Benchmarking of Flexibility and Needs

2004

Irrigation Districts

USBR Upper Columbia Area

on behalf of

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Upper Columbia Area
Water Conservation Office
Yakima, WA

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Executive Summary

ITRC interviewed irrigation district personnel from 25 agricultural districts in eastern Washington, northern Idaho and western Montana.

Data were analyzed to determine the degree of water delivery flexibility provided to farmers and the extent of existing and planned district modernization. This is the fourth such report the Irrigation Training and Research Center (ITRC) has published for irrigation districts in the western US. The first two evaluations were conducted on behalf of the Mid-Pacific Region of the US Bureau of Reclamation (USBR) and included California irrigation districts that had long-term federal contracts. The third report was prepared on behalf of the California Department of Water Resources (DWR) and did not include irrigation districts with long-term federal contracts. The first three evaluations were conducted in 1996, 2000 and 2002, respectively. All three reports can be downloaded from the ITRC's Reports web page (http://www.itrc.org/reports/reportsindex.html). This report was prepared on behalf of the USBR Yakima Office of Water Conservation, Upper Columbia Area of the Pacific Northwest Region and includes districts that receive at least some water from federal facilities.

The interview process identified a **strong perceived need** by the districts for more direct technical assistance and training. This perceived need is greater than what ITRC has seen in California irrigation districts. These needs varied by district and region. In addition to general support, some districts acknowledged interest in small, specialized training efforts customized for single or small groups of districts at local facilities. Interest is especially high for information about automation and Supervisory Control and Data Acquisition (SCADA) systems. The data also indicated that more Rapid Appraisal Process (RAP) visits are needed to determine possible physical and operational improvements (modernization and efficiency) for districts to accommodate the ever-changing needs of their consumers and the environment. Direct technical assistance to individual districts has been and will continue to be a key element of continuing success in modernization.

Other key items include:

1. Many of the districts, and their farmers, are heavily dependent upon electric power to convey and distribute irrigation water. Presently, the power rates are lower than in other areas of the West.
2. Irrigation district personnel, on the average, consider on-farm water usage/conservation to be beyond their scope of responsibility. This indicates that the "Bridging the Headgate" initiative by USBR and others may need more effort.
3. Although 24 of the 25 districts provide water on at least an "arranged" basis, there is still room for improvement of the water delivery flexibility provided to farmers. The overall Flexibility Index was 11.5 (max. possible = 15; min. possible = 3). This compares with an overall Flexibility Index of 10.9 for sixteen non-Federal irrigation districts ranked by ITRC in 2002, and an Index of 12.9 for 58 Federal irrigation districts ranked by ITRC in 2000.
4. Since 1995 the irrigation districts have made numerous improvements, including both software and hardware.

This report summarizes the results and provides brief comments on various aspects of those results.

Background

Purpose

In the summer of 2004, the Irrigation Training and Research Center (ITRC) of California Polytechnic State University, San Luis Obispo (Cal Poly) conducted interviews of selected irrigation districts within the Upper Columbia Area of the US Bureau of Reclamation (USBR), Pacific Northwest Region. This Benchmarking report is similar to three previous Benchmarking of Flexibility and Needs reports prepared over the past eight years by ITRC for the USBR Mid-Pacific Region and Department of Water Resources (DWR).

Key purposes of this project were to:

- Identify the extent of flexibility of water delivery presently offered by irrigation and water districts to farmers,
- Identify educational programs in which districts currently participate or have accomplished, and
- Identify improvements that can be made in regards to technology and water conservation, as well as what types of assistance districts will require in the future to make those improvements.

Evaluation

The evaluation questionnaire sent out to districts contained over 200 questions included in the following general categories:

- Information to describe the present status of water delivery flexibility offered by districts
- Specific district characteristics such as water reliability, water prices, various irrigation methods, water conservation programs, modernization, etc.
- Current and future district-sponsored programs
- Request for technical assistance
- Other district characteristics

The evaluation questions can be found in Appendix A.

District Selection

The USBR's Pacific Northwest Region delivers water to 175 irrigation districts in Washington, Oregon, Idaho, Montana and Wyoming. For this project, districts were interviewed in the Upper Columbia River Area of the Pacific Northwest Region. In order to provide an accurate representation of status and needs, districts were selected based on diversity in location, size, and delivery characteristics. A total of 25 districts with a total cropped acreage of approximately 782,464 acres were chosen for this evaluation. The area is characterized by a few districts with large irrigated acreages, and most districts with small acreages (Figure 1). Refer to Figure 2 for a map showing the location of the 25 districts.

State	No. of Districts	Total Acreage	Irrigated Acreage
Washington	21	1,300,718	757,983
Idaho	2	6,895	5,016
Montana	2	35,020	19,465
TOTAL	25	1,342,633	782,464

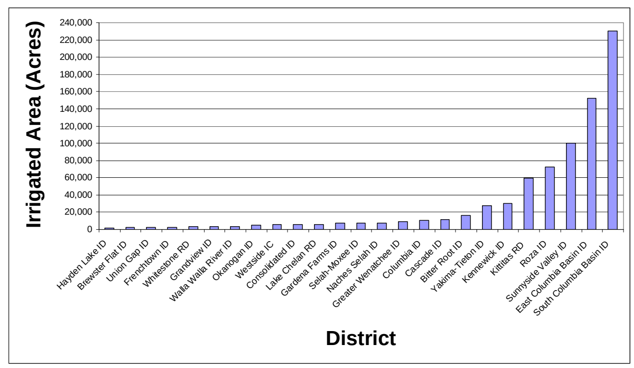

***Figure 1**. Irrigated Acreages of the Participating Districts.*

Interviews

Before conducting interviews, senior district personnel were contacted by phone call to explain the purpose of the project and invite their participation. The questionnaire was sent to each district via email prior to the interview.

Interviews consisted of an in-person meeting with district managers and/or other district personnel with a good understanding of district operations and plans. Districts were very cooperative and managers and engineers took valuable time to participate in a lengthy personal interview.

Feedback sections (questions of needs and opinions) of the questionnaire were well received by the interviewees. Persons interviewed were very willing to discuss their views, opinions, and interests.

Collection of data was completed in August of 2004.

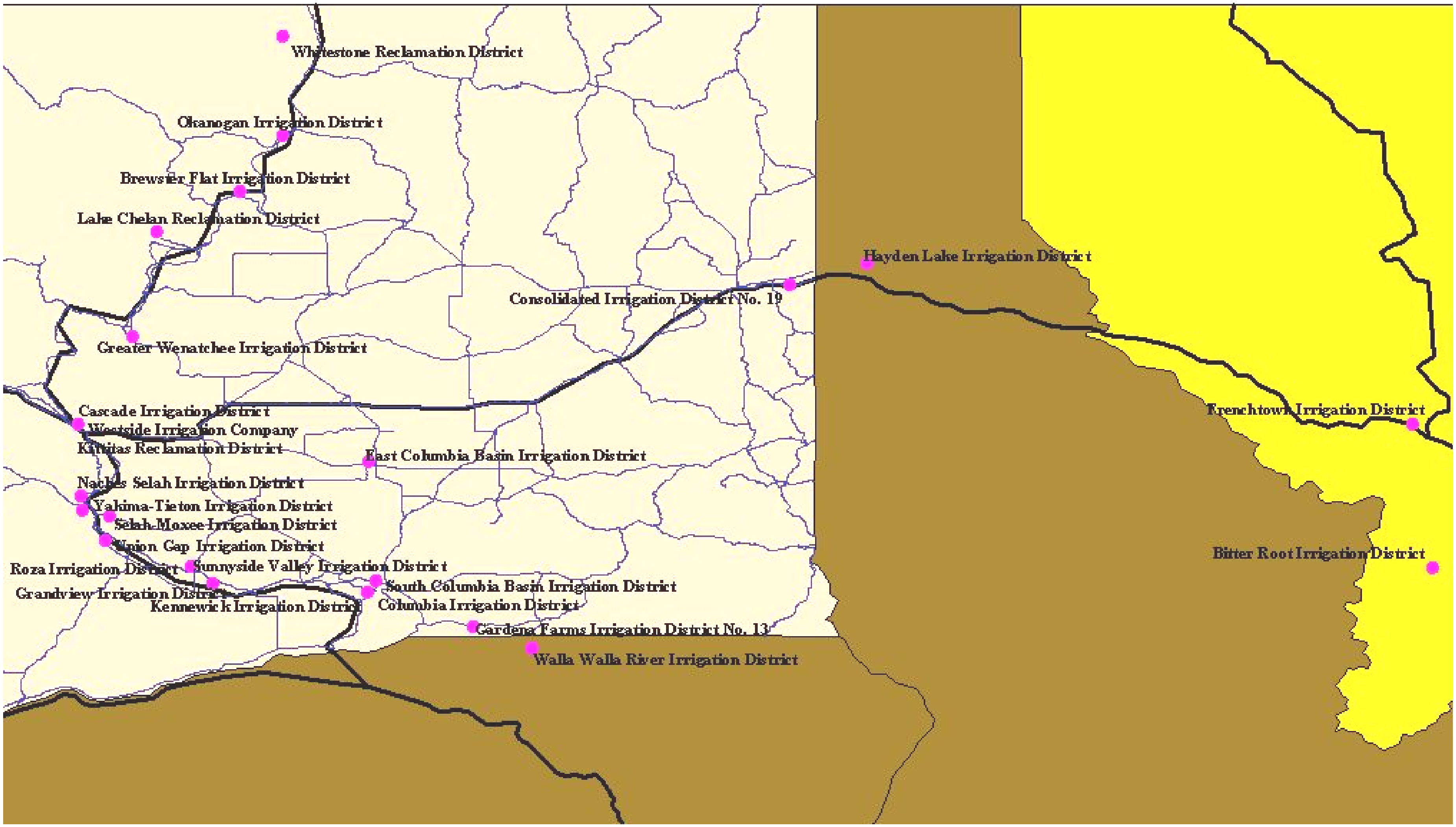

***Figure 2**. Map Showing the Locations of the 25 Districts Interviewed for this Report.*

District Flexibility

Introduction

Answers from the Benchmarking of Flexibility and Needs interviews were compiled to characterize the present status of districts as well as future needs for technical assistance.

The information in this section is provided by topic and describes the characteristics of districts and their customers. Significant figures vary throughout the report as the nature of data varies; the totals generally reflect reported totals, and are not rounded off.

Flexibility Indices

Urban homeowners are accustomed to receiving water from the tap "on demand" (i.e., without providing advance notice), with unlimited flexibility in frequency (when), duration (how long), and flow rate up to system capacity. In the Western US, most agricultural water users (i.e., farmers) receive water with a high degree of equity (not measured in project) and with much more flexibility than most of their counterparts in other areas of the world. Nevertheless, the flexibility of water deliveries for irrigation does not compare with the "demand" flexibility provided to homeowners.

Farmers are requesting more flexible deliveries, and the data show that the degree of water delivery flexibility is relatively high in many cases. As later sections of this report show, irrigation districts are implementing a wide range of measures to improve the level of service they provide to farmers. However, improvements are hindered by high initial costs, plus the lack of technical knowledge of engineering options related to water delivery control.

Frequency Flexibility

Advance ordering of water on an unlimited frequency schedule is utilized on the vast majority of acreage in interviewed districts (Table 1). For those farmers, the mean advance notice time was 15 hours and the mean number of times a farmer cannot get water on the requested day is less than twice per season.

Of all the districts interviewed, five use a strict fixed rotation (no trading turns) on a very limited percentage of their acreage – primarily in small homeowner areas. One small district uses a modified rotation during peak water use periods on all of its acreage.

***Table 1**. Common Characteristics of the Delivery Schedules*

Description	*(n = 25)*
Districts Reporting Fixed Rotation	5
Average Percent of these Districts' Acreage	5%
Acreage	15,230
Number of days between standard rotation	2
Districts Reporting Modified Rotation	1
Average Percent of these Districts' Acreage	100%
Acreage	7,000
Days of deviation from fixed rotation	3
Number of days between standard rotation	14
Hours of advance notice required	24
Districts Reporting Unlimited Frequency	24
Acreage	760,234
Average hours of advance notice required	15
Average number of times in a year a turnout cannot get water on the day requested	1.76

Flow Rate Flexibility

Over half of the districts interviewed reported a relatively high level of flexibility to their farmers. Sixteen districts have policies allowing farmers to receive different flow rates at each irrigation (Table 2). The remaining 9 districts, however, responded that farmers could not receive different flow rates for any irrigation (Table 2).

During an irrigation event, almost 80% of the districts have no restrictions on changing a flow rate (Table 3). Only 6 districts do not allow a flow rate change. Ten of the 19 districts that allow a flow rate change during an irrigation event require no advance notice, one district requires notice one hour in advance, and the remaining 8 districts require 24 hours advance notice (Table 4).

Table 2. *Flexibility of Delivery Flow Rate Selection at Each Event*

Response	Number of Responses *(n = 25)*
Essentially the same flow rate must be delivered for each irrigation	9
The farmer can request several different flow rates through the season	0
Can have different flow rates each irrigation	16

Table 3. *Flexibility of Changing Flow Rate Selection during an Event*

Response	Number of Responses *(n = 25)*
No change is allowed	6
One time	0
Two times	0
There are no restrictions	19

Table 4. *Advance Notice Required before a Flow Rate Change is made During an Event*

Response	*(n = 19)*
No advance notice required	10
1-hour advance notice required	1
24-hour advance notice required	8

Duration Flexibility

Duration flexibility is important for all forms of on-farm irrigation, but it can be very difficult for irrigation districts to allow farmers to shut water off unannounced or at odd times – canals and pipelines with conventional control hardware can overflow if this happens. Farmers would like more duration flexibility to reduce over-irrigation, and avoid unnecessarily high energy and water bills and deep percolation of water and nutrients. Drip and micro irrigation systems are easily automated to provide the correct amount of water to replace evapotranspiration (ET) plus losses due to evaporation and non-uniformity, so they are ideally suited for management with unlimited duration flexibility. As soil infiltration rates change throughout the season with surface irrigation, farmers rarely know exactly when they will complete an irrigation. Since an irrigation could be finished at any hour of the day or night, farmers can prevent over-irrigation if they can shut off their water with no advance notice.

Farmers are allowed to receive water for any duration in 15 districts. The remaining districts allow durations of some other fixed hourly increment for delivery (Table 5). All but two of those districts allow increments of 24 hours in duration. About half of the districts interviewed did not require advance notice to shut off water; all but one of those that do require 24 hours advance notice to shut off (Table 6).

Table 5. *Flexibility in Duration of an Irrigation Event*

Response	*(n = 25)*
Unlimited – any duration is allowed	15
12 hour increments	1
24 hour increments	8
Other fixed, district-determined increment	1

Table 6. *Advance Notice Required by the District before Farmers Can Shut Off Water*

Response	*(n = 25)*
No advance notice required	13
1-hour advance notice required	1
24-hour advance required	11

In order to achieve a high degree of flexibility in irrigation delivery duration, farmers ideally ought to be able to operate their own turnouts. If the district requires that a district employee operate the turnouts, the farmer's ability to automate an on-farm irrigation system disappears. Farm employees must wait until the ditchrider arrives to begin irrigation.

Many delivery canals and pipelines are not designed with adequate control systems to permit farmers to operate turnouts. Often, when one farmer makes a flow rate change, the ditchrider must move along the complete length of the supply canal or pipe to readjust the flows of other open turnouts.

On average, district personnel must be present to open and close farm turnouts 41% of the time (Table 7). It was found that district personnel operate gates within an average of less than one hour (Table 8). When there is not enough flow to match a water order, 14 districts pro-rate the order and 6 districts postpone the water delivery (Table 9).

Table 7. *Percentage of Time District Personnel Must Be Present to Open and Close Farm Turnout Gates*

(n = 25)

Number of districts responding 100%	7
Number of districts responding 0%	7
Average percentage of time in all districts that district personnel must be present to operate turnouts	41%

Table 8. *How Closely to the Prescribed Time Turnout Gates are Operated by District Personnel (n = 19)*

Average time (hours)	0.9

Table 9. *Procedure if There is Not Enough Capacity or Flow Availability to Match Turnout Order (n = 20)*

Pro-rate: farmers receive a portion of their order	14
Postpone: farmers must wait to receive any water delivery	6

Most irrigation districts have areas of their distribution system with limited capacity. When farmers request water orders, district personnel must check the pipeline/canal capacity to ensure there is enough capacity to supply that order without adversely affecting other users.

Flexibility Index (District Level)

The previously mentioned aspects of district delivery policies regarding frequency, flow rate and duration were indexed to quantify the degree of water delivery flexibility provided by each district. Each parameter (frequency, flow rate, and duration) has a rating from 1 – 5, with 5 as the most flexible score. The sum of these individual indices gives the "Flexibility Index," the highest possible score amounting to 15, and the lowest possible equaling 3. A district that allows farmers to obtain water "on demand" without providing advance notice to the district is the most flexible condition within the "Frequency Index" and is assigned a score of 5. A district that allows a farmer to change flow rates during an irrigation event without notifying the district has the most flexible condition within the "Flow Rate Index" and is assigned a score of 5. If no advance notice is required to alter the duration of an irrigation, thereby allowing farmers to receive water for any length of time, a score of 5 is assigned in the "Duration Index".

Guidelines for indexing flexibility outlined in the table below were developed to provide benchmarking that can be used in future evaluations to determine how district operations have changed and to compare districts with each other.

Table 10. *Definition of the Flexibility Index*

Points	Condition
	FREQUENCY
1	Always a fixed rotation
2	Fixed rotation with trading, or limited frequency, or fixed rotation during peak season only
3	More than 24 hours advance notice required before delivery is made
4	24 hours or less advance notice required before delivery
5	Farmer does not need to notify district before delivery
	FLOW RATE
1	Same flow rate must always be delivered
2	Several flow rates are allowed during the season
3	A different flow rate is available each irrigation, with up to 2 changes per irrigation allowed
4	Flow rate can be changed any time, provided advance notice is given to the district
5	Flow rates can be different and changed by the farmer without giving advance notice to the district.
	DURATION
1	District assigns a fixed duration of irrigation
2	District assigns a fixed duration, but allows some flexibility
3	Farmers must select a duration with a 24 hour increment; must give at least 24 hour notice before altering; and the district operates the gates ≥ 80% of the time
4	Farmers can choose any duration; must give at least 8 hours of notice before altering; and the district operates the gates < 80% of the time
5	Farmers can have any duration, with no advance notice required before changing

The average sub-index values for frequency, flow rate, and duration were 4.3, 3.0, and 4.2, respectively. The average total flexibility index (i.e., the sum of the frequency, flow rate, and duration indices) was 11.5 out of a possible 15 (Table 11). In each category, there were several districts achieving the highest rating (i.e., 5), indicating that some districts provide very flexible water supplies in terms of frequency, flow rate, or duration. Five districts scored top ratings in all three categories, and over half (13 out of 25) received a 5 in at least one category.

Table 11. *Average Flexibility Index Summary (n = 25)*

Parameter	Index
Frequency	4.3
Flow Rate	3.0
Duration	4.2
Flexibility Index	**11.5**

Table 12. *Flexibility Index Frequencies (n = 25)*

Flexibility Index	Number of Districts
<11	9
11-11.9	9
12-12.9	1
13-13.9	1
14-15	5

Flexibility Provided by District Supplier

Flexibility in water delivery provided to farmers is affected by the flexibility of water supplies provided to districts. District personnel were asked to characterize this flexibility.

Average required advance notice time prior to flow rate changes was 35 hours (Table 13). In some cases, the district is its own water supplier. These districts were left out of the average so that the result was not skewed. No district was required by its supplier to take water even though it did not have a demand.

Table 13. *Hours of Advance Notice Required of the District Supplier Before a Scheduled Flow Change Occurs (n = 17)*

Average	35

Correlating Flexibility with Various Indicators

One might assume that a high degree of flexibility in water delivery service is correlated with high water prices. But ITRC found no semblance of a correlation between flexibility and any of the following items:

- Estimated on-farm efficiency (although these were very rough estimates by district personnel)
- Design flow rate per acre
- Number of times that flexibility was a subject at board meetings
- The perception of the district personnel that farmers wanted more flexibility
- Water charges, $/acre.

What the lack of correlation does indicate is that modernization of irrigation districts requires a highly specialized program that addresses the specific hardware and software needs of each district.

The other conclusion by ITRC is that there is a wide mix of opinions among irrigation district personnel about the topic of flexibility, and related to their understanding of modernization needs. Figure 3 below shows that some personnel in districts with an average Flexibility Index (value = 11) believe that farmers want much better service (perceived need value = 9), whereas others see no farmer desire (perceived need value = 0).

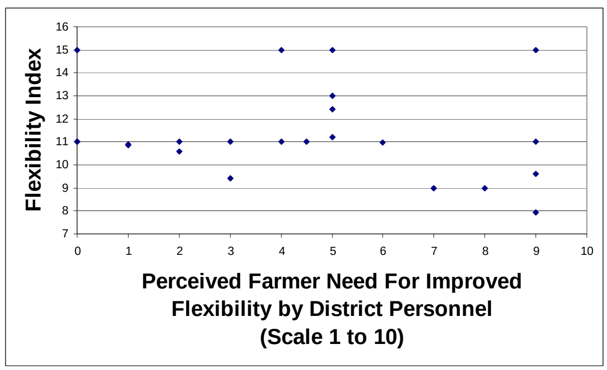

Figure 3. *Relationship between District Personnel Assessment of Farmer Desire, versus Flexibility Index.*

On-Farm Irrigation, Costs, and Pricing

On-Farm Methods

Degrees of supply flexibility required by farmers can be understood by recognizing the types of different irrigation methods utilized and the acreage associated with those methods. Over half of the total acreage represented by the project utilized some sort of sprinkler method. Surface methods (i.e., furrow, border strip or basin) irrigated one quarter of the total acreage. Drip/microspray irrigation, however, represented only 3.8% of the total irrigated acreage. The remaining acreage consisted of urban use or a combination of irrigation methods (i.e., hand-move sprinkler and furrow irrigation on row crops).

A large portion of districts interviewed do not track acreage by irrigation method; therefore some of the values in Table 14 were estimated by district representatives.

Table 14. *Estimated On-Farm Irrigation Methods Used within District Service Areas*

Irrigation Method	Total Acreage	Percent of Total
Furrow	177,212	22.6%
Border strip or basin	19,110	2.4%
Hand-move or side-roll sprinklers	75,398	9.6%
Center pivot *(mainly within 2 large districts)*	240,517	30.7%
Linear move	275	0.0%
Big gun – stationary	286	0.0%
Big gun – moving (traveler)	4,761	0.6%
Permanent sprinklers (trees or vines)	74,094	9.5%
Drip on row crops	15,642	2.0%
Microspray or drip on trees or vines	13,978	1.8%
Solid set sprinklers on row crops	40,040	5.1%
Combination	87,031	11.1%
Urban	*34,621*	*4.4%*
TOTAL	782,964	100.0%

Spills and Drainage

The questionnaire asked district personnel to estimate how much spill, tailwater and drainage had been recirculated over the past five years. Few of the districts interviewed responded that they had recycled their water. Only 5 districts recirculate their spill and drainage waters, and 7 recirculate tailwater and drainage (Table 15).

Table 15*. Recirculation of Spill and Drainage Water*

Response	Number of Districts *(n = 25)*
Districts recirculating spill and drainage water	5
Districts where farmers recirculate tailwater and drainage water	7

Power Costs

Throughout the districts interviewed, a total of 61 district well pumps were listed. Four districts reported that groundwater was pumped on their acreage. The majority of pumping is for surface water. The district values in Table 16 are somewhat skewed, because of the 19 districts reporting power costs, two districts (East Columbia Basin ID, and South Columbia Basin ID) use 90% of the total electricity.

However, Table 14 indicates that the majority of the farm irrigation systems are pressurized. Table 16 shows a rough approximation of the power utilized on-farm – which is additional to the district-level power.

Table 16. *District Power Costs*

Number of districts pumping groundwater	4
Total number of district well pumps*	61
Total number of other district pumps	360
Total kW-hr used per year by districts (not including farms)	1,571,000,000
Approximate kW-hr used per year for on-farm pumping	360,000,000
Average power rate ($/kW-hr) (weighted by kW-hr of consumption) paid by districts	$.0014

* Includes only groundwater pumps owned by the district.

Water Pricing

A fixed pricing structure is employed in the vast majority of districts (20 districts), whereas only one district varies prices by acre depending on the crop type (Table 17). The average water cost for fixed price water was $10.18 per acre-ft and ranged from $1.37 – 45.53 per acre-ft (Table 18). Normalized water prices are summarized in Table 19 using five-year historical deliveries.

Only four of the interviewed districts charge for water on a volumetric basis (Table 17). All four districts reported using a "tiered" pricing structure. Tiered pricing means that the district charges a different price for water depending either on: (i) the amount used (for example, a district could charge one price per acre-ft for the first 3 feet of water used by the water user and another price for each additional acre-ft), or (ii) the district charges one price for each acre-ft of water used in one area of the district and another price in a different area of the district (for example, in one area of the district the water does not have to be lifted using booster pumps, therefore the water is less expensive compared to other areas where water has to be lifted). The mean price for tiered water was $46.35 per acre-foot (Table 19) – more than four times higher than for the fixed price water.

Table 17. *Water Pricing Policies (n = 25)*

Method of Water Pricing	Number of Districts	Acreage
Volumetric ($/AF)		
Tiered	4	47,071
Fixed price per acre ($/acre)		
Price varies by crop	1	152,000
Price does not vary by crop	20	555,493

Table 18. *Water Prices per Acre-Foot* ($/AF)*

Method of Water Pricing	Mean Price	Min. Price	Max. Price
Volumetric	$46.35	$31.00	$82.75
Fixed price per acre	$10.18	$1.37	$45.53

* Based on current price structure and approximate historical five-year deliveries (*n=25*). Includes standby and service charges. Mean prices are weighted by acre-feet.

Table 19. *Water Prices per Acre* ($/acre)*

Method of Water Pricing	Mean Price	Min Price	Max Price
Volumetric	$176	$92	$371
Fixed price per acre	$49	$15	$120

* Based on current price structure and approximate historical five-year deliveries (*n=25*). Includes standby and service charges. Mean prices are weighted by acre-feet.

Delivered Water

The water supply available to the districts is highly variable, by both district and year. Districts that experience wide fluctuations in water supply view groundwater recharge as a major concern, and their policies usually emphasize recharge during wet years rather than flexible deliveries during average or dry years.

On (weighted) average, districts had 5.04 acre-ft per acre per year gross water available for deliveries during the last five years (Table 20). These values include both surface and groundwater supplied by the district.

Table 20. *Average Gross Surface Water Available for Delivery during the Last Five Years (AF/acre/ year) (n = 23)*

Unweighted average	5.15
Weighted average (by irrigated acres)	5.04
Maximum	10.98
Minimum	1.54
Standard Deviation	2.53

Facilities - Present and Future

Regulating Reservoirs

Turnouts with privately owned reservoirs occur in 19 of the districts included in the project. Fourteen of those districts have such reservoirs on fewer than 25% of their total turnouts (Table 21). This information suggests that few farmers have the ability to store surface deliveries (i.e., they must irrigate when they receive water from the district, regardless of whether it is the best time to irrigate). Limited flexibility in deliveries, combined with little to no on-farm storage, will impact a farmer's options for maximizing on-farm water management with sophisticated irrigation systems. In areas with excellent delivery flexibility, reservoirs may still be needed to remove silt from water (for drip systems) or for farmers to take advantage of time-of-use (TOU) electric power rates.

Table 21. *Turnouts Equipped with Farmer Owned Reservoirs*

Percentage of Total Turnouts with Farmer-Owned Reservoirs	Number of Districts (*n = 19*)
<5%	3
5% - 25%	11
25% - 50%	5
50% - 75%	0
>75%	0

Water Conveyance and Delivery Systems

District personnel were asked for estimates of their average conveyance efficiency as well as average on-farm efficiency in their districts. As seen in Table 22, the estimates are 78% and 69%, respectively.

Districts were also asked about the characteristics of their delivery systems, particularly in regards to the amount of time the systems are at capacity (maximum flow rate). Table 23 shows that capacity problems occur relatively frequently.

Table 22. District Estimated Average Conveyance and On-Farm Efficiencies

Response	Efficiency (%) (*n = 24*)
Estimate average conveyance efficiency	78
Estimate average on-farm efficiency	69

Table 23. *Percentage of Time Flow Rate is at Maximum Capacity in Distribution Systems*

Percentage of Time the Flow Rate is at Maximum Capacity	Number of Districts (*n = 25*)	
	Mains	Laterals
0%	4	5
1 - 25%	7	6
26 – 50%	11	10
51 – 75%	1	0
76 – 100%	2	2
Average Percentage	**28%**	**27%**

Flow Measurement

The average capacity for district turnouts is 9.4 GPM per acre, and each turnout supplies on average about two fields (Table 24). It takes an average of 22.8 hours for a flow change to move from the turnout to the farthest point in the district. Out of the districts interviewed, only two reported an average of more than one canal or pipeline break per year.

Table 24. *District Hardware (n = 24)*

Average turnout design capacity (GPM/acre)	9.4
Average number of fields supplied by one turnout	2.2
Percentage of turnouts operators can easily drive up to	92
Average time required to move a change in flow from the source to the most distant location in the district (hours)	23
Average number of canal and/or pipeline breaks occurring per year per district	0.7

The types of flow measurement devices currently in use are depicted in Table 25. Of the turnouts that did have flow meters, weirs or flumes were the most common, and pipeline propeller meters were the second most commonly used flow measurement devices. Amco-type metering gates and canal propeller meters were the least-used turnout measurement devices. Most of the districts use more than one type of measurement device.

Many flow rate measurement devices do not totalize the volume that has passed through a turnout. Instead, the standard procedure is to assume that once a turnout has been adjusted for the desired flow rate, that flow rate will remain constant, and then the volume can be computed (Volume = Flow Rate x Time). In fact, flow rates can change if water levels (or pressures) change either upstream or downstream of the turnout, as often happens. Turnouts with a low head (a small difference in water level on both sides of a turnout) are sensitive to slight water level fluctuations on either side of the turnout.

Turnout flow rate changes over time present three problems: (1) the farmer has difficulty managing a constantly changing water supply, (2) irrigation district personnel are reluctant to allow farmers to make flow rate alterations since those changes can upset the previously adjusted flows of other users, and (3) a farmer may receive more or less water than estimated (although these differences tend to even out with time).

Potential solutions include new turnout designs and better control of water levels or pressures in irrigation district distribution canals or pipelines. ITRC continues to work with districts and others to seek proper solutions for individual cases.

Anticipated Physical Infrastructure Changes

Modernization of water control and water delivery flexibility is closely related to improvements in physical infrastructure. A portion of the evaluation was dedicated to determining what types of structures and control systems are currently in place. Furthermore, questions were asked regarding spending in the immediate future on various physical infrastructure needs. Districts were also asked whether they were interested in obtaining more information on such improvements. The results are recorded in Table 26.

Table 25. *Type of Turnout Flow Measurement Devices*

Turnout Flow Measurement Device	Total # of Turnouts with Device	Percent of Total Customers	Number of Districts
No flow measurement device	2,099	6.5	13
Undershot orifice (slide gate)	107	0.3	3
Weir or flume device without a totalizer	4,646	14.4	6
Weir or flume in a box after a pipe discharge	4,727	14.6	7
Propeller meters (canal)	125	0.4	2
Propeller meters (pipeline)	3,463	10.7	11
CHO	320	1.0	2
Municipal positive displacement and multi-jet	8,800	27.3	2
Flow control valves	2,205	6.8	2
Sprinkler count or size of valves	1,426	4.4	2
Other misc., including orifice plate	4,358 (approx.)	13.5	12 (approx.)
Total	32,276	100.0%	

Table 26. *Present Physical Infrastructures and Anticipated Changes in the Near Future*

Item	Total Quantities Present in 1995	Total Quantities Added Since 1995	Additional Quantities Planned Before 2006	Number of Districts Interested in Additional Information
Special pipeline devices				
Water hammer prevention devices	844	759	105	13
Pressure regulators at farm turnouts	302	30	0	10
Flow control devices at farm turnouts	2866	302	190	16
Special control devices on canals				
Regulating reservoirs	7	14	11	11
Lateral interceptors	3	0	2	6
Flow measurement devices in canals				
Weir/flume, flow rate only	1352	18	36	10
Weir/flume, totalized	4	17	20	10
Other, totalized	5	1	0	7
No device, but gate rating tables	1231	38	9	4
Local water level automation – upstream control				
Computerized	46	31	22	11
Long crested weirs	4	19	4	13
ITRC flap gate	0	0	0	13
Other	0	6	2	1
Local water level automation – downstream control				
Hydraulic gates	5	0	0	11
Computerized	1	7	5	12
Other	0	0	0	0
SCADA Systems				
Remote monitoring package for the main office	6	9	4	9
Remote monitoring at spill sites	4	17	7	10
Remote monitoring at other locations	35	64	24	15
Network for SCADA communications	6	9	2	10
Alarms (phone, beeper) on sites	98	28	21	14
SCADA – Automated/remote flow rate control				
On check structures along the canal	1	53	18	11
On pumps	9	27	12	10
Radios/cellular phones for ditchriders.	150	70	1	3

Table 26. *Present Physical Infrastructures and Anticipated Changes in the Near Future (continued)*

Item	Total Quantities Present in 1995	Total Quantities Added Since 1995	Additional Quantities Planned Between 2004-2006	Number of Districts Interested in Additional Information
Miscellaneous				
Hand-held data recorders with download software	22	25	8	14
Field data management software	1	8	2	15
Water ordering software	2	4	1	14
Billing software	2	8	1	12
Total canals (miles)	1217	0	0	1
Lined canals (miles)	491	27	7	8
Pipelines (miles)	1553	195	32	7
Recirculation of district spill/drainage (# of sites)	15	2	1	5
Recirculation of on-farm spill/drainage by district (# of sites)	603	3	2	6
Propeller meters at turnouts	2464	1192	224	9
Propeller meters in district main or lateral pipelines (not turnouts)	55	58	8	8
Magmeters, ultrasonic, etc. devices in district main or lateral pipelines (not turnouts)	1	29	49	11
Lift stations to canals or booster pumps to pipelines	251	101	23	9
Automation on pump lift stations (into canals)	2	0	0	10
Automation on lift/booster stations for pipelines	10	22	15	13
Variable Frequency Drives on pumps for pipelines	9	43	29	12
Variable Frequency Drives (or other adjustable speed drives) on pumps for canals	3	4	50	9
Other physical improvements	1	1	0	0

Management Perceptions

It may be helpful to note some perceptions of the management level district personnel who assisted in providing the project information. The answers noted in these tables were often given "off-the-cuff" and may not reflect official district policy.

Flexibility

The majority of management personnel interviewed believes that there is some need to improve the current flexibility in the delivery system (Table 27). Nine of the responding persons prefer to improve district flexibility with structures only. The majority of districts are in favor of a combination of new hardware and management concepts (Table 28). However, it was also reported that in almost 50% of the districts, district flexibility has been addressed at board meetings on fewer than six occasions (Table 29) during the last 5 years. Overall, nearly half of the managers believe that farmers do not have an immediate desire for improved district flexibility (Table 30).

Table 27. *Rating by Senior Personnel of the Need to Improve Flexibility of the Present Delivery System*

Response Rating of 0 to 9 (9 = very important)	**Number of Responses** *(n = 25)*
0 – 3	9
4 – 6	7
7 – 9	9
Average	**4.7**

Table 28. *Senior Personnel Preference of Means to Improve Flexibility*

Response	**Number of Responses** *(n = 24)*
Improve district flexibility with new structures	9
Improve flexibility with new management concepts and limited new hardware	1
Combination	14

Table 29. *Number of Times during the Last Five Years the Subject of Improving District Delivery Flexibility has been Addressed at Board Meetings*

Response	**Number of Responses** *(n = 25)*
0 – 5	12
6 – 10	3
11 – 15	1
> 15	9
Average	**12.8**

Table 30. *Senior Personnel Rating of the Average Farmer's Desire for Improving District Flexibility*

Response Rating of 0 to 9 (9 = very important)	**Number of Responses** *(n = 25)*
0 – 3	11
4 – 6	8
7 – 9	6
Average	**4.1**

Functions

Groundwater recharge is not considered a major district function by over 90% of the managers. In addition, in almost all cases, managers responded that canal seepage and on-farm deep percolation are not beneficial uses of water (Tables 31 to 33).

Table 31. *Is Groundwater Recharge a Major Function of the District?*

Response	**Number of Responses** *(n = 25)*
Yes	2
No	23

***Table 32.** Is Canal Seepage Considered a Beneficial Use of Water?*

Response	Number of Responses *(n = 25)*
Yes	5
No	14
N/A	6

***Table 33.** Is On-farm Deep Percolation Considered a Beneficial Use of Water?*

Response	Number of Responses *(n = 25)*
Definitely yes	4
Possibly	7
Probably not	9
Definitely not	4
Do not know	1

Water "Conservation" Potential

Water conservation, as it pertains to this report, is a reduction in water delivered to the district at the districts' diversion point(s). It does not represent a reduction in consumptive use (i.e. evaporation, transpiration, and non-beneficial losses to a salt sink).

Managers believe, on (weighted) average, that district deliveries could be reduced by as much as 23,677 acre-ft during a normal year. However, ten districts observed no potential for reduced water deliveries during a normal year (Table 34). Four of the districts believe they might transfer or sell the conserved water (Table 35). In addition, two of the districts would expand their service area or irrigated area. From the four districts that pump groundwater, two believe that there is no potential to reduce groundwater pumping during a normal year, and two believe there is no potential for reduction during a dry year (Table 36).

In view of the fact that the districts may experience a wide range of water supplies, depending upon the weather, questions were asked for both average years and dry years.

***Table 34.** Manager Estimate of Potential Reduction of District Deliveries (AF/year) (n = 25)*

Statistic	Avg. Year	Dry Year
Number of districts responding "0"	10	14
Unweighted Average	7,694	2,673
Weighted Average	23,677	3,979

***Table 35.** Potential Use of Reduced Diversions*

Response	Number of Responses *(n = 22)*
Expand service area/irrigated area	2
Groundwater recharge	0
Transfer/sell	4
Nothing	6
Other	10

***Table 36.** Potential for Reducing Groundwater Pumping in the District (n = 4)*

Statistic	Avg. Year	Dry Year
Number of districts responding "0"	2	2
Unweighted Average	35%	2%
Weighted Average	2%	1%

District Identification of Desired Technical Assistance

One of the purposes of the evaluation was to assess districts' needs with regards to technical assistance programs. The questionnaire contained not only specific questions about the types of short courses and hardware items, but also questions regarding special assistance from ITRC. The questions were often answered informally by district managers and are listed in Tables 37 and 38. Districts indicated a very strong need for irrigation short courses for staff. Technical assistance from ITRC in the areas of Supervisory Control and Data Acquisition (SCADA) systems, remote monitoring, water measurement, gate automation, and ET scheduling proved to be the most popular interests.

Table 37. *Current and Future District Programs*

Item	Number of Districts Active in these Programs	Number of Districts Planning to be Active in these Programs Before 2006	Number of Districts Interested in Further Information
On-Farm Improvements			
Low interest loans	3	3	12
Mobile Labs	2	2	13
Irrigation Evaluations	4	4	14
Other	4	4	2
Water Delivery Service			
Allow earlier shutoff of water	14	14	3
Reduce carry-overs	2	2	1
Education			
District Newsletter	18	19	16
Seminars/training for the staff			
Water measurement	14	10	16
SCADA	10	9	19
Automation	13	10	19
On-farm irrigation	4	5	14
Other	8	6	6
Short courses for water users			
Irrigator classes	1	1	12
Irrigation scheduling	4	3	14
Salinity	0	0	9
Drainage	0	0	10
Specific irrigation methods	2	2	14
Other	1	1	2
ET scheduling information for water users	3	3	15

***Table 38**. Specific Requests for Technical Assistance*

District Defined Need	Number of Interested Districts
Education assistance	
Staff short courses	15
GIS-GPS short course	4
Short course on pipeline hydraulics	1
Continuing education required for water distribution and water treatment	2
Water conservation coordinator workshop	2
Short course for operators in flow measurement	6
Educating districts on water saving technology via newsletter, e-mail, etc.	1
On-farm assistance	
On site Irrigator/Farmer short courses	1
District infrastructure	
Tour/review district and offer improvement options or review projects or designs and offer opinions about the concept and functionality	4
Prioritizing the repair/replacement system maintenance projects	1
Assistance engineering from open channel to conduit system	3
Engineering feasibility	1
Designing and implementing a SCADA system	3
Design and installation of VFDs	5
Designing and implementing long crested weirs	1
Automatic upstream control gates	1
Canal or pipeline system modifications/consolidation	2
Assistance planning and coordinating upgrades & projects	3
SCADA systems/enhancements/assistance	11
Remote monitoring	6
Flowmeter replacement and/or calibration	2
Options and funding for lining canals	3
Weir/flume design and or best installation location	5
Identifying best flow measurement device for a given situation	3
Design and implementation of a water hammer prevention device for a large pipeline	1
Developing solutions to flow meter problems	3
Pump efficiency testing	1
Assistance with urban pressures, management and service	1
Automating/modernizing check structures & pumps stations	8
Other	
CAD programming	1
Help with water management plan	1
Help locating an engineer to get projects started	1
Locating or installing a local weather station for ET values	2
GIS assistance	3
Groundwater movement and management	1
Conduct a water balance	3
Need assistance settling the district's water right	1
Data management software implementation	1
Grant writing	3
Funding	9
AgroMet station in district	1

Observations and Conclusions

Twenty-five water agencies were interviewed in eastern Washington, northern Idaho and western Montana. Together these districts comprised approximately 782,000 acres of irrigated cropland. Each of the districts obtains at least some federal water, and the obtained data was used to characterize the Status and Needs of this category of districts.

Observations

Some key observations of the data presented in this report include the following:

1. Reservoirs within the district distribution system are perceived as being able to improve flexibility of water delivery. Districts report the planning of an additional 11 regulating reservoirs in their distribution systems (Table 26), indicating a movement towards increased district flexibility and improved water management efforts.
2. Some districts reported having significant capacity problems during peak flow rate periods (Table 23). Enhanced water level and pressure control systems would allow them to safely increase their capacities.
3. Irrigation district personnel manually open and close turnouts in a majority of the districts (Table 7). In addition, they arrive at the turnouts within approximately one hour of their designated time (Table 8). This is a constraint on improved, automatic on-farm irrigation.
4. Irrigation district personnel, on the average, do not associate on-farm irrigation problems and programs as falling within the realm of irrigation district responsibility. 36% of district senior personnel have a low interest level in further improving flexibility (Table 27).
5. Forty percent of the districts believe that improved water management will not decrease demand during a normal water year. Fifty-six percent of the districts believe that district deliveries cannot be reduced during a dry year (Table 34).
6. The weighted average gross surface water supply available to users is 5 acre-ft per acre per year over the last five years (Table 20).
7. District managers have a high level of interest in technical assistance and information from ITRC in the areas of remote monitoring, Supervisory Control and Data Acquisition (SCADA), gate automation, water measurement, ET scheduling, and short courses for district staff (Table 37).
8. Irrigation in this area is heavily dependent upon electric power – both for conveyance and for ultimate on-farm application

Conclusions

1. ITRC believes that districts have made notable improvements in modernization and in providing flexible water deliveries since 1995. However, significant challenges remain to improve flexibility even more, as farmers rapidly shift toward more advanced and improved on-farm irrigation management.
2. There is a strong, expressed demand for more technical assistance.
3. This project revealed a need for specialized, regional training and assistance courses. Many short classes (one-half day to two full days) at the districts will be needed to properly address technical issues.

5. Integrated automatic control systems will need to be installed to improve the level of service provided by the district. This appears to be the major interest of districts interviewed (Tables 37 and 38).
6. The majority of irrigation districts and acreage still charge a flat rate per acre for water, rather than charging volumetrically. In general, ITRC has observed that volumetric charges require an improvement of water delivery service so that the limited water can be utilized as well as possible by the farmer.
7. The link between farm irrigation and district operations, and the impacts on power consumption, diversions, flow rate capacity problems, etc., do not appear to be adequately recognized. This was the case in the Mid-Pacific Region in the early 1990's, and the attitude has since changed drastically. However, to change the attitude, the USBR will probably need to increase its effort and funding for programs that establish this link. Modernization with the goal of improving flexibility is a major component of the linkage.

Appendix A

Benchmarking Questionnaire

District Name:____

Section 1. Please answer in the space provided or on additional paper as needed.

What can the USBR technical assistance program do to help improve your water management efforts?

What examples of recent water (or energy) conservation or modernization have you implemented and would like to publicize? We may be able to help you promote your successful efforts.

Are ITRC and USBR allowed to publicize these recent efforts? (Yes/No):

____

Section 2	**Had as of 1995 (Y/N)**	**Participated in or Accomplished since 1995 (Y/N)**	**Planned Participation Before 2006 (Y/N)**	**Want more information? (Y/N)**
CURRENT AND FUTURE PROGRAMS				
On-Farm Improvements				
Low interest loans				
Mobile Labs				
Irrigation Evaluations				
Other				
Other				
Water Delivery Service				
Allow earlier shutoff of water Explanation: ________________________________				
Reduce carry-overs Explanation: ________________________________				
Other				
Other				
Education				
District Newsletter				
Seminars/training for the staff				
Water measurement				
SCADA				
Automation				
On-farm irrigation				
Other ______________________________				
Other ______________________________				
Short courses for water users				
Irrigator classes				
Irrigation scheduling				
Salinity				
Drainage				
Specific irrigation methods ____________				
Other ____________________________				
Other ____________________________				
ET scheduling information for water users				
Other __________________________________				
Other ________________________________				

Section 3 – Hardware and misc.		
What is the average turnout capacity, in GPM per acre?		GPM/acre
How many fields are supplied by one turnout (on the average)?		#
Operators can easily drive up to what percentage of the farmer turnouts?		#
How many hours are required to move a change in flow from the source to the most distant location in the district?		hours
How many canal breaks occur per year?		#

	Quantities as of 1995 (#)	**Quantities Added Since 1995 (#)**	**Quantities Planned for Addition Before 2006 (#)**	**Want more information? (Y/N)**
CURRENT AND FUTURE <u>PIPELINE</u> IMPROVEMENTS				
*Please answer these questions for the following **<u>PIPELINE</u>** devices*				
Water hammer prevention devices				
Pressure regulators at farm turnouts				
Flow control devices at farm turnouts				

Section 3 – Hardware.	**Quantities as of 1995 (#)**	**Quantities Added Since 1995 (#)**	**Quantities Planned for Addition Before 2006 (#)**	**Want more information? (Y/N)**
CURRENT AND FUTURE CANAL IMPROVEMENTS				
*Please answer these questions for the following **CANAL** devices*				
Regulating reservoirs				
Lateral interceptors				
Flow measurement devices in the canals (such as at the head of a canal or lateral; not for turnouts)				
Weir/flume, flow rate only				
Weir/flume, totalized				
Other, totalized				
No device, but gate rating tables				
Local water level automation - upstream control				
Computerized				
Long crested weirs				
ITRC flap gate				
Other ____________________				
Local water level automation - downstream control				
Hydraulic				
Computerized				
Other ______________________				
Other ______________________				
SCADA Systems				
Remote monitoring package for the main office				
Remote monitoring for _________ spill sites				
Remote monitoring for _________ other locations				

Section 3- Hardware (continued)	**Quantities as of 1995 (#)**	**Quantities Added Since 1995 (#)**	**Quantities Planned for Addition Before 2006 (#)**	**Want more information? (Y/N)**
SCADA Systems (Continued)				
Automated/remote flow rate control				
On check structures along the canal				
On Pumps				
Network for SCADA communications				
Alarms (phone, beeper) for __________ sites				
Radios/cellular phones for ditchriders				
Miscellaneous				
Hand held data recorders with download software				
Field Data management software				
Stock program name: _____________________				
Custom program name and point of contact: ______________________________				
In-house program name and point of contact: _______________________________ __________				
Water ordering software				
Program name and point of contact: _____________________________________ ___				
Billing software				
Program name and point of contact _____________________________________ ___				
Unlined canals (miles)				
Lined canals (miles)				
Pipelines (miles)				
Recirculation of district spill/drainage (# of sites)				
Recirculation of on-farm spill/drainage by district (# of sites)				

Section 3- Hardware (continued)	**Quantities as of 1995 (#)**	**Quantities Added Since 1995 (#)**	**Quantities Planned for Addition Before 2006 (#)**	**Want more information? (Y/N)**
Propeller meters at turnouts				
Propeller meters in district main or lateral pipelines (not turnouts)				
Magmeters, ultrasonic, etc. devices in district main or lateral pipelines (not turnouts)				
Lift stations to canals or booster pumps to pipelines				
Automation on pump lift stations (into canals) Explanation ______________________________				
Automation on lift/booster stations for pipelines				
Variable Frequency Drives on pumps for pipelines				
Variable Frequency Drives (or other adjustable speed drives) on pumps for canals				
Other physical ____________________________				

Section 4. General Data, Water Delivery Service	**Answer**	**Units**
GENERAL DISTRICT CHARACTERISTICS		
What is the acreage used by the following irrigation methods? a. furrow		ac
b. border strip or basin		ac
c. hand move or side roll sprinklers		ac
d. center pivot		ac
e. linear move		ac
f. Big gun – stationary		ac
g. Big gun – moving (traveler)		ac
h. permanent sprinklers (trees or vines)		ac
i. drip on row (produce, etc.) crops		ac
j. microspray or drip on trees or vines		ac
k. solid set sprinklers on row crop		ac
l. combination		ac
RESERVOIRS		
What percentage of turnouts are equipped with farmer owned reservoirs?		%

Section 4. General Data, Water Delivery Service (cont.)	Answer	Units
WATER PRICING		
Volumetric Billing		
Average cost of water for Tier 1 water?		$/af
Tier 1 limit?		af/ac
Average cost of water for Tier 2 water?		$/af
Tier 2 limit?		af/ac
Average cost of water for Tier 3 water?		$/af
Tier 3 limit?		af/ac
Average cost of water for Tier 4 water?		$/af
Tier 4 limit?		af/ac
Fixed Price (Flat rate) Billing		
Average cost of water		$/a-yr
Does the fixed rate vary by crop type? 1 = yes, 2 = no		#

Non-Water Charges		
Assessment Charges		$/a-yr
Standby Charges		$/a-yr

Section 4. General Data, Water Delivery Service (cont.)	**Answer**	**Units**
DELIVERY SYSTEM CHARACTERISTICS		
General		
Percentage of time the flow rate is at maximum capacity for: 1. District mains		%
2. Laterals		%
FLOW MEASUREMENT AT FARM TURNOUTS		
# of customers serviced by each of the following devices at farm turnouts? 1 = No flow measurement devices		#
2 = Armco-type metering gates for a canal		#
3 = Undershot orifice (slide gate) for a canal		#
4 = Weir or flume device in a canal without a continuous record		#
5 = Weir or flume in a box after a pipe discharge		#
6 = Propeller meters (canal)		#
7 = Propeller meters (pipe)		#
8 = Other (describe)		#
FACILITIES AND UPGRADES		
Number of district well pumps?		#
Total (avg.) Annual Power Bill?		$
Cost of electrical power?		$/kW-hr

Section 4. General Data, Water Delivery Service (cont.)	**Answer**	**Units**
DISTRICT FLEXIBILITY		
FREQUENCY		
Rotation		
Percentage of district acreage using a Fixed Rotation Schedule - with no trading of turns?		% acres
How many days between water turns?		days
Percentage of district acreage using a Fixed Rotation Schedule—with farmers trading turns occasionally		% acres
Number of days between water turn as official district policy (even though some farmers actually trade turns between themselves).		days
Percentage of farmers who trade turns at least once a year.		%
Average percentage of irrigations during a season that these farmers trade turns.		%
Percentage of district acreage using a Fixed Rotation ---during peak water use period only		% acres
Number of days between water turn during that time. (Answer questions below to explain frequency policy during non-peak).		days
Limited Frequency—Modified Rotation		
Percentage of district acreage using a Limited Frequency (plus or minus a few days from a fixed).		% acres
Days of deviation from fixed rotation allowed by district.		days
Number of days between standard rotation.		days
Advance notice required by district before schedule change.		hours
Unlimited Frequency		
Percentage of district acreage using a Unlimited Frequency (any day requested).		% acres
Advance notice required by district before delivery		hours
Number of times a turnout cannot get water exactly the day desired during a year		times/yr

Section 4. General Data, Water Delivery Service (cont.)	**Answer**	**Units**
FLOW RATES		
Which of the following 3 choices best describes the flexibility of flow rate availability? 1. Essentially the same flow rate is delivered to each field for ever irrigation 2. The farmer can request several different flow rates through the season 3. The farmer can have a different flow rate each irrigation if he/she requests it		#
How many times can a farmer change a flow rate while an irrigation is in progress? 1 = No times 2 = 1 time 3 = 2 times 4 = There are no restrictions		#
If a farmer can change flow rates during an irrigation, how many hours advance notice must be given to the district before the change is made?		hours
DURATIONS		
What is the flexibility in duration? 1 = Unlimited 2 = 12 hour increments 3 = 24 hour increments 4 = Other fixed, district determined duration		#
Advance notice required before shutting off the water? (0 can be a possible answer)		hours
Percentage of the time district personnel open and close farm turnout gates?		%
When district personnel operate gates, how close do they come to the prescribed time?		hours
If there is not enough capacity/flow availability to match a turnout order, what do you do? 1 = Pro-rate 2 = Postpone		#

Flexibility from Water Supplier (if applicable)	Answer	Units
Allowable unannounced % flow change per supplier turnout? (Actual)		%
Allowable unannounced % flow change for the whole district? (Actual)		%
Hours of advance notice required by the supplier before a scheduled flow change occurs		hours
How many acre-feet of water per year, on the average over the last 10 years, did you have to take even if you didn't need it?		ac-ft
What percent of the time is the supplier unable to provide the flow the district requires?		%
If there is an inability, is it the result of 1) Lack of storage 2) Conveyance capacity limitations 3) Other ______________________________		
What percent flow must the district then accept?		%
DISTRICT FUNCTIONS		
GENERAL		
On a rating of 0 to 9 (9 being very important), rate the need to improve the flexibility of the present delivery system.		#
Which of the following is more preferable? 1 - Improve district flexibility with new structures 2 - Improve flexibility with new management concepts and limited new hardware 3 - Combination of structures and management		#
How many times during the last 5 years, has the subject of improving district delivery flexibility been brought up at board meetings?		#
On a scale of 0 to 9, rate the desire of the average farmer in his district for improved flexibility (9 is a very strong desire).		#

Section 4. General Data, Water Delivery Service (cont.)	**Answer**	**Units**
FUNCTIONS		
Is ground water recharge a major function of the district? 1 = yes 2 = no		#
Is canal seepage considered a beneficial use? 1 = yes 2 = no 3 = n/a		#
Is on-farm deep percolation considered beneficial? 1 = definitely yes 2 = possibly 3 = probably not 4 = definitely not 5 = do not know		#
WATER CONSERVATION PROGRAMS		
General		
What is the potential for reducing district deliveries in your District? a. average year		af/yr
b. dry year		af/yr
What would you do with the saved water? 1. expand service area/irrigated acres 2. ground water recharge 3. transfer/sell 4. nothing 5. Other ____________		#
What is the potential for reducing ground water pumping in the District? a. average year		%
b. dry year		%

Section 5. Other District Characteristics	Answer	Units
General		
Total district area		ac
Total cropped area		ac
Flow rate capacity at diversion		cfs
Actual peak flow at diversion		cfs
ECe of irrigation water		dS/m
Estimated conveyance efficiency		%
Estimated on farm efficiency		%
Surface Water		
Average total surface inflow to district over the past 5 years		af
Estimated recirculation of spills and drainage averaged over the last 5 years by: a. District		af
b. Farmers		af
Groundwater		
District usage of pumped groundwater averaged over the past 5 years		af
Farmer usage of pumped groundwater averaged over the past 5 years		af

Appendix B

Interviewed Districts

Partner Name	Mailing Address	City	State	Zip Code	Contact Name	Phone Number
Bitter Root Irrigation District	1182 Lazy J Lane	Corvallis	MT	59828-9731	Gary Shatzer	(406) 961-1182
Brewster Flat Irrigation District	94C Mountain View Drive	Brewster	WA	98812-9725	Walt Olsen	(509) 689-2634
Cascade Irrigation District	8063 Highway 10	Ellensburg	WA	98926-8537	Tony Jantzer	(509) 962-9583
Columbia Irrigation District	10 East Kennewick Avenue	Kennewick	WA	99336-3756	Larry Fox	(509) 586-6118
Consolidated Irrigation District No. 19	North 120 Greenacres Road	Greenacres	WA	99016-9799	Robert Ashcraft	(509) 924-3655
East Columbia Basin Irrigation District	PO Box E	Othello	WA	99344-0226	Richard Erickson	(509) 488-9671
Frenchtown Irrigation District	PO Box 662	Frenchtown	MT	59834-0063	Ed Alexander	(406) 626-4483
Gardena Farms Irrigation District No. 13	RR 1, Box 137	Touchet	WA	99360-9740	Stuart Durfee	(509) 394-2331
Grandview Irrigation District	PO Box 518	Grandview	WA	98930-0518	Douglas Birdsall	(509) 882-5901
Greater Wenatchee Irrigation District	3300 SE 8th Street	East Wenatchee	WA	98802-9130	Gary Fischer	(509) 884-4042
Hayden Lake Irrigation District	PO Box 162	Hayden	ID	83835-0162	Dennis Hart	(208) 772-2612
Kennewick Irrigation District	12 West Kennewick Avenue	Kennewick	WA	99336-3832	Chuck Garner	(509) 586-9111
Kittitas Reclamation District	PO Box 276	Ellensburg	WA	98926-0276	Jack Carpenter	(509) 925-6158
Lake Chelan Reclamation District	PO Box J	Manson	WA	98831-0399	Paul Cross	(509) 687-3548
Naches Selah Irrigation District	620 Guinan Road	Selah	WA	98942-9641	Roderick Matson	(509) 697-4177
Okanogan Irrigation District	37 A Douglas Road	Okanogan	WA	98840-8002	Tom Sullivan	(509) 826-1250
Roza Irrigation District	PO Box 810	Sunnyside	WA	98944-0810	Tom Monroe	(509) 837-5141
Selah-Moxee Irrigation District	PO Box 166	Moxee	WA	98936-0166	Gerald Helde	(509) 469-0449
South Columbia Basin Irrigation District	PO Box 1006	Pasco	WA	99301-1006	Shannon McDaniel	(509) 547-1735
Sunnyside Valley Irrigation District	PO Box 239	Sunnyside	WA	98944-9803	James Trull	(509) 837-6980
Union Gap Irrigation District	180 Clark Road	Wapato	WA	98951-9628	Fred Bower	(509) 877-7676
Walla Walla River Irrigation District	605 Lamb Street	Milton-Freewater	OR	97862-1941	Brent Stevenson	(541) 938-0144
Westside Irrigation Company	208 West 9th Avenue, Suite 5	Ellensburg	WA	98926-2480	Vern Burghart	(509) 925-5357
Whitestone Reclamation District	PO Box B	Loomis	WA	98827-0126	Jerry Barnes	(509) 223-3295
Yakima-Tieton Irrigation District	470 Camp 4 Road	Yakima	WA	98908-8812	Richard Dieker	(509) 678-4101