3.0 REGIONAL POPULATIONS AND ENVIRONMENTS

3.1 Population and Land Use (3)(6)

The Brunswick Wood Preserving site, is located in northern Glynn County, Georgia on Perry Lane Road. The population of the county was listed as 61,437 in the 1990 U.S. census. The land use surrounding the site is mixed rural residential and industrial. The facility ceased operation in 1991.

Although most of the road frontage along Perry Land Road is fenced with good chain link fence, much of the site, particularly the wooded portions to the north, east and south are either not fenced or are poorly fenced, i.e., barbed-wire in disrepair. Access along the main portion of the site, facing Perry Lane Road. is controlled via one of several gates.

3.2 Site and Local Surface Water Pathways

The west end of the Brunswick Wood Preserving site is located within 100 feet of Burnett Creek, a major tidally influenced creek, which flows into Cowpen Creek, then the Turtle River, the Brunswick River, and ultimately, into the Atlantic Ocean. Figure 3-1 shows this surface water pathway.

Due to the large size of the site, surface water drainage pathways are varied and complex. Figure 3-2 shows the pathways observed during the remedial investigation and prior reconnaissance. Several generalizations may be made regarding the observations. Most of the open part of the site, as is currently configured, drains to the large area excavated during the removal. This would include nearly the entire southern portion of the site, from west to east along the large excavation, created after the rail spur was removed. Ditches are present as surface water conveyances along all of Perry Lane and along the active railroad tracks running along the south side of the west end of the site. The ditch on the north side of Perry Lane contains an active stream which flows the entire length of Perry Lane from the Southern tracks, to the east, to the point at which the stream turns northwest at the location of the abandoned railroad tracks, across from the main entrance of the site. From this point, the stream flows into Burnett Creek.

Drainage in the wooded areas is less definitive. Many small, isolated ponded areas are present in the northern wooded area, around IM-4 and IM-5. This area is very flat and there are few well defined drainage patterns visible. Historical references exist that indicate that the entire area surrounding IM-4 and IM-5 drained to the ditch along Perry Lane Road in at least two places, but these are not obvious or evident today.

3.3 Site Physiography and Climate (3)(7)(8)

The Brunswick Wood Preserving site is located roughly centered in the Brunswick Peninsula, which is located in the Barrier Island Sequence Physiographic District, located within the Coastal Plain Physiographic Province. The Barrier Island Sequence was formed by Pleistocene sea levels advancing and retreating several times forming step-like progressions of decreasing altitudes toward the Atlantic Ocean. These former sea levels left shoreline deposits parallel to the present coastline. Moderate dissection of these former sea level deposits have allowed marshes to exist in poorly drained low areas.

The mean annual precipitation at Brunswick is 51 inches, which comes almost exclusively as rainfall. Although monthly precipitation is greater than six inches June through September and three inches or less, November to January, the period of precipitation excess over evaporation is winter to early spring.

The average daily maximum temperature in July is 89^{o} F; the average daily minimum for January is 42^{o}F. Summers are humid; snow is rare.

Glynn County, including the Brunswick Wood Preserving site, is subject to the strong winds and rains from hurricanes. The heaviest one-day precipitation at Brunswick was 12.4 inches on August 22, 1969. Much of the annual precipitation comes from intense, brief storms. These intense rains, combined with high water tables and flat terrain, make flooding a common rather than a rare phenomenon at the site.

3.4 Site Soils (3)

The Glynn County Soil Survey classifies soils within the Brunswick area as belonging predominantly to the Bohicket-Capers soil association. This soil mapping unit consists of soils that are very poorly drained, having very slow permeability, very low available water capacity, and are moderately alkaline. Bohicket soils are surficially silty clay loams with subsurface profiles of dark grey silty clay extending to a depth of 65 inches or more.

3.5 Ground Water (7)

3.5.1 Regional/Area Hydrogeology

There are three recognized aquifer systems present throughout the Brunswick area. These are, in descending order, the surficial aquifer system, the Miocene aquifer system (composed of the Upper and Lower Brunswick aquifers), and the Floridan aquifer system.

The surficial aquifer system is comprised of recent to Holocene age deposits and appears to be between 180 to 200 feet thick beneath the study area. The lower portions of the surficial aquifer system are Miocene in age and are composed of interbedded sand, marl, clay, and thin limestone beds.

The surficial aquifer is typically unconfined; however, discontinuous layers of clay often create locally confined or semi-confined conditions, confirmed by aquifer test in the area, in the lower portion of the aquifer. The clay layers typically range rom five to 40 feet in thickness. The base of the surficial aquifer system is a dense phosphatic limestone or dolomite which creates a confining layer approximately 70 feet thick, as observed in a well located in the Brunswick area.

The Upper and Lower Brunswick Aquifers, which comprise the main water bearing units of the Miocene Aquifer system, are found stratigraphically below the surficial aquifer system. They are each about 75 feet thick and are separated by a confining layer, consisting of silty clay and dense phosphatic carbonates, which has a thickness of about 50 feet. The aquifer materials in both aquifers is a poorly sorted, fine to coarse grained phosphatic and dolomitic sand.

The third aquifer system in the area is the Floridan Aquifer, located beneath the Miocene Aquifer system. It is separated from the Micocene Aquifer system by an confining unit that is approximately 30 feet thick in the Brunswick area. This confining unit is comprised of silty clay and dense phosphatic carbonate rocks. The rocks making up the Floridan Aquifer system range in age from the younger, Oligocene carbonates, which rest just beneath the Miocene Aquifer system, to the older Eocene carbonates, found in the lower portion of the system. The Upper Floridan aquifer is approximately 450 feet thick in the Brunswick area and contains two distinct permeable fresh water zones. A dense dolomitic limestone, approximately 40 feet thick in the Brunswick area, separates the Upper Floridan aquifer from the Lower Floridan aquifer.

3.5.2 Site Specific Geology/Hydrogeology

During Phase II of the remedial investigation, conducted in October 1997, site specific geological and hydrogeological conditions were investigated using electric cone penetrometer testing (ECPT) methods. Using this technology, site stratigraphy, water-bearing characteristics and hydraulic conductivity were determined for the uppermost water-bearing formations at the site.

ECPT pushes were conducted at ten locations, shown on Figure 3-3 (each push location is designated as PZX, X denoting the location number 1-10. Computer monitored tools were directly pushed into the ground in accordance with ASTM D-3441. Using this method, detailed geotechnical and hydrogeological information was continually collected and recorded.

ECPT soundings were performed at each location by directly pushing a 60°, 10 cm^2 conical point and a 150 cm^2 cylindrical section, located immediately behind the point, into the ground at a constant rate of 2 cm/sec. The following types of measurements were obtained at each location using the device: Cone End Bearing (point stress in TSF); Sleeve Resistance (sleeve stress in TSF); Pore Pressure (kg/cm^2); and Friction Ratios (sleeve resistance TSF/point stress TSF). The ECPT device was linked to a multichannel computer system and transmitted measurement results every ½ second, simultaneously recording and displaying real time data on a monitor. A sounding log (graphical representation) for the above described measurements was produced in the field immediately after each push. Using these logs (see Figures 3-4 through 3-13), field decisions were made regarding the selection of subsequent sounding locations and ground water sample locations.

In addition to the graphical sounding logs, tables were produced for each ECPT location describing soil behavior types. These tables, found in Appendix A, were produced from standard soil behavior charts and characterize, in a general way, the nature of the material which was present, such as fine sands, silty clays, clays, etc.

3.5.2.1 ECPT Findings

3.5.2.1.1 Site Stratigraphy

Stratigraphic profiles or cross sections were prepared for the site using the soil behavior interpretation columns produced for each ECPT location. Four profiles were generated, two oriented more or less east-west across the site and two oriented more or less northwest-southeast across the site (see Figure 3-3). These profiles are shown in Figures 3-14 through 3-17.

From these profiles several characteristics of site stratigraphy can be seen. The general site stratigraphy can be described as one of interbedded fine sands and silty clays and clays. The clayey beds are generally present as stringers or beds of finer material located within the predominantly sandy sequence. There are two significant clayey beds or units within the sequence. One, the upper clay unit, is generally three to five feet thick and is found at or near the surface across the entire site. Field observations during soil sampling indicated that this was a tan to greenish clay, with little or no sand. The other clay unit, the lower clay unit, is also on the order of three to five feet thick and is located approximately thirty feet below ground surface. As can be seen in the four profiles, the lower clay unit is absent under the extreme western portion of the site and thins somewhat near PZ5, along the northern boundary of the site..

Whereas the upper and lower clay units are fairly uniform and continuous over much of the site, the interval in between these two clay units is more complicated. As can be seen in the individual stratigraphic columns included in the site cross-sections, there are numerous thin beds and discontinuous stringers of clay or silty clay present within the thick, predominantly sandy interval at various depths across the site.

The base of the stratigraphic interval defined by the ECPT program is the depth at which the ECPT tool met extreme resistance, generally 400 to 500 kg/cm^2. This is the point at which the tool could not practically be pushed any further. As a general rule, the depth at which this occurred ranged and steadily increased from about 40 feet, under the west end of the site, to about 65 feet, under the east end of the site. There were several locations, however, where there were local deviations from this trend. The exact nature, i.e., lithology, of this material could not be determined.

3.5.2.1.2 Hydrogeology

Most of the saturated interval between the surface and the lower depth of investigation appears to be under water table conditions. The pore pressure curves for each individual ECPT push generally indicate steadily increasing pore pressure with depth, which is indicative of unconfined water table conditions. The spikes present on the pore pressure records are typical for clay beds or stringers and do not necessarily represent narrow zones of increased hydrostatic pressure within the formation. Disregarding these spikes, the pore pressure trends observed at most locations are indicative of a single formation, under unconfined water table conditions, with pore pressure increasing with depth.

The trend at three locations, however, indicates that perched ground water conditions may exist above the lower clay unit found at a depth of 30 feet. This is indicated by a distinct, though small, stepping back of the measured pore pressure immediately beneath the clay. In general, however, the site appears to be characterized by ground water that is under unconfined conditions.

3.5.2.1.3 Hydraulic Conductivity Estimations

At each location and depth at which the Hydrocone was used for ground water sample collection, hydraulic conductivity (K) estimates were determined using the fill rate curves generated during filling of the Hydrocone ground water sampling device. These estimated values are shown in Table 3-1 and were detemined by applying the fill rate curve slopes to standard slug test recovery equations. This method has been used by the contractor to produce estimates of hydraulic conductivity in the absence of other methods. Plots containing the fill rate curves used for hydraulic conductivity determinations are found in Appendix B.

Hydraulic conductivity was found to vary with depth. In the shallow saturated zone, located immediately below the surficial clay layer, most values were in the 10^{-3} to 10^{-4} cm/sec range, averaging 8.6454 X 10^{-3} cm/sec. In the intermediate saturated zone, located beneath the shallow interval and the lower clay unit, values were in the 10^{-3} to 10^{-5} range, averaging 3.6072

X 10^{-3} cm/sec. In the saturated zone located beneath the lower clay unit, values were in the 10^{-4} to 10^{-5} range, averaging 3.0394 X 10^{-4} cm/sec.

Table 3-1 **Upper Surficial Aquifer Permeability Values[1]** **Brunswick Wood Preserving Superfund Site** **Brunswick, Georgia**			
Hydrocone Location	**Shallow Depth**	**Intermediate Depth**	**Deep Depth**
HC1	3.325 X 10^{-4} (17 ft)	2.274 X 10^{-4} (27 ft)	1.832 X 10^{-5} (40 ft)
HC2	8.885 X 10^{-4} (12 ft)	4.343 X 10^{-4} (20 ft)	1.178 X 10^{-4} (37 ft)
HC3	4.935 X 10^{-4} (17 ft)	Data Not Available	4.571 X 10^{-4} (40 ft)
HC5	1.155 X 10^{-3} (17 ft)	Data Not Available	2.051 X 10^{-4} (40 ft)
HC6	Data Not Available	1.229 X 10^{-3} (26 ft)	No Sample
HC7	7.265 X 10^{-4} (15 ft)	1.268 X 10^{-3} (25 ft)	5.63 X 10^{-4} (40 ft)
HC8	5.034 X 10^{-4} (14 ft)	5.397 X 10^{-5} (25 ft)	4.771 X 10^{-4} (38 ft)
HC9	2.412 X 10^{-3} (12 ft)	3.945 X 10^{-4} (25 ft)	2.892 X 10^{-4} (40 ft)
HC10	2.134 X 10^{-3} (15 ft)	Data Not Available	Data Not Available
Average for each interval	8.6454 X 10^{-3}	3.60717 X 10^{-3}	3.0394 X 10^{-4}

1 - All permeability units are cm/sec. Depth of Hydrocone sample used for permeability determination in parentheses.

Based on these results, it appears that the shallower sands have a slightly higher permeability, by approximately an order of magnitude, than the deeper sands. It does not appear that there is a significant difference in permeability between the two lower sands, located immediately above and below the lower clay unit.

3.5.2.1.4 Ground Water Flow Patterns

Ground water flow patterns were defined using a network of thirteen one-inch diameter PVC piezometers. The piezometers were installed using direct push techniques. Large diameter steel push rod or pipe, with a sacrificial tip, was pushed to the desired depth and the piezometer was constructed and installed through the center of the string of pipe. Each piezometer was constructed with five feet of slotted screen placed within the upper 10 feet of the water table. After the piezometers were constructed and installed inside the push rod, the rods were removed, leaving the piezometer in place. Each piezometer was completed with a small concrete pad to prevent direct entry of surface runoff into the annular space around the piezometer. Figure 3-18 shows the locations of the piezometers.

On days four and five after installation of the piezometers, three rounds of water level measurements were obtained at each of the locations. The elevations measured were relative to a casing height of 100.00 feet arbitrarily established for the top of casing elevation for piezometer P11. These measurements were taken as quickly as possible in an effort to obtain a "snap shot" of the water table elevation for the entire system, within a relatively short timeframe, to minimize the effects of tidal fluctuations on a round of measurements. The three rounds were collected at different times, with respect to the tides. Round One was taken at or near high tide; Round Two was taken approximately four hours later, with outgoing tide; and Round Three was taken the next morning at or very near the low tide, while the tide was still outgoing. The measurements for each round were tabulated and are included as Table 3-2.

There was very little difference between the first two rounds of measurements. The third round, however, differed measurably, at all locations, from the previous two. The water levels measured during Round Three, taken near low tide, were all lower than the water levels measured during Round One. There was a noticably greater difference in the water levels measured at the

piezometers located closest to Burnett Creek, as would be expected. The lone exception to this pattern was observed at location PZ08. There is no apparent or obvious reason for this exception.

Using the water table elevations obtained from measurements taken at the piezometers, a ground water contour map of the shallow surficial aquifer was constructed. This map is shown in Figure 3-19. Ground water contours appear to roughly parallel Burnett Creek, with decreasing elevation towards the creek , indicating that shallow ground water is moving generally west across the site towards Burnett Creek.

3.5.3 Ground Water Investigations

3.5.3.1 RCRA Characterization (3)

During the course of the site's regulatory history, little in the way of ground water investigations were conducted to meet the requirements of RCRA. Approximately 12 ground water monitoring wells, all on the eastern half of the site near the CCA treatment area, were installed in an effort to meet the ground water monitoring requirements of RCRA. Four of the wells were approximately 140 feet deep and the other eight were installed in the interval from 20 feet to 60 feet below land surface. The four deep wells were abandoned and many of the remaining eight wells have not been located, either because they were destroyed during the removal or are not visible in the site's current heavily vegetated state.

The site RCRA Facility Assessment, completed by the Georgia Department of Natural Resources, contains a general summary of pertinent RCRA detection monitoring results. Of the four wells for which data was reported, MW -2, MW-3, MW-4 and MW-5, two of the wells, wells MW-3 and MW-4, had elevated levels of total organic carbon, total organic halogen and phenols. Concentrations for each parameter were similar for each well and ranged from 25 mg/L to 82 mg/L (total organic carbon), 0.04 mg/L to 0.16 mg/L (total organic halogen) and 0.07 to 0.72 mg/L (phenols). Compound-specific sampling for RCRA Appendix VIII constituents, conducted in 1985 at well MW-4 in response to the elevated detection parameters, indicated the presence of PAH compounds associated with wood treating using creosote and pentachlorophenol. Specific compounds reported were toluene, phenanthrene, phenol, pentachlorophenol, 2,4-dinitrophenol, naphthalene, acenaphthene, anthracene, chrysene and benz(a)anthracene.

3.5.3.2 EPA Removal Sampling

Several private residential wells located at nearby residences were sampled during the initial steps of EPA's removal activity in 1991. Most, if not all, of these wells are deep wells (probably in excess of 100 feet deep). Only one of these wells showed any wood treating constituents; however, it is very doubtful whether the low levels detected are attributable to the site. Subsequent re-sampling of the well has not shown any contamination.

3.5.3.3 EPA Remedial Investigation Characterization

One of the major goals of the remedial investigation is to determine what, if any, contamination exists n the shallow aquifer on-site, and to detemine if this contamination might be migrating. During Phase I of the in-house remedial investigation, temporary ground water monitoring wells were installed to determine if ground water beneath the site was contaminated. Most of these wells were installed in clusters of two wells, with the first completed to a depth of approximately 20 feet and second completed to a depth of approximately 40 feet (see Figure 2-2). These wells indicated that there were two major sources of ground water contamination, the original ponds located in the vicinity of the office building on the western portion of the site (pentachorophenol and creosote process area), and the large oily bottomed ponds (IM4/IM5) located on the eastern portion of the site. The contamination was characterized by low concentrations of VOCs, primarily BTEX compounds, and PAH compounds, primarily

naphthalene and related compounds. The findings of this aspect of the investigation are discussed in more detail in Section 4.2.1.