

Fort Wingate Depot Activity
Monitoring Well Installation and Abandonment Proposal
December 15, 2010

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Prepared for:
The New Mexico Environment Department
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LIST OF ACRONYMS

BIA	Bureau of Indian Affairs
EPA	Environmental Protection Agency
FWDA	Fort Wingate Depot Activity
GWMP	Facility-Wide Groundwater Monitoring Plan
HWB	Hazardous Waste Bureau
MCL	Maximum Contaminant Level
NMAC	New Mexico Administrative Code
NMED	New Mexico Environmental Department
NTUA	Navajo Tribal Utility Authority
RCRA	Resource Conservation and Recovery Act
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
TNT	Trinitrotoluene
TPMC	TerranearPMC, LLC
USACE	United State Army Corps of Engineers

1.0 INTRODUCTION

This Fort Wingate Depot Activity (FWDA) 2011 Monitoring Well Installation and Abandonment Proposal describes the installation of up to 18 proposed groundwater monitoring wells and the abandonment of 10 groundwater monitoring wells at FWDA. Groundwater monitoring wells are used to monitor groundwater elevations and to collect groundwater samples for the FWDA environmental restoration program. In order to fully delineate some of the known plumes, additional monitoring wells are proposed.

The proposed monitoring well installations will address the following data gaps:

- Background levels of naturally occurring constituents are not defined
- The concentration gradient and lateral extent of several contaminant plumes in the alluvial and bedrock hydrogeologic units are not completely defined. These plumes include an alluvial hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) plume, an alluvial nitrate plume, and bedrock and alluvial perchlorate plumes.

Two sentinel monitoring wells are also proposed for installation as requested by the New Mexico Environment Department (NMED) to monitor potential migration of contaminant off the installation.

The proposed installation and abandonment of all monitoring wells will be executed in accordance with standard procedures and requirements described in New Mexico Administrative Code (NMAC) 19.27.4.

1.1 PURPOSE

This document is submitted to the NMED Hazardous Waste Bureau (HWB) for review and approval, as required by Resource Conservation and Recovery Act (RCRA) Permit No. NM 6213820974 for FWDA. The RCRA Permit No. NM 6213820974 was finalized in December 2005 and became effective 31 December 2005.

1.2 FORT WINGATE BACKGROUND

FWDA is an inactive U.S. Army depot with a former mission to receive, store, and ship material and to dispose of obsolete or deteriorated explosives and military munitions (TerranearPMC, LLC (TPMC) 2008). The active mission of FWDA ceased and the installation closed in January 1993 as a result of the Defense Authorization Amendments and Base Realignment and Closure Act of 1988.

FWDA currently occupies approximately 24 square miles (approximately 15,277 acres) of land in McKinley County in northwestern New Mexico. The installation is located approximately seven miles east of Gallup on U.S. Highway 66 and approximately 130 miles west of Albuquerque on Interstate 40 (Figure 1) (TPMC 2008). FWDA contains facilities formerly used to operate a reserve storage activity that provided care, preservation, and minor maintenance of assigned commodities, primarily conventional military munitions (TPMC 2006). The FWDA mission included the disassembly and demilitarization of unserviceable and obsolete military munitions. Ammunition maintenance facilities existed for the clipping, linking, and repackaging of small arms

2.0 GROUNDWATER PLUME DATA GAPS

Contaminant groundwater plumes were interpolated from groundwater chemical data using the software package, Groundwater Modeling System (GMS) 6.5. Groundwater chemical analytical data associated with monitoring well locations were input into GMS 6.5 to interpolate plume characteristics (concentration gradients and boundaries) where no data exists. In some cases, there were insufficient data to adequately define these characteristics. Additional chemical data is needed to further define the chemical concentration gradients and extents of these plumes. In particular, RDX, nitrate and perchlorate plumes have these data gaps. Proposed well locations and depths are designed to address these data gaps, thereby increasing the accuracy of the interpolation between data points associated with monitoring wells. Below is a discussion of these missing data.

2.1 RDX PLUME DATA GAPS

The RDX plume is located in the alluvial hydrogeologic unit near the former trinitrotoluene (TNT) leaching beds. The concentration of RDX in the center of the plume is an estimate based on the interpolation of chemical data obtained from two monitoring wells (TMW23 and TMW03). TMW23 and TMW03 are approximately 0.3 miles apart. And while the extent of the RDX plume is bound by non-detections in monitoring wells TMW04, TMW06, TMW07, TMW21, TMW22, and TMW29, the northern extent of the plume is not defined, as indicated by RDX detection in TMW23. In order to adequately characterize the RDX distribution in groundwater and northern extent of the plume, two additional monitoring wells are proposed between TMW03 and TMW23, and one monitoring well is proposed north of TMW23 (Figure 4).

2.2 NITRATE PLUME DATA GAPS

The nitrate plume is located in the alluvial hydrogeologic unit near the former TNT leaching beds. The nitrate plume comingles with both the RDX plume discussed above and the perchlorate plume discussed below. Since nitrate can exist naturally in groundwater, the Environmental Protection Agency's (EPA) Maximum Contaminant Level (MCL) of 10 mg/L for nitrate will be used to delineate the extent of the plume. The nitrate plume is bound to the west by nitrate concentrations of less than 10 mg/L at TMW13, TMW15, and TMW25 and to the east where the alluvium is believed to be unsaturated. The nitrate plume is also bound to the north by nitrate concentrations of less than 10 mg/L detected in groundwater samples collected from monitoring wells TMW08, TMW10, and TMW24. However, the nitrate plume boundaries in the east, northeast corner, and northwest corner are not completely delineated. Additional monitoring wells are proposed to establish plume boundaries in these directions. USACE assumes that the alluvium is unsaturated east of the nitrate plume, but no monitoring wells are located east of the plume to verify this condition (Figure 4).

2.3 PERCHLORATE PLUMES DATA GAPS

Perchlorate plumes are located in both the alluvial and bedrock hydrogeologic units between the former TNT leaching beds and former BLDG 528. The alluvial perchlorate plume is estimated based on chemical results of samples collected from monitoring

ammunition (TPMC 2006).

The installation is surrounded by federally owned or administered lands, including both national forest and tribal lands. North and west of FWDA are Navajo tribal trust and allotted lands. The Bureau of Indian Affairs (BIA) administers land east of FWDA. The town of Fort Wingate is located to the east of FWDA on the BIA administered land (TPMC 2006). Red Rock State Park, a Zuni railroad siding, an El Paso Natural Gas fractioning plant and housing area, the Navajo community of Church Rock, and transportation corridors for Interstate 40, U.S. Highway 66, and the Burlington Northern and Santa Fe Railroad are located north of the installation (TPMC 2006). Cibola National Forest borders the south and southeast perimeters of the installation and incorporates mostly undeveloped forest lands (TPMC 2006). To the west is primarily undeveloped tribal trust and allotment land administered by the BIA, Navajo Nation, and individual Native American allottees (TPMC 2006).

Facility-wide groundwater monitoring has been conducted every April and October since 2008 by the Albuquerque District of the United States Army Corps of Engineers (USACE) as part of FWDA's environmental restoration program.

3.0 WELL LOCATIONS AND SPECIFICATIONS

Well locations (shown in Figure 2) were selected to adequately address the data gaps discussed in Section 2. To minimize project cost and duration, proposed well locations were selected to characterize multiple plumes whenever possible. All monitoring well locations are drilling rig accessible and safe for workers.

Monitoring wells proposed for the alluvium will be drilled to approximately 10 feet below the water table. Screens in the alluvium monitoring wells will be placed from 5 feet above the zone of saturation to 10 feet below the zone of saturation, if practical. Monitoring wells proposed for the bedrock will be drilled through the saturated thickness of the sandstone hydrogeologic unit, to the top of an underlying claystone unit. The screens for bedrock monitoring wells will be set through the entire saturated interval of the sandstone, which is estimate between 15 to 25 feet in thickness. The borehole annular space will be backfilled with filter pack to 5 feet above the well screen. A 5 foot bentonite pellet seal will be installed on top of the filter pack followed by grout, which will be backfilled to the surface.

In addition to NMAC 19.27.4, monitoring well design and installation will comply with the following EPA RCRA guidance:

- U.S. EPA, *RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001, November, 1992;
- U.S. EPA, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1, September, 1986; and
- Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and Denne, J.E., *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA 600/4-89/034, 1989.

The Albuquerque District USACE will obtain a well installation permit from the New Mexico Office of the State Engineer (OSE) prior to construction and will provide a copy of the permit to NMED.

The list below summarizes the proposed identifications of monitoring wells and their intended objective.

- 2 Sentinel Wells: MW23, MW24
- 4 Background Wells: BGMW01, BGMW02, BGMW03, BGMW04
- 3 RDX Plume Monitoring Wells: TMW43, TMW44, TMW45
- 2 Nitrate Plume Monitoring Wells: TMW46, TMW47
- 3 or 4 Alluvial Perchlorate Plume Monitoring Wells: TMW39S, TMW41, TMW42, and possibly TMW40S

wells TMW01 and TMW31S. The geometry of the alluvial perchlorate plume is undefined because there are only two monitoring wells in the area suspected of having perchlorate in alluvial groundwater.

The bedrock perchlorate plume is estimated based on results of groundwater samples that have been collected from TMW30, TMW31D and TMW32. However, the bedrock perchlorate plume is not completely delineated to the northwest and southwest. Additional monitoring wells are required to adequately characterize the boundaries of both of the perchlorate plumes (Figure 5).

- 3 Bedrock Perchlorate Plume Monitoring Wells: TMW38, TMW39D, TMW40D

TMW39S and TMW39D, and TMW40S and TMW40D will be located in the same borehole (A.K.A. Dual Completion Wells).

3.1 SENTINEL MONITORING WELLS

Two alluvial sentinel wells, MW23 and MW24, are proposed for installation on the northwest side of FWDA, along U.S. Route 66 per request of NMED. The objective of sentinel wells is monitoring potential off-post migration of contaminant of concerns due to the close proximity of NTUA water supply wells to the installation boundary. The location of these sentinel wells was determined by the proximity of the NTUA wells. NTUA well 16T602 is approximately 135 feet deep and 600 feet to the northwest of proposed wells MW23. MW23 and MW24 are proposed to be drilled to the same depth as NTUA 16T602 to ensure that the groundwater monitored by these sentinel wells is the same as the groundwater drawn from the NTUA wells (Figure 3).

3.2 BACKGROUND WELLS

Four alluvial background wells (BGMW01, BGMW02, BGMW03, and BGMW04) are proposed for installation in on northwest side of FWDA, east and north of Igloo Block A (Figure 3). Historical records, site investigations, and groundwater flow patterns, indicate that the locations of these background wells should be unaffected by historical activities that took place at FWDA. Results will thus be indicative of the naturally occurring constituents (background levels). Samples collected from these proposed background wells will be analyzed for metals only.

3.3 RDX PLUME MONITORING WELLS

Proposed monitoring wells TMW43 and TMW44 will provide chemical data to refine the concentration gradient in the center of the plume. These monitoring wells will also aid in defining the concentration gradient of nitrate in the alluvium, which comingles with the RDX plume. Proposed monitoring well TMW45 will bound the northern extent of the RDX beyond TMW23. Refer to Figure 4.

3.4 NITRATE PLUME MONITORING WELLS

Proposed monitoring wells TNW45, TMW46 and TMW47 will provide chemical data that will delineate the northeast, northwest and eastern boundaries of the alluvial nitrate plume. Additionally, because the nitrate alluvial plume comingles with the RDX plume and alluvial perchlorate plume, monitoring wells installed to characterize these plumes will also be used to further characterize the alluvial nitrate plume (Figure 4).

3.5 PERCHLORATE PLUME MONITORING WELLS

USACE proposes the installation of three monitoring wells for the alluvial perchlorate plume, TMW39S, TMW41, and TMW42, to aid in delineating the lateral extent of the plume (Figure 5). Since the alluvial perchlorate plume comingles with the nitrate plume, these monitoring wells will also help define the alluvial nitrate plume.

If the perchlorate concentrations found in monitoring wells TMW41 and TMW42 indicate that additional data is required to accurately define the boundaries of the plume, an additional well will be installed (TMW40S). If TMW40S is required, it will be part of a dual borehole collocated with TMW40D, which will be drilled in to bedrock to monitor the bedrock perchlorate plume. TMW40S may be required to determine the extent of perchlorate in the alluvium in the northwestern direction.

USACE proposes three bedrock monitoring wells to define the lateral extent of the bedrock perchlorate plume, TMW38, TMW39D, and TMW40D (Figure 5). Chemical data obtained from TMW38 and TMW40D will be used to bound the northwest and southwest extends of the plume. Chemical data collected from TMW39D will be used to evaluate the northeast extent of the plume. All the chemical data collected from these proposed monitoring wells, and the existing monitoring wells, will also be used to determine the transport characteristic of perchlorate in the bedrock hydrogeologic unit.

Table 1: Well Installation Sequence

Sequence	Well ID	Well Purpose	Notes
1	TMW41	Perchlorate Alluvial Plume Monitoring	Samples from this well will be used to determine if TMW40S is necessary.
2	TMW42	Perchlorate Alluvial Plume Monitoring	Samples from this well will be used to determine if TMW40S is necessary.
3	TMW39S&D	Perchlorate Alluvial (S) & Bedrock (D) Plume Monitoring	
4	TMW 38	Perchlorate Bedrock Plume Monitoring	
5	TMW47	Nitrate Plume Monitoring	
6	TMW43	RDX Plume Monitoring	
7	TMW44	RDX Plume Monitoring	
8	TMW45	RDX Plume Monitoring	
9	TMW46	Nitrate Plume Monitoring	
10	BGMW01	Background Monitoring	
11	BGMW02	Background Monitoring	
12	BGMW03	Background Monitoring	
13	BGMW04	Background Monitoring	
14	MW23	Sentinel Monitoring	
15	MW24	Sentinel Monitoring	
16	TMW40S&D	Perchlorate Alluvial (S) & Bedrock (D) Plume Monitoring	Well TMW40S will only be installed if perchlorate concentrations found in TMW42 and TMW43 indicate an additional data point is required to adequately model the alluvial perchlorate plume.

TMW41 and TMW42 will be drilled first so that samples can be collected and analyzed for decision making. Results from of these samples will determine the need for TMW40S.

4.0 WELL ABANDONMENT

A total of 10 groundwater monitoring wells need to be abandoned due to consistent findings of being dry. The abandonment of these monitoring wells will follow the standard procedures and requirements described in NMAC 19.27.4.

The monitoring wells to be abandoned, their locations (northing and easting), their casing diameters, and their total depths are shown in the table below. The locations of the monitoring wells that will be abandoned are shown in Figure 3.

Table 2: Proposed Monitoring Well Abandonment

WELL ID	NORTHING (NMSP-W)	EASTING (NMSP-W)	CASING DIAMETER (INCHES)	BORING / WELL TOTAL DEPTH (FEET)
TMW05	1639949.83	2498884.78	2.0	37.40
FW07	1640839.18346	2498075.06075	4.0	30.50
FW08	1640572.50	2498132.47	4.0	51.00
FW10	1640848.95	2498936.89	4.0	51.50
FW11	1641334.01730	2499124.16239	4.0	28.00
FW12	1641609.81568	2499038.13084	4.0	29.00
FW13	1641688.39486	2498830.00552	4.0	30.50
FW27	1646461.42	2494395.93	4.0	32.00
FW28	1646584.14	2493050.57	4.0	33.00
FW29	1645804.02	2497681.98	4.0	32.00

The abandonment of these monitoring wells will ensure that they do not serve as conduits for the migration of contaminants from the ground surface to hydrogeologic units. Their abandonment will also increase groundwater security by limiting the points of access to hydrogeologic units.

According to NMAC 19.27.4, the OSE is the approving state agency for the design of and implementation of all well abandonments, including monitoring wells. Therefore, USACE will submit a Well Abandonment Plan in accordance with New Mexico regulations to the OSE for review and approval. Once approval is obtained, USACE will provide NMED a copy of the Well Abandonment Plan. In general, all monitoring wells will be abandoned by placing a cement/bentonite slurry in the casing of each monitoring well. The slurry will be placed in each monitoring well through a tremie pipe starting at the bottom and filling upward until the casing is completely sealed with the slurry. This procedure minimizes the potential of bridging. All well casings will be cut off below ground surface, and all well pads will be removed.

Monitoring wells in the Open Burn/Open Detonation (OB/OD) Area also require abandonment. Due to unexploded ordnance issues in the OB/OD Area, the abandonment of these monitoring wells will be addressed in the OB/OD Area Closure Plans.

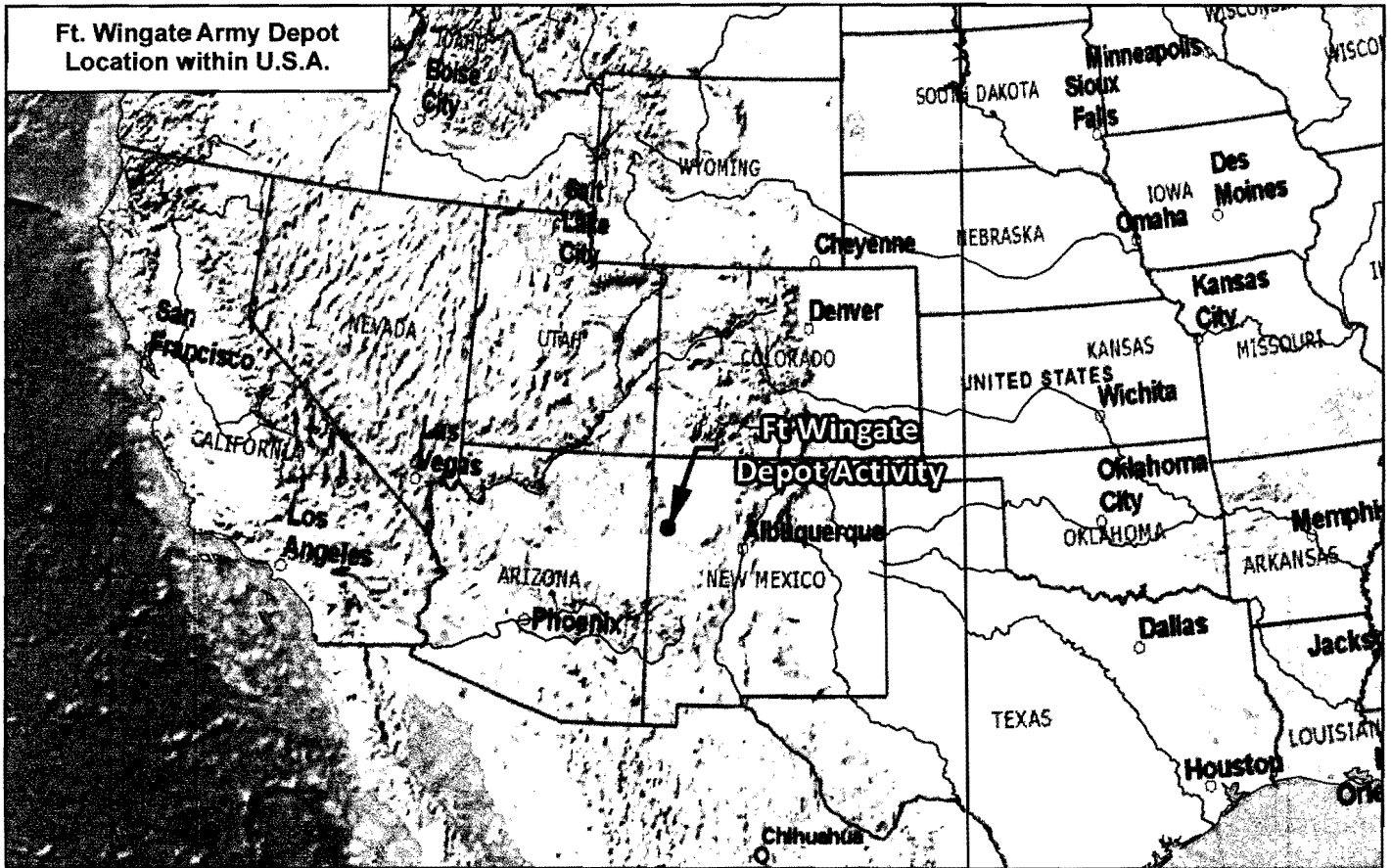
5.0 REFERENCES

TPMC, 2006. March 2006 Supplemental Ground Water Investigation – Administration and TNT Leaching Beds Areas, FWDA, Gallup New Mexico.

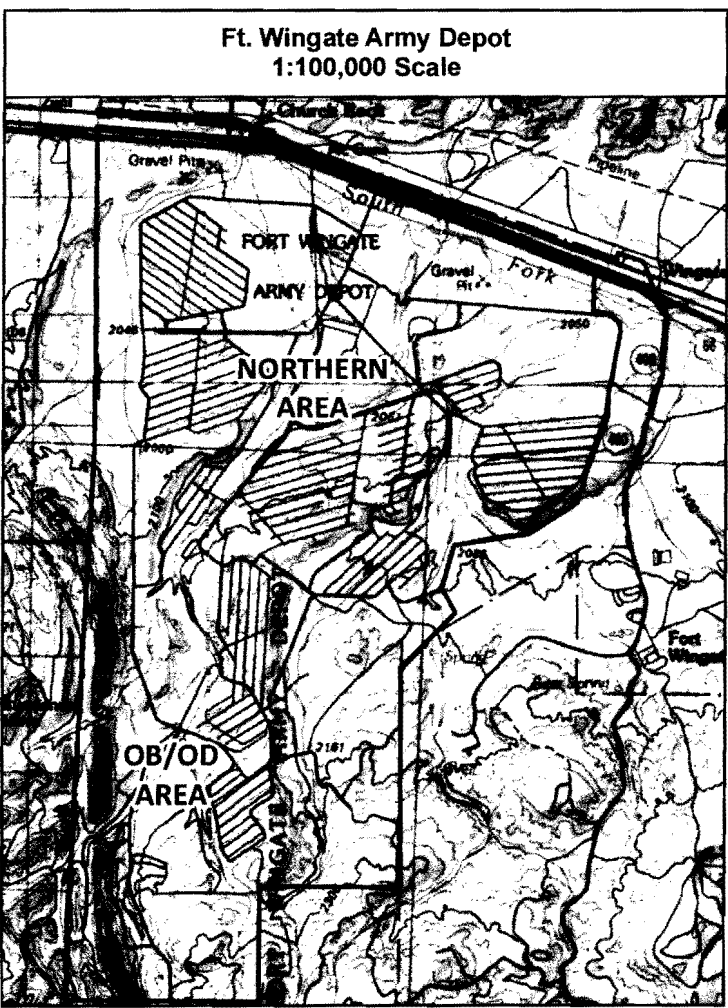
TPMC, 2008. March 2008 Interim Facility-Wide Ground Water Monitoring Plan, FWDA, Gallup, New Mexico.

FIGURES

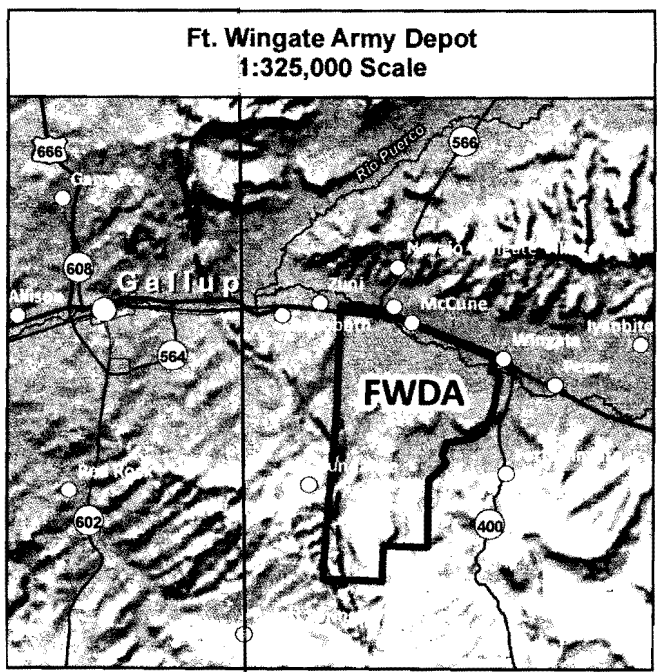
**Ft. Wingate Army Depot
Location within U.S.A.**



**Ft. Wingate Army Depot
1:100,000 Scale**



**Ft. Wingate Army Depot
1:325,000 Scale**



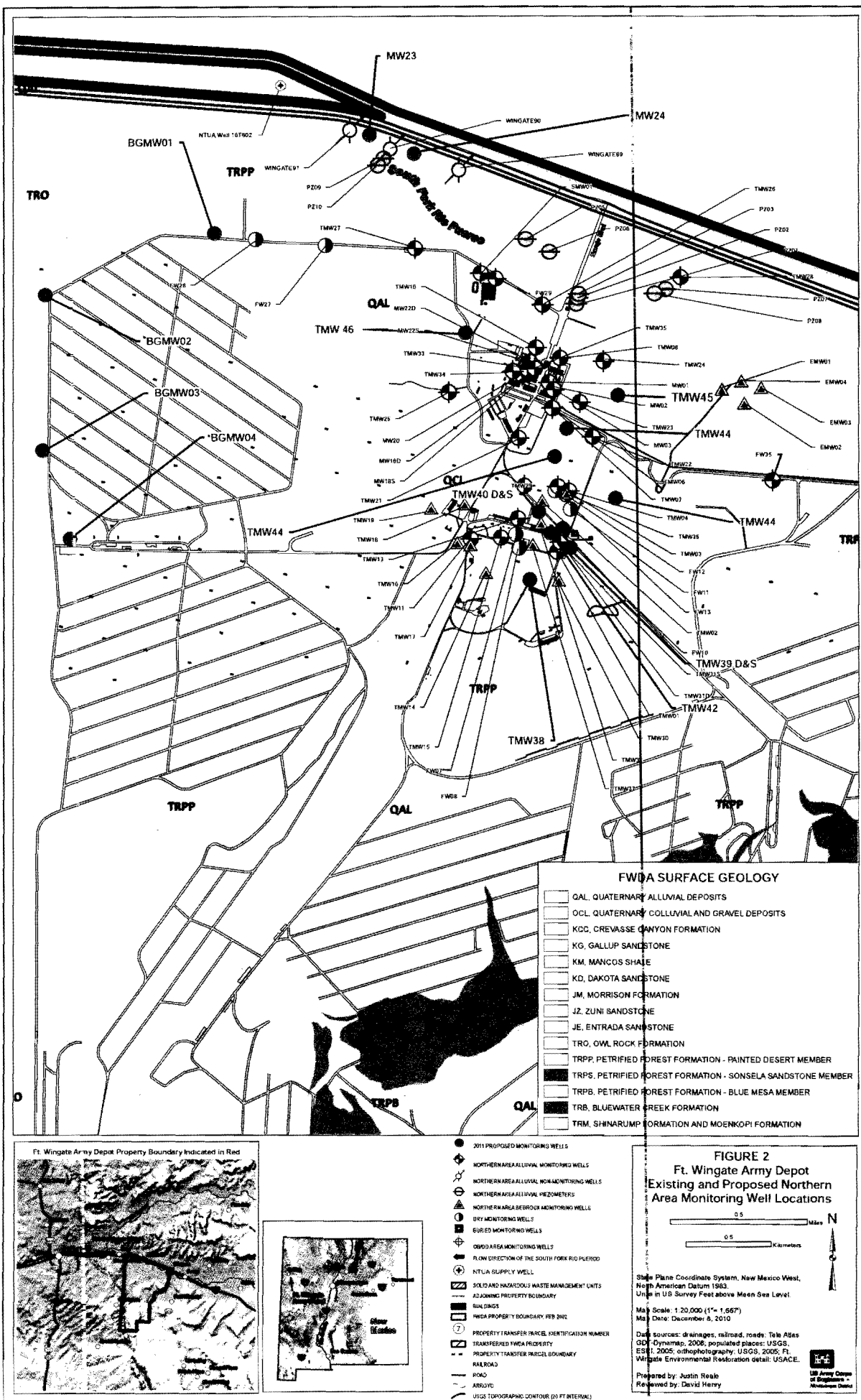
**FIGURE 1
Ft. Wingate Depot Activity
Site Location**

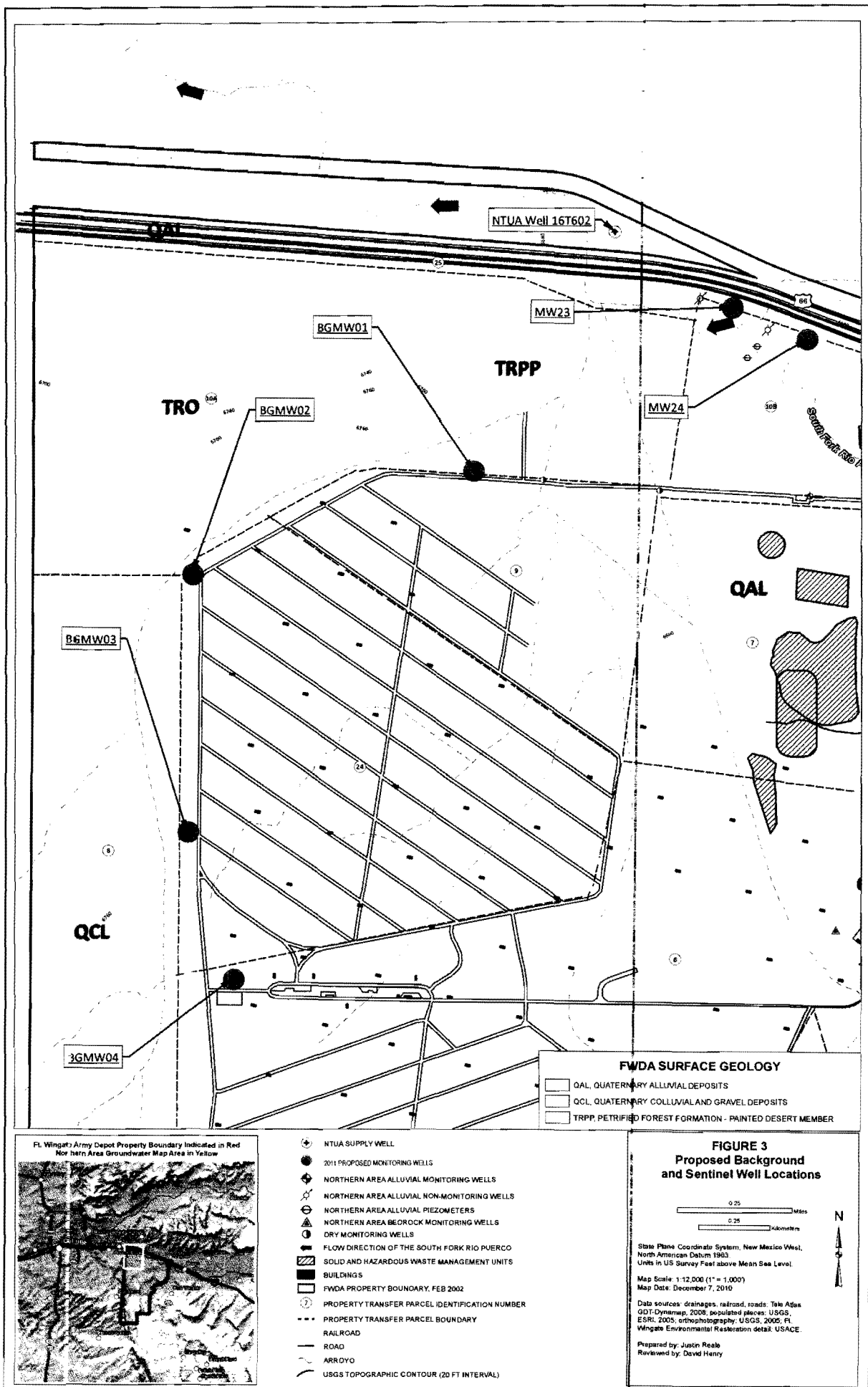
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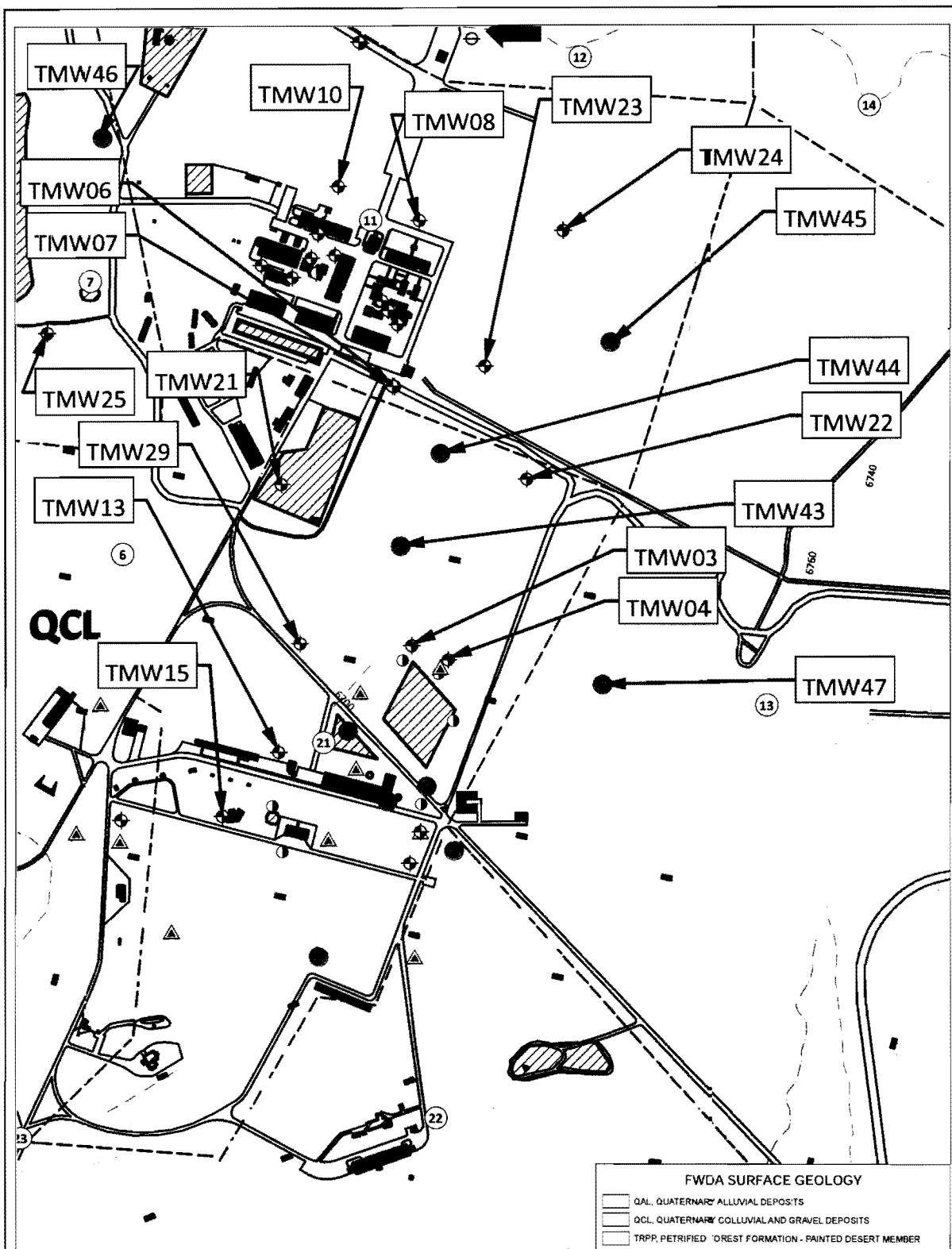
Data sources: drainages, railroad, roads: Tele Atlas
GDT-Dynamap, 2008; populated places: USGS,
ESRI, 2005; orthophotography: USGS, 2005; Ft.
Wingate Environmental Restoration detail: USACE.

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Reviewed by: David Henry



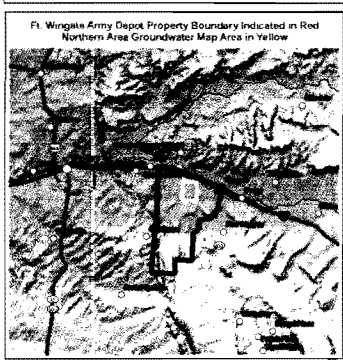






FWDA SURFACE GEOLOGY

- QAL, QUATERNARY ALLUVIAL DEPOSITS
- QCL, QUATERNARY COLLUVIAL AND GRAVEL DEPOSITS
- TRPP, PETRIFIED FOREST FORMATION - PAINTED DESERT MEMBER



Fl. Wingate Army Depot Property Boundary Indicated in Red Northern Area Groundwater Map Area in Yellow

- 2011 PROPOSED MONITORING WELLS
- NORTHERN AREA ALLUVIAL MONITORING WELLS
- NORTHERN AREA ALLUVIAL NON-MONITORING WELLS
- NORTHERN AREA ALLUVIAL PIEZOMETERS
- NORTHERN AREA BEDROCK MONITORING WELLS
- DRY MONITORING WELLS
- FLOW DIRECTION OF THE SOUTH FORK RIO PUERCO
- ▨ SOLID AND HAZARDOUS WASTE MANAGEMENT UNITS
- BUILDINGS
- ▭ FWDA PROPERTY BOUNDARY, FEB 2002
- ① PROPERTY TRANSFER PARCEL IDENTIFICATION NUMBER
- - - PROPERTY TRANSFER PARCEL BOUNDARY
- RAILROAD
- ROAD
- ARROYO
- USGS TOPOGRAPHIC CONTOUR (20 FT INTERVAL)

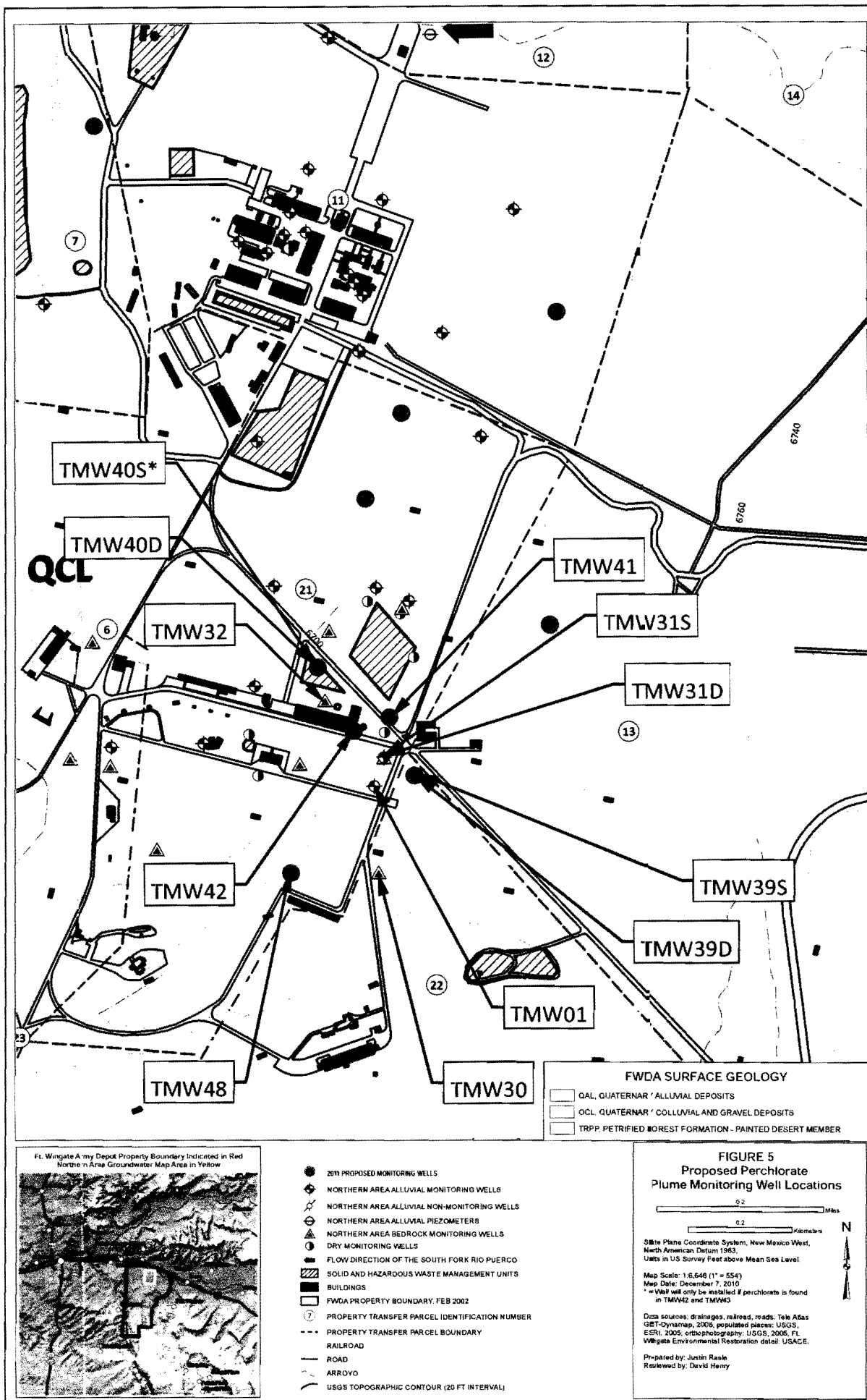
FIGURE 4
Proposed RDX and Nitrate Plume Monitoring Well Locations

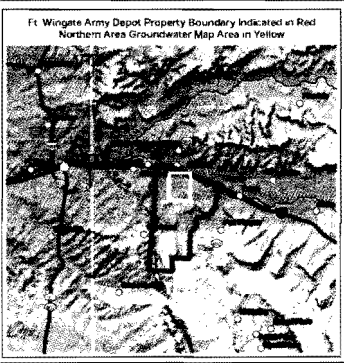
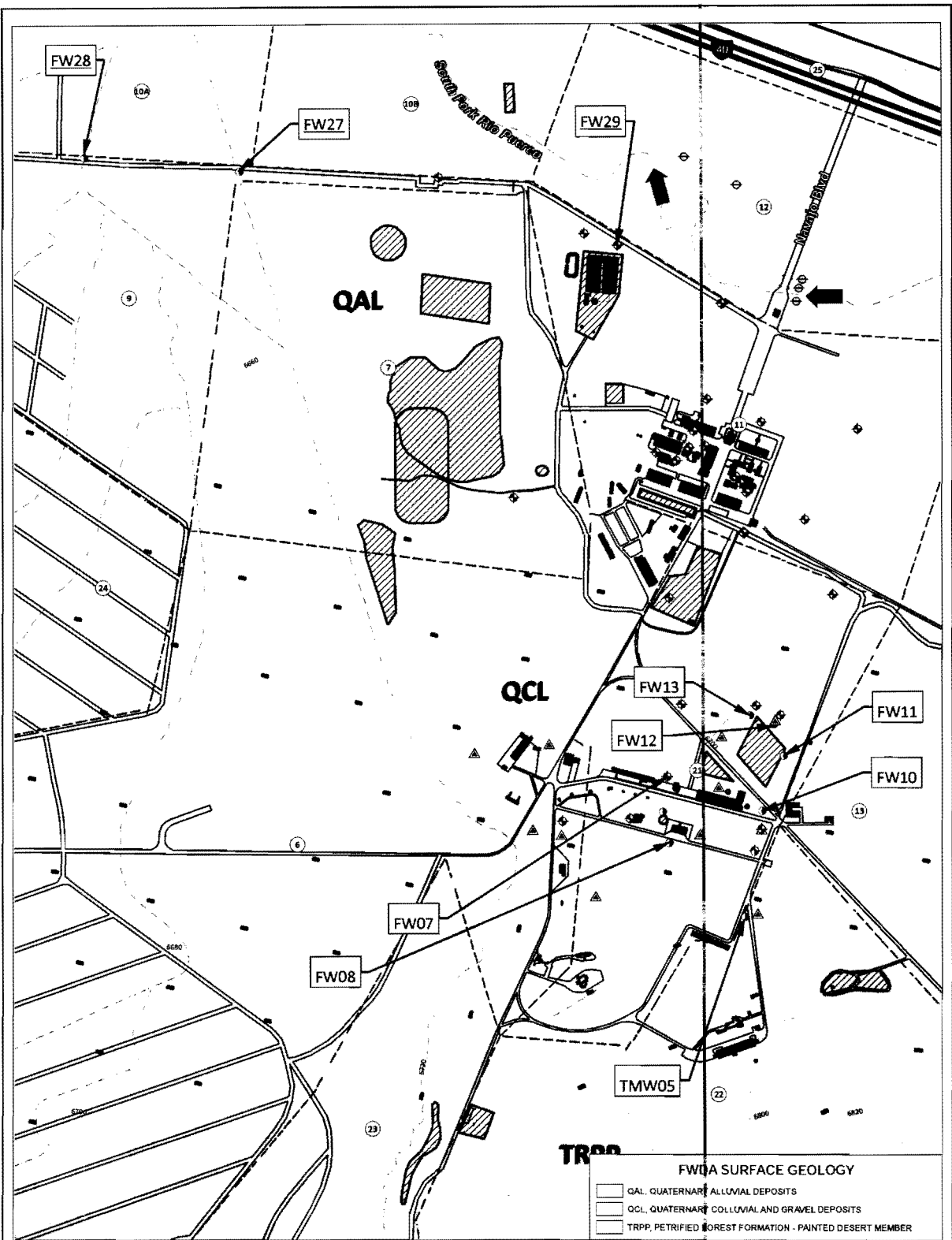
0.2 Miles
0.2 Kilometers

State Plane Coordinate System, New Mexico West, North American Datum 1983. Units in US Survey Feet above Mean Sea Level.
Map Scale: 1:6646 (1" = 554')
Map Date: December 7, 2010

Data sources: drainage, railroad, roads: Tels Atlas GDT-Dynmap, 2006, populated places: USGS, ESRI, 2005, orthophotography: USGS, 2005; Ft. Wingate Environmental Restoration detail: USACE.

Prepared by: Justin Reale
Reviewed by: David Henry





- 2011 PROPOSED MONITORING WELLS
- ◆ NORTHERN AREA ALLUVIAL MONITORING WELLS
- ◇ NORTHERN AREA ALLUVIAL NON-MONITORING WELLS
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- ⑦ PROPERTY TRANSFER PARCEL IDENTIFICATION NUMBER
- - - PROPERTY TRANSFER PARCEL BOUNDARY
- RAILROAD
- ROAD
- ARROYO
- USGS TOPOGRAPHIC CONTOUR (20 FT INTERVAL)

FIGURE 6
Proposed Monitoring Well Abandonment Locations

0.2 Miles
0.2 Kilometers

State Plane Coordinate System, New Mexico West,
North American Datum 1983.
Units in US Survey Feet above Mean Sea Level.

Map Scale: 1:10,000 (1" = 833')
Map Date: December 7, 2010

Data sources: drainages, railroad, roads: Tele Atlas
DOT-Dynamap, 2008; populated places: USGS,
E.R.I., 2005, orthophotography: USGS, 2005; Ft.
Wingate Environmental Restoration data: USACE.

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