Project Description
Daly Ditches Irrigation District [DDID] [Hamilton] was the recipient of $290,000 in American Reinvestment and Recovery Act [ARRA] funds in 2009. This funding was used to replace an aged timber diversion dam on the Bitterroot River south of Hamilton.

This project consisted of replacing the existing timber-frame diversion dam with a more solid dam consisting of a 6’ vertical, sub-surface concrete wall supporting a 6’ vertical grouted rock wall. This new structure served to stabilize the river bank at its interface with a canal adjacent to the Bitterroot River, bypassing an uphill spring running beneath the canal, thus enabling continued functioning of the dam.

The new, replacement diversion dam prevents fish entrainment while encouraging fish passage.

Previous failures of the diversion dam have resulted in a loss of irrigation waters to 41% of the irrigation district.

History
DDID was founded by Marcus Daly in the late 1800s and includes the Hedge Canal Diversion Dam. This canal was constructed adjacent to and uphill of the Bitterroot River in the early 1900s. Upon its construction, it was expected to function for 50 to 75 years. Since its construction, a spring has developed uphill from the canal, which has served to cause significant weakening of the canal bank between the river and the canal. An additional detriment to the original diversion dam has been the continued erosion of the river bank, due to river fluctuations in combination with an unstable bank. This erosion has contributed to increased turbidity in the Bitterroot River, which directly effects fish habitat and spawning grounds, particularly for the endangered Bull Trout [Salvelinus confluentus]. Seasonal damage has resulted in this dam being continuously repaired by DDID approximately every other year for the past decade.

The irrigation afforded by this diversion dam currently irrigates 6,108 acres of land for 778 rural users, and measures 25 miles in length. As part of the contract arrangement with DDID users, DDID owns all water rights to the water in their ditches. This particular di-
version dam canal measures a water intake of 140 cubic feet per second [cfs] during high runoff.

**Chronology**
Work on this project began with design implementation in 2007. The project consisted of replacing the diversion dam and intake structure with more modern facilities. This new design provided options to recreational river users not previously available, as well as affording protection to endangered Bull Trout via fish screens.

Project planning and development were performed by DDID employees and engineers from Morrison-Maierle Inc. [M-MI] [Missoula]. This partnership consisted of identifying and quantifying needs, attaining and administering grants, successfully acquiring requisite permits, all project engineering design, and construction oversight.

Specific project engineering began in March 2008 by M-MI.

Construction of the replacement dam occurred in two phases. Phase I construction occurred from January to April 2010 and consisted of the placement of large diameter boulders [36”-60”] secured with pressure grout [Figure 6-3]. This structure was complimented by a diversion apron, concrete abutment wall, grout cut-off wall, a canal intake structure including triple barrel 48” pipes with headgates, and a trash rack. In addition to the dams’ replacement, the original timber frame headwall had undergone severe deterioration throughout decades of seasonal river fluctuations, and required replacement with a rock stabilizing wall [Figure 6-4].

**Current Project**
Phase II is expected to be complete by spring 2011 and consists of the construction of a boater passage and vertical plate fish screen.
Cost and Source of Funding
The total project cost of the Hedge Canal Diversion Dam replacement was $1,275,670.

An ARRA grant of $290,000 was awarded for work on this project, which was supplemented by a $98,000 grant from Montana’s Fish, Wildlife, and Parks Future Fisheries’ program. Additionally, $350,000 was borrowed by DDID from the Montana Department of Natural Resources and Conservation [DNRC], $100,000 arrived from a DNRC Renewable Resource grant, $6,170 came from Daly Ditches Irrigation District funds for indirect costs, and $431,500 was provided by bi-annual appropriations from the Montana legislature in the form of a US Army Corps of Engineers operations and maintenance supplement.

Project Planning & Design
Project Design was conducted by Morrison-Maierle Engineering [Missoula], in conjunction with DDID. Morrison-Maierle [as of December 2010] received $230,404 for their engineering and design services. These funds reflect 1,443 billable hours, and labor wages totaling $114,151. This figure reflects an average of $79.10/billable hour.

An additional $11,194 was paid in attorney’s fees for 65 billable hours, or $171.16/hr.

Project Labor
Excavation labor was undertaken by Patterson Enterprises [Clinton] at Davis-Bacon state prevailing wage rates. Patterson received $581,462 for their services.

Labor supplied by Patterson consisted of bulldozer operators, excavator operators, skid steer operators, dump truck drivers, roller/compactor drivers, cement masons, and general laborers.

Labor wages totaled $129,691 for 3,341 hours of labor, with an average hourly wage of $38.82.

Total fuel expenses, diesel and gasoline, equaled $31,128, while $21,750 was paid to the land owner for gravel extracted from the land and utilized on the project [1,450 yds³].

A total of $145,000 was expended by Patterson upon project materials.

Patterson subcontracted concrete work to Donaldson Brothers Ready-Mix Inc. [Hamilton] for $55,322. Donaldson employees delivered 134 yards of cement, at a rate of $26-30 per nine yard loads. Additionally, Donaldson contributed 480 yards of grout at a rate of $124/yard [including labor]. Donaldson employees receive full health coverage, but no vacation benefits. Donaldson drivers’ wages range from $15-17/hour. Additionally, a pump truck and pump truck operator were required to facilitate application of the concrete at the site. The pump truck was used for 63 total hours. Its hourly rate includes a driver’s hourly wage [same as above] plus $145/hr. for the pump truck.

Project Oversight
Project oversight was conducted by DDID manager Paul Barteni, in conjunction with Morrison-Maierle Inc., and the US Army Corps of Engineers.

Figure 6.5 – The previous dam required constant maintenance, and its inability to consistently function ultimately necessitated its removal. Here, Patterson Enterprises employees prepare to install the 6’ high subsurface concrete wall. An additional 6’ grouted rock wall will rest atop this structure. [Photo: Property of Morrison-Maierle Inc.]
Figure 6-6 – Replacement of the old dam necessitated excavating 12’ below the riverbed and placing a 6’ concrete wall below the 6’ of grouted rock. [Photo: Property of Morrison-Maierle]

Figure 6-7 – The nature of dam reconstruction required temporary diversion of the Bitterroot River, which can be seen in the background. [Photo: Property of Morrison-Maierle]

Figure 6-8 – Pre-project status of Hedge Canal Diversion Dam [2007]. [Photo: Property of Daly Ditches Irrigation District]

Figure 6-9 – Post-Phase I status of Hedge Canal Diversion Dam. Phase II is to be completed in spring 2011 [Photo: H. Janssen, August 2010]


Project Description
The Duck Creek Dam rests in Petroleum County, 1.5 miles east of Blakeslee Road. The project undertaken at this site was to remove an existing dam structure, and replace it with a reinforced earthen structure, thereby ensuring the continued safety of local residents and travelers along two separate county roads.

The surface area of the dam measures 125 acres, while the storage capacity of the dam registers 702 acre feet. This project was funded with American Reinvestment and Recovery Act [ARRA] funds augmenting BLM Deferred Maintenance Program [DMP] funding.

History
The Duck Creek Dam was constructed by Works Progress Administration workers in 1936 and was designed to function for fifty years. This structure ultimately lasted nearly eighty years. In 1965, the water flow intake was raised 4' owing to problems of opening and closing the intake. Water rights were held by a private landowner until the 1960s when they were transferred to the Bureau of Land Management [BLM].

In a 2001 study of the structure, the BLM identified the Duck Creek Dam as a “High Hazard” structure. Annual climate cycles had led to the eventual erosion and deterioration of this structure, necessitating its continuous repair. This determination was based upon the dams' location resting upgradient from two county roads, Teigen Road and Welter Divide Road, the former of which serves as a rural bus route.

The BLM’s Deferred Maintenance Program [DMP] was created to fund the repair of structures whose annual maintenance costs exceed 25% of the project’s original cost. This federal program is subsidized by taxpayers and provides $13,000,000 annually to the BLM. Once a project is placed on this list, it is prioritized and funded accordingly.

Current use of this site, which is publicly accessible
from a county road, provides habitat and nesting grounds for shorebirds and waterfowl.

**Chronology**

Project work for the Duck Creek Dam replacement began with its identification in 2001 by the BLM as a “High Hazard” structure.

In June 2005, Hansen Environmental Drilling [Glasgow] explored the subsurface conditions within and directly beneath the dam to assist in the engineering processes. Besel Construction [Lewistown] was responsible for backhoe excavation on two separate days in August 2005 to further assist in the exploration of the dam’s subsurface content.

DOWL HKM [Billings] was retained as environmental engineers for this project in the summer of 2006, at which time they collaborated with BLM engineers to design and plan the dam’s replacement. The project’s design and planning stages were completed in fall 2008.

A construction contract was awarded to Youderian Construction [Stanford] in September 2009; however, due to weather conditions, work did not begin until June 2010.

Construction labor consisted of the temporary removal of 1,600 yds³ in common excavation, with an additional 16,205 yds³ of foundation excavation occurring. 2,209 yds³ of sand were placed within the new foundation structure, as well as 159 yds³ of gravel. A final 22,935 yds³ of dirt were added to complete the compacted embankment, yielding a total embankment volume of 25,123 yds³ consisting of sand, gravel, and dirt.

Construction work, including reseeding, was completed in October 2010. BLM reseed mixture was sewn at a ratio of 17.3 lbs/acre and included: Arriba Western Wheatgrass [*Pascopyrum smithii*], Western Yarrow [*Achillea millefolium occidentalis*], Sandberg’s Bluegrass [*Poa secunda*], and other native species.
Cost and Source of Funds
Total project cost was approximately $1,200,000, with $789,067 arriving from American Reinvestment and Recovery Act [ARRA] funds. The remaining $410,933 arrived from the Bureau of Land Management’s [BLM] Deferred Maintenance Program [DMP].

Project Design and Planning
Project planning and design was contracted to engineers at DOWL HKM [Billings] in 2006.

DOWL HKM’s design phase of this project entailed 1,628 hours of labor for $162,834. This figure includes subcontracting work to Hansen Environmental Drilling [Glasgow] totaling $20,000 in labor and costs for two employees over the course of six days’ time. This planning and design figure also includes two days of work for an excavator from Besel Construction [Lewistown] at a rate of $105/hr. including operator wages [$14/hr.] totaling $2,100.

Total project construction costs incurred by DOWL HKM were $37,630 for 261 labor hours.

Total project planning and design, as well as construction costs to DOWL HKM were $200,464 for 1,889 total billable hours.

Project Labor
On-site project labor was provided by a private construction company from Stanford. This company received $666,145 for their work on this project. This figure reflects 1,649 total hours of work on the construction aspect of this project. Employees for this company receive medical and dental insurance, retirement after two years with the company, and one week’s annual paid vacation.

Labor rates depicted below reflect the fringe benefits associated with requisite Davis-Bacon wages.

The skills necessary to complete this project employed three individuals with this company and consisted of general laborers, logging 323 hours at $28.26/hour, heavy equipment operators, registering 548 hours at rates ranging from $35.76-37.29/hour, truck drivers, which logged 315 hours at a rate of $26.35/hour, and the lead contractor who logged 464 hours throughout the project. Total labor expenditures, less the lead contractor’s salary, totaled $37,817, or roughly 6% of the total construction cost.

Project Oversight
Mike Montgomery, a BLM Safety of Dams Engineer for Montana and the Dakotas, was responsible for project oversight and administration. One other BLM employee assisted Montgomery throughout the course of the project. Combined, the two employees logged 1,232 hours for $68,000, producing an average wage of $55.19/hr.
Figure 7-6 – A BLM engineer taking surveys of the dam amidst construction. [Photo: H. Janssen, August 2010]

Figure 7-7 – The dam at completion, facing south. [Photo: Property of Youderian Construction Inc.]

Figure 7-8 – The completed dam, facing east. The sheer size of the structure’s 125 acres is quite apparent. [Photo: Property of Youderian Construction]

Figure 7-9 – The completed dam, facing west. [Photo: Property of Youderian Construction]
Project Description
The Montana Department of Transportation [MDT] participates in mitigation activities involving wetland projects throughout Montana.

The process adopted by MDT is such that wetlands can be created on private land to replace wetlands that are damaged or devalued as a direct result of necessary MDT activities. This mitigation process was created in 2005 as the Wetland Compensatory Mitigation Easement, and is overseen by the US Army Corps of Engineers. The credits earned within this program are placed into a “Mitigation Bank,” whose purpose is to compensate for future activities that disrupt or harm existing wetlands, ultimately resulting in detrimental impacts to aquatic resources. These mitigation bank credits are only applicable to other projects existing within the same watershed. Mitigation bank credits exist on a 1:1 basis [based upon acreage]. This 34-acre site was selected based upon the Easton estate’s interest in developing a wetland on their property.

The project was partially funded by American Reinvestment and Recovery Act [ARRA] funds, and entailed development of a wetlands and flood channel, and was completed with a fencing project to delineate the wetland boundary.

History
This wetland rests along the banks of the Shields River, roughly five miles outside of Wilsall, in Park County. This wetland was created on a 34-acre...
section of private property owned by the Easton family. The development of this wetland ultimately resulted in a 34-acre section remaining a designated wetland in perpetuity, to be privately owned and maintained regardless of the transfer of ownership. The US Army Corps of Engineers was responsible for paying the associated fees for a wetland easement [$343,100], while the property owner received the title easement as well as a tax break.

**Current Project**

In 2010, MDT contracted to Confluence Consulting [Bozeman] to monitor all MDT wetland mitigation sites across Montana. This work consists of completing the requisite annual wetland mitigation report for each site. The components of this report consist of documenting the wetland hydrology present at the site, the presence of hydrophidic vegetation, and the presence of hydric soils.

This report enables MDT to assess the efficacy of each wetland mitigation site, and to determine if alternate approaches to future mitigation projects may be necessary based upon the effectiveness of past sites.

Funding for Confluence’s monitoring did not arise from the funding sources represented herein.

**Cost and Source of Funds**

The total project cost was $1,134,478. Ameri­can Recovery and Reinvestment Act [ARRA] funds provided for this project were $317,339. These funds were provided to the lead contracting firm, and divided among the contractor and subcontractors associated with work on this venture.

**Chronology**

Design and planning work for this project began in 2009 by MDT engineers and surveyors. Preliminary engineering work was also partially subcontracted to several consulting entities.

Contractor and subcontractor work on the creation of this wetland commenced in September 2009 and concluded in April 2010 with minor project follow-up [re-seeding, cataloguing vegetation success rates, etc.].

The flora planted at this site during the revegetation consisted of Thinleaf Alder [Alnus Incana], Sandbar Willow [Salix Exigua], and Red-Osier Dogwood [Cornus Stolonifera].
Project Design
MDT expended $351,726 on preliminary engineering, including labor costs equaling $102,659 for 3,839 total hours. This figure reflects an average wage of $26.74/hour. These preliminary engineering funds are comprised of 86.58% in Federal funds, with a requisite 13.42% match in state funding. Additional consulting engineering was provided by Timberline Resources Inc. [Billings], which totaled $155,250 reflecting 1,308 hours for billed consulting labor [averaging $118.69/hr.].

MDT construction engineering costs totaled $74,957 with a labor wages equaling $39,225 over the course of 1,377 hours, for an average wage of $28.48/hour.

MDT Right of Way costs were $390,457, of which $1,230 of labor is reflected for 89 hours. This represents an average wage of $13.90/hour. There was an additional $1,775 expended upon consulting to the Department of the Interior.

Preliminary project design and planning was conducted by MDT engineers for a total of $96,715 reflecting 5,237 hours. This figure provides an average hourly preliminary engineering rate of $18.47/hour.

Project Labor
Labor for this project, with the exception of pre-project planning and design, was undertaken with Davis-Bacon labor rates being required for all on-site employees. The labor figures represented below do not reflect the fringe wages added to an employees’ hourly wage.

The lead contractor for this project was Advanced Earthworks [Hamilton], with subcontractor labor provided by Olson Fencing [Miles City] and S & K Environmental Restoration [Arlee].

Advanced Earthworks labor consisted of heavy equipment operators and general laborers. Operator labor rates and general labor rates were $22.47-26.91/hour, for a total of 563 hours. Additionally, salaried employees for Advanced Earthworks logged 519 total project hours for $16,742.

Olson Fencing received $3,366 for two employees’ labor on this project. One salaried employee logged 35 hours at a rate of $61.44/hour and was assisted by an hourly employee working at $35.42/hour for a total of 35 hours.

S & K Environmental was represented on this project by one salaried employee who logged 19 hours at a rate of $28.85/hour, and six hourly employees working at $22.47/hour for a total of 126 hours.

The total project funds expended upon project construction labor were $39,125. This figure represents 12% of the total funds expended by contractors on this project.

Project Oversight
Project construction oversight was conducted by MDT engineers and supervisors for $39,225 for 1,378 hours of labor.
Figure 8.6 – Revegetation at the Easton Wetlands site has taken to the area extremely well, as is depicted in this figure. [Photo: H. Janssen, August 2010]

Figure 8.7 – A small body of water remains on the Easton site during an August site visit. [Photo: H. Janssen, August 2010]

Figure 8.8 – A Lesser Yellowlegs [Tringa flavipes] partakes in hunting activities at the Easton-Wetland site. [Photo: H. Janssen, August 2005]

Figure 8.9 – This photo depicts a recent visit by an adult elk, indicating that the Easton project is successfully appealing to local wildlife. [Photo: H. Janssen, August 2005]
Project Description
In 2000, the United States Fish and Wildlife Service, with Secretary of the Interior Bruce Babbitt, signed a 30-year agreement with Plum Creek Timber Company Inc. [PCTC] to pursue fish habitat protection. This agreement, termed the Native Fish Habitat Conservation Plan, required PCTC to evaluate all of their lands within Montana, Idaho, and Washington by the end of 2003. Among the properties researched, Plum Creek identified a total of 135 miles of river corridor pertinent to the initiatives proposed within the agreement. One of the sites identified was a stretch of Forest Road 763 along the Fisher River. This tributary to the Kootenai River is located in Lincoln County, and was identified as an area requiring timely road improvement to recover native Bull Trout migratory corridors. Subsequently, PCTC conceived this project, which was supported by partnerships with the Montana Department of Fish, Wildlife and Parks, the Kootenai National Forest, and the Lincoln County Resource Advisory Committee.

This project’s reclamation objective was to reduce the chronic source of fine and coarse sediment eroding into the Fisher River, and was undertaken through the process of decommissioning Forest Road 763 [Figure 9-1]. Auxiliary objectives to the project were to double the size of the floodplain through the removal of Forest Road 763 [Figure 9-2], to provide greater pool frequency for migrating Bull Trout along a recognized migratory path, to upgrade and improve the bypass road located adjacent to the project site, and to improve river quality of the river corridor for migration and foraging.

History
Plum Creek Timber Company is the largest private landowner in the United States with roughly 7,000,000 acres in 19 states. Approximately 970,000 acres are in Montana.

Forest Road 763 was constructed by the St. Regis Corporation in the 1960s, and the constant washouts adjacent to specific stretches of the river were identified as being a major contributor to reduced river quality, owing to its ongoing contribution of sediment emanating from accelerated erosion.
Chronology

Phase I of this project consisted of decommissioning 7/10 of a mile of Forest Road 763, and, in an agreement between the USFS and PCTC, required an adjacent bypass road to have additional drive dips installed and for the entirety of the road serving as an alternate route to be re-graveled.

Decommissioning of the road consisted of the excavation of 5000 yds³ of earth being removed and end-hauled to an off-site location. This process entailed taking out earth to depths as deep as five feet, and as wide as twenty feet in order to return the floodplain to its historical grade prior to the roads’ construction. Phase I was completed in thirteen days in August 2007.
Phase II of this project was to install two J-Hook veins in the Fisher River [Figures 9-3 & 9-4]. The veins serve to protect the riparian area by dispersing the rivers’ energy along a greater total area, and were undertaken as a cost-effective and stable measure to prevent the river from migrating to the recently restored area.

Phase III of the Fisher Restoration Project was to grade the floodplain surface and revegetate with nursery-grown, containerized shrubs. The Fisher River site was revegetated using Red Osier Dogwood (Cornus Stolonifera) and other native shrubs, totaling 400 shrubs. Additionally, 1,200 conifer seedlings were planted along the remediated riparian corridor. Browse protectors held in place by single stakes surrounded these shrubs and seedlings to protect them from animal foraging.

The final element of this project, Phase IV, involved removing a 48” drain culvert that had been in place along the northern portion of the remediation site, directing Smoke Creek into Fisher River beneath Forest Road 763 [Figure 9-5]. Phase IV returned Smoke
Creek to an open bypass channel, permitting the upstream migration of native Westslope Cutthroat Trout into the upper-reaches of this tributary [Figure 9-6].

**Current Project**

Current activities at the site are limited to the monitoring of vegetation growth in the remediated areas, and the removal of the browse protectors as the transplanted vegetation becomes more stable. Additionally, the J-Hook structures will be monitored at various levels of flow to determine their overall efficacy. A yearly site review is also in effect to determine the overall stability of the project. Present survival rate of the planted vegetation is estimated by Plum Creek’s Forest Hydrologist, Brian Sugden, as 50% for conifer transplants, and 75% for shrub transplants.

**Project Design**

PCTC’s in-house project design for the Fisher River Restoration project first began in 2007, with design assistance provided by the USFS, as well as a mid-sized hydrology consulting firm based in Whitefish.

**Project Labor**

Phases I, II, and IV of this project, the removal of 5000 yds³ of earth, the upgrade of the bypass road, the installation of the J-Hook veins, and the removal of the Smoke Creek culvert, were completed over thirteen days by a small local excavating company [Libby].

These phases created jobs for a Bulldozer D-7E Operator at the rate of $89/hr., totaling 60 hours over the thirteen-day job. A Dump Truck Operator was employed at $68/hr. for a total of 180 hours, hauling nearly 500 truckloads of earth out of the restoration site. A John Deere Excavator-892D was employed for 82 hours at $110/hr, while a John Deere Excavator-892E logged 65 hours, also at $110/hr. P&S general labor for these three phases was credited with 18 hours at $29.15/hr. The final labor required for these phases was the employment of an Oversized Lowboy driver for 11 hours at $92.97/hr.

**Project Cost and Source of Funding**

Total project cost was $90,060 with $39,000 arriving from the Lincoln County Resource Advisory Committee funds. These USFS Federal funds are set aside for county use toward the restoration of fish wildlife habitat. An additional $5,000 in USFS support was attributed to the planning and design portions of the project. The remaining funds of roughly $45,000 were comprised of PCTC funds dedicated specifically for this project.
The total labor cost for the completion of Phases I, II, and IV equaled $35,770.

Phase III of the Fisher River Restoration Project required the mulching, planting, spraying, and watering of the introduced shrubs. Two, small hydrology consulting firms (both based in Missoula) provided labor on this site. The first was responsible for 35 hours of work, at a rate of $44/hr., while the second contributed to this Phase at a rate of $35/hr. for 35 hours. Administrative support supplied by Plum Creek at a rate of $50/hr. totaled 40 hours, and a regional forestry company (Kent, WA) was responsible for planting 1,200 conifer seedlings, spraying, and general labor at a rate of $25/hr. for just over 23 hours, totaling $576. The overall cost of Phase III labor totaled $5,323.

Total labor hours logged on this project, both on and off site, totaled 548.5 hours. The total labor expenditures for this project totaled $41,094. As the entire project, including materials, was completed at a cost of $90,062, this labor reflects 45.63% of funds expended, with the average hourly wage of $74.92/hr.

Project Oversight
Project oversight was provided by Brian Sugden, Plum Creek Forest Hydrologist.

Figure 9-7 – The decommissioned road, Forest Road 763, as viewed from above the Fisher River. [Photo: H. Janssen, September 2010]
Figure 9-8 – An excavator was required to remove soil to depths of five feet below grade in order to restore the area to historical levels. [Photo: Property of Plum Creek]

Figure 9-9 – Removed soil was loaded onto Dump Trucks and taken to an off-site location. [Photo: Property of Plum Creek]

Figure 9-10 – The success of native plant reintroduction is illustrated by the extent of growth since 2007. [Photo: H. Janssen, September 2010]

Figure 9-11 – The propensity of successfully planted flora within the floodplain adjacent to the Fisher River is depicted here. [Photo: H. Janssen, September 2010]
**Project Description**

In 2000, the United States Fish and Wildlife Service, along with Secretary of the Interior Bruce Babbitt, signed into a 30-year agreement with Plum Creek Timber Company Inc. [PCTC] to pursue fish habitat protection. This agreement, termed the *Native Fish Habitat Conservation Plan*, required PCTC to evaluate all of their lands within Montana, Idaho, and Washington by 2003. Among these properties researched, there were identified 135-miles of river corridor applicable to the initiatives proposed within the aforementioned study.

One of the earliest PCTC sites identified was the Thompson River headwaters, located in Sanders County. Within this river corridor, there was identified a 3.5 mile stretch of river that had undergone historical deterioration beginning in the early 20th Century.

PCTC’s restoration objective at this site was to reintroduce native and diverse riparian vegetation which has been historically effected by clearing for hay meadows, grazing, and timber harvesting. These actions have led to an overgrowth of Reed Canary Grass [*Phalaris Arundinacea*] homogenizing the flora of the region. Diversified reintroduction will serve to improve summertime stream temperatures, restore instream habitats, and improve migratory habitats for local populations of Bull and Cutthroat trout.

**History**

PCTC is the largest private landowner in the United States with roughly 7,000,000 acres owned in 19 states. 970,000 acres are in Montana.
Figure 10-1 depicts the devolution of the Thompson River headwaters area from 1933 until present. Native flora removal can be recognized, such that by 1969 the area had been almost completely plowed of native grasses. The final photo, labeled “Current,” indicates the areas of restoration work that were undertaken by PCTC [designated by the black outlines delineating where restoration work would be undertaken].

**Chronology**

Work on the Thompson River Restoration project design first began in late 2002 with in-house project design conducted by PCTC. The primary objectives of this project were to limit the spread of Reed Canary Grass (*Phalaris Arundinacea*), which had limited the viability of native plants along the banks of Thompson River’s headwaters. Reed Canary Grass has been thoroughly documented as suppressing the spread of native flora species and limiting diversity within a given watershed. The replacement of monoculture parcels of Reed Canary Grass with a more diversified biota served as an auxiliary objective of this restoration project.

Reed Canary Grass is not recognized as an invasive species in Montana, although it is designated as “invasive” in other states. Its presence in riparian areas has been documented to serve as a supportive stabilizer in riparian zones. Therefore, the work undertaken by PCTC would require replacing Reed Canary Grass with alternate plant life that would also serve as a riparian stabilizer.

Figure 10-3 – Liner-board, donated by Smurfit-Stone Container Corp., was used to suppress the growth of Reed Canary Grass after it had been mowed and sprayed. [Photo: Property of Plum Creek]

Figure 10-4 – Workers applying the compost mulch milieu atop the liner board. [Photo: Property of Plum Creek]
The primary actions undertaken by PCTC to limit the spread of *Phalaris Arundinacea* were to mow designated areas and then spray Glyphosate (Rodeo) herbicide. After application of this herbicide, three separate approaches were undertaken along this riparian corridor.

The first method, depicted in Figures 10-3 & 10-4, occurred in fall 2003, and consisted of the application of a double layer of liner-board to pre-designated areas. Once this liner-board was installed, four inches of compost mulch were applied atop the liner-board, requiring the total application of 700 yds$^3$ of compost mulch. This growth medium prevented the liner-board from moving, and also prohibited the Reed Canary Grass from reestablishing itself within these areas. Once the compost mulch was applied, holes were created through the liner-board and shrubs were introduced.

A second restoration approach undertaken by PCTC was to apply a polyethylene woven weed mat to designated areas [Figure 10-5]. Once this weed mat was in place, crews sliced through the mat and used an auger to create earthen holes permitting the introduction of the aforementioned flora while preventing the regrowth of Reed Canary Grass [Figure 10-6]. These shrubs were then surrounded by browse protectors.

The third and final approach undertaken by PCTC on this project occurred between 2005 and 2009. It consisted of the identification and encasement in browse protectors of naturally occurring flora already serving to diversify the ecosystem. Owing to the cost-efficiency present in this approach, a large percentage of the overall projects’ plants were protected using this method. This final approach resulted in the protection of 1,177 residual/natural shrubs and can be observed in Figure 10-8.

1,650 separate plants and shrubs were selected to reflect the historical diversity of flora present prior to the introduction of Reed Canary Grass by ranchers. The shrubs planted included: Thinleaf Alder (*Alnus Incana*), Water Birch (*Betula Occidentalis*), Red-Osier Dogwood (*Cornus Stolonifera*), Woods Rose (*Rosa Woodsii*), Geyer’s Willow (*Salix Geyeriana*), and Western Snowberry (*Symphoricarpos Occidentalis*).
Current Project
Maintenance of these plots involved deep watering during the first growing season. According to a 2009 (6-year) study conducted by PCTC, these combined approaches have resulted in an 83% success rate in deterring the return of Reed Canary Grass, preventing ungulate browsing, and promoting a more diversified ecosystem. Presently, browse protectors continue to be removed as shrub size naturally increases. Once these shrubs develop a greater canopy, they will naturally prevent light from aiding in the Reed Canary Grass’s return and the polyethylene mats can be removed.

Pre-Project Planning & Testing
Consultants for this project consisted of a two regional environmental consulting firms [Seattle, WA and Hamilton, MT]. This labor was primarily conducted off site, and consisted of engineering and project design, in conjunction with a Plum Creek Forest Hydrologist, Brian Sugden.

Cost and Funding Source
The total cost to Plum Creek for the completion of this project was $79,808, with an additional $38,616 being contributed by the Department of Fish, Wildlife and Parks Future Fisheries program. The liner-board donation by Smurfit-Stone Container Corp. [Missoula] was valued at $2,700, making the total project cost $121,124. The total project costs are broken down as follows: $59,890 for labor, $39,096 for materials, and $21,919 for project consulting. The majority of expenditures occurred in the first year, 2003, and expenditures have been in a steady decline since this time, with 2010 expenditures resting below $2,000.

Project Labor
Labor for this project, not including project consultation, consisted of: road assessments, mowing, spraying, installation of the liner-board and the polyethylene mat, compost mulch application, use of an auger, planting, browse protector installation, watering, and removal and re-sizing of browse protectors.

Total labor comprised 1,636 total labor hours on the Thompson Restoration project. The positions involved in this project range in pay rate from $10/hr. for general PCTC labor on site to $61/hr. for a front end loader.

Project Oversight
Project Oversight was conducted by Brian Sugden, Plum Creek Forest Hydrologist.

Figure 10-7 – Workers applying the polyethylene mat and removing the Reed Canary Grass that has been mowed. [Photo: Property of Plum Creek]
Figure 10-8 – Large grouping of residual/natural shrubs located along the headwaters of the Thompson River. [Photo: H. Janssen, September 2010]

Figure 10-9 – This depicts the second step involved in the restoration process, the spraying of Glyphosate herbicide to suppress Reed Canary Grass. [Photo: Property of Plum Creek]

Figure 10-10 – Pre-conditions at the Thompson River indicate the homogeneity of Reed Canary Grass [Photo: Property of Plum Creek]

Figure 10-11 – Post-project conditions at the Thompson River display a finite delineation existing between the recently introduced and diverse flora, and that which was pre-existing. [Photo: Property of Plum Creek]
Project Description
Trout Unlimited [TU] undertook reclamation activities along St. Louis Creek, a Ninemile Creek tributary that rests primarily in Lolo National Forest [Lolo NF]. Reclamation activities consisted of a road decommissioning, construction of an on-site waste repository, the removal of historic mine wastes, and the reclamation of the riparian environment. These actions were conducted to reduce natural sediment deliveries and improve water quality, thus yielding enriched riparian wildlife habitat and ameliorated aquatic habitat for native fish production and healthier stream functions.

There were two primary locations of remediation focus, the Frances Copper Mine area and the Snell Association #5 Mine area.

The St. Louis Creek watershed measures 2,819 acres in size, with 8.5 miles of stream within the watershed. This project reclaimed 20 acres of depredated lands.

Figure 11-1 – The underdrain was covered with a thick HDPE fabric to prevent runoff from coming into contact with the contaminated materials in the repository. [Photo: Property of Trout Unlimited]

History
Historic, placer mining began within the St. Louis Creek watershed around 1874; however, significant mining activity did not occur in the area until 1948 with the opening of the Frances Copper mine, which is located near the East Fork of the St. Louis Creek confluence. There were other exploratory mines within the watershed; however, these smaller mines affected minimal impact.

The Frances Copper mine is a designated “strip mine,” which operated from 1948 through 1995. It was owned and operated by Joe Waylett. Minerals extracted from the Frances Copper mine consisted of copper, gold, silver, lead, and antimony. Deposits were extracted using bulldozers and diamond drillers. Environmental damage has been traced to excavations completed at the site in 1974. This process trenched 500’ linear, stripped 150,000 tons of earth, and shipped 3,000 tons of short ore for processing. The mine is documented

Figure 11-2 – Waste being loaded into the hauling trucks for delivery into the repository. [Photo: Property of Trout Unlimited]
as developing and producing a 50-ton-per day milling capacity.

Poor operations and planning at the site led to a serious problem with waste material continuously contributing sediment to St. Louis Creek, increasing turbidity and injecting toxic metals into the waterway. $9,000 of USFS Lolo National Forest [NF] bond monies were allocated to reclaim some of the area in 1981. All claims at the Frances Copper Mine were closed in 1995, and $2,000 in bond monies were left for reclamation.

Further reclamation work was still needed at the site after the 1981 work, to prevent a continual influx of mine wastes into St. Louis Creek as well as to improve the aquatic habitat.

The Snell Association #5 Mine began operations in 1979 and closed in 1996.

**Chronology**

USFS Lolo NF conducted reclamation activities at St. Louis Creek in 1981; however, these activities were insufficient to prevent future degradation of the St. Louis Creek waters. Soil and water samples were collected in 1993 and 2001 to measure the extent of contamination. The results of these samples indicated elevated concentrations of arsenic [As] and copper [Cu] in the soil, as well as elevated concentrations of mercury [Hg], arsenic [As], manganese [Mn], and lead [Pb] in St. Louis Creek.

Forest Road 17432 was decommissioned in 2009, with the majority of reclamation construction beginning in July 2010. The reclamation tasks undertaken during this time consisted of constructing an on-site repository, excavating and removing mine wastes, recontouring and revegetating the surface, and removing fill from floodplain areas. Excavation processes succeeded in removing 15,008 yds³ of mine waste to an on-site repository, while 1,258 yds³ of topsoil were salvaged and used as cover for the repository and waste dumps. 522 yds³ of compost were imported to aid in the revegetation process.
Current Project
Remainder activities for the 2011 construction season at the St. Louis Creek Reclamation site will rehabilitate the stream and riparian areas to their more natural stream structure and functions, including dominant revegetation and aquatic habitat components. These tasks have a $140,800 projected expense occurring over 1,130 labor hours.

Cost and Source of Funds
Total project cost of the St. Louis Creek remediation project equaled $515,450.

These funds were comprised of a $300,000 Montana DNRC Reclamation and Development grant, $112,000 from the Lolo NF regular project funds, $35,000 from Montana Department of Environmental Quality 319 Grant funds [used to fund non-point source remediation projects], a $65,450 Montana Fish, Wildlife, and Parks Future Fisheries grant, and $3,000 from the Trout and Salmon Foundation.

Project Design
Project design was conducted jointly by the Lolo NF, TU, and the Reclamation Research Group [RRG] [Bozeman]. RRG received $2,357 for 36 hours of design work. Preliminary site assessment and investigation required 100 hours of Lolo NF labor and cost roughly $7,000. This facet included field investigations, document preparation, and analytical costs.

The Environmental Evaluation/Cost Assessment [EECA] composed by the Lolo NF required 240 hours at a cost of $13,500. Survey work was conducted by TU, Morrison-Maierle [Missoula] and the Lolo NF in 2007. This work cost the Lolo NF $4,000 and required 104 hours. Morrison-Maierle was compensated $6,194 for their services.

Project Labor
All on-site project labor was conducted with Davis-Bacon prevailing wages, except for principals’ wages, which are not applicable to prevailing wage regulations.

Construction project labor was conducted by Oxbow Earthworks [Blackfoot, ID] and Wildhorse Environmental [Idaho Falls, ID] from July 2010 through September 2010. These companies received a total of $343,243 for their services, of which $118,466 was paid to the subcontractor [Wildhorse]. This payment was for labor and materials. This subcontractor supplied the requisite HAZWOPER certification, and was primarily responsible for erosion control. Construction labor provided by Oxbow and Wildhorse employees consisted of heavy equipment operation, water truck operation, general labor, and administrative oversight.

In return for 441 hours of billable labor, Wildhorse received $118,466. Oxbow labor expenses totaled $48,949 for 1,556 hours.
Rocky Mountain Environmental Restoration [Missoula] was contracted for weed spraying at the site and received $1,081 for 12 hours of labor.

Stalnaker Transport and Construction [Helena] was responsible for decommissioning Forest Road 17432. This labor consisted of 20 hours of excavation for $3,200.

Additional Forest Service staff time from 2008 thru 2010 totaled $80,000.

**Project Oversight**

Project oversight was conducted jointly by Peter Werner, Gallatin NF, Traci Sylte of the Lolo NF, and Rob Roberts, Trout Unlimited Mine Restoration Coordinator.

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**Figure 11-6** – Mine waste being loaded for transport to the repository. [Photo: Property of USFS]

**Figure 11-7** – Sediment control devices being installed along the sloped of reclaimed areas to prevent topsoil runoff before vegetation has the opportunity to stabilize the areas. [Photo: Property of USFS]

**Figure 11-8** – 522 yds³ of compost were placed atop the remediated areas to expedite revegetation activities. [Photo: Property of USFS]

**Figure 11-9** – Reclaimed areas were covered with clean topsoil and regarded at 2.5:1 slope ratios. [Photo: Property of USFS]