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TEXFI INDUSTRIES
PRELIMINARY GROUNDWATER
ASSESSMENT

3136-8-1000 March 17, 1987

CERCLA

Robert L. Martin
Robert Martin, P.G.
Geologist

Henry W. Lyon
Henry W. Lyon
Hydrogeologist

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PRELIMINARY GROUNDWATER ASSESSMENT
FORMER TEXFI PLANT
NEW BERN, NORTH CAROLINA

1. INTRODUCTION

This report summarizes the findings of a preliminary groundwater assessment investigation for the plant site formerly owned by Texfi Industries in New Bern, North Carolina. The investigation was initiated December 15, 1986 by authorization of Mr. John E. Tate, representative for Texfi Industries in accordance with the Chas. T. Main, Inc. (MAIN) proposal to Mr. Tate dated December 11, 1986.

Law Engineering Testing Company (LETCo) was contracted in August, 1986 by Amital Spinning Corporation to perform an environmental audit and preliminary groundwater assessment at the former Texfi plant.

As a result of this assessment, groundwater contamination was identified. MAIN was contracted to provide additional horizontal contaminant delineation in the upper aquifer, conduct initial contaminant screening in the Castle Hayne Limestone aquifer, and quantify basic hydrological parameters in an attempt to identify possible pathways of migration in which contaminated groundwater might travel.

The following is a general description of the investigation conducted during this phase of groundwater assessment. Four monitoring wells were installed, three in the upper aquifer and

one in the Castle Hayne Limestone aquifer. Geologic cross sections were generated from drilling logs and soil samples obtained during drilling. Soil and water samples collected were analyzed for 1,1,1-trichloroethane and 1,1-dichloroethane on the basis of analyses from previously conducted studies. Static water levels were measured and falling head hydraulic conductivity tests were conducted to estimate groundwater/contamination flow directions and velocities.

2. BACKGROUND

A. Site Location

The former Texfi plant is located on the northwest side of Stanley Boulevard (SR 1304), 0.4 miles southwest of State Highway 55 in New Bern, North Carolina (Figure 1). The property is bordered to the southwest by the Atlantic and East Carolina Railway easement and to the northeast by State Highway 55.

A revised site plan indicating the position of existing structures, drainage ditches, and monitoring well locations is shown on drawing 3136-8-1000-R1.

B. Sources of Contamination

During the years of operation (1971-1981), Texfi maintained two above ground trichloroethane storage tanks which were located on the north side of the plant, adjacent to the outside back wall of the manufacturing building. One of these tanks has been removed. The locations of the existing and removed trichloroethane tanks are shown on drawing 3136-8-1000-R1. Following the termination of fiber production at the Texfi plant, the trichloroethane tanks were drained and piping disconnected. According to discussions with representatives of Texfi, a spill located in the vicinity of wells 4A and 6 probably occurred during dismantling operations.

A second area of contamination (1,1 dichloroethane) has been found to exist in the vicinity of well 3A. Texfi

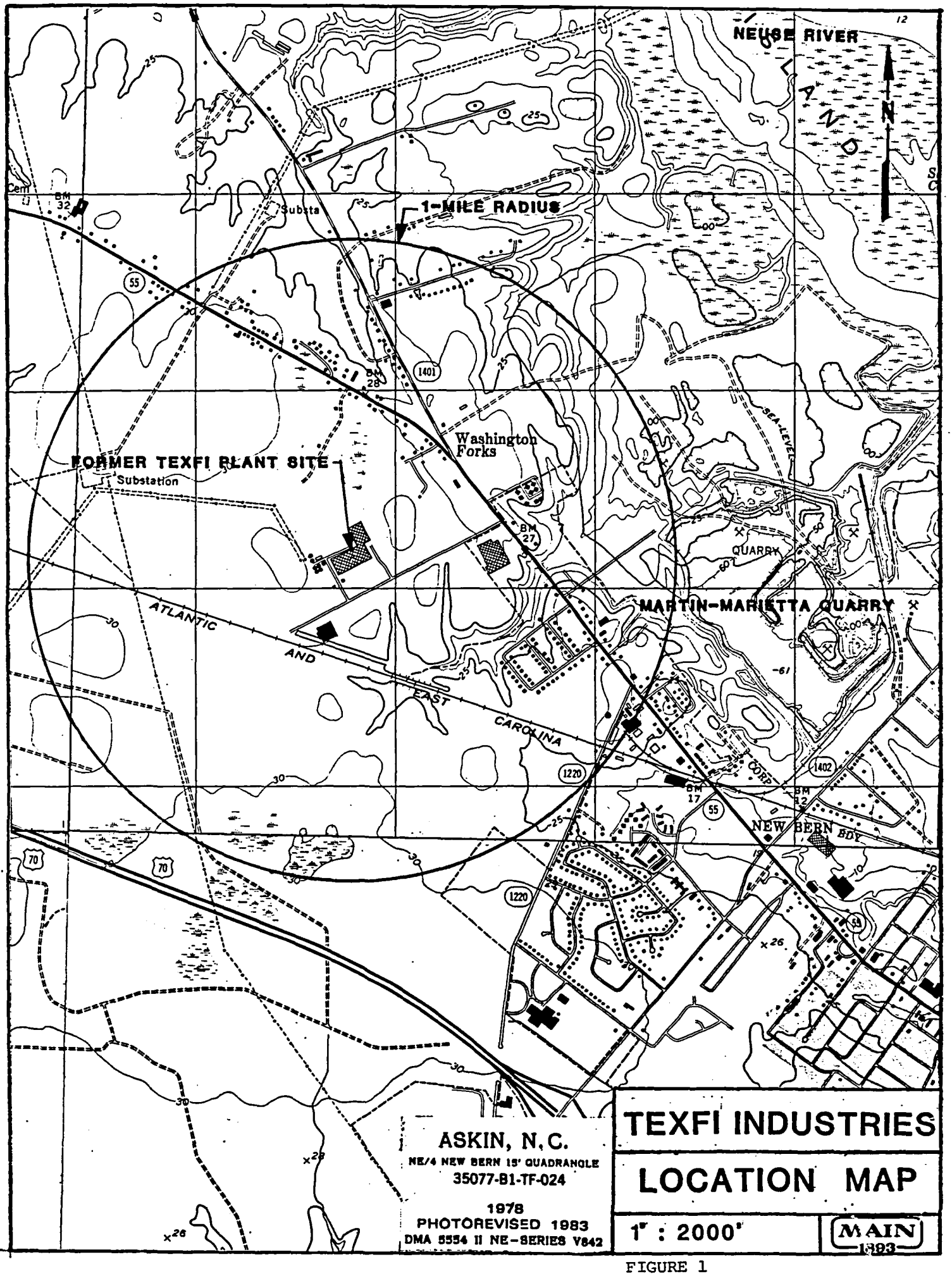

NEUSE RIVER
N
1-MILE RADIUS
Substa
Cem
BM 32
55
1401
BM 28
Washington Forks
FORMER TEXFI PLANT SITE
Substation
BM 27
QUARRY
MARTIN-MARIETTA QUARRY
ATLANTIC AND EAST CAROLINA
1220
1402
BM 17
BM 12
NEW BERN
70
ASKIN, N.C.
NE/4 NEW BERN 15' QUADRANGLE
35077-B1-TF-024
1978
PHOTOREVISED 1983
DMA 5554 II NE-SERIES V842
TEXFI INDUSTRIES
LOCATION MAP
1" : 2000'
MAIN

FIGURE 1

has indicated that this compound was not used in plant operations. Although 1,1-dichloroethane is a degradation product of 1,1,1-trichloroethane, it is hydrogeologically improbable that contamination in the vicinity of well 3A is the result of migration and degradation of trichloroethane spilled in the vicinity of well 6.

C. Previous Investigations

Law Engineering Testing Company (LETCo) conducted an environmental audit in 1986. During a preliminary groundwater assessment, nine (9) permanent and temporary monitoring wells were installed and analyses were conducted on water samples collected from five of the wells. One sample was analyzed for selected volatile organic compounds, metals, oil and grease residue, pesticides, PCB's, semi-volatiles, and total organic carbon. Four wells were analyzed for volatile organics, metals and oil and grease residues.

The report submitted by LETCo on November 14, 1986, indicated two areas of groundwater contamination. At the well 4A location, trichloroethane, dichloroethane, and dichloroethene were detected at concentrations of 370, 240, and 16 ppm respectively. Laboratory analyses conducted on groundwater collected from well 3A yielded concentrations of 0.14, 0.062, and 0.017 for dichloroethane, chloroethane, and dichloroethene respectively. Because the previous investigation only identified contamination locations and did not include determination of vertical and horizontal hydraulic conductivities, no estimates of contaminant transport velocities were given. However, groundwater elevation data

indicated that the general direction of groundwater flow was toward the northeast.

D. Drilling and Well Installation Program

MAIN utilized wells drilled by LETCo to gather water table data. This data was used to identify locations for new monitoring wells. Four (4) permanent groundwater monitoring wells were installed as a part of MAIN's investigation in the locations indicated on drawing 3136-8-1000-R1. The wells were constructed and permitted in accordance with appropriate state regulations. All wells were constructed with PVC casings, manufactured screens, clean sand packing in the screened intervals, bentonite seals, grout seals, concrete collars, and lockable protective caps. Well completion records are included in Appendix A.

Well 6 was installed within 8 feet of Well 4A to a depth of 40.5 feet below grade. Well 6 was screened in the Castle Hayne Formation to collect groundwater samples for analysis and to measure hydraulic head differences between the Castle Hayne and the surficial sediments. Well 4A is screened in the surficial sediments. See drawing 3136-8-1000-R1 for well locations.

Well 7 was located approximately 110 feet north of Well 6 and was screened in the surficial sediments. Water table measurements and groundwater samples were collected from this well.

Wells 8 and 9 were installed on the east and south side of the plant building respectively. Both wells were utilized for potentiometric information and plume delineation.

Wells 7, 8, and 9 were installed in boreholes which were advanced by rotary method utilizing hollow stem augers with split spoon soil samples taken at 2.5 foot intervals. The borehole for Well 6 was advanced to auger refusal then a 4 inch diameter PVC casing was lowered into the hole and grouted in place. The grout was allowed to solidify then a NQ size rock core was drilled to 40.5 feet. The 2 inch diameter well was constructed inside the 4 inch diameter casing. The larger diameter casing allowed the hole to remain open and prevented contamination from moving down the bore hole into the lower formations.

Following construction, all wells were developed by hand bailing and repeated surging of water through the sand filter. Bailing continued until the water in all wells was clear.

E. Groundwater Sampling and Analysis

At completion of well development, all wells were allowed to recover for 48 hours. Wells 7, 8 and 9 were purged one well volume prior to sampling. Well 6 was purged 10 volumes because tap water was used by the drill rig to core and clean out the hole during construction of the well.

Existing Wells 3A and 4A were developed and purged prior to sampling.

All wells were allowed to recover overnight following purging. At the time of sampling, water levels, specific conductance, pH, and temperature were recorded. Samples were collected in septum top vials, packed in ice and transported to MAIN's analytical laboratory within 24 hours.

Each water sample was analyzed for 1,1,1-trichloroethane and 1,1 dichloroethane. Field and laboratory analytical results are summarized in Table 1.

Of the wells screened in the surficial sediments, Wells 3A, 4A, 8, and 9 detected 1,1 dichloroethane (DCA) in the groundwater.

1,1,1-trichloroethane (TCA) was detected in Wells 4A and 9. The highest concentrations for both parameters were encountered in Well 4A at 219 mg/l for DCA and 146 mg/l for TCA. Well 9 contained 5.08 mg/l of DCA and 5.83 mg/l of TCA.

Groundwater samples taken from Well 6 showed .055 mg/l of DCA. No TCA was detected in this well. Laboratory data sheets showing groundwater analytical results are included in Appendix B.

F. Soil Sampling and Analysis

Four soil samples were taken during the drilling operations to better determine the extent of contamination

TABLE - 1

TEXFI INDUSTRIES
LABORATORY ANALYSIS SUMMARY

WATER SAMPLES

WELL	CONC. (PPM) 1,1 DICHLOROETHANE	CONC. (PPM) 1,1,1 TRICHLOROETHANE	pH	SC (umohs)	TEMP (DEG C)
3A	0.37	<.001	5.96	1150	14.0
4A	219.0	146.0	4.95	3600	15.2
6	0.055	<.001	6.93	580	15.5
7	<.005	<.001	6.39	805	15.3
8	0.357	<.001	5.56	1000	15.2
9	5.080	5.83	5.33	850	15.2

SC - SPECIFIC CONDUCTIVITY (umhos/cm)

SOIL SAMPLES

WELL OR LOCATION	DEPTH (FEET)	CONC. (MG/KG) 1,1 DICHLOROETHANE	CONC. (MG/KG) 1,1,1 TRICHLOROETHANE
6	4.0 - 4.5'	<.01	<.005
6	10.5 - 11.0'	0.012	<.005
S-1	1.0'	<.01	0.006
S-2	1.0'	<.01	<.005

above the saturated zone. Two soil samples were taken from split spoon samples in Wells 6 and analyzed for DCA and TCA. One sample taken from 4.0-4.5 feet below grade detected no contamination. The sample from 10.5-11.0 detected .012 mg/kg of DCA.

Two other soil samples taken in the vicinity of Well 6 at a depth of 1 foot detected no contamination. Analytical results for soil samples are found in Table 1. Laboratory data sheets showing analytical results for soil samples are included in Appendix B.

G. Hydrological Field Testing

Hydraulic parameters for the different strata underlying the former Texfi plant were determined by falling head permeability tests performed in the new permanent monitoring wells installed during this phase and on existing Wells 3A and 4A. This test involved measuring the initial water level in the well then instantaneously introducing a sufficient volume of clean water to the well to bring the water level to the top of the casing. Measurements of the falling water level were taken at timed intervals.

Tests conducted on Wells 7 and 9 yielded hydraulic conductivities of 3.3×10^{-5} cm/sec and 2.4×10^{-4} cm/sec, respectively. See Table 2 for a summary of field hydraulic data.

Permeability tests conducted on Wells 6 and 8 produced inconclusive data. The permeability of the stratum screened in each well was too high to accurately deter

mine conductivity using this test method. Hydraulic conductivities for these strata were, therefore, estimated from field tests and published data.

3. HYDROGEOLOGY

A. Regional Hydrogeology

The former Texfi plant is situated in the eastern portion of the Coastal Plain physiographic province of North Carolina. In the subsurface, the Coastal Plain is characterized by a wedge of sediments which thickens in the seaward direction from a thin veneer along the western margin. The sediments which compose this wedge may be divided into several hydrogeologic units depending on differences in hydraulic conductivity and media properties. These units dip eastward at a gradient slightly greater than the topography.

Both phreatic and confined aquifer conditions exist in the region. Phreatic conditions are typically found in the younger unconsolidated post-Miocene sediments of Pliocene, Pleistocene, and Holocene age, which overlie the older lithified sediments. The groundwater for phreatic aquifers is generally derived from localized precipitation and subsequent infiltration. Precipitation averages 50 inches yearly in the New Bern area.

Groundwater also occurs in confined or leaky-confined aquifers. Primary recharge for these aquifers occurs in locations where the aquifer is sufficiently close to the surface to receive rainfall infiltration. These recharge areas are regional in size and are positioned

TABLE - 2

TEXFI INDUSTRIES
WELL AND GROUNDWATER DATA

WELL	BOTTOM ELEV	T/S ELEV	B/S ELEV	SWL (2-17-87)	HYDRAULIC CONDUCTIVITY CM/SEC (FT/D)
1	9.70	19.70	9.70	25.73	NOT MEASURED
1A	9.10	19.10	9.10	14.94	NOT MEASURED
2	9.80	19.80	9.80	23.02	NOT MEASURED
2A	9.10	19.10	9.10	19.55	NOT MEASURED
3	10.70	20.70	10.70	24.92	NOT MEASURED
3A	9.80	19.80	9.80	22.17	1.4 E-04 (0.40)
4	8.50	18.50	8.50	17.14	NOT MEASURED
4A	9.60	19.60	9.60	14.85	7.5 E-05 (0.21)
5	12.30	22.30	12.30	25.69	NOT MEASURED
6	-11.53	-1.86	-10.61	10.85	est 3.53 E-02 (100.0)
7	6.94	16.61	7.86	16.86	3.3 E-05 (0.094)
8	7.00	16.67	7.92	11.19	est 3.0 E-03 (8.5)
9	6.70	16.37	7.62	14.42	2.4 E-04 (0.68)

TOS - TOP OF SCREEN ELEVATION
BOS - BOTTOM OF SCREEN ELEVATION
SWL - STATIC WATER LEVEL ELEVATION
est - ESTIMATED

ALL ELEVATIONS ARE IN FEET RELATIVE TO MEAN SEA LEVEL

NOTE: 1.4 E-04 IS EQUIVALENT TO 1.4×10^{-4}

west of New Bern and hydrographically upgradient. It is not unusual for the potentiometric surface of these aquifers to be located near or above the topographical surface. Secondary recharge occurs through infiltration of water stored in overlying material.

In the New Bern area, groundwater within 100 feet of the surface may be found in three water bearing stratigraphic units; the post-Miocene sediments, the Yorktown Formation, and the Castle Hayne Formation. Groundwater in each unit apparently moves in the general direction of the Neuse River. Preliminary calculations, using published hydraulic conductivity data for the Castle Hayne Limestone, indicate that the natural potentiometric surface in the vicinity of the former Texfi plant has been modified to some degree by the continuing operations at the nearby Martin Marietta Quarry; however, the effect of the quarry on contaminant miration and velocity can not be calculated without additional data.

According to Craven County Environmental Health personnel, city water is supplied for residential and industrial use in an area which extends from the city of New Bern along State Highway 55 to the intersection at Washington Forks. Assuming that production wells were abandoned upon connection with city water supply lines, the area which is downgradient of the site should be relatively inactive with respect to residential or industrial groundwater usage. However, it is possible several downgradient wells are still functioning. Craven County Environmental Health has also informed

MAIN that plans have been made to extend city water further to the northwest.

Existing water supply wells within 1 mile of the former Texfi plant are shown on Figure 2 and associated well data are presented in Table 3. According to the North Carolina Department of Natural Resources and Community Development Division of Environmental Management (DEM), not all water supply wells are properly permitted. It is probable that a number of unpermitted wells may exist within 1 mile of the former Texfi plant.

B. Site Hydrogeology

1. Stratigraphic and Hydrogeologic Unit Descriptions

Subsurface material at the former Texfi plant may be subdivided into three stratigraphic units; the Castle Hayne Formation (Eocene), the Yorktown Formation (Miocene), and a sequence of post-Miocene sediments. Refer to the geologic cross sections (Drawing 3136-8-1000-R2) and boring logs (Appendix C) throughout the following discussion.

a. Castle Hayne Formation

The Castle Hayne Limestone is the oldest material encountered at the study area. In Well 6, the Castle Hayne was encountered at a depth of 35.5 ft. (Elev -7.2 ft.). Based on observations at the nearby Martin Marietta quarry, it appears the upper contact of the Castle Hayne is quite uniform throughout the

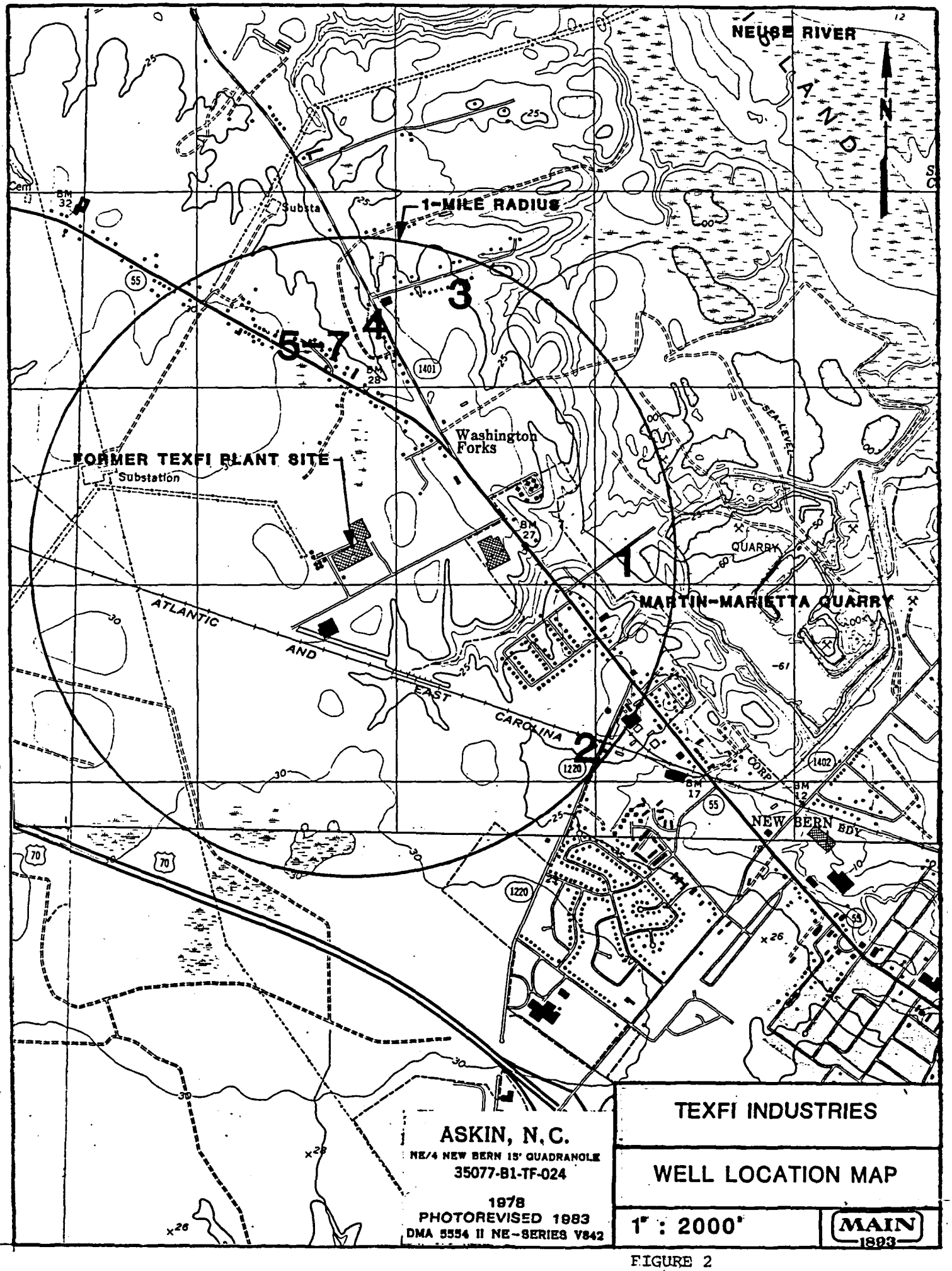

NEUSE RIVER
N
1-MILE RADIUS
Substa
3
4
5
7
Washington Forks
FORMER TEXFI PLANT SITE
Substation
QUARRY
1
MARTIN-MARIETTA QUARRY
ATLANTIC AND EAST CAROLINA
2
NEW BERN
ASKIN, N.C.
NE/4 NEW BERN 15' QUADRANGLE
35077-B1-TF-024
1978
PHOTOREVISED 1983
DMA 5554 II NE-SERIES V842
TEXFI INDUSTRIES
WELL LOCATION MAP
1" : 2000'
MAIN
1893

FIGURE 2

TABLE - 3

RECORDED WATER WELLS WITHIN ONE MILE
OF THE FORMER TEXFI PLANT

MAP LOCATION	OWNER	GENERAL LOCATION	PRODUCTION INTERVAL	TOTAL DEPTH	YIELD (GPM)	USE
1	MARTIN MARIETTA	HIGHWAY 55 WEST	45-55'	45'	-	MONITORING
2	READY MIX CONCRETE	SR 1220	47-87'	87'	220	COMMERCIAL
3	DOODLE LEE CONTR.	BRAIRWOODS DR.	31-45'	45'	15	DOMESTIC
4	CARPENTER ASSOC. BUILD.	SPRING GARDEN RD.	45-55'	55'	15	DOMESTIC
5	PEARL JONES	PLEASANT HILL	35-45'	45'	15	DOMESTIC
6	CLARK RESIDENCE	PLEASANT HILL	35-45'	45'	15	DOMESTIC
7	H.M. CARPENTER BUILD.	PLEASANT HILL	35-55'	55'	15	DOMESTIC

MAP LOCATION NUMBERS CORRESPOND TO WELL LOCATIONS ON FIGURE 2.

area. Castle Hayne material encountered during coring operations at Well 6 is a biomicrite (fossil limestone) composed almost entirely of pelecypod molds. The Castle Hayne is easily distinguished from other material at the site by the presence of large voids (former shell casts) which are formed by the removal of soluble calcareous shell material as result of circulating groundwater. These large voids are responsible for high hydraulic conductivities, thus the Castle Hayne aquifer is the most productive hydrogeologic unit in the area.

Hydraulic conductivity of the Castle Hayne aquifer is variable. A conductivity of 42 ft/day was reported by the North Carolina Department of Natural and Economic Resources in Groundwater Bulletin No. 21, 1974, where as, 300 ft/day was reported by Heath in the USGS Open-File report 80-44, 1980. Both conductivities are very high and under moderate gradient conditions, capable of transmitting a substantial volume of water. Because of the high hydraulic conductivity, MAIN was unable to determine the in-situ hydraulic conductivity using single well slug testing procedures. It is possible to infer a lower conductivity limit based on the observation that material with a hydraulic conductivity greater than 1.0×10^{-3} (2.83 ft/day) screened over a ten foot interval recovers too quickly for accurate measure

ments to be made. Thus, it appears that the published data mentioned above are reasonable values. In the absence of pump test data, 100 ft/day was assumed to be a representative value for the Castle Hayne hydraulic conductivity in the vicinity of the former Texfi plant.

b. Yorktown Formation

Overlying the Castle Hayne limestone is a semi-consolidated unit of fragmented shell debris and quartz sand belonging to the Miocene Yorktown Formation. This unit, as logged in Well 6, begins at a depth of 26.0 ft. (Elev. 2.3 ft.) and extends to a depth of 35.5 ft. (Elev. -7.2 ft.) where it exists in probable unconformable contact with the Castle Hayne Limestone. Stratigraphically the Yorktown is easily distinguished from the overlying and underlying sediments by a fragmented shell content with a sandy matrix and carbonate cement.

Although the Yorktown and the Castle Hayne Formations are readily discernible on a lithologic and stratigraphic basis, they are not easily distinguished hydrologically according to LeGrand (NC Department of Water Resources, Groundwater Bulletin Number 1, 1960). It is therefore reasonable and justified to group the Castle Hayne and Yorktown Formations into one hydrogeologic

unit until sufficient hydrogological data on each unit can be obtained. For the purpose of the investigation, MAIN will consider the hydrological properties of the Yorktown and the Castle Hayne identical and will therefore refer to this pairing as simply the "Castle Hayne".

c. Post-Miocene Sediments

The upper most sequence of sediments beneath the former Texfi plant consists of Pliocene, Pleistocene, and Holocene (recent) sediments.

These sediments appear to be lagoonal in origin, probably associated with a back barrier depositional environment. It is common for sediment sequences deposited in this environment to contain interbedded sand and clay (mud) lenses that formed in response to bar and/or channel migration. The fence diagram (Figure 3) constructed from boring logs illustrates the relationship between these sands and clays. It should be noted that the uppermost clay pinches out in the Well 9 direction while the lower clay pinches out in the Well 8 direction. Although the upper clay is above the zone of saturation, it may be partially responsible for contaminant transport by supporting perched water conditions. In lieu of the fact that several different types of sediments are found within the post-miocene sequence, they

are sufficiently similar to be grouped into two subdivisions, clayey sands and silty to sandy clays. Each of these two sediment groups occurs once within the zone of saturation.

Hydraulic conductivity data obtained from slug tests indicate that the sandy clay conductivity is 3.3×10^{-5} cm/sec (0.094 ft/day). This value was obtained using Well 7 which is screened roughly within the sandy clay unit (see Well 7 on Drawing 3136-8-100-R2). Conductivity for Well 9, which is screened subequally through both sediment groups (see Well 9 on Drawing 3136-8-1000-R2), was calculated at 2.4×10^{-4} cm/sec (0.68 ft/day). Although rapid recovery rates did not allow the hydraulic conductivity to be calculated at Well 8, it is probable that the value is close to 3.0×10^{-3} cm/sec (8.5 ft/day). Well 8 is screened entirely within the clayey sand (see Drawing 3136-8-1000-R2) and thus should yield a hydraulic conductivity higher than either Well 9 or Well 7. Since an order of magnitude increase in conductivity was noted between Well 7 (clay screen interval) and Well 9 (subequal sand and clay interval), it was assumed that a similar increase in conductivity would result from the Well 8 screen interval which is composed entirely of sand.

Apparently, a two order of magnitude difference in hydraulic conductivity exists between the clayey sand and the sandy clay which suggests that each should be considered a different hydrogeologic unit.

2. Estimation of Groundwater Velocity

Groundwater occurs in both phreatic and leaky-confined conditions at the former Texfi plant site. The phreatic, or groundwater table, aquifer is restricted to the post-Miocene sediment sequence. Water levels in monitoring wells screened in this interval are somewhat variable. Water within the "Castle Hayne" aquifer occurs in leaky-confined conditions as indicated by the differing static water levels in Wells 4A and 6 (shown on Drawing 3136-8-1000-R2). According to LeGrand (1960), this condition is normal and should be expected throughout the New Bern area. Based on existing observation well and published data, it appears two flow systems are present and are operating conjunctively. Perched water conditions are common within the soil zone (0-7.0' below grade) as evidenced by standing water in the drainage ditch surrounding the site.

Groundwater velocities within the post-Miocene sediment sequence are variable as a function of hydraulic conductivity and hydraulic gradient. The sandy clay horizontal velocity is estimated to be 1.09×10^{-3} ft/day. Since the "Castle Hayne" is not totally confined, a component of flow also

acts in the vertical direction. Vertical groundwater velocity is calculated from the head differential between Wells 4A and 6 and only applies to the least permeable unit (sandy clay). The estimated vertical velocity is 1.74×10^{-2} ft/day. Horizontal velocity for the clayey sand unit is estimated to be 9.86×10^{-2} ft/day. It appears the less permeable nature of the sandy clay controls the position of the phreatic surface as evidenced by the position of the water table above the sandy clay unit (Drawing 3136-8-1000-R2, Sections A and B). A preliminary potentiometric surface map (Drawing 3136-8-1000-R1) has been generated from water level data obtained from wells 4A, 7, 8, and 9. It is important to realize that the groundwater flow direction determined from these wells may not be indicative of the groundwater flow field on a scale equal in size to the former Texfi property limits. The impermeable floor of the manufacturing building appears to influence the groundwater table surface by restricting infiltration and recharge. This is evidenced by the abrupt change in orientation of the equipotential lines beneath the building.

Site specific groundwater velocity in the "Castle Hayne" cannot be determined due to lack of gradient data. In the absence of gradient data, a regional groundwater gradient of .001 ft/ft may be assumed. This gradient corresponds roughly to the published dip of the Castle Hayne limestone within the region. Thus, the horizontal velocity of

water within the "Castle Hayne" aquifer is estimated at 0.1 ft/day.

As mentioned previously, the aquifer depressurization resulting from the nearby Martin Marietta quarry operation is probably "felt" beneath the former Texfi site. The effect of this depressurization on the position of the potentiometric surface at the study area may not be calculated until additional site specific hydrological information is acquired, however, an estimate may be made based on information obtained from Martin Marietta.

Using a reported groundwater withdrawal rate of 10 million gallons per day, an assumed storativity of 0.05 (to simulate leaky-confined conditions), an effective aquifer thickness of 60 feet, an assumed hydraulic conductivity of 100 ft/day, and assuming that equilibrium within the aquifer is achieved after six months at a constant withdrawal rate; the radius of influence should extend about 2.5 miles beyond the former Texfi plant. Since the plant is located upgradient, the drawdown effect will be less than estimated. Pumping in the Castle Hayne by Texasgulf Phosphate in Aurora, NL has demonstrated that a two-thirds reduction in upgradient radius of influence can be expected (North Carolina Department of Natural and Economic Resources, Groundwater Bulletin No. 21, 1974). Thus, the effective radius of influence of the New Bern quarry is estimated to be 6,000 feet in the direction of the former Texfi plant, or about

1,250 feet beyond the site in the upgradient direction. Proportionally, reducing the drawdown radius to one-third of the zero-gradient value and adding to the existing gradient, a gradient of 0.0018 ft/ft is estimated for the vicinity of the former Texfi plant. The resulting "Castle Hayne" groundwater velocity is thus increased from 0.1 ft/day to .18 ft/day in response to the induced gradient.

In summary, flow nets cannot be developed for this site due to insufficient hydraulic data for the Castle Hayne Formation. Based on the preliminary data available, the flow direction of groundwater in the water table aquifer appears to generally be in the east to northeast direction. The horizontal and vertical velocities of the uppermost aquifer appear to be 9.86×10^{-2} ft/day and 1.74×10^{-2} ft/day, respectively.

The estimated flow direction for the Castle Hayne appears to be east toward the Martin Marietta quarry. The horizontal flow velocity is estimated to be about 0.2 ft/day.

4. CONTAMINATION PLUME DELINEATION

A. Contamination Source

The introduction of TCA into the groundwater reportedly occurred as the result of a one time spill of the solvent during dismantling of an above ground storage tank in the vicinity of Wells 4A and 6. Five to ten

gallons were believed to have been spilled on the ground. The exact time of the spill is unknown, but the event could have occurred as long ago as ten years.

TCA, with specific gravity of 1.34 and solubility of 4,400 mg/l of water, tends to move vertically through the unsaturated zone to the water table. Upon contact with the groundwater, some of the solvent becomes soluble in the water and tends to move in the direction of groundwater flow at the same velocity. If a sufficient volume reaches the water table, some solvent may move downward as a separate phase through the soil and rock at a higher rate than the groundwater flow velocity.

Other compounds, in addition to TCA, have been detected during this investigation and previous studies. DCA, chloroethane, 1,1 dichloroethene, and methylene chloride have been detected.

1,1 dichloroethene (DCA) is a degradation product of TCA, and chloroethane is a degradation product of DCA.

1,1 dichloroethene is synonomous with 1,1 dichloroethylene which is a degradation product of trichloroethylene and tetrachloroethylene. These particular products were not used at this facility according to Texfi sources. Methylene chloride is a common paint solvent. History of its use at this facility is unknown.

A review of laboratory results obtained from previous studies, leads to the conclusion that contamination

found in Wells 2, 3A, and 4A resulted from isolated spills which probably occurred at significantly different times. The compounds found in Well 3A have undergone more complete degradation than compounds found in 4A, as evidenced by the fact that chloroethane was detected in 3A and not in 4A. TCA has achieved complete degradation at Well 3A since none was detected but DCA and chloroethane were detected, at .14 and 0.62 mg/l, respectively.

TCA and DCA were detected in Well 4A and Well 9 during the most recent sampling event in approximately equal concentrations with no chloroethane detected in either well. Since Well 3A is upgradient of 4A and degradation of the compounds in Well 3A is more advanced than Well 4A, separate sources of contamination are indicated.

Methylene chloride at Well 2 is probably the result of a separate spill incident because this compound is not found at any other location.

B. Plume Migration

Solubilized TCA and DCA have moved within the upper aquifer and the Castle Hayne from the area near Wells 4A and 6 under the plant building towards the east and northeast.

Based on calculated and estimated groundwater flow velocities at this site, and the concentrations of contaminants in Wells 8 and 9, it appears that the downgradient edge of the plume has migrated horizontal

ly more than 380 feet from the source. The depth of travel cannot be estimated without additional wells in the Castle Hayne Formation, but contamination is known to exist at .055 mg/l to a depth 40 feet below grade, based on analytical results in Well 6. See Table 1 for a summary of analytical results.

Complete delineation of the contaminant plume(s) will require additional shallow and deep wells to determine additional hydraulic information on the Castle Hayne Formation and collect groundwater samples for analysis.

Soil contamination does not appear to be significant within the unsaturated zone based on analytical results. No contamination was detected in the upper soil strata until a depth of 10.5-11.0 feet. DCA was detected at this depth at .012 mg/kg. See Table 1 for results of soil analysis.

5. REGULATORY CONSIDERATIONS

North Carolina Administrative Code, Title 15, Subchapter 2L, Section .0201 classifies the waters beneath the former Texfi plant as Class GB and Class GA.

Class GB waters are groundwaters occurring "above a depth of 20 feet below land surface". This zone is considered a cycling or mixing zone where natural treatment of water takes place by "adsorption, absorption, filtration, or other natural processes". Water quality standards for Class GB

waters require that there be no increase in deleterious substances unless it can be shown that:

- the increase will not affect adjacent waters of a different class;

- the increase will not cause a threat to public health or environment due to unusual or different hydrological conditions; and

- the increase will not cause an existing or potential water supply to become unsafe or unsuitable for its current use.

Class GA waters in this case are groundwaters suitable for drinking culinary use and food processing without treatment except where necessary to correct naturally occurring conditions. These waters occur at depths greater than 20 feet below land surface and in the saturated zone above a depth of 20 feet where these waters are a principal source of potable water supply. Water quality standards for Class GA waters, with respect to the types of contaminants present, prohibit the introduction of any synthetic, man-made or other substances that do not naturally occur.

By regulation, clean-up of the contamination at this site is required because contamination has been detected in Class GB groundwater and is affecting the quality of an adjacent Class GA groundwater. Since the plume does appear to have traveled beyond the property boundary, imminent hazard or threat to the public health or safety does not seem to exist at this time.

The groundwater regulations have established a criteria for determination of a compliance perimeter for existing facilities. The rules define this location as being 500 feet from the point of discharge (source) or the property boundary, which ever is less.

The compliance perimeter for this facility, by definition, is an imaginary line 500 feet from and concentric to well 4A. The 500 foot boundary applies to this site since the property line is located beyond the 500 foot limit.

According to calculations of groundwater flow velocities and other conservative assumptions it appears that the contamination plume has not traveled beyond the compliance perimeter.

6. GROUNDWATER REMEDIATION

All contaminants found to date at the former Texfi plant can be removed from the groundwater by means of pumping and air stripping or filtration by carbon adsorption.

Pumping can be accomplished through partially cased deep wells drilled into the Castle Hayne Formation and fully cased and screened wells drilled into the surficial sediments. Pumping rates cannot be determined at this time without additional field data.

Air stripping of these solvents will require an efficient treatment system since contaminant levels in the surficial sediments are very high and treated effluent will most likely have to be discharged into surface waters through an NPDES permit or back into the groundwater through injection wells. Discharge of treated effluent into the municipal

sewer/treatment system will not be possible unless all contaminants are removed to levels below the detection limit. The local sewer authority is under a compliance order issued by the State of North Carolina for effluent discharge violations and is restricting sewer discharge permits at the present time.

Air stripping can be accomplished by a manufactured stripping tower with resulting concentrations in the treated discharge less than the detection limit. The use of an existing cooling tower for stripping will require further study to determine its efficiency.

A carbon adsorption unit may be an option if air emissions from stripping are a problem. The carbon unit is very efficient at removing most organics but does not adsorb methylene chloride well. Selection of the type of treatment system and sizing of the units, wells and pumps cannot be accomplished without additional field data on plume size, total concentrations of contaminants and types of contaminants to be removed.

APPENDIX A

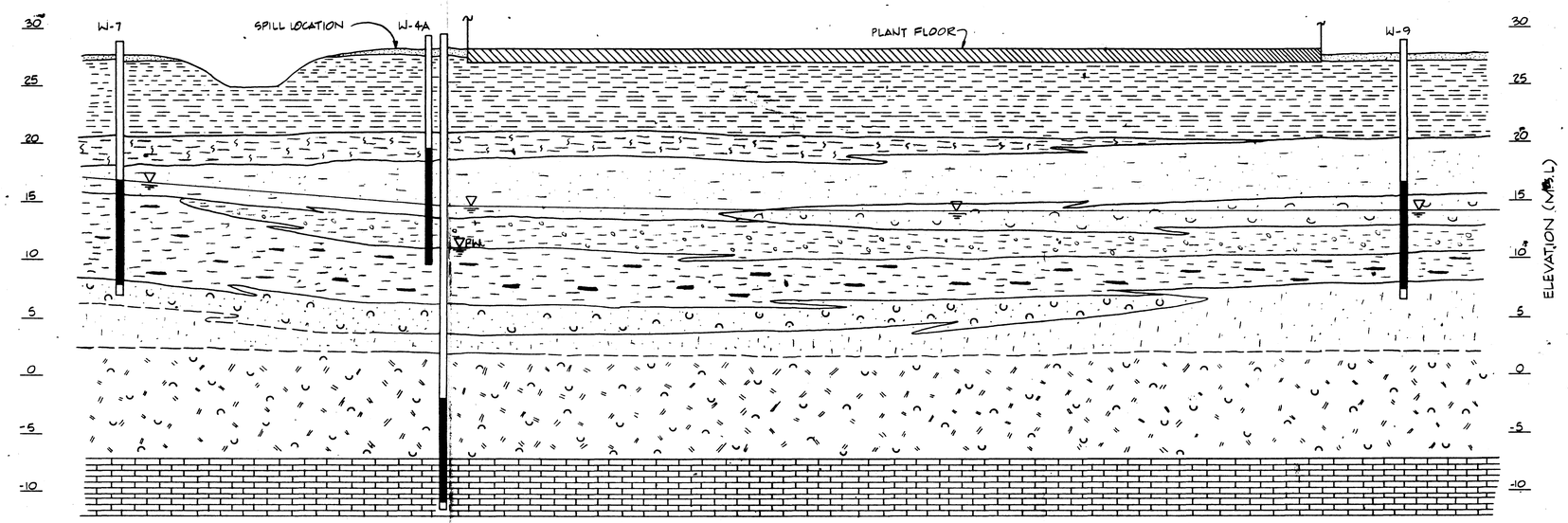
Well Completion Records

APPENDIX B

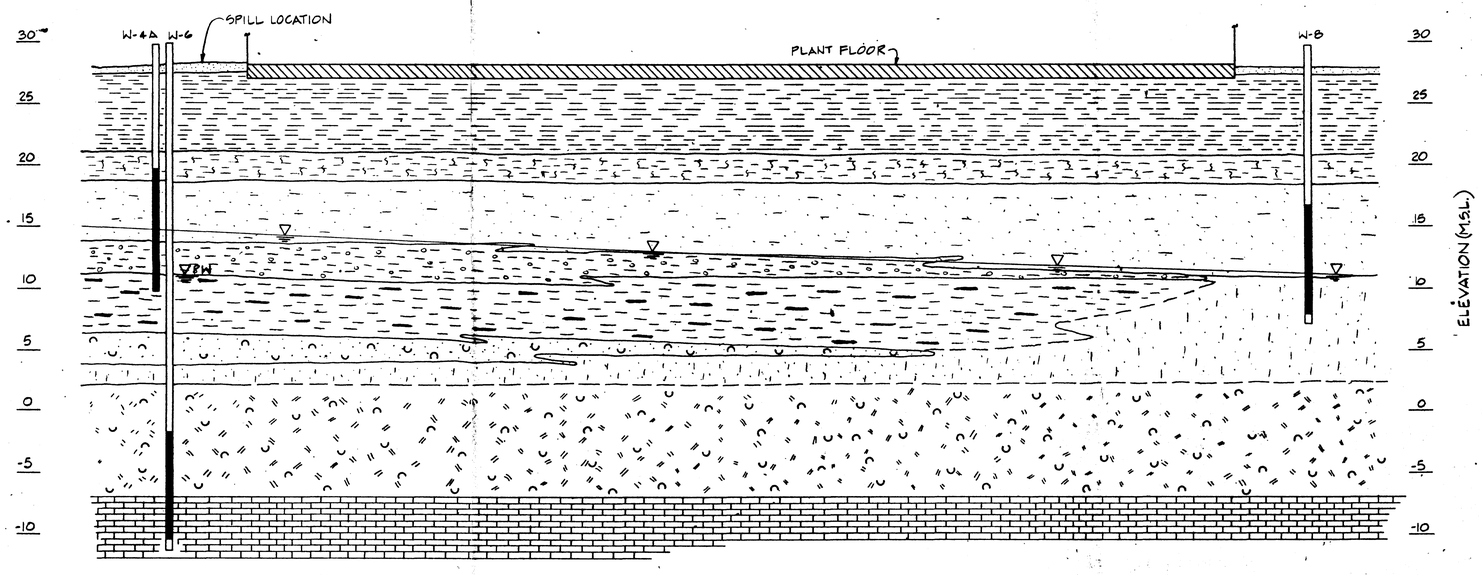
Laboratory Analysis Data Sheets

APPENDIX C

Boring Logs



SECTION A



SECTION B

NOTES

LEGEND

	SURFICIAL SAND, 'A' HORIZON (SP, SM, SC)
	FINE SANDY, SILTY CLAY B & B/C HORIZON (CL)
	SILTY CLAY; ZONES OF ORGANICS & PLANT ROOT MATERIAL (OL)
	ORGANIC CLAYEY MEDIUM TO COARSE SAND (SC)
UNCONSOLIDATED POST-MIOCENE SEDIMENTS	ORGANIC SILTY CLAY WITH APPARENT RIP CLASTS OF SILTY CLAY MATERIAL (OL)
	ORGANIC, FINE SANDY CLAY WITH SILT; UNIT CONTAINS FINE SAND LAMINAE (OL)
	FINE TO COARSE QUARTZ SAND WITH MARINE SHELL FRAGMENTS (SW)
	ORGANIC SILTY FINE SAND (SM)
YORKTOWN FM. (MIOCENE)	SHELL HASH, SAND COMPOSED OF FINE TO COARSE SHELL FRAGMENTS CEMENTED WITH CALCIUM CARBONATE (SW)
CASTLE HAYNE FORMATION (EOCENE)	BIOMICRITE, SANDY PELECYPOD-MOLD LIMESTONE

WATERTABLE SURFACE

PIEZOMETRIC SURFACE

WELL SCREEN INTERVAL

INFERRED CONTACT

NO.	DATE	DESCRIPTION

DRAWN BY | CHECKED BY
DESIGN SUPV. | RESP. ENGR.
SUPV. DISC. ENGR. | CH. DISC. ENGR.
PROJECT ENG. MGR.
PROJECT MGR.
IN CHARGE

DRAWN | CHECKED | DES. SUPV. | RESP. ENGR. | SUPV. DISC. ENG. | CH. DISC. ENG. | PR. ENG. MGR. | MF

MAIN

CHAS. T. MAIN, INC.
BOSTON • NEW YORK • CHARLOTTE • DENVER • PORTLAND

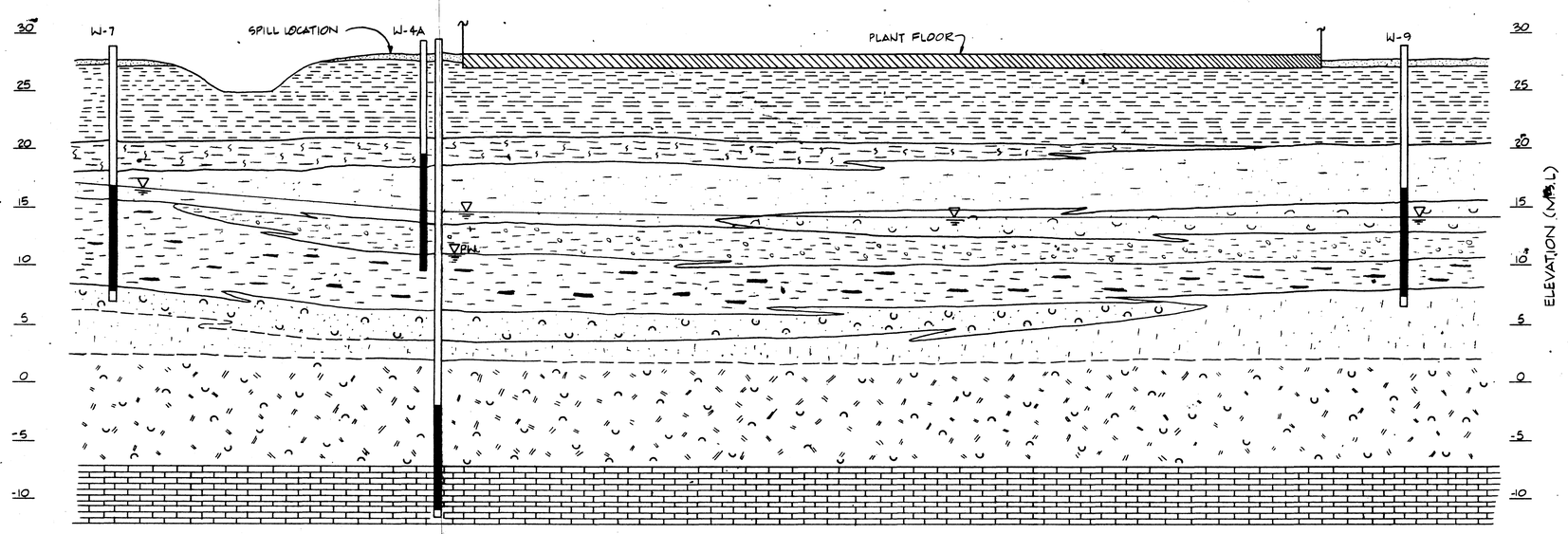
CLIENT/PROJECT TITLE
FORMER TEXFI PLANT
NEW BERN, NORTH CAROLINA
PRELIMINARY GROUNDWATER ASSESSMENT

DEPT. INDUSTRIAL | NO. 30

DRAWING DESCRIPTION
GEOLOGIC CROSS SECTIONS
SHEET 1 OF 1

SCALE 1:5 VERT. 1:20 HORZ.

MAIN'S DWG. NO. 3136-8-1000-1 | REV. 0



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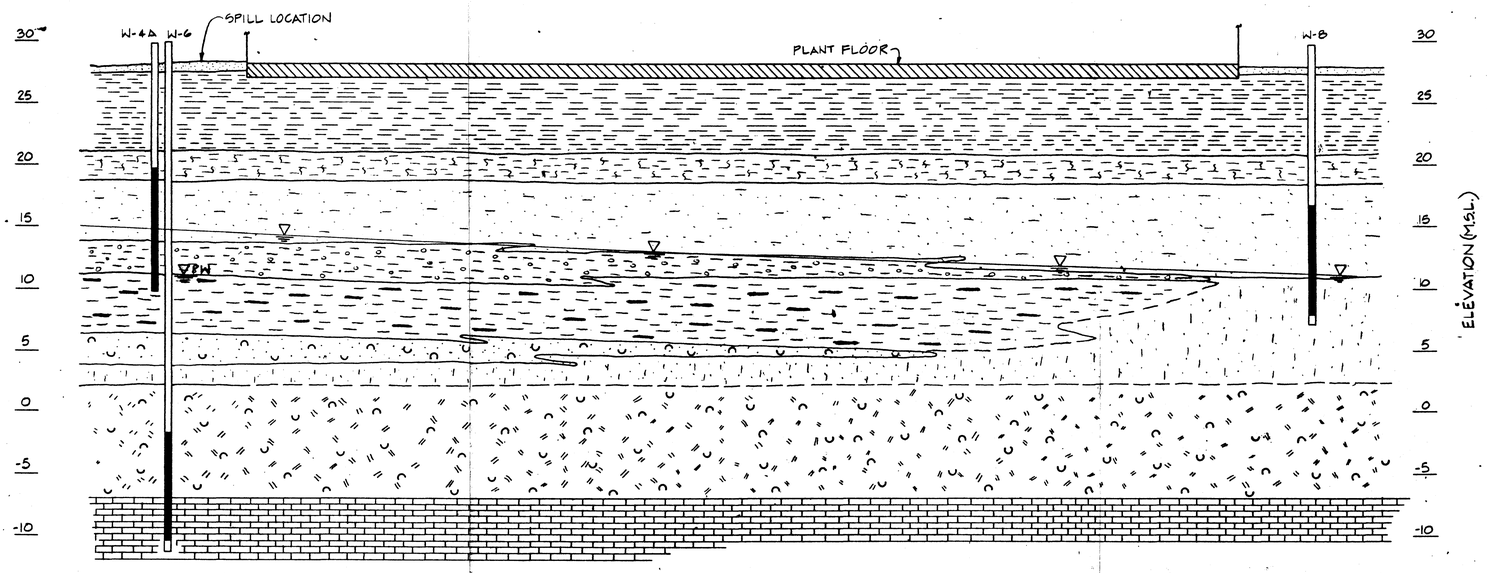

SECTION B

NOTES

LEGEND

UNCONSOLIDATED POST-MIOCENE SEDIMENTS
- SURFICIAL SAND, 'A' HORIZON (SP, SM, SC)
- FINE SANDY, SILTY CLAY B & B/C HORIZON (CL)
- SILTY CLAY; ZONES OF ORGANICS & PLANT ROOT MATERIAL (OL)
- ORGANIC CLAYEY MEDIUM TO COARSE SAND (SC)
- ORGANIC SILTY CLAY WITH APPARENT RIP CLASTS OF SILTY CLAY MATERIAL (OL)
- ORGANIC, FINE SANDY CLAY WITH SILT; UNIT CONTAINS FINE SAND LAMINAE (OL)
- FINE TO COARSE QUARTZ SAND WITH MARINE SHELL FRAGMENTS (SW)
- ORGANIC SILTY FINE SAND (SM)

YORKTOWN FM (MIOCENE)
- SHELL HASH, SAND COMPOSED OF FINE TO COARSE SHELL FRAGMENTS CEMENTED WITH CALCIUM CARBONATE (SW)

CASTLE HAYNE FORMATION (EOCENE)
- BIOMICRITE, SANDY PELECYPOD-MOLD LIMESTONE

- WATERTABLE SURFACE
- PIEZOMETRIC SURFACE
- WELL SCREEN INTERVAL
- INFERRED CONTACT

NO.	DATE	DESCRIPTION

DRAWN BY | CHECKED BY
DESIGN SUPV. | RESP. ENGR.
SUPV. DISC. ENGR. | CH. DISC. ENGR.
PROJECT ENG. MGR.
PROJECT MGR.
IN CHARGE

DRAWN | CHECKED | DES SUPV. | RESP. ENGR. | SUPV DISC ENG. | CH DISC ENG. | PR. ENG. MGR. | MF

MAIN
CHAS. T. MAIN, INC.
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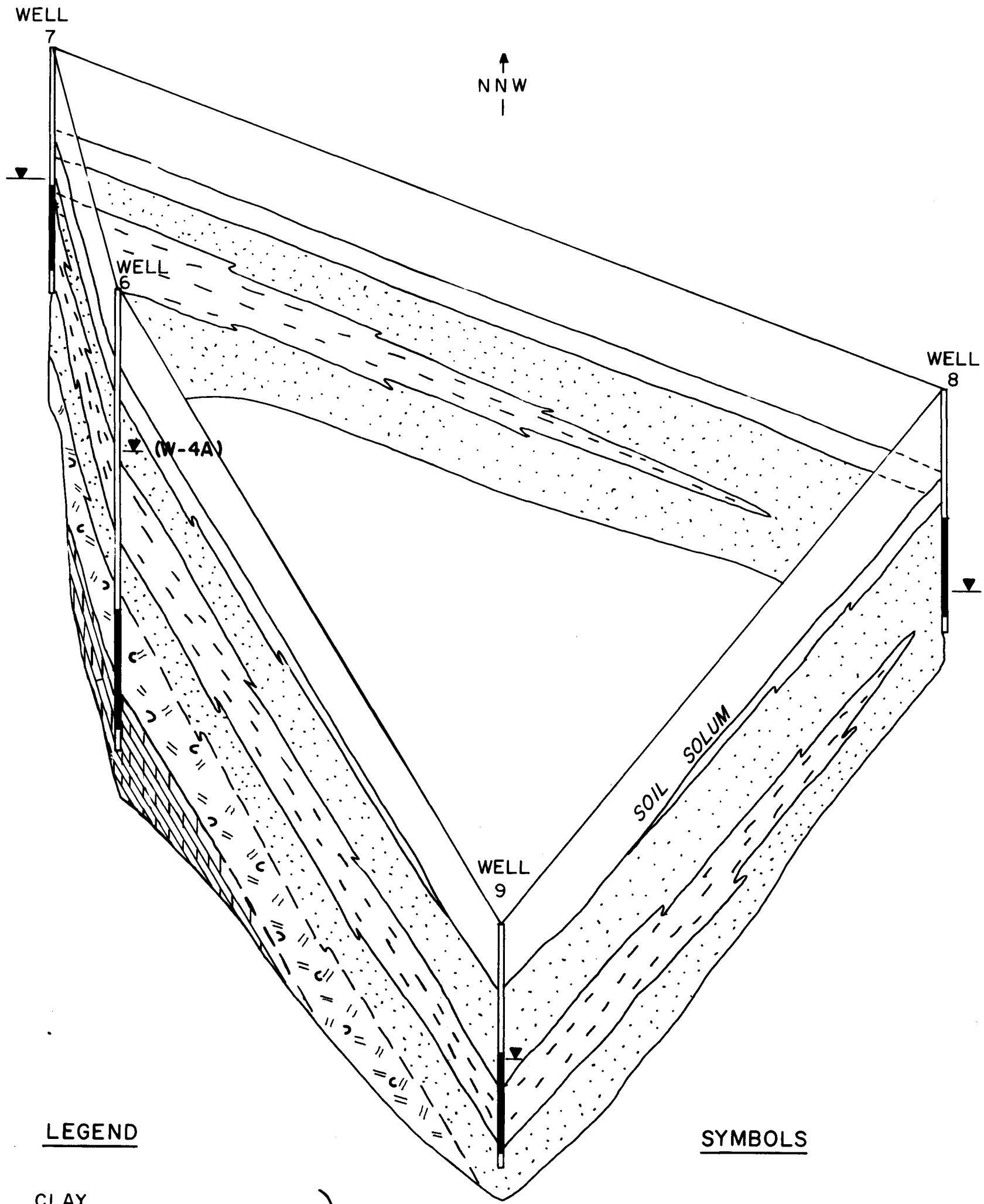
SCALE 1:5 VERT. 1:20 HORZ.

MAIN'S DWG. NO. 3136-8-1000-1 | REV. 0

DUNCAN-PARNELL, INC., CHARLOTTE 185 704-372-7788



LEGEND

	CLAY	POST-MIOCENE SEDIMENTS
	CLAY WITH INTERBEDDED FINE SAND	POST-MIOCENE SEDIMENTS
	SAND	POST-MIOCENE SEDIMENTS
	SEMI-CONSOLIDATED SHELL HASH	YORKTOWN FM.
	PELECYPOD-MOLD LIMESTONE	CASTLE HAYNE FM.

SYMBOLS

WATER TABLE (2·17·87)

WELL SCREEN INTERVAL

FENCE DIAGRAM

1' = 10' VERT.

1" = 50' HORIZ.

MAIN 1893

FORMER TEXFI PLANT
NEW BERN, N.C.

PRELIMINARY GROUNDWATER ASSESSMENT

DN JRW	CH	DWG. NO. 3136-8-1000	FIGURE 3
RE HWL	CDE		