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**EXECUTIVE SUMMARY
FOR
GOSHEN IRRIGATION DISTRICT
MASTER PLAN, LEVEL I STUDY**

Prepared For:

*Wyoming Water Development Commission
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Cheyenne, WY 82002*



Prepared By:

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ANDERSON CONSULTING ENGINEERS, INC.

Civil • Water Resources • Environmental

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TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	EXISTING SYSTEM STUDIES REVIEW	1
III.	GEOGRAPHIC INFORMATION SYSTEM (GIS) DEVELOPMENT	1
IV.	STRUCTURE INVENTORY AND EVALUATION	2
V.	SEEPAGE INVESTIGATION	2
VI.	WATER RIGHTS	3
VII.	WATER QUALITY	3
VIII.	MASTER PLAN DEVELOPMENT	4
IX.	IMPLEMENTATION	6
X.	OPERATING PLANS	7
XI.	FUNDING STRATEGY AND ECONOMIC ANALYSIS	8
XII.	RECOMMENDATIONS	10

LIST OF FIGURES

Figure 1.	Relative Distribution of Tier I Inventory Conveyance Structures	2
Figure 2.	Relative Distribution of Overall Condition of Tier I Structures	2
Figure 3.	Components of GID Master Plan	5

LIST OF TABLES

Table 1.	Summary of Implementation Planning Phases	7
Table 2.	Results of Economic Evaluation	9

I. INTRODUCTION

This project focused on the development of a Master Plan of irrigation system improvements which will provide a ‘roadmap’ for future work within the Goshen Irrigation District (GID). The work included a review of previous investigations and development of a database of proposed improvements; an inventory and assessment of existing structures and facilities; evaluation of seepage losses; re-regulation storage reservoirs; water quality; water rights; development of a comprehensive system Geographic Information System (GIS), development of conceptual design and costs associated with irrigation system improvements, development of an implementation plan; and economic evaluation associated with implementation of the plan of improvements. Formulation of the implementation plan assumed completion of the improvements over a 10-year time period as an ongoing construction effort to minimize the financial impact to the GID water users.

II. EXISTING SYSTEM STUDIES REVIEW

Several investigations have been previously completed on behalf of the WWDC, which pertain to the GID. These investigations include both Level I and Level II studies. Included within the reports summarizing these investigations are numerous recommended improvements. These investigations were reviewed and a summary matrix was prepared which tabulated all previously reported recommendations, and their current status. A total of 106 system improvements were compiled. The status of each was determined based upon documentation of completion within the studies, presence of as-built construction drawings, or input from GID representatives. Based on the results of the review completed, the GID has implemented 75 of the 106 improvements identified in the previous studies. All existing reports were scanned and incorporated in a Digital Library.

III. GEOGRAPHIC INFORMATION SYSTEM (GIS) DEVELOPMENT

During the completion of this study, GIS mapping and a project database were developed to facilitate the planning process, document the inventory of structures, and provide data to promote the operation and management of water deliveries as well as the implementation of planned improvements. Hardware and software requirements were also purchased through the matching funds available from the U. S. Bureau of Reclamation’s 2025 Program. The hardware and software were installed in the GID office and a training session provided to the GID staff on the utilization of the computer system and GIS mapping product.

An Irrigation Geodatabase Tool (IGT) was incorporated which consists of a suite of individual tools, developed using Visual Basic, that enable even the novice user to utilize the powerful functionality of the GIS, to review existing data, and to modify and edit data. The primary purpose of the tool, and the underlying objective driving its development, was to make the GIS a user-friendly and dynamic program.

IV. STRUCTURE INVENTORY AND EVALUATION

Structures associated with the Fort Laramie Canal and its lateral system were inventoried in two phases:

- The Tier I Inventory effort consisted of a detailed inventory effort of primary conveyance systems. It included the field mapping of canal and lateral alignment, plus a detailed assessment and documentation of structure conditions.
- The Tier II Inventory effort consisted of the field mapping of canal/lateral alignment, GPS documentation of structure location, and photo documentation of the structure.

Following these general guidelines, a total of 1,880 individual sites were inventoried. This number includes 280 Tier I structures and 1,600 Tier II structures. Figure 1 displays the relative distribution of Tier I structure types. Of the 280 Tier I structures inventoried, 10 were found to be in ‘failing’ condition, and 64 in ‘poor’ condition. Figure 2 displays the general condition of Tier I structures inventoried.

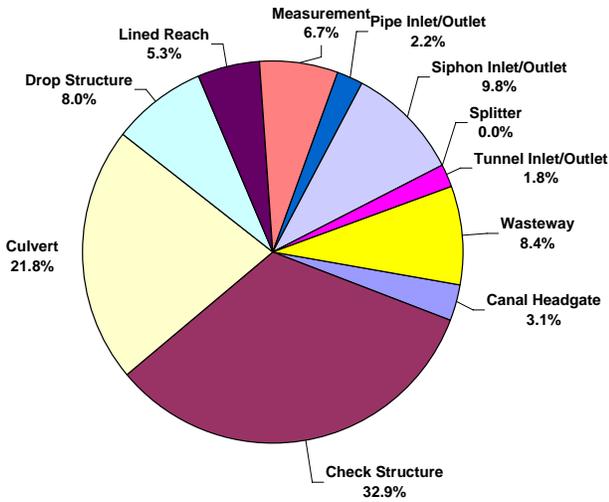


Figure 1. Relative Distribution of Tier I Inventory Conveyance Structures

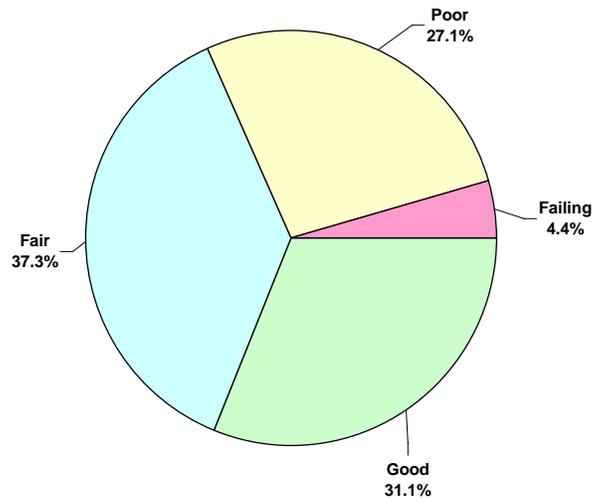


Figure 2. Relative Distribution of Overall Condition of Tier I Structures

V. SEEPAGE INVESTIGATION

The seepage study was conducted to identify and evaluate areas of significant water loss, thereby flagging those locations for potential improvement measures. The GID identified 19 specific locations for conducting a seepage investigation, primarily focusing on the lateral systems. These lateral segments

were earmarked by the GID due to the seepage losses as well as the expense associated with maintenance related to algae control, vegetation removal and sediment accumulation.

The results of the seepage studies provided the following conclusions:

- Estimated seepage losses ranged from slight gains (due to measurement accuracies or irrigation return flows) to a maximum of 38.5% on the East Springer Lateral (mile 7.0 to 8.1).
- Five of the laterals, or subreaches of larger laterals, displayed seepage losses exceeding 4 cfs. These included:
 - Cherry Creek Lateral from Mile 0.0 to 3.2,
 - Cherry Creek Lateral from Mile 6.0 to 10.7,
 - Table Mountain Lateral from Mile 1.9 to 3.1,
 - East Springer Lateral from Mile 7.0 to 8.1, and
 - Springer Main Lateral 10.1 from Mile 0.0 to 1.8.

VI. WATER RIGHTS

The investigation of water right information involved a review of records at the Wyoming State Engineers Office (WSEO), specifically including the tabulation of adjudicated and non-adjudicated water rights for Water Division One. The original supply of water for the GID consists of both direct flow from the North Platte River and storage in Pathfinder Reservoir and Guernsey Reservoir. Supplemental supply is available for diversion from the Platte River, Laramie River, and Horse Creek.

The original supply for the GID is diverted at Whalen Dam and conveyed by the Fort Laramie Canal to provide water to approximately 52,484 acres within Goshen County. An adjudicated allocation of 1 cfs/70 acres is permitted in accordance with the administration of the water rights through the WSEO under permit number 18544. This appropriation consists of 749 individual certificates.

Due to flow availability in the North Platte River combined with inadequate conveyance facilities, the GID consistently diverts approximately 1 cfs/100 acres. It is noted, however, that the secondary supply (reservoir storage) is frequently utilized to supplement the original supply whenever necessary to meet the irrigation requirements of the GID. Utilization of the secondary supply in this manner frequently results in a short-term diversion allocation of approximately 1 cfs/70 acres.

VII. WATER QUALITY

In an effort to characterize the quality of water delivered within the GIS conveyance system, a limited water quality investigation was completed. A one-gallon grab sample was taken from the Fort Laramie Canal near Whalen Dam. This location was considered representative of the quality of water being diverted into the GID system. The test results indicate that the sample taken at Whalen Dam in Fall 2006 meets the suitability requirements for domestic, agriculture, and livestock use.

VIII. MASTER PLAN DEVELOPMENT

The rehabilitation master plan was formulated to identify practical and economic improvements associated with structure rehabilitation, installation of both gravity and pressurized pipeline systems, construction of re-regulation reservoirs, canal and lateral lining, and automation of structures and measurement devices. Structure rehabilitation becomes an important component of the master plan because it reduces the risk associated with the potential loss of irrigation water to the GID water users. Failure of structures could economically impact the water users within the GID through the loss of the irrigation water. Figure 3 displays the general location of project components of the Master Plan.

Through the completion of this project along with input received from the GID manager and board members, 71 structures within the GID have been identified and prioritized for replacement or rehabilitation. After removal of those “poor” and “failing” structures located on laterals earmarked for pipeline replacement projects (26 structures), a total of 45 structures were identified for replacement (16) or rehabilitation (29). Depending on the timing and priority of the pipeline replacement projects, rehabilitation or replacement of the additional 26 structures may be required and should be considered. The total project costs associated with structure rehabilitation/replacement is estimated to exceed \$3.6 million. Rehabilitation of these structures increases the longevity of the irrigation delivery system, and reduces the risk of loss and associated economic hardship for all water users.

The remainder of the project improvements identified in the rehabilitation plan provide for water conservation, improved water management and delivery, and reduction in operation and maintenance expense. Eighteen (18) pipeline projects have been identified with an estimated construction cost of approximately \$43.8 million.

The GID initially identified four canal lining projects to be included in the GID Master Plan. Following completion of the fieldwork and seepage studies, three additional reaches were identified where installation of liners will likely provide for a reduction in seepage. These reaches are located on laterals previously identified by GID as potential pipeline conversion reaches, however, their delivery requirements exceed economically feasible limits for pipeline construction. Completion of the seven lining projects would cost an estimated \$36.4 million. The recommended canal lining projects are listed below:

- Main Canal (Mile 7.5 to 13.5)
- Main Canal (Mile 27.0 to 31.2)
- Main Canal (Mile 36.4 to 39.9)
- Springer Main Lateral (Mile 3.0 to 6.7)
- Cherry Creek Lateral (Mile 0.0 to 3.2)
- Cherry Creek Lateral (Mile 6.0 to 10.4)
- Table Mountain Lateral (Mile 1.9 to 3.1)

The GID presently benefits from the automation of its facilities that was initiated over a decade ago. The system automatically tracks water levels in the main canal, provides for spilling of stormwater captured in the main canal at wasteways, diverts water through headgates, records water measurements

Pipeline Projects		Automation Projects		Structure Replacement		Structure Replacement		Structure Replacement	
Project	Name	Project	Name	Project	Name	Project	Name	Project	Name
1	Main Canal Lateral 45.1	23	Main Canal 45.1 Check	40	Unnamed Drainage Underdrain	41	Siphon No. 2 Inlet	62	No Name Lined
2	Cherry Creek Lateral (58.7)	26	Main Canal 62.2 Check	59	Canal Check No. 12	42	Siphon No. 2 Outlet	63	No Name Lined
3	Springer Main - Jones Spill to Tail End	27	Main Canal 67.5 Check	60	Canal Check No. 12	43	Tunnel No. 1 Outlet	65	Canal Check No. 4
4	North Horse Creek Lateral	28	Main Canal 77.3 Check	61	No Name Lined	44	Siphon No. 1 Inlet	66	Wasteway No. 8 (to Horse Creek)
5	Table Mountain Lateral (83.6)	30	Horse Creek Lateral	64	No Name Lined	45	Siphon No. 1 Outlet	67	Canal Check No. 5
6	East Springer Lateral	Canal Lining Projects		68	Canal Check No. 6	46	Unnamed Drainage Underdrain	72	Canal Check No. 10 (at Horse Creek)
7	East Springer Lateral 7.0	Project	Name	69	Canal Check No. 7	47	Unnamed Drainage Underdrain	73	Canal Check No. 11(wasteway no. 9)
9	Springer Main Lateral 10.1	31	Main Canal 7.5 - 13.5	70	Canal Check No. 8	48	Unnamed Drainage Underdrain	74	No Name Lined
10	Main Canal Lateral 12.7	32	Main Canal 27.0-31.2	71	Canal Check No. 9 (Veteran Highway)	49	Unnamed Drainage Underdrain	80	No Name Siphon
11	Cherry Creek Lateral 6.0	33	Main Canal 36.4 - 39.9	75	No Name Check	50	Wasteway No. 9 - Crockett Drain	81	No Name Check
13	Cherry Creek Lateral 8.0	34	Springer Main 3.0 - 6.7	78	No Name Check	51	Siphon No. 3 Inlet	84	No Name Check
14	Cherry Creek Lateral 8.4	37	Cherry Creek 0.0 - 3.2	79	No Name Check	52	Siphon No. 3 Outlet		
15	Cherry Creek Lateral 3.2	38	Cherry Creek 6.0 - 10.7	82	No Name Check	53	Wasteway No. 2 to North Platte		
16	Main Canal Lateral 38.0	39	Table Mountain 1.9 - 3.1	83	No Name Check	54	Wasteway No. 3 to Laramie River		
17	Main Canal Lateral 40.7	Other Projects		95	No Name Check	55	Wasteway 12.7		
18	Main Canal Lateral 45.6	Project	Name	96	No Name Check	56	Wasteway No. 5		
19	Main Canal Lateral 50.9	35	Geographic Information System			57	Wasteway No. 6 to Cherry Creek		
20	Springer Main Lateral 11.9	36	Horse Creek Reservoir Project			58	Wasteway No. 7 to Box Elder Drain		

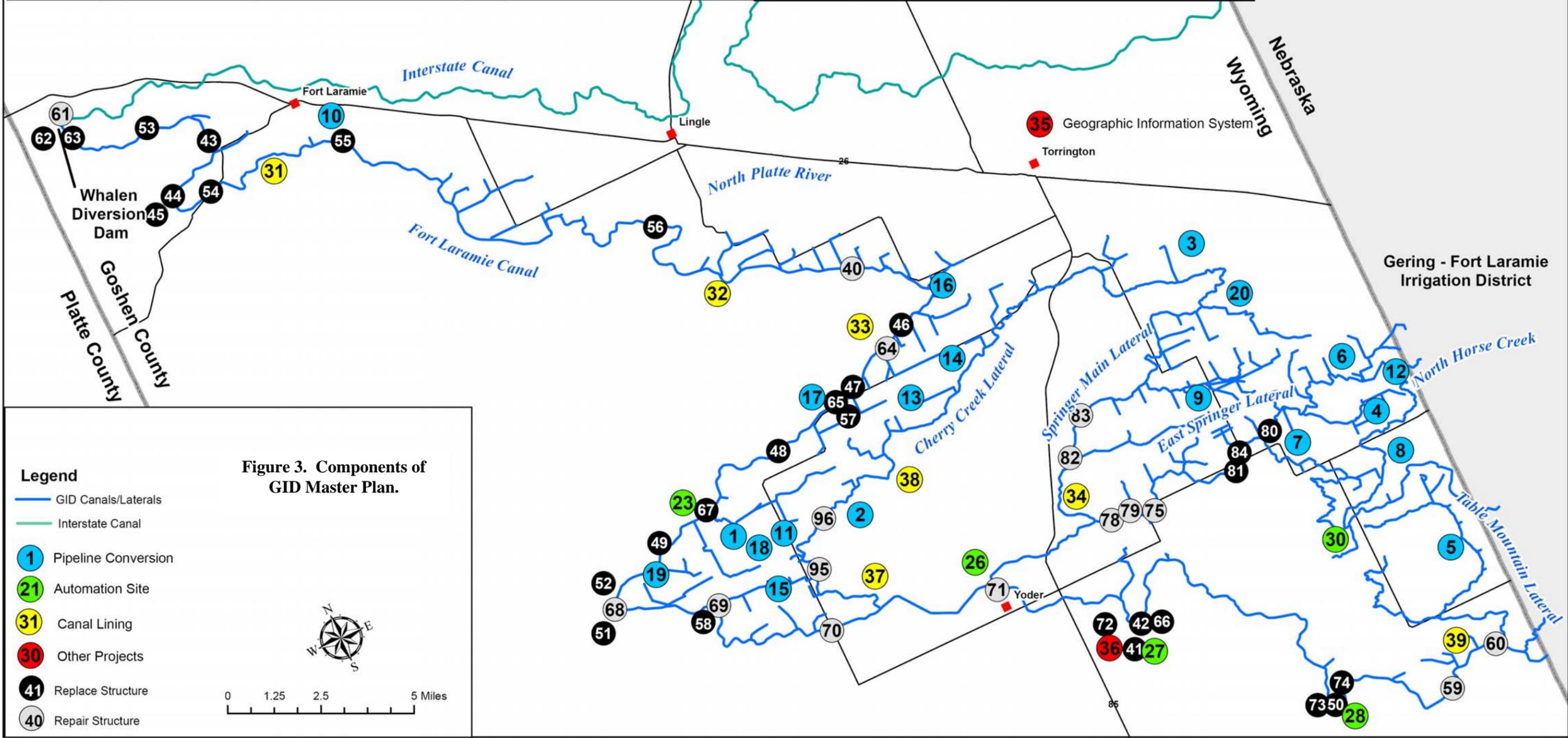


Figure 3. Components of GID Master Plan.

P:\WYWDC25 GID Master Plan\GIS\figures working\GID_improvements.mxd

within laterals, and monitors spills at the end of selected laterals. Operation and management of its water diversions from the North Platte River has been greatly enhanced following implementation of the automation system. Furthermore, water conservation has been realized through a reduction in operational waste. Results of this investigation identified five sites for automation and integration into the existing automation system operated and maintained by the GID. Four sites involve the automation of existing check structures to improve the delivery efficiency and minimize operational waste in the vicinity of the principal lateral headgate structures. The remaining site focuses on the automation of the diversion and headgate structure for the Horse Creek Lateral. Automation of the five sites would cost an estimated \$828,200.

The construction of a re-regulating reservoir within the GID has been documented in several previous studies. Following a review of this information and detailed discussions with the GID manager and board members, the re-regulation reservoir site in the vicinity of the Horse Creek Siphon was identified as the alternative to be included in the master plan. Based on an operational waste analysis using data collected by the GID from 1952 through 1992, it is anticipated that approximately 6,840 acre-feet of water could be captured and reused in an average year. Construction of the re-regulation reservoir was estimated to exceed \$4.6 million. Although construction of other project improvements may ultimately tend to reduce the potential conservation benefits associated with construction of the re-regulation reservoir, the magnitude of the potential conservation dictates that the re-regulation reservoir be included in the rehabilitation plan.

IX. IMPLEMENTATION PLAN

Improvements to the existing facilities that have been identified for implementation are estimated to cost as much as \$89 million. Development of the implementation plan for these projects included consideration of the following factors:

- (a) reducing the risk of failure of existing structures and subsequent loss of income related to the inability to deliver irrigation water;
- (b) benefits related to potential conservation of water, including the increase in potential crop production and income to the GID water users;
- (c) construction capability and capacity of the GID to construct the proposed improvements (estimated to range from \$1 million to \$2 million per year); and
- (d) the ability of the water users to pay for construction of the proposed improvements.

In recognition of these considerations, an initial implementation period of 10 years was considered and an implementation plan for construction of the majority of the improvements identified in the rehabilitation master plan was developed. The plan consists of five phases of construction with each phase representing two years. This time frame assumes an average annual construction of approximately

\$1.5 million or \$3 million during a two-year WWDC funding cycle. For the two-year funding cycle, this value represents approximately \$2 million in pipeline projects for materials assuming GID provides the construction and engineering support. Including construction and engineering, the total project costs for the pipeline projects per two-year period is estimated to be almost \$5.7 million. The total project costs for each two-year implementation period is almost \$6.7 million. For an implementation plan that spans ten years, over \$33 million of total project costs have been identified. A summary of the five planning phases is provided in Table 1.

Table 1. Summary of Implementation Planning Phases.

Item	Phase					Total Cost
	1	2	3	4	5	
Structure Replacement and Rehabilitation Projects						
Number of Structures	6	4	6	27	2	\$3,633,700
Cost of Structures	\$799,200	\$686,400	\$610,300	\$668,200	\$869,600	
Pipeline Replacement Projects						
Number of Pipelines	2	2	2	12	1	\$9,568,200
Cost of Pipelines *	\$1,931,800	\$1,947,200	\$1,903,200	\$1,867,800	1,918,200	
Liner Replacement Projects						
Number of Liner Projects	0	0	1	1	--	\$836,600
Cost of Liner Projects	--	--	\$418,300	\$418,300	--	
Automation Projects						
Number of Projects	2	3	--	--	--	\$828,200
Cost of Projects	\$332,300	\$495,900	--	--	--	
	\$3,063,300	\$3,129,500	\$2,931,800	\$2,954,300	2,787,800	\$14,866,700
Total Cost for All Phases						

*Materials Cost Only

X. OPERATING PLANS

In the last ten to fifteen years, operation of the GID has reflected the automation of its diversion and conveyance facilities. No changes are anticipated in the operation of the GID with implementation of the additional automation sites recommended by this investigation.

With respect to system automation, this study also evaluated the feasibility of the GID to operate the canal delivery system under the assumption that the Gering-Fort Laramie Canal was not diverting its irrigation water. The results of the evaluation indicated that it was not feasible to maintain the water level in the main delivery canal necessary to divert irrigation water to its users. Furthermore, it should be noted that all seepage losses in the main canal are presently shared by both the GID and GFLID. Should the GID wish to divert only its water supplies, all seepage losses will be borne by the GID ultimately reducing the water available to its water users. Given the feasibility of solely operating the water delivery system, along with the potential reduction in the water supplies, the automation of the remaining check structures in the main delivery canal was not further considered.

Implementation of the Horse Creek Re-regulation Reservoir will likely require the formulation of operation and maintenance plans. Although the reservoir is identified on the list of proposed improvements, it has not been included in the 10-year implementation plan.

XI. FUNDING STRATEGY AND ECONOMIC ANALYSIS

The economic analysis focused on identification of alternative funding sources and funding strategy. Alternative funding sources are largely related to federal and state programs. Federal programs include those related to the BOR, USDA/NRCS, and USCOE. Potential funding opportunities exist from these federal sources. However, limitations associated with funding levels, competition for funds, availability of funds and the timeframe to obtain these funds, prevents consideration for immediate availability in a funding strategy

Several state programs may be applicable to fund improvements identified in the rehabilitation plan. Funding sources include the Wyoming Department of Environmental Quality (DEQ), WWDC, Office of State Lands and Investments (SLIB), and Wyoming Business Council. DEQ funding is considered limited and typically focuses on water quality issues. The Wyoming Business Council through the Community Development Block Grant Program also offers limited funding. The SLIB program lends itself more readily to construction of on-farm improvements, individual loans are limited and the terms of the loan are less attractive than those offered through the WWDC. The WWDC through its Level III Development and Rehabilitation Program offers the most attractive funding opportunities involving 67% in grant money with 33% in loans. Although the WWDC has awarded grants/loans in excess of \$15 million, funding has typically been much smaller and limited to funding appropriations associated with single projects.

The funding capability of the GID is also integral to the implementation of the rehabilitation master plan. Financial contribution from the GID largely reflects in-kind contribution of construction resources, or raising existing assessments to undertake debt retirement from funding obtained through sources such as the WWDC. The GID has indicated a willingness to consider construction as an in-kind contribution, raising assessments and the incurrence of debt.

Given the magnitude of the total project costs along with the limitation associated with available funding, an evaluation of the existing assessment along with the assessment associated with the implementation of the rehabilitation plan was conducted. The evaluation included the following scenarios:

- Scenario 1: ability of the existing assessment to satisfy the expenses associated with the operation and maintenance of the GID facilities.
- Scenario 2: assessment necessary to fund the implementation of the initial 10-year plan of improvements.

The existing assessment consists of an O&M assessment of \$18.50. Based on an evaluation of expenses versus revenues, a modest surplus presently exists within the GID. A financial planning model was developed and utilized as a tool to evaluate each scenario through balancing the annual expenses and

revenues. The analysis was conducted for years extending from 2007 to 2040. During this time period, O&M expenses were assumed to increase an average of 2.0% per year to account for inflation. Given the modest surplus, an increase in assessment was identified as a means to balance future expenses and revenues for Scenario 1. The assessment increase consisted of a first-acre assessment along with an increase in the existing O&M assessment as indicated in Table 2. To balance expenses and revenues requires: (a) a first-acre assessment of \$50 in 2009 and increasing to \$500 in 2031; and (b) incremental increases in the O&M assessment ranging from \$0.50 per acre in 2009 to a total increase of \$12.50 per acre in 2035. Comparatively, this represents an increase in the existing assessment ranging from 2.7% in 2009 to 68% in 2035. The increases are necessary to balance expenses versus revenues and allow for inflation associated with the operation and maintenance expenses in future years.

Table 2. Results of Economic Evaluation.

First-Acre Assessment				Project Assessment			
Year	Existing Increase (\$/AC)	Structure Rehab Increase (\$/AC)	Total (\$/AC)	Existing Increase (\$/AC)	Pipeline Costs (\$/AC)	Structure Rehab Increase (\$/AC)	Total (\$/AC)
Scenario 1							
2007	--	--	0	--	--	--	\$18.50
2009	\$50	--	\$50	\$0.50	--	--	\$19.00
2012	\$100	--	\$150	\$1.00	--	--	\$20.00
2016	\$100	--	\$250	--	--	--	\$20.00
2017	--	--	\$250	\$2.00	--	--	\$22.00
2020	\$50	--	\$350	---	--	--	\$22.00
2022	--	--	\$350	\$2.00	--	--	\$24.00
2025	\$50	--	\$400	--	--	--	\$24.00
2026	--	--	\$400	\$2.00	--	--	\$26.00
2030	--	--	\$400	\$2.00	--	--	\$28.00
2031	\$100	--	\$500	--	--	--	\$28.00
2035	--	--	\$500	\$3.00	--	--	\$31.00
Scenario 2							
2007	--	--	0	--	--	--	\$18.50
2009	\$50	--	\$50	\$0.50	\$0.57	--	\$19.57
2011	--	--	\$50	--	--	\$1.00	\$20.57
2012	\$100	--	\$150	\$1.00	--	--	\$21.57
2016	\$100	--	\$250	--	--	\$1.00	\$22.57
2017	--	--	\$250	\$2.00	--	--	\$24.57
2020	\$100	--	\$350	--	--	--	\$24.57
2022	--	--	\$350	\$2.00	--	--	\$26.57
2025	\$50	--	\$400	--	--	--	\$26.57
2026	--	--	\$400	\$2.00	--	--	\$28.57
2030	--	--	\$400	\$2.00	--	--	\$30.57
2031	\$100	--	\$500	--	--	--	\$30.57
2035	--	--	\$500	\$3.00	--	--	\$33.57

Scenario 2, implementation of the 10-year plan of improvements (five phases of two years) assumed WWDC funding (67% grant/33% loan) for structure rehabilitation, canal lining projects, and system automation. In-kind services were assumed to construct the pipeline projects with the materials provided by the WWDC. Engineering expenses related to the pipeline projects were estimated to increase the annual expenses within the GID by \$30,000 and are estimated to increase the assessment by \$0.57 per acre. Total assessment increases for Scenario 2 are also presented in Table 2. Balancing expenses and revenues for Scenario 2 requires a project assessment for structure rehabilitation/automation/liner projects ranging from \$1.00 per acre in 2011 to a maximum of \$2.00 per acre in 2016.

XII. RECOMMENDATIONS

Based on the foregoing information, the following recommendations are provided for consideration:

- the existing expenses versus revenues should be balanced through an increase in the assessment;
- increase the existing assessment through a first-acre assessment and an increase in the O&M assessment in accordance with the information in Table 2; and
- initiate the implementation of the 10-year plan of improvements as indicated for Scenario 2.

It is understood that raising the assessment may economically impact each member of the GID to varying degrees. However, the risk of structure failure should also be considered along with the loss of income that would accompany such a failure. Furthermore, implementation of pipeline projects will provide for water conservation as well as the reduction in operation and maintenance costs.

Given the magnitude of the 10-year plan of improvements, it is imperative that the GID continue to pursue funding from the federal agencies previously identified. As indicated previously, limitations associated with funding levels, competition for funds, availability of funds and the timeframe to obtain these funds, prevents consideration for immediate availability in a funding strategy. However, the duration of the 10-year plan may provide opportunity for integration of federal funds. Consequently, it is recommended that the GID initiate coordination efforts to obtain potential funding from sources such as the NRCS and the BOR.

It is understood that several irrigation districts within the State of Wyoming have structures that were originally constructed over 80 years ago. Deterioration of these structures will continue and ultimately, rehabilitation or replacement will be required. Furthermore, projects that provide for water conservation have become vital to these entities and their water users, especially during the drought conditions experienced in recent years. It is likely that the need for structure rehabilitation and water conservation projects will increase significantly in the near future. With this in mind, it is also likely that the funding available from the WWDC will become more competitive. Given the need identified by the 10-year plan of improvements, it is recommended that the GID conduct coordination with the WWDC to determine the level and commitment of funding and funding strategy that may be available to implement these improvements.