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Proposed SAR Monitoring and Test Plan, Hall-Wentland Site, Umatilla County, Oregon, Revision 3

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Prepared for

HDR/EES and Walla Walla County

K/J Project No. 0492001.00

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Section 1: Introduction

In the winter/spring of 2003 and the autumn/winter/spring of 2003/2004 Mr. Tom Page, working with local landowners in the Beet Road, Winesap Road, and State Line Road area (approximately 2.5 miles west-southwest of College Place, Washington) collected information to evaluate the effectiveness of winter irrigation in improving flows in McEvoy spring creek. Winter irrigation was conducted on property owned by Mr. A.J. Wentland and Mr. Gordan Hall located on the south side of State Line Road near Winesap Road. The Hall-Wentland properties are located in Oregon, a few hundred yards south of the Washington-Oregon border. A 0.5 cubic feet per second (cfs) Oregon winter irrigation water right was used for the recharge water. Mr. Page's activities included periodic water level measurements in several domestic and irrigation wells near the Hall-Wentland properties and between these properties and the Walla Walla River at the Burlingame Ditch Diversion. Mr. Page took the initiative in this because he has observed declining flows and the loss of fish habitat in McEvoy spring creek over the past 40 to 50 years.

In response to the anecdotal observations of Mr. Page and others, the Walla Walla Watershed (WRIA 32) planning unit in Washington, Walla Walla Basin Watershed Council in Oregon, and the Walla Walla Watershed Alliance in both Washington and Oregon have expressed concern about potentially declining shallow aquifer water levels and possible effects of this on diminished spring creek and Walla Walla River flows. Based on this concern, the Washington Department of Ecology (Ecology) provided Walla Walla County with a grant to test the feasibility of shallow aquifer recharge (SAR) at two sites in the Walla Walla Basin. Using this funding, and building on Mr. Page's informal recharge activities, this document presents a proposed SAR monitoring and test plan (the Plan) for one of these sites, the Hall-Wentland site (the Site).

Note, although the work described herein is funded by a Washington State agency, the Site is actually located in Oregon, a few hundred yards south of the Washington-Oregon border (Figure 1). Consequently, much of the monitoring and testing described in this Plan will be done under an Oregon Limited License for testing shallow aquifer recharge as laid out in OAR-690-350-0020. This Plan will be part of the Limited License application for this Site. The Limited License will be administered by Oregon Department of Water Resources (OWRD).

This Plan is based on preliminary hydrogeologic assessment information presented in Kennedy/Jenks Consultants (2003) and ongoing site-specific hydrogeologic characterization work. If the Plan needs to be modified as a result of findings from the characterization work, these modifications will be presented to Ecology (as the funding agency) for review and concurrence. This proposed Plan provides guidance for the project team during the execution of the test, including monitoring SAR test impacts on area groundwater. This Plan also provides area land owners and stakeholders with an understanding of project activities, and provides information useful for regulator oversight and approvals. Permitting and land owner approvals are not covered in this Plan. This Plan also describes general site setting and provides a basic overview of the proposed project.

For this project, Walla Walla County contracted to Economic and Engineering Services, Inc., to gather a project team and oversee the project. Project team members, roles, and responsibilities are generally as follows:

- Economic and Engineering Services, Inc. (EES) - EES, which recently merged with HDR Inc., is the project manager for the project. In addition EES/HDR has the role of gaining final land owner access agreements, permits, and preparing periodic reports to and for the County.

- Kennedy/Jenks Consultants – Kennedy/Jenks Consultants focus is Site hydrogeologic characterization, design of SAR test layout, observation of any construction activity, preparation of the monitoring and test plan (e.g. this document), interpreting pre-test, test and post-test monitoring data, and final reporting.

- Fountainhead Irrigation, Inc. - Fountainhead Irrigation focuses primarily on public outreach, land owner contact, and limited technical support for testing.

- Gordon, Thomas, and Honeywell, LLC (GTH) - GTH's primary role is to provide regulatory support and research.

There are two basic objectives for this proposed Plan. One objective is to define sampling locations, list constituents for sampling, present sampling procedures, and define reporting activities for monitoring to be conducted before, during, and after the SAR test at the Site. Monitoring data will be used to evaluate pre-test (background) groundwater and surface water conditions and assess the impact of SAR testing on area groundwater, including unwanted impacts that may require changes to the SAR test. The second objective of the Plan is to describe the proposed layout of the Site, basic testing activities, and Site operation.

The results of the monitoring and testing described in this proposed plan will be combined with site-specific hydrogeologic characterization data in a report to be produced in June 2005. This report will discuss the results of SAR testing and present recommendations for future SAR activities. Potential recommendations may include additional testing needs at this Site and/or other sites, expanding recharge activities here and/or elsewhere, and changes in operation, monitoring, or testing, to name a few examples.

Section 2: Site Setting

This section briefly introduces the physical setting of the Site, including location and geologic and hydrogeologic setting. Because the proposed testing focuses on the shallow or uppermost aquifer in the Site area, the following review of area geology and hydrogeology centers on suprabasalt sediments. The review of Site geologic and hydrogeologic setting is based on Kennedy/Jenks Consultants (2003) initial reconnaissance of several possible SAR sites in the Walla Walla Basin.

2.1 Location, Physical Description, and Land Use

The Site is located on two pieces of adjacent private property on the south side of State Line Road approximately 2.5 miles southwest of College Place, Washington, just south of the Oregon-Washington border (Figures 1 and 2). The Site is in the SE 1/4, NW 1/4, Section 14, T6N, R35E. The western part of the Site is owned by Mr. A.J. Wentland, the eastern part of the Site is owned by Mr. Gordon Hall. Overall, the Site is an approximately 300 foot long (north-south) by 150 foot wide (east-west) rectangle (Figure 2). Farming, including hay, orchards, and other crops, irrigated pasture, and low density rural residential land use predominates on all sides of the Site.

Interviews with the current land owners reveal that both portions of the Site were used as orchards until approximately 15 years ago. At that time the orchards were removed and the Wentland portion converted to wheat farming, the Hall portion converted to pasture. Wheat farming on the Wentland portion of the Site continued until 4 years ago when farming was converted to alfalfa. The standard alfalfa herbicides Velpar and Gramoxone have been used on the alfalfa field. When the Wentland portion of the Site was used for wheat, the broad-leaf herbicide Bronate was used. On the Hall portion of the Site herbicides generally have not been used, except this year when a broad-leaf herbicide was applied to the pasture. Pesticides are not thought to have been used on either portion of the Site.

Irrigation water is currently delivered to the Hall-Wentland properties via a branch ditch off a larger ditch known as Wells Ditch (Figure 3). Wells Ditch receives water from the East Fork of the Little Walla Walla River (East Little Walla Walla) (Figure 3). A head gate for controlling Wells Ditch flow is located at the Wells Ditch diversion off the East Little Walla Walla. Flow into the branch ditch which feeds the Site is controlled by a check-board structure located on Wells Ditch less than 200 yards south of the Site. The branch ditch onto the Site terminates in an approximately 10 foot by 10 foot pond from which water is pumped for irrigation use on the Site. Overflow water from the pump pond infiltrates into the ground within a few tens of feet of the pond. The branch ditch will be the conduit by which water is supplied to the Site.

2.2 Geology and Hydrogeology

The predominant sedimentary strata underlying the Site and hosting shallow groundwater are Quaternary alluvial gravel (young gravel of Newcomb, 1965) and Mio-Pliocene conglomerate (old gravel of Newcomb, 1965). In the area around the Site these may be capped by a thin veneer of Touchet Beds, although at the Site proper Touchet Beds are absent. Based on well log interpretations the alluvial gravel and Miocene-Pliocene conglomerate are approximately 20 feet-thick and greater than 125 feet-thick, respectively in the immediate area of the Site. This trend generally persists to the north along the East Little Walla Walla valley. However a few hundred yards north of the test site, the alluvial gravel unit may locally pinch out and Mio-Pliocene conglomerate may be found within a few feet of the ground surface.

Based on regional information (Newcomb, 1965; Barker and MacNish, 1976), suprabasalt aquifer gradient and flow direction in the Site area are probably to the north and west, along the course of the East Little Walla Walla towards the Walla Walla River. Some recent water-level data has been collected for this area by Mr. Page. This data suggests the suprabasalt water table beneath the immediate Site area during 2003 and the first half of 2004 ranged from as shallow as 10 feet to as deep as 30 feet bgs. Mr. Page's data also suggests that suprabasalt aquifer groundwater flow in the Site area is generally from south to north throughout the year (Figures 4, 5, and 6). Near the location of McEvoy spring groundwater appears to be less than 10 feet deep. These depths generally place the suprabasalt water table in the alluvial gravel unit. However, where this unit is absent, the water table would be in the Mio-Pliocene conglomerate unit.

Based on the information summarized above, water that infiltrates to the water table at the Site is inferred to move to the north, northeast, or northwest. However, due to the unknown effects from pumping of nearby water wells and the possibility of aquifer property changes (aquifer heterogeneities), groundwater flow direction(s) at the Site may differ from this generalization. Site characterization activities not covered in this Plan will be undertaken to better understand this groundwater flow system.

Section 3: Project Description

This section presents a general overview of the proposed project. This overview includes a narrative description of likely project activities and factors that may influence project activities and operation.

3.1 General Project Narrative

The basic layout of the Site is shown on Figure 3. The Site will likely consist of one or more ditches or trenches excavated at least 2 feet into the ground. The proposed source of recharge water for the test is East Little Walla Walla water delivered to the Site via a branch of Wells Ditch (Figure 4). Water delivered to the Site will be allowed to infiltrate into the ground. Potential Site modifications for this basic testing scenario include:

- Construction of a turn out structure and delivery ditch or trench onto the field to be used for recharge, structure will include controls to limit the amount of water diverted from the Ditch
- Excavation of one or more trenches or ditches to distribute water across Site and facilitate infiltration
- Grading of the Site as needed to promote drainage
- Removal of trash and debris from the portion of the Site used for testing
- Fencing as needed to restrict access
- Re-excavation of trenches or ditches as needed during testing if mud deposition hinders recharge

Contingent on water availability and license approval, testing will be done in February through April 2005. Based on this tentative timeframe the proposed project schedule is as follows:

1. Preliminary planning –2004
2. Site characterization – October - December 2005
3. Finalization of monitoring plan – October – November 2005
4. Pre-test characterization, monitoring, and Site preparation – October - December 2005 and January 2006 (includes site coordinate and elevation surveys)
5. Recharge testing – February through April 2006 (as water is available)
6. Final report to Ecology, same report to OWRD – May - June 2006
7. Following June 2005 - Testing to continue under Limited License if additional funding procured, if this occurs annual reports will be prepared for OWRD for the Limited License

This schedule assumes all site access agreements and regulatory acceptances are in place prior to project activities requiring them.

Testing generally will be conducted, pending OWRD approval of a Limited License, with the following stream and ditch flow stipulations:

- Water is available in Wells Ditch at the point of diversion from Wells Ditch to the Site in excess of senior downstream water rights demands at the time of testing.

- Diversion of water for testing from the East Little Walla Walla to the Site via Wells Ditch does not result in reduction in discharge in the East Little Walla Walla below 3.5 cfs at Washington Department of Ecology stream gauging station 32H090 (East Prong Little Walla Walla River at Stateline).

Based on existing water rights, typical needs of Ditch and East Little Walla Walla users, and existing infrastructure capacity during the planned 2005/2006 test window, total water volume potentially deliverable to the Site via Wells Ditch is estimated to be less than 4 cfs. As stated in the previous bullet though, at no time during testing will East Little Walla Walla discharge at gauging station 32H090 be reduced below 3.5 cfs as a result of testing. Based on the potential quantity of available water during future possible testing (if funding is available) and possible infrastructure modifications, the temporary water permit for this project should be for a maximum of 10 cfs with the aforementioned modifications.

In the event of prolonged freezing weather, Site operation may be temporally suspended to avoid ice damage to the Ditch and/or the Site. Water quantities delivered to the Site will be monitored via a gauge/meter at the diversion from the Ditch into the Site. Based on this monitoring data water quantities discharged to the ground will be calculated. Section 5.0 presents additional proposed test plans.

Groundwater levels in the immediate vicinity of the Site will be monitored before, during, and following testing. This will be done via wells. Currently we plan to possibly build two wells at the Site (see Figure 3 for probable location) and to use existing water wells in the area previously used by Mr. Page (Figure 2). Water quality data also will be collected before, during, and following testing, primarily from purpose built Site wells and from the Ditch at the diversion onto the Site. Parameters to be collected, sampling timing, and other water quality monitoring information are presented in Section 4.

3.2 Outside Influences

Currently identified primary outside influences on testing are water availability from the East Little Walla Walla and Wells Ditch, freezing conditions, and undesirable impacts on area groundwater resulting from testing. The probable effects of these influences on testing, and possible mitigation actions to be implemented during testing, are as follows:

- Flow in the East Little Walla Walla and Ditch will be a limiting factor for the test. Assuming the Limited License is granted, water only will be diverted onto the Site when excess capacity exists in the East Little Walla Walla and Ditch. Excess capacity is defined as

  - total East Little Walla Walla (includes any defined minimum in stream flows) and Ditch flow – total user demand = excess capacity potentially available for testing

- High East Little Walla Walla flows also may 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 Site 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 trenches and ditches on the Site may be periodically re-excavated to remove accumulated fines. The turbidity threshold for operation and preferred mitigation strategy for dealing with this will be based on monitoring and performance data collected during testing.

- In the event of prolonged freezing weather, Site operation may be temporally suspended to avoid ice damage to the Ditch diversion on the Walla Walla River, the Ditch system itself, and/or the recharge ponds and related structures and to avoid the risk of ice jams forming in the Ditch, backing up water in the Ditch, and causing flooding adjacent to the Ditch.

The main purpose of groundwater monitoring is to identify the influence of recharge on area groundwater level and quality. Test monitoring will: (1) directly observe the effects of recharge on water levels and quality (2) use these observations (in conjunction with characterization data) to evaluate whether or not recharge is having an impact on groundwater level and quality that could lead to surface problems, and (3) potentially identify when and where this type of problem may occur.

Section 4: Monitoring Plan

This section outlines the monitoring plan for the proposed project. Monitoring for the proposed testing is designed to meet five basic goals. These are to evaluate: (1) pre-test surface and shallow aquifer groundwater conditions, (2) changes in shallow groundwater caused by factors other than those related to testing, (3) changes in shallow groundwater caused by the testing (track the test performance), (4) potential problems caused by the testing that may require modification of the test and/or mitigation actions, and (5) events that effect test operations, such as a freezing or a flooding. To meet these objectives, monitoring will track:

- Source-water quality and volume coming onto the Site
- Up-gradient groundwater water quality and levels
- Down-gradient groundwater quality and levels, both near and distal to the Site
- Up-gradient and down-gradient surface water discharge and quality

The following sections present proposed monitoring locations, constituents to be sampled, sampling procedures (including QA/QC), and reporting.

4.1 Sampling Parameters

The selection of specific water quality constituent's recommended for sampling in this section is based in part on current monitoring for the nearby Hudson Bay District Improvement Company (HBDIC)/Walla Walla Basin Watershed Council (WWBWC) recharge project on White Ditch (being done under a limited license issued by OWRD) and a basic review of land uses in the East Little Walla Walla and Site area. As noted earlier in this monitoring and test plan land use in the Site area consists predominantly of a mix of rural residential, irrigated orchard agriculture, irrigated alfalfa (and related fodder crops), and pasture/grazing. Small areas of irrigated row crops also are grown.

Based on this land use there is a relatively small probability of volatile organic compounds being present in recharge test source water because of a general lack of sources for these compounds in the Site area. On the other hand, and as explained in the HBDIC/WWBWC monitoring plan (and supporting documents), there has been, and likely continues to be, use of some pesticides and herbicides in the project area. These compounds, if present in source water, could potentially impact groundwater at the Site. Therefore, proposed monitoring focuses on screening source water and groundwater for a range of synthetic organic compounds (SOC's) and related compounds (herbicides and carbamates) that are common in the agricultural setting typical in the Test area. Specific SOC's selected for sampling and analysis are those typically screened for drinking water compliance. These constituents are listed on Table 1.

In addition to SOC sampling, water quality monitoring also will include sampling and analysis for several basic water quality parameters. Constituents comprising the basic water quality parameters proposed for sampling in this Plan are as follows:

- Static water level
- Standard field parameters, pH, electrical conductivity, temperature, and turbidity
- nitrate as nitrogen
- nitrite as nitrogen
- Total dissolved solids (TDS)
- Hardness
- Chloride
- Orthophosphate
- Chemical oxygen demand (COD)
- Fecal coliform

The basic parameters proposed for sampling and analysis are selected to optimize routine sampling to address constituents commonly of concern (nutrients and salts) and provide an indication of potential impacts by analyzing for selected constituents (nitrate and chloride) that are typically good indicators of general water quality. Additional parameters may be proposed for future sampling if the results of the initial proposed sampling indicate this is necessary.

4.2 Monitoring Locations and Frequency

Four basic types of monitoring points will be used, including: (1) source-water monitoring, (2) groundwater monitoring at the Site, (3) groundwater monitoring more distant from the Site (e.g., distal), and (4) surface-water monitoring. Monitoring frequency and constituents for each are described in the following sections.

4.2.1 Source-water Monitoring

Source-water monitoring will be at the point where recharge test water enters the Site. Monitoring will include both water quantity and quality. The volume of water delivered to the Site will be monitored via a gauge at the entrance point. Water quality samples will be collected at the gauge.

Proposed monitoring is as follows:

- Flow volume onto the Site will be gauged and recorded using a data logger. Rating measurements and tables will be generated for flow at the diversion point.
- Water quality sampling proposed for the basic water quality constituents (define in Section 4.1) is as follows. However, the exact timing of these sampling events will be based on predicted Ditch use. OWRD staff will be notified by the project team of pending sampling events at least one week prior to each sampling event, or as is

practicable given actual Ditch use. A total of three sampling events are proposed, as follows:

- Approximately one month prior to the projected beginning of the recharge period, assuming the canal is in operation. If the canal isn't operating than a sample will be collected as soon as is reasonably practicable prior to the start of testing.
- Within 5 days following the start of testing.
- In the final week of testing.

- Two water quality sampling events for SOC's are proposed, as follows:
  - One SOC water quality sampling event will be done concurrent with the basic constituent water quality sampling event one month before SAR testing.
  - The second SOC water quality sampling event will be done during the recharge period. The event is anticipated to occur sometime in late winter or early spring (probably late February to late March) if testing is ongoing at that time. This event will generally coincide with the first 2 to 4 weeks of widespread spring farming activity in the general up gradient area of the Site.

The results of source-water quality monitoring will be used by project and OWRD staff (in consultation with ODEQ staff) to determine if modifications to test operations are warranted. For example, if the basic constituent samplings show unacceptable results (such as nitrate-N, chloride, and TDS exceeding ODEQ guidance levels) proposed testing will be modified and/or additional sampling undertaken to determine if testing can proceed. If SOC sample results indicate specific herbicide's and pesticide's are present in greater than trace concentrations in source water testing will be reevaluated in consultation with OWRD and ODEQ staff.

4.2.2 Groundwater Monitoring

SAR test groundwater monitoring will be done in both on-site and off-site wells. Any wells purpose built for the project will be built to OWRD monitoring wells standards and generally open to the upper 30 to 50 feet of the suprabasalt aquifer. If built, one of these wells potentially will be up gradient (south) of the Site and one or two will be down gradient (north) of the Site (Figure 7). Specific well locations are subject to modification based on final land owner approval and accessibility. Final well locations will be will be identified and reviewed with OWRD and ODEQ staff during characterization and pre-test monitoring. In addition, limited sampling may be attempted from off-site wells. These wells will likely be previously constructed water supply wells used by Mr. Page and that project staff can gain access to.

The purpose built monitoring wells will be used to monitor water quantity and quality impacts from SAR testing in the immediate vicinity of the Site. Off-site down-gradient monitoring will also be used to evaluate distal affects of SAR testing on the suprabasalt aquifer, including migration of the recharge groundwater mound and plume away from the Site. In addition, on-site and off-site monitoring will be used to differentiate test impacts from those caused by other, off-site effects on groundwater.

Proposed monitoring is as follows:

- Water levels will be measured weekly (at a minimum) in all wells prior to the start of recharge testing. This frequency will be used in distal wells throughout and following testing.
- In the month prior to, during, and the month following the test, water level data will be collected (at a minimum) daily in Site wells.
- Five water quality monitoring events for the basic constituents defined in Section 4.1 are proposed for Site wells as follows:
    - Two groundwater quality sampling events are proposed prior to the test for basic water quality parameters. They are proposed for each of the two months preceding the proposed test. All Site wells will be sampled.
    - During testing two sampling events are proposed, one within 5 days following the start of testing, a second 2 weeks following that event.
    - A final groundwater quality sampling event will be done approximately 4 weeks following the end of the test in all previously sampled wells.
    - In addition, concurrent with the aforementioned sampling events, field parameters will be collected from offsite distal wells.
- Two water quality sampling events for SOC's are proposed, as follows:
    - One SOC water quality sampling event will be done concurrent with the basic constituent water quality sampling event one month before SAR testing.
    - The second SOC water quality sampling event will be done during the recharge period. The event is anticipated to occur sometime in late winter or early spring (probably late February to late March) if testing is ongoing at that time. This event will generally coincide with the first 2 to 4 weeks of widespread spring farming activity in the general up gradient area of the Site.

The results of groundwater quality and level monitoring, in conjunction with surface (source) water sampling will be used by project, OWRD, and ODEQ staff to determine if modifications to test operations are warranted. For example, if the basic constituent and SOC samplings show groundwater quality degradation proposed testing will be modified and/or additional sampling undertaken to determine if testing can proceed.

4.2.3 Surface Water and Springs

Surface water monitoring in McEvoy spring creek will be done to evaluate the potential effects of testing on flow. This monitoring will include the collection of both water quality data and flow data. The monitoring point for McEvoy Creek has not yet been selected, but will likely be as far upstream as the project team can get access to. Alternatively, given previous sampling at the McEvoy flume (Figure 2) this may become the primary surface water sampling location. For water quality monitoring of surface water field parameters listed in Section 4.1 are proposed.

4.3 Sampling Procedures

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

This section lists the equipment for groundwater monitoring.

- Submersible pump (Grundfos or similar) or dedicated bailers/sampling line
- Temperature measuring instrument
- pH and conductivity meter(s) with calibration reagents
- Water level meter (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

4.3.1 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 will be measured at an indicated reference point prior to purging any water from the well. The reference points will be on the top of the well casings. Static water levels in all wells should be measured on the same day. 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.

4.3.2 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.

4.3.3 Purging and Field Parameters

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.

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.

4.3.4 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. If a bailer is used it will 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.”

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.

4.3.5 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.

4.3.6 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:

- 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.
- Chain-of-custody forms will be completed, being signed by all sample handlers.
- Holding times for all constituents will be met.
- Field blind duplicate results will evaluated to make sure they are compatible.

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.

4.4 Data Reporting and Analysis

The following procedures for reporting analyses are proposed for this project.

4.4.1 Record Keeping

All field notes, laboratory results, critical calculations, and published reports will be maintained by the project team during the project. Following the project copies of this material will be maintained by Walla Walla County. If possible, both paper and electronic copies will be maintained.

4.4.2 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:

- Verification of analytical methods and detection limits, along with the date the analysis was performed
- Review of document handling, sampling and analytical problems, and actions taken to correct any problems

- Summarizing water level data in tabular and/or graphical form
- Summarizing water quality analytical results in tabular form and/or graphical form
- Performing data validation checks, as appropriate to the data set
- Identifying any significant increases in parameter concentrations

4.4.3 Reporting

All monitoring activities performed during the project will be included in the final project report completed in the summer of 2005. This report will present the following monitoring 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 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
- Comparison of water quality between up-gradient and down-gradient wells

For the Site, it is anticipated that insufficient data will be available for statistical analysis until late in the project. Until that time, evaluation of data set trends will be solely qualitative, with the data being reevaluated after each sampling event.

Section 5: Test Plan

This section describes basic SAR testing elements including: (1) Site layout, including onsite monitoring locations, (2) outline of planned recharge test operation, and (3) potential actions to be taken if undesirable monitoring results are observed.

5.1 Layout

The planned general Site layout is shown on Figure 4. This section briefly describes Site features, including water conveyance to the Site, location of structures onsite, proposed construction, and location of onsite monitoring.

Water Conveyance: Water will be delivered to the Site via the existing branch ditch off Wells Ditch. One or more ditches or trenches will be excavated off this branch ditch or the pump pond for the purpose of distributing water into the recharge point(s). For the testing proposed for the spring of 2005, few or no upgrades are proposed for Wells Ditch and the branch ditch. The only work currently planned for these ditches will be cleaning and removal of obstructions from the branch ditch onto the Site. Testing in later years may include upgrades to Wells Ditch and the branch ditch to increase water transmission capacity.

On-Site Structures: The geologic formation underlying the Site (predominantly Mio-Pliocene conglomerate, e.g., sandy gravel to silty sandy gravel) should provide an adequate level of protection of underlying groundwater by filtering most potential contaminants. Therefore, one or more trenches/ditches will be constructed to direct water onto the Site and promote infiltration. These trenches/ditches will branch off the ditch feeding water to the Site and/or the pump pond. The trenches/ditches will be unlined, providing additional infiltration capacity.

Onsite Monitoring: Flow monitoring will be located on the branch ditch as it enters the Site. Groundwater monitoring will likely be done via two, 2 inch-diameter monitoring wells, one up gradient of the Site and one down gradient of the Site. These wells will be purpose built for monitoring.

5.2 Planned Operation

Construction will be as directed by the project team. Initial test volumes will be less than 2 cfs. As testing progresses, successively larger volume steps will be attempted with the magnitude of each step based on observed changes in groundwater level and water quality in the suprabasalt aquifer. Potential impacts on the aquifer will be evaluated with each step. Maximum anticipated test volume in 2005 is 4 or 5 cfs.

To evaluate immediate impacts on the suprabasalt aquifer, field parameters and water level measurements will be used extensively. Water level measurements will typically be collected with an electronic water level measuring tape and/or well-dedicated transducers and data loggers. Field water quality parameters will be measured most commonly from samples recovered by bailers. If undesirable effects on the underlying aquifer are detected, such as increased turbidity or increased TDS, project staff may close the turnout to shut down testing. If this happens, irrigation district staff will be notified so water is not returned to the Site until the project team determines it is ready to resume the test.

5.3 Mitigation

As stated in the previous section, there is the possibility that undesired impacts on the suprabasalt aquifer could be caused by testing. Examples of these impacts include:

- Water table levels higher than planned, which for this test we define as within 5 feet of the bottom of test trenches/ditches.
- Increases in water quality parameters such as turbidity and TDS which suggests testing is degraded overall area groundwater quality.
- Increased nitrate-N concentrations which indicate testing is violating regulated water quality parameters.
- Changes in up-gradient wells suggesting the recharge mound/plume is impacting up-gradient areas and masking that monitoring.

In these instances the project team plans to take actions that reduce the observed impact. These actions will take two basic forms, (1) reducing test water flow or (2) terminating test. In either case, the project team will assess available monitoring data and determine if testing can resume with increased water volumes or reduces water volumes.

References

Barker, R.A., and Mac Nish, R.D., 1976, Digital model of the gravel aquifer, Walla Walla River Basin, Washington and Oregon: Washington Department of Ecology Water-Supply Bulletin 45, 49 p.

Kennedy/Jenks Consultants (2003), Letter report to Economic and Engineering Services, Inc., Portland, Oregon. 30 June 2003.

Newcomb, R.C., 1965, Geology and ground-water resources of the Walla Walla River Basin, Washington and Oregon: Washington Department of Conservation, Division of Water Resources Water-Supply Bulletin 21, 151 p, 3 plates.

Table 1. Proposed SOC sampling constituents.

DOH#	Compounds	Units	SRL	Trigger	MCL
	Carbamates in Drinking water				
146	Carbofuran	ug/L	1.8	1.8	40.0
148	Oxymal	ug/L	4.0	4.0	200.0
141	3-Hydroxycarbofuran	ug/L	2.0	2.0	
142	Aldicarb	ug/L	1.0	1.0	
143	Aldicarb Sulfone	ug/L	1.6	1.6	
144	Aldicarb Sulfoxide	ug/L	1.0	1.0	
145	Carbaryl	ug/L	2.0	2.0	
147	Methomyl	ug/L	1.0	4.0	
326	Propoxur(Baygon)	ug/L	1.0		
327	Methiocarb	ug/L	4.0		
	Synthetic Organic Compounds				
33	Endrin	ug/L	0.02	0.02	2.0
34	Lindane (BHC-Gamma)	ug/L	0.04	0.04	0.2
35	Methoxychlor	ug/L	0.20	0.20	40.0
117	Alachlor	ug/L	0.40	0.40	2.0
119	Atrazine	ug/L	0.20	0.20	3.0
120	Benzo(a)pyrene	ug/L	0.04	0.04	0.2
122	Chlordane Technical	ug/L	0.40	0.40	2.0
124	Di(ethylhexyl)-Adipate	ug/L	1.30	1.30	400.0
125	Di(ethylhexyl)-phthalate	ug/L	1.30	1.30	6.0
126	Heptachlor	ug/L	0.08	0.08	0.4
127	Heptachlor epoxide (A & B)	ug/L	0.04	0.04	0.2
128	Hexachlorobenzene	ug/L	0.20	0.20	1.0
129	Hexachlorocyclo-Pentadiene	ug/L	0.20	0.20	50.0
133	Simazine	ug/L	0.15	0.15	4.0
118	Aldrin	ug/L	0.20	0.20	
121	Butachlor	ug/L	0.40	0.40	
123	Dieldrin	ug/L	0.20	0.20	
130	Metolachlor	ug/L	1.00	1.00	
131	Metribuzin	ug/L	0.20	0.20	
132	Propachlor	ug/L	0.20	0.20	
179	Bromacil	ug/L	0.20	0.20	
183	Prometon	ug/L	0.20	0.20	
190	Terbacil	ug/L	0.20	0.20	
202	Diazinon	ug/L	0.20	0.20	
208	EPTC	ug/L	0.30	0.30	
232	4,4-DDD	ug/L	0.20	0.20	
233	4,4-DDE	ug/L	0.20	0.20	
234	4,4_DDT	ug/L	0.20	0.20	
236	Cyanazine	ug/L	0.20	0.20	
239	Malathion	ug/L	0.20	0.20	
240	Parathion	ug/L	0.20	0.20	
243	Trifluralin	ug/L	0.20	0.20	
96	Napthalene	ug/L	0.10	0.10	
154	Fluorene	ug/L	0.20	0.20	
244	Acenaphthylene	ug/L	0.20	0.20	
245	Acenaphthene	ug/L	0.20	0.20	
246	Anthracene	ug/L	0.20	0.20	
247	Benz(a)anthracene	ug/L	0.10	0.10	

Table 1. Proposed SOC sampling constituents.

248	Benzo(b)fluoranthene	ug/L	0.20	0.20	
249	Benzo(g,h,i)perylene	ug/L	0.20	0.20	
250	Benzo(k)fluoranthene	ug/L	0.20	0.20	
251	Chrysene	ug/L	0.20	0.20	
252	Dibenzo(A,H)anthracene	ug/L	0.20	0.20	
253	Fluoranthene	ug/L	0.20	0.20	
255	Indeno(1,2,3-CD)Pyrene	ug/L	0.20	0.20	
256	Phenanthrene	ug/L	0.20	0.20	
257	Pyrene	ug/L	0.20	0.20	
258	Benzyl Butyl Phthalate	ug/L	0.60	0.60	
259	Di-N-Butyl Phthalate	ug/L	0.60	0.60	
260	Diethyl Phthalate	ug/L	0.60	0.60	
261	Dimethyl Phthalate	ug/L	0.60	0.60	
36	Toxaphene	ug/L	2.0	2.0	3.0
173	Aroclor 1221	ug/L	20.0	20.0	
174	Aroclor 1232	ug/L	0.5	0.5	
175	Aroclor 1242	ug/L	0.5	0.3	
176	Aroclor 1248	ug/L	0.1	0.1	
177	Aroclor 1254	ug/L	0.1	0.1	
178	Aroclor 1260	ug/L	0.2	0.2	
180	Aroclor 1016	ug/L	0.1	0.1	
	Herbicides in Drinking Water				
37	2,4-D	ug/L	0.2	0.2	70.0
38	2,4,5-TP (Silvex)	ug/L	0.4	0.4	50.0
134	Pentachlorophenol	ug/L	0.1	0.1	1.0
137	Dalapon	ug/L	2.0	2.0	200.0
139	Dinoseb	ug/L	0.4	0.4	7.0
140	Picloram	ug/L	0.2	0.2	500.0
138	Dicamba	ug/L	0.2	0.2	
135	2,4 DB	ug/L	1.0	1.0	
136	2,4,5 T	ug/L	0.4	0.4	
220	Bentazon	ug/L	0.5	0.5	
221	Dichloroprop	ug/L	0.5	0.5	
223	Actiflorfin	ug/L	2.0	2.0	
225	Dacthal (DCPA)	ug/L	0.1	0.1	
226	3,5-Dichlorobenzoic Acid	ug/L	0.5	0.5	

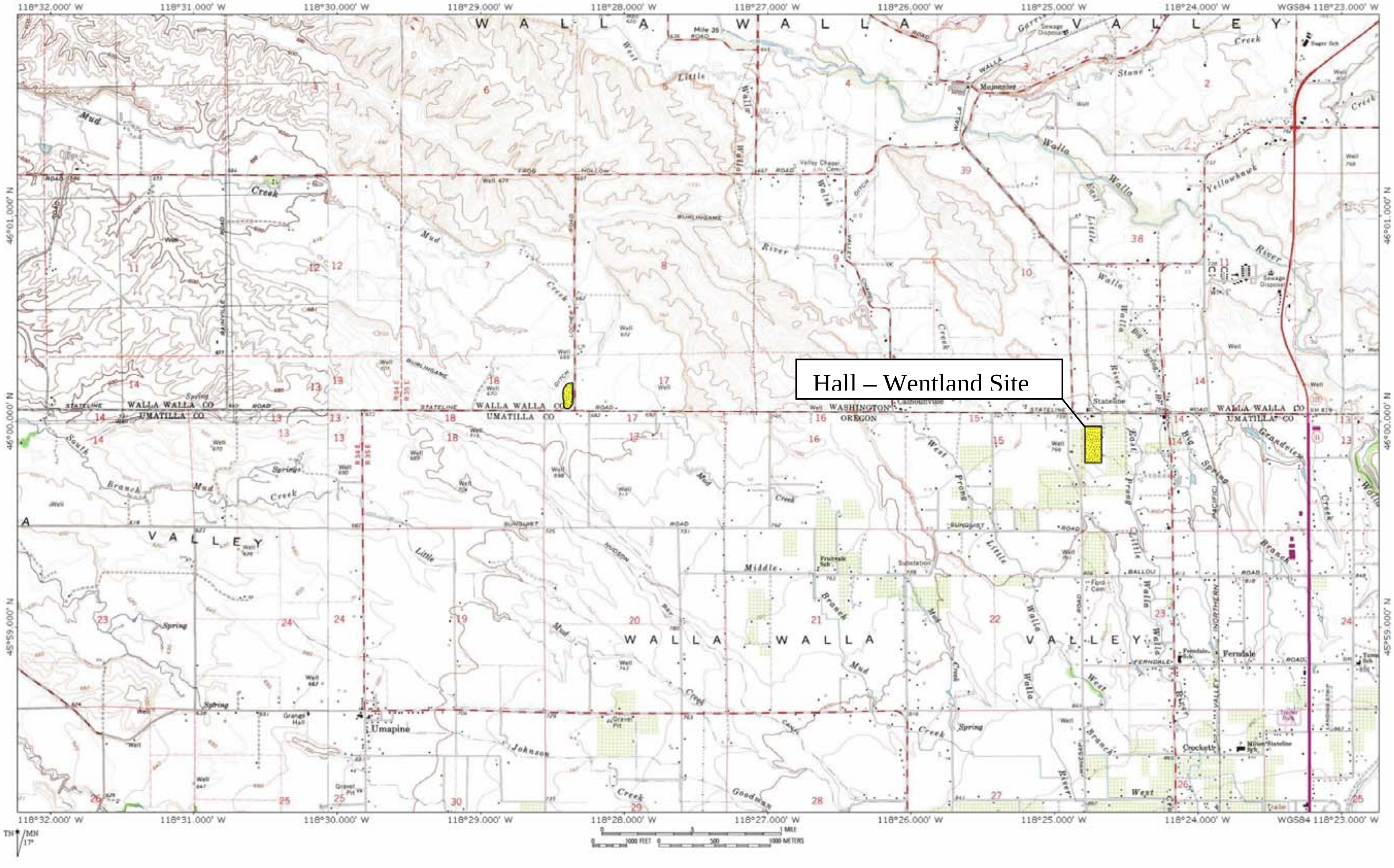

Figure 1. General location map.

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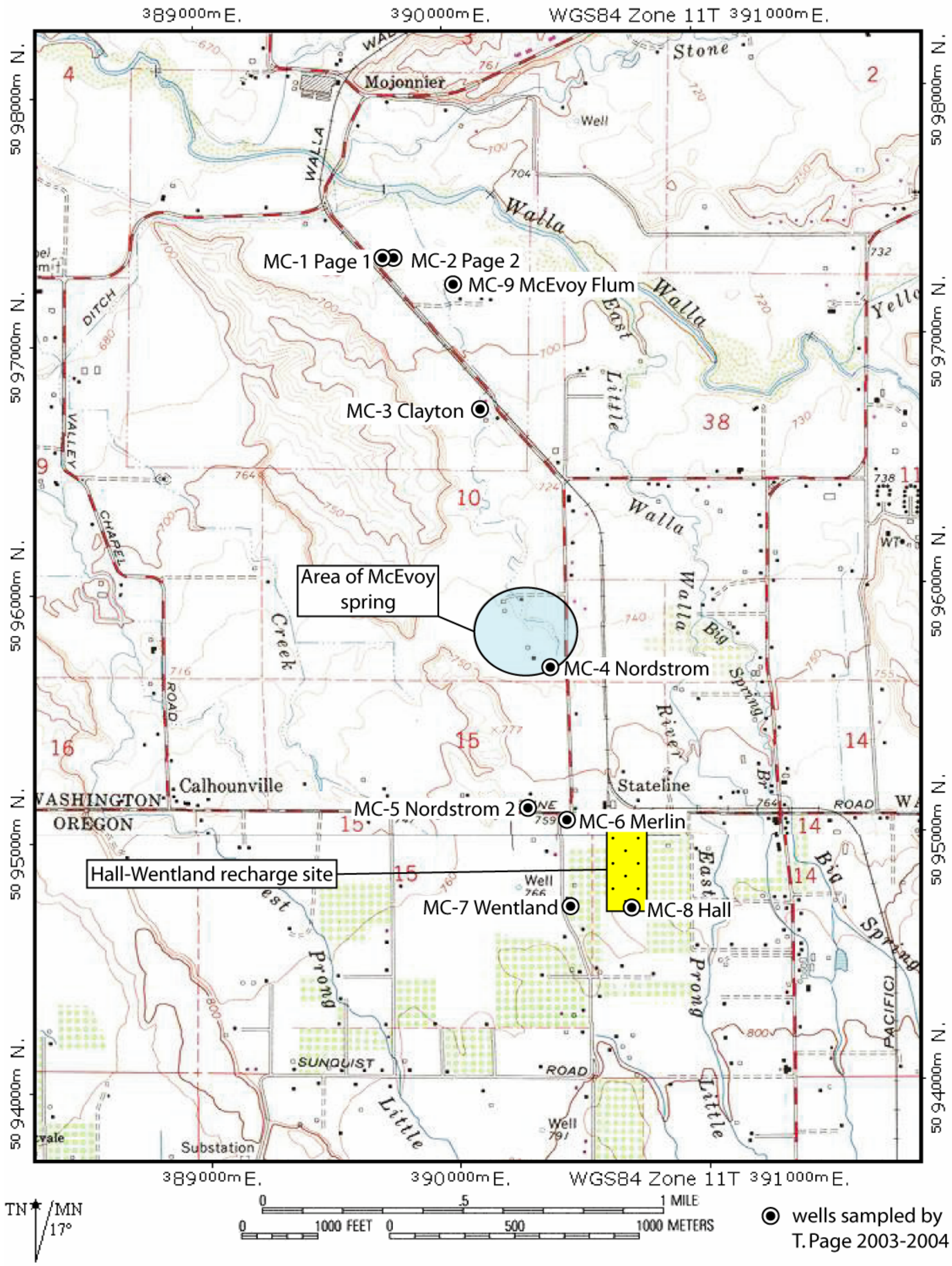


Figure 2. Map showing location of Site, McEvoy spring, and wells used by Mr. Page.

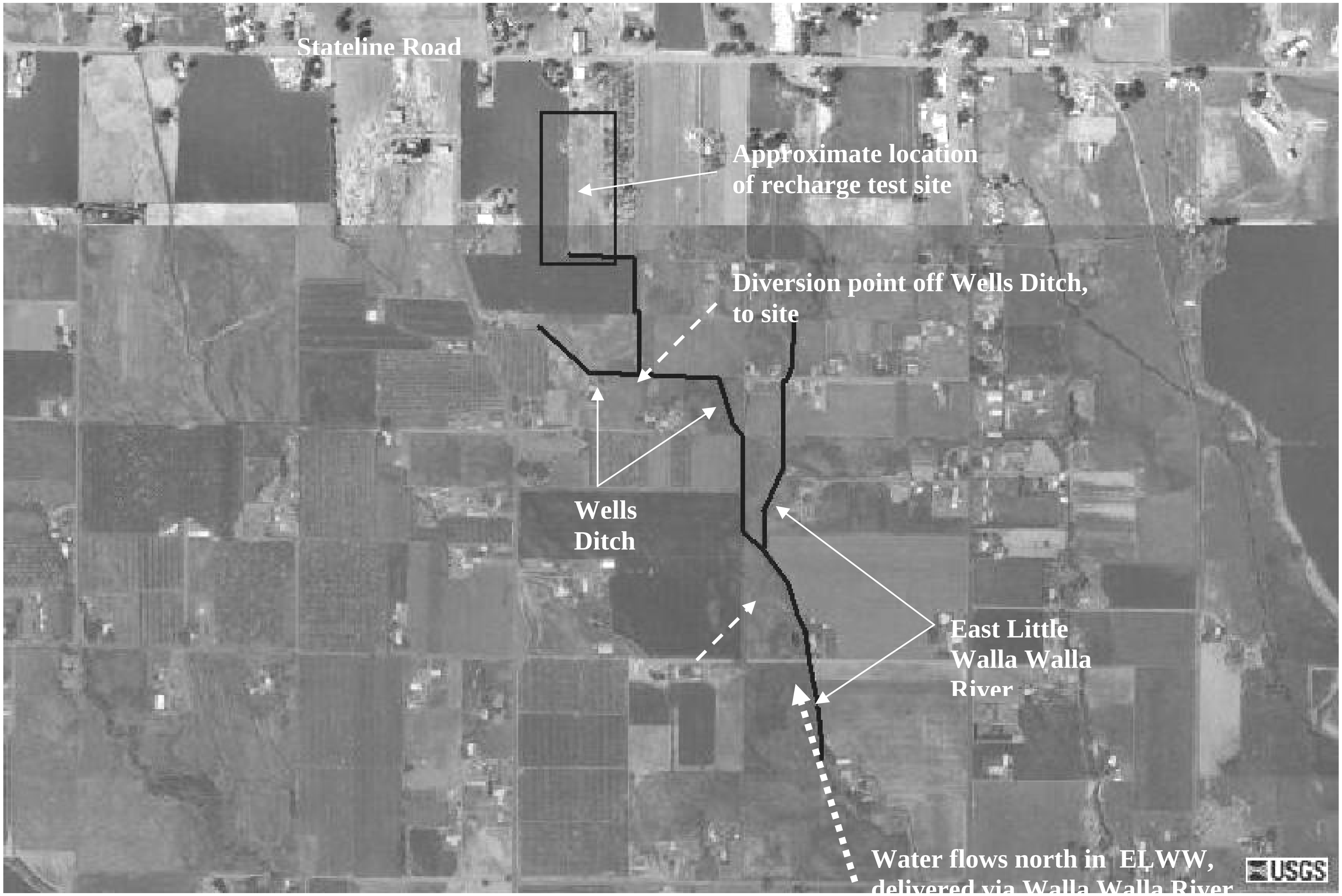

Stateline Road
Approximate location of recharge test site
Diversion point off Wells Ditch, to site
Wells Ditch
East Little Walla Walla River
Water flows north in ELWW, delivered via Walla Walla River
USGS

Figure 3. Map of ditches used to convey water to the Site.

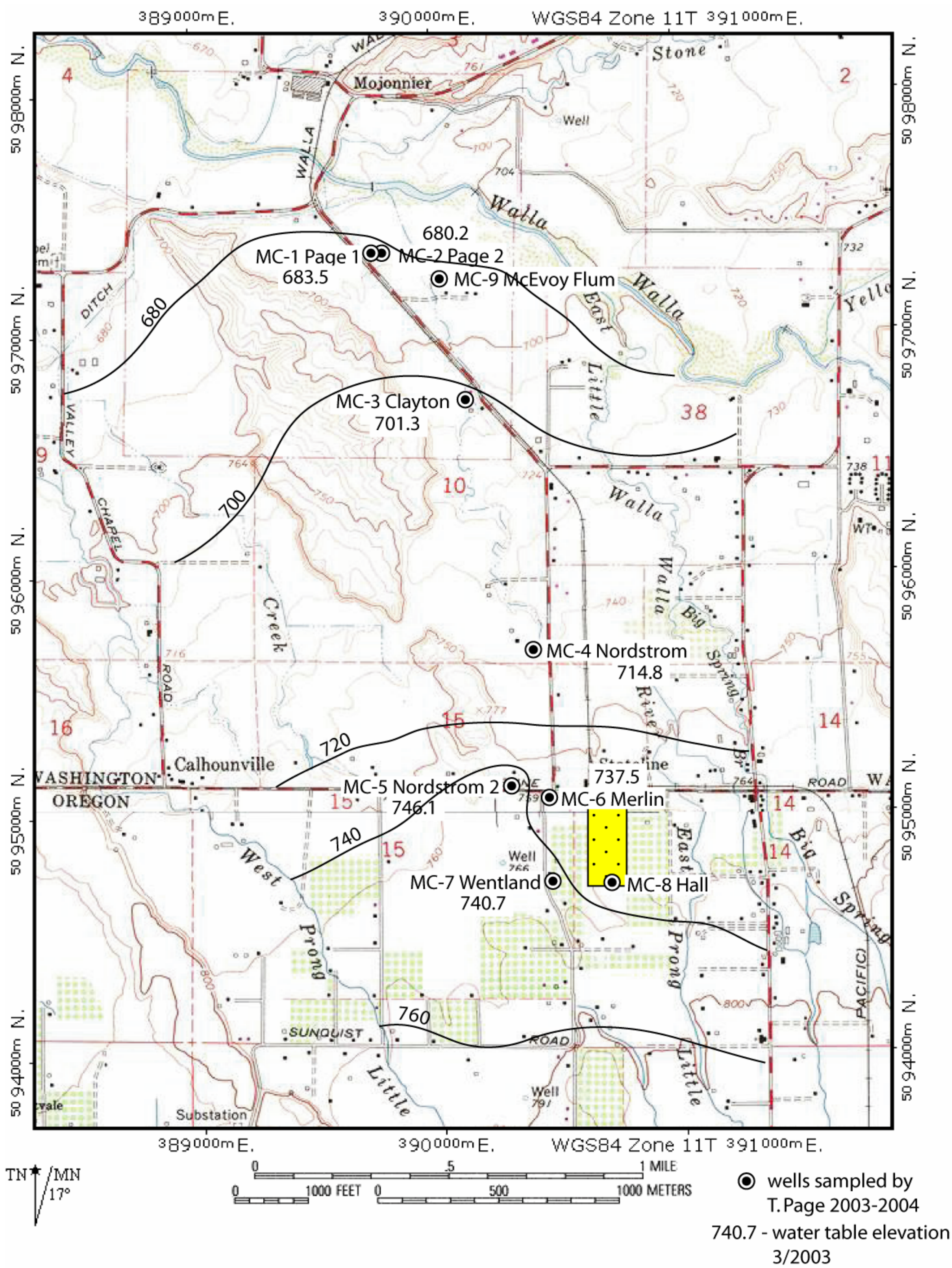


Figure 4. Approximate suprabasalt aquifer water table in March 2003.

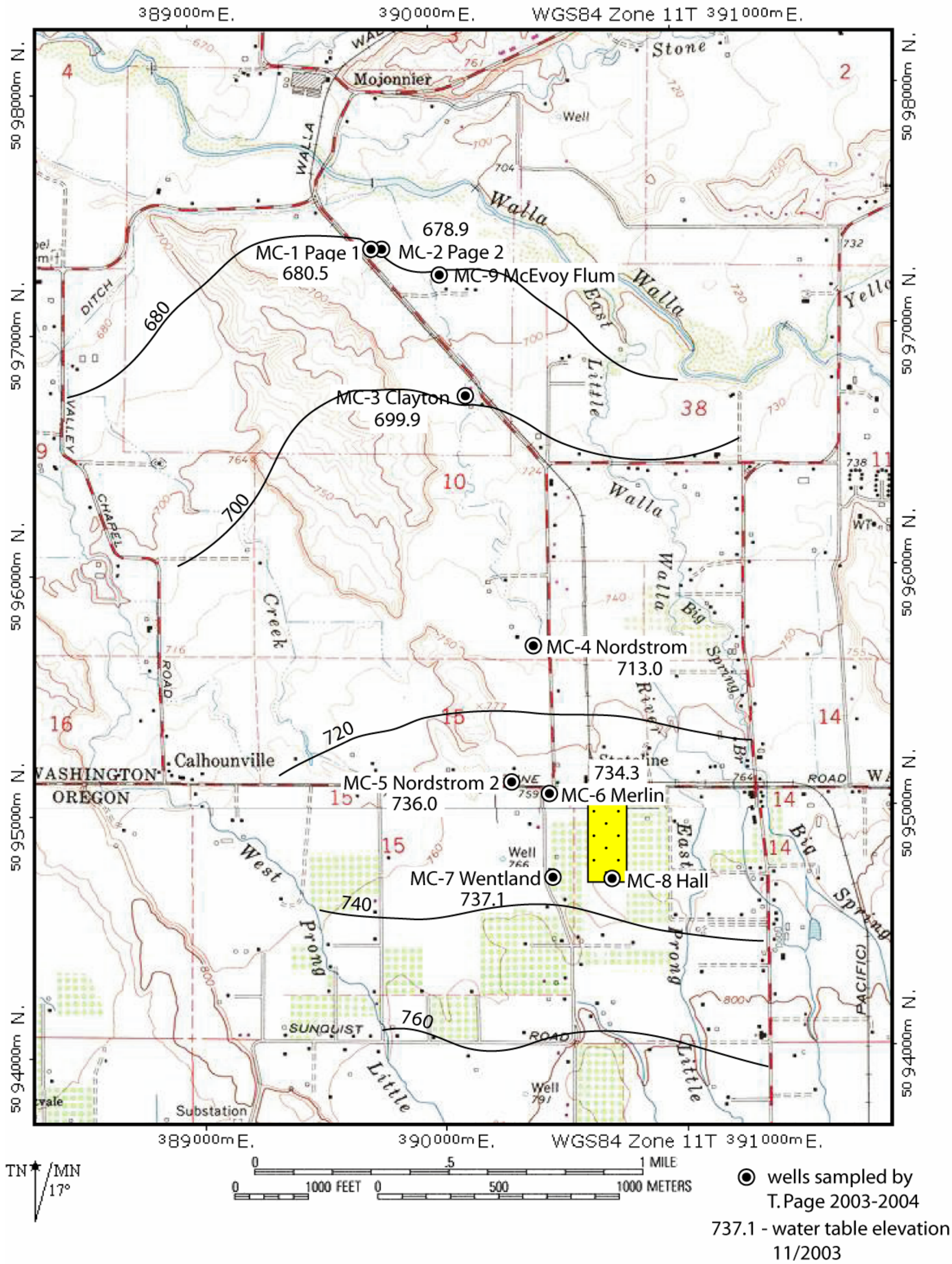
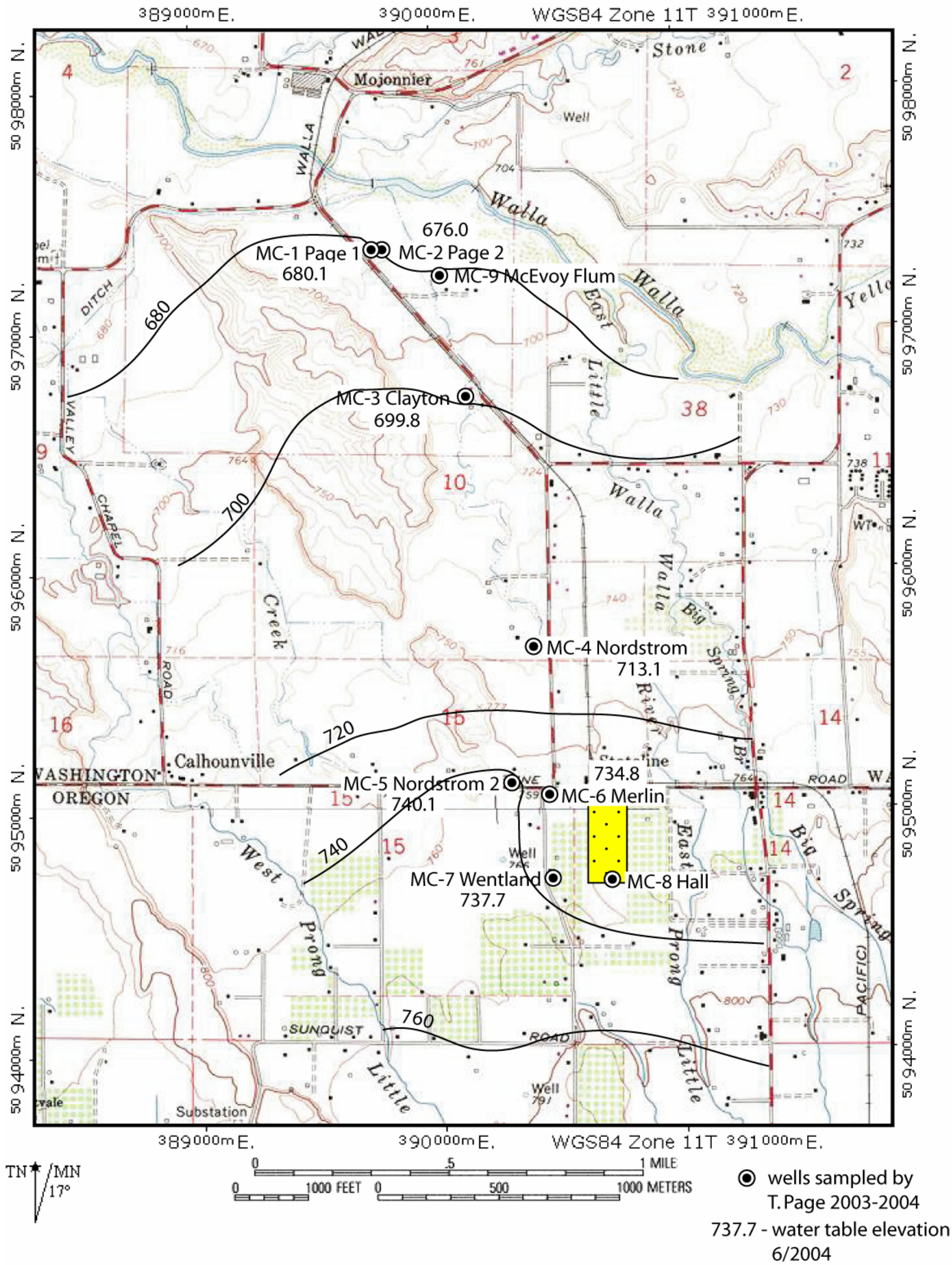


Figure 5. Approximate suprabasalt aquifer water table in November 2003.


389000m E.
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Mojonnier
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Big
Spring
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River
East
Prong
Little
West
Prong
Little
Creek
DITCH
VALLEY
CHAPEL
ROAD
WASHINGTON
OREGON
Calhounville
Stateline
SUNQUIST
ROAD
Big
Spring
PACIFIC
Substation
Well
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Well
676.0
MC-1 Page 1
680.1
MC-2 Page 2
MC-9 McEvoy Flum
680
MC-3 Clayton
699.8
700
MC-4 Nordstrom
713.1
720
734.8
MC-5 Nordstrom 2
740.1
MC-6 Merlin
740
MC-7 Wentland
737.7
MC-8 Hall
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wells sampled by
T. Page 2003-2004
737.7 - water table elevation
6/2004

Figure 6. Approximate suprabasalt aquifer water table in June 2004.

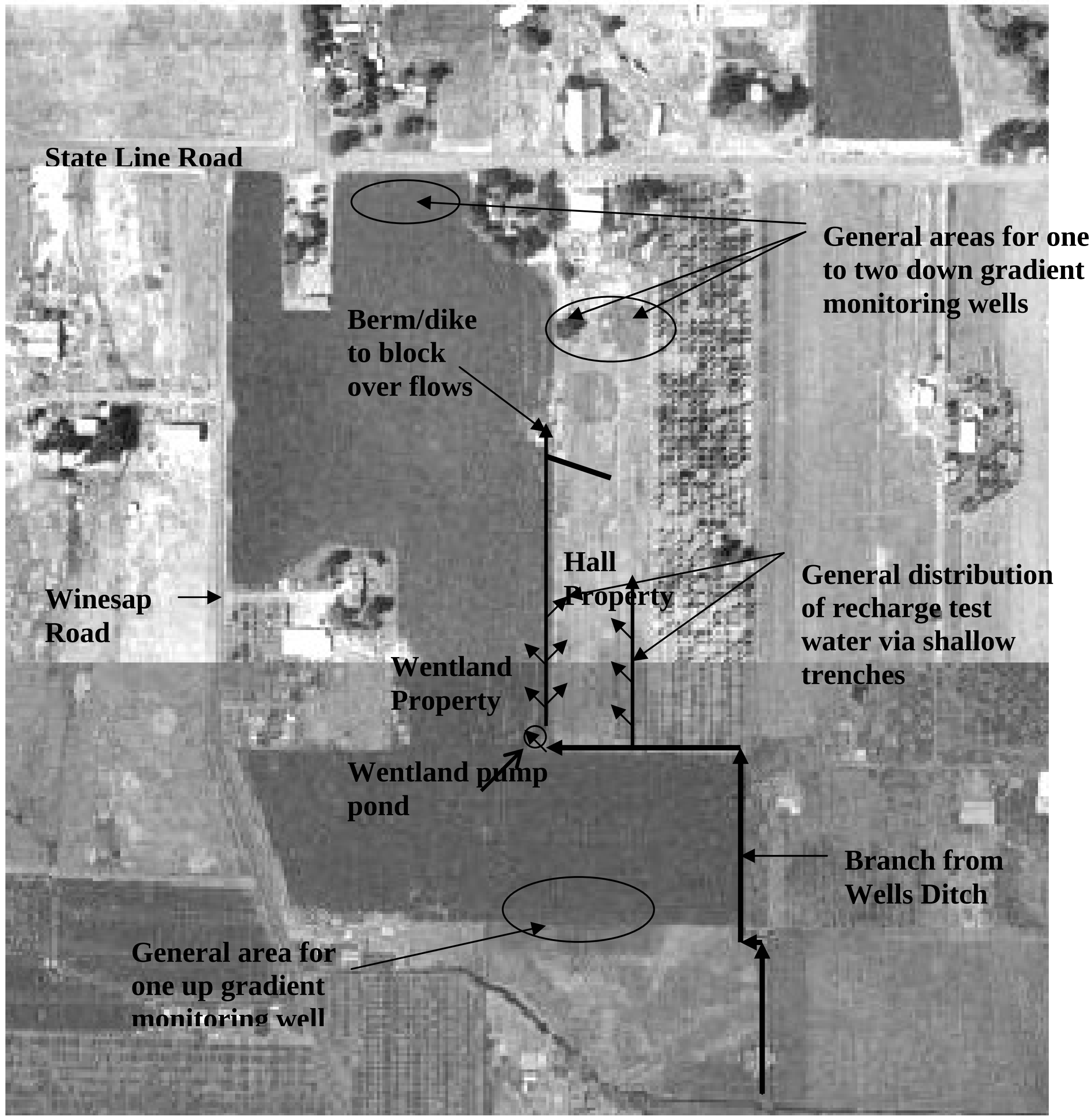

Figure 7. Proposed Site layout.