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Risk Assessment Data Report
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Exposure Scenarios for Human Receptors
Potentially in Contact with Constituents
at the Virginia Wood Preserving Site

INGESTION

Ingestion of Groundwater: Exposure is calculated from the following equation:

\[
Exposure = \frac{(C)(CR)(DF)}{BW}
\]

where:

\( C \) = concentration of constituent (mg/l)
\( CR \) = consumption rate (2 l/day)
\( DF \) = diet fraction or fraction of total water consumed at home (0.75)
\( BW \) = adult body weight (70 kg)

Exposure (mg/kg/day) = \((C \text{ mg/l}) (0.0214 \text{ liter kg}^{-1} \text{ day}^{-1})

Consumption rate, diet fraction, and adult body weight are recommendations from the Exposure Factors Handbook (EPA, 1988b). For potential carcinogenic effects, the exposure is adjusted to a 30-year residency over a 70-year lifetime.

Soil Ingestion: Exposure via incidental soil ingestion is relevant for human receptors coming into direct, unrestricted contact with contaminated soil. People who have extended access to the Site are considered to be the receptors. Ingestion of soil occurs primarily as a result of hand-to-mouth contact and the licking of soil-generated dust from the lips. To ensure consistency in exposure and risk assessments, the USEPA (1989b) has recommended a soil ingestion rate of 0.1 gram/day for adults.

Exposure via soil ingestion can be calculated from the following equation:

\[
Exposure = \frac{(C)(CR)(ED)}{(BW)(365 \text{ days/year})}
\]
where:

\[ C = \text{concentration of constituent in surficial soil (mg/kg)} \]
\[ CR = \text{consumption rate of surficial soil (0.0001 kg/day for adults)} \]
\[ ED = \text{days exposed per year (240 days/year)} \]
\[ BW = \text{adult body weight (70 kg)} \]

For both current and future receptors, it is assumed that exposure duration will be 240 days/year (5 days/week for 48 weeks/year). For potential carcinogenic effects, the exposure is adjusted to 30 years in a 70-year lifetime.

**INHALATION**

**Ambient Dust:** Under current and future conditions, receptors may be exposed via inhalation of dust generated from contaminated soil. Exposure through this route at the Site can be calculated from the following equation:

\[
\text{Exposure} = \frac{(C_{\text{soil}})(CR)(ED)}{(BW)(365 \text{ days/year})}
\]

where:

\[ C_{\text{soil}} = \text{concentration of contaminant in surficial soil (mg/kg)} \]
\[ CR = \text{consumption rate of surficial soil (4.45 x 10^{-8} kg/hr), which is estimated as the product of the NAAQS ambient particulate level in air, 5 x 10^{-8} kg/m^3, the hourly adult air intake for moderate activity, 2.4 m^3/hr (EPA, 1988b), the fraction of outdoor dust derived from soil, 0.5, and the fraction of particulates remaining in the lungs during respiration, 0.75 (Hawley, 1985).} \]
\[ BW = \text{adult body weight (70 kg)} \]
\[ ED = \text{exposure duration is equal to onsite hours per year (1,920 hours/year)} \]

For both current and future receptors, it is assumed that exposure will be 1,920 hours/year (8 hours/day for 240 days/year). For potential carcinogenic effects, the exposure is adjusted to 30 years in a 70-year lifetime. The ambient particulate level in air is the Primary National Ambient Air Quality Standard.
DERMAL ABSORPTION

Soil Constituents: Under current and future conditions, receptors may be exposed via dermal contact with contaminated soil. Dermal exposure calculations are more uncertain than the other routes of entry (EPA, 1988b). An equation for this calculation can be given as follows:

\[
\text{Exposure} = \frac{(C)(CR)(ED)(ME)(AF)}{(BW)(365 \text{ days/year})}
\]

where:

- \(C\) = concentration of contaminant in surficial soil (mg/kg)
- \(CR\) = soil contact rate (amount of soil adhering per day—0.0025 kg/day)
- \(ED\) = days exposed per year (240 days/year)
- \(ME\) = soil matrix effect (the fraction of chemical in soil that is actually in contact with the skin—assumed as 0.15)
- \(AF\) = absorption factor (the fraction of chemical in contact with skin that becomes absorbed)
- \(BW\) = adult body weight (70 kg)

The contact rate of soil (CR) with a receptor depends on the area of skin available for exposure during a soil-related activity and the thickness or mass of adhering soil. The most likely parts of the body to be exposed are the head and upper extremities. Median values for the area of these body parts are given in the Exposure Factors Handbook (1988a) as 1,300 cm² and 3,720 cm², respectively. Using the EPA (1983) estimate for soil and dust that adheres to adult skin during a normal work day (0.5 mg/cm²), the contact rate is calculated to be 2,510 mg/day (0.0025 kg/day).

The absorption process itself is further limited by such factors as the following:

- Loss of volatile chemicals during dermal contact.
- Lack of complete contact between the skin and the chemical absorbed to soil.
- Negligible diffusion of chemicals through soil (during period of contact), which decreases the availability of chemicals in direct contact with skin.

- Low chemical diffusion rates into skin.

Given these limiting factors and the sporadic nature of skin contact with soils, it can be assumed that much less than the total amount of any contaminant in adhering soil can come into direct contact with the skin during exposure. Hawley (1985) refers to soil-related factors as the matrix effect (ME) and estimates that only 15 percent of the soil contaminant can be in contact with skin.

Dermal absorption is calculated for receptors who are potentially in contact with contaminants detected in the shallow soil (0-2 ft. depth). Absorption factors (or percent absorption) are discussed for several metals in SCAQMD (1988). Relevant metals for this assessment and their absorption factors are: arsenic - negligible, and chromium (total and hexavalent) - 0.04. These data are based on absorption of reagent chemicals from aqueous solutions (Skog and Wahlberg, 1964; Wahlberg, 1968) and should be regarded as maximum values. Absorption under environmental conditions would be much less, since the contaminant is being partitioned between skin and soil. Information on dermal absorption of copper and zinc is unavailable, but their absorption factors are assumed to be approximately 0.04, based on the behavior of other metals discussed in SCAQMD (1988).

Information on dermal absorption of organic chemicals is limited (SCAQMD, 1988). Absorption factors for some of the organic contaminants in shallow soil are as follows: chlorinated phenols--0.03, phenol--0.004, chlorinated dioxins and dibenzofurans--0.02, and PAHs--0.058 for benzo(a)pyrene and 0.20 for anthracene.

The alkyl phenols and benzoic acid will be given the absorption factor for phenol (0.004) but other contaminants of concern will be regarded conservatively to have an absorption factor equal to 0.5.
Dermal Absorption of Contaminants in Household Water:

Dermal contact with groundwater occurs predominantly during bathing, showering, washing dishes, and washing of the face and hands. Absorption through the skin by some contaminants in groundwater can be significant under certain circumstances. The equation that describes residential exposure to contaminants by dermal contact and absorption from water is (USEPA, 1989c):

\[
\text{Exposure} = \frac{(C_w)(SA)(PC)(ET)(CF)}{(BW)}
\]

where:

- \( C_w \) = concentration of contaminant in water (mg/l)
- \( SA \) = skin surface area available for contact (cm²)
- \( PC \) = chemical-specific dermal permeability constant (cm/hr)
- \( ET \) = exposure time per day (hr/day)
- \( CF \) = volumetric conversion factor for water (l/l,000 cm³)
- \( F \) = fraction of lifetime exposed (years/years)
- \( BW \) = body weight (kg)

The assumptions used for these parameters are: 2.28 x 10⁴ cm² for \( SA \) (USEPA, 1989b); 8.4 x 10⁻⁴ cm/hr for the \( PC \) of water used in lieu of chemical-specific data as suggested by USEPA (1989c); 0.25 hr/day for \( ET \); and 70 kg for \( BW \) (USEPA, 1989c). For carcinogenic effects, the exposure is adjusted to a 30 year period in a 70-year lifetime.
APPENDIX C-B

Toxicity Characterizations of Contaminants
APPENDIX C-B
Toxicity Characterizations of Contaminants

Toxicological summaries of contaminants presented in this appendix are abstracted principally from information in Hazardous and Toxic Effects of Industrial Chemicals (Sittig, 1979), Contaminated Drinking Water and Your Health (Lappenbusch, 1986), Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites (Clement Associates, 1985), and the USEPA Integrated Risk Information System (IRIS). For values of potency factors and acceptable human intakes, IRIS was the primary source, Health Effects Assessment Summary Tables (HEAST)-Third Quarter FY89 was the secondary source, and the USEAP Public Health Risk Evaluation Database (PHRED) (1988) was the tertiary source. Other references are cited when appropriate.

Qualitative health effects are defined in this section in terms of chemical toxicity and biological toxic effects. Chemical toxicity results from either acute, one-time short-duration exposure, or chronic repeated or continuous exposure to a contaminant at low levels. Biological toxicity effects are grouped as following:

- Carcinogenicity—potential of causing some manifestation of cancer based on epidemiology studies and/or animal test results.
- Tumorigenicity—contaminant acts as a casual agent to produce cancerous or benign tumors.
- Mutagenicity—potential for inducing alterations in the DNA of somatic or germinal cells.
- Reproductive or teratogenic effects—reproductive effects are possible based on animal studies.

When available, the EPA weight-of-evidence rating for potential carcinogens is given. Group A indicates it is considered a human carcinogen (sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer); Group B1 indicates a probable human carcinogen (limited evidence of carcinogenicity in humans from epidemiological studies and sufficient evidence of carcinogenicity in animals); Group B2 indicates a probable human carcinogen (sufficient evidence of carcinogenicity in animals, inadequate evidence of
carcinogenicity in humans; Group C indicates a possible human carcinogen (limited evidence of carcinogenicity in animals); Group D indicates it is not classifiable (inadequate evidence of carcinogenicity in animals); and Group E indicates there is no evidence of carcinogenicity in humans (no evidence for carcinogenicity in at least two adequate animal tests or in both epidemiologic and animal studies).

The potency factors (PFs) and reference doses for acceptable intakes for chronic exposures (AICs) are also given when available. Potency factors and reference doses are quantitative values of toxicity used to estimate potential human health effects. The potency factor is the slope of the dose-response curve for carcinogenic compounds developed from toxicological data. It defines the incremental cancer risk resulting from increased exposure. Reference doses or AICs for noncarcinogens are equivalent to a point along the dose-response curve where toxic effects of exposure are first observed, following application of safety factors to account for unknowns such as cross-species variability, variability of human sensitivity, and duration of the animal studies used to test the toxicity of the constituent in question.

Due to the large number of constituents evaluated (57), and the fact that many of the compounds belong to the same class of chemicals and exhibit similar toxicological effects, some of the constituents will be grouped and discussed by class. PAHs will be divided into Group B2, Group C, and Group D based on the USEPA weight-of-evidence rating. Other classes of compounds that are discussed as a group include the phthalate esters; alkylated phenolic compounds; polychlorinated dibenzo-p-dioxins; and polychlorinated dibenzofurans and dibezofuran. All other constituents will be discussed individually.

C.1 METALS

C.1.1 Aluminum

Aluminum is a nonessential element. The reported intake from drinking water and food is 0.05 and 30 mg/day, respectively. The toxicity of aluminum may include neuron disorder (Alzheimer's disease) and chronic renal failure with senile dementis. Massive oral doses may result in an interference with phosphate absorption, resulting in rickets. Gastrointestinal irritation also occurs following large oral doses of aluminum. There are no reports of carcinogenicity with
exposure to aluminum. No acceptable intakes for chronic exposures (AICs) are available for aluminum.

C.1.2 Arsenic

Arsenic, as a naturally occurring element of the earth's crust, is widely distributed in the environment, and all humans are exposed to low levels in air, water, and food. Arsenic enters the body principally through the mouth. Ingested arsenic is quickly absorbed through the stomach and intestines and enters the bloodstream. Inhalation can be an important exposure route, and inhaled arsenic is also quickly absorbed into the bloodstream from the lungs.

It is uncertain whether arsenic is an essential human nutrient. The adult intake from all sources is reported as 0.07 mg/day. Trivalent arsenic compounds are corrosive to the skin. Prolonged contact results in local hyperemia and later vesicular or pustular eruption. Chronic ingestion or arsenic may cause weight loss, nausea, and diarrhea alternating with constipation, pigmentation and eruption of the skin, hair loss, and peripheral neuritis.

With regard to carcinogenicity, the EPA weight-of-evidence classification is A, human carcinogen. The oral potency factor for arsenic is 1.75E+00 (mg/kg/day)\(^{-1}\). This value was derived from the proposed unit risk value of 5.0E-5 (ug/l)\(^{-1}\) (IRIS, 1989) using the drinking water scenario of ingestion of 2 l/day by a 70-kilogram adult. The unit risk value has recently been withdrawn by USEPA and is being revised (Personal Communication, Roger Cochran, MDE). It will be used in this risk assessment though for lack of another value. The inhalation potency factor is 5.03+01 (mg/kg/day)\(^{-1}\) (IRIS, 1989). An oral AIC of 1.0E-03 mg/kg/day is given in HEAST (1989). This oral RfD is currently being reconsidered by the RFD work group but will be used in this risk assessment for lack of another value.

C.1.3 Barium

Barium is a nonessential element. The daily intakes from water, food, and air are estimated at 0.086, 0.67 and 0.017 mg/day, respectively. Insoluble forms of barium are not very toxic; but soluble barium salts are highly toxic after acute exposure, and they have a prolonged stimulant effect on muscles. Effects on the hematopoietic system and cerebral cortex have also been reported in humans. A benign pneumoconiosis, baritosis, can result from inhaling barium dusts.
There are no reports of carcinogenicity, mutagenicity, or teratogenicity with exposure to barium or its compounds. The oral AIC for barium is 5.0E-02 mg/kg/day (IRIS, 1989). An inhalation AIC is not available.

C.1.4 Beryllium

Beryllium is a nonessential element. The reported intake via drinking water is 0.001 mg/day, while food accounts for another 0.011 mg/day. The results of epidemiological studies of workers exposed to beryllium indicate that beryllium may cause lung cancer in humans. Inhalation exposure to beryllium has resulted in development of lung or bone cancer in animals. Acute respiratory effects are associated with inhalation of beryllium, and dermal exposure can cause contact dermatitis. Chronic exposure to beryllium was reported to have adverse effects on aquatic life at levels as low as 5.3 ug/l.

Based on EPA carcinogenic weight-of-evidence, beryllium is classified as B2, probable human carcinogen. Its inhalation potency factor is 8.4E+00 (mg/kg/day)^-1 (IRIS, 1989). Its oral reference dose (RfD) is 5.0E-03 mg/kg/day (IRIS, 1989).

C.1.5 Chromium

Chromium is an essential element with suggested daily intakes for infant, child, and adult of 0.03, 0.1, and 0.1 mg, respectively. The intestinal absorption rate of chromium (+6) is greater than the rate for chromium (+3). A deficiency of chromium may result in atherosclerosis. The toxicity may include tubular necrosis of the kidney. Carcinogenic weight-of-evidence classification for chromium (+6) is A, human carcinogen by the inhalation route; the inhalation potency factor is 4.1E+01 (mg/kg/day)^-1 (IRIS, 1989). There is no indication that chromium (+6) is carcinogenic by oral administration. The chronic oral acceptable intake (AIC) for noncarcinogenic effects of chromium (tb) is 5.0E-03 mg/kg/day (IRIS, 1989). Chromium (+3) has not been evaluated by the EPA for carcinogenicity; the oral AIC for chronic exposure is 1.0E+00 mg/kg/day (IRIS, 1989).

C.1.6 Copper

Copper is an essential element. Suggested daily intakes for the infant, child, and adult are 0.7, 2 and 2 mg, respectively. A deficiency of copper may result in anemia, loss of pigment, reduced growth, and loss of arterial elasticity. It is toxic to humans at high levels; it causes irritation following acute exposure and anemia.
following chronic exposure. Aquatic organisms are very susceptible to copper
toxicosis.

Copper itself does not appear to have mutagenic, teratogenic, or
carcinogenic effects in animals or humans. Inhalation and oral AICs are not
available for copper.

C.1.7 Manganese

Manganese is a vital micro-nutrient for plants and animals. Manganese is
normally ingested as a trace nutrient in food, with an average human intake of
approximately 10 mg/day (Sollman, 1957).

Oral administration of manganese chloride and manganese sulfate to mice has
produced lymphomas and tumors, respectively. High levels of manganese have
been associated with depressed reproductive performance, depressed hemoglobin
levels, decreased blood pressure, decreased growth rate, and liver changes in
experimental animals.

Human consumption of well water contaminated with high levels of
manganese resulted in lethargy, increased muscle tone and spasms, tremors, and
mental disturbances (Kawamura et al., 1941). After the outbreak, well water was
found to contain 14.3 mg manganese/l.

There are no epidemiological studies suggesting that manganese or its
compounds are carcinogenic. The oral AIC for noncarcinogenic effects is 2.0E-01
mg/kg/day, (PHRED, 1988) and the inhalation AIC is 3.0E-04 mg/kg/day (PHRED,
1988).

C.1.8 Sodium

Sodium is an essential constituent. Suggested daily intakes for the infant,
child, and normal adult are 430, 1,500, and 2,200 mg, respectively. A deficiency of
sodium may result in hyponatremia and muscle fatigue. Several studies suggest
that brain damage and sudden unexpected death in human infants may be induced
by high sodium levels. Exposure to high levels of sodium has also been associated
with age-related increases in high blood pressure in genetically susceptible
individuals.

There is no evidence to suggest that sodium has carcinogenic effects in
humans or experimental animals. No AICs are available for sodium.
C.1.9 Vanadium

Occupational exposure to airborne vanadium compounds can produce eye and skin irritation. Oral exposure may produce gastrointestinal disturbances and discoloration of the oral mucosa and tongue. There is no evidence of chronic oral toxicity. The most important toxic effects of vanadium are associated with inhalation exposure. Symptoms include acute upper and lower respiratory irritation, bronchitis, cough, bronchospasm, and chest pain. Acute effects are reported to occur at concentrations as low as 0.1 mg/m³. Effects on various enzyme systems may also occur, especially after chronic exposure.

There are no data available to suggest that vanadium has carcinogenic, mutagenic, teratogenic, or reproductive effects in humans or experimental animals. The oral AIC for vanadium is 7.0E-03 mg/kg/day (HEAST, 1989).

C.1.10 Zinc

Zinc is an essential trace element that is involved in enzyme functions, protein synthesis, and carbohydrate metabolism. Toxicity of zinc compounds are variable, although they are of generally low toxicity. Ingestion of excessive amounts of zinc may cause fever and gastrointestinal distress. Inhalation of mists or fumes may irritate the respiratory and gastrointestinal tract and contact with zinc chloride may cause skin and eye irritation. Zinc is excess of 0.25 percent in the diet of rats caused growth retardation, anemia and defective mineralization of bone. Zinc toxicity was not observed at dietary levels below 0.25%. The oral AIC for zinc is 2.0E-01 mg/kg/day (PHRED, 1988).

C.2 ORGANIC CHEMICALS

C.2.1 Benzene

A correlation between benzene exposure and chromosomal aberrations in bone marrow and lymphocytes of exposed individuals has been observed at levels above 100 ppm, although results are inconsistent at lower levels. Retardation of fetal development accompanied by a decrease in maternal weight gain have been seen in reproductive toxicity studies, but there is no pattern suggestive of teratogenic activity for benzene. Except for reported hematological effects of long-term benzene exposure (e.g., leucopenia, thrombocytopenia, pancytopenia), most adverse effects associated with benzene exposure are of an acute nature and occur at considerably higher concentrations (e.g., 3,000 to 7,500 ppm for 1 hour).
There is sufficient evidence that benzene is carcinogenic in animals and humans. Several case reports, as well as two cohort studies, have established a relationship between benzene exposure and leukemia. The EPA weight-of-evidence classification is A, human carcinogen. The oral and calculation potency factors are both 2.9E-02 (mg/kg/day)^-1 (IRIS, 1989).

C.2.2 Ethylbenzene

Ethylbenzene primarily causes irritation of the eyes, nose, throat, and skin. Irritating effects are more pronounced at higher concentrations. Narcosis can occur with very high concentrations; dizziness, drowsiness, and weakness may also occur. Prolonged or repeated skin contact with the liquid may cause dermatitis. Limited data suggested possible liver and kidney injury as the effect of chronic exposure.

No human ingestion data are available, and inhalation data are limited. At 200 ppm (870 mg/m^3), the vapor has a transient irritant effect on the eyes. At 2,000 ppm, eye irritation and lacrimation are immediate and severe and are accompanied by moderate nasal irritation. Tolerance to these effects develops after several minutes. Central nervous system effects begin after about 6 minutes at this level. At 5,000 ppm, the irritation of the eyes, nose, and throat becomes intolerable. Currently, the carcinogenic assessment of ethylbenzene has placed it in Group D. The reference dose for oral exposure is 1.0E-01 mg/kg/day (IRIS, 1989). A reference dose for inhalation and potency factors for carcinogenicity are unavailable.

C.2.3 1,2-Dichloroethane

1,2-Dichloroethane is carcinogenic in rats and mice, producing a variety of tumors. It is mutagenic when tested using bacterial test systems. Human exposure by inhalation to 1,2-dichloroethane has been shown to cause headache, dizziness, nausea, vomiting, abdominal pain, irritation of the mucous membranes, and liver and kidney dysfunction. Dermatitis may be produced by skin contact. In severe cases, leukocytosis (or excess of white blood cells) may be diagnosed; and internal hemorrhaging and pulmonary edema leading to death may occur.

The EPA weight-of-evidence classification for 1,2-dichloroethane is B2, probable human carcinogen. The oral and inhalation potency factors are both 9.1E-02 (mg/kg/day)^-1 (IRIS, 1989).
C.2.4 4-Methyl-2-pentanene (Methyl isobutyl ketone (MIBK))

Kidney damage was observed in rats exposed to 400 mg/m³ of MIBK for 2 weeks, but the damage appeared to be reversible. MIBK caused headache, nausea, vomiting, and eye irritation in a number of humans exposed to concentrations of 200 to 2,000 mg/m³.

No studies on the carcinogenicity, mutagenicity reproductive toxicity, or teratogenicity of MIBK were found in the literature reviewed.

The oral AIC for MIBK is 5.0E-02 mg/kg/day (IRIS, 1989). The inhalation AIC is 2.0E-02 mg/kg/day (HEAST, 1989).

C.2.5 Acetone

Acetone is considered to have rather low toxicity, and no chronic health hazards have been associated with exposure to it. Prolonged inhalation of high concentrations may produce irritation of the respiratory tract, coughing, headache, drowsiness, incoordination, and in severe cases, coma. Acetone is also not very toxic to aquatic organisms.

The oral AIC for acetone is 1.0E-01 mg/kg/day (IRIS, 1989). An inhalation AIC is not available.

C.2.6 Pentachlorophenol

Pentachlorophenol has been shown to be embryotoxic and fetotoxic. Pentachlorophenol has not been found to be highly toxic upon chronic exposure, although fatal cases from acute and chronic human exposure have been reported. Chloracne is the major effect associated with human chronic exposures; however, this may actually be caused by the polychlorinated dibenzodioxin contaminants found in technical grade pentachlorophenol. Other effects associated with chronic intoxication include muscle weakness, headache, anorexia, abdominal pain, weight loss, and effects on the liver and kidney.

The oral AIC for pentachlorophenol is 3.0E-02 mg/kg/day (IRIS, 1989).

C.2.7 Phenol

When applied to the skin of mice, phenol appears to have some tumor-promoting effects and may be a weak carcinogen. There is equivocal evidence that phenol is mutagenic. Subchronic exposure to phenol caused liver, kidney, lung, and
heart damage in experimental animals. In human, phenol has been shown to irritate the eyes, nose, and throat.

Phenol is currently being evaluated by the USEPA for evidence of human carcinogenicity. Its oral AIC is 6.0E-01 mg/kg/day (IRIS, 1989). An inhalation AIC is not available.

C.2.8 Toluene

Toluene has been shown to be embryotoxic in experimental animals. The incidence of cleft palate increased in the offspring of dosed mice. Chronic inhalation exposure to high levels of toluene caused cerebellar degeneration and an irreversible encephalopathy in animals. In humans, acute exposure depressed the central nervous system and caused narcosis.

The USEPA weight-of-evidence classification for toluene is D, unclassified. The oral AIC is 3.0E-01 mg/kg/day (IRIS, 1989). The inhalation AIC is 2.0E+00 mg/kg/day (HEAST, 1989).

C.2.9 Xylenes (total)

Acute exposure to high concentrations of xylene vapors in air may cause CNS depression with symptoms including dizziness, drowsiness, nausea, vomiting, abdominal pain, loss of appetite, pulmonary edema, and unconsciousness, as well as reversible effects on the liver and kidneys. Liquid xylene and high vapor concentrations are irritating to the eyes, and the vapor may cause transient, reversible damage to the cornea. Aspiration of liquid into the lungs may cause chemical pneumonitis, pulmonary edema, and hemorrhage. Chronic exposure may result in damage to liver and kidneys, though such effects have not been demonstrated with certainty.

The USEPA weight-of-evidence classification for xylenes is D, unclassified. Orally administered technical xylene mixtures did not result in significant increases in incidences in tumor response in rats or mice of both sexes.

The oral AIC for xylenes (total) is 2.0E+00 mg/kg/day (IRIS, 1989). The inhalation AIC is 3.0E-01 mg/kg/day (HEAST, 1989).
C.2.10 **Benzoic Acid**

Oral administration of benzoic acid to rats and mice was associated with decreased resistance to stress in mice and possibly with reduced food and water intake in rats after 18 months. In humans given oral doses of less than or equal to 1.75 g/day over a 20-day period, irritation, discomfort, weakness, and malaise was observed.

The oral AIC for Benzoic acid is 4.0E+00 mg/kg/day (IRIS, 1989).

C.2.11 **N-Nitrosodiphenylamine**

N-Nitrosodiphenylamine is structurally related to carcinogenic nitrosamines. N-nitrosodiphenylamine has produced mixed responses in genetic toxicology tests. Significant increases in bladder tumors were observed only in high-dose animals.

The EPA weight-of-evidence classification for N-Nitrosodiphenylamine is B2, probable human carcinogenic. Its oral potency factor is 4.9E-03 (mg/kg/day)^-1 (IRIS, 1989).

C.2.12 **Styrene**

Results of a toxicity study of monomeric styrene administered to beagle dogs by oral inhalation produced an increased number of Heinz bodies in the red blood cells (RBC), decreased packed cell volume, and sporadic decreases in hemoglobin and RBC counts for those dogs given doses greater than 200 mg/g/day. Increased iron deposits and elevated number of Heinz bodies were also observed in the liver. Long-term studies in rats and mice showed liver, kidney, and stomach lesions for rats and no significant effects for mice.

Although in IRIS it is stated that styrene is currently being reviewed for carcinogenicity, PHRED lists styrene as a B2 (probable human) carcinogen. Its oral potency factor in PHRED is given as 3.00E-02 (mg/kg/day)^-1 and its inhalation potency factor is given as 2.00E-03 (mg/kg/day)^-1 (PHRED, 1989). Although these values have been withdrawn from IRIS, due to lack of other values, they will be used in this risk assessment. The oral AIC for styrene is 2.0E-01 mg/kg/day (IRIS, 1989).
C.2.13 Phthalate Esters

The four phthalate esters selected as constituents for evaluation are bis (2-ethyl hexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate, and di-n-octyl phthalate. Bis (2-ethyl hexyl) phthalate is carcinogenic in rats and mice, causing hepatocellular carcinomas. Teratogenic and reproductive effects have been observed in experimental animals. Chronic exposure to bis (2-ethyl hexyl) phthalate retarded growth and increased liver and kidney weights in animals. The USEPA weight-of-evidence classification for bis (2-ethylhexyl) phthalate is B2, probable human carcinogen. Its oral potency factor is 1.4E-02 (mg/kg/day)\(^{-1}\) (IRIS, 1989) and its oral AIC is 2.0E-02 mg/kg/day (IRIS, 1989).

Butyl benzyl phthalate, when fed to rats at 1,417 mg/kg/day, produced decreased weights of the heart, kidney, lungs, seminal vesicles, and testes; decreased RBC mass and reduced values for hemoglobin. Lower doses administered to rats produced no evidence of abnormal morphology in any organ.

Butyl benzyl phthalate also caused an increase in mononuclear cell leukemia in female rats. Its USEPA weight-of-evidence rating is C, possible human carcinogen. Potency factors are not available for butyl benzyl phthalate. Its oral AIC is 2.0E-01 mg/kg/day (IRIS, 1989).

Di-n-butyl phthalate caused the death of one-half of all rats that were fed diets containing 1.25 percent of di-n-butyl phthalate within 1 week. The remaining animals survived the study with no apparent ill effects. The USEPA weight-of-evidence classification for di-n-butyl phthalate is D, not classifiable, due to a lack of pertinent data regarding carcinogenicity in available literature. The oral AIC for di-n-butyl phthalate is 1.0E-01 (IRIS, 1989).

Di-n-octyl phthalate was fetotoxic and caused developmental abnormalities in one study in rats. It is a severe eye irritant and a mild skin irritant in rabbits. AICs are not available for di-n-octyl phthalate.

C.2.14 Alkylated Phenolic Compounds

The alkylated phenolic compounds selected as constituents for evaluation include 2,4-dimethylphenol, 2-methylphenol (o-cresol), and 4-methylphenol (p-cresol). 2,4-Dimethylphenol has been shown to act as a promoter in skin painting studies, but is has not been tested for carcinogenicity in a complete
bioassay. It is an ATP blocking agent. Other dimethy phenols have been shown to cause pathological changes in the heart, liver, and kidneys. Potency factors or AICs are not available for 2,4-dimethylphenol.

2-Methylphenol and 4-methylphenol are also known as o- and p-cresol, respectively. The dermal application of cresols promotes skin tumors in mice. Cresols are also highly irritating to the skin, mucous membranes, and eyes. They can impair liver and kidney functions and cause central nervous system disturbances. The oral AIC for both 2-methylphenol and 4-methylphenol is 5.0E-02 (IRIS, 1989).

C.2.15 PAHs-Class B2

PAHs identified by the USEPA weight-of-evidence classification as B2 (probable human carcinogens) that were selected as constituents for evaluation include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene and dibenzo(a,h)anthracene.

Some PAHs have been found to be carcinogenic in several animal species and to have both local and systemic carcinogenic effects. On oral administration, carcinogenic PAHs produce tumors of the forestomach in mice. Lung tumors are produced in hamsters after intratracheal administration and in mice after intravenous administration. In skin painting experiments with mice, carcinogenic PAHs produced skin carcinomas. Other observed effects include induction of lung adenomas in mice following single, subcutaneous injections. Carcinogenic PAHs are reported to be mutagenic in a variety of test systems. The limited available information suggests that PAHs are not very potent teratogens or reproductive toxins.

Many carcinogenic PAHs also have immunosuppressive effects. Applications of carcinogenic PAHs to mouse skin is reported to cause destruction of sebaceous glands, hyperplasia, hyperkeratosis, and ulceration.

Despite sufficient evidence of carcinogenicity of these compounds, oral or inhalation potency factors are not available for these PAHs. An oral potency factor for benzo(a)pyrene of 1.15E+01 (mg/kg/day)^{-1} and an inhalation potency factor for benzo(a)pyrene of 6.10E+00 (mg/kg/day)^{-1} is given in PHRED (1988), but has since been withdrawn from PHRED and IRIS. However, due to the lack of available toxicity criteria, these potency factors will be used in this risk
assessment. In addition, relative potency factors (RPEs) that have been derived for PAHs as compared to benzo(a) pyrene will be used to calculate potency factors for other PAHs (EPA, 1988c).

C.2.16 PAHs-Class C

Indeno (1,2,3-cd) pyrene is the only PAH selected as a constituent for evaluation that is classified by the USEPA weight-of-evidence rating as a C (possible human) carcinogen. Indeno (1,2,3-cd) pyrene has given positive results in a bacterial mutagenicity test and has caused oncogenic transformations in hamster lung cells (RTECS, 1982). Indeno (1,2,3-cd) pyrene has also caused tumorogenic responses when given subcutaneously to mice (RTECS, 1982). There is sufficient evidence to classify it as an animal carcinogen, but insufficient human evidence. Potency factors and AICs are not available for indeno (1,2,3-cd) pyrene, but an RPE of 0.232, as compared to benzo (a) pyrene, has been derived for this PAH (EPA, 1988c), and will be used in this risk assessment.

C.2.17 PAHs-Class D

PAHs that are unclassified (class D) as carcinogens that were selected as constituents for evaluation include acenaphthene, acenaphthylene, anthracene, benzo (g,h,i) perylene, benzo(k)fluoranthene, fluoranthene, fluorene, 2-methylnapthalene, phenanthene, pyrene, and napthalene.

Oral ingestion of PAHs has resulted in considerable body weight loss, changes in the peripheral blood pattern, changes in renal function, and increased serum aminotransferase activity (USEPA, 1984). Limited toxicological information is available on specific PAHs. A summary of available information is discussed below.

Acenaphthene has not been shown to be carcinogenic or mutagenic, but it does cause liver and kidney damage at high exposure levels. Acenaphthylene exhibited weak mutagenic activity in a microbial test system, and may be a skin irritant. Anthracene causes dermatitis and other skin disorders in humans.

Fluoranthene does not appear to be a complete carcinogen, but it has been shown to be a potent carcinogen in animal test systems. Phenanthrene produced application site tumors in skin painting studies and was shown to be mutagenic in several other studies. Humans exposed to materials containing phenanthrene developed chronic dermatitis and other skin disorders.
Naphthalene retarded cranial ossification and heart development in the offspring of exposed pregnant rats. Inhalation exposure caused nausea, headache, and optic and kidney damage in humans and experimental animals. Oral administration produced cataracts in rabbits and induced changes in motor activity in rats and mice. Exposure to high doses of naphthalene caused severe hemolytic effects.

Naphthalene is the only Group D PAH with an oral AIC. Its oral AIC is $4.0 \times 10^{-1}$ mg/kg/day (PHRED, 1988). For the other PAHs, RPEs derived as compared to benzo(a) pyrene (EPA, 1988c) will be used to calculate potency factors, when available.

C.2.18 Polychlorinated Dibeno-p-dioxins

Studies of the health effects of polychlorinated dibenzo-p-dioxins (PCDDs) have generally concentrated on 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) because it is the most toxic of the PCDDs. Studies on the other PCDDs indicate that they cause the same effects, but at different quantitative doses than TCDD.

The structure-activity relationships among the PCDDs are reasonably well-defined. Isomers with two or fewer chlorine atoms in the 2, 3, 7, and 8 positions have low biological activity. Isomers with 3 or 4 of these positions substituted have quantitative and qualitatively similar biological activity to TCDD. The 1, 2, 3, 7, and 8 positions are all only slightly less active than TCDD. Additional substitutions in the 1, 4, 6, and 9 positions considerably reduce biological activity.

A variety of health effects have been associated or attributed to exposure to very low concentrations of PCDDs, especially TCDD in both experimental animals and humans. These effects include cancer, genotoxicity, enzyme induction, teratogenicity and reproductive toxicity, immunotoxicity, chloracne, porphyria cutanea tarda, and neurobehavioral toxicity. TCDD has been shown to induce cancer in mice and rats following dermal or oral administration. Animal studies suggest that immunotoxicity is probably the most potent effect of TCDD. Both immunotoxicity and the enzyme inducing effects of PCDDs are probably mediated through a cytosolic receptor that has a high affinity for PCDDs. Chloracne is the only clear effect that PCDD intoxication has produced in humans.

The USEPA weight-of-evidence classification for 2,3,7,8-TCDD and hexachlorodibenzo-p-dioxins (mixture) is B2, probable human carcinogens. The oral
potency factor for 2,3,7,8-TCDD is 1.56E+05 mg/kg/day (PHRED, 1988). Both the oral and inhalation potency factors for hexachlorodibenzo-p-dioxin (mixture) are 6.2E+03 mg/kg/day (IRIS, 1989). Potency factors are not available for other PCDDs, but International toxicity equivalent factors (I-TEFs) have been derived relative to the toxicity of 2,3,7,8-TCDD (EPA, 1989a) and will be used to calculate potency factors for the chlorinated dioxin isomers.

C.2.19 Polychlorinated Dibenzofurans and Dibenzofuran

Polychlorinated dibenzofurans (PCDF) possess similar chemical structures, patterns of toxic and biologic responses and may share a common mechanism of action at the cellular level as PCDDs. The position of the chlorine atoms on the molecule determine the toxicity of the specific isomer. The most toxic forms of PCDFs are those containing 4-6 chlorine atoms, with four of the chlorine atoms at the lateral positions, i.e., 2, 3, 7, and 8.

The more toxic or biologically active PCDFs have resulted in a variety of health effects in experimental animals, including a wasting syndrome, skin disorders, effects on the immune system, impaired liver function, altered hematological function, impaired reproduction, increased incidence of tumors, and induction of numerous enzyme systems (Ontario Ministry of the Environment, 1985).

Only limited data are available for dibenzofuran, the parent molecule. No LD$_{50}$ data is available. Dibenzofuran was inactive in vitro AHH (aryl hydrocarbon hydroxylene) induction assay. No carcinogenic responses were observed in lifetime studies of rats and mice fed 10,000 ppm dibenzo-p-dioxin, the dioxin analogue to dibenzofuran, in their diet (Ontario Ministry of the Environment, 1985). Dibenzofuran is not considered very toxic.

Potency factors or AICs are not available for dibenzofuran or any of the PCDF isomers. I-TEFs relative to 2,3,7,8-TCDD have been derived (EPA, 1989a) and will be used to calculate potency factors for the chlorinated furan isomers.
APPENDIX D

Field Sampling Records
GROUND WATER SAMPLING RECORD

PROJECT Virginia Wood Preserve SAMPLE OR LOG NO. 2000
LOCATION ———— SAMPLER Jeff Nejay, Jack Ralph
DATE: (Mo/Dy/Yr) 7/21/87 TIME: Start 15:40 End 16:10
SAMPLING LOCATION DESIGNATION: EW - 2A
SAMPLING LOCATION DESCRIPTION (Show Dwg.): Trench Rail

WATER LEVEL OBSERVATIONS: HNU headspace Reading: 0.0
Measuring Pt. = Top of Pipe/Other (Describe)
MP is _______ Feet Above/Below Land Surface
Elevation _______ Feet (of Land Surface)
Well Diameter 2" Depth to Water 6.62 Well Depth 7.02

CONDUCTIVITY METER: Extech —— YSI —— Other (Describe)
Cole Palmer 5985-80 1481-55
Calibration Technique Solution/Resistor
Reading 978 Date: 7/12/87 Time: 17:40

PH METER: Extech 1/1 Field Calibration: Date 7/12/87
Cole Palmer 5985-80 pH4 pH7 pH10
Millivolts/pH 4.01 7.01
Temp °C 23.7

Readings: 1 2 3 4 5
Millivolts/pH
Temp °C
Field Calibration, Other (Describe) O2 meter - Zero 7 full scale readings OK

SAMPLE NO. TYPE PRESERVATIVE COOL TO 4°C
Water Quality: Required
Water Quality: Required

PH Temp Redox / O2 mg/L

@ Only enough water to Sample for UOA and Thiocyanate

Serial Nos. on Seals or Labels: __________________________
No. of Transportation Cases: __________________________

NOTES AND OBSERVATIONS:
Layer of bentonite at bottom of well 7
Present in sample water, very turbid and a slight screen on water surface.
Purge Date/Time: 7-17-87 / 12:12 Using Centrif. Pump
Purge Volume Calculated = 1.05 gal for 5 volumes
Purge Volume Actual = 2.5 gal.

SAMPLER'S SIGNATURE: ______________________ DATE 7/12/87
AR301567 Dames & Moore
**GROUND WATER SAMPLING RECORD**

**PROJECT:** Virginia Wood Preservers  
**SAMPLE OR LOG NO.:** 2001

**LOCATION:**  
**DATE:** (Mo/Dy/Yr) 7/24/89  
**TIME:** Start 17:00  
**End 17:30**

**SAMPLING LOCATION DESIGNATION:** BW-5A

**SAMPLING LOCATION DESCRIPTION (Show Dwg.):** Tulon Rail

**SAMPLING METHOD:** Grab/Bail/Barcad/Other (Describe)

**WATER LEVEL OBSERVATIONS:**  
**Measuring Pt.:** Top of Pipe (Describe)  
**MP is:** Feet Above/Below Land Surface  
**Elevation:** Feet (of Land Surface)  
**Well Diameter:** 2.50  
**Depth to Water:** 2.69  
**Well Depth:** 7.00

**CONDUCTIVITY METER:** Extech — /YSI — Other (Describe)  
**Calibration Technique:** Solution/Resistor  
**Date:** 7/24/89  
**Time:** 09:20  
**Reading:** 1096  
**µmhos cm**  
**Temperature:** 27.2 °C

**PH METER:** Extech  
**Cal Palmer 5985-80**  
**Field Calibration:** Date 7/24/89  
**Time:** 09:20  
**pH4**  
**pH7**  
**pH10**  
**Millivolts/pH**  
**Temp °C**  
**27.2**

**Field Calibration, Other (Describe)**

**SAMPLE NO.**  
**TYPE (Analysis Required):** Water Quality  
**PRESERVATIVE COOL TO 4°C**

<table>
<thead>
<tr>
<th>Preservative</th>
<th>µmhos/cm</th>
<th>pH</th>
<th>Temp °C</th>
<th>Rotor My/Oz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>98</td>
<td>4.33</td>
<td>27.0</td>
<td>144/2.6</td>
</tr>
</tbody>
</table>

**Serial Nos. on Seals or Labels:**  
**No. of Transportation Cases:**

**NOTES AND OBSERVATIONS:**  
**Oily Floater Present**  
**Purge Date:** 7-24-89  
**Volume:** 6.0 gal

**SAMPLER’S SIGNATURE:**  
**DATE:** 7/24/89  
Dames & Moore
**GROUND WATER SAMPLING RECORD**

**PROJECT:** Virginia Wood Preserves  
**SAMPLE OR LOG NO.:** 2002

**LOCATION:**  
**DATE:** (Mo/Dy/Yr) 7-11-89  
**TIME:** Start 14:00 End 19:30

**SAMPLED WATER:**  
**SAMPLE LOCATION DESIGNATION:**  
**SAMPLED LOCATION DESCRIPTION:**

**SAMPLED METHOD:** Grab/Bail/Barcad/Other

**WATER LEVEL OBSERVATIONS:**  
**Measuring Pt. = Top of Pipe/Other:**
**MP is __________ feet Above/Below Land Surface**
**Elevation __________ feet (of Land Surface)**
**Well Diameter __________ feet to Water**

**CONDUCTIVITY METER:** Extech — /YSI — Other

**Calibration Technique:** Solution/Resistor
**Date:** 7/11/89  
**Time:** 7:00
**Reading:** __________ μmhos cm
**Temperature:** 28.8 °C

**pH METER:** Extech — /Cole Palmer —

Field Calibration:  
**Date:** 7/11/89  
**Time:** 7:00
**pH4**  
**pH7**  
**pH10**

**Readings:**

<table>
<thead>
<tr>
<th>Millivolts/pH</th>
<th>Temp °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>____________</td>
<td>__________</td>
</tr>
</tbody>
</table>

**Temperature:** 28.8 °C

**Field Calibration, Other (Describe):**
**HNK reading 56 ppm at 95% RH, DO - zero (full scale ok.)**

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>TYPE (Analysis Required)</th>
<th>PRESERVATIVE</th>
<th>COOL TO 4°C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Quality</strong></td>
<td>**(Analysis **</td>
<td><strong>PH</strong></td>
<td><strong>Temp.</strong></td>
</tr>
<tr>
<td>__________</td>
<td>__________</td>
<td>__________</td>
<td>__________</td>
</tr>
<tr>
<td>__________</td>
<td>__________</td>
<td>__________</td>
<td>__________</td>
</tr>
<tr>
<td>__________</td>
<td>__________</td>
<td>__________</td>
<td>__________</td>
</tr>
</tbody>
</table>

**Serial Nos. on Seals or Labels:**
**No. of Transportation Cases:**

**NOTES AND OBSERVATIONS:**  
**Purge Date/Time:** 7-11-89/10:00
**Purge Vol. calculated = 0.5 x 5 = 2.5 gal**
**Purge Vol. Actual = 4.5 gal in 3 minutes**

**SAMPLER’S SIGNATURE:**  
**DATE:** 7/11/89
## Ground Water Sampling Record

**Project:** Virginia Wood Preservers  
**Sample or Log No.:** 2003

**Location:** Self-Neatly, Jack Burns

**Date (Mo/Dy/Yr):** 7/17/89  
**Time:** Start — End

**Sampling Location Designation:** DM-4A

**Sampling Location Description (Show Dwg.):** Jackson Bail

**Sampling Method:** Grab/Bail/Barcode/Other (Describe)

### Water Level Observations:

- **Water Level:** 0.8 ft
- **Measuring Pt.:** Top of Pipe/Other (Describe)
- **MP is:** Feet Above/Below Land Surface
- **Elevation:** Feet (of Land Surface)
- **Well Diameter:**
- **Depth to Water:**
- **Well Depth:**

**Conductivity Meter:** Extech —— SYSI —— Other (Describe)

**Calibration Technique:** Solution/Resistor

**Date:** / /  
**Time:**

**Reading:** μmhos cm  
**Temperature:** °C

**pH Meter:** Extech / /  
Field Calibration: **Date** / /  
**Time:**

**pH4**  
**pH7**  
**pH10**

**Millivols/pH**  
**Temp °C**

**Readings:** 1 2 3 4 5

**Millivols/pH**  
**Temp °C**

**Field Calibration, Other (Describe):**

---

**Sample No.**  
**Type**  
**Preservative**  
**Cool to 4°C**

**Water Quality:** Analysis Required

**PH**  
**Temp °C**  
**Redox / O2 mg/l**

---

**Serial Nos. on Seals or Labels:**

**No. of Transportation Cases:**

**Notes and Observations:** After purging, well never recharged

**Purge Date/Time:** Enough to take a

**Purge Volume Calculated =**

**Purge Volume Actual =**

**Sampler's Signature:**

**Date:** 7/17/89

---

AR30157@James & Moore
## Ground Water Sampling Record

**Project:** Virginia Wood Preservers  
**Sample or Log No.:** 2004  
**Location:**  
**Date:** August 30, 1988  
**Time:** Start 17:25  
**End:**  
**Sampling Location Designation:** DM-5A  
**Sampling Location Description (Show Dwg.):**  
**Sampling Method:** Grab/Bail/Barcad/Other(Describe)  

### Water Level Observations
- **HNV Reading:** 0  
- **Measuring Ft. = Top of Pipe/Other(Describe):**  
- **MP is:** ——— Feet Above/Below Land Surface  
- **Elevation:** ——— Feet (of Land Surface)  
- **Well Diameter:** ——— Feet to Water  
- **Depth to Water:** ———  
- **Well Depth:** 8.57

### Conductivity Meter
- **Model:** Extech  
- **YSI:** ———  
- **Other(Describe):** ———  
- **Calibration Technique:** Solution/Resistor  
- **Date:** / /  
- **Time:** ———  
- **Reading:** ——— μmhos/cm  
- **Temperature:** ——— °C

### pH Meter
- **Model:** Extech  
- **Field Calibration:** Date / /  
- **Time:** ———  
- **pH4 Reading:** ———  
- **pH7 Reading:** ———  
- **pH10 Reading:** ———  
- **Millivolts/pH:** ———  
- **Temp °C:** ———  
- **Readings:**  
  1  2  3  4  5  
  Millivolts/pH ———  
  Temp °C ———  
- **Field Calibration, Other (Describe):** ———

### Sample No.
- **Type:** (Analysis Required)  
- **Preservative:** Cool to 4°C  

Serial Nos. on Seals or Labels:  
No. of Transportation Cases:  

### Notes and Observations:
- Only 0.27 of water in well — not enough to get 5 samples.

**Sampler's Signature:**  
**Date:** 11/29/89  
**Dames & Moore**
## GROUND WATER SAMPLING RECORD

**PROJECT** Virginia Wood Preservers  
**LOCATION**  
**DATE:** 7/14/87  
**TIME:** Start 14:00  
End 14:30  
**SAMPLING LOCATION DESIGNATION:** BW-9A  
**SAMPLING METHOD:** Grab/Bail/Barcad/Other (Describe)  
**SAMPLING LOCATION DESCRIPTION (Show Dwg.):**  
**CONDUCTIVITY METER:** Extech — YSI — Other (Describe)  
Calibration Technique: Solution/Resistor  
Date: 7/14/87  
Time: 08:00  
Reading 1074 umhos cm  
Temperature: 25.3 °C  

<table>
<thead>
<tr>
<th>pH METER: Extech</th>
<th>Field Calibration: Date</th>
<th>Time</th>
<th>pH4</th>
<th>pH7</th>
<th>pH10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cole Palmer 5985-80</td>
<td>7/14/87</td>
<td>08:00</td>
<td>4.01</td>
<td>7.00</td>
<td>5</td>
</tr>
<tr>
<td>Temp °C</td>
<td>25.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Readings: 1 2 3 4 5

Field Calibration, Other (Describe)  
O2 meter - Zero & Full Scale OK  

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>TYPE</th>
<th>PRESERVATIVE</th>
<th>COOL TO 4°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality: (Analysis Required)</td>
<td>pH</td>
<td>Temp</td>
<td>Redox mv/ O2</td>
</tr>
</tbody>
</table>

312 | 4.54 | 19.8 °C | 1279/5.0 |

Serial Nos. on Seals or Labels:  
No. of Transportation Cases:  

**NOTES AND OBSERVATIONS:**  
Dwage Date/Time: 7-13-87/14:35  
Volume Saturated = 4.2 gal x 5 volumes  
Volume Actual = 20 gal  
Well is a slow recharger  

**SAMPLER'S SIGNATURE:**  
**DATE:** 7/14/87  
Dames & Moore
# GROUND WATER SAMPLING RECORD

**PROJECT:** Virginia Wood Preserves  
**SAMPLE OR LOT NO:** 2006

**LOCATION:**  
**DATE:** (Mo/Dy/Yr) 7-18-89  
**TIME:** Start: 16:30  End: 17:00

**SAMPLING LOCATION DESIGNATION:** BW-104

**SAMPLING LOCATION DESCRIPTION (Show Dwg.):**

**SAMPLING METHOD:** Grab/Bail/Barcad/Other (Describe)

### WATER LEVEL OBSERVATIONS:
- Measuring Pt. = Top of Pipe/Other (Describe)
- MP is ______ Feet Above/Below Land Surface
- Elevation ______ Feet (of Land Surface)
- Well Diameter _____ Feet to Water
- Well Depth ______

### CONDUCTIVITY METER:
- Extech  
- YSI  
- Other (Describe)

#### Calibration Technique:
- Solution/Resistor
- Date: / /  
- Time:

#### pH METER:
- Extech  
- Field Calibration: Date / /  
- Time:

#### Field Calibration, Other (Describe)

### SAMPLE NO.

<table>
<thead>
<tr>
<th>Serial Nos. on Seals or Labels:</th>
<th>No. of Transportation Cases:</th>
</tr>
</thead>
</table>

### NOTES AND OBSERVATIONS:

**Purge Date/Time:** 7-18-89 / 11:00

**Purge Vol. calculated = 1.0 gal. = 5 volume
Purge Vol. Actual = 1.5 gal.**

**SAMPLER'S SIGNATURE:**

---

* Dames & Moore
GROUND WATER SAMPLING RECORD

PROJECT: Virginia Wood Preservers
SAMPLE OR LOG NO: 2007

LOCATION: 7-20-89
DATE: (Mo/Dy/Yr) 7-20-89
TIME: Start 12:00 End 15:30

SAMPLING LOCATION DESIGNATION: SWL-11 A
SAMPLING LOCATION DESCRIPTION (Show Dwg.):
SAMPLING METHOD: Grab/Bail/Barcad/Other (Describe): Teflon Bailor

WATER LEVEL OBSERVATIONS:
Measuring Pt. = Top of Pipe/Other (Describe)
MP is __________ Feet Above/Below Land Surface
Elevation __________ Feet (of Land Surface)
Well Diameter __________ Depth to Water __________ Well Depth __________

CONDUCTIVITY METER: Extech —— /YSI ——— Other (Describe)
Calibration Technique: Solution/Resistor
Reading ___________________ µmhos cm
Temperature: __________ °C

pH METER: Extech / / Field Calibration: Date / / Time:
Reading ___________________ pH4 pH7 pH10

Millivolts/pH ___________________ Temp °C ___________________
Readings: 1 2 3 4 5

Field Calibration, Other (Describe)

SAMPLE NO. TYPE PRESERVATIVE COOL TO 4°C

Water Quality Analysis Required

Serial Nos. on Seals or Labels:
No. of Transportation Cases:

NOTES AND OBSERVATIONS: Water has yellow tint

Date: 7-20-89

SAMPLER'S SIGNATURE: Jack D. Land DATE: 7-20-89

Dames & Moore

III.1-5 AR301574
**GROUND WATER SAMPLING RECORD**

**PROJECT**: Virginia Wood Preservers  
**SAMPLE OR LOG NO.**: 2008

**LOCATION**:  
**DATE**: (Mo/Dy/Yr) **7-26-89**  
**TIME**: Start **07:40**  
**End**: **08:10**

**SAMPLING LOCATION DESIGNATION**:  
**LOCATION DESCRIPTION (Show Dwg.)**:

**SAMPLING METHOD**: Grab/Bail/Barcad/Other(Describe)  
**TELEPHONE**:  
**DATE**: August 30, 1989

**WATER LEVEL OBSERVATIONS**:  
**Measuring Pt.**: Top of Pipe/Other(Describe)  
**MP is**: Feet Above/Below Land Surface  
**Elevation**: Feet (of Land Surface)  
**Well Diameter**:  
**Depth to Water**: 3.91  
**Well Depth**: 8.51

**CONDUCTIVITY METER**: Extech  
**Calibration Technique**: Solution/Resistor  
**Date**: **7/26/89**  
**Time**: **07:15**  
**Reading**: 1099  
**µmhos cm**  
**Temperature**: **27.3 °C**

**PH METER**: Extech  
**Calibration Technique**: Field Calibration  
**Field Calibration**: **7/26/87**  
**Time**: **07:15**  
**pH4**: 4.01  
**pH7**: 7.00  
**pH10**:  
**Millivolts/PH**:  
**Temp °C**: 27.8  
**Readings**: 1 2 3 4 5  
**Millivolts/PH**:  
**Temp °C**:

**SAMPLE NO.**  
**TYPE**  
**Preservative**: COOL TO 4°C

**WATER QUALITY**  
(Analysis Required)  
**Number/CM**:  
**PH**:  
**Temp**:  
**Read MV/O2**:

**Serial Nos. on Seals or Labels**:  
**No. of Transportation Cases**:  
**NOTES AND OBSERVATIONS**:  
**Purge Rate/Time**: 7.25-89/15:00  
**Purge Vol. Calculated**: 3.9 gal. for 5 volumes  
**Purge Vol. Actual**: 4.0 gal. in 2 cycles (intermittent pumping)

**SAMPLER'S SIGNATURE**: Jack D. Pantel

Dames & Moore

---

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>TYPE</th>
<th>PRESERVATIVE</th>
<th>COOL TO 4°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality</td>
<td>Analysis Required</td>
<td>Number/CM</td>
<td>PH</td>
</tr>
<tr>
<td>599</td>
<td>6.14</td>
<td>24.7</td>
<td>28.0/2.4</td>
</tr>
</tbody>
</table>
**GROUND WATER SAMPLING RECORD**

**PROJECT** Virginia Wood Preservers SAMPLE OR LOG NO. 2009  
**LOCATION**  
**DATE:** (Mo/Dy/Yr) 7/10/89  
**TIME:** Start 15:15  
End  
**SAMPLING LOCATION DESIGNATION:** DM-17 A  
**SAMPLING LOCATION DESCRIPTION (Show Diagram):**  
**SAMPLING METHOD:** Grab/Bail/Barcad/Other(Describe)  
Jack Breen  

**WATER LEVEL OBSERVATIONS:**  
- HNU headspace Reading: 0  
- Measuring Pt. = Top of Pipe/Other(Describe)  
- MP is ________ Feet Above/Below Land Surface  
- Elevation ________ Feet (of Land Surface)  
- Well Diameter ________ Depth to Water ________ Well Depth ________

**CONDUCTIVITY METER:** Extech ___________ YSI ___________ Other(Describe) ___________  
**Calibration Technique:** Solution/Resistor  
Date: ___________ Time: ___________  
Reading ________ μmhos cm  
Temperature: ________ °C

**pH METER:** Extech ___________ Field Calibration:  
Date: ___________ Time: ___________  
**pH4**  
**pH7**  
**pH10**  
Millivolts/pH  
Temp °C  
Readings: 1 2 3 4 5  
Millivolts/pH  
Temp °C  
Field Calibration, Other (Describe) ___________

**SAMPLE NO.**  
**TYPE**  
**PRESERVATIVE**  
**COOL TO 4°C**

**Water Quality:** (Analysis Required)  
**PH**  
**Temp**  
Redox  
**mv**

Serial Nos. on Seals or Labels:  
No. of Transportation Cases:  

**NOTES AND OBSERVATIONS:**  
- well is dry  

**SAMPLER'S SIGNATURE:**  
Jack D. Sandt  
**DATE:** 7/10/89  

**Serial Numbers:** AR301576
  
**Date:** August 30, 1989  
**Page:** 24 of 115
**GROUND WATER SAMPLING RECORD**

**PROJECT** Virginia Wood Preserves  
**SAMPLE OR LOG NO.** 2010

**LOCATION**  
**DATE:** (Mo/Dy/Yr) 7-21  7-27  7-27  
**TIME:** Start 1300 (7/21)  
**TIME:** End 16:20 (7/27)

**SAMPLER LOCATION DESIGNATION:** DM-18 A

**SAMPLING LOCATION DESCRIPTION (Show Dwg.):**

**SAMPLING METHOD:** Grab/Bail/Barcod/Other (Describe) — Teflon Rail

**WATER LEVEL OBSERVATIONS:**
- Measuring Ft. = Top of Pipe/Other (Describe)
- MP is __________ Feet Above/Below Land Surface
- Elevation __________ Feet (of Land Surface)
- Well Diameter __________ Depth to Water __________ Well Depth __________

**CONDUCTIVITY METER:** Extech / YSI / Other (Describe)

**CONDUCTIVITY METER:** Extech / YSI / Other (Describe)

**Calibration Technique:** Solution/Resistor
- Date: / /  
- Time: / /  
- Reading _________ μmhos cm  
- Temperature: _________ °C

**pH METER:** Extech / /  
**Field Calibration:** Date / /  
- pH4  
- pH7  
- pH10

**Readings:**
- 1  
- 2  
- 3  
- 4  
- 5

**Field Calibration, Other (Describe):**

**SAMPLE NO.**  
**TYPE** Water Quality  
**QUALITY** (Analysis Required)  
**PRESERVATIVE** PH Temp. Redox/O2 mg/L

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Type</th>
<th>Preservative</th>
<th>pH</th>
<th>Temp.</th>
<th>Redox/O2</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-21</td>
<td></td>
<td></td>
<td>7.44</td>
<td>6.07</td>
<td>25.1</td>
<td>25.8</td>
</tr>
<tr>
<td>7-22</td>
<td></td>
<td></td>
<td>7.08</td>
<td>6.88</td>
<td>22.7</td>
<td>15.4</td>
</tr>
</tbody>
</table>

**Notes and Observations:**  
Water has yellow tint which is retained after filtering.

**Purge Date/Time:** 7-17-87 11:30

**Purge Vol. Calculated:** 2.5 gal for 5 volumes

**Purge Vol. Actual:** 2.6 gal (Pumped dry)

**Well Tests (Very Slow recharge) took total of 10 days to complete sampling (2 sampling times).**

**SAMPLER'S SIGNATURE:** [Signature]

**DATE:** 7/21/89

**Notes and Observations:**
- [Additional remarks or observations that were not fully transcribed]

**Dames & Moore**

**AR301577**
### Ground Water Sampling Record

**Date:** August 30, 1988

**Location:** Virginia Wood Preservers

**Sample No.:** 2011

**Sample Designation:** DM-LR

**Sample Method:** Grab/Bail/Barcod/Other

#### Water Level Observations:
- **Height Above/Below Land Surface:** 27.46 feet
- **Well Diameter:** 2" inches
- **Depth to Water:** 27.46 feet

#### Conductivity Meter:
- **Model:** Extech
- **Calibration Technique:** Solution/Resistor
- **Reading:** 0 μmhos/cm
- **Temperature:** 22°C

#### pH Meter:
- **Model:** Extech
- **Field Calibration:** Date: / / Time: / / Reading: 123 Millivolts/pH Temp: 22°C
- **Field Calibration, Other:** Description

#### Sample Information:

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Type</th>
<th>Preservative</th>
<th>Cool To 4°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water Quality</td>
<td>(Analysis Required)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PH Temp Redox mg/L</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>266 5.50 21.1 731/2.3</td>
<td></td>
</tr>
</tbody>
</table>

**Serial Nos. on Seals or Labels:**

**Notations and Observations:**
- **Date/Time:** 7-11-87 / 12:00
- **Volume Calculated:** 18.1 gal for 5 volumes
- **Volume Actual:** 22 gal in 4 sets

**Sampler's Signature:**

Jack D. Peart Date 7/11/89

Dames & Moore
**GROUND WATER SAMPLING RECORD**

**PROJECT:** Virginia Wood Reserves  
**SAMPLE OR LOG NO.:** 2012  
**LOCATION:**  
**DATE:** (Mo/Dy/Yr) 7-20 to 7-21-89  
**TIME:** Start 16:45 to End 14:00 (7-21)  
**SAMPLING LOCATION DESIGNATION:** DM - 2 R  
**SAMPLING METHOD:** Grab/Bail/Baroda/Other (Describe) Jetten Bail  

**WATER LEVEL OBSERVATIONS:**  
H/N = 1.0  
Measuring Ft. = Top of Pipe/Other (Describe)  
MP is Feet Above/Below Land Surface  
Elevation Feet (of Land Surface)  
Well Diameter Depth to Water Well Depth 20.5 ft

**CONDUCTIVITY METER:** Extech / YSI / Other (Describe)  
**Calibration Technique:** Solution/Resistor  
Date:  
Time:  
Reading μmhos cm Temperature: °C

**pH METER:** Extech  
**Field Calibration:** Date  
Time:  
ph4  
ph7  
PH10

**Readings:**  
Millivolts/pH  
Temp °C

Field Calibration, Other (Describe)

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>TYPE</th>
<th>PRESERVATIVE</th>
<th>COOL TO 4°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Quality:</td>
<td>(Required)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkalinity</td>
<td></td>
<td>6.07</td>
<td>18.5</td>
</tr>
</tbody>
</table>

Serial Nos. on Seals or Labels:  
No. of Transportation Cases:

**NOTES AND OBSERVATIONS:**  
Water slightly turbid

Purge Date/Time: 7-18-89 / 10:00
Purge Vol. Calculated = 8.5 gal for 5 volumes
Purge Vol. Actual = 2.5 gal in one cycle (Purged only)
Well (a slow recharge) took 48 hours to see sufficient recharge to sample

**SAMPLER'S SIGNATURE:** Jack O. Pandet  
**DATE:** 7/21/89

Dames & Moore
GROUND WATER SAMPLING RECORD

PROJECT: Virginia Wood Preservers
SAMPLE OR LOG NO: 2013

LOCATION: DM-3 R

DATE: (Mo/Dy/Yr) 7-20-87 TIME: Start 07:00 End 07:30

SAMPLING LOCATION DESIGNATION: DM-3 R
SAMPLING LOCATION DESCRIPTION (Show Dwg.):

SAMPLING METHOD: Grab/Bail/Barcod/Other (Describe)

WATER LEVEL OBSERVATIONS:

Measuring Point = Top of Pipe/Other (Describe)
MP is __________ Feet Above/Below Land Surface
Elevation __________ Feet (of Land Surface)
Well Diameter __________ Depth to Water __________ Well Depth __________

CONDUCTIVITY METER:
Extech ——— /YSI ——— Other (Describe) ———

Cole Palmer 1481-55
Calibration Technique: Solution/Resistor
Date: 7/20/87 Time: 07:00
Reading __________ µmhos cm Temperature: __________ °C

pH METER:
Extech / / Field Calibration: Date 7/20/87
Cole Palmer 5905-80
Time: 07:00

Millivolts/pH
Temp °C

Readings: 1 2 3 4 5

Field Calibration, Other (Describe)

SAMPLE NO.

TYPE

PRESERVATIVE

COOL TO 4°C

Water Quality: (Analysis Required)

Serial Nos. on Seals or Labels:
No. of Transportation Cases:

NOTES AND OBSERVATIONS:

SAMPLER'S SIGNATURE:

Dames & Moore
**GROUND WATER SAMPLING RECORD**

**PROJECT:** Virginia Wood Preservers

**SAMPLE OR LOG NO.:** 2014

**LOCATION:**

**DATE:** (Mo/Dy/Yr) 7-24/7-27/89

**TIME:** Start 16:00 (7:00) End 15:45 (7:27)

**SAMPLING LOCATION DESIGNATION:** DM-4R

**SAMPLING LOCATION DESCRIPTION:** (Show Dwg.):

**SAMPLING METHOD:** Grab/Bail/Barcad/Other (Describe):

---

**WATER LEVEL OBSERVATIONS:**

- Measuring Pt. = Top of Pipe/Other (Describe):
- MP is ———— Feet Above/Below Land Surface
- Elevation ———— Feet (of Land Surface)
- Well Diameter ———— 2’’
- Depth to Water ———— 18.15 ft (7-27)
- Well Depth ———— 20.58’’

**CONDUCTIVITY METER:** Extech ———— / YSI ———— Other (Describe)

- Calibration Technique: Solution/Resistor
  - Date: 7/27/89
  - Time: 07:15
  - Reading 1100 µhos cm
  - Temperature: 25.0 °C

**PH METER:** Extech ———— / Field Calibration:

- Cole Palmer 5985-80
- Date: 7/27/89
- Time: 07:15
- pH4 4.01
- pH7 7.01
- pH10

**Readings:**

<table>
<thead>
<tr>
<th>Millivolts</th>
<th>Temp °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SAMPLE NO.**

**TYPE**

**PRESERVATIVE**

**COOL TO 4°C**

**Water Quality:**

- (Analysis Required) µhos/cm PH Temp Redox mg/l

- 7-27-89 717 7.82 19.9 -73.1/4.2
- 7-24 Sampled for VOA, SVOA + Thiocyanate
- 7-27 Sampled for Al, Ca, Cu, Zn + Water Quality

**Serial Nos. on Seals or Labels:**

**No. of Transportation Cases:**

**NOTES AND OBSERVATIONS:** Water Slightly Turbid

**Purge Date/Time:** 7-17-89/14:10

**Purge Volume Calculated = 10.5 gal. for 5 Vols**

**Purge Volume Actual = 2.0 gal. - purged dry core; well is very shallow; dryer; had to sample twice over 10 day period to complete sample requirements**

**SAMPLER’S SIGNATURE:**

---

AR301581
**GROUND WATER SAMPLING RECORD**

**PROJECT**: Virginia Woolf Preservatives  
**SAMPLE OR LOG NO.**: 2015

**LOCATION**

**DATE**: (Mo/Dy/Yr) 7-19-89  
**TIME**: Start 15:30  
**End**: 16:00

**SAMPLING LOCATION DESIGNATION**: DM-5

**SAMPLING LOCATION DESCRIPTION**

**SAMPLING METHOD**: Grab/Bail/Barcod/Other (Describe)

**WATER LEVEL OBSERVATIONS**

- Measuring Pt. = Top of Pipe/Other (Describe)
- MP is ___________ Feet Above/Below Land Surface
- Elevation ___________ Feet (of Land Surface)
- Well Diameter 2"  
- Depth to Water ___________ Well Depth 24.6

**CONDUCTIVITY METER**: Extech  
**Calibration Technique**: Solution/Resistor  
**Date**: / /  
**Time**: / /  
**Reading**: ___________ µhos cm  
**Temperature**: ___________ °c

**PH METER**: Extech  
**Calibration Technique**: Date / /  
**Time**: / /  
**pH4**: ___________  
**pH7**: ___________  
**pH10**: ___________

**Field Calibration, Other (Describe)**

**SAMPLE NO.**

**TYPE**

**PRESERVATIVE**

**COOL TO 4°C**

<table>
<thead>
<tr>
<th>Number</th>
<th>pH</th>
<th>Temp</th>
<th>Serial Nos. on Seals or Labels:</th>
</tr>
</thead>
<tbody>
<tr>
<td>137</td>
<td>5.52</td>
<td>18.2</td>
<td></td>
</tr>
<tr>
<td>421/3.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Water Quality** (Analysis Required)

**Serial Nos. on Seals or Labels**

**NOTES AND OBSERVATIONS**

- Pump Date/Time: 7-19-89 09:55
- Pump Vol. Calculated: 18.6 gal for 5 volumes
- Pump Vol. Actual: 15.5 gal in 5 cycles

**SAMPLER'S SIGNATURE**

Dames & Moore  
DATE: 7/17/89

**AR301582**
GROUND WATER SAMPLING RECORD

PROJECT         Virginia Wood Preserves SAMPLE OR LOG NO. 2021
LOCATION        Self Assigned
DATE: (Mo/Dy/Yr) 7-17-87 TIME: Start 10:20 End
SAMPLING LOCATION DESIGNATION: BW-8
SAMPLING LOCATION DESCRIPTION (Show Dwg.): Jackson Bar
SAMPLING METHOD: Grab/Bail/Barcad/Other (Describe) Jackson Bar

WATER LEVEL OBSERVATIONS:
- Measuring Pt. = Top of Pipe/Other (Describe)
- MP is _______ Feet Above/Below Land Surface
- Elevation _______ Feet (of Land Surface)
- Well Diameter _______ Depth to Water ___.80 feet Well Depth

CONDUCTIVITY METER: Extech —— YSI —— Other (Describe)
Cole Palmer 1481-55
Calibration Technique: Solution/Resistor
Date: 7/1/187 Time: 08:00
Reading 1074 μmhos cm Temperature: 25.5°C

pH METER: Extech 5985-80 Field Calibration: Date 7/1/187
Cole Palmer 5985-80 Time: 08:00

<table>
<thead>
<tr>
<th>pH</th>
<th>Millivolts/pH</th>
<th>Temp °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH4</td>
<td>4.01</td>
<td>25.5°</td>
</tr>
<tr>
<td>pH7</td>
<td>7.00</td>
<td></td>
</tr>
<tr>
<td>pH10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Readings: 1 2 3 4 5

Field Calibration, Other (Describe) O2 meter - Zero & full scale readings good.

SAMPLE NO. TYPE PRESERVATIVE COOL TO 4°C
Water Quality: Required

<table>
<thead>
<tr>
<th>Water Quality</th>
<th>PH</th>
<th>Temp</th>
<th>Redox</th>
<th>O2 mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16.51</td>
<td>4.31</td>
<td>19.8</td>
<td>138.7/5.20</td>
</tr>
</tbody>
</table>

Serial Nos. on Seals or Labels: No. of Transportation Cases:

NOTES AND OBSERVATIONS:

Purge Date/Time: 7-14-87 10:00 Using Central pump
Purge Volume Calculated = 5.8 gal. for 5 volumen
Purge Volume Actual = 3.5 gal. purged dry
Well is slow exchanger, allowed to recharge 2 days (after weekend) before sampling.

SAMPLER'S SIGNATURE: Jack D. Parratt DATE 7/1/187

AR301583 Dames & Moore
GROUND WATER SAMPLING RECORD

PROJECT: Virginia Wood Preservers
SAMPLE OR LOG NO: 207
LOCATION: 7-13-89
DATE: (Mo/Dy/Yr): 7-13-89
TIME: Start: 12:00
TIME: End: 17:30
SAMPLING METHOD: Grab/Bail/Barcad/Other
SAMPLER: Jack Parrott

WATER LEVEL OBSERVATIONS:
- HNU headspace Reading: 0
- Measuring Pt. = Top of Pipe
- MP is _________ Feet Above/Below Land Surface
- Elevation _________ Feet (of Land Surface)
- Well Diameter _________ feet
- Depth to Water _________ Well Depth 15.00

CONDUCTIVITY METER: Extech / YSI / Other
Calibration Technique: Solution/Resistor
Calibration: Solution
Reading: ___________ µhos/cm
Temperature: _________ °C

PH METER: Extech
Field Calibration: Date: / / Time: 

<table>
<thead>
<tr>
<th>Millivolts/pH</th>
<th>Temp °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Readings: 1 2 3 4 5

Field Calibration, Other (Describe)

SAMPLE NO. TYPE PRESERVATIVE COOL TO 4°C

<table>
<thead>
<tr>
<th>Water Quality: (Analysis Required)</th>
<th>µhos/cm</th>
<th>pH</th>
<th>Temp °C</th>
<th>Redox %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17.8</td>
<td>4.75</td>
<td>13.8</td>
<td>9.3</td>
</tr>
</tbody>
</table>

Serial Nos. on Seals or Labels:
No. of Transportation Cases:

NOTES AND OBSERVATIONS:
- Water was light brown and turbid
- Sample Date/Time: 7-13-89/13:30
- Using Honda Pump
- Purge Volume Calculated = 8.75 gal. for 5 volumes
- Purge Volume Actual = 9.0 gal. by intermittent pumping

SAMPLER'S SIGNATURE: Jack Parrott
DATE: 7-13-89

AR301584
Dames & Moore
**GROUND WATER SAMPLING RECORD**

**PROJECT:** Virginia Wood Preservers  
**SAMPLE OR LOG NO.** 2018

**LOCATION**  
**DATE:** (Mo/Dy/Yr) 7-18-88  
**TIME:** Start 15:00  End 15:30

**SAMPLING LOCATION DESIGNATION:** BM - 10

**SAMPLING LOCATION DESCRIPTION (Show Dwg.):**

**SAMPLING METHOD:** Grab/Bail/Barcad/Other(Describe)

**WATER LEVEL OBSERVATIONS:**
- **Measuring Pt. = Top of Pipe/Other(Describe):**
- **MP is:** Feet Above/Below Land Surface
- **Elevation:** Feet (of Land Surface)
- **Well Diameter:** 2\"  
- **Depth to Water:** 5.18  
- **Well Depth:** 20.51

**CONDUCTIVITY METER:** Extech  
**Calibration Technique:** Solution/Resistor  
**Date:** 7/18/87  
**Time:** 06:15

**Reading:** 1017  
**µmhos cm**  
**Temperature:** 24.0 °C

**PH METER:** Extech  
**Field Calibration:** Date 7/18/87  
**Time:** 06:15

**Millivols/pH**
- **pH4**  
- **Temp °C:** 24.0

<table>
<thead>
<tr>
<th><strong>Readings</strong></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Millivols/pH</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Temp °C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Field Calibration, Other (Describe):**

**SAMPLE NO. TYPE PRESERVATIVE COOL TO 4°C**

<table>
<thead>
<tr>
<th>Water Quality:</th>
<th>Analysis Required</th>
<th>PH</th>
<th>Temp</th>
<th>Redox mV</th>
<th>O2 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>198</td>
<td>5.25</td>
<td>18.6 °C</td>
<td>815</td>
<td>4.5</td>
<td></td>
</tr>
</tbody>
</table>

**Serial Nos. on Seals or Labels:**

**No. of Transportation Cases:**

**NOTES AND OBSERVATIONS:**

**Purge Date/Time:** 7/18/87 10:37  
**Using Central Pump.**

**Purge Vol. Calculated:** 13.5 gal for 5 inflows

**Purge Vol. Actual:** 12.0 gal in 2 cycles

**SAMPLER'S SIGNATURE:**  
**DATE:** 7/18/87

Dames & Moore

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**Revision:**  
**DATE:** August 30, 1988  
**PAGE:** 24 OF 115

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**ILI-1-5 AR301585**
# Ground Water Sampling Record

**Project:** Virginia Wood Preservers  
**Sample No.** LOG NO. 2019

**Location:**  
**Sampling Location Designation:** SW-11

**Sampling Location Description (Show Dwg.):**

**Sampling Method:** Grab/Bail/Barcod/Other (Describe)

**Water Level Observations:**

- **Measuring Pt.** = Top of Pipe/Other (Describe)
- **MP is** —— Feet Above/Below Land Surface
- **Elevation** —— Feet (of Land Surface)
- **Well Diameter** —— Depth to Water —— Well Depth 12.52'

**Conductivity Meter:** Extech —— YSI —— Other (Describe)

**Calibration Technique:** Solution/Resistor

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Reading</th>
<th>μmhos/cm</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**pH Meter:** Extech / /

**Field Calibration:** Date / /

<table>
<thead>
<tr>
<th>pH4</th>
<th>pH7</th>
<th>pH10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>pH4</th>
<th>pH7</th>
<th>pH10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sample No.**

<table>
<thead>
<tr>
<th>Type</th>
<th>Preservative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cool to 4°C</td>
</tr>
</tbody>
</table>

**Water Quality:**

<table>
<thead>
<tr>
<th>Water Quality</th>
<th>Analysis Required</th>
<th>pH</th>
<th>Temp</th>
<th>Redox</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Analysis Required)</td>
<td>pH</td>
<td>Temp</td>
<td>Redox</td>
<td></td>
</tr>
</tbody>
</table>

| 3430 | 4.92 | 17.7 | 968/5.8 |

**Serial Nos. on Seals or Labels:**

**No. of Transportation Cases:**

**Notes and Observations:**

**Sampler's Signature:** Jack O. Moore  
**Date:** 7/18/89

**Sampler’s Name:** James & Moore
**GROUND WATER SAMPLING RECORD**

**PROJECT** Virginia Wood Preservers SAMPLE OR LOG NO 2020

**LOCATION** SAMPLER Jeff Moore Jack Barnett

**DATE:** (Mo/Dy/Yr) 7-13-89 **TIME:** Start 15:58 End 16:30

**SAMPLING LOCATION DESIGNATION:** SW-1Z

**SAMPLING LOCATION DESCRIPTION (Show Dwg.):**

**SAMPLING METHOD:** Grab/Bail/Barcod/Other (Describe) Tection Ball

**WATER LEVEL OBSERVATIONS:**

<table>
<thead>
<tr>
<th>Measuring Ft. = Top of Pipe/Other (Describe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP is (Feet Above/Below Land Surface)</td>
</tr>
<tr>
<td>Elevation (Feet of Land Surface)</td>
</tr>
<tr>
<td>Well Diameter (Feet)</td>
</tr>
<tr>
<td>Depth to Water (Feet)</td>
</tr>
<tr>
<td>Well Depth (Feet)</td>
</tr>
</tbody>
</table>

**CONDUCTIVITY METER:** Extech / YSI / Other (Describe)

**Calibration Technique:** Solution/Resistor

<table>
<thead>
<tr>
<th>Date:</th>
<th>Time:</th>
<th>Reading</th>
<th>μmhos cm</th>
<th>Temperature (°C)</th>
</tr>
</thead>
</table>

**pH METER:** Extech / / Field Calibration: Date / / Time:

<table>
<thead>
<tr>
<th>pH4</th>
<th>pH7</th>
<th>pH10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millivolts/pH</td>
<td>Temp °C</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Readings:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millivolts/pH</td>
<td>Temp °C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Field Calibration, Other (Describe)

**SAMPLE NO.** (Type) PRESERVATIVE COOL TO 4°C

<table>
<thead>
<tr>
<th>Water Quality: (Analysis Required)</th>
<th>PH</th>
<th>Temp</th>
<th>Redox / O₂ mg/l</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Diameter/CM</th>
<th>33</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>4.01</td>
</tr>
<tr>
<td>Temp</td>
<td>16.6</td>
</tr>
<tr>
<td>Redox / O₂ mg/l</td>
<td>123.3/6.8</td>
</tr>
</tbody>
</table>

**Serial Nos. on Seals or Labels:**

**No. of Transportation Cases:**

**NOTES AND OBSERVATIONS:**

Purge Date/Time: 7-13-89 / 11:20 Using Centrif. Pump

Purge Volume Calculated = 7.0 gal for 5 volumes

Purge Volume Actual = 7.0 gal in 4 cycles

**SAMPLER'S SIGNATURE:**

Jack D. Paunett

**DATE:** 7/13/89

AR301587 Dames & Moore
GROUND WATER SAMPLING RECORD

PROJECT: Virginia Wood Preserves SAMPLE OR LOG NO. 2016
LOCATION: Sample Site No. 3
DATE: (Mo/Dy/Yr) 7-14-89 TIME: Start 14:30 End 14:30

SAMPLING LOCATION DESIGNATION: BW-13
SAMPLING LOCATION DESCRIPTION (Show Dwg.): Jefferson Bell
SAMPLING METHOD: Grab/Bail/Barcad/Other (Describe)

WATER LEVEL OBSERVATIONS: HNU Headspace Reading: 0.0
Measuring Pt. = Top of Pipe/Other (Describe)
MP is _______ Feet Above/Below Land Surface
Elevation _______ Feet (of Land Surface)
Well Diameter _______ Depth to Water _______ Well Depth 20.35

CONDUCTIVITY METER: Extech — /YSI — Other (Describe)
Calibration Technique: Solution/Resistor
Date: / / Time: ________________ µmhos cm Temperature: _______ °C

pH METER: Extech / / Field Calibration: Date / / Time: ________________
Millivolts/pH
Temp °C
Readings: 1 2 3 4 5
Millivolts/pH
Temp °C
Field Calibration, Other (Describe)

SAMPLE NO. TYPE PRESERVATIVE COOL TO 4°C
(Analysis Required)
Water Quality: Water Tests/PH Temp Redox O₂ ppm

804 4.46 17.1 122.5/4.8

Serial Nos. on Seals or Labels:
No. of Transportation Cases:

NOTES AND OBSERVATIONS:
Purge Date/Time: 7-14-89/09:00 Use Honda Pump
Purge Volume Calculated = 13.9 gal for 5 volum
Purge Volume Actual = 15 gal by intermittent purge

SAMPLER'S SIGNATURE: Jack O. Parrott
DATE: 7/14/89

Dames & Moore
GROUND WATER SAMPLING RECORD

PROJECT: Virginia Wood Preserves SAMPLE OR LOG NO. 2022
LOCATION: -
DATE: (Mo/Dy/Yr) 7-14-89 TIME: Start 6:36 End

SAMPLING LOCATION DESIGNATION: BW-14
SAMPLING LOCATION DESCRIPTION (Show Dwg.):
SAMPLING METHOD: Grab/Bail/Barcad/Other(Describe) Tekton Rail

WATER LEVEL OBSERVATIONS:
Measuring Pt. = Top of Pipe/Other(Describe)
MP is ———— Feet Above/Below Land Surface
Elevation ———— Feet (of Land Surface)
Well Diameter ———— Depth to Water ———— Well Depth 22.90

CONDUCTIVITY METER:
Calibration Technique: Solution/Resistor
Calibration Date: / / Time: 
Reading ———— μhmhos cm Temperature: ———— °C

PH METER: Extech / / Field Calibration: Date / / Time: 
Millivolts/pH
Temp °C ————
Readings: 1 2 3 4 5
Field Calibration, Other (Describe)

SAMPLE NO. (Analysis Required)
Water Quality: 
PH Temp Redox /O2 mg/L

Preservative Cool to 4°C

Serial Nos. on Seals or Labels: 
No. of Transportation Cases: 

NOTES AND OBSERVATIONS:
Purge Date/Time: 7-14-89 11:00 Using Centrif Pump
Purge Volume Calculated = 12.6 gal/ for 5 volumes
Purge Volume Actual = 13 gal/ by intermittent pumping

SAMPLER'S SIGNATURE: Jack D. James DATE 7/14/89

Dames & Moore
GROUND WATER SAMPLING RECORD

PROJECT: Virginia Wood Preserves
SAMPLE OR LOG NO.: 2023

LOCATION: 7-25-89

DATE: (Mo/Dy/Yr) 7-25-89
TIME: Start 09:00 End 09:30

SAMPLING LOCATION DESIGNATION: DM-15

SAMPLING LOCATION DESCRIPTION (Show Dwg.): Section Rail

SAMPLING METHOD: Grab/Bail/Barcad/Other (Describe): Clear #1 tool

WATER LEVEL OBSERVATIONS:

- Measuring Pt. = Top of Pipe/Other (Describe)
- MP is ______ Feet Above/Below Land Surface
- Elevation ______ Feet of Land Surface
- Well Diameter ______ Depth to Water ______ Well Depth 23.00

CONDUCTIVITY METER: Extech — / YSI — Other (Describe)

- Calibration Technique: Solution/Resistor
- Date: 7/25/87
- Time: 07:15
- Reading 1099 μmhos cm
- Temperature: 27.3 °C

pH METER: Extech / / Field Calibration: Date 7/25/87

- pH4
- pH7
- pH10

- Millivolts/pH 4.01
- Temp °C 27.3

- Readings: 1 2 3 4 5

Field Calibration, Other (Describe): O2 meter zero & full scale readings good

SAMPLE NO. TYPE PRESERVATIVE COOL TO 4°C

- Water Quality: (Analysis Required)
- PH
- Temp °C
- Redox / O2 %

- 5.70 20.0 53.0 / 3.2

Serial Nos. on Seals or Labels:
No. of Transportation Cases:

NOTES AND OBSERVATIONS:

- Water has oily sheen, creosote smell (strong), and visible creosote (minute particles).

- Purge Date/Time: 7-24-89 / 1:40
- Purge Volume Calculated = 160 gal. 61.5 Volumetric
- Purge Volume Actual = 14.0 gal. by intermittent pumping

SAMPLER'S SIGNATURE: Jack D. Pask Date: 7/25/87

AR301590 Dames & Moore
### GROUND WATER SAMPLING RECORD

**PROJECT:** Virginia Wood Preserves

**LOCATION:** SAMPLED

**SAMPLE LOG NO.:** 2024

**DATE:** (Mo/Dy/Yr) 7-25-87

**TIME:** Start 11:00  End 11:30

**SAMPLING LOCATION DESIGNATION:** DM-16

**SAMPLING LOCATION DESCRIPTION (Show Dwg.):**

**SAMPLING METHOD:** Grab/Bail/Barac8/Other (Describe) Tanen Bail

**WATER LEVEL OBSERVATIONS:**

- **Reading:** 5.0
- **Measuring Pt. = Top of Pipe/Other (Describe)**
- **MP is**
- **Elevation**
- **Well Diameter**
- **Depth to Water** 5.12
- **Well Depth** 25.89

**CONDUCTIVITY METER:** Extech — YSI — Other (Describe)

- **Calibration Technique:** Solution/Resistor
- **Date:** / /  **Time:**
- **Reading** μmhos cm  **Temperature:** °C

**pH METER:** Extech — / /

- **Field Calibration:** Date / /
- **Reading** Millivolts/pH  **Temp °C**
- **Readings:** 1 2 3 4 5

**SAMPLE NO.**

<table>
<thead>
<tr>
<th>Water Quality: (Analysis Required)</th>
<th>TYPE</th>
<th>PRESERVATIVE</th>
<th>COOL TO 4°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH</td>
<td>Temp °C</td>
<td>mv</td>
<td>°C</td>
</tr>
<tr>
<td>2.34</td>
<td>18.9</td>
<td>16.4/5.0</td>
<td></td>
</tr>
</tbody>
</table>

**Serial Nos. on Seals or Labels:**

- **No. of Transportation Cases:**

**NOTES AND OBSERVATIONS:**

- Water has strong creosote odor, but no visible contamination. Slightly turbid, greenish color.

- **Purge Date/Time:** 7-24-87/10:40
- **Purge Volume Calculated:** ~170 gal for 5 volumes
- **Purge Volume Actual:** ~180 gal, purged in 6 cycles (8 gal/cycle)

**SAMPLER'S SIGNATURE:** Jack Parrish

**DATE:** July 25, 1987

**Dames & Moore**

**AR301591**
## Ground Water Sampling Record

**Project:** Virginia Wood Preserver's Sample or Log No. 2025  
**Location:**  
**Date:** 7-19-89  
**Time:** Start 10:15 End 10:45  
**Sampling Location Designation:** On Site 6 Marked Wall  
**Sampling Method:** Grab/Bail/Barcad/Other (Describe) Teflon Rail  

### Water Level Observations
- Headspace Reading: Not Taken  
- Measuring Pt.: Top of Pipe/Other (Describe)  
- MP: __________ Feet Above/Below Land Surface  
- Elevation: __________ Feet (of Land Surface)  
- Well Diameter: __________ Depth to Water: __________ Well Depth: __________

### Conductivity Meter
- **Manufacturer:** Extech / YSI  
- **Calibration Technique:** Solution/Resistor  
- **Reading:** __________ μmhos cm  
- **Temperature:** __________ °C  

### pH Meter
- **Manufacturer:** Extech  
- **Field Calibration:** Date / / Time:  
  - **pH4:** __________  
  - **pH7:** __________  
  - **pH10:** __________
- **Readings:**
  - 1: __________  
  - 2: __________  
  - 3: __________  
  - 4: __________  
  - 5: __________
- **Field Calibration, Other (Describe):**

### Sample No.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Type</th>
<th>Preservative</th>
<th>Cool to 4°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water Quality (Analysis Required)</td>
<td>pH</td>
<td>Temp</td>
</tr>
<tr>
<td>1</td>
<td>37.4</td>
<td>6.05</td>
<td>21.5</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes and Observations:
- Water had organic matter, including dead bugs floating on surface  
- **Volume:** 40 gal. Pumped from well by Markel on the morning of 7-19-89  
- **Volume Calculated:** 3.5 gal. Markel on the morning of 7-19-89  
- **Volume Actual:** 3 gal.  

**Sampler's Signature:** Jack D. Kantor  
**Date:** 7/19/89

Serial Nos. on Seals or Labels:  
No. of Transportation Cases:  

**AR301592**  
Dames & Moore
**GROUND WATER SAMPLING RECORD**

**PROJECT**: Virginia Wood Preservers  
**LOCATION**:  
**DATE**: (Mo/Dy/Yr) 7-13-87  
**TIME**: Start 7:40  
**SAMPLE OR LOG NO.**: 2027  
**SAMPLER**: Jack Carstetter  
**DESIGNATION**:  
**DESCRIPTION (Show Dwg.)**:  
**METHOD**: Grab/Bail/Barcad/Other(Describe): Teflon Bailer

**WATER LEVEL OBSERVATIONS**
- **MP is**: ---
- **Elevation**: ---
- **Well Diameter**: 4" + 1"  
- **Depth to Water**: 13.5'  
- **Well Depth**: 45.5'  

**CONDUCTIVITY METER**
- **CONDUCTIVITY METER**: Extech / YSI — Other(Describe)  
- **Calibration Technique**: Solution/Resistor  
- **Reading**: 999  
- **Temperature**: 25.8 °C

**pH METER**
- **pH METER**: Extech / Field Calibration: Date: 7/13/87  
- **Reading**:  
  - **pH4**: 6.01  
  - **pH7**: 7.00  
  - **pH10**:  
  - **Temp °C**: 25.8 °C

**Field Calibration**: Other (Describe)
- **O2 meter - zero & full scale**

**SAMPLE NO.**
- **TYPE**:  
- **PRESERVATIVE**:  
- **COOL TO 4°C**:  
- **Water Quality (Analysis Required)**:
  - **pH**:  
  - **Temp**:  
  - **Redox/O2**:  
  - **2.63**:  
  - **5.83**:  
  - **17.3**:  
  - **48.3/3.8**:

**Serial Nos. on Seals or Labels**:  
**No. of Transportation Cases**:  
**NOTES AND OBSERVATIONS**:  
- **Purge Date/Time**: 7-11-87 / 16:00  
- **Purge Vol. Calculated**: 114 gal. for 5 column  
- **Purge Vol. Actual**: 50 gal. in 4 columns (pumped dry each fill)

**SAMPLER'S SIGNATURE**: Jack O. Paust DATE  
**DATE**: 7/13/87  
**Dames & Moore**

**AR301593**
# Ground Water Sampling Record

**Project:** Virginia Wood Preservers  
**Sample or Log No.:** 2026

## Sampling Information

- **Location:**  
- **Date:** (Mo/Dy/Yr) 7-19-89  
- **Time:** Start 13:55  
- **End:** 14:20

### Sampling Location Designation
- **Designation:** DM-11 B

### Sampling Location Description
- **Description:** (Show Dwg.)

### Sampling Method
- **Method:** Grab/Bail/Barcad/Other (Describe)
  - **Describe:** Teflon Bail

### Water Level Observations
- **Measuring Pt.:** Top of Pipe/Other (Describe)
- **MP is:** Feet Above/Below Land Surface
- **Elevation:** Feet (of Land Surface)
- **Well Diameter:** Depth to Water
- **Well Depth:** 21.67

### Conductivity Meter
- **Model:** Extech  
- **YSI:** Other (Describe)
- **Other (Describe):**

#### Calibration
- **Technique:** Solution/Resistor
- **Date:** 7/19/89
- **Time:** 07:00
- **Reading:** 1078 μmhos cm  
- **Temperature:** 25.2 °C

### pH Meter
- **Model:** Extech  
- **Field Calibration:** Date 7/19/89
  - **Time:** 07:00

#### Readings
- **Millivolts/pH:**
  - **Temp °C:** 25.2

### Sample Information

#### Sample No.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Water Quality Required</th>
<th>Preservative</th>
<th>Cool To 4°C</th>
</tr>
</thead>
</table>
| 168        | PH: 5.82  
|            |Temp: 18.9  
|            |Redox mV: 02 mV |

- **Serial Nos. on Seals or Labels:**
- **No. of Transportation Cases:**

## Notes and Observations

- **Purge Date/Time:** 7-19-89/08:16  
- **Using Honda Pump**
- **Purge Vol. Calculated:** 56 gal, for 5 volumes
- **Purge Vol. Actual:** 65 gal, in 3 cycles

**Sampler's Signature:**

---

**Dames & Moore**

**Date:** 7/19/89

---

**AR301594**
## SURFACE WATER SAMPLING RECORD

**PROJECT**  
Virginia Cedar Pkwy

**LOCATION**  
New Hope Creek

**SAMPLE OR LOG NO.**

**DATE:** 7/27/89  
**TIME:** Start 17:00  End 17:45

**SAMPLING LOCATION DESIGNATION:**  
SW-1

**SAMPLING LOCATION DESCRIPTION (Show Dwg.):**

**SAMPLING METHOD:** Grab/Other (Describe)

### WATER LEVEL OBSERVATIONS:
- **Surface Water Depth:** 0.35 ft.

### CONDUCTIVITY METER:
- **METER:** Extech / YSI / Other (Describe)

- **Calibration Technique:** Solution/Resistor
- **Date:** / /  
- **Time:** / /  
- **Reading:** μmhos/cm  
- **Temperature:** °C
- **Field Calibration:** Time: Reading: mg/L/ppm  
- **Temperature:** °C

### pH METER:
- **METER:** Extech / /  
- **Field Calibration:** Date: / /  
  - **Time:** / /  
  - **pH4**  
  - **pH7**  
  - **pH10**

- **Millivolts**
- **Temp °C**

<table>
<thead>
<tr>
<th>Readings</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Millivolts/pH</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Temp °C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### FIELD CALIBRATION, OTHER (Describe)

### SAMPLE NO.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>PRESERVATIVE</th>
<th>COOL TO 4°C</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>(Analysis Required)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O2 - 4.4</td>
<td>Eh - 10.3</td>
<td></td>
</tr>
<tr>
<td>Temp - 25.6 (lab)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conc. 2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH 6.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SERIAL NOs. ON SEALS OR LABELS:

### NO. OF TRANSPORTATION CASES:

### NOTES AND OBSERVATIONS:

### SAMPLER'S SIGNATURE:

Jack O. Pasott

### DATE:

7/27/89

Dames & Moore
**SURFACE WATER SAMPLING RECORD**

**PROJECT**
Virginia Wood Prod.

**LOCATION**
Northern Creek

**DATE:** (Mo/Dy/Yr) 7/28/89

**TIME:** Start 1:00 End 9:30

**SAMPLING LOCATION DESIGNATION:** Sw-

**SAMPLING LOCATION DESCRIPTION (Show Dwg.):**

**SAMPLING METHOD:** Grab/Other (Describe)

<table>
<thead>
<tr>
<th>WATER LEVEL OBSERVATIONS:</th>
<th>Surface Water Depth: 75 (In./Ft.)</th>
</tr>
</thead>
</table>

**CONDUCTIVITY METER:** Extech / YSI / Other (Describe)

| Calibration Technique: Solution/Resistor |
| Date: / / Time: _________________________ |
| Reading ________ μmhos cm Temperature ________ °C |
| Field Calibration: Time: __________ Reading: ________ mg/L/ppm Temperature: ________ °C |

**pH METER:** Extech / / Field Calibration: Date: / / Time: __________

<table>
<thead>
<tr>
<th>pH4</th>
<th>pH7</th>
<th>pH10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millivolts</td>
<td>Millivolts/pH</td>
<td></td>
</tr>
<tr>
<td>Temp °C</td>
<td>Temp °C</td>
<td></td>
</tr>
<tr>
<td>Readings: 1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SAMPLE NO.**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>PRESERVATIVE</th>
<th>COOL TO 4°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Analysis Required)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>02 - 4.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cond.</td>
<td>281</td>
<td></td>
</tr>
<tr>
<td>Temp 23.9 (in lab)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>6.55</td>
<td></td>
</tr>
<tr>
<td>Eh</td>
<td>14.2</td>
<td></td>
</tr>
</tbody>
</table>

**Serial Nos. on Seals or Labels:**

**No. of Transportation Cases:**

**NOTES AND OBSERVATIONS:**

Bag Fungi etc. seen in water

**SAMPLER'S SIGNATURE:**

**DATE:** 7/28/89

Dames & Moore
SURFACE WATER SAMPLING RECORD

PROJECT: Virginia Wood Pres
LOCATION: Northern Creek
DATE: 7/28/89
TIME: Start 11:00  End 1:30

SAMPLING LOCATION DESIGNATION:
SAMPLING LOCATION DESCRIPTION (Show Dwg.):
SAMPLING METHOD: Grab/O ther (Describe)

WATER LEVEL OBSERVATIONS:
Surface Water Depth: 0.5 (In./Ft.)

CONDUCTIVITY METER: Extech — YSI — Other (Describe)
Calibration Technique: Solution/Resistor
Date: / / Time: 
Reading: μhmhos cm  Temperature: °C
Field Calibration: Time:  Reading: mg/L/ppm
Temperature: °C

pH METER: Extech / / Field Calibration: Date: / / Time: 

pH4  pH7  pH10

Millivolts
Temp °C

Readings: 1  2  3  4  5

Millivolts/pH
Temp °C

Field Calibration, Other (Describe)

SAMPLE NO.  TYPE  PRESERVATIVE  COOL TO 4°C

(Analysis Required)

0.5 - 1.8
Temp 24.0 in 16
End: 23.0
pH 5.64
Eh 68.3

Serial Nos. on Seals or Labels:
No. of Transportation Cases:

NOTES AND OBSERVATIONS: Water was orange-red color.
Visible: Sheeny or hazy in places. Flow was approximately 0.86 ft/min.

SAMPLER'S SIGNATURE: Jack D. Paned
DATE: 7/28/89

Dames & Moore
SURFACE WATER SAMPLING RECORD

DATE: August 30, 1988

PROJECT: Virginia Wood Procs.

SAMPLE OR LOG NO.: 17000-81

LOCATION: Deep Run Creek

DATE: (Mo/Dy/Yr) 7/26/89

TIME: Start 15:100

End 15:30

SAMPLING LOCATION DESIGNATION: 803-9

SAMPLING LOCATION DESCRIPTION (Show Dwg.): Sample 5, Site plan

SAMPLING METHOD: Grab/Other (Describe)

WATER LEVEL OBSERVATIONS:

Surface Water Depth: 6' (In./Ft.)

CONDUCTIVITY METER: Extech — YSI — Other (Describe)

Calibration Technique: Solution/Resistor

Date: / / Time: ————

Reading ———— μmhos cm Temperature ———— °C

Field Calibration: Time: ———— Reading: ———— mg/L/ppm

Temperature: ——— °C

pH METER: Extech — YSI — Other (Describe)

Field Calibration: Date: / / Time: ————

pH4 pH7 pH10

Millivolts ———— Temp °C

Readings: 1 2 3 4 5

Millivolts/pH ———— Temp °C

Field Calibration, Other (Describe)

SAMPLE NO. TYPE PRESERVATIVE COOL TO 4°C

(Analysis Required)

Temp. (in lat) 27.6

O2 4.8

Cond. 176

pH 6.60

Eh 4.3

Serial Nos. on Seals or Labels: ————

No. of Transportation Cases: ————

NOTES AND OBSERVATIONS:


SAMPLER’S SIGNATURE: Jack D. Lavoie

DATE 7/26/89

Dames & Moore

III.2-3 AR301598
SURFACE WATER SAMPLING RECORD

PROJECT: Virginia Wood Preservers
LOCATION: North Rip Creek
SAMPLE OR LOG NO.
DATE: (Mo/Dy/Yr) 8/11/89 TIME: Start 18:40 End 14:10
SAMPLING LOCATION DESIGNATION:
SAMPLING LOCATION DESCRIPTION (Show Dwg.): 
SAMPLING METHOD: Grab/Other(Describe)

WATER LEVEL OBSERVATIONS:
Surface Water Depth: 6.7 (In./Ft.)

CONDUCTIVITY METER: Extech — YSI — Other(Describe)
Calibration Technique: Solution/Resistor
Date: / / Time: __________________
Reading: _______ μmhos cm Temperature: _______ °C
Field Calibration: Time: __________ Reading: _______ mg/L/ppm
Temperature: _______ °C

pH METER: Extech / / Field Calibration: Date: / / Time: __________
pH4 pH7 pH10
Millivolts
Temp °C
Readings: 1 2 3 4 5
Millivolts/pH
Temp °C
Field Calibration, Other (Describe) 

SAMPLE NO.
(Analysis Required)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>PRESERVATIVE</th>
<th>COOL TO 4°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>Temp</td>
<td>23.7 (in H)</td>
<td></td>
</tr>
<tr>
<td>Cond</td>
<td>2.02</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>6.33</td>
<td></td>
</tr>
<tr>
<td>Eh</td>
<td>15.5</td>
<td></td>
</tr>
</tbody>
</table>

Serial Nos. on Seals or Labels: 
No. of Transportation Cases: 

NOTES AND OBSERVATIONS: Water temp. in case: 21.7°C

SAMPLER'S SIGNATURE

Dames & Moore
SURFACE WATER SAMPLING RECORD

DATE: August 30, 1988

PROJECT

LOCATION
Seasonal FWS

DATE: (Mo/Dy/Yr) 7/31/87
TIME: Start 11:00 End 11:30

SAMPLING LOCATION DESIGNATION:

SAMPLING LOCATION DESCRIPTION (Show Dwg.):

SAMPLING METHOD: Grab/Other (Describe)

WATER LEVEL OBSERVATIONS:
Surface Water Depth: 0.8 (In. Ft.)

CONDUCTIVITY METER: Extech — / YSI — Other (Describe)

Calibration Technique: Solution/Resistor
Date: / / Time: 
Reading — — — — — — — — — — —
µmhos cm
Temperature — — — — — — — — — — — — °C
Field Calibration: Time:
Reading: — — — — — — — — — — — — — — mg/L/ppm
Temperature: — — — — — — — — — — — — °C

pH METER: Extech / / Field Calibration: Date: / / Time: 

pH4

Millivolts
Temp °C

ph 7

Readings: 1 2 3 4 5

Millivolts/pH
Temp °C

Field Calibration, Other (Describe)

SAMPLE NO. TYPE PRESERVATIVE COOL TO 4°C
(Analysis Required)

Serial Nos. on Seals or Labels:
No. of Transportation Cases:

NOTES AND OBSERVATIONS:

SAMPLER’S SIGNATURE: John D. Savitt

DATE 7/3/87

Dames & Moore
**SURFACE WATER SAMPLING RECORD**

**PROJECT:** Virginia Wetlands (17000-acs)  
**LOCATION:** Intermittently Flooded area  
**SAMPLE OR LOG NO.:**  
**DATE:** (Mo/Dy/Yr) 7/27/89  
**TIME:** Start 8:45 AM  
**SAMPLING LOCATION DESIGNATION:**  
**SAMPLING LOCATION DESCRIPTION (Show Dwg.):** Canal in Intermittently Flooded  
**SAMPLING METHOD:** Grab/Other (Describe)  

**WATER LEVEL OBSERVATIONS:**  
Surface Water Depth: 17 (In./Ft.)

**CONDUCTIVITY METER:** Extech — /ysi — Other (Describe) —  
Calibration Technique: Solution/Resistor  
Date: / /  
Time: / /  
Reading: ——— μmhos cm  
Temperature: ——— °C  
Field Calibration: Time: ——— Reading: ——— mg/L/ppm  
Temperature: ——— °C

**pH METER:** Extech — / / Field Calibration: Date: / /  
Field Calibration: Time: ———  
pH4 ——— pH7 ——— pH10  
Millivolts ——— Temp °C ———  
Readings: 1 2 3 4 5  
Millivolts/pH ——— Temp °C ———  
Field Calibration, Other (Describe) ———

**SAMPLE NO.**  | **TYPE**  | **PRESERVATIVE**  | **COOL TO 4°C**  
---|---|---|---
Sample: 2.9  
Field: 11.9  
Eh: 56.0  
Temp: 24.9 (In lab)

**NOTES AND OBSERVATIONS:**  

**SAMPLER'S SIGNATURE:**  
**DATE:** 7/27/89

---

Dames & Moore
SURFACE WATER SAMPLING RECORD

PROJECT: VIRGINIA WIND PRESERVATION
LOCATION: TELLY'S PLAGUE
DATE: (Mo/Dy/Yr) 6/1/89
SAMPLE OR LOG NO.: 06/1589
TIME: Start 15:15 End 15:45
SAMPLING LOCATION DESIGNATION: 6/27/89
SAMPLING LOCATION DESCRIPTION (Show Dwg.): 
SAMPLING METHOD: Grab

WATER LEVEL OBSERVATIONS:
Surface Water Depth: 0.8 (In Ft)

CONDUCTIVITY METER: Extech — /YSI — Other (Describe)

Calibration Technique: Solution/Resistor
Date: / / Time:
Reading —_____ μmhos cm Temperature ——— °C
Field Calibration: Time: ——— Reading: ——— mg/L/ppm
Temperature: ——— °C

pH METER: Extech / / Field Calibration: Date: / / Time:

 Millivolts ———
 pH4 pH7 pH10
 Temp °C ———

Readings: 1 2 3 4 5

 Millivolts/pH
 Temp °C ———

Field Calibration, Other (Describe)

SAMPLE NO. TYPE PRESERVATIVE COOL TO 4°C
(Analysis Required)

O2 - 4.9
Temp - 23.8 (°C)
Cond - 197
pH - 6.68
F0 - 0.8

Serial Nos. on Seals or Labels:
No. of Transportation Cases:

NOTES AND OBSERVATIONS:

SAMPLER'S SIGNATURE: Jack O. Pante DATE 8/1/89

Dames & Moore
**SURFACE WATER SAMPLING RECORD**

**PROJECT**: Virginia Wood Pres

**LOCATION**: Permanently Pended Huren SAMPLER 30C/30K

**DATE**: (Mo/Dy/Yr) 7/31/81 **TIME**: Start 14:30 **End** 15:00

**SAMPLING LOCATION DESIGNATION**: SW-5/3007

**SAMPLING LOCATION DESCRIPTION (Show Dwg.)**: 

**SAMPLING METHOD**: Grab/Other (Describe)

---

**WATER LEVEL OBSERVATIONS**

- **Surface Water Depth**: 0.4 (In/ft)

**CONDUCTIVITY METER**: Extech / YSI — Other (Describe)

- **Calibration Technique**: Solution/Resistor
  - **Reading**: \( \text{umhos cm} \)  
  - **Temperature**: °C
  - **Field Calibration**: Time: __________ Reading: __________ mg/L/ppm Temperature: __________ °C

**pH METER**: Extech / Field Calibration: Date: __________

- **Reading**
  - **pH4**
  - **pH7**
  - **pH10**

- **Millivolts**
  - **Temp °C**
  - **Readings**: 1 2 3 4 5

- **Millivolts/pH**
  - **Temp °C**

**Field Calibration, Other (Describe)**

---

**SAMPLE NO.**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>PRESERVATIVE</th>
<th>COOL TO 4°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>02-9.6</td>
<td>Temp 27.2°C (ml air)</td>
<td></td>
</tr>
<tr>
<td>Cond. 140</td>
<td>pH 6.30</td>
<td>Eh (-30.7)</td>
</tr>
</tbody>
</table>

**Serial Nos. on Seals or Labels**: 

**No. of Transportation Cases**: 

**NOTES AND OBSERVATIONS**: Water temp in pond 27.8°C. Distance to surface of water from top of surveyed stake 0.5'

**SAMPLER'S SIGNATURE**: 

**DATE**: 7/30/89

---

**DAMES & MOORE**

---

**III.2-3 AR301603**
### SURFACE WATER SAMPLING RECORD

**PROJECT**: Virginia Wood Pres

**SAMPLE OR LOG NO.**: [Blank]

**LOCATION**: Seasonally Wet Area

**DATE** (Mo/Dy/Yr): 7/23/89

**TIME** (Start): 7:00

**END**: 15:00

**SAMPLING LOCATION DESIGNATION**: [Blank]

**SAMPLING LOCATION DESCRIPTION (Show Dwg.)**: [Blank]

**SAMPLING METHOD**: Grab/Other (Describe)

### WATER LEVEL OBSERVATIONS:

**Surface Water Depth**: 0.7 (In./Ft.)

### CONDUCTIVITY METER:

**CONDUCTIVITY METER**: Extech — / YSI — Other (Describe)

**Calibration Technique**: Solution/Resistor

**Date**: [Blank]

**Time**: [Blank]

**Reading** μmhos cm

**Temperature** °C

**Field Calibration** Time:

**Reading** mg/L/ppm

**Temperature**: °C

### PH METER:

**PH METER**: Extech / / Field Calibration

**Date**: [Blank]

**Time**: [Blank]

**pH4** pH7 pH10

**Millivolts**

**Temp °C**

**Readings**: 1 2 3 4 5

**Millivolts/pH**

**Temp °C**

Field Calibration, Other (Describe)

### SAMPLE NO.

**SAMPLE NO.** (Analysis Required)

**Preservative** COOL TO 4°C

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Type</th>
<th>Preservative</th>
</tr>
</thead>
<tbody>
<tr>
<td>09</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>Temp</td>
<td>31.2</td>
<td></td>
</tr>
<tr>
<td>Cont</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>5.40</td>
<td></td>
</tr>
<tr>
<td>Eh</td>
<td>73.2</td>
<td></td>
</tr>
</tbody>
</table>

**Serial Nos. on Seals or Labels**: [Blank]

**No. of Transportation Cases**: [Blank]

### NOTES AND OBSERVATIONS:

Much algae growing in water column. Much decaying organic material on bottom (mainly pine needles)

**SAMPLER'S SIGNATURE**: [Signature]

**DATE**: 7/23/89

Dames & Moore

**PAGE 27 OF 115**
SEDIMENT SAMPLING RECORD

PROJECT: Virginia Wood Pres.  
SAMPLE OR LOG NO(S):  
LOCATION: North Run Creek  
SAMPLER: JDP / IWN

DATE: (Mo/Dy/Yr): 7/27/89  TIME: Start 12:00  End 12:45

SAMPLING LOCATION DESIGNATION: SE-1 30-10

SAMPLING LOCATION DESCRIPTION (Show Dwg.):  

SAMPLING METHOD: (Grab/Other/Describe):  

SEDIMENT QUALITY DATA:

DEPTH TO SEDIMENT - WATER INTERFACE (Inches):  

SEDIMENT SOURCE (Stream, Channel, Pond, Puddle or Other):  

CONSISTENCY (Dry, Solid, Semi-solid, Viscous, Suspension or Other): Sand

COLOR: Olive Gray

TEMPERATURE (°C): 23.8°C

OTHER FIELD MEASUREMENTS:

Sample No.  Type  Cool to 4 C
(Analysis Required)

HNH1 = 1.0 (headspace)

pH 7.207

pH 6.26

SERIAL NUMBERS ON SEALS OR LABELS:  

NUMBER OF TRANSPORTATION CASES:  

NOTES AND OBSERVATIONS:

Stream flow measured at 0.39 ft/s

Stream width at sample point 3.50

Stream depth at sample point 0.35

SAMPLER'S SIGNATURE:  
DATE: 7/27/89
SEDIMENT SAMPLING RECORD

PROJECT: Virginia Wood furry 12000-001
SAMPLE OR LOG NO(S):

LOCATION: North Run creek

DATE: (Mo/Dy/Yr): 7/28/89

TIME: Start 1:00 End 4:30

SAMPLING LOCATION DESIGNATION: SE-A 3001

SAMPLING LOCATION DESCRIPTION (Show Dwg.): ___

SAMPLING METHOD: Grab/Other(Describe): ___

SEDIMENT QUALITY DATA:

DEPTH TO SEDIMENT - WATER INTERFACE (Inches): 75'

SEDIMENT SOURCE (Stream, Channel, Pond, Puddle or Other): ___

CONSISTENCY (Dry, Solid, Semi-solid, Viscous, Suspension or Other): Sand

COLOR: Olive grey

TEMPERATURE (°C): 23.1

OTHER FIELD MEASUREMENTS:

Sample No. Type
(Analysis Required) Cool to 4°C

Eh 6.0

pH 6.40

Hall 0.8 (hardness)

SERIAL NUMBERS ON SEALS OR LABELS:

NUMBER OF TRANSPORTATION CASES:

NOTES AND OBSERVATIONS:

SAMPLER'S SIGNATURE: Jack D. Moore

DATE: 7/28/89

Dames & Moore
SEDIMENT SAMPLING RECORD

PROJECT: Virginia Wood Pres 17600-001
SAMPLE OR LOG NO(S): 

LOCATION: North River Creek 
SAMPLER: JDP juin

DATE:(Mo/Dy/Yr): 7/20/81 TIME: Start 11:00 End 11:30

SAMPLING LOCATION DESIGNATION: SE-3/3012

SAMPLING LOCATION DESCRIPTION (Show Dwg.): 

SAMPLING METHOD: Grab/Other(Describe): 

SEDIMENT QUALITY DATA:

DEPTH TO SEDIMENT - WATER INTERFACE (Inches): 6

SEDIMENT SOURCE (Stream, Channel, Pond, Puddle or Other): 

CONSISTENCY (Dry, Solid, Semi-solid, Viscous, Suspension or Other): 

COLOR: Olive grey

TEMPERATURE (°C): 22.5

OTHER FIELD MEASUREMENTS:

Sample No. Type Cool to 4 C (Analysis Required)

EL 35.6
pH 6.06

HNO3 = 0.0 (Analysis)

SERIAL NUMBERS ON SEALS OR LABELS: 

NUMBER OF TRANSPORTATION CASES: 

NOTES AND OBSERVATIONS: 

SAMPLER'S SIGNATURE: [Signature] DATE: 7/28/81

Dames & Moore

III.3-3 AR301607
PROJECT: Virginia Wood Res 17600-001
SAMPLE OR LOG NO(S): SE-4/3013
LOCATION: Richmond, VA (South Fork Creek)
SAMPLE: JDP / JWM
DATE: (Mo/Dy/Yr): 7/26/89
TIME: Start 15:00 End 15:30
SAMPLING LOCATION DESIGNATION: SE-4
SAMPLING LOCATION DISCRIPTION (Show Dwg.): See map site plan
SAMPLING METHOD: Grab / Other (Describe):

SEDIMENT QUALITY DATA:

DEPTH TO SEDIMENT - WATER INTERFACE (Inches): 0.1

SEDIMENT SOURCE (Stream, Channel, Pond, Puddle or Other): Isolated Pools in creek bed

CONSISTENCY (Dry, Solid, Semi-solid, Viscous, Suspension or Other): Greenish grey to Olive grey

COLOR: Greenish grey to Olive grey

TEMPERATURE (°C): 23.3

OTHER FIELD MEASUREMENTS:

Sample No. Type Cool to 4°C (Analysis Required)

02

5.04

9.0

0.3

SERIAL NUMBERS ON SEALS OR LABELS:

NUMBER OF TRANSPORTATION CASES:

NOTES AND OBSERVATIONS:


SAMPLER’S SIGNATURE: Jack D. Parvis
DATE: 7/26/89

Dames & Moore
SEDIMENT SAMPLING RECORD

PROJECT: Virginia Water Preserve 1700-001
SAMPLE OR LOG NO(S): __________
LOCATION: North Run Creek
SAMPLER: __________
DATE: (Mo/Dy/Yr): 8/1/89
TIME: Start 13:40 End 14:10
SAMPLING LOCATION DESIGNATION: SE 5 / 3014
SAMPLING LOCATION DISCRIPTION (Show Dwg.): __________
SAMPLING METHOD: Grab/Other(Describe): __________

SEDIMENT QUALITY DATA:
DEPTH TO SEDIMENT - WATER INTERFACE (in.): 0.7
SEDIMENT SOURCE (Stream, Channel, Pond, Puddle or Other): __________
CONSISTENCY (Dry, Solid, Semi-solid, Viscous, Suspension or Other): __________
COLOR: Olive Grey - Sandy
TEMPERATURE (°C): 21.0°C
OTHER FIELD MEASUREMENTS:

Sample No. Type Cool to 4°C (Analysis Required)

HNU - 0.4

En 30.6
pH 5.95

SERIAL NUMBERS ON SEALS OR LABELS: __________
NUMBER OF TRANSPORTATION CASES: __________
NOTES AND OBSERVATIONS:

SAMPLER’S SIGNATURE: __________
DATE: 8/1/89

Dames & Moore

AR301609
PROJECT: Virginia Water Pros. 17600-00
SAMPLE OR LOG NO(S):

LOCATION: Seasonally Wet Bean
SAMPLER: TBD/JSN

DATE:(Mo/Dy/Yr): 2/3/89
TIME: Start 11:00 End 11:30

SAMPLING LOCATION DESIGNATION: SE-6/3015

SAMPLING LOCATION DESCRIPTION (Show Dwg.):

SAMPLING METHOD: Grab/Other (Describe):

SEDIMENT QUALITY DATA:

DEPTH TO SEDIMENT - WATER INTERFACE (Inches): 0.8

SEDIMENT SOURCE (Stream, Channel, Pond, Puddle or Other):

CONSISTENCY (Dry, Solid, Semi-solid, Viscous, Suspension or Other):

COLOR: Olive Grey

TEMPERATURE (°C):

OTHER FIELD MEASUREMENTS:

Sample No. Type Cool to 4 °C

(Analysis Required)

<table>
<thead>
<tr>
<th>MNW</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.5</td>
</tr>
<tr>
<td>pH</td>
<td>4.27</td>
</tr>
</tbody>
</table>

SERIAL NUMBERS ON SEALS OR LABELS:

NUMBER OF TRANSPORTATION CASES:

NOTES AND OBSERVATIONS:

Intermixed Sand, Silt, Leaves, Pine Needles

SAMPLER'S SIGNATURE: Jack R. Land
DATE: 2/3/89

Dames & Moore
SEDIMENT SAMPLING RECORD

PROJECT: Virginia Wood Res. 17006-001
SAMPLE OR LOG NO(S): SE-7 3016-0
LOCATION: Intermittently ponded area
SAMPLER: SDP/SWN
DATE (Mo/Dy/Yr): 7/27/89
TIME: Start 8:45 End 9:30
SAMPLING LOCATION DESIGNATION: SE-7 3016-0
SAMPLING LOCATION DESCRIPTION (Show Dwg.): Canal in Intermittently ponded area
SAMPLING METHOD: Grab / Other (Describe): —

SEDIMENT QUALITY DATA:
DEPTH TO SEDIMENT - WATER INTERFACE (Inches): 17
SEDIMENT SOURCE (Stream, Channel, Pond, Puddle or Other): —

CONSISTENCY (Dry, Solid, Semi-solid, Viscous, Suspension or Other): —
COLOR: Olive gray
TEMPERATURE (C): 23.6°C

OTHER FIELD MEASUREMENTS:

Sample No. Type Cool to 4 C (Analysis Required)

Eh 70.8
pH 5.90

SERIAL NUMBERS ON SEALS OR LABELS: —
NUMBER OF TRANSPORTATION CASES: —

NOTES AND OBSERVATIONS:


SAMPLER'S SIGNATURE: [Signature]
DATE: 7/27/89

Dames & Moore
SEDIMENT SAMPLING RECORD

PROJECT: Virginia Wood Preserves
LOCATION: Permanently Painted Area
SAMPLE OR LOG NO(S): 309/JUN
SAMPLER:
DATE: (Mo/Dy/Yr): 7/31/89 TIME: Start 14:30 End 15:00
SAMPLING LOCATION DESIGNATION: SE-8/3017
SAMPLING LOCATION DESCRIPTION (Show Dwg.):
SAMPLING METHOD: Grab/Other (Describe):

SEDIMENT QUALITY DATA:
DEPTH TO SEDIMENT - WATER INTERFACE (Feet): 0.4
SEDIMENT SOURCE (Stream, Channel, Pond, Puddle or Other):
CONSISTENCY (Dry, Solid, Semi-solid, Viscous, Suspension or Other):
COLOR: Olive Grey
TEMPERATURE (C): 26.5
OTHER FIELD MEASUREMENTS:

Sample No. | Type (Analysis Required) | Cool to 4 C
---|---|---
| KNU | 0.2 |
| Eh | 108.4 |
| pH | 8.80 |

SERIAL NUMBERS ON SEALS OR LABELS:
NUMBER OF TRANSPORTATION CASES:
NOTES AND OBSERVATIONS: Some organic matter present (wood)

SAMPLER'S SIGNATURE: Jack D. Laney
DATE: 7/31/89
SEDIMENT SAMPLING RECORD

PROJECT: Virginia Wood Reservoirs
SAMPLE OR LOG NO(S):
LOCATION: Valley's Pond
SAMPLER: JDP/JWC
DATE: (Mo/Dy/Yr): 8/1/89
TIME: Start 15:15 End 15:45
SAMPLING LOCATION DESIGNATION: SE-9/1013
SAMPLING LOCATION DESCRIPTION (Show Dwg.):
SAMPLING METHOD: Grab/Other(Describe):

SEDIMENT QUALITY DATA:
DEPTH TO SEDIMENT - WATER INTERFACE (INCHES): 0.8
SEDIMENT SOURCE (Stream, Channel, Pond, Puddle or Other):
CONSISTENCY (Dry, Solid, Semi-solid, Viscous, Suspension or Other):
COLOR: Grey to Dark grey
TEMPERATURE (°C): 21.6
OTHER FIELD MEASUREMENTS:
Sample No. Type (Analysis Required) Cool to 4 C

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Type</th>
<th>Analysis Required</th>
<th>Cool to 4 C</th>
</tr>
</thead>
<tbody>
<tr>
<td>4NU</td>
<td>E4</td>
<td></td>
<td>37.6</td>
</tr>
<tr>
<td></td>
<td>pH</td>
<td></td>
<td>5.92</td>
</tr>
</tbody>
</table>

SERIAL NUMBERS ON SEALS OR LABELS:
NUMBER OF TRANSPORTATION CASES:
NOTES AND OBSERVATIONS:

SAMPLER'S SIGNATURE: Jack D. Parrott
DATE: 8/1/89

Dames & Moore
### SEDIMENT SAMPLING RECORD

**PROJECT:** Virginia Wood Preservers 17000-001  
**SAMPLE OR LOG NO(S):**  
**LOCATION:** Lagoon  
**SAMPLER:** JDF/5WN  
**DATE:** (Mo/Dy/Yr): 8/1/89  
**TIME:** Start ———— End ————  
**SAMPLING LOCATION DESIGNATION:** SE-10  
**SAMPLING LOCATION DESCRIPTION (Show Dwg.):**  
**SAMPLING METHOD:** Grab/Other (Describe): Composite from  

### SEDIMENT QUALITY DATA:

**DEPTH TO SEDIMENT - WATER INTERFACE:**  
**SEDIMENT SOURCE:** Stream, Channel, Pond, Puddle or Other: Lagoon  
**CONSISTENCY (Dry, Solid, Semi-solid, Viscous, Suspension or Other):**  
**COLOR:** Dark Brown & Some yellowish red & black (creosote)  
**TEMPERATURE:**  

### OTHER FIELD MEASUREMENTS:

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Type</th>
<th>Cool to 4 C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Analysis Required)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HNU 7.0 (head space)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eh 95.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pH 5.01</td>
</tr>
</tbody>
</table>

### SERIAL NUMBERS ON SEALS OR LABELS:  
**NUMBER OF TRANSPORTATION CASES:**  

### NOTES AND OBSERVATIONS:

Sampling each corner brought oily sheen to top of water in corner sediment. Hard what appeared to be raw creosote mixed with the sediment. Creosote smell at each corner.

**SAMPLER'S SIGNATURE:** Jack D. Paul  
**DATE:** 8/1/89  
**DAMES & MOORE:**  
**AR301614**
SEDIMENT SAMPLING RECORD

PROJECT: Virginia Wood Pros.
SAMPLE OR LOG NO(S): ______
LOCATION: Seasonally wet area
SAMPLER: SDP, JUN
DATE: (Mo/Dy/Yr): 7/24/89
TIME: Start 14:00 End 15:00
SAMPLING LOCATION DESIGNATION: SE-1/ 3020
SAMPLING LOCATION DESCRIPTION (Show Dwg.) ______
SAMPLING METHOD: Grab/Other (Describe): ______

SEDIMENT QUALITY DATA:
DEPTH TO SEDIMENT - WATER INTERFACE (Inches): 0.7
SEDIMENT SOURCE (Stream, Channel, Pond, Puddle or Other): Stream
CONSISTENCY (Dry, Solid, Semi-solid, Viscous, Suspension or Other): ______
COLOR: ______
TEMPERATURE (°C): 23.5
OTHER FIELD MEASUREMENTS:
Sample No. Type Cool to 4 °C
(Analysis Required)
Eh 10.3 3
pH 4.92
ANN = 0.0
SERIAL NUMBERS ON SEALS OR LABELS: ______
NUMBER OF TRANSPORTATION CASES: ______
NOTES AND OBSERVATIONS: Rotten egg odor

SAMPLER'S SIGNATURE: [Signature]
DATE: 7/24/89

Dames & Moore
APPENDIX E

Wetland Assessment Field Notes
**Project Name:** Project Number: 123-004

**Project Location:** Sampling Site Location: Richmond, VA

**Vegetation:** (* species are dominant)

<table>
<thead>
<tr>
<th>Are plant communities or forest edge clearly distinguishable?</th>
<th>Y N</th>
</tr>
</thead>
<tbody>
<tr>
<td>External edge is scarcely/densely vegetated and is straight/slightly highly irregular:</td>
<td>Y N</td>
</tr>
</tbody>
</table>

**Frequency of management practices:** Grazing M H Mowing times per month

**Managed grass or legume species:**

**Approximate non-deciduous trees:** < 1

**Herbaceous, ground cover, vines:** (<2 ft tall)

<table>
<thead>
<tr>
<th>Species</th>
<th>% Occurrence</th>
<th>Status Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Faise nettle</td>
<td>FACW</td>
<td></td>
</tr>
<tr>
<td>2) Cattail</td>
<td>FACW</td>
<td></td>
</tr>
<tr>
<td>3) Japanese honeysuckle</td>
<td>FACW</td>
<td></td>
</tr>
<tr>
<td>4) Poison Ivy</td>
<td>FACW</td>
<td></td>
</tr>
<tr>
<td>5) Greenbroad</td>
<td>FACW</td>
<td></td>
</tr>
<tr>
<td>6) Juncus effusus</td>
<td>FACW</td>
<td></td>
</tr>
</tbody>
</table>

**Height of ground surface covered by vegetation >1": 80%**

**Factors affecting soil moisture:**

<table>
<thead>
<tr>
<th>Soil Layer of Layer: in.</th>
<th>Matrix</th>
<th>Motile</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6</td>
<td>107%</td>
<td>75%</td>
</tr>
<tr>
<td>B</td>
<td>7.6</td>
<td>25%</td>
<td>65%</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Soil Moisture:**

- Dry Moist
- Saturated
- Inundated (covered)

**Factors affecting soil moisture:**

- Recent rainfall
- Drought conditions
- Near waterbody

**Hydrologic indicators:**

<table>
<thead>
<tr>
<th>Water-borne sediment deposits</th>
<th>Water-stained leaves</th>
<th>Surface scoured areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inundated soil</td>
<td>Saturated soil</td>
<td>Oxidized living rhizomes</td>
</tr>
<tr>
<td>Discolored leaves</td>
<td>Water marks</td>
<td>Drift lines</td>
</tr>
<tr>
<td>Wetland drainage patterns</td>
<td>Morphological plant adaptations</td>
<td>Hydric soil characteristics</td>
</tr>
</tbody>
</table>

**Use reverse side for further comments:** AR301617
**Vegetation:** (*species are dominant)

Are plant communities or forest edge clearly distinguishable?  
 filming

External edge is scarcely (moderately) densely vegetated and is straight /slightly/highly irregular.

Frequency of management practices: Grazing N/A LM H Mowing 6 times per month

Managed grass or legume species —

<table>
<thead>
<tr>
<th>Species</th>
<th>Ave DBH in</th>
<th>Status Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch Pine (not sure)</td>
<td>7 ft</td>
<td>?</td>
</tr>
</tbody>
</table>

**Overstory:** (>2 ft tall, >4" DBH)

<table>
<thead>
<tr>
<th>Species</th>
<th>% Occurrence</th>
<th>Status Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch Pine (7 ft)</td>
<td>6</td>
<td>FAC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Species</th>
<th>% Occurrence</th>
<th>Status Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willow Oak</td>
<td>4</td>
<td>FAC</td>
</tr>
<tr>
<td>Sweet Gum</td>
<td>5</td>
<td>FAC</td>
</tr>
<tr>
<td>Red Maple</td>
<td>6</td>
<td>FAC</td>
</tr>
</tbody>
</table>

**Understory:** (>2 ft tall, 1" to 4" DBH)

<table>
<thead>
<tr>
<th>Species</th>
<th>% Occurrence</th>
<th>Status Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canyon</td>
<td>1</td>
<td>DBL</td>
</tr>
<tr>
<td>Common</td>
<td>2</td>
<td>FAC</td>
</tr>
<tr>
<td>Swamp</td>
<td>3</td>
<td>FAC</td>
</tr>
<tr>
<td>Poison Ivy</td>
<td>4</td>
<td>FAC</td>
</tr>
</tbody>
</table>

**Herbaceous, ground cover, vines:** (<2 ft tall)

<table>
<thead>
<tr>
<th>Species</th>
<th>% Occurrence</th>
<th>Status Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattail</td>
<td>1</td>
<td>FAC</td>
</tr>
<tr>
<td>Common</td>
<td>2</td>
<td>FAC</td>
</tr>
<tr>
<td>Swamp</td>
<td>3</td>
<td>FAC</td>
</tr>
<tr>
<td>Poison Ivy</td>
<td>4</td>
<td>FAC</td>
</tr>
</tbody>
</table>

% of ground surface covered by vegetation >1": 30%

Height of dominant herbaceous vegetation (excluding vines): 4 ft

**Soils/Hydrology**

- **Ground litter:** Mostly leaf litter, 25% logs & sticks
- **Thick leaf litter w/ 25% logs & sticks**
- **Soil Moisture:** Clay, Cracked
- **Factors affecting soil moisture:** Recent rainfall, drought conditions, near waterbody

**Hydrologic indicators:** (circle) Water-bourne sediment deposits, Water stained leaves, Surface scoured areas, Water marks, Drift lines, Morphological plant adaptations, Metric soil characteristics

**Soil Layer of Layer in:**

<table>
<thead>
<tr>
<th>Soil Layer</th>
<th>of Layer in.</th>
<th>Matrix</th>
<th>Motle</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4&quot; 10YR 3/6</td>
<td>2.57</td>
<td>6/2</td>
<td>10YR 6/6</td>
</tr>
<tr>
<td>B</td>
<td>7 1/2&quot; 7.5YR 5/6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use reverse side for further comments
**Project Name:** VWP  
**Project Location:** Richmond, VA  
**Sampling Site Location:** South Peyton Street - Site C

**Scientist(s):** Jeff Busa  
**Date:** 6/23/88

**Vegetation:** (* species are dominant)

- Are plant communities or forest edge clearly distinguishable? **N**
- External edge is scarcely/moderately densely vegetated and is straight slightly highly irregular.
- Frequency of management practices: Grazing **L M H** Mowing **times per month**

**Managed grass or legume species:**

<table>
<thead>
<tr>
<th>Species</th>
<th>% Occurrence</th>
<th>Status Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Gum</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Willow Oak</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Sweet Gum</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Loblolly Pine</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

**Non-deciduous trees:**

<table>
<thead>
<tr>
<th>Species</th>
<th>% Occurrence</th>
<th>Status Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hickory</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Oak</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Walnut</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Herbaceous, ground cover, vines:** (<2 ft tall)

<table>
<thead>
<tr>
<th>Species</th>
<th>% Occurrence</th>
<th>Status Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Juncus effusus</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Greenbrier</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Poison Ivy</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Cattail</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

**Soil Moisture:** Dry Moist Saturated Unundated covered

<table>
<thead>
<tr>
<th>Soil Layer</th>
<th>of Layer</th>
<th>Matrix</th>
<th>Mottle</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>at least 1 ft</td>
<td>5-5-5</td>
<td>1</td>
<td>Clayey</td>
</tr>
</tbody>
</table>

**Factors affecting soil moisture:**

- Recent rainfall
- Drought conditions
- Near waterbody
- Other

**Hydrologic indicators:**

- Unundated soil
- Saturated soil
- Oxidized living rhizomes
- Discored leaves
- Water marks
- Drift lines
- Water-borne sediment deposits
- Water stained leaves
- Surface scoured areas
- Wetland drainage patterns
- Morphological plant adaptations
- Hydric soil characteristics

*Use reverse side for further comments*
Forest Oldfield \(\text{Wetland}\) (circle one)

Sampling Site: Location: North Run Wetland A
Project Name: Kennebunk Project Number:
Project Location: 27/7

Vegetation

Overstory: (>2 ft tall, >4" DBH)

<table>
<thead>
<tr>
<th>Species (* if dominant)</th>
<th>Avg. DBH</th>
<th>Species (* if dominant)</th>
<th>Avg. DBH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Sweet Gum</td>
<td>7</td>
<td>6)</td>
<td></td>
</tr>
<tr>
<td>2) Willow Oak</td>
<td>10</td>
<td>7)</td>
<td></td>
</tr>
<tr>
<td>3) Swamp White Oak</td>
<td>8</td>
<td>8)</td>
<td></td>
</tr>
<tr>
<td>4)</td>
<td>9</td>
<td>9)</td>
<td></td>
</tr>
<tr>
<td>5)</td>
<td>10</td>
<td>10)</td>
<td></td>
</tr>
</tbody>
</table>

Approx. % Closed Canopy: 70%

% hardwoods (oak, hickory, walnut, beech): 30%
% softwood (pine, sweetgum, maple, tulip, blackgum): 70%
% non-deciduous (pines, hollies, cedars): 5%

Trees with cavities? ☑ N Standing dead wood or declining trees? ☑

Understory: (>2 ft tall, 1" to 4" DBH)

<table>
<thead>
<tr>
<th>Species (* if dominant)</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Willow Oak</td>
<td>6)</td>
</tr>
<tr>
<td>2) Sweet Gum</td>
<td>7)</td>
</tr>
<tr>
<td>3) Swamp White Oak</td>
<td>8)</td>
</tr>
<tr>
<td>4)</td>
<td>9)</td>
</tr>
<tr>
<td>5)</td>
<td>10)</td>
</tr>
</tbody>
</table>

% of understory non-deciduous trees: 0

Shrubs: (>2 ft. tall, <1" DEH or <1 in diam. measured 1/2 in above ground):

<table>
<thead>
<tr>
<th>Species (* if dominant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
</tr>
<tr>
<td>2)</td>
</tr>
<tr>
<td>3)</td>
</tr>
<tr>
<td>4)</td>
</tr>
<tr>
<td>5)</td>
</tr>
</tbody>
</table>

Herbaceous layer/ground cover (<2 ft tall):

<table>
<thead>
<tr>
<th>Species (* if dominant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) False Nettle * (wooded)</td>
</tr>
<tr>
<td>2) Foxglove Ivy</td>
</tr>
<tr>
<td>3) Sycamore (open)</td>
</tr>
<tr>
<td>4) Cattail * (open)</td>
</tr>
<tr>
<td>5) Sarcus effusus * (open)</td>
</tr>
</tbody>
</table>

Further Comments:

AR301620
Herbaceous Layer (cont'd)

Approx. % occurrence:
- Grasses
- Sedges
- Forbs (non-grassy herbs)
- rushes
- Annuals
- Perennials
- Briars & small trees
- Introduced species

General:

- Are plant communities or forest edge clearly distinguishable? Y N
- % of ground surface covered by vegetation >1 inch: 25%
- Height of dominant herbaceous vegetation: 2'
- Frequency of management practices (external edge)
  - Grazing
  - Mowing

Soils

Ground litter: (circle one)
- Bare ground, no litter
- Mostly leaf litter
- Thick leaf litter with 25% logs & sticks
- Thick leaf litter with 25-50% logs & sticks

Soil moisture: Dry Moist Saturated Inundated (covered)

Factors affecting soil moisture: recent rainfall drought conditions near waterbody

Indicators of surface water: Discolored leaves

Soil Texture: Sandy Loamy Silty Clayey

Soil Color

<table>
<thead>
<tr>
<th>Soil Layer</th>
<th>Matrix</th>
<th>Mottle</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10 YR 5/2</td>
<td>7.5 YR 5/6</td>
</tr>
<tr>
<td>B</td>
<td>2.5 YR 6/2</td>
<td>10 YR 5/6</td>
</tr>
</tbody>
</table>

Wildlife

Species sighted:
1) 
2) 
3) 
4) 
5) 
6) 
7) 
8) 
9) 
10) 
11) 
12) 
13) 
14) 

Ground dens present:

- Bird/squirrel nests present:

AR301621
Forest Oldfield

Sampling Site: Location

Project Name:

Project Location:

Vegetation

Overstory: (>2 ft tall, >4" DBH)

<table>
<thead>
<tr>
<th>Species (* if dominant) in inches</th>
<th>Avg. DBH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Hickory</td>
<td>7&quot;</td>
</tr>
<tr>
<td>2)</td>
<td></td>
</tr>
<tr>
<td>3)</td>
<td>7&quot;</td>
</tr>
<tr>
<td>4)</td>
<td></td>
</tr>
<tr>
<td>5)</td>
<td></td>
</tr>
</tbody>
</table>

Avg. DBH

Species (* if dominant) in inches:

1) Hickory: 7"
2) Maple: 8"
3) Oak: 9"
4) Tulip: 10"
5) Blackgum: 10"

% Closed Canopy: < 5%
% hardwoods (oak, hickory, walnut, beech):
% softwood (pine, sweetgum, maple, tulip, blackgum):
% non-deciduous (pines, hollies, cedars):

Trees with cavities? ☑
Standing dead wood or declining trees? N

Understory: (>2 ft tall, 1" to 4" DBH)

% of understory non-deciduous trees: 80%

Shrubs: (>2 ft tall, <1" DBH or <1 in diam. measured ½ in above ground):

<table>
<thead>
<tr>
<th>Species (* if dominant)</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Juniper</td>
<td>6)</td>
</tr>
<tr>
<td>2) Common Cardio</td>
<td>7)</td>
</tr>
<tr>
<td>3) Blackgum</td>
<td>8)</td>
</tr>
<tr>
<td>4) Red Maple</td>
<td>9)</td>
</tr>
<tr>
<td>5)</td>
<td>10)</td>
</tr>
</tbody>
</table>

Herbaceous layer/ground cover (<2 ft tall):

Further Comments:
Herbaceous Layer (cont'd)

**Approx. % occurrence:**
- **Grasses** 60
- **Sedges** 40
- **Forbs (non-grassy herbs)**
- **Rushes**
- **Annuals**
- **Perennials**
- **Briars & small trees** 10
- **Introduced species**

**General:**
- Are plant communities or forest edge clearly distinguishable? Y N
- % of ground surface covered by vegetation >1 inch: 25
- Height of dominant herbaceous vegetation
- Frequency of management practices (external edge) Grazing Mowing
- Scarcely/moderately densely vegetated and is straight (slightly/highly irregular)
- Managed grass or legume species:

**Soils**

Ground litter: (circle one)
- Bareground, no litter
- Mostly leaf litter
- Thick leaf litter with 25% logs & sticks
- Thick leaf litter with 25-50% logs & sticks

Soil moisture: Dry Moist Saturated Inundated (covered)

Factors affecting soil moisture: recent rainfall 5 days ago
- drought conditions near waterbody

Indicators of surface water:

**Soil Texture:** Sandy Loamy Silty Clayey

![Soil layers diagram]

Wildlife

Species sighted:
1) 8) 2) 9) 3) 10) 4) 11) 5) 12) 6) 13) 7) 14)

Ground dens present:

Bird/ squirrel nests present:

AR301623
Forest Oldfield / Wetland

Sampling Site: Location

Project Name: 
Project Location: 

Project Number: 7/9/77

Vegetation

Overstory: (>2 ft tall, >4" DBH)

<table>
<thead>
<tr>
<th>Species (* if dominant)</th>
<th>in inches</th>
<th>Avg. DBH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3)</td>
<td></td>
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<td>4)</td>
<td></td>
<td></td>
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<tr>
<td>5)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Approx. % Closed Canopy:
- % hardwoods (oak, hickory, walnut, beech):
- % softwood (pine, sweetgum, maple, tulip, blackgum):
- % non-deciduous (pines, hollies, oaks):

Trees with cavities? Y N
Standing dead wood or declining trees? Y N

Understory: (>2 ft tall, 1" to 4" DBH)

<table>
<thead>
<tr>
<th>Species (* if dominant)</th>
<th>Occurrence</th>
<th>Species (* if dominant)</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td></td>
<td>6)</td>
<td></td>
</tr>
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<td>2)</td>
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<td>7)</td>
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<td>3)</td>
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<td>8)</td>
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<td></td>
<td>9)</td>
<td></td>
</tr>
<tr>
<td>5)</td>
<td></td>
<td>10)</td>
<td></td>
</tr>
</tbody>
</table>

% of understory non-deciduous trees:

Shrubs: (>2 ft tall, <1" DBH or <1 in diam. measured 1/2 in above ground):

<table>
<thead>
<tr>
<th>Species (* if dominant)</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>6)</td>
</tr>
<tr>
<td>2)</td>
<td>7)</td>
</tr>
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<td>3)</td>
<td>8)</td>
</tr>
<tr>
<td>4)</td>
<td>9)</td>
</tr>
<tr>
<td>5)</td>
<td>10)</td>
</tr>
</tbody>
</table>

Herbaceous layer/ground cover (<2 ft tall):

<table>
<thead>
<tr>
<th>Species (* if dominant)</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>6)</td>
</tr>
<tr>
<td>2)</td>
<td>7)</td>
</tr>
<tr>
<td>3)</td>
<td>8)</td>
</tr>
<tr>
<td>4)</td>
<td>9)</td>
</tr>
<tr>
<td>5)</td>
<td>10)</td>
</tr>
</tbody>
</table>

Further Comments:

AR301624
Herbaceous Layer (cont'd)

Approx. % occurrence:
- Grasses: ___
- Sedges: ___
- Forbs (non-grassy herbs): ___
- Rushes: ___
- Annuals: ___
- Perennials: ___
- Briars & small trees: ___
- Introduced species: ___

General:
- Are plant communities or forest edge clearly distinguishable? N
- % of ground surface covered by vegetation >1 inch: ___
- Height of dominant herbaceous vegetation: ___
- Frequency of management practices (external edge): Grazing ___
  Mowing ___
- Scarce/medium/densely vegetated and is straight/slightly/highly irregular: ___
- Managed grass or legume species: ___

Soils

Ground litter: (circle one)
- Bareground, no litter
- Mostly leaf litter
- Thick leaf litter with 25% logs & sticks
- Thick leaf litter with 25-50% logs & sticks

Soil moisture: Dry Moist Saturated

Factors affecting soil moisture: recent rainfall: ___
  drought conditions ___
  near waterbody ___

Indicators of surface water:

Soil Texture: Sandy Loamy Silty

Soil Color

Wildlife

Species sighted:
1) ___ 8)
2) ___ 9)
3) ___ 10)
4) ___ 11)
5) ___ 12)
6) ___ 13)
7) ___ 14)

Ground dens present: ___

Bird/ squirrel nests present: ___
WETLAND DETERMINATION FORM

TIME: ___________________ DATE: 4/13/90  COUNTY: Henrico, VA
NEAREST TOWN: Richmond, VA  WATERWAY: North Run Creek
QUAD: Yellow Town, VA  GROW Allen, VA
PROPERTY OWNER: Virginia Wood Preserving  PARTY DOING WORK: Douglas G. Moore

PHONE: (____)_______  PHONE: (____)_______

IS PROPERTY UNIFORM ___ OR SEPARATE DISCRETE ___ VEGETATIVE UNITS

VEGETATION: (IN ORDER OF DOMINANCE, DRAW LINE ABOVE NON-DOMINANT SPECIES)

% cover— indicator % cover— indicator

TREES: SPECIES:
1. Sweet Gum
2. Willow Oak
3. Swamp White Oak
4. Loblolly Pine
5. Red Maple
6.
7.
8.
9.
10.

SAPLINGS/SHRUBS:
1. None
2.
3.
4.
5.
6.
7.
8.
9.
10.

% OF DOMINANT SPECIES (OBL. - FAC) ___ OTHER INDICATORS:

HYDROPHYTIC VEGETATION: YES ___ NO ___ BASIS: business, trunks, algae

TYPICAL___ ATYPICAL___ (COMPLETE EXPLANATION)

SOIL:
SERIES: Pouncey Ocean Sand on Hydric Soils List: YES ___ NO
MOTTLED: YES ___ NO  MATRIX COLOR: 0-5% OTHER INDICATORS:

COMMENTS: _____________  BASIS: right channel 2.

HYDROLOGY:
INUNDATED: YES ___ NO  DEPTH OF WATER: 3"  SATURATED SOILS: YES ___ NO  DEPTH OF SATURATION/WATER TABLE: 3"
OTHER INDICATORS: water blushed leaves, high winter flood

WETLAND HYDROLOGY: YES ___ NO ___ BASIS: at times inundated, saturated soils, high water table

ATYPICAL SITUATION: YES ___ NO ___ NORMAL CONDITIONS: YES ___ NO
WETLAND DETERMINATION: WETLAND ___ NON-WETLAND ___

PHOTOS TAKEN: YES ___ NO ___ AUTHORITY: 10 ___ 404___ 10/404__ NO. 404__  NONE__ 
JURISDICTION: ABOVE HEADWATERS ___ ISOLATED ___ ADJACENT ___ NWP # ___

DETERMINED BY: Douglas Moore

AR301626
WETLAND DETERMINATION FORM

TIME: ____________________ DATE: 4/13/90 COUNTY: Henrico, VA

NEAREST TOWN: Ashland, VA WATERWAY: __________

PROPERTY OWNER: Virginia Week Preserving PARTY DOING WORK: Dames & Moore

PHONE: ____________________ PHONE: ____________________

IS PROPERTY UNIFORM ___ OR SEPARATE DISCRETE ___ VEGETATIVE UNITS

VEGETATION: (IN ORDER OF DOMINANCE, DRAW LINE ABOVE NON-DOMINANT SPECIES)

% cover— indicator % cover— indicator


% of dominant species (OBL. - FAC.) % of dominant species (OBL. - FAC.)

SAFETY HARNESS: YES NO _

SAPLINGS/SHRUBS: 1. Red Maple 2. Labrador pine

WOODY VINES: FAC 11. Japanese honeysuckle

% of dominant species (OBL. - FAC.) OTHER INDICATORS:

% cover— indicator

HYDROPHYTIC VEGETATION: YES _ NO _ BASIS: ___ indeterminate

TYPICAL___ ATYPICAL _ (COMPLETE EXPLANATION)

SOIL: Pouncey Twenty Farm ON HYDRIC SOILS LIST: YES _ NO

SERIES: MOTTED: YES _ NO _ MATRIX COLOR: 5Y 4/11 HYDRIC SOILS: YES _ NO

COMMENTS: Chroma (Hydric 5 2)

BASIS: Saturated soil

HYDROLOGY:

INUNDATED: YES _ NO _ DEPTH OF WATER: ___

SATURATED SOILS: YES _ NO _ DEPTH OF SATURATION/WATER TABLE: ___

OTHER INDICATORS: ponded water, algae, mud, & in water

WETLAND HYDROLOGY: YES _ NO _ BASIS:

ATYPICAL SITUATION: YES _ NO _ NORMAL CONDITIONS: YES _ NO

WETLAND DETERMINATION: WETLAND _ NON-WETLAND _

PHOTOS TAKEN: YES _ NO _ AUTHORITY: 10 _ 404 _ 10/404 _ NONE _

JURISDICTION: ABOVE HEADWATERS _ ISOLATED _ ADJACENT _ NWP _

DETERMINED BY: Douglas J. Abbott

AR301627
WETLAND DETERMINATION FORM

TIME: ___________________________ DATE: 4/13/90 COUNTY: Henrico, VA
NEAREST TOWN: Richmond, VA WATERWAY: ___________________________
QUAD: Yellow Tavern VA: Combination: C3
PROPERTY OWNER: Virginia Dare Reserving 
PARTY DOING WORK: Dumen & Moore
PHONE: (_______) _______ PHONE: (_______) _______

IS PROPERTY UNIFORM ____ OR SEPARATE DISCRETE X VEGETATIVE UNITS

VEGETATION: (IN ORDER OF DOMINANCE, DRAW LINE ABOVE NON-DOMINANT SPECIES)

% cover— indicator % cover— indicator

1. Loblolly Pine (seed) FAC FAC
2. 
3. 
4. 
5. 

SAPLINGS/SHRUBS:
1. Black Gum
2. Willow Oak
3. Loblolly Pine

% OF DOMINANT SPECIES (OBL. - FAC.) 60% OTHER INDICATORS:

HYDROPHYTIC VEGETATION: YES X NO BASIS: indicator Status indicative

TYPICAL X ATYPICAL (COMPLETE EXPLANATION)

SOIL:
SERIES: Poolesville Sandy Loam ON HYDRIC SOILS LIST: YES X NO
MOTTLED: YES X NO X MATRIX COLOR: 5YR 4/1 HYDRIC SOILS: YES X NO
COMMENTS: Strong HS Small

BASIS: chroma 2a 2

HYDROLOGY:
INUNDATED: YES X NO DEPTH OF WATER: 0"
Saturated Soils: YES X NO DEPTH OF SATURATION/WATER TABLE: 0"

OTHER INDICATORS: Water blackened leaves algae mud 

WETLAND HYDROLOGY: YES X NO BASIS:

ATYPICAL SITUATION: YES X NO NORMAL CONDITIONS: YES X NO
WETLAND DETERMINATION: WETLAND YES NON-WETLAND NO

PHOTOS TAKEN: YES X NO AUTHORITY: 10 404 10/404 10/404_ NONE
JURISDICTION: ABOVE HEADWATERS ISOLATED ADJACENT NWP #

DETERMINED BY: ___________________________

AR301628
**WETLAND DETERMINATION FORM**

**TIME:** ___:___  
**DATE:** 4/13/90  
**COUNTY:** Henrico, VA  
**NEAREST TOWN:** Richmond, VA  
**WATERWAY:**  
**HABITAT:** Yellow Tavern, VA  
**LOCATION:** 6.7  
**PROPERTY OWNER:**  
**PARTY DOING WORK:**  
**PHONE:** ___-______  
**PHONE:** ___-______

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**IS PROPERTY UNIFORM ___ OR SEPARATE DISCRETE ___ VEGETATIVE UNITS**

**VEGETATION:** (IN ORDER OF DOMINANCE, DRAW LINE ABOVE NON-DOMINANT SPECIES)

<table>
<thead>
<tr>
<th>TREES: SPECIES</th>
<th>% cover— indicator</th>
<th>GROUND COVER</th>
<th>% cover— indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>15.</td>
<td></td>
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<tr>
<td>4.</td>
<td>16.</td>
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<td>5.</td>
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<td>6.</td>
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<td>7.</td>
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<td>8.</td>
<td>19.</td>
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<td>9.</td>
<td>19.</td>
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<tr>
<td>10.</td>
<td>19.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SAPLINGS/SHRUBS: ___**

**WOODY VINES: ___**

1. Red Maple
2. Poison Ivy
3. FAC
4. Poison Ivy
5. FAC
6. FAC

**% OF DOMINANT SPECIES (OBL. - FAC. 100%): ___**

**OTHER INDICATORS:**

---

**HYDROPHYTIC VEGETATION:**  
**YES _ NO _ BASIS:**

**INDICATIONS OF WETLAND:**  
**TYPICAL _ ATYPICAL _** (COMPLETE EXPLANATION)

**SOIL:**

**SERIES:**

**MOTTLED:**  
**MATRIX COLOR:**

**HYDRIC SOILS:**  
**YES _ NO _**

**COMMENTS:** Chrome 5  2

**BASIS:** Chrome 5  2

---

**HYDROLOGY:**

**INUNDATED:**  
**SATURATED SOILS:**  
**DEPTH OF WATER:**

**OTHER INDICATORS:**

**PERIODICALLY INUNDATED**

**WETLAND HYDROLOGY:**  
**YES _ NO _ BASIS:** Receiver Run to Parham Road

**ATYPICAL SITUATION:**  
**NORMAL CONDITIONS:**  
**WETLAND DETERMINATION:**  
**WETLAND _ NON-WETLAND**

**PHOTOS TAKEN:**  
**AUTHORITY:** 10  404  10/404

**JURISDICTION:** ABOVE HEADWATERS _ ISOLATED _ ADJACENT _ NWP #

**DETERMINED BY:** Douglas Altman

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AR301629
## APPENDIX E-1

Mammal Species That May Be Found Around the Site

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bat, hoary</td>
<td><em>Lasius cinereus</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heritage G5</td>
</tr>
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<td></td>
<td></td>
<td>Heritage SU</td>
</tr>
<tr>
<td>Bat, seminole</td>
<td><em>Lasius seminolus</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Beaver</td>
<td><em>Castor canadensis</em></td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Furbearer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td>Chipmuck, Fisher's eastern</td>
<td><em>Tamias striatus</em></td>
<td>Pest/Nuisance</td>
</tr>
<tr>
<td>Cottontail, eastern</td>
<td><em>Sylvilagus floridanus</em></td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Furbearer</td>
</tr>
<tr>
<td>Deer, white-tailed</td>
<td><em>Odocoileus virginianus</em></td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td>Fox, eastern gray</td>
<td><em>Urocyon cinereogenteus</em></td>
<td>Pest/Crops</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Furbearer</td>
</tr>
<tr>
<td>Fox, red</td>
<td><em>Vulpes vulpes</em></td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td>Mink, common</td>
<td><em>Mustela vison</em></td>
<td>Furbearer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sensitive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td>Mole, eastern</td>
<td><em>Scalopus aquaticus</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Mole, small star-nosed</td>
<td><em>Condylura cristata</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Mouse, common golden</td>
<td><em>Ochrotomys nuttalli</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Mouse, common white-foot</td>
<td><em>Peromyscus leucopus</em></td>
<td>Pest/Nuisance</td>
</tr>
<tr>
<td>Mouse, eastern harvest</td>
<td><em>Reithrodontomys humulis</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Mouse, house</td>
<td><em>Mus musculus</em></td>
<td>Pest/Nuisance</td>
</tr>
<tr>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Status</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Mouse, meadow jumping</td>
<td>Zapus hudsonius</td>
<td>Pest/Crops</td>
</tr>
<tr>
<td>Mouse, northern white-foot</td>
<td>Peromyscus leucopus</td>
<td>Pest/Nuisance</td>
</tr>
<tr>
<td>Muskrat, large-toothed</td>
<td>Ondatra zibethicus</td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Furbearer</td>
</tr>
<tr>
<td>Opossum, Virginia</td>
<td>Didelphis virginiana</td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Furbearer</td>
</tr>
<tr>
<td>Otter, river</td>
<td>Lutra canadensis</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Raccoon</td>
<td>Procyon lotor</td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Furbearer</td>
</tr>
<tr>
<td>Rat, Norway</td>
<td>Rattus norvegicus</td>
<td>Pest/Nuisance</td>
</tr>
<tr>
<td>Rat, hispid cotton</td>
<td>Sigmodon hispidus</td>
<td>Pest/Crops</td>
</tr>
<tr>
<td>Rat, marsh rice</td>
<td>Oryzomys palustris</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Shrew, northern short-tailed</td>
<td>Blarina brevicauda</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Shrew, southeastern</td>
<td>Sorex longirostris</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Shrew, southern short-tailed</td>
<td>Blarina carolinensis</td>
<td>Unclassified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heritage G5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heritage S3</td>
</tr>
<tr>
<td>Skunk, striped</td>
<td>Mephitis mephitis</td>
<td>Furbearer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sensitive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td>Squirrel, black fox</td>
<td>Sciurus niger</td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pest/Crops</td>
</tr>
<tr>
<td>Squirrel, fox</td>
<td>Sciurus niger</td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pest/Crops</td>
</tr>
<tr>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Status</td>
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<tr>
<td>---------------------</td>
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</tr>
<tr>
<td>Squirrel, southern flying</td>
<td>Glaucomeys volans</td>
<td>Unclassified Pest/Nuisance</td>
</tr>
<tr>
<td>Squirrel, talkative red</td>
<td>Tamiasciurus hudsonicus</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Vole, common pine</td>
<td>Microtus pinetorum</td>
<td>Pest/Crops</td>
</tr>
<tr>
<td>Vole, meadow</td>
<td>Microtus pennsylvanicus</td>
<td>Pest/Crops</td>
</tr>
<tr>
<td>Vole, pine</td>
<td>Microtus pinetorum</td>
<td>Nongame-Protected Pest/Nuisance</td>
</tr>
<tr>
<td>Weasel, long-tailed</td>
<td>Mustela frenata</td>
<td>Furbearer Commercial</td>
</tr>
<tr>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Status</td>
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<tr>
<td>--------------------------</td>
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<td>--------------------------------------</td>
</tr>
<tr>
<td>Blackbird, red-winged</td>
<td>Agelaius phoeniceus</td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Bluebird, eastern</td>
<td>Sialia sialis</td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Bobwhite, northern</td>
<td>Colinus virginianus</td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td>Bufflehead</td>
<td>Bucephala albeola</td>
<td></td>
</tr>
<tr>
<td>Bunting, indigo</td>
<td>Passerina cyanea</td>
<td></td>
</tr>
<tr>
<td>Bunting, snow</td>
<td>Plectrophenax nivalis</td>
<td></td>
</tr>
<tr>
<td>Canvasback</td>
<td>Aythya valisineria</td>
<td></td>
</tr>
<tr>
<td>Cardinal, northern</td>
<td>Cardinalis cardinalis</td>
<td></td>
</tr>
<tr>
<td>Catbird, gray</td>
<td>Dumetella carolinensis</td>
<td></td>
</tr>
<tr>
<td>Chat, yellow breasted</td>
<td>Icteria virens</td>
<td></td>
</tr>
<tr>
<td>Chickadee, Carolina</td>
<td>Parus carolinensis</td>
<td></td>
</tr>
<tr>
<td>Chuck-will's-widow</td>
<td>Caprimullogus carolinensis</td>
<td></td>
</tr>
<tr>
<td>Cormorant, double-crested</td>
<td>Phalacrocorax auritus</td>
<td></td>
</tr>
<tr>
<td>Cowbird, brown-headed</td>
<td>Molothrus ater</td>
<td></td>
</tr>
<tr>
<td>Crow, American</td>
<td>Corvus brachyrhynchos</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
- Federal Migratory
- Nongame-Protected
- Game (Consumptive Recreational)
- Heritage 51
- Pest/Crops
### APPENDIX E-1 (cont'd)

**Bird Species That May Be Found Around the Site (cont'd)**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuckoo, yellow-billed</td>
<td>Coccyzus americanus</td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Dove, mourning</td>
<td>Zenaida macroura</td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td>Dove, rock</td>
<td>Columba livia</td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td>Duck, American black</td>
<td>Anas rubripes</td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td>Duck, ring-necked</td>
<td>Aythya collaris</td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td>Duck, wood</td>
<td>Aix sponsa</td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td>Eagle, bald</td>
<td>Haliaeetus leucocephalis</td>
<td>Federal Endangered</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plan approved by Director</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Egret, cattle</td>
<td>Bubulcus ibis</td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Egret, great</td>
<td>Casmerodius albus</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td>Finch, house</td>
<td>Carpodacus mexicanus</td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Finch, purple</td>
<td>Carpodacus purpureus</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td>Flicker, northern</td>
<td>Colaptes auratus</td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Flycatcher, Acadian</td>
<td>Empidonax virescens</td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
</tbody>
</table>
## APPENDIX E-1 (cont'd)

**Bird Species That May Be Found Around the Site (cont'd)**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flycatcher, great crested</td>
<td><em>Myiarchus crinitus</em></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Gadwall</td>
<td><em>Anas strepera</em></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td>Gnatchatcher, blue-gray</td>
<td><em>Poloptila caerulea</em></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Goldfinch, American</td>
<td><em>Carduelis tristis</em></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-game Protected</td>
</tr>
<tr>
<td>Goose, greater snow</td>
<td><em>Chen caerulescens</em></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td>Goose, lesser snow</td>
<td><em>Chen caerulescens</em></td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td>Grackle, common</td>
<td><em>Quiscalus quiscula</em></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pest/Crops</td>
</tr>
<tr>
<td>Grosbeak, black-headed</td>
<td><em>Pheucticus melanocephalus</em></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pest/Crops</td>
</tr>
<tr>
<td>Grosbeak, blue</td>
<td><em>Guiraca caerulea</em></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Grosbeak, evening</td>
<td><em>Coccothaustes vespertinus</em></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Hawk, Cooper's</td>
<td><em>Accipiter cooperi</em></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sensitive</td>
</tr>
<tr>
<td>Hawk, broad-winged</td>
<td><em>Buteo platypterus</em></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Hawk, red-shouldered</td>
<td><em>Buteo lineatus</em></td>
<td>Federal Migratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sensitive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
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<tr>
<td>Hawk, red-tailed</td>
<td><em>Buteo jamaicensis</em></td>
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### APPENDIX E-1 (cont'd)

**Bird Species That May Be Found Around the Site (cont'd)**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
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<tbody>
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<td>Hawk, sharp-shinned</td>
<td>Accipiter striatus</td>
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<td>Heron, great blue</td>
<td>Ardea herodias</td>
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<td>Heron, little blue</td>
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<td>Hummingbird, ruby-throat</td>
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<td>Jay, blue</td>
<td>Cyanocitta cristata</td>
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<td>Junco, dark-eyed</td>
<td>Junco hyemalis</td>
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<td>Kestrel, American</td>
<td>Falco sparverius</td>
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<td>Killdeer</td>
<td>Charadrius vociferus</td>
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<td>Kingbird, eastern</td>
<td>Tyrannus tyrannus</td>
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<td>Meadowlark, eastern</td>
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<td>Merganser, hooded</td>
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<td>Mimus polyglottos</td>
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<td>Owl, great horned</td>
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<td>Pewee, eastern wood</td>
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<td>Sayornis phoebe</td>
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<td>Pintail, northern</td>
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<td>Rail, king</td>
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<td>Corvus corax</td>
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<td>Redhead</td>
<td>Aythya americana</td>
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<td>Turdus migratorius</td>
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<td>Sandpiper, spotted</td>
<td>Actitis macularia</td>
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<td>Scaup, lesser</td>
<td>Aythya affinis</td>
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<td>Screech-owl, eastern</td>
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<td>Shrike, loggerhead</td>
<td>Lanius ludovicianus</td>
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<td>Gallinago gallinago</td>
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<td>Sparrow, chipping</td>
<td>Spizella passerina</td>
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<td>Sparrow, field</td>
<td>Spizella pusilla</td>
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<td>Sparrow, house</td>
<td>Passer domesticus</td>
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<td>Sparrow, song</td>
<td>Melospiza melodia</td>
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<td>Starling, European</td>
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### Bird Species That May Be Found Around the Site (cont'd)

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<tr>
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<tr>
<td>Swallow, bank</td>
<td>Riparia riparia</td>
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<td></td>
<td>Heritage G5</td>
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<td>Heritage S3</td>
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<tr>
<td>Swallow, barn</td>
<td>Hirundo rustica</td>
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<td>Swallow, tree</td>
<td>Tachycineta bicolor</td>
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<td>Tanager, scarlet</td>
<td>Piranga olivacea</td>
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<td>Teal, blue-winged</td>
<td>Anas discors</td>
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<td>Thrush, wood</td>
<td>Hylocichla mustelina</td>
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<td>Titmouse, tufted</td>
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<td>Towhee, rufous-sided</td>
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<td>Turkey, wild</td>
<td>Meleagris gallopavo</td>
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<td>Vireo solitarius</td>
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<td>Vireo, white-eyed</td>
<td>Vireo griseus</td>
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<td>Vulture, black</td>
<td>Coragyps atratus</td>
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<td>Vulture, turkey</td>
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### APPENDIX E-1 (cont'd)

**Bird Species That May Be Found Around the Site (cont'd)**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
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<tr>
<td>Warbler, Kentucky</td>
<td><em>Oporornis formosus</em></td>
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<td>Warbler, black-and-white</td>
<td><em>Mniotilta varia</em></td>
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<td>Warbler, black-throated</td>
<td><em>Dendroica caerulescens</em></td>
<td>Federal Migratory</td>
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<td>Nongame-Protected</td>
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<tr>
<td>Warbler, black-throated</td>
<td><em>Dendroica virens</em></td>
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<td>Warbler, blackburnian</td>
<td><em>Dendroica fusca</em></td>
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<td>Warbler, cerulean</td>
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<td>Warbler, magnolia</td>
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<td>Warbler, northern parula</td>
<td><em>Parula americana</em></td>
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<td>Warbler, palm</td>
<td><em>Dendroica palmarum</em></td>
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<td>Warbler, pine</td>
<td><em>Dendroica pinus</em></td>
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<td>Warbler, prairie</td>
<td><em>Dendroica discolor</em></td>
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<td>Warbler, prothonotary</td>
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## Bird Species That May Be Found Around the Site (cont'd)

<table>
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<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
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<tbody>
<tr>
<td>Warbler, worm-eating</td>
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<td>Warbler, yellow</td>
<td><em>Dendroica petechia</em></td>
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<td>Warbler, yellow-rumped</td>
<td><em>Dendroica coronata</em></td>
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<td>Waxwing, cedar</td>
<td><em>Bombycilla cedrorum</em></td>
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<td>Whip-poor-will</td>
<td><em>Caprimulgus vociferus</em></td>
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<td>Wigeon, American</td>
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<td><em>Scolopax minor</em></td>
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<td>Woodpecker, downy</td>
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<td>Woodpecker, hairy</td>
<td><em>Picoides villosus</em></td>
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<td>Woodpecker, pileated</td>
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<td>Woodpecker, red-headed</td>
<td><em>Melanerpes erythrocephalus</em></td>
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<td>Heritage G5</td>
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<td>Heritage S3</td>
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<td>Wren, Carolina</td>
<td><em>Thryothorus ludovicianus</em></td>
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<td><em>Troglodytes aedon</em></td>
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# APPENDIX E-1 (cont’d)

Reptile Species That May Be Found Around the Site

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<thead>
<tr>
<th>Common Name</th>
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<td>Copperhead, northern</td>
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<td>Kingsnake, eastern</td>
<td>Lampropeltis getulus</td>
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<td>Lizard, eastern slender</td>
<td>Ophisaurus attenuatus</td>
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<tr>
<td>Racer, northern black</td>
<td>Coluber constrictor</td>
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<td>Skink, broadhead</td>
<td>Eumeces laticeps</td>
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<tr>
<td>Skink, five-lined</td>
<td>Eumeces fasciatus</td>
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<tr>
<td>Snake, black rat</td>
<td>Elaphe obsoleta</td>
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<tr>
<td>Snake, corn</td>
<td>Elaphe guttata</td>
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<td>Snake, eastern garter</td>
<td>Thamnophis sirtalis</td>
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<tr>
<td>Snake, eastern hognose</td>
<td>Heterodon platyrhinos</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Snake, eastern ribbon</td>
<td>Thamnophis sauritus</td>
<td>Unclassified</td>
</tr>
<tr>
<td>Snake, eastern worm</td>
<td>Carphophis amoenus</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Snake, northern brown</td>
<td>Storeria dekayi</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Snake, northern water</td>
<td>Nerodia sipedon</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Snake, queen</td>
<td>Regina septemvittata</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Snake, rough green</td>
<td>Opheodrys aestivus</td>
<td>Unclassified</td>
</tr>
<tr>
<td>Snake, scarlet</td>
<td>Clemmys coccinea</td>
<td>Unclassified</td>
</tr>
<tr>
<td>Stinkpot</td>
<td>Sternotherus odoratus</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Turtle, common snapping</td>
<td>Chelydra serpentina</td>
<td>Game (Consumptive Recreational)</td>
</tr>
<tr>
<td>Turtle, eastern box</td>
<td>Terrapene carolina</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Turtle, eastern mud</td>
<td>Kinosternon subrubrum</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Turtle, eastern painted</td>
<td>Chrysemys picta</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Turtle, spotted</td>
<td>Clemmys guttata</td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Status</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Bullfrog</td>
<td><em>Rana catesbeiana</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Frog, Brimley’s chorus</td>
<td><em>Pseudacris brimleyi</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Frog, green</td>
<td><em>Rana clamitans</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Frog, northern cricket</td>
<td><em>Acris crepitans</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Frog, pickerel</td>
<td><em>Rana palustris</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Frog, southern leopard</td>
<td><em>Rana sphenoecephala</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Frog, upland chorus</td>
<td><em>Pseudacris triseriata</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Newt, red-spotted</td>
<td><em>Notophthalmus viridescens</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Peeper, northern spring</td>
<td><em>Hyla crucifer</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Salamander, Mabee’s</td>
<td><em>Ambystoma mabeei</em></td>
<td>Heritage G4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heritage S2</td>
</tr>
<tr>
<td>Salamander, eastern mud</td>
<td><em>Pseudotriton montanus</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Salamander, eastern tiger</td>
<td><em>Ambystoma tigrinum</em></td>
<td>State Endangered</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heritage G5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heritage S1</td>
</tr>
<tr>
<td>Salamander, four-toed</td>
<td><em>Hemidactylum scutatum</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Salamander, marbled</td>
<td><em>Ambystoma opacum</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Salamander, northern dusty</td>
<td><em>Desmognathus fuscus</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Salamander, northern two-lined</td>
<td><em>Eurycea bislineata</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Salamander, redback</td>
<td><em>Plethodon cinereus</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Salamander, slimy</td>
<td><em>Plethodon glutinosus</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Salamander, spotted</td>
<td><em>Ambystoma maculatum</em></td>
<td>Nongame-Protected</td>
</tr>
</tbody>
</table>
### Amphibians That May Be Found Around the Site

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spadefoot, eastern</td>
<td><em>Scaphiopus holbrooki</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Toad, American</td>
<td><em>Bufo americanus</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Toad, Fowler's</td>
<td><em>Bufo woodhousii</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Toad, eastern narrow-mouth</td>
<td><em>Gastrophryne carolinensis</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Toad, oak</td>
<td><em>Bufo quercicus</em></td>
<td>Heritage G5, Heritage S1</td>
</tr>
<tr>
<td>Treefrog, Cope's gray</td>
<td><em>Hyla chrysoscelis</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Treefrog, barking</td>
<td><em>Hyla gratiosa</em></td>
<td>Heritage G5, Heritage S1</td>
</tr>
<tr>
<td>Treefrog, gray</td>
<td><em>Hyla versicolor</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Treefrog, green</td>
<td><em>Hyla cinerea</em></td>
<td>Nongame-Protected</td>
</tr>
<tr>
<td>Treefrog, pine woods</td>
<td><em>Hyla femoralis</em></td>
<td>Nongame-Protected</td>
</tr>
</tbody>
</table>
## APPENDIX E-1 (cont'd)
### Fish Species That May Be Found Around the Site

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alewife</td>
<td><em>Alosa pseudoharengus</em></td>
<td>Sport Fish</td>
</tr>
<tr>
<td>Bass, largemouth</td>
<td><em>Micropterus salmoides</em></td>
<td>Sport Fish Sensitive</td>
</tr>
<tr>
<td>Bass, smallmouth</td>
<td><em>Micropterus dolomieui</em></td>
<td>Sport Fish</td>
</tr>
<tr>
<td>Bass, striped</td>
<td><em>Morone saxatilis</em></td>
<td>Sport Fish</td>
</tr>
<tr>
<td>Bullhead, brown</td>
<td><em>Ictalurus nebulosus</em></td>
<td>Sport Fish</td>
</tr>
<tr>
<td>Bullhead, yellow</td>
<td><em>Ictalurus natalis</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Carp, common</td>
<td><em>Cyprinus carpio</em></td>
<td>Biological Indicator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial Pest/Nuisance</td>
</tr>
<tr>
<td>Carpsucker, river</td>
<td><em>Carpiodes cyprinus</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Catfish, channel</td>
<td><em>Ictalurus punctatus</em></td>
<td>Sport Fish</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td>Chub, bluehead</td>
<td><em>Nocomis leptocephalus</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Chub, creek</td>
<td><em>Semotilus atromaculatus</em></td>
<td>Biological Indicator</td>
</tr>
<tr>
<td>Chub, river</td>
<td><em>Nocomis micropogon</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Chubsucker, creek</td>
<td><em>Erimyzon oblongus</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Crappie, black</td>
<td><em>Pomoxis nigromaculatus</em></td>
<td>Sport Fish</td>
</tr>
<tr>
<td>Dace, blacknose</td>
<td><em>Rhinichthys atratulus</em></td>
<td>Biological Indicator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td>Dace, mountain redbelly</td>
<td><em>Phoxinus oreas</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Darter, glassy</td>
<td><em>Etheostoma vitreum</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Darter, johnny</td>
<td><em>Etheostoma nigrum</em></td>
<td>Unclassified</td>
</tr>
</tbody>
</table>
### APPENDIX E-1 (cont'd)

#### Fish Species That May Be Found Around the Site (cont'd)

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Darter, swamp</td>
<td><em>Etheostoma fusiforme</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Fallfish</td>
<td><em>Semotilus corporalis</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Gar, longnose</td>
<td><em>Lepisosteus osseus</em></td>
<td>Pest/Nuisance</td>
</tr>
<tr>
<td>Herring, blueback</td>
<td><em>Alosa aestivalis</em></td>
<td>Commercial</td>
</tr>
<tr>
<td>Hogsucker, northern</td>
<td><em>Hypentelium nigricans</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Jumprock, black</td>
<td><em>Moxostoma cervinum</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Madtom, margined</td>
<td><em>Noturus insignis</em></td>
<td>Commercial</td>
</tr>
<tr>
<td>Madtom, tadpole</td>
<td><em>Noturus gyrinus</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Minnow, bluntnose</td>
<td><em>Pimephales notatus</em></td>
<td>EPA Indicator, Biological Indicator</td>
</tr>
<tr>
<td>Mosquitofish</td>
<td><em>Gambusia affinis</em></td>
<td>Commercial, Sport Fish</td>
</tr>
<tr>
<td>Perch, pirate</td>
<td><em>Aphredoderus sayanus</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Perch, white</td>
<td><em>Morone americana</em></td>
<td>Commercial, Sport Fish</td>
</tr>
<tr>
<td>Perch, yellow</td>
<td><em>Perca flavescens</em></td>
<td>Commercial, Sport Fish</td>
</tr>
<tr>
<td>Pickerel, chain</td>
<td><em>Esox niger</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Pumpkinseed</td>
<td><em>Lepomis gibbosus</em></td>
<td>Sport Fish</td>
</tr>
<tr>
<td>Shad, American</td>
<td><em>Alosa sapidissima</em></td>
<td>Sport Fish, Commercial</td>
</tr>
<tr>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Status</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Shad, gizzard</td>
<td>Dorosoma cepedianum</td>
<td>Unclassified</td>
</tr>
<tr>
<td>Shiner, comely</td>
<td>Notropis amoenus</td>
<td>Unclassified</td>
</tr>
<tr>
<td>Shiner, common</td>
<td>Notropis cornutus</td>
<td>Biological Indicator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td>Shiner, golden</td>
<td>Notemigonus crysoleucas</td>
<td>Biological Indicator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
</tr>
<tr>
<td>Shiner, rosefin</td>
<td>Notropis ardens</td>
<td>Unclassified</td>
</tr>
<tr>
<td>Shiner, rosyface</td>
<td>Notropis rubellus</td>
<td>Unclassified</td>
</tr>
<tr>
<td>Shiner, satinfin</td>
<td>Notropis analostomus</td>
<td>Unclassified</td>
</tr>
<tr>
<td>Shiner, spottail</td>
<td>Notropis hudsonius</td>
<td>Commercial</td>
</tr>
<tr>
<td>Shiner, swallowtail</td>
<td>Notropis procne</td>
<td>Unclassified</td>
</tr>
<tr>
<td>Sunfish, bluespotted</td>
<td>Enneacanthus gloriosus</td>
<td>Unclassified</td>
</tr>
<tr>
<td>Sunfish, mud</td>
<td>Acantharchus pomotis</td>
<td>Unclassified</td>
</tr>
<tr>
<td>Sunfish, redbreast</td>
<td>Lepomis auritus</td>
<td>Sport Fish</td>
</tr>
<tr>
<td>Warmouth</td>
<td>Lepomis gulosus</td>
<td>Sport Fish</td>
</tr>
</tbody>
</table>
## Invertebrate Species That May Be Found Around the Site

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mussel, alewife floater</td>
<td><em>Anodonta implicata</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Mussel, eastern elliptio</td>
<td><em>Elliptio complanata</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Mussel, giant floater</td>
<td><em>Anodonta grandis</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Mussel, notched rainbow</td>
<td><em>Villosa constricta</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Mussel, tiny pigtoe</td>
<td><em>Lexingtonia subplana</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Mussel, yellow lampshell</td>
<td><em>Lampsilis cariosa</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Crayfish</td>
<td><em>Cambarus robustus</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Crayfish</td>
<td><em>Cambarus longulus</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Crayfish</td>
<td><em>Cambarus acuminatus</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Crayfish</td>
<td><em>Cambarus diogenes</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Crayfish</td>
<td><em>Orconectes immunis</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Crayfish</td>
<td><em>Orconectes limosus</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Crayfish</td>
<td><em>Falicambarus uhleri</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Crayfish</td>
<td><em>Cambarus bartonii</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Armyworm</td>
<td><em>Pseudaletia unipuncta</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Deerfly</td>
<td><em>Chrysops vittatus</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Moth, gypsy</td>
<td><em>Lymnantria dispar</em></td>
<td>Pest/Nuisance Pest/Livestock</td>
</tr>
<tr>
<td>Tick, American dog</td>
<td><em>Dermacentor variabilis</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Tick, brown dog</td>
<td><em>Rhipicephalus sanguineus</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Tick, lone star</td>
<td><em>Amblyomma americanum</em></td>
<td>Pest/Livestock</td>
</tr>
<tr>
<td>Tick, rabbit</td>
<td><em>Haemaphysalis leporispalustris</em></td>
<td>Unclassified</td>
</tr>
<tr>
<td>Tick, winter</td>
<td><em>Dermacentor albipictus</em></td>
<td>Unclassified</td>
</tr>
</tbody>
</table>
APPENDIX E-1 (cont’d)

Plant Indicator Status Categories*

<table>
<thead>
<tr>
<th>Indicator Category</th>
<th>Indicator Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBLIGATE WETLAND PLANTS</td>
<td>OBL</td>
<td>Plants that occur almost always (estimated probability &gt;99%) in wetlands under normal conditions, but which may also occur rarely (estimated probability &lt;1%) in nonwetlands. Examples: <em>Spartina alterniflora</em>, <em>Taxodium distichum</em>.</td>
</tr>
<tr>
<td>FACULTATIVE WETLAND PLANTS</td>
<td>FACW</td>
<td>Plants that occur usually (estimated probability &gt;67% to 99%) in wetlands under normal conditions, also occur (estimated probability 1% to 33%) in nonwetlands. Examples: <em>Fraxinus pennsylvanica</em>, <em>Juncus effusus</em>.</td>
</tr>
<tr>
<td>FACULTATIVE PLANTS</td>
<td>FAC</td>
<td>Plants that occur with a similar likelihood (estimated probability 33% to 67%) of occurring in wetlands and nonwetlands. Examples: <em>Toxicodendron radicans</em>, <em>Smilax rotundifolia</em>.</td>
</tr>
<tr>
<td>FACULTATIVE UPLAND PLANTS</td>
<td>FACU</td>
<td>Plants that occur sometimes (estimated probability 1% to &lt;33%) in wetlands, but occur more often (estimated probability &gt;67% to 99%) in nonwetlands. Examples: <em>Quercus rubra</em>, <em>Potentilla arguta</em>.</td>
</tr>
<tr>
<td>OBLIGATE UPLAND PLANTS</td>
<td>UPL</td>
<td>Plants that occur rarely (estimated probability &lt;1%) in wetlands, but occur almost always (estimated probability &gt;99%) in nonwetlands under normal conditions. Examples: <em>Pinus echinata</em>, <em>Bromus mollis</em>.</td>
</tr>
</tbody>
</table>

*Categories were originally developed and defined by the USFWS National Wetlands Inventory and subsequently modified by the National Plant List Panel.*
APPENDIX E-1 (cont'd)

Status Definitions

Biological Indicator: A species whose occurrence indicates environmental quality (e.g., presence indicates low levels of dissolved oxygen).

Commercial: A species harvested and sold for direct consumption by humans or harvested for products not directly consumed by humans. Such items include, but are not limited to, products from seaweed, fish meal, fish oil, fish solubles, pearl essence, animal skins and furs, and shells. This also includes a species harvested and sold for bait.

EPA Indicator: Any species officially classified by EPA as an "indicator". Contact the nearest EPA Regional office for the current information.

Federal Endangered: A species officially classified by the Federal Government as being in danger of extinction throughout all or a significant portion of its range.

Federal Migratory: Any bird, whatever its origin and whether or not raised in captivity, which belongs to a species listed on the Federal Migratory Bird List, or which is a mutation of a hybrid of any such species, including any part, nest, or egg of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird or any part, nest, or egg thereof.

Furbearer: A species harvested for fur value and so designated by State or Federal law.

Game (Consumptive recreational): A species harvested recreationally for flesh or trophy value and so designated by State or Federal law. (This section does not include Game Fish, see Sport Fish.)

Natural Heritage Element Ranks: This is a ranking process used nationally by the Natural Heritage Program. These ranks are determined from data supplied by the Natural Heritage Program and reflect their data for Virginia. Included are:

- Heritage G2 - Imperiled globally because of rarity
- Heritage G4 - Apparently secure globally
- Heritage G5 - Demonstrably secure globally
- Heritage S1 - Critically imperiled in state
- Heritage S2 - Imperiled in state
- Heritage S3 - Rare/uncommon in state
- Heritage SU - State status uncertain

Nongame Protected: A species officially classified as "nongame" by Federal or State law and protected as such.
APPENDIX E-1 (cont'd)

Status Definitions (cont'd)

Pest/Nuisance: A species that is considered a pest or nuisance to humans but does not cause livestock or crop losses (e.g., termites).

Pest/Livestock: A species that causes livestock losses (e.g., coyote).

Pest/Crops: A species that causes agricultural or crop losses (e.g., boll weevil).

Sensitive: A species especially susceptible to environmental perturbation (e.g., the effect of pesticides on raptor breeding success).

State Endangered: A species officially classified as endangered by the State Government.

Sport Fish: Any fish species sought recreationally for flesh or trophy value and so designated by State law.

Unclassified: This species has no Federal or State status.

Source: Department of Game and Inland Fisheries, BOVA (Biota of Virginia) search conducted December 4, 1989 for species in and around the VWP site.
APPENDIX F
Boring/Drilling Logs
### BORING SO-1

**Surface Elevation:** 0  
**Location:** VWP, Richmond, Va.

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Sample No.</th>
<th>Blow Count</th>
<th>Symbols</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>26</td>
<td></td>
<td>ML</td>
<td>DARK BROWN SANDY Silt with Trace Clay and gravel (fill) GRAY AND GOLD SILTY CLAYEY SAND</td>
</tr>
<tr>
<td>1</td>
<td>18</td>
<td></td>
<td>ML/CL</td>
<td>GOLD, SILTY CLAY WITH TRACE SAND, LOW PLASTICITY, DAMP, TIGHT</td>
</tr>
<tr>
<td>2</td>
<td>51</td>
<td></td>
<td>SM/SC</td>
<td>GRAY MICACEOUS SAPROLITE, LARGE GRAINED, TIGHT, DAMP</td>
</tr>
</tbody>
</table>

BORING COMPLETED AT A DEPTH OF 6.0 FEET ON 5-24-89

---

**LOG OF BORING**
BORING SO-2

Surface Elevation: 0
Location: VWP, Richmond, Va.

Symbols | Description
---|---
F | SILTY SANDY GRAVEL (FILL)
ML | GRAY SILTY FINE SAND, TRACE GRAVEL AND CLAY
CL | GRAY AND GOLD CLAY WITH TRACE SILT AND FINE SAND, LOW TO MEDIUM PLASTICITY, DAMP (HARD PAN)

BORING COMPLETED AT A DEPTH OF 4.0 FEET ON 5-25-89
BORING SO-3

Surface Elevation: 0
Location: VWP, Richmond, Va.

Symbols | Description
---|---
ML | BROWNISH YELLOW SANDY Silt, MOIST
CL | YELLOWISH RED AND GRAY FRIABLE SANDY CLAY

BORING COMPLETED AT A DEPTH OF 6.0 FEET ON 5-25-89
**BORING SO-4**

Surface Elevation: 0  
Location: VWP, Richmond, Va.

<table>
<thead>
<tr>
<th>Depth (Meters)</th>
<th>Depth (Feet)</th>
<th>Sample No.</th>
<th>Blow Count</th>
<th>Symbols</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>9</td>
<td>□</td>
<td>B</td>
<td>BROWNISH YELLOW SANDY CLAYEY SILT, MOIST</td>
</tr>
<tr>
<td>1</td>
<td>3.3</td>
<td>24</td>
<td>□</td>
<td>M</td>
<td>GRAY SANDY CLAY, DRY, TIGHT, INCREASING HARDNESS WITH DEPTH</td>
</tr>
<tr>
<td>2</td>
<td>6.6</td>
<td>75/11”</td>
<td>□</td>
<td>L</td>
<td>BORING COMPLETED AT A DEPTH OF 6.0 FEET ON 5-25-89</td>
</tr>
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Boring completed at a depth of 6.0 feet on 5-25-89.
### BORING SO-5

**Surface Elevation:** 0  
**Location:** VWP, Richmond, Va.

<table>
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<tr>
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<th>Depth (Feet)</th>
<th>Sample No.</th>
<th>Blow Count</th>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
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<td>F</td>
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</tr>
<tr>
<td>1</td>
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<td>70/10&quot;</td>
<td></td>
<td>F</td>
<td>GOLDEN BROWN AND GRAY SILTY SANDY CLAY, DAMP, SLIGHT TO LOW PLASTICITY, ODOR PRESENT</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>9</td>
<td></td>
<td>ML CL</td>
<td>GOLD, GRAY AND RED SILTY CLAY WITH TRACE OF FINE SAND, TIGHT, LOW PLASTICITY, ODOR (HARD PAN AT 8 FEET)</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>20</td>
<td></td>
<td>CL</td>
<td></td>
</tr>
</tbody>
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BORING COMPLETED AT A DEPTH OF 10.0 FEET ON 5-24-89
**BORING SO-6**

Surface Elevation: 0  
Location: VWP, Richmond, Va.

<table>
<thead>
<tr>
<th>Depth (meters)</th>
<th>Depth (feet)</th>
<th>Sample No.</th>
<th>Symbol</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>14</td>
<td>Fill</td>
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</tr>
<tr>
<td>1</td>
<td>3.3</td>
<td>3</td>
<td>ML</td>
<td>DARK BROWN SILTY CLAY WITH TRACE SAND AND GRAVEL, SLIGHTLY PLASTIC, DRY</td>
</tr>
<tr>
<td>2</td>
<td>6.6</td>
<td>11</td>
<td>ML/CL</td>
<td>GRAY AND GOLD SILTY SANDY CLAY, LOW PLASTICITY, DAMP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CL</td>
<td>GRAY AND GOLD CLAY WITH TRACE SILT AND SAND, LOW TO MEDIUM PLASTICITY, DAMP (HARD PAN)</td>
</tr>
</tbody>
</table>

BORING COMPLETED AT A DEPTH OF 6.0 FEET ON 5-25-89
BORING SO-7
Surface Elevation: 0
Location: VWP, Richmond, Va.

<table>
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<tr>
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<th>Sample No.</th>
<th>Blow Count Samples</th>
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<td>2</td>
<td>ML</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>ML/CL</td>
</tr>
<tr>
<td>3</td>
<td>23</td>
<td>CL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ML/CL</td>
<td>SILTY SAND GRAVEL (FILL)</td>
</tr>
<tr>
<td>ML</td>
<td>DARK BROWN SANDY CLAY WITH SOME SILT AND SMALL GRAVEL, LOW TO MEDIUM PLASTICITY, WET</td>
</tr>
<tr>
<td>ML/CL</td>
<td>DARK BROWN CLAYEY SANDY SILT, ORGANIC MATERIAL, WET</td>
</tr>
<tr>
<td>CL</td>
<td>DARK BROWN SILTY CLAY, MEDIUM PLASTIC, WET</td>
</tr>
<tr>
<td>SM/SC</td>
<td>DARK BROWN CLAY WITH TRACE SILT, WET, MEDIUM PLASTIC</td>
</tr>
<tr>
<td></td>
<td>TAN SAPROLITE WITH LARGE QUARTZ GRAINS AND SOME CLAY, TIGHT, DAMP</td>
</tr>
</tbody>
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BORING COMPLETED AT A DEPTH OF 10.8 FEET ON 5-25-89
BORING SO-8
Surface Elevation: 0
Location: VWK, Richmond, Va.

<table>
<thead>
<tr>
<th>Depth (Meters)</th>
<th>Depth (Feet)</th>
<th>Sample No.</th>
<th>Blow Count</th>
<th>Symbols</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>32</td>
<td></td>
<td>ML</td>
<td>FRIABLE BROWNISH YELLOW SANDY CLAY (HARD PAN)</td>
</tr>
<tr>
<td>1</td>
<td>3.3</td>
<td></td>
<td>7</td>
<td>ML</td>
<td>BROWN SANDY CLAY, LOW PLASTICITY, WET</td>
</tr>
<tr>
<td>2</td>
<td>6.6</td>
<td></td>
<td>7</td>
<td>ML CL</td>
<td>YELLOWISH RED SANDY Silt WITH SOME GRAVEL, MOIST (FILL)</td>
</tr>
<tr>
<td>3</td>
<td>9.9</td>
<td></td>
<td>32</td>
<td>CL</td>
<td></td>
</tr>
</tbody>
</table>

BORING COMPLETED AT A DEPTH OF 6.0 FEET ON 5-25-89
### BORING SO-14

**Surface Elevation:** 0  
**Location:** VWP, Richmond, Va.

<table>
<thead>
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<th>Depth (Meters)</th>
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<th>Sample No.</th>
<th>Blow Count</th>
<th>Symbols</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>8</td>
<td></td>
<td>ML</td>
<td>SILTY SANDY GRAVEL (FILL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ML</td>
<td>GOLDEN BROWN SILTY CLAY WITH TRACE SAND, SLIGHT PLASTICITY, DAMP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CL</td>
<td>GOLD AND GRAY CLAY WITH TRACE SAND AND SILT, LOW PLASTICITY, DAMP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CL</td>
<td>GOLD AND GRAY CLAY WITH TRACE SILT AND SAND, LOW TO MEDIUM PLASTICITY, MOIST</td>
</tr>
</tbody>
</table>

BORING COMPLETED AT A DEPTH OF 6.0 FEET ON 5-25-89
**BORING SO-13**

Surface Elevation: 0  
Location: VWP, Richmond, Va.

<table>
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<th>Sample No.</th>
<th>Symbols</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>1</td>
<td>ML</td>
<td>SILTY SANDY GRAVEL (FILL)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>10</td>
<td>CL</td>
<td>GOLD AND GRAY SILTY SANDY CLAY, LOW PLASTICITY, MOIST</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>24</td>
<td>SC</td>
<td>GRAY AND GOLD CLAYEY SAND WITH TRACE OF SILT, WET</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>CL</td>
<td>GRAY AND GOLD CLAY WITH TRACES OF FINE SAND AND SILT, STIFF, LOW TO MEDIUM PLASTICITY, DAMP (HARD PAN)</td>
</tr>
</tbody>
</table>

BORING COMPLETED AT A DEPTH OF 6.0 FEET ON 5-25-89
# BORING SO-15

**Surface Elevation:** 0  
**Location:** VWP, Richmond, Va.

<table>
<thead>
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<th>Depth (Meters)</th>
<th>Sample No.</th>
<th>Blow Count</th>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>60</td>
<td></td>
<td>Fill</td>
<td>GRAVEL AND SILTY CLAYEY SAND, ODOR PRESENT (FILL)</td>
</tr>
<tr>
<td>1</td>
<td>14</td>
<td></td>
<td>ML</td>
<td>DARK BROWN CLAYEY SILT WITH TRACE SAND, ODOR PRESENT</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td></td>
<td>ML</td>
<td>GOLD AND GRAY SILTY CLAY, LOW PLASTICITY</td>
</tr>
<tr>
<td>2</td>
<td>26</td>
<td></td>
<td>CL</td>
<td>CLAY CONTENT INCREASING WITH DEPTH</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>CL</td>
<td>GOLD AND GRAY CLAY WITH TRACE SILT AND SAND, MEDIUM PLASTICITY, DAMP, TIGHT</td>
</tr>
</tbody>
</table>

BORING COMPLETED AT A DEPTH OF 8.0 FEET ON 5-26-89

---

**PLATE LOG OF BORING**
BORING SO-16

Surface Elevation: 0
Location: VWP, Richmond, Va.

BORING COMPLETED AT A DEPTH OF 6.0 FEET ON 5-25-89

SYMBOLS

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Blow Count</th>
<th>Sample Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td></td>
<td>BROWN AND YELLOW SANDY SILT, MOIST, MEDIUM TO COARSE GRAINED SAND PRESENT</td>
</tr>
<tr>
<td>23</td>
<td>ML</td>
<td>GRADING CLAY AND COARSE SAND</td>
</tr>
<tr>
<td>23</td>
<td>CL</td>
<td>FRIABLE SANDY CLAY, LOW PLASTICITY, DAMP</td>
</tr>
</tbody>
</table>

PLATE
LOG OF BORING
## BORING SO-17

**Surface Elevation:** 0  
**Location:** VWP, Richmond, Va.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Blow Count</th>
<th>Symbols</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>0</td>
<td>Fill</td>
<td>SILTY SAND AND GRAVEL, SOME CLAY (FILL)</td>
</tr>
<tr>
<td>18</td>
<td>0</td>
<td>ML</td>
<td>GOLD AND GRAY SILTY CLAY, TIGHT, DRY, LOW PLASTICITY</td>
</tr>
<tr>
<td>36</td>
<td>0</td>
<td>CL</td>
<td>GOLD, RED AND GRAY CLAY WITH TRACE SILT, TIGHT, DRY, LOW PLASTICITY (HARD PAN)</td>
</tr>
</tbody>
</table>

BORING COMPLETED AT A DEPTH OF 6.0 FEET ON 5-24-89
### BORING SO-18

**Surface Elevation:** 0  
**Location:** VWP, Richmond, Va.

#### Symbols and Description

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Blow Count</th>
<th>Depth (Meters)</th>
<th>Depth (Feet)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>ML</td>
<td>0</td>
<td>0</td>
<td>LIGHT BROWN SILTY SAND WITH TRACE CLAY AND SMALL GRAVEL, DRY</td>
</tr>
<tr>
<td>11</td>
<td>ML</td>
<td>1</td>
<td>3.3</td>
<td>RED CLAY WITH TRACE SILT, LOW TO MEDIUM PLASTICITY, DAMP</td>
</tr>
<tr>
<td>8</td>
<td>ML</td>
<td>2</td>
<td>6.7</td>
<td>DARK BROWN SILTY CLAY WITH TRACE SAND, SLIGHTLY PLASTIC, DAMP</td>
</tr>
<tr>
<td>12</td>
<td>SC</td>
<td>3</td>
<td>10</td>
<td>GRAY SILTY SAND, WET, ODOR PRESENT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>GRAY AND GOLD SILTY CLAY WITH TRACE SAND, TIGHT, LOW TO MEDIUM PLASTICITY (HARD PAN)</td>
</tr>
</tbody>
</table>

BORING COMPLETED AT A DEPTH OF 8.0 FEET ON 5-24-89

---

**PLATE**  
**LOG OF BORING**
BORING DM-1B

Surface Elevation: 0
Location: VWP, Richmond, Va.

Symbols | Description
--- | ---
Fill | DARK BROWN SILTY SANDY GRAVEL WITH SOME CLAY (FILL)
CL | DARK BROWN SILTY CLAY WITH SAND, MOIST, SWAMP ODOR
OL | GRADING TO BLACK CLAY WITH TRACE SAND
CL | GRADING TO MORE SWAMP LIKE CONDITIONS
CL | GRAY SILTY CLAY, SOME MEDIUM TO COARSE SAND, MOIST, FAINT BEDDING
CL | LIGHT GRAY SILTY CLAY WITH MEDIUM SAND GRADING TO COARSE SAND WITH TRACE SILTY CLAY
SM | SAPROITE
SC | LIGHT BROWN MEDIUM SAND TO FINE GRANITIC GRAVEL, SOME SILTY CLAY, MOIST
SM | LIGHT BROWN SILTY SAND, ANGULAR GRAINS, MORE CONSOLIDATED, MOIST, MORE MICACEOUS
SM | PINK AND GRAY GRANITE, FINE GRAINED WITH SOME COARSE ZONES

Granite

FRACTURES (NEAR VERTICAL)
FRACTURES (NEAR VERTICAL)

PLATE
LOG OF BORING
BORING DM-1B (Cont'd)

BORING COMPLETED AT A DEPTH OF 44.5 FEET ON 5-23-89

PLATE LOG OF BORING AR301658
BORING DM-1A

Surface Elevation: 0
Location: VWP, Richmond, Va.

Symbols Description

DARK BROWN SILTY SANDY GRAVEL WITH SOME CLAY (FILL)
DARK BROWN GRADING TO BLACK SILTY CLAY WITH SOME
SAND, MOIST, SWAMPY ODOR, GRADING TO MORE SWAMP
LIKE CONDITIONS TO 5.0 FEET

BLACK CLAY WITH TRACES OF SILT, MOIST, MEDIUM
PLASTIC (HARD PAN)

BORING COMPLETED AT A DEPTH OF
6.0 FEET ON 5-19-89

PLATE
LOG OF BORING
BORING DM-1R

Surface Elevation: 0
Location: VWP, Richmond, Va.

Symbols

<table>
<thead>
<tr>
<th>Depth (Meters)</th>
<th>Depth (Feet)</th>
<th>Blow Count</th>
<th>Samples</th>
</tr>
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<td>Fill</td>
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<td>25</td>
<td>78.8</td>
<td>95/8&quot;</td>
<td>Granite</td>
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<tr>
<td>30</td>
<td>99.0</td>
<td>Bouncing Spoon</td>
<td></td>
</tr>
</tbody>
</table>

Description

- **Fill**: DARK BROWN SILTY SANDY GRAVEL WITH SOME CLAY, FILL
- **CL, OL**: DARK BROWN SILTY CLAY WITH SOME SAND, MOIST, SWAMP ODOR, GRADING TO BLACK, GRADING TO MORE SWAMP-LIKE CONDITIONS
- **CL**: BLACK CLAY, TRACE SILT, DAMP TO MOIST, MEDIUM PLASTICITY, HARDPAN
- **SM, SC**: GRAYISH-WHITE SAPROLITE WITH SOME GOLD STAINING, MEDIUM GRAINED, TRACE CLAY
- **Granite**: 11.5 - DISTINCT CONTACT BETWEEN SAPROLITE AND HARD PAN
- **SM, SC**: GRADING TO GOLD-GRAY-BLACK SAPROLITE, HARDER WITH DEPTH, GRADING TO MORE MICA WITH DEPTH
- **SM, SC**: GRADING TO GOLD AND GRAY SAPROLITE
- **SM, SC**: GRADING TO GRANITE
- **SM, SC**: BOUNCING SPOON

BORING COMPLETED AT A DEPTH OF 27.0 FEET ON 6-4-89.
BORING DM-2R
Surface Elevation: 0
Location: VWP, Richmond, Va.

Symbols

<table>
<thead>
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</table>

Description

- SANDY GRAVEL (FILL)
- GOLDEN BROWN SILTY SANDY CLAY, DAMP
- GOLDEN BROWN CLAY WITH RED AND GRAY STAINING, WITH TRACE SILT AND SAND, LOW TO MEDIUM PLASTICITY, STIFF (HARD PAN)
- GRADING TO SAPROLITE BY 6.0 FEET
- GRAY SAPROLITE WITH RED AND YELLOW STAINING, TIGHT
- GRADING TO LESS RED STAINING AND A MORE GOLD COLORED SAPROLITE, WITH DEPTH
- SAMPLE GETTING TIGHTER AND LESS CLAY WITH DEPTH
- INCREASING MICA WITH DEPTH
- 2" GRAY CLAY ZONE AT 15.0 FEET

BORING COMPLETED AT A DEPTH OF 19.0 FEET ON 6-2-89
BORING DM-3R

Surface Elevation: 0
Location: VWP, Richmond, Va.

Symbols | Description
--- | ---
ML | SILTY SANDY CLAY (FILL)
CL | DARK GRAY SILT GRADING TO YELLOWISH RED SILT,
    | DRY TO MOIST
    | INCREASING SAND WITH DEPTH
SC | RED, GRAY AND YELLOW CLAY, TRACE SILT, LOW TO
    | MEDIUM PLASTICITY
SM | GRADING INTO SAPROLITE
Granite | GRAYISH WHITE SILTY SAND — SAPROLITE WITH SOME
    | CLAY AND TRACE MICA
    | SAPROLITE GRADING TO STIFFER AND MORE MICA
    | WITH DEPTH — GOLD AND GRAY STAINING
    | INCREASING WITH DEPTH
    | CLAY INCREASING WITH DEPTH
    | ALTERNATING FINE AND COARSE GRAINED SAPROLITE
    | WITH DEPTH

Granite at 18.5 feet

Boring completed at a depth of 21.0 feet on 6-4-89

PLATE
LOG OF BORING

AR301672 Dames & Moore
<table>
<thead>
<tr>
<th>Depth (Meters)</th>
<th>Depth (Feet)</th>
<th>Sample No.</th>
<th>Blow Count</th>
<th>Sample Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>7</td>
<td></td>
<td>SILTY SANDY GRAVEL (FILL) GRAY AND GOLD CLAYEY SILTY SAND, DAMP</td>
</tr>
<tr>
<td>1</td>
<td>3.3</td>
<td>21</td>
<td></td>
<td>SILTY CLAY WITH TRACE SAND, DAMP, LOW PASTICITY, STIFF (HADR PAN)</td>
</tr>
</tbody>
</table>

BORING COMPLETED AT A DEPTH OF 4.5 FEET ON 5-19-89
**BORING DM-4R**

**Surface Elevation:** 0  
**Location:** VWP, Richmond, Va.

### Symbols
- **ML**: Silty sandy gravel with clay (fill)  
- **CL**: Gray and gold clayey silty sand, damp, no plasticity  
- **SM**: Silty clay, low plasticity, damp, stiff (hard pan)  
- **SC**: Gold and gray saprolite, large grain quartz, some clay, stiff, moist

### Description
- **ML**: Grain size increasing with depth, clay content decreasing with depth
- **CL**: 14-15 feet grading from saprolite into granite

---

**Plate Log of Boring**

BORING COMPLETED AT A DEPTH OF 18.3 FEET ON 6-3-89
BORING DM-5

Surface Elevation: 0
Location: VWP, Richmond, Va.

Symbols Description

GOLD AND BROWN SILTY CLAY WITH SOME SAND, DAMP TO MOIST, SLIGHT PLASTICITY, PLASTICITY AND CLAY INCREASE WITH DEPTH

GOLD WITH GRAY AND RED CLAY, TRACE SILT, TIGHT, LOW TO MEDIUM PLASTICITY (HARD PAN).

GOLD AND GRAY SAND, SILTY CLAY, TIGHT, SMALL GRAIN, TRACE MICA, SAPROLITE

GRAIN SIZE INCREASING WITH DEPTH, MICA INCREASING WITH DEPTH, CLAY DECREASING WITH DEPTH, TIGHTNESS INCREASING WITH DEPTH

BORING COMPLETED AT A DEPTH OF 21.5 FEET ON 6-2-89
BORING DM-5A
Surface Elevation: 0
Location: VWP, Richmond, Va.

<table>
<thead>
<tr>
<th>Depth (Meters)</th>
<th>Depth (Feet)</th>
<th>Sample No.</th>
<th>Blow Count</th>
<th>Symbols</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td>ML CL</td>
<td>GOLDEN BROWN SILTY CLAY WITH SOME SAND, DAMP TO MOIST, SLIGHT PLASTICITY PLASTICITY AND CLAY INCREASING WITH DEPTH</td>
</tr>
<tr>
<td>1</td>
<td>3.3</td>
<td>11</td>
<td></td>
<td>CL</td>
<td>GOLD WITH GRAY AND RED STAINING TIGHT CLAY WITH TRACE SILT, LOW TO MEDIUM PLASTICITY (HARD PAN)</td>
</tr>
<tr>
<td>2</td>
<td>6.6</td>
<td>29</td>
<td></td>
<td>CL</td>
<td>BORING COMPLETED AT A DEPTH OF 5.5 FEET ON 5-19-89</td>
</tr>
</tbody>
</table>

PLATE
LOG OF BORING

AR301676 Dames & Moore
BORING DM-11B
Surface Elevation: 0
Location: VWP, Richmond, Va.

Symbols | Description
--- | ---
SM | DARK BROWN SANDY SILT, WELL SORTED, GRADING TO GRAY COLOR AND GRADING TO MORE CLAY GOLD AND GRAY SANDY SILTY CLAY, GRADING TO MORE SAND
ML | GOLD SANDY CLAY, SLIGHT PLASTICITY, DAMP
ML/CL | GRAYISH-WHITE SAPROLITE, COARSE GRAVEL, DAMP DENSITY INCREASING WITH DEPTH
SM/SC | GRANITE, VERY HARD, SOME NEAR VERTICAL FRACTURES, FRACTURES NOT VERY ABUNDENT, COMPETENT ROCK SOME GREEN STAINING AT CERTAIN FRACTURES SOME NEAR HORIZONTAL FRACTURES SOME PLAGIOCLASE CRYSTALS

BORING COMPLETED AT A DEPTH OF 30.0 FEET ON 6-7-89.

PLATE LOG OF BORING AR301677 Dames & Moore
# Boring DM-15A

**Surface Elevation:** 0  
**Location:** VWP, Richmond, Va.

<table>
<thead>
<tr>
<th>Depth (Meters)</th>
<th>Depth (Feet)</th>
<th>Sample No.</th>
<th>Blow Count</th>
<th>Symbols</th>
<th>Description</th>
</tr>
</thead>
</table>
| 0              | 0            | 20         |            | □       | SANDY GRAVEL (FILL)  
DARK BROWN SILTY CLAY WITH TRACE SAND, TIGHT, DAMP, ODOR PRESENT, BLACK STAINING |
| 2              | 6.5          | 2          |            | □       | GOLD AND GRAY SILTY SAND WITH ODOR AND BLACK STAINING |
| 9              |              | 9          |            | □       | GRAY AND GOLD SILTY CLAY WITH TRACE OF FINE SAND (HARD PAN) |
| 28             | 94           | 28         |            | □       | BORING COMPLETED AT A DEPTH OF 8.0 FEET ON 5-25-89 |

**PLATE LOG OF BORING**

AR301678 Dames & Moore
**BORING DM–15**

**Surface Elevation:** 0  
**Location:** VWP, Richmond, Va.

<table>
<thead>
<tr>
<th>Depth (Meters)</th>
<th>Depth (Feet)</th>
<th>Sample No.</th>
<th>Blow Count</th>
<th>Samples</th>
<th>Symbols</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>29</td>
<td></td>
<td></td>
<td>Fill</td>
<td>DARK BROWN SILTY SANDY GRAVEL (FILL)</td>
</tr>
<tr>
<td>1</td>
<td>3.3</td>
<td>4</td>
<td></td>
<td></td>
<td>ML CL</td>
<td>GOLD AND GRAY SANDY CLAY, DAMP, LOW PLASTICITY, ODOR PRESENT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>GRADING TO LESS CLAY AND LESS PLASTICITY</td>
</tr>
<tr>
<td>2</td>
<td>6.6</td>
<td>20</td>
<td></td>
<td></td>
<td>CL ML</td>
<td>GRAY SANDY CLAY, LOSS OF ODOR, DAMP, SLIGHT PLASTICITY</td>
</tr>
<tr>
<td>3</td>
<td>9.9</td>
<td>24</td>
<td></td>
<td></td>
<td>CL</td>
<td>GOLD, GRAY AND RED CLAY WITH TRACE SAND, LOW PLASTICITY, DAMP (HARD PAN)</td>
</tr>
<tr>
<td>4</td>
<td>13.2</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td>GRADING INTO SAPROLITE BETWEEN 9 TO 10 FEET</td>
</tr>
<tr>
<td>5</td>
<td>16.5</td>
<td>27</td>
<td></td>
<td></td>
<td>CL</td>
<td>GRAY AND GOLD SAPROLITE, MUCH CLAY, ODOR AT TOP OF SAPROLITE</td>
</tr>
<tr>
<td>6</td>
<td>19.8</td>
<td>25</td>
<td></td>
<td></td>
<td>SC SM</td>
<td>GRADING TO LESS CLAY, GRAY COLOR</td>
</tr>
<tr>
<td>7</td>
<td>23.1</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td>GRADING TO INCREASING MICA WITH DEPTH</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>53</td>
<td></td>
<td></td>
<td>SC</td>
<td>LIGHT BROWN AND WHITE SAPROLITE, LARGE QUARTZ GRAINS, NO CLAY, VERY TIGHT, TRACE MICA</td>
</tr>
</tbody>
</table>

BORING COMPLETED AT A DEPTH OF 21.5 FEET ON 6–6–89

**LOG OF BORING**

**PLATE**

**AR301679** Dames & Moore
BORING DM-16
Surface Elevation: 0
Location: VWP, Richmond, Va.

Symbols  Description

ML  GRAY AND GOLD CLAYEY SILT, TRACE SAND, MOIST
     GRADING TO REDDISH-BROWN

CL  RED, GOLD AND GRAY CLAY WITH TRACE SILT AND
     FINE SAND, TIGHT, LOW TO MEDIUM PLASTICITY,
     DAMP (HARD PAN)

SM  RED, GRAY AND GOLD SAPROLITE, TRACE MICA,
     SOME CLAY
     GRADING TO GRAYISH-WHITE
     GRADING TO LESS CLAY
     MICA INCREASING WITH DEPTH

SC  GRADING FROM SAPROLITE TO GRANITE
     BETWEEN 20.5 TO 21.0 FEET
     LARGER GRAINS AT CONTACT BETWEEN
     GRANITE/SAPROLITE INTERFACE

BORING COMPLETED AT A DEPTH OF
23.5 FEET ON 6-3-89.

PLATE
LOG OF BORING
**BORING DM-17A**

Surface Elevation: 0  
Location: VWP, Richmond, Va.

<table>
<thead>
<tr>
<th>Depth (Meters)</th>
<th>Depth (Feet)</th>
<th>Sample No.</th>
<th>Blow Count</th>
<th>Symbols</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>Fill</td>
<td>SANDY GRAVEL (FILL) GOLDS AND RED CLAY WITH TRACE SAND AND SILT, VERY STIFF, LOW PLASTICITY HARD PAN GRADING 3.0 TO 4.0 FEET</td>
</tr>
<tr>
<td>1</td>
<td>3.3</td>
<td>24</td>
<td>2</td>
<td>ML CL</td>
<td>GOLDS WITH RED MOTTLED CLAY, TRACE SAND, LOW TO MEDIUM PLASTICITY, DAMP</td>
</tr>
<tr>
<td>2</td>
<td>6.6</td>
<td>44</td>
<td>4</td>
<td>CL</td>
<td></td>
</tr>
</tbody>
</table>

BORING COMPLETED AT A DEPTH OF 6.0 FEET ON 5-23-89

---

**PLATE**

**LOG OF BORING**

AR301581 Dames & Moore
### BORING DM-18A

**Surface Elevation:** 0  
**Location:** VWP, Richmond, Va.

<table>
<thead>
<tr>
<th>Depth (Meters)</th>
<th>Depth (Feet)</th>
<th>Sample No.</th>
<th>Blow Count</th>
<th>Symbols</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>97</td>
<td></td>
<td>ML</td>
<td>GOLD AND GRAY SILTY CLAY WITH TRACE SAND, SLIGHT PLASTICITY, DRY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>43</td>
<td></td>
<td>SM</td>
<td>GRAY SILTY SAND, DRY, POWDER-LIKE CONSISTENCY GRADING TO A SAPROLITE 4.0 TO 5.0 FEET</td>
</tr>
<tr>
<td></td>
<td></td>
<td>38</td>
<td></td>
<td>SM/SC</td>
<td>GRAY COARSE GRAINED SAPROLITE, TRACE CLAY, TRACE MICA, DRY</td>
</tr>
</tbody>
</table>

BORING COMPLETED AT A DEPTH OF 6.0 FEET ON 5-22-89

---

**PLATE**

**LOG OF BORING**
APPENDIX F-1

Bennett and Williams Well
Boring Logs
Table A - Symbols used in soil descriptions.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill</td>
<td>Friable clayey sand</td>
</tr>
<tr>
<td>Clay</td>
<td>Loosely cemented clayey sand</td>
</tr>
<tr>
<td>Sandy clay</td>
<td>Weathered granite</td>
</tr>
<tr>
<td>Silt</td>
<td>Silty clay and sand</td>
</tr>
<tr>
<td>Clayey sand</td>
<td>Granite</td>
</tr>
</tbody>
</table>

Boring descriptions from previous investigations of the site are presented in this section. Borings which have been renamed and shown on Plate 2, the site location map, are listed below.

<table>
<thead>
<tr>
<th>Boring Designation on Logs</th>
<th>Boring Designation on Plate 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>P</td>
</tr>
<tr>
<td>B-2</td>
<td>Q</td>
</tr>
<tr>
<td>B-3</td>
<td>R</td>
</tr>
<tr>
<td>B-4</td>
<td>V</td>
</tr>
<tr>
<td>B-5</td>
<td>Y</td>
</tr>
</tbody>
</table>

During previous investigations, two borings, each called B-2, were installed. The name of the boring on Virginia Wood Preservers property is B-2 on Plate 2. The boring in Parham Forest is renamed as Boring Q on Plate 2.
BENNETT & WILLIAMS, INC
CONSULTING GEOLOGISTS

BORING: GMW3A  DATE: 9/10/85  PROJECT: VIRGINIA WOOD PRESERVERS
METHOD: 5.5" HOLLOW STEM AUGER

LOCATION: HENRICO CO., VIRGINIA

SURFACE ELEVATION : 209.1
CASING ELEVATION : 209.6

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>SOIL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-1.3&quot;</td>
<td>SS1</td>
<td>15&quot;</td>
<td>20-12</td>
<td>Dark gray clay and sand, some silty, dry, very stiff. Faint product odor.</td>
</tr>
<tr>
<td>1.3-3.4&quot;</td>
<td>SS2</td>
<td>13&quot;</td>
<td>3-4</td>
<td>Light brown-yellow sand and clay, some silt, medium stiff, damp, semi-plastic. Faint product odor.</td>
</tr>
<tr>
<td>3.4-6.6&quot;</td>
<td>SS3</td>
<td>16&quot;</td>
<td>8-12</td>
<td>Yellow-brown fine to coarse sand and clay, some silt, very stiff, friable, dry to damp. Product odor.</td>
</tr>
</tbody>
</table>

SOIL CLASSIF. | PLASTICITY | LIQUID LIMIT
CL 26 25
**Bennett & Williams, Inc.**
CONSULTING GEOLOGISTS

**Boring: GMW2A**
**Date: 10/8/85**
**Method: 3.5" Hollow Stem Auger**
**Project: Virginia Wood Preservers**
**Location: Henrico Co., Virginia**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample Recovery</th>
<th>Penetration Effort (ft)</th>
<th>Soil Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-2.5'</td>
<td></td>
<td></td>
<td>Yellow brown red and gray clay and sand, some silt, medium stiff, damp.</td>
</tr>
<tr>
<td>2.5-5.0'</td>
<td></td>
<td></td>
<td>Gray and yellow-brown sand and clay, some silt, damp, very stiff.</td>
</tr>
<tr>
<td>5.0-7.3'</td>
<td></td>
<td></td>
<td>Light gray fine to coarse sand and clay, some silt, friable, hard, damp.</td>
</tr>
</tbody>
</table>

**Surface Elevation:** 208.0
**Casing Elevation:** 209.0

**Legend:**
- No samples were taken. Log is extrapolated from Boring GMW2.
<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>LEGEND</th>
<th>SOIL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SS1</td>
<td>15&quot;</td>
<td>20-12</td>
<td></td>
<td>0.0-1.3' Dark gray clay and sand, some silty, dry, very stiff. Faint product odor.</td>
</tr>
<tr>
<td>3</td>
<td>SS2</td>
<td>13&quot;</td>
<td>3-4</td>
<td></td>
<td>1.3-3.4' Light brown-yellow sand and clay, some silt, medium stiff, damp, semi-plastic. Faint product odor.</td>
</tr>
<tr>
<td>6</td>
<td>SS3</td>
<td>16&quot;</td>
<td>8-12</td>
<td></td>
<td>3.4-6.6 Yellow-brown fine to coarse sand and clay, some silt, very stiff, friable, dry to damp. Product odor.</td>
</tr>
<tr>
<td>10</td>
<td>SH1</td>
<td>13&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>45</td>
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</tr>
</tbody>
</table>

**SURFACE ELEVATION:** 209.1

**CASING ELEVATION:** 209.6

**LOCATION:** HENRICO CO., VIRGINIA
# Soil Description

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample</th>
<th>Recovery</th>
<th>Penetration Effort (ft)</th>
<th>Soil Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.6'</td>
<td>SS1</td>
<td>2-2</td>
<td></td>
<td>0.0-0.6' Black clay loam, soft, roots, organics.</td>
</tr>
<tr>
<td>0.6-1.9'</td>
<td>SS2</td>
<td>4-50</td>
<td>-13</td>
<td>0.6-1.9' Gray clay and sand, some silt, soft, damp. No product odor.</td>
</tr>
<tr>
<td>1.9-8.7'</td>
<td>SS3</td>
<td>32-100</td>
<td></td>
<td>1.9-8.7' Light gray-white fine to coarse sand, some clay, with silt, dry to damp, friable, loosely cemented. No product odor.</td>
</tr>
<tr>
<td>8.7-14.0'</td>
<td>SS4</td>
<td>8-11</td>
<td>-13</td>
<td>8.7-14.0' Light gray-brown fine to coarse sand, some clay and silt, trace gravel, wet, medium dense. No product odor.</td>
</tr>
<tr>
<td>14.0-21.0'</td>
<td>SS5</td>
<td>5-11</td>
<td>-13</td>
<td>14.0-21.0' Light gray-white fine to coarse sand and clay, red-brown mottling, dense to very dense, wet. No product odor.</td>
</tr>
</tbody>
</table>
SURFACE ELEVATION : 210.0
CASING ELEVATION : 211.1

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>LEGEND</th>
<th>SOIL CLASS</th>
<th>PLASTICITY</th>
<th>LIQUID LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.6</td>
<td>SS1</td>
<td>3-3</td>
<td>W.H.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.6-1.9</td>
<td>SS2</td>
<td>7-100X</td>
<td>3-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.9-2.6</td>
<td>SS3</td>
<td>21-100X</td>
<td>3-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.6-7.0</td>
<td>SS4</td>
<td>34-16</td>
<td>3-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.0-21.5</td>
<td>SS5</td>
<td>10-12</td>
<td>3-3</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>SS6</td>
<td>3-3</td>
<td>3-3</td>
<td></td>
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</tr>
<tr>
<td>20</td>
<td>SS7</td>
<td>4-8</td>
<td>3-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SOIL DESCRIPTION

0.0-0.6' Dark brown-black clay loam, roots, organics, dry, soft. No product odor.

0.6-1.9' Gray clay and sand, some silt, medium stiff, dry. No product odor.

1.9-2.6' Gray sand and clay, some silt, medium stiff, dry. No product odor.

2.6-7.0' Light gray-white fine to coarse sand, some clay and silt, friable, hard, loosely cemented, dry to damp, red-brown mottling. No product odor.

7.0-21.5' Light gray-white fine to coarse sand, some clay, little silt, trace gravel, very stiff, wet. No product odor.

Auger refusal on granite at 21.5'.
**SOIL DESCRIPTION**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample</th>
<th>Recovery</th>
<th>Penetration Effort (ft)</th>
<th>Soil Classifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.2'</td>
<td>SS1</td>
<td>17'</td>
<td>1-1-3</td>
<td>0.0-0.2' Dark brown clay loam, little silt, organics, wet.</td>
</tr>
<tr>
<td>0.2-1.5'</td>
<td>SS2</td>
<td>17'</td>
<td>4-9-15</td>
<td>0.2-1.5' Grey clay and sand, some silt, wet, soft. No product odor.</td>
</tr>
<tr>
<td>1.5-3.5'</td>
<td>SS3</td>
<td>21'</td>
<td>11-17</td>
<td>1.5-3.5' Grey sand and clay, some silt, trace gravel, wet, red brown mottling, wet, stiff. No product odor.</td>
</tr>
<tr>
<td>3-5.5'</td>
<td>SS4</td>
<td>18'</td>
<td>21-22</td>
<td>3.5-7.7' Dark gray fine to coarse sand and clay, some silt, trace gravel, light brown-red mottling dry to damp, friable, hard. No product odor.</td>
</tr>
<tr>
<td>5.5-7.7'</td>
<td>SS5</td>
<td>18'</td>
<td>16-25</td>
<td>7.7-8.2' Yellow-brown clayey silt and sand, wet, non-plastic, soft. No product odor.</td>
</tr>
<tr>
<td>7.7-8.2'</td>
<td>SS6</td>
<td>18'</td>
<td>22-31</td>
<td>8.2-12.0' Light gray-white fine to coarse sand and silty clay, red-brown mottling, wet, hard. No product odor.</td>
</tr>
<tr>
<td>12.0-12.3'</td>
<td>SS7</td>
<td>14'</td>
<td>28-55</td>
<td>12.3-17.8' Light gray-white fine to coarse sand and silty clay, red-brown mottling, wet, hard. No product odor.</td>
</tr>
</tbody>
</table>

Auger refusal on granite at 17.8'.
<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>LEGEND</th>
<th>SURFACE ELEVATION : 207.5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS1</td>
<td>4-5-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS2</td>
<td>5-5-9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>SS3</td>
<td>12-84</td>
<td>-100X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS4</td>
<td>4-7-9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>SS5</td>
<td>4-7-11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>SH4</td>
<td>12-12</td>
<td>-100X</td>
<td></td>
</tr>
</tbody>
</table>

**SURFACE ELEVATION : 207.5**

**CASING ELEVATION : 208.4**

**SOIL DESCRIPTION**

- **0.0-0.7' Dark brown clay loam, some silt, dry, roots, medium stiff. No product odor.**
- **0.7-3.5' Gray-brown clay and sand, stiff, dry, semi-plastic. No product odor.**
- **3.5-4.0' Light gray-brown fine to coarse sand and clay friable, very stiff, damp. No product odor.**
- **4.0-6.0' Light gray-white sand and clay, some silt, dry to damp, hard, brown-red mottling, friable, loosely cemented. No product odor.**
- **6.0-9.5' Light gray-brown fine to coarse sand and clay friable, very stiff, damp. No product odor.**
- **9.5-14.5' Light gray-white sand and clay, some silt, dry to damp, hard, brown-red mottling, friable, loosely cemented. No product odor.**
- **14.5-17.0' Yellow-brown silty clay and sand soft, wet. No product odor.**
- **17.0-17.6' Light gray-white fine to coarse sand and silty clay, red-brown mottling, wet, medium dense. No product odor.**

Auger refusal on granite at 17.6'.

**SOIL CLASSIFICATION**

- **CL 20 32**
- **ML N/P 20**

**LEGEND**

SURFACE ELEVATION: 207.5
CASING ELEVATION: 208.4

**CONSULTING GEOLOGISTS**

BORING: GMW9
METHOD: 3.5" HOLLOW STEM AUGER
DATE: 9/17/85
LOCATION: HENRICO CO., VIRGINIA

**PROJECT: VIRGINIA WOOD PRESERVERS**
**BORING: GMW9A**  
**DATE: 10/8/85**  
**METHOD: 3.5" HOLLOW STEM AUGER**  
**PROJECT: VIRGINIA WOOD PRESERVERS**  
**LOCATION: HENRICO CO., VIRGINIA**

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (G)</th>
<th>LEGEND</th>
<th>SOIL CLASSIFICATION</th>
<th>PLASTICITY</th>
<th>LIQUID LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LEGEND</td>
<td>NO SAMPLES WERE TAKEN. LOG IS EXTRAPOLATED FROM BORING GMW9.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0-0.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark brown clay loam, some silt, dry, roots, medium stiff. No product odor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.7-3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Gray-brown clay and sand, stiff, dry, semi-plastic. No product odor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5-4.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Light gray-brown fine to coarse sand and clay friable, very stiff, damp. No product odor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0-6.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Light gray-white sand and clay, some silt, dry to damp, hard, brown-red mottling, friable, loosely cemented. No product odor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0-7.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Light gray-brown fine to coarse sand and clay friable, very stiff, damp. No product odor.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CONSULTING GEOLOGISTS

BORING: GMW10  DATE: 9/11/85  PROJECT: VIRGINIA WOOD PRESERVERS
METHOD: 3.5" HOLLOW STEM AUGER  LOCATION: HENRICO CO., VIRGINIA

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-4.3</td>
<td>SS1</td>
<td>12&quot;</td>
<td>2-3-4</td>
</tr>
<tr>
<td>4.3-7.4</td>
<td>SS2</td>
<td>9&quot;</td>
<td>6-9-8</td>
</tr>
<tr>
<td>5.3-7.4</td>
<td>SS3</td>
<td>23&quot;</td>
<td>2-2-3</td>
</tr>
<tr>
<td>7.4-12.0</td>
<td>SS4</td>
<td>16&quot;</td>
<td>-50X</td>
</tr>
<tr>
<td>12.0-12.5</td>
<td>SS5</td>
<td>18&quot;</td>
<td>6-7</td>
</tr>
<tr>
<td>12.5-16.6</td>
<td>SS6</td>
<td>12&quot;</td>
<td>6-7</td>
</tr>
<tr>
<td>16.6-17.2</td>
<td>SS7</td>
<td>18&quot;</td>
<td>34-50</td>
</tr>
<tr>
<td>20-30</td>
<td>SS8</td>
<td>5&quot;</td>
<td>61-90</td>
</tr>
<tr>
<td>25-30</td>
<td>SS9</td>
<td>12&quot;</td>
<td>30-37</td>
</tr>
<tr>
<td>30-37</td>
<td>SS10</td>
<td>5&quot;</td>
<td>100X</td>
</tr>
</tbody>
</table>

SOIL DESCRIPTION

- 0.0-4.3' FILL: Red sandy clay, micaceous, dry
- 4.3-7.4' Dark gray-black silty clay loam, organic rich, soft, roots, damp.
- 5.3-7.4' Gray-brown sand and clay, some silt, wet, non-plastic, medium stiff. Faint product odor.
- 7.4-12.0' Light gray-white sand and clay, dry, loosely cemented, friable, hard. No product odor.
- 12.0-12.5' Variegated green, red, and yellow fine to coarse sand with little clay, damp, medium dense. No product odor.
- 12.5-16.6' Variegated red, brown, yellow fine to coarse sand with silty clay, trace fine gravel, wet, semi-plastic. No product odor.
- 16.6-17.2' Brown-yellow fine to medium sand with little clayey silt, loose, wet. No product odor.
- 17.2-24.5' Brown clayey sand with some silt. Mottled intervals (3") of gray-white and red brown, very dense, wet. No product odor.

Auger refusal on granite at 24.5'.
BORING: GMW10A  DATE: 9/11/85  PROJECT: VIRGINIA WOOD PRESERVERS
METHOD: 5.5" HOLLOW STEM AUGER  LOCATION: HENRICO CO., VIRGINIA

**SURFACE ELEVATION:** 210.4
**CASING ELEVATION:** 211.8

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>SOIL CLASSIFICATION</th>
<th>SOIL CLASSIFICATION</th>
<th>LIQUID LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-4.3'</td>
<td></td>
<td></td>
<td></td>
<td>FILL: Red sandy clay, micaceous, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.3-5.3'</td>
<td></td>
<td></td>
<td></td>
<td>Dark gray-black silty clay loam, organic rich, soft, roots, damp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3-6.9'</td>
<td></td>
<td></td>
<td></td>
<td>Gray-brown sand and clay, some silt, wet, non-plastic, medium stiff. Faint product odor.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NO SAMPLES WERE TAKEN. LOG IS EXTRAPOLATED FROM BORING GMW10.
## SOIL DESCRIPTION

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample</th>
<th>Penetration Effort (ft)</th>
<th>Soil Class</th>
<th>Plasticity</th>
<th>Liquid Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.3'</td>
<td>W.H. 24</td>
<td>-</td>
<td>0.0-0.3' Black clay loam, little silt, roots, damp, soft. No product odor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.3-1.0'</td>
<td>-6-12</td>
<td>-18</td>
<td>0.3-1.0' Gray-black clay and sand, some silt, low plasticity, wet, soft. No product odor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0-3.7'</td>
<td>13-16</td>
<td>24</td>
<td>1.0-3.7' Brown-orange fine to coarse sand and clay, light gray-green and red mottling, damp, very stiff, friable. No product odor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.7-9.2'</td>
<td>19-36</td>
<td>27</td>
<td>3.7-9.2' Brown clayey sand, some gravel. Mottled intervals (3&quot;) of gray-white and red brown, damp to wet. No product odor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auger refusal on granite at 9.2'.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
BORING: GMW11A  
DATE: 9/13/85  
PROJECT: VIRGINIA WOOD PRESERVERS  
METHOD: 5.5" HOLLOW STEM AUGER  
LOCATION: HENRICO CO., VIRGINIA

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6')</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.5'</td>
<td>SS1</td>
<td>4&quot;</td>
<td>W.H.</td>
</tr>
<tr>
<td>0.5-4.0'</td>
<td>SS2</td>
<td>15&quot;</td>
<td>2-2</td>
</tr>
<tr>
<td>4.0-5.0'</td>
<td>SS3</td>
<td>19&quot;</td>
<td>6-9-15</td>
</tr>
</tbody>
</table>

SURFACE ELEVATION: 202.0
Casing ELEVATION: 205.0

SOIL DESCRIPTION

0.0-0.5' Black clay loam, little silt, roots, damp.  
No product odor.

0.5-4.0' Gray-black clay and sand, some silt, soft, low plasticity, wet. No product odor.

4.0-5.0' Brown-orange fine to coarse sand and clay, some silt, very stiff, friable, light gray-green and red mottling, damp. No product odor.

AR301696
**BORING: GMW12**  
**DATE: 10/10/85**  
**PROJECT: VIRGINIA WOOD PRESERVERS**  
**METHOD: 3.5" HOLLOW STEM AUGER**  
**LOCATION: HENRICO CO., VIRGINIA**

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>PENETRATION EFFORT (ft)</th>
<th>SURFACE ELEVATION: 209.4</th>
<th>CASING ELEVATION: 210.0</th>
<th>SOIL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.5'</td>
<td>SS1</td>
<td>20'</td>
<td>3-2-3</td>
<td></td>
<td>0.0-0.5' Black-brown clay loam, some silt, organic rich, roots, dry.</td>
</tr>
<tr>
<td>0.3-4.3'</td>
<td>SS2</td>
<td>13'</td>
<td>2-4-4</td>
<td></td>
<td>0.3-4.3' Light brown-gray clay and sand, some silt, medium stiff, dry. No product odor.</td>
</tr>
<tr>
<td>4.5-5.3'</td>
<td>SS3</td>
<td>11'</td>
<td>6-9-18</td>
<td></td>
<td>4.5-5.3' Light brown fine to coarse sand and clay, moist to dry, gray mottling, stiff. No product odor.</td>
</tr>
<tr>
<td>5.3-9.2'</td>
<td>SS4</td>
<td>24'</td>
<td>10-13</td>
<td>-13</td>
<td>5.3-9.2' Light gray-brown sand and clay, very stiff, friable, dry. No product odor.</td>
</tr>
<tr>
<td>9.2-31.9'</td>
<td>SS5</td>
<td>20'</td>
<td>5-6-9</td>
<td></td>
<td>9.2-31.9' Light gray-white fine to coarse sand and silty clay, red-brown mottling, damp to moist, medium dense. No product odor.</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
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<tr>
<td>30</td>
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</tr>
</tbody>
</table>

Auger refusal on granite at 31.9'.
**SURFACE ELEVATION**: 207.8
**CASING ELEVATION**: 208.8

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION REPORT (ft)</th>
<th>LEGEND</th>
<th>SOIL CLASS</th>
<th>PLASTICITY</th>
<th>LIQUID LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.2'</td>
<td>SS1</td>
<td>12'</td>
<td>1-1-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.2-1.3'</td>
<td>SS2</td>
<td>24'</td>
<td>4-8-10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5-2.3'</td>
<td>SS3</td>
<td>24'</td>
<td>5-9-14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3-5.8'</td>
<td>SS4</td>
<td>9'</td>
<td>8-13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3-5.8'</td>
<td>SS5</td>
<td>21'</td>
<td>5-8-11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.8-12.0'</td>
<td>SS6</td>
<td>18'</td>
<td>3-5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.0-15.0'</td>
<td>SH5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.0-42.0'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **0.0-0.2'**: Dark brown-black clay loam, little silt, organic rich, dry.
- **0.2-1.3'**: Light gray-brown clay and sand, some silt, soft, mottled, organic rich, dry. No product odor.
- **1.5-2.3'**: Yellow fine sand and clay, some silt, roots, medium stiff, damp. No product odor.
- **2.3-5.8'**: Light gray-brown sand and clay, some silt, red-brown mottling, damp, very stiff. No product odor.
- **5.8-12.0'**: Light gray-brown fine to coarse sand and clay, some silt, friable, very stiff, damp. No product odor.
- **12.0-15.0'**: Brownish-gray silty clay and fine to course sand, soft, wet. No product odor.
- **15.0-42.0'**: Light gray-white fine to coarse sand and silty clay, red-brown mottling, wet, medium stiff to stiff. No product odor.
**SURFACE ELEVATION : 213.0**
**CASING ELEVATION : 215.7**

### SOIL DESCRIPTION

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>LEGEND</th>
<th>SOIL CLASS</th>
<th>PLASTICITY</th>
<th>LIQUID LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.3'</td>
<td>SS1</td>
<td></td>
<td>9-13</td>
<td>0.0-0.3' Dark brown-black clay loam and sand, dry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.3-1.3'</td>
<td>SS2</td>
<td></td>
<td>4-7-10</td>
<td>0.3-1.3' Brown-red fine to medium clay and sand, very stiff, dry, white-gray mottling. No product odor.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3-1.8'</td>
<td>SS3</td>
<td></td>
<td>16-16</td>
<td>1.3-1.8' Black sand, uncohesive, asphalt, dry.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.8-4.3'</td>
<td>SS4</td>
<td></td>
<td>16-16</td>
<td>1.8-4.3' Light gray-brown fine to coarse sand and clay, red-brown mottling, very stiff, friable, damp. Trace gravel at 3.8'. No product odor.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.3-14.0'</td>
<td>SS5</td>
<td></td>
<td>6-9</td>
<td>4.3-14.0' Light gray-white sand and clay, some silt trace gravel, red-brown mottling, loosely cemented, dry to damp, hard. No product odor.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.0-23.9</td>
<td>SS6</td>
<td></td>
<td></td>
<td>14.0-23.9 Gray-white fine to coarse sand and silty clay, red-brown mottling, damp, dense to very dense. Wet at 19.0'. No product odor.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auger refusal on granite at 23.9'.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**BENNETT & WILLIAMS, INC**
CONSULTING GEOLOGISTS

**BORING: A**
**DATE:** 9/13/85
**METHOD:** 3.5" HOLLOW STEM AUGER
**PROJECT:** VIRGINIA WOOD PRESERVERS
**LOCATION:** HENRICO CO., VIRGINIA

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS1</td>
<td>12&quot;</td>
<td>1-1-5</td>
<td></td>
</tr>
<tr>
<td>SS2</td>
<td>12&quot;</td>
<td>4-5-7</td>
<td></td>
</tr>
<tr>
<td>SS3</td>
<td>12&quot;</td>
<td>-14</td>
<td></td>
</tr>
</tbody>
</table>

**SURFACE ELEVATION:** 203.8

**SOIL DESCRIPTION**

- **0.0-0.5'** Dark brown clay loam, little silt, trace sand, soft, roots, non-plastic, wet. No product odor.
- **0.5-3.0'** Gray-black sandy silt, some clay, low plasticity, wet, medium stiff, trace gravel. No product odor.
- **3.0-4.0'** Light brown clay and sand, some silt, stiff, plastic, damp. No product odor.
- **4.0-6.0'** Brown-orange fine to coarse sand and clay, light gray-green and red mottling, damp, very stiff. No product odor.
**BORING: BS**  
**DATE:** 11/6/85  
**PROJECT:** VIRGINIA WOOD PRESERVERS  
**METHOD:** 3.5" HOLLOW STEM AUGER  
**LOCATION:** HENRICO CO., VIRGINIA

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>SURFACE ELEVATION: 210.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1.0'</td>
<td>S51 14''</td>
<td>3-3-19</td>
<td></td>
<td>0.0-1.0' FILL. Gray-black sand and gravel.</td>
</tr>
<tr>
<td>1.0-2.7'</td>
<td>S52 24''</td>
<td>-32</td>
<td></td>
<td>1.0-2.7' Light brown clay and sand, some silt, very stiff, dry, semi-plastic. No product odor.</td>
</tr>
<tr>
<td>2.7-4.0'</td>
<td></td>
<td></td>
<td></td>
<td>2.7-4.0' Light brown sand and clay, some silt, trace gravel, hard, friable, some red and white mottling, dry. No product odor.</td>
</tr>
</tbody>
</table>

**SOIL DESCRIPTION**

- **CL**: Clay
- **PLASTICITY**: Plasticity
- **LIQUID LIMIT**: Liquid Limit
BORING: CS  DATE: 11/6/85  PROJECT: VIRGINIA WOOD PRESERVERS
METHOD: 3.5" HOLLOW STEM AUGER
LOCATION: HENRICO CO., VIRGINIA

SURFACE ELEVATION: 210.2

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>LEGEND</th>
<th>SOIL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1.1</td>
<td>SS1</td>
<td>19-23</td>
<td>16</td>
<td>0.0-1.1&quot; FILL. Gray-black sandy gravel and clay, dry.</td>
<td></td>
</tr>
<tr>
<td>1.1-3.4</td>
<td>SS2</td>
<td>11-3-4-4</td>
<td>11</td>
<td>1.1-3.4&quot; Brown-black fine to medium clay and sand, some gravel, damp, medium stiff. Strong product odor.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SS3</td>
<td>18-2-2</td>
<td>18</td>
<td>3.4-4.2&quot; Light gray silty clay, wet, medium stiff. Dark brown non-aqueous phase liquid in some pore spaces. Strong product odor.</td>
<td></td>
</tr>
<tr>
<td>6-7</td>
<td>SS4</td>
<td>18-8-21</td>
<td>18</td>
<td>4.2-6.1&quot; Orange-brown fine to medium sand and clay, gray mottling, soft, wet, non-plastic. Dark brown non-aqueous phase liquid in some pore spaces, and on split spoon sampler. Strong product odor.</td>
<td></td>
</tr>
<tr>
<td>7-8</td>
<td></td>
<td></td>
<td></td>
<td>6.1-7.0&quot; Light gray fine to coarse sand and clay, trace gravel, red mottling, damp, friable, hard. No product visible in pores. Product odor.</td>
<td></td>
</tr>
</tbody>
</table>

SOIL CLASSIF.  PLASTICITY  LIQUID LIMIT

ML  N/P  46
BORGING: DS  
DATE: 11/6/85  
PROJECT: VIRGINIA WOOD PRESERVERS  
LOCATION: HENRICO CO., VIRGINIA

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>SOIL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1'</td>
<td>SS1</td>
<td>17&quot;</td>
<td>7-6-6</td>
<td>0.0-1.0' Brown-orange clay and sand, some silt, damp, stiff. No product odor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-3.5'</td>
<td>SS2</td>
<td>24&quot;</td>
<td>4-6-21</td>
<td>1.0-3.5' Orange-brown fine to medium sand and clay, gray mottling, stiff, damp. No product odor. Wet at 2.6'.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5-4.0'</td>
<td></td>
<td></td>
<td></td>
<td>3.5-4.0' Light brown, yellow, and red fine to coarse sand and clay, damp to dry, hard, friable. Faint product odor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SURFACE ELEVATION: 207.8
<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>SOIL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.7</td>
<td>S1</td>
<td>4-5-6</td>
<td></td>
<td>Light brown clay and sand, wood chips, roots, stiff, dry. No product odor.</td>
</tr>
<tr>
<td>0.7-3.2</td>
<td>S2</td>
<td>10-15</td>
<td></td>
<td>Orange-brown sand and clay, semi-plastic, very stiff, dry. No product odor.</td>
</tr>
<tr>
<td>3.2-4.0</td>
<td></td>
<td>-25</td>
<td></td>
<td>Light brown fine to coarse sand and clay, friable, hard, dry. No product odor.</td>
</tr>
</tbody>
</table>
**BORING: FS**
**DATE: 11/7/85**
**PROJECT: VIRGINIA WOOD PRESERVERS**
**METHOD: 3.5" HOLLOW STEM AUGER**
**LOCATION: HENRICO CO., VIRGINIA**

**SURFACE ELEVATION:** 207.5

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (ft)</th>
<th>LEGEND</th>
<th>SOIL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1.1'</td>
<td>SS1</td>
<td>14'</td>
<td>8-7-7</td>
<td></td>
<td>0.0-1.1' FILL: Black clayey sand and gravel, dry.</td>
</tr>
<tr>
<td>1.1-2.4'</td>
<td>SS2</td>
<td>24'</td>
<td>1-3-4</td>
<td></td>
<td>1.1-2.4' Dark gray fine to medium clay and sand, stiff, green and red mottling, dry. Product odor. Orange-brown at 2.0'.</td>
</tr>
<tr>
<td>2.4-3.8'</td>
<td>SS3</td>
<td>14'</td>
<td>12-29</td>
<td></td>
<td>2.4-3.8' Brown-gray sand and clay, soft, wet. Dark brown non-aqueous phase liquid in some pore spaces. Strong product odor.</td>
</tr>
<tr>
<td>3.8-4.6'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.8-4.6' Light brown-gray fine to medium sand and clay, friable, very stiff, damp, gray mottling. Dark brown non-aqueous phase liquid in some pore spaces. Strong product odor.</td>
</tr>
<tr>
<td>4.6-5.5'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.6-5.5' Light gray-brown fine to coarse sand, some clay, hard, friable, loosely cemented, damp. Product odor.</td>
</tr>
</tbody>
</table>
**SURFACE ELEVATION:** 208.9

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>SOIL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SS1</td>
<td>20-11</td>
<td>0.0-1.0' Black clay loam, some silt, trace gravel, dry.</td>
</tr>
<tr>
<td>1.0</td>
<td>SS2</td>
<td>5-9-14</td>
<td>1.0-2.6' Dark brown fine to medium clay and sand.</td>
</tr>
<tr>
<td>2.6</td>
<td>SS3</td>
<td>11-15</td>
<td>2.6-3.5' Orange-brown fine to coarse sand and clay.</td>
</tr>
<tr>
<td>3.5</td>
<td>SS4</td>
<td>7-8-11</td>
<td>3.5-6.3' Light gray-white fine to coarse sand and clay, some silt, hard, damp to dry, loosely cemented, friable.</td>
</tr>
<tr>
<td>6.3</td>
<td></td>
<td></td>
<td>6.3-8.0' White-gray fine to coarse sand and silty clay, red-brown mottling, damp to moist, medium dense.</td>
</tr>
</tbody>
</table>

**SOIL CLASSIFICATION**

<table>
<thead>
<tr>
<th>FIRM</th>
<th>PLASTICITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td></td>
</tr>
<tr>
<td>N-t</td>
<td></td>
</tr>
<tr>
<td>R-K</td>
<td></td>
</tr>
</tbody>
</table>

**LOCATION:** HENRICO CO., VIRGINIA
<table>
<thead>
<tr>
<th>Depth (FT)</th>
<th>Sample</th>
<th>Recovery</th>
<th>Penetration Effort (6&quot;)</th>
<th>Soil Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S51</td>
<td>15&quot;-19&quot;</td>
<td>12-17</td>
<td>0.0-0.7' Fill: Black sandy clay, trace gravel, dry.</td>
</tr>
<tr>
<td></td>
<td>S52</td>
<td>24&quot;-1-4-7</td>
<td>1-4-7</td>
<td>0.7-2.0' Brown clay and sand, some gravel, very stiff, gray mottling, dry. No product odor.</td>
</tr>
<tr>
<td></td>
<td>S53</td>
<td>15&quot;-21&quot;</td>
<td>7-19</td>
<td>2.0-3.4' Orange-brown sand and clay, some silt, soft, damp to wet, non-plastic. Faint product odor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.4-4.1' Brown-gray clay and sand, some silt, stiff, damp to wet, plastic, red and orange mottling. Faint product odor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.1-5.2' Yellow-brown clay, some silt, little sand, medium stiff, wet, plastic. No product odor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.2-6.0' Light gray-brown fine to coarse sand and clay, little gravel, hard, loosely cemented, friable, some red and orange mottling. No product odor.</td>
</tr>
</tbody>
</table>
**BORING I**

**DATE:** 11/8/85

**METHOD:** 3.5" HOLLOW STEM AUGER

**PROJECT:** VIRGINIA WOOD PRESERVERS

**LOCATION:** HENRICO CO., VIRGINIA

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-1.2</td>
<td>SS1</td>
<td>15</td>
<td>3-3-7</td>
</tr>
<tr>
<td>1.2-1.9</td>
<td>SS2</td>
<td>24</td>
<td>5-7-8</td>
</tr>
<tr>
<td>1.9-3.7</td>
<td>SS3</td>
<td>14</td>
<td>11-20</td>
</tr>
<tr>
<td>5.7-6.0</td>
<td>SS4</td>
<td>24</td>
<td>-21</td>
</tr>
</tbody>
</table>

**SOIL DESCRIPTION**

- **0.0-1.2** Dark brown clay loam, roots.
- **1.2-1.9** Dark gray clay and sand, some silt, stiff, damp. No product odor.
- **1.9-3.7** Light gray sand and clay, some silt, stiff, damp. Some wet seams and gray mottling from 3.3-5.7. No product odor.
- **5.7-6.0** Gray medium to coarse sand, some silt, little clay, medium stiff, wet. No product odor.
- **6.0-8.0** Gray-white fine to coarse sand and clay clay, trace gravel, hard, loosely cemented, friable, damp. No product odor.
**Boring: JS**  
**Date: 11/8/85**  
**Project: Virginia Wood Preservers**  
**Location: Henrico Co., Virginia**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample</th>
<th>Penetration Effort (ft)</th>
<th>Legend</th>
<th>Soil Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-1.1</td>
<td>SS1 17</td>
<td>5-6-6</td>
<td></td>
<td>0.0-1.1' Black clay loam, trace gravel.</td>
</tr>
<tr>
<td>1.1-3.0</td>
<td>SS2 22</td>
<td>10-19</td>
<td></td>
<td>1.1-3.0' Brown-gray clay and sand, some silt, stiff, semi-plastic, dry. No product odor.</td>
</tr>
<tr>
<td>3.0-4.5</td>
<td>SS3 19</td>
<td>8-14</td>
<td></td>
<td>3.0-4.5' Light gray fine to coarse sand and clay, some silt, friable, dry to damp, very stiff. No product odor.</td>
</tr>
<tr>
<td>4.5-6.0</td>
<td></td>
<td>8-14</td>
<td></td>
<td>4.5-6.0' Light gray clay and fine to coarse sand, some silt, damp, stiff. No product odor.</td>
</tr>
</tbody>
</table>

**Surface Elevation:** 205.5

**Soil Classification:**

<table>
<thead>
<tr>
<th>Soil Class</th>
<th>Plasticity</th>
<th>Liquid Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML</td>
<td>N/P</td>
<td>32</td>
</tr>
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### Soil Description

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample</th>
<th>Recovery</th>
<th>Penetration Effort (ft)</th>
<th>Legend</th>
<th>Soil Type and Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>SS1</td>
<td>17-12</td>
<td>-15</td>
<td></td>
<td>0.0-0.7' Fill. Black sand and gravel, some clay, dry.</td>
</tr>
<tr>
<td>24</td>
<td>SS2</td>
<td>6-10</td>
<td>-15</td>
<td></td>
<td>0.7-1.2' Light brown-orange sand and silt, some gravel, very stiff, dry. No product odor.</td>
</tr>
<tr>
<td>24</td>
<td>SS3</td>
<td>14-25</td>
<td>-28</td>
<td></td>
<td>1.2-2.2' Dark gray clay and sand, some silt, very stiff, gasoline odor, dry.</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.2-4.2' Orange-gray clay and sand, some silt, damp, stiff. Gasoline odor.</td>
</tr>
<tr>
<td>42</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.2-6.0' Brown-gray fine to medium sand, some clay, little silt, damp, hard, friable. Gasoline odor.</td>
</tr>
</tbody>
</table>

**Surface Elevation:** 213.1

**Project:** Virginia Wood Preservers

**Location:** Henrico Co., Virginia
<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>LEGEND</th>
<th>SURFACE ELEVATION : 207.6'</th>
<th>SOIL DESCRIPTION</th>
<th>SOIL CLASSIF.</th>
<th>PLASTICITY</th>
<th>LIQUID LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SS1</td>
<td>17&quot;</td>
<td>1-2-2</td>
<td></td>
<td></td>
<td>0.0-0.6' Black clay loam, organic rich, roots, damp.</td>
<td>CL</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>SS2</td>
<td>16&quot;</td>
<td>2-4-6</td>
<td></td>
<td></td>
<td>0.6-1.2' Light brown-orange sand and clay, damp, soft. No product odor.</td>
<td>ML</td>
<td>4</td>
<td>35</td>
</tr>
<tr>
<td>3</td>
<td>SS3</td>
<td>18&quot;</td>
<td>4-8-10</td>
<td></td>
<td></td>
<td>1.2-2.7' Gray-brown clay and silt, little sand, wet, semi-plastic, soft. No product odor.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.7-4.0' Light gray clay and silt, trace sand, wet, stiff. No product odor.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPTH (FT)</td>
<td>SAMPLE</td>
<td>RECOVERY</td>
<td>PENETRATION EFFORT (6&quot;)</td>
<td>LEGEND</td>
<td>SOIL CLASSIF.</td>
<td>PLASTICITY LIMIT</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-0.6'</td>
<td>SSI</td>
<td>4&quot;</td>
<td>2-4-2</td>
<td></td>
<td>CL 7</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.6-2.0'</td>
<td>SS2</td>
<td>17&quot;</td>
<td>6-29</td>
<td></td>
<td>SM N/F</td>
<td>36</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0.6-3.4'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3.4-4.0'</td>
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<td></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**SURFACE ELEVATION: 206.2'**

**SOIL DESCRIPTION**

0.0-0.6' Black clay loam, roots, dry. Product odor.

0.6-2.0' Brown-yellow clay and sand, soft, wet. No product odor.

0.6-3.4' Light brown sand and clay, some silt, stiff, damp. No product odor.

3.4-4.0' Light gray-white fine to coarse sand, some clay and silt, hard, dry, friable, loosely-cemented. No product odor.
BOARING: NS  
METHOD: 3.5" HOLLOW STEM AUGER  
DATE: 11/11/85  
PROJECT: VIRGINIA WOOD PRESERVERS  
LOCATION: HENRICO CO., VIRGINIA  
SURFACE ELEVATION: 207.5

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE</th>
<th>RECOVERY</th>
<th>PENETRATION EFFORT (6&quot;)</th>
<th>SOIL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-1.4'</td>
<td>SS1</td>
<td>12&quot;</td>
<td>13-6-5</td>
<td>0.0-1.4' FILL. Black and gray sand and gravel, some clay.</td>
</tr>
<tr>
<td>1.4-2.2'</td>
<td>SS2</td>
<td>24&quot;</td>
<td>2-5-15</td>
<td>1.4-2.2' Orange-brown clay and sand, some silt, dry, stiff. No product odor.</td>
</tr>
<tr>
<td>2.2-3.4'</td>
<td>SS3</td>
<td>22&quot;</td>
<td>-20</td>
<td>2.2-3.4' Orange-brown clay and sand with light gray fine to coarse sand and clay intervals, some silt, damp to wet, stiff, non-plastic. No product odor.</td>
</tr>
<tr>
<td>3.4-4.3'</td>
<td></td>
<td></td>
<td></td>
<td>3.4-4.3' Brown sand and clay, some silt, very stiff, damp. No product odor.</td>
</tr>
<tr>
<td>4.3-6.0'</td>
<td></td>
<td></td>
<td></td>
<td>4.3-6.0' Light brown-yellow clay and sand, some silt, wet semi-plastic, very stiff. No product odor.</td>
</tr>
<tr>
<td>4.8-6.0'</td>
<td></td>
<td></td>
<td></td>
<td>4.8-6.0' Light gray-white clay with fine to coarse sand, some silt, loosely cemented, damp, hard. No product odor.</td>
</tr>
</tbody>
</table>
APPENDIX G

Well Diagrams
NOT TO SCALE

PERCHED WATER TABLE WELL
DM-4A
2-INCH STAINLESS STEEL PIPE
CONCRETE PAD
GROUND SURFACE
BENTONITE AND CEMENT GROUT
6-INCH BOREHOLE
BENTONITE PELLET SEAL
0.010-INCH SLOTTED STAINLESS STEEL 2-INCH SCREEN
SAND PACK
LOCKING PAD
1.5'

HARD PAN

NOT TO SCALE

PERCHED WATER TABLE WELL
DM-5A

AR301717 Dames & Moore
2-INCH STAINLESS STEEL PIPE
CONCRETE PAD
GROUND SURFACE

BENTONITE AND CEMENT GROUT
6-INCH BOREHOLE
BENTONITE PELLET SEAL
0.010-INCH SLOTTED STAINLESS STEEL 2-INCH SCREEN
SAND PACK

LOCKING PAD

1.5'

HARD PAN

NOT TO SCALE

PERCHED WATER TABLE WELL
DM-15A
2 - INCH STAINLESS STEEL PIPE
CONCRETE PAD
GROUND SURFACE

BENTONITE AND CEMENT GROUT

6-INCH BOREHOLE

BENTONITE PELLET SEAL

0.010 - INCH SLOTTED STAINLESS STEEL 2 - INCH SCREEN

SAND PACK

LOCKING PAD 1.5'

HARD PAN

NOT TO SCALE.

PERCHED WATER TABLE WELL
DM-17A

AR301719  Dames & Moore
SAPROLITE WELL INSTALLATION
DM-1(R)

NOT TO SCALE
CONCRETE PAD
GROUND SURFACE

12-INCH BOREHOLE

8-INCH STEEL CASING

BENTONITE AND CEMENT GROUT

BENTONITE SEAL

6-INCH BOREHOLE

BENTONITE PELLET SEAL

2-INCH STAINLESS STEEL PIPE

0.010-INCH SLOTTED STAINLESS STEEL 2-INCH SCREEN

SAND PACK

BOREHOLE 2.5' INTO BEDROCK

LOCKING PAD

3.0'

1.0'

2.0'

8.0'

6.0'

3.0'

11.0'

3.0'

14.0'

5.0'

16.5'

19.0'

HARD PAN

SAPROLITE

UNWEATHERED BEDROCK

NOT TO SCALE

SAPROLITE WELL INSTALLATION
DM-2(R)

Dames & Moore
CONCRETE PAD
GROUND SURFACE

12-INCH BOREHOLE

8-INCH STEEL CASING

BENTONITE AND
CEMENT GROUT

BENTONITE SEAL

6-INCH BOREHOLE

BENTONITE PELLET SEAL

2-INCH STAINLESS
STEEL PIPE

0.010-INCH SLOTTED
STAINLESS STEEL
2-INCH SCREEN

SAND PACK

BOREHOLE 2' INTO BEDROCK

HARD PAN

SAPROLITE

UNWEATHERED
BEDROCK

NOT TO SCALE

SAPROLITE WELL INSTALLATION
DM-5
CONCRETE PAD
GROUND SURFACE

12-INCH BOREHOLE

8-INCH STEEL CASING

BENTONITE AND CEMENT GROUT

BENTONITE SEAL

6-INCH BOREHOLE

BENTONITE PELLET SEAL

2-INCH STAINLESS STEEL PIPE

0.010-INCH SLOTTED STAINLESS STEEL 2-INCH SCREEN

SAND PACK

UNWEATHERED BEDROCK

UNWEATHERED BEDROCK

12-INCH BOREHOLE

BENTONITE SEAL

BENTONITE AND CEMENT GROUT

LOCKING PAD

1.5'

8.0'

0.0'

10.0'

8.0'

BOREHOLE 2.0' INTO HARD PAN

HARD PAN

SAPROLITE

SAPROLITE WELL INSTALLATION

DM-15

NOT TO SCALE
LOCKING PAD

CONCRETE PAD
GROUND SURFACE

12-INCH BOREHOLE

8-INCH STEEL CASING

BENTONITE AND CEMENT GROUT

BENTONITE SEAL

12-INCH BOREHOLE 2.0’ INTO HARDPAN

HARD PAN

6-INCH BOREHOLE

BENTONITE PELLET SEAL

2-INCH STAINLESS STEEL PIPE

0.010-INCH SLOTTED STAINLESS STEEL 2-INCH SCREEN

SAND PACK

BOREHOLE 2.5’ INTO HARDPAN

UNWEATHERED BEDROCK

SAPROLITE

DM-16

NOT TO SCALE

SAPROLITE WELL INSTALLATION

AR301727 Dames & Moore
NOT TO SCALE

BEDROCK WELL INSTALLATION
DM-1(B)
4-INCH STAINLESS STEEL CASING
CONCRETE PAD
GROUND SURFACE

12-INCH BOREHOLE

8-INCH STEEL CASING
BENTONITE AND CEMENT GROUT

BENTONITE SEAL

7½-INCH BOREHOLE

BENTONITE SEAL

NX CORING (OPEN BOREHOLE)

LOCKING COVER AND PAD LOCK

BOREHOLE 2.0' INTO HARDPAN

HARD PAN

BOREHOLE 3.0' INTO BEDROCK

UNWEATHERED BEDROCK

SAPROLITE

BEDROCK WELL INSTALLATION

DM-11(B)

NOT TO SCALE

Dames & Moore
APPENDIX G-1

Bennett and Williams Well
Construction Specifications
TABLE 1 - "As-buils" for monitoring wells installed.

<table>
<thead>
<tr>
<th>Boring</th>
<th>Surface Elevation</th>
<th>Casing Elevation</th>
<th>Top Bentonite Slurry</th>
<th>Bottom Bentonite Slurry</th>
<th>Top Sand Pack</th>
<th>Bottom Sand Pack</th>
<th>Bottom of Well</th>
</tr>
</thead>
<tbody>
<tr>
<td>GMW2A</td>
<td>208.0</td>
<td>209.0</td>
<td>209.1</td>
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<tr>
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<td>209.1</td>
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<td>GMW8</td>
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<td>208.6</td>
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<td></td>
<td>204.5</td>
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<tr>
<td>GMW10</td>
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<td>210.4</td>
<td></td>
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<td>197.2</td>
<td>190.2</td>
<td>190.2</td>
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<td>GMW10A</td>
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<td>211.8</td>
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<td>207.4</td>
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<td>203.4</td>
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<td>GMW1L</td>
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<td>192.0</td>
<td>192.0</td>
<td>192.0</td>
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<td>GMW11A</td>
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<td>205.0</td>
<td></td>
<td>201.0</td>
<td>197.0</td>
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TABLE 1 (contd.)

<table>
<thead>
<tr>
<th>Boring</th>
<th>Type Riser/Screen</th>
<th>Top Upper Bentonite Pellets</th>
<th>Bottom Upper Bentonite Pellets</th>
<th>Top Lower Bentonite Pellets</th>
</tr>
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<tbody>
<tr>
<td>BN2A</td>
<td>2&quot; stainless steel</td>
<td>206.0</td>
<td>205.0</td>
<td></td>
</tr>
<tr>
<td>BN3A</td>
<td>2&quot; stainless steel</td>
<td>206.9</td>
<td>205.9</td>
<td></td>
</tr>
<tr>
<td>BN4B</td>
<td>2&quot; stainless steel</td>
<td>204.6</td>
<td>203.3</td>
<td>199.4</td>
</tr>
<tr>
<td>BN5F</td>
<td>2&quot; stainless steel</td>
<td>200.7</td>
<td>199.9</td>
<td></td>
</tr>
<tr>
<td>BN9A</td>
<td>2&quot; stainless steel</td>
<td>207.5</td>
<td>204.5</td>
<td></td>
</tr>
<tr>
<td>BN10A</td>
<td>2&quot; stainless steel</td>
<td>199.2</td>
<td>198.2</td>
<td>190.2</td>
</tr>
<tr>
<td>BN10A</td>
<td>2&quot; stainless steel</td>
<td>209.9</td>
<td>207.8</td>
<td></td>
</tr>
<tr>
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<td>2&quot; stainless steel</td>
<td>202.0</td>
<td>196.3</td>
<td>191.3</td>
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<td>BN11A</td>
<td>2&quot; stainless steel</td>
<td>209.4</td>
<td>208.9</td>
<td></td>
</tr>
<tr>
<td>BN12</td>
<td>2&quot; stainless steel</td>
<td>198.3</td>
<td>194.0</td>
<td>188.8</td>
</tr>
<tr>
<td>BN13</td>
<td>2&quot; stainless steel</td>
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<td>189.7</td>
<td></td>
</tr>
<tr>
<td>BN14</td>
<td>2&quot; stainless steel</td>
<td>200.7</td>
<td>198.8</td>
<td>190.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boring</th>
<th>Bottom Lower Bentonite Pellets</th>
<th>Screen Slot</th>
<th>Top Screen</th>
<th>Bottom Screen</th>
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<tbody>
<tr>
<td>BN2A</td>
<td>20 slot</td>
<td>201.0</td>
<td>205.0</td>
<td></td>
</tr>
<tr>
<td>BN3A</td>
<td>20 slot</td>
<td>202.5</td>
<td>204.8</td>
<td></td>
</tr>
<tr>
<td>BN4B</td>
<td>20 slot</td>
<td>199.9</td>
<td>203.3</td>
<td>199.5</td>
</tr>
<tr>
<td>BN5F</td>
<td>20 slot</td>
<td>204.5</td>
<td>203.4</td>
<td>190.2</td>
</tr>
<tr>
<td>BN9A</td>
<td>20 slot</td>
<td>197.2</td>
<td>197.0</td>
<td>197.0</td>
</tr>
<tr>
<td>BN10A</td>
<td>20 slot</td>
<td>205.4</td>
<td>194.3</td>
<td>188.8</td>
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<tr>
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<td>20 slot</td>
<td>205.0</td>
<td>191.4</td>
<td>190.9</td>
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<td>190.9</td>
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<td>194.8</td>
<td>194.8</td>
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<td>20 slot</td>
<td>190.9</td>
<td>198.8</td>
<td></td>
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</tbody>
</table>
APPENDIX H

Grain Size Analysis Report
**Particle-size Analyses**

Several particle-size analyses were performed on sediment samples. These tests, conducted in accordance with ASTM Test Designation 422-72, were used as the basis for the purposes of classification and correlation. The test results are displayed as gradation curves in the following figures. The results yield the following Unified Soil Classifications:

<table>
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<tr>
<th>Sample</th>
<th>Fines*</th>
<th>Unified Soil Classification</th>
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<tbody>
<tr>
<td>SE-1</td>
<td>3</td>
<td>SP</td>
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<tr>
<td>SE-2</td>
<td>5</td>
<td>SP</td>
</tr>
<tr>
<td>SE-3</td>
<td>90</td>
<td>ML</td>
</tr>
<tr>
<td>SE-4</td>
<td>31</td>
<td>SM/SC</td>
</tr>
<tr>
<td>SE-5</td>
<td>*30</td>
<td>SM</td>
</tr>
<tr>
<td>SE-6</td>
<td>68</td>
<td>ML/OL</td>
</tr>
<tr>
<td>SE-7</td>
<td>62</td>
<td>ML/MH</td>
</tr>
<tr>
<td>SE-8</td>
<td>62</td>
<td>ML/OL</td>
</tr>
<tr>
<td>SE-9</td>
<td>*46</td>
<td>SP/SM</td>
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<tr>
<td>SE-10</td>
<td>31</td>
<td>SM/SC</td>
</tr>
<tr>
<td>SE-11</td>
<td>68</td>
<td>ML/MH</td>
</tr>
</tbody>
</table>

(*)Percentage by weight of sample that passes No. 200 U.S. Standard sieve.
Boring No.: SE-2

Soil Type: SP

U.S. STANDARD SIEVE SIZE

3 IN, 1.5 IN, 3/4 IN, 3/8 IN, 4

PERCENT FINER BY WEIGHT

100

GRAIN SIZE IN MILLIMETERS

1000 100 10 1.0 0.1 0.01 0.001

COBBLES COARSE FINE COARSE MEDIUM FINE SILT OR CLAY

DEPTH CLASSIFICATION NAT. WC LL PL PI

SP

GRADATION CURVE
Boring No.: SE-4

Soil Type: SM/SC

U.S. STANDARD SIEVE SIZE

<table>
<thead>
<tr>
<th>PERCENT FINER BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
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</table>

<table>
<thead>
<tr>
<th>GRAIN SIZE IN MILLIMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
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</table>

<table>
<thead>
<tr>
<th>COBBLES</th>
<th>GRANULES</th>
<th>SAND</th>
<th>SILT OR CLAY</th>
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</thead>
<tbody>
<tr>
<td>COARSE</td>
<td>FINE</td>
<td>COARSE</td>
<td>MEDIUM</td>
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</table>

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>CLASSIFICATION</th>
<th>NAT. WC</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SM/SC</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

GRADATION CURVE
Boring No.: SE-5

Soil Type: SM

U.S. Standard Sieve Size

Percent Finer by Weight

Grain Size in Millimeters

Cobbles

Gravel

Sand

Coarse

Fine

Coarse

Medium

Fine

Silt or Clay

Depth

Classification

Nat. WC

LL

PL

PI

SM

Gradation Curve
Boring No.: SE-7

Soil Type: ML/MH

U.S. Standard Sieve Size

Percent Finer by Weight

Grain Size in Millimeters

Classification Table:

<table>
<thead>
<tr>
<th>Depth</th>
<th>Classification</th>
<th>Nat. WC</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ML/MH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gradation Curve
BORING NO.: SE-8

SOIL TYPE: ML/OL

U.S. STANDARD SIEVE SIZE

3 IN. 1.5 IN. 3/4 IN. 3/8 IN. 4

100

90

80

70

60

50

40

30

20

10

0

GRAIN SIZE IN MILLIMETERS

PERCENT FINER BY WEIGHT

1000

100

10

0.1

0.01

0.001

COBBLES

GRAVEL

SAND

COARSE

FINE

SILT OR CLAY

MEDIUM

FINE

DEPTH

CLASSIFICATION

NAT. WC

LL

PL

PI

ML/OL

GRADATION CURVE

AR301743

Dames & Moore
# Virginia Wood Preservers

**Boring No.: SE-9**

**Soil Type:** SM

### U.S. Standard Sieve Size

<table>
<thead>
<tr>
<th>Grain Size in Millimeters</th>
<th>Percent Finer by Weight</th>
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<tbody>
<tr>
<td>0.001</td>
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<td>0.01</td>
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<td>0.02</td>
<td>60</td>
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<td>0.03</td>
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<td>10</td>
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<tr>
<td>0.10</td>
<td>80</td>
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<td>60</td>
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<td>100.0</td>
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### Gradation Curve

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<th>PL</th>
<th>PI</th>
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<tbody>
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</tbody>
</table>

**Rentokil Inc.**
**Rental Kind Inc. Virginia Wood Preservers**

**Boring No.: SE-10**

**Soil Type: SM/SC**

---

**U.S. Standard Sieve Size**

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<thead>
<tr>
<th>COBBLES</th>
<th>GRAVEL</th>
<th>SAND</th>
<th>SILT OR CLAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>COARSE</td>
<td>FINE</td>
<td>COARSE</td>
<td>MEDIUM</td>
</tr>
</tbody>
</table>

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**Depth**

<table>
<thead>
<tr>
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**Gradation Curve**
(Rentokil Inc.) Virginia Wood Preservers

Boring No.: SE-11
Soil Type: ML/MH

U.S. Standard Sieve Size

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Classification Table

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APPENDIX I

DOWNHOLE TESTING REPORT
This appendix describes methods and presents results of tests conducted in two former production wells (PW-1 and PW-2) during implementation of the Plan of Study (POS) for the Virginia Wood Preserving Site in Richmond, Virginia. The tests included TV logging, geophysical logging and packer testing. They were conducted to obtain information on the stratigraphy of the rocks, rock fractures, water-conducting properties of the fractures, and vertical distribution of chemical constituents. They provide detailed information on relatively small-scale features in and immediately adjacent to the boreholes and, in particular, on the vertical variations within the granite bedrock.

I.1 TELEVISION LOGGING

Television logging was conducted by Earth Data of St. Michael, Maryland, under subcontract to Dames & Moore prior to geophysical logging and packer testing.

I.1.1 Purpose

Television logging was conducted to provide visual images showing the character of subsurface rocks, fracturing, and evidence of groundwater movement into the well.

I.1.2 Equipment Used

Equipment consisted of a downhole color television camera, cables to lower it from the surface, and recording equipment. Television images were recorded on VHS videotape cassettes. The depth being viewed was recorded as numerals on the video image. Its viewing direction, lowering speed, and focusing were all remotely controllable. The camera image was observed on a television monitor during logging, allowing personnel to observe any features that might need special attention during logging.
I.1.3 Data Reduction and Management

Tapes were reviewed by Dames & Moore and written notes were prepared. The notes described the principal features observed—in particular, lithologic contacts, the surface texture of borehole walls, fractures, mineral-filled veins, groundwater movement as shown by movement of particles in water, and staining on borehole walls indicating small amounts of seepage into the borehole.

Significant features observed on the tapes are described in Attachment I-1. The principal conclusions from the logs are the following:

• Borehole walls were for the most part relatively smooth.
• Both wells only penetrated granite. The granite varied in color and mineral composition, with variations reflected by layering and granitic veins.
• Most fractures appeared to be very tight. Only a few fractures had a significant opening.
• None of the fractures showed discernible groundwater movement by movement of solid particles suspended in the water.
• Many fractures show staining evidently caused by seepage from the fracture running down the inside of the borehole while the water level is lowered by pumping. The small sizes of the stains (generally extending 1 foot or less down the borehole) indicate extremely small rates of seepage.
• Mineral veins were common, particularly in the deeper half of PW-2, and all were completely filled by minerals.

I.2 GEOPHYSICAL LOGGING

Geophysical logging was performed by Appalachian Coal Surveys of Pittsburgh, Pennsylvania, under subcontract to Dames & Moore.
I.2.1 Purpose

Geophysical logging consists of lowering instruments (called "tools") into a well or borehole to measure the properties of the rocks surrounding the well or of the water in the well by electrical or nuclear methods. These properties were recorded as graphs on paper strip charts as a function of depth. The use of geophysical logging in groundwater investigations is described more fully by Keys and MacCary (1971).

Both production wells were logged to obtain information on stratigraphy and fractures in the bedrock. Various kinds of logs are compared when interpreting subsurface conditions so that important features such as fractures could be confirmed by comparing several logs.

Geophysical logging was of particular value because it cost-effectively measured properties of the bedrock (such as the presence of fractures) that would otherwise have required very costly and time-consuming rock cores. Drilling logs were not available for either well; therefore, geophysical logging was the only practical method to obtain information regarding rocks penetrated by the wells.

I.2.2 Types of Logs Obtained

Eight different geophysical logs were run. The logging methods used were selected for the information that they would provide on bedrock lithology, presence of fractures, and active groundwater movement in the bedrock.

The output of geophysical logs is shown in Attachment I-2. Not all logs were run for the entire depth of the hole, in part because some logs cannot be run through casing, while others can be run only below the water level.

The logging methods used, and the reasons for their use, are as follows:

**Electrical Resistivity and SP Logs.** Electrical resistivity and SP logs measure electrical properties of rock. They are often referred to collectively as "electric logging" or E-logging."
Both are run using the same equipment. The tool consists of a simple electrode, which is lowered into the borehole. Electricity passes through the rock to a second electrode in electrical contact with soil or rock at the surface.

Resistivity logging involves passing an alternating current at constant voltage between the electrodes. The current flowing between the electrodes then depends on the electrical resistance of the rock. A large part of the total resistance depends on the resistance of the rock close to the downhole electrode; consequently, variations in current largely reflect the varying resistivity of the rocks that the electrode passes as it travels down the hole. Since rocks vary considerably in resistivity, a resistivity log is particularly useful in distinguishing different rock types—such as sandstone, for example, being usually much more resistive than shale.

SP logging measures small electrical voltages generated naturally at the contacts between differing rock types, the water in the bedrock, and the water in the borehole. SP logs are used primarily for detecting contacts between different rock units. In the production wells for this investigation, water in the rock and in the borehole are very similar in chemical composition, and the rock was relatively homogeneous, so SP logs were of limited value. They were obtained, however, because they could be recorded along with the resistivity log without additional effort or expense.

**Caliper Logs.** A caliper log measures the inside diameter of the borehole. The caliper tool used consisted of a cylindrical body carrying three arms, hinged at one end and spring-loaded to press against the inside of the borehole. The varying borehole diameter either compresses the arms or allows them to expand as the tool is raised from the bottom of the hole. This changes the position of a variable electrical resistor enclosed in the tool body, thus transmitting a varying electrical signal to the surface. This signal is recorded as a graph showing the varying hole diameter. Caliper logs were particularly useful for detecting fractures and broken intervals. During packer tests, they were used to select depths where packers would likely obtain a good seal against the inside of the borehole.

**Natural Gamma Logs.** Natural gamma logging measures the gamma radiation emitted by rocks surrounding the borehole. The radiation comes from radioactive
isotopes of naturally occurring elements in the rock—in particular, from potassium, uranium, thorium, and their decay products. Natural gamma logs are particularly useful in distinguishing between different rock types, for example, between sandstone and shale, or for distinguishing intrusive dikes from surrounding rock.

**Neutron Porosity Logs.** Neutron porosity logging measures the total porosity of rocks surrounding the borehole. The total porosity includes both effective porosity, representing the open space through which water can move actively, and possible isolated or dead-end spaces through which water cannot move actively.

The neutron tool consists of two parts—a neutron source and a detector. The neutron source emits energetic neutrons into the rock, where they are slowed to energies to which the detector is sensitive and scattered back toward the detector, or else they interact with matter to produce gamma radiation. The detector is sensitive to both the scattered neutrons and to the induced gamma radiation. Slowing and scattering, and gamma production, occur most readily when neutrons collide with hydrogen atoms. In most rocks hydrogen occurs largely in water, so high detector readings indicate high water content and consequently high porosity.

The neutron porosity log was used, with other logs, primarily to detect fractures and broken intervals.

**High-Resolution Density Logs.** This log is a type of gamma-gamma log, which measures the bulk density of the surrounding rock. The method resembles neutron logging. The tool consists of two parts—a gamma radiation source and a detector. The source emits gamma radiation into the rock, where it is scattered in proportion to density. The detector measures the scattered radiation, which is recorded on the chart in terms of equivalent density.

The high-resolution tool is designed to measure density over a relatively narrow vertical extent and is thus excellent for detecting narrow features such as thin beds or fractures. It was used in this investigation as one of the primary logs for locating fractures.

**Fluid Temperature and Conductivity Logs.** Temperature and electrical conductivity of the water in the borehole were logged as a function of depth. Water flowing into the borehole from a fracture often differed in temperature of dissolved ionic
chemical constituents from water already in the borehole. This produced an inflection in the plots of temperature and conductivity with depth. These logs were used, along with high-resolution density and caliper logs, in detecting fractures.

**Geophysical Logging Results.** Geophysical logging results were similar between the two wells. In general, they showed the presence of relatively low-density, high-permeability material near the surface, evidently corresponding to the surface sediments, hardpan and saprolite. There is a sharp downward transition into a denser, lower-porosity material, corresponding to the Petersburg Granite, which is relatively uniform in its properties and shows little evidence of fracturing or groundwater movement.

**Logging in Well PW-1.** Caliper logging showed a relatively uniform hole diameter, decreasing from 6.4 inches at 9 feet depth to 5.6 inches at 224 feet; the decrease is probably due to bit wear during drilling. The interior of the well was smooth. The only features suggestive of fracturing is a small area of enlargement to 6.7 inches at 62 feet.

Natural gamma logging showed mostly uniform count rates near 100 counts/second, indicating a granite of relatively uniform composition. Peaks of 250 counts/second or more occurred at 70, 100, 119, 139, 169, 227, and 243 feet; these are probably due to granite layers or dikes richer in potassium or other radioactive elements.

Density was distinctly lower above 48 feet, which represents the top of the granite. Below this depth, density was fairly constant, except for relatively narrow peaks of higher density that generally coincided with peaks in the natural gamma log.

Electrical resistivity was relatively uniform over most of the depth of the well, except for somewhat higher resistivity above 36 feet, evidently corresponding to sandier surface sediments, and a broad peak of lower resistivity near 48 feet, evidently representing the saprolite.

The spontaneous potential curve was very smooth, without any inflections that would indicate lithological contacts.
Neutron porosity was greatest near the surface, and decreased downward to 48 feet depth. Below that depth it was essentially uniform, and lacked any peaks that would indicate fracture zones or other zones of higher porosity.

Fluid conductivity was constant at 45 ohms-meter for the entire depth of the well.

Fluid temperature changed very smoothly, falling from 64 degrees F at the bottom of the casing to 57 degrees at 18 feet, then rising to 58.9 degrees at 48 feet, and falling to a nearly constant 55.3 degrees below 220 feet. Neither log suggested any active groundwater flow into the well.

Logging in Well PW-2. Caliper logging showed a decrease in diameter from 6.4 inches near the surface to 5.9 inches at 490 feet. Most of this change in diameter took place in two sudden decreases of 0.2 inches at 60 and 320 feet. Otherwise, the interior was smooth and uniform.

Natural gamma logging showed mostly uniform count rates near 100 counts/second, indicating a granite of relatively uniform composition. Peaks of 250 counts/second or more occurred at 62, 70, 179, 232, 412, 453, and 473 feet. The similarity in the number and depths of peaks compared with PW-1 suggests that the peaks may represent layers or dikes occurring as tabular bodies dipping at low angles.

Density was distinctly lower above 24 feet, which represents the top of the granite. Peaks in the gamma log generally correspond with density peaks; however, there are a larger number of density peaks that do not have corresponding gamma peaks. The significance of these latter peaks, if any, is unknown.

Electrical resistivity was constant at 480 ohms from 6 to 24 feet. At 24 feet, there was a sharp increase to 550 ohms, coinciding with the increase in density. Below that depth, resistivity decreased relatively smoothly to the bottom of the hole. Nothing in the resistivity log indicates any large differences in lithology over the depth range logged.

Spontaneous potential was constant near +210 millivolts to a depth of 24 feet, where it increased slightly but rapidly to +270 millivolts. Below that depth, it
showed minor fluctuations that could not be correlated with indications of lithological changes from other logs, but the general pattern was a steady decrease to +90 millivolts at the bottom of the hole.

Neutron porosity was distinctly higher above 24 feet. Below that depth porosity was lower, and was relatively constant to 350 feet. The curve showed broad areas of somewhat higher porosity than adjacent parts of the granite between about 370 and 390 feet, and lower porosity between 402 and 412 feet, and 466 and 476 feet. These inflections are not sharp, and suggest minor variations in lithology rather than fracture zones.

Fluid conductivity had three values depending on depth, with sharp transitions between them: 48.2 ohm-meters from 2 to 9 feet, 47.8 ohm-meters from 9 to 283 feet, and 47.0 ohm-meters from 283 feet to the bottom of the hole. None of the step changes in conductivity could be correlated with any distinctive features in the other logs.

Fluid temperature followed a pattern similar to PW-1 to a depth near 200 feet, where temperature reached a minimum of 56.4 degrees F. Below that depth it increased smoothly to 59.5 degrees at 493 feet. The temperature curve was smooth, with no inflections to suggest fluid flow into the well. In particular, there were no temperature inflections at the depths where inflections occurred in fluid conductivity.

I.3 PACKER TESTING

Packer testing equipment and technical support services were supplied by Earth Data, Inc., of St. Michaels, Maryland, under subcontract to Dames & Moore. The supporting data tables are contained in Attachment I-3.

I.3.1 Purpose

Packer tests were conducted in two 6" former production wells to measure the variation in hydraulic conductivity with depth and to obtain water samples to show the variation in chemical constituent concentrations with depth. The depth intervals tested, and the results obtained, are summarized in Table I-3.1.
3.2 Equipment Used

Borehole intervals were tested by isolating roughly a 50-foot interval, then pumping water from the test section, where practicable, while observing water level drawdown and taking water samples.

The equipment used in packer tests had four functions:

- Isolate a suitable interval of well.
- Pump water from the isolated interval.
- Measure water level in, above, and below the isolated interval.
- Display the water levels during the test for the test inspector's information.

The section of the well to be tested was isolated by means of inflatable packers, balloon-like devices inflated inside the well to make a tight seal with the surrounding rock. Water was pumped with an electric submersible pump mounted between the packers, and water levels were measured using electronic pressure transducers wired to the surface and monitored on an electronic data logger. Equipment is shown diagrammatically in Figure I-1.

The packer consisted of a heavy black rubber sleeve connected to two steel and aluminum end pieces. Packers were manufactured by Baski Water Instruments. The packer was inflated with compressed nitrogen supplied from gas cylinders through thick-walled plastic tubing. Inflation pressure was typically 100 to 300 psi, depending on the depth of packer submergence. Inflation was controlled by a packer control panel that housed valves, pressure regulators, and gauges.

A Gould Series 10E310412 1-hp, 230-v electric submersible pump was used. It could produce up to 18 gpm, depending upon the pumping rate needed for the discrete interval being tested.

The packers and pump were connected and supported by 1 1/2-inch galvanized steel pipe that also served as the pump discharge line. This pipe was attached to a fitting that passed through the center of the upper packer. The pump wires passed through the upper packer by way of compression fittings that sealed the
FIGURE I-1
DOUBLE INFLATABLE PACKER/PUMP ASSEMBLY
opening against water. A similar fitting provided passage for the lower packer inflation tube. The foot valve was removed from the pump to allow conducting the preliminary slug test described in the following section. Also, a roll of 1/8" inert plastic tubing was secured to the 1 1/2-inch galvanized steel discharge pipe for sampling purposes so as to not receive elevated metal concentrations by taking a sample through the galvanized steel discharge pipe.

The pressure transducers produced a voltage from 0 to 100 mv over the pressure range of 0 to 200 psi. In appearance, they were cylinders about 5 inches long and 3/4 inch in diameter, with an internally threaded opening at the bottom and a cable that ran to the surface at the top. There were 3 transducers used in the packer testing. The top transducer was placed above the top packer to check the seal of the upper packer. The middle transducer was placed below the submersible pump between the upper and lower packer to monitor the drawdown in the discrete pumping interval. The bottom transducer was also mounted between the upper and lower packers but had a semirigid plastic tube going through the bottom packer to measure pressure below it.

Packers, pump, and pipe were broken down into separate units for transportation. Packer inflation tubes, the pump power cable, transducer cable, and the inert plastic sample tubing were bundled together and rolled up on 4-foot-diameter reels suspended from a frame that allowed them to be turned easily. The tubes and cables were terminated at connectors near the reel axis.

The top of the 1 1/2-inch steel pipe terminated at a tee coupling installed with one opening horizontal and another upward. During most of the test, the top opening was plugged, and the pump discharge was diverted through the side opening to a mechanical flow meter. Water was discharged through 1 1/2" polyethylene pipe into the wood treatment system at the site, to be used by Rentokil for future wood treatment.

Test results were recorded and displayed using a Metrosonics model 714 electronic data logger. A short cable carried transducer signals from connectors on the cable and tubing reel to input channels 1, 2, and 3 of the data logger. After
each test, the data was down-loaded onto diskettes using a DataVue portable personal computer.

The Dames & Moore geologist monitored the output of the 3 channels to tell whether the packers were forming a good seal. A good seal was indicated by large decrease in pressure (that is, in water level) on channel 2 (between the packers) but little or no pressure change on channels 1 and 3 (above and below the packers).

I.3.3 Methodology

Two kinds of packer tests were conducted—single-packer tests and double-packer tests. In single-packer tests, only one of the two packers was inflated; the test interval was between the packer and the bottom of the well, or else between the packer and the water level in the well. Double-packer tests were conducted by inflating both packers; the test interval was the 50 ft interval between the packers.

The packers, pump, and pipe were steam cleaned before and after use and between the two production wells. A backup of all downhole instruments was brought to the site in case of breakdown. Because of the length of the packers and pump, they were assembled as they were lowered into the borehole. Transducers were mounted as stated above and attached to the pressure tubes. The bundle of cables and inflation tubing was unrolled from the reel and attached to the pump discharge pipe with electrical tape at 5-foot intervals as the packers and pump were lowered.

Information from television and geophysical logs was used to select packer test intervals. Fractures, broken intervals, and sections with excessive diameter were avoided when positioning the packers to improve the likelihood of a good seal between the packers and the borehole wall so as only the discrete interval to be tested was pumped or sampled without outside interference from another interval, above or below the two packers.

After the packers, pump, and other equipment were lowered to the test depth, the following steps were carried out:

- Cables from the cable reel were connected to the data logger.
- The data logger was started.
The packers were inflated. This caused significant water level changes in some test intervals.

Water levels were allowed to stabilize.

The cap on the tee fitting at the top of the pump discharge pipe was opened. A preliminary slug test to evaluate the tightness of the rock in the isolated interval was conducted by pouring one gallon of distilled water into the discharge pipe. The resulting water level rise and fall were observed on the data logger. If more than two minutes were required for water in the isolated interval to return to its previous level, the interval was considered likely to produce little water, and the pumping proceeded cautiously (the control valve was nearly closed when pumping started). This prevented excessive drawdown, which might otherwise have damaged either the pump or transducers. (If more than 30 minutes were required for water in the isolated interval to return to its previous level or if the interval was incapable of accepting the full one gallon of distilled water for the initial slug test, this interval was considered as producing negligible water flow. In this case, the pump was not operated, but the packers were deflated and moved downward to the next test interval.)

The pump was started.

The water level shown on the data logger was observed. If the drawdown was excessive, the pumping rate was reduced. Drawdown was considered excessive if it produced negative pressure (shown by negative output voltage) on the transducer. If the control valve was initially nearly closed, it was sometime necessary to open it further to produce measurable drawdown.

If significant drawdown occurred in the intervals above or below the isolated interval, the packer seal was considered defective. Significant drawdown in these intervals was considered to be more than approximately 10 percent of that in the isolated interval. The packers
were raised or lowered a few feet to try to obtain a better seal under this circumstance.

- The water level in the isolated interval was allowed to stabilize. Generally, this took 10 to 30 minutes dependent upon the hydraulic conductivity of the specified interval.

- The pump discharge was continuously measured with a stopwatch and mechanical flow meter, especially after changes in pumping rate.

- After three volumes of the isolated interval were pumped, a water sample was taken from the 1/8" inert plastic tubing. Water sampling procedures were in compliance with procedures described in the S.O.P. Water samples were analyzed for volatiles, BNA's, and metals, except for one full priority pollutant scan done in the first interval tested in PW-2.

- The uppermost packer test in a borehole was conducted with as a single-packer test with the lower packer located roughly 50 feet below the water surface. The upper packer was deflated.

- After completing each test, pipe was added to lower the equipment by roughly 50 feet, and the next interval was tested.

- The lowest packer test was not conducted with the lower packer exactly at the bottom of the borehole. After testing a 50-foot interval with both packers inflated, the lower packer was deflated and the water level was allowed to stabilize again to test the interval between the upper packer and the bottom of the well. An extreme example occurred in PW-2 where it was believed that there were no water producing intervals below 370 feet depth. After testing interval PW-2G (318-372.6 feet), the top packer was lowered to 369 feet and inflated, with the bottom packer left deflated. The slug test was performed, and this interval (369 feet to the well bottom, approximately 500 feet) was found incapable of accepting the full one gallon slug and was considered to be producing negligible water.
The following were recorded in field notes—the depth interval tested, water level before the test, peak water level after slug test, starting and ending time of the test, volume pumped, and the name of the file created on the diskette.

1.3.4 Data Reduction and Management

Two principal kinds of data were managed—water level and pumping data, used primarily to determine hydraulic conductivity, and chemical analysis data.

Water level data were recorded by the electronic data logger, then transferred to a diskette after the test using the logger's multiple-channel output format. A consistent file-naming convention was used to associate the file with the well and the interval tested. For example, a file from a test of production well PW-2 in the first interval tested would have the file name of PW-2A. Data consisted of records showing the clock time, seconds lapsed since the start of the test, the water levels recorded by the three transducers, and the recording interval. Water levels were recorded on the diskette as feet of water above the transducer, just as reported by the logger, so that they could be interpreted with as little manipulation as possible.

Additional BASIC programs converted data files to a format that could be conveniently imported onto the Lotus 1-2-3 spreadsheet program for plotting. Each record in the output files from the conversion program contained the number of minutes since the start of the test, and water levels from the three transducers converted to depth below the top of casing.

Graphs of water level shown by the transducers were plotted and are presented among figures in Attachment I-3. The graphs were used where possible to determine the drawdown after the water level had stabilized in the tested interval. Some of these graphs have been annotated to illustrate how they were interpreted. Water level recording was started using the Metrosonics data logger before packers were inflated. Packer inflation caused small changes in water levels—first because water was displaced by the packer, then because water levels stabilized about one foot different from one another as a result of vertical hydraulic gradients in the bedrock.
1.3.5 Analysis of Test Results

Hydraulic conductivity of tested intervals was determined in two different ways, depending on whether or not the interval was capable of producing significant water. In productive intervals, hydraulic conductivity was calculated from pumping drawdown; in unproductive intervals, it was calculated from slug test data.

**Pumping Tests in Productive Intervals.** Of the thirteen water producing intervals tested, only three produced sufficient water for sampling. One, PW-1E, was in well PW-1 from 160.25' to the well bottom and produced less than 4 gpm. Two were in well PW-2, PW-2A from the water level to 65 feet, and PW-2C, from 112.55 to 167.6 feet. Both of these intervals produced slightly less than 15 gpm.

When the pump was started in a productive interval, water levels fell very rapidly; the test inspector then adjusted the pump discharge valve to prevent excessive drawdown. The water level stabilization period varied among tests. After water levels stabilized and three well volumes were pumped, samples were taken for chemical analysis. After all the containers have been filled, the pump was turned off and the recovery was monitored on the Metrosonics data logger.

To compute hydraulic conductivity from pumping drawdown, the following formula was used:

\[ Q = 2LkH/\ln(L/r) \]

where:  
- \( Q \) = Pump discharge  
- \( L \) = Length of isolated interval  
- \( k \) = Hydraulic conductivity  
- \( H \) = Drawdown  
- \( r \) = Borehole radius

The suitability of this formula for packer test analysis was investigated by Bliss and Rushton (1984). Results of the packer pumping tests and the depth intervals tested are summarized in Table I-3.1.

The fact that well PW-1, with six inch diameter and 250 feet depth, was producing less than 4 gpm led to concern that a water producing interval might have been missed by having a packer sealed over a water-producing fracture at some
depth in the well. To check this, a pump test was conducted on the entire well from the water table to the well bottom with both packers deflated. This confirmed that indeed the entire well was producing less than 4 gpm as initially found by packer testing.

An apparent defect in well construction was discovered during testing of interval PW-1A (water level to 65.2 feet) in well PW-1. The preliminary slug test suggested that this interval should be capable of producing a small amount of water. The one gallon slug raised the water level in the discharge pipe only 1.80 feet, implying that this interval could produce water in the order of 5 to 10 gpm, by comparison to other intervals already tested on site. However, when the pump was slowly turned on, a dramatic drop in the water level, and the fact that the recovery was almost unmeasurable, showed that this was not a water producing interval in spite of the slug test results.

The explanation for these results appears to lie with the well’s construction. A pitless adapter had to be removed from the casing for the packers to fit in the well. When Earth Data personnel dug down around the well casing for a few feet to remove the pitless adapter, an opening was found between the 6 inch steel casing and the surrounding soil. There was no evidence of grout present in this annulus. This observation and the appearance of deterioration in the 6-inch steel casing seen in downhole television images suggested strongly that the one gallon slug was infiltrating through the well casing into the surrounding soil or annulus, and thus interval PW-1A not a significant water producing interval after all. It is possible that contaminants from the surface soils could have moved downward through the open annulus, thus bypassing the confining clay layer present at the site.

Chemical analyses of packer test water samples were reported to Dames & Moore by Compuchem Laboratories, Inc. Concentrations of constituents analyzed are reported in Appendix B-1.

**Slug Tests in Unproductive Intervals.** In intervals where hydraulic conductivity was too low for a satisfactory pumping packer test, hydraulic conductivity was estimated using data from the preliminary slug test using a method described by the U.S. Naval Facilities Engineering Command (1982). Water was added through the pump
discharge pipe to raise the water in the test interval above its original level. Water level was monitored by the transducer/logger system as it gradually fell to its original level.

The preliminary slug test raised the water level in the middle interval from 0.1 feet to more than 11 feet. The more the water level increased, the lower the hydraulic conductivity of the tested interval. Low hydraulic conductivity was due to the interval not having available fractures to accept the one gallon slug of distilled water. Test intervals that either would not accept the full one gallon slug, or else that would accept the full gallon but where the water level would take extensive time to return to its original position, were considered to have minimal hydraulic conductivity. In intervals PW-2B, and PW-2D through PW-2H, after the slug was introduced, the water level fell less than 0.1 feet in an extended period of time. Data from these intervals were not transferred to a diskette, since the graph would be a straight horizontal line from which no specific numerical value of hydraulic conductivity could be computed.

To analyze each slug test, a time after the start of the test was chosen and called \( t_1 \), and the corresponding difference between the original water level and the water level at \( t_1 \) was computed and called \( H_1 \). Similarly, a number of later times \( t \) were also selected, and corresponding differences in water level \( H_t \) were determined. For each time, the ratio \( H_t/H_1 \) was computed, and an ASCII data set containing time (in minutes after \( t_1 \)) and \( H_t/H_1 \) was written as a disk file. This data set was used as input to an x-y plotting program, which then drew graphs of \( H_t/H_1 \) (on a vertical logarithmic scale) against \( t \) (on a horizontal linear scale). These graphs generally showed a straight-line relation over much of the data range.

The following formula (U.S. Naval Facilities Engineering Command, 1982) was used to compute hydraulic conductivity from slug test data:

\[
k = \frac{r^2 \ln(L/r) \ln(H_t/H_1)}{2L(t_1-t)}
\]

where:

- \( k \) = Hydraulic conductivity
- \( r \) = Borehole radius
- \( L \) = Length of isolated interval
\( H_1, H_2 = \) Differences in water level at times \( t_1, t_2 \), which are two convenient times selected from the linear portion of the semilogarithmic graph of \( \frac{H_1}{H_0} \) against \( t \).

The resulting hydraulic conductivities and tested interval depths are listed in Table X-3.

1.4 SUMMARY OF DOWNHOLE TESTING

Television logging showed that both wells penetrated only granite, and that there were very few fractures in the granite. No groundwater flow was directly observed from any fracture. Staining on borehole walls suggests that seepage occurs from many fractures, but at extremely slow rates.

Geophysical logging showed that the granite was relatively uniform in lithology, with apparent layers or dikes of granite of somewhat different composition from the rest of the granite. There was little evidence of fracturing in the granite, and none of active groundwater flow.

Packer testing showed that the granite had generally very low permeability and does not yield significant amounts of water to the wells. One water-producing zone, probably consisting of one or more fractures, occurs in well PW-2 between 112.55 and 167.6 feet depth. Almost all water yielded by the wells appears to come from the unconsolidated sediments or saprolite, and migrates downward to the open interval in the well around the outside of the wells. This migration is due to the casings being improperly sealed where they pass through the surficial soils and enter the granite.
ATTACHMENT I-1

TECHNICAL NOTES ON TV LOGGING
PW-1 AND PW-2
## Television Logging Observations

**Well PW-1**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Features Noted</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Start logging in casing. Casing walls pitted, heavily rusted.</td>
</tr>
<tr>
<td>6</td>
<td>Casing joint.</td>
</tr>
<tr>
<td>7</td>
<td>Water level.</td>
</tr>
<tr>
<td>26</td>
<td>Casing joint. Casing rough.</td>
</tr>
<tr>
<td>35</td>
<td>Casing joint; casing appears to be breached. Vertical fracture in casing extends downward 18 inches.</td>
</tr>
<tr>
<td>39</td>
<td>Walls much redder.</td>
</tr>
<tr>
<td>47</td>
<td>Bottom of casing.</td>
</tr>
<tr>
<td>49</td>
<td>Two horizontal fractures, .25 inch openings. Black streaks taper downward for 2 feet.</td>
</tr>
<tr>
<td>52</td>
<td>Horizontal fracture, .5 inch opening.</td>
</tr>
<tr>
<td>53</td>
<td>Horizontal fracture, .5 inch opening. Black streak tapers downward for 2 feet.</td>
</tr>
<tr>
<td>58</td>
<td>White vein, 1 inch wide, 45 degree dip. Black streak tapers downward 1 foot.</td>
</tr>
<tr>
<td>60</td>
<td>Dark vein or fracture, 60 degree dip.</td>
</tr>
<tr>
<td>61</td>
<td>Wall broken out for 1 foot down hole; breakout extends about 1 inch to a vertical fracture paralleling the hole axis, giving the hole a flat wall. The fracture continues downward to 64 feet.</td>
</tr>
<tr>
<td>65</td>
<td>Vertical white veins. Dark streak extending downward.</td>
</tr>
<tr>
<td>69</td>
<td>Vertical white pytymatic veins.</td>
</tr>
<tr>
<td>72</td>
<td>Horizontal fracture, .25 inch. Dark stain extends downward 1 foot.</td>
</tr>
<tr>
<td>86</td>
<td>Horizontal fracture. Horizontal fracture extends downward 2 feet.</td>
</tr>
<tr>
<td>91</td>
<td>Dark stain extends downward 1 foot. No visible fracture.</td>
</tr>
<tr>
<td>95</td>
<td>Dark stain extends downward 1 foot.</td>
</tr>
<tr>
<td>99</td>
<td>Dark stain extends downward 2 feet.</td>
</tr>
<tr>
<td>105</td>
<td>Rough spot in wall. Dark stain extends downward 3 feet.</td>
</tr>
<tr>
<td>116</td>
<td>Dark stain (?) extends downward 1 foot; possible fracture.</td>
</tr>
<tr>
<td>119</td>
<td>Fracture, .25 inch, 45 degrees. Dark stain extending downward.</td>
</tr>
<tr>
<td>121</td>
<td>Three white veins, .25 inch, 60, 45, and 45 degrees dip.</td>
</tr>
<tr>
<td>124</td>
<td>Fracture, .1 inch, 45 degrees. Dark stain extends downward 1 foot.</td>
</tr>
<tr>
<td>125</td>
<td>Lithologic contact, dips 45 degrees. redder and rougher rock below contact. Dark stain extends downward at two places for 1 and 2 feet.</td>
</tr>
<tr>
<td>135</td>
<td>Redder rock continues.</td>
</tr>
<tr>
<td>150</td>
<td>Walls slightly rougher for 6 inches. Below this, rock relatively smooth to 176 feet.</td>
</tr>
<tr>
<td>176</td>
<td>Irregular closed fracture.</td>
</tr>
<tr>
<td>187</td>
<td>Walls rough for 1 foot.</td>
</tr>
<tr>
<td>191</td>
<td>Horizontal fracture. Walls rougher, more bluish for 2 feet.</td>
</tr>
</tbody>
</table>
204 Walls slightly rougher for 2 feet.
208 White .25 inch high-angle vein.
212 Horizontal fracture, .5 inch opening. No visible water movement.
  Rough area extends 1 foot above and below fracture.
213 Walls below are darker, more bluish.
227 Low-angle .25 inch white vein.
240 Walls rougher, slightly more pinkish.
243 Bottom of hole. Loose dark sediment.

Well PW-2

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Features Noted</th>
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<tbody>
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<td>Start logging in casing.</td>
</tr>
<tr>
<td>6</td>
<td>Water level. Casing heavily rusted.</td>
</tr>
<tr>
<td>24</td>
<td>Bottom of casing. Rock walls are slightly rough.</td>
</tr>
<tr>
<td>29</td>
<td>Tight high-angle fracture, intersects both walls and extends downward to 33 feet.</td>
</tr>
<tr>
<td>42</td>
<td>Walls slightly rougher for 2 feet.</td>
</tr>
<tr>
<td>45</td>
<td>Three round to irregular 1 inch holes in wall.</td>
</tr>
<tr>
<td>48</td>
<td>Low-angle fracture, .1 inch, 60 degrees.</td>
</tr>
<tr>
<td>50</td>
<td>Dark stain, 1 inch wide, extends downward for 2 inches, tapers downward.</td>
</tr>
<tr>
<td>57</td>
<td>Walls broken outward for several inches; walls very rough. No sign of water movement. Walls normal roughness below.</td>
</tr>
<tr>
<td>60</td>
<td>Walls slightly rougher than usual.</td>
</tr>
<tr>
<td>65</td>
<td>Walls slightly rougher than usual.</td>
</tr>
<tr>
<td>80</td>
<td>Several narrow, vague white veins, 30 degree dip.</td>
</tr>
<tr>
<td>83</td>
<td>Two intersecting white veins, 30 degree dip. Walls are red-orange.</td>
</tr>
<tr>
<td>86</td>
<td>Vague white vein, 2 inches thick, low angle.</td>
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<tr>
<td>91</td>
<td>Two white veins, .1 inch, 30 degrees.</td>
</tr>
<tr>
<td>92</td>
<td>Walls rougher for 1 foot.</td>
</tr>
<tr>
<td>110</td>
<td>Walls lighter, rougher; apparently broad vein dipping 30 degrees.</td>
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<tr>
<td>113</td>
<td>High-angle tight fracture.</td>
</tr>
<tr>
<td>123</td>
<td>High-angle tight fracture.</td>
</tr>
<tr>
<td>125</td>
<td>High-angle tight fracture.</td>
</tr>
<tr>
<td>129</td>
<td>White vein, .1 inch, 30 degrees.</td>
</tr>
<tr>
<td>130</td>
<td>Open fracture, 1 inch width, extends at least 1 inch outward. No water movement. Walls very rough.</td>
</tr>
<tr>
<td>132</td>
<td>Walls broken outward for 3 inches down hole. Intersection with hole is horizontal, very rough.</td>
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<tr>
<td>139</td>
<td>Tight high-angle fracture.</td>
</tr>
<tr>
<td>160</td>
<td>Tight high-angle fracture.</td>
</tr>
<tr>
<td>165</td>
<td>Tight high-angle fracture.</td>
</tr>
<tr>
<td>168</td>
<td>Tight high-angle fracture.</td>
</tr>
</tbody>
</table>
179 Orange-red, dark stain, 1 inch wide at top, tapers downward for 6 inches.
181 Tight fracture, 15 degrees dip, with two dark stains, .25 inches wide, extending downward.
191 Tight fracture, 80 degrees.
203 Tight fracture, 45 degrees.
206 Tight fracture, 45 degrees.
217 Three tight fractures, 45 to 80 degrees.
220 Tight high-angle fracture.
226 Tight high-angle fracture.
232 Tight high-angle fracture.
242 Rough area, 1 foot high, on one side. Dark stain, .5 inch wide at top, tapers downward over 6 inches.
244 Tight high-angle fracture.
248 Tight high-angle fracture.
250 Tight high-angle fracture.
251 About six tight high-angle fractures between 251 and 255 feet.
257 Two tight high-angle fractures.
263 About three tight fractures, near 45 degrees.
270 Tight high-angle fracture. Tight low-angle fracture.
271 Numerous poorly-developed tight fractures with various dips in the interval extending several feet downward.
278 Tight fracture, 60 degrees, with stain .5 inch wide tapering downward for 4 inches.
279 Tight fracture, 30 degrees.
284 About five poorly developed high-angle fractures over 2 foot interval.
286 White vein, .1 inch, 60 degrees.
289 Tight high-angle fracture.
287 White vein, .1 inch, 60 degrees.
290 White vein, .1 inch, 45 degrees.
291 Tight high-angle fracture.
Dark stain, 1 inch wide at top, expanding to 2 inches wide at 291.
293 Horizontal fracture. Dark stains extend downward from fracture in five locations; stains cover about one-quarter of the hole perimeter.
294 Tight high-angle fracture.
295 Numerous .5 inch wide pits; structure unclear but these may represent pits on the surface of a vein.
301 Tight high-angle fracture.
302 Tight high-angle fracture.
305 Tight fracture, 45 degrees.
307 Tight horizontal fracture.
310 Tight fracture, 60 degrees. Irregular dark stains.
311 Tight fracture, 60 degrees.
315 Tight fracture, 70 degrees.
Occasional dark oval spots extend to 320.
320 Vein, 6 inches thick, lighter than surrounding rock, salmon-colored. No openings.
323 Tight high-angle fracture.
326 Four dark oval spots, 1 inch long, elongated downward, in vertical line.
327 Tight high-angle fracture.
331 White vein, .25 inch, 60 degrees.
333 Tight high-angle fracture.
337 Tight high-angle fracture.
338 Tight high-angle fracture.
339 Dark stain, 1 inch wide, extends downward 1 foot.
340 Horizontal fracture. Dark stains extend downward from ten places around the fracture for from .5 to 6 inches. Numerous vague fractures in interval from 340 to 344.
346 Vein, 2 inch thick, anastomosing, 45 degrees, lighter than surrounding rock, salmon-colored. No openings.
354 Vein, .5 inch thick, anastomosing, 70 degrees, lighter than surrounding rock, salmon-colored. No openings.
356 Vein, 1 foot thick, 70 degrees. Vague layering, dipping 45 degrees, between pink granite without visible texture, and slightly darker granite with salt-and-pepper texture.
357 Two tight high-angle fractures, one on each side of hole.
358 Numerous poorly-developed fractures in interval 377 to 380.
359 Dark stain, .5 inch wide, tapers downward for 6 inches.
360 Tight high-angle fracture.
362 Vein, .1 inch, 45 degrees.
364 Vein, .1 inch, 45 degrees.
365 Walls darker, greyer for 1 foot.
366 Irregular dark stains.
368 Pitting of walls; extends downward to 371.
370 Salmon-colored vein, 1 inch, 60 degrees.
371 Salmon-colored vein, 1 inch, 60 degrees.
373 Tight high-angle fracture.
374 Walls rougher, numerous high-angle fractures over interval 390-393.
375 Walls darker, grayer for 1 foot.
376 Walls rougher, pitted. Color darker, less orange.
381 White vein, .25 inch, 80 degrees.
382 Vein, .5 inch, 60 degrees, slightly lighter than surrounding rock.
383 White vein, .1 inch, high-angle.
384 Salmon-colored vein, .5 inch, 70 degrees.
385 Tight high-angle fracture.
386 Three veins, .1 to .5 inch, 70 degrees.
387 Two veins, .1 inch, 80 degrees.
388 Vein, .5 inch, 45 degrees. Other veins are present but are thinner and poorly shown.
389 Pitting on walls. Color still pinkish.
390 Tight high-angle fracture.
395 Vein, .25 inch, 45 degrees.
466 Tight 45 degree fracture.
468 Rock is darker, grayish, and rougher.
   Several dark rings (tool marks?) around hole.
471 Hole follows vertical contact between gray salt-and-pepper
   textured granite exposed in half of the hole, and orange,
   fine-textured granite in the other half. Hole continues to follow
   this contact to bottom of hole.
476 Tight fracture, 80 degrees, cuts both rock types.
477 Tight fracture, 80 degrees, cuts both rock types.
478 White vein, 1 inch, 70 degrees, cuts only gray granite.
483 White vein, .25 inch, 45 degrees, cuts only gray granite.
485 White vein, .25 inch, 45 degrees, cuts only gray granite.
486 Bottom of hole. Dark soft sediment at bottom.
ATTACHMENT I-2

GEOPHYSICAL LOGGING DATA REPORT
**NEUTRON TEMPERATURE WELL: PW-1**

**PROJECT**: VA WOOD  
**CLIENT**: DAMES & MOORE  
**LOCATION**: VA  
**CLIENT ID NO**: RICHMOND  
**DATE**: June 9, 1989

---

### BOREHOLE DATA

- **DRILLING CONTRACTOR**: 250  
- **CUSTOMER TD**: 245  
- **COLOG TD**: 6 inch

### CASING RECORD

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<tr>
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<th>CASING RECORD</th>
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<td>From</td>
</tr>
<tr>
<td>1</td>
<td>TD</td>
<td>6.25</td>
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### GENERAL DATA

- **MUD TYPE**:  
- **TIME SINCE CIRC**:  
- **INSTRUMENTATION**:  
- **LOGGING ENGINEER**: CBC  
- **UNIT/TRUCK**: 81  
- **CLIENT REP**: Chris Kupfer  
- **OTHER SERVICES**: RESISTIVITY SP FLUID RES

---

### LOGGING DATA

<table>
<thead>
<tr>
<th>LOG FUNCTION</th>
<th>RUN NO.</th>
<th>MODEL</th>
<th>PROBE S.N.</th>
<th>UPHOLE S.N.</th>
<th>DIG INT FEET</th>
<th>SPEED FT./MIN</th>
<th>DETECTOR</th>
<th>SPACING Tx-Rx FEET</th>
<th>Rx-Rx FEET</th>
<th>TYPE</th>
<th>SOURCE</th>
<th>SIZE CURIE</th>
<th>FROM</th>
<th>TO</th>
<th>INT. FEET</th>
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</thead>
<tbody>
<tr>
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<td>8903</td>
<td>ACS108</td>
<td></td>
<td>0.25</td>
<td>20</td>
<td>Lil</td>
<td>12 in</td>
<td></td>
<td></td>
<td>ArrBe</td>
<td>3 Ci</td>
<td>6</td>
<td>245</td>
<td>239</td>
</tr>
<tr>
<td>TEMPERATURE</td>
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<td>8903</td>
<td>ACST2</td>
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<td>8903</td>
<td>ACST2</td>
<td></td>
<td>0.25</td>
<td>20</td>
<td>ELEC</td>
<td>12</td>
<td></td>
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<td>245</td>
<td>233</td>
<td>233</td>
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<tr>
<td>RSP</td>
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<td>ACST2</td>
<td></td>
<td>0.25</td>
<td>20</td>
<td>ELEC</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>245</td>
<td>233</td>
<td>233</td>
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</tbody>
</table>

**REMARKS**: AR301774
FLD_CNDTVTY
40 OHM-M 50
S.P. 100 millivolts 300

TEMPERATURE
K 54 DEGREES_F

NEUTRON
K 0 CPS

RESISTIVITY
K 400 OHMS

020PW1.TEO)
HYDROLOGY PW-1
## General Data

- **Hole Medium:** Air/Water
- **Drill Method:** Air Rotary
- **Time Since Circ:** [ ]
- **Viscosity:** [ ]
- **Weight:** [ ]
- **Unit/Truck:** 81
- **Logging Engineer:** CBC
- **Client Rep:** Chris Kupfer
- **Other Services:** Caliper Resistance

## Logging Data

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<th>Equipment</th>
<th>Logging</th>
<th>Detector</th>
<th>Spacing</th>
<th>Source</th>
<th>Size/Curie</th>
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<td>47-245</td>
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<td>239 ft</td>
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**Calibration Factor(s):**

**Digital File Name(s):**

**Remarks:**

AR301778
LITHOLOGY PW-1
**APPALACHIAN COAL SURVEYS**
P.O. BOX 17203 PITTSBURGH, PA 15235
PHONE: (412) 243-3039

**TEMPERATURE NEUTRON**
WELL: PW-2

**PROJECT:** VA WOOD
**CLIENT:** DAMES & MOORE
**LOCATION:** RICHMOND
**STATE:** VA **COUNTY:** HENRICO **ELEV:** **DEPTH REF:** TOC
**DATE:** June 9, 1989
**COLOG ID NO:** 0208901

**BOREHOLE DATA**

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<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
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**HOLE MEDIUM:** AIR/WATER **DRILL METHOD:** AIR Rotary

**GENERAL DATA**

**INSTRUMENTATION:**
**LOGGING ENGINEER:** CBC
**CLIENT REP:** Chris Kupfer
**OTHER SERVICES:** CALIPER RESISTANCE

**UNIT/TRUCK:** 81

**LOGGING DATA**

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<th>MODEL</th>
<th>PROBE S.N.</th>
<th>UPHOLE S.N.</th>
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<th>TX-RX FEET</th>
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<th>SOURCE TYPE</th>
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<td>Lil</td>
<td>12 in</td>
<td></td>
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**CALIBRATION FACTOR(S):**
**DIGITAL FILE NAME(S):**
**REMARKS:**

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**HYDROLOGY PW-2**

**AR301782 RESISTIVITY**
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HYDROLOGY PW-2

AR301787
## Borehole Data

**Drilling Contractor:**
- CUSTOMER TD: 500
- COLOG TD: 490

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**Hole Medium:** AIR/WATER

**Mud Type:**

**Viscosity:**

**Weight:**

**Drill Method:** AIR Rotary

**Time Since Circ:**

**Instrumentation:**

**Logging Engineer:** CBC

**Client Rep:** Chris Kupfer

**Other Services:** CALIPER RESISTANCE

### Logging Data

<table>
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<tr>
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<td>DENSITY</td>
<td>2</td>
<td>ACS106</td>
<td>ACS106</td>
<td>ACS106</td>
<td>0.05</td>
<td>20</td>
<td>5</td>
<td>Am241</td>
<td>0.5 C</td>
<td>24 to 490</td>
</tr>
<tr>
<td>RESISTANCE</td>
<td>1</td>
<td>ACS106</td>
<td>ACS106</td>
<td>ACS106</td>
<td>0.05</td>
<td>20</td>
<td>5</td>
<td></td>
<td></td>
<td>24 to 490</td>
</tr>
</tbody>
</table>

**Remarks:**

**Calibration Factor(S):**

**Digital File Name(S):**

**Source:**

**Remarks:**

---

**Date:** June 9, 1989

**Client:** DAMES & MOORE

**Location:** RICHMOND

**State:** VA

**County:** HENRICO

**Elev:**

**Depth Ref:** TOC

---

**Appalachian Coal Surveys**

P.O. Box 17203 Pittsburgh, PA 15235

Phone: (412) 243-3039

WELL: PW-2

MO: VA WOOD

COLOG ID NO: 0208901

**Logged Interval:**

**Remarks:**

AR301788
ATTACHMENT 1-3

PACKER TEST REPORT
### TABLE I-3.1

Summary of Packer Test Results

<table>
<thead>
<tr>
<th>Interval</th>
<th>Depth</th>
<th>Slug Accepted</th>
<th>Flow Rate</th>
<th>Pumping Rate</th>
<th>Sample Taken</th>
<th>Peak Water Level Above Normal After Slug Test</th>
<th>Hydraulic Conductivity (ft/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Well PW-1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PW-1A</td>
<td>W.T.-65.2'</td>
<td>1 gal.</td>
<td>--</td>
<td>13 gpm</td>
<td>No</td>
<td>1.80'</td>
<td></td>
</tr>
<tr>
<td>PW-1B</td>
<td>60.0'-114.7'</td>
<td>1 gal.</td>
<td>--</td>
<td>--</td>
<td>No</td>
<td>11.18'</td>
<td></td>
</tr>
<tr>
<td>PW-1C</td>
<td>109.75'-163.85</td>
<td>1/2 gal.</td>
<td>--</td>
<td>--</td>
<td>No</td>
<td>7.30'</td>
<td></td>
</tr>
<tr>
<td>PW-1D</td>
<td>160.25'-214.35'</td>
<td>1 gal.</td>
<td>--</td>
<td>--</td>
<td>No</td>
<td>10.11'</td>
<td></td>
</tr>
<tr>
<td>PW-1E</td>
<td>160.25'-Well Bottom</td>
<td>1 gal.</td>
<td>&lt; 4 gpm</td>
<td>&lt; 5 gpm</td>
<td>Yes</td>
<td>9.56'</td>
<td>2.85 x 10^-5</td>
</tr>
<tr>
<td><strong>Well PW-2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PW-2A</td>
<td>W.T.-65.0'</td>
<td>1 gal.</td>
<td>&lt; 15 gpm</td>
<td>17 gpm</td>
<td>Yes</td>
<td>0.10'</td>
<td>2.45 x 10^-3</td>
</tr>
<tr>
<td>PW-2B</td>
<td>60.0'-115.0'</td>
<td>3/4 gal.</td>
<td>--</td>
<td>--</td>
<td>No</td>
<td>8.49'</td>
<td></td>
</tr>
<tr>
<td>PW-2C</td>
<td>112.55'-167.6'</td>
<td>1 gal.</td>
<td>&lt; 15 gpm</td>
<td>17 gpm</td>
<td>Yes</td>
<td>0.75'</td>
<td>8.77 x 10^-4</td>
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<tr>
<td>PW-2D</td>
<td>164.0'-218.6'</td>
<td>5/6 gal.</td>
<td>--</td>
<td>--</td>
<td>No</td>
<td>10.30'</td>
<td></td>
</tr>
<tr>
<td>PW-2E</td>
<td>215.5'-270.1'</td>
<td>3/4 gal.</td>
<td>--</td>
<td>--</td>
<td>No</td>
<td>8.26'</td>
<td></td>
</tr>
<tr>
<td>PW-2F</td>
<td>266.5'-321.1'</td>
<td>3/4 gal.</td>
<td>--</td>
<td>--</td>
<td>No</td>
<td>8.82'</td>
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<td>PW-2G</td>
<td>318.0'-372.6'</td>
<td>3/4 gal.</td>
<td>--</td>
<td>--</td>
<td>No</td>
<td>8.63'</td>
<td></td>
</tr>
<tr>
<td>PW-2H</td>
<td>369.0'-Well Bottom</td>
<td>3/4 gal.</td>
<td>--</td>
<td>--</td>
<td>No</td>
<td>9.16'</td>
<td></td>
</tr>
</tbody>
</table>
Virginia Wood Preserving
Packer Test PW-1A (W.T. to 65.2')

Slug Test
Pump On
Pump Off

Submergence Below T.O.C. (feet)

Time (Min.)

0 10 20 30 40 50 60 70 80 90 100 110

-10 -20 -30 -40 -50 -60 -70 -80 -90

Middle Transducer (M)  Bottom Transducer (B)

7/5/89
Virginia Wood Preserving
Packer Test PW-1B (60.6' to 114.7')

Packer Inflation
Introduce Water Slug

Submergence Below T.O.C. (feet)

Top Transducer (T)  Middle Transducer (M)  Bottom Transducer (B)

7/26/89
Virginia Wood Preserving
Packer Test PW-1C (109.75' to 163.85')

Introduce Water Slug

Submergence Below T.O.C. (feet)

0

Packer Inflation

TIME (Min.)

-10 0 10 20 30 40

Top Transducer (T)  Middle Transducer (M)  Bottom Transducer (B)

7/27/89
Virginia Wood Preserving

Packer Test PW-1D (160.25' to 214.35')

Packer Inflation

 Slug Test

Submergence Below T.O.C. (Feet)

TIME (Min.)

Top Transducer (T)  Middle Transducer (M)  Bottom Transducer (B)

7/27/89

AR301799
Virginia Wood Preserving
Packer Test PW-1E (160.25' to Bottom)

Slug Test

Pump On

Reduce Pumping Rate

Submergence Below TOC (feet)

TIME (Min.)

0 10 20 30 40 50 60 70 80

--- Top Transducer(T) --- Middle Transducer(M) --- Bottom Transducer(B)

7/27/89

RR301800
Virginia Wood Preserving
Pump Test (PW-1)

Submergence Below TOC (feet)

0 10 20 30 40

Time (Min)

Pump On

Pump Off

Bottom Transducer

7/27/89
Virginia Wood Preserving
Packer Test PW-2A (W.T. to 65.0')

Pump On

Pump Off

Submergence Below T.O.C. (feet)

TIME (Min.)

0 10 20 30 40 50 60 70 80 90 100 110

(B)

(M)

— Middle Transducer(M) — Bottom Transducer(B)

6/29/89
Virginia Wood Preserving
Packer Test PW-2C (121.65' to 176.70')

Pump On
Slug Test
Pump Off

Top Transducer (T)  Middle Transducer (M)  Bottom Transducer (B)

6/28/89
APPENDIX J

Core Descriptions
APPENDIX J

Core Description

DM-B1

General Description:

This phaneritic biotite granite is grayish pink in color with black specks. It has a seriated inequigranular texture. Grains range in size from .5 mm to 15 mm. The predominant minerals are orthoclase, quartz, oligoclase, biotite, and amphiboles.

This core was intermittently fractured. Most of these fractures are closed and filled with calcite. Fractures were most abundant between 31.5 and 39.5 feet. Fracture orientation ranges from 55° above the horizontal to nearly vertical.

Detailed Description:

<table>
<thead>
<tr>
<th>Depth (ft) From Surface</th>
<th>Description</th>
<th>Orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-29.5</td>
<td>Unconsolidated sediments.</td>
<td></td>
</tr>
<tr>
<td>29.5-31.5</td>
<td>Phaneritic granite, grain size between .5 and 5 mm. No fractures, but core is broken into 6-inch sections.</td>
<td></td>
</tr>
<tr>
<td>31.5-33.5</td>
<td>Core has a pink appearance and has numerous closed fractures which are near vertical and cemented closed with calcite.</td>
<td>55° from horizontal to near vertical</td>
</tr>
<tr>
<td>33.5-35.5</td>
<td>Similar to material above, pink appearance, numerous closed fractures which are nearly vertical. Grain size between .5 and 5 mm.</td>
<td>Near vertical</td>
</tr>
<tr>
<td>35.5-37.5</td>
<td>Similar to material above closed fractures filled with calcite. No fracture but core broken at 36 feet (rough brake), and again at 37.5 feet along a previously cemented fracture. Zones of coarse grains of orthoclase up to 15 mm.</td>
<td></td>
</tr>
<tr>
<td>Depth (ft) From Surface</td>
<td>Description</td>
<td>Orientation</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>37.5-39.5</td>
<td>From 37.5 to 38.5 feet, core is broken into 2-inch sections with irregular edges. Open fracture present (1-2 mm partially cemented). At 38.5 feet core broken is by fracture, calcite cement absent. At 39.5 feet cemented, near vertical fractures broken with 3 mm of calcite still present on one edge of fracture. Fracture parallel to clean brake filled with 2 mm of calcite cement.</td>
<td>55°</td>
</tr>
<tr>
<td>39.5-41.5</td>
<td>Grain size between .5 mm and 2 mm at 39.5 feet. Core broken on fracture, some calcite cement remaining. At 40 feet, core is irregularly broken. At 40.5 feet, closed fracture cemented with calcite. At 41 feet, core is irregularly broken. At 41.5 feet, core is irregularly broken.</td>
<td>55°</td>
</tr>
<tr>
<td>41.5-43.5</td>
<td>Core is irregularly broken between 41.5 and 42.5 feet. Several small fractures are present which are closed and cemented with calcite (less than 1 mm in thickness).</td>
<td></td>
</tr>
<tr>
<td>43.5-44.5</td>
<td>Core is irregularly broken at 44 feet. At 44.5 feet, core is broken along fracture some calcite remaining on surface.</td>
<td></td>
</tr>
<tr>
<td>44.5</td>
<td>End of core.</td>
<td></td>
</tr>
</tbody>
</table>
DM-11 (B)

**General Description:**

This phaneritic rock is grayish pink in color with black specks. It has a seriated inequigranular texture. Grains range in size from .5 mm to 12 mm. The predominant minerals are orthoclase, quartz, oligoclase, biotite, and amphiboles. The rock type is biotite granite.

This core was intermittently fractured. Most of these fractures are closed and filled with calcite. Fractures were most abundant between 15 and 22 feet. Fracture orientation ranges from 55° above the horizontal to nearly vertical.

**Detailed Description:**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
<th>Orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>From Surface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-15</td>
<td>Unconsolidated sediments.</td>
<td></td>
</tr>
<tr>
<td>15-16.6</td>
<td>Phaneritic granite grain size between .5 to 5 mm. Core is broken along open fracture at 16.6 feet. Calcite cement stained with hematite. Very fine biotite grains spaced less than 1 mm apart.</td>
<td></td>
</tr>
<tr>
<td>16.6-18.6</td>
<td>Distinct change in grain size—larger grains of biotite with grain separation of 5 to 10 mm. Orthoclase grains 5 to 12 mm. Core is broken along fracture at 17.6 feet, calcite cement present. A parallel closed fracture exists at 17.7 feet.</td>
<td></td>
</tr>
<tr>
<td>18.6-20.6</td>
<td>From 18.6 to 19 feet the core is broken into two pieces with irregular brakes, no change in grain size. Between 19 and 20 feet grain size between .5 to 5 mm. From 20 feet to 20.6 feet there are no fractures and a return to larger grains.</td>
<td></td>
</tr>
<tr>
<td>20.6-22</td>
<td>Grain size between .5 and 10 mm. Core is broken at two points in</td>
<td></td>
</tr>
</tbody>
</table>

AR301807
<table>
<thead>
<tr>
<th>Depth (ft) From Surface</th>
<th>Description</th>
<th>Orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>22-24</td>
<td>Predominantly unfractured homogeneous texture. Core is broken along fracture at 23.5 and 24 feet, hematite stained surfaces.</td>
<td>55° to 60°</td>
</tr>
<tr>
<td>24-26</td>
<td>Predominantly unfractured homogeneous texture. Core is broken along previously closed fracture at 25.6 feet, 1-2 mm of calcite cement present.</td>
<td></td>
</tr>
<tr>
<td>26-28</td>
<td>Predominantly unfractured homogeneous texture. Irregular fracture at 27 feet. Core is broken at 27.2 feet a previously cemented fracture with 1 mm layer of calcite cement present. Also change in minerology to predominantly orthoclose and quartz with a disappearance of biotite. Rock appears pink in color.</td>
<td></td>
</tr>
<tr>
<td>28-30</td>
<td>Layer of orthoclase and quartz continues to bottom of core. Predominantly unfractured. Bottom of hole fragmented rock chips.</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>End of core.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX K.

Surveyors Report
Virginia Wood Preserving Site  
3000 Peyton St, Henrico Co, Va.

Virginia State Plane Coordinates  
(South Zone)

| Point No. | N      | E      | N. A. Geo. Datum 1927  
|-----------|--------|--------|------------------------
| SW-2      | 476.470.84 | 2,287,981.74- | 203.69 (Top of Pipe)  
| SW-4      | 476.726.66 | 2,288,725.21 | 200.39 (Top big Nail in Tree)  
| DM-4(R)   | 476.081.89 | 2,288,136.23 | 210.47  
| DM-4(A)   | 476.076.34 | 2,288,136.92 | 210.84  
| DM-11(B)  | 476.231.90 | 2,288,453.29 | 206.14  
| DM-18(A)  | 476.264.17 | 2,288,607.44 | 208.53  
| DM-2(R)   | 476.331.95 | 2,288,779.22 | 208.16  
| DM-17(A)  | 476.389.80 | 2,289,154.87 | 217.10  
| DM-16     | 476.111.62 | 2,288,745.51 | 210.01  
| DM-3(R)   | 475.972.08 | 2,288,556.11 | 210.75  
| DM-15     | 475.934.98 | 2,288,356.08 | 212.32  
| DM-15(A)  | 475.845.19 | 2,288,301.08 | 213.27  
| DM-5      | 475.540.40 | 2,288,339.72 | 215.06  
| DM-5A     | 475.542.34 | 2,288,339.00 | 216.38  
| DM-1(A)   | 475.867.32 | 2,288,970.44 | 211.39  
| DM-1(B)   | 475.875.56 | 2,288,972.47 | 210.83  
| DM-1(R)   | 475.880.34 | 2,288,973.52 | 209.62  
| SW-8      | 475.899.41 | 2,289,018.06 | 206.86 (Top Iron Rod)  

AR301810
Virginia State Plane Coordinates (South Zone)

<table>
<thead>
<tr>
<th>Point No.</th>
<th>N</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW-2</td>
<td>476,470.84</td>
<td>2,287,981.74</td>
</tr>
<tr>
<td>SW-4</td>
<td>476,726.66</td>
<td>2,288,725.21</td>
</tr>
<tr>
<td>DM-4(R)</td>
<td>476,081.59</td>
<td>2,288,136.23</td>
</tr>
<tr>
<td>DM-4(A)</td>
<td>476,076.34</td>
<td>2,288,136.92</td>
</tr>
<tr>
<td>DM-11(B)</td>
<td>476,231.90</td>
<td>2,288,453.29</td>
</tr>
<tr>
<td>DM-18(A)</td>
<td>476,264.17</td>
<td>2,288,607.44</td>
</tr>
<tr>
<td>DM-2(R)</td>
<td>476,331.95</td>
<td>2,288,779.22</td>
</tr>
<tr>
<td>DM-17(A)</td>
<td>476,389.80</td>
<td>2,289,154.87</td>
</tr>
<tr>
<td>DM-16</td>
<td>476,111.62</td>
<td>2,289,745.51</td>
</tr>
<tr>
<td>DM-3(R)</td>
<td>475,972.08</td>
<td>2,288,556.11</td>
</tr>
<tr>
<td>DM-15</td>
<td>475,934.98</td>
<td>2,288,356.08</td>
</tr>
<tr>
<td>DM-15(A)</td>
<td>475,845.19</td>
<td>2,288,301.08</td>
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<tr>
<td>DM-5</td>
<td>475,540.40</td>
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<tr>
<td>DM-5A</td>
<td>475,542.34</td>
<td>2,288,339.00</td>
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<td>DM-1(A)</td>
<td>475,867.32</td>
<td>2,288,970.44</td>
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<td>DM-1(B)</td>
<td>475,875.56</td>
<td>2,288,972.47</td>
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<td>DM-1(R)</td>
<td>475,880.34</td>
<td>2,288,973.52</td>
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<td>PP-1</td>
<td>475,899.41</td>
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N. A. Geo. Datum 1927

<table>
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<th>Elevation MSL</th>
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<tbody>
<tr>
<td>203.69 (Top of Pipe)</td>
</tr>
<tr>
<td>200.39 (Top big Nail in Tree)</td>
</tr>
<tr>
<td>210.47</td>
</tr>
<tr>
<td>210.84</td>
</tr>
<tr>
<td>206.14</td>
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<td>210.83</td>
</tr>
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<td>209.62</td>
</tr>
<tr>
<td>206.86 (Top Iron Rod)</td>
</tr>
</tbody>
</table>

AR301811
<table>
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<tr>
<th>Point No</th>
<th>Ground Elevation (N.A. Geo. Datum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM-1 (R)</td>
<td>208.9</td>
</tr>
<tr>
<td>DM-1 (B)</td>
<td>208.7</td>
</tr>
<tr>
<td>DM-1 (A)</td>
<td>208.8</td>
</tr>
<tr>
<td>DM-5 (A)</td>
<td>213.6</td>
</tr>
<tr>
<td>DM-5</td>
<td>213.2</td>
</tr>
<tr>
<td>DM-4 (A)</td>
<td>208.7</td>
</tr>
<tr>
<td>DM-4 (R)</td>
<td>208.8</td>
</tr>
<tr>
<td>DM-11 (B)</td>
<td>204.5</td>
</tr>
<tr>
<td>DM-18 (A)</td>
<td>205.9</td>
</tr>
<tr>
<td>DM-2 (R)</td>
<td>206.6</td>
</tr>
<tr>
<td>DM-16</td>
<td>208.3</td>
</tr>
<tr>
<td>DM-3 (R)</td>
<td>209.5</td>
</tr>
<tr>
<td>DM-15</td>
<td>210.2</td>
</tr>
<tr>
<td>DM-15 (A)</td>
<td>211.7</td>
</tr>
<tr>
<td>DM-17 (A)</td>
<td>214.5</td>
</tr>
</tbody>
</table>
APPENDIX L

NAPL Field Data Sheets
### Floaters and Sinkers

**Well Number:** BW-2A  
**Well Location:**  
**Ground Level Elevation:**  
**Stickup Elevation:** (Ground + Stickup)  
**Current Observations**

Note: All measurements are made from the lip of the Stickup.

**NU meter trace detection:**

- Air/liquid interface: determined ft.  
- Tape #: 
- Bottom of hole: 

#### FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
<td>6.42</td>
<td>7.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermittent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Int-Inter</td>
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<td>Int-Inter</td>
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</tbody>
</table>

#### Well Log

<table>
<thead>
<tr>
<th>Elev.</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Sample No.</td>
</tr>
<tr>
<td>Floater</td>
<td>Sample No.</td>
</tr>
<tr>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Bunker</td>
<td></td>
</tr>
</tbody>
</table>

**Muddy bottom, no floaters**

---

**III.16-3 534**

**Signature:** AR301815
**FLOATERS AND SINKERS**

**Well Number:** BW-3A

**Ground Level Elevation:** ____________

**Stickup Elevation:** ____________

**Current Observations**

Note: All measurements are made from the lip of the Stickup.

**HNU meter trace detection:** 0.0

**Air/liquid interface:** \( \frac{3}{4} \) ft.\n
**Bottom of hole:** ____________ ft.

**FLEXI-DIP Measurements**

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(continuous)</td>
<td>2.575</td>
<td>2.63</td>
<td>7.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(intermittent)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(inter-cont)</td>
<td></td>
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</tr>
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</table>

**Well Log**

<table>
<thead>
<tr>
<th>Elev. Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
</tr>
<tr>
<td>Floater</td>
</tr>
<tr>
<td>Water</td>
</tr>
<tr>
<td>Sinker</td>
</tr>
</tbody>
</table>

Sample No. 2001-F 7/1983

**Field Observations:**

---

**Signature:** AR301816
FLOATERS AND SINKERS

Well Number: DM-1A  Location: ____________________________

Ground Level Elevation: __________  Stickup: __________

Stickup Elevation: __________  (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

HNU meter trace detection: ____________________________

Air/liquid interface: __________  Tape #: __________

Bottom of hole: __________

FLEXI-DIP Measurements

Interface (circle one)  Depth  Depth  Depth  Depth  Adjusted
(Continuously)  (down)  (up)  (down)  (up)  Depth  Elevation

Inter-Inter-Inter-Contin  5.56  5.55  8.50  8.50

Contin-Inter-Inter-Contin

Contin-Inter-Contin

Well Log

Elev.  Thickness
Air

Sample No. __________

Floater

Water

Sample No. __________

Bunker

Notes and Observations: Well head was flooded with water.

No floater was found at the tailing. There were none.

III-14-3 53A

Signature: AR301817
FLOATERS AND SINKERS

Well Number: DM-4 A

Ground Level Elevation: __________ Stickup: __________
Stickup Elevation: __________ (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

Current Observations

Notes All measurements are made from the lip of the Stickup.

N2 meter trace detection: ____________

Air/liquid interface: _______ ft. Tape: _______

Bottom of hole: _______ ft.

FLEXI-DIP Measurements

Interface (circle one) Depth Depth Depth Depth Adjusted
(circle one) (down) (up) (down) (up) Depth Elevation
Continuous: ____________ __________

Intermittent: ____________ __________

Well Log

<table>
<thead>
<tr>
<th>Elev.</th>
<th>Thickness</th>
</tr>
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<tbody>
<tr>
<td>Air</td>
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</tr>
<tr>
<td>Floater</td>
<td>Sample No. Date</td>
</tr>
<tr>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Sinker</td>
<td>Sample No Date</td>
</tr>
</tbody>
</table>

and Observations:

---

Ill. 14-3 53A

Signature: AR301818
**FLOATERS AND SINKERS**

- **Project:** _____________________________  
  **Location:** _____________________________  
  **Date:** 7-10-89  
  **Time:** 17:25

- **Well Number:** Dm-5A  
  **Well Location:** _____________________________

- **Ground Level Elevation:** ___________  
  **Stickup:** ___________

- **Stickup Elevation:** ___________  
  (Ground + Stickup)

**Current Observations**

- **Note:** All measurements are made from the lip of the Stickup.
- **HNU meter trace detection:** 0-0
- **Air/liquid interface:** 79.5 ft.  
  **Tape #:** ___________
- **Bottom of hole:** ___________ ft.

**FLEXI-DIP Measurements**

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<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
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<th>Depth (up)</th>
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<th>Elevation</th>
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<tbody>
<tr>
<td>(Continuous)</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(Intermittent)</td>
<td>8.30</td>
<td>8.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(Inter)</td>
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<td></td>
<td></td>
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<tr>
<td>(Inter)</td>
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<tr>
<td>(Inter)</td>
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**Well Log**

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<thead>
<tr>
<th>Elev.</th>
<th>Thickness</th>
</tr>
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<tbody>
<tr>
<td>Air</td>
<td></td>
</tr>
<tr>
<td>Floater</td>
<td>Sample No.</td>
</tr>
<tr>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Sinker</td>
<td>Sample No.</td>
</tr>
</tbody>
</table>

**Notes and Observations:** Did not check top of water column for stickup due to little water.
FLOATERS AND SINKERS

**Well Number:** B(A) - 74

**Ground Level Elevation:** __________

**Stickup:** __________ (Ground + Stickup)

**Note:** All measurements are made from the lip of the Stickup.

- **HNU meter trace detection:** __________
- **Air/liquid interface:** __________ ft. __________ Tape __________
- **Bottom of hole:** __________ ft.

**FLEXI-DIP Measurements**

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
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<tbody>
<tr>
<td>Continuous</td>
<td>3.45</td>
<td>8°</td>
<td>8.30</td>
<td>__________</td>
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<tr>
<td>Inter-Inter</td>
<td>__________</td>
<td>__________</td>
<td>__________</td>
<td>__________</td>
</tr>
<tr>
<td>Cont-Cont</td>
<td>__________</td>
<td>__________</td>
<td>__________</td>
<td>__________</td>
</tr>
<tr>
<td>Cont-Inter</td>
<td>__________</td>
<td>__________</td>
<td>__________</td>
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**Well Log**

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<thead>
<tr>
<th>Elev. Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
</tr>
<tr>
<td>Floater</td>
</tr>
<tr>
<td>Water</td>
</tr>
<tr>
<td>Sinker</td>
</tr>
</tbody>
</table>

**Sample No.** __________ **Date** __________

**Notes and Observations:** Muddy bottom, checked report water volume for 57 meters at a clear trailer blue, were none.

**Signature:** __________

**Date:** 7-70-89

**Time:** 15:50
FLOATERS AND SINKERS

Object: _______________________________  Date: 7-12-89
Location: ___________________________________  Time: 14:00

Well Number: RU-10A  Well Location: _______________________________
Ground Level Elevation: _______________  Stickup: _______________
Stickup Elevation: _______________  (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

Air/liquid interface: _______ft.  Tape #________
Bottom of hole: _______________ft.

FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(cont)inuous- (inter)mittent</td>
<td>6.32</td>
<td>7.50</td>
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<td></td>
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<tr>
<td>( ) inter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( ) inter</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Well Log

<table>
<thead>
<tr>
<th>Elev. Thickness</th>
<th>Sample No.</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floater</td>
<td>Sample No.</td>
<td>Date</td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinker</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

and Observations: Notice slight sheen on top of water
so sampled for SODA, gas - 60 cc/ml
obstruction near bottom of well made getting bailing down difficult

III.14-3  53A

Signature: AR301821
## FLOUTERS AND SINKERS

**Subject:** ____________________________  

**Well Number:** BW-11A  

**Well Location:** ____________________________

**Ground Level Elevation:** ____________________________  

**Stickup Elevation:** ____________________________ (Ground + Stickup)

### Current Observations

**Note:** All measurements are made from the lip of the Stickup.

- **U meter trace detection:** ____________________________

- **Air/liquid interface:** 3.60 ft.  
  **Tape #:** __________

- **Bottom of hole:** ____________________________ ft.

### FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
</tr>
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<tr>
<td>Continuous</td>
<td>3.57</td>
<td>8.50</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Intermittent</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Inter-cont</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Int-Inter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Int-Inter</td>
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### Well Log

<table>
<thead>
<tr>
<th>Elev.</th>
<th>Thickness</th>
<th>Sample No.</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Floater</td>
<td>-</td>
<td>Sample No.</td>
<td>Date</td>
</tr>
<tr>
<td>Water</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sinker</td>
<td>-</td>
<td>Sample No.</td>
<td>Date</td>
</tr>
</tbody>
</table>

**and Observations:** **No Floater**

---

**Signature:** AR301822
FLOATERS AND SINKERS

Project: ______________________ Date: 7-12-89

Location: ______________________ Time: 16:45

Well Number: DM-15-A

Ground Level Elevation: ____________ Stickup: ____________

Stickup Elevation: ____________ (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

HNU meter trace detection: 3.0


Bottom of hole: ______________ ft.

FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) continuous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( ) intermittent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( ) intermittent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( ) intermittent</td>
<td></td>
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</table>

Well Log

<table>
<thead>
<tr>
<th>Elev. Thickness</th>
<th>Sample No. 2008-5 7/12/89</th>
</tr>
</thead>
</table>

Notes and Observations: Black substance at bottom of probe but no flexi-dip indication.

Signature: AR301823
FLOATERS AND SINKERS

Project: __________________________________ Date: _______
Location: __________________________________ Time: _______

Well Number: DNI-17A Well Location: _______________________

Ground Level Elevation: ____________ Stickup: ____________

Stickup Elevation: ____________ (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

HNU meter trace detection: ________________________________

Air/liquid interface: Dry ft. Tape #: _______

Bottom of hole: ____________ ft.

FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Continuous (inter)mittent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-inter inter-cont</td>
<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>-inter inter-cont</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cont-inter inter-cont</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>cont-inter inter-cont</td>
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</tbody>
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Well Log

<table>
<thead>
<tr>
<th>Elev.</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td></td>
</tr>
<tr>
<td>Floater</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Sinker</td>
<td></td>
</tr>
</tbody>
</table>

Notes and Observations: Dry

III.14-3  53A  Signature: AR301824
FLOATERS AND SINKERS

Date: 7-12-89

Location: DM-18A

Well Number: DM-18A

Well Location: 

Ground Level Elevation: 

Stickup Elevation: 

Current Observations

Note: All measurements are made from the lip of the Stickup.

Air/liquid interface: ________ ft.

Bottom of hole: ________ ft.

FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Continuous- (Intermittent)</td>
<td>3.68</td>
<td>6.55</td>
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</tr>
</tbody>
</table>

Well Log

Elev. Thickness

Air

Floaters

Water

Sinker

Sample No. 

Sample No. 

Field Observations: No Floaters

Signature: 

AR301825
FLOATERS AND SINKERS

Date: 7-10-89
Time: 12:15

Subject: __________________________
Location: __________________________

Well Number: Dm-1(R) Well Location: __________________________
Ground Level Elevation: ____________ Stickup: ____________
Stickup Elevation: ____________ (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

HNU meter trace detection: ________________
Air/liquid interface: _______ ft. Tape #: ____________
Bottom of hole: ____________ ft.

FLEXI-DIP Measurements

Interface (circle one) Depth Depth Depth Depth Adjusted
(continuous) (down) (up) (down) (up) Depth Elevation

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth Elevation</th>
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<td>inter</td>
<td>6.00</td>
<td>6.11</td>
<td>27.40</td>
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<tr>
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</tr>
<tr>
<td>cont-inter</td>
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</tbody>
</table>

Well Log

Elev. Thickness

Air
Floater
Water
Sinker

Sample No. —________ Date —________
Sample No. —________ Date —________

Notes and Observations:

checked top of water clam
for floaters w clear easterly

Time were none

III.14-3 S3A

Signature: AR301826
## FLOATERS AND SINKERS

**Object:** __________________________________

**Location:** __________________________________

**Well Number:** Dm-2(R)  **Well Location:**

**Ground Level Elevation:** __________

**Stickup Elevation:** __________  (Ground + Stickup)

**Current Observations**

- All measurements are made from the lip of the Stickup.

- **WU meter trace detection:** 10

- **Air/liquid interface:** 9/51.3 ft.  **Tape:** __________

- **Bottom of hole:** __________ ft.

### FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
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</thead>
<tbody>
<tr>
<td>Cont-Inter</td>
<td>10.57</td>
<td>20.53</td>
<td>20.53</td>
<td>20.53</td>
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<td></td>
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<td>Inter-Cont</td>
<td>30.52</td>
<td>40.54</td>
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### Well Log

<table>
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<th>Thickness</th>
</tr>
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<tbody>
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<td>Air</td>
<td></td>
</tr>
<tr>
<td>Froster</td>
<td>Sample No.</td>
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<tr>
<td>Water</td>
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</tr>
<tr>
<td>Sinker</td>
<td>Sample No.</td>
</tr>
</tbody>
</table>

**Additional Observations:** __________________________________

**Signature:** __________
FLOATERS AND SINKERS

- Project: ___________________________
- Date: ___________________________

- Well Number: DM-3R

- Ground Level Elevation: __________
- Stickup: __________

- Stickup Elevation: __________ (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

- HNU meter trace detection: __________
- Air/liquid interface: __________ ft.
- Tape: __________
- Bottom of hole: __________ ft.

FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
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<td></td>
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<td>(r)</td>
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</tr>
<tr>
<td>inter-cont</td>
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</tr>
<tr>
<td>cont-inter</td>
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<td>inter-cont</td>
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<tr>
<td>cont-inter</td>
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<tr>
<td>cont-inter</td>
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</table>

Well Log

- Elev. Thickness

<table>
<thead>
<tr>
<th>Air</th>
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<th>Date</th>
</tr>
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<tbody>
<tr>
<td>Floater</td>
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<td></td>
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<tr>
<td>Water</td>
<td></td>
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</tr>
<tr>
<td>Sinker</td>
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</table>

And Observations:

III.14-3  53A  Signature:  AR301828
FLOATERS AND SINKERS

*Project:* ____________  *Date:* ____________

*Location:* ____________  *Time:* ____________

*Well Number:* DM-4(R)  *Well Location:* ____________

*Ground Level Elevation:* ____________  *Stickup:* ____________

*Stickup Elevation:* ____________  *(Ground + Stickup)*

Current Observations

*Note:* All measurements are made from the lip of the Stickup.

*U* meter trace detection: ____________

*Air/liquid interface:* ____________  *Tape:* ____________

*Bottom of hole:* ____________

FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
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<tbody>
<tr>
<td>Continuous</td>
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<td>____________</td>
<td>____________</td>
<td>____________</td>
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<td>____________</td>
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<tr>
<td>Intermittent</td>
<td>____________</td>
<td>____________</td>
<td>____________</td>
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<td>____________</td>
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</tr>
<tr>
<td>Int-Inter</td>
<td>____________</td>
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<td>Int-Inter</td>
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Well Log

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<tr>
<td>Floater</td>
</tr>
<tr>
<td>Water</td>
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<tr>
<td>Sinker</td>
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</table>

*Sample No.* ____________  *Date:* ____________

*and Observations:* ____________

---

*Signature:* AR301829
FLOATERS AND SINKERS

Date: 7/10/87

Well Number: DM-5

Ground Level Elevation: __________

Stickup Elevation: __________

(Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

HNU meter trace detection: 0.0

Air/liquid interface: 6.45 ft. Tape #: ______

Bottom of hole: __________ ft.

FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth Elevation</th>
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<td>(inter)mittent</td>
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<td>inter</td>
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Well Log

Elev. Thickness

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<th>Date</th>
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<tr>
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<td>Floater</td>
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<tr>
<td>Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinker</td>
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</tbody>
</table>

... and Observations:

Signature: AR30T830
**FLOATERS AND SINKERS**

**Project:** __________________________

**Well Number:** BW-8

**Ground Level Elevation:** __________

**Stickup Elevation:** __________ (Ground + Stickup)

**Well Location:** __________________________

**Date:** 7-16-89

**Time:** 11:40

**Current Observations**

- **Note:** All measurements are made from the lip of the Stickup.
- **HNU meter trace detection:**
  - Air/liquid interface: 1.60 ft.
  - Tape #: __________
  - Bottom of hole: __________ ft.

**FLEXI-DIP Measurements**

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
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<th>Depth (up)</th>
<th>Adjusted Depth Elevation</th>
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<td>cont-inter inter-cont</td>
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<td>cont-inter inter-cont</td>
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**Well Log**

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<tr>
<td>Floater</td>
<td>Sample No.</td>
</tr>
<tr>
<td>Water</td>
<td>Sample No.</td>
</tr>
<tr>
<td>Sinker</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks and Observations:**

- Check top of water column
- For Floaters in a clear cylinder, there were none.

---

**M. J. 14-3**

**Signature:** AR301831
FLOATERS AND SINKERS

Date: 7-10-89
Time: 15:40

Well Number: 2W-9

Ground Level Elevation: __________ Stickup: __________

Stickup Elevation: __________ (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

HNU meter trace detection: C. O

Air/liquid interface: 5.10 ft. Tape 0.

Bottom of hole: __________ ft.

FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth</th>
<th>Depth</th>
<th>Depth</th>
<th>Depth</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
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</thead>
<tbody>
<tr>
<td>(Con)tinuous - (inter)mittent</td>
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<td>inter - inter-cont</td>
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<td>15.10</td>
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<tr>
<td>cont-inter inter-cont</td>
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</tbody>
</table>

Well Log

Elev. Thickness

Air
Floater
Water
Sinker

Sample No. __________ Date
Sample No. __________ Date

Notes and Observations: Muddy bottom, checked top at water column for floaters - W clean.

Trailer: There were none

Signature: AR301832

III.14-3 53A
FLOATERS AND SINKERS

Date: 7-12-89
Time: 14:13

Well Number: BW-10
Well Location: ____________________________________________

Ground Level Elevation: ____________ Stickup: ____________
Stickup Elevation: ____________ (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

NU meter trace detection: O - O
Air/liquid interface: 2.76 ft. Tape O. _______ ft.
Bottom of hole: ____________ ft.

FLEXI-DIP Measurements

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<th>Interface (circle one) (Continuous- Intermittent)</th>
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<th>Depth (down)</th>
<th>Depth (up)</th>
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<td>Sample No.</td>
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Well Log

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<th>Sample No.</th>
<th>Date</th>
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<tr>
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<tr>
<td>Floater</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinker</td>
<td></td>
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</tr>
</tbody>
</table>

and Observations: No Floater

Signature: AR301833
FLOATERS AND SINKERS

Object:________________________ Date:________________________
Location:______________________ Time:________________________

Well Number: R8-11 Well Location:________________________
Ground Level Elevation:__________ Stickup:__________
Stickup Elevation:__________ (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

NU meter trace detection:________________________

ir/liquid interface:__________ ft. Tape 0.__________
Bottom of hole:__________ ft.

FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
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<tbody>
<tr>
<td></td>
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<td></td>
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<td>13.62</td>
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<td>24.52</td>
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<td>Inter</td>
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<tr>
<td>Inter-Cont</td>
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<tr>
<td>Int-Inter</td>
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Well Log

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<th>Thickness</th>
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<tbody>
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<td>Air</td>
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</tr>
<tr>
<td>Floater</td>
<td>Sample No.</td>
</tr>
<tr>
<td>Water</td>
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<tr>
<td>Sinker</td>
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</tbody>
</table>

Field Observations: No Floaters

Signature: AR30-834

III.10-3 53A
FLOATERS AND SINKERS

<table>
<thead>
<tr>
<th>Date: 7/16/89</th>
<th>Time: 15:00</th>
</tr>
</thead>
</table>

Well Number: BW-12

Ground Level Elevation: ____________ Stickup: ____________

Stickup Elevation: ____________ (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

HNU meter trace detection: ________________

Air/liquid interface: 12.60 ft. Tape #. _______

Bottom of hole: ____________ ft.

FLEXI-DIP Measurements

<table>
<thead>
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<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
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<tbody>
<tr>
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<td>12.60</td>
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<tr>
<td>cont-inter</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>inter—cont</td>
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Well Log

<table>
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<th>Elev. Thickness</th>
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<tbody>
<tr>
<td>Air</td>
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<tr>
<td>Floater</td>
</tr>
<tr>
<td>Water</td>
</tr>
<tr>
<td>Sinker</td>
</tr>
</tbody>
</table>

Note and Observations: Checked top of water column for floating in a clear Bailey there were

Signature: AR30T835
FLOATERS AND SINKERS

- Project: __________________________________________
- Location: __________________________________________
- Well Number: BW-13
- Well Location: _____________________________________

Ground Level Elevation: __________ Stickup:___________

Stickup Elevation: __________ (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

- HNU meter trace detection: 0.0
- Air/liquid interface: 3.95 ft. Tape #________
- Bottom of hole: __________ ft.

FLEXI-DIP Measurements

<table>
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<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
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<td>(inter)</td>
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</tr>
<tr>
<td>cont-inter</td>
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<tr>
<td>inter-cont</td>
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<tr>
<td>cont-inter</td>
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Well Log

<table>
<thead>
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<th>Elev. Thickness</th>
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<tbody>
<tr>
<td>Air</td>
</tr>
<tr>
<td>Floater</td>
</tr>
<tr>
<td>Water</td>
</tr>
<tr>
<td>Sinker</td>
</tr>
</tbody>
</table>

Notes and Observations: Checked top of water column for floaters in a clear bailer, none were none.

III.14-3 53A

Signature: AR301836
FLOATERS AND SINKERS

Project: ___________________________ Date: 7-12-87

Location: ___________________________ Time: 8:08:17

Well Number: BW-14
Well Location: ___________________________

Ground Level Elevation: _____________ Stickup: _____________

Stickup Elevation: ___________ (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

HNU meter trace detection: O - O

Air/liquid interface: 8.12 ft. Tape #: __________

Bottom of hole: ___________ ft.

FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
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<th>Elevation</th>
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<tr>
<td>Cont-Inter</td>
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<td>22.90</td>
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<tr>
<td>Inter-Cont</td>
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<td>-----</td>
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Well Log

<table>
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<th>Elev. Thickness</th>
<th>Sample No.</th>
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<tbody>
<tr>
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<tr>
<td>Floater</td>
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<td>Water</td>
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<tr>
<td>Sinker</td>
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</tbody>
</table>

Notes and Observations:

"s and Observations: 2" 55° clear but not for Floaters, there were none."

III.14-3  53A  Signature: AR301837
**FLOATERS AND SINKERS**

**Current Observations**

Note: All measurements are made from the lip of the Stickup.

**Flexi-Dip Measurements**

<table>
<thead>
<tr>
<th>Interface (circle one) (Cont/Intr)</th>
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<th>Elevation</th>
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<td>( )-inter inter-cont</td>
<td>5.25</td>
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<tr>
<td>cont-inter inter-cont</td>
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**Well Log**

<table>
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<th>Elev.</th>
<th>Thickness</th>
<th>Sample No.</th>
<th>Date</th>
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<tbody>
<tr>
<td>Air</td>
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<tr>
<td>Floater</td>
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<td></td>
<td></td>
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<tr>
<td>Water</td>
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</tr>
<tr>
<td>Sinker</td>
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<td>Sample No.</td>
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</table>

**Signatures:**

III.14.3 53A

**Date:** 7/12/89
**Time:** 16:15
**FLOATERS AND SINKERS**

**Well Number:** DM-16  
**Well Location:**

**Ground Level Elevation:** ___________  
**Stickup:** ___________

**Stickup Elevation:** ___________  
*(Ground + Stickup)*

**Current Observations**

*Note: All measurements are made from the lip of the Stickup.*

- HNU meter trace detection: 10.0
- Air/liquid interface: _____ ft.  
- Tape #: ______
- Bottom of hole: _____ ft.

**FLEXI-DIP Measurements**

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
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<tr>
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<td>cont-inter inter-cont</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>cont-inter inter-cont</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Well Log**

<table>
<thead>
<tr>
<th>Elev.</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>10.0</td>
</tr>
<tr>
<td>Floater</td>
<td>Sample No.</td>
</tr>
<tr>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Sinker</td>
<td>Sample No.</td>
</tr>
</tbody>
</table>

**Notes and Observations:**

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**Page:** 53A  
**Signature:** AR301839
FLOATERS AND SINKERS

Date: 7-16-89

Well Number: W14-1(B) Well Location: __________________________

Ground Level Elevation: ____________ Stickup: ____________

Stickup Elevation: ____________ (Ground + Stickup)

Current Observations

Note: All measurements are made from the lip of the Stickup.

HNU meter trace detection: 1.0

Air/liquid interface: 6.95 ft. Tape #: ____________

Bottom of hole: ____________ ft.

FLEXI-DIP Measurements

<table>
<thead>
<tr>
<th>Interface (circle one)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Depth (down)</th>
<th>Depth (up)</th>
<th>Adjusted Depth</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>continuous</td>
<td>6.96</td>
<td>6.87</td>
<td>45.58</td>
<td>45.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>intermittent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cont-inter</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>inter-cont</td>
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<td></td>
</tr>
<tr>
<td>cont-inter</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Well Log

Elev. Thickness

Air
Floaters
Water
Sinker

Sample No. ____________ Date__________

Sample at top of water 0.5

Clear boiler to check for floaters.

There were none.

III.14-3  53A

Signature: ____________
FLOUTERS AND SINKERS

Date: 7-12-89

Well Location: __________________________

Ground Level Elevation: ________________  Stickup: ________________

Stickup Elevation: ________________  (Ground + Stickup)

Current Observations

1: All measurements are made from the lip of the Stickup.

meter trace detection: __________________________

liquid interface: ___________ ft.  Tape #: ______

tom of hole: ___________ ft.

FLEXI-DIP Measurements

\[ \begin{array}{cccccc}
\text{Continous} & \text{Depth (down)} & \text{Depth (up)} & \text{Depth (down)} & \text{Depth (up)} & \text{Adjusted Depth Elevation} \\
\text{inter} & 1.37 & - & \frac{2.67}{2.32} & \text{no signal (null?)} & \\
\text{inter} & - & - & - & - & \\
\text{inter} & - & - & - & - & \\
\text{inter} & - & - & - & - & \\
\end{array}\]

Well Log

\[ \begin{array}{ccc}
\text{Elev.} & \text{Thickness} \\
\text{Air} & & \\
\text{Floater} & \{ & \text{Sample No.} - \text{Date} - \\
\text{Water} & \} & \\
\text{Sinker} & \{ & \text{Sample No.} - \text{Date} - \\
\end{array}\]

and Observations: 50 ft. below, floating, see no signal or bottom, no floaters

III.14-3 53A  Signature: AR301841