The following Clean Water Act and related project reports are available for review and copying at the office of the Executive Director.

BWA1a & B402 – Lake Coeur d'Alene Water Quality Study……USGS *(Coeur d'Alene Lake, Idaho: Insights Gained From Limnological Studies of 1991-92 and 2004-06)*

Purpose of Project - Conduct monitoring of lake water quality to assess nutrient, sediment, and metal loading, and status of and potential trends in lake water quality; to assess improvements/impacts from upstream environmental clean-up projects; and assess impacts from further development projects along the lakeshore.

Conclusions - More than 100 years of mining and processing of metal-rich ores in northern Idaho's Coeur d'Alene River basin have resulted in widespread metal contamination of the basin's soil, sediment, water, and biota, including Coeur d'Alene Lake. Previous studies reported that about 85 percent of the bottom of Coeur d'Alene Lake is substantially enriched in antimony, arsenic, cadmium, copper, lead, mercury, silver, and zinc. Nutrients in the lake also are a major concern because they can change the lake's trophic status—or level of biological productivity—which could result in secondary releases of metals from contaminated lakebed sediments. This report presents insights into the limnological functioning of Coeur d'Alene Lake based on information gathered during two large-scale limnological studies conducted during calendar years 1991–92 and water years 2004–06.

Both limnological studies reported that longitudinal gradients exist from north to south for decreasing water column transparency, loss of dissolved oxygen, and increasing total phosphorus concentrations. Gradients also exist for total lead, total zinc, and hypolimnetic dissolved oxygen concentrations, ranging from high concentrations in the central part of the lake to lower concentrations at the northern and southern ends of the lake. In the southern end of the lake, seasonal anoxia serves as a mechanism to release dissolved constituents such as phosphorus, nitrogen, iron, and manganese from lakebed sediments and from detrital material within the water column.

Nonparametric statistical hypothesis tests at a significance level of α=0.05 were used to compare analyte concentrations among stations, between lake zones, and between study periods. The highest dissolved oxygen concentrations were measured in winter in association with minimum water temperatures, and the lowest concentrations were measured in the Coeur d'Alene Lake hypolimnion during late summer or autumn as prolonged thermal stratification restricted mixing of the oxygenated upper water column and the hypolimnion, where oxygen was consumed. Large differences in median concentrations of dissolved inorganic nitrogen were measured between the euphotic zone and hypolimnion in the deep areas of the lake. These differences in nitrogen concentrations were attributable to several limnological processes, including seasonal inflow plume routing, isolation from wind-driven circulation and associated hypolimnetic enrichment, phytoplanktonic assimilation during summer months, and benthic flux.

Increased chlorophyll-a and total phosphorus concentrations were measured throughout the lake in the 2004–06 study compared with results from the 1991–92 study. No significant change in hypolimnetic dissolved inorganic nitrogen concentration throughout the lake was noted even though total nitrogen loads into the lake decreased between study periods. Total zinc and total lead decreased throughout the lake from the 1991-92 study to the 2004-06 study except in the southern part of the lake, where concentrations were typically low. Median detected nitrogen-to-phosphorus ratios decreased from the 1991–92 study to the 2004–06 study. Whereas the lake was clearly phosphorus-limited in 1991–92, in 2004–06 the lake may have been much closer to the boundary value of 7.2 that separates nitrogen from phosphorus limitation. However, due to changes in analytical reporting limits in the period between the two studies, the data are insufficiently certain to draw reliable conclusions with regard to limiting nutrients. For both studies, the trophic state of the lake was classified as oligotrophic (less productive) or mesotrophic (moderately productive), depending on the constituent used for classification.

Internal circulation from wind-generated waves and changes in the lake's thermocline are important processes for distribution of water-quality constituents throughout Coeur d'Alene Lake. Surficial distribution of trace metals throughout most of the lake, including bays, is relatively uniform. Even south of the Coeur d'Alene River mouth, lakebed sediments are contaminated with trace metals. Inflow plume routing of the two primary inflow sources, the Coeur d'Alene and St. Joe Rivers, also significantly affects the fate and transport of contaminants. Most riverine inflows appear to move through the lake as overflow during summer, interflow during spring and autumn, and underflow during winter.

Benthic flux is another key transport process for contaminants in Coeur d'Alene Lake. The results of in situ benthic flux chamber experiments indicated movement of dissolved metals, nutrients, and dissolved organic carbon out of the lakebed sediments. However, the lake is an overall sink for these constituents when they are associated with particulate material.

BWA1b – Ecological Monitoring, CDA Lake …….. 2 reports; USFWS *(Health of Waterfowl Utilizing Lake CDA, Whole Body Heavy Metal Concentrations in Bullheads and Potential Exposure Risks to Osprey)*

Purpose of Project – Ecological monitoring of CDA Lake was designed to identify baseline conditions for ecological receptors in the Lake. This information is necessary to determine present conditions and future changes in the ecological condition of the Lake. These studies include: (1) an evaluation of bull trout health based on water quality parameters collected by other parties from the lake; (2) an evaluation of waterfowl health through an assessment of lead (Pb) concentrations in waterfowl blood and sediment Pb concentrations in waterfowl feeding areas; and (3) an evaluation of metal residues in whole fish as a baseline of metal bioavailability.

Conclusions - Lead concentrations in palustrine and lacustrine sediment from several CDA Lake bays were higher than those in other Lake reference areas, and were also higher than Bunker Hill Superfund Site target action levels and suggested site-specific toxicity thresholds for swans. Mean blood lead from mallard and wood ducks sampled from bays were within lead toxicity ranges for waterfowl associated with clinical and severe clinical lead poisoning. Based on correlations between blood lead and the sediment ingestion index, waterfowl using CDA Lake appeared to be exposed to lead by ingesting contaminated lake sediment.

Mean lead and zinc concentrations observed at all fish sampling locations were above 1971-1986 averages observed elsewhere in the Basin, as were mean cadmium in all locations except for Round Lake. Fish testing results corroborated waterfowl data in concluding that mining-related metals from the Coeur d'Alene Basin have been transported to CDA Lake and are being accumulated by organisms associated with the Lake. The locations of Harrison Slough, Powderhorn Bay and Cottonwood Bay at the mouth of the CDA River, Beauty Bay, Mica Bay, and Blackwell Island and Cougar Bay near the Spokane River outflow of CDA Lake were the areas studied with the greatest concern for ecological receptor exposure to sediment contaminated with metals.

BWA2 & BW14 – Streambank Stabilization…… 3 Reports; North Wind, Inc. *(Final Report for the Lower CDA River Bank Stabilization Project),* TerraGraphics *(Bank Stabilization Monitoring Report),* Kootenai-Shoshone Soil and Water Conservation District and IDEQ *(Lower Coeur d'Alene Riverbank Stabilization Prioritization)*

Purpose of Project – Phase 1 Streambank Stabilization Construct and monitor the effectiveness of several techniques to protect the CDA River banks from the erosive forces of boat wakes.

Conclusions – Stabilization treatments (5) that emphasize bioengineering approaches were installed along both banks of an 1800-foot-long river reach 1.5 miles upstream from Medimont, Idaho on privately-owned and State-owned land. The treatments constitute research into controlling sediment releases into the Coeur d'Alene River and Coeur d'Alene Lake while supporting wildlife goals. Factors affecting this performance include boat wake impacts; extent of revegetation; ability to adjust to changes in the river; and two flow regimes. The two treatments that show the most success are a rocked low bank with a soil strip placed a little higher than summer pool approach and the brush box Wake breaks installations.

Purpose and Results of Project – Phase 2 Prioritization The purpose of the study was twofold — first to estimate bank erosion rate, then to prioritize the future bank stabilization efforts along 27.25 miles of the Lower Coeur d'Alene River downstream of Cataldo to the mouth. The factors considered in this prioritization were the bank susceptibility to erosion, shear stress applied to the bank by erosion processes, and the amount of heavy metal contamination along the banks. These factors were used to produce a final Streambank Stabilization Prioritization Overlay (Prioritization Overlay) using ArcGIS.

The bank's susceptibility to erosion, or the Bank Erosion Hazard Index (BEHI), and the stress applied by erosion processes, or Near-Bank Stress (NBS) are two streambank erosion factors referenced in *Watershed Assessment of River Stability and Sediment Supply*, (Rosgen, 2006). By establishing the relationship between BEHI and NBS, the bank erosion, or recession rate (feet/year) can be estimated using the Bank Assessment for Non-point source Consequences of Sediment (BANCS) model (Rosgen, 2006). Estimation of bank recession rate is more efficient than monitoring bank erosion using other methods such as bank pins. This study lays the groundwork to determine if the Rosgen methodology for estimating bank recession rates is applicable to the Lower Coeur d'Alene River system. With repeated monitoring of the actual recession rate using bank pins, a correlation between the estimated bank recession rate and the measured recession rate can be established. If there is a weak correlation, then it will be determined that the Rosgen BANCS model for estimating bank recession rates does not apply to this system. In that case, the long term monitoring of the actual recession rate will provide a better understanding of the bank recession rate within this system.

BWA3a&b – Lake Stewardship Outreach Program…….. CDA Tribe and Kootenai-Shoshone Soil and Water Conservation Dist. *(Final Report Lake Stewardship Outreach Program)*

Purpose of Project - This project sought to improve water quality in CDA Lake by developing an information and education program that would educate the public on ways to reduce the amount of nutrients entering the Lake and its tributaries. Develop and present an educational powerpoint presentation that contains historical and current information on how communities established and flourished within the Basin as well as provide ways to ensure the water quality of the Lake, and produce and distribute an educational Lake map.

Conclusions - The Coeur d'Alene Tribe and Kootenai-Shoshone Soil and Water Conservation District (KSSWCD) prepared a brief summary of their perception of the effectiveness of this public education outreach. Additional funding was made available to print more copies of the Lake educational map.

BWA4 - Mullan I and I …… J-U-B Engineers, Inc. *(Groundwater Metal Loading Study/Demonstration Project for the Mullan Treatment System)*

Purpose of Project - This project evaluated sources of metals loading to treatment facilities, investigated the potential reduction of metals loading to the South Fork Coeur d'Alene (SFCDA) River, determined the efficacy of infiltration and inflow (I/I) removal projects to reduce peak plant flows, and advanced the current state of knowledge with regard to the cause and effect of such efforts to reduce pollution, transaction costs, and community coordination.

Conclusions – The key to I/I removal is the ability to repair both main lines and service lines. In the past, service lines had been neglected and they often contribute a significant

portion of the I/I. Targeting the worst areas for rehabilitation produced the greatest relative benefits. In addition to service lines, all main line connections were redone so that the system was tight which resulted in a significant reduction in flow. The construction methods employed were found to be equally effective at removing I/I from the system, provided the approach was followed through fully. Results to date show a flow reduction of 43% to 78%, with an average reduction of 58%.

The reduction in flows has made an impact on metals concentrations and loads in terms of averages and scatter. Complete removal of I/I from the collection system still would not allow the SFSD to meet the limits proposed in the SFCDA River without implementing a metals removal process at the treatment plant. The source of drinking water for Mullan is a tributary of the SFCDA River. The drinking water raw source and the potable water delivered to the City at times do not satisfy the discharge requirements imposed under the Total Maximum Daily Load (TMDL) for discharge at the Waste Water Treatment Plant (WWTP). Therefore, it is not believed that further I/I reduction will significantly reduce metals loading due to current drinking water contributions. The reduction in flows results in a positive net effect for the WWTP. Because the flows are lower and exhibit less scatter, metals loading on average appears lower and less variable. If a metals removal process is required; the smaller peak flows will result in smaller basins, related equipment and chemical usage, resulting in a lower capital and Operation and Maintenance (O&M) investment for the SFSD. Consequently, this project has been successful for the Mullan WWTP with regards to reducing its overall treatment requirements for metals.

For Mullan, it is recommended that further I/I reduction be pursued only to reduce capital improvement and O&M costs at the WWTP. It is not believed that further I/I reduction will significantly reduce metals loading due to the current drinking water contribution. The results of this study are applicable to other communities in the Upper Basin in construction approach, anticipated flow, and metals loading reductions. Metals levels for groundwater and drinking water should be reviewed in other communities that are considering implementing this approach to determine the potential for metals removal.

BW01 – Woodland Park Groundwater……. TerraGraphics *(Third Quarter 2005 Canyon Cr. Groundwater Sampling Event and Comparison to Historical Data)*

Purpose of Project – Canyon Creek is a tributary to the SFCDA River. Based on probabilistic modeling, it is estimated that the Canyon Creek drainage contributes approximately 456 pounds per day of dissolved zinc to the SFCDA River. The ROD for OU-3 calls for treatment of up to 60 cubic feet per second of Canyon Creek water. In an effort to develop the most effective alternative for the Canyon Creek drainage, it is necessary to look at groundwater and surface water contributions. The Water Treatment Project Focus Team (PFT) requested that additional sampling be conducted to add groundwater data to the database in order to help facilitate treatment option decisions in the future. To address this, a quarterly monitoring program was implemented at selected groundwater sites in the Woodland Park area of the Canyon Creek Drainage.

Conclusions – The project successfully sampled groundwater. The data will provide valuable information needed to make responsible treatment option decisions.

BW02 – Meyer Creek Flood …… TerraGraphics *(Meyer Creek Study Final Report)*

Purpose of Project – To assess the condition of the Meyer Creek diversion system and propose possible alternative remedial recommendations and order of magnitude cost estimates to prevent recontamination of the Superfund remedy in the City of Osburn during a flood event.

Conclusions - The results of this study show that that the risk of failure of the Meyer Creek pipe is moderate. Four possible solutions were evaluated. The preferred alternative consists of constructing a combination pipeline and open channel system, partly in the current alignment and partly in a new one. The open channel portions have the added benefit of creating opportunities for linear parks.

BW03 – Upper East Fork 9-Mile/Success Mine Water Quality Evaluation and Treatment System Enhancement…… Idaho National Laboratory *(Final report for Success Mine Reactive Barrier Modification and Evaluation)*

Purpose of Project – Success Mine Passive Water Treatment: 1) Reduce plugging in the Success Mine Apatite Barrier by making design modifications to the sediment chamber and injecting air into the Apatite to break up clogging in the media; 2) Perform a tracer study to determine hydraulic flow paths and residence times; 3) Analyze Apatite to determine forms of metals precipitates and where the reactions occur; and 4) Modify the East Reactor and add new media to the barrier

East Fork Ninemile Creek Monitoring: 1) Conduct monitoring of the East Fork of Ninemile Creek to assess where metal loadings occur; 2) Evaluate how seasonal flows affect metals loading; 3) Evaluate overall water chemistry; and 4) Determine forms of metal precipitates.

Conclusions - At the Success Mine and Mill site, a passive reactive barrier has been installed to treat contaminated groundwater passing through the mine and mill tailings. Since completing the system in 2000, the flow through the system continued to deteriorate. In 2004, the Idaho National Laboratory (INL) was contracted to determine if the flow could be increased by replacing the media or changing to a different media. The first step was to make modifications to the sediment chamber upstream of the reactive barrier. This was completed by modifying the current sediment chamber to allow the operators to visually inspect the sediment chamber for plugging. The second task involved injecting air into the Apatite to help breakup the compacted media and reduce preferential flow. This resulted in a temporary increase in flow through the reactive barrier. It was more successful in the west side of the reactive barrier where the media consists of only Apatite. The east side of the reactive barrier which is a mixture of Apatite and gravel did not respond as well to the air injection.

In November 2005, the old Apatite/gravel mixture was removed from the east side of the reactive barrier. Plastic packing rings were mixed with new Apatite media and placed in the east side of the reactive barrier. This has allowed significantly more water through the east side of the barrier than what has historically been observed. Currently, the system continues to treat water without experiencing water passing through the overflow. In addition, an alternative treatment approach was suggested by the IDEQ. The new approach involved injecting a carbon source (like molasses) into the groundwater to cause in situ precipitation of inorganic contaminants. In order for this to be successful, groundwater flow rates and potential flow paths were investigated. A tracer study was performed in the groundwater up-stream of the reactive barrier. The tracer used in the study was potassium bromide. Both electrical conductivity probes and periodic water samples were used to monitor the flow of the tracer. Although tracer breakthrough was not detected in the monitoring wells using automated electrical conductivity probes, periodic water samples collected during the study did show tracer arrival at 4 of the 10 monitoring stations. Minimum groundwater velocity was estimated from these tracer arrival times at 1.16E-03 ft s-1. Golder Associates had previously estimated the hydraulic conductivity for the area to be 1.7E-3 ft s-1 which agrees closely to the estimate determined in this tracer study (Golder Associates 2000). The flux of water moving through the saturated zone up-stream of the Apatite barrier was estimated to be approximately 50 gpm, based on the minimum groundwater velocity, alluvium porosity, aquifer thickness, and an assumed aquifer width of 15 ft. in the test region. The test was conducted during low flow periods and is expected to be a minimum flow anticipated for the location. Seasonal hydrological changes will impact the groundwater flux and depth to groundwater; therefore, it is anticipated that the aquifer thickness will vary depending on seasonal conditions. The Apatite barrier has been treating about 3 to 5 gallons of water per minute (gpm) during the summer of 2004. When the system was first installed, it treated more than 30 gpm. Based on current tests, it is estimated the barrier is only treating about 1/10 of the water moving through the saturated zone.

This project also included a one-year monitoring project to evaluate the effects of Interstate and Success Mine and Mill sites on the East Fork of Ninemile Creek. The first quarter of monitoring began in November 2004 for the East Fork of Ninemile Creek. The data show that seasonal variations in flow do occur and are significant. The majority of the metal loading that occurs takes place during the spring runoff. Even though concentrations are lower during the runoff period, the overall metal loading is higher. The greatest increase in metal loading occurs near the Success Mine, but there is a detectable increase in metal loading around the Interstate Mine and Mill site also.

BW04 – Page WWTP Metal & Nutrient Removal ……. J-U-B Engineers, Inc.
(Metals Removal Pilot Study for the Page Wastewater Treatment Plant)

Purpose of Project - Evaluate two emerging technologies for precipitation and/or adsorption for removal of heavy metals (lead, cadmium, zinc, and copper) and phosphorus from point source discharges in the Silver Valley, especially the Page WWTP. Determine if the results of this study can be extended to other dischargers in the Valley including the mining companies.

Conclusions – Many of the WWTP effluent samples collected prior to the two pilot plants studied under this project satisfied the NPDES Permit concentration based conditions. If not for the load based limits, a "Do Nothing" approach to the WWTP may be feasible. Abandonment of the load based limits is not likely. This may necessitate implementing additional treatment processes. Removal of heavy metals is attainable to Site Specific Criteria as defined in the Page WWTP NPDES permit. Removal to Gold Book Criteria is not consistently possible. Based on the results of the study, the membrane bio-reactor appears to be the most appropriate choice for use at this time. The probable cost of a full scale system installation in 2006 dollars is $14 million with annual operating and maintenance of 5% to 10% of the capital cost. The study resulted in the following recommendations:

- Investigate the ability to reduce capital expenses by attenuating peak flows at the WWTP by reducing infiltration/inflow to the collection system;
- Evaluate blending options to meet concentration and load based limits;
- Continue to explore methods of simultaneously meeting the metals and phosphorous removal targets;
- Determine an acceptable method for final disposal of the wastes generated from this facility and identify probable construction costs; and
- Revisit the permit conditions to develop more reasonable loading limits during peak flows such as a tiered permit based on actual stream flow.

The results of the study appear to be directly transferable to other dischargers in the Basin utilizing lagoon based wastewater treatment.

BW05 – East Fork Pine Creek Revegetation Pilot Project……. USDI Bureau of Land Management *(East fork Pine Creek Revegetation Pilot Project Final Report)*

Purpose of Project - Vegetation is needed to ultimately stabilize many stream reaches within the Coeur d'Alene River Basin. One premise guiding Pine Creek restoration planning is that sediment source control and revegetation of the floodplain will eventually restore the stability of the watershed. Pioneer species will provide the initial stability of floodplain deposits and channel alignment necessary to reduce sediment inputs.

This project builds on field interpretations and recommendations contained within several previous studies. Following the floods of 1996, which caused substantial damage to infrastructure and resources within the Pine Creek drainage, BLM commissioned a reconnaissance level geomorphic investigation to identify sediment sources and feasibility of flood damage restoration (Kondolf and Matthews, 1996). A follow-up field investigation and report was commissioned to develop a conceptual restoration plan balancing the need to protect existing infrastructure with the goal of accelerating the natural recovery of the stream system towards a properly functioning condition.

The objective of the East Fork Revegetation Pilot project was to identify practical and cost-effective methods to jump-start or accelerate natural revegetation processes, which are ultimately needed to stabilize many stream reaches within the Coeur d'Alene Basin.

Rather than a detailed statistical study, the project was intended to provide an on-the-ground demonstration of the effectiveness and feasibility of several mechanical planting methods on very harsh, rocky sites where soil and fine sediment are in short supply and channel stability is limiting.

The Pine Creek watershed covers approximately 79 square miles. Elevations range from 6408 feet on Latour Peak to 2160 feet at the confluence with the South Fork Coeur d'Alene River at Pinehurst in Shoshone County, Idaho. Pine Creek has two principal forks, which join about 6 miles upstream of Pinehurst. The East Fork is the smaller fork, draining approximately 35 square miles, with an average gradient of 1.7 percent over the 3.9-mile reach from the Douglas Creek confluence to the West Fork confluence. The East Fork basin is sparsely inhabited, but contains many mine sites reflecting intensive historical activity.

Several major floods have occurred in the Pine Creek watershed during the 20th century, the most recent in 1996. Prior to that, extensive flooding occurred in 1933, 1964 and 1974, all resulting in significant channel modification and erosion. Because of all these influential events, the channel morphology and functionality was severely impacted during the 20th century (Kondolf, 1996).

Limitations to Natural Revegetation

As described above, excessive bedload transport and channel instability are geomorphic factors that have affected the ability of Pine Creek to recover to a properly functioning condition. In many areas, floodplain deposits are largely devoid of soil, coarse grained, and often too high to allow initial establishment of riparian plants.

The East Fork of Pine Creek is characterized by excessive bedload sediment, which results in channel instability. Large areas of the floodplain have been essentially devoid of vegetation for decades. Consequently, remobilization of floodplain deposits during moderate and high flows will continue to cause sedimentation problems downstream until streambank stabilizing vegetation is established.

Planting Methods evaluated

A. The project evaluated using an excavator to plant locally-harvested cuttings of willow, cottonwood and dogwood.

B. The project also evaluated using an excavator to plant four species of nursery grown, rooted stock: Sitka willow (Salix sitchensis), Thin-leaf alder (Alnus incana), Red-osier dogwood (Cornus sericea), and Black cottonwood (Populus trichocarpa).

This was the primary planting method employed at nine planting sites within the project.

Success rates were generally high, averaging over 80 percent in year two after planting.

C. A third mechanical method involved excavating narrow planting trenches and comparing relative growth rates and overall survival of bare-root cottonwood stock in trenches back-filled with: 1. native material; 2. topsoil; and 3. mixed soil and compost.

D. A fourth mechanical method involved excavating narrow planting trenches and comparing relative growth rates and overall survival of nursery-grown cottonwood poles in trenches back-filled with: 1. native material; 2. topsoil; and 3. mixed soil and compost

Conclusions –

1. The most efficient way to install the plants was in shallow trenches (3 feet in depth or less) extending to the seasonal low water table. Hand- augering or use of water-jet stingers (for willow whips) is generally infeasible in the rocky substrate. A small excavator, equipped with a narrow bucket was most efficient for excavating trenches deep enough to reach the low- seasonal water table to a depth of at least about 1 foot. A push blade and thumb are useful for backfilling and minor regrading of the excavated material. Average equipment and operator costs ranged from $65-$90 per hour.

2. Revegetation with rooted riparian nursery stock, including willow, dogwood, alder and cottonwood had the highest success rate. Typical supply and deliver costs were between $4 and $5 per plant. Installation costs included excavator time to dig and backfill trenches, as well as labor to handle and place the plants into the trenches.

3. Locally harvested cuttings were successful for willow, but survival of dogwood and cottonwood cuttings was very limited. In the literature, cottonwood and dogwood cuttings are commonly recommended for many sites around the country (USDA, 1995). With the low percent of fines and organic material in the cobbly environment of the East Fork floodplains, survival was very low unless soil and or mulch was added.

When a good local supply is available, willow cuttings are a cost-effective source for trench planting, either alone or as a supplement to rooted-nursery stock. Labor cost for gathering willow was highly dependent on locating a suitable collection area, though availability appears to be improving as stream restoration continues in the Silver Valley.

4. Results for trench planting of nursery-grown cottonwood poles were similarto bareroot nursery stock, with native backfill resulting in very little growth and a high mortality rate after two years. The simple addition of topsoil mixed into the trench backfill resulted in growth rates of about 300 percent for the first two years with bareroot stock.

The advantage to planting tall poles over bareroot stock is ease of installation, since they can be placed in deep trenches extending into the seasonal low water table, as well as limiting damage from browse.

5. Within the project area relatively minor mechanical site preparation could greatly enhance, or often accomplish more for the cost, than planting alone. For example, the maximum effective depth for planting trenches was about three feet in the cobble material. Generally, it was impractical to go deeper- the trench would either cave in or require excessive widening relative to the plant size. Moreover, in trenches exceeding 3 feet, some species of nursery plants would be buried too deeply after backfilling. If, however, high and over-steepened banks could be sufficiently lowered and laid back with minimal grading, required trench depths were shallower and overbank flows could help with natural revegetation of the floodplain.

BW06 – Wetland Inventory…….Ducks Unlimited and USFWS *(Inventory and Evaluation of Private Lands for Potential Restoration of Wetland Habitats in the Coeur d'Alene Basin)*

Purpose of Project – The survey was designed to inventory private wetlands and associated agricultural lands within the Coeur d'Alene Basin to determine: 1) their value as wetland habitat; 2) what modifications may be necessary to restore areas to optimal wetland habitat; 3) landowner acceptance of wetland restoration on the property; and 4) level of mining-related metals contamination on the property. The survey will assist in guiding wetland remediation and agriculture-to-wetland conversion under the OU-3 Record of Decision for the protection of waterfowl, one of its remedial action objectives.

Conclusions – Ten priority areas were identified for conducting initial outreach to private landowners in the project area. Initial efforts to survey interest among landowners in high priority areas were through targeted mailing of an informational letter. Letters were sent to 49 landowners in the ten high priority areas. A second letter was sent to 83 landowners in high priority areas and all other areas of the Basin where suitable sites for wetland restoration were previously identified. An attempt was made to contact all landowners by phone to inquire about interest in wetland restoration. Six letter respondents were interested in learning more about opportunities to restore wetlands on their land and requested a field evaluation. Phone calls to 36 landowners resulted in three landowners requesting more information and a field evaluation.

Soil testing on three properties determined that due to the high levels of metals in the soil and the depth of contamination, the properties were not suitable for agriculture-wetland conversion activities without substantial remediation. After field evaluation on four properties the landowners indicated that they were not interested in pursuing a project at that time. On the remaining two properties, there is little opportunity for wetland restoration due to their small size.

To help meet the goals of this project over the long-term, the following recommendations were offered:

- Maintain regular contact with landowners who showed initial interest in restoring or protecting wetlands and own parcels with good potential for conservation of wetland habitat. Future opportunities are likely to develop with these individuals sometime in the future.

- Make regular attempts to engage landowners in the Basin with informational letters and phone calls. There was a noticeable increase in the number of landowners that responded to the second informational letter. This may be partially a result of a continued presence in the Basin and landowners there becoming more familiar with the intentions of the agencies and organizations involved in remediation and restoration efforts.
- Coordinate efforts among the various agencies and organizations working with landowners in the Basin to send a consistent message regarding remediation and restoration efforts being undertaken there. Maintaining good relationships with landowners that have desirable parcels, particularly those in high priority areas for wetland restoration is essential.
- Find ways to engage landowners that have not been contacted through these initial efforts. Consider conducting annual tours of remediation and restoration projects under way or completed in the Basin to let prospective landowners see first hand what these projects entail and the benefits they provide.
- Explore wetland restoration opportunities outside of the Basin, such as in the St. Joe River basin. There are abundant drained wetlands in the floodplain of the St. Joe that are free of metal contamination and could fulfill much of the habitat needs of waterfowl that migrate through the area.

BW07 – Fish Response to Bank Stabilization …University of Idaho *(Fish Community Structure Associated With Bank Stabilization in the Metals Contaminated Lower Coeur d'Alene River, Idaho)*

Purpose of Project – Bank stabilization efforts will likely be proposed to treat more than 20 miles of the CDA River banks in coming years. Resource management agencies will be asked to evaluate the impact of several bank stabilization project proposals for the CDA River. The objectives of this monitoring effort are: 1) establish baseline fish community structures; 2) evaluate variability in fish community structures over time; 3) evaluate the effect of existing bank stabilization projects on fish communities; 4) determine appropriate monitoring strategies for future bank stabilization projects; and 5) recommend bank stabilization techniques that have positive effects or minimal adverse effects on fish communities.

Conclusions – Salmonid catch in the lower river was greatest during spring when water temperatures were low and juveniles were outmigrating to Coeur d'Alene Lake. Salmonid catches were not statistically different among habitat types although 10 out of 12 jueveniles were captured at stabilized sites. Piscivore catch was lowest during spring. The exact whereabouts of the piscivores at this time were unknown, but many were probably in the chain lakes for more optimal ecological conditions (including temperature) and spawning.

Overall, piscivores were not captured in significantly different numbers at stabilized and unstabilized habitats. Northern pike were captured in greater numbers at stabilized habitats but no individuals were captured in spring. Similarly, northern pikeminnow were abundant at RR sites but were captured in lower numbers during spring. The

highest abundance of salmonids in spring, when predators are least abundant, may result in some benefit to migrating salmonids.

Based on the data available, season seems more important than habitat in affecting salmonid and piscivore impacts. More information is needed by species, season, and habitat type, season, section, and fish size in the lower river, chain lakes, and Coeur d'Alene Lake near the river mouth. Information is also needed on the seasonal movements of piscivores in and out of the chain lakes, and the relation of those movements to the movements and upstream and downstream migrations of salmonids. Extra sampling should be focused in spring, during May and June, when the potential for overlap is greatest.

BW08&B410 – Lower River Sediment Model ……. USGS *(Simulation of Flow, Sediment Transport, and Sediment Mobility of the Lower Coeur d'Alene River, Idaho)*

Purpose of Project – Develop a set of tools that can be used by resource managers for evaluating proposed projects designed to minimize the transport of metal contaminated sediments in the Lower CDA River. Objectives include the utilization of existing data and collection of additional data to develop and calibrate computer models of the river between Cataldo and CDA Lake. These models would be capable of simulating the hydraulic and sediment transport characteristics of the River over a wide range of stream flow and lake elevation conditions. The models would be used to test proposed projects prior to implementation with the goal of improving their design and avoiding unanticipated and costly mistakes.

Conclusions – A computer sediment- transport model**,** HEC-6 was used to simulate water surface and streambed elevations, erosion and deposition of the streambed, and sediment transport. The calibrated model was used to evaluate the feasibility and potential effects of management alternatives on the streambed. Four alternatives were simulated to understand the effects from dredging the streambed and reducing sediment discharge input. Management alternatives 1 and 3 used river discharge data from 2000 and 2 and 4 used data from 1997. Before start of the simulations, seven cross sections in the Dudley reach of the river were deepened 20 feet to simulate dredging about 296,000 cu. yd. of sediments. Simulations indicated that it would take between 24 to 45 years of various flows to fill up the dredged area. It may take many years or even decades for the river to reach equilibrium conditions after incoming total sediment discharge is decreased. Effects from extreme flood events on the channel and flood plain are unknown.

The FASTMECH computer model was used to increase understanding of the two-dimensional flow hydraulics as they vary across the channel and in river beds and simulated bed shear stresses covering a 5.3 mile reach near Dudley. The model showed that flow depths increased as river discharges increased except where high lake elevations cause water-surface elevations to be high due to backwater conditions. The model also showed several areas where reverse flow (back-eddies) occurred and that the potential of sediment mobility occurs when bed shear stress exceeds the critical shear stress of the

particle. Simulated sediment mobility indicated the transport of very coarse sand to fine gravel in these simulations.

BW09& B409 – Model Lake CDA Response …….. USGS *(Interactive Effects of Dissolved Zinc and Orthophosphate on Phytoplankton from CDA Lake, Idaho),* Centre for Water Research, University of Western Australia *(Final reports for Simulation Model to Evaluate Coeur d'Alene Lake's Response to Watershed Remediation, Volume 1: Hydrodynamic modeling using ELCOM, Volume 2: Water Quality modeling using ELCOM-CAEDYM, ELCOM-CAEDYM Model on CD)*

Purpose of Project – Provide the entities responsible for management of CDA Lake with a sophisticated computer modeling system with which to simulate the lake's long-term responses to a wide range of remediation strategies to be implemented under the ROD and the Lake Management Plan.

Conclusions - Using the validated lake models, the processes controlling zinc fate and transport within CDA Lake were explored. Algae play a large role in zinc cycling throughout the lake. Roughly the same amount of dissolved zinc that is released from lakebed sediments into the overlying water column is incorporated into algal biomass in the euphotic zone (the sunlit zone above the summer thermocline), which is then redeposited on the lake bed as the algae dies and sinks to the lake bottom.

The validated models also were used to examine the response of the Lake to a range of long-term scenarios to provide insights into the effects of remedial actions. A combination of low phosphorus concentrations and zinc toxicity is currently keeping the lake's algal biomass at an acceptable level. Efforts to reduce zinc loading from the CDA River are unlikely to result in a significant reduction in zinc toxicity to algal growth in the near term. The Kuwabara *et al* data (2006) suggest that even if zinc concentrations were reduced by an order of magnitude, continued loading from the watershed (although reduced) and also from the lakebed sediment will continue to cause toxicity to non-diatom species).

Decision makers should pay careful attention to nutrient loading to the Lake as it may respond significantly to increased phosphorus input – with or without zinc toxicity. The shallow southern portion of the Lake is already showing signs of this and if the phosphorus loading is not effectively managed there is potential for the symptoms of eutrophication to progress farther into the deep northern body of the Lake. The model simulations suggest that increased phosphorus loading will either produce increased diatom biomass should zinc toxicity remain, or increased biomass of a mixed assemblage including more green and blue-green algal species should the zinc concentrations within the water decrease considerably. However, the overall algal biomass in the Lake should remain below 5 micrograms per liter of chlorophyll-a if phosphorus loading is appropriately managed.

BW10 – North Fork CDA River – Hydrologic and Sediment Yield Studies…….IDEQ *(Watershed Overview & History, North Fork Coeur d'Alene River*

Subbasin; Appendix A, Technical Appendix and Summary of Existing Information; Stream Channel Analysis; Hydrology Analysis; Sediment Source Analysis)

Purpose of Project - Provide a watershed assessment in document form that will effectively aid and support the future development of a Sediment TMDL Implementation Plan for the North Fork Coeur d'Alene River sub-basin (a plan that will be developed by a Watershed Advisory Group).

Conclusions – The final report provides an overview of the North Fork Coeur d'Alene River (North Fork) Watershed Analysis which was completed to support the development of a Sediment TMDL Implementation Plan for the North Fork. In order to provide sufficient information to develop an effective Implementation Plan, the IDEQ requested assistance in compiling information on sediment sources, recent watershed improvements, and aquatic habitat conditions in the listed subbasins of the North Fork watershed. This work was completed in two Phases.

Phase I involved compilation and synthesis of existing watershed data and completion of a Watershed History. This information was presented in *Summary of Existing Information and Knowledge within the North Fork Coeur d'Alene River Subbasin (January 2006).* An initial analysis of the existing information was then completed to identify data gaps and potential field assessment needs. This 'Draft Initial Analysis' included preliminary aerial photo review results and detailed summaries of the existing stream channel data that was obtained from the Forest Service. This initial analysis provided recommendation for field investigations and further analysis recommendations for Sediment Sources, Channel Geomorphic response and Hydrologic Modeling. This information and preliminary analysis is in *North Fork Coeur d'Alene Phase II Report North Fork Coeur d'Alene River Subbasin (July 2006)* and was used to develop a scope of work for Phase II of the assessment.

The actual Phase II Watershed Assessment focused on identifying and quantifying sediment sources and impacts related to the condition of §303(d) listed impaired streams within the North Fork subbasin. This analysis was based on in-depth aerial photo analysis, field surveys in targeted subbasins and detailed hydrologic modeling of targeted subbasins. The hydrologic and sediment source modeling for roads and tributary streams was focused on two sub-basins, the upper Little North Fork CDA River and Big Elk Creek (tributary of Tepee Creek) which represented the range of the past management actions in the watershed. These subbasins were selected because stream segments in both of these basins were listed in the TMDL for sediment and there are several currently-operating stream gages which were critical to the hydrologic modeling.

The next, broader, analysis level was addressing channel response to sediment inputs through time for response reaches of the mainstem North Fork CDA, Tepee and Independence Creeks, plus selected downstream parts of other major tributaries. The Tepee Creek subbasin provided data for burned watersheds with relatively little timber harvest or road-building. The Middle North Fork and some headwater areas of Tepee

Creek provided data for harvested and roaded conditions. These analysis results are presented in four reports. The detailed technical analyses for *Sediment Sources, Stream Channel Analysis and Hydrology Analysis* are in individual reports. In addition to the technical reports the analysis team created a database of road and stream restoration activities and a database of the data and reports located and reviewed during the course of this analysis. The files are included as appendices to the Final Report.

The Final Overview Report presents a summary of watershed conditions and summarizes the key analysis goals and findings to assist the non-technical Watershed Advisory Group (WAG). The following reports are all part of the final work product:

- North Fork Coeur d'Alene Watershed Overview & History
- Appendix A – Technical Appendix: Summary of Existing Information
- Appendix B - Hydrology Analysis North Fork Coeur d'Alene Subbasin
- Appendix C - Sediment Source Analysis North Fork Coeur d'Alene Subbasin
- Appendix D - Stream Channel Analysis North Fork Coeur d'Alene Subbasin
- Appendix E- Reviewed Reports and Data Sources
- Appendix F – Stream and Road Project Database

BW12 – Lower Lakes Aquatic Vegetation ……CDA Tribe *(Lower Lakes Aquatic Vegetation Survey Project Final Report)*

Purpose of Project - The primary purpose of this study was to develop baseline data on submersed aquatic plant species distribution and biomass in Benewah, Chatcolet and Round Lakes. The secondary purpose was to estimate nutrient (primarily phosphorus) release from the existing plant beds into the water column of these lakes and subsequently into CDA Lake. The tertiary purpose was to inspect these lakes for the presence of invasive, noxious aquatic species.

Conclusions - The overall conclusion offered from this baseline assessment of submersed aquatic vegetation in the Lower Lakes area of Coeur d'Alene Lake is that this growth is healthy, very productive and reasonably diverse. The plants that were identified in the Lower Lakes transects and grid point sampling were all native species with the exception of *Myriophyllum spicatum* (Eurasian watermilfoil) which was found widely distributed throughout this area with limited dense growth areas in Chatcolet and Round Lakes. It is expected that this presence will increase significantly in the coming years, absent implementation of control measures. However, harvesting of aquatic vegetation as a means of controlling nutrient inputs to the lake must be further evaluated to determine its cost effectiveness. The loading of the nutrients from aquatic vegetation to the Coeur d'Alene Lake system was higher from the Lower Lakes area than from Coeur d'Alene proper, indicating the importance of these shallow water habitats.

BW13 – Canyon Creek Groundwater Metal Source Characterization …… Idaho National Laboratory *(Canyon Creek Groundwater Metal Source Characterization Final Report)*

Purpose of Project – This project was designed to determine how (in practical terms) zinc and other metals are distributed between different physical and chemical states in the Canyon Creek alluvium. This information will be used to help understand how natural processes can affect the movement of contaminant metals through Canyon Creek and how engineered processes can impact contaminant metal mobility or sequestration.

Conclusions - Based on the results of this preliminary study, several recommendations can be made with respect to estimating metal leaching from Canyon Creek alluvium, predicting the impact on metal concentrations and fluxes into Canyon Creek, and evaluating proposed mitigation approaches.

1. Determine the spatial variability of metal fractions in the alluvium.

   The cores in this study were obtained from a relatively small area of alluvium downstream of Woodland Park. Samples from a wider area are needed to establish that the results obtained in this study are representative of the quantity and distribution of metals in the alluvial sediments downstream of the Woodland Park area. To be cost effective, analyses of these additional samples should focus on the easily leachable fractions (fraction 1 + fraction 2).

2. Develop better measurements and models for groundwater/surface water interactions.

   Existing studies of Canyon Creek (Barton, 2002) have provided initial estimates of groundwater flow and metal fluxes into the stream under low-flow conditions. This study needs to be expanded to better understand the seasonal variations of these flows and how they impact stream quality and metal transport. In particular, information on metal fluxes under high-flow conditions is needed.

3. Establish a sound conceptual/quantitive model for the groundwater hydrology.

   A sound conceptual model should be established so that relevant hydrological processes can be estimated. Such a model would necessarily be based on data from tests and field measurements to obtain the necessary hydrological parameters. The groundwater model should provide an understanding of the groundwater flow paths and their response to seasonal variations in water input into the system. The model should be used to provide groundwater residence times that are needed to estimate the metal concentrations in the groundwater and the time scales for flushing the alluvial sediments. The model could then be used to identify hydrogeochemical zones that could be selectively targeted for specific mitigation activities.

B401 - Mica Bay Nutrient Reduction Project – Phase 2……. Kootenai-Shoshone Soil and Water Conservation District *(Mica Creek Nutrient Reduction Project Final Report; 10 minute DVD Project Overview and Discussion)*

Purpose of Project - The original work planned was intended to be a demonstration and training project for use by wetland delta landowners. It was intended to encourage them to consider altering management of unusable lands for the purpose of providing public benefits by lowering nutrient delivery to near shore areas of CDA Lake. The feasibility study resulting from the first phase of this project indicated that more land and considerable more funding was needed than originally anticipated to implement a meaningful project. IDEQ and the U.S. Fish and Wildlife Service (USFWS) were unsuccessful in their attempts to secure cooperation from enough landowners to implement the project as originally planned.

In August 2006, a willing landowner upstream from the Mica Creek Delta on the lower North Fork Mica Creek contacted the USFWS and IDEQ indicating interest in a streambank and bed stabilization project to control sediment and nutrient impacts to the Mica Creek Delta. Field investigation confirmed that there was significant and active streambank mass failure and erosion on sections of the North Fork Mica Creek located on the landowner's property. IDEQ confirmed that a meaningful stream stabilization project could be completed with the funds available. IDEQ drafted an amended project proposal for Mica Creek that was presented to the BEIPC on November 29, 2006. The BEIPC approved the amended Mica Creek project. As amended, this project will serve as demonstration and training to acreage property owners within the Coeur d'Alene Lake Basin who have streams on their property, on the costs and effectiveness of various streambank and streambed rehabilitation methods to reduce fine sediment/nutrient erosion and export into Coeur d'Alene Lake.

Conclusions - The BEIPC and a group of cooperating agencies with a willing land owner have successfully completed a demonstration project to reduce sediment and nutrient loading to Mica Bay on Coeur d'Alene Lake.

The project had two purposes, to stabilize erosion damage on Mica Creek for the recovery of beneficial uses and to be a demonstration and training project to be used to work with landowners around the lake and along streams feeding the lake. It is intended to encourage landowners to consider land management activities to enhance their property while providing public benefits by lowering sediment and nutrient delivery to streams feeding the lake and near shore areas.

Working with the landowners, the agencies implemented a stream bank and bed stabilization project on a number of areas along the creek to control sediment and nutrient impacts to the Mica Creek Delta. The various applications used were evaluated as to cost and effectiveness.

As part of the education and training portion of the project, a tour of the completed project was advertised and conducted. The tour was given by the involved agencies and the cooperating landowner. Tour components included: discussion on the impact of sediment and associated nutrients to streams and CDA Lake, photo display of pre-project conditions as compared to post-project conditions, costs per linear foot of the various methods used, discussion on the effectiveness of the various methods used, and

discussion of the various cost-share programs available through the agencies involved in the project. Those agencies in addition to the Basin Commission and EPA included the Idaho Department of Environmental Quality, Kootenai/Shoshone Soil and Water Conservation District, Natural Resources Conservation Service, and the Idaho Soil Conservation Commission.

As an educational tool for a wider audience than local farmers and ranchers attending the tour and to serve as a long-term tool, a 10 minute DVD production of the project was produced utilizing filming segments conducted from start to finish. Copies of the DVD can be obtained from the Conservation District; ksswcd@icehouse.net.

B403 – Plummer Wastewater Treatment Pilot …… USKH *(Plummer Idaho Wastewater Disposal Pilot Wetland Project Final Report)*

Purpose of Project - The objective of this project is to show the viability of a wastewater infiltration treatment wetland in Plummer. A successful wetland would benefit water quality in Chatcolet and CDA Lakes by reducing nutrients that now flow into Plummer Creek from the Plummer Wastewater Treatment Facility.

Conclusions – At the onset of this project, the design flow rate was set at 3,000 gpm, however it became apparent in December 2005 that this was unattainable. The flow rate was then set at 1,000 gpm and has remained constant since that time. The one exception, being the time period January 6 and February 10, 2006 when flow had to be halted due to extraordinary high rainfall.

The pilot wetland sample data shows over the course of the study that it is, for the most part, effective at treating the influent levels of phosphorus and nitrate. However, due to the projected flows that will be involved in the full build out, the 200 acres of land needed makes this a less than ideal treatment alternative for the City of Plummer.

B404 – Plummer Creek Watershed Nutrient Load Assessment, Modeling and Management Plan Development……. Coeur d'Alene Tribe *(Plummer Creek Watershed Nutrient Load Assessment, Modeling and Management Plan Development Project)*

Purpose of Project - Characterize nutrient concentrations and transport through the Plummer Creek watershed and into Chatcolet Lake. The results will serve as the basis for developing nutrient and water quality management efforts within the context of a Lake Management Plan, as well as other Tribal, State, and Federal water quality regulatory actions. The project was designed to update the current understanding of nutrient loading sources within the Plummer Creek watershed and to delineate appropriate nutrient loading controls in the form of a Watershed Nutrient Management Plan.

Conclusions - The project was conceived and funded to characterize nutrient concentrations and transport through the watershed and into Chatcolet Lake, and thus, into Coeur d'Alene Lake. The project was designed to update the current understanding of nutrient loading sources within the watershed and to delineate appropriate nutrient

loading controls in the form of a Watershed Nutrient Management Plan. The results are to serve as the basis for developing nutrient and water quality management efforts within the context of a Coeur d'Alene Lake Management Plan, as well as other potential Tribal, State or Federal water quality regulatory actions.

This project began with two years of water monitoring at eight sites spread along Plummer Creek and Little Plummer Creek. This monitoring included flow measurements, field physical/ chemical testing and sample collection for laboratory analysis of nutrient and sediment constituents. This monitoring revealed wide variations between sites and dates during this period, similar to other less intensive monitoring efforts conducted previously.

Modeling work for this project was conducted by TerraGraphics, Environmental Engineering, Inc. under contract with the Tribe. The model used is collectively referred to as the Automated Geospatial Watershed Assessment Tool (AGWA) and includes the Kinematic Runoff and Erosion Model (KINEROS2) and the Soil and Water Assessment Tool (SWAT). These were developed by the USDA Agriculture Research Service and the USEPA Office of Research and Development Landscape Ecology Branch. Model inputs included land cover and land use classifications and local weather data. Nutrient and sediment runoff from three conditions were modeled: pre-European settlement, current and potential future. The 2005 – 2007 water quality data collected for this project was used for model calibration.

The monitoring and modeling results were used to support the development of a watershed nutrient management plan through the characterization of existing nutrient source loads and evaluation of general management alternatives. The management plan also described nutrient and sediment load reduction targets which were based on the analysis of potential future conditions. Once the watershed loading was characterized with the model, the results were presented to stakeholders at two public meetings in an attempt to identify areas and opportunities for future management options. In spite of difficulties calibrating the model with the limited and often inconsistent data, the Management Plan did identify areas of the watershed (sub-watersheds and stream reaches) which were considered high priority for implementation of conservation practices and stream channel stabilization measures. Best Management Practices applicable to forestry, agricultural and developing / developed areas were also presented in the management plan.

B405 – Pinehurst Flood Study……TerraGraphics Environmental Engineering, Inc. *(Pine Creek Sediment Reduction Final Report),* Natures Landscaping & Design, Inc. *(Final Report, Pinehurst Flood Impact CWA Remediation Project)*

Purpose of Project – The final scope of work outlines the specific tasks and overall goals for this project that were agreed upon by IDEQ, the City of Pinehurst, the BEIPC, and other stakeholders. The following list describes the overall goals for the project and specific tasks to be completed in order to meet these goals:

- Sediment transport and water quality improvements for Little Pine Creek (LPC)

- Flood control upgrades in the City of Pinehurst and LPC
- Streambank treatments to consider channel stabilization, hydraulics, and riparian vegetation along LPC
- Increase flood conveyance capacity in high priority areas on LPC
- Hydraulic modeling for LPC and Pine Creek
- Discuss lessons learned from LPC tasks that could be applied to future Pine Creek work

These objectives were meant to serve as general guidance for the work and construction improvements for the Pine Creek basin. It is important to note that changes to the project objectives were expected to occur throughout the development of the subtasks and specific projects. The final tasks agreed upon were:

- Stabilization of the mine waste dump at the General Mine
- Replacement of the culvert at Fairview Avenue
- Removal and strategic replacement of stream crossing structures in the Pinehurst Golf Course reach of LPC
- Channel reconstruction in the Golf Course reach of LPC
- Streambank and recreational access stabilization on LPC through the Avista property
- Hydraulic modeling on Pine Creek and LPC through Pinehurst

Conclusions - The completed pilot projects in the Little Pine Creek drainage improved both water quality and channel stability. As a secondary benefit, flood control measures were incorporated where possible in all the projects. In addition to construction projects on LPC, hydraulic modeling of Pine Creek was commenced to help with future project development and further the project objectives for the Pine Creek watershed.

The Pine Creek hydraulic model as currently developed reflects the existing condition. Additional data should be gathered and analyzed prior to the model's use in future applications and design. Specifically, a detailed study of the hydrology for the Pine Creek watershed should be conducted and the model should be more fully calibrated. This study has determined that the hydrologic information used by FEMA for the Flood Insurance Study in Pinehurst is outdated.

Thorough investigation of additional data that have become available since the 1975 study may improve the peak flow estimates. In addition, model calibration using known data from high flow events would help improve the accuracy of the model.
When the project started there was hope that model correlation between Little Pine Creek and Pine Creek could be made in an effort to help confirm if predicted modeled results actually occurred after construction projects. Although a direct comparison can not be made between these two models, it is reasonable to conclude that modeling predictions accurately reflect actual conditions measured before and after construction on Little Pine Creek. Therefore, it is reasonable to assume that similar results can be obtained with the Pine Creek model.

The lessons learned from the LPC projects can be noted and used when further projects occur in the Pine Creek basin. Although the hydraulic conditions on the various streams in the watershed are significantly different, several similarities exist such as construction methods, design methods, and modeling accuracy.

Overall, the Clean Water Act Pine Creek project was viewed as a success and a significant jumpstart in providing hydraulic information in the Pine Creek basin. Future design projects, modeling, and city developments will be able to use these lessons learned, design methods, and hydraulic models in the Pine Creek watershed.

B406 – Silver Crescent Mine and Mill Complex Habitat Restoration Demonstration….. U.S. Forest Service *(Silver Crescent Mine and Mill Complex Habitat Restoration Demonstration Final Report)*

Purpose of Project – Channel restoration is often an afterthought in the context of large mine reclamation projects since emphasis is largely focused on removal and/or stabilization of contaminated material. While removal of historic contamination sources often show immediate improvement in water quality, channel morphology improvements may occur over decades, resulting in slow progression of stream channel improvement and development of suitable aquatic habitat. Well designed channel restoration can accelerate this process and provide suitable habitat for aquatic organisms over a shorter timeframe. In 2007 The Idaho Panhandle National Forests identified post CERCLA stream restoration needs in East Fork Moon Creek to accelerate stream recovery, meet water quality criteria and improve fisheries, wildlife, sedimentation, and other Land and Resource Management Plan objectives.

Conclusions - Pre- and post-restoration monitoring efforts suggest that the stream channel improvements following restoration work met all of the set objectives. Substantial improvements were observed in fish habitat conditions, stream channel function, fish abundance and biodiversity, aquatic insect biodiversity, and plant biodiversity. Furthermore, these improvements were noted in the first three years following completion of the stream restoration work. In summary, our monitoring efforts suggest that post reclamation stream restoration work such as the East Fork Moon Creek is an important component in mine reclamation projects and should be considered in future mine reclamation plans in the Coeur d'Alene River Basin.

B407 – Canyon Creek Treatability Study….. Pioneer Technical Services *(3 volumes, Conceptual Design, 100% Conceptual Design for Pilot-Scale Lime Lagoon Treatment System, Pilot Scale Lime Treatment System Operation, Maintenance, and Monitoring Plan)*

Purpose of Project – Develop an alkaline precipitation design as a low cost method of achieving a substantial improvement toward ROD goals, and determine if the proposed water treatment technology is implementable in the SFCDA River.

Conclusions – A lime lagoon treatment system is a viable alternative for zinc removal at Canyon Creek. Similar systems have shown that lime lagoon technology can be successful and cost effective. Construction of a lime lagoon treatment system is estimated to cost approximately 52% of the $8.8 million estimate in the OU-3 ROD. Annual operation of a lime lagoon system is estimated to cost approximately 55% of the $600,000 estimate in the OU-3 ROD. A full scale treatment system would occupy about 25 acres in the Woodland Park floodplain.

To complete a detailed final design a number of data needs, such as detailed topography, detailed geotechnical soils characteristics, and detailed regulatory discharge standards will need to be obtained. The project created three documents:

1) 100% Conceptual Design for the Canyon Creek Pilot-Scale Lime Lagoon Treatment System;
2) Pilot-Scale Lime Lagoon Treatment System Operation, Maintenance, and Monitoring Plan; and
3) Conceptual Design for the Canyon Creek Full-Scale Lime Lagoon Treatment System.

B408 – South Fork Sewer Toxicity Study……JUB *(Page WWTP Toxicity Reduction Evaluation)*

Purpose of Project – The Page Wastewater Treatment Plant (WWTP) was originally constructed to serve as a regional facility for most of the communities in the Silver Valley between Cataldo and Wallace. The WWTP is permitted to discharge treated effluent under a NPDES Permit. The plant has historically satisfied the permit limits for typical pollutants such as BOD, TSS, and pH. However, the facility has conducted WET testing, as required in the NPDES Permit, and observed toxicity with the test organism. Additionally, the owner has long-term heavy metals limits based on a TMDL for the receiving stream for cadmium, zinc, lead, and copper below current effluent levels. The owner is currently discharging above the permitted levels through a variance issued by the Idaho Department of Environmental Quality and approved by the EPA. The effluent characteristics of the WWTP are similar to other treatment plants with the exception of high metals concentrations. Comparing effluent heavy metals levels from the WWTP with data in EPA's *Quality Criteria for Water* indicates heavy metals may be a source of toxicity. The facility also has effluent ammonia concentrations that exceed probable toxic limits.

The study investigated the probable source(s) of toxicity in the effluent through a TRE. A TRE is a stepwise process that attempts to isolate and identify likely toxicants in the effluent, determine probable treatment alternatives, and evaluate the effectiveness of toxicity control options through the following six major steps:

- Information and Data Acquisition
- Facility Performance Evaluation
- Toxicity Identification Evaluation

- Toxicity Source Evaluation
- Toxicity Control Evaluation
- Toxicity Control Implementation

Steps 4 and 6 are beyond the scope of this study and will be undertaken by the District on an ongoing basis as appropriate.

Conclusions - The average day design flow for the plant is 4.3 mgd and the peak observed flow is approximately 13.0 mgd, which is due to excessive infiltration and inflow (I/I) entering the collection system. Based on a review of current treatment levels and effluent quality at the facility, the following constituents are potential sources of toxicity:

- Ammonia
- Heavy metals (e.g., cadmium, zinc, lead, copper)

A total of six WET tests were completed during the study. Based on the criterion in the NPDES Permit, the two tests completed in 2006 were both failing tests, with chronic toxicity units (TUc) greater than the permit level of 3.4. Sufficient toxicity was observed in the April 2007 to warrant a Toxicity Identification Evaluation (TIE). A Phase I TIE and a Phase III TIE were initiated. This analytical work showed that removal of zinc from the effluent samples using a chelating agent reduced toxicity. These results indicate zinc appears to be the primary toxicant in the effluent during the sampling period.

Options for reducing zinc and other heavy metals from the effluent include:

- **I/I Reduction**: The Mullan demonstration project showed groundwater contained elevated levels of heavy metals, and infiltrating groundwater resulted in significantly higher metals levels. Removing this I/I resulted in lower concentrations for some metals, lower loads to the WWTP, improved efficiency, and less variability in flows which results in lower capital and operations costs for treatment options.
- **Chemical Precipitation:** The Facility Plan evaluated several options recognized by EPA for removing heavy metals and concluded that chemical precipitation with sulfide at a pH of 8.3 to 8.7 in a covered reactor-clarifier, followed by polishing using multi-media filters could attain a probable effluent of 20 to 1,200 mg/L of zinc. The effluent is currently in this range, therefore this approach is not a practical solution for heavy metals removal.
- **Filtration**: A pilot study completed at the WWTP documented the performance of filtration technologies to remove heavy metals to the levels targeted in the NPDES permit. The implementation costs were very high due to the wide variations in plant flows resulting from I/I.
- **Land Application**: Land applying the effluent would eliminate effluent discharge and consequently potential toxicity to the receiving stream. Land application would be limited to the growing season of a selected crop, which would require effluent storage from late September through April or May and considerable land

for applying treated wastewater. The topography near the WWTP and in the Silver Valley is characterized by narrow valleys, mountains, and streams collecting into the South Fork of the Coeur d'Alene River. Consequently, land application of the wastewater, with complete elimination of effluent discharge, is not a feasible solution.

- **Constructed Wetlands**: Constructed wetlands are commonly used for metals treatment of mine waste. Based on literature searches of similar effluents, this appears to be a viable alternative to reduce effluent metals toxicity. The wetland would be operated year round with the highest performance expected in the summer months and the lowest performance during the spring and fall. Because of the very low metals permit limits and unpredictability of the effluent, constructed wetlands should be piloted for one to two years to verify performance. If successful, 90 percent of current effluent could be treated in a 10- to 20-acre area. Inadequate land exists adjacent to the WWTP to permit all flows to be treated so I/I reduction is critical to the success of this option.

Based on this analysis, I/I reduction appears to be the lowest cost/highest benefit option with constructed wetlands as the least cost treatment option once peak flows have been reduced. The TRE identified zinc as the primary toxicant. A complete TRE process, however, involves Toxicity Source Evaluation (TSE) and Toxicity Control Evaluation (TCE). It is therefore recommended that the owner utilize the conclusions of this study and consider the following:

- Continue systematic I/I identification and rehabilitation projects to reduce extraneous flows from the collection system and ultimately the WWTP.
- Monitor metals levels in the influent and effluent and compare yearly trends with collection system upgrades to identify potential reductions in heavy metals levels.
- In the event further WET tests evidence toxicity, it is recommended that the owner pursue EDTA manipulation to determine if zinc remains the primary toxicant.
- Work with EPA to develop a relationship between zinc levels and toxicity as a surrogate for WET testing.
- If additional metals removal is required once I/I is reduced, consider developing a pilot-constructed wetlands to verify metals removal capabilities.

Depending on the results of these steps and subsequent toxicity in the WWTP effluent, filtration or an alternate treatment method may be required to reduce toxicity further or comply with the final permit limits for heavy metals.

B411 – Alluvium Sorting Study…….IDEQ *(Assessment of the Economics and effectiveness of Alluvium Sorting as a Mine Waste Removal Strategy at the Project Implementation Level)*

Purpose of Project - The pilot work was implemented to answer a number of questions concerning the alluvium sorting approach to mine waste removal and disposal from watersheds in the Basin: 1) Is the additional cost of sorting stream bed materials

contaminated with mine wastes balanced by savings in transportation and repository volume costs; and 2) Is there an added benefit because sorting results in a more homogeneous waste material that reacts to compaction better and ultimately results in lower permeability of compacted waste in the repository. The project also includes a monitoring component. Using a gravel quality monitoring approach, the amount of mine waste contamination will be assessed in the gravels of Prichard Creek at the removal sites pre- and post-project implementation.

Conclusions – The economic and physical (density/permeability) consequences of sorting alluvium demonstrated that the sorting strategy for alluvium-tailings material resulted in a small savings in transportation costs and a large savings in repository construction costs. These savings far offset the added expense of sorting. Large cost savings were obtained despite some inefficiency in the project that could be rectified in subsequent projects. Having a commercial outlet for the oversize material would save additional funds, even if the material was donated. Disposal in the aggregate market will also remove a material from the floodplain that, if not handled properly, will negatively affect revegetation efforts. Sorted material compacted in the repository achieved significantly lower permeability (20 times) than the bulk material with equal compaction treatment. The result was a waste deposit less prone to groundwater percolation independent of the capping system employed.

B412 – Coeur d'Alene Lake Management Plan Implementation……IDEQ and CDA Tribe *(Implementation Survey of the 1996 CDA Lake Management Plan)*

Purpose of the Project - Since the 1996 Coeur d'Alene Lake Management Plan (LMP) was adopted, new information has become available, legal and regulatory decisions have been made, basin-wide remedial actions have been taken, and some implementation has occurred, all of which have impacted the appropriateness and effectiveness of the 1996 LMP and proposed management actions. One of the conclusions of the review and update of the 1996 LMP was that the need exists for a process to routinely evaluate the effectiveness of management actions taken. Some of the biggest threats to lake water quality come from man caused activities adjacent to the nearshore areas surrounding the lake including stormwater runoff from construction and lakeshore development related activities. While the scope of this project proposal is to conduct an extensive evaluation of all activities within a 1 mile perimeter of the lake shore, initial emphasis will be place on development and construction activities.

Conclusions - The project was to conduct a survey of implementation of the existing 1996 Coeur d'Alene Lake Management Plan (LMP) (CLCC *et al*.1996). The main focus of the 1996 LMP strategy was to minimize the release of metals to the water column from lakebed sediments through effective nutrient management and upstream metals load reductions.

A primary component of the 1996 LMP was Management Action Tables (MATs). These tables were developed by numerous individuals in the government, business, and private sectors working within Technical Advisory Groups for broad land use categories such as:

forest practices, wastewater, and agriculture. Management action items within the tables were a compilation of current rules, regulations, recommendations, Best Management Practices (BMPs), and other actions that play a role in water quality management of Coeur d'Alene Lake and its tributaries. A column titled "Lead Group" identified government agencies and other entities who would take the lead for implementing individual action items.

During 2002, Idaho Department of Environmental Quality (IDEQ) and the Coeur d'Alene Tribe (Tribe), in consultation with governmental agencies and other stakeholder groups, conducted an evaluation of the 1996 LMP and its implementation. The evaluation took into account the development of new information and recent legal or regulatory decisions. Local, State, Tribal, and Federal governmental entities participated in this effort, along with industry, business, and environmental representatives. The result was a draft *Coeur d'Alene Lake Management Plan Addendum* (December, 2002) that offered conclusions and recommendations; however it was never finalized. During the development of the 2002 draft (MATs), there was a considerable amount of collaborative effort among stakeholders to revise the 1996 LMP. Thus, IDEQ and Tribal staff decided to utilize these 2002 MATs for the implementation survey.

The purpose of this Implementation Survey between IDEQ and the Tribe was to conduct a survey of measures taken by various agencies, organizations, and industries to fulfill the management actions recommended and specified in the 1996 and 2002 MATs. The survey was intended to evaluate what Best Management Practices (BMPs) are in place to protect water quality and determine the effectiveness of those being used. To initiate the project, IDEQ and Tribal staff created questionnaires tailored to individual stakeholders identified as Lead Groups assigned to MAT recommendations. Questionnaires were mailed out and face-to-face interviews were scheduled. A total of 43 interviews were conducted from June 2006 to May 2009.

During our interviews, we found that there were several common themes among the Lead Groups. They are as follows:

- The key to compliance of various codes requires an "in-the-field" presence of inspectors; additional staff is recommended.
- Across the board, agencies felt there is a real value in education efforts, but there is very little funding allocated. In-the-field inspectors provide one-on-one education.
- Monitoring of BMP effectiveness is not commonly done due to minimal budget allocations.
- There needs to be a better understanding of the current water quality conditions within Coeur d'Alene Lake and its' tributaries.
- Better coordination of activities between basin wide stakeholders is needed.

The MATs include the following land use categories or activities that were evaluated during this survey: 1) Forest Practices, 2) Agricultural Practices, 3) Development and Stormwater, 4) Roads, 5) Wastewater, 6) South Lake and Rivers, and 7) Motorized

Watercraft. In Section 2 of this report, each of these categories has a list of "issues of concern" in relation to the land use and potential impacts to water quality. These issues are too numerous to list in the Executive Summary, but below is a sample within in each category:

Forest Practices

- For all entities interviewed, there is a major emphasis on a lack of funding for road maintenance needs for example, managing legacy roads and replacing culverts.

Agricultural Practices

- There is limited participation in riparian buffer protection programs.

Development and Stormwater

- There remains some non-compliance among development projects, and often notice of noncompliance is dependent upon citizen complaints and random EPA inspections (larger developments). County and City fines for non-compliance do not always discourage violators.

Roads

- Private roads are often built without adequate sediment and stormwater BMPs. For example, a recognized problem involves the "weekend warriors", or folks who use their heavy equipment for grading and digging without getting a permit or having plans approved. In general, private roads need improved stream crossing BMPs and larger culvert sizes (or bridges).

Wastewater

- There are a high number of individual subsurface sewage systems around the lake, and many systems were constructed prior to 1974. These systems did not require permits and some are sub-standard to current requirements. There is a PHD Repair Permit, where if a system has failed and the homeowner wants an upgrade, a PHD inspector goes for a "best fit" for upgrading to current standards. Many older lots cannot meet current standards when they upgrade.

South Lake and Rivers

- There are differing opinions among agencies and citizen representatives between bank stabilization techniques/designs; i.e. predominately hard treatment (aka. rip-rap) versus inclusion of soft treatment (vegetation features) and ecological impacts.

Motorized Watercraft

- The "Clean Marina" Program needs to be revitalized (a program to assist marina operators and boaters to reduce pollution in and around the lake). A draft "Clean Marina" Program was initiated by the Coeur d'Alene Tribe, IDEQ, Kootenai County Parks and Waterways, PHD, US Coast Guard Auxiliary, and IDL in the early 2000's. This program was never finalized or implemented.