APPRAISAL ASSESSMENT OF AUGMENTING KACHESS RESERVOIR STORED WATERS BY GRAVITY FEED FROM CABIN CREEK AND SILVER CREEK

Prepared for the

United States Bureau of Reclamation

CH2MHILL

October 1989

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CONTENTS

KACHESS RESERVOIR STORAGE CAPACITY DISCUSSION

Kachess Dam is an earthfill structure located on the Kachess River about 2 miles northwest of Easton, Washington. This dam, 114 feet high with a volume of 200,000 cubic yards of fill material, was completed in 1912 at the lower end of a natural lake. The watershed above the reservoir is approximately 60 square miles. The average annual discharge from the area between 1938 and 1952 was 197,700 acre-feet with a maximum (1934) of 321,700 acre-feet and a minimum (1945) of 94,610 acre-feet.

The active storage capacity of the reservoir is 239,000 acre-feet. Consequently, there is an existing average excess capacity of 41,300 acre-feet (239,000 - 197,700), if it could be assumed that all the basin run-off was stored and that there were no seepage or evaporation losses. Those are not valid assumptions, therefore the excess capacity is even greater.

The "End of Month Content" reports for Kachess Reservoir covering the period from 1926 through 1988 as recorded by the USBR are shown in Appendix A. Normal operations of the Yakima storage reservoir system is such that the reservoirs are filled by the end of June (run-off conditions permitting) and the seasonal drawdown has been completed by the end of September.

USBR staff indicate that of all the reservoirs in the system, Kachess is the least apt to fill in any given year. The availability of storage capacity to utilize water imported from either Cabin Creek or Silver Creek would be greatly influenced by the manner in which the Bureau operates the reservoir system. Because of the recognized inadequacy of the Kachess watershed, the Bureau has "carried over" in excess of 100,000 acre-feet of water in Kachess Reservoir in all but 13 years since 1946 (a 43-year-period). With the "carry-over" storage in place, the reservoir has usually filled by the end of June.

A more distinct picture of the project potential can be seen in Table C1 "Potential Storage Analysis" by examining in detail the records for the most recent water years. From Table 1, one can conclude that in the water short years when additional storage is most needed, there is usually in excess of 90,000 acre-feet of excess available storage capacity in Kachess Reservoir to receive Cabin Creek and Silver Creek water.

Table C1
POTENTIAL STORAGE ANALYSIS*

Year	End of Month Content June	End of Month Content Sept.	Storage Gained**	Excess Capacity Available
1985	234,280	60,380	125,600	113,400
1986	185,980	24,480	128,770	110,230
1987	153,250	23,760	142,730	96,270
1988	166,490	25,880	148,880	90,120
1989	174,760			

* All quantities in acre-feet.
** Storage gained during "fill" season (September to following June).

Consequently, if both Cabin Creek and Silver Creek were diverted into Kachess Reservoir (a total potential of 45,000 acre-feet of additional storage) there could be room for that water plus a nearly equal amount of "carry-over" storage when it was available.

Engineers
Planners
Economists
Scientists

November 3, 1989

SEA27673.B0

U.S. Bureau of Reclamation
Attention: Larry Vinsonhaler PN-270
Pacific Northwest Region
Box 043 - 550 West Fort Street
Boise, ID 83724

Dear Larry,

I am pleased to submit the following report in response to the attached project scope which you prepared as the basis for this study. The information that you requested in Item 9 will be submitted separately.

In summary, it appears that feasible pipe routes exist to deliver about 35,000 acre-feet of storage water annually to Kachess Reservoir from Cabin Creek and about 10,000 acre-feet per year from Silver Creek. The capital costs as developed in this report ($296/ac-ft for Cabin Creek and $113/ac-ft for Silver Creek) are extremely low on a per annual acre-foot basis when compared to the estimated costs for new storage reservoirs.

We have found this to be a very interesting project. We hope that the Enhancement Round Table group elects to pursue its potential to eventual construction.

Sincerely,

CH2M HILL, INC.

John S. Mayo

John S. Mayo
Yakima Area Manager

ykmr20/056.50
Attachment

ATTACHMENT

(Project Scope)

Appraisal Assessment of Augmenting Kachess Reservoir Stored Waters by Gravity Feed from Cabin Creek or Silver Creek

Extent of Assessment: The work described herein shall consist of the evaluation of run-off from Cabin Creek and Silver Creek which, because of it's occurrence, is "excess to system demands" and could be stored in Kachess Reservoir, identifying the method of diverting and conveying available flows to the reservoir, developing appraisal level cost estimates for the physical facilities which would have to be constructed, and reporting the findings.

Process/Information to be Provided: The work shall consist of the following activities:

1. Analyze existing Yakima Project operational data over a representative period(s) to identify and confirm the amount of Kachess Reservoir capacity which has not filled and is available for augmentation from other sources.

2. Evaluate the available modeled and other flow data of Cabin Creek and Silver Creek to determine annual monthly flows which are "excess to system demands" and may be available for storage in Kachess Reservoir.

3. Conduct a field reconnaissance, both by air and on foot, to establish diversion points and conveyance alignments and photograph salient topographic features.

4. Prepare maps showing a proposed location of a diversion dam and conveyance (pipeline) alignment to divert and convey flows from each creek to an outlet in Kachess Reservoir. Identify land ownership along each route.

5. Plot a profile of the proposed conveyance alignments using elevation data from existing USGS maps.

6. Analyze the necessary pipe sizes for a selected range of delivery flow capacities and determine the most optimum size.

7. Prepare conceptual designs for diversion and discharge structures and any necessary air release valves.

8. Prepare appraisal level cost estimates for constructing the facilities.

9. Scope work items that would have to be accomplished to prepare a feasibility design and cost estimate. Provide a cost estimate of such work.

10. Prepare a report of the evaluations and findings including drawings, maps, and photographs as appropriate. Provide 25 copies of the report.

Timeframe: The major findings shall be available in summary form 10 working days after the Contractor is notified to proceed with the work. The final report will be delivered 30 working days after the Contractor is notified to proceed with the work.

CABIN CREEK

CABIN CREEK
DRAINAGE BASIN YIELD EVALUATION AND
PIPE SIZING DISCUSSION

Flow records for Cabin Creek are shown in Appendix B. The monthly flow data for the years 1929 through 1988 have been modeled by the USBR using available data from nearby gaging stations. Since 1987 however, a stream gage on Cabin Creek itself has been in place and daily measurements have been recorded. This data has significant value in showing typical snow melt run-off characteristics.

Flows for the period March 1 through June 15 for the water years 1987, 1988, and 1989 have been plotted and are shown in Figures C1, C2, and C3. Lines indicating 300 cfs and 400 cfs pipeline capacities are shown. Visual evaluation shows how the two pipeline capacities would match the stream spring run-off characteristics. An arbitrary 40 cfs base flow downstream of the diversion dam has been assumed. The net storable run-off during the March 1 to June 15 period has been calculated as shown in Table C2.

Although the major run-off in Cabin Creek occurs in the spring as shown on the plotted hydrographs, freshets frequently occur during the fall and winter seasons. If they occur at a time when there is not a danger of plugging the pipeline with ice, that run-off could also be transferred to Kachess Reservoir.

During the July through September period when the Bureau is drawing down the reservoirs (storage control), there is no point in carrying Cabin Creek water to Kachess Reservoir. It would be allowed to flow into Lake Easton in the normal existing route.

The elevations shown on the various drawings in this report are interpolated from the available USGS maps which have an 80-foot contour interval. Prior to final design (during a feasibility level study), a topographic survey will be made of the diversion dam and inlet structure site. Only after such a survey, can the final determination of an optimum pipe size be made. The specific elevation of the preferred inlet structure site will determine how much gravity head is available for the transmission pipeline.

Assuming a diversion dam elevation of approximately 2345 feet, the pipe sizes to be considered and their estimated capacities are as shown in Table C3. Computations were made using Mannings Equation and an "n" factor of .014. The cost estimate for the project has been based on a 6.5-foot (78-inch) diameter pipe.

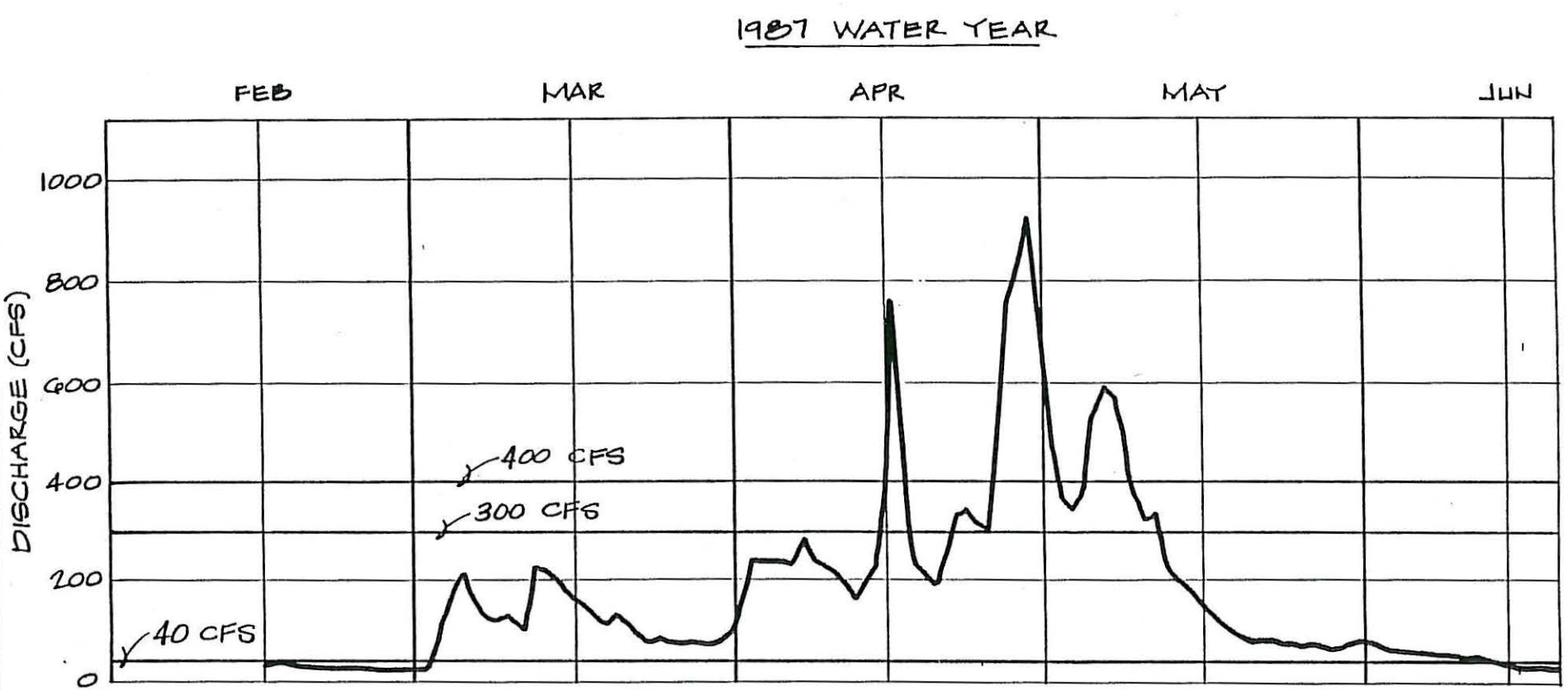

FIGURE C1
CABIN CREEK 1987 HYDROGRAPH

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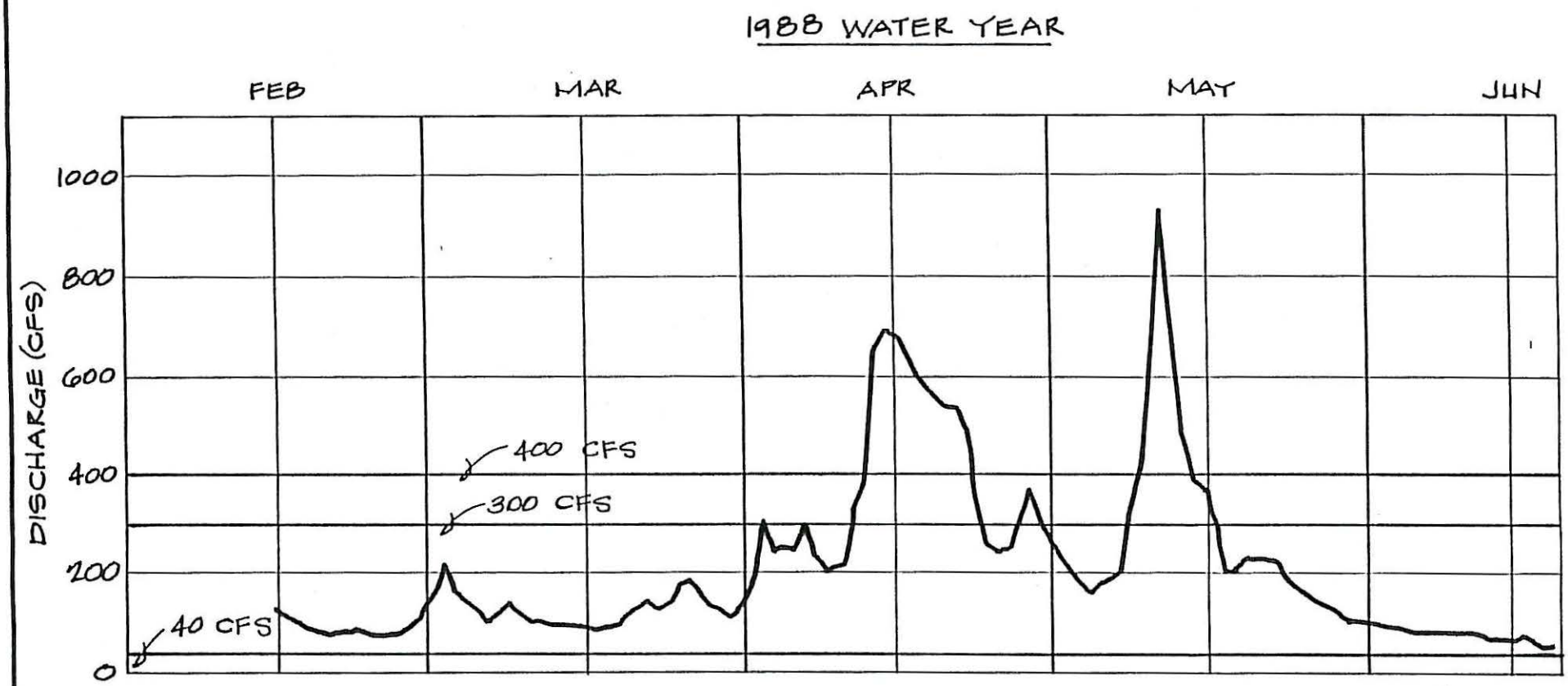


FIGURE C2
CABIN CREEK 1988 HYDROGRAPH

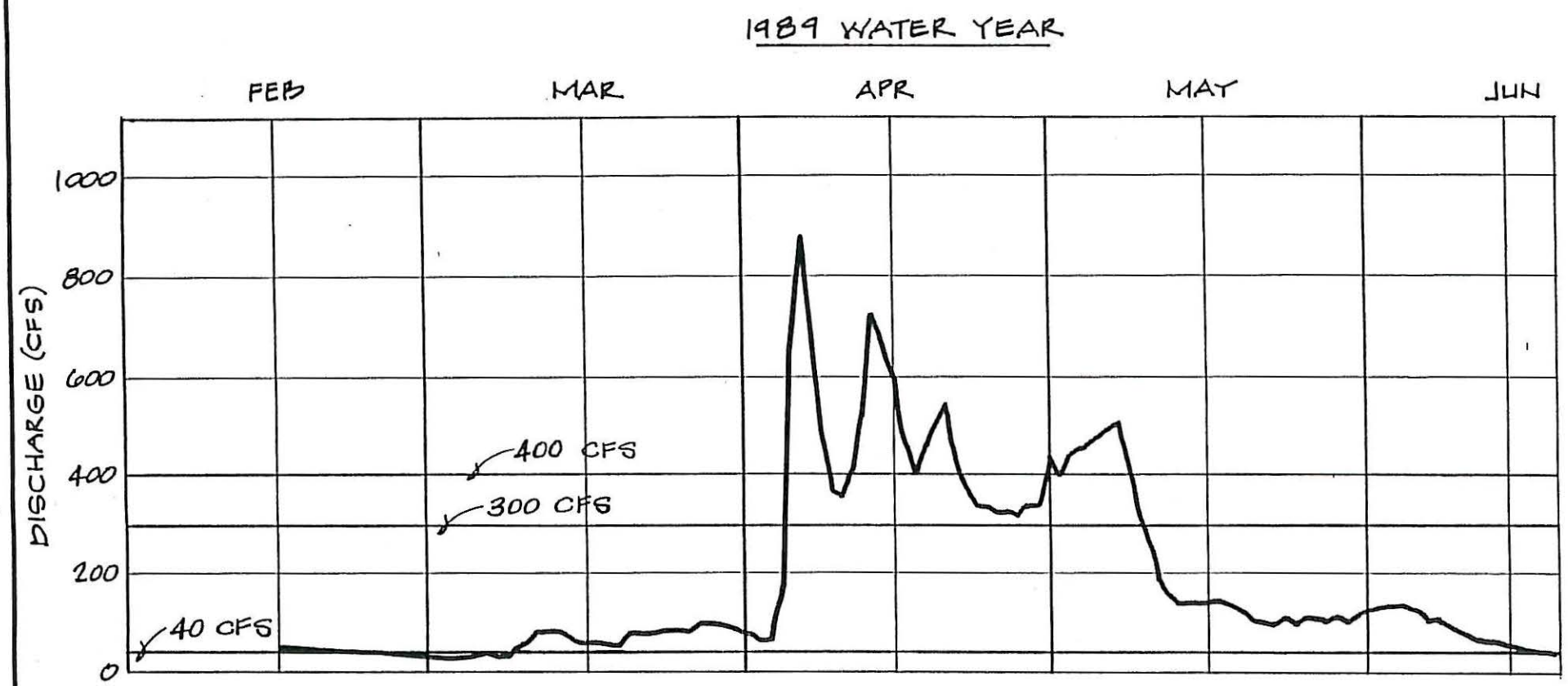


FIGURE C3
CABIN CREEK 1989 HYDROGRAPH

Table C2
NET STORABLE RUN-OFF
(March 1 to June 15)

Pipe Capacity	Storable Run-Off (Acre-Feet) 1987	1988	1989	Average
300 cfs	27,280	32,600	26,320	28,730
400 cfs	30,720	36,480	32,080	33,090

Table C3
CONSIDERED PIPE DIAMETERS AND CAPACITIES

Pipe Diameter (in feet)	Pipe Capacity (in cfs)
5.5	238
6.0	300
6.5	372
7.0	453

DESCRIPTION OF PROPOSED PROJECT

PHYSICAL LAYOUT

The Cabin Creek pipeline project as presently conceptualized can best be understood by studying photographs C1 through C12 (later in this section) and noting their location on the preliminary plan and profile sheet that follows. A number of on-site reconnaissance investigations coupled with two different aerial fly-overs and the resulting photography have given us a good understanding of the project area and construction limitations. Fortunately, a good (although circuitous) pipeline route is available.

The four major challenges relating to pipeline location were satisfactorily resolved allowing a practical alignment to be identified. These were:

1) Finding a diversion dam site at a suitable elevation with a stable foundation for the intake structure.

2) Locating a relatively narrow Yakima River crossing site with stable abutments so that a bridge crossing could be accommodated.

3) Locating a place to cross under Interstate 90 at a suitable grade without having to disturb the highway or traffic on the highway.

4) Determining a location where the outlet can enter Kachess Reservoir without breaching the main dam but still in an area where all available head can be utilized.

The optimum size of pipe for the project is probably 6.0- or 6.5-foot (72-inch or 78-inch) diameter. This will be determined after completion of a feasibility study based on an accurate land survey plus an operational analysis by USBR personnel.

OPERATIONS PLAN

Flows in Cabin Creek vary widely during the spring snow melt periods. The clear-cut logging activities in the watershed have contributed to high debris, sediment, and bed load conditions in Cabin Creek during heavy run-off. The proposed diversion dam and pipeline intake structure are configured to minimize the effects of these conditions. Figure C4 shows a preliminary diversion dam and intake structure.

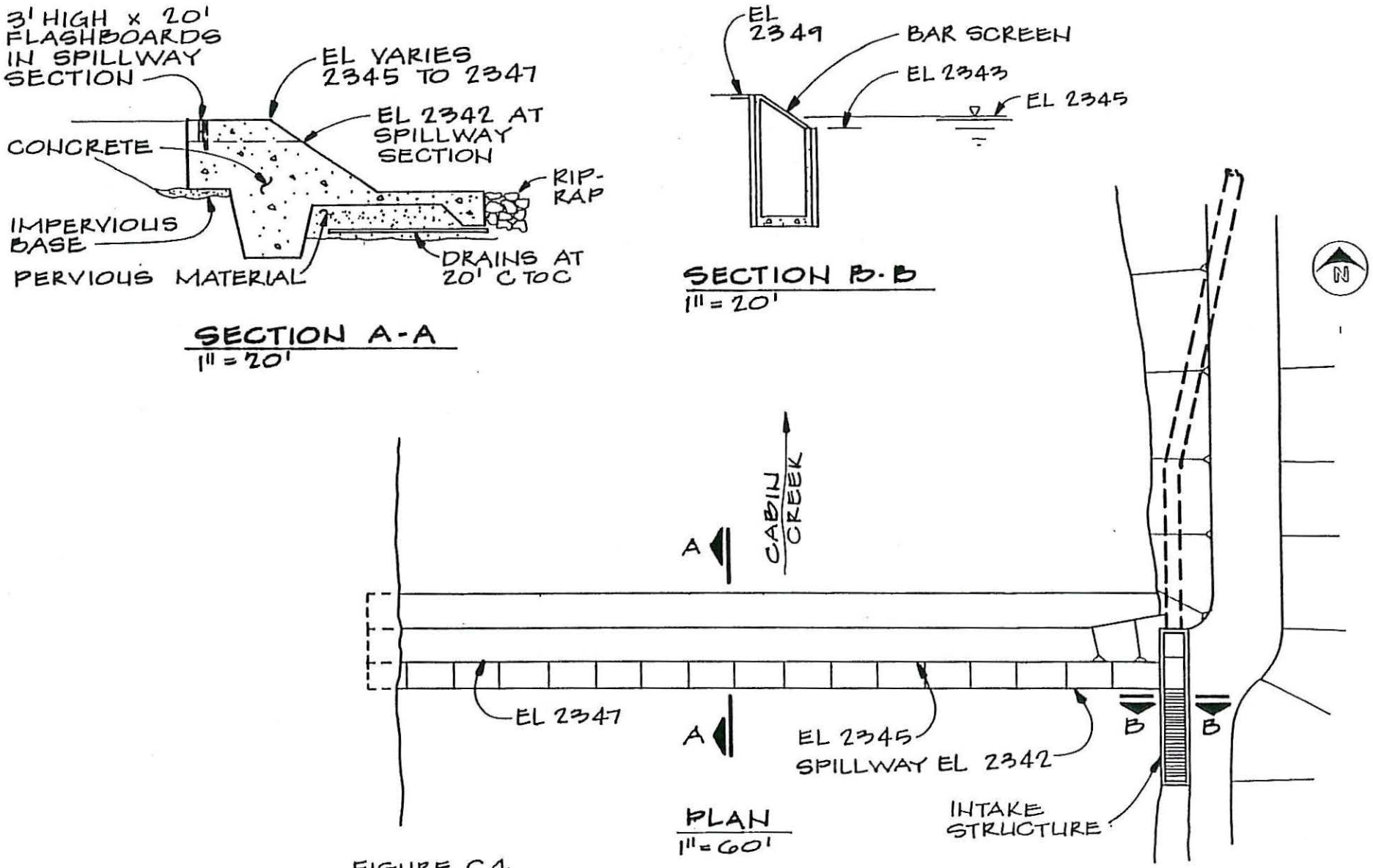


FIGURE C4

CABIN CREEK DIVERSION DAM

At times of extreme flood flows, 3 feet of depth of flashboards can be removed from a 20-foot-wide depressed section of the dam crest. This will allow the floating debris and the bed load to pass over the structure without blocking the pipeline entrance. The flashboards will have to be reinstalled after the peak flood flows subside.

To prevent the streambed of Cabin Creek from changing in location and elevation, a slight slope toward the spillway section is proposed for the dam crest. In addition, the slightly depressed section of the crest will channelize the flows to the desired elevation and location. With the diversion dam spillway crest slightly below the pipeline intake wier, most of the heavy bed load that results from the flood flows will pass over the dam. Small amounts of gravel that pass over the intake wier will be trapped in the sump of the intake structure. This material may have to be removed periodically. Equipment access to this collection sump is provided through removable steel grating.

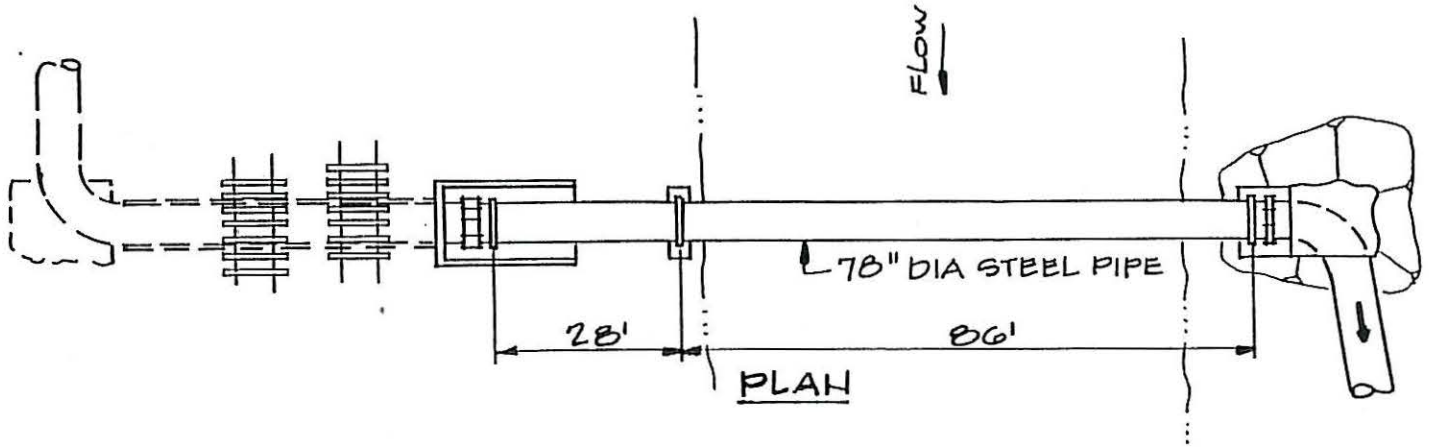
Large floating debris will be excluded from the pipeline by a heavy bar screen at the intake wier. Large steel bars spaced at approximate 6-inch net openings will provide a safe and functional barrier. Considering the size and quantity of debris in the stream, it may be necessary to use a backhoe or similar piece of equipment to clean the screen. Floating debris smaller than 6 inches will be allowed to pass through the pipeline and should cause no problems.

The pipe size and its hydraulic characteristics will limit the maximum flow rate when the Cabin Creek flow is high. At times when the Cabin Creek flow is less than the pipeline capacity, a small notch in the flashboard portion of the diversion dam crest will provide approximately 40 cfs as a base flow in the creek. The configuration of this notch will establish the bypass flow rate.

The inlet to the transmission pipeline will be gated for control at any time that less flow is desired. Normally this gate will be left wide open. Under most conditions, the diversion structure will be self operating.

Figure C5 shows a detail of the pipeline crossing the Yakima River. A pipe bridge will be located high enough to be above all anticipated flood flows. It should not be an obstruction to the flows or be subject to debris loading from the river since it will span the entire river with no midchannel pier. The only operational feature at the site will be a drain valve that will be used occasionally to empty the pipeline.

The topography at the outlet end of the pipeline offers the possibility of gaining slightly more operating head on the pipeline. This will allow the pipe to carry more water without increasing its diameter. As shown in Figure C6, the discharge of the pipe will be placed at a fairly low elevation. When the level of



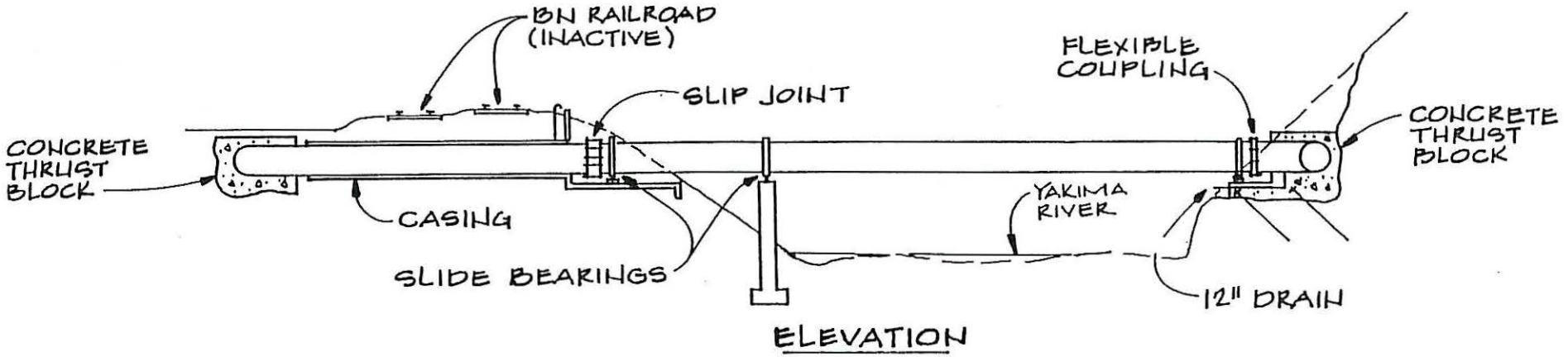


FIGURE C5

PIPE BRIDGE

SCALE: APPROX 1" = 30'

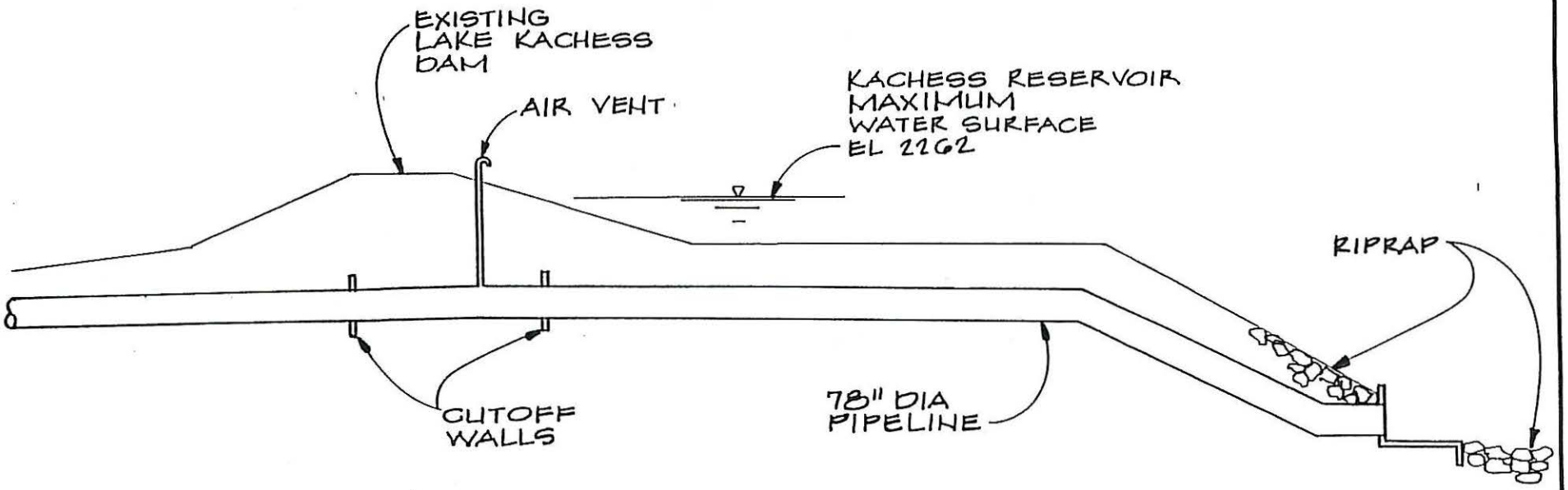


FIGURE C6

CABIN CREEK PIPE OUTLET STRUCTURE

NOT TO SCALE

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Lake Kachess is low, the total operating head on the pipeline will be maximum. This coincides with the time that peak flows are usually available in Cabin Creek. To permit this feature to operate, the air vent shown will be a device that will allow air to escape from the pipeline but will not allow air to enter the pipeline. A partial vacuum will be created producing the added total head. The pipeline will be designed to withstand this partial vacuum loading.

COST ESTIMATE

Project features have been located and defined in sufficient detail to provide a preliminary cost estimate. The estimate quantities and unit costs are showing in Table C3. Costs of projects with similar features have been adjusted for price escalation and used as a basis for the unit price shown.

The cost estimates shown in this report have been prepared for project evaluation and were obtained from information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final production schedule, and other variable factors. As a result, the final project costs may vary from the estimates presented in this report. Because of these factors, funding requirements will need to be carefully reviewed prior to making specific financial decisions or establishing final budgets. Project features and development requirements will be further identified during the feasibility study and design phases. Cost estimates can then be reviewed and further developed.

Table C3
CABIN CREEK PRELIMINARY COST ESTIMATE

Cabin Creek Facilities	Quantity	Unit	Unit Cost	Extended Cost
Diversion Dam				
Roller Compact. Concrete	4,600	CY	$80	$368,000
Excavation & Backfill	4,300	CY	$12	$51,600
Rip Rap	1,700	CY	$25	$42,500
Reinforced Concrete	200	CY	$300	$60,000
Misc. Metalwork	1	LS	$15,000	$15,000
Slidegate	1	EA	$10,000	$10,000
Access Road	3,500	LF	$14	$49,000
Pipeline				
78" Dia RCP	18,980	LF	$325	$6,168,500
Yakima River Crossing				
Railroad Crossing	60	LF	$850	$51,000
Pipe Bridge	140	LF	$2,500	$350,000
Outlet Structure				
Excavation & Backfill	100	CY	$12	$1,200
Reinforced Concrete	20	CY	$300	$6,000
Rip Rap	1,100	CY	$25	$27,500
BASIC CONSTRUCTION COST				$7,200,300
CONTINGENCIES (20%)				$1,440,100
TOTAL ESTIMATED DIRECT CONSTRUCTION COST				$8,640,400
ENGINEERING AND ADMINISTRATION COSTS (20%)				$1,728,100
TOTAL ESTIMATED COST OF CABIN CREEK FACILITIES *				$10,368,500

Based on this cost estimate and an assumed annual capture of 35,000 acre-feet, the cost for this increment of additional storage will be $296 per acre-foot.

* Costs have been estimated at 1990 prices based on similar previous projects.

Photo C1 - Cabin Creek. Proposed Diversion Structure Inlet Site (looking downstream). Structure to be tied to solid rock at right end of diversion dam.

Photo C2 - Cabin Creek. Axis of proposed low diversion dam--(at narrowest point E-W on valley floor)--Length approximately 320 feet.

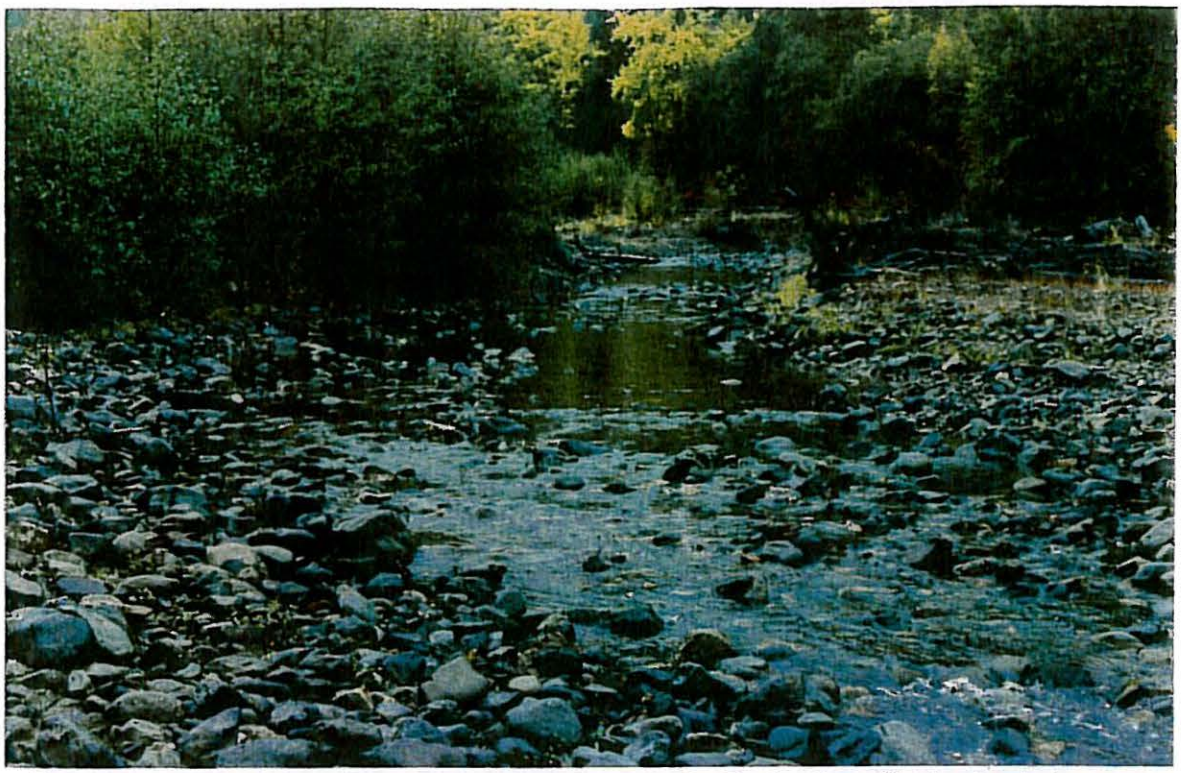


Photo C3 - Cabin Creek. Typical October flow of Cabin Creek when all of water is in one channel.

Photo C4 - Cabin Creek. Proposed pipe alignment on right side of right set of rails on unused Burlington Northern Railway tracks.

Photo C5 - Cabin Creek. Proposed location of upstream end thrustblock and elbow at Yakima River pipe bridge crossing.

Photo C6 - Cabin Creek. Yakima River--looking upstream toward pipe bridge crossing site (abutment near rails showing in upper left section of photo).

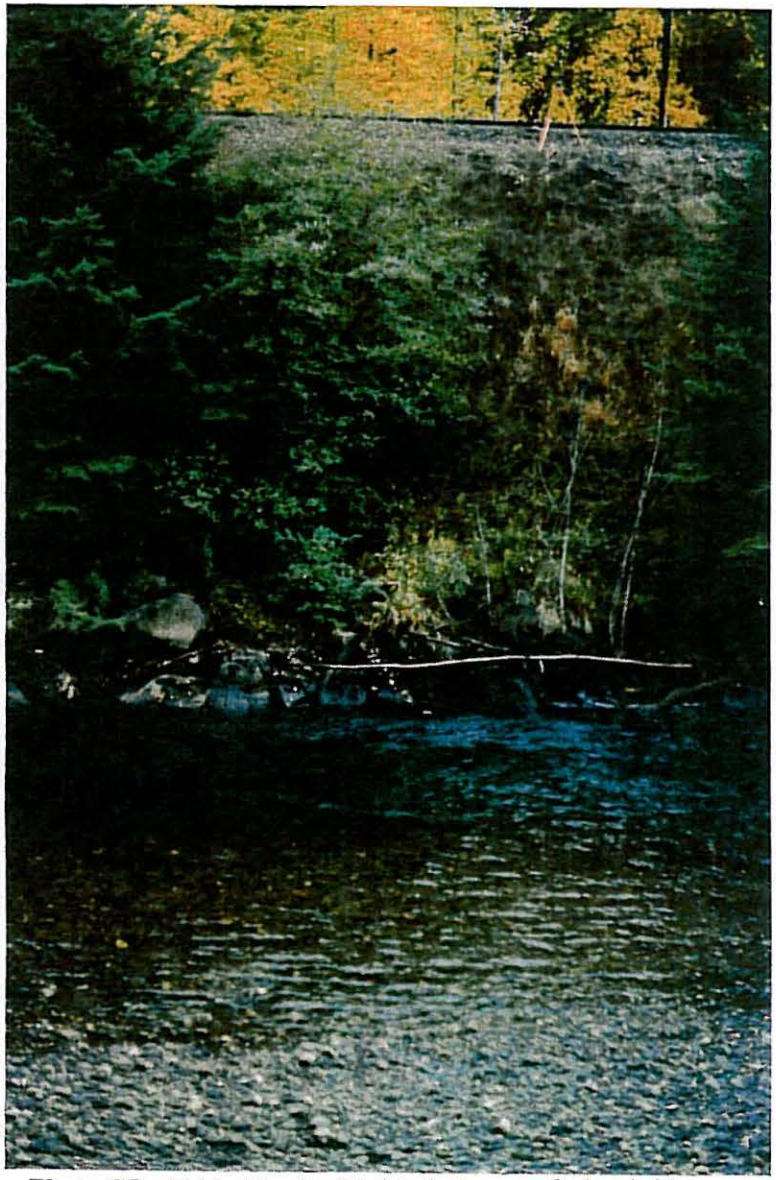


Photo C7 - Cabin Creek. Right abutment of pipe bridge river crossing. (Transit on proposed centerline)

Photo C8 - Cabin Creek. Left abutment of pipe bridge to be founded on solid rock outcrop. Pipe then transverses to the right and upward.

Photo C9 - Cabin Creek. Pipeline route across clear-cut, showing edge of Easton State Park.

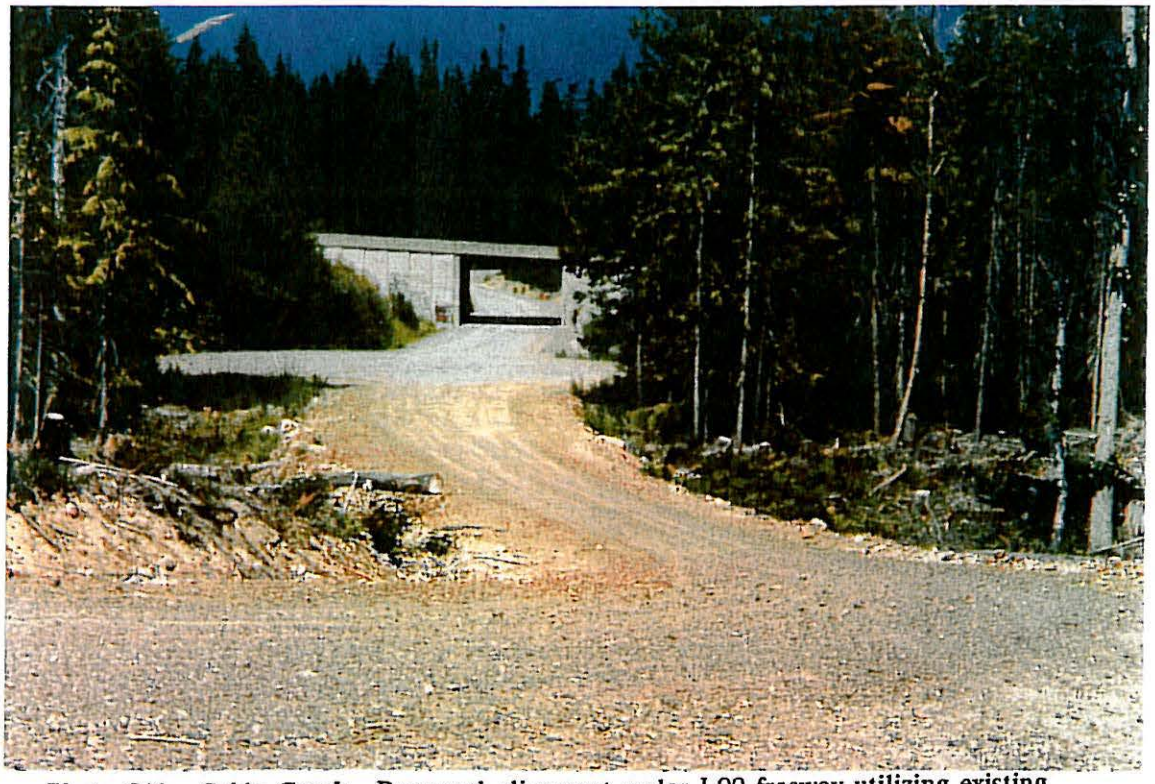


Photo C10 - Cabin Creek. Proposed alignment under I-90 freeway utilizing existing grade separation structure.

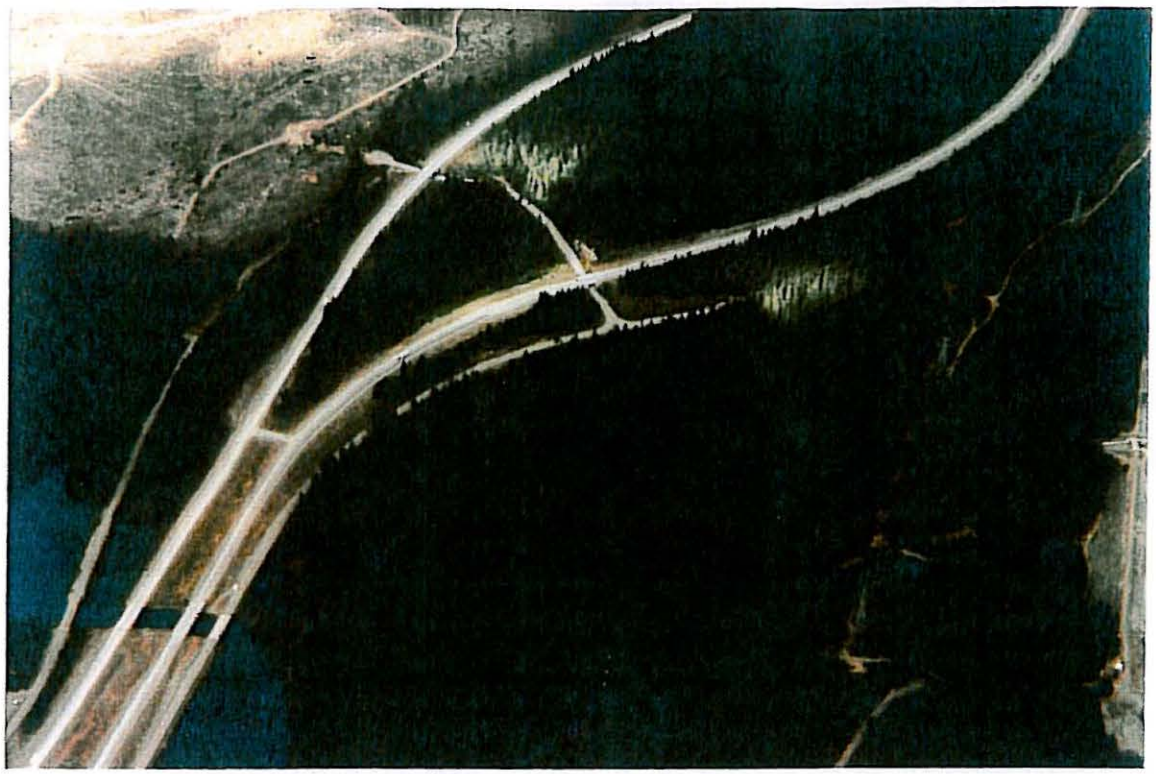
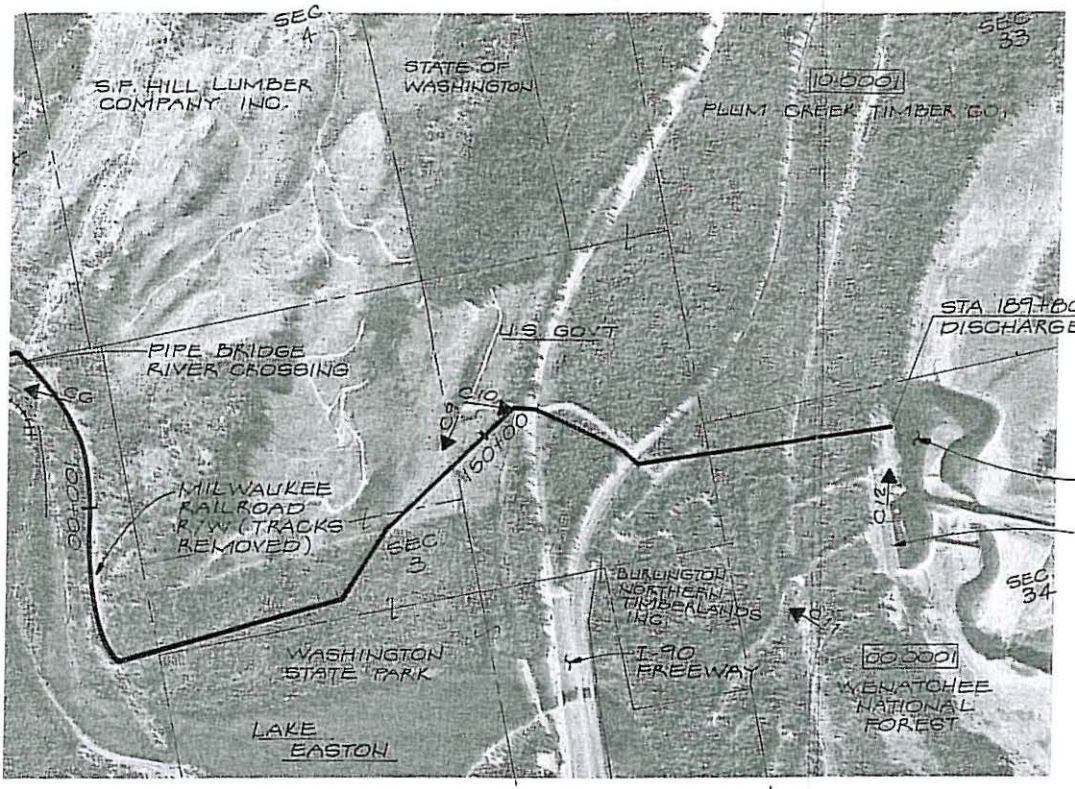


Photo C11 - Cabin Creek. Alignment would cross clear cut, go through both grade separation structures and approach Kachess Reservoir at approximately point X.

Photo C12 - Cabin Creek. Transmission pipe outlet structure site. Pipe would empty into basin on right side of photo.



T. 20 N., R. 13 E.

T. 21 N.

T. 20 N.

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2360
2320
2280
2240
2200

100+00
150+00
STA 189+80± DISCHARGE
200+00

ROUND PROFILE

ORIZ: 1" = 1000'
ERT: 1" 40'

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

PRELIMINARY PLAN AND PROFILE

CABIN CREEK PIPELINE

21

DATE OCT 1989

PROJ NO. SEA 27673.B0

SILVER CREEK

SILVER CREEK
DRAINAGE BASIN YIELD EVALUATION
AND PIPE SIZING DISCUSSION

Since no flow records are available for Silver Creek, the annual run-off has been estimated by using two different methods. The first method included prorating the measured yield of the Cabin Creek watershed using the ratio of the watershed areas. Silver Creek has approximately 5.17 square miles of watershed above the diversion point compared to 27.68 square miles for the Cabin Creek watershed. This method indicates an annual run-off of about 11,300 acre-feet for 1987--a dry year. The second method included using the USGS data as identified for Yakima Subregion 3, in which Silver Creek would be expected to yield 12,400 acre-feet.

An examination of the lower reaches of Silver Creek shows that, except during the spring run-off, the creekbed is dry. This is because the stream, once it leaves the steep mountain valley, runs out onto a porous alluvial fan and the water sinks into the ground. Consequently, we recommend building a system that would function year-round and be sized to catch all but the largest flash run-off. On this basis we predict that about 10,000 acre-feet could be diverted annually from Silver Creek.

Table S1 lists a series of pipe sizes that were considered for this project. Their capacities were calculated using Mannings Equation and an "n" factor of .014. The cost estimate for this project has been based on a 36-inch diameter pipeline which appears to be the largest size that can be supplied by the watershed. More detailed hydrologic investigations are needed during the feasibility study.

Table S1
CONSIDERED PIPE DIAMETERS AND CAPACITIES

Pipe Diameter (in feet)	Pipe Capacity (in cfs)
2.0	42
2.5	75
3.0	123
3.5	185
4.0	264

DESCRIPTION OF PROPOSED PROJECT

PHYSICAL LAYOUT

The Silver Creek pipeline project proposed route is shown in photographs S1 through S6 (later in this section). The relative locations of the photographs are shown on the preliminary plan and profile sheet that follows the photographs. As evidenced by the photographs, previous attempts to divert small amounts of water from Silver Creek have been made. The facilities shown in Figure S1 are designed to overcome the difficulties encountered by these previous projects. A satisfactory pipeline route with few complications exists between Silver Creek and Kachess Reservoir.

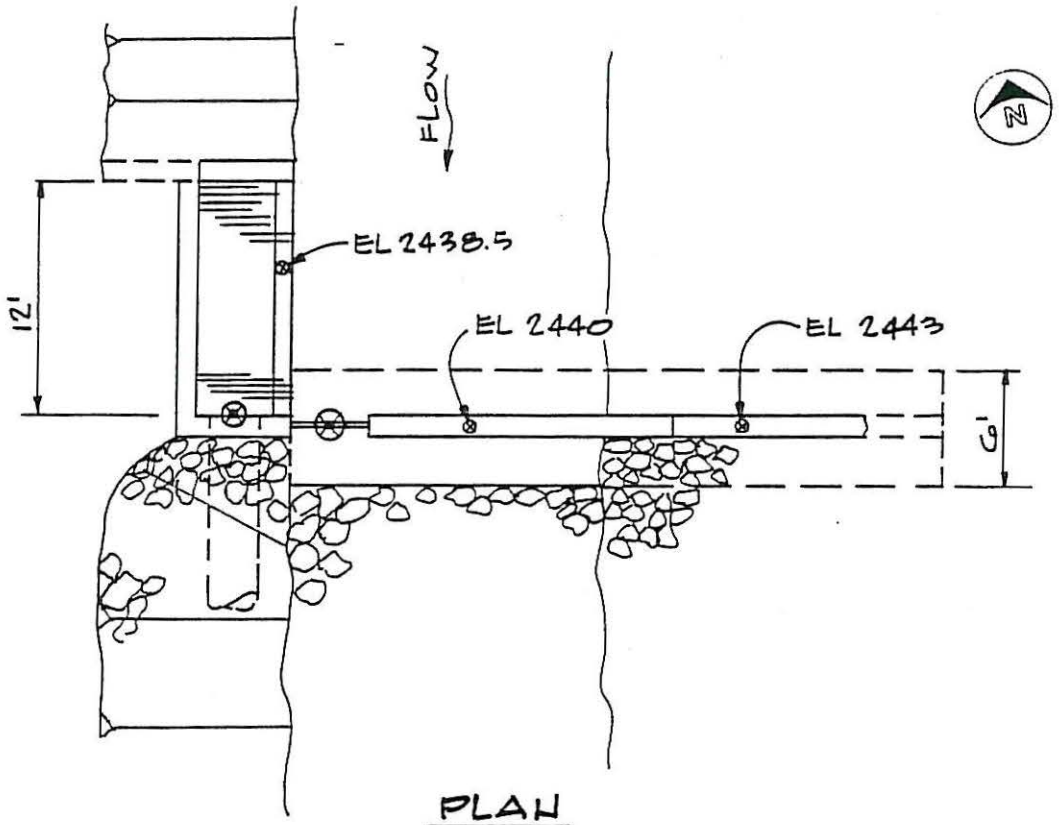
It appears that the optimum pipe size will be between 30 and 36 inches in diameter. More detailed analysis of the watershed yield and operational requirements will be done during the feasibility study. Such work will establish the most practical pipe size.

OPERATIONS PLAN

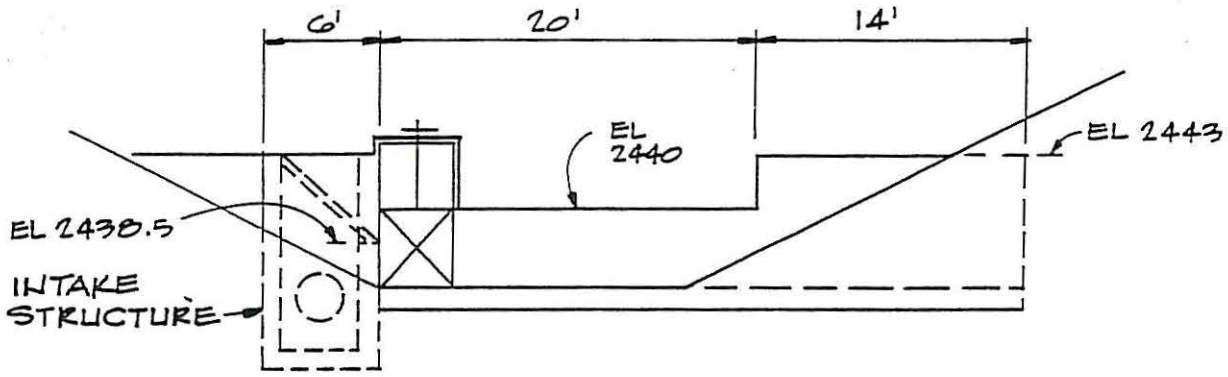
Flows in Silver Creek vary widely during the spring snow melt periods. The absence of recent logging operations in most of the Silver Creek watershed results in a relatively stable natural stream channel. The debris, sediment, and bed load in Silver Creek are moderate during heavy run-off conditions. Currently proposed plans indicate that the watershed will remain in a relatively natural state in the future. The proposed diversion dam and pipeline intake structure are configured to accommodate these conditions. Figure S1 shows a preliminary diversion dam and intake structure.

At times of flood flows, a slidegate in the dam crest can be opened. This will allow the floating debris and the bed load to pass over the structure and through the gate without blocking the pipeline entrance. The slidegate will have to be closed after the peak flood flows subside.

The configuration of the diversion dam structure is intended to prevent the streambed of Silver Creek from changing in location and elevation. With the slidegate opening below the pipeline intake weir, most of the heavy bed load that results from the flood flows will pass through the gate when it is open. Small amounts of gravel that pass over the intake weir will be trapped in the sump of the intake structure. This material may have to be removed periodically.



PLAN



ELEVATION
LOOKING UPSTREAM

FIGURE S1
SILVER CREEK DIVERSION DAM
1" = 20'

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Large floating debris will be excluded from the pipeline by a heavy bar screen at the intake weir. Large steel bars spaced at approximate 4-inch net openings will provide a safe and functional barrier. Debris smaller than 4 inches will be allowed to pass through the pipeline and should cause no problems.

The pipe size and its hydraulic characteristics will limit the maximum flow rate when the Silver Creek flow is high.

The inlet to the transmission pipeline will be gated for control at any time that less flow is desired. Normally this gate will be left wide open. Under most conditions, the diversion structure will be self operating.

Since the transmission pipeline will be on a continuously descending grade, air vents and drains will not be needed other than a vent pipe at the intake structure immediately downstream from the inlet gate.

The outlet end of the pipeline will simply discharge into Kachess Reservoir as shown in Figure S2. The discharge elevation will be above the normal high water level and the pipe outlet will not be submerged. Rip rap will be placed to prevent erosion.

COST ESTIMATE

Project features have been located and defined in sufficient detail to provide a preliminary cost estimate. The estimated quantities and unit costs are shown in Table S2. Costs of projects with similar features have been adjusted for price escalation and were used as a basis for the unit prices shown.

The cost estimates shown in this report have been prepared for project evaluation and were obtained from information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final production schedule, and other variable factors. As a result, the final project costs may vary from the estimates presented in this report. Because of these factors, funding requirements will need to be carefully reviewed prior to making specific financial decisions or establishing final budgets. Project features and development requirements will be further identified during the feasibility and design phases. Cost estimates can then be reviewed and further developed.

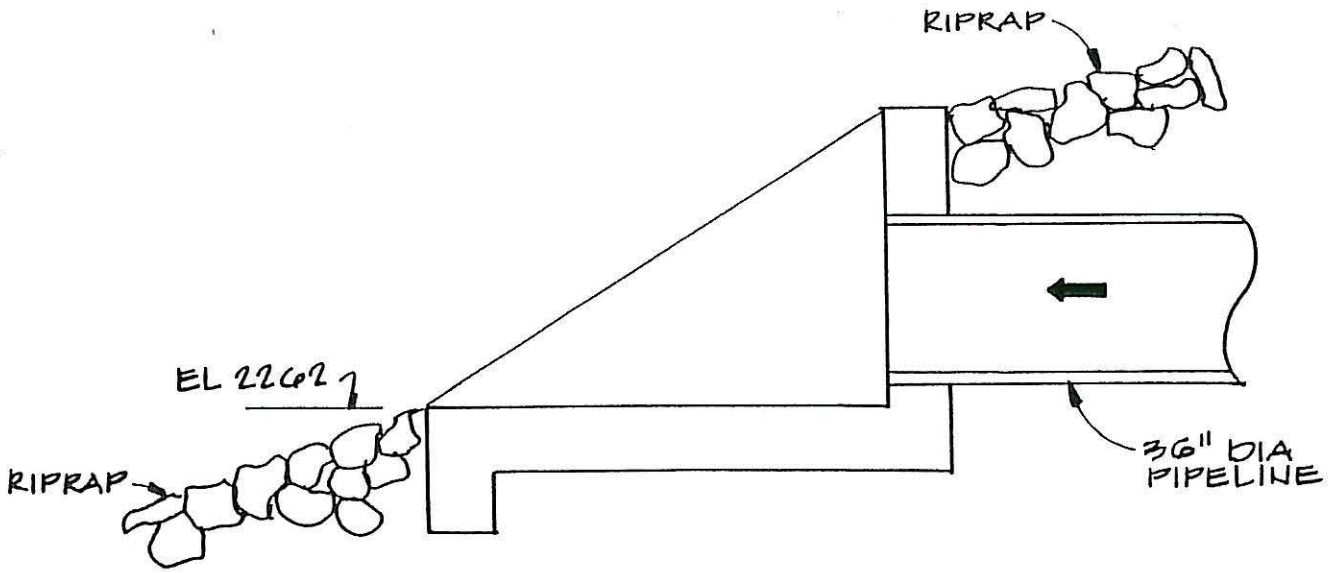


FIGURE S2
SILVER CREEK PIPE OUTLET STRUCTURE
NOT TO SCALE

Table S2
SILVER CREEK PRELIMINARY COST ESTIMATE

Silver Creek Facilities	Quantity	Unit	Unit Cost	Extended Cost
Diversion Dam				
Excavation & Backfill	120	CY	$12	$1,400
Rip Rap	110	CY	$25	$2,800
Reinforced Concrete	32	CY	$300	$9,600
Misc. Metalwork	1	LS	$5,000	$5,000
Slidegate	2	EA	$1,000	$2,000
Access Road	1,300	LF	$14	$18,200
Pipeline				
36" Dia RCP	4,820	LF	$149	$720,100
Outlet Structure				
Excavation & Backfill	50	CY	$12	$600
Reinforced Concrete	15	CY	$300	$4,500
Rip Rap	800	CY	$25	$20,000
BASIC CONSTRUCTION COST				$784,200
CONTINGENCIES (20%)				$156,800
TOTAL ESTIMATED DIRECT CONSTRUCTION COST				$941,000
ENGINEERING AND ADMINISTRATION COSTS (20%)				$188,200
TOTAL ESTIMATED COST OF SILVER CREEK FACILITIES *				$1,129,200

Based on this cost estimate and an assumed annual capture of 10,000 acre-feet, the cost for this increment of additional storage will be $113 per acre-foot.

* Costs have been estimated at 1990 prices based on similar previous projects.

Photo S1 - Silver Creek. Existing old timber diversion structure on Silver Creek in vicinity of proposed new diversion dam.

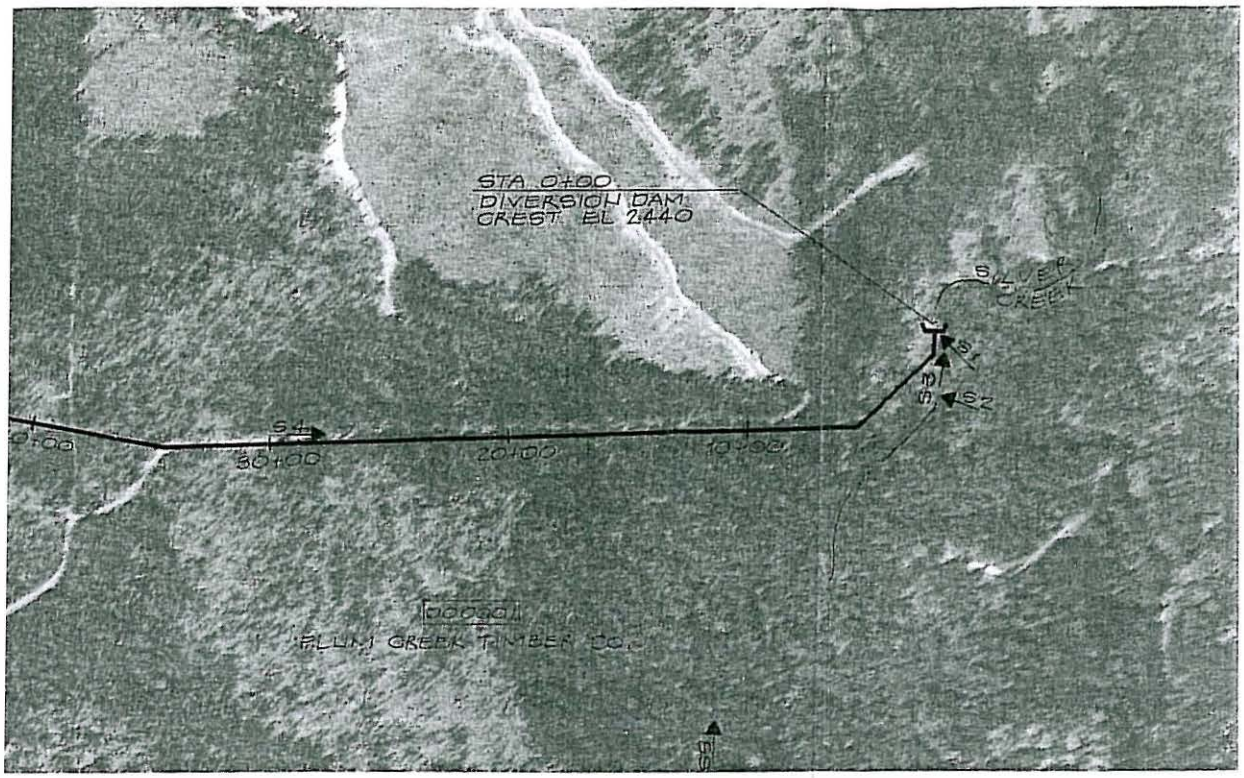
Photo S2 - Silver Creek. Abandoned intake gate beside Silver Creek near proposed new diversion dam.

Photo S3 - Silver Creek. Silver Creek near proposed diversion dam showing October flow.

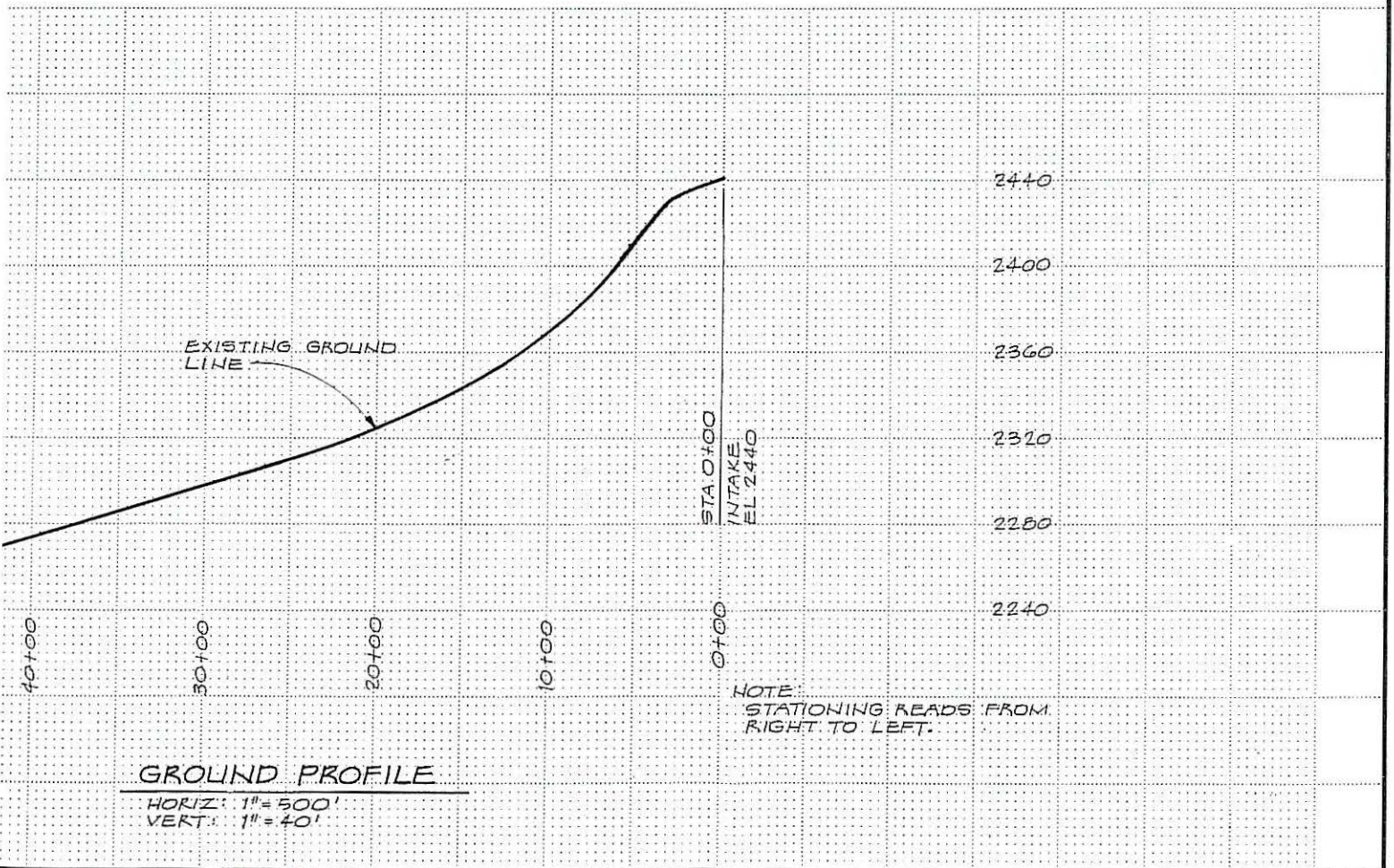
Photo S4 - Silver Creek. Recently constructed logging road which parallels proposed Silver Creek pipe alignment and would furnish project access.

Photo S5 - Silver Creek. Silver Creek near Easton Airstrip showing intermittant nature of the stream.

Photo S6 - Silver Creek. Cabin Creek watershed is shown in upper center of picture. Outlet structure from pipeline would be near Cottonwood trees on far shore beach.



SCALE : 1" = 400' ±



GROUND PROFILE

HORIZ: 1" = 500'
VERT: 1" = 40'

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

PRELIMINARY PLAN AND PROFILE

SILVER CREEK PIPELINE

31

DATE OCT 1989

PROJ NO. SEA 27673.B0

APPENDIX A

YAKIMA ! DIGITAL MODEL BASE STUDY - PRESENT OPERATION 5-JUL-88

01973-1982 AVG W/O 1973,1977,1979 6-8-84

KACHESS RES CONTENT 100 AF UNITS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVERAGE
1926	782.	827.	1103.	1236.	1351.	1581.	1872.	1903.	1600.	1161.	637.	299.	1196.
1927	385.	506.	696.	780.	849.	918.	1140.	1548.	2066.	1911.	1439.	1000.	1103.
1928	1176.	1567.	1700.	1800.	1856.	2061.	2281.	2390.	2367.	1991.	1475.	924.	1799.
1929	948.	1000.	1032.	1049.	1070.	1187.	1298.	1677.	1791.	1372.	808.	405.	1136.
1930	303.	297.	319.	336.	531.	720.	1064.	1180.	1074.	938.	600.	361.	644.
1931	270.	335.	348.	414.	537.	753.	994.	1397.	1463.	1043.	625.	291.	706.
1932	298.	423.	491.	607.	863.	1200.	1542.	2022.	2390.	2151.	1668.	1099.	1229.
1933	1082.	1561.	1700.	1800.	1874.	1946.	2145.	2390.	2390.	2390.	2018.	1712.	1917.
1934	1600.	1600.	1700.	1800.	1950.	2200.	2390.	2390.	2126.	1634.	959.	493.	1737.
1935	585.	870.	1060.	1448.	1586.	1741.	1907.	2361.	2390.	2130.	1661.	1070.	1567.
1936	995.	1016.	1038.	1121.	1182.	1339.	1718.	2390.	2390.	2033.	1538.	967.	1477.
1937	893.	886.	998.	1028.	1087.	1198.	1406.	1821.	2310.	2082.	1612.	1000.	1360.
1938	940.	1230.	1442.	1577.	1615.	1717.	2045.	2390.	2390.	2004.	1480.	956.	1649.
1939	889.	994.	1187.	1413.	1504.	1652.	1951.	2348.	2287.	1885.	1242.	739.	1508.
1940	698.	786.	996.	1050.	1166.	1367.	1668.	2006.	1803.	1309.	616.	201.	1139.
1941	99.	157.	288.	335.	368.	539.	769.	824.	544.	558.	492.	287.	438.
1942	371.	527.	710.	755.	803.	888.	1165.	1269.	1413.	1200.	732.	411.	854.
1943	353.	511.	690.	813.	888.	1021.	1429.	1874.	2305.	2256.	1807.	1417.	1280.
1944	1379.	1414.	1589.	1625.	1696.	1805.	1987.	2204.	2038.	1325.	647.	282.	1499.
1945	151.	208.	309.	581.	745.	842.	973.	1344.	1566.	1156.	600.	239.	726.
1946	240.	399.	533.	675.	731.	843.	1129.	1806.	2254.	2176.	1689.	1182.	1138.
1947	1229.	1315.	1659.	1800.	1950.	2189.	2390.	2390.	2316.	1928.	1468.	1000.	1803.
1948	1206.	1487.	1629.	1728.	1827.	1917.	2100.	2390.	2390.	2182.	1730.	1286.	1823.
1949	1285.	1423.	1564.	1625.	1738.	1850.	2174.	2390.	2390.	2244.	1800.	1414.	1825.
1950	1507.	1600.	1700.	1800.	1895.	2091.	2275.	2390.	2390.	2390.	2041.	1684.	1980.
1951	1600.	1600.	1700.	1800.	1950.	2055.	2371.	2390.	2390.	2390.	2087.	1582.	1007.	1878.
1952	1089.	1234.	1336.	1381.	1455.	1531.	1823.	2269.	2360.	2053.	1557.	917.	1584.
1953	839.	827.	844.	1225.	1469.	1585.	1818.	2232.	2390.	2264.	1817.	1402.	1559.
1954	1384.	1501.	1700.	1800.	1915.	2011.	2239.	2390.	2390.	2390.	2063.	1708.	1958.
1955	1600.	1600.	1695.	1766.	1906.	1986.	2081.	2390.	2390.	2390.	1996.	1628.	1952.
1956	1600.	1600.	1700.	1800.	1860.	1946.	2299.	2390.	2390.	2377.	1953.	1581.	1958.
1957	1594.	1600.	1700.	1789.	1851.	1948.	2238.	2390.	2346.	1902.	1305.	819.	1790.
1958	765.	810.	970.	1076.	1246.	1369.	1633.	2175.	2177.	1732.	1171.	741.	1322.
1959	816.	1230.	1598.	1800.	1905.	2071.	2390.	2390.	2390.	2159.	1688.	1518.	1830.
1960	1600.	1600.	1700.	1770.	1877.	2030.	2330.	2390.	2390.	2034.	1560.	1000.	1857.
1961	1012.	1232.	1314.	1520.	1809.	2010.	2330.	2390.	2390.	2073.	1584.	1004.	1722.
1962	1030.	1134.	1305.	1577.	1743.	1820.	2190.	2390.	2390.	2094.	1633.	1071.	1698.
1963	1091.	1369.	1582.	1729.	1950.	2095.	2264.	2390.	2265.	1836.	1292.	850.	1726.
1964	806.	927.	1009.	1170.	1240.	1355.	1565.	2007.	2390.	2390.	2061.	1740.	1555.
1965	1600.	1600.	1700.	1800.	1950.	2101.	2390.	2390.	2390.	2074.	1595.	1033.	1885.
1966	1004.	1085.	1154.	1234.	1271.	1368.	1679.	2110.	2260.	1936.	1412.	942.	1454.
1967	912.	1003.	1282.	1534.	1716.	1827.	1900.	2292.	2390.	2108.	1624.	1019.	1634.
1968	1218.	1398.	1700.	1800.	1950.	2166.	2289.	2390.	2366.	1979.	1517.	1133.	1825.
1969	1211.	1424.	1586.	1787.	1819.	1911.	2194.	2390.	2390.	2025.	1528.	1050.	1776.
1970	1034.	1080.	1130.	1224.	1298.	1429.	1643.	2069.	2390.	2048.	1550.	1000.	1491.
1971	959.	1075.	1154.	1402.	1663.	1750.	1864.	2390.	2390.	2390.	2016.	1669.	1727.
1972	1600.	1600.	1700.	1800.	1950.	2200.	2390.	2390.	2390.	2390.	2067.	1766.	2020.
1973	1600.	1600.	1700.	1800.	1846.	1942.	2062.	2251.	2072.	1452.	787.	303.	1618.
1974	216.	304.	449.	810.	948.	1094.	1374.	1845.	2390.	2390.	2059.	1731.	1301.
1975	1600.	1600.	1700.	1800.	1909.	2013.	2128.	2390.	2390.	2390.	2065.	1716.	1975.
1976	1600.	1600.	1700.	1800.	1950.	2042.	2260.	2390.	2390.	2315.	2017.	1617.	1974.
1977	1548.	1600.	1700.	1800.	1918.	2024.	2214.	2158.	1951.	1056.	600.	336.	1576.
TOTAL	52587.	58169.	65294.	71990.	78028.	85246.	97767.	111136.	113648.	99783.	75485.	53019.	80179.
AVERAGE	1011.	1119.	1256.	1384.	1501.	1639.	1880.	2137.	2186.	1919.	1452.	1020.	1542.

KAC - KACHESS LAKE, WA - END OF MONTH CONTENT - 1000 AF

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1978	87.14	122.17	178.80	188.32	195.96	217.15	238.18	242.30	237.17	213.46	189.04	172.58	2282.26
1979	153.78	162.40	172.80	178.46	188.20	207.98	229.65	235.73	214.86	132.61	60.72	29.13	1966.32
1980	21.73	24.87	61.15	69.12	77.59	92.61	127.55	163.37	177.86	152.15	122.04	98.13	1188.17
1981	90.53	112.31	164.42	179.65	204.41	217.90	240.39	237.17	236.58	220.44	160.51	109.90	2174.23
1982	109.98	118.30	129.39	147.97	182.65	203.21	221.31	229.71	238.26	216.97	175.43	142.78	2115.94
1983	145.16	153.22	170.02	199.07	207.31	223.60	227.05	238.45	229.92	219.00	181.59	134.92	2329.31
1984	117.07	139.05	147.96	188.78	201.77	221.68	229.96	238.21	236.71	217.68	170.63	129.37	2238.87
1985	124.40	135.63	144.87	149.64	154.09	163.73	200.69	235.74	234.28	186.02	96.86	60.35	1886.30
1986	68.22	93.54	98.07	106.97	128.62	159.18	181.73	213.85	185.98	100.70	45.52	24.48	1406.86
1987	21.64	47.27	55.46	62.23	69.28	90.65	126.73	165.72	153.25	95.44	38.91	23.76	950.35
1988	22.03	23.48	31.76	36.89	49.49	71.03	110.93	149.56	166.49	122.55	56.08	25.88	866.18
AVERAGE	87.42	102.93	133.16	137.01	150.85	169.88	194.02	213.62	210.12	170.64	117.94	86.48	1764.07
MAXIMUM	153.78	162.40	178.80	199.07	207.31	223.60	240.39	242.30	238.26	220.44	189.04	172.58	2329.31
MINIMUM	21.64	23.48	31.76	36.89	49.49	71.03	110.93	149.56	153.25	95.44	38.91	23.76	866.18

APPENDIX B

BAS' DATA FILE TITLE: NO STORAGE UNREGULATED FLOWS
YEAR ATA FILE TITLE: ZERO DIVERSIONS ALL CANALS
CABIN CREEK CFS ON

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVG
36	15	13	124	85	74	148	187	70	3	2	15	3	62
37	57	81	138	60	36	67	171	257	232	37	11	3	96
38	115	193	260	208	66	130	151	376	91	54	13	5	139
39	33	34	8	5	32	65	97	254	64	31	44	3	54
40	0	18	3	16	58	130	267	120	3	13	24	3	55
41	15	27	3	15	61	62	151	262	3	3	3	3	51
42	85	52	44	76	120	336	232	285	108	28	13	10	106
43	26	232	176	146	43	59	193	281	281	93	28	24	132
44	184	210	607	323	221	237	329	215	34	33	26	17	203
45	49	213	127	276	206	102	139	267	121	47	34	17	133
46	8	29	3	18	42	81	311	449	123	44	5	3	93
47	16	12	3	15	[illegible]	62	108	270	227	44	7	3	66
48	36	74	135	101	12	81	208	340	178	47	7	3	102
49	20	45	76	135	59	94	213	231	22	42	24	12	81
50	26	45	120	34	49	89	148	185	3	3	3	5	60
51	29	25	63	[illegible]	[illegible]	81	156	65	3	3	3	10	41
52	54	79	99	[illegible]	[illegible]	44	136	135	104	44	21	5	66
53	34	69	112	81	89	60	292	338	287	86	55	44	125
54	47	24	93	28	45	68	101	151	52	52	23	39	60
55	18	37	31	182	110	41	47	190	82	5	21	10	64
56	29	77	73	85	34	81	197	385	183	49	18	5	102
57	54	27	257	119	121	146	150	158	17	39	78	49	101
58	111	205	150	65	70	91	153	366	229	44	18	7	126
59	42	67	65	46	61	104	281	496	244	57	34	17	126
60	83	180	171	88	72	150	175	351	408	145	54	39	160
61	72	235	220	143	241	106	225	335	101	75	16	18	148
62	55	71	55	28	45	50	168	239	92	47	16	0	72
63	16	5	13	151	189	73	126	224	141	47	21	15	85
64	41	37	221	83	94	73	141	291	222	98	24	3	111
65	33	57	44	50	113	49	69	239	338	115	36	22	96
66	98	222	163	65	30	42	259	532	323	65	16	10	152
67	49	47	337	55	32	50	175	270	72	21	13	0	93
68	20	17	57	47	131	83	158	231	45	18	20	12	69
69	62	247	223	192	90	119	202	220	131	21	16	52	131
70	171	341	172	33	56	85	168	176	129	42	29	22	118
71	37	96	39	94	187	132	210	262	163	36	26	13	107
72	46	44	72	176	142	47	220	155	126	44	24	20	92
73	42	123	127	109	139	98	99	127	57	52	46	24	86
74	29	39	34	55	47	78	168	304	350	102	49	40	108
75	34	45	127	163	194	117	200	203	129	42	3	27	106
76	41	22	31	28	27	52	217	177	86	16	2	12	59
77	11	42	161	176	146	81	72	226	168	49	39	24	99
78	115	94	207	161	200	156	91	132	74	31	24	35	110
79	75	116	106	81	5	52	205	356	146	44	16	44	104
80	46	27	31	29	50	99	124	250	158	39	39	13	76
81	26	24	33	159	182	16	42	421	170	99	46	29	104
82	42	77	86	146	219	333	178	441	277	120	60	49	169
83	47	50	200	128	43	60	81	163	62	65	44	40	83
84	16	29	54	259	104	88	222	340	561	83	2	49	150
85	36	25	150	246	160	86	74	625	314	122	83	45	164
86	62	200	756	143	139	120	227	437	72	67	34	3	189
87	37	42	59	120	63	57	118	119	84	55	37	66	71
AV	49	85	129	103	91	94	170	269	148	51	26	20	103

9-… (Rev. May 1971)

Daily Gage Height, in Feet, and Discharge, in Cubic Feet, per Second, of CABIN ~~River~~ Creek near EASTON WASH. for the Year Ending September 30, 1987

UNITED STATES
DEPARTMENT OF THE INTERIOR

Station Number CABW

Used rating table dated

Drainage Area 29.3 Square Miles. Water-Stage ~~Recorder~~ STAFF GAGES Ratio 0.00 TO 10.14 Gage Read to HUNDREDS (Once Twice) a Day by ARNE AHO

Gage heights used to half tenths between ___ and ___ feet; hundredths below and tenths above these limits.

Δ = (NO GAGE HEIGHTS) DISCHARGE OBTAINED BY CORRELATION WITH DEEP CREEK

* = MEASUREMENT MADE THIS DAY

Day	October Gage height	October Discharge	November Gage height	November Discharge	December Gage height	December Discharge	January Gage height	January Discharge	February Gage height	February Discharge	March Gage height	March Discharge
1	Δ	12	Δ	14	1.62	114	1.16	32	1.08	25	1.10	28
2		12		14	1.59	106	1.16	32	1.26	43	1.12	30
3		11		14	*1.57	101	1.14	30	1.28	46	1.18	35
4		11		13	1.52	88	1.12	29	1.14	30	*1.67	132
5		11		14	1.50	82	1.10	27	1.10	27	1.80	175
6		11		14	1.45	73	*1.11	28	1.08	25	1.90	213
7		11		14	1.45	73	1.09	26	1.08	25	1.82	182
8		10		13	1.40	65	*1.07	25	1.06	23	1.68	135
9		10		12	*1.38	61	1.08	26	1.06	23	1.64	123
10		9		12	1.34	55	1.08	26	1.06	23	1.66	129
11		9		12	1.32	51	1.06	24	1.10	27	1.64	123
12		9		11	1.35	55	1.06	23	1.12	29	1.60	111
13		9		11	1.30	47	1.04	21	1.18	34	1.94	230
14		9		11	1.30	47	1.04	21	1.22	38	1.92	222
15		9		11	1.30	46	0.97	16	1.24	41	1.90	213
16		9		12	*1.28	43	*0.96	15	1.24	41	1.82	182
17		9		12	1.28	43	0.94	14	1.22	38	1.78	168
18		9		22	1.22	36	1.02	20	1.20	36	1.72	148
19		8		29	1.22	36	1.00	18	1.19	35	1.68	135
20		8		72	1.20	34	0.98	16	1.17	33	1.62	117
21	Δ	8		76	1.20	35	0.98	16	1.16	32	1.68	135
22	*0.83	7.9		68	1.20	35	0.98	16	1.14	30	1.62	117
23	Δ	8		306	1.25	41	0.96	15	1.13	30	1.54	96
24		7		1234	1.25	41	0.96	15	1.11	28	1.50	85
25		7		457	1.20	35	0.96	15	*1.10	28	1.52	90
26		7		267	1.20	35	0.94	14	1.12	29	1.50	85
27		7		184	1.18	33	0.98	16	1.10	27	1.48	81
28		9		149	1.16	31	0.96	15	1.10	28	1.48	81
29		13		125	1.14	30	0.98	16	—	—	1.48	79
30		19	Δ	1.5	1.20	35	0.98	16			1.48	79
31	Δ	14			1.18	34	1.04	21			1.50	83
Total		303		3316		1641		644		874		3842
Mean		10		111		53		21		31		124
Maximum		19		1234		114		32		46		230
Minimum		7		11		30		14		23		28
Cfsm.												
Runoff in Inches												
Acre-feet		601		6581		3255		1277		1734		7621

Day	April Gage height	April Discharge	May Gage height	May Discharge	June Gage height	June Discharge	July Gage height	July Discharge	August Gage height	August Discharge	September Gage height	September Discharge	Water Year
1	1.56	103	2.52	669	*1.63	89	1.14	22	0.93	8.5	0.78	3.6	
2	1.80	171	2.34	464	1.58	77	1.12	21	0.92	8.1	0.78	3.6	
3	1.98	243	2.20	375	1.56	73	1.10	19	*0.90	7.1	0.78	3.6	
4	1.98	243	2.16	348	1.55	71	1.08	17	0.90	7.1	*0.79	3.8	
5	1.98	243	2.20	375	1.55	71	1.08	17	0.90	7.1	0.78	3.6	
6	1.98	243	2.42	535	1.52	65	1.08	18	0.90	7.1	0.78	3.6	
7	1.96	234	2.50	590	1.48	58	1.08	18	0.88	6.6	0.78	3.6	
8	2.06	285	2.52	579	1.48	58	1.08	18	0.86	5.9	0.78	3.6	
9	1.98	243	2.46	493	1.48	58	*1.08	18	0.86	5.9	0.78	3.6	
10	1.96	234	2.36	390	1.42	49	1.08	18	0.86	5.9	0.78	3.6	
11	1.92	217	*2.29	328	1.40	47	1.06	17	0.85	5.9	0.78	3.6	
12	1.88	201	2.30	342	1.40	47	1.04	15	0.85	5.9	0.78	3.6	
13	1.80	171	2.12	238	1.38	43	1.04	15	0.85	5.9	0.78	3.6	
14	1.66	201	2.06	217	1.35	41	1.02	14	0.85	5.9	0.78	3.6	
15	1.96	234	1.98	190	1.32	37	1.02	14	0.85	5.9	0.80	4.6	
16	2.20	375	1.92	168	1.30	35	1.00	13	0.84	5.9	0.82	5.3	
17	2.60	765	1.66	151	1.30	35	1.00	13	0.84	5.9	0.82	5.3	
18	2.20	375	1.80	132	1.28	33	1.00	13	0.84	5.9	0.80	4.6	
19	1.96	234	*1.75	120	1.28	33	1.00	13	0.83	5.6	0.78	3.9	
20	1.92	217	1.70	106	1.28	33	1.00	13	0.83	5.6	0.78	3.9	
21	1.88	201	1.68	101	1.28	33	1.00	13	0.82	5.6	0.78	3.9	
22	*2.00	251	1.64	90	1.28	33	1.00	13	0.82	5.6	0.76	3.2	
23	2.14	335	1.62	85	*1.24	30	0.98	11	0.82	5.6	0.76	3.2	
24	2.16	346	1.60	81	1.20	26	0.98	11	*0.82	5.7	*0.76	3.2	
25	2.12	321	1.60	81	1.18	24	0.96	10	0.80	4.9	0.76	3.2	
26	2.10	306	1.58	77	1.16	23	0.96	10	0.80	4.6	0.76	3.2	
27	2.38	516	1.58	77	1.15	22	*0.96	10	0.80	4.6	0.76	3.2	
28	*2.59	753	1.56	73	1.14	21	0.94	9.4	0.80	4.6	0.76	3.2	
29	2.65	835	1.54	69	1.14	21	0.94	9.4	0.80	4.6	0.76	3.2	
30	2.72	935	1.56	73	1.14	21	0.94	9.4	0.78	3.9	0.76	3.2	
31			1.60	81			0.94	9.0	0.78	3.9			
Total		10037		7718		1307		441		181.3		110.9	30417.
Mean		335		249		44		14		5.8		3.7	83.
Maximum		935		669		69		22		8.5		5.3	1234.
Minimum		103		69		21		9.0		3.9		3.2	3.2
Cfsm.													
Runoff in Inches													
Acre-feet		19908		15309		2592		875		360		220	60332

Calendar Year: Max Disch. ___ CF. ___ (G. H.) ___ (ft.) Min. ___ Min. Disch. ___

U.S. GOVERNMENT PRINTING OFFICE: 1971—…

BUREAU OF RECLAMATION
P.O. BOX 1749
YAKIMA, WA 98907

UNITED STATES
DEPARTMENT OF THE INTERIOR

PRELIMINARY

WY 1988

Station Number CABW

Daily Gage Height, in Feet, and Discharge, in Cubic Feet per Second, of CABIN WY 88 Creek

At Near Easton, Wa. for the Year Ending September 30, 1988

Used rating table dated 1-20-87

Drainage Area 293 Square Miles. Water-Stage Recorder Staff Gages Range 0.00 to 10.14 Gage Read to Hundredths (Once / Twice) a Day by Arne Aho

Gage heights used to half tenths between ____ and ____ f. hundredths below and tenths above these limits.

Day	October		November		December		January		February		March		Day	April		May		June		July		August		September		Day
	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge		Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	
1	0.74	3.0	0.74	3.0	1.00	13	0.98	12	1.68	16	1.82	138	1	1.84	151	2.12	274	1.64	98	1.16	25	0.86	5.9	0.72	2.6	1
2	0.74	3.0	0.74	3.0	1.10	20	1.98	12	1.08	16	1.92	171	2	1.96	194	2.04	254	1.64	98	1.16	25	0.86	5.9	0.72	2.6	2
3	0.74	3.0	0.74	3.0	1.20	30	1.98	12	1.10	17	1.96	226	3	2.20	308	1.96	201	1.62	93	1.14	23	0.84	5.3	0.72	2.6	3
4	0.74	3.0	0.74	3.0	1.18	28	0.96	11	1.10	17	1.90	164	4	2.08	243	1.92	186	1.60	88	1.12	21	0.84	5.3	0.72	2.6	4
5	0.74	3.0	0.76	3.2	1.24	33	0.90	7.5	1.12	19	1.84	145	5	2.10	251	1.88	171	1.58	82	1.10	20	0.84	5.3	0.72	2.6	5
6	0.72	2.8	0.76	3.2	1.28	37	0.90	7.5	1.36	42	1.78	126	6	2.10	251	1.92	186	1.58	82	1.10	20	0.82	4.6	0.72	2.6	6
7	0.72	2.8	0.76	3.2	1.28	37	0.90	7.5	1.58	76	1.70	106	7	2.18	302	1.94	194	1.58	82	1.08	18	0.82	4.6	0.72	2.4	7
8	0.72	2.8	0.76	3.2	1.24	33	0.92	9.0	1.70	103	1.76	123	8	2.06	238	1.98	207	1.58	82	1.06	16	0.82	4.6	0.74	2.8	8
9	0.72	2.8	0.76	3.2	1.40	52	0.92	9.0	1.90	164	1.82	141	9	2.00	213	2.22	335	1.58	82	1.06	16	0.80	3.9	0.74	2.8	9
10	0.72	2.8	0.76	3.2	1.80	148	0.92	9.0	2.08	234	1.78	129	10	2.00	213	2.36	435	1.58	82	1.06	16	0.80	3.9	0.72	2.6	10
11	0.72	2.8	0.76	3.2	1.60	90	0.92	9.0	2.20	291	1.72	111	11	2.02	222	2.58	645	1.56	78	1.06	16	0.80	3.9	0.72	2.6	11
12	0.72	2.8	0.78	3.9	1.46	61	0.92	9.0	2.14	257	1.70	106	12	2.22	328	2.80	935	1.54	74	1.08	18	0.80	3.9	0.72	2.6	12
13	0.72	2.8	0.82	5.3	1.36	47	0.94	9.9	2.00	198	1.68	101	13	2.30	382	2.60	669	1.52	70	1.08	18	0.80	3.9	0.72	2.6	13
14	0.72	2.8	0.86	6.6	1.30	40	1.00	13	1.85	145	1.66	96	14	2.60	657	2.42	484	1.52	70	1.08	18	0.80	3.9	0.72	2.6	14
15	0.72	2.8	0.88	7.5	1.26	35	1.08	19	1.78	123	1.66	96	15	2.64	705	2.30	790	1.52	70	1.08	18	0.80	3.9	0.74	2.8	15
16	0.72	2.8	0.90	8.5	1.22	31	1.10	20	1.72	106	1.66	96	16	2.62	681	2.28	375	1.54	74	1.04	15	0.80	3.9	0.78	3.2	16
17	0.72	2.8	0.90	8.5	1.18	28	1.16	26	1.68	96	1.64	90	17	2.60	657	2.18	308	1.56	66	1.00	12	0.82	4.6	0.80	3.9	17
18	0.72	2.8	0.86	6.6	1.16	26	1.14	23	1.62	82	1.64	90	18	2.56	612	1.98	209	1.46	60	.98	11	0.80	3.9	0.80	3.9	18
19	0.72	2.8	0.82	5.3	1.14	24	1.14	23	1.62	82	1.66	96	19	2.54	590	2.00	217	1.44	57	.96	10	0.80	3.9	0.86	5.9	19
20	0.72	2.8	0.82	5.3	1.12	22	1.14	23	1.62	82	1.70	106	20	2.52	568	2.04	234	1.40	51	.96	10	0.80	3.9	0.90	7.5	20
21	0.72	2.8	0.84	5.9	1.08	19	1.16	25	1.60	78	1.78	132	21	2.50	546	2.04	234	1.40	51	.96	10	0.80	3.9	0.82	6.6	21
22	0.72	2.8	0.86	6.6	1.10	20	1.10	19	1.64	88	1.80	138	22	2.46	535	2.04	234	1.36	46	.94	9.4	0.80	3.9	0.84	6.3	22
23	0.72	2.8	0.98	12.0	1.10	20	1.10	19	1.62	82	1.82	145	23	2.42	484	2.02	226	1.32	41	.94	9.4	0.78	3.2	0.80	3.9	23
24	0.72	2.8	0.98	12.0	1.08	19	1.10	19	1.58	74	1.76	126	24	2.22	335	1.92	186	1.32	41	.92	8.5	0.76	3.2	0.80	3.9	24
25	0.72	2.8	1.00	13.2	1.00	13	1.12	20	1.56	70	1.82	145	25	2.10	262	1.88	171	1.30	38	.90	7.5	0.74	2.8	0.80	3.9	25
26	0.72	2.8	1.00	13.2	1.00	13	1.10	19	1.60	78	1.90	171	26	2.06	243	1.86	164	1.26	34	.90	7.5	0.74	2.8	0.80	3.9	26
27	0.72	2.8	0.96	10.8	0.98	12	1.10	18	1.64	88	1.94	186	27	2.08	251	1.82	151	1.22	30	.90	7.5	0.74	2.8	0.80	3.9	27
28	0.72	2.8	0.90	8.0	0.98	12	1.14	21	1.70	103	1.86	158	28	2.18	308	1.78	138	1.20	29	.88	6.6	0.74	2.8	0.80	3.9	28
29	0.74	3.0	0.88	7.1	0.98	12	1.14	21	1.76	120	1.80	138	29	2.28	375	1.76	126	1.18	27	.88	6.6	0.74	2.8	0.80	3.9	29
30	0.74	3.0	0.88	7.1	0.98	12	1.14	21			1.76	126	30	2.20	321	1.68	108	1.18	27	.88	6.6	0.74	2.8	0.80	3.9	30
31	0.74	3.0			0.98	12	1.14	21			1.72	114	31			1.66	103									31
Total	88.4		187.8		999		493.4		2947		4036			11,426		8732		1903		432.2		120.0		107.1		31465.3
Mean	2.85		6.26		32.22		15.92		101.62		130.29			380.86		281.67		63.63		13.94		3.97		3.37		85
Maximum	3.0		13.2		148		26		290		226			705		935.0		98		25		6		7.5		935
Minimum	2.8		3.0		12		8.		16		90			151		103.0		27		7.5		2.8		2		2.6
Cfsm																										
Runoff in inches																										
Acre-feet	175		373		1982		979		5845		8005			22663		17320		3787		857.3		238		212.4		62410

Year

Fourth / Third / Second / First / Quarter — Computed / Checked

Fourth / Third / Second / First / Quarter — Disch. applied / Disch. checked

Fourth / Third / Second / First / Quarter — G.H. copied / G.H. checked

Period Year

U.S. GOVERNMENT PRINTING OFFICE: 1971—423-788

(Rev. May 1971)

BUREAU OF RECLAMATION
P.O. BOX 1749
[illegible] STATES
DEPARTMENT OF THE INTERIOR

PRELIMINARY CABW
10-26-89

Daily Gage Height, in Feet, and Discharge, in Cubic Feet, per Second, of CABIN River / Creek

At (Near) Easton, WA for the Year Ending September 30, 1989

Used rating table dated 1-20-87

Drainage Area 29.3 Square Miles. Water-Stage Recorder Staff gages Ratio 0.00 10.14 Gage Read to Hundredths Once / Twice a Day by Arne Aho

Gage heights used to half tenths between ____ and ____ hundredths below and tenths above these limits.

Day	October		November		December		January		February		March	
	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
1	0.80	e 39		29	1.24	e 49	1.56	101 96	2.24	e 398	1.12	e 24
2	0.80	39		29	1.30	44	1.52	85	1.92	213	1.12	24
3	0.80	39		28	1.30	44	1.62	111	1.72	141	1.12	e 24
4	0.80	e 39		28	1.28	42	1.80	175	1.72	141	1.16	e 33
5	0.70	e 32		27	1.28	42	1.76	154	1.72	141	1.14	31
6	0.80	e 39		28	1.32	47	1.70	135	1.72	141	1.16	33
7	0.80	e 39		29	1.80	161	1.68	129	1.62	114	1.19	35
8	0.78	e 38	Snow	29	1.72	135	1.64	117	1.52	89	1.16	33
9	0.78	e 38		31	1.80	161	1.60	106	1.48	78	1.11	95
10	0.78	e 38		31	1.80	161	1.56	96	1.44	70	1.12	52
11	0.76	3.0		33	1.78	e 154	1.52	85	1.42	66	1.40	64
12	0.76	3.0		33	2.02	e 247	1.52	80	1.38	60	1.48	80
13	0.78	3.1		34	2.42	e 535	1.46	72	1.38	60	1.48	80
14	0.80	3.9		34	2.14	321	1.46	72	1.34	54	1.48	80
15	1.60	58		36	1.98	234	1.47	76	1.32	51	1.44	72
16	2.32	450		34	1.82	171	1.50	80	1.32	51	1.40	64
17	1.94	194		38	1.76	151	1.66	133	1.30	48	1.38	61
18	1.82	103	Snow	39	1.68	126	1.70	168	1.28	46	1.38	61
19	1.62	e 93		41	1.66	120	1.80	168	1.26	43	1.36	58
20	1.50	e 69		43	1.60	103	1.70	135	1.26	43	1.36	58
21	1.46	61		45	1.58	98	1.62	111	1.24	41	1.46	76
22	1.42	55		48	1.56	93	1.58	100	1.24	41	1.48	80
23	1.38	49		53	1.52	82	1.54	90	1.22	38	1.48	80
24	1.30	40		51	1.48	74	1.50	80	1.22	38	1.48	80
25	1.28	37		54	1.42	62	1.46	72	1.20	36	1.50	85
26	1.24	33		55	1.38	57	1.42	64	1.18	34	1.50	85
27	1.22	31		56	1.38	57	1.40	61	1.18	34	1.50	85
28	1.20	30	Snow	54	1.38	e 57	1.40	61	1.16	e 32	1.54	96
29	1.18	e 28		51	1.40	e 61	1.40	61			1.54	96
30	1.19	e 29		50	1.50	80	2.06	380			1.51	96
31	1.16	e 29			1.60	e 106	2.32	e 458			1.50	e 85
Total		1469		1173		3815		3701		2341		1976
Mean		47		39		125		119		83		64
Maximum		450		56		535		458		398		96
Minimum		32		27		128		61		32		31
Cfsm												
Runoff in inches												
Acre-feet		2942		2327		7626		7340		4643		3919

Day	April		May		June		July		August		September		Day
	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	
1	1.48	101 80	2.36	e 435	1.18	101 132	1.22	105 33	.94	102 13	.96	101 15	1
2	1.46	76	2.32	e 398	1.18	132	1.20	31	.94	13	.94	13	2
3	1.40	64	2.38	e 442	1.20	138	1.18	30	.94	13	.90	11	3
4	1.42	68	2.40	e 458	1.20	141	1.18	30	.94	13	.96	9.0	4
5	1.30	175	2.42	e 481	1.20	141	1.16	23	.92	102 11	.96	9.0	5
6	2.50	657	2.24	e 484	1.26	e 129	1.12	24	.92	102 12	.96	9.0	6
7	2.68	891	2.26	e 501	1.20	111	1.10	22	.92	12	.96	9.0	7
8	2.52	681	2.28	e 510	1.28	106	1.10	22	.92	12	.94	8.0	8
9	2.34	492	2.32	e 438	1.64	98	1.08	102 20	.90	11	.94	8.0	9
10	2.20	248	2.26	e 335	1.58	e 82	1.08	102 21	.90	11	.92	7.0	10
11	2.20	e 362	2.18	e 335	1.54	e 74	1.08	21	.90	11	.92	7.0	11
12	2.28	e 420	1.98	e 190	1.52	e 70	1.06	20	.90	11	.92	102 7.0	12
13	2.40	e 518	1.92	e 168	1.50	e 68	1.06	20	.90	11	.92	102 6.6	13
14	2.60	e 729	1.88	e 151	1.48	e 64	1.06	20	.88	102 10	.92	6.6	14
15	2.54	657	1.86	e 149	1.46	e 61	1.06	20	.88	102 10	.92	102 6.6	15
16	2.50	e 612	1.88	e 151	1.44	e 58	1.04	18	.90	11	.92	103 6.3	16
17	2.38	e 484	1.90	e 158	1.42	e 55	1.02	19	.90	11	.80	6.2	17
18	2.28	e 405	1.88	e 151	1.38	e 49	1.02	19	.92	13	.80	6.2	18
19	2.36	e 467	1.86	e 148	1.36	e 47	1.04	20	.92	13	.80	6.2	19
20	2.42	e 510	1.80	e 129	1.36	e 48	1.04	19	.94	14	.80	6.2	20
21	2.46	e 546	1.72	e 106	1.30	41	1.05	20	.96	16	.80	6.2	21
22	2.34	e 442	1.72	e 106	1.30	41	1.05	20	.98	16	.78	4.9	22
23	2.26	e 375	1.70	e 103	1.28	38	1.05	20	.98	16	.78	4.9	23
24	2.22	e 348	1.74	e 114	1.26	36	1.02	18	.98	16	.78	4.9	24
25	2.20	e 335	1.70	e 103	1.24	34	.94	15	.98	16	.76	5.6	25
26	2.20	e 328	1.72	e 108	1.24	34	.94	13	.98	16	.82	5.6	26
27	2.20	e 328	1.72	e 108	1.24	34	.94	13	.98	16	.80	5.6	27
28	2.20	e 321	1.72	e 111	1.22	32	.94	13	.98	16	.80	102 5.6	28
29	2.24	e 348	1.72	e 111	1.22	32	.94	13	.98	16	.80	102 5.3	29
30	2.24	e 348	1.70	e 106	1.22	e 32	.94	13	.98	16	.80	102 5.3	30
31			1.78	e 129			.94	e 13	.98	e 16			31
Total		12435.		7343		2158		628		412		219.8	37,731.
Mean		412		237		72		20		13		7	103
Maximum		897		510		141		33		16		15	897
Minimum		64		103		30		13		10		4.7	3.2
Cfsm													
Runoff in inches													
Acre-feet		24665		14564		4280		1246		817		436	74 837

Min. Discharge 1.20 cfs on 22nd also 10th

Quarters: First Second Third Fourth — Computed Checked — Discharge applied Discharge checked — C.H. copied C.H. checked

U.S. GOVERNMENT PRINTING OFFICE: 1971—423-788

MINIMUM