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IN THE FIELDS OF:

PLANNING
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WATER
SEWAGE
STRUCTURAL
SUBDIVISIONS
AIRPORTS
BRIDGES

March 9, 1984

Department of Water Resources
Statehouse
Boise, Idaho 83720

Attention: Bill Graham

Dear Sir:

Attached is a draft of the Lower Snake River Aquifer Recharge Project Impact and Monitoring Program. With your concurrence, this document will be included in the cooperative agreement to be prepared by the Bureau of Land Management.

Also, currently in preparation is an agreement with the Geological Survey to conduct the necessary monitoring.

Please call me if there are any questions.

Respectfully yours,

EDWARDS * HOWARD * MARTENS, INC.

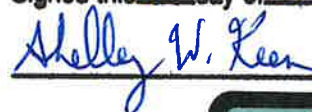

Gerald L. Martens, P.E.

GLM/bn
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The foregoing is a true and certified copy of the document on file at the Department of Water Resources.

Signed this 31st day of October, 2018.



EXHIBIT

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IMPACT EVALUATION AND MONITORING PROGRAM
LOWER SNAKE PLAIN AQUIFER RECHARGE PROJECT

BY

C. E. BROCKWAY, P.E.

March 1984

IMPACT EVALUATION AND MONITORING PROGRAM

LOWER SNAKE PLAIN AQUIFER RECHARGE PROJECT

General

The location of the proposed recharge site is in Sec. 22, Township 5S, Range 17E, Boise Meridian. The area is on U.S. Government land adjacent to the Milner-Gooding canal operated by the Big Wood Canal Company. Ground slopes are generally to the southwest; however, the majority of the area consists of recent exposed basalt flows with shallow soils in the low areas.

Water Supply and Diversion

The source of water for the recharge at this site is the Snake River with the diversion from the Milner Pool. Water is conveyed through the Milner-Gooding canal to the diversion site. A diversion structure to be constructed in early 1984 will be a concrete gated structure with a continuously monitored measuring device.

Water permits and contracts with the Big Wood Canal Company will currently allow diversion of up to 600 cfs during periods of surplus flow in the Snake River at Milner. The capacity of the canal at the diversion point is 600 cfs which is approximately the irrigation requirement for lands downstream of the diversion site. The lack of excess capacity, therefore, limits the diversion for recharge to periods prior to or subsequent to maximum irrigation demand. Current plans are for diversion of approximately 72,000 acre feet during the thirty day period, May 15 through June 15, and an additional 72,000 after the irrigation season. The maximum diversion rate would be 600 cfs.

Water Quality

Water quality of the recharge water will be approximately equal to that of the water in Milner pool. Table 1 shows typical water quality data for the Snake River above Milner pool for 1982 and 1983 from Idaho Department of Health and Welfare Division of Environment records.

Table 1 shows maximum values of suspended solids of 53 mg/l and maximum fecal coliform of 330. These values are low, and recharge of waters of this quality should pose no hazard. Total dissolved solids of the regional groundwater in this area will likely exceed that of the Snake River water.

Geologic Analysis

An analysis of available well driller's logs for the area shows a general profile consisting of multiple layers of basalt flows with inter-layer materials varying from clays and fine grained materials to highly

Table 1. Water quality in the Snake River.

Date	Sus. sol.	J.T.U.	Tot/col	Fec/col	Fec/strep
11/17/81	17.4	1.7	130	7	30
11/17/81	10.3	1.5	110	2	20
12/14/81	2.3	3.1	Samples over time limit---arrived at lab late		
1/25/82	4.9	2.0	7	<1	23
2/23/82	6.0	3.7	15	4	47
2/23/82	10.2	4.3			
3/22/82	9.65	6.5	20	<1	20
4/19/82	29	18	20	<1	43
5/3/82	24	10	100	5	70
5/3/82	28	11			
6/7/82	3.8	3.8	4	1	17
6/7/82			6	2	32
7/26/82	7.0	1.0	40	25	42
8/2/82	5.1	3.3	70	68	100
9/8/82	4.0	5.3	30	40	24
9/8/82	3.0	5.5	200	330	230
10/17/82	9	8.9	12	11	10
11/15/82	9	9.9	14	3	10
11/15/82	11	9.9	13	3	9
12/7/82	3.3	6.8	6	<1	8
1/10/83	4.7	4.5	2	<1	15
2/7/83	< .2	5.2	3	1	26
2/7/83	.07	4.9	5	1	32
3/15/83	6.2	5.7	4	<1	2
1/4/83	52.9	21	130	50	240
5/23/83	7	6.6	4	1	2
5/23/83	7	6.9	7	1	9
6/21/83	9	4.2	59	7	33
7/19/83	42	11	130	25	80
8/23/83	<2	2.4	290	8	13
8/23/83	2	2.5	4	4	12
9/19/83	13.2	5.7	260	120	320

3. Lower Snake Plain Aquifer Recharge Project

permeable fractured basalt. There is only one discernible continuous low permeability strata in all well logs. This strata is a layer of clay or broken rock and clay at a depth of approximately 200 feet. Thickness of the clay varies from 6 to 10 feet.

There are no well logs in the immediate vicinity of the recharge site. However, it is a reasonable assumption that the clay layer is present under the site and adjacent areas. The gradient of the clay layer is approximately 0.3 percent toward the southwest.

The regional water table, as indicated by driller's logs and recent studies by the U.S. Geological Survey for the Regional Aquifer Systems Analysis, lies at or below the clay layer.

Vertical hydraulic conductivity of the formations above the clay will be relatively high on a macro scale although there are lenses and interlayer materials with fine texture which will exhibit low permeabilities. It is expected that the vertical hydraulic conductivity of the clay will be on the order of 0.1 ft/day and the horizontal hydraulic conductivity of the formation above the clay should have conductivities exceeding 10,000 ft/day.

Flow Model during Recharge

The operational infiltration rate of the surface materials at the recharge site is estimated at 6 cubic feet per square foot per day (cfd). This estimate assumes areas of thin soils and exposed basalt with ponded areas between basalt areas. For a maximum inflow of 600 cfs, the expected maximum inundated area is 200 acres. It is entirely possible that the inundated area will be considerably smaller than this estimate especially during the initial period prior to any clogging by suspended materials. It is expected that, with 600 cfs inflow and high vertical permeabilities in the strata above the clay, a mound will form above the clay. The height of the mound will depend on the horizontal hydraulic conductivity of the material above the clay, the vertical hydraulic conductivity of the clay, and on the duration of recharge. The assumptions in the flow model are:

1. Hydraulic conductivity of the material above the clay is sufficient to impede horizontal spreading the recharge water in the first 200 feet.
2. A mound will form above the impeding clay layer.
3. The clay layer is continuous beneath the recharge site and adjacent area and is approximately 6 feet thick.
4. The gradient of the clay layer is 0.3 percent and is uniform in the southwest direction.

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not be
valid

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5. The regional water table is below the clay layer and has a gradient toward the southwest.
6. The vertical hydraulic conductivity of the clay is approximately 0.1 ft/day.
7. Horizontal hydraulic conductivity of the strata just above the clay layer exceeds 10,000 ft/day.

It is not possible without the aid of a three dimensional ground-water flow model to predict the transient response of the system and the buildup and decay of the mound. However, if it is assumed that the mound approximates a cone above the clay layer, a steady state would be achieved with continuous discharge when the saturated area above the clay is equal to about 3000 acres. Since the gradient of the top of the clay layer is toward the southwest, the plume or saturated zone would not be circular but would be skewed toward the southwest. A reasonable estimate of the shape of the saturated area would be that approximately one third of the area would lie upgradient of the recharge site and two thirds downgradient.

With a thirty day recharge period, a steady state flow system will not likely be achieved and the area of saturated material above the clay will be considerably smaller than a steady state solution. With a short duration recharge period, small perched mounds on discontinuous lenses above the clay will dissipate and build up of the mound will be buffered by the short term storage. It is estimated that a 30-day recharge duration with 600 cfs would result in a saturated area of about 600 acres beneath and down gradient from the recharge site.

Monitoring Program

The surface water monitoring plan includes weekly sampling of the recharge water from the Milner-Gooding canal for water quality and continuous measurement of the recharge rate from the diversion site. Discharge will be determined by the difference between canal flows at a current measuring site upstream of the recharge diversion and a measuring device below the recharge diversion. The downstream device will be constructed by the recharge district and daily measurements at both sites will be made by the canal company. The Milner-Gooding canal is concrete lined between the discharge measuring sites so seepage losses will be negligible. Provisions for a stilling well and continuous stage recorder at the diversion will be made for possible future installation of a well. Grab samples will be obtained for water quality analysis, and water quality analysis will include chloride, total suspended solids, electrical conductivity, pH, and fecal coliform. Initial samples of the discharge will be analyzed for pesticides.

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The objective of the groundwater quality monitoring program will be to determine the presence of and quality of the water reaching the top of the clay layer. If the quality of this water is adequate, it can be assumed that the water reaching the regional water table by percolation through the clay layer will not have adverse water quality. The first observation well will be designed to monitor water levels above the clay layer and to obtain water quality samples using portable pumping systems. Water level measurements will be made with steel tape, electrical sounders, or continuous water level recorder. It is possible that cascading water will be present in unused observation wells if significant horizontal flow occurs in the strata above the clay layer.

Monitoring Well Construction

One monitoring well is planned for construction in the spring of 1984. This well will be located south of the recharge area in the direction of the city of Shoshone. The location will be determined by the limits of the expected recharge area as shown on Figure 1. Drilling will be by air-rotary methods. The well will be 6 in. in diameter drilled open hole to approximately 160 feet. Geophysical logging, including caliper, SP, neutron or gamma techniques will be performed prior to installing and cementing casing to the 160 foot depth. Open hole will be drilled from 160 feet to approximately 200 feet or just into the clay formation.

A second well planned for 1984 will be drilled adjacent to the recharge site to obtain additional geologic information and to monitor possible cascading water from strata above the clay layer. Location and construction of the second well will be conditioned by formations encountered in well No. 1 and on monitoring during the 1984 season.

Pre-Project Water Quality Evaluations

~~Project~~ Prior to the 1984 recharge diversions, water quality samples from 5 or 6 wells adjacent to the project will be obtained. These will include primarily wells in and near the city of Shoshone and downgradient from the recharge site. Complete chemical and bacterial will be performed on all samples.