2. CURRENT PROJECT OPERATIONS

This chapter describes and summarizes the general parameters and functions — physical, contractual, environmental, political and social constraints — that affect current Yakima Project operations. The chapter's purpose is to provide insight into current operations and hydrology of the Project as managed by Reclamation's Yakima Field Office. In any given year the Project, with regard to current "considerations and constraints" (see section 2.4), develops an operation scheme to manage the Yakima River basin water supply and to provide maximum benefit for each of the varied water demands in the river system within the considerations and constraints. In this section, a typical operational "water year" (October through September) with four seasons is shown, with the considerations, constraints, and thought processes necessary for defining a year's operations. Detailed information is provided in Section 5 of the *Interim Comprehensive Basin Operating Plan for the Yakima Project, Washington* (*IOP*) of November 2002, published by Reclamation's Upper Columbia Area Office.[4/]

2.1 YAKIMA PROJECT DESCRIPTION

The Yakima Project provides irrigation water for a comparatively narrow strip of fertile land that extends for 175 miles on both sides of the Yakima River in south-central Washington. The irrigable lands eligible for service from Reclamation total about 465,000 acres. There are seven "divisions" (physical and administrative units) in the Project; "Storage" is one of the divisions. Storage dams and reservoirs on the Project are Keechelus, Kachess, Cle Elum, Bumping Lake, Tieton, and Clear Creek. There are six water-delivery divisions: Kittitas, Tieton, Sunnyside, Roza, Kennewick, and Wapato, totaling about 418,000 acres. In addition, Reclamation has water supply contracts with private interests who irrigate over 45,000 acres not included in the six water-delivery divisions.

Reclamation considers the entire river basin outflow when calculating "total water supply available" (TWSA) for all demands (see section 2.4 below) but only physically operates the Storage Division of the Project.

2.2 PROJECT PURPOSES

Reclamation operates the Project to meet four specified purposes: irrigation water supply, municipal and industrial (M&I), instream flows for fish, and flood control. Irrigation operations and flood control management have been the historic priorities for reservoir operations. Instream flows and satisfying some of the requirements of anadromous salmonids have been incorporated as part of the

4 Text and tables in this chapter have been extracted and modified from the *IOP* (Reclamation 2002b); the material has been edited to conform with the format of this Phase I assessment report.

current routine operation of the system and take primary status at certain times of the water year based on legislation, judicial order, and water supply available.

Hydroelectric power is produced incidentally to other Project purposes. Reservoir storage releases are not made to meet hydroelectric power demand; sometimes power is subordinated to meet instream flow requirements. This includes the Wapatox Power Plant (owned by PacifiCorp) which is currently not operated. Reclamation is concluding purchase of the water rights from this plant for use as instream flow.

Recreational needs are considered but are incidental to other Project purposes. The Yakima River Basin Water Enhancement Project (YRBWEP) Act was enacted in 1994 as Title XII of Public Law 103–434. Section 1205(e) of the law authorized fish, wildlife, and recreation as "an additional purpose" of the Yakima Project and said the existing storage rights "shall include storage for the purposes of fish, wildlife, and recreation." However, "the above specified purposes shall not impair the operation of the Yakima Project to provide water for irrigation purposes nor impact existing contracts."

Reclamation tailors its operations to ensure that public safety requirements are satisfied (flood control and recreational use), that water delivery contractual obligations are met (irrigation and M&I), and that instream flow targets (fish and wildlife habitat) are met. Maximizing flood control, irrigation water delivery, and meeting target streamflows requires continuous water management adjustments and includes many system operation considerations.

2.3 WATER SUPPLIES AND DEMANDS

The five major Project reservoirs are Bumping (1910), Kachess (1912), Keechelus (1917), Rimrock at Tieton Dam (1925), and Cle Elum (1933). They provide most of the system's ability to store and release irrigation water, to meet flood control needs, and to meet instream flow requirements. Clear Creek Reservoir is operated primarily to maintain maximum pool elevation for recreation opportunities.

For the purpose of the general development of this Phase I assessment, there are adequate data and hydrology information currently available on Hydromet and the Internet. The *IOP* (Reclamation 2002b) has detailed information on the current operations, hydrology, and yearly operational "considerations and constraints."

Parker gage, downstream from Union Gap at RM 103.7, marks the division between the Lower Yakima Basin and Upper Yakima Basin. As measured at Parker gage, the average annual "unregulated" (natural) flow of the Upper Yakima Basin is about 3.4 million acre-feet (MAF). Annual natural flows have ranged from a high of 5.6 MAF (1972) to a low of 1.5 MAF (1977). Average annual irrigation diversions by entities recognized in the "1945 Consent Decree" [see Glossary] total about 2.2 MAF (1961-1990). This does not include the other water demands that

must be satisfied in the Yakima River basin, including instream flows, hydroelectric generation (Wapatox Powerplant natural flow right), and M&I uses.

The Yakima Field Office Manager (FOM) is responsible for Reclamation's operational control and management of the "total water supply available" (TWSA) for the Yakima River basin. TWSA is

> "…that amount of water available in any year from natural flow of the Yakima River, and its tributaries, from storage in the various Government reservoirs on the Yakima watershed and from other sources, to supply the contract obligations of the United States to deliver water and to supply claimed rights to the use of water on the Yakima River and its tributaries, heretofore recognized by the United States."[5/]

Note that the April 1-September 30 TWSA water entitlements total 2.31 MAF for irrigation; in order to maintain YRBWEP target flows, an additional 0.13 to 0.23 MAF is needed. These combine to a total entitlement of 2.44 to 2.54 MAF during the 183-day period, plus 76,000 acre-feet carryover storage water to meet October's demands. As a rule, the water year needs to supply natural runoff of 2.77 MAF to 2.87 MAF of water to meet and support current entitlements; this also allows for minimum winter flows, which require 0.33 MAF.

The "total demand" is supplied through a combination of stored water releases, unregulated (natural) flows, bypassed reservoir inflows,[6/] and return flows. Total storage in the basin is a little over 1 MAF. Currently, Reclamation services storage contracts totaling 1.74 MAF, whereas the total yearly runoff passing through the storage reservoir system averages only 1.71 MAF. The total storage contract amount is not called for every year by all of the storage contract holders. However, Reclamation must carefully manage the runoff passing through the storage reservoir system (requires exacting reservoir operations) each year to ensure the annual demand is satisfied.

Demands cannot always be met in years of below-average runoff. Project operations make use of a monthly forecasting process to provide advance indication of water availability to supply total system demands for the current water year. On a daily basis, the Project must take into account varying weather conditions, water demands, "travel time" of the flow from the reservoirs to the point of use, inflow from unregulated tributaries, return flows, and other factors to maintain appropriate flow levels at selected control points (generally, gaging station locations) in the Yakima River basin.

Reclamation makes efforts to reduce impacts of Project operations on the fishery resource and to provide for appropriate water flows, while at the same time providing water for irrigation purposes. Reclamation implements three atypical operation strategies beginning in late August each year. These are "Flip-Flop," "Mini Flip-Flop," and "KRD Canal Bypass." Each of these operational schemes is designed to balance the need for irrigation water delivery with the protection of spring chinook salmon redds in the upper arm of the Yakima River above Roza Dam.

5 A detailed explanation of the 1945 Consent Decree may be found in Section 4.5.1 of the *IOP*.

6 "Bypassed reservoir inflows" are streamflows into the reservoirs that are released rather than stored.

2.3.1 Flip-Flop— Flip-Flop operation meets Lower Yakima Basin irrigation demands (below Parker gage) primarily from upper mainstem Yakima River (the arm above Roza Dam) storage during the summer months and then reduces flows in the upper mainstem Yakima River during the latter part of the irrigation season. Late-season Lower Yakima Basin demands are then met primarily from Rimrock Lake on the Naches River arm. The purpose of the Flip-Flop operation is to encourage spring chinook salmon in the upper mainstem Yakima River above Roza Dam to spawn at lower river stage levels. This minimizes the river flows (and storage releases) required to keep the redds watered and protected during the subsequent incubation period (November through March.)

2.3.2 Mini Flip-Flop — In years of sufficient water supply, heavier releases are made from Keechelus during June, July, and August to meet upper mainstem Yakima River above Roza Dam demands; Keechelus releases are reduced to provide suitable spawning flow in the Yakima River reach from Keechelus to the upper end of Lake Easton. This minimizes the river flows (and Keechelus storage releases) required to keep the redds watered and protected during the subsequent incubation period (November through March).

2.3.3 KRD Canal Bypass — The operation uses storage upstream from Easton Diversion Dam to supply some of the irrigation diversion demands in the lower Kittitas/Ellensburg valley, Roza Irrigation District, and flow demands below Roza Diversion Dam while maintaining target spawning flows in the Easton reach of the Yakima River. Flows are bypassed through the Kittitas Reclamation District KRD canal beginning about September 1 and continuing to about mid-October when KRD's irrigation season ends. This allows the target flow below Easton Diversion Dam (about 200 cfs) to be maintained while releases from Keechelus Lake and Kachess Lake totaling about 1,450 cfs are continued for downstream demand.

There may be some room for changes in reservoir operations for fish passage enhancement. However, any proposed changes would require an in-depth review of the individual operation adjustment and accounting of the total effect on basin storage as a whole. With experience as an indicator, some changes in operation (such as flood control) could require several years of negotiations among the Yakima River basin's clientele.

2.4 OPERATIONAL CONSIDERATIONS AND CONSTRAINTS (CCs)

Each year, in light of the annual prevailing conditions and all current legal considerations, the Yakima FOM will ensure that the concerned parties are involved as part of the consultation process used to make decisions for basin operation. To maintain continuity on the development of the year's operation, the Yakima FOM will maintain contact with the different groups on a monthly or as needed basis via meetings or other forms of communication.

At these meetings, issues of significant concern to the Project operations in the river basin may be addressed with the Yakima FOM and others, allowing public input for possible inclusion into the strategy for the upcoming operational season. If consensus of operation cannot be reached, the

Yakima FOM, after review of available science and data, will make the decision for the seasonal operations. These meetings could include

- the monthly "SOAC" (System Operations Advisory Committee) meetings for fishery-related issues;
- the monthly "River Operations" meetings concerning future months' plans for operations (for all interested parties);
- "Managers" meetings (irrigation district managers and other interested parties) for discussion of the water supply for the on-going year which normally starts in March or earlier if a shortfall is foreseen.

2.5 OPERATING SEASONS

Each irrigation operating season, from mid-March through October of each year, is affected by factors spanning a 15-month time period. Reservoir and diversion operations occurring in August through October of one irrigation season can influence operations during the following irrigation season. System operations must include continual planning and adjustments to successfully satisfy the multiple demands on the Yakima River. System operations can be divided into four general time periods during the year and these correspond in general to the seasons of the year. These time periods and their relationships to the irrigation season and water measurement period (the water year) are shown below.

Table 2-1. Operating Periods and Seasons; Yakima River Basin 15-Month Operation Year (USBR 2002b)

Fall			**Winter**				**Spring/Summer**				**Summer/Fall**			
Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct

Average Irrigation Season (mid-March–October 21)

Water Year (October 1-September 30)

Table 2-2 at the end of this chapter demonstrates the operational "considerations and constraints" (CCs) during each of the four seasons. The chart is intended to show only the time periods during which the CCs are considered when making operational decisions. It does not necessarily show when releases or other changes are actually made.

2.5.1 Fall Operations (August, September, October) — In August, river operators begin the transition to "Fall Operations" which establishes the demands, constraints, and operational criteria for the next operating period. The Fall Operations period overlaps summer/fall operations, to close the irrigation season. During August, September and October when the reservoirs are being drawn down to meet irrigation needs, releases are coordinated to maintain system storage flexibility so that flows can be ensured and provided for spawning, incubation, and rearing of spring chinook salmon eggs and fry during the next operating time period. Fishery flow needs are coordinated with SOAC.

2.5.2 Winter Operations (November, December, January, February) — Streamflows into the reservoirs in excess of downstream targets are stored. Flows are bypassed or releases are made to provide instream flows for the incubation of spring chinook salmon eggs and fry and other current fisheries demands. Release schedules also consider flood control requirements. Flood control operations that may occur are guided by flood control space guidelines for the storage reservoirs and forecasts of future runoff. Flood Control Operations (CC5) must consider real time streamflows downstream from the dams prior to releasing water from the reservoirs. For example, streamflows are evaluated prior to reservoir releases. Along the Yakima River, the gaging points are Easton (RM 202.0), Cle Elum (RM 183.1), Ellensburg (RM 155.9), Parker (RM 103.7), and Kiona (RM 29.9). Along the Naches River, the gaging points are at Cliffdell (RM 36.0) and near Naches (RM 17.1). The main objective during Flood Control Operations is to provide maximum protection against floods in the Yakima River basin, without jeopardizing the irrigation water supply for the following year. Other issues or constraints at this time include migration flows and possible power subordination in the lower river system.

2.5.3 Spring/Summer Operations (March, April, May, June) — Streamflows into the reservoirs in excess of downstream targets are stored. Irrigation diversion demands are largely met from natural flows accruing downstream from the reservoirs from unregulated tributaries. Some releases are made for instream flow maintenance for incubation and rearing (I&R) where unregulated inflow downstream from the dams is inadequate. Occasionally releases are made for enhanced passage flows, spikes, or other flow enhancements needed to encourage outmigration. Other issues or constraints at this time include migration flows, and possible power subordination in the lower river system. Releases to maintain appropriate flood control space are implemented as necessary. Spring/Summer Flood Control Operations (CC6) at the five Project reservoirs occur each water year, even including most dry years. The volume of runoff potential is estimated by the runoff forecast in balance with the TWSA process. The runoff forecast and the flood space guide curves are taken into account in the refill process and in the timing of attaining a full storage system. Reservoirs are generally brought to their highest level during the late-May through June time period. Some of the reservoir inflow is stored and some is passed through the reservoir to supplement unregulated flows and return flows to meet downstream diversion demands. Unregulated flows and return flows are generally adequate to meet irrigation diversions through June. However, storage releases have begun as early as May in dry years and as late as August in wet years. The average date of storage control (period of record, 1926-1999) in the Yakima River basin is June 24.

2.5.4 Summer/Fall Operations (July, August, September, October) — During July, reservoirs are generally operated to maximize storage and still meet downstream demands. From July through the end of the irrigation season (normally October 20) releases from stored water are required to meet both irrigation needs and Title XII instream flow targets. The system is on "storage control" when reservoir storage must be released to meet downstream demands, including the Title XII target flows. This results in a decline in total storage. Other issues or constraints at this time include passage flows, and power subordination. During Summer/Fall operations, the system is operated to bring the current irrigation season to conclusion. Starting in August, however, operations also switched to establishing the demands, constraints, and operation criteria for the next season.

TABLE 2-2. YAKIMA RIVER BASIN 15-MONTH OPERATION YEAR (note: ///// indicates time period of importance); see section 5.2 of the *IOP* (USBR 2002b) for explanation of CCs.

		Fall Operations			Winter Operations				Spring/Summer Operations				Summer/Fall Operations			
	Considerations & Constraints (CCs)	**August**	**September**	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**
1	Average Irrigation Season	///// ///// ///// /////	///// ///// ///// /////	///// ///// /////					///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// /////
2	Irrigation Supply – Flood Waters								///// /////	///// ///// ///// /////	///// ///// /////					
3	TWSA – Irrigation Supply Period	///// ///// ///// /////	///// ///// ///// /////							///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	
4	OWSA – Irrigation Supply Period			///// ///// /////												///// ///// /////
5	Flood Control – Winter				///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////								
6	Flood Control – Spring/Summer								///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////					
7	Runoff Forecast – Monthly						/////	/////	/////	/////	/////	/////	/////			
8	TWSA Compiled – Monthly								//// ////	//// ///	/// ////	/// ///	/// ////			
9	OWSA Compiled – October			/ ////												/ ////
10	TWSA – Short, Prorationing	///// ///// ///// /////	///// ///// ///// /////							///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	
11	TWSA – Short, NRP								///// /////	///// ///// ///// /////	///// ///// ///// /////					
12	TWSA – Short, Water Bucket	///// ///// ///// /////	///// ///// ///// /////							///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	
13	Storage Control – Historical & Average	///// ///// ///								///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /*//	///// ///// ///// /////	///// ///// ///		
14	YRBWEP Title XII Flow Period	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////						///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////
15	Flip-Flop Operation		///// ///												///// ///--------------	----------//
16	Mini Flip-Flop Operation	//////												//////	------------------	----------//
17	Spawning Flows		///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////				///// ///// ///// /////	///// ///// ///// /////
18	Incubation Flows			/ /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////							/ /////
19	Rearing Flows	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////
20	Ramping Rates	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////
21	Passage Flows	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////
22	Flushing/Pulse Flows – Out-migration									///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////				
23	Power Subordination	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////
24	Hydroelectric Power Operations	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////
25	Winter Operations & Ice Watch					///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////							
26	O&M – Hydrology	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////
27	O&M – Dams & Diversion	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////
28	O&M – Fish Facilities	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////
29	Minimum Sep. 30 Storage – 76 kaf			//											//	
30	Maximize Storage Content											///// ///// ///// /////	///// ///// ///// /////			
31	Develop Storage Content				///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////	///// ///// ///// /////					
	Considerations & Constraints (CCs)	**August**	**September**	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**
		Fall Operations			Winter Operations				Spring/Summer Operations				Summer/Fall Operations			