

4.5.1 Historical Soil Sample Analytical Results

AG&M Phase II EI historical soil analytical results are summarized on Table 7. Sample locations are shown on Figure 4. Based on review of the historical soil-analytical data, the following results were identified:

- Fluoranthene and pyrene were detected above the laboratory quantitation limits but below the RGs in the soil samples collected from test boreholes SB-26 and SB-27.
- Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, and phenanthrene were detected above the RGs in the soil sample collected from Test Borehole SB-26.
- Barium was detected above the RG in the soil samples collected from test boreholes SB-7, SB-8, SB-9, SB-25, and SB-26.
- Arsenic was detected above the RG in the soil samples collected from test boreholes SB-8, SB-25, and SB-26.
- Chromium was detected above the RG in the soil samples collected from test boreholes SB-8, SB-25, and SB-26.
- Lead was detected above the RG in the soil samples collected from test boreholes SB-26 and SB-27.
- Cadmium was also detected above the RG in the soil sample collected from Test Borehole SB-26.

4.5.2 Historical Groundwater Sample Analytical Results

AG&M Phase II EI historical groundwater analytical results are summarized on Table 8. Based on review of the historical groundwater-analytical data, the following results were identified:

- Tetrachloroethene was detected above the NCAC 2L Groundwater Quality Standards in the groundwater samples collected from SB-25/MW.
- Bis (2-Ethylhexyl) phthalate was detected above the 2L Standards in the groundwater sample collected from SB-27/MW.
- Naphthalene was detected below the 2L Standards in the groundwater sample collected from SB-26/MW.
- Acetone was detected below the 2L Standards in the groundwater sample collected from SB-27/MW.

4.6 Machine Shop Area

During the Phase II EI, by AG&M, soil and groundwater samples were collected in the vicinity of the Machine Shop Area to determine if past practices may have impacted the soil and groundwater beneath the Site (Figure 4).

4.6.1 Historical Soil Sample Analytical Results

AG&M Phase II EI historical soil analytical results are summarized on Table 9. Based on review of the historical soil data, the following results were identified:

- VOCs and SVOCs were not detected above the laboratory quantitation limits in the soil samples collected from SB-11, SB-15, and SB-19.
- Barium was detected above the RG in the soil samples collected from SB-11, SB-15, and SB-19.

4.6.2 Historical Groundwater Sample Analytical Results

Historical groundwater analytical results are summarized on Table 10. Based on review of the historical groundwater data, the following results were identified:

- Chloroform was detected above the NCAC 2L Groundwater Quality Standards in the groundwater samples collected from SB-13 and SB-15; and
- Tetrachloroethene was detected above the 2L Standards in the groundwater samples collected from SB-13, SB-15, and SB-17.

4.7 WWTF/Former Debris Landfill Areas

Regarding the two former debris landfills, Fieldcrest received, a letter dated December 1, 1998, from NCDENR Division of Solid Waste Management ("DSWM") stating that "the Solid Waste Section does not plan to take further action concerning these sites". Fieldcrest is currently in the process of obtaining closure from the DSWM for the two former Debris Landfills. Based on this information and the results of the AG&M EI, additional intrusive investigation for the WWTP/Debris Landfill Areas (Figure 2) was not warranted during this RI.

4.7.1 Historical Soil Sample Analytical Results

A Fieldcrest letter dated August 26, 1998 was submitted to the NCDENR Division of Solid Waste stating that potential asbestos containing material had been observed in the test pits dug by Maxim. Analytical data, indicating that asbestos was not detected in the sampled material from the test pits, was included with the letter to the state.

Polynuclear aromatic hydrocarbons ("PAHs") were detected in the sample collected from Test Pit No. 3, however, the sample was collected from roofing shingles, which naturally contain these types of constituents.

4.7.2 Historical Groundwater Sample Analytical Results

VOCs, SVOCs, oil and grease, and TPH were not detected above the laboratory quantitation limits in the groundwater sample collected from the temporary monitoring well (LTMW) installed downgradient of the debris landfill (Figure 2). The location of well LTMW was not clearly defined in previous reports by others.

5.0 Hydrogeologic Setting

The geology and hydrology of the NC Finishing Site and the general area are discussed in this section.

5.1 Regional Hydrogeology

The topography in this portion of the Piedmont is characterized by rolling hills with topographic elevations ranging from approximately 630 to 750 feet above National Geodetic Vertical Datum ("NGVD") (Figure 1). However, the topography of the Site is generally level (elevation of approximately 650 feet NGVD) where land surface has been altered by grading and filling. Topography is steeper along the banks of the Yadkin River where elevations descend rapidly to approximately 625 to 630 feet NGVD.

The Yadkin River is the major surface-water drainage system in the area and the Site is located on the south bank of the river. Headwaters of the High Rock Lake on the Yadkin are located just east and downstream of the Site and have a normal pool elevation of 624 feet NGVD.

The Site is located within the Piedmont Physiographic Province of North Carolina, which is underlain by massive crystalline and metamorphic rocks that are divided into lithotectonic belts. The Site is located in the Carolina Slate Belt.

The bedrock beneath the Site consists of a massive felsic intrusion, typically light gray or pink metagranitic rock. The upper bedrock surface is irregular due to differential weathering and ranges in depth from 2 to more than 75 feet below land surface ("BLS"). The depth to rock increases toward the river.

Bedrock is overlain by a layer of unconsolidated material/soil called saprolite that is developed by the in-place chemical weathering of the underlying bedrock. The surficial soils in the northeastern portion of the Site in the vicinity of FMW-206 consist of fill material overlying the saprolite. Along the river, surficial soils consist of fluvial materials ranging from sand to clay deposited by riverine floods.

The more permeable soils in the saprolite generally exist at the top of the bedrock where less complete chemical and physical weathering of the rock has produced porous and permeable silty sand. This zone is the most permeable of the subsurface materials and is conducive to groundwater flow.

The hydrogeologic sequence at the Site consists of two units, the Shallow Aquifer and the Bedrock Aquifer. The Bedrock Aquifer appears to be used for potable-water supply in the vicinity of the Site. Potable water service is also provided by the municipal water supply system. The Shallow Aquifer is not used for water supply.

The Shallow Aquifer is formed by the unconsolidated materials both saprolite and fluvial deposits near the river, which range in thickness from 15 to more than 75 feet. Groundwater is under unconfined-aquifer conditions and the groundwater surface generally occurs within 4 to 30 feet of land surface. Recharge areas for this aquifer are very localized, and can be influenced by surface development of impervious cover (i.e., buildings, parking lots, roads, etc.), major road construction, and variations in annual rainfall. Groundwater flow is generally toward the nearest surface water feature, which is the Yadkin River adjacent to the Site.

The Bedrock Aquifer is present below the Shallow Aquifer and appears to be in direct hydraulic connection with the Shallow Aquifer. Groundwater in the Bedrock Aquifer is present in fractures. Groundwater flow is generally to the north/northeast. Discharge from the Bedrock Aquifer is believed to be to the Yadkin River, which is located adjacent to the north and northeast of the Site. Recharge to the aquifer is generally by downward leakage from the Shallow Aquifer.

5.1.1 Geology

The bedrock beneath the Site consists of a massive felsic intrusion, typically light gray or pink metagranitic rock. The upper bedrock surface is irregular due to differential weathering and ranges in depth from 2 to more than 75 feet below land surface ("BLS").

Bedrock is generally overlain by a layer of unconsolidated material/soil called saprolite that is developed by the in-place chemical weathering of the underlying bedrock. The surficial soils have the greatest thickness in the northeastern portion of the Site in the vicinity of FMW-206 at the former Burn Pit and consist of fill material and residuum overlying the saprolite. Along the river, surficial soils consist of fluvial materials ranging from sand to clay deposited by riverine floods.

The more permeable soils in the saprolite generally exist at the top of the bedrock where less complete chemical and physical weathering of the rock has produced porous and permeable silty sand. This zone is the most permeable of the subsurface materials and is conducive to groundwater flow.

5.2 Site Geology

Because of continued weathering, rock in the Piedmont Province is now generally covered with a mantle of soil that has formed from the in-place (*in situ*) chemical weathering of the parent bedrock. The soils that overlie bedrock have variable thicknesses, and are generally referred to as residuum (residual soils) and saprolite.

Residuum is typically finer grained, has a higher clay content, and retains less of the original rock and mineral structure than the underlying saprolite because of the advanced weathering. Similarly, the soils typically become coarser grained with increasing depth because of decreased weathering. As the degree of weathering decreases, residuum grades into saprolite,

which generally retains the overall appearance, texture, gradation, foliation and structure of the parent rock. Saprolite generally grades into partially weathered rock ("PWR") and fractured rock with increasing depth as the unweathered bedrock is approached.

The typical geologic sequence in the study area consists of, in descending order, soil (including fill material), residuum (residual soil without relic structure), saprolite (contains relic structure), weathered rock, and bedrock. The contacts between the different lithologies are gradational over a few inches to several feet. Hydrogeologic cross sections (A-A', and B-B', Figure 5) of the study area are presented in Figures 6 and 7, respectively.

5.2.1 Unconsolidated Material

The residuum consists mainly of clayey, sandy silt. The residuum is typical reddish orange to reddish brown in color and does not contain any relic structure of the parent bedrock. The thickest residuum (approximately six to eight feet) was encountered at FMW-206 (which also contained the thickest fill material) in the northeastern corner of the Site (Figure 6).

Saprolite was encountered throughout the study area. The saprolite was typically a sandy silt to a silty sand and contained relic structures of the parent bedrock such as weathered crystal structures, quartz veins and fractures. The saprolite generally coarsened downward to bedrock. The saprolite was typically mottled red, pink and tan to white. The thickness of the saprolite ranged from 74 feet at FMW-204 located south of the Site to less than 2 feet at FMW-202 located southwest of the Site (Figure 7).

5.2.2 Bedrock

Bedrock in the area is identified as the intrusive Granite of Salisbury Plutonic Site. The Salisbury Plutonic Suite occurs in the Charlotte belt of central North Carolina. This hypidiomorphic granular (presence of minerals) granite is homogeneous, medium-grained and distinctly leucocratic (lighter than usual color for rock type). Based on core samples and video of bedrock borings, bedrock appeared to be pink, massive to weakly foliated and mainly comprised of potassium feldspar, albite, and quartz; with numerous high angle to vertical quartz veins; some up to one and one-half inches thick and fractures.

Depth to bedrock at the Site ranged from approximately 5 to 90 feet BLS (Table 2). The estimated configuration of the top of competent, relatively unweathered bedrock is presented in Figure 8. In general, the configuration to the top of competent bedrock is a subdued reflection of land surface topography with the slope on the rock surface generally less than the topographic slope.

The bedrock-surface elevation ranges from a maximum of 648.6 feet NGVD at Borehole FMW-302 in the southwestern portion of the Site to a minimum of 610 feet NGVD at Borehole FMW-306 in the northeastern portion of the Site near the Burn Pit/Clarifier Area. The bedrock-surface slope appears to be steeper than topography in the southeastern portion of the Site where a westward-trending, linear bedrock depression which is not reflected in the

land surface topography (Figure 8). This bedrock feature may be due to slightly greater weathering of the bedrock in a potential fracture zone.

Numerous fractures were encountered in all the bedrock test boreholes. The fractures varied from nearly horizontal to high angle. Two open fractures were encountered at bedrock test borehole FMW-304 at depths of 63 ft and 68 ft bls with fracture apertures of 3 and 2 feet, respectively.

5.3 Shallow Aquifer Hydrology

A Shallow Aquifer is present in the unconsolidated material overlying bedrock in the study area. The Shallow Aquifer appears to be separated from the bedrock aquifer in areas where the saprolite layer thickens. The aquifer is under water table aquifer conditions.

Thirty-one monitoring wells have been installed to monitor the Shallow Aquifer in the study area. The FMW-100 series wells and wells FMW-1, CMW-1 and MW-1 through MW-18 are completed in the upper portion of the aquifer. The FMW-200 series wells, and wells VE-1 and VE-2, are completed in the basal portion of the aquifer above the weathered rock layer. Monitoring Well FMW-207 is completed at the top of bedrock (auger refusal) at a depth of 57 feet BLS.

The configuration of the groundwater surface in the upper portion of the Shallow Aquifer for May 10, 2001 and October 8, 2002 are presented in Figure 9 and Figure 10, respectively. The configuration of the groundwater surface in the lower portion ("basal") of the Shallow Aquifer for May 10, 2001 and October 8, 2002 are presented in Figure 11 and Figure 12, respectively. The direction of groundwater flow is generally radial in the direction of the Yadkin River adjacent to the site. The groundwater flow is generally northeasterly from the northern portion of the site, and easterly to southeasterly from the central and southern portions of the Site.

A groundwater-level data summary is presented in Table 11. Hydrogeologic Cross Sections A-A' and B-B' (Figures 6 and 7) illustrate some the vertical-head relationships discussed below.

Variations in vertical and horizontal gradients across the study area are presented in Table 12. Based on May 10, 2001 water level data, the western, northwestern and eastern portions of the Site, a downward vertical gradient is present. Downward vertical gradients average 0.07 feet at FMW-102 and FMW-202, 0.08 feet at FMW-107 and FMW-207, 0.03 feet at FMW-105 and FMW-205, 0.14 feet at MW-1 and VE-1, and 0.03 feet at MW-13 and VE-2.

In the southeastern central portion of the Site, an upward vertical gradient appears to be present (0.11 feet at FMW-104 and FMW-204). The direction of vertical flow has been both downward and upward in these wells during the measurement period.

5.3.1 Groundwater Hydrology

The hydrogeologic sequence at the Site consists of two units, the Shallow Aquifer and the Bedrock Aquifer. The Bedrock Aquifer appears to be used for potable-water supply in the vicinity of the Site. Potable water service is also provided by the municipal water supply system. The Shallow Aquifer is not used for water supply.

The Shallow Aquifer is formed by the unconsolidated materials both saprolite and fluvial deposits near the river, which range in thickness from 15 to more than 75 feet. Groundwater is under unconfined-aquifer conditions and the groundwater surface generally occurs within 4 to 30 feet of land surface. Recharge areas for this aquifer is very localized, and can be influenced by surface development of impervious cover (i.e., buildings, parking lots, roads, etc.), major road construction, and variations in annual rainfall. Groundwater flow is generally toward the nearest surface water feature, which is the Yadkin River adjacent to the Site.

The saprolitic soils typically have high porosity but low permeabilities, and therefore, generally store a large volume of groundwater that is not, however, readily transmitted. The saprolitic soils are considered leaky, semi-permeable aquifers, which generally store water from precipitation and recharge groundwater (downward infiltration) to the underlying bedrock.

The Bedrock Aquifer is present below the Shallow Aquifer and appears to be in direct hydraulic connection with the Shallow Aquifer. The Bedrock Aquifer is heterogeneous and anisotropic. The extent, orientation, and degree of interconnection of the fractures control groundwater flow within the Bedrock Aquifer. Groundwater in the Bedrock Aquifer is present in fractures. The movement of groundwater is strongly influenced by fractures, joints, and topography. Groundwater flow is generally to the north/northeast. Discharge from the Bedrock Aquifer is believed to be to the Yadkin River, which is located adjacent to the Site to the north and northeast. Recharge to the aquifer is generally by downward leakage from the Shallow Aquifer.

6.0 Receptor Information

6.1 Exposure Assessment

Regulatory agency file reviews and area reconnaissance surveys were performed by S&ME and others during previous investigations to identify the potential receptors within the Site area. The results of the file reviews and reconnaissance/well surveys are discussed herein.

6.1.1 Environmentally Sensitive Areas

The Site and adjacent properties were evaluated for the existence of the environmentally sensitive areas via telephone contacts with the various government agencies outlined in the *REC Rules and Implementation Guidance* document. The findings of the evaluation are described herein.

Ms. Susan Giles of the North Carolina Division of Parks and Recreation was contacted concerning sensitive environments under the oversight of the Natural Heritage Program and the Planning and Development Section. Ms. Giles indicated that two Significant Natural Heritage Areas ("SNHA") are present within one mile of the Site, (1) High Rock Reservoir Wetlands, and (2) Yadkin River/Grant's Creek Forest Bottomlands. Ms. Giles also provided information regarding two rare plants that are present near the Site: (1) the Carolina Birdfoot Trefoil (*Lotus helleri*), a Federal Species of Concern/State Candidate for Protection, located approximately ½-mile east of the Site; and (2) the Piedmont Indigo Bush (*Amorpha shwerinii*), a State Significantly Rare Candidate, reported along the southern perimeter of the WWTP, which is located south of the plant.

Several attempts were made to contact Mr. Justin Kenny of NOAA to determine if there were marine sanctuaries on or adjacent to the Site. At the date of this RI there were no response to the telephone calls. However, Mr. Chris Ostrum of NOAA was contacted during a previous investigation (by others) regarding the same issue. Mr. Ostrum indicated that there were no marine sanctuaries in the inland areas of North Carolina.

Ms. Renee Gledhill-Early of the North Carolina Department of Cultural Resources ("NCDRC") was contacted to evaluate the Site with respect to National and State Historical Sites. According to a letter dated October 29, 1999 by Mr. David Brook, Deputy State Historic Preservation Officer, NCDRC is not aware of any properties of architectural, historic, or archaeological significance, which would be affected by the project.

Mr. Doug Huggett of the North Carolina Division of Coastal Management indicated that there are no coastal protection areas in Rowan County.

Several attempts were made to contact Mr. Fred Harris and Frank McBride of the NC Wildlife Resources Commission ("NCWRC") to determine if there were environmentally sensitive areas under the oversight of the NCWRC on or adjacent to the Site. At the date of this RI Report there were no response to the telephone calls. However, Mr. Joe Mickey of NCWRC

was contacted during a previous investigation (by others) regarding the same issue. Mr. Mickey indicated that the Site is not located on or adjacent to areas designated for protection.

Mr. Jay Sauber of the NC Division of Water Quality was contacted to determine if there were any Critical Areas identified under the Clean Lakes Program. Mr. Sauber indicated that the two upper arms of High Rock Lake contain high levels of nutrients, mercury and excessive sedimentation. He also indicated that these concerns were not the result of NCF plant operations.

Mr. Bill Pickens of NC Division of Forest Resources – State Preserves and Forests indicated that the NC Division of Forest Resources have no concerns on the Site or areas in the vicinity of the Site.

Several attempts were made to contact the following agencies (as outlined in the *REC Rules and Implementation Guidance* document) concerning environmentally sensitive areas on or adjacent to the Site under their oversight;

- NC Planning and Natural Resources;
- NC Division of Water Quality – State-Designated Areas for Protection or Maintenance of Aquatic Life;
- US Fish & Wildlife Service - Terrestrial Areas Utilized for Breeding by Large or Dense Aggregations of Animals;
- National Park Service;
- US Forest Service – Designated and Proposed Federal Wilderness and Natural Areas;
- US Forest Service – National Preserves and Forest;
- US Army Corps of Engineers – Wetlands; and
- US Forest Service – Federal Land Designated for the protection of Natural Ecosystems.

At the date of this RI, there have been no responses to our mail requests and telephone inquiries.

6.2 Area Reconnaissance Survey

In October 1999, S&ME personnel performed a reconnaissance survey of the surrounding property within an approximate ¼-mile radius of the Site to evaluate land use and identify potential receptors. The Site is located within a mixed commercial, residential, and agricultural area; the area land use surrounding the Site is shown on Figure 13.

The Site is bounded on the north and east by the Yadkin River, the south by North Carolina Highway 29, and the west by vacant lots and a church. The properties surrounding the Site and the available property owner information are summarized on Table 13, and the adjacent properties are shown on Figure 14.

At the Site, S&ME has identified and inspected 20 existing monitor wells (MW-1 through MW-4, MW-7 through MW-18, VE-1, and VE-2) at the Former 20,000-Gallon UST Area, one existing well (FMW-1) at the Clarifier Area, and one existing monitoring well (CMW-1) at the Chemic Area; the well locations are shown on Figure 5. (Note: groundwater monitoring wells MW-5, and MW-6 have apparently been abandoned or destroyed.) The well designations and functions were identified from previous reports and Site drawings.

The groundwater monitoring well designation for the Chemic Area well MW-1 was changed to CMW-1. The change is made in part for clarity due to the presence on-Site of another MW-1 in the Former 20,000-Gallon UST Area. Previously undiscovered Well FMW-1 was sampled during the RI Investigation, however, this well was not identified in previous reports or site drawings. Well FMW-1 was abandoned during the Phase II activities. The monitoring well identification nomenclature is discussed in detail in the Sampling and Analysis Plan ("SAP") Section 8.1 of the RI Work Plan.

6.2.1 Rowan County Property Assessor

The Rowan County Property Assessor records reveal that two residential properties in the area of the Site have basements. The properties (Map ID Nos. 2 and 3) are located west of the Site as shown on Figure 14.

Portions of the plant have basements and crawl spaces. In addition, rinse water from various plant operations is transported through concrete ditches beneath the building. These ditches can be observed in the basement.

6.2.2 Computer Database Research

In January 1998, Maxim obtained an environmental records computer database research report from Environmental Risk Information & Imaging Services ("ERIIS") for the Site and surrounding area. The ERIIS report contains an inventory of facilities of potential environmental concern.

The database search identified two sites within ½-mile of the Site. Both sites were listed in the North Carolina Leaking Underground Storage Tanks ("NCLRST") database and identified Fieldcrest Cannon-NC Finishing as the Owner of both (NCDENR Incident Nos. 17467 and 16198). Based on the database information and information obtained from Fieldcrest, these two listings refer to the removal of the 550-gallon and 2,000-gallon gasoline/diesel USTs and the 3,000-gallon kerosene UST from the former Garage UST Area (Incident No. 17467), and the 20,000-Gallon UST (Incident No. 16198).

6.2.3 Public Potable Water Supply

Based on area reconnaissance and review of records obtained from the North Carolina Public Water Supply Department ("NCPWSD"), no potable public-supply water systems are located within an approximate one-mile radius of the Site. The NCPWSD defines a potable public-supply water system as a well or surface water intake, which serves 25 or more people.

The Yadkin United Methodist Church property and the Site are connected to the City of Spencer water supply (verbal communication, Mr. Kevin Peele, Environmental Manager, Color-Tex, NC Finishing, and Adam Karagosian, S&ME, October 27, 1999). The City of Spencer's public potable water is obtained from the City of Salisbury Water Department.

6.2.4 Private Potable Water Supply Wells

Although public potable water is available in the area from the City of Salisbury, several properties located west of the Site have private potable water-supply wells. Based upon visual inspection (i.e., presence of a well pump house and/or absence of a water meter) and information obtained from county officials, 19 properties within an approximately 1,500-foot radius of the Site were identified with wells (Figure 14). The closest private water well is located approximately 1,250 feet west (up-gradient) of the Site. No additional details (e.g., well depths, production rates, etc.) are currently available for these wells (Table 13). No down-gradient supply wells exist between the Site and the Yadkin River.

No water supply wells and no potable water intakes are present on-Site (verbal communication, Mr. Kevin Peele, Environmental Manager, Color-Tex, NC Finishing to Adam Karagosian, S&ME, October 27, 1999).

NC Finishing had operated a non-potable surface-water intake on the Yadkin River northwest of the Site, which provided process water and emergency firewater (Figure 2). The process water was withdrawn from the river and pumped into the pond. The river water initially enters a settling reservoir within the pond to allow the removal of fines prior to the water being used at the Site.

6.2.5 Subsurface Structures

Underground utility services at the Site include potable water-supply lines, storm drains, sewer lines, electrical service, and telephone lines. The locations of the identifiable overhead and underground utilities are shown on Figures 3 and 4.

6.2.6 Surface Water

The nearest body of surface water is an on-Site pond (currently dry) used to store process water for the plant. This pond is approximately 20 feet from the retaining wall for the 200,000-gallon AST. The WWTP contains a large pond on the northeastern side of the facility.

The nearest off-Site surface water is the Yadkin River, which borders the Site property on the north and northeast (Figure 1). In accordance with 15A NCAC 2B, the Yadkin River is classified as Class C surface water subject to the Class C surface water quality action levels contained in 15A NCAC 2B.

7.0 Chemical Analyses

Chemical analyses for the RI were performed by Shealy Environmental Services, Inc. ("Shealy") of Cayce, South Carolina (North Carolina No. 329). Shealy analyzed samples for volatile organic compounds ("VOCs") by Method 8260A with identification of Tentatively Identified Compounds ("TICs"), semi-volatile organic compounds ("SVOCs") by Method 8270 with identification of TICs, metals by Method 6010, TPH by Method 8015B and EPH/VPH by MADEPH.

7.1 Soil Samples

Thirty-three soil samples were collected for chemical analysis during the Geoprobe™ assessment. A summary of analyses is presented in Table 14. Shealy analyzed the samples for VOCs, SVOCs, metals, TPH and VPH/EPH.

7.2 Shallow Aquifer Groundwater Samples

Ten groundwater samples were collected during the Geoprobe™ assessment. The samples were analyzed for VOCs and SVOCs by Shealy. Ten groundwater samples were analyzed by Shealy for VOCs and SVOCs, and two samples were analyzed for VOCs only. A summary of performed analyses is presented in Table 14.

Groundwater samples were collected for chemical analysis from 17 Shallow Aquifer monitoring wells. The samples were analyzed by Shealy for VOCs, SVOCs, and Metals. In addition, groundwater-quality field data were collected from selected samples by S&ME. The groundwater-quality field data included pH, specific conductivity (SC), temperature (Temp), redox, dissolved oxygen (DO), NO₃, CL, SO₄, alkalinity (Alk), CO₂ and FE. A summary of performed analyses is presented in Table 14.

7.3 Surface Water Samples

Six surface water samples were collected from the Yadkin River for chemical analysis. The samples were analyzed by Shealy for VOCs, SVOCs and Metals. A summary of performed analyses is presented in Table 14.

7.4 Sediment Samples

Six samples of sediment were collected from the Yadkin River for chemical analysis. The samples were analyzed by Shealy for VOCs, SVOCs and Metals. A summary of performed analyses is presented in Table 14.

8.0 Soil-Sample Analytical Results

Fifty-two soil samples were collected for chemical analysis during the RI Investigation. The detected VOC analytical results for the soil samples are summarized in Table 15. The detected SVOC analytical results for the soil samples are summarized in Table 16. The metals analytical results for the soil samples are summarized in Table 17. The TPH and EPH/VPH analytical results for soil samples are summarized in Table 18. The locations of the soil samples are shown in Figure 5.

8.1 Chemic Area

Thirteen soil samples were collected from soil borings in the Chemic Area for chemical analysis during the RI Investigation.

8.1.1 VOCs

VOCs were detected in only two soil samples (FPH-103 and FPH-104) at concentrations greater than laboratory detection methods.

1,2-dichlorobenzene (0.1 mg/kg), 1,3-dichlorobenzene (0.0073 mg/kg), and 1,4-dichlorobenzene (0.015 mg/kg) were detected in the soil sample from FPH-103-1.5-2.0 and acetone (0.022 mg/kg) was detected in the soil sample from FPH-104-1.5-2.0 at concentrations below the EPA Region IX Preliminary Remedial Goals ("RG"). The detected VOC analytical results for the soil samples are summarized in Table 15.

Acetone was detected in several of the samples collected. However, concentrations of Acetone were detected in Quality Control ("QC") samples and probably represent laboratory contaminants.

8.1.2 SVOCs

Di-n-Butylphthalate was the detected in soil samples from FPH -102 (0.41 mg/kg) and FPH-103 (0.42 mg/kg) and 10 SVOCs were detected in the soil samples obtained from probe hole FPH-104. All detected SVOCs were at concentrations less than their respective RG, except benzo(a)pyrene (0.49 mg/kg) which exceeded the RG for benzo(a)pyrene of 0.062 mg/kg. The detected SVOC analytical results for the soil samples are summarized in Table 16.

8.1.3 RCRA Metals

Metals were detected in 10 samples collected from five probe holes. Arsenic, barium, cadmium, chromium, lead, mercury and silver were detected in the samples. No metals were detected at concentrations above their respective RG, except arsenic. The metals analytical results for the soil samples are summarized in Table 17.

Arsenic was detected in three samples at concentrations ranging from 4.7 mg/kg to 9.1 mg/kg which are above the RG for arsenic (4.4 mg/kg). Arsenic was detected in soils collected from FPH-101 through FPH-104 (Chemic Area), FPH-106 (Production Facility), and FPH-109 (Machine Shop).

Arsenic was also detected in the three background samples collected from probe holes FPH-117 and FPH-118 at concentrations ranging from 1.5 mg/kg to 4.0 mg/kg.

8.1.4 TPH and MADEP EPH/VPH

Four soil samples were collected from 2 soil borings at the suspect former UST. No TPH and MADEP EPH/VPH parameters were detected at concentrations above their respective Action Levels, except TPH-DRO. The TPH and EPH/VPH analytical results for soil samples are summarized in Table 18.

TPH-DRO was detected in one soil sample (FPH-103-1.5 ft) at a concentration of 34 mg/kg. The Action Level for TPH-DRO is 10 mg/kg, however the deeper soil sample (FPH-103-11ft) detected TPH-DRO concentration of 5.5 mg/kg.

8.2 Clarifier/Burn Pit Area

Nine soil samples were collected from five probe holes (FPH-111 through FPH-115) in the Clarifier/Burn Pit Area for chemical analysis during the RI Investigation.

8.2.1 VOCs

No VOCs were detected above laboratory detection limits in the soil samples collected from the four probe holes in the Clarifier/Burn Pit Area, except naphthalene.

Naphthalene was detected in one sample at a concentration of 3.8 mg/kg which is below the RG for naphthalene (11.2 mg/kg). The detected VOC analytical results for the soil samples are summarized in Table 15.

8.2.2 SVOCs

Ten SVOCs were detected in the soil samples obtained from five probe holes (FPH-111 through FPH-115). All detected SVOCs present were at concentrations less than their respective RG, except benzo(a)pyrene and benzo(b)fluoranthene which exceeded their respective RG (0.062 mg/kg and 0.62 mg/kg, respectively).

Concentrations of benzo(a)pyrene (1.8 mg/kg and 0.51 mg/kg) and benzo(b)fluoranthene (1.4 mg/kg and 0.64 mg/kg) exceeded their RGs in samples collected from FPH-113 and FPH-115 (Burn Pit/Clarifier area). The detected SVOC analytical results for the soil samples are summarized in Table 16.

8.2.3 RCRA Metals

Metals were detected in 10 samples collected from probe holes FPH-111 through FPH-115. Arsenic, barium, cadmium, chromium, lead, mercury and silver were detected in the samples. No metals were detected at concentrations above their respective RG, except arsenic, cadmium and lead.

Arsenic was detected in 2 samples from the same probe hole (FPH-113) at concentrations ranging from 10 mg/kg to 36 mg/kg which are above the RG 4.4 mg/kg. Cadmium and lead were also detected at concentrations (22 mg/kg and 400 mg/kg, respectively) above their RGs (7.4 mg/kg and 400 mg/kg, respectively) from probe hole FPH-113. The metals analytical results for the soil samples are summarized in Table 17.

8.3 Machine Shop Area

Thirteen soil samples were collected from six soil borings (FPH-107, FPH-109, FPH-110, HA-4, HA-5, and GP-5) in the Machine Shop Area for chemical analysis during the RI Investigation.

8.3.1 VOCs

No VOCs were detected at concentrations above the RG in the soil samples collected from the six soil borings (FPH-107, FPH-109, FPH-110, HA-4, HA-5, and GP-5) in the Machine Shop Area.

Three VOCs (acetone, naphthalene, and tetrachloroethylene) were detected in soil samples at concentrations above laboratory detection limits but were below their respective RG. The detected VOC analytical results for the soil samples are summarized in Table 15.

8.3.2 SVOCs

No VOCs were detected at concentrations above the laboratory detection limit in the soil samples collected from the six soil borings (FPH-107, FPH-109, FPH-110, HA-4, HA-5, and GP-5) in the Machine Shop Area.

8.3.3 RCRA Metals

Metals were detected in 2 samples collected from the probe holes. Arsenic, barium, cadmium, chromium, lead, mercury and selenium were detected in the samples. No metals were detected at concentrations above their respective RG. The metals analytical results for the soil samples are summarized in Table 17.

8.4 South Production Building Area

Fourteen soil samples were collected from 7 soil borings probe holes (FPH-116, HA-1, HA-2, HA-3, GP-2, GP-3 and GP-4) in or adjacent to the South Production Building Area (former 20,000-gallon UST Area).

8.4.1 VOCs

VOCs were detected in 14 soil samples collected from soil borings (FPH-116, HA-1, HA-2, HA-3, GP-2, GP-3 and GP-4) in or adjacent to the South Production Building Area (former 20,000-gallon UST Area). Naphthalene was detected in the three soil samples collected from GP-3 at concentrations ranging from 30 mg/kg to 36 mg/kg, which are above the RG for naphthalene (11 mg/kg). However, no other VOC concentration exceeded the RG. The naphthalene is possible a result of the former 20,000-gallon UST release and is being investigated by the NCDENR-UST Section. The detected VOC analytical results for the soil samples are summarized in Table 15.

8.4.2 SVOCs

Six SVOCs were detected in the soil samples obtained from 3 soil sample from probe hole (GP-3). All detected SVOCs present were at concentrations less than their respective RG, except 2-methylnaphthalene and naphthalene which exceeded their respective RG (11.2 mg/kg and 11.2 mg/kg).

Concentrations of 2-methylnaphthalene (52 mg/kg to 83 mg/kg) and naphthalene (20 mg/kg to 44 mg/kg) exceeded their RGs in samples collected from GP-3. The detected SVOC analytical results for the soil samples are summarized in Table 16.

8.4.3 RCRA Metals

Metals were detected in 9 samples collected from soil borings (FPH-116, HA-1, HA-2, HA-3, GP-2, GP-3 and GP-4). Arsenic, barium, cadmium, chromium, lead, mercury and selenium were detected in the samples. No metals were detected at concentrations above their respective RG, except arsenic.

Arsenic was detected at a concentration above the RG (4.4 mg/kg) in one sample (FPH-116 8-12) at a concentration of 5.9 mg/kg. The metals analytical results for the soil samples are summarized in Table 17.

9.0 Shallow Aquifer Groundwater Quality

Groundwater samples were collected during the Geoprobe™ assessment.

9.1 Geoprobe™ Groundwater Samples

Eleven groundwater samples were collected during the Geoprobe™ assessment of the RI. The VOC analytical results for the groundwater samples are summarized in Table 19. The SVOC analytical results for the samples are summarized in Table 20. The metals analytical results for the samples are summarized in Table 21. The locations of the groundwater samples are shown in Figure 5.

9.2 Chemic Area

Three groundwater samples were collected during the Geoprobe™ assessment at probe holes FPH-101, FPH-102, and FPH-103.

9.2.1 VOCs

Benzene was detected above its RG (1 µg/L) in the groundwater sample from the probe hole FPH-103 with a concentration of 11 µg/L. No other VOCs were detected in groundwater samples collected from the three probe holes (FPH-101, FPH-102, and FPH-103) at concentrations that exceeded their respective RG.

9.2.2 SVOCs

SVOC concentrations (1,2-dichlorobenzene, 1,4-dichlorobenzene, di-ethylphthalate and naphthalene) were detected in two groundwater samples collected from two probe holes (FPH-102 and FPH-103) greater than the laboratory detection limits. However, no SVOC concentration detected in the shallow groundwater samples exceeded its respective RG.

9.2.3 RCRA Metals

RCRA Metal concentrations above the laboratory detection limit were detected in groundwater samples collected from the three probe holes (FPH-101, FPH-102, and FPH-103). However, no metals concentrations detected in the shallow groundwater samples exceeded its respective RG, except chromium and lead.

Lead was detected at a concentration above the RG (0.0154 µg/L) in the groundwater samples from FPH-101-25, FPH-102-24, and FPH-102-35 at concentrations of 0.029 µg/L, 0.016 µg/L and 0.038 µg/L, respectively. Chromium was detected at a concentration above the RG (0.05 µg/L) in the sample from FPH-101-25 (0.05 µg/L).

9.3 Clarifier/Burn Pit Area

Two groundwater samples were collected during the Geoprobe™ assessment at probe holes FPH-112, and FPH-113.

9.3.1 VOCs

No VOCs were detected in groundwater samples collected from the probe holes (FPH-112 and FPH-113) at concentrations that exceeded the laboratory detection limit, except methyl-tertiary-butyl ether ("MTBE"). MTBE was detected at a concentration (6 µg/L) below the RG for MTBE (200 µg/L).

9.3.2 SVOCs

No SVOCs were detected in groundwater samples collected from the probe holes (FPH-112 and FPH-113) at concentrations that exceeded the laboratory detection limit.

9.3.3 RCRA Metals

Barium and chromium concentrations above the laboratory detection limit were detected in the probe holes. However, no metals concentrations detected in the shallow groundwater samples exceeded its respective RG.

9.4 Machine Shop Area

Three groundwater samples were collected during the Geoprobe™ assessment at probe holes FPH-107, FPH-110, and GP-5.

9.4.1 VOCs

Tetrachloroethene was detected above its RG (0.7 µg/L) in the groundwater samples from the probe holes FPH-107 and FPH-110 with concentrations of 37 µg/L and 110 µg/L, respectively. These were the only two VOCs detected in the samples collected from the probe holes at concentrations that exceeded their respective RG.

9.4.2 SVOCs

No SVOCs were detected in groundwater samples collected from the probe holes (FPH-107, FPH-110 and GP-5) at concentrations that exceeded the laboratory detection limit.

9.4.3 RCRA Metals

Barium and chromium concentrations above the laboratory detection limit were detected in the probe holes. However, no metals concentrations detected in the shallow groundwater samples exceeded its respective RG.

9.5 South Production Building Area

One groundwater sample was collected during the Geoprobe™ assessment at probe hole FPH-116.

9.5.1 VOCs

No VOCs were detected in the sample from probe hole FPH-116 at a concentration above laboratory detection limits.

9.5.2 SVOCs

No SVOCs were detected in the sample from probe hole FPH-116 at a concentration above laboratory detection limits.

9.5.3 RCRA Metals

No metals were detected in the sample from probe hole FPH-116 at a concentration above laboratory detection limits, except barium (0.088 µg/L). However, barium was not detected at a concentration that exceeded the RG (2 µg/L).

9.6 Monitoring Well Samples

Groundwater samples were collected from 11 monitoring wells on April 12 and 13, 2001, 6 monitoring wells on June 22, 2001 and from 21 monitoring wells on October 9, 2002. The VOC analytical results for the groundwater samples are summarized in Table 22. The SVOC analytical results for the groundwater sample are summarized in Table 23. The RCRA metals analytical results for the groundwater samples are summarized in Table 24. The groundwater-quality field data for the groundwater samples are summarized in Table 25. The well locations are shown in Figure 5.

9.7 Chemic Area

Two wells (CMW-1 and FMW-103) in the Chemic Area were sampled on April 12, 2001 and on October 9, 2002.

9.7.1 VOCs

No VOCs were detected from the groundwater samples from both sampling dates from monitoring wells FMW-103. However, naphthalene was detected in well CMW-1 (18 µg/L) during the April 2001 sampling event, but no other VOCs were detected at concentrations greater than laboratory detection limits. Bromoform was detected in well CMW-1 (13 µg/L) during the October 2002 sampling event at a concentration that exceeded the RG (0.19 µg/L), but no other VOCs were detected at concentrations greater than laboratory detection limits.

9.7.2 SVOCs

No SVOCs were detected in the groundwater samples from both sampling dates from monitoring wells FMW-103. However, groundwater samples from monitoring well CMW-1 contained SVOC concentrations greater than laboratory detection limits. One SVOC, 1,4-dichlorobenzene (120 µg/L), was detected in the sample collected in October from CMW-1 at a concentration that exceeded the RG (75 µg/L). No other SVOCs were detected at concentrations that exceeded the respective RG.

9.7.3 RCRA Metals

RCRA metals were detected in the samples collected from wells CMW-1 and FMW-103 during both sampling events at concentrations above laboratory detection limits. However, no metals were detected at concentrations that exceed the respective RG.

9.8 Clarifier/Burn Pit Area

Four wells (FMW-1, FMW-206, FMW-107 and FMW-207) were sampled on April 12 and 13, 2001 and six wells (FMW-107, FMW-108, FMW-109, FMW-110, FMW-206 and FMW-207) were sampled on October 9, 2002.

9.8.1 VOCs

Chloroform and tetrachloroethene ("PCE") were detected in the samples collected from the monitoring wells at concentrations that exceeded their RGs (0.19 µg/L and 0.7 µg/L, respectively). Chloroform concentrations were detected in wells FMW-108 (9 µg/L) and FMW-206 (10 µg/L). PCE concentrations were detected in wells FMW-108 (30 µg/L) and FMW-206 (68 µg/L). Total chlorinated VOCs and PCE isoconcentrations for the Shallow Aquifer (upper and basal portions) are shown on Figures 16 through 19.

9.8.2 SVOCs

Groundwater samples from two monitoring wells (FMW-207 and FMW-110, contained SVOC concentrations greater than laboratory detection limits. However, no SVOCs were detected at concentrations that exceeded their respective RG.

9.8.3 RCRA Metals

Barium (2.20 µg/L), chromium (0.37 µg/L), lead (1.8 µg/L) and mercury (0.014 µg/L) were detected in one sample collected from FMW-206 at concentrations above their respective RG (2 µg/L, 0.05 µg/L, 0.15 µg/L, and 0.0011 µg/L). Chromium was detected in the samples collected from FMW-1 (0.07 µg/L) at concentrations that exceeded the RG.

9.9 Machine Shop Area

Two wells (FMW-105 and FMW-205) were sampled on April 12 and 13, 2001 and on October 9, 2002.

9.9.1 VOCs

PCE was detected in the samples collected from the monitoring wells at concentrations that exceeded the RG (0.7 µg/L). PCE concentrations were detected in wells FMW-105 (15 µg/L) and FMW-205 (29 µg/L). No other VOCs were detected above laboratory detection limits in these wells. Total chlorinated VOCs and PCE isoconcentrations for the Shallow Aquifer are shown on Figures 16 through 19.

9.9.2 SVOCs

No SVOCs were detected at concentrations that exceeded laboratory detection limits.

9.9.3 RCRA Metals

Cadmium (0.014 µg/L) and lead (0.015 µg/L) were detected in one sample collected from FMW-105 at concentrations above their respective RG (0.005 µg/L and 0.015 µg/L). No other metals were detected at concentrations above their respective RG.

9.10 South Production Building Area

Twelve wells (VE-1, VE-2, MW-7, MW-8, MW-11, MW-12, MW-13, MW-15, MW-16, MW-18, FMW-104 and FMW-204) were sampled either on April 12, 2001 or October 9, 2002.

9.10.1 VOCs

Five VOCs (benzene, chlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, and trichloroethene) were detected in the samples collected from five monitoring wells at concentrations that exceeded their RGs (1 µg/L, 50 µg/L, 620 µg/L, 75 µg/L, and 2.8 µg/L, respectively).

Wells FMW-104, FMW-204 and MW-7 revealed benzene concentrations were above the RG. Chlorobenzene was detected in wells FMW-104, FMW-204, MW-8 and VE-1 at concentrations above the RG. Well VE-1 also detected concentrations of 1,2-dichlorobenzene, 1,4-dichlorobenzene and trichloroethene above their respective RGs. Total chlorinated VOCs and PCE isoconcentrations for the Shallow Aquifer are shown on Figures 16 through 19.

9.10.2 SVOCs

1,4-dichlorobenzene and Pentachlorophenol was detected in the sample collected from the well MW-7 at concentrations that exceeded the RG (75 µg/L and 0.3 µg/L). No other VOCs were detected above laboratory detection limits in these wells.

9.10.3 RCRA Metals

Lead (0.033 µg/L) was detected in one sample collected from MW-13 at concentrations above the RG (0.015 µg/L). No other metals were detected at concentrations above their respective RG.

9.11 Natural Attenuation Parameters

Shallow aquifer groundwater samples were field measured for natural attenuation potential of VOCs and SVOCs. Total alkalinity, nitrate ("NO₃"), sulfate ("SO₄"), dissolved oxygen ("DO"), oxidation-reduction potential ("redox"), pH, temperature, and ferrous iron data were collected to (1) establish a natural attenuation data base and (2) determine whether conditions beneath the site are supportive for in-situ natural degradation of VOC and SVOC. Additionally, total chloride data were collected to assess whether the groundwater encountered in each RI monitor well is representative of the same groundwater zone. Table 25 presents the analytical results for the shallow aquifer (upper and basal portion) natural attenuation parameters.

The groundwater samples collected were field measured for DO, redox, pH, conductivity, and temperature using properly calibrated meters. The samples were also measured for ferrous iron (Fe²⁺) using a Hach™ colorimetric test kit.

Natural Attenuation parameters were measured in samples collected from all 11 RI monitoring wells (FMW-102 through FMW-105, FMW-107, FMW-202, FMW-204, FMW-205, FMW-206 and FMW-207) on April 12, 2001 and October 9, 2002 and included Fe²⁺, Chloride ("Cl"), NO₃, SO₄, Alkalinity and Carbon Dioxide ("CO₂"). Additionally, groundwater samples from wells FMW-202, FMW-204, FMW-205 and FMW-207 were submitted to Shealy for laboratory analysis of natural attenuation parameters (alkalinity, Cl, Fe²⁺, nitrate, nitrite, sulfate, sulfide, sulfite and total iron). The field data are summarized in Table 25. The results of the natural attenuation parameters are presented in the following sections.

9.11.1 pH

Bioremediation of VOCs, SVOCs and particularly hydrocarbon compounds is most favorable at a neutral pH (6 to 8 standard pH units). However, biodegradation may occur in groundwater naturally exhibiting pH values as low as 4 to 4.5 standard pH units.

The pH of the shallow groundwater samples collected from the wells ranged generally from 6 to 8 standard pH units for both the April 2001 and October 2002 sampling events; therefore, the groundwater pH at the site is supportive for natural biodegradation.

9.11.2 Temperature

Biodegradation of VOCs, SVOCs and particularly hydrocarbon compounds can generally occur within a temperature range of approximately 41 to 113 degrees Fahrenheit (°F). The

temperature of the groundwater beneath the site ranged from approximately 58 to 78°F for the April 2001 and October 2002 sampling events. Therefore, the groundwater temperatures are supportive for natural biodegradation.

9.11.3 Dissolved Oxygen

The DO readings were collected to assess the potential for in-situ aerobic biodegradation of the VOCs, SVOCs and hydrocarbon compounds. Oxygen is the preferred electron receptor for the biodegradation of VOCs, SVOCs and particularly hydrocarbon compounds, followed by nitrate, ferric iron (Fe^{3+}), and sulfate. DO concentrations in the shallow groundwater ranged from 0.19 mg/L to 9.07 mg/L for the April 2001 and October 2002 sampling events. Typically, water saturated with air contains DO concentrations ranging from approximately 6 to 12 mg/L (Norris, 1994). Generally, DO concentrations greater than 1 to 2 mg/L indicate that aerobic degradation of VOCs, SVOCs and hydrocarbon compounds may occur (USEPA, 1994). Therefore, the DO concentrations detected at the site are conducive to aerobic degradation of the hydrocarbon compounds.

9.11.4 Nitrate and Nitrite

Once the available oxygen sources have been depleted, nitrate (NO_3) may be utilized by in-situ bacteria as an alternate electron receptor for the anaerobic biodegradation of hydrocarbon compounds. Nitrate is reduced during anaerobic biodegradation; therefore, nitrate concentrations which are lower than background suggest that anaerobic biodegradation is occurring.

Analysis of groundwater samples for nitrate concentration was performed for the October 2002 sampling event. Laboratory analysis of the groundwater samples collected from FMW-202, located upgradient on the site, revealed a maximum nitrate concentration of 0.53 mg/L. Laboratory analysis of the groundwater samples collected from FMW-204 (South Production Building Area), FMW-205 (Machine Shop Area) and FMW-207 (Burn Pit/Clarifier Area) revealed nitrate concentrations of 0.13, 12, and 2.2 mg/L, respectively. These analytical results suggest that anaerobic biodegradation may be occurring or may have occurred in these areas.

9.11.5 Ferrous Iron

Once the available oxygen and nitrate sources have been depleted, Fe^{3+} is commonly utilized by in-situ bacteria as an alternate electron receptor for the anaerobic biodegradation of hydrocarbon compounds. During anaerobic biodegradation, Fe^{3+} is reduced to Fe^{2+} . Accordingly, Fe^{2+} concentrations typically increase as DO is depleted and anaerobic biodegradation occurs. The observed maximum Fe^{2+} concentration detected in the October 2002 groundwater samples was 0.14 mg/L in FMW-202. These data are inconclusive for determining whether anaerobic biodegradation using Fe^{3+} as an electron receptor is occurring or has occurred at the site.

9.11.6 Sulfate and Sulfide

Once the available oxygen sources have been depleted, sulfate may be utilized by in-situ bacteria as an alternate electron receptor for the anaerobic biodegradation of hydrocarbon compounds. Sulfate is reduced during anaerobic biodegradation to sulfide. Therefore, sulfate concentrations that are lower than background suggest the occurrence of anaerobic biodegradation. A greater ratio of sulfides to sulfates indicates the reduction (use) of sulfates during anaerobic biodegradation. These parameters were analyzed for groundwater samples collected during the October 2002 sampling event.

Laboratory analysis revealed sulfate was detected in groundwater samples from beneath the site at FMW-202 (upgradient), FMW-204 (South Production Building Area), FMW-205 (Machine Shop Area) and FMW-207 (Burn Pit/Clarifier Area) with concentrations of 6.6, 470, 21 and 59 mg/L, respectively. Whereas, sulfite analysis for the same wells revealed no detected sulfite concentrations above laboratory detection limits. These results are inconclusive for assessing anaerobic biodegradation at the site.

9.11.7 Redox

Redox potential of groundwater generally ranges from 222 to -127 millivolts (mV). The lower the redox potential, the more reducing and anaerobic the environment; negative redox values indicate that the groundwater is strongly reduced and biodegradation has already occurred. Positive redox values indicate that the groundwater is oxidizing, and aerobic biodegradation is occurring or may occur in the future. Redox measurements were collected at the site for both the April 2001 and October 2002 sampling events. Redox measurements at the site were positive during the October 2002 sampling event, suggesting that aerobic biodegradation is occurring or may occur in the future.

9.11.8 Total Alkalinity and Carbon Dioxide

Aerobic biodegradation of hydrocarbon compounds produces carbon dioxide and organic acids, which tend to increase the alkalinity of the groundwater. Accordingly, increased alkalinity values are indicative of aerobic biodegradation. The data collected during the April 2001 and October 2002 sampling event revealed alkalinity concentrations ranging from 13 to greater than 100 mg/L and less than 10 to greater than 100 mg/L. October 2002 laboratory results for samples from FMW-202, FMW-204, FMW-205 and FMW-206 revealed alkalinity values of 24, 440, 30 and 90 mg/L, respectively. These results suggest aerobic biodegradation may be occurring or may have occurred at the site. The carbon dioxide concentrations reported for the samples ranged from less than 10 mg/L to 50 mg/L collected during both sampling events indicate the results are inconclusive for assessing aerobic biodegradation at the site.

9.11.9 Total Chloride

Order-of-magnitude differences in chloride values between samples from monitor wells suggest that the monitor wells may be screened in different groundwater zones. October 2002

Laboratory results of the groundwater samples collected from wells FMW-202 (upgradient), FMW-204 (South Production Building Area), FMW-205 (Machine Shop Area) and FMW-207 (Burn Pit/Clarifier Area) indicate total chloride concentrations of 8.8 mg/L, 350 mg/L, 73 mg/L and 290 mg/L, respectively. This information suggests that samples from wells FMW-202 and FMW-205 are from a different groundwater zone than those of FMW-204 and FMW-207, which appear to be from the same groundwater zone.

10.0 Bedrock Aquifer Groundwater Quality

Four test boreholes (FMW-302, FMW-304, FMW-305 and FMW-306) were drilled into the Bedrock Aquifer during the RI to evaluate lateral and vertical groundwater quality in the aquifer. One test borehole, FMW-302, was drilled as a background borehole and is located upgradient on the western side of the site. Chloroform was present in all discrete-interval samples collected from FMW-302 at concentrations exceeding the RG (0.19 µg/L). Chloroform was also present in discrete-interval samples collected from FMW-304 and FMW-306 at concentrations exceeding the RG.

Boreholes FMW-304 (South Production Building), FMW-305 (Machine Shop Area), and FMW-306 (Clarifier/Burn Pit) were located in areas impacted by contaminants. Geophysical logging, borehole video camera inspection, and discrete-interval hydraulic testing and groundwater sampling were performed in each test borehole.

10.1 Discrete-Interval Groundwater Sampling

Discrete-interval groundwater samples were collected from water-bearing fractures in the four bedrock test boreholes. Five to six intervals were sampled in each borehole. Discrete-interval sampling was performed from September 24, 2002 to October 22, 2002. Discrete-interval groundwater samples collected during the RI were analyzed for Method 8260 VOCs and Method 8270 SVOCs by Shealy.

The VOC analytical results for the discrete-interval groundwater samples are summarized in Table 26. The SVOC analytical results for the discrete-interval groundwater samples are summarized in Table 27. Groundwater-quality field data for the discrete-interval groundwater samples are summarized in Table 29. The test borehole locations are shown in Figure 5.

10.2 Clarifier/Burn Pit Area

Five discrete-interval groundwater samples were collected from FMW-306 during the RI. Shealy analyzed the groundwater samples for Method 8260 VOCs and Method 8270 SVOCs.

10.2.1 VOCs

Tetrachloroethene (53 µg/L), chloroform (8.7 µg/L) and MTBE (9.2 µg/L) were detected in one discrete-interval groundwater sample (63.5 ft to 73.5 ft) with tetrachloroethene and chloroform exceeding their RG (0.7 µg/L and 0.19 µg/L, respectively). One shallower sample and three deeper groundwater samples did not contain any VOCs.

10.2.2 SVOCs

SVOCs were not detected in any of the six discrete-interval groundwater sample collected from test borehole FMW-306.

10.3 Machine Shop Area

VOCs and SVOCs were not detected in any of the six discrete-interval groundwater sample collected from test borehole FMW-305.

10.4 South Production Building Area

Five discrete-interval groundwater samples were collected from FMW-304 during the RI. VOC analytical results are summarized in Table 26. The SVOC analytical results are summarized in Table 27.

10.4.1 VOCs

Six VOCs (benzene, chlorobenzene, chloroform, 1,2-dichlorobenzene, 1,3-dichlorobenzene and 1,4-dichlorobenzene) were detected in the discrete-interval groundwater sample sets with five VOCs (benzene, chlorobenzene, chloroform, 1,2-dichlorobenzene and 1,4-dichlorobenzene) exceeding their respective RG.

Benzene, chlorobenzene and chloroform were detected at concentrations exceeding their respective RG in all discrete-interval samples collected from borehole FMW-304. 1, 2-dichlorobenzene was detected at a concentration exceeding the RG in one discrete-interval sample and 1,4-dichlorobenzene was detected at a concentration exceeding the RG in two discrete-interval samples.

10.4.2 SVOCs

Three SVOCs (1,2-dichlorobenzene, 1,3-dichlorobenzene and 1,4-dichlorobenzene) were detected in the discrete-interval groundwater sample set collected from Borehole FMW-304. One SVOC, 1,4-dichlorobenzene, exceeded the RG (75µg/L) in two samples.

Bis-2-ethylhexylphthalate (19µg/L) was detected in a single discrete-interval sample collected from borehole FMW-302 (GW-06 from 214 feet to 225 feet BLS); five shallower samples did not contain any SVOCs.

10.5 Field Water-Quality and Natural Attenuation Parameters

Field water-quality and Natural Attenuation parameters were measured during discrete-interval sampling in the four bedrock test boreholes. Field water-quality parameters included pH, Specific Conductivity, Temperature, and Dissolved Oxygen ("DO") and were measured using properly calibrated meters. Natural Attenuation parameters included Nitrate, Chloride, Sulfate, Alkalinity, Carbon Dioxide, and Ferrous Iron (Fe^{2+}) and were measured with Hach™ colorimetric test kits. Test results are summarized on Table 28.

In general, concentrations of Chloride were greater than 20 mg/L in all samples collected from boreholes FMW-304, FMW-305, and FMW-306. Chloride concentrations at FMW-302 (upgradient) ranged from 3.6 to greater than 8 mg/L. Higher chloride concentrations appear to correlate with elevated concentrations of VOCs.

Total alkalinity, nitrate, sulfate, sulfide, DO, pH, temperature, and ferrous iron data were collected to (1) establish a natural attenuation data base and (2) determine whether conditions beneath the site are supportive for in-situ natural degradation of the contaminants. Additionally, total chloride data were collected to assess whether the groundwater encountered in each discrete interval is representative of the same groundwater zone. Table 28 presents the analytical results for natural attenuation parameters.

10.5.1 pH

Bioremediation of VOCs and SVOCs compounds is most favorable at a neutral pH (6 to 8 standard pH units). However, biodegradation may occur in groundwater naturally exhibiting pH values as low as 4 to 4.5 standard pH units.

The pH of the discrete groundwater samples collected from the wells ranged from 6.7 to 8.4 standard pH units for the discrete-interval sampling event; therefore, the groundwater pH at the site is supportive for natural biodegradation.

10.5.2 Temperature

Biodegradation of VOC and SVOC compounds can generally occur within a temperature range of approximately 41 to 113 degrees Fahrenheit (°F). The temperature of the groundwater beneath the site ranged from approximately 63.8 to 75°F. Therefore, the groundwater temperatures are supportive for natural biodegradation.

10.5.3 Dissolved Oxygen

The DO readings were collected to assess the potential for in-situ aerobic biodegradation of the contaminants. Oxygen is the preferred electron receptor for the biodegradation of hydrocarbon compounds, followed by nitrate, ferric iron (Fe^{3+}), and sulfate. DO concentrations in the discrete-interval groundwater ranged from 2.4 milligrams per liter (mg/L) to 8.0 mg/L. Typically, water saturated with air contains DO concentrations ranging from approximately 6 to 12 mg/L (Norris, 1994). Generally, DO concentrations greater than 1 to 2 mg/L indicate that aerobic degradation of BTEX and other VOCs may occur (USEPA, 1994). Therefore, the DO concentrations detected at the site are generally conducive to aerobic degradation of the hydrocarbon compounds.

10.5.4 Nitrate

Once the available oxygen sources have been depleted, nitrate may be utilized by in-situ bacteria as an alternate electron receptor for the anaerobic biodegradation of contaminants. Nitrate is reduced during anaerobic biodegradation; therefore, nitrate concentrations which are lower than background suggest that anaerobic biodegradation may be occurring.

Test results of discrete-interval groundwater samples collected from FMW-302 located upgradient (background) on the site, revealed nitrate concentrations ranging from 0.2 to 0.8

mg/L. Test results of the discrete-interval groundwater samples collected FMW-305 (Machine Shop Area) and FMW-306 (Burn Pit/Clarifier Area) revealed nitrate concentrations ranging from 0.0 mg/L to 0.3 mg/L and 0.1 to <5 mg/L, respectively. These analytical results suggest that anaerobic biodegradation may be occurring or may have occurred in these areas. However, the nitrate concentrations in samples FMW-304 ranged from 1.0 to 2.5 mg/L.

10.5.5 Ferrous Iron

Once the available oxygen and nitrate sources have been depleted, Fe^{3+} is commonly utilized by in-situ bacteria as an alternate electron receptor for the anaerobic biodegradation of certain VOC and SVOC compounds. During anaerobic biodegradation, Fe^{3+} is reduced to Fe^{2+} . Accordingly, Fe^{2+} concentrations typically increase as DO is depleted and anaerobic biodegradation occurs. Field test revealed Fe^{2+} concentrations ranging from 0.1 to 2.0 mg/L. These data are inconclusive for determining whether anaerobic biodegradation using Fe^{3+} as an electron receptor is occurring or has occurred at the site.

10.5.6 Sulfate

Once the available oxygen sources have been depleted, sulfate may be utilized by in-situ bacteria as an alternate electron receptor for the anaerobic biodegradation of certain VOC and SVOC compounds. Sulfate is reduced during anaerobic biodegradation to sulfide. Therefore, sulfate concentrations that are lower than background suggest the occurrence of anaerobic biodegradation. A greater ratio of sulfides to sulfates indicates the reduction (use) of sulfates during anaerobic biodegradation.

Sulfate was detected in discrete-interval groundwater samples from FMW-302 (upgradient) ranged from 20 to 30 mg/L and in samples from FMW-305 and FMW-306 ranged from 10 to 20 mg/L whereas in FMW-304 sulfate concentrations ranged from 30 to 40 mg/L. These results are inconclusive for assessing anaerobic biodegradation at the site.

10.5.7 Total Alkalinity and Carbon Dioxide

Aerobic biodegradation of VOCs and SVOCs produces carbon dioxide (" CO_2 ") and organic acids, which tend to increase the alkalinity of the groundwater. Accordingly, increased alkalinity values are indicative of aerobic biodegradation. The data collected during the discrete-interval groundwater sampling revealed alkalinity and CO_2 concentrations ranging from 13 to greater than 100 mg/L and from less than 10 to greater than 100 mg/L. These results inconclusive for assessing aerobic biodegradation is occurring or may have occurred at the site.

10.5.8 Total Chloride

Order-of-magnitude differences in chloride values between samples from discrete-intervals of the same bedrock test borehole may suggest that the intervals were screened in different groundwater zones. Results of analyses of the discrete-interval groundwater samples collected from FMW-302 indicate total chloride concentrations ranging from 3.6 to 7 mg/L.

Whereas, the results of analyses of the discrete-interval groundwater samples collected from FMW-304, FMW-305 and FMW-306 revealed total chloride concentrations of 20 mg/L. This information may suggest that samples from FMW-302, FMW-304, FMW-305, and FMW-306 were from the same groundwater zone, within the individual test borehole. Although an order-of-magnitude differences in chloride values between test boreholes were not apparent, the data may suggest that samples from FMW-302 are from a different groundwater zone than those of FMW-304, FMW-305, and FMW-306, which appear to be from the same groundwater zone.

11.0 Surface-Water Sample Analytical Results

Six surface water samples were collected from four locations for chemical analysis from the Yadkin River (Figure 5). Four samples (YSW-01, YSW-02, YSW-03, and YSW-04) were collected on June 27, 2000 and two samples (YSW-05 and YSW-06) were collected on April 13, 2001. Sample YSW-05 was collected at the approximate location of YSW-01, and YSW-06 was collected at the approximate location of YSW-04.

The VOC, SVOC, and RCRA Metals analytical results for the surface water samples are summarized in Tables 29. VOCs were not detected above laboratory method detection limits in the six surface water samples analyzed. Three SVOCs, bis(2-ethylhexyl)phthalate (24 $\mu\text{g/L}$), 2-methylphenol (19 $\mu\text{g/L}$), and phenol (86 $\mu\text{g/L}$) were detected in the surface-water sample suite. Bis(2-ethylhexyl)phthalate believed to be a laboratory contaminant. Three metals (arsenic, barium and lead) were detected.

Phenol (86 $\mu\text{g/L}$) and 2-methylphenol (19 $\mu\text{g/L}$) were detected in Sample YSW-02. The NCAC 02B .0211 Fresh Surface Water Quality Standard for Class C waters for phenolic compounds states: "only such levels as shall not result in fish-flesh tainting or impairment of other best usage."

Arsenic and barium were detected in two samples, YSW-05 and YSW-06. The highest arsenic concentration (13 $\mu\text{g/L}$) and highest barium concentration (42 $\mu\text{g/L}$) were detected in sample YSW-05. The NCAC 02B .0211 Surface Water Standard for Arsenic is 50 $\mu\text{g/L}$; barium is not listed. The highest lead concentration (6 $\mu\text{g/L}$) was detected in Sample YSW-01. Lead was also detected at concentrations above laboratory method detection limits in samples YSW-03 (3.4 $\mu\text{g/L}$) and YSW-04 (5.7 $\mu\text{g/L}$). The NCAC 02B .0211 Surface Water Standard for Lead is 25 $\mu\text{g/L}$.

12.0 Sediment Sample Analytical Results

Six sediment samples were collected from four locations for chemical analysis from the Yadkin River (Figure 5). Four samples (YSD-01, YSD-02, YSD-03 and YSD-04) were collected on June 27, 2000 and two samples (YSD-05 and YSD-06) were collected on April 13, 2001. Samples YSD-05 and YSD-06 were collected at the approximate locations of samples YSD-01 and YSD-04, respectively. The analytical results are summarized in Table 30.

Two VOCs were detected in sediment sample YSD-05 (upgradient location). Acetone (0.052 mg/kg), and toluene (0.011 mg/kg), however acetone is believed to be laboratory contaminants and the RG for toluene is 104 mg/kg.

Seventeen SVOCs were detected in sediment sample YSD-01 (upgradient location). Benzo(a)anthracene (7mg/kg), benzo(a)pyrene (7 mg/kg), benzo(b)fluoranthene (7.8 mg/kg), dibenzo(a,h)anthracene (1.7 mg/kg) and inden(1,2,3-cd)pyrene (4.1mg/kg) were detected in the sediment sample at concentrations above their respective RBC, RG and/or S-2 Target

Concentrations. However, no SVOC constituents were detected in sample YSD-05 (confirmatory sample) collected near sample location YSD-01.

RCRA Metals were detected the sediment sample suite, however, no metals were detected at a concentration that exceeded their respective RG in any sample.

13.0 Evaluation of Risk

13.1 Conceptual Exposure Scenario Development

Based upon the available information, a conceptual exposure scenario was developed for the site. Developing the exposure scenario and potential exposure pathways included identifying (1) the specific chemical of concern ('CoC') and CoC source areas, (2) transport mechanisms (e.g., groundwater migration), (3) exposure routes (e.g., ingestion of groundwater), and (4) potential receptors (e.g., construction workers at the site).

For a potential receptor to be exposed to a CoC, the exposure pathway must be complete (i.e., there must be a source, a transport mechanism, an exposure route, and a potential receptor). The exposure scenarios for the identified CoC beneath the Site (current and potential future use) will be discussed in the following sections.

13.2 Identification of Chemical of Concerns

Parameters detected in surficial (0 to 3 feet below ground surface ["bgs"]) and subsurface (greater than 3 feet bgs within the vadose zone) soil samples above laboratory detection limits in the RI sampling events were identified as the CoC:

13.2.1 Chemic Area

- Acetone
- Anthracene
- Arsenic
- Barium
- Benzene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(k)fluoranthene
- Cadmium
- Chromium
- Chrysene
-
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Lead
- Mercury
- MTBE
- Phenanthrene
- Pyrene
- Silver
- 1,2-Dichlorobenzene
- 1,2-Dichloropropane

13.2.2 Clarifier/Burn Pit Area

- Acetone
- Acenaphthene
- Di-n-octylphthalate
- Dibenzo(a,h)anthracene

- Anthracene
- Arsenic
- Barium
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Bis(2-ethylhexyl)phthalate
- Cadmium
- Carbazole
- Chromium
- Chrysene
- Di-n-butylphthalate
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Lead
- Mercury
- Naphthalene
- Phenanthrene
- Pyrene
- Silver
- Tetrachloroethylene (PCE)
- Total Xylenes
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene

13.2.3 Machine Shop Area

- Acetone
- Acenaphthene
- Anthracene
- Arsenic
- Barium
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Bis(2-ethylhexyl)phthalate
- Cadmium
- Carbazole
- Chromium
- Chrysene
- Di-n-butylphthalate
- Di-n-octylphthalate
- Dibenzo(a,h)anthracene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Lead
- Mercury
- Naphthalene
- Phenanthrene
- Pyrene
- Silver
- Tetrachloroethylene (PCE)
- Total Xylenes
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene

13.2.4 South Production Area

- Acetone
- Acenaphthene
- Anthracene
- Arsenic
- Barium
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Bis(2-ethylhexyl)phthalate
- Cadmium
- Carbazole
- Chromium
- Chrysene
- Di-n-butylphthalate
- Di-n-octylphthalate
- Dibenzo(a,h)anthracene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Lead
- Mercury
- Naphthalene
- Phenanthrene
- Pyrene
- Silver
- Tetrachloroethylene (PCE)
- Total Xylenes
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene

Likewise, parameters detected in groundwater samples above laboratory detection limits in the RI sampling events were identified as the CoC:

- Arsenic
- Barium
- Benzene
- Chlorobenzene
- Chloroform
- Chromium
- cis-1,2-dichloroethene
- Diethylphthalate
- 1,2-dichlorobenzene
- 1,3-dichlorobenzene
- 1,4-dichlorobenzene
- 2-methylnaphthalene
- Ethylbenzene
- Lead
- Mercury
- Methyl-tertiary-butylether (MTBE)
- Naphthalene
- Tetrachloroethylene (PCE)
- Toluene
- Trichloroethene
- Total Xylenes

13.3 Chemical Characteristics of the Chemicals of Concern

The following chemical characteristics will be discussed in detail in the RI Report:

- Toxicity. Human carcinogen or systemic hazard.
- Henry's Law Constant. Compounds with Henry's Law Constant of greater than 100 atmospheres (atm) rapidly volatilize.
- Solubility. Compounds with relatively higher water solubilities are generally more mobile in the subsurface.
- Organic carbon partition coefficient (K_{oc}). K_{oc} is an approximation of the propensity of a compound to adsorb to organic matter in soil. Compounds with relatively high K_{oc} tend to remain sorbed to soil and not migrate.
- Octanol-water partitioning coefficient (K_{ow} - equilibrium partitioning between soil and water phase). K_{ow} is considered an index of the potential to bioaccumulate (USEPA, 1989). Relatively high K_{ow} values are associated with greater partitioning to octanol and greater bioaccumulation potential (octanol is used as a surrogate for lipids). K_{ow} can be used to predict bioconcentration in fatty organic tissue. Compounds that are biodegradable tend to have negligible bioaccumulation.
- Degradation rates and other miscellaneous parameters.

13.4 Source Areas

The primary source areas for the CoCs are the Machine Shop Area, Chemic Area, Burn Pit/Clarifier Area and the South Production Building Area (former 20,000-gallon UST Area) in the vicinity of U.S. Highway 29 (see Figure 5).

13.5 Maximum Observed Concentrations

The maximum observed concentrations of CoC in groundwater and soil samples, based upon the RI sampling events, are:

13.5.1 Chemic Area

CoC	Maximum Observed CoC Concentration in Groundwater ($\mu\text{g/L}$)	Maximum Observed CoC Concentration in Surficial Soil (mg/kg)	Maximum Observed CoC Concentration in Subsurface Soil (mg/kg)
Acetone	BDL - Not a CoC	0.022	BDL - Not a CoC
Anthracene	BDL - Not a CoC	BDL - Not a CoC	0.46
Arsenic	0.024	9.1	3.3

CoC	Maximum Observed CoC Concentration in Groundwater (µg/L)	Maximum Observed CoC Concentration in Surficial Soil (mg/kg)	Maximum Observed CoC Concentration in Subsurface Soil (mg/kg)
Barium	0.08	45	54
Benzene	11	BDL - Not a CoC	BDL - Not a CoC
Benzo(a)anthracene	BDL - Not a CoC	BDL - Not a CoC	0.49
Benzo(a)pyrene	BDL - Not a CoC	BDL - Not a CoC	0.47
Benzo(k)fluoranthene	BDL - Not a CoC	BDL - Not a CoC	0.48
Cadmium	0.0024	1.3	0.95
Chromium	BDL - Not a CoC	110	63
Di-n-butylphthalate	BDL - Not a CoC	0.42	BDL - Not a CoC
Di-n-octylphthalate	BDL - Not a CoC	BDL - Not a CoC	0.45
Lead	BDL - Not a CoC	18	48
Mercury	0.0032	0.54	BDL - Not a CoC
Naphthalene	BDL - Not a CoC	BDL - Not a CoC	0.62
Phenanthrene	BDL - Not a CoC	BDL - Not a CoC	1.1
Pyrene	BDL - Not a CoC	BDL - Not a CoC	0.76
1,2-dichlorobenzene	460	0.1	BDL - Not a CoC
1,3-dichlorobenzene	9.6	0.0073	BDL - Not a CoC
1,4-dichlorobenzene	120	0.015	BDL - Not a CoC

13.5.2 Clarifier/Burn Pit Area

CoC	Maximum Observed CoC Concentration in Groundwater (µg/L)	Maximum Observed CoC Concentration in Surficial Soil (mg/kg)	Maximum Observed CoC Concentration in Subsurface Soil (mg/kg)
Arsenic	0.022	10	36
Barium	2.2	240	1,100
Benzo(a)anthracene	BDL - Not a CoC	1.8	BDL - Not a CoC
Benzo(a)pyrene	BDL - Not a CoC	1.8	BDL - Not a CoC
Benzo(b)fluoranthene	BDL - Not a CoC	1.4	BDL - Not a CoC
Benzo(g,h,i)perylene	BDL - Not a CoC	1.1	BDL - Not a CoC
Benzo(k)fluoranthene	BDL - Not a CoC	1.7	BDL - Not a CoC
Cadmium	BDL - Not a CoC	BDL - Not a CoC	22
Chloroform	10	BDL - Not a CoC	BDL - Not a CoC
Chromium	0.37	280	140
Chrysene	BDL - Not a CoC	1.9	BDL - Not a CoC
Diethylphthalate	BDL - Not a CoC	BDL - Not a CoC	BDL - Not a CoC
Fluoranthene	BDL - Not a CoC	3.5	BDL - Not a CoC
Indeno(1,2,3-cd)pyrene	BDL - Not a CoC	1	BDL - Not a CoC

CoC	Maximum Observed CoC Concentration in Groundwater (µg/L)	Maximum Observed CoC Concentration in Surficial Soil (mg/kg)	Maximum Observed CoC Concentration in Subsurface Soil (mg/kg)
Lead	1.8	34	400
Mercury	0.014	0.14	0.21
MTBE	7.4	BDL - Not a CoC	BDL - Not a CoC
PCE	68	BDL - Not a CoC	BDL - Not a CoC
Phenanthrene	BDL - Not a CoC	3.1	BDL - Not a CoC
Pyrene	BDL - Not a CoC	2.5	BDL - Not a CoC
Silver	BDL - Not a CoC	BDL - Not a CoC	0.36
1,2-dichlorobenzene	36	BDL - Not a CoC	BDL - Not a CoC
1,2-dichloropropane	34	BDL - Not a CoC	BDL - Not a CoC

13.5.3 Machine Shop Area

CoC	Maximum Observed CoC Concentration in Groundwater (µg/L)	Maximum Observed CoC Concentration in Surficial Soil (mg/kg)	Maximum Observed CoC Concentration in Subsurface Soil (mg/kg)
Acetone	BDL - Not a CoC	BDL - Not a CoC	0.18
Anthracene	BDL - Not a CoC	BDL - Not a CoC	BDL - Not a CoC
Arsenic	0.016	4.6	1.3
Barium	0.086	16	130
Cadmium	0.014	BDL - Not a CoC	BDL - Not a CoC
Chloroform	6	BDL - Not a CoC	BDL - Not a CoC
Chromium	BDL - Not a CoC	60	44
Lead	0.015	10	7.9
Naphthalene	BDL - Not a CoC	0.022	BDL - Not a CoC
PCE	29	BDL - Not a CoC	0.0068
Silver	BDL - Not a CoC	BDL - Not a CoC	0.48
Total Xylenes	BDL - Not a CoC	BDL - Not a CoC	0.0068

13.5.4 South Production Building Area

CoC	Maximum Observed CoC Concentration in Groundwater (µg/L)	Maximum Observed CoC Concentration in Surficial Soil (mg/kg)	Maximum Observed CoC Concentration in Subsurface Soil (mg/kg)
Acetone	BDL - Not a CoC	0.022	0.059
Arsenic	0.02	BDL - Not a CoC	0.004
Barium	0.15	BDL - Not a CoC	0.092
Benzene	11	BDL - Not a CoC	BDL - Not a CoC

CoC	Maximum Observed CoC Concentration in Groundwater (µg/L)	Maximum Observed CoC Concentration in Surficial Soil (mg/kg)	Maximum Observed CoC Concentration in Subsurface Soil (mg/kg)
Cadmium	BDL - Not a CoC	BDL - Not a CoC	0.0024
Chlorobenzene	200	BDL - Not a CoC	BDL - Not a CoC
Chloroform	BDL - Not a CoC	BDL - Not a CoC	BDL - Not a CoC
Chromium	0.0064	BDL - Not a CoC	0.088
Di-n-octylphthalate	BDL - Not a CoC	BDL - Not a CoC	0.45
Ethylbenzene	BDL - Not a CoC	BDL - Not a CoC	1.7
Fluoranthene	BDL - Not a CoC	BDL - Not a CoC	1
Lead	0.033	0.034	0.034
Mercury	0.00053	BDL - Not a CoC	BDL - Not a CoC
Naphthalene	12	BDL - Not a CoC	44
Phenanthrene	BDL - Not a CoC	BDL - Not a CoC	3.4
Trichloroethene	17	BDL - Not a CoC	BDL - Not a CoC
Total Xylenes	BDL - Not a CoC	BDL - Not a CoC	7
1,2-dichlorobenzene	780	BDL - Not a CoC	BDL - Not a CoC
1,3-dichlorobenzene	21	BDL - Not a CoC	BDL - Not a CoC
1,4-dichlorobenzene	120	BDL - Not a CoC	BDL - Not a CoC
2-methylnaphthalene	BDL - Not a CoC	BDL - Not a CoC	83

13.6 Transport Mechanisms

The following potential current and future transport mechanisms for the CoC from the source areas were identified:

- Direct contact with surficial soil, subsurface soil, and/or groundwater.
- Volatilization from surficial soil, subsurface soil, and/or groundwater.
- Leaching from surficial soil and/or subsurface soil to groundwater.
- Groundwater transport to a surface water source.

Wind erosion and particulate transport of the surficial soils and storm water transport of the surficial soils to the area surface waters were not considered complete transport mechanisms because the surficial soils exhibiting detectable CoC concentrations are located in areas covered by asphalt, concrete or under buildings.

13.6.1 Exposure Pathways

Based upon the source areas and the potential transport mechanisms, the following potentially complete current and future exposure pathways were identified:

- Inhalation, dermal contact, and ingestion by direct contact with surficial soil, subsurface soil, and/or groundwater (non-potable water).
- Inhalation, dermal contact, and ingestion from surface water.
- Ambient air inhalation by volatilization from surficial soil, subsurface soil, and/or groundwater.
- Enclosed space (indoor air) inhalation by volatilization from surficial soil, subsurface soil, and/or groundwater.

No public potable water supply wells were identified within at least a ½-mile radius of the site. The only confirmed private potable water well is located approximately 1,250 feet west (up-gradient) of the site.

13.6.2 Summary of Exposure Scenarios

The following is a summary of the potentially complete current and future exposure scenarios for the receptors identified in Section 6.0.

Source Areas	Transport Mechanisms	Exposure Routes	Potential Receptors
Surficial Soil	Direct Contact	Inhalation, Dermal Contact, Ingestion	On-site: Construction Workers
	Volatilization	Inhalation (ambient)	On-site: Commercial Workers, Construction Workers
	Volatilization	Inhalation (enclosed-space)	On-site: Commercial Workers, Construction Workers
	Leaching to Dissolved Phase		
Subsurface Soil	Direct Contact	Inhalation, Dermal Contact, Ingestion	On-site: Construction Workers
	Volatilization	Inhalation (ambient)	On-site: Commercial Workers, Construction Workers
	Volatilization	Inhalation (enclosed-space)	On-site: Commercial Workers, Construction Workers
	Leaching to Dissolved Phase		
Dissolved-Phase	Groundwater Transport	Ingestion (potable water)	Off-site: Residents
	Direct Contact	Inhalation, Dermal Contact, Ingestion (non-potable water)	On-site: Construction Workers Off-site: Construction Workers

Source Areas	Transport Mechanisms	Exposure Routes	Potential Receptors
	Volatilization	Inhalation (ambient)	On-site: Commercial Workers Construction Workers Off-site: Construction Workers
	Volatilization	Inhalation (enclosed-space)	On-site: Commercial Workers, Construction Workers Off-site: Construction Workers

13.7 Tier 1 Evaluation

To evaluate the level of risk posed by the CoC at a site, a tiered evaluation was performed. A Tier 1 evaluation involves comparing the maximum on-site CoC concentrations for the exposure pathways that are determined to be potentially complete to conservative Risk-Based Screening Levels (RBSLs) which were the EPA Region IX RGs.

The EPA Region IX Remediation Goals (RGs) used for the Tier 1 risk evaluation are the RGs for unrestricted land use for each environmental medium found in the Registered Environmental Consultant Program Rules and Implementation Guidance, June 2001 (REC Guidance). A Tier 1 evaluation is very conservative in that potential receptors are assumed to be located directly above the source area. The Tier 1 RGs have been established using current USEPA risk assessment guidance and are based upon:

- A total carcinogenic excess risk of 10^{-6} for carcinogenic compounds; and
- A hazard quotient of 0.2 for non-carcinogenic compounds.

Maximum observed on-site CoC concentrations from the most recent sampling event were compared to the RGs. If the CoC concentration is lower than the RG value, no further action is required to protect human health or the environment. If maximum CoC concentrations are greater than the RG values, additional tier evaluation is required.

CoC	Max. Observed CoC Conc. in Groundwater (µg/L)	Max. Observed CoC Conc. Surficial Soil (mg/kg)	Max. Observed CoC Conc. Subsurface Soil (mg/kg)	Table D-1 Soil RG's (mg/kg)	Table D-2 Groundwater RG's (µg/L)
Acetone	BDL	0.022	0.18	320	700
Anthracene	BDL	0.46	BDL	4400	2100
Arsenic	24	10	36	4.4	50
Barium	1,300	240	1,100	NL	2000

CoC	Max. Observed CoC Conc. in Groundwater (µg/L)	Max. Observed CoC Conc. Surficial Soil (mg/kg)	Max. Observed CoC Conc. Subsurface Soil (mg/kg)	Table D-1 Soil RG's (mg/kg)	Table D-2 Groundwater RG's (µg/L)
Benzene	290	BDL	BDL	0.65	1
Benzo(a)anthracene	BDL	1.8	BDL	0.62	0.05
Benzo(a)pyrene	BDL	1.8	BDL	0.062	0.0047
Benzo(b)fluoranthene	BDL	1.4	BDL	0.62	0.047
Benzo(g,h,i)perylene	BDL	1.1	BDL	NL	210
Benzo(k)fluoranthene	BDL	1.7	BDL	6.2	0.47
Cadmium	BDL	1.3	22	7.4	5
Chlorobenzene	260	BDL	BDL	30	50
Chloroform	12	BDL	BDL	0.24	0.19
Chromium	70	280	140	20,000	50
Chrysene	BDL	1.9	BDL	62	5
Diethylphthalate	5.8	BDL	BDL	9800	5000
Di-n-butylphthalate	BDL	0.42	BDL	1220	700
Di-n-octylphthalate	BDL	0.45	BDL	NL	NL
Ethylbenzene	7.5	BDL	BDL	300	29
Fluoranthene	BDL	3.5	BDL	460	280
Indeno(1,2,3-cd)pyrene	BDL	1	BDL	0.62	0.047
Lead	38	48	400	400	15
Mercury	0.28	0.54	0.21	4.6	1.1
MTBE	6	BDL	BDL	NL	NL
Naphthalene	18	3.8	44	11.2	21
PCE	140	0.0068	BDL	5.7	0.7
Phenanthrene	BDL	3.1	BDL	NL	210
Pyrene	BDL	2.5	BDL	460	210
Silver	BDL	BDL	0.48	78	18
Trichloroethene	17	BDL	BDL	2.8	2.8
Total Xylenes	58	BDL	0.0068	280	530
1,2-dichlorobenzene	780	0.1	BDL	74	620
1,3-dichlorobenzene	21	0.0073	BDL	2.6	620
1,4-dichlorobenzene	140	0.015	BDL	3.4	75
2-methylnaphthalene	14	BDL	83	11.2	28
cis-1,2-dichloroethene	5.1	BDL	BDL	8.6	70

13.7.1 Tier 1 Soil Evaluation

Arsenic concentrations in both the surficial and subsurface soils were above its respective RG. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene and inden(1,2,3-cd)pyrene

concentrations in surficial soils were above their respective RG's. Cadmium concentrations in subsurface soils were above its respective RG. No other CoC in soils were detected above their RG values.

13.7.2 Tier 1 Groundwater Evaluation

Benzene, chlorobenzene, chloroform, chromium, lead, PCE, Trichloroethene, 1,2-dichlorobenzene and 1,4-dichlorobenzene concentrations were above their respective RG.

13.8 Tier 2 Evaluation

S&ME recommends that the Tier 2 Risk Assessment be performed for submittal to NCDENR to evaluate potential cleanup objectives. The Risk Assessment will focus on the detected method-list VOCs, SVOCs and Metals. The Risk Assessment will include soil and groundwater media.

A feasibility study should be prepared following the Risk Assessment. Applicable technologies, including the IRM technologies, should be evaluated. The feasibility study should conclude with a conceptual remedial plan for submittal to NCDENR.

14.0 Conclusions

S&ME offers the following preliminary conclusions based on the data presented above.

1. The Site is located on a bend of the Yadkin River at the headwaters of High Rock Lake. The river forms the northern and eastern boundaries of the Site as the river channel swings from an east/west orientation north of the Site to a north/south orientation east of the Site. The Yadkin River flows to the southeast and is the dominant hydrologic feature at the Site and serves as a major groundwater discharge point.

The majority of the Site, including the most of the plant structures and parking lots, rest on the uplands overlooking the river. A process-water pond and a few small structures are located on a small terrace east of the plant just above the Yadkin River floodplain. The Site extends onto the floodplain but only two water-intake structures are located on the floodplain.

2. The geologic sequence in the study area consists of unconsolidated material overlying igneous bedrock. Bedrock is principally pink granite with fractures ranging in orientation from horizontal to near vertical. Two significant cavities were encountered in Bedrock test Borehole FMW-304 in the upper portion of the bedrock. The cavities are filled with what appears to be fluvial silt.

The unconsolidated material includes residual soil and/or saprolite in the upland portion of the Site. Fluvial deposits overlie bedrock in the floodplain portion of the Site along the Yadkin River. In the upland portion of the Site, the contact between the unconsolidated saprolite and bedrock is generally gradational with saprolite grading downward to weathered rock and then competent bedrock. A sharp contact is present between the fluvial deposits and the underlying bedrock in the floodplain portion of the Site. In the northern portion of the Site, the fluvial deposits along the river are generally less than 20 feet thick. In the southern portion of the Site near Highway 29, the fluvial deposits are more than 90 feet thick at existing well VE-2.

The Shallow Aquifer is present in the unconsolidated material overlying bedrock. The Bedrock Aquifer is present in the granitic bedrock. A confining layer is not present between the two aquifers.

3. Groundwater in the Shallow Aquifer at the Site is under water table conditions. Groundwater flow is generally semi-radial from the Site to the river, which is the discharge point for the aquifer. Groundwater flow is toward the northeast in the northern portion of Site and to east-southeast in the southern portion of Site. The former process-water pond appears to have accentuated the radial flow regime in the Shallow Aquifer as it formed a groundwater mound during its operational period.
4. Groundwater flow in the Bedrock Aquifer (based on limited data) also appears to be generally semi-radial from the Site towards the Yadkin River. Groundwater from the Bedrock Aquifer is expected to discharge to the river in the northern portion of the Site where the fluvial deposits are relatively thin (<20 feet thick) with some smaller component of discharge to the Basal portion of the Shallow Aquifer. In the southern portion of the Site where the fluvial

deposits are thicker, discharge from the Bedrock Aquifer will be principally to the Shallow Aquifer with a minor component of discharge to the river.

5. A downward vertical gradient from the Shallow Aquifer to the Bedrock Aquifer appears to be present throughout most of the upland portion of the Site. An upward vertical gradient from the Bedrock Aquifer to the Shallow Aquifer is expected to be present on the floodplain.
6. Soil impacted by metals and SVOCs above their respective RGs is present in the vicinity of the Machine Shop and the Burn Pit/Clarifier. Other detected metals, VOCs and SVOCs are below their respective RGs.
7. Releases of PCE at the Machine Shop have impacted groundwater in the Shallow Aquifer and upper part of the Bedrock Aquifer in the northern portion of the Site. PCE is present at concentrations above the North Carolina 2L.

The Shallow Aquifer PCE plume originates at the Machine Shop and extends to the northeast apparently to the Yadkin River. The Bedrock Aquifer is not impacted by PCE at the Machine Shop, but an impact is present in the upper portion of the aquifer in the area of the Burn Pit/Clarifier (downgradient from the Machine Shop) as evidenced by shallow discrete-interval sample data from Bedrock Test Borehole FWM-306. The vertical extent of impact in the Bedrock Aquifer appears to be less than 30 feet. The lateral extent of the Bedrock Aquifer PCE plume is expected to be similar to the Shallow Aquifer plume except that it is truncated in the upgradient direction and probably extends to the river. However, PCE has not been detected in any surface-water samples collected from the river.

8. Releases of chlorobenzenes at the Chemic Area and the adjacent southern part of the plant building have impacted groundwater in the Shallow Aquifer and the Bedrock Aquifer in the southern portion of the Site. Chlorobenzene, 1,2-dichlorobenzene, and 1,4-dichlorobenzene are the principal constituents of concern and were detected at concentrations greater than their respective North Carolina 2Ls in many samples.

The Shallow Aquifer chlorobenzene plume originates at the Chemic Area and the adjacent southern part of the plant building and extends to the east-southeast out into the floodplain of the Yadkin River. The chlorobenzene plume extends off Site into the median area of Highway 29 but does not reach the river. The chlorobenzene plume is intermixed in the upper part of the Shallow Aquifer with the historical fuel-oil release from the former 20,000-gallon UST and 100,000-gallon AST.

The Bedrock Aquifer is impacted by chlorobenzenes, and Benzene from the historical fuel-oil releases, at the southern part of the plant building, but the lateral extent of impact appears to be limited; chlorobenzenes have not been detected in groundwater samples collected from existing well VE-2 which is downgradient and 90-feet deep. The vertical extent of chlorobenzene impact in the Bedrock Aquifer, however, appears to be potentially more than 200 feet. In the impact area, horizontal permeability along fractures in the bedrock appears to be limited, potentially as evidenced by the fluvial silt filled cavities, but vertical permeability is more open.

9. Surface-water and sediments in the Yadkin River do not appear to have been impacted by Site contaminants.

Appendix G
Certification Statements

G.1. Certification of Documents

All work plans, reports and project schedules submitted to the branch must first be certified by a representative of the remediating party and then by the RSM. The "certification of documents" statements are shown below. The language in the certification statements is specified in the rules and may not be modified under any circumstances.

Remediating Party Certification Statement (.0306(b)(2)):

"I certify under penalty of law that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this certification, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material and information contained herein is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for willfully submitting false, inaccurate or incomplete information."

M. Abba 12/19/02
RP Signature Date

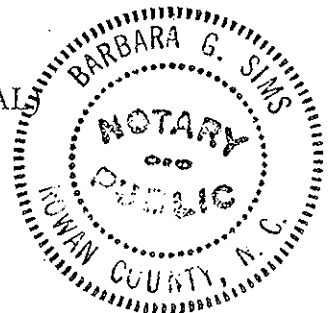
Michael S. Abba
RP Name

North Carolina (Enter State)
Rowan COUNTY

I, Barbara G. Sims, a Notary Public of said County and State, do hereby certify that Michael S. Abba did personally appear and sign before me this the 19th day of December, 2002.

Barbara G. Sims
Notary Public (signature)

(OFFICIAL SEAL)



My commission expires: Nov. 7 2005

Registered Site Manager Certification Statement (.0306(b)(1)):

"I certify under penalty of law that I am personally familiar with the information contained in this submittal, including any and all supporting documents accompanying this certification, and that the material and information contained herein is, to the best of my knowledge and belief, true, accurate and complete and complies with the Inactive Hazardous Sites Response Act G.S. 130A-310, et seq, and the voluntary remedial action program Rules 15A NCAC 13C .0300. I am aware that there are significant penalties for willfully submitting false, inaccurate or incomplete information."

[Signature]
RSM Signature

January 9, 2003
Date

DANE A. HORNA
RSM Name

NORTH CAROLINA (Enter State)

MECKLENBURG COUNTY

I, Julie R. Petersen, a Notary Public of said County and State, do hereby certify that Dane A. Horna did personally appear and sign before me this the 9th day of January, 2003.

[Signature]
Notary Public (signature)

(OFFICIAL SEAL)

My commission expires: 9/10/07

G.2 Certification of Work Phase Completion

The attached Completion Certification forms must be used to certify the completion of work phases in accordance with .0306(b)(5) and (b)(6). The RSM must use the attached forms or photocopies of these forms only. Retyped or computer-generated forms are unacceptable. All information on the forms must be typed or neatly printed. The forms must include the notarized signature of the RSM.

REMEDIAL INVESTIGATION COMPLETION CERTIFICATION
15A NCAC 13C.0306(b)(5)(B)

Site Name NC Finishing Plant

Street Address 2555 N. US Hwy 29
Spencer, NC 28159

County Rowan

Site ID No. NCD 041 414 780

The remedial investigation, which is the subject of this certification has, to the best of my knowledge, been completed in compliance with the Inactive Hazardous Sites Response Act G.S. 130A-310, et seq. and the voluntary remedial action program Rules 15A NCAC 13C .0300, and [REC Name] S&ME, Inc. is in compliance with Rules .0305(b)(2) and .0305(b)(3), of this section. I am aware that there are significant penalties for willfully submitting false, inaccurate or incomplete information.

Dane Horna
RSM Signature

December 5, 2002
Date

Dane Horna
RSM Name

S&ME, Inc.
REC Name

9751 Southern Pine Blvd.
Mailing Address

004
REC No.

Charlotte, NC 28273
City, State, ZIP

North Carolina (Enter State)
Mecklenburg COUNTY

I, Julie R. Petersen, a Notary Public of said County and State, do hereby certify that Dane Horna did personally appear and sign before me this the 5th day of December, 2002.

Julie R. Petersen
Notary Public (signature)

(OFFICIAL SEAL)

My commission expires: 9/10/07