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GROUND-WATER DEVELOPMENT AND PROBLEMS IN IDAHO 1/

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Boise, Idaho

Status of Development

The development of ground water for irrigation in Idaho, as most of you know, has proceeded at a phenomenal rate since the Second World War. In the period 1907 to 1944 inclusive only about 328 valid permits and licenses to appropriate ground water were issued by the State. Thereafter 28 permits became valid in 1945, 83 in 1946, and 121 in 1947. Since 1947 permits and licenses have been issued at the rate of more than 400 a year.

As of November 1953 about 2,500 valid permits and licenses for about 14,000 cubic feet per second had been issued by the State Department of Reclamation. In rounded figures this represents a full and supplemental water supply of about 2.25 million acre-feet for approximately 800,000 acres. The rate of development and the wide distribution and size of areas in which development is proceeding make it difficult to keep records up to date on the status of each area. Data collected as late as last fall on developed acreage and total pumpage already are obsolete for some areas.

1/ Presented at the Annual Convention of the Idaho State Reclamation Association, Twin Falls, Idaho, May 8, 1954. Publication authorized by the Director, U. S. Geological Survey.

Summary of Ground-Water Appropriations 1/

(Valid permits and licenses)

Period	Permits	Cubic feet per second		Acres served
1907-1944	328	2,277.5		164,139
1945	28	40.8	Supplemental	3,900
		51.7	New Land	2,565
1946	83	344.2	Supplemental	8,709
		158.5	New Land	9,312
1947	121	126.3	Supplemental	7,529
		262.2	New Land	13,673
1948	424	429.9	Supplemental	23,977
		2,214.4	New Land	171,008
11/15/48 to 11/15/50	675	4,243.2	Supplemental	62,674
			New Land	126,629
11/15/50 to 10/31/52	905	467.87	Supplemental	26,369
		3,596.96	New Land	218,656
Totals	2,564	14,213		838,441

1/ Idaho Dept. Reclamation, 1953, 17th Bienn. Rept., 1951-52.

The more important regions of current and probable future interest in ground water in the State are the Rathdrum Prairie in northern Idaho, the Boise and Payette River valleys in southwestern Idaho, the Snake River Plain and its tributary valleys in south-central Idaho, and the Malad River valley in Oneida County in southeastern Idaho. These areas contain most of the Idaho land that is suitable for irrigation agriculture.

Some areas having special interest, because of present development or proposed near-future development, are the Boise Valley, the Grandview-Bruneau area, the Dry Creek-Murtaugh area, the Lower Goose Creek basin, the Minidoka North Side area, the Raft River valley, the Boise valley, and the American Falls district. There are some important areas in central and north-central Idaho that are irrigated with surface water, but in which the status of ground-water supplies is poorly known.

The Snake River above Weiser drains more than 40 million acres of land in Idaho, Wyoming, Oregon, Nevada, and Utah.[1/] Five million or more acres is suitable for agriculture if a dependable supply of irrigation water can be obtained.[2/] Nearly 2.5 million acres already has been developed by both private and federal projects, utilizing surface water.[3/]

1/ Simons, W. D., 1953, Irrigation and streamflow depletion in Columbia River Basin above The Dalles, Oreg.: U. S. Geological Survey, Water Supply Paper 1220.

2/ Simons, W. D., 1953, op.cit.

3/ Kulp, M. R., 1953, in Idaho Dept. Reclamation 17th Bienn. Rept. 1951-52, p. 7-8.

Boise Valley

The potentialities for extensive ground-water development are not confined to areas where surface water is unavailable. Indeed, some of our most important ground-water reserves are in areas of intensive surface-water development, having been built up in part by excess irrigation surface water that escapes to the ground. The Boise Valley, for example, has been under intensive development with surface water during the past 50 years. The valley contains the largest integrated package-unit area of irrigated land in the State. Aside from occasional water shortages in drought periods, the supply of water in the Boise River watershed has been more than ample for the irrigated area. This area ordinarily is considered to be one of surface-water development exclusively. Recent investigations by the Geological Survey, however, have disclosed that the total ground-water production in the valley for all purposes— irrigation, drainage, industrial, municipal, domestic, and stock —exceeds 140,000 acre feet annually. This is equal to 25 percent of the estimated total annual ground-water pumpage on the Snake River Plain east of King Hill, the largest area of ground-water development in Idaho. The figure for the Boise Valley does not include the large amount of ground water that is intercepted by drainage ditches, which may greatly exceed the amount pumped from wells.

Bruneau - Grandview Area

It is estimated that in the Bruneau - Grandview area about 20,000 acre-feet of water is discharged annually by artesian wells, most of which flow continuously throughout the year. Only about 20 wells actually are used for irrigation, but some of these have very large yields. The largest well in the area discharges about 425 inches of water (3,800 gpm) continuously by artesian flow.

Investigation has disclosed the existence of highly productive artesian aquifers at depths ranging from about 700 feet to probably as much as 2,500 feet, but much of the artesian water is not of the best quality for irrigation because of its undesirably high percentage of sodium. Use of the water for irrigation should be in areas having suitable soil and good soil drainage, and the type of crops to be irrigated also should be considered carefully.

Dry Creek - Murtaugh Area

The Dry Creek-Murtaugh area is the most intensively developed area of ground-water irrigation in the State; competition for water is keen, and conflicts of interest are already in sight. New wells continue to be drilled and old wells deepened. More than 45,000 acre-feet of water was pumped in the 1953 season for about 15,000 acres of land. An equal number of additional acres has been applied for under the Desert Land Entry laws.

Lower Goose Creek Area

In the Lower Goose Creek valley, between Oakley and Burley in Cassia County, ground water is used to supplement the surface-water supply and to develop new land. For many years a supply of water sufficient for lands below the Goose Creek Reservoir has been sought. Wells have been drilled in the drainage basin above the reservoir, and diversion of water from other streams to the reservoir has been considered. A partial and seemingly satisfactory solution of the problem has been achieved by pumping ground water from wells on some lands that receive their basic supply from stored water in Goose Creek Reservoir. It is reported that about 40 percent of the water supply for the Oakley Irrigation District is ground water.

In recent years more than 15 wells have been drilled north of Oakley in the basin, and more than 3,000 acres outside the irrigation district has been brought under irrigation. A preliminary investigation by the Geological Survey in 1952 indicated that the safe yield of the ground-water reservoir in the vicinity of Oakley had not been exceeded at that time. Because of prospective large new developments water levels in the basin should be observed regularly to obtain long-term records of changes in ground-water storage. Water-level records are invaluable as an aid to detecting any signs of depletion of the ground-water resources.

Northward from Oakley the occurrence of ground water is complicated by faults and other geologic structures which have not been adequately studied. Some successful wells have been drilled, but some have been poor. Ground water is available but the amount that might be pumped safely cannot be estimated at present. The area requires careful study.

Raft River Basin

The Raft River basin contains several tens of thousands of acres of arable land that has not yet been developed. The amount of arable land available is so great that its potential water requirement far exceeds the recoverable supply of ground water. In 1952 about 22,700 acre-feet of water was pumped, of which about 8,000 acre-feet was used to supplement surface water. The total amount of ground water that could be recovered is substantial but unknown. Moreover, the probable effect of pumping ground water on the flow of the Raft and Snake Rivers requires intensive study.

American Falls Area

Development of ground water in the American Falls basin south of the reservoir, including Michaud Flats, has been spotty. Some wells are highly productive; others almost complete failures. The permeability of the geologic formations that contain water is highly variable and ingenuity is required to develop wells satisfactorily. Parts of the Fort Hall Indian Reservation seems to be promising for ground-water development. Private capital has made a successful start in the Bannock Creek valley adjacent to Michaud Flats, and this area may attract additional interest in the future.

Snake River Plain above King Hill

Although much of the interest in and development of ground water hitherto has been on the fringes of the Snake River plain and bordering tributary valleys, recent development tends more toward the plain itself, as in southern Minidoka County and the Blackfoot-Tader area. The U. S. Bureau of Reclamation is developing the first Federal ground-water reclamation project in Minidoka County just north of the Minidoka North Side Gravity Division. The project includes about 58,000 acres, and indications are that private development adjacent to the project may be as large or larger. The estimated total ground-water pumpage in Minidoka County and areas immediately adjacent was more than 75,000 acre-feet in 1953. When full development is attained pumping may approach a rate of 2,000 cubic feet per second at the peak of the irrigation season.

In the Blackfoot-Tader area of western Bingham County, and southwestward into northwestern Power County, development in recent years has been sufficiently rapid to cause some concern among water users about the effect pumping may have on ground-water discharge to the Snake River between Blackfoot and the American Falls dam. The Geological Survey has made some studies on the eastern Snake River Plain during several past years, but the total area concerned is very large, the problems are complex, and a very large amount of additional work is necessary before a comprehensive report can be written. Interim reports on parts of the plain are being released from time to time.

Records are available of more than 200 irrigation wells in the Blackfoot-Tager and Aberdeen-Springfield areas, but the record is not complete. Incomplete records of pump discharges suggest that the total amount of ground water pumped from these wells in 1953 was probably on the order of 85,000 acre-feet.

Ground-water development in southeastern Jerome County in the Hazelton-Eden-Milner district got off to a slow start in 1948, increased in 1951, and reached a peak in 1952. Since then the rate of development has slowed somewhat. Pumpage in 1952, the last year for which records are available, was about 22,000 acre-feet. In 1953 pumpage probably was on the order of 28,000 acre-feet.

A few of the other areas in the Snake River Plain, which probably will be developed to some extent in the near future, are northeastern Jerome County and southern Lincoln County, certain scattered sections of Gooding County, and northwestern Power County.

Rough estimates of the total amount of ground water pumped in 1953 indicate about 130,000 acre-feet from valleys tributary to the Snake River Plain above King Hill, about 275,000 acre-feet from the Snake River Plain proper above King Hill, and about 170,000 acre-feet in various areas between King Hill and Weiser. The grand total apparently was more that 675,000 acre-feet.

Ground Water Pumpage in Southern Idaho in 1953

Area	Pumpage (acre-feet)
Central Snake River Plain	
Aberdeen-Springfield area	85,000
Minidoka North Side Pumping Division and vicinity	76,000
Southeastern Jerome County	28,000
Western Jefferson County	85,000
Other	100,000
Total	374,000
South Side tributary valleys	
Bruneau-Grandview area	31,000
Dry Creek-Murtaugh	50,000
Goose Creek basin including Burley district	40,000
Raft River basin	30,000
Michaud Flats	10,000
Other	?
Total	161,000+
Western Snake River Plain	
Boise Valley	140,000
Total	675,000+

Ground-Water Recharge with Surplus Snake River Water

Last year, and informally many years earlier, Lynn Crandall,[1] the Geological Survey District Engineer at Idaho Falls and Watermaster of Irrigation District Number 36, suggested that excess flood runoff from the upper Snake River drainage basin might be diverted to the basalt areas of the Snake River Plain and allowed to percolate into the ground to recharge the ground-water reservoir. This suggestion received considerable well-merited public attention and it is appropriate to discuss some of the implications of the idea and a few of the physical and technical problems involved.

The basic proposal of ground-water recharge is fundamentally sound and practical. Artificial recharging of ground-water reservoirs has been notably successful in California, New York, New Jersey, and elsewhere. Basically, to use conveniently and efficiently excess floodwater for ground-water recharge requires (1) a suitable diversion point on the river, (2) permeable subsurface rocks in an area where recharge to the proper water-bearing formation would be assured, (3) a feasible transmission route for the diverted surface water. Reasonably accurate information must be available about the amount of water that is surplus, where it can be diverted, the means of diverting it, the permeability and other physical characteristics of the rocks over which the floodwater

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[1] Crandall, Lynn, 1953, Ground-water flows of the Snake River Plain, presented at the Ann. Convention, Idaho State Rec. Ass. Pocatello, Idaho, March 31, 1953.

WOULD TRAVEL ENROUTE TO THE RECHARGE AREA, THE CHARACTER OF THE ROCKS IN THE RECHARGE AREA, THE EFFECTS THAT WILL RESULT FROM DISPOSING OF EXCESS WATER, THE COST VERSUS THE BENEFITS TO BE GAINED, AND MANY OTHER THINGS.

GOOD INFORMATION ALREADY IS AVAILABLE ABOUT THE AMOUNT AND LOCATION OF SURPLUS FLOODWATER IN THE SNAKE RIVER. POSSIBLE METHODS OF ARTIFICIALLY RECHARGING A GROUND-WATER RESERVOIR INCLUDE (1) WATER-SPREADING GROUNDS, (2) OPEN CANALS WITH LEAKY BOTTOMS, TERMINATING IN INFILTRATION PONDS, (3) OR WELLS DRILLED IN THE BOTTOM OF A CANAL OR NEAR THE RIVER. MR. CRANDALL DISCUSSED SOME OF THESE METHODS LAST YEAR. HE MENTIONED POSSIBLE DIVERSION POINTS NEAR ST. ANTHONY, AT IDAHO FALLS, AND AT AMERICAN FALLS. HE DISCUSSED ALSO POSSIBLE SEEPAGE LOSSES FROM A DIVERSION CANAL AND THE USE OF INTAKE WELLS TO LEAD WATER INTO THE GROUND-WATER RESERVOIR.

TWO METHODS OF DIVERTING FLOODWATER TO A SUITABLE DISPOSAL SYSTEM ARE (1) DIVERSION DAMS AND (2) PUMPS. OWING TO THE HIGH ALTITUDE OF MUCH OF THE SNAKE RIVER PLAIN RELATIVE TO THE RIVER, GRAVITY DIVERSION WOULD REQUIRE LONG AND COSTLY CANALS IN ORDER TO REACH FAVORABLE RECHARGE AREAS. DIVERSION BY PUMPING WOULD REDUCE THE LENGTH OF THE CANALS BUT WOULD INVOLVE SUBSTANTIAL OTHER COSTS.

THE FEASIBILITY OF WATER-SPREADING GROUNDS, INFILTRATION PONDS, OR LEAKY CANALS DEPENDS ON THE CHARACTER OF THE ROCKS BENEATH THE SURFACE, PRINCIPALLY THOSE ABOVE THE WATER TABLE. WHERE THERE ARE TIGHT BASALT LAYERS OR IMPERMEABLE SEDIMENTS BETWEEN SUCCESSIVE BASALT FLOWS ABOVE THE WATER TABLE, WEEKS OR MONTHS MIGHT BE REQUIRED FOR WATER TO TRAVEL FROM THE SURFACE TO THE GROUND-WATER RESERVOIR. BECAUSE NATURAL FLOOD

FLOWS OCCUR ONLY DURING ABOUT 1 TO 8 WEEKS EACH YEAR, QUICK DISPOSAL IS NECESSARY UNLESS STORAGE IS PROVIDED. IF THE ROCKS UNDERLYING THE DISPOSAL SITE WERE NOT HIGHLY PERMEABLE, VERY LARGE SPREADING GROUNDS OR INFILTRATION PONDS WOULD BE NECESSARY. THE SNAKE RIVER BASALT IS NOT EVERYWHERE HIGHLY PERMEABLE, AS IS SHOWN BY SOME EXISTING CANALS ON THE PLAIN THAT LOSE VERY LITTLE WATER. IN SOME PLACES THE TIGHTNESS OF THE CANALS IS CAUSED BY A MUD SEAL, BUT IN OTHERS THE BASALT ITSELF APPEARS TO BE QUITE IMPERMEABLE.

AT FIRST SIGHT A LAVA FIELD LIKE HELL'S HALF ACRE MIGHT APPEAR TO BE A SUITABLE RECHARGE AREA. NO DIRECT INFORMATION IS AVAILABLE, HOWEVER, ABOUT THE CHARACTER OF THE ROCKS BENEATH THE SURFACE. HELL'S HALF ACRE LIES AT A HIGHER ALTITUDE THAN PARTS OF THE PLAIN IMMEDIATELY TO THE SOUTH. IF THERE ARE IMPERMEABLE BEDS BENEATH THE SURFACE A PERCHED WATER TABLE COULD DEVELOP FROM ARTIFICIAL RECHARGE AND SOME OF THIS WATER EVENTUALLY MIGHT APPEAR IN NEW SPRINGS AROUND THE SOUTHERN MARGIN OF THE LAVA FIELD. SIMILAR SPECULATIONS MIGHT BE MADE ABOUT MOST LOCALITIES IN THE SNAKE RIVER PLAIN. MY SOLE POINT IS THAT SELECTION OF A RECHARGE AREA PROBABLY WOULD REQUIRE A SUBSTANTIAL AMOUNT OF SUBSURFACE EXPLORATION.

LET US ASSUME THAT HALF A MILLION ACRE-FEET OF FLOOD WATER WOULD HAVE TO BE DISPOSED OF IN A PERIOD OF 4 WEEKS. AN AREA OF RATHER PERMEABLE GEOLOGIC MATERIALS WOULD ALLOW ABOUT 2 ACRE-FEET OF WATER PER ACRE PER DAY TO PERCOLATE INTO THE GROUND. TO DISPOSE OF 500,000 ACRE-FEET OF WATER IN 4 WEEKS WOULD REQUIRE A PERCOLATION AREA OF NEARLY 9,000 ACRES (14 SQUARE MILES) AND A DIVERSION CANAL HAVING A CAPACITY OF NEARLY

9,000 cfs. Naturally, the rocks beneath the surface would have to be able to absorb and carry away this large amount of water quickly enough so that the water table would not be built up to the land surface within the 4 week period.

There are vast areas of the Snake River Plain that may never be used for anything but grazing. In such places, <u>if</u> the topography were such that diverted water would not flood useful land areas or return at the surface to the river, containment of the water in disposal ponds or spreading grounds might not be essential.

Recharge wells, the alternative to surface "spreading" structures, might have to extend a considerable distance below the water table in order to develop adequate intake capacity. Many irrigation wells on the Snake River Plain penetrate 50 to 150 feet or more below the water table. Some of these wells produce up to 10 cubic feet of water per second with very small drawdown. A recharge capacity of 500,000 acre-feet of water in 4 weeks would require 900 wells having a capacity of 10 cubic feet per second each to dispose of the excess water.

Floodwaters commonly are muddy and often contain a considerable amount of trash. Channel infiltration in a diversion-canal system might be seriously impeded by deposition of a mud seal from flood waters. Control of silt and trash would have to be provided or the effectiveness of any disposal method would be impaired.

In addition to the geology of a prospective recharge area, close attention would have to be given to the occurrence and movement of ground water. Recharge in areas where ground water is locally tributary to the Snake River would increase return flow to the river. Recharge elsewhere might increase the return flow only through the large springs in the Snake River valley below Milner.

Let us consider for a moment the amount of water available for artificial recharge and compare it with the amount of ground water that is in transient storage in the Snake River basalt. The amount of water spilled annually past Milner by the Snake River since the American Falls dam was built has ranged from about 4 million acre-feet in 1928 to 113,000 acre-feet in 1935, averaging about 1,360,000 acre-feet. When additional storage space becomes available at the Palisades reservoir on the upper Snake River, the average annual excess flow of floodwater will be reduced. On the basis of a crude but conservative estimate it is believed [1] that the ground-water reservoir in the Snake River Plain contains not less than 5 billion acre-feet, or about 4,000 times the amount of the present average annual floodwater under consideration. If 1 million acre-feet of floodwater were added to the ground-water reservoir, the addition to ground-water resources would be only a small fraction of a percent of the present total. Not all the water could be pumped for irrigation, because the irrigation season is only about 120 to 180 days

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[1] Nace, R. L., Ground-water use and development in Idaho, presented at at the Ann. Convention, Idaho State Rec. Ass., Pocatello, Idaho, March 30, 1953.

long, whereas ground water moves through the aquifer continuously. Some of the recharge water, however, would be available for irrigation and other purposes on the Snake River Plain, the amount depending on the placement of the recharge area or areas in relation to areas suitable for irrigation, and on the rate of flow of the water. The remainder would be discharged from the springs in the Snake River valley.

The areas of most intensive ground-water development in Idaho are in certain tributary valleys of the Snake River Plain where the surface-water supply is entirely inadequate for the available arable acreage and the ground-water reservoirs receive only a limited amount of natural replenishment. It might be feasible to use the floodwater to supplement natural recharge in some such areas. The Michaud Flats, the Raft River valley, the Goose Creek basin, the Dry Creek-Murtaugh area near Twin Falls, and other areas might well be considered. The cost of artificial recharge in such areas might be greater than in the Snake River Plain, but the added benefits might outweigh the added cost.

For example, in the Raft River Valley, according to records of the U. S. Bureau of Land Management, more than 60,000 acres of new ground-water development is proposed or under construction under desert land entries. Water requirements for full and supplemental irrigation of the land would be on the order of 150,000 acre-feet, which far exceeds the safe yield of aquifers in the Raft River basin. Because only a part of any artificially recharged water could be intercepted by wells, it might be necessary to supply several times as much recharge as would be pumped. In this instance, however, the excess recharge would not be wasted. At

LEAST SOME GROUND WATER THAT LEAVES THE RAFT RIVER VALLEY CROSSES BY UNDERFLOW TO THE NORTH SIDE OF THE SNAKE RIVER, AND HENCE ESCAPING RECHARGE WATER WOULD REACH THE GROUND-WATER RESERVOIR OF THE SNAKE RIVER PLAIN AND ACCOMPLISH PART OF THE SAME PURPOSE THAT WOULD BE SERVED BY UPSTREAM RECHARGE IN THE BASALT. THE POINT I WISH TO MAKE IS THAT ARTIFICIAL RECHARGE POSSIBILITIES ARE NUMEROUS. AT THE PRESENT TIME THERE IS NO GENERAL SHORTAGE OF GROUND WATER ON THE SNAKE RIVER PLAIN, BUT IN SEVERAL OF THE TRIBUTARY VALLEYS THERE IS NOW OR WILL BE IN THE FORESEEABLE FUTURE A CRITICAL WATER SHORTAGE. ALL THE TRIBUTARY VALLEYS CONTRIBUTE SOME GROUND WATER TO THE SNAKE RIVER PLAIN, AND SOME OF THE ARTIFICIAL RECHARGE NOT INTERCEPTED BY WELLS WOULD STILL REACH THE CENTRAL BASALT PLAIN AND BE AVAILABLE FOR INTERCEPTION THERE.

OF COURSE, IN TRIBUTARY VALLEYS THE SAME PROBLEMS OF DIVERSION, CANAL CONSTRUCTION, PERMEABILITY OF RECHARGE AREAS, AMOUNT OF WATER AVAILABLE FOR ARTIFICIAL RECHARGE, COST, BENEFITS, AND OTHER FACTORS WOULD EXIST IN ANY PLAN FOR USING EXCESS FLOODWATER OF THE SNAKE RIVER FOR GROUND-WATER RECHARGE.

THE PROPER SOLUTION OF THIS AND OTHER GROUND-WATER PROBLEMS CAN BE FOUND ONLY BY SYSTEMATIC SCIENTIFIC INVESTIGATION, FOLLOWED BY SOUND ENGINEERING AND ECONOMIC PLANNING AND PUBLIC ACCEPTANCE.

I WOULD LIKE TO POINT OUT THAT THE MISSION OF THE GEOLOGICAL SURVEY IS NOT TO DECIDE WHAT WILL BE DONE WITH FLOODWATERS OR, IN FACT, ANY OTHER SUPPLY OF WATER. WE ARE NOT IN THE CONSTRUCTION BUSINESS; OUR ONLY PURPOSE IS TO DETERMINE FACTS, INCLUDING WHAT <u>CAN</u> BE DONE ABOUT WATER BUT NOT WHAT <u>SHOULD</u> BE DONE. THAT PHASE IS UP TO THE PEOPLE OF IDAHO AND TO THE AGENCIES WHO HAVE CONSTRUCTION AND ACTION RESPONSIBILITIES.