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GROUNDWATER REMEDY EVALUATION AND FIELD VERIFICATION PLAN

FERNALD CLOSURE PROJECT
FERNALD, OHIO

FEBRUARY 2005

U.S. DEPARTMENT OF ENERGY

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REVISION 0, PCN 1
FINAL

REVISION SUMMARY

Revision	Date	Description of Revision
0	10-28-04	Final version of plan submitted to agencies, which includes comment responses.
0 PCN 1	1-26-05	Revised to include additional comment responses from Ohio Environmental Protection Agency.

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2.0 AQUIFER REMEDY WITH NO RE-INJECTION

This approach (designated Approach C) evolved from Scenario 2 of the Comprehensive Groundwater Strategy Report. For modeling purposes, Approach C was divided into five pumping rate periods, Table 2.1.1. Important modeling dates for these pumping periods are;

- 10/1/04, Begin construction of the CAWWT
- 4/1/05, Begin full-scale operation of CAWWT. CAWWT could be ready for operation as early as February 2005.
- 4/1/06, Begin operation of WSA Phase II wells
- 4/1/12, Model prediction that clean-up goals reached off property.

PCN 1 Approach C was developed assuming a groundwater treatment capacity of 800 gpm from SPIT and IAWWT. The CAWWT will provide a total treatment capacity of 1800 gpm. Initially, 1200 gpm of this capacity will be assigned to the treatment of groundwater and 600 gpm will be assigned to the treatment of storm water. At site closure in 2006, the full capacity of 1800 gpm will be assigned to treat groundwater, as storm water treatment will no longer be required. Although Approach C cannot serve as a final design for the remedy (not all components of the Aquifer Remedy have been determined yet and modeled treatment capacity is too low), it can be used to demonstrate cleanup without large-scale well-based re-injection. A final groundwater remedy design will be issued, pending outcome of field verification activities outlined in Section 5.

2.1 FLOW MODEL RESULTS

The large VAM3D model (120 x 112 x 12) was used to set boundary conditions for the smaller zoom model. For each pumping period, the large VAM3D model was run to steady state. Steady state head values from the large model at nodes closest to the zoom model boundary nodes were assigned to the zoom model using a FORTRAN program. The zoom model was then run to steady state with the constant head boundaries derived from the larger model.

As discussed in Section 3.2 of the Conceptual Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas (DOE 2000a), the large VAM3D flow model is calibrated to an October 1998 groundwater monitoring data set (nominal aquifer conditions). Validation was done to wet and dry season data sets from July 1998 and October 1999, respectively. Nominal corresponds to the October 1998 elevation data set. An explanation of how the nominal boundary conditions were derived can be found in the Great Miami Aquifer VAM3D Flow Model Recalibration Report, which was issued in 2000.

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2.2.2 Transport Model Source Terms

Operable Unit 5 remedial investigation/feasibility study source terms that correspond to sources in the Storm Sewer Outfall Ditch and WPRAP were retained in the model through year 2006. After 2006, these source terms were removed to reflect the complete remediation of all contaminated material at the Fernald Site.

2.2.3 Predicted Total Uranium Concentrations

Figures 2.2.8 through 2.2.16 show predicted total uranium concentrations in zoom model layers 11 and 12 at the end of each pumping period, under nominal flow boundary conditions. Concentrations are shown in zoom model layers 11 and 12 because these two layers contain most of the > 30 μg/L uranium plume. As seen in Figure 2.2.16, the total uranium concentrations in the aquifer are below 30 μg/L in 2020, except in a small area near the Pilot Plant Drainage Ditch. Total uranium concentrations in this area drop below 30 μg/L between 2022 and 2023.

PCN 1 ### 2.2.4 Ability to Meet Discharge Limits at the Parshall Flume

The ability to meet discharge limits at the Parshall Flume was assessed using "Test Pump". Test Pump is an excel spreadsheet that calculates a flow weighted discharge concentration, based on pre-defined treatment capabilities, extraction well uranium concentrations, and pumping rates. Groundwater treatment capacity will be limited to 700 gpm or less during the CAWWT construction time period. If discharge limits can be met during this time period then discharge limits will be met during the subsequent pumping periods when 1200 $^{+}$ gpm and eventually 1800 gpm are available for groundwater treatment. Table 5.1 illustrates that the discharge limits can be met during the CAWWT construction time period. The blended outfall concentration is predicted to be 26 ug/L and the mass of uranium per year to the river is predicted to be 589 pounds.

2.3 APPROACH C MODELING CONCLUSIONS

Modeling results indicate that the discharge limits in the OU5 Record of Decision can be met with pumping rates defined for Approach C. The Operable Unit 5 Record of Decision refers to a modeling scenario based on 28 wells operating 27 years, at a combined maximum pumping rate of 4000 gpm. Pumping rates for Approach C are presented in Table 2.1.1. The lowest net extraction rate for Approach C is 4275 gpm.

Particle path figures predict capture of the 30 μg/L uranium plume throughout the life of the aquifer remedy using the pumping rates defined for Approach C. These results are considered conservative in that Approach C only provides for 800 gpm groundwater treatment and up to 1800 gpm will actually be

Table of Residual Statistics between Observed Concentrations and Model Results

Well ID	Initial Model Conditions Developed from Observed Maximum Concentrations at Model Time 0 (3/31/02) (µg/L) *Used in the South Field Extraction System Phase II Modeling Report*	Observed Wellhead Total Uranium Concentration At 3/31/02 (µg/L)	Squared Residual Between Modeled and Observed Total Uranium Concentrations	Initial Model Conditions Developed from Observed Average Concentrations at Model Time 0 (12/31/03) (µg/L) *Used in the Groundwater Remedy Evaluation and Field Verification Plan*	Observed Wellhead Total Uranium Concentration At 12/31/03 (µg/L)	Squared Residual Between Modeled and Observed Total Uranium Concentrations
SP 3924	13.06	27.90	220.23	6.82	31.00	584.67
SP 3925	11.27	25.90	214.04	43.37	24.40	359.86
SP 3926	8.05	33.80	663.06	12.90	30.80	320.41
SP 3927	5.08	3.20	3.53	4.23	3.60	0.40
SP Opt 6	54.53	54.50	0.00	35.57	51.70	260.18
SP Opt 7	73.24	60.10	172.66	36.83	46.60	95.45
SF 17	50.85	28.00	522.12	39.28	29.80	89.87
SF 18	86.98	50.00	1367.52	32.07	43.30	126.11
SF 19	61.82	55.50	39.94	20.65	50.60	897.00
SF 20	51.16	47.20	15.68	22.79	40.10	299.64
SF 21	104.06	82.20	477.86	100.60	57.20	1883.56
SF 22	261.79	117.90	20704.33	21.11	70.90	2479.04
SF 23	138.17	150.10	142.32	109.50	101.40	65.61
SF 24	26.26	72.00	2092.15	16.20	67.00	2580.64
SF 25	126.51	55.50	5042.42	213.14	44.80	28338.36
WSA 1	86.87	143.30	3184.34	95.62	74.00	467.42
WSA 2	35.57	200.40	27168.93	28.08	81.00	2800.53
WSA 4	34.08	172.70	19215.50	43.67	45.60	3.72
		Sum of Squared Residuals	81246.65		**Sum of Squared Residuals**	41652.48
		Average Squared Residual	4513.70		**Average Squared Residual**	2314.03
		Average Residual	67.18		**Average Residual**	48.10

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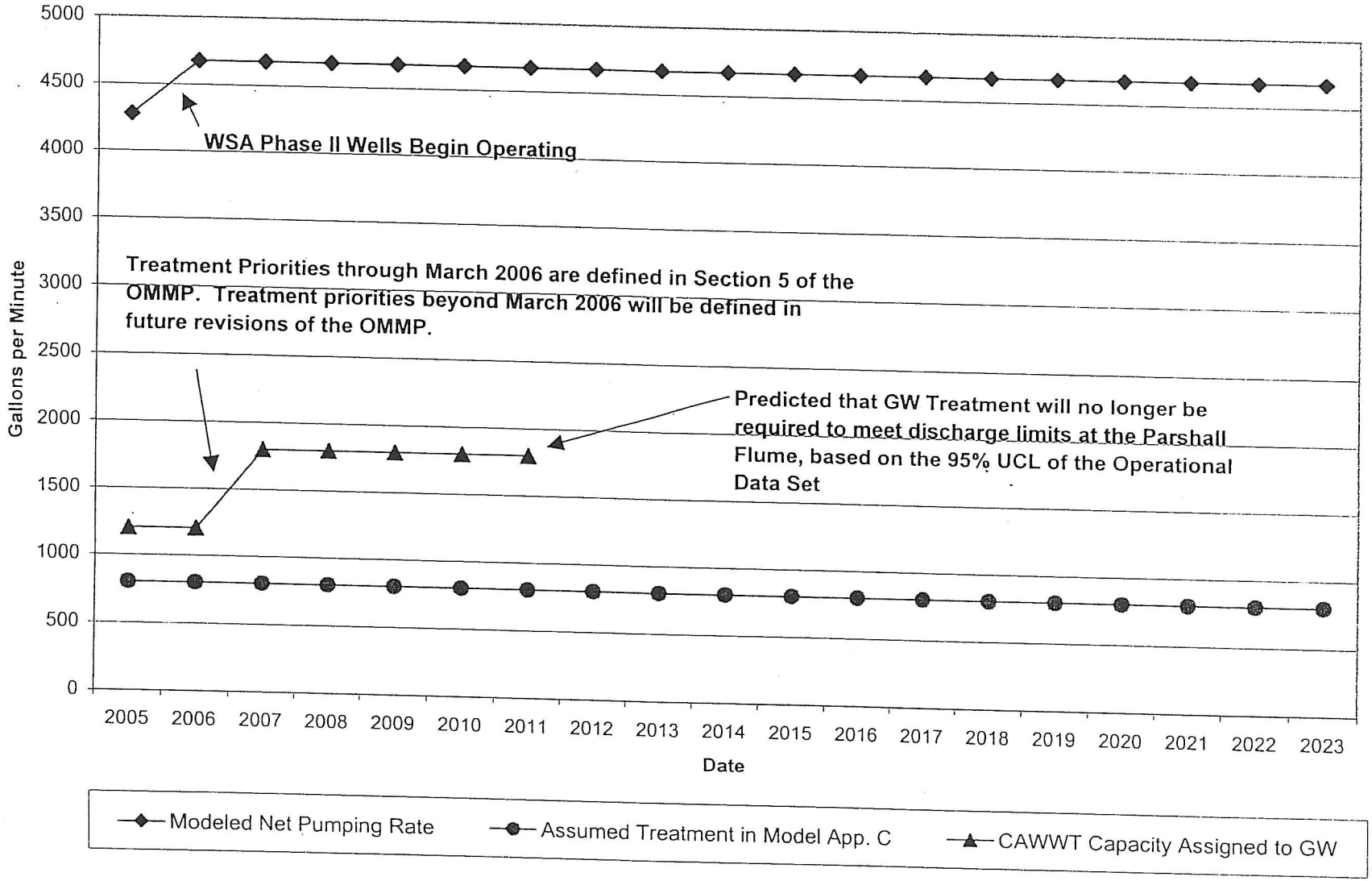
Groundwater Modeling Approach C
Modeled Net Pumping Rate Versus Predicted Treatment



3.0 AQUIFER REMEDY WITH INDUCED RECHARGE THROUGH THE SSOD

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For modeling purposes, this approach is referred to as Approach C-Improved. Approach C-Improved enhances Approach C by adding 500 gpm of additional recharge down the SSOD. If implemented, groundwater pumped from construction wells, located on the east side of the Fernald Site property, would be conveyed to the head of the northeastern fork of the SSOD and allowed to flow into the SSOD at a rate of 500 gpm see Figure 3.1

PCN 1 Approach C-Improved was also modeled assuming a groundwater treatment capacity of 800 gpm. For the same reasons discussed in Section 2 for Approach C, Approach C-Improved cannot serve as a final design for the remedy (not all components of the Aquifer Remedy have been determined yet and modeled treatment capacity is too low), but it can be used to demonstrate how the remedy will respond if an induced recharge of 500 gpm through the SSOD is added to the clean-up operation.

3.1 FLOW MODEL RESULTS

The procedure used to model flow in Approach C was also used for Approach C-Improved. The large VAM3D model was used to set boundary conditions for the smaller zoom model. For each pumping time period, the large VAM3D model was run to steady state. Steady state head values from the large model at nodes closest to the zoom model boundary nodes were assigned to the zoom model using a FORTRAN program. The zoom model was then run to steady state with the constant head boundaries derived from the larger model.

Pumping rates for Approach C-Improved are provided in Table 3.1.1. The first two pumping periods (1/1/04 to 10/1/04 and 10/1/04 to 4/1/05) have the same pumping rates as those defined for Approach C (See Section 2). Pumping rates in the last three time periods differ from those defined for Approach C in that Approach C-Improved contains induced recharge through the SSOD at a rate of 500 gpm and some higher pumping rates. The pumping rates in the last three pumping periods of Approach C-Improved are higher than the last three pumping periods of Approach-C because induced recharge into the SSOD allows more pumping from the aquifer without increasing the net extraction rate from the aquifer.

Predicted groundwater elevations for the Approach C-Improved design are shown for nominal boundary conditions in Figures 3.1.1 through 3.1.3 for the last three pumping periods for Approach C-Improved, Model Layer 12. Figures 3.1.4 through 3.1.6 show 10-year time-of-travel, non-retarded, particle paths for the last three pumping periods. The particles modeled for these figures were seeded in the same manner as for Approach C. The 30 μg/L uranium plume shown in Figures 3.1.4 through 3.1.5 is the same

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area near the Pilot Plant Drainage Ditch. Total uranium concentrations in this area drops below 30 µg/L between 2021 and 2022. Concentrations are shown in zoom model layers 11 and 12 because these two layers contain most of the 30 µg/L uranium plume.

3.2.4 Ability to Meet Discharge Limits at the Parshall Flume

The ability to meet discharge limits at the Parshall Flume was assessed using "Test Pump". Test Pump is an excel spreadsheet that calculates a flow weighted discharge concentration based on pre-defined treatment capabilities, extraction well uranium concentrations, and pumping rates. Table 5.3 illustrates that the discharge limits will not be met during the CAWWT construction time period. The blended outfall concentration is predicted to be 30.6 µg/L and the mass of uranium per year to the river is predicted to be 802 pounds.

3.3 APPROACH C-IMPROVED MODELING CONCLUSIONS

Modeling results indicate that the Operable Unit 5 Record of Decision established target-pumping rate of 4000 gpm can be met or exceeded using Approach C-Improved. Table 3.1.1 lists pumping rates for Approach C-Improved. The lowest net extraction rate for Approach C-Improved is 4565 gpm.

PCN 1 Modeling results indicate that the OU5 Record of Decision established discharge limits would not be met with pumping rates defined for Approach C-Improved when the CAWWT is operational. This reflects a modeled groundwater treatment capacity of 800 gpm; when initially a 1200 gpm groundwater treatment capacity will actually be available, and an 1800 gpm groundwater treatment capacity will be available after site closure in 2006. The field verification exercise in Section 5 will be used to demonstrate what pumping rates should be used for Approach C-Improved that will achieve best capture of the 30 µg/L uranium plume. Once these new rates are modeled using actual available treatment capacities it is felt that discharge limits will be safely met.

Particle path figures predict capture of the 30 µg/L uranium plume throughout the life of the aquifer remedy using the pumping rates defined for Approach C-Improved. These results are considered conservative in that Approach C-Improved only provides for 800-gpm groundwater treatment capacity and more groundwater treatment capacity (1200 gpm) is actually being targeted. This means that higher pumping rates could actually be achieved which should increase capture.

Modeled aquifer cleanup for Approach C-Improved occurs between 2021 and 2022.

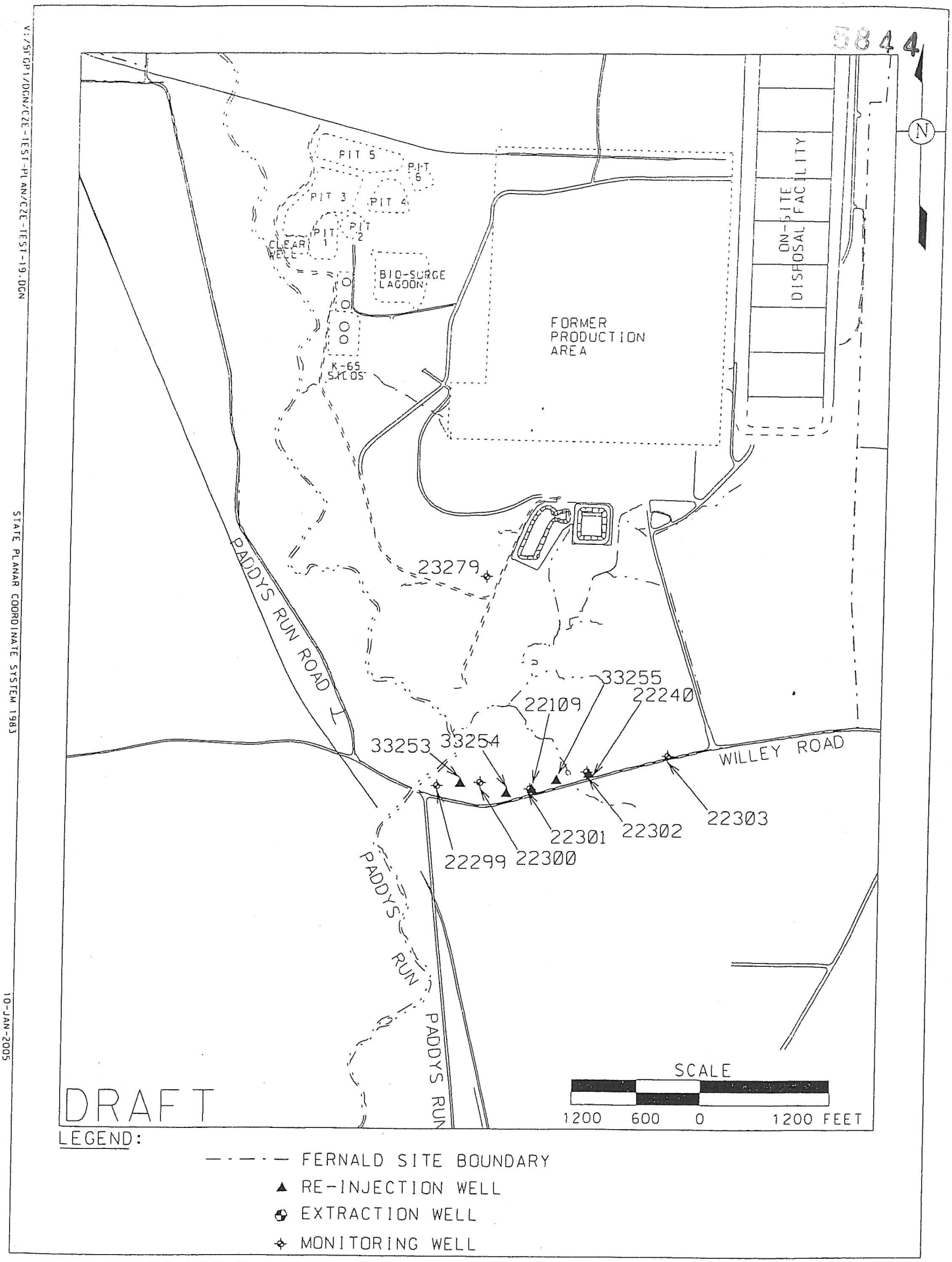

FIGURE 5.1. LOCATION MAP FOR PART-1 FIELD VERIFICATION