Harlingen Irrigation District Cameron County No. 1
TWDB Contract 2002-484001
Project Plan

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Prepared by

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1 Summary of Proposed Project

The funds requested under this proposal will be used by the District to complete the engineering reports required the U.S. Department of Interior, Bureau of Reclamation (Reclamation) under the "Guidelines for Preparing and Reviewing Proposals for Water Conservation and Improvement Projects Under Public Law 106-576." The projects proposed by the District include the installation of flow measurement devices, line earthen canals, or replace earthen canals with pipelines.

2 Problems and Opportunities to be Addressed by Proposed Project

The project proposes to conserve water through reducing seepage and evaporation and improving the District's ability to match water supply with water demand.

3 Alternatives Considered

3.1 Flow Measurement

The four flow measurement alternatives considered were:

1) No flow measurement,
2) Flow measurement at the unit level,
3) Flow measurement at the delivery points, and
4) Combined measurement at the delivery points and unit level.

The District currently measures water at the delivery point. This information is used to determine the water charges for each user. The "no flow measurement" option was not considered because it would not provided the information needed to improve the operational control and water delivery efficiency of the District. Currently, the District has or is in the process of installing flow measurement devices at each delivery point within the District.

3.2 Canal Lining and Pipelines

The three types of linings being considered:

1) Concrete Paving with steel reinforcement (concrete),
2) Shotcrete with polyfiber reinforcement (shotcrete), and
3) Polyurethane Geocomposite (urethane).

The United States Bureau of Reclamation Pacific Northwest Region's Canal Lining Program has evaluated canal lining materials including combinations of geosynthetics, shotcrete, grout-filled mattresses, soil, elastometric coatings, and sprayed-in-place foam. The results of Reclamation's are published under several articles and summarized under their report titled "Canal Lining Demonstration Project, Year 7, Durability Report.

Typically irrigation district canals are maintained with motorized excavation equipment such as a back-hoe or Gradeall type tractors. Conventional concrete paving is best suited for surviving long-term maintenance work. The disadvantage to concrete paving is the time and expense of preparing the canal beds and banks for paving.

Earthen canal lined with shotcrete is less expensive than conventional concrete paving but may have a significantly shorter life cycle. Hidalgo County Irrigation District No. 6 is currently preparing to use shotcrete to repair portions of their main canal.

Urethane liners are relatively new to Texas and appear to be promising. Currently, Hidalgo County Irrigation District No. 1 is lining approximately one mile of canal using an urethane liner with favorable results. All three liners will be considered and evaluated for the proposed project.

The three types of pipelines considered were

1) PVC,
2) RCP, and
3) Fiberglass (AWWA C950)

PVC (poly-vinyl chloride) irrigation pressure pipe is typically used for pipe diameter of 24" or less diameter. RCP (reinforced concrete pipe) is used for pipe diameters of 30" or greater. PVC pipe has the advantage of being much quicker and easier to install than RCP but because of cost and structural concerns, RCP is used for diameters greater than 24". Fiberglass pipe is relatively easy to install and has greater structural strength than PVC but is considerably more costly than RCP. The table below summarizes the advantages, disadvantages and cost differences between PCV, RCP, and Fiberglass pipe.

Comparison of PVC, RCP, and Fiberglass Irrigation Pressure Pipe

Pipe Type	Diameter	Class	Cost per ft	Advantage	Disadvantage
PVC	24"	PIP	$18.00	ease of installation	Cost, only available in 34" dia. or less, strength
	36"	NA	NA		
	60"	NA	NA		
	72"	NA	NA		
RCP	24"	III	$17.00	Cost, Strength, lifecycle	difficult to install, high transportation cost
	36"	III	$28.00		
	60"	IV	$65.00		
	72"	IV	$98.00		
Fiberglass	24"	C950	--	light weight, easy to handle	difficult to adapt to turnouts, cost
	36"	C950	$43.00		
	60"	C950	--		
	72"	C950	$140.00		

4 Recommended Alternative

4.1 Flow Measurement

The recommended alternative for the flow measurement portion of this project was the installation of flow measurement and telemetry at the sub-main and unit level. A "unit" within the District is composed of the land irrigated using a canal or pipeline lateral to the main canal. There are approximately 40 units within the District consisting of approximately 500 to 1000 acres each. The main canal is divided in to several sub-main reaches. The proposed metering at the sub-main and unit levels will provided the District with the flow information needed to balance the distribution of water in the main canal between the sub-main reaches and evaluate the delivery efficiency of each unit. The unit level efficiency information will be used to prioritize which units should be targeted for improvements or investigated for water loss. Cumulative flow measurements at unit levels are sufficient to evaluate overall unit level efficiency. Real-Time or near real-time flow measurement is need to minimize the over delivery of water (waste) to specific units.

4.2 Canal Lining and Pipelines

The recommended alternative for the pipeline portion of this project was the installation of RCP for pipelines diameters of 30" or greater and PVC for pipelines of diameter 24" and less. The recommend alternatives for canal liners portion of this project was the installation of both urethane and concrete liners depending on the specific conditions of each location. The selection of a pipeline or a canal liner will be determined based on the relative costs of each per cfs of flow capacity. Typically the maximum economical size for RCP is approximately 72" and thus irrigation pipelines are typically limited to a flow of approximately 80 to 140 cfs. The final flow rate depends on the distance and change in elevation between the main canal and the farm turnout. Other benefits of pipelines over canals include reduced maintenance costs, smaller right-of-ways, increased on-farm water use efficiency, and increased public safety.

5 How Alternative will Improve Water Supply of Region M

5.1 Flow Measurement

The project will install flow measurement at each of the District's pump sites where water pressure is increased to operate pipelines, and at canal division points. These devices will be permanently installed to monitor deliveries into particular laterals of the system, and send this information, by telemetry, to the District headquarters. The proposed flow measurement system will allow the

District to determine what areas are being irrigated and how much water is being supplied to these areas. Many of the District's pump sites have multiple pumps. Often, energy used in pumping water is wasted because more water is pumped than is used in the system. By having more information, the District can operate the system more efficiently. Spot checking of the flow rates has revealed that as high as 40% of the time, the District is pumping more water than required for irrigation on the particular pipeline or lateral. Most of this excess water is returned to the main canal. In many cases only one farmer will be irrigating on a system through one or more turnouts. In case of multiple farmers, portable measurement devices will be used to determine individual operator usage, accuracy of the measurement, and for water accounting. The telemetry system will allow real-time monitoring without additional field personnel.

5.2 Canal Lining and Pipelines

The second proposed project is canal lining/pipeline installation. This project will save water by eliminating seepage, which has been estimated at 215 acre feet/mile per year by an ongoing Texas A&M study as a part of the Region M regional water planning work. Texas A&M performed a ponded seepage test in the District which resulted in a similar rate of seepage. One or more seepage tests are planned to be conducted during the course of this project and will be documented in the Project Report. The proposed canal lining/pipelines will not only eliminate the seepage and its associated pumping requirements and costs, but will eliminate the need for several of the pumping stations that are required to deliver water to high blocks that could not previously be irrigated under gravity conditions. This will result in the flow rate of water delivered to individual fields to be increased or allow for a greater number of fields to be simultaneously irrigated.

6 General Location Map and District Boundaries

Figure 1 shows the approximate District boundaries, Figure 2 shows a detail of the District, and Figure 3 shows the District's existing distribution system. Large format versions of Figure 2 and Figure 3 are attached as Appendix B and Appendix C, respectfully. Appendix D is a large format drawing of the proposed locations of the canal lining/pipeline projects. Appendix E is a large format drawing of the proposed meter locations.

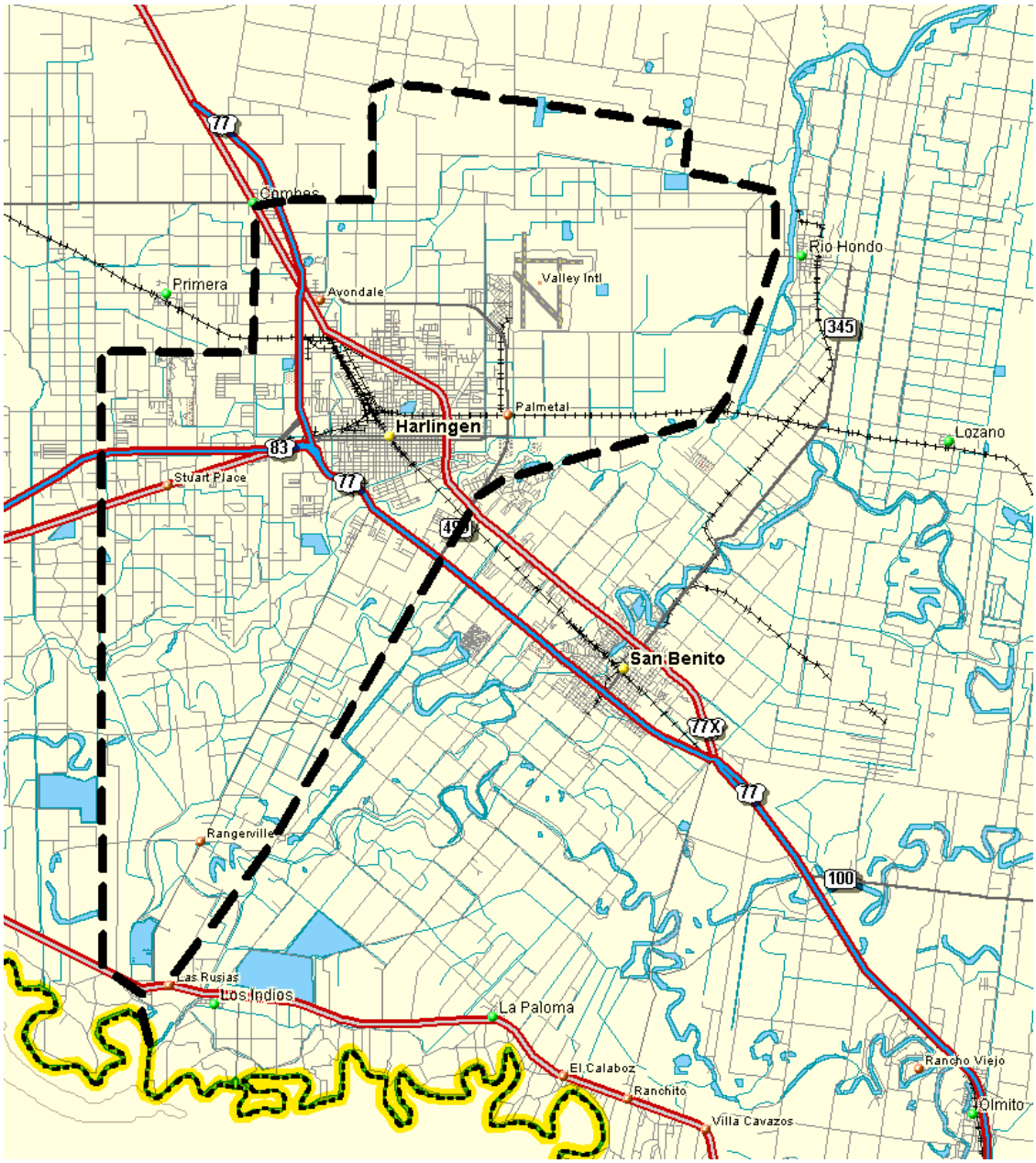


Figure 1: Approximate Boundaries of
Harlingen Irrigation District Cameron County No. 1

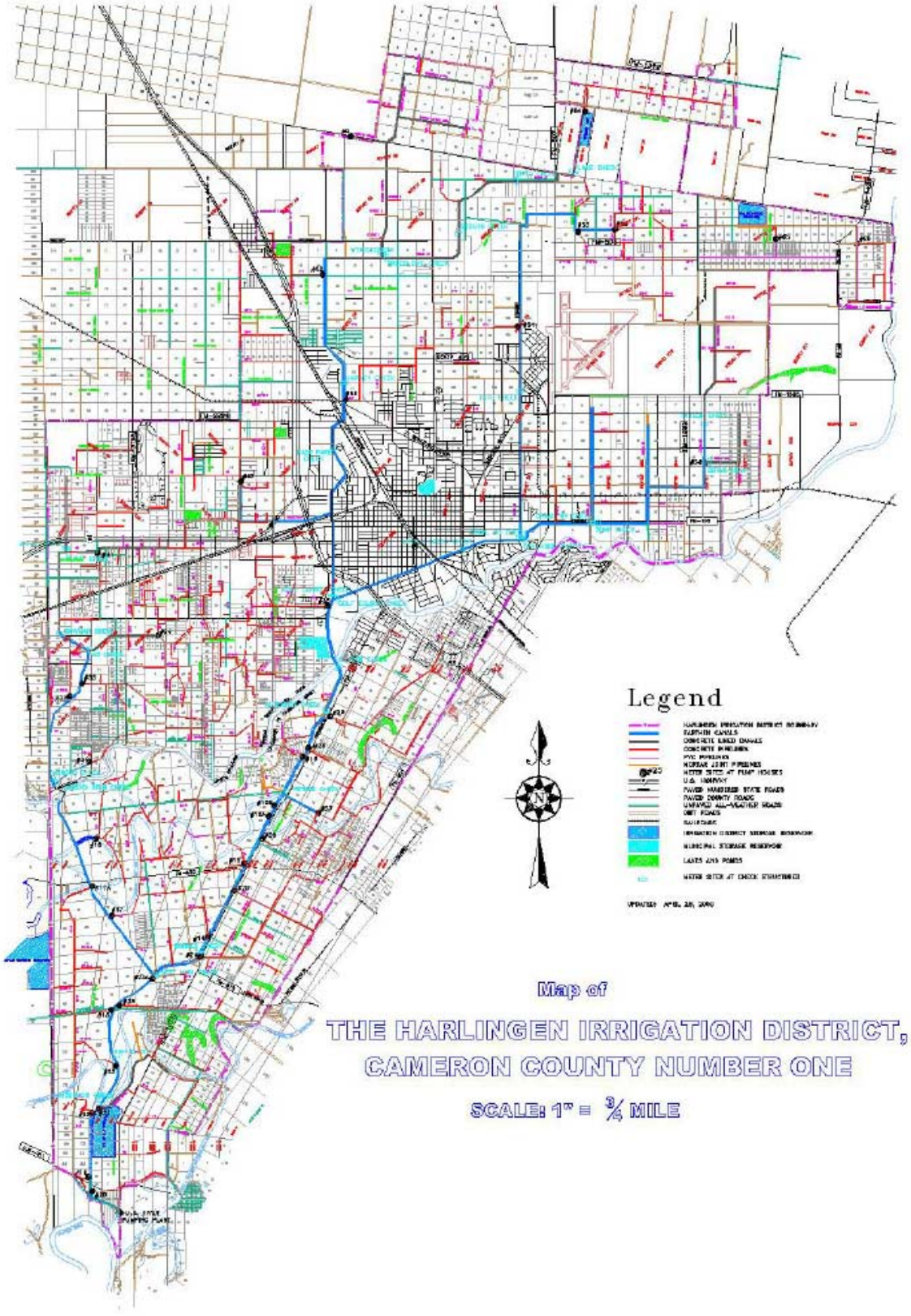


Figure 2: Detailed Boundaries of Harlingen Irrigation District
Cameron County No. 1

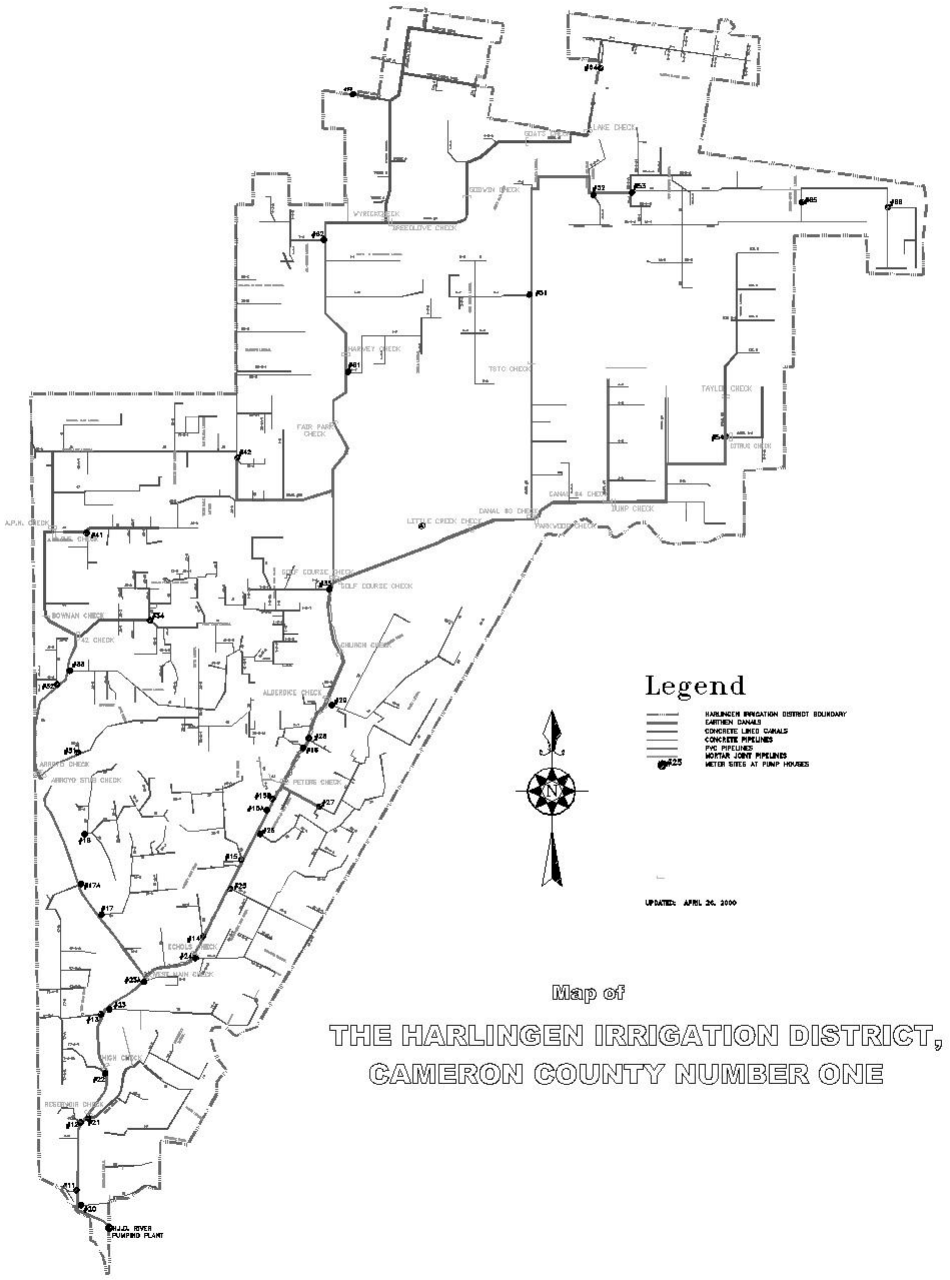
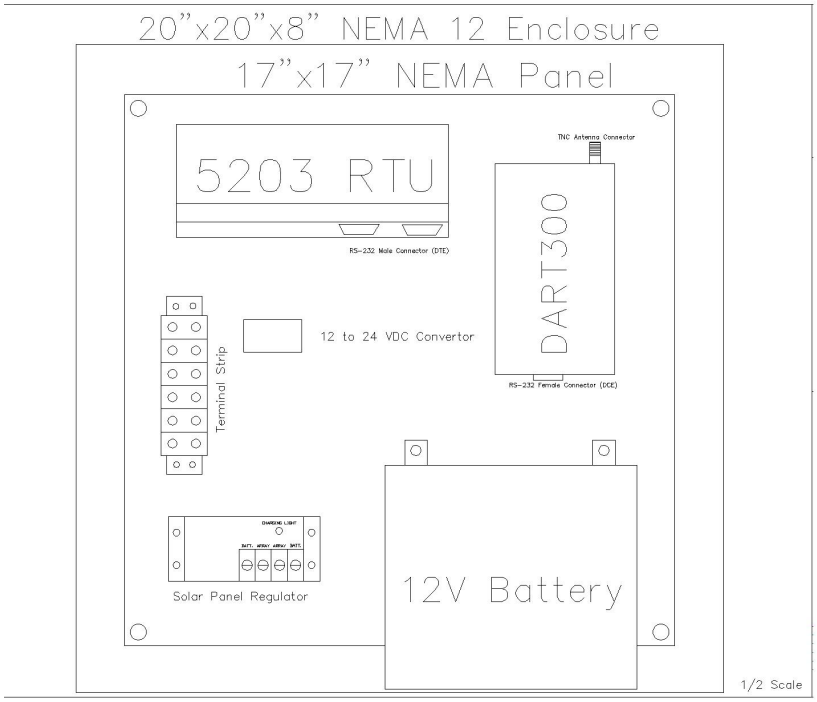
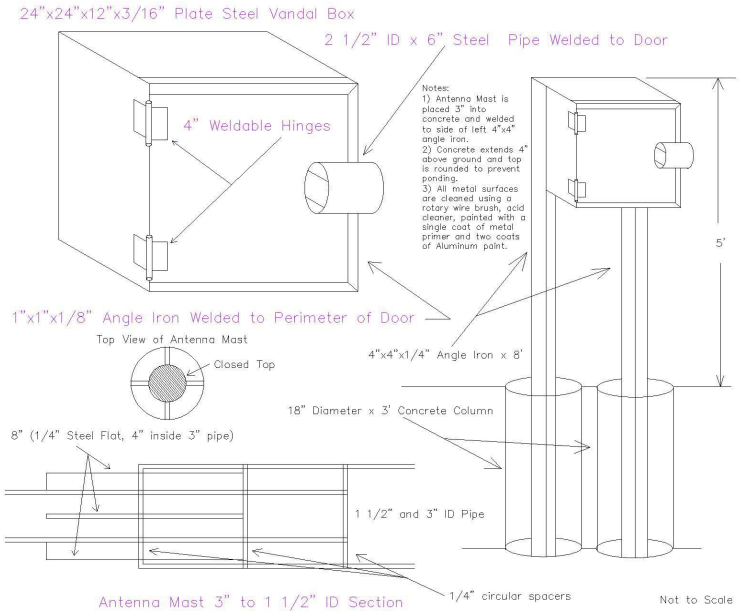


Figure 3: Distribution System of Harlingen Irrigation District
Cameron County No. 1

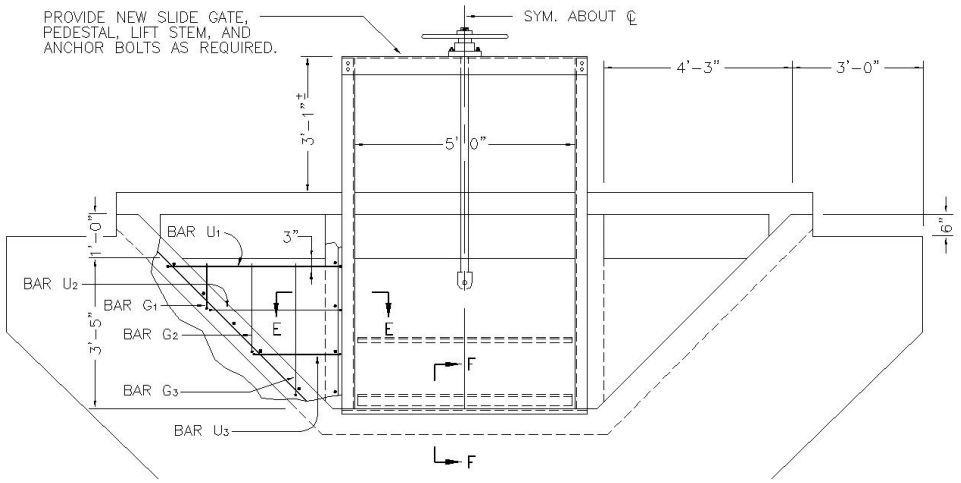
7 Conceptual Engineering Drawings of Structures



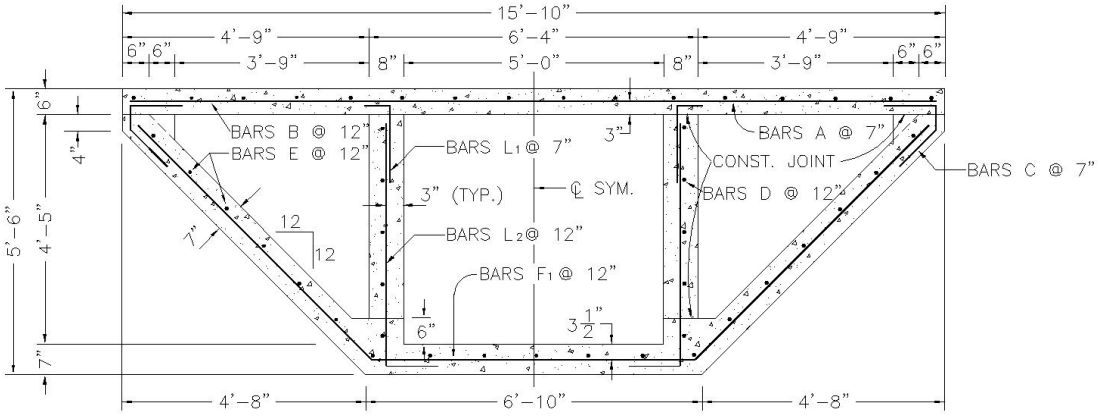
Telemetry System Electronic Components



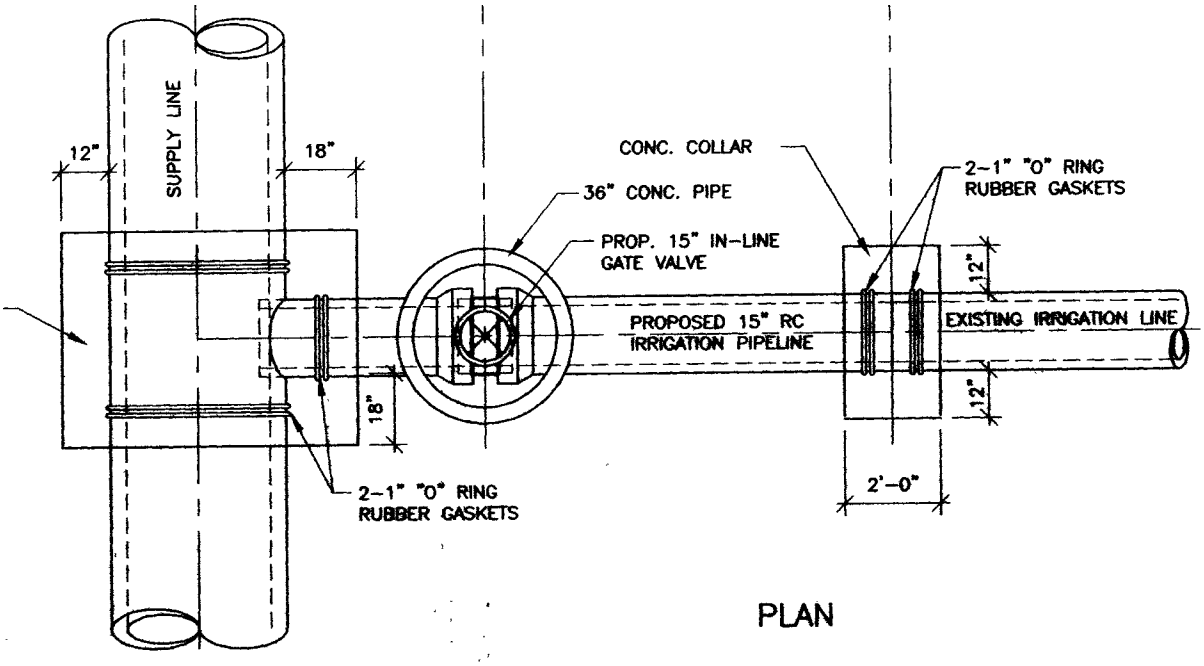
Telemetry Vandal Box



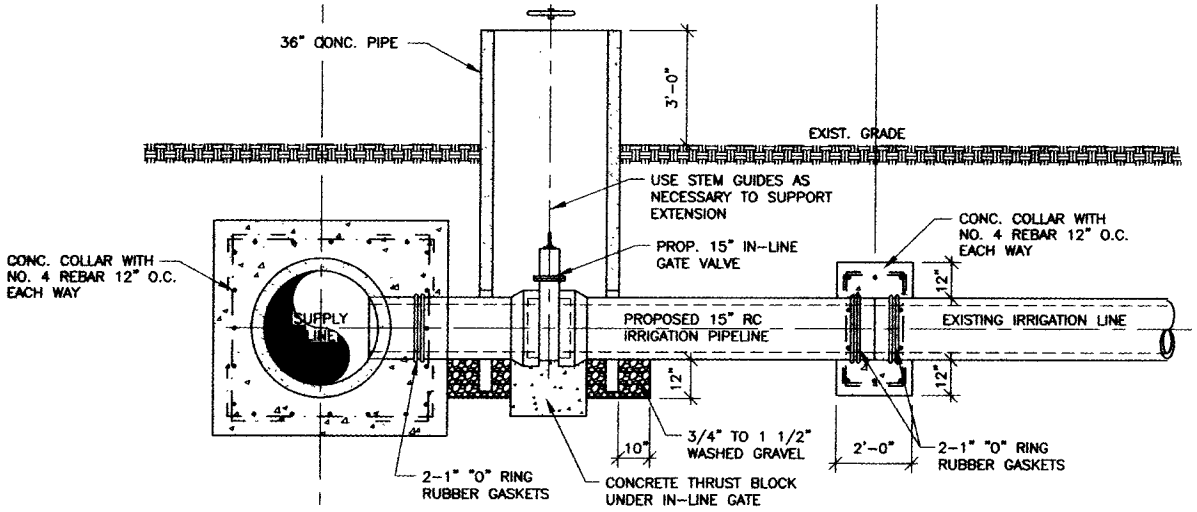
Canal Turnout End View



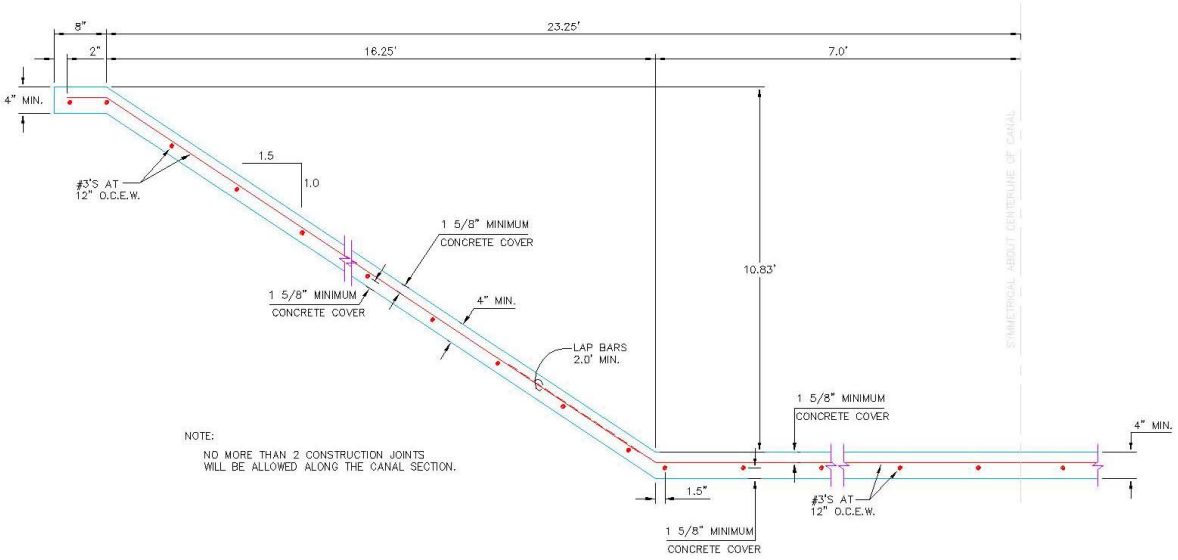
Canal Turnout End View – Reinforcing Steel Detail



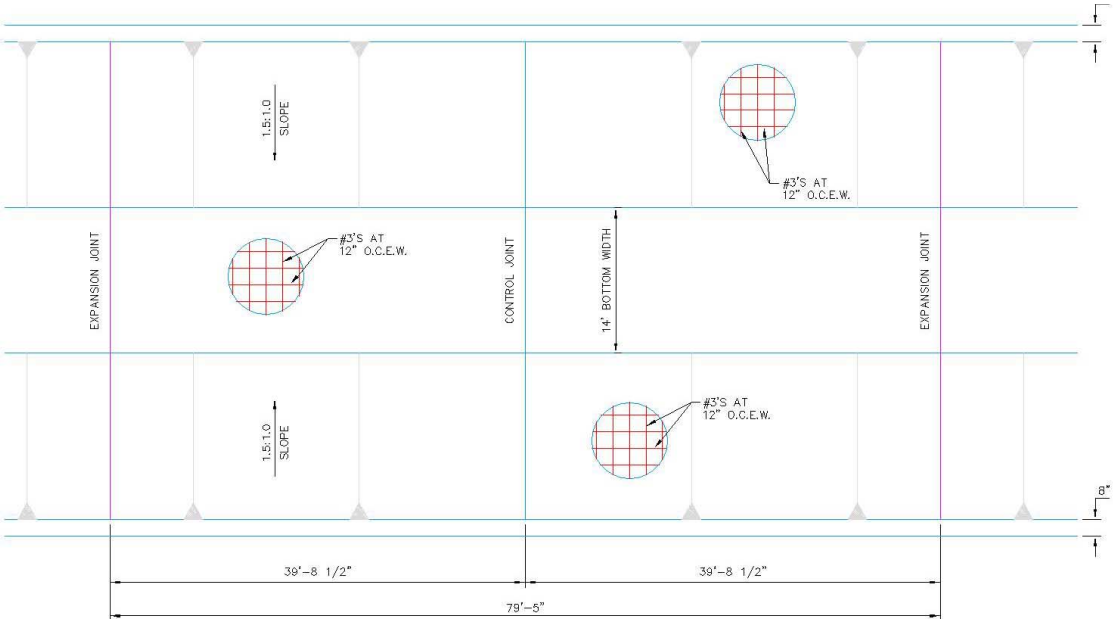
Plan View of Pressure Pipe Turnout



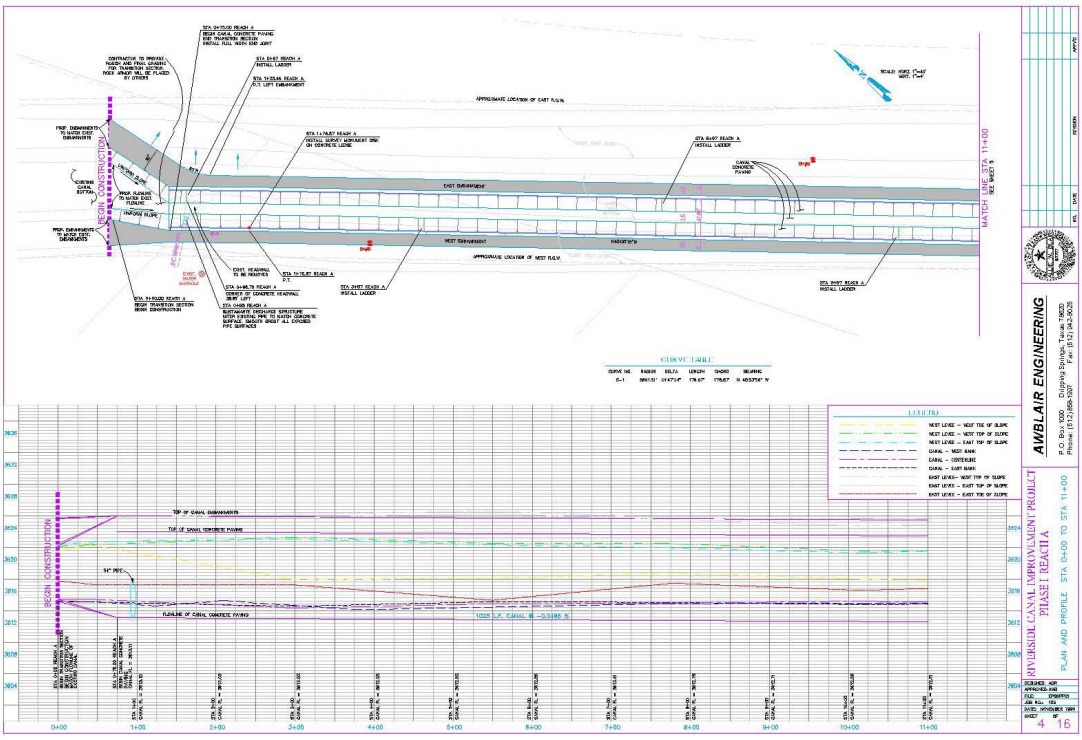
Side View of Pressure Pipe Turnout



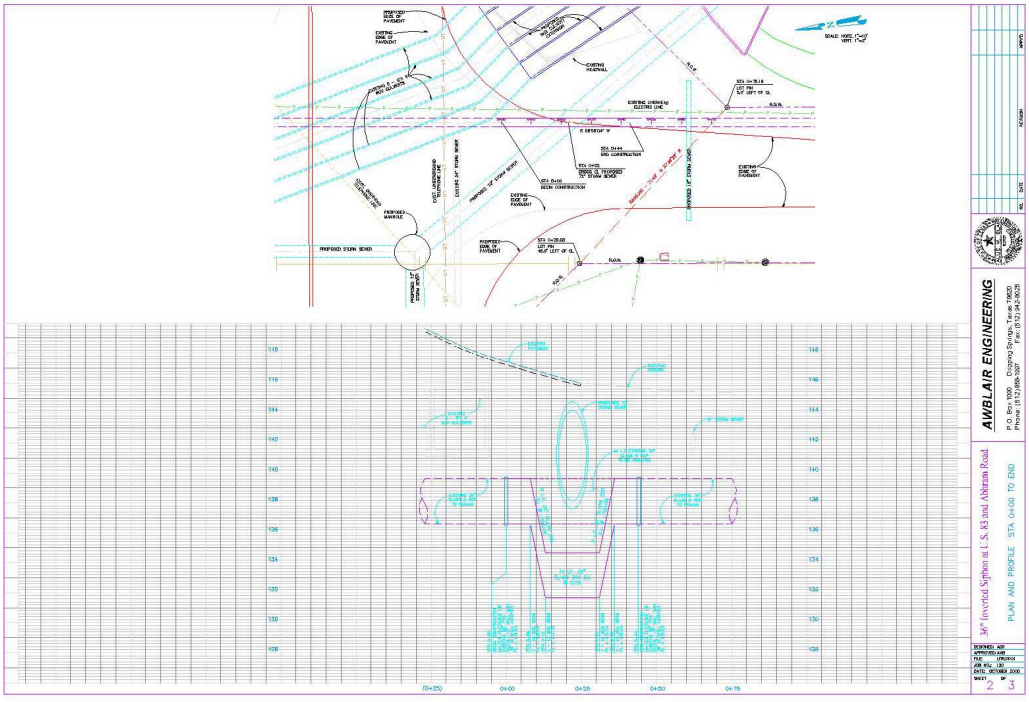
Concrete Paving Cross-Section



Concrete Paving Plan View



Typical Plan and Profile Sheet for Canal



Typical Plan and Profile Sheet for Pipeline

8 General Standards for Design

8.1 Flow Measurement Systems

The are no comprehensive standards for flow measurement in irrigation systems. The following references will be used as guidelines in the design and installation of the flow measurement systems proposed for this project.

United States Geological Survey, Steam Gauging Procedures, USGS Water Supply Paper 888.

United States Bureau of Reclamation, Water Measurement Manual, 1974.

American Water Works Association, C704-92, Propeller Meter.

8.2 Telemetry System Requirements

The follow specifications are typical of that which may be used to for a request for proposal for the telemetry portion of the flow measurement system:

Mandatory Requirements

Mandatory system and functional requirements are basic to graphical user interface Telemetry Systems or are necessary for successful implementation of Telemetry at District. Lists the various mandatory features of the Telemetry System. Mandatory features are essential requirements for the preferred Telemetry System.

1) Remote Terminal Unit (RTU)

The RTU must have the following capabilities:

1) 2 channels of 12 bit or greater A/D Conversion
2) analog ports must accept 0-5VDC, 0-20mA input
3) 2 channels of digital output (current limited)
4) local or remote (over the air) programming
5) 12-15V DC Power
6) one local RS232 interface for programming or sensor connection (9600 baud, 8 bit, 1 stop, no partity)
7) one RS232 to RF modem interface
8) operational temperature range –40 to 185 F
9) Current draw for active A/D, Digital I/O, RS232, and Radio Interface must be less than 100mA at 13.4VDC
10) Current draw for inactive A/D, Digital I/O, RS232, and Radio Interface must be less than 50mA at 13.4VDC

2) Radio and RF Modem

The Radio and RF Modem must have the following capabilities:

1) frequency separation of 12.5 or 25 kHz
2) programmable to District FCC assigned frequency of 456.475 MHz
3) 15 watt ERP at 20 ft nominal antenna height and 10db Yagi Antenna

4) a minimum of 1,200 baud remote programmable (over the air) FSK packet modem using AX.25 protocol. (other modems with CRC type error correction, TCP/IP, or X.25 are acceptable)
5) 12 VDC operation with less than 20mA at 13.4 VDC current draw.

3) RTU/Radio/Modem Enclosure

RTU must be cable of being mounted inside a Steel NEMA 12 20"x20"x8" enclosure on a standard 17x17 panel with room for the storage battery to be placed on the bottom of the encloure.

4) Power Supply and Battery System

1) System must be 12 VDC powered and supply 100 mA of 24VDC power for loop powered 4-20mA transmitters. The system must contain one 105 Amp Hour 12 VDC sealed lead-acid battery.

5) Radio Antenna

1) 10 db gain or greater Yagi antenna with female UHF connector, 2" (I.D.) pole mountable with antenna lightening arrestor.

6) Solar Panel Voltage Regulator

1) The RTU must contain a voltage regulator with large enough amperage capacity for a 30 Watt solar panel.

7) Host Computer Software

Software must run on a PC (x86) Pentium 166 mHz 64mbyte industrial computer system currently installed at the District Dispatch Office. The system currently runs WIN98 but can be upgraded to run Windows 2000 if necessary and has a 40 Gb HD. Proposal must include cost for software and hardware upgrades (if any) needed to run proposed Host Computer Software. At a minimum the software must be able to periodically pole or on-demand update of up to 128 RTU's. The software should have the following features:

1) Display of current, last 24 hours, and monthly water level and flow data for any or all RTU's.
2) host computer should store all engineering and conversion data such as water level slope and offset for scaling mA readings to gage depth, flow rating table coefficients of the equation form Q (cfs) = a x (H-c)^b where the units of H are feet.
3) RTU's should only transmit raw mA for position or water level to Host Computer (battery voltage and enclosure temperature maybe converted to engineering units prior to transmitting).
4) High and low alarm set points for each of the RTU must be programmable and such alarms must be capable of being sent to alpha-numeric pagers.
5) All hourly data must be format for display in HTML and capable of being transmitted via FTP to the Districts web site.
6) Remote control of Host Software via dial-up or TCP/IP.
7) Display of real-time water level and flow data on remote computers via dial-up or TCP/IP.

Additional Functional Requirements

Functional requirements in addition to the mandatory requirements include those functions that could be added or interfaced to a basic Telemetry System to adapt it to more complex system operations. These functions are not considered mandatory, but are preferred by District. Because the method of implementation of these features may be different for each

Vendor, explanation and details are requested for many of these features. Each provided. The total number pages for responses to these items should be no more than ten (10) pages.

1. Operating System - Define the operating system used, and its version. Have you modified the operating system in any way to allow the Telemetry software to operate? Are any 16-bit components used or required?

2. Database Structure - Provide details of the database structure used for the real-time and historical data. Provide details of the data model used for the historical database.

3. Communications Protocol Drivers - Provide a list of all communications protocol drivers supported by your software.

4. Screen Resolution - Define maximum screen resolution your software supports.

5. Alarm Configuration and Management - Does your software system allow a Dispatcher to enter comments associated with a specific alarm and keep the information with the alarm history. Provide details on how this feature is accomplished.

6. Logging of Alarm Limit Changes - It is desirable for the Telemetry System to provide a feature to log alarm limit changes in the database to a separate event log. This alarm limit change log should be viewable. Provide details for how your software system provides this function.

7. Operator Interface – PC Based Functions - Does your software system generate a tone when an operator command is not valid? Elaborate on feedback mechanisms provided by your software system.

8. Device Tagging - Provide details of how your software supports the functional requirements for device tagging, defined as a mechanism for electronically marking a device, such as a canal; gate as out-of-service or unavailable.

9. Generalized Data Calculator - Provide details of the data calculator provided. Does the software support the use of Excel for data calculator functions?

10. Report Generation - Provide details of the report generation package provided. Does the software use Excel for this function? Be specific about its capabilities for custom reports, editing of completed reports, cut and paste of external objects.

11. System Internal Integrity Monitoring and Support - Provide complete details of how your software system supports full redundancy and can be configured so that the failure of any one hardware or software subsystem will not result in the loss of critical system functions.

12. System Upgrade - Provide complete details of how a system upgrade is accomplished.

13. Naming Conventions - Provide details of the point naming conventions your system supports.

14. Communication Channel Monitoring - Provide details of the communications analysis tool provided by your software system to allow the operator to diagnose communications problems.

15. Supervisory Control Prompts - It is desirable that the Telemetry software supports supervisory control prompts to a caution page to be displayed to the Dispatcher when selecting designated devices for control. These devices may include certain large canal gates where considerable caution is required to avoid system damage or adverse effects on operations elsewhere in the system. The caution page should contain advisory notes or standard operating procedures (SOPs) which must be observed when remotely operating this device. The Dispatcher must acknowledge viewing the caution page and enter a user password before proceeding to actual control action. All control actions including user ID must be logged. Does your software system provide this function? If so, provide details for how it's implemented.

16. Security Access - Provide details of how operator logon security access is implemented.

17. Remote Telemetry Nodes - The future District Telemetry system may include more than one Remote Telemetry Node. These nodes will provide complete access to and control over the complete Telemetry System or a portion of the system and its facilities from remote locations. However, it is required that control capability of the system be coordinated so that only the dispatcher at the District Dispatcher Office (DDO) or at a remote location may issue control commands. Provide details of how Remote Telemetry Nodes are implemented, particularly in the case where the Telemetry System at the DDO is unavailable.

18. On-Line Training System - The Telemetry system should provide an on-line training mode that guides an operator through the Telemetry System operations. Provide details on your software system's on-line training system.

19. On-Line Help and O&M Manuals - The system vendor should provide an additional electronic version of the system O&M manuals that may be accessed on-line. This feature should use a manual format that allows District to include its own system help and procedure manuals in the list of manuals available on-line. Provide details on your software system's on-line help and O&M manuals.

20. Systems Integration - Provide details of other systems, such as GIS systems (ArcInfo and ArcView), you have successfully interfaced with using this Telemetry System software.

21. FTP Transfer of Data - Provide details of data from the RTU's can be formatted into HTML and transferred via FTP for real-time display on the District web site.

8.3 Canal Lining and Pipelines

The primary standards proposed for design and construction of the canal linings and pipelines are:

Texas Department of Transportation, 1993 Specification for Construction and Materials

Natural Resources Conservation Service, Conservation Practice Standard Irrigation Canal or Lateral, Code 320.

Natural Resources Conservation Service, Conservation Practice Standard

Irrigation Water Conveyance, High-Pressure, Underground, Plastic Pipeline, Code 430 DD.

United States Bureau of Reclamation, Design of Small Canal Structures, 1978

ASTM C 76 Standard Specification for Reinforced Concrete Culverts, Storm Drain, and Sewer Pipe with Reclamation's R4 Joint Design

ASTM C 443 Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

ASTM C 655 Standard Specification for Reinforced Concrete D-Load Culvert Storm drain and Sewer Pipe.

8.4 Typical Reinforced Concrete Irrigation Pipe Bid Specification

REQUEST FOR SEALED BIDS
FOR PURCHASE AND DELIVERY OF
36" CLASS IV REINFORCED CONCRETE PIPE

The District is requesting sealed bids for the purchase and delivery of 36" CLASS IV Reinforced Concrete Pipe for the Blue Bonnet Pipeline Project. Copies for the Request for Sealed Bids can be obtained from the District by calling xxx-xxx-xxxx during normal business hours. Sealed bid must be received at the District Offices no later than 2:00 PM on October 18, 2000.

TOTAL QUANTITY: **4560 linear feet of 36"**
16 linear feet of 72"
136 linear feet of 60"
all gaskets and any recommend gasket preparation material, pipe and gasket must meet specifications

CLASS: ASTM C76 Pipe Class IV – Wall B

FOB DELIVERY:

DISTRICT CONTACT:

ENGINEERING CONTACT:

SPECIFICATIONS

Pipe

A. Except as modified herein, precast reinforced concrete pipe shall conform to the design shown on the plans and to ASTM C76, pipe class IV Wall B or ASTM C655 for circular pipe.

B. All precast concrete pipe shall be machine made or cast by a process which will provide for uniform placement of the concrete in the form and compaction by mechanical devices which will assure a dense concrete. The aggregate used shall be sized, graded, proportioned, and mixed in batch mixers with such proportions of cement and water as will produce a homogenous concrete mixture of such quality that the pipe will conform to the test and design requirements of these specifications. All pipe shall be manufactured with Type II cement. Concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed concrete will not be acceptable for use in precast concrete pipe.

Physical Test Requirements

A. The acceptability of the pipe shall be determined by the results of the physical tests outlined herein; by appropriate material tests required in ASTM C 76, C 506, C 507, or C 655; by absorption tests on selected samples from the wall of the pipe; and by inspection of the finished pipe to determine its conformance with the required design and its freedom from defects. Three-Edge Bearing tests shall be performed on one (1) pipe for each 100 pipes or fraction thereof of each design or shape, size, class or D-load for the load to produce a 0.01 inch crack and, at the discretion of the District, the pipe may be tested to an ultimate load.

B. The manufacturer shall plug and seal coreholes in the pipe wall, after testing, in a manner satisfactory to the Engineer.

Marking

A. The following information shall be clearly marked on each section of pipe:

1. The class or D-load of pipe.
2. The date of manufacture.
3. The name or trademark of the manufacturer.

B. One end of each section of pipe with elliptical reinforcement shall be clearly marked during the process of manufacture or immediately thereafter on the inside and the outside of opposite walls to show the location of the "top" or "bottom" of the pipe as it should be installed, unless the external shape of the pipe is such that the correct position of the top and bottom is obvious. Marking shall be indented on the pipe section or painted thereon with waterproof paint.

Inspection

The quality of materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by the District at the pipe manufacturing plant. In addition, the finished pipe shall be subject to further inspection by the District at the project site prior to and during installation.

Causes for Rejection

Pipe shall be subject to rejection for failure to conform to any of the specification requirements. Individual sections of pipe may be rejected because of any of the following:

1. Fractures or cracks passing through the shell, except for a single end crack that does not exceed the depth of the joint.
2. Defects that indicate imperfect proportioning, mixing and molding.
3. Surface defects indicating honeycombed or open texture.
4. Damaged ends, where such damage would prevent making a satisfactory joint.
5. Any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more, regardless of position in the wall of the pipe.

Jointing Materials

A. Unless otherwise specified on the plans the Supplier shall use rubber gaskets and such gaskets shall be supplied with the pipe at the time of delivery. The Supplier shall furnish the District the Manufacturer's Certificate of Compliance.

B. Gaskets for Bell and Spigot joints shall be of a solid circular cross section and shall be extruded or molded and cured in such a manner that any cross section will be dense, homogenous, and free of porosity, blisters, pitting, and other imperfections. These gaskets shall conform to ASTM C 361.

C. The gasket shall be an O-ring type, circular in cross section, or approved equal. The gasket shall be designed to fit into a notch or indention in the spigot of the pipe.

D. The rubber gasket shall be an integral part of the joint design and all dimensions and variations of both the rubber gasket and the concrete surface shall not exceed the tolerances specified in ASTM C 443. The Supplier shall furnish the District the Manufacturer's Certificate of Analysis.

8.5 Typical Canal Lining Specifications

A copy of a typical specification for canal lining project is attached as Appendix A to this document.