Water Quality Status Report No. 10

Water Quality and Pollution Report

Middle Snake River, Adrian to Weiser

River Mile 397 – 345

Idaho – Oregon

1961 – 1964

State of Idaho
Department of Health
Engineering and Sanitation Division

#10

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CONTENTS

Water Pollution Control

Report on Middle Snake River

(Adrian to Farewell Bend)

Introduction

A study of the middle Snake River from Adrian to Farewell Bend, Oregon, was completed by the Oregon State Sanitary Authority and the Idaho State Department of Health with the cooperation of the United States Public Health Service.

The Snake River is the state border between Idaho and Oregon throughout most of this section. The Boise River-8%, Payette River-23%, Malheur River-less than 2%, and the Weiser River-9% (Owyhee River is not gaged) comprise the Snake River at Weiser based upon the mean annual flow and are tributaries to the Snake River in this section.

The Snake River is a relatively shallow stream estimated to average 4 to 6 feet deep. The velocity is estimated to be about 2 feet per second during mean flows and has a channel width varying considerably but more frequently 300 to 400 feet.

The land throughout this section is heavily irrigated. The river has a normal high spring runoff and normal decreased flows in July and August (based on the Weiser Station), but the peak discharge normally only slightly doubles the mean water year flow. Some 10 hydroelectric projects are above this section on the Snake River.

A comparison of the mean values of 37 mineral analysis of samples collected from August 11, 1911, to August 14, 1912, at the power house, 1 mile below Weiser [2] with the mean of 11 samples collected monthly except for

Survey Objectives

Prior to the survey, objectives were outlined by the States of Idaho and Oregon to focus survey information to be of maximum value in (1) establishing water quality objectives, (2) defining existing pollution problems and (3) establishing minimum treatment requirements in regard to municipalities and industries.

OBJECTIVE (1): Augment the basic data collected on the Snake River system.

Status (1): River surveys were completed on August 22-24, 1961, and January 16, 1962, and supplemented with municipal and industrial plant surveys. Existing and special survey data has been supplemented with mineral analysis and sanitary data collected monthly from August, 1960, to July, 1962, and quarterly since that time at the Malheur River and Snake River stations. The stations used in the survey are listed in the Appendix by river miles.

OBJECTIVE (2): Collect basic biological data on the main stem of the Snake River and rivers tributary to the Snake River.

Status (2): Basic data was collected and a biological report was completed. (See Appendix). The biological data has been supplemented by many separate surveys and observations made in collecting routine samples.

OBJECTIVE (3): Evaluate the existing industrial wastes loading to the basin.

Status (3): The municipal and industrial waste loadings have been evaluated in terms of location and population equivalent, etc., where such information is available. See Tables A and B, pages 9 and 10.

OBJECTIVE (4): Assess the present public use of these waters relative to water quality requirements.

Status (4): The predominate use of water appears to be irrigation. However, in this particular section the streams would be more closely classified as

return channels for irrigated lands.

The highest water quality requirement is for municipal supplies. Municipal use has been suggested (Ontario) but the hardness and other qualities (algae) are deterrents to use for this purpose.

Recreation has the second water quality requirement. Farewell Bend State Park in Oregon and an area below Weiser are developed or are being developed for recreational purposes. Backwater of Brownlee Dam, which extended into this study section, has increased recreational use and more utilization can be expected. Boating and water skiing activities are increasing each year throughout the study area. Boat docks and shore installations are being built by communities and organizations to promote recreational use of the river.

Special water quality requirements which are not common to municipal and recreational uses must be applied to agricultural and industrial supplies.

Results and Conclusions of Study

1. The bacteriological quality as measured by M.P.N. samples does not meet standards recommended for recreational use.
2. The bacteriological quality occasionally does not meet recommended standards of raw water quality for water treatment plants. (Appendix F, 1)
3. Settleable and soluble solids discharged to the river create objectionable sludge deposits and bacterial slime growths. These problems are the most pronounced below the cities of Nyssa, Ontario and Payette.
4. The Snake River as it enters the study area is nutrient rich and supports abundant biological and algae populations.
5. Irrigation return waters are one of the prime sources of nutrients.
6. Phosphates are suggested to be the limiting factor in algae production.
7. Algae produce such quantities of oxygen during the day that at the time and at the points sampled, there was sufficient dissolved oxygen present to satisfy three times that required by the five-day B.O.D. present at the stations.
8. Experience has shown that primary treatment will not remove sufficient nutrient, i.e. phosphates, to materially change the physical, chemical, or visual character of the stream, unless the stream character is changed upstream.
9. Algae, as they die, add materially to the organic load (oxygen demand) of the stream.
10. Oxygen deficiencies may be expected in the depths of the Brownlee pool due in part to the settling and decay of algae loads.
11. Settleable solids must be removed to prevent objectionable bottom deposits.
12. Winter B.O.D. loadings are higher than summer loadings.
13. The dissolved oxygen content during the summer run increased from 70% saturation at Adrian to 120% saturation at Weiser. A diurnal oxygen sample at

Adrian was 80.5% and at Weiser 76% of the oxygen saturation value. As suspected, the pH dropped significantly at both stations at night. This seems to verify the role played by algae in this river system section.

14. Additional studies and research on the Snake River system should be undertaken and should include basic data relating to the quantity and quality of return irrigation waters, including such components as phosphates, sodium and coliform bacteria. Attempts should also be made to determine phosphorous and nitrogen availability relative to algae production.

TABLE A

Major Oregon Municipal and Industrial Waste Discharges to the Snake River System

Name	Location	Flow** MGD	Season	Treatment or Pretreatment	P.E. (B.O.D.)	River Mile
Ore-Ida	Ontario	2.9	Summer Winter	Partial Screen " "	135,000 160,000	Snake-383
Idaho Canning	Nyssa	0.5	Summer	Partial Screen	31,000	Snake-388
Amalgamated Sugar	Nyssa	11.0	Winter	" "	290,000 (1) Main Outfall (2) Carrier plus (3) Lime Cake	 Snake-389 Snake-389 Snake-390
Pioneer Meat*	Ontario		All	Septic Tank	60*	Snake-371
Hawley Meat	Vale		All	" "	60*	Snake-367 Malheur-18
Hopkins Wholesale Meat	Nyssa		All	Septic Tank	30*	Snake-380 Ditch-3
Treasure Valley Meat	Nyssa		All	Septic Tank & Drain Field	30*	Snake-382 Ditch-7
Ontario Meat	Ontario		All	Septic Tank	60	Snake-367
Ontario Municipal	N.W. Ontario	2.0	All	2-Cell Lagoon	1250 (6000)**	Snake-367 Malheur-1½
Nyssa Municipal	E. Nyssa	0.79	All	Primary	3100 (3670)	Snake-389
Vale Municipal	E. Vale	0.35	Partial	2-Cell Lagoon	0-1000 (1764)**	Malheur-18

* P.E. Cows-50; Hogs-20 less 30% for pretreatment
** Estimated where not available

TABLE B - Idaho Municipal and Industrial Waste Discharges to the Middle Snake River System
(Exclusive of Boise River - Previous Report)

Name	Location	Flow MGD	Season	Treatment or Pretreatment	P.E. (BOD)	River Mile
Marsing Municipal	W. Marsing	0.07	All	None	500	Snake 424
Homedale Municipal	N.E. Homedale	0.10	All	Septic Tanks	1,000	Snake 413
Fruitland Municipal	W. Fruitland	0.09 (Winter) 0.90 (Summer)	All	None	800	Snake 369
Emmett Municipal	W. Emmett	0.37 (Winter) 7.8 (Summer)	All	None	3,700	Snake 365 Payette 30
New Plymouth Municipal	N.E. New Plymouth	0.08 (Winter) 0.76 (Summer)	All	Septic Tanks	600	Snake 365 Payette 10 Dr. Ditch 2
Payette Municipal	N.W. Payette	0.44 (Winter) 2.0 (Summer)	All	Primary	3,000	Snake 365 Payette 1
Weiser Municipal	W. Weiser	0.45 (Winter) 2.5 (Summer)	All	Primary	3,000	Snake 351
Welles-Davies (Meat Packing) and Mosier Rendering Company	Payette (Common Sewer)	0.02	All	None	6,000	Snake 365 Payette 2
Idaho Canning Company	Payette	0.70	Summer (30 Days)	40 Mesh Screen	60,000	Snake 365 Payette 1
Gem Canning Company	Emmett	0.68	Summer (30 Days)	Screen	50,000	Snake 365 Payette 30
Fruitland Canning Assoc.	Fruitland	0.65	Summer (30 Days)	Partial Screen	50,000	Snake 369
Cambridge Municipal		0.13	All	Septic Tanks	350	Snake 352 Weiser 44
Council Municipal		0.15	All	Septic Tanks	550	Snake 352 Weiser 65

Water Quality Objectives for the Snake River Section

1. Reduce the bacteriological loading to a level accepted for recreational use and public water supply, although return irrigation waters may necessitate adoption of an alternate standard.
2. Provide for treatment and the disposal and dispersal of treated wastes such that they will not cause:
   (a) The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or related forms of aquatic life or injurious to public health, recreation, agriculture or industry.
   (b) Objectionable discoloration, turbidity, scum, oily slick or floating solids, or coat the aquatic life with oil films.
   (c) The development of bacterial slimes or other growths having a deleterious effect on stream bottoms, fish or related forms of aquatic life, or which are injurious to health, recreation, agriculture or industry.
   (d) The dissolved oxygen content of the waters to be less than five (5) parts per million, and the hydrogen-ion concentration (pH) of the waters to be outside of the range of 6.5 to 9.0.
   (e) The liberation of dissolved gases, such as carbon dioxide, hydrogen sulfide or any other gases, in sufficient quantities to be deleterious to fish or related forms of aquatic life, recreation or other reasonable uses made of such waters.
3. To evaluate return irrigation waters and encourage research to further measure the effect of these waters and determine methods of reducing minerals and nutrients returned with the waters to the river system.

Treatment Requirements

The following treatment requirements are set forth by the States of Idaho and Oregon for municipalities and industries in this section of the Snake River.

Municipalities: (Treatment)

Municipal sewage treatment plants with effluents discharging to the Snake River shall comply with a biochemical reduction of 35% and a suspended solids reduction of 55% with chlorination of the effluent from mechanical treatment plants. Where recreational use is made of downstream waters a higher degree of treatment shall be required.

Further studies may reveal the necessity for complete treatment for water quality and nutrient reduction and chlorination of all domestic sewage effluents discharged to the receiving waters.

Industrial Wastes: (General)

Wherein possible it is requested that industries initiate in-plant controls to minimize waste loads discharged to the public waters. Such in-plant devices may include separation and direct discharge of unpolluted cooling waters, separation and separate treatment of strong wastes, dry cleanup, screens on drains, and automatic turnoff on washdown hoses.

Industrial Wastes: (Treatment)

Removal of suspended and settleable solids and floating material equivalent to that removed by a 20 mesh screen and effective settling.

Meat packing and slaughter houses shall provide for separate collection and disposal of blood from the killing floor and paunch manure. The remaining waste flow shall receive the equivalent of primary treatment with effective disinfection of the effluent.

Potato and onion packing houses shall provide adequate sedimentation prior to discharge to the public waters or municipal sewer system.

Bacteria slimes are more of a problem during the summer months since they tend to interfere with irrigation and recreational use. Industrial wastes having a high organic dissolved and finely suspended solids content produce these bacteria slimes. These wastes also tend to create an environment favorable for the multiplication of coliform bacteria which present a health hazard to recreational use of the stream. For this reason those industries which have this type of waste and operate during the summer should be encouraged to develop a land disposal method for their waste flow.

Domestic Sewage from Industrial Plants:

Domestic sewage shall be maintained separate from industrial wastes unless the treatment provided includes adequate disinfection, and the approval of the appropriate state agency is obtained to combine the wastes for treatment.

Discussion

The Snake River receives sufficient wastes from municipal, industrial and return irrigation water sources to provide nutrients for the highly developed algal growth observed on the surveys.

From the data collected it is observed that the oxygen levels are generally good. The diurnal fluctuation drops the oxygen level to the 6-7 mg/L range at some sampling points and tributary streams. The diurnal fluctuation (ex. Ontario 8.4 to 6.3 mg/L) appears to be greater than the influence of any waste introduced.

The biochemical oxygen demand throughout the entire river section is considered to be relatively high. The presence of decaying algae appears to be the primary factor in the high organic loading values.

Very high levels of NO_3, NH_3-N and PO_4 indicate nutrient rich waste waters presumed predominately caused by irrigation return waters.

Figure I, at the top, graphically shows the 5-day B.O.D. loading in pounds per day at the Snake River sampling points. The B.O.D. loading increases 300% from Adrian to Weiser, which also illustrates that the increase is general rather than a point source increase caused by a single industry or municipality. Samples collected in the January period do indicate an increased B.O.D. effect from Nyssa to Ontario which is presumed to be caused by the Amalgamated Sugar Company at Nyssa. From long term samples it is estimated that the ultimate B.O.D. increased from 2.3 at Nyssa to 5.7 mg/L at Ontario. The January B.O.D. -5 loading is significantly higher than the August loading.

Figure I, middle, illustrates the organic loading at sampling points on the Snake River and tributary streams in pounds of BOD-5 per day per C.F.S. The Boise River and the Malheur River had loadings significantly higher than the

other sampling points.

From Figure I, bottom, it can be seen that the M.P.N. values are high and fluctuate. A significant increase occurs below the Ontario sampling point. The values at Weiser from September 1960 to July 1961 varied from an M.P.N. value of 600 to 70,000 with a mean of 10,700 coliforms per 100 ml.

Figure I, bottom, illustrates also the general climb in dissolved oxygen. The percent saturation increased from 70% at Adrian to 120% saturation at Weiser during the August sampling period. The temperature increased during the summer about 2 degrees from Adrian to Weiser.

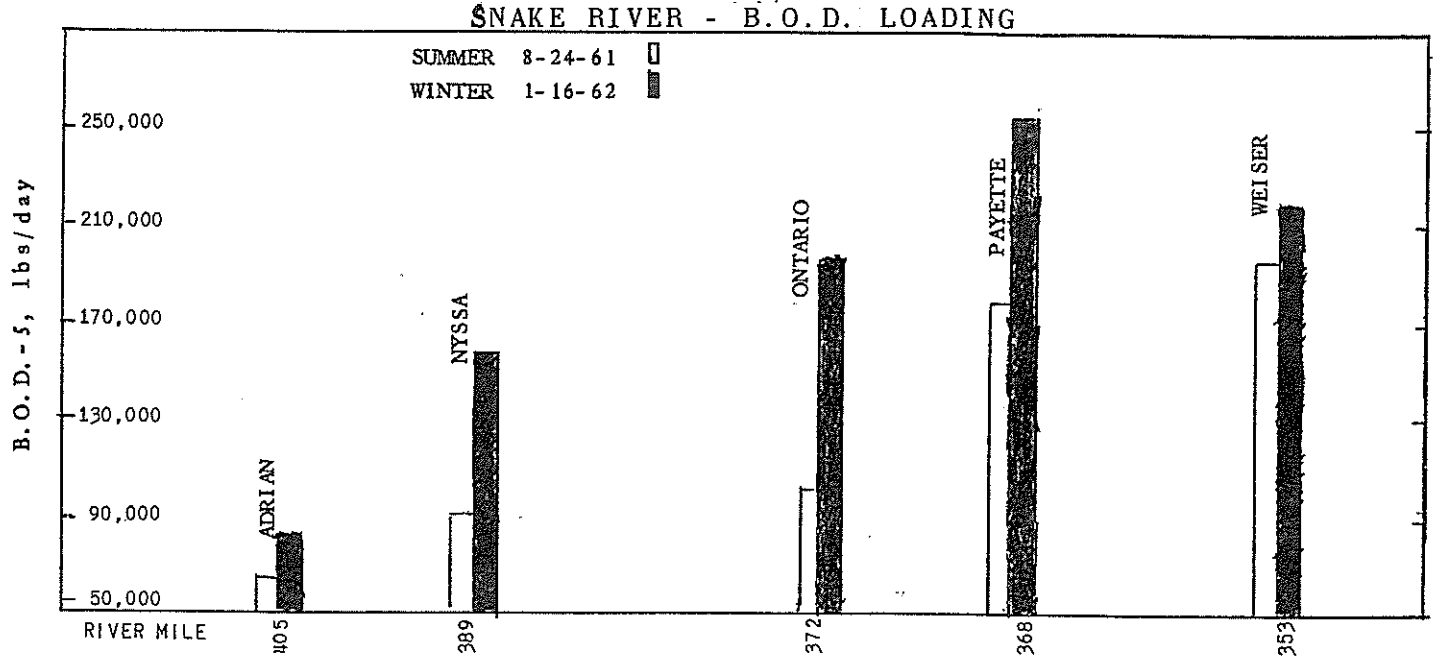
Special attention is herein drawn to an evaluation of water quality data from the Malheur River because this stream serves as an integral part of the Owyhee Irrigation Project. Most of its summer flow results from irrigation return waters, part of which are diverted and returned several times before joining the Snake River at Ontario. Except for natural spring runoff, the Malheur River has its peak flows in July and August when irrigation return waters from the Owyhee Project are the greatest.

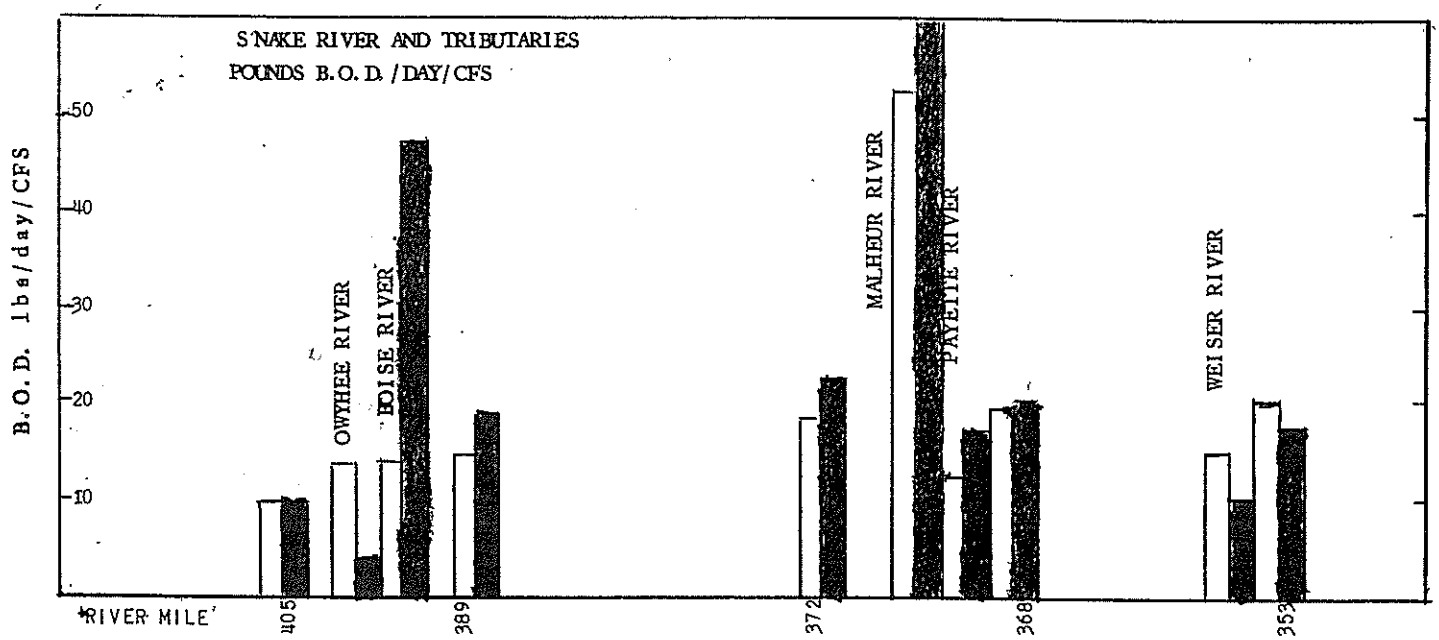
Water quality data from the Malheur River sampling station, near its mouth, show very pronounced parallel peaks of total solids and cations in the period when irrigation return waters peak; see Figure II. Sodium and chloride ion curves follow almost exactly the irrigation return water curves, which illustrates the effect of the return water on the total river water quality.

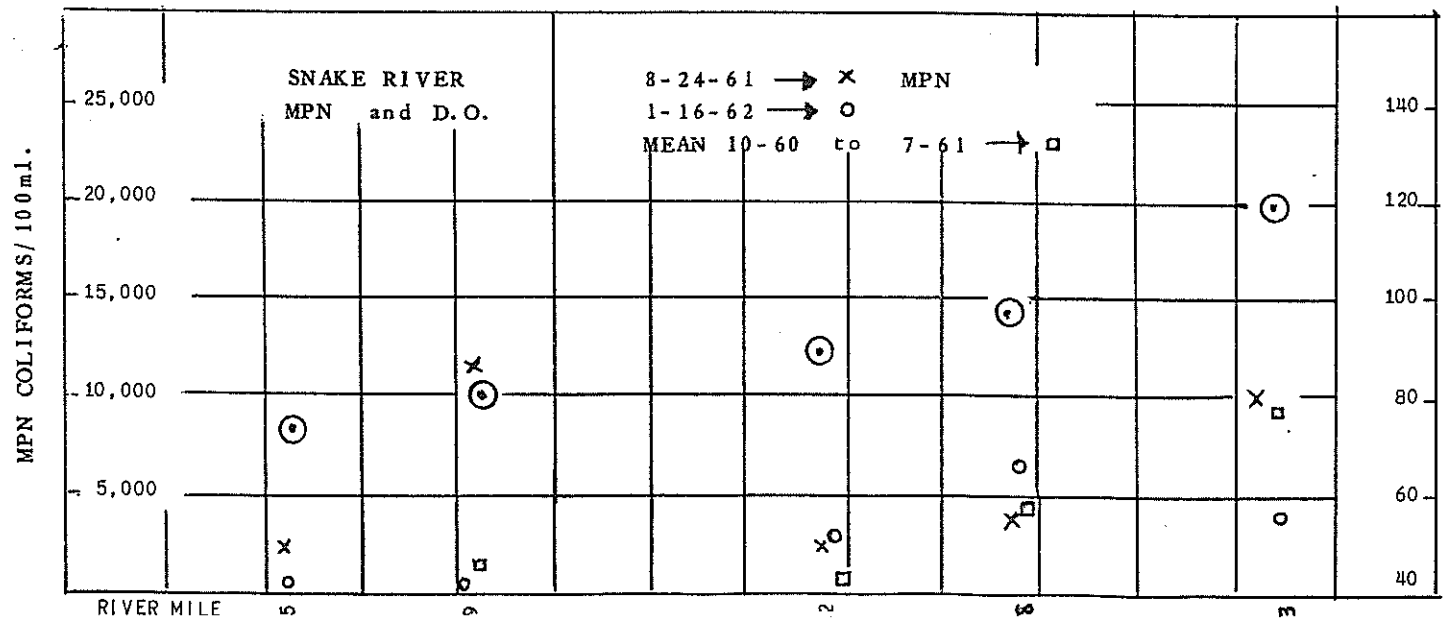
Sodium and chloride ion concentrations in the Snake River at Weiser peaked during October rather than through mid-summer, as was found in the tributary streams, Figure III. This later peaking of substances is attributed to a time lag allowing for the impact of irrigation return waters from the whole upper Snake River Basin to reach Weiser. There is also a late fall surge of unexpected algal growth in the Snake River following nutrient increases in October.

FIGURE I

SNAKE RIVER - B.O.D. LOADING



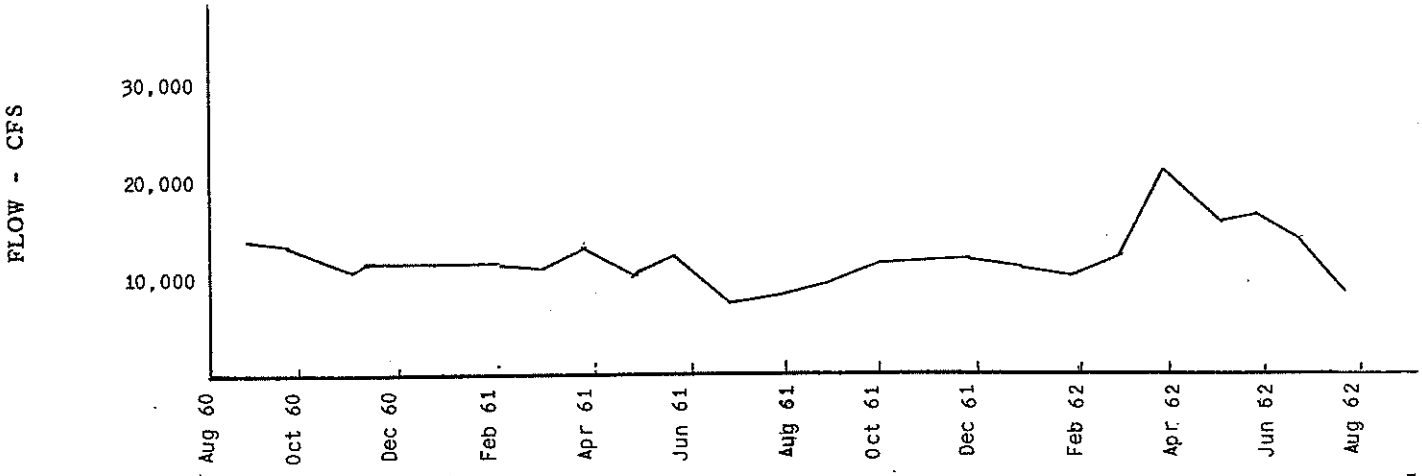


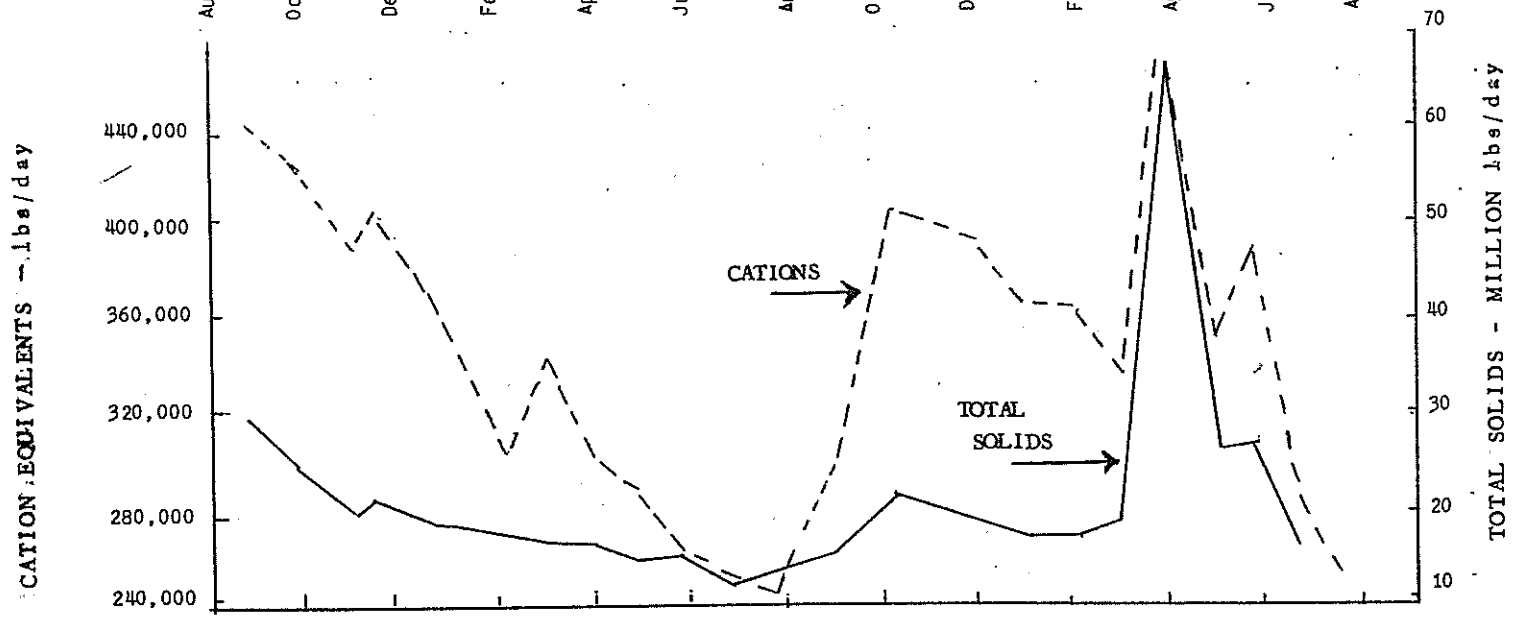


SNAKE RIVER AT WEISER

MEAN FLOW WATER YEAR - CFS	
1959-60	14,460
1960-61	11,700
1961-62	13,660

MAXIMUM DISCHARGE --- CFS	
4-10-60	29,300
2-1-61	18,800
2-14-62	30,700





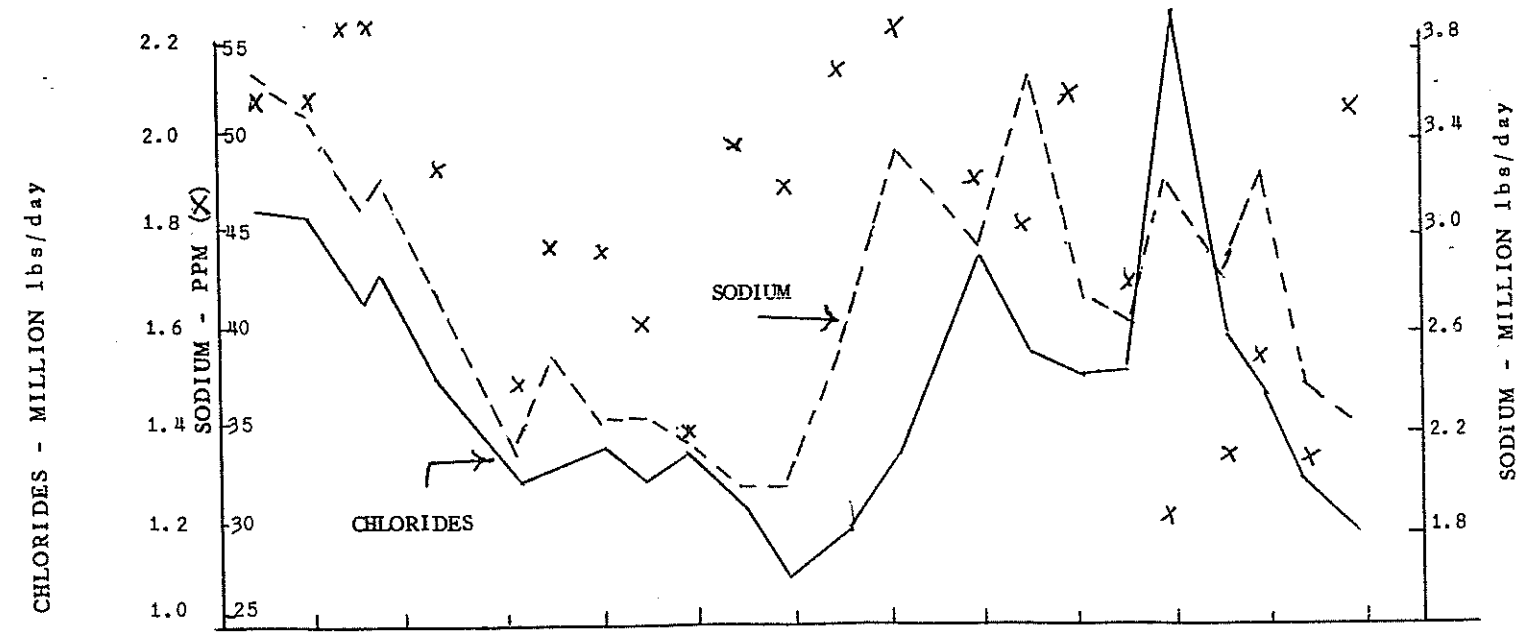


Table I illustrates the D.O. and B.O.D. found in August in the basin and compares measured values with calculated values assuming a constant D.O.-B.O.D. through the section.

The Boise River enters the Snake River between Adrian and Nyssa. The Snake River increases in B.O.D. loading 20% by calculation and 50% by measurement from Adrian to Nyssa. From Nyssa to Ontario there is approximately a 30% increase in B.O.D. loading. The major contributors of waste in this section are Idaho Canning Company at Nyssa and the effluent from the Nyssa municipal treatment plant. The Payette River enters the Snake River below Payette. In this section the Snake River increases in B.O.D. loading by 30%;20% of the increase is calculated to be attributable to Ore-Ida. The amount of B.O.D. added by the Malheur River is minor, 0.4%.

The Weiser River enters the Snake River at Weiser. The Snake River between Payette and Weiser increased in B.O.D. loading by 30%.

Overall the B.O.D. loading from Adrian to Weiser is increased by 300%. The dissolved oxygen as shown on Tables I and II also increased. Table II illustrates the D.O. and B.O.D. loadings found during January in the basin.

The Snake River increased in B.O.D. loading 30% by calculation and 50% by measurement from Adrian to Nyssa.

From Nyssa to Ontario a 20% increase in B.O.D. loading occurred. The major contributors were the Amalgamated Sugar Company at Nyssa and the effluent from the Nyssa sewage treatment plant.

The Snake River increases in the B.O.D. loading by 43% between Ontario and Payette. Three percent of the increase in B.O.D. loading was attributable by calculation to Ore-Ida. The Malheur River contribution was minor.

From Payette to Weiser the Snake River increased about 1% in B.O.D. loading by claculation; however, by analysis of samples collected, an 8%

reduction in B.O.D. loading is shown to have occurred.

The relationship of phosphate nutrient availability to algal production in the Snake River is not clearly understood at this time; however, there are several observed conditions about this matter which deserve mentioning herein. Phosphate nutrient is known to be one of the absolute requirements for algal growth and its overall availability will limit or enhance gross production.

Data from the main-stem Snake River during summer periods did not show a presence of phosphates equal to the amounts discharged from tributary streams. Therefore, it has been concluded that phosphates were readily taken up by the standing algae crop. Table III shows how phosphates added during August by the Owyhee and Boise Rivers were substantially reduced at Nyssa and below detectable amounts at Ontario. A similar phosphate reduction occurred between Ontario and Payette.

Table IV shows an availability of surplus phosphate during the winter period when climatic conditions would not support high algal development. Also, there were probably phosphates being released to the surrounding waters from decomposed algae and other organics. Notice in Tables III and IV that the phosphate availability at Weiser was double in January over that found in August.

This whole condition points to the fact that phosphates originating in irrigation waters apparently assist in nourishing the tremendous algal growths found in the Snake River. These growths, in turn, add a substantial B.O.D. loading to the stream upon decomposition. Their effect would be particularly felt where such loadings build up in downstream impoundments.

SNAKE RIVER 8-24-61

Comparison of B.O.D. and D.O. Loadings at Measured and Calculated Points

Snake River Miles	Pounds D.O.	Pounds B.O.D.	B.O.D. lbs/cfs
405 Adrian 5764 cfs	189,000	62,000	10.7
Owyhee 391 20 cfs →	+740	+247	12.3
	189,740	62,247	
	+32,200	← +11,900 Boise R 391 820 cfs	14.5
Sub. Tot.	221,940	74,147 calc. Sub. Tot.	
389 Nyssa 6604 cfs	241,000	92,500 measured	14.
372 Ontario 6604 cfs	327,000	124,000	18.8
Malheur R 369 19 cfs →	+1,330	+995	52.
	328,330	124,995	
	+79,600	← +41,700 Payette R 368 1760 cfs	12.3
Sub. Tot.	407,930	166,695 calc. Sub. Tot.	
368 Payette 8383 cfs	381,000	183,350 measured	21.9
	+12,370	← +4,120 Weiser R 352 247 cfs	16.7
Sub. Tot.	393,370	187,470 calc. Sub. Tot.	
353 Weiser 8630 cfs	465,000	190,500 measured	22.0

TABLE I

SNAKE RIVER 1-16-62

Comparison of B.O.D. and D.O. Loadings at Measured and Calculated Points

Snake River Miles	Pounds D.O.	Pounds B.O.D.	B.O.D. lbs/cfs
405 Adrian 8528 cfs	540,000	87,000	10.2
Owyhee 391 20 cfs →	+1,190	+60	3.
	541,190	87,060	
	+27,100	← +23,600 Boise R 391 510 cfs	46.4
Sub. Tot.	568,290	110,660 calc. Sub. Tot.	
389 Nyssa	600,000	161,000 measured	17.8
372 Ontario 3058 cfs	634,000	200,000	22.1
Malheur R 369 32 cfs →	+1,910	+138	60
Sub. Tot.	635,910	200,138 calc. Sub. Tot.	
	+163,000	← +41,800 Payette R. 368 2160 cfs	19.3
Sub. Tot.	793,910	241,938 calc. Sub. Tot.	
368 Payette 11,250 cfs	795,000	244,000 measured	21.5
	+25,600	← +3,960 Weiser R 352 350 cfs	11.3
Sub. Tot.	810,600	247,960 calc. Sub. Tot.	
353 Weiser 11,600 cfs	792,000	225,000 measured	19.5

TABLE II

SNAKE RIVER 8-24-61

Comparison of Phosphates at measured and Calculated Points

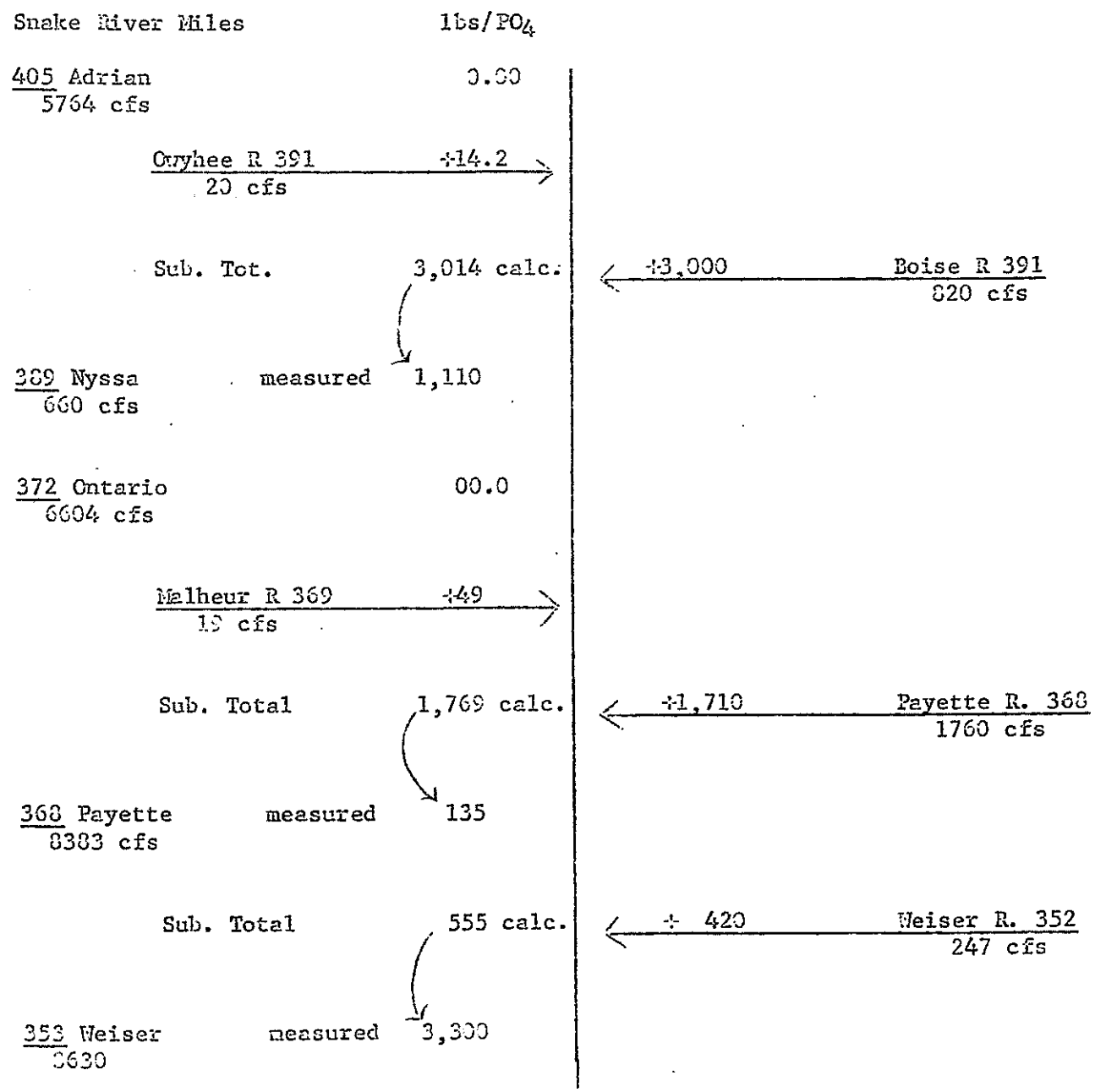


TABLE III

SNAKE RIVER 1-16-62

Comparison of Phosphates at Measured and Calculated Points

Snake River Miles		lbs/PO_4
405 Adrian 8528 cfs		2,200
	Owyhee R 381 20 cfs → + 20.4	
		← +1,510 Boise R 391 510 cfs
	Sub. Tot.	3,730 calc.
389 Nyssa 9058 cfs	measured	3,350
372 Ontario 9058 cfs		3,080
	Malheur R 369 32 cfs → +1,380	
		← +1,280 Payette R 368 2160 cfs
	Sub. Tot.	5,740 calc.
368 Payette 11250 cfs .135	measured	8,190
		← + 189 Weiser R 352 350 cfs
	Sub. Tot.	8,379 calc.
353 Weiser 11600 cfs	measured	6,250

TABLE IV

APPENDIX A

Biological Report

RESULTS OF A PRELIMINARY BIOLOGICAL SURVEY

of the

SNAKE RIVER AND TRIBUTARIES

between
Adrian, Oregon, and Weiser, Idaho

August 22 - 23, 1961

Biological samples were taken from the Snake River and its tributaries between Adrian, Oregon, and Weiser, Idaho, supplementary to a chemical and physical survey designed to identify general water qualities and possible sources of pollution. From the cursory classification of biological groups, Table A-1 and Table A-2, and visual observations at each station a few general conclusions have been drawn:

1. All of the streams observed carried excessive loadings of sediments from irrigation return waters. The Owyhee, Malheur, and Boise Rivers were outstanding in this respect. Also, the addition of agricultural fertilizers and other nutrients via irrigation return waters is suspected because of great algal blooms in most areas.
2. The Snake River carried an exceptionally heavy load of algae in suspension. Dominant types at the time of the survey were Anabaena, Pediastrum, Spirogyra, Aphanizomenon, Staurastrum, and Anacystis.
3. The high organic content of the Snake River can be expected to deposit in the storage reservoirs downstream where, upon decomposition, it will have a high B.O.D.
4. The high organic loading of algae in Snake River appears to exceed by manyfold all sources of industrial and domestic wastes in the study area.
5. Two areas of gross organic pollution were found. Bacterial slimes blanket the bottom in both areas:

a. The Snake River on the Oregon side below the City of Ontario.

b. The Payette River below the City of Payette.

6. Fish types, numbers and distribution indicate that all of the waters surveyed were suitable for maintaining warm water fishes - large and smallmouth bass, crappies, catfish, bluegills, carp and suckers.

   Undoubtedly the fish populations of the Malheur, Weiser, and possibly the Owyhee Rivers are limited by high turbidities.

7. Bottom fauna productivity followed rather closely the pattern of fish production. It was generally high in quality and quantity except for those streams with higher turbidities and the two zones of bacterial slime growth at Payette and Ontario.

TABLE A-1

AQUATIC INSECTS - SNAKE RIVER SURVEY

August 22-23, 1961

Station	Order	Family	Number
Owyhee River (1)	Trichoptera	Hydropsychidae	2
(Hwy 201 Br. 1½ miles north of Adrian)	Diptera	Chrionomidae	18
		Simuliidae	2
8-22-61	Odonata	Coenagrianidae	2
	Ephemeroptera	Baetidae	1
	Mussels		6
	Oligochaetes		6
	Rhynchobdellida	Glossiphonidae	1
Owyhee River (2)	Diptera	Simuliidae	6
		Chrionomidae	14
(Br. north of Adrian)	Mussels		5
8-22-61	Oligochaetes		13
	Ephemeroptera	Baetidae	5
Snake River (3)	Odonata	Gomphidae	1
	Mussels		2
(½ mile above Adrian bridge)	Snail		1
	Trichoptera	Hydropsychidae	3
8-22-61	Ephemeroptera	Coenidae	24
		Heptageniidae	60
	Rhynchobdellida	Glossiphonidae	5
	Oligochaetes		1
Boise River (4)	Trichoptera	Hydropsychidae	46
(1 mile south of Parma)	Odonata	Gomphidae	1
	Diptera	Chrionomidae	8
		Simuliidae	12
	Ephemeroptera	Coenidae	25
	Lepidoptera	Pyralididae	6

Station	Order	Family	Number
Boise River (cont'd)	Rhynchobdellida	Glossiphoniidae	1
	Oligochaetes		
Snake River (5)	Mussels		12
	Trichoptera	Hydropsychidae	209
(1½ miles below Nyssa)	Odonata	Gomphidae	3
		Coenagrionidae	3
8-22-61	Lepidoptera	Pyralididae	5
	Ephemeroptera	Heptageniidae	66
	Diptera	Simuliidae	2
		Chrionomidae	4
	Rhynchobdellida	Glossiphaniidae	2
Malheur River (6)	Trichoptera	Hydropsychidae	29
(1 mile north of Ontario)	Diptera	Simuliidae	7
		Chrionomidae	6
	Oligochaetes	(earthworms)	10
	Arhynchobdellida	Erpodellidae	3
Snake River (7)	Diptera	Simuliidae	1
(½ mile north of Ontario)	Trichoptera	Hydropsychidae	2
Payette River (8)	Odonata	Gomphidae	1
(Hwy Br. 4 miles South of Payette)	Trichoptera	Hydropsychidae	20
	Ephemeroptera	Ephemeridae	1
		Heptageniidae	47
	Diptera	Chrionomidae	3
	Oligochaetes		1
	Lepidoptera	Pyralididae	2
Snake River (9)	Ephemeroptera	Heptadeniidae	15
		Coenidae	22
(at Payette Br.)	Trichoptera	Hydropsychidae	5
8-23-61	Arhynchobdellida	Erpodellidae	10
	Oligochaetes	(earthworms)	4

Station	Order	Family	Number
Snake River (10)	Trichoptera	Hydropsychidae	44
(Br. to Weiser - Oregon side)	Ephemeroptera	Heptageniidae	78
		Caenidae	12
	Lepidoptera	Pyralididae	3
	Rhynchobdellida	Glossiphaniidae	2
Weiser River (11)	Odonata	Gomphidae	2
(Hwy 30 Br., Weiser)	Trichoptera	Hydropsychidae	25
8-23-61	Lepidoptera	Pyralididae	26
	Diptera	Chrionomidae	8
		Tipulidae	3
	Oligochaetes		5
	Lepidoptera	Pyralididae	1
	Ephemeroptera	Baetidae	2
		Ephemerellidae	10
	Pelecypoda	(Mussel)	1

TABLE A-2

FISH COLLECTIONS - SNAKE RIVER SURVEY

August 23, 1961

1. Owyhee River one mile upstream from Hwy. 201 bridge 1½ miles north of Adrian

Pomoxis annularis	20
Micropterus salmoides	1
Pantosteus jordani	1
Acrocheilus alutaceus	1
Ptychocheilus oregonensis	5
Lepomis macrochirus	1
Ameiurus nebulosus	1
Astacus sp.	1

2. Snake River ½ mile upstream from Adrian bridge

Pantosteus jordani	1
Ptychocheilus oregonensis	1
Micropterus dolomieui	1

3. Boise River one mile south of Parma

Pomoxis annularis	3
Micropterus salmoides	2
Richardsonius balteatus	1
Cyprinus carpio	1
Ameiurus nebulosus	1

4. Snake River 1½ miles below Nyssa

Cyprinus carpio	7
Pantosteus jordani	2
Ptychocheilus oregonensis	1

5. Malheur River one mile north of Ontario at Hwy. 30 bridge

Cyprinus carpio	17
Pomoxis annularis	1
Mylocheilus caurinus	1
Ptychocheilus oregonensis	1
Richardsonius balteatus	1

6. Snake River ½ mile north of Ontario

No fish found

7. Payette River 4 miles south of Payette, Hwy. 95 bridge

Micropterus salmoides	7
Astacus sp.	2

8. Snake River at Payette

No fish seining done

9. Snake River at Weiser

Micropterus salmoides 1

10. Weiser River at Weiser, Hwy. 30 bridge

No fish found

11. Snake River at Farewell Bend

No seining done

APPENDIX B

Sampling Station Description

Description of Sampling Stations

of Snake River and Tributaries

	Miles	Location
1	345	Snake River - Oasis on Hwy. 30 one mile northwest of Wikiup Gulch (bank sample).
2	351	Snake River - Weiser, Idaho, Bridge. Three stations at 1/4 points on river.
3	365	Snake River - Payette, Idaho, Bridge. Two stations at 1/3 points on river.
4	374	Snake River at Hwy. 30 Bridge in Ontario.
5	385	Snake River at Hwy. 20 Bridge in Nyssa. Two stations at 1/3 points on river.
6	397	Snake River at Hwy. Bridge in Adrian.
7	352-0.5	Weiser River - at Hwy. 30 N. Bridge in Weiser, Idaho.
8	366-1	Payette River - on Hwy. Bridge 1/2 mile south of railroad Bridge.
9	369-0.4	Malheur River - 1-1/2 mile northwest of Ontario Hwy. 201 Bridge.
10	391-3	Boise River - Hwy. Bridge 20 and 26 near Parma, Idaho.
11	392-2	Owyhee River - Hwy. Bridge 201 two miles south of Owyhee.

APPENDIX C

Laboratory and Field Data

(Exclusive of USGS Data and Data Included in Charts)

River Mile	Station	DATE	pH FIELD	TEMP. C°	D.O. mg/L	B.O.D. mg/L	PO_4 mg/L	NH_3 mg/L	NO_3 mg/L	T.S. mg/L	S.S. mg/L	TURB.	COLOR	pH LAB.	ALK mg/L	HARD mg/L	COND. μ mhos / cm	MPN 100 ml
Snake 345	#1																	
	Bank Sample	8-22-61	8.5	27	9.5	3.4	0.021	0.96	0.89	369	36	5	5	8.38	163	187	465	1100
	" "	8-24-61	8.8	25	10.2	4.9	0.012	0.63	0.23	393	45	13	5	8.60	168	176	540	2400
	Diurnal	8-24-61	8.2	25	6.7													
	Bank Sample	1-16-62		1	12.8	1.6	0.08	1.15	0.62	385	4	4	3	8.2	177	206		930
Snake 351	#2																	
	East-Side	8-22-61	8.3	26	8.8	3.7	0.003	0.95	0.79	491	120	19	10	8.05	158	189	430	24000
	" "	8-24-61	8.7	25	9.5	4.1	0.183	0.57	0.73	357	27	5	10	8.30	153	55	505	9300
	" "	1-16-62	8.4	1	12.6	3.5	0.08	0.82	0.56	309	17	4	3	8.1	141	153	400	15000
	Middle	8-25-60	--	18	8.8	4.3	0.12	--	0.72	471	114	20	5	7.8	176	181	570	--
	"	8-22-61	8.3	26	8.9	4.1	0.012	1.04	0.98	378	54	9	7	7.65	153	203	450	2300
	"	8-24-61	8.7	25	10.4	4.9	0.000	0.75	0.47	396	40	9	5	8.45	162	181	545	110000
	Diurnal	8-24-61	8.3	25	6.4													
	Middle	1-16-62	8.4+	1	13.0	4.1	0.11	0.83	0.82	378	12	4	3	8.1	173	198	540	15000
	"	1-16-64		2	13.5	4.3	0.08		1.52					7.9			390	
	West Side	8-22-61	8.3	27	9.4	4.0	0.015	1.04	0.96	405	52	10	7	8.50	167	191	450	24000
	" "	8-24-61	8.7	26	10.1	4.1	0.030	1.62	0.44	399	44	9	7	8.55	166	177	550	15000
	" "	1-16-62	--	--	12.3	3.2	0.11	0.85	0.87	402	17	2	3	7.9	185	205	540	--
Snake 365	#3																	
	East Side	8-22-61	8.1	26	8.3	4.2	0.041	0.88	0.86	406	43	10	5	8.12	172	208	532	24000
	" "	8-24-61	8.7	24	8.4	3.8	0.000	0.66	0.90	362	33	7	10	8.18	148	181	530	4300
	" "	1-16-62	--	2	12.9	3.5	0.14	0.80	0.57	254	16	4	3	8.1	120	130	350	4300
	Diurnal	8-24-61	8.2	25	6.3													
	Middle	1-16-64	--	1	14.0	4.7	0.08	--	1.52	--	--	--	--	8.0	--	--	440	--
	West Side	8-22-61	8.2	26	8.5	4.1	0.006	0.93	0.86	426	25	7	5	8.22	180	209	560	4300
	" "	8-24-61	8.7	24	8.6	4.4	0.006	0.60	0.90	410	35	7	5	8.30	176	190	580	1500
	" "	1-16-62	8.4+	2	13.1	4.5	0.13	0.93	0.86	454	10	4	3	8.3	215	232	640	110000
Snake 374	#4																	
	Middle	8-25-60	--	14	8.6	1.9	--	--	--	--	--	--	--	--	--	--	--	--
	"	8-22-61	8.7	26	8.9	--	0.012	0.88	1.24	445	15	7	5	8.19	181	216	575	2300
	"	8-24-61	8.7	24	9.2	3.5	0.000	0.70	1.17	457	31	4	5	8.20	190	172	635	2000
	"	1-16-62	8.4+	2	13.0	4.1	0.063	0.82	1.00	425	14	4	1	8.2	199	227	600	24000
	"	1-16-64	--	1	12.7	3.4	0.12	--	1.58	--	--	--	--	7.8	--	--	390	--

River Mile	Station	DATE	pH FIELD	TEMP. C°	D.O. mg/L	B.O.D. mg/L	PO_4 mg/L	NH_3 * mg/L	NO_3 * mg/L	T.S. mg/L	S.S. mg/L	TURB.	COLOR	pH LAB.	ALK mg/L	HARD mg/L	COND. U mhos/cm	MPN 100 ml
Snake 385	#5																	
	East Side	8-22-61	8.5	25	7.4	3.5	0.048	0.95	0.53	416	43	7	7	8.05	172	195	445	--
	" "	8-24-61	8.8	23	6.8	2.1	0.045	0.60	1.24	427	53	9	5	8.02	173	214	550	--
	Middle																	
	Diurnal	8-24-61	8.3	24	6.5	--	--	--	--	--	--	--	--	--	--	--	--	--
	Middle	1-16-62	--	--	12.4	3.8	0.091	1.09	0.50	411	15	5	3	8.2	194	221	500	2300
	"	1-16-64	--	1	13.0	1.9	--	--	--	--	--	--	--	--	--	--	--	--
	West Side	8-22-61	8.4	24	7.5	3.3	0.000	0.71	1.01	431	57	12	5	7.98	164	205	450	1100
	" "	8-24-61	8.8	23	6.8	2.6	0.018	0.64	1.19	426	51	7	5	7.95	161	205	545	--
	" "	1-16-62	8.4	0.5	12.1	2.8	0.046	0.99	1.20	405	14	5	2	8.2	190	221	500	4300
Snake 397	#6																	
	Middle	8-22-61	8.5	24	6.6	--	0.006	0.96	0.97	406	36	7	5	7.90	157	202	450	--
	"	8-24-61	8.3	23	6.1	2.0	0.000	0.60	1.22	388	42	7	5	7.72	155	214	500	2400
	Diurnal	8-24-61	8.2	24	6.8	--	--	--	--	--	--	--	--	--	--	--	--	--
	Middle	1-16-62	8.4+	2	11.8	1.9	0.048	0.80	1.00	396	0	4	2	8.2	185	216	600	910
	"	1-16-64	--	1	12.1	2.2	0.06	--	1.58	--	--	--	--	8.0	--	--	375	--
Snake 352	#7																	
	Middle	8-22-61	8.7	27	10.6	2.6	0.108	0.87	0.59	314	62	29	20	8.25	142	125	355	--
Weiser	"	8-24-61	8.8	25	9.3	3.1	0.316	0.68	0.34	314	64	26	20	7.95	137	132	360	11000
0.5	Diurnal	8-24-61	7.8	23	5.3	--	--	--	--	--	--	--	--	--	--	--	--	--
	Middle	1-16-62	8.2	1	13.6	2.1	0.10	0.79	0.34	143	14	4	4	7.8	66	68	150	910
Snake 366	#8																	
	Middle	8-22-61	8.7	25	9.3	3.2	0.060	0.92	0.42	197	61	9	15	8.02	83	79	191	11000
Payette	"	8-24-61	8.7	22	8.4	4.4	0.018	0.66	0.53	188	49	7	10	7.85	85	65	208	24000
1	Diurnal	8-24-61	8.0	22	6.1	--	--	--	--	--	--	--	--	--	--	--	--	--
	Middle	1-16-62	--	1	14.0	3.6	0.11	0.85	0.23	115	20	4	7	7.5	47	51	120	4300
Snake 369	#9																	
	Middle	8-25-60	--	14	8.6	1.9	--	--	--	--	--	--	--	--	--	--	--	--
Malheur	"	8-22-61	8.9	25	16.2	13.3	0.252	1.39	0.07	1375	84	24	17	8.45	335	430	1460	4600
0.4	"	8-24-61	8.8	23	13.0	9.7	0.480	1.12	0.58	1221	85	16	20	8.25	425	319	1680	9300
	Diurnal	8-24-61	8.0	23	5.0	--	--	--	--	--	--	--	--	--	--	--	--	--
	Middle	1-16-62	--	1	11.1	0.8	0.80	1.07	0.05	1033	34	15	4	8.2	379	324	1400	46000

River Mile	Station	DATE	pH FIELD	TEMP. C°	D.O. mg/L	B.O.D. mg/L	PO_4 mg/L	NH_3 * mg/L	NO_3 * mg/L	T.S. mg/L	S.S. mg/L	TURB.	COLOR	pH LAB.	ALK mg/L	HARD mg/L	COND. U mhos cm	MPN 100 ml
Snake	#10																	
391	Middle	8-22-61	8.2	23	8.1	3.2	0.392	1.04	1.15	--	15	10	17	8.30	271	331	610	4600
Boise	"	8-24-61	8.5	21	7.3	2.7	0.557	0.79	1.14	626	67	13	20	7.81	274	232	720	--
3	"	1-16-62	8.4+	4	9.9	8.6	0.55	1.49	0.50	551	45	10	3	7.7	254	216	--	24000
	"	1-16-64	--	2	9.9	6.5	0.53	--	2.44	--	--	--	--	7.1	--	--	620	--
Snake	#11																	
392	Middle	8-22-61	8.3	21	7.1	3.3	0.045	0.94	1.57	908	103	26	15	7.71	255	299	840	--
Owyhee	"	8-24-61	7.8	20	6.9	2.3	0.132	0.91	2.00	934	72	24	10	7.75	283	176	1080	--
2	"	1-16-62	8.4+	2	11.2	0.6	0.19	0.83	2.7	1208	12	15	3	8.0	297	327	1600	1500
	"	1-16-64	--	0.5	13.3	2.0	0.16	--	3.14	--	--	--	--	7.7	--	--	890	--

* - mg/L as nitrogen

SNAKE RIVER SAMPLES
B.O.D.

Days	#1*	#2*
1	1.7	0.5
2	2.6	0.9
3	3.3	1.2
4	3.9	1.4
5	4.3	1.5
7	4.4	2.0
9	5.4	2.6
11	6.6	2.5
13	5.9	3.5
15	7.2	2.9
20	6.7	3.5
pH	8.4	8.3

#1 - Snake River at Ontario

#2 - Snake River at Nyssa

Analysis of B.O.D. Data at Nyssa and Ontario

Ontario			Nyssa		
t	y, B.O.D.	ty	t	y, B.O.D.	ty
1	1.7	1.7	1	.5	.5
2	2.6	5.6	2	.9	1.8
3	3.3	9.9	3	1.2	3.6
	7.6	17.2		2.6	5.9

$$\frac{\Sigma y}{\Sigma Yt} = \frac{7.6}{17.2} = .441$$

$$\frac{\Sigma y}{\Sigma Yt} = \frac{2.6}{5.9} = .441$$

from graph $\frac{k1 = .12}{\frac{\Sigma y}{L} = 1.15}$ deoxygenation rate/day

$$L = \frac{7.6}{1.15}$$

$k_1 = .12$

$\frac{\Sigma y}{L} \cong 1.15$

L = 6.6 ultimate B.O.D. (Ontario)

L = 2.26 ultimate (Nyssa)

Ontario Sequence 7 day

$$\frac{\Sigma y}{Yt} = \frac{25.6}{116.5} = .216$$

graph $k_1 = 0.13$

$$\frac{\Sigma y}{L} = 4.50$$

$$L = \frac{25.6}{4.5} = 5.7 \text{ ultimate B.O.D.}$$

Deoxygenation rate per day, k_1, at Nyssa and Ontario on a 3 day sequence give equal values, 0.12, however, the 7 day sequence at Ontario give a significant higher value and ultimate B.O.D. values as follows: Nyssa - 2.26 and Ontario 6.6 and 5.7. The twenty day sample as measured in the laboratory was 6.6 for Ontario and 3.5 for Nyssa.

"Simplified Method for Analysis of B.O.D. Data", Sewage and Industrial Wastes, Vol. 22, No. 10, Oct. 1950.

RIVER FLOWS (CFS)

	1961				1962
	August 21	August 22	August 23	August 24	January 16
Snake River at Weiser	8550	8630	8630	8630	11600
Weiser River at Weiser	258	230	251	247	350
Payette River at Emmett	1740	1720	1790	1760	1920
Boise River at Boise	470	655	793	820	
Malheur River at Little Valley	20	21	19	19	32
Brownlee Reservoir (Equivalent CFS)	+994	-710	-710	+355	

APPENDIX D

Data Interpretation and Assumptions

Data Interpretation and Assumptions Made

Flows: The flow at points on the main stem of the Snake River are not known so that to interpret total loading on the stream, the flow at the sampling point was computed by the subtraction of downstream tributary points from the known flow at Weiser and tributary gage stations. There is room for error because gage stations do not occur at sampling points and in return irrigation waters of unknown quantities. For example: The Owyhee predominately returns to the Malheur and Snake.

Station Data: Where 2 or more points are sampled at a particular station, the values were averaged for a single value at that station.

APPENDIX E

Irrigation

Irrigation in this Section of the Snake River

Return water from the irrigation project waters in this section are comprised of minor surpluses and runoff, but primarily drainage waters. An indication of the flow is that in January 1964 with major tributary streams dammed with no releases from the dams, and with snow cover, but temperatures 5 - 15° F., the Malheur at Vale was measured at 125 C.F.S.

The Greater Boise Project comprises 305,000 acres and does not include the Owyhee or Warm Springs districts listed below.

Owyhee Project:

The Owyhee Project comprises about 107,000 acres of irrigated land and is divided roughly by states into a North Board of Control (Oregon) and a South Board of Control (Idaho).

North Board of Control (Adrian to Weiser): Paul House, Manager.

Area: 65,611 acres (in Oregon under N.B.C.)
(49,543 is Owyhee)

Owyhee Reservoir: 715,000 acre-ft. (Usable) storage.

Pump Stations: (1) 6 miles S. of Nyssa, called Ontario-Nyssa station, utilizes Snake River Water, Capacity - 130 c.f.s.

(2) 2 miles N. of Payette, called Dead Ox Station, utilizes Dead Ox Canal which is combined Snake River and return water, capacity - 176 c.f.s.

Owyhee Ditch Company: This separate project has rights on Owyhee River, but also works on exchange from pumps and North Board of Control.

Area: 13,000 acres

Pump Station: On Snake River, capacity - 222 c.f.s.

River Rats: As the name indicates a number of non-project lands are irrigated by private pumps from the Snake River.

Warm Springs Irrigation District: Ed Bates, Vale, Manager.

This is composed of the Vale, Malheur and smaller projects and in 1964 is expected to have 55,000 acres under irrigation.

Area: 55,000 acres

Reservoirs: Bully Creek - 31,000 acre-ft.

Beulah (Agency) - 60,000 acre-ft.

Warm Springs -191,000 acre-ft.

APPENDIX F

References

References

(1) Manual Recommended Water-Sanitation Practice. U.S. Dept. H.E.W., 1946, page 12.
"--averaging not more than 5,000 per 100 m.l. in any one month, and exceeding this number in not more than 20% of the samples examined in one month."

(2) Quality of the Surface Waters of Oregon, Dept. of Interior, U.S.G.S. by Walton Van Winkle, 1914.

(3) Pollution from Irrigation, Vol. 35, No. 5, May 1963, page 623, by E. F. Eldridge.