CHAPTER 7

PROJECT COSTS

7.1 Project Cost Summary

Total project costs were estimated at $193 million in October 1998 dollars. Table 7-1 summarizes project costs within the Fort Peck Indian Reservation at $126 million and project costs within Dry Prairie's service area at $67 million. Non-contract costs total $43 million, 28.82% and 28.18% of contract costs in the Fort Peck and Dry Prairie areas, respectively. General items, minor items and contingencies account for $37 million, 33% of the cost of major construction items for the project as a whole, which is comparable to other regional projects. The following report sections summarize the determination of project costs.

The definitions below summarize the project cost categories:

- **Field Costs** - includes project cost accounts normally part of construction contracts for building the project facilities (Table 7-1). Each contract for construction will include general items, major contract items, and minor contract items. Contingencies will not be a contract item but are also included in field costs for budget purposes.

- **General Items** - includes mobilization, de-mobilization, taxes, bonds and insurance costs. Costs related to recordkeeping by the contractor, preparation of as-built drawings and related overhead expenses are also included.

- **Major Contract Items -** includes the intake on the Missouri River, water treatment plant, pipelines, pumping stations, storage tanks, supervisory control and data acquisition (SCADA) instrumentation, and operation and maintenance buildings.

- **Minor Contract Items** - includes tees, air relief valves, drains, isolation valves, highway crossings, railroad crossings, stream crossings and upgrades of existing electrical distribution systems to accommodate pumping stations. In this case, an inventory of minor items was conducted but may not have included all minor costs. From 85% to 90% of minor costs was considered part of the inventory. Other minor costs remained unlisted.

- **Unlisted Items** - Unlisted items are minor items that were not inventoried in the preparation of the project cost estimates. Unlisted items were computed at 12 percent of the minor field items and were intended to represent costs for flow and pressure control devices, vaults, canal crossings and other items that were not addressed in the cost estimates for minor contract items and were not specifically listed.

- **Contract Costs** - the sum of field costs before including contingencies and intended to represent the full amount of the budget for construction of all project facilities. In the definition presented here, easement costs are also included although a cost *in support* of construction rather than an *actual* construction cost.

TABLE 7-1

TOTAL PROJECT COSTS - FORT PECK / DRY PRAIRIE

		Fort Peck			Dry Priarie			
Project Cost Accounts	**Units**	**Quantity**	**Unit Price**	**Total Cost**	**Quantity**	**Unit Price**	**Total Cost**	**Combined Cost**
Contract Items								
General Items								
Mobilization - Demobilization	L.S.	- -	- -	$1,613,000	- -	- -	$879,000	$2,492,000
Taxes. Bonds & Insurance	L.S.	- -	- -	3.226.000	- -	- -	879.000	4.105.000
General Requirements	L.S.	- -	- -	806,000	- -	- -	439,000	1,245,000
Subtotal General				$5.645.000			$2.197.000	$7.842.000
Major Contract Items								
Intake	L.S.	1	$2.379.700	$2.380.000	0	- -	0	$2.380.000
Water Treatment Plant	L.S.	1	14,438,000	14,438,000	0	- -	0	14,438,000
24" Welded Steel / Ductile Iron Pipe	L.F.	128.244	58.09	7.450.000	0	58.09	0	7.450.000
20" Welded Steel / Ductile Iron Pipe	L.F.	0	46.30	0	0	46.30	0	0
18" Welded Steel / Ductile Iron Pipe	L.F.	0	41.27	0	0	41.27	0	0
16" Welded Steel / Ductile Iron Pipe	L.F.	158.656	34.53	5.478.000	0	34.53	0	5.478.000
14" PVC Pipe	L.F.	278,257	27.49	7,649,000	94,983	17.75	1,686,000	9,335,000
12" PVC Pipe	L.F.	75.490	19.50	1.472.000	206.370	12.48	2.575.000	4.047.000
10" PVC Pipe	L.F.	0	16.19	0	145.413	10.33	1.502.000	1.502.000
8" PVC Pipe	L.F.	222,082	10.28	2,283,000	409,629	6.58	2,695,000	4,978,000
6" PVC Pipe	L.F.	683.515	7.40	5.058.000	766.572	4.72	3.618.000	8.676.000
4" PVC Pipe	L.F.	541,941	4.40	2,385,000	1,269,576	2.79	3,542,000	5,927,000
3" PVC Pipe	L.F.	1.312.766	3.28	4.306.000	1.994.573	2.08	4.149.000	8.455.000
2" PVC Pipe	L.F.	3.834.809	2.61	10.009.000	5.077.347	1.65	8.378.000	18.387.000
Transmission Pumping Stations	L.S.	7	480,000	3,360,000	13	196,846	2,559,000	5,919,000
Branch Pumping Stations	L.S.	41	98.463	4.037.000	49	81.531	3.995.000	8.032.000
Reservoirs	L.S.	2	1,320,500	2,641,000	2	1,196,000	2,392,000	5,033,000
SCADA	L.S.	48	12.000	576.000	62	12.000	744.000	1.320.000
O and M Buildings	L.S.	1	1.000.000	1.000.000	1	1.000.000	1.000.000	2.000.000
Subtotal Major Items				$74,522,000			$38,835,000	$113,357,000
Minor Contract Items								
Easements								
Donation	L.F.	4.341.456	$0.00	$0	7.473.347	$0.00	$0	$0
Fair Market	L.F.	2,894,304	0.23	666,000	2,491,116	0.29	722,000	1,388,000
Tees	EA.	835	284	237.000	1.175	162	190.000	427.000
Air Relief Valves	EA.	261	3,751	979,000	359	2,997	1,076,000	2,055,000
Drains	EA.	280	2.218	621.000	382	1.639	626.000	1.247.000
Isolation Valves	EA.	393	952	374.000	500	566	283.000	657.000
Rural Meter Pits	EA.	2,701	750	2,026,000	1,550	750	1,163,000	3,189,000
Road Crossings	L.F.	13.566	33.69	457.000	17.344	22.77	395.000	852.000
Railroad Crossings	L.F.	2,244	45.45	102,000	8,874	22.20	197,000	299,000
Stream Crossings	L.F.	3.366	49.61	167.000	5.406	22.01	119.000	286.000
Electrical Distribution	L.S.	1	500.000	500.000	1	500.000	500.000	1.000.000
Unlisted Minor Items	%	12%	–	656,000	12%	–	546,000	1,202,000
Subtotal Minor Items				$6.785.000			$5.817.000	$12.602.000
Total Contract Cost				$86.952.000			$46.849.000	$133.801.000
Contingencies	%	12.5%		10.869.000	12.5%		5.856.000	$16.725.000
Total Field Cost				$97,821,000			$52,705,000	$150,526,000
Non Contract Costs								
Environmental Mitigation	%	- -	0.50%	$489.000	- -	0.50%	$264.000	$753.000
Reclamation Oversight	%	- -	4.00%	3.913.000	- -	4.00%	2.108.000	6.021.000
Administration								
Easement Acquisition	%	- -	2.68%	2.621.000	- -	1.44%	759.000	3.380.000
Construction Contracts	%	- -	0.38%	374,000	- -	0.72%	379,000	753,000
Accounting	%	- -	1.10%	1.078.000	- -	0.52%	274.000	1.352.000
Legal	%	- -	0.36%	350.000	- -	0.67%	353.000	703.000
Sponsor Coordination/Training	%	- -	1.86%	1,824,000	- -	2.65%	1,397,000	3,221,000
Non-Labor Costs	%	- -	3.19%	3.118.000	- -	2.93%	1.544.000	4.662.000
Pre-Construction Investigations								
Value Engineering/Feasibility	%	- -	1.00%	978.000	- -	1.00%	527.000	1.505.000
Environmental Compliance	%	- -	0.50%	489.000	- -	0.50%	264.000	753.000
Professional Coordination	%	- -	0.25%	245,000	- -	0.25%	132,000	377,000
Design Surveys and Geotechnical	%	- -	0.75%	734.000	- -	0.75%	395.000	1.129.000
Design	%	- -	5.25%	5,136,000	- -	5.25%	2,767,000	7,903,000
Construction Inspection	%	- -	7.00%	6.847.000	- -	7.00%	3.689.000	10.536.000
Total Non-Contract Costs			28.82%	$28.196.000		28.18%	$14.852.000	$43.048.000
Total Project Costs before Value Engineering				$126.017.000			$67.557.000	$193.574.000
Value Engineering Savings				530,000			284,000	814,000
Total Project Costs after Value Engineering				$125.487.000			$67.273.000	$192.760.000
Total General, Minor Items and Contingencies				$23,299,000			$13,870,000	$37,169,000
% of Major Items				31%			36%	33%

- **Contingencies** - Contingencies, in the context of the determination of pre-construction costs, were intended to represent an addition to quantities and unit prices of major and minor field items to provide greater certainty in the cost estimates for budgeting by the sponsors, federal, state and local agencies. Contingencies as used here are comparable, but not equivalent to, design-level contingencies that are intended to account for unforeseen circumstances during construction, such as unusual soil conditions, the discovery of a cultural site or extreme weather.

- **Non-Contract Costs** - Non-contract costs are part of the project costs not related to the construction contracts or construction budgeting. Non-contract costs include the mitigation of environmental impacts to comply with commitments made by the sponsors pursuant to the National Environmental Policy Act (NEPA); federal oversight; project administration; during-construction investigations, such as special studies to evaluate alternatives for reducing construction costs of a particular project component, the preparation of supplemental environmental assessments based on project conditions not initially contemplated or not sufficiently well-defined and value engineering; geotechnical and other investigations in support of design; preparation of plans and specifications by a design engineer; and field inspection of construction to insure conformance with plans and specifications.

- **Project Costs** - Project costs are the sum of the field and non-contract costs and constitute the total budget for all project activities through the construction phase of the project to be funded by federal, state and local sources. Project costs do not include post-construction activities of operation, maintenance and replacement.

7.2 River Intake

The location of the river intake was selected based on impact of location on cost of the main transmission pipeline. The chosen location provides the lowest life-cycle cost. Life-cycle costs of moving the intake and water treatment plant to the west increase by an estimated $23.1 million.[1] The selected intake location is not specific nor definite but is attached to a segment of the Missouri River between Poplar at the eastern end and an undefined stretch of River to the west, but not extending beyond Wolf Point. In this segment total project costs of all facilities and the present value of future electrical costs are lower than at intake points to the east or west.

Costs of alternatives for intake siting are strongly influenced in this project by the structure of demands. While Glasgow represents a large demand on the west side of the project, demands for Wolf Point, Poplar, Scobey, Plentywood and Culbertson dominate the middle and east side of the project. Larger pipelines for longer distances are required with intake near Glasgow. Similarly, if the

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[1] Assiniboine and Sioux Tribes and Dry Prairie Rural Water, December 7, 2001, *Accountability Report on Value Engineering, Fort Peck Reservation Rural Water System: Assiniboine and Sioux RWS and Dry Prairie RWS*, Watson Engineering, Inc, Helena, Montana, p. 3.

intake is moved eastward from Poplar, larger pipelines for longer distances are required than with the intake near Poplar. An intake near the center of the main transmission line, rather than on one of the southern corners results in the shortest length of larger diameter pipelines, the most significant cost item in the project. The least costs result with a centrally located intake because demand flows can be split to the east, west and north at relatively short distances from the intake and water treatment plant. With intake and water treatment plant near the project corners (east or west), larger flows must travel greater distances to reach the center of the project resulting in a higher proportion of larger pipelines and larger pumping stations.

The proposed intake is typical of any intake to be constructed on the Missouri River, and the costs are applicable at Poplar or at any alternate location along the described reach of the River. The intake will consist of screens placed in the bed of the stream to draw water directly from the River. The screens will be designed to limit intake velocities to such low rates that the risk of impinging fish in their minnow stages will not constitute a serious fishery concern. Design velocities will be limited to 0.25 to 0.50 fps and will be subject to approval by state and federal fishery agencies. The intake screens will be placed in a pre-designed sump.

Observations of the River immediately south of the community of Poplar have resulted in determinations that the thalweg, or deepest part of the stream, can generally be reached over a distance of 150 feet. From the intake screen (placed in the thalweg[2]) to the bank, a 42 in. raw water pipeline will be built in a pre-designed trench that will be excavated using equipment on a barge. Water will be conveyed in the 42 in. raw water pipeline to a wet-well structure at a desirable location above the 100 year floodplain level (or to a protected area in the floodplain "fringe"). The gradient of the 42 in. raw water pipeline will be set to deliver water from the screens to the wet-well by gravity without the employment of pumping facilities. Consideration will be given to a siphon design, which will reduce the requirements for trenching and will operate by gravity given priming at the top of the siphon configuration. Direct gravity flow without siphon action is the most desirable intake from the standpoint of operation. Siphons are sensitive to loss of vacuum but are more cost-effective if properly constructed and maintained.

The wet-well structure will be located mid-way between the River bank and the water treatment plant, a total distance in the Poplar area of 1,600 feet. Based on terrain in the area, it was estimated that the base of the wet-well would be excavated to a depth of as much as 30 feet below the surface to permit gravity flow from the Missouri River to the wet-well. The wet well will be constructed with a diameter of approximately 15 feet to accommodate vertical turbine pumps placed in the wet well to lift raw water to the water treatment plant. The pumping units will be housed in a facility with heat and ventilation that will be equipped with cranes to remove and repair the pumping units. The pumping station will also be equipped with air to be delivered in small diameter pipe (3 in.) to the screens in the River to maintain them free of debris for continuous unimpaired operation.

[2]An artificial, protected sump on the River bank may be considered for locating the intake screens to remove them from the natural channel in order to minimize exposure to heavy debris and shifting bed.

The intake system from the water treatment plant to the screens will also be equipped with chemical feed (potassium permanganate solution) to oxidize particles taken into the intake that would contribute to taste and odor and, further, to reduce potential for trihalomethane formulation in the disinfection process at the treatment plant. The chemicals will be placed in the intake to allow time for mixing and chemical reaction prior to raw water entering the treatment plant.

Costs of the intake as described are presented in Table 7-2. In the event the wet-well or treatment plant were sited at an alternate location to the chosen site south of Poplar, some variation in distance from the River bank to the wet-well and from the wet-well to the treatment plant would be expected. At the Poplar site, for example, movement of the wet-well or water treatment plant to a location further north would increase the cost of the intake but decrease costs of the 24 in. finished water pipeline leaving the treatment plant. The 42 in. raw water intake will be constructed of low-pressure materials, probably polyethylene or other nonmetallic material, between the River and the wet-well. Therefore, any extension of the raw water intake will be partially offset by reduction in the length of high-pressure welded steel or ductile iron pipe leaving the water treatment plant. The unit costs of the raw water pipeline may be reduced significantly by combining the contract for raw water pipeline with the construction of finished water pipeline leaving the water treatment plant. This would increase the quantity of pipeline construction and decrease unit prices. The unit prices as presented in Table 7-2 were based on a contract for a small amount of large diameter pipe.

TABLE 7-2

RIVER INTAKE FIELD COSTS

Item	Units	Quantity	Unit Price	Total Price
Intake Screens	Each	6	15,500	93,000
42" Tee	LS	1	150,000	150,000
River Sump, Fabric, RR	LS	1	80,000	80,000
42" Raw Water Pipe In River	ft	150	400	60,000
42" Raw Water Pipe Buried	ft	1,450	350	508,000
Wet Well Structure	LS	1	470,000	470,000
Pump Station, 9133 gpm	LS	1	900,000	900,000
Air and Permanganate				0
2" PP Pipes	ft	1,600	12.00	19,000
3" Air Pipe	ft	800	25.00	20,000
Air Vault, Electrical	LS	1	70,000	70,000
Buoys	LS	1	10,000	10,000
Field Cost				$2,380,000

7.3 Water Treatment Plant

Micro filtration, media filtration or a conventional water treatment plant are proposed alternatives for the project as described in Section 6.2. Pilot studies will be conducted to the extent necessary to make final determinations of the most cost effective water treatment plant.[3] Section 4.7.6 describes in more detail the sizing of the water treatment plant at 13.63 million gallons per day (10,324 gallons per minute entering the distribution system).

The cost estimate for this project's treatment plant was made by comparison of costs of other treatment plants on the Missouri River and throughout the region. This was considered a superior approach to a more detailed cost estimate derived from generalized estimating criteria. Detail in the Accountability Report is not considered adequate or reliable without more investigation.[4] Table 7-3 summarizes the costs of other treatment plants in the region that involve comparable treatment processes. All construction contracts in Table 7-3 were indexed to October 1998 prices. Size of water treatment plants range from a 70,000 gallon per day plant at Twin Buttes, North Dakota, to a 13.4 million gallon per day plant for the Mni Wiconi Project in South Dakota. Projects are included in the Missouri River Basin of Montana, North Dakota, South Dakota and Wyoming and in states outside the Missouri River Basin, including Texas and Oklahoma.

TABLE 7-3

REGIONAL WATER TREATMENT PLANT
CONSTRUCTION COSTS ADJUSTED TO OCTOBER 1998 DOLLARS

Project	Year Constructed	Capacity (mgd)	Label	Construction Contract	Cost Index (Oct)	Cost Index (Oct 98)	Adjusted Construction Contract (Oct 98)
Twin Buttes, ND	1991	0.07	1	875,000	185	227	1,074,000
Neihart, MT	1997	0.13	2	800,000	224	227	811,000
Mandaree, ND	1991	0.18	3	854,000	185	227	1,048,000
Four Bears, ND	1991	0.29	4	1,570,000	185	227	1,926,000
White Shield, ND	1991	0.29	5	1,380,000	185	227	1,693,000
Seeley Lake, MT	1997	0.67	6	1,900,000	224	227	1,925,000
Culbertson, MT	1994	1.00	7	1,290,000	197	227	1,486,000
Red Lodge, MT	1994	1.44	8	1,700,000	197	227	1,959,000
Benbrook, TX	1995	2.50	9	4,270,000	206	227	4,705,000
Hoquiam, OK	1995	4.00	10	4,420,000	206	227	4,871,000
Big Goose, WY	1994	4.40	11	6,130,000	197	227	7,064,000
WEB, SD	1983	7.50	12	7,747,000	154	227	11,419,000
Oahe, ND	1994	9.00	13	9,920,000	197	227	11,431,000
Ten Mile, MT	1995	9.00	14	9,500,000	206	227	10,468,000
Mni Wiconi, SD	1997	13.40	15	17,200,000	224	227	17,430,000

[3] See note 1, *supra*, pp 7, *et seq.*

[4] *Ibid*.

Figure 7-1 presents the relationship between October 1998 construction costs and capacity of treatment plant. A linear relationship fits the data points best, as shown in Table 7-4, and provides a basis for predicting the costs of the treatment plant south of Poplar at $17.38 million for the 13.63 million gallon per day treatment plant proposed for this project.

TABLE 7-4

WATER TREAT MENT PLANT COST PREDICTIONS
(13.63 Million Gallons per Day, MGD)

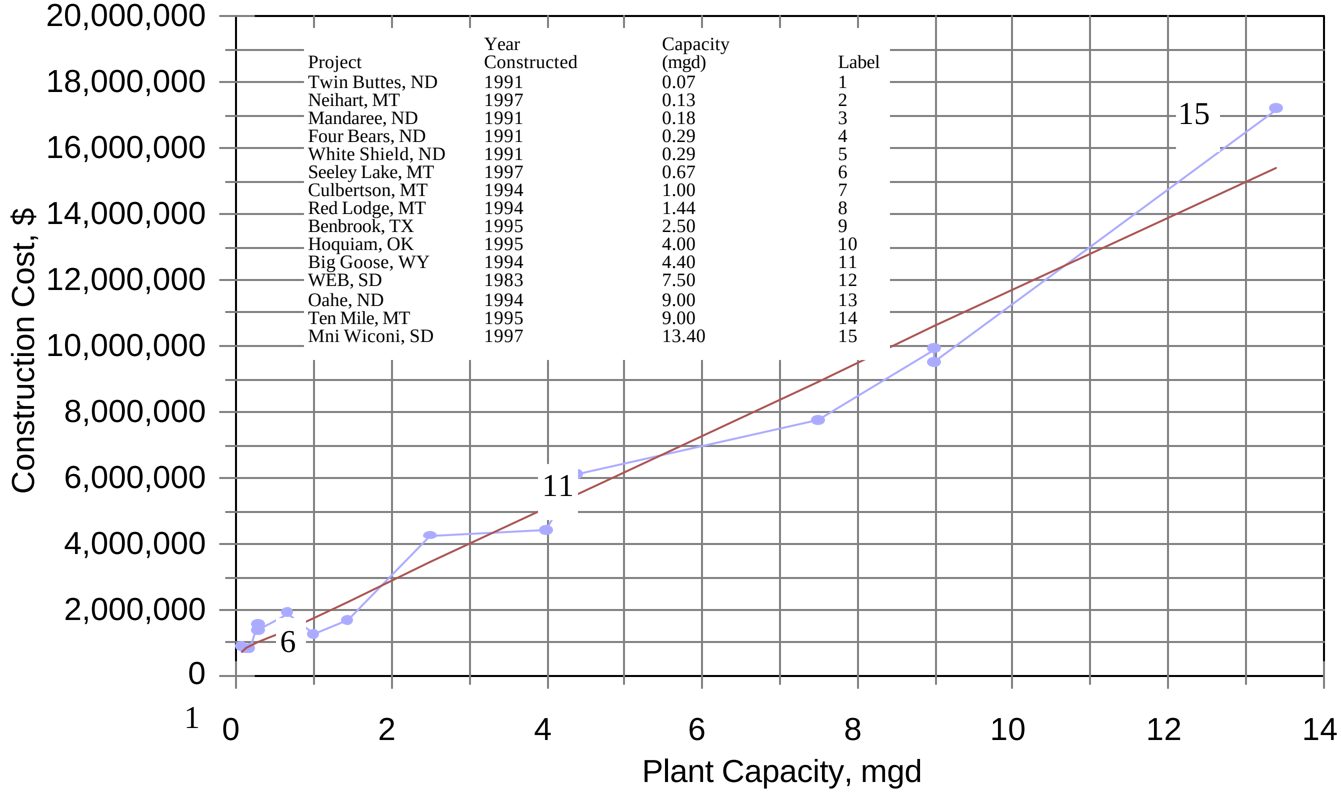
Form	Regression Equation		Regression Coefficients A	B	C	R^2	Predicted Field Cost
Linear	WTP Field Cost =	A + B x MGD	960,752	1,204,706	–	0.978	$17,379,690
Quadratic	WTP Field Cost =	A + B x MGD + C x MGD^2	974,441	1,191,223	1,176	0.976	17,427,998
Exponential	WTP Field Cost =	A x MGD^B	2,868,564	0.559	–	0.890	12,340,167

As will be in shown in the following section on pipe prices, there is a significant difference between labor rates in Montana and some surrounding states, including North Dakota and South Dakota. Federal prevailing wage rates in Montana are higher than in those states. Therefore, in addition to differences in treatment plants related to site conditions, processes and other factors affecting comparability, examination of the cost relationship is needed to determine if project costs in Montana are higher than costs in South Dakota, for example. The small project at Neihart does not produce a data point above the linear relationship. Project costs at Seeley Lake (label 6) are slightly above the average for the size of plant, but the treatment plant at Culbertson (label 7), a community within the project area, has a construction cost below the average for its size of plant. Treatment plants in Red Lodge (label 8) and Helena (label 14) also have costs below the average relationship. The water treatment plant for the WEB Project in South Dakota (label 12), falls below the average relationship (as expected if labor rates between states are a significant factor), but the treatment plant for the Mni Wiconi Project in South Dakota has costs that are above the average relationship for treatment plants of its size, a size comparable to the treatment plant proposed for this project. There is no clear relationship between projects in the states of the region that could be attributed to labor rates. Site conditions and the functions performed by the water treatment plant are probably greater factors than labor rates. The Mni Wiconi Project costs, for example, include the cost of the first major pumping station in that project, the costs of the sludge lagoons and costs of environmental mitigation related to the treatment plant but not part of the basic facilities. Other treatment plants included in the relationship may or may not include comparable components.

The costs of the treatment plant predicted by the relationship displayed in Figure 7-1 are field costs and include all mobilization, taxes, insurance, bonds, general overhead and contingencies that are used to build the cost estimates presented in Table 7-1. For consistent presentation of cost estimates, it was necessary to back out the above listed costs (19.5%) to arrive at the cost estimate of $14.438 million presented in Table 7-1. When costs of mobilization, taxes, insurance, bonds, general overhead and contingencies are re-applied, the total field cost of the water treatment plant is reproduced at the $17.38 million level.

WATER TREATMENT PLANT COSTS

1998 DOLLARS



(Linear Fit)

Cost =960,752 + 1,204,706 x mgd

FIGURE 7-1

7.4 Unit Pipe Prices

7.4.1 Introduction and Summary

This section of the chapter summarizes unit pipe prices and their derivation. The cost of constructing pipelines is the largest single cost in the project, accounting for $65 million of the total project cost as presented in Table 7-1. Project costs are sensitive to the unit prices of pipe. Tables 7-5a and 7-5b summarize the selected unit pipe prices in October 1998 values. Table 7-6 compares selected unit pipe prices with Bureau of Reclamation estimates for this project. Comparison with bid prices received by the State in the project region in August 2000 is also presented.

The methodology of arriving at unit pipe prices involved examination of bidding on projects in South Dakota, namely the Mni Wiconi and Mid-Dakota Projects. The chief difference between projects building in South Dakota and projects in Montana, however, is the difference in prevailing wage rates in the two states. It will be shown that prevailing wage rates in South Dakota for labor classifications used in a rural water project of the type proposed for Fort Peck and Dry Prairie are half (or less than half) of the prevailing wage rates in Montana.

As shown in Tables 7-5a and 7-54b, different unit prices were derived for the Fort Peck Indian Reservation and Dry Prairie. Experience in South Dakota demonstrates that contractors are bidding at higher rates on the Indian reservations than outside them. Part of the price difference is due to wage rate differences on South Dakota reservations as contrasted with the rest of the State, part is due to remoteness of the reservations, part is due to preference provisions in construction contracts and part is due to lack of competition between a smaller set of contractors bidding on the reservations than on comparable projects outside the reservations. Contractor perceptions of risk related to dispute resolution and tribal courts and perceptions regarding the availability of qualified labor force may also contribute to higher prices. While many of the reasons for differences in unit pipe prices on and off the South Dakota Indian reservations may be dissipated with experiences of contractors on the large projects underway in that State, the historic differences have been applied here to insure conservatism. In actual practice, the Fort Peck Tribes have been strong advocates of the proposed project, the major project components are to be built along U.S. Highway 2 with access to rail for material deliveries, and the cooperation among sponsors in the project area has been a positive factor. The tribal council has taken steps throughout project planning to insure the integrity of the project for its membership and has also taken steps to accommodate Dry Prairie and federal and state guidance as necessary for project implementation. There may be little if any actual difference in pipe prices between Fort Peck and Dry Prairie in the course of this project.

TABLE 7-4a

WEIGHTED UNIT PIPE PRICE BY DIAMETER
FORT PECK INDIAN RESERVATION

		Total Costs Per Foot								
		AWWA C-905 DR 41 100	AWWA C-905 DR 25 165	AWWA C-905 DR 18 235	AWWA C-900 DR 18 150	AWWA C-900 DR 14 200	ASTM D2241 SDR 26 160	ASTM D2241 SDR 21 200	ASTM D2241 SDR 17 250	
Nominal Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00	Selected Price
1.5	--	--	--	--	--	--	--	--	--	
2	--	--	--	--	--	--	2.21	2.48	2.80	2.61
3	--	--	--	--	--	--	2.99	3.42	3.98	3.28
4	--	--	--	--	5.77	7.02	4.07	4.70	5.46	4.40
6	--	--	--	--	9.52	11.60	6.83	7.98	9.33	7.40
8	--	--	--	--	12.63	15.52	8.73	10.29	12.19	10.28
10	--	--	--	--	18.16	22.26	12.78	15.07	17.84	16.19
12	--	--	--	--	21.70	26.74	15.06	17.87	21.28	19.50
					--	--	--	--	--	
14	--	15.68	23.66	31.31	--	--	--	--	--	27.49
16	34.53	30.47	40.55	51.22	--	--	--	--	--	34.53
18	41.27	--	--	--	--	--	--	--	--	41.27
20	46.30	--	--	--	--	--	--	--	--	46.30
24	58.09	--	--	--	--	--	--	--	--	58.09

TABLE 7-4b

WEIGHTED UNIT PIPE PRICE BY DIAMETER
DRY PRAIRIE

		Total Costs Per Foot								
		AWWA C-905 DR 41 100	AWWA C-905 DR 25 165	AWWA C-905 DR 18 235	AWWA C-900 DR 18 150	AWWA C-900 DR 14 200	ASTM D2241 SDR 26 160	ASTM D2241 SDR 21 200	ASTM D2241 SDR 17 250	
Nominal Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00	Selected Price
1.5	--	--	--	--	--	--	--	0.00	0.00	
2	--	--	--	--	--	--	1.40	1.56	1.77	1.65
3	--	--	--	--	--	--	1.90	2.17	2.52	2.08
4	--	--	--	--	3.65	4.45	2.58	2.98	3.46	2.79
6	--	--	--	--	6.07	7.40	4.36	5.09	5.95	4.72
8	--	--	--	--	8.08	9.93	5.59	6.59	7.81	6.58
10	--	--	--	--	11.59	14.20	8.16	9.62	11.38	10.33
12	--	--	--	--	13.89	17.11	9.64	11.43	13.61	12.48
					--	--	--	--	--	
14	--	10.13	15.28	20.22	--	--	--	--	--	17.75

In order to reflect the difference between Montana and South Dakota prevailing wage rates, it was necessary to separate unit pipe prices into basic components. Those components included material prices, equipment costs for excavating or trenching, labor costs for installing pipe and operating excavation equipment and overhead and profit. These basic costs were derived for pipe diameters ranging from 2 inches to 24 inches and for pressure classes ranging from 150 to 350 pounds per square inch (psi). Specifications for ASTM, AWWA and welded steel or ductile iron were considered. Following a trial division of pipe prices into its components, each pipe cost was calibrated to experience in South Dakota on-Reservation and off-Reservation. Part of the calibration process involved application of prevailing wage rates to basic assumptions on labor and productivity. Assumptions were also made with respect to reductions in material, equipment, and overhead and profit rates to match the experience in South Dakota. Following calibration to South Dakota pipe prices, all assumptions respecting material prices, equipment costs and overhead and profit were maintained, and Montana wage rates were applied to arrive at Montana unit pipe prices.

Selected pipe sizes were derived through a process of optimization designed to minimize the present value of pipeline and pumping station construction, operation, maintenance and replacement costs. The methodology is described further in Chapter 4.

In addition to the selected prices presented in Table 7-5a and 7-5b, Bureau of Reclamation estimates for this project are presented for comparison in Table 7-6. Bureau of Reclamation derived estimates based, in part, on experience from bid prices received in communities in the project region. In general, selected prices and Bureau of Reclamation estimates are in reasonably close agreement. Reclamation unit prices are generally less than selected unit pipe prices presented in Table 7-1 for all Dry Prairie pipe prices. Reclamation unit prices are higher than Fort Peck Indian Reservation prices for 18 inch through 24 inch diameters and lower for all smaller diameters.

TABLE 7-6

COMPARISON OF UNIT PIPE PRICES
FROM DIFFERENT SOURCES

Nominal Diameter	Selected		USBR Recommended		Average "Little"
(in)	ASRWS	DPRWS	ASRWS	DPRWS	Fort Peck
2	$2.61	$1.65	$2.48	$1.59	$4.01
3	3.28	2.08	3.00	1.92	4.66
4	4.40	2.79	4.02	2.57	5.70
6	7.40	4.72	6.47	4.14	6.79
8	10.28	6.58	8.72	5.58	9.44
10	16.19	10.33	11.40	7.30	10.28
12	19.50	12.48	14.42	9.22	--
14	27.49	17.75	28.02	17.93	--
16	34.53	19.08	34.16	--	--
18	41.27	--	44.40	--	--
20	46.30	--	49.95	--	--
24	58.09	--	62.16	--	--
30	75.30	--	--	--	--

Bid prices for the "little" Fort Peck Rural Water Project (near Fort Peck Dam, not the Fort Peck Assiniboine and Sioux Rural Water System) received by the State of Montana in August 2000 were also reviewed as presented in Table 7-6. Prices were adjusted downward to reflect October 1998 prices based on cost trends[5] and to reflect a deduction available from the low bidder for award of two bid schedules. After the adjustment, prices bid were significantly higher for the smaller diameters than either the selected unit prices or Bureau of Reclamation estimates. Pipe bid was generally class 160 and class 200, comparable to the pipe classes that reflect the selected prices. The State bid prices were noticeably higher than the selected unit prices for the Assiniboine and Sioux Rural Water System for diameter classes 2 through 4 inches but less for larger diameters. State bid prices were noticeably higher than the selected unit prices for Dry Prairie in all diameters through 10 inch. The State bid prices, however, were for two small schedules with combined pipe value of $931,000. Moreover, crude oil prices reached $34.83 per barrel at the end of August 2000, as compared with $11.13 to $14.78 per barrel in the third quarter 1998[6], and PVC pipe (manufactured from petroleum-based resin) was in short supply and high demand. Cost indices only reflected a 6% difference between periods and are too imprecise to properly reflect differences in unit pipe prices. The State bid prices were not considered representative of prices to be received by the Assiniboine and Sioux or Dry Prairie Rural Water Systems.

Those seeking to review the detailed cost derivations supporting this summary can find greater detail in Appendix C, Volume II. The greater detail was provided in a separate appendix for the reason that (1) pipe costs are the highest major cost item and (2) experience from South Dakota is not only extensive but discloses differences in pricing factors that must be considered here.

7.4.2 Easements Costs

Construction of the pipeline will involve traversing private and public lands on the Fort Peck Indian Reservation and within Dry Prairie. Within the Fort Peck Indian Reservation trust lands owned by the Assiniboine and Sioux Tribes and individual Indians will be crossed by the rural water system in addition to private lands that are no longer in trust status. Within the Dry Prairie region most of the lands are privately held, but the State of Montana owns considerable land in Daniels County, in particular, and there is potential for crossing federal lands at the Medicine Lake Wildlife Refuge and other lands administered by the Bureau of Land Management.

It was assumed that private landowners would provide donation easements for the project due to the benefit they will receive from the delivery of project water. This is a common practice in other projects of this nature within the Great Plains region. The practice off-Reservation has been to permit no exceptions to donation easements. The practice is proposed for this project, both on and off-Reservation, for private owners of fee simple lands.

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[5] U.S. Bureau of Reclamation, April 2000, Construction Cost Trends, <www.usbr.gov/tsc/cost-trend>

[6] <www.eia.doe.gov/oil_gas/petroleum/info_glance/petroleum.html>, Brent Crude, August 31, 2000.

Costs of easements for both trust and public lands were based on fair market value of grazing lands, dry crop lands and irrigated lands. The State of Montana has established fair market value estimates (July 1996) of $200, $350 and $1,250 per acre for grazing, dry crop and irrigated lands in Valley, Daniels, Sheridan and Roosevelt counties as a basis for easement fees for State owned lands[7]. These values were checked against the minimum easement charges required by the Trust Land Management Division, Department of Natural Resources and Conservation, of $440, $744 and $935 per mile for "pipelines" crossing grazing, agricultural and irrigated lands, respectively[8]. For the easement widths proposed for the project, the easement costs would total $848, $1,485 and $5,303 per mile, respectively, based on a permanent 35 foot width and the highest of the cost criteria, namely the fair market value estimate.

A width for construction easement of 75 feet is proposed for this project with permanent easement of 35 feet for operation and maintenance. Easement documents would be proposed that would permit disturbance outside the permanent 35 feet of easement within restricted areas to accommodate the space necessary to repair a pipeline break or for other short-term, confined maintenance activity. Within the permanent easement agricultural activities would be permissible, but no permanent structures, tree planting or other activities that would hinder operations would be permitted. Landowners would be compensated for crop or other damages during construction and for crop or other damages during operation and maintenance activities.

Permanent easements are also proposed for project facilities other than the pipelines. Pumping stations, storage tanks, control facilities would be situated upon lands with permanent easements. Major structures, such as the water treatment plant, intake and maintenance buildings would be located upon lands purchased by the project.

Table 7-7 presents estimates of the distribution of trust lands and private lands within the Fort Peck Indian Reservation and a subdivision of the land ownership types into grazing, dry crop and irrigated acres. A similar presentation is made in Table 7-7 for Dry Prairie that lists State, Federal and private lands by land-use category. The total pipeline distance within the project of 16,846,089 feet was distributed among the ownership and land-use types, and it was determined that a total of 13,536 acres, including 2,327 acres of trust land and 1,930 acres of State lands, would be contained within the permanent 35 foot easement. The cost of easements across the trust and State lands was estimated at $1,382,604.

Easements on Indian trust lands in South Dakota have averaged about $0.15 per foot for 50 foot permanent easements.

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[7] Glasgow Unit Office, July 22, 1996, *Worksheet – Fee Schedule – Easements, Phillips, Valley, Daniels, Sheridan, Roosevelt, McCone and Garfield Counties*.

[8] ARM 36.2.1005, “Minimum Easement Charges.”

TABLE 7-7

ESTIMATED COSTS OF EASEMENTS

Average Construction Easement Width	75	ft
Permanent Easment Width	35	ft

Area/Ownership	Pipe Length (feet)	Grazing Acres	Dry Crop Acres	Irrigated Acres	Total Easement Acres	Total Cost	Unit Cost ($/ft
Fort Peck							
% Area		57%	40%	3%			
Trust	2,896,160	1,326	931	70	2,327	$678,330	0.23
Private	4,344,239	1,990	1,396	105	3,491	Donation	--
Subtotal	7,240,399	3,316	2,327	175	5,818	678,330	--
Dry Prairie							
% Area		50%	40%	10%			
State	2,401,423	965	772	193	1,930	704,274	0.29
Federal	0	0	0	0	0	0	--
Private	7,204,268	2,894	2,315	579	5,789	Donation	--
Subtotal	9,605,690	3,859	3,087	772	7,718	704,274	--
Total	16,846,08	7,175	5,414	946	13,536	$1,382,604	--
Value Per Acre		$200	$350	$1,250			

7.5 Pumping Stations, Storage Tanks, SCADA and Electrical Distribution

Each pumping station in the project will be coordinated with a storage tank and supervisory control and data acquisition (SCADA) equipment. Certain pumping station and storage tank combinations will require improvements in the existing electrical distribution system operated by Northern Electric, Sheridan Electric or Valley Electric, the rural electric cooperatives serving the project area. Cost of these facilities are presented in this section.

7.5.1 Pumping Stations

Pumping station costs from the Mni Wiconi project were also examined as a basis for cost estimating in northeastern Montana. Table 7-8 summarizes costs of nine pumping stations in the Mni Wiconi Project with capacity ranging from 0.5 to 2,000 horsepower. Major cost elements in the pumping stations include (1) site work and structure to house the pumping units and controls, (2) piping, valves and pumping units within the pump house including electrical, heating, ventilation and pump controls and (3) landscaping, fencing and access roads that are not part of the pumping station but are necessary for access and security. Total pump station costs as presented in Table 7-8 range from $41,500 to $1,288,893 from the smallest to the largest pumping station, respectively.

Costs per horsepower generally decline from the smallest pumping station to the largest. In the Mni Wiconi experience, the expected relationship held with the exception of pump stations 5, 6 and 7. These pump stations had extra costs associated with requirements of the National Park Service for facilities placed in the Badlands National Park.

For the current project, the Mni Wiconi Project experience was modified to form a basis for pump station costs as presented in Table 7-9. Total costs for pump stations 1 through 4 were adopted from Mni Wiconi. Total costs for pump stations 5, 6 and 7 were based on $2,000 per horsepower, and total station costs for pump stations 8 and 9 were based on $5,000 per horsepower.[9] The costs of pump stations with capacity less than 160 horsepower were based on pre-assembled pumps stations constructed outside the project and delivered to the project site for installation. Therefore, the costs of labor in assembly of the pump stations would be incurred at a manufacturing plant, either in Montana or elsewhere, and would be at rates applicable to manufacturing rather than construction. Differences between South Dakota and Montana in prevailing wage rates for heavy construction would be applicable but of less impact.

In addition to the costs of the "total pump station", site and structural work were estimated to range from $15,000 to $150,000 per pumping station (Table 7-9). Fencing, landscaping and roads for access to the pumping stations were estimated to range from $10,000 to $15,000 per pumping station. Costs of a completed pumping station were projected to range from $562 to $5,000 per horsepower from a 2,000 horsepower pump station to a 0.5 horsepower pump station, respectively. Note that the range of cost per horsepower for the Fort Peck/Dry Prairie Project is the same as the range for the Mni Wiconi Project but without the anomaly in the Mni Wiconi Project for 25, 7.5 and 2 horsepower pumping stations.

From the data points presented in Table 7-9, equations were developed for predicting pump station costs as follows:

$$\text{Pump Station Costs} = A + B \times \text{Horsepower} + C \times \text{Horsepower}^2$$

Where	A	=	18,560	for 25 horsepower or less
	B	=	13,710	
	C	=	-350.9	
	A	=	164,768	for more than 25 horsepower
	B	=	695.303	
	C	=	-0.06701	

[9]This represents a significant departure from experience in Mni Wiconi (OSRWSS). OSRWSS was not considered representative for pump stations 5, 6 and 7. Site conditions were special at these sites. Also, OSRWSS moved from site-constructed to pre-constructed pump stations for the sizes of pump stations 5 and smaller as a cost control measure. Pre-constructed pump stations are less costly due to the assembly line process of the manufacturer. Unfortunately, the larger more complicated pump stations are not subject to prefabrication in a controlled, central setting.

TABLE 7-8

MNI WICONI PUMP STATION COSTS

Pump Station Name	Pump Station Name	Pump Station Size (hp)	Site Work/ Structure	Piping/ Valves/ Turbines	Electrical/ Heating/ Ventilating Controls	Total Pump Station	Fence/ Landscape/ Roads	Total	Total Station Per HP
Core Pipeline Pump Sta. No.	Pump Station 1	2,000.0	149,000	805,000	318,393	1,123,393	16,500	1,288,893	562
Kadoka South Pump Sta. No 1	Pump Station 2	500.0	150,000	--	--	355,000	15,000	520,000	710
Evergreen Pump Station	Pump Station 3	240.0	196,560	107,000	122,800	229,800	5,000	431,360	958
Porcupine Pump Station	Pump Station 4	160.0	196,600	98,000	122,000	220,000	5,000	421,600	1,375
Red Shirt 1	Pump Station 5	25.0	100,000	95,000	53,000	148,000	18,000	266,000	5,920
Red Shirt 3	Pump Station 6	7.5	84,000	37,500	48,000	85,500	11,100	180,600	11,400
Red Shirt 2	Pump Station 7	2.0	85,000	37,500	46,000	83,500	12,710	181,210	41,750
Red Shirt Residential	Pump Station 8	1.0	27,500	5,000		5,000	12,000	44,500	5,000
Cuny Table Residential	Pump Station 9	0.5	27,000	2,500		2,500	12,000	41,500	5,000

TABLE 7-9

PUMP STATION COSTS
FORT PECK/DRY PRAIRIE

Pump Station Name		Pump Station Size (hp)	Site Work/ Structure	Total Pump Station	Fence/ Landscape/ Roads	Fort Peck Total	Total Station Per HP
Pump Station 1	Field Constructed	2,000.0	150,000	1,123,393	15,000	1,288,393	562
Pump Station 2	"	500.0	100,000	355,000	15,000	470,000	710
Pump Station 3	"	240.0	100,000	229,800	15,000	344,800	958
Pump Station 4	"	160.0	90,000	220,000	12,000	322,000	1,375
Pump Station 5	Pre-Fabricated	25.0	80,000	50,000	12,000	142,000	2,000
Pump Station 6	"	7.5	75,000	15,000	12,000	102,000	2,000
Pump Station 7	"	2.0	30,000	4,000	10,000	44,000	2,000
Pump Station 8	"	1.0	15,000	5,000	10,000	30,000	5,000
Pump Station 9	"	0.5	15,000	2,500	10,000	27,500	5,000

Predicted values from the equation given above are nearly the same or higher than the estimated costs (actual data points used to derive the equation) in Table 7-9 except for pumping stations with horsepower of 160, which has a predicted cost of $274,000 (versus $322,000 in Table 7-9) and stations of 240 horsepower with a predicted cost of $328,000 (versus $344,800 in Table 7-9). The difference in predicted and estimated costs was considered significant for pump stations of that size but not significant in the overall project cost estimate. Figure 7-2 presents a graphical representation of the cost of pump stations separated into the major elements of cost. In actual practice, the pre-fabricated pumps stations would include the costs of the structural housing in the estimate of "total pump station" costs. Some consideration may also be given to the building of accessible "trails" to pump stations as distinguished from gravel roads and to less secure fencing that chain link as a potential cost-saving measure. The costs as currently estimated include the conservative estimates of housing costs and the assumption of gravel roads and chain link fencing.

On-site and pre-fabricated pumping stations will typically include four pumping units: a pumping unit with half maximum day demand capacity, a backup pumping unit with half maximum day demand capacity, and two pumping units with 1/4 maximum day demand capacity. Only one of the larger pumping units would operate at any one time. In the event of the failure of any two of the three operating pumping units it would be possible to deliver maximum day demand. The pre-assembled pumping stations are normally delivered to the site in their final constructed condition, including housing. They are then unloaded and placed in-line for both water and power. With completion of site work and attachment to a field-constructed foundation, they are ready to operate.

Pumping station structures will be equipped with heating and ventilation equipment and with smooth nose sampling taps. The stations may also serve as injection points for the maintenance of residual disinfectant (chloramine) levels that will diminish with distance from the water treatment plant. Safe chemical storage would be provided with each facility. Costs are considered adequate to incorporate disinfectant injection.

More detail on pumping stations is available in the attachments to Appendix B, Volume II.

7.5.2 Storage Tanks

Storage tanks would be provided at each pumping station in the project. The purpose of the storage tanks is to provide a source of water at the suction end of the pumping station to improve operation. When the pumping station is seeking more flow than the upstream pipeline can provide, the storage tank is available to supply additional water. Moreover, storage tanks will conserve usable storage for use during peak periods of the day. The location of storage tanks at pump stations is not necessary. In some cases, a storage tank would be better located at a high point between pumping stations. In most cases, however, the upstream pumping station would be at a lower elevation than the downstream pumping station, and the intervening terrain would be gradually rising.

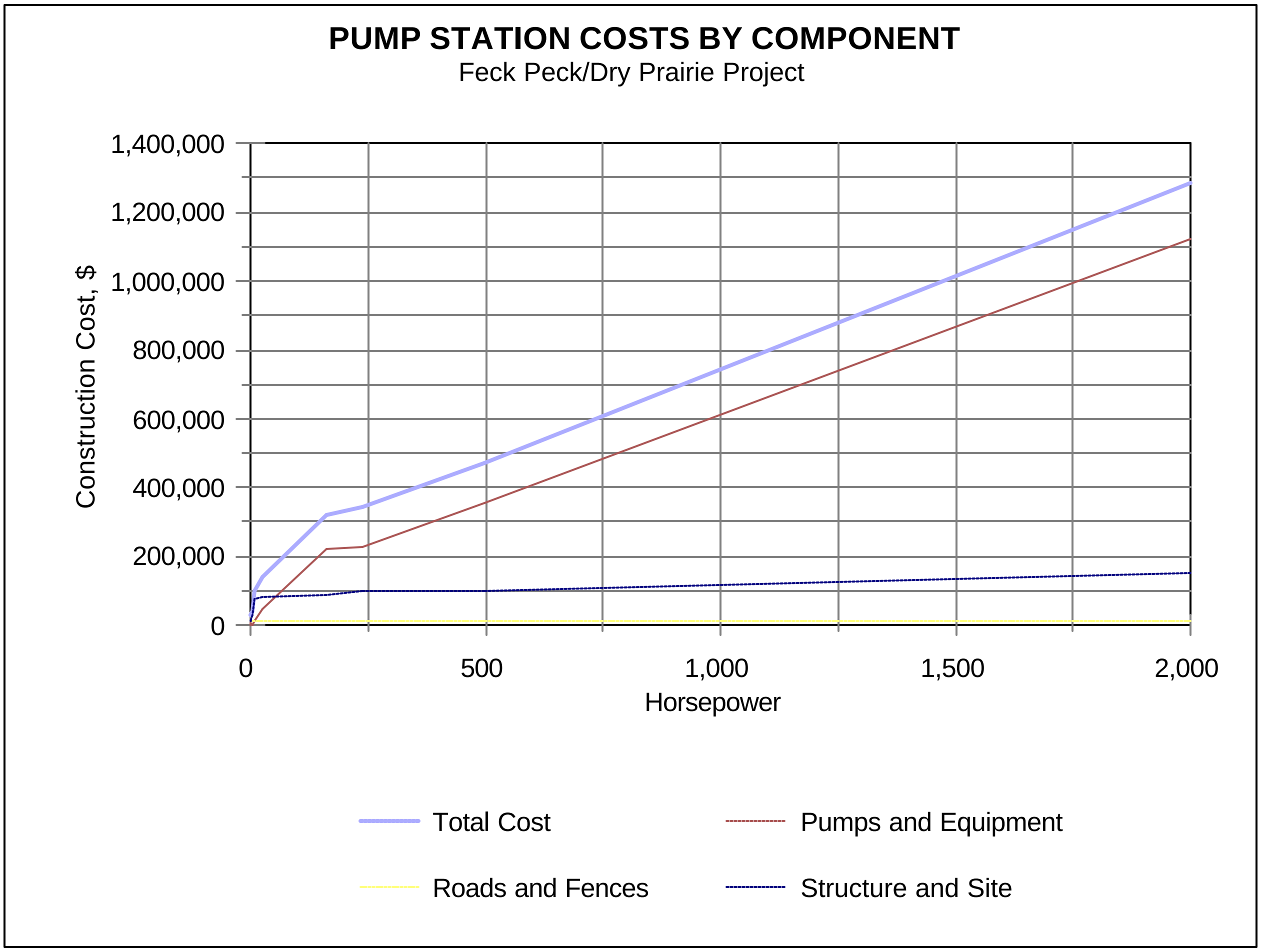

FIGURE 7-2

On the main transmission lines storage in the amount of 1,095,960 gallons was provided at the first pumping station to deliver water during two hours of back wash time at the water treatment plant at the maximum day rate. Criteria for other storage tanks on the transmission lines of the project (not the branch lines) will provide six hours of difference between (a) peak hour demand for the rural household connections between pumping stations and (b) maximum day flow. Storage for an additional hour at one-third of the maximum day flow rate was also provided for operational enhancement of pump performance. These criteria produce a requirement for 2,766,560 gallons of storage along the main transmission line that connects Glasgow to Culbertson on the south, Culbertson to Plentywood on the east, Plentywood to Scobey and Opheim on the north and to Glasgow to St. Marie on the west (Table 7-10). The main transmission line also connects Wolf Point with Scobey.

The preliminary design of the transmission line provides all water to Plentywood from Culbertson and all water to Opheim from Scobey and results in storage requirements at Plentywood of approximately 145,000 gallons and at Opheim of 37,000 gallons. Project storage from the main transmission system will supplement existing storage in the project communities.

The branch lines are currently designed with the hydraulic model for peak hour flows. The pipelines have been sized to carry peak hourly flows that do not require supplements from storage. The criteria described above for improved operation of the pumps generally requires much less than 5,000 gallons. On this basis, a determination was made to provide a minimum of 5,000 gallons in storage tanks at each branch line pumping station. A total of 915,000 gallons would be provided at the 89 small, booster pumping stations on the branch lines. This determination may be revisited as more detailed plans are made for the creation of fire service districts in the rural areas.

Costs of storage tanks were derived from experience in South Dakota as presented in Table 7-11. Five (5) elevated tanks and twelve (12) ground level storage tanks have been bid in the Mni Wiconi Project with costs (indexed to October 1998) ranging from $0.76 to to $2.61 per gallon. Cost per gallon vary from the higher end of the range for small storage tanks to the lower end of the range for larger storage tanks. In general elevated tanks are more costly than comparably sized ground level storage tanks. For the purposes of cost estimating, ground level storage tanks were assumed adequate at all pump stations.

TABLE 7-10

TRANSMISSION LINE STORAGE

TRANSMISSION LINE STORAGE

Pump Station	Flow Rate (gpm)	Peak Flow Diff (gpm)	Storage (gal)
1	9,133	--	1,095,960
2	1,897	333	157,820
3	1,358	167	87,280
4	813	391	157,020
Plentywood		265	145,400
5	6,512	195	200,440
6	1,885	27	47,420
7	1,870	24	46,040
8	1,812	151	90,600
9	1,719	95	68,580
10	800	14	21,040
11	543	283	112,740
12	273	22	13,380
13	158	164	62,200
14	68	99	37,000
Opheim		56	37,000
15	2,482	287	152,960
16	1,726	286	137,480
17	247	76	32,300
18	168	112	43,680
19	100	24	10,640
20	77	23	9,820
Total			2,766,560

TABLE 7-11

STORAGE TANK COSTS

Storage Tank	Type	Capacity (gal)	Site Work	Valves/ Piping	Tank	Total	Bid Date	Pump Plnt Structure Index	October 1998	Indexed Cost	Indexed Cost Per Gallon
Kennebec	Elevated	150,000				299,600	17-Feb-99	214	214	299,600	2.00
Presho	Elevated	300,000				410,000	17-Feb-99	214	214	410,000	1.37
Murdo	Elevated	250,000				390,000	17-Feb-99	214	214	390,000	1.56
Wall	Elevated	300,000				412,000	17-Feb-99	214	214	412,000	1.37
Murdo	Elevated	300,000				416,000	17-Feb-99	214	214	416,000	1.39
Redshirt No. 1	Ground	63,000	52,850	--	71,000	123,850	22-Oct-98	214	214	123,850	1.97
White Clay/Wakpamni	Ground	89,000	17,555	8,500	73,000	99,055	15-Sep-95	197	214	107,603	1.21
Redshirt No. 2	Ground	96,000	34,450	--	90,000	124,450	22-Oct-98	214	214	124,450	1.30
Vivian	Ground	100,000				261,000	17-Feb-99	214	214	261,000	2.61
Redshirt No. 3	Ground	117,000	37,900	--	97,500	135,400	22-Oct-98	214	214	135,400	1.16
Core Phase II - No.	Ground	141,000	16,500	2,500	290,000	309,000	18-Jun-98	213	214	310,451	2.20
American Horse	Ground	183,000	53,500	--	187,500	241,000	1-Jan-97	205	214	251,580	1.37
Slim Buttes	Ground	238,000	18,000	--	165,000	183,000	15-Sep-95	197	214	198,792	0.84
Manderson IV, Sharps	Ground	250,000	27,000	15,120	196,500	238,620	13-Aug-98	213	214	239,740	0.96
Manderson III	Ground	263,000	23,690	--	169,000	192,690	1-Jan-97	205	214	201,150	0.76
Manderson IV, Porc B	Ground	282,000	31,400	--	196,560	227,960	13-Aug-98	213	214	229,030	0.81
Core Phase II - No.	Ground	411,500	59,000	156,500	318,000	533,500	18-Jun-98	213	214	536,005	1.30

An equation was fit to the indexed cost per gallon in the last column of Table 7-11, which is as follows:

$$\text{Storage tank Costs Per Gallon} = A + B \times \text{Gallons} + C \times \text{Gallons}^2$$

Where A = 2.7449
B = -1.1382e-5
C = 1.9e-11

This equation was used for storage tank costing as summarized in Table 7-1.

7.5.3 Supervisory Control and Data Acquisition (SCADA) Instrumentation

The purpose of a SCADA system is to provide communication links throughout the project and to monitor and coordinate the operation of pump stations and storage tanks. Operations at the treatment plant can also be monitored and coordinated with pumping stations and storage tanks. Information is available from the system on a real-time basis or nearly so. SCADA systems can be monitored and controlled by personal computers at one or more locations throughout the project. It is not necessary that hardware at each pumping station and storage tank is supplied by a single manufacturer. It is only necessary that a common software is used to permit coordination. On the Fort Peck Indian Reservation, the SCADA system would have its fundamental operations headquartered at the water treatment plant, as proposed here. Users on the system, whether on the Fort Peck Indian Reservation or in the Dry Prairie, region would be permitted to monitor operations at the treatment plant or at any pumping station or storage tank, but only operators at the treatment plant would be provided with the capability to control operations within the Reservation. Similarly, only operators as designated within Dry Prairie would have access to controls of pumping stations and storage tanks outside the Fort Peck Indian Reservation.

Several alternatives are available for SCADA system, including dedication of telephone lines from pumping station to pumping station, radio telemetry between pumping stations and satellite communications. Without undertaking an exhaustive investigation, satellite communications are generally regarded as too expensive, although technology may improve the cost-effectiveness of the system in the future. Telephone lines are generally considered reliable and do not involve substantial additional investment but are generally regarded as more costly in operation and maintenance than radio telemetry. Radio telemetry was chosen for the purpose of cost estimation as the method of SCADA communication. SCADA costs were estimated at $12,000 dollars per loop between pumping stations, storage tanks or other points of communication. This cost was applied to the pumping stations in the project.

Line of sight is required for radio transmission between remote terminal units. Each remote site would be used to relay or leapfrog information to a central unit at the treatment plant within the Fort Peck Indian Reservation and to a currently undefined location or locations for Dry Prairie. Later investigations will more specifically define workable locations on higher ground for remote terminal units that can collect line of sight information from multiple units.

7.5.4 Electrical Distribution

Single phase power will be adequate for all pump stations in the 10 to 15 horsepower range, although innovations in Sheridan Electric's system are successfully driving motors up to 60 hp with single phase power. Five pump stations on the main transmission line have requirements less than 15 horsepower. Of the 90 pump stations on the branch lines, only 10 require more than 15 horsepower, and none are larger than 30 horsepower. For electrical demands requiring 15 horsepower or less, single phase power with a-day-phase equipment will be workable. Single phase power is available at all proposed pumping station locations.

Single phase power where workable will create additional operation and maintenance requirements to insure that current is maintained in balance. Qualified electrical staff will be required by the project to insure that imbalance does not occur. Shorter lives of motors will result from periodic or sustained low-level imbalances, and equipment burnout can result from short-term imbalances of unacceptable proportions.

An important consideration in the project respecting electrical distribution is the final location of the intake, water treatment plant and first pumping station in relation to the electrical transmission facilities of the Western Area Power Administration. The Western substation is located near Wolf Point, and a future decision will be required on whether to extend the federal power lines from the substation to these major project facilities. If federal power lines were extended to the Poplar area, for example, the project must weigh the alternative (1) of investment of significant funds in the construction of a federal branch power line with little future operation and maintenance cost against the alternative (2) of wheeling power through the Sheridan Electric distribution system at a negotiated cost of wheeling.

An additional assumption in the cost estimating of improvements in the existing electrical distribution system is that a bill crediting system could be arranged between the rural electrical cooperatives and Western for pumping stations on the branch lines to avoid the cost of demand-hour meters. Cost of demand-hour meters are approximately $25,000 per unit, and the installation of such a meter at each power delivery point is impractical. Costs of the larger pumping stations on the main transmission system are considered adequate to cover the costs of demand-hour meters, but costs of smaller pumping stations on the branch lines are not adequate to accommodate a demand-hour meter.

The cost estimate of Table 7-1 includes $500,000 for the Fort Peck system and $500,000 for the Dry Prairie system, a total of $1,000,000 and the equivalent of approximately 25 miles of three phase power line at a cost of $40,000 per mile.

There is a mechanism other than the use of construction funds to provide electrical upgrades necessary for the project. Annual electrical costs are estimated at more than $650,000 of which one third is for payment of Western energy costs (15.5 mills per kilowatt hour, $0.0155 m/kwh) and two-thirds is for payment of OMR expenses (30 m/kwh) of the participating rural electric cooperatives and/or investor owned utilities.

As in other projects of this nature, the added cost of operating and maintaining the rural electric cooperatives (aside from service of new debt) is minimal. Therefore, there is opportunity for capital improvement of the facilities operated by the rural electric cooperatives from the revenues received from the Fort Peck Reservation Rural Water System. Sufficient revenues (estimated at $450,000 annually at the rate of 30 mills per kilowatt hour) will be received by the rural electric cooperatives to finance (at 5% over 30 years) as much as $7,000,000 in capital improvements without increasing electrical rates to its members. The sponsors could reach agreement with the rural electric cooperatives for sponsor financing of improvements through wheeling contracts with the rural electric cooperatives to use up to 30 mills per kilowatt hour of the total 45 mills per kilowatt hour to new power line construction. To the extent the rural electric cooperatives do not require the $450,000 annually for new capital improvements, discounts in the wheeling costs (OMR) of the cooperatives could be made available to the Assiniboine and Sioux and Dry Prairie Rural Water Systems, thereby lowering costs to the water project while simultaneously lowering costs per kilowatt hour to its existing cooperative members.

These concepts require acceptance and agreements between sponsors and the rural electric cooperatives. Half of the revenues discussed above, in combination with the $1,000,000 programmed for power improvements, would create $4,500,000, which is considered more than required.

7.6 Minor Construction Items and Contingencies

Minor construction items constitute 31% and 36% of the cost of major construction items for the Fort Peck and Dry Prairie systems, respectively, (Table 7-1). Major construction items include the intake on the Missouri River, the water treatment plant, pipelines, pumping stations, storage tanks and SCADA system. Minor construction items include mobilization, taxes, bonds and insurance, general requirements, easements, bends, tees, flow and pressure control, air relief, drains, isolation valves, meter pits, road crossings, railroad crossings, stream crossings, operation and maintenance buildings and contingencies. The definitions are arbitrary and were adopted for the simple purpose of distinguishing between the types of construction items for this specific project. The percentages may be compared with other projects, such as Mni Wiconi, where initial planning attached 23.75% to the major construction items as defined here.

7.6.1 Mobilization, Taxes, Bonds, Insurance and General Overhead

Table 7-12 summarizes estimates of contractor costs for moving equipment, materials and manpower to and from the job site, taxes, bonds, insurance and general requirements, such as preparation of shop drawings, operation and maintenance manuals, storm water plans, safety plans, handling and storage and required record keeping. The addition to construction costs for these items, applied to both major and minor items exclusive of contingencies, was estimated at 7% for the Fort Peck Indian Reservation and 5% for Dry Prairie. The difference between the two areas is the gross receipts tax. The Fort Peck Assiniboine and Sioux Tribes apply 3% percent to construction pursuant to the Tribal Employment Rights Ordinance (TERO), and Montana applies a 1% gross receipts tax. In all other cases, costs are the same in both areas of the project.

TABLE 7-12

CONSTRUCTION CONTRACT COSTS
FOR GENERAL OVERHEAD AND REQUIRMENTS

Item	Fort Peck %	Dry Prairie %
General Overhead		
Mobilization/Demobilization	2	2
TERO/Gross Receipts Tax	3	1
Bonds and Insurance	1	1
	6	4
General Requirements	1	1
Shop Drawing Submittals		
O and M Manuals		
Storm Water Plan		
Quality Control		
Handling and Storage		
Record Keeping (Wages)		
Total	7	5

7.6.2 Valves and Other Appurtenance Costs

Table 7-13 summarizes estimates of installed costs of isolation valves, drains, air relief valves, bends, tees and flow control valves. Estimates were based on experience in similar projects and include a 15% addition for conservatism in the estimates of the number of items and their cost.

Isolation valves are for the purpose of closing off the flow of water along the main transmission line and branch lines. Isolation valves were generally placed on all pipelines at a frequency of one per two miles except on two and three inch pipelines where the frequency was reduced to one per five miles. Isolation valves will permit drainage and repair of the pipelines.

Drains and air relief valves were counted on the main transmission line from the ground profiles along the pipeline route as shown on preliminary plan sheets. Drains and air relief valves on the branches were counted on a typical branch, and the results were applied proportionally to the length of other branches while accounting for the proper diameter of piping specific to each branch.

Hydraulic modeling of the pipelines provided for examination of hydraulic grade line in relation to the ground profiles along the preliminary pipeline routes. Pumping stations were located to maintain a minimum 35 psi at all locations; and pumping head, including residual head from the upstream pumping station, was limited to a maximum of 250 psi. Pressure reducing valves were not necessary at most locations along the hydraulic grade line but may be required at a few locations in final design. The cost of pressure reducing valves is presented in Table 7-13.

TABLE 7-13

CONSTRUCTED COSTS OF VALVES
AND OTHER APPURTENANT ITEMS

Item	Criteria	Pipe Size (in)	Project Costs	Plus 15%
Isolation Valve				
		24	8,000	9,200
		20	6,500	7,475
		18	5,000	5,750
		16	3,000	3,450
		14	2,500	2,875
		12	2,000	2,300
		10	1,500	1,725
		8	975	1,121
		6	600	690
		4	500	575
		3	500	575
		2	350	403
Blow Off Valves				
	8	24	6,000	6,900
	6	20		
	4	18	3,700	4,255
	3	12	2,500	2,875
	2	10	1,600	1,840
	1	6	1,500	1,725
Air Relief Valves w/ Vaults or Comparable				
	6	24	15,000	17,250
	4	24	10,000	11,500
	3	24	5,000	5,750
	2	24	4,500	5,175
	2	18	4,500	5,175
	2	12	4,500	5,175
	2	6	4,500	5,175
	1	4	1,250	1,438
Bends				
		24	2,800	3,220
		20	2,200	2,530
		18	1,800	2,070
		16	1,200	1,380
		14	500	575
		12	500	575
		10	400	460
		8	200	230
		6	200	230
		4	200	230
		3	100	115
		2	100	115
Tees		24	3,400	3,910
		20	2,500	2,875
		18	2,000	2,300
		16	2,000	2,300
		14	487	560
		12	420	483
		10	400	460
		8	350	403
		6	300	345
		4	200	230
		3	150	173
		2	100	115
Flow Control				
	PRV		25,000	28,750
	Electronic Flow Con		25,000	28,750
	Hydraulic Flow Cont		15,000	17,250

Similarly, electronic flow control and hydraulic flow control valves may be used in final project design where the cost of SCADA exceeds the cost of flow control valves.

7.6.3 Meter Pits

Meter pits will be installed at each rural household for the purpose of measuring water use. In the Dry Prairie area of the project, meters will be used for billing purposes. Within the Fort Peck Indian Reservation, where meters will not be used for billing purposes, meters will be used for the purpose of accounting for leakage in both homes and the regional water system as a water conservation measure. The number of meters was based on the 1990 number of rural households outside existing public water systems.

7.6.4 Highway, Railroad and Stream Crossings

Table 7-14 summarizes the cost of the significant crossings contemplated in the project. Quantities of crossings were based on an actual count. The length of crossing for all types was assumed at 100 feet. This should be adequate for all types of crossings on the average. Unit costs were based on the size of pipe, which would be encased in a larger protective pipe at each crossing. Unit costs were based on horizontal boring or drilling beneath the roadway, railroad or stream. Casings will be jacked through the bore and carrier pipes will be installed through the casing at each bore.

7.6.5 Operation and Maintenance Buildings

Operation and maintenance buildings will be required for future project activities following construction. It was assumed that 5,000 square feet of new building, in combination with existing facilities for operation and maintenance currently available in the communities, would be adequate for both the Fort Peck Indian Reservation and Dry Prairie. Cost of buildings were estimated at $100 per foot, resulting in the estimates of $500,000 in each of the project areas.

7.6.6 Contingencies

Contingencies were estimated at 12.5% and were applied to all contract items listed in Table 7-1, including mobilization, taxes, bonds and general requirements. Having accounted for major and minor construction items, this level of contingency was considered conservative. A higher level of contingency would be required in the absence of the listing and accounting for minor construction items, which have a significant cost as summarized above.

TABLE 7-14

CONSTRUCTION COSTS OF CROSSINGS

Item	Criteria	Pipe Size (In)	Project Costs	Plus 15%
Paved Road, Railroad and Stream Crossing (Bore and Jack)				
		24	35,700	41,055
		20	27,000	31,050
		18	20,000	23,000
		16	15,000	17,250
		14	11,016	12,668
		12	7,344	8,446
		10	6,426	7,390
		8	3,213	3,695
		6	3,213	3,695
		4	2,234	2,569
		3	2,234	2,569
		2	1,607	1,847

7.7 Non-Contract Costs

Non-contract costs are costs incurred by the sponsors for all activities surrounding, but not including, the construction of the project. These activities include environmental mitigation (including, among other things, reclamation of wetlands, stream crossings and re-seeding construction corridors), federal oversight, sponsor administration, technical investigations required during construction, design, field surveys and geotechnical investigations in support of design and construction inspection. The costs presented in this section reflect growing federal and sponsor experience in similar projects and some reduction in non-contract costs based on the benefit of past experience. The non-contract costs proposed here reflect a new level of efficiency in the implementation of rural water projects.

7.7.1 Environmental Mitigation

There were no specific requirements for environmental mitigation identified at the time of this report. The intake on the Missouri River will be designed in such a manner that the smallest of fish will not be affected by its operation. The cost of screens for this purpose is already reflected in the intake costs. It is expected that some wetlands may be crossed by the pipelines. The Medicine Lake Wildlife Refuge will be avoided to the extent possible, but complete avoidance may not be practical. Trees and shrubs that are removed in stream and coulee bottoms will be replaced on a 2:1 basis. Crop damages will be paid, and pipeline routes will be re-seeded to natural grasslands where crop lands are not present. One half of 1 percent (.5%) or $754,000 is included in the project cost estimate of Table 7-1 for environmental mitigation.

7.7.2 Federal Oversight

The Bureau of Reclamation will oversee the expenditure of federal funds in construction of the project. The functions of the Bureau of Reclamation will be to review initial planning documents for the purpose of providing guidance, direction and requirements of the United States for project implementation. Reclamation will also review and approve final plans and specifications for construction of the project and will provide guidance and direction on construction agreements resulting from a bidding or force account process. Reclamation will take all necessary steps to ensure compliance with federal environmental requirements. Reclamation will develop and monitor cooperative agreements with the sponsors for the planning, design and construction of the project. The agency will provide periodic financial reviews to determine the effectiveness of expenditures and the ability to complete the project within the congressionally authorized ceiling. Training may also be provided by Reclamation. The project cost estimate provides $6.0 million for Reclamation oversight based on 4% of contract costs. The Bureau of Indian Affairs, responsible for funding operation, maintenance and replacement (OMR) after project construction on the Fort Peck Indian Reservation, will participate to the extent necessary to properly address the effect of design on future OMR activities and costs.

7.7.3 Sponsor Administration

Table 7-15 summarizes the estimated cost of sponsor administration. Costs were based on the completion of the project over a 10 year period, although not all functions would last throughout the entire period.

Easement acquisition is one of the most intensive activities in the project. Many of the trust lands on the Fort Peck Indian Reservation will have multiple owners, including some tracts with more than 100 heirs. On the basis of the information presented in Table 7-15, it was estimated that 7 staff members would be required from the membership of the Fort Peck Assiniboine and Sioux Tribes throughout the project implementation years to obtain easements within the Reservation boundaries. The process will involve certified mail contact of each heir to a particular allotment and the receipt of written permission for easement by a minimum of 50 percent of those contacted. Easement plats will be prepared before and after construction, and payment will be made to each of the heirs on the basis of the fair market value of the permanent easement. Average wages and benefits in both the Fort Peck and Dry Prairie regions were estimated at $18.00 per hour for this activity.

One staff member was estimated as the requirement for a construction contract administrator within both the Fort Peck and Dry Prairie areas. This individual would be responsible for developing vouchers for pay requests by contractors, maintaining construction contract files containing the original agreement and any subsequent change orders, monitoring project construction schedules for compliance, insuring environmental compliance and maintaining records of contractor employment and wages.

TABLE 7-15

SPONSOR ADMINISTRATIVE COSTS

Cost Item	Fort Peck	Dry Prairie
Easement Aquisition		
Feet of Pipe	7,240,399	9,605,690
Average feet per tract	660	1,320
Estimated Tracts	10,970	7,277
Owners per Tract	30	1
Estimated Contacts	329,109	7,277
Contacts per Person per Day	16	1
Days Required	20,569	7,277
Days Available	2,880	2,880
Staff Numbers Calculated	7	3
Staff Numbers Used	7	2
Average Wage	$15.00	$15.00
Payroll Additives	$3.00	$3.00
Total Cost	$2,620,800	$748,800
Construction Contracts Administration		
Staff Numbers Used	1	1
Average Wage	15.00	15.00
Payroll Additives	3.00	3.00
Total Cost	$374,400	$374,400
Project Accounting		
Staff Numbers Used	2	.5
Average Wage	$18.00	$18.00
Payroll Additives	$3.60	$3.60
Total Cost	$1,078,272	$269,568
Legal/Accounting		
Annual Hours Legal	200	200
Annual Hours Accounting	200	200
Legal Rate	$100	$100
Accounting Rate	$75	$75
Year of Service	10	10
Total Cost	$350,000	$350,000
Sponsor Coordination/Training		
Management Staff		
Annual Hours	2,080	2,080
Staff Numbers	2.5	2.0
Total Wage	$58.00	$43.00
Total Payroll Additive	$11.60	$8.60
Total Cost	$1,737,216	$1,287,936
Sponsor Advisor/Steering		
Members	6	6
Meetings per Year	12	12
Cost per member/meeting	100	100
Total Cost	$86,400	$86,400
Non-Labor Costs		
Local Travel		
Vehicles	5	2
Vehicle Costs (2 Replace)	$300,000	$120,000
Vehicle Miles/Year	30,000	30,000
Annual Mileage and Repairs	$45,000	$18,000
Regional Travel		
Man-Trips per Year	25	25
Mileage per Trip	1,000	1,000
Days per Trip	2	2
Mileage Costs	$113,750	$113,750
Lodging	$48,750	$48,750
Meals	$16,250	$16,250
National Travel		
Man-Trips per Year	3	3
Airfare	$1,500	$1,500
Days per Trip	4	4
Travel Costs	$58,500	$58,500
Lodging	$19,500	$19,500
Meals	$5,460	$5,460
Space Costs		
Heating	$31,200	$31,200
Water and Sewer	$8,580	$8,580
Phones	$643,500	$608,400
Photocopiers	$195,000	$195,000
Faxes	$12,000	$12,000
Computers	$37,500	$19,500
Software	$37,500	$19,500
Indirect at 18%	$1,281,749	--
Total Administrative Costs	$9,052,577	$4,362,744

Both parts of the project would employ a project accounting staff that would be responsible for coding and bookkeeping for all project costs, while complying with Federal and State standards for this activity. An initial coding system would be established for each contract and non-contract expenditure and for records of time and activity by all non-contract staff. A system for acquisition of all purchased items by purchase order, voucher or comparable accounting tool would be developed and implemented. The system would be reviewed periodically by the professional accounting staff described further. Two staff members were used in the cost estimate for the Fort Peck Indian Reservation, and a halftime staff member was used in the cost estimate for the Dry Prairie area for this activity.

In addition to the project accounting staff, 200 hours of professional accounting were provided annually in the cost estimate for sponsor administration. Moreover, 200 hours of legal expertise were provided annually in the cost estimate. Legal expertise would be required for review of cooperative agreements and modifications between the sponsors and the Bureau of Reclamation, for review of construction and consulting contracts, and to represent the sponsor in any claim made against the project. Legal expertise may also be required for wheeling agreements with the local rural electric cooperatives and for other purposes. The average professional rates used in the analysis were $75.00 to $100 per hour.

Sponsor coordination and training were also provided in the cost estimate for non-contract activities. It was estimated that 2.5 individuals would be required on the Fort Peck Indian Reservation to manage the tribal staff. The staff would include a project director, an assistant and a secretary, the latter sharing duties with the easement and contract administration staff. It was estimated that two individuals would be required for Dry Prairie for the same functions.

Each sponsor will have costs for advisory or steering committee members that are representatives of the project from outside the project staff. It was estimated that these individuals would receive $100 per meeting and would be available for 12 meetings per year. A total of 6 advisory or steering committee members for each sponsor was included in the cost estimate.

In addition to staff and committee members, each sponsor will incur non-labor costs for travel and the maintenance of office equipment and space. These costs are summarized in the non-labor section of Table 7-15.

7.7.4 Investigations

Following project authorization, before and after the start of construction, there will be needs to conduct a variety of investigations ranging from value engineering (to save project costs without sacrificing project function) to special studies related to alternatives for pipeline routing based on difficult construction conditions or failure to obtain easements in the most desirable locations. Certain of these investigations will relate to environmental compliance. Project-wide meetings between sponsors, Reclamation, the State of Montana and agencies having regulatory responsibility in the project will require participation by project professionals, including legal, engineering and accounting staff.

7.7.5 Design Surveys and Geotechnical

Prior to final design and preparation of plans and specifications, detailed field surveys of proposed pipeline routes for the larger pipelines and detailed soil studies of foundation conditions for pumping stations and storage tanks will required. Field surveys will be required for all metal pipeline projects to ensure that the plans and specifications reflect the proper grade for pipeline construction. Soil studies will be undertaken to determine their corrosiveness and to design cathodic protection systems. Requirements for field surveys will diminish with pipeline size. Floodplain assessment, special wetland assessment and other types of surveys in support of design may be required.

7.7.6 Design

Design will be performed by the contract engineer for each sponsor, subject to each sponsor input, review and approval, and will involve the preparation of plans, specifications, bidding documents and construction contract agreements. Costs were estimated at 5.25% for this activity. Federal statutes limit this activity to 6%. See Section 7.2.2 for the roles of the Bureau of Reclamation and the Bureau of Indian Affairs.

7.7.7 Construction Inspection

Each sponsor will employ a staff to inspect construction of each project segment for the purpose of insuring compliance with the contractual plans and specifications developed by the engineer. The engineer will supplement each sponsor's inspection staff to the extent necessary. This is one of the most fundamental elements of the project and is intended to ensure that the constructed quality of the project meets the contractual requirements specified by the sponsor in the agreement with the construction. Costs of this project activity are generally estimated at 10% of the cost of construction, but proper planning at the outset of the project will permit gains in efficiency to the extent that 7% of the cost of construction will be adequate. The activities discussed in this section to define costs are addressed further in Section 8.3.

7.8 Value Engineering

The sponsors participated in a value engineering (VE) session conducted by the Bureau of Reclamation from February 25 through March 2, 2001. The purpose was to determine alternatives to the plan presented in this report that would not diminish the ability of the project to function properly and adequately and would reduce construction and/or OMR costs. Sponsor participation provided a general understanding of the value engineering proposals as they were formulated by the VE team.

The VE study and the response of the sponsors (Accountability Report) are included in Volume II of this report as Appendices A and B, respectively. Table 7-16 summarizes the results of the sponsor evaluation of the VE proposals. The decision of the sponsors to accept or reject VE proposals is also given in Table 7-16. Plentywood pipeline reconfiguration, Opheim pipeline reconfiguration and disinfection with chloramines were proposals of the VE Report that were accepted and are reflected in Table 7-1. The Flaxville Road reconfiguration, Nashua intake, nano filtration and gravity intake proposals of the VE report were not accepted due to higher life-cycle costs.

Reconfiguration design criteria, such as permitting an increase in pressure from 200 to 250 psi and siting reservoirs on high points along the pipeline route were accepted by the sponsors as valid considerations for final design; provided, however, that final decisions during design will depend upon the impact of design criteria upon life-cycle costs. At this stage of preliminary design, the reconfiguration concepts have an added life-cycle cost of $9,649,035, including an increase in construction costs of $13,512,000 and a savings in annual operation, maintenance and replacement cost of $179,827. One of the primary purposes of reconfiguration was to reduce the number of pumping stations on the main transmission pipeline and on the branch lines to reduce initial pump station construction and future OMR costs. The VE proposal would decrease the number of pumping stations on the main transmission pipeline from 20 to 12. The impact of reduction of pumping stations on branch lines would be the less significant. The reduction in number of pumping stations would be achieved, however, at an additional life-cycle cost as given above. Because parts of the VE reconfiguration proposal has merit, the sponsors have chosen to "provisionally accept" the VE recommendations for reconfiguration subject to design-level costing.

Pilot testing of waters from the Missouri River will be required in design level investigations to more fully assess the value engineering proposals for conventional water treatment, micro-filtration and media filtration. Therefore, the sponsors have chosen to continue investigation of water treatment alternatives in design level investigations and will select among the water treatment alternatives based on more detailed life-cycle costing. Both the micro-filtration and media filtration alternatives were provisionally accepted.

TABLE 7-16

DECISIONS ON VALUE ENGINEERING RECOMMENDATIONS

Alternative Number	Alternative Description	Sponsor Decision	Life Cycle Savings		Savings Composition	
			VE Report	Confirmed Potential	Annual OMR	Construction
1A	Poplar Intake: Design Changes/Pipeline Reconfiguration					
	Plentywood Reconfiguration	Accepted	–	1,098,458	$13,202	$814,850
	Opheim Reconfiguration	Accepted	–	–	–	–
	Flaxville Road Reconfiguration	Not Accepted	–	–	–	–
	Other Design Criteria	Partially Accepted	–	-10,747,493	166,625	-14,326,967
	Total Savings	Partially Accepted	$10,172,000	-9,649,035	179,827	-13,512,117
1B	*Nashua Intake: Pipeline Reconfiguration*	Rejected	-46,600	-18,925,568	196,144	-23,139,170
	Water Treatment					
2A	Micro Filters, Pump Intake	Partially Accepted	6,823,368	4,130,287	118,310	1,588,730
2B	*Micro Filters, Gravity Intake*	Not Accepted	17,121,875	4,325,370	114,945	1,856,101
3A	*Nano Filters, Pump Intake*	Not Accepted	21,176,769	-19,348,900	-752,200	-5,017,870
3B	*Nano Filters, Gravity Intake*	Not Accepted	-6,322,765	-20,981,686	-755,565	-4,750,499
4A	*Media Filter, Pump Intake*	Partially Accepted	16,569,750	11,544,488	477,355	1,289,860
4B	*Media Filter, Gravity Intake*	Not Accepted	26,822,857	11,739,571	473,990	1,557,231
5	Disinfection with Chloramines	Accepted	749,366	0	0	0
6	Gravity Intake	Not Accepted	1,321,780	97,987	-3,365	169,975
	Total		$19,019,914	($24,346,329)	$216,071	($38,620,592)

Note : Alternative descriptions in *italics* are not included in totals.