SECTION 1

INTRODUCTION

1.0 Introduction

This 2011 annual groundwater corrective action report has been prepared for the U.S. Department of Energy (DOE) Kansas City Plant (KCP) to satisfy the annual reporting requirements of the KCP's Missouri Hazardous Waste Management Facility Permit (number MO980010524) (permit) issued October 6, 1999 and revised September 30, 2006.

Special permit condition II.F requires DOE to submit a comprehensive evaluation of the facility-wide groundwater monitoring program for the preceding calendar year (i.e., January through December) by March 1st of the ensuing year.

As required by the permit, this report contains all raw analytical data, groundwater analysis results, and field parameter measurement results, copies of field sampling and well inspection log sheets, well repair documentation, QA/QC data, volume of groundwater extracted and mass of contaminant extracted. The report also discusses any exceedence of the groundwater protection standards and limits in the permit, as well as a narrative discussion of the facility-wide groundwater monitoring program and conclusions concerning the overall adequacy and effectiveness of the program. In addition, a discussion of surface water, stormwater and surface sediment data results required by the permit are discussed including analysis of stormwater sampling in regulated stormwater outfall 002.

Other specific items discussed include the following:

- The rate and direction of groundwater movement and potential effects on any corrective action designed or implemented at the facility for removal, containment or control of the groundwater contaminant plume(s);

- The horizontal and vertical extent and concentrations of hazardous constituents in groundwater throughout the contaminant plume(s);

- Any surface and/or subsurface well integrity or siltation problems and their potential or actual influence on the groundwater data or efficiency of the groundwater corrective action program;

- The quantity of contamination extracted and quantity of groundwater extracted;

- The conclusions and summary of analytical results from surface water monitoring; and

- Information related to the operation of the groundwater treatment system, including the following:
    - Groundwater extraction rates and volumes
    - Treatment system efficiency and
    - Groundwater treatment plant operation and maintenance.

1.1 Report Organization

This report is divided into six sections plus appendices.

- Section 1 discusses the site setting, the history of the groundwater program, site conceptual model and the relationship between the conceptual model and the current monitoring system along with a description of the facility-wide groundwater monitoring program.

- Section 2 discusses the results of the 2011 groundwater corrective action program for the Blue River Groundwater Flow System (BRGFS). The nature, extent, movement and concentrations of hazardous constituents in groundwater are provided.

- Section 3 provides a discussion of the Indian Creek Groundwater Flow System (ICGFS) similar to that for the BRGFS.

- Section 4 discusses the operation and maintenance activities conducted in support of the groundwater monitoring, groundwater pumping and groundwater treatment systems. This includes results of internal and external well integrity inspections, groundwater extraction rates and volumes, treatment system efficiency and the amount of contaminants removed from the water bearing unit at the site.

- A summary and discussion of the adequacy of the existing groundwater corrective action program and its ability to contain and remediate the plume is also provided along with any recommended changes. Also provided are discussions related to pilot tests of potential groundwater filtration and treatment technologies that were evaluated at the facility in 2011.

- Section 5 discusses surface water data collected as required by the permit concentrating on activities conducted in regulated stormwater Outfall 002.

- Section 6 contains references.

Appendix A contains Plates 1 and 2 that show sitewide groundwater flow directions and locations of groundwater contamination for upper and lower completion wells sampled during the second semi-annual sampling event in October and November 2011. Plates 3 and 4 provide a visual representation of the locations where site groundwater clean-up standards, as defined in the permit, are exceeded in upper and lower completion monitoring wells. All well completions are sampled and/or water levels taken during the second semi-annual event.

Appendix B contains the Quality Assurance (QA) reviews of the analytical data from the 2011 second semi-annual groundwater-sampling event.

Appendix C contains groundwater treatment system sampling results collected in 2011.

Appendix D contains an annual summary of stormwater Outfall 002 analytical data.

Appendix E contains a report entitled “Filtra Systems - STiR Pilot Study Report” documenting the results of a pilot study on a possible groundwater filtration process also discussed in Section 4.

Appendix F contains a report entitled “Pilot Study of the VOC Eater Technology” discussed in Section 4.

1.2 2011 RCRA Class 3 Permit Modification Request

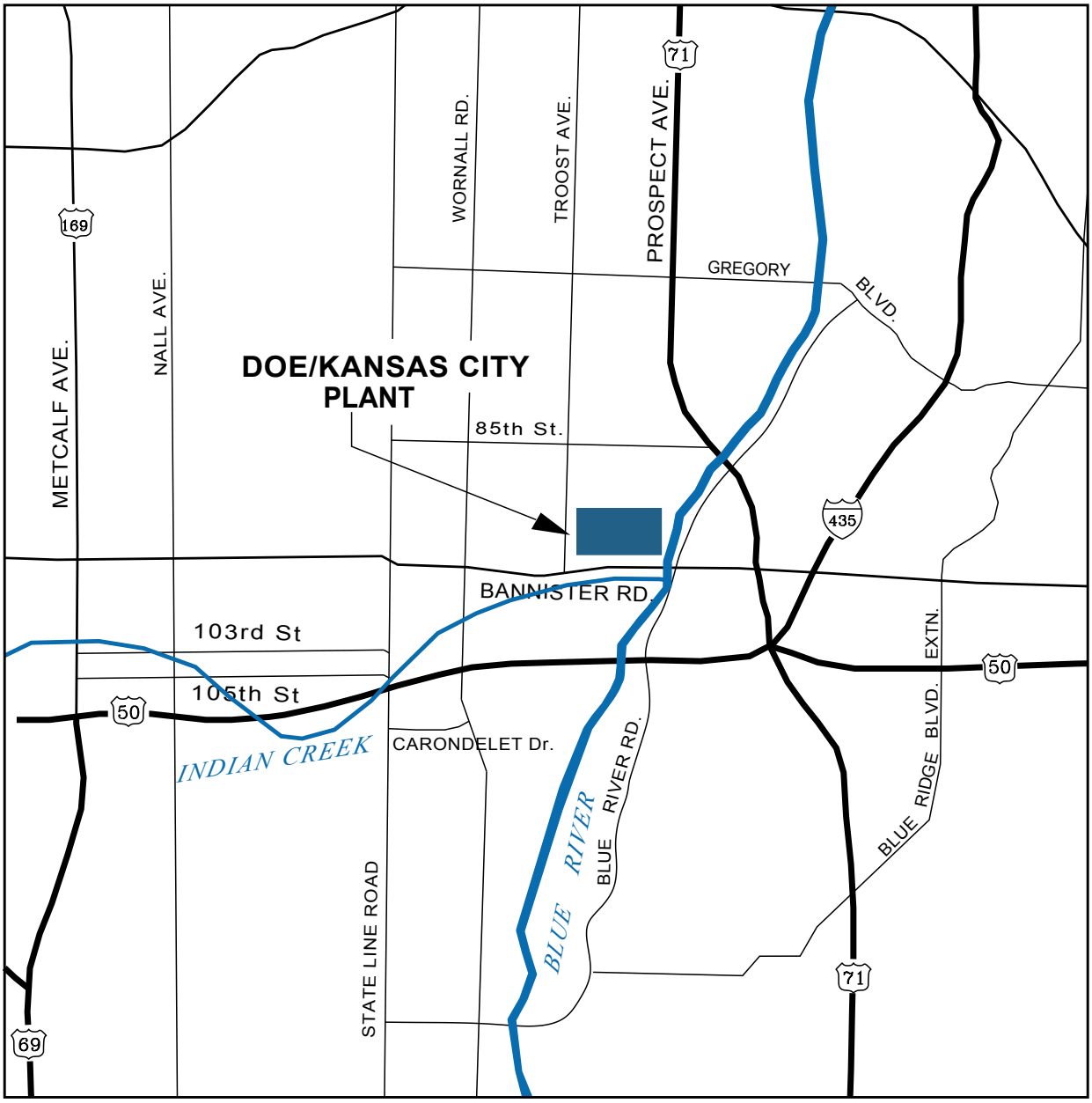
A modification to the existing Missouri Hazardous Waste Management Facility Permit was submitted to MDNR and EPA in 2011. This modification request proposes to expand the area covered by the permit to include the entire Bannister Federal Complex and to add the General Services Administration (GSA) as a Permittee. The modification also proposes to modify the site groundwater pumping and monitoring system incorporating conclusions reached in a groundwater pumping system optimization report submitted in 2010 (Laase, 2010b). The modification proposes changes to select perimeter and effectiveness wells and point of compliance wells, as designated in the permit, along with changes in the number and location of groundwater pumping wells comprising the site groundwater pumping system. Though not yet approved, explanatory text is provided to serve to transition this report to the proposed revised configuration.

Also included in the 2011 report are water levels collected from the area of the Old Landfill in the southeast portion of the Bannister Federal Complex. This data was utilized in the preparation of site potentiometric surface maps. The United States Army Corps of Engineers (USACE) is performing environmental investigations of the Old Landfill. GSA is also conducting investigations of areas currently under their control in coordination with and oversight from EPA Region VII. Water level and water quality data were collected from wells originally installed by GSA in the area of Building 50.

Should the modification request be approved as proposed, the entire BFC will be evaluated from a risk standpoint. In very general terms, this risk based clean-up will determine the amount of contamination that can safely remain on site in soil and groundwater and related environmental media to be protective of human health and the environment. EPA generally interprets protective clean-up standards to mean consistent concentrations that an individual could be exposed to on a daily basis without appreciable risk of deleterious effects in a lifetime.

1.3 Site Background/Evolution of Groundwater Monitoring Program

The Bannister Federal Complex, (BFC) of which the KCP is a part, is located 13 miles south of downtown Kansas City, Missouri, within the incorporated city limits (Fig. 1.1). The federal complex is bordered on the east by the Blue River and Blue River Parkway and on the south by Bannister Road and Indian Creek. Site-characterization and remedial activities have been conducted since 1983. The present monitoring well network is presented in Plates 1 and 2 provided as Appendix A. These plates show existing well locations (including wells currently



Kansas City Plant
National Security Asset

NNSA
National Nuclear Security Administration

The Kansas City Plant is operated and managed by Honeywell Federal Manufactureing & Technologies, LLC, for the NNSA.

Project Name:	2011 Annual Groundwater Corrective Action Report
Drawing Name:	Figure 1.1: Location of the DOE Kansas City Plant in the Kansas City Area
Date:	01/12/2012

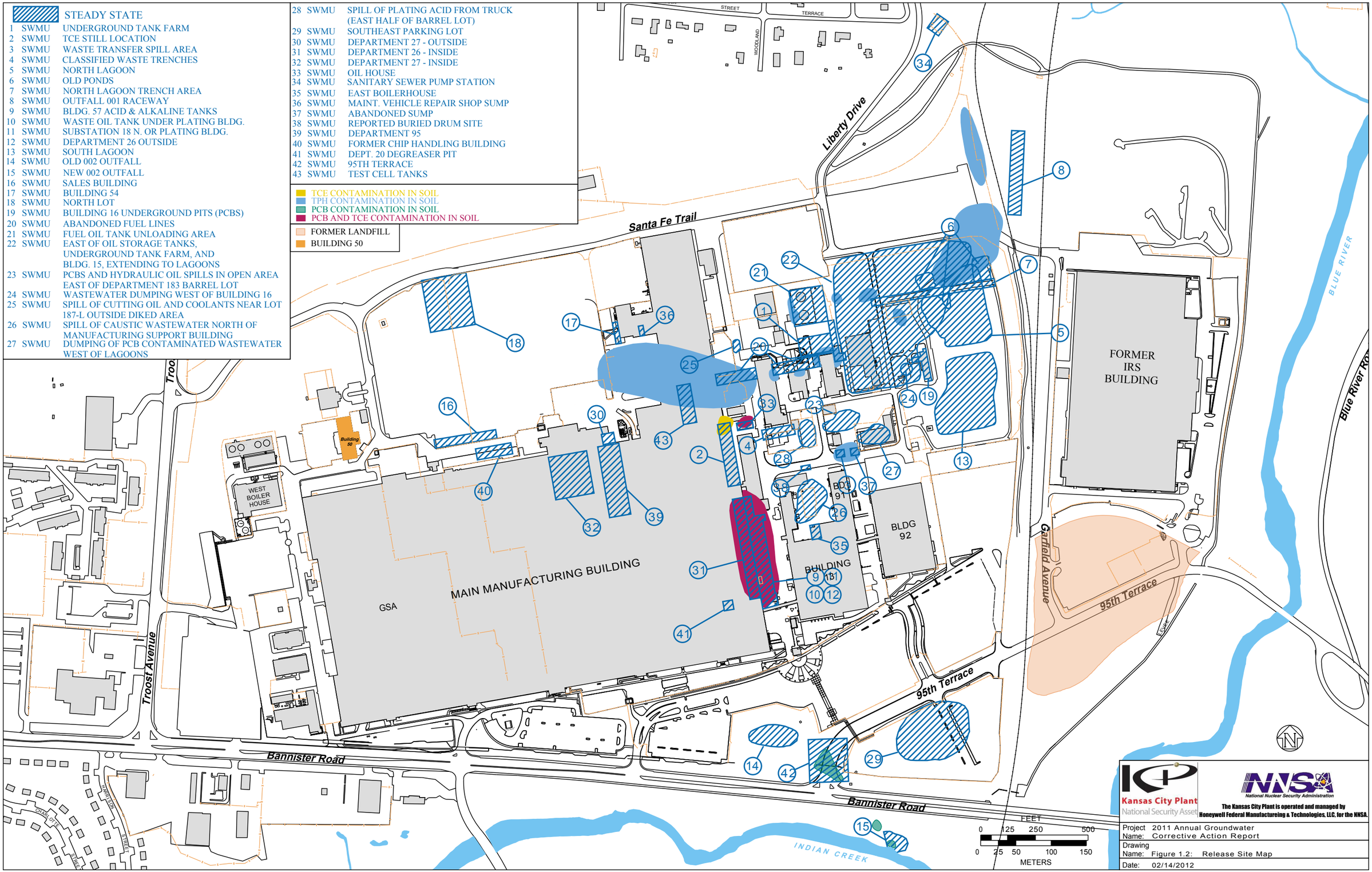
owned and managed by the GSA and the USACE), overall total VOC contaminant concentrations of areas monitored by DOE and potentiometric surfaces calculated from the 2011 second semi-annual sampling event in shallow (upper) completion wells and deep (lower) completion wells.

The earliest groundwater monitoring wells at the BFC were installed to determine the presence of groundwater contamination in and around three RCRA regulated hazardous waste management units at the facility; the North and South Lagoons and the Underground Tank Farm and the Old Landfill as well as a former landfill south of the IRS/NARA Building (Fig. 1.2). Later, wells were installed in support of RCRA Facility Investigations (RFI's) conducted pursuant to RCRA corrective action. Wells were installed in areas of known or suspected historical releases. If deemed to provide valuable environmental data allowing a more accurate representation of contamination in the investigated area or to provide a boundary of contamination in a particular area, the wells were left in place. Other groundwater monitoring wells have primarily been installed to support innovative environmental remediation technologies or to determine the potential movement of contamination along the perimeter of a plume. Together these wells serve to define the nature, rate and extent of groundwater contamination at the facility.

In late 2006 the KCP completed active remediation based on a risk based approach to RCRA corrective action for all DOE owned and/or controlled areas of the BFC. These areas were originally identified in a DOE Response to an EPA request for information regarding potential releases from Solid Waste Management Units in 1986. This list was later used in the establishment of areas to be addressed under a RCRA 3008(h) Administrative Order on Consent signed in 1989. The Order was superseded in 1999 by the signing of the current permit. All RCRA corrective action components (RCRA Facility Investigation (RFI), Corrective Measures Study (CMS), and Corrective Measure Implementation (CMI)) at all DOE SWMU's that required these tasks were completed to the satisfaction of MDNR, EPA and stakeholders. Figure 1.2 shows all SWMU's at the facility. It also shows the outline of the two other primary areas being investigated on the BFC the Building 50 area and the Old Landfill.

The KCP remains in an operations and maintenance mode under corrective action authority with activities funded by NNSA's Long Term Stewardship (LTS) program. The site is primarily engaged in the management and implementation of ongoing programs to manage risks created by the hazardous constituents that remain. Many tasks performed under LTS are memorialized in a permit required document submitted for MDNR approval called the Long Term Operation Maintenance & Monitoring (LT OM&M) Plan. Activities include sampling and analysis of environmental media, inspection, maintenance and repair activities, implementation of institutional and engineering controls and reporting.

Groundwater extracted from ten pumping wells is treated at a groundwater treatment facility located at the KCP's Industrial Wastewater Pretreatment Facility (IWPF) (Building 98) (Fig. 1.3). The groundwater pumping system is designed to contain groundwater contamination. Several wells comprising the system were also installed to serve as contaminant source removal wells. Additional flows to the groundwater treatment system are derived from a groundwater seep collection sump at the stormwater Outfall 001 Raceway, two building footing tile drains


STEADY STATE
1 SWMU UNDERGROUND TANK FARM
2 SWMU TCE STILL LOCATION
3 SWMU WASTE TRANSFER SPILL AREA
4 SWMU CLASSIFIED WASTE TRENCHES
5 SWMU NORTH LAGOON
6 SWMU OLD PONDS
7 SWMU NORTH LAGOON TRENCH AREA
8 SWMU OUTFALL 001 RACEWAY
9 SWMU BLDG. 57 ACID & ALKALINE TANKS
10 SWMU WASTE OIL TANK UNDER PLATING BLDG.
11 SWMU SUBSTATION 18 N. OR PLATING BLDG.
12 SWMU DEPARTMENT 26 OUTSIDE
13 SWMU SOUTH LAGOON
14 SWMU OLD 002 OUTFALL
15 SWMU NEW 002 OUTFALL
16 SWMU SALES BUILDING
17 SWMU BUILDING 54
18 SWMU NORTH LOT
19 SWMU BUILDING 16 UNDERGROUND PITS (PCBS)
20 SWMU ABANDONED FUEL LINES
21 SWMU FUEL OIL TANK UNLOADING AREA
22 SWMU EAST OF OIL STORAGE TANKS, UNDERGROUND TANK FARM, AND BLDG. 15, EXTENDING TO LAGOONS
23 SWMU PCBS AND HYDRAULIC OIL SPILLS IN OPEN AREA EAST OF DEPARTMENT 183 BARREL LOT
24 SWMU WASTEWATER DUMPING WEST OF BUILDING 16
25 SWMU SPILL OF CUTTING OIL AND COOLANTS NEAR LOT 187-L OUTSIDE DIKED AREA
26 SWMU SPILL OF CAUSTIC WASTEWATER NORTH OF MANUFACTURING SUPPORT BUILDING
27 SWMU DUMPING OF PCB CONTAMINATED WASTEWATER WEST OF LAGOONS
28 SWMU SPILL OF PLATING ACID FROM TRUCK (EAST HALF OF BARREL LOT)
29 SWMU SOUTHEAST PARKING LOT
30 SWMU DEPARTMENT 27 - OUTSIDE
31 SWMU DEPARTMENT 26 - INSIDE
32 SWMU DEPARTMENT 27 - INSIDE
33 SWMU OIL HOUSE
34 SWMU SANITARY SEWER PUMP STATION
35 SWMU EAST BOILERHOUSE
36 SWMU MAINT. VEHICLE REPAIR SHOP SUMP
37 SWMU ABANDONED SUMP
38 SWMU REPORTED BURIED DRUM SITE
39 SWMU DEPARTMENT 95
40 SWMU FORMER CHIP HANDLING BUILDING
41 SWMU DEPT. 20 DEGREASER PIT
42 SWMU 95TH TERRACE
43 SWMU TEST CELL TANKS
TCE CONTAMINATION IN SOIL
TPH CONTAMINATION IN SOIL
PCB CONTAMINATION IN SOIL
PCB AND TCE CONTAMINATION IN SOIL
FORMER LANDFILL
BUILDING 50
Santa Fe Trail
Liberty Drive
Troost Avenue
Bannister Road
95th Terrace
Garfield Avenue
BLUE RIVER
Blue River Ro
INDIAN CREEK
FORMER IRS BUILDING
MAIN MANUFACTURING BUILDING
GSA
WEST BOILER HOUSE
BUILDING 50
BLDG 92
BLDG 91
BUILDING 131
FEET
0 125 250 500
0 25 50 100 150
METERS
Kansas City Plant
National Security Asset
NNSA
National Nuclear Security Administration
The Kansas City Plant is operated and managed by Honeywell Federal Manufactureing & Technologies, LLC, for the NNSA.
Project Name: 2011 Annual Groundwater Corrective Action Report
Drawing Name: Figure 1.2: Release Site Map
Date: 02/14/2012

under the Main Manufacturing Building (MMB) and base flows from stormwater Outfall 002. Figure 1.3 also shows an area of groundwater seepage discussed in detail in the 2005 and 2006 annual groundwater corrective action reports.

1.4 Site Characteristics

1.4.1 Alluvial Hydrostratigraphy and Geology

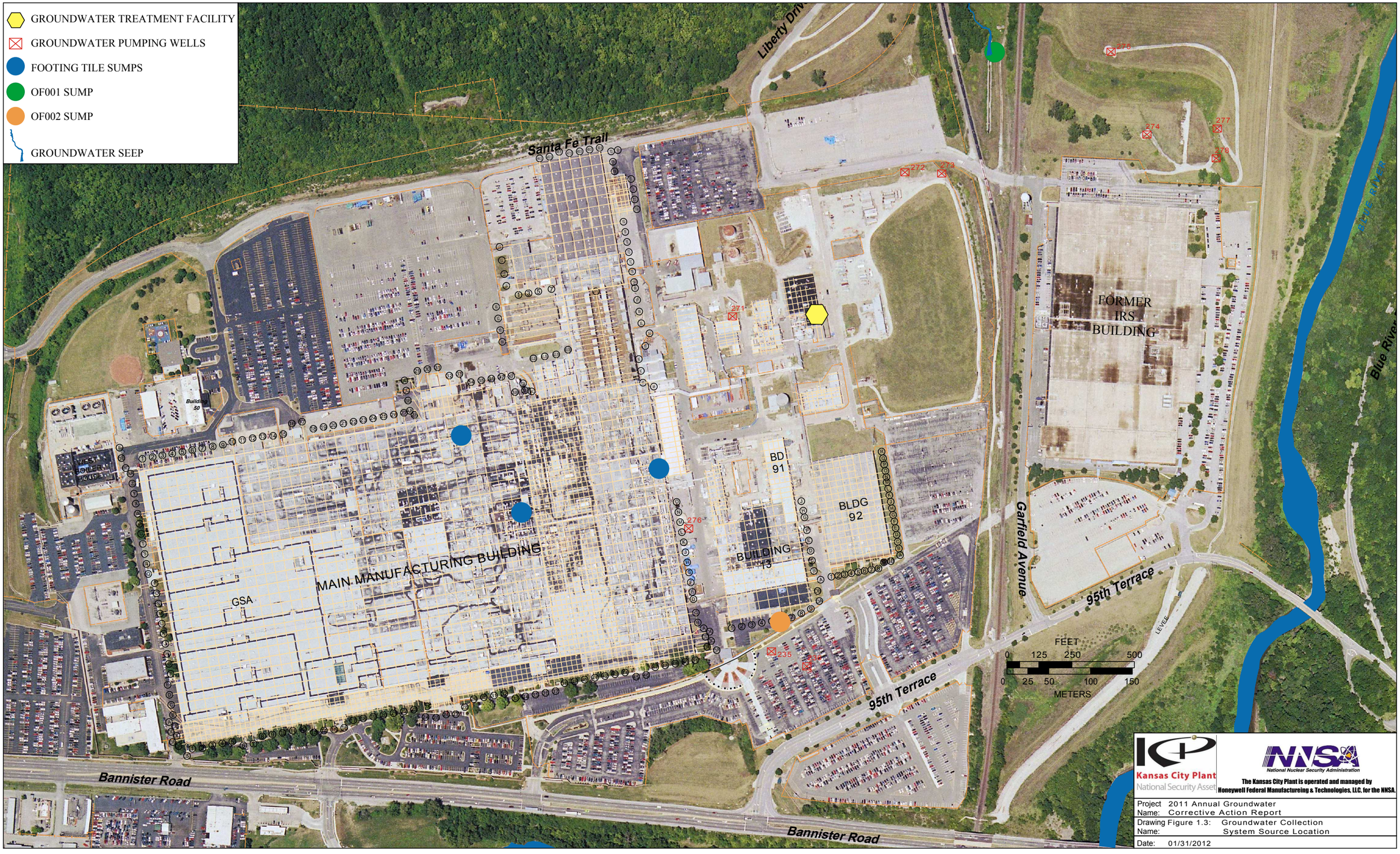
Alluvium at the KCP is approximately 40-45 ft thick and includes a continuous upper layer of thin-bedded clayey silt, with minor amounts of sand and a basal gravel within a sand-silt-clay matrix. The basal gravel, ranging in thickness from a few inches to 8 ft, consists of fragments of eroded bedrock in a sand-silt-clay matrix and is likewise continuous throughout the site. These two layers are separated in certain areas by a layer of olive to blue-green clayey silt. All three layers transmit water and constitute the alluvial aquifer. Some secondary permeability features exist due to small burrow and root zones. These features, however, do not extend to significant depths within the aquifer. In many parts of the facility, fill material has been added over the years and now comprises near surface material. This is especially true in areas northeast of the KCP including areas near the former north and south lagoons.

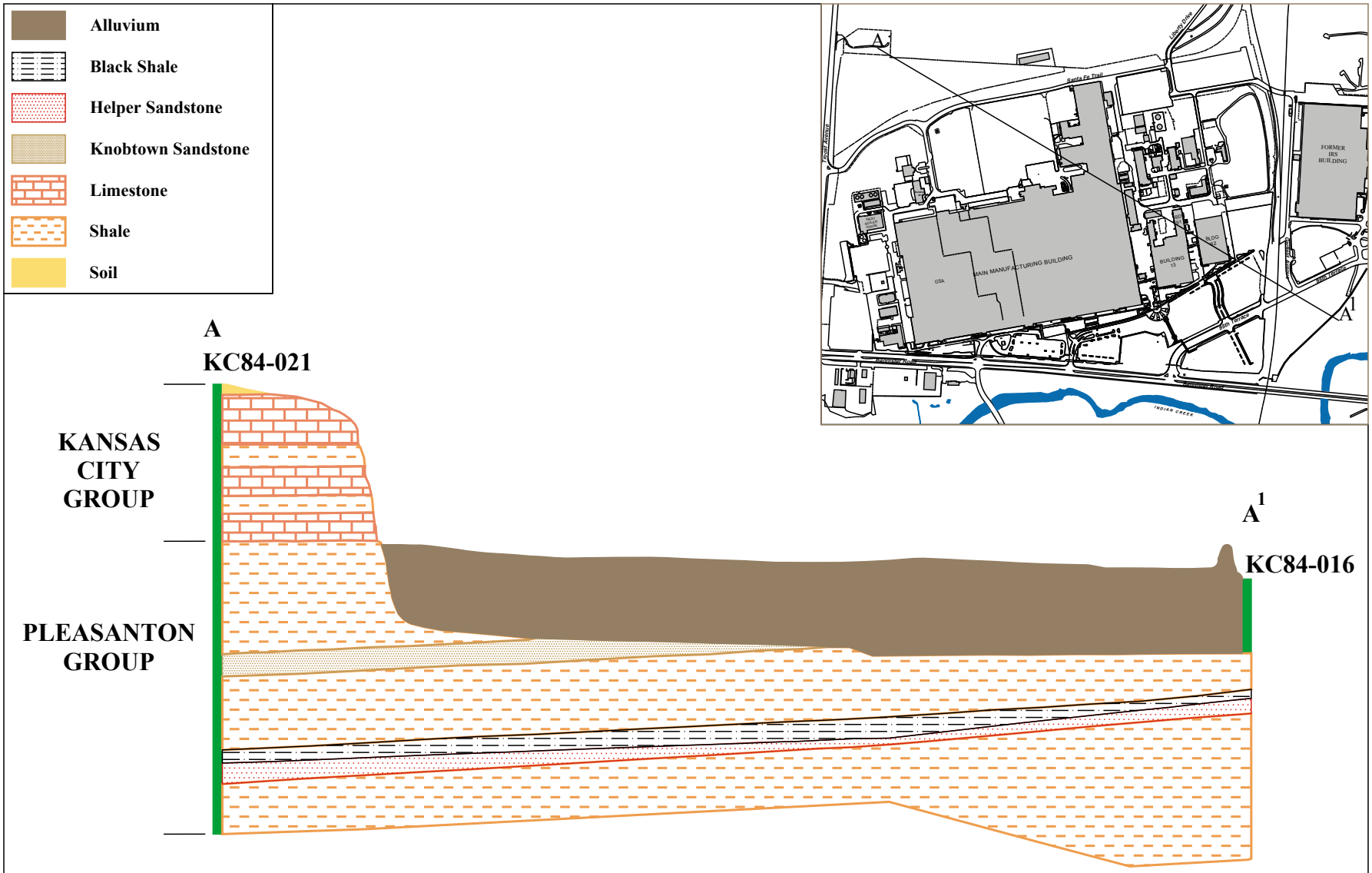
Groundwater monitoring wells at the KCP are screened in the upper alluvium to monitor for potential floating contaminants and shallow contaminant sources. The basal gravel in the lower alluvium is monitored because it is the most conductive water bearing zone. Wells that monitor this zone are called lower completion wells. These wells monitor contaminants that have a specific gravity greater than that of water (e.g., trichloroethylene).

1.4.2 Bedrock Stratigraphy and Geology

The bedrock underlying the alluvium consists of shales and sandstones of the Pleasanton Group. The erosional surface of the Pleasanton Group slopes gently to the east towards the Blue River (Fig. 1.4). The overlying sandstones, shales and limestones of the Kansas City Group have been eroded away and are no longer present at the site.

The Knobtown Sandstone within the Pleasanton Group underlies the alluvium across the central portion of the KCP (Fig. 1.5). This sandstone is a well-sorted, very fine-grained, well-cemented, lithic arkose. Generally, the Knobtown consists of monocrystalline quartz, sedimentary rock fragments, authigenic clay, potassium feldspar, plagioclase, chlorite from altered biotite, muscovite, and carbonaceous material. Results of thin-section analyses indicate approximately 12% intergranular pore space (Korte et al. 1985). The Knobtown ranges in thickness from approximately 5 ft to 10 ft and is present in the upper 30 ft of the Pleasanton Group except where it has been removed by Quaternary erosion (DOE 1984). The surrounding unnamed shales of the Pleasanton Group are present in the remaining portions of the site. These shale units are comprised of dense, indurated shale that show no evidence of secondary permeability. The shale's are dark green to gray and occasionally contain light-green sand stringers. Another sandstone unit, the Helper sandstone, is found as a part of the bedrock at the KCP. Approximately 20 feet of unnamed shale are present over the Helper sandstone at the KCP with


GROUNDWATER TREATMENT FACILITY
GROUNDWATER PUMPING WELLS
FOOTING TILE SUMPS
OF001 SUMP
OF002 SUMP
GROUNDWATER SEEP
Liberty Drive
Santa Fe Trail
FORMER IRS BUILDING
Blue River
BD 91
BLDG 92
BUILDING 13
MAIN MANUFACTURING BUILDING
GSA
Garfield Avenue
95th Terrace
Bannister Road
FEET
0 125 250 500
0 25 50 100 150
METERS
Kansas City Plant
National Security Asset
National Nuclear Security Administration
The Kansas City Plant is operated and managed by Honeywell Federal Manufactureing & Technologies, LLC, for the NNSA.
Project Name: 2011 Annual Groundwater Corrective Action Report
Drawing Name: Figure 1.3: Groundwater Collection System Source Location
Date: 01/31/2012



Kansas City Plant
National Security Asset

National Nuclear Security Administration

The Kansas City Plant is operated and managed by Honeywell Federal Manufactureing & Technologies, LLC, for the NNSA.

Project Name: 2011 Annual Groundwater Corrective Action Report

Drawing Name: Figure 1.4: Bedrock Stratigraphy

Date: 01/31/2012

at least 20 feet of additional shale present below the Helper based on logs derived from bedrock wells at the facility (Kayenta, 2002).

1.4.3 Hydraulic Properties, Alluvium

Ten constant-rate-pumping tests have been performed at the KCP to determine the hydraulic conductivity and the storativity of the unconsolidated material. Five of the pumping tests were conducted in wells that fully penetrated the alluvial aquifer and produced vertically averaged hydraulic conductivity estimates between 1.1 ft/d (3.9×10^{-4} cm/s) and 3.0 ft/d (1.1×10^{-3} cm/s). The other five pumping tests were conducted in wells screened solely in the basal gravel and produced an estimated basal gravel hydraulic conductivity between 14 ft/d (4.9×10^{-3} cm/s) and 34 ft/d (1.2×10^{-2} cm/s). The green clay aquifer test also determined the vertical hydraulic conductivity of the green clay to be between 0.26 ft/d and 0.34 ft/d (DOE 1992). Storativity values from the tests ranged from 5.0×10^{-4} to 2.0×10^{-3}.

Laboratory testing on soil cores measured total porosity at 40% (DOE 1999). Effective porosity in the alluvium was not measured and accurate measurement is difficult. Collecting an unconsolidated core is often unsuccessful because the collection process disturbs the material and/or bypass occurs along the core sleeve. Tracer tests in the field take considerable time and/or the tracer is missed because actual flow directions are often not known. Additionally, an estimate of hydraulic conductivity is needed which varies spatially. Transport models at the KCP utilize an effective porosity of 10%. An effective porosity of 10% was also used to calculate horizontal groundwater velocities in the basal gravel.

1.4.4 Hydraulic Properties, Bedrock

Packer tests conducted on bedrock wells indicate that the bedrock has very low hydraulic conductivity. For example, packer tests conducted on the Pleasanton Shale showed no-flow conditions. Because packer tests can measure hydraulic conductivity's as low as 0.0001 ft/d (3.5×10^{-8} cm/s), it is safe to assume that the hydraulic conductivity of the Pleasanton shale is 0.00001 ft/d (3.5×10^{-9} cm/s) or lower. Based on packer tests of former bedrock wells 21, 22, and 23 the hydraulic conductivity of the Knobtown Sandstone ranges from 0.005 to 0.04 ft/d (1.8×10^{-6} to 1.4×10^{-5} cm/s) (Korte et al. 1985; Madril et al. 1986). Bail tests of wells 122, 123, and 124, analyzed using Hvorslev's method, produced similar measurements to Knobtown Sandstone hydraulic conductivities (2×10^{-5} to 4×10^{-5} cm/s) (DOE 1990a).

1.5 Subsurface Contaminant Nature and Migration

The primary groundwater contaminant at the KCP is trichloroethylene (TCE) and it's anaerobically produced degradation products 1, 2-dichloroethylene (1, 2-DCE) and vinyl chloride. Other compounds including 1,1-dichloroethane (1,1-DCA) and 1,1-dichloroethene (1,1-DCE) are found at the site but at significantly lower frequency and concentration when compared to the three primary compounds. Due to the low solubility of the chlorinated solvents they are considered immiscible in water.