

Group Design Exercise

Read through your project site packet and then work with your group to address the following questions. Assign the task of taking notes to a member of your group. They will be responsible for presenting your group's selected design alternative at the end of the exercise.

1. For the project site you have been assigned to, what are the primary objectives and constraints identified by your group?
2. What design option did your group select for the site? Describe the overall project you would propose and the key considerations that went into making your selection.
3. What additional information would be needed to confirm these decisions?

San Juan Creek Project Description

Background

Located in central California, San Juan Creek is a major tributary to the Spanish Bay estuary and supports runs of steelhead trout. Most of the habitat suitable for spawning and summer rearing is located within the upper portions of the mainstem, as well as within several tributaries.

The upper portion of the San Juan Creek watershed lies in relatively steep coastal hills. Within these hills the stream flows through a moderately entrenched channel that has numerous large pools. This portion of the stream maintains good flows and cool water temperatures throughout the summer, making it excellent rearing habitat for salmonids. Further upstream near the headwaters is a dam and small water supply reservoir. The dam regulates flow to the lower channel during the summer months, but does not typically influence the winter's storm hydrograph.

As San Juan Creek emerges from the hills it flows through a correctional facility, where an old abandoned diversion dam is located. The upstream side of the dam has become completely filled with substrate. Downstream the channel runs parallel to the highway before reaching Spanish Bay. A low-gradient depositional channel containing large amounts of gravel and sand characterizes this portion of the stream. The channel capacity is relatively low, with overbank flows typically occurring several times each year. Below the diversion dam, the channel is intermittent during most years, with isolated pools forming during summer months.

Fish and Game recently conducted habitat surveys and fish sampling throughout most of the stream. They characterized the lower stream reach as containing suitable habitat for steelhead but lacking summer rearing habitat due to intermittent summer flows and warm water temperatures in the remaining isolated pools. During the survey, Fish and Game also found several red-legged frogs, an endangered species.

Fish and Game has determined that passage must be improved for both adult and juvenile steelhead at the diversion dam location. The project team (that's you) must develop a preferred alternative to present to Fish and Game for approval before a final engineering design is completed. The survey crew has made a hand drawn site map and surveyed a longitudinal profile to assist you in selecting a preferred design alternative.

Project Site Description:

The abandoned diversion dam consists of a concrete weir spanning the channel. The weir is 45.4 feet wide, and contains a three-foot wide low-flow notch. The weir width is 1.8 feet and it has an irregular apron on the downstream side. The overall drop from the low flow notch to the tailwater control is 4.5 feet. At one point an effort was made to chip away the apron at the low-flow notch to improve the attraction flow for migrating steelhead. An 18-inch sewer line is located approximately 2.5 feet below the top of the weir, encased within the concrete.

Downstream of Dam: A large scour pool below the dam, followed by a streambed composed of regularly spaced riffles, pools, and point bars. The streambed is composed of a mixture gravel, cobble, and some sand. Channel banks are gently sloping, 3-4 feet in height. Buildings are located along both banks of the stream, but are set back at least 50 feet.

Upstream of Dam: Immediately upstream of the dam the streambed is composed predominately of cobbles and gravel, and appears to be highly aggraded. During the site survey, stream flow was subsurface upstream of the dam. Further upstream, surface flow reappeared. The banks are 2-3 feet high and composed predominately of clay. Approximately 4,500 feet upstream of the dam is the limit of anadromy – a waterfall of approximately 25 feet in height.

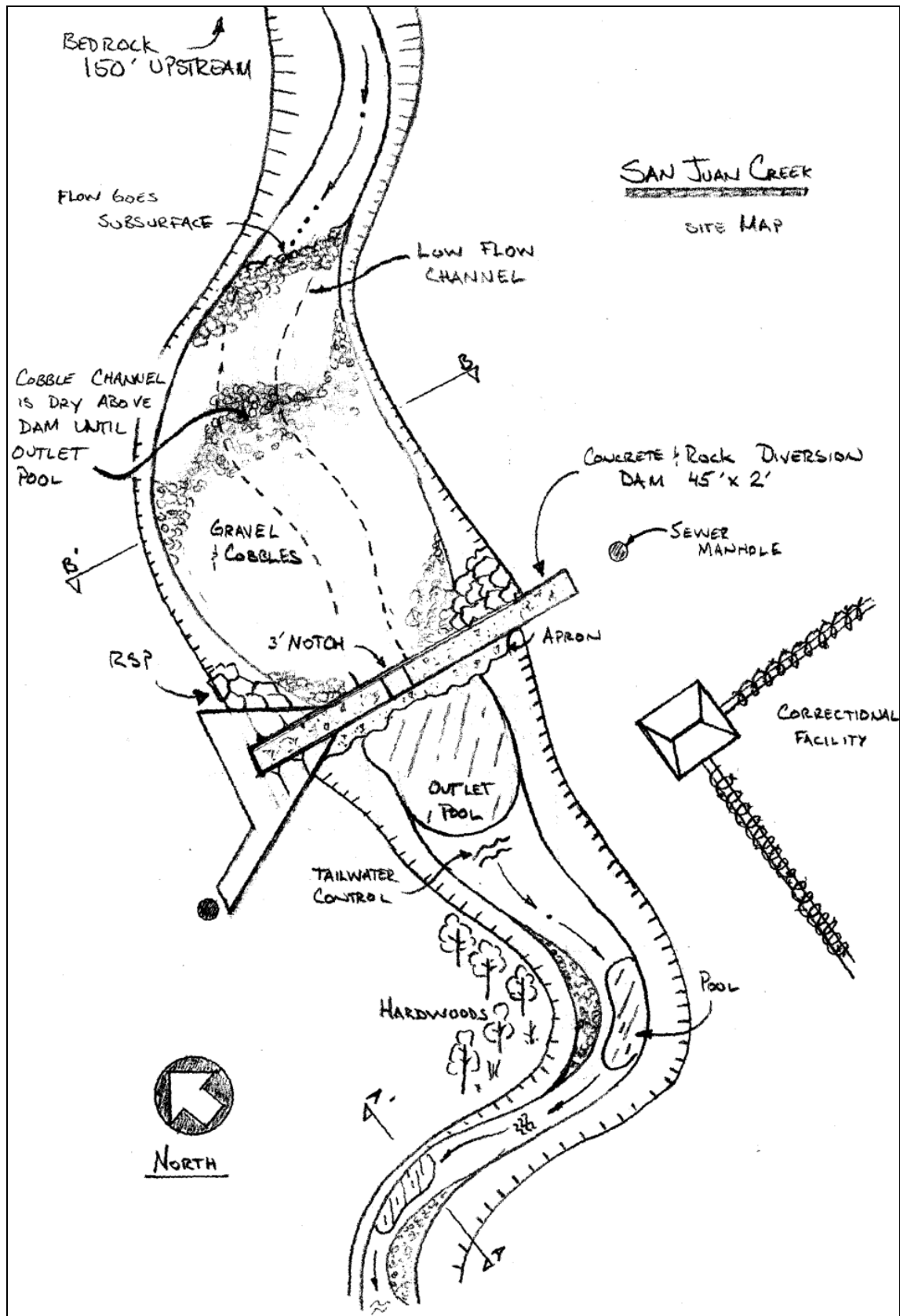
Stream Substrate: Predominately cobbles and gravel with lesser amounts of sand. Some boulders and bedrock.

Average Bankfull Width: 14.0 feet

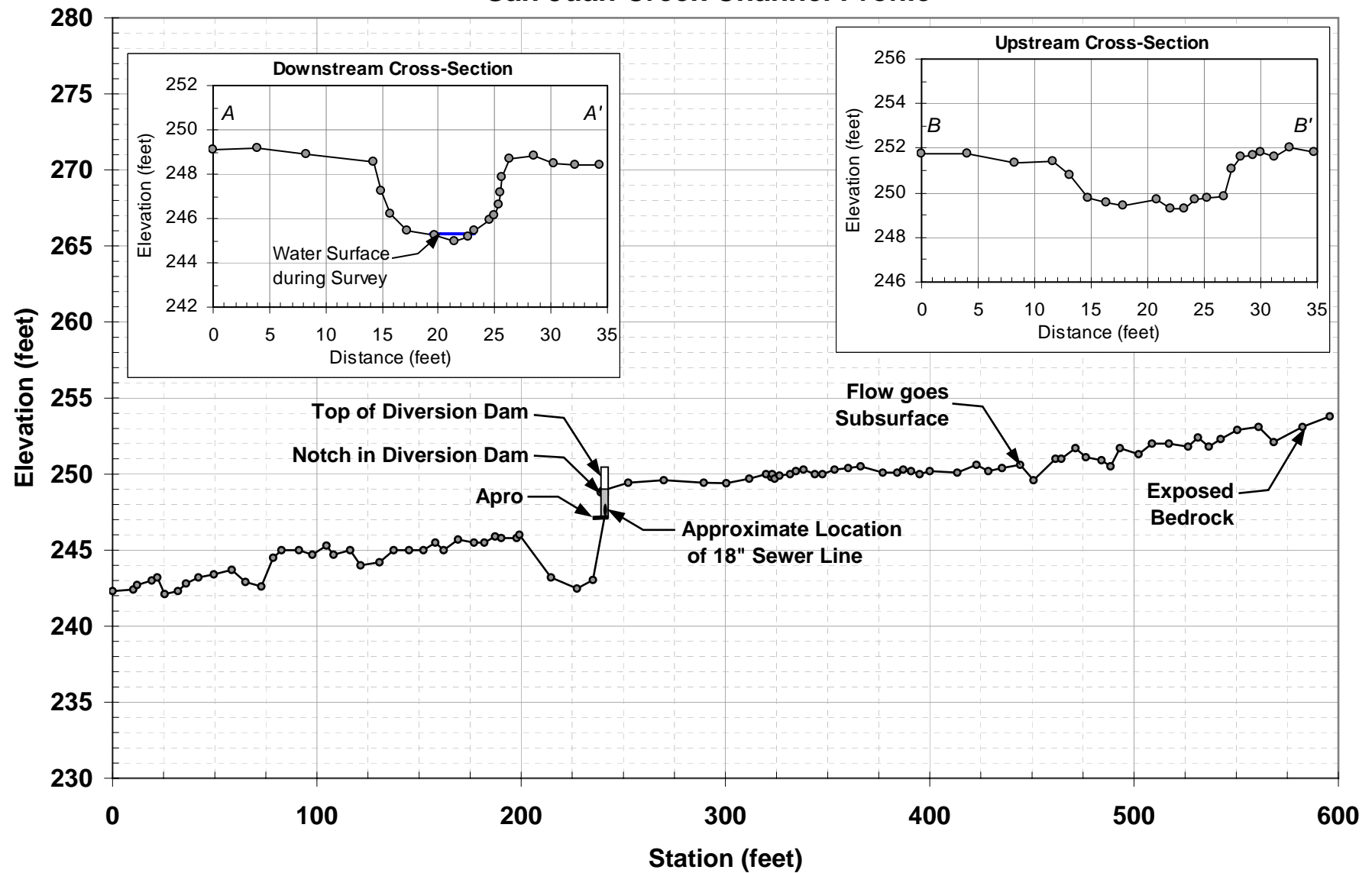
Average Channel Slope: 1.2%

Channel Type: Stable streambed with moderate entrenchment/narrow floodplain, and cobble to gravel substrate with lesser amounts of boulders (Rosgen B3).

Hydrology: The entire 4.3 square mile watershed is rain dominated. Flows within the stream are typically flashy, responding rapidly to rainfall events. Mean annual precipitation is 25 inches. After rains cease, the stream quickly returns to base flow conditions. During summer months flows become extremely low within the downstream reaches, often going sub-surface.



San Juan Creek Channel Profile



Marsh Creek Project Description

Background

Horse Creek is a fourth order stream located approximately 30-miles from the Pacific Ocean. It is a tributary to a larger river system that supports good runs of coho salmon and steelhead trout. Land use within the Horse Creek Watershed is a mixture of industrial timber and rural residential.

Marsh Creek flows through industrial timberlands composed of second and third growth conifer forests before draining into Horse Creek. Although its overall drainage area is quite small, it is fed by a number of perennial springs emerging from the surrounding hillsides. On Horse Creek, several hundred feet upstream from the mouth of Marsh Creek, there is a series of cascades that function as a complete barrier for coho and a low-flow barrier for adult steelhead.

The landowner maintains an unpaved haul road, which crosses Marsh Creek approximately 250 feet upstream of its confluence with Horse Creek. The road was originally constructed as a railroad line used during historical logging activities. The existing culvert is rusted-through and has an outlet perched more than 4-feet above a large deep scour pool. From the outlet pool, it appears that the culvert rests on a layer of exposed clay. Adult and juvenile coho have been observed leaping unsuccessfully at the culvert outlet on numerous occasions.

The stream reach immediately upstream of the crossing consists of marshy wetland habitat. Recent Fish and Game habitat surveys found that the lower channel and wetland contain an abundance of large wood, likely pushed into the channel during early logging activities. Substrate within this portion of the channel consists of sand with some small gravel. Further upstream the channel becomes quite steep, as it drains a relatively steep and highly erosive hillside. The beginning of this steeper reach denotes the upstream limit of anadromy. The habitat survey concluded that Marsh Creek has the potential to provide excellent rearing habitat for coho salmon but contains only limited spawning habitat.

As part of the terms of a recently approved timber harvest plan, the landowner has agreed to upgrade their stream crossing on Marsh Creek so it will “provide fish passage and accommodate the 100-year peak flow”. The landowner has hired your firm to develop a preliminary design alternative that will be presented to Fish and Game for review. Fish and Game also informed the landowner that a pair of Marbled Murrelet (a threatened species) is nesting in trees adjacent to the stream crossing, limiting the work-window to between September 15 and October 15. The survey crew has made a hand drawn site map and surveyed a longitudinal profile to assist the design team (that’s you) in selecting a preferred design alternative.

Project Site Description:

The existing crossing consists of a 48-inch diameter corrugated metal culvert that is 50-ft in length. The overall culvert slope is 1.0 %. The outlet is perched more than 4-ft above the outlet pool.

Downstream of Culvert: A large scour pool has formed at the culvert outlet. Below the pool the channel has steep banks and the bed contains some large wood that creates step pools. Riparian vegetation consists mostly of large alders and some mature redwoods. Several of the alders have recently fallen across the stream.

Upstream of Culvert: Upstream of the culvert the channel is very narrow and relatively deep. Channel banks are only 1.5-2 feet in height and there are considerable amounts of logs and root-wads buried into the streambed and banks. The floodplain is composed of a variety of wetland species with some alders and conifers growing on higher ground further away from the channel.

Upstream Channel Type: - Meandering stream with relatively narrow but deep channel, wide floodplain, and sand and small gravel substrate (Rosgen E5).

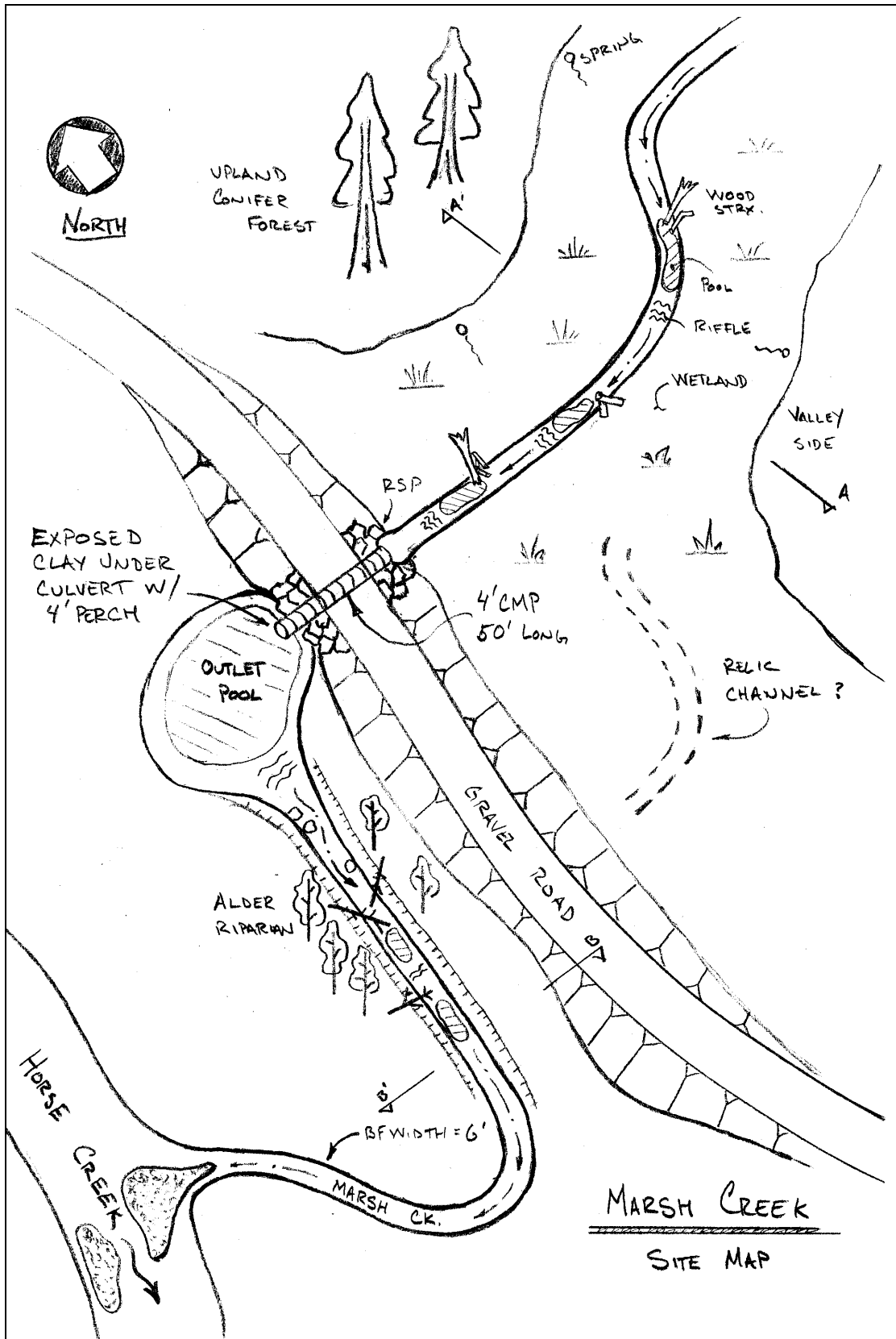
Stream Substrate: Predominately sand and small gravel.

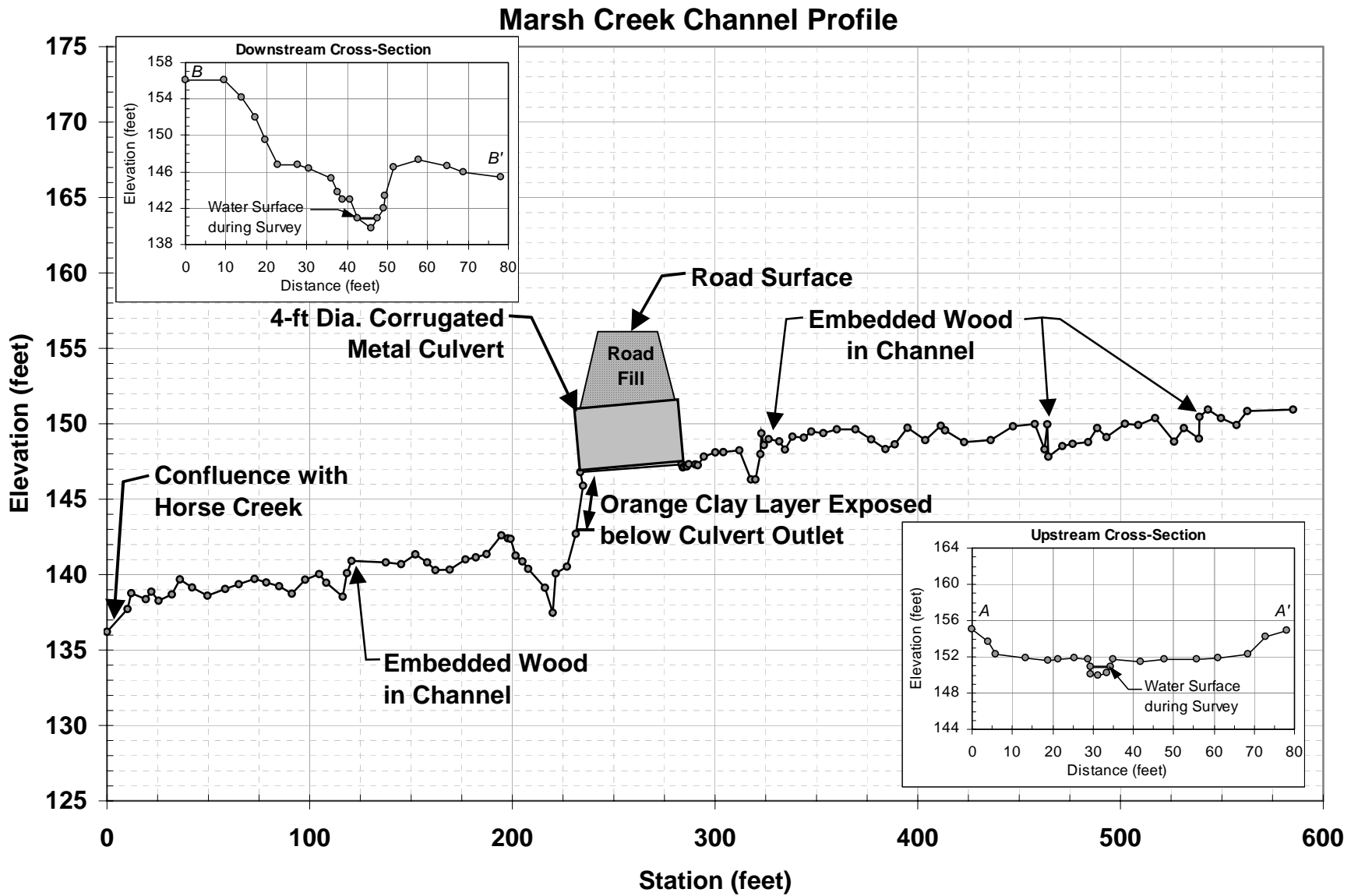
Average Bankfull Widths: Upstream = 6-feet, Downstream = 10 feet.

Average Channel Slope: Upstream = 0.9%, Downstream = 1.7%

Bed Controls: Embedded wood.

Hydrology: The region is rain dominated. However, the channel network is relatively short and the stream seems to be largely spring fed. The stream appears to also have a substantial amount of floodplain storage for its size and responds relatively slow to rainfall.





Verde Creek Project Description

Background

The relatively small Verde Creek flows directly into a coastal estuary. There are numerous stories and some documentation by Fish and Game that this stream historically had healthy runs of steelhead as well as supporting a sizable population of resident rainbow trout. The upper portion of the Verde Creek watershed lies in relatively unpopulated low coastal hills east of the growing town of Las Truchas. Much of the upper portion of the stream is now protected in a State Park. However, the lower portion of the watershed is highly urbanized, with the stream flowing through the center of Las Truchas.

Fish and Game recently conducted habitat surveys and fish sampling throughout most of the stream. The lower portions of the stream were identified as having poor habitat for salmonids due to a lack of large wood and suitable pools, high summer water temperatures, and excessive amounts of fine sediment delivered from bank failures. However, the upstream reaches within the State Park were found to contain suitable spawning and rearing habitat, including several deep pools that contained resident rainbow trout.

The Verde Creek Watershed Council has identified migration barriers that block access to spawning and rearing habitat as being the key limiting factor to restoring a viable steelhead run. Although residents of Las Truchas occasionally observe an adult steelhead attempting to migrate upstream, the fish likely have great difficulty negotiating several steep perched culverts within town.

As part of an ongoing effort to restore steelhead runs to Verde Creek, the local Watershed Council approached the Roads Department and requested that they improve steelhead passage at the stream crossing under 5th Street near downtown Las Truchas. The Roads Department agreed to do a preliminary site assessment and develop a preferred alternative. In exchange, the Watershed Council has agreed to pursue grant funding for final design and implementation of the selected alternative. The survey crew has made a hand drawn site map and surveyed a longitudinal profile to assist the project team (that's you) in selecting a preferred design alternative.

Project Site Description:

The watershed council has identified this crossing as a vertical (leap) barrier for steelhead at all flows, a depth barrier at low flows, and a velocity barrier at high flows.

The crossing consists of 10-ft x 8-ft (width x height) concrete box culvert that is 80-ft in length. The culvert bottom slope is 2.2% and the outlet is perched approximately 4-ft above the outlet pool. The road surface is situated approximately 5-feet above the top of the culvert and the survey crew estimates there is at least 500 cubic yards of fill material associated with the crossing.

Through the watershed council, the landowner at the outlet side of the culvert is willing to have his bank on the east side of the stream be used as both a staging area and as an access point for heavy equipment.

Downstream of Culvert: Channel has vertical sandy banks that are over 10 feet in height. Above the banks is a large terrace where several houses are located. The local residents claim that the streambed has dropped several feet over the last decade.

Upstream of Culvert: Upstream channel banks are 3-4 feet in height. At top of the banks is a small terrace, with a large upper terrace located 6-8 feet above the channel bed. Several homes are located along this portion of the stream.

Approximately 300 feet upstream of the culvert is another stream crossing. It is a 12-foot wide open-arch set on concrete footings. The streambed within the open-arch is mostly large gravel and fish passage does not appear to be an issue.

Stream Substrate: Predominately gravel with a mixture of sand and cobble.

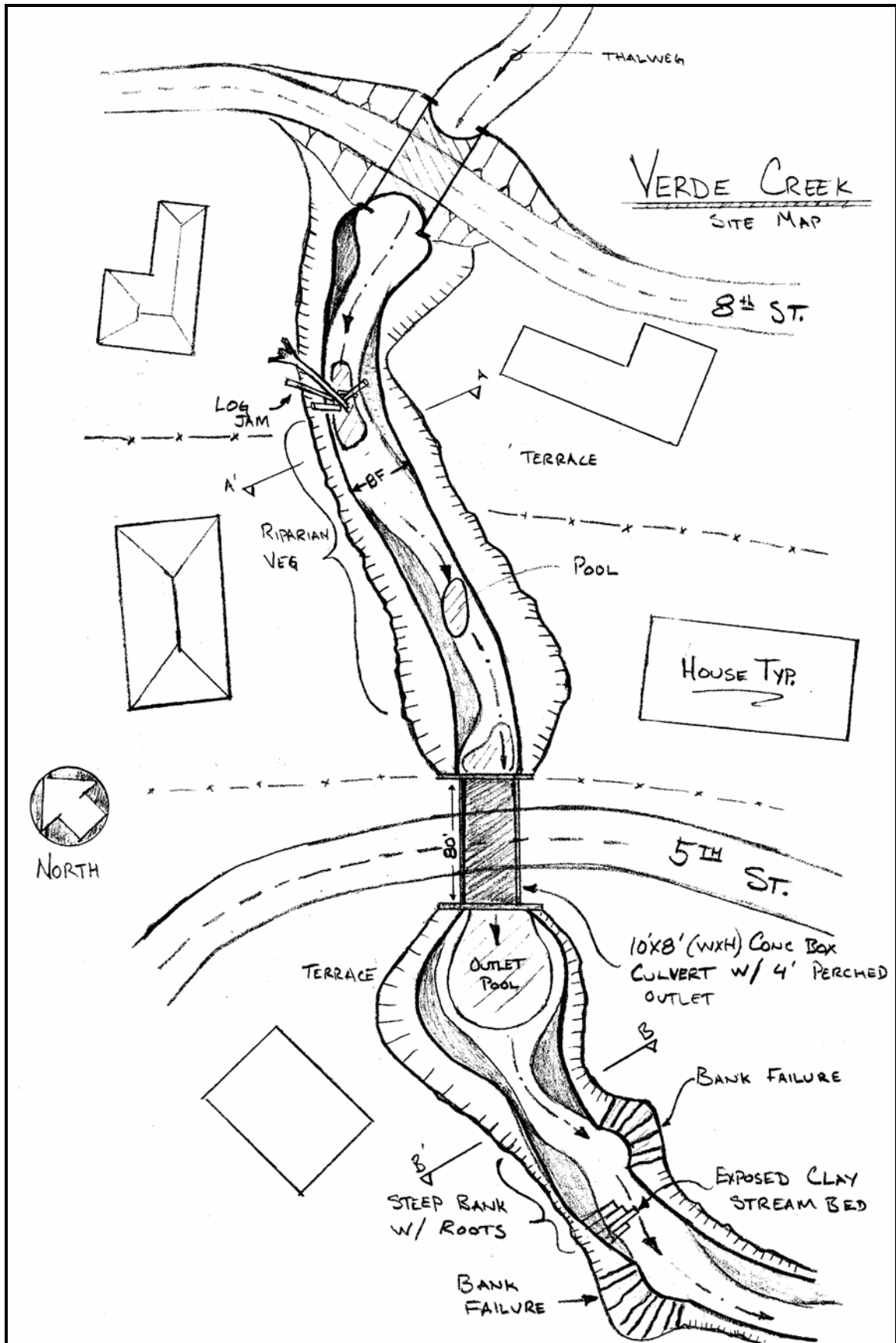
Average Bankfull Widths: Upstream = 13 ft, Downstream = 16.5 ft.

Average Channel Slope: 2.4%

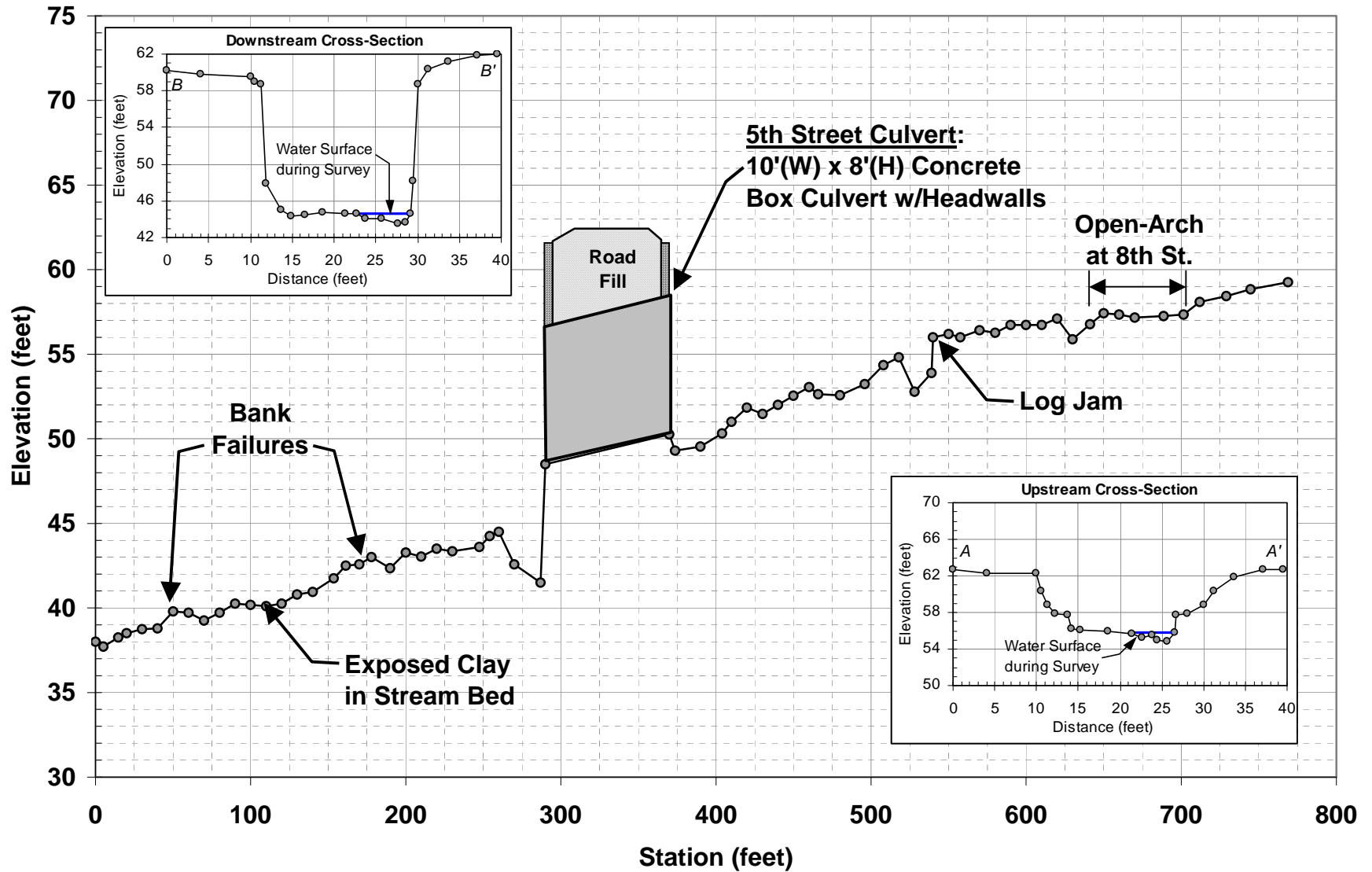
Bed Controls: Moderately resistant clay layer exposed in the downstream channel bed.

Channel Type: A moderately entrenched channel with a series of riffles (rapids) and scour pools (Rosgen B4).

Hydrology: The entire watershed is rain dominated. Flows within the lower portions of the stream are flashy, responding rapidly to rainfall events. After rains cease, the stream quickly returns to base flow conditions. During summer months flows become extremely low within the downstream reaches, where the culvert is located.



Verde Creek Profile



Mill Creek Project Description

Background

Mill Creek is a relatively small tributary to the Deer River as it flows through the small agricultural region of Deer Valley. Deer River has runs of steelhead trout and coho salmon. Most of the steelhead and coho are believed to spawn in smaller tributaries, not in the mainstem of the river. In addition, water temperatures within the river become extremely elevated during summer months as the river nearly dries-up.

The upper portion of the Mill Creek Watershed lies in the relatively steep hills east of the valley. Within these hills the stream flows through a highly entrenched bedrock channel that has numerous large pools. This portion of the stream is perennial, with good flows and cool water temperatures throughout the summer, making it excellent rearing habitat for salmonids. However, it contains only very limited spawning habitat.

As Mill Creek emerges from the hills and into the alluvial valley it flows through a pasture, under Johnson Road, and then through a newly constructed subdivision before reaching the river. A low-gradient depositional channel containing large amounts of gravel and sand characterizes this portion of the stream. The channel capacity is relatively low, with overbank flows typically occurring several times each year. At the stream crossing, Johnson Road becomes flooded during these overbank flows. This portion of the channel is intermittent, drying during summer months.

Fish and Game recently conducted habitat surveys and fish sampling throughout most of the stream. They characterized the stream as containing suitable habitat for steelhead and, to a lesser degree, coho. The lower portions of the stream contains suitable spawning habitat but, since the channel is intermittent, it lacks summer rearing habitat. During the survey, Fish and Game also found several red-legged frogs, an endangered species.

Several subdivisions have recently been constructed in Deer Valley, with more being planned. To accommodate the increased traffic, the Roads Department is planning to widen Johnson Road, which crosses Mill Creek. At the Mill Creek crossing they also wish to reduce the frequency of waters overtopping the road. However, the Roads Department has a relatively small budget for the project and just learned that any proposed design will need to “provide fish passage”. The project team (that’s you) must develop a preferred alternative to present to Fish and Game for approval before a final engineering design is completed. The survey crew has made a hand drawn site map and surveyed a longitudinal profile to assist you in selecting a preferred design alternative.

Project Site Description:

The existing crossing consists of two 3-ft diameter concrete round culverts that are 36-ft in length. The culverts are installed at about a 0.8 % slope. The culvert outlets are perched approximately 1-ft above the outlet pool.

Downstream of Culvert: A large scour pool at the culvert outlet, followed by a streambed composed of regularly spaced riffles, pools, and point bars. The streambed is composed of gravel and some sand. Channel banks are gently sloping, 3-4 feet in height. Houses are set back away from the right bank of the stream.

Upstream of Culvert: Immediately upstream of the culvert the streambed is composed predominately of sand. Further upstream the streambed returns to gravel. The banks are 2-3 feet high and composed predominately of sand. Cattle have open access to the stream and stream banks are devoid of vegetation. Approximately 400 feet upstream is the base of the rolling hills.

Stream Substrate: Predominately gravel with lesser amounts of sand.

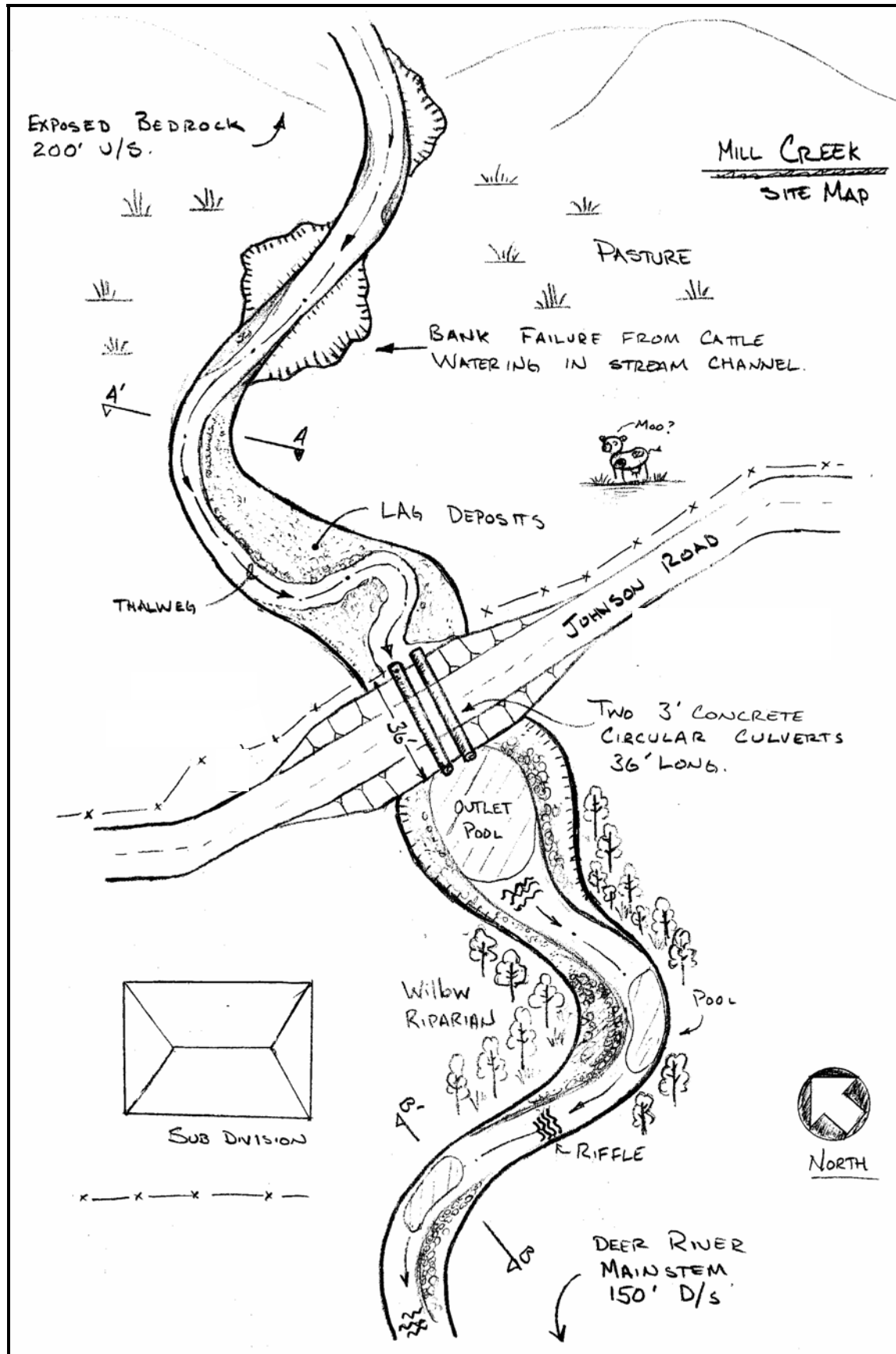
Average Bankfull Widths: 10-feet

Average Channel Slope: Downstream = 1.2%, Upstream = 0.8%

Bed Controls: Exposed bedrock was identified in the upstream channel, as the stream emerges from the hills.

Channel Type: Meandering stream with slight entrenchment/wide floodplain, and gravel substrate (Rosgen C4).

Hydrology: The entire watershed is rain dominated. Flows within the lower portions of the stream are flashy, responding rapidly to rainfall events. After rains cease, the stream quickly returns to base flow conditions. During summer months flows become extremely low within the downstream reaches, where the culvert is located.



Mill Creek Channel Profile

