An Estimation of Montana's Restoration Economy

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An Estimation of the Economic Impacts of Restoration in Montana, authored by

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Introduction

The Research and Analysis Bureau (R&A) of the Montana Department of Labor and Industry, in a project jointly funded with the Montana Department of Natural Resources and Conservation, was asked to estimate the economic activity resulting from public spending on restoration activities in Montana. The State of Montana and local governments have spent significant public dollars (generated both from tax revenues and lawsuit settlements) cleaning up environmental damage, rebuilding public utility systems, and restoring ecosystems harmed by prior industrial activity. Private business and nonprofits have also invested significant private funding into restoration activities. Jobs and economic activity have resulted from this spending, but it is not clear how much economic activity is generated for each dollar of funding.

For most industries, generating an estimate of economic activity is fairly straightforward. The Bureau of Labor Statistics (BLS), the U.S. Census Bureau, and the U.S. Department of Commerce all maintain federal economic statistics that provide insight into industry activity. Using tools such as IMPLAN, this data can be used to construct multipliers that demonstrate how many jobs and value added dollars are added to the economy for every dollar of public funding.

Generating an economic impact estimate is not as straightforward for restoration as it is for other industries because the restoration industry is not well-defined and because it includes workers classified in many other industries. The North American Industrial Classification System (NAICS), the official taxonomy of industries used to classify employment and economic statistics, does not include a specific category for restoration. Instead, restoration employment is divided into multiple categories, such as including the dirt-moving work into the construction industry, the technical planning and consultants into the professional activities industry, and the hazardous waste removal into the remediation industry.

The solution to these obstacles was to complete a case study on a restoration project in Montana in order to identify the industries included in restoration activities, the number and type of workers involved in restoration, and the wages and benefits for these jobs. The Montana Departments of Natural Resources and Conservation (DNRC) and Labor and Industry (DLI) combined resources for this case study. The original memorandum of understanding (MOU) between DNRC and DLI focused on the Milltown Dam project stated the goals of the study broadly:

1. The initial economic impact of the employment, wages, and compensation added to the community. Identify in which industries the Milltown restoration jobs are categorized and draw conclusions for extrapolation in the Clark Fork Basin, other projects, and across Montana.
2. The secondary impact of these additional wages on seemingly-unrelated industries;
3. Long-term impacts benefiting the community from a cleaner environment, possibly including
    a. Increases in property values (wealth generation) and increased property taxes;
    b. Improved human and animal health from cleaner water;
    c. Decreased future use of public funds for water treatment facilities.
4. Long-term impacts benefiting the economy in terms of

    a. Increased tourism;
    b. Increased recreational benefits (fish and water quality, recreation, boating, new state park); or
    c. Other economic benefits possible to quantify.
5. If time allows, an analysis of the future workforce supply for restoration jobs, including the supply of Montana graduates able to fill restoration jobs.

Given the extensive resource requirements of valuing ecological services, this research relies heavily on existing literature to achieve the goals relating to the long-term impacts of restoration. The long-term benefits to restoration are summarized in Section II and in Appendix A. Much of the long-term benefits of restoration of the Milltown Dam are quantified in the natural resource damage assessments completed as a part of the superfund process and as a part of the litigation between the State of Montana and the Atlantic Richfield Company for injuries to the natural resources in the Upper Clark Fork River Basin.[1] The State found compensable damages for past and future lost use and non-use values of the injured natural resources from 1981 forward to be $410.5 million.[2]

The study focuses on a deficiency in the existing literature – the estimation of the short-term economic impact of restoration funding in terms of the jobs and wages added to the local economy, finding that approximately 31.5 jobs are created for each million dollars of restoration funds spent. In addition, this research identifies employment trends and wage differentials that suggest that most restoration jobs are filled by temporary workers who earn slightly higher wages, but are not required to have a specialized skill set for restoration work. The short-term economic benefits to restoration are described in Section I and the methodology is detailed in Appendix B.

In order to achieve the goals relating to short-term economic impacts, a case study was conducted on the Silver Bow Creek Streamside Tailings project to develop a multiplier using IMPLAN software. This multiplier can then be used to estimate the employment impacts of the Milltown Dam project or other similar mine reclamation sites. This methodology was selected primarily due to data availability. The Montana Department of Environmental Quality, which manages the Silver Bow Creek Streamside Tailings project, provided all of the payroll and contract records for this research. Similar data was not yet available for the Milltown Dam project. Further, because the Silver Bow Creek Streamside Tailings project has been ongoing for a number of years, the project provided a broader range of restoration activities from planning to execution to post-work sampling. On the other hand, the Milltown Dam project was not yet complete enough to provide a full sample of restoration jobs.

In addition to the data from the Montana Department of Environmental Quality, this research was supplemented by data from the following sources: Bureau of Labor Statistics data collected by the DLI; property tax information on the value of residential homes in the Silver Bow Creek area before and after restoration work from the Montana Department of Revenue; and

[1] For additional information on the litigation between the State of Montana and the Atlantic Richfield Co., please see the website of the Natural Resource Damage Program at www.doj.mt.gov/langs/naturalresource/default.asp.
[2] Ando et al, 2004. Natural Resource Damage Program, Montana Department of Justice, 1995 and 2008b.

background information from available literature and extensive interviews of project supervisors, administrators, and policy makers involved in the Silver Bow Creek Streamside Tailings project.

Section I – Short- Term Economic Benefits to Restoration

Definition of the Restoration Industry:
The term "restoration" is used by ecologists to refer specifically to a holistic and complete restoration of an ecosystem to its original condition – a state which many government-led "restoration" projects may not achieve. Three terms are commonly used in ecological restorations that define the extent of clean-up activities: restoration, remediation, and reclamation. All of these terms have legal definitions provided by environmental laws and regulations. In general, restoration is considered the highest level of environmental cleanup and refers to efforts to return the site to full use or to its original state, if possible. Remediation is one part of restoration efforts. Remediation refers to efforts to bring an area into acceptable use, including the removal of waste to bring the area up standards deemed to be safe for human and ecological health. Another term often used as a part of restoration is reclamation. Reclamation is another subset of restoration and refers to efforts to return the land to some beneficial use. Reclamation efforts may include re-vegetation, planting of native grasses, and the removal of waste dumps (although not necessarily up to the level of health standards). Complete restoration is preferred in both in terms of environmental quality and for future economic use of the property, although restoration is also perceived to be the most costly option.[3]

For the purposes of this study, all activity repairing environmental damage is included as restoration, regardless of these nuances. This study includes all workers and businesses that are involved in repairing damage to Montana's habitats and ecosystems in the restoration industry. Examples of restoration projects include cleaning up Superfund sites, mine reclamation, water treatment, brownfield redevelopment, and forest restoration. The ecosystems are often damaged by industrial activities, but may be damaged by natural causes, such as forest restoration to remove trees harmed by pine beetles. This study is particularly focused on the impact of the restoration industry in relation to mine cleanup, and the results of this study may not be applicable to other types of restoration, particularly forestry, which may require different types of workers and job activities than mine restoration.

A definitional distinction exists between the restoration industry and the recently coined term 'green economy.' The "green economy" refers to the economic activity generated by occupations and industries that aid in environmental protection, promote conservation, or encourage renewable energy sources.[4] Jobs in alternative energy production, recycling, or installing energy efficient windows can be considered green jobs. Restoration jobs are a subset of green jobs and refer specifically to employment related to restoring a damaged ecological environment.

[3] A fourth term, redevelopment, is often used to describe the planning for the proposed private or public use of the site following restoration activities. This study does not include the benefits of redevelopment, as redevelopment occurs after restoration is complete and is therefore a separate process.
[4] For elaboration on the definition of green jobs with respect to the Montana Economy, please see the white paper on green jobs by the Research and Analysis Bureau, Montana Department of Labor and Industry, 2009, at www.ourfactsyourfuture.com.

Existing Statistics on the Restoration Industry

For most industries, the economic impact of the industry can be easily determined using official economic statistics and known relationships between the industry and its suppliers and customers. However, the North American Industry Classification System (NAICS), the official taxonomy that classifies industry statistics, does not recognize restoration as a separate industry.

Rather, portions of the restoration industry are categorized into other industries. For example, the dirt moving jobs are classified under Construction (NAICS 23), and environmental research is classified in Professional and Technical Services (NAICS 54). Mine cleanup activities may be categorized in Hazardous Waste Collection (NAICS 562112), while forest restoration projects may be categorized in Support Activities for Forestry (NAICS 1153). Further, the NAICS system categorizes jobs and businesses according to their primary business activity, which would exclude businesses that receive a minority share of their income from restoration work. If a landscaping business spends 20% of the time in remediation services and the remainder of time building golf courses, it would not be included in the remediation services category. The division of the restoration industry into various NAICS codes makes it difficult to estimate the employment or economic impact of restoration using existing statistics.

Remediation (NAICS 56291) is the industry that most closely resembles mine restoration. Therefore, this industry can provide some insight into the mine restoration industry in Montana. Figure 1.1 displays Montana employment in the Remediation Industry for the years 2003 through 2008 compared to employment in all Montana industries. The small number of workers in the Remediation category – 277 in 2008 – makes it clear that most workers on restoration projects are categorized in other NAICS industries. There has been above average employment growth in the Remediation Industry in recent years, with a compound annual growth rate of 10.3% compared to growth of 2.1% for all industries. The above-average growth rate suggests that the restoration industry has experienced rapid growth in recent years, although this growth cannot be measured directly with existing statistics.

Chart 1.1 Montana Employment and Employment Growth in Remediation Compared to all Industries, 2003 to 2008

	Remediation		All Industries	
	Jobs	**Job Growth over Prior Year**	**Jobs**	**Job Growth over Prior Year**
2003	170		393,541	
2004	178	4.7%	403,432	2.5%
2005	182	2.2%	413,460	2.5%
2006	240	31.9%	426,182	3.1%
2007	243	1.3%	436,656	2.5%
2008	277	14.0%	437,620	0.2%

Compound Annual Growth Rate over 2003 to 2008 Period

Remediation	10.3%	All Industries	2.1%

Using employment in Remediation as a proxy for all restoration employment also suggests that Montana has a slightly higher concentration of employment in restoration than the national average. Using data from 2007, about 0.056% of Montana's employment is in the Remediation Industry compared to 0.052% in the U.S., for a location quotient of 1.06.[5] However, this location quotient is still relatively small in comparison to other industries in Montana. In comparison, the location quotient for mining in Montana is 3.85.

Study Methodology

Because the restoration industry does not fit nicely into one NAICS category, the challenge for this research was to determine what types of activities are conducted in a restoration project, to assign these activities and jobs to a NAICS code, and then to use the distribution to construct a restoration industry multiplier. To determine the relevant industries, this research conducted a case study on the restoration efforts from 1998 to 2002 in the Streamside Tailings Operable Unit (OU), one of seven operable units in the Silver Bow Creek/ Butte Area superfund site.

The funding spent in the Streamside Tailings project was categorized by industry, and then IMPLAN economic modeling software was used to construct economic multipliers using input-output analysis with 2002 data and industry schema and a state-based study area. The funding was adjusted for inflation for back years. The breakdown of spending by industry is detailed in Appendix B.

The use of input-output analysis and tools like IMPLAN to generate multipliers is fairly widespread. Moseley and Nielsen-Pincus (2009) used similar methodology to estimate the impacts of forest restoration, and found a multiplier of 20 jobs and $2.3 million in economic activity resulting from each $1 million invested. Similar methodology was also used to estimate restoration activities by Baker (2004) and Kerkvliet (2008).

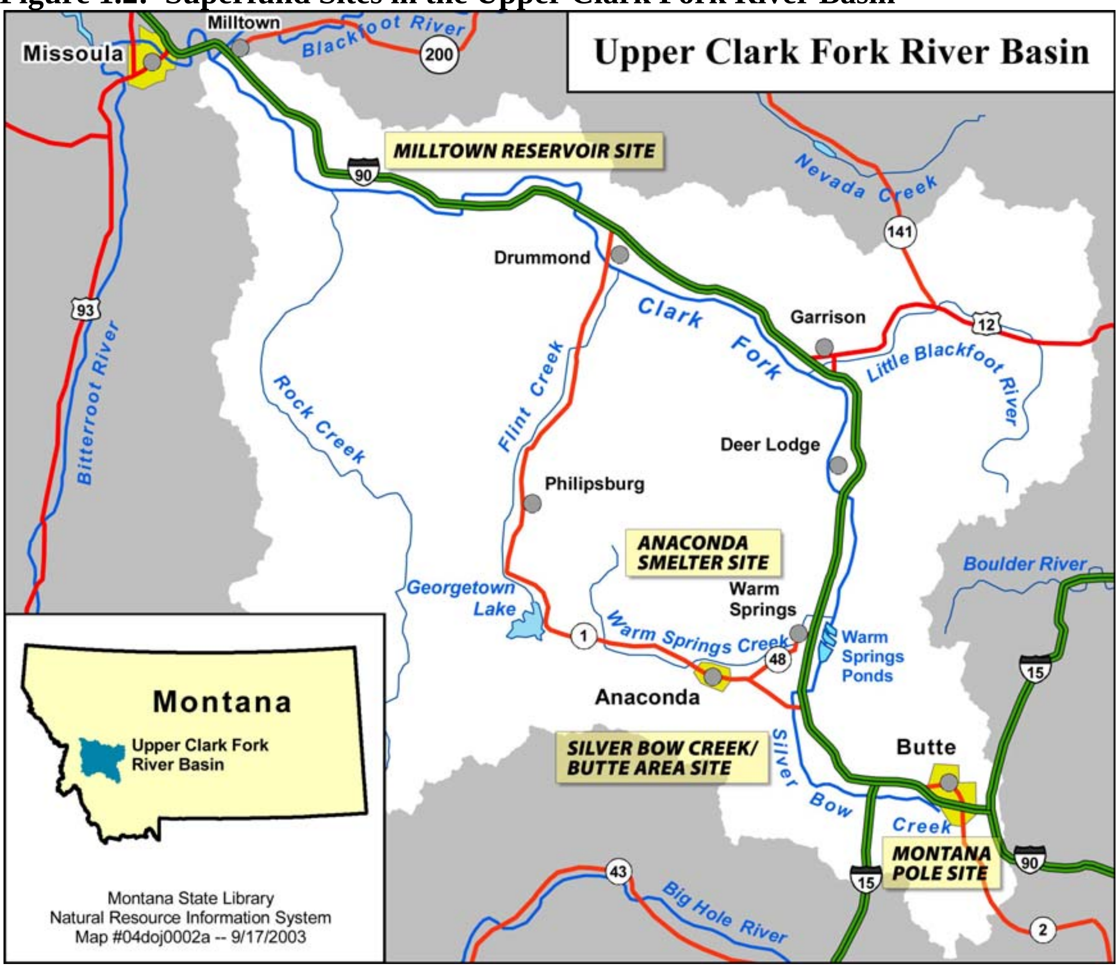
The case study area, the Streamside Tailings OU of the Silver Bow Creek/ Butte Area superfund site, is just one small portion of the extensive, long-term efforts to clean up mine-related pollution in the Upper Clark Fork River Basin in Western Montana. The Upper Clark Fork River Basin, shown in Figure 1.2, includes the largest geographical superfund site in the U.S. and includes four separate superfund sites listed on the National Priorities List. The area is polluted by mine wastes from over 100 years of gold, silver, and copper mining and smelting in the Butte - Anaconda area. Pollutants from mining and mineral processing activities flowed downstream from Silver Bow Creek to the Clark Fork River, and then were trapped by the Milltown Dam. Flooding of these rivers distributed the contaminants throughout the basin, as did airborn contaminants from smelting activities.

The Streamside Tailings OU is located in the Silver Bow Creek/ Butte Area site, which was listed as a superfund site in 1982. The Streamside Tailings OU includes approximately 25 miles of Silver Bow Creek and encompasses the 100-year floodplain adjacent to the creek that has

[5] A location quotient is a metric measuring the concentration of an industry within a particular area in comparison to the average concentration of that industry. A location quotient greater than one indicates that an industry is more concentrated than average, while a quotient less than one indicates a lower concentration than average. This location quotient is calculated by dividing the Montana percentage of employment in remediation by the U.S. percentage of employment in remediation, or 0.056%/ 0.052%.

been contaminated by mine and smelter wastes. The OU also includes nearby railbeds because mine tailings were used to build the railbeds. An estimated 4.6 million cubic yards of mill tailings and other mining wastes were present in the OU when restoration work began. The mine wastes in the OU contributed to downstream contamination, including toxic levels of arsenic, cadmium, copper, lead, mercury, and zinc. Silver Bow Creek is also impacted by urban wastewater discharge and historic wood treatment plants, although the mining waste far outweighs the other pollutants.[6] Restoration activities in the Streamside Tailings OU started in 1999. At the time of the 5-year review in 2005, approximately 200 acres had been remediated, with over 874,000 cubic yards of tailings removed from the floodplain.[7] To date, 3.8 million cubic yards of contaminated soils have been removed from the OU. Cleanup is scheduled to be completed between 2011 and 2013.[8] The Streamside Tailings OU was divided into reaches of approximately one mile in length. Case study data was collected from Reaches A-E, but the payroll data was limited to Reaches A-C. The restoration work included in this study took place from 1998 to 2002.

Figure 1.2: Superfund Sites in the Upper Clark Fork River Basin



[6] Environmental Protection Agency, U.S. Department of Interior. 1995. and Chavez, Joel. 2008-2009.
[7] CDM. 2005.
[8] Chavez, Joel. 2008-2009.

The multiplier constructed in the case study was then applied to the restoration activities taking place in the Milltown Reservoir/ Clark Fork River Superfund Site. This superfund site is located at the confluence of the Clark Fork and Blackfoot Rivers, near the city of Missoula and the communities of Milltown and Bonner. The Milltown Reservoir site was polluted by contaminants from the mining, milling, and smelting operations in the Butte – Anaconda area and includes approximately 120 miles of the Clark Fork River upstream of the Milltown Dam. The contaminated sediments floated downstream through the Silver Bow Creek and the Clark Fork River, and were ultimately trapped in the Milltown Reservoir by the dam. Over 6.6 million cubic yards of contaminated sediments are in the reservoir.[9] In 1981, four community water wells were found to be contaminated with arsenic and other heavy metals from the sentiments in the Milltown Reservoir.[10] Clean up activities in the Milltown Reservoir site are currently underway and are expected to be completed by 2012.[11]

Results for the Jobs and Economic Activity Multipliers

According to the data compiled in the case study, there are approximately 10.97 Montana jobs created in the restoration industry for each million dollars of government-directed funding spent on restoration activities. In addition, 20.56 Montana jobs are created in related industries, retail, or other consumer-based industries because of the additional jobs in restoration. In total, 31.53 jobs are created in Montana for every million dollars of funding spent on restoration. These jobs are expressed as annual full-time equivalent (FTE) positions. These job multipliers were estimated using an IMPLAN-based model using data collected from Silver Bow Creek.

The case study results also indicate that each $1 million dollars in restoration spending results in $2.59 million in total economic activity. The $2.59 million includes $1.06 million in employee compensation (wages and benefits), $0.21 million in proprietor income, $0.51 million in other property income (such as rent), and $0.11 million in business taxes collected by federal, state, and local governments.

Based on the findings from the IMPLAN model on the Silver Bow Creek project, the majority of restoration jobs are within the construction sector, followed by environmental consulting, government, and transportation. The breakdown of jobs by sector is shown in Chart 1.3.

[9] Environmental Protection Agency, U.S. Department of Interior. 2009.
[10] Environmental Protection Agency, U.S. Department of Interior. 1984.
[11] Environmental Protection Agency, U.S. Department of Interior. 2007.

Chart 1.3 Breakdown of Types of Jobs in the Restoration Industry		
General Sector	**Description**	**Percentage of Restoration Jobs**
Construction	Highway, water-system, dirt-moving, construction	35%
Environmental Consulting	Environmental or engineering services	15%
Government	Oversight, research, education	10%
Transportation	Rail and truck transportation	9%
Business Support Services	Security, employment services, legal, accounting, etc.	9%
Remediation	Removing, hauling, and storing hazardous materials	9%
Natural Resources	Logging, stone mining, forest nurseries, and forestry support activities	7%
Other	Hotels, food service, real estate, wholesale trade, fertilizer, garden supply stores, and other	3%

Understanding the Multiplier:
The multiplier was constructed using IMPLAN software by categorizing restoration spending into existing industries and evaluating the overall impact. IMPLAN creates social accounting matrixes and calculates economic multipliers utilizing existing employment and economic statistics and known relationships between industries.

The multipliers reported above are Social Accounting Matrix (SAM) multipliers, meaning that the overall economic impact includes economic activity generated in households and government agencies from the restoration funding in addition to the impact on private businesses and nonprofit organizations. This type of multiplier was appropriate given that many of the impacts of restoration are experienced by government and households. Government agencies fund and oversee restoration projects, while households receive many of the benefits of improved ecological health resulting from restoration. When comparing the impacts of the restoration economy with other industries, comparable SAM multipliers should be used, rather than other types of multipliers that do not account for household or government feedbacks.

In general, this research reports both the direct impact of restoration funding on restoration-related industries and the overall economic activity in the economy resulting from increased incomes in the study area. The overall economic activity includes jobs and economic activity that results from households receiving additional income from restoration-related jobs. For example, if a timber mill in Montana lays-off 100 workers, there are direct impacts to the timber industry and its workers. There are also indirect impacts for the suppliers and customers of the timber mill. Finally, there are also overall impacts that arise from the loss of labor income from the timber mill. At an average wage of $35,000, the layoffs at the timber mill result in a loss of

$3,500,000 in household income in the economy. These households are no longer able to spend these wages in the local economy, which leads to negative impacts in seemingly unrelated industries. The overall economic impact multipliers used in this research include the impacts of a change in household income.

The multiplier does not include any benefits gained from improvements in human or ecological health or from increased use of the restored natural resources. The multiplier also does not include jobs in the restoration economy that are unrelated to the spending of government-directed restoration funds. There may be other restoration jobs funded through other means that would not be included in the multiplier. For example, there are many nonprofit organizations that promote restoration activities in Montana. If the nonprofit received a portion of the government-directed funds as a part of the restoration project, perhaps to disseminate information on the project, the nonprofit's activities would be included in the multiplier. If the nonprofit received additional donations from area households due to the increased area income from the restoration project, its jobs would be included in the multiplier. However, if the nonprofit did not receive any additional funding from the restoration project, either directly from the project or indirectly through increased donations, the nonprofit's jobs and activities would not be included in the multiplier.

Further, the multiplier does not include any calculation of incidence distribution for the costs of restoration projects. For example, if the restoration project was funded by taxpayer dollars, taxpayers in the economy would bear the cost of the restoration project, which would need to be subtracted from the benefits for an estimate of the overall economic impact. The Silver Bow Creek project was funded with natural resource settlement funds, not through an increased tax burden, which primarily places the restoration costs on the customers and owners of the Atlantic Richfield Company.

The jobs and economic activity that result from restoration spending are not permanent and expire when the restoration spending expires, similar to any other publicly-funded project. If $1 million was spent per year for two years on a project, then nothing in the third year, there would be 31.53 FTE jobs and $2.59 million in activity for the first year, 31.53 FTE jobs and $2.59 in activity for the second year, and no jobs or activity for the third year. That being said, there are a number of jobs, particularly in engineering, environmental consulting, and government, that are effectively permanent because new funding streams are found to continue work on other restoration projects.

<u>Cautions of Extrapolation and Methods to Track Restoration Jobs:</u>
The purpose of constructing a multiplier for restoration work is to be able to attach a general number of jobs and dollars of economic activity to each dollar of public funding spent on restoration activities. The conclusions reached in this research can then be generalized to all restoration work in Montana. However, the information gathered here may not be easily generalizable to the larger restoration industry. For example, the multiplier may not adequately represent restoration activities undertaken by private industry, particularly because of fewer government oversight jobs.

Further, the multiplier may be too specific to the Silver Bow Creek project or, more generally, to restoration work related to mining. Forest or wetlands restoration are likely substantively different, as indicated by Moseley and Nielsen-Pincus (2009), who found a multiplier of 20 jobs per $1 million for forestry and wetlands restoration compared to the 31.5 jobs found in this study using similar methodology. The use of a multiplier that does not suit the activity may misrepresent the restoration economy.

Also, the multipliers created in this study may only apply to restoration activities in the 1998 to 2003 timeframe and may not apply to other timeframes. The multipliers rely on known relationships between inputs, labor, and capital. Over time, these relationships change because of new technologies or improved practices. Further research on current projects using updated relationships would indicate whether the multipliers are constant over time.

As an example of the dangers of extrapolation, one method to generalize these results is to utilize the breakdown of jobs by industry. This case study found that 9% of restoration jobs were in the remediation industry. The Quarterly Census of Employment and Wages (QCEW), a data series quantifying payroll employment maintained by the U.S. Department of Labor and the Montana DLI, indicates that the remediation industry employed 277 people in 2008. Extrapolating from these conclusions, a possible 3,078 individuals worked in the restoration industry in 2008 (277 / 9%).

Similarly, knowing that 15% of restoration employment is in environmental or engineering services and 3,307 payroll employees work in these NAICS codes (NAICS codes 54133 and 54162), we could extrapolate that 22,046 individuals were employed in the restoration industry in 2008. In other words, extrapolation using the results of this case study using the employment distribution by industry leads to substantively different results, indicating that the case study results may not be generalizable.

This research also attempted to utilize existing confidential UI employment data to track restoration jobs. The hiring history for each of the contractors identified in the case study was examined to determine whether the restoration project created abnormal trends or patterns that could be used to identify restoration hiring in other projects. For example, if employment trends for the contractors working for Silver Bow Creek restoration project showed a clear hiring of 200 more workers for the restoration project, the hiring trends of employers in the Milltown Dam area could be examined to determine which contractors were involved in the project. However, there was not an obvious hiring pattern demonstrated by the contractors on the Silver Bow Creek Streamside Tailings project. This may be because the contracts were only awarded to contractors who were large enough and already had sufficient workers to handle the full restoration project. Further, construction was the only industry found to have a large number of restoration jobs; other businesses outside the construction industry only required a few workers, making the hiring indistinguishable from normal variation in employment levels.

Macroeconomic statistics, including employment and the unemployment rate in the area, also did not display obvious indications of increased hiring that would be helpful to track restoration jobs in other areas. For example, while employment in the area surrounding the Streamside Tailings project increased, it was not obvious that the hiring was related to restoration rather than other industries. The lack of pattern may be because employment statistics track the location of the job by the address of the employer, rather than the location of where the work was performed. Therefore, restoration hiring done by a Helena contractor would be recorded in Lewis and Clark County rather than in the counties surrounding the restoration site.

Extrapolation to the Milltown Dam Project:

It is the opinion of the authors that the restoration multiplier constructed in the case study is sufficiently reliable to be used on similar mine restoration projects that involve the rebuilding of streambeds, soil removal, and other construction-type work similar to the Streamside Tailings project. The Milltown Dam project fits these characteristics, and the use of the multiplier to this project is appropriate. An estimated $113 million will be spent on the Milltown Dam project, resulting in approximately 1,240 FTE jobs in restoration and 2,323 FTE jobs in other industries (a total of 3,563 FTE). These jobs would be spread over the full timeframe of the project, meaning that if the Milltown Dam project takes 10 years to complete, it would produce an average of 356.3 FTE jobs per year (3,563 FTE / 10 years).

Further, the Silver Bow Creek case study indicates that each $1 million spent on restoration results in an estimated $2.59 million in economic output. Extrapolating these results, the $113 million budgeted for the Milltown project would result in approximately $292.7 million in economic activity. This economic activity includes $120.2 million in employee compensation, $23.4 million in proprietor income, and $12.8 million in business taxes collected by federal, state, and local governments. Again, this income would be spread over the full timeframe of the project.

Results on the Quality of Restoration Jobs:

The case study also collected payroll data from portions of the Silver Bow Creek Streamside Tailings project in order to validate the conclusions of the IMPLAN model and to analyze the average pay for each restoration job. The payroll information was limited to Reaches A-C of the Streamside Tailings OU (the contract data used in the IMPLAN model was collected for Reaches A-E). Also, the payroll data only covered a portion of the blue-collar jobs, like construction and security jobs, and it did not include data from other types of jobs, such as consultants, researchers, or scientists. Drivers, laborers, mechanics, operators, security guards, and flaggers were the most common jobs included in the payroll data. The payroll data for Reach A indicated a total of 18.75 FTE construction jobs, which was comparable to the 20 FTE indicated by the IMPLAN simulation model.

The payroll data was matched with confidential Unemployment Insurance (UI) wage records from the Montana Department of Labor and Industry to determine whether restoration jobs were temporary, seasonal, or permanent. The UI records covered the period from the third quarter of 1997 (1997 Q3) to the 4^{th} quarter of 2003 (2003 Q4) to examine the work histories of the workers before and after the restoration project. Of the 151 workers included in the payroll data, 95% (144) were matched with UI wage records. Data entry error is the likely cause for the 5% of workers that were not found in the UI data.

Of the 144 workers that were matched with UI records, only 21% of the workers had earnings in every quarter from 1997 Q3 to 2003 Q4. The non-continuous work pattern was expected because the majority of the workers included in the payroll data were construction workers, and the construction industry is highly seasonal. Most workers had consistent work patterns on an annual basis, with 73% of workers showing wage earnings both before and after working on the restoration project

An average of 52% of the reported wages came from the restoration project. For individual workers, the percent of wages from the restoration project ranged from 6% of earnings to 100% of earnings. Only 13% of the workers received 100% of their wages from the restoration project. About 30% of workers received the majority of wages from the restoration project, while 48% received less than half of their income from the restoration project.

The remainder of wages either came from a different employer or from the same employer on a different project. Approximately 50% of workers worked for only one employer during the period in which they worked on the restoration project. About 27% worked for one employer in most quarters, but worked multiple jobs in one quarter. 16% worked for multiple employers in multiple quarters, while the remaining 4% worked multiple jobs in all quarters.

Of those workers earning less than 50% of their wages from the restoration project, 52% of them worked for only one employer, which indicates that the restoration contractor likely held contracts for multiple projects (not necessarily restoration) and moved the workforce around on all of the projects. Further, no worker was consistently employed for all three reaches of the payroll data (reaches A-C), which was expected because different contractors were used for different reaches. However, the movement of workers between restoration and other projects, and the changing of the full workforce from one reach to another, suggests that the skill set for restoration work is not highly specialized. Rather, it is likely that blue collar workers can be easily moved from non-restoration work to restoration work without a lengthy training period. Further research is needed to explore skill requirements for restoration jobs.

The payroll data also included the addresses where the paycheck was mailed, which was used as an indicator of the residency of the worker. Of the 151 workers included in the payroll data, 64% received their paychecks in a Butte zipcode, with 14% receiving checks in the Anaconda zipcode. Similarly, 66% of the total earnings were received by Butte workers, with 21% of the earnings received by Anaconda workers. Regionally, 90% of the workers came from the Butte region (towns with zip codes starting with “597”), with 7% of workers coming from the Missoula area (zip codes starting with “598”). Butte region workers received 98% of the total earnings. The local workforce is welcome news to community economic developers seeking a homegrown workforce, but it also suggests that restoration work is not an exportable industry where teams of Montana workers travel to complete restoration projects in other states.

Based on the payroll data, construction jobs in restoration paid above average wages and benefits. In 2001, the average worker in heavy and civil engineering construction (NAICS code 237) earned $38,841. From the payroll data for the Streamside Tailings project, the pay rate for construction workers was approximately $49,400 annually. However, because most of the workers only worked a few months on the project, the average amount paid per construction worker was $9,900.

Occupational data for wages paid per hour also indicates that restoration workers earn above average wages. Chart 1.4 displays the average wage per hour paid in restoration for Reach A of the Silver Bow Creek project compared to the average wage per hour for Montana as a whole in 2000. With the exception of security guards, the average wage paid in restoration was higher than the median and average paid in the state. There were no workers characterized as "hazardous material removal workers" in the payroll data from the Silver Bow Creek project. However, Chart 1.4 includes this occupation's average wage in the state for comparison purposes. The last occupation, overall construction and extraction occupations, is the average for all such workers in Montana and the average wage paid from the payroll data collected.

Chart 1.4: Average Wage Paid in Restoration Compared to the Montana Average Wage for Selected Construction Occupations, 2000

		Restoration Wage (in dollars)	Montana Wage (in dollars)	
Code	**Occupation**	**Average (Including Overtime)**	**Median**	**Average**
33-9032	Security Guards	6.03	7.08	8.06
47-1011	First-Line Supervisors of Construction Workers	19.86	18.13	18.64
47-2061	Construction Laborers	15.77	11.02	12.00
47-2073	Operating Engineers and Other Construction Equipment Operators	18.39	14.99	15.22
47-4031	Fence Erectors	19.25	10.05	10.63
47-4041	Hazardous Material Removal Workers	n.a.	13.47	14.68
47-4051	Highway Maintenance Workers (Flaggers)	16.79	12.4	12.67
53-3032	Truck Drivers, Heavy and Tractor-Trailer (Drivers)	17.91	12.99	13.86
47-0000	**Overall Construction and Extraction Occupations**	**16.14**	**14.09**	**14.76**

Source: Payroll data compared to similar occupations in the Occupational Employment Statistics, Bureau of Labor Statistics

Section II – Long-term Economic Benefits of Restoration in Montana

The economic impact of restoration activity extends beyond the short-term impacts of increased jobs and economic activity induced by the restoration project. Restoration activities provide health and tourism benefits from cleaner environments and increased tax revenues for state and local governments. Restoration may impact property values for properties near the restoration site. There also may be negative impacts of restoration projects, such as placing large demands on the local labor supply for heavy construction or other industries or requiring the construction of temporary housing for restoration workers that may not be used after completion of the project.

The Memorandum of Understanding for this study outlined the estimation of these indirect long-term economic benefits to restoration, but this research attempted to maximize limited resources by focusing on the short-term impacts to address a deficiency in the existing literature. This section reviews the existing literature of the long-term benefits of restoration and their applicability to Montana.

The Value of Ecological Services

Ecological services are the services provided to humans by the environment, such as clean water and air, predictable weather patterns, and recreation opportunities. Determining the value of ecological systems is an emerging area of research in natural resource economics, but providing an ecological value determination remains quite complicated because no market exists for many of the services provided by the environment.

Economists and ecologists use a variety of methods to value natural resources and the services they provide, with the value estimate differing significantly depending on which method is used. Some resources are valued by the costs required to repair the damage, such as the cost to a mining company to restore the mine site to the original condition. Another method is to measure the public costs to return the natural resource to an acceptable quality, such as measuring the value of clean water by determining the cost paid by city water systems to bring unsafe water up to human consumption standards. However, this method does not compensate society for "non-use" values, or the loss of the resource when it was unavailable for use due to environmental damage.[12]

Another method is to use property value differentials to determine how much people value living in a good environment, or surveying individuals in the affected area to determine the collective amount residents are willing to pay to have a resource restored. However, critics argue that many of these methods understate the value of the natural resource because only the value to humans or to specific individuals are included, not the value of the resource to other parts of the ecosystem.[13] "Damages to ecosystem services, public health, etc. are more difficult to valuate, partly because we know too little about the importance of ecosystem services…Often, these costs

[12] Damigos. D., 2006.
[13] Berger et al. 2008.

are based on willingness to pay to avoid damage or willingness to accept compensation to tolerate a deteriorated [environment]."[14]

As a part of the litigation between the State of Montana and the Atlantic Richfield Company for injuries to the natural resources in the Upper Clark Fork River Basin, the state conducted a Natural Resource Damage Assessment that provides the best available ecological valuation of the damaged resources. This study cost the state $8 million to complete.[15] The economists for the state valued the groundwater, fisheries, surface water, and terrestrial resources at $12 million per year using a contingent valuation method.[16] Using a travel cost model (also called a recreation model by Natural Resource Damage Program 2008b), economists found that the public lost over $2.5 million annually from the loss of fishing opportunities in the Upper Clark Fork Basin.[17] A third study estimated the value of the groundwater services in the City of Butte that were lost due to the damage, resulting in damage estimates ranging from $50.7 million to $210.8 million for the total time frame of the damages.[18]

In other words, separate valuations of the loss of recreation use resulted in substantially different estimates for the ecological value of the damaged resource. The State of Montana used the higher estimation from the contingent valuation method, plus the estimate of nonresident non-use value from the travel cost model, to arrive at a total compensable damage estimate of $410.5 million for the damages in the Upper Clark Fork Basin. The state's total claim also included restoration cost damages of $341.7 million and assessment and enforcement costs of $12.3 million for a total claim of $764.5 million.[19]

Increases in Property Values

Another methodology to value the benefits of restoration not included in the state's Natural Resource Damage Assessment is the use of property value increases due to restoration activities. Greenberg and Hughes (1990) found that the presence of a Superfund site decreased the property value growth rate for communities in New Jersey. It is reasonable to assume the negative impacts would dissipate subsequent to or during restoration. The Environmental Protection Agency (EPA) (2003 through 2004) used property value increases for a quarter-mile and half-mile radiuses around 13 different superfund sites to estimate the property value increases (and resulting property tax increases) resulting from restoration.[20] However, the EPA's use of simple difference between property values before and after cleanup likely overestimates the values due to restoration, as the property values would likely increase even without clean-up efforts.

[14] Hylander and Goodsite. 2006.

[15] For additional information on the litigation between the State of Montana and the Atlantic Richfield Co., please see the website of the Natural Resource Damage Program at www.doj.mt.gov/langs/naturalresource/default.asp.

[16] Natural Resource Damage Program, Montana Department of Justice, 1995.

[17] There is a reporting discrepancy between the recreation values are reported by Morey et al. (2002) and Ando et al. (2004) as $2.5 million annually and the Natural Resource Damage Program, Montana Department of Justice, 1995, which apparently rounds this figure to $2 million annually. As Morey was the economist who conducted the travel cost study, the $2.5 million reported directly from the researcher was used in this paper.

[18] Natural Resource Damage Program, Montana Department of Justice, 1995 and 2008b. Ando et al., 2004.

[19] Natural Resource Damage Program, Montana Department of Justice, 2008b.

[20] Environmental Protection Agency, U.S. Department of Interior. 2003-2004.

With data help from the Montana Department of Revenue and GIS assistance from the Department of Natural Resources, this research attempted to measure the value of restoration through property value increases. The Montana Department of Revenue reappraises residential property every six years, with reappraisals occurring in 1996, 2002, and 2008. If the growth rate for property values close to the restoration site were lower than those further away from the restoration site from 1996 to 2002 before restoration, and the growth rate changed during the 2002 to 2008 timeframe after completion of the restoration work, the additional growth may be due to a cleaner environment and higher amenity values. However, data limitations prevented the joining of property values for all three reappraisals, so this analysis was not possible.[21] This analysis is further complicated by the presence of multiple superfund sites in the Upper Clark Fork River Basin.

Further, this research attempted a second method to value the impacts of restoration on property values by examining whether home sales in the Upper Clark Fork Basin were lower than expected given the property characteristics and demand from population growth. This method utilized results from a home price model developed for the Montana Department of Revenue by Dr. Scott Rickard from Montana State University – Billings.[22] The Rickard model estimated county effects that were assumed to be price differentials due to population growth and local amenity values, including negative amenities like superfund sites. A similar approach was used by Kiel and Zabel (2001) to estimate the benefits of restoring superfund sites in Massachusetts.

Unfortunately, regressions using the county effects from the Rickard model did not reveal that the impacted counties had lower than expected property values, although the aggregation of home sales by county and omitted variable bias likely influenced the estimates. A more sophisticated model on micro-data that accounts for other amenities in addition to the negative amenity of superfund site proximity may result in more meaningful results. Future research in this area is encouraged, particularly as additional restoration work is completed.

[21] Silbaugh, 2009.
[22] Rickard, 2008.

Appendix A: Results Specific to the Memorandum of Understanding

The conclusions of the restoration study are briefly summarized below using the outline specified in the Memorandum of Understanding between the Montana Departments of Natural Resources and Labor and Industry. The language from the MOU is bolded.

1. **The initial economic impact of the employment, wages, and compensation added to the community. Identify in which industries the Milltown restoration jobs are categorized and draw conclusions for extrapolation in the Clark Fork Basin, other projects, and across Montana.**
2. **The secondary impact of these additional wages on seemingly-unrelated industries;**

According to the data compiled in the Silver Bow Creek case study, there are approximately 10.97 jobs created in the restoration industry for each million dollars of public funding spent on restoration activities. The jobs are primarily in the construction, environmental consulting, and government industries. In addition, 20.56 jobs are created in related industries, retail, or other consumer-based industries because of the additional jobs in restoration. In total, 31.53 jobs are created for every million dollar of public funding spent on restoration. These jobs are expressed as full-time equivalent (FTE) positions. These job multipliers were estimated using an IMPLAN-based model using data collected from Silver Bow Creek.

The authors of this research believe that this multiplier can be reasonably used for all mine reclamation work that involves significant heavy construction work through the removal of polluted soils and streambed restoration. Using this multiplier, the $113 million spent restoring the Milltown Dam area is estimated to result in approximately 1,240 FTE restoration jobs through the entire timeframe of the project, plus an additional 2,323 FTE jobs in other industries (a total of 3,563 FTE).

3. **Long-term impacts benefiting the community from a cleaner environment, possibly including**
    a. **Increases in property values (wealth generation) and increased property taxes;**

Although other research has identified a positive relationship between environmental cleanup and increased residential property values, this research failed to find such a relationship in the area surrounding Silver Bow Creek. Property tax impacts on the area around Milltown Dam, if present, would not be expected to happen until after cleanup is complete. The continued monitoring and examination of property value increases in the Upper Clark Fork River may be a more fruitful area of research as restoration efforts continue.

b. **Improved human and animal health from cleaner water;**
c. **Decreased future use of public funds for water treatment facilities.**

Placing a value on human life and health is a difficult subject fraught with subjectivity and metaphysical and social implications. The Baseline Human Health Risk Assessment for the

Milltown Reservoir Operating Unit indicated that the cancer risk associated with drinking the contaminated groundwater would increase the risk of cancer by over 1 chance in 100 (Environmental Toxicology International, 1993). The Milltown Dam area population has been using water from other sources since the groundwater wells were found to be contaminated in 1981. However, the risks associated with incidental ingestion of arsenic through the eating of vegetables grown in the contaminated soils, dust in the home, or through the ingestion of animals that drank contaminated water were estimated by the human health risk assessment to be low except under one restrictive scenario.

In terms of ecological health, the pollutants from the Butte – Anaconda mining operations has eliminated trout from the Silver Bow Creek and significantly reduced trout stocks in the 125-mile stretch of the upper Clark Fork River.[23] The State of Montana conducted a natural resource damage assessment for the Upper Clark Fork Basin in preparation for the litigation between the State and the Atlantic Richfield Corporation (ARCO) at a cost of $8 million. The damages to the groundwater and other natural resources were estimated based on the contingent valuation methods, with resulting values for use and nonuse of the damaged natural resources of $12 million per year.[24] The travel cost study placed these damages at $2.5 million per year.[25] The costs for public water systems were estimated to be $40 to $80 million compared to the original environmental state.[26]

4. **Long-term impacts benefiting the economy in terms of**
    a. **Increased tourism;**
    b. **Increased recreational benefits (fish and water quality, recreation, boating, new state park); or**
    c. **Other economic benefits possible to quantify.**

Using a travel cost methodology, Morey et al. (2002) estimated that resident anglers would take an average of 0.36 trips each and nonresidents would take an average of 0.07 trips each to the Silver Bow Creek and Upper Clark Fork River if the rivers were restored to their original condition.[27] Assuming that all of the mean trip cost of $840 for nonresidents and $77 for residents is spent in the local community, and assuming that there are 65,000 nonresident anglers and 71,000 resident anglers, the local economy would gain $5.79 million in increased tourism from anglers with a fully restored river. However, much of that tourism is currently directed towards other Montana streams, so some communities in Montana would lose tourism dollars equal to $5.02 million. The net impact of restoring the Silver Bow Creek and Upper Clark Fork River to the Montana economy was estimated to be $764,000. This study used data collected in 1992. Estimation of the tourism impacts may differ significantly using updated data.

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[23] Morey et al., 2002.
[24] Natural Resource Damage Program, Montana Department of Justice, 1995 and 2008b.
[25] Ando et al, 2004 and Morey et al, 2002.
[26] Ando et al, 2004.
[27] A description of the travel cost valuation methodology also can be found in Damigos, 2006.

5. If time allows, an analysis of the future workforce supply for restoration jobs, including the supply of Montana graduates able to fill restoration jobs.

Time did not allow for an analysis of the potential future workforce supply for restoration jobs. Interested parties are encouraged to review the proceedings from the Restoration Workforce Conference, where employers involved in the restoration industry provided their perspective on the availability of workers and skill shortages of graduates entering the restoration workforce.[28]

The research did reveal some interesting information about the types of jobs available and the permanency and wages of those jobs, particularly for the blue-collar workers involved in the project. The results of the case study for Silver Bow Creek indicated that while jobs in the restoration industry paid more than similar jobs in other industries, the work was often temporary and seasonal. The restoration industry does not appear to require any specific skills, as workers were able to move easily in between restoration and non-restoration jobs held by the same contractor.

[28] Montana Department of Natural Resources and Conservation, 2008.

Appendix B – Detailed Methodology

The majority of cost data used in this research is actual cost data from Reaches A, B, and C of the Streamside Tailings Project. Reach A was under construction from September 1999 to December 2000. The costs paid by the contractor for Reach A were divided equally by month, so that 3/15 of the spending was assigned to 1999 and the remainder assigned to 2000. Similar methodology was used to divide the contractor's spending on Reaches B and C between 2001 and 2002. Construction on Reaches B and C took place from May 2001 to August of 2002. Dividing the spending by year allowed for the appropriate inflationary adjustments to be made when calculating the economic impact of the restoration spending.

However, there were some costs associated with the Streamside Tailings Project that were difficult to separate by time frame or by specific reach. For example, environmental engineering plans and other consulting were developed for the full project and could not be associated with a specific reach. For these types of costs, it was assumed that the benefit of the cost was similar every year. Therefore, the average spending per year was used as the cost included in the IMPLAN model.

Because restoration is not a defined industry in IMPLAN, the public dollars spent on restoration projects were divided into smaller defined industries. For example, approximately $250,000 was spent on trees for re-vegetation and planting along the Greenway trail in 2001. This spending was categorized in the forest nurseries industry. The division of project costs into various industries was subjective, but was done in close consultation with restoration experts, particularly Joel Chavez, project manager of the Silver Bow Creek Streamside Tailings OU with the Montana Department of Environmental Quality. The division of the funding by industry is shown in Chart B.1 below.

This categorization allowed the use of IMPLAN to estimate the jobs and wages associated with the restoration spending. For example, the $250,000 spent in the forest nurseries industry in 2001 added an estimated 0.4 jobs and $39,502 in labor income in the forest nurseries industry, and 5.2 jobs and $143,217 in labor income to the Montana economy.

IMPLAN provides the choice to enter the demand to each industry on either a commodity or industry basis. In general, the demand was input on a industry basis, with the exception of forest nurseries, stone mining, sand, gravel, and clay mining, pesticide and agriculture chemicals, signage, building materials and garden supply, real estate, and railroad rolling equipment manufacturing. The authors felt that the demand to these industries was purely for the commodities themselves and not for the other services provided by the industry.

Chart B.1 Division of Funding by Industry

Restoration Costs by Sector and Year

Implan Sector	Description	1999	2000	2001	2002
15- Forest Nursuries	Trees for revegitation, trees along Greenway trail	64,931	259,724	250,000	250,000
18- Agriculture and forestry support activities	Weed spraying, fertilizer spreading	44,536	178,145	110,000	110,000
25- Sand, Gravel, and Clay Mining	Sediment Excavation and hauling	2,400	9,600	10,061	11,499
29- Support Activities for other Mining	Hauling non-impacted soils to stockpile, clearing	22,113	88,453	1,867	2,133
37- Manufacturing and industrial Building	Installing fencing	33,636	134,543	104,799	106,913
39- Highway Construction	Hauling roads, county road culvert crossing, Greenway trail	60,031	240,124	51,844	59,250
40- Water System Construction	Groundwater dewatering, diversion system	45,204	180,816	95,773	109,455
41- Other new Construction	Reconstructed channel, soil excavation and placement	225,721	902,883	750,315	857,503
158- Fertilizer, Mixing only, Manufacturing	Soil lime treatment and placement	142,543	570,173	500,000	500,000
159- Pesticide and other Agricultural Chemicals	Weed spraying	2,222	8,889	8,889	8,889
205- Iron or steel pipe manufacturing	Culvert crossing	1,400	5,600		
356- Railroad Rolling equipment manufacturing	Railroad materials	1,928	7,710		
392- Railroad Transportation	Railroad	288,900	1,155,600	1,155,600	1,155,600
394- Truck Transportation	Equipment hauling for mobilization	30,000	120,000	81,060	92,641
404- Building Materials and Garden Supply	Fencing and foliage	3,737	14,949	11,644	11,879
431- Real Estate	Soil and land rental from land owners	18,056	72,222	72,222	72,222
439- Architectural and Engineering Services	Surveying, engineering	47,778	191,111	191,111	191,111
445- Environmental and Other Technical Services	Environmental consulting and engineering	176,250	705,001	705,001	705,001
457- Investigation and security services	Site security	15,299	61,195	42,020	48,023
459- Other Support Services	Hauling water, traffic control	56,967	227,868	194,020	217,451
460- Waste Management and Remediation	Debris and waste loading and disposal, railroad materials remediation,	20,887	83,547	432,819	494,650
462- Colleges, Universities, and Junior Colleges	Research	25,000	100,000	100,000	100,000
11003- Federal Government, Investment	EPA oversight	21,538	86,150	86,150	86,150
12001- State/Local Government, noneducation	DEQ oversight	84,449	337,794	337,794	337,794
12002- State/Local Education	Clark Fork River Education	25,000	100,000	100,000	100,000
Total		**1,460,524**	**5,842,096**	**5,392,989**	**5,628,164**

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