FINAL REPORT

SAINT MARY CANAL SYSTEM
HYDROPOWER FEASIBILITY STUDY

PREPARED FOR

THE BLACKFEET TRIBE

PREPARED BY

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MARCH 2007

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SAINT MARY CANAL SYSTEM HYDROPOWER FEASIBILITY STUDY

INTRODUCTION

The Blackfeet Tribe requested HKM Engineering Inc. evaluate the hydropower potential associated with delivering water through the five drops on the Saint Mary Canal System. The Blackfeet Tribe and the Montana DNRC entered into a Memorandum of Agreement on June 7, 2006 to conduct a study to determine the feasibility of incorporating hydropower generation facilities within the existing St. Mary Canal System on the Blackfeet Reservation as part of the rehabilitation of those facilities.

The existing irrigation water diversion and conveyance facilities were originally designed for a canal capacity of 850 cubic feet per second (cfs). Due to several years of deterioration and degradation of the irrigation facility infrastructure, the existing canal capacity has decreased to 650 cfs to 725 cfs, depending on canal location. The "safe" operating capacity below the St. Mary River siphon is about 650 cfs because of the slides and sloughing of the earthen canal embankment. The maximum "safe" diversion rate is about 725 cfs when the seepage from the diversion dam to the St. Mary River siphon is accounted for. The highest measured flow rate at the St. Mary River siphon has been 678 cfs during the last ten years. Figure 1 depicts the basic components of the St. Mary Diversion Facilities and illustrates the general location of the five drop structures where the potential hydroelectric facilities would be located.

The Thomas, Dean & Hoskins, Inc. (TD&H) August 2006 Report, "St. Mary Diversion Facilities Feasibility and Preliminary Engineering Report for Facility and Rehabilitation" outlines three alternatives for the five drop structures for the Saint Mary Canal. The three drop structure alternatives are: Replacement In-Kind with concrete chute and terminal drop structures; Replacement with Modified Configuration with either concrete chute and USBR Type III stilling basins or concrete pipe drop and impact-type energy dissipater; and Replacement with Hydropower-Ready Configuration. The preliminary design and estimated costs for each of the three drop structure alternatives analyzed by TD&H are presented in the August 2006 Report.

The 1921 International Joint Commission Order and current Procedures Manual identifies the baseline parameters upon which water can be diverted from the St. Mary River under current river allocation rules between the United States and Canada. Projected divertable flows to the project were developed by Montana Department of Natural Resources and Conservation (DNRC) for this study using 700 cfs and 850 cfs canal capacities.

Appraisal level capital costs for the turbines, steel pipelines (penstocks), and related hydroelectric equipment are estimated for specific development alternatives. Construction costs, including the transformers, and switching gear were determined and evaluated against the net annual power revenue from generation. The Total Incremental Costs for the St. Mary Canal Hydropower Alternatives at canal capacities of 700 cfs and 850 cfs were calculated by subtracting the Total Irrigation System Installed Cost (without hydropower) from the Total Hydropower System Installed Cost.

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ST. MARY CANAL SYSTEM DIVERSION FACILITIES

Figure 1

HKM ENGINEERING

Two of the hydropower alternatives analyzed have one hydropower facility with a total of three turbines at each site. One hydropower alternative evaluated has three hydropower facilities with three turbines at each site for a total of nine turbines. The three turbine configuration was utilized at each hydropower facility in order to maximize generation given the flow variability of the Saint Mary Canal. The following sections of this report identify three alternatives which exhibit varying degrees of hydropower development potential. Costs and conclusions/ recommendations are presented at the end of this report. Contact was made with the Bureau of Reclamation Power Division, Great Plains Region, and some private small hydropower project developers to obtain general guidelines for project feasibility. See Appendix D, General Hydropower and Hydrology Information, for details.

SAINT MARY CANAL SYSTEM – TD&H ALTERNATIVE

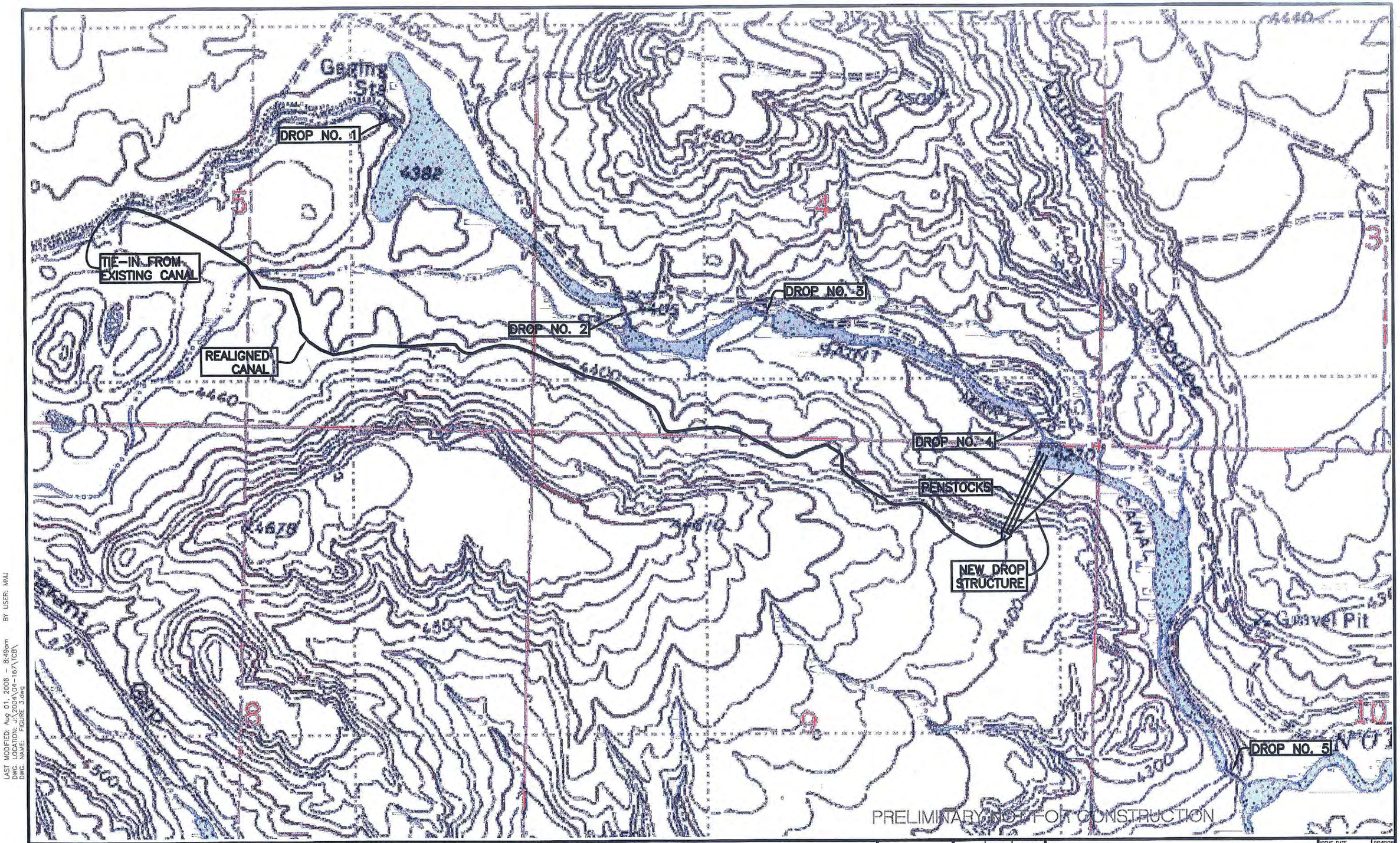
This hydropower alternative evaluates the potential of hydroelectric generation associated with the TD&H alternative proposed in their August 2006 report, "St. Mary Diversion Facilities Feasibility and Preliminary Engineering Report for Facility and Rehabilitation". This alternative consists of relocating 9,500 feet of the St. Mary Canal and bypassing Drop Structures 1 through 4. A single drop structure with three penstocks from the end of the realigned canal to the downstream end of the existing Drop No. 4 is proposed to maximize head for hydropower generation. The inlet of the single drop structure with three penstocks would be designed to be "Hydropower Ready" or bifurcate for future hydropower development.

Figures 2 and 3, developed by Turner, Collie, and Braden for TD&H, present the basic components of the TD&H Hydropower Alternative for the St. Mary Canal System. The elevation difference between the point of diversion and the three Turbines at Drop 4 is about 160 feet.

Water supply estimates used for power generation calculations were developed using the following criteria:

1. Study Period: Water Years 1980 – 2004
2. Natural Flow St. Mary River at International Boundary – Natural Flows developed by Montana DNRC.
3. Canadian Share of St. Mary River – Canadian Share of St. Mary River developed by Montana DNRC.
4. U.S. Share of St. Mary River – U.S. Share of St. Mary River developed by Montana DNRC.
5. Net Storage Gain (Release) from Sherburne Reservoir – Based on historical end-of-month storage minus previous month end-of-month storage; historical end-of-month contents for Lake Sherburne from USGS Water Resources Data books.
6. St. Mary River Flow Available for U.S. Diversions (1921 IJC Order) – Equal to U.S Share of St. Mary River minus Net Storage Gain or Release for Lake Sherburne.
7. Historical Diversions to St. Mary Canal – USGS gage records for gage 05018500, St. Mary canal at St. Mary Crossing, near Babb, Montana. Compiled by HKM.

FIGURE 2



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ST. MARY CANAL

HYDROPOWER READY OPTION
CANAL, PENSTOCKS AND DROP STRUCTURE

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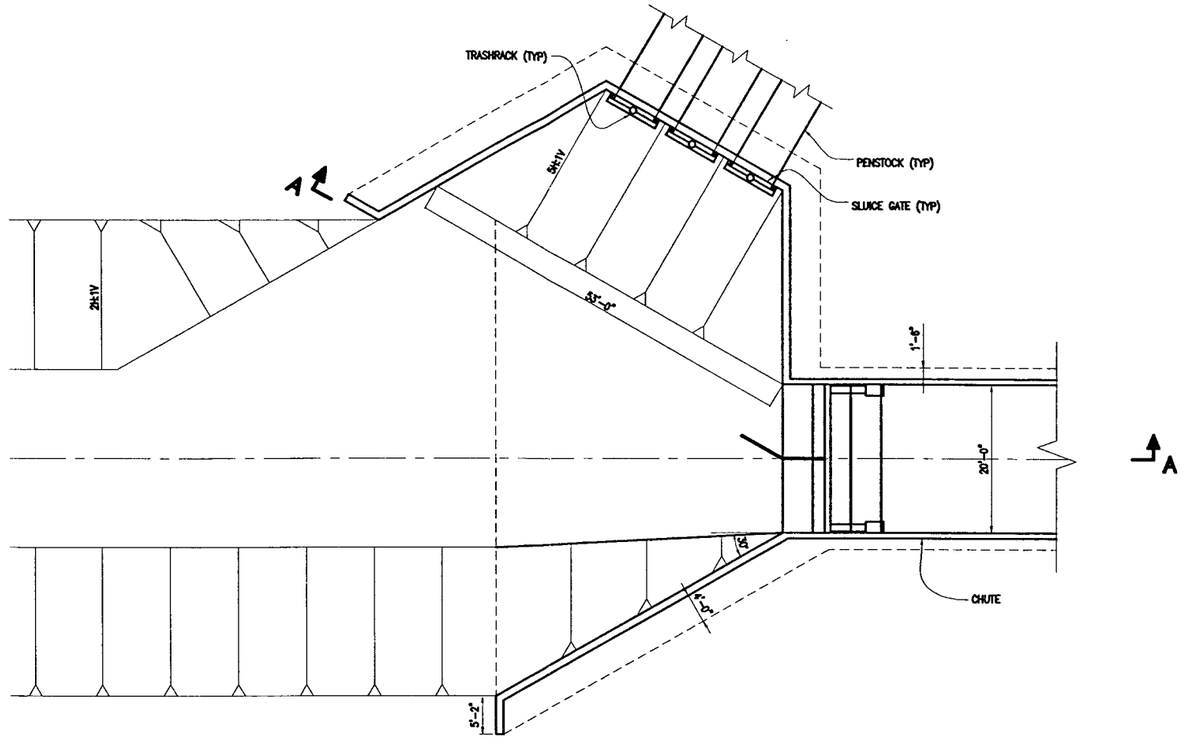

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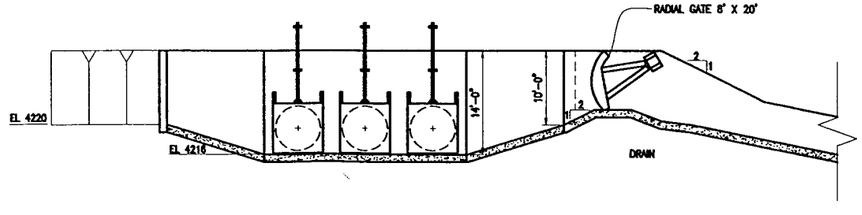

SECTION A-A
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NOTES:

1. A SEPARATE FLOW MEASUREMENT STRUCTURE CAN BE INSTALLED UPSTREAM OF THIS DROP STRUCTURE.
2. ALL DIMENSIONS ARE APPROXIMATE AND WILL BE CONFIRMED DURING FINAL DESIGN.

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ST. MARY CANAL

HYDROPOWER READY OPTION W/INLET MOD
CHUTE W/USBR TYPE III BASIN

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J:\2004\04-167\TCB\FIGURE 5.dwg, 8/1/2006 8:50:33 AM, TDH Great Falls, MMJ

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8. Divertable Flow at 700 cfs St. Mary Canal Capacity – Equal to St. Mary Flow Available for U.S. Diversions based on Montana DNRC modeled flows for the IJC Report or 1,388 Acre-Feet per Day, whichever is less.
9. Divertable Flow at 850 cfs St. Mary Canal Capacity - Equal to St. Mary Flow Available for U.S. Diversions based on Montana DNRC modeled flows for the IJC Report or 1,686 Acre-Feet per Day, whichever is less.
10. Seepage loss to Drop 1 from Saint Mary River Siphon is 2 percent of gaged flow based on Bureau of Reclamation records.
11. Irrigation season is April 1 to October 31 as per 1921 IJC Order.

Power Generation Table 1 in Appendix A summarizes the results of this hydropower alternative. This tabulation documents the water delivered to the turbines for each month during water years 1980-2004 study period, based on the criteria noted above. The turbine flows in CFS were calculated from the power water supplied (acre-feet). The head in feet for the turbine was determined, the overall turbine/generator/hydraulic efficiency utilized was 70 percent, and the power constant of 0.085 was utilized to obtain generation in kW. After the generation was determined, the operating time was calculated at 95 percent per month operational time in hours, and the kW generation multiplied by the operating hours resulted in total turbine generation in kWh for each month of the study. During the non-irrigation season, the operating hours for the turbines was set to zero.

Results The following summaries reflect the results of the water supply and power generation assessments completed for the TD&H hydropower alternative.

Saint Mary Canal at 700 cfs Canal Capacity Option- TD&H Alternative

Turbine Specifications – TD&H Alternative – 700 cfs Canal Capacity

Turbine	Head (ft)	Minimum Monthly Flow (cfs)	Average Monthly Flow (cfs)	Maximum Monthly Flow (cfs)
Drop 4	160	0	275	686

Turbine Capacity – TD&H Alternative – 700 cfs Canal Capacity

Turbine	Max Monthly kW	Min Monthly kW	Avg Monthly kW
Drop 4	6,529	0	2,621

Turbine Generation- TD&H Alternative – 700 cfs Canal Capacity

Turbine	Max Monthly kWh	Min Monthly kWh	Avg Monthly kWh
Drop 4	4,616,055	0	1,630,869

Saint Mary Canal at 850 cfs Canal Capacity Option – TD&H Alternative

Turbine Specifications – TD&H Alternative – 850 cfs Canal Capacity

Turbine	Head (ft)	Minimum Monthly Flow (cfs)	Average Monthly Flow (cfs)	Maximum Monthly Flow (cfs)
Drop 4	160	0	284	833

Turbine Capacity – TD&H Alternative – 850 cfs Canal Capacity

Turbine	Max Monthly kW	Min Monthly kW	Avg Monthly kW
Drop 4	7,928	0	2,705

Turbine Generation- TD&H Alternative – 850 cfs Canal Capacity

Turbine	Max Monthly kWh	Min Monthly kWh	Avg Monthly kWh
Drop 4	5,605,210	0	1,684,831

Conclusions – TD&H Alternative

The two major contributing factors to the feasibility of hydropower generation are the head and flow. For the 700 cfs canal capacity option, at 160 feet of head and an average flow of 275 cfs, the average monthly generation is 1,630,869 kWh for a total average annual generation of about 19,570 MWh. The capacity of the turbines ranges from 0 kW to 6,529 kW due to the high variability of the power water available, ranging from 0 cfs to 686 cfs (canal capacity). Sizing of the turbines will be dependent on the monthly flow variability, flow duration curve, and the economic viability of the capital cost of construction for the capacity in kW versus generation in kWh. Maximum flow design would result in three turbines sized at a total capacity of 6,529 kW. Maximum flow design is utilized in this hydropower evaluation because the turbine/generator system is located on a canal system and must accommodate the maximum flow without any bypass flow.

For the 850 cfs canal capacity option, at 160 feet of head and an average flow of 284 cfs, the average monthly generation is 1,684,831 kWh for a total average annual generation of about 20,218 MWh. This is only 648 MWh more than the 700 cfs canal capacity option. The capacity of the turbines ranges from 0 kW to 7,928 kW due to the high variability of the power water available, ranging from 0 cfs to 833 cfs (canal capacity). Sizing of the turbines will be dependent on the monthly flow variability, flow duration curve, and the economic viability of the capital cost of construction for the capacity in kW versus generation in kWh. Maximum flow design would result in turbines sized at a total capacity of 7,928 kW, which is 1,399 kW more than the 700 cfs canal capacity option.

SAINT MARY CANAL SYSTEM – HKM ALTERNATIVE

The HKM Alternative has three penstocks and turbines for Drop 1 to Drop 3 with 89.95 feet of head, three penstocks and turbines for Drop 4 with 66.14 feet of head, and three penstocks and turbines for Drop 5 with 56.60 feet of head. No parallel Drop/Chute structures are to be constructed for bypass flows during load rejection. Full irrigation water supply will be delivered through the forebays, penstocks, and afterbays with automatic valves and wicket gates when the Turbines are not generating.

Load rejection must be considered when selecting the type of turbines for the hydropower system. Pelton turbines are an impulse type turbine with a fixed nozzle and moving buckets. For a Pelton turbine, a hinged deflector plate is utilized between the jet flow from the nozzle and the bucket to divert flow to the draft tube when load rejection occurs. Francis turbines are a reaction type turbine that combines radial flow and axial flow concepts. For a Francis turbine, the flow of water to the turbine runner must be shut off for load rejection. For river/reservoir hydropower systems, flow to the Francis turbine is shut down when load rejection occurs and the reservoir and surge tanks store the water flow until the unit is back on-line or a bypass valve is opened at the turbine. For pipeline/canal hydropower systems, flow to the Francis turbine has to be shut down when load rejection occurs and a bypass at the pipeline/canal intake structure with a parallel pipeline/canal system can be utilized to continue to deliver water as proposed for the preceding TD&H Alternative. Another alternative to the parallel pipeline/canal system for load rejection at a Francis turbine is to install a bypass valve at the turbine that is opened by a synchronous gravity-activated counter-weight system, as proposed for this hydropower alternative.

Figure 4 presents the basic components of the HKM Hydropower Alternative for the St. Mary Canal System.

Water supply estimates used for power generation calculations were developed using the following criteria:

1. Study Period: Water Years 1980 – 2004
2. Natural Flow St. Mary River at International Boundary – Natural Flows developed by Montana DNRC.
3. Canadian Share of St. Mary River – Canadian Share of St. Mary River developed by Montana DNRC.
4. U.S. Share of St. Mary River – U.S. Share of St. Mary River developed by Montana DNRC.
5. Net Storage Gain (Release) from Sherburne Reservoir – Based on historical end-of-month storage minus previous month end-of-month storage; historical end-of-month contents for Lake Sherburne from USGS Water Resources Data books.
6. St. Mary River Flow Available for U.S. Diversions (1921 IJC Order) – Equal to U.S Share of St. Mary River minus Net Storage Gain or Release for Lake Sherburne.
7. Historical Diversions to St. Mary Canal – USGS gage records for gage 05018500, St. Mary canal at St. Mary Crossing, near Babb, Montana. Compiled by HKM.

T 37 N
R 11 W

HKM ENGINEERING

Gaging Sta

SAINT MARY CANAL

Drop 1

PENSTOCKS

Drop 2

Drop 3

SAINT MARY CANAL

Drop 4

Penstocks

Penstocks

Drop 5

Penstocks

Dubray Coulee

Gravel Pit

North Fork Milk River

Grant Gap

4400 4500 4600 4373 4361 4440 4678 4610 4405 4450 4360 4300

5 4 3 8 9 10

N
W E
S

1,000 500 0 1,000 2,000 3,000 Feet

ST. MARY CANAL SYSTEM
HKM HYDROPOWER ALTERNATIVE

Figure 4

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8. Divertable Flow at 700 cfs St. Mary Canal Capacity – Equal to St. Mary Flow Available for U.S. Diversions based on Montana DNRC modeled flows for the IJC Report or 1,388 Acre-Feet per Day, whichever is less.
9. Divertable Flow at 850 cfs St. Mary Canal Capacity - Equal to St. Mary Flow Available for U.S. Diversions based on Montana DNRC modeled flows for the IJC Report or 1,686 Acre-Feet per Day, whichever is less.
10. Seepage loss to Drop 1 from Saint Mary River Siphon is 2 percent of gaged flow based on Bureau of Reclamation records.
11. Irrigation season is April 1 to October 31 as per 1921 IJC Order.

Power Generation Table 2 in Appendix B summarizes the results of this hydropower alternative. This tabulation documents the water delivered to the three hydropower sites with nine turbines for each month during water years 1980-2004 study period, based on the criteria noted above. The turbine flows in CFS were calculated from the power water supplied (acre-feet). The head in feet for each turbine was determined, the overall turbine/generator/hydraulic efficiency utilized was 70 percent, and the power constant of 0.085 was utilized to obtain generation in kW. After the generation was determined, the operating time was calculated at 95 percent per month operational time in hours, and the kW generation multiplied by the operating hours resulted in total turbine generation in kWh for each month of the study. During the non-irrigation season, the operating hours for the turbines was set to zero.

Saint Mary Canal at 700 cfs Canal Capacity Option – HKM Alternative

Turbine Specifications – HKM Alternative – 700 cfs Canal Capacity

Turbine	Head (ft)	Minimum Monthly Flow (cfs)	Average Monthly Flow (cfs)	Maximum Monthly Flow (cfs)
Drops 1-3	90	0	275	686
Drop 4	66	0	275	686
Drop 5	57	0	275	686

Turbine Capacity – HKM Alternative – 700 cfs Canal Capacity

Turbine	Max Monthly kW	Min Monthly kW	Avg Monthly kW
Drops 1-3	3673	0	1474
Drop 4	2693	0	1081
Drop 5	2326	0	934

Monthly Turbine Generation – HKM Alternative – 700 cfs Canal Capacity

Turbine	Max Monthly kWh	Min Monthly kWh	Avg Monthly kWh
Drops 1-3	2,596,531	0	917,364
Drop 4	1,904,123	0	672,734
Drop 5	1,644,470	0	580,997

Saint Mary Canal at 850 cfs Canal Capacity Option- HKM Alternative

Turbine Specifications – HKM Alternative – 850 cfs Canal Capacity

Turbine	Head (ft)	Minimum Monthly Flow (cfs)	Average Monthly Flow (cfs)	Maximum Monthly Flow (cfs)
Drops 1-3	90	0	284	833
Drop 4	66	0	284	833
Drop 5	57	0	284	833

Turbine Capacity – HKM Alternative – 850 cfs Canal Capacity

Turbine	Max Monthly kW	Min Monthly kW	Avg Monthly kW
Drops 1-3	4460	0	1518
Drop 4	3270	0	1113
Drop 5	2824	0	962

Monthly Turbine Generation – HKM Alternative – 850 cfs Canal Capacity

Turbine	Max Monthly kWh	Min Monthly kWh	Avg Monthly kWh
Drops 1-3	3,152,931	0	947,717
Drop 4	2,312,149	0	694,993
Drop 5	1,996,856	0	600,221

Conclusions – HKM Alternative

The two major contributing factors to the feasibility of hydropower generation are the head and flow. For Drops 1-3 turbines and the 700 cfs canal capacity option, at 90 feet (27.4 m) of head and an average flow of 275 cfs and maximum design flow of 686 cfs, the average monthly generation is 917,364 kWh for a total average annual generation of about 11,008 MWh. For Drop 4 turbines and the 700 cfs canal capacity option, at 66 feet (20.1 m) of head and an average flow of 275 cfs, the average monthly generation is 672,734 kWh for a total average annual generation of about 8,073 MWh. For Drop 5 turbines and the 700 cfs canal capacity option, at 57 feet (17.4 m) of head and an average flow of 275 cfs, the average monthly generation is 580,997 kWh for a total average annual generation of about 6,972 MWh. The three hydropower sites with nine turbines have a combined average annual generation of about 26,053 MWh

The combined capacity of each hydropower site ranges from 0 kW to 3,673 kW due to the high variability of the power water available, ranging from 0 cfs to 686 cfs (canal capacity). Sizing of the turbines will be dependent on the monthly flow variability, flow duration curve, and the economic viability of the capital cost of construction for the capacity in kW versus generation in kWh. Maximum flow design would result in a combined capacity of 8,692 kW for the nine turbines at the three hydropower sites.

For Drops 1-3 turbines and the 850 cfs canal capacity option, at 90 feet (27.4 m) of head and an average flow of 284 cfs, the average monthly generation is 947,717 kWh for a total average annual generation of about 11,373 MWh. For Drop 4 turbines and the 850 cfs canal capacity option, at 66 feet of head and an average flow of 284 cfs, the average monthly generation is 694,993 kWh for a total average annual generation of about 8,340 MWh. For Drop 5 turbines and the 850 cfs canal capacity option, at 57 feet of head and an average flow of 284 cfs, the average monthly generation is 600,221 kWh for a total average annual generation of about 7,203 MWh. The three hydropower sites with nine turbines have a combined average annual generation of about 26,916 MWh and this is only 863 MWh or 3.3% more than the 700 cfs canal capacity option.

The combined capacity of each hydropower site ranges from 0 kW to 4,460 kW due to the high variability of the power water available, ranging from 0 cfs to 833 cfs (canal capacity). Sizing of the turbines will be dependent on the monthly flow variability, flow duration curve, and the economic viability of the capital cost of construction for the capacity in kW versus generation in kWh. Maximum flow design would result in a combined capacity of 10,554 kW for the nine turbines at the three hydropower sites. This is 1,862 kW more capacity than the 700 cfs canal capacity option.

For the 700 cfs canal capacity option, the HKM Hydropower Alternative with the three hydropower sites and nine turbines generate a combined average annual generation of about 26,053 MWh compared to the average annual generation of about 19,570 MWh for the TD&H Hydropower Alternative. The HKM Hydropower Alternative generates 6,483 MWh more than the TD&H Hydropower Alternative on an annual basis for the 700 cfs canal capacity option, an increase of 33 percent. For the 850 cfs canal capacity option, the HKM Hydropower Alternative with the three hydropower sites and nine turbines generates a combined average annual generation of about 26,916 MWh compared to the average annual generation of about 20,218

MWh for the TD&H Hydropower Alternative. The HKM Hydropower Alternative generates 6,698 MWh more than the TD&H Hydropower Alternative on an annual basis for the 850 cfs canal capacity option, an increase of 33 percent. The HKM Hydropower Alternative would require additional capital cost for the three hydropower sites over the TD&H Hydropower Alternative with one hydropower site. The feasibility of the increased generation by 33 percent will be dependent on the capital recovery factor for this increased capital cost which will be addressed in the cost section of this report.

SAINT MARY CANAL SYSTEM – DROP 5 ALTERNATIVE

This alternative consists of relocating a portion of the St. Mary Canal and bypassing Drop Structures 1 through 5. A single drop structure with three penstocks from the end of the realigned canal to three turbines at the downstream end of the existing Drop No. 5 is proposed to maximize head for hydropower generation. The single drop structure with three penstocks would be designed to bifurcate at each of the three turbine/generators by opening a synchronous gravity-activated counter-weight system during load rejection, as proposed in the preceding HKM Hydropower Alternative.

Figure 5, developed by HKM shows the basic components of this Hydropower Alternative for the St. Mary Canal System. The elevation difference between the point of diversion and the three Turbines at Drop 5 is about 213 feet.

Water supply estimates used for power generation calculations were developed using the following criteria:

1. Study Period: Water Years 1980 – 2004
2. Natural Flow St. Mary River at International Boundary – Natural Flows developed by Montana DNRC.
3. Canadian Share of St. Mary River – Canadian Share of St. Mary River developed by Montana DNRC.
4. U.S. Share of St. Mary River – U.S. Share of St. Mary River developed by Montana DNRC.
5. Net Storage Gain (Release) from Sherburne Reservoir – Based on historical end-of-month storage minus previous month end-of-month storage; historical end-of-month contents for Lake Sherburne from USGS Water Resources Data books.
6. St. Mary River Flow Available for U.S. Diversions (1921 IJC Order) – Equal to U.S Share of St. Mary River minus Net Storage Gain or Release for Lake Sherburne.
7. Historical Diversions to St. Mary Canal – USGS gage records for gage 05018500, St. Mary canal at St. Mary Crossing, near Babb, Montana. Compiled by HKM.
8. Divertable Flow at 700 cfs St. Mary Canal Capacity – Equal to St. Mary Flow Available for U.S. Diversions based on Montana DNRC modeled flows for the IJC Report or 1,388 Acre-Feet per Day, whichever is less.
9. Divertable Flow at 850 cfs St. Mary Canal Capacity - Equal to St. Mary Flow Available for U.S. Diversions based on Montana DNRC modeled flows for the IJC Report or 1,686 Acre-Feet per Day, whichever is less.

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HKM ENGINEERING

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Gaging Sta

Drop 1

SAINT MARY CANAL

Tie-in from existing St. Mary Canal

REALIGNED CANAL

Drop 2

Drop 3

SAINT MARY CANAL

Drop 4

Dubray Coulee

Gravel Pit

New Drop Structure

PENSTOCKS

Drop 5

North Fork Milk River

Grant Gap

4400 4500 4600 4405 4373 4361 4440 4678 4610 4450 4360

5 4 3 8 9 10

N W E S

1,000 500 0 1,000 2,000 3,000 Feet

ST. MARY CANAL SYSTEM
DROP 5 ALTERNATIVE

Figure 5

10. Seepage loss to Drop 1 from Saint Mary River Siphon is 2 percent of gaged flow based on Bureau of Reclamation records.
11. Irrigation season is April 1 to October 31 as per 1921 IJC Order.

Power Generation Table 3 in Appendix C summarizes the results of this hydropower alternative. This tabulation documents the water delivered to the three turbines for each month during water years 1980-2004 study period, based on the criteria noted above. The turbine flows in CFS were calculated from the power water supplied (acre-feet). The head in feet for the turbines was determined, the overall turbine/generator/hydraulic efficiency utilized was 70 percent, and the power constant of 0.085 was utilized to obtain generation in kW. After the generation was determined, the operating time was calculated at 95 percent per month operational time in hours, and the kW generation multiplied by the operating hours resulted in total turbine generation in kWh for each month of the study. During the non-irrigation season, the operating hours for the turbines was set to zero.

Results The following summary documents the results of the water supply and power generation studies done for the Drop 5 Hydropower Alternative.

Saint Mary Canal at 700 cfs Canal Capacity Option- Drop 5 Alternative

Turbine Specifications – Drop 5 Alternative – 700 cfs Canal Capacity

Turbine	Head (ft)	Minimum Monthly Flow (cfs)	Average Monthly Flow (cfs)	Maximum Monthly Flow (cfs)
Drop 5	213	0	275	686

Turbine Capacity – Drop 5 Alternative – 700 cfs Canal Capacity

Turbine	Max Monthly Kw	Min Monthly kW	Avg Monthly kW
Drop 5	8,692	0	3,489

Turbine Generation- Drop 5 Alternative – 700 cfs Canal Capacity

Turbine	Max Monthly kWh	Min Monthly kWh	Avg Monthly kWh
Drop 5	6,145,123	0	2,171,095

Saint Mary Canal at 850 cfs Canal Capacity Option – Drop 5 Alternative

Turbine Specifications – Drop 5 Alternative – 850 cfs Canal Capacity

Turbine	Head (ft)	Minimum Monthly Flow (cfs)	Average Monthly Flow (cfs)	Maximum Monthly Flow (cfs)
Drop 5	213	0	284	833

Turbine Capacity – Drop 5 Alternative – 850 cfs Canal Capacity

Turbine	Max Monthly kW	Min Monthly kW	Avg Monthly kW
Drop 5	10,554	0	3,594

Turbine Generation- Drop 5 Alternative – 850 cfs Canal Capacity

Turbine	Max Monthly kWh	Min Monthly kWh	Avg Monthly kWh
Drop 5	7,461,936	0	2,242,931

Conclusions – Drop 5 Alternative

The two major contributing factors to the feasibility of hydropower generation are the head and flow. For the 700 cfs canal capacity option, at 213 feet of head and an average flow of 275 cfs, the average monthly generation is 2,171,095 kWh for a total average annual generation of about 26,053 MWh. The capacity of the turbines ranges from 0 kW to 8,692 kW due to the high variability of the power water available, ranging from 0 cfs to 686 cfs (canal capacity). Sizing of the turbines will be dependent on the monthly flow variability, flow duration curve, and the economic viability of the capital cost of construction for the capacity in kW versus generation in kWh. Maximum flow design would result in the single hydropower site with three turbines having a combined capacity at 8,692 kW.

For the 850 cfs canal capacity option, at 213 feet of head and an average flow of 284 cfs, the average monthly generation is 2,242,931 kWh for a total average annual generation of about 26,916 MWh. This is only 862 MWh or 3.3% more than the 700 cfs canal capacity option. The capacity of the turbines ranges from 0 kW to 10,554 kW due to the high variability of the power water available, ranging from 0 cfs to 833 cfs (canal capacity). Sizing of the turbines will be dependent on the monthly flow variability, flow duration curve, and the economic viability of the capital cost of construction for the capacity in kW versus generation in kWh. Maximum flow design would result in the three turbines having a combined capacity of 10,554 kW, which is 1,862 kW more than the 700 cfs canal capacity option.

For the 700 cfs canal capacity option, the Drop 5 Hydropower Alternative with the three turbines generates an average annual generation of about 26,053 MWh compared to the average annual generation of about 19,570 MWh for the TD&H Hydropower Alternative. The Drop 5 Hydropower Alternative generates 6,483 MWh more than the TD&H Hydropower Alternative on an annual basis for the 700 cfs canal capacity option, an increase of 33 percent. The Drop 5 Hydropower Alternative with three turbines at a single hydropower site generates the same MWh as the HKM Hydropower Alternative with nine turbines at three hydropower sites on an annual basis for the 700 cfs canal capacity option, as both alternatives have the same head and flow. For the 850 cfs canal capacity option, the Drop 5 Hydropower Alternative with the single turbine generates a combined average annual generation of about 26,916 MWh compared to the average annual generation of about 20,218 MWh for the TD&H Hydropower Alternative. The Drop 5 Hydropower Alternative generates 6,698 MWh more than the TD&H Hydropower Alternative on an annual basis for the 850 cfs canal capacity option, an increase of 33 percent. The Drop 5

Hydropower Alternative with three turbines at a single hydropower site generates the same MWh as the HKM Hydropower Alternative with nine turbines at three hydropower sites on an annual basis for the 850 cfs canal capacity option, as both alternatives have the same head and flow. The Drop 5 Hydropower Alternative would require additional capital cost for the additional length of the three penstocks and re-aligned canal over the TD&H Hydropower Alternative. The feasibility of the increased generation by 33 percent will be dependent on the capital recovery factor for this increased capital cost which will be addressed in the cost section of this report.

HYDROELECTRIC TURBINE SELECTION

The type of turbine selected for the turbine sites for the Saint Mary Canal Hydropower Project is dependent on flow and net effective head (See Appendix D for General Hydropower and Hydrology Information). For an irrigation canal/pipeline system, the hydropower unit is sized based on the flow duration curve or maximum flow that can be utilized when no parallel pipeline systems are constructed and the maximum irrigation demand is delivered through the penstock for the hydropower unit. The type of turbine is also selected based on turbine efficiency for the minimum flow.

In general, for high head and low flows (head greater then 200 feet and flow less then 100 cfs), a twin nozzle Pelton turbine, rated at an efficiency at 92% (turbine only) for a flow range of 10%-100% of the maximum design flow for each nozzle, should be utilized. Pelton turbines for small hydropower units have been designed and installed for a head as low as 70 feet with a flow of 4.5 cfs according to Brett Bauer of Canyon Hydro Inc., Deming, Washington. However, for flows greater than 100 cfs, the head requirements for Pelton turbines are very high at 500 feet and above. For low head (head less then 200 feet) and high flows (flows greater than 100 cfs), the Francis turbine rated at an efficiency of 89% (turbine only) should be utilized for a flow range of 40%-100% of the maximum design flow. For example, if the maximum design flow is 100 cfs, then a Pelton turbine will only work if the minimum flow is 10 cfs or greater, and a Francis turbine will work if the minimum flow is 40 cfs or greater. The overall turbine/generator/hydraulic efficiency utilized was 70 percent.

For the three Saint Mary Canal Hydropower Alternatives, the hydropower system will be designed with multiple turbine/generator units to utilize the maximum canal capacity for irrigation flows. In general, the range of the canal flows during the irrigation season meet the Francis turbine flow range of 40%-100% of the maximum design flow if multiple units are installed. Three Francis turbine/generator units will be utilized for each hydropower alternative to maximize the operating time of the hydropower units for the canal flow range. For the 700 cfs canal capacity option (686 cfs net maximum flow at Drop 1), the penstock size requirement for the three Francis turbines is three 4.5-foot diameter steel penstocks with a maximum pipe velocity of 14.5 feet per second. Each penstock would have a flow capacity of about 230 cfs. For the 850 cfs canal capacity option (833 cfs net maximum flow at Drop 1), the penstock size requirement is three 5-foot diameter steel penstocks with a maximum pipe velocity of 14.3 feet per second. Each penstock would have a flow capacity of about 280 cfs. The maximum pipe velocities are less than the hydropower equipment maximum operating velocity of 15 feet per second.

For the three Saint Mary Canal Hydropower Alternatives, the Drop 5 Hydropower Alternative is the only alternative that has a head greater than 200 feet for a Pelton turbine at 213 feet (64.9 m) of head. However, the maximum design flow range of 228.7 cfs (6.5 m^3/s) to 277.7 cfs (7.9 m^3/s) does meet the design requirements for a Pelton turbine. The Drop 5 Hydropower Alternative would require a Francis or Kaplan turbine. See Figure 6, Turbine Selection Chart developed by the European Small Hydropower Association, "Layman's Guidebook on How to Develop a Small Hydro Site", 1998. This turbine selection chart was utilized to determine the turbine type for all three Saint Mary Canal Hydropower Alternatives.

The TD&H Hydropower Alternative with 160 feet (48.8 m) of head and maximum design flow range **for each of the three turbines** of 228.7 cfs (6.5 m^3/s) to 277.7 cfs (7.9 m^3/s) would require three Francis or Kaplan type turbines as shown by Figure 6.

The Drop 1-3 turbine for the HKM Hydropower Alternative with a head of 90 feet (27.4 m) and maximum design flow range **for each of the three turbines** of 228.7 cfs (6.5 m^3/s) to 277.7 cfs (7.9 m^3/s) would require three Francis or Kaplan type turbines as shown by Figure 6. The Drop 4 and Drop 5 turbines for the HKM Hydropower Alternative have a head of 66 feet (20.1 m) and 57 feet (17.4 m), respectively, and maximum design flow range **for each of the three turbines** of 228.7 cfs (6.5 m^3/s) to 277.7 cfs (7.9 m^3/s) which would require three Francis or Kaplan type turbines as shown by Figure 6.

The minimum flow of 0 cfs for all turbines is during the winter months when the canal is not operating. Therefore, the minimum flow is not a significant factor in turbine selection because during the operating irrigation season the minimum flow is usually above 200 cfs.

For the Drop 5 and HKM Hydropower Alternatives, the drop structures would be designed with penstocks that bifurcate at each turbine/generator by opening a synchronous gravity-activated counter-weight system, as proposed in the HKM Hydropower Alternative. The synchronous gravity-activated counter-weight system would deflect the entire water flow to the afterbay of the powerplant upon full load rejection. A canal overflow siphon could be installed in the canal at the penstock intake as another option for flow regulation during a load rejection at the hydropower sites. For the TD&H Hydropower Alternative, the inlet of the drop structure for Drops 1-4 would be designed to be "Hydropower Ready" or bifurcate for future hydropower development. The TD&H Hydropower Alternative requires a parallel drop structure system and penstock system and each system would be sized for the entire St. Mary Canal capacity.

A schematic of the recently installed hydropower turbine/generator system for Tiber Reservoir is shown in Figure 7 and a general cross-section diagram and parts list for a vertical Kaplan turbine is shown in Figure 8. The hydropower turbine/generators for all three hydropower system alternatives would be similar to the hydropower turbine/generator represented in Figures 7 and 8. The hydropower system configurations for all three Saint Mary Canal alternatives are depicted in the previous Figures 2 through 5.

FIGURE 6 – TURBINE SELECTION CHART

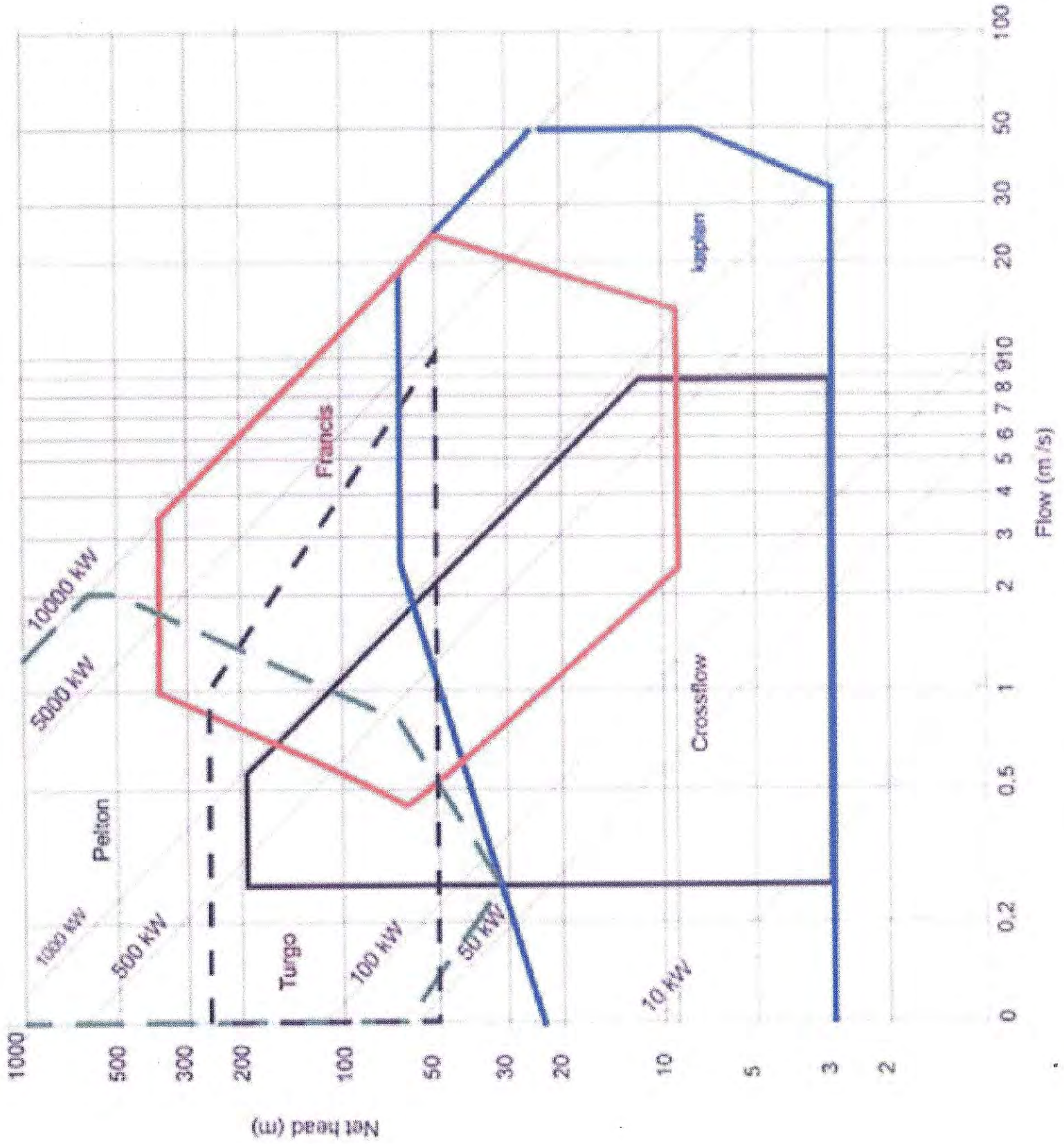


FIGURE 7: TIBER RESERVOIR/DAM HYDROPOWER TURBINE/GENERATOR SCHEMATIC

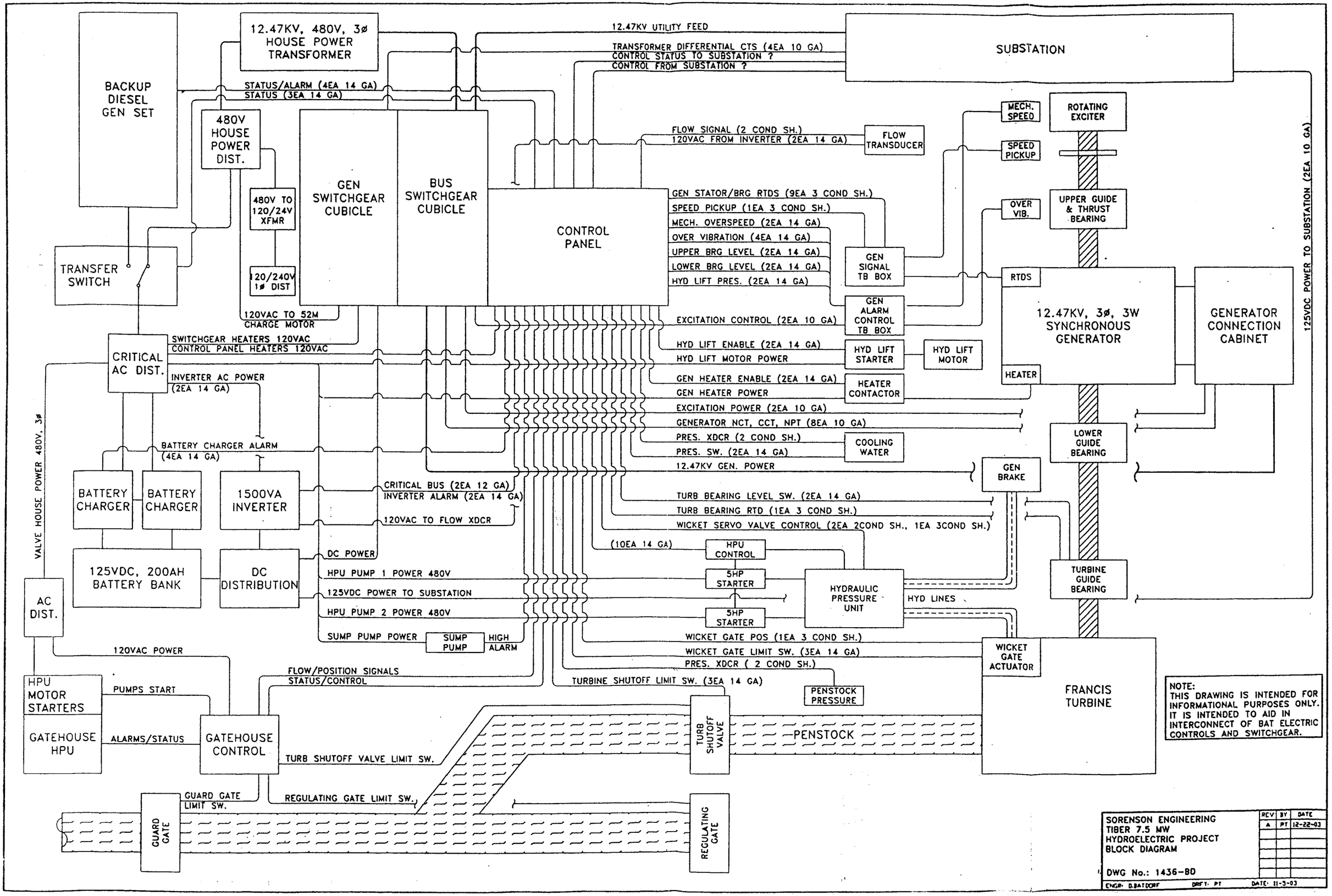
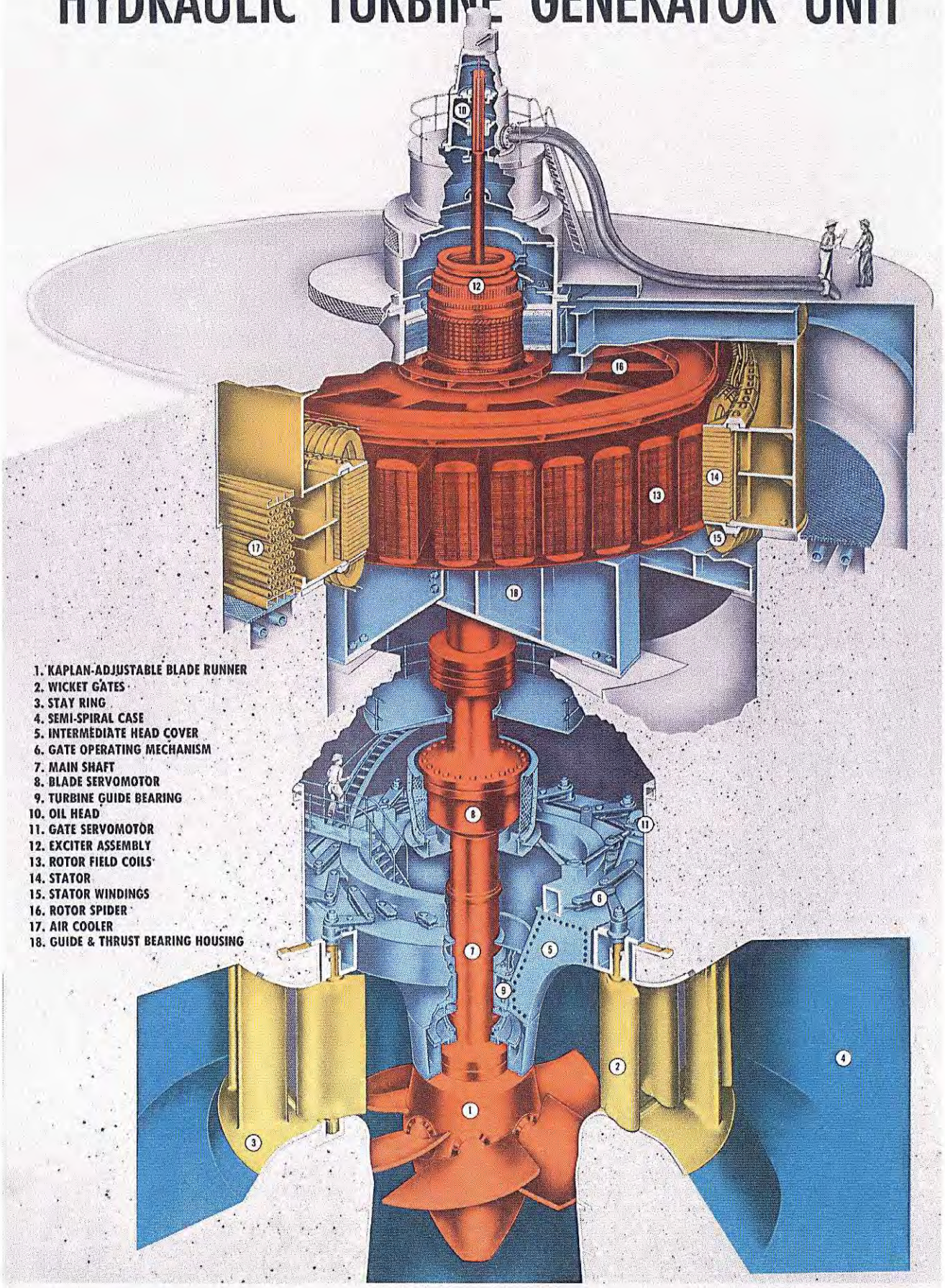


FIGURE 8

HYDRAULIC TURBINE GENERATOR UNIT



1. KAPLAN-ADJUSTABLE BLADE RUNNER
2. WICKET GATES
3. STAY RING
4. SEMI-SPIRAL CASE
5. INTERMEDIATE HEAD COVER
6. GATE OPERATING MECHANISM
7. MAIN SHAFT
8. BLADE SERVOMOTOR
9. TURBINE GUIDE BEARING
10. OIL HEAD
11. GATE SERVOMOTOR
12. EXCITER ASSEMBLY
13. ROTOR FIELD COILS
14. STATOR
15. STATOR WINDINGS
16. ROTOR SPIDER
17. AIR COOLER
18. GUIDE & THRUST BEARING HOUSING

ALLIS-CHALMERS

COSTS OF TURBINES AND RELATED HYDROELECTRIC EQUIPMENT

An appraisal level economic viability study was completed on all three hydropower alternatives. Construction costs, including the transformers, transmission lines, and switching gear were determined and evaluated against the net annual power revenue from generation. Total Installed Cost with Penstock, Total Annual Cost, Total Annual Gross Revenue, Total Annual Net Loss or Revenue, and Total Unit Cost were determined for the Hydropower System at 700 cfs and 850 cfs canal capacities. The Total Incremental Costs for the St. Mary Canal Hydropower Alternatives at canal capacities of 700 cfs and 850 cfs were calculated by subtracting the Total Irrigation-Only System Installed Cost from the Total Hydropower System Installed Cost.

The definitions below are categories utilized in the project cost summary:

- Major Field Item Costs – includes project costs for major components of the project such as power house and other civil works, turbine/generator with controls, penstocks, canal re-alignment and improvements as needed, parallel hydropower ready configuration as needed, transformer, sub-station, and transmission line/switchyard costs.

- Unlisted Items – Unlisted items are minor items that were not inventoried in the preparation of the project cost estimates for the major field items. Unlisted items were computed at 10 percent of the major field cost.

- Contingencies – Contingencies, in the context of the determination of pre-construction costs, were intended to represent an addition to quantities and/or unit prices of major field items. This cost was identified to be 20 percent of the subtotal of the Major Field Item cost plus the Unlisted Item Costs.

- Engineering – Engineering, in the context of the determination of pre-construction costs, were intended to include preparation of plans and specifications by a design engineer, electrical/mechanical and other investigations in support of design, administration and field inspection of construction to ensure conformance with plans and specifications, and administration of the engineering and construction contracts. This cost was identified to be 20 percent of the subtotal of the Major Field Item cost plus Contingencies Cost and the Unlisted Item Costs.

- Total Installed Cost – the sum of installed costs including field costs, unlisted items, contingencies, and engineering costs intended to represent the full amount of the budget for construction of all project facilities.

- Capital Recovery Factor – Equal to the sinking fund factor plus the interest rate. When multiplied by the present debt, the factor is used to determine the uniform end-of-year payment necessary to repay the debt in *n* years with interest rate *i*.

- Annual Cost of Capital – Equal to the Total Installed Cost multiplied by the Capital Recovery Factor. The uniform end-of-year payments necessary to repay the debt or Total Installed Cost in *n* years with interest rate *i*.

- Total Annual Cost – Equal to the Annual O&M Cost plus the Annual Cost of Capital.

Appendix E contains additional data for the General Hydropower Cost Estimates and Economic Feasibility for the Saint Mary Canal System. The following summaries in Table 1 and 2 reflect the results of the Hydropower Cost Estimates and Economic Feasibility for the Saint Mary Canal System Hydropower Alternatives.

As shown by Table 1, none of the three proposed Hydropower Alternatives are economically viable. Unit costs range from $3,314 per KW to $4,664 per KW for the St. Mary Canal Hydropower Alternatives and unit costs must range from $1,000 per KW to a maximum of $1,500 per KW to be economically feasible. Current power rates of $0.055 per KWHr would have to increase to a range above $0.122 per KWHr to $0.171 per KWHr for the St. Mary Canal Hydropower Alternatives to be economically feasible. At a power rate range of $0.122 per KWHr to $0.171 per KWHr for the St. Mary Canal Hydropower Alternatives, the annual costs equal the annual gross revenue for the total annual generation produced.

The installed hydropower unit cost of $1,500 per KW utilized for the installed cost of the hydropower units included engineering, contingencies, unlisted items, power house and other civil works, turbine/generator with controls, penstocks, canal re-alignment and improvements as needed, parallel hydropower ready configuration as needed, transformer, sub-station, and transmission line/switchyard costs. The higher range hydropower unit cost of $1,500 per KW was utilized for this study because this value is an industry standard for hydropower systems developed in existing canal systems due to the additional costs for developing hydropower on a canal system. Hydropower systems developed for reservoirs utilize the lower range hydropower unit cost of $1,000 per KW since the forebay, intake, and afterbay are already constructed and penstocks of significant length are not required. Glacier Electric, the electrical cooperative for the St. Mary Canal area, provided estimated costs for the transformers, sub-stations, and transmission lines. The transmission line that the proposed St. Mary Canal Hydropower Alternatives would tie into is the 34.5 KV Port of Del-Bonita Crossing line about 13 miles from the drop structures. A single-pole 34.5 KV transmission line would cost approximately $75,000 per mile for a total cost of $975,000 for the 13 miles. The sub-stations are estimated to cost $42,000 each and depending on the hydropower alternative selected, the total cost ranges from $42,000 to $126,000. The transformers are estimated to cost $65,000 each and depending on the hydropower alternative selected, the total cost ranges from $65,000 to $195,000. Total transformer, transmission line, and sub-station estimated cost for the St. Mary Canal Hydropower Alternatives ranges from $1,082,000 to $1,296,000. However, as previously stated, this cost was included in the $1,500 per KW utilized to determine the installed cost of the hydropower units. A tie-in to the Canadian power grid could also be an alternative that could be evaluated if additional hydropower studies are conducted for the Saint Mary Canal.

Table 1

Saint Mary Canal System Cost Estimates for Hydropower Alternatives

ITEM	TOTAL HYDROPOWER INSTALLED COST WITH PENSTOCK (DOLLARS)	TOTAL INSTALLED UNIT COST FOR HYDROPOWER WITH PENSTOCK (DOLLARS/KW)	TOTAL ANNUAL O&M COST (DOLLARS)	TOTAL ANNUAL COST OF HYDROPOWER (DOLLARS)	TOTAL ANNUAL GROSS HYDROPOWER REVENUE (DOLLARS)	TOTAL ANNUAL NET (LOSS) OR REVENUE FOR HYDROPOWER (DOLLARS)	TOTAL DROP STRUCTURE IRRIGATION-ONLY SYSTEM INSTALLED COST (DOLLARS)	TOTAL INCREMENTAL COST OF HYDROPOWER SYSTEM VERSUS IRRIGATION SYSTEM (DOLLARS)
TD&H ALTERNATIVE 700 CFS CANAL 6529 KW	$30,450,974	$4,664	$456,765	$2,740,866	$1,076,350	$(1,664,516)	$7,097,000	$23,353,974
HKM ALTERNATIVE 700 CFS CANAL 8692 KW	$29,608,524	$3,406	$444,128	$2,665,038	$1,432,915	$(1,232,123)	$7,097,000	$22,511,524
DROP-5 ALTERNATIVE 700 CFS CANAL 8692 KW	$34,830,259	$4,007	$522,454	$3,135,042	$1,432,915	$(1,702,127)	$7,097,000	$27,733,259
TD&H ALTERNATIVE 850 CFS CANAL 7928 KW	$33,404,342	$4,213	$501,065	$3,006,696	$1,111,990	$(1,894,706)	$8,635,200	$24,769,142
HKM ALTERNATIVE 850 CFS CANAL 10554 KW	$34,980,660	$3,314	$524,710	$3,148,579	$1,480,380	$(1,668,199)	$8,635,200	$26,345,460
DROP-5 ALTERNATIVE 850 CFS CANAL 10554 KW	$40,500,346	$3,837	$607,505	$3,645,401	$1,480,380	$(2,165,021)	$8,635,200	$31,865,146

Table 2

Saint Mary Canal Hydropower System Design and Cost Estimates

ANNUAL PROJECT COST Item	O & M	Life (years)	Interest	Hydropower Field Cost	Unlisted Items 10%	Contingencies 20%	Engineering 20%	Total Installed Cost	O & M Cost	Capital Recovery Factor	Annual Cost of Capital	Total Annual Cost
TD&H at 700 cfs	1.50%	40	7.000%	$ 19,224,100	$ 1,922,410	$ 4,229,302	$ 5,075,162	$ 30,450,974	$ 456,765	0.07501	$ 2,284,101	$ 2,740,866
Canal Capacity												
TD&H at 850 cfs	1.50%	40	7.000%	$ 21,088,600	$ 2,108,860	$ 4,639,492	$ 5,567,390	$ 33,404,342	$ 501,065	0.07501	$ 2,505,631	$ 3,006,696
Canal Capacity												
HKM at 700 cfs	1.50%	40	7.000%	$ 18,692,250	$ 1,869,225	$ 4,112,295	$ 4,934,754	$ 29,608,524	$ 444,128	0.07501	$ 2,220,910	$ 2,665,038
Canal Capacity												
HKM at 850 cfs	1.50%	40	7.000%	$ 22,083,750	$ 2,208,375	$ 4,858,425	$ 5,830,110	$ 34,980,660	$ 524,710	0.07501	$ 2,623,869	$ 3,148,579
Canal Capacity												
DROP-5 at 700 cfs	1.50%	40	7.000%	$ 21,988,800	$ 2,198,880	$ 4,837,536	$ 5,805,043	$ 34,830,259	$ 522,454	0.07501	$ 2,612,588	$ 3,135,042
Canal Capacity												
DROP-5 at 850 cfs	1.50%	40	7.000%	$ 25,568,400	$ 2,556,840	$ 5,625,048	$ 6,750,058	$ 40,500,346	$ 607,505	0.07501	$ 3,037,896	$ 3,645,401
Canal Capacity												

The primary cost factor for the St. Mary Canal Hydropower Alternatives is the steel pipeline for penstocks ranging in price from $359.00 per foot installed for the 54-inch diameter pipe to $397.00 per foot installed for the 60-inch diameter steel pipe. These steel pipeline costs were provided by Liberty Companies in Great Falls, Montana. Liberty Companies has been involved with supplying steel penstocks for over 60 hydropower projects. The recommended pipe configuration is with bell and spigot ends to allow for penstock deflection and reduced labor costs for welding the pipe ends together.

Table 2 summarizes the Field Costs, Annual Costs, and Installed Costs of the three Saint Mary Canal Hydropower Alternatives at the 700 cfs and 850 cfs canal flows. The O&M rate utilized was 1.5% and the service life of the equipment utilized was 40 years, which are industry standards for hydropower facilities. Hydropower Field Costs ranged from $18,692,250 for the HKM Hydropower Alternative at a canal capacity of 700 cfs to $25,568,400 for the Drop-5 Hydropower Alternative at a canal capacity of 850 cfs. The Total Installed Costs were then calculated by adding the Field Costs to: 1.) Unlisted Items at 10% of Field Costs 2.) Contingencies at 20% of Field Costs plus Unlisted Items and 3.) Engineering at 20% of Field Costs plus Unlisted Items plus Contingencies. The Total Installed Costs ranged from $29,608,524 for the HKM Hydropower Alternative at a canal capacity of 700 cfs to $40,500,346 for the Drop-5 Hydropower Alternative at a canal capacity of 850 cfs.

The Annual O&M Costs ranged from $444,128 for the HKM Hydropower Alternative at a canal capacity of 700 cfs to $607,505 for the Drop-5 Hydropower Alternative at a canal capacity of 850 cfs. The Annual Cost of Capital ranged from $2,220,910 for the HKM Hydropower Alternative at a canal capacity of 700 cfs to $3,037,896 for the Drop-5 Hydropower Alternative at a canal capacity of 850 cfs. The Total Annual Cost (Capital plus O&M) ranged from $2,665,038 for the HKM Hydropower Alternative at a canal capacity of 700 cfs to $3,645,401 for the Drop-5 Hydropower Alternative at a canal capacity of 850 cfs.

As shown by Table 1, the Total Incremental Cost for the St. Mary Canal Hydropower Alternatives ranges from $22,511,524 for the HKM Hydropower Alternative at a canal capacity of 700 cfs to $31,865,146 for the Drop-5 Hydropower Alternative at a canal capacity of 850 cfs when compared to the irrigation only system. The **Annual Net Loss** for Hydropower ranged from $1,232,123 for the HKM Hydropower Alternative at a canal capacity of 700 cfs to $2,165,021 for the Drop-5 Hydropower Alternative at a canal capacity of 850 cfs. Since Annual Net Losses occur for all hydropower alternatives, the feasibility of each hydropower alternative from a cost and rate of return basis does not appear to be favorable.

FERC REQUIREMENTS, LICENSING, AND PERMITS

The Federal Energy Regulatory Commission (FERC) requirements are outlined in the "Hydroelectric Licensing under the Federal Power Act, Final Rule and Tribal Policy Statement", Issued July 23, 2003. Other FERC literature that should be referenced for information regarding the FERC Licensing process is the "Handbook for Hydroelectric Project Licensing and 5 MW Exemptions from Licensing", issued April, 2004 and the "Understanding the Study Criteria, Integrated Licensing Process", issued April 6, 2005.

The Blackfeet Tribe will utilize the information contained in this study to determine the extent of further action, if any, for FERC Licensing of the Saint Mary Canal Drop Structure Hydropower Alternatives. For example, the Blackfeet Tribe could pursue an Application for Preliminary Permit for the Saint Mary Canal Drop Structure Hydroelectric Project to FERC, similar to the November 2001 Sherburne Dam Hydroelectric Project Application for Preliminary Permit to FERC by the Blackfeet Tribe.

Appendix F contains a few of the relevant FERC Licensing Information that would apply to the Saint Mary Canal Hydroelectric Project should the Blackfeet Tribe choose to apply for a Preliminary Permit. Three hydroelectric licensing processes, a schematic of the Integrated Licensing Process Final Rule, and the exemption from licensing are presented in Appendix F. If the proposed Saint Mary Canal Hydroelectric Project is determined to be exempt from FERC Licensing, then the administrative cost of the proposed project is greatly reduced, especially the environmental analysis component of the project.

A Preliminary FERC Permit secures priority of application for license and provides the prospective developer with time to evaluate the proposed hydroelectric project. A Preliminary Permit also allows time to complete studies required to support a development application, but the Preliminary Permit is not a prerequisite to filing a license application. A Preliminary FERC Permit would allow the Blackfeet Tribe to secure the proposed Saint Mary Canal Drop Structure Hydroelectric Project for 3 years and prevents other entities from filing for permits at this site. The estimated cost to complete the Preliminary FERC Permit process is $250,000 to $300,000. A Preliminary Permit does not preclude another entity from filing a license application directly to FERC for the Saint Mary Canal Drop Structure Hydroelectric Project.

The Application for a Preliminary Permit must contain an Initial Statement, a Verification Statement, and Four Numbered Exhibits. The Initial Statement must include applicant information, project data, requested term of the permit, affected political jurisdictions, and a verification of the facts presented. The Verification Statement contains the signature of Notary Public or other authorized official verifying the information contained in the application is true. Exhibit 1 describes the project with four items: (1) a characterization of the project structures, reservoir, and transmission facilities; (2) estimates of energy and capacity; (3) identification of affected United States lands; and (4) other information demonstrating how the proposed development of the water resource would be in the public interest. Exhibit 2 describes project studies, either completed or planned, for assessing project feasibility, determining environmental impacts, and preparing the application. Exhibit 3 is a statement of costs and financing that must provide an estimate of the costs of doing the project studies described in Exhibit 2, the source of funding for these studies, and a description of the anticipated market for the power to be generated by the proposed project. Exhibit 4 includes maps that clearly show the location of the project, the location and relationship of the principal project features, a proposed boundary for the project, and any areas with special protected status under the National Wild and Scenic River System or Wilderness Act. The developer must file the Application for Preliminary Permit in order to secure the Permit for a maximum of 3 years. If the permittee fails to file an acceptable License Application during the 3-year term of the permit, then the permittee's priority of application for a license is lost, but the permittee can still file a License Application.

FERC's policy statement, issued July 23, 2003, commits to promoting a government-to-government relationship with federally-recognized tribes potentially affected by a licensing proceeding. A meeting shall be held no later than 30 days following the filing of the Notice of Intent between FERC staff and each Indian tribe likely to be affected by a licensing action, if the Indian tribe agrees to such a meeting. The purpose of the meeting is to assure tribal issues and interests are known and considered by FERC in its licensing decision and to facilitate the Indian tribe's participation in the Integrated Licensing Process.

STUDY CONCLUSIONS AND RECOMMENDATIONS

The St. Mary Canal Hydropower System would not generate sufficient power revenue to recover the costs required to design and install hydropower units for any of the proposed hydropower alternatives in place of the irrigation only system for the five drop structures. All of the turbines have sufficient flow, although seasonal, but the head is not sufficient to generate electricity at a rate that will allow for a reasonable capital recovery. The total incremental cost for the St. Mary Canal Hydropower Alternatives ranges from $22,511,524 to $31,865,146 when compared to the irrigation only system costs for the five drop structures. Potential hydropower alternatives that utilize the existing canal alignment, five turbine sites, and five sets of penstocks at all five drop structures could be further investigated for financial feasibility.

The HKM Hydropower Alternative is the least cost hydropower alternative for the 700 cfs canal capacity option at a Total Installed Cost for Hydropower System with Penstock at $29,608,524. The TD&H Hydropower Alternative is the least cost hydropower alternative for the 850 cfs canal capacity option at a Total Field Cost for Hydropower System with Penstock at $33,404,342. However, the re-aligned canal for the TD&H Alternative has many easement and canal stability issues that need to be addressed before this could be further considered as a viable hydropower alternative. The Drop-5 Hydropower Alternative also utilizes a re-aligned canal and has the same easement and canal stability issues. Bureau of Reclamation, Great Plains Region, engineers have identified geotechnical stability concerns with the proposed canal re-alignment as shown in Figure 2. At a minimum, the canal would have to be lined for the entire re-aligned length and these costs have not been factored into the TD&H August 2006 report, "St. Mary Diversion Facilities Feasibility and Preliminary Engineering Report for Facility and Rehabilitation". Therefore, the incremental hydropower cost versus irrigation system only cost for the TD&H and Drop-5 Hydropower Alternatives would increase substantially due to the canal lining costs. Lining the re-aligned canal may not prevent the canal stability problems associated with this proposed canal alignment because the existing slide areas are caused by unknown groundwater sources upgradient of the existing canal. Lining a re-aligned canal would not prevent geotechnical instability from these unknown groundwater sources. The re-aligned canal would still experience stability problems due to the slides. If re-alignment of the St. Mary Canal is not feasible due to geotechnical engineering or easement issues, the TD&H and Drop-5 Hydropower Alternatives should be dropped as viable hydropower alternatives.

The Drop-5 Hydropower Alternative has the highest Total Field Cost for Hydropower System with Penstock at $21,988,800 for the 700 cfs canal capacity option and $25,568,400 for the 850 cfs canal capacity option. The high field cost of the Drop-5 Hydropower Alternative is due to the length and cost of the penstock, as well as the cost of the re-aligned canal.

For the HKM Hydropower Alternative, from Drop 1 to Drop 3, the St. Mary Canal is replaced with three 54-inch or 60-inch diameter buried steel penstocks for a total length of 5,250 feet. This is an additional 4,450 feet of penstock greater then the TD&H Hydropower Alternative penstock length of 800 feet. However, the HKM Hydropower Alternative does not have any easement issues or canal stability issues that are major issues for the TD&H Hydropower and Drop-5 Hydropower Alternatives. According to the Bureau of Reclamation, the O&M of the St. Mary Canal for this reach of the canal would also be greatly reduced because the slide areas that have sloughed into the canal over the years would no longer present a problem.

Hydropower Total Installed Unit Costs are at $3,314 per KW for the HKM Hydropower Alternative at 850 cfs canal capacity and $4,664 per KW for the TD&H Hydropower Alternative at 850 cfs canal capacity. Unit cost must range from $1,000 per KW to a maximum of $1,500 per KW to be economically feasible. In addition, all three alternatives have Total Annual Net Losses ranging from $1,232,123 to $$2,165,021. Since the unit costs and annual net loss of the HKM Hydropower Alternative are the lowest for the three Hydropower Alternatives analyzed and the HKM Hydropower Alternative has significant O&M benefits, then the HKM Hydropower Alternative could be further studied for potential of reducing the unit cost per KW to an acceptable value. Possible reductions in unit costs and annual net losses could be realized by increasing the United States share of the Saint Mary River diversions. Increasing the Saint Mary Canal flows could result in increased annual generation, decreased hydropower unit costs, and possibly in annual net revenue being realized. Another possible reduction in hydropower unit costs is by utilizing continuous formed concrete pipe in place of the steel penstocks.

In order to reduce the unit cost for hydropower generation, conjunctive wind generation potential should be evaluated for the St. Mary Canal area. Wind turbines could be installed near the drop structures and within the canal easement. The wind turbines may be able to utilize the same transformer, sub-station, and transmission line as the hydropower units. By co-generating with hydro and wind, the duration of generation can be increased to twelve months instead of 6 months for only hydropower. Co-generation of hydro and wind may make the hydropower cost effective to install.

A reservoir site from Drop 1 to Drop 4 has been explored by the Bureau of Reclamation Great Plains Region. The reservoir would be utilized for re-regulation of canal flows, increased allocation of the United States share of the Saint Mary River, and a forebay to a powerplant. The dam would be about 125 feet high and the reservoir storage capacity would be approximately 15,000 acre-feet at elevation 4,380 feet. The dam would be located near St. Mary Canal Drop 4. Significant recreational benefits would also be realized from the development of a reservoir along the Saint Mary Canal.

APPENDIX A
TD&H HYDROPOWER ALTERNATIVE

TABLE 1 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - TD&H ALTERNATIVE - REALIGNED CANAL WITH THREE 72-INCH PENSTOCKS TO DROP 4

						Power Water Supplied and Generation												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Turbine Head (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Turbine Generation for 700 cfs Capacity (kW)	Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Turbine Generation for 700 cfs Capacity (kWh)	Turbine Generation for 850 cfs Capacity (kWh)
1980	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1980	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1980	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1980	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1980	Mar	6,902	11,817	11,817	236	236	11,580	188	11,580	195	160	70%	0.085	1,793	1,853	0	0	0
1980	Apr	24,908	15,424	15,924	308	318	15,115	254	15,606	262	160	70%	0.085	2,418	2,497	200	483,643	499,341
1980	May	31,738	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1980	Jun	39,461	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1980	Jul	41,841	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1980	Aug	40,643	38,393	13,812	768	276	37,626	612	13,536	220	160	70%	0.085	5,825	2,096	707	4,118,560	1,481,661
1980	Sep	13,977	13,435	13,435	269	269	13,166	221	13,166	221	160	70%	0.085	2,106	2,106	684	1,440,773	1,440,773
1980	Oct	0	6,351	6,582	127	132	6,224	101	6,451	105	160	70%	0.085	964	999	707	681,258	706,105
1981	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1981	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1981	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1981	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1981	Mar	25,256	19,433	22,309	389	446	19,045	310	21,863	367	160	70%	0.085	2,949	3,498	0	0	0
1981	Apr	20,876	17,368	14,314	347	286	17,021	286	14,027	236	160	70%	0.085	2,723	2,244	200	544,614	448,837
1981	May	34,088	43,031	49,707	861	994	42,170	686	48,713	792	160	70%	0.085	6,529	7,542	707	4,616,055	5,332,215
1981	Jun	39,023	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1981	Jul	41,337	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1981	Aug	38,372	43,031	37,154	861	743	42,170	686	36,411	592	160	70%	0.085	6,529	5,637	707	4,616,055	3,985,614
1981	Sep	32,886	16,712	5,033	334	101	16,378	275	4,933	83	160	70%	0.085	2,620	789	684	1,792,248	539,770
1981	Oct	0	3,552	3,727	71	75	3,481	57	3,652	59	160	70%	0.085	539	565	707	381,007	399,771
1982	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1982	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1982	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1982	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1982	Mar	0	8,799	8,692	176	174	8,623	140	8,518	143	160	70%	0.085	1,335	1,363	0	0	0
1982	Apr	0	4,380	4,380	88	88	4,292	72	4,292	72	160	70%	0.085	687	687	200	137,344	137,344
1982	May	31,747	27,489	31,253	550	625	26,939	438	30,628	498	160	70%	0.085	4,171	4,742	707	2,948,808	3,352,586
1982	Jun	31,622	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1982	Jul	36,042	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1982	Aug	0	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1982	Sep	0	37,803	16,364	756	327	37,047	623	16,037	270	160	70%	0.085	5,927	2,566	684	4,054,106	1,754,941
1982	Oct	0	5,283	5,673	106	113	5,177	84	5,560	90	160	70%	0.085	802	861	707	566,687	608,588
1983	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1983	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1983	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1983	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1983	Mar	16,400	8,721	8,427	174	169	8,547	139	8,258	139	160	70%	0.085	1,323	1,321	0	0	0
1983	Apr	23,451	5,776	5,776	116	116	5,660	95	5,660	95	160	70%	0.085	906	906	200	181,116	181,116
1983	May	18,539	23,787	25,644	476	513	23,311	379	25,131	409	160	70%	0.085	3,609	3,891	707	2,551,643	2,750,880
1983	Jun	37,989	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1983	Jul	42,498	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1983	Aug	39,558	33,651	14,607	673	292	32,978	536	14,315	233	160	70%	0.085	5,106	2,216	707	3,609,833	1,566,923

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TURBINE POWER GENERATION - TD&H ALTERNATIVE - REALIGNED CANAL WITH THREE 72-INCH PENSTOCKS TO DROP 4

						Power Water Supplied and Generation												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Turbine Head (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Turbine Generation for 700 cfs Capacity (kW)	Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Turbine Generation for 700 cfs Capacity (kWh)	Turbine Generation for 850 cfs Capacity (kWh)
1983	Sep	90	5,368	5,368	107	107	5,260	88	5,260	88	160	70%	0.085	842	842	684	575,626	575,626
1983	Oct	0	2,715	2,847	54	57	2,660	43	2,790	45	160	70%	0.085	412	432	707	291,207	305,442
1984	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1984	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1984	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1984	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1984	Mar	19,908	14,632	14,563	293	291	14,339	233	14,272	240	160	70%	0.085	2,220	2,283	0	0	0
1984	Apr	12,664	7,135	7,135	143	143	6,992	118	6,992	118	160	70%	0.085	1,119	1,119	200	223,724	223,724
1984	May	21,723	25,383	28,569	508	571	24,875	405	27,998	455	160	70%	0.085	3,851	4,335	707	2,722,893	3,064,667
1984	Jun	39,913	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1984	Jul	41,881	43,031	48,246	861	965	42,170	686	47,281	769	160	70%	0.085	6,529	7,320	707	4,616,055	5,175,499
1984	Aug	27,976	27,898	10,574	558	211	27,340	445	10,362	169	160	70%	0.085	4,233	1,604	707	2,992,721	1,134,257
1984	Sep	0	7,045	7,045	141	141	6,904	116	6,904	116	160	70%	0.085	1,104	1,104	684	755,474	755,474
1984	Oct	0	6,161	6,402	123	128	6,038	98	6,274	102	160	70%	0.085	935	971	707	660,899	686,787
1985	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1985	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1985	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1985	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1985	Mar	3,615	4,242	4,001	85	80	4,157	68	3,921	66	160	70%	0.085	644	627	0	0	0
1985	Apr	33,739	8,617	9,322	172	186	8,444	142	9,136	154	160	70%	0.085	1,351	1,462	200	270,194	292,313
1985	May	40,399	40,754	45,240	815	905	39,939	650	44,335	721	160	70%	0.085	6,184	6,864	707	4,371,759	4,853,011
1985	Jun	41,133	40,255	50,567	805	1011	39,450	663	49,555	833	160	70%	0.085	6,311	7,928	684	4,317,024	5,422,862
1985	Jul	32,914	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1985	Aug	39,566	29,540	10,004	591	200	28,949	471	9,804	159	160	70%	0.085	4,482	1,518	707	3,168,812	1,073,159
1985	Sep	24,295	20,066	19,860	401	397	19,665	330	19,463	327	160	70%	0.085	3,146	3,114	684	2,151,965	2,129,854
1985	Oct	0	11,812	14,436	236	289	11,576	188	14,147	230	160	70%	0.085	1,792	2,190	707	1,267,120	1,548,543
1986	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1986	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1986	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1986	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1986	Mar	0	19,433	22,309	389	446	19,045	310	21,863	367	160	70%	0.085	2,949	3,498	0	0	0
1986	Apr	14,740	30,246	25,783	605	516	29,641	498	25,267	425	160	70%	0.085	4,742	4,042	200	948,423	808,489
1986	May	17,560	30,848	33,339	617	667	30,231	492	32,672	531	160	70%	0.085	4,681	5,058	707	3,309,160	3,576,341
1986	Jun	26,240	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1986	Jul	38,370	43,031	48,647	861	973	42,170	686	47,674	775	160	70%	0.085	6,529	7,381	707	4,616,055	5,218,468
1986	Aug	35,540	18,980	7,305	380	146	18,601	303	7,158	116	160	70%	0.085	2,880	1,108	707	2,036,072	783,580
1986	Sep	3,230	7,784	7,784	156	156	7,628	128	7,628	128	160	70%	0.085	1,220	1,220	684	834,764	834,764
1986	Oct	0	8,867	9,264	177	185	8,690	141	9,078	148	160	70%	0.085	1,345	1,406	707	951,197	993,741
1987	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1987	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1987	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1987	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1987	Mar	21,420	13,708	13,340	274	267	13,434	218	13,073	220	160	70%	0.085	2,080	2,092	0	0	0
1987	Apr	12,720	14,081	14,378	282	288	13,799	232	14,090	237	160	70%	0.085	2,208	2,254	200	441,529	450,856
1987	May	30,230	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1987	Jun	37,060	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862

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						Power Water Supplied and Generation												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Turbine Head (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Turbine Generation for 700 cfs Capacity (kW)	Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Turbine Generation for 700 cfs Capacity (kWh)	Turbine Generation for 850 cfs Capacity (kWh)
1987	Jul	31,060	43,031	36,471	861	729	42,170	686	35,742	581	160	70%	0.085	6,529	5,534	707	4,616,055	3,912,362
1987	Aug	35,640	33,278	21,449	666	429	32,613	530	21,020	342	160	70%	0.085	5,049	3,254	707	3,569,841	2,300,917
1987	Sep	9,390	6,969	6,969	139	139	6,830	115	6,830	115	160	70%	0.085	1,093	1,093	684	747,420	747,420
1987	Oct	0	2,645	2,749	53	55	2,592	42	2,694	44	160	70%	0.085	401	417	707	283,740	294,903
1988	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1988	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1988	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1988	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1988	Mar	15,040	3,950	3,949	79	79	3,871	63	3,870	65	160	70%	0.085	599	619	0	0	0
1988	Apr	35,750	16,179	16,179	324	324	15,856	266	15,856	266	160	70%	0.085	2,537	2,537	200	507,343	507,343
1988	May	39,500	36,384	42,333	728	847	35,656	580	41,486	675	160	70%	0.085	5,520	6,423	707	3,902,992	4,541,157
1988	Jun	41,180	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1988	Jul	37,520	33,988	19,115	680	382	33,308	542	18,733	305	160	70%	0.085	5,157	2,900	707	3,645,938	2,050,527
1988	Aug	8,160	5,645	5,645	113	113	5,532	90	5,532	90	160	70%	0.085	857	857	707	605,586	605,586
1988	Sep	0	3,016	3,016	60	60	2,956	50	2,956	50	160	70%	0.085	473	473	684	323,470	323,470
1988	Oct	0	9,878	10,457	198	209	9,681	157	10,248	167	160	70%	0.085	1,499	1,587	707	1,059,690	1,121,740
1989	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1989	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1989	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1989	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1989	Mar	13,140	11,807	11,229	236	225	11,571	188	11,004	185	160	70%	0.085	1,791	1,761	0	0	0
1989	Apr	32,060	16,149	16,452	323	329	15,826	266	16,123	271	160	70%	0.085	2,532	2,580	200	506,395	515,902
1989	May	41,860	39,485	44,933	790	899	38,696	629	44,034	716	160	70%	0.085	5,991	6,818	707	4,235,692	4,820,061
1989	Jun	42,750	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1989	Jul	42,460	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1989	Aug	39,080	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1989	Sep	37,040	41,643	18,932	833	379	40,810	686	18,554	312	160	70%	0.085	6,529	2,968	684	4,465,886	2,030,333
1989	Oct	29,060	10,428	8,169	209	163	10,219	166	8,005	130	160	70%	0.085	1,582	1,239	707	1,118,606	876,286
1990	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1990	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1990	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1990	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1990	Mar	0	19,433	22,309	389	446	19,045	310	21,863	367	160	70%	0.085	2,949	3,498	0	0	0
1990	Apr	13,790	33,436	31,595	669	632	32,768	551	30,963	520	160	70%	0.085	5,242	4,954	200	1,048,480	990,737
1990	May	37,780	40,804	41,714	816	834	39,988	650	40,880	665	160	70%	0.085	6,191	6,329	707	4,377,127	4,474,773
1990	Jun	30,130	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1990	Jul	40,280	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1990	Aug	37,270	43,031	47,147	861	943	42,170	686	46,204	751	160	70%	0.085	6,529	7,154	707	4,616,055	5,057,554
1990	Sep	35,780	27,876	5,659	558	113	27,318	459	5,546	93	160	70%	0.085	4,371	887	684	2,989,483	606,858
1990	Oct	11,840	13,756	14,453	275	289	13,481	219	14,164	230	160	70%	0.085	2,087	2,193	707	1,475,607	1,550,463
1991	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1991	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1991	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1991	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1991	Mar	2,830	19,433	22,309	389	446	19,045	310	21,863	367	160	70%	0.085	2,949	3,498	0	0	0
1991	Apr	36,280	17,055	13,482	341	270	16,714	281	13,212	222	160	70%	0.085	2,674	2,114	200	534,802	422,757

TABLE 1 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - TD&H ALTERNATIVE - REALIGNED CANAL WITH THREE 72-INCH PENSTOCKS TO DROP 4

						Power Water Supplied and Generation												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Turbine Head (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Turbine Generation for 700 cfs Capacity (kW)	Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Turbine Generation for 700 cfs Capacity (kWh)	Turbine Generation for 850 cfs Capacity (kWh)
1991	May	36,780	34,334	39,688	687	794	33,647	547	38,894	633	160	70%	0.085	5,209	6,022	707	3,683,100	4,257,448
1991	Jun	35,030	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1991	Jul	37,900	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1991	Aug	37,910	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1991	Sep	31,430	41,643	32,071	833	641	40,810	686	31,430	528	160	70%	0.085	6,529	5,028	684	4,465,886	3,439,372
1991	Oct	264	6,000	3,574	120	71	5,880	96	3,503	57	160	70%	0.085	910	542	707	643,588	383,443
1992	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1992	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1992	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1992	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1992	Mar	20,110	7,296	7,298	146	146	7,150	116	7,152	120	160	70%	0.085	1,107	1,144	0	0	0
1992	Apr	14,650	8,391	8,391	168	168	8,223	138	8,223	138	160	70%	0.085	1,316	1,316	200	263,128	263,128
1992	May	31,200	40,921	41,032	818	821	40,103	652	40,211	654	160	70%	0.085	6,209	6,226	707	4,389,710	4,401,577
1992	Jun	16,940	39,163	38,854	783	777	38,380	645	38,077	640	160	70%	0.085	6,140	6,092	684	4,199,977	4,166,778
1992	Jul	30,150	19,669	19,868	393	397	19,275	313	19,470	317	160	70%	0.085	2,984	3,015	707	2,109,914	2,131,255
1992	Aug	24,570	7,468	7,468	149	149	7,319	119	7,319	119	160	70%	0.085	1,133	1,133	707	801,150	801,150
1992	Sep	0	7,110	7,110	142	142	6,968	117	6,968	117	160	70%	0.085	1,115	1,115	684	762,514	762,514
1992	Oct	0	8,902	9,252	178	185	8,724	142	9,067	147	160	70%	0.085	1,351	1,404	707	954,989	992,519
1993	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1993	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1993	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1993	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1993	Mar	1,150	8,430	8,281	169	166	8,262	134	8,115	136	160	70%	0.085	1,279	1,298	0	0	0
1993	Apr	19,570	6,723	6,723	134	134	6,588	111	6,588	111	160	70%	0.085	1,054	1,054	200	210,800	210,800
1993	May	37,140	31,225	36,052	625	721	30,601	498	35,331	575	160	70%	0.085	4,738	5,470	707	3,349,620	3,867,378
1993	Jun	38,830	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1993	Jul	31,280	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1993	Aug	31,670	43,031	22,871	861	457	42,170	686	22,414	365	160	70%	0.085	6,529	3,470	707	4,616,055	2,453,467
1993	Sep	28,190	17,105	14,293	342	286	16,763	282	14,008	235	160	70%	0.085	2,682	2,241	684	1,834,345	1,532,860
1993	Oct	239	7,327	7,582	147	152	7,180	117	7,431	121	160	70%	0.085	1,112	1,150	707	785,945	813,373
1994	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1994	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1994	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1994	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1994	Mar	0	11,097	11,052	222	221	10,875	177	10,831	182	160	70%	0.085	1,684	1,733	0	0	0
1994	Apr	2,550	19,022	19,345	380	387	18,641	313	18,958	319	160	70%	0.085	2,982	3,033	200	596,468	606,609
1994	May	32,580	39,363	45,580	787	912	38,576	627	44,668	726	160	70%	0.085	5,973	6,916	707	4,222,559	4,889,486
1994	Jun	37,220	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1994	Jul	36,200	43,031	34,494	861	690	42,170	686	33,805	550	160	70%	0.085	6,529	5,234	707	4,616,055	3,700,311
1994	Aug	35,540	13,621	6,694	272	134	13,349	217	6,560	107	160	70%	0.085	2,067	1,016	707	1,461,182	718,061
1994	Sep	18,620	3,440	3,440	69	69	3,371	57	3,371	57	160	70%	0.085	539	539	684	368,862	368,862
1994	Oct	0	3,369	3,667	67	73	3,302	54	3,593	58	160	70%	0.085	511	556	707	361,412	393,321
1995	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1995	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1995	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1995	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0

TABLE 1 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - TD&H ALTERNATIVE - REALIGNED CANAL WITH THREE 72-INCH PENSTOCKS TO DROP 4

						Power Water Supplied and Generation												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Turbine Head (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Turbine Generation for 700 cfs Capacity (kW)	Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Turbine Generation for 700 cfs Capacity (kWh)	Turbine Generation for 850 cfs Capacity (kWh)
1995	Mar	1,970	17,624	17,458	352	349	17,272	281	17,109	288	160	70%	0.085	2,674	2,737	0	0	0
1995	Apr	11,920	4,959	4,959	99	99	4,860	82	4,860	82	160	70%	0.085	778	778	200	155,511	155,511
1995	May	37,170	37,297	43,879	746	878	36,551	594	43,001	699	160	70%	0.085	5,659	6,658	707	4,000,904	4,706,991
1995	Jun	9,260	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1995	Jul	12,330	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1995	Aug	12,890	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1995	Sep	0	41,643	31,098	833	622	40,810	686	30,476	512	160	70%	0.085	6,529	4,876	684	4,465,886	3,334,971
1995	Oct	0	21,144	18,305	423	366	20,721	337	17,939	292	160	70%	0.085	3,208	2,777	707	2,268,176	1,963,608
1996	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1996	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1996	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1996	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1996	Mar	0	19,433	22,309	389	446	19,045	310	21,863	367	160	70%	0.085	2,949	3,498	0	0	0
1996	Apr	0	41,643	41,192	833	824	40,810	686	40,368	678	160	70%	0.085	6,529	6,458	200	1,305,815	1,291,671
1996	May	10,950	33,933	34,825	679	697	33,255	541	34,129	555	160	70%	0.085	5,149	5,284	707	3,640,105	3,735,777
1996	Jun	28,570	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1996	Jul	36,200	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1996	Aug	37,170	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1996	Sep	34,610	40,455	26,475	809	529	39,646	666	25,945	436	160	70%	0.085	6,343	4,151	684	4,338,488	2,839,226
1996	Oct	1,580	5,336	5,560	107	111	5,229	85	5,449	89	160	70%	0.085	810	844	707	572,358	596,465
1997	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1997	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1997	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1997	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1997	Mar	0	17,029	16,929	341	339	16,689	271	16,590	279	160	70%	0.085	2,584	2,654	0	0	0
1997	Apr	0	11,811	11,729	236	235	11,575	195	11,494	193	160	70%	0.085	1,852	1,839	200	370,365	367,779
1997	May	26,840	39,305	45,294	786	906	38,519	626	44,388	722	160	70%	0.085	5,964	6,872	707	4,216,389	4,858,819
1997	Jun	34,630	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1997	Jul	36,930	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1997	Aug	35,810	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1997	Sep	34,600	41,643	33,612	833	672	40,810	686	32,940	554	160	70%	0.085	6,529	5,270	684	4,465,886	3,604,650
1997	Oct	3,700	14,901	9,525	298	190	14,603	237	9,334	152	160	70%	0.085	2,261	1,445	707	1,598,492	1,021,743
1998	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1998	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1998	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1998	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1998	Mar	6,730	6,247	5,857	125	117	6,122	100	5,739	96	160	70%	0.085	948	918	0	0	0
1998	Apr	27,540	9,802	10,182	196	204	9,606	161	9,979	168	160	70%	0.085	1,537	1,596	200	307,352	319,293
1998	May	37,290	43,031	51,775	861	1036	42,170	686	50,740	825	160	70%	0.085	6,529	7,856	707	4,616,055	5,554,085
1998	Jun	36,220	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1998	Jul	37,420	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1998	Aug	36,430	43,031	32,307	861	646	42,170	686	31,661	515	160	70%	0.085	6,529	4,902	707	4,616,055	3,465,678
1998	Sep	28,870	19,121	4,081	382	82	18,739	315	4,000	67	160	70%	0.085	2,998	640	684	2,050,614	437,698
1998	Oct	3,700	3,071	3,206	61	64	3,010	49	3,142	51	160	70%	0.085	466	487	707	329,441	343,958
1999	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1999	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0

TABLE 1 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - TD&H ALTERNATIVE - REALIGNED CANAL WITH THREE 72-INCH PENSTOCKS TO DROP 4

						Power Water Supplied and Generation												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Turbine Head (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Turbine Generation for 700 cfs Capacity (kW)	Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Turbine Generation for 700 cfs Capacity (kWh)	Turbine Generation for 850 cfs Capacity (kWh)
1999	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1999	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
1999	Mar	0	9,372	9,349	187	187	9,184	149	9,162	154	160	70%	0.085	1,422	1,466	0	0	0
1999	Apr	14,440	7,921	7,416	158	148	7,763	130	7,268	122	160	70%	0.085	1,242	1,163	200	248,391	232,560
1999	May	30,720	24,869	27,456	497	549	24,371	396	26,907	438	160	70%	0.085	3,773	4,166	707	2,667,726	2,945,241
1999	Jun	36,090	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
1999	Jul	37,350	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1999	Aug	36,060	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
1999	Sep	24,930	41,643	21,271	833	425	40,810	686	20,846	350	160	70%	0.085	6,529	3,335	684	4,465,886	2,281,149
1999	Oct	0	14,063	10,367	281	207	13,782	224	10,160	165	160	70%	0.085	2,134	1,573	707	1,508,600	1,112,098
2000	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2000	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2000	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2000	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2000	Mar	5,580	19,433	22,309	389	446	19,045	310	21,863	367	160	70%	0.085	2,949	3,498	0	0	0
2000	Apr	24,040	19,562	16,140	391	323	19,170	322	15,818	266	160	70%	0.085	3,067	2,531	200	613,402	506,121
2000	May	36,730	34,211	37,780	684	756	33,526	545	37,024	602	160	70%	0.085	5,191	5,732	707	3,669,863	4,052,747
2000	Jun	35,730	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
2000	Jul	32,040	43,031	44,162	861	883	42,170	686	43,279	704	160	70%	0.085	6,529	6,701	707	4,616,055	4,737,371
2000	Aug	31,760	21,782	8,159	436	163	21,347	347	7,995	130	160	70%	0.085	3,305	1,238	707	2,336,648	875,186
2000	Sep	12,820	5,958	5,958	119	119	5,839	98	5,839	98	160	70%	0.085	934	934	684	638,938	638,938
2000	Oct	0	5,275	5,497	106	110	5,170	84	5,387	88	160	70%	0.085	800	834	707	565,898	589,658
2001	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2001	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2001	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2001	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2001	Mar	0	1,551	1,587	31	32	1,520	25	1,556	26	160	70%	0.085	235	249	0	0	0
2001	Apr	7,730	3,988	3,362	80	67	3,909	66	3,295	55	160	70%	0.085	625	527	200	125,065	105,435
2001	May	39,900	31,548	36,685	631	734	30,917	503	35,951	585	160	70%	0.085	4,787	5,566	707	3,384,261	3,935,290
2001	Jun	37,060	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
2001	Jul	35,950	38,945	24,681	779	494	38,166	621	24,187	393	160	70%	0.085	5,909	3,745	707	4,177,693	2,647,564
2001	Aug	10,490	5,744	5,744	115	115	5,629	92	5,629	92	160	70%	0.085	872	872	707	616,151	616,151
2001	Sep	0	2,777	2,777	56	56	2,722	46	2,722	46	160	70%	0.085	435	435	684	297,860	297,860
2001	Oct	0	1,659	1,815	33	36	1,626	26	1,778	29	160	70%	0.085	252	275	707	178,006	194,658
2002	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2002	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2002	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2002	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2002	Mar	266	12,479	12,324	250	246	12,230	199	12,078	203	160	70%	0.085	1,893	1,932	0	0	0
2002	Apr	24,210	7,307	7,307	146	146	7,161	120	7,161	120	160	70%	0.085	1,146	1,146	200	229,137	229,137
2002	May	31,040	24,418	27,690	488	554	23,930	389	27,136	441	160	70%	0.085	3,705	4,201	707	2,619,368	2,970,359
2002	Jun	15,170	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
2002	Jul	3,540	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
2002	Aug	36,630	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
2002	Sep	35,740	40,038	30,802	801	616	39,237	659	30,186	507	160	70%	0.085	6,277	4,829	684	4,293,778	3,303,319
2002	Oct	5,930	4,552	4,768	91	95	4,461	73	4,673	76	160	70%	0.085	691	723	707	488,275	511,500

TABLE 1 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - TD&H ALTERNATIVE - REALIGNED CANAL WITH THREE 72-INCH PENSTOCKS TO DROP 4

						Power Water Supplied and Generation												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Turbine Head (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Turbine Generation for 700 cfs Capacity (kW)	Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Turbine Generation for 700 cfs Capacity (kWh)	Turbine Generation for 850 cfs Capacity (kWh)
2003	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2003	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2003	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2003	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2003	Mar	0	10,740	10,699	215	214	10,525	171	10,485	176	160	70%	0.085	1,630	1,677	0	0	0
2003	Apr	20,580	16,936	16,673	339	333	16,597	279	16,339	275	160	70%	0.085	2,655	2,614	200	531,060	522,806
2003	May	28,370	26,785	28,347	536	567	26,249	427	27,780	452	160	70%	0.085	4,064	4,301	707	2,873,283	3,040,863
2003	Jun	37,390	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
2003	Jul	38,480	43,031	52,252	861	1045	42,170	686	51,207	833	160	70%	0.085	6,529	7,928	707	4,616,055	5,605,210
2003	Aug	34,240	22,643	8,201	453	164	22,190	361	8,037	131	160	70%	0.085	3,436	1,244	707	2,429,002	879,786
2003	Sep	8,920	3,812	3,812	76	76	3,736	63	3,736	63	160	70%	0.085	598	598	684	408,781	408,781
2003	Oct	0	2,743	2,914	55	58	2,688	44	2,856	46	160	70%	0.085	416	442	707	294,240	312,575
2004	Nov	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2004	Dec	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2004	Jan	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2004	Feb	0	0	0	0	0	0	0	0	0	160	70%	0.085	0	0	0	0	0
2004	Mar	369	9,124	8,953	182	179	8,941	145	8,774	147	160	70%	0.085	1,384	1,404	0	0	0
2004	Apr	27,280	12,176	12,176	244	244	11,932	201	11,932	201	160	70%	0.085	1,909	1,909	200	381,808	381,808
2004	May	34,090	40,810	42,668	816	853	39,993	650	41,815	680	160	70%	0.085	6,192	6,474	707	4,377,742	4,577,093
2004	Jun	36,130	41,643	50,567	833	1011	40,810	686	49,555	833	160	70%	0.085	6,529	7,928	684	4,465,886	5,422,862
2004	Jul	28,130	43,031	50,431	861	1009	42,170	686	49,422	804	160	70%	0.085	6,529	7,652	707	4,616,055	5,409,872
2004	Aug	35,580	33,576	15,855	672	317	32,904	535	15,538	253	160	70%	0.085	5,094	2,406	707	3,601,747	1,700,836
2004	Sep	19,870	15,388	14,927	308	299	15,081	253	14,628	246	160	70%	0.085	2,413	2,340	684	1,650,289	1,600,800
2004	Oct	0	6,817	7,213	136	144	6,680	109	7,069	115	160	70%	0.085	1,034	1,094	707	731,225	773,769
Avg		14611	17062	17576	341	352	16721	275	17224	284				2621	2705		1630869	1684831
Max		42,750	43,031	52,252	861	1,045	42,170	686	51,207	833				6,529	7,928		4,616,055	5,605,210
Min		0	0	0	0	0	0	0	0	0				0	0		0	0

APPENDIX B
HKM HYDROPOWER ALTERNATIVE

TABLE 2 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - HKM ALTERNATIVE - REALIGNED CANAL WITH ONE PENSTOCK FOR DROPS 1-3, ONE PENSTOCK FOR DROP 4, AND ONE PENSTOCK FOR DROP 5

						Power Water Supplied and Generation																											
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Turbine Head for Drops 1-3 (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Drops 1-3 Turbine Generation for 700 cfs Capacity (kW)	Drops 1-3 Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Drops 1-3 Turbine Generation for 700 cfs Capacity (kWh)	Drops 1-3 Turbine Generation for 850 cfs Capacity (kWh)	Turbine Head for Drop 4 (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Drop 4 Turbine Generation for 700 cfs Capacity (kW)	Drop 4 Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Drop 4 Turbine Generation for 700 cfs Capacity (kWh)	Drop 4 Turbine Generation for 850 cfs Capacity (kWh)	Turbine Head for Drop 5 (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Drop 5 Turbine Generation for 700 cfs Capacity (kW)	Drop 5 Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Drop 5 Turbine Generation for 700 cfs Capacity (kWh)	Drop 5 Turbine Generation for 850 cfs Capacity (kWh)
1980	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1980	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1980	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1980	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1980	Mar	6,902	11,817	11,817	236	236	11,580	188	11,580	188	90	70%	0.085	1,009	1,009	0	0	0	66	70%	0.085	740	740	0	0	0	57	70%	0.085	639	639	0	0	0
1980	Apr	24,908	15,424	15,924	308	318	15,115	254	15,606	262	90	70%	0.085	1,360	1,404	200	272,049	280,879	66	70%	0.085	998	1,030	200	199,503	205,978	57	70%	0.085	861	889	200	172,298	177,890
1980	May	31,738	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1980	Jun	39,461	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1980	Jul	41,841	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1980	Aug	40,643	38,393	13,812	768	276	37,626	612	13,536	220	90	70%	0.085	3,277	1,179	707	2,316,690	833,434	66	70%	0.085	2,403	864	707	1,698,906	611,185	57	70%	0.085	2,075	747	707	1,467,237	527,842
1980	Sep	13,977	13,435	13,435	269	269	13,166	221	13,166	221	90	70%	0.085	1,185	1,185	684	810,435	810,435	66	70%	0.085	869	869	684	594,319	594,319	57	70%	0.085	750	750	684	513,275	513,275
1980	Oct	0	6,351	6,582	127	132	6,224	101	6,451	105	90	70%	0.085	542	562	707	383,208	397,184	66	70%	0.085	397	412	707	281,019	291,268	57	70%	0.085	343	356	707	242,698	251,550
1981	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1981	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1981	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1981	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1981	Mar	25,256	19,433	22,309	389	446	19,045	310	21,863	356	90	70%	0.085	1,659	1,904	0	0	0	66	70%	0.085	1,216	1,396	0	0	0	57	70%	0.085	1,050	1,206	0	0	0
1981	Apr	20,876	17,368	14,314	347	286	17,021	286	14,027	236	90	70%	0.085	1,532	1,262	200	306,345	252,471	66	70%	0.085	1,123	926	200	224,653	185,145	57	70%	0.085	970	799	200	194,019	159,898
1981	May	34,088	43,031	49,707	861	994	42,170	686	48,713	792	90	70%	0.085	3,673	4,242	707	2,596,531	2,999,371	66	70%	0.085	2,693	3,111	707	1,904,123	2,199,539	57	70%	0.085	2,326	2,687	707	1,644,470	1,899,602
1981	Jun	39,023	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1981	Jul	41,337	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1981	Aug	38,372	43,031	37,154	861	743	42,170	686	36,411	592	90	70%	0.085	3,673	3,171	707	2,596,531	2,241,908	66	70%	0.085	2,693	2,325	707	1,904,123	1,644,066	57	70%	0.085	2,326	2,008	707	1,644,470	1,419,875
1981	Sep	32,886	16,712	5,033	334	101	16,378	275	4,933	83	90	70%	0.085	1,474	444	684	1,008,139	303,621	66	70%	0.085	1,081	326	684	739,302	222,655	57	70%	0.085	933	281	684	638,488	192,293
1981	Oct	0	3,552	3,727	71	75	3,481	57	3,652	59	90	70%	0.085	303	318	707	214,316	224,871	66	70%	0.085	222	233	707	157,165	164,906	57	70%	0.085	192	201	707	135,734	142,419
1982	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1982	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1982	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1982	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1982	Mar	0	8,799	8,692	176	174	8,623	140	8,518	139	90	70%	0.085	751	742	0	0	0	66	70%	0.085	551	544	0	0	0	57	70%	0.085	476	470	0	0	0
1982	Apr	0	4,380	4,380	88	88	4,292	72	4,292	72	90	70%	0.085	386	386	200	77,256	77,256	66	70%	0.085	283	283	200	56,654	56,654	57	70%	0.085	245	245	200	48,929	48,929
1982	May	31,747	27,489	31,253	550	625	26,939	438	30,628	498	90	70%	0.085	2,346	2,667	707	1,658,704	1,885,829	66	70%	0.085	1,720	1,956	707	1,216,383	1,382,942	57	70%	0.085	1,486	1,689	707	1,050,513	1,194,359
1982	Jun	31,622	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1982	Jul	36,042	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1982	Aug	0	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1982	Sep	0	37,803	16,364	756	327	37,047	623	16,037	270	90	70%	0.085	3,334	1,443	684	2,280,434	987,154	66	70%	0.085	2,445	1,058	684	1,672,319	723,913	57	70%	0.085	2,112	914	684	1,444,275	625,198
1982	Oct	0	5,283	5,673	106	113	5,177	84	5,560	90	90	70%	0.085	451	484	707	318,762	342,331	66	70%	0.085	331	355	707	233,758	251,042	57	70%	0.085	286	307	707	201,882	216,809
1983	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1983	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1983	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1983	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1983	Mar	16,400	8,721	8,427	174	169	8,547	139	8,258	134	90	70%	0.085	744	719	0	0	0	66	70%	0.085	546	527	0	0	0	57	70%	0.085	471	456	0	0	0
1983	Apr	23,451	5,776	5,776	116	116	5,660	95	5,660	95	90	70%	0.085	509	509	200	101,878	101,878	66	70%	0.085	374	374	200	74,710	74,710	57	70%	0.085	323	323	200	64,523	64,523
1983	May	18,539	23,787	25,644	476	513	23,311	379	25,131	409	90	70%	0.085	2,030	2,189	707	1,435,299	1,547,370	66	70%	0.085	1,489	1,605	707	1,052,553	1,134,738	57	70%	0.085	1,286	1,386	707	909,023	980,001
1983	Jun	37,989	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1983	Jul	42,498	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1983	Aug	39,558	33,651	14,607	673	292	32,978	536	14,315	233	90	70%	0.085	2,872	1,247	707	2,030,531	881,394	66	70%	0.085	2,106	914	707	1,489,056	646,356	57	70%	0.085	1,819	790	707	1,286,003	558,216
1983	Sep	90	5,368	5,368	107	107	5,260	88	5,260	88	90	70%	0.085	473	473	684	323,790	323,790	66	70%	0.085	347	347	684	237,446	237,446	57	70%	0.085	300	300	684	205,067	205,067
1983	Oct	0	2,715	2,847	54	57	2,660	43	2,790	45	90	70%	0.085	232	243	707	163,804	171,811	66	70%	0.085	170	178	707	120,123	125,995	57	70%	0.085	147	154	707	103,743	108,814
1984	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1984	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1984	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1984	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1984	Mar	19,908	14,632	14,563	293	291	14,339	233	14,272	232	90	70%	0.085	1,249	1,243	0	0	0	66	70%	0.085	916	912	0	0	0	57	70%	0.085	791	787	0	0	0
1984	Apr	12,664	7,135	7,135	143	143	6,992	118	6,992	118	90	70%	0.085	629	629	200	125,845	125,845	66	70%	0.085	461	461	200	92,286	92,286	57	70%	0.085	399	399	200	79,702	79,702
1984	May	21,723	25,383	28,569	508	571	24,875	405	27,998	455	90	70%	0.085	2,166	2,438	707	1,531,627	1,723,875	66	70%	0.085	1,589	1,788	707	1,123,193	1,264,175	57	70%	0.085	1,372	1,544	707	970,031	1,091,788
1984	Jun	39,913	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1984	Jul	41,881	43,031	48,246	861	965	42,170	686	47,281	769	90	70%	0.085	3,673	4,118	707	2,596,531	2,911,218	66	70%	0.085	2,693	3,020	707	1,904,123	2,134,893	57	70%	0.085	2,326	2,608	707	1,644,470	1,843,771
1984	Aug	27,976	27,898	10,574	558	211	27,340	445	10,362	169	90	70%	0.085	2,381	902	707	1,683,405	638,020	66	70%	0.085	1,746	662	707	1,234,497	467,881	57	70%	0.085	1,508	572	707	1,066,157	404,079
1984	Sep	0	7,045	7,045	141	141	6,904	116	6,904	116	90	70%	0.085	621	621	684	424,954	424,954	66	70%	0.085	456	456	684	311,633	311,633	57	70%	0.085	393	393	684	269,138	269,138
1984	Oct	0	6,161	6,402	123	128	6,038	98	6,274	102	90	70%	0.085	526	546	707	371,756	386,318	66	70%	0.085	386	401	707	272,621	283,300	57	70%	0.085	333	346	707	235,445	244,668
1985	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1985	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1985	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1985	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1985	Mar	3,615	4,242	4,001	85	80	4,157	68	3,921	64	90	70%	0.085	362	341	0	0	0	66	70%	0.085	265	250	0	0	0	57	70%	0.085	229	216	0	0	0
1985	Apr	33,739	8,617	9,322	172	186	8,444	142	9,136	154	90	70%	0.085	760	822	200	151,984	164,426	66	70%	0.085	557	603	200	111,455	120,579	57	70%	0.085	481	521	200	96,257	104,136
1985	May	40,399	40,754	45,240	815	905	39,939	650	44,335	721	90	70%	0.085	3,478	3,861	707	2,459,114	2,729,819	66	70%	0.085	2,551	2,831	707	1,803,351	2,001,867	57	70%	0.085	2,203	2,445	707	1,557,439	1,728,885
1985	Jun	41,133	40,255	50,567	805	1011	39,450	663	49,555	833	90	70%	0.085	3,550	4,460	684	2,428,326	3,050,360	66	70%	0.085	2,603	3,270	684	1,780,772	2,236,931	57	70%	0.085	2,248	2,824	684	1,537,940	1,931,895
1985	Jul	32,914	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1985	Aug	39,566	29,540	10,004	591	200	28,949	471	9,804	159	90	70%	0.085	2,521	854	707	1,782,457	603,652	66	70%	0.085	1,849	626	707	1,307,135	442,678	57	70%	0.085	1,597	541	707	1,128,889	382,313
1985	Sep	24,295	20,066	19,860	401	397	19,665	330	19,463	327	90	70%	0.085	1,770	1,752	684	1,210,480	1,198,043	66	70%	0.085	1,298	1,284	684	887,685	878,565	57	70%	0.085	1,121	1,109	684	766,637	758,761
1985	Oct	0	11,812	14,436	236	289	11,576	188	14,147	230	90	70%	0.085	1,008	1,232	707	712,755	871,055	66	70%	0.085	739	903	707	522,687	638,774	57	70%	0.085	638	780	707	451,411	551,668
1986	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1986	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1986	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1986	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1986	Mar	0	19,433	22,309	389	446	19,045	310	21,863	356	90	70%	0.085	1,659	1,904	0	0	0	66	70%	0.085	1,216	1,396	0	0	0	57	70%	0.085	1,050	1,206	0	0	0
1986	Apr	14,740	30,246	25,783	605	516	29,641	498	25,267	425	90	70%	0.085	2,667	2,274	200	533,488	454,775	66	70%	0.085	1,956	1,668	200	391,224	333,502	57	70%	0.085	1,689	1,440	200	337,876	288,024
1986	May	17,560	30,848	33,339	617	667	30,231	492	32,672	531	90	70%	0.085	2,633	2,845	707	1,861,402	2,011,692	66	70%	0.085	1,931	2,087	707	1,365,028	1,475,241	57	70%	0.085	1,667	1,802	707	1,178,888	1,274,071
1986	Jun	26,240	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1986	Jul	38,370	43,031	48,647	861	973	42,170	686	47,674	775	90	70%	0.085	3,673	4,152	707	2,596,531	2,935,388	66	70%	0.085	2,693	3,045	707	1,904,123	2,152,618	57	70%	0.085	2,326	2,630	707	1,644,470	1,859,079
1986	Aug	35,540	18,980	7,305	380	146	18,601	303	7,158	116	90	70%	0.085	1,620	623	707	1,145,291	440,764	66	70%	0.085	1,188	457	707	839,880	323,227	57	70%	0.085	1,026	395	707	725,351	279,150
1986	Sep	3,230	7,784	7,784	156	156	7,628	128	7,628	128	90	70%	0.085	686	686	684	469,555	469,555	66	70%	0.085	503	503	684	344,340	344,340	57	70%	0.085	435	435	684	297,385	297,385
1986	Oct	0	8,867	9,264	177	185	8,690	141	9,078	148	90	70%	0.085	757	791	707	535,048	558,979	66	70%	0.085	555	580	707	392,369	409,918	57	70%	0.085	479	501	707	338,864	354,020
1987	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0

TABLE 2 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - HKM ALTERNATIVE - REALIGNED CANAL WITH ONE PENSTOCK FOR DROPS 1-3, ONE PENSTOCK FOR DROP 4, AND ONE PENSTOCK FOR DROP 5

						Power Water Supplied and Generation																											
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Turbine Head for Drops 1-3 (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Drops 1-3 Turbine Generation for 700 cfs Capacity (kW)	Drops 1-3 Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Drops 1-3 Turbine Generation for 700 cfs Capacity (kWh)	Drops 1-3 Turbine Generation for 850 cfs Capacity (kWh)	Turbine Head for Drop 4 (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Drop 4 Turbine Generation for 700 cfs Capacity (kW)	Drop 4 Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Drop 4 Turbine Generation for 700 cfs Capacity (kWh)	Drop 4 Turbine Generation for 850 cfs Capacity (kWh)	Turbine Head for Drop 5 (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Drop 5 Turbine Generation for 700 cfs Capacity (kW)	Drop 5 Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Drop 5 Turbine Generation for 700 cfs Capacity (kWh)	Drop 5 Turbine Generation for 850 cfs Capacity (kWh)
1987	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1987	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1987	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1987	Mar	21,420	13,708	13,340	274	267	13,434	218	13,073	213	90	70%	0.085	1,170	1,139	0	0	0	66	70%	0.085	858	835	0	0	0	57	70%	0.085	741	721	0	0	0
1987	Apr	12,720	14,081	14,378	282	288	13,799	232	14,090	237	90	70%	0.085	1,242	1,268	200	248,360	253,606	66	70%	0.085	911	930	200	182,131	185,978	57	70%	0.085	786	803	200	157,295	160,617
1987	May	30,230	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1987	Jun	37,060	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1987	Jul	31,060	43,031	36,471	861	729	42,170	686	35,742	581	90	70%	0.085	3,673	3,113	707	2,596,531	2,200,703	66	70%	0.085	2,693	2,283	707	1,904,123	1,613,849	57	70%	0.085	2,326	1,971	707	1,644,470	1,393,779
1987	Aug	35,640	33,278	21,449	666	429	32,613	530	21,020	342	90	70%	0.085	2,840	1,831	707	2,008,036	1,294,266	66	70%	0.085	2,083	1,342	707	1,472,560	949,128	57	70%	0.085	1,799	1,159	707	1,271,756	819,702
1987	Sep	9,390	6,969	6,969	139	139	6,830	115	6,830	115	90	70%	0.085	615	615	684	420,424	420,424	66	70%	0.085	451	451	684	308,311	308,311	57	70%	0.085	389	389	684	266,268	266,268
1987	Oct	0	2,645	2,749	53	55	2,592	42	2,694	44	90	70%	0.085	226	235	707	159,604	165,883	66	70%	0.085	166	172	707	117,043	121,648	57	70%	0.085	143	149	707	101,082	105,059
1988	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1988	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1988	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1988	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1988	Mar	15,040	3,950	3,949	79	79	3,871	63	3,870	63	90	70%	0.085	337	337	0	0	0	66	70%	0.085	247	247	0	0	0	57	70%	0.085	214	213	0	0	0
1988	Apr	35,750	16,179	16,179	324	324	15,856	266	15,856	266	90	70%	0.085	1,427	1,427	200	285,381	285,381	66	70%	0.085	1,046	1,046	200	209,279	209,279	57	70%	0.085	904	904	200	180,741	180,741
1988	May	39,500	36,384	42,333	728	847	35,656	580	41,486	675	90	70%	0.085	3,105	3,613	707	2,195,433	2,554,401	66	70%	0.085	2,277	2,650	707	1,609,984	1,873,227	57	70%	0.085	1,967	2,288	707	1,390,441	1,617,787
1988	Jun	41,180	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1988	Jul	37,520	33,988	19,115	680	382	33,308	542	18,733	305	90	70%	0.085	2,901	1,631	707	2,050,840	1,153,421	66	70%	0.085	2,127	1,196	707	1,503,949	845,842	57	70%	0.085	1,837	1,033	707	1,298,865	730,500
1988	Aug	8,160	5,645	5,645	113	113	5,532	90	5,532	90	90	70%	0.085	482	482	707	340,642	340,642	66	70%	0.085	353	353	707	249,804	249,804	57	70%	0.085	305	305	707	215,740	215,740
1988	Sep	0	3,016	3,016	60	60	2,956	50	2,956	50	90	70%	0.085	266	266	684	181,952	181,952	66	70%	0.085	195	195	684	133,431	133,431	57	70%	0.085	168	168	684	115,236	115,236
1988	Oct	0	9,878	10,457	198	209	9,681	157	10,248	167	90	70%	0.085	843	892	707	596,076	630,979	66	70%	0.085	618	654	707	437,122	462,718	57	70%	0.085	534	565	707	377,515	399,620
1989	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1989	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1989	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1989	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1989	Mar	13,140	11,807	11,229	236	225	11,571	188	11,004	179	90	70%	0.085	1,008	958	0	0	0	66	70%	0.085	739	703	0	0	0	57	70%	0.085	638	607	0	0	0
1989	Apr	32,060	16,149	16,452	323	329	15,826	266	16,123	271	90	70%	0.085	1,424	1,451	200	284,847	290,195	66	70%	0.085	1,044	1,064	200	208,888	212,810	57	70%	0.085	902	919	200	180,403	183,790
1989	May	41,860	39,485	44,933	790	899	38,696	629	44,034	716	90	70%	0.085	3,370	3,835	707	2,382,577	2,711,284	66	70%	0.085	2,471	2,812	707	1,747,223	1,988,275	57	70%	0.085	2,134	2,429	707	1,508,965	1,717,147
1989	Jun	42,750	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1989	Jul	42,460	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1989	Aug	39,080	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1989	Sep	37,040	41,643	18,932	833	379	40,810	686	18,554	312	90	70%	0.085	3,673	1,670	684	2,512,061	1,142,062	66	70%	0.085	2,693	1,224	684	1,842,178	837,512	57	70%	0.085	2,326	1,057	684	1,590,972	723,306
1989	Oct	29,060	10,428	8,169	209	163	10,219	166	8,005	130	90	70%	0.085	890	697	707	629,216	492,911	66	70%	0.085	653	511	707	461,425	361,468	57	70%	0.085	564	442	707	398,503	312,177
1990	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1990	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1990	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1990	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1990	Mar	0	19,433	22,309	389	446	19,045	310	21,863	356	90	70%	0.085	1,659	1,904	0	0	0	66	70%	0.085	1,216	1,396	0	0	0	57	70%	0.085	1,050	1,206	0	0	0
1990	Apr	13,790	33,436	31,595	669	632	32,768	551	30,963	520	90	70%	0.085	2,949	2,786	200	589,770	557,290	66	70%	0.085	2,162	2,043	200	432,498	408,679	57	70%	0.085	1,868	1,765	200	373,521	352,950
1990	May	37,780	40,804	41,714	816	834	39,988	650	40,880	665	90	70%	0.085	3,483	3,560	707	2,462,134	2,517,060	66	70%	0.085	2,554	2,611	707	1,805,565	1,845,844	57	70%	0.085	2,206	2,255	707	1,559,351	1,594,138
1990	Jun	30,130	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1990	Jul	40,280	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1990	Aug	37,270	43,031	47,147	861	943	42,170	686	46,204	751	90	70%	0.085	3,673	4,024	707	2,596,531	2,844,874	66	70%	0.085	2,693	2,951	707	1,904,123	2,086,241	57	70%	0.085	2,326	2,548	707	1,644,470	1,801,754
1990	Sep	35,780	27,876	5,659	558	113	27,318	459	5,546	93	90	70%	0.085	2,458	499	684	1,681,584	341,358	66	70%	0.085	1,803	366	684	1,233,162	250,329	57	70%	0.085	1,557	316	684	1,065,003	216,193
1990	Oct	11,840	13,756	14,453	275	289	13,481	219	14,164	230	90	70%	0.085	1,174	1,234	707	830,029	872,135	66	70%	0.085	861	905	707	608,688	639,566	57	70%	0.085	744	781	707	525,685	552,352
1991	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1991	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1991	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1991	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1991	Mar	2,830	19,433	22,309	389	446	19,045	310	21,863	356	90	70%	0.085	1,659	1,904	0	0	0	66	70%	0.085	1,216	1,396	0	0	0	57	70%	0.085	1,050	1,206	0	0	0
1991	Apr	36,280	17,055	13,482	341	270	16,714	281	13,212	222	90	70%	0.085	1,504	1,189	200	300,826	237,801	66	70%	0.085	1,103	872	200	220,606	174,387	57	70%	0.085	953	753	200	190,523	150,607
1991	May	36,780	34,334	39,688	687	794	33,647	547	38,894	633	90	70%	0.085	2,930	3,387	707	2,071,744	2,394,814	66	70%	0.085	2,149	2,484	707	1,519,279	1,756,197	57	70%	0.085	1,856	2,145	707	1,312,104	1,516,716
1991	Jun	35,030	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1991	Jul	37,900	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1991	Aug	37,910	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1991	Sep	31,430	41,643	32,071	833	641	40,810	686	31,430	528	90	70%	0.085	3,673	2,828	684	2,512,061	1,934,647	66	70%	0.085	2,693	2,074	684	1,842,178	1,418,741	57	70%	0.085	2,326	1,791	684	1,590,972	1,225,276
1991	Oct	264	6,000	3,574	120	71	5,880	96	3,503	57	90	70%	0.085	512	305	707	362,018	215,687	66	70%	0.085	376	224	707	265,480	158,170	57	70%	0.085	324	193	707	229,278	136,602
1992	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1992	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1992	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1992	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1992	Mar	20,110	7,296	7,298	146	146	7,150	116	7,152	116	90	70%	0.085	623	623	0	0	0	66	70%	0.085	457	457	0	0	0	57	70%	0.085	394	394	0	0	0
1992	Apr	14,650	8,391	8,391	168	168	8,223	138	8,223	138	90	70%	0.085	740	740	200	148,009	148,009	66	70%	0.085	543	543	200	108,540	108,540	57	70%	0.085	469	469	200	93,739	93,739
1992	May	31,200	40,921	41,032	818	821	40,103	652	40,211	654	90	70%	0.085	3,493	3,502	707	2,469,212	2,475,887	66	70%	0.085	2,561	2,568	707	1,810,755	1,815,651	57	70%	0.085	2,212	2,218	707	1,563,834	1,568,062
1992	Jun	16,940	39,163	38,854	783	777	38,380	645	38,077	640	90	70%	0.085	3,454	3,427	684	2,362,487	2,343,813	66	70%	0.085	2,533	2,513	684	1,732,490	1,718,796	57	70%	0.085	2,187	2,170	684	1,496,242	1,484,415
1992	Jul	30,150	19,669	19,868	393	397	19,275	313	19,470	317	90	70%	0.085	1,679	1,696	707	1,186,827	1,198,831	66	70%	0.085	1,231	1,243	707	870,339	879,143	57	70%	0.085	1,063	1,074	707	751,657	759,259
1992	Aug	24,570	7,468	7,468	149	149	7,319	119	7,319	119	90	70%	0.085	637	637	707	450,647	450,647	66	70%	0.085	467	467	707	330,475	330,475	57	70%	0.085	404	404	707	285,410	285,410
1992	Sep	0	7,110	7,110	142	142	6,968	117	6,968	117	90	70%	0.085	627	627	684	428,914	428,914	66	70%	0.085	460	460	684	314,537	314,537	57	70%	0.085	397	397	684	271,646	271,646
1992	Oct	0	8,902	9,252	178	185	8,724	142	9,067	147	90	70%	0.085	760	790	707	537,182	558,292	66	70%	0.085	557	579	707	393,933	409,414	57	70%	0.085	481	500	707	340,215	353,585
1993	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1993	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1993	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1993	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1993	Mar	1,150	8,430	8,281	169	166	8,262	134	8,115	132	90	70%	0.085	720	707	0	0	0	66	70%	0.085	528	518	0	0	0	57	70%	0.085	456	448	0	0	0
1993	Apr	19,570	6,723	6,723	134	134	6,588	111	6,588	111	90	70%	0.085	593	593	200	118,575	118,575	66	70%	0.085	435	435	200	86,955	86,955	57	70%	0.085	375	375	200	75,098	75,098
1993	May	37,140	31,225	36,052	625	721	30,601	498	35,331	575	90	70%	0.085	2,665	3,077	707	1,884,162	2,175,400	66	70%	0.085	1,954	2,256	707	1,381,718	1,595,294	57	70%	0.085	1,688	1,949	707	1,193,302	1,377,754
1993	Jun	38,830	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1993	Jul	31,280	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1993	Aug	31,670	43,031	22,871	861	457	42,170	686	22,414	365	90	70%	0.085	3,673	1,952	707	2,596,531	1,380,075	66	70%	0.085	2,693	1,431	707	1,904,123	1,012,055	57	70%	0.085	2,326	1,236	707	1,644,470	874,048
1993	Sep	28,190	17,105	14,293	342	286	16,763	282	14,008	235	90	70%	0.085	1,509	1,261	684	1,031,819	862,234	66	70%	0.085	1,106	924	684	756,667	632,305	57	70%	0.085	955	798	684	653,486	546,081
1993	Oct	239	7,327	7,582	147	152	7,180	117	7,431	121	90	70%	0.085	625	647	707	442,094	457,522	66	70%	0.085	459	475	707	324,202	335,516	57	70%	0.085	396	410	707	279,993	289,764
1994	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1994	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0

TABLE 2 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - HKM ALTERNATIVE - REALIGNED CANAL WITH ONE PENSTOCK FOR DROPS 1-3, ONE PENSTOCK FOR DROP 4, AND ONE PENSTOCK FOR DROP 5

						Power Water Supplied and Generation																											
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Turbine Head for Drops 1-3 (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Drops 1-3 Turbine Generation for 700 cfs Capacity (kW)	Drops 1-3 Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Drops 1-3 Turbine Generation for 700 cfs Capacity (kWh)	Drops 1-3 Turbine Generation for 850 cfs Capacity (kWh)	Turbine Head for Drop 4 (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Drop 4 Turbine Generation for 700 cfs Capacity (kW)	Drop 4 Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Drop 4 Turbine Generation for 700 cfs Capacity (kWh)	Drop 4 Turbine Generation for 850 cfs Capacity (kWh)	Turbine Head for Drop 5 (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Drop 5 Turbine Generation for 700 cfs Capacity (kW)	Drop 5 Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Drop 5 Turbine Generation for 700 cfs Capacity (kWh)	Drop 5 Turbine Generation for 850 cfs Capacity (kWh)
1994	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1994	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1994	Mar	0	11,097	11,052	222	221	10,875	177	10,831	176	90	70%	0.085	947	943	0	0	0	66	70%	0.085	695	692	0	0	0	57	70%	0.085	600	597	0	0	0
1994	Apr	2,550	19,022	19,345	380	387	18,641	313	18,958	319	90	70%	0.085	1,678	1,706	200	335,513	341,217	66	70%	0.085	1,230	1,251	200	246,043	250,226	57	70%	0.085	1,062	1,081	200	212,492	216,104
1994	May	32,580	39,363	45,580	787	912	38,576	627	44,668	726	90	70%	0.085	3,360	3,890	707	2,375,189	2,750,336	66	70%	0.085	2,464	2,853	707	1,741,806	2,016,913	57	70%	0.085	2,128	2,464	707	1,504,287	1,741,880
1994	Jun	37,220	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1994	Jul	36,200	43,031	34,494	861	690	42,170	686	33,805	550	90	70%	0.085	3,673	2,944	707	2,596,531	2,081,425	66	70%	0.085	2,693	2,159	707	1,904,123	1,526,378	57	70%	0.085	2,326	1,865	707	1,644,470	1,318,236
1994	Aug	35,540	13,621	6,694	272	134	13,349	217	6,560	107	90	70%	0.085	1,163	571	707	821,915	403,909	66	70%	0.085	853	419	707	602,738	296,200	57	70%	0.085	736	362	707	520,546	255,809
1994	Sep	18,620	3,440	3,440	69	69	3,371	57	3,371	57	90	70%	0.085	303	303	684	207,485	207,485	66	70%	0.085	222	222	684	152,156	152,156	57	70%	0.085	192	192	684	131,407	131,407
1994	Oct	0	3,369	3,667	67	73	3,302	54	3,593	58	90	70%	0.085	288	313	707	203,294	221,243	66	70%	0.085	211	229	707	149,083	162,245	57	70%	0.085	182	198	707	128,753	140,120
1995	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1995	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1995	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1995	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1995	Mar	1,970	17,624	17,458	352	349	17,272	281	17,109	278	90	70%	0.085	1,504	1,490	0	0	0	66	70%	0.085	1,103	1,093	0	0	0	57	70%	0.085	953	944	0	0	0
1995	Apr	11,920	4,959	4,959	99	99	4,860	82	4,860	82	90	70%	0.085	437	437	200	87,475	87,475	66	70%	0.085	321	321	200	64,148	64,148	57	70%	0.085	277	277	200	55,401	55,401
1995	May	37,170	37,297	43,879	746	878	36,551	594	43,001	699	90	70%	0.085	3,183	3,745	707	2,250,509	2,647,683	66	70%	0.085	2,334	2,746	707	1,650,373	1,941,634	57	70%	0.085	2,016	2,372	707	1,425,322	1,676,866
1995	Jun	9,260	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1995	Jul	12,330	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1995	Aug	12,890	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1995	Sep	0	41,643	31,098	833	622	40,810	686	30,476	512	90	70%	0.085	3,673	2,743	684	2,512,061	1,875,921	66	70%	0.085	2,693	2,011	684	1,842,178	1,375,676	57	70%	0.085	2,326	1,737	684	1,590,972	1,188,083
1995	Oct	0	21,144	18,305	423	366	20,721	337	17,939	292	90	70%	0.085	1,805	1,562	707	1,275,849	1,104,529	66	70%	0.085	1,323	1,146	707	935,623	809,988	57	70%	0.085	1,143	989	707	808,038	699,535
1996	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1996	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1996	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1996	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1996	Mar	0	19,433	22,309	389	446	19,045	310	21,863	356	90	70%	0.085	1,659	1,904	0	0	0	66	70%	0.085	1,216	1,396	0	0	0	57	70%	0.085	1,050	1,206	0	0	0
1996	Apr	0	41,643	41,192	833	824	40,810	686	40,368	678	90	70%	0.085	3,673	3,633	200	734,521	726,565	66	70%	0.085	2,693	2,664	200	538,649	532,814	57	70%	0.085	2,326	2,301	200	465,197	460,158
1996	May	10,950	33,933	34,825	679	697	33,255	541	34,129	555	90	70%	0.085	2,896	2,972	707	2,047,559	2,101,375	66	70%	0.085	2,124	2,180	707	1,501,543	1,541,008	57	70%	0.085	1,834	1,882	707	1,296,787	1,330,871
1996	Jun	28,570	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1996	Jul	36,200	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1996	Aug	37,170	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1996	Sep	34,610	40,455	26,475	809	529	39,646	666	25,945	436	90	70%	0.085	3,568	2,335	684	2,440,400	1,597,065	66	70%	0.085	2,616	1,712	684	1,789,626	1,171,181	57	70%	0.085	2,260	1,479	684	1,545,586	1,011,474
1996	Oct	1,580	5,336	5,560	107	111	5,229	85	5,449	89	90	70%	0.085	455	475	707	321,952	335,512	66	70%	0.085	334	348	707	236,098	246,042	57	70%	0.085	288	301	707	203,903	212,491
1997	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1997	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1997	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1997	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1997	Mar	0	17,029	16,929	341	339	16,689	271	16,590	270	90	70%	0.085	1,453	1,445	0	0	0	66	70%	0.085	1,066	1,060	0	0	0	57	70%	0.085	921	915	0	0	0
1997	Apr	0	11,811	11,729	236	235	11,575	195	11,494	193	90	70%	0.085	1,042	1,034	200	208,330	206,876	66	70%	0.085	764	759	200	152,775	151,709	57	70%	0.085	660	655	200	131,942	131,021
1997	May	26,840	39,305	45,294	786	906	38,519	626	44,388	722	90	70%	0.085	3,355	3,866	707	2,371,719	2,733,086	66	70%	0.085	2,460	2,835	707	1,739,260	2,004,263	57	70%	0.085	2,125	2,448	707	1,502,088	1,730,954
1997	Jun	34,630	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1997	Jul	36,930	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1997	Aug	35,810	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1997	Sep	34,600	41,643	33,612	833	672	40,810	686	32,940	554	90	70%	0.085	3,673	2,964	684	2,512,061	2,027,616	66	70%	0.085	2,693	2,174	684	1,842,178	1,486,918	57	70%	0.085	2,326	1,877	684	1,590,972	1,284,157
1997	Oct	3,700	14,901	9,525	298	190	14,603	237	9,334	152	90	70%	0.085	1,272	813	707	899,152	574,731	66	70%	0.085	933	596	707	659,378	421,469	57	70%	0.085	805	515	707	569,463	363,996
1998	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1998	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1998	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1998	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1998	Mar	6,730	6,247	5,857	125	117	6,122	100	5,739	93	90	70%	0.085	533	500	0	0	0	66	70%	0.085	391	367	0	0	0	57	70%	0.085	338	317	0	0	0
1998	Apr	27,540	9,802	10,182	196	204	9,606	161	9,979	168	90	70%	0.085	864	898	200	172,885	179,602	66	70%	0.085	634	659	200	126,783	131,708	57	70%	0.085	547	569	200	109,494	113,748
1998	May	37,290	43,031	51,775	861	1036	42,170	686	50,740	825	90	70%	0.085	3,673	4,419	707	2,596,531	3,124,173	66	70%	0.085	2,693	3,241	707	1,904,123	2,291,060	57	70%	0.085	2,326	2,799	707	1,644,470	1,978,643
1998	Jun	36,220	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1998	Jul	37,420	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1998	Aug	36,430	43,031	32,307	861	646	42,170	686	31,661	515	90	70%	0.085	3,673	2,757	707	2,596,531	1,949,444	66	70%	0.085	2,693	2,022	707	1,904,123	1,429,592	57	70%	0.085	2,326	1,746	707	1,644,470	1,234,648
1998	Sep	28,870	19,121	4,081	382	82	18,739	315	4,000	67	90	70%	0.085	1,686	360	684	1,153,470	246,205	66	70%	0.085	1,237	264	684	845,878	180,551	57	70%	0.085	1,068	228	684	730,531	155,930
1998	Oct	3,700	3,071	3,206	61	64	3,010	49	3,142	51	90	70%	0.085	262	274	707	185,311	193,476	66	70%	0.085	192	201	707	135,894	141,883	57	70%	0.085	166	173	707	117,363	122,535
1999	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1999	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1999	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1999	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
1999	Mar	0	9,372	9,349	187	187	9,184	149	9,162	149	90	70%	0.085	800	798	0	0	0	66	70%	0.085	587	585	0	0	0	57	70%	0.085	507	505	0	0	0
1999	Apr	14,440	7,921	7,416	158	148	7,763	130	7,268	122	90	70%	0.085	699	654	200	139,720	130,815	66	70%	0.085	512	480	200	102,461	95,931	57	70%	0.085	442	414	200	88,489	82,850
1999	May	30,720	24,869	27,456	497	549	24,371	396	26,907	438	90	70%	0.085	2,122	2,343	707	1,500,596	1,656,698	66	70%	0.085	1,556	1,718	707	1,100,437	1,214,912	57	70%	0.085	1,344	1,484	707	950,377	1,049,242
1999	Jun	36,090	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
1999	Jul	37,350	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1999	Aug	36,060	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
1999	Sep	24,930	41,643	21,271	833	425	40,810	686	20,846	350	90	70%	0.085	3,673	1,876	684	2,512,061	1,283,146	66	70%	0.085	2,693	1,376	684	1,842,178	940,974	57	70%	0.085	2,326	1,188	684	1,590,972	812,659
1999	Oct	0	14,063	10,367	281	207	13,782	224	10,160	165	90	70%	0.085	1,200	885	707	848,587	625,555	66	70%	0.085	880	649	707	622,297	458,740	57	70%	0.085	760	560	707	537,439	396,185
2000	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2000	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2000	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2000	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2000	Mar	5,580	19,433	22,309	389	446	19,045	310	21,863	356	90	70%	0.085	1,659	1,904	0	0	0	66	70%	0.085	1,216	1,396	0	0	0	57	70%	0.085	1,050	1,206	0	0	0
2000	Apr	24,040	19,562	16,140	391	323	19,170	322	15,818	266	90	70%	0.085	1,725	1,423	200	345,038	284,693	66	70%	0.085	1,265	1,044	200	253,028	208,775	57	70%	0.085	1,093	902	200	218,524	180,306
2000	May	36,730	34,211	37,780	684	756	33,526	545	37,024	602	90	70%	0.085	2,920	3,224	707	2,064,298	2,279,670	66	70%	0.085	2,141	2,365	707	1,513,818	1,671,758	57	70%	0.085	1,849	2,042	707	1,307,389	1,443,791
2000	Jun	35,730	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
2000	Jul	32,040	43,031	44,162	861	883	42,170	686	43,279	704	90	70%	0.085	3,673	3,769	707	2,596,531	2,664,771	66	70%	0.085	2,693	2,764	707	1,904,123	1,954,166	57	70%	0.085	2,326	2,387	707	1,644,470	1,687,689
2000	Aug	31,760	21,782	8,159	436	163	21,347	347	7,995	130	90	70%	0.085	1,859	696	707	1,314,364	492,292	66	70%	0.085	1,363	511	707	963,867	361,014	57	70%	0.085	1,177	441	707	832,431	311,785
2000	Sep	12,820	5,958	5,958	119	119	5,839	98	5,839	98	90	70%	0.085	525	525	684	359,402	359,402	66	70%	0.085	385	385	684	263,562	263,562	57	70%	0.085	333	333	684	227,622	227,622
2000	Oct	0	5,275	5,497	106	110	5,170	84	5,387	88	90	70%	0.085	450	469	707	318,318	331,683	66	70%	0.085	330	344	707	233,433	243,234	57	70%	0.085	285	297	707	201,601	210,066
2001	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2001	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2001	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0

TABLE 2 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY

TURBINE POWER GENERATION - HKM ALTERNATIVE - REALIGNED CANAL WITH ONE PENSTOCK FOR DROPS 1-3, ONE PENSTOCK FOR DROP 4, AND ONE PENSTOCK FOR DROP 5

						Power Water Supplied and Generation																												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Turbine Head for Drops 1-3 (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Drops 1-3 Turbine Generation for 700 cfs Capacity (kW)	Drops 1-3 Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Drops 1-3 Turbine Generation for 700 cfs Capacity (kWh)	Drops 1-3 Turbine Generation for 850 cfs Capacity (kWh)	Turbine Head for Drop 4 (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Drop 4 Turbine Generation for 700 cfs Capacity (kW)	Drop 4 Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Drop 4 Turbine Generation for 700 cfs Capacity (kWh)	Drop 4 Turbine Generation for 850 cfs Capacity (kWh)	Turbine Head for Drop 5 (ft)	Turbine Efficiency (%)	Turbine Power Formula Constant	Drop 5 Turbine Generation for 700 cfs Capacity (kW)	Drop 5 Turbine Generation for 850 cfs Capacity (kW)	Turbine Operating Time (hours)	Drop 5 Turbine Generation for 700 cfs Capacity (kWh)	Drop 5 Turbine Generation for 850 cfs Capacity (kWh)
2001	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2001	Mar	0	1,551	1,587	31	32	1,520	25	1,556	25	90	70%	0.085	132	135	0	0	0	66	70%	0.085	97	99	0	0	0	57	70%	0.085	84	86	0	0	0
2001	Apr	7,730	3,988	3,362	80	67	3,909	66	3,295	55	90	70%	0.085	352	297	200	70,349	59,307	66	70%	0.085	258	217	200	51,589	43,492	57	70%	0.085	223	188	200	44,554	37,561
2001	May	39,900	31,548	36,685	631	734	30,917	503	35,951	585	90	70%	0.085	2,693	3,131	707	1,903,647	2,213,601	66	70%	0.085	1,975	2,296	707	1,396,008	1,623,307	57	70%	0.085	1,705	1,983	707	1,205,643	1,401,947
2001	Jun	37,060	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
2001	Jul	35,950	38,945	24,681	779	494	38,166	621	24,187	393	90	70%	0.085	3,324	2,106	707	2,349,952	1,489,255	66	70%	0.085	2,437	1,545	707	1,723,298	1,092,120	57	70%	0.085	2,105	1,334	707	1,488,303	943,195
2001	Aug	10,490	5,744	5,744	115	115	5,629	92	5,629	92	90	70%	0.085	490	490	707	346,585	346,585	66	70%	0.085	359	359	707	254,162	254,162	57	70%	0.085	310	310	707	219,504	219,504
2001	Sep	0	2,777	2,777	56	56	2,722	46	2,722	46	90	70%	0.085	245	245	684	167,546	167,546	66	70%	0.085	180	180	684	122,867	122,867	57	70%	0.085	155	155	684	106,113	106,113
2001	Oct	0	1,659	1,815	33	36	1,626	26	1,778	29	90	70%	0.085	142	155	707	100,129	109,495	66	70%	0.085	104	114	707	73,428	80,296	57	70%	0.085	90	98	707	63,415	69,347
2002	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2002	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2002	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2002	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2002	Mar	266	12,479	12,324	250	246	12,230	199	12,078	196	90	70%	0.085	1,065	1,052	0	0	0	66	70%	0.085	781	771	0	0	0	57	70%	0.085	675	666	0	0	0
2002	Apr	24,210	7,307	7,307	146	146	7,161	120	7,161	120	90	70%	0.085	644	644	200	128,890	128,890	66	70%	0.085	473	473	200	94,519	94,519	57	70%	0.085	408	408	200	81,630	81,630
2002	May	31,040	24,418	27,690	488	554	23,930	389	27,136	441	90	70%	0.085	2,084	2,363	707	1,473,395	1,670,827	66	70%	0.085	1,528	1,733	707	1,080,489	1,225,273	57	70%	0.085	1,320	1,497	707	933,150	1,058,190
2002	Jun	15,170	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
2002	Jul	3,540	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
2002	Aug	36,630	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
2002	Sep	35,740	40,038	30,802	801	616	39,237	659	30,186	507	90	70%	0.085	3,531	2,717	684	2,415,250	1,858,117	66	70%	0.085	2,589	1,992	684	1,771,183	1,362,619	57	70%	0.085	2,236	1,720	684	1,529,658	1,176,808
2002	Oct	5,930	4,552	4,768	91	95	4,461	73	4,673	76	90	70%	0.085	388	407	707	274,655	287,719	66	70%	0.085	285	298	707	201,413	210,994	57	70%	0.085	246	258	707	173,948	182,222
2003	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2003	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2003	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2003	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2003	Mar	0	10,740	10,699	215	214	10,525	171	10,485	171	90	70%	0.085	917	913	0	0	0	66	70%	0.085	672	670	0	0	0	57	70%	0.085	581	578	0	0	0
2003	Apr	20,580	16,936	16,673	339	333	16,597	279	16,339	275	90	70%	0.085	1,494	1,470	200	298,721	294,078	66	70%	0.085	1,095	1,078	200	219,062	215,658	57	70%	0.085	946	931	200	189,190	186,250
2003	May	28,370	26,785	28,347	536	567	26,249	427	27,780	452	90	70%	0.085	2,286	2,419	707	1,616,222	1,710,485	66	70%	0.085	1,676	1,774	707	1,185,229	1,254,356	57	70%	0.085	1,448	1,532	707	1,023,607	1,083,307
2003	Jun	37,390	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
2003	Jul	38,480	43,031	52,252	861	1045	42,170	686	51,207	833	90	70%	0.085	3,673	4,460	707	2,596,531	3,152,931	66	70%	0.085	2,693	3,270	707	1,904,123	2,312,149	57	70%	0.085	2,326	2,824	707	1,644,470	1,996,856
2003	Aug	34,240	22,643	8,201	453	164	22,190	361	8,037	131	90	70%	0.085	1,933	700	707	1,366,313	494,880	66	70%	0.085	1,417	513	707	1,001,963	362,912	57	70%	0.085	1,224	443	707	865,332	313,424
2003	Sep	8,920	3,812	3,812	76	76	3,736	63	3,736	63	90	70%	0.085	336	336	684	229,939	229,939	66	70%	0.085	247	247	684	168,622	168,622	57	70%	0.085	213	213	684	145,628	145,628
2003	Oct	0	2,743	2,914	55	58	2,688	44	2,856	46	90	70%	0.085	234	249	707	165,510	175,824	66	70%	0.085	172	182	707	121,374	128,937	57	70%	0.085	148	158	707	104,823	111,355
2004	Nov	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2004	Dec	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2004	Jan	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2004	Feb	0	0	0	0	0	0	0	0	0	90	70%	0.085	0	0	0	0	0	66	70%	0.085	0	0	0	0	0	57	70%	0.085	0	0	0	0	0
2004	Mar	369	9,124	8,953	182	179	8,941	145	8,774	143	90	70%	0.085	779	764	0	0	0	66	70%	0.085	571	560	0	0	0	57	70%	0.085	493	484	0	0	0
2004	Apr	27,280	12,176	12,176	244	244	11,932	201	11,932	201	90	70%	0.085	1,074	1,074	200	214,767	214,767	66	70%	0.085	787	787	200	157,496	157,496	57	70%	0.085	680	680	200	136,019	136,019
2004	May	34,090	40,810	42,668	816	853	39,993	650	41,815	680	90	70%	0.085	3,483	3,642	707	2,462,480	2,574,615	66	70%	0.085	2,554	2,671	707	1,805,819	1,888,051	57	70%	0.085	2,206	2,306	707	1,559,571	1,630,589
2004	Jun	36,130	41,643	50,567	833	1011	40,810	686	49,555	833	90	70%	0.085	3,673	4,460	684	2,512,061	3,050,360	66	70%	0.085	2,693	3,270	684	1,842,178	2,236,931	57	70%	0.085	2,326	2,824	684	1,590,972	1,931,895
2004	Jul	28,130	43,031	50,431	861	1009	42,170	686	49,422	804	90	70%	0.085	3,673	4,304	707	2,596,531	3,043,053	66	70%	0.085	2,693	3,156	707	1,904,123	2,231,572	57	70%	0.085	2,326	2,726	707	1,644,470	1,927,267
2004	Aug	35,580	33,576	15,855	672	317	32,904	535	15,538	253	90	70%	0.085	2,866	1,353	707	2,025,982	956,720	66	70%	0.085	2,101	992	707	1,485,720	701,595	57	70%	0.085	1,815	857	707	1,283,122	605,923
2004	Sep	19,870	15,388	14,927	308	299	15,081	253	14,628	246	90	70%	0.085	1,357	1,316	684	928,288	900,450	66	70%	0.085	995	965	684	680,744	660,330	57	70%	0.085	860	834	684	587,916	570,285
2004	Oct	0	6,817	7,213	136	144	6,680	109	7,069	115	90	70%	0.085	582	616	707	411,314	435,245	66	70%	0.085	427	451	707	301,630	319,180	57	70%	0.085	368	390	707	260,499	275,655
Avg		14611	17062	17576	341	352	16721	275	17224	284				1474	1518		917364	947717				1081	1113		672734	694993				934	962		580997	600221
Max		42,750	43,031	52,252	861	1,045	42,170	686	51,207	833				3,673	4,460		2,596,531	3,152,931				2,693	3,270		1,904,123	2,312,149				2,326	2,824		1,644,470	1,996,856
Min		0	0	0	0	0	0	0	0	0				0	0		0	0				0	0		0	0				0	0		0	0

APPENDIX C
DROP 5 HYDROPOWER ALTERNATIVE

TABLE 3 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - DROP 5 ALTERNATIVE - REALIGNED CANAL WITH ONE PENSTOCK TO DROP 5

						Power Water Supplied and Generation for One Penstock for Drops 1-5												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Drops 1-5 Turbine Head (ft)	Drops 1-5 Turbine Efficiency (%)	Drops 1-5 Turbine Power Formula Constant	Drops 1-5 Turbine Generation for 700 cfs Capacity (kW)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kW)	Drops 1-5 Turbine Operating Time (hours)	Drops 1-5 Turbine Generation for 700 cfs Capacity (kWh)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kWh)
1980	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1980	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1980	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1980	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1980	Mar	6,902	11,817	11,817	236	236	11,580	188	11,580	188	213	70%	0.085	2,387	2,387	0	0	0
1980	Apr	24,908	15,424	15,924	308	318	15,115	254	15,606	262	213	70%	0.085	3,219	3,324	200	643,850	664,747
1980	May	31,738	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1980	Jun	39,461	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1980	Jul	41,841	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1980	Aug	40,643	38,393	13,812	768	276	37,626	612	13,536	220	213	70%	0.085	7,755	2,790	707	5,482,833	1,972,461
1980	Sep	13,977	13,435	13,435	269	269	13,166	221	13,166	221	213	70%	0.085	2,804	2,804	684	1,918,029	1,918,029
1980	Oct	0	6,351	6,582	127	132	6,224	101	6,451	105	213	70%	0.085	1,283	1,330	707	906,924	940,002
1981	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1981	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1981	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1981	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1981	Mar	25,256	19,433	22,309	389	446	19,045	310	21,863	356	213	70%	0.085	3,925	4,506	0	0	0
1981	Apr	20,876	17,368	14,314	347	286	17,021	286	14,027	236	213	70%	0.085	3,625	2,988	200	725,017	597,515
1981	May	34,088	43,031	49,707	861	994	42,170	686	48,713	792	213	70%	0.085	8,692	10,040	707	6,145,123	7,098,512
1981	Jun	39,023	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1981	Jul	41,337	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1981	Aug	38,372	43,031	37,154	861	743	42,170	686	36,411	592	213	70%	0.085	8,692	7,505	707	6,145,123	5,305,849
1981	Sep	32,886	16,712	5,033	334	101	16,378	275	4,933	83	213	70%	0.085	3,488	1,051	684	2,385,930	718,569
1981	Oct	0	3,552	3,727	71	75	3,481	57	3,652	59	213	70%	0.085	717	753	707	507,215	532,196
1982	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1982	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1982	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1982	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1982	Mar	0	8,799	8,692	176	174	8,623	140	8,518	139	213	70%	0.085	1,777	1,756	0	0	0
1982	Apr	0	4,380	4,380	88	88	4,292	72	4,292	72	213	70%	0.085	914	914	200	182,839	182,839
1982	May	31,747	27,489	31,253	550	625	26,939	438	30,628	498	213	70%	0.085	5,552	6,313	707	3,925,601	4,463,130
1982	Jun	31,622	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1982	Jul	36,042	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1982	Aug	0	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1982	Sep	0	37,803	16,364	756	327	37,047	623	16,037	270	213	70%	0.085	7,890	3,416	684	5,397,028	2,336,266
1982	Oct	0	5,283	5,673	106	113	5,177	84	5,560	90	213	70%	0.085	1,067	1,146	707	754,402	810,182
1983	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1983	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1983	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1983	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1983	Mar	16,400	8,721	8,427	174	169	8,547	139	8,258	134	213	70%	0.085	1,762	1,702	0	0	0
1983	Apr	23,451	5,776	5,776	116	116	5,660	95	5,660	95	213	70%	0.085	1,206	1,206	200	241,111	241,111
1983	May	18,539	23,787	25,644	476	513	23,311	379	25,131	409	213	70%	0.085	4,805	5,180	707	3,396,875	3,662,109
1983	Jun	37,989	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185

TABLE 3 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - DROP 5 ALTERNATIVE - REALIGNED CANAL WITH ONE PENSTOCK TO DROP 5

						Power Water Supplied and Generation for One Penstock for Drops 1-5												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Drops 1-5 Turbine Head (ft)	Drops 1-5 Turbine Efficiency (%)	Drops 1-5 Turbine Power Formula Constant	Drops 1-5 Turbine Generation for 700 cfs Capacity (kW)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kW)	Drops 1-5 Turbine Operating Time (hours)	Drops 1-5 Turbine Generation for 700 cfs Capacity (kWh)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kWh)
1983	Jul	42,498	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1983	Aug	39,558	33,651	14,607	673	292	32,978	536	14,315	233	213	70%	0.085	6,797	2,950	707	4,805,590	2,085,967
1983	Sep	90	5,368	5,368	107	107	5,260	88	5,260	88	213	70%	0.085	1,120	1,120	684	766,302	766,302
1983	Oct	0	2,715	2,847	54	57	2,660	43	2,790	45	213	70%	0.085	548	575	707	387,669	406,620
1984	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1984	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1984	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1984	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1984	Mar	19,908	14,632	14,563	293	291	14,339	233	14,272	232	213	70%	0.085	2,955	2,942	0	0	0
1984	Apr	12,664	7,135	7,135	143	143	6,992	118	6,992	118	213	70%	0.085	1,489	1,489	200	297,833	297,833
1984	May	21,723	25,383	28,569	508	571	24,875	405	27,998	455	213	70%	0.085	5,127	5,771	707	3,624,851	4,079,838
1984	Jun	39,913	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1984	Jul	41,881	43,031	48,246	861	965	42,170	686	47,281	769	213	70%	0.085	8,692	9,745	707	6,145,123	6,889,883
1984	Aug	27,976	27,898	10,574	558	211	27,340	445	10,362	169	213	70%	0.085	5,635	2,136	707	3,984,059	1,509,980
1984	Sep	0	7,045	7,045	141	141	6,904	116	6,904	116	213	70%	0.085	1,470	1,470	684	1,005,725	1,005,725
1984	Oct	0	6,161	6,402	123	128	6,038	98	6,274	102	213	70%	0.085	1,244	1,293	707	879,821	914,286
1985	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1985	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1985	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1985	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1985	Mar	3,615	4,242	4,001	85	80	4,157	68	3,921	64	213	70%	0.085	857	808	0	0	0
1985	Apr	33,739	8,617	9,322	172	186	8,444	142	9,136	154	213	70%	0.085	1,798	1,946	200	359,696	389,141
1985	May	40,399	40,754	45,240	815	905	39,939	650	44,335	721	213	70%	0.085	8,232	9,138	707	5,819,904	6,460,570
1985	Jun	41,133	40,255	50,567	805	1011	39,450	663	49,555	833	213	70%	0.085	8,402	10,554	684	5,747,038	7,219,185
1985	Jul	32,914	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1985	Aug	39,566	29,540	10,004	591	200	28,949	471	9,804	159	213	70%	0.085	5,967	2,021	707	4,218,480	1,428,643
1985	Sep	24,295	20,066	19,860	401	397	19,665	330	19,463	327	213	70%	0.085	4,188	4,145	684	2,864,803	2,835,369
1985	Oct	0	11,812	14,436	236	289	11,576	188	14,147	230	213	70%	0.085	2,386	2,916	707	1,686,853	2,061,497
1986	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1986	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1986	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1986	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1986	Mar	0	19,433	22,309	389	446	19,045	310	21,863	356	213	70%	0.085	3,925	4,506	0	0	0
1986	Apr	14,740	30,246	25,783	605	516	29,641	498	25,267	425	213	70%	0.085	6,313	5,382	200	1,262,588	1,076,301
1986	May	17,560	30,848	33,339	617	667	30,231	492	32,672	531	213	70%	0.085	6,231	6,734	707	4,405,319	4,761,003
1986	Jun	26,240	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1986	Jul	38,370	43,031	48,647	861	973	42,170	686	47,674	775	213	70%	0.085	8,692	9,826	707	6,145,123	6,947,086
1986	Aug	35,540	18,980	7,305	380	146	18,601	303	7,158	116	213	70%	0.085	3,834	1,475	707	2,710,522	1,043,141
1986	Sep	3,230	7,784	7,784	156	156	7,628	128	7,628	128	213	70%	0.085	1,625	1,625	684	1,111,279	1,111,279
1986	Oct	0	8,867	9,264	177	185	8,690	141	9,078	148	213	70%	0.085	1,791	1,871	707	1,266,280	1,322,918
1987	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1987	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1987	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1987	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0

TABLE 3 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - DROP 5 ALTERNATIVE - REALIGNED CANAL WITH ONE PENSTOCK TO DROP 5

						Power Water Supplied and Generation for One Penstock for Drops 1-5												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Drops 1-5 Turbine Head (ft)	Drops 1-5 Turbine Efficiency (%)	Drops 1-5 Turbine Power Formula Constant	Drops 1-5 Turbine Generation for 700 cfs Capacity (kW)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kW)	Drops 1-5 Turbine Operating Time (hours)	Drops 1-5 Turbine Generation for 700 cfs Capacity (kWh)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kWh)
1987	Mar	21,420	13,708	13,340	274	267	13,434	218	13,073	213	213	70%	0.085	2,769	2,695	0	0	0
1987	Apr	12,720	14,081	14,378	282	288	13,799	232	14,090	237	213	70%	0.085	2,939	3,001	200	587,785	600,202
1987	May	30,230	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1987	Jun	37,060	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1987	Jul	31,060	43,031	36,471	861	729	42,170	686	35,742	581	213	70%	0.085	8,692	7,367	707	6,145,123	5,208,331
1987	Aug	35,640	33,278	21,449	666	429	32,613	530	21,020	342	213	70%	0.085	6,722	4,333	707	4,752,351	3,063,096
1987	Sep	9,390	6,969	6,969	139	139	6,830	115	6,830	115	213	70%	0.085	1,455	1,455	684	995,003	995,003
1987	Oct	0	2,645	2,749	53	55	2,592	42	2,694	44	213	70%	0.085	534	555	707	377,729	392,590
1988	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1988	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1988	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1988	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1988	Mar	15,040	3,950	3,949	79	79	3,871	63	3,870	63	213	70%	0.085	798	798	0	0	0
1988	Apr	35,750	16,179	16,179	324	324	15,856	266	15,856	266	213	70%	0.085	3,377	3,377	200	675,401	675,401
1988	May	39,500	36,384	42,333	728	847	35,656	580	41,486	675	213	70%	0.085	7,349	8,551	707	5,195,858	6,045,415
1988	Jun	41,180	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1988	Jul	37,520	33,988	19,115	680	382	33,308	542	18,733	305	213	70%	0.085	6,865	3,861	707	4,853,655	2,729,764
1988	Aug	8,160	5,645	5,645	113	113	5,532	90	5,532	90	213	70%	0.085	1,140	1,140	707	806,187	806,187
1988	Sep	0	3,016	3,016	60	60	2,956	50	2,956	50	213	70%	0.085	630	630	684	430,620	430,620
1988	Oct	0	9,878	10,457	198	209	9,681	157	10,248	167	213	70%	0.085	1,995	2,112	707	1,410,712	1,493,317
1989	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1989	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1989	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1989	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1989	Mar	13,140	11,807	11,229	236	225	11,571	188	11,004	179	213	70%	0.085	2,385	2,268	0	0	0
1989	Apr	32,060	16,149	16,452	323	329	15,826	266	16,123	271	213	70%	0.085	3,371	3,434	200	674,139	686,795
1989	May	41,860	39,485	44,933	790	899	38,696	629	44,034	716	213	70%	0.085	7,976	9,076	707	5,638,765	6,416,706
1989	Jun	42,750	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1989	Jul	42,460	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1989	Aug	39,080	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1989	Sep	37,040	41,643	18,932	833	379	40,810	686	18,554	312	213	70%	0.085	8,692	3,952	684	5,945,211	2,702,881
1989	Oct	29,060	10,428	8,169	209	163	10,219	166	8,005	130	213	70%	0.085	2,106	1,650	707	1,489,145	1,166,556
1990	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1990	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1990	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1990	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1990	Mar	0	19,433	22,309	389	446	19,045	310	21,863	356	213	70%	0.085	3,925	4,506	0	0	0
1990	Apr	13,790	33,436	31,595	669	632	32,768	551	30,963	520	213	70%	0.085	6,979	6,595	200	1,395,789	1,318,919
1990	May	37,780	40,804	41,714	816	834	39,988	650	40,880	665	213	70%	0.085	8,242	8,426	707	5,827,050	5,957,041
1990	Jun	30,130	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1990	Jul	40,280	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1990	Aug	37,270	43,031	47,147	861	943	42,170	686	46,204	751	213	70%	0.085	8,692	9,523	707	6,145,123	6,732,868
1990	Sep	35,780	27,876	5,659	558	113	27,318	459	5,546	93	213	70%	0.085	5,818	1,181	684	3,979,750	807,880
1990	Oct	11,840	13,756	14,453	275	289	13,481	219	14,164	230	213	70%	0.085	2,779	2,919	707	1,964,402	2,064,054

TABLE 3 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - DROP 5 ALTERNATIVE - REALIGNED CANAL WITH ONE PENSTOCK TO DROP 5

						Power Water Supplied and Generation for One Penstock for Drops 1-5												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Drops 1-5 Turbine Head (ft)	Drops 1-5 Turbine Efficiency (%)	Drops 1-5 Turbine Power Formula Constant	Drops 1-5 Turbine Generation for 700 cfs Capacity (kW)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kW)	Drops 1-5 Turbine Operating Time (hours)	Drops 1-5 Turbine Generation for 700 cfs Capacity (kWh)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kWh)
1991	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1991	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1991	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1991	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1991	Mar	2,830	19,433	22,309	389	446	19,045	310	21,863	356	213	70%	0.085	3,925	4,506	0	0	0
1991	Apr	36,280	17,055	13,482	341	270	16,714	281	13,212	222	213	70%	0.085	3,560	2,814	200	711,955	562,795
1991	May	36,780	34,334	39,688	687	794	33,647	547	38,894	633	213	70%	0.085	6,935	8,017	707	4,903,127	5,667,727
1991	Jun	35,030	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1991	Jul	37,900	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1991	Aug	37,910	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1991	Sep	31,430	41,643	32,071	833	641	40,810	686	31,430	528	213	70%	0.085	8,692	6,694	684	5,945,211	4,578,664
1991	Oct	264	6,000	3,574	120	71	5,880	96	3,503	57	213	70%	0.085	1,212	722	707	856,777	510,459
1992	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1992	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1992	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1992	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1992	Mar	20,110	7,296	7,298	146	146	7,150	116	7,152	116	213	70%	0.085	1,474	1,474	0	0	0
1992	Apr	14,650	8,391	8,391	168	168	8,223	138	8,223	138	213	70%	0.085	1,751	1,751	200	350,289	350,289
1992	May	31,200	40,921	41,032	818	821	40,103	652	40,211	654	213	70%	0.085	8,266	8,288	707	5,843,802	5,859,600
1992	Jun	16,940	39,163	38,854	783	777	38,380	645	38,077	640	213	70%	0.085	8,174	8,110	684	5,591,219	5,547,024
1992	Jul	30,150	19,669	19,868	393	397	19,275	313	19,470	317	213	70%	0.085	3,973	4,013	707	2,808,823	2,837,233
1992	Aug	24,570	7,468	7,468	149	149	7,319	119	7,319	119	213	70%	0.085	1,509	1,509	707	1,066,532	1,066,532
1992	Sep	0	7,110	7,110	142	142	6,968	117	6,968	117	213	70%	0.085	1,484	1,484	684	1,015,097	1,015,097
1992	Oct	0	8,902	9,252	178	185	8,724	142	9,067	147	213	70%	0.085	1,798	1,869	707	1,271,330	1,321,291
1993	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1993	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1993	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1993	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1993	Mar	1,150	8,430	8,281	169	166	8,262	134	8,115	132	213	70%	0.085	1,703	1,673	0	0	0
1993	Apr	19,570	6,723	6,723	134	134	6,588	111	6,588	111	213	70%	0.085	1,403	1,403	200	280,628	280,628
1993	May	37,140	31,225	36,052	625	721	30,601	498	35,331	575	213	70%	0.085	6,307	7,282	707	4,459,182	5,148,447
1993	Jun	38,830	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1993	Jul	31,280	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1993	Aug	31,670	43,031	22,871	861	457	42,170	686	22,414	365	213	70%	0.085	8,692	4,620	707	6,145,123	3,266,178
1993	Sep	28,190	17,105	14,293	342	286	16,763	282	14,008	235	213	70%	0.085	3,570	2,983	684	2,441,972	2,040,620
1993	Oct	239	7,327	7,582	147	152	7,180	117	7,431	121	213	70%	0.085	1,480	1,532	707	1,046,289	1,082,803
1994	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1994	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1994	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1994	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1994	Mar	0	11,097	11,052	222	221	10,875	177	10,831	176	213	70%	0.085	2,242	2,232	0	0	0
1994	Apr	2,550	19,022	19,345	380	387	18,641	313	18,958	319	213	70%	0.085	3,970	4,038	200	794,048	807,548
1994	May	32,580	39,363	45,580	787	912	38,576	627	44,668	726	213	70%	0.085	7,951	9,207	707	5,621,282	6,509,129
1994	Jun	37,220	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185

TABLE 3 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - DROP 5 ALTERNATIVE - REALIGNED CANAL WITH ONE PENSTOCK TO DROP 5

						Power Water Supplied and Generation for One Penstock for Drops 1-5												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Drops 1-5 Turbine Head (ft)	Drops 1-5 Turbine Efficiency (%)	Drops 1-5 Turbine Power Formula Constant	Drops 1-5 Turbine Generation for 700 cfs Capacity (kW)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kW)	Drops 1-5 Turbine Operating Time (hours)	Drops 1-5 Turbine Generation for 700 cfs Capacity (kWh)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kWh)
1994	Jul	36,200	43,031	34,494	861	690	42,170	686	33,805	550	213	70%	0.085	8,692	6,968	707	6,145,123	4,926,040
1994	Aug	35,540	13,621	6,694	272	134	13,349	217	6,560	107	213	70%	0.085	2,751	1,352	707	1,945,199	955,919
1994	Sep	18,620	3,440	3,440	69	69	3,371	57	3,371	57	213	70%	0.085	718	718	684	491,047	491,047
1994	Oct	0	3,369	3,667	67	73	3,302	54	3,593	58	213	70%	0.085	681	741	707	481,130	523,608
1995	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1995	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1995	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1995	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1995	Mar	1,970	17,624	17,458	352	349	17,272	281	17,109	278	213	70%	0.085	3,560	3,526	0	0	0
1995	Apr	11,920	4,959	4,959	99	99	4,860	82	4,860	82	213	70%	0.085	1,035	1,035	200	207,023	207,023
1995	May	37,170	37,297	43,879	746	878	36,551	594	43,001	699	213	70%	0.085	7,534	8,863	707	5,326,204	6,266,182
1995	Jun	9,260	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1995	Jul	12,330	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1995	Aug	12,890	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1995	Sep	0	41,643	31,098	833	622	40,810	686	30,476	512	213	70%	0.085	8,692	6,491	684	5,945,211	4,439,680
1995	Oct	0	21,144	18,305	423	366	20,721	337	17,939	292	213	70%	0.085	4,271	3,697	707	3,019,509	2,614,053
1996	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1996	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1996	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1996	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1996	Mar	0	19,433	22,309	389	446	19,045	310	21,863	356	213	70%	0.085	3,925	4,506	0	0	0
1996	Apr	0	41,643	41,192	833	824	40,810	686	40,368	678	213	70%	0.085	8,692	8,598	200	1,738,366	1,719,537
1996	May	10,950	33,933	34,825	679	697	33,255	541	34,129	555	213	70%	0.085	6,854	7,034	707	4,845,889	4,973,253
1996	Jun	28,570	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1996	Jul	36,200	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1996	Aug	37,170	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1996	Sep	34,610	40,455	26,475	809	529	39,646	666	25,945	436	213	70%	0.085	8,444	5,526	684	5,775,612	3,779,720
1996	Oct	1,580	5,336	5,560	107	111	5,229	85	5,449	89	213	70%	0.085	1,078	1,123	707	761,952	794,044
1997	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1997	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1997	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1997	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1997	Mar	0	17,029	16,929	341	339	16,689	271	16,590	270	213	70%	0.085	3,440	3,419	0	0	0
1997	Apr	0	11,811	11,729	236	235	11,575	195	11,494	193	213	70%	0.085	2,465	2,448	200	493,048	489,606
1997	May	26,840	39,305	45,294	786	906	38,519	626	44,388	722	213	70%	0.085	7,939	9,149	707	5,613,067	6,468,303
1997	Jun	34,630	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1997	Jul	36,930	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1997	Aug	35,810	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1997	Sep	34,600	41,643	33,612	833	672	40,810	686	32,940	554	213	70%	0.085	8,692	7,016	684	5,945,211	4,798,691
1997	Oct	3,700	14,901	9,525	298	190	14,603	237	9,334	152	213	70%	0.085	3,010	1,924	707	2,127,993	1,360,196
1998	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1998	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1998	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1998	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0

TABLE 3 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - DROP 5 ALTERNATIVE - REALIGNED CANAL WITH ONE PENSTOCK TO DROP 5

						Power Water Supplied and Generation for One Penstock for Drops 1-5												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Drops 1-5 Turbine Head (ft)	Drops 1-5 Turbine Efficiency (%)	Drops 1-5 Turbine Power Formula Constant	Drops 1-5 Turbine Generation for 700 cfs Capacity (kW)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kW)	Drops 1-5 Turbine Operating Time (hours)	Drops 1-5 Turbine Generation for 700 cfs Capacity (kWh)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kWh)
1998	Mar	6,730	6,247	5,857	125	117	6,122	100	5,739	93	213	70%	0.085	1,262	1,183	0	0	0
1998	Apr	27,540	9,802	10,182	196	204	9,606	161	9,979	168	213	70%	0.085	2,046	2,125	200	409,162	425,058
1998	May	37,290	43,031	51,775	861	1036	42,170	686	50,740	825	213	70%	0.085	8,692	10,458	707	6,145,123	7,393,875
1998	Jun	36,220	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1998	Jul	37,420	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1998	Aug	36,430	43,031	32,307	861	646	42,170	686	31,661	515	213	70%	0.085	8,692	6,526	707	6,145,123	4,613,684
1998	Sep	28,870	19,121	4,081	382	82	18,739	315	4,000	67	213	70%	0.085	3,991	852	684	2,729,880	582,686
1998	Oct	3,700	3,071	3,206	61	64	3,010	49	3,142	51	213	70%	0.085	620	648	707	438,568	457,894
1999	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1999	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1999	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1999	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
1999	Mar	0	9,372	9,349	187	187	9,184	149	9,162	149	213	70%	0.085	1,893	1,888	0	0	0
1999	Apr	14,440	7,921	7,416	158	148	7,763	130	7,268	122	213	70%	0.085	1,653	1,548	200	330,671	309,596
1999	May	30,720	24,869	27,456	497	549	24,371	396	26,907	438	213	70%	0.085	5,023	5,546	707	3,551,410	3,920,852
1999	Jun	36,090	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
1999	Jul	37,350	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1999	Aug	36,060	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
1999	Sep	24,930	41,643	21,271	833	425	40,810	686	20,846	350	213	70%	0.085	8,692	4,440	684	5,945,211	3,036,779
1999	Oct	0	14,063	10,367	281	207	13,782	224	10,160	165	213	70%	0.085	2,841	2,094	707	2,008,324	1,480,481
2000	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2000	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2000	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2000	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2000	Mar	5,580	19,433	22,309	389	446	19,045	310	21,863	356	213	70%	0.085	3,925	4,506	0	0	0
2000	Apr	24,040	19,562	16,140	391	323	19,170	322	15,818	266	213	70%	0.085	4,083	3,369	200	816,591	673,773
2000	May	36,730	34,211	37,780	684	756	33,526	545	37,024	602	213	70%	0.085	6,910	7,631	707	4,885,505	5,395,219
2000	Jun	35,730	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
2000	Jul	32,040	43,031	44,162	861	883	42,170	686	43,279	704	213	70%	0.085	8,692	8,920	707	6,145,123	6,306,625
2000	Aug	31,760	21,782	8,159	436	163	21,347	347	7,995	130	213	70%	0.085	4,400	1,648	707	3,110,662	1,165,092
2000	Sep	12,820	5,958	5,958	119	119	5,839	98	5,839	98	213	70%	0.085	1,244	1,244	684	850,586	850,586
2000	Oct	0	5,275	5,497	106	110	5,170	84	5,387	88	213	70%	0.085	1,066	1,110	707	753,352	784,983
2001	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2001	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2001	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2001	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2001	Mar	0	1,551	1,587	31	32	1,520	25	1,556	25	213	70%	0.085	313	321	0	0	0
2001	Apr	7,730	3,988	3,362	80	67	3,909	66	3,295	55	213	70%	0.085	832	702	200	166,492	140,361
2001	May	39,900	31,548	36,685	631	734	30,917	503	35,951	585	213	70%	0.085	6,372	7,410	707	4,505,298	5,238,855
2001	Jun	37,060	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
2001	Jul	35,950	38,945	24,681	779	494	38,166	621	24,187	393	213	70%	0.085	7,866	4,985	707	5,561,553	3,524,570
2001	Aug	10,490	5,744	5,744	115	115	5,629	92	5,629	92	213	70%	0.085	1,160	1,160	707	820,251	820,251
2001	Sep	0	2,777	2,777	56	56	2,722	46	2,722	46	213	70%	0.085	580	580	684	396,526	396,526
2001	Oct	0	1,659	1,815	33	36	1,626	26	1,778	29	213	70%	0.085	335	367	707	236,971	259,138

TABLE 3 - SAINT MARY CANAL SYSTEM POWER FEASIBILITY STUDY
TURBINE POWER GENERATION - DROP 5 ALTERNATIVE - REALIGNED CANAL WITH ONE PENSTOCK TO DROP 5

						Power Water Supplied and Generation for One Penstock for Drops 1-5												
Water Year	Month	Historical Diversions to St. Mary Canal (ac-ft)	Divertable Flow at 700 cfs Canal Capacity (ac-ft)	Divertable Flow at 850 cfs Canal Capacity (ac-ft)	Seepage Loss to Drop 1 for 700cfs Capacity (ac-ft)	Seepage Loss to Drop 1 for 850cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (ac-ft)	Turbine Water Supplied at 700 cfs Capacity (cfs)	Turbine Water Supplied at 850 cfs Capacity (ac-ft)	Turbine Water Supplied at 850 cfs Capacity (cfs)	Drops 1-5 Turbine Head (ft)	Drops 1-5 Turbine Efficiency (%)	Drops 1-5 Turbine Power Formula Constant	Drops 1-5 Turbine Generation for 700 cfs Capacity (kW)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kW)	Drops 1-5 Turbine Operating Time (hours)	Drops 1-5 Turbine Generation for 700 cfs Capacity (kWh)	Drops 1-5 Turbine Generation for 850 cfs Capacity (kWh)
2002	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2002	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2002	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2002	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2002	Mar	266	12,479	12,324	250	246	12,230	199	12,078	196	213	70%	0.085	2,521	2,489	0	0	0
2002	Apr	24,210	7,307	7,307	146	146	7,161	120	7,161	120	213	70%	0.085	1,525	1,525	200	305,039	305,039
2002	May	31,040	24,418	27,690	488	554	23,930	389	27,136	441	213	70%	0.085	4,932	5,593	707	3,487,034	3,954,290
2002	Jun	15,170	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
2002	Jul	3,540	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
2002	Aug	36,630	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
2002	Sep	35,740	40,038	30,802	801	616	39,237	659	30,186	507	213	70%	0.085	8,357	6,429	684	5,716,092	4,397,544
2002	Oct	5,930	4,552	4,768	91	95	4,461	73	4,673	76	213	70%	0.085	919	963	707	650,016	680,935
2003	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2003	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2003	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2003	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2003	Mar	0	10,740	10,699	215	214	10,525	171	10,485	171	213	70%	0.085	2,169	2,161	0	0	0
2003	Apr	20,580	16,936	16,673	339	333	16,597	279	16,339	275	213	70%	0.085	3,535	3,480	200	706,973	695,986
2003	May	28,370	26,785	28,347	536	567	26,249	427	27,780	452	213	70%	0.085	5,410	5,726	707	3,825,058	4,048,148
2003	Jun	37,390	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
2003	Jul	38,480	43,031	52,252	861	1045	42,170	686	51,207	833	213	70%	0.085	8,692	10,554	707	6,145,123	7,461,936
2003	Aug	34,240	22,643	8,201	453	164	22,190	361	8,037	131	213	70%	0.085	4,574	1,657	707	3,233,608	1,171,215
2003	Sep	8,920	3,812	3,812	76	76	3,736	63	3,736	63	213	70%	0.085	796	796	684	544,190	544,190
2003	Oct	0	2,743	2,914	55	58	2,688	44	2,856	46	213	70%	0.085	554	589	707	391,707	416,116
2004	Nov	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2004	Dec	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2004	Jan	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2004	Feb	0	0	0	0	0	0	0	0	0	213	70%	0.085	0	0	0	0	0
2004	Mar	369	9,124	8,953	182	179	8,941	145	8,774	143	213	70%	0.085	1,843	1,808	0	0	0
2004	Apr	27,280	12,176	12,176	244	244	11,932	201	11,932	201	213	70%	0.085	2,541	2,541	200	508,282	508,282
2004	May	34,090	40,810	42,668	816	853	39,993	650	41,815	680	213	70%	0.085	8,243	8,618	707	5,827,869	6,093,254
2004	Jun	36,130	41,643	50,567	833	1011	40,810	686	49,555	833	213	70%	0.085	8,692	10,554	684	5,945,211	7,219,185
2004	Jul	28,130	43,031	50,431	861	1009	42,170	686	49,422	804	213	70%	0.085	8,692	10,187	707	6,145,123	7,201,892
2004	Aug	35,580	33,576	15,855	672	317	32,904	535	15,538	253	213	70%	0.085	6,782	3,203	707	4,794,825	2,264,238
2004	Sep	19,870	15,388	14,927	308	299	15,081	253	14,628	246	213	70%	0.085	3,212	3,116	684	2,196,948	2,131,065
2004	Oct	0	6,817	7,213	136	144	6,680	109	7,069	115	213	70%	0.085	1,377	1,457	707	973,443	1,030,080
Avg		14611	17062	17576	341	352	16721	275	17224	284				3489	3594		2171095	2242931
Max		42,750	43,031	52,252	861	1,045	42,170	686	51,207	833				8,692	10,554		6,145,123	7,461,936
Min		0	0	0	0	0	0	0	0	0				0	0		0	0

APPENDIX D
GENERAL HYDROPOWER AND HYDROLOGY INFORMATION

Saint Mary Canal System Hydropower Feasibility Study

General Hydropower Information

According to Kerry McCalman, Bureau of Reclamation Power Division, Great Plains Region, the minimum feasible size of a small hydropower unit is 2 MW. This is based on information from the power customers served by hydropower in the Great Plains Region through the Western Area Power Administration (WAPA). The current power sales market is at 50 to 55 mills/KWh or $0.05 to $0.055/KWh. WAPA currently pays 45 to 65 mills/KWh on the open market when power has to be purchased. The Pick-Sloan preferred power rate for irrigation is set at 2.5 mills/KWh. Some entities, such as the City of Aspen, Colorado, are willing to pay a high rate for green power. The City of Aspen is currently paying 80 mills/KWh for generation from a small hydropower unit at Ruedi Reservoir in Colorado.

Ted Sorenson of Sorenson Engineering in Idaho has engineered and installed numerous small hydropower units and recently completed a 7 MW unit at Tiber Dam located in north-central Montana. The general specifications that he utilizes for the feasibility of small hydropower units are:

Head < 20 feet is not feasible.

At the minimum head of 20 feet, 400 cfs or greater flow is required.

1 mile per 100 feet of drop is the maximum length of pipeline for economic construction cost feasibility.

The smallest hydropower unit installed to date is 175 KW. Most small hydropower units installed range from 400 to 500 KW in size.

The hydropower unit should be sized in KW for 30 percent of the flow duration curve for River/Reservoir systems. For irrigation canal/pipeline systems, the unit is sized based on the flow duration curve or maximum flow that can be utilized when no parallel pipeline systems are constructed and the type of turbine is selected based on turbine efficiency for the minimum flow. For example, if the average flow is 100 cfs, then a Pelton turbine will only generate electricity when the minimum flow is 10 cfs or greater, and a Francis turbine will generate electricity if the minimum flow is 40 cfs or greater.

In general, for high head (head greater then 200 feet), a twin nozzle Pelton turbine, rated at an efficiency at 92% (turbine only) for a flow range of 10%-100% of the maximum design flow for each nozzle, should be utilized. Pelton turbines for small hydropower units have been designed and installed for a head as low as 70 feet with a flow of 4.5 cfs according to Brett Bauer of Canyon Hydro Inc., Deming, Washington. However, for flows greater than 100 cfs, the head requirements for Pelton turbines are very high at 500 feet and above. For low head (head less then 200 feet) and high flows (flows greater than

100 cfs), the Francis turbine rated at an efficiency of 89% (turbine only) should be utilized for a flow range of 40%-100% of the maximum design flow. The overall turbine/generator/hydraulic efficiency utilized should be 70 percent.

The interconnection transmission line can have a capacity as low as 12.4 kV.

Load rejection must be considered when selecting the type of turbine for the hydropower system. Pelton turbines are an impulse type turbine with a fixed nozzle and moving buckets. For a Pelton turbine, a hinged deflector plate is utilized between the jet flow from the nozzle and the bucket to divert flow to the draft tube when load rejection occurs. Francis turbines are a reaction type turbine with radial flow and rotating nozzles. For a Francis turbine, the flow of water to the turbine runner must be shut off for load rejection. For river/reservoir hydropower systems, flow to the Francis turbine is shut down when load rejection occurs and the reservoir and surge tanks store the water flow until the unit is back on-line or a bypass valve is opened at the turbine. For pipeline/canal hydropower systems, flow to the Francis turbine has to be shut down when load rejection occurs and a bypass at the pipeline/canal intake structure with a parallel pipeline/canal system can be utilized to continue to deliver water. Another alternative to the parallel pipeline/canal system for load rejection at a Francis turbine is to install a bypass valve at the turbine that is opened by a synchronous gravity-activated counter-weight system.

General cost guidelines for hydropower development are $1500 per KW unit size. This general cost guideline includes most costs associated with the development and installation of the hydropower unit. These costs include design and engineering, turbine, generator, transformer, switching gear, automation equipment, FERC licensing, permits, machinery, civil works, electrical works, and all other associated costs. The general cost guideline does not include the highly variable costs of transmission lines for the power grid interconnection or the steel pipeline (penstock) costs. Tiber Reservoir hydropower unit was installed for $950/KW and at a unit size of 7.5 MW, the total installed cost was $7,125,000. A large factor in the cost of the hydropower system is the turbine and generator cost. Tiber Reservoir hydropower system turbine and generator were purchased from China, where the turbine and generator costs are about 50% of the European turbine and generator costs. In general, the hydropower system total costs are lower for high head installations ($1000/KW) and higher for low head installations ($2000/KW). The Tiber Reservoir hydropower unit did not require a long steel pipeline (penstock) as the hydropower unit is operated at the dam utilizing reservoir head.

The current market value for hydropower generation is 5.5 cents per KWHr. Turbine unit sizes above 500 KW are financially feasible at a power generation market value of 5.5 cents per KWHr without consideration for penstock or transmission line costs. Turbine unit sizes below 500 KW are financially feasible at a power generation market value of 10 cents per KWHr to 11 cents per KWHr without consideration for penstock or transmission line costs.

Saint Mary Canal System Hydropower Feasibility Study

Hydrology

I. U.S. Annual diversion only 175,339 acre-feet or 71 percent of full apportionment from 1980 to 2004.

II. New minimum release from Sherburne of 25 cfs results in a U.S. apportionment loss of approximately 7,700 acre-feet.

III. U.S. is likely to rehabilitate diversion and canal infrastructure to a capacity equal to or greater than 850 cfs. Diversion and conveyance facilities originally designed for 850 cfs capacity in 1927. Current safe capacity is between 650 cfs to 725 cfs.

IV. Approximately 60 to 80 cfs is lost due to seepage from the canal prior to measurement at USGS Station 05018500, or about 10 percent of canal flows. Between the St. Mary Siphon and Drop No.1, seepage losses range from 10 to 30 cfs depending on flow or about 2 percent of canal flows. Prior to the St. Mary – Milk River Divide (Drop No. 1), all seepage losses enter drainages that flow into Canada. Due to seepage losses, a diversion rate 955 cfs is required to achieve a flow of 850 cfs at Drop No. 1.

V. A canal freeboard should be designed to provide a minimum of capacity for a 25-year, 24-hour storm.

VI. Alberta Environment (AENV) and Montana DNRC developed an agreeable data set of flow measurements for determination of St. Mary River natural flows, which flows were then utilized for hydrologic models for canal diversion rates and alternative accounting periods. The data set includes 25 years of baseline flow data from November 1, 1979 to October 31, 2004 (water years 1980 to 2004). The natural flow calculations basically follow the IJC accounting procedures except that additional considerations were given by AENV and DNRC to calculate the daily inflows and outflows influencing Sherburne Reservoir during the off-season. DNRC determined the average annual U.S. apportionment to be 246,002 acre-feet, while AENV computed 246,447 acre-feet. In the last 25 years, the U.S. diverted on average 175,339 acre-feet or 71 percent of the U.S. apportionment.

Modeled Monthly St. Mary Canal Flows at Siphon								
IJC spreadsheet model with 15/16 day balancing period								
	650 CFS Canal			**700 CFS Canal**			**850 CFS Canal**	
		Annual			Annual			Annual
Month	Acre-feet	Sum		Acre-feet	Sum		Acre-feet	Sum
Nov-79	0	211,751		0	213,124		0	216,641
Dec-79	0			0			0	
Jan-80	0			0			0	
Feb-80	0			0			0	
Mar-80	11,817			11,817			11,817	
Apr-80	15,247			15,424			15,924	
May-80	39,957			43,031			52,252	
Jun-80	38,669			41,643			50,567	
Jul-80	39,957			43,031			52,252	
Aug-80	39,957			38,393			13,812	
Sep-80	19,896			13,435			13,435	
Oct-80	6,252			6,351			6,582	
Nov-80	0	225,137		0	227,802		0	235,062
Dec-80	0			0			0	
Jan-81	0			0			0	
Feb-81	0			0			0	
Mar-81	18,343			19,433			22,309	
Apr-81	19,128			17,368			14,314	
May-81	38,937			43,031			49,707	
Jun-81	38,669			41,643			50,567	
Jul-81	39,957			43,031			52,252	
Aug-81	39,957			43,031			37,154	
Sep-81	26,594			16,712			5,033	
Oct-81	3,552			3,552			3,727	
Nov-81	0	206,164		0	211,459		0	221,433
Dec-81	0			0			0	
Jan-82	0			0			0	
Feb-82	0			0			0	
Mar-82	8,799			8,799			8,692	
Apr-82	4,380			4,380			4,380	
May-82	25,342			27,489			31,253	
Jun-82	38,669			41,643			50,567	
Jul-82	39,957			43,031			52,252	
Aug-82	39,957			43,031			52,252	
Sep-82	38,669			37,803			16,364	
Oct-82	10,391			5,283			5,673	
Nov-82	0	165,649		0	164,691		0	165,487
Dec-82	0			0			0	
Jan-83	0			0			0	
Feb-83	0			0			0	
Mar-83	8,721			8,721			8,427	
Apr-83	5,776			5,776			5,776	
May-83	23,701			23,787			25,644	
Jun-83	38,669			41,643			50,567	

Modeled Monthly St. Mary Canal Flows at Siphon
IJC spreadsheet model with 15/16 day balancing period

	650 CFS Canal		700 CFS Canal		850 CFS Canal	
		Annual		Annual		Annual
Month	Acre-feet	Sum	Acre-feet	Sum	Acre-feet	Sum
Jul-83	39,957		43,031		52,252	
Aug-83	39,957		33,651		14,607	
Sep-83	6,153		5,368		5,368	
Oct-83	2,715		2,715		2,847	
Nov-83	0	172,828	0	172,927	0	173,100
Dec-83	0		0		0	
Jan-84	0		0		0	
Feb-84	0		0		0	
Mar-84	14,632		14,632		14,563	
Apr-84	7,135		7,135		7,135	
May-84	23,896		25,383		28,569	
Jun-84	38,669		41,643		50,567	
Jul-84	39,957		43,031		48,246	
Aug-84	35,434		27,898		10,574	
Sep-84	7,045		7,045		7,045	
Oct-84	6,062		6,161		6,402	
Nov-84	0	198,790	0	198,317	0	205,681
Dec-84	0		0		0	
Jan-85	0		0		0	
Feb-85	0		0		0	
Mar-85	4,341		4,242		4,001	
Apr-85	8,617		8,617		9,322	
May-85	39,266		40,754		45,240	
Jun-85	38,669		40,255		50,567	
Jul-85	39,957		43,031		52,252	
Aug-85	35,230		29,540		10,004	
Sep-85	19,967		20,066		19,860	
Oct-85	12,742		11,812		14,436	
Nov-85	0	198,229	0	200,833	0	204,996
Dec-85	0		0		0	
Jan-86	0		0		0	
Feb-86	0		0		0	
Mar-86	18,343		19,433		22,309	
Apr-86	31,565		30,246		25,783	
May-86	28,735		30,848		33,339	
Jun-86	38,669		41,643		50,567	
Jul-86	39,957		43,031		48,647	
Aug-86	24,334		18,980		7,305	
Sep-86	7,784		7,784		7,784	
Oct-86	8,842		8,867		9,264	
Nov-86	0	197,161	0	198,386	0	198,176
Dec-86	0		0		0	
Jan-87	0		0		0	
Feb-87	0		0		0	

Modeled Monthly St. Mary Canal Flows at Siphon
IJC spreadsheet model with 15/16 day balancing period

	650 CFS Canal			700 CFS Canal			850 CFS Canal	
		Annual			Annual			Annual
Month	Acre-feet	Sum		Acre-feet	Sum		Acre-feet	Sum
Mar-87	13,733			13,708			13,340	
Apr-87	15,270			14,081			14,378	
May-87	39,957			43,031			52,252	
Jun-87	38,669			41,643			50,567	
Jul-87	39,957			43,031			36,471	
Aug-87	39,957			33,278			21,449	
Sep-87	6,972			6,969			6,969	
Oct-87	2,645			2,645			2,749	
Nov-87	0	149,940		0	150,684		0	151,261
Dec-87	0			0			0	
Jan-88	0			0			0	
Feb-88	0			0			0	
Mar-88	3,950			3,950			3,949	
Apr-88	15,530			16,179			16,179	
May-88	34,358			36,384			42,333	
Jun-88	38,669			41,643			50,567	
Jul-88	38,988			33,988			19,115	
Aug-88	5,645			5,645			5,645	
Sep-88	3,016			3,016			3,016	
Oct-88	9,784			9,878			10,457	
Nov-88	0	243,861		0	247,218		0	254,786
Dec-88	0			0			0	
Jan-89	0			0			0	
Feb-89	0			0			0	
Mar-89	11,852			11,807			11,229	
Apr-89	15,654			16,149			16,452	
May-89	37,502			39,485			44,933	
Jun-89	38,669			41,643			50,567	
Jul-89	39,957			43,031			52,252	
Aug-89	39,957			43,031			52,252	
Sep-89	38,669			41,643			18,932	
Oct-89	21,601			10,428			8,169	
Nov-89	0	260,058		0	263,011		0	265,695
Dec-89	0			0			0	
Jan-90	0			0			0	
Feb-90	0			0			0	
Mar-90	18,343			19,433			22,309	
Apr-90	32,886			33,436			31,595	
May-90	39,957			40,804			41,714	
Jun-90	38,669			41,643			50,567	
Jul-90	39,957			43,031			52,252	
Aug-90	39,957			43,031			47,147	
Sep-90	36,582			27,876			5,659	
Oct-90	13,706			13,756			14,453	

Modeled Monthly St. Mary Canal Flows at Siphon
IJC spreadsheet model with 15/16 day balancing period

	650 CFS Canal			**700 CFS Canal**			**850 CFS Canal**	
		Annual			Annual			Annual
Month	Acre-feet	Sum		Acre-feet	Sum		Acre-feet	Sum
Nov-90	0	238,387		0	246,170		0	266,195
Dec-90	0			0			0	
Jan-91	0			0			0	
Feb-91	0			0			0	
Mar-91	18,343			19,433			22,309	
Apr-91	18,195			17,055			13,482	
May-91	32,549			34,334			39,688	
Jun-91	38,669			41,643			50,567	
Jul-91	39,957			43,031			52,252	
Aug-91	39,957			43,031			52,252	
Sep-91	38,669			41,643			32,071	
Oct-91	12,048			6,000			3,574	
Nov-91	0	138,445		0	138,922		0	139,273
Dec-91	0			0			0	
Jan-92	0			0			0	
Feb-92	0			0			0	
Mar-92	7,296			7,296			7,298	
Apr-92	7,793			8,391			8,391	
May-92	39,957			40,921			41,032	
Jun-92	38,669			39,163			38,854	
Jul-92	21,407			19,669			19,868	
Aug-92	7,468			7,468			7,468	
Sep-92	7,110			7,110			7,110	
Oct-92	8,744			8,902			9,252	
Nov-92	0	197,620		0	198,515		0	198,621
Dec-92	0			0			0	
Jan-93	0			0			0	
Feb-93	0			0			0	
Mar-93	8,588			8,430			8,281	
Apr-93	6,723			6,723			6,723	
May-93	29,341			31,225			36,052	
Jun-93	38,669			41,643			50,567	
Jul-93	39,957			43,031			52,252	
Aug-93	39,957			43,031			22,871	
Sep-93	27,157			17,105			14,293	
Oct-93	7,227			7,327			7,582	
Nov-93	0	174,503		0	174,586		0	174,837
Dec-93	0			0			0	
Jan-94	0			0			0	
Feb-94	0			0			0	
Mar-94	11,143			11,097			11,052	
Apr-94	18,406			19,022			19,345	
May-94	37,794			39,363			45,580	
Jun-94	38,669			41,643			50,567	

Modeled Monthly St. Mary Canal Flows at Siphon
IJC spreadsheet model with 15/16 day balancing period

	650 CFS Canal			**700 CFS Canal**			**850 CFS Canal**	
		Annual			Annual			Annual
Month	Acre-feet	Sum		Acre-feet	Sum		Acre-feet	Sum
Jul-94	39,957			43,031			34,494	
Aug-94	21,824			13,621			6,694	
Sep-94	3,440			3,440			3,440	
Oct-94	3,270			3,369			3,667	
Nov-94	0	241,815		0	250,373		0	270,770
Dec-94	0			0			0	
Jan-95	0			0			0	
Feb-95	0			0			0	
Mar-95	17,624			17,624			17,458	
Apr-95	4,959			4,959			4,959	
May-95	34,719			37,297			43,879	
Jun-95	38,669			41,643			50,567	
Jul-95	39,957			43,031			52,252	
Aug-95	39,957			43,031			52,252	
Sep-95	38,669			41,643			31,098	
Oct-95	27,261			21,144			18,305	
Nov-95	0	261,472		0	268,505		0	285,432
Dec-95	0			0			0	
Jan-96	0			0			0	
Feb-96	0			0			0	
Mar-96	18,343			19,433			22,309	
Apr-96	38,669			41,643			41,192	
May-96	35,458			33,933			34,825	
Jun-96	38,669			41,643			50,567	
Jul-96	39,957			43,031			52,252	
Aug-96	39,957			43,031			52,252	
Sep-96	38,669			40,455			26,475	
Oct-96	11,751			5,336			5,560	
Nov-96	0	245,883		0	252,395		0	272,159
Dec-96	0			0			0	
Jan-97	0			0			0	
Feb-97	0			0			0	
Mar-97	17,061			17,029			16,929	
Apr-97	11,107			11,811			11,729	
May-97	37,828			39,305			45,294	
Jun-97	38,669			41,643			50,567	
Jul-97	39,957			43,031			52,252	
Aug-97	39,957			43,031			52,252	
Sep-97	38,669			41,643			33,612	
Oct-97	22,635			14,901			9,525	
Nov-97	0	205,140		0	208,978		0	210,228
Dec-97	0			0			0	
Jan-98	0			0			0	
Feb-98	0			0			0	

Modeled Monthly St. Mary Canal Flows at Siphon

IJC spreadsheet model with 15/16 day balancing period

	650 CFS Canal		700 CFS Canal		850 CFS Canal	
		Annual		Annual		Annual
Month	Acre-feet	Sum	Acre-feet	Sum	Acre-feet	Sum
Mar-98	6,325		6,247		5,857	
Apr-98	9,802		9,802		10,182	
May-98	39,957		43,031		51,775	
Jun-98	38,669		41,643		50,567	
Jul-98	39,957		43,031		52,252	
Aug-98	39,957		43,031		32,307	
Sep-98	27,402		19,121		4,081	
Oct-98	3,071		3,071		3,206	
Nov-98	0	222,165	0	225,573	0	230,929
Dec-98	0		0		0	
Jan-99	0		0		0	
Feb-99	0		0		0	
Mar-99	9,372		9,372		9,349	
Apr-99	7,339		7,921		7,416	
May-99	24,757		24,869		27,456	
Jun-99	38,669		41,643		50,567	
Jul-99	39,957		43,031		52,252	
Aug-99	39,957		43,031		52,252	
Sep-99	38,669		41,643		21,271	
Oct-99	23,446		14,063		10,367	
Nov-99	0	190,164	0	190,895	0	190,571
Dec-99	0		0		0	
Jan-00	0		0		0	
Feb-00	0		0		0	
Mar-00	18,343		19,433		22,309	
Apr-00	20,645		19,562		16,140	
May-00	33,021		34,211		37,780	
Jun-00	38,669		41,643		50,567	
Jul-00	39,957		43,031		44,162	
Aug-00	28,333		21,782		8,159	
Sep-00	5,958		5,958		5,958	
Oct-00	5,239		5,275		5,497	
Nov-00	0	127,892	0	127,856	0	127,218
Dec-00	0		0		0	
Jan-01	0		0		0	
Feb-01	0		0		0	
Mar-01	1,587		1,551		1,587	
Apr-01	3,889		3,988		3,362	
May-01	29,863		31,548		36,685	
Jun-01	38,669		41,643		50,567	
Jul-01	39,957		38,945		24,681	
Aug-01	9,490		5,744		5,744	
Sep-01	2,777		2,777		2,777	
Oct-01	1,659		1,659		1,815	

Modeled Monthly St. Mary Canal Flows at Siphon
IJC spreadsheet model with 15/16 day balancing period

	650 CFS Canal			**700 CFS Canal**			**850 CFS Canal**	
		Annual			Annual			Annual
Month	Acre-feet	Sum		Acre-feet	Sum		Acre-feet	Sum
Nov-01	0	210,514		0	216,500		0	237,962
Dec-01	0			0			0	
Jan-02	0			0			0	
Feb-02	0			0			0	
Mar-02	12,479			12,479			12,324	
Apr-02	7,307			7,307			7,307	
May-02	24,500			24,418			27,690	
Jun-02	38,669			41,643			50,567	
Jul-02	39,957			43,031			52,252	
Aug-02	39,957			43,031			52,252	
Sep-02	38,669			40,038			30,802	
Oct-02	8,975			4,552			4,768	
Nov-02	0	166,370		0	168,333		0	173,464
Dec-02	0			0			0	
Jan-03	0			0			0	
Feb-03	0			0			0	
Mar-03	10,760			10,740			10,699	
Apr-03	16,837			16,936			16,673	
May-03	26,190			26,785			28,347	
Jun-03	38,669			41,643			50,567	
Jul-03	39,957			43,031			52,252	
Aug-03	27,402			22,643			8,201	
Sep-03	3,812			3,812			3,812	
Oct-03	2,743			2,743			2,914	
Nov-03	0	201,840		0	202,564		0	202,790
Dec-03	0			0			0	
Jan-04	0			0			0	
Feb-04	0			0			0	
Mar-04	9,124			9,124			8,953	
Apr-04	11,448			12,176			12,176	
May-04	39,216			40,810			42,668	
Jun-04	38,669			41,643			50,567	
Jul-04	39,957			43,031			50,431	
Aug-04	39,957			33,576			15,855	
Sep-04	16,762			15,388			14,927	
Oct-04	6,707			6,817			7,213	
Average Annual		202,071			204,745			210,911

SAINT MARY CANAL SYSTEM HYDROPOWER FEASIBILITY STUDY

SUMMARY OF SEEPAGE LOSSES FOR SELECT YEARS - TD&H

BEGINNING DATE	ENDING DATE	AVERAGE DISCHARGE AT DIVERSION DAM (CFS)	AVERAGE DISCHARGE AT ST. MARY SIPHON (CFS)	AVERAGE DISCHARGE AT DROP NO. 1 (CFS)	AVERAGE SEEPAGE LOSS FROM DAM TO SIPHON (CFS)	AVERAGE SEEPAGE LOSS FROM SIPHON TO DROP NO. 1 (CFS)	AVERAGE % SEEPAGE LOSS FROM DAM TO DROP NO. 1 (%)
6/24/1930	8/13/1930	632	522	500	110	22	20.89%
6/29/1934	8/18/1934	815	694	683	121	11	16.20%
6/23/1935	8/9/1935	832	720	700	112	20	15.87%
5/18/1946	9/23/1946	652	583	574	69	9	11.96%
7/5/1949	9/12/1949	603	542	533	61	9	11.61%
5/23/1963	9/15/1963	--	690	676	--	14	NA
6/4/1999	9/17/1999	651	597	--	54	--	NA
5/10/2000	7/19/2000	648	606	--	42	--	NA
7/30/2000	9/12/2000	576	516	--	60	--	NA
5/31/2001	8/5/2001	698	616	--	82	--	NA

ESTIMATED SEEPAGE LOSSES FOR REHABILITATED ST. MARY CANAL USING MORITZ EQUATION - TD&H

AVERAGE DIVERSION RATE AT DIVERSION DAM (CFS)	TOTAL SEEPAGE LOSS AT DROP NO. 1 (CFS)	TOTAL DISCHARGE AT DROP NO. 1 (CFS)	AVERAGE % SEEPAGE LOSS FROM DAM TO DROP NO. 1 (%)
850	99	751	11.65%
1000	107	893	10.70%
955	105	850	10.99%
1113	113	1,000	10.15%

ST. MARY CANAL FLOWS FROM USGS WATER RESOURCES DATA, MONTANA

YEAR	MONTH	ST. MARY CANAL AT THE INTAKE (CFS)	AVERAGE DISCHARGE AT ST. MARY SIPHON (CFS)	AVERAGE SEEPAGE LOSS FROM DAM TO SIPHON (CFS)	AVERAGE % SEEPAGE LOSS FROM DAM TO SIPHON (%)
1997	MAY	538	436	102	18.96%
1997	JUNE	624	582	42	6.73%
1997	JULY	622	601	21	3.38%
1997	AUGUST	609	582	27	4.43%
1997	SEPTEMBER	581	581	0	0.00%
1997	OCTOBER	75.8	60.2	15.6	20.58%
TOTAL	(ACRE-FEET)	185511	172883	12628	
AVERAGE	(CFS)	508.3	473.7	34.6	9.01%
1998	MARCH	146	109	37	25.34%
1998	APRIL	518	463	55	10.62%
1998	MAY	642	607	35	5.45%
1998	JUNE	681	609	72	10.57%
1998	JULY	691	609	82	11.87%
1998	AUGUST	672	592	80	11.90%
1998	SEPTEMBER	527	485	42	7.97%
1998	OCTOBER	76.5	60.2	16.3	21.31%
TOTAL	(ACRE-FEET)	240154	214684	25470	
AVERAGE	(CFS)	494.1875	441.775	52.4125	13.13%

SAINT MARY CANAL SYSTEM HYDROPOWER FEASIBILITY STUDY

DESIGN CAPACITY FOR CANAL SET AT 850 CFS AND COMBINE DROPS 1, 2, AND 3 INTO ONE PENSTOCK

DROP NUMBER	HYDRAULIC HEAD AT DROP (FT)	LENGTH OF DROP (FT)	DESIGN CANAL CAPACITY (CFS)	DISTANCE TO NEXT DROP (FT)	DESIGN HEAD FOR TURBINE (FT)	TURBINE EFFICIENCY (%)	POWER FORMULA CONSTANT	TURBINE UNIT SIZE (MW)
1	35.4	202.46	850					
				2,665				
2	28.19	232.94	850					
				1,340				
3	26.36	202.05	850		89.95	70%	0.085	4.5
				2,565				
4	66.14	333.12	850		66.14	70%	0.085	3.3
				3,980				
5	56.6	275.15	850		56.6	70%	0.085	2.9

DESIGN CAPACITY FOR CANAL SET AT 700 CFS AND COMBINE DROPS 1, 2, AND 3 INTO ONE PENSTOCK

DROP NUMBER	HYDRAULIC HEAD AT DROP (FT)	LENGTH OF DROP (FT)	DESIGN CANAL CAPACITY (CFS)	DISTANCE TO NEXT DROP (FT)	DESIGN HEAD FOR TURBINE (FT)	TURBINE EFFICIENCY (%)	POWER FORMULA CONSTANT	TURBINE UNIT SIZE (MW)
1	35.4	202.46	700					
				2,665				
2	28.19	232.94	700					
				1,340				
3	26.36	202.05	700		89.95	70%	0.085	3.7
				2,565				
4	66.14	333.12	700		66.14	70%	0.085	2.8
				3,980				
5	56.6	275.15	700		56.6	70%	0.085	2.4

APPENDIX E
GENERAL HYDROPOWER COST ESTIMATES AND ECONOMIC FEASIBILITY

ST. MARY CANAL HYDROPOWER SYSTEM DESIGN AND COST ESTIMATES

ANNUAL PROJECT COST Item	O & M	Life (years)	Interest	Hydropower Field Cost	Unlisted Items 10%	Contingencies 20%	Engineering 20%	Total Installed Cost	O & M Cost	Capital Recovery Factor	Annual Cost of Capital	Total Annual Cost
TD&H at 700 cfs	1.50%	40	7.000%	$ 19,224,100	$ 1,922,410	$ 4,229,302	$ 5,075,162	$ 30,450,974	$ 456,765	0.07501	$ 2,284,101	$ 2,740,866
Canal Capacity												
TD&H at 850 cfs	1.50%	40	7.000%	$ 21,088,600	$ 2,108,860	$ 4,639,492	$ 5,567,390	$ 33,404,342	$ 501,065	0.07501	$ 2,505,631	$ 3,006,696
Canal Capacity												
HKM at 700 cfs	1.50%	40	7.000%	$ 18,692,250	$ 1,869,225	$ 4,112,295	$ 4,934,754	$ 29,608,524	$ 444,128	0.07501	$ 2,220,910	$ 2,665,038
Canal Capacity												
HKM at 850 cfs	1.50%	40	7.000%	$ 22,083,750	$ 2,208,375	$ 4,858,425	$ 5,830,110	$ 34,980,660	$ 524,710	0.07501	$ 2,623,869	$ 3,148,579
Canal Capacity												
DROP-5 at 700 cfs	1.50%	40	7.000%	$ 21,988,800	$ 2,198,880	$ 4,837,536	$ 5,805,043	$ 34,830,259	$ 522,454	0.07501	$ 2,612,588	$ 3,135,042
Canal Capacity												
DROP-5 at 850 cfs	1.50%	40	7.000%	$ 25,568,400	$ 2,556,840	$ 5,625,048	$ 6,750,058	$ 40,500,346	$ 607,505	0.07501	$ 3,037,896	$ 3,645,401
Canal Capacity												

ST. MARY CANAL HYDROPOWER SYSTEM DESIGN AND COST ESTIMATES

ANNUAL PROJECT COST Item	Total Installed Cost	O & M Cost	Annual Cost of Capital	Total Annual Cost	Total Annual Generation (KWHr)	Power Purchase Rate ($/KWHr)	Total Annual Gross Revenue ($)	Total Annual Net Revenue or (Loss) ($)
TD&H at 700 cfs	$ 30,450,974	$ 456,765	$ 2,284,101	$ 2,740,866	19,570,000	$0.055	$1,076,350	$ (1,664,516)
Canal Capacity								
TD&H at 850 cfs	$ 33,404,342	$ 501,065	$ 2,505,631	$ 3,006,696	20,218,000	$0.055	$1,111,990	$ (1,894,706)
Canal Capacity								
HKM at 700 cfs	$ 29,608,524	$ 444,128	$ 2,220,910	$ 2,665,038	26,053,000	$0.055	$1,432,915	$ (1,232,123)
Canal Capacity								
HKM at 850 cfs	$ 34,980,660	$ 524,710	$ 2,623,869	$ 3,148,579	26,916,000	$0.055	$1,480,380	$ (1,668,199)
Canal Capacity								
DROP-5 at 700 cfs	$ 34,830,259	$ 522,454	$ 2,612,588	$ 3,135,042	26,053,000	$0.055	$1,432,915	$ (1,702,127)
Canal Capacity								
DROP-5 at 850 cfs	$ 40,500,346	$ 607,505	$ 3,037,896	$ 3,645,401	26,916,000	$0.055	$1,480,380	$ (2,165,021)
Canal Capacity								

Interest Rate = 7.00%

ST. MARY CANAL HYDROPOWER STUDY
FIELD COSTS FOR INSTALLED HYDROPOWER UNITS
TURBINE SIZE BASED ON MAXIMUM DESIGN FLOW - DECEMBER 2006

HYDROPOWER ALTERNATIVE	DESIGN TURBINE UNIT SIZE (KW)	AVERAGE HYDROPOWER SYSTEM UNIT COST WITHOUT PENSTOCK ($/KW)	HYDROPOWER CAPITAL COST ($)	HYDRO-POWER READY ADDED COST ($)	TOTAL HYDROPOWER CAPITAL COST ($)	PENSTOCK DIAMETER (INCHES)	TOTAL PENSTOCK LENGTH (3-PIPES) (FEET)	STANDARD STEEL PENSTOCK INSTALLED ($/FOOT)	TOTAL FIELD COST FOR PENSTOCK ($)	IRRIGATION CANAL RE-ALIGNMENT COSTS ($)	TOTAL FIELD COST FOR HYDROPOWER SYSTEM WITH PENSTOCK ($)	TOTAL HYDROPOWER SYSTEM UNIT COST WITH PENSTOCK ($/KW)
TD&H at 700 cfs	6529	$1,500	$9,793,500	$2,203,000	$11,996,500	54	2400	$359	$861,600	$6,366,000	$19,224,100	$2,944
Canal Capacity												
TD&H at 850 cfs	7928	$1,500	$11,892,000	$1,364,800	$13,256,800	60	2400	$397	$952,800	$6,879,000	$21,088,600	$2,660
Canal Capacity												
HKM at 700 cfs	8692	$1,500	$13,038,000	$0	$13,038,000	54	15750	$359	$5,654,250	$0	$18,692,250	$2,151
Canal Capacity												
HKM at 850 cfs	10554	$1,500	$15,831,000	$0	$15,831,000	60	15750	$397	$6,252,750	$0	$22,083,750	$2,092
Canal Capacity												
DROP-5 at 700 cfs	8692	$1,500	$13,038,000	$0	$13,038,000	54	7200	$359	$2,584,800	$6,366,000	$21,988,800	$2,530
Canal Capacity												
DROP-5 at 850 cfs	10554	$1,500	$15,831,000	$0	$15,831,000	60	7200	$397	$2,858,400	$6,879,000	$25,568,400	$2,423
Canal Capacity												

ST. MARY CANAL HYDROPOWER STUDY
TOTAL COSTS FOR INSTALLED HYDROPOWER UNITS VERSUS IRRIGATION SYSTEM
TURBINE SIZE BASED ON MAXIMUM DESIGN FLOW - DECEMBER 2006

HYDROPOWER ALTERNATIVE	HYDROPOWER UNIT CAPITAL COST ($)	PENSTOCK DIAMETER (INCHES)	TOTAL PENSTOCK LENGTH (3-PIPES) (FEET)	STANDARD STEEL PENSTOCK INSTALLED ($/FOOT)	TOTAL INSTALLED COST FOR STEEL PENSTOCK ($)	IRRIGATION CANAL RESHAPING COSTS ($)	IRRIGATION CANAL RE-ALIGNMENT COSTS ($)	TOTAL PIPE DROP IRRIGATION SYSTEM INSTALLED COSTS ($)	TOTAL INSTALLED COST FOR HYDROPOWER SYSTEM WITH PENSTOCKS ($)	TOTAL INCREMENTAL INSTALLED COST OF HYDROPOWER SYSTEM ($)
TD&H at 700 cfs	$11,996,500	54	2400	$359	$861,600	$2,900,000	$6,366,000	$7,097,000	$30,450,974	$23,353,974
Canal Capacity										
TD&H at 850 cfs	$13,256,800	60	2400	$397	$952,800	$3,400,000	$6,879,000	$8,635,200	$33,404,342	$24,769,142
Canal Capacity										
HKM at 700 cfs	$13,038,000	54	15750	$359	$5,654,250	$2,900,000	$0	$7,097,000	$29,608,524	$22,511,524
Canal Capacity										
HKM at 850 cfs	$15,831,000	60	15750	$397	$6,252,750	$3,400,000	$0	$8,635,200	$34,980,660	$26,345,460
Canal Capacity										
DROP-5 at 700 cfs	$13,038,000	54	7200	$359	$2,584,800	$2,900,000	$6,366,000	$7,097,000	$34,830,259	$27,733,259
Canal Capacity										
DROP-5 at 850 cfs	$15,831,000	60	7200	$397	$2,858,400	$3,400,000	$6,879,000	$8,635,200	$40,500,346	$31,865,146
Canal Capacity										

NOTE: IRRIGATION CANAL RE-ALIGNMENT COSTS INCLUDE ESTIMATED COSTS FOR THE NEW CANAL, THE COSTS FOR THE OLD CANAL ABANDONMENT, AND LAND ACQUISITION COSTS.

SAINT MARY CANAL SYSTEM HYDROPOWER FEASIBILITY STUDY

TD&H 2006 FEASIBILITY AND PRELIMINARY ENGINEERING REPORT

CANAL CAPACITY (CFS)	TURBINE UNIT SIZE (MW)	ALTERNATIVE NUMBER	INCREMENTAL COST ($)	POWER SELLING PRICE ($/KwHr)	PRESENT VALUE OF REVENUE ($)	REVENUE LESS INCREMENTAL COST ($)
850	7.5	1A	$19,088,000	$0.03	$14,941,584	-$4,146,416
850	7.5	1B	$19,088,000	$0.05	$24,902,640	$5,814,640
850	7.5	1C	$19,088,000	$0.07	$34,863,696	$15,775,696
850	7.5	2A	$24,088,000	$0.03	$14,941,584	-$9,146,416
850	7.5	2B	$24,088,000	$0.05	$24,902,640	$814,640
850	7.5	2C	$24,088,000	$0.07	$34,863,696	$10,775,696
850	7.5	3A	$29,088,000	$0.03	$14,941,584	-$14,146,416
850	7.5	3B	$29,088,000	$0.05	$24,902,640	-$4,185,360
850	7.5	3C	$29,088,000	$0.07	$34,863,696	$5,775,696

SAINT MARY CANAL SYSTEM HYDROPOWER FEASIBILITY STUDY

USBR April 11, 2003 ST. MARY CANAL MILK RIVER PROJECT ENGINEERING APPENDIX

CANAL LINING AND RESHAPING

CANAL CAPACITY (CFS)	ESTIMATED COST - PARTIAL LINING/ RESHAPING ($)
670	$1,145,000
700	--
850	$1,490,000

DROP #1 STRUCTURE REPLACEMENT ALTERNATIVES

CANAL CAPACITY (CFS)	ESTIMATED COST BAFFLED APRON DROP OPTION ($)	DROP #1 ESTIMATED COST PIPE DROP OPTION ($)	ESTIMATED COST CHUTE & STILLING BASIN OPTION ($)
670	$660,000	$620,000	$950,000
700	--	--	--
850	$740,000	$810,000	$960,000

DROP #2 STRUCTURE REPLACEMENT ALTERNATIVES

CANAL CAPACITY (CFS)	ESTIMATED COST BAFFLED APRON DROP OPTION ($)	DROP #2 ESTIMATED COST PIPE DROP OPTION ($)	ESTIMATED COST CHUTE & STILLING BASIN OPTION ($)
670	$730,000	$700,000	$1,000,000
700	--	--	--
850	$770,000	$890,000	$1,050,000

SAINT MARY CANAL SYSTEM HYDROPOWER FEASIBILITY STUDY

USBR April 11, 2003 ST. MARY CANAL MILK RIVER PROJECT ENGINEERING APPENDIX

DROP #3 STRUCTURE REPLACEMENT ALTERNATIVES

		DROP #3	
	ESTIMATED COST	ESTIMATED COST	ESTIMATED COST
CANAL	BAFFLED APRON	PIPE DROP	CHUTE & STILLING
CAPACITY	DROP OPTION	OPTION	BASIN OPTION
(CFS)	($)	($)	($)
670	$600,000	$600,000	$890,000
700	--	--	--
850	$590,000	$790,000	$1,000,000

DROP #4 STRUCTURE REPLACEMENT ALTERNATIVES

		DROP #4	
	ESTIMATED COST	ESTIMATED COST	ESTIMATED COST
CANAL	BAFFLED APRON	PIPE DROP	CHUTE & STILLING
CAPACITY	DROP OPTION	OPTION	BASIN OPTION
(CFS)	($)	($)	($)
670	$970,000	$840,000	$1,100,000
700	--	--	--
850	$1,100,000	$1,050,000	$1,125,000

DROP #5 STRUCTURE REPLACEMENT ALTERNATIVES

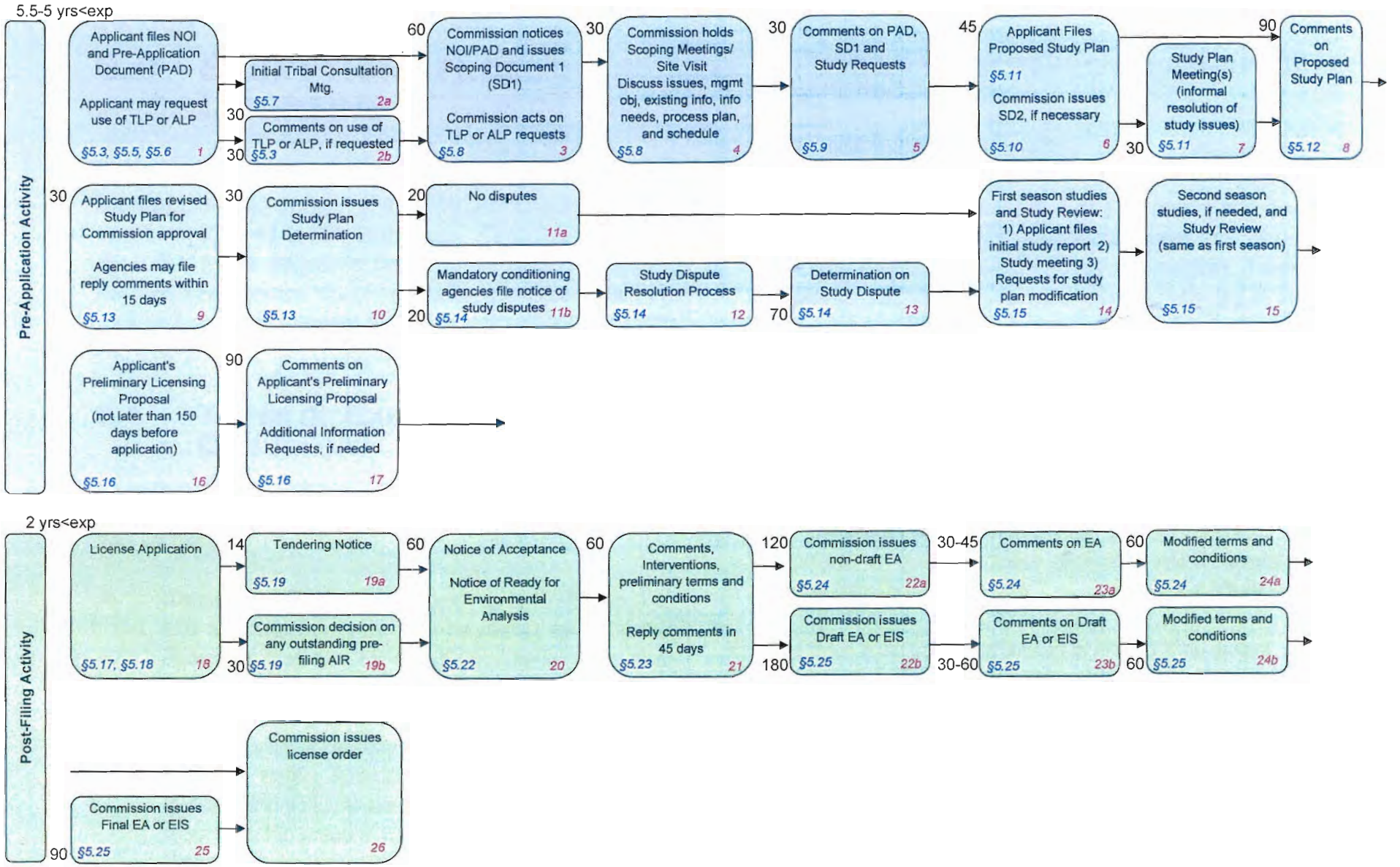
		DROP #5	
	ESTIMATED COST	ESTIMATED COST	ESTIMATED COST
CANAL	BAFFLED APRON	PIPE DROP	CHUTE & STILLING
CAPACITY	DROP OPTION	OPTION	BASIN OPTION
(CFS)	($)	($)	($)
670	$950,000	$660,000	$1,200,000
700	--	--	--
850	$1,000,000	$890,000	$1,300,000

APPENDIX F
FERC LICENSING INFORMATION

Table 1. Comparison of Three Hydroelectric Licensing Processes.

	Traditional Licensing Process (TLP)	Alternative Licensing Process (ALP)	Integrated Licensing Process (ILP)
Consultation with Resource Agencies and Indian Tribes	Paper driven	Collaborative	Integrated
Deadlines	• Pre-filing - some deadlines for participants • Post-filing - defined deadlines for participants	• Pre-filing - deadlines defined by collaborative group • Post-filing - defined deadlines for participants	• Defined deadlines for all participants throughout the process, including FERC
Study Plan Development	• No FERC involvement • Developed by applicant based on early agency, tribal, and public recommendations	• FERC staff advisory assistance • Developed by collaborative group	• Plan approved by FERC • Developed through study plan meetings with FERC staff involvement
Study Dispute Resolution	• OEP Director opinion advisory	• OEP Director opinion advisory	• Informal dispute resolution available to all participants • Formal dispute resolution available to agencies w/ mandatory conditioning authority. • OEP Director opinion binding on applicant
Application	• Draft and final application include Exhibit E	• Draft and final application includes applicant-prepared EA or 3rd party EIS	• Preliminary licensing proposal (or draft application) and final application include Exhibit E that has form and contents of an EA
Additional Information Requests	• Available to participants after filing of application	• Available to participants primarily before filing of application • Post-filing requests available but should be limited due to collaborative approach	• Available to participants before filing of application • No formal avenue to request additional info after application filed
Timing of Resource Agency Terms and Conditions	• Terms and conditions filed 60 days after REA notice • Schedule for filing final terms and conditions permitted	• Terms and conditions filed 60 days after REA notice • Schedule for filing final terms and conditions permitted	• Terms and conditions filed 60 days after REA notice • Modified terms and conditions 60 days after comments on the single EA or draft NEPA document

Integrated Licensing Process
Final Rule



6.0 EXEMPTIONS FROM LICENSING

Exemptions from licensing are exactly that: exemptions from the licensing provisions of Part I of the FPA, and subject only to the conditions attached to the exemption. This means that the exemption is not subject to the comprehensive development standard of FPA Section 10(a)(1); mandatory conditions under FPA sections 4(e) and 18; eminent domain authority of FPA section 21; and so forth. **16 USC 823A; 16 USC 2705, 2708**

6.1 TYPES OF EXEMPTIONS AND WHO CAN APPLY

Two types of small hydroelectric projects are eligible for exemptions from licensing:

- A small conduit hydroelectric facility up to 15 MW (up to 40 MW for certain projects) may be eligible for a Conduit Exemption (see **18 CFR 4.31(b)(2)**). The applicant must have all the real property interests necessary to develop and operate the project, or an option to obtain the interests. The facility cannot occupy federal lands. The conduit is not a project work. Applications for exemptions of small hydroelectric conduits are categorically exempt from the requirement to prepare an EA or EIS. See Hydroelectric Project Handbook for Filings Other Than Licenses and 5-MW Exemptions for information on how to obtain a conduit exemption.

- A small hydroelectric project of 5 MW or less may be eligible for a 5 MW exemption. The applicant must propose to install or add capacity to a project located at a non-federal, pre-1977 dam, or at a natural water feature. If *only federal lands are involved,* any applicant is eligible. If *some federal lands are involved,* any applicant who has all the real property interests in the nonfederal lands necessary to develop and operate the project or an option to obtain the interests is eligible. **18 CFR 4.31(c)(2)**

There are several limitations on submission and acceptance of exemption applications:

- If there is an unexpired preliminary permit in effect for the project, an initial exemption application will be accepted only from the permit holder. q**18 CFR 4.33(d)(1)(i)**

- If there is an unexpired license in effect for the project, an exemption application will be accepted only from the licensee. **18 CFR 4.33(d)(1)(ii)**

- If a license application has been accepted which was submitted in a timely manner by the holder of a preliminary permit, an exemption application will only be accepted from the former permittee. **18 CFR 4.33(d)(2)**

- If a license application is filed by a qualified exemption applicant, and that license application is the first (or only) accepted application, then the applicant may request its license application be treated as an application for exemption. **18 CFR 4.33(d)(3)**

6.2 OBTAINING AN EXEMPTION

The procedures for applying for an exemption, including pre-filing consultation, are the same as those described for a license (see chapter 2, section 2.3), with the following specific exceptions:

- An applicant has less time (up to 45 days instead of 90) to correct any deficiencies in the application. **18 CFR 4.32(e)(1)**

- Exemption orders for 5 MW or less exemptions are typically supported by an EA and seldom require an EIS.

- Procedures for post-filing consultation among the Commission, fish and wildlife agencies, and Indian tribes are distinct for exemption applications. All timely fish and wildlife recommendations under 30(c) of FPA are mandatory. **18 CFR 4.94; 18 CFR 4.105;18 CFR 4.34(g)**

The applicant is required to submit a fee accompanying the application to reimburse fish and wildlife agencies for costs incurred in connection with their review of the application pursuant to section 30(e) of the FPA. **18 CFR 4.302**

The procedures for filing competing exemption applications are the same as those for competing licenses (see chapter 7).

6.3 5 MW OR LESS EXEMPTIONS

This section describes aspects of the regulations that pertain specifically to exemptions for small hydroelectric projects of 5 MW or less. **18 CFR 4.101**

6.3.1 APPLICATION CONTENT

An application for exemption for a small hydroelectric project of 5 MW or less must include the following:

- Introductory statement.

- Exhibit A describes the small hydroelectric project and its proposed mode of operation.

- Exhibit B provides a general location map that must show the location of the physical structures and their relationship to the water body and identifiable landmarks, land ownership information, and a proposed project boundary.

- Exhibit E, or a draft preliminary EA if using an alternative process, is the environmental report and must reflect pre-filing consultation requirements. Commensurate with the scope and degree of environmental impact, it must include a description of the project's environmental setting, the expected environmental impacts, and proposed measures to protect the environment.

- Exhibit G is a set of drawings showing the project structures and equipment.

- Identification of all Indian tribes potentially affected.

- Appendix containing evidence that the applicant has the necessary real property interests in any nonfederal lands. **18 CFR 4.107**

- Fish and wildlife agency reimbursement fees must accompany filed applications. **18 CFR 4.302**

6.3.2 DEVELOPMENT OF TERMS AND CONDITIONS

The procedural steps for a 5 MW or less exemption application are essentially the same as those that govern applications for license, including the three-stage consultation process or alternative licensing process. See chapters 4 and 5 for descriptions of the procedures, from initial actions through the public notice declaring the application ready for environmental analysis. After completion of the EA, the procedural steps for an exemption application differ from those for a license application.

The Commission must include those terms and conditions that the fish and wildlife agencies determine, in a timely manner, are appropriate to prevent loss of, or damage to, fish and wildlife resources. 18 CFR 4.34(f)(2)

Deadlines and procedures for filing comments and terms and conditions are the same as those that govern license applications (see chapter 2).

The Commission then prepares an EA and determines whether an exemption is to be granted. In granting an exemption from licensing, the Commission will impose certain standard terms and conditions (see **18 CFR 4.106**)and may set additional non-standard terms and conditions. **18 CFR 4.105(b)(2)**

If the exemption application is dismissed, the process is terminated. There is no opportunity to convert the exemption application to an application for license.