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REV. 0

United States Department of Energy

LONG-TERM SURVEILLANCE PLAN FOR THE TUBA CITY, ARIZONA DISPOSAL SITE

September 1996

Uranium Mill Tailings Remedial Action Project

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LONG-TERM SURVEILLANCE PLAN FOR THE TUBA CITY, ARIZONA, DISPOSAL SITE

September 1996

This document supersedes UMTRA-DOE/AL-350218.0000.

Prepared for
U.S. Department of Energy
Environmental Restoration Division
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LIST OF ACRONYMS

Acronym	Definition
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
LTSP	long-term surveillance plan
NRC	U.S. Nuclear Regulatory Commission
POC	point of compliance
QA	quality assurance
QC	quality control
RAP	remedial action plan
RRM	residual radioactive material
TDS	total dissolved solids
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act
U.S. 160	U.S. Highway 160
USGS	U.S. Geological Survey

CHANGE HISTORY

Document version	Date	Pages/comments
Rev. 0, Ver. 1	2/10/9	Initial version of final.
Rev. 0, Ver. 2	2/12/96	Addressed NRC comments on ground water monitoring; transferred document from HTI to In-house.
Rev. 0, Ver. 3	2/19/96	Author and client comments incorporated into edited document. Single-spaced in preparation for signoff.
Rev. 0, Ver. 4	9/23/96	Addressed NRC comments on ground water monitoring, POC monitoring for Sub Part A compliance.

5.0 GROUND WATER MONITORING

The Tuba City disposal cell is designed to provide long-term protection against future ground water contamination downgradient from the site and to comply with the final EPA ground water protection standards in Subpart A of 40 CFR Part 192 (1995). The residual radioactive materials (RRM) from the Tuba City site were stabilized in place with remedial action completed in 1990. Consequently, ground water contamination related to uranium processing activities prior to surface remedial action is still present beneath and downgradient from the site. Transient drainage (a component of disposal cell design), and periodic infiltration of surface runoff from the cell cover via the south and southwest aprons may impact ground water beneath and downgradient from the disposal site. Planned contaminant containment activities to be initiated at the downgradient edge of the disposal cell late in 1996 will also impact ground water quality in the uppermost aquifer. All of these conditions limit the effectiveness of normal point of compliance (POC) monitoring of ground water in the uppermost aquifer as a reliable indicator of disposal cell performance.

The DOE plans to perform evaluative monitoring of ground water in the uppermost aquifer to evaluate trends in ground water quality, monitor the downgradient extent of contamination in ground water, analyze the impacts of transient drainage and surface runoff, and assess the effects of ground water restoration measures associated with containing the contamination related to uranium processing activities. The evaluative monitoring well network will consist of three monitor wells adjacent to the south apron on the downgradient edge of the disposal cell, one upgradient background monitor well, two baseline monitor wells within the area of contamination, and one monitor well downgradient from the edge of the contamination. Additional monitor wells may be installed by the DOE as required to effectively monitor ground water conditions at the site. The evaluative monitoring described in the LTSP will be carried out in conjunction with UMTRA Ground Water Project activities, and will be protective of human health and the environment.

Application for Subpart A licensing of the Tuba City disposal cell will be submitted with the condition that the need for ground water monitoring at a POC for Subpart A compliance be assessed and implemented after completion of Subpart B activities. The long-term monitoring program at the Tuba City site is outlined in this LTSP, which will function as the concurrence document for the Subpart A licensing process.

5.1 GROUND WATER CHARACTERIZATION

Ground water in the vicinity of the Tuba City site was characterized to establish baseline conditions for ground water quality prior to disposal cell closure. Statistical methods were applied to evaluate ground water quality and resultant trends over time. This document summarizes ground water conditions; details are available in other Tuba City site documents, including Appendix D of the RAP (DOE, 1989), and the water sampling and analysis plan (DOE, 1996).

5.1.1 Hydrogeologic setting

Near-surface geologic formations at the Tuba City site are part of the Glen Canyon Group, which is composed of (in descending order from land surface) the Navajo Sandstone, the Kayenta Formation, and the Moenave Formation. The Navajo Sandstone is a fine- to medium-grained sandstone unit locally cemented with carbonate and displaying large-scale crossbeds. The Navajo Sandstone is approximately 430 ft (130 m) thick in the site vicinity. It intertongues with the underlying Kayenta Formation in a zone as much as 300 ft (90 m) thick. The Kayenta Formation consists of interbedded fine-grained sandstone and mudstone. The bedding is lenticular and cross-bedding is common in the sandy units. The Moenave Formation consists of very fine- to fine-grained sandstone and thin siltstone strata (DOE, 1989).

The Navajo Sandstone is the major aquifer in the Tuba City site vicinity and with the underlying Kayenta Formation, makes up what is referred to as the "N-aquifer" of the region (Cooley et al., 1969). There is no continuous hydraulic barrier to ground water flow between the Navajo Sandstone and Kayenta Formation (DOE, 1989). The lower boundary of the N-aquifer occurs at the contact between the Kayenta and Moenave Formations. Although overlain by the Carmel Formation and a silty member of the Entrada Sandstone, which created confined aquifer conditions in many areas, the N-aquifer is unconfined in the Tuba City area (Harshbarger et al., 1957). The major recharge area for the N-aquifer is in the vicinity of Shonto, about 40 mi (64 km) north of Tuba City (Eychaner, 1983). Ground water flow diverges from the recharge area, flowing northeast toward Laguna Creek and south toward Tuba City and Moenkopi Wash. Local infiltration, including Greasewood Lake (dry), undoubtedly provides some recharge in the site area.

The depth to the water table in the Navajo Sandstone ranges from about 20 to 150 ft (6 to 45 m) below land surface in the site vicinity. Figures 5.1 and 5.2 show the shallow ground water table surface and deeper potentiometric surface determined for wells completed in the Navajo Sandstone at the site. The ground water table gradient is to the southeast toward Moenkopi Wash. Springs occurring on both sides of Moenkopi Wash indicate the N-aquifer discharges to the wash (USGS, 1969). Hydraulic conductivity in the Navajo Sandstone (based on slug tests performed in eight monitor wells) ranged from 50 to 900 ft (15 to 270 m) per year, with a geometric mean of 160 ft (50 m) per year. The average linear ground water velocity ranged from 10 to 200 ft (3 to 60 m) per year with a geometric mean of 30 ft (10 m) per year, assuming a hydraulic gradient of 0.04, and an effective porosity of 0.2 (Freeze and Cherry, 1979; DOE, 1989).

Ground water levels have been relatively consistent over time, generally fluctuating less than two feet per year. An exception was a water level increase of about four feet in monitor well 906 just south of the disposal cell in 1993. The cause of this increase may very likely be related to focused infiltration of precipitation runoff from the disposal cell during 1992 and 1993.

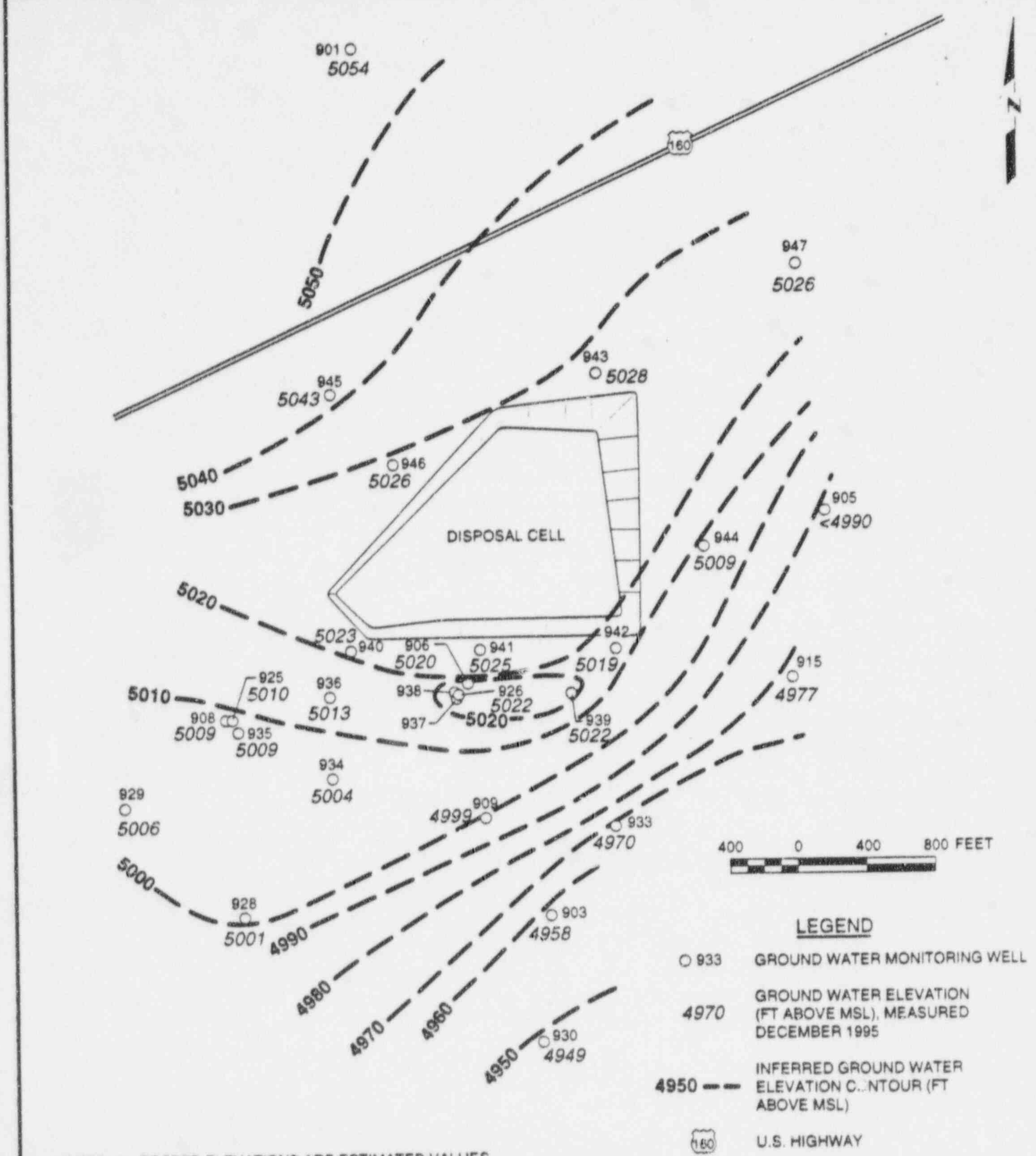
The years 1992 and 1993 were very wet in the Tuba City area with average annual precipitation of 11.6 and 10.8 inches, respectively, versus normal precipitation of approximately 5.0 inches. The water level in this monitor well has subsequently shown a declining trend. Monitor well 906 is the only site monitor well that appears to be affected by disposal cell runoff.

5.1.2 Ground water quality

Ground water quality at the Tuba City site has been determined by collecting and analyzing ground water samples from a network of DOE monitor wells (Figure 5.3). The current network of wells at the site consists of 38 monitor wells, including three disposal cell wells (940, 941, and 942); four extraction wells (925, 926, 936, and 939), and one deep test well (948). Additionally, the former Rare Metals Corporation of America water supply wells (968, 970, 971, and 972) are located north of U.S. 160. Seventeen monitor wells, the four extraction wells, the water supply well, and the disposal cell wells were installed in late 1995 and were sampled for the first time in December 1995.

Background ground water quality

Background ground water quality is defined as the quality of ground water that would exist if uranium processing activities had not occurred. Background ground water quality in the N-aquifer has been established using data collected from monitor wells 901, 910, and 917. Monitor wells 901 and 910 are upgradient from the disposal site and monitor well 917 is crossgradient from the disposal cell.



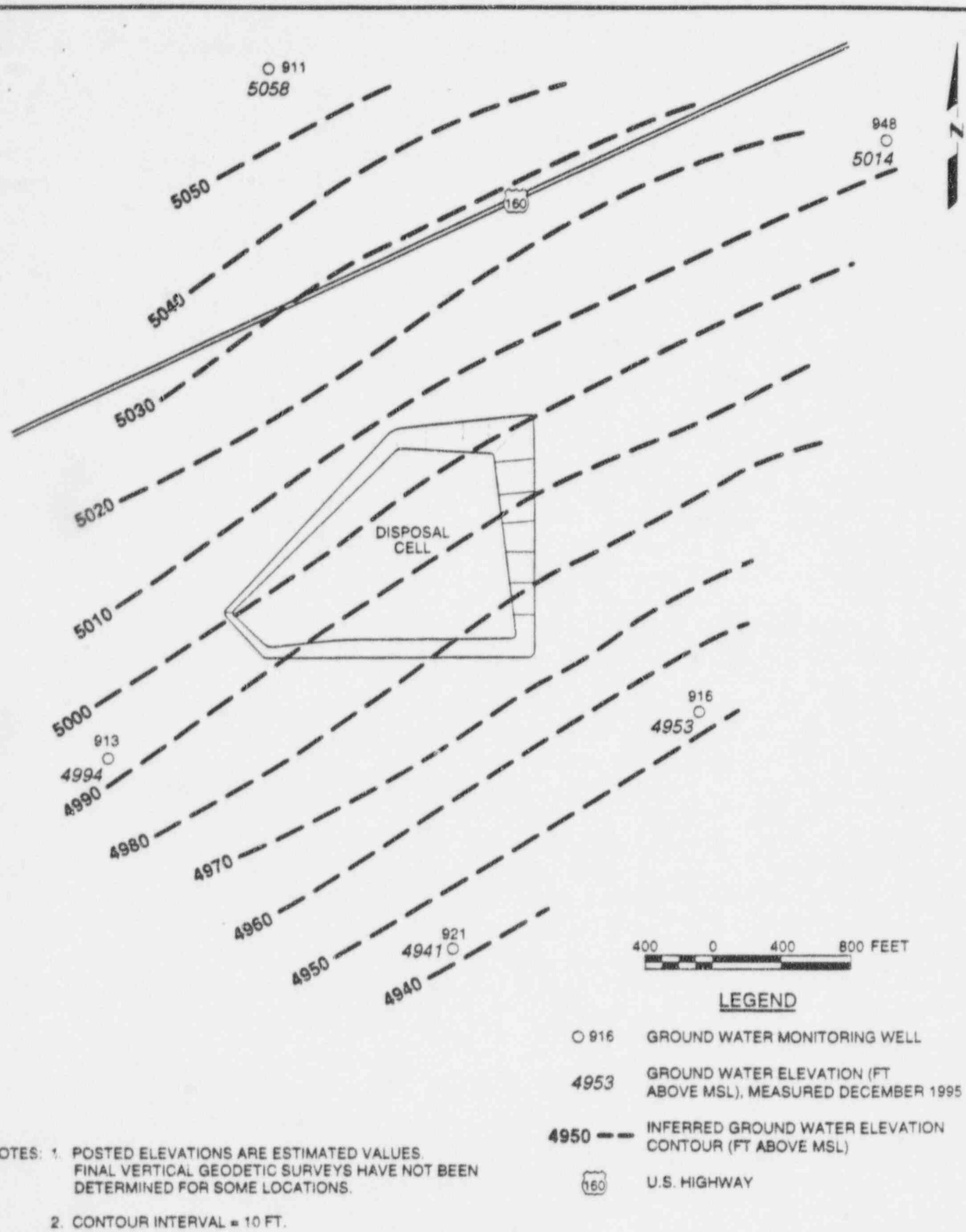
NOTES: 1. POSTED ELEVATIONS ARE ESTIMATED VALUES. FINAL VERTICAL GEODETIC SURVEYS HAVE NOT BEEN DETERMINED FOR SOME LOCATIONS.

2. CONTOUR INTERVAL = 10 FT.

FIGURE 5.1
ESTIMATED WATER TABLE ELEVATION CONTOUR MAP OF SHALLOW NAVAJO SANDSTONE AQUIFER TUBA CITY PROCESSING SITE/DISPOSAL SITE

MAC: SITE/TUB/LTSP/WTRTBLSHALLOW

TUB LTSP



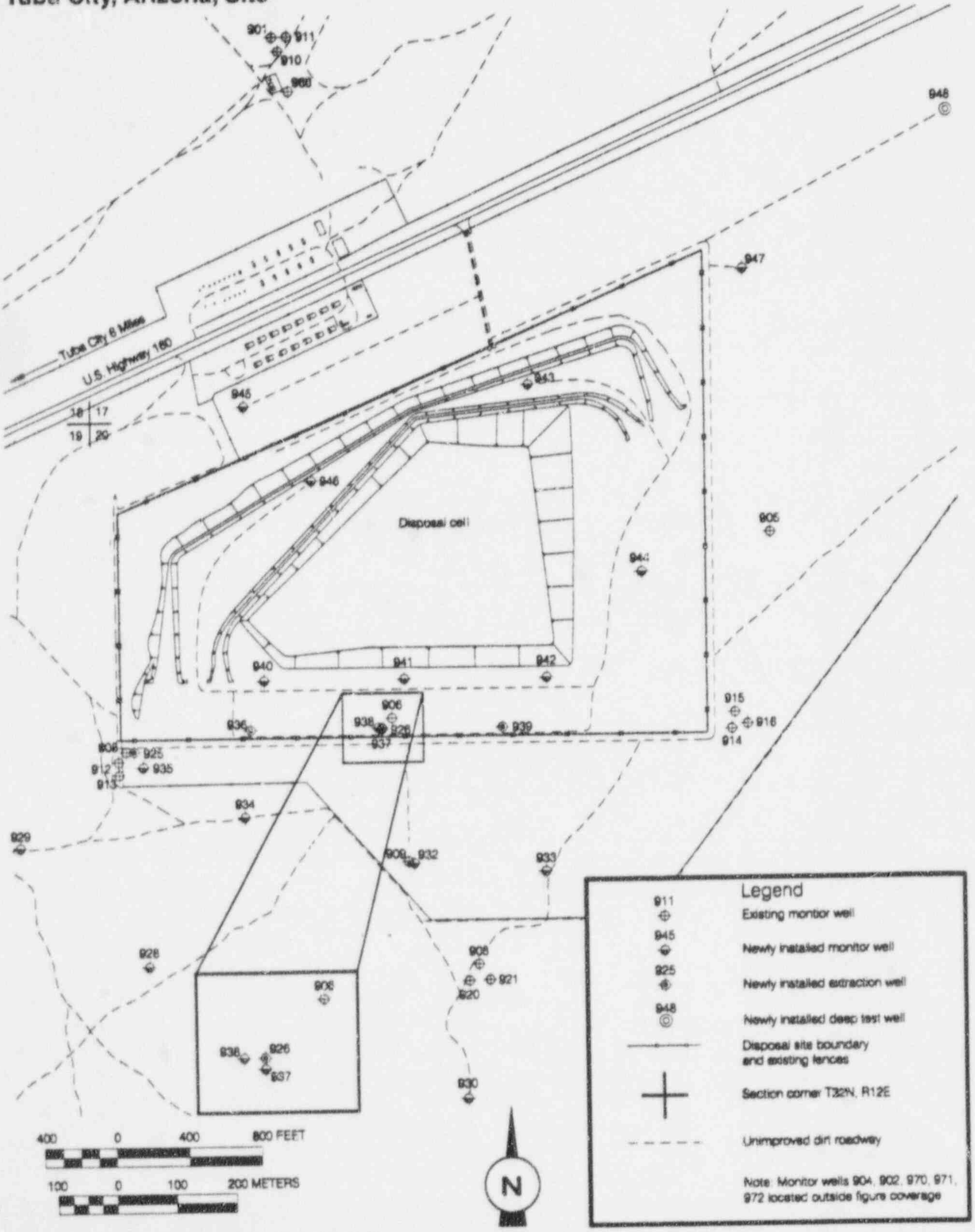
NOTES: 1. POSTED ELEVATIONS ARE ESTIMATED VALUES. FINAL VERTICAL GEODETIC SURVEYS HAVE NOT BEEN DETERMINED FOR SOME LOCATIONS.

2. CONTOUR INTERVAL = 10 FT.

FIGURE 5.2
ESTIMATED POTENTIOMETRIC SURFACE OF DEEP NAVAJO SANDSTONE AQUIFER TUBA CITY PROCESSING SITE/DISPOSAL SITE

AC: SITE/TUB/LTSP/POTENDEEP TUB LTSP

Figure 5.3
Ground Water Monitor Well, Extraction Well, and Deep Test Well Locations Tuba City, Arizona, Site



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Background ground water quality has been characterized from ground water samples collected between 1988 and 1991. Background ground water quality in the N-aquifer is characterized as calcium bicarbonate or sodium bicarbonate water with low total dissolved solids (TDS) (450 milligrams per liter [mg/L] or less) and slightly basic pH. Table 5.1 presents a statistical summary of background ground water quality.

Baseline ground water quality

Baseline ground water quality was established for the Tuba City site as a way to evaluate disposal cell performance because surface remedial action at the Tuba City site involved stabilization in place (RRM was not removed from its original location). Determination of baseline conditions is required because activities associated with uranium milling operations have degraded ground water quality beneath and downgradient from the disposal cell to the extent that hazardous constituent concentrations are greater than background. In some locations, these concentrations exceed the maximum concentration limits (MCL) specified in 40 CFR §192.02(a)(1995). Consequently, background ground water quality and MCLs are not appropriate for determining the concentration limits needed to evaluate disposal cell performance.

Baseline ground water quality conditions for the Tuba City site were defined statistically and are summarized in Table 5.2. Water quality data for 1988 to 1991 from monitor wells 906, 908, 909, and 912 were used to define baseline conditions. In general, most inorganic constituents (with and without MCLs) at these locations were present at concentrations comparable to background. However, nine constituents (cadmium, lead, molybdenum, nitrate, selenium, tin, uranium, zinc, and net gross alpha) were determined to have concentrations that statistically exceed background.

5.1.3 Extent of contamination

Residual radioactive materials at the Tuba City site were stabilized in place. Ground water in the uppermost aquifer was contaminated by uranium processing activities which occurred from 1956 until 1966, and from residual drainage until completion of surface remedial activities in 1990. Site-related contaminants in ground water have been detected at least 1500 feet downgradient from the processing site and include molybdenum, nitrate, selenium, strontium, sulfate, and uranium. Concentrations of these constituents have remained relatively constant over time, except for an increase in concentrations of uranium, nitrate, and sulfate noted during 1993 in monitor well 906, coincident with the rise in ground water level. After peaking in 1993, concentrations have generally declined through the last ground water sampling round in mid-1995.

The sources of contaminants in ground water and reasons for recent variations in concentrations are not well established, but could be related to the following conditions:

- Concentrations of existing constituents in ground water (those present prior to disposal cell closure) may increase temporarily as recharge is eliminated from the cell footprint as a result of the thick low-permeability cover.
- The contribution of contaminants in transient drainage is a possibility, but probably does not represent a significant and long-term source. The slimes were composed of very fat clays and are not significantly covered by other materials, and thus were not subjected to loading to the point where massive amounts of water were ejected. Transient drainage would possibly have been released relatively quickly, and may not even have been detected by the existing ground water monitoring program. Much of it may have remained in the vadose zone.
- The possible contribution of contaminants caused by infiltration of runoff from the disposal cell cover (approximately 40 acres) collecting in the south and southwest aprons and percolating through remnants of the holding ponds (with a possible source of contaminants in the vadose zone) may be substantial in years of elevated precipitation (1992/1993), particularly in the vicinity of monitor well 906, which is installed in close proximity to the apron and holding ponds.

Contaminated ground water in the uppermost aquifer near the source area (represented by monitor well 906) is characterized by nitrate concentrations at 1310 mg/L, sulfate at 3640 mg/L, and TDS at 7100 mg/L. Ground water quality at the fringe of the contaminated area (represented by monitor well 903, approximately 1400 ft (427 m) south of well 906) is characterized by nitrate concentrations at 43 mg/L, sulfate at 37 mg/L, and TDS at 268 mg/L (DOE, 1996).

Figure 5.4 gives the locations of cross sections showing the vertical distribution of nitrate, sulfate, TDS, and uranium (Figures 5.5 and 5.6). Contaminant migration appears to be contained vertically, with constituents concentrated in the upper 50 ft (15 m) of the aquifer. The monitor well cluster 908, 912, and 913 appears to provide evidence of contaminant stratification, with nitrate concentrations ranging from 1200 mg/L in the shallowest well (908) to virtually background in the deepest well (913). The stratification of contaminants within

Table 5.1 Statistical summary of background ground water quality, Tuba City, Arizona, site

Constituent	MCL (mg/L)	Number of samples	Detection limit[a]	Percentage above detection limit	Minimum	Median	Maximum
EPA inorganics with MCLs							
Arsenic	0.05	18	0.001 - 0.01	0	BD	BD	BD
Barium	1.0	18	0.0013-0.1	72	0.063	0.092	0.10
Cadmium	0.01	18	0.001	0	BD	BD	BD
Chromium	0.05	24	0.0032-0.01	4	BD	BD	0.0039[b]
Lead	0.05	24	0.0017-0.01	8	BD	BD	0.0035[b]
Mercury	0.002	12	0.0002	0	BD	BD	BD
Molybdenum	0.10	24	0.0048-0.01	0	BD	BD	BD
Net gross alpha (pCi/L)	15	24	NA	NA	0.0	1.42	5.56
Nitrate	44	24	0.1-1.0	100	10.9	15.0	21.7
Ra-226 & Ra-228 (pCi/L)	5	24	NA	NA	0.0	0.6	3.6
Selenium	0.01	24	0.0016-0.005	0	BD	BD	BD
Silver	0.05	12	0.01	0	BD	BD	BD
Uranium	0.044	24	0.0003-0.003	75	0.0006	0.0014	0.012

Table 5.1 Statistical summary of background ground water quality, Tuba City, Arizona, site (Concluded)

Constituent	Number of samples	Detection limit[a]	Percentage above detection limit	Minimum	Median	Maximum
Appendix IX inorganic constituents without MCLs[c]						
Antimony	9	0.003	11	BD	BD	0.007
Beryllium	12	0.005-0.010	0	BD	BD	BD
Cobalt	12	0.03-0.05	0	BD	BD	BD
Copper	12	0.01-0.02	0	BD	BD	BD
Cyanide	12	0.01	0	BD	BD	BD
Nickel	18	0.0061-0.04	0	BD	BD	BD
Sulfide	12	0.1	33	BD	BD	1.2
Thallium	12	0.01-0.1	0	BD	BD	BD
Tin	18	0.005	0	BD	BD	BD
Vanadium	24	0.0051-0.01	92	0.0076	0.012	0.03
Zinc	24	0.0026-0.005	63	0.017	BD	0.056

[a]Detection limits vary for parameters because of differences in sample analysis procedures over time (1988 to 1991).
[b]Maximum value reported above detection limit.
[c]From 40 CFR Part 264.

Notes: 1. Data from upgradient wells TUB-01-0[illegible] -0910, and -0917, collected from 1988 to 1991.
2. Measurements are in milligrams per lit[illegible]ept as noted.

BD – below detection.
NA – not applicable for combined radiological parameters.
pCi/L – picocuries per liter.

Table 5.2 Baseline statistical summary of ground water quality of monitor wells screened in the contaminant plume, Tuba City, Arizona, site

Constituent	MCL (mg/L)	Number of samples	Detection limit[a]	Percentage above detection limit	Minimum	Median	Maximum
EPA inorganics with MCLs							
Arsenic	0.05	32	0.01-0.05	13	BD	BD	0.017[b]
Barium	1.0	28	0.0013-0.1	36	BD	BD	0.08[b]
Cadmium	0.01	32	0.001	19	BD	BD	0.004
Chromium	0.05	40	0.0032-0.01	13	BD	BD	0.18
Lead	0.05	40	0.0017-0.011	15	BD	BD	0.02
Mercury	0.002	20	0.0002	0	BD	BD	BD
Molybdenum	0.10		0.0048-0.01				
906		10		70	BD	0.025	0.12
908		10		20	BD	BD	0.12
909		10		20	BD	BD	0.04
912		10		20	BD	BD	0.02
Net gross alpha (pCi/L)	15	40	NA	NA	0.0	14	147
Nitrate	44		0.10-1.0				
906		10		100	770	992	1200
908		10		100	620	860	1100
909		10		100	710	890	1070
912		10		100	189	288	383
Ra-226 & Ra-228 (pCi/L)	5	40	NA	NA	0.0	0.9	11
Selenium	0.01		0.0016-0.03				
906		10		40	BD	BD	0.018[b]
908		10		100	0.005	0.022	0.039
909		10		50	BD	0.007	0.013[b]
912		10		40	BD	BD	0.009[b]
Silver	0.05	20	0.01	0	BD	BD	BD
Uranium	0.044		0.0003-0.003				
906		10		100	0.502	0.615	0.990
908		10		100	0.082	0.113	0.167
909		10		100	0.043	0.055	0.085
912		10		100	0.022	0.030	0.046

Table 5.2 Baseline statistical summary of ground water quality of monitor wells screened in the contaminant plume, Tuba City, Arizona, site (Concluded)

Constituent	Number of samples	Detection limit[a]	Percentage above detection limit	Minimum	Median	Maximum
Appendix IX inorganic constituents without MCLs[c]						
Antimony	12	0.003-0.006	0	BD	BD	BD
Beryllium	20	0.005-0.01	0	BD	BD	BD
Cobalt	20	0.03-0.05	0	BD	BD	BD
Copper	20	0.01-0.02	10	BD	BD	0.01[b]
Cyanide	20	0.01	5	BD	BD	0.02
Nickel	28	0.0061-0.04	18	BD	BD	0.45
Sulfide	20	0.1	20	BD	BD	8.5
Thallium	20	0.01-0.10	15	BD	BD	0.10
Tin	28	0.005-0.05	25	BD	BD	0.057
Vanadium	40	0.0051-0.01	65	0.007	0.01	0.10
Zinc	40	0.0026-0.01	68	BD	0.011	0.617

[a]Detection limits vary for parameters because of differences in sample analysis procedures over time (1988 to 1991).
[b]Maximum value reported above detection.
[c]From 40 CFR Part 264.

Notes: 1. Data are from monitor wells TUB-01-0906, -0908, -0909, and -0912, collected from 1988 to 1991.
2. Measurements are in milligrams per liter except as noted.

BD – below detection.
NA – not applicable for combined radiological parameters.
pCi/L – picocuries per liter.

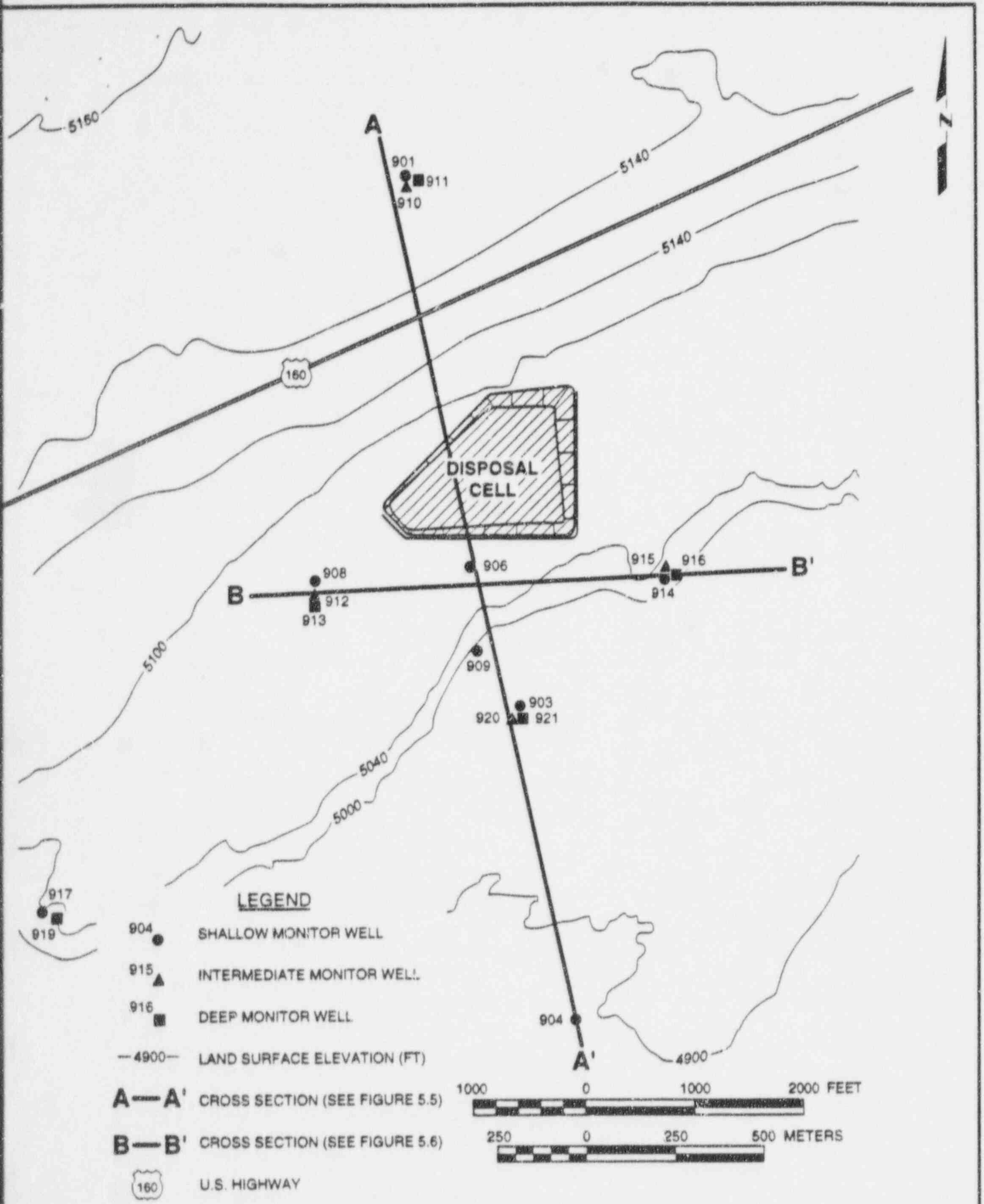


FIGURE 5.4
CROSS SECTION LOCATIONS
TUBA CITY, ARIZONA, SITE

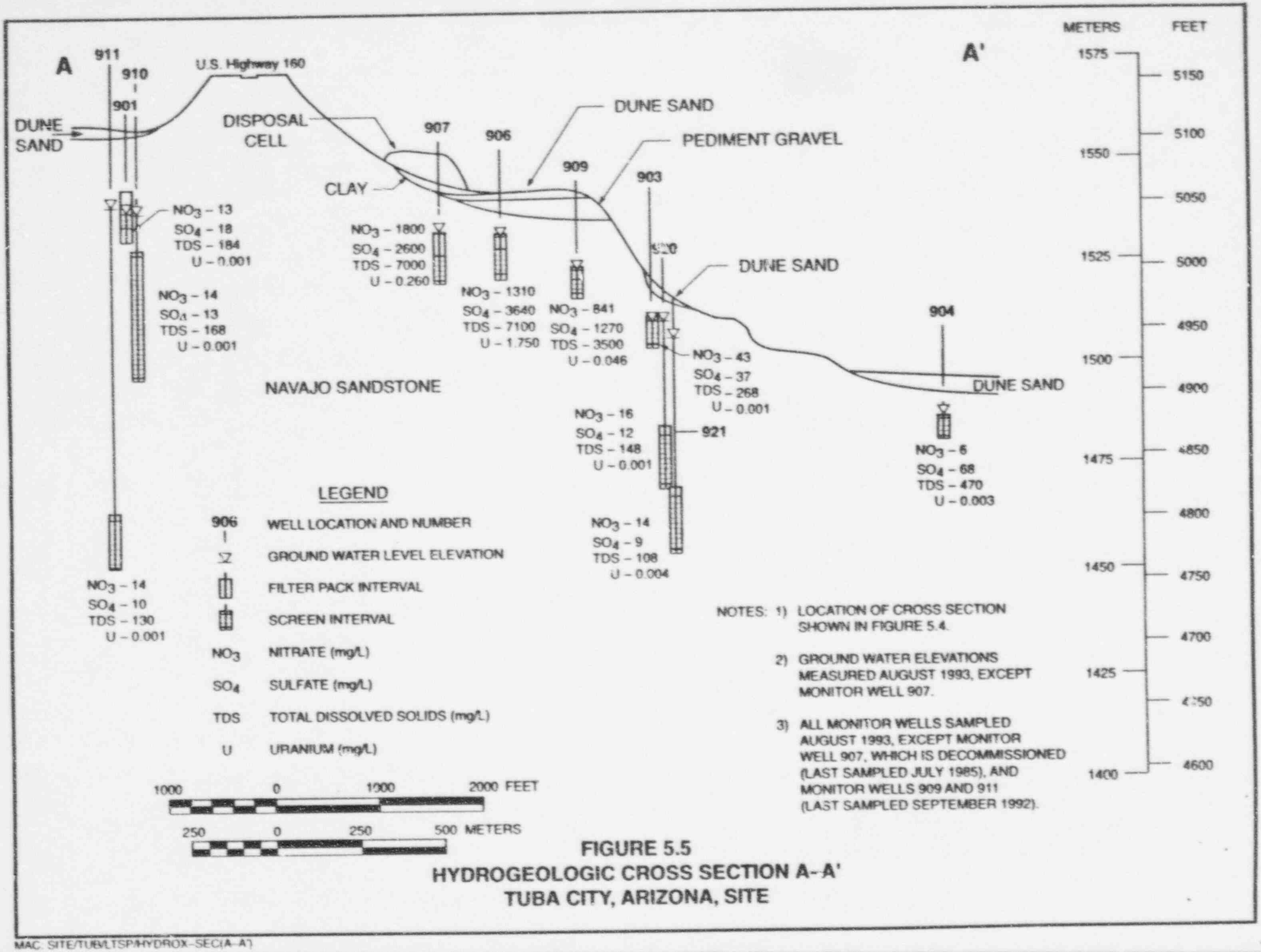


FIGURE 5.5
HYDROGEOLOGIC CROSS SECTION A-A'
TUBA CITY, ARIZONA, SITE

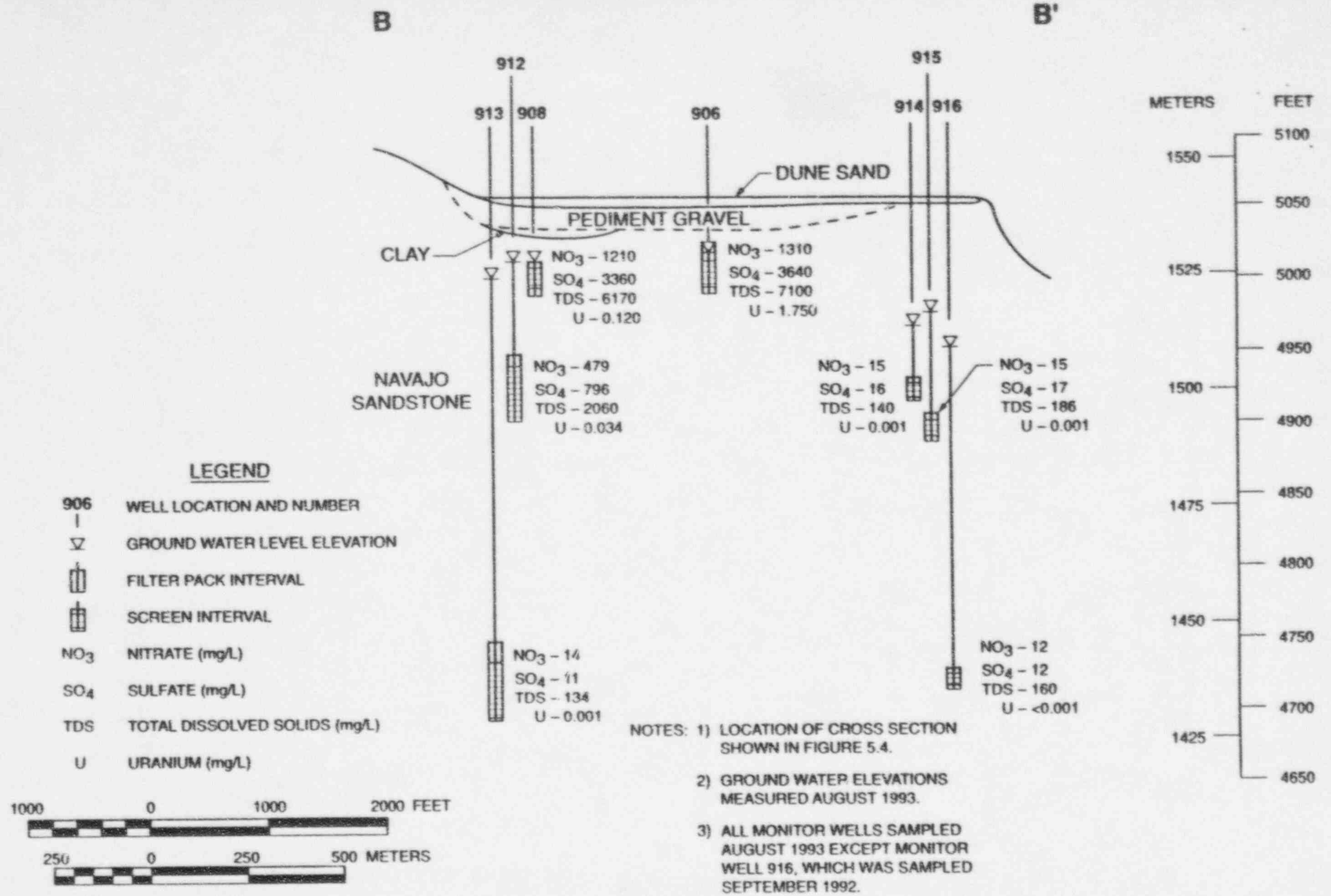


FIGURE 5.6
HYDROGEOLOGIC CROSS SECTION B–B'
TUBA CITY, ARIZONA, SITE

MAC: SITE/TUB/LTSP/HYDROX-SEC(B-B')

ground water is not unexpected because the source was located on the surface, the Navajo Sandstone is naturally stratified, and there is no active, local, natural recharge mechanism to drive constituents deep into the aquifer. In addition, the difference in water levels in well clusters suggests the vertical ground water migration is impeded by subsurface barriers.

Additional information on the extent of groundwater contamination at the site is provided in the water sampling and analysis plan (DOE, 1996).

5.2 GROUND WATER MONITORING PROGRAM

5.2.1 Long-term ground water monitoring

Pursuant to 40 CFR §192.03 (1995), the DOE will implement a ground water monitoring program to be carried out over a period of time commencing upon completion of remedial actions taken to comply with the standards in 40 CFR §192.02 (1995), and of a duration which is adequate to demonstrate that future performance of the system of disposal can be reasonably expected to be in accordance with the design requirements of 40 CFR §192.02(c) (1995). According to 40 CFR §192.20(a)(4) (1995), performance of the disposal system and prevention of contamination of ground water may also be assessed by indirect methods as well as by direct monitoring of ground water.

Long-term monitoring of ground water in the uppermost aquifer at point of compliance (POC) wells to demonstrate disposal cell performance is not technically feasible at the Tuba City site due to: 1) pre-existing site-related contamination in ground water, 2) possible transient drainage resulting from disposal cell construction, and 3) infiltration of surface water via the south and southwest cell aprons and possible leaching of vadose zone contaminants downgradient from the disposal cell. Also, changes in the ground water/aquifer system resulting from planned contaminated ground water containment activities, will have an impact on ground water quality conditions in the uppermost aquifer.

Application for Subpart A licensing of the Tuba City disposal cell will be submitted with the condition that the need for ground water monitoring at a POC for Subpart A compliance be assessed and implemented after completion of Subpart B activities. The long-term monitoring program at the Tuba City site is outlined in this LTSP, which will function as the concurrence document for the Subpart A licensing process.

5.2.2 Evaluative ground water monitoring

The DOE plans to perform evaluative monitoring of ground water in the uppermost aquifer to: 1) evaluate trends in ground water quality, 2) monitor the downgradient extent of contamination in ground water, 3) analyze the impacts of transient drainage and surface runoff, and 4) assess the effects of

ground water restoration measures associated with containing the contamination related to uranium processing activities.

Trends in ground water quality will be evaluated by comparing the analytical results from the monitor wells at the downgradient edge of the disposal cell and the baseline monitor wells within the area of contamination with baseline concentrations for constituents of concern that have been established in Section 5.1.2. Significant variations in concentrations of constituents of concern will be noted, and may trigger additional investigations, pending coordination with ongoing Subpart B activities, and consultation with the NRC.

The downgradient extent of contamination will be evaluated by assessing analytical results from the monitor well that is out of the area of site-related contamination. If it appears that the contamination is migrating further downgradient, investigative measures will be implemented to ensure that human health and the environment in areas downgradient from the contamination are protected.

A postclosure engineering assessment of both transient drainage from the disposal cell and infiltration of surface runoff from the cover is being performed under the UMTRA Ground Water Project. Ground water information from the evaluative monitoring will be used in this assessment.

Ground water restoration to contain the contamination related to uranium processing activities will be initiated at the downgradient edge of the disposal cell late in 1996. This will consist of pumping ground water from a series of extraction wells for a period in excess of six months. This activity will significantly impact ground water flow and quality characteristics in the area, and will preclude any meaningful disposal cell performance monitoring during this period. Ground water conditions will be monitored to assess the effectiveness of the ground water remediation activities.

Ground water monitoring network

The evaluative monitoring well network will consist of seven existing monitor wells (Figure 5.7). Three monitor wells (940, 941, and 942) are adjacent to the south apron on the downgradient edge of the disposal cell. One upgradient monitor well (945) will be sampled to assess background conditions. Two baseline monitor wells (906 and 908) are within the area of site-related contamination. One monitor well (903) is downgradient from the edge of the contamination. If increase in contaminant levels are noted in monitor well 903, monitor well 930 further downgradient will be sampled.

Monitor Well	Ground Elevation	Screen Depth (Top)	Screen Length	Comment
TUB01-0903	4980.4	28.0	20.0	Downgradient
TUB01-0906	5060.4	44.0	20.0	Baseline
TUB01-0908	5055.9	52.0	15.0	Baseline

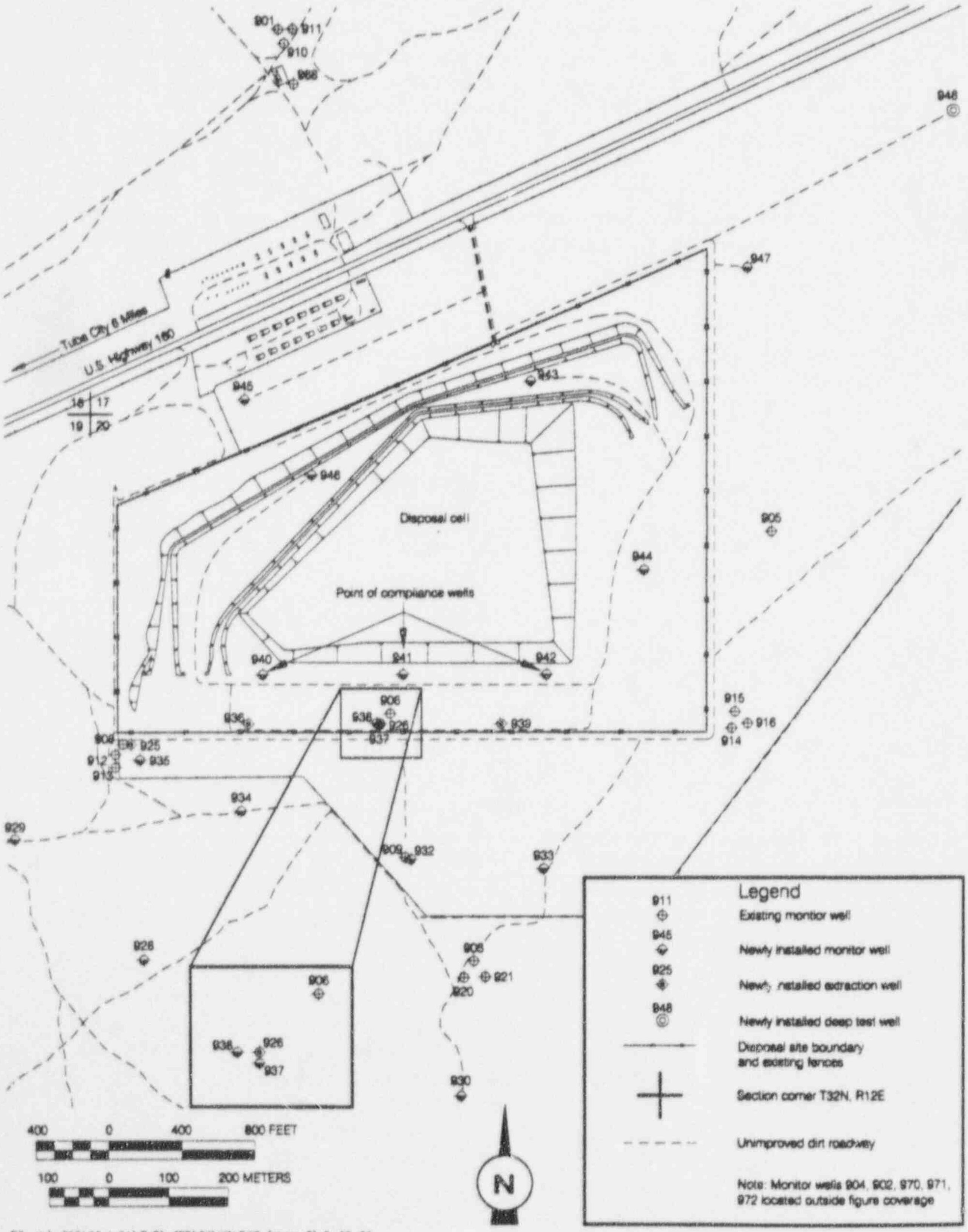
TUB01-0940	5062.2	45.0	20.0	Disposal cell
TUB01-0941	5062.3	45.0	20.0	Disposal cell
TUB01-0942	5062.5	54.0	20.0	Disposal cell
TUB01-0945	5137.3	110.0	20.0	Background

Additional monitor wells may be installed by the DOE as required to effectively monitor ground water conditions at the site. These monitor wells may be used as POC wells for Subpart A monitoring if deemed necessary after completion of Subpart B activities. The evaluative monitoring described in the LTSP will be carried out in conjunction with UMTRA Ground Water Project activities, and will be protective of human health and the environment.

5.2.3 Evaluative ground water monitoring

The parameter list for the evaluative monitoring contains the following hazardous constituents: nitrate, molybdenum, selenium, and uranium. These constituents exceeded MCLs prior to cell closure at least once in one or more monitor wells impacted by uranium processing. Additionally, these constituents are considered sensitive indicators of disposal cell performance due to their presence in the tailings material, relatively high mobility in ground water, and low concentration in background ground water quality. Conversely, cadmium, lead, tin, and zinc, while also present in wells impacted by uranium processing activities prior to cell closure, are not considered reliable indicators of cell performance because they are relatively immobile in the subsurface. Consequently, cadmium, lead, tin, and zinc are not included in the proposed list of hazardous constituents included in the evaluative monitoring. Although higher than background prior to cell closure, net gross alpha is not considered a reliable indicator of performance due to the potential influence of radionuclides other than uranium-238 decay products (Faure, 1977).

**Figure 5.7
Ground Water Monitor Well Network
Tuba City, Arizona Site**



Provisional upper baseline limits are proposed for evaluative monitoring for each hazardous constituent: nitrate, 1379 mg/L; molybdenum, 0.14 mg/L; selenium, 0.05 mg/L; and uranium, 1.171 mg/L. These limits were derived based on preclosure (1988 to 1991) data obtained from well 906 with the exception of selenium, which was found primarily in monitor well 908. The resulting limits are concentrations that, with 95 percent confidence, would be exceeded less than 5 percent of the time during long-term monitoring if ground water conditions in the vicinity of the monitor well did not change. The limits are called "upper tolerance limits" in the literature and were calculated following EPA guidance (EPA, 1989).

Additional analytes may be added to support an assessment of ground water restoration efforts. Standard field parameters and water levels also will be measured during sampling.

The upper baseline limits proposed here are provisional because baseline conditions were established for locations other than the disposal cell monitor wells. Monitoring wells 906 and 908 with the POC network will allow a comparison of constituent concentrations at disposal cell and baseline locations to determine transient excursions from baseline conditions, potential chemical gradients between baseline and disposal cell locations, and stabilization of postclosure disposal cell hydrology.

<u>Sampling frequency</u>

At a minimum the evaluative monitoring well network will be sampled semiannually for the next 2 years, after which sampling frequency will be reevaluated.

5.3 CORRECTIVE ACTION

The EPA standards (40 CFR §192.04 [1995]) require implementation of a corrective action program within 18 months if the ground water concentration limits established for the disposal site under 40 CFR §192.02(c)(1995) are or may be exceeded. The corrective action program will restore the performance of the disposal system to the original concentration limits established under 40 CFR §192.02(c)(3), to the extent reasonably achievable.

NRC regulations (10 CFR §40.27(b)[1995]) require annual site inspections (at a minimum) to confirm the integrity of the disposal site and to determine if maintenance and/or monitoring are required. The condition of the disposal cell cover is of concern with respect to potential impacts to ground water. For example, should subsidence or cracking be detected, prompt maintenance would be necessary to avoid potential seepage through the cover by runoff or snowmelt. The proposed inspection frequency and reporting requirements (to the NRC) are specified criterion 12, Appendix A. The requirement for instituting maintenance and emergency measures is specified in 10 CFR §40.27(b)(5).

Observations at the Tuba City site indicate increased concentrations of potentially hazardous constituents in ground water downgradient from the disposal cell. These increases are attributed to possible transient drainage related to disposal cell construction, or to infiltration of surface run-off from the cell cover and possible leaching of constituents from the unsaturated zone. Concentrations of hazardous constituents in ground water that exceed the approved concentration limits may indicate only that these phenomena are taking place. They would not represent failure of the disposal system and would not require the DOE to initiate a corrective action program, in accordance with 40 CFR §192.04(1995). Regulation 40 CFR §192.20(a)(4)(1995) states, "Temporary excursions from applicable limits of ground water concentrations that are attributable to a disposal operation itself shall not constitute a basis for considering corrective action under 40 CFR §192.04(1995) during the disposal period . . . ." Although this section of the regulations explicitly refers to excursions prior to cell closure, the effects of cell compaction (e.g., transient drainage) may not appear until after closure. Therefore, transient drainage from a completed disposal cell is not an indicator of disposal cell failure, if it is related only to excess water draining from the compacting tailings.

However, if migrating ground water contamination presents an imminent threat to downgradient water users, corrective action to protect human health and the environment may be required, regardless of the source of contamination. If corrective action is necessary, the DOE will submit a corrective action plan for NRC review and concurrence (a copy of the plan will be transmitted to the affected tribal government). The plan will include a ground water monitoring plan to demonstrate the effectiveness of the corrective action, which the DOE will implement after consultation with the NRC.

5.4 DATA VALIDATION AND QUALITY ASSURANCE

The UMTRA Project TAC has established standard operating procedures for monitor well installation and development, water and soil sampling, sample preservation and transport, field procedures, chain of custody samples for laboratory analysis, acquisition protocols, and validating and managing analytical data. All aspects of ground water monitoring are conducted in accordance with these procedures, which are updated regularly to reflect changes in industry standards, best management practices, and DOE and EPA guidance. Ground water monitoring at the Tuba City site will remain the responsibility of the DOE until the site comes under the NRC general license. The quality assurance (QA) procedures described below are consistent with the Resource Conservation and Recovery Act ground water technical enforcement guidance document (EPA, 1986) and the long-term surveillance program QA program plan (DOE, 1992c).

5.5 REPORTING

The DOE maintains and updates specific records and reports required to document long-term surveillance program activities at the Tuba City UMTRA

Project site. The DOE will submit an annual report to the NRC documenting the results of the LTSP, as required by 10 CFR §40.27. DOE will keep all relevant and required records at an appropriate location. These documents will be available for review by the NRC, tribal representatives, and the public.