

THE STREAM GAGING NEEDS  
OF THE WATER RESOURCES PROGRAM  
(a review of the USGS Cooperative Program)

by

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This Open File Technical Report presents the results of a hydrologic investigation by the Water Resources Program, Department of Ecology. It is intended as a working document and has received internal review. This report may be circulated to other Agencies and the Public, but it is not a formal Ecology Publication.

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## INTRODUCTION

Fundamental to the management of surface water in Washington is a streamflow-measurement network capable of monitoring water diversions, minimum instream flows, and water availability in all parts of the state. Implementation of the Instream Resource Protection Program (IRPP), development of future Basin Management Plans, and tracking of water availability require access to adequate, streamflow information. Under current IRPP regulations, the Water Resources Program (WRP) is responsible for regulating instream flows at about 135 locations. These include both major rivers and many tributary streams. In addition, the WRP is responsible for regulating water rights with minimum-streamflow provisions in all areas of the state whether an IRPP has been completed or not.

Traditionally, the WRP relies on the surface-water-gaging network of the United States Geological Survey (USGS) to meet its needs. Under the USGS/Ecology Cooperative program, the WRP funds gaging by the USGS on streams and rivers deemed important to the state. The emphasis of the WRP has been on gaging locations necessary to regulate water allocation. This includes:

- 1) gaging of hydropower diversions,
- 2) monitoring of irrigation use, and
- 3) forecasting of expected flows and resultant "water supply".

In recent years, the USGS has decreased the number of gaging stations in operation and has turned to cooperators such as the WRP for funding of additional gaging. Although most of the original IRPP control stations are at USGS gaging sites, many gages are no longer in service (inactive). Only about 29 of the 135 IRPP control locations are presently gaged by the USGS (active). The reduction in gaging activity closed many stations necessary for future IRPP development, water availability-studies, or other management needs.

Because of the changing needs of the WRP and the changing status of USGS gages, the WRP must periodically re-evaluate the existing gaging network. In the remainder of this report, I describe a gaging network designed to meet the needs of the WRP for the foreseeable future. This report can be used to determine gage funding and should be updated as the needs of the WRP change.

## PURPOSE

The purpose of this study is three fold:

- 1) to evaluate the surface-water-gaging needs of the Water Resources Program,
- 2) to establish a list of necessary gaging stations, and
- 3) to compare the current USGS gaging program with Ecology's needs.

The list of necessary gaging stations will change as needs are redefined, but the majority of the list should remain constant.

## EVALUATION METHODS

It is a given that some level of surface-water gaging is necessary for the WRP to fulfill its obligations. The unknowns are the number and location of the necessary stations. I evaluated these needs using the "KEY-gaging-station" concept. I borrowed this concept from an earlier Ecology report (WRIS No. 11, 1976). It's author, Ed Garling, introduced the basic requirements for a streamflow-gaging network:

"The foundation for base flow management is an adequate flow measurement network for controlling out-of-stream water diversions. In the conduct of field activities to maintain base flow levels, certain KEY control stations will be designated as regional streamflow indicators. The KEY control station network shall be used to monitor general streamflow conditions and will serve to identify where flows are approaching required base flow levels, thus signaling when water right regulation will be necessary."

The KEY-gaging-station network was embodied in the IRPP work of the early 1980's. Although 135 stream locations were selected for instream-flow regulation, no decisions were made at that time about which stations should be gaged. I have expanded the KEY-gaging-station concept to include stations necessary to serve other responsibilities of the WRP, in addition to the IRPP. These include water allocation, regulation of minimum flows, drought assessment, water-use planning, and the general need for water-availability information.

I selected the KEY gaging stations during several meetings with the supervisors and staff of the various WRP Sections. The meetings focused on defining the surface-water-gaging needs of each Section.

Prior to the meetings, I developed a database containing information on active and inactive USGS streamflow-gaging stations in Washington. Data included station name, ID, location, and funding source. I used the locational information from the database within a Geographic Information System (GIS) to produce maps illustrating the major river systems, the Water Resource Inventory Area (WRIA) boundaries, and the locations of active and inactive gaging stations. From this database and maps, I developed a preliminary list of KEY gaging stations subdivided by WRIA. In selecting preliminary stations, I generally chose sites on larger rivers as KEY stations for continuous gaging, staying away from the smaller streams and creeks. The criteria for selection included:

- 1) a suitable location within the WRIA, usually near the river mouth or at locations that divided the basin into useful sub-basins,
- 2) the size and importance of the sub-basin served by the gage,
- 3) the level of water-related activities in the sub-basin, such as irrigation and municipal water supply, and
- 4) the potential for future surface-water development in the sub-basin.

The number of KEY gaging sites I believed to be necessary to serve a particular WRIA differed depending on:

- 1) the expected availability of surface water,
- 2) the intensity of water use (out of stream), and
- 3) the need for instream-resource protection.

For example, highly irrigated areas with numerous, conditional water rights or watersheds serving major cities require more gages than less developed basins.

Because KEY gaging stations should serve many purposes, I do not believe that all IRPP control stations need to be KEY stations. Flows at many IRPP stations are closely related and can be easily predicted from KEY gaging locations. Other IRPP stations are of interest for such a short time each year that a visual inspection and a few discharge measurements will suffice. With this in mind, I assume that most of the smaller IRPP streams and creeks will be monitored, as needed, by Water Resources staff. Although staff gages may be installed, continuous records will not generally be collected. The highest-priority KEY stations are those that serve multiple WRP functions.

The preliminary lists of KEY gaging stations were discussed and modified during the aforementioned meetings in each Region and at Headquarters. Discussions centered on past, present, and expected future responsibilities of the Water Resources Program in each WRIA. Discussions focused on:

- 1) the regulation of water withdrawals during low flow,
- 2) defining natural conditions for purposes of setting instream flows,
- 3) determining water available for allocation,
- 4) defining interactions between ground-water withdrawals and surface-water flows, and
- 5) drought assessment.

The meetings resulted in final lists of desirable, surface-water-gaging stations. When feasible, gaging locations were selected from the list of existing USGS station locations, either active or inactive. Where prior USGS gaging had not occurred, new stations were proposed. The stations on the final list were assigned a priority for funding during the 1990-1992 bienium. Although the list of stations should be relatively static with time, the funding priority among stations may change as activities within the state change.

Because the flows of the Columbia River are controlled and monitored by the federal government, the gaging requirements of the Columbia mainstem are not included.

## GAGING-STATION REQUIREMENTS

The Water Resources Program's requirements for continuous streamflow gaging are 124 stations. This includes 34 stations in the Northwest Region (Table 1.), 55 stations in the Southwest Region (Table 2.), 21 stations in the Central Region (Table 3.), and 14 stations in the Eastern Region (Table 4.). The tables indicate the station name, the WRIA in which it is located, the USGS ID number, whether it is presently active, whether the station is funded by the WRP, and the station's funding priority for 1990-1992. The final column in each table lists the "purpose" for which the station is needed. Purposes, coded from 1 to 10, are:

1. instream-flow regulation,
2. water-right regulation,
3. data for future appropriations,
4. basin planning,
5. IRPP,
6. hydropower regulation,
7. municipal water supply,
8. drought forecasting,
9. baseline station,
10. necessary to complete a state-wide gaging network.

Many KEY gaging stations serve more than one purpose and have several codes assigned.

## PRESENT STATUS

Of the 124 necessary streamflow-gaging stations, 85, or about 2/3, are currently active. The WRP funds 23 of these active stations, the remainder are funded by other local, state, and federal agencies. Although each Region has a different number of KEY gaging stations, with more in Western than in Eastern Washington, the percentages of active versus inactive gages in each Region are similar, varying from 65% active in the Southwest Region to 76% active in the Central Region.

TABLE 1. Surface Water Gaging Stations necessary in the Northwest Region.

WRIA	STATION	USGS ID	Active 1990	Ecology Funded	Priority 1990	Purpose	
1	Nooksack River, Deming	12210500	Yes	Yes	6	1,2,3,5,	
	Nooksack River, Ferndale	12213100	Yes		5	1,2,3,5,	
	Middle Fk. Nooksack	12208000	No		28	1,2,3,5,	
	North Fk. Nooksack	12207200	No		29	1,2,3,5,	
	South Fk. Nooksack	12209000	No		30	2,3,5,8	
	None						
2	None						
					17	2,3,4,6,	
3	Skagit River, near Mt. Vernon	12200500	Yes		33	1,2,3,4,	
	Samish River, near Burlington	12201500	No				
4	Skagit River, near Concrete	12194000	Yes		21	2,3,4,6,	
	Skagit River, at Marblemount	12181000	Yes		22	2,3,4,6,	
	Skagit River, at Newhalem	12178000	Yes		23	2,3,4,6,	
	Baker River, at Concrete	12193500	Yes		24	2,3,4,6,	
	Sauk River, near Sauk	12189500	Yes		25	3,4,8	
	Sauk River, above Whitechuck	12186000	Yes		31	3,4,8	
	Suiattle River, near Darrington	12188400	No		32	3,4	
5	Stillaguamish River, Silvana	12167700	No		18	1	
	N.F. Stilliguamish, Arlington	12167000	Yes	Yes	19	1	
	S.F. Stillaguamish, Arlington	12164500	No		20	1	
None							
6	None						
					15	1,5	
	South Fk. Skykomish	12133000	No		14	1,5	
	Skykomish River, near Goldbar	12134500	Yes	Yes	16	1,5	
	Sultan River	12138150	No		13	1,5	
	Skykomish River, Monroe	12141100	No		8	1,5	
	North Fk. Snoqualmie	12143000	No		9	1,5	
	Snoqualmie River, Snoqualmie	12144500	Yes		7	1,5	
	Tolt River, Carnation	12148500	Yes		10	1,5	
	Snoqualmie River, Carnation	12149000	Yes		Yes	11	1,5
	Pilchuck River, near mouth	12155400	Yes			12	1,5
	Snohomish River, Monroe	12150800	Yes				
	8	Cedar River, at Renton	12119000		Yes		1
Cedar River, near Landsburg		12117500	Yes			3	1,5,7
Cedar River, near Cedar Falls		12115000	Yes			27	1,5,7
9	Green River, at Tukwila	12113350	Yes			26	1,2
	Green River, near Auburn	12113000	Yes		4	1	
	Green River, near Palmer	12106700	Yes		2	1,7	
	Soos Creek, near Hatchery	12112600	Yes	Yes	34	4,9	
15	None						

TABLE 2. Surface Water Gaging Stations necessary in the Southwest Region.

WRIA	STATION	USGS ID	Active 1990	Ecology Funded	Priority 1990	Purpose
10	Puyallup River, at Puyallup	12101500	Yes		8	1,2,3,5
	Puyallup River, at Alderton	12096500	Yes		27	1,2,3,5
	Puyallup River, near Orting	12093500	Yes		28	1,2,3,5
	Puyallup River, near Electron	12092000	Yes		29	1,2,3,5
	Carbon River, near Mouth	12095690	Yes		10	1,2,3,5
	White River, above Lake Tapps	12100496	Yes		9	1,2,5
11	Nisqually River, near mouth	proposed	No		11	1,2,3,5
	Nisqually River, at McKenna	12089500	Yes		46	1,2,3,5
	Nisqually River, at La Grande	12086500	Yes		12	1,2,3,5
	Nisqually River, near National	12082500	Yes		30	1,2,3,5
	Mashel River, near La Grande	12087000	No		31	1,2,3,5
12	None					
13	Deschutes River, near Olympia	12080010	Yes	Yes	13	1,2,3,5
	Deschutes River, near Rainier	12079000	Yes		17	1,2,3,5
14	None					
15	Huge Creek, near Wauna	12073500	Yes	Yes	55	1,2,4
16	Duckabush River, near Brinnon	12054000	Yes	Yes	45	3,4
	Skokomish River, near Potlatch	12061500	Yes		6	3,4,6
	N.F. Skokomish River, Potlatch	12059500	Yes		18	3,4,6
	Dosewallips River, at Brinnon	12053500	No		44	3,4
	Hamma Hamma River nr Hoodspport	12055000	No		43	3,4
17	Little Quilcene River-Quilcene	12052000	No		51	1,2,3,4
	Big Quilcene River, nr Quilcene	12052500	No		47	3,4
18	Elwah River, near Port Angeles	12045500	Yes		7	3,4,6
	Dungeness River, near Sequim	12048000	Yes	Yes	1	1,2,5,8
	Dungeness River, at Woodcock	proposed	No		32	1,2,5,8
19	None					
20	Hoh River, at Hiway 101	12041200	Yes		42	3,4
	Soleduck River, nr Quillayute	12042500	No		48	3,4
	Bogachiel River, near Forks	12042800	No		50	3,4
21	Quinault River, at Quinault	12039500	Yes		40	3,4
	Queets River, near Clearwater	12040500	Yes		41	3,4
	Clearwater River, nr Clrwater	12040000	No		49	3,4

TABLE 2. Continued.

WRIA	STATION	USGS ID	Active 1990	Ecology Funded	Priority 1990	Purpose
22	Humptulips River, nr Humptulps	12039000	No	Yes	39	1,2,3,5
	Wynochee River, Black Creek	12037400	Yes		14	1,2,3,5
	Satsop River, near Satsop	12035000	Yes		21	1,2,3,5
	Chehalis River, near Satsop	12035002	No		19	1,2,3,5
23	Chehalis River, at Porter	12031000	Yes	Yes	3	1,2,3,5
	Chehalis River, nr Grand Mound	12027500	Yes		2	1,2,3,5
	Black River, at Littlerock	12029000	No		33	1,2,3,5
	Skookumchuck River, nr Bucoda	12026400	Yes		34	1,2,3,5
	Newaukum River, near Chehalis	12025000	Yes		15	1,2,3,5
	Chehalis River, near Chehalis	12023500	No		20	1,2,3,5
Chehalis River, near Doty	12020000	Yes	22	1,2,3,5		
24	Willapa River, near Willapa	12013500	Yes	Yes	4	1,2,3,4
	Naselle River, near Naselle	12010000	Yes		35	1,2,3,4
25	Elochoman River, nr Cathlamet	14247500	No		36	1,2,3,4
26	Cowlitz River, at Castle Rock	14243000	Yes		5	3,4
	Cowlitz River, Mayfield Dam	14238000	Yes		38	3,4
	Cowlitz River, near Randle	14233400	Yes		16	3,4
	Toutle River, nr Silver Lake	14242580	Yes		52	3,4
	Cispus River, near Randle	14232500	Yes		23	3,4
	Tilton River, near Cinebar	14236200	Yes		24	3,4
27	Lewis River, near Mouth	proposed	No		25	3,4
	E.F. Lewis River, near Mouth	proposes	No		26	3,4
	Kalama River, near Kalama	14223600	No		37	3,4
28	None					
29	Wind River, near Carson	14128500	No		53	3,4
	White Salmon River, Underwood	14123500	Yes		54	10

TABLE 3. Surface Water Gaging Stations necessary in the Central Region.

WRIA	STATION	USGS ID	Active 1990	Ecology Funded	Priority 1990	Purpose
29	White Salmon, near Underwood	14123500	Yes		15	10
30	Klickitat River, at Pitt	14113000	Yes		14	1,2,4
31	None					
37	Yakima River, at Union Gap	12500450	Yes	Yes	18	1,2,5
	Yakima River, at Kiona	12510500	Yes		17	1,2,5
	Yakima River, at Mabton	12508990	Yes		16	1,2,5
38	American River, at Nile	12488500	Yes	Yes	21	9
39	Yakima River, at Umtanum	12484500	Yes	Yes	19	1,2,5,8
40	None					
44	None					
45	Wenatchee River, at Plain	12457000	Yes	Yes	9	1,2,5
	Wenatchee River, at Peshastin	12459000	Yes		7	1,2,5
	Wenatchee River, at Monitor	12462500	Yes		3	1,2,5,8
	Icicle Creek, near mouth	12458500	No		11	1,2,5
46	Entiat River, at Entiat	12453000	No		13	10
47	None					
48	Methow River, at Patteros	12449950	Yes		2	1,2,5
	Methow River, Winthrop	12448500	Yes	Yes	8	1,2,5
	Twisp River, at Twisp	12448998	Yes	Yes	10	1,2,5
49	Okanogan River, at Malott	12447200	Yes	Yes	1	1,2,5
	Okanogan River, at Tonasket	12445000	Yes		6	1,2,5
	Okanogan River, at Oroville	12439500	Yes		4	1,2,5
	Smilkameen River, at Nighthawk	12442500	Yes		5	1,2,5
50	None					
51	None					
52	San Poil River, at Keller	12435000	No		12	1,2,1
60	Kettle River, at Boyds	12405000	No		20	1,2,1

TABLE 4. Surface Water Gaging Stations necessary in the Eastern Region.

WRIA	STATION	USGS ID	Active 1990	Ecology Funded	Priority 1990	Purpose
32	Walla Walla River, nr Touchet	14018500	Yes		4	2,4
	Walla Walla River, ab Touchet	Proposed	No		3	2,4
33	None					
34	Palouse River, at Colfax	13349210	Yes		12	9
	Palouse River, at Hooper	13351000	Yes		13	9
35	Tucannon River, near Starbuck	13344500	Yes		9	2,4,9
	Asotin Creek	13334500	Yes	Yes	6	2,4,8,9
36	Esquatzel Coulee, at Eltopia	12513500	No		10	10
41	Crab Creek, near Beverly	12472600	Yes		11	9,10
42	None					
43	None					
51	None					
52	Sanpoil River, abv 13 Mile Cr.	12433890	No		8	4,10
53	None					
54	Chamokane Creek, nr Springdale	12433100	No		5	9,1
55	Little Spokane River, Dartford	12431000	Yes	Yes	1	1,2,4
56	Hangman Creek, at Spokane	12424000	Yes		7	2,4,9
57	None					
58	None					
59	Colville River, Kettle Falls	12409000	Yes		2	1,2,4
60	Kettle River, near Laurier	12404500	Yes		14	9
61	None					
62	None					