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Station # 12

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15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Impact Level	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-EN-TP-033		0	Hydrologic Test Plan for the Environmental Remediation Disposal Facility	3Q	1,2	1	

16. KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
1, 2, 3, or 4 (see MRP 5.43)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

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(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. L. C. Swanson	[signature]	9/29/93	H6-06	*B. J. Hobbs			H6-06	6	
1	1	Cog. Mgr. R. L. Jackson	[signature]	9/30	H6-06	*M. A. Tredway			R3-54	6	
1	1	QA W. R. Thackaberry	[signature]	9/29	H4-16	*L. M. Montgomery			H6-08	3	
		Safety				Central Files (2)			L8-04	3	
		Env.				EPIC (2)(1)			H6-08	3	
1	1	D. C. Weekes	[signature]	9/29/93	H6-06	ERC			H6-07	3	
1	1	J. V. Borghese	[signature]	9/29/93	H6-06	IRA (2)			H4-17	3	
6		*J. A. Coates		[redacted]							

18.	19.	20.	21. DOE APPROVAL (if required)
L. C. Swanson [signature] 9/29/93 Signature of EDT Originator Date	Authorized Representative for Receiving Organization Date	R. L. Jackson [signature] 9/30/93 Cognizant/Project Engineer's Manager Date	Ltr. No. [] Approved [] Approved w/comments [] Disapproved w/comments

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OCT 1993 RECEIVED EDMC

BD-7400-172-1 (07/91)

9513339.0027

Date Received: 9/30/93 VB	**INFORMATION RELEASE REQUEST**	Reference: WHC-CM-3-4

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ID Number (include revision, volume, etc.): WHC-SD-EN-TP-033, Rev. 0

List attachments: N/A

Date Release Required:

Title	Unclassified Category	Impact Level
Hydrologic Test Plan for the Environmental Remediation Disposal Facility	UC-630	3Q

New or novel (patentable) subject matter? [X] No [] Yes
If "Yes", has disclosure been submitted by WHC or other company?
[] No [] Yes Disclosure No(s).

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CHECKLIST FOR SIGNATORIES

Review Required per WHC-CM-3-4	Yes	No	Reviewer - Signature Indicates Approval: Name (printed)	Signature	Date
Classification/Unclassified Controlled Nuclear Information	[]	[X]			
Patent - General Counsel	[X]	[]	Not required per OGC Memo 2/4/93	LC Swanson lab	9/29/93
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Other Program/Project	[]	[X]			

Information conforms to all applicable requirements. The above information is certified to be correct.

	Yes	No
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Transmit to DOE-HQ/Office of Scientific and Technical Information	[X]	[]

Author/Requestor (Printed/Signature): L. C. Swanson *LC Swanson* Date: 9/29/93

Intended Audience: [] Internal [] Sponsor [X] External

Responsible Manager (Printed/Signature): R. L. Jackson *[signature] for* Date: 9/20/93

INFORMATION RELEASE ADMINISTRATION APPROVAL STAMP

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SUPPORTING DOCUMENT

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3. Number

WHC-SD-EN-TP-033

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aquifer, test plan, ERDF, aquifer testing, hydraulic conductivity

APPROVED FOR PUBLIC RELEASE
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6. Author

Name: L.C. Swanson

Signature

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7. Abstract

Hydrologic tests are planned at seven wells that will be drilled at the proposed Environmental Remediation Disposal Facility (ERDF). These wells are supporting hydrologic, geologic, and hydrochemical characterization at this new facility.

WHC, 1993, *Hydrologic Test Plan for the Environmental Remediation Disposal Facility*, WHC-SD-EN-TP-033, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

9. Impact Level 3Q

10. RELEASE STAMP

OFFICIAL RELEASE (11)
BY WHC
DATE SEP 30 1993
Station #12

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FIGURES:

TABLES:

1.0 INTRODUCTION

Hydrologic tests are planned at seven wells that will be drilled at the proposed Environmental Remediation Disposal Facility (ERDF). These wells are supporting hydrologic, geologic, and hydrochemical characterization at this new facility. Figure 1 shows the approximate location of the wells in relation to the proposed ERDF.

Hydrologic testing will consist of instantaneous slug tests, slug interference tests, step-drawdown tests, and constant rate discharge tests (generally single-well). These test results and later groundwater monitoring data will be used to determine groundwater flow directions, flow rates, and the chemical makeup of the groundwater below the proposed ERDF.

The seven wells will be drilled in two phases. In Phase I four wells will be drilled and tested: two to the top of the uppermost aquifer (water table) and two as characterization boreholes to the top of basalt. The Phase I wells are located in the northern portion of the proposed ERDF site (699-32-72, 699-SDF-6, -7 and -8) (Figure 1). If Phase II drilling proceeds, the remaining three wells will be installed and tested (two deep and one shallow). A phased approach to drilling is warranted because of current uncertainty in the land use requirements at the proposed ERDF.

1.1 SCOPE

This test plan provides technical guidance for performing hydrologic tests at seven wells at the proposed ERDF facility, in accordance with the *Site Characterization Plan for the Environmental Restoration Disposal Facility* (Weekes and Borghese 1993) (Section 11.6.3, "Aquifer Testing"). Specific items included in this test plan are test design requirements, equipment requirements, field operational requirements, implementation requirements, and data collection guidelines for the aquifer testing. This test plan was prepared in accordance with Environmental Investigations Instruction (EII) 10.1, "Aquifer Testing" (WHC 1988a).

Field testing will occur during well drilling and/or after the monitoring well is completed. After field testing a report will be issued summarizing the test results. Field testing will consist of the following types of tests:

- Instantaneous slug injection and withdrawal tests (Papadopulos and Cooper 1967, Bouwer and Rice 1976)
- Constant rate discharge drawdown and recovery tests (Neuman 1975, Cooper and Jacob 1946)
- Slug interference tests (Spane 1992).

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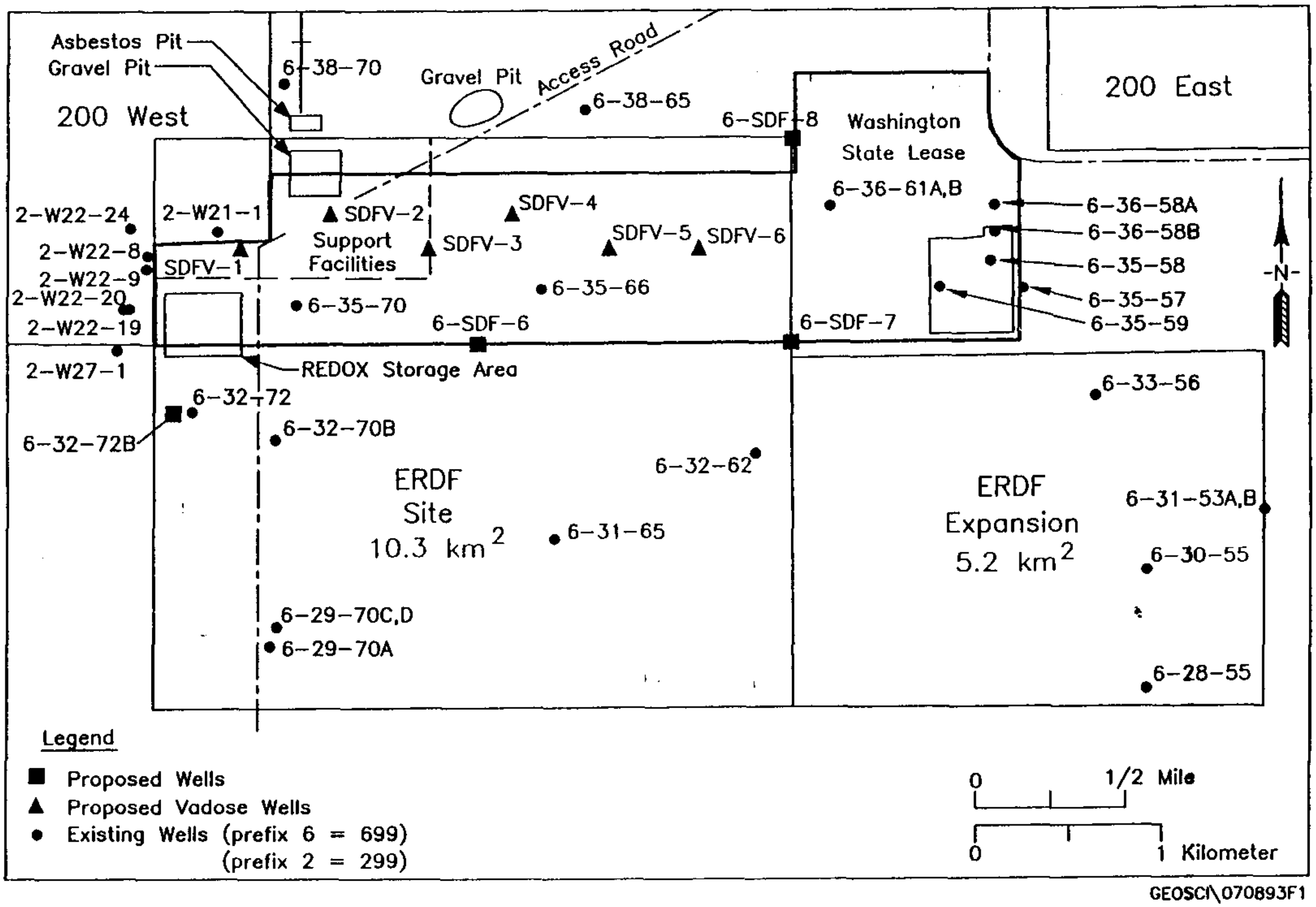

Figure 1. Location Map for the Proposed Aquifer Test Wells.

1.2 PURPOSE AND OBJECTIVES

The primary purpose of these aquifer tests is to characterize the hydrology beneath the proposed ERDF. Aquifer testing is expected to provide estimates of transmissivity or hydraulic conductivity for the single-well tests, and additionally specific yield, possibly the elastic storage coefficient, and the vertical hydraulic conductivity for the multiple well test (at well 699-32-72B). At this later well the aquifer will be tested at several depth intervals.

The general objective of this test plan is to provide administrative and technical guidance for the field testing. Specific information contained in this test plan includes:

(1) The expected hydrogeology at the test wells
(2) A discussion about the types of tests that will be performed
(3) The test well configuration and test equipment requirements
(4) The general sequence of field testing activities
(5) Specific test design and data collection requirements
(6) The handling of purgewater produced during testing
(7) Applicable procedures and quality assurance guidelines.

2.0 SITE HYDROGEOLOGY

A brief description of the expected hydrogeology for the test sites is presented below. For greater detail refer to the characterization work plan (Weekes and Borghese 1993).

The top of the unconfined aquifer at the proposed test sites usually is situated within the Ringold Formation unit "E". This unit is a clast-supported granule to cobble gravel in a sandy matrix, often with intercalated sands and muds. In the western portion of the proposed ERDF, Upper Ringold and Plio-Pleistocene sediments are present near the top of the unconfined aquifer. The bottom of the unconfined aquifer is defined by either the lower mud sequence of the Ringold Formation (if present) or the top of basalt. The expected general sequence of stratigraphic units from ground surface to total depth for well 699-32-72B is shown in Figure 2.

Movement of groundwater in the unconfined aquifer occurs primarily in the Ringold Formation. Groundwater flow direction is generally to the east or southeast in the area of the ERDF. Hydraulic parameters are not available for any of the proposed test sites. However, values are reported for the Ringold unit E for 200 West Area wells and range from 100 ft^2/d to 50,000 ft^2/d (WHC 1992).

The wells will be completed and screened in the fluvial gravels and intercalated fluvial sands of the Ringold Formation unit E or the Upper Ringold. Estimated total depths and groundwater elevations for each of the wells are listed in Table 1.

Figure 2. Aquifer Testing Intervals at Well 699-32-72B.

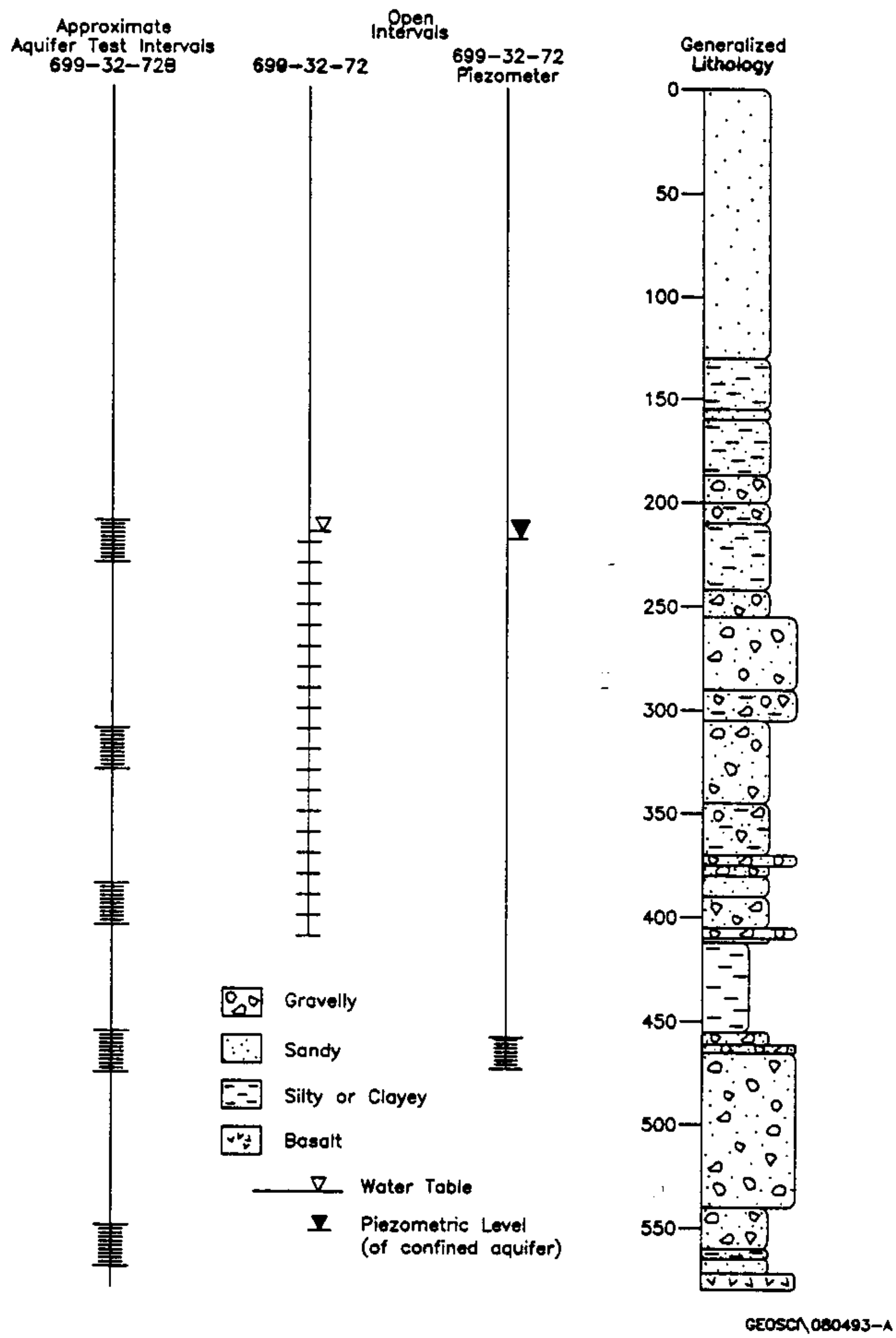

Table 1. Predicted Total Depth of Each Borehole and the Drilling Phase that the Borehole will be Installed.

Well number	Total depth[a], ft (m)	Drilling phase
699-32-72B	580 (177)	I
699-SDF-2	600 (183)	II
699-SDF-3	580 (177)	II
699-SDF-4	255 (78)	II
699-SDF-6	570 (174)	I
699-SDF-7	323 (98)	I
699-SDF-8	358 (109)	I

[a]Estimated depth below ground surface.

3.0 WELL CONSTRUCTION AND CONFIGURATION

In Phases I and II of the drilling program, wells 699-SDF-4, -7, and -8 will be drilled to the top of the Ringold Unit E and completed as groundwater monitoring wells at the top of the uppermost aquifer (unconfined). The other four wells (699-32-72B, 699-SDF-2, -3, and -6) are deeper characterization wells that will be drilled to the top of basalt, then backfilled and completed at the top of the uppermost aquifer. These wells will then be used to collect groundwater chemistry samples and water-level data.

All of the wells will be constructed to RCRA standards as outlined in WAC-173-160, and implemented by the Hanford Site Generic Well Specification (Reynolds 1992). The final well materials will consist of 4-in.-diameter stainless steel casing and a 20-ft stainless steel continuous wire-wrap 10 slot (0.010-in.) screen. NOTE: Screen slot size and filter pack will be based on grain size analyses of the formation.

Aquifer testing will occur after completing wells 699-SDF-7 and 699-SDF-8 as 4-in. monitoring wells. At wells 699-SDF-6 and 699-32-72B aquifer tests will follow a drill and test sequence. A 6- to 8-in. telescoping screen will be used in both of these well at each of the recommended test intervals (up to 3 at well 699-SDF-6 and up to 5 at well 699-32-72B). The screen will be removed before drilling continues to the next test interval. Screen slot sizes will be either 0.010 or 0.020 in. depending on the results of the geology log.

In general, a 20-ft screen will be used for wells completed at the top of the aquifer. A shorter 10-ft section of screen may be used in the deeper test intervals if the geologist determines that there is a high risk of the screen becoming lodged in the aquifer sediments during testing.

Well 699-32-72B is unique in that it could be tested in five different intervals as the borehole is advanced (a drill and test sequence). Figure 2 shows the recommended test intervals. This well was chosen for more detailed testing because a nearby well (699-32-72) could be used as an observation point. The presence of the observation well permits the use of the slug interference test, which is advantageous in areas with contaminated purgewater, because none is produced. In addition, if it is determined that the slug interference test is providing test results that are equivalent to the constant rate discharge test, the step-drawdown and constant rate discharge tests can be eliminated at this well.

Well 699-SDF-6 likewise can be tested at multiple depth intervals: at the top of the water-table, above the lower mud unit, and below the lower mud unit. There are no nearby observation wells to monitor during these tests, so slug interference tests will not be performed.

Well development will be necessary in each of the wells prior to testing to prevent excessive production of sand during the constant discharge tests. Development could be accomplished using either a surge block and then pumping the well, or just pumping the well. The Geosciences aquifer test lead will give final approval that the well is sufficiently developed for testing.

4.0 DESCRIPTION OF TEST ACTIVITIES

The hydrologic testing sequence for each test well or test interval consists of the following: an instantaneous slug injection and withdrawal test, a step-drawdown test, a constant rate discharge test, and a final slug test. However, if high volumes of contaminated purgewater will be produced, the step test and the constant rate test may be omitted. The decision to omit these tests will be made by the site hydrologist.

In addition to the tests listed above, a slug interference test may be conducted at well 699-32-72B in each of the five planned test intervals (Figure 2). This type of test does not produce contaminated purgewater. This type of test requires the use of an observation well. For this reason, it will not be used at the other test sites.

The step-drawdown test will be used primarily to determine an optimum discharge rate for the constant rate discharge tests. Although, if the testing is done in the final 4-in. screen, the development data may be used to determine the optimum pumping rate to minimize the production of purgewater. A final slug test may be conducted at each test site to determine if additional development occurred during the constant discharge test. A final slug test will not be needed if a constant discharge test is not conducted.

4.1 TEST DESCRIPTION

The primary objective for the aquifer tests is to determine aquifer hydraulic parameters. For single-well constant discharge tests, the transmissivity or hydraulic conductivity can be estimated. If an observation well is available, additional hydraulic parameters may be estimated from the constant discharge test data, including the vertical hydraulic conductivity, the specific yield, and possibly the elastic storage coefficient.

Slug tests stress the aquifer by instantaneously changing the level of the water within the well with the use of a slugging rod, or by some other volumetric means. Slug interference tests are similar to instantaneous slug tests, except an observation well is used in addition to the stress well to monitor the slug pulse that is transmitted through the aquifer.

During step-drawdown and constant discharge and recovery tests, water is removed from the aquifer at a constant rate. Aquifer parameters can be estimated using several methods using the time-drawdown data collected during the test. The step-drawdown test consists of discharging groundwater at a constant rate for a certain period of time, then increasing the pumping rate. This process is repeated several times. A step-drawdown test can be used to estimate the efficiency of the well and, especially for this testing program, an optimum pumping rate for the constant rate discharge test.

The slug tests provide an estimate of the aquifer hydraulic conductivity near the borehole, whereas the other testing methods give estimates of aquifer properties integrated over the volume of the drawdown cone (constant discharge test) or between wells (slug interference test). The slug test results will be compared to the hydraulic conductivities estimated from the constant rate discharge test. In an isotropic and homogeneous system with no interferences from the drilling operations, the two should be equal. These conditions almost never exist. The only question is how much difference is there between the test results.

Aquifer testing will be initiated only after several administrative tasks are completed. These tasks include:

- A groundwater chemistry evaluation to determine if purgewater produced from testing needs to be contained
- An assessment of the impact of purgewater on endangered, threatened, or sensitive plant and animal species if water is to be disposed to the ground.

4.2 TESTING LIMITATIONS

Some of the limitations on the test methods were previously discussed in Section 4.1, and others are listed below. Because of these limitations, the test results should be used with caution. Additional limitations are as follows.

- Slug tests are affected by local, small-scale aquifer heterogeneities and near borehole formational disturbances (e.g., from the drilling operation). They may not represent the aquifer as a whole and, therefore, should be viewed and used with caution.
- The test results will generally apply to the part of the aquifer being stressed and should not be considered representative of the entire saturated thickness.

- The estimated hydraulic properties for the single-well constant discharge tests will be approximations of the true hydraulic properties, because several key assumptions of the single-well test analysis are violated. One significant assumption is the requirement for a fully penetrating well screen. Analytical methods are available to handle this variation, but only for multiple-well tests. The analysis report will qualify the data results with respect to the analysis assumptions.
- If large volumes of contaminated purgewater will be produced, the constant rate discharge test for that well may be cancelled or the test length may be shortened. Currently, there is no practical means of handling large amounts of contaminated purgewater.

5.0 DESCRIPTION OF TEST REQUIREMENTS

The following sections describe pre- and post-test monitoring, equipment requirements, and test design and data collection requirements for the aquifer tests.

5.1 GENERAL EQUIPMENT REQUIREMENTS

A calibrated transducer should be used in the pumping and observation wells for the baseline monitoring, pre-test water-level monitoring, and during the aquifer tests. Calibrated equipment other than flow measurement devices shall be controlled as described in EII 3.2 of WHC-CM-7-7 (WHC 1988a). The transducer should be located in the well as stated in EII 10.1, "Aquifer Testing." Steel tapes and electric tapes used for measuring water levels must meet the calibration and standardization requirements in EII 10.2.

The transducers must record at a log-scale frequency at the start of the slug tests, step-drawdown tests, constant discharge tests, and the beginning of the recovery monitoring, with a maximum recording frequency not to exceed 1 h. Recording frequencies for baseline monitoring and pre-test monitoring should be set at a maximum interval of 1 h.

For the step-drawdown tests and constant discharge tests, the pump should be installed within 5 ft of the bottom of the screen or at a depth that is at least 3 to 5 ft below the level of maximum expected drawdown. This setting should provide an adequate buffer to prevent cavitation.

5.2 PRE- AND POST-TEST MONITORING

Barometric pressures must be recorded at 1-h intervals before testing is initiated, throughout the testing activities, and for 1 to 2 weeks after all testing completed. If onsite barometric recording is conducted, the recording rate must be set at the same recording frequency as the water-level transducer frequencies.

Prior to the step-drawdown and constant discharge tests, water levels should also be monitored from 1 to 5 days. In general, pre-test monitoring should exceed the expected length of the test by a factor of about 2 or 3. If time for testing is limited, this period may be reduced to 1 day. However, the longer monitoring period is preferred. The maximum measurement interval is 1 h.

Water levels must be monitored just prior to initiation of the test to establish any short-term trends or disturbances from recent operational activities. The time of monitoring could range from 30 min to 1 day, or until stable conditions are evident (water level is at static).

After pumping is terminated for the step-drawdown and constant rate discharge tests, water-level data collection will continue throughout the recovery period until a dynamic equilibrium is re-established or the recovery trend is clearly defined. In most cases full recovery is expected to occur in about 2 or 3 days. A final slug test can then be performed at the well, if time is not a critical factor.

5.3 SLUG TESTS

Instantaneous slug tests will be conducted in all wells following the procedure contained in the Environmental Investigation Instruction Manual (WHC-CM-7-7, Section 10.1, "Aquifer Testing").

5.4 SLUG INTERFERENCE TESTS

Slug interference tests will be performed at well 699-32-72B using the pressurized gas test method (Spane 1992). This testing method requires the use of an observation well (699-32-72 is available). An example test configuration for this method is shown in Figure 2. Appendix A contains the procedure for conducting the test.

5.4.1 Equipment Setup

The upper portion of the casing will be pressurized, depressing the water level to several feet below the static water level but not below the top of the screen. After the water level stabilizes, the gas pressure is instantaneously released and the water-level responses at the stress well (699-32-72B) and the observation well (699-32-72) are measured and recorded. It is important that the transducers at the stress and observation wells be synchronized during this test.

Usually a downhole packer is set in the observation well to isolate the test interval, minimizing the effects of borehole storage and simplifying data analysis. However, a packer will not be used in this case because of a piezometer in the well. The effects of borehole storage will be compensated when analyzing the test data.

An electric water-level tape may be used to determine the depth that the water level is depressed in the stress well just before release of the pressure. The water level should be depressed 10 to 25 ft (but not below the top of the well screen) to maximize the magnitude of the induced pulse in the nearby observation well.

5.5 STEP-DRAWDOWN AND CONSTANT DISCHARGE TESTS

The step-drawdown test will be used to determine the optimum pumping rate for the constant rate discharge test. Three to five steps at 60 to 90 min in length will be necessary to make this determination, unless diagnostic development data are available during well completion. A reasonable drawdown for the long-term test would be 5 ft or more in the pumping well, not exceeding 25% of the aquifer thickness or 50% of the screen length.

A constant rate discharge test will be conducted at each of the test wells after the step-drawdown test. Well 699-32-72 will be used as an observation well during the pumping test at well 699-32-72B.

During the step-drawdown and constant discharge test, the riser pipe from the pump must have a backflow valve or a surface valve installed to prevent water in the pipe draining back into the aquifer after the pump is shutoff. At the minimum, a valve should be installed at ground surface that can be closed at the end of the pumping period.

5.5.1 Discharge Rates

A calibrated flow measurement device (which includes orifice-type devices) must be used to monitor the discharge rates. The orifice device is considered calibrated if it was constructed according to standard industry specifications (e.g., Driscoll 1986). The discharge rate will be confirmed during the test using, for example, a stop watch and container of known volume. The error of the flow measurement device should not exceed ±10% of the total flow.

Flow measurement devices must be installed with the correct length of straight run pipe upstream and downstream from the device per the manufacturer's recommendations or standard industry practice (e.g., Driscoll 1986). If a rotor meter type flow meter is used for low flow rates (<20 gal/min), the factory calibration is acceptable, provided the flow rate is also confirmed while running the test. Expected flow rates may range from 1 to 50 gal/min based on the estimated hydraulic conductivities.

Flow rates should be recorded at least every 5 min at the start of the test, and at a maximum of 30- to 60-min intervals after the first 30 min. If a transducer can be used for recording flow rates, the rate should be set to a logarithmic recording frequency at the start of the test with a maximum rate of every 30 to 60 min.

The discharge rate for the pumping test will depend on the results of the step-drawdown test, or the development data. The aquifer test lead will make the final determination of the flow rate with verbal concurrence from the site hydrologist. Flow rate measurement requirements and calibration of flow rate measurement devices are covered in Section 5.3.1.

The entrance velocities of groundwater into the wells are not expected to produce significant turbulence at an estimated maximum flow rate of 350 gal/min (this is usually the maximum discharge rate for an 8-in. casing). For an 8-in. 10 slot continuous wire-wrap screen 20 ft long, the entrance velocity at 350 gal/min is about 0.2 ft/s. This velocity is significantly below the upper limit of 2 to 4 ft/s given by Roscoe Moss Company (1990), and that recommended by the American Water Well Association (A 100-84) of 1.5 ft/s. Assuming that 50% of the screen area is blocked, the entrance velocity will still be below this standard at 0.4 ft/s.

5.5.2 Length of Test

The constant rate discharge test should run until the effects of delayed yield have dissipated (if applicable), and a straight line is well developed on a semi-log plot of drawdown versus time. It is anticipated that the test will run 8 to 24 h. Final determination on the length of the test is at the discretion of the aquifer test lead with verbal concurrence by the site hydrologist. The rationale for stopping the test will be recorded on the field activity report.

6.0 PURGEWATER REQUIREMENTS

Purgewater will be handled in two ways, depending on the quality of the water at the test well. If the groundwater at the test well is designated as uncontaminated, the water can be released to ground surface at least 100 ft away from the well. This water is not expected to recharge the aquifer during the test, because the top of the water table is so deep. If the groundwater is determined to be contaminated, the water will be contained in a purgewater truck and transported to an acceptable disposal facility.

Geosciences will document the quality of the groundwater for each well, and thereby determine the method of disposal. Test sites where both the purgewater is contaminated and the transmissivity of the aquifer is relatively high will probably not be tested because of the large volumes of purgewater that will be produced. At this time, no satisfactory method for handling large volumes of contaminated purgewater is available.

A sample of the purgewater should be collected at the end of each constant discharge test for information and analyzed in the field for hexavalent chromium per field screening methodology (standard field test kit) and total activity per standard WHC laboratory procedure. This information will be useful as a screening tool to determine if any unknown contaminant plumes were intercepted and moved to the well during the constant rate discharge tests. Total estimated volumes of generated purgewater are about 105,000 gal assuming 11 tests, an average of 20 gal/min discharge, and an average test time of 8 h.

7.0 PROCEDURES AND DOCUMENTATION

Testing documentation and procedural control is covered by EII 10.1 and 10.2 (WHC-CM-7-7). Field activity reports will be used to record daily field activities during aquifer testing per EII 6.7. Standard activities and any unusual observations should be recorded on a daily activity log. Data collected during the testing will be stored according to EII 1.6 and incorporated into the project file after testing is completed. The wells will be installed using the Generic Well Specification (Reynolds 1992). This specification meets the requirements of WAC-173-160 (Ecology 1990).

8.0 QUALITY ASSURANCE

Data quality is controlled by this test plan and EII 10.1, "Aquifer Testing." The data at the test wells can be reproduced if the initial test fails by re-running the test. Some of the test sites will require an evaluation of the impact to endangered, threatened, and sensitive species because well water will be disposed to the ground.

The quality assurance documents that cover the test activities are the *Quality Assurance Manual* (WHC 1988b) and the *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990). This aquifer test plan and the aquifer testing is assigned an impact level of 3Q.

9.0 RESPONSIBILITIES

Specific responsibilities for the testing activities are contained in EII 10.1. Personnel performing individual test activities will be identified in the daily field activity log. Geosciences personnel will be the primary lead for aquifer testing and will direct and schedule field activities. Geosciences is responsible for evaluating the quality of groundwater that will be produced from each well.

Kaiser Engineers Hanford or Environmental Field Services will support the testing by conducting camera surveys, operating the slugging rod during slug testing, setting and removing pumps, and providing certain equipment required during testing (such as pump generators, outdoor lighting, discharge pipe).

Environmental Protection or an equivalent organization will determine the potential impact to endangered, threatened, or sensitive plant and animal species where groundwater will be disposed to the ground. A letter of confirmation will be provided for those areas where the groundwater is discharged directly to the ground.

10.0 HEALTH AND SAFETY

Site safety will be controlled by the applicable site safety plan. Kaiser Engineers Hanford is responsible for writing this document for each drilling and test site.

11.0 REFERENCES

Bouwer, H. and R. C. Rice, 1976, "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells," *Water Resources Res.*, Vol. 12, No. 3, pp. 423-428.

Cooper, H. H., Jr. and C. E. Jacob, 1946, "A Generalized Graphical Method for Evaluating Formation Constants and Summarizing Well-Field History," *American Geophysical Union Trans.*, Vol. 27, No. 4, pp. 526-534.

Driscoll, F. G., 1986, *Groundwater and Wells*, 2nd edition, Johnson Division, UOP Inc., St. Paul, Minnesota.

Ecology, 1990, *Minimum Standards for Construction and Maintenance of Wells*, Chapter 173-160 WAC, Washington State Department of Ecology, Lacey, Washington.

Neuman, S. P., 1975, "Analysis of Pumping Test Data from Anisotropic Unconfined Aquifers Considering Delayed Yield Gravity Response," *Water Resources Res.*, Vol. 10, pp. 303-312.

Papadopulos, I. S. and H. H. Cooper, Jr., 1967, "Drawdown in a Well of Large Diameter," *Water Resources Res.*, Vol. 3, no. 1, pp. 241-244.

Roscoe Moss Company, 1990, *Handbook of Ground Water Development*, John Wiley and Sons, New York, pp. 224-225.

Spane, F. A., Jr., 1992, *Applicability of Slug Interference Tests Under Hanford Site Test Conditions: Analytical Assessment and Field Test Evaluation*, PNL-8070, Pacific Northwest Laboratory, Richland, Washington.

Reynolds, K. D., 1992, *Generic Specification- Groundwater Monitoring Wells*, WHC-S-014, Rev. 7, Westinghouse Hanford Company, Richland, Washington.

Weekes, D. C. and J. V. Borghese, 1993, *Site Characterization Plan for the Environmental Restoration Disposal Facility*, WHC-SD-EN-AP-128, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988a, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, Vol. 1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988b, *Quality Assurance Manual*, WHC-CM-4-2, Westinghouse Hanford Company, Richland Washington.

WHC, 1990, *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan*, WHC-EP-0383, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992, *Hydrogeologic Model for the 200 West Groundwater Aggregate Area*, WHC-SD-EN-TI-014, Rev. 0, prepared by M. P. Connelly and B. H. Ford, Westinghouse Hanford Company, Richland Washington, and J. V. Borghese, Pacific Northwest Laboratory, for Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

SLUG INTERFERENCE TEST PROCEDURE

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SLUG INTERFERENCE TEST PROCEDURE

Prerequisite

1. Before installing any calibrated test equipment, verify and record that the equipment will remain in calibration over the period of the test.

2. Pre-test monitoring of water-levels at each well must start at least 1 day before the field testing begins to establish water-level trends (although a longer period is optimum). A barometric pressure transducer must be used to monitor atmospheric pressure changes over the same period of time. Both transducers must be set to the same recording rate and time (a maximum of 1-h intervals).

Procedure

1. Install an inflatable packer on a working string in the observation well as close as possible to the top of the well screen. The packer generally should not be seated inside the well screen, but may be if the screen is a louvered or bridge slot type. The packer must be set below the top of the water table. NOTE: The test can still be conducted even if a packer is not set (e.g., testing a well with a wire wrap screen that transects the water table), although this is not the preferred method.

2. Begin baseline monitoring of water-levels and barometric pressures at the observation well(s) at 10-minute intervals.

3. Makeup the wellhead assembly to the stress well (Figure A-1).

4. Install two pressure transducers in the screen section of the stress well: one at the maximum depth that the water level will be depressed, and the other above the water table. An electric tape may be placed at or below the lower transducer as a check to ensure that the water level is not depressed into the well screen. Begin baseline monitoring with the transducer at 10-minute intervals.

5. Connect the gas line from the gas cylinder to the wellhead assembly, and make sure the ball valves are closed. An inert type of gas must be used such as nitrogen.

6. Set the transducer recording rates to 1 minute for both the observation well and stress well. Make sure that the transducers in both the stress and observation wells are recording at the same rate and at the same time.

7. Pressure the well casing by opening the valve on the gas cylinder, and thereby depress the water level in the well to near the top of the well screen (maximizing the volume displaced), but not below the screen top. The well should be pressurized until the pressure reading on both transducers is about the same. If the water-level drops below the

electric tape, the tape will no longer buzz when tested. This indicates that the water level has dropped into the screen, and the test must be abandoned (the test can be restarted after the water-level restabilizes).

8. Hold the water-level at this elevation until the transducers indicate the formation has restabilized (i.e., the pressure readings are relatively constant).

9. Reset the transducer recording rates to the most rapid recording rate (less than 1 second is preferred), making sure that the transducers in the stress and observation wells are synchronized.

10. Open the ball valve on the wellhead assembly to instantaneously release the pressure in the casing, and monitor the water level recovery in both the stress well and the observation wells until they return to static.

11. Repeat the process of pressurizing and depressurizing as many times as desired. At least two cycles are recommended.

Variations in Stress Well Configuration

A. If the stress well has a double screen section, and the upper screen section will be tested, an inflatable packer on a working string must be installed in the blank casing section between the screens. Placement of the packer will isolate the two screen sections. The wellhead assembly is constructed to allow access to the lower screen section, but still allow pressurization and depressurization of the upper screen interval (annular space).

   Using this configuration, a third transducer should be installed through the working string to monitor water-level changes in the lower screen section. The recording rate and recording times must be synchronized with the transducer in the upper screen.

B. If in a double screened well the lower screen section is to be tested, the same packer and transducer configuration can be used as for Variation A above. However, the working string is pressurized and then depressurize instead of the annular space.

Figure A-1. General Well Configuration for Slug Interference Test.