ROZA IRRIGATION DISTRICT

COMPREHENSIVE WATER CONSERVATION PLAN REPORT

COMPREHENSIVE WATER CONSERVATION PLAN

FINAL DOCUMENT

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Submitted by

ROZA IRRIGATION DISTRICT

Yakima Project

Sunnyside, Washington

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"Anyone who can solve the problem of water
will be worthy of two Nobel Prizes - one for science
and one for peace".

John F. Kennedy

ROZA IRRIGATION DISTRICT
COMPREHENSIVE WATER CONSERVATION PLAN

EXECUTIVE SUMMARY

The Roza Irrigation District is located in Central Washington, along the eastern slopes of the Cascades Mountains in the lower Yakima River Basin. Water is supplied to the basin from five storage reservoirs. Irrigation water is diverted from the Yakima River in the Ellensburg Canyon at the Roza Diversion Dam. The Roza Main Canal is 94.8 miles long and ends east of Benton City. The District serves 72,000 acres lying along the northern rim of the lower Yakima River Basin.

Roza Irrigation District Organization

Title 87 is the statutory basis of Roza Irrigation District. The District is also under contract with the Federal government. The Federal Contract also stipulates many operational and organizational characteristics of the Roza Irrigation District. The history of Roza Irrigation District begins in the late 1800's. Construction was completed in 1951 although service to the first portion of the District was in 1941. Rehabilitation of facilities officially began in 1984. The Board has approved a set of operating procedures and policies, which is the basis for decisions made. The Board sets assessments and in 1998 the cost is $78.00 per acre for up to three acre feet per acre of use. Extra water costs $32.00 per acre-foot.

Land Base and Land Use

There are just over 98,000 acres within the boundaries of the Roza Irrigation District. Using 1990 figures, an estimated 60,000 acres were in marketable crop, 26,000 acres of land is not assessed, and 12,000 is assessed but in 1990 did not produce a marketable crop. Land use within the District boundaries is primarily agriculture. The District does border closely the areas of East Selah and Terrace Heights but there is no strong trend toward annexation of the District area to the cities.

Water Supply, Use and Rights

Roza Irrigation District presently operates under Federal Contract 14-06-W-69, which supersedes all other contracts. Water right consists of 393,000 acre-feet per year and states monthly scheduling for the period of March through October. It also provides for proration in water short years. In addition to contract water supply the 1945 Consent Decree states that "the United States shall continue to divert available flood water from the Yakima River and its tributaries in accordance with its

practice prior to the entry of this judgement, and the quantities of such water which the parties to this judgement are entitled to receive shall be over and above the schedules of diversions herein above set forth." Water supply in the Yakima River Basin averages 3.4 million acre feet per year. There is storage for 1+ million acre feet and use is just over 2 million acre feet. Over half the demand for the water in the basin is met by the timing of snowmelt and precipitation. There have been 8 years of proration since the Roza Irrigation District was constructed, due to the unfortunate situation of insufficient storage to manage the water in the basin (1973, 1977, 1979, 1987, 1988, 1992, 1993, and 1994). Of these, the worst by far was 1994, when the Roza Irrigation District received only a 37% supply.

The Roza Irrigation District's average use has been decreasing over time. Presently the system operates on average at 59% efficiency. (i.e. water diverted from stream compared to delivered to farm). The inefficiencies are due to Main canal operational spill and losses and lateral operational spills and losses. There is also the on-farm efficiency, which is not quantitatively considered.

Present Facilities and Operation

The original system design consists of the main canal that is 94.8 miles long. The main canal has 7 wasteways for emergency purposes and the lower 6 are also used as operational spillways. There are also check structures in the lower half of the system, which are operated manually. The main canal delivers water to open laterals which have delivery boxes with weir blades to measure the water delivered to the farms. The district delivers water to the areas below the main canal by gravity to 45,000 acres and with 18 pumping plants to 27,000 acres above the main canal. The Bureau of Reclamation operates and maintains the first 11 miles of the main canal and the Roza Irrigation District operates and maintains the portion below 11 mile. There are 12 ditchriders that change water orders from Monday through Friday 8:00 a.m. to 4:30 p.m. Each ditchrider is responsible for a portion of the main canal and laterals. A watermaster and two assistant watermasters oversee the operation of the water delivery.

Water Needs and Adequacy of Water Supply

Projections in the changes in the cropping patterns show an increase in orchard, grapes and hops with a decrease in mint and other crops. The projected changes in cropping patterns will not affect water demand. The number of acres assessed within the District will remain fairly constant due to Federal Contract stipulations and the impact of urbanization will not be significant. The District is still threatened by proration in water short years. Improved system efficiencies are required to reduce shortages in water supply.

Benefits of Preferred System of Improvements and Rehabilitation

The preferred system improvements and rehabilitation plan for the Roza Irrigation District consist of five components: enclosed conduit systems on gravity laterals, enclosed conduit systems on pump laterals, canal automation and main canal gauging, reregulation reservoirs and lining portions of the main canal.

The enclosed conduit systems consist of replacing the old concrete delivery boxes, weir blades and open ditches or low head pipe with PVC pipe and flow meters. The main benefit derived from enclosing the gravity laterals and the pump laterals is the reduction of lateral losses to virtually zero. The flowmeter is a much more precise measurement of both flow rate and total volume of water used, so farmers have better control of the water. The farmer is provided with more flexibility in operation. The District has a reduction in maintenance costs and a reduction in liability for the open lateral and the seepage, operational spills and drains. On-farm pumping costs are eliminated or greatly reduced. Erosion will be minimized due to conversion to sprinkler systems and chemical spraying along the laterals eliminated. On the pump laterals it will also mean upgrading the pumping plants to a more flexible pumping system.

Canal Automation consists of automating check structures along the main canal so that a constant elevation can be maintained to the deliveries. The District is presently conducting a study that includes modeling the main canal to determine the best location for the automated gates. The automation will also include gauging and developing an overall communication system between gates and with the District Office. The benefits of automating the main canal are that flow fluctuations in the main canal will not cause changes in pool elevations. The system of manually changing check boards in the existing check structures is not dynamic enough to handle the increases in fluctuations created by allowing the farmers the ability to shut off. The check structures will allow the main canal to operate at lower flows. This is especially important in water short years.

The reregulation reservoirs are located fairly close to the main canal and are used to dampen the fluctuations in main canal flows. When there is excess water in the canal, they will be operated in the storage mode. When there is a sag in the canal, water will be released from the reservoir. Without reregulation reservoirs, the enclosed conduit systems and canal automation would potentially create larger operational spill. The largest reregulation reservoir at Wasteway #5 remains unbuilt. When completed, it will be the backbone of the modernization project. The funding of Wasteway #5 reregulation dam and reservoir are sought through YRBWEP.

The District is only lining those areas of the main canal where the structural soundness of the system is in question due to recent increases in seepage rate or where seepage is damaging productive cropland or houses. It will not be a net water saving activity, but one to preserve the present integrity of the main canal.

Time Line and Location of New Facilities

The time line for construction of the above-discussed improvement projects the enclosed conduit system on the gravity laterals being completed in 2003. The enclosed conduit system on the pump laterals starting in 2004 and finishing in 2017. The main canal automation construction began in 1993 and should finish in 2012. Wasteway 6 reregulation reservoir was built in 1988 and Wasteway 7 reregulation reservoir was constructed in 1993. Wasteway 5 is tentatively planned for construction starting in 2001. Lining of the main canal will happen during all of the rehabilitation as need arises.

Costs of Rehabilitation

Cost estimates for the construction and operation and maintenance of the projects, not including power; are given in 1992 dollars. The cost of the enclosed conduit system on gravity laterals is estimated at $15,868,000. Cost for the enclosed conduit on the pump laterals is $25,320,000. Operation and maintenance costs are estimated at $8.90 for the old system and $3.80 for the new system. Canal automation is estimated to cost $4,800,000 and operation and maintenance would start at $10,000 and when totally installed may be as high as $90,000 a year, not including power costs. Wasteway 6 reregulation reservoir cost $870,000 to build and Wasteway 7 cost $300,000. Wasteway 5 is estimated to cost $15,500,000 and maintenance and operation $50,000 a year. Lining portions of the main canal is estimated to cost $2,460,000. The total annual cost for capital and operation and maintenance is estimated to be $1,796,290.

Impacts of the Rehabilitation

Impacts of the rehabilitation projects have been broken down into several categories, including net water savings, water management, energy demand, socioeconomic, transfer of net water saving, wetlands, water quality and environmental.

Average estimated net water savings are estimated to be nearly 60,000 acre-feet upon completion of the whole rehabilitation program. The operational efficiencies will increase from 59% to 71%. It is estimated that the enclosed conduit system on the pump and gravity laterals will save an average of 20,798 acre-feet annually; the main canal automation 13,866 acre-feet annually; and

the three reregulation reservoirs together will save 25,300 acre-feet annually. Two of these reservoirs are already installed but full potential net water savings will not be realized until all features are completed.

Irrigation Water Management between the farmer and the District will not change from the farmer's perspective nor will the process that exists between Roza Irrigation District and the Bureau. The changes will most likely be in the manner that the watermaster and assistant watermasters manage the water. It is most likely that gage readings, automated check structures on the project as well as the status of the reregulation reservoirs will all be remotely sensed and information will be sent to the office. Remote control of key facilities will also be a key to the new management of the water.

It is estimated that there will be changes in energy demand. It is felt that the decrease in demand for on farm pumping will balance the increase in power demand by the District. Roza Irrigation District will however experience an increase in demand for power. It is assumed that the power costs to operate the three reregulation reservoirs will average $15,250 annually. The canal automation and telemetry is estimated to cost $1,600 annually.

The socioeconomic impacts of the rehabilitation are summarized by comparing the leveled cost per acre-foot at $182 with the Wymer Dam and reservoir. Wymer Dam and Reservoir is another project in the Yakima Basin that is comparable in size and net water savings. The Wymer Dam and Reservoir's leveled cost per acre-foot is $216.59. The employment impact analysis estimates a total of 1,784 man-years of labor will be generated by the projects over the 35-year construction period. Using a multiplier the jobs created in the area will range from 14 to 68. Average additional income generated by the project will be $3.8 million dollars annually in 1992 dollars.

Impacts of transferring net water savings to other users are not discussed as the Yakima basin is in adjudication. There are many decisions yet to be made during this case that may potentially change the District's use of water from the current use. The District is not in the position to discuss transfer of net water savings until it is known where it stands after the case is completed. The district expects to be able to discuss water savings issue by the time YRBWEP funding contract negotiations come up.

The majority of wetlands on the District have been created from the application of irrigation water and to some degree the seepage of conveyance and distribution facilities. The area, which is now Roza Irrigation District, was once desert and sagebrush with possibly some growth in the natural drains closer to the Yakima River that supported the large drainages such as Sulphur Creek.

The wetlands present today are created by a number of water sources. Only some of the sources are directly related to District operation. The lands on which these wetlands exist belong to the farmers. There are many other factors besides quantity of water that affects the wetlands.

Water quality in the Yakima River Basin decreases as water moves from the upper reaches to the lower reaches of the river. Some of the main contributions to the poor water quality are the return flows from agriculture, which introduce high levels of sediment to the water. The rehabilitation projects will decrease the return flow in the basin and encourage the implementation of best management practices.

Environmental impacts are discussed in an environmental review and were addressed through a formal SEPA process. A declaration of non-significance was filed. Each construction project will go through a formal SEPA process when funds for the specific project are applied.

Financial Planning

A budget is projected out to the year of 2017 incorporating the rehabilitation projects. Currently, the district is seeking funding options to replace the amounts received in past years through Referendum 38 Funds. This year, the modernization program will be funded by water user assessments. The Roza Irrigation District has been constructing these projects with a "pay as you go" philosophy. The Yakima River Basin Water Enhancement Project is being contemplated as the funding source for the reregulation reservoir at Wasteway #5.

The Roza Irrigation District is committed to the Comprehensive Water Conservation Plan, realizing that it broadly describes the direction of the District. Details will change over time but the broad direction and principles incorporated in this plan have been committed to as the direction of the District. It is often hard to commit to such long-term improvements, but to see a real overall change in water conservation and improved water quality people must be prepared to commit in the long term.

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1.1.1 Figure 1.1 is a map of the Roza Irrigation District's location within the Yakima River Basin and Washington State.

1.1.2 Roza Irrigation District is located in Central Washington, along the eastern slopes of the Cascades in the lower Yakima River Basin. Water is supplied to the basin from five storage reservoirs. Only three reservoirs are physically capable of supplying Roza Irrigation District because the location of the diversion dam is upstream of the Naches River confluence with the Yakima River. Lakes Keechelus, Kachess, and Cle Elum are located on the Upper Yakima River between Snoqualmie Pass and Cle Elum. They supply water to Roza Irrigation District as well as other Districts. Rimrock Lake is located on White Pass on the Tieton River, which flows to the Naches River, which in turn flows into the Yakima. Bumping Lake is the fifth reservoir and is located on a tributary of the Naches River. Irrigation water is diverted from the Yakima River in the Ellensburg Canyon at the Roza Diversion Dam. The Roza Main Canal is 94.8 miles long and ends east of Benton City. The District assesses and irrigates approximately 72,500 acres lying along the northern rim of the lower Yakima River Basin. The main crops are orchard fruit, grapes both wine and juice, hops, mint, asparagus and grain crops.

1.2 Statutory Basis of Roza Irrigation District's Organization and Operation

The Board of Directors establishes policy and formulates rules and regulations for operation of the District, as authorized and required under Title 87, Revised Code of Washington, and in accordance with the District's Federal Repayment Contract of which Reclamation Law is an integral part.

Title 87, Revised Code of Washington, is the statutory basis for the organization and operation of Roza Irrigation District. This State Law covers irrigation districts in general, director divisions, delinquent assessments, refunding bonds (1923 and 1929 acts), certification of bonds, revenue bonds for water, power, drains, sewage, etc., indemnity to state on land settlement contracts, dissolution of districts with or with out bonds and insolvent districts, adjustment of irrigation, diking and drainage district indebtedness, districts under contract with United States, association of irrigation districts, joint control of irrigation districts and irrigation and rehabilitation districts.

The Federal Repayment Contract between the United States of America and the Roza Irrigation District describes many organizational and operational characteristics of the District. The following is a listing of some items spelled out in this contract: Scope and term of amendatory contract, works built or to be built by the United States, District's construction charge obligation, establishment of irrigation blocks, determination of basic annual installments, power plant and power rates, storage and delivery of water by the United States, proration among contracting parties, protection of water supply, irrigable area of the District, interim operation of the

project works in keeping with Federal Reclamation Laws, transferred works, operation and maintenance of reserved works, keeping transferred works in repair, title of transferred works, operation and maintenance charge levies and assessments, reserve funds, default, computation of costs, refusal to deliver water in case of default, penalty for delinquency in payment, all benefits conditioned upon payment, lands for which water is furnished, limitations on area, United States not liable for water shortages or interruptions, waste, seepage and return flow waters, inspection of transferred works, use of project facilities for miscellaneous purposes, books, records, reports, crop returns and census, overhead, inspection, and repair charges to be paid by the District, employment of manager, performance of work with contributed funds, right-of-way, termination of recordable contracts, confirmation of contract, changes in District organization, public lands subject to assessment, regulations and determination against employees or applicants for employment prohibited, contingent on appropriations or allotment of funds, assessments prohibited, officials not to benefit.

1.3 History of Development

The following is a history of Roza Irrigation District as found in the references, C. R. Lentz Review-1974, and the Roza Irrigation Handbook.

1865. An act of Territorial Legislation created Yakima County, which was then comprised of Kittitas, Yakima, Benton and Klickitat counties.

February 4,1886. The Washington Territory Act discussed regulation of irrigation and water rights in Yakima and Kittitas Counties.

1889. Washington officially achieved statehood.

1909-1933. Six reservoirs were built on the Yakima River Basin.

1905. Benton County was officially formed.

March 4,1904. Power of eminent domain for irrigation districts was granted.

1882 & 1906. Fires in Yakima Courthouse destroyed records.

The Roza Irrigation District was originally included in the area broadly covered by the "High Line" proposal. In 1912 Christian Anderson made surveys for the "High Line." The "High Line" proposal contemplated a diversion near Easton and the irrigation of the Kittitas, Moxee, Roza and Kennewick Divisions as well as some 140,000 acres between the North Slope of the Rattlesnake Hills and the Columbia River. This scheme was found infeasible due to the limited water supply above Easton, prohibiting costs and contemplated construction difficulties.

Also, in 1912 the Northern Pacific Railway Company had H.R. King survey the possibility of diverting Yakima River water north of Selah near the mouth of Roza Creek to serve lands presently under the Roza and Kennewick Districts as well as an additional 100,000 acres by pumping to the northside of the Rattlesnake Hills.

1910-1923. Most of the surface return flows into the Yakima River are discharges from constructed drains located principally in the Moxee, Sunnyside and Yakima Indian Reservation areas. The major surface and subsurface drainage works for Moxee and Sunnyside Districts were constructed in the period 1910 to 1923, financed for the most part through County Drainage Improvement Districts. Extensive drains were constructed on the Wapato Project within the Yakima Indian Reservation, as part of the irrigation system, which involves substantial reuse of irrigation water within the Wapato Project Boundaries.

1917. Surveys were made by the Reclamation Service, under direction of Mr. C. E. Crownover, to determine the most feasible plan for development of the lands that could be irrigated by water from the Yakima River and its tributaries. Ferd Bonsted, on behalf of the Reclamation Service, laid out a line diverting from the Tieton and Naches Rivers a short distance above their confluence with the Yakima River and serving some 120,000 acres in the Roza Wenas and Moxee areas. These studies were first carried out at the expense of the Reclamation Service and later under contracts with the Kennewick, Moxee and Roza Divisions.

March 1919. A Board of Engineers decided to divide the "Highline" scheme into the Kennewick, Moxee, Roza and Kittitas Divisions and to have future studies made on each division separately.

March 8,1920. A petition was filed with the Yakima County Commissioners to establish the "Yakima-Benton Irrigation District" (now the Roza Irrigation District) comprising some 45,000 acres of land in the Roza Division.

April 16, 1920. After an election was held relative to the proposed Board of Directors, the Yakima County Commissioners declared the District "organized". They declared H. Lloyd Miller, Ross Morris and A. D. Patterson a duly elected Board of Directors.

July 6,1920. A contract was entered into by the Yakima-Benton Irrigation District with the U.S. Reclamation Service for further investigation and report on the Roza Division. The district provided $15,000 for further investigation.

July 8,1921. Storage contract with the U.S. Reclamation Service for 285,000 acre feet of water was executed. U.S.B.R. investigation revealed that some 72,000 acres could the district serve best, by pumping above the gravity system. The U.S.B.R. further recommended the district be enlarged to serve all the lands contemplated. The district furnished additional funds for further studies, not to exceed $40,000.

1922. The investigation report that was started in 1920 was completed. It included a plan essentially as presently developed.
1926. Soil Surveys and land classifications were made by A.T. Strahorn, USDA A complete set of 1"=400' scale section maps with contours and land classification data were made and are on file in the Yakima Office.

April 15, 1935. The previous storage contract was supplemented to provide for 375,000 acre feet of water for the district. Water to be provided from storage and natural flow for a cost of approximately $2,500,000. Payment

of the 2.5 million dollars to be in 80 semi-annual installments, beginning with the June 15 payment following the first season in which water was available for diversion by the district. These contracts are in effect at this time and payments are incorporated into the July 22, 1953 repayment contract.

Although the Roza Division was part of the "Ten Year Irrigation Plan" provided by the Department of Interior in 1927, construction had been delayed for lack of funding.

September 18, 1935. U.S. President Franklin D. Roosevelt approved an allotment of $5 million (later reduced to $4 million) from the Emergency Relief Funds to begin construction of the Roza Dam and irrigation distribution system.

December 13, 1935. A contract with the U.S.B.R. to construct the irrigation distribution system was executed after the landowners, by vote on November 9, agreed to assume the obligation to repay some $15 million in construction costs.

January 9, 1936. A contract for construction of Tunnels # 1, 2, and 3 was awarded to Morrison-Knudsen Company of Boise, Idaho. The company started excavation of Tunnel #3 on February 6. On June 19 excavators uncovered the fossilized remains of a mastodon during tunnel excavation.

November 2, 1938. The Yakima-Benton Irrigation District changed its name to the Roza Irrigation District. Also a boundary change was made, increasing the district's size from 45,000 to 72,500 acres.

December 1939. Tunnels #1 and #3 where completed. Tunnel #2 was not constructed due to a change in the design. First water ran in the upper section of the main canal for test purposes.

1941. Block #1 received water for irrigation of crops.

November 16, 1942. The War Production Board stopped all construction except that necessary to place 6,100 acres under water for the 1943 season.

1943-51. Construction proceeded as funds and materials were available completing an average of 8000 acres per year. Most of the construction was completed by 1950; the U.S.B.R. operated the distribution system for the district, at the district's expense, through 1960.

July 22, 1953. Amendatory Repayment Contract. RID signed a contract that supersedes all of the previous contracts. It restates the 375,000 acre-feet water supply and monthly scheduling for period April through October and provides for proration in short water supply years.

1958-62. A $600,000 Roza-Sunnyside Outlet Drain System was constructed involving drain channel rehabilitation and new surface and pipe drain systems discharging usually into existing county drains. Portions of the latter were quit claimed from the County to the United States, with operation and maintenance performed by the Sunnyside Valley Irrigation District on behalf of the Sunnyside and Roza Divisions.

January 1, 1961. The U.S.B.R. turned over the operation of the distribution system, except the dam, power canal and power plant, to the district. The district Board of Directors retained Mr. Van E. Nutley, P.E. in July 1960 as the manager prior to the district assuming operations of the system. A good number of the U.S.B.R. personnel switched to district employment, assisting in a smooth transition.

1961. Outlet drainage programs started.

1973. The first union contract was signed with Laborers #614. The ditch riders were relieved of the responsibility of living in district houses. The district started furnishing transportation to ditch riders in lieu of mileage.

1977. This year proved to be one of the most eventful in the history of the Roza. Early predictions by the U.S.B.R. of only 6% of normal water supply for the Roza Division prompted many immediate actions by both the Roza District and individual farmers. Many farmers of permanent crops faced total ruin if adequate water supplies could not be obtained. Deep, expensive wells were drilled, pumps installed on drains, and additional lands were leased purely for the water they may receive. Over 14,000 acres were left idle and another 1,000 acres was dry cropped to make more water available to the permanent crops. Wheat and barley were substituted for higher water use crops such as sugar beets and potatoes. Reallocations of water by the U.S.B.R. eventually brought the Roza Irrigation District up to 70% of normal supply, but for most farmers it came too late. Investments in other water sources had already been made.

Availability of State and Federal grants and low interest loans were used by many landowners to help defray some of the over-whelming costs of these projects. Local improvement districts were also established by the Roza to help utilize some of the available funds. The Roza Irrigation District also attempted to construct emergency pumping facilities from the Columbia River. However, financing of this project could not be acquired in time to construct the necessary facilities for the 1977 irrigation season.

1980. In response to a petition, by landowners, a special election was held February 26, 1980 regarding the matter of increasing the Board from three to five members. The majority vote was affirmative and the Board membership was increased from three to five Directors. By order of the Yakima County Commissioners, the district was divided into five director divisions on April 15, 1980.

1984. Board of Directors officially adopted a long-term rehabilitation program of district conveyance facilities with a targeted completion date of approximately 20 years. Various elements of the program will be constructed each year using district forces.

1988. The first of three proposed re-regulation reservoirs was constructed at Wasteway 6.

1992-1994. Three consecutive years of drought. Supply was 58%, 67% and 37% respectively. This was the worst drought in the history of the Roza.

1994. A reregulation reservoir was constructed at Wasteway 7.

1.4 Management and Administration

Refer to Figure 1.2 for the Roza Irrigation Districts Organizational Chart. There are approximately 1700 landowners on the District. They are represented by a board of 5 directors who each represent a division. Directors for the district are elected for three-year terms by the electors of the Division in which they have title or evidence of title to land. A person having title or evidence of title to land in more than one division is an elector of the Division, in which they hold land nearest their residence. Additionally, to be an elector, a person must be eighteen years of age, a resident of Washington State and a United States Citizen. Directors must be electors of their Division and otherwise qualified in accordance with State Law.

2.0 LAND BASE AND LAND USE AND GROUND WATER DEVELOPMENT

2.1 General Layout Map

2.1 Base Map. There is a separate set of maps (scale 1:1000) included with the comprehensive plan. The base map has been reproduced from a blueline reproducible aerial photograph. The operations map has been reproduced on vellum to overlay on the aerials. Included on the map is a legend that will help identify the different features of the District's water delivery facilities.

2.2 Service Area. Reduced copies of the operations map are given in **Appendix IV.** The operations map is updated annually. It shows the acreage eligible to receive water.

TABLE 2.1 Break Down of Land within Roza District Boundary.

Category 1: Land with out a surface water right **(Not Assessed)**	
Non Classified land within the district	500
Non irrigable land	13,500
Right of ways on Main Canals and Lateral	4,000
Well water rights within the RID boundaries (WDOE, Yakima Office, 2-20-90)	6,000
Land Classified as irrigable but not given water right	2,000
Category 2: Land that is irrigable, has a water right **(Assessed)** and is irrigated but produces no marketable crop, using 1990 as an example.	
Urban and Suburban lands	500
Farmsteads, roads, ditches, drains	3,000
Cropland unharvested and soil building	6,000
Fallow land	3,500
---TOTAL FOR OTHER USES	39,000

Note: All the figures in **Table 2.1** have been rounded to the nearest 500 acres. Land Classified as irrigable but not given a water right can change if the Roza Irrigation District Board of Directors agree upon it, to the extent that the total acreage issued water rights within the Roza Irrigation District cannot be less than 71,000 and more than 73,000 acres. Land in categories 1 and 2 will vary from year to year and make up the difference between the acreage in crops and the total acreage given a water right.

General Geology in the Roza Irrigation District. The Roza Irrigation District has been divided into six areas of similar geology (see Figure 2.1.). The similarity in soils and geology means that similar types of problems occur in maintenance and operation of the system in these areas. The areas are as follows:

2.2.1 AREA ONE. Area one consists of the land irrigated by pumps 1,2 and 3 and all gravity laterals below these pumplands. Pump 1 lands have shallow soils, underlain with fractured and jointed basalt. Pumps 2 and 3 have caliche type soils and gravels with some basalt. This whole area has no moisture retention ability. There are lots of leaks from open ditches in this area.

2.2.2 AREA TWO. Area two consists of pumps 4, 5, 6, and 7 and the gravity laterals that are below these pumplands. Pumps 5 and 6 have only about a half mile each of open ditch on them. This area varies between clays to more silty types of soil. The better soils exist below the main canal. Here the soils are deeper and have better moisture holding ability.

2.2.3 AREA THREE. Area three consists of pumps 8, 9, 9A, and 10 and the gravity laterals below. Pump 10 area is quite gravelly. In this area the geology returns to gravels and some basalt. This area, especially pump 8 and 10, are bad for leaks. The gravity laterals in this area are low maintenance as they are mostly all in the enclosed conduit system.

2.2.4 AREA FOUR. Area four consists of pump 12 and the west branch of pump 13 and the east branch of pump 13 with Griffin Road being the most easterly boundary for the pumplands. This area is underlain primarily by basalt. Seepage problems are bad here. All the old gravity laterals are shallow and exposed at times. They often have splits and require a lot of maintenance.

2.2.5 AREA FIVE. Area Five consists of the east branch of pump 13 from Griffin Road and pump 14 and 15 with Griffin Road being the most westerly boundary for the pumplands. The gravity laterals are divided by pump 13. Here the soils are deep and sandy. All the old gravity laterals are shallow and sometimes exposed. The old water boxes have often been raised and all leak badly.

2.2.6 AREA SIX. Area six consists of pump 16 and 17 and the gravity laterals that lie below it traveling as far west as the District Line Road. This area has shallow sandy soils that overlie basalt. There are basalt outcrops visible in some areas.

2.3 Agricultural Use. **Table 2.2** shows the percentage of acres of crops in marketed production for each of the six years (1985-1990). These acreage percentages are only those which produced a marketable crop. It does not include permanent crops not yet in production, any weather damaged crops that cannot be harvested, fallow ground and other situations which land is irrigated yet not presently producing marketable produce. The ditch riders and landowners made the acreage estimates. Total acreage within Roza Irrigation District boundary is 98,500 according to Yakima Project - Roza Division Summary of Land Appraisal 1937.

TABLE 2.2 Roza Irrigation District
Current Distribution of Crops

CROP	DISTRIBUTION (percent)
Orchards	42
Vineyards	17
Hops	12
All other	29
TOTAL AREA CROPPED	100

2.4 Future Land Uses. The forecasts of state and county population indicate that Yakima County projected population growth is approximately 1.25% per year for 1980-2000. Benton County is projected at approximately 0.75% per year during the same time period. (O.F.M., 1986)

The 1990 Population Trends for Washington State provide a projected change in population by land area for cities and towns. Roza Irrigation District boundaries at the present do not coincide with any city or town boundaries but does border close to several listed in **Table 2.3.**

TABLE 2.3 1980-90 Area Annexed by Cities Close to Roza District Boundaries (O.F.M., 1986).

CITY	AREA ANNEXED 1980-90 (square miles)
Selah	0.416
Yakima (includes Terrace Heights)	1.150
Zillah	0.259

The Yakima County Comprehensive Plan was adopted in 1977. A summary of the plan states one of the goals is to preserve the county's agricultural lands. This was to be accomplished by "instituting large acreage zoning in agricultural areas with lot sizes to be determined by the average farm size in each area..."
The plan also "provides areas for part-time farmers and rural residential use on city fringes and discourage commercial development in agricultural areas".

The Benton County Comprehensive Land Use Plan was adopted in 1985. It is more in depth than the Yakima County Plan and provides more information relating to land use. Their policies for agricultural lands are: (1) That areas designated "exclusive agriculture" on the plan map shall be preserved to the maximum extent possible and protected from the encroachment of incompatible uses. (2) That areas designated "general agriculture" on the plan map shall be preserved to the extent practical until such time that demand for high density residential or other uses is established to warrant the change. (3) In the event of a conflict between residential uses and the

normal agricultural activities of a preexistent agricultural use, County support shall be in favor of the agricultural use to the extent practicable. Roza Irrigation District is all zoned "exclusive agriculture".

Law, under the Growth Management Act, requires all the counties within Washington State to complete an updated comprehensive plan that covers specific areas of which agriculture is one. Roza Irrigation District has been in contact with the Yakima and Benton County Planners and will be involved with the process to develop these Comprehensive plans. The process is only beginning and is planned to be completed some time within 3-4 years. Roza Irrigation District will use the existing comprehensive plans from Yakima and Benton Counties, as well as any new information as it is known, to develop the District's Comprehensive Plan. It should be noted that the majority of Roza Irrigation District is within Yakima County in which the least amount of relevant information exists.

2.5 Groundwater development

Groundwater development on the Roza Irrigation District is spread throughout and it is not a part of the supply managed under district control. There are numerous wells, used for a variety of functions including irrigation, domestic, and industrial. **Table 2.4** shows a listing of the number of wells in the various townships excluding the East Selah/Pomona area. Those data are not available at this time. The data were excerpted from a map compiled by the Washington State Department of Ecology (DOE), entitled "Wells with Associated Water Right Documents Located within the Boundary of the Roza Irrigation District". The map, hydrographs of select wells, and a generalized stratigraphic column **Fig.2.2** were obtained from the DOE. It would appear that the wells are primarily tapping the top two aquifers, the Ellensburg Formation consisting of alluvium, and the Saddle Mountain Formation, a basalt flow. **Figures 2.3 and 2.4** are hydrographs of select wells within the district. The hydrographs for the Ellensburg Formation show a drawdown during the drought years of 1992-4 and a subsequent full recovery for the displayed wells within the Ellensburg Formation. Those for the Saddle Mountain Formation show a drawdown effect extending from the drought period through 1995 with recovery beginning in 1996.

To the best of our knowledge, there are no data quantifying the volumes of water withdrawn. From observation of drought conditions, it can be deduced that groundwater was extensively and intensively used, without which many growers would not have survived the three year drought of 1992-4, especially 1994.

By deductive reasoning one can conclude that the heaviest draft of groundwater would be for irrigation, in those years when it is pumped, and that it dwarfs the withdrawal for other uses. In years when the surface water supply is adequate, there is little, if any, pumpage to meet irrigation demand, because of pumping costs.

TABLE 2.4 DATA EXTRACTED FROM A MAP ENTITLED "WELLS WITH ASSOCIATED WATER RIGHT DOCUMENTS LOCATED WITHIN THE ROZA IRRIGATION DISTRICT

TOWNSHIP	NUMBER OF WELLS
T13NR19E	34
T13NR20E	17
T12NR19E	6
T12NR20E	83
T11NR20E	72
T11NR21E	82
T11NR22E	22
T11NR23E	3
T10NR22E	9
T10NR23E	60
T10NR24E	9
T10NR26E	11
T 9NR24E	47
T 9NR25E	47
T 9NR26E	14

3.0 WATER SUPPLY, USE AND RIGHTS

3.1 Water Supply and Rights

3.1.1 Sources of Water Supply and Associated Rights/Claims. The 1945 Consent Decree (Article 17) states that "the United States shall continue to divert available flood water from the Yakima River and its tributaries in accordance with its practice prior to the entry of this judgement, and the quantities of such water which the parties to this judgement are entitled to receive shall be over and above the schedules of diversions herein above set forth". Hydrographic records indicate that Roza Irrigation District has consistently made flood water diversions in March, and has also diverted flood waters in excess of monthly contract schedules, in the contract period up to the date of storage control. This date varies and is announced annually by the United States Bureau of Reclamation (commonly about June 25).

STATE OF WASHINGTON WATER FILINGS. The chronology of water filings by the United States on behalf of the Roza Irrigation District is as follows:

- All United States claims administered by the Bureau of Reclamation on the Yakima Project which are covered by certificate or permit are based on the Act of March 4, 1905, and have priority date of May 10, 1905. These include the following:
- Permit No. 1727 amended, Application No. 3203. The original permit was dated June 22, 1931 for 1,150 cfs and amended to 2,200 cfs on August 14, 1931. Diversion was at present site of Roza Dam; purpose was irrigation, domestic, and power for irrigation pumping and commercial use to serve 75,000 acres. Application filed October 16, 1930; recorded in Supervisor's office, Book 7 of Permits, page 1727.

- Permit No. 1762, Application No. 3205. This permit pertained to the "Moxee Valley Power Canal", permit approved August 14, 1931. The plan included a 3,000 cfs diversion for power purposes from Yakima River in the NW1/4 of Section 7-13-19 (Below confluence of Naches and Yakima Rivers). This plan was later abandoned.

- Application No. 3206, no permit issued. This application filed October 16,1930 for the "Moxee Division" proposed a 490 cfs diversion from Tieton River in the NW1/4 NE1/4 of Section 9-14-16 (3 miles above confluence with Naches River) for irrigation and power purposes. This plan was later abandoned.

- Certificate of Surface Water Right. This certificate issued by the State of Washington Supervisor of Water Resources on May 22, 1961 No. 1727, with a priority date of May 10, 1905. Besides the recording on May 22, 1961 in Certificate, Volume 17, Page 8122 of the State records, the Certificate is also filed in the record of Kittitas, Yakima and Benton Counties. (Filed in Yakima County May 26, 1961, Volume 616, page 464)

The certificate notes point of diversion from Yakima River at Present Roza Dam Site (NE1/4NE1/4 Section 32-15-19); limited to 2,200 cfs diversion for irrigation, domestic supply and power generation; irrigation use is limited to 393,000 AF per year at maximum flow of 1,193 cfs to serve 72,600 acres within the Roza Division. The Proof of Appropriation related to Permit

1727 states that water is used "all year for power; April through October for irrigation". Amended Permit No.1727 has a notation that irrigation use shall be "during irrigation season" rather than April 1 to October 31 inclusive. (Amended May 8, 1961 G.F.). This has been interpreted by both Bureau of Reclamation and Department of Ecology personnel to include diversion in March, and any periods if for irrigation purposes. (Refer to June 28, 1973 file memo by Water Rights Specialist, Subject: Meeting with Glenn Fiedler, State of Washington Department of Ecology, re: Water Registration Procedures.) **Figure 3.1** is a copy of the Certificate of Water Right.

The Roza Irrigation District's water supply is adequately covered by the State Certificate and contract of July 22, 1953 with the United States and no further water right claim registration is needed on behalf of this District. In years of low water supply, when proration is necessary, the RID may receive an inadequate supply, based on present water rights. In no case is power generation permitted at Roza Powerplant through use of storage contract water and priority natural flow rights if such use is adverse to the irrigation users interest. Power generation is an incidental project benefit from water released for other project purposes. **Appendix V** is a copy of the portion of the contract discussing storage and delivery of water by the United States.

OTHER COMMENTARY. February 10, 1940, agreement by United States-Terrace Heights Irrigation District and Roza Irrigation District provides for carriage of Terrace Heights water in Roza Canal; states monthly schedule of water claimed by Terrace Heights at headworks of Selah-Moxee Canal and at delivery points out of Roza Canal-- the latter being 10% less than at Selah-Moxee headworks; also refers to June 4, 1930, contract between Terrace Heights and Selah-Moxee regarding carriage of former's water in latter's canal.

Roza Division Surface Water Right Certificate, issued May 22, 1961, provides for 393,000 acre feet for irrigation of 72,000 acres. Inasmuch as the USBR contract quantity is 375,000-acre feet for the period April 1 through October 20 this provides 18,000-acre feet of March water for priming and startup.

Roza Power Plant was constructed and is operated by the Bureau of Reclamation. It is located in Terrace Heights area, two miles northeast of Yakima; water is delivered at Mile 10.9 from Roza Main canal, 2,100 cfs capacity; one 11,250 kW generator serves 18 Roza Irrigation District electric pumping plants; surplus power is fed into BPA system. The first commercial power at this plant was generated in August 1958. The power plant is capable of using up to 1,123 cfs for power water. The water right for power generation is included in Certificate of Surface Water Right issued by State of Washington on May 22, 1961 based on Permit No. 1727. Diversion is limited to 2,200 cfs for irrigation, domestic supply and power generation, with maximum power diversion of 1,123 cfs and with preference to be given to irrigation.
Return flow waters from the Yakima Project which re-enter the Yakima River and have been diverted, returned and diverted again for irrigation purposes under RCW 90.40.020 and the various Bureau of Reclamation contracts, while still within Project boundaries are considered as part of the basic water rights of the project until they leave the boundaries thereof.

Historically, water deliveries have been premised on this statement. Obviously, it is not necessary to register these waters under RCW 90.14.041.

3.1.2 Water Entitlements and Contracts. The following information was taken from the C. R. Lentz Review, Yakima Project Water Rights and Related Data, December 1974. A chronology of contracts pertaining to water rights is listed, State of Washington water filings and other commentary to help explain the steps leading to the present water rights/claims in the Yakima River Basin.

CHRONOLOGY OF CONTRACTS PERTAINING TO WATER RIGHTS. The Roza Irrigation District (prior to February 7, 1939 -Yakima Benton Irrigation District) has negotiated the following contracts with the U.S. Bureau of Reclamation:

- July 8, 1921 - Contract I1r-463 for purchase of 285,000 acre-feet per year of Warren Act Water supply.

- April 15, 1935 - Contract I1r-463 for increasing water supply to a total of 375,000 acre-feet per year.

- December 13, 1935 - Contract I1r-842 for construction of irrigation works to serve 72,000 acres of land.

- July 22, 1953 - Contract 14-06-W-69 supersedes all of the above contracts; restates the 375,000 acre foot water supply and monthly scheduling for period April through October; and provides for proration in short water supply years. **This is the contract the Roza Irrigation District presently operates under.**
The 9.6 cfs maximum flow supply for the Terrace Heights Irrigation District consists of 1,345.2 acre-feet of Warren Act Water and 1,905.3 AF of natural flow for a total of 3,259.5 AF diversion at Roza Dam.

Note: A re-analysis indicated Terrace Heights maximum diversion should be 10.6 cfs consisting of 1,354.2 AF of Warren Act Water and 2,208.1 AF of natural flow for a total of 3,562.3 AF.

Article 7 of the 1945 Consent Decree reiterates the July 8, 1921 and April 15, 1935 contracts and states the water delivery schedule, which conforms to that, specified in the July 22, 1953 contract. These are listed in **Table 3.1.**

TABLE 3.1 CONTRACT ENTITLEMENT FOR ROZA IRRIGATION DISTRICT

April	10%	37,500 AF	630 cfs
May	15%	56,250 AF	915 cfs
June	19%	71,250 AF	1,198 cfs
July	19%	71,250 AF	1,159 cfs
August	19%	71,250 AF	1,159 cfs
September	12%	45,000 AF	756 cfs
October	6%	22,500 AF	366 cfs
Total	**100%**	**375,000 AF**	------

The entire Roza Irrigation District contract is subject to proration in years of water shortage.

3.2 Water Use

3.2.1 Roza Irrigation District Diversions.

Appendix VI is a table that summarizes the total water diverted for irrigation and the water delivered to the farm for years 1942-1995. This was developed from the USBR Monthly Water Distribution Records.

Figure 3.2 is a plot of the data from 1960-95 less water short years (1973, 1977, 1979, 1987, 1992, 1993, and 1994). The lines of best fit were calculated and demonstrate the acre-feet of water diverted and delivered to the farm are both decreasing. Note however the R^2 values are only 0.46 for delivered to farm and 0.28 for diverted from stream. Therefore the figures do not demonstrate a strong linear relationship. However as a trend we can say that it appears the water diverted from stream and delivered to farms has been slowly decreasing over the years. In time we should see that the water diverted from stream is decreasing at a greater rate than water delivered to farm. This will result from the increases in delivery efficiency due to rehabilitation of the system. The reason this phenomena has not already dramatically appeared when the quantities of water are plotted, is that the rehabilitation components all work together to conserve water. Enclosing laterals alone will help some, but as the farmers are given the ability to shut off when they want, the District must then be able to handle fluctuations in the main canal via reregulation reservoirs and automation. A projection of how the plot may look when all construction is complete is given in **Section III** of the Comprehensive Plan.

3.2.2 Deliveries and Operational Spills. Table 3.2 is a listing of Roza Irrigation District diversions for the period 1970-1995. It is derived from the U.S.B.R. recorded billings. Billing numbers are derived by adjusting recorded flows at 11 Mile for diversions above that point and subtracting Terrace Heights pumping plus 10% conveyance.
Water for Roza Irrigation District, Terrace Heights Irrigation District (THID) and hydroelectric generation is diverted from the Yakima River at the Roza Dam (River Mile 127.9) into the Roza Main Canal which has a design intake capacity of 2,200 cfs. At canal mile 11, a bifurcation diverts water to the Roza Powerplant and water is spilled back into the Yakima River at river mile 113.3. The design capacity of the Roza Canal decreases to 1,300 cfs at canal mile 11. Roza Irrigation District took over the operation and maintenance of the main facilities from the USBR in 1961. The first 11 miles of the Roza Main Canal continue to be operated and maintained by the USBR. Costs for this reach of the canal are allocated between Roza Irrigation District and power revenues. The Roza Power Plant is operated and maintained by USBR. Diversions for hydroelectric generation continue year round unless sufficient flow to generate is unavailable, extreme icing occurs, or the plant is down for maintenance.

Terrace Heights Irrigation District obtains their allotted water from the Roza Main Canal through various head works off the main canal. These appear on the general layout map between mileposts 11 and 15.

Table 3.3 shows three average supply years as found from Table 3.2.

Diverted from Stream is the quantity of water that is diverted from the Yakima River less the quantity used for power generation and distribution to Terrace Heights Irrigation District. Roza Irrigation District has no other source of water input into the system so the **Net Supply 3** the same as Diverted from Stream. The Bureau develops this quantity from actual data measurements and a formula that takes into account all the events in the first 15 miles of canal. The quantity of water **Delivered to laterals** is the amount that is measured over the weir or by flow meter at the turnouts to the laterals. **Main Canal Operational Spill** is the amount of water that is returned to the Yakima River through various wasteways. This water is necessary to run the system and is measured at each wasteway. **Main Canal Loss** is the quantity assumed to be lost in seepage and evaporation on the main canal. This is calculated by subtracting the quantities diverted to laterals and main canal operational spill from net supply.

Lateral Operational Spill is the summation of the measured operational spill water returned to the system via natural drains such as Sulphur Creek or the water finds its way into the ditch or canal that lies downhill of the Roza Main Canal such as the Union Gap ditch or Sunnyside Canal. The lateral operational spill is measured over check boards and weirs at various lateral spillway locations. **Delivered to Farms** is the amount that reaches the farmer. Either a weir blade or a flowmeter measures it. **Lateral Loss** is calculated by subtracting lateral operational spill and the quantity delivered to farmers from the quantity delivered to the lateral.

3.2.3 System Inflow-Outflow. Generally Speaking, return flows in the Basin imply water quantities that have already been diverted for irrigation, municipal or industrial uses, and is again available for reuse for similar or other purposes. Non-consumptive power water diversions into canal systems are also considered in this category. Return flow from surface diversions within the basin is estimated to be 1,290,000 acre feet annually or about 50 percent of surface diversion. (Lentz, 1974)

The principle sources of return flows on the Yakima Project are from surface drains carrying waste water and ground water and from ground water infiltration into the Yakima River with greatest return flow in the area below Sunnyside Dam. In the lower 80 miles of the river nearly the entire summer flow of 1,200-2,000 cfs consists of irrigation return flows.

There are eight main drains returning flow from the left bank of the Yakima River in the area from the Sunnyside Dam to Prosser Dam. Flows total 512 cfs during the winter and 1536 cfs during the irrigation season. The lower portion of **Table 3.4** shows the principle return flows in the Basin.

Roza Irrigation District does experience some return flow to the main canal from the pump lands above the main canal. The return flows are not of large enough magnitude or consistent enough to rely on them for supply further down stream in the system.

The upper portion of **Table 3.4** gives the net outflow from Roza Irrigation District that returns to drains or natural river drainages in cubic feet per second. These numbers were developed using the USBR values for main canal waste and lateral waste for Roza Irrigation District in acre-feet and converting them to a flow. To be more inclusive it is necessary to include

subsurface flow as well. This is reflected in the lower part of the table.

To quantify return flows that would be returning from Roza Irrigation District the average monthly water distribution figures for the past 10 years (less 1987) has been used. It has been estimated that district wide there is an average return flow of approximately 375 cfs during the irrigation season. This figure includes main canal and lateral waste, 75% of the main canal and lateral losses and water that is loss to subsurface flow from on-farm water application, minus 15% for evaporation and evapotranspiration. During the off season the return flows are estimated to average 115 cfs. This was estimated using 25% of the main canal and lateral seepage and subsurface losses from on-farm water application. A preliminary study carried out by R. W. Beck in the Sulfur Creek Basin supports these general calculations.

3.3 Water Quality

3.3.1 WATER QUALITY STANDARDS. Surface water quality standards for Washington State are found in WAC 173-201. Yakima River is classified as a Class A water from the mouth of the River to Cle Elum River (river mile 185.6). From the Cle Elum River to the headwaters it is classified as Class AA. Any surface water that is not classified under this system is given a Class A rating. Sulfur Creek has been classified as Class B. A description of the water quality parameters for the different classes is given in the WAC (**Appendix VII**). "The purpose of this chapter is to establish water quality standards of the state of Washington consistent with public health and public enjoyment there of, and the propagation and protection of fish, shellfish, and wildlife, pursuant to the provisions of chapter 90.48 RCW and the policies and purposes thereof." The Roza Irrigation District main canal is diverted from the Yakima River at RM 127.9. It returns to the Yakima River through wasteways such as Sulphur, Snipes, and/or Corral Creeks and numerous associated drains, which carry irrigation return flow to the Yakima River. It is difficult to isolate solely Roza Irrigation District return flow.

The 1990 Statewide Water Quality Assessment Report (305(B)) (**Appendix VIII**) describes the beneficial use classifications in Washington State. There are two main criteria by which the Yakima River's beneficial use is rated, Water Quality Limited Status and Designated Use.

The lower Yakima River during different periods has a **water quality limited status**. This is because various water quality standards as set out by Chapter 173-201 WAC are not met. Using data from the NAWQA Program Studies, Synoptic Nutrient Study (**Table 3.5**), the turbidity readings at Parker can be used as a background (3.5 NTU). Comparing turbidity further down the river, it should not exceed 8.5 NTU. Looking down the table it is clear that violations of the numeric water quality standards for turbidity exist. Observed historic values of turbidity range from 11 NTU to 26 NTU. The temperature criteria are also violated during the irrigation season.

3.3.2 WATER QUALITY CHANGES AS WATER MOVES THROUGH THE BASIN. Surface water quality in the Yakima Basin becomes progressively worse as the water moves downstream. Water quality in the upper tributary reaches is

excellent but only fair to good in the Lower Yakima Valley. In the lower Basin, below Sunnyside Dam, the water quality degrades rapidly. During the summer most of the flow is diverted at Sunnyside and Wapato Dams. Also downstream turbid, nutrient, and bacterial rich return flows make up a large portion of the river's flow. Return flows from agriculture are the major source of turbidity, nitrogen, phosphorus, and dissolved and suspended solids in the reach. The high temperatures associated with low flows and high turbidity prevent anadromous fish utilization during portions of the summer months. **Appendix X describes** this in detail. Modeling of the Yakima River demonstrates that because of the low gradients in lower river reaches, increasing the flows by large amounts of additional water will not lower temperatures enough to benefit fish. **Appendix XIV** is a copy of the results of a 1990 Water Quality Index Analysis giving the relative severity of water quality deterioration in select drains in the basin.

The USGS in their National Water Quality Assessment (NAWQA) Program studied and compiled all existing water quality data for the Yakima Basin. The report spans several volumes in its entirety, however a nice 15-page summary was also provided. This has been included as **Appendix XI**. This summary describes the historical water-quality conditions in the basin, long-term trends in water quality, and relations of historical conditions and trends with natural and human factors. This helps to give an understanding of the items that impact water quality and degree to which they are impacting. This report is not summarized into the body of this report as it is already condensed and USGS prefer to have people read this information in the format they present it.

The National Water Quality Assessment (NAWQA) program provides a nationally consistent description of current water-quality conditions for a large part of the Nation's water resources, define long-term trends in water quality and identify, describe and explain to the extent possible the major natural and human factors that affect observed water quality conditions and trends. This program monitors the chemical and physical characteristics of water in several locations that are beneficial to Roza Irrigation District as indicators of what is happening within the system. The Yakima Basin was used as an area in which existing data was collected and complied and some sampling done for the program. Roza Irrigation District assumes the Yakima River at Parker to be the background measurement (IE. water quality at the point of diversion). NAWQA provides measurement of Sulphur Creek, Granger Drain and many other drains and points on the Yakima River that are effected by return flows from Roza Irrigation District. **Figures 3.3-3.8** provide a snap shot of conductivity, turbidity, sediments and nutrients as portrayed by charts excerpted from the Yakima River Basin NAWQA Study Report.

The Pacific Northwest Region of the Bureau of Reclamation has a water quality Monitoring Program. The Moxee Drain, Granger Drain and Snipes Creek Drain are monitored through this program. The Yakima Project water quality surveillance is conducted on a continuing basis.

3.3.3 WATER QUALITY AS WATER MOVES THROUGH THE DISTRICT. As water travels through the Roza Irrigation District it also degrades in quality. **Table 3.6** and Figures 3.9 through 3.14 demonstrate the change in concentrations of nitrogen, phosphorus and suspended sediments in the Roza Main Canal. The

degradation of water is due primarily to the return flows from the pumplands above the main canal. As Roza Irrigation District is the highest in elevation in the lower basin, return flows experienced by the main canal are only from the farmers within the Roza Irrigation District. The District maintains a policy that the manager will shut off water whenever water is damaging District property, running unreasonable amounts of silt into the canal or laterals or making District roads or county roads impassable, or adversely affecting another water user.

3.3.4 ANALYSIS OF SEDIMENTATION WITHIN THE SYSTEM. The water in the Yakima River at the point of diversion to the main Roza Canal is very good. As the water travels through the Roza Irrigation District canal, laterals and drains and is returned to the Yakima River the water quality does deteriorate. This is mainly due to the large amount of sediment that is returning to the river. Flood waters in the Yakima River that carry high amounts of sediment in the early season cause lots of sedimentation of the main canal and laterals. This is the major source for sedimentation in the main canal. Roza Irrigation District must dig areas of the main canal and laterals every year to keep the sediment cleaned out. Reports done by the U.S.G.S. help define the quantity of sediment. **Figure 3.5** as extracted from the NAWQA report demonstrates graphically the increase in sediment loading that occurs as water moves down the Yakima Basin.

Sedimentation affects the operations of the Roza Irrigation District delivery system. On a yearly basis portions of the main canal and laterals must be cleaned and sometimes reshaped.
Sedimentation causes other problems as well. WDOE reported on the "Occurrence and Significance of DDT Compounds...Yakima River Basin". WDOE Basic Water Monitoring Program routinely monitored between 1979-84 showed higher levels of DDT and metabolites DDE and DDD in Yakima River fish than anywhere else did in Washington State. Results show that "transport of the organochlorine pesticides DDT and metabolites and dieldrin to the Yakima River occurs primarily during the irrigation season." The actual figures can be compared with CH 173-201 WAC to find the levels are at times over the allowable limits. They recommended, "Ecology should work with the Soil Conservation Service, Soil Conservation Districts, irrigation Districts and farmers to design, fund and implement a plan to reduce soil erosion..."

The Water Quality Protection Needs Evaluation was submitted to the state legislature, January 1987, by WDOE. This report states, "Control of sediment through the use of BMP's would provide the greatest water quality improvement since other sediment-related materials such as pesticides and phosphates, would also be controlled". The report states that approximately 80% of DDT in agricultural runoff is associated with the particulate phase. If erosion were controlled then this would also effectively reduce the levels of DDT in the Yakima River.

On a more general basis the Handbook of Non-Point Pollution discusses sediment problems. It is recognized that sediment from nonpoint sources is the most wide spread pollutant of surface water. The question of "how much suspended sediment is deleterious to surface waters cannot be precisely determined and standards are only available for turbidity". Soil loss is the primary source of sediment. Effects of excessive sediment loading on receiving waters include deterioration in aesthetic values, loss

of storage capacity in reservoirs, and accumulation of bottom deposits, which impose additional oxygen demand and inhibit some advantageous benthic processes.

CH2M-Hill prepared a study called "Agricultural Return Flow Management in the State of Washington", for the Department of Ecology in 1975. This study discussed alternative methods of improving water quality in irrigated agricultural areas. These were identified as; 1) Improve on-farm practices to reduce pollutants added to return flows. 2) Improve distribution efficiencies to allow better use of available supplies. 3) Treat irrigation wastewater prior to discharge.

Roza Irrigation District recognizes the importance of creating an efficient and effective water delivery system to not only decrease the direct contribution to water quality degradation, but also assist the farmer by providing more control of their system. The components of the preferred conservation plan will directly address item two in the above paragraph and also assist addressing item one. Item three would be addressed much later when other conservation and on-farm Best Management Practices are in wide use so as to reduce the quantity of water to be treated.

3.3.5 CHARACTERIZATION. The quality of water received, used, and returned by the Roza Irrigation District has been documented by numerous reports prepared by various agencies. There are data collected from the late 1960's through the present. In the interest of space, only the 1995 data from the DOE water quality surveys is presented in this report. These data shown on Table 3.9 a and b and Figures 3.9 through 3.14 were gathered by DOE as part of their background information in setting up a TMDL policy and are soon to appear in a published report. TMDL signifies Total Maximum Daily Load, which will be used as a management tool to implement water quality improvement in the Yakima Valley. The historic data can be found in the following several reports. This is not an exhaustive list, but does cover water quality sampling for at least 30 years.

Effects of Irrigation and Storage on Water Quality, 2 volumes, U.S. Bureau of Reclamation, November 1975

Status Report on Water Quality Investigations, Yakima River Basin, Washington, prepared for the Bureau of Reclamation by CH2M-Hill, May 1977

1976 Sulphur Creek Study, Agricultural Engineering Department, Washington State University, June 1977

Status of Water Quality in the Yakima River Basin from 1976 to 1979, Water and Power Resources Service, May 1980

National Water Quality Assessment for the Yakima River Basin, several open-file reports by the U.S. Geological Survey, 1991-3

Sulphur Creek Characterization Project, Final Report, South Yakima Conservation District, December 1995

Large amounts of data are available on the Environmental Protection Agency's STORET system characterizing water supply and return flows. The data for the Yakima River at Umtanum, which describes water, diverted into

the Roza Main Canal covers the period 1974 to 1991.

Return flow data are also available, but to isolate return flow attributable only to the Roza lands is a daunting task. Data for the Moxee Drain at Birchfield Road characterizes a mixture of return flows from the Union Gap Irrigation District, the Moxee Ditch Company, the Selah-Moxee Irrigation District, and the Roza Irrigation District. In the lower Yakima Valley, drains from the north side of the river carry a mixture of return flows from the Roza Irrigation District as well as districts in the Sunnyside Division. Since most of the drains have been sampled near their confluence with the Yakima River, analyses of water quality parameters cannot be interpreted to be attributable to any one district.

In the spring of 1997, the Roza/Sunnyside Board of Joint Control hired a Water Quality Specialist to begin a program of monitoring and analyzing return flows to quantify and characterize return flow waters in the joint service area. Data have been gathered fir numerous sites in the Granger Drain area, which has been noted the most critical water quality limited area in the lower valley. Future plans are to monitor flows and to correct water quality abuses through joint efforts. Although sediment-settling ponds have been constructed, it is the intent of the program to encourage and if need be, to enforce water quality compliance via on-farm improvements. Both districts have budgeted for water quality improvements in future years.

4.0 FACILITIES AND OPERATIONS

4.1 Facilities

4.1.1 Facility Map. Roza Irrigation District Operations Map has been provided that shows all of the existing water supply facilities **(Appendix IV)**. A legend of the operations map is provided on the clear overlay to aid in the understanding of the operation map's symbolism. The legend is also included on the following page as **Table 4.1**. As the map is often times crowded with information more specific information about the facilities are summarized in table later in this section of the comprehensive water conservation plan. A small condensed version of the Roza Irrigation District system is shown on Figure 4.1.

The main canal is 94.8 miles long. There are 2,025 acres of right-of-way and 187 miles of main canal roads. There are 63.92 miles of earth, 24.18 miles of concrete lined, 2.00 miles of single side concrete lined, 2100 feet of PVC lined and 5.00 miles of single sided shotrock riprap canal. There are also 4.54 miles of tunnel and 1.8 miles of inverted siphons. The water is regulated in the main canal and at the Yakima River Diversion through radial gates. Below 59.0 mile there are check structures in the main canal, which help control the water surface in the main canal. The majority of these are manually operated flashboard types of checks.

The main canal has 6 wasteways of which 9.72 miles are concrete lined and 14.76 miles are unlined. Wasteway 2 is used regularly in conjunction with the power plant operation. Wasteways 3 and 4 are rarely used. Wasteways 5, 6, and 7 are relied on for the smooth operation of the lower end of the canal where changes made in water deliveries are often more critical to the operation of the whole system. Wasteway 6 reregulation reservoir capacity is 155 ac-ft and Wasteway 7 reregulation reservoir holds about 10 ac-ft.

The distribution system consists of 380 miles of laterals, 1,081 acres of lateral right-of-ways and 250 miles of lateral roads. Approximately 90 miles of the laterals are piped under enclosed conduit systems, 120 miles are low-pressure pipe, and the rest are earthen laterals. There are approximately 2,300 deliveries.

Serving the 27,000 acres of pump lands, there are 18 pumping plants consisting of 57 electric motors and pumps. There are 10.76 miles of discharge tubing and pump lifts range from 100 to 253 feet.

Water surface elevation at the headworks is 1,220.6 feet and the water surface elevation at the end of the canal 94.6-mile is 1,041.9 feet.

Water is measured at each delivery either over a weir blade or through a flow meter. Gates or valves are used to regulate the flow to the deliveries and these remained locked at all times. The farmers usually have their own valves and can shut off if necessary.

4.1.2 On-Farm Facilities. Figure 4.2 indicates that about two-thirds of the district area is covered by sprinkler, drip and/or micro-jet irrigation systems.

4.2 Operations.

The USBR controls the first 11 miles of the project, including the power station and the radial gates at 11 mile. The radial gates at 11 mile regulate the flow of water to the irrigation canal. The power station at 11 mile creates power for use by the 18 Roza Irrigation District pumping plants. Excess energy is picked up and marketed by BPA and distributed over their grid. The Bureau of Reclamation and the Roza Irrigation District jointly maintain the first 11 miles of the main canal and the diversion from the Yakima River. Roza Irrigation District is in charge of all operation and maintenance of the laterals between 0-11 miles. Between 11-15 mile Roza Irrigation District has a joint agreement with Terrace Heights Irrigation District. Roza Irrigation District delivers water to Terrace Heights Irrigation District laterals and operates and maintains the Terrace Heights Irrigation District pumping plant.
All facilities from 11 mile to 94.8 mile are operated and maintained solely by Roza Irrigation District. Roza Irrigation District operates and maintains delivery facilities until the water crosses over the delivery weir blade, through the flow meter or over the weir blade at the lateral wasteway. After this point the responsibility is the landowners. However, upon request Roza Irrigation District will help maintain drains under the following conditions: (1) it is in the best interests of the Roza Irrigation District. (2) Time and funds are available. (3) Adequate right-of-way to perform the work is provided by the landowner. (4) Two or more Roza District landowners contribute return flow to the drain.

Outside District boundaries Roza Irrigation District jointly maintains drains through complex agreements between Roza Irrigation District and Sunnyside Valley Irrigation District and Drainage Improvement District (DID) #11.

The Watermaster controls the overall operation of the irrigation water distribution (See Organizational Chart, **Figure 1.2**). The Roza Irrigation District is divided into 12 beats with a ditchrider assigned to each beat. A ditchrider is responsible for carrying out the changes in deliveries on a daily basis and communicating to the watermaster the changes in water orders. The watermaster records changes in water orders on a daily basis as well as the projected changes for the following day. A 24-hour notice is required when making changes in water deliveries. Changes are carried out as quickly as reasonably possible but Roza Irrigation District reserves the right to take as long as 48 hours if necessary. Also recorded are gage heights at 11.0, 59.0, and 59.1 mile as well as the flows in wasteways 5,6 and 7. Using this information the Watermaster will order a change the main canal control gates, located at 11.0, 59.0 and 84.6 mile to redistribute the water. Changes are also made in main canal check structures to fine-tune this distribution of water. If the changes in demand are larger a change will be phoned up to the USBR so that the gates at 11.0 mile can be appropriately adjusted. A 24 or 48 hour notice is required by the USBR for changes made to the radial gates at 11.0 mile.

Each ditchrider is responsible for patrolling a section of the main canal and all the laterals and pumping plants associated with that section of main canal. (**Table 4.2**)

TABLE 4.2 DITCH RIDERS RESPONSIBILITY FOR LATERALS

BEAT	GRAVITY LATERAL	PUMP LATERAL
1	5.2-26.7	P1, P5, THP
2	14.9, 24.6	P2,P3,P4
3	28.2-37.0	P6
4	37.2-43.5	P7,P8
5	44.2-50.0	P9
6	50.3-57.7	P9A,P10
7	57.9-67.3	P12
8	67.5-73.3,74.0,74.3	
9	64.0, 73.9A	P13,P14
10	74.7-75.5	P15
11	75.7-88.1	P81.5
12	88.5-94.8	P16, P17

The delivery gates or valves are set and then locked. The landowner must place their water orders or changes in water needs with the ditchrider 24 hours before the change, excluding weekends and holidays. The ditch riders are equipped with hand held computers in which they record all the changes on a daily basis as they adjust the gates or valves at the laterals, wasteways and deliveries. These hand held computers are down loaded each night and then up loaded again each morning so each ditchrider has the most up to date information on how much water each parcel has used. It also provides the watermaster with reports on water use, those users who will be out of water in 10 days, water users out of water, users drawing water, readings by beat, water hydrograph, canal flows by beat or between selected mile posts, gage and wasteway reports and Friday main canal turnout readings. This information is directly linked to the accounting system.

There are 6 ditch riders who work from Roza Irrigation District's main office in Sunnyside and 6 who work out of two satellite offices and are overseen by an upper and lower end assistant watermaster.

The following policies and procedures are taken directly from the Roza Irrigation, Handbook as approved by the Board of Directors.

4.2.1 IRRIGATION SEASON. The irrigation season, in accordance to the repayment contract, is from April 1 to October 20. Water for priming is usually turned into the canal on or about March 15.

4.2.2 DELIVERY, PAYMENT AND POOLING OF WATER. Water will not be delivered to a landholding of forty acres or more until the appropriate Reclamation Law reporting/certifying forms are on file with the District. These requirements for these forms to be completed are outlined in the repayment contract between Roza Irrigation District and the United States. The Roza Irrigation District operates on a payment in advance system of collection and no water is delivered after April 1 unless all assessments are paid. There will be a minimum charge for lots less than one acre. Assessment is based on an allotment of water not to exceed three acre feet per acre. Additional water shall be paid for in advance. No water may be transferred to any delivery until all assessments have been paid on the unit where the delivery delivers. On landholdings of forty or more acres, pooling of

water will be allowed only within the landholding, as it is reported/certified under Federal Reclamation Law. On landholdings of forty or more acres, pooling of water will be allowed only within the landholding, provided; all assessments on lands within the landholding are paid by the pool operator or a report/certificate of landholdings is filed with the District. No changes in pooling will be allowed after June 1 without approval by the Board of Directors.

4.2.3 DELIVERY POINTS. The delivery point for all land shall remain as constructed and designated by the Bureau of Reclamation unless released in writing by the landowner, revised by construction at the landowner's expense or as mutually agreed to by the District and landowner when the original delivery system is replaced by a new closed conduit delivery system. Additional delivery structures will be furnished by the landowner except that the District will furnish the delivery hardware. Flowmeters may be substituted for delivery boxes when authorized by District. Roza Irrigation District at the landowner expense will supply Flowmeters and hardware. The District will provide installation of the facility. Weirs will be raised only at the expense of the wateruser and with the permission of the Manager. No water will be pumped directly from District canals, laterals, or boxes above the landowner weir without a license. The owner of subdivided or platted property or small tracts shall provide his own water measurement device and distribution system.

4.2.4 DELIVERY AMOUNT AND WATER RATIONING. Distribution of Water Supply is stated in Article 14 U.S. Repayment Contract. Water will be delivered on demand, modified by the designed capacity of the system and availability of the water. In times of shortage or rationing, whether it is district wide, on a given lateral, pump or pipeline, each landowner will be given his proportionate share of the water available at that specified time and on a continuous flow proportionate basis. Any water rationed will be computed on the basis of current assessed acres. Where a subdivision, or several small tracts of land, receives water from one turnout the water delivery amount will be divided over 200 days and this amount shall run continuously barring trouble in either Roza system or the customer's system. Based on an inherent policy of fairness and equality to all water users, requirements of State Law and the District Repayment Contract, no special consideration can be given to those water users wishing to use irrigation water for frost control. All water deliveries of the District shall be made in accordance with the existing rules and regulations of the District as published in the District Handbook, except as may be amended by subsequent Board Action.

4.2.5 FLOW RESTRICTIONS. Excessively high flows through the flow meters can cause damage to the district delivery systems when those flows are shut off. In order to protect district property, deliveries by flow meter shall be limited to a maximum draw of 15 gallons per minute per assessed acre on any delivery where static pressures exceed 10 p.s.i. Violation of this limitation will result in the installation of a restrictive orifice plate by the district. The cost of installing such an orifice plate will be charged to the landowner and will become a part of the landowner's assessment. The charges for the installation of the orifice plate shall be established by the Board and shall be in the amount to recover all of the district's cost, including, but not limited to materials, labor, supervision, equipment, and overhead. In the event of additional

violations, water delivery to the landowner may be terminated, or at the discretion of the Board, a civil action may be commenced in appropriate superior court to obtain a restraining order to prevent violations of the rules. The district shall be entitled to recover its costs and attorney fees incurred to enforce these rules.

4.2.6 RESPONSIBILITY FOR TAILWATER DISPOSAL. The Manager shuts off water whenever tail water is damaging District property, running unreasonable amounts of silt into the canal or laterals or making District roads or County roads impassable, or adversely affecting another water user. Whenever a water user has lands on both sides of a lateral he must pass his tail water across the lateral at his expense. The above tail water regulations apply equally to canals and laterals of the Roza Irrigation District and to those of adjacent irrigation districts and to the County Roads.

4.2.7 PUMP PLANTS. Pumping plants will be operated whenever the demand exceeds one-third the capacity of a single pump. No Roza Irrigation District pumping plant which has been off for more than 30 minutes will be restored to service between 5:00 PM and 6:00 AM.

4.2.8 LOCKING BOXES. Delivery boxes, turnout gates, and flowmeters will be locked at all times.

4.2.9 FLOODED WEIRS. Every effort is made to secure correct readings at flooded measuring devices, but it is the water user's responsibility for flooding and the user must bear the possible loss of water. Water may be shut off if the water from the flooded weir interferes with lateral operation.

4.2.10 DISTRICT RIGHT-OF-WAY. Farming operations over pipe right-of-way are permitted, providing such operations do not damage or interfere with the routine operations and maintenance of the pipe. Routine repairs and maintenance, whenever possible will be made in cooperation with the landowner, so as not to interfere with his operations. However, the District at all times reserves the right to enter upon said right of ways to make any repairs and/or replacements necessary. If the farming operations damage the pipe, regardless of the amount of cover over said pipe, the landowner is liable for all damages, to include direct and consequential damages, and furthermore, shall be liable for any costs, fees, or disbursements necessary to collect such damages. The following will not be allowed at anytime: fences, bridges and piped crossings across the canal and laterals and access roads, obstructions, including but not limited to buildings, equipment or debris, birds and animals.

4.2.11 CROSS DRAINAGE CHANNELS. Culverts under canals and laterals must not be plugged by leveling or damming channel below so as to interfere with free flow of water in a structure.

4.2.12 OUTLET DRAINS. The district may, at the request of the landowner, clean existing outlet drains, provided: it is in the best interests of RID as a whole, time and funds are available, adequate right-of-way is provided and two or more Roza Irrigation District landowners are contributing surface flow to the drain.

4.2.13 COOPERATIVE PIPING. Whenever it is in the best interest of Roza Irrigation District, time and funds permitting, laterals will be piped by District forces, provided that the landowner shall pay the cost of materials required as determined by RID personnel, and further provided the landowner shall pay 100% of any blasting costs which may be necessary to facilitate said installation.

4.2.14 ORDERING WATER OR DELIVERY CHANGES. Record-a-calls have been placed in the three watermaster's offices for convenience when ordering water or delivery changes. The landowner gives name, lateral, delivery number, amount of water desired and date requested. Normally 24 hours advance notice is required for water orders. Orders received with less than 24 hours will be honored when possible. RID always reserves the right to postpone water delivery orders for 48 hours when necessary. Water is charged on a 24-hour basis. No charge is made for the day the water is turned on, but the day it is shut off is charged. No water delivery changes are made on weekends or holidays. Watermaster is in his office between 7:30 and 8:30 am weekdays, during the irrigation season. Emergency numbers are available 24 hours a day on the record-a-calls.

4.2.15 ORDERING WATER FROM BUREAU OF RECLAMATION. Roza Irrigation District also must follow a procedure for ordering and receiving water from the Bureau of Reclamation. The Bureau of Reclamation requires a minimum of 24 hours notice for changes in water delivery at the head gates (MilePost 11.0 of the Main canal). When cutting flow to the canal, the Bureau can often accommodate the order that day. When adding water to the canal 48 hours is usually needed when the basin is on storage control. In water short years, 48 hours notice is necessary for all changes. If the basin is not on storage control and there is water in the river, increases in flow can often be accommodated the day the order is made. This is covered in more detail in the repayment contract Roza Irrigation District has with the United States.

4.3 Structural Integrity and Maintenance.

The performance of facilities has been summarized on several tables. Each table references the Roza Main Canal Mile Post to locate the facilities. A brief description of each table provided is given below.

4.3.1 MAIN CANAL REACH INFORMATION. Table 4.3 lists each reach of the Roza Main Canal. A reach is defined as a length of canal, which is bounded on the upstream and downstream ends by a flow control structure such as some type of check structure. Some reaches are bounded by section changes where the base width, side slope, longitudinal slope, bed elevation, seepage rate or other hydraulic parameter changes.

The information provided on the Reach Table includes the main canal mile post at the end of the reach, the name or description of the reach, the length of the reach, the maximum design flow, the maximum normal depth, the cross sectional area the maximum velocity, longitudinal slope and the seepage rate for the reach given peak flow conditions. The total seepage rate for the main canal is estimated at 177 cfs when peak flow conditions exist. These were calculated by starting out with a figure for main canal

losses at peak flow. During the peak of the season, 1180 cfs is the maximum water that can be delivered through the gate at 11 mile. When this peak flow is running, 1000 cfs is delivered to laterals and approximately 10 cfs is spilled at wasteways. This leaves a residual figure of 170 cfs as main canal loss. From this figure evaporation, evapotranspiration are calculated to be 10 cfs. Seepage from 11 mile to 94.6 is then 160 cfs. Using ratios of surface areas in each reach to total surface area of either lined and unlined sections and assuming the lined reaches leak slightly more that the unlined reaches a figure for seepage in each reach was calculated. The numbers were extrapolated to the main canal reaches above 11. mile. The total seepage of 177 cfs was then determined. The resulting seepage for reaches were spot-checked in a couple areas where outlets for lining drains could be observed. The figures were also checked against the seepage appendix in the WSU Consumptive Use Manual. **Appendix XII** contains a table of lateral losses and spills based on water operations in 1989.

4.3.2 MAIN CANAL CONTROL STRUCTURES. Two tables are used to define the main canal control structures that presently exist. They are referenced to their Main Canal Mile Post for operational purposes when referring to the operations map. **Table 4.4** gives the name when the check is related to another significant structure, the type of structure, and the installation date, if known. This is updated as structures are added. The maximum design flow, height and width, and number of gates are stated.

Table 4.5 provides further information that was developed subjectively. A rating on the overall physical condition of the check structure is given. A note is made if the structure is modified from original design. Presently only 5 fall into this category but as the main canal is automated many of the existing check structures will be retrofitted. The column titled "date of modification" will be used to record when retrofitting has been done. Stability was determined by looking at the structures and classifying the structure in one or more of the stability categories developed. The Operation and Maintenance notes column is to keep notes of special work to aid with the stability of the canal around these check structures. A date can also be given in this column if known. The amount of use and ease of use categories were developed by the ditch riders, who must work with the checks.

4.3.3 LATERAL INFORMATION. In **Table 4.6**, each of the laterals that deliver water from the main canal is listed numerically, by milepost. The description column is used to further name the lateral such as Pump 2 Left (P2L) or Terrace Heights Pump Lateral (THPL). The number of acres that each lateral delivers water to are listed, as well as an explanation of the type of lateral. Some of the deliveries have zero acres assigned to the lateral, however their delivery remains restricted to their total assessed acres. These are deliveries the farmers pay to have installed because they make the water management easier for the farmer. The farmer is charged for all water used through these deliveries. Laterals can be gravity open, gravity enclosed (Enclosed conduit system) or pumped open. The number of deliveries on each lateral and the maximum design flow for the beginning of the laterals, diameter of turnout and date of installation of the gravity enclosed laterals. Projected dates are given for enclosed conduit projects that Roza Irrigation District has already received funding.

4.3.4 PUMPING PLANTS. Additional information on the pumping plants has been provided. Again the pumping plants are referenced to the milepost as well as the pump number given. The pump information is divided into two parts for some pumping plants, as there is a low and high delivery tube.

Table 4.7 gives the vertical lift and total rated capacity of the pumps for the each discharge tube. A maximum design capacity of the lateral is given. The total motor rating and the number of units are given. So for P1-H there are two motors each 150 hp. The efficiency of the pumping plant is given for the peak demand and the voltages for each plant as well.

Table 4.8 lists the total number of irrigated acres, the length of discharge tube, the elevation of the discharge and which motors are interchangeable with other motors on the project. The Roza Irrigation District has no variable speed motors, so bypasses have been added to all the pumping plants to prevent cavitation problems during low flow. Information is provided that states if the bypass is used and some quantification of its use. On the pumping plants that have both high and low tubes the ability to bypass water from the high tube to the low exists. These are noted as well as how often it is used.

4.3.5 REREGULATION RESERVOIR INFORMATION. Table 4.9 provides information on the two reregulation reservoir that have been completed and one that is planned. The type of structure, the acre feet of storage, date completed or proposed to be built, the acres of surface water, information about the pumping plant, height of dam, crest length and information about the lining are provided. In general the old system presents maintenance and operation problems because it is beginning to show some aging effects. Also, many of the old pipelines have permanent crops grown on top of them. This makes access difficult for repairs. The old weir boxes often leak. The area where the enclosed conduit system has been installed is relatively maintenance free. The pipe routes are along county roads and farm roads as much as possible providing better access for operation and maintenance.

5.0 FUTURE WATER NEEDS

5.1 Forecast Future Trends of Water Use

5.1.1 ACRES OF LAND TO BE IRRIGATED. **Table 5.1** shows a breakdown of the total acres assessed by RID for the years 1980-95.

TABLE 5.1. ASSESSED ACRES FOR ROZA IRRIGATION DISTRICT 1980-95.

	Assessed Acres Paid	Army Contract	Assessed Acre Unpaid	TOTAL ASSESSED ACRES
1980	71,226.91	489	805.60	72,521.51
1981	71,488.37	489	544.14	72,521.51
1982	71,538.65	489	493.06	72,520.71
1983	71,590.21	489	444.60	72,523.81
1984	71,404.87	489	628.64	72,522.51
1985	71,382.18	489	650.03	72,521.21
1986	71,131.76	489	879.85	72,518.61
1987	71,281.24	489	894.77	72,665.01
1988	71,314.45	489	861.56	72,665.01
1989	71,345.20	489	798.21	72,632.41
1990	71,299.50	489	848.21	72,636.71
1991	71,313.72	489	685.49	72,488.71
1992	71,704.03	489	295.18	72,488.21
1993	71,681.65	489	320.06	72,490.71
1994	71,745.43	489	256.18	72,490.61
1995	71,386.01	489	614.80	72,489.81

The assessed acres paid is the total acres that have paid their water assessments by October 31 of that year. The Army Contract is acreage with a special contract to receive water from Roza Irrigation District. The Assessed Acres Unpaid shows acres that the assessment has not been paid before October 31 of that year. There are several reasons for this, which could include bankruptcy or foreclosures. Note that these acres would not be the same acres as there is always some land in these transitory stages but it would not be the same land.

The assessed acreage remains constant as Roza Irrigation District only has the ability to change the assessable acres within the limits of a minimum of 71,000 acres and a maximum of 73,000 acres. The projection for the next 15 years is that these figures may vary some but will for the most part remain constant.

The number of assessed acres represents the number of irrigated acres in the Roza Irrigation District. Under Federal Contract the District can only irrigate the number of acres that are being assessed. This statement is also supported by incomplete review done by the District, comparing acres assessed with acres irrigated.

5.1.2 CROPPING PATTERNS. Historical data of the cropping patterns were used to forecast the future trend of cropping patterns. (USBR, 1960-90)

Cropping patterns within the Roza Irrigation District were plotted for each of the years a crop census was taken (1960-1990). The crop reports only list the acres with crops, which are harvested and marketable. The crop reports do not define new plantings or crops lost due to frost or rain damage. This means that the crop reports do not correctly show the irrigated acres but they do provide an indication on cropping trends within the Roza Irrigation District.

Linear regression was used to project a trend forward ten years. Crops with the largest acreage were used and the rest were classified into "other crops". The final row in the table "Non Cash Crop" is the balance of acres irrigated that no crop was harvested for that year. It is assumed there will not be an effect on water demand from this group of irrigated lands. **Figures 5.1-5.6** show the results of the projections. Orchard, Hops and Grapes have been increasing over the past 30 years. Asparagus, mint and other crops have been constantly decreasing. The accuracy of the linear regression analysis is good with the correlation coefficient (R^2) varying between 0.87-0.95.

These plots demonstrate the trend towards permanent crops such as orchard and grapes. Sugar beets were a high water use crop, which are no longer grown in this area. **Table 5.2** summarizes calculations that were done to numerically demonstrate that these changes in cropping patterns would not impact the total demand for water within the Roza Irrigation District.

TABLE 5.2 ACRES OF LAND AND WATER DEMAND INDICATION FOR CROPS WITHIN ROZA IRRIGATION DISTRICT

	1990 # OF ACRES	1990 WATER DEMAND INDICATOR	2000 # OF ACRES	2000 WATER DEMAND INDICATOR
ORCHARD	21,793	31,164	25,843	36,955
GRAPES	8,755	10,594	12,085	14,623
HOPS	7,327	10,917	8,701	12,946
ASPARAGUS	1,327	2,123	910	1,456
MINT	3,070	5,372	804	1,407
OTHER CROPS	17,500	19,600	10,876	12,181
NON CASH CROP	12,013	-	12,516	-
TOTAL	**71,785**	**79,770**	**71,735**	**79,568**

The Water Demand Indicator figures are derived by multiplying the acres of a crop by a factor. The number has no units and is only used to compare the two years in a relative sense. The factor was developed as follows: **(See Table 5.3)**

1) The consumptive use for each of the crops was determined. (WSU, USDA, SCS, 1985) An average was used for orchards, mint and other miscellaneous crops grouped into the "other" category. The consumptive use for asparagus was assumed to be 80% of orchard. These figures were indexed using apples as 1. This created the "Consumptive Use" portion of the Factor.
2) A percentage was stated that reflects the approximate overall efficiency of water delivered to the plant. This percentage takes into account the differences in type of irrigation system used to apply the

water for example the difference between sprinkler and rill irrigation. (James, 1988)

3) The overall factor was calculated using the following equation; Consumptive Use Factor/Irrigation Efficiency. The Factor was multiplied by the numbers of acres in each category for 1990 and 2000 to show relative changes in total water demand due to changes in cropping patterns.

TABLE 5.3 DEVELOPMENT OF WATER DEMAND INDICATOR FACTOR

	Annual Consumptive Use (inches)	Use Factor	Irrigation Efficiency	Overall Factor
Orchard	41.00	(1)	70%	1.43
Grapes	27.35	(0.67)	55%	1.21
Hops	30.71	(0.74)	50%	1.49
Asparagus	32.80	(0.80)	50%	1.60
Mint	35.93	(0.88)	50%	1.75
Other	25.19	(0.61)	55%	1.12

It can be seen from the original table that the overall effect of the changing crop patterns will have a negligible effect on water demanded by the district. The trend is toward higher water use crops that also use more efficient on-farm irrigation systems. While the systems are more efficient, use of the systems for frost water and cooling water can increase water demand. This relationship creates a situation where the changes in cropping patterns result in approximately the same demand for irrigation water. These figures assume that on farm efficiencies remain constant, which is not necessarily true. Also remember that the Roza Irrigation District has no control over which crops are making money and therefore we have not made any projections on changes due to such phenomena. We have assumed the trend of past years will remain.

5.1.3 CHANGES FROM RURAL TO URBAN USE. The Roza Irrigation District is higher in elevation than other districts within the Yakima River Basin. The effects of change from rural to urban land use do not effect Roza Irrigation District as much as other irrigation districts.

Table 5.4 lists the number of short plats done in Yakima and Benton Counties within Roza Irrigation District for the years 1979-95. In the Yakima County the majority of the short plats were in the Selah, Terrace Heights, and Zillah areas where the District does border closer to cities. Short platting was popular for several years within Roza Irrigation District (1983-86), but more recently it has leveled off. The short plats recently completed affect less than 3% of the irrigable area for service. When the land is short platted, it does not change the zoning of the property. That is an action done by the county separate from the short plat or segregation process.

TABLE 5.4 NUMBER OF SHORT PLATS WITHIN ROZA IRRIGATION DISTRICT 1979-95

	YAKIMA COUNTY	BENTON COUNTY
1979	20	1979-1989
1980	9	TOTAL = 35
1981	8	
1982	12	
1983	12	
1984	21	
1985	25	
1986	12	
1987	16	
1988	14	
1989	7	
1990	11	1
1991	10	3
1992	9	2
1993	12	3
1994	14	5
1995	17	2
Total	229	51

It has been the experience of Roza Irrigation District, that when people short plat that they continue to utilize their water right. Short platting and segregating land zoned as agriculture or exclusively agriculture does not cause the land to revert to and urban classification. Short plat law was changed in 1984 so that the person short platting is required to provide a delivery system to the new parcel of land. This accommodates the use of the water and will not decrease the demand for water with in the district.

Yakima and Benton County Planning information indicate the Roza Irrigation District boundaries remain outside any city boundaries. In the Benton County Comprehensive Plan all land within Roza Irrigation District boundaries is classified as "exclusively agriculture". Due to the zoning policies in the counties, urbanization of the area is not a possibility until zoning laws are changed.

5.2. Estimation of Irrigation Water Requirements

The approach taken to determine the water diversions by month for Roza Irrigation District focuses around several key points.

1) There are no significant changes in acres of land to be irrigated within Roza Irrigation District.
2) The changes in cropping patterns do not significantly increase or decrease the water demanded within Roza Irrigation District.
3) The amount of short platting that is occurring with the Roza Irrigation District Boundaries does not significantly effect the amount of water used to any large extent.

These points are all supported in above discussion. The critical factor

affecting water demand is the increase in efficiency due to enclosing the laterals and making use of the reregulation reservoirs and canal automation. Lining of the main canal as a capital project will be used to maintain the integrity of the main canal and prevent main canal seepage from damaging farmer's crops.

Table 5.5 gives the monthly water distribution as an average of the years 1980-1989 (less 1987 as it was a really short year in which the District shut off in September), for Roza Irrigation District as it presently exists. These averages were developed using the Bureau of Reclamation data (USBR, 1980-89). It should be noted that the averages are calculated from numbers, which vary quite largely at times.

The following definitions will clarify the information in each column of the table. Average Diverted from Stream is the average quantity of water that is diverted from the Yakima River less the average quantity used for power generation and distribution to Terrace Heights Irrigation District. The Bureau develops this quantity from actual data measurements and a formula that takes into account all the events in the first 15 miles of the Roza main canal.

Average efficiency is the percent of the average water diverted for irrigation use that is delivered to farm.

Entitlement is the amount of water for which the District has claimed a right for and has contracted with the Bureau to receive. The contract supply is subject to proration in years of water shortage.

The average quantity of water Delivered to Laterals is the amount that is measured over the weir at the turnouts to the laterals or the sum of the flow meter readings. Average Main Canal Operational Spill is the amount of water that is returned to the Yakima River through various wasteways. This water is necessary to run the system and is measured at each wasteway. Average Main Canal Loss is the quantity assumed to be lost in seepage, evaporation and transpiration on the main canal. This is calculated by subtracting the quantities diverted to laterals and main canal operational spill from net supply.

Average Lateral Operational Spill is the summation of the measured waste water returned to the system via natural drains such as Sulphur Creek or the water that finds its way into the ditch or canal that lies downhill of the Roza Main Canal such as the Union Gap ditch or Sunnyside Canal. The lateral waste is measured over check boards and weirs at various lateral wasteway locations. Average Delivered to Farm is the average amount that reaches the farmer. Either a weir blade or a flowmeter measures it. Average Lateral Loss is calculated by subtracting average lateral operational spill and the average quantity delivered to farmers from the average quantity delivered to the lateral.

This table shows that the average delivered to farm fluctuates around three acre-feet per acre. The average diverted from stream is around 5 acre-feet per acre. The system presently operates at about 59% efficiency. This compares water diverted from stream to water delivered to farm.

5.3 Comparison of Future Water Needs to Water Supply.

Roza Irrigation District has serious water supply problems in water short years when the entitlement is prorated. When prorated the entitlement is reduced from the storage date onwards. Roza Irrigation District is allowed to move some of its water in later months to the month it is presently operating. This amount that is moved however, is very small for fear that a harsher proration will be necessary in later months and Roza Irrigation District will have already over used its prorated amount for that month. This water is "moved" to an earlier month to try to aid the farmer through to the harvest stage of crop. The end result in years of heavy proration is that Roza Irrigation District water is cut off early. In years of lighter proration, water is not moved forward and the water season will last until October 20.

For the period of full operation on the Roza Irrigation District (1950-present), Roza Irrigation District has experienced seven years of harsh proration (1973,1977,1979,1987,1992,1993, and 1994) and an additional year of moderate proration (1988).

The average total yield of the Yakima Basin is about 3.5 million acre feet. The average total irrigation diversion is approximately 2.1 million acre feet. Total storage in the basin is just over a million acre feet. Because of the complex relationship between snow pack, snowmelt, precipitation and storage it is difficult to predict total available water supply.

From the above discussion the following generalizations may be made:

1) Within the next 15 years there is a high probability that Roza Irrigation District will receive 70% or less of entitlement in at least 1 year.

2) Within the next 15 years it is possible Roza Irrigation District could receive less than 50% of entitlement in any one year.

3) If snowpack is moderate or runoff is early there is insufficient Basin storage to meet irrigation demands.

4) With the increased demand for in stream flows, since 1981, to provide fish habitat, these shortages will be even more frequent and greater in magnitude.

5) ESA listings on the basin could make proration a regular occurrence.

Therefore it follows, additional storage and improved system efficiency are required to assure adequate supplies in all years. The Rehabilitation and Betterment Projects that Roza Irrigation District is presently carrying out are designed to reduce the water requirements throughout the entire irrigation season. This will reduce the impact of water short years, which will enhance supplies for both irrigators, in stream flows, and other demands on the water resource.

6.0 IDENTIFICATION AND ASSESSMENT OF WATER CONSERVATION OPPORTUNITIES

6.1 Water Conservation Goals, Objectives and Existing Water Conservation Measures

6.1.1 Goals and Objectives for Water Conservation Program.

The Roza Irrigation District strives to provide equitable delivery to all their water users even in periods of proration. It is the long-term goal to have enclosed conduit service to all customers, on both the gravity and pump lands. Currently, the enclosed conduit system saves water otherwise lost to evaporation and seepage, assures better supply to those not yet on the system, and improves water quality by reducing return flow and sediment runoff.

6.1.2 Past and Current Efforts. Refer to **Tables 6.1, 6.2, and 6.3** for a listing of the conservation work already constructed. About one third of the district is served by enclosed conduit. The largest water savings come from these efforts. Canal lining has some benefits, primarily that of stopping heavy leaks. Reregulation reservoirs can help to attenuate fluctuations imposed by changes made on the enclosed conduit systems. Main canal checks improve service to pump lands by holding pump forebays at a higher and steady elevation. The district plans on continuing with these improvements until all the system is fully piped, and the main canal has adequate check structures. Work is done dependent on the funding and manpower to do the work.

6.1.3 On-Farm Coordination. On-farm conservation is a potentially significant water conservation measure. The District provides an incentive to its farmers to improve their on-farm water management with the construction of the enclosed conduit system, which in some cases provides water under pressure. When enclosed conduit systems are installed, approximately 1/3 of the farmers will be able to sprinkle without any pumping. Another third will only have to use booster pumps. The remaining third will have to provide pressure to deliver water from the system. Other agencies such as Natural Resources Conservation Service, Agricultural Stabilization and Conservation Service, and conservation districts are set up to provide on-farm assistance and advise farmers about on-farm improvements. The Roza Irrigation District works with these agencies in an indirect manner. Another option, which could be considered to increase the service to the farmer, would be to allow water changes to be made on weekends or for periods less than 24 hours. This would be more expensive to implement and there is not enough automation or reregulation in the main canal to compensate for potential increased changes in demand. Key to this operation would be reregulation capability without which fluctuations result in spills. Due to the travel time inherent in the system, more water would be wasted than saved in trying to serve the farmer in this capacity. The Roza Irrigation District does not want to spend time and money on a solution based on present systems deficiencies that is only going to put off the inevitable. The system is getting old and needs to be rehabilitated. By developing an overall plan and organizing the upgrade, time and effort spent will result in a better system that is easier to operate and is more efficient.

6.2 Identification of Potential Water Conservation Measures

6.2.1 Entity System

The following methods of improving the water delivery system have been identified in the rehabilitation plan.

1) Enclosed conduit systems on gravity laterals
2) Enclosed conduit systems on pump laterals
3) Canal automation and main canal gauging
4) Reregulation reservoirs
5) Lining Portions of the Main Canal
6) Off-line storage reservoirs

Conceivably, there are other methods that could be used but the Roza Irrigation District Board feels at this time, they are not cost effective. Already in place, the district has an accounting of water delivery to customers, and charges an escalated rate for water use in excess of 3 AF/acre (see Section 7.1).

6.2.2 On-farm systems. The conservation measures undertaken by the district have been a positive incentive for growers to install more sophisticated on-farm systems. Usually on the heels of conversion from open gravity laterals to enclosed conduit, there will be an upgrade of the on-farm system, not only to sprinklers, but also to drip and micro-jet systems as well. This is noted in Section 4.1.2.

6.3 Proposed Water Conservation Plan

6.3.1 Proposed Measures

6.3.1.1 Enclosed Conduit Systems on Gravity Laterals

The enclosed conduit system replaces old concrete delivery boxes, weir blades and open ditches or low head concrete pipe with PVC pipe and flow meters. The Roza Irrigation District has been enclosing approximately 2000 acres (10 miles of pipe) a year since 1983-84. Of the 45,000 acres that are gravity fed from the main canal, 27,000 acres are presently in enclosed conduit system. The Roza Irrigation District has developed an effective and efficient system for all phases of the enclosed conduit system as all the work has been done by district forces. Cost of conversion from open gravity to enclosed conduit for the remainder of the gravity lands is about $8,100,000.

Benefits derived from the enclosed conduit systems are a reduction of lateral losses to virtually zero, improved measurement and operational flexibility. The flow meter is a much more precise measurement of both flow rate and total volume of water used, so that the farmers have better control of the water. Some flow control is achieved using the two valves on each side of the flow meter, but the system cannot compensate for all possible changes the farmers may make. The enclosed conduit system provides the farmer more flexibility in operation. Reduced maintenance costs for the District and a reduction in liability for the open lateral and the seepage, operational spills and drains are added benefits. On-farm

pumping costs are either eliminated or greatly reduced. Erosion will be minimized due to conversion to sprinkler, drip, and micro-jet systems. Chemical spraying will be reduced along with the long-term operation and maintenance costs.

6.3.1.2. Enclosed Conduit Systems on Pump Laterals

Once Roza Irrigation District has enclosed all of the gravity laterals, then the pump laterals will be enclosed. Enclosing the pump laterals is more difficult because along with laying the pipe and installing flowmeters, it also involves the automation of the pumping plant operation. Each option would be considered in progression to better understand how each progressive step improves efficiency for the plant previously converted.

The options are as follows:

1) Add manual frequency drive to existing system. Manual frequency drives are set manually, not electronically.
2) Option 1 plus automation based on flow in discharge pipe or elevation at head works.
3) Option 1 plus enclosed conduit and flowmeters with bypass from head weir to main canal.
4) Enclose system with flowmeters, add frequency drive and automate based upon pressure at the old head weir location.
5) Option 4 plus Booster pump at old head weir location.

The benefits of enclosing the pump laterals are the same benefits derived from enclosing the gravity laterals. There are also additional benefits when upgrading the pumping plants from the power savings realized from automation. The cost of the enclosed conduit system conversion on gravity lands is about $450 per acre. Conversion of pump laterals could be $550 to $600 per acre or possibly more, depending on pumping plant reconfiguration.

6.3.1.3. Canal Automation

Canal automation involves automating check structures along the main canal so that a constant elevation can be maintained to the deliveries. Check structures presently exist in the main canal but only in the lower third. Check structures would be especially beneficial downstream of each pumping plant in the upper portion of the main canal. Presently the check structures are manually adjusted. Automation becomes a necessity as the farmers are given more flexibility and control of the water. The way the District has been run in the past, has been the easiest for open ditch service, but with improving service to the farmer the new delivery system will be more flexible for the farmer and require more from the District as far as changes made at check structures.

Presently Roza Irrigation District is modeling the main canal to aid in the location of automated structures. One demonstration gate was constructed in 1992, followed by installation of automated overshot gates at four more sites since, and the use of the gates in Roza Irrigation District operations is also being studied as part of the Canal Automation Study. It is Roza Irrigation District's intention to continue to construct one check structure a year. This began in the winter of 1992 and is also a component of the preferred rehabilitation plan. Thus far, five check structures have

been installed. These include 77.3 check and the check structures downstream of pumping plants 2, 7, 8, and 9. See Table 6.2 for a listing of information on check structures completed before January 1997.

The benefits of automating the main canal lie in the attenuation of fluctuations in the main canal. Manually changing the level at check structures with checkboards will become insufficient as more control of the water supply timing is given to the farmer. If several farmers shut off then the flow in the main canal will increase. Conversely, if several turn on, it can create a temporary deficit in the main canal. In order to provide the farmers with a constant supply of water so they can operate more efficiently, it is important to keep the water elevations constant. Automated check structures will do this job on a continuous basis. Changes in flow will be compensated for by the reregulation reservoirs. Automated check structures will allow the system to operate at lower flows. The water level of the canal must be maintained at a minimum level above the turnouts in order for water to fill the laterals properly. Automated check structures will hold this minimum acceptable water level in the canal while requiring less flow diversion from the Yakima River. This will be important in water short years and early and late in the season when demand is small.

6.3.1.4. Reregulation Reservoirs

These reservoirs are located fairly close to the main canal and are used to dampen the fluctuations in the main canal flows. As more enclosed conduit systems are installed, more landowners have the ability to shut off their irrigation water when they desire. Presently, if the level in the main canal rises, the extra water will spill into the wasteways and travel back into the Yakima River. The reregulation reservoirs will momentarily store the unneeded water. When the canal level drops due to increasing farmer demands, the water is pumped out of the reregulation reservoir back into the main canal. The reregulation reservoirs are situated at the lower half of the main canal, as this area is where the fluctuations are more critical and the canal is smaller.

Roza Irrigation District presently has reregulation reservoirs just upstream of wasteways 6 and 7. A large reregulation reservoir is planned upstream of wasteway 5. Reregulation reservoirs are a component of the preferred rehabilitation plan. The off-site storage reservoirs are not felt to be economically justified at the present time. The cost of the remaining reregulation reservoir at Wasteway #5 is about $15,500,000.

The reregulation reservoirs provide several benefits to the operation of the District. As the main canal waste is stored and the reregulation reservoir used to match supply and demand, this will result in less water required at the head gate. This is a benefit for the District especially during the water short years. Reregulation reservoirs will also allow the District to make use of water presently lost due to diurnal effects. Without reregulation reservoirs, the increase in flow during the night is lost down the wasteways. The reregulation reservoirs will store the water at night and then allow it to be used during the daytime. The reregulation reservoirs are important as they absorb the fluctuations in demand that become more prevalent as more enclosed conduit systems are installed. Without the reregulation reservoirs these fluctuations will become spill in a wasteway. It is important to note however that this operational spill

will not be reduced to zero. There can also be situations when the reregulation reservoirs are not able to fully dampen all fluctuations.

6.3.1.5. Lining Portions of the Main Canal

This involves digging out the main canal and placing a liner of 20 mil thick PVC plastic, 1.5 feet below the original grade of the canal usually on the downhill side only. The topsoil and riprap are then placed on top of the liner. Roza Irrigation District presently installs lining on an as needed basis. Roza Irrigation District is lining those areas where the structural soundness of the system is in question due to recent increases in seepage rate or where seepage is damaging productive cropland. Considering the high value of the perennial crops on the Roza Irrigation District, landowners will not tolerate seepage problems occurring on their lands. Seepage areas are identified and repaired in a timely fashion. Failure to do so in the past has resulted in litigation more costly than any repair. Presently the cost estimates of embarking on a project to line the entire main canal are not reasonable. This item is included in the preferred plan only to stop area specific leaks, to protect the integrity of the existing system, and to prevent problems with seepage encroaching on farmland. The cost of lining the main canal will cost $2 per square foot and more depending on the amount of lining drain required.

6.3.1.6. Off-line Storage

In 1994, the Roza Irrigation District performed a water user survey. Two of the recurring suggestions for system improvements were (1) to seek additional storage and (2) to pursue the current conservation measures construction at an accelerated rate. As a result, additional storage has been investigated. Potential storage sites exist off-line along the main canal in draws on the high side of the Roza Main Canal. Among those looked at were two sites in Washout Canyon upstream of Pump Plant 10, one near Sagebrush Ridge upstream of Pump Plant 14 and one on Spring Creek at a narrows called The Gap. If one or more of these sites becomes a serious candidate, the next step is to perform geologic exploration to determine water holding capability of the reservoir area, structural soundness of a foundation placed on the proposed axis, and the suitability of the rock on-site for construction aggregate. Drawbacks to all of the potential sites are energy costs because of the pumplift, and also, the length of the penstock between the canal and the damsite.

6.3.1.7 Rate Structure

The price structure for the district water has for many years encouraged water conservation. In 1998 the operation and maintenance charge for the first three acre feet is $78.00 per acre with extra water available for $32.00 per acre-foot. The increases in these costs are shown on Table 7.1. Because the Board wants to accelerate the modernization efforts of the district facilities, these rates will, in all likelihood, continue to increase.

6.3.2 Proposed Water Conservation Plan Schedule

FIRST TIER (YEARS 1-5) Figure 6.1 shows features to be built in the next 5 years. The only feature of the conservation plan to be included in Tier

#1 of the YRBWEP is the Sulphur Creek Reregulation Reservoir. The district will, on its own, construct the next 5 years worth of enclosed conduit, up to 10,000 acres of open-gravity to close-pipe conversion, and completion of check structures upstream of Wasteway 5. The district has already been actively pursuing the conservation construction program for over 10 years, however, the last few years it has not realized a fully commensurate saving, but has experienced some increased spills. It is believed that the solution is reregulation and automation. However, the Board still wants the district to continue its aggressive approach to water conservation.

SECOND TIER (YEARS 6-10) Figure 6.2 shows Tier 2 features. Tier 2 would include the completion of enclosure of all gravity service, completion of check structures downstream of all pump plants, telemetry of operational data to district headquarters, and possibly the conversion of a pump lateral system to enclosed conduit.

THIRD TIER (ON UNTIL COMPLETION) Figure 6.3 shows the remainder of conservation measures being completed by 2017. The third tier involves conversion of the remainder of the service area to enclosed conduit, completion of the check structure construction, and additional telemetry as required and lining and drainage improvement between M.P 11.0 and 26.0.

6.3.3 First Tier Measures

6.3.3.1. Tier 1 measures are located on Figure 6.1.

That portion of the enclosed conduit system that has already been installed is listed in **Table 6.1.** The Board of Directors will decide upon the project locations on an annual basis. The gravity laterals will be enclosed first.

The location of the automated check structures will be determined by the canal automation study. They will be placed strategically along the main canal. The majority will be downstream of wasteway 5, but some will be placed upstream of wasteway 5. Currently most of the check structures are being constructed below pumping plants upstream of wasteway 5 to provide improved head at pump stations in low-flow situations. Some of the automated structures may be located at existing check structure sites. In these cases the old check structures could be retrofitted. Figures 6.1 and 6.2 show approximate location of check structures along the main canal. One of the critical needs for check structures is just downstream of the pumping plants. When Roza Irrigation District must function at low flows it becomes very difficult to keep the appropriate head over the intake tubes so that a steady amount of water can be delivered.

The exact location of the canal lining is unknown until problems arise. It is possible to plan for these only during the water season prior to the work. There is no plan at present to line specific sections on an on-going basis.

The First Tier measure to be built with the federal assistance is the proposed reregulation reservoir just upstream of wasteway five. The start of construction on this facility could begin as early as 2001. It is shown on **Figure 6.3.** It is important to locate reregulation reservoirs close to the wasteways. If they are too far away from the operational wasteways,

their control and management becomes more difficult due to the response time required between the reservoir, canal control and the wasteway.

6.3.3.2 Conceptual Designs of Measures. The plans thus far developed for Wasteway #5 reregulation reservoir are shown on **Figure 6.8.** The next phase of the project is to determine the geologic soundness of the area for water holding, foundation and building materials.

Figure 6.8 (6 sheets) shows the plan and location of wasteway 5 reregulation reservoir. The reservoir's surface area is 23 acres and it will impound up to 2200 acre feet of water. This dam will be constructed of roller compacted concrete (RCC). There are several benefits of RCC dams, probably the most important being that the spillway could be located on the face of the dam, eliminating additional cost to construct an adjacent spillway. The size of the RCC dam would be much smaller, so if appropriate materials were found on site, less material would be required to construct the roller compacted concrete dam. Also roller compacted concrete construction is much quicker. This dam will have a grout curtain at the base of the dam and depending on the material making up the sides, grouting may have to be done in order to prevent excess seepage around the dam. RCC dams have a history of seeping some when first filled with water and then as silt fills in the spaces becoming quite effective at storing water.

The district plans to continue work on the other water conservation features as well.

Enclosed Conduit Systems. **Figure 6.4** shows a standard flowmeter hook up. The figure shows where Roza Irrigation District's responsibility ends and the farmer's begins as far as operation and maintenance. The Roza Irrigation District installs two valves that are used to control flow to each delivery within certain limits. An air vent, air release and pressure relief are also installed on the manifolds of the flowmeters. Everything that is above ground is steel. The flowmeter set up is supported on a concrete pad. The District extends these pads during construction as specified by the farmer, to accommodate the farmer's barrel screens and other items needed to make the hookups. Concrete posts are placed around the flowmeters to protect them from vehicles and farm equipment. Each parcel of land that is owned separately is provided with a flowmeter so that the new system does not have shared deliveries as in the old delivery system. As of this year, the district requires each landowner to have a worm-gear-driven butterfly valve at their point of delivery. This gives the farmer the ability to turn off the water for repairs and/or screen flushing without calling the district for shut off the delivery. The worm-gear-driven valve is necessary to prevent water hammer that can result when a system is shut off too rapidly, as is the case with fast closing valves.

The largest pipe used thus far on the enclosed conduit system (ECS) is 24". The pipe is gasketed and buried with a minimum cover of 30". New turnouts from the main canal are usually constructed for the new systems. Occasionally PVC pipe is pushed through an existing concrete line. All fittings are thrust blocked.

Canal Automation. Roza Irrigation District studied Main Canal Gate Alternatives as part of the Canal Automation Study. **Table 6.4** summarizes the findings for a variety of gate options. Roza Irrigation District chose to use the over shot gate. **Figure 6.5** shows an isometric view of a typical

check structure. The Roza Irrigation District will continue to build new check structures using a canal model to aid in their location. Some of the existing structures that are still in good repair will be retrofitted with automatic gates. An overshot gate will be used in these situations too. It is presently estimated that approximately 40 of the automated gates may be installed. Not all the bays within a check structure will be automated. As in the 77.3 check structure the two outside gates are manually set and only the center gate is automated. This has also worked effectively at other sites and will help to reduce cost and maintenance of these structures. Presently someone must go out to the check structure site to check the status of the gate and correct any alarms. In the future Roza Irrigation District will begin to incorporate some type of remote sensing and a control communications network. Critical information about the status of gates, reregulation reservoirs and staging sites will then be accessible from the office and strategic management points in the system can be remotely monitored.

Reregulation Reservoirs. **Figure 6.1** shows the location for wasteway 6 and 7 reregulation reservoirs. **Figures 6.6 and 7** contain the plan and profile for the dam embankments at wasteways 6 and 7. Wasteway 6 is below the main canal, and it is lined. Wasteway 7 reservoir is located above the main canal and it is unlined. As the reservoir is located above the main canal any seepage would return to the main canal. The surface area of the reservoir is 2.3 acres and the capacity, 12 acre feet. The dam was constructed of material existing on site, plus a small amount of clay hauled from another on-district source.

Main Canal Lining. **Figure 6.9** shows a standard cross section of the main canal with the PVC liner installed. This shows a full cross section lining. Some areas only curtains are used on the lower bank of the main canal. The curtains are secured to bedrock at the bottom. These two methods are the ones Roza Irrigation District presently use. A minimum of a foot of soil is placed back on top of the liner and then the area is rip rapped.

Roza Irrigation District has lined only earthen sections of the main canal to date. When relining concrete lined sections, it is possible that an asphalt liner could be placed over the existing concrete lining and secured at the top of the concrete lining. **Figure 6.10** demonstrates the installation of such a lining. Currently, only leaking areas that are causing crop damage or property damage along the main canal or areas where the integrity of the system is in question, are lined.

Off-Line Storage. **Figure 6.11** is a general map of the district showing the proposed off-line storage sites that have been proposed and been cursorily reviewed. Development costs are rather high because of one or more of the following factors: (1) size of structure, (2) length of penstock, and (3) pump lift involved.

6.3.3.3 Cost Estimates. All cost estimates are the total project cost to complete the project in today's dollars. The costs are what it would cost the district to install the projects using their own equipment and labor. If Roza Irrigation District were to contract out the design and construction, these prices could be increased by forty percent or more. The cost estimates are based on the assumption that projects are completed as

given in the time schedule above. **Table 6.5** shows cost estimates for construction by year until the completion of the rehabilitation. Changes in operation and maintenance costs are shown in **Table 6.6**. It is assumed that other maintenance costs and operating costs will remain approximately the same. Some costs in operation may decrease as the system becomes more automated but there will be increased cost in the maintenance of the controls. Overall the cost of maintenance will decrease as shown in the table.

Enclosed Conduit Systems. The total cost to finish enclosing all the open and low head piped laterals is estimated at $41,188,000. It is assumed that the pump laterals will be more costly to enclose. To provide pressure to all landowners would be an additional $4,000,000 which would not be a cost contributing to water conservation. Maintenance costs are estimated at $8.90 for the old system and $3.80 for the new system. **Table 6.6** breaks out the change in maintenance costs on laterals by year assuming the time line developed is upheld.

Canal Automation. The automation has been estimated to cost $4,800,000 to complete. It is planned to build one check structure a year at an average present cost of $240,000 a year. This cost includes development of the remote sensing and control systems using telemetry or something of comparable nature. Maintenance costs on the canal automation are assumed to start at $10,000 and increase to approximately $90,000 a year when all the structures are in place. This does not include power costs for operating the gates. Those are discussed in Section 6.3.3.9.

Reregulation Reservoirs. Wasteway 7 reregulation reservoir cost $300,000. Wasteway 5 reregulation reservoir is estimated to cost $15,500,000. Maintenance costs for the reregulation reservoir at wasteway #7 are about $750 a year. For the reregulation reservoir at wasteway #5, O&M is estimated at $50,000 a year.

Main Canal Lining. This cost is not included when calculating the cost of net water savings. Roza Irrigation District will install main canal lining only on an as needed basis. Capital costs are estimated at $60,000 for a half mile, 75,000 for 3/4 of a mile and $90,000 for a mile. The majority of the concrete lining is in the main canal but some PVC liner is also installed in the old open lateral systems where serious leakage problems are occurring. It is assumed that maintenance costs on the main canal will be kept within reasonable amounts by doing lining, but no real increases or decreases in maintenance costs will be seen.

Off-Line Storage. Off-stream storage is a costly venture, which could range from $20,000,000 for a small site to over $60,000,000 depending on the site circumstances, pumping requirements, spillway requirements, length of penstock, and land acquisition. Any seriously considered site will need extensive safety-of-dams investigation, including geology, spillway sizing, flood routing, and an emergency preparedness plan.

6.3.3.4 Time line. For the foreseeable future, the Roza Irrigation District will be expanding their enclosed conduit system and constructing check structures on an annual basis. Tier 1 work for conservation measures over and above the aforementioned for the next five years will include design data gathering, design, environmental documentation and safety-of-

dams compliance. Beginning with geologic investigations as soon as 1998, favorable site suitability findings will trigger design. Once there is sufficient knowledge of the proposed structure, environmental and safety-of-dams compliance documentation can begin concurrently. Analyses for safety-of-dams will include preparation of the probable maximum precipitation; the dam break and resultant flood inundated area map, and emergency preparedness plan. It is estimated that this work could be completed in 5 years.

6.3.3.5 Reduction in Average Water Diversions.

Table 6.7 was developed to estimate the approximate net water savings realized per year at the completion of the rehabilitation by project type. A description of the assumptions made to develop the table is given in the following text. **Table 6.8** shows the average water demand at approximately the year 2017, the estimated completion date for the Rehabilitation and Betterment.

The following assumptions were used to make the projection:

A) The lateral operational spill and lateral losses will be negligible in 20 years when the enclosed conduit systems have all been installed. The Table presents it as zero, for all practical purposes. This means that the amount of water delivered to the laterals will be the same as the amount delivered to the farm.

B) Average Main Canal Losses are assumed to be the same. These figures were not decreased due to main canal lining, as the lining will not result in net water savings.

C) The Average Main Canal Operational Spill is assumed to decrease with the completion of the reregulation storage and canal automation. (Roza Irrigation District and Sunnyside Valley Irrigation District, 1985)

Using these assumptions the average quantities are calculated backwards to determine an average quantity diverted from Stream. When **Table 6.8** is compared with **Table 5.5**, it can be seen that the system efficiency will improve from 59% to 71% on average. This is an increase in water delivery efficiency of 12% overall.

TABLE 6.8 WATER DIVERTED BY ROZA IRRIGATION DISTRICT

MONTH	ENTITLEMENT (AF)	PRESENT AVERAGE DIVERSION (AF)	AVERAGE FOLLOWING IMPROVEMENTS (AF)
March	18000	9667	9667
April	37500	33569	25403
May	56250	54066	43213
June	71250	60240	50836
July	71250	67220	58613
August	71250	66726	57288
September	45000	44149	35532
October	22500	16644	11765
Total	393000	352281	292317

ENCLOSED CONDUIT SYSTEMS. The estimated average net water savings when all the laterals, both gravity and pump, are enclosed is 20,798 acre feet. There is an unmeasured amount of water, farmer's waste that is also saved when enclosed conduit systems are installed. Roza Irrigation District does not have the ability to measure or estimate this figure.

CANAL AUTOMATION. It is assumed that 40% of the lateral losses are not realized until completion of the canal automation. The estimated average net water saving due to canal automation is 13,866 acre feet.

REREGULATION RESERVOIRS. The three reregulation reservoirs provide an average net water saving of 25,300 acre feet. Upon completion the reregulation reservoir at wasteway #5 is estimated to have an average net water savings of 13,751 acre feet annually. Likewise, the reregulation reservoir at wasteway #6 is estimated to have an average net water savings of 8,870 acre feet annually and the reregulation reservoir at wasteway #7, 2,679 acre feet.

It is important to note the interrelationship of the estimated average annual net water saving of the various projects. They are all dependent on each other for achieving the overall estimated average annual net water savings. The enclosed conduit system saves evaporation and seepage losses incurred in the distribution system because the water neither seeps into the ground nor does it evaporate from an open surface. However, any time the irrigator shuts off or turns on there is a resultant fluctuation felt in the main canal. The net effect to the system is the summation of all the shut-offs and turn-ons which occur. To smooth out operational fluctuations, a district can put in reregulation reservoirs. But one reregulation reservoir alone does not save as much as three or more strategically placed at or near wasteways. Using these reservoirs the district can start to minimize the spills by reacting to the fluctuations in the canal. Important in the decision to store water is knowing how long it takes to restore flow to an area once water is stored into the reregulation reservoir. It is estimated that a reregulation reservoir at Wasteway 5, the district could save half of the present main canal spill and half of the lateral spill by enclosing the laterals between Wasteways 2 and 5. The lower two reservoirs can save like percentage of the spills and recoveries for their respective reaches. To be effective, the reregulation reservoirs must be able to react to the changes within the time required to get water back into the system. Spills occur presently because it takes 3 days for adjustments at the headworks to settle through the district. Automation by itself does not save water. At times, the checks will back up water into the high-leak area of the canal. At the lower flow level, without the checks, less seepage would occur. The telemetry portion of automation serves only as a tattletale telling how much off-target the system is at the checkpoints. It is only by being able to capture savings, and releasing them at a time when the water is needed, that there is a savings realized. It is estimated that the remaining 40% of the lateral loss recovered from the enclosed conduit system construction will be realized through automation.

Using the above rationale Figure **6.12** was developed. The graph shows Average Water Diverted and Average Water Delivered to Farm by Year as projected to the end of the rehabilitation. The graph clearly demonstrates a decreasing trend in water demand while still providing the farmers adequate service.

Figure 6.13 is a bar chart that compares average use presently and at completion of the rehabilitation with entitlement. This graph demonstrates that on average Roza Irrigation District uses less than entitlement and after the rehabilitation is complete will be able to operate on even less water. The main benefit to Roza Irrigation District is that in water short years, when prorated, the farmers will not be impacted as much because water can be delivered more efficiently.

The annual average cost per acre foot of water saved has been calculated in the socioeconomic section of this report. This is a handy way to compare projects but it is not the only benefit gained by these projects. Things such as improved water quality are also important benefits of these projects and need to be factored in to final decision making. The estimated average net water saved on completion of the rehabilitation is 59,964 acre feet.

IMPACTS OF TRANSFERRING NET WATER SAVINGS TO OTHER USERS. The Law of the River, as confirmed by Judge Stauffacher, is the 1945 Consent Decree. The Yakima River is presently in adjudication. Judge Stauffacher is in the process of deciding the priority dates and quantities of water to which each user is entitled. The 1945 Consent Decree defined the entitlement for the irrigation districts in the Yakima Basin by month. The adjudication and water law as it exists presently in the basin is based on the priority dates of the various users. The junior water rights must be prorated in water short years to reserve a full supply to the senior water users. Reverse of this situation means that if the senior water users have sufficient water supply then the remaining water supply in the Basin is used to fulfill the junior users demand. The USBR, Yakima Project, is in charge of managing the Yakima River and the releases from the reservoirs. The Bureau has developed a tool to project the Total Water Supply Available (TWSA) to the basin on a monthly basis. The water year for the Bureau runs from October 1 - September 30. TWSA is a relationship between the snowpack, precipitation, runoff, water stored in the reservoirs, usable return flow, and time of year. Projections are made on a monthly basis and the Bureau uses this figure to make decisions on how the water will be distributed to the users. When the TWSA projected for a month falls below the users demand then the junior users are prorated an appropriate amount so that the senior water users are not adversely affected.

WATER SAVINGS EFFECT ON RETURN FLOW BACK TO YAKIMA RIVER **TABLE 6.9**

MONTH	ABOVE PARKER	PARKER TO PROSSER	PROSSER TO KIONA
APRIL	467	3847	3853
MAY	757	5005	5091
JUNE	785	3920	4699
JULY	826	3428	4354
AUGUST	854	3922	4662
SEPTEMBER	723	3685	4208
OCTOBER	202	2268	2275
TOTAL	4747	26075	29141

Because of the concern for adverse effects and the concern for reduction of useable return flows above Sunnyside Dam for its effect on TWSA, the effect of the Roza I.D. improvements was estimated. **Table 6.9** shows the effect of the water conservation measures on the return flows to the mainstem Yakima River. **Table 6.7** shows the reduction in diversion attributable to the Sulphur Creek Reregulation Reservoir at the district's diversion point and the reduction in river returns between Parker and Prosser.

The water conservation projects Roza Irrigation District is carrying out are pieces to a much larger and more comprehensive view of the Yakima River Basin. The proposed Federal Legislation, the Yakima Enhancement Bill, has been developed to convey this larger perspective of the Basin. The conservation done in the Basin by various agencies must be directed in a manner that will improve the water quality and quantity in the basin as a whole. In order to "free up" water for new beneficial uses which include, but would not be limited to, improved in stream flows, recreation, and improved water quality, conservation by the present users must take place. However, it is important to keep in mind that there is a very complicated relationship between water conserved and increase in water available in the Basin for other uses. It is not a one to one relationship and the relationship changes depending on the month of the water season.

Conservation is necessary because it will decrease the amount of water demanded by the present users. This will result in lower target TWSA required by the users. This means that in water short years less water will be required to satisfy the needs of present users in the basin so the shortage is not as severe. It also means the basin has the potential to operate with more carryover from one year to the next so the chances of experiencing a water short year are decreased.

Water saved will first be used to avoid proration of junior water users during water short years. Under the Yakima Enhancement Bill, conservation would also allow for higher target flows in the stretch of the Yakima River between Sunnyside Dam and Prosser Dam. This is an approach that improves in stream flows for the Yakima River in its most critical reach and is structured under present water law so it does not upset the precedence of past law and methods of operation. Roza Irrigation District will continue to operate in a manner that is consistent with the historical operation of the Yakima Project by the U.S.B.R. unless the court directs some change.

The Yakima Enhancement Bill concept is a very important tool to draw together conservation efforts of individual agencies. As individual irrigation districts conserve water the U.S.B.R. can improve river management for fish as long as all existing rights are being fulfilled. Roza Irrigation District is not prepared to discuss any transfers of conserved water that bypass junior users during the adjudication process. However, district management understands and accepts that a necessary aspect of the YRBWEP program is going to be water transfers. The district expects to be able to deal appropriately with this issue by the time funding would become available for a Roza construction project.

6.3.3.6 Impact on Ground Water Development

The three consecutive drought years of 1992-94 brought about a large increase in groundwater pumping. During this time there was a steady decline in the water surface elevations in the Wanapum aquifer. Since the State of Washington did not specify the amount or place of use, nor do they perform any monitoring or metering of pumping, quantification of supply, and any impacts are impossible to determine. Figures 2.3 and 2.4 indicate the groundwater levels and show which levels have since rebounded, and those that are showing a more modest recovery.

The Wasteway #5 Reregulation Reservoir is expected to raise the water table in the area immediately adjacent and downstream of the reservoir.

6.3.3.7 Impact on Wetlands

The Roza Irrigation District has developed an overlay mapping system to readily identify wetlands associated with the operation of the District. Please refer to the overlay mapping system. The base maps are blue line aerial photographs that were run on paper. One set of overlays is the National Wetland Inventory Maps. The scale has been changed from 1": 2000' to approximately 1": 1000' to match the operations map that is also an overlay. The operations maps provide the District Boundary lines. Overlaying these three pieces of information provides the basis for future site specific inventory of the district. These maps will be used as the basis for discussing and determining the extent of impact a project may have on wetlands existing in the project site. These wetlands are not under jurisdiction of the Corp of Engineers through Section 404 of the Clean Water Act. Full district coverage on a 7.5 minute USGS quadrangle base is available at District headquarters in Sunnyside, WA. A reduced copy of one map of the set is included as **Figure 6.14.**

The hydrology of the wetlands existing within the Roza Irrigation District will be discussed in general terms. The majority of wetlands on the Roza Irrigation District have been created from the application of irrigation water and to a small degree, leakage or seepage of the conveyance and distribution facilities. The area that is now the Roza Irrigation District was at one time desert and sage brush with possibly some vegetative growth in the natural draws closer to the Yakima River, especially in the large drainages such as Sulphur Creek. The landowner management along these draws also has a large impact on the wetlands. This can be demonstrated by looking down along one of these natural draws and observing the degree to which the farmers have impact on the drain. Some areas look like a low spot in the land and the drain is kept as a drain ditch. In other spots, the farmers have ignored maintenance of the drains. As a result, cottonwood trees, willows and cattails or some combination of the phreatophytes have overtaken the drain. The wetlands present today are created by a number of water sources. Refer to **Figure 6.15.**

With high value crops grown in the district, the amount of wetland present is small. Canal seepage areas are repaired in short order. The land upon which these wetlands exist is private. The District is responsible to farmers to maintain the delivery system so it does not damage farmer's crops or prevent farmers from using the land for production. The drains must be cleaned occasionally so that they do not silt in and begin

encroaching on farmland. These areas are not regulated by the Corp of Engineers under Section 404 of the Clean Water Act. The enclosed conduit systems will decrease the amount of flow into the drains as the operational spills at the end of laterals will be removed and seepage areas along laterals will be removed. Roza Irrigation District has determined that approximately 50% of the water in these drains could be eliminated. This will not completely dry up the drains. The reregulation reservoirs will not have a direct impact on wetlands. Automated check structures will not have any direct impact on the wetlands as they are built in the canal and are used to regulate the height of water with in the canal. They will have an indirect impact, as they are one of the components of a system that will allow the Roza Irrigation District to realize net water savings. Individually however, they will have no impact to wetlands as they are built in the main canal during the winter. The wetlands present should be enhanced by the project, because although the quantity may be somewhat diminished, the quality will be much enhanced.

Construction of the Wasteway #5 Reregulation Reservoir would result in a net increase in wetlands. Beginning with a reservoir pool of about 23 acres, along with the associated shoreline, there will be a channel downstream of the dam that will carry any seepage resulting from the impoundment. Decrease in wetland area alongside Sulphur Creek Wasteway will be unaffected as the first 3 miles consists of a concrete flume and the remaining 7 miles of channel to the Yakima River are rock lined. This project will increase, not decrease wetland area.

6.3.3.8 Impact on Water Quality

**** Impact of Decreased Head Gate Diversions on the Hydrologic Cycle**
Contrary to popular belief, a reduction in surface water diversions does not directly equate to increased in stream flows of equal magnitude at a chosen point in the river system. The increase in stream flows will be a result of actions set forth in the Yakima Enhancement Bill. Under the present operation of the Yakima Basin and the structure of existing water laws, water conserved by one user is passed on to be used by a more junior water right holder until all water rights are fulfilled. When all the users can operate with less water, this will make water available for use by the next water right holder. This conserved water would vary in amount from one year to the next and from month to month, depending on the Total Water Supply Available in the Basin. If the water can be used to benefit in stream flows then this will be a real benefit for the Yakima River, especially in the reach between the Sunnyside Dam and Prosser Dam. This area is known for having water quality problems related to low in stream flows. This reach of the Yakima River also receives poor quality return flows from the lands above the River. The conservation projects will reduce the return flows and associated sediments to these drains. When both Roza and the farmers conserve the return flows will become primarily subsurface flow. As the amount of surface run off decreases the flow rate in the drains will decrease and allow the sediments to settle out properly before reaching the river. All the conservation components will be beneficial to the quality of the return flows to the Yakima River.

**** Potential Changes in Impacts of the Rehabilitation Projects on Water Quality**

Agricultural return flow quality control has been studied since the early 1970's. The studies have progressed through the usual order of investigating the problem, discussing possible solutions and implementing demonstration projects. The preferred rehabilitation projects are following through with a recognized solution to the poor water quality in the lower Yakima River. CH2M Hill's report on Agricultural Return Flow Management in the State of Washington describes the methodology well. The alternative methods of improving water quality in an irrigated agricultural area were identified as:

1) Improve on-farm practices to reduce pollutants added to return flows.
2) Improve distribution efficiencies to allow better use of available supplies.
3) Primary treatment of irrigation waste water prior to discharge to streams.

Item 1 is being addressed through Best Management Practices (BMP's) administered through local conservation districts, U.S. Natural Resources Conservation Service, and Agricultural Stabilization and Conservation Service.
Item 2 is up to the United States Bureau of Reclamation and local irrigation districts. Roza Irrigation District has been and will continue to pursue the district modernization plan aimed at conserving water and improving water quality in the Basin.

Item 3 is difficult and costly to pursue until the return flow quantities have been greatly reduced. Some major drains now carry 300 to 400 cubic feet per second. It is generally recognized that treating discharge should follow implementation of BMP's and improvement of irrigation district efficiencies.

The Wasteway #5 reregulation reservoir impacts both water quality and quantity. The enclosed conduit systems increase the efficiency of the water delivery to the farmer. Silt load from Roza Irrigation District and farmers will continue to be greatly reduced by the project. Previous experience shows that the rate of increase to more modern irrigation methods (BMP's) will rise sharply following the installation of the enclosed conduit system. The project provides the farmer with a more flexible system. The enclosed conduit systems also provides working pressure for about two-thirds of the project. This provides incentive for conversion from rill irrigation to sprinkler. The farmers can often receive cost sharing funds from ASCS for their flowmeters and barrel screens. In order to receive this funding they must complete a conservation plan for the farm. The enclosed conduit systems have encouraged many farmers on the project to participate in this plan.

Board of Joint Control water quality monitoring, that began in 1997, will continue as a regular function of the work undertaken by the districts. The changes in water quality in joint drains will be monitored on an ongoing basis.

6.3.3.9 Net Energy Savings

Estimates of the changes in power demanded due to the rehabilitation projects have been estimated. Presently Roza Irrigation District does not know how well solar power can be adapted to the new facilities. It is assumed that solar power will be used to operate all the automated check structures downstream of 77.3 demonstration gate. It is also possible to use solar power to operate the remote sensing and controls. The actual feasibility of this is currently under study.

***** Monthly and Seasonal Energy Requirements for Present System**

Table 6.10 summarizes the power use for each pumping plant by month for the years 1980-1995. **Table 6.11** summarizes total power usage by pumping plant for the years 1980-95. The average for these years is stated at the bottom of each column and total power use for all the plants in the column on the far right. The Bureau under contract provides all of this power. It is assumed that this power usage will remain constant until such time a decision is made about the way in which the pump laterals will be enclosed. There is also a minimal power use by the pumps that are used as pump backs along the main canal to return water from lining drains back into the main canal. These are located in areas where access is a problem. The power for these pumpbacks is purchased from both Pacific Power and Benton REA.

***** Changes in Energy Requirements for Preferred Rehabilitation Plan**

The rehabilitation projects will affect the power use. Some components will create more demand and others will conserve power. Below is a description of the changes due to each of the projects. **Table 6.12** gives the estimated cost of power usage of the rehabilitation projects.

ENCLOSED CONDUIT SYSTEM ON GRAVITY LATERALS. The gravity enclosed conduit systems do not change the amount of power the district consumes. They will reduce headgate diversions, which will allow the water in the power canal (from 0.0-11 mile) to be used to generate power. This increase in power generation will only be realized during peak flow period on the Roza Irrigation District. On farm there is the possibility for power savings and is discussed in the socioeconomic economic section.

ENCLOSED CONDUIT SYSTEM ON PUMP LATERALS. There will be neither a decrease or increase in energy consumption if the pump laterals are enclosed. Conveyance losses will be eliminated and will result in a decreased volume of water being pumped. This will be countered by the need for larger head requirements at the top of the hill. Other changes in energy consumption will depend upon other decisions made about how the pump stations will be rehabilitated. The use of variable speed drives will result in a decrease of power consumption but will require a large capital outlay initially. This is especially true on the plants that must be stepped from 230 to 480 volts.

CANAL AUTOMATION. Automation of the main canal will require an increase in energy use. The first automated gate that was installed (77.3) uses solar energy to power the gate movement and controls. Roza Irrigation District uses AC power to control and operate other automated gates along

the main canal above Wasteway #5. The larger gates in the upper end will be located just downstream of the pumping plants. This allows Roza Irrigation District to use USBR power to control these gates. The only cost for such installation is labor and materials. These costs are included in the capital cost of the automated gates. The power needed to operate the gates runs about 50 kWh a month and is estimated to cost $100 a year per gate. This would include communications. It is assumed that eventually as many as 16 gates may use AC power. The balance would run on solar power.

It is also assumed that any telemetry system repeater stations would run on solar power. This will create huge savings, as power lines will not have to be installed to remote locations.

REREGULATION RESERVOIRS. The reregulation reservoirs will require power for the pumping plants. These are large pumps, so solar power is not an option. These pumps will increase the power consumption of the District. **Table 6.12** gives estimates based on past experience of operating the reservoir at wasteway #6. These are average annual costs and will depend on the water year. It is felt that over all the power consumption will increase as the District becomes more automated. The main increase in power costs will come from pumping at the reregulation reservoirs, not from the automated gates or telemetry.

OFF-LINE STORAGE. Because water stored off-line will likely need to be pumped into storage through some length of penstock, pumping costs will exceed any one of the present pumping plants. Careful analysis will be a pre-requisite of any selection process.

6.3.3.10 Socioeconomic impacts. The Roza Irrigation District contracted with Economic and Engineering Services, Inc. of Olympia to do a socio-economic impact study of the conservation plan. The objectives of the Socioeconomic Impact Study were to discuss and quantify the economic and employment impacts that will occur if the conservation plan measures were implemented. The study entails two elements, an economic analysis and an employment impact study. The economic analysis is presented from both the perspective of the irrigator and that of society. The employment impact study predicts the income and employment effect of the modernization of facilities. The study is included as **Appendix XIV.**

Economic Analysis

The total project capital cost is estimated at $60,838,000 in 1992 dollars. The capital costs are summarized in **Table 6.13** below.

Table 6.13. Summary of Capital Costs by Project (1992 Dollars)

Enclosed Conduit System Gravity	$14,798,000	$1860/AF
Enclosed Conduit System Pump	23,895,000	$1860/AF
Main Canal Automation	4,800,000	$ 346/AF
Lining	1,845,000	
Reregulation Reservoirs	15,500,000	$1127/AF
TOTAL	**$60,838,000**	**$1015/AF**

The Roza Irrigation District anticipates grower acceptance for the

repayment of the 17.5% funding. The 1994 grower survey was fairly explicit in the need to proceed with water conservation measures and storage. It is assumed that the useful life of the facilities is approximately fifty years. No bonding costs occur in this analysis, as Roza Irrigation District intends to pay for as much of the capital items each year as possible for the foreseeable future. The Roza Irrigation District is seeking YRBWEP funds to design and construct the Wasteway #5 reregulation reservoir. The cost per acre foot of the conservation measures when completed is $1015.

The operation and maintenance costs are summarized in **Table 6.6**. Costs are in 1992 dollars and separated by maintenance costs and power costs. The modernization is projected to increase the net power usage. Operation and maintenance costs are assumed to remain approximately the same because technical support people will need to be trained or hired to maintain and troubleshoot the new facilities.

The maintenance of the enclosed conduit system declines over time as more of the old system is replaced with lower maintenance new system. Other costs increase as more of the check structures are installed. This is primarily because there is not an old facility being presently maintained. Annual variable costs in 1992 dollars range from $370,000 to 580,000. A total variable cost over the fifty years of project life is estimated to total $17,708,054 in 1992 dollars.

The cumulative net water savings are estimated to average just under 60,000 acre-feet. The schedule for these savings is related directly to the construction schedule.

SOCIETY PERSPECTIVE PLAN VALUE. The Roza Irrigation District experiences proration in water short years. Water saved by these conservation projects will lessen the impact of proration to the water users in water short years. Appreciable additional flows will be available only in average or above average water years for in stream flows. The approach in the socioeconomic study is to examine the avoided cost of alternative water supply as society's value for the water.

Several alternatives were used to compare costs. A report titled "Plan Formulation Summary: A Report to the Regional Director of the Bureau of Reclamation Pacific, Northwest Region and Director State of Washington Department of Ecology" (1986), proposes a number of water supply projects. Three of these were considered for comparison: Cle Elum Lake Raise, Bumping Lake Englargement and Wymer Dam and Reservoir. Wymer Dam and Reservoir was chosen as a reasonable comparison to Roza Irrigation District's modernization because of its size and reliability.

IRRIGATOR PERSPECTIVE PLAN VALUE. The irrigator is concerned with how Roza Irrigation District's preferred plan will affect the operation of the farm, the operation costs and the water supply available. Three possible benefits could be realized; 1) improved service could reduce operating costs, 2) a larger supply would be available in years of prorated water use, and 3) additional water may be available for a different crop mix.

Improved quality of water service may reduce operating costs. Water delivered under the enclosed conduit system takes advantage of gravity pressure. Approximately one-third of the acreage will not require pumps

to operate on-farm sprinkle systems. Another third will only have to boost the water pressure. The remaining third will have no benefit and must still pump to obtain necessary pressure. The summarized potential annual savings in energy costs to the irrigators is $444,000 expressed in 1992 dollars. Other non-quantifiable benefits include flexibility and improved ability for frost protection.

A larger supply would be available in years of prorated water use. Severe to moderate reductions have taken place in several years since Roza Irrigation District has been in operation (1950). The most severe condition was experienced in 1994 when only 37% of the contracted amount were made available for district diversion. Not only was the drastic reduction the worst of record, but it also came on the heels of two years of prorationing. Conservation measures will reduce minimum operating requirements and allow a longer irrigation season under such severe flow restrictions. The possibility of additional water being available for a different crop mix is severely limited in the Roza Irrigation District. One constraint is the nature of the allocation of the water within the District. Also the projected changes in crop mix for the Roza Irrigation District has been given in **Table 5.3** and it is demonstrated that these trends in cropping patterns will not increase the demand for water.

Employment Impact Analysis

The construction of the project will have employment impacts in Yakima and Benton Counties. Construction jobs will be directly generated by the project. Some of the materials for construction are directly purchased from the region. Other jobs and income will be generated by the "multiplier" effect of construction workers spending salaries on goods and services in the region.

The University of Washington has developed an input/output model for the State of Washington that is used to analyze the employment impacts. It is estimated that a total of 1,784 man-years of labor will be generated by the project over the 35-year construction period. Average additional income generated by the project will be $3.8 million dollars annually in 1992 dollars.

6.3.3.11 Environmental effects

Process. An Environmental Report (**Appendix XIII**) was developed for the "Preferred Rehabilitation Plan." The SEPA Checklist (also in **Appendix XIII**) was then written from the items discussed in the Environmental Report. The Environmental Report and the SEPA Checklist were sent to all agencies that have been involved in the oversight of this Comprehensive Water Conservation Plan, for comments. A period of 30 days for these comments was given. At the end of the 30 days a Declaration of Non Significance was signed by Roza Irrigation District and sent to all agencies. It was also published in the Yakima Herald Republic and the Tri-Cities Herald on Wednesday, December 4, 1991. The FONSI is also given in **Appendix XIII.** A comment period of 15 days was given. At the end of the fifteen days we had received comments from the Environmental Review Section and the Water Resources Section of Department of Ecology. Roza Irrigation District replied to the comments from Water Resources Section by phone. A

meeting was held in Yakima to discuss the comments from the Environmental Review Section. At this meeting it was decided that it would be most appropriate for Roza Irrigation District to compose a reply letter. This was done and both letters are included in **Appendix XIII**. Roza Irrigation District will be going through the SEPA process again as one of the components in the design phase. In this process a more in depth look at impacts will be taken for the specific site the project is to be built. The following is a portion of the Environmental Report that discusses impacts.

Natural Environment

EARTH. The Roza Irrigation District is the youngest irrigation district in the Yakima Basin so in comparison, it is positioned higher in elevation than other irrigation districts in the Lower Yakima River Basin. Because the Roza District sits higher in elevation off the valley floor, the slopes of the land are steeper than on neighboring districts in the lower valley. Slopes average from 3-6% with localized slopes exceeding 20% in some areas. The topography is rolling to hilly with some areas of steep slopes.

The soils found in Roza Irrigation District are mostly well drained soils of medium texture, overlying basalt. Caliche layers exist in some areas. Roza Irrigation District contains 98,000 acres within district boundaries of which 14,000 are class six lands. Class six lands were determined non-irrigable using open gravity canals when the district was first formed. They were felt to be non-farmable due to extreme slopes, due to rocky or gravelly ground, shallow soil, or otherwise limiting drainage or topography. Under today's technology, many of these lands can now support orchards and vineyards.

The rehabilitation projects will include removal of old concrete delivery boxes and elimination of open laterals by piping. Back fill for pipelines will be required but often silt from silt basins along the main canal is used. The reregulation reservoirs will require more earth moving and fill materials. Roza Irrigation District uses as much material from the project site or sites on the District as possible. Sometimes fill and aggregate must be brought in as a higher quality or quantity is needed. After construction only 1% of the site area will be covered by impervious structures, i.e. flowmeter structures and lining of the main canal.

Erosion could occur during construction of the reregulation reservoir. After construction seeding will control erosion and compacting exposed, mined or worked areas.

The enclosed conduit systems will decrease erosion, as laterals will be enclosed. They will also provide the farmer with more control of the water that has been proven to reduce erosion. The soil erosion will be decreased with the installation of the projects as it provides the farmer with a means to operate with less water.

AIR QUALITY. Air quality in the Yakima River Basin ranges from good to excellent. The air quality in the Yakima Valley is usually in compliance with the National Ambient Air Quality Standards and Washington State standards. Occasionally, standards are exceeded for short periods. Carbon monoxide and suspended particulates exist in the metropolitan area of Yakima. The lower valley has areas of high levels of natural windborne

particulates originating from fallow croplands during windy periods. Burning crop and forest residues and vehicle travel on gravel roads are often sources of particulates during the summer and fall. The east Moxee area is similar to the urban Yakima area that is surrounded by hills and ridges. This area can experience poor atmospheric dispersal of pollutants from automobiles and industry during winter inversions.

The preferred rehabilitation project will not affect long-term air quality in the lower Yakima Basin. During construction, the heavy equipment will emit exhaust and raise dust but the proper measures will be taken to reduce these as much as possible. Once laterals are enclosed there is no need for burning weeds along them which will help to improve air quality.

CLIMATE. Summer temperatures average 82 degrees Fahrenheit in the Lower Yakima Valley. Winter temperatures range from 15 to 25 with minimum temperatures of -20 to -25 recorded in most areas. The rainfall is about 6-10 inches annually. The Yakima Valley has an arid climate with irrigation providing humidity normally not present. The Wasteway #5 reregulation reservoir project will not have an effect on the climate of the Yakima Valley.

SURFACE WATER. Surface water quality in the Yakima Basin degrades as the water moves downstream. Water quality in the upper tributary reaches is excellent but only fair to good in the lower Yakima Valley. River water upstream of the Roza Dam is considered good, but as the river flows from Roza Dam to Sunnyside Dam treated wastes from the communities of Yakima, Selah, Union Gap and Terrace Heights plus irrigation return flows from the Yakima area and the Naches, Ahtanum, and Moxee Valleys are added. But under average flow conditions, quality is degraded only slightly as the Naches River has good quality and is added to the Yakima River in this reach. In the lower basin, below Sunnyside Dam, the water quality degrades rapidly. During the summer most of the flow is diverted at Sunnyside and Wapato Dams. Also downstream turbid, nutrient and bacteria rich return flows make up a large portion of the river flow. Return flows from agriculture are the major source of turbidity, nitrogen, phosphorus, dissolved and suspended solids in the reach. The high temperatures prevent anadromous fish utilization during the summer months. Also refer to John Easterbrooks's letter in **Appendix XIII** for comments on this subject.

Water quantity in the Yakima Basin has been discussed briefly in the introduction. The Yakima River Basin drains 6,155 square miles. The average annual discharge of the basin is 2.9 million acre-feet. There is only storage for 1 million acre feet so demands on the water must be fulfilled by natural run off for as long as possible.

There are various drains and wasteways within the Roza District that drain the irrigated farmlands. A small part of the drain waters are from Roza's operations, but the majority of the impact on these drains is the result of on farm practices. None of these drains will be covered as a result of the project. Normal amount of maintenance on these drains will continue. This means possibly every 3-7 years the drains will be cleaned, not all within any given year.

The Wasteway 5 reregulation reservoir is sited in the upland area of Sulphur Creek across the natural drainage. This dam will be designed for maximum probable flood event so as to minimize the flood effects down stream of the structure.

Part of the rehabilitation project work is to fill in open laterals as the enclosed conduit systems are built. These foregone surface waters will be compensated for by the increase in farmer ponds. They are becoming more useful to farmers for operations for as frost control in spring and cooling of apples in mid to late summer. Water from the Roza main canal can be used to back fill the pipelines by puddling, but the projects will not require any more surface water diversions. The overall purpose of the rehabilitation projects is to be able to reduce Roza Irrigation District head gate diversions from the Yakima River.

GROUND WATER. The source of shallow water in the Yakima basin is the infiltration of rain or surface waters through soils. The porous nature of the surface soils in the Yakima basin allows for fairly high infiltration rates. Therefore, shallow ground water has the potential of being more susceptible to pollution from agricultural practices. The shallow ground water is found near rivers and streams in the basin. Normally shallow ground water seeps into the surface waters. The primary source of deep ground water is from recharge in the high mountains.
None of the projects in the proposed rehabilitation plan involve the use of groundwater. The enclosed conduit projects will however decrease the amount of water returned to the Yakima River via drains from operational wastes and losses. The reregulation reservoir will provide some seepage to the shallow ground water.

RUNOFF. Runoff on Roza Irrigation District into the main canal is water that returns to the main canal through overshot drains from irrigated areas. Most of the natural drainages have undershot drains under the Roza main canal. Sources of runoff include snowmelt and rainwaters derived from upland peripheral lands and Roza Irrigation District operational losses and waste. The majority of the run off on the Roza Irrigation District is from on-farm use. The proposed rehabilitation project will reduce this runoff. Runoff will be reduced as the rehabilitation projects provide more flexibility and control of water for the farmer. In turn, farmers make better use of their water. The enclosed conduit systems encourage farmers to change from rill irrigation to more efficient methods such as sprinkler, drip, or microjet because for many of them, pressure is provided by the new improved delivery system.

PLANTS. The Roza Irrigation District has many types of plants found within the boundaries of the district. The most obvious are the agricultural crops such as orchard, grapes, hops, mint, grains, row crops and others. However, there are other plants which place a consumptive use on district waters, including pasture, grass, shrubs, cattails, cottonwood trees, and other deciduous trees and evergreen trees.

The rehabilitation projects will eliminate any plants growing along the open laterals. These plants are destroyed annually with the ditching and burning done as maintenance to the laterals. The area where laterals once existed will be returned to their original slope and the landowner will be able to make use of the land as set forth in Roza Irrigation District

policies. The laterals and main canal are not considered regulated wetlands according to Department of Ecology, so what plant life along the immediate water surface is not considered prime habitat for supporting animal life. The construction of the reregulation reservoir will disturb a fairly large land area, but the sites is located on farmland that does not have any specialty plant life.

ANIMALS. There are no fish on the Roza Irrigation District that are directly involved with the operation of the district. Individual farmers may have ponds that they stock. There are upland birds and mammals in the District that may make their homes in areas where a specific project will be constructed. See attached list of animals and birds commonly found in the Yakima River Basin in **Appendix XIII**. There are no endangered species found on the Roza Irrigation District.

The reregulation reservoir will enhance wildlife since it should increase the faunal and floral diversity of the impacted area yet maintain its integrity.

ENERGY. Presently the energy used by Roza Irrigation District to operate and maintain the water delivery facilities includes electrical power at each of the pumping plants, the reregulation reservoirs at wasteways 6 and 7, and several pumpbacks along the main canal. Pumpbacks are used to return water from the exit end of a lining drain back to the main canal. During the construction phase of the project, fossil fuels will be used by heavy equipment. For operation of the completed projects the pumping plants will use electricity. Where possible solar power will be used to operate automated gates at check structures. A powerline upgrade and new substation will be required for the Wasteway #5 reregulation reservoir. The use of variable speed drives with existing pumping plant facilities will help to reduce the use of electricity. It may be necessary to boost the pumping capabilities at existing pumping plants, depending on the design. The enclosed conduit systems reduce the farmers need to pump as the natural fall in elevation provides some operating pressure for approximately half of the farmers on each lateral.

It is believed the overall result of the rehabilitation projects can actually increase the demand on electricity used by the District. When considering the farmers decrease in demand for pumping power, the overall demand may decrease.

Built Environment

WETLANDS. Wetlands on Roza Irrigation District have been artificially created since the irrigation project began delivering water to farmers. The area that is now the Roza Irrigation District was at one time desert and sagebrush with possibly some growth in the natural drains that supported the large drainages. The wetlands there today are created from water coming from a number of sources. The majority of this water is runoff from irrigated farmland and subsurface drainage from shallow ground water that has been applied for leaching purposes on the agricultural lands and then moves along a basalt layer or caliche layer to a natural drain. Roza Irrigation District operational wastes and losses also provide a source of water as well as runoff from melting winter snow pack and rain water during rain storms from the hills above.

Added to original text: (The Roza Irrigation District has a set of National Wetland Inventory maps covering their entire service area. These are on the USGS 7.5-minute quadrangle base. An excerpt covering a small portion of the

district area northeast of Sunnyside is shown on **Figure 6.14**. Space does not allow inclusion of the full district coverage. Anyone interested in viewing the entire district map coverage should contact district headquarters in Sunnyside.)
The land on which these wetlands exist is farmers' land. The Roza Irrigation District is responsible to the farmers to maintain the delivery system so it does not damage farmers' crops or prevent farmers from using the land for production. The drains must be cleaned occasionally so that they do not silt in and begin encroaching on farmland. District policy states that "The District may, at the request of the landowner, clean existing drains provided it is in the best interests of the District as a whole, time and funds are available, adequate right-of-way is provided and two or more Roza landowners are contributing surface flow to the drain."

The enclosed conduit systems will decrease the amount of flow into the drains as the operational spill at the end of laterals and seepage areas along laterals will be eliminated. The reregulation reservoir and automated check structures will not have a direct impact on these wetlands. They are however components of the rehabilitation project which will in totality improve water quality in the Basin. Lining of the main canal will remove any seepage from the main canal that is draining into these draws. Lining drains that will be placed under the lined section may discharge drain water. If a high water table exists, due to the irrigation above the main canal, discharge will occur into the natural drain.

The Roza Irrigation District does realize that the rehabilitation projects will decrease the amount of flow in the natural draws. These rehabilitation projects will not however dry up this artificially created wetland areas. **Figure 6.15** demonstrates all the sources that feed the natural drainages. If the Roza Irrigation District were able to run its entire system "watertight" only half the water that it presently contributes to the natural draws would return to the Yakima River. It is unrealistic to think that Roza Irrigation District could operate 100% watertight. There will still be some operational and system losses.

The landowner management along these draws has a large impact on these wetlands. This can be demonstrated by looking down along one of these natural draws and observing the degree to which the farmers have an impact on these wetlands. Some areas look like a low spot in the land and the drain is kept as a drain ditch. In other spots, the farmer has allowed cottonwood trees, willows, and cattails to grow.

SURFACE WATER DRAINS. There are also man made drains on the Roza Irrigation District. These are built to transport water to natural draws. Some of the characteristics of the drains are similar to the wetlands described above. The deeply incised nature of drains does not tend to make drains effective as wetlands.

ENVIRONMENTAL HEALTH. The rehabilitation projects do not involve any sort of environmental health hazards such as exposure to toxic chemicals or risk of fire and explosion. There is no noise in the areas that will effect Roza Irrigation District's rehabilitation projects but some short and long term noise will be created by the projects. The short-term noise will involve construction equipment. All work will be done from 8:00 a.m. until 4:30 p.m. Monday through Friday. The projects often require overtime to meet

the deadline of water being turned on. When projects get behind, overtime work will be required on weekends. The roller compacted concrete dam at wasteway 5 will be constructed 24 hours a day once the concrete is being laid. Long-term noise will consist of the same amount of noise related to current operations and maintenance of the water distribution system. To control the noise as much as possible, new pumping facilities could be placed below ground level and enclosed in a building to minimize noise. During construction the contractor or our crew, will be required to comply with applicable Federal, State and local laws and regulations concerning other prevention, control and abatement of excessive noise.

LAND USE. The current use of land within the Roza Irrigation District is irrigated agriculture with some non-irrigated agriculture and wasteland. The agricultural crops grown include orchard, grapes, hops, mint, pasture and row crops. Structures on the sites include single family dwellings, farm buildings, farm structures and irrigation facilities. The current zoning classification of all the project sites is agriculture. The current comprehensive plans for Yakima and Benton Counties designate the District as either agriculture or exclusively agriculture. There are no areas in the district that are classified as "environmentally sensitive" areas. The rehabilitation projects, specifically the enclosed conduit systems will eliminate the old concrete delivery boxes. There will be no change in the number of people residing or working in the project area. The project would not displace any current residents.

TRANSPORTATION. There is no public transportation system on the Roza Irrigation District. Benton and Yakima County provide the county roads that are used through out the District. The proposed rehabilitation project will have no effect on existing transportation infrastructure.

PUBLIC SERVICES AND UTILITIES. The proposed rehabilitation projects will not result in an increased need for public services in general. In fact the enclosed conduit systems will result in a decrease in demand for on-farm pumping.

Utilities presently available to Roza Irrigation District are electricity and telephone. Electricity presently exists at all pump backs on the main canal, all existing pumping plants, Wasteway 6 and 7 reregulation reservoirs and the gate actuator at the entrance to siphon 9. Telephone service to wasteway 6 reregulation reservoir exists as a modem is used for remote sensing. Wasteway #7 reregulation reservoir communications are handled via dial-up telephone modem to the Lower Watermaster's Office. Utilities proposed for the projects are an up-graded transmission line and a new power substation for the reregulation reservoir at wasteway 5, and possible power drops to those automated gates where solar power is impractical.

Permits Required

This section addresses how the proposed Rehabilitation Projects will comply with relative Federal, State, local laws, regulations, authorities, and permit requirements.

FEDERAL LEGISLATION. The following is a list of various pieces of Federal Legislation and any relationship to preferred rehabilitation plan that implies necessity to comply.

1. National Environmental Policy Act (NEPA) This Act requires that federally sponsored actions or projects be evaluated from an environmental perspective to adequately determine impacts on the quality of the human environment. The conservation plan items have been screened through the SEPA process with a finding of non-significant impact (FONSI). There will be a NEPA analysis as well done on the Wasteway #5 reregulation Reservoir as a requirement of the federal funding. (See also under state regulations SEPA.)

2. Endangered Species Act This Act requires full protection of plant and animal species that are currently in danger of extinction (endangered) or those that may be so in the foreseeable future (threatened). Section 7 of this Act requires consultation with the Service to determine potential project impacts on threatened and endangered species. To our knowledge, the Roza Irrigation District has no federally listed endangered or threatened animal species within the District. Presently, there are no federally listed endangered or threatened plants in Washington.

3. Fish and Wildlife Coordination Act Under this authority, fish and wildlife must receive consideration equal to other water project features. As required by the Act, impacts to fish and wildlife will be evaluated in consultation with the U.S. Fish and Wildlife Service and the Washington State Department of Wildlife. It is believed that these projects have no direct impact on fish. The wildlife will be considered at a State level.

4. Executive Order 11990, Protection of Wetlands Under this directive and in carrying out resource management programs, all Federal agencies are to take actions that will minimize the destruction, loss or degradation of wetland areas. The rehabilitation projects described above will not destroy or depreciate wetlands in the project area. The rehabilitation projects will improve the quality of the water in the wetlands by reducing the erosion and sediment loading in the drains.

5. Executive Order 11988, Flood plain Management This executive order requires that Federal agency programs management reduces the risk of flood plain losses; minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by flood plains. The Corps of Engineers has completed Flood plain and floodway mapping in the Yakima Basin. In some areas, 100-year flood elevations have been mapped (based on National Geodetic Vertical Datum of 1929). Areas not included in this mapping only the horizontal extent of the 100-year flood plain is shown. Additional information will be needed for final design to determine the full extent of the 100-year flood plain at each project site.

6. Clean Water Act The goal of the clean water act is to "restore and maintain the chemical, physical, and biological integrity of the Nation's water." Under Section 401 of the Clean Water Act, Reclamation would concurrently acquire water quality certification or modification approval from the Washington Department of Ecology to assure compliance with the

states water quality standards. Roza Irrigation District would not fall under the 401 regulation.

7. Clean Air Act This Act was passed in 1963 and amended many times. It establishes air quality criteria, national ambient air quality standards and a mechanism for State implementation of air quality standards. None of the construction projects have any stationary emissions source, nor are any of the sites in a DOE non-attainment area. Therefore, the rehabilitation projects are not regulated by the Clean Air Act.

8. National Historic Preservation Act, Archeological Resources Protection Act, American Indian Religious Freedom Act, National Landmarks Program and the World Heritage List All these Acts safeguard our heritage from Federally sponsored or permitted projects.

STATE LEGISLATION. The following is a list of various pieces of Washington State Legislation and any relationship to preferred rehabilitation plan that implies necessity to comply.

1. State Environmental Policy Act (SEPA) This act was implemented to ensure that Washington State decision makers would consider the environmental impacts of proposed projects. This environmental assessment and checklist is being prepared under the normal SEPA process. Responses and comments received at this stage in the project planning will be taken into consideration when the individual construction projects are in design phase and once again go through the SEPA process.

LOCAL GOVERNMENT. Compliance with Yakima and Benton County Comprehensive Land Use Plans and Zoning Requirements. Roza Irrigation District is working with both counties as they prepare their updated comprehensive land use plans in accordance with the Growth Management Act.

GOVERNMENT APPROVALS OR PERMITS REQUIRED. The following is a list of all possible approvals or permits that could be required for construction and use of the preferred rehabilitation plan components.

1. Yakima and Benton County Road Crossing Permits any time a project crosses a county road.
2. WDOE Dam Safety Approval Permit for the dams at the reregulation reservoirs.
3. Labor and Industry Electrical Section, Electrical Work Permit for any wiring done on automation controls or power for pumping plants.
4. FCC Permit if Roza Irrigation District uses radio communication for remote sensing or control.
5. Yakima County Special Property Use Permit for the reservoir.
6. Special permit from Benton County to carry heavy loads before frost comes out of the ground.

Recommendations

The environmental assessment points out how the different projects that are a part of Roza Irrigation District's rehabilitation plan will impact the environment. It appears that there are not going to be any major negative effects on the environment. Each construction project will be explored more in depth when the project is in the preliminary design phase. At this

point it seems there is no reason to prevent the Roza Irrigation District from proceeding with the preferred rehabilitation plan for the improved water conservation and improved water quality in the Yakima River Basin.

Consultation and Coordination

Below is a list of agencies and individuals that were contacted by Roza Irrigation District in the preparation of this draft environmental assessment.

Yakima County Conference of Governments - Lon Wyrick
Benton-Franklin Governmental Conference
Washington Department of Wildlife, Brent Renfrow
Yakima Indian Nation, Carroll Palmer
Washington Department of Fisheries, John Easterbrooks
Soil Conservation Service, Jerry Jacoby
U.S. Fish and Wildlife Service, Mike Tehan
Bureau of Reclamation, Brian Person
Department of Ecology, Ray Newkirk
Yakima County Planning Department, Rich Nourse
Benton County Planning Department, Phil Mees

6.3.3.12 On-Farm Coordination

Each year the Roza Irrigation District meets with farmer/growers in the area of that years enclosed conduit system to go over the proposed project, discussing removal of existing structures, proposed pipeline alignment, signing of required agreements and rights-of-way, location of utilities in the pipeline path, and to layout district and grower expectations and responsibilities.

6.3.4 Second and Third-Tier Measures Time-line. It should be noted that the procurement of funding for these projects plays a large role in the number of these projects that are carried out. If Roza Irrigation District can obtain sufficient funding, then projects will proceed at the shown rate, or even a faster pace. The projects will be discussed on the basis of what Roza Irrigation District has done in the past and the continuation of the same type of work to new areas of the District. Roza Irrigation District has already committed to several projects.

The Enclosed Conduit Systems have been installed on gravity laterals at an average rate of 2000 acres per year, since 1983. Presently, 60% of the gravity fed acres are under enclosed conduit with a remaining 18,000 acres to be enclosed. When these are completed the pump laterals will be enclosed of which there are approximately 27,000 acres. For the first few years of enclosing pump laterals less acreage will be enclosed due to the higher cost of construction as some remodeling and automation of pumping plants will also be required. When the check structures are completed, it is assumed that the enclosure of the pump laterals might proceed faster. Canal Automation and Reregulation is proceeding as fast as these facilities can reasonably be funded. One check structure is to be automated annually with completion in about 2012.

Lining of the main canal and open laterals will take place in those areas designated as having the worst seepage problems. Roza Irrigation District plans to stay with this plan until such a time as the other rehabilitation projects have been completed and the water savings in a major undertaking of lining the entire main canal is economically feasible.

7.0 FINANCIAL

7.1 Present Financial Situation

7.1.1 Operating Income and Expenses and assessment structure. **Table 7.1** shows the actual income and expense for years 1993-96. **Table 7.2** gives the projected budget for the next 5 years. **Table 7.3** lists the assessment rates for the years 1986-97. The current assessment rate is $72 per acre of irrigable land. This payment is for up to three acre-feet of water. If additional water is required, the cost is $30 per acre-foot. The Board has raised the assessments by $5/acre this year to cover drought-related catch up work, storage reservoir maintenance, restoration of reserve funds, higher cost of doing business due to health and safety concerns, water quality issues, and higher power costs.

TABLE 7.3 ASSESSMENT RATES FOR YEARS 1986-97.

YEAR	ASSESSMENT ($/ACRE)	Extra Water $/AF
1997	$ 72.00	$30.00
1996	67.00	25.00
1995	67.00	25.00
1994	58.50	25.00
1993	50.00	20.00
1992	45.00	18.00
1991	43.00	18.00
1990	43.00	18.00
1989	42.00	17.00
1988	42.00	16.00
1987	40.00	14.50
1986	38.50	14.00

The assessment is divided into two parts. First, $4.10 of the assessment rate goes directly to pay for original construction of the project. The balance goes toward operation and maintenance expenses.

Roza Irrigation District assessments are levied annually against the irrigable lands of the District to provide monies for operation and maintenance of facilities and repayment of facility construction costs. If additional water is required a fee is required based on the additional acre-feet required. The Board of Directors has intentionally set the cost for extra water higher to encourage users to conserve water. The Board has also discussed the possibility of lowering the amount of water received when the original assessment is paid to 2 or 2.5 acre feet to further encourage on farm conservation measures. The Roza Irrigation District Board of Directors evaluates the financial situation and set the assessment rate for the following year, in November. The setting of the assessment rates must also, at a minimum, follow the guidelines covered under the repayment contract. The minutes from the meetings are on file in Roza Irrigation District office. Irrigation assessments, by State Law, are a lien against the property assessed and are paramount and superior to any

other lien theretofore or thereafter created. These assessments become due and payable on the fifteenth day of February and are delinquent IF NOT PAID BY OCTOBER 31. Delinquent assessments accrue interest at the rate of 12%. Property having delinquent assessments may be sold at public auction to recover assessments.

7.1.2 Current Indebtedness

Assessments provide approximately 78% of total income, with the balance coming from sales of extra water, reimbursable work done by RID interest earnings on RID investments. The district has exhausted its share of State Referendum Funds and Centennial Clean Water Fund Grant monies are no longer available for this type of work.

BALANCE SHEET. **Appendix I** is the Balance Sheet for 1994-95.

INCOME STATEMENT. **Appendix II** is the Income and Expense Statement for 1994-95. Power costs are broken out in these statements and shown under expenses to the Bureau.

LOAN REPAYMENT SCHEDULE. The loan repayment schedule is shown below and has been copied from the last auditor's report that is **Appendix III.**

The payables represent amounts due to the USBR by the District on the LID and the original construction of the irrigation system. The annual requirements to amortize all debts outstanding as of December 31, 1995, including interest, are as follows are shown in **Table 7.4.**

TABLE 7.4. OUTSTANDING DEBT AS OF DECEMBER 31, 1995

	1996		270,509.01
	1997		270,509.01
	1998		270,509.01
	1999		270,509.01
	2000		270,509.01
Total	2001-2023	$	6,834,443.10

RESERVE FUND ACCOUNT. The Roza Irrigation District is required by contract with the Bureau of Reclamation to have a reserve account to cover emergencies or cash flow problems as arise. Figure 7.1 shows activities of the account for the past few years. The various long-term contracts contain commitments and restrictions regarding cash reserve balance and debt service requirements. The District is in compliance with all commitments and restrictions. Neither note bears interest.

STATE AUDITOR'S EXAMINATION AND REPORT. **Appendix III** is a copy of the most recent state auditor's examination and report, January 1, 1994 through December 31, 1995.

7.1.3. Funding the Rehabilitation Projects

Roza Irrigation District plans to continue rehabilitation at the present rate of construction as long as the same relative amount of grant monies can be procured. If funding decreases then the projects will be cut back to a level that the funding can accommodate. The construction window and the willingness of the water users to cover the construction costs determine the size of the annual modernization construction package. The following discussion describes the present funding of projects and the possibilities for funding beyond the present methods. The Board strongly supports a "Pay-as- We-Build" philosophy.

The Roza Irrigation District is aware of the fact that Referendum 38 monies available to the district are about exhausted and will not be around long enough to see the rehabilitation to completion. A $1.5 million limit over a five-year period was set. The pool of money was reevaluated in 1994 and the limit per entity was at the discretion of the State. The Roza Irrigation District has exhausted this source of funding.

The Roza Irrigation District has explored the possibility of using Federal Loans to finance the rehabilitation projects. The repayment rates for these loans were calculated in a manner that made repayment of the loans too large of a burden on those farmers in the District whose returns were below average. This happens with Roza Irrigation District because there is such a diversity of crops within the District. There are always some crops doing well and others hurting. The Federal Loans were not structured to account for this. The District has no way to assess different rates to different crop types. This is one reason the Board adopted a "pay as you go" policy for the rehabilitation projects.

The cost of revenue bonding is also high for the District and the repayment schedule could snowball to the point that no more rehabilitation could be taken on.

The proposed Yakima Enhancement Bill would provide a funding source from both the Federal and State Governments for conservation projects in the Yakima Basin. The Board has elected to raise assessments to cover rehabilitation in order to get more construction done.

The preceding discussion demonstrates that flexibility is a key to the financial program for the District. There is never certainty in business, but by keeping a healthy reserve, paying for the projects as they are built and remaining flexible in funding resources, it is felt Roza Irrigation District will remain financially sound. Part of the flexibility also means adjusting the size and timing of projects appropriately.

7.2 Financial Plan for Tier #1. The Roza Irrigation District plans to continue rehabilitation at least at the current rate of construction. The Board has also directed the management and staff to explore ways in which the work could be accelerated, and what it would mean in commitment to manpower, equipment, and funds. This work is under way, and as yet incomplete. State funding under Referendum 38 has been exhausted, however, the district is still committed to about $1,000,000 annually for system conversion. The value of crops and general well being of the farmers on the Roza Irrigation District does cycle over time. The Board may elect to

further raise assessments based on the aforementioned study given to staff. At present, plans are to continue construction at the current rate.

The Yakima River Basin Water Enhancement Project (YRBWEP) is being contemplated as the funding source for the reregulation reservoir on Sulphur Creek above Wasteway #5.

If YRBWEP money were to become available, the district would contract for geological exploration of the reservoir and damsite. Once foundation and reservoir area soundness was determined, staff would begin the design storm and floodway analyses, downstream hazard classification, and emergency plans as required under Washington State Safety-of-Dams.

Contractors would be hired for geologic exploration and analysis and roller-compacted concrete construction. District engineering staff would be responsible for compliance studies and reports, penstock and pumping plant design and construction, overall construction inspection, and contract administration.

Funding needs are assumed as follows

Tier 1 - year 1	$200,000
- year 2	$300,000
- year 3	$7,500,000
- year 4	$7,500,000

Table 7.2 does not include funding for the reregulation reservoir, as the starting date and project timing are as yet unknown. It does show increases in assessments and an increase in expenses, which are assumed to be allocated to some phase of the rehabilitation of district facilities. The continued progress on the work since 1984 bears testimony to the district's commitment and diligence. The district has been able to do this because they have kept their financial program flexible. The future work will be predicated on continued flexibility. During construction of the reregulation reservoir, the district may elect to increase assessments, or to curtail the other rehabilitation work to cover construction costs.

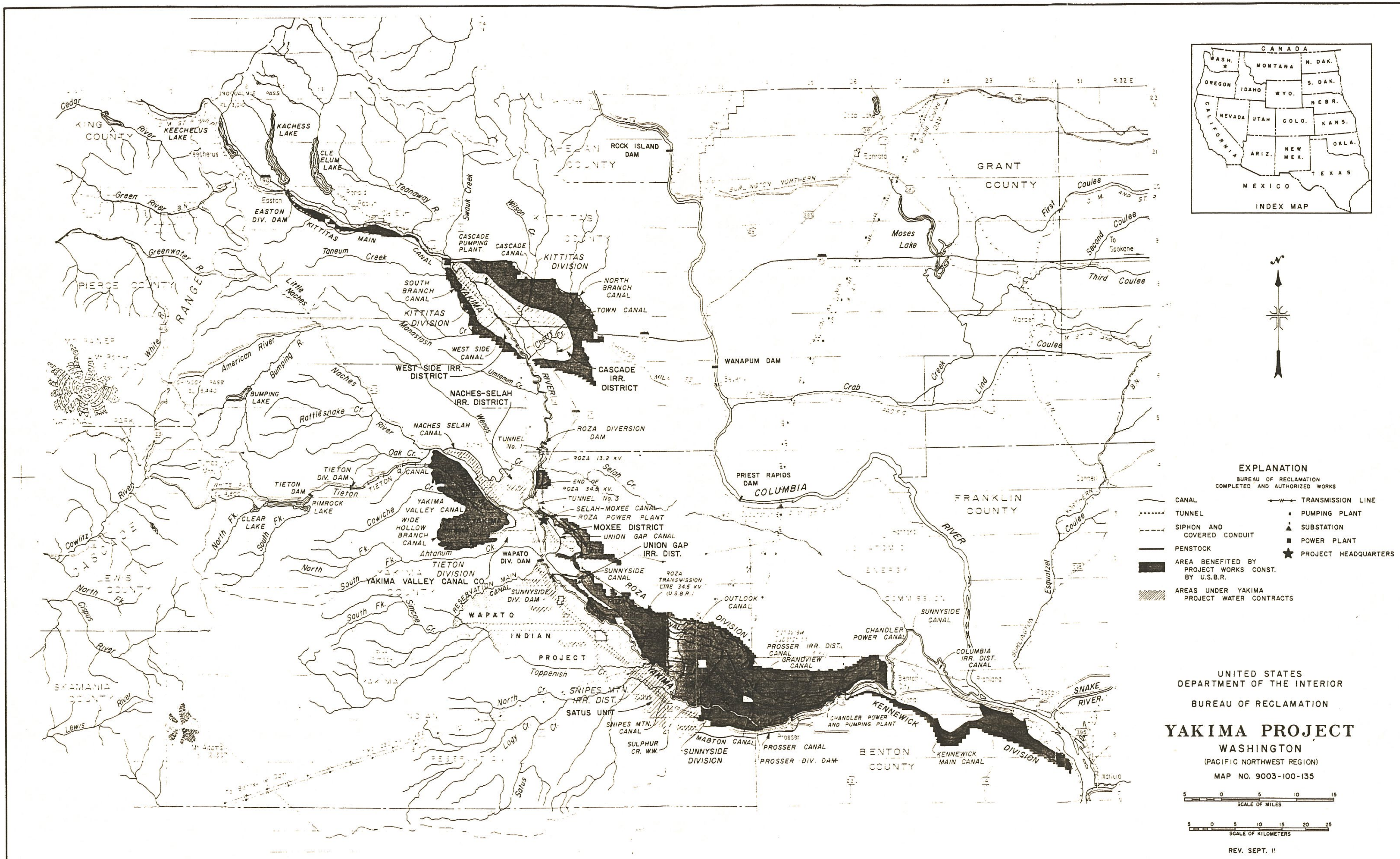

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
YAKIMA PROJECT
WASHINGTON
(PACIFIC NORTHWEST REGION)
MAP NO. 9003-100-135
SCALE OF MILES
SCALE OF KILOMETERS
REV. SEPT. 11
EXPLANATION
BUREAU OF RECLAMATION
COMPLETED AND AUTHORIZED WORKS
CANAL
TUNNEL
SIPHON AND COVERED CONDUIT
PENSTOCK
AREA BENEFITED BY PROJECT WORKS CONST. BY U.S.B.R.
AREAS UNDER YAKIMA PROJECT WATER CONTRACTS
TRANSMISSION LINE
PUMPING PLANT
SUBSTATION
POWER PLANT
PROJECT HEADQUARTERS
INDEX MAP
CANADA
WASH.
MONTANA
N. DAK.
OREGON
IDAHO
WYO.
S. DAK.
NEBR.
CALIFORNIA
NEVADA
UTAH
COLO.
KANS.
ARIZ.
NEW MEX.
OKLA.
TEXAS
MEXICO
KING COUNTY
KEECHELUS LAKE
KACHESS LAKE
CLE ELUM LAKE
EASTON DIV. DAM
KITTITAS MAIN CANAL
CASCADE PUMPING PLANT
CASCADE CANAL
KITTITAS DIVISION
NORTH BRANCH CANAL
TOWN CANAL
SOUTH BRANCH CANAL
WEST SIDE CANAL
CASCADE IRR. DISTRICT
WEST SIDE IRR. DISTRICT
NACHES-SELAH IRR. DISTRICT
PIERCE COUNTY
BUMPING LAKE
NACHES SELAH CANAL
TUNNEL No. 1
ROZA DIVERSION DAM
ROZA 13.2 KV
END OF ROZA 34.5 KV.
TUNNEL No. 3
SELAH-MOXEE CANAL
ROZA POWER PLANT
MOXEE DISTRICT
UNION GAP CANAL
UNION GAP IRR. DIST.
TIETON DIV. DAM
TIETON DAM
RIMROCK LAKE
CLEAR LAKE
YAKIMA VALLEY CANAL
WIDE HOLLOW BRANCH CANAL
WAPATO DIV. DAM
TIETON DIVISION
YAKIMA VALLEY CANAL CO.
SUNNYSIDE DIV. DAM
SUNNYSIDE CANAL
ROZA TRANSMISSION LINE 34.5 KV (U.S.B.R.)
OUTLOOK CANAL
WAPATO INDIAN PROJECT
PROSSER IRR. DIST. CANAL
GRANDVIEW CANAL
SNIPES MTN. IRR. DIST.
SATUS UNIT
SNIPES MTN. CANAL
SULPHUR CR. W.W.
SUNNYSIDE DIVISION
MABTON CANAL
PROSSER CANAL
PROSSER DIV. DAM
CHANDLER POWER AND PUMPING PLANT
KENNEWICK DIVISION
KENNEWICK MAIN CANAL
BENTON COUNTY
CHANDLER POWER CANAL
COLUMBIA IRR. DIST. CANAL
SNAKE RIVER
FRANKLIN COUNTY
GRANT COUNTY
ROCK ISLAND DAM
WANAPUM DAM
PRIEST RAPIDS DAM
COLUMBIA RIVER
Moses Lake
First Coulee
Second Coulee
Third Coulee
To Spokane
Crab Creek
Lind Coulee
Esquatzel Coulee
Cascade Range
Yakima River
Naches River
Tieton
Cowlitz
Cispus River
Lewis River
SKAMANIA COUNTY
LEWIS COUNTY
YAKIMA COUNTY
Toppenish Cr.
Satus
Logy Cr.
Simcoe Cr.
Ahtanum Ck.
Cowiche Cr.
Wenas
Selah Cr.
Umtanum Cr.
Manastash Cr.
Taneum Creek
Teanaway R.
Swauk Creek
Wilson Cr.
Cherry Cr.
Little Naches
American River
Bumping R.
Rattlesnake Cr.
Oak Cr.
Greenwater R.
Green River
Cedar River
White R.

FIGURE 1.1

ROZA IRRIGATION DISTRICT

ORGANIZATION CHART

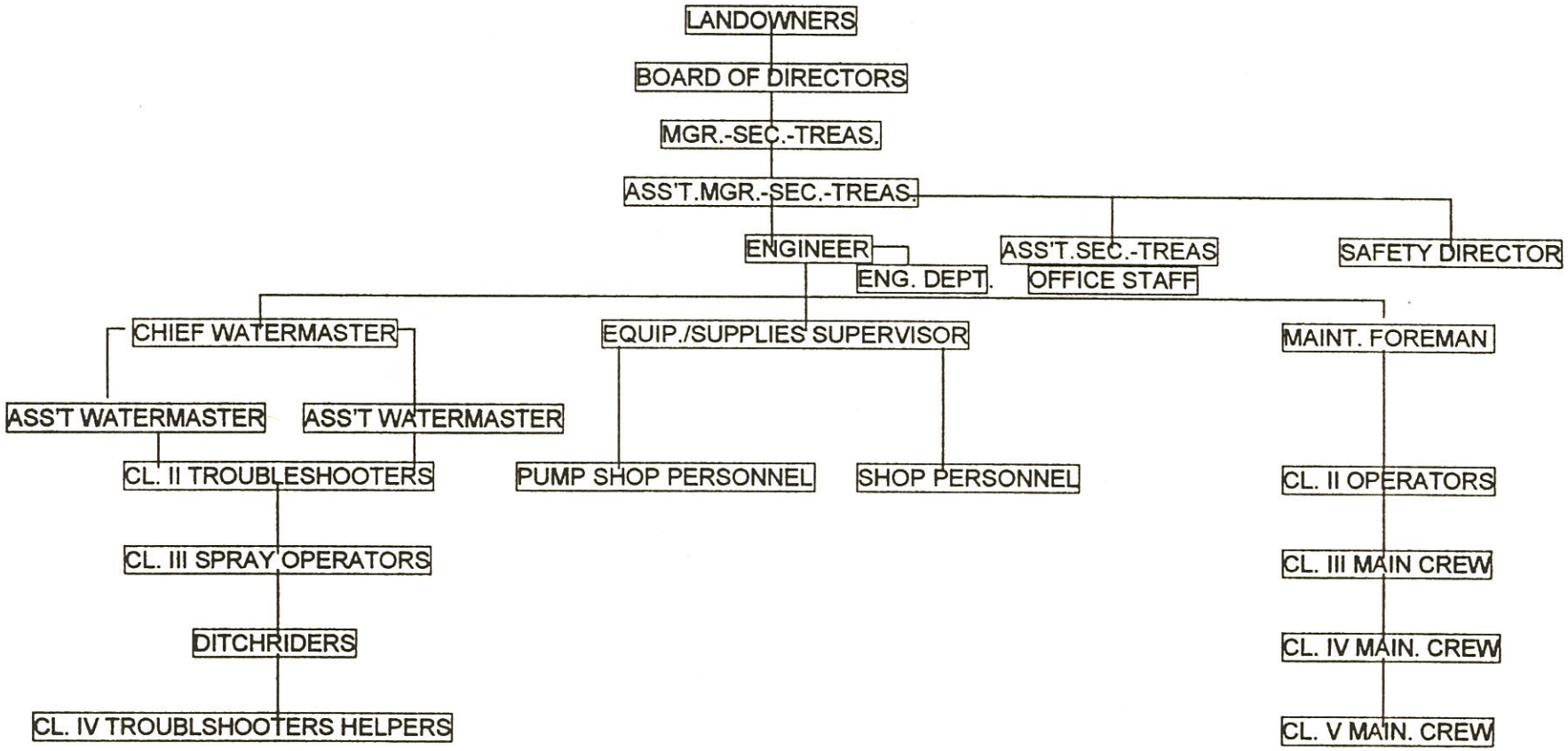


FIGURE 1.2

ROZA IRRIGATION DISTRICT		
DATE: APRIL 10, 1997	REVISED:	DRAWN BY: M. STEWART
SCALE: 1" = 4 miles		APP.BY: D. PERALA
ROZA IRRIGATION DISTRICT GEOLOGY & SOIL TYPES		
Sunnyside, Washington	JOB NUMBER	DRAWING NUMBER DNIJCDN

R 19 E
R 20 E
R 21 E
R 22 E
R 23 E
R 24 E
R 25 E
R 26 E
R 27 E

T 14 N
T 13 N
T 12 N
T 11 N
T 10 N
T 09 N
T 08 N

PUMP #1
AREA 1
TUNNEL #3
WASTEWAY #2
TERRACE HEIGHTS PUMP
PUMP #2 AND CHECK
M.P.11
PUMP #3
M.P.20
MOXEE
PUMP #4
PUMP #5
TUNNEL #5
WASTEWAY #3
PUMP #6
TUNNEL #6
M.P.30
ROZA MAIN CANAL
PUMP #7 AND CHECK
WASTEWAY #4
AREA 2
PUMP #8 AND CHECK
PUMP #9 AND CHECK
PUMP #9A
PUMP #10
M.P.40
ZILLAH
WASTEWAY #5
PUMP #12
M.P.50
GRANGER
AREA 3
OUTLOOK
PUMP #13
PUMP #14
SUNNYSIDE
M.P.60
CHECK 77.3
PUMP #15
SEVERYNS PUMP
PUMP #16
PUMP #17
WASTEWAY #7 REREGULATION RESERVOIR
M.P.70
AREA 4
GRANDVIEW
M.P.80
M.P.90
CORRAL CREEK
BENTON CITY
WASTEWAY #6 AND REREGULATION RESERVOIR
WHITSTRAN
AREA 5
AREA 6
MABTON
PROSSER

YAKIMA COUNTY
BENTON COUNTY

ROZA MAIN CANAL
R.I.D. ENCLOSED CONDUIT SYSTEM
PUMP PLANTS
CHECK STRUCTURE

FIGURE 2.1

Generalized Stratigraphic Column
for the Five Principal Aquifers
of the Yakima River Basin

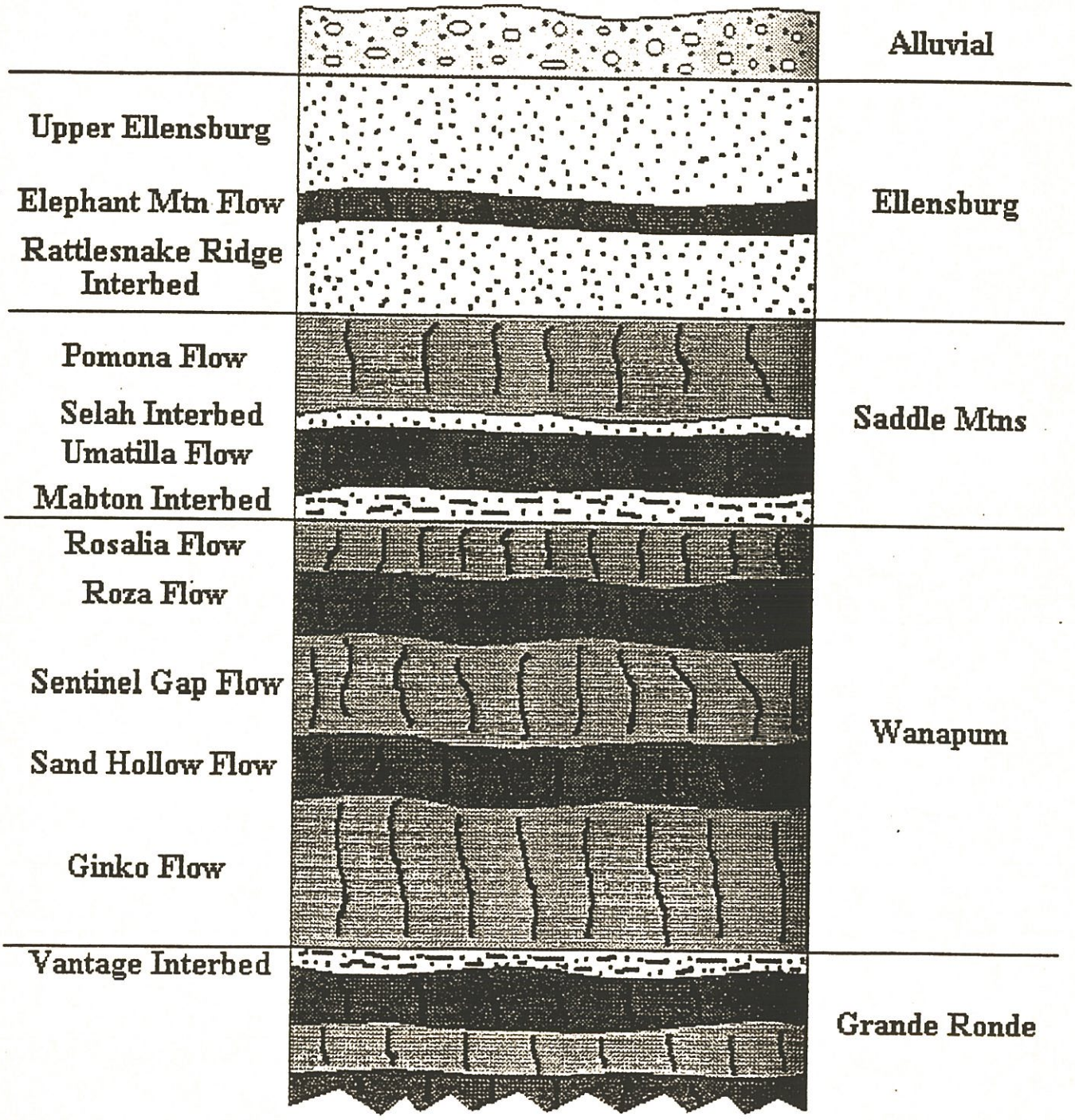
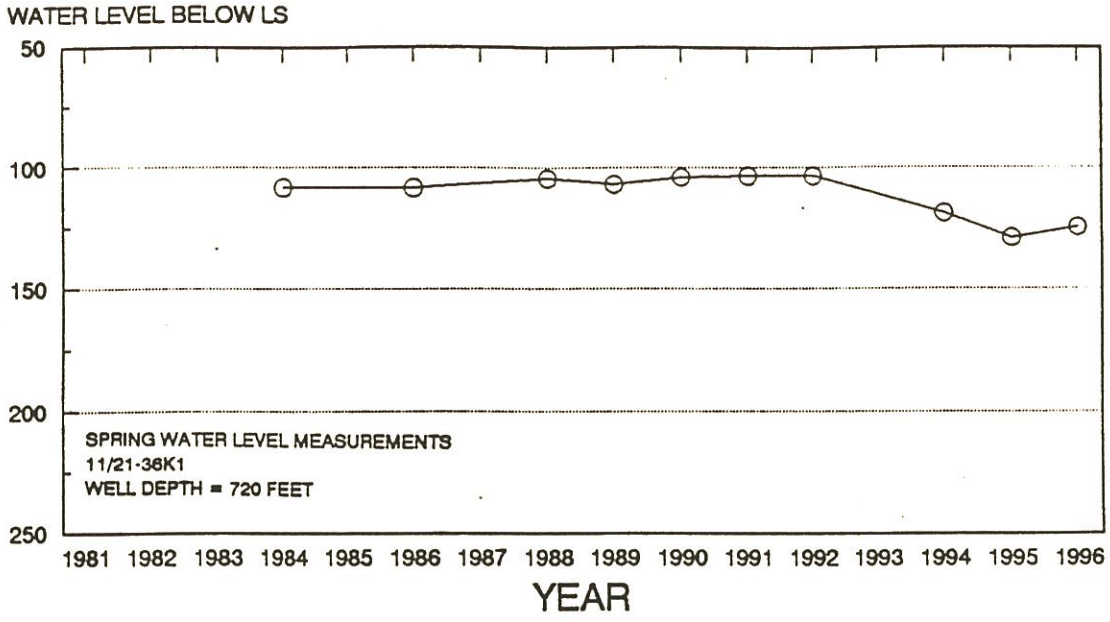


FIGURE 2.2

ELLENSBURG AQUIFER



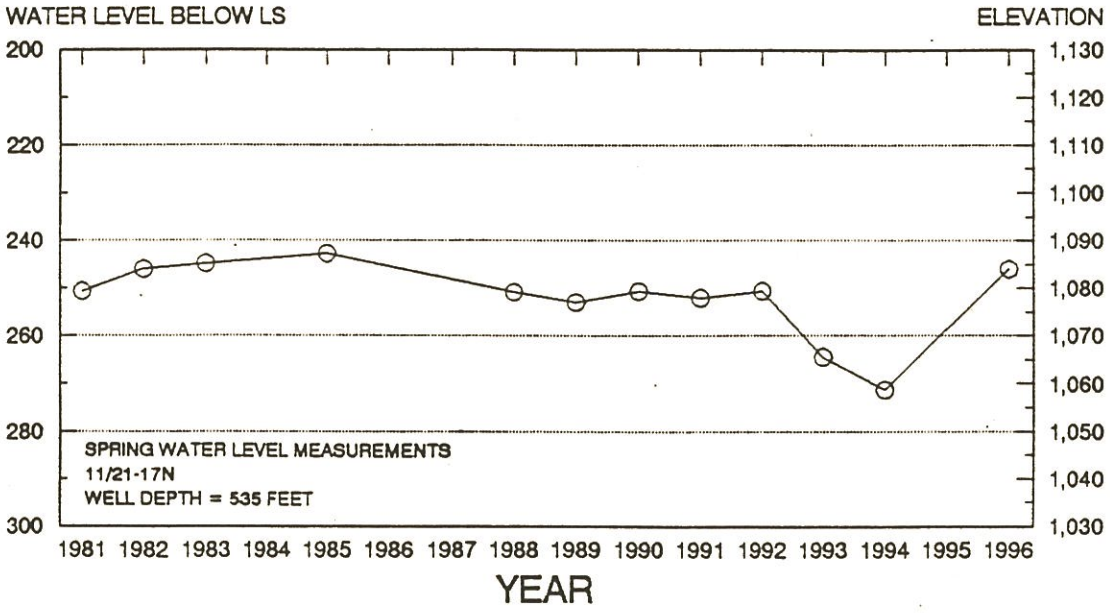
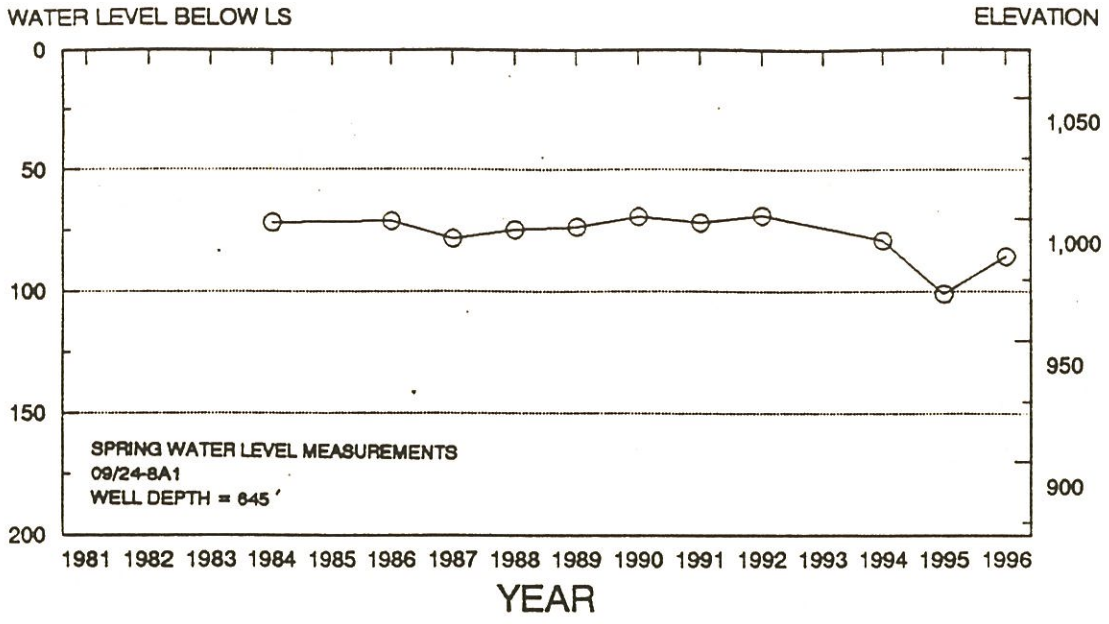
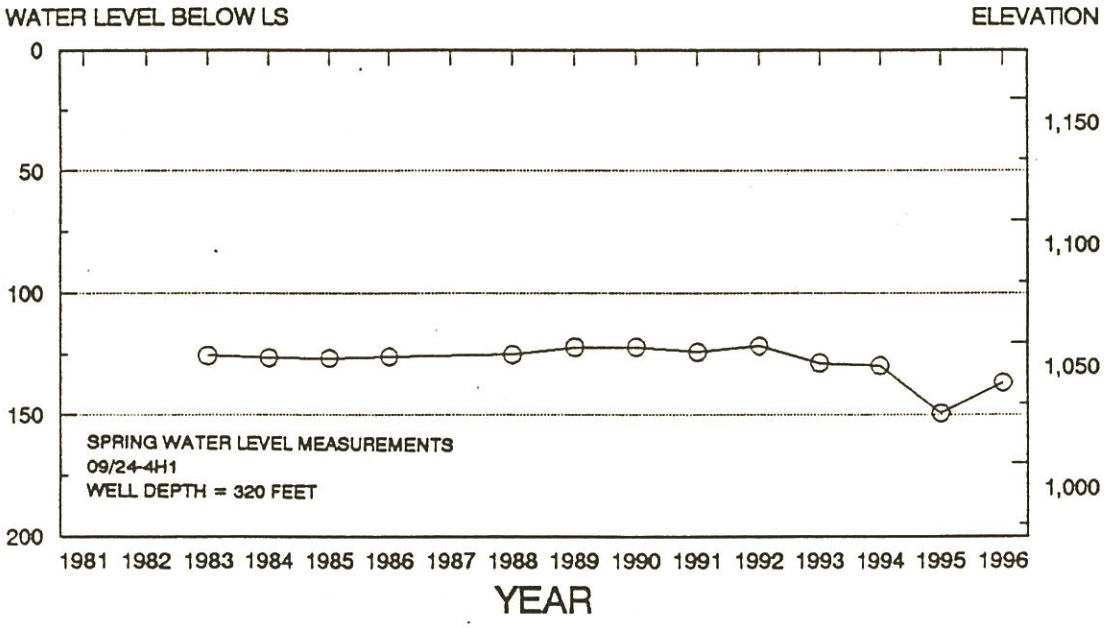


FIGURE 2.3

SADDLE MOUNTAINS AQUIFER





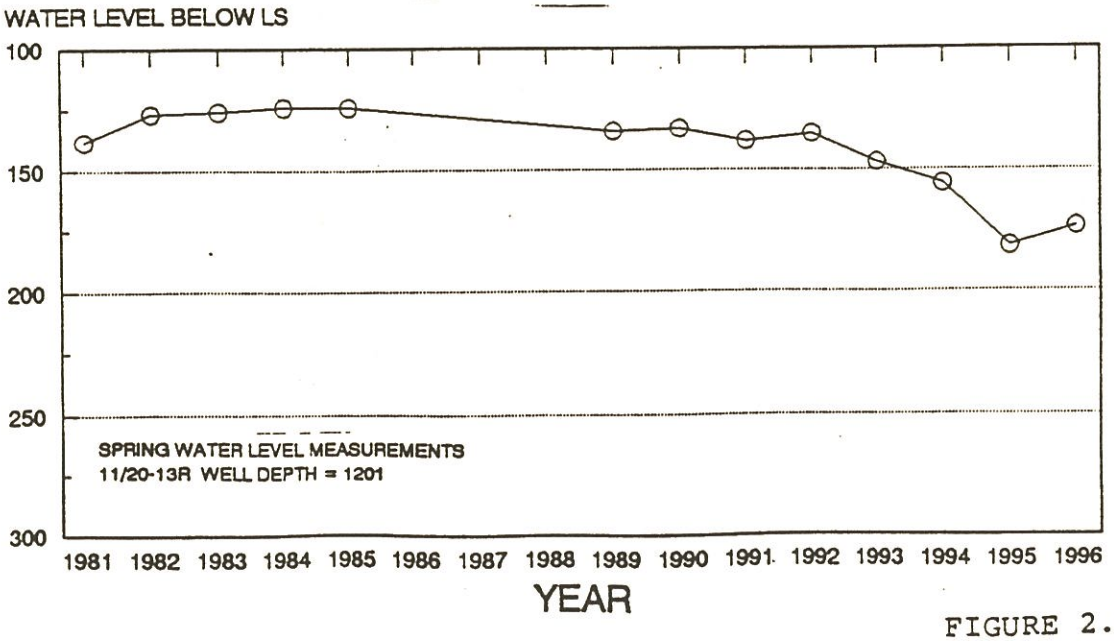


FIGURE 2.4

VOL 616 PAGE 464 CERTIFICATE RECORD NO. 17 , PAGE NO. 212

STATE OF WASHINGTON, COUNTY OF Yakima, Benton, and Kittitas

CERTIFICATE OF SURFACE WATER RIGHT

(In accordance with the provisions of Chapter 117, Laws of Washington for 1917, and amendments thereto, and the rules and regulations of the State Supervisor of Water Resources thereunder.)

This is to certify that UNITED STATES OF AMERICA BUREAU OF RECLAMATION *of* Boise, *State of* Idaho, *has made proof to the satisfaction of the State Supervisor of Water Resources of Washington, of a right to the use of the waters of* Yakima River, *a tributary of* Columbia River, *with point or points of diversion within the* NE¼NE¼ *Sec.* 32, *Twp.* 15 *N., R.* 19 *E., W. M., under and subject to provisions contained in* Appropriation *Permit No.* 1727 *issued by the State Supervisor of Water Resources, and that said right to the use of said waters has been perfected in accordance with the laws of Washington, and is hereby confirmed by the State Supervisor of Water Resources of Washington and entered of record in Volume* 17, *at Page* 8122, *on the* 22nd *day of* May, 19 61 *that the priority date of the right hereby confirmed is* May 10, 1905; *that the amount of water under the right hereby confirmed, for the following purposes is limited to an amount actually beneficially used and shall not exceed* 2200 cubic feet per second for the purposes of irrigation, domestic supply and power generation; irrigation use being limited to 393,000 acre-feet per year for irrigation of 72,600 acres.

A description of the lands under such right to which the water right is appurtenant, and the place where such water is put to beneficial use, is as follows:

Lands within the Roza Division of the Yakima Project, State of Washington.

FILED BY U. S. Bureau of Reclamation
JUN 6 8 58 AM '61
VERNER MILLER, AUDITOR
DEPUTY
RECORDED IN VOL. 1 PAGE 312
VOLUME 1 PAGE 312
INDEXED BY
CHECKED BY
MAIL TO:
U. S. Bureau of Reclamation
Box 937
Boise, Idaho

The right to the use of the water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in Sections 6 and 7, Chapter 122, Laws of 1929.

IN WITNESS WHEREOF, the seal and signature of the State Supervisor of Water Resources affixed this 22nd *day of* May, 19 61

State Supervisor of Water Resources.

ENGINEERING DATA
O.K.

Filed for Record MAY 26 1961 11 22 A.M.
Request of U. S. Reclamation, Boise, Idaho
EUGENE NAFF, County Auditor

1 PAGE 213

FIGURE 3.1

ROZA IRRIGATION DISTRICT
DIVERSION VS. FARM DELIVERY

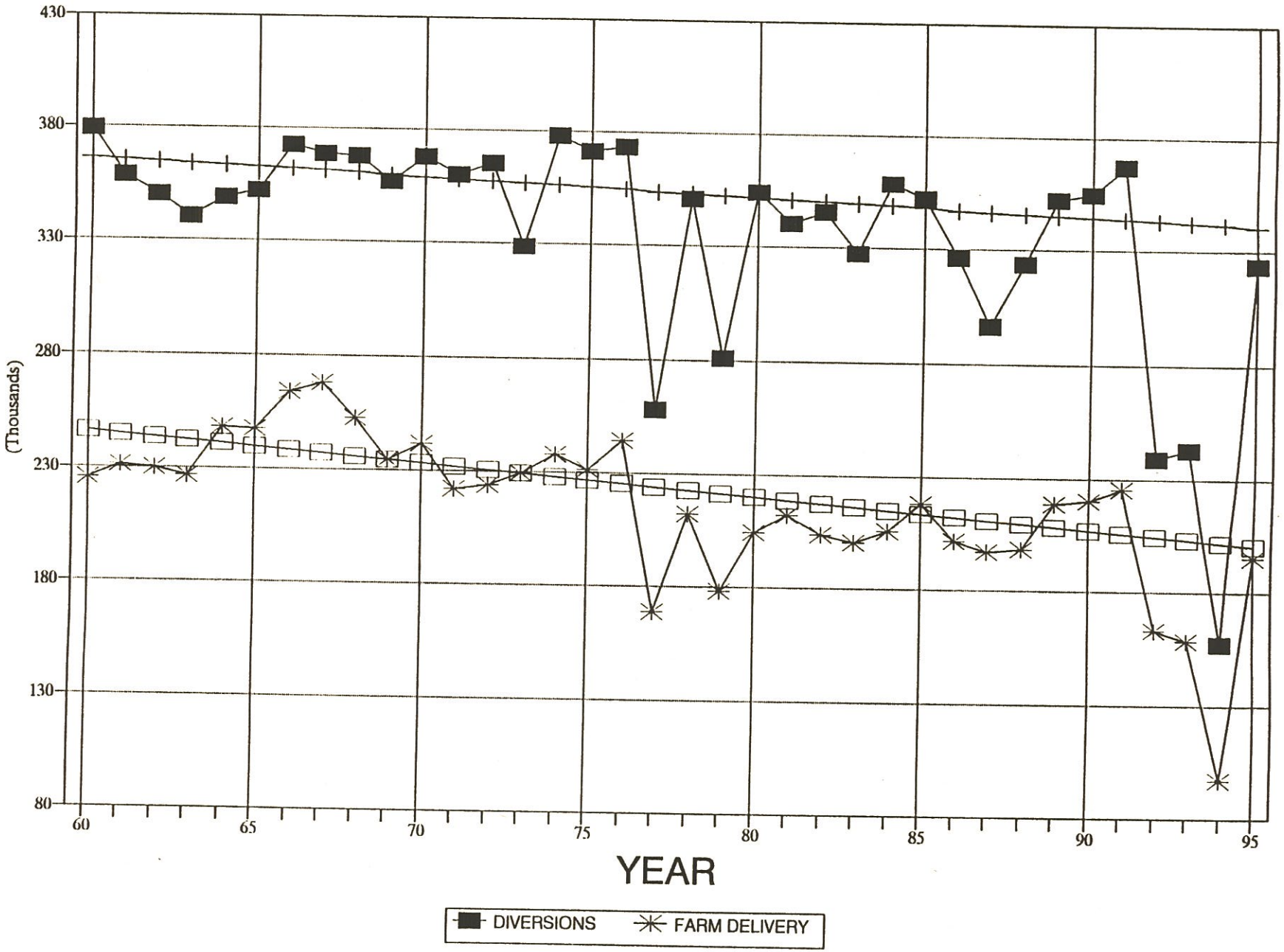


FIGURE 3.2

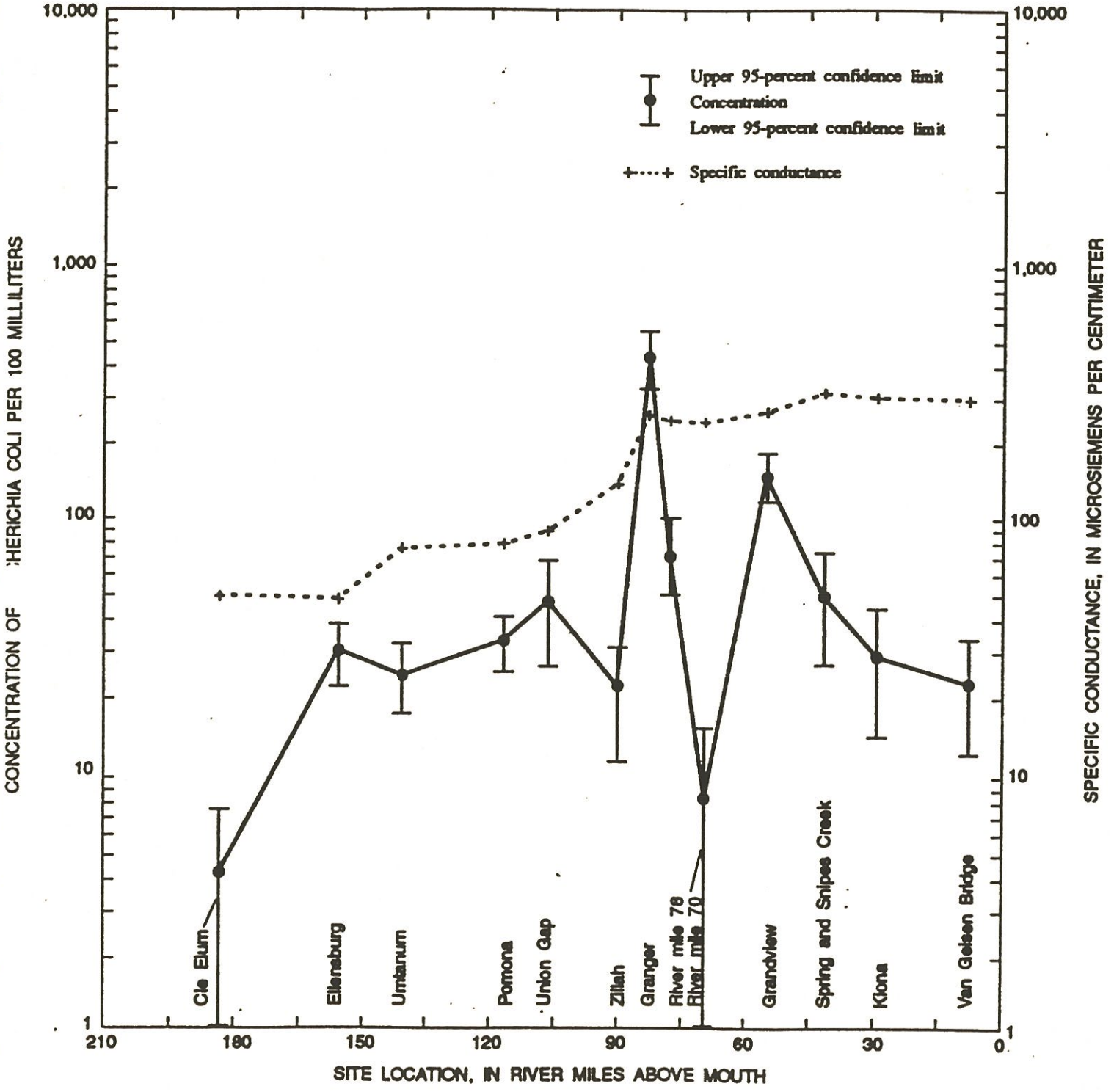
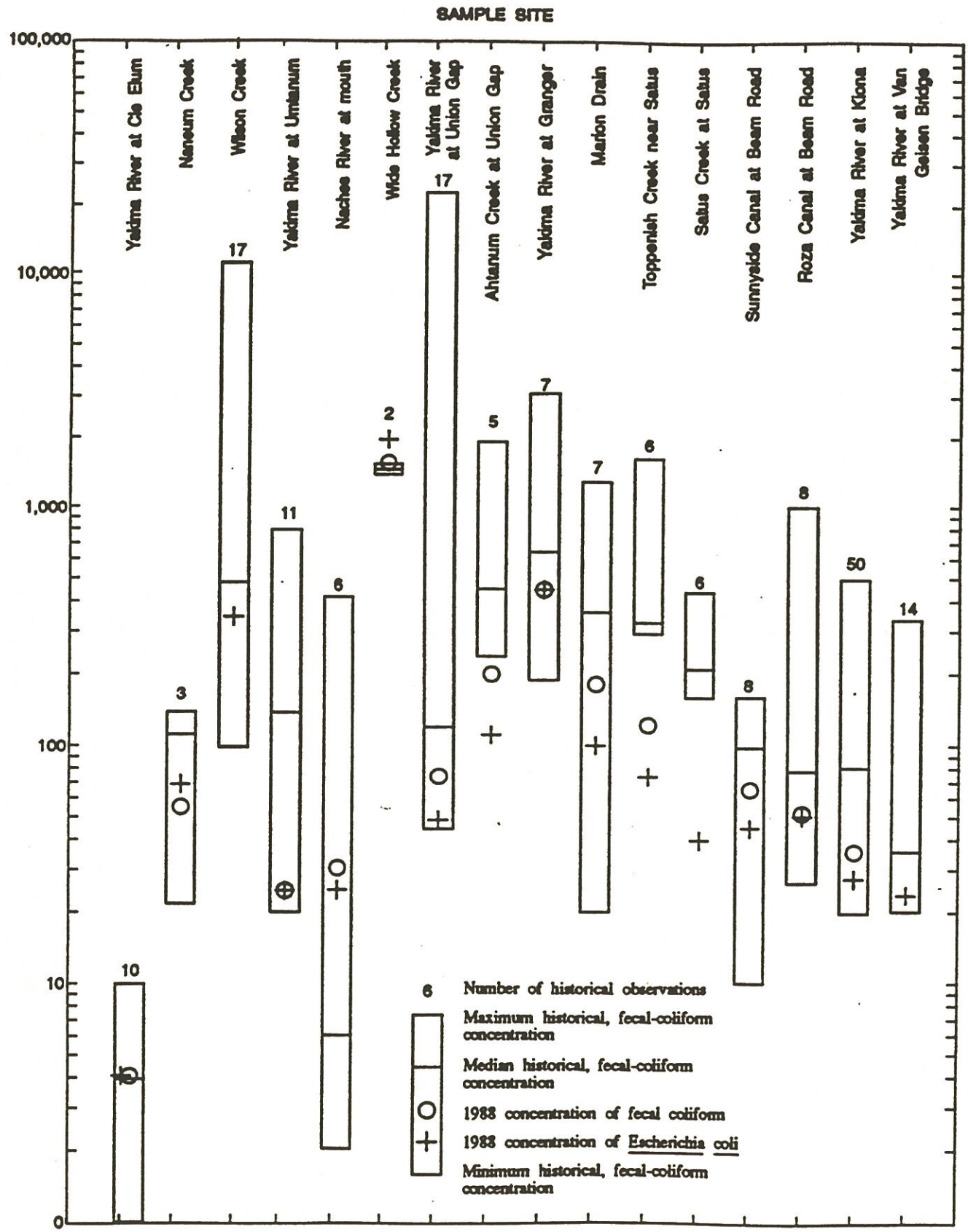


Figure 6.--Concentrations of Escherichia Coli and specific conductance in water samples collected along the main stem Yakima River.

FIGURE 3.3



re 4.–Maximum, minimum, and medians of historical, fecal-coliform bacteria concentrations for the months of July, August, and September (1972 through 1985) compared with fecal-coliform and Escherichia coli bacteria concentrations observed at sixteen sample-collection sites during the July 1988 synoptic survey.

FIGURE 3.4

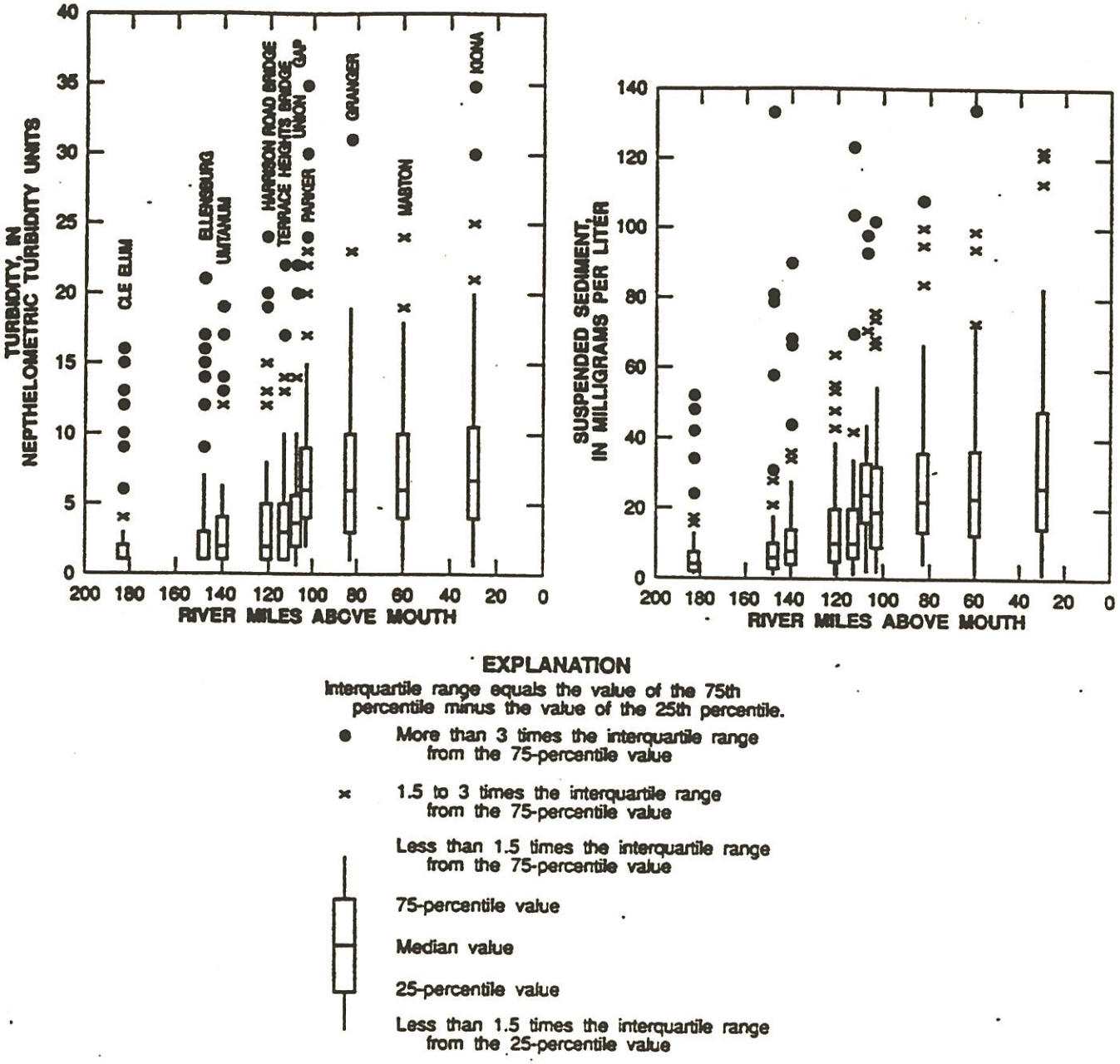


Figure 37.--Turbidity values and suspended-sediment concentrations in the Yakima River, Washington, 1974-81 water years (some large values are not shown).

FIGURE 3.5

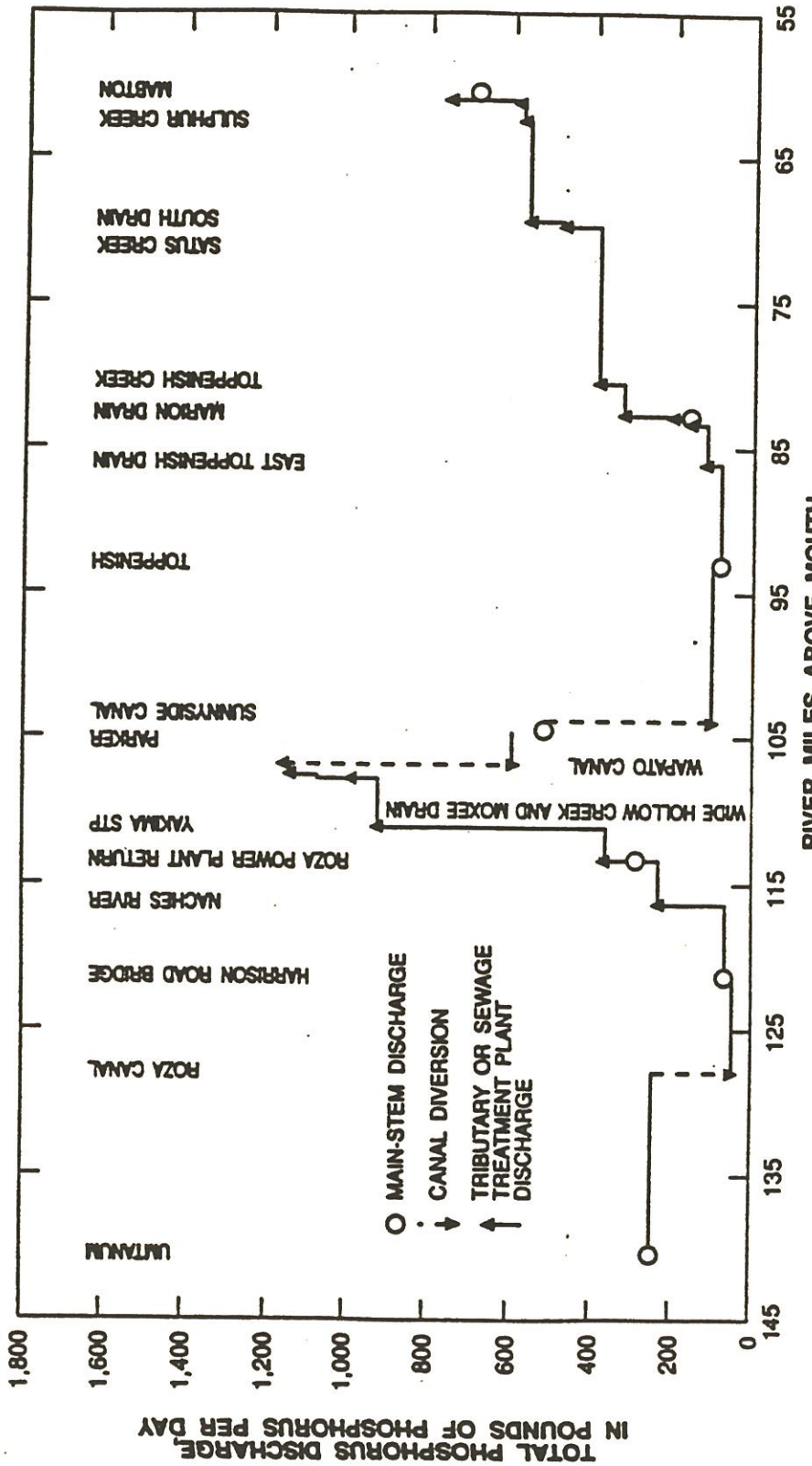


Figure 51.--Total phosphorus discharge in the Yakima River, Washington, in relation to tributary contributions and canal diversions, September 22-25, 1975. Phosphorus discharges are based on instantaneous measurements.

Table 29.--Instantaneous streamflows and total phosphorus discharges in the main stem, selected major tributaries, and canals in the Yakima River basin, Washington, September 22-25, 1975

[ft^3/s = cubic feet per second; lb/d = pounds per day; "Est." indicates estimated; RM = Yakima River Mile; "NA" = not applicable]

FIGURE 3.6

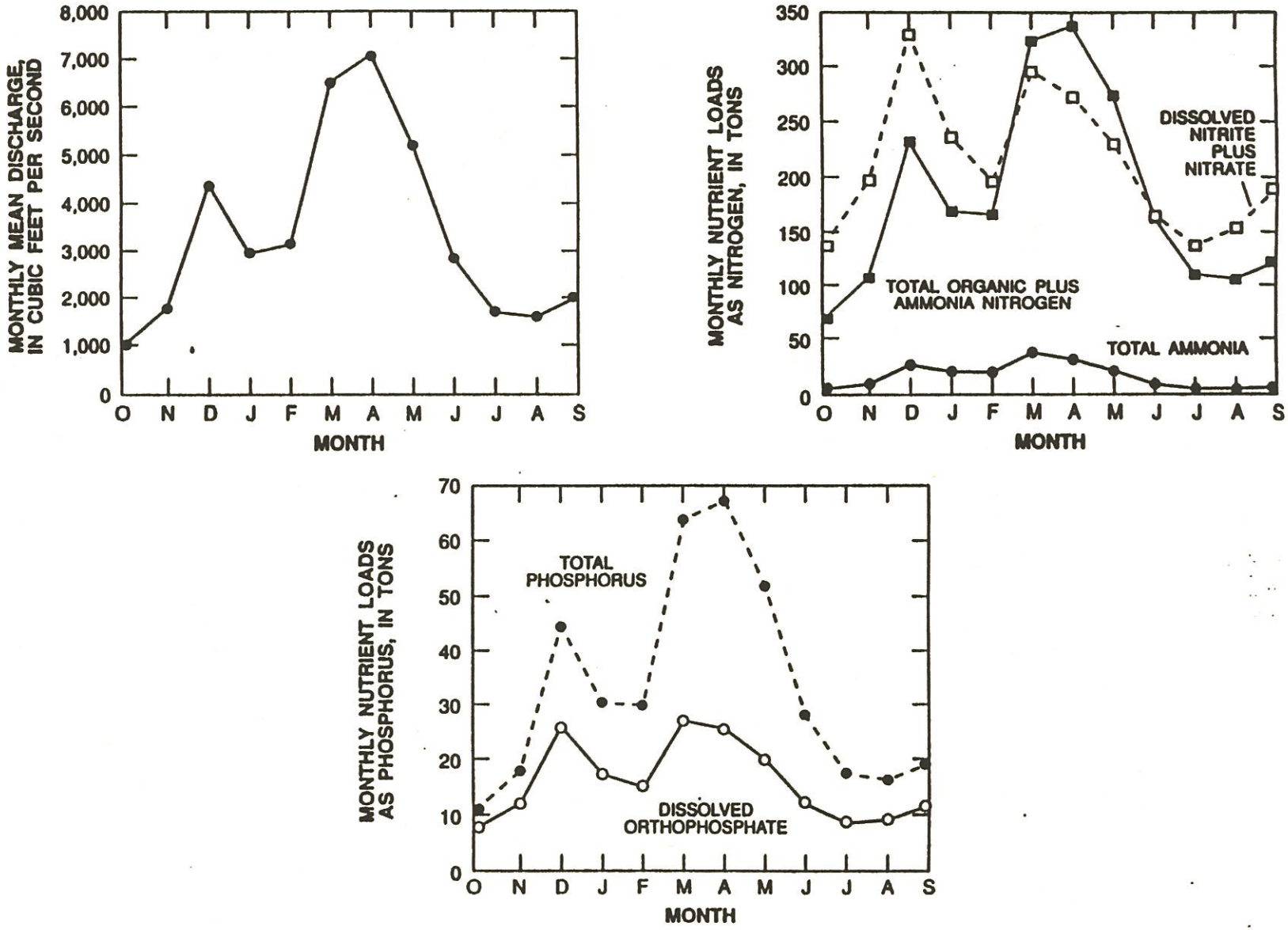


Figure 50.--Selected nutrient loads and monthly mean discharge in the Yakima River at Kiona, Washington, 1980 water year.

FIGURE 3.7

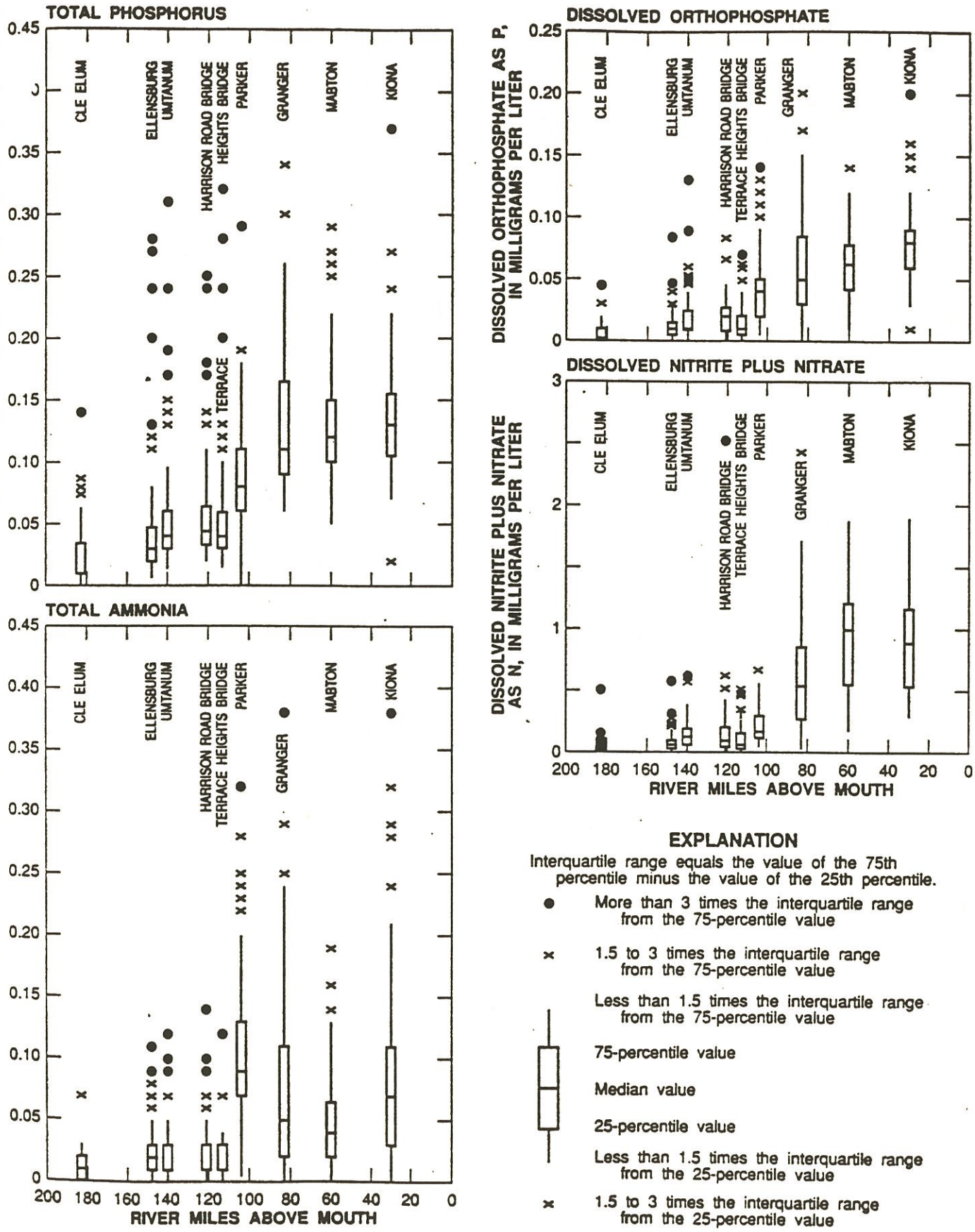


Figure 43.--Concentrations of total phosphorus, dissolved orthophosphate, dissolved nitrite plus nitrate, and total ammonia, in the Yakima River, Washington, 1974-81 water years (some large values are not shown).

FIGURE 3.8

ROZA MAIN CANAL
CONDUCTIVITY

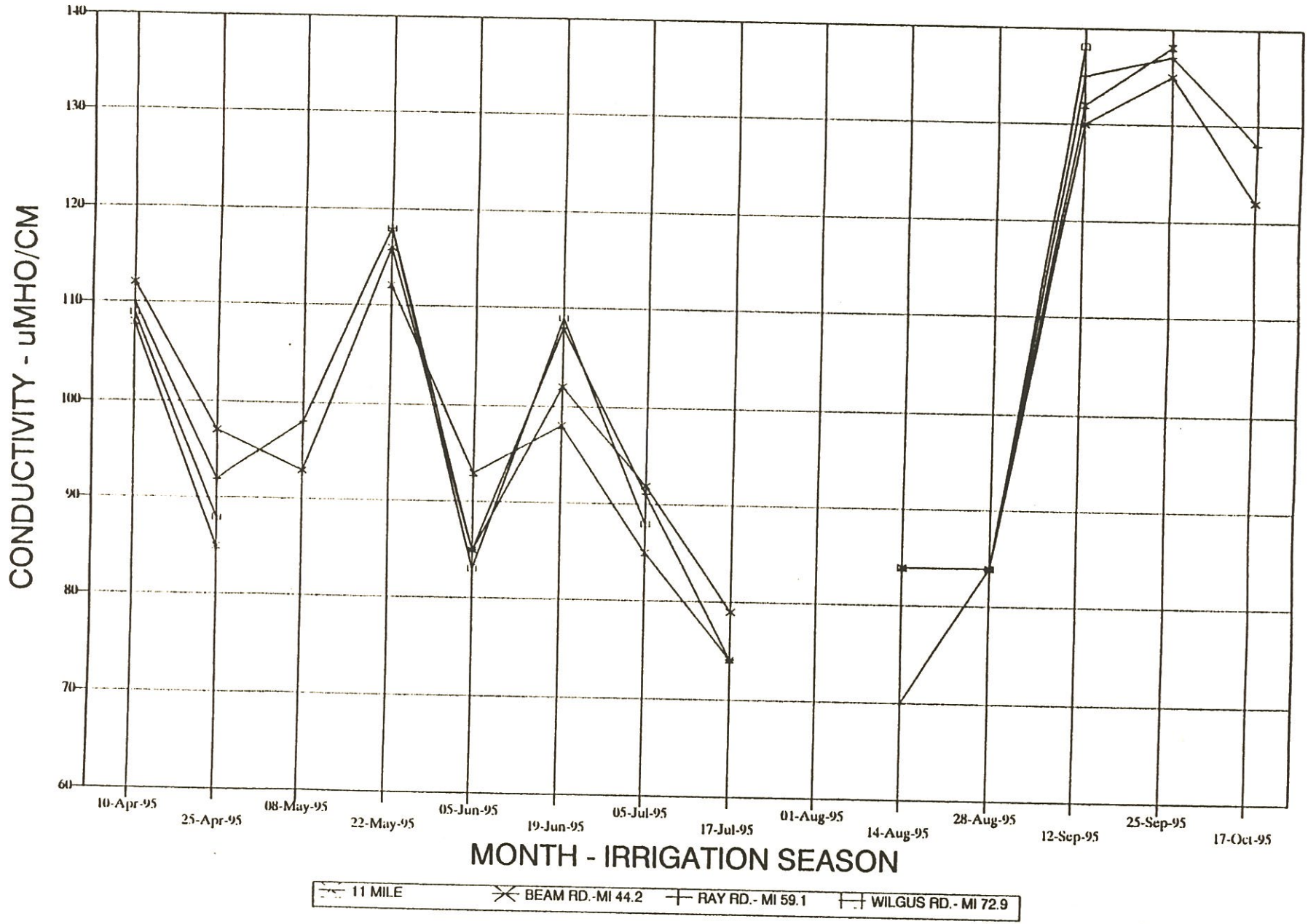


FIGURE 3.9

ROZA MAIN CANAL
TURBIDITY

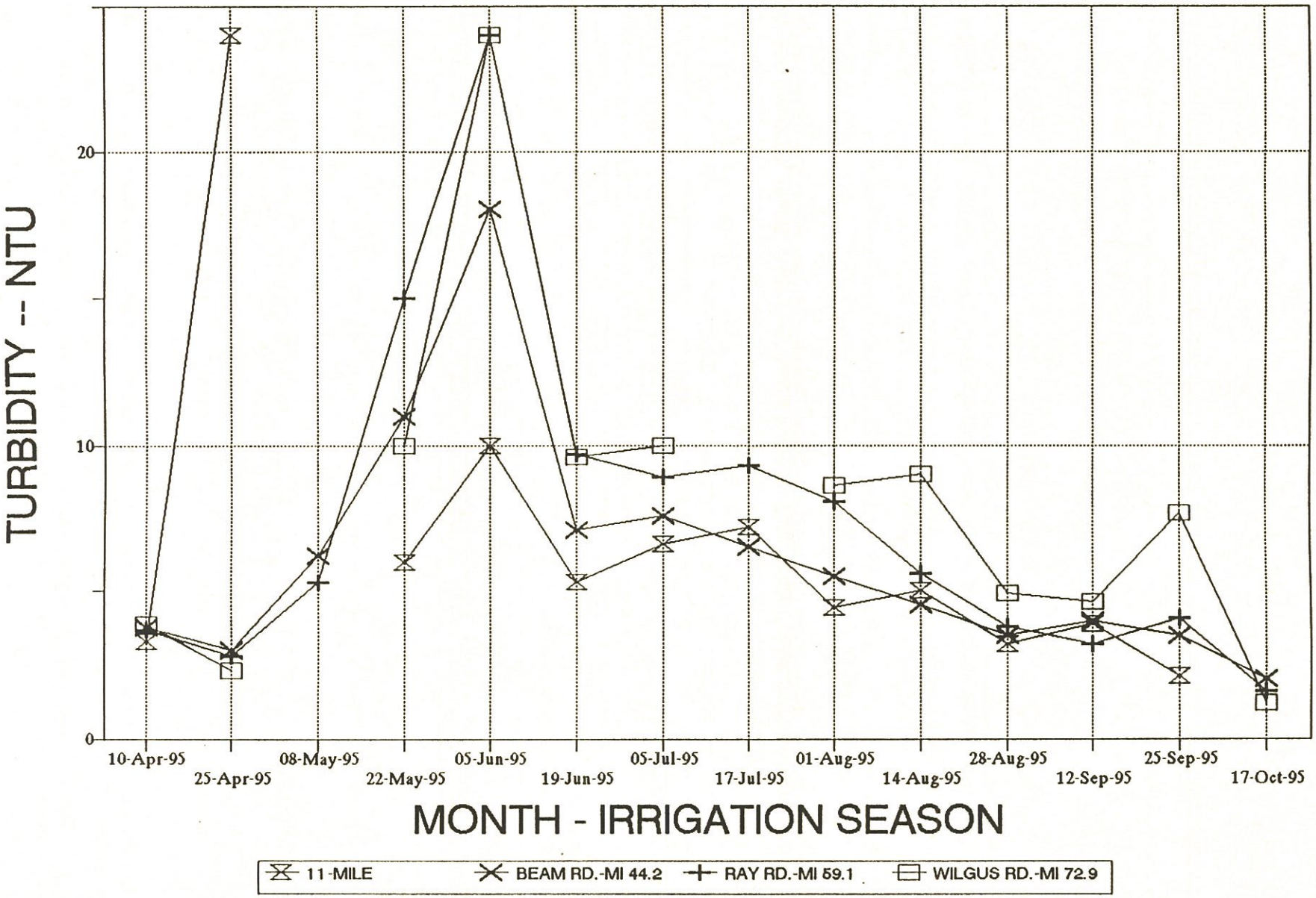


FIGURE 3.10

ROZA MAIN CANAL
SEDIMENT

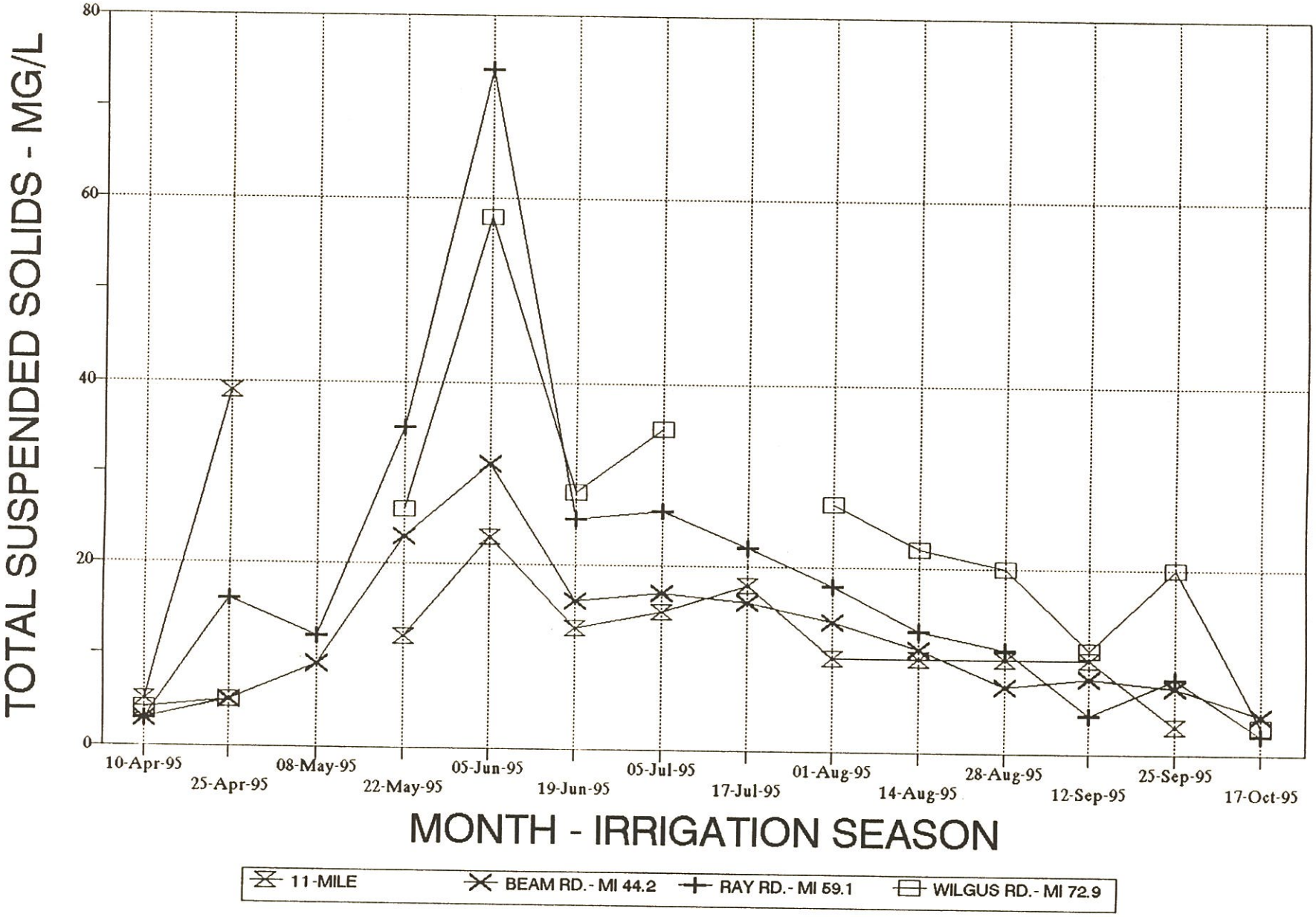


FIGURE 3.11

ROZA MAIN CANAL
FECAL COLIFORM

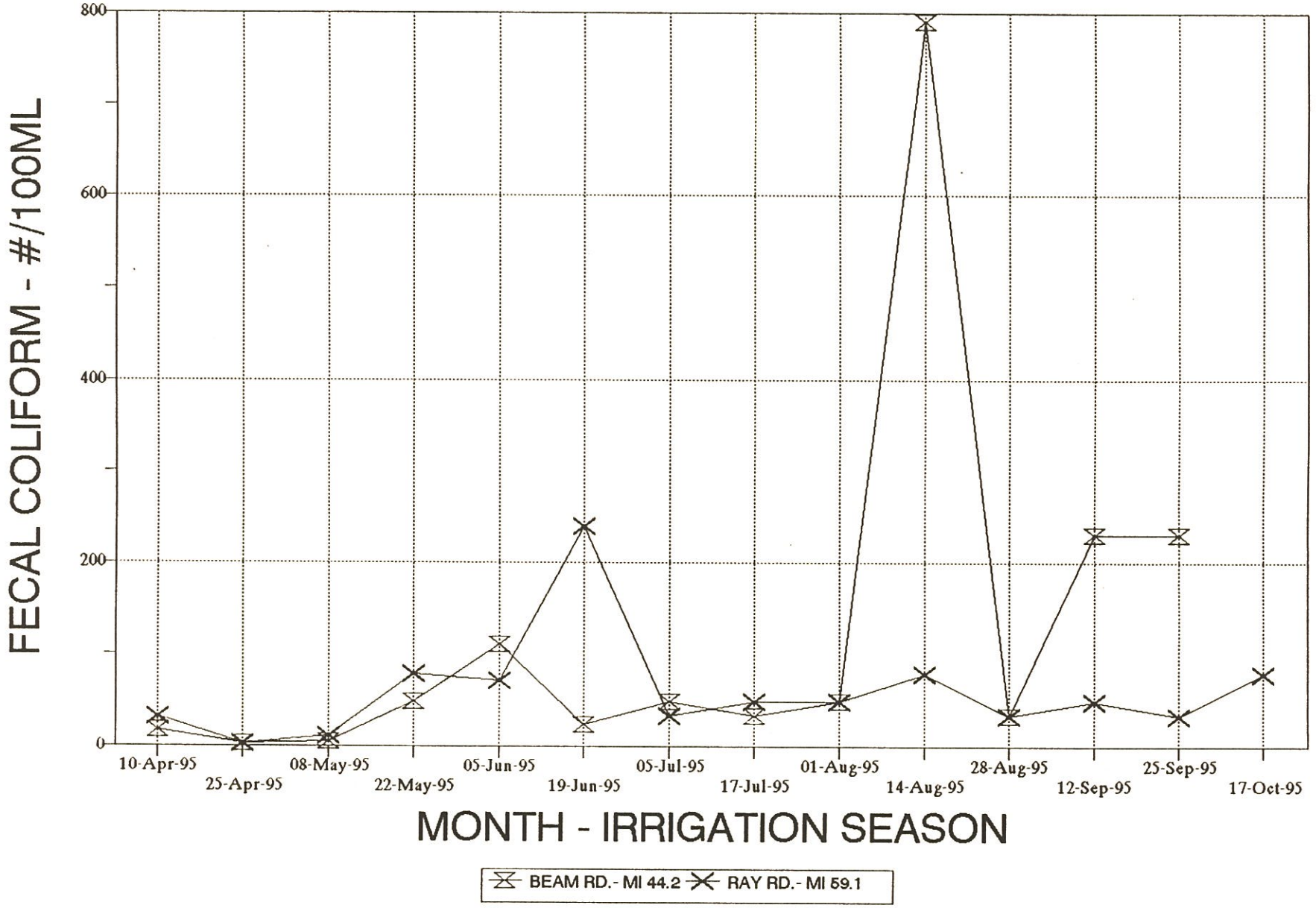


FIGURE 3.12

ROZA MAIN CANAL
NITRITE + NITRATE

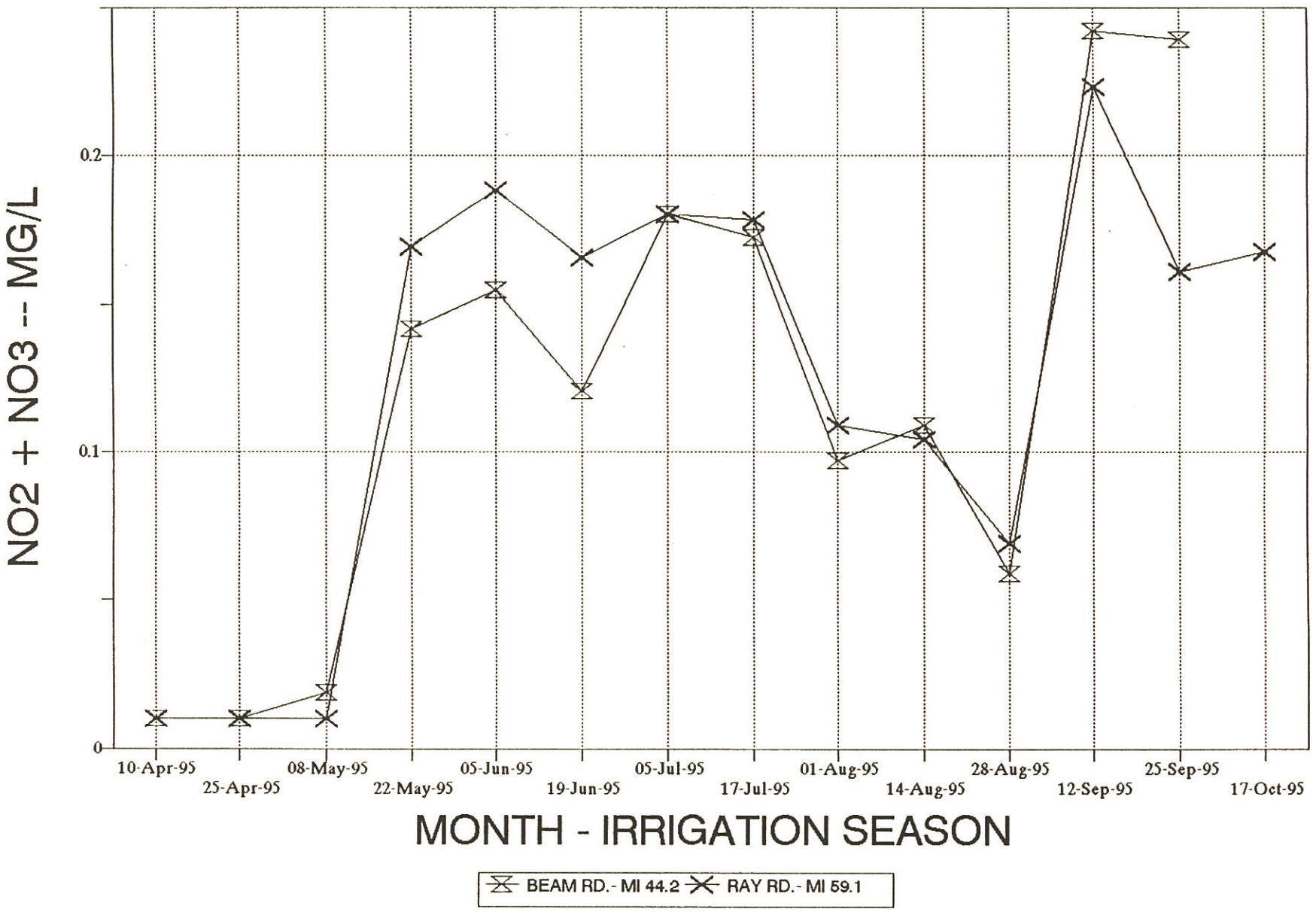


FIGURE 3.13

ROZA MAIN CANAL
TOTAL PHOSPHORUS

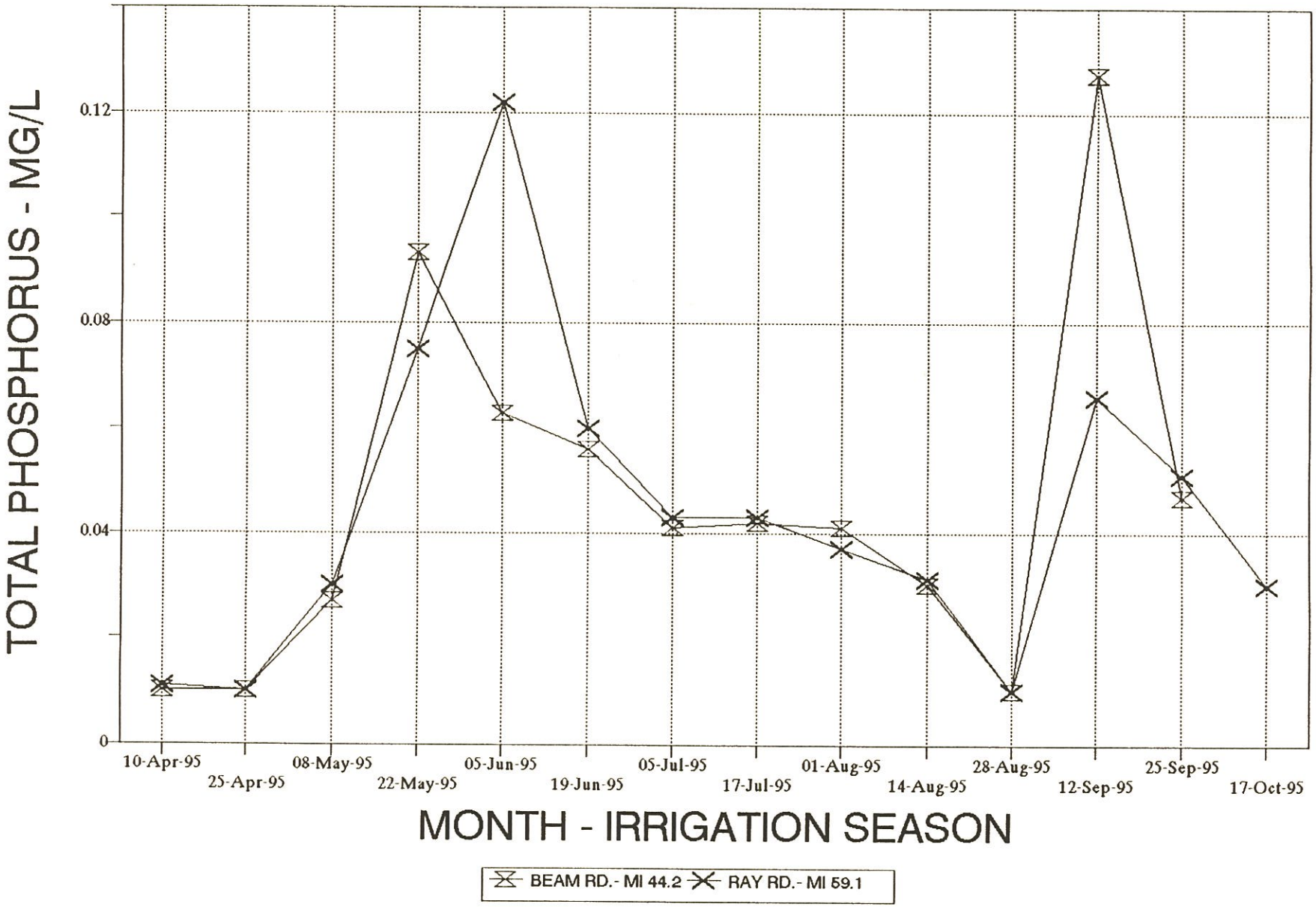


FIGURE 3.14

ROZA IRRIGATION DISTRICT

DATE: APRIL 10, 1997	REVISED:	DRAWN BY: M. STEWART
SCALE: 1" = 4 miles		APP.BY: D. PERALA
EXISTING SYSTEM		
Sunnyside, Washington	JOB NUMBER	DRAWING NUMBER 0N1JC0N

R 19 E
R 20 E
R 21 E
R 22 E
R 23 E
R 24 E
R 25 E
R 26 E
R 27 E

T 14 N
T 13 N
T 12 N
T 11 N
T 10 N
T 09 N
T 08 N

PUMP #1
TUNNEL #1
WASTEWAY #2
TERRACE HEIGHTS PUMP
PUMP #2 AND CHECK
M.P.11
PUMP #3
M.P.20
PUMP #4
MOXEE
PUMP #5
TUNNEL #5
WASTEWAY #3
PUMP #6
TUNNEL #6
ROZA MAIN CANAL
M.P.30
PUMP #7 AND CHECK
WASTEWAY #4
PUMP #8 AND CHECK
PUMP #9 AND CHECK
PUMP #9A
M.P.40
ZILLAH
PUMP #10
WASTEWAY #5 AND REREGULATION RESERVOIR
M.P.50
PUMP #12
PUMP #13
GRANGER
OUTLOOK
SUNNYSIDE
M.P.60
CHECK 77.3
PUMP #14
PUMP #15
SEVERYNS PUMP
PUMP #16
PUMP #17
WASTEWAY #7 REREGULATION RESERVOIR
M.P.70
M.P.80
M.P.90
CONRAL CREEK
BENTON CITY
GRANDVIEW
WASTEWAY #6 AND REREGULATION RESERVOIR
WHITSTRAN
MABTON
PROSSER
YAKIMA COUNTY
BENTON COUNTY

ROZA MAIN CANAL
R.I.D. ENCLOSED CONDUIT SYSTEM
PUMP PLANTS
CHECK STRUCTURE

FIGURE 4.1

1996 IRRIGATION APPLICATION
ROZA IRRIGATION DISTRICT

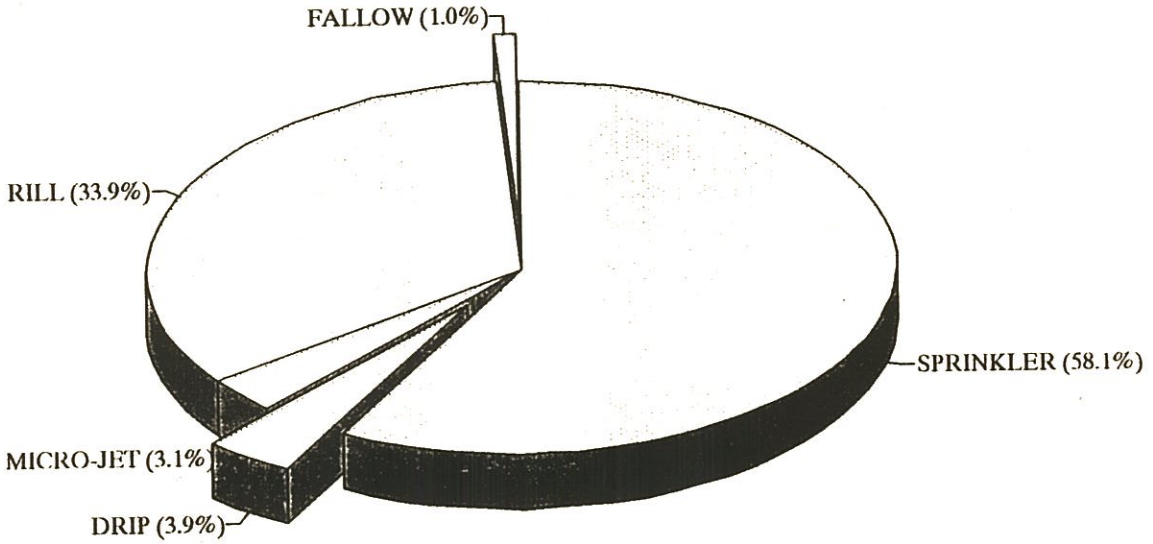


FIGURE 4.2

FORECAST OF ORCHARD ACREAGE
FOR YEARS 1991-2005

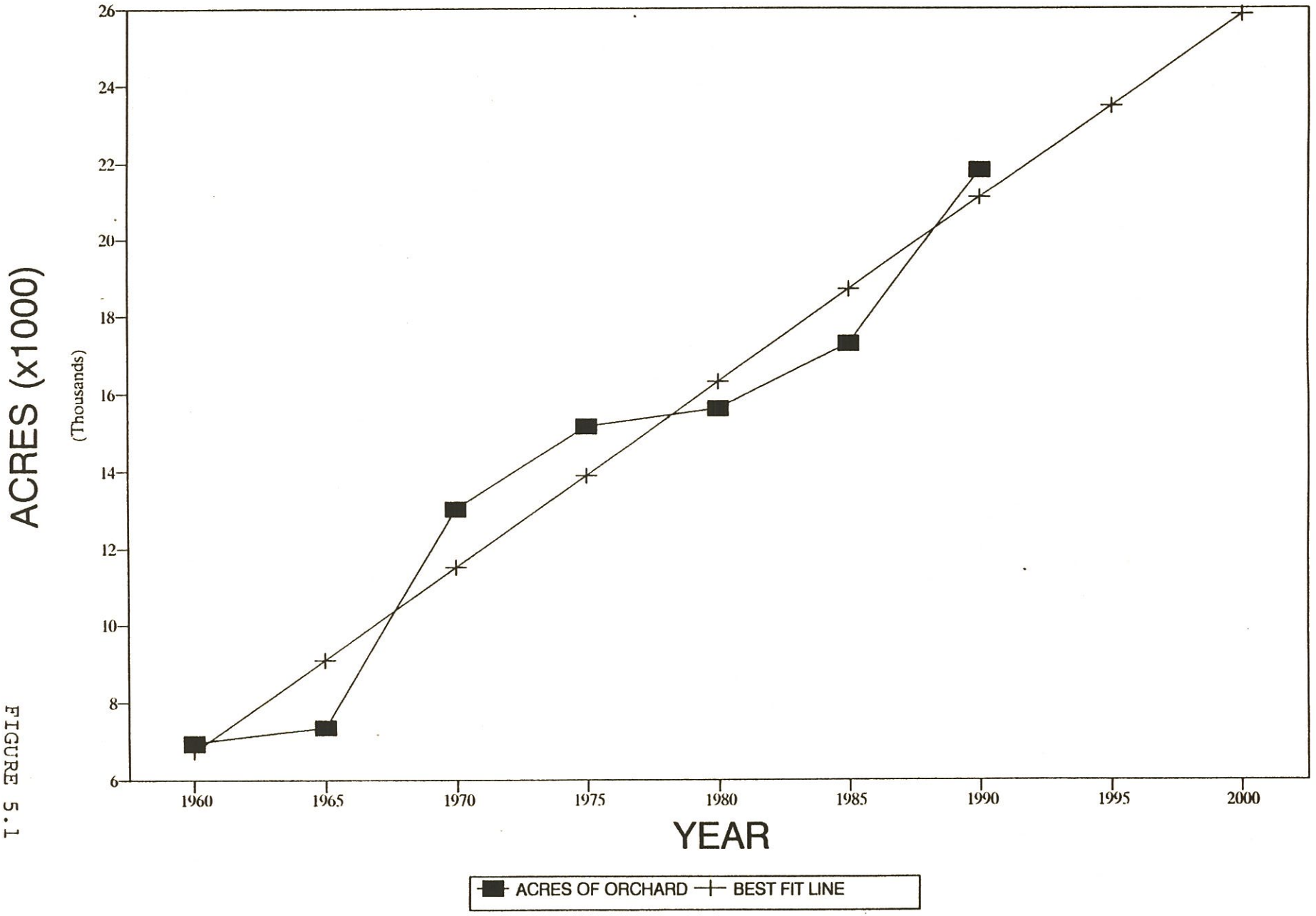


FIGURE 5.1

FORECAST OF MINT ACREAGE
FOR YEARS 1991-2005

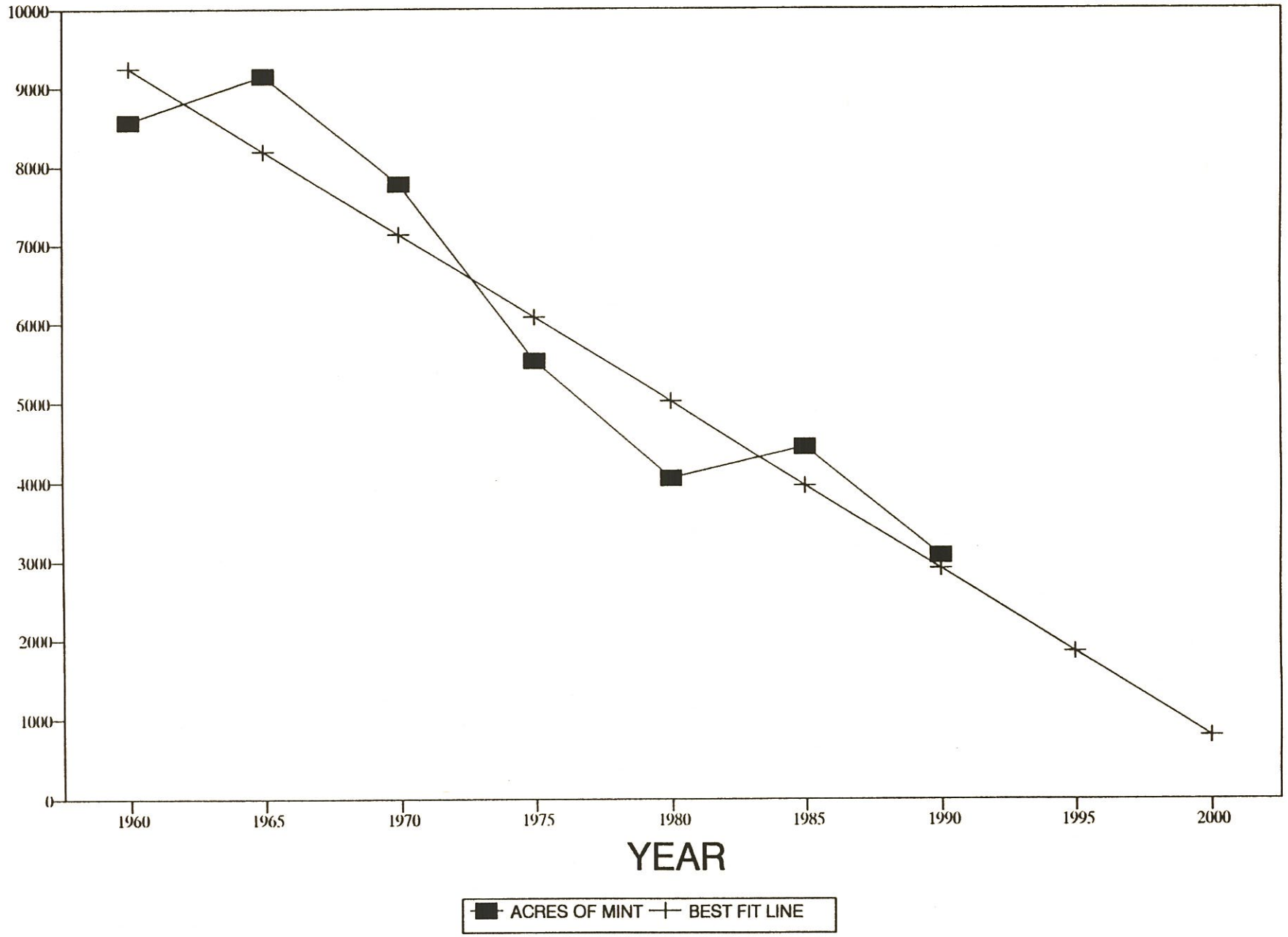


FIGURE 5.2

FORECAST OF HOP ACREAGE
FOR YEARS 1991-2005

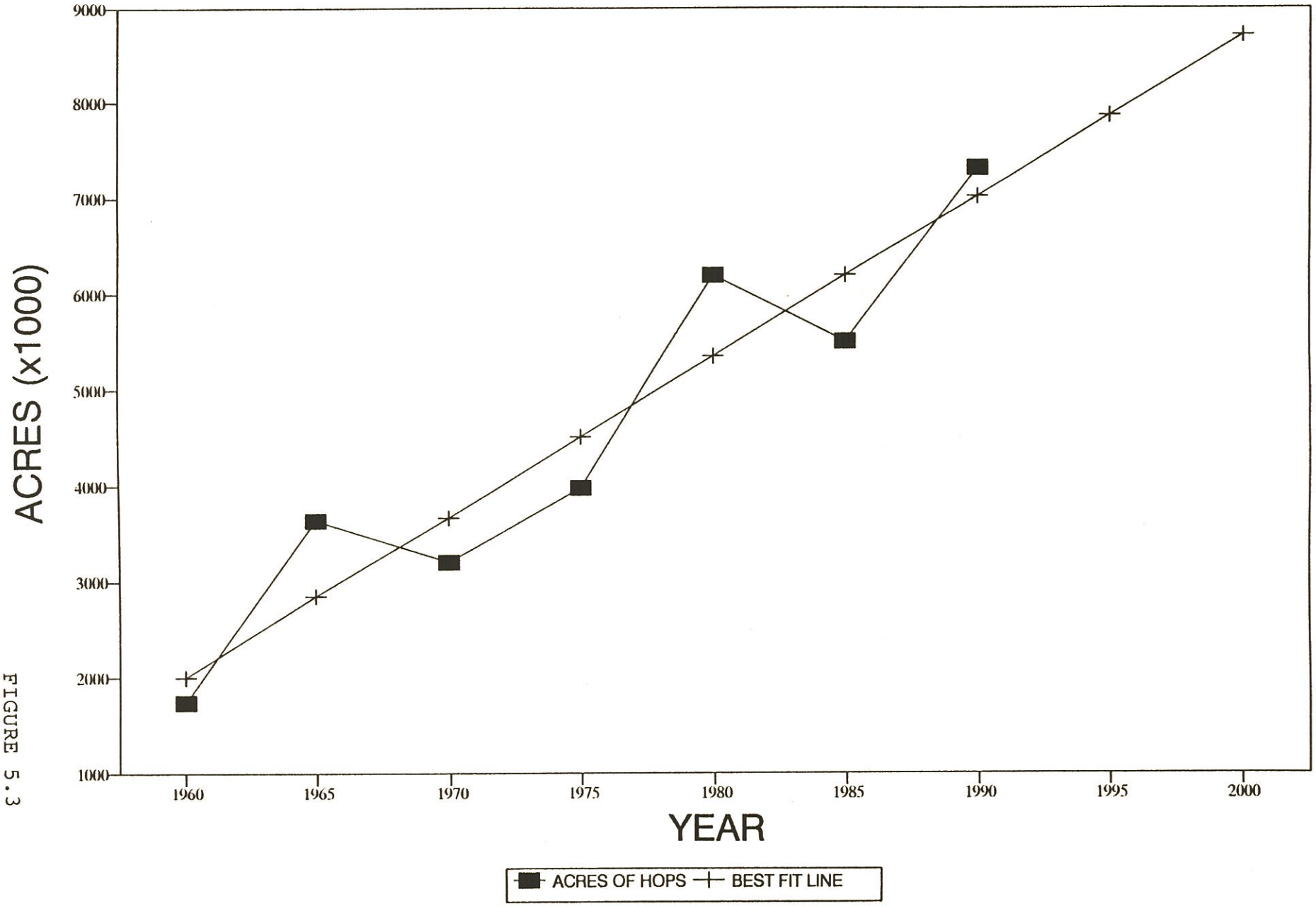


FIGURE 5.3

FORECAST OF GRAPE ACREAGE
FOR YEARS 1991-2005

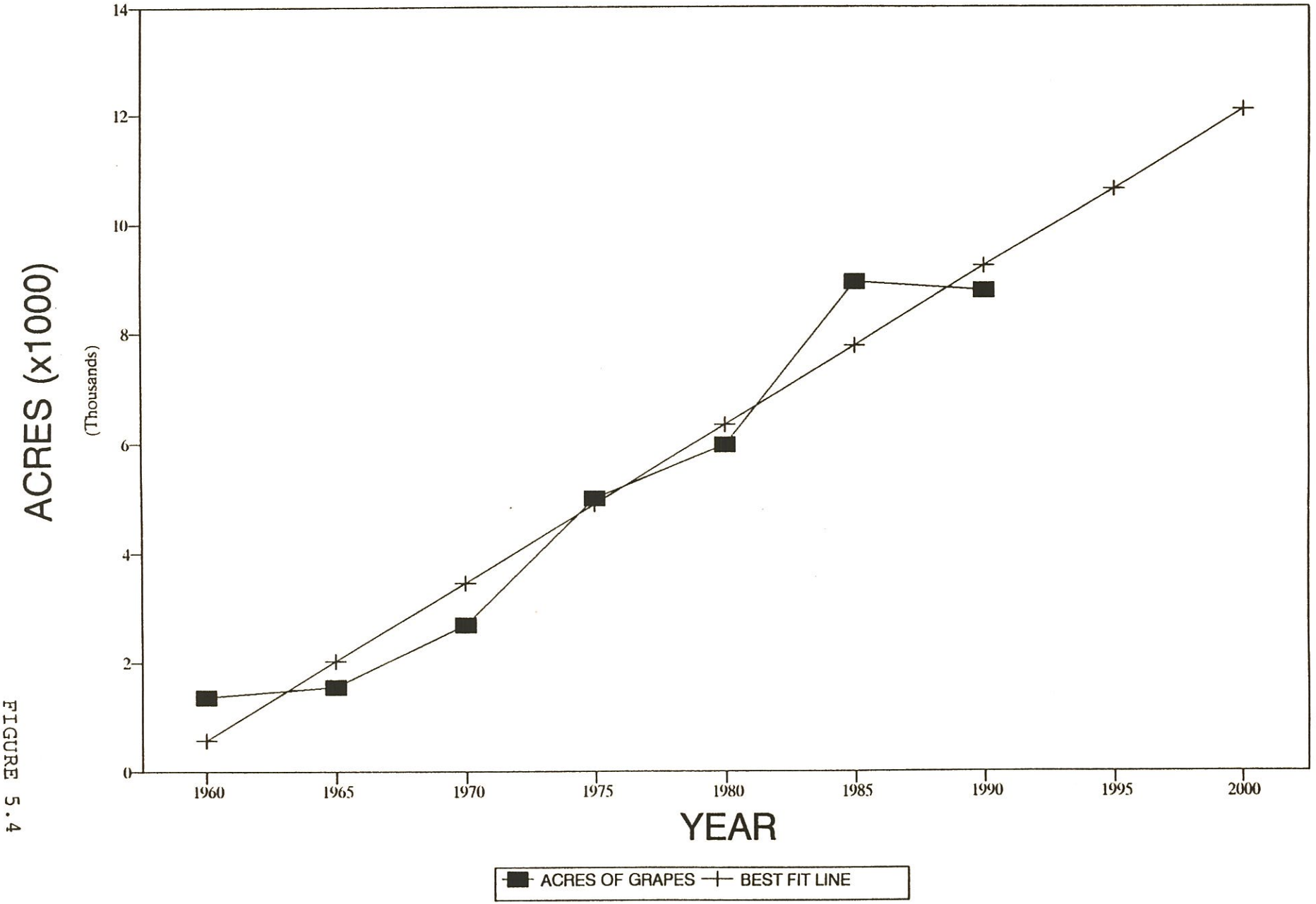


FIGURE 5.4

FORECAST OF ASPARAGUS ACREAGE
FOR YEARS 1991-2005

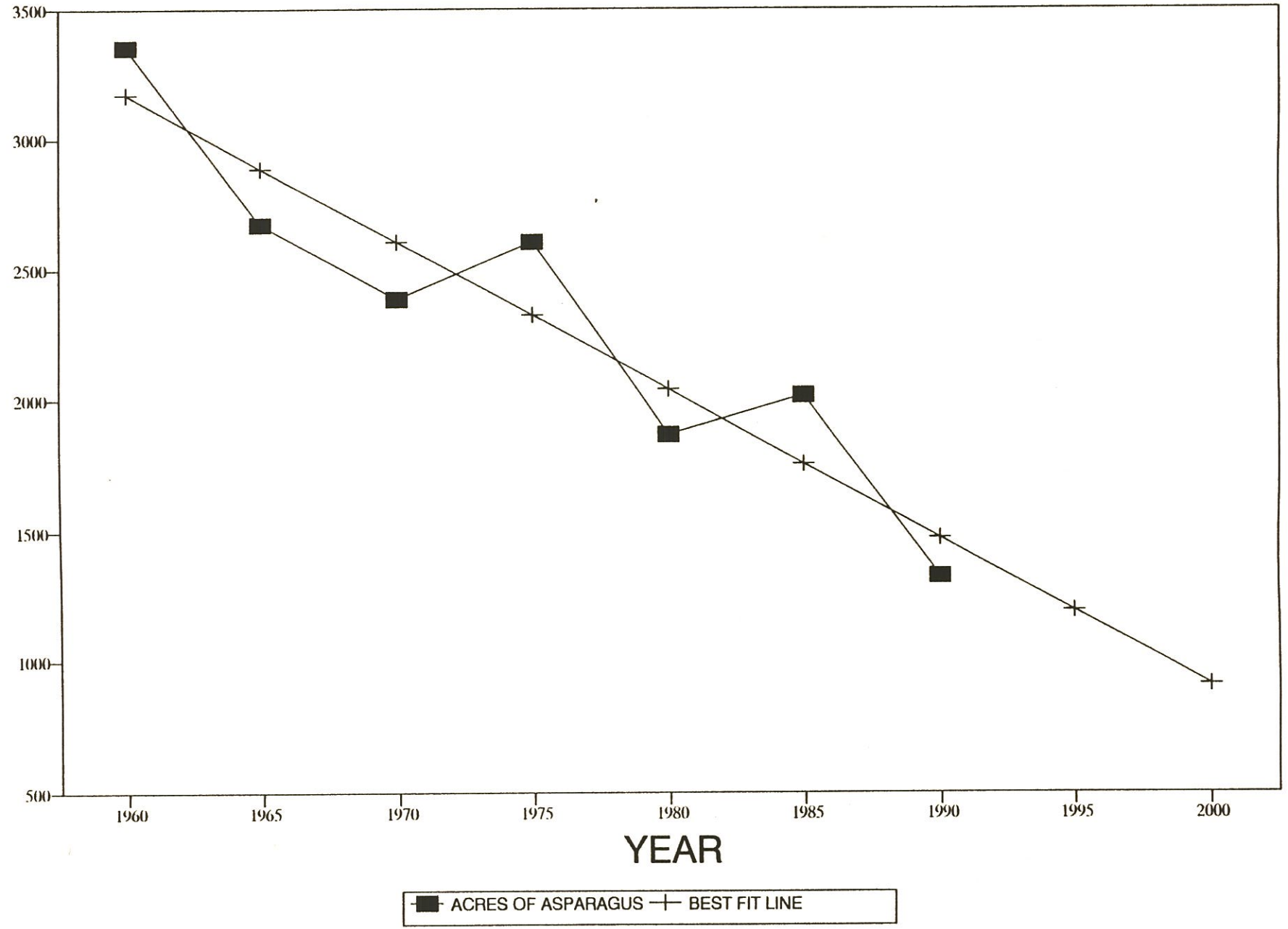


FIGURE 5.5

FORECAST OF OTHER ACREAGE
FOR YEARS 1991-2005

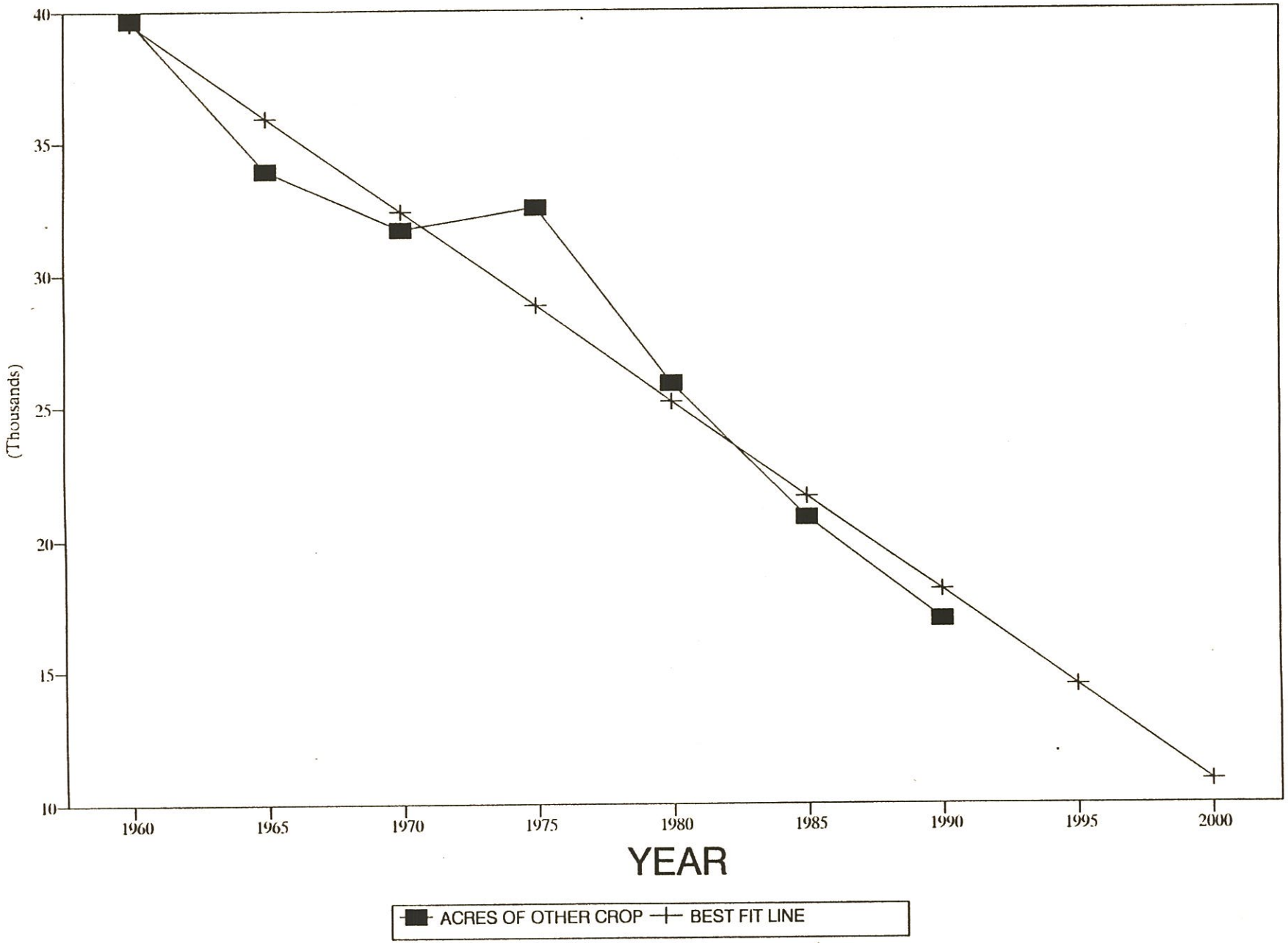


FIGURE 5.6

ROZA IRRIGATION DISTRICT		
DATE: APRIL 10, 1997	REVISED:	DRAWN BY: M. STEWART
SCALE: 1" = 4 miles		APP.BY: O. PERALA
ROZA IRRIGATION DISTRICT FACILITY MAP-TIER 1		
Sunnyside, Washington	JOB NUMBER	DRAWING NUMBER ONEJCON

R 19 E
R 20 E
R 21 E
R 22 E
R 23 E
R 24 E
R 25 E
R 26 E
R 27 E

T 14 N
T 13 N
T 12 N
T 11 N
T 10 N
T 09 N
T 08 N

PUMP #1
TUNNEL #1
WASTEWAY #2
TERRACE HEIGHTS PUMP
PUMP #2 AND CHECK
M.P.11
PUMP #3
M.P.20
PUMP #4
MOXEE
PUMP #5
TUNNEL #5
WASTEWAY #3
PUMP #6
TUNNEL #6
ROZA MAIN CANAL
M.P.30
PUMP #7 AND CHECK
WASTEWAY #4
PUMP #8 AND CHECK
PUMP #9 AND CHECK
PUMP #9A
M.P.40
ZILLAH
PUMP #10
WASTEWAY #5 AND REREGULATION RESERVOIR
M.P.50
PUMP #12
PUMP #13
GRANGER
OUTLOOK
SUNNYSIDE
M.P.60
CHECK 77.3
PUMP #14
PUMP #15
SEVERYNS PUMP
PUMP #16
PUMP #17
WASTEWAY #7 REREGULATION RESERVOIR
M.P.70
M.P.80
M.P.90
CORAL CREEK
BENTON CITY
GRANDVIEW
WASTEWAY #6 AND REREGULATION RESERVOIR
WHITSTRAN
MABTON
PROSSER
YAKIMA COUNTY
BENTON COUNTY

ROZA MAIN CANAL
R.I.D. ENCLOSED CONDUIT SYSTEM
PUMP PLANTS
CHECK STRUCTURE

FIGURE 6.1

ROZA IRRIGATION DISTRICT

DATE: APRIL 10, 1987	REVISED:	DRAWN BY: M. STEWART
SCALE: 1" = 4 miles		APP.BY: O. PERALA

ROZA IRRIGATION DISTRICT FACILITY MAP-TIER 2

Sunnyside, Washington	JOB NUMBER	DRAWING NUMBER ON.JCON

R 19 E
R 20 E
R 21 E
R 22 E
R 23 E
R 24 E
R 25 E
R 26 E
R 27 E

T 14 N
T 13 N
T 12 N
T 11 N
T 10 N
T 09 N
T 08 N

PUMP #1
TUNNEL #1
WASTEWAY #2
TERRACE HEIGHTS PUMP
PUMP #2 AND CHECK
M.P.11 (T)
PUMP #3 AND CHECK
M.P.20
PUMP #4 AND CHECK
MOXEE
PUMP #5 AND CHECK
TUNNEL #5
WASTEWAY #3
PUMP #6 AND CHECK (T)
TUNNEL #6
ROZA MAIN CANAL
M.P.30
PUMP #7 AND CHECK
WASTEWAY #4
PUMP #8 AND CHECK
PUMP #9 AND CHECK
PUMP #9A AND CHECK
M.P.40
ZILLAH
PUMP #10 AND CHECK
WASTEWAY #5 AND REREGULATION RESERVOIR (T)
PUMP #12 AND CHECK
M.P.50
CHECK 77.3
PUMP #15 AND CHECK
PUMP #16 AND CHECK (T)
PUMP #17
WASTEWAY #7 REREGULATION RESERVOIR (T)
GRANGER
OUTLOOK
PUMP #13
PUMP #14
SUNNYSIDE
M.P.60
SEVERYNS PUMP
M.P.70
M.P.90
CORRAL CREEK
BENTON CITY
M.P.80
WASTEWAY #6 AND REREGULATION RESERVOIR (T)
WHITSTRAN
GRANDVIEW
MABTON
PROSSER
YAKIMA COUNTY
BENTON COUNTY

ROZA MAIN CANAL
R.I.D. ENCLOSED CONDUIT SYSTEM
PUMP PLANTS
CHECK STRUCTURE
(T) TELEMETRY

FIGURE 6.2

ROZA IRRIGATION DISTRICT

DATE: APRIL 10, 1997	REVISED:	DRAWN BY: M. STEWART
SCALE: 1" = 4 miles		APP.BY: O. PERALA

ROZA IRRIGATION DISTRICT FACILITY MAP-TIER 3

Sunnyside, Washington	JOB NUMBER	DRAWING NUMBER ONEJCON

R 19 E | R 20 E | R 21 E | R 22 E | R 23 E | R 24 E | R 25 E | R 26 E | R 27 E

T 14 N
T 13 N
T 12 N
T 11 N
T 10 N
T 09 N
T 08 N

PUMP #1
TUNNEL #1
WASTEWAY #2
LINING & DRAINAGE REHAB M.P.11.0-26.0
TERRACE HEIGHTS PUMP
PUMP #2
M.P.11 (T)
M.P.20
PUMP #3
MOXEE
PUMP #4
PUMP #5
TUNNEL #5
WASTEWAY #3
PUMP #6 (T)
TUNNEL #6
M.P.30
ROZA MAIN CANAL
PUMP #7
WASTEWAY #4
PUMP #8
PUMP #9
PUMP #9A
M.P.40
ZILLAH
PUMP #10
WW5 REREGULATION RESERVOIR
WASTEWAY #5 (T)
PUMP #12
M.P.50
PUMP #13
GRANGER
OUTLOOK
PUMP #14
M.P.60
SUNNYSIDE
PUMP #15
SEVERYNS PUMP
PUMP #16 (T)
PUMP #17
WASTEWAY #7 REREGULATION RESERVOIR (T)
M.P.70
M.P.90
CONRAL CREEK
BENTON CITY
GRANDVIEW
M.P.80
WASTEWAY #6 AND REREGULATION RESERVOIR
WHITSTRAN (T)
MABTON
PROSSER

YAKIMA COUNTY
BENTON COUNTY

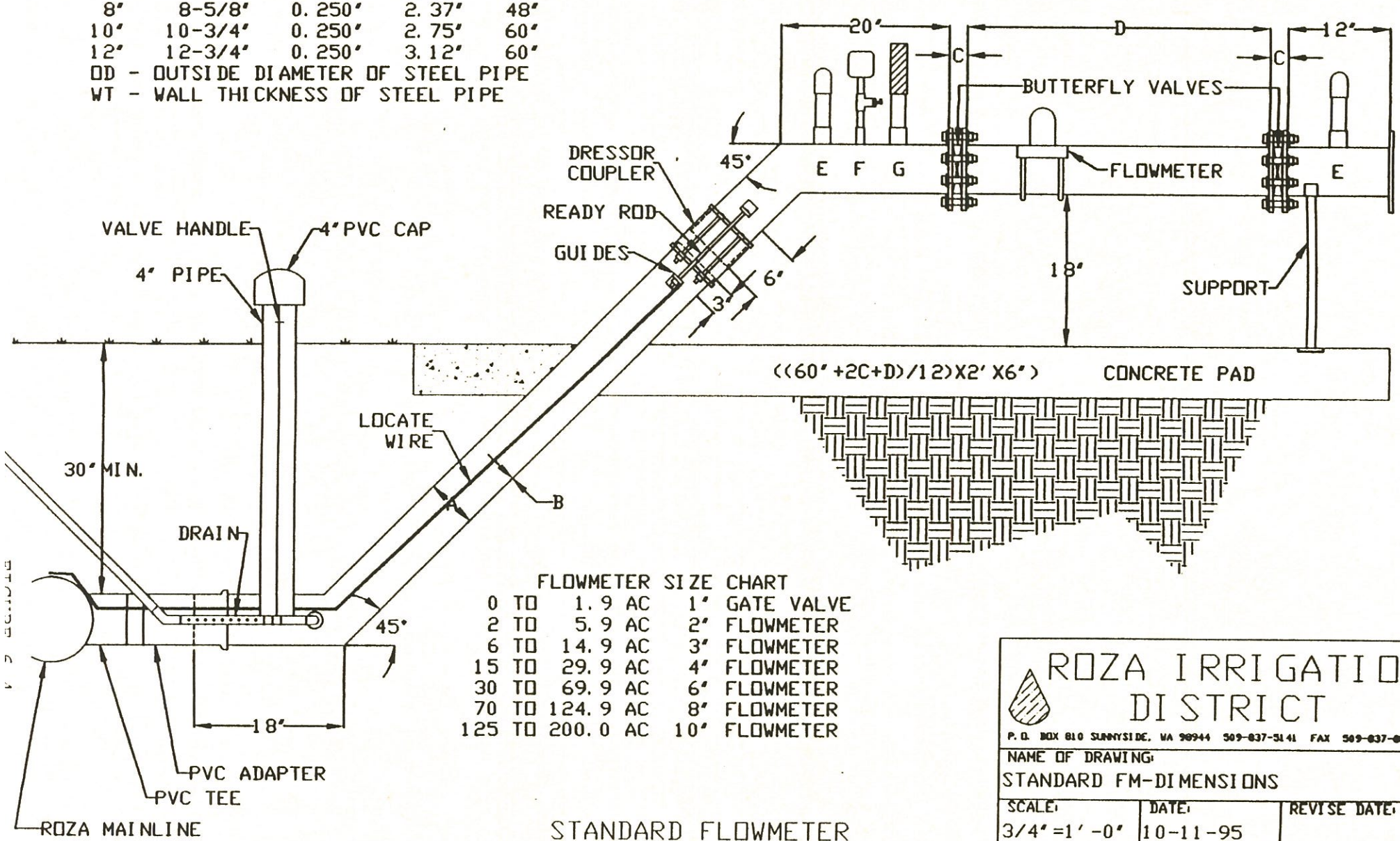
ROZA MAIN CANAL
R.I.D. ENCLOSED CONDUIT SYSTEM
PUMP PLANTS
AUTOMATED CHECK STRUCTURE
(T) TELEMETRY

FIGURE 6.3

SIZE	A-OD	B-WT	C	D
2"	2-3/8"	0.154"	1.62"	24"
3"	3-1/2"	0.216"	1.75"	24"
4"	4-1/2"	0.237"	2.00"	24"
6"	6-5/8"	0.250"	2.12"	36"
8"	8-5/8"	0.250"	2.37"	48"
10"	10-3/4"	0.250"	2.75"	60"
12"	12-3/4"	0.250"	3.12"	60"

OD - OUTSIDE DIAMETER OF STEEL PIPE
WT - WALL THICKNESS OF STEEL PIPE

A - DIAMETER OF PIPE
B - WALL THICKNESS OF PIPE
C - BUTTERFLY VALVES
D - FLOWMETER TUBE
E - 2" AIR VENT
F - 1" AIR RELEASE
G - 2" PRESSURE RELIEF



STANDARD FLOWMETER

FLOWMETER SIZE CHART		
0 TO 1.9 AC	1"	GATE VALVE
2 TO 5.9 AC	2"	FLOWMETER
6 TO 14.9 AC	3"	FLOWMETER
15 TO 29.9 AC	4"	FLOWMETER
30 TO 69.9 AC	6"	FLOWMETER
70 TO 124.9 AC	8"	FLOWMETER
125 TO 200.0 AC	10"	FLOWMETER

ROZA IRRIGATION DISTRICT
P.O. BOX 810 SUNNYSIDE, WA 98944 509-837-5141 FAX 509-837-8541

NAME OF DRAWING: STANDARD FM-DIMENSIONS		
SCALE: 3/4"=1'-0"	DATE: 10-11-95	REVISE DATE:
DRAWN BY: KIM PFAFF	CHECKED BY: DANA CARR	REV. CHECK

CHECK STRUCTURE
TYPICAL

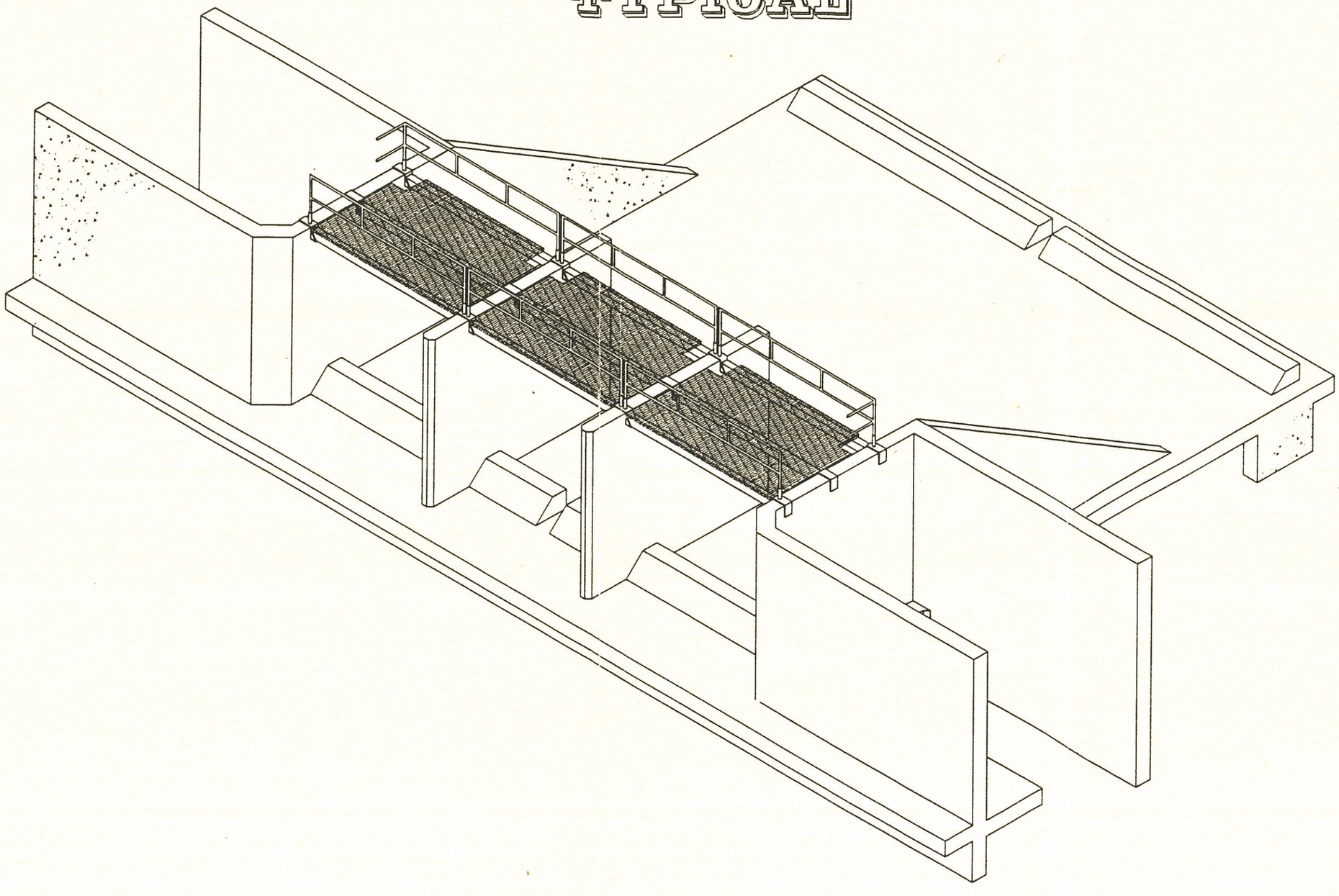
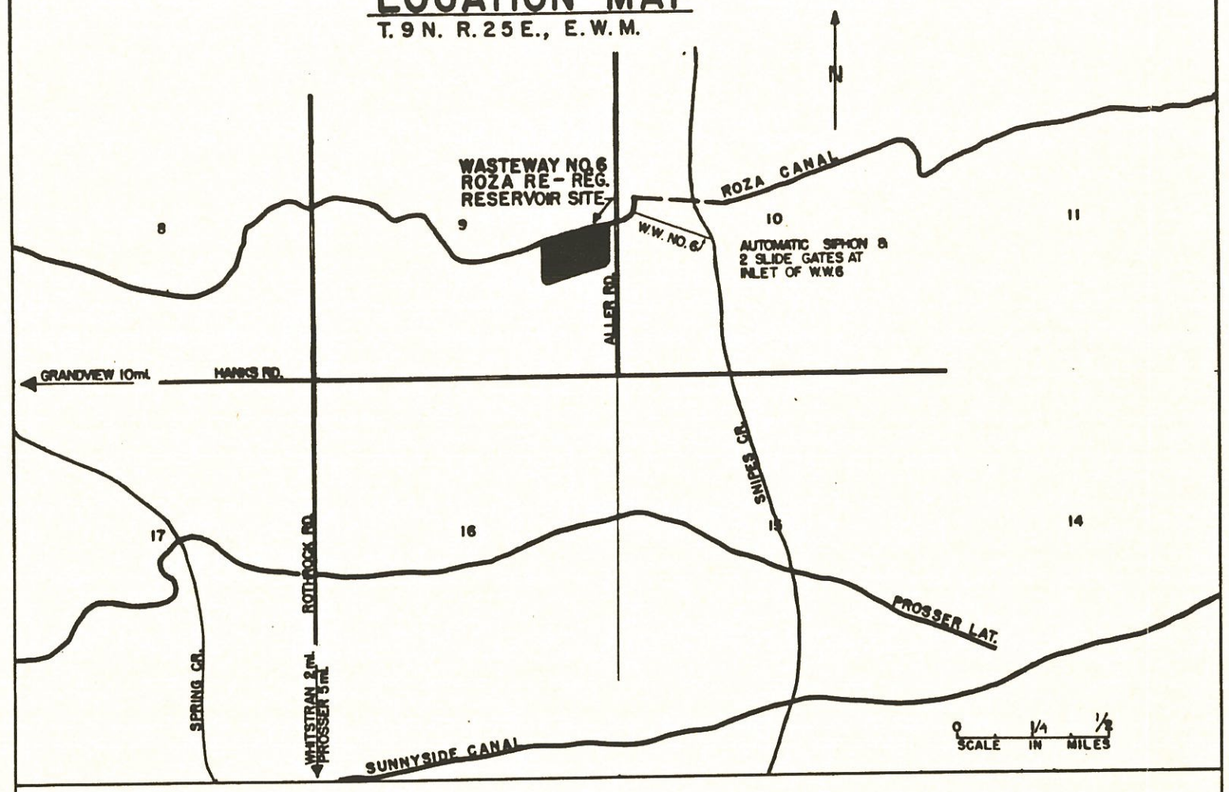
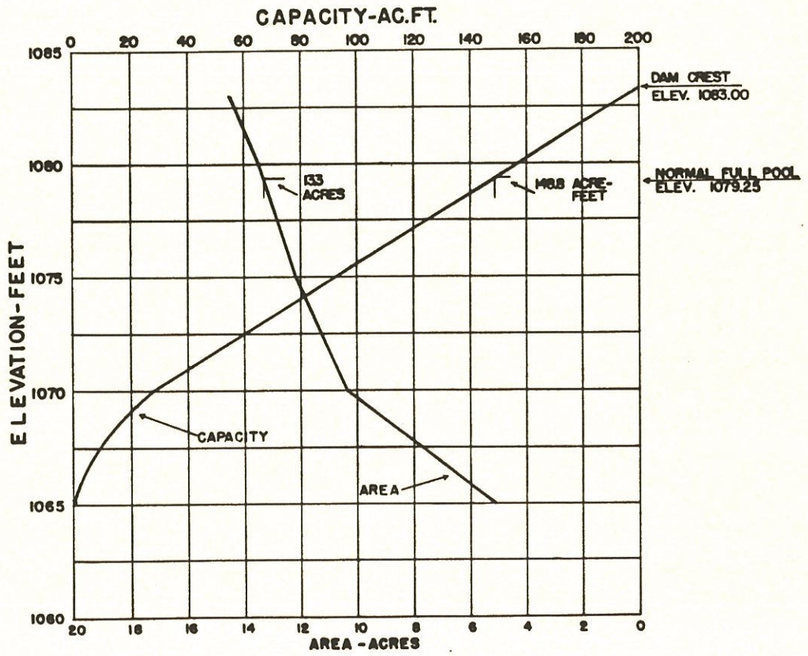


FIGURE 6.5

LOCATION MAP

T. 9 N. R. 25 E., E. W. M.





AREA – CAPACITY

ROZA IRRIGATION DIST.
YAKIMA PROJECT
SUNNYSIDE, WASHINGTON

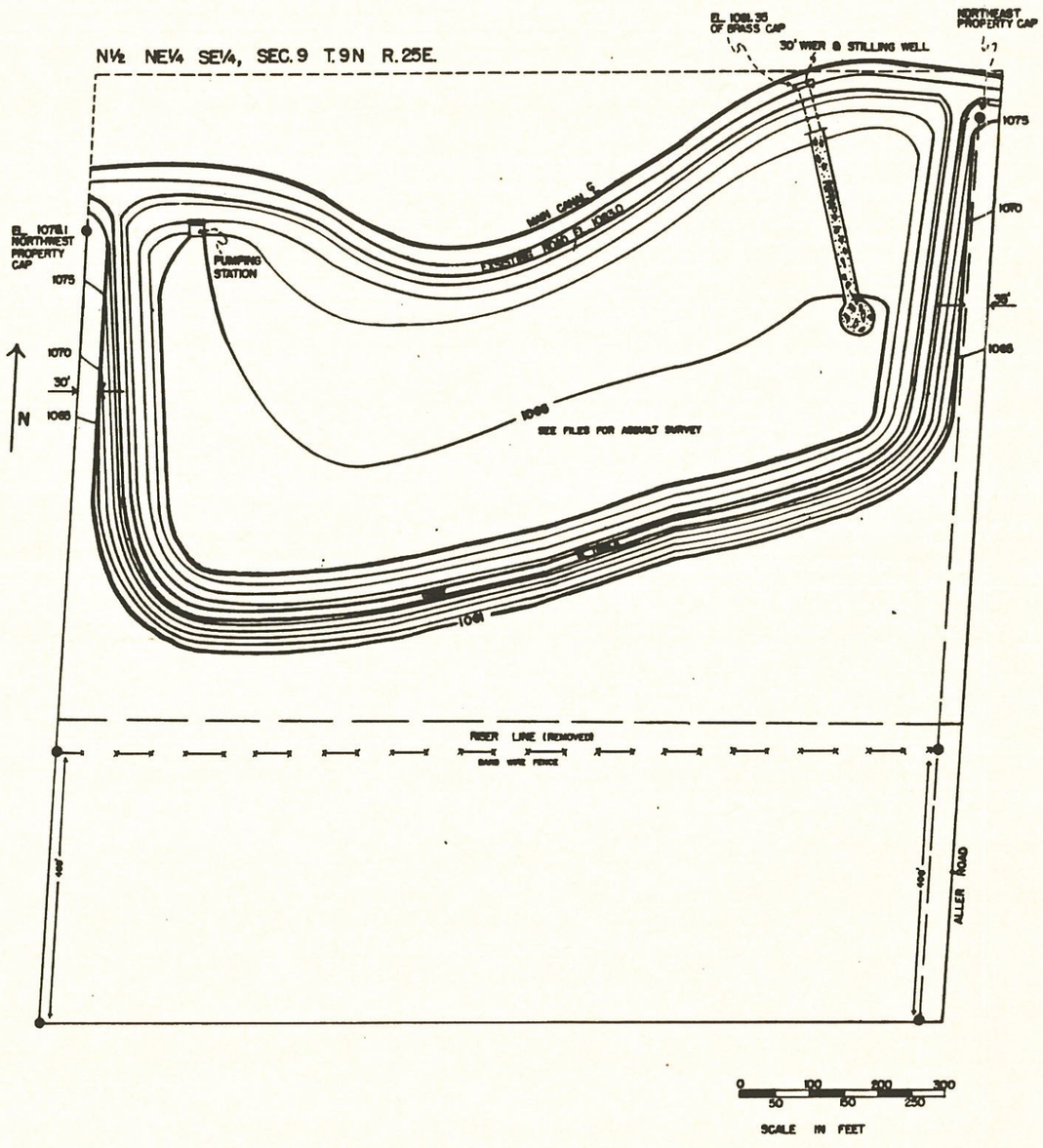
SCALE: SHOWN	AS BUILT	DRAWN: D.L.C.
DATE: NOV '86		CHECKED: D.L.S.

ED. 7-68 K.A.S.C.

AREA-CAPACITY GRAPH & LOCATION MAP

FIGURE 6.6 SHEET 1 of 3

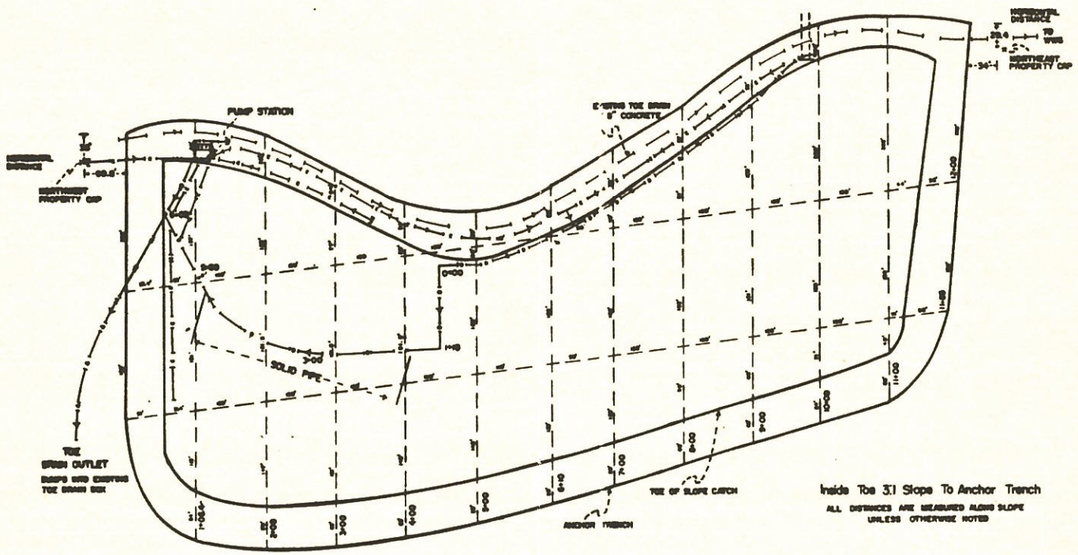
W.W.6 RESERVOIR

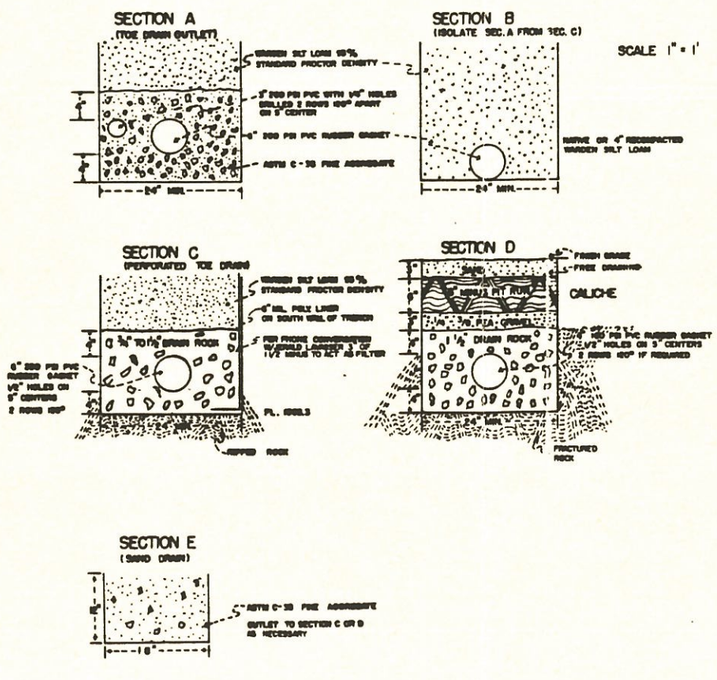


SEC. A
SEC. B
SEC. C
SEC. D
SEC. E

N

SUBGRADE DRAINAGE SYSTEM





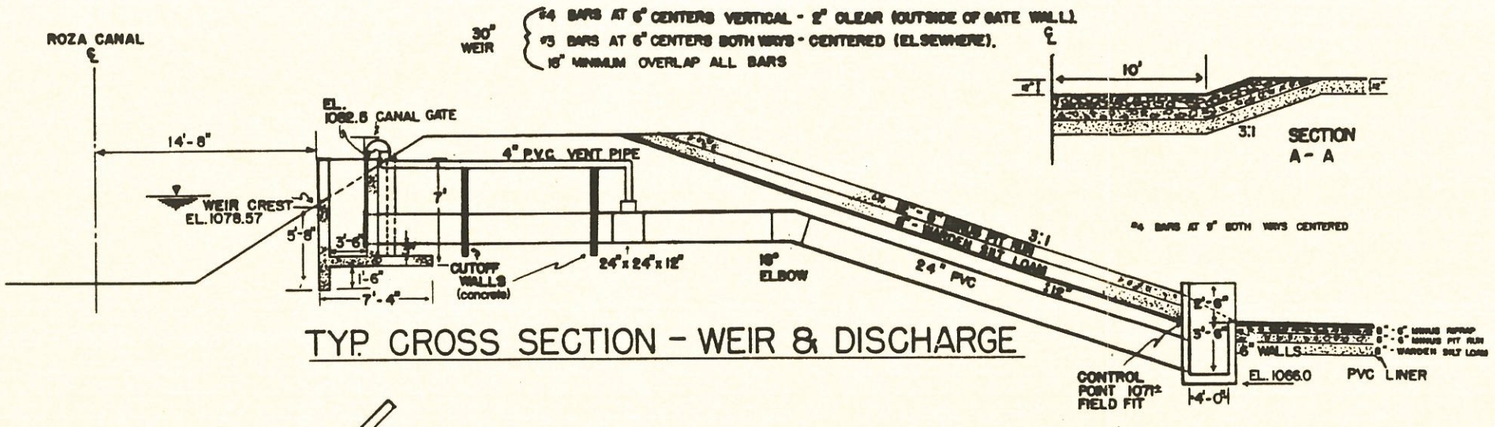
Donald J. Schramm
STATE OF WASHINGTON
REGISTERED CIVIL ENGINEER

ROZA IRRIGATION DISTRICT YAKIMA PROJECT SUNNYSIDE, WASHINGTON		
SCALE: 1" = 100'		CHECKED:
DRAWN: KAS		DATE: 9-1-88

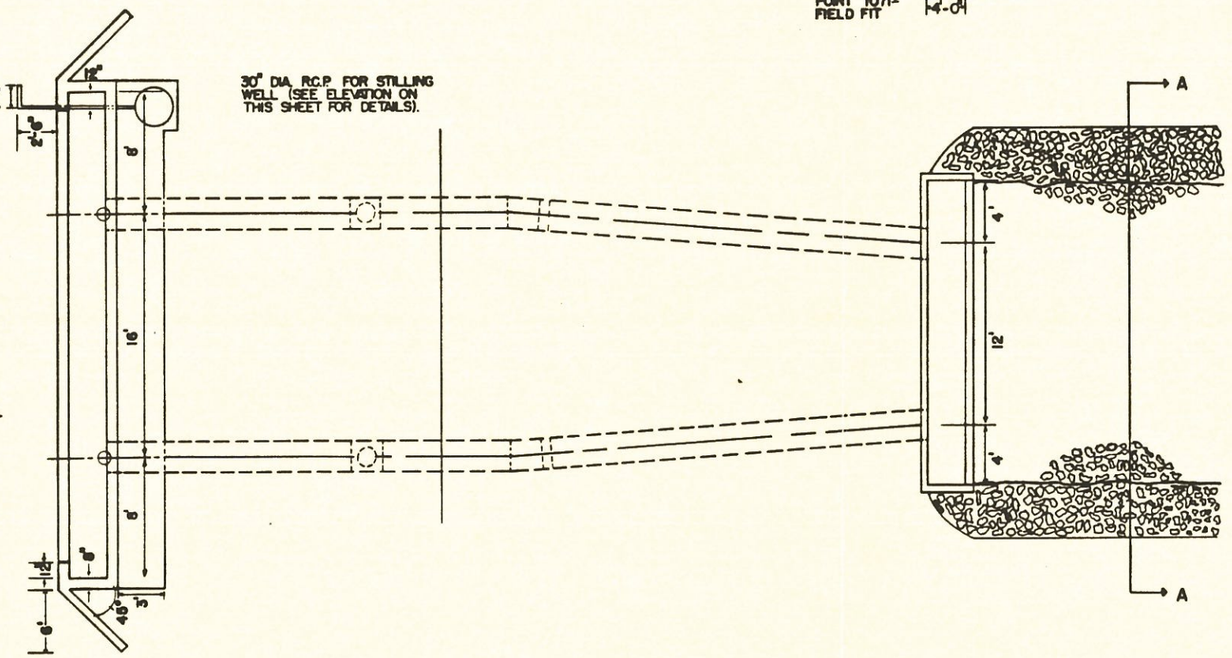
D.K.A.N. 2-69

AS BUILT

FIGURE 6.6 SHEET 2 of 3



TYP. CROSS SECTION - WEIR & DISCHARGE



PLAN - WEIR & DISCHARGE

W.W. NO. 6

- EL. 1079.25 — SIPHON ON
- EL. 1079.20 — MODIFIED NORMAL POOL SIPHON RUNNING
- EL. 1079.15 — MODIFIED SIPHON OFF (SIPHON PAN)
- EL. 1079.10
- EL. 1079.0 — HISTORICAL NORMAL POOL
- EL. 1078.9 — HISTORICAL SIPHON OFF

30' WEIR

- EL. 1079.0
- EL. 1078.9
- EL. 1078.8
- EL. 1078.7
- EL. 1078.6 — PUMP 1 OFF; 30" WEIR BLADE; PUMP 3 OFF
- EL. 1078.5 — PUMP 2 OFF; PUMP 1 OFF
- EL. 1078.4 — PUMP 1 ON
- EL. 1078.3
- EL. 1078.2 — PUMP 2 ON
- EL. 1078.1
- EL. 1078.0 — PUMP 3 ON

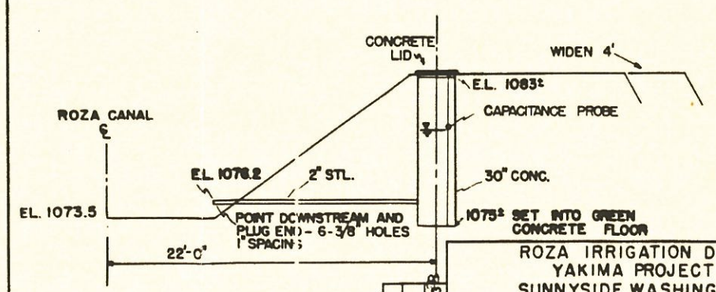
(475' FROM STILLING WELL TO W.W.6)

PUMP 1 - VARIABLE SPEED
PUMP 2 & 3 - CONSTANT SPEED

CONTROL SCHEME

EL. 1066.8 IN RESERVOIR — ALL PUMPS OFF

ELEVATION STILLING WELL



ROZA IRRIGATION DIST.
YAKIMA PROJECT
SUNNYSIDE, WASHINGTON

SCALE: 1" = 5'	As Built	DRAWN: D.L.C.
DATE: DEC. '86		CHECKED: D.L.S.

PUMP STATION - PLAN & SECTION
30' WEIR - PLAN & SECTION
STILLING WELL & CONTROL SCHEME

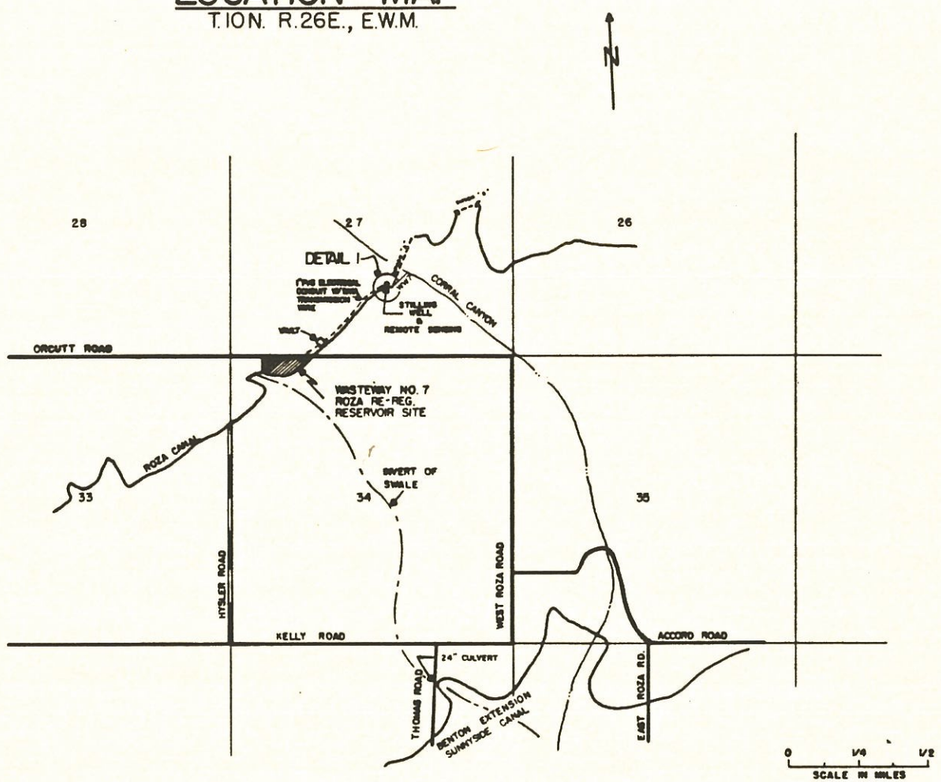
SHEET 3 OF 4

REVISED 2-89 K.A.N.
REVISED 7-88 K.A.S.C.
REVISED 3-29-88 K.A. CRAGER

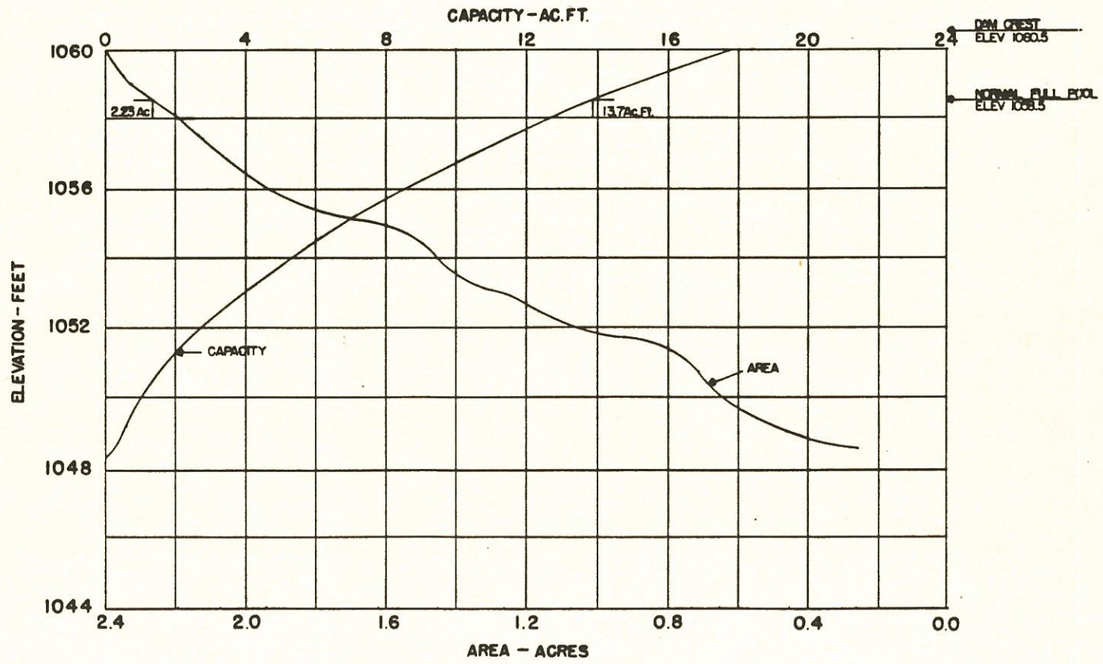
FIGURE 6.6 SHEET 3 of 3

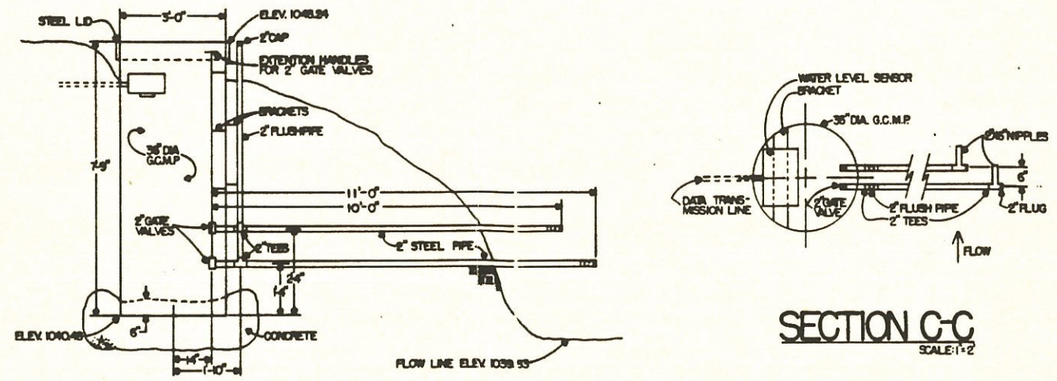
LOCATION MAP

T.10N. R.26E., E.W.M.



AREA - CAPACITY



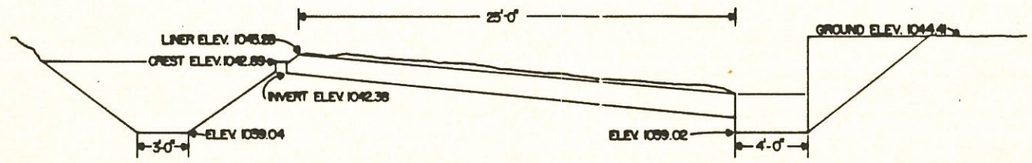


SECTION A-A

SCALE 1"=2'

SECTION C-C

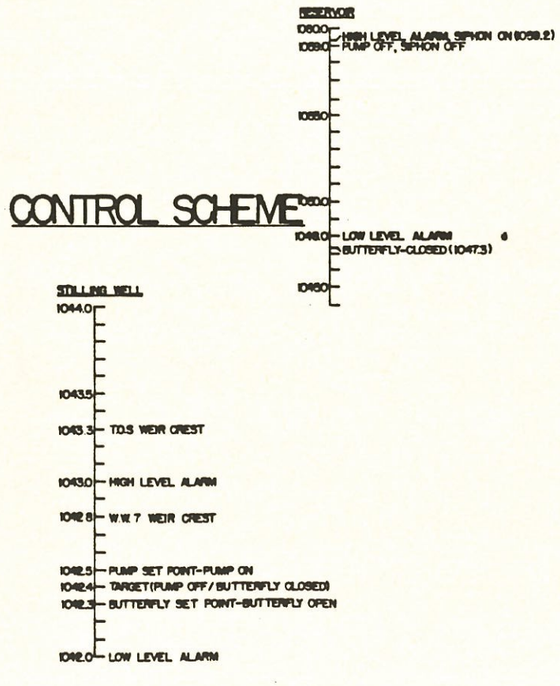
SCALE: 1"=2'

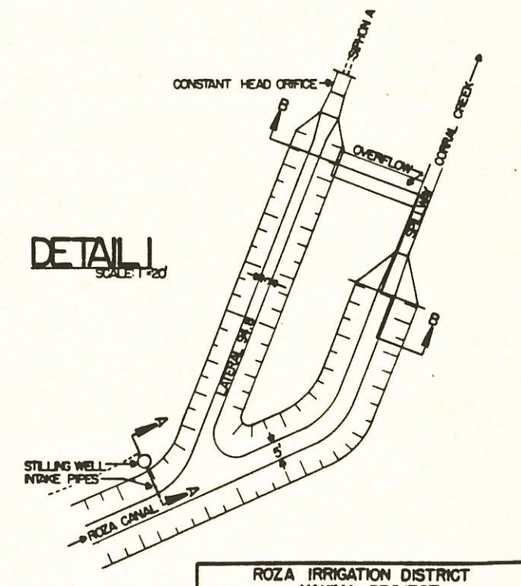


SECTION B-B

SCALE 1/4"=1'

CONTROL SCHEME





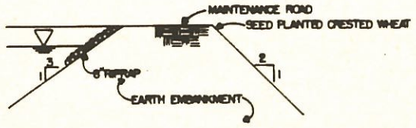
DETAIL I

SCALE: 1"=20'

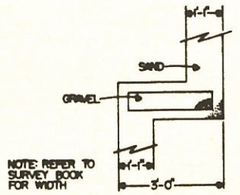
JOHN S. MEYER
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER

ROZA IRRIGATION DISTRICT YAKIMA PROJECT SUNNYSIDE, WASHINGTON		
SCALE: SHOWN		DRAWN: R.D.S.
DATE: SEPT. 1,94		CHECKED:
WASTEWAY NO.7 RESERVOIR: AREA CAPACITY GRAPH & LOCATION MAP STILLING WELL & CONTROL SCHEME		
		SHEET 1 OF 3

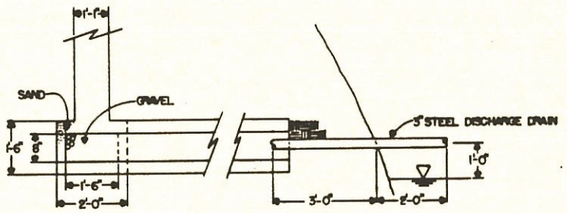
FIGURE 6.7 SHEET 1 of 3



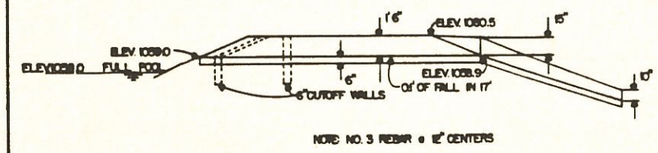
DETAIL A
EMBANKMENT



DETAIL B
HORIZONTAL CHIMNEY DRAIN

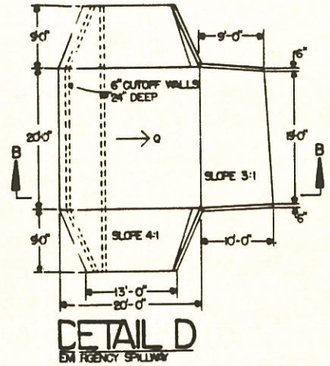


DETAIL C
CHIMNEY DRAIN

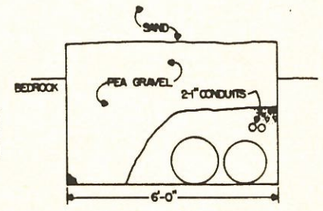


NOTE: NO. 3 REBAR @ 12" CENTERS

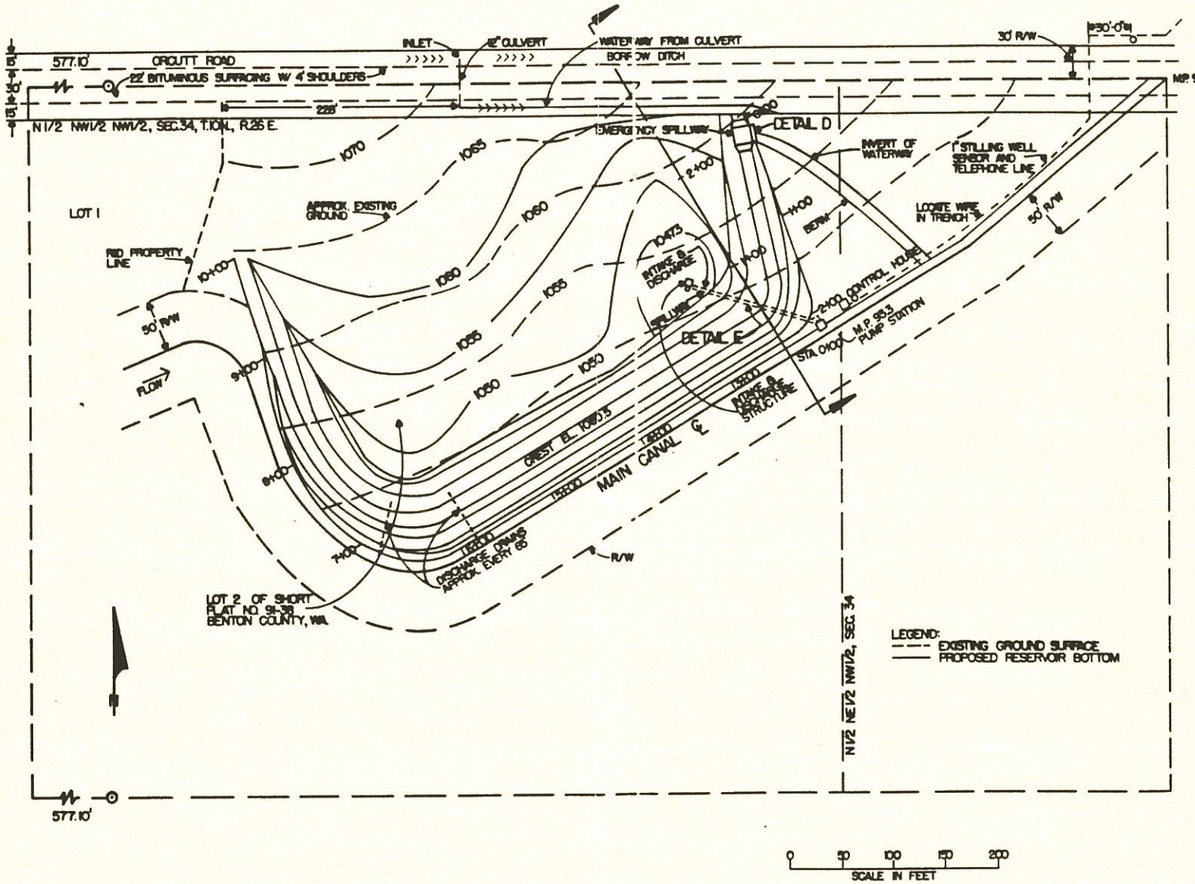
SECTION B-B



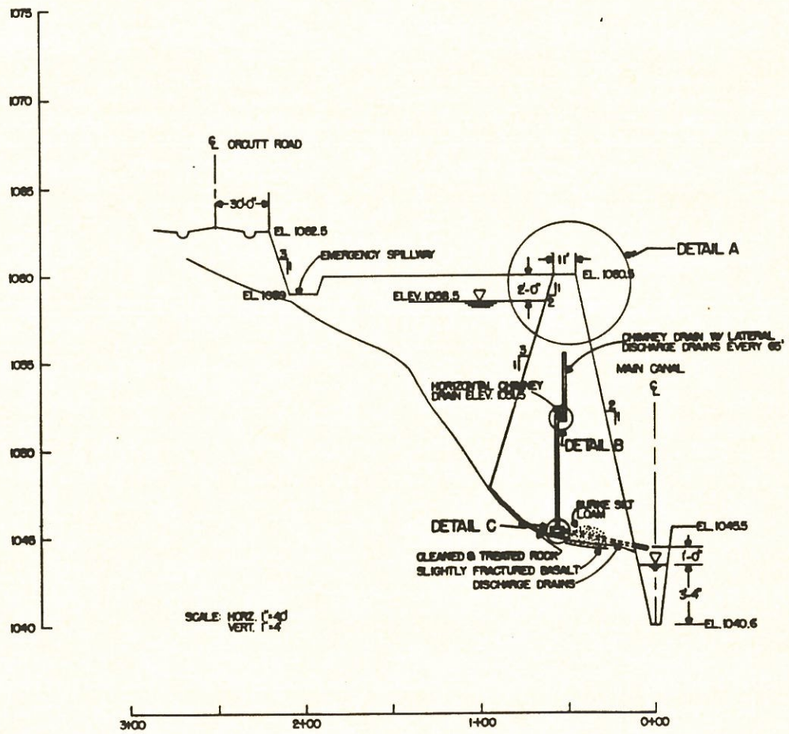
DETAIL D
EMERGENCY SPILLWAY



DETAIL E
PIPES UNDER CHIMNEY DRAIN



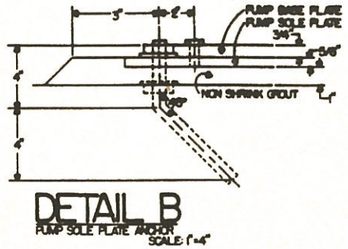
SITE PLAN



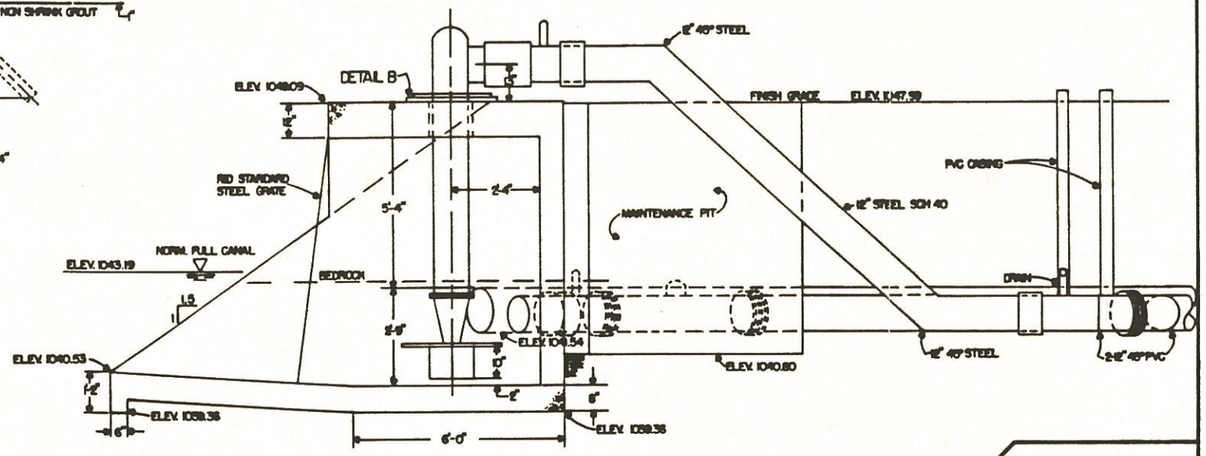
RESERVOIR SECTION A-A

ROZA IRRIGATION DISTRICT YAKIMA PROJECT SUNNYSIDE, WASHINGTON		
SCALE: SHOWN		DRAWN: KPS
DATE: SEPT. 1, 94		CHECKED:
WASTEWAY NO. 7 RESERVOIR: SITE PLAN & RESERVOIR SECTION		
		SHEET 2 OF 3

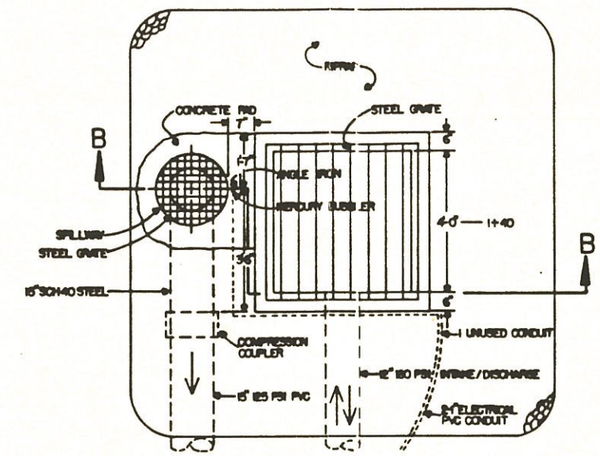
FIGURE 6.7 SHEET 2 of 3



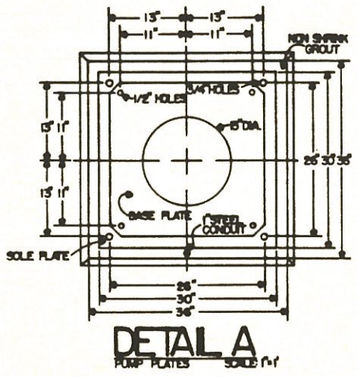
DETAIL B
PUMP SOLE PLATE ANCHOR
SCALE: 1"=1'



SECTION A-A



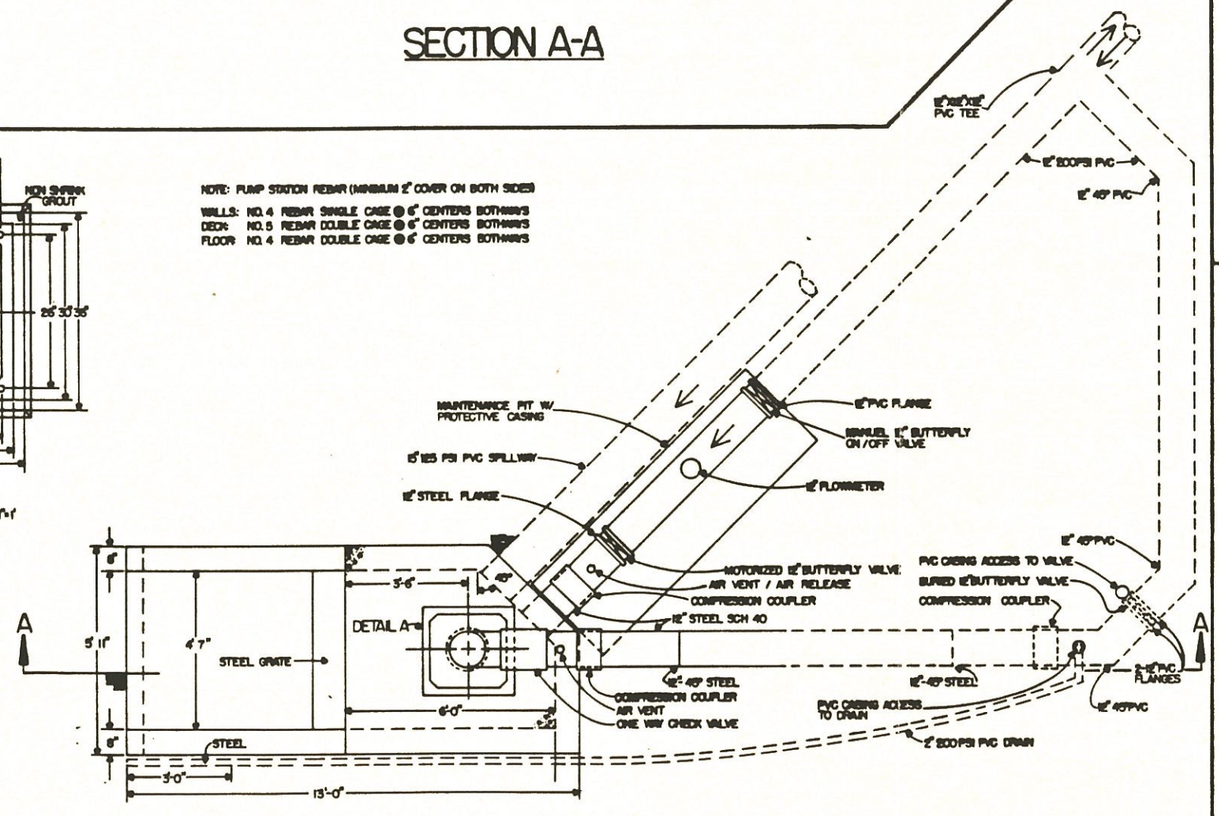
INTAKE / DISCHARGE STRUCTURE



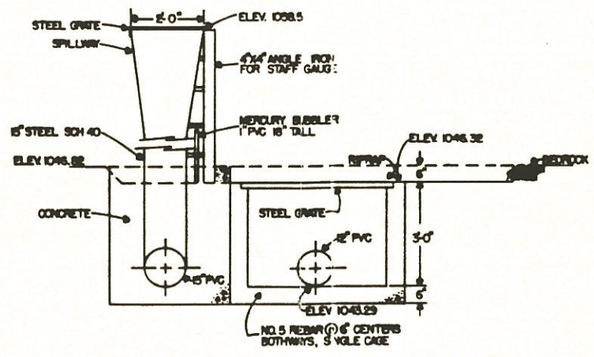
DETAIL A
PUMP PLATES SCALE 1"=1'

NOTE: PUMP STATION REBAR (MINIMUM 2" COVER ON BOTH SIDES)

WALLS: NO. 4 REBAR SINGLE CAGE @ 6" CENTERS BOTHWAYS
DECK: NO. 5 REBAR DOUBLE CAGE @ 6" CENTERS BOTHWAYS
FLOOR NO. 4 REBAR DOUBLE CAGE @ 6" CENTERS BOTHWAYS



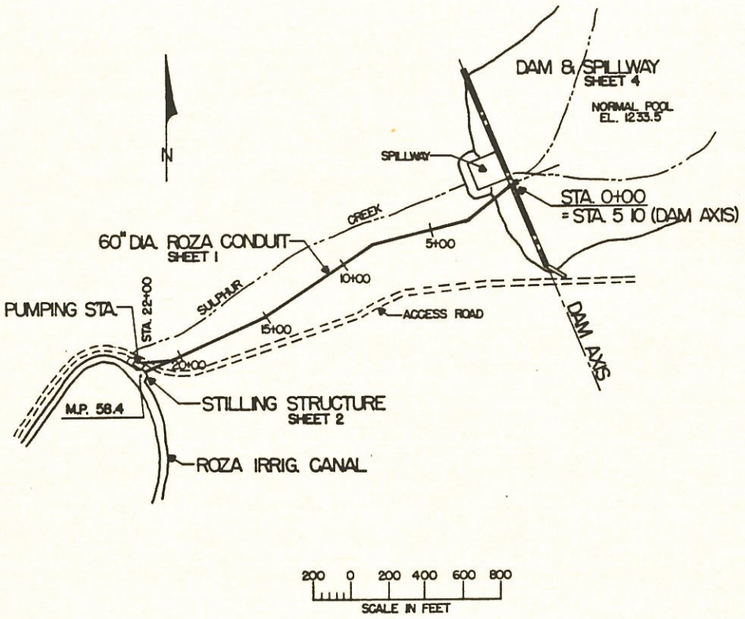
PLAN VIEW



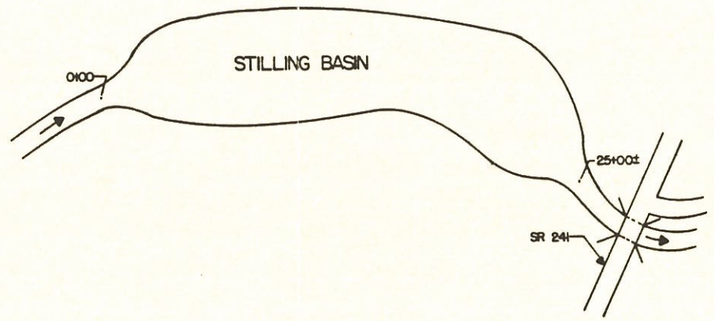
SECTION B-B

ROZA IRRIGATION DISTRICT YAKIMA PROJECT SUNNYSIDE, WASHINGTON		
SCALE: 1"=2'		DRAWN: T.P.S.
DATE: SEPT. 1, 94		CHECKED:
WASTEWAY NO. 7 RESERVOIR: PUMP STATION - PLAN & SECTION INTAKE / DISCHARGE - PLAN & SECTION		
		SHEET 3 OF 3

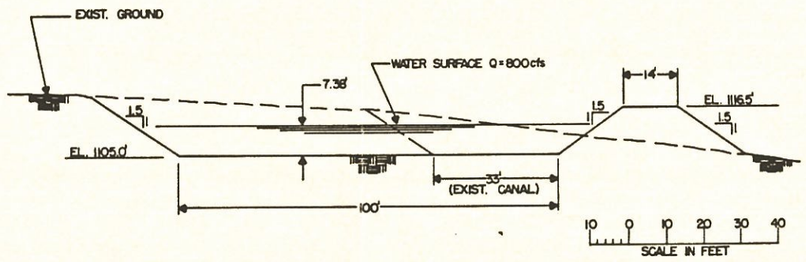
FIGURE 6.7 SHEET 3 of 3



PLAN-ROZA CONDUIT / FORCE MAIN

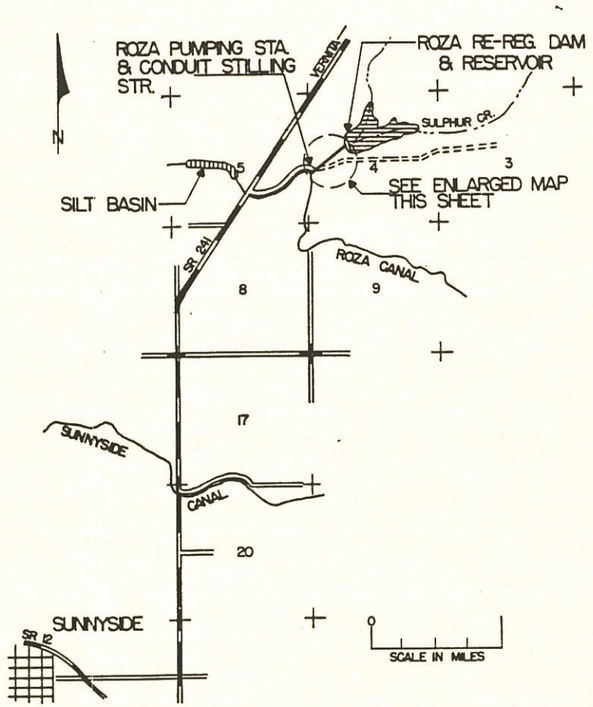


PLAN-SILT BASIN

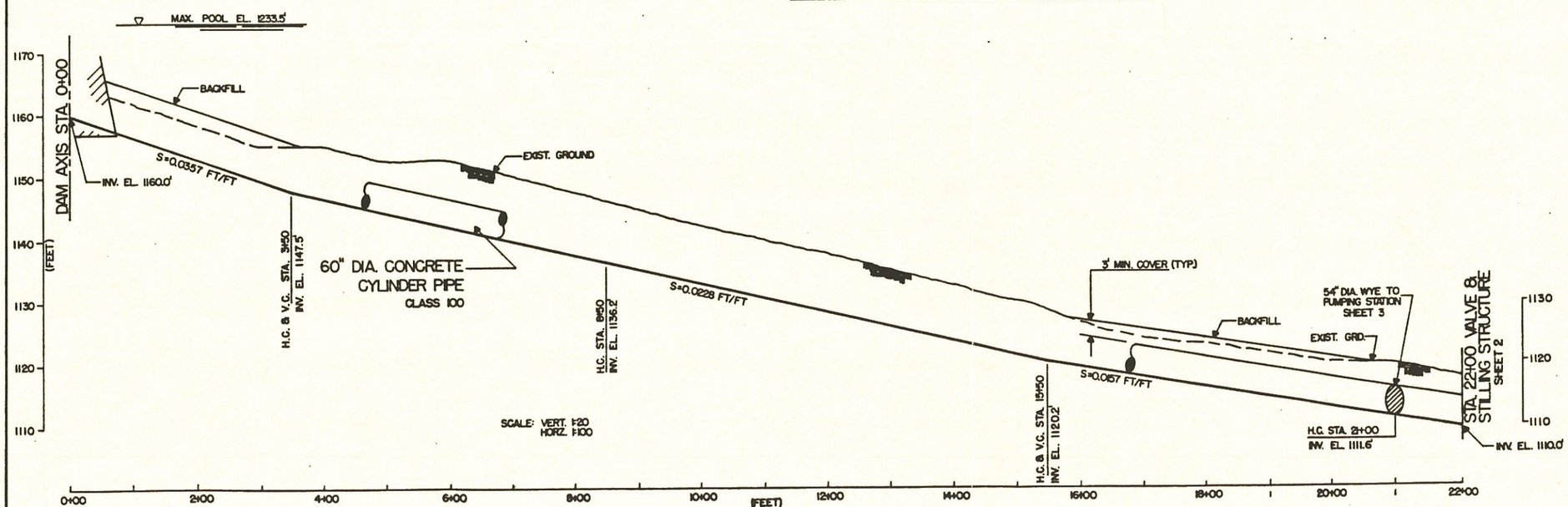


TYP. CROSS SECTION-SILT BASIN

T.11N., R.23 E.W.M.



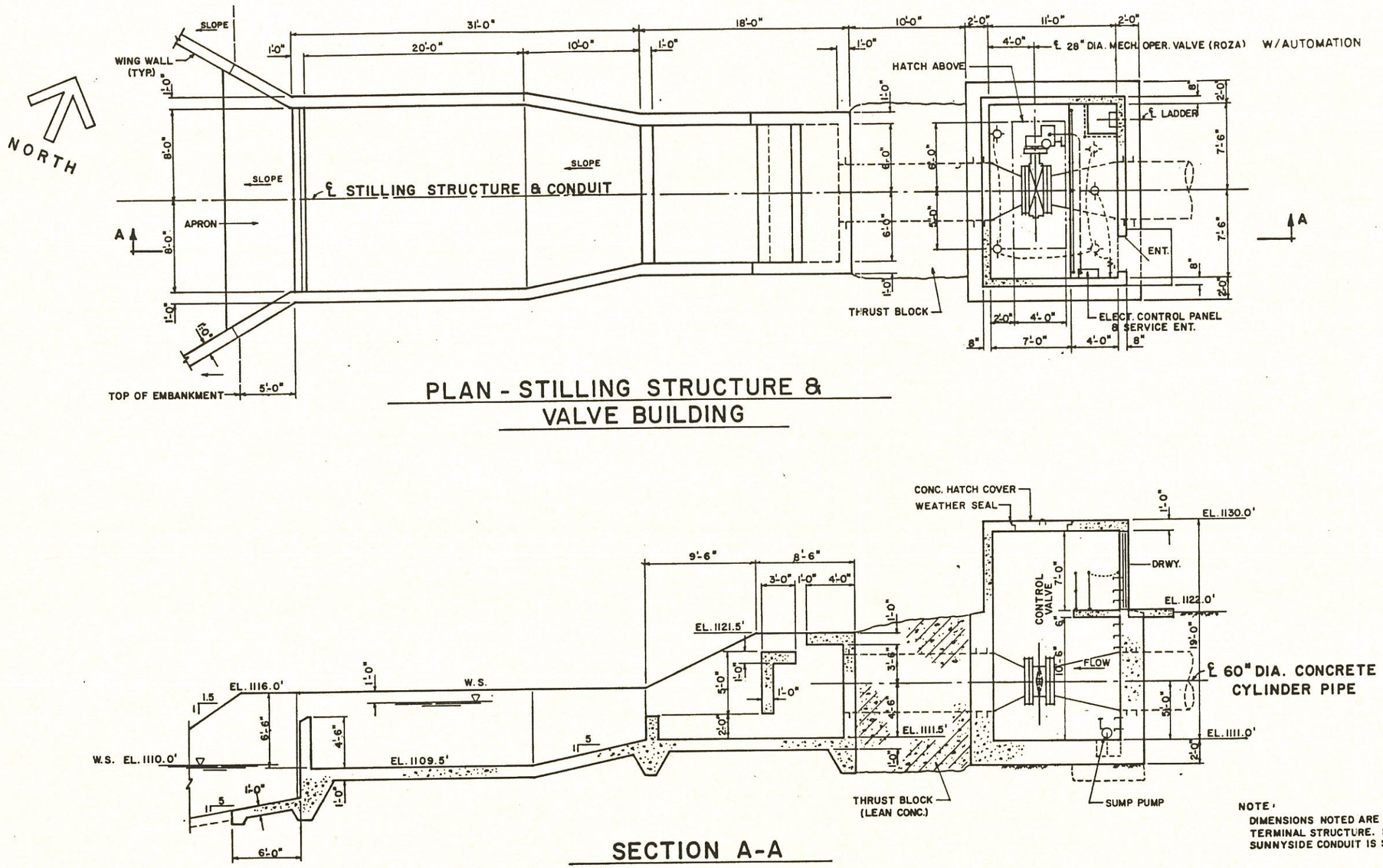
LOCATION MAP



PROFILE-ROZA CONDUIT

FIGURE 6.8 Sheet 1 of 6

ROZA IRRIGATION DISTRICT YAKIMA PROJECT SUNNYSIDE, WASHINGTON		
SCALE: SHOWN		DRWN: KP
DATE: AUG. '85		CHK'D:
PLAN & PROFILES ROZA CONDUIT & FORCE MAIN		
REVISED 6/93 KP		SHEET NO: 1 OF 5



PLAN - STILLING STRUCTURE & VALVE BUILDING

SECTION A-A

NOTE:
DIMENSIONS NOTED ARE FOR ROZA CONDUIT TERMINAL STRUCTURE. STRUCTURE FOR SUNNYSIDE CONDUIT IS SIMILAR.

SCALE IN FEET

FIGURE 6.8 Sheet 2 of 6

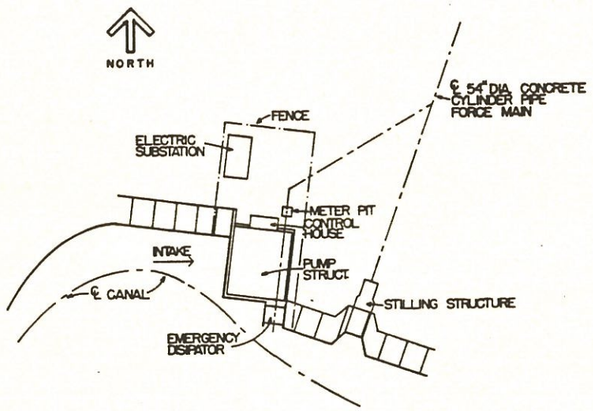
ROZA IRRIGATION DISTRICT
YAKIMA PROJECT
SUNNYSIDE, WASHINGTON

SCALE: SHOWN
DATE: AUG. '85
DRWN: WP
CHK'D: DCJ

CONDUIT TERMINAL STRUCTURES

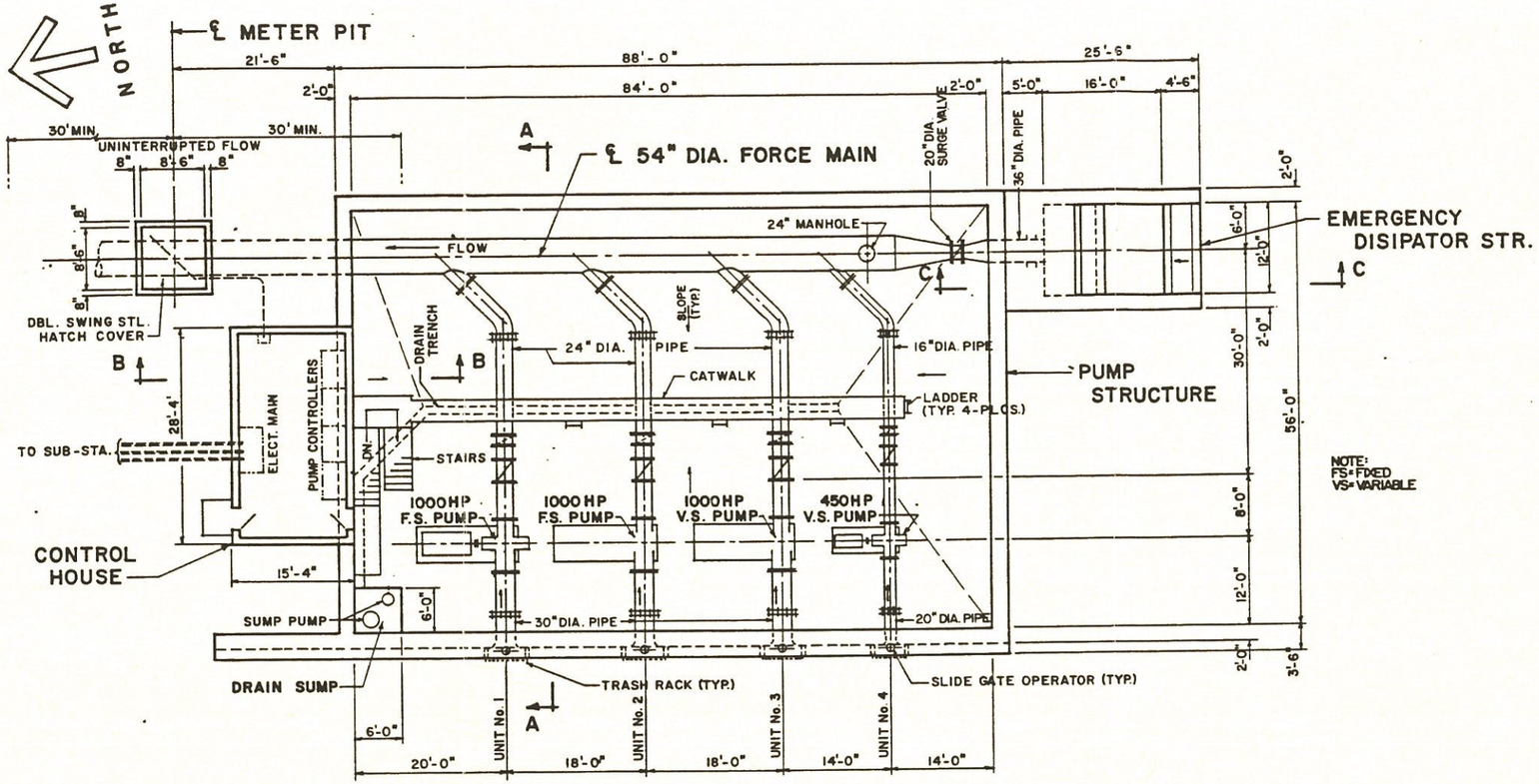
REVISED 6/93 WP

SHEET NO: 2 OF 5



SITE PLAN

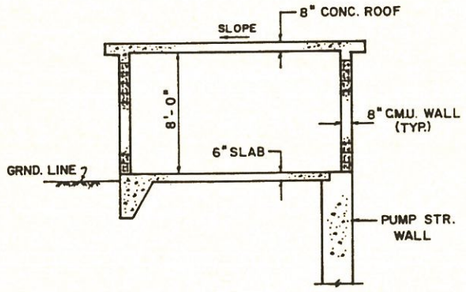
50 0 100
SCALE IN FEET



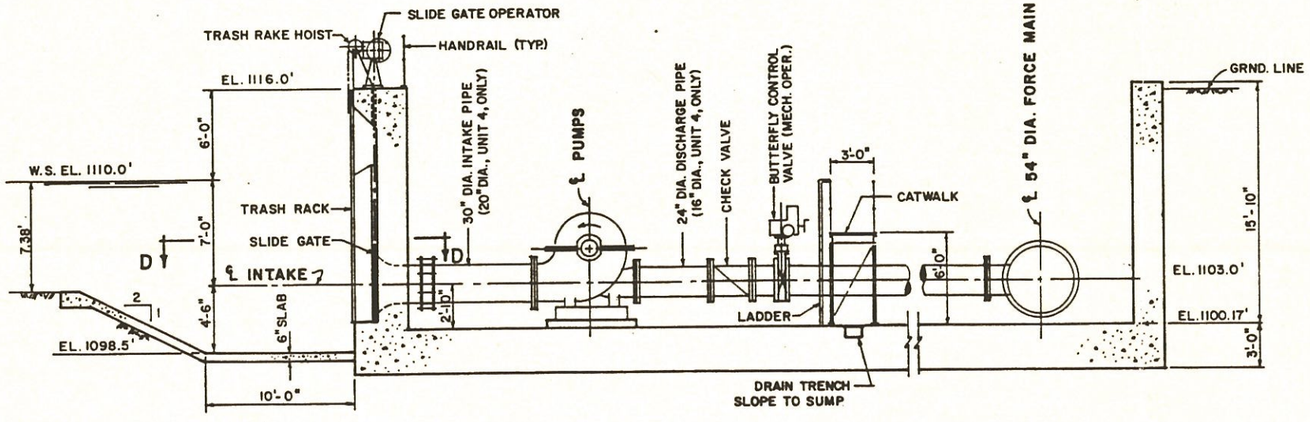
NOTE:
FS=FIXED
VS=VARIABLE

PLAN

5 0 10
SCALE IN FEET

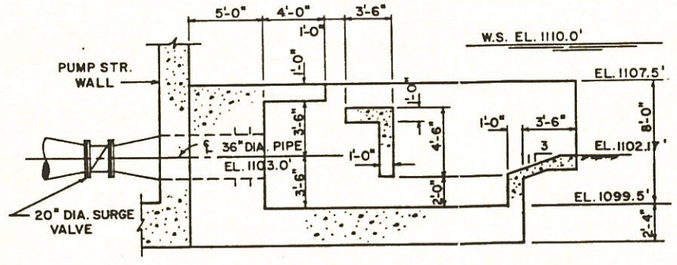


SECTION B-B

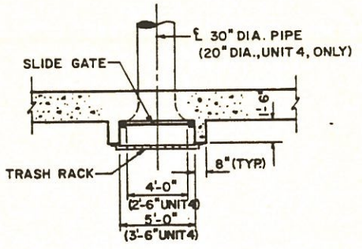


SECTION A-A

5 0 5 10
SCALE IN FEET



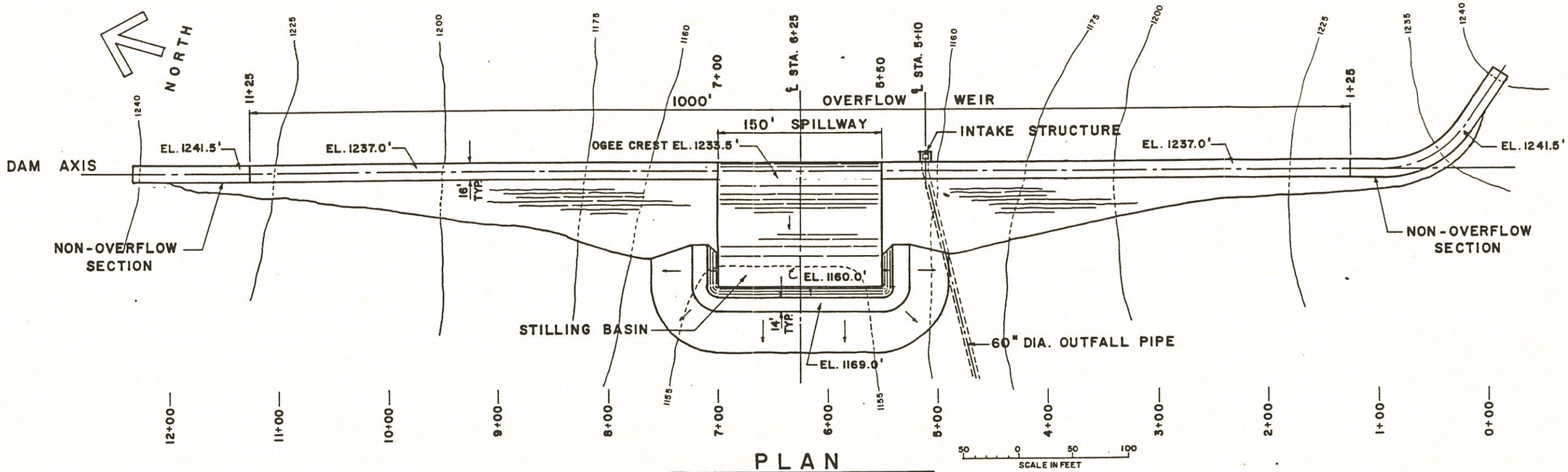
SECTION C-C



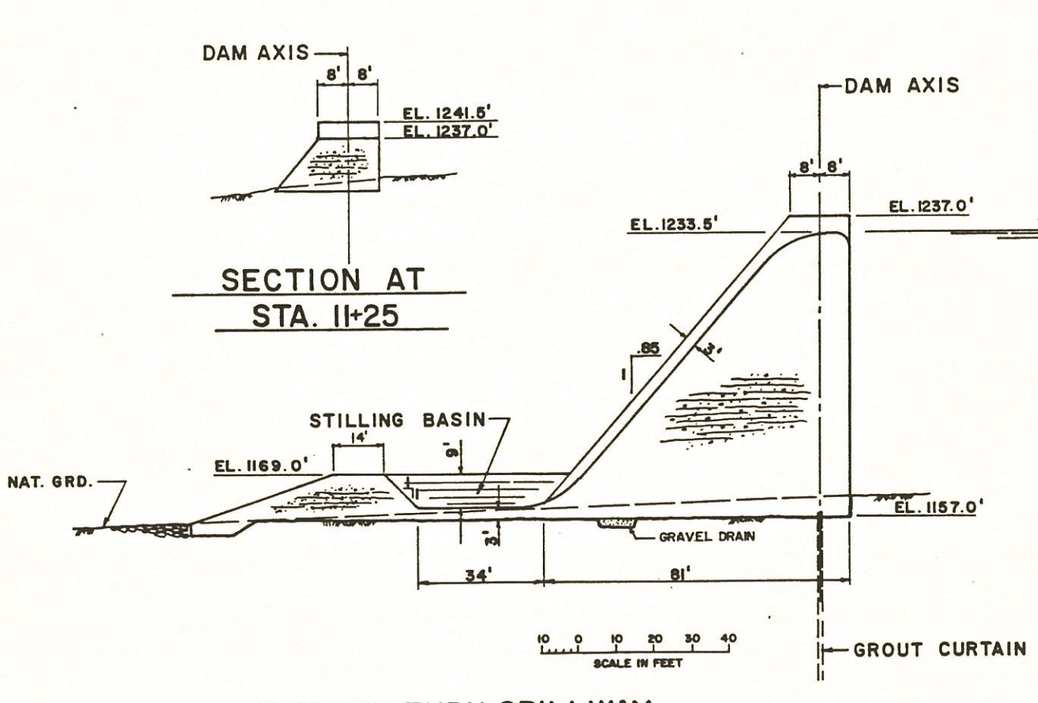
SECTION D-D

FIGURE 6.8 Sheet 3 of 6

ROZA IRRIGATION DISTRICT YAKIMA PROJECT SUNNYSIDE, WASHINGTON		
SCALE: SHOWN		DRWN: WS
DATE: AUG. '85		CHK'D: DCJ
ROZA PUMP STATION		
REVISED 6/93-SO		SHEET NO: 3 OF 5

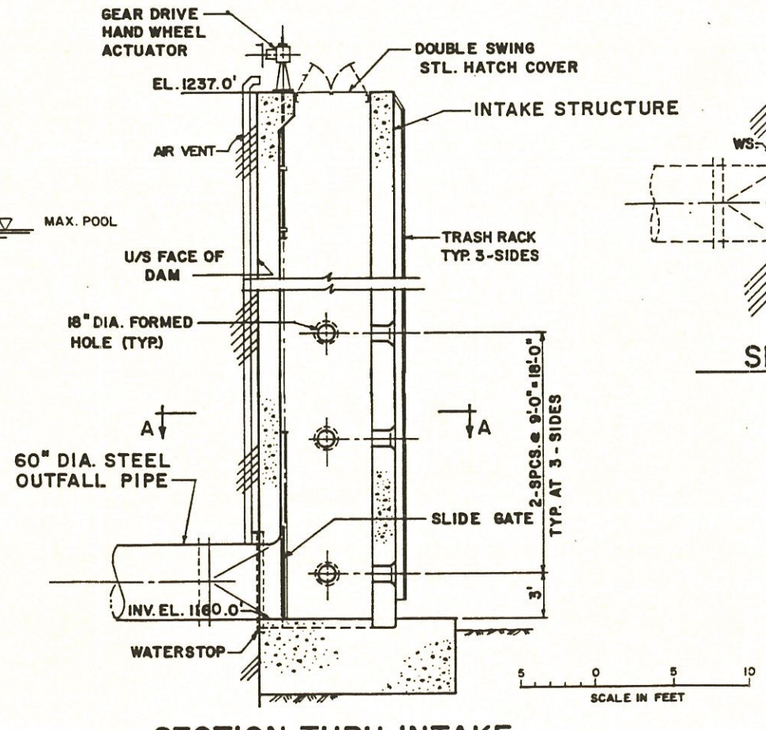


PLAN

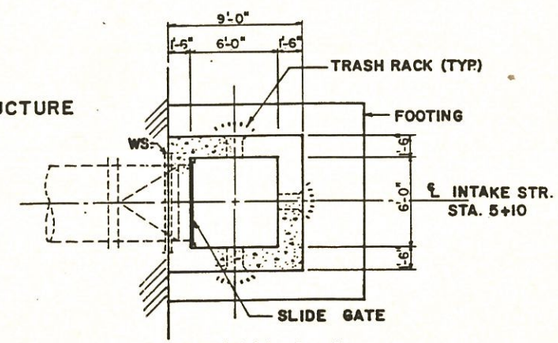


SECTION AT STA. 11+25

SECTION THRU SPILLWAY STA. 6+25



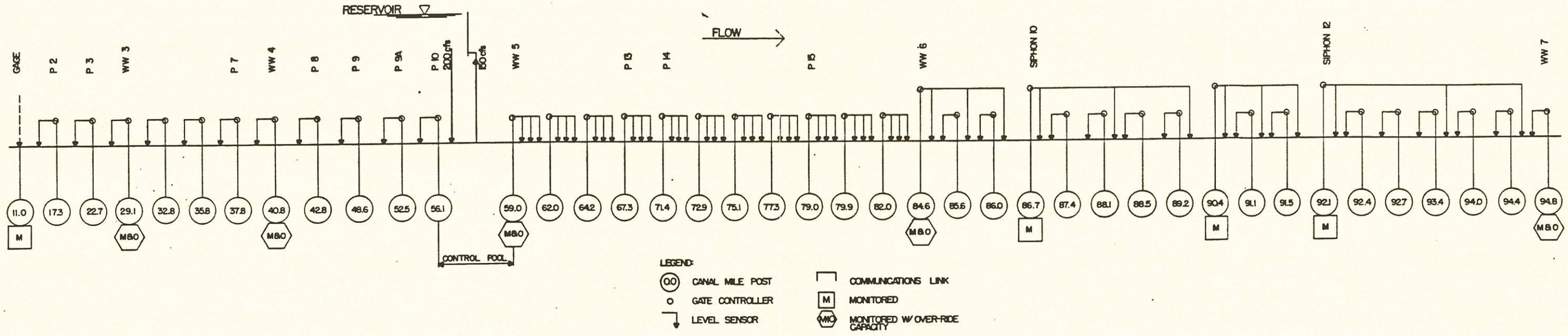
SECTION THRU INTAKE STRUCTURE AT STA. 5+10



SECTION A-A

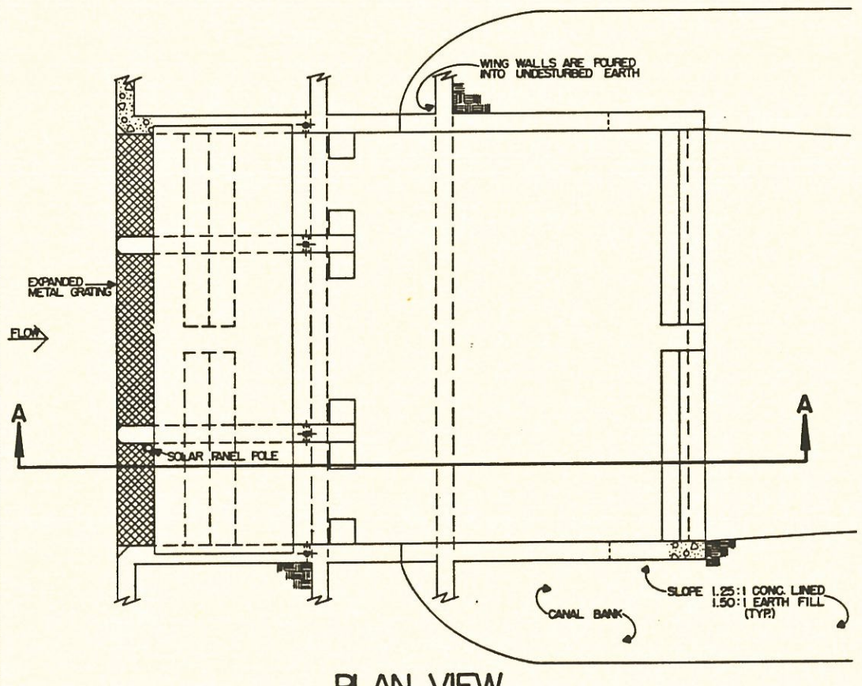
FIGURE 6.8 Sheet 4 of 6

ROZA IRRIGATION DISTRICT YAKIMA PROJECT SUNNYSIDE, WASHINGTON		
SCALE: SHOWN		DRWN: MB
DATE: AUG. '85		CHK'D: DCJ
ROZA RE-REG. DAM		
REVISED 6/95 KV		SHEET NO: 4 OF 5

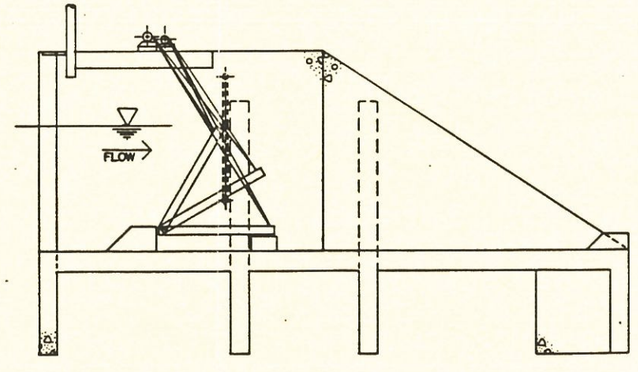


ROZA SCHEMATIC

Figure 6.8 Sheet 5 of 6



PLAN VIEW



SECTION A-A

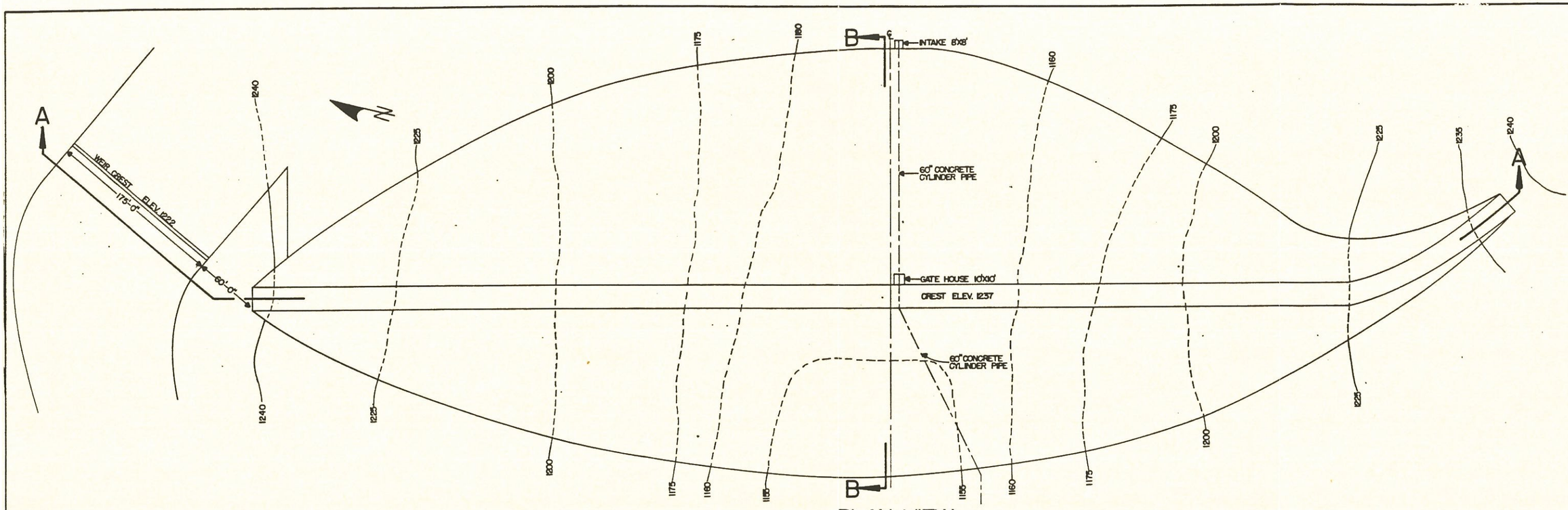
ROZA CHECK STRUCTURES			ROZA CHECK STRUCTURES		
MILE POST	NO. OF GATES	DESIGN FLOW(cfs)	MILE POST	NO. OF GATES	DESIGN FLOW(cfs)
17.3	3	1300	85.6	2	125
22.7	1	1300	86.0	2	125
29.1	2	1150	86.7	2	125
32.8	3	1100	87.4	2	125
35.8	3	1100	88.1	2	100
37.8	3	1100	88.5	2	100
40.8	2	1000	89.2	2	100
42.8	3	1000	90.4	2	100
48.6	3	900	91.1	2	100
52.5	3	850	91.5	2	100
56.1	3	800	92.1	2	75
59.0	2	650	92.4	2	75
62.0	3	600	92.7	2	75
64.2	3	600	93.4	2	75
67.3	4	500	94.0	2	75
71.4	3	450	94.4	2	75
72.9	4	400	94.8	1	75
75.1	4	350			
77.3	3	350			
78.9	3	350			
79.9	3	300			
82.0	3	300			
84.6	1	125			

ROZA IRRIGATION DISTRICT
YAKIMA PROJECT
SUNNYSIDE, WASHINGTON

SCALE: NONE | DRWN: KAP
DATE: JUNE '93 | CHK'D:

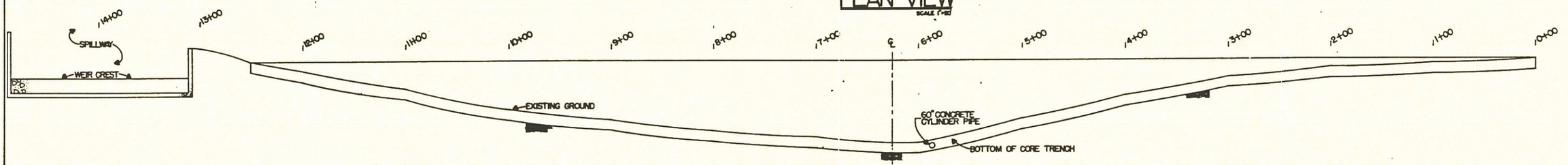
CANAL CHECK STRUCTURES
CANAL CONTROL

REVISED 6/93 KP | SHEET NO.: 5 OF 5



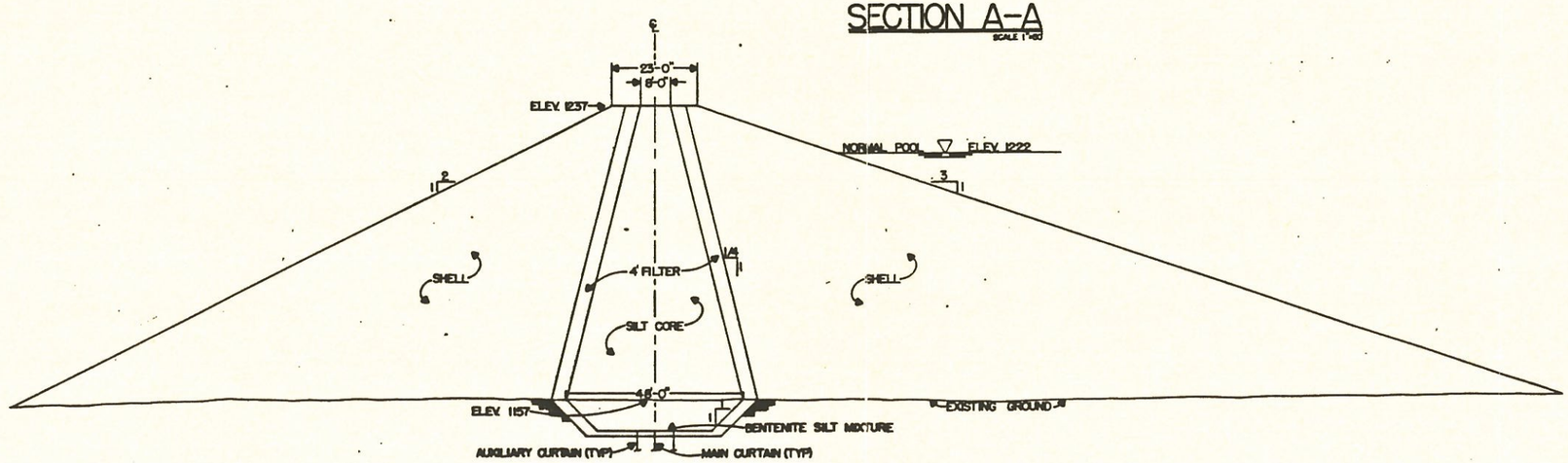
PLAN VIEW

SCALE 1"=80'



SECTION A-A

SCALE 1"=80'



SECTION B-B

SCALE 1"=80'

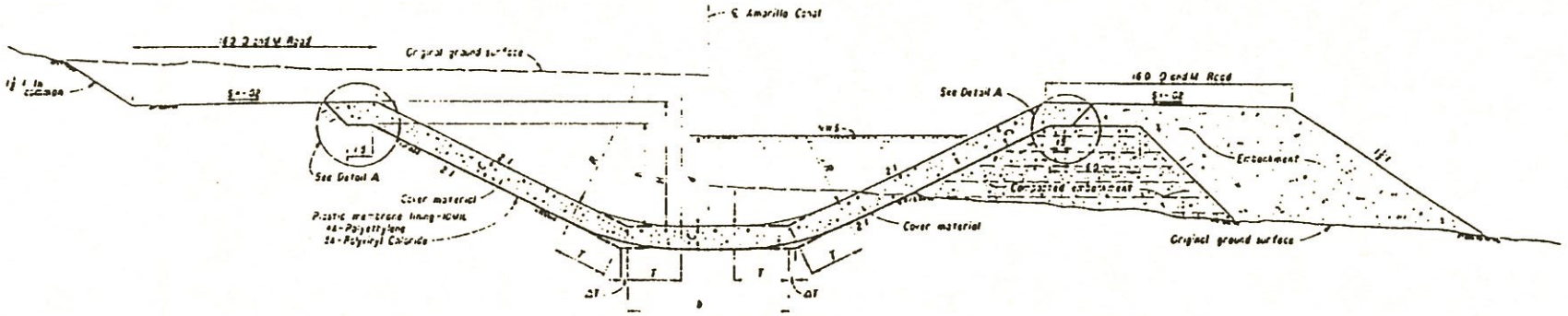
FIGURE 6.8 Sheet 6 of 6

ROZA IRRIGATION DISTRICT YAKIMA PROJECT SUNNYSIDE, WASHINGTON	
SCALE: AS SHOWN	DRWN: KO
DATE: JULY 27, 93	CHK'D: GLW
80' DAM ALTERNATIVE	
	SHEET NO. 2 OF 2

Reference: USBR "Performance of Plastic Canal Linings" 1984

HYDRAULIC PROPERTIES

CANAL SECTION	TYPE	A	V	Q	r	n	s	b	d	h	H	c	T	R	ΔT
4A	PE	125.50	1.51	190	3.48	.0225	.0004	10.5	5.72	6.60	8.10	1.33	35	1483	35
5A	PVC	86.02	1.98	170	2.83	.0225	.00025	10.75	4.40	5.25	6.70	1.25	35	1483	255



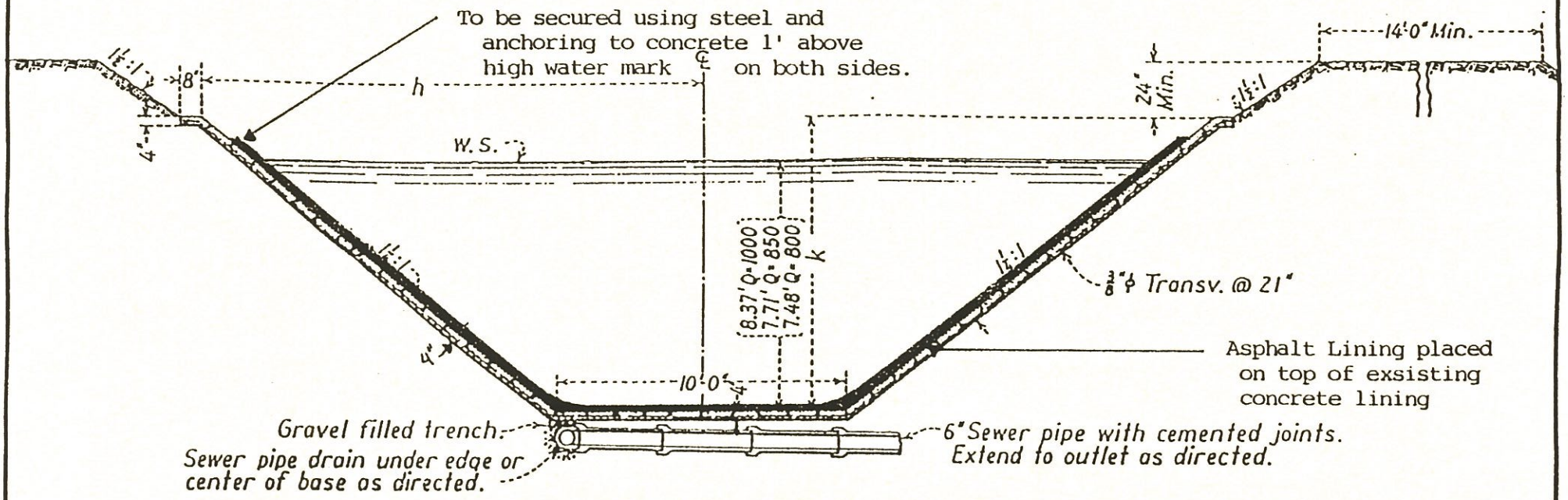
TYPICAL CANAL SECTION WITH PLASTIC MEMBRANE LINING

No Scale

FIGURE 6.9

Standard Cross Section of Main Canal with PVC Liner

Reference: USBR Spec #956
RID Main Canal



No Scale

FIGURE 6.10

Standard Cross Section of Main Canal with Asphalt liner

ROZA IRRIGATION DISTRICT		
DATE: APRIL 10, 1997	REVISED:	DRAWN BY: H. STEWART
SCALE: 1" = 4 miles		APP.BY: D. PERALA
POTENTIAL OFF STREAM STORAGE SITES		
Sunnyside, Washington	JOB NUMBER	DRAWING NUMBER DNEJCON

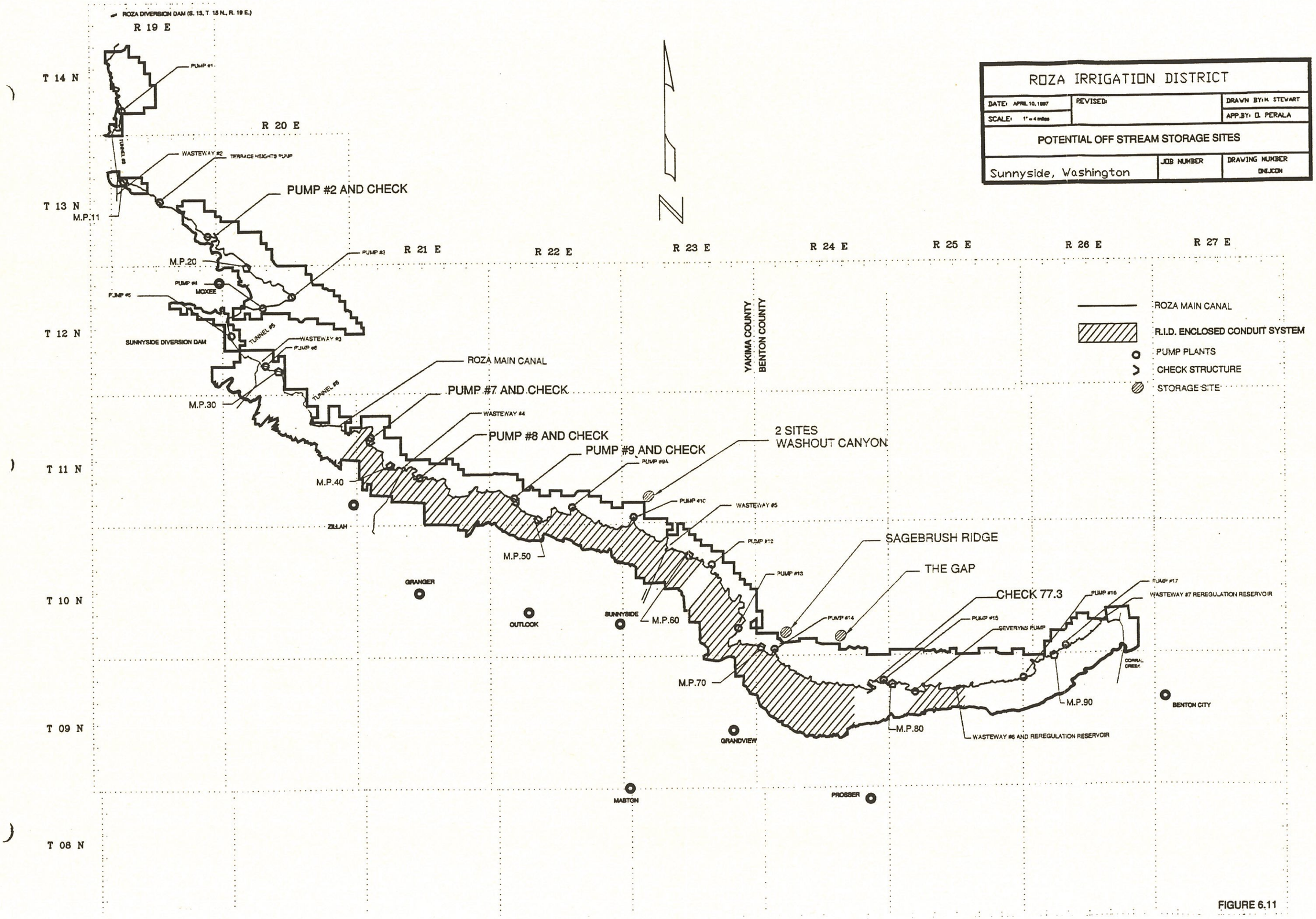


FIGURE 6.11

ROZA IRRIGATION DISTRICT
PROJECTED CHANGES IN DEMAND

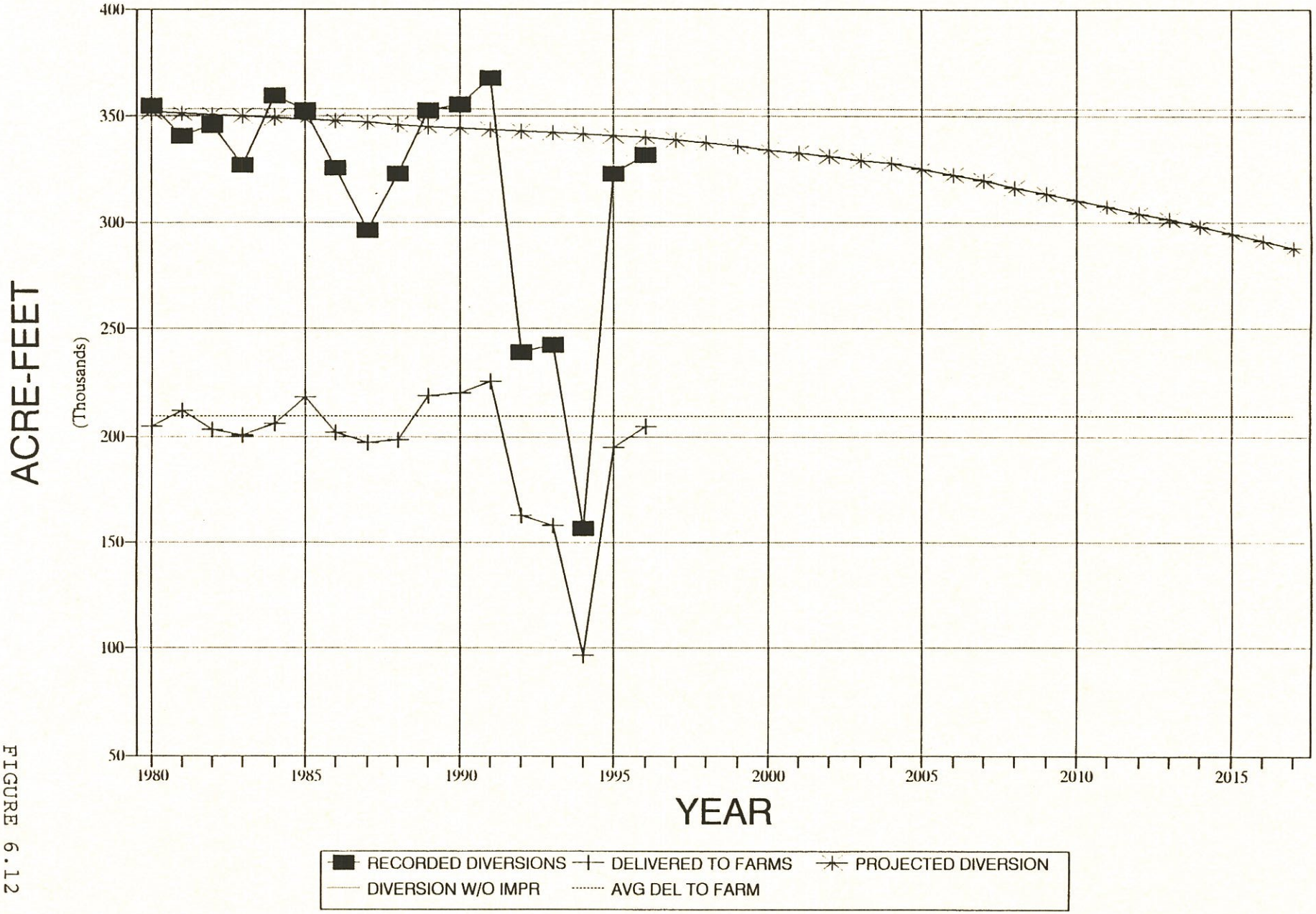


FIGURE 6.12

1970-95 DIVERSION STATS
WITHOUT SHORTAGE YEARS

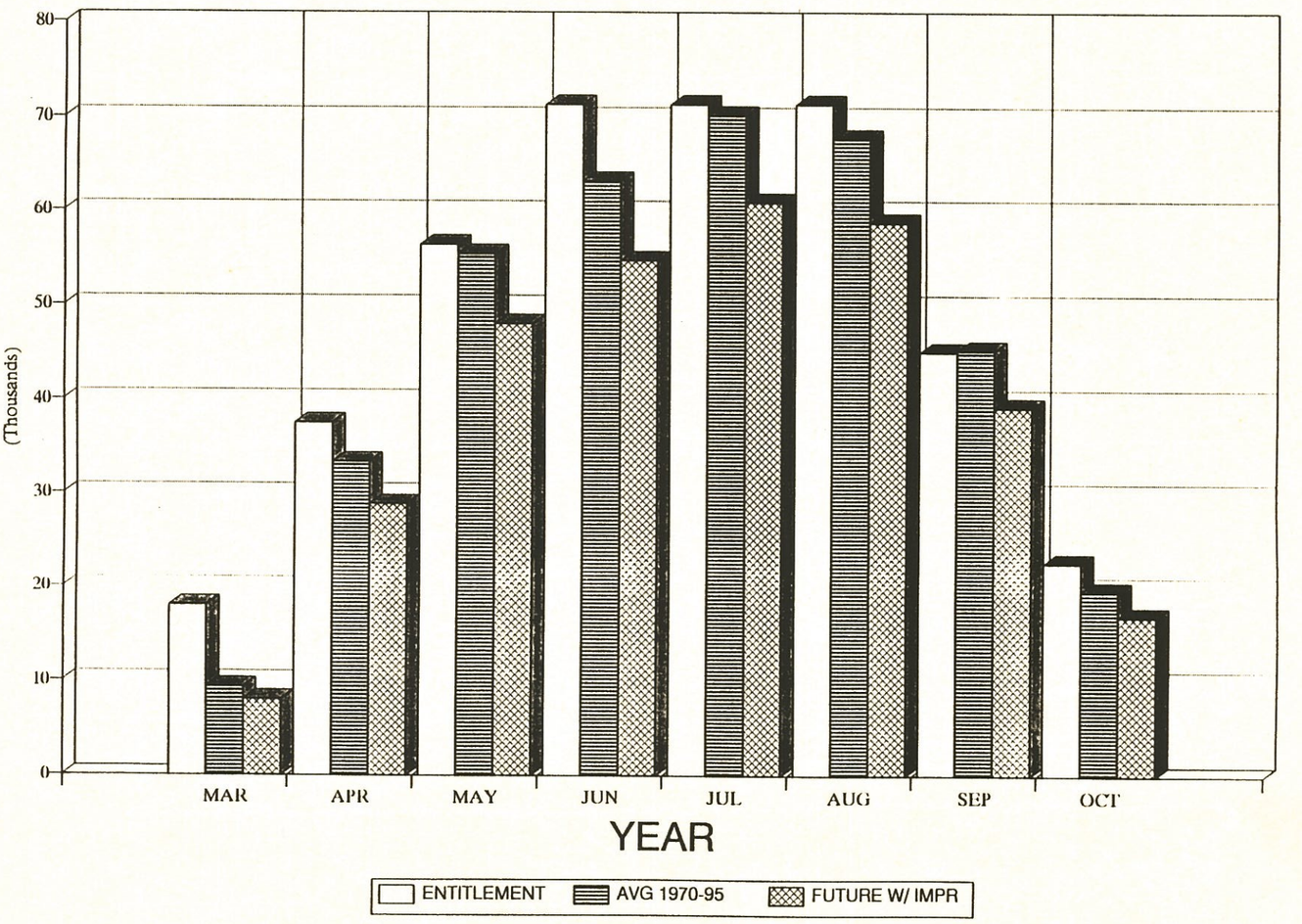
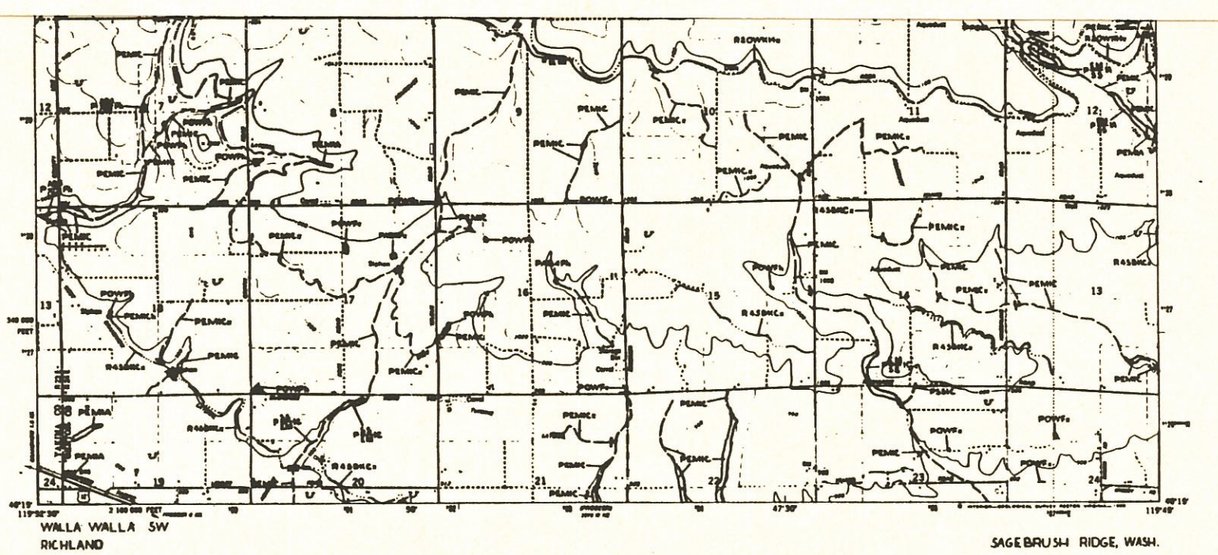


FIGURE 6.13



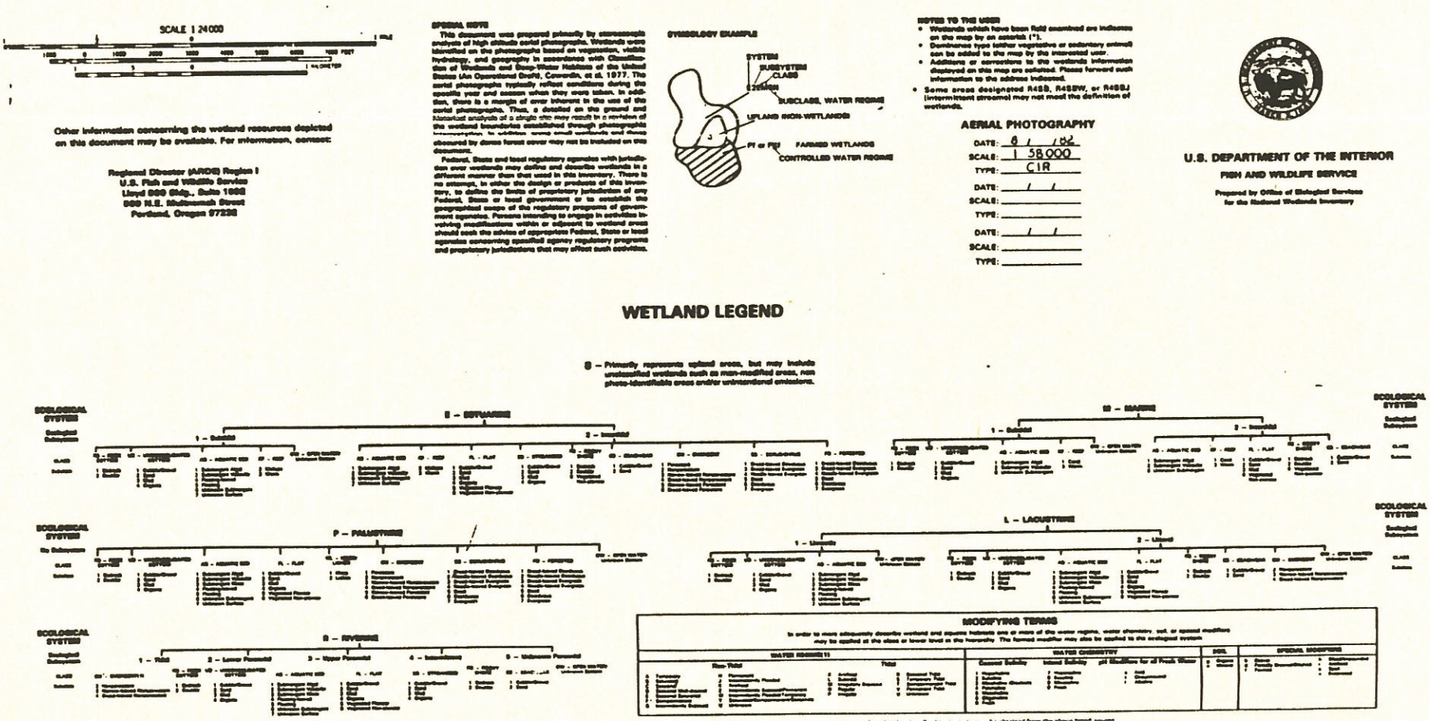


FIGURE 6.14

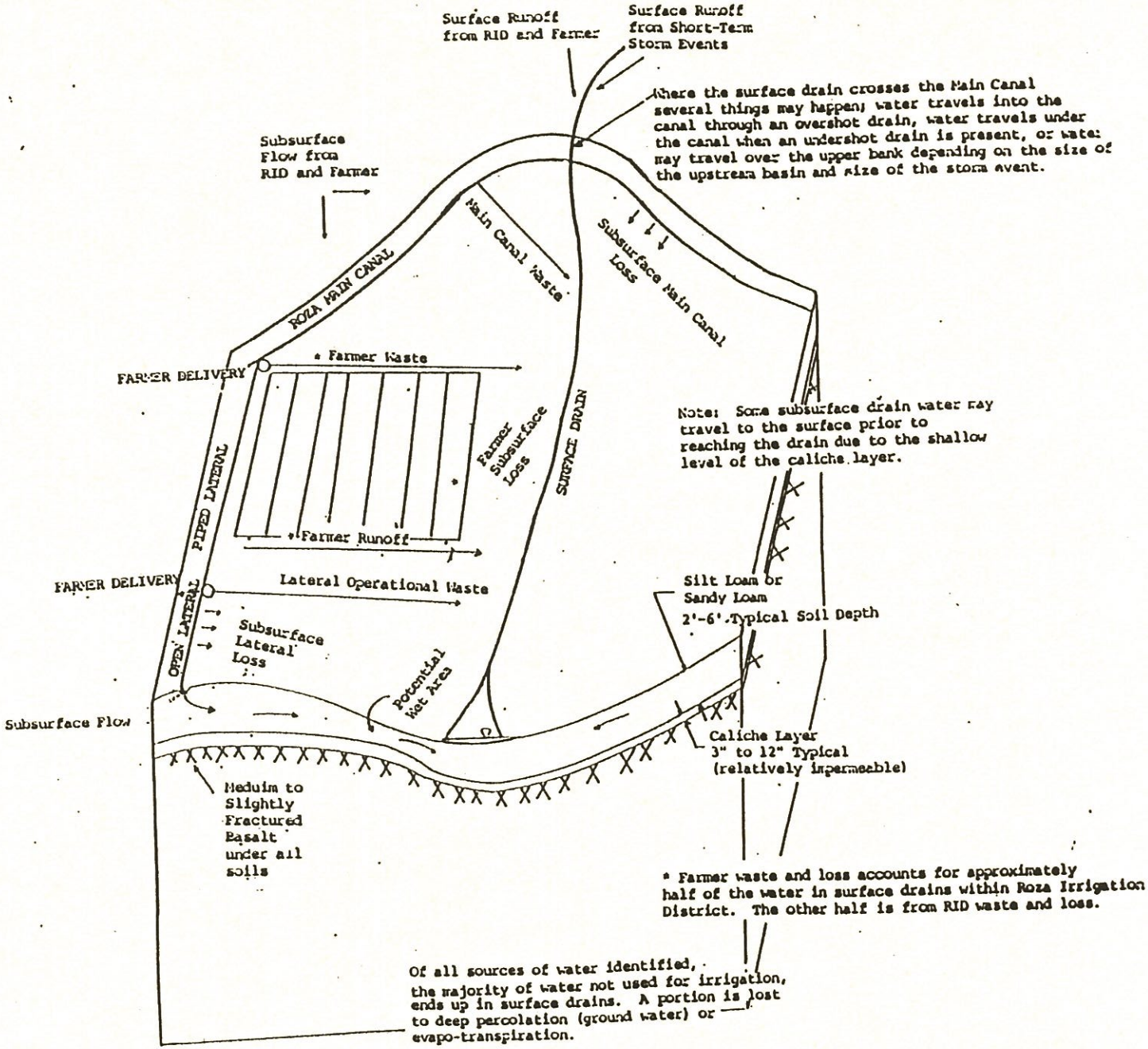


FIGURE 6.15 SOURCES OF WATER FOR WETLAND AREAS

ROZA IRRIGATION DISTRICT
RESERVE FUNDS

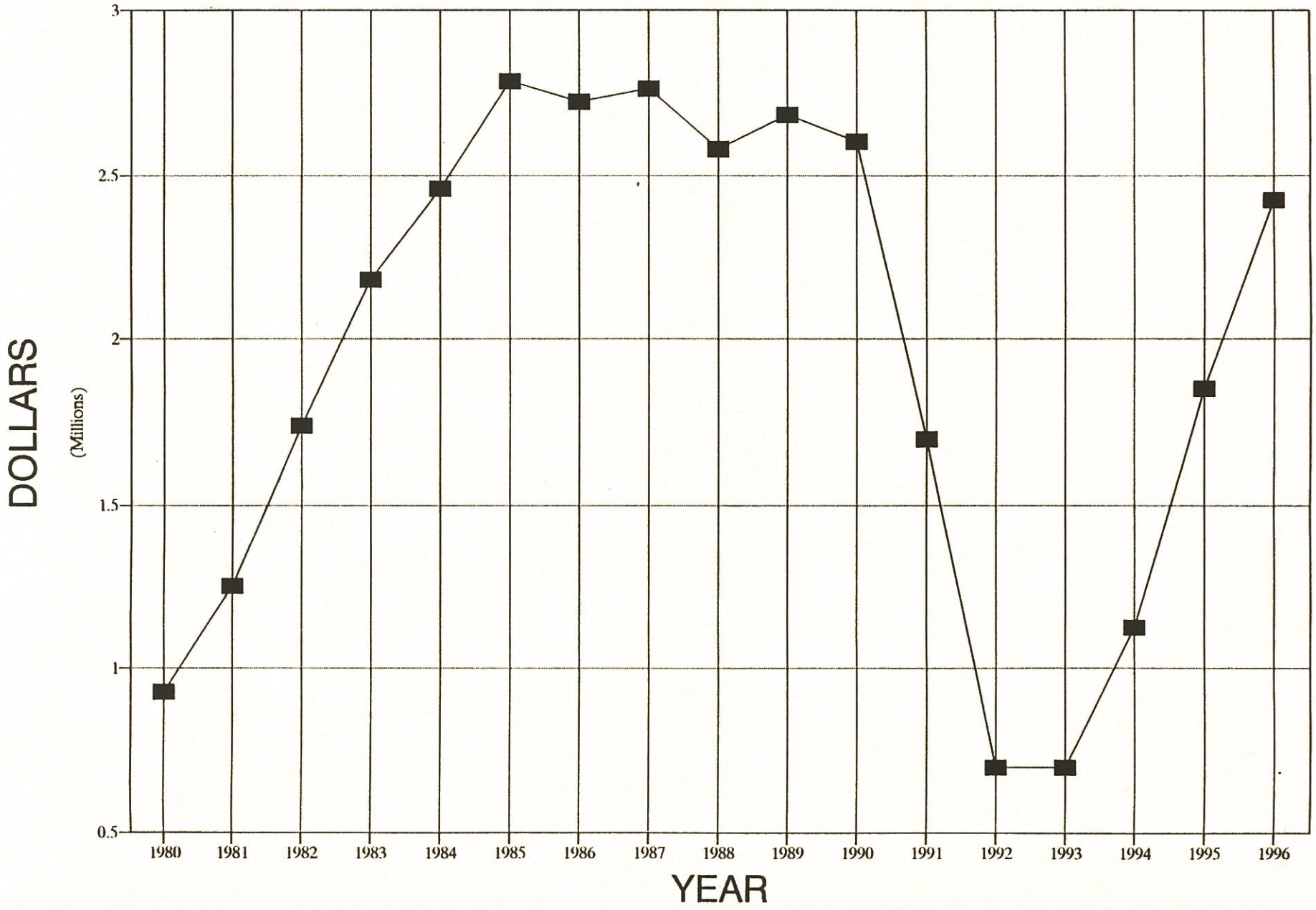


FIGURE 7.1

ROZA IRRIGATION DISTRICT

11 MILE ADJUSTED FOR PUMP #1 AND TERRACE HGTS.

TABLE 3.2

YEAR	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	MAR-OCT TOTAL	APR-OCT TOTAL
70	11633	32645	60149	68516	73280	68767	44640	20348	379978	368345
71	12592	31814	63491	60746	71471	73179	37866	21783	372942	360350
72	14005	34782	57365	63450	71960	68949	49459	19972	379942	365937
73	10535	44421	63705	62906	67339	62993	27378	0	339277	328742
74	8971	28581	51910	71833	72188	69293	57054	27259	387089	378118
75	10537	29798	56156	71495	74996	67303	48573	23132	381990	371453
76	13056	35816	63459	65747	71509	64783	48227	24270	386867	373811
77	0	21641	31113	43308	56558	60641	44809	0	258070	258070
78	9195	32509	51664	67331	69916	65779	41947	22218	360559	351364
79	8050	36588	65540	67588	65847	31156	0	10411	285180	277130
80	5660	30467	57247	56043	72290	71109	44279	23299	360394	354734
81	6220	31540	50797	55949	67425	67398	49148	18449	346926	340706
82	6910	28918	57010	66287	66186	64555	43646	19457	352969	346059
83	7240	28763	51617	60957	58651	64351	40302	22617	334498	327258
84	8117	31620	50820	62562	72589	72478	48330	20762	367278	359161
85	8299	39902	63307	65435	72907	68940	42077	0	360867	352568
86	9913	36434	50640	63248	68407	67779	39673	0	336094	326181
87	9669	37360	63555	61380	63481	50504	20380	0	306329	296660
88	31630	40400	51848	45407	56645	60870	46133	22174	355107	323477
89	3014	34085	53127	66272	69888	63049	43743	22594	355772	352758
90	13246	48401	52594	55830	70853	63935	42778	21026	368663	355417
91	10680	43274	58671	57372	70776	70797	49382	27968	388920	378240
92	13713	37739	52819	44318	45675	45092	20255	0	259611	245898
93	0	24043	46117	38602	44742	48259	42287	4050	248100	248100
94	9304	39330	18772	26468	33350	34104	4878	0	166206	156902
95	9187	32128	44775	56792	66871	64906	42969	15101	332729	323542
1970 TO 1995 FIGURES - W/O 1973-77-79-87-88-92-93-94										
SUM	168475	611477	994799	1135865	1262163	1217350	814093	350255	6554477	6386002
AVERAGE	9360	33971	55267	63104	70120	67631	45227	19459	364138	354778
MAXIMUM	14005	48401	63491	71833	74996	73179	57054	27968	388920	378240
MINIMUM	3014	28581	44775	55830	58651	63049	37866	0	332729	323542

ROZA IRRIGATION DISTRICT - THREE AVERAGE YEARS TABLE 3.3
MONTHLY WATER DISTRIBUTION IN 1984

MONTH	DIVERTED	MAIN CANAL WASTE	MAIN CANAL LOSS	DELIVERY TO LATERALS	LATERAL WASTE	LATERAL LOSS	TOTAL DELIVERY TO FARM	AF/A
APRIL	31,620	7,823	13,405	10,392	584	2,919	6,889	0.10
MAY	50,820	7,894	10,101	32,825	1,260	6,300	25,265	0.35
JUNE	62,562	4,777	12,076	45,709	1,199	7,058	37,452	0.52
JULY	72,589	2,315	11,175	59,099	816	6,492	51,791	0.72
AUGUST	72,478	2,520	11,859	58,099	942	7,540	49,617	0.69
SEPTEMBER	48,330	3,627	10,202	34,501	1,129	6,806	26,566	0.37
OCTOBER	20,762	2,599	6,183	11,980	762	3,118	8,100	0.11
TOTAL	359,161	31,555	75,001	252,605	6,692	40,233	205,680	2.86
PCT	1.00	0.09	0.21	0.70	0.02	0.11	0.57	

MONTHLY WATER DISTRIBUTION IN 1989

MONTH	DIVERTED	MAIN CANAL WASTE	MAIN CANAL LOSS	DELIVERY TO LATERALS	LATERAL WASTE	LATERAL LOSS	TOTAL DELIVERY TO FARM	AF/A
APRIL	34,085	8,796	9,119	16,170	587	4,005	11,578	0.16
MAY	53,127	5,916	7,486	39,725	1,627	5,470	32,628	0.45
JUNE	66,272	2,934	10,877	52,461	1,578	5,608	45,276	0.63
JULY	69,888	2,596	10,620	56,672	1,622	5,586	49,464	0.69
AUGUST	63,049	4,400	8,974	49,675	1,778	5,453	42,444	0.59
SEPTEMBER	43,743	4,250	8,182	31,311	1,872	4,335	25,103	0.35
OCTOBER	22,594	2,736	3,828	16,030	1,250	2,277	12,503	0.17
TOTAL	352,758	31,628	59,086	262,044	10,314	32,734	218,996	3.04
PCT	1.00	0.09	0.17	0.74	0.03	0.09	0.62	

MONTHLY WATER DISTRIBUTION IN 1990

MONTH	DIVERTED	MAIN CANAL WASTE	MAIN CANAL LOSS	DELIVERY TO LATERALS	LATERAL WASTE	LATERAL LOSS	TOTAL DELIVERY TO FARM	AF/A
APRIL	48,401	6,503	10,788	31,110	1,541	3,301	26,268	0.36
MAY	52,594	7,889	7,490	37,215	2,246	4,805	30,164	0.42
JUNE	55,830	5,165	8,636	42,029	1,816	4,515	35,699	0.50
JULY	70,853	2,801	10,369	57,683	1,429	6,019	50,235	0.70
AUGUST	63,935	3,729	12,098	48,108	1,565	5,714	40,828	0.57
SEPTEMBER	42,778	2,873	8,150	31,755	1,630	4,702	25,423	0.35
OCTOBER	21,026	2,694	3,392	14,940	1,246	1,969	11,726	0.16
TOTAL	355,417	31,654	60,923	262,840	11,473	31,025	220,343	3.06
PCT	1.00	0.09	0.17	0.74	0.03	0.09	0.62	

TABLE 3.4 - PART 1

NET OUTFLOW FROM ROZA IRRIGATION DISTRICT
THAT RETURNS TO DRAINS OR NATURAL RIVER DRAINAGE - CFS UNITS

MONTH	1985	1986	1987	1988	1989
APRIL	122	129	148	133	158
MAY	100	148	185	126	127
JUNE	80	77	82	90	78
JULY	46	100	67	65	71
AUGUST	90	88	30	78	104
SEPTEMBER	120	148	7	100	103
OCTOBER	3	0	0	52	67

These numbers were developed using the USBR values for Main Canal and Lateral Waste for Roza I.D.
Flow is expressed in mean daily cfs converted from monthly volumes in acre feet.

TABLE 3.4 - PART 2

PRINCIPAL IRRIGATION RETURN FLOW SURFACE DRAINS DISCHARGING DIRECTLY TO YAKIMA RIVER

DRAIN	LOCATION		DRAINAGE AREA	AVG. FLOW APR-OCT	PHYSICAL APPEARANCE
Wilson Creek and	East side Kittitas Project		390	440	Turbid
Cherry Creek					
Wenas Creek	Wenas Valley		192	5	Clear
Selah Drain	City of Selah		1	5	Turbid
Moxee Drain DID #11	Moxee City Area		11	37	Turbid
Wide Hollow Creek	N. Ahtanum Valley		35	30	Clear
Ahtanum Creek	Ahtanum Valley		212	20	Clear
DID # 35	Southeast of Grandview		2	3	------
DID # 31	4 miles west of Grandview		3	5	------
DID # 12	6 miles west of Grandview		3	12	------
Granger Drain	Granger-Outlook area		20	60	Turbid
DID #2,25,27,&32					
Sulphur Creek	Sunnyside-Grandview area		32	90	Turbid
DID # 3,5,9,&20					
Grandview Drain	Southeast Grandview area		5	15	Turbid
Main (Marion) Drain	Wapato Project		150	590	Clear
East Toppenish Drain	Wapato Project		-----	55	Slightly turbid
Subdrain 35	Wapato Project		-----	45	------
Lower Toppenish Creek	Wapato Project		560	108	Slightly turbid
Coulee Drain	Wapato Project		-----	34	------
Lower Satus Creek	Wapato Project		427	77	Slightly turbid
South Drain	Wapato Project		-----	15	------
DID # 7	South of Satus Creek		5	30	Slightly turbid
Satus Drain 302	2 miles north of Mabton		8	22	Turbid
Joint DID # 11	Mabton-Byron area		5	--	------
Spring Creek	Whitstran area		2	35	Turbid
Snipes Creek	South of Whitstran		-----	50	Turbid
Corral Creek	West of Benton City		-----	25	Turbid
Drain #4A	Benton City		1	3	Clear

NOTES:
DID - DRAINAGE IMPROVEMENT DISTRICT
Flow in many creeks consists mainly of irrigation return flow in the irrigation season.
This table is taken from a Feb. 1962 report by Prof. R.O. Sylvester, Univ. of Washington.

YAKIMA RIVER BASIN

NATIONAL WATER QUALITY ASSESSMENT - NAWQA

SYNOPTIC NUTRIENT STUDY -- AUGUST, 1986 SAMPLING

TABLE 3.5

SITE ID	SITE NAME	DATE	TIME	SPEC COND	TURB	FLOW	TEMP CELS	NH3 N	HPO4 P	ORG +NH3 N	TOT PHOS P	NO3+ NO2 N	
				uS/cm	NTU	CFS	DEG	mg/l	mg/l	mg/l	mg/l	mg/l	
76	SATUS DRAIN 303 @ HWY 22	8-17	1310	384	12.0	14.5	24.7	0.01	0.07	0.7	0.10	3.4	
77A	SATUS PUMP CANAL 2 @ HAPPY RD.	8-16	1205	220	7.0	62.5	21.1	0.01	0.09	0.5	0.09	2.4	
77B	SATUS PUMP CANAL 3 @ WINNIER RD.	8-17	1435	293	11.0	71	23.0	0.01	0.09	0.5	0.09	2.3	
78	GRANGER DRAIN @ GRANGER	8-17	1000	302	52.0	67	16.5	0.05	0.13	1.0	0.48	1.3	
79	SULPHUR CR. WASTEWAY @ HOLADAY RD.	8-16	1230	315	26.0	259	18.9	0.09	0.12	0.9	0.24	2.3	
80	YAKIMA RIVER NR PARKER (R.M.103.7)	8-15	1345	106	3.5	252	21.5	0.01	0.05	0.3	0.05	0.17	BACKGROUND
81	YAKIMA RIVER @ DONALD RD.(R.M.100)	8-15	1430	106	3.0		23.1	0.01	0.04	0.4	0.04	<0.1	
82	YAKIMA RIVER @ TOPPENISH HWY (R.M.97)	8-15	1550	119	1.8		23.2	<0.01	0.03	0.4	0.04	<0.1	
83	YAKIMA RIVER @ ZILLAH (R.M.91)	8-16	1230	138	2.9		21.5	0.03	0.02	0.6	0.04	<0.1	
84	YAKIMA RIVER @ GRANGER (R.M.83)	8-17	1000	199	3.8		18.3	0.01	0.04	0.4	0.06	0.76	
85	YAKIMA RIVER NR SNIPES MTN (R.M.78.3)	8-17	1140	234	10.0		19.5	0.01	0.05	0.5	0.10	1.2	
86	YAKIMA RIVER (R.M.73)	8-17	1335	245	10.0		20.0	<0.01	0.05	0.5	0.08	1.2	
87	YAKIMA RIVER (R.M.68)	8-17	1515	257	18.0		22.0	<0.01	0.07	0.7	0.16	1.3	
88	YAKIMA RIVER U/S OF SULPHUR CR.	8-17	1735	253	13.0		22.0	0.03	0.06	0.5	0.13	1.1	
89	YAKIMA RIVER @ EUCLID RD. NR GRANDVIEW	8-18	1124	288	14.0	1530	21.0	0.01	0.08	0.5	0.09	1.4	
90	DRAIN 1 MI. U/S OF GRANDVIEW GAGE	8-17	1330	227	16.0	12.2	20.0	<0.01	0.06	0.4	0.07	1.4	
91	DRAIN U/S OF PROSSER	8-17	930	284	17.0	9.3	19.1	<0.01	0.06	0.4	0.07	1.4	
92	DRAIN AT PROSSER	8-17	1130	360	7.4	5.9	21.4	<0.01	0.06	0.7	0.07	2.1	
93A	SNIPES CR PLUS SPRING CR	8-18	1445	207	14.0	56	21.7	0.01	0.04	0.4	0.08	0.78	
93B	SNIPES CR PLUS DRAIN	8-18	1450	233	15.0	38	21.7	<0.01	0.05	0.5	0.05	1.1	
94	YAKIMA RIVER @ PROSSER (R.M.47.5)	8-18	1252	288	12.0		22.0	<0.01	0.07	0.6	0.12	1.3	
95	CHANDLER CANAL	8-18	1515	312	12.0	1250	22.6	<0.01	0.07	0.5	0.09	1.3	
96	YAKIMA RIVER BELOW PROSSER DAM	8-18	1000			204							
97	YAKIMA RIVER (R.M.42)	8-18	1045	352	9.0		21.1	0.01	0.09	0.5	0.12	1.4	
98	YAKIMA RIV. AB CHANDLER PLANT(R.M.36.5)	8-18	1230	360	9.0		23.0	0.01	0.06	0.5	0.07	1.3	
99	CORRAL CR. CANYON NR MOUTH	8-18	1330	365	4.0		19.8	0.01	0.03	0.3	0.03	1.8	
100	KENNEWICK MAIN CANAL	8-19	1845	302	12.0	292	22.4	0.01	0.07	0.5	0.09	1.4	
101A	YAKIMA RIVER AT KIONA (R.M.30)	8-19	1120	312	11.0	1400	21.8	0.01	0.06	0.6	0.07	1.3	
101B	YAKIMA RIVER AT KIONA (R.M.30)	8-19	1125	312	12.0	1400	21.8	0.01	0.07	0.6	0.08	1.3	
102	YAKIMA RIVER (R.M.24)	8-19	1300	315	12.0		22.9	0.01	0.07	0.6	0.07	1.3	
103	YAKIMA RIVER (R.M.17)	8-19	1500	317	10.0		23.3	<0.01	0.07	0.8	0.08	1.2	
104	YAKIMA RIVER @ VAN GIESEN RD. (R.M.8.4)	8-19	1615	317	9.0		24.8	0.01	0.06	0.6	0.08	1.1	
107	SELLS WELL	8-16	940	927	1.1		13.2	0.01	0.43	0.7	0.46	9.2	
108A	YAKIMA RIVER @ MABTON GAGE	8-18	950	288	18.0	1360	20.0	0.05	0.08	0.6	0.18	1.3	
108B	YAKIMA RIVER @ MABTON GAGE	8-18	1015	288	16.0	1360	20.0	0.06	0.08	0.5	0.13	1.4	
109	YAKIMA RIVER BELOW ROZA DAM NR POMONA	8-14	1030			1906							
111	TIETON CANAL @ HEADWORKS	8-14	1500			326							

1995 WATER QUALITY SAMPLES RETRIEVED BY DEPARTMENT OF ECOLOGY -- USED IN DEVELOPMENT OF TMDL PROCESS

field_id	Date	Time	Temp	pH	Sp.Cond.	NH3-N		NO2+N	TPN	Total P		Turbidity	TSS	TNVSS	TS	TNVS	E coli m	Fecal Col	pH
				Field	umohos/	mg/L		mg/L	mg/L	mg/L		NTU	mg/L	mg/L	mg/L	mg/L	#/100m	#/100ml	Lab
ROZA11	11-Apr-95	1430	8.2		108							3.3	5						
ROZA11	26-Apr-95	1820	11.9	8.18	85							24	39						7.6
ROZA11	23-May-95	715	14.2	8.1	112							6	12	11	140	95			
ROZA11	06-Jun-95	725	12.7	7.8	93							10	23	20					
ROZA11	20-Jun-95	725	12.4	8.03	98							5.3	13	11					
ROZA11	06-Jul-95	625	14.5	7.79	85							6.6	15	13					
ROZA11	18-Jul-95	730	15.3	7.75	74							7.2	18	16					
ROZA11	02-Aug-95	1725	16.2	7.97								4.4	10	10					
ROZA11	15-Aug-95	655	16.2	7.76	84							5	10	8					
ROZA11	29-Aug-95	1430	16.2	7.91	84							3.2	10	9					
ROZA11	12-Sep-95	1945	17.3	8.33	132							3.9	10	8					
ROZA11	26-Sep-95	1705	14.2	8.07	138							2.1	3	2					
ROZABEAM	10-Apr-95	1945	8.2		112	0.01	U	0.01	0.131	0.01	U	3.8	3				7.8	17	8.2
ROZABEAM	25-Apr-95	1725	13.5	8.37	97	0.01	U	0.01	0.096	0.01	U	3	5				2	2	
ROZABEAM	08-May-95	1800	14.1	8.76	93	0.01	U	0.019	0.213	0.027		6.2	9				4.5	4.5	
ROZABEAM	22-May-95	1500	17.6	8.18	116	0.011		0.142	0.273	0.093		11	23	23	128	82	49	49	
ROZABEAM	05-Jun-95		14.9	7.77	85	0.01		0.155	0.087	0.063		18	31	28			70	110	
ROZABEAM	19-Jun-95	1655	15.9	8.35	102	0.01	U	0.121		0.056		7.1	16	14			23	23	
ROZABEAM	05-Jul-95	1235	16.2	8.16	92	0.011		0.18	0.366	0.041		7.6	17	15			49	49	
ROZABEAM	17-Jul-95	1625	18.1	8.3	79	0.012		0.172	0.265	0.042		6.5	16	14			13	33	
ROZABEAM	01-Aug-95	1620	18	8.63		0.03		0.097	0.254	0.041		5.5	14	12			22	49	
ROZABEAM	14-Aug-95	1525	17.2	8.11	84	0.013		0.109	0.234	0.03		4.5	11	10			17	790	
ROZABEAM	28-Aug-95	1535	17.7	8.29	84	0.01	U	0.059	0.188	0.01	U	3.5	7	6			33	33	
ROZABEAM	12-Sep-95	1115	17.3	7.92	130	0.01	U	0.242	0.445	0.127		4	8	7			130	230	
ROZABEAM	25-Sep-95	1230	13.9	8	135	0.01	U	0.239	0.367	0.047		3.5	7	6			230	230	
ROZABEAM	17-Oct-95	1225	12	7.95	122							2	4	3					
ROZARAY	10-Apr-95	1915	10		110	0.01	U	0.01	0.126	0.011		3.7	3				17	31	8.6
ROZARAY	25-Apr-95		14.2	8.48	92	0.01	U	0.01	0.131	0.01	U	2.8	16				1.8	1.8	
ROZARAY	08-May-95	1720	14.8	8.98	98	0.01	U	0.01	0.179	0.03		5.3	12				11	11	
ROZARAY	22-May-95	1405	16.4	8.04	118	0.011		0.169	0.299	0.075		15	35	31	139	96	79	79	
ROZARAY	05-Jun-95	1705	16.5	7.82	85	0.029		0.188	0.446	0.122		24	74	68			70	70	
ROZARAY	19-Jun-95	1535	16.2	7.74	108	0.012		0.166	0.366	0.06		9.7	25	23			130	240	
ROZARAY	05-Jul-95	1150	17.6	8.1	91	0.013		0.18	0.41	0.043		8.9	26	24			33	33	
ROZARAY	17-Jul-95	1520	18.5	8.17	74	0.01	U	0.178	0.313	0.043		9.3	22	20			49	49	
ROZARAY	01-Aug-95	1510	17.8	8.87		0.022		0.109	0.265	0.037		8.1	18	17			49	49	
ROZARAY	14-Aug-95	1405	16.7	7.98	70	0.017		0.104	0.233	0.031		5.6	13	12			49	79	
ROZARAY	28-Aug-95	1420	17.3	7.85	84	0.01	U	0.069	0.182	0.01	U	3.8	11	10			17	33	
ROZARAY	12-Sep-95	1725	20.1	8.31	135	0.023		0.223	0.356	0.066		3.2	4	4			33	49	
ROZARAY	25-Sep-95	1115	15	8.67	137	0.011		0.161	0.306	0.051		4.1	8	8			23	33	
ROZARAY	17-Oct-95	1100	11.6	7.89	128	0.01	U	0.167	0.302	0.03		1.6	2	2			79	79	
ROZAWILGUS	11-Apr-95	1220	10.4		109							3.9	4						
ROZAWILGUS	26-Apr-95	1030	13.8	8.7	88							2.3	5						8.3
ROZAWILGUS	23-May-95	1435	17.4	8.21	118							10	26	22	126	92			
ROZAWILGUS	06-Jun-95		14.2	7.6	83							24	58	54					
ROZAWILGUS	20-Jun-95	1515	17.6	8.31	109							9.6	28	26					
ROZAWILGUS	06-Jul-95	1415	18.2	8.04	88							10	35	32					
ROZAWILGUS	02-Aug-95	1115	18.7	8.09								8.6	27	25					
ROZAWILGUS	15-Aug-95	1055	17.7	7.92	84							9	22	19					
ROZAWILGUS	29-Aug-95	1125	18	8.22	84							4.9	20	18					
ROZAWILGUS	13-Sep-95	1035	18.7	8.29	138							4.6	11	10					
ROZAWILGUS	27-Sep-95	910	15.4	8.35	133							7.7	20	18					
ROZAWILGUS	18-Oct-95	1225	11.3	7.98	128							1.2	3	2					

TABLE 3.6

TABLE 4.1

Legend for Operations Map

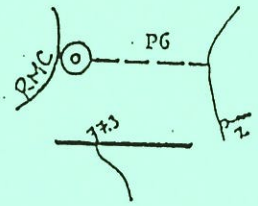
ROZA MAIN CANAL

ROZA IRRIGATION DISTRICT BOUNDARY

DISTRICT MAINTAINED PIPELINE

DISTRICT MAINTAINED OPEN LATERAL

PROPERTY BOUNDARY

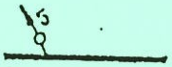


PUMPING PLANT (18 in total)

LATERAL DIVERSION OFF MAIN CANAL
(Number indicates mile post of main canal)

WW — WASTEWAY ON LATERAL

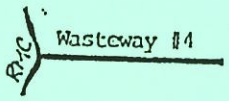
POINT OF DELIVERY OFF LATERAL



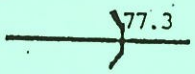
POINT OF DELIVERY OFF MAIN CANAL

TUNNEL IN MAIN CANAL (1,3,5,7,8)

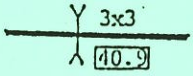
SIPHON IN MAIN CANAL (1-12, Selah, Moxee)
(Also exist in laterals)



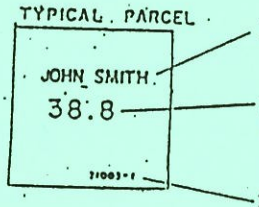
WASTEWAY ON MAIN CANAL (#2-7)



CHECK STRUCTURE ON MAIN CANAL



DRAIN UNDER MAIN CANAL
(3'x3' drain at Mile Post 40.9)



LANDOWNER ON RECORD (County Auditors Office)

IRRIGABLE ACRES WITH WATER RIGHT
(If nothing shown, not assessed or served water.)

PARCEL NUMBER

BENCH FLUME — FLUME SECTION OF MAIN CANAL (3 in total)

WW#6 Re-reg — WASTEWAY REREGULATION RESERVOIR (WW #6 only)

COUNTY ROAD

PROPERTY TIE

Nat. Gas Line — NATURAL GAS PIPE LINE

U.S.B.R. POWER LINE

TABLE 4.1

ROZA MAIN CANAL - DESCRIPTION BY REACH TABLE 4.3

MILE POST (at end)	NAME AND TYPE	REACH LENGTH (FT)	MAXIMUM DESIGN FLOW(cfs)	MAXIMUM NORMAL DEPTH (ft)	CROSS-SECTIONAL AREA (ft^2)	MAXIMUM VELOCITY (ft/sec)	LONGITUDNAL SLOPE (ft/ft)	SEEPAGE RATE (cfs)
10.9	Wasteway #2	735.3	2100	12.00	302.35	6.94	0.00040	0.2191
11.4	Lined	1986.2	1300	9.07	211.67	6.14	0.00039	0.7259
11.5	Lined Bench Flume	722.0	1300	9.09	209.56	6.21	0.00040	0.2623
11.8	Lined	1469.2	1300	9.07	211.67	6.14	0.00039	0.6425
13.9	Lined One Side	11172.0	1300	9.57	520.17	2.50	0.00010	5.8834
14.4	Lined	2750.8	1300	9.07	211.67	6.14	0.00039	1.2030
17.4	Earth	15687.0	1300	9.57	520.17	2.50	0.00010	8.2611
22.7	Lined	28160.0	1300	9.07	211.67	6.14	0.00039	12.3148
22.8	Siphon, Moxee	295.0	1300	=	153.94	8.45	0.00120	0.1383
27.3	Lined	24293.3	1300	9.07	211.67	6.14	0.00039	10.6239
28.1	Tunnel #5	3988.0	1250	11.41	140.06	8.92	0.00106	1.4144
28.4	Lined	1135.0	1250	8.89	205.47	6.08	0.00039	0.4894
28.9	Earth	2760.0	1250	9.64	486.44	2.57	0.00011	1.3800
29.1	Lined	1065.0	1250	8.89	205.47	6.08	0.00039	0.4592
29.2	Earth	569.6	1250	9.64	486.44	2.57	0.00011	0.2848
29.2	Earth, WW#3	635.4	1250	9.64	486.44	2.57	0.00011	0.3177

MILE POST (at end)	NAME AND TYPE	REACH LENGTH (FT)	MAXIMUM DESIGN FLOW(cfs)	MAXIMUM NORMAL DEPTH (ft)	CROSS-SECTIONAL AREA (ft^2)	MAXIMUM VELOCITY (ft/sec)	LONGITUDNAL SLOPE (ft/ft)	SEEPAGE RATE (cfs)
29.2	Earth, WW #3	635.4	1250	9.64	486.44	2.57	0.00011	0.3177
29.9	Lined	2945.3	1150	8.48	191.65	6.00	0.00040	1.2281
30.0	Tunnel #7	820.0	1150	11.25	131.36	8.76	0.00108	0.2828
30.1	Lined	424.4	1150	8.48	191.65	6.00	0.00040	0.1770
30.3	Siphon #2	1345.6	1150	-	132.73	8.66	0.00139	0.5858
31.0	Lined	2595.0	1150	8.48	191.65	6.00	0.00040	1.0820
31.4	Earth	1893.9	1150	9.21	458.80	2.51	0.00011	0.9261
32.0	Lined	3140.0	1150	8.48	191.65	6.00	0.00040	1.3093
32.8	Earth	5497.2	1150	9.21	458.80	2.51	0.00011	2.6882
32.9	Lined	340.0	1150	8.48	191.65	6.00	0.00040	0.1418
33.2	Tunnel #8	1535.0	1100	11.25	131.36	8.37	0.00098	0.5295
33.9	Lined	3824.9	1100	8.82	185.44	5.93	0.00040	1.5591
34.1	Siphon #3	685.0	1100	-	132.73	8.29	0.00127	0.2982
34.9	Lined	3880.0	1100	8.82	185.44	5.93	0.00040	1.5815
35.2	Siphon #4	2310.0	1100	-	132.73	8.29	0.00127	1.0057
35.6	Earth	1798.5	1100	8.96	442.98	2.48	0.00011	0.8681
36.0	Lined	1981.5	1100	8.82	185.44	5.93	0.00040	0.8077
36.3	Earth	1820.0	1100	8.96	442.98	2.48	0.00011	0.8785
36.9	Lined	4077.7	1100	8.82	185.44	5.93	0.00040	1.6621
37.1	Siphon #5	850.0	1050	-	99.40	10.56	0.00250	0.3205
40.8	Earth, WW #4	19365.1	1050	8.58	419.30	2.50	0.00012	9.1659

MILE POST (at end)	NAME AND TYPE	REACH LENGTH (FT)	MAXIMUM DESIGN FLOW(cfs)	MAXIMUM NORMAL DEPTH (ft)	CROSS-SECTIONAL AREA (ft^2)	MAXIMUM VELOCITY (ft/sec)	LONGITUDNAL SLOPE (ft/ft)	SEEPAGE RATE (cfs)
40.8	Earth, WW #4	19365.1	1050	8.58	419.30	2.50	0.00012	9.1659
42.2	Earth	7578.5	1000	8.34	404.57	2.47	0.00012	3.5402
42.4	Lined	1314.0	1000	8.37	171.27	5.84	0.00040	0.5160
43.6	Earth	6610.0	1000	8.34	404.57	2.47	0.00012	3.0878
44.0	Lined	2090.0	1000	8.37	171.27	5.84	0.00040	0.8207
44.4	Earth	2110.0	1000	8.34	404.57	2.47	0.00012	0.9857
46.1	Earth	9138.1	950	7.94	380.41	2.50	0.00013	4.1706
50.0	Earth	20835.0	900	7.70	366.14	2.46	0.00013	9.3915
51.1	Siphon #6	600.0	850	-	108.43	7.84	0.00129	0.2359
51.5	Earth	1920.0	850	7.64	339.67	2.50	0.00014	0.7824
51.8	Lined	1670.0	850	7.71	151.41	5.61	0.00040	0.6168
55.3	Earth	18770.0	850	7.64	339.67	2.50	0.00014	8.0309
55.4	Siphon #7	530.0	800	-	108.43	7.38	0.00114	0.2084
58.8	Earth	18260.0	800	7.38	325.24	2.46	0.00014	7.6863
58.9	Lined	1240.0	800	7.48	144.74	5.53	0.00040	0.4491
59.0	Earth, WW #5	3877.6	800	7.38	325.24	2.46	0.00014	1.6322

ROZA MAIN CANAL - DESCRIPTION BY REACH TABLE 4.3

MILE POST (at end)	NAME AND TYPE	REACH LENGTH (FT)	MAXIMUM DESIGN FLOW(cfs)	MAXIMUM NORMAL DEPTH (ft)	CROSS-SECTIONAL AREA (ft^2)	MAXIMUM VELOCITY (ft/sec)	LONGITUDNAL SLOPE (ft/ft)	SEEPAGE RATE (cfs)
59.0	Earth, WW #5	3877.6	800	7.38	325.24	2.46	0.00014	1.6322
60.6	Earth	8684.0	650	7.25	260.09	2.50	0.00016	2.7098
61.1	Lined	2400.0	600	7.46	121.78	4.93	0.00035	0.7888
61.4	Earth, Check 61.4	1950.0	600	6.78	238.45	2.52	0.00018	0.6817
61.6	Earth	385.0	600	6.78	238.45	2.52	0.00018	0.1346
62.1	Lined	2531.7	600	7.46	121.78	4.93	0.00035	0.8321
63.7	Earth, Check 63.7	9230.0	600	6.78	238.45	2.52	0.00018	3.2267
64.0	Lined	1687.8	600	7.46	121.78	4.93	0.00035	0.5547
64.2	Earth, Check 64.2	1260.0	600	6.78	238.45	2.52	0.00018	0.4405
65.6	Earth	7387.2	600	6.78	238.45	2.52	0.00018	2.5825
66.1	Lined	2550.0	600	7.46	121.78	4.93	0.00035	0.8381
67.2	Earth	6179.2	600	6.78	238.45	2.52	0.00018	2.1602
67.3	Earth, Check 67.3	343.8	500	6.38	200.59	2.49	0.00019	0.1093
68.6	Earth, Check 68.6	6327.0	500	6.36	200.59	2.49	0.00019	2.0109
68.7	Earth	500.0	500	6.36	200.59	2.49	0.00019	0.1589
69.1	Lined	1910.4	500	6.83	106.12	4.72	0.00035	0.5873
69.8	Earth	3962.5	500	6.36	200.59	2.49	0.00019	1.2594
70.6	Earth, Check 70.6	4091.3	450	6.19	181.27	2.48	0.00020	1.2245
71.1	Earth	2900.0	450	6.19	181.27	2.48	0.00020	0.8679
72.9	Earth, Check 72.9	9745.0	400	5.94	159.85	2.50	0.00022	2.7113
74.7	Earth	9468.1	400	5.94	159.85	2.50	0.00022	2.6343
75.1	Earth, Check 75.1	2024.0	350	5.69	139.60	2.51	0.00024	0.5227
77.3	Earth, Check 77.3	10350.3	350	5.69	139.60	2.51	0.00024	2.6729
780	Earth, Check 78.0	3711.5	350	5.69	139.60	2.51	0.00024	0.9585
78.1	Siphon #8	566.1	300	-	36.67	8.81	0.00282	0.1294
79.0	Earth, Check 79.0	4528.8	300	5.43	120.25	2.50	0.00026	1.0750
79.9	Earth, Check 79.9	4945.3	300	5.43	120.25	2.50	0.00026	1.1738
82.0	Earth, Check 82.0	9750.9	300	5.43	120.25	2.50	0.00026	2.3145
84.6	Earth, WW #6	14679.4	300	5.43	120.25	2.50	0.00026	3.4843

MILE POST (at end)	NAME AND TYPE	REACH LENGTH (FT)	MAXIMUM DESIGN FLOW(cfs)	MAXIMUM NORMAL DEPTH (ft)	CROSS-SECTIONAL AREA (ft^2)	MAXIMUM VELOCITY (ft/sec)	LONGITUDNAL SLOPE (ft/ft)	SEEPAGE RATE (cfs)
84.6	Earth, WW #6	1467.8	300	5.43	120.25	2.50	0.00026	3.4843
84.8	Siphon #9	1271.6	125	-	15.90	7.86	0.00456	0.1908
85.6	Earth, Check 85.6	5332.6	125	4.03	52.57	2.38	0.00040	0.8119
86.0	Earth, Check 86.0	1758.6	125	4.03	52.57	2.38	0.00040	0.2677
86.6	Earth, Check 86.6	3921.9	125	4.03	52.57	2.38	0.00040	0.5971
86.7	Siphon #10	720.4	125	-	15.90	7.86	0.00459	0.1085
87.4	Earth, Check 87.4	3434.9	125	4.03	52.57	2.38	0.00040	0.5230
88.0	Earth	3360.0	125	4.03	52.57	2.38	0.00040	0.5116
88.1	Earth, Check 88.1	540.0	100	3.60	41.04	2.44	0.00050	0.0725
88.5	Earth, Check 88.5	1600.0	100	3.60	41.04	2.44	0.00050	0.2148
89.2	Earth, Check 89.2	4500.0	100	3.60	41.04	2.44	0.00050	0.6042
89.6	Earth, Check 89.6	2244.0	100	3.60	41.04	2.44	0.00050	0.3013
89.7	Siphon #11	215.5	100	-	15.09	6.28	0.00290	0.0308
90.4	Earth, Check 90.4	3039.0	100	3.60	41.04	3.44	0.00050	0.4080
91.1	Earth, Check 91.1	4114.4	100	3.60	41.04	2.44	0.00050	0.5524
91.5	Earth, Check 91.5	1800.0	100	3.60	41.04	2.44	0.00050	0.2417
92.0	Earth	2846.9	100	3.60	41.04	2.44	0.00050	0.3822
92.1	Siphon #12	455.0	75	-	9.62	7.80	0.00064	0.0533
92.4	Earth, Check 92.4	1435.5	75	3.32	33.13	2.27	0.00050	0.1723
92.7	Earth, Check 92.7	250.0	75	3.32	33.13	2.27	0.00050	0.0300
93.4	Earth, Check 93.4	3200.0	75	3.32	33.13	2.27	0.00050	0.3842
93.9	Earth, Check 93.9	2250.0	75	3.32	33.13	2.27	0.00050	0.2701
94.4	Earth, Check 94.4	3000.0	75	3.32	33.13	2.27	0.00050	0.3602
94.8	Earth, WW #7	1824.9	75	3.32	33.13	2.27	0.00050	0.2191
		466871.3						174.4059

MILE POST	NAME (DESCRIPTION)	TYPE OF STRUCTURE	DATE OF INSTALLATION	DESIGN FLOW (cfs)	GATE HEIGHT (ft)	NUMBER OF GATES	GATE WIDTH (ft)
0	Diversion	Radial Gates		2200	15.00	2	14.00
11.0	Wasteway #2	Radial Gates		1300	11.50	2	12.00
16.8	Pump Stn. #2	Overshot Gates	Winter 1995	1150	Sill@1.5'H=8.66	3	10.00
29.2	Wasteway #3	Radial Gates		1150	9.67	2	17.00
37.5	Pump Stn. #7	Overshot Gates	Winter 1996	1050	Sill@1.5'H=8.66	3	10.00
40.8	Wasteway #4	Radial Gates		1000	8.75	2	16.50
42.5	Pump Stn. #8	Overshot Gates	Winter 1997	1000	Sill@1.5'H=8.66	3	10.00
48.5	Pump Stn. #9	Overshot Gates	Winter 1994	900	Sill@1.5'H=8.66	3	10.00
59.0	Wasteway #5	Radial Gates		650	7.50	2	15.00
61.4		Flash Boards		600	7.50	3	7.00
63.7		Flash Boards		600	7.50	1	25.00
64.2		Flash Boards		600	4x9/2x4.83	6	5.50
67.3	Pump 13	Flash Boards		500	4x9/2x4.83	6	5.50
68.7		Flash Boards		500	7.36	1	22.00
70.6		Flash Boards		450	7.19	4	6.00
72.9		Flash Boards		400	6.67	4	6.00
75.1		Flash Boards		350	6.67	4	5.00
77.3		Overshot Gates	Spring 1991	350	Sill@1.2'H=4.00	3	(2)4.0/(1)7.0
77.8	Siphon #8	Flash Boards		300	6.00	1	3.30
79.0		Flash Boards		300	6.50	4	4.00
79.9		Flash Boards		300	6.42	3	6.00
82.0		Flash Boards		300	6.42	3	6.00
84.6	Siphon #9 (WW#6)	Sluice Gate		125	6.00	2	6.00
85.6		Flash Boards		125	5.50	2	4.80
86.0		Flash Boards		125	5.50	2	4.80
86.6	Siphon #10	Flash Boards		125	6.00	1	4.50
87.4		Flash Boards		125	5.50	2	4.80
88.1		Flash Boards		100	5.00	2	4.00
88.5		Flash Boards		100	5.00	2	4.00
89.2		Flash Boards		100	5.00	2	4.00
89.5	Siphon #11	Flash Boards		100	5.08	1	5.50
90.4		Flash Boards		100	5.00	2	4.00
91.1		Flash Boards		100	5.00	2	4.00
91.5		Flash Boards		100	5.00	2	4.00
91.8	Siphon #12	Flash Boards		75	5.00	1	3.50
92.4		Flash Boards		75	4.50	2	3.75
92.7		Flash Boards		75	4.50	2	3.75
93.4		Flash Boards		75	4.50	2	3.75
93.9		Flash Boards		75	4.50	2	3.75
94.4		Flash Boards		75	4.50	2	3.75
94.8	Wasteway #7	Flash Boards		75	3.50	1	2.00

TABLE 4.4

MILE POST	PHYSICAL CONDITION OVERALL	MODIFIED FROM ORIGINAL	DATE OF MODIFICATION	STABILITY	OPERATION & MAINTENANCE NOTES	AMOUNT OF USE	EASE OF USE
0	Fair			6		B	Moderate
11.0	Fair			6		H,A	Moderate
16.8	Excellent	New Construction		6		E	Very Easy
29.2	Fair			6		H,A	Moderate
37.5	Excellent	New Construction		9		E	Very Easy
40.8	Fair			6		H,A	Moderate
42.5	Excellent	New Construction		9		E	Very Easy
48.5	Excellent	New Construction		9		E	Very Easy
59.0	Fair			6		B	Moderate
61.4	Poor	Wood Foot Bridge		4		D	Hard
63.7	Fair			4		H	Very Hard
64.2	Poor	Wood Foot Bridge		1		D	Hard
67.3	Fair			3,2		D	Hard
68.7	Fair			4		D	Very Hard
70.6	Fair			7		D	Hard
72.9	Fair			2	U/S & D/S	D	Hard
75.1	Fair			2	D/S, Lower Bank	D	Hard
77.3	Excellent			2		D	Very Easy
77.8	Fair			5		H	Hard & Dangerous
79.0	Fair	wood & bar missing		8		D	Hard
79.9	Fair	1 pillar removed		2		D	Hard
82.0	Fair	2 pillars removed		2		D	Hard
84.6	Fair			5		B	Hard
85.6	Fair			2	U/S	C	Hard
86.0	Fair			2	D/S	C	Hard
86.6	Fair			5		D	Hard
87.4	Fair			2		C	Hard
88.1	Fair	Made into bridge		2		D	Hard
88.5	Fair			3,2		C	Hard
89.2	Fair			2	D/S	D	Hard
89.5	Fair			5		H	Hard
90.4	Fair			2		C	Hard
91.1	Fair			3,2		C	Hard
91.5	Fair			8		C	Hard
91.8	Fair			5		D	Hard
92.4	Fair			2,3		C	Hard
92.7	Fair			2	D/S Only	C	Hard
93.4	Fair			2	lower bank	C	Hard
93.9	Fair			3		C	Hard
94.4	Fair			6	D/S-tunnel	C	Hard
94.8	Fair			4		B	Hard

STABILITY

1 Moderate Errosion-no corrective action taken
2 Riprap dumped recently to mitigate problem
3 Hand placed Riprap
4 Check positioned within lined section
5 Check at entrance to siphon ie lined section
6 Concrete on both u/s & d/s sides of structure
7 Needs Attention
8 Nothing Done, No Apparent Problem
9 Treated with Shotcrete

AMOUNT OF USE

A Only during startup
B Daily
C Weekly
D Set and then left all season
E Water Short Periods
F Peak Irrigation Demand
G During dewater
H Not used for regular operation

TABLE 4.5

ROZA IRRIGATION DISTRICT LATERALS - TABLE 4.6

MILE POST	NAME (DESCRIPTION)	TOTAL ACRES	TYPE OF LATERAL	NUMBER OF DELIVERIES	ACTUAL FLOW (CFS) **	DIAMETER OF TURNOUT	DATE OF GE INSTALLATION
5.5		30.20	Gravity Enclosed (GE)	1	0.408	=	1981
5.6		3.90	Gravity Open (GO)	1	0.072	=	
6.5		1.26	GE	1	0.016	=	1980
6.9		15.10	GO	1	0.272	=	
7.2		16.70	GO	1	0.296	=	
7.3	P1-H	300.30	Pump Open (PO)	29	7.280	=	=
7.3	P1-L	905.54	PO	58	8.480	=	=
7.4		28.60	GO	2	0.512	=	
7.7		6.70	GO	1	0.120	=	
8.0		22.70	GO	2	0.408	=	
8.5		41.80	GO	2	0.744	=	
8.8		11.40	GO	2	0.200	=	
11.7		8.81	GO	2	0.160	12	
11.9		5.69	Gravity Enclosed (GE)	2	0.080	2	1978
12.0		0.60	GE	1	0.008	2	1983
12.1	Share with THID	19.01	GO	4	0.640	12	
12.5	Share with THID	8.90	GO	2	1.160	12	
12.9	THL	0.00	GO	2	0.728	12	
13.0	THPL	0.00	PO	12	4.272	=	=
13.3	THL	0.00	GO	1	0.488	=	
13.6	THL	0.00	GO	1	0.288	=	
14.1	THL	0.00	GO	1	0.672	=	
14.6	THL	0.00	GO	1	0.384	=	
14.9		9.80	GE	1	0.128	4	1982
15.0		24.50	GO	1	0.440	12	
15.7		58.40	GO	2	1.040	12	
15.9		53.60	GO	3	0.952	18	
16.4		45.10	GO	2	0.800	18	
16.5		117.50	GO	5	2.096	24	
16.9	P2-L	78.30	PO	5	0.000	24	=
16.9	P2-LL	311.90	PO	17	14.400	=	=
16.9	P2-LR	812.60	PO	44	0.000	=	=
16.9	P2-H	118.80	PO	3	0.000	=	=
16.9	P2-HL	304.00	PO	19	21.440	=	=
16.9	P2-HR	1305.10	PO	67	0.000	=	=
17.1		45.20	GO	4	0.808	18	
17.5		32.10	GO	2	0.056	12	
17.9		40.60	GO	3	0.720	12	
18.3		101.90	GO	6	1.816	24	
18.8		97.40	GO	2	0.176	18	
19.1		93.50	GO	3	1.664	24	
19.5		136.00	GO	4	2.424	24	
19.9		89.00	GO	4	1.584	18	
20.3		131.50	GO	4	2.344	18	
20.5		159.40	GO	3	2.840	24	
20.9		25.20	GO	1	0.448	18	
21.3		79.00	GO	5	1.408	18	
22.1		50.70	GO	1	0.904	12	

= Diameter of Turnout is unknown

ROZA IRRIGATION DISTRICT LATERALS - TABLE 4.6

MILE POST	NAME (DESCRIPTION)	TOTAL ACRES	TYPE OF LATERAL	NUMBER OF DELIVERIES	ACTUAL FLOW (CFS) **	DIAMETER OF TURNOUT	DATE OF GE INSTALLATION
22.6	P3-L	76.20	PO	5	0.000	=	=
22.6	P3-LL	400.00	PO	25	9.680	=	=
22.6	P3-LR	367.60	PO	20	0.000	=	=
22.6	P3-H	116.10	PO	5	0.000	=	=
22.6	P3-HL	260.40	PO	6	20.080	=	=
22.6	P3-HR	1135.50	PO	43	0.000	=	=
22.9		180.20	Gravity Open	6	3.208	18	
23.2		54.90	GO	1	0.976	12	
23.9		88.10	GO	2	1.568	12	
24.1	P4	29.00	PO	1	0.000	=	=
24.1	P4-L	644.20	PO	28	9.040	=	=
24.1	P4-R	88.80	PO	1	0.000	=	=
24.3		65.90	GO	2	1.176	12	
24.6		0.00	Gravity Enclosed	1		8	1980
24.7		40.00	GO	1	0.712	12	
24.8		55.40	GO	2	0.984	12	
25.1		0.00	GE	1		12	1980
26.1		32.10	GO	3	1.368	12	
26.7		229.50	GO	19	4.088	18	
27.1	P5	247.20	Pump Open	14	2.480	=	=
28.2		136.50	GO	9	2.432	18	
28.4		14.00	GE	1	0.184	10	1988
28.7		480.10	GO	24	8.552	27	
29.1		59.00	GE	2	0.792	12	1976
29.3		20.30	GE	1	0.272	10	1989
29.6		153.80	GE	3	2.744	12	1980
29.7	P6-L	148.50	PO	8	3.520	=	=
29.7	P6-R	110.60	PO	2	0.000	=	=
30.1		13.40	GO	1	0.240	12	
30.3		15.80	GO	1	0.280	12	
30.7		93.60	GO	5	1.664	12	
31.1		30.10	GE	1	0.400	12	1984
31.3		603.40	GO	22	10.752	21	
31.5		128.70	GE	7	1.720	18	1978
32.0		18.80	GE	1	0.248	12	1985
32.4		56.20	GE	1	0.752	12	1985
32.8		695.20	GO	38	12.384	24	
33.8		277.80	GO	11	4.952	18	
34.2		219.60	GO	11	3.912	18	
34.6		33.80	GE	1	0.448	12	1989
34.7		61.90	GO	4	1.104	18	
35.2		190.10	GO	8	3.384	18	
35.5		913.90	GO	30	9.800	30	
36.0		157.00	GO	4	2.000	18	
36.5		34.00	GO	1	0.600	12	
36.6		0.00	GE	1		10	1987
36.8		11.40	GE	1	0.152	10	1988
37.2		27.00	GO	1	0.480	12	
37.8		45.20	GO	2	0.808	12	

ROZA IRRIGATION DISTRICT LATERALS - TABLE 4.6

MILE POST	NAME (DESCRIPTION)	TOTAL ACRES	TYPE OF LATERAL	NUMBER OF DELIVERIES	ACTUAL FLOW (CFS) **	DIAMETER OF TURNOUT	DATE OF GE INSTALLATION
37.9	P7	54.30	PO	1	0.000	=	=
37.9	P7-L	315.80	PO	12	14.000	=	=
37.9	P7-R	744.10	Pump Open	25	0.000	=	=
38.1		273.30	GE	7	9.624	30	1991-92
38.5		45.80	GO	2	0.816	12	
38.7		45.60	GE	1	0.608	12	1984
39.1		18.40	GE	1	0.248	10	1985
39.2		25.50	GE	2	0.344	10	1986-87
39.4		697.80	GE	24	9.328	21	1986-87
39.7		1164.30	Gravity Enclosed	48	13.992	24,10	1986-87
40.4		33.40	GE	1	0.448	10	1985-86
40.5		134.20	GE	3	1.792	12	1985-86
40.7		2.60	GE	1	0.032	10	1984
40.8		0.00	GE	2		12	1984
41.0		578.90	GE	30	7.824	21	1985-86
41.9		111.60	GE	3	1.488	12	1985-86
42.1		0.00	GE	1		12	
42.4		296.10	GE	6	1.576	12	1991-92
42.6		217.60	GE	4	4.528	18	1991-92
42.9	P8	83.40	PO	4	0.000	=	=
42.9	P8A	109.30	PO	2	18.960	=	=
42.9	P8-L	148.50	PO	7	0.000	=	=
42.9	P8-R	1027.60	PO	30	0.000	=	=
43.1		698.40	GE	24	9.336	21	1984-85
43.5		122.40	GO	2	7.256	48	
44.2		159.60	GE	3	1.584	12	1991-92
44.5		0.00	GE	1		10	1983
44.7		1127.90	GE	34	15.072	24	1984-85
45.4		1195.30	GE	35	15.976	10,10,24	1989-90
45.7		127.40	GE	2	1.704	10	1989-90
46.6		110.30	GE	4	1.472	10,10	1989-90
47.2		538.40	GE	14	7.200	8,10,18,	1989-90
47.6		0.00	GE	1		12	1980
48.1		273.40	GE	7	3.256	12	1991-92
48.5		0.00	GE	1		10	1981
48.5	P9	68.30	PO	3	0.000	=	=
48.5	P9L	799.90	PO	21	19.680	=	=
48.5	P9R	908.90	PO	25	0.000	=	=
48.6		421.40	GO	10	0.720	18	1991-92
48.9		55.30	GE	3	0.984	12	1991-92
49.2		511.80	GE	17	0.224	18	1990-91
49.3		32.90	GE	1	0.440	12	1985
49.7		434.30	GE	13	0.880	18	1990-91
50.0		38.40	GE	1	0.688	30	1991-92
50.3		48.80	GE	1	0.656	12	1981
50.4		298.90	GE	11	0.192	21	1990-91
50.8		46.90	GE	2	0.056	12	1990-91
51.3		0.00	GE	1		12	1988
51.4		34.80	GO	1	0.624	18	1991-92
51.5		104.20	GE	3	1.632	24	1991-92
52.0		175.70	GE	5	3.128	24	1991-92

ROZA IRRIGATION DISTRICT LATERALS - TABLE 4.6

MILE POST	NAME (DESCRIPTION)	TOTAL ACRES	TYPE OF LATERAL	NUMBER OF DELIVERIES	ACTUAL FLOW (CFS) **	DIAMETER OF TURNOUT	DATE OF GE INSTALLATION
52.5	P9A	111.70	PO	4	0.000	=	=
52.5	P9A-L	299.80	PO	6	20.720	=	=
52.5	P9A-R	1279.20	Pump Open	32	0.000	=	=
52.8		447.00	GE	12	4.312	21	1991-92
53.4		630.10	GE	27	8.424	24	1990-91
53.8		22.00	GE	1	0.304	12	1990-91
54.2		350.50	GE	17	4.688	18	1990-91
54.4		11.20	GO	1	0.200	12	
54.7		61.20	GE	1	0.816	12	1985
54.9		0.00	GE	1		10	1984
55.0		574.90	GE	17	7.688	18	1990-91
55.5		103.70	Gravity Enclosed	2	1.384	10	1987-88
56.1	P10	565.90	PO	17	8.800	=	=
56.4		316.10	GE	12	4.224	10	1987-88
56.7		261.10	GE	16	2.880	12	1990-91
57.0		167.80	GE	4	2.240	12	
57.2		171.00	GE	6	2.288	24	1990-91
57.7		88.90	GE	2	1.192	18	1990-91
57.9		156.80	GE	6	2.096	30	1990-91
58.3		0.00	GE	1		12	1979
58.4		26.70	GE	1	0.360	12	1990-91
59.0		745.80	GE	19	9.968	21	1984-85
59.1		717.70	GE	22	9.592	24	1983-84
59.3		19.80	GE	2	0.264	10	1985-86
59.5		374.20	GE	9	5.000	18	1983-84
59.9		49.30	GE	4	0.656	8,8,8	1983-84
60.3		435.40	GE	12	5.824	8,8,15	1983-84
60.8		82.30	GE	2	1.104	8	1983-84
61.4		273.40	GO	5	2.504	18	1997-98
61.9	P12	58.70	PO	4	0.000	=	=
61.9	P12-L	182.10	PO	7	7.360	=	=
61.9	P12-R	356.60	PO	10	0.000	=	=
62.2		140.50	Gravity Open	6	0.840	12	1997-98
62.5		8.00	GO	1	0.144	12	1997-98
62.7		83.30	GO	5	0.848	12	1997-98
63.2		450.30	GO	8	4.488	18	1997-98
63.5		0.00	GE	1		30	1983
63.6		694.80	GO	11	6.384	30	1997-98
64.0		0.00	GE	1		12	1983
64.2		96.00	GO	1	1.120	12	1997-98
64.5		67.40	GO	1	0.904	12	1997-98
65.4		27.10	GE	2	0.832	12	1996-97
66.0		212.20	GE	6	2.520	12	1996-97
66.2		154.50	GE	6	1.728	12	1996-97
66.6		145.00	GE	5	1.792	12	1996-97
67.1		48.00	GE	2	0.544	12	1996-97
67.2	EAST TURBINE	3233.80	GE	80	57.616	3'X3'GATE	1993-96
67.2	P13	209.50	PO	8	0.000	=	=
67.2	P13-L	2168.80	PO	56	34.880	=	=
67.2	P13-H	581.70	PO	24	0.000	=	=
67.2	WEST TURBINE	1006.90	GE	23	17.944	3'X3'GATE	1996-97

ROZA IRRIGATION DISTRICT LATERALS - TABLE 4.6

MILE POST	NAME (DESCRIPTION)	TOTAL ACRES	TYPE OF LATERAL	NUMBER OF DELIVERIES	ACTUAL FLOW (CFS) **	DIAMETER OF TURNOUT	DATE OF GE INSTALLATION
67.3		19.90	GE	1	0.352	12	1996-97
67.5		61.50	GE	3	1.200	12	1995-96
67.9		113.80	Gravity Enclosed	3	1.520	12	1983
68.2		625.80	GE	14	8.360	12,12,12	1979-80
68.3		173.80	GE	4	3.096	12	1995-96
68.6		78.20	GE	2	1.392	12	1995-96
69.1		52.80	GE	2	0.944	12	1993-94
69.2		10.20	GE	1	0.184	12	1993-94
69.3		28.70	GE	2	0.512	12	1993-94
69.8		138.20	GE	4	2.464	12	1993-94
70.0		0.00	GE	1		12	1981
70.1		299.00	GE	7	5.328	18	1993-94
70.3		0.00	GE	1		10	1985
70.6		281.50	GE	8	5.016	18	1995-96
70.9		10.10	GO	1	0.184	12	1993-95
71.1	P14	1698.00	Pump Open	46	20.560	=	=
71.3		37.00	GE	1	0.496	12	1984
71.6		104.90	GE	3	1.872	12	1993-94
72.1		65.30	GE	2	1.160	12	1993-94
72.4		449.40	GE	10	8.000	18	1993-95
72.9		730.80	GE	26	13.024	30	1993-94
73.0		6.00	GE	1	0.080	12	1987
73.3		150.70	GE	1	2.688	12	1992-93
73.9		0.00	GE	1		12	1980
74.0		923.10	GE	21	16.448	30	1992-93
74.3		78.10	GE	1	1.392	12	1992-93
74.7		1912.30	GO	45	34.072	36	
75.1		31.20	GO	1	0.560	12	
75.5		56.90	GO	2	1.016	12	
75.7		59.20	GO	2	1.056	12	
76.6		1181.70	GO	31	21.056	30	
76.8		46.80	GO	1	0.832	12	
77.0		18.00	GE	1	0.240	10	1986
77.3		1344.30	GO	31	23.952	30	
78.6		60.10	GO	3	1.072	12	
79.0	P15-LL	455.40	PO	15	26.880	=	=
79.0	P15-LR	1816.40	PO	40		=	=
79.0	P15-H	0.00	PO	1		=	=
79.0	P15-HL	587.10	PO	14	22.480	=	=
79.0	P15-HR	1393.10	PO	31	0.000	=	=
79.3		51.80	GO	2	0.920	12	
79.5		97.90	GO	3	1.744	12	
79.9		29.60	GO	1	0.528	12	
81.0		158.40	GO	4	2.824	12	
81.3		158.90	GO	4	2.832	12	
81.5	SERVERNS PUMP	167.60	PO	4	2.080	=	=
81.7		75.50	GO	2	1.344	12	
82.0		474.70	GE	16	6.344	10,10,10	1988-89
82.8		14.60	GO	1	0.264	12	
83.3		40.80	GE	1	0.544	10	1988-89

ROZA IRRIGATION DISTRICT LATERALS - TABLE 4.6

MILE POST	NAME (DESCRIPTION)	TOTAL ACRES	TYPE OF LATERAL	NUMBER OF DELIVERIES	ACTUAL FLOW (CFS) **	DIAMETER OF TURNOUT	DATE OF GE INSTALLATION
83.8		57.80	GO	1	1.032	12	
84.1		107.40	GE	2	1.432	10	1988-89
84.3		35.30	GE	1	0.064	10	1988-89
84.6		221.20	Gravity Enclosed	9	2.960	10	1988-89
84.7		0.00	GE	1	0.000		
84.9		44.20	GO	2	0.784	12	
85.5		0.00	GE	1		2	1986
85.6		427.50	GO	13	7.616	18	
86.0		569.30	GO	15	10.144	21	
86.5		81.30	Gravity Open	2	1.448	12	
86.8		62.20	GO	2	1.112	12	
87.4		459.20	GO	10	8.184	21	
87.8		126.50	GO	2	2.256	12	
88.1		97.10	GO	4	1.728	12	
88.3	P16-LL	1347.20	PO	34	14.720	=	=
88.3	P16-LR	133.10	PO	4	0.000	=	=
88.3	P16-H	60.70	Pump Open	3	0.000	=	=
88.3	P16-HL	924.90	PO	22	10.720	=	=
88.3	P16-HR	96.00	PO	1	0.000	=	=
88.5		389.90	GO	12	6.944	18	
88.9		105.90	GO	3	1.888	12	
89.2		61.90	GO	2	1.104	12	
90.2		28.00	GO	2	0.496	12	
90.4		68.90	GO	4	1.224	12	
91.1		122.80	GO	4	0.144	12	
91.5		207.00	GO	7	3.688	12	
91.7		130.60	GO	6	2.328	12	
92.1	P17	647.50	PO	20	6.800	=	=
92.4		387.50	GO	29	6.904	18	
92.7		32.60	GO	1	0.504	=	
93.7		0.00	GE	1	0.000	12	1977
93.4		228.60	GO	3	2.102	=	
93.9		164.00	GO	6	2.440	12	
94.2		28.10	GO	2	0.504	12	
94.4		243.10	GO	10	4.328	18	
94.7		225.50	GO	10	4.016	18	
94.8		367.80	GO	13	6.552	20	
					1007		
		71999					

PUMP PLANT CHARACTERISTICS - TABLE 4.7 - PART 1

MILE POST	PUMP NUMBER	VERTICAL LIFT (ft)	RATED CAPACITY (cfs)	DESIGN CAPACITY LATERALS(cfs)	TOTAL MOTOR RATING (hp)	NUMBER OF UNITS	PUMPING PLANT EFFICIENCY	VOLTS
7.2	1-H	203.0	17.0	13.6	600	2	60.1%	2300
7.2	1-L	103.0	22.0	17.6	400	2	45.5%	480
13.0	THID	87.6	6.0	8.7	80	2	48.8%	480
16.8	2-H	220.0	33.6	26.8	1200	3	76.9%	2300
16.8	2-L	100.0	23.0	18.0	400	2	66.6%	2300
22.3	3-H	221.8	30.9	25.1	1200	3	67.1%	2300
22.5	3-L	145.6	16.0	12.1	400	2	52.4%	2300
24.0	4	160.0	14.0	11.3	400	2	66.7%	2300
27.0	5	111.0	5.5	3.1	100	1	75.1%	480
29.6	6	148.0	5.5	4.4	125	1	57.2%	480
37.5	7	151.0	21.6	17.5	600	3	56.5%	2300
42.5	8	140.0	32.1	23.7	750	3	55.7%	2300
48.5	9	179.0	30.6	24.6	900	3	64.8%	2300
52.4	9A	158.0	33.0	25.9	900	3	66.1%	2300
56.1	10	136.0	13.5	11.0	300	2	56.8%	480
61.8	12	142.4	11.8	9.2	300	2	49.4%	480
67.3	13	101.2		43.6			54.7%	2300
-NEW	13-1&2		36.0		500	2	=	2300
-OLD	13-3&4		31.0		500	2	=	2300
71.0	14	233.0	33.0	25.7	1200	3	68.5%	2300
78.8	15-H	250.0	35.1	28.1	1500	3	69.7%	2300
78.8	15-L	136.0	42.0	33.6	1050	3	74.1%	2300
81.5	SEVERYNS	58.9	3.0	2.6	30	1	34.3%	480
88.3	16-H	253.0	21.9	13.4	900	3	60.0%	2300
88.3	16-L	133.2	24.0	18.4	600	2	51.1%	2300
92.1	17-1	226.2	4.8	8.5	250	1	53.9%	2300
92.1	17-2	226.2	13.0		500	1	=	2300

Total Rated Capacity = 560 cfs

Total Design Capacity of Laterals = 415 cfs

Total Number of Units = 57

PUMP PLANTS CONTINUED - TABLE 4.8 - PART 2

MILE POST	PUMP NUMBER	ACRES IRRIGATED	LENGTH OF DISCHARGE PIPE (ft)	WATERS ELEVATION DISCHARGE	MOTOR INTERCHANGABLE WITH	BYPASS BACK TO MAIN CANAL	BYPASS FROM HIGH TO LOW
7.2	1-H	300.3	3540	1401.10	2L		Yes, seldom
7.2	1-L	905.54	736	1301.33	9,16H		
13.0	THID	347.51	982	1271.59	-		
16.8	2-H	1730.3	3839	1401.20	3H,14	Yes	Yes, often
16.8	2-L	1200.4	1115	1281.10	1L		
22.3	3-H	1512	5450	1391.50	2H,14	Yes	Yes, low flow
22.5	3-L	843.8	2413	1315.25	4,7		
24.0	4	762	1282	1326.00	3L,7	Yes	
27.0	5	247.2	1115	1270.60	-	Yes, often	
29.6	6	259.1	820	1300.50	-	Yes, often	
37.5	7	1114.2	1673	1281.77	3L,4	Yes	
42.5	8	1368.8	1142	1267.21	-		
48.5	9	1777.1	2005	1301.32	1H,16H	Yes	
52.4	9A	1690.7	2438	1276.20	16L		
56.1	10	565.9	793	1251.00	12		
61.8	12	597.4	2366	1250.82	10	Yes	
67.3	13	2960	1065	1203.70	-	Yes, at times	
-NEW	13-1&2						
-OLD	13-3&4						
71.0	14	1698	2396	1330.90	2H,3H	Yes	Yes, into P13
78.8	15-H	1980.2	7478	1335.90	-	Yes, 4 AC-FT	
78.8	15-L	2271.8	3685	1222.50	-	maximum	
81.5	SEVERYNS	167.6	639	1142.00	-	Yes, from H.W.	
88.3	16-H	1081.6	5491	1316.32	1H,9	Yes	Yes, low flows
88.3	16-L	1480.3	1806	1196.75	9A		
92.1	17-1	647.5	2669	1275.70	-	Yes	Yes, low flows
92.1	17-2						

Total Irrigated Acres = 27509

ROZA IRRIGATION DISTRICT - REREGULATION RESERVOIRS - TABLE 4.9

NAME	TYPE	STORAGE (AC-FT)	SURFACE AREA (ACRES)	DATE INSTALLED	NUMBER PUMPING UNITS	FLOW OF EACH PUMP (CFS)	MOTOR HP RATING	HEIGHT OF DAM (FT)	CREST LENGTH (FT)	LINING
Wasteway #6	Earth Homogeneous	150	13	1988	3	10	3 @ 25	18	2150	Yes, PVC
Wasteway #7	Earth Homogeneous	15	2.3	1993	1	5	15	14	500	Unlined
Wasteway #5	Roller Compacted Concrete	2200	50	Proposed 2001	4	Total of 150	3500	80	1000	Unlined

TABLE 5.5 Average Monthly Water Distribution for Roza Irrigation District, 1980-1989 less 1987.
UNDER PRESENT CONDITION OF THE SYSTEM
Average Acres Irrigated = 72,548.

	AVERAGE DIVERTED FROM STREAM	AVERAGE SYSTEM EFFICIENCY	ENTITLE-MENT	MAIN CANAL OPER. SPILL	MAIN CANAL LOSSES	DELIVERED TO LATERALS	LATERAL OPER. SPILL	LATERAL LOSSES	DELIVERED TO FARMS
MARCH	9,667	10	18,000	3,000	5,000	1,667	167	500	1000
APRIL	33,569	34	37,500	6,765	10,649	16,155	645	3,974	11,536
MAY	54,066	58	56,250	6,281	9,177	38,608	1,087	6,343	31,178
JUNE	60,240	65	71,250	3,939	9,810	46,491	1,116	6,042	39,333
JULY	67,220	69	71,250	3,288	10,344	53,588	965	6,132	46,491
AUGUST	66,726	69	71,250	3,283	9,688	53,755	1,028	6,526	46,201
SEPTEMBER	44,149	56	45,000	4,652	8,070	31,427	1,195	5,671	24,561
OCTOBER	16,644	47	22,500	2,150	3,744	10,750	449	2,487	7,814
TOTAL (AF)	352,281	59	393,000	33,358	66,482	252,441	6,652	37,675	208,114
AF/ACRE	4.86		5.42	0.46	0.92	3.48	0.09	0.52	2.87
PERCENT NET SUPPLY	100			9	19	72	2	11	59

* NOTE: March supply is an estimated value, as only measured value is diverted from Yakima River.

SUMMARY OF ENCLOSED CONDUIT CONSTRUCTION

12-Jun-98

YEAR	ACRES	LATERALS/TURNOUTS ENCLOSED	FLOWMETERS	VALVES	MILES OF PIPE	TOTAL COST	COST PER ACRE
MISC.	1159.6	5.5, 6.5, 11.9, 12.0, 14.9, 22.9, 24.6, 24.7, 25.1, 28.4, 29.1, 29.3, 29.6, 31.1, 31.5, 32.0, 34.6, 36.6, 36.8, 38.7, 39.1, 40.7, 40.8, 44.5, 47.6A, 50.3, 51.3, 54.7, 54.9, 58.3, 64.0, 64.5, 73.9A, 75.1, 77.0, 85.5	50				
1979-1980	800.1	67.9, 68.2 (HARRISON ROAD)	16				
1982-1983	167.8	57.0 (ARROWSMITH ROAD)	4				
1983-1984	1683.0	59.1, 59.3, 59.5, 60.3, 60.8 (VAN BELLE BASIN-PHASE A)	43	2	9.3	$495,147.78	$294.21
1984-1986	3548.3	40.4, 40.5, 41.0, 41.9, 43.1, 43.5, 44.7, 59.0	87	4	18.6	$793,072.56	$223.51
1986-1987	1887.6	39.2, 39.4, 39.7	73	16	10.5	$945,969.86	$501.15
1987-1988	1385.5	449.2, 49.3, 49.7, 50.0, 50.4, 55.5, 56.4	57	6	6.6	$503,450.57	$363.37
1988-1989	879.4	82.0, 83.3, 84.1, 84.3, 84.6	27	1	5.1	$462,031.99	$525.39
1989-1990	1971.4	45.4, 45.7, 46.6, 47.2	47	9	8.7	$695,651.88	$352.87
1990-1991	2188.2	53.4, 53.8, 54.2, 55.0, 56.7, 57.2, 57.7, 57.9, 58.4	69	23	10.9	$802,091.35	$366.55
1991-1992	2484.0	38.1, 42.4, 42.6, 44.2, 48.1, 48.2, 48.9, 50.0 51.5, 52.0, 52.8	73	8	11.8	$858,328.56	$345.54
1992-1993	2560.9	72.9*, 73.3, 74.0, 74.3 (EAST TURBINE)	54	2	13.5	$978,584.88	$382.13
1993-1994	1241.0	68.3*, 69.1, 69.3, 69.8, 70.1, 71.3, 71.6, 72.1, 72.9* (EAST TURBINE)	34	6	5.0	$461,110.54	$371.56
1994-1995	1567.0	68.3*, 70.3, 72.4* (EAST TURBINE)	43	5	11.6	$745,027.81	$475.45
1995-1996	1830.8	67.5, 68.3*, 68.6, 70.6 (EAST TURBINE)	57	15	10.0	$904,810.53	$494.22
1996-1997	1740.2	65.4, 66.0, 66.2, 66.6, 67.1, 67.3 (WEST TURBINE)	61	0	11.0	$969,780.83	$557.28
1997-1998**	1613.1**	61.4, 62.2, 62.7, 63.2, 63.6, 64.2	43**	0	9.0**		
TOTALS	24967.3	SINCE CONSERVATION RESOLUTION (1983-84 PROJECT)	725		132.6	$9,615,059.14	$385.11
	27094.8	WHOLE DISTRICT	795		132.6		

* DENOTES A PARTIAL LATERAL

** DENOTES PROJECT NOT YET COMPLETED, FIGURES NOT INCLUDED IN CALCULATIONS

TABLE 6.1

STUDIES

YEAR	TITLE	COST	GRANT TYPE		TOTAL GRANT
			REF 38	CCWF	
1990-94	CANAL AUTOMATION STUDY/ WW5 REREG RECONNAISSANC STUDY (INCLUDING 77.3 CHECK CONSTRUCTION = $94,800)	$175,796.93	$26,369.54	$52,213.73	$78,583.27
1991-92	COMPREHENSIVE WATER CONSERVATION PLAN	$92,076.12	$45,000.00		$45,000.00

AUTOMATED CHECK STRUCTURES

YEAR	LOCATION	FLOW (CFS)	# GATES	CONCRETE (YD)	COST	GRANT TYPE		TOTAL GRANT
						REF 38	CCCF	
1991-92	MILEPOST 77.3	350	3	45	$94,800.00	$14,220.00	$22,752.00	$36,972.00
1993-94	PUMP 9	900	3	140	$190,854.40	$47,713.60		$47,713.60
1994-95	PUMP 2	1150	3	191	$264,350.97	$66,087.74		$66,087.74
1995-96	PUMP 7	1050	3	175	$308,110.46	$77,027.62		$77,027.62

REREGULATION RESERVOIRS

YEAR	LOCATION	VOLUME (AF)	COST	GRANT TYPE		GRANT TOTAL
				REF 38	CCWF	
1988	WASTEWAY 6	150	$863,013.22	$172,602.62		$172,602.62
1994	WASTEWAY 7	10.4	$403,843.31	$100,708.58	$90,750.00	$191,458.58

TABLE 6.2

SUMMARY OF PVC LINING INSTALLATIONS

YEAR	LOCATION	LENGTH	WIDTH	COST	COST PER SQ FT	GRANT $ USED
MISC.	U/S OF 62.2 6MIL CURTAIN	800	21			
	P9A-R U/S MAPLE GROVE RD	300	21			
	PUMP 13E U/S DEL 8	700	21			
	PUMP 13E D/S DEL 16	780	21			
	P3HR U/S DEL 2	450	21			
	P2HR DEL 6A TO 6B	600	28			
	32.8 U/S B LINE	100	21			
	32.8 U/S DEL 8	170	21			
	TOTAL	86100	SQ FT			
1989-90	75.7 M.C. CURTAIN	1000	15			
	U/S OF 93.4 M.C.	800	40			
	TOTAL	47000	SQ FT	$36,629.20	$0.78	$9,157.30
1990-91	P13W - HOLMANSON ROAD TO DEL 13A	450	21			
	P14 - D/S OF HEADWEIR	350	28			
	D/S OF 93.0 M.C.	300	35			
	P8R SANDLIN WATER	850	21			
	P1L U/S DEL 7	500	21			
	TOTAL	58100	SQ FT	$39,934.10	$0.69	$9,983.53
1991-92	14.2 M.C. - CURTAIN	600	21			
	P2 HR U/S BITTNER ROAD	565	28			
	P8 U/S HOUGHTON ROAD	725	28			
	P8R D/S OF HEAD WEIR	270	21			
	TOTAL	54390	SQ FT	$54,302.70	$1.00	$13,575.68
1992-93	NO LINING INSTALLED					
1993-94	P3LR D/S HEAD WEIR	300	20			
	P14 D/S DEL 9A	600	22			
	92.4 M.C.	300	40			
	94.8 D/S SIPHON B	600	15			
	TOTAL	40200	SQ FT	$31,419.98	$0.78	$7,855.00
1994-95	P2 LR U/S FAUCHER ROAD	260	21			
	M.C. U/S SIPON 12	300	42			
	88.5 M.C. - WATER	435	40			
	TOTAL	35460	SQ FT	$52,847.05	$1.49	$13,211.76
1995-96	P8R D/S OF HEAD WIER	350	28			
	P2 HR U/S BITTNER ROAD	500	28			
	P14 D/S HEAD WEIR	530	28			
	P15 D/S OF MCDONALD ROAD	600	21			
	TOTAL	51240	SQ FT	$93,159.65	$1.82	$23,289.91
	TOTAL INSTALLED (NOT INCL. MISC.)	286390	SQ FT	$308,292.68	$1.08	$77,073.17

TABLE 6.3

TABLE 6.4 MAIN CANAL GATE ALTERNATIVES FOR AUTOMATION

SUMMARY OF CHECK STRUCTURE CRITERIA

Criterion	Rubber Dam	AMIL Gate	Radial Gate	Overshot Gate	Sluice Gate	Stop Logs
Automation	Yes	(1)	Yes	Yes	Yes	No
Manual Back-up	Yes	(2)	Yes	Yes	Yes	(3)
Flow Measurement	No	(4)	Yes	Yes	Yes	Yes
Debris Resistant	Yes	No	No	Yes	No	Yes
Maintenance Req't	(5)	Annual	Annual	Annual	Annual	(6)
Resistance to vandals	Poor	Good	Good	Good	Good	Fair
Rough Cost x 1000 (@ 350 cfs)	$139	$91	$74	$60	$102	$19

NOTES

(1) Mechanically Automated
(2) No back-up necessary
(3) Manually operated
(4) Flow Chart available noting Flow vs. Head differential
(5) Subject to condition of rubber
(6) Subject to condition of logs

This table from "Main Canal Gate Alternatives - Canal Automation Study"
Prepared by Roza Irrigation District, September 1990

ROZA IRRIGATION DISTRICT MODERNIZATION PROJECT
WATER SYSTEM CAPITAL COSTS (1992 DOLLARS)

TABLE 6-5

Year	Enclosed Conduit System Gravity	Enclosed Conduit System Pump	Main Canal Automation	Lining	Reregulation Reservoirs	TOTAL CAPITAL COSTS
1992	888,000		240,000	90,000		1,218,000
1993	1,070,000		240,000	90,000		1,400,000
1994	1,070,000		240,000	90,000		1,400,000
1995	1,070,000		240,000	90,000		1,400,000
1996	1,070,000		240,000	90,000		1,400,000
1997	1,070,000		240,000	90,000		1,400,000
1998	1,070,000		240,000	90,000	200,000	1,600,000
1999	1,070,000		240,000	90,000	300,000	1,700,000
2000	1,070,000		240,000	90,000	7,500,000	8,900,000
2001	1,070,000		240,000	90,000	7,500,000	8,900,000
2002	1,070,000		240,000	90,000		1,400,000
2003	1,070,000		240,000	90,000		1,400,000
2004	1,070,000		240,000	90,000		1,400,000
2005	1,070,000	795,000	240,000	90,000		2,195,000
2006		2,100,000	240,000	90,000		2,430,000
2007		2,100,000	240,000	90,000		2,430,000
2008		2,100,000	240,000	90,000		2,430,000
2009		2,100,000	240,000	90,000		2,430,000
2010		2,100,000	240,000	90,000		2,430,000
2011		2,100,000	240,000	90,000		2,430,000
2012		2,100,000		45,000		2,145,000
2013		2,100,000				2,100,000
2014		2,100,000				2,100,000
2015		2,100,000				2,100,000
2016		2,100,000				2,100,000
Sum	14,798,000	23,895,000	4,800,000	1,845,000	15,500,000	60,838,000

CHANGES IN COST OF SYSTEM MAINTENANCE

YEAR BEGINNING	ENCLOSED CONDUIT SYSTEM	MAIN CANAL AUTOMATION	REREGULATION RESERVIOR WW #5	REREGULATION RESERVIOR WW #6	REREGULATION RESERVOIR WW #7	TOTAL CHANGE IN MAINTENANCE COSTS
1992	554540	10000		7500		572040
1993	544300	10646		7500		562446
1994	534060	11333		7500	750	553643
1995	523820	12065		7500	750	544135
1996	513580	12845		7500	750	534675
1997	503340	13674		7500	750	525264
1998	493100	14558		7500	750	515908
1999	485420	15498		7500	750	509168
2000	480300	16499		7500	750	505049
2001	475180	17564		7500	750	500994
2002	464940	18699		7500	750	491889
2003	454700	19907	50000	7500	750	532857
2004	444460	21192	50000	7500	750	523902
2005	435571	22561	50000	7500	750	516382
2006	426859	24018	50000	7500	750	509127
2007	418322	25570	50000	7500	750	502142
2008	409956	27221	50000	7500	750	495427
2009	401757	28979	50000	7500	750	488986
2010	393722	30851	50000	7500	750	482823
2011	385847	32844	50000	7500	750	476941
2012	378130	34965	50000	7500	750	471345
2013	370568	37223	50000	7500	750	466041
2014	363156	39627	50000	7500	750	461033
2015	355893	42187	50000	7500	750	456330
2016	348775	44912	50000	7500	750	451937
2017	341800	47812	50000	7500	750	447862

TABLE 6.6

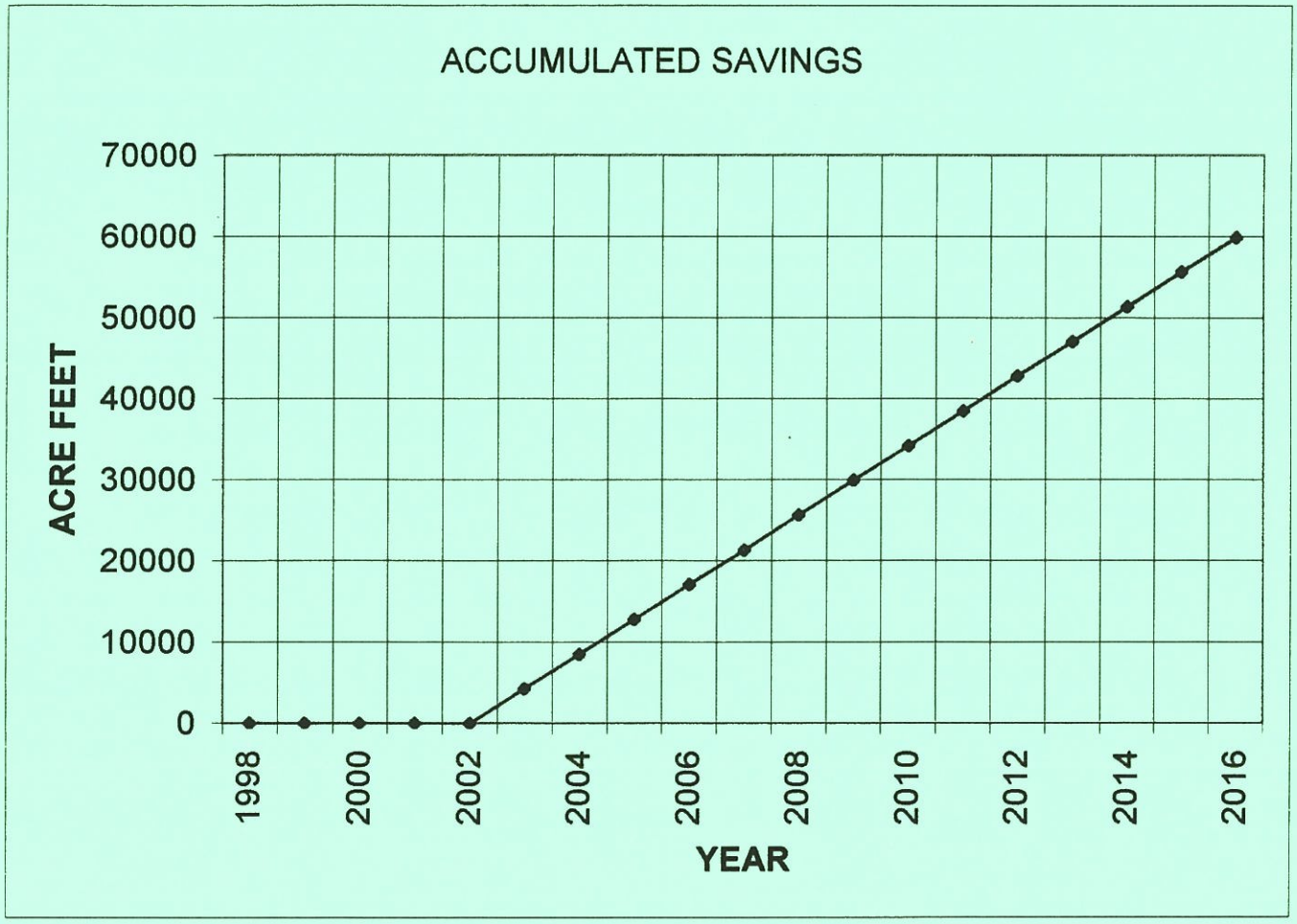
WATER SAVED BY CONSERVATION MEASURES

TABLE 6.7

MONTH	REREG at WW5	ALL REREGS	Enclosed Conduit	Automation	Savings from all Measures
April	2635	4758	2045	1363	8166
May	3041	5328	3315	2210	10853
June	1884	3677	3436	2291	9404
July	1283	2575	3619	2413	8607
August	1705	3202	3741	2494	9438
September	1808	3336	3169	2112	8617
October	1395	2424	1473	982	4879
TOTAL	13751	25300	20798	13866	59964

NOTES:

Reregulation reservoirs are assumed to save operational losses, half of main canal spill plus all lateral spill.
Enclosed conduit is credited for saving only 60% of the evaporation and seepage losses.
The remaining 40% of the savings is credited to automation needed to operate the reregulation reservoirs.



ROZA IRRIGATION DISTRICT PUMPING PLANT #1 TABLE 6.10
Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	71200	242400	268900	301400	345900	187300	67800	0	0	1484900
1981	0	0	0	115200	243800	251800	271300	340900	246100	13700	0	0	1482800
1982	0	0	0	42200	235500	312800	290600	316400	240300	-4100	0	0	1433700
1983	0	0	0	80000	222800	287900	278800	295500	172100	79000	0	0	1416100
1984	0	0	0	53500	203400	249300	303800	313500	208000	81100	0	0	1412600
1985	0	0	0	118100	279900	293100	309200	258200	167000	0	0	0	1425500
1986	0	0	0	138700	216300	313700	281900	246900	191100	100	0	0	1388700
1987	0	0	6100	169700	275400	277000	270700	223900	75300	0	0	0	1298100
1988	0	0	103000	123200	265700	176500	266200	263900	223600	83100	0	0	1505200
1989	0	0	0	144700	218100	267300	304000	282400	288900	88400	0	0	1593800
1990	0	0	60500	185400	280600	222800	284200	259500	210100	91700	0	0	1594800
1991	0	0	33600	173200	255400	207800	293000	286500	246400	70000	0	0	1565900
1992	0	0	34000	200400	250300	195200	213000	219900	95100	0	0	0	1207900
1993	0	0	0	76700	196100	194000	207400	224500	199700	6400	0	0	1104800
1994	0	0	0	159400	68500	170500	207200	198500	46300	0	0	0	850400
1995	0	0	0	154000	209000	256800	283200	277100	233600	91700	0	0	1505400

TERRACE HEIGHTS PUMPING PLANT
Power Useage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	27000	43800	51600	53600	56400	44600	28400	0	0	305400
1981	0	0	3200	35400	49000	45800	53200	50000	47800	17800	0	0	302200
1982	0	0	1400	31200	52400	48600	49800	54200	43400	15000	0	0	296000
1983	0	0	600	23200	49200	50600	52600	50000	38600	18600	0	0	283400
1984	0	0	5200	23200	37600	43200	49200	47600	39800	15400	0	0	261200
1985	0	0	0	30200	48000	49859	54461	30606	32	32	0	0	213190
1986	0	0	0	31813	48500	47805	50657	52020	34722	47	0	0	265564
1987	0	0	0	32996	47774	48937	50189	47172	22988	0	0	0	250056
1988	0	0	14216	34254	40792	40948	48646	40081	37670	15502	0	0	272109
1989	0	0	0	26678	43612	46348	51428	47683	45904	24308	0	0	285961
1990	0	0	11734	40128	46157	43669	48039	44880	46828	16821	0	0	298256
1991	0	0	4690	36895	52335	42916	48108	51079	9856	59206	0	0	305085
1992	0	0	10557	40383	51752	43972	46674	51469	19596	0	0	0	264403
1993	0	0	8	20604	43569	43877	49952	46767	42978	5896	0	0	253651
1994	0	0	11005	40564	18647	40322	49381	46754	11034	0	0	0	217707
1995	0	0	7718	27137	36021	43910	49185	44463	44028	20311	0	0	272773

ROZA IRRIGATION DISTRICT PUMPING PLANT #2
Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	89000	471000	541000	730000	779000	447000	266000	0	0	3323000
1981	0	0	0	196000	532000	575000	717000	740000	600000	133000	0	0	3493000
1982	0	0	0	191000	580000	600000	618000	762000	562000	118000	0	0	3431000
1983	0	0	0	143000	523000	721000	766000	720000	484000	238000	0	0	3595000
1984	0	0	0	172000	471000	649000	732000	741000	682000	240000	0	0	3687000
1985	0	0	0	199000	689000	738000	755000	732000	509000	0	0	0	3622000
1986	0	0	0	320000	568000	685000	742000	77000	428000	0	0	0	2820000
1987	0	0	0	233000	615000	672000	693000	597000	239000	0	0	0	3049000
1988	0	0	247000	387000	525000	502000	690000	721000	582000	224000	0	0	3878000
1989	0	0	0	234000	549000	663000	756000	725000	566000	232000	0	0	3725000
1990	0	0	53000	382000	546000	592000	720000	623000	639000	206000	0	0	3761000
1991	0	0	0	296000	663000	473000	701000	772000	581000	292000	0	0	3778000
1992	0	0	109000	363000	645000	568000	604000	655000	260000	0	0	0	3204000
1993	0	0	0	169000	519000	609000	638000	615000	534000	59000	0	0	3143000
1994	0	0	83000	387000	183200	341000	438000	434000	103000	0	0	0	1969200
1995	0	0	39000	275000	408000	569000	725000	635000	581000	99000	0	0	3331000

ROZA IRRIGATION DISTRICT PUMPING PLANT #3 TABLE 6.10

Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	82000	458000	648000	715000	791000	332000	261000	0	0	3287000
1981	0	0	0	268000	603000	614000	743000	740000	463000	133000	0	0	3564000
1982	0	0	0	212000	687000	684000	625000	787000	521000	56000	0	0	3572000
1983	0	0	0	187000	576000	711000	741000	708000	376000	158000	0	0	3457000
1984	0	0	0	146000	523000	704000	742000	719000	666000	170000	0	0	3670000
1985	0	0	0	247000	671000	698000	751000	724000	449000	0	0	0	3540000
1986	0	0	0	339000	620000	659000	720000	730000	372000	0	0	0	3440000
1987	0	0	0	32000	257000	568000	637000	615000	575000	214000	0	0	2898000
1988	0	0	162000	351000	466000	502000	632000	632000	469000	159000	0	0	3373000
1989	0	0	0	175000	566000	660000	729000	689000	428000	219000	0	0	3466000
1990	0	0	85000	429000	551000	541000	696000	546000	474000	116000	0	0	3438000
1991	0	0	0	265000	670000	426000	687000	756000	494000	266000	0	0	3564000
1992	0	0	51000	354000	675000	585000	631000	694000	261000	0	0	0	3251000
1993	0	0	0	167000	520000	458000	567000	548000	490000	49000	0	0	2799000
1994	0	0	100000	350000	172000	309000	388000	376000	93000	0	0	0	1788000
1995	0	0	33000	203000	344000	593000	720000	667000	383000	83000	0	0	3026000

ROZA IRRIGATION DISTRICT PUMPING PLANT #4

Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	30100	123200	145000	164100	170300	104000	41000	0	0	777700
1981	0	0	0	84400	157400	136800	159800	171800	147300	23500	0	0	881000
1982	0	0	0	45500	149900	137300	127300	174900	122200	18500	0	0	775600
1983	0	0	0	54800	114700	154400	162900	167900	93100	45700	0	0	793500
1984	0	0	0	58400	125500	139100	166600	164700	138300	43200	0	0	835800
1985	0	100	0	39300	156600	163600	171700	166400	105600	100	0	0	803400
1986	0	0	0	77100	128300	143100	159400	171000	94800	200	0	0	773900
1987	0	0	100	92600	144800	158800	157400	234600	42700	0	0	0	831000
1988	0	0	3500	3400	141500	105800	156800	165600	131100	37500	0	0	745200
1989	0	0	0	73300	120800	147700	168300	164600	104900	44200	0	0	823800
1990	0	0	16600	73300	131000	83800	151500	135700	119600	32600	0	0	744100
1991	0	0	100	81600	151000	111700	160500	172700	128200	52200	0	0	858000
1992	0	0	21100	92200	126800	128500	138800	155200	55200	0	0	0	717800
1993	0	0	0	38100	104000	116400	147600	132400	225000	17800	0	0	781300
1994	0	0	48400	47000	53200	55100	94900	80300	19200	0	0	0	398100
1995	0	0	26300	77200	95000	135300	169700	156800	147500	33500	0	0	841300

ROZA IRRIGATION DISTRICT PUMPING PLANT #5

Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	7500	37300	42100	39600	45300	34400	23200	0	0	229400
1981	0	0	0	31400	44200	38600	42400	42900	34700	0	0	0	234200
1982	700	0	400	32900	44000	47700	36200	45100	37600	2500	0	0	247100
1983	3000	0	1100	30700	47000	46500	50200	45700	38000	24200	0	0	286400
1984	0	1600	500	24600	43200	43700	45900	46300	46800	13300	0	0	265900
1985	0	1300	600	25400	44700	53600	39500	53700	38300	600	0	0	257700
1986	0	1700	0	43400	43800	40400	48700	51500	39100	500	0	0	269100
1987	1800	0	2900	42300	48000	48200	47600	43400	21000	0	0	0	255200
1988	0	0	37500	41700	41000	42400	44500	51400	45000	23700	0	0	327200
1989	0	1200	0	24000	43400	47600	52100	50000	45500	2400	0	0	266200
1990	0	0	11700	41400	35700	52900	50600	47900	46300	20600	0	0	307100
1991	0	0	6300	44300	45600	38400	50200	54700	40600	26300	0	0	306400
1992	0	0	18200	37900	48000	40300	43400	50500	20000	0	0	0	258300
1993	0	0	400	22900	43300	46100	50800	48400	43300	6000	0	0	261200
1994	0	0	20100	38900	17300	36600	44400	37600	8800	0	0	0	203700
1995	0	0	11500	30100	39300	45700	56200	51300	47900	18700	0	0	300700

ROZA IRRIGATION DISTRICT PUMPING PLANT #6 TABLE 6.10
Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	1700	46900	56000	64400	65400	70400	54700	21600	200	0	381300
1981	1600	0	4100	57400	65100	59100	64000	65300	61300	9400	0	0	387300
1982	1200	0	400	29200	65200	60200	63200	67000	55300	-1800	0	0	339900
1983	2100	0	300	41100	61500	63800	66500	62000	50800	21100	0	0	369200
1984	0	2000	11800	48200	61300	63900	63700	63800	50900	0	0	0	365600
1985	0	700	500	50700	62500	75300	54900	68700	52900	600	0	0	366800
1986	0	102000	1900	5300	14500	59900	66400	67500	42600	0	0	0	360100
1987	0	1200	-29900	58200	63200	63000	66400	57700	26300	0	0	0	306100
1988	0	0	54200	60400	61200	59300	65000	65800	62700	31500	0	0	460100
1989	0	600	0	47200	60800	58000	68500	64100	55700	32300	0	0	387200
1990	0	2100	20300	51200	57700	60500	63800	58700	60500	26000	0	0	400800
1991	0	0	11900	55300	65900	55000	64200	65800	50500	36300	0	0	404900
1992	0	0	14700	55000	67900	52400	56600	62300	24600	0	0	0	333500
1993	0	0	2600	29600	57600	67500	51900	57100	55800	7900	0	0	330000
1994	0	0	13500	52100	24200	48200	60200	57500	14200	0	0	0	269900
1995	0	0	17200	46100	55600	53500	67700	60500	62500	26200	0	0	389300

ROZA IRRIGATION DISTRICT PUMPING PLANT #7
Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	61600	190000	190300	224200	287700	131000	176200	0	0	1261000
1981	0	0	0	109500	183900	189900	225700	270200	170900	44500	0	0	1194600
1982	0	0	0	87400	242600	222200	233500	273300	165200	10300	0	0	1234500
1983	0	0	0	37800	198300	265500	250900	214100	147000	49100	0	0	1162700
1984	0	0	0	64100	194100	252000	254100	237700	114200	45600	0	0	1161800
1985	0	0	0	77100	238000	271500	274400	193900	113500	100	0	0	1168500
1986	0	0	0	105400	207400	229700	244900	227300	108900	200	0	0	1123800
1987	0	0	0	157700	233400	222100	202100	166000	61000	0	0	0	1042300
1988	0	0	123200	137200	144300	127200	168400	179800	158400	144800	0	0	1183300
1989	0	0	0	2100	234300	242500	211700	191800	133100	51600	0	0	1067100
1990	0	0	33500	167600	190700	214200	200300	178900	150200	35600	0	0	1171000
1991	0	0	18000	152700	229400	183800	250800	248100	169100	97400	0	0	1349300
1992	0	0	55000	168000	229900	166700	176400	198700	83500	0	0	0	1078200
1993	0	0	0	57100	213100	185700	213100	218500	148300	20000	0	0	1055800
1994	0	0	47900	185200	68700	140200	173300	151400	35400	0	0	0	802100
1995	0	0	23600	82200	172400	200100	275000	249200	182600	46200	0	0	1231300

ROZA IRRIGATION DISTRICT PUMPING PLANT #8
Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	105000	234900	232700	314500	334400	161400	87600	0	0	1470500
1981	0	0	20100	173800	297200	267500	323300	332700	220900	66600	0	0	1702100
1982	0	0	500	153900	303000	301900	295700	330700	206600	48300	0	0	1640600
1983	0	0	22100	135300	226000	305800	261000	315100	149600	99100	0	0	1514000
1984	0	0	24400	153600	240000	253000	286100	326800	193500	69500	0	0	1546900
1985	0	0	6900	191200	315500	334300	345800	328900	174200	700	0	0	1697500
1986	0	0	41000	235500	323300	293100	326300	338300	207300	500	0	0	1765300
1987	0	0	41300	266000	333400	322400	347700	246400	102200	0	0	0	1659400
1988	0	0	177600	141300	366400	239300	273800	305000	213200	103100	0	0	1819700
1989	0	0	0	171800	301400	317400	350200	331100	253000	109900	0	0	1834800
1990	0	0	92200	269400	279800	276600	335300	316900	261200	64500	0	0	1895900
1991	0	0	57000	279800	306800	262700	345300	376900	269300	70000	0	0	1967800
1992	0	0	74400	271800	299900	201000	226600	251000	97300	0	0	0	1422000
1993	0	0	0	134900	270200	271100	249900	224800	57500	0	0	0	1208400
1994	0	0	96400	218900	81000	157000	205700	204800	49800	0	0	0	1013600
1995	0	0	72700	186600	230000	288000	352400	320500	256200	64100	0	0	1770500

ROZA IRRIGATION DISTRICT PUMPING PLANT #9 TABLE 6.10

Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	187400	360600	455000	489000	512500	323500	168600	0	0	2496600
1981	0	0	500	287000	445200	407100	496500	463200	395300	125000	0	0	2619800
1982	0	0	0	222300	483600	475900	485800	515400	338700	101700	0	0	2623400
1983	0	0	17400	180200	372300	470300	460300	395200	283700	115100	0	0	2294500
1984	0	0	21800	265100	444400	500400	482000	504500	329300	89100	0	0	2636600
1985	0	0	0	303200	465500	496500	494200	481400	256200	900	0	0	2497900
1986	0	0	28700	376000	484400	438400	469700	498200	258800	700	0	0	2554900
1987	0	0	42300	389500	471600	475000	484800	400900	155600	0	0	0	2419700
1988	0	0	314600	422500	443800	401700	472900	488400	372500	99300	0	0	3015700
1989	0	0	0	287100	454100	472600	523300	494900	408800	104200	0	0	2745000
1990	0	0	131600	426500	407600	462500	490800	509200	426500	-2900	0	0	2851800
1991	0	0	74800	413700	480500	470800	377100	513400	376600	157200	0	0	2864100
1992	0	0	124000	332400	442200	326900	342200	379200	139300	0	0	0	2086200
1993	0	0	100	196200	343200	308800	344300	420700	347700	41900	0	0	2002900
1994	0	0	140500	293300	92000	158700	307600	298200	72300	0	0	0	1362600
1995	0	0	86900	272100	334400	424100	523700	480400	340700	86100	0	0	2548400

ROZA IRRIGATION DISTRICT PUMPING PLANT #9A

Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	67200	315200	455000	419200	454400	174400	64000	0	0	1949400
1981	0	0	0	181600	294980	332420	296900	267000	260560	48000	0	0	1681460
1982	0	0	0	137300	378820	389040	271220	284000	212580	59680	0	0	1732640
1983	0	0	0	142031	390740	409000	300780	249100	218380	114640	0	0	1824671
1984	0	0	0	103500	357860	396640	367080	378020	227080	61600	0	0	1891780
1985	0	0	0	243640	385880	421820	373340	368140	194060	780	0	0	1987660
1986	0	0	4120	284460	267480	321100	360000	389200	213220	540	0	0	1840120
1987	0	0	0	28080	240800	384000	376860	366360	273640	115340	0	0	1785080
1988	0	0	152100	247100	315500	277120	279560	388820	336820	59980	0	0	2057000
1989	0	0	0	151260	369180	377100	428340	395840	295920	80220	0	0	2097860
1990	0	0	63040	279580	239080	349280	394800	329200	339920	87220	0	0	2082120
1991	0	0	43920	278360	365920	259840	393640	437960	327280	130980	0	0	2237900
1992	0	0	105020	294620	510160	278880	88180	271980	105340	0	0	0	1654180
1993	0	0	2800	516500	284400	130400	516300	402200	303400	36000	0	0	2192000
1994	0	0	70300	313360	93820	155320	211540	211480	53560	0	0	0	1109380
1995	0	0	84660	321880	390720	355100	239620	410840	352380	111780	0	0	2266980

ROZA IRRIGATION DISTRICT PUMPING PLANT #10

Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	50300	111700	125900	127300	126800	98000	55900	0	0	695900
1981	0	0	2400	73300	127500	117800	127900	125800	127600	34800	0	0	737100
1982	500	0	0	8100	155000	138400	130000	133500	94800	63500	0	0	723800
1983	1100	0	0	13400	92200	132600	119100	161500	113500	42000	0	0	675400
1984	0	500	0	40300	108500	138700	143900	136000	180000	74600	0	0	822500
1985	0	0	0	93300	130100	151900	153400	147100	78900	800	0	0	755500
1986	0	0	0	95000	100500	126900	125400	130800	68600	300	0	0	647500
1987	0	0	0	75800	125600	118400	124800	107200	44400	0	0	0	596200
1988	0	0	55000	70100	93400	94600	118600	125300	82800	35100	0	0	674900
1989	0	300	0	76400	130500	133800	138600	126700	64900	39000	0	0	710200
1990	0	0	36200	115500	121800	127800	138400	129700	69200	31800	0	0	770400
1991	0	0	0	93900	133500	102600	123600	141400	77600	52500	0	0	725100
1992	0	0	15300	100800	116200	95100	101600	112800	43800	0	0	0	585600
1993	0	0	400	52000	113400	106500	108700	103800	101800	10100	0	0	596700
1994	0	0	39200	106500	41100	49000	62300	60100	17800	0	0	0	376000
1995	0	0	0	77700	99800	118200	142600	128300	93100	31400	0	0	691100

ROZA IRRIGATION DISTRICT PUMPING PLANT #12 TABLE 6.10
Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	3700	50300	85000	96200	115900	175700	80000	47400	0	0	654200
1981	0	0	1400	42900	120900	120200	160500	167900	91300	3200	0	0	708300
1982	2800	0	1100	51400	111800	147500	120300	127000	92800	63500	0	0	718200
1983	5200	0	0	37600	102100	130800	117900	87900	93800	5300	0	0	580600
1984	0	5000	1900	14300	116700	122900	145200	161400	103900	50300	0	0	721600
1985	0	4400	1500	64700	136900	153100	183300	170300	98600	2500	0	0	815300
1986	0	7000	800	34500	104900	94600	136100	137000	75200	0	0	0	590100
1987	0	0	5200	63500	117700	140400	137400	147800	75300	0	0	0	687300
1988	0	0	61500	108400	86700	106700	119000	140200	94200	42700	0	0	759400
1989	0	6900	0	44500	97300	129900	146300	103400	110200	35700	0	0	674200
1990	0	6600	15100	67200	217900	31400	125200	118300	108200	35800	0	0	725700
1991	0	0	1500	54000	140900	95100	147200	148500	74900	42200	0	0	704300
1992	0	0	17500	58700	79700	58400	63500	71800	31700	0	0	0	381300
1993	0	0	7500	42700	42700	61000	69100	62200	45100	8600	0	0	338900
1994	0	0	9600	53500	26200	46900	62000	58800	16100	0	0	0	273100
1995	0	0	7200	35600	42500	79700	110600	100100	59000	12300	0	0	447000

ROZA IRRIGATION DISTRICT PUMPING PLANT #13
Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	163800	251900	318300	502200	508700	274500	158800	0	0	2178200
1981	0	0	0	150000	263800	260800	406700	485500	335200	100400	0	0	2002400
1982	0	0	0	127800	352200	367900	383400	414500	280700	91700	0	0	2018200
1983	0	0	600	42700	220400	370400	349100	364000	148500	204300	0	0	1700000
1984	0	10000	0	68900	275500	376900	397500	381200	270100	81600	0	0	1861700
1985	0	0	0	167000	343700	377600	466300	407100	211900	8600	0	0	1982200
1986	0	0	0	170600	278800	346400	388000	400500	175100	0	0	0	1759400
1987	0	0	7900	206800	370500	370000	385900	281100	129000	0	0	0	1751200
1988	0	0	136500	182000	278100	278000	355900	219100	369000	108600	0	0	1927200
1989	0	0	0	130000	296500	353200	489000	410700	298600	112500	0	0	2090500
1990	0	0	52600	266500	297900	361700	398700	329800	263300	116900	0	0	2087400
1991	0	0	0	161400	379900	271500	395800	435400	258200	176500	0	0	2078700
1992	0	0	24100	217800	337600	223300	223000	245400	105900	0	0	0	1377100
1993	0	0	0	59400	286900	276600	292200	280000	248300	37400	0	0	1480800
1994	0	0	57300	226600	107900	95300	351200	221100	63900	0	0	0	1123300
1995	0	0	0	96700	199700	299400	419700	349800	225500	72700	0	0	1663500

ROZA IRRIGATION DISTRICT PUMPING PLANT #14
Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	209400	310800	362400	590400	583700	295000	131100	0	0	2482800
1981	0	0	0	296700	393000	362300	539300	576400	332500	107800	0	0	2608000
1982	0	0	11300	176000	372500	471900	544700	488900	332700	161700	0	0	2559700
1983	0	0	40800	202000	367900	490400	432500	525200	399600	245400	0	0	2703800
1984	0	0	0	183700	416600	445700	581700	554100	411300	214800	0	0	2807900
1985	0	0	0	262000	540900	555800	619500	587100	211900	13300	0	0	2790500
1986	0	0	37900	306700	482500	551400	565400	574300	269000	0	0	0	2787200
1987	0	0	12100	315600	565300	534900	597400	438200	181400	0	0	0	2644900
1988	0	0	219100	363100	447000	456400	547700	551200	481100	263000	0	0	3328600
1989	0	0	0	237200	498700	525900	602200	539500	448000	225000	0	0	3076500
1990	0	0	96800	427100	505100	460700	545900	465400	384500	223200	0	0	3108700
1991	0	0	28000	338000	539900	384500	569500	596300	355800	281600	0	0	3093600
1992	0	0	91900	325000	499800	483300	533800	581800	254900	0	0	0	2770500
1993	0	0	100	189500	465500	425100	535500	510900	450900	84300	0	0	2661800
1994	0	0	128400	455600	190100	275600	355500	347400	92800	0	0	0	1845400
1995	0	0	77300	353100	417600	416000	617200	511900	460700	182600	0	0	3036400

ROZA IRRIGATION DISTRICT PUMPING PLANT #15 TABLE 6.10

Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	178000	555000	736000	982000	1129000	522000	408000	0	0	4510000
1981	0	0	0	290000	694000	679000	981000	902000	762000	356000	0	0	4664000
1982	0	0	3000	255000	658000	856000	889000	1000000	646000	309000	0	0	4616000
1983	0	0	12000	200000	764000	907000	769000	956000	650000	413000	0	0	4671000
1984	0	0	0	239000	594000	865000	1039000	1078000	774000	311000	0	0	4900000
1985	0	0	0	296000	873000	937000	1013000	981000	665000	3400	0	0	4768400
1986	0	0	11000	417000	665000	910000	940000	983000	456000	0	0	0	4382000
1987	0	0	10000	368000	870000	865000	1018000	862000	329000	0	0	0	4322000
1988	0	0	327000	486000	630000	677000	956000	933000	804000	444000	0	0	5257000
1989	0	0	0	319000	689000	891000	1028000	933000	787000	461000	0	0	5108000
1990	0	0	87000	528000	591000	817000	981000	834000	718000	327000	0	0	4883000
1991	0	0	40000	472000	837000	701000	1073000	1128000	673000	475000	0	0	5399000
1992	0	0	97000	461000	922000	440000	704000	825000	366000	0	0	0	3815000
1993	0	0	0	245000	695000	705000	831000	859000	813000	125000	0	0	4273000
1994	0	0	112000	695000	268000	398000	526000	549000	263000	0	0	0	2811000
1995	0	0	40000	227000	543000	839000	1138000	1015000	639000	267000	0	0	4708000

ROZA IRRIGATION DISTRICT SEVERYNS PUMPING PLANT

Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	5605	13613	18773	16682	19737	5826	7826	1	0	88063
1981	0	0	0	5188	15282	14628	16434	16131	14565	2752	0	0	84980
1982	0	0	0	9447	15723	14561	16326	18562	5703	2978	0	0	83300
1983	0	0	11003	18	1237	16673	16252	17089	9096	3669	0	0	75037
1984	0	0	0	13	11467	15919	16018	16977	12860	3976	0	0	77230
1985	0	0	0	10043	15119	16968	17523	18923	12845	682	0	0	92103
1986	0	0	0	9825	14707	13613	15029	16382	13400	0	0	0	82956
1987	0	0	2031	11557	15046	14412	16755	16270	8788	0	0	0	84859
1988	0	0	10310	14247	13741	11975	11555	16513	16801	8933	0	0	104075
1989	0	0	0	8077	14773	14349	17072	17156	16744	10365	0	0	98536
1990	0	0	1800	12291	9547	19163	6199	16321	15546	7700	0	0	88567
1991	0	0	0	2999	11132	11413	17252	19271	10558	10550	0	0	83175
1992	0	0	2084	3448	12421	12896	15850	6765	5723	0	0	0	59187
1993	0	0	0	930	12607	24330	6438	15520	15489	3367	0	0	78681
1994	0	0	454	8906	4791	11147	15510	14084	3873	0	0	0	58765
1995	0	0	22	3820	10455	13049	18371	16996	15268	8331	0	0	86312

ROZA IRRIGATION DISTRICT PUMPING PLANT #16

Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	133000	347000	354000	558000	652000	363000	189000	0	0	2596000
1981	0	0	0	223000	452000	373000	553000	614000	560000	227000	0	0	3002000
1982	0	0	0	142000	445000	515000	469000	632000	506000	237000	0	0	2946000
1983	0	0	13000	148000	394000	560000	517000	581000	425000	283000	0	0	2921000
1984	0	0	12000	175000	386000	414000	626000	604000	429000	167000	0	0	2813000
1985	0	0	0	231000	410000	510000	631000	612000	312000	2400	0	0	2708400
1986	0	0	15000	239000	329000	534000	578000	641000	291000	0	0	0	2627000
1987	0	0	35000	330000	533000	588000	627000	509000	191000	0	0	0	2813000
1988	0	0	178000	313000	354000	400000	566000	570000	524000	216000	0	0	3121000
1989	0	0	0	303000	454000	557000	630000	470000	443000	267000	0	0	3124000
1990	0	0	74000	409000	451000	480000	599000	462000	453000	170000	0	0	3098000
1991	0	0	39000	304000	403000	361000	611000	671000	366000	302000	0	0	3057000
1992	0	0	71000	295000	399000	379000	463000	737000	45000	0	0	0	2389000
1993	0	0	0	137000	366000	392000	440000	485000	479000	93000	0	0	2392000
1994	0	0	93000	315000	169000	276000	385000	360000	105000	0	0	0	1703000
1995	0	0	48000	240000	313000	391000	653000	601000	497000	166000	0	0	2909000

ROZA IRRIGATION DISTRICT PUMPING PLANT #17 TABLE 6.10

Power Usage in KW-Hours

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
1980	0	0	0	100	198400	216200	240800	291600	144500	120400	0	0	1212000
1981	0	0	0	136300	245400	227900	258600	277500	255400	24500	0	0	1425600
1982	0	0	0	19400	254900	248400	254600	286100	179800	142700	0	0	1385900
1983	0	0	0	32300	189700	256100	272000	246100	193500	164900	0	0	1354600
1984	0	0	0	67000	216100	242100	247300	261900	160000	120500	0	0	1314900
1985	0	0	0	61500	241500	248900	262000	271500	142300	7100	0	0	1234800
1986	0	0	0	62000	233900	233700	281100	302300	156100	400	0	0	1269500
1987	0	0	0	76400	294000	287100	306000	273100	142100	0	0	0	1378700
1988	0	0	93800	86500	169200	238800	250900	272900	279000	150400	0	0	1541500
1989	0	0	0	43600	234400	273900	303800	300200	220300	113000	0	0	1489200
1990	0	0	0	144100	271100	258900	299500	193000	162900	330100	0	0	1659600
1991	0	0	0	120800	281800	221100	289500	322000	215400	173200	0	0	1623800
1992	0	0	300	97500	270500	222300	238900	258100	117200	0	0	0	1204800
1993	0	0	100	34900	201500	116400	92000	98000	160200	46200	0	0	749300
1994	0	0	400	131000	35200	62200	85100	87700	27000	0	0	0	428600
1995	0	0	0	63200	237800	204700	308700	270100	204800	41400	0	0	1330700
AVG 17	0	0	5913	73538	223463	222419	249425	250756	172531	89675	0	0	1287719
MAX	0	0	93800	144100	294000	287100	308700	322000	279000	330100	0	0	1659600
MIN	0	0	0	100	35200	62200	85100	87700	27000	0	0	0	428600

ROZA IRRIGATION DISTRICT PUMPING PLANT POWER USEAGE
KW-Hours of Useage by Plant for Years 1980-90

	Plant #1	THP	Plant #2	Plant #3	Plant #4	Plant #5	Plant #6	Plant #7	Plant #8	Plant #9	Plant #9A	Plant #10	Plant #12	Plant #13	Plant #14	Plant #15	Severyns	Plant #16	Plant #17	TOTAL
1980	1484900	305400	3323000	3287000	777700	229400	381300	1261000	1470500	2496600	1949400	695900	654200	2178200	2482860	4510000	88063	2596000	1212000	31383363
1981	1482800	302200	3493000	3564000	881000	234200	387300	1194600	1702100	2619800	1681460	737100	708300	2002400	2608000	4664000	84980	3002000	1425600	32774840
1982	1433700	296000	3431000	3572000	775600	247100	339900	1234500	1640600	2623400	1732640	723800	718200	2018200	2559700	4616000	83300	2946000	1385900	32377540
1983	1416100	283400	3595000	3457000	793500	286400	369200	1162700	1514000	2294500	1824671	675400	580600	1700000	2703800	4671000	75037	2921000	1354600	31677908
1984	1412600	261200	3687000	3670000	835800	265900	365600	1161800	1546900	2636600	1891780	822500	721600	1861700	2807900	4900000	77230	2813000	1314900	33054010
1985	1425500	213190	3622000	3540000	803400	257700	366800	1168500	1697500	2497900	1987660	755500	815300	1982200	2790500	4768400	92103	2708400	1234800	32727353
1986	1388700	265564	2820000	3440000	773900	269100	360100	1123800	1765300	2554900	1840120	647500	590100	1759400	2787200	4382000	82956	2627000	1269500	30747140
1987	1298100	250056	3049000	2898000	831000	255200	306100	1042300	1659400	2419700	1785080	596200	687300	1751200	2644900	4322000	84859	2813000	1378700	30072095
1988	1505200	272109	3878000	3373000	745200	327200	460100	1183300	1819700	3015700	2057000	674900	759400	1927200	3328600	5257000	104075	3121000	1541500	35350184
1989	1593800	285961	3725000	3466000	823800	266200	387200	1067100	1834800	2745000	2097860	710200	674200	2090500	3076500	5108000	98536	3124000	1489200	34663857
1990	1594800	298256	3761000	3438000	744100	307100	400800	1171000	1895900	2851800	2082120	770400	725700	2087400	3108700	4883000	88567	3098000	1659600	34966243
1991	1565900	305085	3778000	3564000	858000	306400	404900	1349300	1967800	2864100	2237900	725100	704300	2078700	3093600	5399000	83175	3057000	1632800	35975060
1992	1207900	264403	3204000	3251000	717800	258300	333500	1078200	1422000	2086200	1654180	585600	381300	1377100	2770500	3815000	59187	2389000	1204800	28059970
1993	1104800	253651	3143000	2799000	781300	261200	330000	1055800	1208400	2002900	2192000	596700	338900	1480800	2661800	4273000	78681	2392000	749300	27703232
1994	850400	217707	1969200	1788000	398100	203700	269900	802100	1013600	1362600	1109380	376000	273100	1123300	1845400	2811000	58765	1703000	428600	18603852
1995	1505400	272773	3331000	3026000	841300	300700	389300	1231300	1770500	2548400	2266980	691100	447000	1663500	3036400	4708000	86312	2909000	1330700	32355665

TABLE 6.11

INCREASES IN POWER COSTS DUE TO REHABILITATION
(1992 DOLLARS)

YEAR BEGINNING	REREGULATION RESERVOIR WW #5	REREGULATION RESERVOIR WW #6	REREGULATION RESERVOIR WW #7	CANAL AUTO AND TELEMETRY	TOTAL INCREASE IN POWER COSTS
1992		3500			3500
1993		3500			3500
1994		3500	2000		5500
1995		3500	2000	200	5700
1996		3500	2000	200	5700
1997		3500	2000	400	5900
1998		3500	1750	400	5650
1999		3500	1750	600	5850
2000		3500	1750	600	5850
2001		3500	1750	800	6050
2002		3500	1750	800	6050
2003	10000	3500	1750	800	16050
2004	10000	3500	1750	1000	16250
2005	10000	3500	1750	1000	16250
2006	10000	3500	1750	1000	16250
2007	10000	3500	1750	1000	16250
2008	10000	3500	1750	1200	16450
2009	10000	3500	1750	1200	16450
2010	10000	3500	1750	1400	16650
2011	10000	3500	1750	1400	16650
2012	10000	3500	1750	1400	16650
2013	10000	3500	1750	1600	16850
2014	10000	3500	1750	1600	16850
2015	10000	3500	1750	1600	16850
2016	10000	3500	1750	1600	16850
2017	10000	3500	1750	1600	16850

TABLE 6.12

ROZA IRRIGATION DISTRICT -SUMMARY OF INCOME & EXPENSE - TABLE 7.1

INCOME	1993	1994	1995	1996	1997
ASSESSMENTS	3,313,209.48	3,926,538.06	4,540,119.32	4,544,954.62	4,904,795
USBR	502,858.06	536,717.89	404,288.70	453,945.57	450,000
INTEREST	63,836.21	102,453.23	169,651.11	188,777.10	211,000
RENTAL HOUSES	24,511.65	24,541.41	24,209.68	24,129.68	24,000
REFERENDUM 38	151,934.71	316,451.82	316,737.45	130,551.90	0
CENT. CLEAN WATER	34,812.32	71,423.19	0.00	0.00	0
LID GRANTS	0.00	24,672.90	0.00	0.00	0
MISCELLANEOUS	145,835.06	157,625.91	522,477.48	740,480.35	810,000
TOTAL INCOME	4,236,997.49	5,160,424.41	5,977,483.74	6,082,839.22	6,399,795
EXPENSES					
DISTRIBUTION FACILITIES	1,383,943.44	1,704,446.45	1,932,555.44	1,954,264.41	2,100,400
REIMBURSABLES	429,507.50	441,911.51	317,218.01	370,702.57	350,000
PROPERTY & EQUIPMENT	88,054.40	27,549.88	61,149.61	96,494.78	74,000
USBR - POWER	315,726.00	211,607.00	367,987.00	550,931.00	1,168,000
USBR CONTRACTS - OTHER	305,214.91	374,731.17	497,100.52	565,446.38	
ADMINISTRATION & PAYROLL	1,666,381.52	1,720,653.50	1,896,076.93	1,887,677.98	1,950,000
DEPRECIATION	70,219.93	153,667.43	155,974.57	170,852.22	200,000
BOJC					88,750
TOTAL EXPENSES	4,259,047.70	4,634,566.94	5,228,062.08	5,596,369.34	5,931,150
NET INCOME/LOSS	(22,050.21)	525,857.47	749,421.66	486,469.88	468,645

ROZA IRRIGATION DISTRICT - PROJECTED FINANCIAL STATEMENT - TABLE 7.2

INCOME	1998	1999	2000	2001	2002
ASSESSMENTS	5,616,000	6,048,000	6,480,000	6,912,000	7,344,000
USBR	450,000	450,000	450,000	450,000	450,000
INTEREST	220,000	225,000	225,000	225,000	225,000
RENTAL HOUSES	24,000	24,500	24,500	24,500	24,500
REFERENDUM 38	0	0	0	0	0
CENT. CLEAN WATER	0	0	0	0	0
LID GRANTS	0	0	0	0	0
MISCELLANEOUS	580,000	600,000	750,000	450,000	600,000
TOTAL INCOME	6,890,000	7,347,500	7,929,500	8,061,500	8,643,500
EXPENSES					
DISTRIBUTION FACILITIES	2,380,400	3,169,964	3,210,912	3,253,293	3,297,158
REIMBURSABLES	350,000	350,000	350,000	350,000	350,000
PROPERTY & EQUIPMENT	49,000	100,715	104,240	107,888	111,664
USBR - POWER	1,183,000	750,000	750,000	750,000	750,000
USBR CONTRACTS - OTHER					
ADMINISTRATION & PAYROL	2,000,000	2,070,000	2,142,450	2,217,436	2,295,046
DEPRECIATION	230,000	230,000	230,000	230,000	230,000
BOJC	185,164	200,000	250,000	250,000	250,000
TOTAL EXPENSES	6,377,564	6,870,679	7,037,602	7,158,617	7,283,868
NET INCOME/LOSS	512,436	476,821	891,898	902,883	1,359,632

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