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WORK PLAN

PHASE II GROUND-WATER STUDY
SIEMENS NUCLEAR POWER CORPORATION
RICHLAND, WASHINGTON

PROJECT NO. WA183.06

February 24, 1992

Prepared for

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WORK PLAN

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SIEMENS NUCLEAR POWER CORPORATION
RICHLAND, WASHINGTON

INTRODUCTION

This work plan has been prepared by Geraghty & Miller, Inc. for a Phase II Ground-Water Study (Phase II study) to be conducted at the Siemens Nuclear Power Corporation (SNP) fuels fabrication facility (SNP facility) in Richland, Washington (Figure 1). This work plan is an expansion of the Phase I Ground-Water Study (Phase I Study) Work Plan (Geraghty & Miller 1991), i.e., the tasks outlined herein compliment and augment the tasks of the ongoing Phase I Study.

The purpose of the work plan is to present a technical approach for obtaining ground-water quality and flow system data to supplement Phase I Study data. The Phase II Study is consistent with the remedial investigation (RI) requirements of an independent action under the State of Washington Model Toxics Control Act (MTCA) and data generated will be used to support the ongoing remedial investigation and feasibility study (FS).

The Phase II Study is an integral part of the RI/FS. The development and implementation of the Phase II Study Work Plan are identified as Tasks 4 and 5, respectively, in the RI/FS Scope of Work (Geraghty & Miller 1992). Data generated during the Phase II Study will be presented and interpreted in the RI/FS report.

The work plan consists of the following elements:

- A summary of **background** information concerning the site including preliminary results from the Phase I Study.

- A statement identifying the **objectives** of the Phase II study.

- A summary of the general **technical approach** that will be taken to accomplish those objectives.

- A discussion of specific **tasks** that will be undertaken as part of the technical approach. These tasks include piezometer and monitoring well installation and aquifer testing. (Report preparation and project management tasks are covered under the RI/FS scope of work.)

- A **schedule** for carrying out the various tasks of the Phase II study.

The Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HASP) included in the Phase I Study work plan will generally be followed during the Phase II Study. Deviations from the SAP are noted in the Technical Approach section of this work plan.

BACKGROUND

SITE LOCATION AND SETTING

The SNP facility is located at 2101 Horn Rapids Road in Richland, Washington (Figure 1). The topography at the SNP site and surrounding area is relatively flat. The SNP property consists of approximately 320 acres, most of which is undeveloped. The active facility area, which is fenced, comprises approximately 42 acres of the property.

The area surrounding the SNP property is relatively undeveloped. The Hanford Reservation lies to the north and east. Immediately to the north and east is the 1100-EM-1 operable unit, one of four areas of the Hanford Reservation on the Comprehensive Environmental Response, Compensation, and Liabilities Act (CERCLA)

National Priorities List (NPL). The Horn Rapids Landfill (HRL), one of the operable subunits of the 1100-EM-1 operable unit, lies directly north of SNP across Horn Rapids Road. The South Pit portion of the HRL lies northeast of the active portion of the SNP facility and south of Horn Rapids Road. Potato fields lie to the south and west of the SNP property.

SITE DESCRIPTION

The primary function of the SNP facility is the manufacture of nuclear fuel assemblies for boiling-water and pressurized-water reactors. From incorporation until 1973, SNP was known as the Jersey Nuclear Company. From 1973 to 1987, the company was known as the Exxon Nuclear Power Company; and from 1987 to 1991, Advanced Nuclear Fuels Corporation. In 1991, the company's name changed to the Siemens Nuclear Power Corporation. Throughout its history, the facility has operated under a license from the U.S. Nuclear Regulatory Commission (NRC).

The active portion of the SNP's property includes the UO_2 building where UF_6 is converted to UO_2, an office complex, several warehouses and shops, an ammonia recovery facility, and five process wastewater lagoons (Figure 2). Pursuant to environmental regulation by the NRC, 26 ground-water monitoring wells were installed at the site between 1973 and 1990 to assess the impact of the wastewater lagoons on ground-water quality. One of the wells has been abandoned, and three others have not been in continuous use.

Most of the area surrounding the office, process, and storage buildings is paved. The areas adjacent to the lagoons are primarily covered with sand and gravel. The lagoons are located on the east side of the facility and are surrounded by berms of soil. Process wastewater is piped to the lagoons through underground pipes, which are currently being replaced with encased pipes.

HYDROGEOLOGY

The following description of the regional hydrogeology for the vicinity of the SNP facility was obtained from the Phase I Remedial Investigation (RI) Report for the Hanford Site 1100-EM-1 Operable Unit (U.S. Department of Energy [USDOE] 1990) and a report prepared by J-U-B Engineering for Exxon Nuclear Company (J-U-B 1982). The discussion of the site hydrogeology is based on these two reports and the data collected during the installation of monitoring wells for the Phase I Study.

Regional Hydrogeology

The SNP facility is located within the Pasco Basin which is bounded on the north, south, and west by anticlinal ridges and on the east by a broad zone of gradually increasing bedrock elevation. Figure 3 presents a generalized stratigraphic column for the region. The basin is underlain by numerous basalt flows with interbedded sediments of the Columbia River Basalt Group. The basalts are overlain by unconsolidated alluvial sediments of the Ringold Formation, which in turn are overlain by glaciofluvial sediments of the Hanford Formation. Surficial eolian and fluvial sediments overlie the Hanford Formation.

The Ringold Formation contains interbedded gravels, sands, silts, and clays. Four fining-upward sequences of sediments have been identified in the Ringold Formation, each of which contains a basal gravel. The sedimentary sequences can be differentiated based upon the composition of the basal gravels in the units. The basal gravels in the lowest sequence in the Ringold Formation were derived from within the Pasco Basin and are basalt-rich. The basal gravels of the overlying sequences were derived from granitic and metamorphic sources outside the Pasco Basin and are generally basalt-poor.

The Hanford Formation consists of moderately to poorly sorted glaciofluvial sediments. The sediments were deposited during several episodes of catastrophic flooding resulting from glacial ice-dam failures in western Montana and northern Idaho. Within the Pasco Basin, the coarse-grained, main-channel facies of these flood deposits are informally referred to as the Pasco Gravels. The Pasco Gravels consist predominantly of basaltic gravels in a sand or silty-sand matrix.

Ground-water aquifers in the Pasco Basin occur in both the basalt bedrock and overlying sediments (Figure 3). Confined aquifers occur in the sedimentary interbeds within the Columbia River basalts. Recharge to the basalt interbed aquifers is primarily from precipitation to the exposed basalt ridges surrounding the basin. Ground-water flow and discharge in the aquifers in the basalts is believed to be primarily to the Columbia River. The basalt interbed aquifers appear to also discharge upwards into the overlying sedimentary aquifers. The hydraulic conductivities for the basalt interbed aquifers range from 10^{-10} centimeters per second (cm/s) to 10^{-3} cm/s, or 10^{-6} feet per day (ft/d) to 10 ft/d.

Confined to semiconfined aquifers occur in the lower portion of the Ringold Formation and result from interfingering of silt aquitards and more permeable lenses of sand and gravel. These aquifers appear to be laterally discontinuous and may merge with the overlying unconfined aquifer.

The uppermost unconfined aquifer in the Pasco Basin occurs in the upper Ringold Formation and the lower Hanford Formation. The aquifer is laterally extensive and highly transmissive. Recharge to the unconfined aquifer occurs primarily from runoff of precipitation to the ridges surrounding the basin. Local surface water bodies and discharge of the underlying confined aquifers also contribute to the recharge of the unconfined aquifer. Percolation of precipitation does not appear to contribute significantly to the aquifer recharge. Ground-water flow and discharge in the unconfined aquifer is primarily to the Columbia River. Hydraulic conductivities for the aquifer range from 10^{-3} cm/s to 1 cm/s (1 ft/d to 1,000 ft/d).

Site Hydrogeology

The local hydrogeologic system in the vicinity of the SNP facility appears to be consistent with the regional hydrogeologic system. The facility is underlain primarily by poorly and well graded sands and gravels of the Hanford and Ringold Formations. The irregular erosional contact between the Pasco Gravels and upper portions of the Ringold Formation results in the water table beneath the site occurring in both of the stratigraphic units. Ground-water generally occurs at approximately 10 to 15 ft below land surface (bls) at the SNP facility and at approximately 30 to 35 ft bls near the South Pit area.

A silt aquitard, underlying the unconfined aquifer, has been identified in previous studies (J-U-B 1982 and USDOE 1990). The thickness of the aquitard was determined to be at least 17 ft at on-site Well TW-16 (J-U-B 1982) and approximately 33 ft at Well MW-9, which is located at the HRL (USDOE 1990). During the Phase I Study drilling, the aquitard was encountered in the boreholes for GM-2 and GM-11 at depths of approximately 32.5 ft bls and 47 ft bls, respectively. The thickness of the aquitard beneath the SNP facility has not been determined. This aquitard may or may not be continuous beneath the SNP facility and adjacent areas.

Ground-water level measurements at the SNP facility in November 1991 indicate that the direction of ground-water flow in the unconfined aquifer is to the north-northeast (Figure 4). These results are consistent with past observations. The hydraulic gradient ranges from approximately 0.0003 to 0.001 across the site.

Ground-water recharge to the unconfined aquifer at the SNP site is most likely from the Yakima River, which is located approximately 2.5 miles southwest of the SNP site (Freshley et al. 1989) and from vertical discharge from deeper basalt aquifers (USDOE 1988). Discharge from the unconfined aquifer is to the Columbia River.

GROUND-WATER QUALITY

Potential constituents of concern in ground water at the SNP facility include trichloroethene (TCE), 1,1,1-trichloroethane (TCA), nitrate, ammonia, fluoride, and radionuclides (measured as gross-alpha and gross-beta radiation). These constituents have been identified as being present in the ground water at the SNP facility during previous sampling events, most recently the November 1991 sampling conducted as part of the Phase I Study. (A summary of past ground-water sampling activities at the SNP facility is provided in the Phase I Study work plan [Geraghty & Miller 1991].) The areal distributions of these constituents, based on the November 1991 ground-water sampling event results, are discussed below. The results of the November 1991 sampling effort will be documented in detail in the forthcoming Quarterly Ground-Water Monitoring Report.

Trichloroethene and 1,1,1-Trichloroethane

The distributions of TCE and TCA based on analytical results from the November 1991 sampling are shown in Figure 5. The highest concentration of TCE was 35 micrograms per liter (μg/L) in the sample from Well GM-12, located near the South Pit. TCE concentrations in samples from Wells GM-3 through GM-11 ranged from 2 μg/L to 23 μg/L. TCE was not detected in samples from upgradient Wells GM-1 and GM-2.

TCA concentrations ranged from nondetectable to 5 μg/L. TCA was not detected in samples from GM-7, GM-8, GM-10, GM-11, GM-12, or from upgradient Wells GM-1 and GM-2.

Nitrate and Ammonia

The distributions of nitrate and ammonia based on November 1991 analytical results are shown in Figure 6. Nitrate concentrations ranged from 5.46 mg/L to 45.7 mg/L (expressed as nitrogen, NO_3-N) in Wells GM-3 through GM-12. Samples from upgradient Wells GM-1 and GM-2 contained 4.26 mg/L and 3.87 mg/L, respectively.

Ammonia concentrations based on the November 1991 sampling ranged from 0.030 mg/L to 45.0 mg/L (expressed as nitrogen, NH_3-N) in Wells GM-3 through GM-12. Samples from upgradient Wells GM-1 and GM-2 contained 0.041 mg/L and 0.035 mg/L, respectively.

Fluoride

The distribution of fluoride based on November 1991 analytical results is shown in Figure 7. Fluoride concentrations ranged from 0.254 mg/l to 7.10 mg/L in Wells GM-3 through GM-12. Samples from upgradient Wells GM-1 and GM-2 contained 0.300 mg/L and 0.335 mg/L, respectively.

Radionuclides

The distributions of gross-alpha and gross-beta concentrations based on the November 1991 analytical results are shown in Figure 8. Gross-alpha concentrations ranged from 5.3 ± 2.8 picocuries per liter (pCi/L) to 87 ± 20 pCi/L in Wells GM-3 through GM-12. Samples from upgradient Wells GM-1 and GM-2 contained 10 ± 6 pCi/L and 19 ± 8 pCi/L, respectively.

Gross-beta concentrations ranged from 10 ± 2 picocuries per liter (pCi/L) to 90 ± 11 pCi/L in Wells GM-3 through GM-12. Samples from upgradient Wells GM-1 and GM-2 contained 15 ± 3 pCi/L and 22 ± 4 pCi/L, respectively.

PHASE II GROUND-WATER STUDY

The Phase II study was developed on the basis of the preliminary results of the Phase I Study. The following sections present the objectives, the technical approach, a discussion of the major tasks, and a schedule for the Phase II study.

OBJECTIVES

The overall objective of the Phase II Study is to provide ground-water flow and water quality information necessary to complete the RI/FS. Specific objectives of the Phase II study are as follows:

1. **Further characterization of the distribution of contaminants in the unconfined aquifer.** Additional data regarding the areal distribution of contaminants in the unconfined aquifer are necessary to complete the RI/FS. These data will be used to assist in determining if ongoing sources of contamination exist and to evaluate potential remedial options. These data are also necessary for the risk evaluation task of the RI.

2. **Further delineation of the ground-water flow system in the unconfined aquifer.** Additional characterization of the ground-water flow directions and gradients is necessary to identify potential flow paths and rates of ground-water movement. Knowledge of the ground-water flow system is essential to being able to assess potential sources of contamination and identify scenarios for contaminant migration during the RI and evaluating the need and options for cleanup during the FS. These data will be used to develop the ground-water flow model.

3. **Aquifer characterization.** Knowledge of aquifer parameter values is necessary for estimation of ground-water flow and contaminant migration rates. These parameter values are required input during ground-water model development.

TECHNICAL APPROACH

This section presents an overview of the general technical approach that will be taken to meet the objectives of the Phase II Study. Activities to be completed during the Phase II Study are as follows:

- Installation of three piezometers.

- Installation of four ground-water monitoring wells.

- Collection of soil samples during piezometer and monitoring well installation to define lithology and stratigraphy and for limited chemical and physical analyses.

- Performance of a pumping test to determine aquifer parameter values critical to understanding the fate and transport of the contaminants in the subsurface.

- Development of a ground-water flow model.

The following sections summarize each component of the proposed Phase II Study.

Task 1: Piezometer and Monitoring Well Installation

Geraghty & Miller proposes to install three 2-inch diameter piezometers during this phase of the investigation. The piezometers will be used to provide ground-water level data to aid in delineation of ground-water flow patterns.

Twelve ground-water monitoring wells were installed as part of the Phase I Study. To augment this network of wells, Geraghty & Miller proposes to install four additional 2-inch diameter ground-water monitoring wells during this phase of the investigation. The monitoring wells will be used to provide ground-water level and water-quality data for delineation of ground-water flow patterns and constituent distributions. Each of the boreholes for the monitoring wells will be drilled down to the aquitard to identify its depth at each location. The following summarizes pertinent information regarding the proposed piezometers and monitoring wells.

Piezometer Locations

The proposed piezometer locations are shown on Figure 9. Locations for piezometers P-1 and P-2 were selected to provide water level elevation data for areas remote to the active facility to aid in understanding regional ground-water flow patterns. This information is necessary for development of a regional ground-water flow model. Piezometer P-3 will be installed near Well GM-2 to form a cluster. The screened interval of P-3 will be placed beneath the silt aquitard to allow evaluation of the hydraulic relationship between the unconfined aquifer and the presumably confined aquifer beneath the silt aquitard.

Monitoring Well Locations

The proposed ground-water monitoring well locations are shown in Figure 9. The locations shown are approximate. Final locations will be selected after the evaluation of factors such as the locations of underground utilities and pipes, the locations of buildings, access requirements for drill rigs, SNP's daily operational needs, and the comments of regulatory officials.

All proposed monitoring wells will be completed within the unconfined aquifer. The actual depth will be determined by the depth of the water table and the depth of the silt aquitard. The rationale for each of the proposed monitoring well locations is summarized below.

- Wells GM-13, GM-14, and GM-15 are located within the area of identified contamination (plume) and will provide additional data to characterize the ground-water quality.

- Well GM-16 is located east of the plume and will provide data for establishing the eastern plume boundary.

Drilling Methodology

The piezometers and monitoring wells will be drilled using the Odex™ drilling method. This method proved to be effective during Phase I Study monitoring well installations. The Odex™ method uses a drill pipe to rotate a pilot bit and an eccentric reamer to advance the borehole. Temporary casing is installed in the reamed borehole as drilling progresses. The drill cuttings are forced up the drill pipe using compressed air and are diverted to 55-gallon drums. Soil samples are collected during drilling with a wire-line sampler and can be obtained at any depth. The temporary casing is removed during the monitoring well construction process.

Soil samples will be collected with a wire-line or drive sampler during drilling for chemical and physical analyses. Samples will be collected at 5-foot intervals and at every change in lithology unless cobbles preclude drive sampling. Geologic logging will be performed by a geologist using methods consistent with Environmental Investigation Instruction (EII) 9.1, *Geologic Logging* (WHC 1988).

One soil sample from each borehole will be submitted to a geotechnical laboratory for grain-size analysis. This sample will be collected from a depth which corresponds to the screened interval for the well. The results will be used to estimate aquifer characteristics.

A limited number of samples will be collected and analyzed for TCE. These samples will be collected, if possible, from each of the monitoring well boreholes from a depth just above the apparent depth of the water table. Analytical results will be used to assess the distribution of TCE in the soil. If possible, a limited number of soil samples will also be collected from boreholes in areas of known ammonium hydroxide spills and analyzed for ammonia and nitrate. (Collection of drive samples during the Phase I Study drilling was generally not effective because of the presence of cobbles. Although drive sampling will be attempted during the Phase II Study drilling, it is not anticipated that many samples will be successfully collected.) All soil cuttings will be retained in barrels pending receipt of analytical results.

A detailed description of the soil sampling and analysis procedures is included in the Sampling and Analysis Plan (SAP) (Geraghty & Miller 1991, Appendix A).

Piezometer and Monitoring Well Construction Materials

The proposed monitoring well materials and design are consistent with USDOE protocol. A consistent approach will promote comparability of USDOE data with data generated during this investigation. The proposed monitoring well construction details are shown on Figure 10.

The monitoring wells will be constructed using 2-inch diameter stainless-steel screen and 2-inch diameter PVC casing (Figure 10). The selection of stainless-steel well screens was based on the following criteria: (1) state regulations require use of either PVC or stainless-steel (Chapter 173-160 Washington Administrative Code); and (2) the USDOE monitoring wells were constructed with stainless-steel casing and screen, and similar construction of the proposed monitoring wells will promote data comparability. The PVC casing will extend from the top of the well screen, which will be located above the seasonal high ground-water level, to the ground surface.

Piezometers P-1 and P-3 will be constructed of the same materials as the monitoring wells to preserve the option of collecting ground-water samples from them if it is deemed appropriate in the future. Piezometer P-2 will be constructed similarly to the monitoring wells with the exception that the well screen material will be PVC. It is not anticipated that Piezometer P-2 will be sampled in the future.

Piezometer and Monitoring Well Installation Methodology

The installation methodology for piezometers and monitoring wells will be identical. Each borehole will be drilled as specified in the Drilling Methodology subsection. After reaching the total depth, the stainless-steel or PVC screen and the PVC casing for each piezometer or monitoring well will be installed through the temporary steel casing. The filter pack material and bentonite plug will be placed as the temporary casing is withdrawn allowing these materials to fill the annular space between the screen or riser and the borehole wall. The filter pack will extend approximately 3 ft above the top of the screen. The bentonite plug will be placed above the filter pack and will be a minimum of 2 ft thick. Stainless-steel centralizers will be used to keep the screen centered in the borehole during the installation process. The borehole will be sealed from the top of the bentonite plug to the surface with concrete. A locking steel protective casing which will extend above the ground surface will be embedded in the concrete. If necessary, some wells may be finished with covers that are flush with the ground surface.

Piezometer and Monitoring Well Completion

All piezometer and monitoring well completions will be consistent with EII 6.8, *Well Completion* (WHC 1988). The top-of-casing elevation of each piezometer and monitoring well will be surveyed to the nearest 0.01 ft, relative to the established datum used by USDOE. Horizontal locations will be surveyed to the nearest foot.

Piezometer and Monitoring Well Development

Each monitoring well will be developed following completion and prior to ground-water sampling to remove fine-grained materials and to enhance hydraulic communication with the aquifer. Piezometers will also be developed to enhance hydraulic communication. Development methodologies will be consistent with EII 10.4, *Well Development Activities* (WHC 1988). Development water from monitoring wells will be retained in barrels pending ground-water analytical results.

Task 2: Pumping Well Installation

It is necessary to install a pumping well prior to conducting the pumping test to determine key aquifer parameter values for the unconfined aquifer. These parameter values are necessary for the development of the ground-water flow model.

Pumping Well Location

The proposed location for Pumping Well PW-1 is north of the lagoons near Well GM-8 (Figure 9). This location is within the plume and may be an appropriate extraction well location if ground-water remediation is deemed necessary in the future.

The pumping well will be screened within the unconfined aquifer. The bottom of the well screen will be placed within a few feet of the silt aquitard.

Also shown on Figure 9 is an alternate pumping well location to be used if handling of discharge water from within the plume is infeasible. Options for the handling of discharge water are currently being evaluated.

Pumping Well Construction Materials

The proposed construction details for the pumping well are shown on Figure 11. The well will be constructed of 6-inch pipe-size stainless-steel continuous wire-wrap screen and 6-inch diameter steel sump and riser. The filter pack will be designed to match the aquifer material collected from nearby monitoring well borings during the Phase I monitoring well installations. The screen slot size will be selected to retain 90 percent, by weight, of the filter pack material.

Pumping Well Installation Methodology

The pumping well will be installed by the cable-tool method. Temporary casing will be driven as the borehole is advanced to maintain an open borehole. Upon completion of the borehole to the total depth for the pumping well, the stainless-steel screen and steel casing will be installed through the temporary steel casing. The filter pack material and bentonite plug will be placed as the temporary casing is withdrawn, allowing these materials to fill the annular space between the screen or riser and the borehole wall. The filter pack will extend approximately 3 ft above the top of the screen. The bentonite plug will be placed above the filter pack and will be a minimum of 2 ft thick. Stainless-steel centralizers will be used to keep the screen centered in the borehole during the installation process. The borehole will be sealed from the top of the bentonite plug to the ground surface with concrete. A concrete pad will be placed around the wellhead. A locking steel cap will be placed on the top of the well casing.

Pumping Well Completion

The pumping well completion will be consistent with EII 6.8, *Well Completion* (WHC 1988). The top-of-casing elevation of the pumping well will be surveyed to the nearest 0.01 ft, relative to the established datum used by USDOE. The horizontal location will be surveyed to the nearest foot.

Pumping Well Development

The pumping well will be developed by surging and bailing to enhance permeability and remove fine-grained materials from the filter pack and aquifer in the vicinity of the screened interval. This process enhances hydraulic communication between the well and the aquifer, thereby improving performance of the well during the pumping test.

Task 3: Pumping Test

A constant-rate pumping test will be performed to estimate the transmissivity and storage coefficient of the unconfined aquifer. The duration of the constant-rate test is anticipated to be 24 to 72 hours. The actual duration will be determined during the test as data are evaluated. Following pump shut-off at the conclusion of the constant-rate test, water level data will be collected to monitor recovery.

Prior to the start of the constant-rate pumping test, a step-drawdown pumping test will be performed to determine the optimal pumping rate for the constant-rate test. The step-drawdown test will be run at a minimum of three successively greater pumping rates for approximately 1 to 2 hours at each rate.

Water samples will be collected during the constant-rate test to monitor changes in water quality. Each sample will be analyzed for the parameters identified in the SAP (Geraghty & Miller 1991, Appendix A) and total dissolved solids (TDS). The first sample will be taken within the first 60 minutes after the start of pumping, the second sample approximately 6 hours after the start of the test, and subsequent samples at approximately 12 hour intervals. This sampling schedule may vary depending on field conditions. The actual number of samples collected will depend on the duration of the pumping test and variation in the field-monitored parameters (pH, specific conductance, and temperature) over time.

Task 4: Ground-Water Sampling and Analysis

The proposed monitoring wells will be sampled approximately two weeks after installation and development and will then be included in the ongoing Phase I Study ground-water monitoring program (Geraghty & Miller 1991). This program includes collection of water level elevation data on a monthly basis and collection and analysis of ground-water samples on a quarterly basis. Piezometer P-3 will be sampled for general water quality parameters (all parameters identified in Table A-3 of the SAP [Geraghty & Miller 1991, Appendix A] except volatile organics, barium, and radionuclides). Well TW-14 will also be added to the Phase I Study ground-water monitoring program to provide qualitative continuity between historic water quality data and data generated during the Phase I Study. Water level measurements and ground-water sample collection are scheduled to be concurrent with corresponding USDOE activities at the HRL.

Detailed descriptions of the water level measurement and ground-water sampling and analysis procedures are provided in the SAP (Geraghty & Miller 1991, Appendix A). The SAP meets the requirements specified in the MTCA (Chapter 173-340-820 WAC). The methods that will be used to ensure that defensible data are generated during ground-water monitoring are outlined in the Quality Assurance Project Plan (Geraghty & Miller 1991, Appendix B).

Ground-water samples collected from monitoring wells will be analyzed for the constituents identified in Table A-3 of the SAP (Geraghty & Miller 1991, Appendix A) and for TDS. Purge water generated during sampling will be retained in barrels pending analytical results.

Task 5: Ground-Water Modeling

A computer ground-water flow model will be developed to simulate hydraulic conditions in the vicinity of the SNP facility. Following development, the model will be calibrated using observed conditions and verified using a subset of the data not used in calibration. The model will be used to during the RI/FS process to predict future ground-water flow conditions and, if necessary, to evaluate the hydraulic impact of various remediation scenarios.

SCHEDULE

Figure 12 presents a preliminary schedule for carrying out the Phase II study. The schedule includes the period from March through April 1992. The schedule anticipates a start date of early-March 1992 for monitoring well, piezometer, and pumping well installations. This schedule is designed to integrate with the RI/FS schedule presented in the RI/FS Scope of Work (Geraghty & Miller 1992).

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FIGURES

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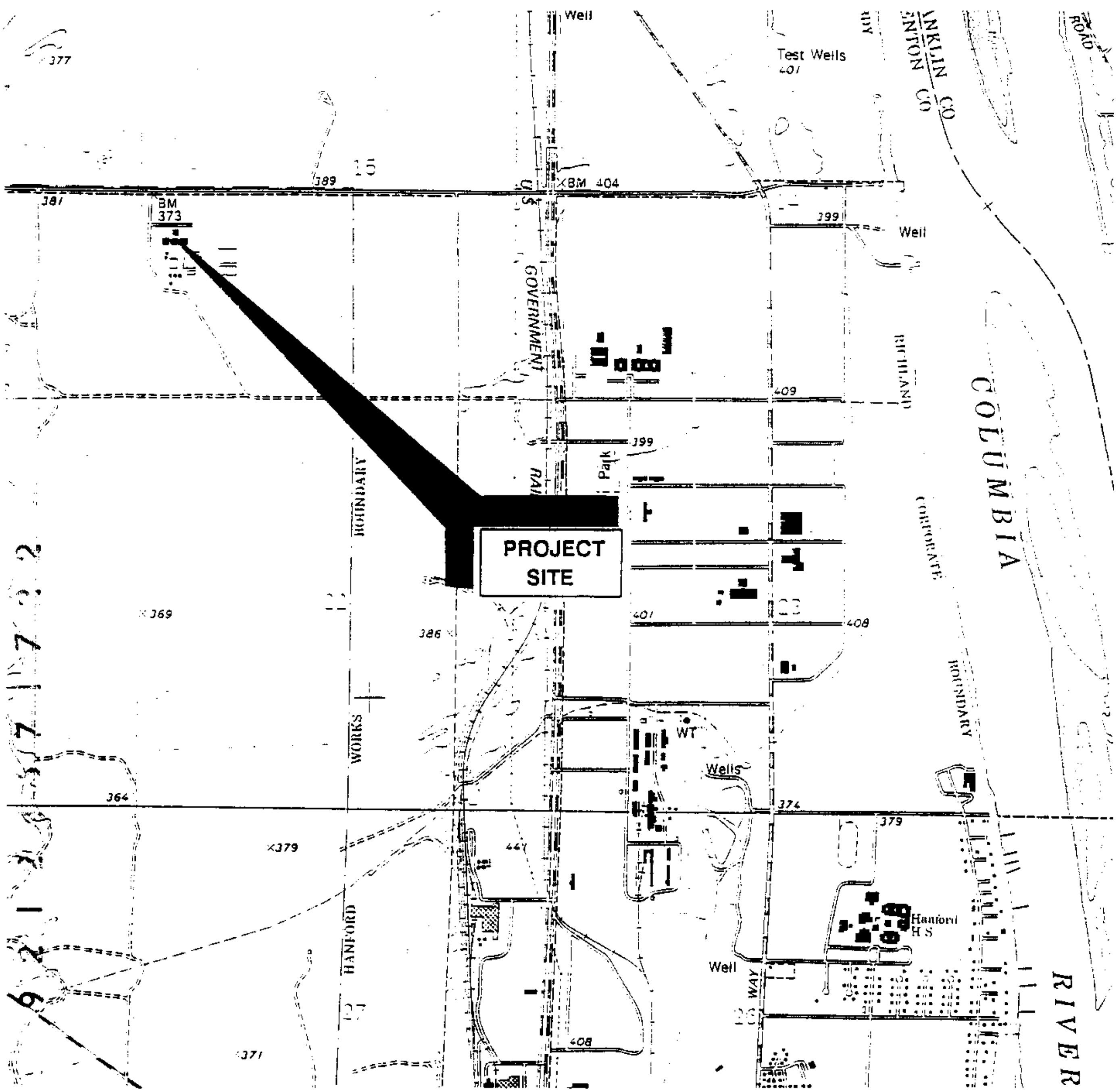
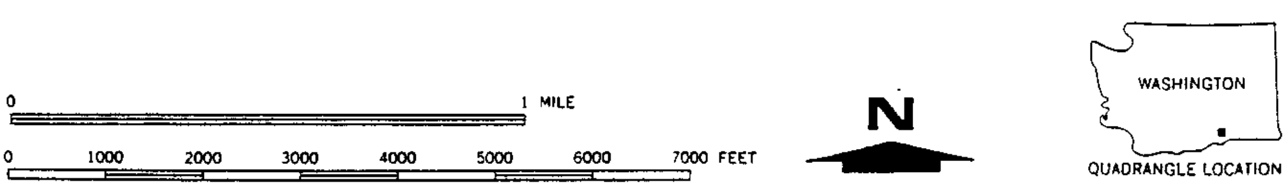


SOURCE: USGS 7.5 Minute Topographic Map, RICHLAND, WASHINGTON Quadrangle, 1978.



GERAGHTY & MILLER, INC.
Environmental Services

SITE LOCATION MAP

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE **1**

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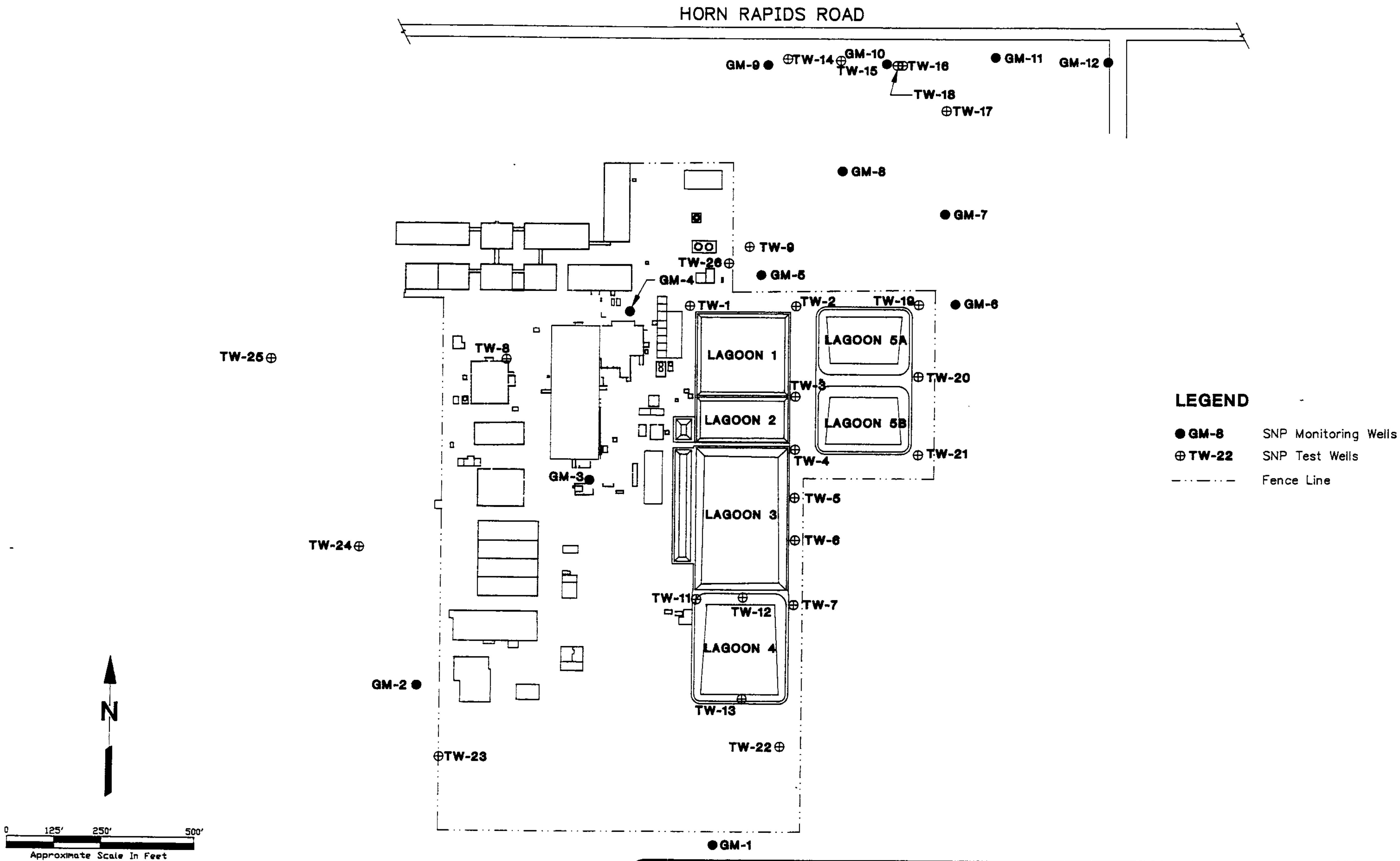

GERAGHTY & MILLER, INC.
Environmental Services

JOB #WA183.03

SITE PLAN

Siemens Nuclear Power Corporation
2101 Horn Rapids Road
Richland, Washington 99352

FIGURE 2

DRAFTER: CH | APPROVED: LER | CHECKED: JB | DRAWING: x | FILE NO.: WA183.03 | PRJCT NO.: WA183.03 | DWG DATE: 02-17-92

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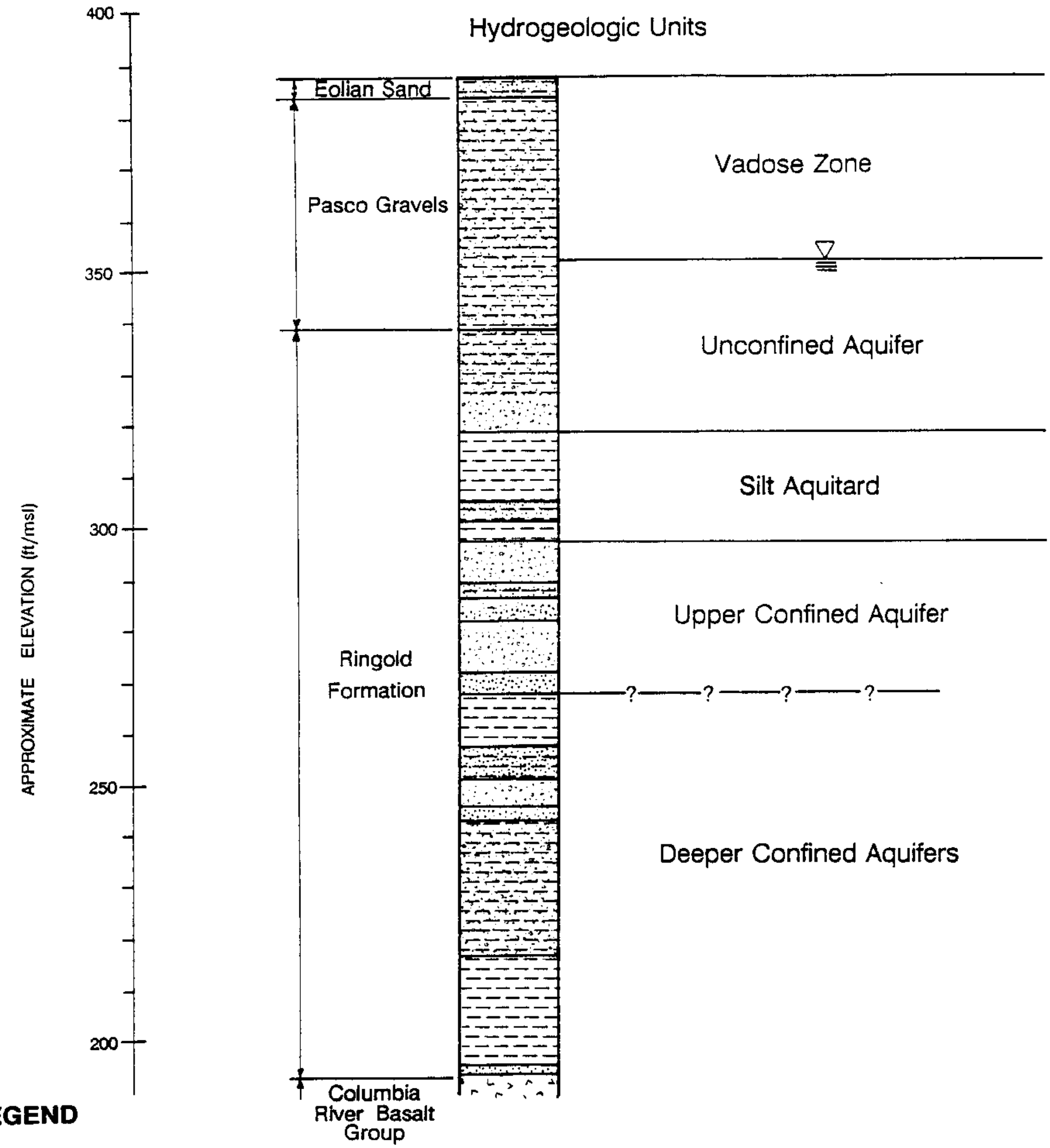


LEGEND

- Sand
- Silty Sand
- Sandy Gravel/Gravelly Sand
- Silty Sandy Gravel/Silty Gravelly Sand
- Clay/Silt/Sandy Silt
- Basalt

REFERENCE: DOE, 1990

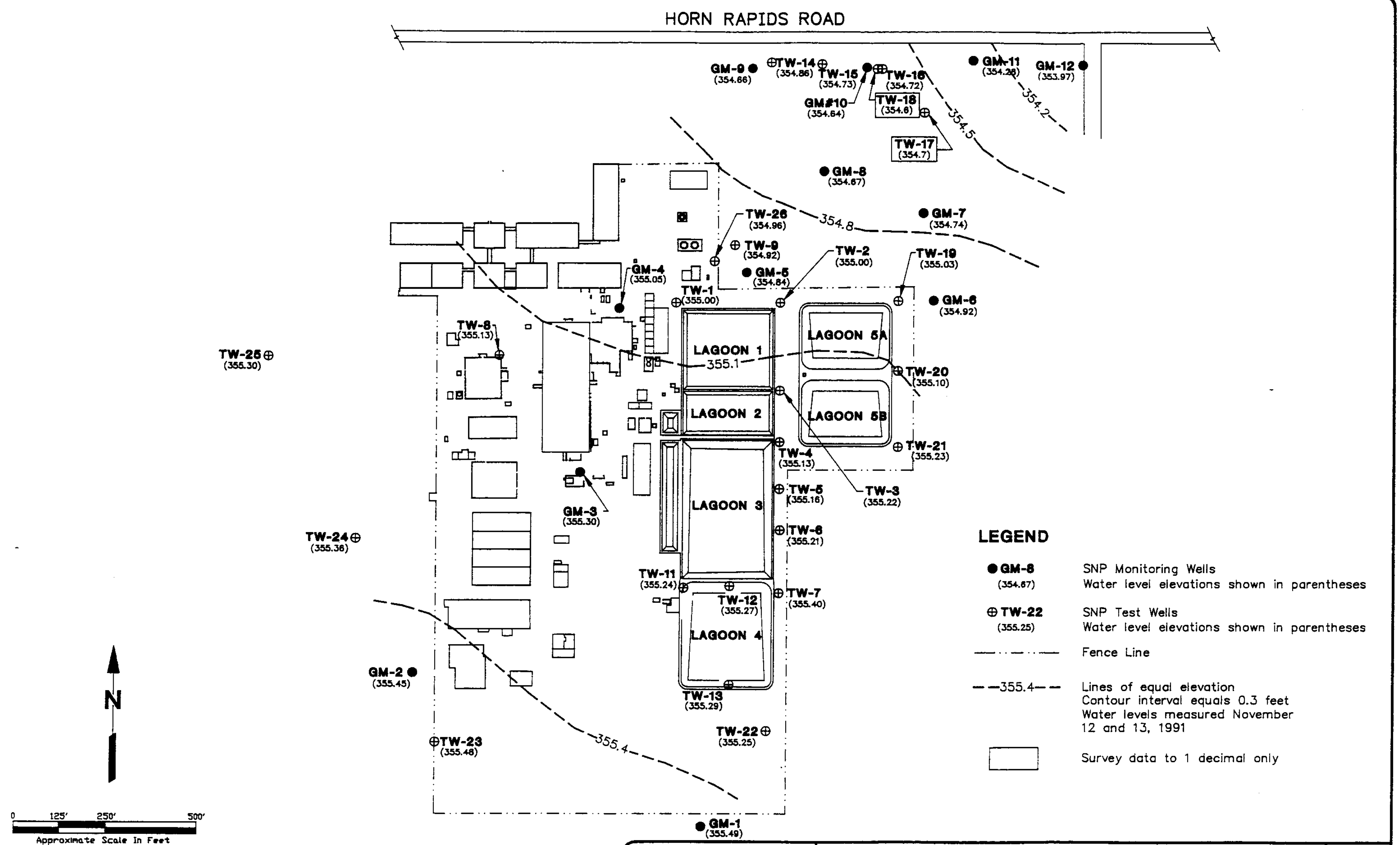
DRAFTER: SAC | APPROVED: LER | CHECKED: | DRAWING: | FILE NO.: 9212157134 | PRJCT NO.: WA183.03 | DWG DATE: AUG 1991

GERAGHTY & MILLER, INC.
Environmental Services

GENERALIZED HYDROSTRATIGRAPHIC COLUMN

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE **3**



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JOB #WA183.03

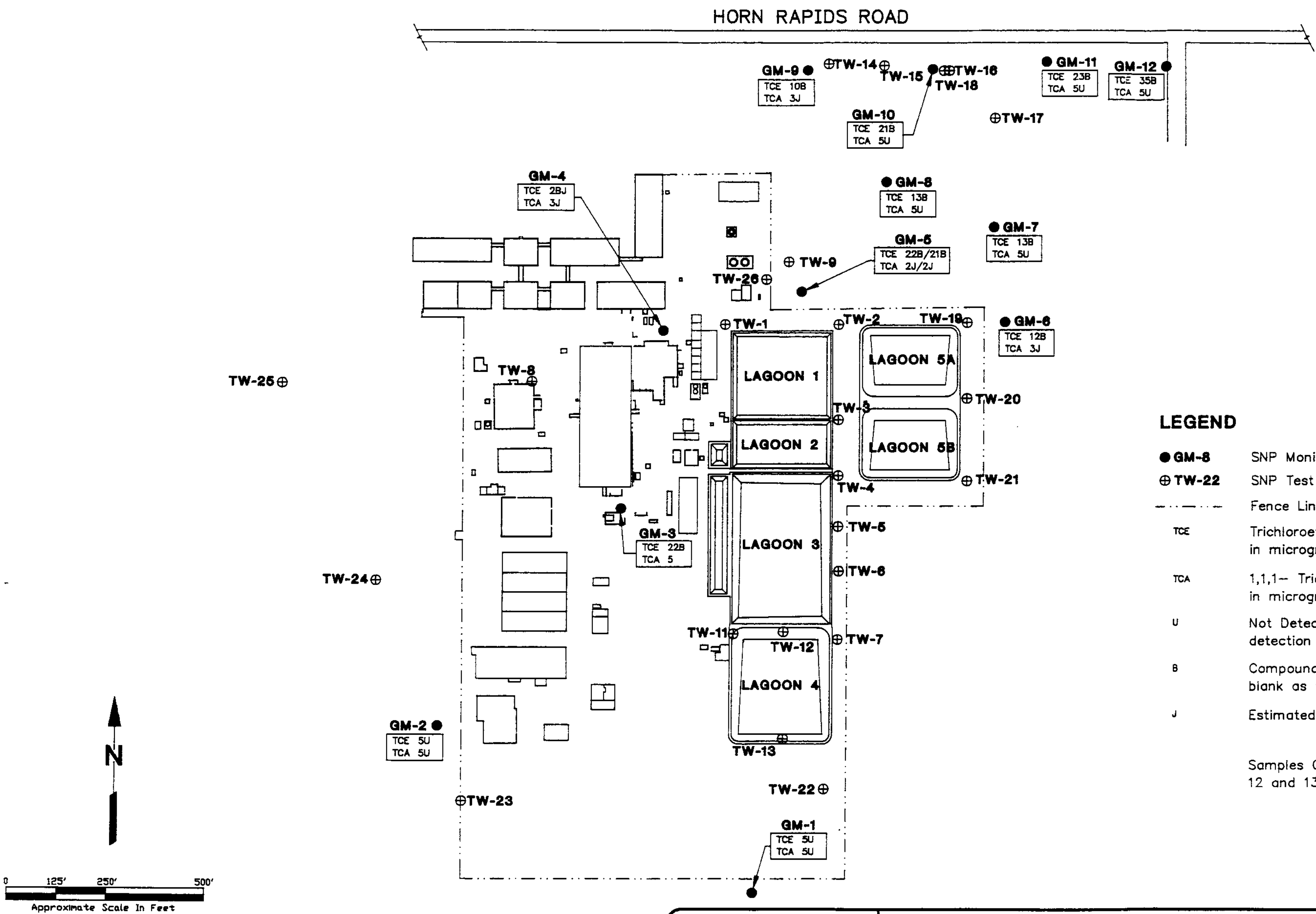
WATER TABLE SURFACE MAP

Siemens Nuclear Power Corporation
2101 Horn Rapids Road
Richland, Washington 99352

FIGURE 4

DRAFTER: CH | APPROVED: LER | CHECKED: JB | DRAWING: X | FILE NO.: WA183.03 | PRJCT NO.: WA183.03 | DWG DATE: 02-17-92

9 2 1 2 4 5 7 1 7 2 5



LEGEND

● GM-8	SNP Monitoring Wells
⊕ TW-22	SNP Test Wells
-·-·-·-	Fence Line
TCE	Trichloroethene Concentration in micrograms per liter
TCA	1,1,1– Trichloroethane Concentration in micrograms per liter
U	Not Detected above given detection limit
B	Compound found in associated blank as well as in sample
J	Estimated value

Samples Collected on November 12 and 13, 1991

GERAGHTY & MILLER, INC.
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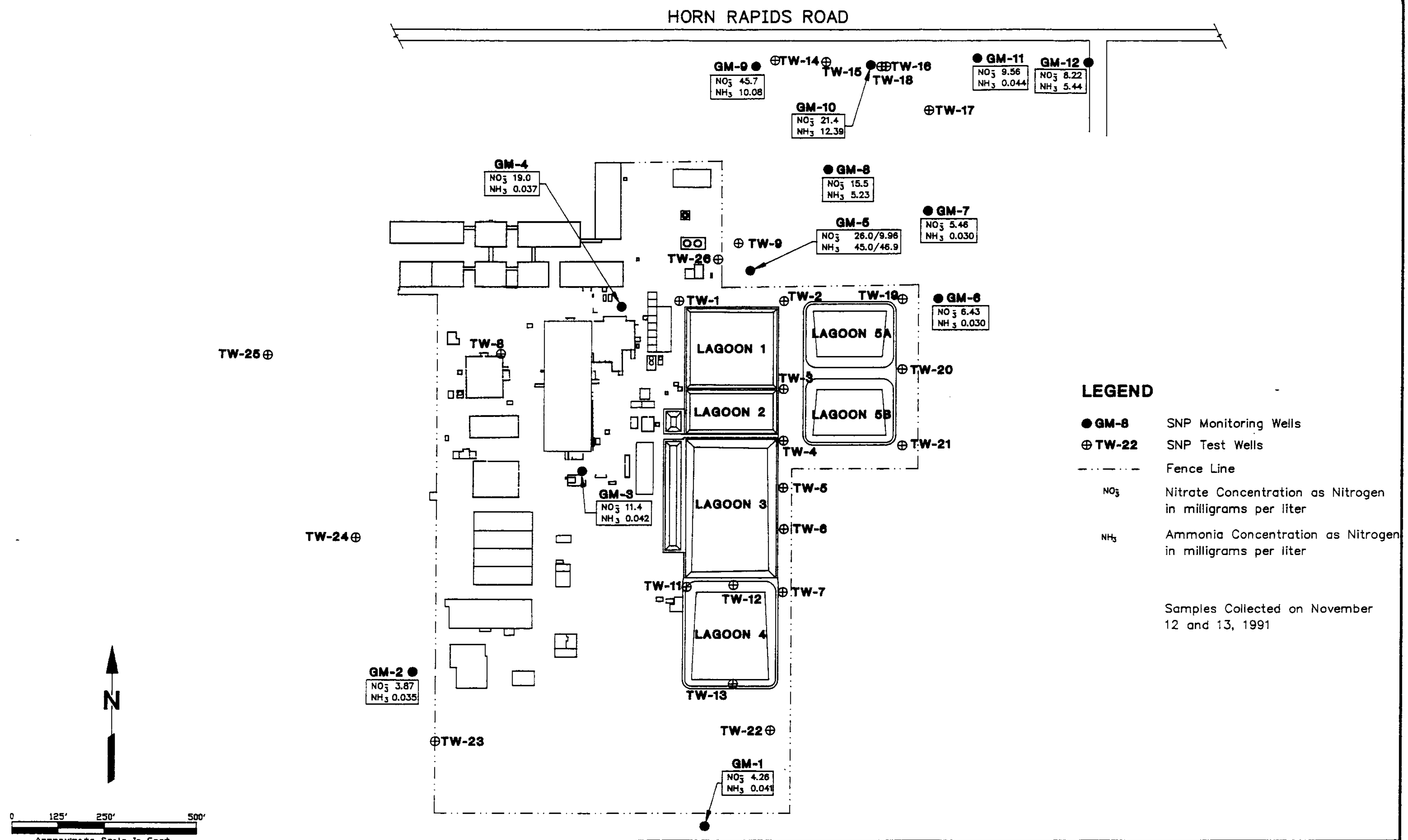
TCE AND TCA CONCENTRATIONS IN THE GROUND WATER NOVEMBER 1991

Siemens Nuclear Power Corporation
2101 Horn Rapids Road
Richland, Washington 99352

FIGURE 5

DRAFTER: CH | APPROVED: LER | CHECKED: JB | DRAWING: X | FILE NO.: WA183.03 | PRJCT NO.: WA183.03 | DWG DATE: 02-17-92

9 2 1 2 4 6 7 1 7 2 6



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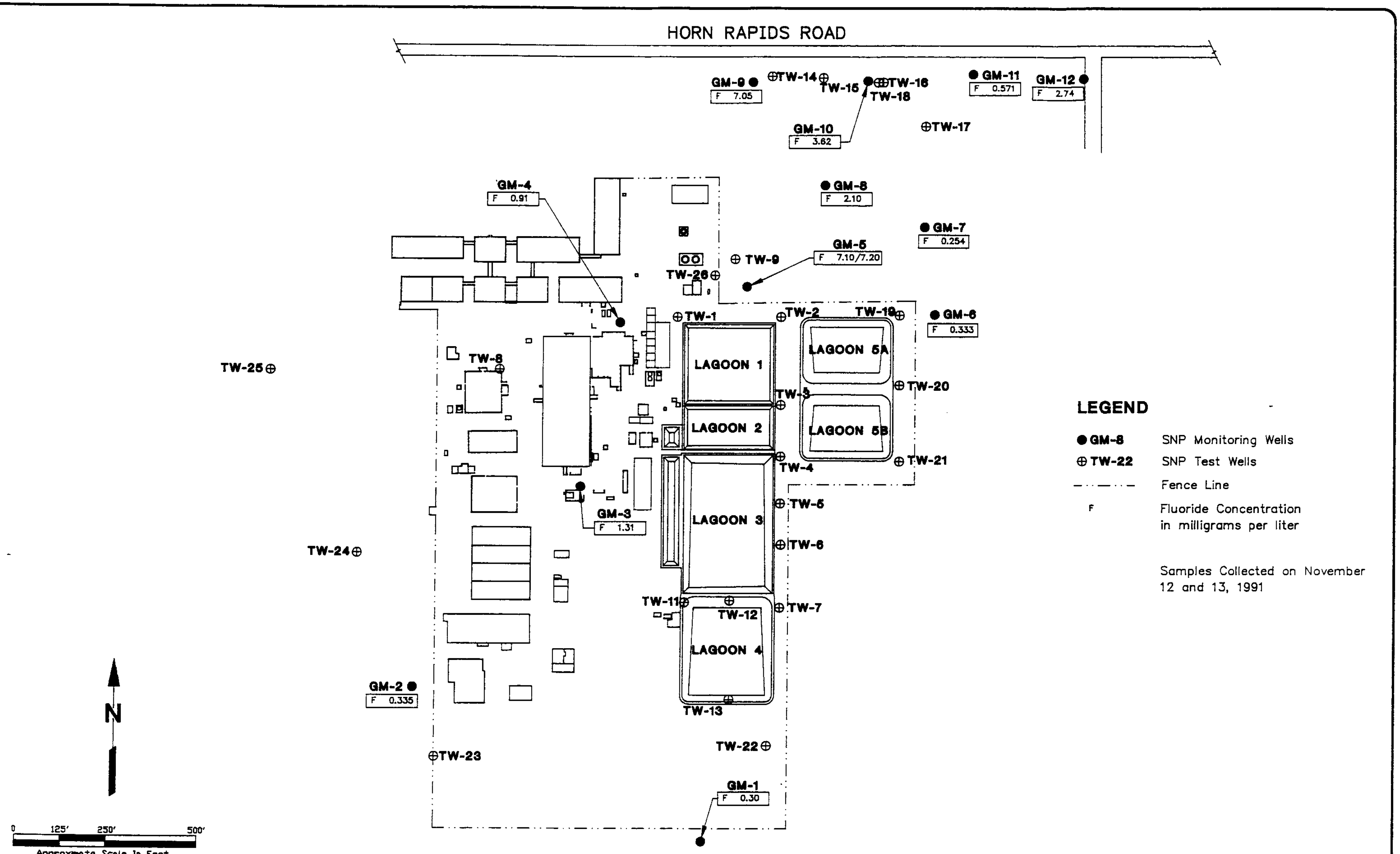
JOB #WA183.03

NITRATE AND AMMONIA CONCENTRATIONS IN THE GROUND WATER NOVEMBER 1991

Siemens Nuclear Power Corporation
2101 Horn Rapids Road
Richland, Washington 99352

FIGURE 6

DRAFTER: CH | APPROVED: LER | CHECKED: JB | DRAWING: x | FILE NO.: WA183.03 | PRJCT NO.: WA183.03 | DWG DATE: 02-17-92



DRAFTER: CH | APPROVED: LER | CHECKED: JB | DRAWING: X | FILE NO.: WA183.03 | PRJCT NO.: WA183.03 | DWG DATE: 02-17-92

9212457178 3

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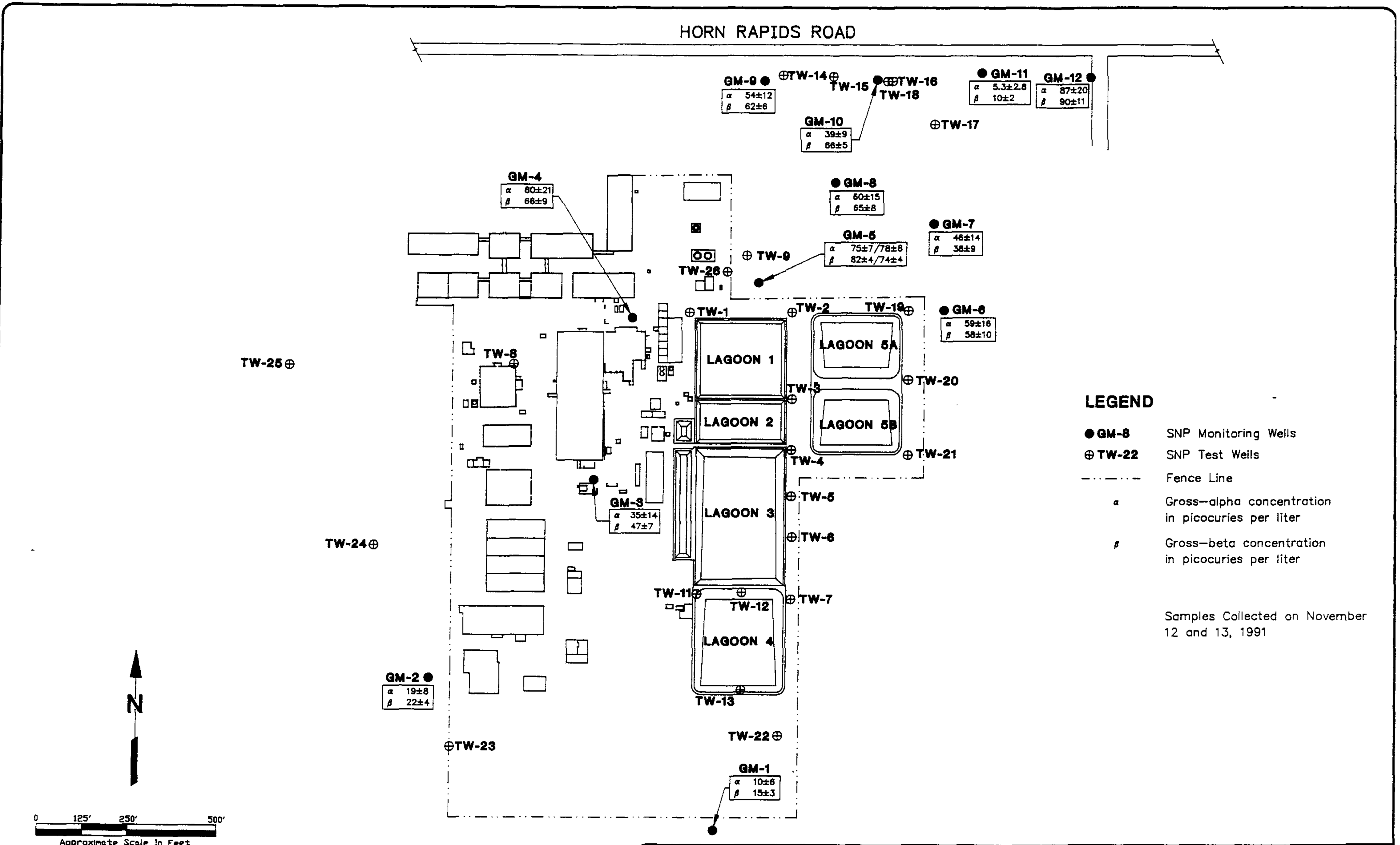
JOB #WA183.03

FLUORIDE CONCENTRATIONS IN THE GROUND WATER NOVEMBER 1991

Siemens Nuclear Power Corporation
2101 Horn Rapids Road
Richland, Washington 99352

FIGURE 7



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RADIONUCLIDE CONCENTRATIONS IN THE GROUND WATER NOVEMBER 1991

Siemens Nuclear Power Corporation
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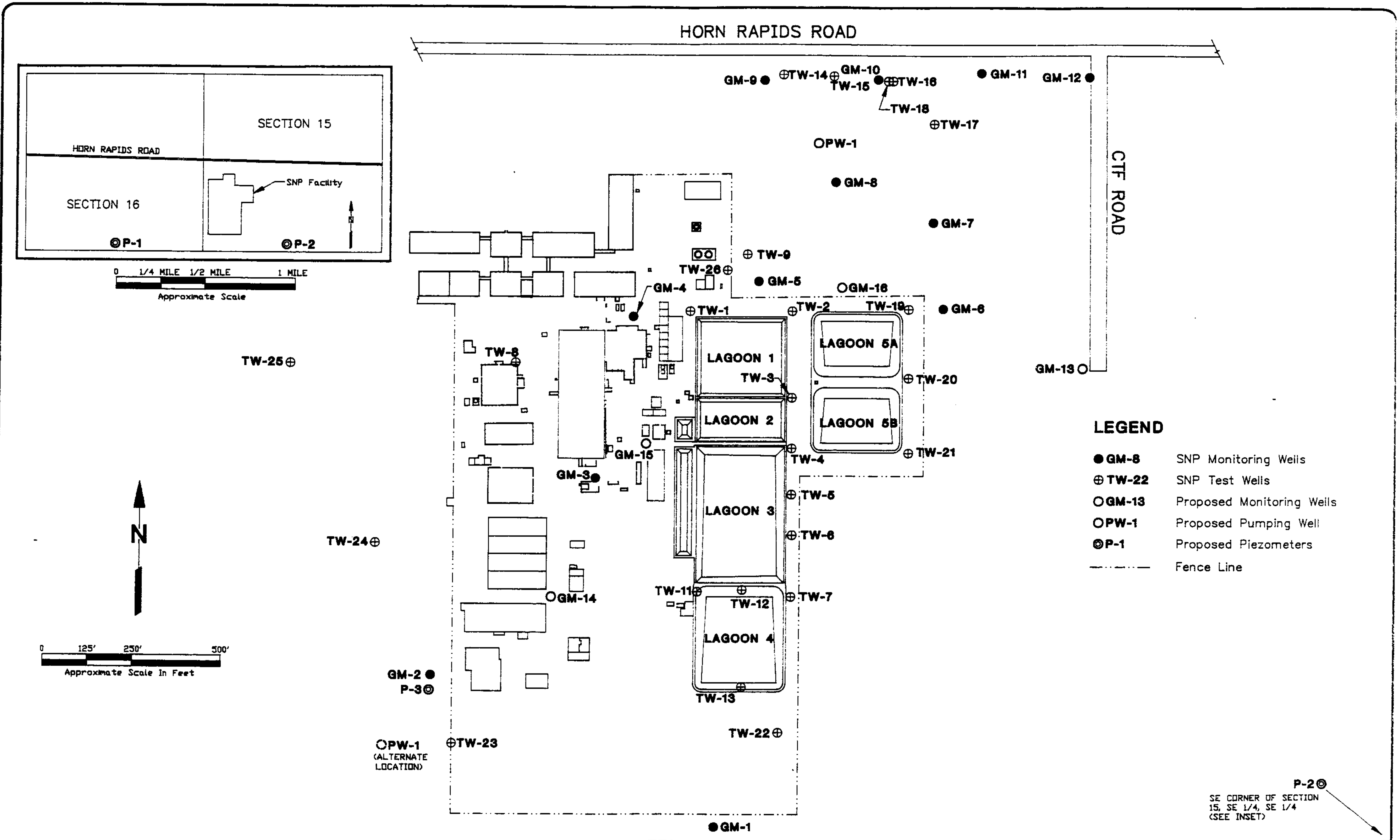
Richland, Washington 99352

FIGURE
8

DWG DATE: 02-17-92 | PRJCT NO.: WA183.03 | FILE NO.: WA183.03 | DRAWING: X | CHECKED: JB | APPROVED: LER | DRAFTER: CH

9 2 1 2 4 5 7 1 7 2 9



DWG DATE: 02-17-92 | PRJCT NO.: WA183.03 | FILE NO.: WA183.03 | DRAWING: X | CHECKED: JB | APPROVED: LER | DRAFTER: CH

9 2 1 2 4 5 7 1 7 5 0

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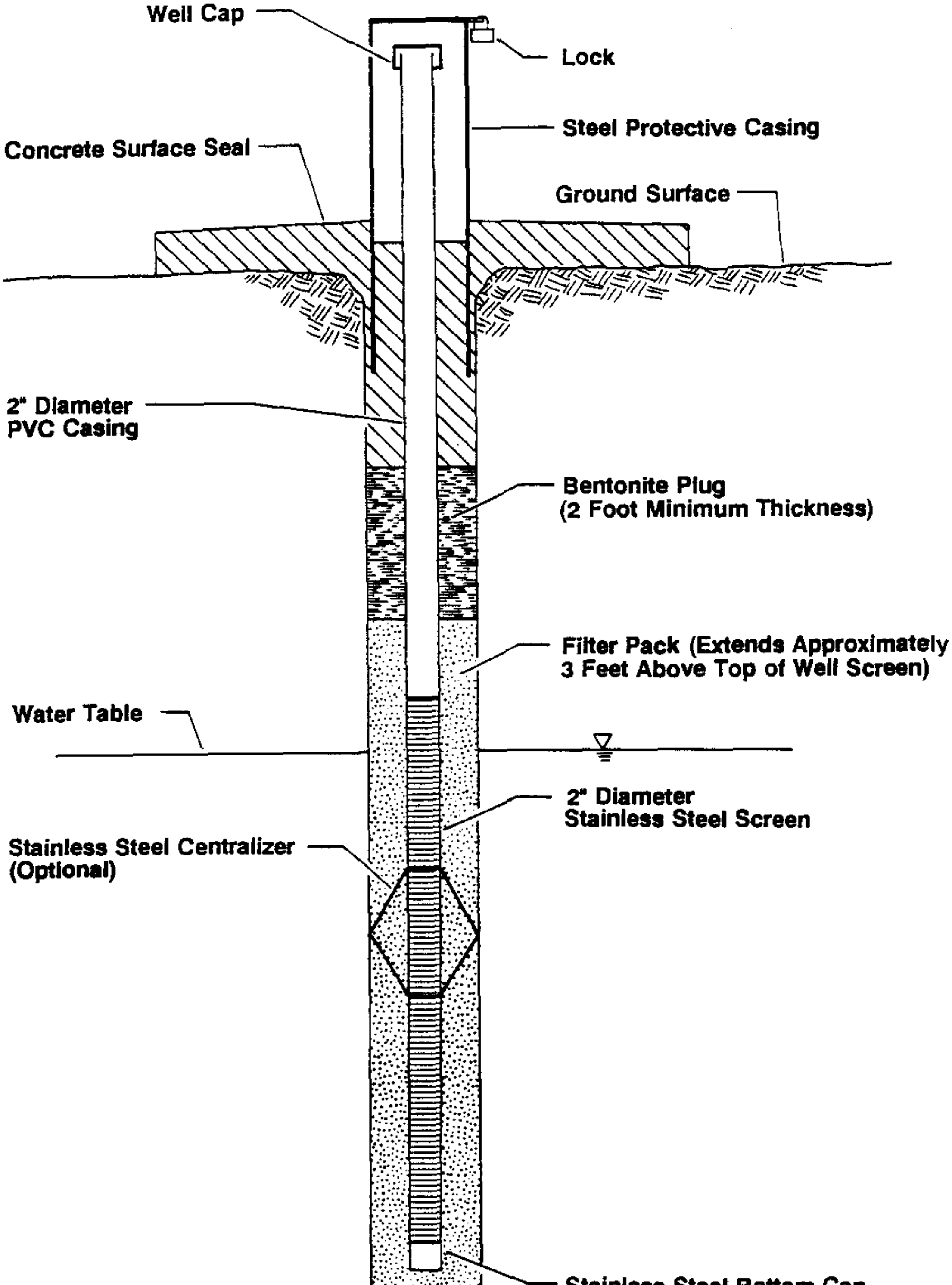
JOB #WA183.03

LOCATION OF PROPOSED WELLS

Siemens Nuclear Power Corporation
2101 Horn Rapids Road
Richland, Washington 99352

FIGURE 9

163135



NOT TO SCALE

DRAFTER: SAC | APPROVED: PJW | CHECKED: | DRAWING: | FILE NO.: | PRJCT NO.: WA183.03 | DWG DATE: JULY 1991

9 2 1 2 5 7 1 7 7

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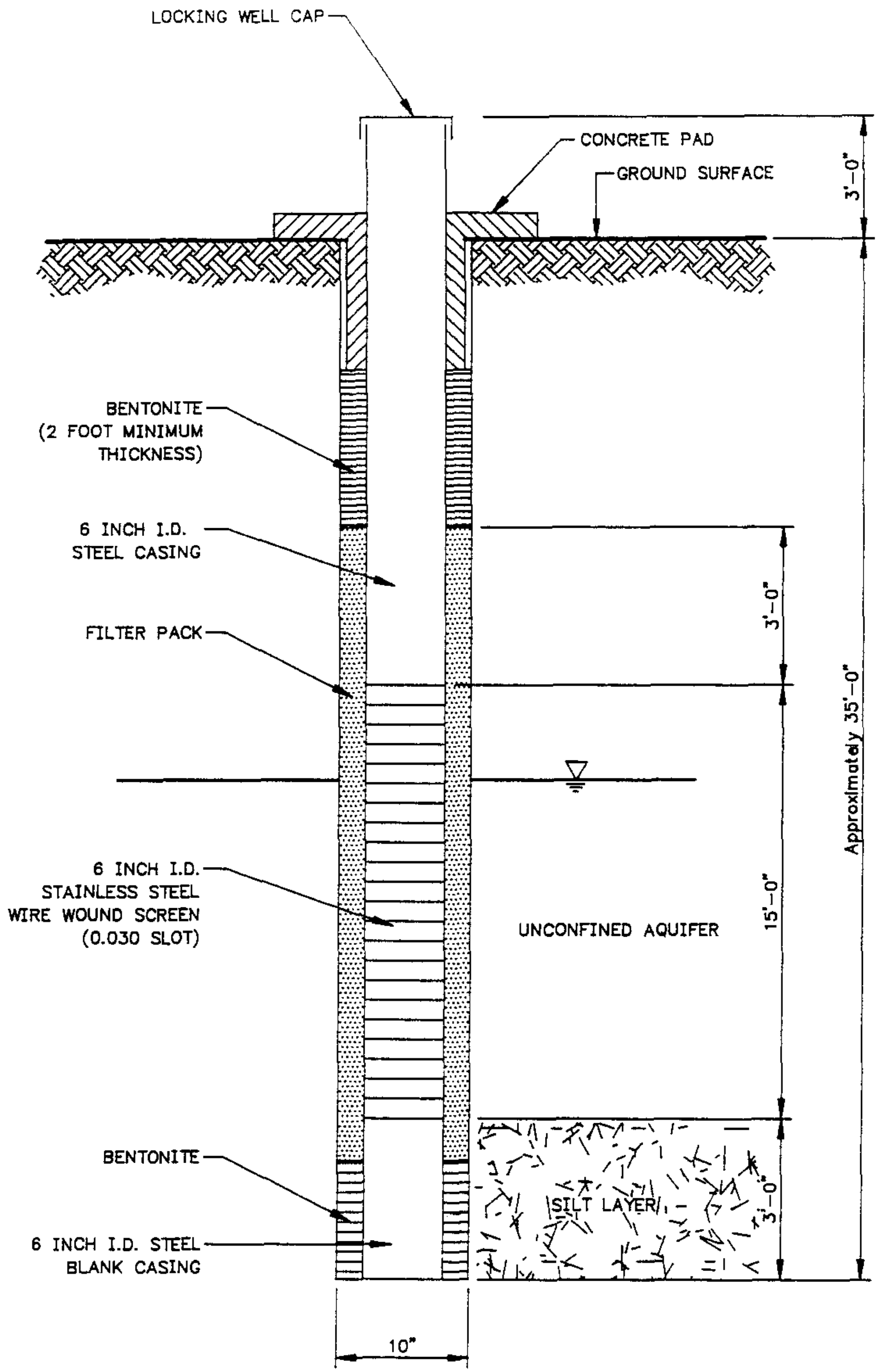
Environmental Services

PROPOSED GROUND-WATER MONITORING WELL CONSTRUCTION

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE **10**



DRAFTER: SMB
APPROVED: LER
CHECKED: JB
DRAWING: X
FILE NO.: WA183.03
PRJCT NO.: WA183.03
DWG DATE: 02-17-92

9 2 1 2 4 5 7 1 7 3 2

GERAGHTY & MILLER, INC.
Environmental Services

JOB #WA183.03

PROPOSED PUMPING WELL CONSTRUCTION

Siemens Nuclear Power Corporation
2101 Horn Rapids Road
Richland, Washington 99352

FIGURE
11

DWG DATE:	PRJCT NO.:	FILE NO.:	DRAWING:	CHECKED:	APPROVED:	DRAFTER:

9 2 1 2 3 5 7 1 7 3 3

PRELIMINARY SCHEDULE FOR PHASE II GROUND-WATER STUDY
Siemens Nuclear Power Corporation
Richland, Washington

Activity	Duration	March 1992					April 1992			
		Mar 1	Mar 8	Mar 15	Mar 22	Mar 29	Apr 5	Apr 12	Apr 19	Apr 26
Install / Develop Piezometers & Monitoring Wells	2.5w									
Install / Develop Pumping Well	2.5w									
Pumping Test	1w									
Develop & Calibrate Ground-Water Flow Model	12w									

Project: WA18306
File: I:\SNPC\WA18306\PH2GW.M
Date: 2/18/92

Critical | Progress | Summary
Noncritical | Milestone

GERAGHTY & MILLER, INC.
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PRELIMINARY SCHEDULE FOR PHASE II STUDY

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE
12

163135