8593

SUBSURFACE INVESTIGATION

SUNBURY WASTEWATER TREATMENT PLANT IMPROVEMENTS

SUNBURY, OHIO

Report to

FLOYD BROWNE ASSOCIATES, INC.

MARION, OH

Prepared by

BBC&M ENGINEERING, INC.
GEOSCIENCES AND MATERIALS ENGINEERS

DUBLIN, OHIO

July 2002

BBCM

BBC&M ENGINEERING, INC.

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July 18, 2002
01108593.000

Mr. Michael P. Davis, P.E.
Floyd Browne Associates, Inc.
107 N. Main St., Suite 200
Marion, OH 43302

Re: Subsurface Investigation
Sunbury WWTP Improvements
Sunbury, Ohio

Dear Mr. Davis:

In accordance with our proposal dated May 16, 2002, which you authorized on May 21, 2002, BBC&M Engineering, Inc. has completed a subsurface investigation for the proposed structures to be installed as part of the Sunbury Wastewater Treatment Plant (WWTP) improvements in Sunbury, Ohio (see the Vicinity Map submitted as Plate 1 of the Appendix). Our observations and recommendations associated with the investigation are presented in the following report.

We appreciate having been given the opportunity to be of service on this project. If you have any questions, please do not hesitate to contact this office.

Respectfully submitted,

BBC&M ENGINEERING, INC.
Dublin, Ohio

Jonathan P. Sterenberg, E.I.
Staff Engineer

Timothy Van Echo, P.E.
Vice President

Bethanie L. Meek, P.E.
Project Engineer

submitted: 3 copies

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APPENDIX

PROJECT DESCRIPTION

It is proposed to construct several new structures as part of the Sunbury WWTP improvements located on Middleview Road in Sunbury, Ohio (see the Vicinity Map submitted as Plate 1 of the Appendix). Information was provided by your office regarding the proposed new structure types, approximate dimensions, and bearing elevations. A summary is shown in the following table:

Treatment Unit	Surface Area Dimensions	Top of Structure Elevation	Bottom Elevation	Boring No.
Influent Lift Station	9' X 27'	936.0	913.0	B-1
Preliminary Treatment Facilities	25' X 30'	962.0	946.2	B-2 Not Accessible
Aeration Splitter Box	14' X 20'	949.0	944.0	Not Accessible
Aeration Basins	124' X 37'	947.8	934.3	B-3, 4, 5, 6
Clarifier Splitter Box	12' X 14'	944.0	939.0	No Boring
Secondary Clarifiers	55' diameter	944.5	929.1	B-7, 8
Scum/Secondary Plant Drain Lift Station	6' diameter	947.5	924.0	B-9
RAS/WAS Pump Station	15' X 9'	943.0	938.0	B-10
Post Aeration Basin	9' X 30'	941.0	923.0	B-11
Sludge Transfer Station	20' X 20'	941.0	925.0	B-11
Solids Handling Facility	30' X 40'	937.0	933.0	B-12
Sludge Storage Area	25' X 47'	937.0	933.0	B-13

FIELD WORK

On June 4 and June 5, 2002, twelve (12) soil borings were performed ranging in depths from 15 to 25 feet at the locations shown on the Plan of Borings, submitted as Plate 2A and 2B in the Appendix. Boring B-2 was eliminated due to access difficulties. The borings were field located by BBC&M and top-of-boring elevations were estimated using the topographic information provided by Floyd Browne Associates.

The borings were drilled with a truck-mounted drill rig using a 4-1/2-inch O.D. continuous-flight auger. At regular intervals, disturbed, but representative soil samples were obtained by lowering a 2-inch O.D. split-barrel sampler to the sampling depth in the boring where it was driven into the soil by blows from a 140-pound hammer freely falling 30 inches (Standard Penetration Test). Samples were examined in the field, and representative portions were preserved in airtight glass jars. Upon completion of drilling, water levels were measured and all borings were backfilled with soil cuttings.

LABORATORY TESTING

In the laboratory, all samples were visually identified and on a few representative samples, moisture content, liquid and plastic limit determinations, and grain-size determinations were performed. Based on the results of the laboratory visual identifications and tests, soil descriptions on the field logs were modified, if necessary, and laboratory-corrected logs are submitted as Plates 4 through 16. Results of the grain size determinations are presented in curve form on Plates18 through 20 of the Appendix. Results of the laboratory tests are shown on the individual boring logs and a summary is presented on Plate 17 in the Appendix.

Soil and rock described in this report have been classified basically in accordance with the Unified Soil Classification System, but this system has been augmented by the use of special adjectives to designate the approximate percentages of minor soil and rock components. Definitions of these special adjectives, and an explanation of the symbols and terms used on the boring logs are presented on Plates 3A and 3B.

GENERAL SUBSURFACE CONDITIONS

In general, 3 to 6 inches of topsoil were encountered in the grass areas of the site with isolated areas of 2 inches of gravel in the vicinity of Borings B-1 and B-11. Beneath the topsoil and gravel, soil identified as fill or possible fill was encountered to depths of 3.5 to 7.0 feet below the ground surface. The fill was described as stiff to hard brown silty clay and clayey silt. A few isolated areas (Borings B-4, 5, 8 and 10) encountered no soil that was identified as fill or possible fill. Isolated areas of dark-gray organic silty clay and clayey silt were encountered underlying the fill in Borings B-1, 3, 6, 7 and 13 indicating possible buried topsoil. Underlying the possible topsoil, gravel and fill, natural soil was encountered described as stiff to hard clayey silt and silty clay. Boring B-13 was terminated in this natural cohesive layer. Isolated layers of medium-dense to dense granular soils were encountered in Borings B-1 and B-12 underlying the cohesive soil. Boring B-12 was terminated in this granular layer. The remaining borings were terminated in very-soft to soft gray shale.

Groundwater observations were made as each boring was being advanced, at the completion of drilling, and 24-hours after the completion of drilling. Groundwater seepage was noted during drilling in Borings B-1, B-3 and B-5 at depths ranging from 9.0 to 17.6 feet below the ground surface. Groundwater was encountered in Borings B-1, B-2, B-6 and B-12 at depths ranging from 10.1 to 13.0 feet below the ground surface. At the completion of drilling, water had accumulated in a majority of the borings to depths ranging from 5.3 to 16.0 feet below the ground surface. All other borings were observed to be "dry", meaning water was not observed in the boring. Groundwater levels after 24-hours were observed to be at depths ranging from 5.8 to 11.4 feet below the ground surface.

Summarized below are the depths of groundwater and the top of bedrock encountered in borings performed for this investigation:

Table No. 1 - Subsurface Data - Depth of Groundwater and Bedrock

Boring Number	Ground Surface Elevation (msl - ft.)	Depth of Existing Fill or Possible Fill (ft.)	Depth of Groundwater At Completion of Drilling (ft.)	Depth of Groundwater At 24-hr After Drilling (ft.)	Depth Top of Bedrock Surface Encountered (ft.)
B-1	936.0	4.0	5.3	7.9, caved @ 10.5	--
B-3	937.5	3.5	5.6	5.8, caved @ 12.5	16.0
B-4	938.3	None	5.7	--	3.0
B-5	938.4	None	16.0	--	0.3
B-6	937.1	6.0	9.8	--	15.0
B-7	940.8	4.0	14.5	--	11.6
B-8	939.5	None	16.4	--	1.0
B-9	942.5	3.5	"dry"	8.7, caved @ 17.5	8.9
B-10	940.1	None	6.3	--	0.3
B-11	940.3	2.5	"dry"	10.4, caved @ 11.0	10.5
B-12	935.5	4.5	8.0	9.6, caved @ 10.8	--
B-13	937.1	7.0	"dry"	8.2, caved @ 11.7	--

Because a majority of the borings caved upon completion or by the time the 24-hour water level reading was obtained, the water levels shown in the table above may not be representative of the "true" groundwater table.

If more detailed descriptions of the subsurface conditions are desired at a particular location, the logs from the individual explorations should be examined. The logs are presented as Plates 4 through 15 in the Appendix of this report.

ANALYSES AND RECOMMENDATIONS

Geotechnical Evaluation

In general, the borings revealed up to 7.0 feet of soil identified as fill or possible fill in a majority of the borings. Underlying the fill, natural stiff to hard deposits of silty clay and clayey silt were encountered with isolated areas of medium-dense to dense granular soil.

Very soft to soft shale was encountered underlying the natural cohesive material in most of the borings.

Site characteristics which may require additional costs for construction of the proposed structures include the following:

1) Presence of up to 7.0 feet of existing fill or possible fill over organic soils in the area of the proposed slab-on-grade structures;

2) Excavation of up to 10 feet of very-soft to soft shale bedrock to attain anticipated bearing elevation for the secondary clarifiers, the RAS/WAS pump station and the sludge transfer station;

3) The location of the groundwater table and the potential need for dewatering.

These issues will be discussed in the following sections.

General Site Preparation

It is recommended that all topsoil, organic soil, gravel or any other unsuitable material be stripped from the structure areas. Following stripping, the entire exposed subgrade should be proofrolled using a heavily-loaded, tandem-axle truck to promote uniformity and to detect soft, wet or weak zones which might not have been revealed by the explorations. It is recommended that any observed unsuitable materials, or subgrade soils which exhibit significant pumping and/or rutting during proofrolling, either be scarified, aerated and compacted or completely removed and replaced with controlled fill in accordance with recommendations presented below. Visual observation of the removal of these unsuitable materials by the Geotechnical Engineer of Record or the engineer's representative may result in at least a partial reduction of the necessary undercutting in these areas.

New fill should consist of clean, inorganic soil free of any miscellaneous materials, cobbles, and boulders. The new fill for the building pad should be placed in uniform, thin lifts (maximum 8 inch thick) and be compacted to a unit dry weight equal to at least 100 percent of the maximum unit dry weight and within ±2% of optimum moisture content as determined in the laboratory by the Standard Test Methods for Moisture-Density Relations of Soils (ASTM D 698). Fill should not be placed in a frozen condition or upon a frozen subgrade. A source of borrow should be designated well in advance of construction, and bulk samples should then be obtained and tested in the laboratory for compaction characteristics to have the results available for control of any new fill when construction begins.

Slab-on-Grade Structures

a) Foundations

It is understood that conventional spread foundations are to be used for the Sludge Transfer Station and Solids Handling Facility structures (in the areas of Borings B-12 and B-13). Because of the subsurface conditions encountered in these borings, BBC&M recommends the following options based on potential associated risks:

1. The soils present at the proposed bearing elevation of 933.0 are anticipated to consist of very-stiff to hard silty clay that is an existing fill. The two structures may be supported on the existing fill and be designed for a maximum allowable bearing pressure of 1,000 psf. However, the manner in which the existing fill was placed is not known and, therefore, cannot be considered a controlled fill. For this reason, it should be understood that if the existing fill is used for structure foundation support, there is a risk of differential settlement and cracking. **If the owner is unwilling to accept this risk, then Options 2 or 3 should be considered.** In any case, exterior foundations should be placed at a frost depth of at least 3.0 feet (36 inches) below the lowest adjacent grade or in accordance with local code.

2. Overexcavate through any existing fill or organic soils to expose the natural very-stiff silty clay present at approximate depths of 4.5 feet (Boring B-12) to 12.0 feet (Boring B-13) below the ground surface. Foundations may then bear directly on the natural very-stiff silty clay. Foundations bearing on a natural very-stiff to hard silty clay may be designed for a maximum allowable bearing pressure of 3,000 psf. Any overexcavations required to obtain natural very-stiff to hard silty clay should be backfilled in a controlled manner with a low strength concrete. It is recommended that the concrete have a minimum 28-day compressive strength of 1,000 pounds per square inch (psi), and be placed at least one day prior to the placement of footing concrete.

3. Construct short drilled shaft foundations along the perimeter of the structure to support all structural loading. With this option, it is recommended that additional borings be performed to better determine the depths at which adequate bearing soils would be encountered. Once the information was available, design recommendations could be provided.

b) Floor Slab Support

Regardless of the foundation option chosen, it is recommended that the subgrade soils within 2 feet of the proposed subgrade consist of newly compacted fill. Provided the new fill is prepared in a manner described in the General Site Preparation section of this report, the soils should adequately support the 700 psf floor slab loading.

c) Groundwater Considerations

Based on the groundwater observations made during and at the completion of drilling in Borings B-12 and B-13, it is possible that shallow excavations, extending through only cohesive soil may encounter small amounts of seepage. Deeper excavations, such as overexcavations through existing fill, or excavations extending through granular seams, pockets/lenses, or layers could encounter more significant groundwater flows. Option 2 in the Foundations section requires overexcavations up to 12 feet that will likely encounter the groundwater table. If pumping from sumps is not keeping the water los enough to allow for foundation installation, the dewatering wells may be necessary.

During construction, surface runoff and precipitation should not be permitted to collect and stand in excavations as the soil will absorb water. Soils softened by standing water or disturbed by construction activities should be removed from excavations before concrete is placed. It is recommended that excavations be performed in accordance with the latest OSHA regulations.

Below Grade Structures

a) Excavation Considerations

Excavations ranging from 3.2 to 23.0 feet below the existing ground surface will be required to attain the proposed bearing levels for a majority of the below grade structures, including the secondary clarifiers, aeration basins, and lift stations. Based on subsurface conditions encountered during our investigation, it is anticipated that most excavations will be terminated in very-soft to soft brown and gray shale bedrock. Isolated areas of stiff to very-stiff organic silty clay overlying stiff to very-stiff clayey silt and silty clay were encountered in Borings B-3 and B-6. Boring B-1 revealed dense fine to coarse gravel at the bearing elevation.

At the termination depths, auger refusal was not encountered in the very-soft to soft shale. Based on this, it is our opinion that an appropriately-sized backhoe equipped with a rock bucket or ripper bucket should be able to excavate the shale down to anticipated bearing elevations, however the excavation may require additional time and effort. It may be necessary to attach some type of pneumatic hammer to the backhoe.

If bedrock having a rock hardness described as hard (well-cemented and cannot be powdered by a knife) is encountered, it is possible that rock excavation techniques, such as pneumatic equipment or chemical or hydraulic splitting, will be required. Summary data regarding the elevation of bedrock encountered at each boring location is presented in Table No. 1 on Page 3.

Due to the presence of granular soils encountered above the bedrock in Borings B-1, granular soils may be present during construction, and sloughing and caving of excavation walls during construction could be possible. Provisions should be made to brace the walls of all excavations or slope the excavation walls back at a safe angle. Under all conditions, excavations should be performed in accordance with the most recent OSHA regulations.

For any excavations performed near existing structures (i.e., influent lift station and sludge transfer station), measures will have to be taken to protect the integrity of existing adjacent foundations. The walls of the excavations will need to be adequately braced or anchored in some manner to minimize settlement of existing adjacent structures.

b) Foundations

Influent Lift Station

Boring B-1, performed in the area of the proposed influent lift station, encountered dense fine to coarse gravel at the proposed bearing elevation. A 9-foot by 27-foot mat bearing on this granular material and embedded in excess of 20 feet below the adjacent ground surface will result in a net increase in pressure of less than 1000 psf. At such a loading, the dense fine to coarse gravel should provide adequate bearing and settlement will be minimal and immediate.

Preliminary Treatment Facilities

Boring B-2 was proposed for the preliminary treatment facilities. However, due to access restrictions, no boring could be performed at this location. It is recommended that borings or test pits be performed prior to construction, but after clearing and grading to better define the soil/rock conditions present and to be able to develop foundation recommendations.

Aeration Splitter Box and Aeration Basins

It is understood that the proposed aeration tanks are to be constructed in the area of the existing Oxidation Pond No.2. The following site preparation and foundation recommendations apply:

1. Site Preparation: It is recommended that prior to construction, the existing Oxidation Pond No.2 be drained, and any sediment, organic soils or saturated soils be completely removed. Following removal of unsuitable materials, the entire exposed subgrade should be proofrolled using a heavily-loaded, tandem-axle truck to promote uniformity and to detect soft, wet or weak zones which might not have been revealed by the explorations. Unsuitable areas should be either scarified, aerated and recompacted or completely removed and replaced with compacted/controlled fill.

2. Foundations: No borings were able to be performed within Oxidation Pond No. 2. However, at the proposed bearing elevations, Borings B-3, B-4, B-5 and B-6 revealed either existing fill described as very-stiff to hard clayey silt or very-soft brown shale. If it is elected to construct the proposed mat foundation on the existing fill encountered at this site, it is strongly recommended that, where present, at least the uppermost 2 feet of existing fill be reworked following the removal of all vegetation, topsoil, miscellaneous debris, and organic or otherwise unsuitable materials. It is recommended that any shale encountered at proposed bearing elevations (i.e., in the areas of Borings B-4 and B-5) be overexcavated to 2 feet below the bearing elevation and replaced with a controlled cohesive fill to provide a uniform bearing surface for the mat foundation. Provided the subgrade is prepared in this manner, it should be suitable to support the estimated net increase in pressure of 700 psf. Settlements should be less than 1-inch. .

Remaining Structures

Very-soft to soft shale was encountered at the bearing elevations provided by Floyd Browne for the remaining structures. See the individual logs for Borings B-7 through B-11. To minimize differential settlement and point-load concerns, it is recommended that the very-soft to soft shale be overexcavated to a depth of 2 feet below the bearing elevation and replaced with a compacted/controlled cohesive fill to provide a uniform bearing surface for the mat foundations. Provided the subgrade is prepared in this manner, the new fill should be suitable to support the clarifiers, scum/secondary plant drain lift station, RAS/WAS pump station, post aeration basin, and sludge transfer station. For most of these structures, the net loading is expected to be less than the overburden soils that will be removed for construction, therefore, settlements should be negligible.

c) Lateral Earth Pressures

Below-grade portions of the proposed structures, or walls acting as retaining walls, should be designed to withstand lateral earth pressures, as well as hydrostatic pressures, that may develop behind the walls. If it is anticipated that the walls of the proposed structures will be fixed at both the top and bottom preventing significant lateral deflections or rotations from occurring, then an "at-rest" earth pressure condition exists. If the walls are capable of deflecting a distance of at least 1 percent of their height, then an "active" earth pressure condition may be assumed for design purposes.

The magnitude of lateral earth pressures varies on the basis of soil type, permissible wall movement, and configuration of backfill, i.e. sloping or level. At the time of preparing this report, the method of below-grade excavation was unknown. It is assumed that some excavation and construction will be performed with sheeting and bracing techniques and other excavations will be simply laid back at a safe angle in accordance with OSHA regulations. The two assumed construction techniques present two different lateral loading

scenarios which are discussed below.

Because cohesive soils and granular soils with significant clay content can cause high magnitudes of lateral loads due to creep and swelling pressures, it is recommended that these materials not be used to backfill against below-grade walls.

In any case, it is recommended that a free-draining granular material such as bank run sand and gravel containing a maximum of 20 percent passing the No. 200 sieve, or a coarse angular gravel such as No. 57 limestone, be used as backfill against below-grade walls. This granular zone should provide drainage to a gravity drain line, so that hydrostatic pressures do not develop against the wall.

1) Sloped Excavations

If sloped back excavations are utilized for construction and granular backfill is used, equivalent fluid unit weights for drained conditions may be used for design purposes above the maximum anticipated groundwater level (such as the 100-year flood level). The drained condition parameters could be used for walls above the maximum anticipated groundwater levels. The appropriate design parameters are listed in Table No.2 below.

Table No. 2 - Soil Parameters for Design of Below-grade Walls

PARAMETERS	BACKFILL			
	BANK RUN SAND AND GRAVEL *	COARSE ANGULAR GRAVEL (NO. 57 LIMESTONE) *	NATURAL COHESIVE SOILS	NATURAL GRANULAR SOILS
EQUIVALENT FLUID WEIGHTS (pcf)				
DRAINED				
Active Case	35	30	63	35
At-Rest Case	55	45	88	55
UNDRAINED				
Active Case	84	76	94	84
At-Rest Case	96	84	107	96
EARTH PRESSURE COEFFICIENT				
Active Case	0.28	0.26	0.5	0.28
At-Rest Case	0.43	0.41	0.7	0.43
UNIT WEIGHT (pcf)				
Saturated	140	115	145	140
Moist	125	110	125	125
Buoyant	63	48	63	63

* These design parameters to be used only if granular backfill is placed in a wedge as described in the text.

In order to use the equivalent unit weights presented for the granular backfills, the backfill must be placed in a wedge formed by the back of the wall and a line rising from the base of the footing at a maximum 60-degree angle from the horizontal.

2) Sheeted and Braced Excavation

The type of natural soils encountered in the construction excavation will govern the magnitude of the horizontal pressure to be used for structural design. Lateral pressures of a relatively low magnitude will be developed by natural granular soils, whereas a cohesive soil will result in creep and the development of much higher pressures with time. Table No. 2 on page 11 provides the appropriate design parameters for design of lateral soil loads on below grade structure walls. Hydrostatic and surcharge effect due to adjacent sloped backfill or adjacent structural loads should also be considered when designing the below-grade structures.

To minimize future surface settlement of the backfill placed behind the below-grade structure wall, the backfill should be compacted to a dry unit weight of no less than 95% of the maximum dry unit weight determined in the laboratory by the Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (ASTM D698). Overcompaction in areas directly behind the wall should be avoided as this might cause damage to the structure.

d) Groundwater and Foundation Uplift Considerations

During drilling operations, groundwater and/or groundwater seepage was noted during drilling in Borings B-1, B-3, B-5, B-6 and B-12 at depths ranging from 9.5 to 17.6 feet below the ground surface. At the completion of drilling, groundwater was measured in a majority of the borings at depths ranging from 5.3 to 16.0 feet below the ground surface. Groundwater levels after 24-hours ranged from 5.8 to 11.4 feet below the ground surface. Based on observations made during drilling, at completion, and 24-hours after completion, it is likely that deep excavations will encounter the groundwater table. Dewatering well(s) may be necessary in the area of Boring B-1 for construction of the influent lift station. Because of the shallowness of the shale bedrock in a majority of the locations for other structures, it is believed that dewatering wells will not be feasible and therefore, groundwater will have to be controlled by pumping from sumps.

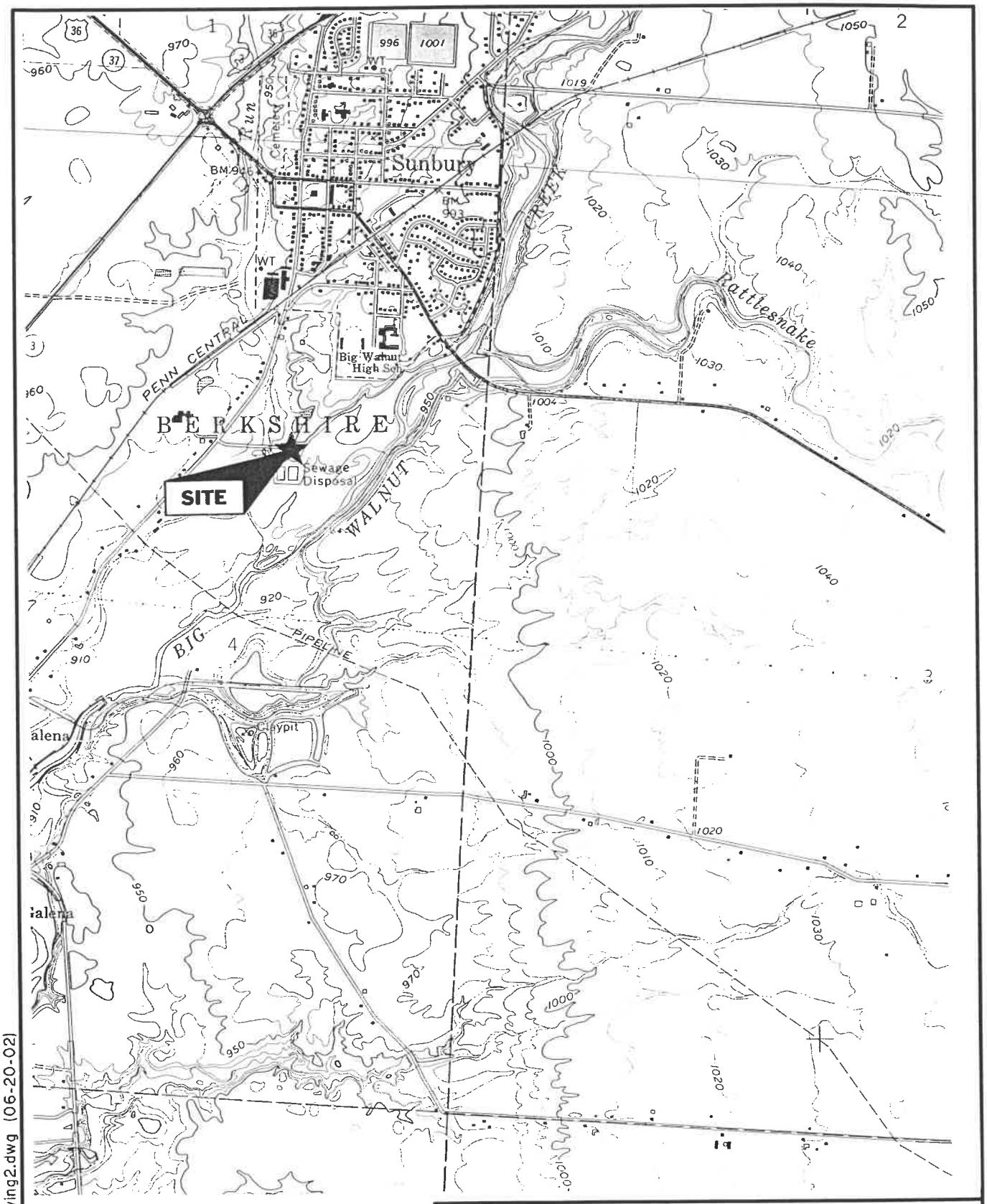
Under all conditions, it is essential that the groundwater level be lowered below a level that assures that the integrity of the foundation bearing surface is not affected. This may require the use of a "mud-mat." During construction, surface runoff and precipitation should not be permitted to collect and stand in excavations as the soil will absorb water. Soils softened by standing water or disturbed by construction activities should be removed from excavations before concrete is placed.

To resist any potential uplift pressures created by groundwater, the mat foundations and any floors should be designed for uplift pressures resulting from the difference in elevation between the maximum anticipated hydrostatic head around the structure and the bottom of mat or floor of a structure. The structure dead weight and the frictional resistance developed between the backfill and structure walls must provide an adequate factor of safety against the anticipated hydrostatic uplift force. Uplift resistance may be increased by increasing the dead weight of the structure (mat and/or walls), cantilevering the mat foundation beyond the walls, or anchoring the mat/foundation to the underlying soil/rock strata using piles or post-tensioned soil or rock anchors.

Final Considerations

It is recommended that BBC&M be provided the opportunity to review the final foundation and site grading plans in order to verify that the intent of our recommendations has been followed. During site preparation and foundation excavation, it is recommended that a representative from this office be on site to observe proofrolling operations, foundation excavations, and bearing conditions to verify or ascertain that such soil conditions are similar to those encountered in our borings.

APPENDIX



BBC&M Filename: Drawing2.dwg (06-20-02)

VICINITY MAP

SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

Project: 011-08593-000	Drawn By: D.J.H.
Drawing Date: 6/20/02	Approved By: J.P.S.
Revision Date:	Scale: 1" = 2000'

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PLATE I

INFLOW RETENTION BASIN

INFLUENT LIFT STATION

B-I

OVERFLOW MH

GRIT REMOVAL TANK

SLUDGE HOLDING TANK NO.3 (AERATION TANKS)

SLUDGE HOLDING TANK NO.4 (AERATION TANKS)

SLUDGE HOLDING TANK NO.5 (SETTLING TANKS)

UV/EFF. METER FACILITY

(AEROBIC DIGESTER NO.2) SLUDGE HOLDING TANK NO.2

(AEROBIC DIGESTER NO.1) SLUDGE HOLDING TANK NO.1

SLUDGE PUMP STATION

B-II

POST AERATION BASIN

SLUDGE TRANSFER STATION

GUARD POST, TYP.

OPERATION BUILDING

B-12

SOLIDS HANDLING FACILITY

GARAGE

DECHLORINATION FACILITY

B-7

SECONDARY CLARIFIER NO.1

B-9

FUTURE SECONDARY CLARIFIER

SECONDARY CLARIFIER NO.2

B-8

RAS/WAS PUMP STATION

B-10

FUTURE SECONDARY CLARIFIER

PRELIMINARY TREATMENT FACILITIES

FUTURE ANAEROBIC BASIN

BLOWER FACILITY

SCUM/SECONDARY PLANT DRAIN LIFT STATION

EXISTING FILL MOUND

CLARIFIER SPLITTER BOX

LEGEND

B-I BORING NUMBER AND LOCATION

PLAN OF BORINGS

SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

Project: 011-08593-000	Drawn By: D.J.H.
Drawing Date: 6/20/02	Approved By: J.P.S.
Revision Date:	Scale: 1" = 40'

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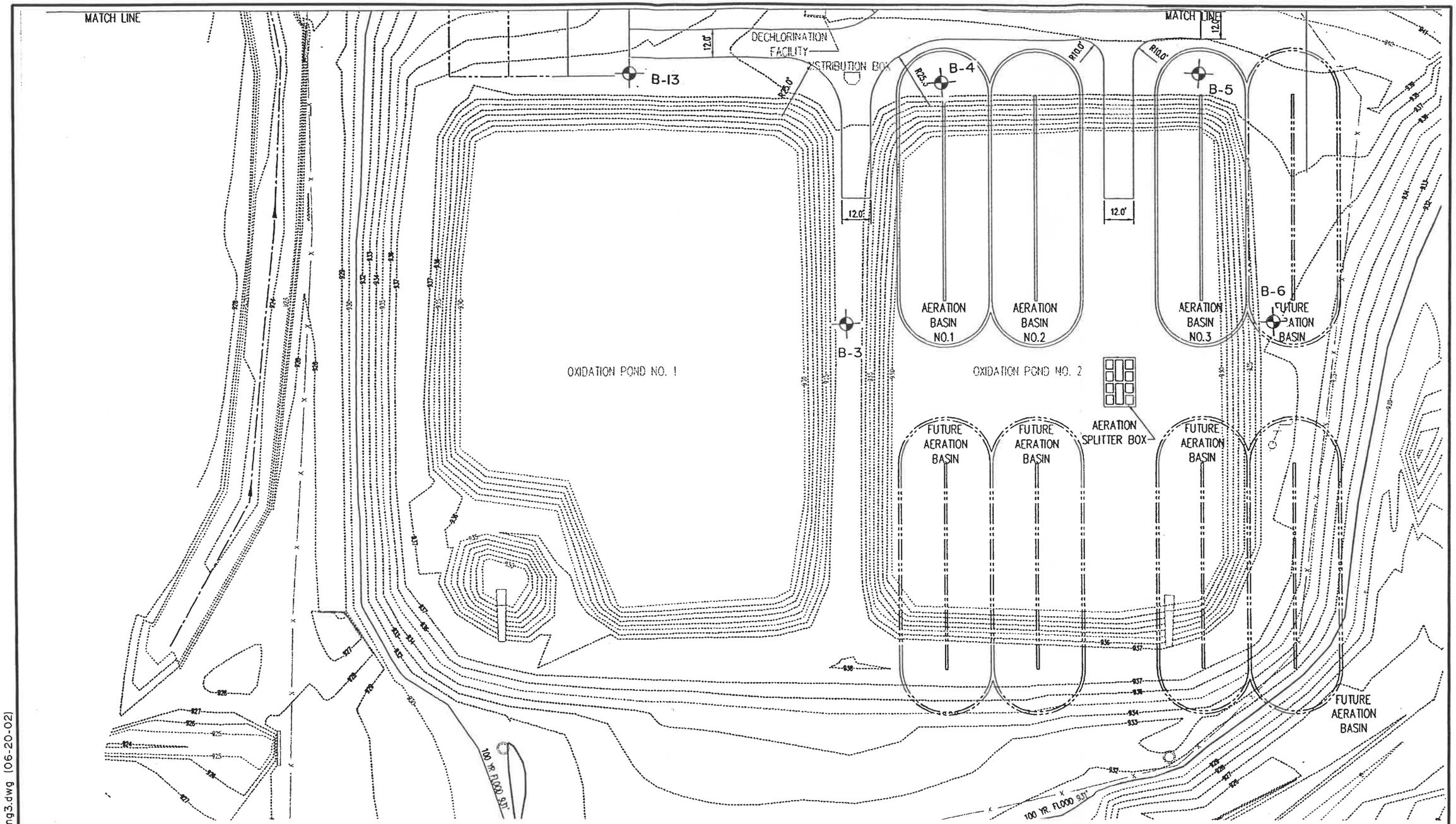
PLATE 2A



LEGEND

B-1 BORING NUMBER AND LOCATION

PLAN OF BORINGS

SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

Project: 011-08593-000	Drawn By: D.J.H.
Drawing Date: 6/20/02	Approved By: J.P.S.
Revision Date:	Scale: 1" = 40'

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PLATE 2B

EXPLANATION OF SYMBOLS AND TERMS USED ON BORING LOGS

SAMPLING DATA

 - Blocked-in "SAMPLES" column indicates sample was attempted and recovered within this depth interval.

 - Sample was attempted within this interval but not recovered.

2/5/9 - The number of blows required for each 6-inch increment of penetration of a "Standard" 2-inch O.D. split-barrel sampler, driven a distance of 18 inches by a 140-pound hammer freely falling 30 inches. Addition of one of the following symbols indicates the use of a split-barrel other than the 2" O.D. sampler:

2S - 2½"O.D. split-barrel sampler

3S - 3" O.D. split-barrel sampler

P - Shelby tube sampler, 3" O.D., hydraulically pushed.

R - Refusal of sampler in very-hard or dense soil, or on a resistant surface.

50-2" - Number of blows (50) to drive a split-barrel sampler a certain number of inches (2), other than the normal 6-inch increment.

S/D - Split-barrel sampler (S) advanced by weight of drill rods (D),

S/H - Split-barrel sampler (S) advanced by combined weight of rods and drive hammer (H).

SOIL DESCRIPTIONS - All soils have been classified basically in accordance with the Unified Soil Classification System, but this system has been augmented by the use of special adjectives to designate the approximate percentages of minor components as follows:

Adjective	Percent by Weight
trace	1 to 10
little	11 to 20
some	21 to 35
"and"	36 to 50

The following terms are used to describe density and consistency of soils:

Term (Granular Soils)	Blows per foot
Very-loose	Less than 5
Loose	5 to 10
Medium-dense	11 to 30
Dense	31 to 50
Very-dense	Over 50

Term (Cohesive Soils)	Qu (tsf)
Very-soft	Less than 0.25
Soft	0.25 to 0.5
Medium-stiff	0.5 to 1.0
Stiff	1.0 to 2.0
Very-stiff	2.0 to 4.0
Hard	Over 4.0

EXPLANATION OF SYMBOLS AND TERMS USED ON BORING LOGS FOR SAMPLING AND DESCRIPTION OF ROCK

SAMPLING DATA

When bedrock is encountered and rock core samples are attempted, the "SAMPLING EFFORT" column is used to record the type of core barrel used (NXM), the percentage of core recovered (REC) for each run of the sampler, and the Rock Quality Designation (RQD) value. Rock-core barrels can be of either single- or double-tube construction, and a special series of double-tube barrels, designated by the suffix M, is commonly used to obtain maximum core recovery in very-soft or fractured rock. Three basic groups of barrels are used most often in subsurface investigations for engineering purposes, and these groups and the diameters of the cores obtained are as follows:

AX, AW, AXM, AWM	-	1⅛ inches
BX, BW, BXM, BWM	-	1⅝ inches
NX, NW, NXM, NWM	-	2⅛ inches

Rock Quality Designation (RQD) is expressed as a percentage and is obtained by summing the total length of all core pieces which are at least 4 inches long and then dividing this sum by the total length of core run. It has been found that there is a reasonably good relationship between the RQD value and the general quality of rock for engineering purposes. This relationship is shown as follows:

RQD - %	General Quality
0 - 25	Very-poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

ROCK HARDNESS

The following terms are used to describe rock hardness:

Term	Meaning	Mohs' Hardness
Very-soft	Rock such as shale can be easily picked apart by the fingers. Sandstone is poorly cemented and very friable. The rock resembles hard clay or dense sand, but has rock structure.	Less than 1
Soft	Rock such as shale, siltstone or limestone can be scratched or powdered by fingernail pressure. Sandstone is mostly poorly cemented, and individual sand grains can be separated from the main rock mass by a fingernail.	1 to 1½
Medium-hard	Rock cannot be scratched by a fingernail, but can be powdered by a knife. Sandstone is mostly well cemented, but individual grains can be removed by scratching with a knife.	2½ to 5½
Hard	Rock is well cemented and cannot be powdered by a knife. Rock can be powdered by a steel file.	5½ to 6½
Very-hard	Rock cannot be scratched by a steel file and the core sample rings when struck with a hammer.	Greater than 6½

BBC&M ENGINEERING, INC.

LOG OF BORING NO. B-1
SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

LOCATION: See Plan | ELEVATION: 936.0 | DATE: 6/4/02

DRILLING METHOD: 4-1/2" O.D. Continuous-flight Auger | COMPLETION DEPTH: 25.0'

SAMPLER(S): 2" and 2-1/2" O.D. Split-barrel Samplers

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				GRAVEL - 2 INCHES		
	1		7/11/11	FILL: Hard brown clayey silt, little fine to coarse sand, some fine to coarse gravel.		H=4.5+
5	2		2/2/2	Hard dark-gray organic silty clay, little fine to coarse sand, trace fine to coarse gravel.		H=4.0-4.5
	2S		/6			
	3		2/4/5	Very-stiff brown mottled with gray silty clay, some fine to coarse sand, trace fine gravel, contains desiccated, silt seams.		H=3.0-3.75
10						
	4		4/7/8	Medium-dense to dense brown fine to coarse sand, some fine to coarse gravel, some silty clay.		G
15						
	5		23/20/15			
20						
	6A		9/25/43			G
	6B			Very-soft to soft gray shale, fragmental structure.		H=4.5+
25						
30						

- Encountered slight seepage at 9.5'.
- Encountered water at 12.5'.
- Encountered cobble at 11.3'.

WATER LEVEL:	5.3	7.9	
WATER NOTE:		Caved at 10.5'	
DATE:	6/04/02	6/05/02	

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION, Q - UNCONFINED COMPR, T - TRIAXIAL COMPR, C - CONSOLIDATION } SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BORLJ 18593000.GPJ BBC&M DT 7/18/02

JOB: 01108593.000

PLATE 4

BBC&M ENGINEERING, INC.

LOG OF BORING NO. B-3
SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

LOCATION: See Plan | ELEVATION: 937.5 | DATE: 6/4/02

DRILLING METHOD: 4-1/2" O.D. Continuous-flight Auger | COMPLETION DEPTH: 18.9'

SAMPLER(S): 2" O.D. Split-barrel Sampler

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT)	TEST RESULTS
0				TOPSOIL - 6 INCHES	10 20 30 40	
	1		5/5/5	FILL: Hard brown and gray clayey silt, some fine to coarse sand, trace fine to coarse gravel.		H=4.5+
				Stiff to very-stiff dark-gray organic silty clay, little fine to coarse sand, trace fine gravel, possible buried topsoil.		
5	2		3/4/4			H=1.5-2.5
				Stiff to very-stiff gray and brown clayey silt, some fine to coarse sand, trace fine gravel.		
	3		2/5/3			H=1.75-2.25 G
10				Hard brown mottled with gray silty clay, little fine to coarse sand, trace fine to coarse gravel, similar to very-soft shale.		
	4		14/27/36			H=4.5+
15				Very-soft to soft gray shale, fragmental structure.		
	5		50-5"R			
20						
25				- Encountered seepage at 9.0'. - Encountered water at 13.0'. - Encountered cobbles at 9.5' and 12.5'.		
30						

WATER LEVEL: ▽ 5.6 | ▼ 5.8 | ▼

WATER NOTE: | Caved at 12.5'

DATE: 6/04/02 | 6/05/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BORLJ 18593000.GPJ BF DT 7/18/02

JOB: 01108593.000

PLATE 5

BBC&M ENGINEERING, INC.

LOG OF BORING NO. B-4
SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

LOCATION: **See Plan** ELEVATION: **938.3** DATE: **6/5/02**

DRILLING METHOD: **4-1/2" O.D. Continuous-flight Auger** COMPLETION DEPTH: **18.8'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				TOPSOIL - 3 INCHES		
	1		4/7/11	Hard brown clayey silt, some fine to coarse sand, trace fine to coarse gravel.		H=4.0-4.25
				Very-soft to soft brown shale, fragmental structure.		
5	2		45/32/35			
	3		40/50-4"R			
10				Soft gray shale, fragmental structure.		
	4		50-4"R			
15						
	5		50-3"R			
20						
25				- Encountered cobbles at 1.5'. - No seepage encountered.		
30						

WATER LEVEL: ▽ 5.7 ▼ ▼

WATER NOTE:

DATE: 6/05/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BORLJ 18593000.GPJ BF DT 7/18/02

JOB: 01108593.000

PLATE 6

BBC&M ENGINEERING, INC.

LOG OF BORING NO. B-5
SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

LOCATION: See Plan | ELEVATION: 938.4 | DATE: 6/5/02

DRILLING METHOD: 4-1/2" O.D. Continuous-flight Auger | COMPLETION DEPTH: 19.0'

SAMPLER(S): 2" O.D. Split-barrel Sampler

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				TOPSOIL - 3 INCHES		
	1		11/14/18	Very soft to soft brown shale, fragmental structure, similar to hard silty clay.		
5	2		31/46/50-5"R	Very-soft to soft gray shale, fragmental structure.		
	3		50-5"R			
10						
	4		50-5"R			
15						
	5		50-6"R			
20						
25				- Encountered cobbles at 4.5'. - Encountered slight seepage at 17.6'.		
30						

WATER LEVEL: ▽ 16.0 | ▼ | ▼

WATER NOTE: Caved at 16.5'

DATE: 6/05/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION, Q - UNCONFINED COMPR, T - TRIAXIAL COMPR, C - CONSOLIDATION } SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BORLJ 18593000.GPJ BB_DT 7/18/02

JOB: 01108593.000

PLATE 7

BBC&M ENGINEERING, INC.

LOG OF BORING NO. B-6
SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

LOCATION: See Plan | ELEVATION: 937.1 | DATE: 6/5/02

DRILLING METHOD: 4-1/2" O.D. Continuous-flight Auger | COMPLETION DEPTH: 19.3'

SAMPLER(S): 2" O.D. Split-barrel Sampler

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT)	TEST RESULTS
0				TOPSOIL - 3 INCHES	10 20 30 40	
	1		4/4/3	POSSIBLE FILL: Very-stiff to hard brown clayey silt, some fine to coarse sand, little fine gravel, few roots.		H=4.25-4.5
5	2		2/2/3	POSSIBLE FILL: Stiff to very-stiff brown silty clay, some fine to coarse sand, little fine gravel.		H=2.0-2.5
				Stiff dark-gray organic silty clay, some fine to coarse sand, trace fine gravel.		
	3 ▽		1/1/2			H=1.5
10				Stiff brown mottled with gray silty clay, "and" fine to coarse gravel, little fine to coarse sand.		
	4		2/3/4			H=1.5-2.0
15				Very-soft to soft gray shale, fragmental structure.		
	5		36/50-3"R			
20						
25				- Encountered water at 10.1'.		
30						

WATER LEVEL: ▽ 9.8 | ▽ | ▽

WATER NOTE:

DATE: 6/05/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BORLJ 18593000.GPJ BE OT 7/18/02

JOB: 01108593.000

PLATE 8

LOG OF BORING NO. B-7
SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

BBC&M ENGINEERING, INC.

LOCATION: See Plan | ELEVATION: 940.8 | DATE: 6/5/02

DRILLING METHOD: 4-1/2" O.D. Continuous-flight Auger | COMPLETION DEPTH: 18.8'

SAMPLER(S): 2" O.D. Split-barrel Sampler

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	TEST RESULTS
0				TOPSOIL - 3 INCHES	
	1		3/4/4	POSSIBLE FILL: Stiff to very-stiff brown silty clay, little fine to coarse sand, trace fine to coarse gravel.	H=1.5-2.0
5	2		2/3/4	Stiff to very-stiff brown silty clay, some fine to coarse sand, little fine to coarse gravel, iron stains.	H=1.5-2.0
	3		1/1/2	Stiff dark-brown organic silty clay, some fine to coarse sand, trace fine to coarse gravel.	H=2.0
10				Very-soft to soft gray shale, fragmental structure.	
	4		50-5"R		
15					
	5		50-4"R		
20					
25				- Encountered cobble at 5.0'. - No seepage encountered.	
30					

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT — LIQUID LIMIT
10 20 30 40

WATER LEVEL: ▽ 14.5 ▼ ▼
WATER NOTE: Caved at 17.2'
DATE: 6/05/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BORLJ 18593000.GPJ BBC&M_DT 7/18/02

JOB: 01108593.000

PLATE 9

BBC&M ENGINEERING, INC.

LOG OF BORING NO. B-8
SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

LOCATION: See Plan | ELEVATION: 939.5 | DATE: 6/5/02

DRILLING METHOD: 4-1/2" O.D. Continuous-flight Auger | COMPLETION DEPTH: 18.9'

SAMPLER(S): 2" O.D. Split-barrel Sampler

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				TOPSOIL - 3 INCHES		
				Loose brown fine to coarse sand, "and" silt, some fine to coarse gravel.		
	1		27/17/17	Very-soft to soft brown shale, fragmental structure.		
5	2		34/35/45			
	3		22/50-5"R			
10				Very-soft to soft gray shale, fragmental structure.		
	4		36/50-5"R			
15						
	5		50-5"R			
20						
25				- Encountered cobbles at 1.5', 4.7', 10.0' and 11.8'. - No seepage encountered.		
30						

WATER LEVEL: ▽ 16.4 | ▼ 11.4 | ▽

WATER NOTE: Caved at 18.6'

DATE: 6/05/02 | 6/05/02 P.M.

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION, Q - UNCONFINED COMPR, T - TRIAXIAL COMPR, C - CONSOLIDATION — SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BORLJ 18593000.GPJ BBE DT 7/18/02

JOB: 01108593.000

PLATE 10

BBC&M ENGINEERING, INC.

LOG OF BORING NO. B-9
SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

LOCATION: See Plan | ELEVATION: 942.5 | DATE: 6/4/02

DRILLING METHOD: 4-1/2" O.D. Continuous-flight Auger | COMPLETION DEPTH: 23.5'

SAMPLER(S): 2" O.D. Split-barrel Sampler

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				TOPSOIL - 5 INCHES		
	1		6/12/10	FILL: Hard brown mottled with gray silty clay, some fine to coarse sand, trace fine to coarse gravel.		H=4.5+
				Hard brown silty clay, little fine to coarse sand, trace fine gravel, similar to very-soft shale.		
5	2A		12/16/22			H=4.5+
	2B			Hard brown mottled with gray and red silty clay, little fine to coarse sand, trace fine to coarse gravel, similar to very-soft shale.		H=4.5+
	3A		40/35/50-5"R			H=4.5+
10	3B			Very-soft to soft gray shale, fragmental structure.		
	4		50-4"R			
15						
	5		50-2"R			
20						
	6		50-0"R			
25				- Encountered cobbles at 5.0' and 8.2'. - No seepage encountered.		
30						

WATER LEVEL: ▽ "Dry" | ▼ 8.7 | ▼

WATER NOTE: | Caved at 17.5' |

DATE: 6/04/02 | 6/05/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION, Q - UNCONFINED COMPR, T - TRIAXIAL COMPR, C - CONSOLIDATION } SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BORLJ 18593000.GPJ BE DT 7/18/02

JOB: 01108593.000

PLATE 11

LOG OF BORING NO. B-10
SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

BBC&M ENGINEERING, INC.

LOCATION: See Plan | ELEVATION: 940.1 | DATE: 6/5/02

DRILLING METHOD: 4-1/2" O.D. Continuous-flight Auger | COMPLETION DEPTH: 14.3'

SAMPLER(S): 2" O.D. Split-barrel Sampler

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT)	TEST RESULTS
0				TOPSOIL - 3 INCHES	10 20 30 40	
	1		13/25/30	Very-soft to soft gray and brown shale, fragmental structure.		
5	2		50-4"R			
	3		20/50-4"R	Very-soft to soft gray shale, fragmental structure.		
10	4		32/50-4"R			
15						
20				- No seepage encountered.		
25						
30						

WATER LEVEL: ▽ 6.3 | ▼ | ▼

WATER NOTE: Caved at 12.0'

DATE: 6/05/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BORLJ 1859300.GPJ BE DT 7/18/02

JOB: 01108593.000

PLATE 12

LOG OF BORING NO. B-11
SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

LOCATION: See Plan | ELEVATION: 940.3 | DATE: 6/4/02

DRILLING METHOD: 4-1/2" O.D. Continuous-flight Auger | COMPLETION DEPTH: 15.0'

SAMPLER(S): 2" O.D. Split-barrel Sampler

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				GRAVEL - 2 INCHES		
	1		11/3/4	POSSIBLE FILL: Loose brown fine to coarse sand, trace fine to coarse gravel, trace silt.		
				Very-stiff brown mottled with gray silty clay, some fine to coarse sand, trace fine to coarse gravel.		
5	2		3/5/7			H=2.5-3.0
	3		7/7/9			H=3.5
10 ▼				Very-soft to soft gray shale, fragmental structure.		
	4		14/22/30			H=4.5+
15						
20				- Encountered cobble at 10.5'. - No seepage encountered.		
25						
30						

WATER LEVEL: ▼ "Dry" | ▼ 10.4 | ▼

WATER NOTE: | Caved at 11.0' |

DATE: 6/04/02 | 6/05/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION, Q - UNCONFINED COMPR, T - TRIAXIAL COMPR, C - CONSOLIDATION — SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BORLJ 18593000.GPJ BB 7/18/02

JOB: 01108593.000

PLATE 13

LOG OF BORING NO. B-12
SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

LOCATION: See Plan | ELEVATION: 935.5 | DATE: 6/4/02

DRILLING METHOD: 4-1/2" O.D. Continuous-flight Auger | COMPLETION DEPTH: 15.0'

SAMPLER(S): 2" O.D. Split-barrel Sampler

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				TOPSOIL - 5 INCHES		
	1		3/5/8	FILL: Hard brown mottled with dark-brown silty clay, little fine to coarse sand, trace fine to coarse gravel.		H=4.5+
5	2		3/4/3	Very-stiff brown silty clay, some fine to coarse sand, some fine to coarse gravel.		H=2.5-3.0
	3		1/2/3	Stiff to very-stiff gray mottled with brown silty clay, "and" fine to coarse sand, trace fine to coarse gravel, iron stains.		H=1.5-2.5
10						
	4		6/8/8	Medium-dense gray fine to coarse gravel, some fine to coarse sand, little silt.		
15						
20				- Encountered cobble at 2.0'. - Encountered water at 12.0'.		
25						
30						

WATER LEVEL: ▽ 8.0 | ▼ 9.6 | ▼
WATER NOTE: | Caved at 10.8' |
DATE: 6/04/02 | 6/05/02 |

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BORLJ 18593000.GPJ BE DT 7/18/02

JOB: 01108593.000

PLATE 14

BBC&M ENGINEERING, INC.

LOG OF BORING NO. B-13
SUNBURY WWTP IMPROVEMENTS
SUNBURY, OHIO

LOCATION: See Plan | ELEVATION: 937.1 | DATE: 6/4/02

DRILLING METHOD: 4-1/2" O.D. Continuous-flight Auger | COMPLETION DEPTH: 15.0'

SAMPLER(S): 2" O.D. Split-barrel Sampler

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				TOPSOIL - 5 INCHES		
	1		3/3/2	FILL: Very-stiff to hard brown mottled with gray silty clay, some fine to coarse sand, little fine to coarse gravel.		H=3.5-4.5+
5	2		2/2/3			H=4.5+
				Very-stiff gray organic silty clay, some fine to coarse sand, trace fine to coarse gravel.		
	3A		2/2/2			H=2.5-3.0
	3B			Stiff gray organic silty clay, little fine to coarse sand, trace fine gravel.		H=1.25-1.5
10						
				Very-stiff gray mottled with brown silty clay, little fine to coarse sand, little fine to coarse gravel.		
	4		3/4/6			H=3.5-4.25
15						
20				- No seepage encountered.		
25						
30						

WATER LEVEL: "Dry" | 8.2 | | WATER NOTE: | Caved at 11.7' | DATE: 6/04/02 | 6/05/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION, Q - UNCONFINED COMPR, T - TRIAXIAL COMPR, C - CONSOLIDATION — SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BORLJ 18593000.GPJ BB DT 7/18/02

JOB: 01108593.000

PLATE 15

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC	LL	PL	PI	GRADATION			COMPACTION		TRIAXIAL			DIRECT SHEAR			UNCONFIN COMPRESS	CONSOLID.	SPECIFIC GRAVITY	UNIT WEIGHT DRY	REMOLDED	PERMEABILITY				RELATIVE DENSITY	LOI	SHELBY TUBE LOG OF	ROCK CORE LOG
						sieve	Hydrometer short	Hydrometer long	standard	modified	uncons. undrain	consolid undrain w/pores	drained	drained	undrain	residual				PCF		cohesive	non/cohes	wall rigid	wall flexible	%	%		
		%	%	%	%	* SEE INDIVIDUAL TEST CURVES																							
B-1	14.25					*																						
B-1	24.25					*																						
B-3	8.75																									4.70		
B-3	9.25	20	28	20	8	*	*																					
B-3	9.50																									2.10		
B-7	1.75	17	40	24	16																							
B-12	1.75	15	38	19	19																							
B-13	5.25	17	35	18	17																							

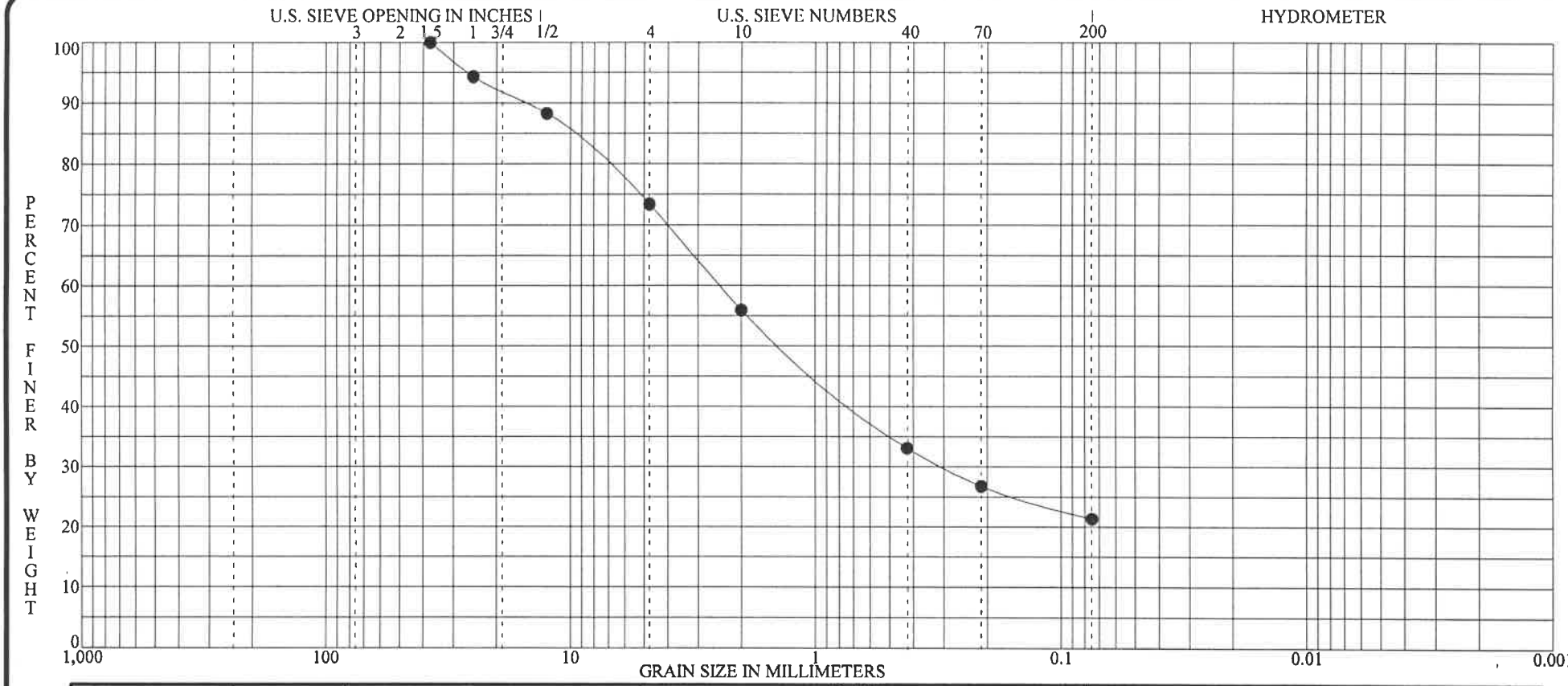
BBC&M ENGINEERING, INC.

TESTING SUMMARY - STANDARD

PROJECT SUNBURY WWTP IMPROVEMENTS
LOCATION SUNBURY, OHIO
JOB NO. 01108593.000 DATE 7/18/02

PLATE 16

SUMREG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**B-1 S-4 13.5' to 14.3'**	**Brown fine to coarse sand, some fine to coarse gravel, some silty clay.**						

	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1 S-4 13.5' to 14.3'**	**37.5000**	**2.4483**	**0.3038**		**26.6**	**52.0**	**21.4**	

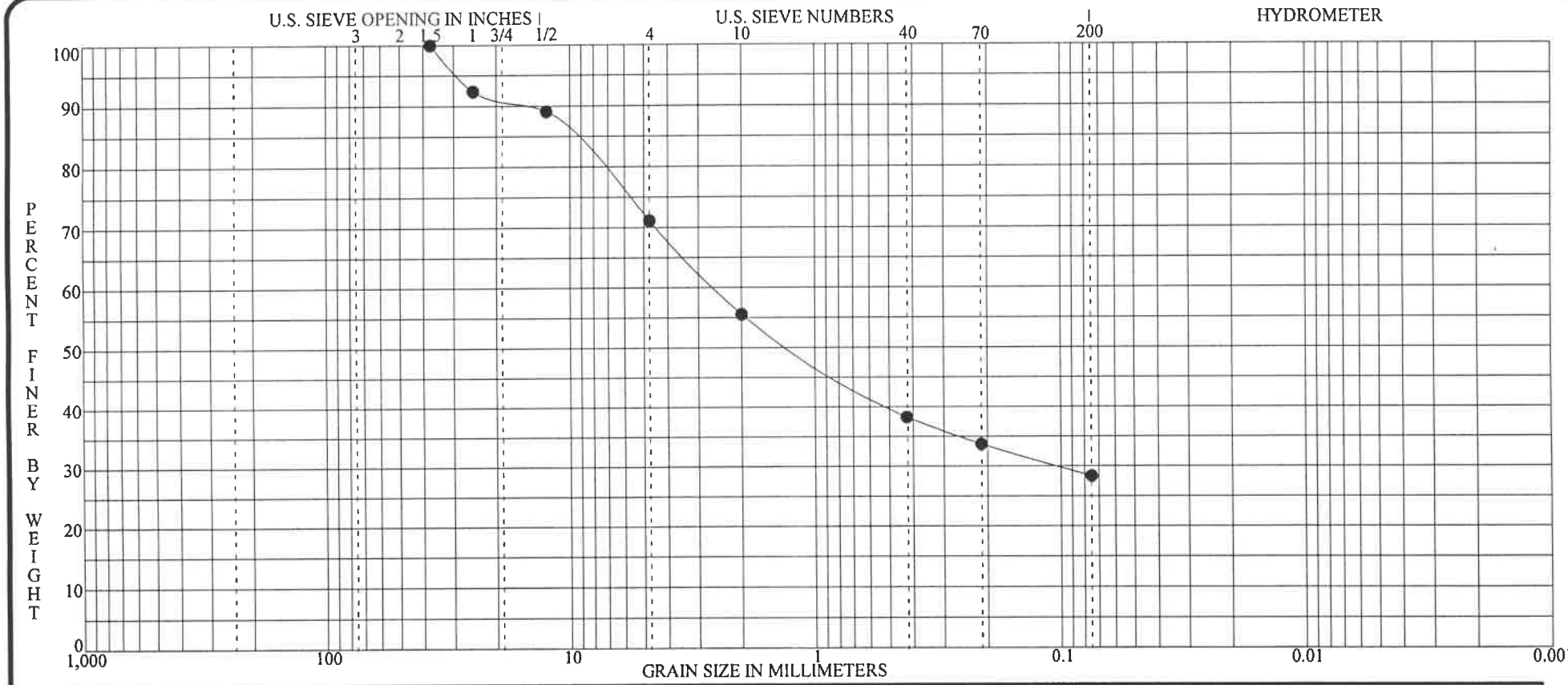
PLATE 17

GRN-REG

BBC&M ENGINEERING, INC.

GRADATION CURVE

PROJECT **SUNBURY WWTP IMPROVEMENTS**
LOCATION **SUNBURY, OHIO**
JOB NO. **01108593.000** DATE **6/13/02**



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**B-1 S-6A 23.5' to 23.9'**	**brown fine to coarse sand, some fine to coarse gravel, some silty clay.**						

	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1 S-6A 23.5' to 23.9'**	**37.5000**	**2.5620**	**0.1040**		**28.9**	**42.8**	**28.3**	

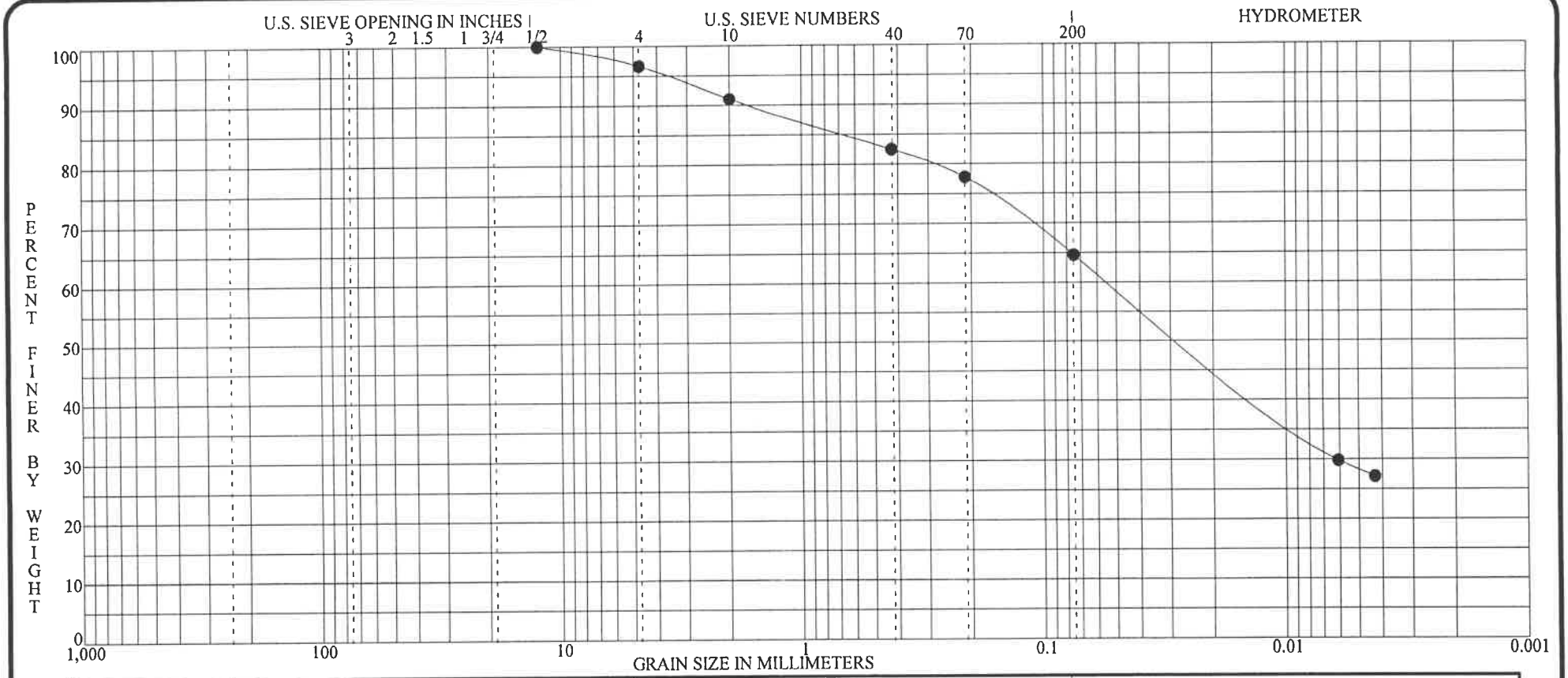
BBC&M ENGINEERING, INC.

GRADATION CURVE

PROJECT **SUNBURY WWTP IMPROVEMENTS**
LOCATION **SUNBURY, OHIO**
JOB NO. **01108593.000** DATE **6/13/02**

PLATE 18

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	B-3 S-3 8.5' to 9.3'	Gray and brown clayey silt, some fine to coarse sand, trace fine gravel.	20	28	20	8		

	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-3 S-3 8.5' to 9.3'	12.5000	0.0537	0.0062		3.3	32.1	36.4	28.3

BBC&M ENGINEERING, INC.

GRADATION CURVE

PROJECT SUNBURY WWTP IMPROVEMENTS
LOCATION SUNBURY, OHIO
JOB NO. 01108593.000 DATE 6/13/02

PLATE 19

GRN-REG