ST. MARY DIVERSION & MILK RIVER PROJECT

PRELIMINARY ECONOMIC ANALYSIS

IMPACTS AND BENEFIT-COST ANALYSIS

PHASE II
TASK 4 – ECONOMIC ANALYSIS

FINAL REPORT

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BIOECONOMICS

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REPORT OVERVIEW

The Milk River Project, which was authorized in 1903 and constructed between 1906 and 1936, diverted water from the St. Mary River into the North Fork of the Milk River and dramatically increased flows in the Milk River in Montana, particularly during late summer months. The increased flows brought with them changes in the agricultural, recreational, and socioeconomic structure of Montana's Milk River Basin. One hundred years after the project was first begun, many components of the Milk River Project are in need of repair or replacement. This report is a preliminary analysis of the economic importance of the Milk River Project waters to Montana in general and the Milk River area in particular.

An assumption of this study (following Reclamation 2004) is that in the absence of significant rehabilitation of the St. Mary facilities, at some point in the not-too-distant future the diversion will cease to function. Accordingly, the estimates reported here contrast a future "with" a rehabilitated St. Mary facility and an alternative future "without" such a facility. This report provides, to the degree possible with readily accessible data and information sources, estimates of the potential regional economic impacts associated with: 1) construction expenditures associated with rehabilitation of the St. Mary Diversion facilities, and 2) the increased productivity that would result from reconstructing the facility relative to the alternative of continued future deterioration and/or failure of the project. In addition to the regional economic analysis, the report provides a cost-benefit analysis of the "with" and "without" cases. The methods applied here are generally consistent with guidance provided in the U.S. Water Resources Council (1983), *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies,* commonly referred to as the "principles and guidelines."

The main findings of this report are that the regional economic impacts of an assumed $120 million investment in rehabilitation of the St. Mary Diversion will provide about 256,000 million acre feet of additional water each year and result in a significant increase in agricultural production in the Milk River basin, on the order of $16.4 million per year. The combined economic impact of the reconstruction spending and the associated increase in agricultural production over the next 100 years is on the order of $350illion in the seven-county Northern Montana study area and $455 million for the State of Montana in terms of cumulative discounted impacts on total output over the 100 year planning period. This very significant impact relative to the cost reflects the fact that substantial private sector infrastructure is already in place on Milk River project farms and districts to efficiently utilize this increment in water.

With regard to annual net economic benefits, these are estimated to total $24 to $39 million annually, compared to the amortized annual project costs of about $6.6 million for a project scaled at an 850 cfs canal. In other words, project benefits exceed costs by about a four to one ratio. These project benefits are shared over a number of sectors including irrigated agriculture, municipal and rural water uses, recreation, fish and wildlife, and ecosystem services including the provision of wetlands. The net present value of project benefits over the 100 year planning life is estimated to be between $410 and $660 million. Again, compared to total project costs of around $120 million this is about a 4:1 benefit cost ratio. The relative efficiency of this proposed investment is, again, in large part because the necessary private infrastructure is already in place.

The main components of the annual project benefits of $24 to $39 million per year are summarized as follows. A significant net annual benefit (increased production less costs) is related to the increased agricultural production (on the order $11 million annually). The provision of municipal and rural water systems serving approximately 18,600 individuals provides benefits of $3.3 to $5.35 million annual, compared to the costs of alternative sources. The project will result in substantially improved fisheries in the Milk River and Nelson and Fresno Reservoirs, as well as providing for increased wildlife production, in part on irrigated farmsteads. Benefits accrue for improved fishing and associated increased recreational use in the Milk River and Fresno and Nelson reservoir and hunting (including deer and upland birds), as well as other recreation, totals $6 to $12 million per year. Having adequate flows in the Milk River is associated with the viability of approximately 7,340 acres of riverine wetlands, with a total value of about $5 to $7 million annually (based on the cost of wetland acquisition in the basin).

The basin is currently characterized as having relatively high unemployment rates, particularly on the four area reservations where unemployment ranges from 57% to 77%. Accordingly, there are also significant secondary regional economic impacts that lead to the employment of currently unemployed resources, with an annual benefit of $2.3 to $3.8 million annually. There may also be significant project benefits associated with other ecosystem services, such as increased Milk River instream flow and improved riparian habitat, and increased water availability at Bowdoin National Wildlife Refuge that could mitigate saline concentrations and airborne dispersal of salts, and increase wildlife and waterfowl productivity. The project may also benefit endangered species including the pallid sturgeon and several Montana species of concern including paddlefish and sauger. The main report provides a literature review of studies of similar resources in Montana and other U.S. locations, which provides an indication that there may be quite substantial benefits associated with these other ecosystem services.

The estimates presented here are based on a review of existing studies. Given the "off the shelf" nature of the current analysis, this report also identifies a number of key data gaps and missing information associated with all of the major benefit categories. A description of a potential scope of work for the next phase of economic studies is described, including a number of tasks to provide benefit estimates more specific to the project area, along with NEPA compliance analysis and writing.

The following executive summary provides more detailed summary discussion of the main points above.

ESTIMATED REGIONAL ECONOMIC IMPACTS

Rehabilitation of the St. Mary Diversion facilities would have two significant impacts on the local area economies associated with the construction spending in the local area during the five-year construction period, and the increased agricultural production associated with the Milk River Project water. Table ES1 presents the results of a combined analysis of these two impacts. The analysis is presented for two specific analysis areas: 1) a seven-county segment of the Hi-Line between Glacier County and Valley County, and 2) the State of Montana. The seven-county area impacts to total output of goods and services are estimated to be on the order of $22 and $20 million annually for construction impacts during the five year rehabilitation period, and for increased agricultural production following rehabilitation. Total discounted cumulative impacts over the 100 year life of the project are estimated on the order of $350 million for the counties.

Table ES1: Estimated Combined Impacts of Construction and Agricultural Production: Annual and Cumulative Impacts

Impact Area	7-county Impact	State of Montana Impact
(A) Annual Impacts		
St. Mary Reconstruction (years 1-5)	$22.4 million	$38.8 million
Increase Agricultural Production (years 6 on)[a]	$20.2 million	$22.9 million
(B) Cumulative Discounted Impacts[b]		
St. Mary Reconstruction	$94.6 million	$163.9 million
Increase Agricultural Product[c]	$258.0 million	$291.6 million
Total	**$352.6 million**	**$455.5 million**

[a] conservatively assumes no agricultural production from project water during construction
[b] using a 5.875 real rate from Reclamation (2004)
[c] assumes a project life of 100 years

ESTIMATES OF NET ECONOMIC BENEFITS

BENEFITS ASSOCIATED WITH USE OF UNDEREMPLOYED RESOURCES

Much of the local economic area surrounding the St. Mary Diversion facilities as well as the counties included in the Milk River Project irrigation districts fit the definition of areas with significant underemployed resources. Extremely high unemployment rates within the four Indian reservations proximate to the area indicate significant underemployment of labor. Additionally, the loss of population in recent years within the Milk River Drainage indicates the underemployment of other resources such as housing stock and commercial capacity. For purposes of this analysis, we count all secondary employment and value added (income) effects of the construction and agricultural production spending within the region as a project benefit. The reasoning is that increases to employment associated with these impacts are relatively small compared to the unemployed, or underemployed labor pool in the area. In any case, this is an area for further analysis.

Table ES2 shows the estimated annual direct and secondary (indirect and induced) impacts associated with St. Mary rehabilitation and the increment of increased agricultural production attributable to use of the St. Mary irrigation flows. It is assumed that rehabilitation expenditures will occur over a 5-year period. Total project cost is estimated at the $119.6 million level for the 850 cfs rehabilitation.[1]

Table ES2: Estimated Direct and Secondary Impacts to Total Value Added: Annual Regional Economic and Cost Benefit Impacts of the St. Mary Rehabilitation

Impact Event	Seven-county area		State of Montana (including seven-county impacts)		Time period
	Direct impacts	***Secondary Impacts***	*Direct impacts*	*Secondary Impacts*	
St. Mary rehabilitation spending	$7.7 million	**$3.8 million**	$12.0 million	$8.3 million	Years 1-5
Increased agricultural production	$8.5 million	**$2.3 million**	$8.5 million	$3.6 million	Years 6 on

The highlighted seven-county secondary impacts column from Table ES2 indicates the potential level of annual benefits associated with the rehabilitation project that could be counted within a cost-benefit accounting framework. In general, these secondary benefits are estimated to be between $2.3 and $3.8 million annually.

[1] TDH 2005, "Rehabilitation Plan: St. Mary Diversion." Construction period of 5 years assumed due to 5-year interest calculation in Table 8.2.1. Total project cost also from Table 8.2.1, Page 174.

BENEFITS ASSOCIATED WITH INCREASED AGRICULTURAL PRODUCTION

The largest current use of Milk River Project water flows is for irrigation of the approximately 120,000 acres receiving some project water. The use of irrigation along the Milk River results in significantly higher crop yields in comparison with dryland yields for the same crops in the area. Reclamation (2003) reports that while dryland alfalfa production in the area averages 1.1 tons per acre, irrigated production yields 3.5 tons per acre. The increased production associated with irrigated acreage compared to comparable dryland cropland translates into higher gross revenue for crops produced. While there are also increased costs associated with irrigated agricultural production, the benefits of increased production outweigh the incremental costs of irrigation.

The production function approach to valuing agricultural irrigation water is based on the microeconomic profit-maximizing model of the firm. A basic result of this model is that a farm (business) will be willing to pay a price for inputs equal to the contribution of that input to production (this is called the "marginal physical product") times that value of the output. Multiplying this amount by the net irrigation per acre applied to a crop yields a "short run" estimate of the incremental value of irrigation water to production of a specific crop.

In the case of irrigation use of Milk River Project water, an estimate can be derived of the short term value of water to crop production using available estimates of the marginal physical product of water in production of alfalfa, along with Reclamation data on additional water at the farm headgate attributable to the Milk River Diversion, on-farm application efficiency, and acres irrigated.

Table ES3: Estimate of Irrigation Water Value Based on Alfalfa Production Functions

Marginal physical product of irrigation in alfalfa production[a]	.19 tons/inch
Additional water at farm headgate compared to without project scenario[c]	13.25 inches
Average on-farm distribution efficiency[d]	43%
Adjustment for reduced yield in establishment year[e]	.90
Extra tons benefit per acre	**0.97 tons/acre**
Average Montana 2003-2005 alfalfa price[b]	$74.67/ton
Water value per acre	**$72.43 / acre**
Assumed acres irrigated with project water[f]	151,525
Total annual value of Milk River Project water to crop production.	**$10.97 million**

[a] Duffield et. at (1991) [b] Montana Agricultural Statistics Service (2006) [c] US BOR (2004) Table 6.1 [d] US BOR (2004) page 48. [e] for simplicity, assumes ½ of normal production in establishment year. [f] derived from US BOR (2004) Table 6.1.

Table ES3 shows an estimated total annual marginal value of crop production from use of Milk River Project water of approximately $10.97 million. Like Reclamation (US BOR 2004), this estimate denominates all production in terms of alfalfa. Additionally, like Reclamation, the estimates compare a reconstructed water supply (850 cfs) which delivers an average 26.36 inches/acre to the farm headgate with a "without project" scenario where only 13.11 inches/acre are delivered to the farm.[2]

Another estimate of the net benefits of Milk River Project water to agriculture is provided in Reclamation (2004, Table 6.1). Reclamation provides an estimate of net benefits to agricultural production increases between "with" and "without" cases of $7.681 million. For purposes of our analysis, we use as a probable range for agricultural benefits Reclamation's $7.681 million to the estimate from the production function approach ($10.97 million).

ESTIMATED MUNICIPAL WATER USE BENEFITS

The towns of Havre, Chinook, Harlem, and Fort Belknap, and the Hill County Water District draw water from the Milk River for their municipal, residential, and industrial supply. Reclamation (2004) states that "with no St. Mary water there would be a drastic effect on these towns and the rural water district." In the absence of the contracted St. Mary flows these water users would need to find alternative sources of their MR&I water. Montana DEQ and U.S. Census report that there are approximately 18,600 people served by MR&I water from the Milk River and associated aquifers.[3]

The value of this MR&I water to the municipalities and the county water district can be estimated in several ways. One method is to measure the difference between the costs associated with the current supply and the costs associated with procuring a replacement supply of similar quality. Another approach is to observe what water customers pay in time and effort to obtain acceptable drinking water when a municipal source is either of unacceptably low quality or not available. This so-called "averting cost" can include, among other things, the cost of boiling water, filtering water and hauling water from another source. This method provides a minimum estimate of municipal water users net benefits.

Residential use of water is the most highly valued and vital use of this resource. Developing a firm estimate of the value of MR&I water from the Milk River Project requires detailed information on current costs of the water supply as well as engineering estimates of costs of alternative supplies including any needed water treatment facilities. The recent congressional $22 million funding vote for systems on the Fort Peck and Rock Boy's Reservations as well as for the Dry Prairie Rural Water Project in Culbertson indicate that alternative water supply costs in areas of Northeast Montana can be substantial.

Given the likelihood that readily available substitute water supplies for the Milk River municipal systems would be of a lower quality, one method of estimating the benefits of use of St. Mary water for MR&I is to look at existing examples of consumer behavior when faced with low quality municipal water supplies. An example from the city of Butte, Montana was extensively studied in conjunction with the State of Montana v. Atlantic Richfield Company "Superfund" litigation. In the course of this litigation, studies of Butte water users found that households within Butte spent an average of between $336 and $541 (1995 dollars) per year in purchasing, treating, or traveling to get higher quality water. In current dollars, this "averting behavior cost" is between $438 and $705 per household per year.

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[2] US BOR (2004) Table 5.1.

[3] DEQ 2005: Second Administrative Order on Consent Docket No. PWS-01-14, & http://ceic.commerce.state.mt.us/c2000/PL2000/PLplacearea.xls

As noted previously, approximately 18,600 people living along the Milk River rely on diverted flows or associated aquifers for their household water. The simple average number of people per household in these counties is 2.54, slightly above the Montana average of 2.45 people per household.[4] This translates into approximately 7,600 Hi-Line households relying on Milk River Project water for residential use. At an estimated avoided cost of averting behavior of between $438 and $705 per year per household, the estimated annual benefits associated residential use of the St. Mary water is approximately $3.3 to $5.36 million.

ESTIMATED RECREATIONAL BENEFITS

Much recreation in Montana has a strong link to water resources. Fishing, swimming, picnicking, wildlife watching, and even hunting can all, to some degree, be dependent on water levels or the presence of irrigated farmlands. The St. Mary diversion water provides significantly augmented flows in the Milk River as well as water for maintenance of water levels at Fresno and Nelson Reservoir, and at Bowdoin NWR. Estimation of the net benefits associated with recreation tied to the project flows is a two-step process: 1) estimation of the total recreational use of the river and reservoir water resources, and 2) estimation of the portion of that recreational use that is directly tied to flows from the St. Mary Diversion.

Table ES4 provides a summary of recreational benefits associated with Milk River Project water. While estimates are provided in the table for certain recreational activities, values for other activities for which data is unavailable, or the tie to Milk River water is less well defined, are not estimated. For instance, while estimates of hunting values at Bowdoin NWR are available from FWS use statistics, estimates of off-refuge waterfowl hunting that may be tied to the habitat and attractiveness of the refuge lands to passing waterfowl are not estimated. Therefore, for a number of different reasons the approximately $10.5 to $12.0 million annual net economic value of recreation attributable to Milk River Project water (shown in Table ES4) may provide an underestimation of total Milk River project water-dependent activities in the "with" verses "without" comparison.

Table ES4: Summary of Upper Range of Net Economic Recreational Use Value Estimates Associated with St. Mary Flows (Current $million)

Resource	Annual NEV Fishing	Annual NEV Non-fishing, Non-hunting Recreation	Annual NEV Hunting	Total
Milk River	$1.7 to $2.1 million	$2.7 to $3.4 million	$4.2 million	$8.6 to $9.7
Fresno & Nelson Reservoirs	included in above	$1.6 to $2.0 million	Included above	$1.6 to $2.0
Bowdoin NWR	0	$0.2 million	$0.1 million	$0.3
Total	*$1.7 to $2.1 million*	*$4.5 to $5.6 million*	*$4.3 million*	*$10.5 to $12.0*

[4] http://quickfacts.census.gov/qfd/states/30000.html

Because these estimates are based on readily available studies that are not generally specific to the Milk River Basin, there is additional uncertainty about the true range of values. For example, these estimates may still be somewhat conservative in that they are largely comparisons of the "without" case to current use levels, not a comparison of the "with" and "without" cases. On the other hand, it is also possible that recreational values may be somewhat lower than the upper range of $10.5 to $12.0 cited below. None of the value per day estimates relied upon here explicitly take into account possible substitution effects. Additionally, where state-level or even regional-level values are used, it is not known if the recreational use affected by the Milk River Project is of a quality comparable to the relevant regional or state estimate. For example, the deer hunting estimates specific to Montana ($75 to $165 per day for residents and nonresidents respectively) may be higher than the average deer hunting value for the U.S. ($63 to $85 for state residents and nonresidents respectively) in part because Montana hunts are typically high quality hunts for mule deer. In the case at hand, however, the change in hunter days along the Milk River is for whitetail. It is not known if these hunts are more appropriately valued at the U.S. average or at the Montana average. Accordingly, recreational benefits could be as much as 50% lower (e.g. around $6 million per year) due to these factors. Additionally, given uncertainty about impacts on use, let alone values, we have not formally incorporated the variability due to the statistical precision (standard errors) of the original estimates. For purposes of the summary below (Table ES4), a preliminary range for recreational values is determined to be $6 to $12 million annually.

ESTIMATED WATER QUALITY BENEFITS

The diverted St. Mary water provides a source of high quality water for the Milk River system. Reclamation (2004) notes that the loss of the St. Mary water would result in less dilution of pollutants, and therefore would result in a decrease in water quality within the river.

The Milk River, including Fresno Reservoir, downstream to the Missouri River has been assessed as having one or more beneficial uses impaired or threatened as a result of human activity. These waters are therefore on the Montana 303(d) list of impaired streams and are scheduled to have TMDLs completed by 2011. Loss of St. Mary dilution flows would further exacerbate the problems associated with these impaired waters.

ESTIMATED BENEFITS ASSOCIATED WITH ECOSYSTEM SERVICES

The "direct-use" benefits of ecosystems services, such as recreation, associated with the diverted St. Mary water are substantial, as described above. There are additional indirect ecosystem benefits associated with the diverted water. These ecosystem benefits include so-called passive use or nonuse values. These are values associated with a resource independent of direct use. For example, some individuals may place a value on knowing that the Milk River has a healthy riparian ecosystem or healthy fisheries independent of any plans to ever themselves actually visit the Milk River area. For example, individuals may place a value on the continued existence of rare fish like the paddlefish and the pallid sturgeon, independent of actually expecting to ever see one. The guidance from the economics literature is that these values need to be included in benefit cost analysis. Consistent with the guidance from the U.S. Water Resources Council (1984) principles and guidelines, these benefits are measured in terms of willingness to pay.

There are numerous examples in the economics literature of studies that place a value on indirect ecosystem services (National Research Council 2004). Examples of passive use values in the economics literature include values associated with protecting endangered species (such as the grey wolf or grizzly in Montana), protecting streamflows for trout populations, or protecting air quality. The myriad of ecosystem services supplied by St. Mary water include support for endangered species (piping plover and pallid sturgeon), support of riparian zones and wetlands, and support of wildlife populations. However, to date there do not appear to have been any studies of ecosystem services undertaken specific to the Milk River area. The information needed to develop estimates for ecosystem services in this case include: 1) information on actual water allocations that will be made in the "with" case that may benefit ecosystem services, for example flows specifically reserved or made available for Bowdoin NWR or pallid sturgeon, 2) the physical and biological effect of these flows on the service at issue (for example, a given amount of feet may increase waterfowl production at Bowdoin by a given amount, or reduce salinity levels by some amount, or decrease the risk of extinction for the pallid sturgeon, and etc.), and 3) economic values for quantity changes in the services at issue (for example, the value of increased wildlife production, reduced salinity, decreased risk of extinction, etc.). Based on our review of the existing studies, neither the hydrological, biological, or economic information on possibly valuable indirect ecosystem services associated with increased flows for the St. Mary Project are available for most services. One possible exception is wetlands, as is discussed below.

An example of an ecosystem type for which direct evidence of existing value to society is available for the Milk River is in the case of wetlands. Enhanced Milk River flows and return flows from irrigation all maintain and enhance wetlands within the Milk River drainage. These wetlands provide ecosystem services ranging from filtering and cleansing water flows to providing wildlife habitat. Loss of the diverted St. Mary flows would impact the extent and quality of wetlands within the river corridor.

One method of estimating benefits is to examine public policy decisions for evidence of what values society through its public decisions has placed on particular resources or services. In the case of preservation of wetlands, there is clear information on values associated with wetland protection in the Milk River Drainage. The Montana Department of Transportation (DOT) has a restriction associated with its highway work stipulating that any wetlands that are drained or destroyed in the course of road building, repair, or expansion must be replaced with newly developed wetlands within the same drainage.[5] Within the Milk River Drainage, the DOT has developed two replacement wetland zones associated with past and projected future road work in the drainage. The two replacement wetlands are located near Zurich and Hinsdale. Costs associated with development of these replacement wetlands provide a Milk River-specific estimate of the benefits associated with wetlands sustained by St. Mary Flows.

Montana DOT reports that replacement wetlands within the Milk River Drainage cost the department between $11,000 and $16,000 per acre. Clearly, society places a significant value on the ecosystem services provided by Milk River wetlands, as demonstrated through their willingness to replace lost wetlands at considerable expense.

National Wetlands Inventory data are available for approximately one-half of the river miles between Fresno Dam and the mouth of the Milk River. Within these inventoried sections there are a 3,768 acres of riverine wetlands located within one mile of the river. It is these wetlands which depend on surface water that stand to be lost without continued St. Mary flows. Table ES5 details the calculation of estimated annual value of the riverine wetlands along the Milk River based on the replacement cost estimates from Montana DOT.

[5] Personal communication, Larry Urban, Wetland Mitigation Specialist, Montana Department of Transportation, Nov 7, 2005.

Table ES5: Estimated Annual Milk River Riverine Wetlands Benefits

Estimate	Value
Acres of inventoried riverine wetlands within 1 mile of river[a]	3,768
Percent of river un-inventoried	48.65%
Estimated riverine wetland acres along entire Milk R. below Fresno Dam	7,339
Estimated replacement cost per acre	$11,000 to $16,000
Estimated total value of Milk River riverine wetlands	$80.73 million to $117.43 million
Estimated annual value of wetlands (at 5.875%)	$4.74 million to $6.90 million annually

To conclude this section, available studies indicate that ecosystem services could potentially provide significant economic benefits related to the St. Mary water diversion. However, at present there is considerable uncertainty about how large these benefits are in the absence of key data on the allocation of St. Mary water to these uses, the biological response to water allocations and other mitigation efforts, and the economic values associated with these uses by regional and national households, and visitors.

SUMMARY OF APPROXIMATE ESTIMATED BENEFITS

As described above, there are substantial economic benefits associated with diversion of St. Mary water in to the Milk River Drainage. These benefits include benefits to agriculture, recreation, municipal water use, water quality, and ecosystem services. Additionally, the secondary economic impacts associated with ongoing agricultural production tied to St. Mary flows, and spending on reconstruction of the diversion facilities represent benefits to the Hi-Line economy.

Table ES6 summarizes preliminary and approximate estimated benefits associated with the Milk River Project water. The table shows estimates of annual value for most categories of benefits. The annual benefit estimates in Table ES6 generally represent the incremental benefits of a rehabilitated St. Mary Diversion in comparison to a scenario without any St. Mary water in the Milk River System. However, the estimates for hunting benefits and fishing may be more representative of a comparison of the "without" case to current water availability, not to the "with rehabilitation" case. The following section on net present value estimation of estimated benefits addresses expected changes in water flow from the St. Mary system over the expected life of the rehabilitated system.

Table ES6: Summary of Approximate Preliminary Annual Benefits Associated with St. Mary Diversion Rehabilitation ($ million)

Benefit Category	Estimated Annual Benefits
Agricultural production value	$7.68 to $10.97
Secondary regional impacts of increased agricultural production and construction	$2.3 to $3.8
Recreation[a]	$6.00 to $12.00
Municipal, Residential, and Industrial uses	$3.30 to $5.35
Water quality	Not estimated
Indirect Ecosystem services: instream flows, Bowdoin NWR enhancement, endangered species.	Not estimated
Carriage water benefits	Not estimated
Wetlands	$4.74 to $6.90
Hydropower	Not estimated
Approximate Total Annual	$24.0 to $39.0

ESTIMATED NET PRESENT VALUE OF BENEFITS

While the preceding table outlines a partial and preliminary estimate of benefits associated with Milk River Project water, in order to estimate the net present cumulative value of these annual benefit streams two additional pieces of information are necessary. First, one must know if the estimated annual benefits are constant, increasing or decreasing over the life of the project. Second, a rate at which to discount future benefits must be selected. Using the Reclamation (2004) interest rate of 5.875% (assumed to be a real rate), and assuming all annual benefits identified in Table 27 are constant into the future, results in a present value on the order of $410 to $660 million. This estimate is likely conservative. Unit values for some benefit categories have been approximately constant in real terms over the last few decades (for example, alfalfa prices). However, the unit values and/or use levels for other significant benefit categories, including recreation, have generally been increasing. For example, sales of nonresident upland game bird licenses in Montana have increased at an average rate of about 2.5% per year over the last 30 years. These estimates are additionally based on the simplifying assumption that, in the absence of significant rehabilitation, the St. Mary water delivery system would fail in the near future.

The estimated approximately one-half billion dollars in project benefits is about four times the $120 million in estimated rehabilitation costs. This implies a preliminary benefit-cost ratio for the project of about 4:1.

NEXT PHASES ECONOMIC STUDIES

As described in the previous section, there are significant data gaps and missing key information for a number of economic sectors related to the Milk River Project. The following narrative lists the key tasks that should be included in the scope of work for the next phases of economic studies.

Irrigation Economics. Collect data on project area farm expenditures, production, and land values and characteristics through a survey of a sample of 300 randomly selected project area farms. This survey would be implemented through combined phone/mail survey methods. Analyze data to identify project level marginal value product schedules and marginal costs that account for crop and input substitution, and can be used to compute project benefits.

Regional economic analysis. Use farm survey data to estimate regional purchase coefficients. Identify appropriate percent spent locally parameters for project construction impacts, and extent to which secondary project impacts will utilize underemployed resources, based on actual engineering and economic experience in other projects, and characteristics of local population and economies. Estimate regional economic impacts of the project, including construction, at several regional scales: Glacier County, 7-county Northern Montana, and State of Montana.

Agricultural and Rural residential property values. Use farm survey data, supplemented by real estate transactions data, to estimate hedonic models that distinguish the value associated with irrigated agriculture and residential property services, proximity to water resources and hunting opportunity. Use these models to refine estimates of the irrigation benefits and to estimate the impact of a rehabilitated project on residential property values and associated project benefits.

Municipal, rural and industrial water supplies. Estimate the potentially significant project benefits associated with MR&I use of project water. The task includes review of statewide groundwater well database for information on groundwater availability, and investigation of alternative costs associated with all current Milk River MR&I water users. Review actual cost for new rural water supply systems in the region Additionally, this task includes collection and examination of Montana data on current municipal water rates and implied price elasticities, in order to estimate municipal benefits.

Recreation benefits. Estimate recreation benefits for all key recreational uses of the project, including fishing in the Milk River and Fresno and Nelson reservoirs, as well as non-angling recreation including boating and general shoreline use at these resources. Implement a survey of Milk River recreationists to identify mix of activities and to estimate net benefits through recreation demand models. Implement a survey of upland game bird hunters and deer hunters to measure net economic values and expenditures and to relate use to irrigated project lands.

Water quality. Estimate benefits of project to meeting TMDL standards in impaired Milk River waters. Identify costs of alternative approaches to meeting standards in the absence of project rehabilitation, including increased emission controls at major point and non-point sources.

Valuation of ecosystem services. Estimate the total economic values associated with improved ecosystem services in the Milk River riparian corridor and at Bowdoin National Wildlife Refuge. Conduct focus groups in four communities to identify key resources and services, to likely include the Milk River riparian cottonwood habitat, key fisheries species including pallid sturgeon and paddlefish, and the productivity of Bowdoin NWR, particularly related to avoidance of avian botulism, increased waterfowl productivity, and control of toxic concentrations of salts and minerals. Design a household survey to collect data sufficient for estimating the non-market values of the relevant ecosystem services. Implement a pilot survey to identify the geographic scale of the market.

Implement a survey to collect data. Estimate the non-market valuation model and associated project benefits.

NEPA compliance. Conduct analysis and do report writing to provide project team with draft and final socio-economic sections to include the following components of a St. Mary rehabilitation project EIS: Affected Environment and Environmental Consequences chapters, and sections concerning project impacts on "Economic Justice", cumulative impacts, irretrievable and irreversible commitment of resources, and potential impacts on small entities. The latter will provide an analysis sufficient to meet the standards of the SBREFA legislation.

A budget for these eight tasks is summarized in Table 28. The estimated range for the budget total, based on current labor and data collection costs, is $485,000 to $615,000.

INTRODUCTION

The Milk River Project, which was begun in 1907 and completed in 1936, diverted water from the St. Mary River into the North Fork of the Milk River and dramatically increased flows in the Milk River in Montana, particularly during late summer months. The increased flows brought with them changes in the agricultural, recreational, and socioeconomic structure of Montana's Milk River Basin. One hundred years after the project was first begun, many components of the Milk River Project are in need of repair or replacement. This report is a preliminary analysis of the economic importance of the Milk River Project waters to Montana in general and the Milk River area in particular.

SCOPE OF ANALYSIS

This analysis provides, where possible, preliminary estimates of the benefits and impacts associated with diversion of St. Mary water into the Milk River. The following quote from a Montana DNRC publication describes the wide scope of potential benefits derived from the augmented Milk River flows.

> *The St. Mary Facilities are the keystone to large-scale irrigated agriculture in the Milk River Basin. The system provides water to irrigate over 110,000 acres on approximately 660 farms within the Bureau of Reclamation's Milk River Project. Together, these farms produce approximately 8.3% of all cattle/calves produced in the State and approximately 7.8% of all irrigated hay and 8.2% of all irrigated alfalfa produced in Montana. Although the St. Mary Facilities were originally built to provide irrigation water, the beneficiaries extend far beyond irrigated agriculture. The Milk River provides municipal water to approximately 14,000 people in the communities of Havre, Chinook, and Harlem … In addition, two rural water systems are supplied from Fresno Reservoir. Beneficiaries also include fisheries, recreation, tourism, water quality, and wildlife. In a normal irrigation season (May through September), approximately 70 percent of Milk River flow near Havre originates from the St. Mary River Basin. In dry years the imported water may make up to 90 percent of the Milk River flows past Havre. During the drought of 2001, 95 percent of available water in the Milk River originated in the St. Mary River Basin!* Source: "The Need to Rehabilitate the St. Mary Facilities," Paul Azevedo, Montana Department of Natural Resources and Conservation

An assumption of this study (following Reclamation 2004) is that in the absence of significant rehabilitation of the St. Mary facilities, at some point in the not-too-distant future the diversion will cease to function. Accordingly, the estimates reported here contrast a future "with" a rehabilitated St. Mary facility and an alternative future "without" such a facility. This report provides, to the degree possible with readily accessible data and information sources, estimates of the potential regional economic impacts associated with: 1) construction expenditures associated with rehabilitation of the St. Mary Diversion facilities, and 2) the increased productivity that would result from reconstructing the facility relative to the alternative of continued future deterioration and/or failure of the project. In addition to the regional economic analysis, the report provides a cost-benefit analysis of the "with" and "without" cases. The methods applied here are generally consistent with guidance provided in the U.S. Water Resources Council (1983), *Economic and*

Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, commonly referred to as the "principles and guidelines."

OUTLINE OF ANALYSIS

The following analysis of the economic impacts associated with the St. Mary Diversion and the Milk River Project is presented for two general accounting frameworks: county and state level employment and output impacts (regional economic impacts), and benefit/cost impacts.

The regional economic accounting framework is used to estimate changes in local area economic activity such as employment, personal income, or total economic output which might result from an economic change in the area. Common uses of this type of framework and analysis include estimating the impacts on local employment and income of a large business either entering or leaving a local area. In order to perform a regional economic analysis it is necessary (among other things) to have baseline data on the structure and size of the local economy being examined, as well as an estimate of the direct expenditure changes associated with the alternatives being examined.

The benefit-cost accounting framework is used to examine the economy-wide impacts of a proposed action. A social benefit cost analysis compares all costs associated with a specific action with the benefits associated with that action. The analysis focuses on representative annual values and impacts for an unspecified future year. Results are also summarized in the context of a present value framework over the planning period. The planning period is assumed to be 100 years.

Figure 1 outlines the classes of benefits associated with the increased Milk River flows resulting from the St. Mary Diversion. The most immediately visible of these benefits is the increase in irrigated agriculture, the primary purpose of the original St. Mary diversion project.

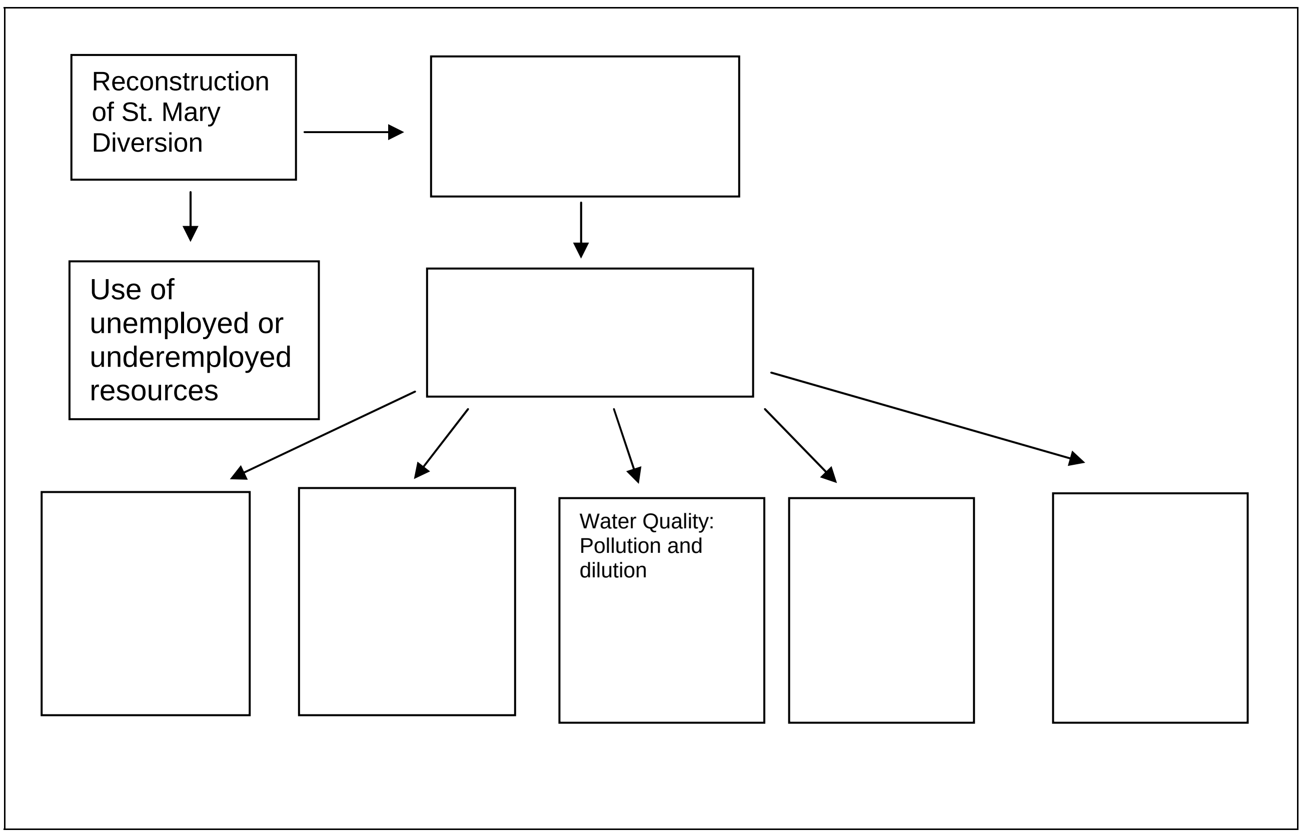


Figure 1: Benefits Associated with Diversion of St. Mary Water to the Milk River Drainage

In addition to the approximately 150,000 acres within the Milk River drainage that are current or potential productive irrigated agriculture as a result of the project, there are several other large classes of benefits associated with the St. Mary diversion that accrue to residents of the Hi-Line area of Northern Montana, and to non-residents as well.

A second major class of benefits is associated with recreational uses tied to diverted water. These uses include fishing at Fresno Reservoir, Nelson Reservoir, and on the Milk River. Additionally, waterfowl and upland game hunting in the area, for example on Bowdoin NWR, is to a degree tied to diverted water flows.

Three municipalities along the Milk River depend on the diverted flows for municipal water. These Towns are Havre, Chinook, and Harlem. There are also several rural water systems served by water from Fresno Reservoir. Additionally, Havre uses Milk water to dilute city effluent in the river. This class of municipal use has significant value.

A final, but potentially very large, class of values associated with the diverted water falls under the broad classification of "ecosystem values." These values include importance of the diverted water to threatened or endangered species (for instance, in the case of the piping plover at Bowdoin NWR and the pallid sturgeon in the Milk and Missouri Rivers), and the importance of the flows in creating and maintaining a unique and extensive cottonwood riparian zone, as well as irrigated farmsteads, and the wildlife habitat associated with these areas.

The following analysis will first address the regional economic impact issues associated with the decision to reauthorize and repair the diversion facilities. This section will focus on two primary components: the positive economic impacts to Glacier County and the State of Montana associated with reconstruction of the diversion facilities, and the positive economic impacts associated with increased production due to rehabilitation of the facilities compared to the alternative of continued deterioration of the diversion facilities.

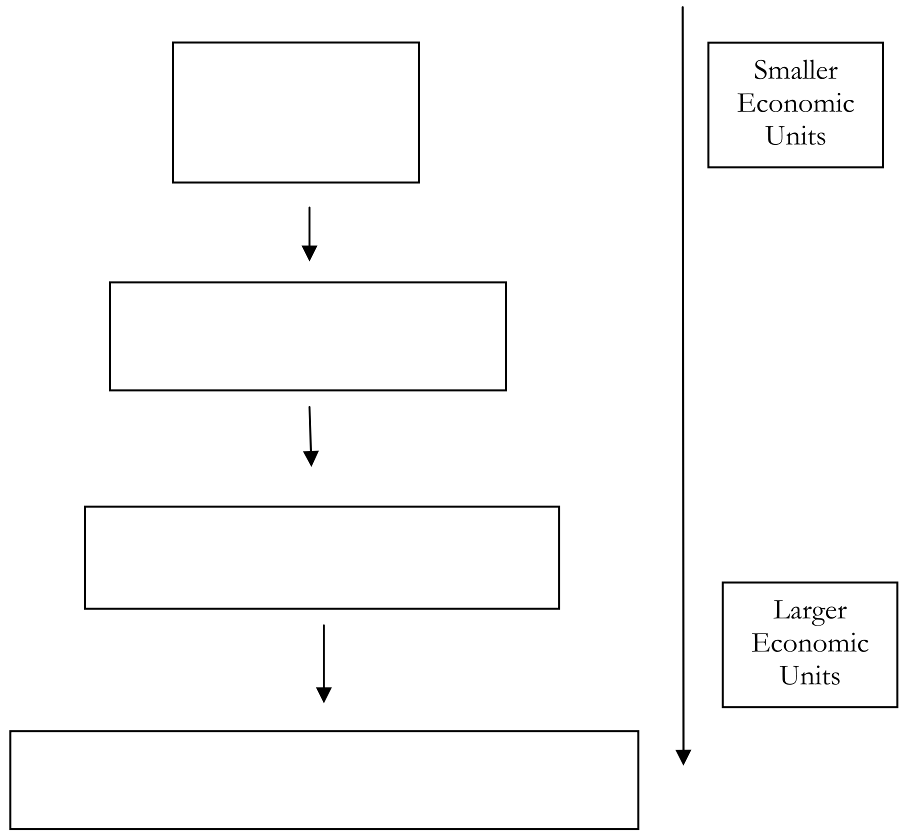
Following the discussion of regional economic impacts, the report presents benefit/cost estimates associated with the primary classes of impacts discussed above: agriculture, recreation, municipal uses, and ecosystem services.

A final section of the report identifies data gaps and key missing information, and outlines recommendations for the next phases of economic studies.

SOCIOECONOMIC SETTING

The socioeconomic setting of the Milk River Project and the St. Mary diversion facilities can be described on several levels. At the broadest level of analysis is the economy of the entire U.S. The next smaller analysis area is the State of Montana, and within Montana are individual counties or groups of counties. Final socioeconomic units are the individual Native American Reservations along Montana's Hi-Line. Figure 2 presents the conceptual relationship between these socioeconomic levels, beginning with the smallest economic areas and progressing to the largest. The following discussion of the socioeconomic setting of the Milk River Project also begins with characteristics specific to Tribal lands likely to be impacted by the project and moves toward characteristics of the Hi-Line counties and the State of Montana.

Figure 2: Conceptual Relationship between Analysis Area Economies



MONTANA HI-LINE TRIBAL ECONOMIES

The St. Mary Diversion facilities and the Milk River Project lands are located between the bookends of the Blackfeet Reservation (on which the diversion facilities are located) and the Assiniboine & Souix Tribes Fort Peck Reservation (which mark the bottom few miles of the Milk River before its confluence with the Missouri River). Between these two reservations is the Fort Belknap Reservation, which borders the Milk River and receives irrigation water from the river. West of the Fort Belknap Reservation is the Rocky Boys Reservation. This reservation is located off the Milk River and includes no project-irrigated lands.

Table 1 highlights the population and unemployment levels for the Hi-Line Tribes. These extremely high unemployment statistics presented by the Bureau of Indian Affairs are calculated differently from the Montana Department of Labor and Industry unemployment rates.[6] BLS unemployment statistics consider on those individuals actively looking for work as included in the labor force. In areas of chronically high unemployment, use of this measure of unemployment underestimates the large percentage of "discouraged workers" who are no longer actively looking for

[6] For instance, the Montana Dept. of Labor and industry estimates of 2004 unemployment rates for Montana reservations are 12.8% for the Blackfeet Reservation, 11.5% for the Fort Belknap Reservation, 8.0% for the Fort Peck Reservation, and 14.9% for the Rocky Boy's Reservation.

work. For these high-unemployment areas, the Bureau of Indian Affairs calculated statistics provides a more complete picture of employment on reservation lands.

Table 1: Tribal Population and Employment (2003)

Reservation	Tribal Enrollment	Total work force[a]	Unemployed as a % of work force	Employed but below poverty guidelines
Fort Peck Indian Reservation	11,473	3,356	57%	33%
Blackfeet Reservation	15,640	5,332	68%	48%
Fort Belknap Indian Reservation	6,427	2,097	63%	21%
Rocky Boy's Indian Reservation	5,505	2,327	77%	29%

Source: Bureau of Indian Affairs, U.S. Dept. of the Interior, at http://dli.mt.gov/resources/indianlabormarket.asp

[a]Total work force is defined as the reservation population between 16 and 64 that is not disabled or incarcerated.

Glacier County, Montana is a sparsely populated county with relatively low income and relatively high unemployment levels in comparison to the entire state of Montana. Additionally, median housing values within Glacier County are only 61% of housing values in the state of Montana as a whole (Table 2).

Table 2: Socioeconomic Characteristics of Glacier County and the State of Montana

Statistic	Glacier county	Montana
Population 2004	13,508	926,865
Population change 2000-04	2.0%	2.7%
Native American Population 2000	61.8%	6.2%
Median value of owner-occupied housing units	$60,900	$99,500
Per capita income 1999	$11,597	$17,151
Unemployment Rate 2004	8.0%	4.4%
Persons per square mile 2000	4.4	6.2

Source: US Census Quick Facts at: httc://quickfacts.census.gov

In 2003, Glacier County reported a total of 270 firms in the county. Nearly all of these firms (98.5%) had less than 50 employees, and 61% reported between 1 and 4 employees (Table 3). Employment in the county is dominated by service-sector jobs. Overall, 46% of county employment is found in three sectors: accommodation and food services, retail trade, and other services.

When compared to the State of Montana and the rest of the U.S., Glacier County has relatively low per capita income, low housing values, high unemployment, and high poverty levels.

Table 3: Glacier County Number of Firms, by Industry and Size- 2003

		Number of Employees per Firm								
	Total	*1-4*	*5-9*	*10-19*	*20-49*	*50-99*	*100-249*	*250-499*	*500-999*	*1000 or more*
Forestry, fishing, hunting, and agriculture support	2	2	0	0	0	0	0	0	0	0
Mining	15	9	2	3	1	0	0	0	0	0
Utilities	9	4	0	4	1	0	0	0	0	0
Construction	26	19	1	3	3	0	0	0	0	0
Manufacturing	2	2	0	0	0	0	0	0	0	0
Wholesale trade	10	5	3	2	0	0	0	0	0	0
Retail trade	46	22	10	7	6	1	0	0	0	0
Transportation & warehousing	10	7	1	2	0	0	0	0	0	0
Information	4	1	2	1	0	0	0	0	0	0
Finance & insurance	11	6	2	2	1	0	0	0	0	0
Real estate & rental & leasing	4	3	0	1	0	0	0	0	0	0
Professional, scientific & technical services	18	15	3	0	0	0	0	0	0	0
Management of companies & enterprises	1	0	0	0	1	0	0	0	0	0
Admin, support, waste mgt, remed. Serv.	6	6	0	0	0	0	0	0	0	0
Educational services	2	0	1	0	0	0	1	0	0	0
Health care and social assistance	22	13	6	1	0	0	2	0	0	0
Arts, entertainment & recreation	4	3	1	0	0	0	0	0	0	0
Accommodation & food services	50	30	8	7	5	0	0	0	0	0
Other services (except public administration)	27	17	7	3	0	0	0	0	0	0
Auxiliaries (exc corp., subsid. & reg. mgt)										
Unclassified establishments	1	1	0	0	0	0	0	0	0	0
Total	270	165	47	36	18	1	3	0	0	0

Source: Census County Business Patterns

FOUR-COUNTY MILK RIVER PROJECT AREA

The four-county Milk River area has seen a significant decline in population over the last several decades. Between 1970 and 2003 the population of the counties declined by 16%, from 41,121 to 34,631. In addition to population declining in the counties, in recent years (between 1990 and 2000) the median age in the area has risen from 33.1 to 37.3 years (Sonoran Institute, 2005a).

In addition to the trends of declining and aging population in the area, Table 4 shows a number of additional demographic and economic characteristics of the counties. Adjusted for inflation, personal income growth in the counties has significantly lagged behind the median growth rate for all US counties (0.3% for the Milk River counties vs. 2.2% for all US counties). Similarly, per capita income in 2003 was marginally lower than for all US counties.

Table 4: Local Area Economic Profile: Hill, Blaine, Phillips, and Valley Counties and the US.

	Milk River Project 4-County Area	**US Median**
Population Growth (Annualized rate, 1970-2003)	-0.5%	0.7%
Employment Growth (Annualized rate, 1970-2003)	0.3%	1.4%
Personal Income Growth (Adjusted for Inflation, Annualized rate, 1970-2003)	0.3%	2.2%
Non-labor Income Share of Total in 2003	44.7%	37.6%
Median Age*	37.3	37.3
Average Earnings Per Job (2003)	$ 24,743	$ 28,076
Education Rate (% of population 25 and over who have a college degree)*	18.1%	14.5%
Ratio Poor/Rich (Number of households that made under $30K for every household that made over $100K.)*	12.2	8.7
Government share of Total employment	20%	15%
Unemployment Rate in 2004**	4.4%	5.4%

* from 2000 US Census ** from Bureau of Labor Statistics

Table 5 outlines changes in the structure of employment in the four-county area between 1970 and 2000. Over this period total farm and agricultural services employment has fallen by 20%, and total on-farm employment has fallen by 27%. Other sectors seeing a decline in employment over the past 3 decades are manufacturing, and transportation and public utilities. Offsetting the declines in employment in these sectors was a large, 80% increase in service sector employment in the counties. Additionally, a 15% increase in retail trade employment occurred during the period.

In 2000, the four largest employment sectors in the four-county area were services (24.1%), government (20%), retail trade (17.2%), and farm (14.8%).

Table 5: Milk River Project Counties, Employment by Industry: Changes from 1970 to 2000

	1970	**% of Total**	**2000**	**% of Total**	**New Employment**
Total Employment	18,147		19,814		1,667
Wage and Salary Employment	12,596	69.4%	13,661	68.9%	1,065
Proprietors' Employment	5,551	30.6%	6,153	31.1%	602
Farm and Agricultural Services	4,179	23.0%	***3,346***	16.9%	-833
Farm	4,031	22.2%	2,930	14.8%	-1,101
Ag. Services	148	0.8%	***416***	2.1%	268
Mining	69	0.4%	***277***	1.4%	208
Manufacturing (incl. forest products)	1,012	5.6%	***316***	1.6%	-696
Services and Professional	8,422	46.4%	11,151	56.3%	2,729
Transportation & Public Utilities	1,412	7.8%	***1,226***	6.2%	-186
Wholesale Trade	472	2.6%	656	3.3%	184
Retail Trade	2,977	16.4%	3,413	17.2%	436
Finance, Insurance & Real Estate	916	5.0%	1,090	5.5%	174
Services (Health, Legal, Business, Others)	2,645	14.6%	4,766	24.1%	2,121
Construction	610	3.4%	768	3.9%	158
Government	3,854	21.2%	3,956	20.0%	102

* Estimates for data that were not disclosed are italicized in the above table.

Source: BEA REIS 2003 CD Table CA25

MONTANA AND THE U.S.

Table 6 compares selected US Bureau of the Census statistics for the State of Montana and the entire United States. The Montana statistics show a consistent trend when compared to the US. Montana has a higher share of American Indians in its population, a lower average housing value, and a higher share of population below the poverty level than does the U.S. Additionally, Montana has lower median household income and lower per capita income than does the U.S. as a whole.

Table 6: Selected Socioeconomic Characteristics, Montana and U.S.

Statistic	Montana	US Total
Population, 2004 estimate	926,865	293,655,404
Population, percent change, April 1, 2000 to July 1, 2004	2.70%	4.30%
Population, 2000	902,195	281,421,906
Population, percent change, 1990 to 2000	12.90%	13.10%
Persons 65 years old and over, percent, 2000	13.40%	12.40%
Female persons, percent, 2000	50.20%	50.90%
American Indian and Alaska Native persons, percent, 2000 (a)	6.20%	0.90%
Median value of owner-occupied housing units, 2000	$99,500	$119,600
Median household income, 1999	$33,024	$41,994
Per capita money income, 1999	$17,151	$21,587
Persons below poverty, percent, 1999	14.60%	12.40%
Persons per square mile, 2000	6.2	79.6

Source: http://quickfacts.census.gov/qfd/states/30000.html

SUMMARY OF THE SOCIOECONOMIC SETTING

The statistics presented in Tables 1-6 show a consistent pattern with respect to per capita income as summarized in Table 7. The 1999 per capita income for Montana is significantly less than that for the US as a whole. Further, the per capita incomes in the counties which include the St. Mary Diversion facilities and the Milk River Project lands are significantly lower than for the entire state of Montana. Finally, the employment statistics in Table 1 show that within the Hi-Line counties, the Reservations suffer from extremely high functional unemployment.

Table 7: Comparison of 1999 Per Capita Income across Areas

Hi-line Counties	Montana	United States
Glacier $11,597		
Hill $14,935		
Blaine $12,101	Montana $17,151	United States $21,587
Phillips $15,058		
Valley $16,246		

An economic analysis of the impacts associated with a given action compares economic outcomes in two or more alternative settings. In the case of this analysis the two settings represent two very different physical and socioeconomic futures for the Glacier County to Valley County span of the northern tier of Montana. Consistent with language employed in environmental impact assessments, the first alternative future is the "no action" future. That is, the future in which the St. Mary Diversion facilities are allowed to further age and become unusable. The second alternative is a future which includes a reconstructed St. Mary Diversion.

NO ACTION ALTERNATIVE FUTURE: THE WITHOUT PROJECT CASE

The no action alternative future used in this analysis draws its assumptions of impacts that would result from not rehabilitating the St. Mary Diversion facilities from those employed by the U.S. Bureau of Reclamation (Reclamation) in its 2004 Regional Feasibility Report on North Central Montana. The excerpt from this report, below, outlines the primary assumptions of impacts employed in this analysis [pp. 47-50].

> General Assumptions
>
> It was assumed that the State water rights adjudication process would be completed with issuance of final decrees, and water rights would be enforced in the Milk River. Irrigated acres junior in right to the Blackfeet and Fort Belknap Reservations and the Milk River Project would be left without a water supply in all but extremely wet years when some natural flows would be available. It was assumed that holders of junior water rights would agree to contribute to the construction and operation and maintenance costs of any water supply project that provided them with water. Based on this assumption, the hydrology model provides an equal share of water to all current irrigated acres in the basin along with the additional acres proposed for development under the Fort Belknap Compact. Irrigated acres would thus total about 150,000 acres. It was assumed that the St. Mary Canal system would most likely not be operable by 2050, and there would be no diversion of water from the St. Mary to the Milk River if no Federal action were taken.
>
> Effects of the Future Without the Project Condition
>
> Based on the assumptions above, the future would affect irrigation, MR&I supplies, threatened and endangered species, water quality, settlement of reserved water rights, fish & wildlife, and recreation as described below.

Irrigation

With no St. Mary River water, loss of storage capacity in Fresno Reservoir, and with Canada using its full share of the river, the Milk River basin could not support irrigation at the present level. The water supply would be significantly reduced from present levels of 18.12in/ac (inches/acre) at the farm headgates to an average of 11.82 in/ac annually. This would be much less the 29 in/ac needed annually according to the U.S. Natural Resources Conservation Service (nd). The water supply would vary greatly from year to year with no St. Mary River water and Fresno's reduced storage capacity.

MR&I

Towns (Havre, Chinook, Harlem, and Fort Belknap) and the Hill County Water District draw water directly from the Milk River for their MR&I supply. Based on the 2000 Census, total population served by the river is about 12,055. With no St. Mary River water there would be a drastic effect on these towns and the rural water district. They would have to find another water supply, possibly from Tiber Reservoir, or request reallocation of storage in Fresno Reservoir. While the reallocation would be minor, it would still affect the irrigation water supply, perhaps leading to further loss of irrigation in the basin.

Threatened and Endangered Species

The bull trout in the St. Mary River basin would probably benefit from no St. Mary system. The river would revert to a more natural hydrologic pattern and the barrier to fish migration would be removed. No St. Mary water for the piping plover around Nelson Reservoir wouldn't necessarily be adverse as more shoreline could provide more habitat. Operation of Nelson would probably change as some acres were no longer irrigated. Effects (if any) on the pallid sturgeon are unknown.

Water Quality

Loss of the diluting effect of good quality water from the St. Mary River would result in a decrease of water quality in the Milk River. As on-farm and canal efficiencies improved, the volume of return flows from irrigated fields back to the river would decrease, but concentrations of pollutants would increase. Segments of the river would probably be dewatered more often; when flowing, water temperatures would increase. A number of stream segments in the region and Fresno Reservoir are impaired, with TMDL (total maximum daily load) development scheduled for 2011-2013… Probable causes of impairment include nutrients, metals, habitat alternation, flow alternation, bank erosion, riparian degradation, thermal modification, among others.

Reserved Water Rights

No water from the St. Mary would require the Tribes, State, and Federal Negotiating Team in the Fort Belknap Compact to re-enter negotiations on alternative remedies to supply water to portions of the Reservation served from the Milk River and to water rights arising under state law within the Milk River Project. The [Blackfeet] Tribe may be interested in using the St. Mary Canal to transport water to the North Fork of the Milk River for benefit of the Tribe. With no St. Mary Canal this possibility would be removed.

Fish and Wildlife

In the future without a project, fisheries in the St. Mary River basin would generally benefit by no St. Mary Diversion Dam through elimination of the canal entrainment and return to more natural flows. In the Milk River, however, fisheries could suffer as irrigation demands were met without St Mary River water, resulting in very little water left in the river. Reservoirs would probably fluctuate more than at present, resulting in adverse effects on reservoir fisheries.

Wildlife in the St Mary River basin would generally remain the same, but habitat in the Milk River basin could be affected. Water probably couldn't be provided as consistently to the Bowdoin National Wildlife Refuge, reducing habitat, which could lead to overcrowding and disease outbreaks among waterfowl. Loss of waterfowl production, however, would become more detrimental than loss to disease. On the other hand, if loss of water resulted in some croplands reverting back to grasslands, upland species such as sage grouse could benefit from increased habitat.

Recreation

No St. Mary River water would have an adverse effect on water-borne recreation and other forms of recreation in Fresno and Nelson reservoirs since water levels probably would drop. Fishing below the reservoirs would also decrease because releases from the reservoirs would decline.

Source: US Bureau of Reclamation 2004, pages 47-50.

As the excerpt above outlines, the loss of St. Mary water in the Milk River Drainage would have far ranging impacts affecting irrigation, wildlife, recreation, water quality, municipal use and water rights adjudication. Under the no action alternative future, for the purposes of this report, it is assumed that water from the Milk River Project would decline and will have become unavailable by the time reconstruction would be completed.

The preceding excerpts from Reclamation (2004) provide some guidance on the types and direction (positive or negative) of impacts. However, for many impacts quantitative measures have not been specified. This is particularly true for fish and wildlife and ecosystem services. In Reclamation (2004), these uses are described in terms of "opportunities." However, how much water will be actually allowed, for example, to Bowdoin NWR is not specified. For purposes of the following analysis, Reclamation's assumptions are preliminarily further refined and quantified based on discussions with individuals familiar with the basin. A limitation of the current study is that the actual water allocations in the "with" and "without" cases and the associated biological and physical impacts are not always well defined at this time. In short, alternatives that might be associated with water allocation decisions are not as well defined as they would have to be for NEPA compliance.

THE WITH PROJECT CASE: RECONSTRUCTION OF THE ST. MARY DIVERSION

Under the alternative future in which the St. Mary facilities are reconstructed, several impacts are assumed to result. The first major impact would be associated with expenditures made for reconstruction of the diversion facilities. These expenditures (estimated to be in excess of 120 million dollars) would impact economic output and employment within the Hi-Line counties in particular and in Montana in general. The impacts of these expenditures would largely last only during the reconstruction period (perhaps 3-4 years).

The second impact of the alternative future under which the St. Mary facilities are reconstructed would be the continuation of ongoing positive impacts associated with the additional water available within the Milk River Drainage. These positive impacts would be associated with increased production for irrigated agriculture, enhanced recreation, positive impacts on wildlife and some endangered species, enhanced municipal water supplies, and positive water quality impacts.

It is assumed under this alternative future that benefits from the rehabilitated diversion facilities would flow to the region for 100 years into the future.

REGIONAL ECONOMIC IMPACT ANALYSIS

The analysis of regional economic impacts associated with reconstruction of the diversion facilities is presented in three parts. The first portion of the impact analysis looks at only the impacts of the reconstruction of the diversion. The area of impact analysis presented for this model is both Glacier County and the entire state of Montana. A second impact model is estimated for the four counties directly benefiting from the ongoing flows of augmented Milk River flows (Hill, Blaine, Phillips, and Valley Counties). This second model of regional economic impacts describes benefits associated with the agricultural uses of St. Mary water within the counties. The areas of analysis presented for this model are the 4-county region, and the entire state of Montana. The final regional model presented is a combined model of the 7-county Hi-Line (Glacier to Valley counties), and includes both reconstruction and ongoing flow augmentation benefits. The impact areas for this combined analysis are the 7-counties, Montana, and the entire US.

ESTIMATED LOCAL AREA AND STATE IMPACT OF RECONSTRUCTION OF THE DIVERSION FACILITIES (GLACIER COUNTY AND MONTANA)

The St. Mary Diversion facilities are wholly located within Glacier County Montana, and are located on lands contained within the Blackfeet Indian Reservation. Reconstruction of the St. Mary diversion facilities would likely result in a large expenditure of primarily Federal money in Montana in general and Glacier County and the Blackfeet Reservation in particular. Estimates of total reconstruction costs range under the alternatives from $120 to $127 million over the term of the project. The degree to which these reconstruction expenditures positively impact Montana and the counties and communities surrounding the diversion facilities depend on such factors as whether local firms are hired to perform some of the work, whether local workers are hired to do a portion of the work, and where workers are housed during the construction period. The primary data sources used in estimating the impacts of reconstruction expenditures were personal communications with DNRC personnel and IMPLAN modeling software and data (Minnesota IMPLAN Group, 1997).

As noted, the reconstruction of the St. Mary Diversion facilities would require the expenditure of between $120 and $127 million. Construction items, construction contingencies, and TDH recommended items total 71% of the estimated costs.[7] Non-contract costs including planning, designs and specifications, administration, and compliance is estimated at approximately 24% of total costs. One last item, Tribal fees constitute approximately 5% of total costs (TDH, 2005).

[7] TDH 2005. Table 8.2.1, page 174.

ESTIMATED IMPACTS OF PROJECT RECONSTRUCTION

As a relatively sparsely populated, low income county, Glacier County does not have a heavily developed and diverse economy. In applying the IMPLAN modeling process, the accuracy of results will depend to a large extent on the degree to which valid assumptions are made regarding the share of project spending that is made with firms and individuals living in Glacier County. While it is unambiguous that the 5% Tribal tax on total project costs will be spent within the County, assumptions must be made regarding the ability of county firms to capture contracts for other project costs. The IMPLAN modeling software makes default assumptions on local purchases based on the size and the structure of the local economy. For a one-time large construction project, however, these assumptions may overstate the ability of local firms to compete with large state or national construction and engineering firms. While the results presented below offer estimated impacts based on IMPLAN Model default assumptions of local purchase coefficients, an alternative "low-impact" estimate is also presented for the county which assumes Glacier County firms will capture no more than 10% of total construction business and 5% of study, compliance, and engineering business related to the project.[8]

Table 8 shows the estimated Glacier County and State of Montana impacts associated with reconstruction of the St. Mary Diversion. The results show three impact levels: a minimum impact for Glacier county scenario, a Glacier County impact based on IMPLAN default assumptions, and a State of Montana impact. The estimated impacts shown in Table 8 are based on the low-end estimate of total project costs of approximately $119 million.

[8] The default IMPLAN model assumptions are that the regional purchase coefficient for construction is 53.1%, and for Engineering and compliance is 12.6%.

Table 8: Total (Five Year) Estimated Glacier County and Montana Impacts of St. Mary Diversion Reconstruction

Impact Category	*Estimated Impacts*		
	Glacier County – Minimal Impact	*Glacier County – Default Impact*	*State of Montana Impact*
Share of construction business	10%	53.1%	--
Share of studies, compliance, engineering	5%	12.6%	--
Impact on total output of goods and services	17,674,000	64,220,000	193,895,000
Impact on employment	196	799	2,474
Impact on total value added[a]	9,727,866	31,840,000	101,887,000
Impact on State and Local non-education taxes	527,000	1,891,000	6,448,000

[a] Total Value Added = labor income + other property income + indirect business taxes.

The impacts outlined in Table 8 represent substantial impacts to both Montana in general and to Glacier County in particular. Impacts estimated for Glacier County for total output of goods and services range from 5% of total output for the minimal impact scenario to 15% of output for the IMPLAN default scenario. Impacts to total Glacier County employment range from increases of 3.5% to 14.2%. Within a county experiencing relatively low income, high poverty, and high unemployment, these impacts are positive and substantial.

ESTIMATED IMPACTS ASSOCIATED WITH REHABILITATING THE ST. MARY DIVERSION

The reconstruction of the St. Mary facilities would have a very significant positive regional economic impact on Glacier County and Montana. It could also result in an increase in agricultural production compared to continued deterioration and/or failure of the system. Rebuilding the facilities would have a substantial positive impact on the counties primarily impacted by the diverted flows. The four counties of Hill, Blaine, Phillips, and Valley and the Fort Belknap Reservation comprise the area most directly affected by flow augmentation. It is expected that rehabilitating the diversion facilities would lead to significant improvements in agricultural production, and increases in recreational spending. The following analysis focuses on the four-county economy and also on the Montana economy.

ESTIMATED INCREASE IN PRODUCTIVITY DUE TO ST. MARY REHABILITATION

Avoiding the decommissioning of the St. Mary Diversion facilities would add significant quantities of irrigation water to the Milk River Drainage. The Bureau of Reclamation has provided two estimates of what this water to irrigators would mean in terms of increases in agricultural output in the area. In their 2004 Regional Feasibility Report for North Central Montana, Reclamation provides estimates of increased agricultural production increases associated with reconstruction of the St. Mary facilities under two alternatives.[9] These estimates of the increase in agricultural production ranged from $14.8 million to $16.9 million annually.

As an alternative methodology, Reclamation estimated changes in farm productivity for an individual typical composite farm in the project area under both irrigated and non-irrigated assumptions. This analysis made assumptions as to crop mix and productivity under the two scenarios.[10] Table 9 outlines the assumptions contained in the Reclamation analysis. Overall, Reclamation estimated that irrigated cropland in the area would produce an average of $135.91 per acre per year in increased crop revenues over non-irrigated cropland in the area.

Table 9: Milk River Project Projected Changes in Per Acre Gross Production, Irrigated vs. Non-irrigated.

With Irrigation					
Crop	*Yield per acre*	*Acres*	*Price/unit*	*Gross revenue*	*Gross per acre*
Barley	60	40	$ 2.86	$ 6,864	
Barley straw	0.3	40	$ 25.00	$ 300	
Alfalfa	3.5	224	$ 74.67	$58,541	
Est. Alfalfa	1.5	56	$ 74.67	$ 6,272	
Wheat	50	80	$ 3.66	$14,640	
wheat straw	0.3	80	$ 25.00	$ 600	
				$87,218	$ 218.04
Without Irrigation					
Alfalfa	1.1	400	$ 74.67	$32,855	
				$32,855	$ 82.14
Net change in gross per acre without irrigation					*$ 135.91*

Source: Prices-Montana Department of Agricultural Statistics (3-year 2003-05 prices). Yield and acres, Reclamation, 2003.

[9] US BOR, 2004. At page 67 the Reclamation estimates that as an alternative to decommissioning the diversion facilities, reconstruction would lead to increases in production over the "no irrigation" alternative of between $14.9 million per year for the 500 cfs alternative and $16.9 million per year for the 1000 cfs alternative.

[10] US BOR, 2003. Tables 1, 2, and 3 provide data used in the above analysis.

In a 2005 Reclamation report[11], the Bureau reports a total of 120,557 irrigated acres receiving project water. This distribution is roughly distributed between 110,000 acres for the Joint Board of Control Irrigation Districts and 11,000 acres of additional contract water.[12] Multiplying the Reclamation-estimated increase in crop production value under irrigation of $135.91 by 120,557 irrigated acres results in estimated annual crop value attributable to project water of $16.4 million. This estimated value is consistent with the Reclamation estimates of $14.9 to $16.9 shown above.

ESTIMATED LOCAL AREA ECONOMIC IMPACTS OF PROJECT WATER IRRIGATION

According to the Reclamation benefits analysis, the addition of project water to the Milk River would lead to an approximately $16.4 million dollar increase in crop value. This value would be generally split as 63% increases in alfalfa production value and 37% increases in grain production value. The IMPLAN regional economic modeling program and associated data for the four-county Milk River Area were used to model the local area economic impacts associated with addition of project irrigation water, as compared to not having that water available.[13]

Table 10 shows the summary results of the impact modeling associated with project water irrigation for the area. The IMPLAN model predicts that a direct increase in agricultural production in the counties of $16.4 million will lead to a total increase in output in the four counties of $20.1 million annually. Additionally, the added production attributable to irrigation from St. Mary's water would lead to an increase of 242 full and part-time jobs in the county and an increase of value added production of $10.6 million relative to the "without" case.[14] The estimated IMPLAN model also reports that state and local non-education taxes would be higher by $700,000 annually due to project water.

Table 10: Estimated Four-County Annual Impacts of Irrigation Productivity Increases of Milk River Project Water

Impact Category	Four-county Impact	Montana Impact
Impact on total output of goods and services	$20,114,000	$22,871,000
Impact on employment	242 jobs	308 jobs
Impact on total value added	$10,645,000	$12,068,000
Impact on State and Local non-education taxes	$700,000	$832,000

[11] US BOR 2005. Milk River Project, Montana: Preliminary Current Use Operation and Maintenance Cost Allocation, Draft Report. Note this calculation uses the Reclamation figure of 120,557 acres although Reclamation (2004) cites approximately 151,000 acres as benefiting from a rehabilitated diversion.

[12] The Joint Board of Control oversees the Alfalfa Valley, Dodson, Ft. Belknap, Glasgow, Harlem, Malta, Paradise Valley, and Zurich Irrigation Districts.

[13] IMPLAN data for 2002 (the most recent year available) was used in model construction.

[14] Total value added is equal to labor income plus other property income plus indirect business taxes.

While in the context of the entire four-county economy the estimated impacts are generally minor, in the context of the specific industries impacted they represent major changes. Overall the IMPLAN model predicts the increases will represent a 7% increase in total output from grain production, an increase of 25% in output from other crop production, and a 9% increase in output from the agriculture and forestry support activities sector. In a region that has seen the relative size and profitability of agriculture decline over several decades, this type of additional production is important to this slowly declining economic sector.

A potential regional economic impact not modeled is the impact of expenditures in the counties from anglers and hunters from outside the counties that is affected by Milk River flows. Results from the Montana DFWP angler pressure survey indicate that nonresident angling pressure in the area is limited to approximately 5% of total pressure.[15] Inclusion of impacts associated with changes in non-local angler and hunter spending would add to the agricultural impacts presented above.

ESTIMATED COMBINED IMPACTS ASSOCIATED WITH ST. MARY REHABILITIATION ON THE SEVEN-COUNTY HI-LINE, MONTANA, AND THE U.S.

The previous two analyses examined the estimated local-area economic impacts to the county or county groups most directly affected by the two primary results of rehabilitation: reconstruction expenditures, and increased agricultural production. This section presents a combined impact analysis of these two impacts. The analysis is presented for two specific analysis areas: 1) a seven-county segment of the Hi-Line between Glacier County and Valley County, and 2) the State of Montana. Table 11 summarizes this data. The seven-county area impacts are estimated to be on the order of $22 and $20 million annually for construction impacts during the five year rehabilitation period, and for increased agricultural production following rehabilitation. Total discounted cumulative impacts over the 100 year life of the project are estimated on the order of $350 million for the counties.

[15] For example in 2003 Montana DFWP reports that 5% of total estimated pressure at Fresno reservoir and 5.2% of pressure on the Milk River downstream of Canada were from non-residents (Montana DFWP 2004).

Table 11: Estimated Combined Impacts of Construction and Agricultural Production on Total Output of Goods and Services: Annual and Cumulative Impacts

Impact Area	7-county Impact	State of Montana Impact
(A) Annual Impacts		
St. Mary Reconstruction (years 1-5)	$22.4 million	$38.8 million
Increase Agricultural Production (years 6 on)[a]	$20.2 million	$22.9 million
(B) Cumulative Discounted Impacts[b]		
St. Mary Reconstruction	$94.6 million	$163.9 million
Increase Agricultural Product[c]	$258.0 million	$291.6 million
Total	**$352.6 million**	**$455.5 million**

[a] conservatively assumes no agricultural production from project water during construction
[b] using a 5.875 real rate from Reclamation (2004)
[c] assumes a project life of 100 years

BENEFITS OF EMPLOYMENT OF UNDEREMPLOYED RESOURCES

The impacts associated with both construction expenditures and increased agricultural productions and sales are estimated within the IMPLAN input-output modeling program as primary (direct impacts) and secondary (indirect and induced impacts). Primary impacts represent only regional economic gains within a local area of analysis (such as a county or group of counties) and do not represent benefits appropriate for a cost-benefit analysis. These direct impacts represent expenditures in one region at the expense of the same expenditures being made in another part of the economy. Additionally, the neoclassical assumptions of labor mobility and fully employed resources suggest that all impacts, both primary and secondary, from a regional economic activity represent a zero-sum activity for the economy as a whole.[16]

[16] Hamilton, J., N. Whittlesey, M. Robison and J. Ellis. "Economic Impacts, Value Added, and Benefits in Regional Project Analysis." Amer. J. Arg. Econ. 73:334-44. For example, Hamilton et. al state "The assumptions of full employment and complete mobility can often be applied plausibly to all inputs used in generating secondary project impacts. Thus, regardless of the size of the estimated change in value added from secondary impacts, it may be exactly offset by opportunity costs of the inputs used, leaving net secondary project benefits of zero." p. 336.

A special case exception to this rule exists in the case of projects occurring in areas of underemployed resources. Hughes and Holland (1993) state:

> *"When a region is characterized with high levels of chronic idle or underemployed resources (i.e., high unemployment rates on a continuous basis), the neoclassical assumptions of fully employed resources may be relaxed and some of the secondary economic activity arising from a project considered a true net benefit." p. 761*

Much of the local economic area surrounding the St. Mary Diversion facilities as well as the counties included in the Milk River Project irrigation districts fit the definition of areas with significant underemployed resources. Extremely high unemployment rates within the four Indian reservations proximate to the area indicate significant underemployment of labor. Additionally, the loss of population in recent years within the Milk River Drainage indicates the underemployment of other resources such as housing stock and commercial capacity. For purposes of this analysis, we count all secondary employment and value added (income) effects of the construction and agricultural production spending within the region as a project benefit. The reasoning is that increases to employment associated with these impacts are relatively small compared to the unemployed, or underemployed labor pool in the area. In any case, this is an area for further analysis.

Table 12 shows the estimated annual direct and secondary (indirect and induced) impacts associated with St. Mary rehabilitation and the increment of increased agricultural production attributable to use of the St. Mary irrigation flows. For the sake of exposition it is assumed that rehabilitation expenditures will occur over a 5-year period. Total project cost is estimated at the $119.6 million level for the 850 cfs rehabilitation.[17]

Table 12: Estimated Direct and Secondary Impacts to Total Value Added: Annual Regional Economic and Cost Benefit Impacts of the St. Mary Rehabilitation

Impact Event	Seven-county area		State of Montana (including seven-county impacts)		Time period
	Direct impacts	***Secondary Impacts***	*Direct impacts*	*Secondary Impacts*	
St. Mary rehabilitation spending	$7.7 million	**$3.8 million**	$12.0 million	$8.3 million	Years 1-5
Increased agricultural production	$8.5 million	**$2.3 million**	$8.5 million	$3.6 million	Years 6 on

[17] TDH 2005, "Rehabilitation Plan: St. Mary Diversion." Construction period of 5 years assumed due to 5-year interest calculation in Table 8.2.1. Total project cost also from Table 8.2.1, Page 174.

The highlighted seven-county secondary impacts column from Table 12 indicates the potential level of annual benefits associated with the rehabilitation project that could be counted within a cost-benefit accounting framework. In general, these secondary benefits are estimated to be $3.8 million annually in the first 5 years and $2.3 million annually thereafter.

A potential additional source of regional economic impact not modeled above is the effect of nonresident hunting and fishing expenditures on the Hi-Line region.

BENEFIT-COST ANALYSIS OF MILK RIVER PROJECT

OVERVIEW OF BENEFIT-COST ANALYSIS

The analysis of benefits stemming from the diversion of St. Mary water into the Milk River Drainage is divided into two primary classes: direct use benefits and indirect use values. Table 13 outlines the types of benefits discussed below. Direct use benefits include uses such as direct recreation, use of the water for municipal water systems, irrigation of cropland, and the possibility of incorporating hydropower into the reconstructed diversion facilities. Indirect benefits include ecosystem services such as support for wildlife and riparian zones, and support to local economic stability. A final indirect benefit is the role of St. Mary flows as "carriage water" for natural Milk River flows. The presence of the diverted water allows the natural flows to carry substantially further downstream than would be the case in the absence of the diverted flows. These carriage water benefits are noted, but not explicitly estimated.

Table 13: Classes of Benefits Associated with Milk River Project Flows.

Direct Use Benefits	Indirect Use Benefits
Irrigation	Ecosystem services
Increased ag land value	Bowdoin NWR uses
Recreational use	Habitat and wildlife production
Fishing	Support cottonwood riparian zone
Hunting	Wetland support
Wildlife Viewing	Endangered species
Municipal water use	Increased turbidity to Missouri
Drinking water	Piping plover habitat
Dilution flows	Local economic support
Possible Hydropower production	
Carriage Water	
Benefits of employment of underemployed resources	

ESTIMATED IRRIGATION WATER BENEFITS

The largest current use of Milk River Project water flows is for irrigation of the approximately 120,000 acres receiving some project water. The use of irrigation along the Milk River results in significantly higher crop yields in comparison with dryland yields for the same crops in the area. Reclamation (2003) reports that while dryland alfalfa production in the area averages 1.1 tons per acre, irrigated production yields 3.5 tons per acre. The increased production associated with irrigated acreage compared to comparable dryland cropland translates into higher gross revenue for crops produced. While there are also increased costs associated with irrigated agricultural production, the benefits of increased production outweigh the incremental costs of irrigation.

METHODS FOR ESTIMATING VALUE OF IRRIGATION TO CROPLAND

There are a number of approaches to estimate the value of water in agricultural production, (Gibbon, 1986). This section highlights approaches using differences in land values between irrigated and non-irrigated parcels. A following section examines values based on microeconomic production theory and the farm budget approach.

The most direct measure of the incremental value per acre of irrigation is the difference between the value per acre of comparable irrigated and dryland cropland, net of the value of any infrastructure improvements found on the properties. Methods of determining the difference between the values of dryland and irrigated agriculture within a region vary in method and precision. Table 14 presents a listing of methods for determining the additional value of irrigation to cropland within the St. Mary Project area. The available methods outlined in Table 14 progresses from the most casual to the most precise.

Table 14: Available Methods for Estimating Irrigated and Non-irrigated Land Values in the Milk River Project Area.

Method / Estimate	Advantages	Disadvantages
USDA annual estimate of land values and cash rents	Estimates for current year are readily available	Estimate is for entire state and may not reflect local Milk River conditions
Casual examination of the area real estate market	Provides examples of land values for specific area at the current time	Examples may not reflect overall market in the area—problem of selection bias
Use of existing Bureau of Reclamation estimate	Estimate has been used by Reclamation and is readily available	Estimates require considerable data on costs, prices, and production which all must be representative of the case at hand
Estimate value using hedonic model of land prices	When sufficient data is available, a well estimated model provides defensible value estimates for different contributors to land value.	Data in some areas may be difficult to collect and assess for quality. Requires a large-scale effort to estimate defensible models.

The most readily accessible estimates of the value of irrigated and non-irrigated land in the Milk River Project area come from federal agencies. The U.S. Department of Agriculture publishes an annual estimate of the values of agricultural land for each state. The 2005 USDA estimates report average Montana irrigated cropland value at $1,800 per acre, and non-irrigated cropland at $440 per care. [18] The difference between these estimates leads to an estimated value of irrigation to Montana cropland value of $1,360 per acre. The use of a statewide estimate such as that provided by USDA is potentially problematic for several reasons. A statewide estimate in Montana runs the risk of accurately reflecting "average" values without being accurate for many areas. The demographic, and meteorological differences across Montana lead to very different land values, particularly between some western and southwestern areas with rapid population growth, and some eastern Montana areas, that have actually experienced declining populations in recent years. A second difficulty in using the USDA value estimates is that the estimates do not control for the amount of irrigation

[18] USDA National Agricultural Statistics Service. "Land Values and Cash Rents: 2005 Summary. August 2005." at Page 9.

water the land receives. For instance, Reclamation reports that currently Milk River Project Farmers receive an average of 18.12 inches/acre at the headgate, but the US Natural Resource Council reports that 29 inches/acre is needed to fully irrigate in this area.[19] Therefore, while the Milk River Project land is irrigated, it is not "fully irrigated" in many years, and may not be representative of irrigated lands in other parts of Montana.

A second readily available estimate of irrigated and non-irrigated land value in the area comes from the US Bureau of Reclamation. In the Reclamation analysis of the benefits of irrigated agriculture in the Milk River basin it was estimated that irrigated land within the Milk River Project had a value of $610 per acre, and non-irrigated cropland had a value of $330 per acre.[20] These estimates were based on conversations with a Farm Credit Services appraiser from the area. Clearly the $280 incremental value associated with irrigation from the Reclamation report is significantly less than the USDA estimated increment of $1,360.

A third method for informing the estimation of the value of agricultural land in the Milk River area is through casual examination of parcels currently offered for sale in the area. Conversations with local area real estate agents and examination of some current agricultural land listings point towards increasing difficulty in assessing the impact of irrigation alone to land values. In addition to the crop productivity of the land, the recreational value is increasingly accounting for a larger share of land value in the Milk River area.[21] Quality upland game, waterfowl, and big game hunting opportunities are becoming more sought after in rural Montana. A review of recent listings for agricultural land in the Malta, Glasgow area shows that recreational opportunities, as well as proximity to the Milk River are significant components in agricultural land value in the area. Table 15 presents a cursory review of selected land listings in the region. Noted in the table are the parcel size, price per acre, type of land (irrigated cropland, dry cropland, or rangeland), whether the land has Milk River frontage, and whether recreational opportunities are mentioned in the ad. The listings shown in Table 15 highlight several differences between types of land. The highest priced parcels are those irrigated parcels that have both Milk River frontage and that specifically advertise the recreational aspects of the parcel. The second highest priced parcels are two irrigated parcels without river frontage, and with no specific mention of recreational potential. Finally, the lowest priced parcels are non-irrigated or rangeland parcels.

The parcels in Table 15 were screened to exclude parcels with significant non-irrigation related infrastructure, and to exclude both small (below 50 acre) and very large (over 500 acres) parcels. The listings shown however, while useful in pointing out general characteristics and asking prices for Milk River cropland, are not exhaustive of all area listings or recent transactions.

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[19] US BOR 2004, at page 49.

[20] US Bureau of Reclamation, Great Plains Region. "Draft Milk River Benefits Analysis," April 2003. The report additionally estimated that dryland grazing was valued at $100 per acre.

[21] Personal Communication, Jim Knudsen, Missouri River Real Estate, August 2005.

Table 15: Selected Milk River Area Agricultural Land Listings

Type of Land	Acres	Price asked per acre	Milk River Frontage?	Recreational Opportunities Mentioned?
Irrigated cropland	148	$743	NO	NO
56% Irrigated cropland	146	$2,014	YES	YES
Non-irrigated cropland	160	$468	NO	NO
80% Irrigated cropland	50	$950	NO	YES
Irrigated cropland	140	$1,786	YES	YES
Irrigated cropland	402	$1,555	YES	YES
63% Irrigated cropland	320	$781	NO	NO
Dryland	80	$649	NO	NO
Dryland	160	$531	NO	YES
Dryland	320	$200	NO	NO

Source: http://www.missouririverrealty.com/farm%20ranch%20&%20acreages.html accessed on Oct. 28, 2005.

The per acre prices shown in Table 15 are, in general, more supportive of the aggregate statewide land valuation estimates provided by USDA than of those provided by Reclamation in its Milk River benefits analysis. However, the characteristics of the parcels detailed in Table 15 also suggest that absent such highly valued amenities such as river frontage and recreational opportunities prices would likely more closely reflect the Reclamation estimates than those of USDA.

The final available method of estimating land values is use of a hedonic model. This type of model utilizes data on actual land values (either actual transaction data or assessment data) in a local area in combination with detailed information on parcel characteristics such as the value of farm improvements, volume of irrigation rights, location, recreational, visual, or social amenities, and soil type. The hedonic model can be used to estimate the increment to land value associated with amenities suggested in the listings shown in Table 15, such as river frontage and irrigation rights.

ESTIMATION OF VALUE OF IRRIGATION THROUGH USE OF CROP PRODUCTION FUNCTONS

The production function approach to valuing agricultural irrigation water is based on the microeconomic profit-maximizing model of the firm. A basic result of this model is that a farm (business) will be willing to pay a price for inputs equal to the contribution of that input to production (this is called the "marginal physical product") times that value of the output. Multiplying this amount by the net irrigation per acre applied to a crop yields a "short run" estimate of the incremental value of irrigation water to production of a specific crop.

In the case of irrigation use of Milk River Project water, an estimate can be derived of the short term value of water to crop production using available estimates of the marginal physical product of water in production of alfalfa, along with Reclamation data on additional water at the farm headgate attributable to the Milk River Diversion, on-farm application efficiency, and acres irrigated.

The marginal physical product estimate used is from Duffield et. al (1991) who reported crop production functions for alfalfa from studies done in Montana. The average marginal physical product from these studies was 0.19, or for every additional inch of water received by the alfalfa yield would increase by 0.19 tons of alfalfa.[22] Table 16 shows the calculation of annual value associated with Milk River Project irrigation water using the crop production function approach.

Table 16: Estimate of Irrigation Water Value Based on Alfalfa Production Functions

Marginal physical product of irrigation in alfalfa production[a]	.19 tons/inch
Additional water at farm headgate compared to without project scenario[c]	13.25 inches
Average on-farm distribution efficiency[d]	43%
Adjustment for reduced yield in establishment year[e]	.90
Extra tons benefit per acre	**0.97 tons/acre**
Average Montana 2003-2005 alfalfa price[b]	$74.67/ton
Water value per acre	**$72.43 / acre**
Assumed acres irrigated with project water[f]	151,525
Total annual value of Milk River Project water to crop production.	**$10.97 million**

[a] Duffield et. al (1991) [b] Montana Agricultural Statistics Service (2006) [c] US BOR (2004) Table 6.1 [d] US BOR (2004) page 48. [e] for simplicity assumes ½ normal yield in establishment year. [f] derived from US BOR (2004) Table 6.1.

Table 16 shows an estimated total annual marginal value of crop production from use of Milk River Project water of approximately $10.97 million. Like Reclamation (US BOR 2004), these estimates denominate all production in terms of alfalfa. Additionally, like Reclamation, the estimates compare a reconstructed water supply (850 cfs) which delivers an average 26.36 inches/acre to the

[22] A detailed discussion of the application of alfalfa production functions to Montana crops can be found in Duffield, Neher, Josephson, and Josephson (1991).

farm headgate with a "without project" scenario where only 13.11 inches/acre are delivered to the farm.[23]

ESTIMATION OF VALUE OF IRRIGATION THROUGH USE OF FARM BUDGET ANALYSIS

Reclamation (2003) utilized the farm budget analysis method to estimate the value of irrigation water to farm production and value in the Milk River Area. The method used by Reclamation compared two farm enterprise budgets, one representing a typical irrigated Milk River Project farm, and the other a dryland farm of the same size in the area. The Reclamation analysis used historic yield and price data to estimate revenues and costs for each of the hypothetical farm types. The analysis estimated a value to irrigation water of $38.87 per irrigated acre.

Still another estimate is provided in Reclamation (2004, Table 6.1), specifically for the case at hand, with an estimate of net benefits to agricultural production increases between "with" and "without" cases of $7.681 million. For purposes of our analysis here, we will use as a probable range for agricultural benefits Reclamation's $7.681 million to the upper estimate from the production function approach ($10.97 million).

ESTIMATED MUNICIPAL WATER USE BENEFITS

The towns of Havre, Chinook, Harlem, and Fort Belknap, and the Hill County Water District draw water from the Milk River for their municipal, residential, and industrial supply. Reclamation (2004) states that "with no St. Mary water there would be a drastic effect on these towns and the rural water district."[24] In the absence of the contracted St. Mary flows these water users would need to find alternative sources of their MR&I water. Montana DEQ and U.S. Census report that there are approximately 18,600 people served by MR&I water from the Milk River or associated aquifers.[25]

The value of this MR&I water to the municipalities and the county water district can be estimated in several ways. One method is to measure the difference between the costs associated with the current supply and the costs associated with procuring a replacement supply of similar quality. Another approach is to observe what water customers pay in time and effort to obtain acceptable drinking water when a municipal source is either of unacceptably low quality or not available. This so-called "averting cost" can include, among other things, the cost of boiling water, filtering water and hauling water from another source. This method provides a minimum estimate of municipal water users net benefits. A third method is to construct an economic demand function for municipal water and measure the net benefits, or "consumer surplus," associated with the price-quantity relationship. A key statistic in this type of analysis is the "price elasticity of demand," which can be estimated from historical data on water rates and consumption amounts, provided there is sufficient variation over time in rates and consumption.

[23] US BOR (2004) Table 5.1.
[24] US BOR, 2004 at page 49.
[25] DEQ 2005: Second Administrative Order on Consent Docket No. PWS-01-14, & http://ceic.commerce.state.mt.us/c2000/PL2000/PLplacearea.xls

REPLACEMENT COST

There are two aspects to estimating the value of the St. Mary water to Milk River MR&I users from a replacement cost approach. First is the cost of obtaining a replacement source of water relative to the cost of contracting for and pumping the Milk River water. The second aspect concerns the *quality* of the most likely replacement water relative to the quality of the Milk River water. Estimation of the benefits to municipal, residential, and industrial users associated with use of the diverted St. Mary flows must take into account both the costs associated with the next most reliable source of the same quantity, and any additional costs associated with bringing the replacement water up to the same quality as the Milk River flows.

An example can be seen in the community of Havre. Havre has in the past used well water to provide a portion of their MR&I needs. However, while groundwater is relatively plentiful in Havre, the water quality is relatively low with samples testing high in nitrates.[26] The issue of residential water quality problems in the region of the Hi-Line was underlined in a recent news story regarding congressional votes on a federal energy-water spending bill that included funds to build water treatment facilities for the Fort Peck Assiniboine-Souix Rural Water Supply System, as well as funds for the Rocky Boy's/North Central Montana regional water supply system.[27]

Residential use of water is the most highly valued and vital use of this resource. Developing a firm estimate of the value of MR&I water from the Milk River Project requires detailed information on current costs of the water supply as well as engineering estimates of costs of alternative supplies including any needed water treatment facilities. The recent congressional $22 million funding vote for systems on the Fort Peck and Rock Boy's Reservations as well as for the Dry Prairie Rural Water Project in Culbertson indicate that alternative water supply costs in areas of Northeast Montana can be substantial.[28]

AVOIDANCE COSTS

Given the likelihood that readily available substitute water supplies for the Milk River municipal systems would be of a lower quality, one method of estimating the benefits of use of St. Mary water for MR&I is to look at existing examples of consumer behavior when faced with low quality municipal water supplies. An example from the city of Butte, Montana was extensively studied in conjunction with the State of Montana v. Atlantic Richfield Company "Superfund" litigation. In the course of this litigation, studies of Butte water users found that households within Butte spent an average of between $336 and $541 (1995 dollars) per year in purchasing, treating, or traveling to get higher quality water.[29] In current dollars, this "averting behavior cost" is between $438 and $705 per household per year.

As noted previously, approximately 18,600 people living along the Milk River rely on diverted flows or associated aquifers for their household water. The simple average number of people per household in these counties is 2.54, slightly above the Montana average of 2.45 people per household.[30] This translates into approximately 7,600 Hi-Line households relying on Milk River

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[26] Personal Communication, David Peterson, Director of Public Works Administration, City of Havre. November 8, 2005.
[27] Missoulian newspaper, November 8, 2005.
[28] Ibid.
[29] W. Desvousges, 1995. "Volume V, Report on Potential Economic Losses Associated with Groundwater." Page 24 notes an estimated range of averting costs of 348 to 666 dollars per household.
[30] http://quickfacts.census.gov/qfd/states/30000.html

Project water for residential use. At an estimated avoided cost of averting behavior of between $438 and $705 per year per household, the estimated annual benefits associated residential use of the St. Mary water is approximately $3.3 to $5.35 million.

RESIDENTIAL WATER DEMAND

Further analysis of this issue would require collection of historical municipal water rates and consumption data for area households, and estimating an economic demand model for municipal water use.

ESTIMATED RECREATIONAL BENEFITS

BENEFITS TO RESIDENT ANGLERS

Much recreation in Montana has a strong link to water resources. Fishing, swimming, picnicking, wildlife watching, and even hunting can all, to some degree, be dependent on water levels or the presence of irrigated farmlands. The St. Mary diversion water provides significantly augmented flows in the Milk River as well as water for maintenance of water levels at Fresno and Nelson Reservoir, and at Bowdoin NWR. Estimation of the net benefits associated with recreation tied to the project flows is a two-step process: 1) estimation of the total recreational use of the river and reservoir water resources, and 2) estimation of the portion of that recreational use that is directly tied to flows from the St. Mary Diversion.

Table 17 outlines the total estimated fishing pressure on both the Milk River downstream of the Canadian border, and Fresno and Nelson Reservoirs, based on data collected biennially by the Montana Department of Fish, Wildlife, and Parks.

Table 17: Montana Department of Fish, Wildlife, and Parks Estimated Annual Fishing Pressure, 1993-2003

Water	1993	1995	1997	1999	2001	2003
Milk Section 1	1,825	702	2,485	2,082	2,074	2,206
Milk Section 2	994	1,266	1,879	1,801	761	1,595
Milk Section 3	2,537	1,857	1,727	2,527	3,532	3,738
Milk Section 4	875	1,822	1,563	1,377	2,284	1,188
Milk Section 5	282	0	847	0	41	140
Milk River total	**6,513**	**5,647**	**8,501**	**7,787**	**8,692**	**8,867**
Fresno Reservoir	8,785	14,153	18,233	15,085	3,875	5,777
Nelson Reservoir	7,185	8,724	17,587	12,915	8,463	12,558
TOTALS	22,483	28,524	44,321	35,787	21,030	22,002

Source: MT DFWP Statewide Angling Pressure Estimates, 1993-2003 publications.

Over the period of 1993-2003, estimated angler use averaged slightly less than 30,000 angler days per year on the Milk below the Canadian Border and the two primary reservoirs on the drainage. It is clear from the use estimates in Table 17 that use levels have fluctuated over the years with particularly low use seen at Fresno in recent drought years.

While there is substantial variation in the year-to-year flow and visitation estimates used in the modeling, none of the observed data correspond with the expected scenario in which without St. Mary water the Milk River would stop flowing in late summer in 6 out of 10 years.[31] For the case at hand, based on conversations with the Montana DFWP fishery biologist in Glasgow, it is anticipated that in the "without" case, and for dry years, reservoirs would be drawn down to very low levels in the summer and the Milk River would essentially be dry. This would mean that the fishery would be unproductive, if not entirely nonexistent in many years. Accordingly, angler use in the "without" case is assumed to approach zero. In the "with" case there would be substantially more water than the average of recent years. For purposes of the present report, it is assumed that an average of the best several recent years (1997 and 1999) at about 40,000 angler days would be supported in the "with" case. Montana DFWP estimates that mainstem and reservoir angling and other water-based recreation along the Milk River would likely decrease by 80% to 100% without St. Mary Diversion water.[32]

A day of fishing within the Milk River System has value to anglers over and above the amount an angler must spend in order to make their fishing trip. The US Fish and Wildlife Service conducts a national survey every five years in order to estimate the net economic value (NEV) associated with fishing, hunting, and wildlife-related recreation. The 2001 USFWS survey estimated the aggregate NEV per day of trout, bass, and walleye fishing in the US. The aggregate values for these activities were not statistically different across the three fish species.[33] The simple average of the NEV per day for these three species was $53.51 per day when adjusted for inflation since the study was conducted in 2001. Combining this NEV estimate with the estimated loss of 80% to 100% of 40,000 angling days per year in the presence of St. Mary flows yields an estimated NEV per year of $1.71 million to $2.1 million associated with angler use supported by the project water flows.

BENEFITS TO NON-FISHING RESERVOIR USERS

The US BOR Regional Feasibility Report provides an estimate of total annual average visitor days at both Fresno and Nelson Reservoirs.[34] The report cites 64,362 visitor days at Fresno and 23,803 visitor days at Nelson. Subtracting average annual (1993-2003) estimated angler use from these total visitation estimates yields approximately 53,400 non-angling visitor days per year at Fresno and 12,600 non-angling days at Nelson Reservoir. It is not clear if this estimate is typical of the "with" case, or if it is conservative. For this analysis it is assumed that non-angling recreation in the drainage is tied to water flows in the same proportion as angling use. That is, loss of St. Mary flows would lead to a reduction in non-angling recreation at the reservoirs of approximately 100% of historical use or an estimated 66,000 annual non-fishing visitor days at Fresno and Nelson Reservoirs.

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[31] Milk River International Alliance et. al, "The Milk River: International Lifeline of the Hi-line." Page 9.
[32] Personal communication, Bill Weidenheft, Montana DFWP. Nov. 13, 2005.
[33] USFWS 2003, "Net Economic Values for Wildlife Related Recreation in 2001," reported aggregate NEV per day for trout fishing of $51, for Bass fishing $48 and for walleye fishing $44.
[34] US BOR 2004, at page 26.

While no specific estimates of reservoir use values in the Milk River drainage are available, estimates of non-angling water-based use valuation estimates are available in the economics literature. Rosenberger and Loomis (2001) provide summary results for numerous types of recreational activities. A conservative estimate of NEV per day of $30.41 is based on Rosenberger and Loomis summary statistics based on 12 studies of general recreation.[35] At an estimated NEV per day of $30.41 for non-fishing reservoir recreation and an estimated 66,000 non-fishing use days at the two reservoirs, it is estimated that the total annual NEV for this component of recreational use of St. Mary water is $2.0 million.

Under this estimate of recreation benefits, and based on an estimated loss of 80% to 100% of river and reservoir recreation without the St. Mary flows, it is estimated that the annual benefits associated with Milk River and reservoir angling range from $1.7 to $2.1 million. Additionally, it is estimated that non-angling reservoir estimated range from $1.6 to $2.0 million annually.

BENEFITS ASSOCIATED WITH NON-ANGLING RECREATION ALONG MILK RIVER

A final class of recreation associated with use of the Milk River is non-angling recreation along the mainstem river. Although no specific estimates of non-angling recreational use of the non-reservoir sections of the Milk have been estimated, information is available regarding the share of total river and stream recreation in the area that is attributable to angling. Duffield et. al (1990)[36] estimated the shares of total river and stream use attributable to angling, floating, and shoreline recreation in the Lower Missouri River Basin. They found that 28.1% of total use was attributable to angling. Applying this percentage to Montana DFWP estimates of total annual angler use of the Milk River in 1997 and 1999 (about 8,150 angler days), yields and estimate of total non-angling user days of approximately 27,300 recreation days. The estimated share of this use due to enhanced flows is assumed to be between 80% and 100% (Montana DFWP) yields an estimated 23,200 to 29,000 recreation days attributable to St. Mary Flows.

The Duffield et. al (1990) report estimated net economic value per day associated with non-angling recreation in the Lower Missouri River Basin region (corrected to 2005 dollars) at $105.59 for Montana residents and $310.44 for nonresidents.[37] Based on these parameters and an assumed 5.2% share of use for non-residents, the annual benefits to non-angling use of the Milk River attributable to St. Mary flows is estimated as between $2.7 and $3.4 million.

BENEFITS ASSOCIATED WITH USE OF BOWDOIN NWR

Bowdoin NWR is a 15,550-acre refuge approximately 7 miles east of Malta, Montana. The US Fish and Wildlife Service (FWS) reports that in 2004 the refuge received an estimated 7,147 total visitors.[38] Table 18 details the FWS estimates of total 2004 visitor use by activity type. Wildlife viewing activities dominate use of the refuge accounting for over 75% of estimated annual visitation.

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[35] Rosenberger and Loomis (in Table 1. page 4) provide summary estimates for 21 separate classes of activities. The use of the summary estimate for general recreation is conservative in that more specific estimates associated with reservoir recreation are generally higher. For example, the mean of estimates for picnicking is $44.20, for swimming $26.42, and for motorized boating $44.55.
[36] Duffield, J., D. Patterson, C. Neher, and S. Allen. "Instream Flows in the Missouri River Basin: A Recreation Survey and Economic Study." Report for the Montana Department of Natural Resources and Conservation. (July, 1990).
[37] Ibid at Table 38. Updated from 1989 to current dollars using CPI-U.
[38] US Fish and Wildlife Service, 2005. "Banking on Nature: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation. Table 6-12, Page 363.

Table 18 also shows estimated net economic value per day for the activities reported by FWS.[39] It is estimated that the annual net economic value associated with recreational activities at Bowdoin NWR is approximately $285,000. It is also estimated that this entire amount is attributable to St. Mary water in the Milk River system. Bowdoin NWR relies on the contracted Milk River Project water to maintain its habitat. Loss of this water would profoundly change the habitat within the refuge as well as exacerbate occasional refuge problems of salt concentration and outbreaks of avian botulism.[40] Note that this estimate is for current use, and therefore provides a possibly quite conservative estimate for the "with project" case.

Table 18: Bowdoin NWR Annual Use and Net Economic Value.

Recreational Use	visitors	Net economic value per day	Total annual net economic value
Wildlife viewing	5,438	38.44	209,019
Other recreation	88	50.86	4,459
Small game hunting	1,336	44.73	59,748
Waterfowl hunting	286	39.62	11,344
Total annual	7,147		$284,571

BENEFITS TO HUNTING

Water from the St. Mary Diversion not only benefits fish populations and associated recreation in the Milk River Drainage, but it also supports habitat for big game and upland bird populations. Montana DFWP estimates that a very large portion of the whitetail deer hunting and pheasant hunting in the Milk River hunt districts and counties would not occur without the supplemental St. Mary water in the system.[41] Tables 19 and 20 show total deer hunting in hunt districts surrounding the Milk River (Table 19) and Montana DFWP estimated losses in whitetail hunter days in the event of loss of the St. Mary water (Table 20). In total, it is estimated that approximately 14,000 deer hunter days in the seven hunting districts abutting the Milk River would be lost without St. Mary Diversion water in the Milk River system. Again, this is a comparison of "current use" to the "without" case, and is a conservative estimate for the benefits associated with a rehabilitated diversion facility.

[39] Net economic value estimates are from Rosenberger and Loomis (2001), adjusted to 2005 price levels using the CPI(U).
[40] Personal communication, Kathy Tribby, Refuge Operations Specialist, Bowdoin NWR. Nov.,14, 2005.
[41] Personal communication, Pat Gunderson, Montana Department of Fish, Wildlife and Parks.

Table 19: Total deer hunters for 2003 from requested hunting districts, broken down by resident and non-resident hunter numbers and hunter days.

Total 2003 Deer Hunter Numbers and Hunter Days by Hunt District						
Hunt District	**Res #'s**	**Non-Res #'s**	**Total Hunter #'s**	**Res HDs**	**Non-Res HDs**	**Total HDs**
600	1,308	88	1,396	5,679	302	5,981
610	741	58	799	3,037	237	3,274
611	585	130	715	2,293	432	2,725
620	954	120	1,093	4,164	572	4,735
630	1,269	526	1,795	6,474	1,647	8,121
670	999	523	1,522	4,280	1,975	6,255
690	2,120	276	2,396	9,443	1,072	10,515

Table 20: Estimated Average Number of Deer Hunters for 2003 Attributable to Augmented Milk River Flows.

Years	Res HDs	Non-Res HDs	Total HDs
1999- 2003 average	11,533	2,493	14,026

Tables 21 and 22 show estimated total pheasant hunting in the 4-county Milk River Area (Table 21), and the estimated loss in hunter days associated with the absence of St. Mary flows (Table 22). In total, MT DFWP estimates that approximately 13,000 pheasant hunting days in the counties are directly attributable to the enhanced flows.[42]

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Table 21: Total pheasant hunters for 2003 from requested counties, broken down by resident and non-resident hunter numbers and hunter days

Total 2003 Pheasant Hunters by County						
County	**Res #'s**	**Non-Res #'s**	**Total Hunter #'s**	**Res HDs**	**Non-Res HDs**	**Total HDs**
Blaine	589	367	956	2,770	1,310	4,080
Hill	388	242	630	2,230	1,055	3,285
Phillips	828	515	1,343	3,649	1,726	5,375
Valley	857	533	1,390	4,443	2,101	6,544

Table 22: Estimated Average Number of Pheasant Hunter Days for 1999-2003 Attributable to Augmented Milk River Flows

Years	Res HDs	Non-Res HDs	Total HDs
1999- 2003 average	8,759	4,360	13,119

[42] Ibid.

Table 23 shows aggregate estimates of the benefits to hunting associated with St. Mary flows in the Milk River Drainage. Estimates for the net economic benefits associated with a day of resident and nonresident pheasant hunting are drawn from the Brooks (1992) study of values associated with Montana upland game bird hunting. Based on the Brooks estimates updated to 2005 dollars, a day of upland bird hunting is estimated to be valued at $199.50 for Montana residents and $264.89 for nonresidents. The total estimated annual benefits associated with project flows for bird hunting is estimated at approximately $2.9 million.

Table 23 also summarizes estimated benefits associated with whitetail deer hunting attributable to current use levels relative to the "without" case. Using an estimated net economic benefit per day of $74.67 for residents and $164.56 for nonresidents (Brooks, 1988, updated to 2005 dollars), the estimated total annual benefit of the flows to deer hunters is approximately $1.2 million.

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Table 23: Estimated Annual Benefits Associated with Pheasant and Deer Hunting near Milk River

Species/ Hunters	Estimated hunter days due to increased flows	Value per day	Total annual benefit
Pheasant – Resident	8,759	$199.50	$1.75 million
Pheasant - Nonresident	4,360	$264.89	$1.16 million
Whitetail – Resident	11,533	$74.67	$0.86 million
Whitetail - Nonresident	2,493	$164.56	$0.41 million
Total annual benefits			$4.18 million

Table 24 provides a summary of a potential upper bound of recreational benefits associated with Milk River Project water. While estimates are provided in the table for certain recreational activities, values for other activities for which data is unavailable, or the tie to Milk River water is less well defined, are not estimated. For instance, while estimates of hunting values at Bowdoin NWR are available from FWS use statistics, estimates of off-refuge waterfowl hunting that may be tied to the habitat and attractiveness of the refuge lands to passing waterfowl are not estimated. Therefore, for a number of different reasons the approximately $10.5 to $12.0 million annual net economic value of recreation attributable to Milk River Project water (shown in Table 27) may provide an underestimation of total Milk River project water-dependent activities in the "with" verses "without" comparison.

Table 24: Summary of Upper Range of Net Economic Recreational Use Value Estimates Associated with St. Mary Flows (Current $ million)

Resource	Annual NEV Fishing	Annual NEV Non-fishing, Non-hunting Recreation	Annual NEV Hunting	Total
Milk River	$1.7 to $2.1 million	$2.7 to $3.4 million	$4.2 million	$8.6 to $9.7
Fresno & Nelson Reservoirs	included in above	$1.6 to $2.0 million	Included above	$1.6 to $2.0
Bowdoin NWR	0	$0.2 million	$0.1 million	$0.3
Total	*$1.7 to $2.1 million*	*$4.5 to $5.6 million*	*$4.3 million*	*$10.5 to $12.0*

Because these estimates are based on readily available studies that are not generally specific to the Milk River Basin, there is additional uncertainty about the true range of values. For example, these estimates may still be somewhat conservative in that they are largely comparisons of the "without" case to current use levels, not a comparison of the "with" and "without" cases. On the other hand, it is also possible that recreational values may be somewhat lower than the upper range of $10.5 to $12.0 cited above. None of the value per day estimates relied upon here explicitly take into account possible substitution effects. Additionally, where state-level or even regional-level values are used, it is not known if the recreational use affected by the Milk River Project is of a quality comparable to the relevant regional or state estimate. For example, the deer hunting estimates specific to Montana ($75 to $165 per day for residents and nonresidents respectively) may be higher than the average deer hunting value for the U.S. ($63 to 85 for state residents and nonresidents respectively) in part because Montana hunts are typically high quality hunts for mule deer. In the case at hand, however, the change in hunter days along the Milk River is for whitetail. It is not known if these hunts are more appropriately valued at the U.S. average or at the Montana average. Accordingly, recreational benefits could be as much as 50% lower (e.g. around $6 million per year) due to these factors. Additionally, given uncertainty about impacts on use, let alone values, we have not formally incorporated the variability due to the statistical precision (standard errors) of the original estimates. For purposes of the summary below (Table 27), a preliminary range for recreational values is determined to be $6 to $12 million annually.

ESTIMATED WATER QUALITY BENEFITS

The diverted St. Mary water provides a source of high quality water for the Milk River system. Reclamation (2004) notes that the loss of the St. Mary water would result in less dilution of pollutants, and therefore would result in a decrease in water quality within the river.

The Milk River, including Fresno Reservoir, downstream to the Missouri River has been assessed as having one or more beneficial uses impaired or threatened as a result of human activity. These waters are therefore on the Montana 303(d) list of impaired streams and are scheduled to have

TMDLs completed by 2011. Loss of St. Mary dilution flows would further exacerbate the problems associated with these impaired waters.

ESTIMATED BENEFITS ASSOCIATED WITH ECOSYSTEM SERVICES

The "direct-use" benefits of ecosystems services, such as recreation, associated with the diverted St. Mary water are substantial, as described above. There are additional indirect ecosystem benefits associated with the diverted water. These ecosystem benefits include so-called passive use or nonuse values. These are values associated with a resource independent of direct use. For example, some individuals may place a value on knowing that the Milk River has a healthy riparian ecosystem or a healthy fisheries independent of any plans to ever themselves actually visit the Milk River area. For example, individuals may place a value on the continued existence of rare fish like the paddlefish and the pallid sturgeon, independent of actually expecting to ever see one. The guidance from the economics literature is that these values need to be included in benefit cost analysis. Consistent with the guidance from the U.S. Water Resources Council (1984) principles and guidelines, these benefits are measured in terms of willingness to pay.

A recent National Research Council report, entitled Valuing Ecosystem Services, (National Research Council 2004) reviews this area of economic analysis and concludes that: "If the benefits and costs of a policy are evaluated, the benefits and costs associated with changes in ecosystem services should be included along with other impacts to ensure that ecosystem effects are adequately considered in policy making." Additional, the National Research Council recommends that economic valuation of changes in ecosystem services should be based on the comprehensive definition embodied in a total economic valuation framework, that is to say that "both use and nonuse [passive use] values should be included".

There are numerous examples in the economics literature of studies that place a value on indirect ecosystem services (National Research Council 2004). Examples of passive use values in the economics literature include values associated with protecting endangered species (such as the grey wolf or grizzly in Montana), protecting streamflows for trout populations, or protecting air quality. The myriad of ecosystem services supplied by St. Mary water include support for endangered species (piping plover and pallid sturgeon), support of riparian zones and wetlands, and support of wildlife populations. However, to date there do not appear to have been any studies of ecosystem services undertaken specific to the Milk River area. The information needed to develop estimates for ecosystem services in this case include: 1) information on actual water allocations that will be made in the "with" case that may benefit ecosystem services, for example flows specifically reserved or made available for Bowdoin NWR or pallid sturgeon, 2) the physical and biological effect of these flows on the service at issue (for example, a given amount of feet may increase waterfowl production at Bowdoin by a given amount, or reduce salinity levels by some amount, or decrease the risk of extinction for the pallid sturgeon, and etc.), and 3) economic values for quantity changes in the services at issue (for example, the value of increased wildlife production, reduced salinity, decreased risk of extinction, etc.). Based on our review of the existing studies, neither the hydrological, biological, or economic information on possibly valuable indirect ecosystem services associated with increased flows for the St. Mary Project are available for most services. One possible exception is wetlands, as is discussed below.

In the remainder of this section available information is summarized for a set of four indirect ecosystem services: 1) wetlands, 2) instream flow in the Milk River for riparian vegetation and fisheries, 3) Bowdoin NWR productivity and control of saline concentrations and avian diseases, and 4) endangered fish species and species of special concern, including pallid sturgeon and paddlefish. While studies specific to the Milk River are generally not available, related studies in other areas provide some indication of the possible significance and range of values for these ecosystem services in the Milk River basin. The benefit transfer method uses values developed for a given study site to estimate values at another site (usually referred to as the transfer or policy site). Rosenberger and Loomis (2003) provide an overview of this literature. In general the benefit transfer requires: information on the quality or character of the specific resource in both the study and transfer setting, some sense of the quantity change at issue, and the spatial extent of the market. Most of the relevant studies use the so-called total valuation framework, in which both direct use and passive use values are included. Values for most such studies are in terms of willingness to pay per household or individual, which is aggregated over the spatial market these values are defined for (such as a county, state, multi-state region, or nation).

An example of an ecosystem type for which direct evidence of existing value to society is available for the Milk River is in the case of wetlands. Enhanced Milk River flows and return flows from irrigation all maintain and enhance wetlands within the Milk River drainage. These wetlands provide ecosystem services ranging from filtering and cleansing water flows to providing wildlife habitat. Loss of the diverted St. Mary flows would impact the extent and quality of wetlands within the river corridor.

One method of estimating benefits is to examine public policy decisions for evidence of what values society through its public decisions has placed on particular resources or services. In the case of preservation of wetlands, there is clear information on values associated with wetland protection in the Milk River Drainage. The Montana Department of Transportation (DOT) has a restriction associated with its highway work stipulating that any wetlands that are drained or destroyed in the course of road building, repair, or expansion must be replaced with newly developed wetlands within the same drainage.[43] Within the Milk River Drainage, the DOT has developed two replacement wetland zones associated with past and projected future road work in the drainage. The two replacement wetlands are located near Zurich and Hinsdale. Costs associated with development of these replacement wetlands provide a Milk River-specific estimate of the benefits associated with wetlands sustained by St. Mary Flows.

Montana DOT reports that replacement wetlands within the Milk River Drainage cost the department between $11,000 and $16,000 per acre. Clearly, society places a significant value on the ecosystem services provided by Milk River wetlands, as demonstrated through their willingness to replace lost wetlands at considerable expense. This is an area for further analysis.

National Wetlands Inventory data are available for approximately one-half of the river miles between Fresno Dam and the mouth of the Milk River. Within these inventoried sections there are a 3,768 acres of riverine wetlands located within one mile of the river. It is these wetlands which depend on surface water that stand to be lost without continued St. Mary flows. Table 25 details the calculation of estimated annual value of the riverine wetlands along the Milk River based on the replacement cost estimates from Montana DOT.

[43] Personal communication, Larry Urban, Wetland Mitigation Specialist, Montana Department of Transportation, Nov 7, 2005.

Table 25: Estimated Annual Milk River Riverine Wetlands Benefits

Estimate	Value
Acres of inventoried riverine wetlands within 1 mile of river[a]	3,768
Percent of river un-inventoried	48.65%
Estimated riverine wetland acres along entire Milk R. below Fresno Dam	7,339
Estimated replacement cost per acre	$11,000 to $16,000
Estimated total value of Milk River riverine wetlands	$80.73 million to $117.43 million
Estimated annual value of wetlands (at 5.875%)	$4.74 million to $6.90 million annually

[a] Personal Communication, Sean Fields, Benton Lakes NWR.

With regard to the value of instream flows in the Milk River, primarily for fisheries and riparian habitat, there are three Montana studies that provide evidence of general magnitudes of benefits associated with these services.

In a study of licensed Montana anglers, Duffield, Neher, Patterson and Champ (2005) found that Montana resident and nonresident anglers were willing to pay an average of $1.50 and $7.00, respectively to protect streamflows and associated fish populations in isolated Montana streams. These were one time actual cash donations to a private trust fund administered by Montana Trout Unlimited, primarily for coldwater fisheries. In a separate study, Duffield and Brown (1995) found that average annual willingness to pay to protect streamflows in five Montana rivers, including the Gallatin, Clark Fork, Smith, Big Hole and Bitterroot rivers using contingent valuation methods averaged $6.70 for protection of one river and $12.43 for all five rivers. The aggregated value for all five rivers is about $7.5 million and for one river $4.0 million (1989 dollars).

A third instream flow study (Duffield, Neher, Patterson, and Allen 1990) focused on annual contributions to help purchase water needed for instream flows on Missouri River Basin streams. Specific streams listed in the questionnaire included the Smith River, Teton, Marias, Judith, Belt Creek, Big Spring Creek, Musselshell and all sections of the Missouri River. The Milk River was not included. The willingness to pay was estimated at $16.86 for lower Missouri River subbasin Montana residents, $22.26 middle subbasin, $27.44 upper, and $14.92 out of basin Montana residents, and $33.07 for nonresident anglers. The aggregate annual value was estimated to be $13.6 million (11.9 to 15.2 million dollars is the 95% confidence interval).

In current 2005 dollars, the latter two instream flow studies indicate a range of values for increasing streamflows in one to up to 22 Montana rivers or river segments of $6.4 million to $21.8 million. The lower end of this range may still be overly high for a single river such as the Milk, which is not as well known as most of the other study rivers. The actual quantity change in flows at the study sites and the Milk River, as well as the extent of the spatial market would have to be investigated to further refine these estimates in a benefit transfer.

A recent study that is also potentially relevant for valuing improvements in Milk River riparian areas is a study by Colby and Orr (2005) that estimates the value of protecting riparian habitat along the Upper San Pedro River in southeastern Arizona. The study notes that lush riparian habitat along the river depends on adequate streamflows; in the absence of adequate flows trees and other plants would die, habitat would be degraded, and the bird biodiversity in this area would decline. The one-time willingness to pay on the part of visitors to the area was estimated to be $78.50. Aggregated over the number of visitors per year, this implied a value for protecting riparian habitat in this area of $2.0 to $3.5 million.

In addition to the Milk River corridor, another important ecological resource in the basin is the Bowdoin NWR. The refuge currently receives about 3,500 acre feet per year from the project, but has a need for 14,000 to 16,000 to control saline concentration and airborne dispersion of salts to adjacent farmlands, and to control increased incidence of avian botulism breakouts in the refuge.[44] Additionally, increased water for the refuge would increase waterfowl and wildlife biodiversity and production. Because this is a resource of national significance (being part of the National Wildlife Refuge system), it is likely that the spatial extent of the market may be at least regional if not national. An example for a similar case of restoration of wetlands and control of contamination from agricultural runoff is the Hanemann, Loomis, and Kanninen (1991) study of the Central Valley Project of California. Per household willingness to pay to increase wetlands, and reduce contamination in evaporative pools, were, respectively, $251 and $308 across all California households, in 1991 dollars. The study also measured the value of increased instream flows in the upper San Joaquin River which was estimated at $181 per household. The increased streamflows would benefit salmon and other fish in the river and wildlife and vegetation along the river. The study also measured the willingness to pay for wetland restoration in other Pacific Flyway states, including Nevada, Oregon, and Washington. These willingness to pay models could potentially provide an informative benefit transfer to the Milk Project and Bowdoin NWR by correcting for differences in spatial extent of the restoration and socio-economic differences in regional populations, including income levels.

A final category of potentially significant ecosystem services concern fisheries, particularly federal endangered species and Montana species of concern. In the Milk River system these include five of Montana's 18 species of concern: blue sucker, paddlefish, pallid sturgeon, pearl dace, and sauger. The pallid sturgeon is also a federally listed endangered species, and is the species that has received the most attention and restoration effort in recent years. The pallid sturgeon is a very unusual fish that evolved over 70 million years ago and is very dinosaur-like in appearance, as well as being one of the largest fish in the Missouri and Mississippi River system. The largest individuals have been recorded in Montana and the Dakota's and weighed over 80 pounds. This long-lived species is also much endangered as habitat alterations appear to have stopped all or almost all natural reproduction. Extinction has been predicted to be within decades in the absence of significant recovery successes. Several of the key recovery areas for the species are in Montana, in the Missouri R. above and below Fort Peck and in the lower Yellowstone. The Milk River may provide potential spawning habitat and, in any case, contributes warm turbid water to the Missouri below Fort Peck.

The economics literature shows that society places a significant value on the continued survival of endangered and threatened species. Loomis and White (1996) provide a literature review of economic values for these types of species. The values for fisheries reported at that time varied from as high as $63 average annual value per household for Pacific salmon and steelhead (range of $31 to

[44] Personal communication, Kathy Tribby, Bowdoin NWR.

$88) to $6 to $8 for Atlantic salmon, squawfish, and striped shiner. The estimate for the latter is based on a Wisconsin study (Boyle and Bishop 1987) that measured willingness to pay for this obscure and little known endangered species that lives only in a section of the Milwaukee River. The aggregated value estimated for this species based on Wisconsin taxpayer rolls was around $3 million. A more recent study (Ekstrand and Loomis 1998) estimated values for nine endangered species (including humpback chub, razorback sucker, Colorado squawfish, and silvery minnow) in the Colorado, Green, and Rio Grande River basins at $50 to $330 per U.S. households. Using the lowest estimated value implies a national benefit estimate of about $4.6 billion.

It is likely that the relevant spatial market for valuation of pallid sturgeon would also be national, or at least the regional states that adjoin this specie's current occupied habitat including Montana, North Dakota, South Dakota, Nebraska, Iowa, Kansas, Missouri, Illinois, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana. The relevant values for pallid sturgeon on the Milk River would heavily depend on the biological issue of how significant restoration efforts in that basin would be for preventing extinction and aiding recovery of the species, and on the issue of what kind of resources would be dedicated to this task, including water allocation.

To conclude this section, available studies indicate that ecosystem services could potentially provide significant economic benefits related to the St. Mary water diversion. However, at present there is considerable uncertainty about how large these benefits are in the absence of key data on the allocation of St. Mary water to these uses, the biological response to water allocations and other mitigation efforts, and the economic values associated with these uses by regional and national households, and visitors.

SUMMARY OF APPROXIMATE ESTIMATED BENEFITS

As detailed in the preceding sections, there are substantial economic benefits associated with diversion of St. Mary water in to the Milk River Drainage. These benefits include benefits to agriculture, recreation, municipal water use, water quality, and ecosystem services. Additionally, the secondary economic impacts associated with ongoing agricultural production tied to St. Mary flows, and spending on reconstruction of the diversion facilities represent benefits to the Hi-Line economy.

Table 26 summarizes preliminary and approximate estimated benefits associated with the Milk River Project water. The table shows estimates of annual value for most categories of benefits. The annual benefit estimates in Table 26 generally represent the incremental benefits of a rehabilitated St. Mary Diversion in comparison to a scenario without any St. Mary water in the Milk River System. However, the estimates for hunting benefits and fishing may be more representative of a comparison of the "without" case to current water availability, not to the "with rehabilitation" case. The following section on net present value estimation of estimated benefits addresses expected changes in water flow from the St. Mary system over the expected life of the rehabilitated system.

Table 26: Summary of Approximate Preliminary Annual Benefits Associated with St. Mary Diversion Rehabilitation

Benefit Category	Estimated Annual Benefits (million 2000 dollars)
Agricultural production value	\$7.68 to \$10.97
Secondary regional impacts of increased agricultural production and construction	\$2.3 to \$3.8
Recreation[a]	\$6.00 to \$12.00
Municipal, Residential, and Industrial uses	\$3.30 to \$5.35
Water quality	Not estimated
Indirect Ecosystem services: instream flows, Bowdoin NWR enhancement, endangered species.	Not estimated
Carriage Water	Not estimated
Wetlands	\$4.74 to \$6.90
Hydropower	Not estimated
Approximate Total Annual	\$24.0 to \$39.0 million

COMPARISON OF ESTIMATES WITH RECLAMATION BENEFIT ESTIMATES

Reclamation (2004) provided benefit estimates for irrigated agriculture associated with a rehabilitated St. Mary Diversion. Additionally, Reclamation noted the likely direction and relative magnitude of non-agriculture benefits attributable to the project. Table 27 compares the estimates from Table 26 with the results from Reclamation (2004).[45]

Table 27 shows the primary significant difference between the current study estimates and those estimated by Reclamation are that the current study estimates benefits for categories of benefits which Reclamation acknowledges are positive, but has not estimated. The estimated benefits associated with irrigated agriculture (excluding secondary benefits) in the current study are in the same range as the Reclamation (2004) estimates. Additionally, Reclamation (2004) provides net benefit estimates for recreation, limited to recreational use at Fresno and Nelson reservoirs, at \$1.8 million, which again is similar to the estimate of this report.

[45] Reclamation (2004) Table S.1. St. Mary System Enhancements, 850 cfs option.

Table 27: Comparison of Current Stud and Reclamation Benefit Estimates

Benefit Category	Estimated Annual Benefits (Current Study) (million $)	Estimated Annual Benefits (Reclamation 2004)
(A) Agricultural Benefits		
Agricultural production value	$10.97	$7.68
(B) Other Benefits		
Secondary regional impacts of increased agricultural production and construction	$2.3 to $3.8	Not estimated
Recreation	$6.0 to $12.0	Positive
Municipal, Residential, and Industrial uses	$3.3 to $5.35	Positive
Water quality	Not estimated	Slightly positive
Ecosystem services	Not estimated	Positive [a]
Carriage Water	Not Estimated	Not Estimated
Wetlands	$4.7 to $6.9	Not estimated
Total annual	$24.0 to $39.0	$7.68

[a] estimated as positive for impacts to Bowdoin NWR and for Fish and Wildlife.

ESTIMATED NET PRESENT VALUE OF BENEFITS

While the preceding table outlines a partial and preliminary estimate of benefits associated with Milk River Project water, in order to estimate the net present cumulative value of these annual benefit streams two additional pieces of information are necessary. First, one must know if the estimated annual benefits are constant, increasing or decreasing over the life of the project. Second, a rate at which to discount future benefits must be selected. Using the Reclamation (2004) interest rate of 5.875% (assumed to be a real rate), and assuming all annual benefits identified in Table 27 are constant into the future, results in a present value on the order of $410 to $660 million. This estimate is likely conservative. Unit values for some benefit categories have been approximately constant in real terms over the last few decades (for example, alfalfa prices). However, the unit values and/or use levels for other significant benefit categories, including recreation, have generally been increasing. For example, sales of nonresident upland game bird licenses in Montana have increased at an average rate of about 2.5% per year over the last 30 years. A simplifying assumption in this computation is that, in the absence of significant rehabilitation investment, the project would likely fail in the near future.

The estimated approximately one-half billion dollars in project benefits is about four times the $120 million in estimated rehabilitation costs. This implies a preliminary benefit-cost ratio for the project of about 4:1.

This section identifies key data gaps and key missing information related to the economic significance of the project, and economically sound approaches to rehabilitation and management. Based on the analysis of data gaps and key missing information, a scope of work and budget for the next phases of economic studies for the project is described.

DATA GAPS AND KEY MISSING INFORMATION

This study has presented an off-the-shelf reporting of the likely types and magnitudes of benefits associated with rehabilitation of the St. Mary diversion facilities. The approximate magnitude benefit estimates provided in summary Table 26 are necessarily based on readily available data, combined with judgments and assumptions informed by conversations with knowledgeable individuals in the Milk River area including state and federal government staff.

The next logical step in refining and supporting the estimates in this report is to identify specific follow-up studies and surveys that could supply missing data and strengthen the defensibility of the estimates. Below is a brief discussion of what we believe are the primary data gaps and missing information.

Irrigation economics. As discussed above, the primary approach used in this paper to identify irrigation benefits is the production function approach, specifically applied to alfalfa. A more realistic model needs to include other irrigated crops (such as grains) and to identify the substitution patterns related to the crop mix, and the tradeoff of labor, land, capital and other inputs. For such a model, it is necessary to have actual cost, production, and inventory data at the farm level for a sample of project farms. This data could be collected in a farm survey. The Reclamation farm budget analysis (Reclamation, 2003) that supports their regional feasibility and cost allocation studies (Reclamation 2004; 2005) and is based on assumed costs and production choices for the Milk River Project farms in that the study shows strongly negative net income. This is inconsistent with positive prices for irrigated land ownership in the area.

Regional economic analysis. A key assumption implicit in the regional economic analysis is that the regional purchase coefficients (relating to where project farms purchase their inputs) provided in the default IMPLAN model are appropriate for the case at hand. These coefficients can be identified more precisely by a survey of area farms. Related issues are the percent spent locally assumptions for construction impacts and the extent to which secondary impacts (indirect and induced impacts) actually utilized chronically idle or underemployed resources, including labor. A detailed review of case studies in other regions would provide missing information on these parameters.

Agricultural and Rural Residential property values. One major area of potential benefits not quantified in this report is the increment to property value associated with residential property services that are tied to flow levels in the Milk River, reservoir levels, and irrigated farmsteads. Proximity to water resources is generally associated with significantly higher property values. The same can be said of other amenities that might be related to irrigated properties, such as improved hunting or wildlife observation for the property owner. A data set for such an analysis, which could also investigate irrigation-related values, could also be obtained in a survey of area farms, as well as realtors.

Municipal, rural and industrial water supplies. The estimates reported here are values from the economics literature. These need to be refined by looking at the costs of alternative sources of supply, as a function of quality and quantity, for the actual water supply systems in the basin. Related to this, information on costs should be examined from several current major rural water supply projects now underway in the region. The value of municipal water can be inferred from consumer response to changes in water rates. This data should be collected and analyzed for the systems using Milk River water.

Recreation benefits. Recreation benefits appear to be quite significant for the project. The estimates presented are based on approximate estimates of use and literature values. The key data gaps are for non-angling use on the Milk River, and net benefit estimates related to non-angling, deer hunting, and upland bird hunting. Recreation surveys including data on valuation and expenditures could be implemented for these sectors. Upland game bird hunting is particularly important because of relatively high nonresident participation, and because of the potential for future growth in this use.

Water quality. The values discussed in this report are based on national average costs of compliance with TMDL regulations. The costs for this basin may be significantly different than national averages. All of the Milk River segments from Fresno Dam to the mouth are currently not in compliance with TMDL regulations. A plan needs to be in place by 2011. Having sufficient water in the river to dilute current concentrations of pollutants could provide significant savings relative to alternatives such as increased control of point and non-point emissions. This could be investigated through economic studies of the costs of controlling these emissions for the specific sources now present in the basin.

Valuation of ecosystem services. Important resources that could benefit from increased flows in the Milk River include Bowdoin National Wildlife Refuge, riparian ecosystems along the Milk, including native fisheries and cottonwoods, and endangered pallid sturgeon and Montana species of special concern, including paddlefish. This category of potential project benefits could potentially be the largest single component of project benefits, but is also the category about which the least is known. Because the values at issue include existence and bequest values (also referred to as passive use values), potential beneficiaries include individuals who may care about these resources, but may not ever visit them in person. Accordingly, the only way to measure these values is through surveys of Montana and other regional households.

NEPA compliance. It is likely that the rehabilitation of the St. Mary facilities will require a NEPA process in the form of an environmental impact statement (EIS). There will need to be a significant socioeconomic component to the analysis and writing of such a statement for each of the following standard EIS sections: 1. Affected Environment, 2) Environmental Consequences, 3) Cumulative Effects, 4) Economic Justice, 5) Irreversible and Irretrievable Commitment of Resources, and 6) Potential Impact on Small Entities. The bulk of this work would be in the first two elements, affected environment and environmental consequences. These sections would draw on detailed work on all areas of benefits, costs, and regional economic impacts as described above. However, for the case at hand, economic analysis would also be critical to the environmental justice component, given the likely significant impacts of the project on minority and disadvantaged individuals,. Particularly on area reservations. The last section, potential impacts on small entities is also primarily an economic analysis, and would be a significant section for the case at hand, based on the requirements of the SBREFA legislation.

Optimal project scale. The focus in the current report is on regional economic impacts and project benefits and costs. For purposes of this analysis, the focus has been on an 850 cfs project. An important issue for analysis is the comparison of marginal benefits and costs of a larger or smaller scale project. This task would need to be closely coordinated with the project engineering team, and is not examined further here.

Hydropower. Hydropower benefits were not investigated in the current report, pending the development of engineering feasibility and cost estimates. These could be quantified in a future task that would investigate the potential market for any power generated by the project. This work would need to be closely coordinated with the project engineering team, and is not examined further here.

NEXT PHASES OF ECONOMIC STUDY: SCOPE OF WORK AND BUDGET

This section provides a detailed scope of work and budget for the next phases of economic studies for the project, including NEPA compliance.

As described in the previous section, there are significant data gaps and missing key information for a number of economic sectors related to the Milk River Project. The following narrative lists the key tasks that should be included in the scope of work for the next phases of economic studies. Budget for the studies is summarized in Table 28.

Irrigation Economics. Collect data on project area farm expenditures, production, and land values and characteristics through a survey of a sample of 300 randomly selected project area farms. This survey would be implemented through combined phone/mail survey methods. Analyze data to identify project level marginal value product schedules and marginal costs that account for crop and input substitution, and can be used to compute project benefits.

Regional economic analysis. Use farm survey data to estimate regional purchase coefficients. Identify appropriate percent spent locally parameters for project construction impacts, and extent to which secondary project impacts will utilize underemployed resources, based on actual engineering and economic experience in other projects, and characteristics of local population and economies. Estimate regional economic impacts of the project, including construction, at several regional scales: Glacier County, 7-county Northern Montana, and State of Montana.

Agricultural and Rural residential property values. Use farm survey data, supplemented by real estate transactions data, to estimate hedonic models that distinguish the value associated with irrigated agriculture and residential property services, proximity to water resources and hunting opportunity. Use these models to refine estimates of the irrigation benefits and to estimate the impact of a rehabilitated project on residential property values and associated project benefits.

Municipal, rural and industrial water supplies. Estimate the potentially significant project benefits associated with MR&I use of project water. The task includes review of statewide well database for information on groundwater availability, and investigation of alternative costs associated with all current Milk River MR&I water users. Review actual cost for new rural water supply systems in the region Additionally, this task includes collection and examination of Montana data on current municipal water rates and implied price elasticities, in order to estimate municipal benefits.

Recreation benefits. Estimate recreation benefits for all key recreational uses of the project, including fishing in the Milk River and Fresno and Nelson reservoirs, as well as non-angling recreation including boating and general shoreline use at these resources. Implement a survey of Milk River recreationists to identify mix of activities and to estimate net benefits through recreation demand models. Implement a survey of upland game bird hunters and deer hunters to measure net economic values and expenditures and to relate use to irrigated project lands.

Water quality. Estimate benefits of project to meeting TMDL standards in impaired Milk River waters. Identify costs of alternative approaches to meeting standards in the absence of project rehabilitation, including increased emission controls at major point and non-point sources.

Valuation of ecosystem services. Estimate the total economic values associated with improved ecosystem services in the Milk River riparian corridor and at Bowdoin National Wildlife Refuge. Conduct focus groups in four communities to identify key resources and services, to likely include the Milk River riparian cottonwood habitat, key fisheries species including pallid sturgeon and paddlefish, and the productivity of Bowdoin NWR, particularly related to avoidance of avian botulism, increased waterfowl productivity, and control of toxic concentrations of salts and minerals. Design a household survey to collect data sufficient for estimating the non-market values of the relevant ecosystem services. Implement a pilot survey to identify the geographic scale of the market. Implement a survey to collect data. Estimate the non-market valuation model and associated project benefits.

NEPA compliance. Conduct analysis and do report writing to provide project team with draft and final socio-economic sections to include the following components of a St. Mary rehabilitation project EIS: Affected Environment and Environmental Consequences chapters, and sections concerning project impacts on "Economic Justice", cumulative impacts, irretrievable and irreversible commitment of resources, and potential impacts on small entities. The latter will provide an analysis sufficient to meet the standards of the SBREFA legislation.

A budget for these eight tasks is summarized in Table 28. The estimated range for the budget total, based on current labor and data collection costs, is $485,000 to $615,000.

Table 28: Estimated Budget, Next Phase Economic Studies

Task	Budget
Irrigation Economics	95,000 – 105,000
Regional economic analysis	30,000 – 40,000
Agricultural and Rural residential property values	35,000 -- 45,000
Municipal, rural and industrial water supplies	30,000 – 40,000
Recreation benefits	70,000 – 100,000
Water quality	20,000 – 30,000
Valuation of ecosystem services	120,000 – 150,000
NEPA compliance	85,000 – 105,000
Total Budget	**485,000 – 615,000**

Boyle, K. and R. Bishop. 1987. "Valuing wildlife in benefit-cost analyses: A case study involving endangered species." Water Resources Research 23(5):943-950.

Brown, T. and J. Duffield. 1995. "Testing Part-whole Valuation Effects in Contingent Valuation of Instream Flow Protection." Water Resources Research 31:2341-2351.

Colby, B. and P. Orr. 2005. "Economic Tradeoffs in Preserving Riparian Habitat." Natural Resources Journal 45:15-31.

DeLucia, D., P. Perkins, and J. Dalton. 2003. "Milk River Mitigation Measures Study: Final Report. Report for the Montana Reserved Water Rights Compact Commission, Helena, MT.

Duffield, J. 1995. "Revised Report and Rebuttal: Assessment of Damages to Groundwater and Literature Review of Water Use Values in the Upper Clark Fork River Basin." Report to the State of Montana Natural Resource Damage Litigation Program.

Duffield, J., C. Neher, M. Josephson, and R. Josephson. 1991. "Market Value of Agricultural Water Leased for Instream Flows." Report for Montana DFWP, Helena, MT.

Duffield, J., C. Neher, D. Patterson, and P. Champ. 2005. "Field-testing existence values II: A cash/contingent valuation experiment". Benefits and Costs in Natural Resources Planning. Proceedings W1133 Western Regional Research Project, Salt Lake, February 16.

Duffield, J., D. Patterson, C. Neher, and S. Allen. "Instream Flows in the Missouri River Basin: A Recreation Survey and Economic Study." Report for the Montana Department of Natural Resources and Conservation. (July, 1990).

Ekstrand, E. and J. Loomis. 1998. "Incorporating respondent uncertainty when estimating willingness to pay for protecting critical habitat for threatened and endangered fish." Water Resources Research 34(11):3149-3155.

Gibbons, D. 1986. The Economic Value of Water. Resources for the Future, Washington, DC.

Hamilton, J., N. Whittlesey, M. Robison and J. Ellis. "Economic Impacts, Value Added, and Benefits in Regional Project Analysis." 1991. Amer. J. Arg. Econ. 73:334-44.

Hanemann, Michael, John Loomis and Barbara Kanninen. 1991. "Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation." Amer. J. Agr. Econ 73:1255-1263.

Hughes, D. and D. Holland. 1993. "economic Impacts, Value Added, and Benefits in Regional Project Analysis: Comment. Amer. J. Agr. Econ. 75:759-762.

Kulshreshtha, S., D. Schaly, and K. Russel. 1993. "Irrigation Impact Study: Volume 4 of 7, Economic Input-Output." Report for the Alberta Irrigation Projects Association, Lethbridge, AB.

Loomis, J. and D. White. 1996. "Economic Benefits of Rare and Endangered Species: Summary and Meta-Analysis." Ecological Economics 18:197-206.

Milk River International Alliance et. al, "The Milk River: International Lifeline of the Hi-line."

Minnesota IMPLAN Group. 1997. IMPLAN Regional Economic Modeling System Software.

Missoulian newspaper, November 8, 2005. "Panel OKs $53 million for Montana improvement."

Missouri River Realty. 2005. http://www.missouririverrealty.com/farm%20ranch%20&%20acreages.html accessed on Oct. 28, 2005.

Montana Agricultural Statistics Service. Production and price information. www.nass.usda.gov/mt/

Montana Reservation Unemployment Rates. http://dli.mt.gov/resources/indianlabormarket.asp

Montana Department of Labor and Industry, Research and Analysis Bureau. 2005. "2004 Reservation Unemployment Rates."

Montana Department of Fish, Wildlife and Parks. 2005. "Montana Statewide Angling Pressure: Mail Survey 2003." Bozeman, MT.

Montana Department of Fish, Wildlife and Parks. 2003. "Montana Statewide Angling Pressure: Mail Survey 2001." Bozeman, MT.

Montana Department of Fish, Wildlife and Parks. 2001. "Montana Statewide Angling Pressure: Mail Survey 1999." Bozeman, MT.

Montana Department of Fish, Wildlife and Parks. 1999. "Montana Statewide Angling Pressure: Mail Survey 1997." Bozeman, MT.

Montana Department of Fish, Wildlife and Parks. 1997. "Montana Statewide Angling Pressure: Mail Survey 1995." Bozeman, MT.

Montana Department of Fish, Wildlife and Parks. 1995. "Montana Statewide Angling Pressure: Mail Survey 1993." Bozeman, MT.

National Research Council. 2005. Valuing Ecosystem Services: Toward Better Environmental Decision-Making . Washington, D.C.: The National Academies Press, 277 pp.

Rosenberger, R., and J. Loomis. 2001. "Benefit Transfer of Outdoor Recreation Use Values: A Technical Document Supporting the Forest Service Strategic Plan (2000 revision). Ft. Collins, CO. 59p.

Rosenberger, R., and J. Loomis. 2003. "Benefit Transfer", Chapter 12 in P. Champ, K. Boyle, and T. Brown eds. A Primer on Nonmarket Valuation. Boston: Kluwer Academic Publishers, 576 pp.

Sonoran Institute. 2005. Economic Profiling System.

TDH 2005, "Rehabilitation Plan: St. Mary Diversion."

Underwood, Mclellan Ltd. 1984. "Irrigation Development in Alberta: the Economic Impact." Report for the Alberta Irrigation Projects Association, Lethbridge, AB.

U.S.D.A. National Agricultural Statistics Service. "Land Values and Cash Rents: 2005 Summary. August 2005."

U.S. Census Quickfacts. http://quickfacts.census.gov

U.S. Department of the Interior, Bureau of Reclamation, Great Plains Region. "Draft Milk River Benefits Analysis," April 2003

U.S. Department of the Census. 2003 County Business Patterns Data.

U.S. Department of the Census, Bureau of Economic Analysis. Regional Economic Information System 2003 CD.

U.S. Fish and Wildlife Service. 2003. "Net Economic Values for Wildlife-Related Recreation in 2001." Washington, D.C.

U.S. Fish and Wildlife Service, 2005. "Banking on Nature: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation.

U.S. Water Resources Council. 1984.

TDH. Inc. 2005. "Rehabilitation Plan: St. Mary Diversion Facilities." Report for Montana DNRC, Helena, MT.

U.S. Department of the Interior, Bureau of Reclamation. 2003. "Draft Milk River Benefits Analysis." Great Plains Region, Billings, MT.

U.S. Department of the Interior, Bureau of Reclamation. 2004. "Regional Feasibility Report: North Central Montana." Billings, Montana.

U.S. Department of the Interior, Bureau of Reclamation. 2005. "Milk River Project, Montana: Preliminary Current Use Operation and Maintenance Cost Allocation, Draft Report."

APPENDIX A: BUREAU OF RECLAMATION COMMENTS ON DRAFT PRELIMINARY ECONOMIC ANALYSIS

Discussion:

The total benefits estimated by the state study are between $24.2 million and $41.3 million in direct economic benefits. The state irrigation benefit study relies primarily on secondary data especially for estimating recreation economic values and is an appraisal of the benefits that would be examined more thoroughly at a feasibility level. The state irrigated benefit study does not adhere to the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies developed to guide the formulation evaluation studies of Federal water resource development projects (P&G). The agricultural benefits only constitute between 32 and 54 percent of the study benefits. Other benefits, particularly recreation, municipal water and wetlands constitute the major constituent of the remaining benefits. The study concludes with an analysis of data gaps and key missing information that will be needed to develop sound estimates of benefits to replace the preliminary estimates. We believe if the proposed scope of work is pursued and the P&G guidelines on estimating National Economic Development (NED) benefits are followed that the benefits analysis could be used to determine project economic feasibility at the federal level.

1. Irrigated agriculture benefits.

The P&G identifies methodology for assessing NED agricultural benefits which the authors did not use in the preliminary analysis. Farm budgets used for the P&G analysis examine agricultural production for a farm unit with and without irrigation. As such the process ostensibly captures the differences in production including changes in cropping patterns, associated input costs and other changes. It also uses normalized prices from USDA for prices received. The state study relied on average alfalfa price and marginal physical product from water. A review of the state seasonal average alfalfa price for the time period used in the state analysis (2001-2004) gave an average of $83.12 as compared to the $88.29 per ton cited in the state study. Insufficient information was available in the state study to make an assessment of the price differential. The value per acre used in the study would be $80.63 based on increased production times the price of crop using the $83.12 average. No deductions for increased production costs or payments to other factors were accounted for which results in an overstatement of irrigation value. Assumed acres irrigated 151,525 – derived from the North Central Study result in an annual benefit of $13.03 million.

2. Recreation Benefits.

The state study used visitor days at the reservoirs and along the stream. For the reservoirs it dropped the drought years to estimate visitation in the "with" case and assumed 80%-100% reduction in visitation in the without case. The benefit day values were taken from recognized sources in what has come to known as "benefit transfer" valuation. The methodology is appropriate if care is used in selecting the values to make certain that the activities being valued are significantly similar.

The state study attaches significant values to the riverine recreation. However, the data cited for visitation is too general and does not establish a statistical relationship between water levels and visitation. Recreation ties to non-fishing water supply levels in the river were anecdotal. Without reliable data to tie water supply to habitat, habitat to increased recruitment of fauna and increased populations to increased usage, the estimates would be too unreliable to use for economic justification purposes. Total recreation benefits are estimated at $10.5 to $12.0 million. Substantial off-reservoir recreation was included in the state study including stream fishing, riparian area recreation, big game hunting and upland birds. While reservoir and river fishing probably have sufficient data ties for recreation values, it was felt that the other data were not strong enough to support the changes attributable to hunting and other pursuits along and adjacent to the river corridor that would be attributable with the loss of imported St. Mary's water.

3. Other benefits.

M&I water supply was estimated at $3.3 to $5.4 million annually based on "averting costs." P&G analysis permits the use of avoided or opportunity cost in the measurement of M&I benefits. More extensive analysis is proposed for the future to look at alternative demand and alternative costs. Ecosystem services are proposed for measurement and monetization for inclusion in the NED benefits. As an example, the study cites benefits to wetlands at $4.7 to $6.9 million annually. The study proposes to examine other categories more thoroughly in a future study. The study also includes benefits to underemployed and unemployed resources during and after construction. These are allowed under P&G but are limited to labor employed on site for installation. The study proposes to evaluate these effects further.

APPENDIX B: ST. MARY CANAL REHABILITIATION TYPICAL WORKFORCE ESTIMATES PREPARED BY TD&H

TYPICAL WORKFORCE [1]
ST. MARY CANAL REHABILITATION

- 30 to 40 pieces of equipment with operators including, dozers, excavators, graders, scrapers, loaders, rock trucks, compactors, tractors with disc cultivator, water trucks, fuel and services trucks,

- 6 to 10 laborers performing miscellaneous task,

- 4 to 6 skilled laborers including carpenters, iron workers, and concrete finishers for various reinforced concrete structures,

- 2 grade hops/contractor surveyors

- 3 to 5 administrative staff including superintendent, foremen, QA/QC compliance officer, health and safety officer, administrative assistants,

- Miscellaneous subcontractors and suppliers including redi-mix concrete, aggregates, fencing, etc.

[1] Assumes 4 to 6 miles of earthen canal with typical related structures completed between September and April. Based on recent and on-going projects of similar size and scope.