR	261.54		263.13	0.011811	10.11	10.09	0.20		3.36	172.52	31.21	0.75
McGuinn	375	5-YR	260.68		262.00	0.011487	9.22	9.22	0.07		2.98	146.39	29.41	0.73
McGuinn	375	2-YR	259.33		260.15	0.009210	7.28	7.28			2.00	108.57	26.58	0.63
McGuinn	375	BANKFULL	258.70		259.33	0.008158	6.40	6.40			1.60	92.14	25.26	0.59
McGuinn	375	1/2 BF	257.36		257.72	0.006631	4.80	4.80			0.99	60.37	22.46	0.52
McGuinn	375	WINTER	255.12		255.16	0.002744	1.64	1.64			0.16	15.86	16.33	0.29
McGuinn	375	SUMMER	254.13		254.13	0.000381	0.16	0.16			0.00	1.53	12.61	0.08
McGuinn	315	100-YR	264.65		265.37	0.002394	6.87	6.39	0.32	0.24	0.97	452.20	60.91	0.39
McGuinn	315	50-YR	263.88		264.55	0.002511	6.66	6.28	0.26	0.22	0.96	406.01	58.44	0.39
McGuinn	315	25-YR	263.06		263.69	0.002651	6.42	6.15	0.19	0.19	0.94	359.28	55.89	0.40
McGuinn	315	10-YR	261.98		262.52	0.002700	5.89	5.77	0.11	0.14	0.90	301.40	49.58	0.39
McGuinn	315	5-YR	261.00		261.44	0.002698	5.32	5.28	0.06	0.09	0.84	255.52	45.36	0.38
McGuinn	315	2-YR	259.45		259.73	0.002492	4.20	4.20		0.02	0.62	188.26	42.23	0.35
McGuinn	315	BANKFULL	258.75		258.97	0.002358	3.71	3.71			0.52	158.95	41.23	0.33
McGuinn	315	1/2 BF	257.31		257.44	0.002184	2.85	2.85			0.34	101.77	37.84	0.31
McGuinn	315	WINTER	254.95		254.98	0.003431	1.36	1.36			0.13	19.09	31.56	0.31
McGuinn	315	SUMMER	254.03	254.03	254.04	0.125270	1.00	1.00			0.19	0.24	9.69	1.11
McGuinn	285	100-YR	264.65		265.25	0.002917	6.61	5.67	0.60	0.40	1.08	509.32	80.82	0.38
McGuinn	285	50-YR	263.84		264.45	0.003259	6.58	5.73	0.56	0.39	1.11	445.34	77.10	0.40
McGuinn	285	25-YR	262.98		263.60	0.003727	6.55	5.81	0.51	0.37	1.14	380.58	73.15	0.42
McGuinn	285	10-YR	261.80		262.41	0.004419	6.39	5.85	0.36	0.29	1.15	297.47	67.73	0.44

HEC-RAS Plan: Proposed   River: San Geronimo   Reach: McGuinn (Continued)

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
McGuinn	285	5-YR	260.76		261.32	0.005025	6.06	5.81	0.29	0.18	1.26	232.19	54.83	0.46
McGuinn	285	2-YR	259.22		259.61	0.005298	5.02	5.00	0.14		1.17	158.16	42.13	0.45
McGuinn	285	BANKFULL	258.54		258.85	0.005138	4.52	4.52	0.03		1.02	130.49	38.95	0.43
McGuinn	285	1/2 BF	257.14		257.34	0.004838	3.61	3.61			0.71	80.40	32.81	0.41
McGuinn	285	WINTER	254.83		254.87	0.003755	1.56	1.56			0.17	16.68	22.12	0.32
McGuinn	285	SUMMER	253.63	253.53	253.63	0.004605	0.56	0.56			0.04	0.43	3.23	0.27
McGuinn	245	100-YR	264.57		265.14	0.002486	6.48	5.46	0.56	0.30	0.93	528.93	82.20	0.37
McGuinn	245	50-YR	263.74		264.32	0.002815	6.48	5.52	0.52	0.30	0.94	461.69	80.12	0.39
McGuinn	245	25-YR	262.86		263.45	0.003229	6.46	5.61	0.49	0.29	0.99	393.59	75.17	0.41
McGuinn	245	10-YR	261.64		262.24	0.003910	6.34	5.69	0.39	0.26	1.01	305.64	69.36	0.44
McGuinn	245	5-YR	260.58		261.13	0.004526	6.06	5.70	0.39	0.21	1.13	236.88	55.20	0.46
McGuinn	245	2-YR	258.98		259.40	0.005245	5.17	5.10	0.13	0.09	1.03	154.98	46.70	0.46
McGuinn	245	BANKFULL	258.29		258.63	0.005735	4.73	4.73	0.01	0.02	1.05	124.65	40.28	0.47
McGuinn	245	1/2 BF	256.87		257.12	0.006288	3.95	3.95			0.82	73.35	33.50	0.47
McGuinn	245	WINTER	254.21	254.21	254.50	0.041524	4.31	4.31			1.42	6.03	10.57	1.00
McGuinn	245	SUMMER	253.13	253.13	253.17	0.067380	1.71	1.71			0.37	0.14	1.54	1.00
McGuinn	221.9	100-YR	264.56		265.06	0.002125	5.97	5.22	0.40	0.29	0.82	553.15	82.29	0.33
McGuinn	221.9	50-YR	263.74		264.23	0.002280	5.84	5.22	0.40	0.26	0.84	488.26	75.47	0.34
McGuinn	221.9	25-YR	262.88		263.35	0.002432	5.65	5.17	0.43	0.22	0.87	427.56	67.89	0.35
McGuinn	221.9	10-YR	261.69		262.11	0.002669	5.33	4.98	0.34	0.16	0.83	349.09	63.34	0.35
McGuinn	221.9	5-YR	260.62		260.99	0.002887	4.98	4.76	0.25	0.09	0.80	283.88	58.39	0.36
McGuinn	221.9	2-YR	259.00		259.26	0.002848	4.07	4.05	0.03		0.63	195.25	50.18	0.34
McGuinn	221.9	BANKFULL	258.30		258.50	0.002623	3.60	3.60			0.58	163.78	41.75	0.32
McGuinn	221.9	1/2 BF	256.90		257.00	0.001765	2.62	2.62			0.32	110.82	34.00	0.26
McGuinn	221.9	WINTER	253.97	251.95	253.98	0.000416	0.85	0.85			0.04	30.52	17.45	0.11
McGuinn	221.9	SUMMER	252.62	251.14	252.62	0.000000	0.02	0.02			0.00	12.10	10.76	0.00
McGuinn	190	100-YR	263.94		264.92	0.005142	8.20	7.43	0.97	0.39	1.83	389.00	61.91	0.50
McGuinn	190	50-YR	263.06		264.07	0.006068	8.28	7.60	0.89	0.34	1.95	335.64	59.35	0.53
McGuinn	190	25-YR	262.09		263.16	0.007598	8.45	7.90	0.80	0.31	2.17	279.78	55.86	0.58
McGuinn	190	10-YR	260.75		261.89	0.010732	8.63	8.35	0.60	0.14	2.63	208.36	48.60	0.66
McGuinn	190	5-YR	259.53		260.73	0.015131	8.80	8.73	0.42		3.29	154.69	40.69	0.76
McGuinn	190	2-YR	257.60	257.60	258.94	0.027431	9.32	9.32			4.21	84.76	31.62	1.00
McGuinn	190	BANKFULL	257.02	257.02	258.21	0.027469	8.74	8.74			3.69	67.49	28.75	1.01
McGuinn	190	1/2 BF	255.81	255.81	256.77	0.027140	7.90	7.90			2.97	36.69	18.86	1.00
McGuinn	190	WINTER	253.57	253.57	253.90	0.040885	4.62	4.62			1.47	5.63	8.83	1.02
McGuinn	190	SUMMER	252.56	252.56	252.62	0.081396	1.99	1.99			0.49	0.12	0.98	1.00
McGuinn	145	100-YR	260.61	260.61	264.21	0.026263	15.23	15.23			7.87	189.73	26.42	1.00
McGuinn	145	50-YR	260.01	259.99	263.34	0.026079	14.65	14.65			7.42	174.04	25.99	1.00
McGuinn	145	25-YR	259.74	259.34	262.46	0.022014	13.23	13.23			6.10	167.01	25.79	0.92
McGuinn	145	10-YR	259.15		261.18	0.017866	11.45	11.45			4.66	151.93	25.36	0.82
McGuinn	145	5-YR	258.41		260.00	0.015583	10.11	10.11			3.74	133.53	24.83	0.77
McGuinn	145	2-YR	257.06	256.03	258.02	0.012180	7.85	7.85			2.40	100.64	23.86	0.67
McGuinn	145	BANKFULL	256.40	255.42	257.15	0.011245	6.95	6.95			1.96	84.93	23.38	0.64
McGuinn	145	1/2 BF	255.07	254.26	255.51	0.010380	5.32	5.32			1.29	54.49	22.14	0.60

HEC-RAS Plan: Proposed River: San Geronimo Reach: McGuinn (Continued)

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
McGuinn	145	WINTER	252.98	252.27	253.03	0.004462	1.83	1.83			0.21	14.23	15.49	0.34
McGuinn	145	SUMMER	251.81	251.13	251.81	0.000033	0.10	0.10			0.00	2.49	5.37	0.03
McGuinn	108	100-YR	261.80	259.09	262.98	0.005002	8.75	8.48	0.31	0.49	1.92	340.67	48.05	0.54
McGuinn	108	50-YR	261.23	258.60	262.30	0.005006	8.33	8.13	0.23	0.43	1.82	313.58	46.79	0.54
McGuinn	108	25-YR	260.63	258.07	261.58	0.005005	7.87	7.74	0.14	0.37	1.72	285.68	45.45	0.53
McGuinn	108	10-YR	259.70	257.32	260.50	0.005001	7.19	7.12		0.28	1.58	244.53	42.52	0.52
McGuinn	108	5-YR	258.75	256.61	259.43	0.005000	6.61	6.57		0.19	1.42	205.42	40.14	0.51
McGuinn	108	2-YR	257.13	255.32	257.60	0.005001	5.50	5.50		0.03	1.12	143.59	36.16	0.49
McGuinn	108	BANKFULL	256.38	254.80	256.77	0.005000	5.03	5.03			0.99	117.41	33.72	0.47
McGuinn	108	1/2 BF	254.94	253.84	255.19	0.005002	4.02	4.02			0.71	72.14	29.43	0.45
McGuinn	108	WINTER	252.81	252.46	252.86	0.005002	1.72	1.72			0.20	15.12	22.91	0.37
McGuinn	108	SUMMER	251.80	251.68	251.80	0.005001	0.58	0.58			0.04	0.42	3.18	0.28

HEC-RAS Plan: Existing   River: San Geronimo   Reach: Watson

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Watson	535	100-YR	270.14		271.96	0.007848	11.27	9.91	1.42	0.42	2.59	213.84	31.14	0.66
Watson	535	50-YR	269.47		271.18	0.008174	10.91	9.72	1.36	0.31	2.58	193.35	29.34	0.67
Watson	535	25-YR	268.71		270.29	0.008497	10.43	9.42	1.28	0.21	2.55	172.00	27.49	0.67
Watson	535	10-YR	267.64		269.01	0.008927	9.65	8.84	1.15		2.44	143.68	25.36	0.67
Watson	535	5-YR	266.68		267.85	0.008639	8.91	8.23	0.95		2.16	120.28	23.31	0.65
Watson	535	2-YR	265.02		265.82	0.007508	7.31	6.86	0.60		1.58	84.51	19.76	0.59
Watson	535	BANKFULL	264.26		264.90	0.006792	6.47	6.13	0.46		1.30	70.19	18.14	0.56
Watson	535	1/2 BF	262.91		263.27	0.005233	4.83	4.63	0.26		0.81	47.48	15.64	0.47
Watson	535	WINTER	260.40		260.43	0.001598	1.43	1.42	0.02		0.11	13.40	11.46	0.23
Watson	535	SUMMER	259.20		259.20	0.000077	0.11	0.11			0.00	1.52	6.16	0.04
Watson	445	100-YR	270.45		271.23	0.003066	7.28	6.41	0.46	0.33	1.00	330.62	56.57	0.42
Watson	445	50-YR	269.68		270.45	0.003359	7.19	6.51	0.43	0.28	1.04	288.75	51.45	0.43
Watson	445	25-YR	268.81		269.56	0.003702	7.03	6.57	0.38	0.22	1.10	246.70	45.65	0.45
Watson	445	10-YR	267.58		268.27	0.004224	6.68	6.49	0.29	0.09	1.19	195.59	37.41	0.46
Watson	445	5-YR	266.52		267.13	0.004604	6.28	6.21	0.18		1.24	159.43	31.49	0.47
Watson	445	2-YR	264.76		265.19	0.004542	5.29	5.29			1.04	109.62	25.43	0.45
Watson	445	BANKFULL	263.99		264.34	0.004141	4.73	4.73			0.86	90.91	23.46	0.42
Watson	445	1/2 BF	262.66		262.86	0.003156	3.56	3.56			0.52	61.83	20.38	0.36
Watson	445	WINTER	260.33		260.34	0.000577	0.94	0.94			0.05	20.31	14.85	0.14
Watson	445	SUMMER	259.20		259.20	0.000002	0.03	0.03			0.00	5.60	11.12	0.01
Watson	375	100-YR	270.33		270.98	0.002964	6.48	6.30		0.30	1.12	336.42	45.95	0.39
Watson	375	50-YR	269.55		270.18	0.003139	6.36	6.23		0.25	1.12	301.56	43.44	0.40
Watson	375	25-YR	268.67		269.27	0.003352	6.19	6.12		0.18	1.12	264.63	40.62	0.41
Watson	375	10-YR	267.41		267.95	0.003710	5.90	5.89		0.07	1.12	215.80	36.56	0.42
Watson	375	5-YR	266.31		266.79	0.004010	5.58	5.58			1.09	177.37	33.55	0.43
Watson	375	2-YR	264.51		264.87	0.004082	4.80	4.80			0.88	120.78	29.40	0.42
Watson	375	BANKFULL	263.75		264.04	0.003973	4.34	4.34			0.75	98.99	27.64	0.40
Watson	375	1/2 BF	262.45		262.62	0.003484	3.38	3.38			0.50	65.12	24.24	0.36
Watson	375	WINTER	260.31		260.32	0.000227	0.69	0.69			0.02	27.54	14.59	0.09
Watson	375	SUMMER	259.20		259.20	0.000000	0.01	0.01			0.00	12.45	12.51	0.00
Watson	335	100-YR	270.29		270.86	0.001993	6.38	5.44	0.33	0.38	0.75	389.71	58.04	0.35
Watson	335	50-YR	269.49		270.06	0.002166	6.29	5.46	0.31	0.34	0.75	344.16	55.95	0.36
Watson	335	25-YR	268.59		269.14	0.002371	6.16	5.48	0.28	0.30	0.76	295.60	51.82	0.37
Watson	335	10-YR	267.29		267.82	0.002707	5.89	5.46	0.21	0.22	0.77	232.54	45.68	0.39
Watson	335	5-YR	266.17		266.65	0.003031	5.56	5.37	0.12	0.12	0.77	184.43	40.31	0.40
Watson	335	2-YR	264.37		264.71	0.003455	4.69	4.68	0.03	0.03	0.79	123.85	29.97	0.40
Watson	335	BANKFULL	263.61		263.89	0.003523	4.24	4.24			0.70	101.48	28.55	0.40
Watson	335	1/2 BF	262.31		262.48	0.003326	3.34	3.34			0.48	65.94	26.24	0.37
Watson	335	WINTER	260.28		260.30	0.001842	1.15	1.15			0.08	16.56	22.27	0.23
Watson	335	SUMMER	259.20		259.20	0.000325	0.19	0.19			0.00	0.91	5.06	0.08
Watson	300	100-YR	270.13		270.78	0.002430	6.81	5.59	0.39	0.33	0.77	379.44	67.44	0.38
Watson	300	50-YR	269.29		269.96	0.002779	6.86	5.80	0.34	0.32	0.80	324.36	63.03	0.40
Watson	300	25-YR	268.33		269.03	0.003232	6.87	6.06	0.28	0.30	0.85	267.37	56.46	0.43
Watson	300	10-YR	267.01		267.69	0.003879	6.68	6.31	0.21	0.23	1.01	201.21	41.99	0.45

HEC-RAS Plan: Existing   River: San Geronimo   Reach: Watson (Continued)

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Watson	300	5-YR	265.89		266.51	0.004410	6.32	6.20	0.14	0.17	1.13	159.69	32.95	0.47
Watson	300	2-YR	264.09		264.55	0.005515	5.47	5.47			1.14	106.13	27.73	0.49
Watson	300	BANKFULL	263.33		263.72	0.005808	5.03	5.03			1.03	85.43	26.60	0.49
Watson	300	1/2 BF	262.04		262.32	0.006569	4.18	4.18			0.80	52.61	24.58	0.50
Watson	300	WINTER	260.05		260.14	0.017429	2.49	2.49			0.47	7.63	17.03	0.66
Watson	300	SUMMER	259.15		259.16	0.023154	0.99	0.99			0.13	0.17	1.88	0.58
Watson	270	100-YR	270.28		270.64	0.001321	4.99	4.46	0.26	0.10	0.52	474.87	68.31	0.29
Watson	270	50-YR	269.45		269.81	0.001462	4.93	4.48	0.25	0.09	0.53	419.62	65.05	0.30
Watson	270	25-YR	268.51		268.86	0.001662	4.86	4.50	0.23	0.07	0.55	360.19	61.30	0.31
Watson	270	10-YR	267.16		267.50	0.002054	4.75	4.51	0.20	0.04	0.59	281.40	55.40	0.33
Watson	270	5-YR	266.00		266.32	0.002554	4.62	4.50	0.16		0.64	220.07	49.84	0.36
Watson	270	2-YR	264.06		264.36	0.003992	4.38	4.38	0.01		0.75	132.56	40.76	0.43
Watson	270	BANKFULL	263.25		263.53	0.004685	4.25	4.25			0.76	101.09	36.41	0.45
Watson	270	1/2 BF	261.88		262.12	0.005973	3.87	3.87			0.70	56.84	28.58	0.48
Watson	270	WINTER	259.64		259.74	0.010560	2.49	2.49			0.41	7.64	11.66	0.54
Watson	270	SUMMER	258.60		258.61	0.015174	0.82	0.82			0.09	0.21	2.29	0.48
Watson	245	100-YR	270.27		270.60	0.001002	4.70	4.44	0.13	0.10	0.45	477.77	54.63	0.25
Watson	245	50-YR	269.45		269.76	0.001037	4.53	4.33	0.13	0.09	0.45	434.51	51.43	0.25
Watson	245	25-YR	268.52		268.81	0.001081	4.33	4.18	0.12	0.08	0.44	387.99	49.17	0.26
Watson	245	10-YR	267.19		267.44	0.001154	4.02	3.92	0.09	0.06	0.42	323.91	47.07	0.26
Watson	245	5-YR	266.03		266.25	0.001228	3.71	3.66	0.07	0.04	0.39	270.59	45.25	0.26
Watson	245	2-YR	264.11		264.26	0.001390	3.11	3.11	0.02	0.01	0.34	186.48	42.26	0.26
Watson	245	BANKFULL	263.30		263.42	0.001458	2.82	2.82			0.30	152.63	41.00	0.26
Watson	245	1/2 BF	261.92		262.00	0.001513	2.25	2.25			0.22	97.79	38.89	0.25
Watson	245	WINTER	259.52		259.56	0.004251	1.49	1.49			0.15	12.72	21.19	0.34
Watson	245	SUMMER	258.60		258.60	0.000080	0.12	0.12			0.00	1.45	5.70	0.04
Watson	225	100-YR	270.33		270.55	0.000590	3.78	3.61	0.08	0.07	0.30	587.13	61.58	0.20
Watson	225	50-YR	269.51		269.71	0.000602	3.63	3.50	0.07	0.06	0.29	537.35	59.53	0.20
Watson	225	25-YR	268.58		268.76	0.000617	3.45	3.36	0.06	0.05	0.28	482.86	57.33	0.20
Watson	225	10-YR	267.24		267.39	0.000636	3.16	3.11	0.04	0.03	0.26	407.82	54.64	0.20
Watson	225	5-YR	266.07		266.20	0.000649	2.88	2.86	0.03	0.02	0.24	345.80	52.05	0.19
Watson	225	2-YR	264.14		264.22	0.000659	2.34	2.34	0.00		0.19	247.70	49.35	0.18
Watson	225	BANKFULL	263.32		263.39	0.000625	2.07	2.07			0.15	207.77	48.15	0.18
Watson	225	1/2 BF	261.94		261.97	0.000501	1.53	1.53			0.09	143.40	44.86	0.15
Watson	225	WINTER	259.54		259.54	0.000105	0.41	0.41			0.01	46.45	33.85	0.06
Watson	225	SUMMER	258.60		258.60	0.000000	0.01	0.01			0.00	18.93	17.89	0.00
Watson	200	100-YR	269.83		270.48	0.002182	6.68	5.99	0.40	0.31	0.88	354.07	47.21	0.38
Watson	200	50-YR	269.01		269.64	0.002349	6.54	5.94	0.38	0.32	0.90	316.70	44.52	0.39
Watson	200	25-YR	268.09		268.69	0.002586	6.37	5.86	0.35	0.31	0.91	276.28	42.72	0.40
Watson	200	10-YR	266.76		267.32	0.003027	6.09	5.73	0.33	0.29	0.93	221.64	39.68	0.42
Watson	200	5-YR	265.61		266.13	0.003605	5.84	5.60	0.27	0.25	0.95	176.91	38.38	0.44
Watson	200	2-YR	263.69		264.15	0.005570	5.42	5.38	0.11	0.10	1.06	107.75	33.14	0.51
Watson	200	BANKFULL	262.89		263.31	0.007274	5.24	5.24			1.15	82.01	30.36	0.56
Watson	200	1/2 BF	261.55		261.91	0.009650	4.83	4.83			1.10	45.53	23.64	0.61

HEC-RAS Plan: Existing River: San Geronimo Reach: Watson (Continued)

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Watson	200	WINTER	259.45		259.53	0.007648	2.23	2.23			0.32	8.52	12.08	0.47
Watson	200	SUMMER	258.60		258.60	0.000153	0.16	0.16			0.00	1.05	4.04	0.06
Watson	175	100-YR	269.16	265.57	270.35	0.004530	8.76	8.68	0.06	0.10	1.69	244.26	26.18	0.50
Watson	175	50-YR	268.41	265.11	269.52	0.004669	8.43	8.36	0.06	0.08	1.67	224.76	26.02	0.50
Watson	175	25-YR	267.56	264.58	268.56	0.004861	8.04	7.99	0.06	0.06	1.64	202.65	25.83	0.50
Watson	175	10-YR	266.33	263.78	267.19	0.005205	7.45	7.42	0.05	0.02	1.58	171.14	25.55	0.50
Watson	175	5-YR	265.26	263.11	266.00	0.005533	6.89	6.88	0.05		1.51	143.92	25.27	0.51
Watson	175	2-YR	263.46	261.95	264.00	0.006017	5.86	5.85	0.02		1.27	99.07	24.62	0.51
Watson	175	BANKFULL	262.70	261.37	263.14	0.006323	5.35	5.35			1.15	80.38	24.19	0.52
Watson	175	1/2 BF	261.39	260.41	261.69	0.006405	4.40	4.40			0.86	49.96	21.28	0.51
Watson	175	WINTER	259.36	258.89	259.40	0.003226	1.56	1.56			0.15	12.20	15.75	0.31
Watson	175	SUMMER	258.60	258.15	258.60	0.000026	0.07	0.07			0.00	2.28	7.67	0.02
Watson	150		Bridge											
Watson	135	100-YR	266.18	266.18	269.77	0.020176	15.30	14.70	0.87	1.15	5.63	144.24	21.45	0.99
Watson	135	50-YR	265.62	265.62	268.95	0.020736	14.71	14.21	0.81	1.08	5.50	132.30	21.17	1.00
Watson	135	25-YR	265.00	265.00	268.01	0.021193	13.97	13.57	0.73	0.99	5.29	119.40	20.87	0.99
Watson	135	10-YR	264.07	264.07	266.65	0.022652	12.94	12.69	0.61	0.85	5.07	100.09	20.41	1.00
Watson	135	5-YR	263.28	263.28	265.47	0.023694	11.88	11.74	0.46	0.68	4.74	84.30	20.02	0.99
Watson	135	2-YR	262.08	261.92	263.50	0.023276	9.56	9.56		0.13	3.74	60.69	18.86	0.93
Watson	135	BANKFULL	261.46	261.33	262.65	0.024367	8.76	8.76			3.37	49.08	18.26	0.94
Watson	135	1/2 BF	260.36	260.36	261.22	0.029848	7.46	7.46			2.78	29.51	17.35	1.01
Watson	135	WINTER	258.93	258.93	259.11	0.045101	3.40	3.40			0.95	5.60	16.12	1.02
Watson	135	SUMMER	258.48	258.48	258.52	0.076534	1.52	1.52			0.32	0.11	1.57	1.00
Watson	115	100-YR	266.37	265.14	268.40	0.010006	11.55	10.96	0.80	0.87	3.20	193.43	30.47	0.74
Watson	115	50-YR	265.86	264.66	267.72	0.010010	11.03	10.56	0.70	0.75	3.05	178.08	29.69	0.73
Watson	115	25-YR	265.28	264.07	266.94	0.010018	10.42	10.07	0.57	0.62	2.88	160.88	28.79	0.72
Watson	115	10-YR	264.41	263.25	265.80	0.010003	9.47	9.29	0.36	0.43	2.62	136.68	27.28	0.70
Watson	115	5-YR	263.64	262.53	264.78	0.010001	8.58	8.52	0.19	0.25	2.39	116.20	25.65	0.68
Watson	115	2-YR	262.24	261.23	263.01	0.010018	7.05	7.05			1.95	82.23	22.82	0.65
Watson	115	BANKFULL	261.54	260.64	262.18	0.010002	6.45	6.45			1.70	66.68	21.49	0.65
Watson	115	1/2 BF	260.33	259.67	260.75	0.010004	5.23	5.23			1.25	42.05	19.20	0.62
Watson	115	WINTER	258.38	258.15	258.46	0.010009	2.26	2.26			0.35	8.41	14.63	0.52
Watson	115	SUMMER	257.62	257.58	257.62	0.010010	0.55	0.55			0.04	0.31	4.48	0.37

HEC-RAS Plan: Proposed River: San Geronimo Reach: Watson

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Watson	535	100-YR	270.18		271.98	0.007735	11.21	9.86	1.40	0.42	2.55	214.97	31.24	0.66
Watson	535	50-YR	269.51		271.21	0.008018	10.84	9.66	1.34	0.32	2.54	194.67	29.46	0.66
Watson	535	25-YR	268.77		270.32	0.008291	10.35	9.34	1.26	0.21	2.49	173.45	27.59	0.66
Watson	535	10-YR	267.70		269.04	0.008632	9.55	8.74	1.12	0.02	2.37	145.28	25.48	0.66
Watson	535	5-YR	266.75		267.89	0.008339	8.80	8.12	0.93		2.10	121.92	23.46	0.64
Watson	535	2-YR	265.09		265.86	0.007197	7.20	6.76	0.58		1.52	85.86	19.90	0.58
Watson	535	BANKFULL	264.33		264.94	0.006485	6.37	6.02	0.45		1.25	71.40	18.29	0.55
Watson	535	1/2 BF	262.97		263.31	0.004973	4.74	4.55	0.25		0.78	48.35	15.74	0.46
Watson	535	WINTER	260.43		260.46	0.001480	1.40	1.38	0.02		0.10	13.74	11.51	0.22
Watson	535	SUMMER	259.21		259.21	0.000068	0.11	0.11			0.00	1.59	6.29	0.04
Watson	445	100-YR	270.49		271.25	0.003020	7.24	6.37	0.46	0.33	0.98	332.67	56.81	0.42
Watson	445	50-YR	269.73		270.48	0.003290	7.14	6.46	0.42	0.28	1.02	291.15	51.77	0.43
Watson	445	25-YR	268.87		269.60	0.003602	6.97	6.50	0.38	0.22	1.07	249.34	46.04	0.44
Watson	445	10-YR	267.66		268.33	0.004059	6.60	6.40	0.29	0.09	1.15	198.39	37.91	0.46
Watson	445	5-YR	266.61		267.20	0.004402	6.18	6.11	0.18		1.19	162.09	31.81	0.46
Watson	445	2-YR	264.85		265.26	0.004299	5.18	5.18			0.99	111.88	25.65	0.44
Watson	445	BANKFULL	264.08		264.41	0.003897	4.63	4.63			0.82	92.97	23.68	0.41
Watson	445	1/2 BF	262.74		262.93	0.002947	3.47	3.47			0.50	63.36	20.55	0.35
Watson	445	WINTER	260.36		260.38	0.000539	0.91	0.91			0.04	20.83	15.01	0.14
Watson	445	SUMMER	259.21		259.21	0.000002	0.03	0.03			0.00	5.74	11.16	0.01
Watson	375	100-YR	270.37		271.01	0.002923	6.45	6.27		0.30	1.11	338.15	46.07	0.39
Watson	375	50-YR	269.60		270.22	0.003079	6.32	6.19		0.25	1.10	303.71	43.60	0.40
Watson	375	25-YR	268.74		269.32	0.003263	6.14	6.06		0.18	1.10	267.16	40.82	0.40
Watson	375	10-YR	267.49		268.02	0.003558	5.82	5.80		0.07	1.09	218.87	36.83	0.41
Watson	375	5-YR	266.41		266.87	0.003810	5.48	5.48			1.05	180.64	33.78	0.42
Watson	375	2-YR	264.62		264.96	0.003790	4.68	4.68			0.83	123.96	29.65	0.40
Watson	375	BANKFULL	263.86		264.13	0.003641	4.21	4.21			0.70	102.03	27.89	0.39
Watson	375	1/2 BF	262.54		262.71	0.003147	3.26	3.26			0.46	67.45	24.51	0.35
Watson	375	WINTER	260.35		260.35	0.000215	0.68	0.68			0.02	28.06	14.66	0.09
Watson	375	SUMMER	259.21		259.21	0.000000	0.01	0.01			0.00	12.60	12.53	0.00
Watson	335	100-YR	270.33		270.89	0.001963	6.34	5.41	0.33	0.38	0.74	391.98	58.14	0.35
Watson	335	50-YR	269.54		270.10	0.002119	6.25	5.42	0.31	0.33	0.73	347.06	56.08	0.36
Watson	335	25-YR	268.65		269.20	0.002301	6.10	5.42	0.28	0.29	0.74	299.07	52.13	0.37
Watson	335	10-YR	267.38		267.89	0.002585	5.80	5.37	0.21	0.22	0.74	236.69	46.11	0.38
Watson	335	5-YR	266.28		266.74	0.002850	5.46	5.25	0.13	0.13	0.73	188.73	40.82	0.39
Watson	335	2-YR	264.49		264.82	0.003146	4.56	4.55	0.03	0.03	0.73	127.46	30.21	0.38
Watson	335	BANKFULL	263.73		263.99	0.003185	4.09	4.09			0.65	105.02	28.76	0.38
Watson	335	1/2 BF	262.42		262.58	0.002915	3.19	3.19			0.44	68.90	26.46	0.35
Watson	335	WINTER	260.31		260.33	0.001563	1.09	1.09			0.07	17.44	22.34	0.22
Watson	335	SUMMER	259.21		259.21	0.000272	0.18	0.18			0.00	0.97	5.23	0.07
Watson	300	100-YR	270.22		270.80	0.003310	6.54	5.50	0.55	0.45	1.06	385.36	67.97	0.37
Watson	300	50-YR	269.38		270.00	0.003827	6.63	5.70	0.49	0.45	1.12	329.98	63.48	0.39
Watson	300	25-YR	268.42		269.08	0.004509	6.69	5.95	0.41	0.42	1.20	272.42	56.95	0.41
Watson	300	10-YR	267.10		267.75	0.005480	6.55	6.19	0.30	0.34	1.43	205.02	42.97	0.44

HEC-RAS Plan: Proposed River: San Geronimo Reach: Watson (Continued)

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Watson	300	5-YR	265.99		266.58	0.006202	6.20	6.08	0.21	0.25	1.61	162.91	33.39	0.46
Watson	300	2-YR	264.21		264.64	0.007443	5.30	5.30	0.03	0.03	1.57	109.43	27.90	0.47
Watson	300	BANKFULL	263.45		263.82	0.007728	4.84	4.84			1.40	88.82	26.79	0.47
Watson	300	1/2 BF	262.17		262.41	0.008213	3.94	3.94			1.05	55.77	24.80	0.46
Watson	300	WINTER	260.14		260.20	0.014972	2.05	2.05			0.46	9.27	18.28	0.51
Watson	300	SUMMER	259.17		259.18	0.018032	0.78	0.78			0.11	0.22	2.11	0.43
Watson	270	100-YR	270.32		270.66	0.001827	4.81	4.33	0.37	0.21	0.70	489.75	74.09	0.28
Watson	270	50-YR	269.49		269.83	0.002049	4.79	4.37	0.36	0.19	0.73	430.03	69.70	0.29
Watson	270	25-YR	268.55		268.89	0.002361	4.76	4.42	0.34	0.16	0.77	366.69	64.67	0.30
Watson	270	10-YR	267.20		267.53	0.002957	4.68	4.46	0.29	0.09	0.85	284.51	57.00	0.33
Watson	270	5-YR	266.04		266.36	0.003690	4.57	4.45	0.23		0.94	222.27	50.05	0.36
Watson	270	2-YR	264.12		264.40	0.005669	4.31	4.31	0.03		1.08	134.70	41.00	0.42
Watson	270	BANKFULL	263.30		263.57	0.006620	4.17	4.17			1.08	103.15	36.71	0.44
Watson	270	1/2 BF	261.94		262.16	0.008205	3.76	3.76			0.98	58.48	28.79	0.47
Watson	270	WINTER	259.72		259.79	0.012787	2.21	2.21			0.49	8.60	13.42	0.49
Watson	270	SUMMER	258.60		258.61	0.020259	0.78	0.78			0.12	0.22	2.34	0.45
Watson	245	100-YR	270.29		270.61	0.001431	4.60	4.30	0.19	0.19	0.62	493.19	60.79	0.25
Watson	245	50-YR	269.47		269.77	0.001497	4.46	4.22	0.18	0.17	0.63	445.12	56.55	0.25
Watson	245	25-YR	268.54		268.82	0.001576	4.28	4.11	0.18	0.14	0.63	394.31	52.98	0.25
Watson	245	10-YR	267.21		267.45	0.001699	3.99	3.89	0.14	0.09	0.60	326.26	49.06	0.26
Watson	245	5-YR	266.05		266.26	0.001812	3.70	3.65	0.10	0.06	0.58	271.54	45.68	0.26
Watson	245	2-YR	264.13		264.28	0.002043	3.10	3.09	0.02	0.02	0.50	187.41	42.30	0.26
Watson	245	BANKFULL	263.32		263.44	0.002139	2.80	2.80			0.45	153.56	41.04	0.26
Watson	245	1/2 BF	261.95		262.02	0.002203	2.23	2.23			0.32	98.59	38.92	0.25
Watson	245	WINTER	259.53		259.56	0.006170	1.48	1.48			0.22	12.87	21.35	0.33
Watson	245	SUMMER	258.60		258.60	0.000120	0.12	0.12			0.00	1.45	5.70	0.04
Watson	225	100-YR	270.34		270.56	0.000872	3.76	3.60	0.11	0.09	0.43	588.76	63.18	0.20
Watson	225	50-YR	269.52		269.72	0.000892	3.62	3.49	0.10	0.08	0.43	538.06	60.10	0.20
Watson	225	25-YR	268.59		268.77	0.000914	3.44	3.35	0.09	0.07	0.41	483.42	57.35	0.20
Watson	225	10-YR	267.25		267.40	0.000944	3.16	3.11	0.07	0.04	0.38	408.35	54.66	0.19
Watson	225	5-YR	266.08		266.21	0.000963	2.88	2.86	0.05	0.02	0.35	346.35	52.07	0.19
Watson	225	2-YR	264.15		264.24	0.000976	2.34	2.34	0.01	0.00	0.28	248.32	49.37	0.18
Watson	225	BANKFULL	263.33		263.40	0.000925	2.06	2.06			0.23	208.41	48.17	0.17
Watson	225	1/2 BF	261.95		261.99	0.000740	1.53	1.53			0.14	143.96	44.89	0.15
Watson	225	WINTER	259.54		259.55	0.000156	0.41	0.41			0.01	46.57	33.87	0.06
Watson	225	SUMMER	258.60		258.60	0.000000	0.01	0.01			0.00	18.93	17.89	0.00
Watson	200	100-YR	269.83		270.48	0.002182	6.68	5.99	0.40	0.31	0.88	354.07	47.21	0.38
Watson	200	50-YR	269.01		269.64	0.002349	6.54	5.94	0.38	0.32	0.90	316.70	44.52	0.39
Watson	200	25-YR	268.09		268.69	0.002586	6.37	5.86	0.35	0.31	0.91	276.28	42.72	0.40
Watson	200	10-YR	266.76		267.32	0.003027	6.09	5.73	0.33	0.29	0.93	221.64	39.68	0.42
Watson	200	5-YR	265.61		266.13	0.003605	5.84	5.60	0.27	0.25	0.95	176.91	38.38	0.44
Watson	200	2-YR	263.69		264.15	0.005570	5.42	5.38	0.11	0.10	1.06	107.75	33.14	0.51
Watson	200	BANKFULL	262.89		263.31	0.007274	5.24	5.24			1.15	82.01	30.36	0.56
Watson	200	1/2 BF	261.55		261.91	0.009650	4.83	4.83			1.10	45.53	23.64	0.61

HEC-RAS Plan: Proposed River: San Geronimo Reach: Watson (Continued)

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Watson	200	WINTER	259.45		259.53	0.007648	2.23	2.23			0.32	8.52	12.08	0.47
Watson	200	SUMMER	258.60		258.60	0.000153	0.16	0.16			0.00	1.05	4.04	0.06
Watson	175	100-YR	269.16	265.57	270.35	0.004530	8.76	8.68	0.06	0.10	1.69	244.26	26.18	0.50
Watson	175	50-YR	268.41	265.11	269.52	0.004669	8.43	8.36	0.06	0.08	1.67	224.76	26.02	0.50
Watson	175	25-YR	267.56	264.58	268.56	0.004861	8.04	7.99	0.06	0.06	1.64	202.65	25.83	0.50
Watson	175	10-YR	266.33	263.78	267.19	0.005205	7.45	7.42	0.05	0.02	1.58	171.14	25.55	0.50
Watson	175	5-YR	265.26	263.11	266.00	0.005533	6.89	6.88	0.05		1.51	143.92	25.27	0.51
Watson	175	2-YR	263.46	261.95	264.00	0.006017	5.86	5.85	0.02		1.27	99.07	24.62	0.51
Watson	175	BANKFULL	262.70	261.37	263.14	0.006323	5.35	5.35			1.15	80.38	24.19	0.52
Watson	175	1/2 BF	261.39	260.41	261.69	0.006405	4.40	4.40			0.86	49.96	21.28	0.51
Watson	175	WINTER	259.36	258.89	259.40	0.003226	1.56	1.56			0.15	12.20	15.75	0.31
Watson	175	SUMMER	258.60	258.15	258.60	0.000026	0.07	0.07			0.00	2.28	7.67	0.02
Watson	150		Bridge											
Watson	135	100-YR	266.18	266.18	269.77	0.020176	15.30	14.70	0.87	1.15	5.63	144.24	21.45	0.99
Watson	135	50-YR	265.62	265.62	268.95	0.020736	14.71	14.21	0.81	1.08	5.50	132.30	21.17	1.00
Watson	135	25-YR	265.00	265.00	268.01	0.021193	13.97	13.57	0.73	0.99	5.29	119.40	20.87	0.99
Watson	135	10-YR	264.07	264.07	266.65	0.022652	12.94	12.69	0.61	0.85	5.07	100.09	20.41	1.00
Watson	135	5-YR	263.28	263.28	265.47	0.023694	11.88	11.74	0.46	0.68	4.74	84.30	20.02	0.99
Watson	135	2-YR	262.08	261.92	263.50	0.023276	9.56	9.56		0.13	3.74	60.69	18.86	0.93
Watson	135	BANKFULL	261.46	261.33	262.65	0.024367	8.76	8.76			3.37	49.08	18.26	0.94
Watson	135	1/2 BF	260.36	260.36	261.22	0.029848	7.46	7.46			2.78	29.51	17.35	1.01
Watson	135	WINTER	258.93	258.93	259.11	0.045101	3.40	3.40			0.95	5.60	16.12	1.02
Watson	135	SUMMER	258.48	258.48	258.52	0.076534	1.52	1.52			0.32	0.11	1.57	1.00
Watson	115	100-YR	266.37	265.14	268.40	0.010006	11.55	10.96	0.80	0.87	3.20	193.43	30.47	0.74
Watson	115	50-YR	265.86	264.66	267.72	0.010010	11.03	10.56	0.70	0.75	3.05	178.08	29.69	0.73
Watson	115	25-YR	265.28	264.07	266.94	0.010018	10.42	10.07	0.57	0.62	2.88	160.88	28.79	0.72
Watson	115	10-YR	264.41	263.25	265.80	0.010003	9.47	9.29	0.36	0.43	2.62	136.68	27.28	0.70
Watson	115	5-YR	263.64	262.53	264.78	0.010001	8.58	8.52	0.19	0.25	2.39	116.20	25.65	0.68
Watson	115	2-YR	262.24	261.23	263.01	0.010018	7.05	7.05			1.95	82.23	22.82	0.65
Watson	115	BANKFULL	261.54	260.64	262.18	0.010002	6.45	6.45			1.70	66.68	21.49	0.65
Watson	115	1/2 BF	260.33	259.67	260.75	0.010004	5.23	5.23			1.25	42.05	19.20	0.62
Watson	115	WINTER	258.38	258.15	258.46	0.010009	2.26	2.26			0.35	8.41	14.63	0.52
Watson	115	SUMMER	257.62	257.58	257.62	0.010010	0.55	0.55			0.04	0.31	4.48	0.37

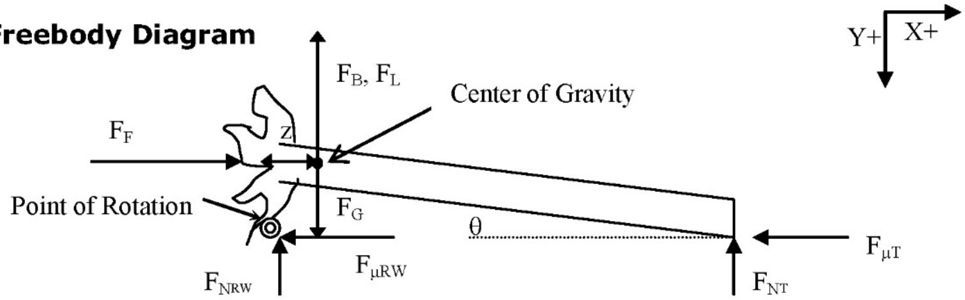
HEC-RAS Plan: Plan 01   River: San Geronimo   Reach: Freund

Reach	River Sta	Profile	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Total	Shear LOB	Shear ROB	Shear Total	Flow Area	Top Width	Froude # Chl
			(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	(ft)	
Freund	139.52	100-yr	88.82	88.82	89.12	0.045804	4.36	4.36			1.39	1.84	3.16	1.01
Freund	139.52	50-yr	88.77	88.77	89.04	0.046074	4.22	4.22			1.32	1.66	3.04	1.00
Freund	139.52	25-yr	88.70	88.70	88.96	0.046734	4.07	4.07			1.25	1.48	2.90	1.00
Freund	139.52	10-yr	88.64	88.64	88.87	0.047861	3.90	3.90			1.19	1.28	2.75	1.01
Freund	139.52	5-yr	88.56	88.56	88.77	0.048787	3.69	3.69			1.10	1.08	2.59	1.01
Freund	139.52	2-yr	88.38	88.38	88.53	0.052156	3.07	3.07			0.84	0.65	2.25	1.00
Freund	139.52	BF	88.38	88.38	88.53	0.052156	3.07	3.07			0.84	0.65	2.25	1.00
Freund	139.52	1/2 BF	88.26	88.26	88.36	0.056078	2.52	2.52			0.64	0.40	2.02	1.00
Freund	139.52	Winter	88.06	88.06	88.09	0.089178	1.32	1.32			0.27	0.05	1.06	1.04
Freund	139.52	Summer	88.02	88.02	88.02	0.000978	0.07	0.07			0.00	0.01	0.75	0.09
Freund	117.53	100-yr	84.68	84.68	84.85	0.053584	3.31	3.31			0.95	2.41	7.76	1.05
Freund	117.53	50-yr	84.66	84.66	84.81	0.052219	3.14	3.14			0.88	2.23	7.61	1.02
Freund	117.53	25-yr	84.62	84.62	84.77	0.050871	3.03	3.03			0.83	1.98	6.95	1.00
Freund	117.53	10-yr	84.49	84.49	84.71	0.050739	3.70	3.70			1.11	1.35	3.30	1.02
Freund	117.53	5-yr	84.42	84.42	84.62	0.050932	3.56	3.56			1.05	1.12	2.91	1.01
Freund	117.53	2-yr	84.23	84.23	84.38	0.054972	3.10	3.10			0.87	0.65	2.22	1.01
Freund	117.53	BF	84.23	84.23	84.38	0.054972	3.10	3.10			0.87	0.65	2.22	1.01
Freund	117.53	1/2 BF	84.12	84.12	84.21	0.046954	2.35	2.35			0.55	0.43	2.02	0.90
Freund	117.53	Winter	83.87	83.87	83.90	0.082667	1.42	1.42			0.30	0.05	0.79	1.01
Freund	117.53	Summer	83.77	83.77	83.78	0.104625	0.53	0.53				0.00	0.16	0.86
Freund	100.01	100-yr	80.35	80.35	80.51	0.045013	3.20	3.20			0.87	2.50	7.87	1.00
Freund	100.01	50-yr	80.31	80.31	80.47	0.047481	3.15	3.15			0.86	2.22	7.46	1.02
Freund	100.01	25-yr	80.28	80.28	80.42	0.048860	3.04	3.04			0.82	1.97	7.11	1.02
Freund	100.01	10-yr	80.24	80.24	80.37	0.050457	2.92	2.92			0.78	1.72	6.75	1.02
Freund	100.01	5-yr	80.20	80.20	80.32	0.052091	2.76	2.76			0.72	1.45	6.34	1.02
Freund	100.01	2-yr	80.06	80.06	80.17	0.052407	2.63	2.63			0.67	0.76	3.52	1.00
Freund	100.01	BF	80.06	80.06	80.17	0.052407	2.63	2.63			0.67	0.76	3.52	1.00
Freund	100.01	1/2 BF	79.95	79.95	80.03	0.056530	2.33	2.33			0.57	0.43	2.56	1.00
Freund	100.01	Winter	79.77	79.77	79.79	0.085672	1.18	1.18			0.23	0.06	1.37	1.00
Freund	100.01	Summer	79.73	79.73	79.73	0.001115	0.07	0.07			0.00	0.02	1.04	0.10
Freund	80.19	100-yr	74.63	74.63	74.85	0.043425	3.81	3.81			1.12	2.10	4.74	1.01
Freund	80.19	50-yr	74.59	74.59	74.79	0.044264	3.66	3.66			1.06	1.91	4.67	1.01
Freund	80.19	25-yr	74.54	74.54	74.73	0.045233	3.50	3.50			0.99	1.71	4.59	1.01
Freund	80.19	10-yr	74.50	74.50	74.67	0.046479	3.32	3.32			0.92	1.51	4.50	1.01
Freund	80.19	5-yr	74.45	74.45	74.60	0.047989	3.10	3.10			0.84	1.29	4.41	1.01
Freund	80.19	2-yr	74.34	74.34	74.43	0.052066	2.48	2.48			0.61	0.81	4.20	1.00
Freund	80.19	BF	74.34	74.34	74.43	0.052066	2.48	2.48			0.61	0.81	4.20	1.00
Freund	80.19	1/2 BF	74.26	74.26	74.32	0.057915	2.08	2.08			0.48	0.48	3.57	1.00
Freund	80.19	Winter	74.10	74.10	74.11	0.043320	0.92	0.92			0.13	0.08	1.53	0.73
Freund	80.19	Summer	74.04	74.04	74.04	0.003450	0.11	0.11			0.00	0.01	0.68	0.17

Appendix D

Large Wood Structure Stability Analyses

Figure 1: Freebody Diagram



Required Calculations

Force Balance / Momentum

$\Sigma Fy = 0$, $F_F (\sin\theta) + F_G = F_B + F_L + F_{NT} + F_{NRW}$

$\Sigma Fx = 0$, $F_F (\cos\theta) = F_{\mu RW} + F_{\mu T}$

$\Sigma Mo = 0$, $F_{NT} (L_T \cos\theta + z) + F_B z + F_L z = (F_G + B_R)z + F_F (2/3\ d_w)$

Geometric Calculations and Forces

$\mu_{BED} = \tan\phi$

$\theta = \tan^{-1}((½D_{RW})/(L_T))$

$z = (½\ D_{RW}) \sin\theta$

$\forall_{RW} = (\pi (D_{RW})^2)/4)\ L_{RW}\ (1-\eta_P)$

$\forall_T = (\pi (D_T/2)^2)\ L_T$

$\forall_{Tsub} = (d_w/\sin\theta)(\pi r^2)$

$A_{Rwsub} = (A_{RW})(P_{sub})$

$\forall_{Rwsub} = A_{RWsub} L_{RW}$

$F_G = (\forall_T + \forall_{RW})\ \rho_T$

$F_B = (\forall_{Tsub} + \forall_{RWsub})\ \rho_w$

STOP, CHECK FS_B

> $FS_B = F_G/F_B$
>
> If $FS_B < 1.5$, add required ballast (B_R) to obtain $FS_B = 1.5$ before continuing calculations
>
> $FS_B = (F_G + B_R)/F_B$
>
> $B_R = ((FS_B)(F_B)) - F_G$

$F_F = (v^2/2g)\ A_{RWsub}\ \rho_w\ C_D$

$F_L = (v^2/2g)\ (\forall_T + \forall_{RW})\ \rho_w\ C_L$

Sum of Moments and Factors of Safety

1. ΣFy, $F_F (\sin\theta) + (F_G + B_R) = F_B + F_L + F_{NT} + F_{NRW}$
2. ΣMo, $F_{NT} (L_T\cos\theta + z) + F_B z + F_L z = (F_G + B_R) z + F_F (2/3\ d_w)$

Solve Equation 2. for F_{NT}, substitute into Equation 1. Solve for F_{NRW}

3. $F_{\mu T} = F_{NT}\ \mu_{BED}$
4. $F_{\mu RW} = F_{NRW}\ \mu_{BED}$

$FS_M = (F_{\mu T} + F_{\mu RW}) / (F_F (\cos\theta))$

$FS_B = ((F_G + B_R) + F_F (\sin\theta)) / (F_B + F_L)$

Notation and Constants

F_B	=	force due to buoyancy		
F_G	=	force due to gravity		
F_F	=	force due to flow		
F_μ	=	force due to friction between LW and bed		
F_L	=	force due to lift		
F_N	=	force normal to LW at the tip and the rootwad		

Subscripts T and RW refer to the tree and rootwad respectively

ρ_T	=	density of the tree	See Table 2	
ρ_W	=	density of water	=	62.4 $\#/ft^3$
S_g	=	Specific Gravity		
		Water	=	1.0
		Rock (average for quartz)	=	2.65
g	=	acceleration due to gravity	=	32.2 ft/s^2
B_R	=	ballast required (submerged weight)	=	#
v	=	velocity of flowing water	=	ft/s
d_w	=	depth of water	=	ft
η_P	=	porosity		
θ	=	angle from rootwad face to vertical	=	degrees
ϕ	=	internal angle of friction for bed material (*See Table 1*)	=	degrees
μ_{BED}	=	coefficient of friction for bed material		
z	=	distance in the x direction from the center of gravity to the point of interest	=	ft
L_T	=	length of the tree	=	ft
D_T	=	diameter of the tree	=	ft
L_{RW}	=	thickness of the rootwad	=	ft
D_{RW}	=	diameter of the rootwad	=	ft
$\forall$	=	volume	=	ft^3
A	=	area	=	ft^2
P_{sub}	=	proportion submerged (from Figure 2)		

Subscripts T, RW, and BD refer to tree, rootwad, and boulder respectively. *Subscript SUB refers to the submerged values.*

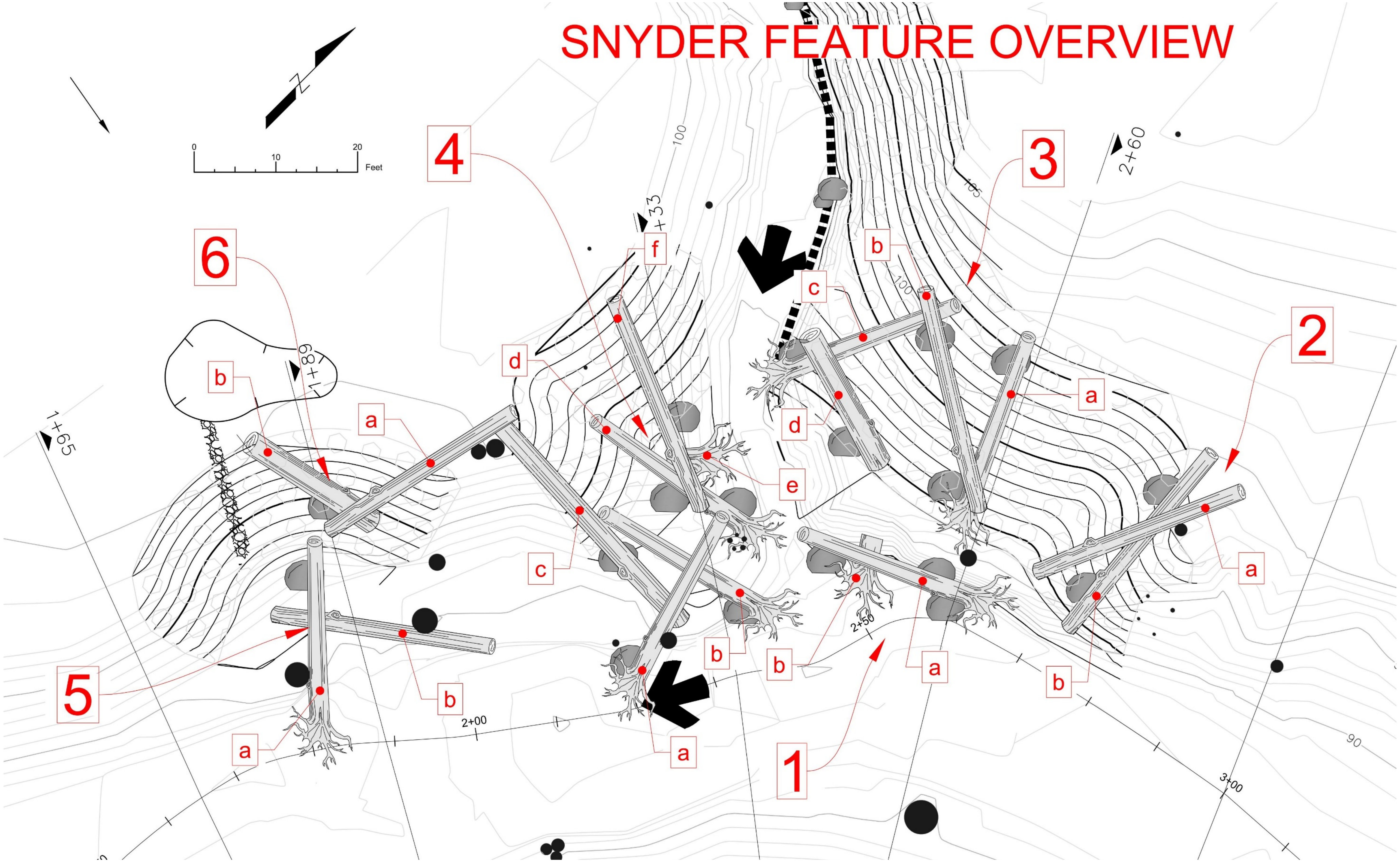
C_D	=	coefficient of fluid drag		
		C_{DT}	=	0.3
		C_{DRW}	=	1.2
		C_{DBD}	=	0.2
C_L	=	coefficient of lift for large roughness element =	0.18	
FS_B	=	factor of safety – buoyancy		
FS_M	=	factor of safety -- momentum		

C_D and C_L values derived from: D'Aoust and Millar, 1999

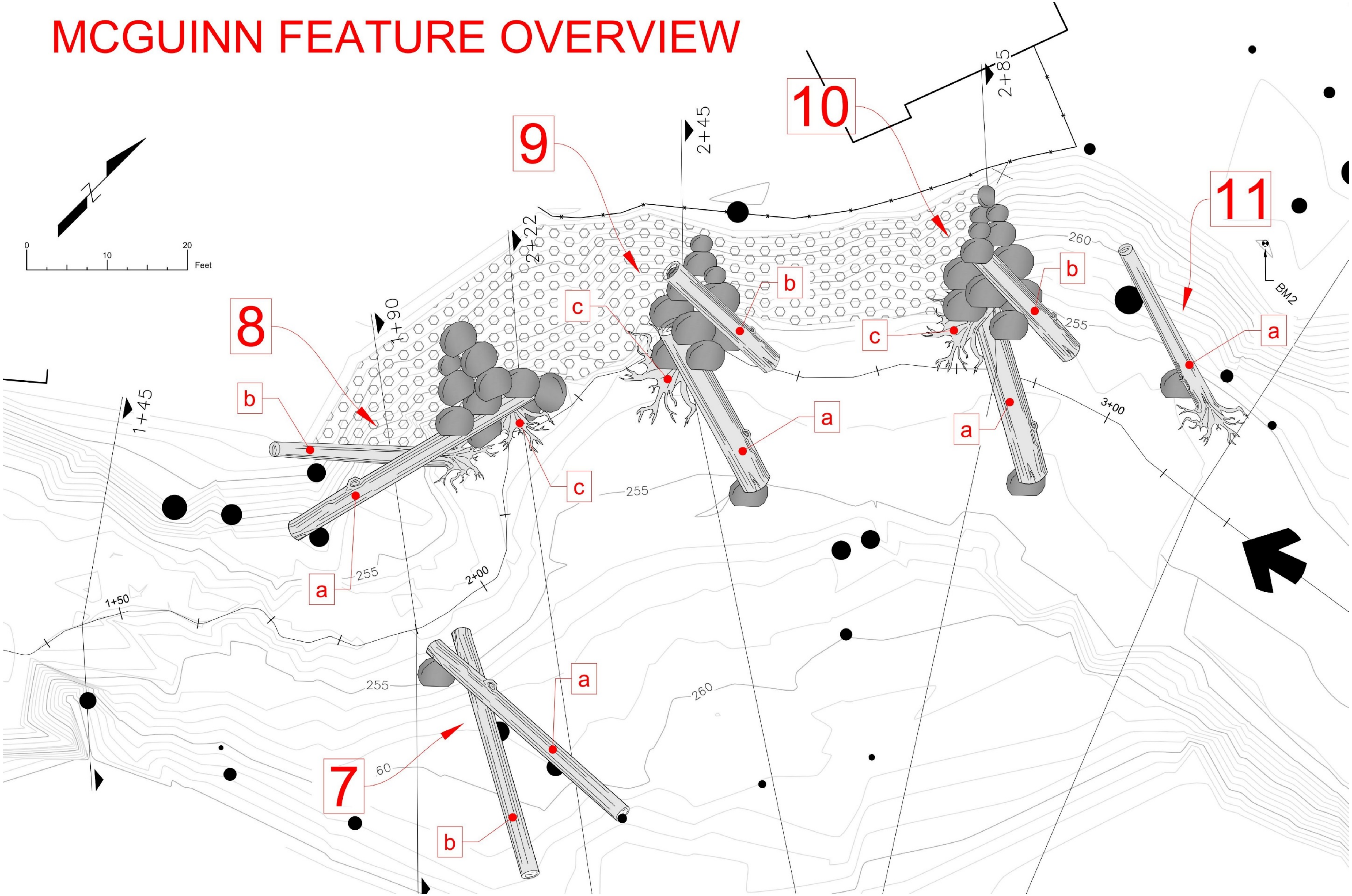
Large Wood Stability Analysis

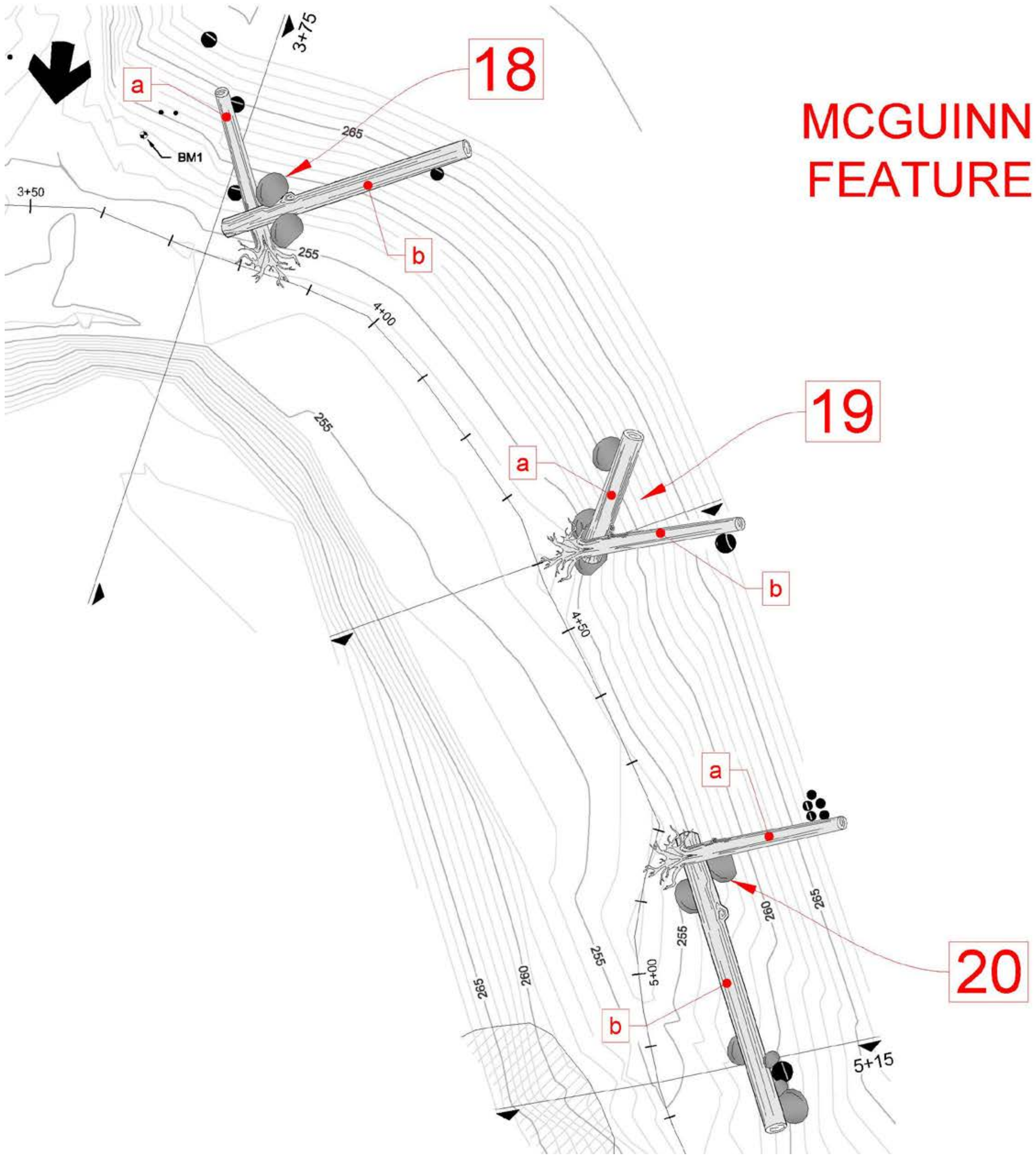
Feature number	Feature component number	Total pieces of wood (#)	Log length (ft)	Log width (ft)	Tree with rootwad	Rootwad length (ft)	Rootwad width (ft)	Tree volume (ft^3)	Rootwad volume (ft^3)	Total volume (ft^3)	% submerged	Force gravity (lbs)	Force boyancy (lbs)	Ballast from live tree anchor (lbs)	Log flow acting area (ft^2)	Rootwad flow acting area (ft^2)	Channel velocity for force of lift calculation	Force of lift from flow (lbs)	Force of flow (lbs)	Weight of boulder required to counteract buoyancy & lift (tons) FS_B=1.5	Normal force (without live tree ballast) (lbs)	Resistance force from live tree ballast (lbs)	Factor of safety for momentum (FS_M=2 min)	Governing factor of safety	Final weight of boulder required for FS_B=1.5 min & $FS_{M=2}$ min (tons)
1	**1A**	2	20	1.5	Yes	5	3	35	44	79	100%	2673	4950	0	0	15	11.33	1776	2239	9.3	1694.9	0.0	1.0	Momentum	13.6
	1B		Rootwad		N/A	5	3	0	44	44	100%	1483	2746	0	0	15	11.33	985	2239		3499.6	0.0			
2	**2A**	2	30	2	No	0	0	94	0	94	80%	3175	4702	8000	60	0	11.33	2109	2239	4.9	-603.2	8000.0	3.1	Bouyancy/ Lift	4.9
	2B		30	2	No	0	0	94	0	94	80%	3175	4702	0	0	0	11.33	2109	0		-603.2	0.0			
3	**3A**	4	20	1.5	Yes	5	3	35	44	79	80%	2673	3960	0	22.5	15	8	885	1535	14.0	2153.6	0.0	2.3	Bouyancy/ Lift	14.0
	3B		30	2	No	0	0	94	0	94	80%	3175	4702	0	0	0	8	1051	0		1746.2	0.0			
	3C		20	1.5	Yes	5	3	35	44	79	80%	2673	3960	0	0	15	8	885	1116		2153.6	0.0			
	3D		20	1.5	No	0	0	35	0	35	100%	1190	2204	0	30	0	8	394	558		2917.5	0.0			
4	**4A**	6	25	1.5	Yes	5	3	44	44	88	100%	2971	5501	8000	30	15	8	984	1674	18.1	217.5	8000.0	2.4	Bouyancy/ Lift	18.1
	4B		25	2	Yes	5	3	79	44	123	100%	4128	7644	0	40	15	8	1367	1860		-1151.5	0.0			
	4C		40	1.5	No	0	0	71	0	71	80%	2381	3527	8000	0	0	8	789	0		1797.0	8000.0			
	4D		25	2	Yes	5	3	79	44	123	100%	4128	7644	0	40	15	8	1367	1860		-1151.5	0.0			
	4E		Rootwad		N/A	5	3	0	44	44	100%	1483	2746	0	0	15	8	491	1116		1977.6	0.0			
	4F		30	2	No	0	0	94	0	94	80%	3175	4702	0	60	0	8	1051	1116		1152.2	0.0			
5	**5A**	2	25	2	Yes	5	3	79	44	123	100%	4128	7644	8000	40	15	11.33	2743	3731	3.4	-5550.8	8000.0	2.1	Bouyancy/ Lift	3.4
	5B		30	2	No	0	0	94	0	94	100%	3175	5878	8000	0	0	11.33	2109	0		-4105.0	8000.0			
6	**6A**	2	30	2	No	0	0	94	0	94	80%	3175	4702	8000	60	0	11.33	2109	2239	3.0	-1773.5	8000.0	2.7	Bouyancy/ Lift	3.0
	6B		20	2	No	0	0	63	0	63	80%	2116	3135	0	0	0	11.33	1406	0		-561.2	0.0			
Snyder Total		18																							57.0
7	**7A**	2	40	2	No	0	0	126	0	126	80%	4233	6270	8000	80	0	6.08	810	860	0.0	-2847.0	8000.0	13.0	Bouyancy/ Lift	0.0
	7B		40	2	No	0	0	126	0	126	80%	4233	6270	8000	0	0	6.08	810	0		-2847.0	8000.0			
8	**8A**	3	40	2	No	0	0	126	0	126	100%	4233	7837	8000	80	0	6.08	810	860	2.9	-3209.6	8000.0	5.2	Bouyancy/ Lift	2.9
	8B		35	2	Yes	5	3	110	44	154	80%	5186	7683	8000	0	15	6.08	992	645		-2283.6	8000.0			
	8C		Rootwad		N/A	5	3	0	44	44	100%	1483	2746	0	0	15	6.08	284	645		-341.6	0.0			
9	**9A**	3	25	3	No	0	0	177	0	177	100%	5952	11021	0	75	0	6.08	1139	806	14.3	-289.7	0.0	3.5	Bouyancy/ Lift	14.3
	9B		20	1.5	Yes	5	3	35	0	35	100%	1190	2204	0	0	15	6.08	228	645		4676.6	0.0			
	9C		Rootwad		N/A	5	3	0	44	44	100%	1483	2746	0	0	15	6.08	284	645		4371.7	0.0			
10	**10A**	3	25	3	No	0	0	177	0	177	100%	5952	11021	0	75	0	6.08	1139	806	14.3	-289.7	0.0	3.5	Bouyancy/ Lift	14.3
	10B		20	1.5	Yes	5	3	35	0	35	100%	1190	2204	0	0	15	6.08	228	645		4676.6	0.0			
	10C		Rootwad		N/A	5	3	0	44	44	100%	1483	2746	0	0	15	6.08	284	645		4371.7	0.0			
11	**11A**	1	35	2	Yes	5	3	110	44	154	100%	5186	9603	8000	60	15	6.08	992	1289	2.2	-2710.1	8000.0	4.4	Bouyancy/ Lift	2.2
18	**18A**	2	30	2	Yes	5	3	94	44	138	100%	4657	8624	8000	50	15	6.08	891	1182	0.0	-4856.6	8000.0	4.7	Bouyancy/ Lift	0.0
	18B		40	2	No	0	0	126	0	126	80%	4233	6270	8000	80	0	6.08	810	860		-2846.2	8000.0			
19	**19A**	2	25	2	No	0	0	79	0	79	100%	2645	4898	0	50	0	6.08	506	537	3.6	-521.2	0.0	4.0	Bouyancy/ Lift	3.6
	19B		30	2	Yes	5	3	94	44	138	80%	4657	6899	8000	50	15	6.08	891	1182		-894.7	8000.0			
20	**20A**	2	30	2	Yes	5	3	94	44	138	80%	4657	6899	8000	15	15	6.08	891	806	0.0	-3132.6	8000.0	5.8	Bouyancy/ Lift	0.0
	20B		40	2	No	0	0	126	0	126	100%	4233	7837	8000	80	0	6.08	810	860		-4414.5	8000.0			
Mcguinn Total		18																							37.3
12	**12A**	6	30	2	No	0	0	94	0	94	100%	3175	5878	8000	60	0	4.8	379	402	21.9	1449.9	8000.0	7.8	Bouyancy/ Lift	21.9
	12B		40	2	No	0	0	126	0	126	80%	4233	6270	0	0	0	4.8	505	0		1990.0	0.0			
	12C		25	2	Yes	5	3	79	44	123	80%	4128	6115	0	0	15	4.8	492	402		2052.7	0.0			
	12D		25	2	Yes	5	3	79	44	123	80%	4128	6115	0	0	15	4.8	492	402		2052.7	0.0			
	12E		25	2	Yes	5	3	79	44	123	80%	4128	6115	0	0	15	4.8	492	402		2052.7	0.0			
	12F		25	2	Yes	5	3	79	44	123	80%	4128	6115	0	40	15	4.8	492	670		2052.7	0.0			
13	**13A**	2	35	2	No	0	0	110	0	110	100%	3704	6858	6000	70	0	4.8	442	469	6.8	637.3	6000.0	15.1	Bouyancy/ Lift	6.8
	13B		35	2	No	0	0	110	0	110	100%	3704	6858	0	0	0	4.8	442	0		637.3	0.0			
14	**14A**	1	Rootwad		N/A	5	3	0	44	44	100%	1483	2746	0	0	15	4.8	177	402	2.3	1452.7	0.0	3.0	Bouyancy/ Lift	2.3
15	**15A**	1	Rootwad		N/A	5	3	0	44	44	100%	1483	2746	0	0	15	4.8	177	402	2.3	1452.7	0.0	3.0	Bouyancy/ Lift	2.3
16	**16A**	1	Rootwad		N/A	5	3	0	44	44	100%	1483	2746	0	0	15	4.8	177	402	2.3	1452.7	0.0	3.0	Bouyancy/ Lift	2.3
17	**17A**	2	20	1.5	No	0	0	35	0	35	100%	1190	2204	0	20	0	4.8	142	134	4.2	1451.4	0.0	4.1	Bouyancy/ Lift	4.2
	17B		Rootwad		N/A	5	3	0	44	44	100%	1483	2746	0	0	15	4.8	177	402		1167.6	0.0			
Watson Total		13																							40.0

SNYDER FEATURE OVERVIEW

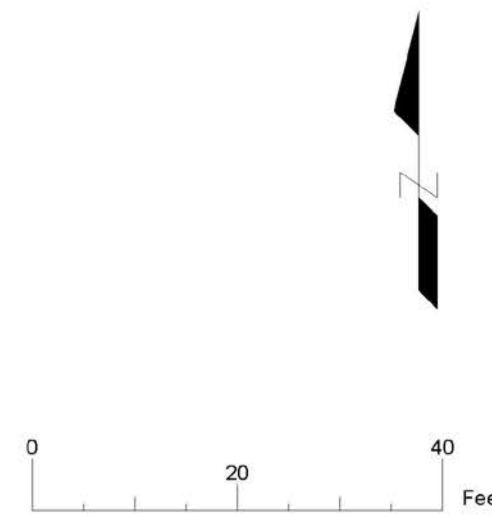


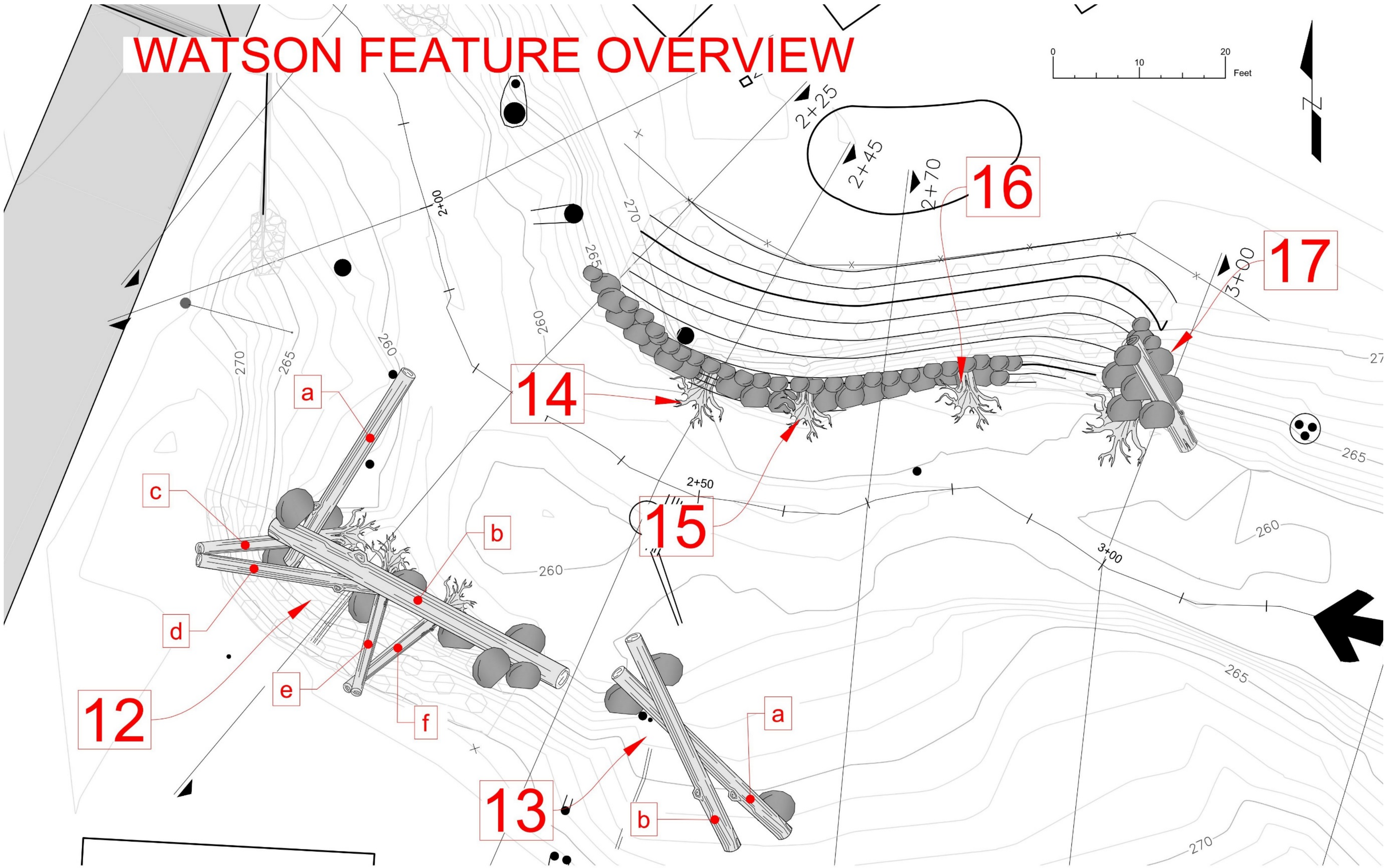
MCGUINN FEATURE OVERVIEW





MCGUINN UPSTREAM FEATURE OVERVIEW





WATSON FEATURE OVERVIEW
0
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Feet
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c
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e
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a
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2+00
2+25
2+45
2+50
2+70
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Appendix E

Marin County Creek Permit Questionnaire Key

Marin County Creek Permit Checklist Questions	Snyder	McGuinn	Watson
1) Describe how the project will help the stream attain an equilibrium condition so that the channel will erode and transport sediment and create and sustain instream habitat without creating conditions leading to excessive erosion and/or excessive deposition. In the process of addressing this issue of equilibrium, explain what factors are influencing the channel you are working with, such as:	See Section 8.1.2 Project objectives and Section 8.1.3 Snyder Design for a description of how project site will be improved geomorphologically and salmon habitat will be increased--- Also, See Section 8.1.5.1 Biological Evaluation for further discussion of salmon habitat improvements and Section 8.1.5.3 Site Physiography for further description of geomorphologic improvements	See Section 8.2.2 Project objectives and Section 8.2.3 Mcguinn Design for a description of how project site will be improved geomorphologically and salmon habitat will be increased	See Section 8.3.2 Project objectives and Section 8.3.3 Watson Design for a description of how project site will be improved geomorphologically and salmon habitat will be increased
a. Is the bed materials composed of fine sediments, gravel, cobble, or bedrock?	See Section 5- Geomorphology	See Section 5- Geomorphology	See Section 5- Geomorphology
b. Is the stream influenced by landscape features such as alluvial fans or tides?	The stream at this project location is not influenced by alluvial fans or tides	The stream at this project location is not influenced by alluvial fans or tides	The stream at this project location is not influenced by alluvial fans or tides
c. What are the channel slopes and valley slopes, and what is the condition of the streamside riparian vegetation?	See Section 8.1.3- Snyder Design	See Section 8.2.3- McGuinn Design	See Section 8.3.3- Watson Design
2) Stream channel classification systems can be used to aid your descriptions of the conditions and channel types.	Stream channel classification is not applicable	Stream channel classification is not applicable	Stream channel classification is not applicable
3) Describe the dimensions of the stream's active channel or bankfull channel that you plan to protect or restore to achieve a balanced sediment transport and storage.	See Figure 6 for approximate floodplain extents and Table 5- Bankfull Width, Mean Total Stream Velocity and Shear Values	See Figure 7 for approximate floodplain extents and Table 5- Bankfull Width, Mean Total Stream Velocity and Shear Values	See Figure 8 for approximate floodplain extents and Table 5- Bankfull Width, Mean Total Stream Velocity and Shear Values
4) Describe how these dimensions are derived. Provide information on the drainage area of the watershed being drained to your project site.	Results were derived per Section 7.2.1- Existing conditions hydraulic models (Snyder, McGuinn, and Watson)- Drainage areas and flows are listed in Table 1 per methodology described in Section 7.1.1	Results were derived per Section 7.2.1- Existing conditions hydraulic models (Snyder, McGuinn, and Watson)- Drainage areas and flows are listed in Table 1 per methodology described in Section 7.1.1	Results were derived per Section 7.2.1- Existing conditions hydraulic models (Snyder, McGuinn, and Watson)- Drainage areas and flows are listed in Table 1 per methodology described in Section 7.1.1
5) Describe how the project protects and/or restores the floodplain.	See Snyder Design Plan and Profile and Sections (Appendix A) for proposed restoration of floodplain with natural structures. See Snyder Design Planting Plan for native planting in the floodplain and on banks. See Sections 8.1.2-8.1.5 for bank and floodplain restoration descriptions	See McGuinn Design Plan and Profile and Sections (Appendix A) for proposed restoration of floodplain with natural structures. See McGuinn Design Planting Plan for native planting in the floodplain and on banks. See Sections 8.2.2-8.2.4 for bank and floodplain restoration descriptions	See Watson Design Plan and Profile and Sections (Appendix A) for proposed restoration of floodplain with natural structures. See Watson Design Planting Plan for native planting in the floodplain and on banks. See Sections 8.3.2-8.3.4 for bank and floodplain restoration descriptions
6) Describe how the project protects and/or restores the native streamside vegetation.	See Snyder Design Planting Plan for native planting streamside restoration (Appendix A)	See McGuinn Design Planting Plan for native planting streamside restoration (Appendix A)	See Watson Design Planting Plan for native planting streamside restoration (Appendix A)
7) Describe how the project protects or restores the stream channel slope by avoiding destabilizing grade control structures and/or by addressing an equilibrium channel length. Provide information on the valley slope and the proposed channel slope and sinuosity of the stream.	See Section 8.1.3- Downstream bedrock controls channel gradient. See Section 8.1.3- Snyder Design for valley and channel slopes. The sinuosity is not relevant because we do not propose any alterations to existing channel geometry	See Section 8.2.3- McGuinn Design- Two middle right bank structures are designed primarily to promote bank stability and control channel gradient. See Section 8.2.3- McGuinn Design for valley and channel slopes. Sinuosity is not relevant because we do not propose any alterations to existing channel geometry	See Section 8.3.3- Watson Design- The channel gradient is bedrock controlled. See Section 8.3.3 for valley and channel slopes. Sinuosity is not relevant because we do not propose any alterations to existing channel geometry
8) For projects that entail the restoration of stream banks, provide information on the shear stresses expected to act on the banks and what soil bioengineering systems are proposed to address the stabilization needs.	See Section 7.2.1 Existing conditions hydraulic models (Snyder, McGuinn, and Watson)- Table 5- Bankfull Width, Mean Total Stream Velocity, and Shear Values for shear stresses- See Snyder Plan and Profile, Sections, and Planting Plans (Appendix A) for proposed bank stabilization and soil bioengineering systems	See Section 7.2.1 Existing conditions hydraulic models (Snyder, McGuinn, and Watson)- Table 5- Bankfull Width, Mean Total Stream Velocity, and Shear Values for shear stresses - See McGuinn Plan and Profile, Sections, and Planting Plans (Appendix A) for proposed bank stabilization and soil bioengineering systems	See Section 7.2.1 Existing conditions hydraulic models (Snyder, McGuinn, and Watson)- Table 5- Bankfull Width, Mean Total Stream Velocity, and Shear Values for shear stresses - See Watson Plan and Profile, Sections, and Planting Plans (Appendix A) for proposed bank stabilization and soil bioengineering systems
9) Are salmonids present in the stream where your project is located or could salmonids reach this area if migration barriers were to be removed? If so describe how the proposed project will avoid or remove migration barriers and protect or enhance spawning or rearing habitat.	See Sections 8.1.3 Snyder Design & 8.1.5.1 Biological evaluation for habitat related information	See Section 8.2.3 Mcguinn Design for habitat related information	See Section 8.3.3 Watson Design for habitat related information