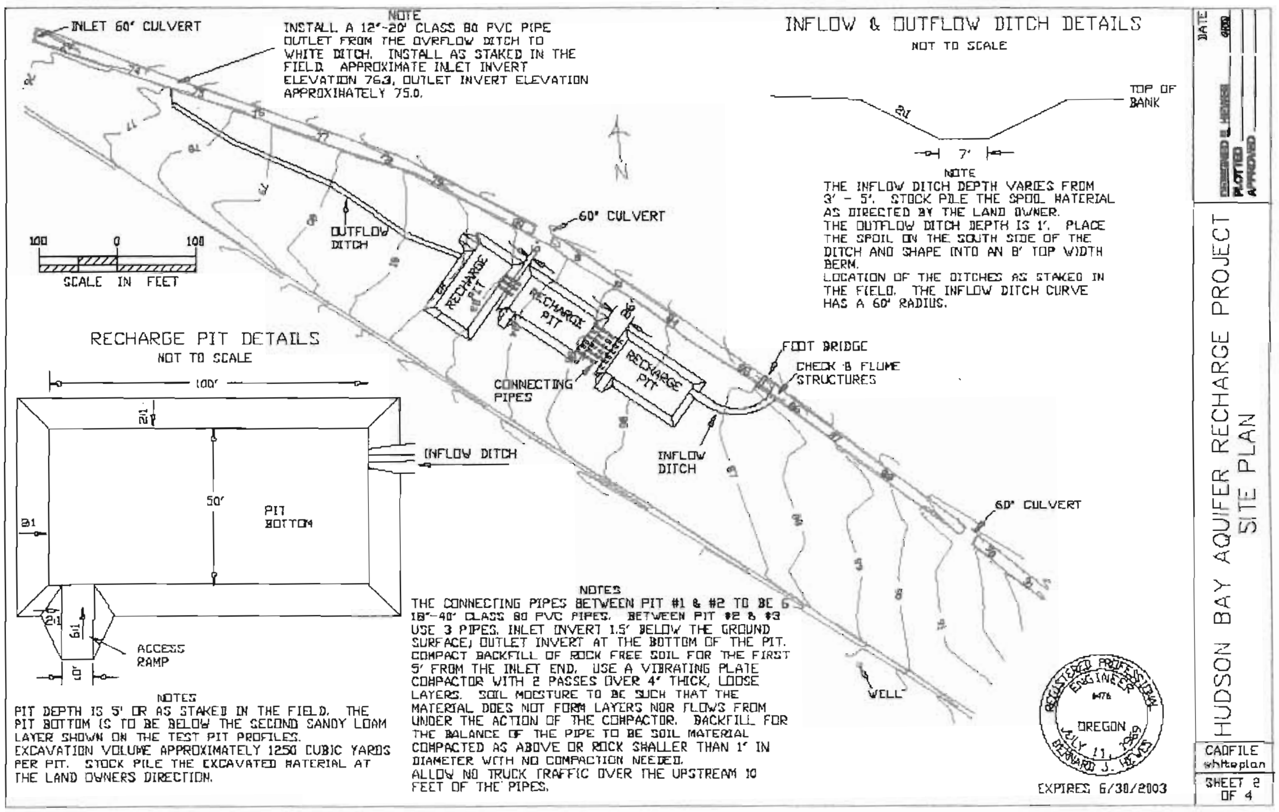
Hudson Bay Aquifer Recharge Project

An application for ASR Testing Limited License to Oregon Water Resources Department (OWRD) (OAR 690-350-0020)



Prepared for the HBDIC by:

Walla Walla Basin Watershed Council
Kennedy and Jenks Consultants, Inc.

October 20, 2003

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Limited License Supplemental Application Materials
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Introduction

The Walla Walla Basin Watershed Council (WWBWC), in cooperation with the Hudson Bay District Improvement Company (HBDIC), has proposed to test shallow aquifer recharge at a site located adjacent to the HBDIC's *White Ditch* in section 33, T6N, R35E. At the test site a series of three infiltration pits will be built. Water will be supplied to these pits via a diversion from the canal. Recharge activities are proposed during the winter and spring months, when the Walla Walla River (the source of water for the canal) is running at higher flows. The proposed shallow aquifer recharge testing would be done under an ASR Testing Limited License granted by Oregon Water Resources Department (OWRD) (OAR 690-350-0020). By recharging shallow groundwater it is hoped that a portion of the recharge water will return to restore diminished spring-creek and Walla Walla River baseflows. Testing <u>will not include</u> removal of stored water by pumping or other artificial means.

The Limited License Application requires several supporting documents be attached (690-350-0020 (3)(b)), including (but not limited to) those describing proposed testing, groundwater conditions (including hydrogeologic conditions and groundwater quality), and source water quality. Information not included in this assessment report, but still needed for the application, will be collected during proposed site-specific hydrogeologic characterization, monitoring, and testing process. This limited license application is to gain approval of the proposed shallow aquifer recharge testing. The complete list of Attachments as called for in include:

Attachment 1. Project Layout and Size, 690-350-0020(3)(a)(E) and (I) and 690-350-0020(3)(b)(B)
Attachment 2. Water Rights Statement, 690-350-0020(3)(a)(F) and (G)
Attachment 3. Land Use Approval, 690-350-0020(3)(a)(H)
Attachment 4. Proposed Test Program, 690-350-0020(3)(b)(A)
Attachment 5. Proposed Monitoring Program, 690-350-0020(3)(b)(A)
Attachment 6. Site Hydrogeology, 690-350-0020(3)(b)(C), (E), and (G)
Attachment 7. Source Water Quality, 690-350-0020(3)(b)(D)

Overview of Watershed Conditions

The quantity, storage, timing, and availability of water are several major challenges facing watershed managers in the Walla Walla River Basin. The relationship between the Walla Walla River and its distributaries with that of the shallow alluvium aquifer has been shown to be highly interdependent (Piper, 1933, Newcomb, 1965, Barker & McNish, 1975, Bower et. al., 2001). The Walla Walla Basin Watershed Council, Walla Walla Watershed Alliance, and Hudson Bay District Improvement Company (HBDIC), working with their partners in OWRD, ODEQ and ODFW, propose to explore the utility of artificially recharging the shallow alluvial aquifer as a way to help offset the loss of natural recharge opportunities throughout the basin.

Surface water and shallow groundwater in the Walla Walla Basin (the Basin) form an interconnected system. In some areas, especially upstream areas where streams leave the mountains and highlands surrounding the Basin to flow out onto the Basin floor, streams historically probably branched out onto the Basin floor and some of the water they carried seeped into the ground, recharging the shallow groundwater system. This shallow groundwater, recharged near the edge of the Basin, formed the main source of clean, cool groundwater found further down basin where it returned to the surface via springs and base flow to the Walla Walla River. Through the years, the issuance of hundreds of surface and groundwater rights has resulted in the allocation of nearly all of the naturally available water in the basin. These allocations have pressured water resources, compelling the

Washington State Department of Ecology to close ground waters to further appropriations due to concerns about dropping water table levels. Other indicators of overstressed water resources include: (1) dry or dropping well levels, some wells in OWRD's inventory of state-observation-wells, (2) dry or dropping flow volumes in the spring branches, and (3) loss of natural and artificial groundwater recharge opportunities through irrigation efficiency and improved surface water management.

The state of Oregon has recognized use of artificial recharge as a tool "that can be an effective and efficient method for storing water for futures uses."(OWRD, Umatilla Basin Report, 1988). Artificial recharge has been shown to work in other areas of Umatilla County such as the County Line Water Improvement District Project, in operation since 1977. An OWRD review of this project states "It has been instrumental in arresting and reversing ground water level declines in a portion of the Ordnance Critical Ground Water Area." (OWRD, 1988). The USGS also noted the need for artificial recharge in the Walla Walla valley to offset increased water demands and loss of natural and artificial recharge mechanisms: "(Irrigation efficiency measures) can diminish the infiltration to recharge the ground water," wrote Newcomb in his important 1965 report. "Consequently, any such plans for changes in river regimen could well be required to provide for compensatory recharge or to sustain counter charges for their diminution of natural recharge and storage.

This project will comprise of three major components: Construction-Operation, Monitoring-Evaluation and Outreach-Education.

Construction-Operation: After receiving the appropriate permits and/or approval from OWRD, OWDF, ODEQ, USFWS, NOAA Fisheries and the Umatilla County Planning Department, a series of three pits specifically designed for passive artificial recharge will be constructed on land provided by the Hudson District Improvement Company (HBDIC). The land is being leased from one of the district's patrons by the HBDIC and a written agreement for the lease has been secured. The pits will be constructed in such a way to maximize recharge rates while minimizing the ground water quality impacts during the winter/spring recharge period. Project features include a concrete check structure in adjacent White Ditch, a concrete flow-measuring flume, an open connection ditch, three excavated pits, pipes connecting the pits and an outflow ditch from the down stream pit. These pits are designed to handle 50 cubic feet per second (cfs) of water anticipated to be available during the winter/spring Walla Walla River runoff. The actual volume of winter-spring water delivered will depend on the above-mentioned permitting and review process and the actual field verified constraints once in operation. Operation of this structure will be based on the instructions provided by OWRD in the operation permit and agreed to by the various project partners and agencies.

Monitoring-Evaluation: Monitoring of project will be conducted at several levels including: (1) on-site subsurface hydrologic and hydrogeologic monitoring, (2) off-site subsurface hydrologic and hydrogeologic monitoring, (3) off-site surface monitoring of springs through flow and photo-point measurements, (4) on/off-site water quality monitoring of key physical and chemical properties. The results of this intensive monitoring will be evaluated to identify impacts of the proposed project on groundwater levels and flow beneath and around the site, on surface water and spring discharges down gradient of the site, and on base flow to the Walla Walla River. Monitoring will also identify potential problems associated with the project

Outreach-Education: This project will also serve as an important outreach and education tool for the general public and water users of the Walla Walla valley. Particular focus and time will be spent on utilizing the site and the results for the recharge analysis to educate people on the role that ground water plays in the rivers and streams of the Walla Walla Watershed.

This project meets all of the habitat restoration actions from the *Oregon Aquatic Habitat Restoration and Enhancement Guide* including:

1. Change the trend of aquatic habitat function from one of a diminishing ability to support salmonids and other organisms to one that supports a complex, self-sustaining system. Such systems provide high quality habitat and ecological capacity for salmonids and other species; or
2. Correct or improve conditions caused by past management and/or disturbance events; or
3. Maximize beneficial habitat in the short term where watershed degradation has been extensive and natural processes will need substantial time to restore habitat; or
4. Create beneficial habitat and restore stream function to the fullest extent possible within developed areas where no reasonable expectation of returning to natural conditions exists.

HUDSON BAY AQUIFER RECHARGE PROJECT
LOCATED IN THE NE$\frac{1}{4}$ OF SEC33, T6 N, R35E W.M.

Figure 1 Scaled Map of Project and Surrounding Area

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SCALE IN FEET

ONE INCH EQUALS 400FT

NOTE
THE PURPOSE OF THIS MAP IS TO IDENTIFY THE APPROXIMATE LOCATION OF THE PROJECT. IT IS NOT INTENDED TO PROVIDE INFORMATION RELATIVE TO THE EXACT LOCATION OF PROPERTY OWNERSHIP BOUNDERY LINES OR ANY OTHER SIGNIFICANT MAP SUBJECTS

LEGEND

POWELL PV CANAL

TAX LOT BOUNDERY LINES

QUARTER QUARTER LINES

28 27 / 33 34 — SECTION CORNER

HUDSON BAY AQUIFER RECHARGE PROJECT
LOCATED IN THE NE1/4 OF SEC33, T6 N, R35E W.M.
FIGURE 1A

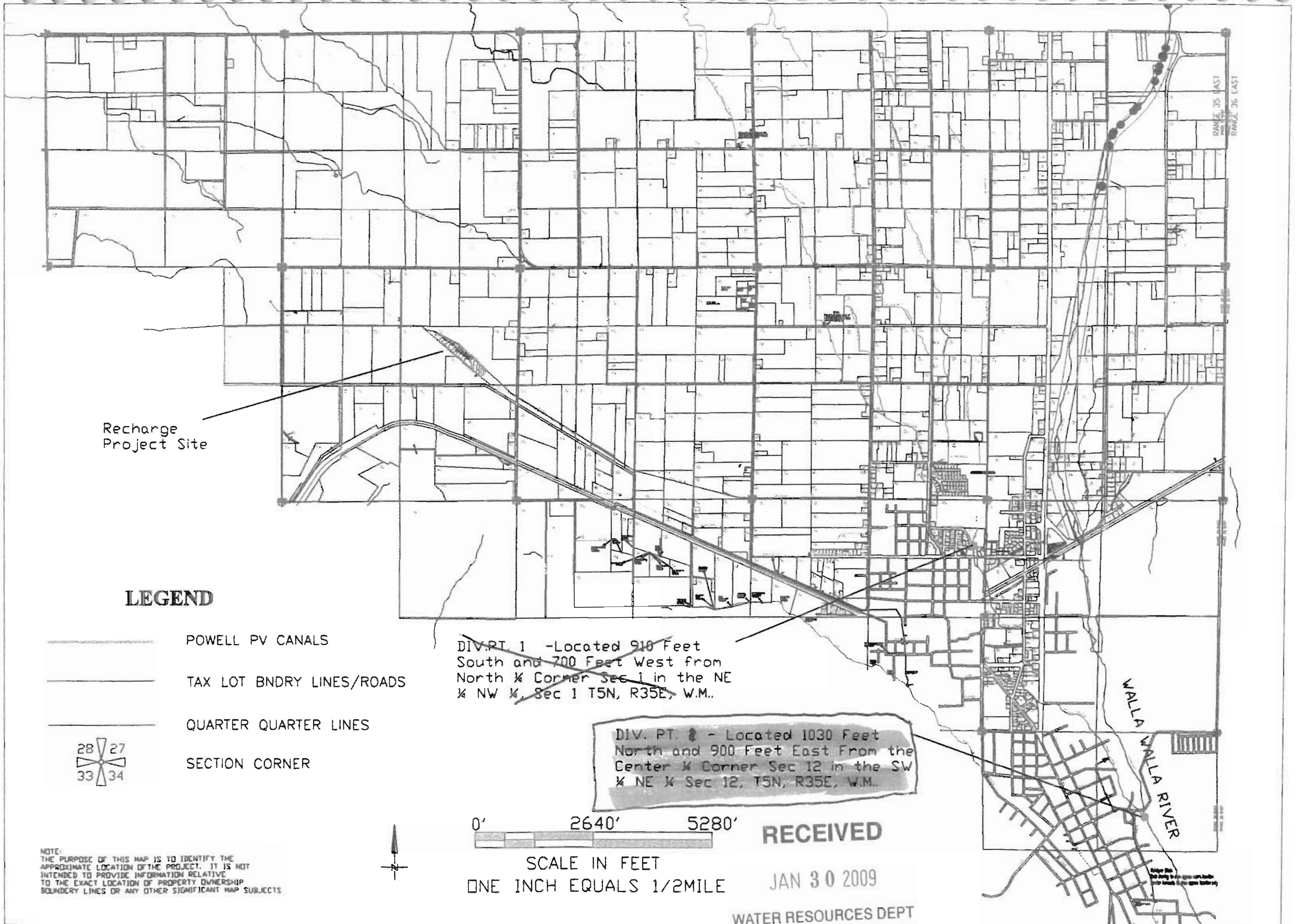
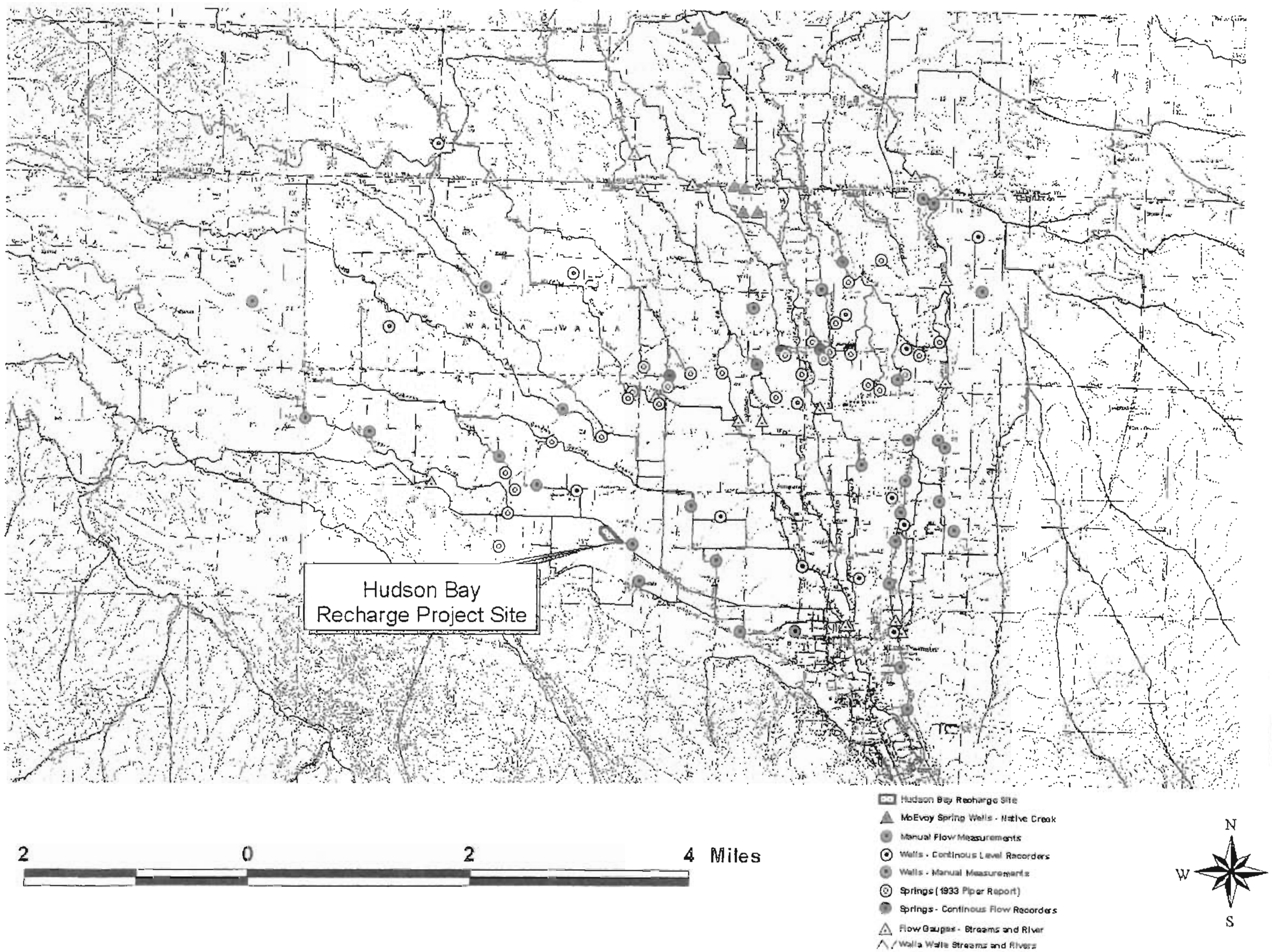


Figure 2 WWBW Monitoring and Recharge Site Map

FIGURE 2. WWBWC Monitoring Network and Hudson Bay Recharge Project 2003



Attachment 1. Project Layout, 690-350-0020(3)(a)(E) and (I) and 690-350-0020(3)(b)(B)

Prepared by Bernard Hewes, Licensed Engineer in the State of Oregon.

This project entails diverting water from an existing irrigation ditch to three pits to be excavated for the purpose of infiltrating the water into the shallow aquifer. Project features include a concrete check structure in the existing White Ditch, a concrete flow measuring flume, an open ditch, three excavated pits, pipes connecting the pits and an outflow ditch from the down stream pit.

These items were sized to handle 50 cubic feet per second (cfs) of water. This is the amount anticipated will be available from excess flow in the Walla Walla River and that the Hudson Bay District is able to deliver.

Data gathered to design the project consisted of a site topographic survey and installing two sites for testing the water infiltration capacity of the natural materials and determining the layers in the soil profile. In addition the Soil Survey of Umatilla County Area, Oregon was consulted. This is a US Dept. of Agriculture, Natural Resources Conservation Service publication giving general soils information.

The topographic survey data was used to prepare a topographic map with one foot contour intervals at a scale of 1" = 60'. This information was used to help determine the location of the project features.

Two test pits were excavated to a depth of 6'-7' each. A 24" diameter by 5' long section of corrugated metal pipe was set on end in the bottom of the pit and about one foot of fill placed around it to hold it in place. Water was pumped into the pipe at a rate that would sustain a water depth of one foot in the pipe. Both flow rate and total flow was measured. The test was run for 6.25 hours in the first pit and 3.5 hours for the second pit.

PIT #1
Soil profile:
0-12" sandy loam
12"-36" gravelly sandy loam, approximately 50% of the material volume is gravel size particles with an estimated D 50 size of about 0.75"
36"-48" sandy loam, in parts of the trench this layer does not exist
48"-?" gravelly sandy loam approximately 20% of the volume is gravel size particles

The inflow rate at the end of the test period was 4.0 gallons per minute (gpm). This resulted in an infiltration rate of 1.7 gpm/sq. ft./ foot of head.

PIT #2
Soil profile:
0"-13" gravelly sandy loam
13"-39" cobbly sandy loam, the D50 of the gravel is approximately 1"
39"-52" gravelly sandy loam
52"-? sand gravel mix D 50 estimated to be about 0.25"

In this pit the inflow rate of 11.9 gpm was maintained for 3.5 hours and at no time did water puddle in the bottom of the pipe. The infiltration rate is in excess of 3.8 gpm/sq. ft.

The area needed for infiltrating the water was determined assuming an infiltration rate for the entire area of 3.0 gpm/sq.ft./ per foot of head. For an inflow rate of 50 cfs the infiltration area needs to be

7480 square feet. The infiltration rate of 3.0 gpm/sq.ft. was chosen because the pits will be located in the area with soil surface texture similar to test pit #2.

Due to the possibility of fine soil particles plugging the infiltration area, unknowns concerning the long-term infiltration rate and that the amount of water available is not yet known extra infiltration area is being provided. Three separate pits with bottom dimensions of 50 feet X 100 feet are proposed. This will provide an infiltration area of 15,000 square feet.

The pits will be excavated to a depth of about 5 feet to get below the second sandy loam layer noted in both test pits. This will allow the water depth to be 2.5 feet - 3.5 feet. That will increase the rate of infiltration over the test values derived with one foot of water depth. The overall safety factor for the infiltration area is well over 2.

Inflow to the system will be measured with a ramp flume and continuously recorded. The ramp flume is sized to provide 5% flow rate accuracy over a flow range of 10 cfs-50 cfs

Any outflow from the last pit will be safely returned to the White Ditch through a 12-inch pipe. The pipe will be on a slope that will keep water from flowing out of White Ditch.

Engineering Attachments:

Attachment 1A: Location Map
Attachment 1B: Site Plan
Attachment 1C: Structure Details
Attachment 1D: Structure Reinforcing Steel
Attachment 1E: Signed and Stamped Copy of *Project Engineering Report*

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Attachment 2. Water Rights Statement, 690-350-0020(3)(a)(F) and (G)

Water Right Applicant:

Hudson Bay District Improvement Co.

P.O. Box 110
Milton-Freewater, Oregon 97862
Project Contact: John Zerba, WBDIC Board Member
Telephone: (541)-938-6100
Operations Contact: Jon Brough, WBDIC District Manager
Telephone: (541)-520-2856
Recharge Project Manager (WWBWC), Bob Bower, Hydrologist
Telephone: (541)-938-2170

Source of Water:

Walla Walla River, a tributary of the Colombia River, within the Umatilla River Basin.

Purpose of Use:

Artificial Groundwater Recharge using water diverted during the fall, winter, and spring freshet flows on the Walla Walla River and utilizing the HBDIC recharge structure near Milton-Freewater, Oregon.

Proposed Period of Use:

November 1 through May 15 and as Further limited below

Point of Diversion Location:

~~NE ¼ NW ¼, Section 1, SW ¼ NE ¼~~, Section 12, T5N, R35E, W.M.; ~~DIV.PT. 1 910 Feet South and 700 Feet West from North ¼ Corner Section 1~~; DIV. PT. 2 – 1030 Feet North and 900 Feet East From the Center ¼ Corner Section 12.

Minimum Instream Flow Information:

When water is diverted under this permit, the use is further limited to times when there is, at a minimum, the following streamflows in the Tum-a-lum branch (mainstem) of the Walla Walla River, between the Little Walla Walla River diversion and Nursery Bridge Dam and flowing past Nursery Bridge Dam.

Utilizing the Minimum Perennial Streamflows information (table 1, page 31) in OWRD Umatilla Basin Report (OWRD, 1988) and HBDIC's current winter water diversion permit (Permit Number 53662) the following represent the minimum instream flows at Nursery Bridge Dam:

- November – 64 cfs
- December through January – 95 cfs
- February through May 15 – 132 cfs

Nursery Bridge is located just downstream of Nursery Bridge and is downstream of the Little Walla Walla Diversion, the East Side Canal and the District's Canal, also described as point of diversion 1 in this application.

In order for diversion to occur under this permit, the above described streamflows must be met in the Tum-a-lum branch of the Walla Walla River, between the Little Walla Walla River diversion and Nursery Bridge Dam and following past Nursery Bridge Dam (see OWRD permit (Permit Number 53662 for operating and maintenance requirements for this station). Said streamflows shall be measured at the gauging station described below. In the event the primary gage experiences mechanical difficulties, stream flows at Nursery Bridge Dam shall be calculated by subtracting from the streamflows at Little Walla Walla Diversion (Cemetery Bridge) from those streamflows recorded at either the WWBWC gauge at Grove School Bridge or a combination of streamflows at OWRD's North and South Fork stations (#s).

Attachment 3. Land Use Approval, 690-350-0020(3)(a)(H)

The HBDIC recharge project staff has consulted with both the Umatilla County Planning department and the current landowner (Hulette Johnson). Attached you will find two documents addressing the anticipated land use and zoning issues needed for construction and operation of this project. The first (Attachment 3A) a Land Use Form approved by the Umatilla County Planning Department. This was originally submitted as a requirement in the funding request to the Oregon Watershed Enhancement Board. The second Attachment (Attachment 3B) was is a lease agreement between the HBDIC and the current landowner and water right holder, Hulette Johnson.

Land Use Attachments

Attachment 3A: Umatilla County Land Use Approval
Attachment 3B: Lease Agreement with Landowner

Attachment 4. Proposed Test Program, 690-350-0020(3)(b)(A)

Introduction

The Walla Walla Basin Watershed Council (WWBWC), in cooperation with the Hudson Bay Improvement District (HBID), has proposed to test shallow aquifer recharge at a site located adjacent to the Hudson Bay Canal in section 33, T6N, R35E. At the test site a series of three infiltration pits will be built. Water will be supplied to these pits via a diversion from the canal. Recharge activities are proposed for winter and spring months when the Walla Walla River (the source of water for the canal) is at peak annual flows. The proposed shallow aquifer recharge testing will be done under an ASR Testing Limited License granted by Oregon Water Resources Department (OWRD) (OAR 690-350-0020).

Preliminary Test Site-Specific Hydrogeologic Characterization

Site-specific hydrogeologic characterization is designed to identify and define local conditions to provide a technical basis for designing the monitoring which will be used to evaluate testing. For this project a number of characterization needs are outlined in the 3 July 2003 hydrogeologic assessment letter report (Attachment 6). These needs include determining the physical properties of the geologic units underlying the test site, investigating the presence of a possible semi-confined aquifer in the upper part of the suprabasalt aquifer system, identifying aquifer hydraulic properties, and establishing suprabasalt aquifer baseline conditions, including seasonal variation, for groundwater depth, flow direction, and quality. These, and other site characterization issues, will be addressed using test site-specific hydrogeologic characterization data collected predominantly using:

1. Test pits, boreholes, and wells constructed for the direct observation of ` subsurface conditions
2. Infiltration tests (constant and falling head) designed to evaluate spatial variability at a site both laterally and vertically (note, the water source for this activity may require a temporary permit)
3. Aquifer testing and water level measurements to evaluate baseline aquifer physical conditions before testing
4. Surface and ground water quality data collected to evaluate the affect (if any) of test site operation on area groundwater quality
5. Well and canal records describing water use in the project area
6. Water flow metering at the test site that indicates surface water in-flow and out-flow during testing

At this time, geophysical investigations are not being considered because of the lack of subsurface control and ground truth data that could be used to constrain geophysical interpretations. The following sections describe proposed soils, geologic, hydrogeologic, surface water, and water quality characterization for this project.

Soil Characteristics

The HBDIC recharge project will be constructed by excavating the top 5 feet (72 inches) of soil from each of the recharge pits (See Engineering Design Report, ATTACHMENT 1). Test Pits constructed and evaluated in the Engineering Design Report provide site-specific soil profile information. Additionally, the "Soil Survey of Umatilla County Area, Oregon, (USDA, 1988) provides some general information about soil in the upper 60 inches at the project site. The two soils present at the site are: Freewater (29A) and Cowsly (22C). As the entire soil layer will be removed during construction, it was not found useful to further characterize the specific soil properties further.

Geology

Geologic features control the physical characteristics of aquifer hosting materials, and therefore the distribution and movement of groundwater through an aquifer. Understanding the nature and occurrence of these features, both regionally and locally, provide constraints on testing, data interpretation, monitoring, mitigation, and final design. The objective of geologic characterization is to develop a three dimensional physical framework that describes the materials hosting the vadose zone and groundwater at the test site. Within this framework, or conceptual model, the nature and distribution of those factors thought to control groundwater movement and distribution will be evaluated.

Site-specific geologic characterization will be accomplished largely through the analysis of data collected during the drilling of several proposed boreholes at the site and comparison of that data to information collected during the preparation of the hydrogeologic assessment report. A minimum of three boreholes are proposed for the immediate vicinity of the test site. One of these boreholes will be located on the inferred up-gradient side of the test site, two will be located on the inferred down-gradient side (Attachment 5C). As testing progresses, additional boreholes may be drilled to collect additional characterization, testing, and/or monitoring data. Subsurface hydrogeologic conditions will be interpreted via drilling cuttings and spilt-spoon sample logging.

The project hydrogeologic assessment identified work needed to complete site-specific hydrogeologic characterization. Hydrogeologic characterization targets, and the rational for them, are described below.

It is likely that the uppermost, unconfined part of the shallow aquifer system, is hosted by predominantly uncemented alluvial gravel beneath the test site. However, it is not clear from the available data how deep the alluvial gravels extend and what their properties are beneath the test site. Identifying the three-dimensional extent of these strata is critical to the proposed testing because water probably will move more rapidly through these uncemented strata, both downwards and laterally, then in the deeper, more cemented Mio-Pliocene conglomerate that comprises the majority of the shallow aquifer system in the area.

Area data indicates that, if present, the unconfined part of the shallow aquifer system at the site may be relatively thin and underlain by a semi-confined zone at depths of less than 75 feet. Characterization will identify if this semi-confined zone is actually present, and if found, the nature of the confining layer separating it from the overlying unconfined zone and the basic hydrologic properties of the semi-confined zone. Knowing the nature and extent of the confined aquifer underlying the site is critical in evaluating if the proposed recharge will affect this deeper aquifer. If data collected indicates that the project could potentially affect this deeper aquifer, monitoring will need to be designed to not only assess shallower unconfined aquifer impacts but deeper confined aquifer impacts as well.

The nature and distribution of the confining layer atop the confined aquifer should be identified in order to support evaluation of the thickness and distribution of the unconfined aquifer (if present). If the unconfined aquifer is absent, or only present seasonally, we will still need to identify the nature and extent of the confining layer because, just as it inhibits upward movement of groundwater, it will restrict the downward movement of recharge water. Knowing where the confining layer is will provide information on where recharge water may potentially collect atop this layer and where it will potentially spread to.

Mapping for the assessment identified a potential depression in the top of the older Mio-Pliocene conglomerate below the western end, and west of, the test site. The depth, shape, and orientation of this feature will need to be evaluated because it will effect how the aquifer(s) underlying the test site responds to the testing. If an unconfined aquifer indeed underlies the site, this depression may act as a "reservoir" for water introduced into this aquifer. Alternatively, it may serve as a recharge pathway, hydrologically connecting the upper, unconfined part of the suprabasalt aquifer system with deeper, confined parts of the aquifer system.

Hydrogeology

Piezometers and/or observation wells will be constructed in the borings drilled for geologic characterization. If additional geologic characterization boreholes are drilled (either close to or more distal from the test site) one or more of these also may be converted to observation wells. All but one of the boreholes converted to monitoring wells will be completed as 2-inch observation wells that fully penetrate the unconfined aquifer (if present) or above the confining layer (if unconfined aquifer not present). At least one of the geologic characterization boreholes should be of sufficient size to accommodate a 4-inch diameter well which will be used for aquifer testing.

Test site-specific hydrogeologic work would be done, in large part, concurrently with the site-specific geology work. The hydrogeologic assessment concluded that the following information must be collected for the uppermost part of the suprabasalt system at the test site:

1. Depth, thickness, and lateral and vertical extent of the vadose zone and the uppermost aquifer(s) underlying a site.

2. Nature and effect of perching layers (if any) in the vadose zone.

3. Aquifer and vadose zone physical and hydrologic properties - including, grain size, matrix content, induration, hydraulic conductivity, transmissivity, and porosity

4. Groundwater flow direction and velocity, including both spatial and temporal variation

5. Anthropomorphic effects, primarily changes in groundwater pumping, surface water (including canals), and irrigation activities.

For characterization it is important to build monitoring (or observation) wells in such a way as to provide means for accurately measuring the target aquifer. Well construction considerations are listed below:

1. Most project observation wells will probably be 2 inch-diameter piezometer type installations. These should be built to ensure that they are monitoring the anticipated aquifer targets, and we recommend building to well construction standards and avoiding cost cutting measures designed to get more/cheaper wells (these commonly result in poorly built wells unsuitable for collection of the high quality data we feel is necessary to support the project).

2. For aquifer testing, a 4 inch-diameter observation well is the minimum recommended diameter and at least one such well should be built.

3. The minimum number of observation wells at the test site is 3, one up-gradient and 2 down-gradient. If funding can be procured we recommend that more than 3 observation wells be installed. Most, if not all, of these additional observation wells could be built in geotechnical borings drilled for geologic characterization.

In addition to the observation wells built near the test site, it seems likely that observation wells will eventually need to be built more distant from the site. The purpose of these observation wells would be to more accurately trace the down gradient migration of recharge water away from the test site. A minimum of 3 more distant observation wells, 1 up-gradient and 2 down-gradient is again recommended. These might include at least some previously built groundwater supply wells that would be available for use. However, these should only be used if construction details can be verified and if they are not being used as water supply wells. Access to offsite observation well drilling locations will need to be acquired from willing landowners. The WWBWC currently has a network of existing wells that could be used for the purpose of tracking the recharge water distally from the site.

Aquifer testing designed to collect aquifer hydraulic property data will be part of site characterization. During aquifer testing, the 2-inch observation wells will be monitored to observe the effects of testing on the surrounding aquifer. Aquifer testing would include an 8-hour step-drawdown test to establish probable sustainable yields in the suprabasalt aquifer, followed by a 24 to 72 hour constant discharge test. Water level data collected during aquifer testing will be analyzed using standard analysis techniques.

Combining the interpretations developed in the completed hydrogeologic assessment with the drilling and testing data collected during site-specific characterization, a conceptual model of test site hydrogeologic conditions will be prepared.

Surface Water

One of the main objectives of the project is to increase surface water quantity (base flow) and improve its quality (temperature). To document that, surface water bodies that the project may influence need to be identified and monitoring points on them established and characterized (includes collection of baseline data). These locations will be used as monitoring locations during subsequent testing.

The hydrogeologic assessment identified three, down gradient, spring-feed streams, Goodman Spring Branch, Johnson Creek, and Dugger Creek, which are most likely to be affected by recharging the shallow aquifer. During test-site specific characterization these streams will be examined and monitoring points identified. At these points stream conditions will be photographed and stream conditions documented prior to the initiation of testing that will include the following parameters:

Flow volume and discharge

Water temperature

Water quality (temperature)

Hydrophilic plants and habitat quality

Sampling frequency will be designed to collect enough data to demonstrate the range of conditions likely at the monitoring points so that site background conditions can be documented enough to provide an adequate baseline to measure test results against.

Water Quality

Both surface and groundwater quality at the test site, and at likely down-gradient discharge points, needs to be documented. There are several reasons for this, including:

1. We do not want to introduce contaminated water into the shallow aquifer via recharge activities and violate antidegradation rules. We need to establish background water quality parameter concentrations and monitor source-water quality periodically during testing and operations.

2. Certain source-water conditions (e.g., turbidity) have the potential to degrade or even "plug" the recharge system. From an operational standpoint, one would monitor for those conditions and halt test operations when the source-water exceeded those conditions.

3. Up-gradient groundwater quality needs to be monitored so that the effects of recharge on water quality can be differentiated from those water quality conditions caused by recharge activities, including leaching of vadose zone constituents by recharge water.

Sampling Quality Assurance and Quality Control (QA/QC) protocols will need to be established and followed for characterization and later monitoring. QA/QC for the project, which is described in Attachment 5, includes:

- Sampling equipment
- Measurement techniques for field parameters
- Decontamination procedures
- Well purging guidance for groundwater samples
- Sampling methods
- Chain of custody and sample handling procedures
- Record keeping
- QA/QC guidelines

Characterization Conclusions

With the completion of site-specific characterization, updated monitoring and test plans will be prepared if necessary. These monitoring and test plans will be based on the results of the characterization effort which includes the generation of a site conceptual groundwater flow model that describes probable aquifer conditions, suprabasalt aquifer water level(s) and groundwater flow direction(s) (including seasonal variations), and discharge points for recharge water.

Preliminary Test Site Operation Plan

The objective of proposed artificial groundwater recharge testing to be done under the limited license is to evaluate the feasibility of restoring diminished shallow aquifer water levels and increasing decreased spring creek flows using infiltration pits and winter high flow water diverted from the Walla Walla River to these pits. Testing will be done over five years. If testing indicates shallow aquifer recharge and spring creek flow restoration is feasible using infiltration, test results will be used to design and implement larger scale artificial groundwater recharge at this, and potentially other sites in the area. Testing **will not include** removal of stored water by pumping or other artificial means.

This preliminary test plan describes how the test site will be operated during testing. Elements included in the preliminary test plan include: (1) site construction, (2) test operations, (3) mitigation activities, and (4) reporting. The preliminary test plan may be modified as testing proceeds.

Site Construction
The basic layout of the test site is shown on Figure 1. The site, located adjacent to the Hudson Bay Canal, will consist of three infiltration pits excavated approximately 3 feet into Quaternary alluvial gravel which immediately underlies the test site (Attachment 6). Water will be delivered to the pits via a diversion structure in the canal. Any water that does not infiltrate into the ground from these pits will be returned to the canal via a return ditch or pipe.

More detailed site construction information describing: (1) test site survey and layout (2) specifications for pits/basins/pits used for infiltration (3) water supply design (including diversion from canals if appropriate) (4) monitoring points (both on and off site) and (5) site access controls (fences, etc.) are described in detail in Attachment 1, (1A-1E), Engineering Design.

Test Operations
Test operations describe how the site will be used during testing and possible reasons for changing the test as new data and information is collected during the test. Test operations include:

1. Test timing, including timing of recharge and monitoring frequencies

2. Quantities of water used

3. Outside influences that effect test, including weather (probably freezing), elevated river turbidity, river flooding, trip wires for identifying potential offsite impacts before they occur so they can be mitigated and or testing suspended to prevent worsening conditions

4. Responsible parties for diversion and delivery of water, operation of test, monitoring, and data review

5. Permissions required to access offsite monitoring points

These are discussed further in the following paragraphs.

Test Timing, Monitoring, and Water Quantities
Testing is tentatively planned to begin in the winter of 2003/2004 and continue for 5 years. Test operation will generally be conducted in the winter when Walla Walla River flows are at their highest and irrigation activities are at their lowest. A maximum of approximately 50 cfs will be delivered to the test site during normal operation. However, in the event minimum Walla Walla River flows are not meet, water will not be diverted from the river for test site use. Depending on stream flows in any given year, recharge water may be delivered as early as December to as late as March/April. In addition, in the event of prolonged freezing weather, test site operation may be temporally suspended to avoid ice damage to the canal diversion on the Walla Walla River, the canal system itself, and/or the recharge pits and related structures.

Water quantities delivered to the test site will be monitored via a gauge at the diversion from the canal into the test site. The return canal from the test site back into the canal will also be monitored to determine the quantity of water that leaves the test site (if any) because it did not infiltrate into the ground. Based on this monitoring data, and estimated evaporation loses that could occur during operation; water quantities discharged to the ground will be calculated.

Groundwater levels in the immediate vicinity of the test site will be monitored before, during, and following recharge test events via three (at a minimum) observation wells constructed during characterization, potentially via existing water wells in the area if any can be found that can be used for shallow aquifer water level monitoring, and potentially with new observation wells built as the test progresses. During the recharge test event, tentatively scheduled for the winter/spring of 2003/2004 water levels will be measured as follows:

1. Throughout the calendar year water levels will be measured at least weekly, beginning with the granting of the limited license.

2. In the month prior to the anticipated start of recharge activity and in the month following the termination of recharge, water levels will be measured daily.

3. During recharge water levels will be measured daily, at a minimum.

Based on preliminary engineering design studies (Attachment 1) and the hydrogeologic assessment (Attachment 6) most, if not all, of the water delivered to the test site will probably infiltrate into the ground. However, because this project is a test project, the current plan is to initially operate the test site at approximately half capacity. The quantity of water discharged to the site will than be increased or decreased as experience and observations dictate. Final operating quantities will determined based on test results.

Water quality data will also be collected before, during, and following recharge events. Parameters to be collected, sampling timing, and other water quality monitoring information are presented in the Monitoring Plan (Attachment 5).

Outside Influences

The primary currently identified outside influences on testing are Walla Walla River flow levels, freezing conditions, source water turbidity levels, and increased groundwater water levels resulting from testing that impact surface activities and conditions. The likely effects of these on testing, and possible mitigation actions to be implemented during testing, are as follows:

Low flows in the Walla Walla River will impact testing because the use of Walla Walla River water for recharge will be conditional, based on river flows exceeding a certain threshold. When flows do not, water will not be delivered to the test site and testing will not occur.

High Walla Walla River flows may also effect testing. In the event of high flow during a flood or rapid snow melt event, turbidity will generally increase. The repeated delivery of turbid water to the test site infiltration pits may eventually lead to plugging of pore space and reduced infiltration capacity. To mitigate against this, delivery of recharge water may be terminated or scaled back during high flow events. Alternatively, the pits may be periodically re-excavated to remove these fines. The preferred mitigation strategy for dealing with this will be based on monitoring and performance data collected during testing.

The effects of freezing on the test are outlined earlier in this Attachment and repeated here. In the event of prolonged freezing weather, test site operation may be temporally suspended to avoid ice damage to the canal diversion on the Walla Walla River, the canal system itself, and/or the recharge pits and related structures and to avoid the risk of ice jams forming in the canal, backing up water in the canal, and causing flooding adjacent to the canal.

It is possible that recharge testing could cause groundwater levels to reach the ground surface at locations where human activity and habitat is negatively impacted. One of the main purposes of groundwater level monitoring is to identify increasing water levels in the test site area in order to: (1) directly observe the effects of recharge on water levels (2) use these observations (in conjunction with characterization data) to evaluate whether or not recharge is having an impact on groundwater levels that could lead to surface problems, and (3) identify when and where this type of problem may occur. If water level monitoring data suggest increased groundwater levels are approaching the ground surface and that flooding of low lying areas seems possible, the quantity of recharge test water being delivered to the infiltration pits will be reduced or, if necessary, terminated.

Responsible Parties and Access Permission

The test will be managed primarily by the Hudson Bay District Irrigation Company, lead by John Brough, Operations Manager, and the Walla Walla Basin Watershed Council (WWBWC) technical staff, lead by Mr. Bob Bower, Hydrologist. HBDIC and WWBWC staff (or a subcontractor working for the HBDIC and WWBWC) will compile monitoring and testing data, prepare reports as necessary to meet license requirements, and in consultation with Hudson Bay Irrigation District (HBDIC) staff make decisions regarding timing and quantity of water delivered to the site and when to suspend recharge activities. Submittal of all monitoring reports to OWRD will be the responsibility of HBDIC and WWBWC staff. The HBDIC and WWBWC may choose to subcontract report preparation and delivery to a subcontractor.

HBDIC staff will be responsible for operating all facilities associated with removing recharge test water from the Walla Walla River and delivering it to the test site, including operation of the diversion structure which routes water from the canal into the pits. HBDIC staff also will maintain all equipment associated with water delivery and pit operation, including reexcavation of the pits, if necessary.

Mitigation

As stated above, one of the objectives of monitoring is to identify likely unintended consequences of recharge testing before they occur. When the precursors to these consequences, such as changing water quality detrimental to aquatic habitat or groundwater levels rising to close to the surface in areas where shallow groundwater is not desired, can be detected soon enough via monitoring, recharge activities will be modified and/or terminated to mitigate against these effects.

Reporting

Data and observations collected during testing, including monitoring data, will be compiled into reports. The basic objective of these reports will be to describe what was done during the test, what was observed at the monitoring points, interpret the data collected, and recommend changes to testing, monitoring, and mitigation plans. These reports will be produced annually. Based on the proposed recharge schedule, annual reports will be submitted to OWRD in the summer following each winter recharge test.

More frequent reporting will be done when monitoring reveals the presence of an undesired effect from testing. If monitoring reveals that undesired consequences of testing are likely to occur, WWBWC staff (or designated representative) will report the monitoring information to OWRD staff.

At the conclusion of the 5-year recharge testing done under the limited license a final report will be prepared. The final reports will describes the project, data colleted during testing and monitoring, interpretations of how well the recharge project worked in achieving project goals, and recommendations for future operations. The final report will be submitted to OWRD in the summer following the fifth annual winter recharge event.

Attachment 5. Proposed Monitoring Program, 690-350-0020(3)(b)(A)

Overview of Basin Wide Monitoring Plan

In 2003, the WWBWC expanded its watershed monitoring strategy to include collecting basin line information for the numerous spring-creeks and district ditches spread out across the Walla Walla River valley (Oregon). Starting in June 2003, many new flow stations (15-minute stage and temperature recorders) were installed at or near the sources of nearly all the springs in the Oregon portion of the system (Figure 2). The WWBWC monitoring program has a total of 28 continuous flow stations with additional 15 continuous static well recorders with many more manual measurement locations. The objectives of this monitoring (specifically for the spring-creek and shallow aquifer system) is to accomplish the following:

1. Be able to discern between Walla Walla River Water (coming from districts water rights and use) and spring waters (emerging strictly from the shallow aquifer). It is understood that the application of irrigation water will undoubtedly show up as spring returns, but this monitoring is intended as a beginning to understanding this complicated system.
2. Collect baseline information on spring flow as it relates to seasonal and yearly fluctuations.
3. Many of the spring-creek monitoring stations were sited based on the presence of historical data collected by Piper (USGS, 1933). Where Piper had collected spring-creek flow, we attempted to locate our gauges as near as possible to his historic data sites. The intention is to allow us the ability to compare and contrast historical and current spring-creek conditions based on a significant period of time. Most of these Piper's original sites were located upstream of any irrigation with draws, making them key locations for us in this type of comparison.
4. Monitor water table levels continuously for daily, seasonal and yearly fluctuations and timing. Some of the wells being recorded have periods of record dating back to the 1930s, allowing us some opportunity to understand any long-term changes in the aquifer system.

Recharge Project Monitoring Plan

The proposed ground water recharge project exists inside this larger monitoring network and it is expected that this will help provide useful information in testing of the proposed testing (see below). Some of the sites shown in this larger network were specifically located to provide proximal and distal pre-construction and operation information for this project (Figure 2). Site specific monitoring includes observation wells and surface monitoring stations (Attachment 5B).

Monitoring for the site-specific proposed testing is designed to meet four basic objectives. These are to identify: (1) changes in the natural system caused by factors other than those related to testing, (2) changes in the natural system caused by the testing (track the test performance), (3) potential problems caused by the testing that may require modification or termination of the test and/or mitigation actions, and (4) events that effect test operations, such as a freezing or a flooding. To meet these objectives, monitoring will track:

1. Source water quality and volume coming onto the test site

2. Up-gradient groundwater water quality

3. Up-gradient groundwater level changes to provide the information needed to differentiate recharge test effects from other, natural and artificial, effects on the groundwater levels beneath test site

4. Down-gradient groundwater quality and levels, both near and distal to the test site

5. Surface water discharge and quality changes

Four basic types of monitoring points are planned for this project:

1. Source water

2. Test site groundwater

3. Distal groundwater

4. Surface water (e.g., springs).

Monitoring data collected at these points during testing will be evaluated against what is known about pre-test conditions to identify testing effects on the surrounding environment, differentiate those effects from others in the environment, and identify when changes in test operations appear necessary. Pre-test conditions will be determined during the planned site-specific characterization activities described in Attachment 4 and are partially described in the preliminary hydrogeologic assessment (Attachment 6).

This preliminary monitoring plan discusses monitoring activities to be undertaken at the four types of monitoring points and sampling and QA/QC protocols.

Sampling and Analysis Program

The groundwater-monitoring program proposed for the test project is outlined in the following sections. Annual reporting is proposed and a Water Quality Analysis Report will be prepared following five years of testing.

<u>As stated in the introduction, four types of monitoring are proposed:</u> (1) source water at the test site (2) site-specific groundwater (3) distal groundwater and (4) surface water (springs).

(1) Source Water at Test Site
Source water monitoring will be at the point of diversion onto the test site. Monitoring will include both water quantity and quality. The volume of water delivered to the test site will be monitored via a gauge at the diversion. Water quality samples will be collected at the gauge.

Proposed monitoring frequency is as follows:

> Gauge data will be recorded 15-minute readings via a continuous recording data logger. Rating measurements and tables will be generated for each surface flow site and continuously checked for shifts.
>
> Three source water quality-sampling events are proposed for each yearly seasonal recharge period. They are proposed for approximately: (1) one month prior to the projected beginning of the recharge period (2) during the mid part of the recharge period and (3) approximately one month following the end of the recharge period. The exact timing of these will be based on predicted Walla Walla River flows and may vary from year-to-year. OWRD and ODEQ staff will be notified by WWBWC staff of pending sampling events at least two weeks prior to each sampling event.

The results of source water quality monitoring will be used to determine if modifications to test operations are warranted. During testing different sampling frequencies may be tried to identify those that are most effective.

(2) Site Groundwater
Site groundwater monitoring, consisting of the collection of water quality and water level data, will be conducted at the three observations wells built during characterization. The purpose of site groundwater monitoring is to establish water quantity and quality impacts from testing to groundwater in the immediate vicinity of the site. In addition, up-gradient monitoring will be used to differentiate test impacts from those caused by other activities not controlled by the testing.

Proposed monitoring frequency is as follows:

> Water levels will be measured weekly throughout the year when recharge testing is not underway.
>
> In the month prior to, during, and the month following the yearly seasonal recharge period, water levels will be collected daily (at a minimum) for the first year of testing. Measurement frequency during subsequent years will be based on previous observations and proposed in annual reports.
>
> Three groundwater quality sampling events are proposed for each yearly seasonal recharge period. They are proposed for approximately: (1) one month prior to the projected beginning of the recharge period (2) during the mid part of the recharge period and (3) approximately one month following the end of the recharge period. The exact timing of these will be based on predicted Walla Walla River flows and may vary from year-to-year. OWRD and ODEQ staff will be notified by WWBWC staff of pending sampling events at least two weeks prior to each sampling event.

The proposed locations of site-specific groundwater observation wells are shown on Figure 1. The results of groundwater quality and level monitoring will be used to determine if modifications to test operations are warranted. During testing different sampling frequencies may be tried to identify those that are most effective.

(3) Distal Groundwater
Distal groundwater monitoring, consisting of the collection of water quality and water level data, will be conducted at observation wells more distal from the test site than the site observation wells. Initially, during the first year of recharge testing, these wells will probably be previously constructed water supply wells that can be used by WWBWC staff and can be shown to be open to only the shallow aquifer. If funding for new wells can be procured for subsequent years, dedicated distal groundwater observations wells may be built to improve the monitoring coverage.

A minimum of 3 distal observation wells will be used, 1 up-gradient and 2 well down-gradient. The locations of these will be determined during site specific characterization currently planned for the winter of 2003. Monitoring frequency is the same as proposed for site-specific groundwater monitoring. Figure 5B shows the approximate site locations for the site-specific observation wells.

Distal monitoring will be used to identify longer term quantity impacts from testing. This includes the formation and migration of a groundwater mound and recharge water plume at, and away from, the test site, towards intended and unintended receptors. Up-gradient monitoring will be a part of this so that testing effects can be differentiated from offsite events. Sampling frequency will be determined from characterization data and modified as more is learned during testing.

(4) Surface Water (Springs)
The WWBWC is currently monitoring most of the surface springs, creeks and rivers of Oregon's lower Walla Walla River basin (See Figure 2.) While this project will specifically Surface water monitoring in Dugger, Johnson and Goodman Spring-Creeks will be done to identify the effects of recharge on flow. This monitoring will include the collection of both water quality (specifically temperature), flow and habitat improvements (photo-documentation). As with groundwater monitoring, surface water monitoring will need up-gradient and pre-project condition monitoring information so that effects unrelated to test site operations/testing can be differentiated from those due to testing. Pre-project surface flow monitoring was started during the 2003 summer irrigation season at Dugger and Johnson Spring-Creeks in the form of a continuous.

Sampling Parameters
Sampling methods are specified in the following sections. The chemical monitoring parameters are to be conducted on a two-tiered system. Level 1 monitoring will be conducted during all three water quality-monitoring events (each recharge period). Consistently elevated concentrations of nitrate will be initiate the level 2 chemical analysis. Samples will be tested for chemicals in the level 2 list. Operation of the recharge project will depend on the absence/presence of the chemical parameters on this list. ATTACHMENT 5B describes the specific method and documents used to determine the level 1 and 2 chemical parameters (pesticides, herbicides, insecticides, fungicides, etc.) listed below.

Monitoring is proposed for the following parameters:

Physical Parameters (all monitoring types)

Static water level (in observation and WWBWC network well)

Standard field parameters, including pH, turbidity, electrical conductance, and temperature

Flow (in cubic feet per second)

Chemical Parameters –Level 1 (On-site monitoring only)

Total nitrogen as nitrate (screening parameter for Level 2 Chemical screening)

TKN

Total dissolved solids

Chemical oxygen demand

Chloride

Orthophosphate

Fecal Coliforms (Presence/absence only)

Chemical Parameters –Level 2 (On-site monitoring only)

Rubigan (Fenarimol)

Ridomil (Metalxyl)

Systhane/Rally (Myclobutanil)

Devrinol (Napropamide)

DDD-DDE-DDT

Elgetol (DNOC sodium salt)

Alar/B-Nine (Daminozide)

Lindane (Lindane)

Sampling dates will be coordinated for all monitoring points used in the project.

This list of analytes was selected to optimize routine sampling to address constituents commonly of concern (nutrients and salt) and provide prompt indication of potential impacts by analyzing for anions (nitrate and chloride) that are known as groundwater tracers (DEQ, 1995). Additional parameters will be proposed for future sampling if the results of the initial proposed sampling indicate this is necessary.

Sampling Procedure
Equipment and sampling procedures proposed for recharge test monitoring are provided in the following sections.

Equipment
This section lists the equipment for groundwater monitoring.

Submersible pump (*Grundfos* or similar) or dedicated bailers/sampling line

Temperature measuring instrument (*Vemco* data logger)

pH and conductivity meter(s) with calibration reagents

Water level and flow meters (*Tru-traks, In-situ Mini-trolls*, *Stevens 420 loggers,* 0.01 foot resolution required)

Shipping cooler with ice packs or ice

Five-gallon pail marked at the 5-gallon level, stopwatch

Laboratory supplied sample containers with appropriate preservatives

Tap water, deionized water, phosphate-free soap, cleaning brushes, field note book, log sheets

Water Level
An electronic water level meter will be used to measure the depth to groundwater in each observation well to the nearest 0.01 foot. Static water levels must be measured at the indicated reference point prior to purging any water from the well. The reference points will be on the top of the observation well casings. The static water levels in all wells should be measured on the same day for each site. Coordination with quarterly sampling of other wells in the vicinity should be attempted. Accumulation of sediment in the well should also be checked by lowering a weighted tape to the bottom of the well, reading the depth at the well casing's reference point, and comparing this value to the as-built well depth.

Decontamination
All non-disposable field equipment that may potentially come in contact with any soil or water sample shall be decontaminated in order to minimize the potential for cross-contamination between sampling locations. Thorough decontamination of all sampling equipment shall be conducted prior to each sampling event. In addition, the sampling technician shall decontaminate all equipment in the field as required to prevent cross-contamination of samples collected in the field. The procedures described in this section are specifically for field decontamination of sampling equipment. At a minimum, field-sampling equipment should be decontaminated following these procedures:

1. Wash the equipment in a solution of non-phosphate detergent (Liquinox® or equivalent) and distilled/deionized water. All surfaces that may come in direct contact with the samples shall be washed. Use a clean Nalgene and/or plastic tub to contain the wash solution and a scrub brush to mechanically remove loose particles. Wear clean latex or plastic gloves during all washing and rinsing operations.

2. Rinse twice with distilled/deionized water.

3. Dry the equipment before use, to the extent practicable.

Purging and Field Parameters (On site wells only)
Sufficient water will be purged to ensure that the sample collected represents water from the geological formation. Borehole volumes are calculated as the volume of water in the casing and the volume of water in the filter pack.
During purging, measure pH, temperature, and electrical conductivity of the water removed. At a minimum, these parameters are measured at the start of purging and after each successive borehole volume is removed. Temperature should be measured first because it changes most rapidly. Purging continues until at least three borehole volumes have been purged and the field parameters are established to within ± 10 percent over three consecutive measurements. At this point, the observation well is considered adequately purged and can be sampled.
Occasionally, observation wells installed in low permeability formations may be purged nearly dry (within 6 inches of bottom of well) prior to stabilization of groundwater parameters and prior to purging at least three borehole volumes. If this happens at least one set (more if possible) of purge water groundwater parameters (pH, temperature, EC) need to be measured. Sample collection can be done after the water level has recovered at least 75 percent of the drawdown ensuring most of the well water is from the formation. Prior to groundwater sample collection several measurements are required as explained above. These include static water level and total depth, pH, temperature, and electrical conductivity.
All field instruments should be calibrated each day prior to sample collection. Instrument calibration and maintenance should precisely follow the manufacturers recommended procedures. Electrical conductivity and pH standards used to calibrate the instruments should be within the range encountered at the monitoring sites. Calibration records should be recorded on the sample collection forms.

Water Sampling
Samples will be collected after sufficient water has been purged according to the procedure described above. Samples will be collected from the discharge end of the pump hose after the flow rate has been reduced to less than approximately 0.2 gallons per minute. Discharge from a bailer should be controlled to minimize agitation and aeration. Sample containers should be sealed with tape, labeled, and immediately placed in a cooler with ice. Sample containers should be filled completely to eliminate head space. Sample containers should be provided by the analytical laboratory and should be requested at least one week in advance of the sampling. The containers should be appropriate for

the parameters analyzed and all shipping coolers should have chain-of-custody seals placed on them prior to shipping.

One additional sample should be collected from one of the sample points for quality control purposes. This sample should be evaluated as a "blind duplicate."

Sample Preservation and Holding Time. Samples should be stored immediately after collection in an ice chest containing sufficient ice to cool the samples to 4 degrees Celsius (°C). Use "blue ice" if possible. If water ice must be used, the ice should be sealed in plastic bags, as should the sample bottles. Samples should remain cooled at 4°C and delivered to the laboratory within 24 hours of collection. Sample receipt at the laboratory must be sooner if analysis includes parameters with a shorter holding time. Care should be taken to prevent excessive agitation of samples or breakage/leakage of containers. Samples should be analyzed within the specified holding time for each constituent.

Resampling

In accordance with OAR 340-40-030(5), resampling is done if monitoring indicates a significant increase (or decrease for pH) in the concentration of a monitored parameter at a sampling point. Determining if a significant increase in parameter concentration has occurred is customarily done either by assessing concentrations in relation to established concentration limits or by using a statistical analysis. Since background or baseline conditions have yet to be established for the test site a concentration limit has not been set and insufficient data exists upon which to base a statistical analysis. The criteria to guide resampling decisions will be reevaluated is subsequent test project annual reports.

Chain of Custody and Sample Handling

A chain-of-custody form should be completed and signed by the sampler on the day samples are collected. The chain-of-custody form must be signed by laboratory personnel upon receipt and any other individuals that maintain custody of the samples in the interim. Coolers should be sealed and shipped or driven to the lab as soon as possible. The method of shipping (bus, next day air, etc.) is usually determined by the parameter having the shortest holding time. In any case, shipping times of more than 24 hours should not be used as the cooler(s) may warm and compromise sample quality.

Field Records and Data Validation

All field notes, analytical results, and other pertinent data associated with the project should be maintained in a secure location and be archived for at least a five-year period. Data validation for both field and lab Quality Assurance and Quality Control (QA/QC) will be performed using a checklist. All pertinent information with respect to QA/QC will be checked.

The following items are included on the QA/QC review checklist:

1. Field data sheets (or notebooks) and observations (observations are used to check for potentially erroneous data) will be reviewed to make sure they are completely filled out.

2. Chain-of-custody forms will be completed, being signed by all sample handlers.

3. Holding times for all constituents will be met.

4. Field blind duplicate results will be evaluated to make sure they are compatible.

5. Laboratory method blanks, matrix spike, matrix spike duplicates, and surrogate percent recovery data supplied by the analytical laboratory will be evaluated to make sure they are compatible.

Data Reporting and Statistical Analysis
The following procedures for reporting analysis are proposed for this project.

Record Keeping
All field notes, laboratory results, critical calculations, and published reports will be maintained at the WWBWC office for a period of five years following completion of the final testing and monitoring report. If possible, both paper and electronic copies will be maintained.

Evaluation
Monitoring data and observations should be evaluated when they are received from the sampler and laboratory.

Materials to be received include:
Field monitoring and sample collection records

Original laboratory reporting sheets

Data evaluation will include:

1. Verification of analytical methods and detection limits, along with the date the analysis was performed
2. Review of document handling, sampling and analytical problems, and actions taken to correct any problems
3. Summarizing water level data in tabular and/or graphical form
4. Summarizing water quality analytical results in tabular form and/or graphical form
5. Performing data validation checks, as appropriate to the data set
6. Identifying any significant increases in parameter concentrations (will be done later in project only after enough data has been collected to warrant)

Annual Review and Reporting
All monitoring activities performed during the previous monitoring year will be included in an annual report to be submitted to OWRD during the summer following the preceding seasonal recharge period. The annual report will present the following information:

Water quality data, including duplicate sample results in tabular form and time-series plots for specific parameters

Water level data, including hydrographs showing water level changes over time

Basic statistical parameters for each parameter of interest: mean, median, maximum, minimum, standard deviation, number of data points, and number of non-detects

Evaluation of all field and laboratory data, including observed changes and groundwater flow direction and gradient

Discussion and conclusions, including recommended changes to recharge testing

The methods needed to evaluate water quality and water level data will depend on the objectives of the evaluation. In general, the principal objective is to evaluate whether or not recharge tests have affected groundwater levels and quality. Evaluation methods include: a comparison of water quality data with a concentration limit or with background water quality; comparison of water quality over time; or comparison of water quality between up-gradient and down-gradient wells. For the test site, insufficient data are available for a statistical analysis to be performed because concentration limits have not yet been established. Until that time, evaluation of dataset trends will be solely qualitative, but revisited in each annual report until a database has been compiled that is sufficient for statistical analysis.

Final Recharge Test Project Report

At the conclusion of five years of recharge testing under the limited license a final report will be prepared. The report will contain the data collected for the test project; analysis and interpretation of that data (including statistical analysis as appropriate), and a recommendation for proposed future artificial groundwater recharge activities at the test site. The report will be complete enough to serve as supplemental material to a permanent artificial groundwater recharge permit under OAR 690-350-0110, if such a permit is sought following completion of the test project.

Monitoring Plan Attachments

Attachment 5A. Methodology Water Quality Assessment and Evaluation
Attachment 5B. Figure 5A Map of On-site Recharge Well Locations
Attachment 5C Chemicals of interest for Hudson Bay Recharge Project

Attachment 6. Site Hydrogeology, 690-350-0020(3)(b)(C), (E), and (G) (attached)

Attachment 7. Source Water Quality, 690-350-0020(3)(b)(D)

Overview

This project will utilize winter-spring flow from the Walla Walla River as the *source* water for recharge during the project operation. The time period that Walla Walla River water will be used is November 15th through May 15th. A review of existing reports and data was conducted to identify any areas of concern regarding source water quality for the recharge project. What little information that exists for source water quality conditions is discussed below.

In 2003, the WWBWC tracked turbidity levels through a winter storm event (1/27/3 through 2/3/3) and found turbidity levels to be a potential issue on the Walla Walla River (mainstem) during peak flow events (WWBWC, Unpublished data). Turbidity could be problematic for project operations, as it may act to decrease the rate of infiltration by plugging and layering the bottom of the recharge pits. Turbidity may also be a preliminary screen for fecal contamination issues, as bacteria may use the large particles as a vector for mobilization.

The other known source water quality information was obtained from the Environmental Protection Agencies STORET database. STORET provided some historical water quality data that showed several parameters (circa 1960s) that were accounted for in the recharge project's monitoring plan (ATTACHMENT 5). STORET data that was collected nearest to the source water POD at the Little Walla Walla Diversion (*NE ¼ NW ¼, Section 1, SW ¼ NE ¼ Section 12, T5N, R35E, W.M.; DIV.PT. 1*) is attached in table form as ATTACHMENT 7A.

From the review of all known source water information, the parameters that appeared to be of concern are:

1. Fecal Coliforms
2. Turbidity

There was no other relevant information found for source water quality conditions. The monitoring plan covers the establishment of source water quality conditions during operation of the recharge facility. This will insure safe water quality conditions for the recharge project.

Attachment 7A Source Water Quality Information

Resources and References:

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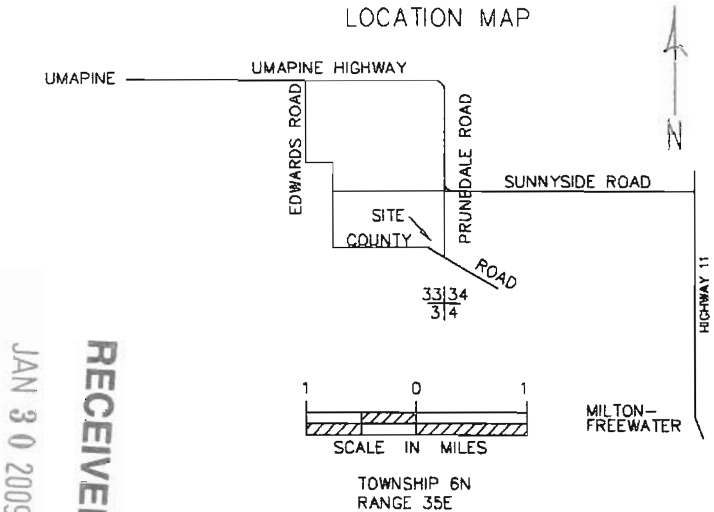
Attachments

Attachment 1A

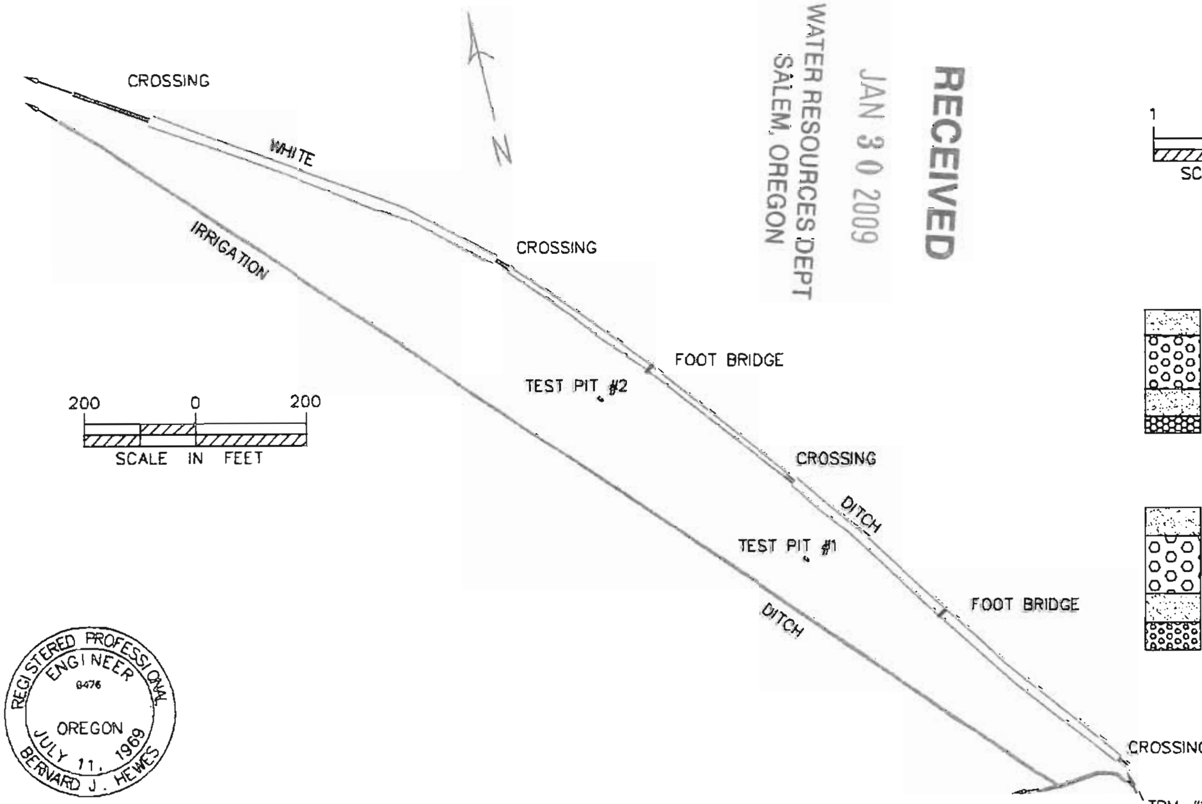
HUDSON BAY AQUIFER RECHARGE PROJECT
SITE PLAN & LOCATION MAP

LOCATION MAP



TOWNSHIP 6N
RANGE 35E

SITE PLAN VIEW



TEST PIT #1

0–12" SANDY LOAM

12"–36" GRAVELLY SANDY LOAM. APPROX. 50 % OF THE VOLUME IS GRAVEL SIZE PARTICLES WITH AN ESTIMATED D_{50} SIZE OF ABOUT 0.75".

36"–48" SANDY LOAM

48"–? GRAVELLY SANDY LOAM APPROX. 20% OF THE VOLUME IS GRAVEL SIZE PARTICLES.

TEST PIT #2

0–13" GRAVELLY SANDY LOAM

13"–39" COBBLY SANDY LOAM. THE D_{50} OF THE GRAVEL IS APPROXIMATELY 1"

39"–52" GRAVELLY SANDY LOAM

52"–? SAND GRAVEL MIX D_{50} ESTIMATED TO BE ABOUT 0.25".

TBM #1 LOCATION IS AT THE TOP OF THE WALL ON THE NORTH WEST CORNER OF A CONCRETE TURNOUT BOX ON THE LEFT SIDE OF WHITE DITCH NEAR THE UPSTREAM END OF A 44"X72" CMP. PAINTED RED SPOT. ELEVATION 100.00.

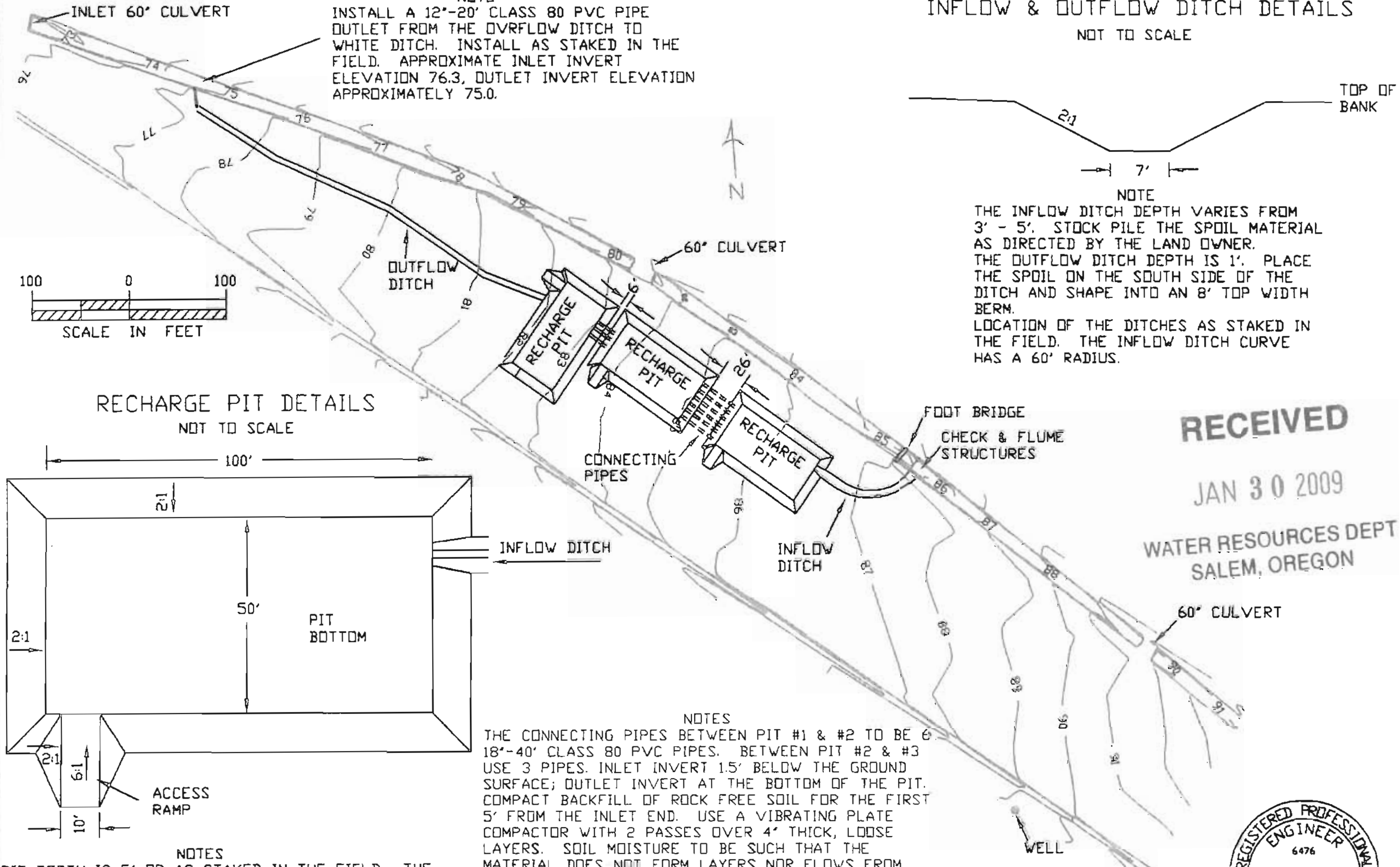
REGISTERED PROFESSIONAL ENGINEER
8476
OREGON
JULY 11, 1969
BERNARD J. HEWES

EXPIRES 6/30/2003

DESIGNED B. HEWES	DATE 4/03
PLOTTED	
APPROVED	
CADFILE whitereloc	
SHEET 1 OF 4	

Attachment 1B

NOTE
INSTALL A 12"-20' CLASS 80 PVC PIPE OUTLET FROM THE OVRFLOW DITCH TO WHITE DITCH. INSTALL AS STAKED IN THE FIELD. APPROXIMATE INLET INVERT ELEVATION 76.3, OUTLET INVERT ELEVATION APPROXIMATELY 75.0.



INFLOW & OUTFLOW DITCH DETAILS

NOT TO SCALE

NOTE
THE INFLOW DITCH DEPTH VARIES FROM 3' - 5'. STOCK PILE THE SPOIL MATERIAL AS DIRECTED BY THE LAND OWNER.
THE OUTFLOW DITCH DEPTH IS 1'. PLACE THE SPOIL ON THE SOUTH SIDE OF THE DITCH AND SHAPE INTO AN 8' TOP WIDTH BERM.
LOCATION OF THE DITCHES AS STAKED IN THE FIELD. THE INFLOW DITCH CURVE HAS A 60' RADIUS.

RECHARGE PIT DETAILS

NOT TO SCALE

NOTES
PIT DEPTH IS 5' OR AS STAKED IN THE FIELD. THE PIT BOTTOM IS TO BE BELOW THE SECOND SANDY LOAM LAYER SHOWN ON THE TEST PIT PROFILES.
EXCAVATION VOLUME APPROXIMATELY 1250 CUBIC YARDS PER PIT. STOCK PILE THE EXCAVATED MATERIAL AT THE LAND OWNERS DIRECTION.

NOTES
THE CONNECTING PIPES BETWEEN PIT #1 & #2 TO BE 6 18"-40' CLASS 80 PVC PIPES. BETWEEN PIT #2 & #3 USE 3 PIPES. INLET INVERT 1.5' BELOW THE GROUND SURFACE; OUTLET INVERT AT THE BOTTOM OF THE PIT. COMPACT BACKFILL OF ROCK FREE SOIL FOR THE FIRST 5' FROM THE INLET END. USE A VIBRATING PLATE COMPACTOR WITH 2 PASSES OVER 4" THICK, LOOSE LAYERS. SOIL MOISTURE TO BE SUCH THAT THE MATERIAL DOES NOT FORM LAYERS NOR FLOWS FROM UNDER THE ACTION OF THE COMPACTOR. BACKFILL FOR THE BALANCE OF THE PIPE TO BE SOIL MATERIAL COMPACTED AS ABOVE OR ROCK SMALLER THAN 1" IN DIAMETER WITH NO COMPACTION NEEDED.
ALLOW NO TRUCK TRAFFIC OVER THE UPSTREAM 10 FEET OF THE PIPES.

REGISTERED PROFESSIONAL ENGINEER 6476
OREGON
JULY 11, 1969
BERNARD J. HEWES
EXPIRES 6/30/2003

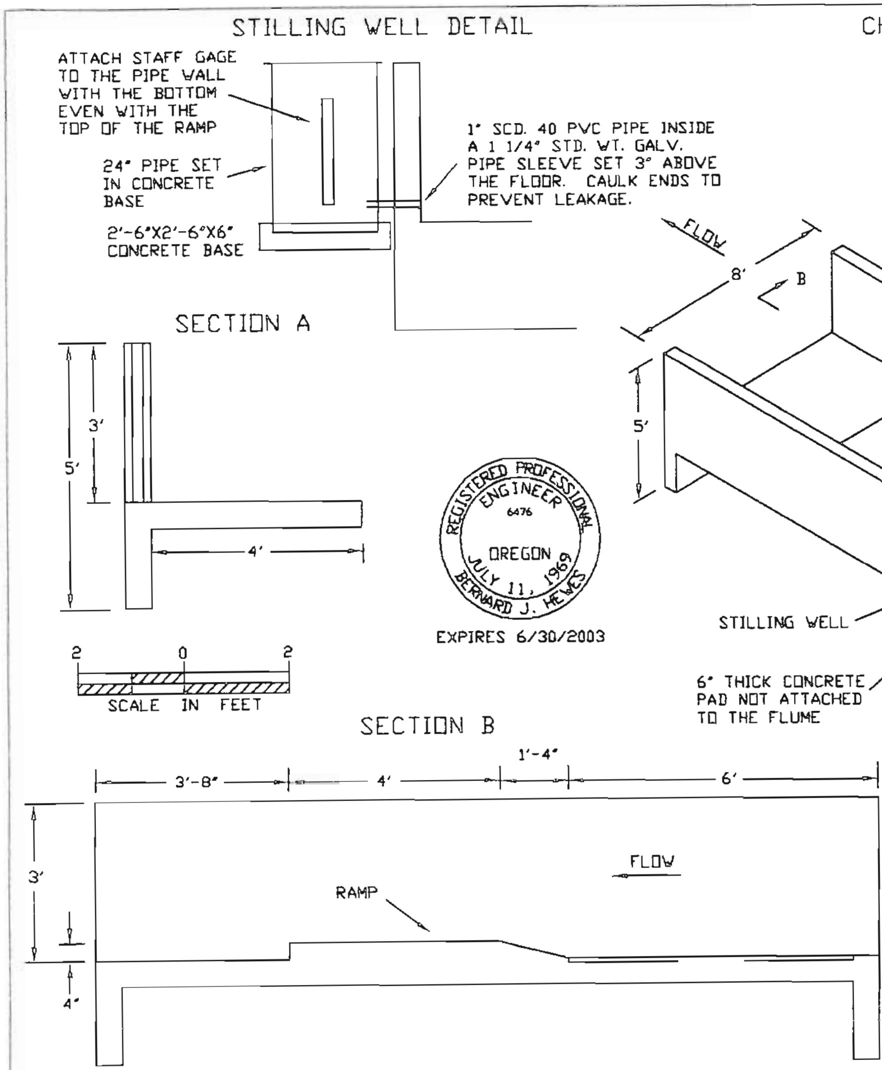
DATE 4/03
DESIGNED B. HEWES
PLOTTED
APPROVED

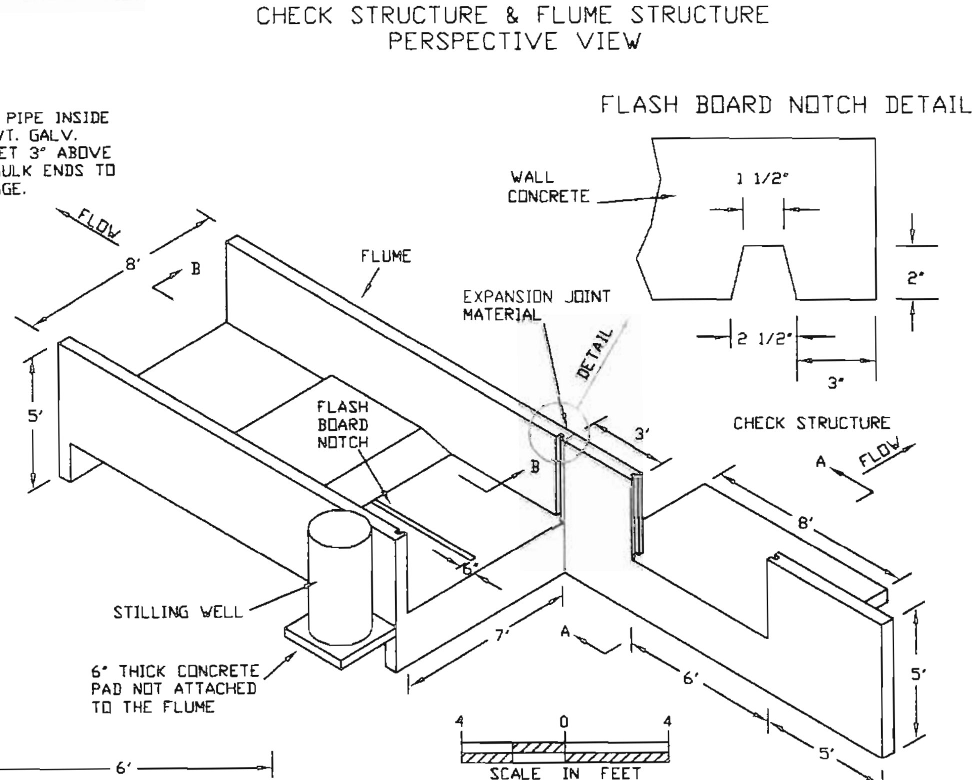
HUDSON BAY AQUIFER RECHARGE PROJECT
SITE PLAN

CADFILE whiteplan

SHEET 2 OF 4

Attachment ... 1.C





NOTES

INSTALL THE CONCRETE IN ACCORDANCE WITH CONSTRUCTION SPECIFICATION 42, ATTACHED.
ALL WALLS AND FLOORS TO BE 6" THICK.
USE 4000 PSI STRENGTH CONCRETE. 1.6 CUBIC YARDS NEEDED FOR THE CHECK STRUCTURE AND 4.9 CUBIC YARDS NEEDED FOR THE FLUME.
SEPARATE THE TWO STRUCTURES USING A 6'X 1/2"X 5' STRIP OF ASPHALT EXPANSION JOINT FILLER.
THE STILLING WELL PIPE MAY BE CORRUGATED METAL OR CLASS 80, MINIMUM, PVC PIPE.
THE FLASH BOARD NOTCH IN THE BOTTOM OF THE FLUME IS TO HOLD THE BOTTOM OF A SPLITTER WALL. USE 2 PIECES OF 3/4" MARINE PLYWOOD. HOLD THE TOP AT THE DOWNSTREAM END WITH A 2"X8"X8' WITH 2-2"X4"X8" CLEATS. AT THE UPSTREAM END USE 2-2"X12"X8' WITH 2-2"X4"X24" CLEATS.

DATE 4/03
DESIGNED B. HEWES
PLOTTED
APPROVED

HUDSON BAY AQUIFER RECHARGE PROJECT
STRUCTURE DETAILS

CADFILE whiteck

SHEET 3 OF 4

Attachment 1D

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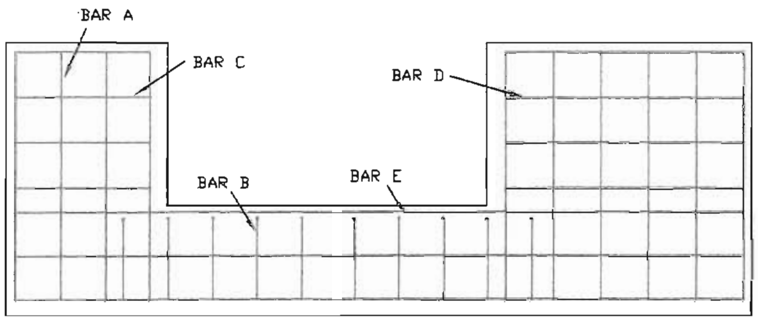
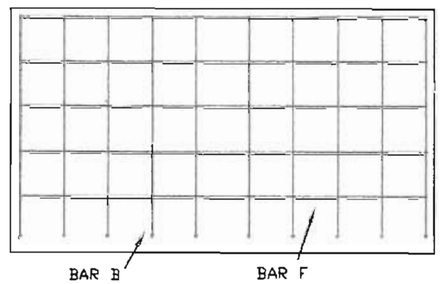
CHECK STRUCTURE ELEVATION VIEW



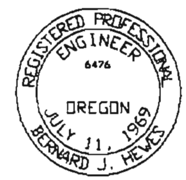
APRON PLAN VIEW



REINFORCING STEEL SCHEDULE

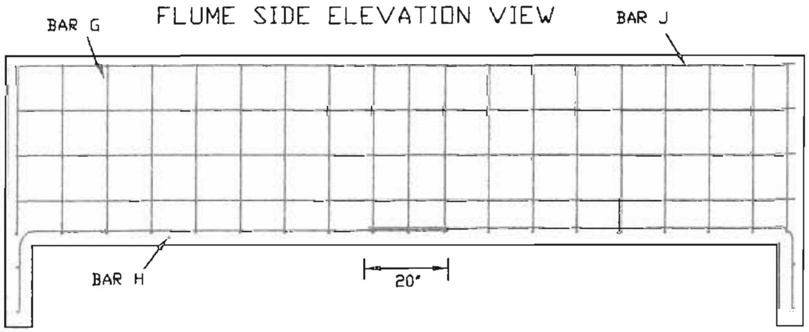
BAR	NO.	SHAPE	A	B	C
		CHECK			
A	10	STRAIGHT	4'-7"	-	-
B	10	A⌊ B	1'-7"	4'-1"	-
C	4	STRAIGHT	2'-6"	-	-
D	4	STRAIGHT	4'-6"	-	-
E	3	STRAIGHT	13'-8"	-	-
F	5	STRAIGHT	7'-8"	-	-
		FLUME			
G	19	A⌊ B ⌋C	3'-1"	7'-6"	3'-1"
H	20	A⌊ B	1'-6"	8'-1"	-
I	4	STRAIGHT	7'-6"	-	-
J	8	STRAIGHT	14'-6"	-	-

NOTES
ALL BARS TO BE NUMBER 4.
BARS TO BE PLACED IN THE CENTER OF THE WALLS AND FLOOR.
NEED 820 LINEAL FEET OF REINFORCING BARS WITHOUT ANY WASTE.

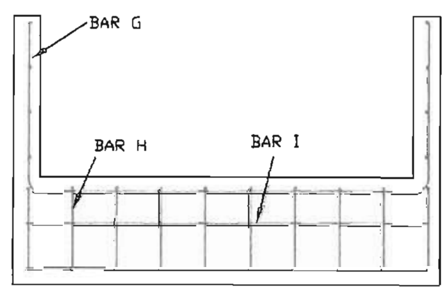


EXPIRES 6/30/2003

FLUME SIDE ELEVATION VIEW



FLUME END WALL ELEVATION VIEW



DATE 4/03
DESIGNED B. HEWES
PLOTTED
APPROVED

HUDSON BAY AQUIFER RECHARGE PROJECT
STRUCTURE REINFORCING STEEL

CADFILE whlteckst

SHEET 4 OF 4

Attachment 1 E

HUDSON BAY AQUIFER RECHARGE PROJECT

ENGINEERING REPORT

This project entails diverting water from an existing irrigation ditch to three pits to be excavated for the purpose of infiltrating the water into the shallow aquifer. Project features include a concrete check structure in the existing White Ditch, a concrete flow measuring flume, an open ditch, three excavated pits, pipes connecting the pits and an outflow ditch from the down stream pit.

These items were sized to handle 50 cubic feet per second (cfs) of water. This is the amount anticipated will be available from excess flow in the Walla Walla River and that the Hudson Bay District is able to deliver.

Data gathered to design the project consisted of a site topographic survey and installing two sites for testing the water infiltration capacity of the natural materials and determining the layers in the soil profile. In addition the Soil Survey of Umatilla County Area, Oregon was consulted. This is a US Dept. of Agriculture, Natural Resources Conservation Service publication giving general soils information.

The topographic survey data was used to prepare a topographic map with one foot contour intervals at a scale of 1" = 60'. This information was used to help determine the location of the project features.

Two test pits were excavated to a depth of 6'-7' each. A 24" diameter by 5' long section of corrugated metal pipe was set on end in the bottom of the pit and about one foot of fill placed around it to hold it in place. Water was pumped into the pipe at a rate that would sustain a water depth of one foot in the pipe. Both flow rate and total flow was measured. The test was run for 6.25 hours in the first pit and 3.5 hours for the second pit.

PIT #1

Soil profile:
0-12" sandy loam
12"-36" gravelly sandy loam, approximately 50% of the material volume is gravel size particles with an estimated D_{50} size of about 0.75"
36"-48" sandy loam, in parts of the trench this layer does not exist
48"-?" gravelly sandy loam approximately 20% of the volume is gravel size particles

The inflow rate at the end of the test period was 4.0 gallons per minute (gpm). This resulted in an infiltration rate of 1.7 gpm/sq. ft./ foot of head.

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PIT #2

Soil profile:

0"-13" gravelly sandy loam

13"-39" cobbly sandy loam, the D_{50} of the gravel is approximately 1"

39"-52" gravelly sandy loam

52"-? sand gravel mix D_{50} estimated to be about 0.25"

In this pit the inflow rate of 11.9 gpm was maintained for 3.5 hours and at no time did water puddle in the bottom of the pipe. The infiltration rate is in excess of 3.8 gpm/sq. ft.

The area needed for infiltrating the water was determined assuming an infiltration rate for the entire area of 3.0 gpm/sq.ft./ per foot of head. For an inflow rate of 50 cfs the infiltration area needs to be 7480 square feet. The infiltration rate of 3.0 gpm/sq.ft. was chosen because the pits will be located in the area with soil surface texture similar to test pit #2.

Due to the possibility of fine soil particles plugging the infiltration area, unknowns concerning the long term infiltration rate and that the amount of water available is not yet known extra infiltration area is being provided. Three separate pits with bottom dimensions of 50 feet X 100 feet are proposed. This will provide an infiltration area of 15,000 square feet.

The pits will be excavated to a depth of about 5 feet to get below the second sandy loam layer noted in both test pits. This will allow the water depth to be 2.5 feet - 3.5 feet. That will increase the rate of infiltration over the test values derived with one foot of water depth. The overall safety factor for the infiltration area is well over 2.

Inflow to the system will be measured with a ramp flume and continuously recorded. The ramp flume is sized to provide 5% flow rate accuracy over a flow range of 10 cfs-50 cfs

Any outflow from the last pit will be safely returned to the White Ditch through a 12-inch pipe. The pipe will be on a slope that will keep water from flowing out of White Ditch.

By: Bernard J. Hewes   Date: 8/21/03

Bernard J. Hewes

REGISTERED PROFESSIONAL ENGINEER 6476 OREGON JULY 11, 1989 BERNARD J. HEWES

Attachment 3A

LAND USE
INFORMATION SHEET

This information is needed to determine if the proposed project complies with statewide planning goals and is compatible with local comprehensive plans (ORS 192.180)

CITY/COUNTY LAND USE INFORMATION (to be completed by local planning official):

Recharge - Hudson Bay project

Please check below the one that applies:

☐ This project is not regulated by the local comprehensive plan and zoning ordinance.

☒ This project has been reviewed and is compatible with the local comprehensive zoning ordinance. (Please cite appropriate plan policies, ordinance section, and case numbers.)
152.056

☐ This project has been reviewed and is not compatible with the local comprehensive plan and zoning ordinance. (Cite appropriate plan policies, ordinance section, and case numbers).

☐ Compatibility of this project with the local planning ordinance cannot be determined until the following local approvals are obtained:

_______ Conditional Use Permit　　_______ Development Permit
_______ Plan Amendment　　_______ Zone Change
_______ Other

An application has ___ has not ___ been made for the local approvals checked above.

* Signature of Local Official: Patty Perry

Title: Senior Planner　　Date: 5-27-03

Must be authorized signature from your local City/County Planning Department

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ATTACHMENT 5A: Methodology to Determine Chemical Constituents for Water Quality Assessment and Evaluation

Introduction:

The Artificial Groundwater Recharge rules (OAR 690-350-120) require both up front water quality and a water quality-monitoring plan. Further, for any recharge project the rules (OAR 690-350-120 (3) (b) require an applicant to either obtain a water quality permit (typically a water pollution control facility (WPCF) permit) or show that a permit is not necessary. Also, rules OAR 690-350-120 (3)(g) require a "Project Description Report" (ATTACHMENT 5) that outlines the proposed groundwater quality-monitoring plan. This attachment is intended to specifically help clarify the method by which the list of chemical constituents was determined.

Project Area Sample Chemical Review Methodology

Working with Tom Darnell, OSU Extension agent in Milton-Freewater, a chemical constituents review was conducted in order to determine what types of chemicals should be examined in the surface and groundwater monitoring for the project. Several steps were followed to determine which chemicals were of interest.

Review Steps

1. Reviewed the ODEO Report: *April 1999 Milton-Freewater Groundwater Quality Study: As part of the Statewide Groundwater Monitoring Program* (Richardson, et. al., 2000). Particular attention was focused on the constituents tested, testing protocol and timing, and the results-conclusions.
2. Reviewed *OSU Extension Pesticide Properties Database* and determined which were used in the Milton-Freewater area and a list was comprised. (Table 4A1, 4A2)
3. Determined which were currently and/or historically used in the area utilizing past chemical studies in the basin (see references). This included interviewing the current landowner on the site-specific history of chemical use on that property (see signed written statement below).
4. Determined which chemicals were important to monitor for during the recharge period (winter-spring). Considered each chemical's typical seasonal application period, solubility in water, soil half-life, and soil movement ratings.
5. Considered project design (top soil removed), and finalized list of chemicals of interest.

Final List of Chemicals to Monitor for Recharge Project

Chemicals Currently Used:

Rubigan (Fenarimol)
Ridomil (Metalxyl)
Systhane/Rally (Myclobutanil)
Devrinol (Napropamide)

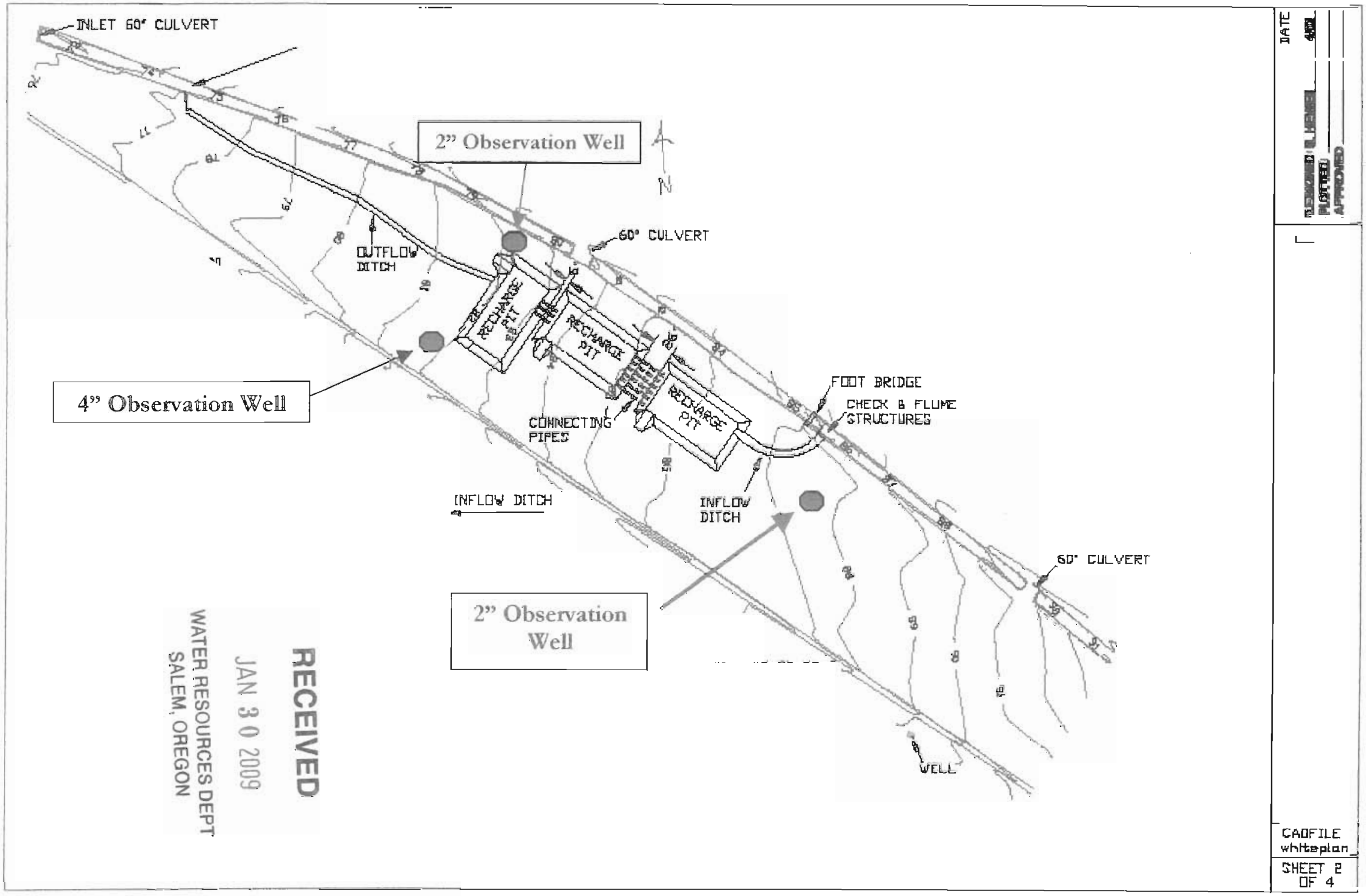
Chemicals Historically Used:

DDD-DDE-DDT
Elgetol (DNOC sodium salt)
Alar/B-Nine (Daminozide)
Lindane (Lindane)

Laboratory Resources

Nitrate Analysis:	Walla Walla County-City Health Department 310 W. Popular, P. O. Box 1753 Walla Walla, WA 99362 Telephone (509) 527-3290
Chemical Analysis:	KUO Testing Labs, INC. 337 south 1st Avenue Othello, WA 99344 Telephone: (509)-488-0118

Attachment 5B Map of On-Site Monitoring Well Locations



Attachment 5D

History of Chemical[1] Use: Recharge Site Specific

Landowner Statement of Past Use:

"Gentleman,

I have been the owner of a certain parcel of land in the valley with an address known as 84140 Prunedale Rd., Milton-Freewater, Oregon, 97862.

I have owned this land since 1978 at which time we took over the existing orchard of apples and farmed it for two years at which time we began removing various blocks of tress and replanting with new varieties. In the past few years we raised Nursery Tree Stock and began leveling the land to its present condition, letting it lay in a dormant stage for a year and then planting cover crops to enrich the soil for a future cherry orchard.

The pesticides applications were the normal tree fruit pesticides as allowed by regulations of the industry. The herbicide applications were Round-Up, Simizine and Paraquat. No other chemicals were used on this parcel of land during my ownership. If you should have other questions, please contact me at the following: (541)-278-6305, (509)-386-6175, or (541)-558-3752 or email at:
Hjohnson@co.umatilla.or.us"

Landowner: [signature] Date: 10-17-03

[1] Chemical is defined here to include insecticides, fertilizers, herbicides, rodenticides, fungicides, and all other non-natural chemicals.

ATTACHMENT 7A: Source Water Quality Data

1STORET RETRIEVAL DATE 99/06/23
402388 28AWALL03780
46 01 08.6 118 24 45.1 4
WALLA WALLA RIVER AT HWY 11 (MILTON-FREEWATER)
41059 OREGON UMATILLA
PACIFIC NORTHWEST 131007
COLUMBIA RIVER BASIN BELOW YAKIMA RIVER
21400000 17070102007 00
0000 FEET DEPTH

[ ] Grey areas samples that correspond to Recharge Project

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INITIAL DATE	67/04/24	67/08/21	67/12/11	68/04/02	68/08/05	68/12/16	69/03/04	69/12/10	70/04/28
INITIAL TIME	1235	1400	1440	1615	1750	1100	1510	1145	930
MEDIUM	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
00010 WATER TEMP CENT	8	25.5	7	8.5	25	5	8.6	5	6
00011 WATER TEMP FAHN	46.4$	77.9$	44.6$	47.3$	77.0$	41.0$	47.5$	41.0$	42.8$
00027 COLLECT AGENCY CODE	10	10	10	10	10	10	10	10	10
00070 TURB JKSN JTU	250	2		10	3	8		7	1
00080 COLOR PT-CO UNITS	20	4		3	5	3		1	3
00095 CNDUCTVY AT 25C MICROMHO	67	225	200	72	243	69	95		71
00300 DO MG/L	10.3	12.2	10.6	11.4	10.7	12.2	11.6	11.7	12.7
00301 DO SATUR PERCENT	89	150	89	99	131	95	99	94	105
00310 BOD 5 DAY MG/L	0.7	1.3	0.9	0.5	1.3	1.6	0.8	1.5	1.5
00400 PH SU	7.3	8.3	7.7	7.5	8.40L	7.2	7.6	7.5	7.5
00410 T ALK CACO3 MG/L	30	108		33	105	30		54	31
00500 RESIDUE TOTAL MG/L	518			99	184	101		118	87
00530 RESIDUE TOT NFLT MG/L	368	11		10	10	21		18	12
00610 NH3+NH4- N TOTAL MG/L	0.13	0.34		0.38	0.32	0.17		0.08	0.12
00612 UN-IONZD NH3-N MG/L	.0004$	.036$		.002$	.040$	.0003$		.0003$	.0005$
00619 UN-IONZD NH3-NH3 MG/L	.0005$	.043$		.002$	.049$	.0004$		.0004$	.0006$
00620 NO3-N TOTAL MG/L	0.03	0.02		0.07	0.38	0.54		0.73	0.13
00660 ORTHOPO4 PO4 MG/L	0.06	0.16		0.1	0.18	0.56		0.16	0.03
00760 SWL PBI MG/L	1K	1K	29	1K					
00940 CHLORIDE TOTAL MG/L	2			1	8	2		2	1
00945 SULFATE SO4-TOT MG/L	8	33		4	14	4		6	3
22413 HARDNESS TOTLDISS WTR MG/L	28			37	99	35		49	24
31505 TOT COLI MPN CONF /100ML	620	2400	7000	60	230	2300	620	450K	620
31615 FEC COLI MPNECMED /100ML			230						60
31677 FECSTREP MPNADEVA /100ML								240	

ATTACHMENT 7A: Source Water Quality Data

INITIAL DATE	70/07/13	70/11/30	71/05/11	71/08/16	72/02/28	72/08/30	73/02/12	73/06/13	73/09/24
INITIAL TIME	1400	1645	2000	1620	1610	1130	845	1055	1400
MEDIUM	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
00010 WATER TEMP CENT	24	5.5	15.5	26	9	20.5	2.5	16.5	16
00011 WATER TEMP FAHN	75.2$	41.9$	59.9$	78.8$	48.2$	68.9$	36.5$	61.7$	60.8$
00027 COLLECT AGENCY CODE	10	10	10	10	10	10	10	10	10
00070 TURB JKSN JTU		5	3	1	28	2	15	3	2
00080 COLOR PT-CO UNITS		0	1	2	10	5	5	5	0
00094 CNDUCTVY FIELD MICROMHO							90		

(SAMPLE CONTINUED FROM PREVIOUS PAGE)

INITIAL DATE	70/07/13	70/11/30	71/05/11	71/08/16	72/02/28	72/08/30	73/02/12	73/06/13	73/09/24
INITIAL TIME	1400	1645	2000	1620	1610	1130	845	1055	1400
MEDIUM	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
00095 CNDUCTVY AT 25C MICROMHO	236	66	51	200	67	221	87		
00300 DO MG/L	12.5	11.5	9.5	14.2	11	12.5	12.9	11.7	11.5
00301 DO SATUR PERCENT	151	95	99	172	97	137	97	117.0$	115.0$
00310 BOD 5 DAY MG/L	2	0.7	0.8	2.3	0.7	0.9	1.4		
00400 PH SU	8.6	7.5	7.3	8.9	7.1	8.4	7.3		
00410 T ALK CACO3 MG/L		29	21	96	23	92	29	82	95
00500 RESIDUE TOTAL MG/L		89	75	172	280	170	100	153	164
00530 RESIDUE TOT NFLT MG/L		12	12	4	106	8	32	10	3
00610 NH3+NH4- N TOTAL MG/L		0.34	0.06	0.66	0.09	0.14	0.04	0.1	0.17
00612 UN-IONZD NH3-N MG/L		.001$	.0003$	.215$	.0002$	.013$	.00008$		
00619 UN-IONZD NH3-NH3 MG/L		.002$	.0004$	.261$	.0002$	.016$	.00010$		
00620 NO3-N TOTAL MG/L		0.02	0.1	0.15	0.3	0.51	0.14	0.36	0.39
00625 TOT KJEL N MG/L							0.2		
00650 T PO4 PO4 MG/L							0.3		
00660 ORTHOPO4 PO4 MG/L		0.06	0.09	0.13	0.09	0.04	0.09	0.1	0.14
00930 SODIUM NA,DISS MG/L					2.4		2.8		
00935 PTSSIUM K,DISS MG/L					2		1.5		
00940 CHLORIDE TOTAL MG/L		1	0.7	5	0.8	3	1	6	4
00945 SULFATE SO4-TOT MG/L		3	.1K	11	3	11	2	6	4
22413 HARDNESS TOTLDISS WTR MG/L		26	19	80	22	84	28	71	79
31505 TOT COLI MPN CONF /100ML	230	2400	2400	230	620	620	290		
31615 FEC COLI MPNECMED /100ML	230	45K	45K	45K	45K		60		

1STORET RETRIEVAL DATE 99/06/23
402389 28AWALL04860
45 54 13.6 118 22 02.9 4
WALLA WALLA RIVER U/S MILTON-FREEWATER
41059 OREGON UMATILLA
PACIFIC NORTHWEST 131007
COLUMBIA RIVER BASIN BELOW YAKIMA RIVER
21400000 17070102011 00
0000 FEET DEPTH

INITIAL DATE	67/04/24	67/08/21	67/12/11	68/04/03	68/08/06	68/12/16	69/03/04	69/12/10
INITIAL TIME	1300	1520	1700	810	905	1030	1540	1055
MEDIUM	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
00010 WATER TEMP CENT	6	21	5	6.5	16	5	6.4	3
00011 WATER TEMP FAHN	42.8$	69.8$	41.0$	43.7$	60.8$	41.0$	43.5$	37.4$
00027 COLLECT AGENCY CODE	10	10	10	10	10	10	10	10
00070 TURB JKSN JTU	5	7	15	2	5	9	12	2
00080 COLOR PT-CO UNITS	6	2	4	4	4	3	2	0
00095 CNDUCTVY AT 25C MICROMHO	59	180	69	57	93	57	63	
00300 DO MG/L	11.2	8.7	11.9	11.6	9.7	11.1	11.6	12.9
00301 DO SATUR PERCENT	94	101	98	98	102	87	99	100
00310 BOD 5 DAY MG/L	0.6	0.8	1.1	0.6	0.4	0.2	0.7	1.2
00400 PH SU	7.4	7.5	7.5	7.3	7.3	7	7.5	7.7
00410 T ALK CACO3 MG/L	26	32	32	26	40	16	27	33
00500 RESIDUE TOTAL MG/L	89	101	83	113	98	92	81	67
00530 RESIDUE TOT NFLT MG/L	2	8	6	7	22	26	7	6
00610 NH3+NH4- N TOTAL MG/L	0.14	0.17	0.32	0.12	0.18	0.11	0.06	0.03
00612 UN-IONZD NH3-N MG/L	.0005$	.002$	.001$	.0003$	.001$	.0001$	.0003$	.0002$
00619 UN-IONZD NH3-NH3 MG/L	.0006$	.003$	.002$	.0004$	.001$	.0002$	.0003$	.0002$
00620 NO3-N TOTAL MG/L	0.01	0.02	0.02	0.03	0.04	0.39	0.3	0.12
00660 ORTHOPO4 PO4 MG/L	0.02	0.1	0.1	0.07	.01K	0.01	0.11	0.1
00760 SWL PBI MG/L	8	1K	1					
00940 CHLORIDE TOTAL MG/L	1	5	1	1	6	2	2	0.8
00945 SULFATE SO4-TOT MG/L	3	0.6	4	2	15	3	1	3
22413 HARDNESS TOTLDISS WTR MG/L	23	36	29	24	32	25	26	31
31505 TOT COLI MPN CONF /100ML	230	620	210	230	620	210	60	60
31615 FEC COLI MPNECMED /100ML			210					
31677 FECSTREP MPNADEVA /100ML								5K

ATTACHMENT 7A: Source Water Quality Data

INITIAL DATE	74/05/06	74/07/30	74/11/11	75/05/27	75/07/08	75/11/10		
INITIAL TIME	1420	1745	1630	1930	1745	1745		
MEDIUM	WATER	WATER	WATER	WATER	WATER	WATER		
00010 WATER TEMP CENT	10.5	20.5		10.5	27	4.7		
00011 WATER TEMP FAHN	50.9$	68.9$		50.9$	80.6$	40.5$		
00027 COLLECT AGENCY CODE	10	10	10	10	10	10		
00070 TURB JKSN JTU	7	2	1	1	2	1.0K		
00080 COLOR PT-CO UNITS	5	5	1K	5	15	1K		
00094 CNDUCTVY FIELD MICROMHO	49	80		55	170	80		
00095 CNDUCTVY AT 25C MICROMHO	53	90		54	195	72		
00300 DO MG/L	10.8	9		10.8	8.7	11.9		
00301 DO SATUR PERCENT	101	103		102	106	95		
00310 BOD 5 DAY MG/L	1	0.3		0.6	3	0.4		
00400 PH SU	7.5	8		7.3	8	7.7		
00410 T ALK CACO3 MG/L	17	34	33	20	65	34		

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INITIAL DATE	74/05/06	74/07/30	74/11/11	75/05/27	75/07/08	75/11/10		
INITIAL TIME	1420	1745	1630	1930	1745	1745		
MEDIUM	WATER	WATER	WATER	WATER	WATER	WATER		
00500 RESIDUE TOTAL MG/L	62	76	68	64	180	87		
00530 RESIDUE TOT NFLT MG/L	39	4	1K	5	38	3		
00610 NH3+NH4- N TOTAL MG/L	0.03	0.02	0.06	0.01	0.19	0.02		
00612 UN-IONZD NH3-N MG/L	.0002$	.0008$		.00004$	.012$	.0001$		
00619 UN-IONZD NH3-NH3 MG/L	.0002$	.0010$		.00005$	.014$	.0001$		
00620 NO3-N TOTAL MG/L	0.01	0.05	0.06	0.1	0.72	0.12		
00650 T PO4 PO4 MG/L	0.2	0.2		0.3	0.5	0.1		
00660 ORTHOPO4 PO4 MG/L	0.01	0.14	0.08	0.09	0.08	0.11		
00930 SODIUM NA,DISS MG/L	2.1	3		2.4	8.4	3		
00935 PTSSIUM K,DISS MG/L	1.6	2.4		1.3	3.5	2		
00940 CHLORIDE TOTAL MG/L	0.4	0.9	1	1	6	1		
00945 SULFATE SO4-TOT MG/L	2	1	2	2	8	2		
22413 HARDNESS TOTLDISS WTR MG/L	14	27	27	19	60	27		
31505 TOT COLI MPN CONF /100ML	60	7000L		230	7000	2400		
31615 FEC COLI MPNECMED /100ML	45K	620		45	7000	230		

AHachment 3B

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LAND LEASE

1. PARTIES

The parties to this Lease are HULETTE M. JOHNSON, SHIRLEY A. JOHNSON, and H. MARC JOHNSON, hereinafter referred to as Landlord, and HUDSON BAY DISTRICT IMPROVEMENT COMPANY, and Oregon Non-profit Improvement District, hereinafter referred to as Tenant.

2. DATE

This Lease will begin the first of the following month, after the Tenant has obtained a water right certificate for the purpose of ground water recharge for this site from the State of Oregon.

3. DESCRIPTION OF LEASED PREMISES

Landlord leases to Tenant and Tenant leases from Landlord, under the terms and conditions stated herein, the real property in Umatilla County, State of Oregon, described in Exhibit "A" attached hereto and by such reference incorporated herein.

4. TERM OF LEASE

The term of this Lease will be from the date of this lease for a period of five(5) years. Tenant shall have the option to renew this lease with notice to Landlord of not less than 90 days prior to the end of the initial term and any renewal terms for future additional five year terms upon the mutual agreement of renegotiated rental terms for each renewal period.

5. POSSESSION

The Tenant shall be granted possession of the property upon execution of this document by all parties, together with the receipt of the initial lease payment as prescribed in RENT.

6. RENT

Tenant shall pay advance annual rent payments in the amount of three thousand six hundred dollars($3,600) plus annual assessment for irrigation water for surface water rights delivered by Tenant to 84140 Prunedale Road, beginning with INV # 1276C for 2003. Landlord shall pay same assessment to Tenant upon receipt of said annual assessment payment from Tenant. Tenant shall make each annual payment for the term of this lease to Landlords address, 52833 Sunquist Road, Milton-Freewater, Oregon, 97862, or otherwise as notified. The initial payment shall be due on the date this agreement is executed by Tenant and Landlord, and Tenant it therefore granted possession to said real property.

7. INSURANCE

Tenant shall maintain liability insurance on the leased property in an amount acceptable to the Landlord and shall provide proof of such insurance naming Landlords as additional insureds. Tenant shall also be responsible for necessary insurance on laborers. Tenant shall also be responsible for insurance coverage on personal property kept or installed upon this leased premises.

8. USE OF PREMISES

Tenant agrees that they will use the property for ground water recharge/storage, ponding.

9. LANDLORDS OBLIGATIONS

Landlord shall install electricity, pump, collection pond and mainline with the assistance of Tenant necessary to connect the source of irrigation water provided by Tenant to the existing delivery systems of Landlord's.

If there is a mortgage or other encumbrance on said premises, Landlord covenants to keep same in good standing, at all times, to make payments when due and not to suffer or permit default in said encumbrance.

Landlord shall pay all property taxes upon the real property subject to this lease in a timely manner.

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10. TENANT'S OBLIGATIONS

Tenant shall provide all labor and materials for the construction of the ground water recharge pond, Landlord's irrigation collection pond and pumping station or other improvements required by Tenant, including maintenance of bridges and culverts.

Tenant shall pay all taxes of any kind and necessary insurance for labor to maintain to maintain improvements including any increase in property taxes as a result of said improvements as made by Tenant.

Tenant shall pay for all maintenance and operation of improvements constructed on said premises.

Tenant agrees that earth material excavated from the recharge pond shall be placed along the edges of the recharge area to produce a basin-like pond. Excess material shall be placed in other areas of Landlords property as directed by Landlord and spread evenly where located so that agricultural activities may continue.

Tenant upon termination of lease, shall replace all soil to a level topography using stored material from the sides of said 'recharge' pond, together with other off site soil as approved by Landlord, necessary to return the recharge pond to a level premise ~~for agricultural growing activities.~~

Tenant shall pay for all costs incurred for control of noxious weeds and vegetation around perimeter of ponding areas, and shall spray the perimeter of said pond including the banks of the Hudson Bay Canal and the Pleasantview Canal including bridges and culverts to maintain a clean ground cover as directed by Landlord

Tenant shall provide signage for trespass prevention and notice of man-made hazard upon premises at the commencement of work efforts at the recharge area.

Tenant shall install any and all fences and gates necessary as may be required by an insurance company or others around the recharge pond.

11. LIENS

Tenant shall pay, as due, all claims for work done on and for services rendered or materials furnished to the leased premises incurred and owing by Tenant and shall keep the premises free of any liens resulting from acts of the Tenant.

12. COVENANTS OF TITLE

Landlord covenants that he is the owner of the above described property free of any encumbrance that would impair or interfere with Tenant's rights under this Lease, and that Landlord has full right and authority to lease the premises described herein.

13. WASTE

Tenant shall not commit or permit to be committed any waste, strip, damage to or misuse of the premises.

14. INDEMNIFICATION

Tenant shall indemnify, hold harmless and defend Landlords from all claims, loss or liability arising out of or related to any activity of Tenant on the leased premises or any condition of the leased premises in the possession or under the control of the Tenant.

15. ASSIGNMENT

No part of the leased property may be assigned, mortgaged, or subleased, nor may a right of use of any portion of the property be conferred on any third person by any other means without the prior written consent of Landlord. This provision shall apply to all transfers to and by trustees in bankruptcy, receivers, administrators, executors, and legatees. No consent in one instance shall prevent the provision from applying to a subsequent instance.

16. DEFAULT

The following shall be events of default:

Failure to pay rent when due.

Failure of either Landlord or Tenant to comply with any other term or condition or fulfill any other obligation of this Lease within twenty(20) days after written notice by Landlord or Tenant specifying the nature of the default with reasonable particularity.

Abandonment by the Tenant of the property

If the default is of such a nature that it cannot be completely remedied within the twenty-day period and the defaulting party thereafter proceeds with reasonable diligence and in good faith to effect the remedy as soon as practicable, default shall not be declared unless the defaulting party ceases to effect the remedy.

17. TAXES

The Landlord shall pay all real property taxes for real property for the term of this Lease. Tenant shall be liable to pay any taxes, personal or real, incurred as a result of improvements placed upon the leased premises.

18. NONWAIVER

Waiver by either party of strict performance of any provision of this Lease shall not be a waiver of or prejudice the party's right to require strict performance of the same provision in the future or of any other provision of this Lease.

19. ATTORNEY FEES

If suit or action is instituted in connection with any controversy arising out of the Lease, the prevailing party shall be entitled to recover, in addition to costs, such sums as the Court may adjudge reasonable as attorney fees.

20. SUCCESSION

Subject to the above-stated limitations on transfer of Tenant's interest, this Lease shall be binding upon and inure to the benefit of the parties, their respective successors and assigns.

21. INSPECTION OF PREMISES

The Landlord reserves the right to themselves and their agents to go upon the premises at reasonable and proper times to inspect the same for the purpose of determining that the Lease is being properly observed and that all of the terms of this lease are being performed by the Tenant.

22. IMPROVEMENTS

Any improvements to the real property by Tenant shall remain the property of the Landlord upon termination of this Lease, unless the Tenant obtains the written consent of Landlord to remove said improvements prior to the time the improvements are placed on the property. However, Tenant shall be responsible for refilling the recharge "pond" as set forth in paragraph 10 above.

23. TERMINATION

The Tenant agrees to deliver the property to the Landlord at the end of the term of this Lease and in as good a condition as when accepted, and pursuant to paragraph 10 above.

24. TIME IS OF THE ESSENCE

The parties acknowledge and agree that time is of the essence with respect to all of the terms, conditions, and provisions of this Lease.

25. NOTICES

Any notice required or permitted under this Lease shall be given when actually delivered or when deposited in the United States Mail as certified mail, addressed as follows:

LANDLORD: HULETTE M. JOHNSON, et., al.
52833 Sunquist Road
Milton-Freewater, Oregon 97862

TENANT: HUDSON BAY DISTRICT IMPROVEMENT COMPANY
P.O. Box 110
Milton-Freewater, Oregon 97862

26. WATER DUES

The annual irrigation water dues as billed to Landlord by Tenant shall be paid by Landlord to Tenant as billed. As part of the rent agreement in paragraph 6 above, Tenant shall pay Landlord an equal amount of said water dues within thirty(30) days of receipt of said water dues from Landlord, during the term of this Lease and any renewals thereof.

27. CAPTIONS AND HEADINGS

The captions and headings throughout this Lease are for convenience and reference only and the words contained therein shall in no way be held or deemed to define, limit, describe, explain or modify the meaning of any provisions of or the scope or intent of this Lease.

28. ENTIRE AGREEMENT

This document is the entire, final, and complete agreement of the parties pertaining to the Lease of the premises described herein, and supersedes and replaces all written and oral agreements theretofore made or existing by and between the parties or their representatives in so far as the premises are concerned.

IN WITNESS WHEREOF, the parties have executed this Lease on the 15th day of October, 2003.

LANDLORD:

HULETTE M. JOHNSON,

SHIRLEY M. JOHNSON

H. MARC JOHNSON

TENANT:

HUDSON BAY IMPROVEMENT CO.

BY: ________________

it's Secretary/Treasurer

STATE OF OREGON)
)ss.
County of Umatilla)

On this 15th day of Oct 2003 personally appeared before me the above named HULETTE M. JOHNSON, SHIRLEY M. JOHNSON, and H. MARC JOHNSON and acknowledged the foregoing to be a voluntary act and deed.

OFFICIAL SEAL
KATHLEEN F. YENNEY
NOTARY PUBLIC-OREGON
COMMISSION NO. 337142
MY COMMISSION EXPIRES SEPT. 24, 2004

NOTARY PUBLIC FOR OREGON

My commission expires: 9-24-2004

STATE OF OREGON)
)ss.
County of Umatilla)

On this 15th day of Oct 2003, personally appeared before me the above named John C. Zerba, in his capacity as Secretary/Treasurer of HUDSON BAY IMPROVEMENT CO. and acknowledged the foregoing to be a voluntary act.

OFFICIAL SEAL
KATHLEEN F. YENNEY
NOTARY PUBLIC-OREGON
COMMISSION NO. 337142
MY COMMISSION EXPIRES SEPT. 24, 2004

NOTARY PUBLIC FOR OREGON
My Commission expires: 9-24-2004

STATE OF OREGON)
)ss
County of Umatilla)

OFFICIAL SEAL
JACQUELINE A. BUTTS
NOTARY PUBLIC-OREGON
COMMISSION NO. 368700
MY COMMISSION EXPIRES MAY 15, 2007

On this 22 day of October 2003, personally appeared before me the above named H. Marc Johnson, and acknowledged the foregoing to be a voluntary act and deed.

Jacqueline A Butts
NOTARY PUBLIC FOR OREGON

My commission expires May 15, 2007.

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Exhibit "A"

TRACT I:

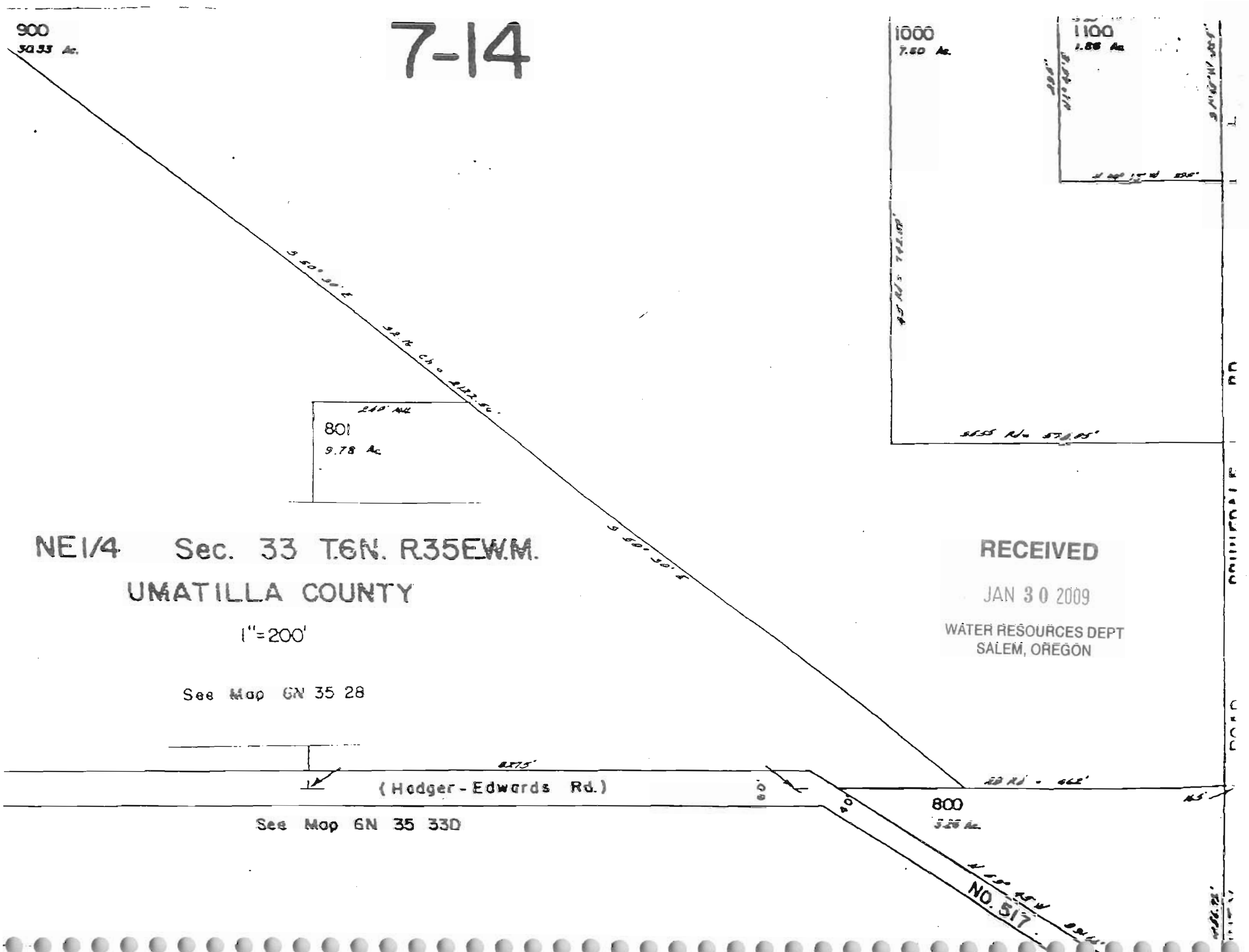
Township 6 North, Range 35, East of the Willamette Meridian:
Section 33: A tract of land located in the South Half of the Northeast Quarter, and being a portion of that tract of land conveyed to William J. Jackson, by Deed recorded in Book 369, Page 267, Deed Records, and being described as follows, to-wit:

Commencing at the quarter section corner on the line between Sections 33 & 34; running thence North 20 chains: thence West 33-16/100 chains; thence Southeasterly 32-16/100 chains, more or less, to a point on the center line; running East and West through said Section 33, said point being 7 chains West of the point of beginning; thence East 7 chains to the point of beginning. Excepting Therefrom, beginning at the Northeast corner of the Southeast Quarter of the Northeast Quarter of said Section 33: and running thence South 45 rods: then West 35-5/9 rods; thence North 45 rods; thence East 33-5/9 rods to the place of beginning. All being East of the Willamette Meridian, Umatilla County, Oregon. Subject to any and all water rights of way and roads.

TRACT III:

Beginning at the Northeast corner of the Southeast Quarter of the Northeast Quarter of Section 33, Township 6 North, Range 35; running thence South 45 rods; thence West 35 and 5/9 rods; thence North 45 rods; thence East 35 and 5/9 rods to the place of beginning. Excepting therefrom that tract of land conveyed to the State of Oregon, by and through its State Highway Commission by deed recorded in Book 130, Page 573 of the Deed Records of Umatilla County, Oregon. Also, excepting any portion of said premises lying within that strip of land conveyed to Walla Walla and Columbia River Railroad Company, by deed recorded in Book "D", Page 834 of the said Deed Records. All being East of the Willamette Meridian, in the County of Umatilla and State of Oregon;

Excepting any and all water rights of way.


7-14
900
1000
7.50 Ac.
1100
801
9.78 Ac.
NE1/4 Sec. 33 T.6N. R.35E.W.M.
UMATILLA COUNTY
1"=200'
See Map 6N 35 28
(Hodger-Edwards Rd.)
See Map 6N 35 33D
800
NO. 517