

DRAFT Summary Report

Wetland and Stream Channel Restoration at the Arcata Redwood Co. Mill B site

1999

Davison Creek Trailhead

A Redwood National and State Parks, ISTEa joint



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Background:

Mill B was an old growth redwood salvage mill constructed prior to 1954. The mill site was cut into a ridge located approximately 25 feet in elevation above the wetland / floodplain of Prairie Creek. Prior to 1962, a upper log deck was constructed adjacent to the south side of the mill site in the alluvial flats of Davison Creek. In 1967 a lower log deck was constructed on the wetland / floodplain of Prairie Creek, and extending to the south east of the earlier deck.

The lower deck was approximately three acres in area and consisted of 6 to 14 vertical feet of fill. The fill was quarried from a ridge immediately to the west of the deck. This deck extended from the base of the quarried ridge to Prairie Creek. During the construction of the lower deck, Davison Creek was diverted to the north, under the deck, and drained by a ditch dug through the wetland.

As part of a trailhead development project, the wetland of Prairie Creek and Davison Creek stream channel, that were buried by the lower deck were to be restored to their original morphology. The confined portion of Davison Creek along the upper deck was to be widened. Three humboldt stream crossings located upstream of the upper deck were identified as significant resource threats and scheduled for removal.

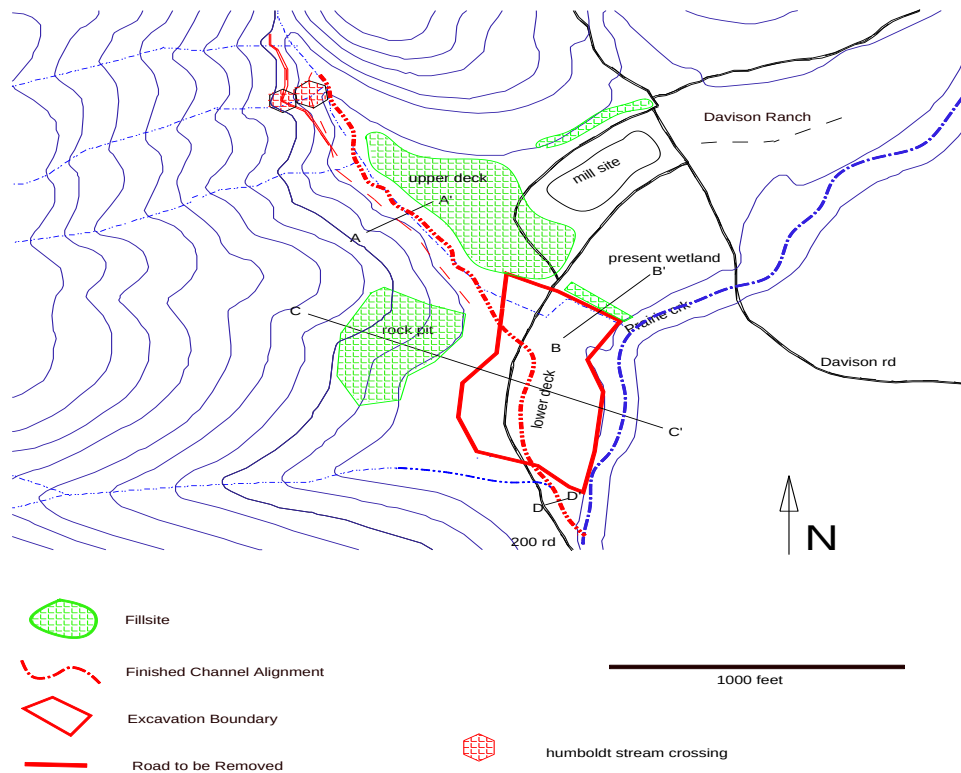
Project Description (as built):

Figure 1. Plan Map for wetland and stream channel restoration as built.

Restoration of the wetlands and stream channel buried by the lower deck required the excavation of approximately 30,000 cubic yards of fill. Most of this fill was placed in the rock pit on the ridge to the west of the deck and reshaped to mimic surrounding topography. The remaining fill was exported to two sites, the upper deck and a full cut road bench above the old mill site. Fill placed on the upper deck was to be shaped to conform with a designed parking lot. Fill placed on the road cuts (southwest of upper deck and northwest of old mill site) was shaped and sloped to provide appropriate drainage.

Davison Creek was widened in its existing ‘modified’ channel parallel to the upper deck. Below the point where Davison Creek crossed the 200 road, the channel was restored to its ‘pre-deck’ alignment. At the crossing of Davison Creek an eight foot culvert (as described in the July 14’ 1999 BA for NMFS) was installed.



Figure 2. Alteration in slope / wetland profile at cross section C C’.

The restored reach of Davison Creek morphology varied slightly from that described in the BA plan, cross section C. The anticipated channel form, identified in early test pit assessments, showed a prominent natural levee associated with the wetland interface of Davison Creek. However, the final exhumed channel had either a subtle levee or no levee at all (figure 2).

Only two other minor alterations occurred from the restoration plan submitted to NMFS and USFWS in respective BA's dated July 14, 1999. A portion of wetland originally thought to be an artificial ditch along the 200 road was recognized to be an old channel form. This feature was to be back filled, but instead was retained to allow natural flow patterns to exist through the wetland regime. In addition, the northern most humboldt crossing (refer to plan map, figure 1) was not excavated because of considerations of restoration benefits to excavation impacts.

Project Narrative:

Excavation and removal of the lower deck began on August 23, 1999. Before excavated fill could be trucked to the parking lot site, a remnant pile of recycled asphalt had to be relocated to Davison Ranch. During the relocation of the asphalt, the excavator began developing a pile of fill to facilitate loading the trucks with the RNSP loader. By August 26, the fill pile had encumbered excavation to the point that the trucks had to be diverted from asphalt relocation for pile removal. The result was approximately a two day setback in excavator and truck production.

Initial production rate estimates anticipated the rented Caterpillar D8R to push 125 yd³ per hour from the deck to the rock pit. Meanwhile RNSP’s John Deere 230 excavator would pull back fill from the wetland surface, placing it into RNSP dump trucks at an estimated rate of 100 yd³ per hour. The trucks then dumped the fill at the parking lot site.



Photo 1. Trucks end hauling fill to parking lot site.

Estimates of production were based upon past work in RNSP. Road removal work performed in 1998 on the M-Line had average production rates of 100 yd³ per hour in rougher terrain with similar push distances. Since the dozer had a relatively flat and straight push to the fill site, a rate higher than that on the M-Line was expected. Therefore, initial estimates for the dozers production were 125 yd³ per hour. However, the fill contained an abundance of (2 to 10 feet in diameter) rock and this reduced dozer production to less than 50 yd³ per hour.



Photo 2. Rocks in foreground (averaged 18 to 48 inches in diameter), frequently encountered during excavation.

The presence of the rock also plagued the end hauling process. The original plan had the dump trucks spread the fill on the parking lot area in eight to 10 inch lifts, minimizing the need for mechanical spreading and utilizing repeated truck traffic for maximum compaction. Typically, 50% the truck loads would contain a rock two to four feet in diameter, making it impossible to spread thin lifts. An alternative plan to dump in piles and spread fill by other means was quickly adopted.

Excavator Production

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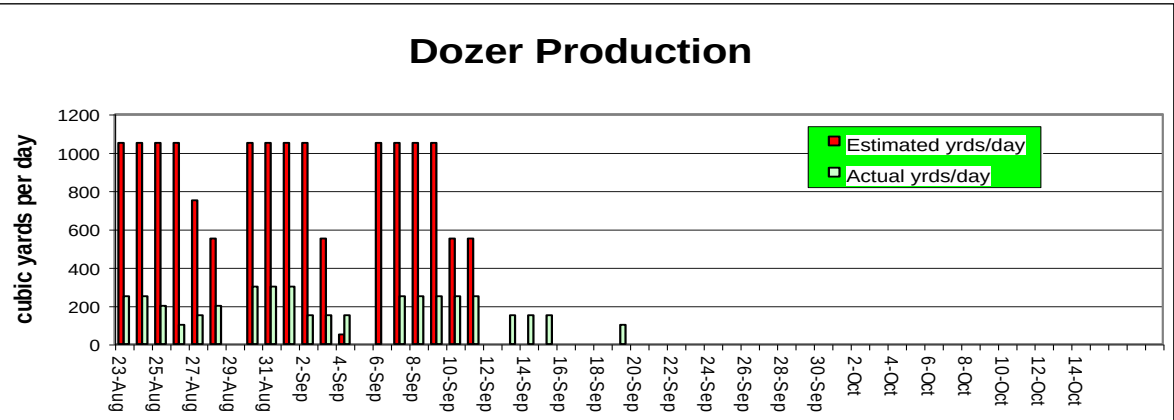
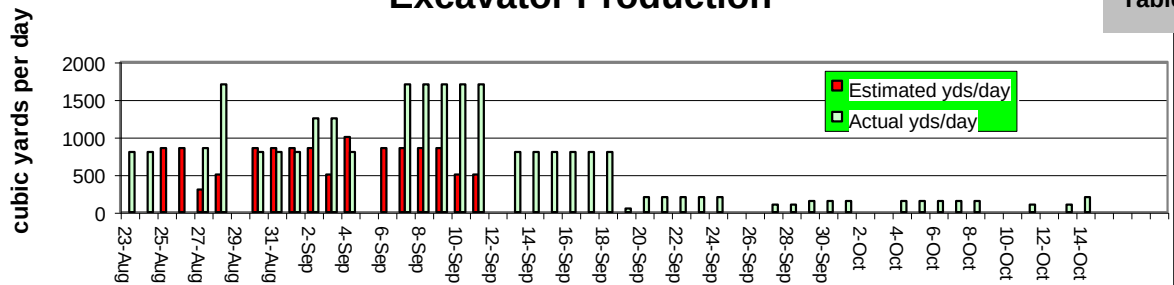


Figure 3. Estimated and actual production (yd³/day) for excavator(s) and dozer(s). The dozer production was significantly reduced due the abundance of large rocks in the fill, requiring increased production from the excavator(s). Dozer ‘production’ is absent after implementation of the MMP since the excavators were generating all the fill. Production is determined by which machine generates fill to be moved and does not relate to how fill was delivered to fillsite once mobilized.

The rocks also hampered attempts to spread piles with the RNSP backhoe. Instead the rented D8R dozer, was diverted from production in the rock pit and used to spread piles and flatten lifts for the parking lot. A sheepsfoot rolling compactor that was rented to aid in flattening piles, provide compaction, and allow the rented dozer to go back to moving deck fill into the rock pit.

The estimated volume for the lower deck was based on surrounding topography adjacent to the fill prism. The deck was roughly rectangular at 520 x 250 feet with an estimated depth 5.6 feet. Actual depth of fill averaged 10 feet with the lowest portion of the wetland having 14 feet of fill.



Photo 3. 'Representative wetland' north east of excavation site.

The expected morphology was based on the current condition of the adjacent wetland to the north east. As the actual morphology became apparent during excavation, a number of factors that were not previously considered came into play. For thirty years the representative wetland had been alcoved between Davison Ranch / Road and the lower deck, creating an artificial impoundment of the Prairie Creek floodplain. The impounded condition would create slower water during submerged periods, increasing deposition. The increased deposition would, in turn, fill in some of the depressional features. In addition, since the area had been pasture land, it may well have been mechanically leveled to enhance grazing quality.

The pre-existing morphology of the buried wetland was easily interpretable during excavation. The wetland soils were intact and composed of silt, fine and coarse sands relative to their proximity to Prairie Creek. The deck fill was consistently of a different nature, providing an obvious contact with the buried original soil (see photo 4.). Subtle depressions of a foot or more in the wetland surface were identifiable and replicable. Restoration of the original morphology was easier than anticipated, but blending that morphology with areas that were not being restored was a continuous challenge.



Photo 4. Original wetland soil surface contrasted with imported deck fill.

Davison Creek was diverted as part of the lower deck construction. A 36-inch culvert lead to a stand pipe that daylighted on the deck surface. The culvert then made a 90 degree bend at a flat grade to an outlet in a constructed ditch through the wetland to the north. The excavation plan called for removing all fill up to the Davison Creek culvert, allowing the preexisting diversion to flow while the new culvert was being installed. Due to the additional depth of excavation and the configuration of the original diversion culvert, a significant amount of water began ‘leaking’ onto the exhumed wetland surface.

The morphology of the restored wetland and the interception of ground water caused the wetland to collect water. The pond was typically one to two feet in depth along the lower edge of the fill slope. Excavation along the pond produced liquefied soil and sticky mud (herein referred to as muck).

When the moisture content of the excavated material increases, it becomes harder to push with a dozer (dozers are typically the most efficient way to move dirt short distances). Moisture tends to cause material to stick to the blade (especially when pushing uphill) and greatly reduces traction (getting stuck usually happens when muck is present). One strategy for dealing with excessively moist material is to blend or mix with dry material. To do this, an additional excavator was rented and used to repeatedly pile muck (a

procedure referred to as multiple bailing). In this fashion, we were able to incorporate enough dry fill into the muck that it eventually became pushable again (typically after the third bailing effort). Multiple bailing greatly reduces production rates (typically to 10 - 15 yd³s per hour). Consequently, in order to meet deadlines, more equipment is required. The drop in production can be seen in the production chart (fig 3.).

The drop in production caused by the excessive moisture in the fill and the threat of turbid water entering Prairie Creek instigated the development of a Muck Management Plan (MMP). The MMP entailed pumping of the impoundment, installing a new diversion culvert and procuring additional equipment. The high turbidity of the impounded water required that it not be allowed to flow directly into Prairie Creek. Water from the impoundment was pumped across Prairie Creek to the middle of the eastern wetland to allow for ground percolation. A new, relatively water tight, diversion pipe was installed upstream of the culvert on Davison Creek and additional equipment was contracted.



Photo 5. Inlet of diversion pipe with designer / builder (Dave Anderson, Fisheries Biologist).



Photo 6. Multiple bailing effort to mix muck with dry fill. Note ponded water at base of excavation.

An excavator and dozer from the Yurok Tribe were rented to assist with the MMP. Due to previous commitments, the Tribe's equipment had to be released, and other equipment rented. A Caterpillar 330 excavator, Caterpillar D6H (Z Logging LLC) and D8H (Rocky Brown) dozers were rented to assist in the final phases of restoration work. The new diversion pipe and pumping procedure proved to be effective, allowing the excavation to continue with reasonable production rates.

During the final portion of deck removal, eleven Large, Formidable Rocks (LFR's) were uncovered. The LFR's were schist boulders, eight to 10 feet in diameter that had been blown out of quarry pit in the initial phase of deck construction (personal communication, Robert Miller). The boulders had been too big to move easily, therefore simply rolled down from the quarry and left in the stream channel at the base of the ridge.



Photo 7. Large, Formidable Rocks (LFR's) at base of slope. Both excavators were required to move the boulders.

Initially, there was little hope that we would be able to remove the LFR's. Neither 230 or the 330 excavator could move the boulders. An attempt to locate a licensed blaster was made, but the window of opportunity to access the LFR's was short. One LFR was split using expanding clay. The expansion process required one day for drilling and placing the clay and another 24 hours or more to actually split the boulder. The excavator operators (Paul Harris, RNP and Roger Henslee, Z Logging LLC) figured out a methodology using both excavators, side by side, that allowed them to pull the LFR's onto the deck surface. Once a LFR was on the deck, a D8 could roll the LFR to a more appropriate burial location. Removal of the LFR's required a total of one and a half days for both excavators, and a half day for a D8.

Once the LFR's were removed, final exhumation of the original hillslope could be completed. While one excavator was working the base of the hill from the south, the other excavator began preparing the channel for culvert installation. Culvert installation took one day.

An eight-foot diameter culvert was installed for crossing the 200 Road over Davison Creek. The culvert was buried three to four feet deep, allowing channel bed materials to be consistent between upstream and down stream reaches – much as they would through a pipe arch or bridge. Installation entailed digging a bed for the culvert below original grade, back filling with salvaged gravel from old culvert, and restoring channel grade within culvert from stockpiled channel bed material.



Photo 8. Installing new culvert for Davison Creek. Eight foot diameter culvert was buried half way, allowing channel bed to migrate vertically and horizontally.

The morning following the culvert installation, the 330 excavator spent half a day installing grade control structures designed and implemented by RNP hydrologist and fishery biologists (Randy Klein, David Anderson and Baker Holden III). The transitional structures were required to blend the restored channel elevation with the remaining channel form along the upper deck (observations of buried topsoil above the new culvert indicate that the pre-existing channel ran under what is now the parking lot and trail areas). Requirements for the grade stabilization structures focused on providing fish passage while maintaining present grade control. The designed structure incorporated on site logs and rock in an interlocked fashion, creating a gradual stair step or shoot and pool morphology. It has been proposed that this feature be named Baker Falls.

The original project plan incorporated the removal of 3 humboldt crossings on tributaries to Davison Creek. As the reduced production rates and diverted forces pushed timelines back, these crossings were abandoned from the working plan. Terry Spreiter dedicated a number of days to acquiring additional forces and

funding to accomplish the removal of the humboldt crossings. Without her efforts, those stream crossing would still be there, failing into Davison Creek.

After the culvert installation, the remaining fill from the original diversion culvert was excavated and some placed on the remaining road bench parallel to Davison Creek, above the culvert inlet and the rest on the newly created ridge. The ridge was finished by blending fill into the original hillslope and spreading organic material. The organic material consisted of brush and trees that were removed from the work site prior to excavation. The lower portion of the southern side of the ridge did not receive organics due to a shortage of woody debris.

Final wetland detailing and planting restoration was conceived and coordinated by Jim Popenoe. Further information on wetland conditions and recovery will be documented in up coming vegetation management reports. A copy of the Vegetation Restoration Plan is attached to the NMFS BA in the appendices.

Cost Summary:

Vendor	Service	Cost
Yurok Tribe	Equipment / Operators	\$24,000
Z Logging LLC	Equipment / Operators	\$39,372
Rocky Brown	Equipment / Operator	\$25,768
Hufford Sand & Gravel	10 yard dumps	\$6,760
Babich Trucking	10 yard dump	\$560
Yount Trucking	10 yard dump	\$1,680
Johnson Industries	40' of 8' culvert	\$3,605
Hilfiker	360' of 12" flex pipe	\$1,551
RNSP		Cost
Labor		\$28,301
Equipment		\$37,385
Materials		\$7,616
Mitigation		Cost
Labor		\$1,200
Straw		\$1,286
Sand bags		\$195
Silt fence		\$350
Total		\$179,629

General Discussion / Future Recommendations:**Particle size vs. Elevation**

During the initial phase of wetland excavation, the presence of residual rock on the wetland surface became a concern. While trying to minimize the removal of the original wetland soil material, some rocks remained on the exhumed wetland surface. A floodplain wetland such as this is derived from sorted fine sediments, consisting mainly of sand and silt size particles, deposited during large flood events. The coarse rock fragments and clay were outside the range in the particle size distribution expected of a wetland soil. Additionally, the presence of rock on the surface might have negative impacts for the scour and deposit regime of high flow events.

After considerable debate, it was decided to remove as much of the rock as possible. The effort to remove the rock resulted in a no more than a loss of 1 foot of wetland elevation relative to the original landform. The excavator operators were extremely diligent in minimizing original soil material inclusion while digging. Since wetlands tend to develop through series of depositional events, it was felt that there was a better chance for the elevation to recover through natural depositional processes rather than to leave an armor layer on the wetland surface.

Blending into Non-Restored Areas

The most critical factor in landform restoration is blending the restored area into the surrounding lands. Typically, a restored area would connect with healthy landforms. In this project, the ‘natural’ Davison Creek channel through the wetland had to be adapted to an artificial channel upstream of the wetland. The adjacent wetlands to the north and south are likely not in the same condition that they were when the lower deck was constructed.

The blending of the stream channel from the low energy regime of the restored wetland to the artificially high energy regime of the entrenched channel along the upper deck will likely be problematic and will likely require maintenance as long as it exists in as impaired condition. The morphology of the stream channel in the wetland / 'upper deck' area is greatly influenced by flood waters of Prairie Creek. The presence of the upper deck and new parking lot eliminate to possibility of that portion of the stream channel to react with flood waters as it would have before upper deck construction. Baker Falls was designed and constructed to accommodate this disparity. Monitoring during high water events will be required to ensure the longevity of the upper reach and developed areas.

The only way to have prevented the impaired condition of the channel would have been to restore the entire length of stream channel. After the area was restored, a suitable location for the parking lot and structures could then be identified. In this instance, there would not have been such a location had the area been fully restored.

The blending of the lower channel and southern wetland edge presented some compromises. The thirty years of accumulated sediments combined with subtle deposits of deck debris left the topography of the adjacent land to the south somewhat higher than would have been prior to deck construction. This accumulation was observed in a soil pit dug near the confluence of Davison and South Fork Davison Creek that showed almost two feet of sediment over an older soil. The result was that Davison Creek has to flow uphill to the confluence with South Fork Davison Creek. With time, the reunited stream flows will return the lower reach of this system to a more balanced morphology.

A similar situation was encountered along the northern portion of the restored wetland. There is almost two feet of elevation change where the restored wetland meets the existing wetland. The cause of this difference is not as clear. Possible factors could be thirty years of vegetation building the peat / organic layer, enhanced sediment deposition due to morphologic changes associated with Prairie Creek or something to do with past grazing effects to soil accumulation.

Time restraints

Restoration of mechanically disturbed landforms is a complex process based on a simple premise.

Exhuming buried topography is somewhat analogous to an archeological dig. Great care is taken to identify original topsoil elements and trace their extents, there by recreating the morphology that natural processes had shaped the landscape into prior to disturbance. At present, technology has not provided a mechanism for precise quantification of disturbed lands. Estimating extent of disturbance and prior ground conditions is based on limited geomorphic clues, historical air photo analysis and professional experience (although the observant eye is often more perceptive than the trained eye). Inevitably, the excavation process provides more clues to the buried topography. As more information is gathered during the uncovering process, adjustments based on the new findings is required. The adjustments tend to be changes in excavation boundaries either vertical or horizontal.

During the lower deck excavation, additional depth was excavated based on the soil / fill contact. The added depth was required to provide the appropriated soil conditions for wetland function. A subtle adjustment to excavation boundaries was not pursued at the southern extent of the restored wetland. Due to the structure of the environmental compliance process and the timelines required by following development contract, the time to pursue geomorphic adjustments was limited to critical areas within the plan only.

Acknowledgments:

H.A. Blankenship, Les Schwabb, CC, C. Renner, Simpson, Arcata Redwood Co., Mill A / Joe Costa Trucking, Yurok Tribe (Steve Namitz, Tike, Darrel...), Z Logging LLC (Roger, Art, Albert, Larry & Jim Andersen), Rocky Brown, RNP staff: Rick Wallen, Dick Mayle, Rich Schneider, Paul Harris, Donnie Frazier, Harold Wood, Mike Allen, Lee Wilson, Ben Demaris, Jim Brooks, Jim Popenoe, Jim Deshon, Tom Dore, Rod Poole, Darrel Mason, Steve Nova, Darrel Jr., Leonel Arguello, Tony La Banca, Tony Henkleman Corky Farley, Howard Sakai, Candy Gibson, Randy Klein, Dave Anderson, Baker Holden III, Terry Spreiter, Terry Hofstra, Stephen Underwood, Lyn Giddings, Tekla Vines, CCC's, Alder Camp (CDF),

Appendices:

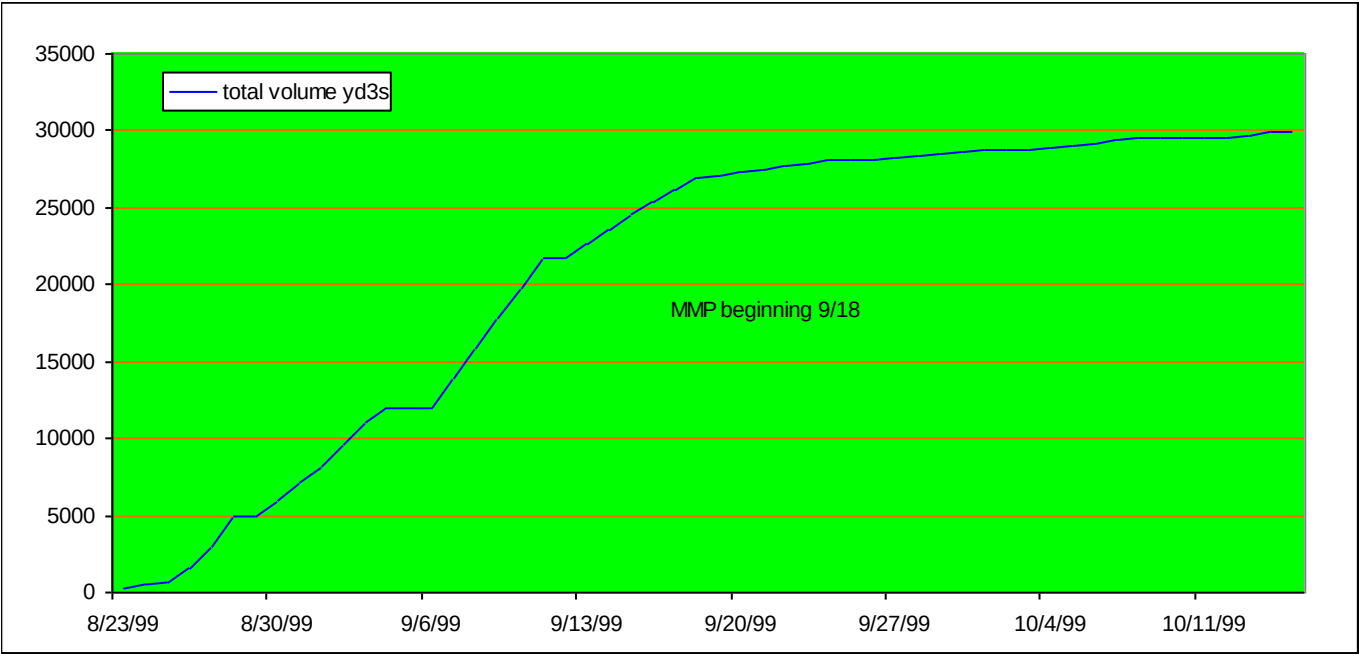
- A:** BA
- B:** Revegetation Plan
- C:** Cost Estimate(s)
- Q:** Progress schedule
- P:** Photos

Appendix A: BA and BO for USFWS and NMFS

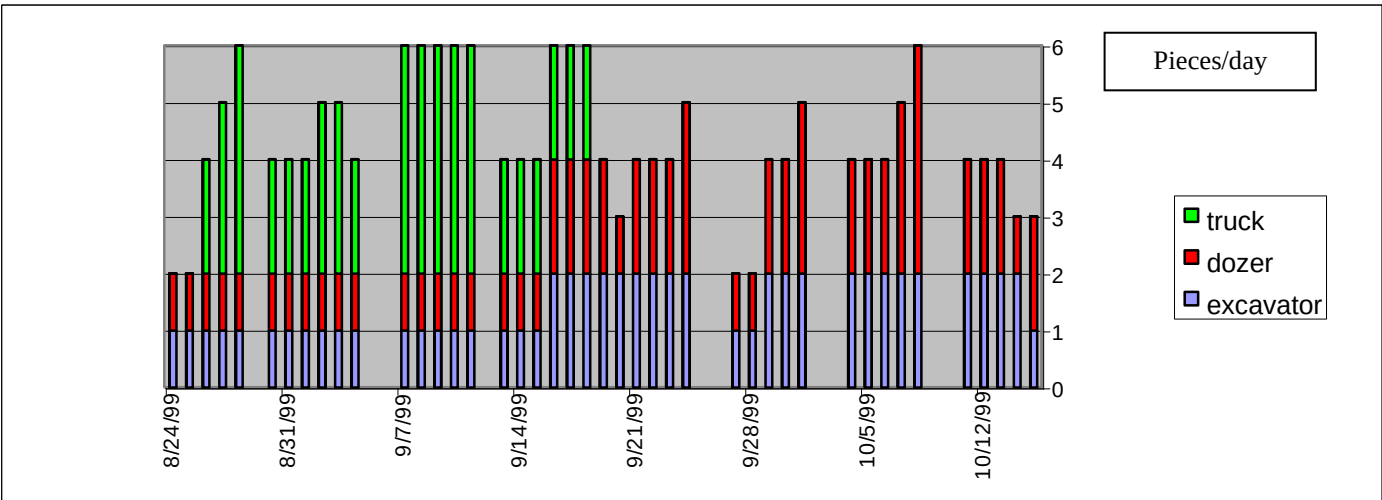
Appendix B: Revegetation Plan

Appendix C: Cost Estimate

Appendix Q: Cumulative volume through time and equipment working graphs



Overall production graph based on total volume (cubic yards) of fill excavated per day. Rate of fill excavated declines as the Muck Management Plan (MMP) becomes necessary.



Amount of equipment working on site. Contrast with cumulative volume chart; as MMP develops, more heavy equipment to move less volume.

Appendix P: Photos

Upper Davison Creek along developed area



Before



After widening

Looking down the lower deck from the top of the rock pit



August 24, 1999



October 7, 1999