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BIG CREEK FLOOD CONTROL PROJECT

CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX A

SOILS, GEOLOGY AND CONSTRUCTION MATERIALS

Prepared by
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For
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FEBRUARY 1979

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The site of work along Big Creek lies within the Erie Plain of the Central Lowland Physiographic Province. The Erie Plain is characterized by somewhat rolling topography which slopes regionally to the northwest. In the vicinity of the project site, Big Creek has deeply dissected the regional topography, providing local relief of upwards to 125 feet. Along most of its exposed length, Big Creek flows over a shale bedrock surface. In places, small bedrock riffles and pools have formed. At other places, the bedrock is covered by a

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) thin veneer of platy shale gravel. Outcrops of bedrock occur throughout the Big Creek Valley.

Overburden within the project site is characterized by both natural, in-place soils and soils re-worked for use in structures such as railroad embankments, highways, and bridge formations. Whether re-worked or natural, the overburden is dominated by sandy, silty clay. In many instances, natural soils are distinguished from re-worked deposits only in degree of compaction and associated mechanical properties. It is clear that most of the re-working entailed use of local soils. However, in a few places, as described below, imported fill material with widely varying properties are locally dominant.

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SECTION A

DRILLING AND TESTING PROGRAM

A1. General. A drilling program was mutually agreed upon by both Gannett Fleming Corddry and Carpenter, Inc., Consulting Engineers, Harrisburg, Pennsylvania, and the Buffalo District, Corps of Engineers. This drilling program was performed by F. T. Kitlinski & Associates, Inc., Consulting Foundation Engineers, of Harrisburg, Pennsylvania. A subsurface exploration plan, showing the location of all test borings, is presented on Plate A1. One truck-mounted Sprague & Henwood Model 35H drilling rig and two skid-mounted Sprague & Henwood Model 40C drilling rigs were employed for drive sampling in overburden and core drilling in rock. One truck-mounted Mobile drill, Model B30, was employed for auger drilling. Drilling and field testing were performed in two phases. The purpose of the Phase I program was to determine the general feasibility of the project site. The purpose of the Phase II program was to secure sufficient additional data for sound design of the containment structures and appurtenances. The Phase II program was begun following a field meeting organized to evaluate the results of the Phase I program. Drilling and field testing were done during May and June 1978. Logs of core borings and auger borings are presented in Subappendix A1.

A2. Drive Sampling. The purpose of drive sampling was to obtain knowledge of the composition, thickness, sequence, and structure of overburden materials. Sampling was performed by driving a 3-inch split-spoon sampler with a 300-pound hammer, free falling through a distance of 18 inches. Blow counts were recorded for every 6 inches of penetration of the sampler. A total of 324 linear feet of overburden was penetrated, of which 200 linear feet were drilled during the Phase I drilling and 124 linear feet were drilled during the Phase II drilling.

A3. Core Drilling. Core drilling in rock commenced when drive sampling became impractical, due to refusal of the drive sampler to penetrate further. All rock cores recovered were drilled with a standard double-tube core barrel, using a 3-inch (NX) diamond drill bit. Phase I drilling totaled 159 linear feet and Phase II drilling totaled 88 linear feet for a total of 247 linear feet.

A4. Auger Boring. Auger borings were made in overburden using power-driven, 6-inch diameter earth augers. Auger boring samples were taken every 3 feet and at changes in material. The purpose of the auger borings was to supplement knowledge of overburden obtained from spoon sampling and to obtain large bag samples of overburden materials for laboratory testing. A total of 111 linear feet of auger boring was performed.

A5. Field Permeability Tests. Four of the test borings were tested for permeability during the drilling process. A total of 15 field permeability tests were performed. A field permeability test is a test performed in cased drill holes to determine the coefficient of permeability of the "in-situ" soil. The tests were run immediately before the sample was taken and after the casing was advanced and cleaned. The tests were performed by maintaining the water level in the casing at a constant elevation for at least 15 minutes. Readings of the amount of water necessary to maintain the water level were taken at three 5-minute intervals.

A6. Pressure Testing. The hydraulic pressure test consists of pumping water into isolated portions of a drilled hole. Portions of the drilled hole are isolated by a device fitted with expandable rubber "packers" set 5 feet apart. When the device is set at the desired depth, the packers are expanded, effectively sealing off the 5-foot portion of the hole between the packers and the portion of the hole between the lower packer and the bottom of the drill hole. The zone between the packers and the zone between the lower packer and bottom of hole can then be tested independently by forcing water into the desired section of the hole. Although the packers were set firmly, leakage through rock fissures occurred at the packers. Despite repeated attempts in several holes to run the pressure tests, excessive leakage through rock fissures around the packers prevented the necessary pressure build-up for a meaningful test. One complete pressure test was run. However, due to leakage, no pressure build-up could be obtained, either between or below the packers, and the attempt was abandoned.

A7. <u>Undisturbed Sampling</u>. Borings were made to obtain "undisturbed" soil samples, which, on testing, would show properties as close to "in-situ" properties as any sample that can be obtained. "Undisturbed" samples were taken at selected locations at depths where the taking of "undisturbed" samples was both feasible and practical. Both 3-inch and 5-inch Shelby tube samples were taken in soft material in which the Shelby tubes could be pressed mechanically. Four undisturbed Shelby tube samples were obtained: one 3-inch and three 5-inch.

SECTION B

GEOLOGY

A8. Physiography and Topography. The site of work along Big Creek lies within the Erie Plain of the Central Lowland Physiographic Province. The Erie Plain is characterized by somewhat rolling topography which slopes regionally to the northwest (Reference A1). In the vicinity of the project site, Big Creek has deeply dissected the regional topography, providing local relief of upwards to 125 feet. Along most of its exposed length, Big Creek flows over a shale bedrock surface. In places, small bedrock riffles and pools have formed. At other places, the bedrock is covered by a thin veneer of platy shale gravel. Outcrops of bedrock occur throughout the Big Creek Valley.

A9. Previous Locations of Big Creek and Manmade Features Within the Project Site. The position of Big Creek within the limits of the Big Creek Flood Control Project is in part in a natural location and in part in a manmade location. Drawings received from the Chessie System show the location of Big Creek prior to and after the Baltimore and Ohio Railroad construction that was performed in 1918. These drawings also show other features such as the borrow pit used for railroad embankment material, an abandoned foundation of a power plant located at the trash pile at the downstream end of the project, a reservoir for the power plant, and retaining walls that are now covered with the trash pile material. The previous locations of Big Creek and the manmade features within the project site are presented on Plate A2.

A10. Man has significantly altered the location of Big Creek as well as the topography within the project site. When the present manmade features are added to the above-noted workings of man, the result is a project site that has been greatly changed by man. Generally, a report dealing with soils and geology primarily addresses the natural soils and geology. For this report, the effects of man have been significant; and it is important to distinguish between a natural condition and a manmade alteration. The effects of these manmade alterations on the Big Creek Flood Control Project will be discussed in subsequent paragraphs where applicable.

A11. General Geologic Setting. Bedrock within the project site consists predominantly of soft, blue-grey shale. A plan of the project site showing the top of rock contours is presented on Plate A3. The shale represents a portion of the Chagrin Formation of Devonian Age (References A1 and A3). Erosion and downcutting by Big Creek have removed all traces of glacial deposits within the immediate vicinity of the project site. Most of the soil cover within the study area has been re-worked by the activities of man. Natural soils remaining are predominantly fluvial or flood plain soils. Subsoils are composed principally of sandy, silty clay.

A12. Bedrock-Shale. Blue-grey shale predominates throughout the project site. It is exposed nearly continuously in the creek bottom throughout the limits of the project. It is also exposed in outcrop immediately outside the limits of the project at the upstream and downstream ends of the project area. With one exception, described below, shale was the only rock type encountered in the test borings. The outcrops of bedrock in the vicinity of the project site show the shales to be horizontally bedded.

A13. Because of its topographic position and character, it is believed that the blue-grey shale encountered along Big Creek in the vicinity of the project area is part of the Chagrin Formation of Devonian Age (Reference A1). An outcrop of the overlying black Cleveland shale has been reported along Big Creek upstream (west) of the project site (References A2 and A3). However, no evidence of the Cleveland shale was encountered within the project site.

A14. The Chagrin Formation within the project site consists of silty shale. On freshly exposed surfaces, it is medium to dark blue-grey in color. Weathered surfaces are commonly light blue-grey to light grey.

A15. Shale encountered in test borings appears well indurated upon extraction from the core barrel. However, after a short period of exposure and drying (about 1/2 hour), numerous hairline fractures or partings began to develop. The partings develop parallel to bedding (horizontal) at 1/4-inch spacings. Upon continued exposure, refraction partings develop at right angles between many of the horizontal fractures.

A16. Soft, apparently discontinuous, zones of poorly indurated grey shale are scattered throughout the subsurface in the project area. Depths to these zones are variable and apparently unrelated to topography, ground-water level, or proximity to Big Creek. Similarly, clay seams are present within the shale in the project area. Thickness of the poorly indurated shale ranges from 0.05 foot to about 0.6 foot. Thickness of the clay seams generally averages less than 0.1 foot.

A17. Vertical and near vertical fractures (joints) were observed in outcrops on exposed surfaces. However, as vertical fracturing of the shale recovered from drill holes was not extensive, it is probable that the spacing of a vertical joint set is not close. Vertical fracturing of shale in outcrops may also be the result of the development of refraction partings as described above, rather than a response to a regional joint system. Intersection of vertical fractures and horizontal partings frequently resulted in the production of numerous small blocky fragments during drilling. Weathering along vertical fracture surfaces was not common, although clay was detected on a few surfaces. Most vertical and practically all horizontal fractures were fresh, showing little or no weathering or clay filling.

A18. Weathering of the shale in vertical cuts was observed to result in the production of numerous, small, 1/2- to 1-inch platy shale fragments, silty clay, and sand. Exposed slopes comprised of these materials tend to form a sticky, somewhat coherent, easily erodible mass. The slope angle of these deposits formed at the base of cuts averages about 40 to 45 degrees. Excavations in bedrock should allow for the development of this detritus.

A19. Weathering of horizontal surfaces in excavations is expected to proceed initially with the development of horizontal and vertical partings due to unloading and dewatering. It is anticipated that this air-slaking tendency of the shale will extend to a depth of from 4 to 6 inches below a freshly exposed surface. The result of this form of weathering is the production of an easily erodible surface on top of bedrock. On surfaces continually covered with water, the air-slaking tendency of the shale is eliminated or reduced.

A20. The shale bedrock surface as exposed in Big Creek and interpolated between test borings appears moderately uniform with an overall slope to the east (downstream) within the project site. The overall slope is interrupted twice within the project site. The first interruption starts about 1,500 feet upstream from the West 25th Street bridge and consists of successive low mounds elongated roughly parallel to Big Creek. The second, and more prominent interruption, occurs in the vicinity of the West 25th Street bridge. Here, the bedrock surface rises abruptly, causing Big Creek to turn sharply to the northeast. In plan view, the bedrock surface appears as a tongue-shaped mass which has been cut by Big Creek and both the Norfolk and Western Railroad and the Baltimore and Ohio Railroad mainlines. Within the flood plain of the project site, downstream of the West 25th Street tongue, the bedrock surface continues its downstream slope.

A21. Bedrock-Siltstone. Thin, irregular lenses of hard-grey to tannish-grey siltstone were observed in outcrops near the project site. The siltstone lenses are discontinuous and haphazardly distributed. A small portion of a siltstone lens was encountered in one test boring. Volumetrically, the siltstone present within the project site is insignificant compared to the shale. The presence of the small siltstone lenses is not expected to affect the behavior of the shale in excavation or construction.

SECTION C

SOILS

A22. General. Overburden within the project site is characterized by both natural, in-place soils and soils re-worked for use in structures such as railroad embankments, highways, and bridge foundations. Whether re-worked or natural, the overburden is dominated by sandy, silty clay. In many instances, natural soils are distinguished from re-worked deposits only in degree of compaction and associated mechanical properties. It is clear that most of the re-working entailed use of the local soils. However, in a few places, as described below, imported fill material with widely varying properties are locally dominant.

A23. The major soil associations present within the project site are described below. Although soils are present with characteristics which fall between the classifications described, such soils are of minor importance and can usually be considered to be associated with one of the major classes.

A24. Clays. In terms of volume and areal extent, sandy, silty clay is the dominant soil type present within the project site. The sandy, silty clay varies from light to medium grey in color and commonly contains weathered and stained shale fragments. Where this material has been re-worked, oxidation laminae may be present or complete oxidation of the soil may have occurred, imparting a brown color to the soil. A zone of oxidation also occurs within the natural soils. In this zone, the natural soil has a brown color; below the zone of oxidation, the soil is usually grey.

A25. Despite color variation and some minor variations in grain size distribution, the sandy, silty clay is quite uniform in its physical properties. This clay exhibits low to medium plasticity: values for the plasticity index range from 10 to 16, and liquid limits range from 28 to 37. The sandy, silty clay is classified CL according to the Unified Soil Classification System.

A26. In some places a sticky, grey, highly plastic clay is present at the interface between the overburden and the top of rock. This grey clay, where present, is of limited thickness and is similar to the clay encountered within the shale. Because of its limited occurrence, it is not expected to affect design or construction.

A27. Silts. Sandy, clayey silt is present within the project area which is apparently gradational to the sandy, silty clay. The silt is most commonly medium brown with some variation to reddish brown and orange. Some grey, sandy, clayey silt is present. The silts generally have low plasticity. The plasticity index averaged 6, and the liquid limit averaged 25. However, where the silt is gradational to silty clay, it has higher plasticity. The sandy, clayey silt is classified ML or CL-ML according to the Unified Soil Classification System.

A28. Sands. Of the several soils types present within the project site, the sands are the most diverse in character. They range from dark-grey, silty, fine- to medium-grained sand with some clay (SM-SC) to light- and dark-brown silty, clayey, fine- to coarse-grained sand with some gravel (SC). In addition, some filled areas are composed of brown, pebbly to gravelly, medium- to coarse-grained sand (SP). The fine fractions of all sands in the project area are of low plasticity. A portion of the sand fraction of these soils is composed of sand-sized shale fragments, which on mechanical crushing (such as rolling) would disaggregate to form silty clay or clayey silt.

A29. Gravels. Some of the gravel encountered within the project site has been imported as railroad ballast. Natural gravels within the project area are of two basic types: stream gravels composed of hard shale and siltstone platelets, and gravel composed of shale fragments formed from the incomplete weathering of bedrock. The latter gravel contains a significant portion of fine material of low plasticity. Such gravels are classified GC according to the Unified Soil Classification System.

A30. Fills. Several different types of fill are present within the project site. Fills composed of locally derived, re-worked soils have been included with the parent soils, due to their similarity. Such fill differs from the parent soil chiefly in degree of compaction, as measured in the field during drive sampling and in the degree of oxidation of the soil. Re-worked soil is more highly oxidized resulting in a color difference and tends to be brown compared to the natural grey of the undisturbed soil below the zone of oxidation.

A31. Silty coarse gravel fill is present throughout the length of the project as railroad ballast. Fill composed of pebbly to gravelly sand has been used as cover in the Zoo parking lot at the upstream end of the project. Fill composed of miscellaneous construction material was encountered along the right bank of Big Creek in the vicinity of test borings DC-78-23; DC-78-25; and A-78-9. Such fill consists of fine- to coarse-grained sands and silts with gravel and cobbles composed of brick, miscellaneous rock types, and cinder block. Wood fragments are common throughout.

A32. Volumetrically, the dominant type of fill is located at the right bank of the diversion channel downstream from the West 25th Street bridge; and it consists of garbage and miscellaneous trash. Fine material included with the fill consists of a heterogeneous mix of clay; silt; fine, medium, and coarse sand; foundry sand; and pebbles of variable composition. Among the types of material observed which comprise the trash are: miscellaneous types of organic debris; wood of varying sizes and types; glass; bricks; sheet metal; tires; mattresses; automobiles and various automobile parts including engine blocks; coal; and other types of material. It is unlikely that this material, when excavated, can be used for construction of any of the various elements of the project. An attempt was made to try and find an old USGS topographic map for use in estimating the amount of material in the trash pile. A topographic map could not be found. However, a 1918 drawing received from the Chessie System was useful in estimating the extent of the trash pile. Based on the location of certain features that existed in 1918, an assumed location for the toe of hillside in 1918 was established as shown on Plate A2. This assumed location for the toe of hillside in 1918 when compared with the existing toe of the hillside, gives an indication of how far the trash material extends into the hillside. The soil and geologic section presented on Plate A7 cuts through the trash material and shows the amount of trash material to be excavated at the section. The log of Boring D-78-13, shown on the section, gives the composition of the trash material and indicates that the depth of trash material at the boring is 36 feet. At Boring D-78-26, the depth of trash is 30 feet and at Boring A-78-8, the depth of trash is 15 feet. Logs of these borings are presented in Subappendix A1. It is estimated that about 110,000 cubic yards of trash material will have to be excavated at the diversion channel.

SECTION D

SOILS TESTING

A33. <u>Soils from Project Site</u>. This Section covers the testing of soils from the project site. Testing of borrow material is covered in Section H. Testing of soils from the project site was performed by F. T. Kitlinski & Associates, Inc., Consulting Foundation Engineers, of Harrisburg, Pennsylvania. The Laboratory Testing Program was performed in three phases. The first phase involved mechanical analyses and determination of Atterberg limits and natural moisture content of 20 samples recovered from the Drive Sampling Program. These 20 samples were chosen as representative of the various types of overburden materials present within the project site. The purpose of the first phase testing was to determine similarities and differences among soils throughout the project site.

A34. The second phase of the Laboratory Testing Program involved testing of undisturbed samples recovered from the 5-inch tubes. In addition to mechanical analyses and Atterberg limits and natural moisture content determinations, consolidation and unconfined compression tests were performed. The purpose of the second phase testing, in addition to classification, was to determine "in-place" properties of the soil in both the Norfolk and Western and Baltimore and Ohio Railroad embankments and in the area between the embankments.

A35. The third phase of the Laboratory Testing Program was performed to determine the potential behavior of the soils of various elements of the project both during and after construction. In addition to the tests previously mentioned, tests for dry density, permeability, shear strength, compaction, and consolidation were performed.

A36. The laboratory test data is presented in Subappendix A2. The laboratory test results are summarized on Plates A9 through A12, inclusive.

A37. The results of laboratory testing confirm field observations as to the general nature of the soils comprising the overburden within the project site. The soils are dominated by sandy, silty clay of low to moderate plasticity. Average natural moisture content of the sandy, silty clay is somewhat less than 20 percent, with higher values for material recovered from swampy areas. Silts showed considerably higher moisture content than the clays.

A38. In order to organize Phase III testing to obtain values for design purposes, it was necessary to review existing data from the field observations and results of Phase I and Phase II laboratory testing. Five separate sets of samples relating to different field conditions and proposed project elements were assembled. Composite samples of materials were assembled and tested as representative of the following group of soils.

Composite No.*	Description
(1) and (2)	Material to be used for Railroad embankment and levee.
(3)	Material representative of existing Norfolk and Western Railroad embankment.
(4)	Material representative of existing Baltimore and Ohio Railroad embankment.
(5)	Natural material lying between the two railroad embankments. Much of this material was quite wet due to swampy conditions.

*For samples that make up the composites, see Plate A12.

A39. For design purposes, shear strength envelopes on the composite samples were combined to form the composite envelopes shown on Plate A13. As discussed in Section G, adopted shear parameters were selected from these shear envelopes.

A40. Shear test results on the Composite No. 5 sample are presented in Subappendix A2. Low shear values obtained from the test were not considered to be realistic for the natural foundation material. The test sample was re-molded to the in-situ density and moisture content. It is believed that the reason for the low shear values is due to extremely wet condition at which the sample had to be compacted in order to meet the required moisture content. As a result of the breakdown of the original soil structure, the re-molded sample, at the same high moisture content, possessed only very minimal shear strength. Compared with the shear values from other tests, it is believed that the results from Composite No. 5 are not representative of the project soils. The shear test results from Composite No. 5 were, therefore, not used for the purpose of selecting adopted shear parameters.

A41. Comparison of permeability tests as performed in the laboratory on re-molded samples with field permeability tests shows differences of several orders of magnitude, even though both types of tests were performed on similar types of material. Laboratory permeability test results are summarized on Plates A11 and A12, and field permeability test results are presented in Subappendix A2. In addition to the approximate methods used in the field tests as compared to the laboratory techniques, several factors contribute to the disparity of results. Field permeability tests were performed on materials that were very often poorly compacted as indicated by the standard penetration test. Laboratory permeability tests were performed on compacted samples. Tests were run only after the specimens had been allowed to fully consolidate under the applied cell pressure. Laboratory permeability tests were performed on re-molded samples. As previously discussed, re-molding tends to disaggregate sand-sized particles of shale into clay and silt, thus lowering the permeability.

SECTION E

FOUNDATION CONDITIONS AFFECTING DESIGN AND CONSTRUCTION

A42. Floodway Channel. A soil and geologic profile along the centerline of the floodway channel is presented on Plate A4. Typical soil and geologic sections through the floodway channel are shown on Plates A8 and A8a.

A43. From Station 85+10F to 90+00F, a considerable amount of earth excavation will be required through the existing Baltimore and Ohio Railroad embankment. Except for some track ballast, the material consists predominantly of sandy, silty clay. A maximum thickness of about 4 feet of shale excavation will be required. The upper 1 foot of shale is weathered and easily rippable.

A44. From Station 90+00F to 95+00F, minimal excavation will be required. From Station 95+00F to 97+00F, excavation of up to 8 feet of sandy, silty clay will be necessary.

A45. From Station 97+00F to 100+00F, in addition to excavation in overburden of sandy, silty clay, excavation of up to 2 feet of a surface veneer of silty sand will be required. A small amount of excavation in mostly weathered shale will be necessary in the vicinity of Station 100+00F.

A46. From Station 100+00F to 103+70F, only minimal excavation will be necessary, all of it in sandy, silty clay. From Station 103+70F to 108+00F, considerable excavation through the existing Baltimore and Ohio Railroad embankment will be required. In addition to track ballast and drainage material, most of the overburden consists of sandy, silty clay. Minimal excavation in weathered shale will be necessary.

A47. From Station 108+00F to 118+30F, only minor excavation in weathered shale will be required along this reach of the floodway channel. However, up to 7 feet of overburden excavation will be required. Overburden excavation will involve stripping of the gravelly sand in the Zoo parking lot and removal of silty sand, clayey sand, and silty or sandy clay.

A48. Modified Channel. A soil and geologic profile along the centerline of the modified channel is presented on Plate A5. Sections B and C on Plate A8 represent typical soil and geologic sections through the modified channel.

A49. From Station 70+00M to 75+60M, excavation along this reach of the modified channel will be performed almost totally in shale. Maximum excavation along this reach will be about 7 feet, and this will be along the low-flow channel. Where the shale has not been recently exposed to erosion by water, it is likely that the upper 1 foot of shale is weathered and easily rippable.

A50. From Station 75+60M to 83+50M, maximum excavation in shale is about 3 feet. Most of the excavation in this section will be performed in sandy, silty clay with lesser quantities of sand, gravelly sand and silty sand.

A51. From Station 83+50M to 90+00M, excavation along this reach of the modified channel will involve only small quantities of mostly weathered shale. A small volume of sandy, silty clay near Station 88+50M must also be excavated.

A52. Diversion Channel. A soil and geologic profile along the centerline of the diversion channel is presented on Plate A5. Section A on Plate A7 represents a typical soil and geologic section through the diversion channel.

A53. From Station 59+50D to 66+25D, up to 5 feet of rock excavation will be required. While a portion of the shale is weathered and easily ripped, it may be necessary to employ blasting techniques in part of this reach. Overburden consists of three types of material: sandy, silty clay; silty sand; and fill composed of trash. The clay and sand may be used in project fills, but the trash must be removed from the site. Thickness of trash along the centerline varies from about 1 foot to more than 8 feet. If a 1V on 2H slope is used for the cut through the trash pile, the maximum height of cut would be about 115 feet.

A54. From Station 66+25D to 69+50D, rock excavation will be minimal, generally less than 2 feet. As most of this is probably weathered shale, machine excavation methods will probably suffice. Up to 25 feet of overburden will be excavated along this reach of the diversion channel. The overburden along this reach of the diversion channel consists predominantly of sandy, silty clay with lesser amounts of clayey gravel, silty sand, and sand. These overburden materials may be used in project fills.

A55. From Station 69+50D to 73+00D, at both ends of this reach of the diversion channel, most of the required excavation will be in overburden consisting predominantly of sandy, silty clay. However, the central part of this reach will require extensive excavation of shale. The maximum depth of shale excavation will be about 10 feet. Because of the extent of rock excavation required, some blasting will be necessary where specifications will permit blasting. Along the reach close to the West 25th Street bridge piers, hand-excavation methods will be required.

A56. Relocated Baltimore and Ohio Railroad Mainline. A soil and geologic profile along the centerline of the relocated Baltimore and Ohio Railroad mainline is presented on Plate A6. Section A on Plate A7, Sections B and C on Plate A8, and Sections D and E on Plate A8a are cut through the relocated mainline and show the foundation conditions for the railroad embankment.

A57. Very little excavation will be necessary in constructing the relocated mainline. Such excavation as will be required will be performed primarily in silty, sandy clay. A small amount of rock excavation may be necessary near Station 108+00R. Most of the fill to be placed in the relocated railroad embankment will be founded on silty, sandy clay.

A58. Relocated Baltimore and Ohio Railroad Spurline. The portion of the relocated spurline along the right bank of Big Creek will essentially be at its present grade. Very little embankment fill will be required. Construction will essentially involve placement of subbase material on the existing ground surface. On the left bank, between the spurline bridge and the relocated mainline, the embankment for the spurline will be founded on silty, sandy clay.

A59. Seepage Considerations. The right bank of the floodway channel from the upstream end of the levee to the modified channel is the only reach of the project requiring seepage considerations. The existing Baltimore and Ohio Railroad embankment will act as a levee along part of this reach. As noted previously, the railroad embankment was constructed from local soils which are predominantly sandy, silty clay. The levee will also be constructed from local soils. The foundation soils beneath the levee and railroad embankment are also predominantly sandy, silty clays. As discussed in Paragraph A41, the results of field permeability tests were considerably different from the results of laboratory permeability tests on re-molded samples. Laboratory tests on re-molded samples showed the soil to be practically impervious while field permeability tests in the railroad embankment showed the soil to be considerably less impervious. Although it is recognized that the field tests can only give approximate values, it is at least an indication that some seepage can be expected through the railroad embankment during the design flood. Seepage is not anticipated to be a problem at the levee. Considering that the maximum head from design flood to landside ground surface along the levee is 6 feet and that the levee will be constructed of impervious fill with an impervious cutoff trench, the danger of boils caused by underseepage at the levee is not a concern. Unlike the levee, there is no cutoff trench in the railroad embankment to reduce underseepage. However, the maximum head from design flood to landside ground surface along the railroad embankment is only 3 feet. On the average, the design water surface is about 1 foot below landside ground surface. Because this head is small, the danger of boils caused by underseepage at the railroad embankment is not a concern.

A60. Miscellaneous Foundation Conditions Affecting Design and Construction. Some of the foundation conditions affecting design and construction are discussed in Appendix B, Alternative Studies. Alternative solutions to various foundation problems are discussed in Appendix B with one of the alternatives being selected for final design. A brief discussion on the alternative studies that dealt with foundation conditions is presented in the following paragraphs.

A61. Channel side slope protection will be required at various locations along the project in order to prevent scour from high water velocity. An alternative study was made on side slope protection. Riprap protection was selected in those areas where 12- or 18-inch thick riprap is required as slope protection; and in those areas which require more than an 18-inch layer of riprap, gabions were selected.

A62. As discussed previously, the bedrock at the project site is shale that has the characteristic of air-slaking. That is, the rock disintegrates after being exposed to the air. Air-slaking shales are expected to be a problem along reaches where the bottom of the various channels will be excavated into rock and the flows along these reaches will be infrequent. An alternative study was made for protection of air-slaking shales. A grass cover alternative involving a 1-foot thick layer of seeded earthfill was selected for areas where the design channel velocity is sufficiently small that erosion of the earth and grass would not occur. Riprap protection involving 12-inch riprap on 6-inch bedding was selected for areas where design channel velocities are such that increased protection is required.

A63. A discussion on special measures required during construction of the flume in the diversion channel is presented in Appendix B. These measures will be required because of the air-slaking characteristic of the rock and because of the close clearances between the flume and the West 25th Street bridge piers. Close line-drilling will be required to control the limits of the hand-excavated area. The vertical surfaces should be covered quickly with about 3 inches of reinforced shotcrete, to seal in the rock moisture and provide some structural support.

A64. A discussion on problems associated with the trash pile at the downstream end of the project is presented in Appendix B.

The diversion channel will cut through the trash material. Environmentally, it would be undesirable to cut through the trash pile and leave the surface exposed. A 3-foot thick layer of seeded earthfill will be placed on the finished cut slope.

A65. Sedimentation. The purpose of discussing sedimentation in this report is to evaluate the potential problems (bank stabilization, sediment deposition, environmental, aesthetic and maintenance) associated with sediment control in the project area along Big Creek.

A66. Erosion and deposition of soil by water are discussed below to assess what effect the proposed construction would have on sedimentary processes in and adjacent to the project area.

A67. The proposed project increases the efficiency of the existing creek and diverts excess waters through diversion and floodway channels away from areas where excessive flood damage presently occurs. Thus, there is an increase in the sediment transporting capacity of the creek. However, this does not mean that there will actually be an increase in the sediment transported because the creek bottom is set on rock (soft, blue-grey shale; see Appendix A "Soils, Geology and Construction Materials" for additional data) which will reduce possible scour. The soils above the shale and the proposed construction materials are described in detail in Appendix A. The erosion potential of the channel within the project area will be reduced by providing for bank protection upstream and downstream of bridges, on the outside of sharp channel bends, and at locations where the average channel velocity exceeds six feet per second. The erosion potential upstream and downstream of the project area will not be affected by this project. Upstream of the project the existing channel has vertical stone walls and a shale bed which will resist erosion from the higher velocities anticipated. The project will not affect the creek flows downstream of the project area.

A68. Transportation of materials in the creek and the resulting changes in bed configuration are important considerations in the design of any improvement project. The transport is accomplished by three different processes (suspension, contact or traction(bed load) and saltation) which may occur singly or in combination. The materials may be intermittently moved by one process and then another. Observations of Big Creek suggest that bed load is not great.

A69. The suspended load generally consists of the smaller particles moving in suspension in the fluid, while the larger particles that are rolled or slide along the bed by tractive forces comprise the bed load. The suspended load usually comprises the greatest part of the total load in most streams and therefore, is important in considering deposition during low flows. The bed load is of greater importance in the formation of bed and banks. Consequently, in this project, the sediment transported by bed load would be of most interest as it could affect the mechanics of the creek.

A70. The Big Creek Flood Control project has been designed to preserve to the maximum extent the natural setting of the Cleveland Zoo, and to provide diversion and floodway channels, wherever required, to carry the portion of the design flow that exceeds the creek's capacity. Since bank stabilization and deposition are not presently considered problems under natural low flow and flooding conditions along Big Creek, the improved conditions are not anticipated to affect the transport of sediment by bed load either. During construction some additional sediment will enter the stream. However, the environmental protection section of the specification will require the contractor to limit the amount of sediment that would be transported downstream. In conclusion, it does not appear that a sedimentation problem exists on Big Creek and any environmental, aesthetics, shoaling or bank stability problems that may occur can readily be handled as part of the project's regular maintenance.

SECTION F

CONSTRUCTION MATERIALS

A71. General. A materials survey to determine construction material sources for the Big Creek Flood Control Project was performed and interested sources were investigated. The survey consisted of an analysis of the results of quarry and borrow area investigations, laboratory testing of samples, and the evaluation of available service records. The survey included a sufficient number of stone sources that are capable of producing the required materials for construction of the project.

A72. Material Design Criteria.

A72.1 Material Types and Gradations.

A72.1.1 General - The required materials include bedding material designed for both 12-inch and 18-inch riprap, gabion stone, coarse and fine aggregates for concrete, and a semi-impervious to impervious material for the levee embankment.

A72.1.2 Bedding Material - This stone material will consist of a reasonably well-graded material having the following gradation and shall fall within the limits of the gradation band shown on Figure A1.

Sieve Designation U. S. Standard Square Mesh	Percent Finer by Weight
3 - inches	100
2 - inches	85 - 100
1-1/2 - inches	78 - 90
3/4 - inches	68 - 78
1/2 - inches	60 - 73
No. 4	43 - 60
No. 10	26 - 43
No. 20	12 - 26
No. 40	0 - 12
No. 200	0 - 03

A72.1.3 Twelve-Inch Riprap - This stone will consist of a reasonably well-graded material having the following gradation and shall fall within the limits of the gradation band shown on Figure A2.

Percent Lighter By Weight	Limits of Stone Weight in Pounds
100	85 - 32
50	25 - 15
15	12 - 5
5	9 - 3

Stones shall be predominantly angular in shape. Not more than 25 percent of the stones reasonably well distributed throughout the gradation shall have a length more than 2.5 times the breadth or thickness. No stone shall have a length exceeding 3.0 times its breadth or thickness.

A72.1.4 Eighteen-Inch Riprap - This stone will consist of a reasonably well-graded material having the following gradation and shall fall within the limits of the gradation band shown on Figure A3.

Percent Lighter By Weight	Limits of Stone Weight in Pounds
100	275 - 110
50	85 - 55
15	45 - 15
5	35 - 10

Stones shall be predominantly angular in shape. Not more than 25 percent of the stones reasonably well distributed throughout the gradation shall have a length more than 2.5 times the breadth or thickness. No stone shall have a length exceeding 3.0 times its breadth or thickness.

A72.1.5 Gabion Stone - This stone material will consist of a randomly graded stone. Stone dimensions shall range between a minimum of four inches and a maximum of nine inches except for the gabion baskets 36 inches high, for which the minimum shall be 12 inches.

A72.1.6 Coarse Aggregate for Concrete - This material will consist of a reasonably well-graded aggregate having the following gradation and shall fall within the limits of the gradation band shown on Figure A4.

Sieve Designation U.S. Standard Square Mesh	Percent Finer By Weight
1-1/2 inch	100
1 inch	95 - 100
1/2 inch	25 - 60
No. 4	0 - 10
No. 8	0 - 5

A72.1.7 Fine Aggregate for Concrete - This material will consist of a reasonably well-graded aggregate having the following gradation and shall fall within the limits of the gradation band shown on Figures A5 or A5a.

Sieve Designation U.S. Standard Square Mesh	Percent Finer By Weight	
	Natural Sand	Manufactured Sand
3/8-inch	100	
No. 4	95 - 100	100
No. 8	70 - 95	90 - 100
No. 16	45 - 80	50 - 75
No. 30	25 - 60	30 - 60
No. 50	10 - 30	14 - 30
No. 100	1 - 10	4 - 12
No. 200	0 - 4	0 - 5

A72.1.8 Levee Embankment Material - Suitable materials for this purpose will conform to the following soil classifications (Unified Soil Classification System) or mixtures thereof:

(GM) - silty gravels, gravelly sandy silt
(GC) - clayey gravels
(SM) - silty sands, sandy silt
(SC) - clayey sand, sandy silt
(CL) - Inorganic clay, gravelly clay, silty clay, lean clay or sandy clay
(CH) - Inorganic clay, fat clay.

A72.1.8.1 The embankment material may have a maximum size of six inches (longest dimension); however, at least 90 percent will be smaller than two inches and 40 percent will be finer than the number 200 sieve (0.074 mm). The minimum plasticity index shall be eight.

A72.1.9 Although graded riprap and randomly graded materials are not standard production items for most stone suppliers, most of the sources have produced satisfactory materials in the past. Contractors will be required to provide the selected sources adequate lead time to produce the various products. Some of the suppliers may require the Contractor to do his own sorting and blending in order to obtain the proper gradations. As several similar projects could be under construction at the same time as Big Creek, the Contractor will be permitted to propose more than one source for each or any of the products required.

A73. Material Weights. The allowable minimum weight this design is based on is 155 Pounds Per Cubic Foot (2.48 SSD) for the bedding and for the 12 and 18-inch riprap.

A74. Material Quality.

A74.1 General - Quality requirements for each material type are discussed below. Riprap samples have been subjected to a series of tests established by the Ohio River Division Laboratories, Cincinnati, OH. Test number P-11, "Riprap and Breakwater Stone Evaluation," includes a series of tests to determine stone durability. The smaller sizes (i.e. bedding material, coarse and fine aggregates for concrete) have been subjected to a series of tests included in ORDL test numbers C-21 and C-22, "Elementary Acceptance Tests for Fine Aggregates (C-21) and Coarse Aggregates (C-22) for Civil Works." Embankment materials have been subjected to a series of laboratory tests to classify these materials as to their engineering properties. Those tests include Atterberg Limits and Mechanical Analysis. Four point proctors to determine the moisture-density relationship also were performed on material obtained from the preliminary hand augered borings.

A74.2 Material Quality - Design criteria is a limiting factor on the number of available stone sources. Some stone producers have been eliminated from the list because their stone failed to meet the minimum specific gravity requirement (2.48). Possible sources for ripraps, bedding material, gabion stone, coarse and fine agregates for concrete are listed on Plates A15 through A23. Test results for those sources are listed on Plates A24 through A32. A possible source, Metroparks Borrow Area, Berea, OH, for offsite borrow material is shown on Plate A23 and test results from that source are shown on Plate A32.

A74.3 Twelve and Eighteen-Inch Riprap. These stones will be a hard, durable, nonsoluble material, free from visible cracks, seams, and overburden spoil. Only those sources from which the samples did not show any significant breakdown during the wet-dry and freeze-thaw tests are suitable. The wet-dry tests were performed for 35 cycles and the freeze-thaw tests for 80 cycles.

A74.4 Bedding Material - These stones will be a hard, durable, nonsoluble material which is sound, free from visible cracks, seams, organic or deleterious material, and overburden spoil. Listed sources were subjected to tests such as the Los Angeles abrasion, magnesium sulfate loss, specific gravity, and absorption and a petrographic examination. Only suitable sources are listed.

A74.5 Gabion Stone - These stones will be a hard, durable, nonsoluble material, free from visible cracks, seams, and overburden spoil. Samples from listed sources were subjected to wet-dry, freeze-thaw, Los Angeles abrasion, magnesium sulfate loss, specific gravity, and absorption. Samples also were subjected to a petrographic examination. Only suitable sources are listed.

A74.6 Coarse and Fine Aggregates for Concrete - These materials will be a sound, hard, durable material that is produced from a crushed product and shall be, free from cracks, seams, organic, and deleterious materials. Aggregates that contain five percent or more of potentially reactive chert will require low alkali cement. Aggregates that contain a combined total of 20 percent or more of potentially reactive chert will not be permitted. Coarse aggregates will contain fractured, sharp faces and shall be free of laitence (washing of coarse aggregates may be required). Fine aggregates may be either natural sand (lake, beach, or glacial) or manufactured sand (crushed dolomite, limestone, or crushed conglomerates).

A74.7 Embankment Fill for Relocated Baltimore and Ohio Railroad Mainline and Spurline - Earthen material required for the railroad embankment fills will be obtained from both available required common excavation and from an offsite borrow. Available rock excavation, although small in quantity, will be utilized in the railroad embankment fills. A discussion on the types of rock that will be encountered at the project site is presented in Section B. A discussion on project soils is presented in Section C.

A74.8 The embankment for the relocated mainline must be completed before the existing Baltimore and Ohio Railroad embankment can be removed. This, therefore, limits the amount of common excavation and rock excavation that will be available for use in the relocated mainline embankment because of its high, natural moisture content. Available common excavation will come from swampy areas along the floodway. This soil is saturated, and it would either have to be spoiled or its moisture content would have to be reduced to at least plus two percent of optimum before it could be utilized in the railroad embankment. Soil above the water table is also high in moisture content, and it would have to be handled similarly. Generally, the soil is a mixture of sandy, silty clay, classified as CL. A summary of soil test results on the project soils is presented on Plates A9 through A12, inclusive. Lowering the moisture content probably will be difficult because of the fineness and permeability of the soil. Also, the success in lowering the moisture content will depend on weather conditions during the construction season. If the climate during the construction season is very wet, it may be difficult to reduce the moisture content of the impervious project soil to the moisture content required for proper compaction. As noted previously, the soil could be spoiled and all railroad embankment material could be obtained from the borrow area. However, the cost of borrow material for the project is expected to be expensive. Even though it may be difficult to reduce the moisture content of the common excavation material, it may be more economical than spoiling and using borrow material. It is intended that the following be included in the Contract Specifications: if the natural moisture content of the common excavation material is more than four percent of optimum moisture content and difficulty is experienced in drying the material to an acceptable moisture content, with written approval of the Contracting Officer, the material may be spoiled.

A74.9 Levee Fill, Compacted Backfill, and Miscellaneous Fills - The fills discussed in this paragraph include the following: (1) levee fill, (2) compacted backfill used in connection with wall construction, (3) compacted earthfill on the trash pile cut slope, (4) earthfill used to protect air-staking shale, and (5) random earthfill along the modified channel side slope required to obtain the desired channel template. Unlike the relocated railroad mainline embankment, the majority of these fills will be placed during the second construction season when the bulk of the required common excavation will be performed. The quantity of common excavation material exceeds the quantity of the various fills required, and the soils excavated will be suitable for use in these fills. Generally, the common excavation material consists of a mixture of sandy, silty clay, classified as CL. A summary of soil test results on the project soils is presented on Plates A9 through A12, inclusive. The high moisture content problem discussed in Paragraph A74.8 for the soils excavated during the first construction season woud also apply to some soils excavated during the second construction season. Although some of the common excavation will be in low-lying swampy areas, a considerable amount of excavation will be from the existing Baltimore and Ohio Railroad embankment. The railroad embankment is higher in elevation and has a lower moisture content mainly because water in the embankment can drain out. As with the first construction season wet project soils; the procedures for handling the wet project soils encountered during the second construction season will be as outlined in Paragraph A74.8.

A75. Possible Sources.

A75.1 General - Riprap, bedding, gabion and embankment materials, coarse and fine aggregate for concrete can be produced from those sources listed on Plates A15 through A23. However, all material from those sources may not be suitable. The right will be reserved in the specifications to reject materials from certain localized areas, zones, strata, channels, or stockpiles, when such materials become unsuitable.

A75.2 It is anticipated that selective quarrying will be required for riprap. Blasting techniques used for normal aggregate production may require adjustments or, in some cases, complete tailoring to produce riprap. Also, the specifications will require that shale and other undesirable materials will be excluded by suitable and adequate processing. Selective excavation and loading may be required for embankment materials.

A75.3 Twenty-two sources are capable of producing the required products. Transportation and logistics may be a problem for some of the smaller quarry sources.

A75.4 Twelve-Inch Riprap - Thirteen suitable sources are available within a 90-mile radius of the project site.

A75.5 Eighteen-Inch Riprap - Thirteen suitable sources are available within a 90-mile radius of the project site.

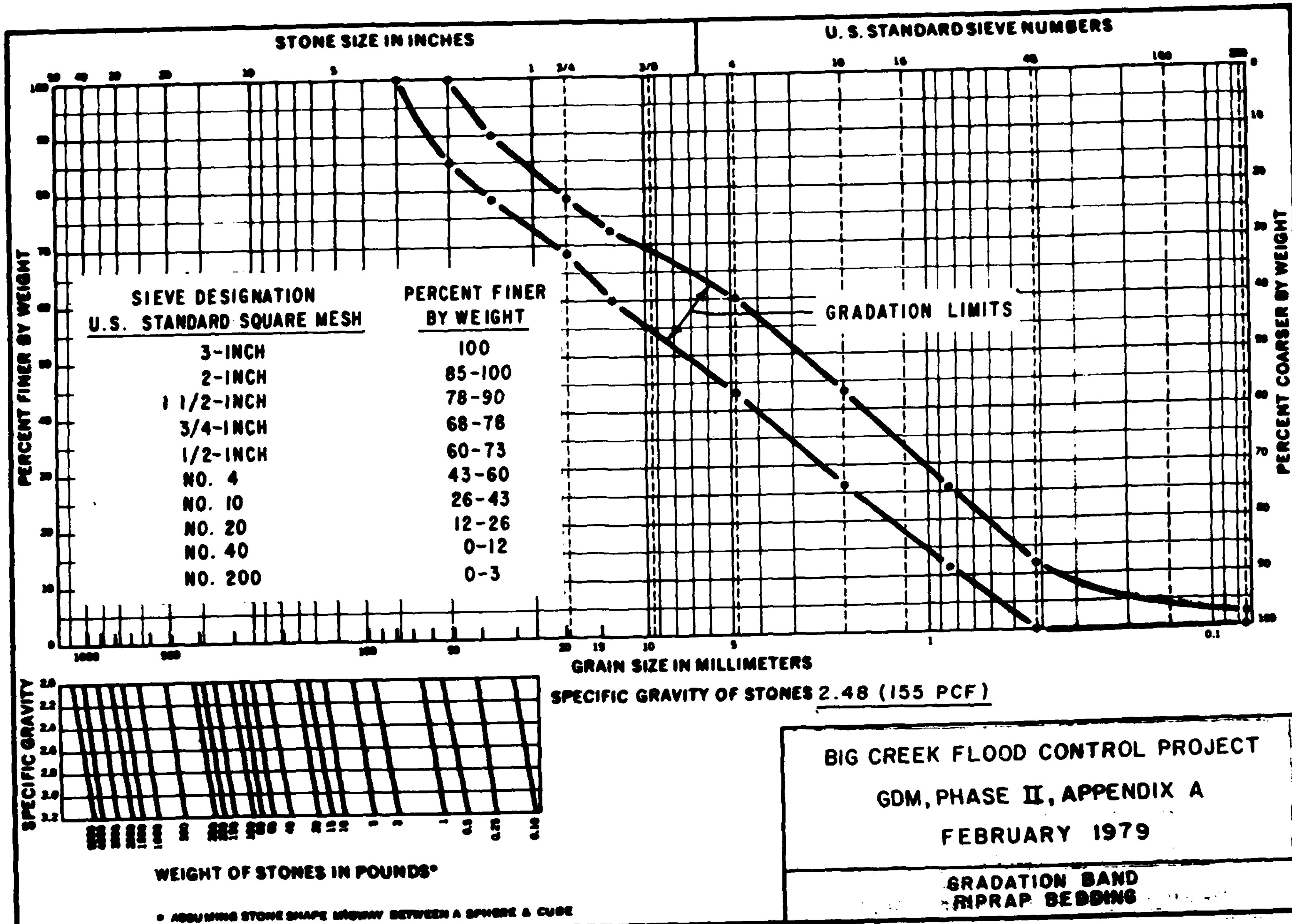
A75.6 Only specific ledges in some quarries are suitable for the production of either of the above riprap gradations. For example, the upper lift (lift 2) in Marblehead Stone Division, Standard Slag Company quarry at Marblehead, OH, contains a significant amount of chert and cherty dolomite that makes this lift unsuitable for any product for this project. However, lift 3 at this quarry has produced suitable stone materials for other projects. Some quarries will require selective quarrying, handling and loading that production might become a problem. Only two known sources possess grizzly equipment for the production of riprap, i.e., Standard Slag Company, Marblehead Stone Division, Marblehead, OH, and Sandusky Crushed Stone Company, Inc., at Parkertown, OH. The Woodville Lime and Chemical Company at Woodville, OH, produces a 12-inch "Kiln Stone" for the steel industry. That material was used successfully for riprap at Fremont, OH, Flood Control Project.

A75.7 Bedding Material - Eleven suitable sources are available within a 90-mile radius of the project site.

A75.8 Gabion Stone - Thirteen suitable sources are available within a 90-mile radius of the project site.

A75.9 Concrete Aggregates - Seven suitable sources are available within a 90-mile radius of the project site.

A75.10 Embankment Materials - Embankment materials other than those discussed in paragraphs A74.7 through A74.9 were investigated at the Metroparks Borrow Area, Berea, OH. This site is approximately 13 miles from the project. Based on data obtained from three hand-augered holes advanced to a depth of five feet, the material is classified as sandy clay (CL). In general, this stockpile contains material that was stockpiled during the construction of the Ohio Turnpike. A detailed subsurface exploration program is being performed and the results from that program will be included in the Plans and Specifications for project construction.



SIEVE DESIGNATION U.S. STANDARD SQUARE MESH	PERCENT FINER BY WEIGHT
3-INCH	100
2-INCH	85-100
1 1/2-INCH	78-90
3/4-INCH	68-78
1/2-INCH	60-73
NO. 4	43-60
NO. 10	26-43
NO. 20	12-26
NO. 40	0-12
NO. 200	0-3

SPECIFIC GRAVITY OF STONES 2.48 (155 PCF)

BIG CREEK FLOOD CONTROL PROJECT

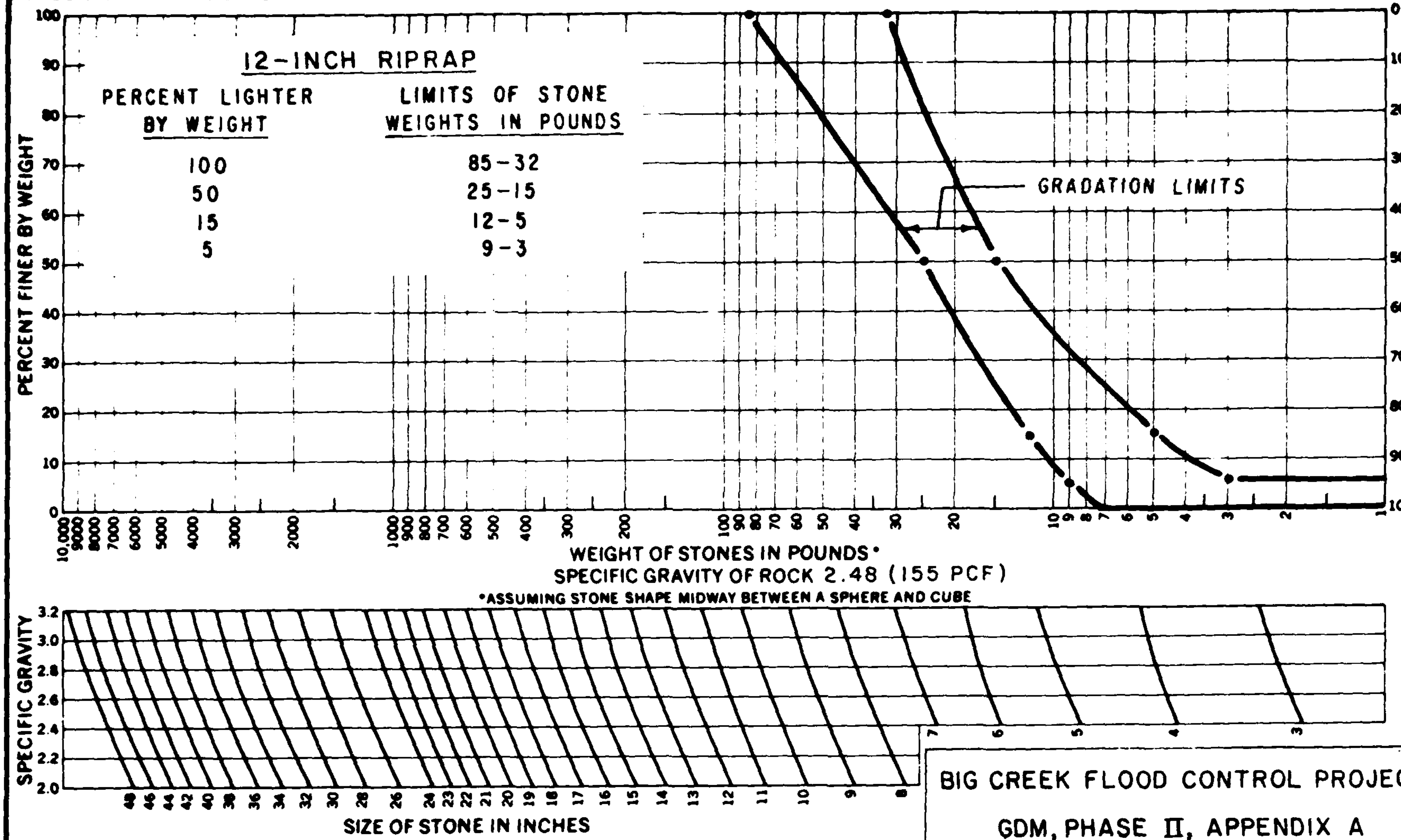
GDM, PHASE II, APPENDIX A

FEBRUARY 1979

GRADATION BAND
RIPRAP BEDDING

ENG FORM 4056
APR 67

FIGURE A-1



BIG CREEK FLOOD CONTROL PROJECT

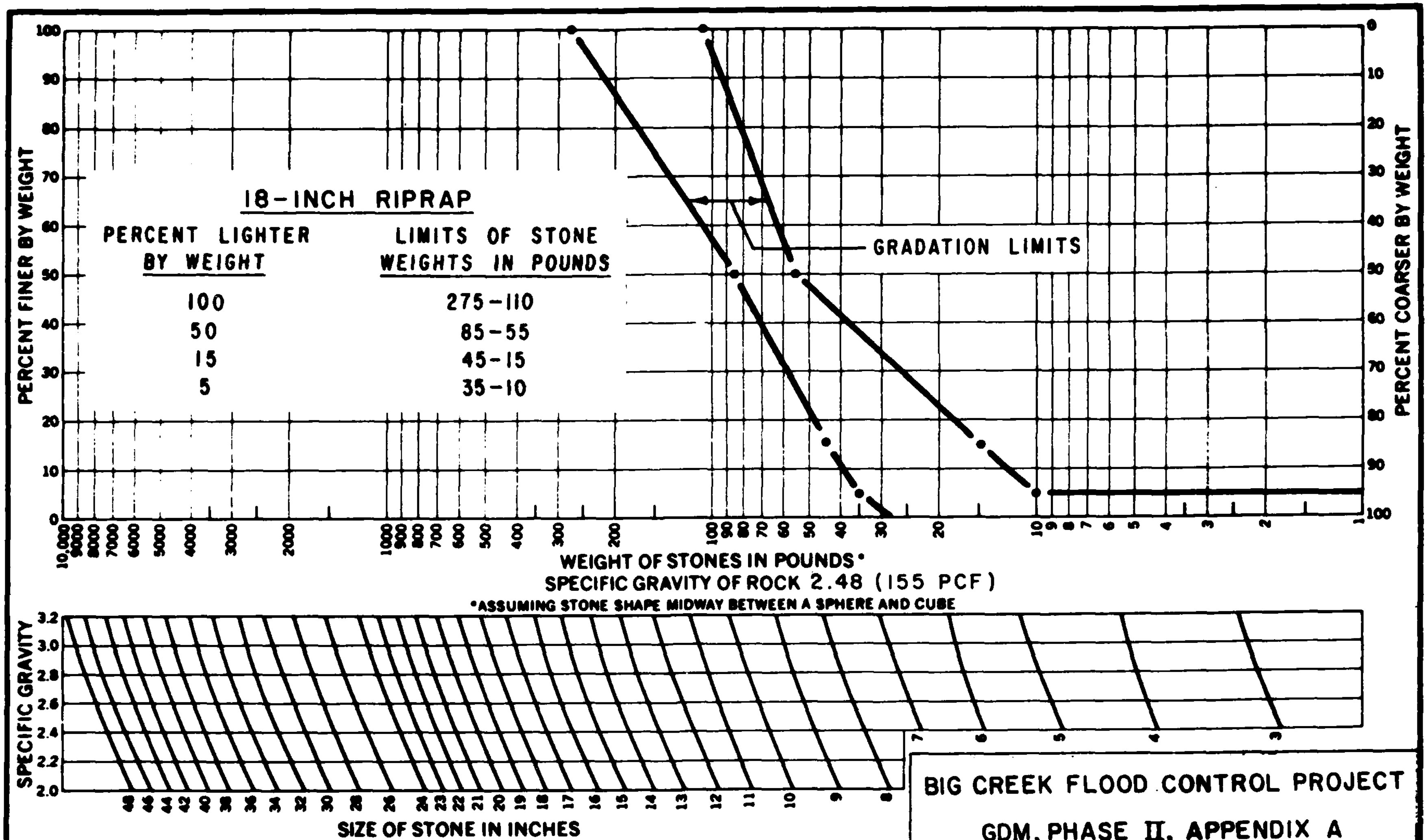
GDM, PHASE II, APPENDIX A

FEBRUARY 1979

12" RIPRAP GRADATION BAND

ENG FORM 4055 APR 67

FIGURE A-2



BIG CREEK FLOOD CONTROL PROJECT

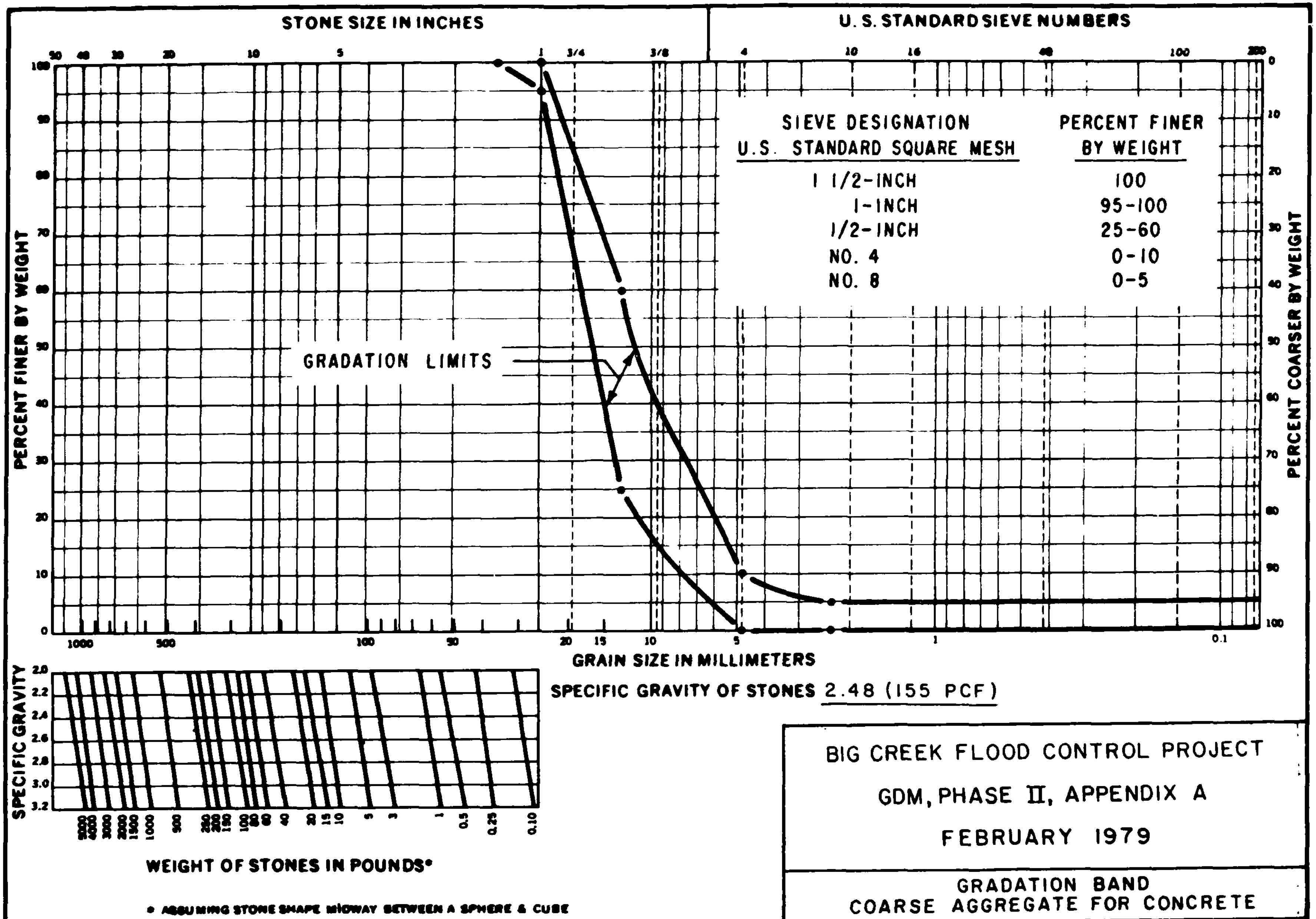
GDM, PHASE II, APPENDIX A

FEBRUARY 1979

18" RIPRAP GRADATION BAND

ENG FORM 4055
APR 67

FIGURE A-3



SIEVE DESIGNATION U.S. STANDARD SQUARE MESH	PERCENT FINER BY WEIGHT
1 1/2-INCH	100
1-INCH	95-100
1/2-INCH	25-60
NO. 4	0-10
NO. 8	0-5

BIG CREEK FLOOD CONTROL PROJECT

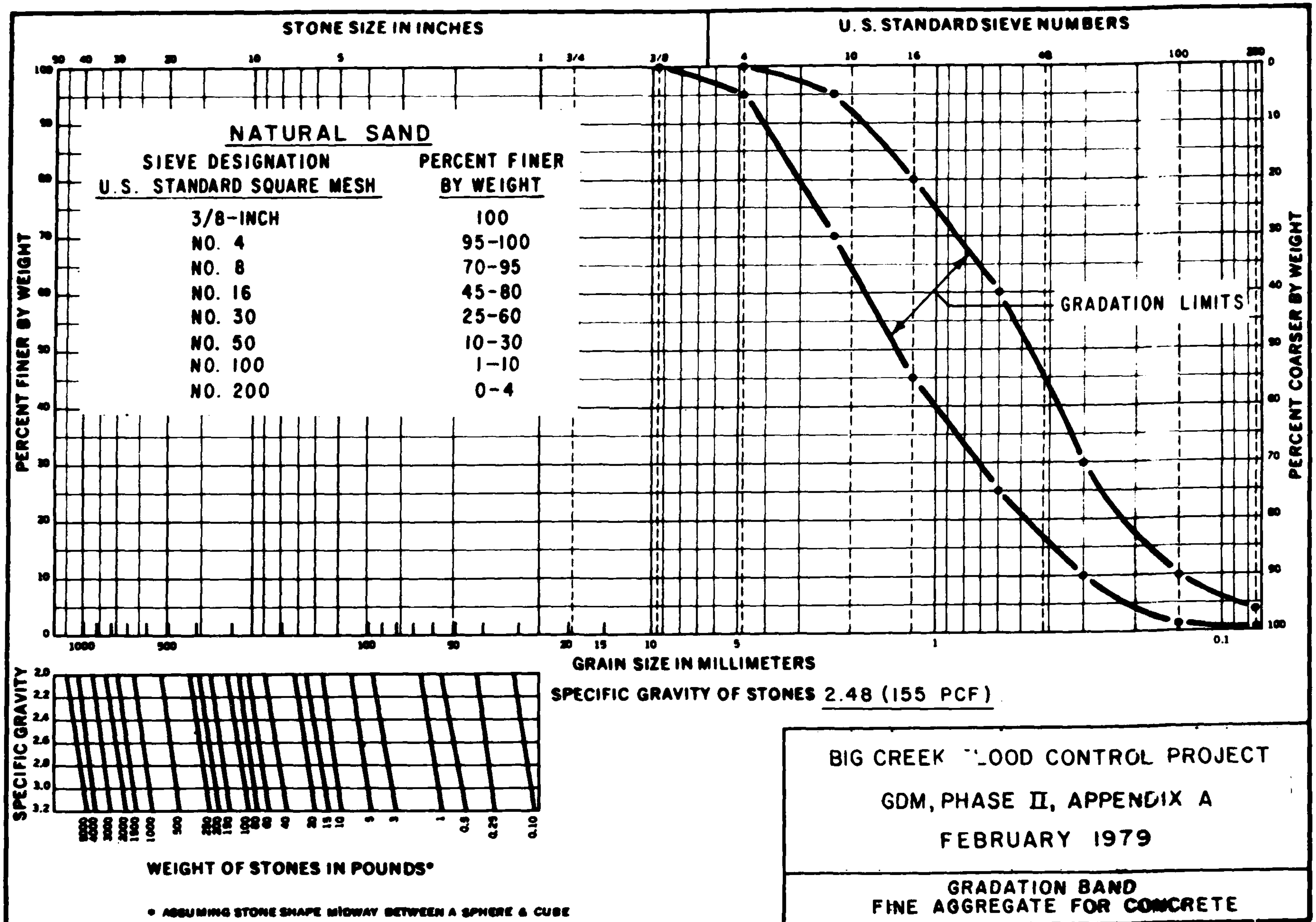
GDM, PHASE II, APPENDIX A

FEBRUARY 1979

GRADATION BAND
COARSE AGGREGATE FOR CONCRETE

ENG FORM 4056
APR 67

FIGURE A-4



BIG CREEK FLOOD CONTROL PROJECT

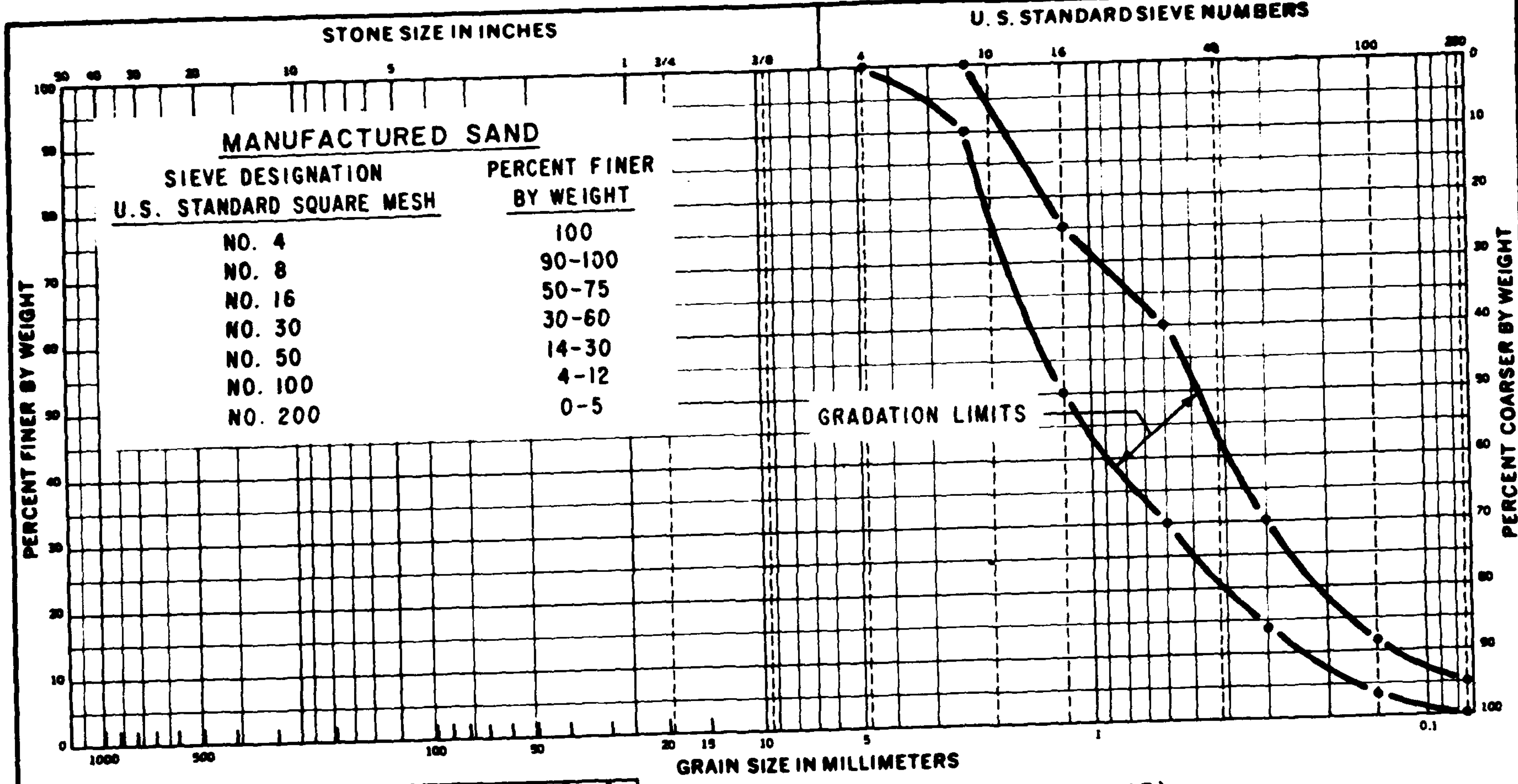
GDM, PHASE II, APPENDIX A

FEBRUARY 1979

GRADATION BAND
FINE AGGREGATE FOR CONCRETE

ENG FORM 4056
APR 67

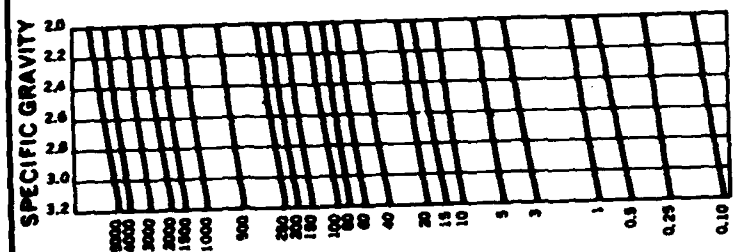
FIGURE A-5



MANUFACTURED SAND

SIEVE DESIGNATION U.S. STANDARD SQUARE MESH	PERCENT FINER BY WEIGHT
NO. 4	100
NO. 8	90-100
NO. 16	50-75
NO. 30	30-60
NO. 50	14-30
NO. 100	4-12
NO. 200	0-5

SPECIFIC GRAVITY OF STONES 2.48 (155 PCF)



* ASSUMING STONE SHAPE MIDWAY BETWEEN A SPHERE & CUBE

BIG CREEK FLOOD CONTROL PROJECT

GDM, PHASE II, APPENDIX A

FEBRUARY 1979

GRADATION BAND
FINE AGGREGATE FOR CONCRETE

FIGURE A-5A

ENG FORM 4056
APR 67

SECTION G

ADOPTED DESIGN VALUES FOR

SLOPE STABILITY ANALYSES

A77. General. Final design of the Big Creek Flood Control Project requires a stability analysis on the relocated railroad embankments, the levee, the cut slope through the trash pile, and other cut slopes. The purpose of this Section is to establish the design values for the various soils for use in the stability analyses.

A78. Cases to be Analyzed. Two cases will be analyzed for the various stability analyses to be performed. They are the construction case and the sudden drawdown case. The construction case represents the condition immediately after construction, and the sudden drawdown case represents the condition immediately after the design flood has receded to a normal flow condition. With respect to the latter condition, it has been assumed that the creek banks will remain saturated for a period of time after the post-flood level of the creek has dropped to the normal creek level.

A79. Soils for which Design Values are Required. For the purpose of running slope stability analyses, the project soils will be divided into the following: (1) fill material, (2) existing Norfolk and Western Railroad embankment material, (3) existing Baltimore and Ohio Railroad embankment material, (4) natural foundation material, and (5) trash pile material. The fill material includes both the relocated railroad embankments and the levee.

A80. Adopted Shear Strength Parameters for Design for Project Soils. The unconsolidated-undrained (U-U) shear strength values will be used for the construction case. The consolidated-drained (C-D) and consolidated-undrained (C-U) shear strength values will be used for the sudden drawdown case. The shear strength test envelopes and the envelopes adopted for design for the construction and sudden drawdown cases for all materials except the trash pile material are presented on Plate A13. The procedure for determining adopted design values for trash pile material is presented in Paragraphs A81 through A83, inclusive. A summary of the adopted shear strength parameters from Plate A13 is as follows:

ADOPTED SHEAR STRENGTH PARAMETERS FOR PROJECT SOILS

	Construction Case		Sudden Drawdown Case	
	ø (Degrees)	C (TSF)	ø (Degrees)	C (TSF)
(1) Relocated RR Embankments & Levee*	11	0.60	23	0.12
(2) Existing N&W RR Embankment	2.5	0.67	20	0.20
(3) Existing B&O RR Embankment	0	0.48	18	0.30
(4) Natural Foundation Material	0	0.60	19	0.25

*Based on material from required common excavation. The same shear strength parameters would be used for rock excavation material used in the relocated RR embankments. Only a small quantity of rock excavation would be available for use in the relocated RR embankments.

A81. In order to run a stability analysis on the cut slope through the trash pile, shear strength parameters and the unit weight for the trash material must be established. The shear strength parameters are the angle of internal friction (ø) and the cohesion (c). A detailed description of the various materials in the trash pile are given in Paragraph A32. Although some samples of trash material were obtained and tested, these samples only represent a small portion of the various materials in the trash pile. The trash pile is so heterogenous that it is believed that even if a detailed exploration and testing program were performed on the trash pile, the results would not be conclusive as to the mechanical properties of the trash pile as a whole. It is believed that the most useful information available is the existing slope of the trash pile. If certain assumptions are made, the angle of inclination of the slope is the angle of repose of the trash material. One assumption is that the trash material was dumped or spread in such a manner that the slope was formed from the trash sliding down the slope. Another assumption is that there is no bond between the various particles of trash; that is, cohesion of the trash material is equal to zero. The angle of inclination of the slope of the trash pile is shown on Plate A14. Three cross sections cut through the trash pile give angles of inclination varying from 33° to 38°. Based on the above assumptions, the angle of repose, therefore, varies between 33° and 38°. For design purposes, an angle of 30° will be adopted.

A82. After determining the angle of repose of the trash material, it is necessary to determine the relationship between angle of repose and angle of internal friction. Laboratory experiments have shown that the angle of internal friction depends to a large extent on the initial density of the material. However, it is approximately equal to the angle of repose of the material in the loosest state. For design purposes it will, therefore, be assumed that the angle of internal friction of the trash material is equal to the angle of repose(30°). This should be conservative in that it would be the angle of internal friction of the trash material in the loosest state. As noted previously, the cohesion of the trash material was assumed equal to zero. This should also be conservative. Considering that the trash pile is a heterogenous mixture, it probably has some cohesion.

A83. It must be recognized that the above procedure is a soil mechanics approach, and it can only give approximate shear strength values for the trash material. Although the trash pile contains soil, it also contains a variety of other materials. The trash pile will change with time. It will continue to settle and become more dense. The organic material in the trash pile will continue to decompose. The trash material becoming more dense will tend to increase its shear strength, while the decomposition of organic matter would tend to decrease it. In Appendix B, Alternative Studies, the selected alternative for excavating through the trash pile provides for a seeded, 3-foot thick layer of earthfill to be placed on the excavated slope. This layer of earthfill should help in reducing the rate of decomposition of organic matter in the trash pile. The effects of changes in the trash pile over the 50-year life of the project cannot be predicted with any degree of certainty. Some changes will tend to increase the long-term stability of the cut slope while others will decrease it. For design purposes, it will be assumed that the stability of the cut slope will not change over the life of the project.

A84. Adopted Unit Weights for Design for Project Soils. In addition to needing shear strength parameters for stability analyses, unit weights of the various materials will also be needed. Based on information from the laboratory tests on the project soils, the following unit weights will be used.

Material	Unit Weight (lbs/ft^3) Moist	Saturated
Relocated Railroad Embankment & Levee	125	130
Existing N&W Railroad Embankment	125	130
Existing B&O Railroad Embankment	125	130
Natural Foundation Material	125	130

A85. In order to arrive at a unit weight for the trash material, the unit weights of several types of material in the trash pile will be considered. These are as follows:

Material	Unit Weight (lbs/ft^3)
Paper	58
Rubber Goods	94
Glass	156
Wood	22-59
Cotton	93
Leather	59
Common Brick	120
Ashes, Cinders	40-45
Sand, Gravel, Dry, Loose	90-105

For design purposes, a unit weight of 90 lbs/ft^3 will be used for the trash material. This is an assumed value since no tests were run on the trash material for the purpose of determining a unit weight.

SECTION H

OFFSITE BORROW MATERIAL

A86. General - A source of borrow materials for the levee embankments was investigated at the Rocky River Metropark, Berea, Ohio. This borrow area is approximately 13 miles from the construction site, and is located adjacent to the entrance of the park and the Ohio Turnpike. The borrow area is approximately 1400 ft. x 400 ft. x 36 ft. deep and contains approximately 150,000 cu. yds. of material. A maximum of 110,000 cu. yds. of material will be required. This material was stockpiled during the construction of the Ohio Turnpike. Suitable levee embankment materials consist of the following Unified Soil Classifications, GM, GC, SM, SC, CL, and CH.

A87. 1979 Boring Program - A boring program to determine the suitability of the borrow material was performed in April 1979. The borings and their locations are shown on PLATE A33. This program consisted of a total of 11 borings taken to a maximum depth of 34 feet. The borings were advanced using a 3.5 inch O.D. Split Spoon Sampler driven by a 375 lb. hammer free falling 18 inches. Blow counts were recorded every 6 inches of drive. Jar and composite bag samples were obtained for each drive or change of materials. Laboratory tests were performed on these samples to determine the classification and compaction qualities respectively of the borrow material. Boring log information is shown on Plates A34 and A35.

A88. Laboratory Test Results - Laboratory tests were performed on the jar and bag samples. All testing was conducted by the Ohio River Division Laboratory. Tests performed were visual classification, Atterberg Limits, Moisture Content, determination, Standard Proctor Compaction Tests, and Gradation Tests.

A summary of all soil laboratory result is presented in Appendix A, Fig. A-7.

The laboratory test results indicate the borrow material is generally a sandy gravelly CLAY with a Unified Classification of CL. The gravel appears to be a weathered shale. The values for the optimum dry density ranged from 107 pcf - 117 pcf with the optimum moisture contents varying from 8.5% - 19%. The natural moisture content of the borrow material ranged from 9% - 40% but was generally at or slightly less than the optimum moisture content. Since this was sampled in the early spring, the high moisture contents of the samples are probably indicative of the seasonal moisture fluctuations. Those zones of the borrow material with moisture contents well above optimum are not expected to be a problem. During removal of the borrow material, this wet material can be mixed with the other drier material, producing a mixture with a moisture content of the material. The moisture content and density of the material will be checked in the field at the time of construction. The water table was encountered only in holes D79-5 and D79-7.

The values of the Shear Strength Parameters for this material are shown in Appendix D. These values are presumptive and are considered conservative and at least meet or exceed those used in the design.

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BORING NO.	SAM. NO.	DEPTH OR ELEV. OF SAMPLE	LABORATORY CLASSIFICATION	MECHANICAL ANALYSIS GRAVEL %	SAND %	FINES %	D_{10}	ATTERBERG LIMITS LL	PL	SPECIFIC GRAVITY G	NAT WATER CONT %	NATURAL DRY DENSITY LBS/CU FT	COMPACTION DATA OPT WATER %	MAXIMUM DRY DENSITY LBS CU FT	INIT
D79-1	2	1.5'-3.0'	SANDY CLAY (CL)	6	30	64					10 6				
D79-1	B-2	4.8'-7.9'	SANDY CLAY (CL)					38	21	2.74			19.2	107.7	
D79-1	6	6.0-7.5'	CLAY (CL)	1	11	88					17 8				
D79-1	8	7.9'-9.0'	SANDY CLAY (ML)	2	23	75		NP			21.1				
D79-1	10	10.5'-12'	SANDY CLAY (CL)	9	33	58					13.8				
D79-1	11	12'-13.5'	SILTY CLAY (CL-ML)		30	70					16.1				
D79-1	13	15'-16.5'	SANDY CLAY (CL)		30	70									
D79-2	B-1	4.5'-18'	SANDY CLAY (CL)					36	17	2.75			18.5	109 8	
D79-2	2	1.5'-3.0'	SANDY CLAY (CL)	3	18	79					16.6				
D79-2	4	4.5'-6.0'	SANDY CLAY (CL)	10	25	65									
D79-2	7	7.5'-9.0'	SANDY CLAY (CL)	1	19	80		33	18		19.0				
D79-2	10	10.5'-12'	SANDY CLAY (CL)	5	15	80		35	19		16.2				
D79-2	13	15'-16.5'	CLAY (CL)	5	10	85									
D79-2	19	22.5'-24'	SANDY CLAY (CL)		15	75		36	18		18.3				
D79-3	B-1	0'-24.7'	SANDY CLAY (CL)					31	17	2.78			15.9	115.3	
D79-3	1	0'-1 5'	SANDY CLAY (CL)		20	80									
D79-3	3	3.0'-4.5'	SANDY CLAY (CL)	10	22	68		32	19		12.8				
D79-3	5	6.0'-7.5'	SANDY CLAY (CL)	3	19	78		35	18		15.5				
D79-3	7	8.0'-9.0'	CLAY (CH)		13	87		53	26		19.8				
D79-3	10	10.5'-12'	SANDY CLAY (CL)		20	80		35	20						
D79-3	14	16.5'-18'	SANDY CLAY (CL)	5	20	75		33	18		16.2				
D79-3	21	25.5'-27'	SANDY CLAY (CL)	10	25	65									
D79-4	B-1	4.5'-18'	SANDY CLAY (CL)					28	16	2.77			15 0	116.5	
D79-4	1	0.0'-1.5'	SANDY CLAY (CL)	15	25	60									
D79-4	6	4.7'-6.0'	SANDY CLAY (CL)	2	23	75		25	16						
D79-4	7	6.0'-7.5'	SANDY CLAY (CL)		25	75		24	15		9.1				
D79-4	13	12'-13.5'	SANDY CLAY (CL)	5	25	70		27	15		16.9				
D79-4	16	16.5'-18'	CLAY (CL)		10	90									
D79-5	B-1	1.9'-4.5'	SANDY CLAY (CL)					30	17	2.82			16.0	114.8	
D79-5	3	1.9'-3.0'	SANDY CLAY (CL)	10	33	67		29	19		14.6				
D79-5	7	6.0'-7.5'	SANDY GR. CLAY (CL)	25	15	60		36	19		13.9				
D79-5	11	10.5'-12'	SANDY CLAY (CL)	5	20	75		37	18		15.0				
D79-5	B-2	4.5'-8.0'	GR.CLAYEY SAND (SC)					31	19						
D79-6	B-1	0'-30 0'	SANDY CLAY (CL)					31	17	2.78			15.9	115.0	
D79-6	1	0.0'-1.5'	SANDY CLAY (CL)	10	20	70		30	17		15.0				
D79-6	6	6.0'-7.5'	GR. SANDY CLAY (CL)	15	25	60		39	22		15.6				
D79-6	10	12'-13.5'	GR. SANDY CLAY (CL)	20	25	55									
D79-7	B-1	1.5'-11 5'	SANDY CLAY (CL)					31	17	2.74			16.2	114.5	
D79-7	2	1.5'-3.0'	SANDY GR. CLAY (CL)	25	20	55		37	23		14.8				
D79-7	4	6.0'-7.5'	SANDY CLAY (CL)		35	65									

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1 JAN 73

TEST DATA SUMMARY

PROJECT BIG CREEK F.C.P., METROPARK BORROW AREA I

PACTION DATA		SHEAR DATA													PERMEABILITY	
PT. ATER %	MAXIMUM DRY DENSITY LBS CU FT	INITIAL e	DRY DENSITY LBS/CU FT	W_1 %	W_F %	S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_m T/SQ FT	σ_t T/SQ FT	c T/SQ FT	ϕ DEGREES	e	K FT/MIN.
.2	107.7														
8.5	109 8														
15.9	115.3														
15 0	116.5														
16.0	114.8														
15.9	115.0														
16.2	114.5														

T – TRIAXIAL COMPRESSION
UC – UNCONFINED COMPRESSION
V.C. – VISUAL CLASSIFICATION

DS – DIRECT
Q – UNCONS
B – BAG SA

2

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SHEET 1 OF 2

METROPARK BORROW AREA I

	SHEAR DATA								PERMEABILITY		CONSOLIDATION DATA				
	S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_m T/SQ FT	σ_1 T/SQ FT	c T/SQ FT	ϕ DEGREES	e	K FT/MIN.	P_O T/SQ FT	P_C T/SQ FT	C_C	t_{50}	REMARKS
															V.C.
															V.C.
															V.C.
															V.C.
															V.C.
															V.C.
															V.C.
															V.C.
															V.C.
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															V.C.
															V.C.
															V.C.
															V.C.
															V.C.
															V.C.
															V.C.
															V.C.

T – TRIAXIAL COMPRESSION
UC UNCONFINED COMPRESSION
V.C. – VISUAL CLASSIFICATION

DS – DIRECT SHEAR
Q – UNCONSOLIDATED UNDRAINED
B – BAG SAMPLE

S – CONSOLIDATED DRAINED
R – CONSOLIDATED UNDRAINED

FIGURE A

3

BORING NO.	SAM. NO.	DEPTH OR ELEV. OF SAMPLE	LABORATORY CLASSIFICATION	MECHANICAL ANALYSIS GRAVEL %	SAND %	FINES %	D_{10}	ATTERBERG LIMITS LL	PL	SPECIFIC GRAVITY G	NAT WATER CONT %	NATURAL DRY DENSITY LBS/CU FT	COMPACTION DATA OPT WATER %	MAXIMUM DRY DENSITY LBS CU FT	IN
D79-7	14	21'-27.5'	GR.CLAYEY SAND (SC)	16	40	44									
D79-8	B-2	6.5'-15.5'	SANDY CLAY (CL)					29	15	2.76			16.4	114.6	
D79-8	2	1.5'-3'	SANDY CLAY (CL)	3	39	58		31	19		12.6				
D79-8	5	4.5'-6'	SANDY CLAY (CL)	3	35	62									
D79-8	9	9'-10.5'	SANDY CLAY (CL)	1	18	81		32	18		14 6				
D79-8	11	12'-13.5'	SANDY CLAY (CL)	9	25	66		33	18		15.0				
D79-9	3	3.0'-4.0'	SANDY CLAY (CL)	4	21	75		38	20		21.0				
D79-9	8	9'-10 5'	SANDY CLAY (CL)		18	82		32	17		14.4				
D79-9	12	15'-16 5'	SANDY CLAY (CL)	2	20	78					21.2				
D79-9	16	19.5'-21'	SANDY CLAY (CL)		20	80		33	18		39.3				
D79-9	18	22.5-24'	SANDY CLAY (CL)	5	25	70									
D79-10	3	2.0'-3.0'	SHALE AND CLAY					47	22		18.2				
D79-10	7	6.0 -7.5'	SHALE, CLAY & SAND					38	18		14.8				
D79-10	14	12.5'-13.5	SANDY CLAY (CL)	5	25	70									

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1 JAN 73

T DATA SUMMARY

PROJECT BIG CREEK F.C.P., METROPARK BORROW AREA I

SHEAR DATA											PERMEABILITY		CONSOLIDATION		
DRY DENSITY LBS/CU FT	W_1 %	W_F %	S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_m T/SQ FT	σ_1 T/SQ FT	c T/SQ FT	ϕ DEGREES	e	K FT/MIN.	P_O T/SQ FT	P_C T/SQ FT	C_C

T TRIAXIAL COMPRESSION
UC - UNCONFINED COMPRESSION
V.C - VISUAL CLASSIFICATION
DS - DIRECT SHEAR
Q - UNCONSOLIDATED UNDRAINED
B - BAG SAMPLE

2

RY

SHEET 2 OF 2

TROPARK BORROW AREA I

SHEAR DATA								PERMEABILITY		CONSOLIDATION DATA				
S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_m T/SQ FT	σ_1 T/SQ FT	c T/SQ FT	ϕ DEGREES	e	K FT/MIN.	P_O T/SQ FT	P_C T/SQ FT	C_C	t_{50}	REMARKS
														V.C.
														V.C.
														V.C.
														V.C.
														V.C.
														V.C.
														V.C.
														V.C.
														V.C.
														V.C.
														V.C.

T – TRIAXIAL COMPRESSION
UC – UNCONFINED COMPRESSION
V.C – VISUAL CLASSIFICATION

DS – DIRECT SHEAR
Q – UNCONSOLIDATED UNDRAINED
B – BAG SAMPLE

S – CONSOLIDATED DRAINED
R – CONSOLIDATED UNDRAINED

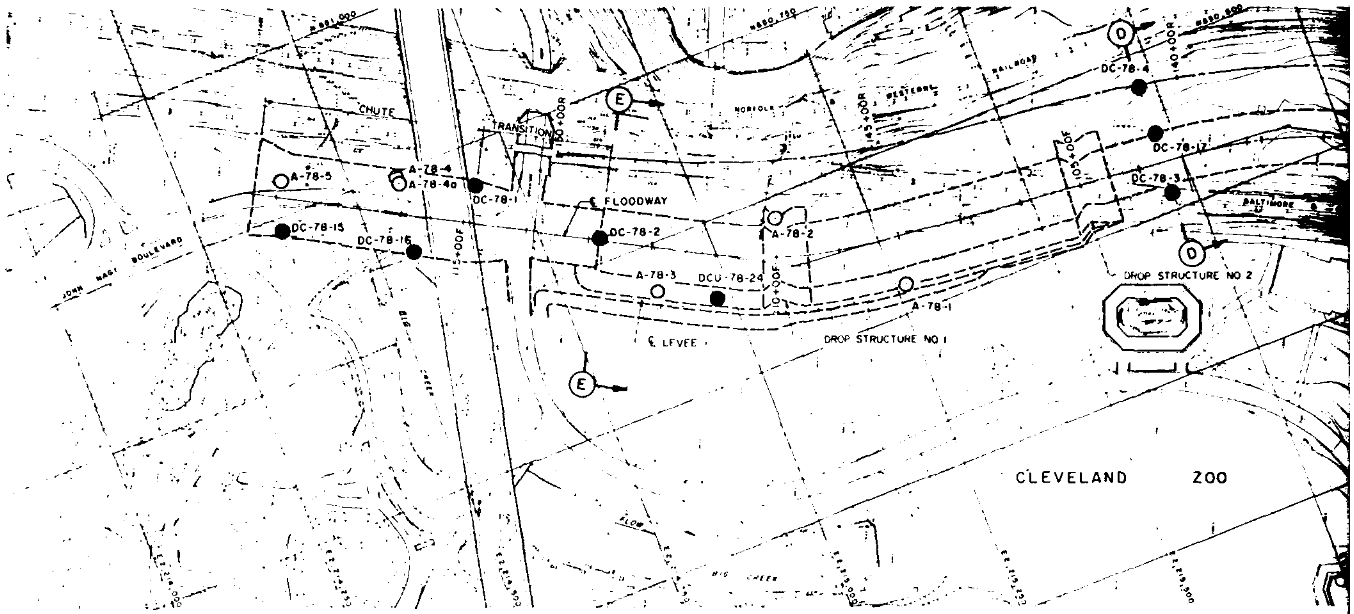
FIGURE A7

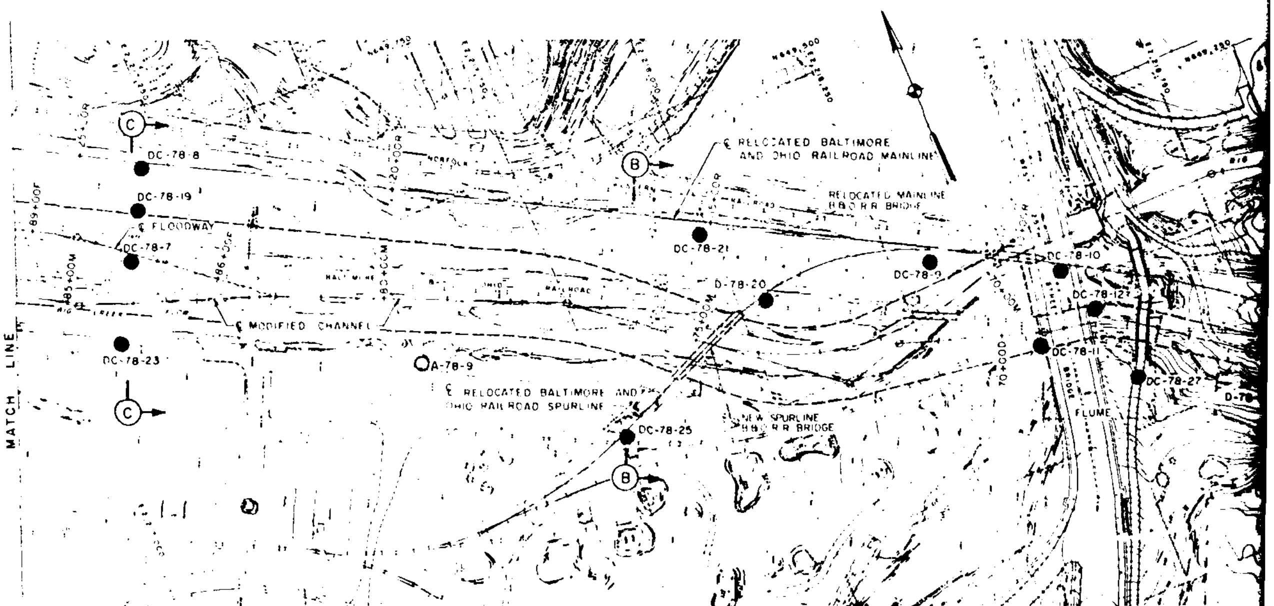
REFERENCES

A1 Cushing, H.P., Leverett, F., and Van Horn, F.R.: Geology and Mineral Resources of the Cleveland District, Ohio, USGS Bulletin 818, 1931.

A2 Semuc, E.J.: The Devonian System, in Guide to the Geology of Northeastern Ohio, Edited by Banks, P.O., and Feldmann, R.M., 1970.

A3 Hoover, K.V.: Devonian-Mississippian Shale Sequence in Ohio, Ohio Geological Survey Information Circular No. 27, 1960.





PLAN OF SUBSURFACE EXPLORATION

SCALE 1 IN = 100 FT

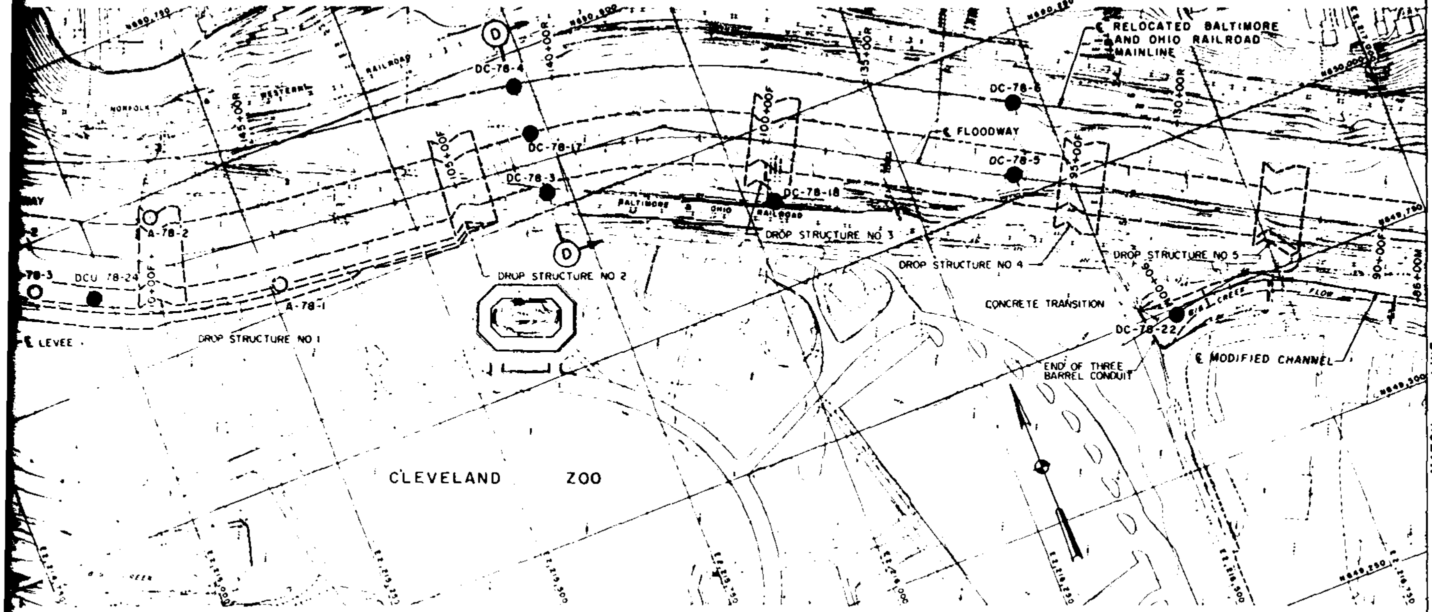
100 50 0 100 200

LEGEND

● Vertical Drill Hole
○ Auger Boring

HOLE NUMBER AND DESIGNATION

Drive Sample
Undisturbed Sample
Core Boring
Auger Boring
Year Drilled
Hole Number



PLAN OF SUBSURFACE EXPLORATION

SCALE 1 IN = 100 FT

100 50 0 100 200

LEGEND

● Vertical Drill Hole

○ Auger Boring

HOLE NUMBER AND DESIGNATION D U C A - 78 - 15

- Drive Sample
- Undisturbed Sample
- Core Boring
- Auger Boring
- Year Drilled
- Hole Number

GENERAL NOTES:

1. Sections cut on plan are for typical soil and geologic cross sections. Sections A, B and C are shown on Plate A7. Sections D and E are shown on Plate A8.
2. For logs of core borings and auger borings, see Subappendix A1.
3. Between end of the three barrel conduit and the West 25th Street bridge, the [illegible] channel and modified channel are based on [illegible] modifications made [illegible] presented in this Appendix are based on the [illegible] shown.

PHASE II
GENERAL DESIGN MEMORANDUM

REV	DATE	DESCRIPTION	BY

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PLAN OF
SUBSURFACE EXPLORATION

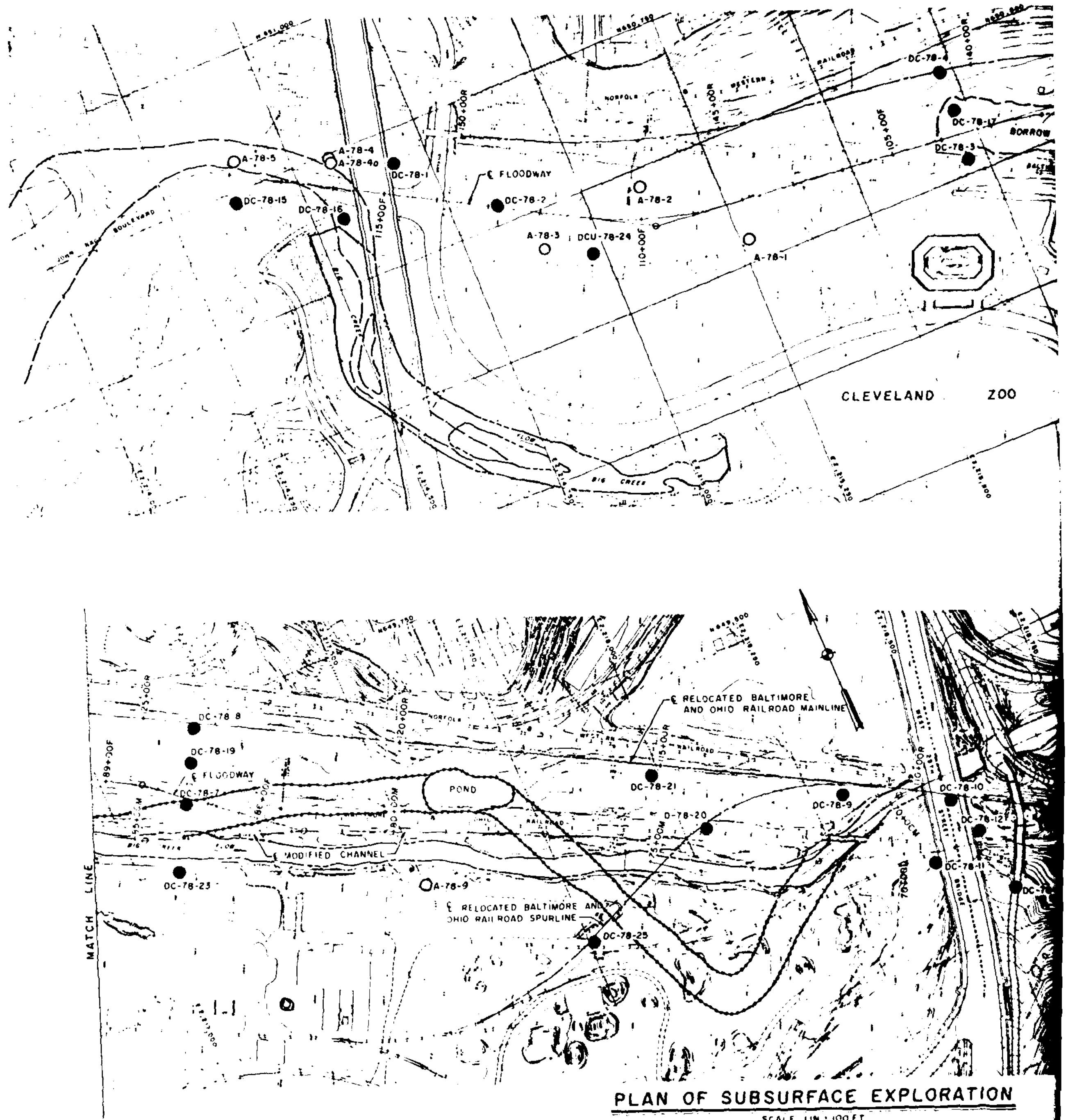
GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG PA

DRAWING NUMBER

SCALE 1 IN = 100 FT | DATE FEB 1979 | SHEET

PLATE A1

2



PLAN OF SUBSURFACE EXPLORATION

SCALE 1 IN = 100 FT

100 50 0 100 200

LEGEND

Big Creek prior to 1918 B & O Railroad construction

Big Creek after 1918 B & O Railroad construction where significantly different from present location

Present location of Big Creek

LEGEND

● Vertical Drill Hole

○ Auger Boring

HOLE NUMBER AND ...

Drive Sample...

Undisturbed ...

Core Boring...

Auger Boring...

Year Drilled...

Hole Number...

PLAN OF SUBSURFACE EXPLORATION

SCALE 1 IN = 100 FT

100 50 0 100 200

LEGEND

Big Creek prior to 1918 B & O Railroad construction

Big Creek after 1918 B & O Railroad construction where significantly different from present location

Present location of Big Creek

LEGEND

● Vertical Drill Hole

○ Auger Boring

HOLE NUMBER AND DESIGNATION – D U C A - 78 - 15

- Drive Sample – D
- Undisturbed Sample – U
- Core Boring – C
- Auger Boring – A
- Year Drilled – 78
- Hole Number – 15

GENERAL NOTES:

1 Big Creek location prior to and after 1918 construction based on drawings received from Chessie System

PHASE II

GENERAL DESIGN MEMORANDUM

REV	DATE	DESCRIPTION

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PLAN SHOWING
PREVIOUS LOCATIONS OF
BIG CREEK AND MANMADE FEATU[RES]

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS
HARRISBURG, PA

DRAWING NUMB[ER]

SCALE 1 IN = 100 FT. | DATE FEB 1979 | SHEET

PLATE

PLAN OF SUBSURFACE EXPLORATION

SCALE: 1 IN = 100 FT

100 50 0 100 200

LEG

- Vertical Drill Hole
- Auger Boring

HOLE NUMBER AND DES

Drive Sample

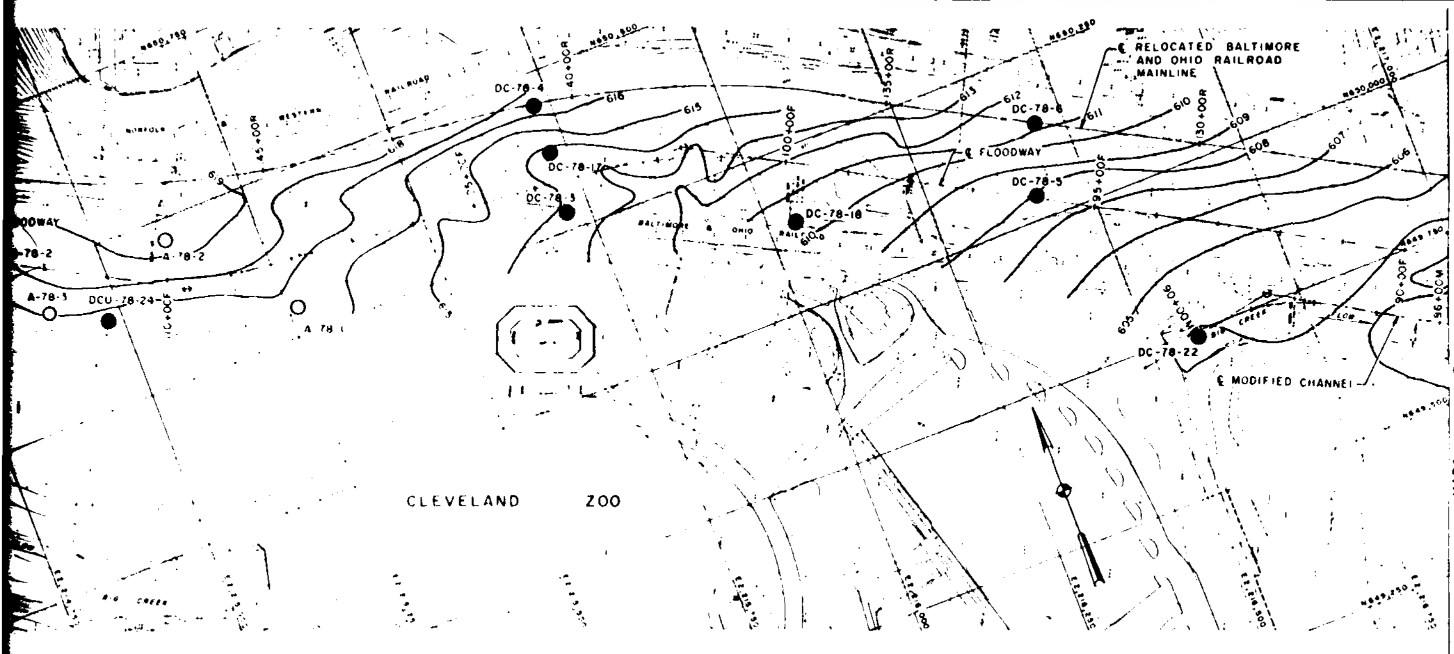
Undisturbed S

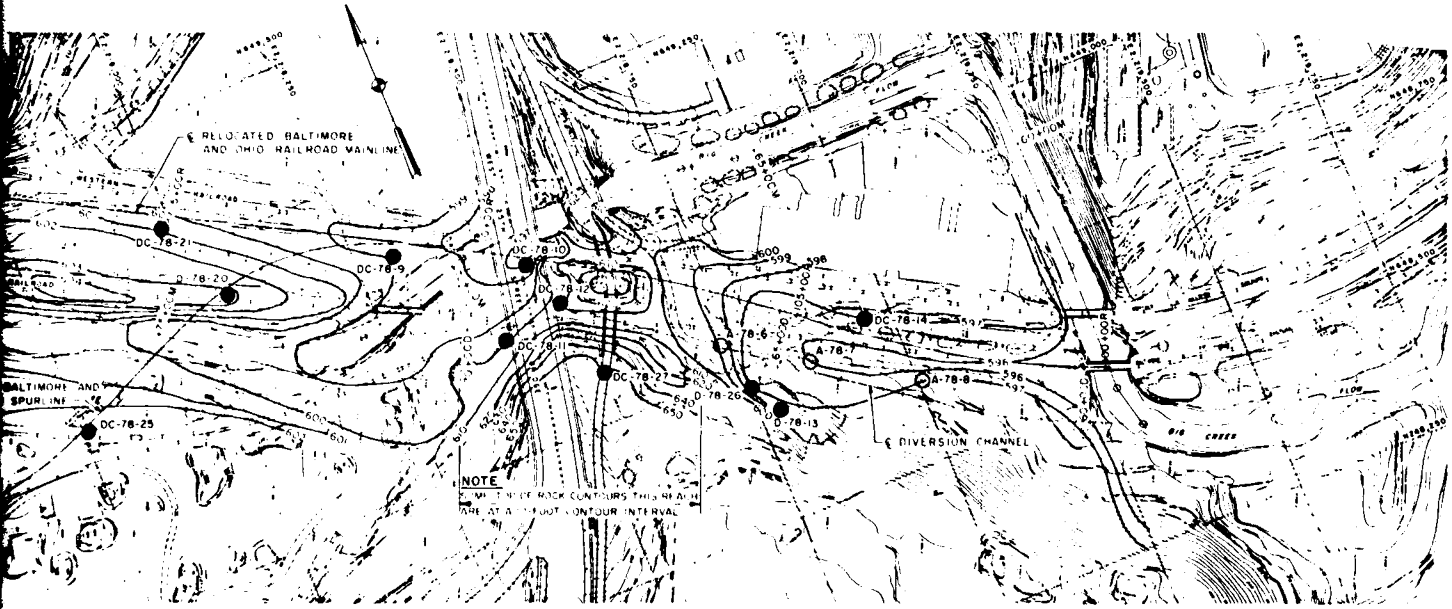
Core Boring

Auger Boring

Year Drilled

Hole Number





PLAN OF SUBSURFACE EXPLORATION

SCALE 1 IN = 100 FT

100 50 0 100 200

GENERAL NOTES:

1. Top of Rock Contours at 1-Foot Interval except as noted

LEGEND

● Vertical Drill Hole

○ Auger Boring

HOLE NUMBER AND DESIGNATION - D U C A - 78 - 15

- Drive Sample
- Undisturbed Sample
- Core Boring
- Auger Boring
- Year Drilled
- Hole Number

PHASE II

GENERAL DESIGN MEMORANDUM

REV	DATE	DESCRIPTION	BY

U.S ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

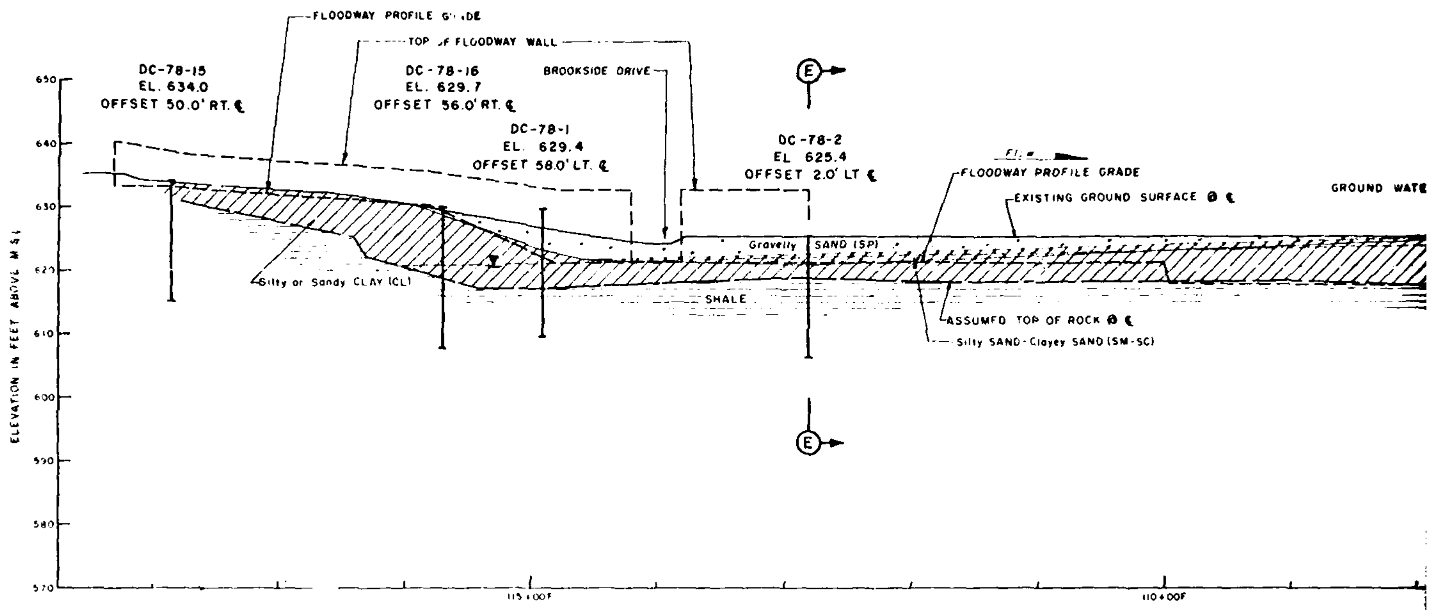
TOP OF ROCK CONTOURS

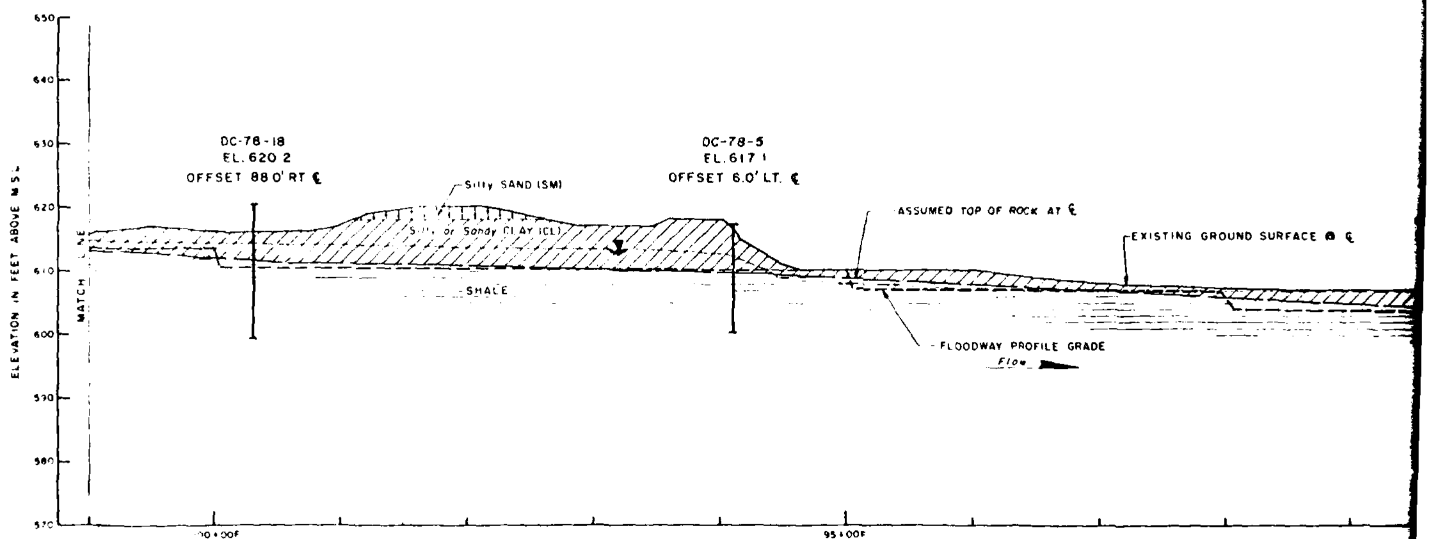
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS

DRAWING NUMBER

SCALE 1 IN. = 100 FT. DATE FEB 1979 SHEET

PLATE A3





SYMBOLS

OVERBURDEN

- TOPSOIL, Sod & Roots
- Silty or Sandy CLAY (CL)
- Clayey or Sandy SILT (ML)
- Clayey SAND (SC)
- Silty SAND (SM)
- CLAY, Plastic (CH)
- Clayey GRAVEL (GC)
- Silty GRAVEL (GM)
- SAND (SP or SW)
- GRAVEL (GP or GW)
- ROCK FRAGMENTS
- Dump Material (Trash)

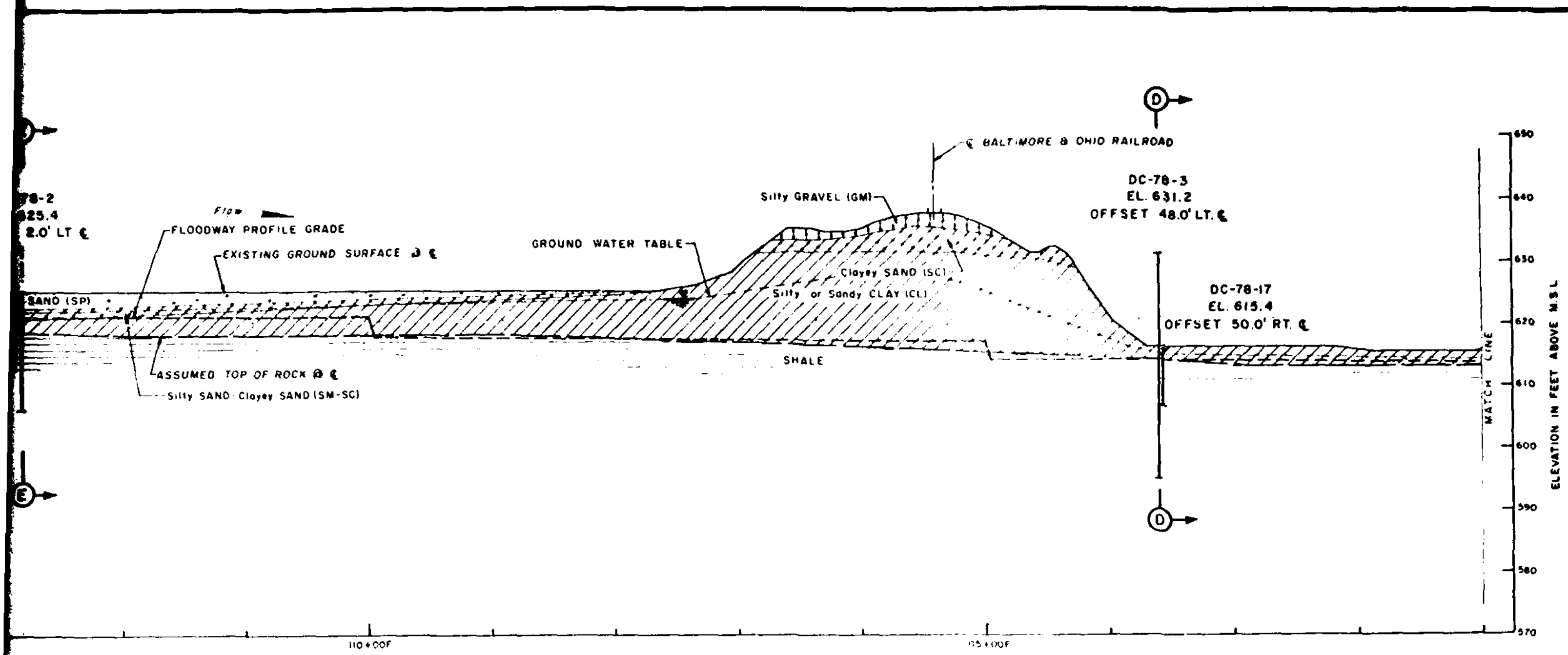
ROCK

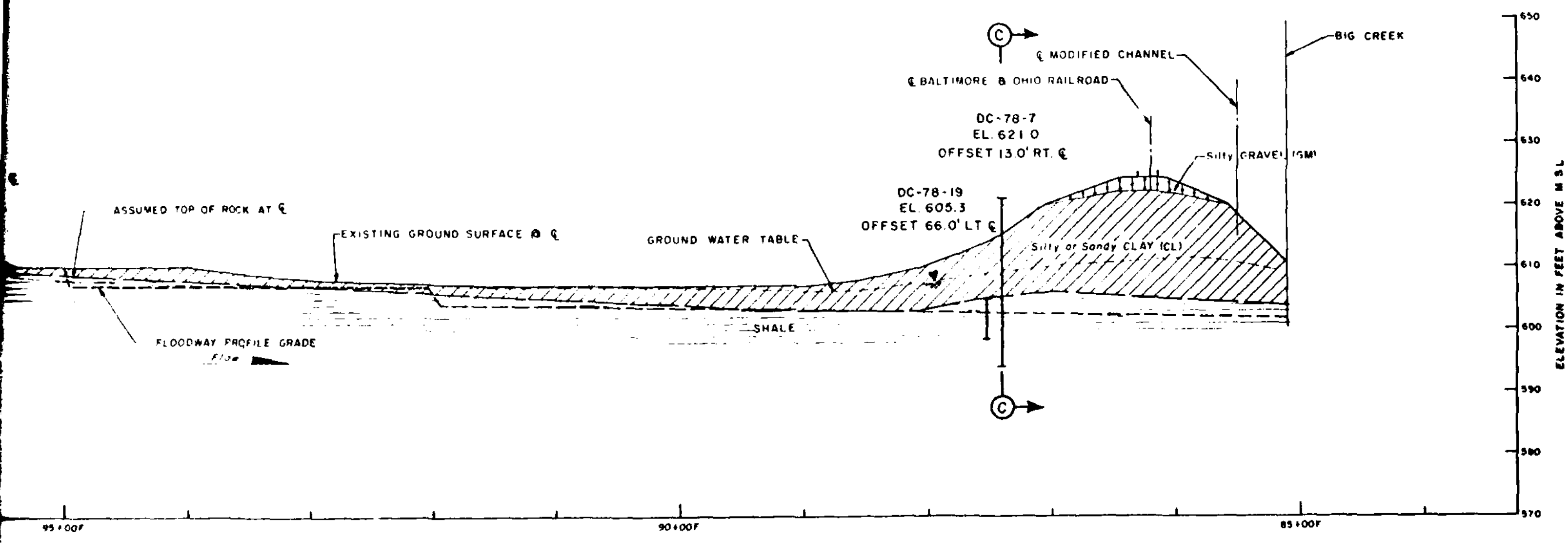
- SHALE
- SILTSTONE

SCALE

HORIZ - 1 IN = 50 FT   50 25 0 50 100

VERT - 1 [illegible]   10 5 0





SCALE

HORIZ - 1 IN = 50 FT   VERT - 1 IN = 10 FT

50 25 0 50'   10 10 5 0 10' 20'

GENERAL NOTES:

1. For Plan of Subsurface Exploration, see Plate A1
2. For Section (C), see Plate A8
3. For Sections (D) and (E), see Plate A8a

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

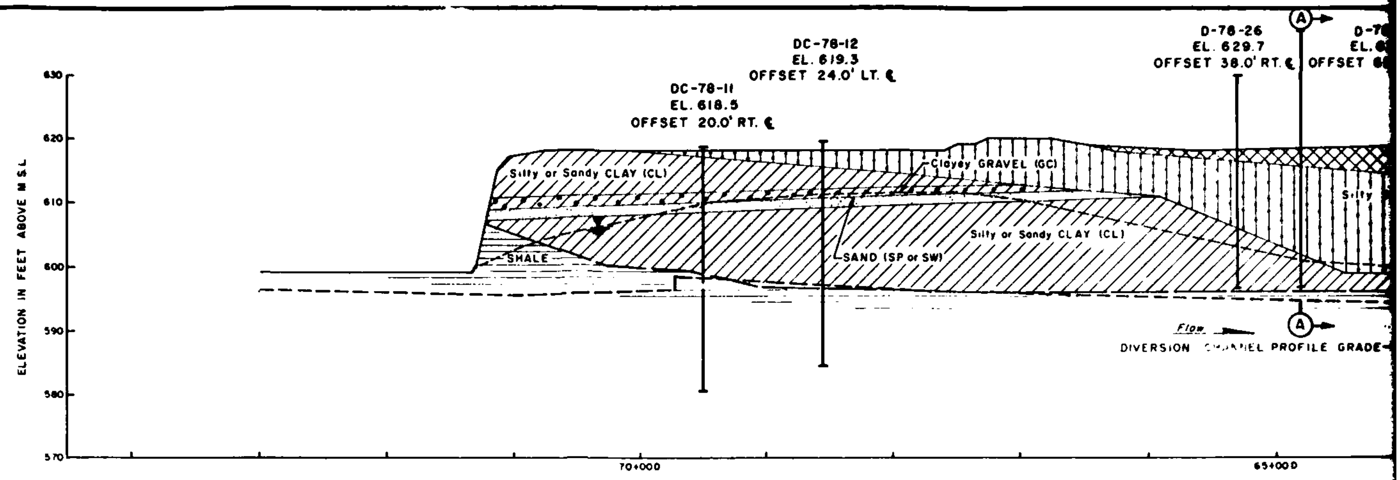
SOIL AND GEOLOGIC PROFILE
ALONG € FLOODWAY

GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS

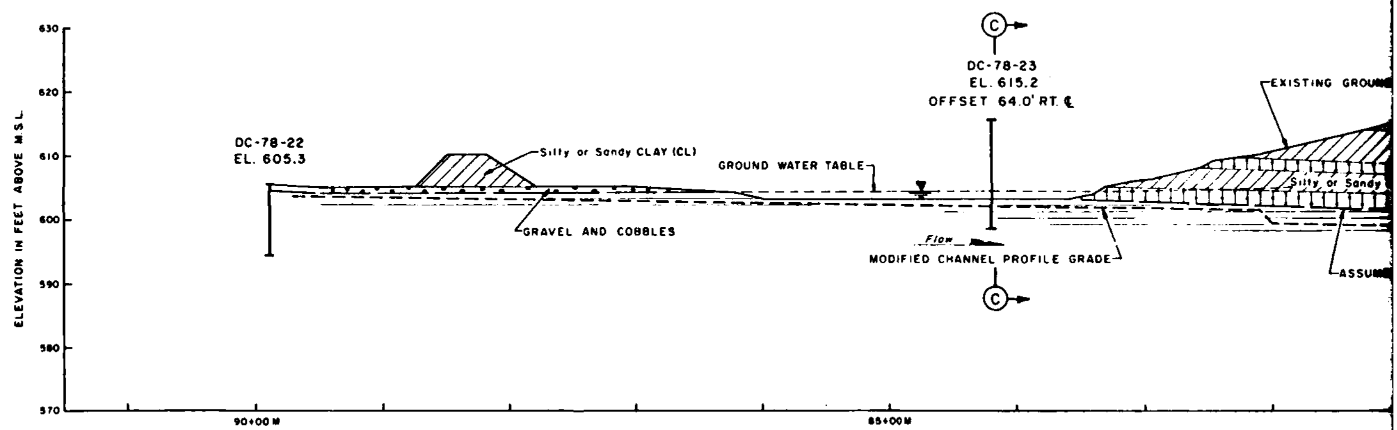
DRAWING NUMBER

SCALE AS SHOWN | DATE FEB 1979 | SHEET

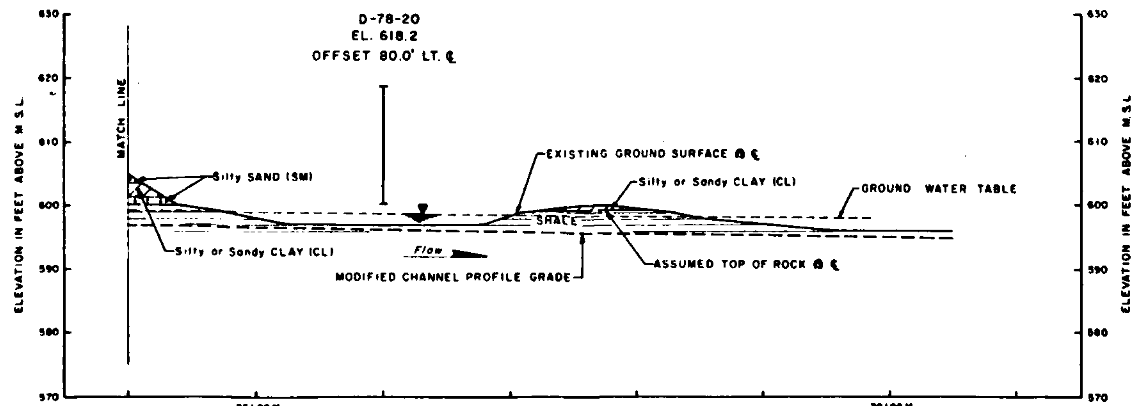
PLATE A



PROFILE ALONG ℄ OF DIVERSION CHANNEL

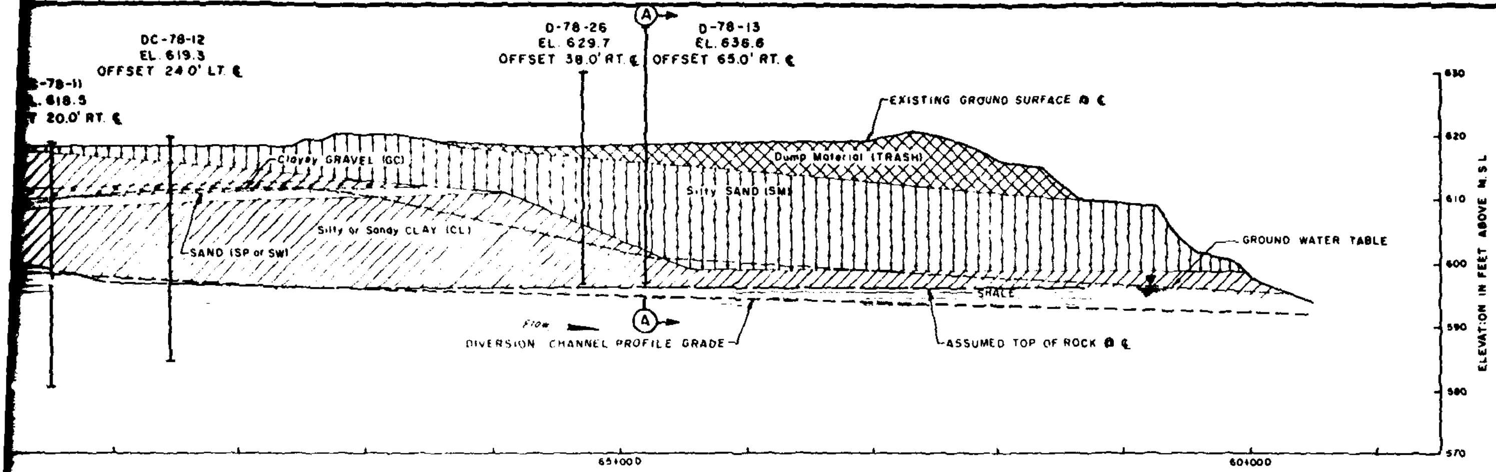


PROFILE ALONG ℄ OF MODIFIED CHANNEL

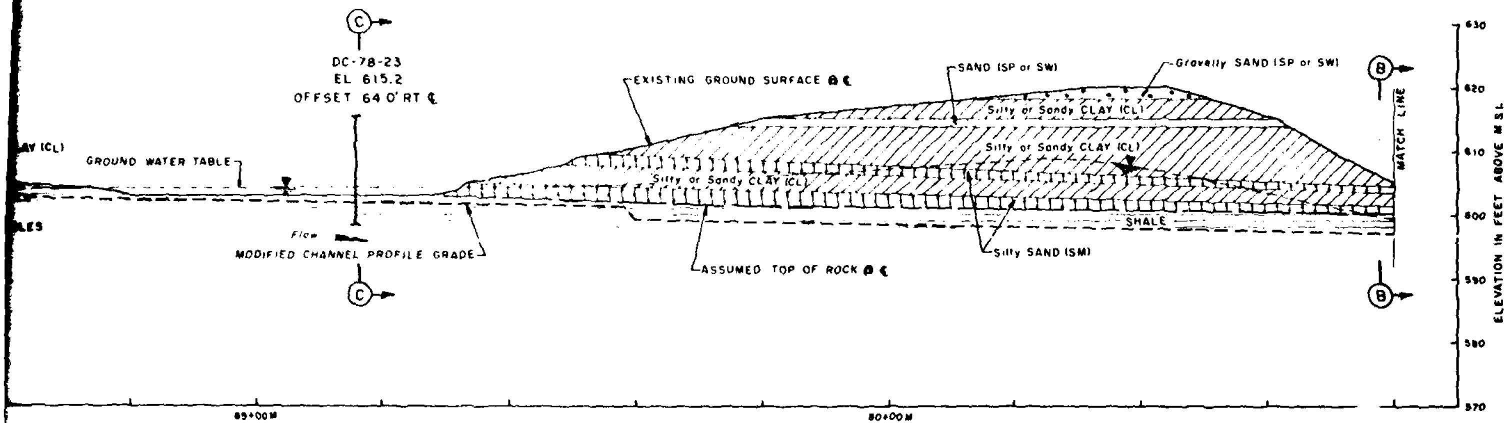


PROFILE ALONG ℄ OF MODIFIED CHANNEL

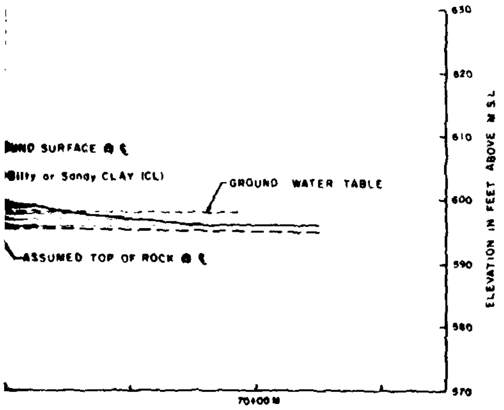
SCALE:
HORIZ. 1 IN. = 50 FT.
VERT. 1 IN. = 10 FT.



PROFILE ALONG ℄ OF DIVERSION CHANNEL



PROFILE ALONG ℄ OF MODIFIED CHANNEL



...DIFIED CHANNEL

SCALE

HORIZ. 1 IN. = 50 FT. — 50' 25' 0 50' 100'

VERT. 1 IN. = 10 FT. — 10' 5' 0 10' 20'

GENERAL NOTES:

1. For Plan of Subsurface Exploration, see Plate A1
2. For symbols, see Plate A4
3. For Section (A), see Plate A7
4. For Sections (B) and (C), see Plate A8

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

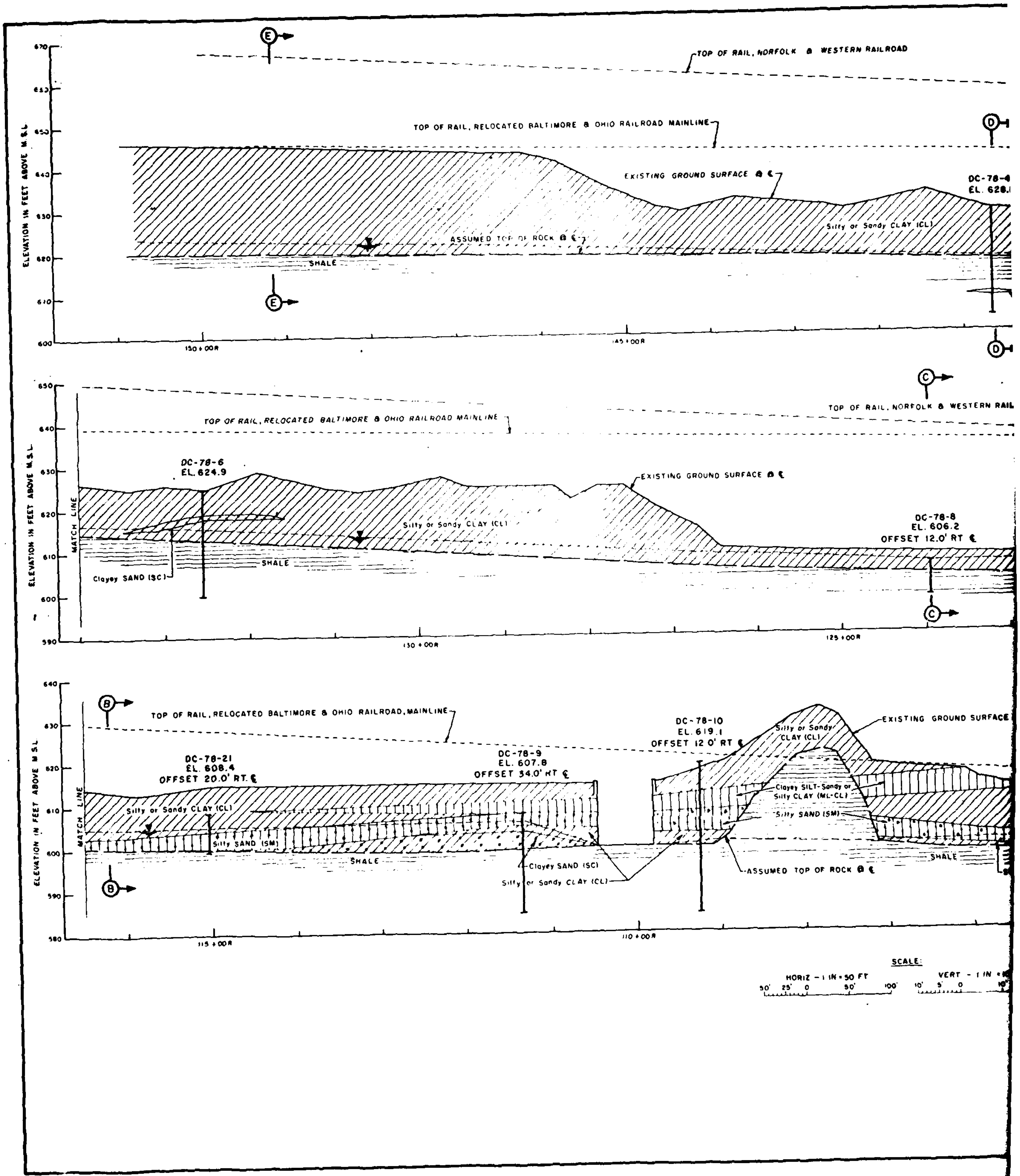
SOIL AND GEOLOGICAL PROFILE
ALONG ℄ OF MODIFIED CHANNEL
AND ℄ OF DIVERSION CHANNEL

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS

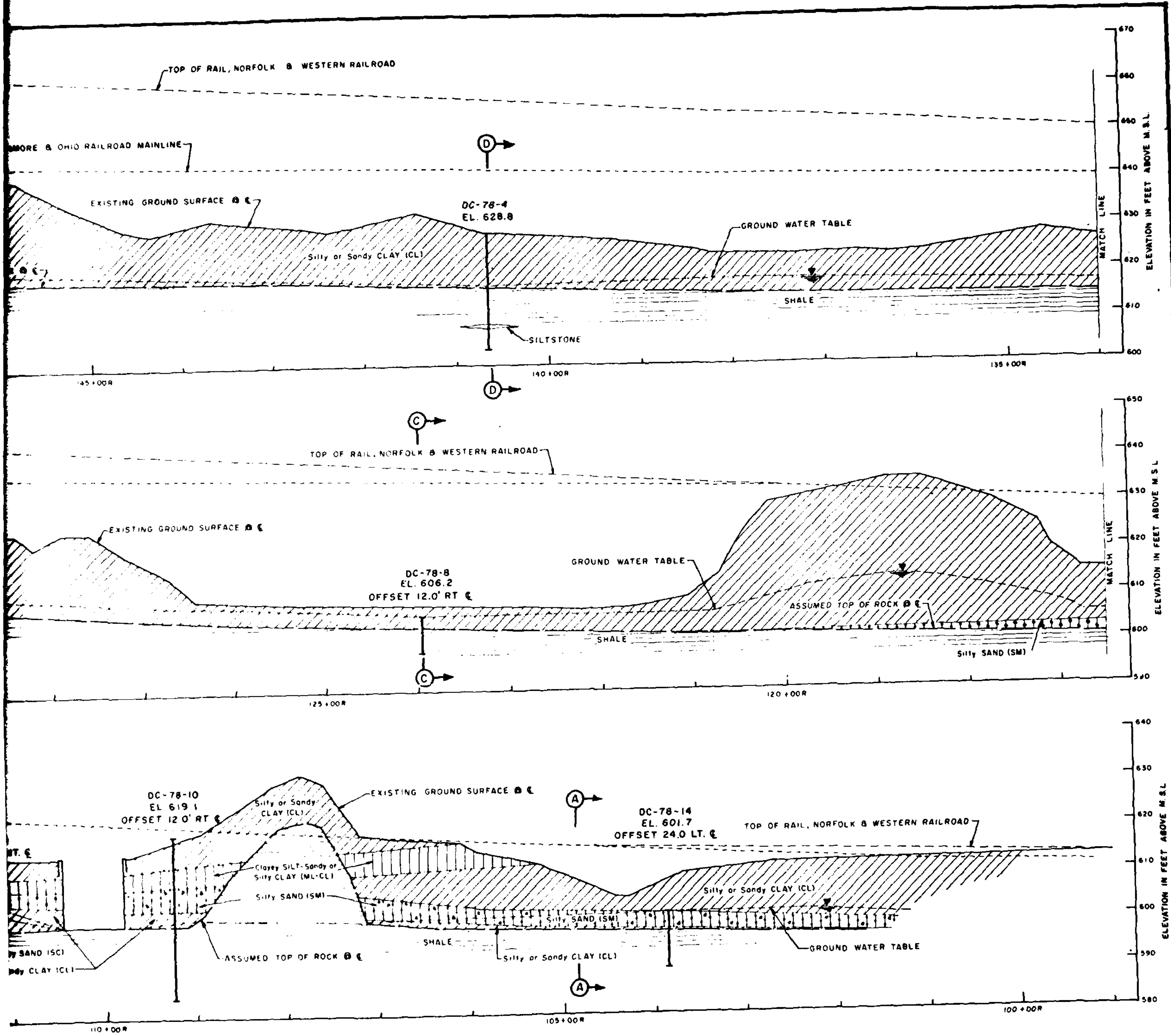
DRAWING NUMBER

SCALE: AS SHOWN | DATE: FEB 1979 | SHEET

PLATE



TOP OF RAIL, NORFOLK & WESTERN RAILROAD
TOP OF RAIL, RELOCATED BALTIMORE & OHIO RAILROAD MAINLINE
EXISTING GROUND SURFACE @ ℄
DC-78-4
EL. 628.
Silty or Sandy CLAY (CL)
ASSUMED TOP OF ROCK @ ℄
SHALE
ELEVATION IN FEET ABOVE M.S.L.
150+00R
145+00R
TOP OF RAIL, NORFOLK & WESTERN RAIL
TOP OF RAIL, RELOCATED BALTIMORE & OHIO RAILROAD MAINLINE
DC-78-6
EL. 624.9
EXISTING GROUND SURFACE @ ℄
MATCH LINE
Silty or Sandy CLAY (CL)
DC-78-8
EL. 606.2
OFFSET 12.0' RT ℄
SHALE
Clayey SAND (SC)
130+00R
125+00R
TOP OF RAIL, RELOCATED BALTIMORE & OHIO RAILROAD, MAINLINE
DC-78-10
EL. 619.1
OFFSET 12.0' RT ℄
Silty or Sandy CLAY (CL)
EXISTING GROUND SURFACE
DC-78-21
EL. 608.4
OFFSET 20.0' RT. ℄
DC-78-9
EL. 607.8
OFFSET 34.0' RT ℄
Clayey SILT-Sandy or Silty CLAY (ML-CL)
Silty SAND (SM)
SHALE
Clayey SAND (SC)
Silty or Sandy CLAY (CL)
ASSUMED TOP OF ROCK @ ℄
115+00R
110+00R
SCALE:
HORIZ - 1 IN = 50 FT
VERT - 1 IN =



SCALE

HORIZ - 1 IN = 50 FT
50 25 0 50' 100'

VERT - 1 IN = 10 FT
10' 5 0 10' 20'

GENERAL NOTES

1. For Plan of Subsurface Exploration, see Plate A1
2. For Symbols, see Plate A4
3. For Section (A) see Plate A7
4. For Sections (B) and (C), see Plate A8
5. For Sections (D) and (E), see Plate A8a

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

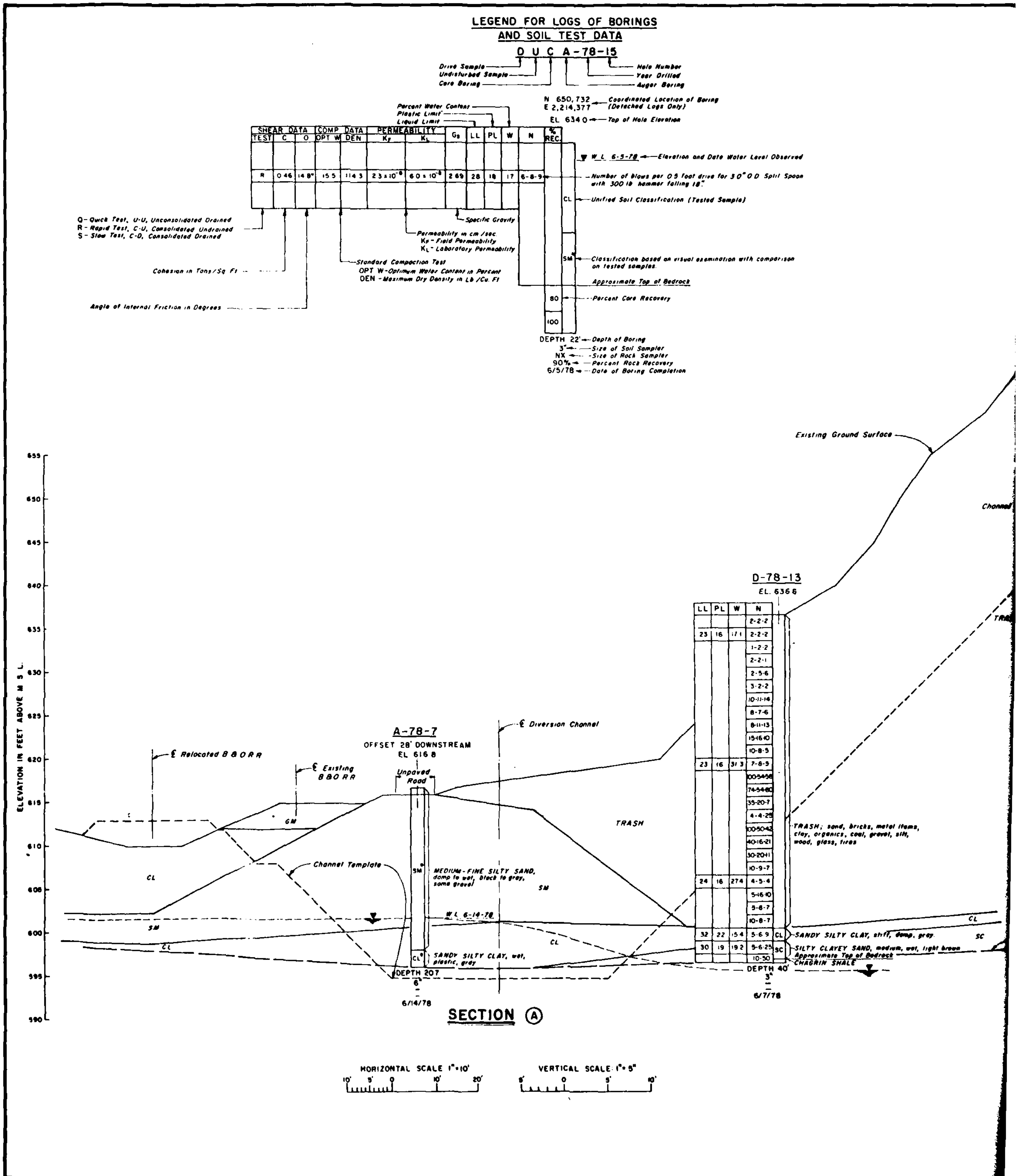
SOIL AND GEOLOGIC PROFILE
ALONG ℄ RELOCATED
MAINLINE B&O RAILROAD

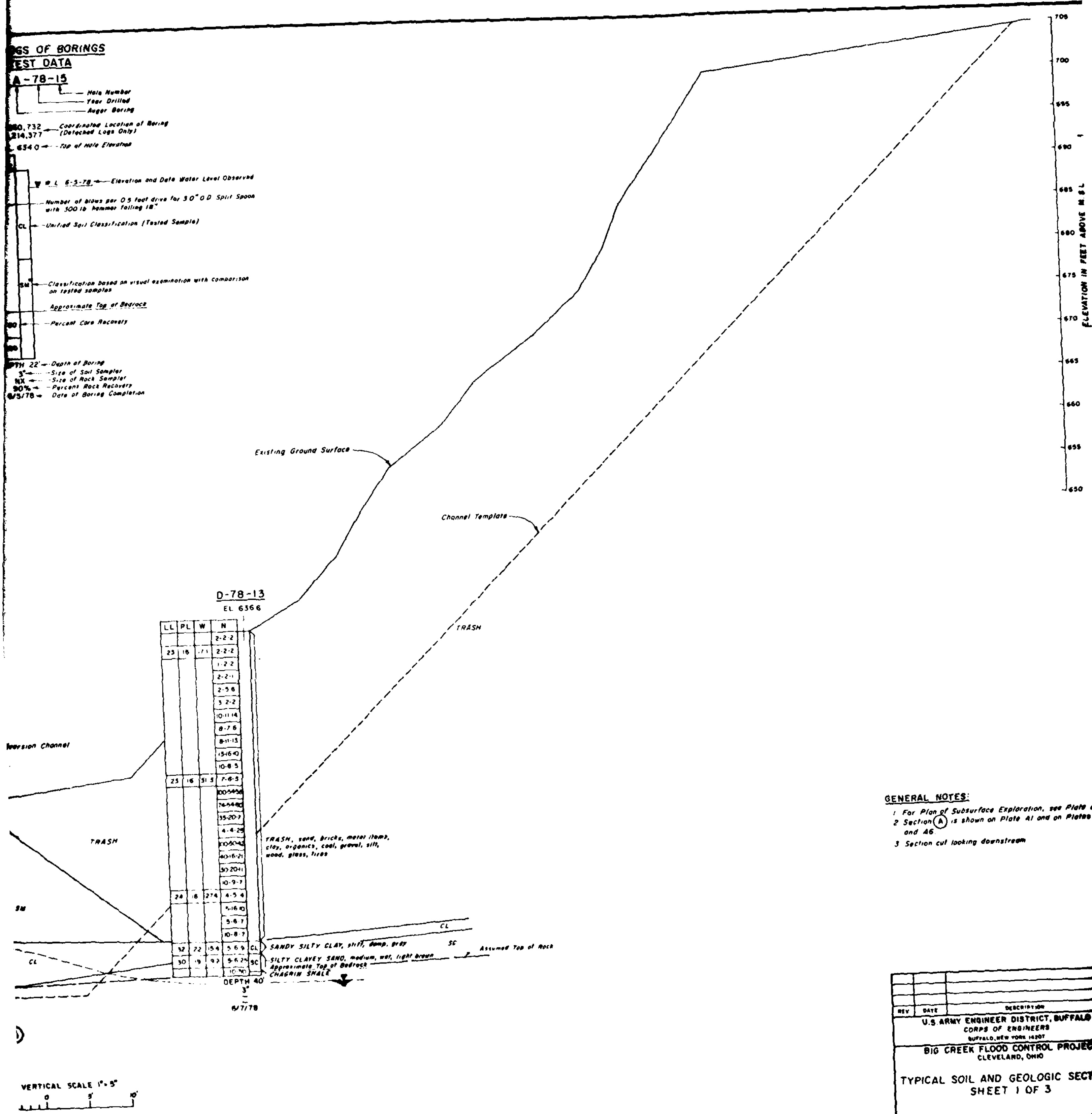
GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS

DRAWING NUMBER

SCALE AS SHOWN | DATE FEB 1979 | SHEET

PLATE A


LEGEND FOR LOGS OF BORINGS
AND SOIL TEST DATA
D U C A-78-15
Drive Sample
Undisturbed Sample
Core Boring
Hole Number
Year Drilled
Auger Boring
N 650,732
E 2,214,377
Coordinated Location of Boring (Detached Logs Only)
EL 634.0
Top of Hole Elevation
Percent Water Content
Plastic Limit
Liquid Limit
SHEAR DATA
TEST
C
Ø
COMP DATA
OPT W
DEN
PERMEABILITY
Kf
KL
Gs
LL
PL
W
N
% REC
W.L. 6-5-78
Elevation and Date Water Level Observed
Number of blows per 0.5 foot drive for 3.0" O.D. Split Spoon with 300 lb hammer falling 18"
Unified Soil Classification (Tested Sample)
Q - Quick Test, U-U, Unconsolidated Drained
R - Rapid Test, C-U, Consolidated Undrained
S - Slow Test, C-D, Consolidated Drained
Specific Gravity
Permeability in cm/sec.
Kf - Field Permeability
KL - Laboratory Permeability
Standard Compaction Test
OPT W - Optimum Water Content in Percent
DEN - Maximum Dry Density in Lb/Cu. Ft
Cohesion in Tons/Sq Ft
Angle of Internal Friction in Degrees
Classification based on visual examination with comparison on tested samples.
Approximate Top of Bedrock
Percent Core Recovery
DEPTH 22'
Depth of Boring
Size of Soil Sampler
Size of Rock Sampler
Percent Rock Recovery
Date of Boring Completion
6/5/78
Existing Ground Surface
ELEVATION IN FEET ABOVE M.S.L.
D-78-13
EL. 636.6
A-78-7
OFFSET 28' DOWNSTREAM
EL 616.8
Unpaved Road
℄ Diversion Channel
℄ Relocated B & O R R
℄ Existing B & O R R
Channel Template
TRASH
MEDIUM-FINE SILTY SAND, damp to wet, black to gray, some gravel
SANDY SILTY CLAY, wet, plastic, gray
W.L. 6-14-78
DEPTH 20.7'
6/14/78
TRASH; sand, bricks, metal items, clay, organics, coal, gravel, silt, wood, glass, tires
SANDY SILTY CLAY, stiff, damp, gray
SILTY CLAYEY SAND, medium, wet, light brown
Approximate Top of Bedrock
CHAGRIN SHALE
DEPTH 40'
6/7/78
SECTION (A)
HORIZONTAL SCALE 1"=10'
VERTICAL SCALE 1"=5'



GENERAL NOTES:

1. For Plan of Subsurface Exploration, see Plate A
2. Section (A) is shown on Plate A1 and on Plates and A6
3. Section cut looking downstream

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJEC
CLEVELAND, OHIO

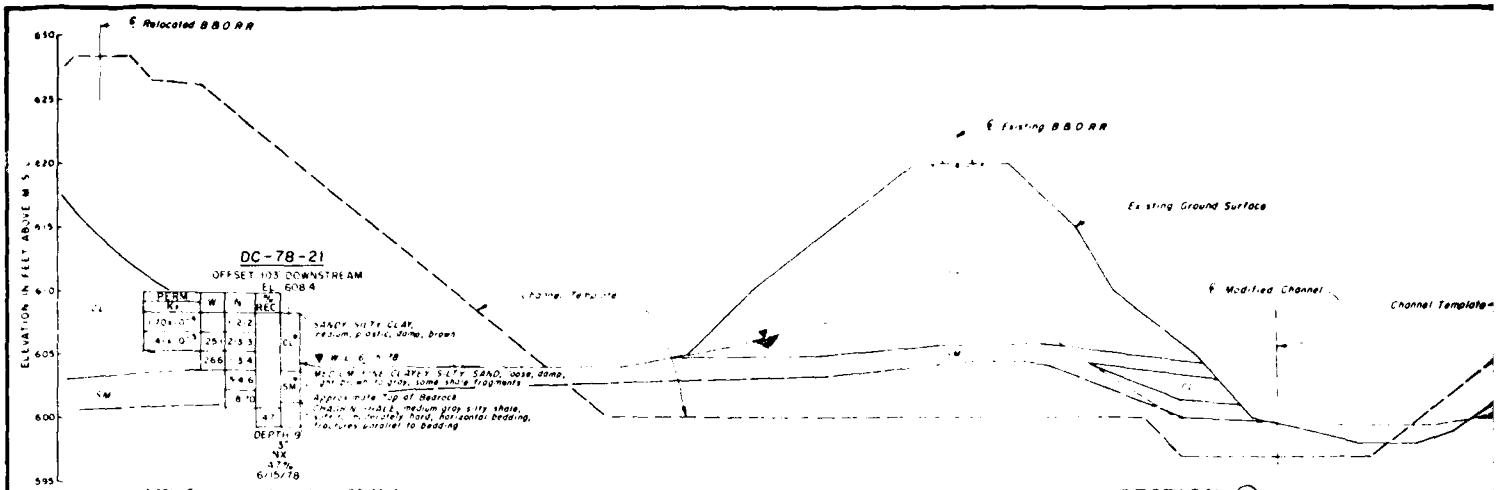
TYPICAL SOIL AND GEOLOGIC SECT
SHEET 1 OF 3

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PA.

DRAWING NU

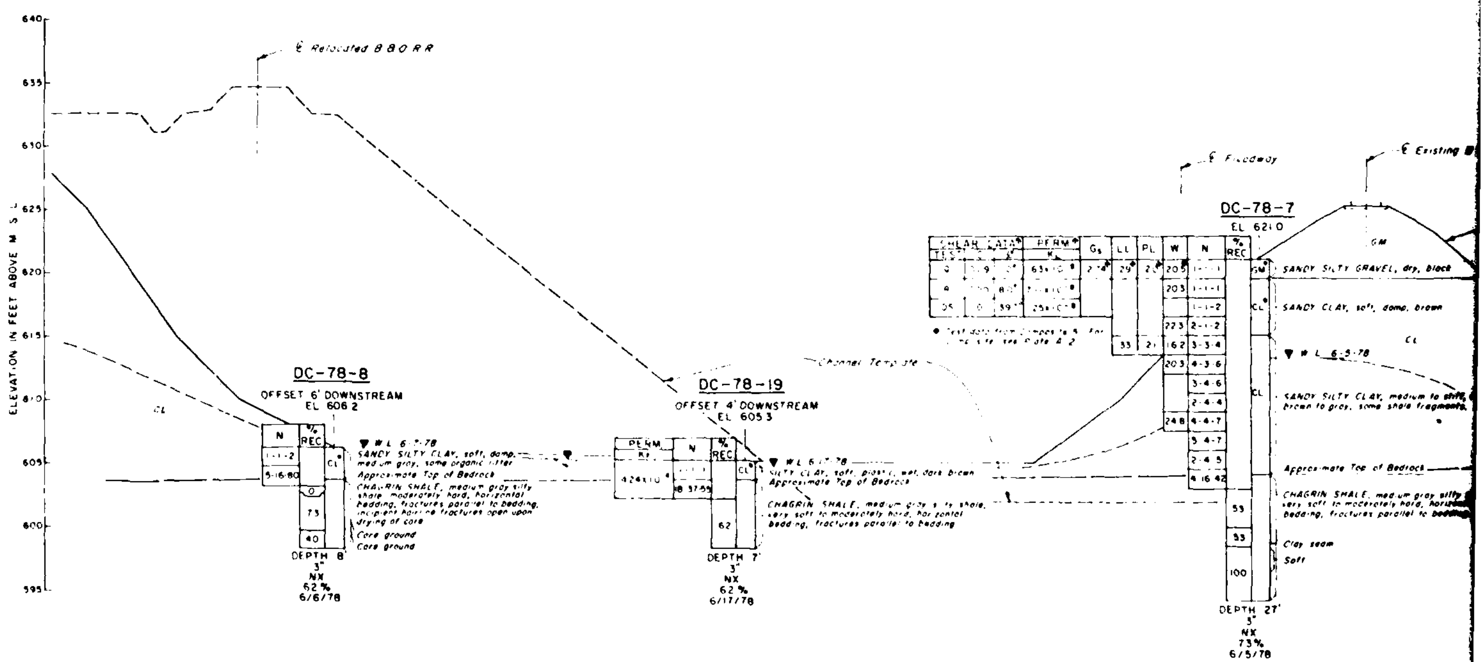
SCALE AS SHOWN | DATE FEB 1979 | SHEET

PLAT



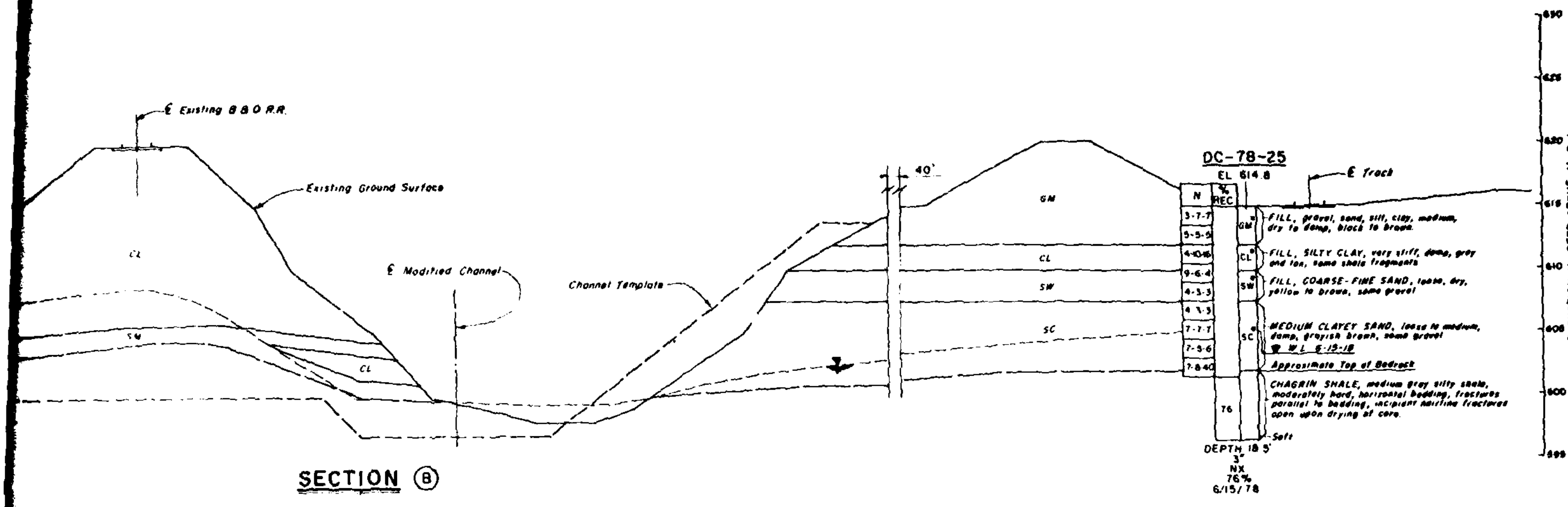
SECTION (B)

HORIZONTAL SCALE 1"=10 VERTICAL SCALE 1"=5



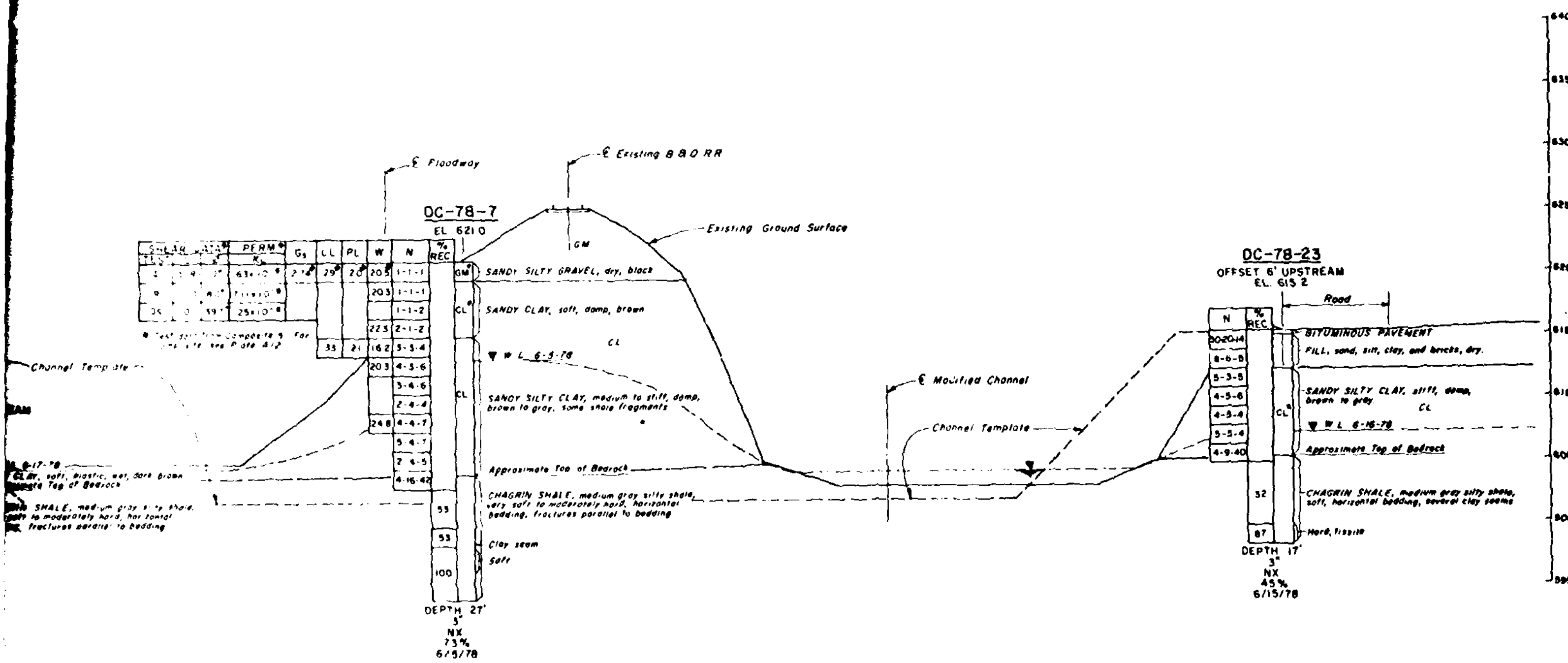
SECTION (C)

HORIZONTAL SCALE 1"=10 VERTICAL SCALE 1"=5'



SECTION Ⓑ

HORIZONTAL SCALE 1"=10' VERTICAL SCALE 1"=5'



GENERAL NOTES:

1. Sections cut on Plan on Plate A1 and on the Profiles on Plates A4 and A5
2. For additional general notes and legend for logs of borings and soil test data, see Plate A7
3. Sections cut looking downstream

SECTION Ⓒ

HORIZONTAL SCALE 1"=10' VERTICAL SCALE 1"=5'

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

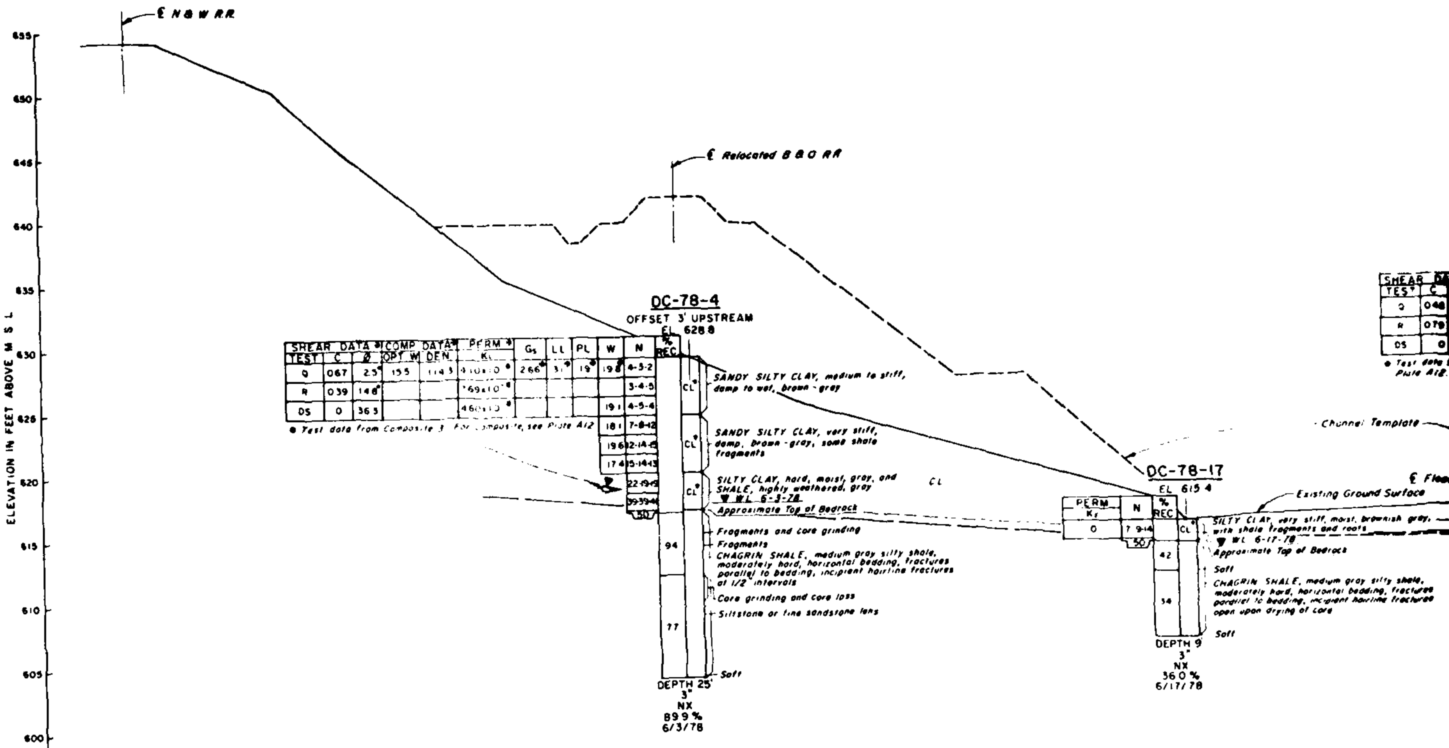
TYPICAL SOIL AND GEOLOGIC SECTIONS
SHEET 2 OF 3

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PA

DRAWING NUMBER

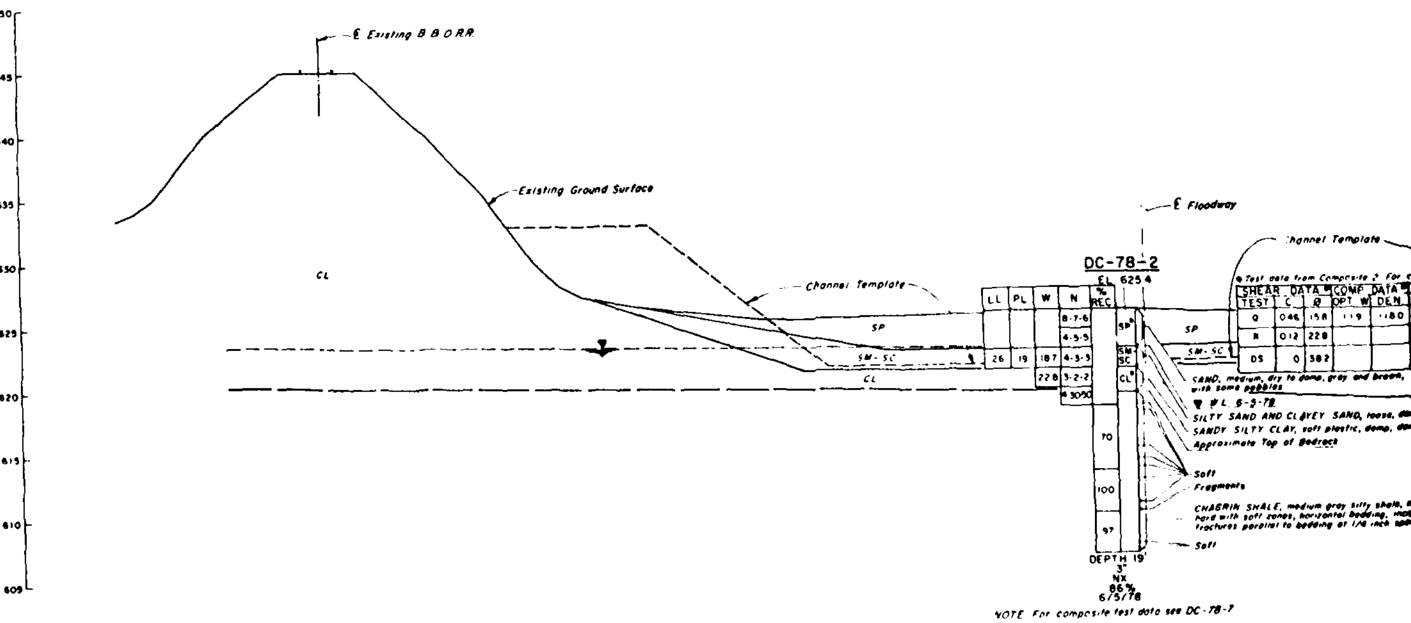
SCALE AS SHOWN | DATE FEB 1979 | SHEET

PLATE A



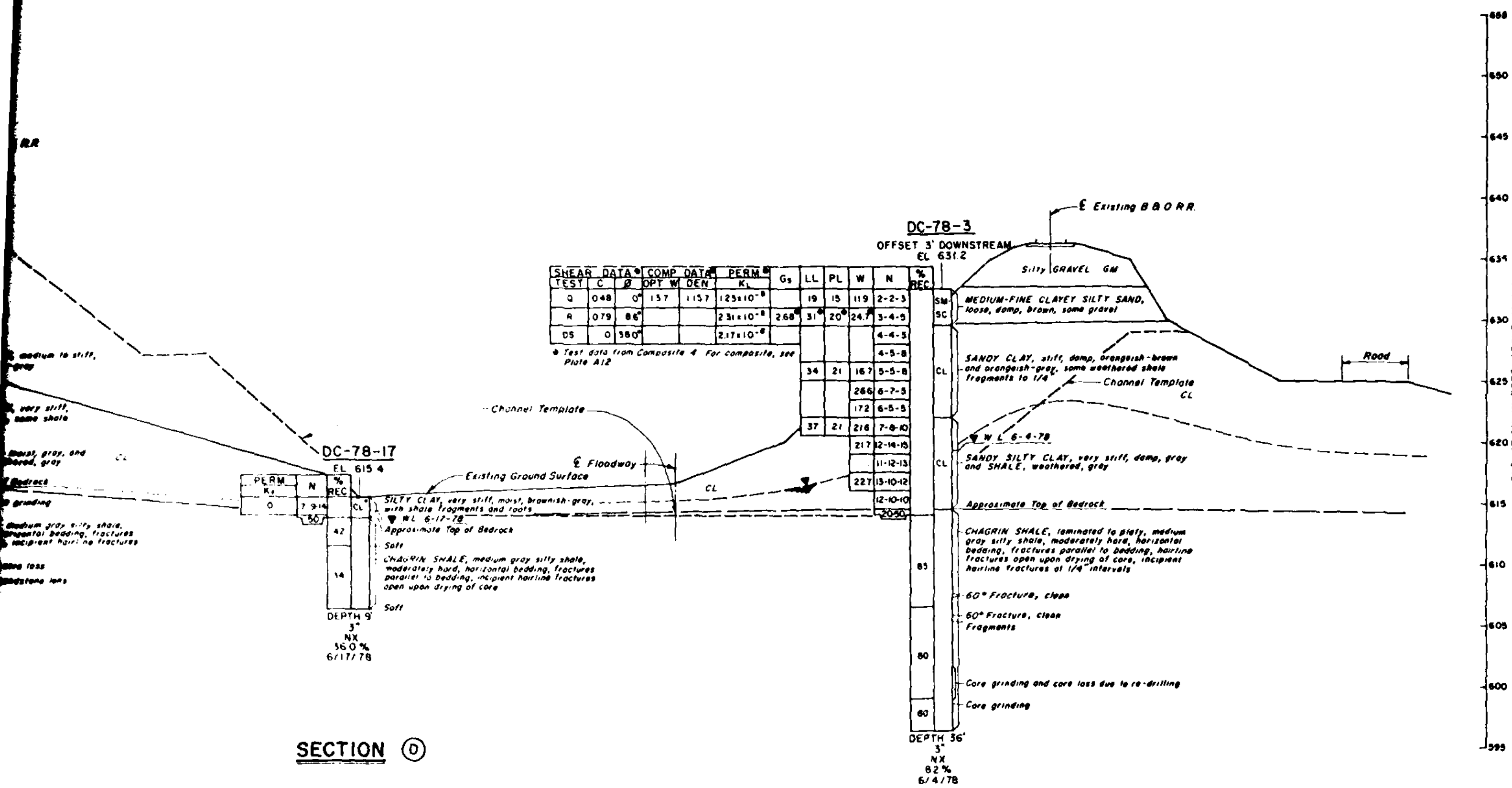
SECTION (D)

HORIZONTAL SCALE 1" = 10'   VERTICAL SCALE 1" = 5'



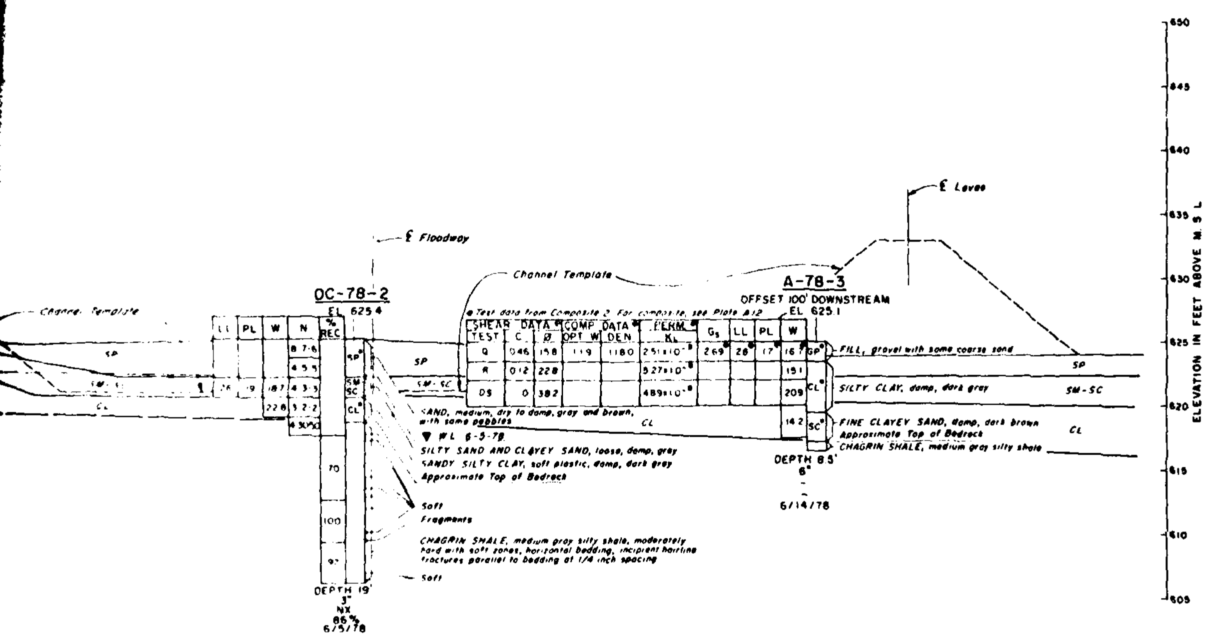
SECTION (E)

HORIZONTAL SCALE 1" = 10'   VERTICAL SCALE 1" = 5'



SECTION (D)

HORIZONTAL SCALE 1" = 10'   VERTICAL SCALE 1" = 5'



SECTION (E)

HORIZONTAL SCALE 1" = 10'   VERTICAL SCALE 1" = 5'

GENERAL NOTES:

1. Sections cut on Plan on Plate A1 and on the Profiles on Plates A4 and A6
2. For additional general notes and legend for logs of borings and soil test data, see Plate A7
3. Sections cut looking downstream

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

TYPICAL SOIL AND GEOLOGIC SECTION
SHEET 3 OF 3

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PA

DRAWING NUMBER

SCALE AS SHOWN | DATE FEB 1979 | SHEET

PLATE

BUFFALO DISTRICT, CORPS OF ENGINEERS
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

BORING NO.	SAMPLE NO.	DEPTH-ELEV. OF SAMPLE (FEET)	LABORATORY CLASSIFICATION	MECHANICAL ANALYSIS GRAVEL %	SAND %	FINES %	D_{10} (mm)	ATTERBERG LIMITS LL	PL	SPECIFIC GRAVITY G	NATURAL WATER CONTENT %
A-78-1	2	1.5-3.0	CL*								21.1
A-78-1	3	3.0-5.0	CL*								24.3
A-78-2	4	5.0-7.0	CL*								18.6
A-78-3	2	1.5-3.0	CL*								15.1
A-78-3	3	3.0-5.0	CL*								20.9
A-78-3	4	5.0-7.5	SC*								14.2
DC-78-1	2	1.5-3.0	GC	37	31	32	0.003	26	17		7.6
DC-78-1	4	4.5-6.0	CL	19	30	51	—	31	20		11.2
DC-78-1	6	7.5-9.0	CL	4	30	66	—	31	20		23.7
DC-78-1	7	9.0-10.5	CL	14	27	59	—	33	20		29.0
DC-78-2	3	3.0-4.5	SM-SC	5	49	46	—	26	19		18.7
DC-78-2	4	4.5-6.0	CL*								22.8
DC-78-3	1	0.0-1.5	SM-SC	14	49	37	0.006	19	15		11.9
DC-78-3	5	6.0-7.5	CL	8	23	69		34	21		16.7
DC-78-3	6	7.5-9.0	CL*								26.6
DC-78-3	7	9.0-10.5	CL*								17.2
DC-78-3	8	10.5-12.0	CL	0	5	95	—	37	21		21.6
DC-78-3	9	12.0-13.5	CL*								21.7
DC-78-3	11	15.0-16.5	SHALE-CL*								22.7
DC-78-4	3	3.0-4.5	CL*								19.1
DC-78-4	4	4.5-6.0	CL*								18.1
DC-78-4	5	6.0-7.5	CL*								19.6
DC-78-4	6	7.5-9.0	CL*								17.4
DC-78-5	3	3.0-4.5	ML-SC*								19.2
DC-78-5	4	4.5-6.0	CL	6	26	68	—	32	21		16.6
DC-78-5	5	6.0-7.5	ML-SHALE*								19.0
DC-78-5	6	7.5-9.0	SHALE*								15.0

DS – Direct Shear
T – Triaxial Compression
UC – Unconfined Compression

S – Consolidated Drained (C-D)
R – Consolidated Undrained (C-U)
Q – Unconsolidated Undrained (U-U)

NP – Nonpla
NOTE: Labo
* Classifi

SOIL TEST DATA SUMMARY

(Soils from Project Site)

SOIL

...RAL ...ER ...ENT %	NATURAL DRY DENSITY LBS./CU.FT.	COMPACTION DATA OPTIMUM WATER %	COMPACTION DATA MAXIMUM DRY DENSITY LBS./CU.FT.	SHEAR DATA INITIAL e	DRY DENSITY LBS./CU.FT.	W_1 %	W_f %	S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_3 TONS/SQ.FT.	σ_1 TONS/SQ.FT.	C TONS/SQ.FT.	Ø DEGREES	PER... e
.1																
.3																
.6																
.1																
.9																
.2																
7.6																
1.2																
3.7																
9.0																
8.7																
2.8																
1.9																
6.7																
6.6																
17.2																
21.6																
21.7																
22.7																
9.1																
18.1																
19.6																
17.4																
19.2																
16.6																
19.0																
15.0																

...nplastic

...Laboratory Classification based on Unified Soil Classification System.

...sification based on visual examination with comparison on tested samples.

2

SHEAR DATA									PERMEABILITY		CONSOLIDATION DATA				REMARKS
W_f %	S_I %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_3	σ_1	C	Ø DEGREES	e	K CM./SEC.	P_o	P_c	C_c	t_{50}	
					TONS/SQ.FT.						TONS/SQ.FT.				

SHEET 1 OF 4

ion System.

amples.

FEB. 1979

BUFFALO DISTRICT, CORPS OF ENGINEERS
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

BORING NO.	SAMPLE NO.	DEPTH-ELEV. OF SAMPLE (FEET)	LABORATORY CLASSIFICATION	MECHANICAL ANALYSIS				ATTERBERG LIMITS		SPECIFIC GRAVITY	NATURAL WATER CONTENT
				GRAVEL %	SAND %	FINES %	D_{10} (mm)	LL	PL	G	%
DC-78-6	2	1.5 - 3.0	CL	9	27	64	–	28	18		17.5
DC-76-6	3	3.0 - 4.5	CL *								20.5
DC-78-6	4	4.5 - 6.0	CL *								20.5
DC-78-6	5	6.0 - 7.5	SC *								16.5
DC-78-6	6	7.5 - 9.0	CL *								14.7
DC-78-6	7	9.0 - 10.5	CL *								13.3
DC-78-7	2	1.5 - 3.0	CL *								20.3
DC-78-7	4	4.5 - 6.0	CL *								22.3
DC-78-7	5	6.0 - 7.5	CL	20	25	55	–	33	21		16.2
DC-78-7	6	7.5 - 9.0	CL *								20.3
DC-78-7	9	12.0 - 13.5	CL *								24.8
DC-78-9	3	3.0 - 4.5	CL *								25.9
DC-78-10	2	4.5 - 6.0	SC	18	39	43	–	31	19		19.3
DC-78-10	3	9.0 - 10.5	CL-ML	2	46	52	–	25	19		18.2
DC-78-11	4	4.5 - 6.0	CL	5	11	84	–	37	23		16.1
DC-78-12	6	7.5 - 9.0	ML	8	26	66	–	44	30		39.0
DC-78-12	7	9.0 - 10.5	GC	50	16	34	0.002	31	20		15.7
D-78-13	2	1.5 - 3.0	SM-SC	11	40	49	–	23	16		17.1
D-76-13	12	16.5 - 18.0	CL-ML	5	31	64	0.005	23	16		31.3
D-78-13	21	30.0 - 31.5	SC	16	44	40	0.005	24	16		27.4
D-78-13	25	36.0 - 37.5	CL	8	37	55	–	32	22		15.4
D-78-13	26	37.5 - 39.0	SC	27	34	39	–	30	19		19.2
DC-78-18	4	4.5 - 6.0	CL *								36.8
DC-78-18	5	6.0 - 7.5	CL *								33.2
D-78-20	3	3.0 - 4.5	SC *								18.3
D-78-20	4	4.5 - 6.0	CL *								25.5
D-78-20	5	6.0 - 7.5	CL	4	30	66	–	30	20		15.7
D-78-20	6	7.5 - 9.0	CL *								24.9
D-78-20	7	9.0 - 10.5	CL *								21.5
D-78-20	8	10.5 - 12.0	CL *								24.0
D-78-20	9	12.0 - 13.5	CL *								23.9
D-78-20	10	13.5 - 15.0	SC	26	46	28	0.003	27	19		8.[illegible]
DC-78-21	2	1.5 - 3.0	CL *								25.[illegible]
DC-78-21	3	3.0 - 4.5	CL *								26.[illegible]
DCU-78-24	ST-1	3.0 - 5.0	GC	35	33	32	–	31	18	2.77	22.[illegible]
U-78-5A	ST-1	2.0 - 4.0	ML	0	27	73	–	41	28	2.64	32.[illegible]
U-78-6A	ST-1	3.0 - 4.0	CL	1	26	73	–	30	19	2.69	21.[illegible]
U-78-20A	ST-1	4.0 - 5.0	CL	6	15	79	–	29	21	2.72	21.[illegible]

DS - Direct Shear
T - Triaxial Compression
UC - Unconfined Compression
q_u - Unconfined Compressive Strength

S - Consolidated Drained (C-D)
R - Consolidated Undrained (C-U)
Q - Unconsolidated Undrained (U-U)

NP - Nonpl
NOTE: Lab
* Classi

PHASE II

SOILS, GEOLO

SOIL TEST DATA SUMMARY

(Soils from Project Site)

URAL RY SITY CU.FT.	COMPACTION DATA: OPTIMUM WATER %	COMPACTION DATA: MAXIMUM DRY DENSITY LBS./CU.FT.	SHEAR DATA: INITIAL e	DRY DENSITY LBS./CU.FT.	W_1 %	W_f %	S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_3 TONS/SQ.FT.	σ_1 TONS/SQ.FT.	C TONS/SQ.FT.	Ø DEGREES	PERMEABILITY: e	K CM./SEC
				85.9	32.4	—	93.5	UC	2.8 x 5.6							
				99.4	21.4	—	83.9	UC	2.8 x 5.6							
				102.6	21.1	—	88.0	UC	2.8 x 5.6							

y Classification based on Unified Soil Classification System.

based on visual examination with comparison on tested samples.

PHASE II GENERAL DESIGN MEMORANDUM
APPENDIX A
SOILS, GEOLOGY AND CONSTRUCTION MATERIALS

	SHEAR DATA									PERMEABILITY		CONSOLIDATION DATA				REMARKS
	W_f %	S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_3 (TONS/SQ.FT.)	σ_1 (TONS/SQ.FT.)	C (TONS/SQ.FT.)	Ø DEGREES	e	K CM./SEC.	P_o (TONS/SQ.FT.)	P_c (TONS/SQ.FT.)	C_c	t_{50}	
4	—	93.5	UC	2.8 x 5.6								.17	1.95	.23		q_u = .28 TSF
4	—	83.9	UC	2.8 x 5.6												q_u = .55 TSF
1	—	88.0	UC	2.8 x 5.6								.28	1.95	.28		q_u = .44 TSF

SHEET 2 OF 4

ion System.

samples.

FEB. 1979

PLATE A10

BUFFALO DISTRICT, CORPS OF ENGINEERS
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

BORING NO.	SAMPLE NO.	DEPTH-ELEV. OF SAMPLE	LABORATORY CLASSIFICATION	MECHANICAL ANALYSIS				ATTERBERG LIMITS		SPECIFIC GRAVITY	NATURAL WATER CONTENT	NA DE LBS
				GRAVEL %	SAND %	FINES %	D_{10} (mm)	LL	PL	G	%	
COMP	(1)		CL	1	16	83	–	32	20	2.72	24.7	
COMP	(2)		CL	3	28	69	–	28	17	2.69	16.7	
COMP	(3)		CL	4	21	75	–	31	19	2.66	19.8	
COMP	(4)		CL	4	18	78	–	31	20	2.68	24.7	
COMP	(5)		CL	4	26	70	–	29	20	2.74	20.5	
COMP	(1)		CL									
COMP	(1)		CL									
COMP	(1)		CL									
COMP	(2)		CL									
COMP	(2)		CL									
COMP	(2)		CL									
COMP	(3)		CL									
COMP	(3)		CL									
COMP	(3)		CL									
COMP	(4)		CL									
COMP	(4)		CL									
COMP	(4)		CL									
COMP	(5)		CL									
COMP	(5)		CL									
COMP	(5)		CL									
COMP	(1)		CL									
COMP	(1)		CL									
COMP	(1)		CL									
COMP	(2)		CL									
COMP	(2)		CL									
COMP	(2)		CL									
COMP	(3)		CL									
COMP	(3)		CL									
COMP	(3)		CL									
COMP	(4)		CL									
COMP	(4)		CL									
COMP	(4)		CL									

DS – Direct Shear
T – Triaxial Compression
UC – Unconfined Compression

S – Consolidated Drained (C-D)
R – Consolidated Undrained (C-U)
Q – Unconsolidated Undrained (U-U)

NP – Nonplasti
NOTE: Laborat
* Classificat

OIL TEST DATA SUMMARY

(Soils from Project Site)

AL	COMPACTION DATA		SHEAR DATA												PERMEABILITY	
Y FT.	OPTIMUM WATER %	MAXIMUM DRY DENSITY LBS./CU.FT.	INITIAL e	DRY DENSITY LBS./CU.FT.	W_i %	W_f %	S_i %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_3 TONS/SQ.FT.	σ_1 TONS/SQ.FT.	C TONS/SQ.FT.	Ø DEGREES	e	K CM./SEC.
	14.9	115.6														
	11.9	118.0														
	15.5	114.3														
	13.7	115.7														
				109.0	18.2	17.3	88.9	T	2.8 x 5.6	Q	1.00	3.149				
				109.2	18.9	17.9	92.7	T	2.8 x 5.6	Q	2.00	4.249	1.10	0°		
				107.8	18.6	17.8	88.1	T	2.8 x 5.6	Q	4.00	6.189				
				114.2	14.5	15.6	83.0	T	2.8 x 5.6	Q	1.00	2.950				
				113.2	15.5	14.3	86.4	T	2.8 x 5.6	Q	2.00	5.662	0.46	15.8°		
				113.5	14.8	14.9	83.1	T	2.8 x 5.6	Q	4.00	8.160				
				101.7	21.7	21.9	91.3	T	2.8 x 5.6	Q	1.00	2.493				
				100.8	22.3	21.3	91.7	T	2.8 x 5.6	Q	2.00	3.712	0.67	2.5°		
				100.3	22.4	21.9	91.0	T	2.8 x 5.6	Q	4.00	5.811				
				100.2	23.0	21.5	92.1	T	2.8 x 5.6	Q	1.00	2.366				
				102.4	21.9	21.9	92.7	T	2.8 x 5.6	Q	2.00	2.949	0.48	0°		
				103.9	21.6	21.4	95.0	T	2.8 x 5.6	Q	4.00	4.858				
				88.9	31.4	34.1	93.2	T	2.8 x 5.6	Q	1.00	1.170				
				86.8	35.2	32.5	99.5	T	2.8 x 5.6	Q	2.00	2.180	0.09	0°		
				87.8	33.0	31.4	95.4	T	2.8 x 5.6	Q	4.00	4.240				
				106.4	18.7	19.8	85.5	T	2.8 x 5.6	R	1.00	3.806				6.09 x 10^{-}
				105.7	18.1	20.6	81.3	T	2.8 x 5.6	R	2.00	5.145	1.19	5.1°		5.68 x 10^{-}
				106.2	18.9	20.4	85.9	T	2.8 x 5.6	R	4.00	7.403				2.97 x 10^{-}
				111.1	16.8	22.9	88.5	T	2.8 x 5.6	R	1.00	2.513				2.51 x 10^{-}
				110.5	16.6	24.4	86.0	T	2.8 x 5.6	R	2.00	4.846	0.12	22.8°		5.27 x 10^{-}
				110.9	16.1	22.7	84.3	T	2.8 x 5.6	R	4.00	9.334				4.89 x 10^{-}
				100.3	21.9	23.8	89.0	T	2.8 x 5.6	R	1.00	2.652				4.10 x 10^{-}
				100.9	20.2	23.7	83.3	T	2.8 x 5.6	R	2.00	4.408	0.39	14.8°		7.69 x 10^{-}
				99.9	21.9	25.3	88.1	T	2.8 x 5.6	R	4.00	7.762				4.60 x 10^{-}
				102.4	20.4	28.2	86.4	T	2.8 x 5.6	R	1.00	3.189				1.23 x 10^{-}
				103.6	19.0	23.7	82.9	T	2.8 x 5.6	R	2.00	4.528	0.79	8.6°		2.31 x 10^{-}
				102.4	20.9	26.0	88.5	T	2.8 x 5.6	R	4.00	7.523				2.17 x 10^{-}

Classification based on Unified Soil Classification System.
sed on visual examination with comparison on tested samples.

NOTE:
FOR COMPOSITE SAMPLE DESCRIPTION, SE

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PHASE II GENERAL DESIGN MEMORANDUM
APPENDIX A
SOILS, GEOLOGY AND CONSTRUCTION MATERIALS

SHEAR DATA										PERMEABILITY		CONSOLIDATION DATA				
W_I %	W_f %	S_I %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_3 TONS/SQ.FT.	σ_1 TONS/SQ.FT.	C TONS/SQ.FT.	Ø DEGREES	e	K CM./SEC.	P_o TONS/SQ.FT.	P_c TONS/SQ.FT.	C_c	t_{50}	REMARKS
												–	1.70	.21		
18.2	17.3	88.9	T	2.8 x 5.6	Q	1.00	3.149									SPECIMEN #1
18.9	17.9	92.7	T	2.8 x 5.6	Q	2.00	4.249	1.10	0°							SPECIMEN #2
18.6	17.8	88.1	T	2.8 x 5.6	Q	4.00	6.189									SPECIMEN #3
14.5	15.6	83.0	T	2.8 x 5.6	Q	1.00	2.950									SPECIMEN #1
15.5	14.3	86.4	T	2.8 x 5.6	Q	2.00	5.662	0.46	15.8°							SPECIMEN #2
14.8	14.9	83.1	T	2.8 x 5.6	Q	4.00	8.160									SPECIMEN #3
21.7	21.9	91.3	T	2.8 x 5.6	Q	1.00	2.493									SPECIMEN #1
22.3	21.3	91.7	T	2.8 x 5.6	Q	2.00	3.712	0.67	2.5°							SPECIMEN #2
22.4	21.9	91.0	T	2.8 x 5.6	Q	4.00	5.811									SPECIMEN #3
23.0	21.5	92.1	T	2.8 x 5.6	Q	1.00	2.366									SPECIMEN #1
21.9	21.9	92.7	T	2.8 x 5.6	Q	2.00	2.949	0.48	0°							SPECIMEN #2
21.6	21.4	95.0	T	2.8 x 5.6	Q	4.00	4.858									SPECIMEN #3
31.4	34.1	93.2	T	2.8 x 5.6	Q	1.00	1.170									SPECIMEN #1
35.2	32.5	99.5	T	2.8 x 5.6	Q	2.00	2.180	0.09	0°							SPECIMEN #2
33.0	31.4	95.4	T	2.8 x 5.6	Q	4.00	4.240									SPECIMEN #3
18.7	19.8	85.5	T	2.8 x 5.6	R	1.00	3.806				6.09×10^{-8}					SPECIMEN #1
18.1	20.6	81.3	T	2.8 x 5.6	R	2.00	5.145	1.19	5.1°		5.68×10^{-8}					SPECIMEN #2
18.9	20.4	85.9	T	2.8 x 5.6	R	4.00	7.403				2.97×10^{-8}					SPECIMEN #3
16.8	22.9	88.5	T	2.8 x 5.6	R	1.00	2.513				2.51×10^{-8}					SPECIMEN #1
16.6	24.4	86.0	T	2.8 x 5.6	R	2.00	4.846	0.12	22.8°		5.27×10^{-8}					SPECIMEN #2
16.1	22.7	84.3	T	2.8 x 5.6	R	4.00	9.334				4.89×10^{-8}					SPECIMEN #3
21.9	23.8	89.0	T	2.8 x 5.6	R	1.00	2.652				4.10×10^{-8}					SPECIMEN #1
20.2	23.7	83.3	T	2.8 x 5.6	R	2.00	4.408	0.39	14.8°		7.69×10^{-8}					SPECIMEN #2
21.9	25.3	88.1	T	2.8 x 5.6	R	4.00	7.762				4.60×10^{-8}					SPECIMEN #3
20.4	28.2	86.4	T	2.8 x 5.6	R	1.00	3.189				1.23×10^{-8}					SPECIMEN #1
19.0	23.7	82.9	T	2.8 x 5.6	R	2.00	4.528	0.79	8.6°		2.31×10^{-8}					SPECIMEN #2
20.9	26.0	88.5	T	2.8 x 5.6	R	4.00	7.523				2.17×10^{-8}					SPECIMEN #3

SHEET 3 OF 4

NOTE:

FOR COMPOSITE SAMPLE DESCRIPTION, SEE PLATE A12.

lication System.
ested samples.

FEB. 1979

PLATE AI

BUFFALO DISTRICT, CORPS OF ENGINEERS
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

BORING NO.	SAMPLE NO.	DEPTH-ELEV. OF SAMPLE (FEET)	LABORATORY CLASSIFICATION	MECHANICAL ANALYSIS GRAVEL %	SAND %	FINES %	D_{10} (mm)	ATTERBERG LIMITS LL	PL	SPECIFIC GRAVITY G	NATURAL WATER CONTENT %	N D LB
COMP	(5)		CL									
COMP	(5)		CL									
COMP	(5)		CL									
COMP	(1)		CL					32	20	2.72		
COMP	(1)		CL					32	20	2.72		
COMP	(1)		CL					32	20	2.72		
COMP	(2)		CL					28	17	2.69		
COMP	(2)		CL					28	17	2.69		
COMP	(2)		CL					28	17	2.69		
COMP	(3)		CL					31	19	2.66		
COMP	(3)		CL					31	19	2.66		
COMP	(3)		CL					31	19	2.66		
COMP	(4)		CL					31	20	2.68		
COMP	(4)		CL					31	20	2.68		
COMP	(4)		CL					31	20	2.68		
COMP	(5)		CL					29	20	2.74		
COMP	(5)		CL					29	20	2.74		
COMP	(5)		CL					29	20	2.74		

DS – Direct Shear
T – Triaxial Compression
UC – Unconfined Compression

S – Consolidated Drained (C-D)
R – Consolidated Undrained (C-U)
Q – Unconsolidated Undrained (U-U)

NP – Nonplast
NOTE: Labora
Classificat

PHASE

SOIL TEST DATA SUMMARY
(Soils from Project Site)

SOILS, GEC

NATURAL DRY DENSITY LBS./CU.FT.	COMPACTION DATA: OPTIMUM WATER %	COMPACTION DATA: MAXIMUM DRY DENSITY LBS./CU.FT.	SHEAR DATA: INITIAL e	DRY DENSITY LBS./CU.FT.	W_i %	W_f %	S_i %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_3 TONS/SQ.FT.	σ_1 TONS/SQ.FT.	C TONS/SQ.FT.	Ø DEGREES	PERMEABIL e	K CM./
				88.0	32.8	34.8	95.3	T	2.8 x 5.6	R	1.00	1.180				1.63
				84.3	37.9	34.6	100	T	2.8 x 5.6	R	2.00	2.634	0.00	8.0°		7.11
				84.9	38.2	40.6	100	T	2.8 x 5.6	R	4.00	5.366				1.25
			0.54	110.1	16.5	20.0	83.2	DS	3.0 x 0.494							
			0.49	113.5	16.5	19.5	90.9	DS	3.0 x 0.494				0	37.8°		
			0.59	106.8	16.5	11.0	76.4	DS	3.0 x 0.494							
			0.51	110.9	15.7	18.8	82.6	DS	3.0 x 0.494							
			0.51	110.9	15.7	18.1	82.6	DS	3.0 x 0.494				0	38.2°		
			0.51	110.9	15.7	17.3	82.6	DS	3.0 x 0.494							
			0.46	113.7	21.9	21.1	100.	DS	3.0 x 0.494							
			0.46	113.7	21.9	20.9	100	DS	3.0 x 0.494				0	36.3°		
			0.46	113.7	21.9	19.9	100	DS	3.0 x 0.494							
			0.46	114.2	21.5	22.0	100	DS	3.0 x 0.494							
			0.46	114.2	21.5	21.7	100	DS	3.0 x 0.494				0	38.0°		
			0.46	114.2	21.8	21.5	100	DS	3.0 x 0.494							
			0.99	86.0	32.0	28.8	89.0	DS	3.0 x 0.494							
			0.99	86.0	32.0	27.2	89.0	DS	3.0 x 0.494				0	39.7°		
			0.99	86.0	32.0	26.9	89.0	DS	3.0 x 0.494							

NOTES:

COMPOSITE (1)- COMPOSITE SAMPLE OF A-78-1 BAGS 2A AND 3A, AND A-78-2 BAG 4A

COMPOSITE (2)- COMPOSITE SAMPLE OF A-78-3 BAGS 2A, 3A, AND 4A

COMPOSITE (3)- COMPOSITE SAMPLE OF DC-78-4 SAMPLES 3, 4, 5, AND 6; DC-78-6 SAMPLES 3, 4, 5, 6, AND

COMPOSITE (4) COMPOSITE SAMPLE OF DC-78-3 SAMPLES 6, 7, 9, AND 11; DC-78-18 SAMPLES 4 AND 5; D-7

COMPOSITE (5) COMPOSITE SAMPLE OF DC-78-2 SAMPLE 4; DC-78-5 SAMPLES 3, 5, AND 6; DC-78-7 SAMP

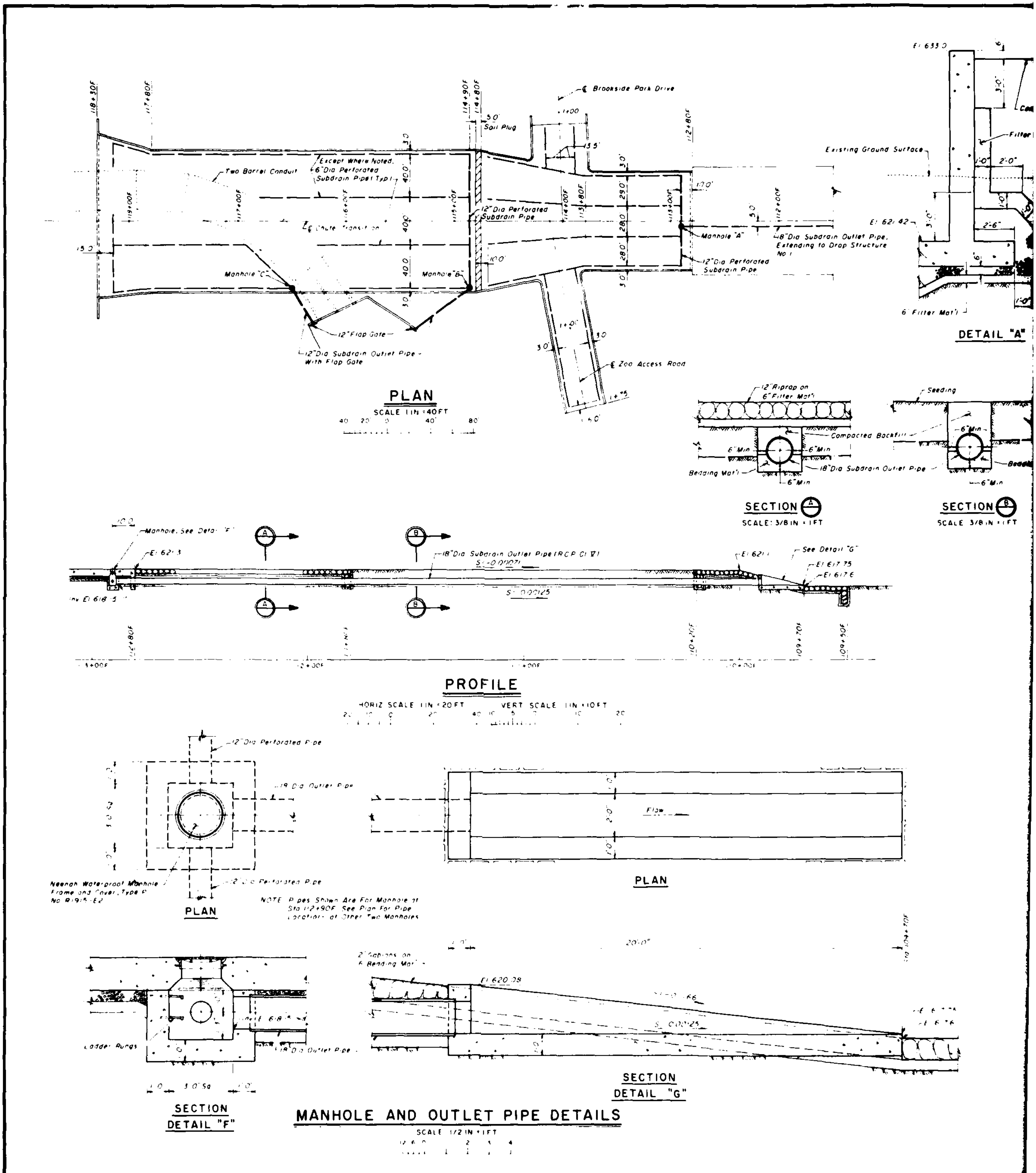
ic

tory Classification based on Unified Soil Classification System.

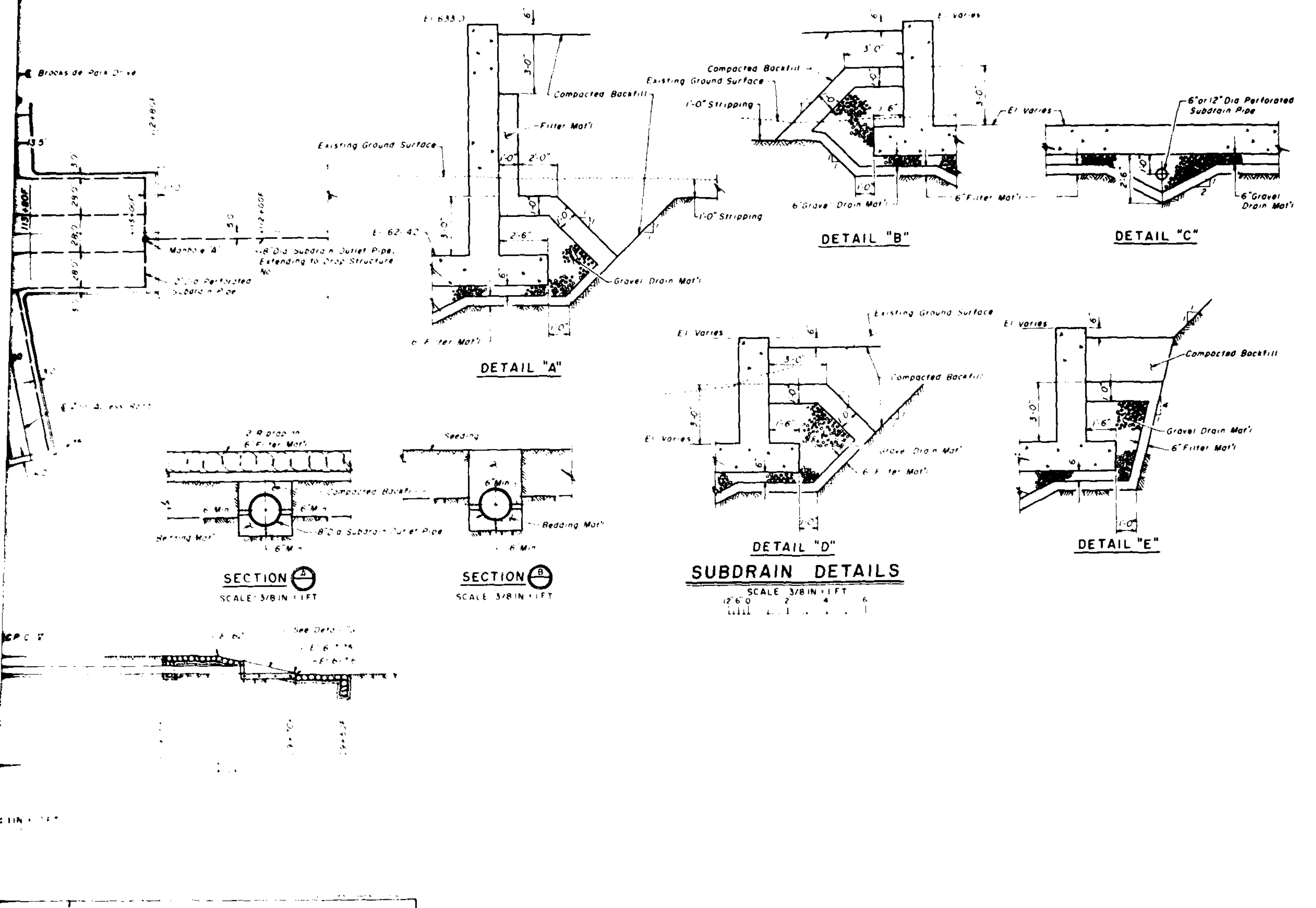
tion based on visual examination with comparison on tested samples.

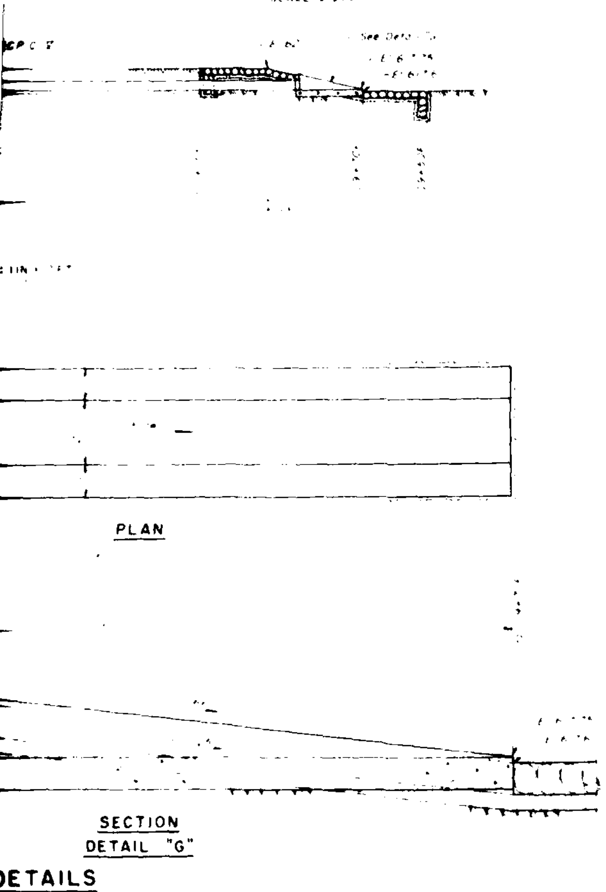
	SHEAR DATA									PERMEABILITY		CONSOLIDATION DATA				
[illegible] %	W_f %	S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_3 TONS/SQ. FT.	σ_1 TONS/SQ. FT.	C TONS/SQ. FT.	Ø DEGREES	e	K CM./SEC.	P_o TONS/SQ. FT.	P_c TONS/SQ. FT.	C_c	t_{50}	REMARKS
2.8	34.8	95.3	T	2.8 x 5.6	R	1.00	1.180				1.63×10^{-8}					SPECIMEN #1
7.9	34.6	100	T	2.8 x 5.6	R	2.00	2.634	0.00	8.0°		7.11×10^{-8}					SPECIMEN #2
.2	40.6	100	T	2.8 x 5.6	R	4.00	5.366				1.25×10^{-8}					SPECIMEN #3
.5	20.0	83.2	DS	3.0 x 0.494												SPECIMEN #1
.5	19.5	90.9	DS	3.0 x 0.494				0	37.8°							SPECIMEN #2
.5	11.0	76.4	DS	3.0 x 0.494												SPECIMEN #3
.7	18.8	82.6	DS	3.0 x 0.494												SPECIMEN #1
.7	18.1	82.6	DS	3.0 x 0.494				0	38.2°							SPECIMEN #2
.7	17.3	82.6	DS	3.0 x 0.494												SPECIMEN #3
.9	21.1	100.	DS	3.0 x 0.494												SPECIMEN #1
.9	20.9	100	DS	3.0 x 0.494				0	36.3°							SPECIMEN #2
.9	19.9	100	DS	3.0 x 0.494												SPECIMEN #3
.5	22.0	100	DS	3.0 x 0.494												SPECIMEN #1
.5	21.7	100	DS	3.0 x 0.494				0	38.0°							SPECIMEN #2
.8	21.5	100	DS	3.0 x 0.494												SPECIMEN #3
2.0	28.8	89.0	DS	3.0 x 0.494												SPECIMEN #1
2.0	27.2	89.0	DS	3.0 x 0.494				0	39.7°							SPECIMEN #2
2.0	26.9	89.0	DS	3.0 x 0.494												SPECIMEN #3

[illegible] A-78-1 BAGS 2A AND 3A, AND A-78-2 BAG 4A
[illegible] A-78-3 BAGS 2A, 3A, AND 4A
[illegible] 78-4 SAMPLES 3, 4, 5, AND 6; DC-78-6 SAMPLES 3, 4, 5, 6, AND 7; DC-78-9 SAMPLE 3; DC-78-21 SAMPLES 2 AND 3
[illegible] SAMPLES 6, 7, 9, AND 11; DC-78-18 SAMPLES 4 AND 5; D-78-20 SAMPLES 3, 4, 6, 7, 8, AND 9
[illegible] SAMPLE 4, DC-78-5 SAMPLES 3, 5, AND 6; DC-78-7 SAMPLES 2, 4, 6, AND 9



Brookside Park Drive
Soil Plug
Two Barrel Conduit
Except Where Noted, 6" Dia Perforated Subdrain Pipe (Typ)
12" Dia Perforated Subdrain Pipe
Manhole "A"
Manhole "B"
Manhole "C"
18" Dia Subdrain Outlet Pipe, Extending to Drop Structure No. 1
12" Dia Perforated Subdrain Pipe
12" Flap Gate
12" Dia Subdrain Outlet Pipe With Flap Gate
Zoo Access Road
PLAN
SCALE 1 IN = 40 FT
Existing Ground Surface
Filter
6" Filter Mat'l
DETAIL "A"
12" Riprap on 6" Filter Mat'l
Compacted Backfill
Bedding Mat'l
18" Dia Subdrain Outlet Pipe
6" Min
Seeding
SECTION A
SCALE: 3/8 IN = 1 FT
SECTION B
SCALE 3/8 IN = 1 FT
Manhole, See Detail "F"
18" Dia Subdrain Outlet Pipe (RCP Cl V)
See Detail "G"
PROFILE
HORIZ SCALE 1 IN = 20 FT
VERT SCALE 1 IN = 10 FT
12" Dia Perforated Pipe
18" Dia Outlet Pipe
Neenah Waterproof Manhole Frame and Cover, Type P No. R-1915-E2
PLAN
NOTE: Pipes Shown Are For Manhole at Sta 112+90F. See Plan For Pipe Locations of Other Two Manholes
Flow
PLAN
2' Gabions on 6" Bedding Mat'l
Ladder Rungs
18" Dia Outlet Pipe
SECTION
DETAIL "F"
SECTION
DETAIL "G"
MANHOLE AND OUTLET PIPE DETAILS
SCALE 1/2 IN = 1 FT





GENERAL NOTES:

1. For Chute-Transition Plan and Profile See Plates 7 and 10
2. Manhole "B" and "C" will be similar to Manhole "A" except pipes dimensions
3. Details "A" thru "E" are related to Plates 11 and 12

REV	DATE	DESCRIPTION

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

CHUTE-TRANSITION
SUBDRAINAGE SYSTEM
PLAN AND DETAILS

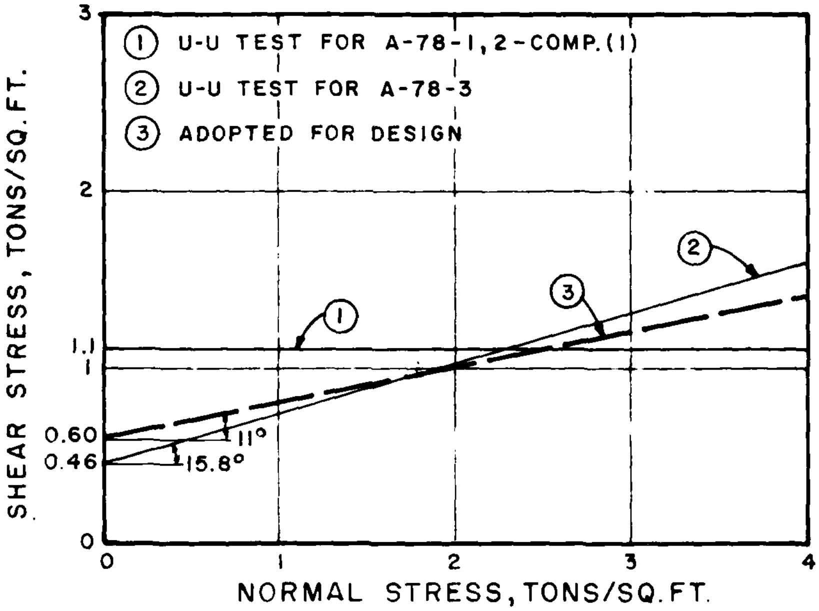
GANNETT FLEMING CORDDRY AND CARPENTER, INC
CONSULTING ENGINEERS

DRAWING NUMBER

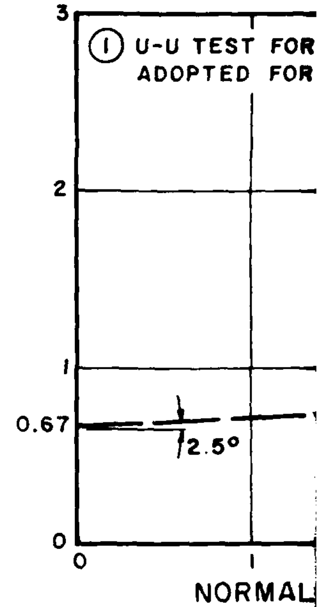
SCALE AS SHOWN | DATE MARCH, 1979 | SHEET

PLATE 12

2



RELOCATED R.R. EMBANKMENT AND LEVEE



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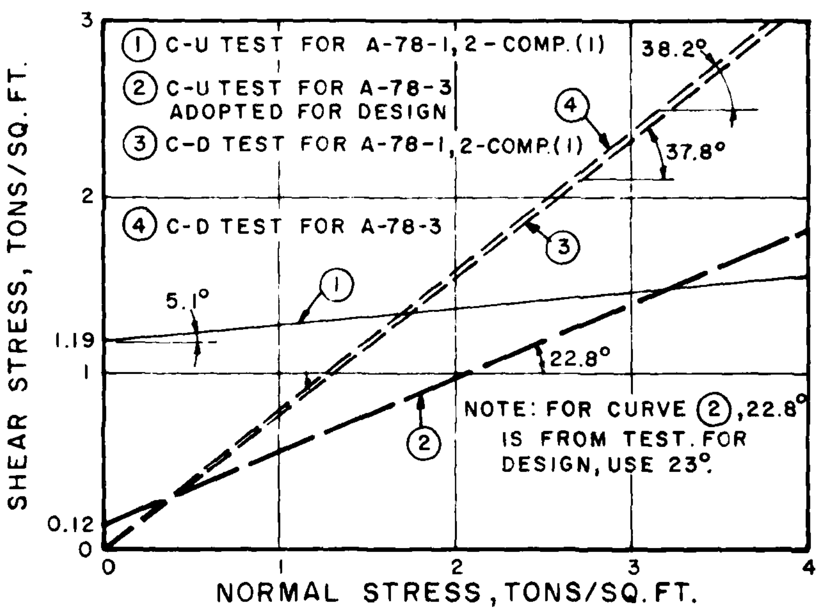
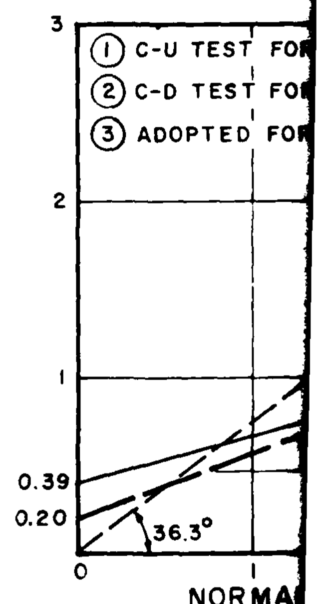


RELOCATED R.R. EMBANKMENT AND LEVEE



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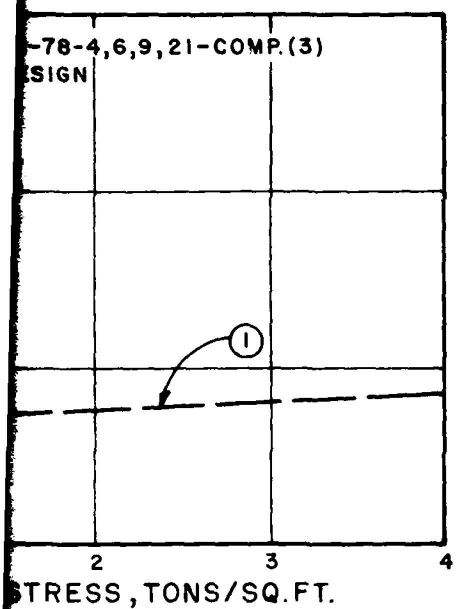
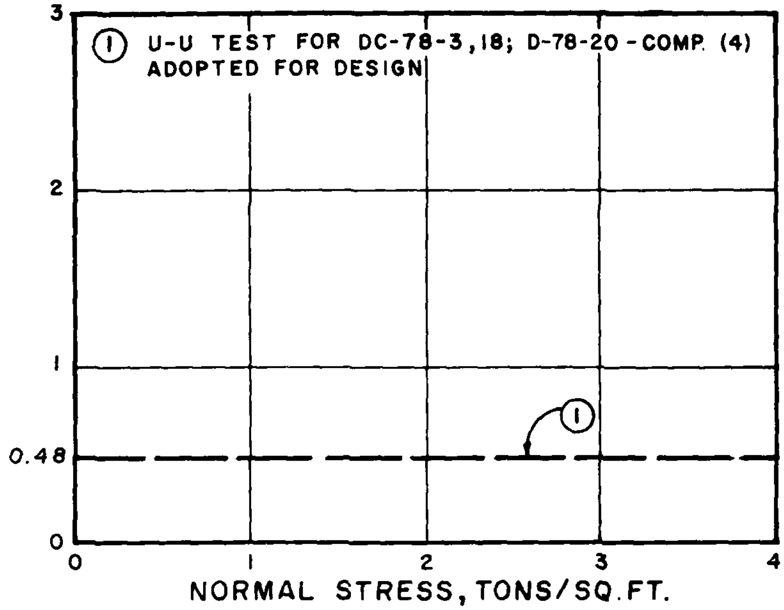
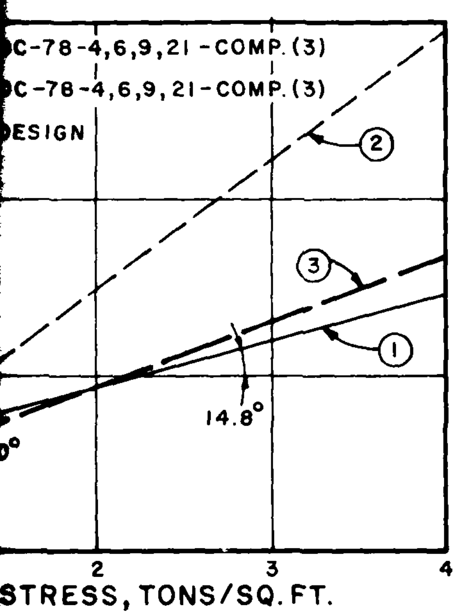


. & W. R.R. EMBANKMENT

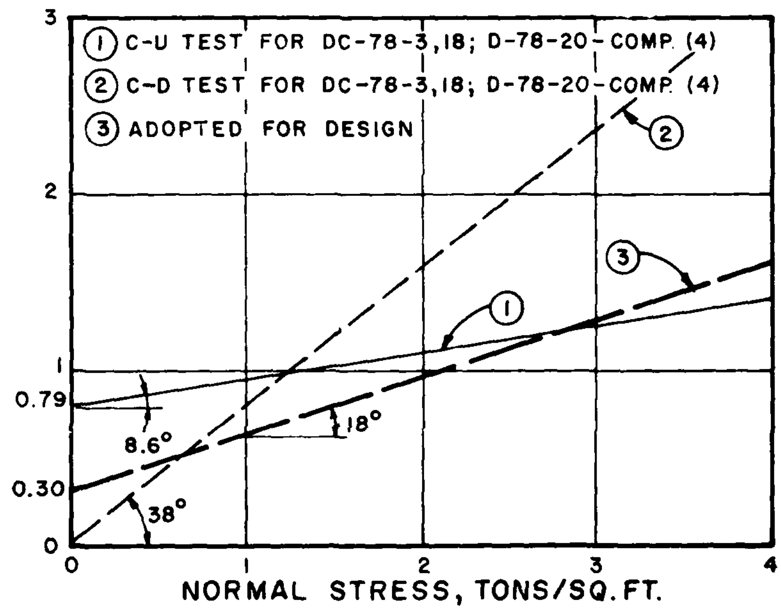


EXISTING B. & O. R.R. EMBANKMENT

CONSTRUCTION CASE

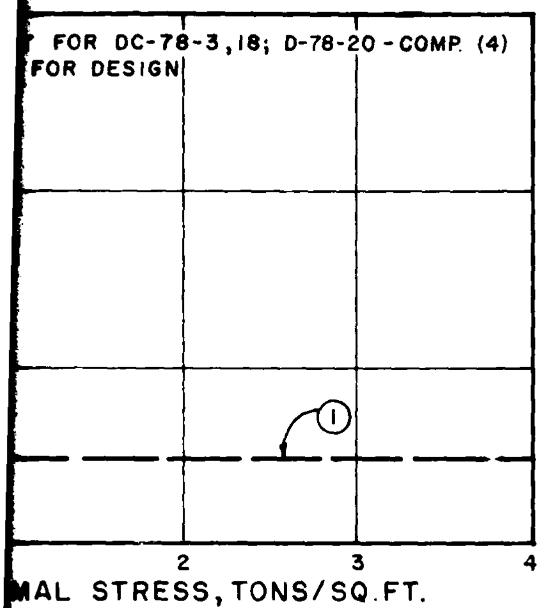


& W. R.R. EMBANKMENT

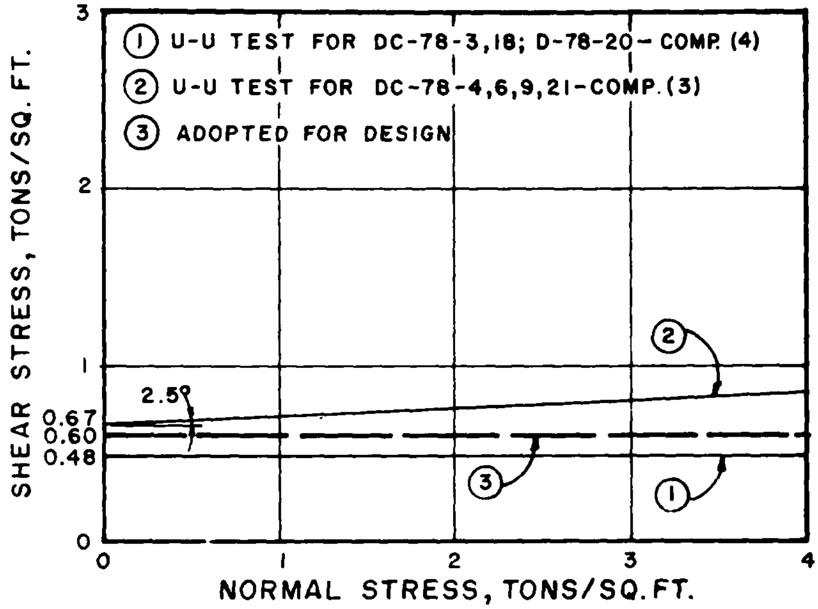


EXISTING B. & O. R.R. EMBANKMENT

SUDDEN DRAWDOWN CASE



IG B. & O. R.R. EMBANKMENT



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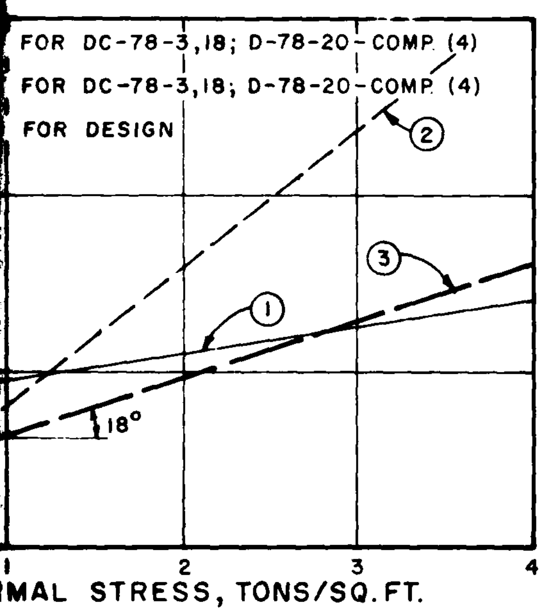
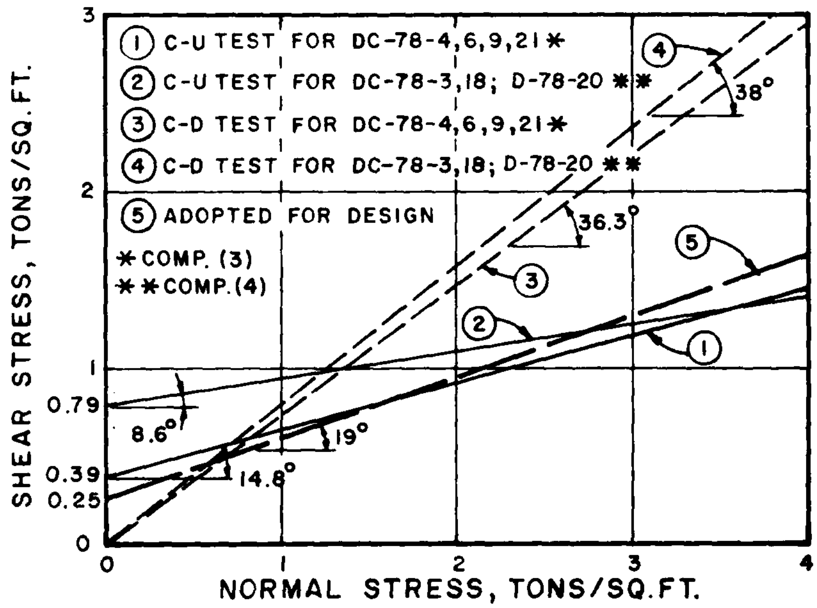


NG B. & O. R.R. EMBANKMENT



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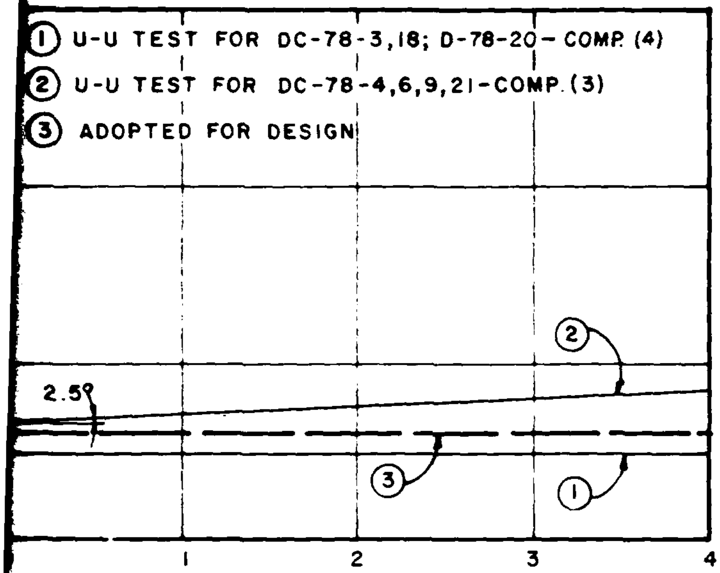
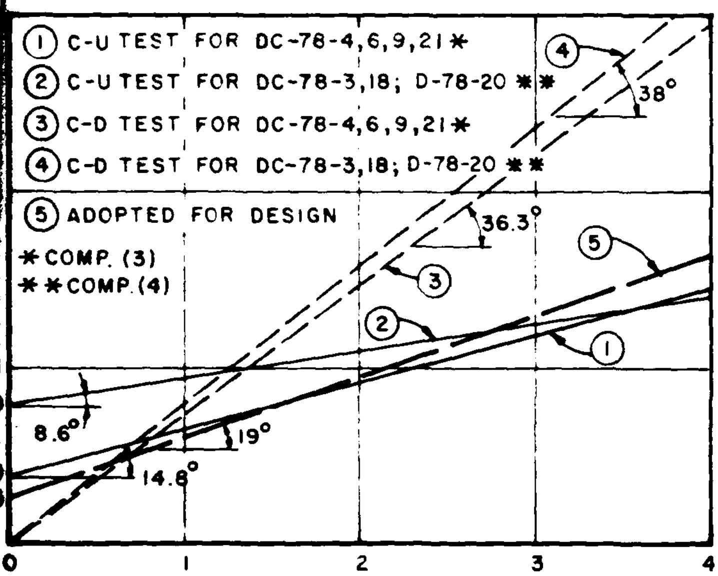


NATURAL FOUNDATION MATERIAL



NATURAL FOUNDATION MATERIAL

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

SOILS, GEOLOGY AND CONSTRUCTION MATERIALS

SHEAR PARAMETERS FOR PROJECT SOILS

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PENNSYLVANIA

FEB. 1979

PLATE NO. A13

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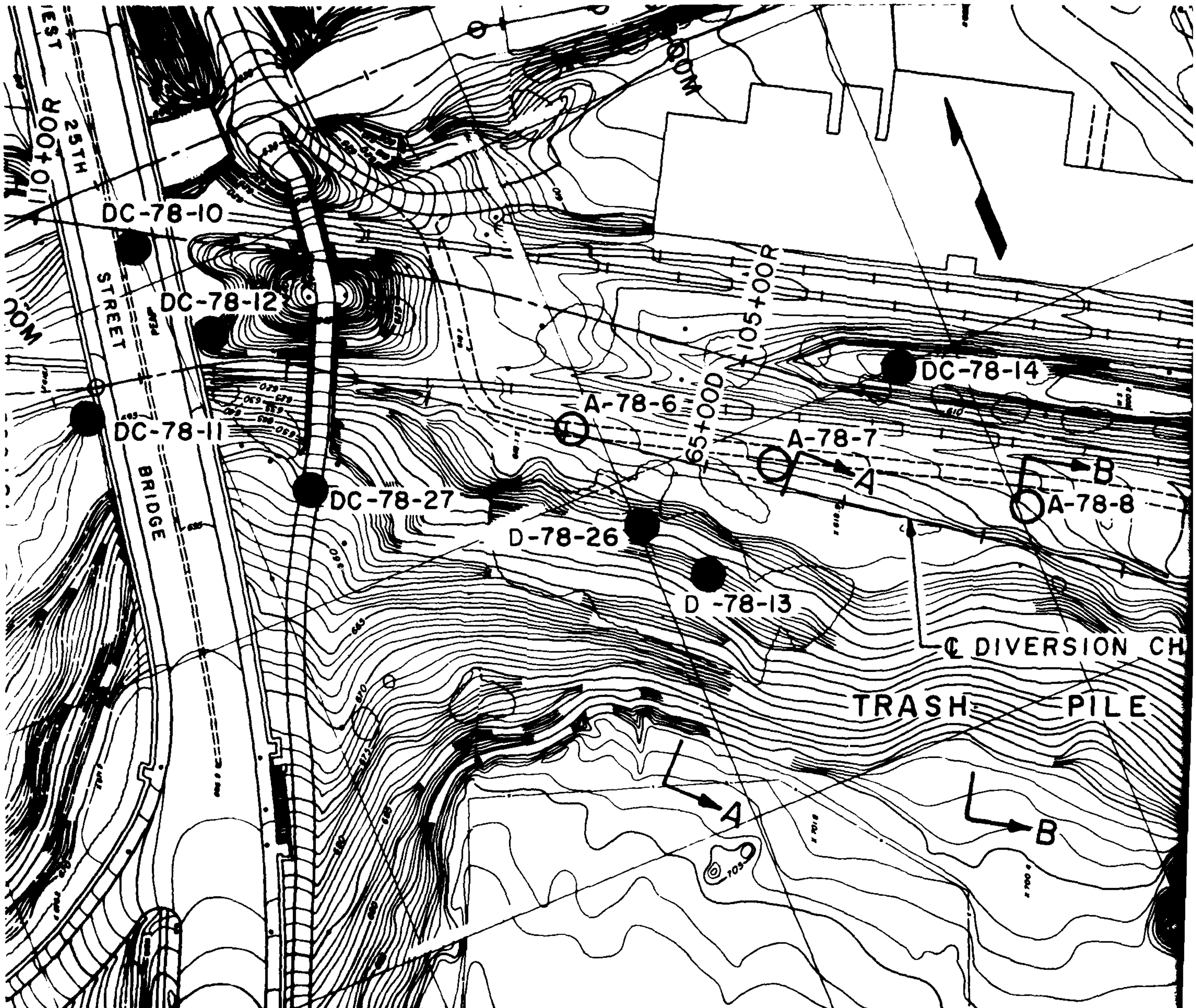
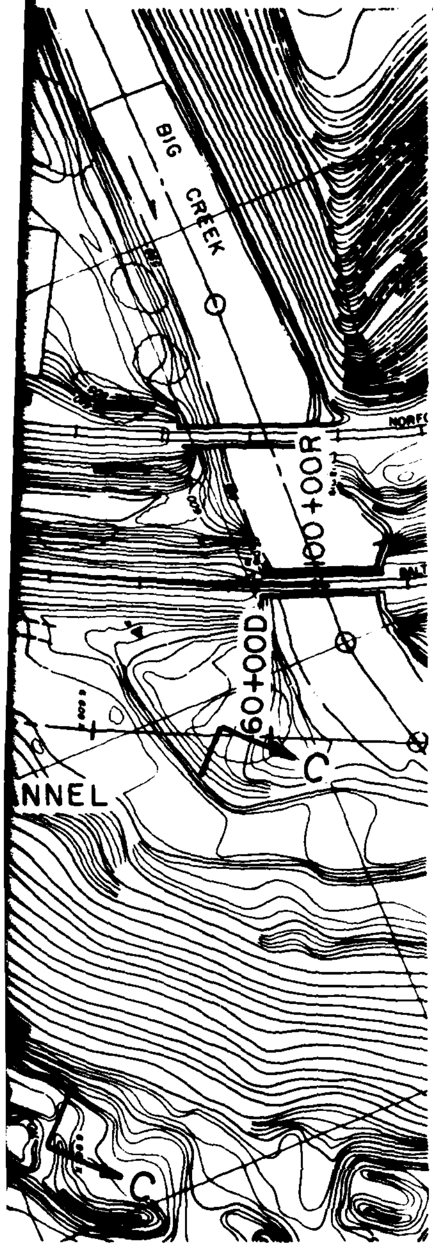
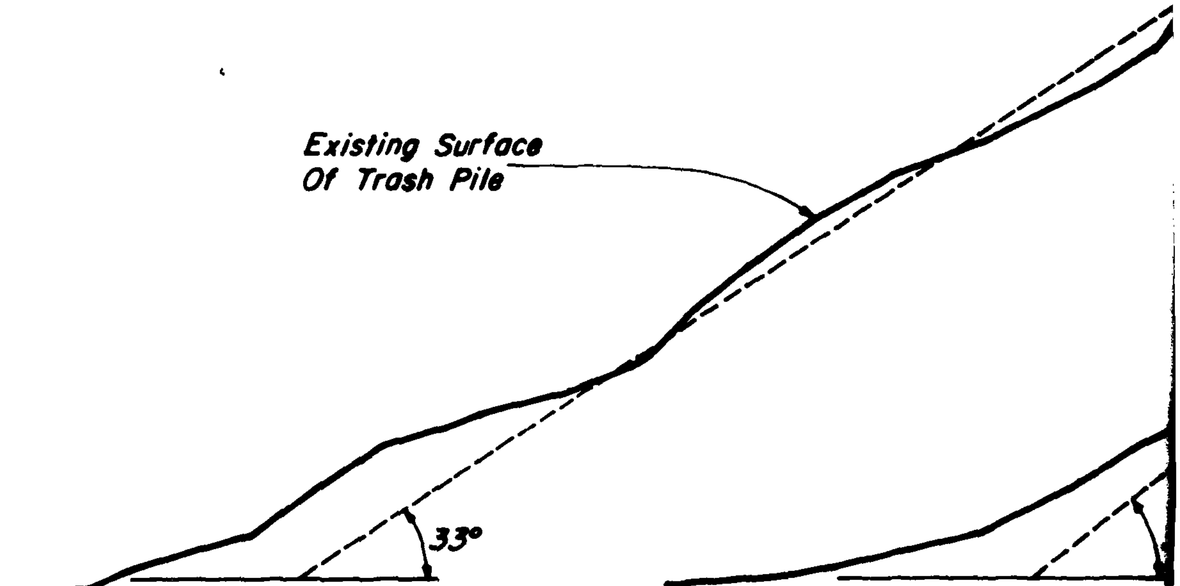
SOILS, GEOLOGY AND CONSTRUCTION MATERIALS



PLAN

SCALE 1 IN. = 100 FT.

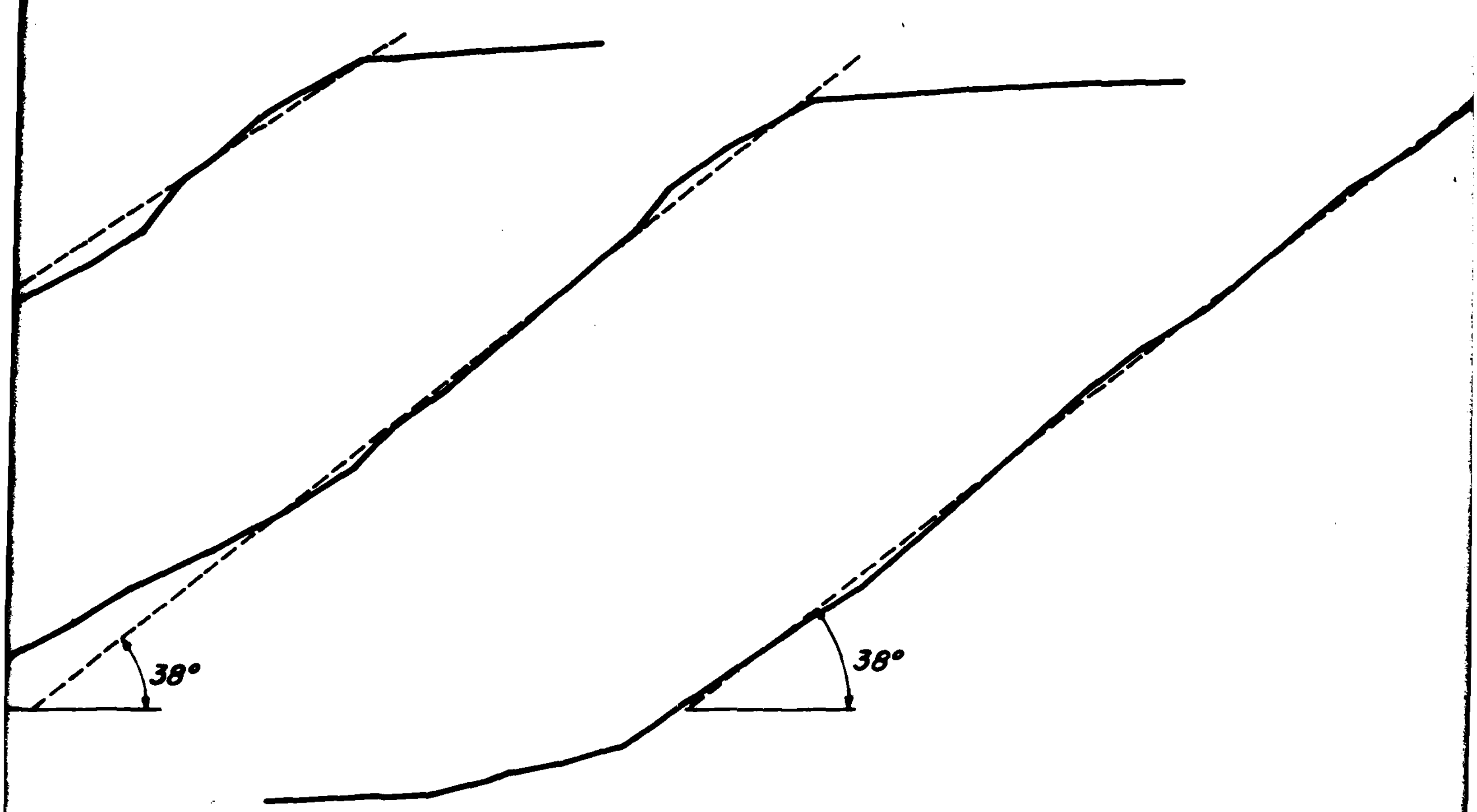




SECTION (A)

SECTION (B)

SECTIONS
SCALE: 1 IN. = 20 FT.



(B)

SECTION (C)

FT.

BIG CREEK FLO
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SOILS, GEOLOGY
MAT

ANGLE
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U. S. ARMY ENGIN
PHASE II GENER

GANNETT FLEMING
AND CARPENT
CONSULTING EN
HARRISBURG, PEN

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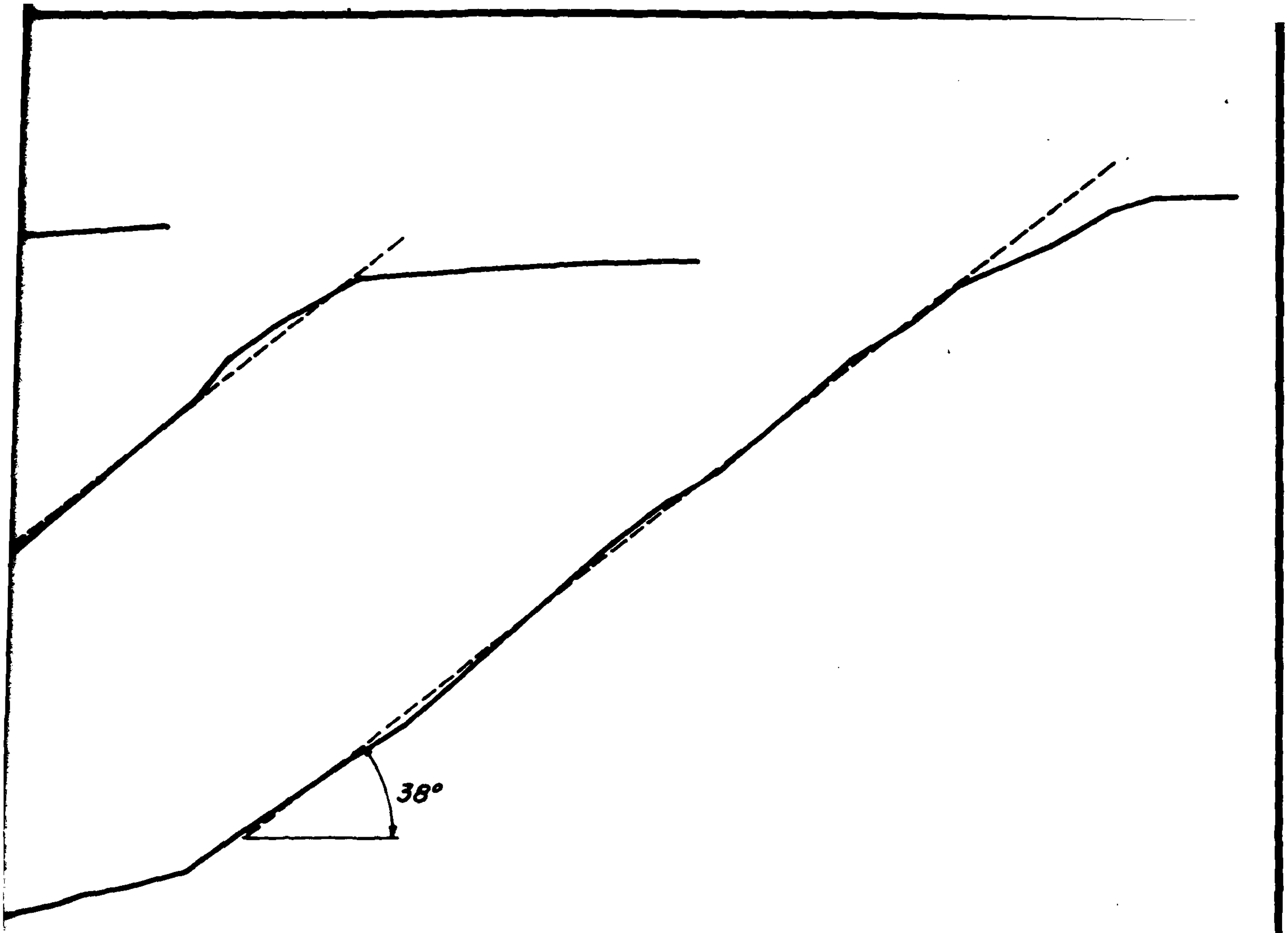


SECTION (C)

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

SOILS, GEOLOGY AND CONSTRUCTION MATERIALS

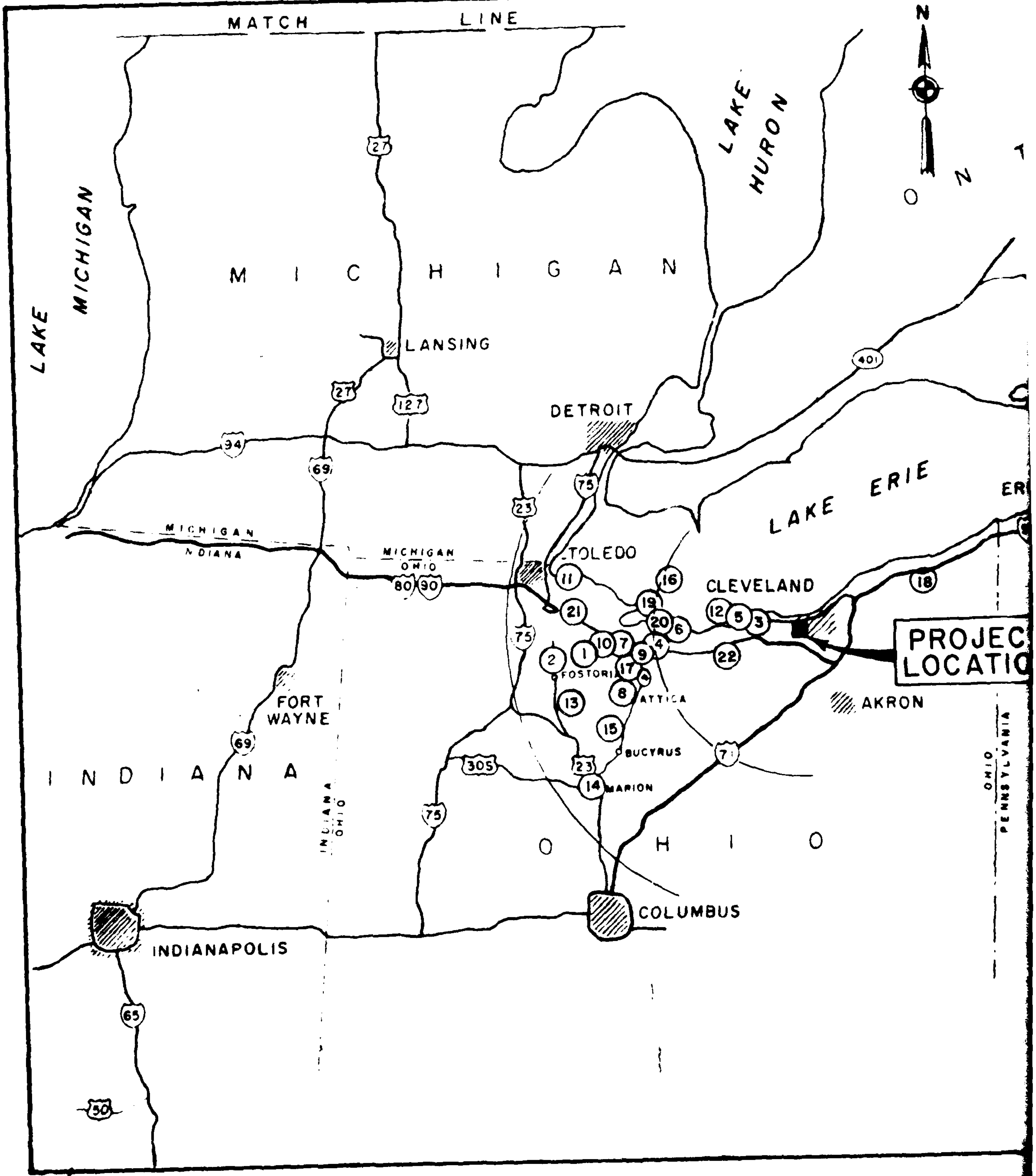
ANGLE OF REPOSE
FOR TRASH PILE

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

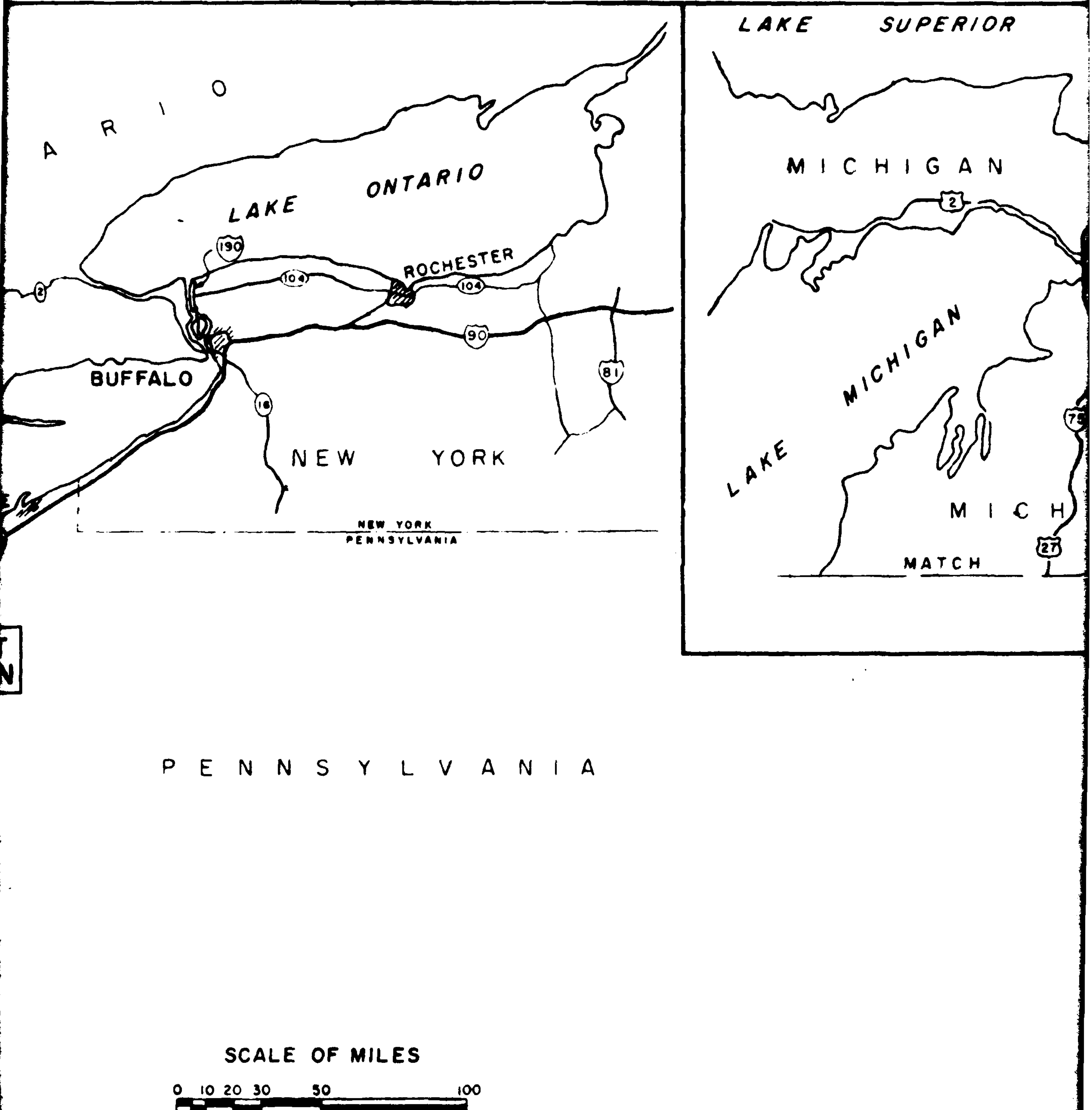
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PENNSYLVANIA

FEB., 1979

PLATE NO. A14



MATCH LINE
N
LAKE MICHIGAN
LAKE HURON
MICHIGAN
LANSING
27
127
69
94
DETROIT
75
23
401
LAKE ERIE
MICHIGAN
INDIANA
MICHIGAN
OHIO
80
90
TOLEDO
CLEVELAND
PROJEC
LOCATIO
FOSTORIA
ATTICA
BUCYRUS
MARION
AKRON
FORT WAYNE
INDIANA
INDIANA
OHIO
305
71
18
OHIO
OHIO
PENNSYLVANIA
COLUMBUS
INDIANAPOLIS
65
50


ARIO
LAKE ONTARIO
190
104
ROCHESTER
104
2
90
BUFFALO
81
16
NEW YORK
NEW YORK
PENNSYLVANIA
PENNSYLVANIA
SCALE OF MILES
0 10 20 30 50 100
LAKE SUPERIOR
MICHIGAN
2
LAKE MICHIGAN
75
MICH
27
MATCH

2

NOTES:

1. NUMBER IN CIRCLE INDICATES QUARRY OR SOIL BORROW SITE.
2. FOR QUARRY NAMES AND PRODUCTS SEE PLATE A

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

LOCATION MAP
POSSIBLE MATERIAL SOURCES

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO
PHASE II, APPENDIX A, DATED: FEBRUARY 1979

AD-A102 431 CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT F/6 13/2
BIG CREEK FLOOD CONTROL PROJECT, CLEVELAND, OHIO. PHASE II. GEN--ETC(U)
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MAP SUPPLEMENT SHEET
SUMMARY OF POSSIBLE SOURCES FOR CONSTRUCTION MATERIALS

SITE NUMBER	SOURCE	QUARRY OR PIT LOCATION	RADIAL DISTANCE	12" RIPRAP	18" RIPRAP	BEDDING MATERIAL	GABION STONE	COARSE AGGREGATE	FINE AGGREGATE	LEVEE EMBANKMENT MATERIAL			
1.	BASIC INDUSTRIES	MAPLE GROVE, OH	76 MI.						X				
2.	BROUGH STONE CO.	WEST MILLGROVE, OH	89 MI.	X	X	X	X	X					
3.	CLEVELAND BUILDERS SUPPLY	CLEVELAND, OH	10 MI.					X	X				
4.	ERIE BLACKTOP	CASTALIA, OH	54 MI.	X	X		X						
5.	ERIE SAND AND GRAVEL	LORAIN, OH	21 MI.						X				
6.	ERIE SAND AND GRAVEL	SANDUSKY, OH	47 MI.						X				
7.	FRANCE STONE CO.	BELLEVUE, OH	57 MI.	X	X	X	X						
8.	FRANCE STONE CO.	BLOOMVILLE, OH	67 MI.	X	X	X	X						
9.	FRANCE STONE CO.	FLATROCK, OH	57 MI.	X	X	X	X						
10.	GOTTRON BROS.	FREMONT, OH	70 MI.				X	X					
11.	E. KRAEMER AND SON INC.	CLAY CENTER, OH	82 MI.	X	X	X	X	X					
12.	MENTOR CARTAGE CO.	LORAIN,OH	21 MI.						X				
13.	NATIONAL LIME AND STONE	CAREY, OH	88 MI.	X	X	X	X						
14.	NATIONAL LIME AND STONE	MARION, OH	89 MI.	X	X	X	X						
15.	NATIONAL LIME AND STONE	SPORE, OH	75 MI.	X	X	X	X						
16.	QUALITY QUARRIES, INC.	KELLEYS ISLAND, OH	50 MI.	X	X								
17.	SANDUSKY CRUSHED STONE	PARKERTOWN, OH	52 MI.	X	X	X	X	X					
18.	R.W. SIDLEY	THOMPSON, OH	45 MI.						X				
19.	STANDARD SLAG CO.	MARBLEHEAD, OH	49 MI.	X	X	X	X	X					

19.	STANDARD SLAG CO.	MARBLEHEAD, OH	40 MI.	X	X	X	X	X					
20.	WAGNER QUARRIES	SANDUSKY, OH	54 MI.					X					
21..	WOODVILLE LIME AND CHEMICAL	WOODVILLE, OH	81 MI.	X	X	X	X	X	X				
22.	METRO PARK BORROW AREA I	BEREA, OH	13 MI.							X			

NOTES:

12" RIPRAP 5-85 POUNDS

18" RIPRAP 15-275 POUNDS

BEDDING MATERIAL FOR RIPRAP #200-3 IN.

GABION STONE 4"-12"

COARSE AGGREGATE FOR CONCRETE #200-1 1/2"

FINE AGGREGATE FOR CONCRETE #200- 3/8"

X - INDICATES QUARRY IS CAPABLE OF PRODUCING THAT MATERIAL.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

MATERIAL SURVEY
SUMMARY OF SOURCES

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO
PHASE II, APPENDIX A, DATED FEBRUARY 197

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE
BROUGH STONE CO. QUARRY AT WEST MILGROVE, OHIO OFFICE AT TOLEDO, OHIO	NIAGARAN DOLOMITE	12 AND 18 INCH RIPRAP BEDDING, GABION AND C.A.	89 MI.
ERIE BLACKTOP (FORMERLY BUCKEYE STONE CORP) QUARRY AT CASTALIA, OH OFFICE AT CASTALIA, OH	COLUMBUS LIMESTONE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	54 MI.
FRANCE STONE CO. QUARRY AT BELLEVUE, OH OFFICE AT TOLEDO, OH	COLUMBUS LIMESTONE LUCAS DOLOMITE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	57 MI.
FRANCE STONE CO. QUARRY AT BLOOMVILLE, OH OFFICE AT TOLEDO, OH	COLUMBUS LIMESTONE	12 AND 18 INCH RIPRAP BEDDING AND GABION	67 MI.
FRANCE STONE CO. (FORMERLY NORTHERN OHIO STONE CO.) QUARRY AT FLAT ROCK, OH OFFICE AT TOLEDO, OH	LUCAS DOLOMITE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	57 MI.
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	
ED KRAEMER & SONS, INC. (WHITE ROLK QUARRY) QUARRY AT CLAY CENTER, OH OFFICE AT CLAY CENTER, OH	NIAGARAN DOLOMITE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	82 MI.

LABORATORY TEST RECORD			
DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	DATE USED
NOVEMBER 1972	ORD LAB LAB #103/73.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (LORAIN DIKE)(ARMOR STONE)	UNKNOWN
AUGUST 1976	ORD LAB LAB #101/76T.307B	CONFINED DREDGE SPOIL DISPOSAL AREA AT LORAIN (CONCRETE AGGRE-GATE)	UNKNOWN
FEBRUARY 1977	ORD LAB LAB #103/765.606B	CONFINED DREDGE SPOIL DISPOSAL AREA AT LORAIN, OH. ARMOR AND UNDERLAYER STONE	1977
NOVEMBER 1970	ORD LAB LAB #101/71.320C	FREMONT OH FLOOD CONTROL PROJECT (SANDUSKY RIVER)	UNKNOWN
JANUARY 1977	ORD LAB LAB #103/77.601B	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (LORAIN DIKE)(UNDERLAYER STONE)	1977
MARCH 1972	ORD LAB LAB #103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PRO-GRAM (COARSE AGGREGATE FOR CONCRETE AND RIPRAP)	UNKNOWN
JANUARY 1977	ORD LAB LAB #103/77.601B	CONFINED DREDGE SPOIL DISPOSAL PRO-GRAM (LORAIN)(ARMOR STONE)	UNKNOWN
NOVEMBER 1972	ORD LAB LAB #103/73.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM	UNKNOWN
MARCH 1972	ORD LAB LAB #103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PRO-GRAM (CELL FILL, CONCRETE AGGRE-GATES-COARSE AND RIPRAP)	UNKNOWN
JUNE 1977	ORD LAB LAB #103/76T.608B	CONFINED DREDGE SPOIL DISPOSAL PRO-GRAM (ARMOR, UNDERLAYER, CELL FILL & CORE STONE) CLEVELAND DIKE, 14	UNKNOWN
MARCH 1972	ORD LAB LAB #103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PRO-GRAM (RIPRAP, CA & FA FOR CONCRETE, AND CELL FILL)	UNKNOWN
OCTOBER 1977	ORD LAB LAB #103/77.628B	CONFINED DIKED DISPOSAL AREA, LORAIN DIKE AND LAKEVIEW PARK, LORAIN, OH	1977

	SERVICE RECORD		
D	PROJECT	EVALUATION	R
	UNKNOWN	UNKNOWN	UNIT WEIGHT VARIES FROM 158 P. AVAILABLE SEVERAL MILES AWAY F
	UNKNOWN	UNKNOWN	EXCESS AMOUNT (14.8%) OF MINUS AGGREGATE. WILL REQUIRE WASH
	LORAIN DIKED DISPOSAL AREA	UNKNOWN	GENERALLY BLASTED FOR CRUSHED VERY LARGE STONE. SSD VARIES
	UNKNOWN	UNKNOWN	SSD FOR BEDDING IS 2.71. LEDG
	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (LORAIN DIKE) USED FOR UNDERLAYER (70#-150#) & ARMOR STONE (500-1100#)	TOO EARLY TO EVALUATE	SSD FOR FIVE UNITS VARIES FRO LEDGE ROCK IS EXTREMELY SLABB
	UNKNOWN	UNKNOWN	SPECIFIC GRAVITY FOR CONCRETE MATERIALS VARY FROM 154 TO 16 (138.5 P.C.F.) AND NOT ACCEPT AVAILABLE.
	UNKNOWN	UNKNOWN	RETESTED-UNIT WEIGHT VARIES F QUARRYING REQUIRED. L2-B3,L2- SUITABLE FOR USE.
	UNKNOWN	UNKNOWN	UNIT WEIGHT FOR LIFT THREE VA LIFT TESTED. RETESTING REQUI
	UNKNOWN	UNKNOWN	UNIT WEIGHT VARIES FROM 153. AVAILABLE.
	UNKNOWN	UNKNOWN	SELECTIVE QUARRYING AND LOAD OTHER HORIZONS. SPECIFIC GR 2.58
	UNKNOWN	UNKNOWN	SSD FOR LEDGE ROCK VARIES FROM 2.68 TO 2.72
	CONFINED DIKED DISPOSAL AREA, LORAIN DIKE AND LAKEVIEW PARK, OH	UNKNOWN	ONLY MIDDLE BENCH TESTED. REEF ROCK NOT ACCEPTABLE. ONLY EAST-FACE OF MIDDLE BENCH ACCEPTABLE. SSD IS 2.59.

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REMARKS
UNIT WEIGHT VARIES FROM 158 P.C.F. TO 165 P.C.F. RAIL FACILITIES AVAILABLE SEVERAL MILES AWAY FROM QUARRY.
EXCESS AMOUNT (14.8%) OF MINUS #200 MATERIAL WAS RECORDED IN FINE AGGREGATE. WILL REQUIRE WASHING.
GENERALLY BLASTED FOR CRUSHED MATERIALS. INPLACE MATERIAL SUITABLE FOR VERY LARGE STONE. SSD VARIES FROM 2.47 TO 2.70.
SSD FOR BEDDING IS 2.71. LEDGE ROCK SSD IS 2.69
SSD FOR FIVE UNITS VARIES FROM 2.68 TO 2.72. UNIT EB-5 NOT ACCEPTABLE. LEDGE ROCK IS EXTREMELY SLABBY.
SPECIFIC GRAVITY FOR CONCRETE AGGREGATE IS 2.58. UNIT WEIGHT FOR RIPRAP MATERIALS VARY FROM 154 TO 161 P.C.F. LEDGE NO. 5 HAS A VERY LOW UNIT (138.5 P.C.F.) AND NOT ACCEPTABLE FOR THIS PROJECT. RAIL FACILITIES AVAILABLE.
RETESTED-UNIT WEIGHT VARIES FROM 149.8 TO 170.4 P.C.F. SELECTIVE QUARRYING REQUIRED. L2-B3, L2-B6, L2-B7, L2-B8, L2-B10 AND L2-B11 ARE UNSUITABLE FOR USE.
UNIT WEIGHT FOR LIFT THREE VARIES FROM 156 TO 163 P.C.F. THIS IS ONLY LIFT TESTED. RETESTING REQUIRED PRIOR TO USE FOR ANY PRODUCT.
UNIT WEIGHT VARIES FROM 153.5 TO 171 P.C.F. RAIL FACILITIES NOT AVAILABLE.
SELECTIVE QUARRYING AND LOADING IS REQUIRED TO REMOVE CHERT BANDS AND OTHER HORIZONS. SPECIFIC GRAVITY FOR TWO LIFTS VARIES FROM 2.46 TO 2.58
SSD FOR LEDGE ROCK VARIES FROM 2.68 TO 2.72
ONLY MIDDLE BENCH TESTED. REEF ROCK NOT ACCEPTABLE. ONLY EAST-FACE OF MIDDLE BENCH ACCEPTABLE. SSD IS 2.59.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

POSSIBLE SOURCES
RIPRAP, BEDDING, GABION STONE

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO
PHASE II, APPENDIX A, DATED: FEBRUARY 1979 4

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE
NATIONAL LIME AND STONE CO. QUARRY AT CAREY, OH OFFICE AT FINDLAY, OH	MONROE DOLOMITE NIAGARAN DOLOMITE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	88 MI.
NATIONAL LIME AND STONE CO. QUARRY AT MARION, OH OFFICE AT FINDLAY, OH	DELAWARE DOLOMITE COLUMBUS LIMESTONE	12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE	89 MI.
NATIONAL LIME AND STONE CO. QUARRY AT SPORE (BUCYRUS), OH OFFICE AT FINDLAY, OH	DELAWARE DOLOMITE COLUMBUS LIMESTONE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	75 MI.
QUALITY QUARRIES QUARRY AT KELLEYS ISLAND, OHIO	AMHERSTBURG AND LUCAS DOLOMITE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	50 MI.
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	
SANDUSKY CRUSHED STONE CO. QUARRY AT PARKERTOWN, OH OFFICE AT PARKERTOWN, OH	DELAWARE DOLOMITE COLUMBUS LIMESTONE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	52 MI.
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	

AL NCE	LABORATORY TEST RECORD			
	DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	DATE USED
MI.	NOVEMBER 1972	ORD LAB LAB #103/73.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (RIPRAP, ARMOR, CORESTONE, ETC.)	UNKNOWN
MI.	NOVEMBER 1972	ORD LAB LAB #103/73.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (RIPRAP, ARMOR, CORESTONE, ETC.)	UNKNOWN
MI.	NOVEMBER 1972	ORD LAB LAB #103/73.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (RIPRAP, ARMOR STONE, CORE STONE, ETC.)	UNKNOWN
MI.	JULY 1976	ORD LAB LAB #103/76T.603B	CONFINED DREDGE SPOIL DISPOSAL PROGRAM DIKE 14 (ARMOR STONE)	1976
	DECEMBER 1977	ORD LAB LAB #103/78.601B	CONFINED DREDGE SPOIL DISPOSAL PROGRAM DIKE 4 (ARMOR STONE)	1977
	NOVEMBER 1978	ORD LAB LAB #103/78.631B	CONFINED DREDGE SPOIL DISPOSAL PROGRAM DIKE 14 (ARMOR STONE)	1978
MI.	MARCH 1972	ORD LAB LAB #103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (FINE & COARSE AGGREGATES FOR CONCRETE, CELL FILL & RIPRAP).	1973-1974
	DECEMBER 1974	ORD LAB LAB #103/75.617B	CONFINED DREDGE SPOIL DISPOSAL DIKE AT HURON, OH	1974-1975
	FEBRUARY 1977	ORD LAB LAB #101/77.310B	CONFINED DREDGE SPOIL DISPOSAL DIKE AT LORAIN (CONCRETE AGGREGATE)	UNKNOWN

SERVICE RECORD			RE	
	PROJECT	EVALUATION		
	UNKNOWN	UNKNOWN	ONLY NIAGARAN DOLOMITE TESTED. ING REQUIRED PRIOR TO APPROVAL	
	UNKNOWN	UNKNOWN	ONLY THE THIRD LIFT SAMPLED AN TIES AVAILABLE. UNIT WEIGHT VA RETESTING REQUIRED PRIOR TO AP	
	UNKNOWN	UNKNOWN	RAIL FACILITIES AVAILABLE. ONLY LAWARE DOLOMITE IS TOO THIN BE FROM 2.62 TO 2.64. RETESTING R	
	CDSD DIKE 14, CLEVELAND OH	TOO EARLY TO EVALUATE		
	CDSD DIKE 14, CLEVELAND OH	TOO EARLY TO EVALUATE		
	CDSD DIKE 14, CLEVELAND OH	TOO EARLY TO EVALUATE	ONLY LIFT 1 AND LIFT 1A MEET ACCEPTABLE.	
	SANDUSKY RIVER LOCAL FLOOD PROTECTION PROJECT, FREMONT, OH (RIPRAP)	UNKNOWN	ONLY MATERIALS FROM LIFTS 3 AND 5 ACCEPTABLE FOR USE.	BIG
	CDDS, HURON DIKE OH CELL FILL	UNKNOWN	SSD FOR AGGREGATE IS 2.56.	RIP
	UNKNOWN	UNKNOWN	SSD FOR AGGREGATE IS 2.65. QUARRY HAS GRIZLY FOR RIPRAP PROD.	PHA

	REMARKS
	ONLY NIAGARAN DOLOMITE TESTED. SSD VARIES FROM 2.28 TO 2.52. RETESTING REQUIRED PRIOR TO APPROVAL FOR USE.
	ONLY THE THIRD LIFT SAMPLED AND TESTED(COLUMBUS LIMESTONE) RAIL FACITIES AVAILABLE. UNIT WEIGHT VARIES FROM 156 TO 171 P.C.F. IN THIS LIFT RETESTING REQUIRED PRIOR TO APPROVAL FOR USE.
	RAIL FACILITIES AVAILABLE. ONLY THE COLUMBUS LIMESTONE SAMPLED AS DELAWARE DOLOMITE IS TOO THIN BEDDED FOR RIPRAP PRODUCTION. SSD VARIES FROM 2.62 TO 2.64. RETESTING REQUIRED PRIOR TO APPROVAL FOR USE.
	ONLY LIFT I AND LIFT IA MEET SSD REQUIREMENTS. LIFT II IS NOT ACCEPTABLE.
	ONLY MATERIALS FROM LIFTS 3 AND 5 ACCEPTABLE FOR USE.
	SSD FOR AGGREGATE IS 2.56.
	SSD FOR AGGREGATE IS 2.65. QUARRY HAS GRI[illegible]LY FOR RIPRAP PROD.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

POSSIBLE SOURCES
RIPRAP, BEDDING, GABION STONE

U.S ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO
PHASE II, APPENDIX A, DATED: FEBRUARY 1979

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE
STANDARD SLAG CO. QUARRY AT MARBLEHEAD, OHIO OFFICE AT MARBLEHEAD, OHIO	LUCAS AND AMHERSTBURG DOLOMITE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	49 MI.
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	

L	LABORATORY TEST RECORD			
CE	DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	DATE USED
.	DECEMBER 1968	ORD LAB LAB #103/69.607C	CLEVELAND DIKED DISPOSAL AREA NO.2 CLEVELAND HARBOR, OH (CORE STONE AND ARMOR STONE)	1969
	MARCH 1972	ORD LAB LAB #103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (CORE, INTERMEDIATE, FILTER AND ARMOR STONE)	1973-1974
	SEPTEMBER 1977	ORD LAB LAB #103/77.628B	LAKEVIEW PARK AND LORAIN DIKED DISPOSAL AREA	1974-1977
				1977-1979
				1978
				1977
				1978
				1977-1978
	MAY 1978	ORD LAB LAB #103/78.611B	PRESQUE ISLE PA BEACH REPLENISHMENT ARMOR STONE	1978
	AUGUST 1978	ORD LAB LAB #103/78.624B	CLEVELAND HARBOR, OH WEST PIER REPAIR	1978

SERVICE RECORD			
	PROJECT	EVALUATION	RE
	CLEVELAND DIKED DISPOSAL AREA NO.2 CLEVELAND HARBOR, OH (RIPRAP STONE)	SATISFACTORY	ALSO TESTED FOR FINE AND COARSE SPECIFIC GRAVITY FOR FINE AGGRE LEDGE ROCK VARIES FROM 2.62 TO FACILITIES AVAILABLE. FOR MINUS FROM LIFT 3 ACCEPTABLE FOR CONC FOR ANY PRODUCT. WEIGHTED UNIT
	CLEVELAND DIKED DISPOSAL AREA NO. 12, CLEVELAND HARBOR OH (ARMOR, UNDERLAYER, CORESTONE AND FILTER)	SATISFACTORY	
	LORAIN DIKED DISPOSAL AREA, LORAIN HARBOR, OH (ARMOR, CORE AND UNDERLAYER STONE)	TOO EARLY TO EVALUATE	
	CLEVELAND DIKED DISPOSAL AREA NO. 14, CLEVELAND HARBOR OH, CORESTONE	TOO EARLY TO EVALUATE	
	HURON HARBOR, 1978 DEEPENING. SLOPE PROTECTION UNDERWATER	TOO EARLY TO EVALUATE	TESTING NOT PERFORMED.
	ASHTABULA HARBOR, 1977 DEEPENING CONTRACT AND BREAKWATER REPAIR	TOO EARLY TO EVALUATE	TESTING NOT PERFORMED.
	CATAWEA ISLAND, OH SLOPE PROTECTION RIPRAP, MATTRESS AND FILTER	TOO EARLY TO EVALUATE	TESTING NOT PERFORMED
	ERIE DIKED DISPOSAL AREA. ERIE HARBOR. PA; CORE STONE. UNDERLAYER STONE AND ARMOR STONE	TOO EARLY TO EVALUATE	TESTING NOT PERFORMED
	PRESQUE ISLE, PA. BEACH REPLENISHMENT ARMOR STONE	TOO EARLY TO EVALUATE	TESTED BED MH-1 (LOW BENCH, AV TESTED FOR BEDDING)
	CLEVELAND HARBOR, OH WEST PIER REPAIR (ARMOR STONE 8-18 TON)	TOO EARLY TO EVALUATE	AVG. SSD IS 2.55
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ORD		REMARKS
	EVALUATION	
NO.2	SATISFACTORY	ALSO TESTED FOR FINE AND COARSE AGGREGATES FOR CONCRETE AND CELL FI SPECIFIC GRAVITY FOR FINE AGGREGATE IS 2.59; FOR COARSE AGGREGATE 2 LEDGE ROCK VARIES FROM 2.62 TO 2.75. SELF UNLOADING VESSELS AND BA FACILITIES AVAILABLE. FOR MINUS 6 INCH MATERIAL ONLY CRUSHED STONE FROM LIFT 3 ACCEPTABLE FOR CONCRETE AGGREGATE. LIFT 2 IS NOT ACCEPT FOR ANY PRODUCT. WEIGHTED UNIT WEIGHT AVERAGE IS 156 P.C.F.
NO. R, TER)	SATISFACTORY	
ORAIN	TOO EARLY TO EVALUATE	
NO. STONE	TOO EARLY TO EVALUATE	
	TOO EARLY TO EVALUATE	TESTING NOT PERFORMED.
ING R	TOO EARLY TO EVALUATE	TESTING NOT PERFORMED.
TECTION	TOO EARLY TO EVALUATE	TESTING NOT PERFORMED
IE HAR- YER	TOO EARLY TO EVALUATE	TESTING NOT PERFORMED
LENISH-	TOO EARLY TO EVALUATE	TESTED BED MH-1 (LOW BENCH, AVG SSD IS 2.52. MINUS 10 INCH MATERI TESTED FOR BEDDING)
IER RE-	TOO EARLY TO EVALUATE	AVG. SSD IS 2.55

BIG CREEK FLOOD CONTROL PROJE
CLEVELAND, OHIO

POSSIBLE SOURCES
RIPRAP, BEDDING, GABION STO

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO
PHASE II, APPENDIX A, DATED: FEBRUARY

PLAT

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE
WOODVILLE LIME AND CHEMICAL CO. QUARRY AT WOODVILLE, OHIO OFFICE AT WOODVILLE, OHIO	NIAGARAN DOLOMITE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	81 MI.
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	

AL NCE	LABORATORY TEST RECORD			
	DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	DATE USED
MI.	OCTOBER 1970	ORD LAB LAB #101/71.320C	FREMONT, OHIO LOCAL FLOOD PROTECTION (RIPRAP)	1971
	SEPTEMBER 1970	ORD LAB LAB #101/71.312C	FREMONT, OHIO LOCAL FLOOD PROTECTION (FINE AND COARSE AGGREGATES FOR CONCRETE, GRANULAR FILL, BASE COURSE, BEDDING AND FILTER.	1971
	DECEMBER 1968	ORD LAB LAB #103/69.607C	CLEVELAND DIKED DISPOSAL NO. 2	UNKNOWN
	OCTOBER 1967	UNKNOWN	CLEVELAND PILOT STUDY DISPOSAL AREA (RIPRAP)	1968

SERVICE RECORD			RE
	PROJECT	EVALUATION	
	FREMONT, OHIO LOCAL FLOOD PROTECTION (RIPRAP)	TOO EARLY TO EVALUATE	AVERAGE WEIGHT IS 165 P.C.F. RA PABLE OF PRODUCING ALL SIZES; NO FROM NORMAL PRODUCTION BLASTING.
	FREMONT, OHIO LOCAL FLOOD PROTECTION PROJECT (CONCRETE FLOOD WALLS).	TOO EARLY TO EVALUATE	SPECIFIC GRAVITY FOR FINE AGGREG FROM 3.03 TO 3.30. ALL STONE SI APPROVAL.
	UNKNOWN	UNKNOWN	
	CLEVELAND PILOT STUDY DISPOSAL AREA	SATISFACTORY	
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	EVALUATION	REMARKS
C-	TOO EARLY TO EVALUATE	AVERAGE WEIGHT IS 165 P.C.F. RAIL FACILITIES AVAILABLE. QUARRY CA-PABLE OF PRODUCING ALL SIZES; HOWEVER, 18" RIPRAP WOULD BE OVERSIZE FROM NORMAL PRODUCTION BLASTING.
C-	TOO EARLY TO EVALUATE	SPECIFIC GRAVITY FOR FINE AGGREGATE VARIES FROM 2.68 TO 2.70 FM VARI[illegible] FROM 3.03 TO 3.30. ALL STONE SIZES WILL REQUIRE RETESTING PRIOR TO APPROVAL.
	UNKNOWN	
	SATISFACTORY	

BIG CREEK FLOOD CONTROL PROJE[C]
CLEVELAND, OHIO

POSSIBLE SOURCES
RIPRAP, BEDDING, GABION STO[NE]

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO
PHASE II, APPENDIX A, DATED FEBRUARY 1[illegible]

PLAT[E]

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE
BASIC INDUSTRIES CO. QUARRY AT MAPLE GROVE, OH OFFICE AT MAPLE GROVE, OH	NIAGARAN DOLOMITE	F.A.	76 MI.
		F.A.	
		F.A.	
CLEVELAND BUILDERS SUPPLY (READY MIX PLANT) STOCKPILES AT CLEVELAND, OH OFFICE AT CLEVELAND, OH	C.A.-LUCAS AND AMHERST-BURG DOLOMITE F.A. - LAKE SAND	C.A. AND F.A.	10 MI.
		C.A. AND F.A.	
		C.A. AND F.A.	
ERIE SAND AND GRAVEL CO. STOCKPILE AT LORAIN, OH OFFICE AT ERIE, PA	LAKE SAND	F.A.	21 MI.
ERIE SAND AND GRAVEL CO. STOCKPILE AT SANDUSKY, OH OFFICE AT ERIE, PA.	LAKE SAND	F.A.	47 MI.
GOTTRON BROS. QUARRY AT FREMONT, OH OFFICE AT FREMONT, OH	MONROE DOLOMITE AND NIAGARAN DOLOMITE	C.A.	70 MI.

AL	LABORATORY TEST RECORD			
NCE	DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	DATE USED
MI.	OCTOBER 1970	ORD LAB LAB #101/71.312C	FREMONT FLOOD CONTROL PROJECT, SANDUSKY RIVER	UNKNOWN
	SEPTEMBER 1976	ORD LAB LAB #101/76T.306B	CONFINED DIKED DISPOSAL AREA, LORAIN HARBOR, OH	UNKNOWN
	FEBRUARY 1977	ORD LAB LAB #101/77.310B	CONFINED DIKED DISPOSAL AREA, LORAIN HARBOR, OH	UNKNOWN
MI.	JANUARY 1977	ORD LAB LAB #101/77.312B	CONFINED DIKED DISPOSAL AREA, CLEVELAND, OH DIKE 14 (DOAN'S BROOK CULVERT)	1978
	MARCH 1978	ORD LAB LAB #101/78.310B	CONFINED DIKED DISPOSAL AREA, CLEVELAND DIKE 14 (DOAN'S BROOK CULVERT)	1978
	JULY 1978	ORD LAB LAB #101/78.319B	CLEVELAND HARBOR, OH WEST PIER REPAIR	1978
MI.	JULY 1973	ORD LAB LAB #101/74.305C	VERMILION HARBOR, OH DETACHED BREAKWALL (CONCRETE CAP)	1973
MI.	JULY 1975	ORD LAB LAB #101/76.302B	CONFINED DREDGE SPOIL DISPOSAL DIKE AT HURON (CONCRETE AGGREGATE)	UNKNOWN
MI.	AUGUST 1970	ORD LAB LAB #101/71.312C	LOCAL FLOOD PROTECTION SANDUSKY RIVER, FREMONT, OH	1970-1972

SERVICE RECORD		REM
PROJECT	EVALUATION	
UNKNOWN	UNKNOWN	FM IS 2.81. MANUFACTURED SAND
UNKNOWN	UNKNOWN	SSD FOR FA IS 2.65; FM IS 2.83 MA
UNKNOWN	UNKNOWN	SSD FOR FA IS 2.59; FM IS 2.98 MA
DOAN'S BROOK CULVERT, DIKE 14	TOO EARLY TO EVALUATE	FA IS FROM ERIE SAND AND GRAVEL LOW ALKALI CEMENT IS REQUIRED.
DOAN'S BROOK CULVERT, DIKE 14	TOO EARLY TO EVALUATE	CA IS FROM STANDARD SLAG CO.; MA
CLEVELAND HARBOR, OH WEST PIER, REPAIR	TOO EARLY TO EVALUATE	ERIE SAND AND GRAVEL CO.; LAKE S SLAG CO.: SSD IS 2.56.
VERMILION HARBOR, OH, DETACHED BREAKWALL (CONCRETE CAP)	TOO EARLY TO EVALUATE	SPECIFIC GRAVITY IS 2.63. LOW A
UNKNOWN	UNKNOWN	FINE AGGREGATES WILL REQUIRE TE
LOCAL FLOOD PROTECTION SANDUSKY RIVER, FREMONT, OH	SATISFACTORY	SSD VARIES FROM 2.58 TO 2.67. RETESTING REQUIRED PRIOR TO USE.

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EVALUATION	REMARKS
UNKNOWN	FM IS 2.81. MANUFACTURED SAND
UNKNOWN	SSD FOR FA IS 2.65; FM IS 2.83 MANUFACTURED SAND
UNKNOWN	SSD FOR FA IS 2.59; FM IS 2.98 MANUFACTURED SAND
TOO EARLY TO EVALUATE	FA IS FROM ERIE SAND AND GRAVEL (LAKE SAND: SSD IS 2.63 FM IS 2.62) LOW ALKALI CEMENT IS REQUIRED.
TOO EARLY TO EVALUATE	CA IS FROM STANDARD SLAG CO.; MARBLEHEAD, OH SSD IS 2.55.
TOO EARLY TO EVALUATE	ERIE SAND AND GRAVEL CO.; LAKE SAND SSD IS 2.63, FM IS 2.66, STANDARD SLAG CO.: SSD IS 2.56.
TOO EARLY TO EVALUATE	SPECIFIC GRAVITY IS 2.63. LOW ALKALI CEMENT REQUIRED FOR CONCRETE.
UNKNOWN	FINE AGGREGATES WILL REQUIRE TESTING PRIOR TO APPROVAL.
SATISFACTORY	SSD VARIES FROM 2.58 TO 2.67. RETESTING REQUIRED PRIOR TO USE.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

POSSIBLE SOURCES FOR COARSE AND FINE AGGREGATES FOR CONCRETE

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO
PHASE II, APPENDIX A, DATED FEBRUARY 1979

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE
E. KRAEMER AND SON, INC. QUARRY AT CLAY CENTER, OHIO OFFICE AT CLAY CENTER, OHIO	NIAGARAN DOLOMITE	C.A.	82 MI.
MENTOR CARTAGE CO. STOCKPILE AT LORAIN, OHIO OFFICE AT LORAIN, OHIO	LAKE SAND	F.A.	21 MI.
SANDUSKY CRUSHED STONE CO. QUARRY AT PARKERTOWN, OHIO OFFICE AT PARKERTOWN, OHIO	DELAWARE DOLOMITE AND COLUMBUS LIMESTONE	F.A. AND C.A.	52 MI.
R.W. SIDLEY PIT AT THOMPSONVILLE, OHIO OFFICE AT PAINSVILLE, OHIO	SHARON CONGLOMERATE	F.A.	45 MI.
STANDARD SLAG CO. QUARRY AT MARBLEHEAD, OH OFFICE AT MARBLEHEAD, OH	LUCAS AND AMHERSTBURG DOLOMITE	C.A.	49 MI.
WAGNER QUARRIES QUARRY AT SANDUSKY, OH OFFICE AT SANDUSKY, OH	COLUMBUS LIMESTONE	C.A. AND F.A.	54 MI.

RADIAL DISTANCE	LABORATORY TEST RECORD			DATE US
	DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	
82 MI.	MARCH 1972	ORD LAB LAB #103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (ARMOR STONE)	UNKNOWN
21 MI.	AUGUST 1965	ORD LAB LAB #101/66.304C	LORAIN HARBOR, OHIO BREAKWALL	UNKNOWN
52 MI.	MARCH 1972	ORD LAB LAB #103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (FINE AND COARSE AGGREGATES FOR CONCRETE, CELL FILL AND RIPRAP)	1973-1974
	FEBRUARY 1977	ORD LAB LAB #101/77.310B	CONFINED DREDGE SPOIL DISPOSAL DIKE AT LORAIN (CONCRETE AGGREGATE)	UNKNOWN
45 MI.	JULY 1974	HERRON TESTING LABS. LAB #H15707	SIDLEY PRECAST OFFICE	
	NOVEMBER 1974	ORD LAB LAB #103/75.610B	CONFINED DREDGE SPOIL DISPOSAL DIKE AT LORAIN (CONCRETE AGGREGATE)	UNKNOWN
49 MI.	MARCH 1978	ORD LAB LAB #101/78.310B	CONFINED DREDGE SPOIL DISPOSAL DIKE AT CLEVELAND, OH (DOAN'S BROOK CULVERT)	1978
	JULY 1978	ORD LAB LAB #101/78.319B	CLEVELAND HARBOR, OH WEST PIER REPAIR	1978
54 MI.	AUGUST 1965	ORD LAB LAB #101/66.304C	LORAIN HARBOR, OH, COARSE AGGREGATE FOR CONCRETE	1966
	APRIL 1972	ORD LAB LAB #103/72.606C	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (FINE AND COARSE AGGREGATES FOR CONCRETE, CELL FILL, GRANULAR FILL AND RIPRAP)	UNKNOWN
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D	SERVICE RECORD		R
	PROJECT	EVALUATION	
	UNKNOWN	UNKNOWN	UNIT WEIGHT VARIES FROM 167 P.C AVAILABLE. COARSE AGGREGATE FO TO APPROVAL.
	UNKNOWN	UNKNOWN	RETESTING IS REQUIRED PRIOR TO
	SANDUSKY RIVER LOCAL FLOOD PROTECTION PROJECT, FREMONT OH (RIPRAP)	SATISFACTORY	ONLY MATERIAL IN LIFTS 3 AND 5 162.2 TO 169.7 P.C.F. SPECIFI FOR COARSE AGGREGATES 2.65: RA
	UNKNOWN	UNKNOWN	
	UNKNOWN	UNKNOWN	SPECIFIC GRAVITY IS 2.62.
	UNKNOWN	UNKNOWN	SPECIFIC GRAVITY IS 2.60.
	DOAN'S BROOK CULVERT (DIKE 14)	TOO EARLY TO EVALUATE	SSD IS 2.55.
	CLEVELAND HARBOR, OH WEST PIER REPAIR	TOO EARLY TO EVALUATE	SSD IS 2.56
	LORAIN BREAKWATER, LORAIN, OH CONCRETE CAP	SATISFACTORY	SSD IS 2.70
	UNKNOWN	UNKNOWN	SSD FOR F.A. IS 2.63. SSD FOR C.A. IS 2.69.

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	REMARKS
	UNIT WEIGHT VARIES FROM 167 P.C.F. TO 169 P.C.F. RAIL FACILITIES AVAILABLE. COARSE AGGREGATE FOR CONCRETE WILL REQUIRE TESTING PRIOR TO APPROVAL.
	RETESTING IS REQUIRED PRIOR TO APPROVAL FOR USE.
	ONLY MATERIAL IN LIFTS 3 AND 5 IS ACCEPTABLE. UNIT WEIGHT VARIES FROM 162.2 TO 169.7 P.C.F. SPECIFIC GRAVITY FOR FINE AGGREGATES IS 2.62; FOR COARSE AGGREGATES 2.65: RAIL FACILITIES AVAILABLE.
	SPECIFIC GRAVITY IS 2.62.
	SPECIFIC GRAVITY IS 2.60.
	SSD IS 2.55.
	SSD IS 2.56
	SSD IS 2.70
	SSD FOR F.A. IS 2.63. SSD FOR C.A. IS 2.69.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

POSSIBLE SOURCES FOR COARSE AND FINE AGGREGATES FOR CONCRETE

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO
PHASE II, APPENDIX A, DATED: FEBRUARY 1979

POSSIBLE SOURCES OF COARSE AND FINE AGGREGATE:			
SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE
WAGNER QUARRIES QUARRY AT SANDUSKY, OH OFFICE AT SANDUSKY, OH	COLUMBUS LIMESTONE	C.A. AND F.A.	54 MI.
		C.A. AND F.A.	
WOODVILLE LIME AND CHEMICAL CO. QUARRY AT WOODVILLE, OH OFFICE AT WOODVILLE, OH	NIAGARAN DOLOMITE	C.A. AND F.A.	81 MI.
SOURCE OF LEVEE EMBANKMENT MATERIAL:			
METROPARK BORROW AREA 1 BEREA, OH	SANDY CLAY (CL)	LEVEE EMBANKMENT	13 MI.

L CE	LABORATORY TEST RECORD			
	DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	DATE USED
I.	AUGUST 1973	ORD LAB LAB #101/74.305C	VERMILION HARBOR, OH, COARSE AGG- REGATE FOR CONCRETE	1973
	SEPTEMBER 1975	ORD LAB LAB #101/76.302B	CONFINED DREDGE SPOIL DISPOSAL DIKE AT HURON, OH (CONCRETE AGGREGATE)	UNKNOWN
II.	SEPTEMBER 1970	ORD LAB LAB #101/71.312C	FREMONT, OH LOCAL FLOOD PROTECTION (FINE AND COARSE AGGREGATE)	1971
II.	OCTOBER 1978	ORD LAB LAB #102/79.502B	BIG CREEK FLOOD CONTROL PROJECT	

SERVICE RECORD			
	PROJECT	EVALUATION	RE
	VERMILION BREAKWATER, VERMILION OH, CONCRETE CAP	TOO EARLY TO EVALUATE	SPECIFIC GRAVITY FOR COARSE AGG
	UNKNOWN	UNKNOWN	
	FLOOD WALLS AT FREMONT, OH (FA ONLY IN CONCRETE)	SATISFACTORY	SSD FOR FA VARIES FROM 2.68 TO 3.30. RETESTING OF BOTH CA AND
			PRELIMINARY HAND AUGERS ONLY, INCLUDED IN PLANS AND SPECS.

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REMARKS
SPECIFIC GRAVITY FOR COARSE AGGREGATE IS 2.68.
SSD FOR FA VARIES FROM 2.68 TO 2.70. FM FOR FA VARIES FROM 3.03 TO 3.30. RETESTING OF BOTH CA AND FA REQUIRED PRIOR TO APPROVAL.
PRELIMINARY HAND AUGERS ONLY, DETAIL SUBSURFACE EXPLORATIONS TO BE INCLUDED IN PLANS AND SPECS.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

POSSIBLE SOURCES FOR COARSE AND FINE AGGREGATES FOR CONCRETE AND LEVEE EMBANKMENT MATERIAL 4

U S ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO
PHASE II, APPENDIX A, DATED FEBRUARY 1979

SOURCE	FORMATION	PROPOSED USE	LAB NO.	
BASIC INDUSTRIES CO. QUARRY AT MAPLE GROVE, OH OFFICE AT MAPLE GROVE, OH	NIAGARAN DOLOMITE	FINE AGGREGATE	ORD 101/71.312C	DOLOMITE - M POROUS, LIG PYRITE IN MI
			ORD 101/76T.306B	DOLOMITE - M CALCITE)
			ORD 101/77.310B	DOLOMITE - M WITH PALE O AND CALCITE.
BROUGH STONE CO. QUARRY AT WEST MILLGROVE, OH.	NIAGARAN DOLOMITE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	ORD 103/73.606C	DOLOMITE - M POROUS AND WITH MEDIUM DOLOMITE (LITTLE MAT
	NIAGARAN DOLOMITE	FINE AGGREGATE	ORD 101/76.307B	FINE AGGREG DOLOMITE
	NIAGARAN DOLOMITE	COARSE AGGREGATE	ORD 101/76.307B	COARSE AGG CLES OF DOL
		12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE	ORD 103/76T.606B	DOLOMITE - TRACES OF STYLOLITES,
CLEVELAND BUILDERS SUPPLY STOCKPILES AT CLEVELAND	LAKE SAND AND CRUSHED AGGREGATE	FINE AND COARSE AGGREGATE	ORD 101/77.312B	QUARTZ WIT CHERT -10%
	LAKE SAND AND CRUSHED AGGREGATE	FINE AND COARSE AGGREGATE	ORD 101/78.310B	LAKE SAND: STONE - 22 FRAGMENTS
	LAKE SAND AND CRUSHED AGGREGATE	FINE AND COARSE AGGREGATE	ORD 101/78.310B	CRUSHED S MITE - 6%;

SUMMARY SHEET FOR LABORATORY

.NO.	PETROGRAPHIC ANALYSIS	TEST RESUL SP.GRAV.	ABS.	$MgSO_4$	L.A.A.	F&E
.312C	DOLOMITE - MODERATELY HARD, SUGARY-TEXTURED, FINE TO MEDIUM GRAINED, POROUS, LIGHT GRAY TO YELLOWISH BROWN. TRACE OF WEATHERED DOLOMITE AND PYRITE IN MINUS #30 SIEVE SIZES.					8 %
T.306B	DOLOMITE - MODERATELY HARD, SUGARY-TEXTURED, DENSE (95% DOLOMITE, 5% CALCITE)	2.65	2.76%	31.3%		9 %
.310B	DOLOMITE - HARD, DENSE TO FINELY CRYSTALLINE TO MODERATELY POROUS, WHITE WITH PALE ORANGE AND LIGHT GRAY GRAINS, CRYSTAL FRAGMENTS OF DOLOMITE AND AND CALCITE.	2.59	4.76 %			10 %
.606C	DOLOMITE - MODERATELY HARD, FINE TO MEDIUM-GRAINED, SUGARY-TEXTURED. POROUS AND ABSORBENT, RUBBLY, BRECCIA-LIKE STRUCTURE. PALE OLIVE GRAY WITH MEDIUM GRAY MOTTLING. DOLOMITE (KLINTITE) - RUBBLY TEXTURE WITH APPEARANCE OF BRECCIA WITH LITTLE MATRIX, POROUS, VUGGY, LIGHT YELLOWISH GRAY.	2.54 TO 2.66	1.71 % TO 1.43%			
.307B	FINE AGGREGATE - ALMOST ENTIRELY HARD, TOUGH, UNWEATHERED GRAINS OF DOLOMITE	2.71	1.24%	16.5%		
.307B	COARSE AGGREGATE - ALMOST ENTIRELY MODERATELY HARD, TOUGH, POROUS PARTICLES OF DOLOMITE.	2.63	2.15%	1.3%	2.8%	
T.606B	DOLOMITE - MASSIVE, MODERATELY HARD, SUGARY TEXTURED, POROUS LENSES, TRACES OF PYRITE, SOME INTERNAL FRACTURES FROM DOLOMITIZATION, TIGHT STYLOLITES, NON WEATHERED. VERY LIGHT GRAY.	2.50 TO 2.69	0.90% TO 1.73%			
7.312B	QUARTZ WITH SANDSTONE AND SILTSTONE - 63%; IGNEOUS - 9%; LIMESTONE- 8%; CHERT -10%; SOFT LIMESTONE, SANDSTONE AND SILTSTONE - 3%; SOFT SHALE - 7%	2.63	1.68%	12.69%		5%
.310B	LAKE SAND: QUARTZ - 47%; LIMESTONE AND DOLOMITE - 7%; SANDSTONE AND SILTSTONE - 22%; IGNEOUS AND METAMORPHIC - 6%; CHERT - 6%; WEATHERED ROCK FRAGMENTS - 1%; SHALE - 10%; SHELLS - 1%.	2.63	2.0%			
.310B	CRUSHED STONE: SANDY DOLOMITE - 12%; BANDED DOLOMITE - 4%; SHALY - DOLOMITE - 6%; CALC DOLOMITE - 10%; DOLOMITE - 61%; DOLOMITIC LIMESTONE - 7%.	2.55	3.7%	31.1%		
	7					

TORY TESTING

RESULTS							
A.	F&E PART	L.W. PART	SO. PART	CLAY LUMPS	WET-DRY(80 CYCLES)	FREEZE-THAW(35 CYCLES)	
	8 %						QUITE
	9 %						
	10 %						
					NO EFFECT NO EFFECT	NO EFFECT NO EFFECT	RESIST
%							
					LOSS VARIED FROM 0.0% TO 1.80%. AVG LOSS FOR 8 LEDGE SAMPLE IS 0.37%.	LOSS VARIES FROM 0.04% TO 0.75% AVG. LOSS FOR 8 LEDGE ROCK SAMPLE IS 0.29%.	
	5%		7%				FAIR
							LAKE STO
	3						

[illegible]CLES)	FREEZE-THAW (35 CYCLES)	REMARKS
		QUITE SUITABLE FOR FA FOR CONCRETE.
	NO EFFECT NO EFFECT	RESISTANT TO WEATHERING BUT EASILY BROKEN
.0% TO 8 LEDGE	LOSS VARIES FROM 0.04% TO 0.75% AVG. LOSS FOR 8 LEDGE ROCK SAMPLE IS 0.29%.	
		FAIR QUALITY. LOW ALKALI CEMENT REQUIRED. (LAKE ERIE SAND)
		LAKE SAND FROM ERIE SAND AND GRAVEL, CLEVELAND, OH. CRUSHED STONE FROM STANDARD SLAG QUARRY, MARBLEHEAD OH

BIG CREEK FLOOD CONTROL PROJECT
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SOURCE	FORMATION	PROPOSED USE	LAB.NO.	
ERIE BLACKTOP INC. QUARRY AT CASTALIA, OH	COLUMBUS LIMESTONE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	ORD 101/71.320C	DOLOMITIC L FINE GRAINE
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	ORD 101/71.320C	CRUSHED STO
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	ORD 103/77.601B	DOLOMITE LI HARD TO MA FINELY GRA
ERIE SAND AND GRAVEL CO. STOCKPILES AT CLEVELAND, OH	LAKE SAND	FINE AGGREGATE	ORD 101/78.310B	
ERIE SAND AND GRAVEL CO. STOCKPILES AT LORAIN, OH	LAKE SAND	FINE AGGREGATE	ORD 101/76.302B	QUARTZ - S IGNEOUS AN FRAGMENTS
ERIE SAND AND GRAVEL CO. STOCKPILES AT SANDUSKY, OH	LAKE SAND	FINE AGGREGATE	ORD 101/76.302B	QUARTZ - S IGNEOUS AN FRAGMENTS
FRANCE STONE CO. QUARRY AT BELLEVUE, OH	COLUMBUS LIMESTONE LUCAS DOLOMITE	COARSE AGGREGATE	ORD 103/72.606C	DOLOMITE -
		COARSE AGGREGATE	ORD 103/72.606C	DOLOMITE - ABSORBENT, BROWN DOLOMITE - ABSORBENT,
		COARSE AGGREGATE	ORD 103/72.606C	DOLOMITE - ABSORBENT,
		12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	ORD 103/77.601B	VARIETY O SANDY DOL LIFT ZONE

SUMMARY SHEET FOR LABORATORY

O.						
	TEST RESULT					
	PETROGRAPHIC ANALYSIS	SP.GRAV.	ABS.	$MgSO_4$	L.A.A.	F&E P
0C	DOLOMITIC LIMESTONE: MODERATELY HARD TO HARD, TOUGH WITH BLOCKY FRACTURE, FINE GRAINED TO DENSE, MEDIUM OLIVE GRAY.	2.69	0.40%			
0C	CRUSHED STONE: DOLOMITIC LIMESTONE - 63%; LIMESTONE - 37%.	2.71	1.06%	8.5%	25.5%	
1B	DOLOMITE LIMESTONE AND DOLOMITE: LAMINATED TO THICK BEDDED; MODERATELY HARD TO HARD, TRACES OF PYRITE AND DISSEMINATED CLAY THROUGHOUT; VERY FINELY GRAINED, YELLOWISH BROWN.	2.68 TO 2.78	0.11% TO 1.09%			
0B						
2B	QUARTZ - 39%; LIMESTONE AND DOLOSTONE - 10%; SANDSTONE AND SILTSTONE - 34% IGNEOUS AND METAMORPHIC ROCK FRAGMENTS - 6%; CHERT - 5%, WEATHERED ROCK FRAGMENTS - 3%; SHALE - 1%; MUSSEL SHELLS - 2%.	2.63	0.89%	13.1%		8%
2B	QUARTZ - 33%; LIMESTONE AND DOLOSTONE - 25%; SANDSTONE AND SILTSTONE - 10% IGNEOUS AND METAMORPHIC ROCK FRAGMENTS - 9%; CHERT - 11%; WEATHERED ROCK FRAGMENTS - 7%; SHALE - 2%; COAL - 1%; MOLLUSK SHELLS - 2%.	2.57	1.22%	11.52%		7%
6C	DOLOMITE-87 %; SANDY DOLOMITE - 12%; LAMINATED DOLOMITE - 1%.	2.58	3.39%	5%	27%	5%
6C	DOLOMITE - HARD, VERY FINE-GRAINED, VERY EVEN-TEXTURED, MICROPOROUS, ABSORBENT, SUB-CONCHOIDAL TO SUB BLOCKY FRACTURE, MODERATELY YELLOWISH BROWN	2.47 TO 2.58	2.86% TO 5.60%			
6C	DOLOMITE - MODERATELY HARD, FINE-GRAINED, MICROPOROUS TO MACROPOROUS, ABSORBENT, IRREGULAR FRACTURE, MODERATELY YELLOWISH BROWN. DOLOMITE - MODERATELY HARD, FINE-GRAINED, BANDED, MICROPOROUS TO POROUS, ABSORBENT, IRREGULAR FRACTURE, MODERATE YELLOWISH BROWN.					
1B	VARIETY OF DOLOMITES; SANDY CALCAREOUS DOLO., CALC. DOLO.; CHERTY DOLO.; SANDY DOLO.; LAMINATED DOLO.; DOLOMITE AND DOLOMITIC LIMESTONE. QUARRY LIFT ZONED INTO 11 BEDS; 23 SAMPLES.	2.40 TO 2.73	0.58% TO 5.3%			

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ART	SO. PART	CLAY LUMPS	WET-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)	REMAR
			NO EFFECT	NO EFFECT	LEDGE ROCK.
					CRUSHED STONE
			NO EFFECT	NO EFFECT	SELECTIVE QUARRYING REQUIRED. TESTED. UPPER BED (5?) NOT AC
					SEE RESULTS FROM CLEVELAND BUI
					DUE TO HIGH CHERT CONTENT THE RECOMMENDED.
					DUE TO HIGH CHERT CONTENT THE RECOMMENDED.
					3/4 TO 1 1/2 INCH AGGREGATE
			NO EFFECT NO EFFECT	CRACKING AND BREAKING DOWN OF SPECIMEN ON ONE SURFACE INTO 1" ANGULAR PARTICLES. SURFACE SPALLING	LEDGE NO. 5 LOW SPECIFIC GRAV RIPRAP.
				PARTIAL OPENING OF A THIN SHALY BEDDING SEAM.	FIVE SAMPLES TESTED.
			LOSS RANGES FROM 0.03% TO 0.30% (5 SAMPLES)	LOSS RANGES FROM 0.07% TO 2.57%	SELECTIVE QUARRYING REQUIRED

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TO ACCOMPANY
PHASE II, APPEND

S	WET-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)	REMARKS
	NO EFFECT	NO EFFECT	LEDGE ROCK.
			CRUSHED STONE
	NO EFFECT	NO EFFECT	SELECTIVE QUARRYING REQUIRED. EIGHT LEDGE ROCK SAMPLES TESTED. UPPER BED (5?) NOT ACCEPTABLE FOR USE.
			SEE RESULTS FROM CLEVELAND BUILDERS SUPPLY. (ORD ICI/78.310B)
			DUE TO HIGH CHERT CONTENT THE USE OF LOW ALKALI CEMENT IS RECOMMENDED.
			DUE TO HIGH CHERT CONTENT THE USE OF LOW ALKALI CEMENT IS RECOMMENDED.
			3/4 TO 1 1/2 INCH AGGREGATE
	NO EFFECT NO EFFECT	CRACKING AND BREAKING DOWN OF SPECIMEN ON ONE SURFACE INTO 1" ANGULAR PARTICLES. SURFACE SPALLING	LEDGE NO. 5 LOW SPECIFIC GRAVITY (2.22) NOT ACCEPTABLE FOR RIPRAP.
		PARTIAL OPENING OF A THIN SHALY BEDDING SEAM.	FIVE SAMPLES TESTED.
	LOSS RANGES FROM 0.03% TO 0.30% (5 SAMPLES)	LOSS RANGES FROM 0.07% TO 2.57%	SELECTIVE QUARRYING REQUIRED.

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SOURCE	FORMATION	PROPOSED USE	LAB NO.	
FRANCE STONE CO. QUARRY AT BLOOMVILLE, OH	COLUMBUS LIMESTONE	12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE	ORD 103/73.606C	DOLOMITE - MO ABSORBENT, SU
				DOLOMITE - MO ABSORBENT, TI YELLOWISH BRO
				DOLOMITE - MO APPEARANCE BU TURE, PALE YE
FRANCE STONE COMPANY (FORMERLY NORTHERN OHIO STONE COMPANY) QUARRY AT FLAT ROCK, OHIO	LUCAS DOLOMITE	COARSE AGGREGATE	ORD 103/72.606C	DOLOMITE - MO POROUS, CLOSE ODOR, GRAYISH
				DOLOMITIC LI UNSORTED DOLO ORANGE.
				DOLOMITIC LI WEATHERED DOL
GOTTRON BROS. QUARRY AT FREMONT, OH	MONROE AND NIAGARAN DOLOMITE	COARSE AGGREGATE	ORD 101/71.312C	MONROE DOLOMI SHALY, INTER
		COARSE AGGREGATE	ORD 101/71.312C	NIAGARAN DOLO TEXTURED, IR
		COARSE AGGREGATE	ORD 101/71.312C	DOLOMITE - I
E. KRAEMER AND SON, INC. QUARRY AT CLAY CENTER, OH	NIAGARAN DOLOMITE	12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE	ORD 103/72.606C	DOLOMITE - M VUGGY, BRECC GRAY MOTTLIN
		12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE	ORD 103/72.606C	DOLOMITE - M VERY LIGHT G
		12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE	ORD 103/77.628B	DOLOMITE - M CHALKY AND W

SUMMARY SHEET FOR LABORATORY

O.	PETROGRAPHIC ANALYSIS	TEST RESULT SP.GRAV.	ABS.	$MgSO_4$	L.A.A.	F&E PA
C	DOLOMITE - MODERATELY HARD, FINE - GRAINED, EVEN-TEXTURED, MICROPOROUS, ABSORBENT, SUB-BLOCKY FRACTURE, YELLOWISH GRAY	2.5	3.62%			
	DOLOMITE - MODERATELY HARD, VERY FINE-GRAINED, EVEN-TEXTURED, MICROPOROUS ABSORBENT, TIGHT PAPER-THIN, SHALY BEDDING PLANES, BLOCKY FRACTURE, PALE YELLOWISH BROWN.	2.62	2.33%			
	DOLOMITE - MODERATELY HARD, VERY FINE-GRAINED, VERY EVEN-TEXTURED, DENSE APPEARANCE BUT VERY MICROPOROUS, ABSORBENT, CHERT NODULES, BLOCKY FRACTURE, PALE YELLOWISH BROWN.	2.58	0.24%			
C	DOLOMITE - MODERATELY HARD, FINE-GRAINED, EVEN-TEXTURED, DENSE TO MACROPOROUS, CLOSELY SPACED, PAPER THIN CARBONACEOUS SEAMS, PETROLIFEROUS ODOR, GRAYISH ORANGE.	2.46	4.51%			
	DOLOMITIC LIMESTONE - HARD, FINE TO MEDIUM-GRAINED, MODERATELY DOLOMITIC, UNSORTED DOLOMITE RHOMBS AND FOSSIL DETRITUS IN A CALCEROUS MIX, GRAYISH ORANGE.	2.75	0.80%			
	DOLOMITIC LIMESTONE - 96%, LIMESTONE - 3%, SANDY DOLOMITIC LIMESTONE - 1%, WEATHERED DOLOMITIC LIMESTONE - 1%.	(-3/4") 2.61 (1-1/2") 2.58	2.99% 3.34%	11% 15%	26% 42%	3%
812C	MONROE DOLOMITE - HARD, FINE-GRAINED, DENSE WITH MICROPORES, PAPER-THIN, SHALY, INTERNAL PARTINGS, BLOCKY FRACTURE, PALE YELLOWISH BROWN.	2.67	0.35%			
812C	NIAGARAN DOLOMITE - HARD, FINE TO MEDIUM-GRAINED, POROUS TO VUGGY, SUGARY TEXTURED, IRREGULAR FRACTURE, MOTTLED LIGHT TO MEDIUM GRAY.	2.66	0.51%			
812C	DOLOMITE - 100%	2.61 TO 2.67	0.42% TO 0.45%	3.7%	46.3%	2% TO
806C	DOLOMITE - MODERATELY HARD TO HARD, FINE TO MEDIUM-GRAINED, MEGAPOROUS TO VUGGY, BRECCIATED APPEARANCE, YELLOWISH GRAY WITH MEDIUM TO LIGHT MEDIUM GRAY MOTTLING.	2.68 TO 2.72	0.60% TO 2.04%			
806C	DOLOMITE - HARD, FINE-GRAINED, VUGGY, POROUS, VUGS FILLED WITH CALCITE VERY LIGHT GRAY, MOTTLED.	C.A. #4 MAX 2.71 F.A. 2.72	1.91% 1.65%	4% 19%	28%	6% 16
828B	DOLOMITE - MODERATELY HARD, DENSE TO MEDIUM GRAINED, POROUS AND ABSORBENT CHALKY AND WITH FRACTURE SYSTEMS, BLOCKY FRACTURE, VERY LIGHT GRAY.	2.59	1.89%			

RY TESTING

SULTS						
8E PART	L.W. PART	SO. PART	CLAY LUMPS	WET-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)	
				NO EFFECT ~~NO EFFECT~~	NO EFFECT ~~NO EFFECT~~	
				NO EFFECT	SOME SURFACE SPALLING OVER ENTIRE SURFACE.	FIVE SAMPLES AND ABSORPTI
					PARTIAL OPENING OF VERY THIN SHALY BEDDING SEAM.	
3%	NONE NONE					TESTED FOR
				NO EFFECT	NO EFFECT	QUARRY CAPA INTERESTED.
2% TO 6%						
				NO EFFECT	NO EFFECT	BI
6% 16:	NONE	NONE	NONE			
3				NOT TESTED MATERIAL FROM MIDDLE BENCH, (REEF ROCK)	NOT TESTED NORTH FACE NOT ACCEPTABLE	

PS	WET-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)	REMARKS
	NO EFFECT	NO EFFECT	
	NO EFFECT	NO EFFECT	
	NO EFFECT	SOME SURFACE SPALLING OVER ENTIRE SURFACE.	FIVE SAMPLES TESTED, SPECIFIC GRAVITY RANGES FROM 2.46 TO 2.7 AND ABSORPTION RANGES FROM 0.80% TO 4.51%.
		PARTIAL OPENING OF VERY THIN SHALY BEDDING SEAM.	
			TESTED FOR CONCRETE AGGREGATES AND CELL FILL.
	NO EFFECT	NO EFFECT	QUARRY CAPABLE OF PRODUCING LARGE RIPRAP BUT MANAGEMENT NOT INTERESTED.
	NO EFFECT	NO EFFECT	
	NOT TESTED MATERIAL FROM MIDDLE BENCH, (REEF ROCK)	NOT TESTED NORTH FACE NOT ACCEPTABLE	

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SOURCE	FORMATION	PROPOSED USE	LAB.NO.	
MENTOR CARTAGE CO. STOCKPILE AT LORAIN, OH	LAKE SAND	FINE AGGREGATE	ORD 101/66.304C	FINE AGGREGA IGNEOUS ROCK
NATIONAL LIME AND STONE CO. QUARRY AT CAREY, OH	NIAGARAN DOLOMITE	12 AND 18 INCH RIPRAP BEDDING AND GABION STONE	ORD 103/73.606C	DOLOMITE - ABSORBENT, WITH SOME LI
				DOLOMITE - ABSORBENT,
				DOLOMITE - FRACTURE, PA
NATIONAL LIME AND STONE COMPANY QUARRY AT MARION, OH	COLUMBUS LIMESTONE	12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE.	ORD 103/73.606C	DOLOMITE - ABSORBENT, YELLOWISH
				DOLOMITE - MODERATE AN
			ORD 103/73.606C	DOLOMITIC L ROUS, SUB-
NATIONAL LIME AND STONE COMPANY QUARRY AT SPORE, OH	COLUMBUS LIMESTONE	12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE	ORD 103/73.606C	DOLOMITE - ABSORBENT,
				DOLOMITE - BENT, BLOCK

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SUMMARY SHEET FOR LABORATOR

AB. NO.	TEST RESU					
	PETROGRAPHIC ANALYSIS	SP. GRAV.	ABS.	$MgSO_4$	L.A.A.	F&
/66.304C	FINE AGGREGATE - DENSE HARD GRAINS OF QUARTZ, QUARTZITE, LIMESTONE, IGNEOUS ROCK - 87%; CHERT - 6%; SHALE - 4%; WEATHERED GRAINS - 3%.	2.66	1.1%	16.0%	5%	
/73.606C	DOLOMITE - MODERATELY HARD, MEDIUM - GRAINED, SUGARY - TEXTURED, POROUS, ABSORBENT, IRREGULAR TO SUB BLOCKY FRACTURE, VERY PALE YELLOWISH GRAY WITH SOME LIGHT OLIVE GRAY MOTTLING.	2.28 TO 2.52	0.91 TO 5.98%			
	DOLOMITE - MODERATELY HARD, FINE - GRAINED, SUGARY - TEXTURED, POROUS, ABSORBENT, IRREGULAR FRACTURE, WHITE WITH - LIGHT GRAY MOTTLING.					
	~~DOLOMITE - MODERATELY HARD, FINE - GRAINED, POROUS, ABSORBENT, IRREGULAR~~ FRACTURE, PALE YELLOWISH GRAY.					
/73.606C	DOLOMITE - MODERATELY HARD, FINE - GRAINED, EVEN TEXTURED, POROUS, ABSORBENT, SUB - BLOCKY FRACTURE, TRACE OF ASPHALT FILLING PORES, PALE YELLOWISH BROWN.	2.50	3.46%			
	DOLOMITE - MODERATELY HARD, VERY FINE - GRAINED, MICROPOROUS, ABSORBENT, MODERATE AMOUNT OF PETROLEUM, VERY LIGHT TAN WITH YELLOWISH BROWN MOTTLING	2.58	2.83%			
/73.606C	DOLOMITIC LIMESTONE - MODERATELY HARD, FINE - GRAINED, DENSE TO MICROPOROUS, SUB-BLOCKY FRACTURE, LIGHT YELLOWISH GRAY WITH MEDIUM GRAY MOTTLING	2.73	0.69%			
/73.606C	DOLOMITE - MODERATELY HARD, FINE-GRAINED WITH SUGARY-TEXTURE, MICROPOROUS ABSORBENT, YELLOWISH GRAY WITH SLIGHT DARK GRAY MOTTLING.	2.64	2.13%			
	DOLOMITE - MODERATELY HARD, FINE TO MEDIUM-GRAINED, MICROPOROUS, ABSORBENT, BLOCKY FRACTURE, YELLOWISH GRAY.	2.63	1.50%			
	7					

TESTING

TS						
ART	L.W. PART	SO. PART	CLAY LUMPS	WET-DRY(80 CYCLES)	FREEZE-THAW(35 CYCLES)	
						DUE TO HIGH CHERT QUIRED. RETESTING
						NOTE RELATIVELY L
				ONE PARTIALLY OPENED FRACTURE.	NO EFFECT	
				NO EFFECT	NO EFFECT	
				NO EFFECT	NO EFFECT	
				NO EFFECT	PARTING OF STYLOLITE	
				NO EFFECT	NO EFFECT	
	3					

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TO A

PHASE I

…PS	WET-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)	REMARKS
			DUE TO HIGH CHERT CONTENT USE OF LOW ALKALI CEMENT IS REQUIRED. RETESTING REQUIRED PRIOR TO APPROVAL.
			NOTE RELATIVELY LIGHT SSD. SELECTIVE QUARRYING REQUIRED.
	ONE PARTIALLY OPENED FRACTURE.	NO EFFECT	
	NO EFFECT	NO EFFECT	
	NO EFFECT	NO EFFECT	
	NO EFFECT	PARTING OF STYLOLITE	
	NO EFFECT	NO EFFECT	

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SOURCE	FORMATION	PROPOSED USE	LAB.NO.	
QUALITY QUARRIES QUARRY AT KELLEYS ISLAND, OH	AMHERSTBURG AND LUCAS DOLOMITE	12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE	ORD 103/76T.603B	LIFT I C... PLANES OF ...
			ORD 103/76T.603B	LIFT II D... EVENLY TE... LOWISH BR...
			ORD 103/78.601B	LIFT IA ... MENT IS C... ORANGE TO ...
			ORD 103/78.601B	LIFT II -... RUBBLY AP... BROWN TO ...
			ORD 103/78.601B	LIFT II-... POROUS, ... CONTAINS ... LOW BROW...
			ORD 103/78.601B	LIFT II-... LY DENSE ... GRAINED ... BROWN.
			ORD 103/78.631B	CONTACTS ...

SUMMARY SHEET FOR LABORATORY

.NO.	PETROGRAPHIC ANALYSIS	SP.GRAV.	ABS.	$MgSO_4$	L.A.A.	F&E
				TEST RESUL		
T.603B	LIFT I CALCAREOUS DOLOMITE: MODERATELY HARD, POROUS, ABSORBENT, NO PLANES OF WEAKNESS, MOTTLED YELLOWISH BROWN.	2.48 TO 2.60	2.27% TO 4.48%			
T.603B	LIFT II DOLOMITE: MODERATELY HARD, INTERCONNECTED PORE SPACE, FINE-GRAINED EVENLY TEXTURED, TOUGH BLOCKY FRACTURE, MEDIUM GRAY MOTTLING, PALE YELLOWISH BROWN.	2.41 TO 2.48	41.3% TO 6.06%			
.601B	LIFT IA DOLOMITE: MASSIVE, MODERATELY HARD, FINE GRAINED, FOSSIL REPLACEMENT IS CALCITE ALONG BEDDING PLANES, IRREGULAR BLOCKY FRACTURE, VERY PALE ORANGE TO VERY PALE YELLOW BROWN.	2.47 TO 2.51	4.15 TO 4.8%			
.601B	LIFT II - UNIT I, LOWER: CALCITIC DOLOMITE: MASSIVE, MODERATELY HARD, RUBBLY APPEARANCE, INTERCONNECTED PORE SYSTEM, MOTTLED, PALE YELLOWISH BROWN TO VERY LIGHT GRAY TO MEDIUM LIGHT GRAY.	2.33 TO 2.34	5.85% TO 6.72%			
.601B	LIFT II-UNIT 5. DOLOMITE: RUBBLY APPEARANCE, STYLOLITIC, FRACTURED, TOUGH, POROUS, VUGGY, ABSORBENT. APPEARS TO BE "PEWORKED". FINE GRAINED, MASSIVE, CONTAINS CALCITE "DOG TOOTH SPAR". MOTTLED, GRAYISH ORANGE TO PALE YELLOW BROWN, MEDIUM LIGHT GRAY AND LIGHT OLIVE GRAY.	2.45	5.07%			
8.601B	LIFT II-UNIT 6 DOLOMITE: THIN TO MEDIUM BEDDED, MODERATELY HARD, MODERATELY DENSE WITH VERY FINE INTERCONNECTED PORE SPACE, FINE TO VERY FINE GRAINED DOLOMITE RHOMBS. MOTTLED PALE YELLOWISH BROWN TO DARK YELLOWISH BROWN.	2.44	4.26 %			
78.631B	CONTACTS BETWEEN KI-L2-1 (LOWER) AND KI-L2-2.					
	2					

ESTING

.W. PART	SO. PART	CLAY LUMPS	WET-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)	RE
			NO EFFECT	NO EFFECT	
			NO EFFECT	NO EFFECT	
			0.04% LOSS	0.34% LOSS	
			0.22% LOSS	0.215% LOSS	SSD IS TO LIGHT FOR THIS
			0.07% LOSS	0.233% LOSS	
			0.04% LOSS	0.365% LOSS	
			TESTED FOR STYLOLITE BREAKDOWN NO EFFECT	NO EFFECT	
	3				

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MPS	WET-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)	REMARKS
	NO EFFECT	NO EFFECT	
	NO EFFECT	NO EFFECT	
	0.04% LOSS	0.34% LOSS	
	0.22% LOSS	0.215% LOSS	SSD IS TO LIGHT FOR THIS PROJECT (ALL OF LIFT II).
	0.07% LOSS	0.233% LOSS	
	0.04% LOSS	0.365% LOSS	
	TESTED FOR STYLOLITE BREAKDOWN NO EFFECT	NO EFFECT	

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PLATE A2

SOURCE	FORMATION	PROPOSED USE	LAB NO.	
SANDUSKY CRUSHED STONE CO. QUARRY AT PARKERTOWN, OH	DELAWARE DOLOMITE AND COLUMBUS LIMESTONE	COARSE AND FINE AGGREGATE	ORD 103/72.606C	LIMESTONE - STONE - 1%, -1%, CHERT
				DOLOMITIC L FOSSILIFER DOLOMITIC
				DOLOMITIC FRACTURE,
				CHERTY LIM TO CHONCHO
				LIMESTONE - SUB-BLOCKY TROL PARTI
				DOLOMITE - SUB-BLOCKY DARK YELLO
			ORD 103/75.617B	FOSSILIFER
			ORD 101/76T.306B	DOLOMITE - ARGILLACE LIMESTONE
		RIPRAP, BEDDING AND GABION STONE.	ORD/77.310B	DOLOMITE - - 5%; CRI
R.W. SIDLEY PIT AT THOMPSON, OH	SHARON CONGLOMORATE	FINE AGGREGATE	HERRON TESTING H15707	
			ORD 103/75.610B	QUARTZ -

SUMMARY SHEET FOR LABORATORY

NO.	TEST RESUL					
	PETROGRAPHIC ANALYSIS	SP. GRAV.	ABS.	$MgSO_4$	L.A.A.	F&E
.606C	LIMESTONE - 11%, DOLOMITIC LIMESTONE - 66%, ARGILLACEOUS DOLOMITIC LIMESTONE - 1%, FOSSILIFEROUS DOLOMITIC LIMESTONE - 20%, CARBONACEOUS SHALE -1%, CHERT - 1%.	2.62	2.0%	86%		14%
	DOLOMITIC LIMESTONE - 53%, FOSSILIFEROUS DOLOMITIC LIMESTONE - 33%, FOSSILIFEROUS LIMESTONE - 9%, SHALY DOLOMITIC LIMESTONE - 2%, CHERTY DOLOMITIC LIMESTONE - 2%, CHERT - 1%.	2.65	1.99%	2%	29%	6%
	DOLOMITIC LIMESTONE - HARD, FINE-GRAINED, EVEN-TEXTURED, DENSE, BLOCKY FRACTURE, MODERATE BROWNISH GRAY.	2.69	0.44%			
	CHERTY LIMESTONE - HARD, FINE-GRAINED, VERY EVEN-TEXTURED, DENSE, BLOCKY TO CHONCHODIAL FRACTURE, MODERATE BROWNISH GRAY.	2.42	7.84%			
	LIMESTONE - HARD, COARSE-GRAINED, DENSE, FOSSILIFEROUS, SUB-CONCHOIDAL TO SUB-BLOCKY FRACTURE, PAPER-THIN, SHALY, INTERNAL BEDDING SEAMS THAT CONTROL PARTING, MODERATE OLIVE GRAY.	2.72	0.48%			
	DOLOMITE - HARD, FINE-GRAINED, EVEN-TEXTURED, MICROPOROUS, ABSORBENT, SUB-BLOCKY FRACTURE, PAPER-THIN, WAVY, DISCONTINUOUS CARBONACEOUS SEAMS. DARK YELLOWISH BROWN.	2.67	1.54%			
75.617B	FOSSILIFEROUS LIMESTONE - 29%; DOLOMITE - 67%; CHERT - 4%.	2.56	3.2%			6.0%
76T.306B	DOLOMITE - 26%; CALCAREOUS DOLOMITE - 19%; DOLOMITIC LIMESTONE - 20%; ARGILLACEOUS DOLOMITIC LIMESTONE - 22%; LAMINATED ARGILLACEOUS DOLOMITIC LIMESTONE - 6%; LAMINATED DOLOMITE - 6%; CHERTY DOLOMITIC LIMESTONE - 1%.	2.65	2.0%	9.31%	24.4%	20%
77.310B	DOLOMITE - 83%; LIMESTONE TO CALCITIC DOLOMITE - 10%; WEATHERED DOLOMITE - 5%; CRINOIDAL LIMESTONE - 2%; CALCAREOUS SHALE - TRACE.	2.65	1.9%			
ON ING 07		2.59	0.8%	NO. 504 1.17%		
75.610B	QUARTZ - 97%; SANDSTONE AND SILTSTONE - 2%; IGNEOUS, METAMORPHIC - 1%.	2.62 TO 2.60	0.49 TO 0.28 %	2.5 TO 4.5 %	26.13	1.

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TESTING

RT	L.W. PART	SO. PART	CLAY LUMPS	WET-DRY(80 CYCLES)	FREEZE-THAW(35 CYCLES)	
	NONE	NONE	NONE			TESTED FOR FINE AGG
	NONE	NONE	NONE			TESTED FOR CELL FIL
				NO EFFECT		
					COMPLETE DISINTEGRATION OF THE LARGE CHERT NODULES AFTER ONE FREEZE-THAW CYCLE.	CONTAINS LARGE CHE BENT AND HIGHLY SU TEST.
				OPENING AND PARTING OF THIN SHALY BEDDING SEAMS.		
					TIGHT HAIRLINE CRACKS PARALLEL TO BEDDING.	
						CELL FILL MATERIAL
						FAIR QUALITY FOR
				NO. 400 SILICA SAND		
					TESTED FOR C.A. #4-3/4" FINE AGGREGATE.	
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UMPS	WET-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)	REMARKS
			TESTED FOR FINE AGGREGATE FOR CONCRETE.
			TESTED FOR CELL FILL AND COARSE AGGREGATE FOR CONCRETE.
	NO EFFECT		
		COMPLETE DISINTEGRATION OF THE LARGE CHERT NODULES AFTER ONE FREEZE-THAW CYCLE.	CONTAINS LARGE CHERT NODULES THAT ARE CHALKY. POROUS, ABSORBENT AND HIGHLY SUSCEPTIBLE TO BREAKDOWN UNDER FREEZE-THAW TEST.
	OPENING AND PARTING OF THIN SHALY BEDDING SEAMS.		
		TIGHT HAIRLINE CRACKS PARALLEL TO BEDDING.	
			CELL FILL MATERIAL.
			FAIR QUALITY FOR COARSE AGGREGATE
	NO. 400 SILICA SAND		
		TESTED FOR C.A. #4-3/4" FINE AGGREGATE.	

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

SUMMARY SHEET
LABORATORY TEST RESULTS

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO
PHASE II, APPENDIX A, DATED FEBRUARY 1979

SOURCE	FORMATION	PROPOSED USE	LAB. NO.	
STANDARD SLAG CO. QUARRY AT MARBLEHEAD, OH	LUCAS AND AMHERSTBURG DOLOMITE	12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE COARSE AND FINE AGGREGATE	ORD 103/69.607C	DOLOMITE HARD, LOWISH BROWN
		12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE COARSE AND FINE AGGREGATE	ORD 103/72.606C	LIMESTONE - 6% CARBONACEOUS DOLOMITE - 81%
				DOLOMITIC LIME SLIGHTLY POROU DOLOMITIC LIME SIZED DOLITES,
		12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE COARSE AND FINE AGGREGATE	ORD 103/76.601B	
		12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE COARSE AND FINE AGGREGATE	ORD 103/76.615B	
		12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE COARSE AND FINE AGGREGATE	ORD 103/76.616B	
		12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE COARSE AND FINE AGGREGATE	ORD 103/75.628B	DOLOMITE - G FRAGMENTS SCA SEAMS, ALONG CALCITE-HEALE
		12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE COARSE AND FINE AGGREGATE	ORD 103/75.628B	DOLOMITE - 6 SANDY LIMESTO
		12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE COARSE AND FINE AGGREGATE	ORD 103/75.633B	DOLOMITE - H SUGARY TEXTU

SUMMARY SHEET FOR LABORATORY

NO.	PETROGRAPHIC ANALYSIS	SP.GRAV.	ABS.	$MgSO_4$	L.A.A.	F&E F
		TEST RESULT				
7C	DOLOMITE HARD, VERY FINE-GRAINED, DENSE, IRREGULAR FRACTURE, DARK YELLOWISH BROWN WITH VERY LIGHT TAN BLOTCHES.	2.62	2.01%			
06C	LIMESTONE - 6%, SANDY DOLOMITIC LIMESTONE - 8%, DOLOMITIC LIMESTONE - 85%, CARBONACEOUS SHALE - 1%.	2.59	3.58%		32%	21%
	DOLOMITE - 81%, LIMESTONE - 19%	2.62	2.74%	8%	26%	18%
	DOLOMITIC LIMESTONE - HARD, MEDIUM-GRAINED, SUGARY-TEXTURED, DENSE TO SLIGHTLY POROUS, ABSORBENT, SUB-BLOCKY FRACTURE, MODERATE BROWNISH GRAY.	2.64	1.78%			
	DOLOMITIC LIMESTONE - HARD, FINE-GRAINED, SUB-LITHOGRAPHIC TEXTURE, FINE-SIZED OOLITES, SUB-CONCHOIDAL FRACTURE, PALE YELLOWISH BROWN.	2.75	0.68%			
001B		2.54	3.68%			
615B		2.55	3.75%			
616B		2.38-2.64	1.6-6.0%			
628B	DOLOMITE - GRAYISH, FINE-GRAINED WITH MEDIUM SIZED CALCAREOUS FOSSIL FRAGMENTS SCATTERED THROUGH THE MATRIX, NUMEROUS BRANCHING STYLOLITIC SEAMS, ALONG WHICH SAND IS CONCENTRATED, BEDDING: THIN TO MEDIUM. CALCITE-HEALED FRACTURES.	2.27-2.71	0.3-8.1%			
628B	DOLOMITE - 64%, CALCAREOUS SANDY DOLOMITE - 21%, SHALY DOLOMITE - 10%, SANDY LIMESTONE - 1%, LITHOGRAPHIC LIMESTONE - 1%, CHERT - 2%	2.48-2.50	4.5-5.4%	13.5-30.2% 1½" TO ¾" RESP.	"A" 41	
633B	DOLOMITE - MASSIVE, UNIFORM, MODERATELY HARD, VERY FINELY CRYSTALLINE, SUGARY TEXTURED, MODERATELY POROUS, FOSSILIFEROUS, LIGHT BROWN	2.28-2.76	0.3-8.4%			

TESTING

T	L.W. PART	SO. PART	CLAY LUMPS	WET-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)	
				NO EFFECT	NO EFFECT	
	NONE	NONE	NONE			F.M. 2.72, TESTED FO TESTED FOR COARSE AG
				NO EFFECT	NO EFFECT	TESTED FOR RIPRAP AN ABS-2.71%)
						1 1/2" MINUS
						2" MINUS
				EFFECTS NEGLIGIBLE, WT. LOSS 0.00-1.37%	MOSTLY SURFACE SPALLING SOME FRACTURING 0.48-6.23% AV.WT.LOSS	13 SAMPLES TESTED F
				SEPARATION OF PRE-EXISTING FRACTURES.	NO EFFECT TO SEVERE DISINTEGRA-TION	11 SAMPLES TESTED,
					SEPARATION OF PRE-EXISTING FRAC-TURES.	
						31 LEDGEROCK SAMPLE TION.
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PHASE II,

-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)	REMARKS
...ECT	NO EFFECT	
		F.M. 2.72, TESTED FOR FINE AGGREGATE FOR CONCRETE TESTED FOR COARSE AGGREGATE FOR CONCRETE.
...ECT	NO EFFECT	TESTED FOR RIPRAP AND LARGER STONE (SAMPLE SS-3, SG-2.57, ABS-2.71%)
		1 1/2" MINUS
		2" MINUS
...TS NEGLIGIBLE, WT. 0.00-1.37%	MOSTLY SURFACE SPALLING SOME FRACTURING 0.48-6.23% AV.WT.LOSS	13 SAMPLES TESTED FROM "SOLUTION CHIMNEYS" IN QUARRY
...ATION OF PRE-EXISTING ...URES.	NO EFFECT TO SEVERE DISINTEGRATION	11 SAMPLES TESTED, UNITS 7,8,9,15,17 ARE SUITABLE FOR RIPRAP
	SEPARATION OF PRE-EXISTING FRACTURES.	
		31 LEDGEROCK SAMPLES TESTED FOR SPECIFIC GRAVITY AND ABSORPTION.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

SUMMARY SHEET
LABORATORY TEST RESULTS

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO
PHASE II, APPENDIX A, DATED FEBRUARY 1979

4

SOURCE	FORMATION	PROPOSED USE	LAB.
WAGNER QUARRIES QUARRY AT SANDUSKY, OH	COLUMBUS LIMESTONE	COARSE AND FINE AGGREGATE	ORD 101/66.
			ORD 103/72.
		COARSE AND FINE AGGREGATE	ORD 103/72.
		COARSE AND FINE AGGREGATE	ORD 101/74.
		COARSE AND FINE AGGREGATE	ORD 101/76.
WOODVILLE LIME AND CHEMICAL CO. QUARRY AT WOODVILLE, OH	NIAGARAN DOLOMITE	COARSE AND FINE AGGREGATE 12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE	ORD 101/71
		COARSE AND FINE AGGREGATE 12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE	ORD 101/71
		COARSE AND FINE AGGREGATE 12 AND 18 INCH RIPRAP, BEDDING AND GABION STONE	ORD 101/71

SUMMARY SHEET FOR LABORATOR

B. NO.	TEST RESU					
	PETROGRAPHIC ANALYSIS	SP. GRAV.	ABS.	$MgSO_4$	L.A.A.	F&I
.904C	DOLOMITIC LIMESTONE - 92.5%, FOSSILIFEROUS LIMESTONE - 6%, CHERT - 1%, SHALE - 0.5%.	2.70	0.7%	1.9%	24.5%	2%
2.606C	DOLOMITIC LIMESTONE - 91%, LIMESTONE - 9%, CARBONACEOUS SHALE - TRACE, CALCITE - TRACE	2.63	1.82%		38%	12%
2.606C	LIMESTONE - 53%, DOLOMITIC LIMESTONE - 24%, FOSSILIFEROUS LIMESTONE -18%, ARGILLACEOUS LIMESTONE - 5%.	2.69	0.91%	8%	20%	16%
	DOLOMITIC LIMESTONE - HARD, FINE-GRAINED, SLIGHTLY FOSSILIFEROUS, DENSE, IRREGULAR TO SUB-BLOCKY FRACTURE, MODERATE BROWNISH GRAY.	2.72	0.23%			
	LIMESTONE - HARD, MEDIUM-GRAINED, EVEN-TEXTURED, DENSE, SLIGHTLY DOLOMITIC, BLOCKY FRACTURE, MEDIUM-GRAY.	2.74	0.55%			
74.305C	LIMESTONE - 29%, DOLOMITIC LIMESTONE - 40%, FOSSILIFEROUS DOLOMITIC LIMESTONE - 27%, LIMESTONE - 4%.	2.68	1.37%	1.15%	24.7%	15%
76.302B	LIMESTONE - ARGILLACEOUS, LIGHT GRAY, MODERATELY HARD, DENSE, FOSSILIFEROUS - 40%, CALCAREOUS DOLOMITE - 16%, SHALY DOLOMITE - 39%, CHERT - 1%, ARGILLACEOUS CALCAREOUS DOLOMITE - 4%.	2.66	1.50%	0.44%	3%	3%
	LIMESTONE - ARGILLACEOUS, LIGHT GRAY, MODERATELY HARD - 29%, CALCAREOUS DOLOMITE - 16%, SLIGHTLY ARGILLACEOUS CALCAREOUS DOLOMITE - 34%, SLIGHTLY SHALY CALCAREOUS DOLOMITE - 19%, ARGILLACEOUS CALCAREOUS DOLOMITE - 2%, WEATHERED FRAGS. CHERT - TRACE.	2.63	1.42%	0.40%	28.6%	3%
71.320C	DOLOMITE - MODERATELY HARD, FINE GRAINED, MACROPOROUS, VUGGY, OLIVE GRAY LIGHT MEDIUM GRAY TO YELLOWISH GRAY; OCCASIONALLY IRON STAINED.	2.65	1.84%			
71.312C	DOLOMITE - HARD, MEDIUM GRAINED, DENSE, POROUS, LIGHT GRAY TO LIGHT TAN.	2.68	2.1%	24.9%		20%
71.312C	DOLOMITE - MODERATELY HARD, FINE GRAINED, POROUS TO VUGGY.	2.70	1.91%	24%		
	2					

TESTING

RT	L.W PART	SO. PART	CLAY LUMPS	WET-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)	
	NONE					CRUSHED STONE. 3/4" T
	NONE					SAMPLE TESTED FOR FIN
	NONE				NO EFFECT	TESTED FOR COARSE AG
				NO EFFECT		THIS QUARRY RELUCTANT
						TEST PERFORMED ON 4"
						OHIO #4 COARSE CONCR
						OHIO #57 COARSE CONC
				NO EFFECT	NO EFFECT	SAMPLES CONTAINED S FRACTURES WERE NOT E CYCLES.
						TESTED FOR FINE AG FM-3.03)
						TESTED FOR FINE AG FM-3.30)
						TESTED FOR COARSE A FILTER MATERIAL, BA
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PHASE II

WET-DRY(80 CYCLES)	FREEZE-THAW(35 CYCLES)	REMARKS
		CRUSHED STONE. 3/4" TO 1 1/2". TESTED FOR CONCRETE AGGREGATE SAMPLE TESTED FOR FINE AGGREGATE FOR CONCRETE; FM-2.90
	NO EFFECT	TESTED FOR COARSE AGGREGATE FOR CONCRETE.
NO EFFECT		THIS QUARRY RELUCTANT TO PRODUCE GRADED RIPRAP. TEST PERFORMED ON 4" TO 3/4".
		OHIO #4 COARSE CONCRETE AGGREGATE OHIO #57 COARSE CONCRETE AGGREGATE.
NO EFFECT	NO EFFECT	SAMPLES CONTAINED SOME BLASTING FRACTURES. APPARENTLY THESE FRACTURES WERE NOT EFFECTED BY THE FREEZE THAW, WET-DRY CYCLES.
		TESTED FOR FINE AGGREGATES FOR CONCRETE (MANUFACTURED SAND FM-3.03)
		TESTED FOR FINE AGGREGATE FOR CONCRETE (MANUFACTURED SAND FM-3.30)
		TESTED FOR COARSE AGGREGATE FOR CONCRETE. GRANULAR BACKFILL, FILTER MATERIAL, BASE COURSE AND BEDDING.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

SUMMARY SHEET LABORATORY TEST RESULTS

US ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO
PHASE II, APPENDIX A, DATED: FEBRUARY 1979

BORING NO	SAMPLE NO	DEPTH OF ... SAMPLE	LABORATORY CLASSIFICATION	MECHANICAL ANALYSIS [illegible]	SAND %	FINES %	D_{10}	ATTERBERG LIMITS LL	PL	SPECIFIC GRAVITY G	NAT WATER CONT %	NATURAL DRY DENSITY LBS/CU FT	COMPACTION DATA OPT WATER %	MAXIMUM DRY DENSITY LBS/CU FT	INI
HA 78-1	1	0.0-2.0	CL	11	26	63		29	15						
	2	2.0-3.0'	CL	3	21	76		37	19						
	3	3.0-4.0'	CL		20	80		-	-						
	4	4.0-5.0'	CL		10	90		-	-						
	5	5.0-6.0'	CL	1	10	89		45	21						
HA 78-2	1	1.0-2.0'	CL	3	32	65		34	18						
	2	2.0-3.0'	CL	2	32	66		-	-						
	3	3.0-4.0'	CL	3	28	69		34	16						
	4	4.0-5.0'	CL	3	30	67		-	-						
HA 78-3	1	1.0-2.0'	CL	-	-	-		34	18						
	2	2.0-3.0'	CL	4	30	66		-	-						
	3	3.0-4.0'	CL	-	-	-		34	16						
	4	4.0-5.0'	CL	3	35	62		-	-						
COMPOSITE SAMPLE FROM: HA 78-1, SAMPLES 1, 2, 5; HA 78-2, SAMPLES 2, 3; HA 78-3, SAMPLES 1, 3								32	17	2.76	-	-	15.6	116.6	
TP78-1	1	0.0-1.0	CL	8	30	62		-	-						
TP78-2	1	0.0-1.0	CL	7	28	65		30	16						
TP78-3	1	0.0-2.0	CL	-	33	67		-	-						

TEST DATA SUMMARY

PROJECT BIG CREEK F.C.P. METRO PARKS, BORROW AREA, BEREA, OHIO

	SHEAR DATA												PERMEABILITY		CONSO	
	INITIAL e	DRY DENSITY LBS CU FT	W_1 %	W_F %	S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_m T/SQ FT	σ_1 T/SQ FT	c T/SQ FT	ϕ DEGREES	e	K FT/MIN.	P_0 T/SQ FT	T/

T – TRIAXIAL COMPRESSION

UC – UNCONFINED COMPRESSION

DS – DIRECT SHEAR

Q – UNCONSOLIDATED UN

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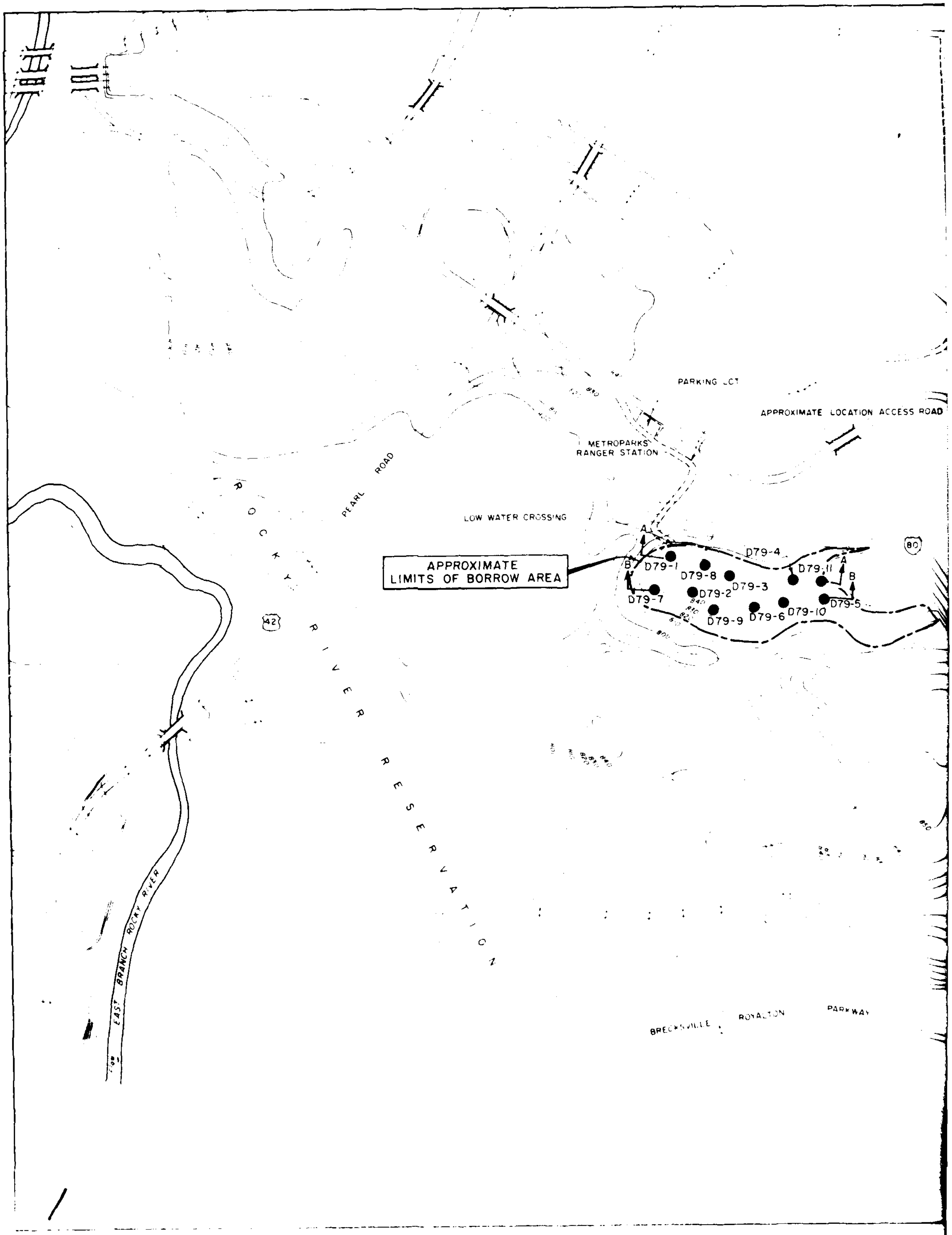
SHEET ______ OF ______

METRO PARKS, BORROW AREA, BEREA, OHIO

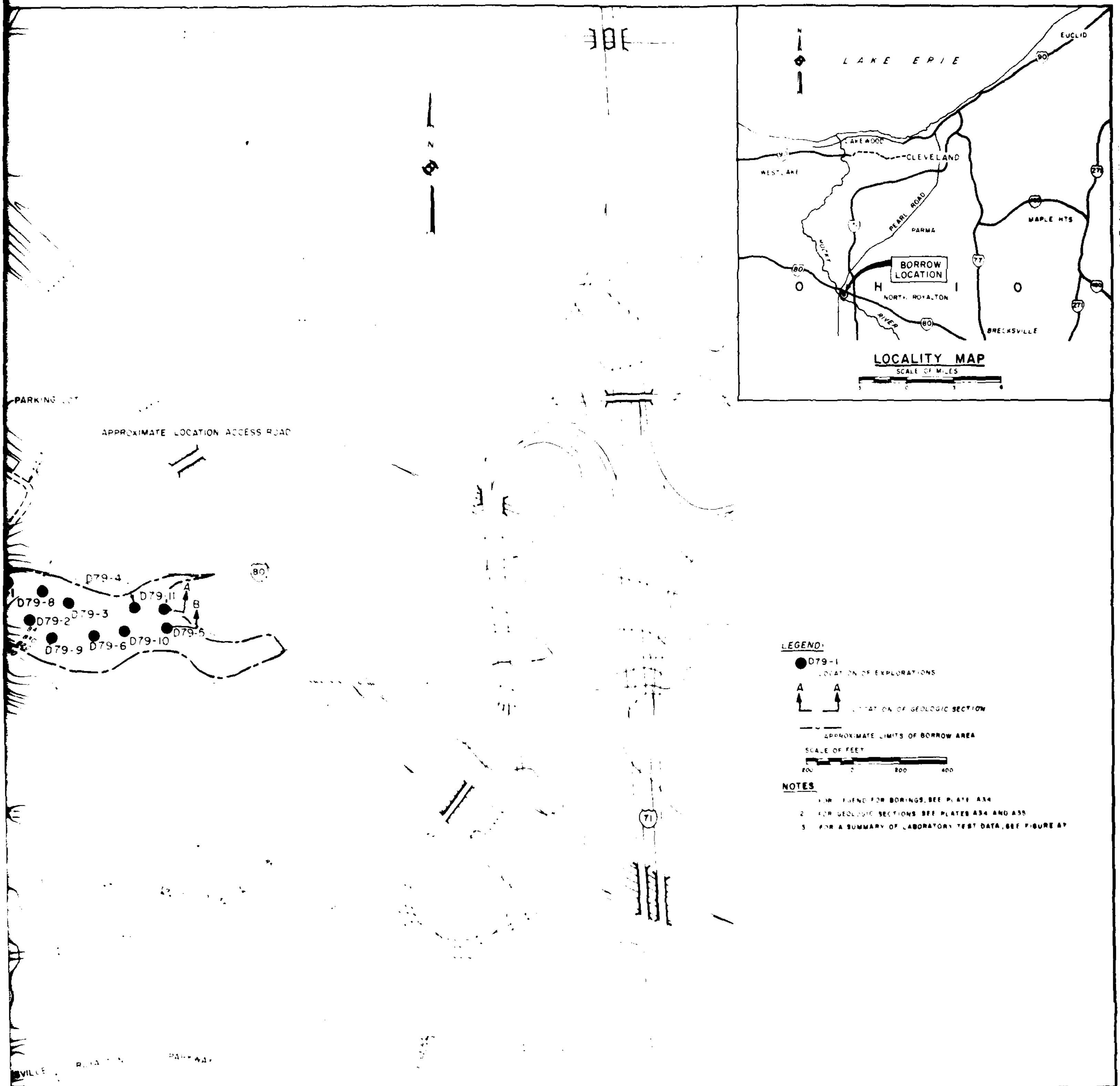
SHEAR DATA								PERMEABILITY		CONSOLIDATION DATA				REMARKS
S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_m T/SQ FT	σ_1 T/SQ FT	[illegible] T/SQ FT	ϕ DEGREES	e	K FT/MIN.	P_O T/SQ FT	P_C T/SQ FT	C_C	t_{50}	

T – TRIAXIAL COMPRESSION
UC – UNCONFINED COMPRESSION
DS – DIRECT SHEAR
Q – UNCONSOLIDATED UNDRAINED
S – CONSOLIDATED DRAINED
R – CONSOLIDATED UNDRAINED

PLATE A32



PARKING LOT
APPROXIMATE LOCATION ACCESS ROAD
METROPARKS
RANGER STATION
PEARL ROAD
LOW WATER CROSSING
ROCKY RIVER RESERVATION
42
80
APPROXIMATE
LIMITS OF BORROW AREA
A
B
D79-1
D79-2
D79-3
D79-4
D79-5
D79-6
D79-7
D79-8
D79-9
D79-10
D79-11
EAST BRANCH ROCKY RIVER
BRECKSVILLE ROYALTON PARKWAY



BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

LOCATION OF SUBSURFACE EXPLORATIONS METROPARK BORROW AREA NO. 1

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO PHASE II, APPENDIX A, DATED FEBRUARY 1979

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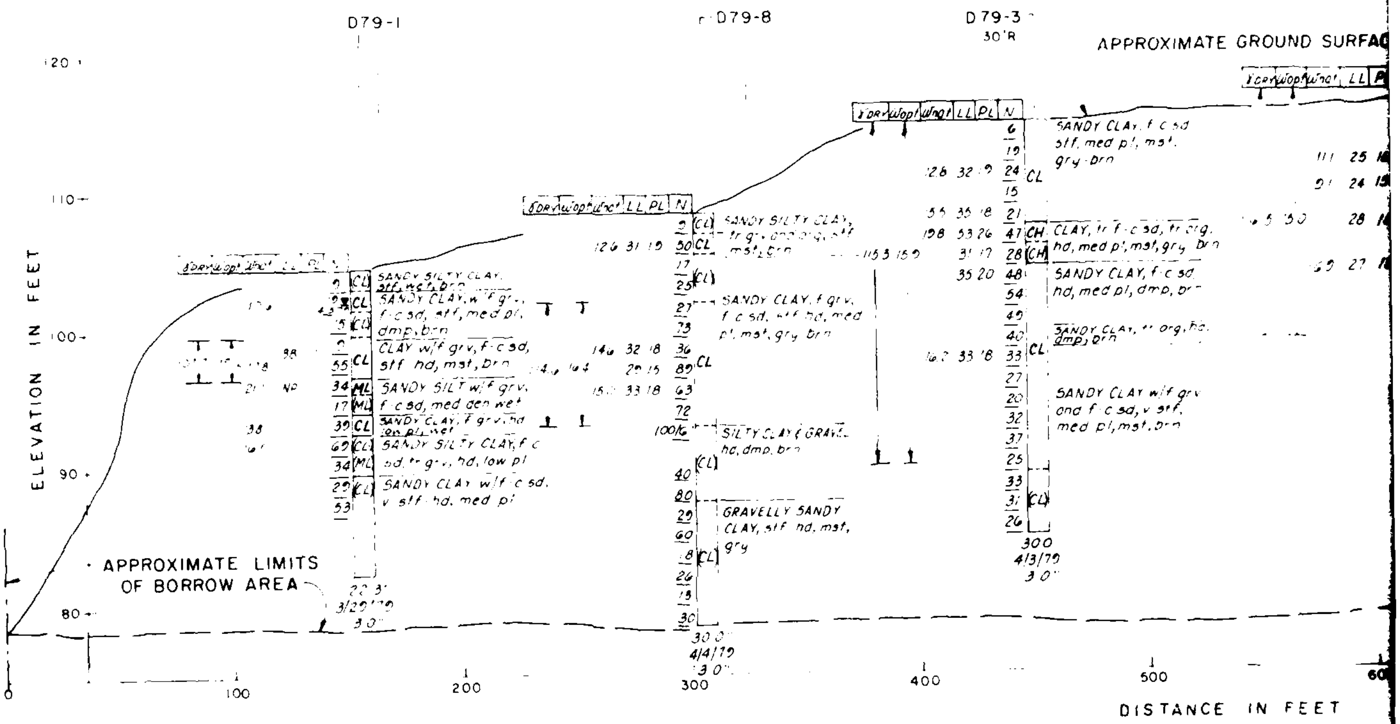

GEOLOGIC SECTION A-A

ABBREVIATIONS

LEGEND (UNIFIED SOIL CLASSIFICATION SYSTEM)

- GW WELL GRADED GRAVELS, GRAVEL SAND MIXTURES, LITTLE OR NO FINES.
- GP POORLY GRADED GRAVELS OR GRAVEL SAND MIXTURES, LITTLE OR NO FINES.
- GM SILTY GRAVELS, GRAVEL SAND SILT MIXTURES.
- GC CLAYEY GRAVELS, GRAVEL SAND CLAY MIXTURES.
- SW WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
- SP POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES.
- SM SILTY SANDS, SAND SILT MIXTURES.
- SC CLAYEY SANDS, SAND CLAY MIXTURES.
- ML INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.
- CL INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
- OL ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.
- MH INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS.
- CH INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.
- OH ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.
- PT PEAT AND OTHER HIGHLY ORGANIC SOILS.

CLASSIFICATION FROM ACTUAL LABORATORY TESTS WHERE LL AND PL ARE SHOWN.

DUAL CLASSIFICATION, WHERE USED, IS IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM.

FOR DETAILS ON THE UNIFIED SOIL CLASSIFICATION SYSTEM, SEE WATERWAYS EXPERIMENT STATION TECHNICAL MEMORANDUM [illegible] DATED MARCH [illegible] AND REVISED IN [illegible]

Hole numb
Dr
Yo
Bo
Of

Elevation
Standard
Plastic li
Liquid lim
Natural m
Optium dr
Optium m
Liquid Li
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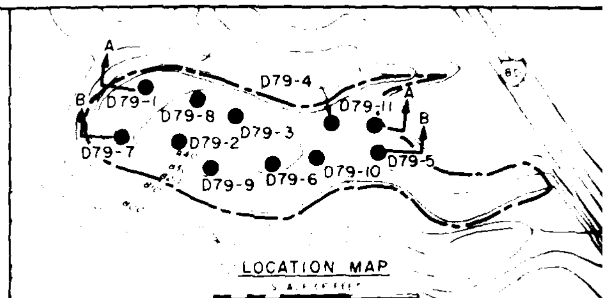
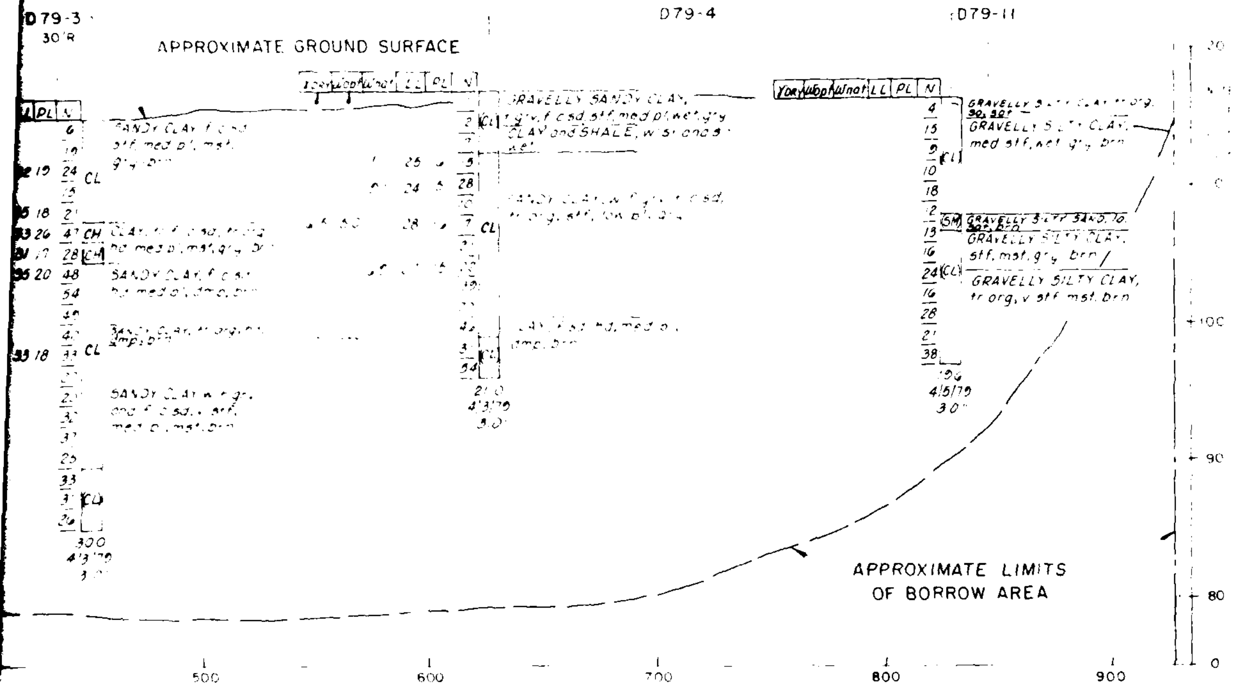
Dividing
Unified s
Dividing
(i.e. Bos
Visual cl

Total dep
Drilling
Diameter



LOCATION MAP



DISTANCE IN FEET

GEOLOGIC SECTION A-A

LEGEND FOR BORINGS

Hole number and designation
Drive sample
Year of boring
Boring number
Offset (Left or right of ℄)
Elevation and date water level encountered
Standard penetration test (Blows/Ft)
Plastic limit
Liquid limit
Natural moisture content %
Optimum dry density, PCF
Optimum moisture content %
Liquid Limit and Plastic Limit
Respectively of composite sample
used in compaction test
Dividing line between classifications
Unified soil classification determined in laboratory
Dividing line between method of classification
(i.e. Based on testing or visual)
Visual classification
Total depth of exploration
Drilling completion date
Diameter of soil sample

D 79-3

50 R

Material classification from visual and laboratory descriptions as appropriate

CLAY, tr f sd, so-med, sof, brn

CL

CH

TERMS FOR RELATIVE DENSITY AND CONSISTENCY

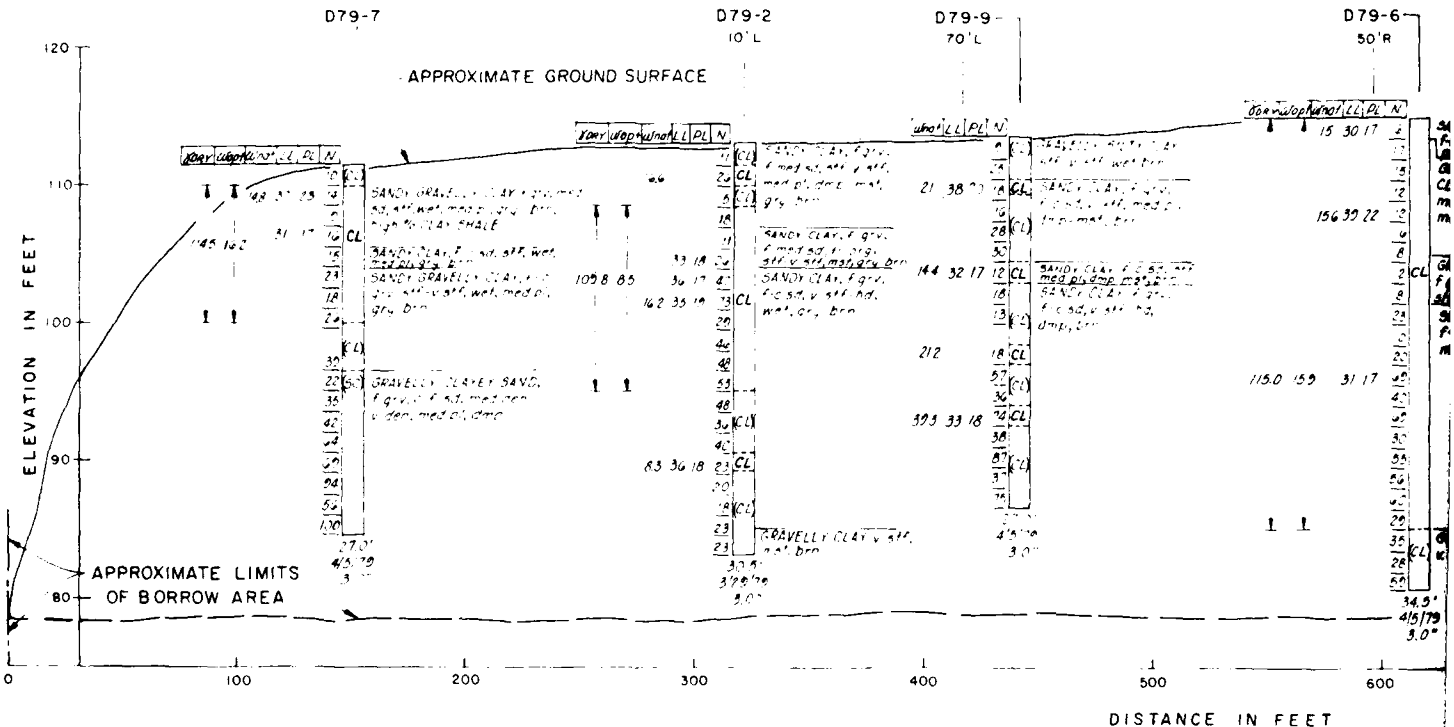
RELATIVE DENSITY OF SAND		CONSISTENCY OF CLAY	
PENETRATION RESISTANCE, N (BLOWS FT.)	RELATIVE DENSITY	PENETRATION RESISTENCE, N (BLOWS FT.)	CONSISTENCY
0-5	VERY LOOSE	<2	VERY SOFT
5-17	LOOSE	2-4	SOFT
17-45	MEDIUM DENSE	4-8	MEDIUM STIFF
45-70	DENSE	8-18	STIFF
>70	VERY DENSE	18-35	VERY STIFF
		>35	HARD

NOTE: N = STANDARD PENETRATION TEST
SAMPLER 3.5" O.D. (3.0" I.D.) SPLIT SPOON
HAMMER 375 LB. FALL 18"

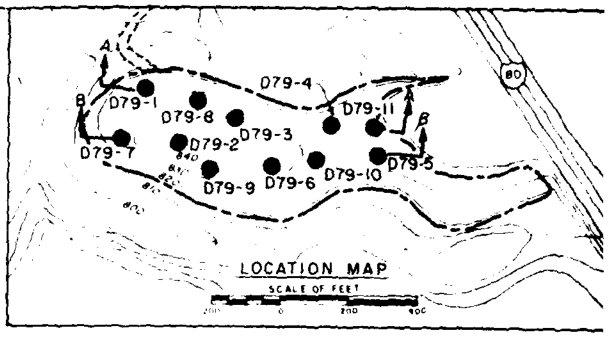
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

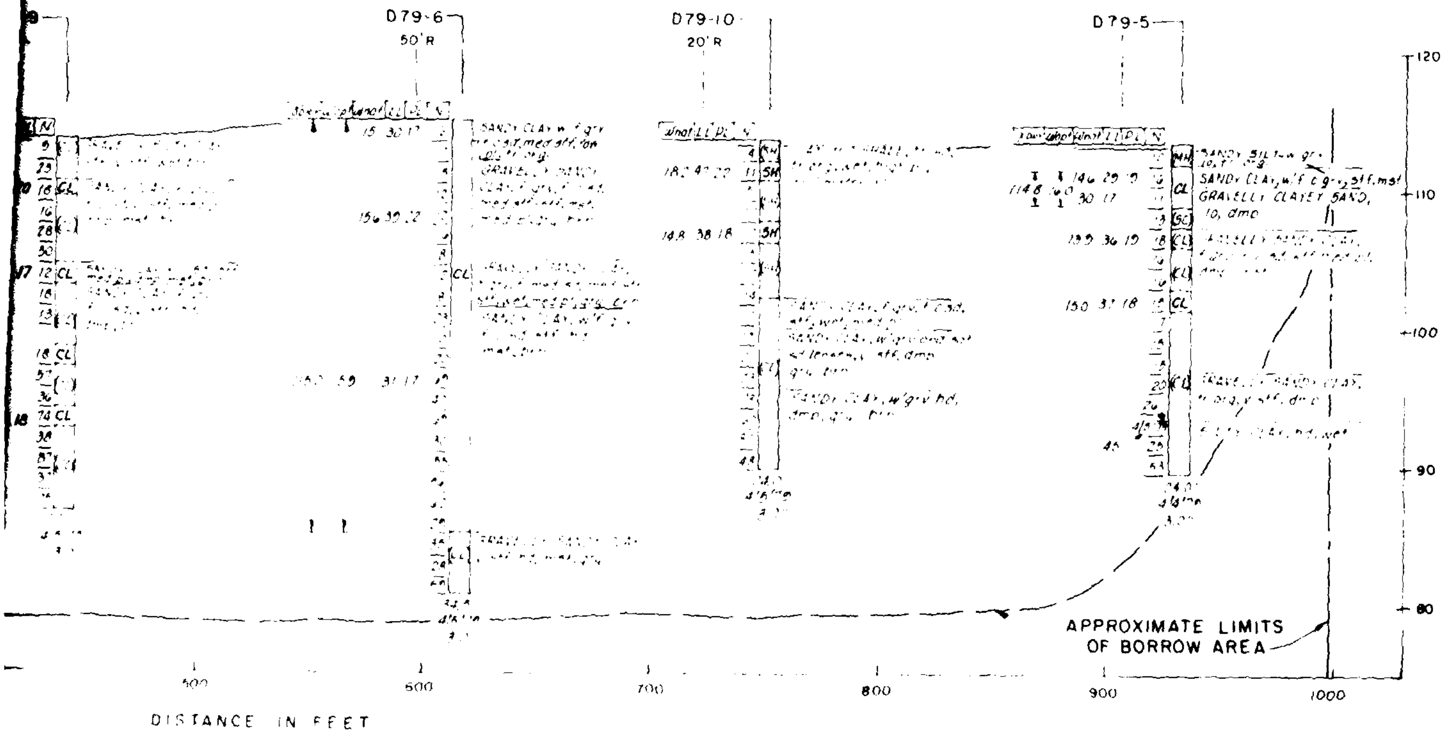
GEOLOGIC PROFILE A-A
METROPARK BORROW AREA NO.

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO PHASE
APPENDIX A, DATED FEBRUARY 1979



GEOLOGIC SECTION B-B





GEOLOGIC SECTION B-B

NOTES

1. FOR GENERAL LOCATION OF BORROW AREA SEE PLATE A33.
2. FOR OTHER GEOLOGIC SECTION SEE PLATE A34.
3. FOR SUMMARY OF LABORATORY TEST DATA, SEE FIGURE A?

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

GEOLOGIC PROFILE B-B
METROPARK BORROW AREA NO. I

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN MEMO PHASE I
APPENDIX A, DATED FEBRUARY 1979

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX A

SOILS, GEOLOGY, AND CONSTRUCTION MATERIALS

FEBRUARY 1979

SUBAPPENDIX A1

LOGS OF DRILL HOLES AND AUGER BORINGS

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Hole No. DC-78-1

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 of 2 SHEETS

1. PROJECT BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT NX, DIAMOND
2. LOCATION (Coordinates or Station) N 650,688 E 214,685	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) M.S.L.
3. DRILLING AGENCY F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL S & H 35H
4. HOLE NO. (As shown on drawing title and file number) DC-78-1	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: 8 JARS; UNDISTURBED:
5. NAME OF DRILLER WAYNE BOTTS	14. TOTAL NUMBER CORE BOXES 1
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 622.8
	16. DATE HOLE — STARTED 4 JUNE 78; COMPLETED 4 JUNE 78
	17. ELEVATION TOP OF HOLE 629.4
7. THICKNESS OF OVERBURDEN 11.5'	18. TOTAL CORE RECOVERY FOR BORING 7.4' = 87 %
8. DEPTH DRILLED INTO ROCK 8.5'	19. SIGNATURE OF INSPECTOR Peter G Rabyk
9. TOTAL DEPTH OF HOLE 20.0'	

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5	1, 2, 4	Grey Clayey SAND with black pebbles and small gravel. Dry.		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples). Drove 18" Recovered 12" Loss 6"
	1.5–3	8, 8, 8	Brown and grey CLAY. Variable to weathered shale. Dry.		JAR #2 (3')	Drove 18" Recovered 16" Loss 2"
	3–4.5	4, 4, 3	Grey CLAY with oxidation layers @ 1/8" to 1/4" intervals. Variable to weathered shale. Damp.		JAR #3 (4.5')	Drove 18" Recovered 18" Loss 0
	4.5–6	3, 2, 7	Grey and brown, silty CLAY with pebbles and shale fragments. Damp.		JAR #4 (6.0')	Drove 18" Recovered 14" Loss 4"
	6–7.5	10, 8, 5	Grey and brown, clayey SAND with weathered shale fragments. Damp.		JAR #5 (7.5')	Drove 18" Recovered 14" Loss 4"
	7.5–9	5, 5, 5	Brownish grey, sandy CLAY with trace of course sand and pebbles. Damp.		JAR #6 (9.0')	Drove 18" Recovered 18" Loss 0
	9–10	2, 3	Dark grey, silty CLAY with fine sand. Wet.		JAR #7	Drove 18" Recovered 10" Loss 8"

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) PROJECT A1-1 HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 629.4 | **Hole No.** DC-78-1

PROJECT BIG CREEK - CLEVELAND, OHIO | INSTALLATION BUFFALO DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		4	Silty CLAY See above.		10.5'	See Sheet 1
	11	12	Slightly weathered, grey SHALE. Platey.		JAR #8	Drove 12" Recovered 8" Loss 4"
618.4		50/0.5			11.5'	
	12 – 16		Approx. Top of Rock Soft Zone Ground Core Fragments Medium Grey, well indurated SHALE. Hard. Fractures parallel bedding Horizontal.	90%	RUN #1	Clean Fractures 14 pieces
609.4	17 – 20		Ground Core Soft Zone Fragments Soft Zone	83%	RUN #2	Clean Fractures 16 pieces
			Bottom of Hole			

Hole No. DC-78-2

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX, DIAMOND
2. LOCATION (Coordinates or Station): N 650,537 E 214,840	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S. & H. 35H
4. HOLE NO. (As shown on drawing title and file number): DC-78-2	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5 JARS; UNDISTURBED
5. NAME OF DRILLER: WAYNE BOTTS	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 622.4
	16. DATE HOLE: STARTED 5 JUNE 78; COMPLETED 5 JUNE 78
	17. ELEVATION TOP OF HOLE: 625.4
7. THICKNESS OF OVERBURDEN: 7.5'	18. TOTAL CORE RECOVERY FOR BORING: 9.9' = 86 %
8. DEPTH DRILLED INTO ROCK: 11.5'	19. SIGNATURE OF INSPECTOR: [signature] G [signature]
9. TOTAL DEPTH OF HOLE: 19.0'	

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5	8, 7, 6	Grey and brown, medium SAND with some pebbles. Dry.		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples) Drove 18" Recovered 12" Loss 6"
	1.5–3.0	4, 5, 5	Grey and brown, clayey medium SAND with pebbles and rotted shale fragments. Damp.		JAR #2 (3.0')	Drove 18" Recovered 12" Loss 6"
	3.0–4.5	4, 3, 3	Medium grey sandy CLAY with some coarse sand and scattered small pebbles. Damp.		JAR #3 (4.5')	Drove 18" Recovered 16" Loss 2"
	4.5–6.0	3, 2, 2	Dark grey silty CLAY with some medium and coarse sand. Damp, plastic.		JAR #4 (6.0')	Drove 18" Recovered 18" Loss 0
617.9	6.0–7.5	4, 30, 50/0.5'	Weathered (crumbly) grey silty SHALE. Dry.		JAR #5 (7.5')	Drove 18" Recovered 9" Loss 9"
	7.5–10		Approx. Top of Rock. Soft Zone. Well indurated, medium grey silty SHALE. Fracture parallel to bedding. Horizontal.	70%	RUN #1	Clean Fractures 8 pieces.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: 625.4 | **Hole No.** DC-78-2

PROJECT: BIG CREEK-CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10					
			Soft Zone			
	11			70%	RUN #1	Clean Fracture: 8 pieces
			Soft Zone			
	12					
			Soft Zone			
					12.5'	
	13					
			Soft Seam		RUN #2	Clean Fractures 11 pieces
	14		Well indurated, medium grey silty SHALE. Fracture parallel to bedding. Horizontal.	100%		
	15		Soft Seam			
			Fragments		15.8'	
	16					
	17			97%	RUN #3	Clean Fractures 19 pieces
			Incipient hairline fractures @ 1/4" spacing with refraction breaks.			
	18					
			Soft Zone			
			Soft Zone			
606.4	19				19.0'	
			Bottom of Hole.			

Hole No. DC-78-3

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 of 4 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX, DIAMOND
2. LOCATION (Coordinates or Station): N 650,278 E 215,715	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F. T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S. & H. 40C
4. HOLE NO. (As shown on drawing title and file number): DC-78-3	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13 JARS; UNDISTURBED
5. NAME OF DRILLER: GUY MALLOTT	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: [✓] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 618.0
	16. DATE HOLE: STARTED 4 JUNE 78; COMPLETED 4 JUNE 78
7. THICKNESS OF OVERBURDEN: 18.6'	17. ELEVATION TOP OF HOLE: 631.2
8. DEPTH DRILLED INTO ROCK: 17.4'	18. TOTAL CORE RECOVERY FOR BORING: 14.3' = 82 %
9. TOTAL DEPTH OF HOLE: 36.0'	19. SIGNATURE OF INSPECTOR: Peter G. Ralak

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	2, 2, 3	Black coarse SAND and GRAVEL with a trace of clay. Dry.		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples) Drove 18" Recovered 10" Loss 8"
	1–2	3, 4, 5	Grey and brown clayey SAND with pebbles and trace of organic litter. Damp.		JAR #2 (3.0')	Drove 18" Recovered 17" Loss 1"
	3–4	4, 4, 3	Grey, yellow, and brown Sandy CLAY with rotted shale fragments. Damp.		JAR #3 (4.5')	Drove 18" Recovered 18" Loss 0
	5	4, 5, 8			JAR #4 (6.0')	Drove 18" Recovered 18" Loss 0
	6–7	5, 5, 8	Orange and grey to orange and brown, Sandy CLAY with weathered shale fragments and pebbles (± 1/4"). Damp.		JAR #5 (7.5')	Drove 18" Recovered 18" Loss 0
	8	6, 7, 5			JAR #6 (9.0')	Drove 18" Recovered 18" Loss 0
	9–10	6, 5			JAR #7	Drove 18" Recovered 18" Loss 0

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 631.2	Hole No. DC-78-3
PROJECT BIG CREEK- CLEVELAND, OHIO	INSTALLATION BUFFALO DISTRICT	SHEET 2 OF 4 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	5	Sandy CLAY See above		#7 10.5'	See Sheet 1
		7	Medium grey silty CLAY with some fine sand. Damp, plastic			
	11	8			JAR #8	Drove 18" Recovered 18" Loss 0
		10			12.0'	
	12	12				
		14			JAR #9	Drove 18" Recovered 18" Loss 0
	13	15			13.5'	
		11				
	14	12			JAR #10	Drove 18" Recovered 18" Loss 0
		13			15.0'	
	15	13	Weathered grey SHALE with brown oxidized partings variable to grey silty clay. Damp.			
		10			JAR #11	Drove 18" Recovered 14" Loss 4"
	16	12			16.5'	
		12				
	17	10			JAR #12	Drove 18" Recovered 12" Loss 6"
		10			18.0'	
	18	20	Weathered grey SHALE variable to grey silty clay.		JAR #13 18.6'	Drove 7" Recovered 6" Loss 1"
612.6		50/0.1'	Approx. Top of Rock			
	19					
	20		Medium grey, well indurated SHALE. Fractures parallel to bedding. Horizontal. Core ground at top of run. Some soft portions. Incipient hairline fractures at 1/4" intervals	85%	RUN #1	Clean Fractures 11 pieces
	21					
	22					

ENG FORM 1836-A MAY 67 | PROJECT A1-6 | HOLE NO.

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 631.2 **Hole No.** DC-78-3

PROJECT: BIG CREEK - CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 3 OF 4 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	22					
	23			85%	RUN #1	Clean Fractures 11 pieces
	24		Fragments			
	25		Irregular but clean 60° fracture			
	26					
	27		60° Fracture (clean)			
			Fragments.			
			Medium grey, well indurated SHALE. Fractures parallel to bedding. Horizontal.			
	28					
	29			80%	RUN #2	Clean Fractures 18 pieces
	30					
	31					
	32		Ground core and core loss due to re-drilling.			
	33					
			Core ground (nipple)	80%	RUN #3	Clean Fractures 7 pieces
	34					

ENG FORM 1836-A | PROJECT | HOLE NO

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 631.2				Hole No. DC-78-3	
PROJECT BIG CREEK-CLEVELAND, OHIO			INSTALLATION BUFFALO DISTRICT			SHEET 4 OF 4 SHEETS
ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	34					
	35		Medium grey, well indurated SHALE. See above.	80%	RUN #3	Clean fractures 7 pieces
595.2	36				36.0'	
			Bottom of Hole			

ENG FORM 1836-A

PROJECT A1-8 | HOLE NO.

Hole No. DC-78-4

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO
2. LOCATION (Coordinates or Station): N 650,452 E 215,725
3. DRILLING AGENCY: F. T. KITLINSKI
4. HOLE NO. (As shown on drawing title and file number): DC-78-4
5. NAME OF DRILLER: GUY MALLOTT
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 12.1'
8. DEPTH DRILLED INTO ROCK: 12.9'
9. TOTAL DEPTH OF HOLE: 25.0'
10. SIZE AND TYPE OF BIT: NX, DIAMOND
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
12. MANUFACTURER'S DESIGNATION OF DRILL: S.&H. 40C
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 8 JARS | UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 1
15. ELEVATION GROUND WATER: 617.5
16. DATE HOLE: STARTED 3 JUNE 78 | COMPLETED 3 JUNE 78
17. ELEVATION TOP OF HOLE: 628.8
18. TOTAL CORE RECOVERY FOR BORING: 10.8' = 84 %
19. SIGNATURE OF INSPECTOR: Peter G. [illegible]

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5	4, 3, 2	Dark grey silty CLAY with some medium sand, wet, cohesive.		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples) Drove 18" Recovered 16" Loss 2"
	1.5–3.0	3, 4, 5	Brown and grey variegated silty CLAY with some fine and medium sand. Damp, cohesive.		JAR #2 (3.0')	Drove 18' Recovered 18' Loss 0
	3.0–4.5	4, 5, 4	Medium grey silty CLAY with some fine sand. Some brown oxidation layers. Damp.		JAR #3 (4.5')	DROVE 18" Recovered 18' Loss 0
	4.5–6.0	7, 8, 12	Medium grey and brown variegated silty CLAY with some fine sand and trace of shale fragments. Damp.		JAR #4 (6.0')	Drove 18' Recovered 18' Loss 0
	6.0–7.5	12, 14, 15	Medium grey silty CLAY with some fine sand. Damp.		JAR #5 (7.5')	Drove 18' Recovered 18' Loss 0
	7.5–9.0	15, 14, 13	Grey and brown sandy CLAY with some shale fragments. Damp.		JAR #6	Drove 18" Recovered 18' Loss 0
			[illegible] CLAY and [illegible]		JAR #7	Drove 18" Recovered 16" Loss 0

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 628.8		Hole No. DC-78-4
PROJECT BIG CREEK - CLEVELAND, OHIO	INSTALLATION BUFFALO DISTRICT		SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	19			JAR #7	See sheet 1
		39	Medium grey CLAY and weathered SHALE.		JAR #8	Drove 18"
	11	39				Recovered 15"
		41	50/0.1			Loss 0
616.7	12		No recovery (SH.)		12.0'	
			Approx. Top of Rock.			
	13					
			Fragments and core grinding		RUN #1	Clean Fractures 8 pieces
	14			94%		
			Fragments			
	15		Medium grey, well indurated silty SHALE. Horizontal bedding. Fractures parallel to bedding. Incipient hairline fractures at 1/2" spacing.			
	16					
	17				17.0'	
	18		Evidence of core grinding (source of core loss?)			
	19			77%	RUN #2	Clean Fractures 17 pieces
	20		Siltstone or fine sandstone lens.			
	21					
	22					

ENG FORM 1836-A

PROJECT A1-10 HOLE NO

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 628.8					Hole No. DC-78-4
PROJECT BIG CREEK-CLEVELAND, OHIO			INSTALLATION BUFFALO DISTRICT			SHEET 5 OF 5 SHEETS
ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	22					
	23		Medium grey, well indurated silty SHALE. See above	77%	RUN #2	Clean Fractures 17 pieces
	24					
			Soft Seam.			
603.8	25		Bottom of Hole.		25.0'	

Hole No. DC-78-5

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT NX, DIAMOND
2. LOCATION (Coordinates or Station) N 650,038 E 216,420	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) M.S.L.
3. DRILLING AGENCY F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL S. & H. 40C
4. HOLE NO. (As shown on drawing title and file number) DC-78-5	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 6 JARS; UNDISTURBED
5. NAME OF DRILLER GUY MALLOTT	14. TOTAL NUMBER CORE BOXES 1
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 613.1
	16. DATE HOLE: STARTED 6 JUNE 78; COMPLETED 6 JUNE 78
	17. ELEVATION TOP OF HOLE 617.1
7. THICKNESS OF OVERBURDEN 9.2'	18. TOTAL CORE RECOVERY FOR BORING 5.3' = 68 %
8. DEPTH DRILLED INTO ROCK 7.8'	19. SIGNATURE OF INSPECTOR Peter G. Rakelen
9. TOTAL DEPTH OF HOLE 17.0'	

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5	2, 3, 5	Dark grey brown, silty CLAY with some small pebbles and organic litter. Damp, plastic		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples) Drove 18" Recovered 16" Loss 2"
	1.5–3.0	4, 3, 4	Dark grey brown, silty CLAY with some organic litter. Damp, plastic.		JAR #2 (3.0')	Drove 18" Recovered 18" Loss 0
	3.0–4.5	6, 6, 7	Medium brown, clayey SILT to fine SAND. Damp.		JAR #3 (4.5')	Drove 18" Recovered 16 Loss 2"
	4.5–6.0	9, 8, 1	Orange and grey, clayey SILT with some fine sand. Transitional to weathered shale. Contains some crumbly weathered shale fragments. Damp.		JAR #4 (6.0')	Drove 18" Recovered 16" Loss 2"
	6.0–7.5	7, 7, 7			JAR #5 (7.5')	Drove 18" Recovered 14" Loss 4"
	7.5–9.0	12, 19, 31	Medium grey crumbly weathered SHALE.		JAR #6 (9.0')	Drove 18" Recovered 10" Loss 8"
	9.0–9.2	50/0.2	No Recovery		(9.2')	
607.9	9.2–10		Approx. Top of Rock silty SHALE. See below		RUN #1	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT | HOLE NO.

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 617.1	Hole No. DC-78-5
PROJECT BIG CREEK-CLEVELAND, OHIO	INSTALLATION BUFFALO DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10					
	11		Medium grey, silty SHALE. Mostly hard. Fractures parallel. Horizontal bedding.	58%	RUN #1	Clean Fractures 10 pieces
	12		Incipient hairline fractures open on drying with refraction hairlines between planes.			
	13		Badly ground core with soft zone near top of Run #1. Fragments at bottom of Run #1.		13.7'	
	14					
	15		Soft zone with fragments.	82%	RUN #2	Clean Fractures 7 pieces
	16		Soft core			
600.1	17		Bottom of Hole		17.0	

ENG FORM 1836-A

PROJECT A1-13 HOLE NO

Hole No. DC-78-6

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX, DIAMOND
2. LOCATION (Coordinates or Station): N 650,143 E 216,461	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S. & H. 40C
4. HOLE NO. (As shown on drawing title and file number): DC-78-6	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 9 JARS; UNDISTURBED
5. NAME OF DRILLER: GUY MALLOTT	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 615.4
	16. DATE HOLE: STARTED 5 JUNE 78; COMPLETED 6 JUNE 78
7. THICKNESS OF OVERBURDEN: 13.6'	17. ELEVATION TOP OF HOLE: 624.9
8. DEPTH DRILLED INTO ROCK: 11.4'	18. TOTAL CORE RECOVERY FOR BORING: 5.6' = 49 %
9. TOTAL DEPTH OF HOLE: 25.0'	19. SIGNATURE OF INSPECTOR: [signature]

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	3, 2, 2	Dark grey Sandy CLAY with some Coarse sand. Damp.		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples). Drove 18", Recovered 14", Loss 4"
	2	3, 3, 4	Dark grey sandy CLAY. Damp, plastic.		JAR #2 (3.0')	Drove 18", Recovered 18", Loss 0
	3	5, 6, 8	Dark grey and brown, sandy CLAY with some rotted shale fragments and organic litter, including wood fragments. Damp.		JAR #3 (4.5')	Drove 18", Recovered 18", Loss 0
	4.5	10, 11, 13			JAR #4 (6.0')	Drove 18", Recovered 12", Loss 6"
	6	13, 14, 14	Medium grey, clayey fine SAND with some medium and coarse sand and rotted shale fragments. Damp.		JAR #5 (7.5')	Drove 18", Recovered 15", Loss 3"
	7.5	14, 15, 17	Medium grey, sandy CLAY. Damp, plastic.		JAR #6 (9.0')	Drove 18", Recovered 18", Loss 0
	9	15, 14			JAR #7	Drove 18", Recovered 18", Loss 0

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: 624.9 | **Hole No.** DC-78-6

PROJECT: BIG CREEK - CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	14	Sandy CLAY. See above.		JAR #7 10.5'	See sheet 1
		14	Grey silty CLAY. wet, sticky.		JAR #8	Drove 18" Recovered 18" Loss 0
	11	14	Brown sandy CLAY. Damp.			
		16			12.0'	
	12	19	Crumbly, weathered, grey SHALE. Dry.		JAR #9	Drove 18" Recovered 10" Loss 8"
		21				
	13	37	50/0.1'		13.5'	
611.3			No Recovery Approx. Top of Rock			
	14					
	15		45° Fractures (clean)	72%	RUN #1	Clean Fractures 6 pieces
	16		Fragments 45° Fractures (clean) Fragments			
	17		Fragments. Soft Zone		17.5'	
			Soft Zone with fragments.			
	18		Medium grey SHALE. Well indurated, hard. Horizontal bedding parallel to fractures. Incipient hairline fractures open on drying.			
	19			51%	RUN #2	Clean Fractures 12 pieces
	20					
	21					
	22					

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 624.9				Hole No. DC-78-6	
PROJECT BIG CREEK-CLEVELAND, OHIO			INSTALLATION BUFFALO DISTRICT			SHEET 5 OF 5 SHEETS
ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	22					
			Medium grey SHALE. See above.			
	23			51%	RUN #2	
			Soft Zone with fragments			
			Soft Zone with fragments.			
	24					
599.9	25				25.0'	
			Bottom of Hole			

ENG FORM 1836-A

Hole No. DC-78-7

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT: BIG CREEK-CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX, DIAMOND
2. LOCATION (Coordinates or Station): N649,601 E217,140	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S.&H. 40C
4. HOLE NO. (As shown on drawing title and file number): DC-78-7	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 12 JARS; UNDISTURBED
5. NAME OF DRILLER: BOE HALL	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 613.2
	16. DATE HOLE: STARTED 5 JUNE 78; COMPLETED 5 JUNE 78
7. THICKNESS OF OVERBURDEN: 18.0'	17. ELEVATION TOP OF HOLE: 621.0
8. DEPTH DRILLED INTO ROCK: 9.0'	18. TOTAL CORE RECOVERY FOR BORING: 6.6' = 73 %
9. TOTAL DEPTH OF HOLE: 27.0	19. SIGNATURE OF INSPECTOR: Peter G. Tr[illegible]

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5	1, 1, 1	Black pebbly (cindery) medium SAND. Dry.		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples) Drove 18" Recovered 12" Loss 6"
	1.5–3.0	1, 1, 1	Medium brown sandy (fine) CLAY. Moist. Cohesive.		JAR #2 (3.0')	Drove 18" Recovered 18" Loss 0
	3.0–4.5	1, 1, 2	Brown clayey coarse SAND with shale fragments. Damp. Barely cohesive.		JAR #3 (4.5')	Drove 18 Recovered 11" Loss 7"
	4.5–6.0	2, 1, 2	Brown silty CLAY with pebbles and shale fragments. Damp.		JAR #4 (6.0')	Drove 18 Recovered 18 Loss 0
	6.0–7.5	3, 3, 4			JAR #5 (7.5')	Drove 18" Recovered 18" Loss 0
	7.5–9.0	4, 3, 6			JAR #6 (9.0')	Drove 18" Recovered 16" Loss 2"
	9.0–10	3, 4	Medium brown sandy CLAY with coarse sand and pebbles. Damp.		JAR #7	Drove 18" Recovered 18" Loss 0

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT A1-17 HOLE NO.

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 621.0 **Hole No.** DC-78-7

PROJECT: BIG CREEK - CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	6	Sandy CLAY. See above.		JAR #7	
	11	2 4 4	Grey sandy CLAY with some pebbles. Damp.		JAR #8 12.0'	Drove 18" Recovered 17" Loss 1"
	12–13	4 4 7	Grey sandy CLAY) (no pebbles). Damp. Cohesive		JAR #9 13.5'	Drove 18" Recovered 18" Loss 0
	14	5 4 7	Medium grey silty CLAY with wood fragments (near base). Damp.		JAR #10 15.0'	Drove 18" Recovered 15" Loss 3"
	15–16	2 4 5	Dark grey clayey fine SAND. Damp.		JAR #11 16.5'	Drove 18" Recovered 16" Loss 2"
	17	4 16 42	Medium grey weathered SHALE: Disaggregates to Clayey sand. Dry.		JAR #12 18.0'	Drove 18" Recovered 16" Loss 2"
603.0	18		Approx. Top of Rock			
	19–20		Stiff Grey CLAY (Weathered Shale ?)	53%	RUN #1 21.0'	
	21–22		Strong shale partings. (Core ground 21.0 to 21.05)		RUN #2	Clean Fractures 17 pieces

ENG FORM 1836-A | SHEET A1-18 | HOLE NO.

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 621.0 **Hole No.** DC-78-7

PROJECT BIG CREEK-CLEVELAND, OHIO | INSTALLATION BUFFALO DISTRICT | SHEET 5 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	22		Sticky grey clay seam.	53%	RUN #2	
					22.7'	
	23		Medium grey SHALE, well indurated.			
	24		Soft zone and fragments.	100%	RUN #3	Clean Fractures 10 pieces and fragments
	25					
	26					
594.0	27				27.0'	
			Bottom of Hole			

ENG FORM 1836-A Sept 57 | GPO | PROJECT A1-19 | HOLE NO.

Hole No. DC-78-8

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT: BIG CREEK-CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX, DIAMOND
2. LOCATION (Coordinates or Station): N 649,728 E 217,211	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S. & H. 40C
4. HOLE NO. (As shown on drawing title and file number): DC-78-8	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2 JARS; UNDISTURBED
5. NAME OF DRILLER: BOB HALL	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 606.2 (24 hrs.)
	16. DATE HOLE: STARTED 6-JUNE 78; COMPLETED 6 JUNE 78
7. THICKNESS OF OVERBURDEN: 3.0'	17. ELEVATION TOP OF HOLE: 606.2
8. DEPTH DRILLED INTO ROCK: 5.0'	18. TOTAL CORE RECOVERY FOR BORING: 2.8' = 62 %
9. TOTAL DEPTH OF HOLE: 8.0'	19. SIGNATURE OF INSPECTOR: Peter C. Rabin...

ELEVATION a	DEPTH b	Blows c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0 – 2	1, 1, 2, 5	Dark brown silty CLAY with sand and organic litter. Damp		JAR #1 (to 1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples). Drove 18"; Recovered 16"; Loss 2"
	2 – 2.5	1½	Medium grey silty CLAY. Damp.		JAR #2	Drove 18; Recovered 15; Loss 3"
603.2	2.5 – 3	80/0.5'	Grey crumbly weathered SHALE		3.0"	
	3 – 3.5		Approx. Top of Rock. Tricone - No recovery.	0%	3.5'	
	3.5 – 6.5		Medium grey SHALE. Horizontal bedding. Fractures parallel to bedding. Incipient hair-line fractures open on drying. Core ground (≈5.9); Core ground (≈6.5)	73%	RUN #1 (to 6.5')	Clean fractures, Some Clay. 10 pieces
598.2	6.5 – 8			40%	RUN #2 (to 8.0')	5 pieces
	8		Bottom of Hole.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

Hole No. DC-78-9

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT BIG CREEK-CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT NX, DIAMOND
2. LOCATION (Coordinates or Station) N 649,121 E 218,312	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) M.S.L.
3. DRILLING AGENCY F. T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL S & H. 40C
4. HOLE NO. (As shown on drawing title and file number) DC-78-9	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: 6 JARS; UNDISTURBED:
5. NAME OF DRILLER BOB HALL	14. TOTAL NUMBER CORE BOXES 1
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.	15. ELEVATION GROUND WATER 605.8
	16. DATE HOLE — STARTED: 7 JUNE 78; COMPLETED: 7 JUNE 78
7. THICKNESS OF OVERBURDEN 9.0'	17. ELEVATION TOP OF HOLE 607.8
8. DEPTH DRILLED INTO ROCK 14.0'	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 23.0'	19. SIGNATURE OF INSPECTOR Pete G. Rakul—

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5	1, 1, 1	Dark grey silty medium SAND with clay and organic litter. Damp.		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples) Drove 18" Recovered 16" Loss 2"
	1.5–3.0	1, 1, 2	Dark grey silty fine SAND with clay and some medium sand. Damp.		JAR #2 (3.0')	Drove 18" Recovered 16" Loss 2"
	3.0–4.5	2, 1, 3	Medium brown silty CLAY with some fine sand. Damp, plastic.		JAR #3 (4.5')	Drove 18" Recovered 18" Loss 0
	4.5–6.0	1, 3, 3	Brown medium SAND with fine and coarse sand and some silt. Damp, non plastic.		JAR #4 (6.0')	Drove 18" Recovered 14" Loss 4"
	6.0–7.5	5, 3, 4	Brown medium SAND. with clay and fine sand. Damp		JAR #5 (7.5')	Drove 18" Recovered 15" Loss 3"
	7.5–9.0	5, 27	Brown clayey medium SAND. wet		JAR #6 (9.0')	Drove 18" Recovered 14" Loss 4"
596.8	9	72	Weathered grey SHALE			
	9–10		Approx. Top of Rock. Medium gray SHALE. See below.		RUN #1	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 607.8 **Hole No.** DC-78-9

PROJECT: BIG CREEK - CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10					
	11					
	12					
	13			76%	RUN #1	Clean Fractures. Some clay seams. 18 pieces and fragments
	14		Medium Grey silty SHALE. Horizontal bedding. Fractured parallel to bedding. Incipient hair-line fractures, open on drying. Refractions between fractures.			
	15		Vertical fracture, partly open.			
			Ragged vertical fracture.			
	16					
	17				17.0'	
	18		Soft zone			
	19			88%	RUN #2	Some clay. 12 pieces and many fragments.
	20		Soft zone			
	21					
	22					

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BIG CREEK FLOOD CONTROL PROJECT, CLEVELAND, OHIO. PHASE II. GEN--ETC(U)
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DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: 607.8

Hole No. DC-78-9

PROJECT: BIG CREEK- CLEVELAND, OHIO

INSTALLATION: BUFFALO DISTRICT

SHEET 3 OF 3 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	22		Medium grey SHALE. See above.		RUN #2	
584.8	23		Soft zone		23.0'	
			Bottom of Hole			

Hole No. DC-78-10

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 4 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX, DIAMOND
2. LOCATION (Coordinates or Station): N 649,028 E 218,497	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S. & H. 35H
4. HOLE NO. (As shown on drawing title and file number): DC-78-10	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5 JARS; UNDISTURBED
5. NAME OF DRILLER: WAYNE BOTTS	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 598.8
	16. DATE HOLE: STARTED 1 JUNE 78; COMPLETED 1 JUNE 78
7. THICKNESS OF OVERBURDEN: 22.0'	17. ELEVATION TOP OF HOLE: 619.1
8. DEPTH DRILLED INTO ROCK: 13.0'	18. TOTAL CORE RECOVERY FOR BORING: 11.3' = 87 %
9. TOTAL DEPTH OF HOLE: 35.0'	19. SIGNATURE OF INSPECTOR: Peter G. Rzeb...

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	2			JAR #1	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples)
		2				Drove 18"
	1	3			1.5'	Recovered 18" Loss 0"
	2–4		Grey CLAY. Layered with brown oxidation stains at 1/4" intervals. Contains some silt. Becomes sticky with some silt, sand and shell fragments toward base. Damp.		4.5'	
		1			JAR #2	Drove 18"
	5	2				Recovered 16"
		3			6.0'	Loss 2"
	6–8					
	8–9		Greyish brown clayey SILT with some fine sand and trace of medium to coarse sand. Damp.		9.0'	
		3			JAR #3	Drove 18" Recovered 16"
	10	2				Loss 2"

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: 619.1 | **Hole No.** DC-78-10

PROJECT: BIG CREEK - CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 4 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	2	Clayey SILT. See above		JAR #3 10.5'	
	11					
	12					
	13	3	Brown fine SAND with clay, silt, some medium sand, trace coarse sand. Very damp to wet.		JAR #4	
	14	4				Drove 18" Recovered 16" Loss 2"
		3			15.0'	
	15					
	16					
	17					
	18	3	Dark grey silty CLAY with fine sand and some medium sand. Trace of coarse sand. Damp.		JAR #5	Drove 18" Recovered 16" Loss 2"
		4				
	19	5				
	20					
	21					
	22		Fragments			

ENG FORM 1836-A JUN 67 | PROJECT A1-25 | HOLE NO.

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 619.1 **Hole No.** DC-78-10

PROJECT: BIG CREEK - CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 3 OF 4 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
597.1	22		Approx. Top of Rock.			
	23		Grinding			
	24		Fragments	78%	RUN #1	22 pieces.
	25		Grinding			
	26		Well indurated medium grey SHALE. Horizontal bedding Fractures parallel to bedding. Incident hairline fractures parallel bedding at 0.01' intervals. No weathering or oxidation of fractures.			
	27					
	28					
	29		Grey SHALE as above. Fractures parallel bedding.			
			Grinding			
	30			92%	RUN #2	23 pieces
	31					
	32		Clay seam			
	33		Clay seam.			
	34					

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: 619.1 | **Hole No.** DC-78-10

PROJECT: BIG CREEK - CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 4 OF 4 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	34		Grey SHALE. See above.			
584.1	35				35.0'	
			Bottom of Hole			

ENG FORM 1836-A JUN 67 | PROJECT: A1-27 | HOLE NO.

Hole No. DC-78-11

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 4 SHEETS

1. PROJECT: BIG CREEK-CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX, DIAMOND
2. LOCATION (Coordinates or Station): N 648,931 E 218,425	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S.&H. 35H
4. HOLE NO. (As shown on drawing title and file number): DC-78-11	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13 JARS; UNDISTURBED
5. NAME OF DRILLER: WAYNE BOTTS	14. TOTAL NUMBER CORE BOXES: 2
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 609.6
	16. DATE HOLE: STARTED 3 JUNE 78; COMPLETED 3 JUNE 78
	17. ELEVATION TOP OF HOLE: 618.5
7. THICKNESS OF OVERBURDEN: 19.5'	18. TOTAL CORE RECOVERY FOR BORING: 16.9' = 91 %
8. DEPTH DRILLED INTO ROCK: 18.5'	19. SIGNATURE OF INSPECTOR: [signature]
9. TOTAL DEPTH OF HOLE: 38.0	

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5	1, 3, 4	Medium grey silty CLAY with fine sand and some medium sand. Black Cindery small pebbles (<1/4") near base. Damp.		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples). Drove 18" Recovered 16" Loss 2"
	1.5–3.0	3, 3, 2	Grey silty CLAY with sand and cindery gravel. Damp.		JAR #2 (3.0)	Drove 18" Recovered 18" Loss 0
	3.0–4.5	3, 4, 3			JAR #3 (4.5')	Drove 18" Recovered 18" Loss 0
	4.5–6.0	3, 3, 21	Grey CLAY with brown oxidation layers at 1/4" intervals. Transitional to weathered shale. Damp.		JAR #4 (6.0')	Drove 18" Recovered 18" Loss 0
	6.0–7.5	3, 3, 2			JAR #5 (7.5)	Drove 18" Recovered 18" Loss 0
	7.5–9.0	2, 2, 2	Clayey GRAVEL (weathered shale fragments). Damp.		JAR #6 (9.0")	Drove 18" Recovered 9" Loss 9"
	9.0–10	1, 1	Clayey coarse SAND (Rock fragments) with pebble sized shale fragments. Wet.		JAR #7	Drove 18" Recovered 10" Loss 8"

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 618.5 **Hole No.** DC-78-11

PROJECT: BIG CREEK-CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 4 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	2	Coarse SAND see above.		JAR #7 10.5'	
	11	1, 1, 2	Weathered SHALE FRAGMENTS and wet grey CLAY. wet.		JAR #8 12.0'	Drove 18" Recovered 12" Loss 6"
	12, 13	3, 3, 6	Medium grey sandy CLAY with some shale fragments. Damp.		JAR #9 13.5'	Drove 18" Recovered 18" Loss 0
	14	6, 9, 11	Weathered SHALE with some grey clay.		JAR #10 15.0	Drove 18" Recovered 16" Loss 2"
	15, 16	3, 4, 5	Grey sandy CLAY with pebble size shale fragments. Damp.		JAR #11 16.5	Drove 18" Recovered 18" Loss 0
	17	5, 8, 10	Grey sandy CLAY with Some small shale fragments. Wet, sticky.		JAR #12 18.0'	Drove 18" Recovered 18" Loss 0
599.0	18, 19	8, 10, 50/0.5'	Weathered grey SHALE with brown oxidized partings.		JAR #13 19.5'	Drove 18" Recovered 14" Loss 4"
	20, 21, 22		Approx. Top of Rock Vertical fractures Core grinding at top of run.	80%	RUN #1	Clean Fractures 11 pieces.

ENG FORM 1836-A | PROJECT A1-29 | HOLE NO.

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 618.5	Hole No. DC-78-11
PROJECT BIG CREEK - CLEVELAND, OHIO	INSTALLATION BUFFALO DISTRICT	SHEET 3 OF 4 SHEETS

ELEVATION a	DEPTH b	~~LEGEND~~ Blows c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	22					
	23			80%	RUN #1	Clean Fractures 10 pieces.
			Soft zone with fragments			
	24					
	25		Medium grey well indurated SHALE. Horizontal bedding. Fractures parallel to bedding. Incipient hairline fractures open on drying. (¼" spacing)	90%	RUN #2	Clean Fractures 19 pieces.
	26					
	27		Incipient vertical hairline fracture			
	28					
	29					
	30			98%	RUN #3	Clean Fractures 22 pieces.
			Fragments			
	31					
	32					
			Core ground			
	33					
	34					

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 618.5	Hole No. DC-78-11
PROJECT BIG CREEK-CLEVELAND, OHIO	INSTALLATION BUFFALO DISTRICT	SHEET 4 OF 4 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	34					
	35		Medium grey SHALE. See above.		RUN #4	Clean Fractures 27 pieces.
	36			95%		
	37					
			clean, 45° fragments.			
580.5	38		Bottom of Hole			

ENG FORM 1836-A JUN 67 | PROJECT A1-31 | HOLE NO.

Hole No. DC-78-12

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 4 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX DIAMOND
2. LOCATION (Coordinates or Station): N 648,953 E 218,524	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S.&H. 55H
4. HOLE NO. (As shown on drawing title and file number): DC-78-12	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 8 JARS; UNDISTURBED
5. NAME OF DRILLER: WAYNE BOTTS.	14. TOTAL NUMBER CORE BOXES: 2
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 613.0
	16. DATE HOLE: STARTED 2 JUNE 78; COMPLETED 2 JUNE 78
7. THICKNESS OF OVERBURDEN: 12.0'	17. ELEVATION TOP OF HOLE: 619.3
8. DEPTH DRILLED INTO ROCK: 23.0'	18. TOTAL CORE RECOVERY FOR BORING: 22.0' = 95 %
9. TOTAL DEPTH OF HOLE: 35.0'	19. SIGNATURE OF INSPECTOR: Peter G. Rodecker

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5	1, 2, 5	Grey CLAY and cinder FILL. Damp.		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples) Drove 18" Recovered 12" Loss 6"
	1.5–3.0	3, 3, 2	Black to dark brown, medium to coarse SAND with clay. Damp.		JAR #2 (3.0')	Drove 18" Recovered 10" Loss 8"
	3.0–4.5	4, 4, 6	Dark grey clayey fine to medium SAND with some coarse sand. Damp. Cohesive		JAR #3 (4.5')	Drove 18" Recovered 16" Loss 2"
	4.5–6.0	4, 3, 4	Medium grey silty CLAY with some fine sand. Trace of medium sand. Brown oxidation layers. Damp.		JAR #4 (6.0)	Drove 18" Recovered 16" Loss 2"
	6.0–7.5	4, 3, 4	Black and grey silty CLAY with trace fine sand. Wood fragments. Damp.		JAR #5 (7.5)	Drove 18" Recovered 14" Loss 4"
	7.5–9.0	4, 3, 2	Black and grey silty CLAY with trace fine sand, with scattered pebbles (1/4"-1/2") or cinders. Damp		JAR #6 (9.0')	Drove 18" Recovered 16" Loss 2"
	9.0–10	1, 2	Medium grey pebbly CLAY with coarse and medium sand. Wet.		JAR #7	Drove 18" Recovered 14" Loss 4"

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 619.3 | Hole No. DC-78-12

PROJECT: BIG CREEK-CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 4 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	2	Grey CLAY see above.		JAR #7 10.5	
	11	2 2	Sticky grey CLAY.		JAR #8	Drove 18" Recovered 14" Loss 4"
607.3	12	50	Weathered grey SHALE.		12.0'	
	12–17		Approx. Top of Rock. Core grinding Core grinding (13) Fragments (15.3) Soft zone (15.5)	90%	RUN #1 17.0'	Driller breaks 21 pieces
	17–20		Medium grey well indurated SHALE. Fractures parallel to bedding (Horizontal) Incipient hairline fractures at 1/4" intervals.	97%	RUN #2	Driller breaks 20 pieces
	20–22					Driller breaks 8 pieces

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 619.3 | Hole No. DC-78-12

PROJECT BIG CREEK-CLEVELAND, OHIO | INSTALLATION BUFFALO DISTRICT | SHEET 3 OF 4 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	22					
				97%	RUN #2	
	23					
	24				24.0'	
	25					
	26		Medium grey well indurated SHALE. Fractures parallel to bedding (Horizontal)			
	27		Incipient hairline fractures at 1/4" intervals.	96%	RUN #3	clean driller breaks 24 pieces
	28					
	29					
	30					
	31				31.5'	
	32		Core grinding			
			1 Vertical Fracture (clean)	100%	RUN #4	Clean.
			Core grinding			
	33					
	34					

ENG FORM 1836-A | PROJECT | HOLE NO.

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 619.3	Hole No. DC-78-12
PROJECT BIG CREEK-CLEVELAND, OHIO	INSTALLATION BUFFALO DISTRICT	SHEET 4 OF 4 SHEETS

ELEVATION a	DEPTH b	LEGEND Blows c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	34		Medium grey SHALE See above.	100%	RUN #4	
584.3	35				35.0'	
			Bottom of Hole			

ENG FORM 1836-A JAN 67

PROJECT A1-35

HOLE NO.

Hole No. D-78-13

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 4 SHEETS

1. PROJECT	BIG CREEK - CLEVELAND, OHIO
2. LOCATION (Coordinates or Station)	N 648,670 E 218,785
3. DRILLING AGENCY	F.T. KITLINSKI
4. HOLE NO. (As shown on drawing title and file number)	DC-78-13
5. NAME OF DRILLER	WAYNE BOTTS
6. DIRECTION OF HOLE	[x] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	39.5'
8. DEPTH DRILLED INTO ROCK	0.5' (DRIVEN)
9. TOTAL DEPTH OF HOLE	40.0'
10. SIZE AND TYPE OF BIT	NX DIAMOND
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	M.S.L.
12. MANUFACTURER'S DESIGNATION OF DRILL	S. & H. 35H.
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 27 JARS; UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: 6-JUNE 78; COMPLETED: 7 JUNE 78
17. ELEVATION TOP OF HOLE	636.6
18. TOTAL CORE RECOVERY FOR BORING	0.42' = 42 %
19. SIGNATURE OF INSPECTOR	Peter G. Rolche

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	2, 2, 2			JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples). Drove 18" Recovered 8" Loss 10"
	1.5–3.0	2, 2, 2	Black and brown clayey coarse sand with pieces of brick, metal, etc. Damp, FILL.		JAR #2 (3.0')	Drove 18 Recovered 6" Loss 12"
	3.0–4.5	1, 2, 2			JAR #3 (4.5')	Drove 18" Recovered 10" Loss 8"
	4.5–6.0	2, 2, 1	Black organic material and grey silty clay. Wet, sticky, FILL.		JAR #4 (6.0')	Drove 18" Recovered 16" Loss 2"
	6.0–7.5	2, 5, 6	Greyish brown sandy CLAY with coal fragments wet, plastic FILL.		JAR #5 (7.5')	Drove 18" Recovered 18" Loss 0
	7.5–9.0	3, 2, 2	Grey sandy clay with some large gravel. Wet, plastic FILL.		JAR #6 (9.0')	Drove 18" Recovered 8" Loss 10"
	9.0–10	10, 11	Medium to coarse Sand. See below.		JAR #7	Drove 18" Recovered 10" Loss 8"

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT A1-36 HOLE NO.

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 636.6		Hole No. D-78-13
PROJECT BIG CREEK-CLEVELAND, OHIO	INSTALLATION BUFFALO DISTRICT.		SHEET 2 OF 4 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	14			JAR #7 10.5	
	11	8, 7, 6	Grey brown, medium to coarse sand with clay, silt, organic debris. Fill, Damp, Contains some gravel. FILL		JAR #8 12.5'	Drove 18" Recovered 12" Loss 6"
	12, 13	8, 11			JAR #9 13.5'	Drove 18" Recovered 12" Loss 6"
	14	13, 15, 16, 10	Dark grey clayey fine Sand with gravel, organic debris. wet fill. Pieces of wood. FILL.		JAR #10 15.0'	Drove 18" Recovered 14" Loss 4"
	15, 16	10, 8, 5	Clayey medium sand with debris. wet. FILL.		JAR #11 16.5'	Drove 18" Recovered 12" Loss 6"
	17	7, 6, 5			JAR #12 18.0'	Drove 18" Recovered 6" Loss 12"
	18, 19	100, 54, 56	Dark grey fine sandy silt. wet, soupy FILL (High blow counts due to pushing tire (bouncing))		JAR #13 19.5'	Drove 18" Recovered 4" Loss 14"
	20	74, 54, 80			JAR #14 21.0'	Drove 18" Recovered 6" Loss 12"
	21, 22	35, 20	No Recovery.		JAR #15	Drove 18" Recovered 0 Loss 18"

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 636.6 | Hole No. D-78-15

PROJECT: BIG CREEK-CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 3 OF 4 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	22	7			JAR #15 22.5	
	23	4 / 4 / 25	No Recovery		JAR #16 24.0	Drove 18 Recovered 0 Loss 18
	24–25	100 / 50 / 42			JAR #17 25.5'	Drove 18' Recovered 0 Loss 18'
	26	40 / 16 / 21	Dark grey sandy silt, wet, soup, FILL		JAR #18 27.0	Drove 18" Recovered 3" Loss 15"
	27–28	30 / 20 / 11	No Recovery		JAR #19 28.5	Drove 18" Recovered 0 Loss 18'
	29	10 / 9 / 7	Dark grey sandy silt with coarse gravel, pieces of wood, metal. wet FILL. (Trap used for recovery).		JAR #20 30.0'	Drove 18' Recovered 4" Loss 14'
	30–31	4 / 5 / 4			JAR #21 31.5'	Drove 18' Recovered 3" Loss 15"
	32	5 / 16 / 10	Black silty sand with trash and gravel. wet. FILL.		JAR #22 33.0'	Drove 18" Recovered 8" Loss 10"
	33–34	5 / 6	Black coarse sand with gravel and trash. FILL.		JAR #23	Drove 18" Recovered 6" Loss 12"

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 636.6 Hole No. D-78-13

PROJECT: BIG CREEK - CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 4 OF 4 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	34	7			JAR #23 34.5'	
		10	Black coarse sand with gravel and trash. FILL.		JAR #24	Drove 18" Recovered 6" Loss 12"
	35	8				
		7	Beginning of Natural Overburden.		36.0'	
	36	5	Black, grey and orange sandy CLAY. Damp.		JAR #25	Drove 18" Recovered 14" Loss 4"
		6				
	37	9			37.5	
		5	Grey silty CLAY with some fine sand. wet, sticky		JAR #26	Drove 18" Recovered 16" Loss 2"
	38	6				
		25			39.0'	
	39	10			JAR #27	Drove 12" Recovered 5" Loss 7"
597.1			Approx. Top of Rock			
		50/0.5	Crumbly weathered grey SHALE. Dry.		40'	
596.6	40		Bottom of Hole.			

ENG FORM 1836-A

A1-39

Hole No. DC-78-14

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT: BIG CREEK-CLEVELAND	10. SIZE AND TYPE OF BIT: NX DIAMOND
2. LOCATION (Coordinates or Station): N 648,750 E 218,960	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S.&H. 40C
4. HOLE NO. (As shown on drawing title and file number): DC-78-14	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2 JARS; UNDISTURBED
5. NAME OF DRILLER: BOB HALL	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 601.7 (24 hrs.)
	16. DATE HOLE: STARTED 1 JUNE 78; COMPLETED 2 JUNE 78
7. THICKNESS OF OVERBURDEN: 4.5'	17. ELEVATION TOP OF HOLE: 601.7
8. DEPTH DRILLED INTO ROCK: 7.5'	18. TOTAL CORE RECOVERY FOR BORING: 3.8' = 51 %
9. TOTAL DEPTH OF HOLE: 12.0'	19. SIGNATURE OF INSPECTOR: [signature]

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5	None wt. of Tools.	No recovery. Re-drove. Organic debris with silty sand. wet. Some pebbles		JAR #1 (to 1.5')	Drove 2" O.D. split spoon with 300 lb. hammer falling 18" (all samples) Drove 18" Recovered 0" Loss 18"
	1.5–3.0		Black GRAVEL and SAND.		3.0'	
	3.0–3.5	5			JAR #2	Drove 18" Recovered 12" Loss 6"
	3.5–4.0	12	Grey sticky CLAY			
597.2	4.0–4.5	37	Weathered grey SHALE		4.5'	
	4.5		Approx. Top of Rock.			
	4.5–6.5		Well indurated grey SHALE, fractured parallel to bedding (horizontal). Incipient hairline fractures (horizontal) at 1/4" intervals. Some migratory hairline fractures perpendicular to bedding appear as shrinkage fractures. Fractures appear upon drying.	85%	RUN #1 (6.5')	Clean. Driller breaks 9 pieces
	6.5–10.0			48%	RUN #2 (10.0')	Clean. Driller breaks 11 pieces

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 601.7		Hole No. DC-78-14
PROJECT BIG CREEK - CLEVELAND, OHIO	INSTALLATION BUFFALO DISTRICT		SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10					
	11		Grey SHALE See above.	20%	RUN #3	Clean. Driller bre[illegible] 4 pieces
589.7	12		Bottom of Hole		12.0'	

ENG FORM 1836-A JUN 67 | PROJECT A1-41 | HOLE NO.

Hole No. DC-78-15

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO
2. LOCATION (Coordinates or Station): N 650,732 E 214,377
3. DRILLING AGENCY: F.T KITLINSKI
4. HOLE NO (As shown on drawing title and file number): DC-78-15
5. NAME OF DRILLER: WAYNE BOTT
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 3.0'
8. DEPTH DRILLED INTO ROCK: 16.0'
9. TOTAL DEPTH OF HOLE: 19.0'
10. SIZE AND TYPE OF BIT: NX DIAMOND
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
12. MANUFACTURER'S DESIGNATION OF DRILL: S.EH. 35H
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2 JARS; UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 1
15. ELEVATION GROUND WATER: [illegible]
16. DATE HOLE: STARTED 5 JUNE 78; COMPLETED 5 JUNE 78
17. ELEVATION TOP OF HOLE: 634.0
18. TOTAL CORE RECOVERY FOR BORING: 13.0' = 84 %
19. SIGNATURE OF INSPECTOR: Peter C. Rakela

ELEVATION (a)	DEPTH (b)	BLOWS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	0 – 1.5	2, 2, 2	Medium grey silty CLAY with medium sand, pebbles and shale fragments. Damp		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples) Drove 18" Recovered 15" Loss 3"
	1.5 – 3.0	3, 5, 50/0.5'	Crumbly grey weathered SHALE. Dry.		JAR #2 (3.0')	Drove 18" Recovered 12" Loss 6"
631.0	3		Approx. Top of Rock		(3.5')	Roller Bit
	3.5 – 8		Ground core (at ~5.9'). Well indurated hard grey SHALE. Horizontal bedding parallel to fractures. Incipient hairline fractures at 1/4" spacing. Refraction breaks open along with hairline fractures. Hairline fractures open about 1/4 to 1/2 hour after being cored.	55%	RUN #1	Clean Fractures 8 pieces.
	8 – 10		(Also at 8.0') Core ground nipple (at ~9.9')	96%	RUN #2	Clean Fractures 12 pieces.

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE PROJECT HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: 634.0 | **Hole No.** DC-78-15

PROJECT: BIG CREEK-CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10					
	11		Core ground nipples	96%	RUN #2	Clean Fractures 12 pieces
	12					
	13				13.5'	
			Well indurated, hard grey SHALE. See above			
	14					
	15			95%	RUN #3	Clean Fractures 10 pieces
	16					
	17					
	18		Core ground nipples.			
615.0	19.		Bottom of Hole		19.0'	

ENG FORM 1836-A | PROJECT A1-43 | HOLE NO

Hole No. DC-78-16

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 of 2 SHEETS

1. PROJECT: BIG CREEK-CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX, DIAMOND
2. LOCATION (Coordinates or Station): N 650,628 E 214,559	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S.&H. 35H
4. HOLE NO. (As shown on drawing title and file number): DC-78-16	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 7 JARS; UNDISTURBED
5. NAME OF DRILLER: WAYNE BOTTS	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 620.2
	16. DATE HOLE: STARTED 14 JUNE 78; COMPLETED 14 JUNE 78
7. THICKNESS OF OVERBURDEN: 10.5'	17. ELEVATION TOP OF HOLE: 629.7
8. DEPTH DRILLED INTO ROCK: 11.5'	18. TOTAL CORE RECOVERY FOR BORING: %
9. TOTAL DEPTH OF HOLE: 22.0'	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	2 / 6 / 13	Brown GRAVEL and SAND FILL. Dry		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples). Drove 18" Recovered 12" Loss 6"
	2	6 / 9 / 8	Brown and grey with orange medium to coarse SAND with some clay. Damp.		JAR #2 (3.0')	Drove 18" Recovered 15" Loss 3"
	3	13 / 30 / 10	Grey gravel and sand. Fill. Dry.		JAR #3 (4.5')	Drove 18" Recovered 13" Loss 5"
	5	8 / 7 / 8	Medium grey sandy CLAY with pebbles and rock fragments. Damp.		JAR #4 (6.0')	Drove 18" Recovered 16" Loss 2"
	6	5 / 5 / 4	Medium grey silty CLAY with some medium and coarse sand. Damp.		JAR #5 (7.5')	Drove 18" Recovered 16" Loss 2"
	8	6 / 13 / 11	Medium grey silty CLAY with trace medium and coarse sand. Damp.		JAR #6 (9.0')	Drove 18" Recovered 18" Loss 0
	9 – 10	8 / 11	Grey silty CLAY to clayey SILT with trace of coarse sand. Damp.		JAR #7	Drove 18" Recovered 18" Loss 0

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 629.7 **Hole No.** DC-78-16

PROJECT: BIG CREEK - CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10		Grey, silty CLAY See above		JAR #7 10.5'	
	11		Feldspathic gneiss boulder (FILL)			
	12–14		Silty CLAY. Some pieces of indurated clay.	44%	RUN #1	
615.3			Probable Top of Rock.			
	15				15.5'	1 piece + fragments.
	16–19		Medium grey silty SHALE. Fractures parallel to horizontal bedding. Incipient hairline fractures open on drying.	35%	RUN #2	1 piece + Clay and fragments.
	20				20.0'	
	21			90%	RUN #3	1 soft piece + fragments
607.7	22		Bottom of Hole		22.0'	

ENG FORM 1836-A | PROJECT A1-45 | HOLE NO.

Hole No. DC-78-17

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX DIAMOND
2. LOCATION (Coordinates or Station): N 650,375 E 215,721	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S & H. 40C
4. HOLE NO. (As shown on drawing title and file number): DC-78-17	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 JAR; UNDISTURBED
5. NAME OF DRILLER: GUY MALLOTT	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 614.4
	16. DATE HOLE: STARTED 17 JUNE 78; COMPLETED 17 JUNE 78
7. THICKNESS OF OVERBURDEN: 1.6'	17. ELEVATION TOP OF HOLE: 615.4
8. DEPTH DRILLED INTO ROCK: 7.4'	18. TOTAL CORE RECOVERY FOR BORING: 2.7' 36 %
9. TOTAL DEPTH OF HOLE: 9.0'	19. SIGNATURE OF INSPECTOR: Peter G. Rabalais

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	7	Brownish grey silty CLAY with shale fragments and roots. Damp.		JAR #1	Drove 3" O.D. split spoon with 300 lb. hammer falling 18". Drove 18" Recovered 14" Loss 4"
		9				
	1	14			1.5'	
613.8		50/0.1	Started to core at 1.6'			Approx Top of Rock
	2					
	3			42%	RUN #1	Some clay. Clean. 5 pieces
	4				4.0'	
	5		Medium grey silty SHALE. Horizontal bedding. Fractured parallel to bedding. Incipient hairline fractures open upon exposure. Mostly hard but with soft zones at 1.6', 4.0', 9.0'			
	6			34%	RUN #2	Clean 4 pieces
	7					
	8					
606.4	9				9.0'	
			Bottom of Hole			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE

PROJECT A1-46 HOLE NO.

Hole No. DC-78-18

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT BIG CREEK- CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT NX DIAMOND
2. LOCATION (Coordinates or Station) N 650,138 E 216,044	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) M.S.L.
3. DRILLING AGENCY F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL S.&H. 40C
4. HOLE NO. (As shown on drawing title and file number) DC-78-18	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 7 JARS; UNDISTURBED
5. NAME OF DRILLER GUY MALLOTT	14. TOTAL NUMBER CORE BOXES 1
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 616.2
	16. DATE HOLE: STARTED 16 JUNE 78; COMPLETED 16 JUNE 78
	17. ELEVATION TOP OF HOLE 620.2
7. THICKNESS OF OVERBURDEN 9.7'	18. TOTAL CORE RECOVERY FOR BORING 5.7' = 50 %
8. DEPTH DRILLED INTO ROCK 11.3'	19. SIGNATURE OF INSPECTOR Peter G. Ruhalen
9. TOTAL DEPTH OF HOLE 21.0'	

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5	6, 5, 7	Grey and dark brown silty CLAY with shale fragments and organic material (Roots). Damp.		JAR #1 1.5'	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples). Drove 18" Recovered 15" Loss 3"
	1.5–3.0	13, 9, 11	Light brown clayey SILT with some roots. Damp.		JAR #2 3.0'	Drove 18" Recovered 14" Loss 4"
	3.0–4.5	10, 11, 11	Tan, fine to medium SAND with some small pebbles. Damp.		JAR #3 4.5'	Drove 18" Recovered 14" Loss 4"
	4.5–6.0	6, 7, 9	Reddish brown, silty CLAY. Damp, plastic.		JAR #4 6.0'	Drove 18" Recovered 18" Loss 0
	6.0–7.5	7, 7, 7	Medium grey, silty CLAY. Damp, plastic.		JAR #5 7.5'	Drove 18" Recovered 18" Loss 0
	7.5–9.0	8, 9, 9	Grey, silty CLAY with some fine sand. Trace of medium and coarse sand. Damp.		JAR #6 9.0'	Drove 18" Recovered 18" Loss 0
	9.0–9.7	12			JAR #7 9.7'	Drove 8" Recovered 4" Loss 4"
610.5	9.7	50/0.2'	Grey weathered SHALE fragments			
	10					

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: 620.2 | **Hole No.** DC-78-18

PROJECT: BIG CREEK - CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10					
	11					
	12			40%	RUN #1	8 pieces. Clear Fractures with some clay.
	13		Medium grey, silty SHALE. Generally hard but with several clay seams and soft zones. Horizontal bedding parallel to fractures. Incipient hairline fractures in hard shale develope upon exposure.			
	14					
	15					
	16		Core ground		16.0'	
	17		Core ground			
	18			64%	RUN #2	10 pieces
			Clay seam			Pressure Test Packers Set: ① 13' and 18' - No seat ② 12' and 17' - No seat
	19					
	20		Clay seam (?)			
599.2	21		Bottom of Hole		21.0'	

ENG FORM 1836-A | PROJECT | HOLE NO.

Hole No. DC-78-19

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO
2. LOCATION (Coordinates or Station): N 649,671 E 217,180
3. DRILLING AGENCY: F.T. KITLINSKI
4. HOLE NO. (As shown on drawing title and file number): DC-78-19
5. NAME OF DRILLER: BOB HALL
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 3.0'
8. DEPTH DRILLED INTO ROCK: 4.0'
9. TOTAL DEPTH OF HOLE: 7.0'
10. SIZE AND TYPE OF BIT: NX, DIAMOND
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
12. MANUFACTURER'S DESIGNATION OF DRILL: S. & H. 40C
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED: 2 JARS; UNDISTURBED:
14. TOTAL NUMBER CORE BOXES: 1
15. ELEVATION GROUND WATER: 604.8
16. DATE HOLE: STARTED 16 JUNE 78; COMPLETED 17 JUNE 78
17. ELEVATION TOP OF HOLE: 605.3
18. TOTAL CORE RECOVERY FOR BORING: 2.5' = 62 %
19. SIGNATURE OF INSPECTOR: Peter G. [signature]

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	1, 1, 1	Dark greyish brown, silty CLAY with organic material. Wet, plastic.		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples). Drove 18" Recovered 12" Loss 6"
	2	18, 37	Laminated grey and brown, deeply weathered SHALE. (Turns to clay when wet.)		JAR #2	Drove 18" Recovered 10" Loss 8"
602.3	3	55	Medium grey, weathered (chippy) SHALE.		3.0'	
	4–6		Medium grey, silty SHALE. Horizontal bedding parallel to fractures. Shale is soft in middle of run. Broken fragments at top of run.	62%	RUN #1	Clean Fractures 8 pieces, some clay
598.3	7		Bottom of Hole		7.0'	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT A1-49 HOLE NO.

Hole No. D-78-20

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT: BIG CREEK-CLEVELAND, OHIO
2. LOCATION (Coordinates or Station): N 649,164 E 218,042
3. DRILLING AGENCY: F.T. KITLINSKI
4. HOLE NO. (As shown on drawing title and file number): DC-78-20
5. NAME OF DRILLER: BOB HALL
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 18.0'
8. DEPTH DRILLED INTO ROCK: —
9. TOTAL DEPTH OF HOLE: 18.0'
10. SIZE AND TYPE OF BIT: NX DIAMOND
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
12. MANUFACTURER'S DESIGNATION OF DRILL: S.CH. 40C
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 12 JARS; UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER: 607.2
16. DATE HOLE: STARTED 18 JUNE 78; COMPLETED 18 JUNE 78
17. ELEVATION TOP OF HOLE: 618.2
18. TOTAL CORE RECOVERY FOR BORING: 0' = 0 %
19. SIGNATURE OF INSPECTOR: Peter O. [signature]

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5	1, 1/2, 1/2	Black medium sand and gravel. Dry, cindery FILL, with roots.		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples). Drove 18" Recovered 10" Loss 8"
	1.5–3.0	1, 1, 1	Black and brown, medium SAND with coarse sand, fine sand, some silt. Dry.		JAR #2 (3.0')	Drove 18" Recovered 12" Loss 6"
	3.0–4.5	1, 1, 1	Grey, clayey fine SAND with some medium and coarse sand. Some weathered shale fragments. Damp.		JAR #3 (4.5')	Drove 18" Recovered 12" Loss 6"
	4.5–6.0	1, 2, 2	Brown, silty CLAY with fine sand. Damp.		JAR #4 (6.0')	Drove 18" Recovered 16" Loss 2"
	6.0–7.5	2, 4, 5	Brown, clayey SILT to silty CLAY with fine sand, trace medium sand. Damp, plastic.		JAR #5 (7.5')	Drove 18" Recovered 18" Loss 0
	7.5–9.0	4, 6, 7	Grey, brown and orange (oxidation stain) silty CLAY with rotted shale fragments. Damp, plastic.		JAR #6 (9.0')	Drove 18" Recovered 16" Loss 2"
	9.0–10	4, 3	Brown, silty CLAY with trace of fine sand. Damp, plastic.		JAR #7	Drove 18" Recovered 18" Loss 0

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE | PROJECT | HOLE NO.

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 618.2 **Hole No.** D-78-20

PROJECT: BIG CREEK-CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	5	Brown silty CLAY See above		JAR #7 10.5'	
	11	2 / 3 / 6	Medium Grey, silty CLAY. Damp, plastic.		JAR #8 12.0'	Drove 18" Recovered 18" Loss 0
	12	3 / 5 / 5	Brown, silty CLAY, trace of fine sand. Damp, plastic.		JAR #9 13.5'	Drove 18" Recovered 18" Loss 0
	13–14	7 / 8 / 6	Brown, silty CLAY with abundant weathered shale fragments. Damp to wet.		JAR #10 15.0'	Drove 18" Recovered 16" Loss 2"
	15–16	4 / 4 / 6	Brownish grey, rotted SHALE fragments with some clay. Wet.		JAR #11 16.5'	Drove 18" Recovered 12" Loss 6"
			Approx. Top of Rock			
601.2	17	2	Brown, fine to medium SAND with clay, weathered shale.		JAR #12	Drove 18" Recovered 12" Loss 6"
		32 / 175/0.5'	Brown and grey, silty SHALE (Driven)		18.0'	
600.2	18		Bottom of Hole.			

ENG FORM 1836-A JAN 67 | PROJECT A1-51 | HOLE NO

Hole No. DC-78-21

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT BIG CREEK - CLEVELAND, OHIO		10. SIZE AND TYPE OF BIT NX, DIAMOND	
2. LOCATION (Coordinates or Station) N 649,301 E 217,985		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) M.S.L.	
3. DRILLING AGENCY F.T. KITLINSKI		12. MANUFACTURER'S DESIGNATION OF DRILL S.4H. 40C	
4. HOLE NO. (As shown on drawing title and file number) DC-78-21		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 5 JARS / UNDISTURBED
5. NAME OF DRILLER BOB HALL		14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.		15. ELEVATION GROUND WATER 604.4	
		16. DATE HOLE	STARTED 15 JUNE 78 / COMPLETED 15 JUNE 78
		17. ELEVATION TOP OF HOLE 608.4	
7. THICKNESS OF OVERBURDEN 7.5'		18. TOTAL CORE RECOVERY FOR BORING 0.7' = 47 %	
8. DEPTH DRILLED INTO ROCK 1.5'		19. SIGNATURE OF INSPECTOR Peter G. Rabela	
9. TOTAL DEPTH OF HOLE 9.0'			

ELEVATION a	DEPTH b	Blows c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	1, 2, 2	Dark brown, silty CLAY with fine sand, roots and other organic litter. Damp.		JAR #1 (1.5')	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples). Drove 18" Recovered 14" Loss 4"
	1					
	2	2, 3, 3	Medium brown, silty CLAY with some fine sand. Damp, plastic.		JAR #2 (3.0')	Drove 18 Recovered 18 Loss 0
	3	1, 3, 4	Grey and orange, silty CLAY with trace of fine sand. Damp, plastic.		JAR #3 (4.5')	Drove 18" Recovered 18" Loss 0
	4					
	5	3, 4, 6	Light brown, clayey, silty, fine to medium SAND with abundant rotted shale fragments (up to gravel size) Damp, sticky.		JAR #4 (6.0')	Drove 18" Recovered 14" Loss 4"
	6	1, 8	Medium grey, clayey SILT with shale fragments		JAR #5	Drove 18" Recovered 16" Loss 2"
			Approx. Top of Rock			
600.9	7	70	Weathered SHALE.		(7.5')	
	8		Medium grey, silty SHALE. Horizontal bedding parallel to fractures. Core ground in upper part of run. Soft shale in bottom 0.3' of recovered core.	47%	RUN #1 (9.0')	4 pieces, some clay
599.4	9		Bottom of Hole. 9.5' Observation pipe left in hole.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE

PROJECT

HOLE NO.

Hole No. DC-78-22

DRILLING LOG

DIVISION	NORTH CENTRAL
INSTALLATION	BUFFALO DISTRICT
SHEET	1 OF 2 SHEETS
1. PROJECT	BIG CREEK-CLEVELAND, OHIO
2. LOCATION (Coordinates or Station)	N 649,742 E 216,579
3. DRILLING AGENCY	F.T KITLINSKI
4. HOLE NO. (As shown on drawing title and file number)	DC-78-22
5. NAME OF DRILLER	GUY MALLOTT
6. DIRECTION OF HOLE	☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	1.4
8. DEPTH DRILLED INTO ROCK	9.6'
9. TOTAL DEPTH OF HOLE	11.0'
10. SIZE AND TYPE OF BIT	NX DIAMOND
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	M.S.L.
12. MANUFACTURER'S DESIGNATION OF DRILL	S & H. 40C
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 1 JAR; UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	1
15. ELEVATION GROUND WATER	605.1
16. DATE HOLE	STARTED 18 JUNE 78; COMPLETED 18 JUNE 78
17. ELEVATION TOP OF HOLE	605.3
18. TOTAL CORE RECOVERY FOR BORING	4.4' = 46 %
19. SIGNATURE OF INSPECTOR	Peter G. Rakel

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	9	Misc. Point Bar Mat'l. (shale, brick, wood, human and animal waste, glass, paper) with medium sand size shale fragments.		JAR #1	Drove 3" O.D. split spoon with 300 lb. hammer falling 18". Drove 16" Recovered 3" Loss 13"
	1	14				
		61/0.4'	Probable Top of Rock		1.4"	
603.6			Brick and concrete			
	2–4		Interbedded soft and hard medium grey, silty SHALE. Horizontal bedding parallel to fractures. Incipient hairline fractures develope upon exposure.	58%	RUN #1	7 pieces
	4				4.0'	
	4–9		Mostly hard, medium grey, silty SHALE. Some soft shale. Presence of clay seams inferred from core loss and presence of fragments in center of run.	42%	RUN #2	7 pieces
	9–10		Hard, grey, silty SHALE. Horizontal bedding and fractures. Core loss may indicate clay or soft shale.	40%	RUN #3	5 pieces

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT A1-53 HOLE NO.

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 605.3		Hole No. DC-78-22
PROJECT BIG CREEK-CLEVELAND, OHIO	INSTALLATION BUFFALO DISTRICT		SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c BLOWS	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10		Hard, grey, silty SHALE See above.		RUN #3	
594.3	11				11.0	
			Bottom of Hole.			

Hole No. DC-78-23

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 of 2 SHEETS

1. PROJECT: BIG CREEK-CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX, DIAMOND
2. LOCATION (Coordinates or Station): N 649,485 E 217,076	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F. T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S.EH. 35H
4. HOLE NO. (As shown on drawing title and file number): DC-78-23	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 7 JARS; UNDISTURBED
5. NAME OF DRILLER: WAYNE BOTTS	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 607.3
	16. DATE HOLE: STARTED 15 JUNE 78; COMPLETED 15 JUNE 78
	17. ELEVATION TOP OF HOLE: 615.2
7. THICKNESS OF OVERBURDEN: 10.5'	18. TOTAL CORE RECOVERY FOR BORING: 2.9' = 45 %
8. DEPTH DRILLED INTO ROCK: 6.5'	19. SIGNATURE OF INSPECTOR: Peter G. [signature]
9. TOTAL DEPTH OF HOLE: 17.0'	

ELEVATION a	DEPTH b	BLOWS	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	50	Blacktop		JAR #1	Drove 2" O.D. split spoon with 300 lb. hammer falling 18" (all samples).
	1	20, 14	Brown, fine SAND with gravel. Dry.		1.5'	Drove 18" Recovered 14" Loss 4"
	2	8, 6, 5	Black and orange, fine SAND with coarse sand, pebbles and gravel. Dry (Fill?)		JAR #2 3.0'	Drove 18" Recovered 14" Loss 4"
	3, 4	5, 3, 5	Medium brown, clayey SILT to silty CLAY. Damp.		JAR #3 4.5'	Drove 18" Recovered 16" Loss 2"
	5	4, 5, 6			JAR #4 6.0'	Drove 18" Recovered 18" Loss 0
	6, 7	4, 5, 4	Brown silty CLAY with trace of coarse sand sized rock fragments. Damp.		JAR #5 7.5'	Drove 18" Recovered 16" Loss 2"
	8	5, 5, 4	Light grey and orange (oxidation stains), clayey SILT with trace of fine sand — Transitional to weathered shale. Damp.		JAR #6 9.0'	Drove 18" Recovered 18" Loss 0
	9, 10	9, 40			JAR #7	Drove 18" Recovered 14" Loss 4"

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE | PROJECT | HOLE NO.

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 615.2 **Hole No.** DC-78-23

PROJECT: BIG CREEK - CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10		Weathered SHALE (No oxidation)		JAR #7	
604.7					10.5'	
	11		Approx. Top of Rock			
	12					
	13		Mostly broken pieces of soft grey SHALE. Contains several clay seams.	32%	RUN #1	
	14					
	15				15.5'	
	16		Medium grey, silty SHALE. Hard, fissile.	87%	RUN #2	Clean fractures 3 pieces
598.2	17				17.0'	
			Bottom of Hole.			

ENG FORM 1836-A | PROJECT A1-56 | HOLE NO.

Hole No. DCU-78-24

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX DIAMOND
2. LOCATION (Coordinates or Station): N 650,385 E 214,985	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S.&H. 35H
4. HOLE NO. (As shown on drawing title and file number): DC-78-24	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4 JARS; UNDISTURBED 1 SHELBY
5. NAME OF DRILLER: WAYNE BOTTS	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 622.6
	16. DATE HOLE: STARTED 14 JUNE 78; COMPLETED 15 JUNE 78'
7. THICKNESS OF OVERBURDEN: 8.0'	17. ELEVATION TOP OF HOLE: 624.8
8. DEPTH DRILLED INTO ROCK: 5.0'	18. TOTAL CORE RECOVERY FOR BORING: 4.8' = 96 %
9. TOTAL DEPTH OF HOLE: 13.0'	19. SIGNATURE OF INSPECTOR: Peter G. Ralston

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0 – 1.5	12, 12, 6	Brown, grey and orange, silty CLAY with rotted pebbles and rock fragments. Damp.		JAR #1 (1.5)	Drove 3" O.D. split spoon with 300-lb. hammer falling 18". Drove 18" Recovered 16" Loss 2"
	1.5 – 3.0	5, 4, 5			JAR #2 (3.0')	Drove 18" Recovered 16" Loss 2"
	3.0 – 5.0				3" Shelby (5.0')	
	5.0 – 6.5	2, 2, 3	No Recovery (See below, [Sample 4].)		JAR #3 (6.5')	Drove 18" Recovered 0 Loss 18"
	6.5 – 8.0	1, 1	Grey silt to fine sand. Wet, soupy.		JAR #4 (8.0')	Drove 18" Recovered 12" Loss 6"
		30	Weathered SHALE.			
616.8	8 – 10		Approx. Top of Rock. Soft. See next sheet. High angle fracture terminates at closed incipient fracture.	96%	RUN #1	Clean Fractures 12 pieces

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT)

PROJECT | HOLE NO.

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 624.8					Hole No. DCU-78-24
PROJECT BIG CREEK - CLEVELAND, OHIO		INSTALLATION BUFFALO DISTRICT				SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10					
	11		Medium grey, silty SHALE. Generally well indurated and hard. Fractures parallel to horizontal bedding. Incipient hairline fractures open on exposure.	46%	RUN #1	Clean Fracture. 12 pieces
	12					
611.8	13				13.0'	
			Bottom of Hole			

ENG FORM 1836-A

Hole No. DC-78-25

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT NX, DIAMOND
2. LOCATION (Coordinates or Station) N 649,050 E 217,758	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) M.S.L.
3. DRILLING AGENCY F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL S.& H. 35H
4. HOLE NO. (As shown on drawing title and file number) DC-78-25	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 9 JARS — UNDISTURBED
5. NAME OF DRILLER WAYNE BOTTS	14. TOTAL NUMBER CORE BOXES 1
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 605.0
	16. DATE HOLE — STARTED 15 JUNE 78 — COMPLETED 15 JUNE 78
7. THICKNESS OF OVERBURDEN 13.5'	17. ELEVATION TOP OF HOLE 614.8
8. DEPTH DRILLED INTO ROCK 5.0'	18. TOTAL CORE RECOVERY FOR BORING 3.8' = 76 %
9. TOTAL DEPTH OF HOLE 18.5'	19. SIGNATURE OF INSPECTOR Peter G. Rakalen

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	3 / 7 / 7	Black, medium to coarse sand with gravel. Dry (FILL).		JAR #1 (1.5)	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples). Drove 18" Recovered 10" Loss 8"
	2	5 / 5 / 5	Brown SILT with clay and fine sand, some coal fragments. Damp.		JAR #2 (3.0')	Drove 18" Recovered 14" Loss 4"
	3	4 / 10 / 16	Grey and tan, silty CLAY with shale fragments. Damp.		JAR #3 (4.5')	Drove 18" Recovered 16" Loss 2"
	5	9 / 6 / 4	Yellow, fine to medium SAND, partly indurated. Dry, (FILL).		JAR #4 (6.0')	Drove 18" Recovered 16" Loss 2"
	6	4 / 3 / 3	Dark grey and brown, medium to coarse SAND with pebbles and gravel. Dry, (FILL).		JAR #5 (7.5')	Drove 18" Recovered 12" Loss 6"
	8	4 / 3 / 3	Greyish brown, medium to coarse SAND with some clay. Damp.		JAR #6 (9.0)	Drove 18" Recovered 12" Loss 6"
	9–10	7 / 7	Brown, sandy CLAY with pebbles and assorted rock fragments. (Including partially indurated sand.) Damp (FILL).		JAR #7	Drove 18" Recovered 14" Loss 4"

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT A1-59 HOLE NO.

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 614.8 **Hole No.** DC 78-25

PROJECT: BIG CREEK - CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	7	Sandy CLAY See above		JAR #7 10.5'	
	11	7 / 5 / 6	Brown to tan, medium SAND with gravel and some fine sand. Damp (FILL).		JAR #8 12.0'	Drove 18" Recovered 12" Loss 6"
	12–13	7 / 8	Brown, medium SAND with some clay		JAR #9	Drove 18 Recovered 12" Loss 6"
601.3		40	Weathered grey SHALE		13.5'	
	14–18		Approx. Top of Rock Medium grey, silty SHALE. Horizontal bedding parallel to fractures. Incipient hairline fractures open upon exposure Soft clayey shale at bottom (0.6') of run.	76%	RUN #1 18.5'	16 pieces
596.3			Bottom of Hole			

Hole No. D-78-26

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT: BIG CREEK-CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX DIAMOND
2. LOCATION (Coordinates or Station): N 648,717 E 218,754	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F. T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S.&H. 35H
4. HOLE NO. (As shown on drawing title and file number): DC-78-26	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 22 JARS; UNDISTURBED
5. NAME OF DRILLER: WAYNE BOTTS	14. TOTAL NUMBER CORE BOXES: 0
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: DRY
	16. DATE HOLE: STARTED 16 JUNE 78; COMPLETED 16 JUNE 78
7. THICKNESS OF OVERBURDEN: 33.0'	17. ELEVATION TOP OF HOLE: 629.7
8. DEPTH DRILLED INTO ROCK: —	18. TOTAL CORE RECOVERY FOR BORING: — %
9. TOTAL DEPTH OF HOLE: 33.0'	19. SIGNATURE OF INSPECTOR: Peter G. Rabalen

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5	1, 1, 2	Brown and grey gravel with medium and fine sand. Damp. FILL.		JAR #1 (1.5)	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples). Drove 18", Recovered 12", Loss 6"
	1.5–3.0	4, 6, 20	Grey, sandy clay with rock fragments, pebbles, some wood fragments and gravel. Damp. FILL.		JAR #2 (3.0')	Drove 18", Recovered 10", Loss 8"
	3.0–4.5	15, 2, 3	Grey, clayey medium sand with gravel and coarse sand. Damp. FILL		JAR #3 (4.5')	Drove 18", Recovered 8", Loss 10"
	4.5–6.0	3, 2, 1	Dark grey to black, silty, fine to medium sand with coarse sand. Wet, runny. (Foundry sand ?) FILL.		JAR #4 (6.0')	Drove 18", Recovered 6", Loss 12"
	6.0–7.5	1, 1, 1	Dark grey to black, silty, coarse sand with some clay. Wet, sticky. FILL		JAR #5 (7.5')	Drove 18", Recovered 17", Loss 1"
	7.5–9.0	2, 1, 2	Black, silty, medium sand with fine and coarse sand. Pebbles. Wet, runny. FILL.		JAR #6 (9.0')	Drove 18", Recovered 10", Loss 8"
	9.0–10	6, 8	Grey and brown, clayey fine sand, with silt and some medium sand. Wet, sticky. FILL.		JAR #7	Drove 18", Recovered 18", Loss 0

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT A1-61 HOLE NO.

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 629.7 **Hole No.** D-78-26

PROJECT: BIG CREEK- CLEVELAND, OHIO | INSTALLATION: BUFFALO DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	5	Clayey fine Sand. See above		JAR #7 10.5'	
	11	10 12 16	Black, fine sand, partly indurated. Damp. (Foundry sand ?) FILL.		JAR #8 12.0'	Drove 18" Recovered 14" Loss 4"
	12 13	10 12 16	Black, fine sand with shale fragments, wood fragments. wet, runny. FILL.		JAR #9 13.5'	Drove 18" Recovered 8" Loss 0"
	14	28 24 27	Black, clayey, fine Sand with large wood fragments. Wet, sticky. FILL.		JAR #10 15.0'	Drove 18" Recovered 16" Loss 2"
	15 16	32 21 24	Grey, fine sandy clay with shale fragments, some pieces of wire. Wet, very sticky. FILL		JAR #11 16.5'	Drove 18" Recovered 18" Loss 0
	17	50 20 9			JAR #12 18.0'	Drove 18" Recovered 18" Loss 0
	18 19	5 12 9	Dark grey, clayey, fine Sand with gravel and trash. Wet. FILL.		JAR #13 19.5	Drove 18" Recovered 18" Loss 0
	20	5 10 9	Dark grey, clayey, fine sand with gravel, medium and coarse sand and trash. Wet. FILL.		JAR #14 21.0'	Drove 18" Recovered 14" Loss 4"
	21 22	6 6	Clayey fine SAND. See below.		JAR #15	Drove 18" Recovered 12" Loss 6"

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 629.7	Hole No. D-78-26
PROJECT BIG CREEK - CLEVELAND, OHIO	INSTALLATION BUFFALO DISTRICT	SHEET 3 OF 3 SHEETS

ELEVATION a	DEPTH b	BLOWS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	22	4			JAR #15 22.5'	
	23	6, 6, 7	Medium to dark grey, clayey fine SAND with gravel, some coarse sand and trash. Wet, sticky. FILL		JAR #16 24.0'	Drove 18" Recovered 14" Loss 4"
	24, 25	5, 4, 3			JAR #17 25.5	Drove 18" Recovered 14" Loss 4"
	26	3, 4, 7	Black, medium sand with fine and coarse sand, some pebbles, miscellaneous rock fragments, brick and shell fragments and other trash. wet, oily. FILL.		JAR #18 27.0'	Drove 18" Recovered 16" Loss 2"
	27, 28	5, 5, 4			JAR #19 28.5'	Drove 18" Recovered 18" Loss 0
	29	3, 2, 2	Medium grey, clayey, fine to medium sand with coarse sand and pebbles. Wet, sticky. FILL.		JAR #20 30.0'	Drove 18" Recovered 15" Loss 3"
	30, 31	4, 4, 50	Medium grey and orange, silty CLAY with some fine sand with trace of shale fragments. (Weathered). Damp.		JAR #21 31.5'	Drove 18" Recovered 16" Loss 2"
597.2	32	15, 18	Approx. Top of Rock		JAR #22	Drove 18" Recovered 14" Loss 4"
596.7	33	50	Grey weathered SHALE		33.0'	
			Bottom of Hole			

ENG FORM 1836-A JAN 67

PROJECT

HOLE NO.

Hole No. DC-78-27

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: NX, DIAMOND
2. LOCATION (Coordinates or Station): N 648,834 E 218,550	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: S & H. 35H
4. HOLE NO. (As shown on drawing title and file number): DC-78-27	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3 JARS; UNDISTURBED
5. NAME OF DRILLER: WAYNE BOTTS	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 652.4
	16. DATE HOLE: STARTED 16 JUNE 78; COMPLETED 17 JUNE 78
	17. ELEVATION TOP OF HOLE: 653.7
7. THICKNESS OF OVERBURDEN: 4.0'	18. TOTAL CORE RECOVERY FOR BORING: 5.2' 52 %
8. DEPTH DRILLED INTO ROCK: 10.0'	19. SIGNATURE OF INSPECTOR: [signature]
9. TOTAL DEPTH OF HOLE: 14.0'	

ELEVATION a	DEPTH b	BLOWS	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	10	Asphalt.		JAR #1	Drove 3" O.D. split spoon with 300 lb. hammer falling 18" (all samples)
	1	8, 9	Black, medium to Coarse SAND.		1.5'	Drove 18"; Recovered 12"; Loss 6"
	2	4, 5, 7	Grey, fine SAND with silt, coarse sand, pebbles and gravel. Damp.		JAR #2; 3.0'	Drove 18; Recovered 13; Loss 5"
	3	33, 100	Weathered grey SHALE with some oxidized (brown) laminations. Dry		JAR #3; 4.0'	Drove 12; Recovered 8; Loss 4
649.7	4		Approx. Top of Rock.			
	5–9		Fragments of medium grey, silty SHALE	10%	RUN #1; 9.0'	
	9–10		Silty SHALE. See below.		RUN #2	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE | PROJECT | HOLE NO.

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 653.7 **Hole No. DC-78-27**

PROJECT BIG CREEK - CLEVELAND, OHIO | INSTALLATION BUFFALO DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	Blows c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10					
	11		Hard, well indurated, medium grey, silty SHALE. Horizontal bedding. Fractures parallel to bedding. Incipient hairline fractures (horizontal) develope upon exposure.	84%	RUN #2	11 pieces
	12					
	13					
639.7	14				14.0'	
			Bottom of Hole.			

Hole No. AB-78-1

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT: BIG CREEK-CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: 6" AUGER DRILL
2. LOCATION (Coordinates or Station): N 650,297 E 215,267	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: MOBILE B30
4. HOLE NO. (As shown on drawing title and file number): AB-78-1	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3 JAR - 2 BAG; UNDISTURBED
5. NAME OF DRILLER: WARD WRIGHT	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 14 JUNE 78; COMPLETED 14 JUNE 78
7. THICKNESS OF OVERBURDEN: 7.2'	17. ELEVATION TOP OF HOLE: 623.9
8. DEPTH DRILLED INTO ROCK: 1.3"	18. TOTAL CORE RECOVERY FOR BORING: 0 %
9. TOTAL DEPTH OF HOLE: 8.5'	19. SIGNATURE OF INSPECTOR: P. G. Kohler

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		FILL			
	1		Grey, silty CLAY with brown, medium to coarse sand.		#1 JAR 1.5	
	2		Tan and grey, silty CLAY. Damp, plastic.		#2 JAR #2a BAG 3.0'	
	3–5		Light brown and orange brown (oxidation), silty CLAY with trace of fine sand. Damp, plastic.		#3 JAR #3a BAG 5.0'	
616.7	5–7		Brown, silty CLAY with some coarse sand.		#4 JAR #4a BAG 7.2'	
615.4	8		Approx. Top of Rock. Grey, silty SHALE		No Sample 8.5'	
			Bottom of Hole			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT) PROJECT HOLE NO.

Hole No. A-78-2

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT: BIG CREEK-CLEVELAND, OHIO
2. LOCATION (Coordinates or Station): N 650,470 E 215,109
3. DRILLING AGENCY: F.T. KITLINSKI
4. HOLE NO. (As shown on drawing title and file number): AB-78-2
5. NAME OF DRILLER: WARD WRIGHT
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 7.0'
8. DEPTH DRILLED INTO ROCK: 1.5'
9. TOTAL DEPTH OF HOLE: 8.5'
10. SIZE AND TYPE OF BIT: 6" AUGER DRILL
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
12. MANUFACTURER'S DESIGNATION OF DRILL: MOBILE B30
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4 JARS-3 BAGS; UNDISTURBED
14. TOTAL NUMBER CORE BOXES
15. ELEVATION GROUND WATER: —
16. DATE HOLE: STARTED 14 JUNE 78; COMPLETED 14 JUNE 78
17. ELEVATION TOP OF HOLE: 626.8
18. TOTAL CORE RECOVERY FOR BORING: 0 %
19. SIGNATURE OF INSPECTOR: Peter G. Rolulen

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0 – 1.5		Grey, silty CLAY with some sand.		#1 JAR 1.5'	
	1.5 – 3.0		Light brown, silty CLAY with some fine sand. Damp, plastic.		#2 JAR #2a. BAG. 3.0'	
	3.0 – 5.0		Light brown, silty CLAY with trace of coarse sand.		#3 JAR #3a BAG 5.0'	
	5.0 – 7.0		Increasing quantity of coarse sand.		#4 JAR #4a BAG. 7.0'	
	6		Some grey clay			
619.8	7		Approx. Top of Rock			
	7 – 8.5		Medium grey Shale		No Sample 8.5	
618.3	8.5		Bottom of Hole.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT A1-67 HOLE NO.

(TRANSLUCENT)

Hole No. A-78-3

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: 6" AUGER DRILL
2. LOCATION (Coordinates or Station): N650,427 E214,892	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: MOBILE B30
4. HOLE NO (As shown on drawing title and file number): AB-78-3	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4 JARS - 3 BAGS; UNDISTURBED
5. NAME OF DRILLER: WARD WRIGHT	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER: —
	16. DATE HOLE: STARTED 14 JUNE 78; COMPLETED 14 JUNE 78
7. THICKNESS OF OVERBURDEN: 7.8'	17. ELEVATION TOP OF HOLE: 625.1
8. DEPTH DRILLED INTO ROCK: 0.7'	18. TOTAL CORE RECOVERY FOR BORING: 0 %
9. TOTAL DEPTH OF HOLE: 8.5	19. SIGNATURE OF INSPECTOR: Peter G. Kalsder

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5		Gravel FILL with black coarse sand (Road ballast)		#1 JAR; 1.5'	
	1.5–2.5		Grey, silty CLAY with gravel.	2.5'	#2 JAR; #2a BAG; 3.0'	
	2.5–5.5		Brown and dark grey, silty CLAY with some fine sand. Damp.	5.5'	#3 JAR; #3a BAG; 5.0'	
	5.5–7.8		Dark grey brown, clayey, fine SAND (sandy clay) with medium and coarse sand. Damp.	7.8'	#4 JAR; #4a BAG; 7.0'; No Sample	
617.3	7.8		Approx. Top of Rock			
616.6	8.5		Medium grey, silty SHALE		8.5'	
			Bottom of Hole			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT | HOLE NO.

Hole No. A-78-4

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT BIG CREEK- CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT 6" AUGER DRILL
2. LOCATION (Coordinates or Station) N 650,734 E 214,572	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) M.S.L.
3. DRILLING AGENCY F. T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL MOBILE B30
4. HOLE NO. (As shown on drawing title and file number) AB-78-4	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 1 JAR — UNDISTURBED
5. NAME OF DRILLER WARD WRIGHT	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER —
	16. DATE HOLE — STARTED 14 JUNE 78 — COMPLETED 14 JUNE 78
7. THICKNESS OF OVERBURDEN 1.5'	17. ELEVATION TOP OF HOLE 632.1
8. DEPTH DRILLED INTO ROCK —	18. TOTAL CORE RECOVERY FOR BORING 0 %
9. TOTAL DEPTH OF HOLE 1.5'	19. SIGNATURE OF INSPECTOR Peter G. [illegible]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		Topsoil	0.5'	#1	
	1		Light grey, clayey, medium SAND. Damp. Stopped boring. On top of structure or water main.		JAR	
630.6					1.5	
			Bottom of Hole			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT A1-69 HOLE NO.

Hole No. A-78-4A

DRILLING LOG	DIVISION: NORTH CENTRAL	INSTALLATION: BUFFALO DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT: BIG CREEK- CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: 6" AUGER DRILL
2. LOCATION (Coordinates or Station): NEAR FULTON ROAD BRIDGE	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: MOBILE B30
4. HOLE NO. (As shown on drawing title and file number): AB-78-4A	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4 JARS; UNDISTURBED
5. NAME OF DRILLER: WARD WRIGHT	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER —
	16. DATE HOLE: STARTED 14 JUNE 78; COMPLETED 14 JUNE 78
7. THICKNESS OF OVERBURDEN: 7.2'	17. ELEVATION TOP OF HOLE: 632.1
8. DEPTH DRILLED INTO ROCK: —	18. TOTAL CORE RECOVERY FOR BORING: 0 %
9. TOTAL DEPTH OF HOLE: 7.2'	19. SIGNATURE OF INSPECTOR: Pete G. Rabalais

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		Topsoil	0.5	#1 JAR	
	1		Light grey, clayey, medium SAND. Damp.		1.5'	
	2				#2 JAR	
	3		Dark grey, clayey, fine to medium SAND with pebbles, rock fragments and gravel. Damp.		3.0' #3 JAR	
	4					
	5					
	6			6.4'	6.0' #4 JAR	
624.9	7		Grey, clayey SAND with silt, rock fragments and coarse sand sized brick chips. (FILL)? Damp.		7.2'	
			Bottom of Hole Refusal on Shale			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) PROJECT HOLE NO.

Hole No. A-78-5

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: 6" AUGER DRILL
2. LOCATION (Coordinates or Station): N 650,806 E 214,402	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F. T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: MOBILE B30
4. HOLE NO. (As shown on drawing title and file number): AB-78-5	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3 JARS; UNDISTURBED
5. NAME OF DRILLER: WARD WRIGHT	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: —
	16. DATE HOLE: STARTED 14 JUNE 78; COMPLETED 14 JUNE 78
7. THICKNESS OF OVERBURDEN: 5.4'	17. ELEVATION TOP OF HOLE: 635.5
8. DEPTH DRILLED INTO ROCK: —	18. TOTAL CORE RECOVERY FOR BORING: 0 %
9. TOTAL DEPTH OF HOLE: 5.4'	19. SIGNATURE OF INSPECTOR: Peter G. Rabular

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		Topsoil	0.2'		
	1		Brown, clayey, medium SAND with rock fragments.		#1 JAR 1.5'	
	2		Grey, fine to medium, sandy CLAY with some coarse sand. Damp.	2.5'	#2 JAR	
	3		As above, but with some weathered rock fragments.		3.0'	
	4		Grey or brown, clayey SILT with some coarse rock fragments. Some laminations noted. Contains trace of brick or terra cotta fragments. (FILL)? Dry.		#3 JAR	
630.1	5		Color change to brown		5.4'	
			Bottom of Hole Refusal on Bedrock.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) PROJECT A1-71 HOLE NO.

Hole No. A-78-6

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT: BIG CREEK-CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: 6" AUGER DRILL
2. LOCATION (Coordinates or Station): N 648,797 E 218,732	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: MOBILE B30
4. HOLE NO. (As shown on drawing title and file number): AB-78-6	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 8 JAR-4 Bag; UNDISTURBED
5. NAME OF DRILLER: WARD WRIGHT	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 597.8
	16. DATE HOLE: STARTED 14 JUNE 78; COMPLETED 14 JUNE 78
7. THICKNESS OF OVERBURDEN: 20.5'	17. ELEVATION TOP OF HOLE: 618.3
8. DEPTH DRILLED INTO ROCK: 0.5'	18. TOTAL CORE RECOVERY FOR BORING: 0 %
9. TOTAL DEPTH OF HOLE: 21.0'	19. SIGNATURE OF INSPECTOR: Peter G. Roberts

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5		Grey to black, fine to medium SAND with coarse sand and pebbles. Dry.		#1 JAR 1.5'	
	1.5–3.0		Black to grey, clayey, fine to medium SAND with some coarse sand. Damp.		#2 JAR 3.0'	
	3.0–6.0		Change Grey, silty, fine SAND with some clay and medium sand. (weathered grey shale). Dry. Possible shale boulder or cobble		#3 JAR #5a BAG. 6.0'	
	6.0–6.4		Brown, medium SAND with some clay & pebbles. Wet.	6.4'		
	6.4–9.0		Apparent interbedded Grey shale and clay seams.		#4 JAR 9.0'	
	9.0–10		Sandy CLAY See below.		#5 JAR #5a BAG	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT) PROJECT HOLE NO.

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 618.3	Hole No. A-78-6
PROJECT BIG CREEK - CLEVELAND, OHIO	INSTALLATION BUFFALO DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10 – 12		Dark grey, Sandy CLAY with coarse sand and small pebbles or rock fragments. Damp to wet.		#5 JAR; #5a BAG; 12.0'	
	12 – 15		Dark grey, silty CLAY with fine sand and trace of medium and coarse Sand. Damp to wet.		#6 JAR; #6a BAG; 15.0'	
	15 – 18		Grey and brown, silty CLAY. wet to damp, plastic		#7 JAR; #7a BAR; 18.0'	
	18 – 20.5		Brown, silty CLAY with some fine sand, coarse sand. Damp to wet, plastic.		#8 JAR	
597.8	20 – 20.5		Picked up rock fragments	20.5'		
	20.5		Approx. Top of Rock.			
597.3	20.5 – 21		Medium grey SHALE		21.0'	
	21		Bottom of Hole.			

ENG FORM 1836-A JUN 67

PROJECT A1-73 HOLE NO

Hole No. A-78-7

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT: BIG CREEK-CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: 6" AUGER DRILL
2. LOCATION (Coordinates or Station): N 648,722 E 218,857	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L
3. DRILLING AGENCY: F.T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: MOBILE B30
4. HOLE NO. (As shown on drawing title and file number): AB-78-7	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 8 JARS; UNDISTURBED
5. NAME OF DRILLER: WARD WRIGHT	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 601.8
	16. DATE HOLE: STARTED 14 JUNE 78; COMPLETED 14 JUNE 78
7. THICKNESS OF OVERBURDEN: 20.7'	17. ELEVATION TOP OF HOLE: 616.8
8. DEPTH DRILLED INTO ROCK: —	18. TOTAL CORE RECOVERY FOR BORING: — %
9. TOTAL DEPTH OF HOLE: 20.7'	19. SIGNATURE OF INSPECTOR: Peter G. Kolaleu

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1.5		Black, fine to medium SAND with gravel. Moist.		#1 JAR 1.5'	
	1.5–3		Black, medium SAND with fine sand, pebbles and gravel. Moist.		#2 JAR 3.0'	
	3–6				#3 JAR 6.0'	
	6–9		Black, fine to medium SAND with some clay and pebbles. Damp. Increase in clay with trace of gravel toward base.		#4 JAR	
	9–10		Grey SAND, See below.		#5 JAR	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT A1-74 HOLE NO.

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 616.8	Hole No. A-78-7
PROJECT	INSTALLATION	SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10–12		Grey, medium to coarse SAND with some clay, pebbles and rock fragments. Damp.		#5 JAR 12.0'	
	12–16.5		Black, medium SAND with silt, fine sand and some Clay. Wet, sticky. Stiffer at 16.5'		#6 JAR 15.0' #7 JAR	
	16.5–18.5		Black, silty, fine to medium SAND. Wet (soupy).		18.0'	
	18.5–20.7		Olive grey, silty CLAY, with fine sand. Wet, sticky, Plastic.	18.5'	#8 JAR. 20.7'	
596.1	20.7		Bottom of Hole			

ENG FORM 1836-A JUN 67

GPO 1969 O—350-545

PROJECT A1-75 HOLE NO.

Hole No. A-78-8

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT BIG CREEK-CLEVELAND, OHIO		10. SIZE AND TYPE OF BIT 6" AUGER DRILL	
2. LOCATION (Coordinates or Station) N 648,629 E 219,003		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) M.S.L	
3. DRILLING AGENCY F.T. KITLINSKI		12. MANUFACTURER'S DESIGNATION OF DRILL MOBILE B30	
4. HOLE NO. (As shown on drawing title and file number) AB-78-8		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: 5 JARS	UNDISTURBED:
5. NAME OF DRILLER WARD WRIGHT		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER 597.4	
		16. DATE HOLE — STARTED: 14 JUNE 78	COMPLETED: 14 JUNE 78
7. THICKNESS OF OVERBURDEN 17.5'		17. ELEVATION TOP OF HOLE 614.4	
8. DEPTH DRILLED INTO ROCK —		18. TOTAL CORE RECOVERY FOR BORING — %	
9. TOTAL DEPTH OF HOLE 17.5'		19. SIGNATURE OF INSPECTOR Peter G. Robulen	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0 – 1.5				#1 JAR (1.5')	
	1.5 – 3.0				#2 JAR (3.0')	
	3.0 – 6.0		Black, fine SAND with some pebbles. Dry. Contains miscellaneous trash: metal, concrete, brick, glass, wood, etc.		#3 JAR (6.0')	
	6.0 – 9.0				#4 JAR (9.0')	
	9.0 – 10					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE PROJECT A1-76 HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 614.4 | **Hole No.** A-78-8

PROJECT EIG CREEK-CLEVELAND, OHIO | INSTALLATION BUFFALO DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10					
	11		Black, fine SAND with some pebbles. Dry.		No Recovery	
	12				12.0'	
	13					
	14				No Recovery	
	15				15.0	
	16		Dark grey, coarse SAND with clay and silt. wet, sticky. Change.		#5 JAR.	
	17			17.0'		
596.9			Medium grey SHALE (weathered)		17.5'	
			Bottom of Hole Refusal on Shale.			

ENG FORM 1836-A JUN 67

PROJECT A1-77 | HOLE NO

Hole No. A-78-9

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION BUFFALO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT: BIG CREEK - CLEVELAND, OHIO	10. SIZE AND TYPE OF BIT: 6" AUGER DRILL
2. LOCATION (Coordinates or Station): N 649,280 E 217,500	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M.S.L.
3. DRILLING AGENCY: F. T. KITLINSKI	12. MANUFACTURER'S DESIGNATION OF DRILL: MOBILE B30
4. HOLE NO. (As shown on drawing title and file number): AB-78-9	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4 JARS; UNDISTURBED
5. NAME OF DRILLER: WARD WRIGHT	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER —
	16. DATE HOLE: STARTED 15 JUNE 78; COMPLETED 15 JUNE 78
7. THICKNESS OF OVERBURDEN: 12.2'	17. ELEVATION TOP OF HOLE 613.5
8. DEPTH DRILLED INTO ROCK: 0.3'	18. TOTAL CORE RECOVERY FOR BORING — %
9. TOTAL DEPTH OF HOLE: 12.5'	19. SIGNATURE OF INSPECTOR: Pete G. Ruel...

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0 – 1.0		Yellow brick, cobbles and road ballast.	1.0'	#1 JAR (0 – 3.0')	
	1.0 – 3.0		Brown, fine to medium SAND with silt and some clay.		3.0'	
	3.0 – 4.0		Gravel, cobbles, rubbish, fill.	4.0'	#2 JAR (3.0 – 6.0')	
	4.0 – 7.3		Grey, brown and black (fuel oil coating), clayey, fine SAND with silt. Damp to wet.	7.3'	6.0'; #3 JAR (6.0 – 9.0')	
	7.3 – 10		Brown and black (fuel oil coating), medium SAND with fine sand and silt, some clay. Wet to damp. Oily, fill?		9.0'	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE | PROJECT A1-78 | HOLE NO.

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 613.5				Hole No. A-78-9
PROJECT BIG CREEK-CLEVELAND, OHIO		INSTALLATION BUFFALO DISTRICT			SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10		See sheet 1		No Recovery.	
	11					
	12				12.0'	
601.3			Black (fuel oil) clayey SAND	12.2	#4 JAR.	
601.0			Grey SHALE (weathered)	12.5'		
			Bottom of Hole Refusal on shale			

ENG FORM 1836-A JAN 67

PROJECT A1-79

HOLE NO.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX A

SOILS, GEOLOGY, AND CONSTRUCTION MATERIALS

FEBRUARY 1979

SUBAPPENDIX A2

LABORATORY AND FIELD TEST DATA

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Standard Compaction Tests	A2-50
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Triaxial Tests - Consolidated Undrained	A2-56
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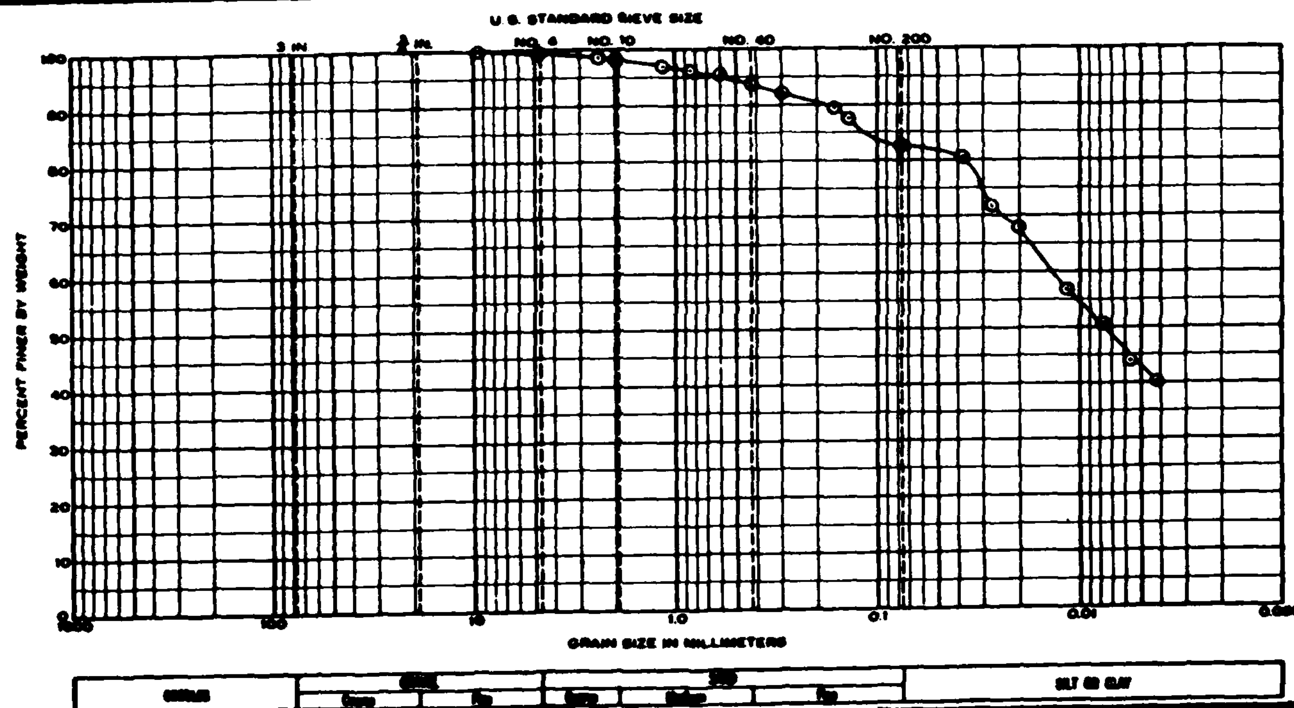
Direct Shear Tests	A2-81
Field Permeability Tests	A2-86
Hydraulic Pressure Tests	A2-91



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	Spec. Gravity
Bags 2A & 3A		Orange brown, silty	24.7	32	20	12	2.72
(A-78-1)		clay w/some sand					
Bag 4A (A-78-2)							
Composite		Unified Class.: CL					

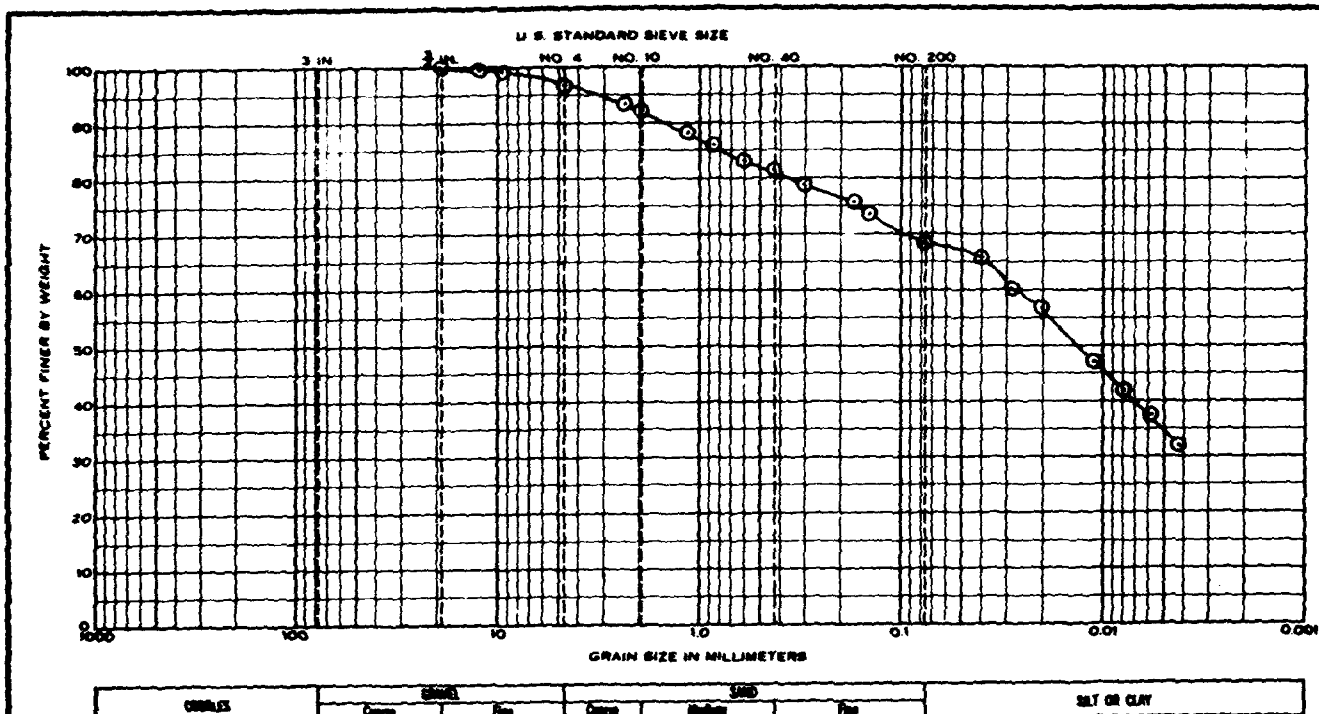
Project: Big Creek Flood Control Project, Cleveland, Ohio

Area:

Boring No. A-78-1 & A-78-2

Date: September, 1978

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	Spec. Gravity
Bags 2A,	1.5 -7.5	Brownish grey,	16.7	28	17	11	2.69
3A & 4A		sandy, silty clay					
Composite							
		Unified Class.: CL					

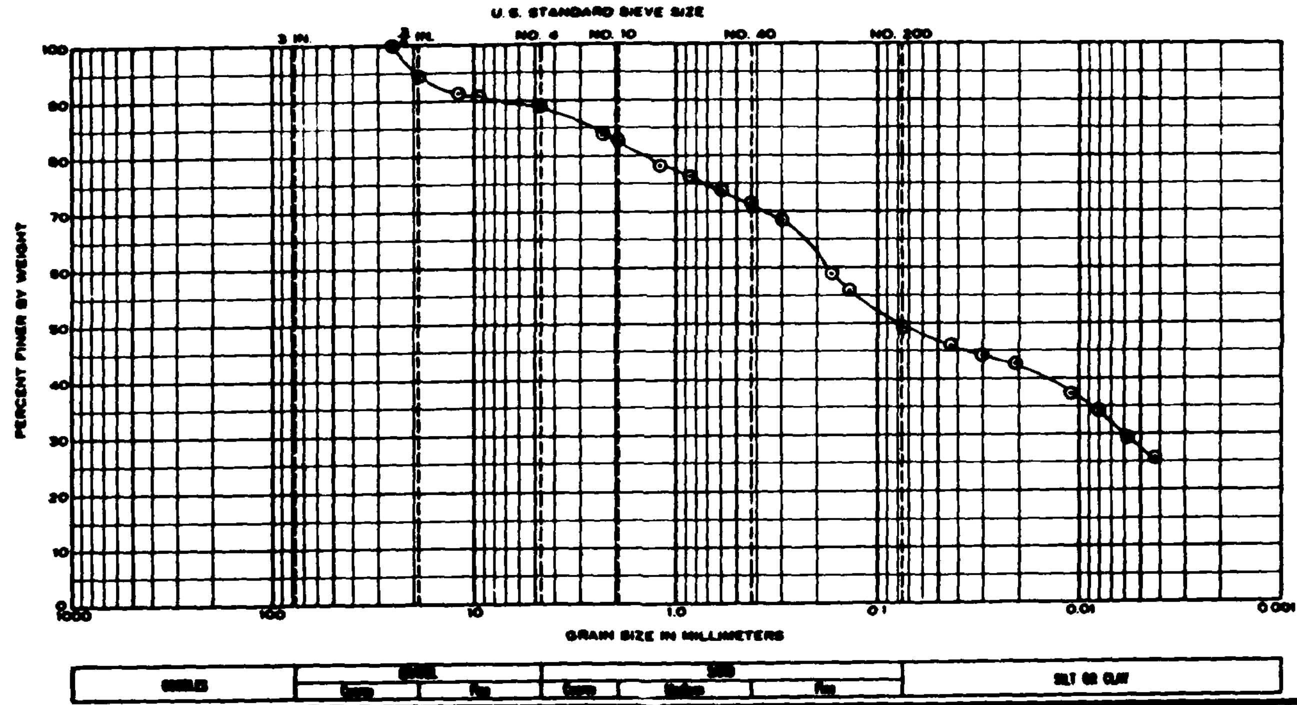
GRADATION CURVES

Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. A-78-3

Date September, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
2	1.5 -3.0	Brownish grey, silty, clayey, fine- to coarse-grained sand w/a trace of brick and plastic fragments	17.1	23	16	7
		Unified Class.: SM-SC				

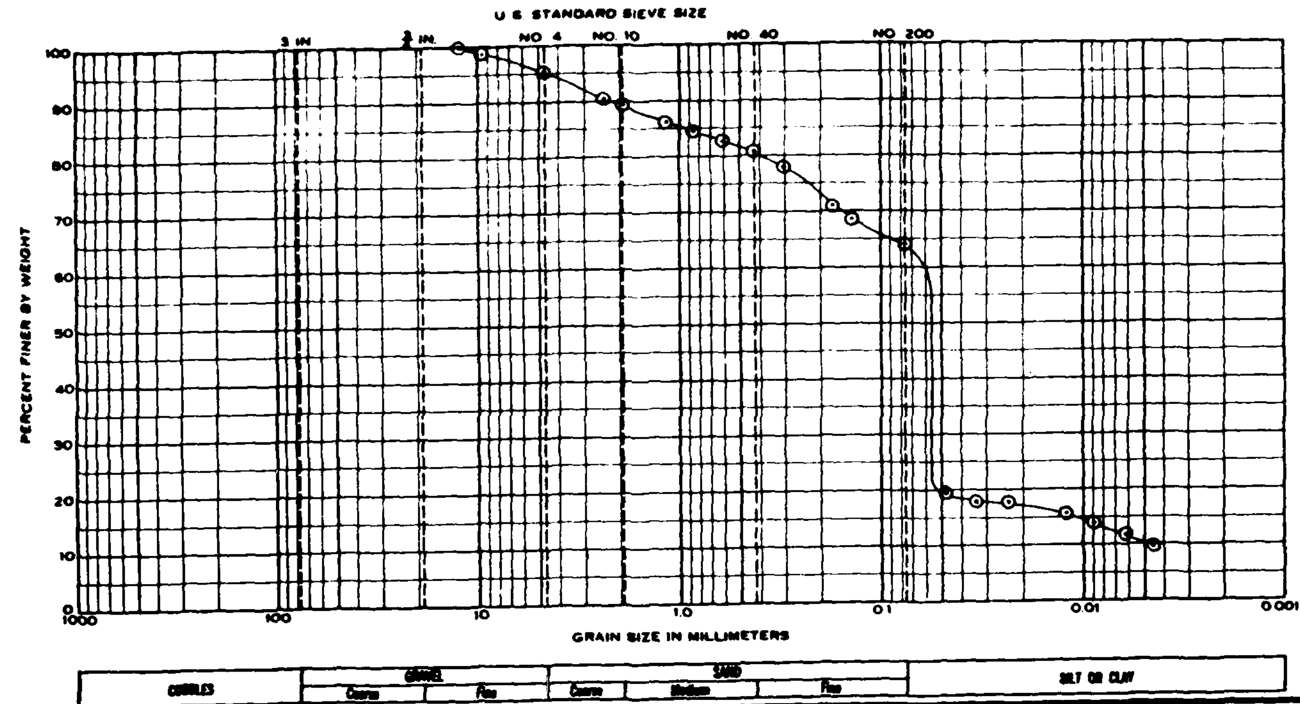
Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. D-78-13

Date September, 1978

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
12	16.5-18.0	Grey, sandy, clayey silt w/a trace of gravel	31.3	23	16	7	
		Unified Class.: CL-ML					

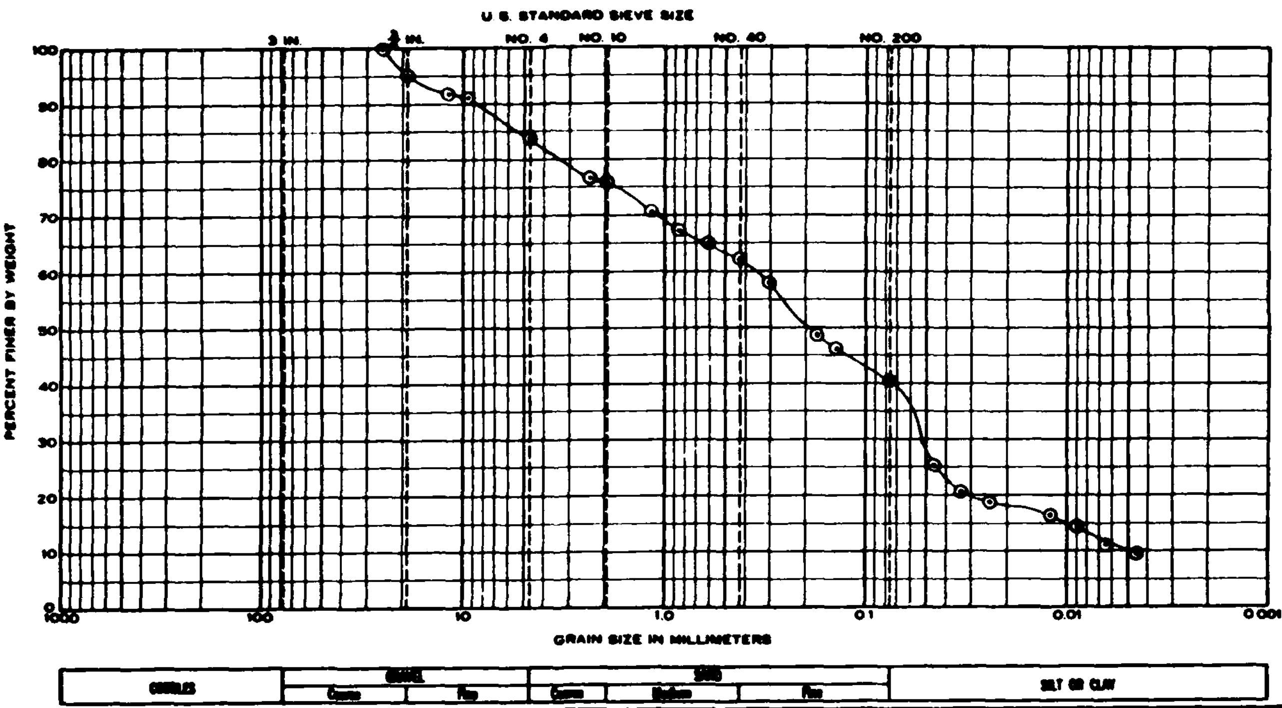
Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. D-78-13

Date September, 1978

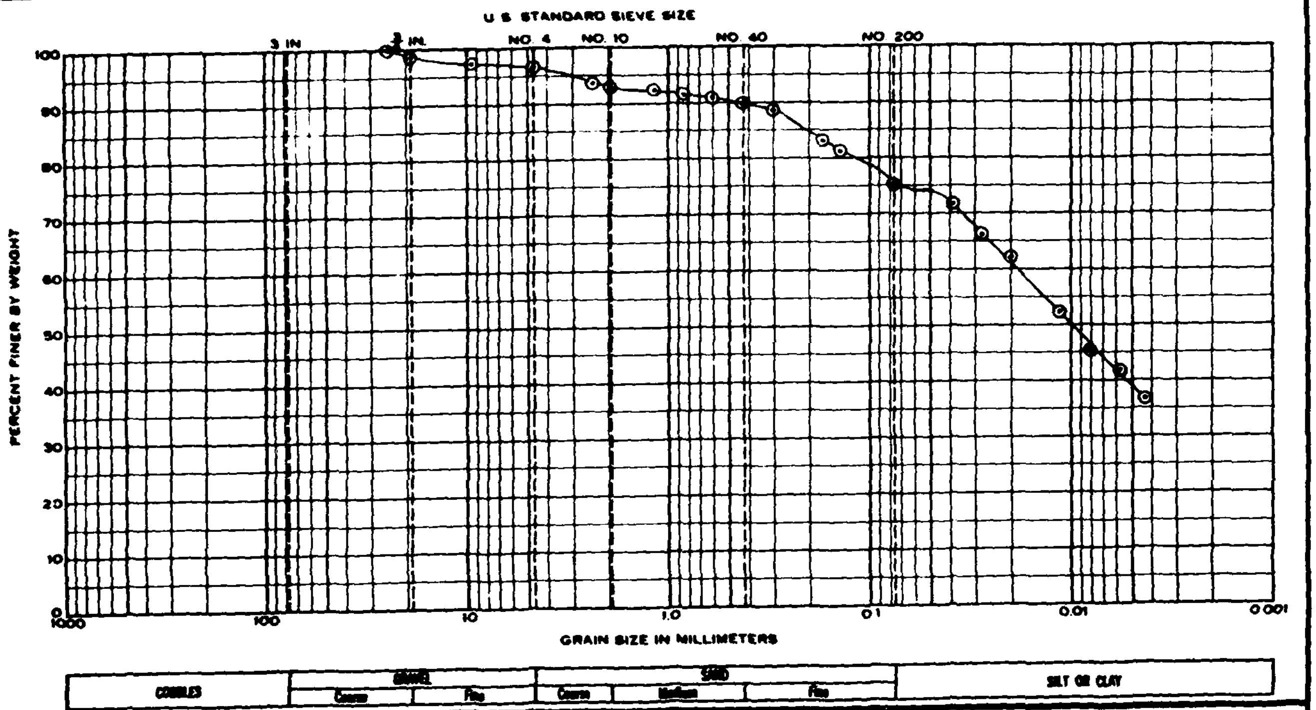
GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
21	30.0-31.5	Grey, silty, clayey fine- to coarse-grained sand w/some gravel and wood fragments	27.4	24	16	8
		Unified Class.: SC				

Project	Big Creek Flood Control Project, Cleveland, Ohio
Area	
Boring No.	D-78-13
Date	September, 1978

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	Spec. Gravity
3-6 (DC-78-4)		Brown, silty clay	19.8	31	19	12	2.66
3-7 (DC-78-6)		w/some sand					
3 (DC-78-9)							
2 & 3 (DC-78-21)		Unified Class.: CL					
Composite							

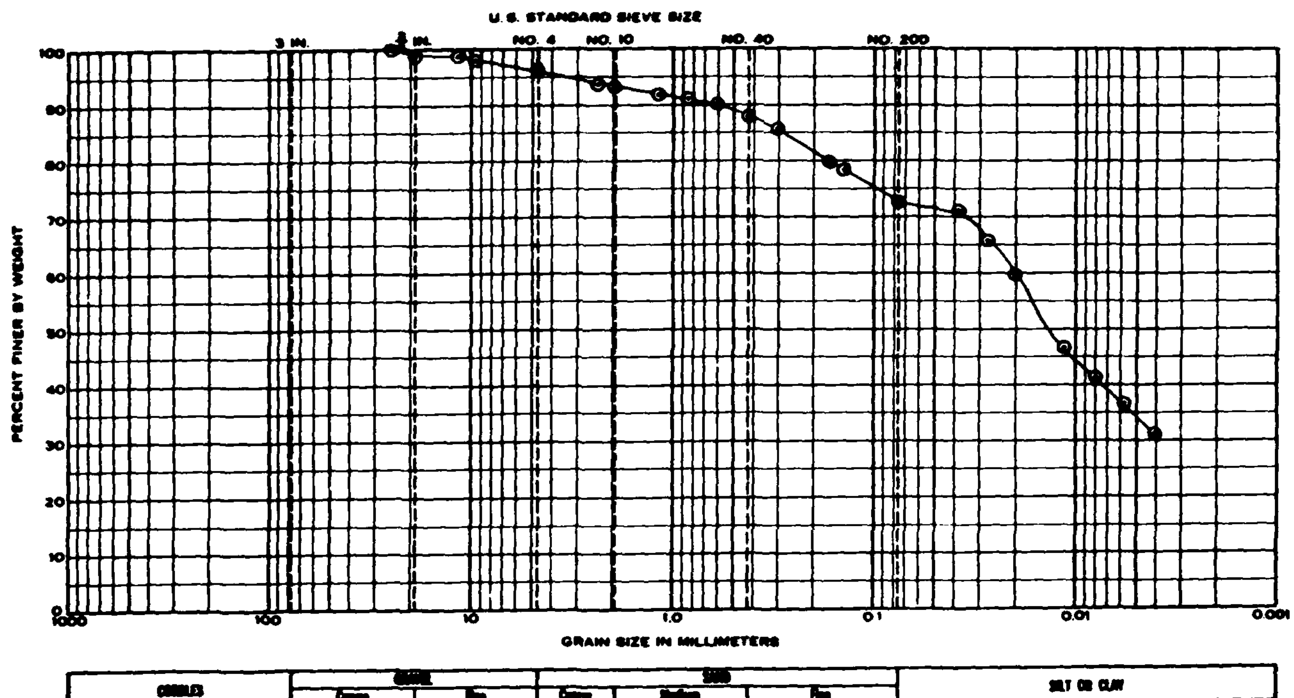
GRADATION CURVES

Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. DC-78-4, 6, 9 & 21

Date September, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	Spec. Gravity
6,7,9,11	(DC-78-3)	Brown, silty clay	24.7	31	20	11	2.68
4 & 5	(DC-78-18)	w/some sand					
3,4,6-9	(DC-78-20						
		Unified Class.: CL					
Composite							

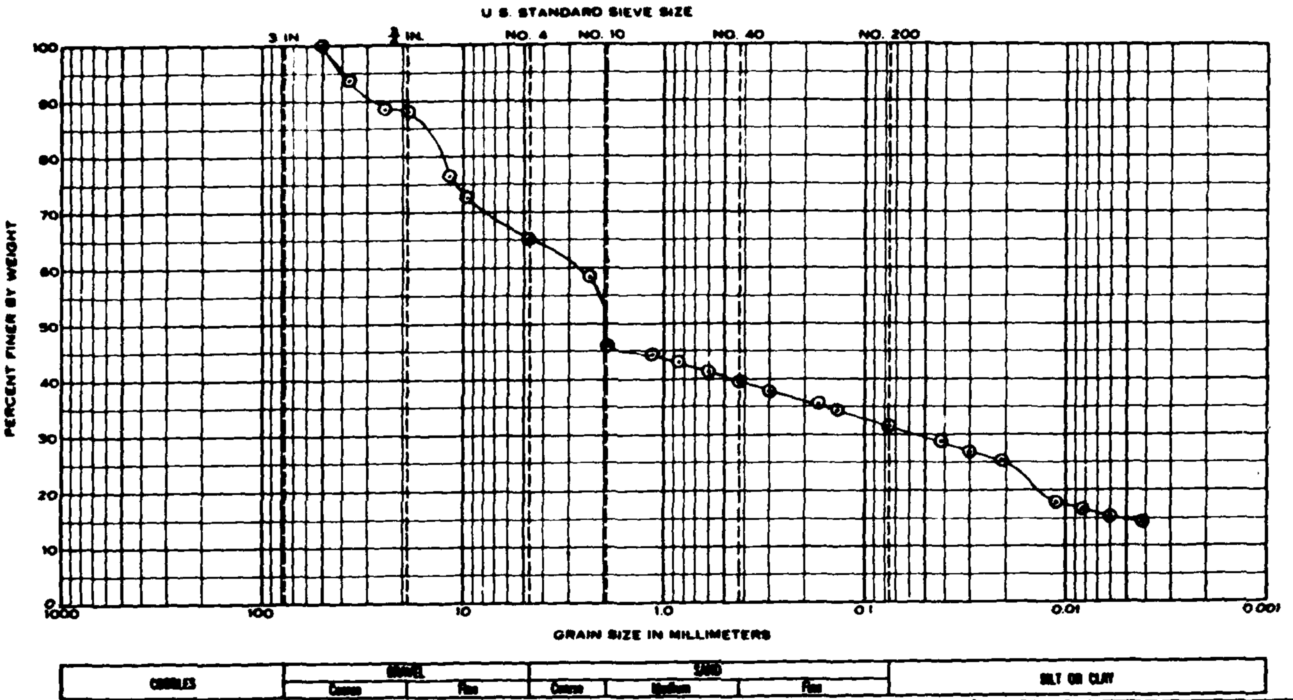
GRADATION CURVES

Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. DC-78-3, 18 & 20

Date September, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	Spec. Gravity
Shelby Tube #1	3.0-5.0	Orange brown, silty, clayey, sandy gravel	22.4	31	18	13	2.77
		Unified Class: GC					

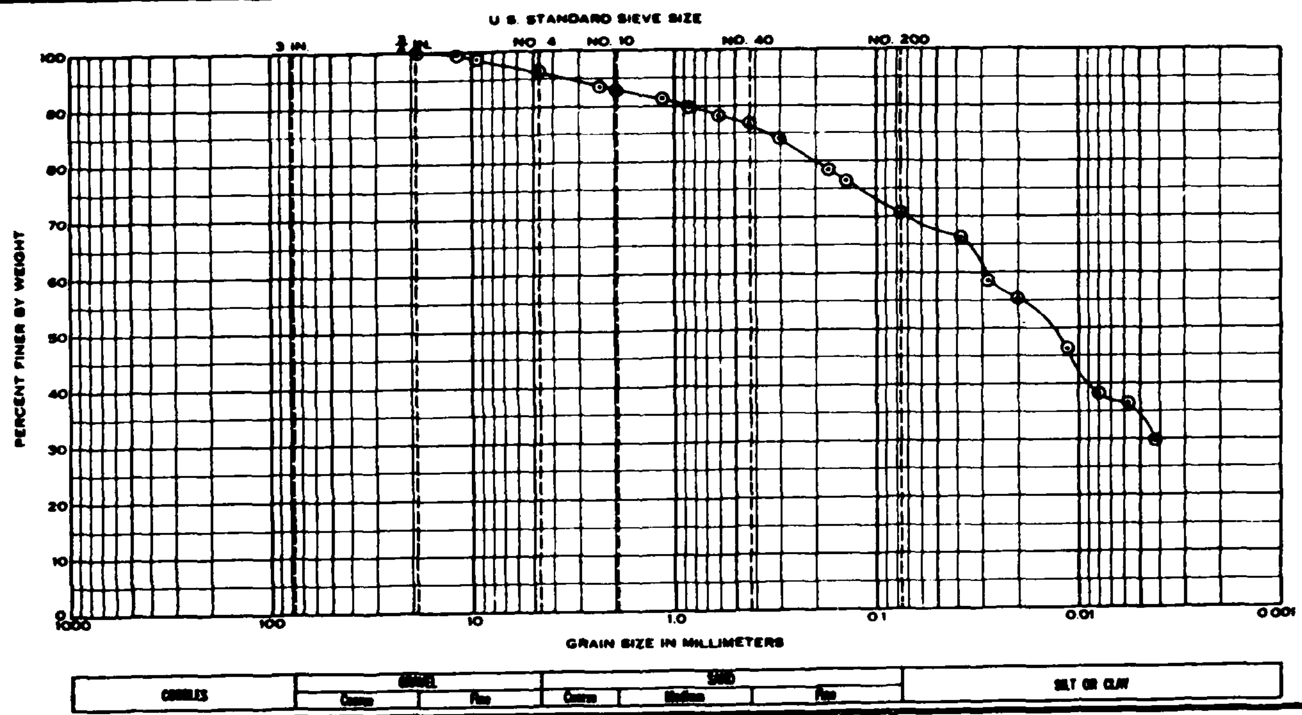
Project: Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. DCU-78-24

Date: September, 1978

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	Spec. Gravity
4	(DC-78-2)	Greyish brown,	20.5	29	20	9	2.74
3,5,6	(DC-78-5)	sandy, silty clay					
2,4,6,9	(DC-78-7)						
		Unified Class.: CL					
Composite							

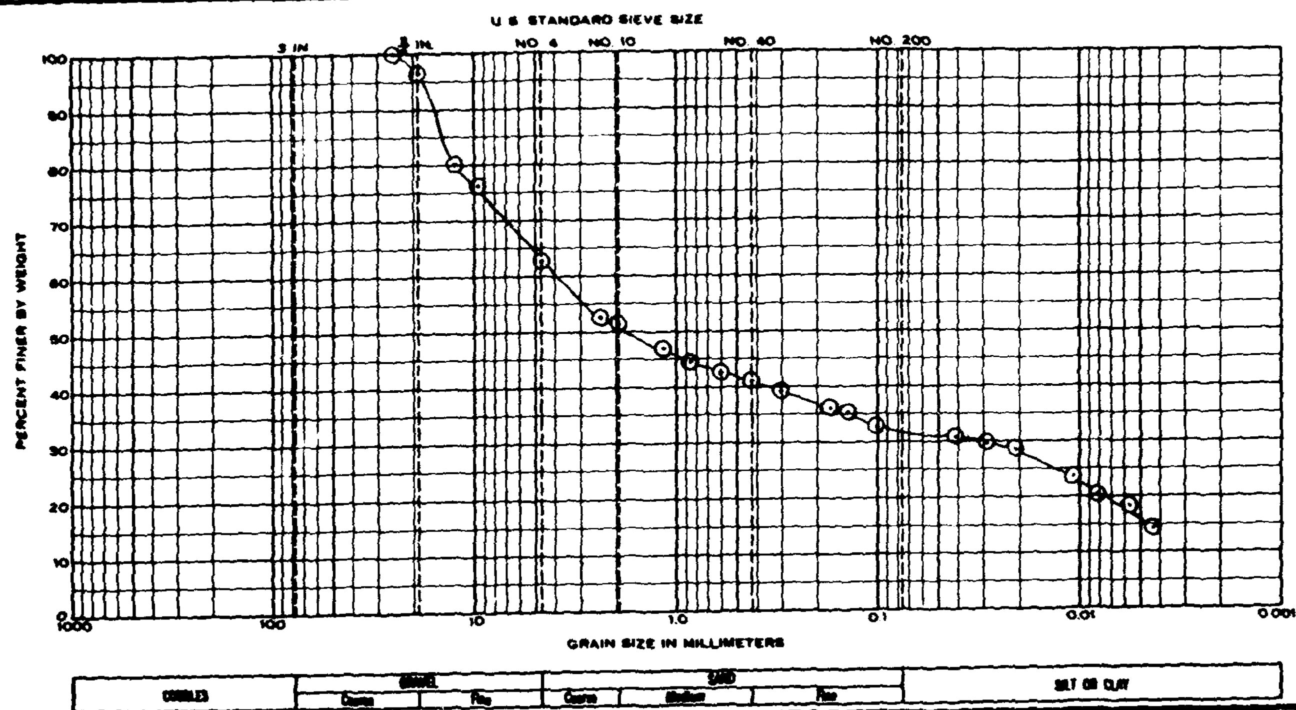
GRADATION CURVES

Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. DC-78-2, 5 & 7

Date September, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #2	1.5'-3.0'	Light grey shale fragments mixed w/some sand, silt, and clay Unified Class.: GC	7.6	26	17	9

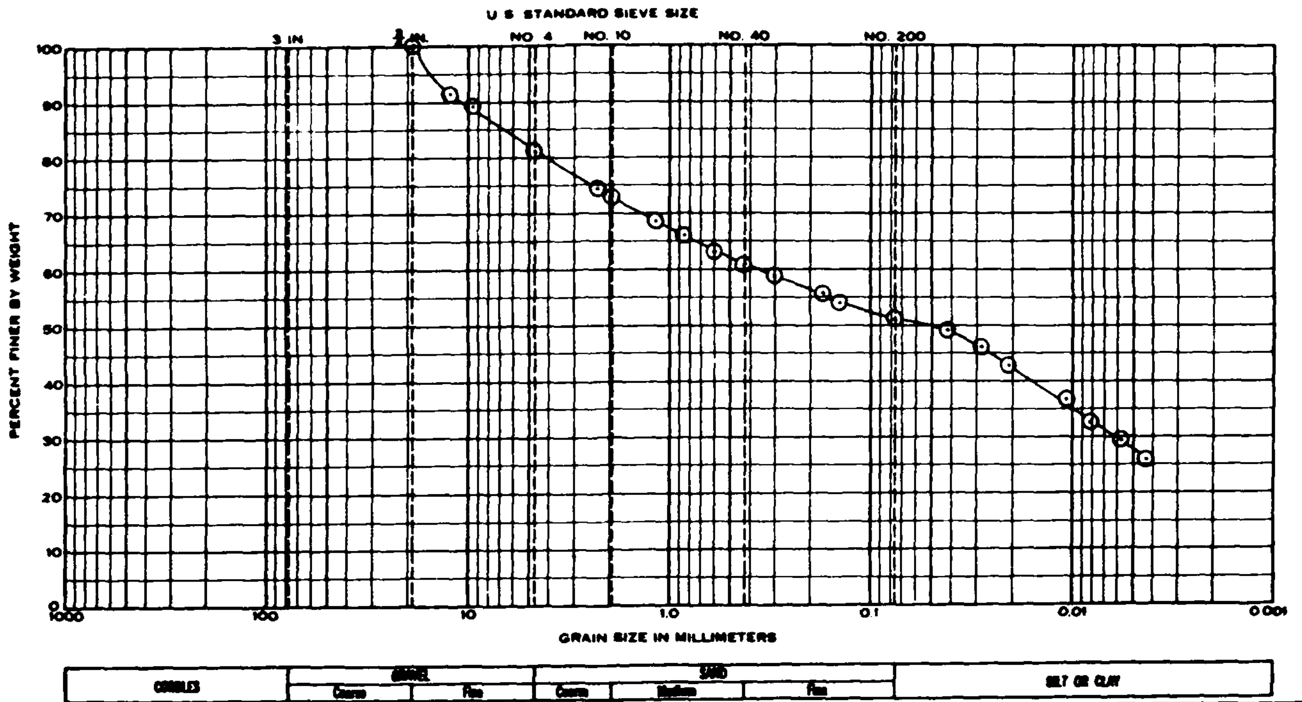
Project: Big Creek Flood Control Project, Cleveland, Ohio

Area:

Boring No. DC-78-1

Date: July, 1978

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #4	4.56.0'	Greyish brown, sandy, silty clay w/some shale fragments Unified Class.: CL	11.2	31	20	11

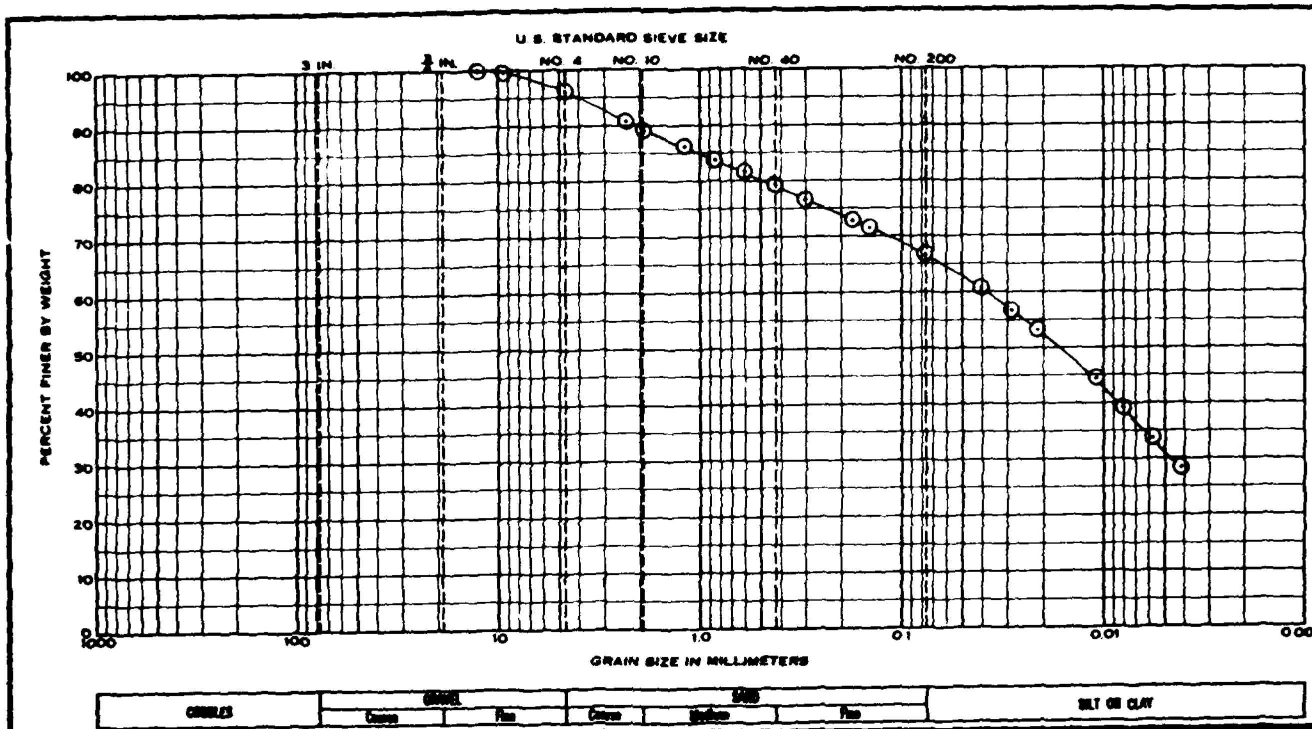
Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. DC-78-1

Date July, 1978

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #6	7.5'-9.0'	Light grey, sandy, silty clay	23.7	31	20	11
		Unified Class.: CL				

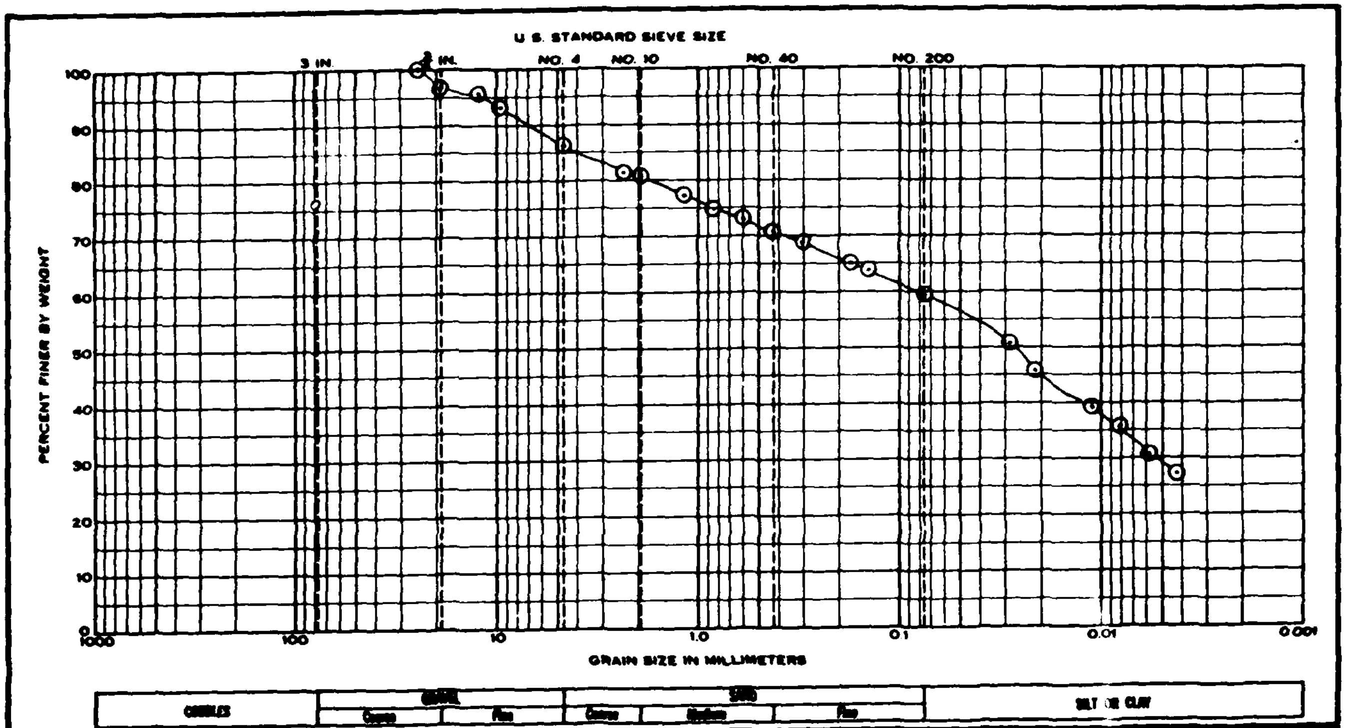
Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. DC-78-1

Date July, 1978

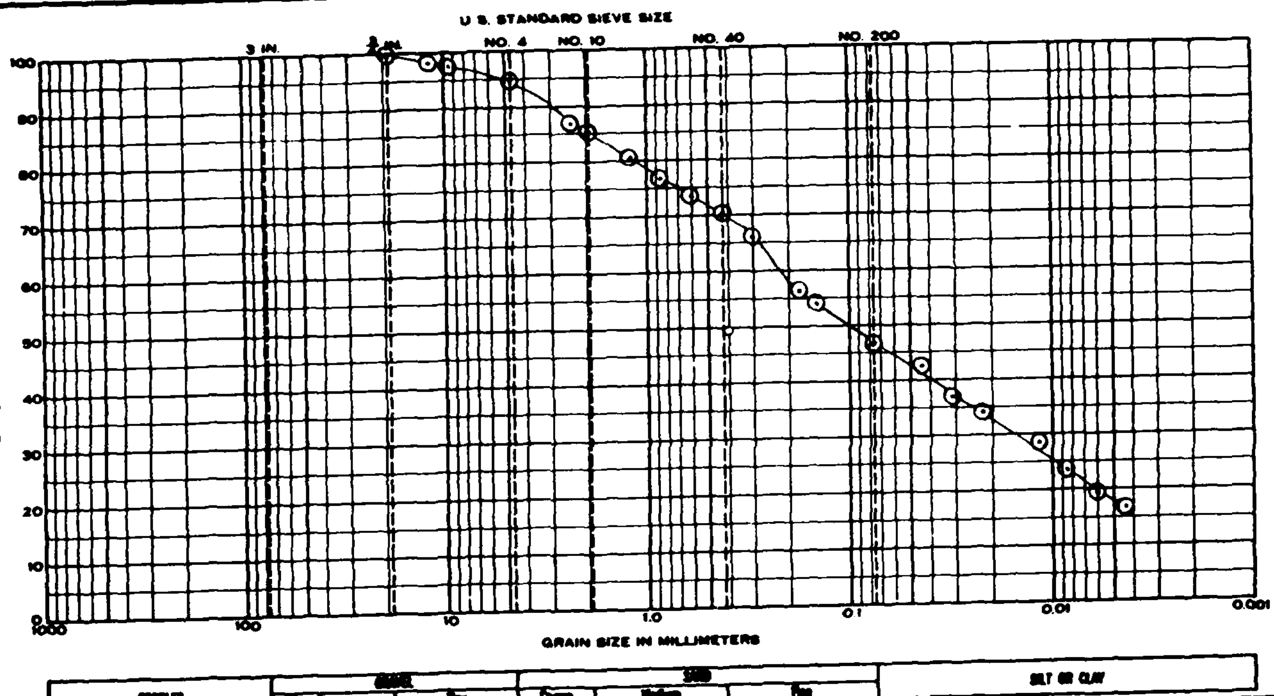
GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
Jar #7	9.0'-10.5	Dark grey, sandy, silty clay w/some shale fragments	29.0	33	20	13	
		Unified Class.: CL					

GRADATION CURVES

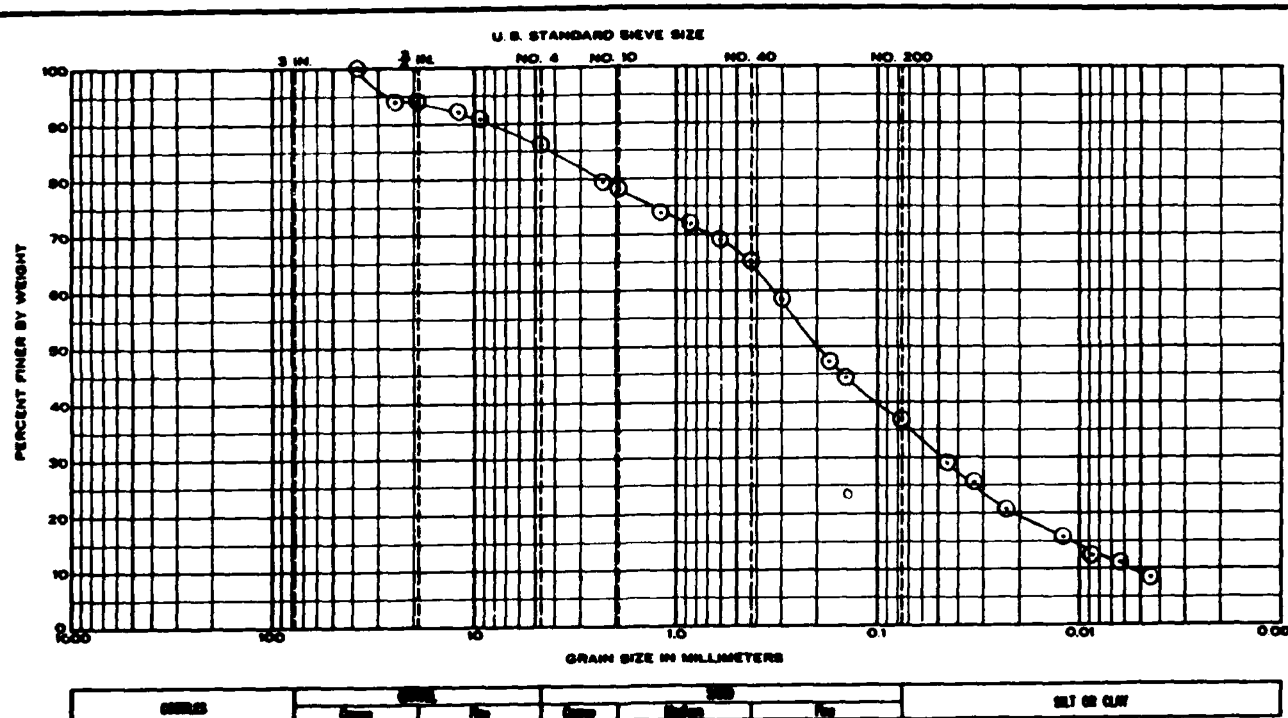
Project	Big Creek Flood Control Project, Cleveland, Ohio
Area	
Boring No.	DC-78-1
Date	July, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #3	3.0'-4.5'	Dark grey, silty, fine- to medium-grained sand w/ some clay Unified Class.: SM-SC	18.7	26	19	7

GRADATION CURVES

Project Big Creek Flood Control Project, Cleveland, Ohio
Area
Boring No. DC-78-2
Date July, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #1	0'0"-1.5	Dark brown, silty fine- to medium-grained sand w/ some gravel and a trace of clay	11.9	19	15	4

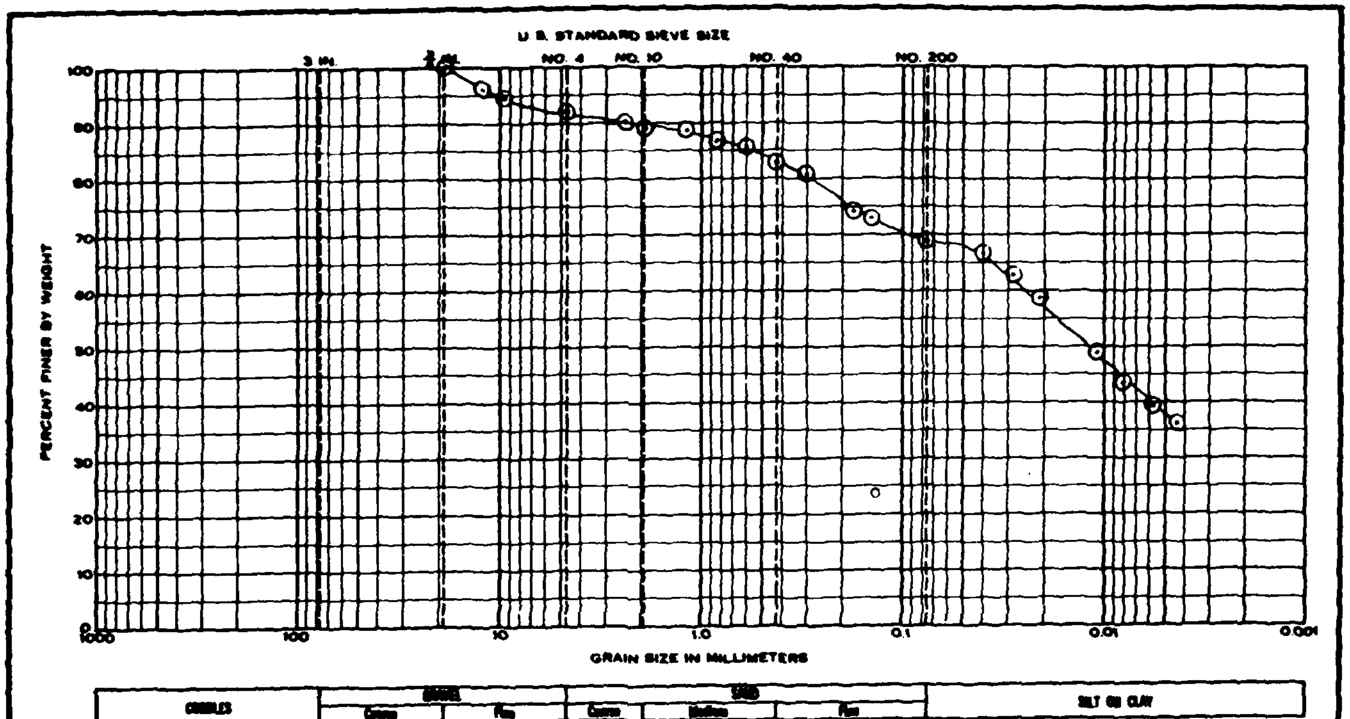
GRADATION CURVES

Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. DC-78-3

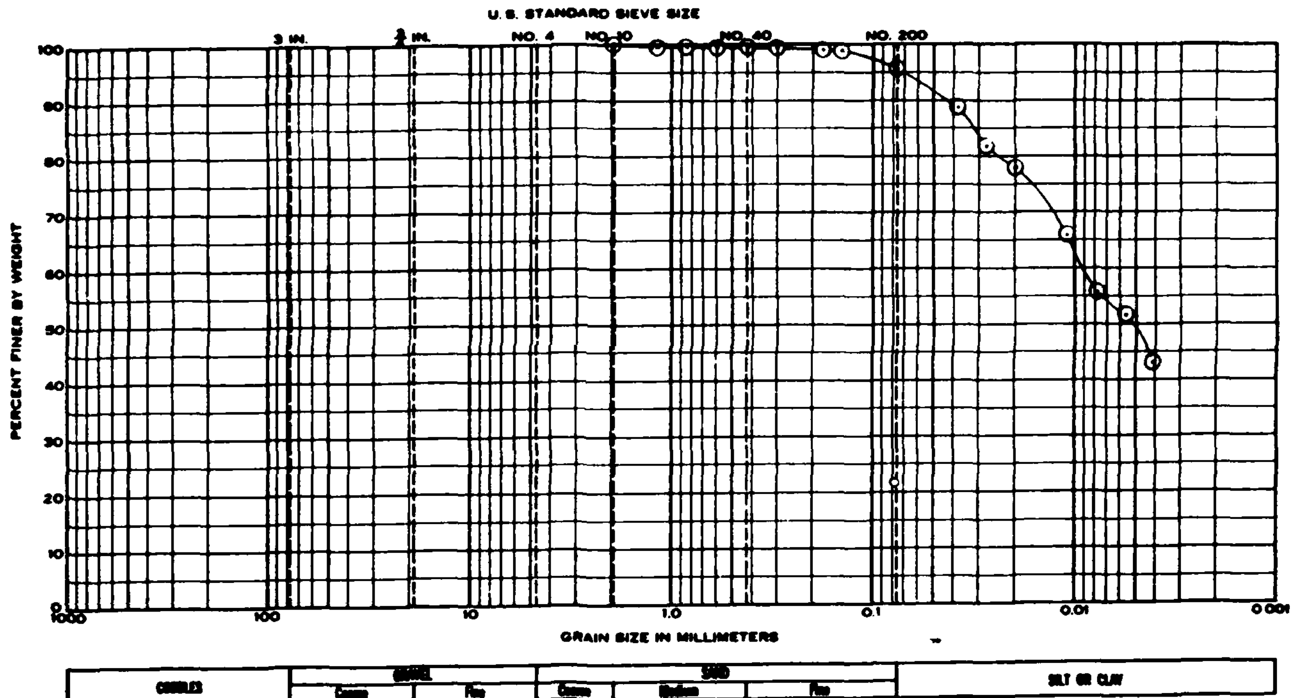
Date July, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #5	6.0'-7.5'	Light brown, silty clay w/some sand and a trace of shale fragments Unified Class.: CL	16.7	34	21	13

Project	Big Creek Flood Control Project, Cleveland, Ohio
Area	
Boring No.	DC-78-3
Date	July, 1978

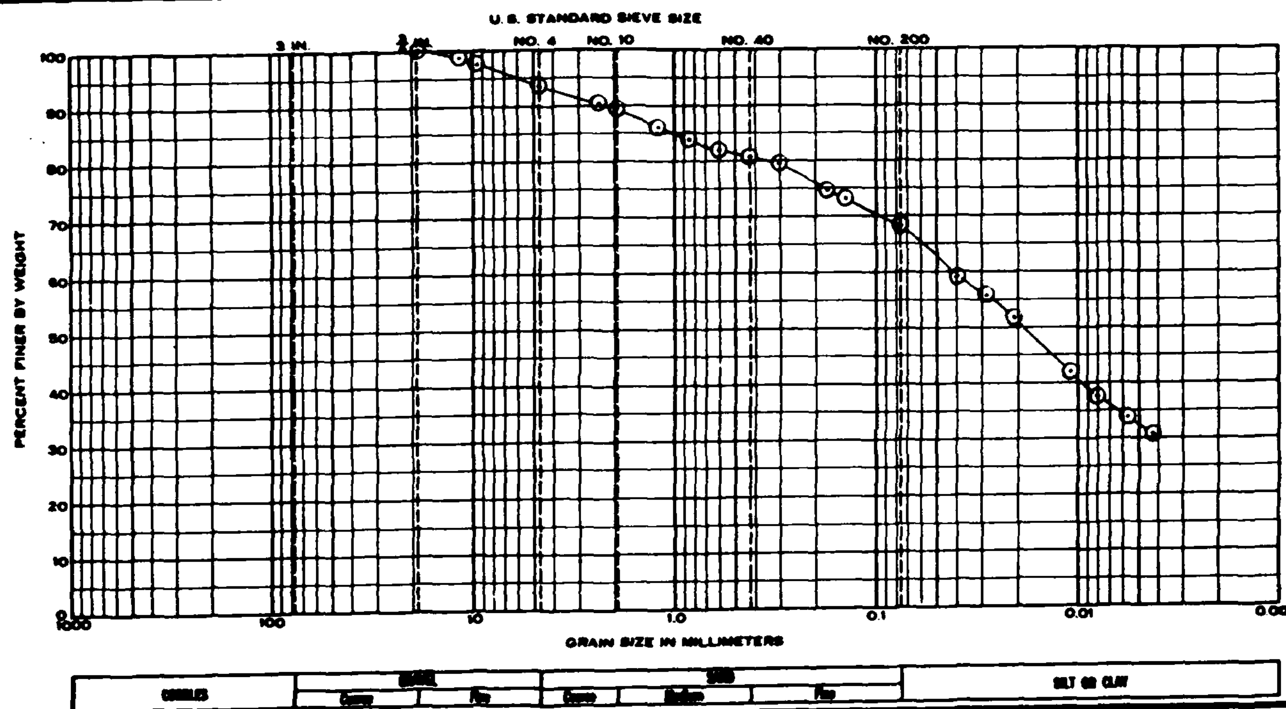
GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #8	10.5'-12.0'	Grey, silty clay	21.6	37	21	16
		Unified Class.: CL				

Project	Big Creek Flood Control Project, Cleveland, Ohio
Area	
Boring No.	DC-78-3
Date	July, 1978

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #4	4.5'-6.0'	Brown, sandy, silty clay	16.6	32	21	11
		Unified Class.; CL				

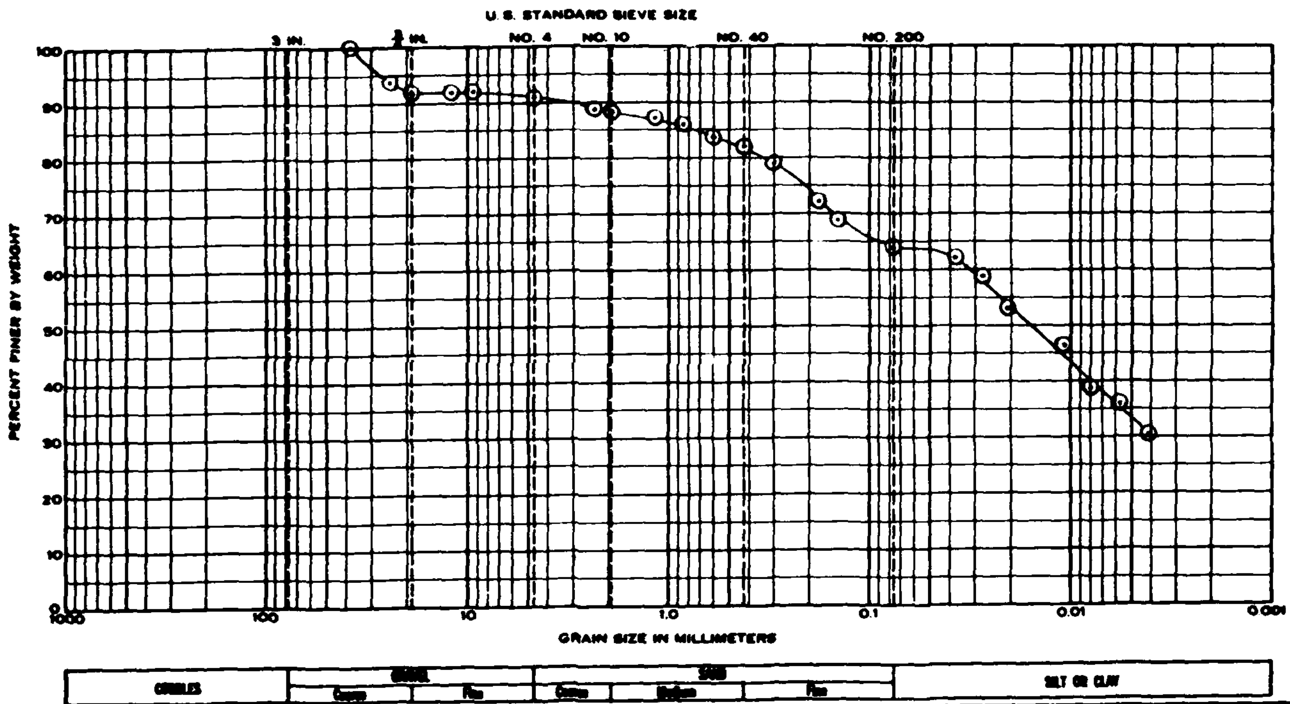
GRADATION CURVES

Project: Big Creek Flood Control Project, Cleveland, Ohio

Area:

Boring No. DC-78-5

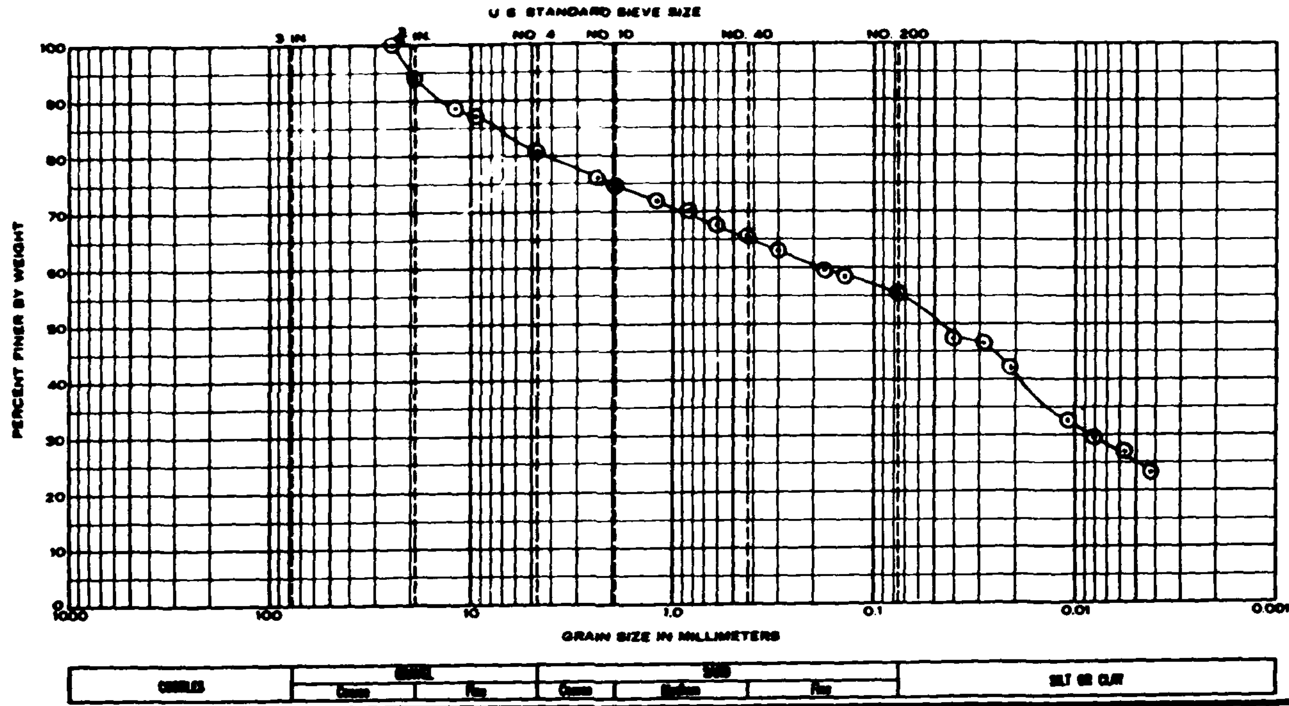
Date: July, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #2	1.5'-3.0'	Grey, sandy, silty clay w/a trace of shale fragments	17.5	28	18	10
		Unified Class.: CL				

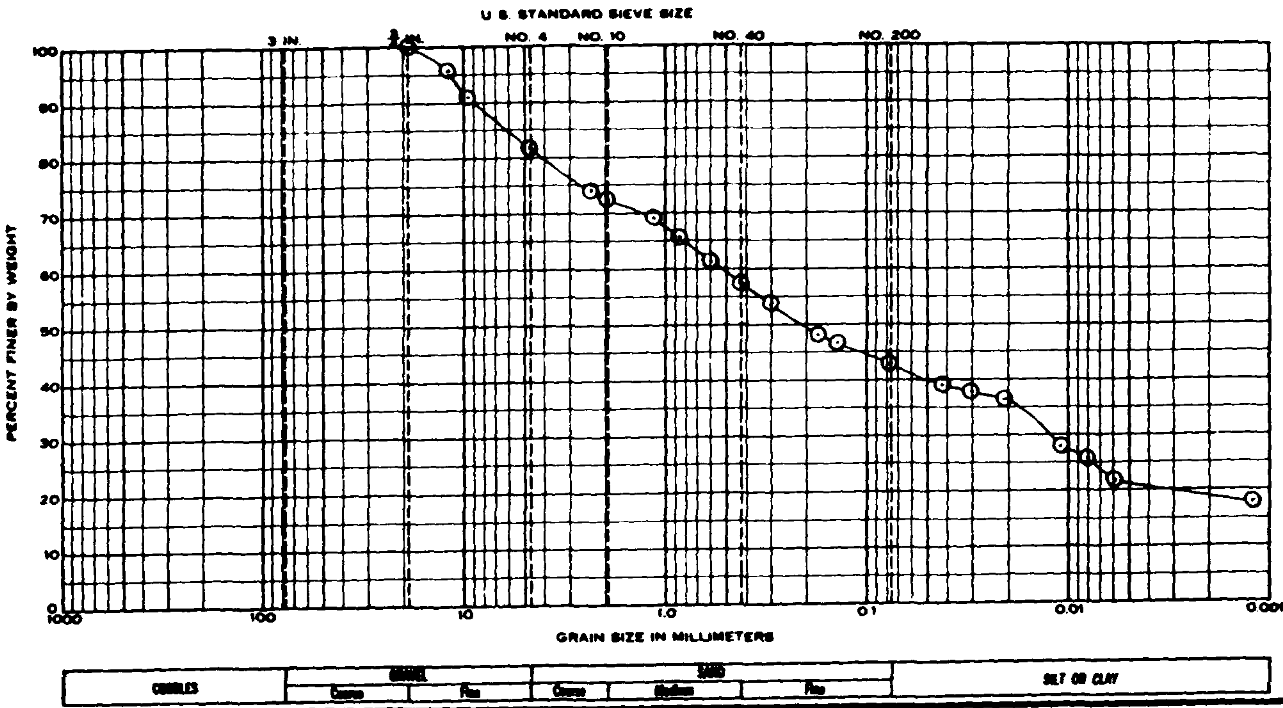
Project	Big Creek Flood Control Project, Cleveland, Ohio
Area	
Boring No.	DC-78-6
Date	July, 1978

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	Project	Big Creek Flood Control Project, Cleveland, Ohio
Jar #5	6.0'-7.5	Brown, sandy, silty clay w/some rock fragments	16.2	33	21	12	Area	
		Unified Class.: CL					Boring No.	DC-78-7
							Date	July, 1978

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #2	4.5'-6.0'	Brownish grey, silty, clayey, fine- to coarse-grained sand w/ some gravel	19.3	31	19	12

Unified Class.: SC

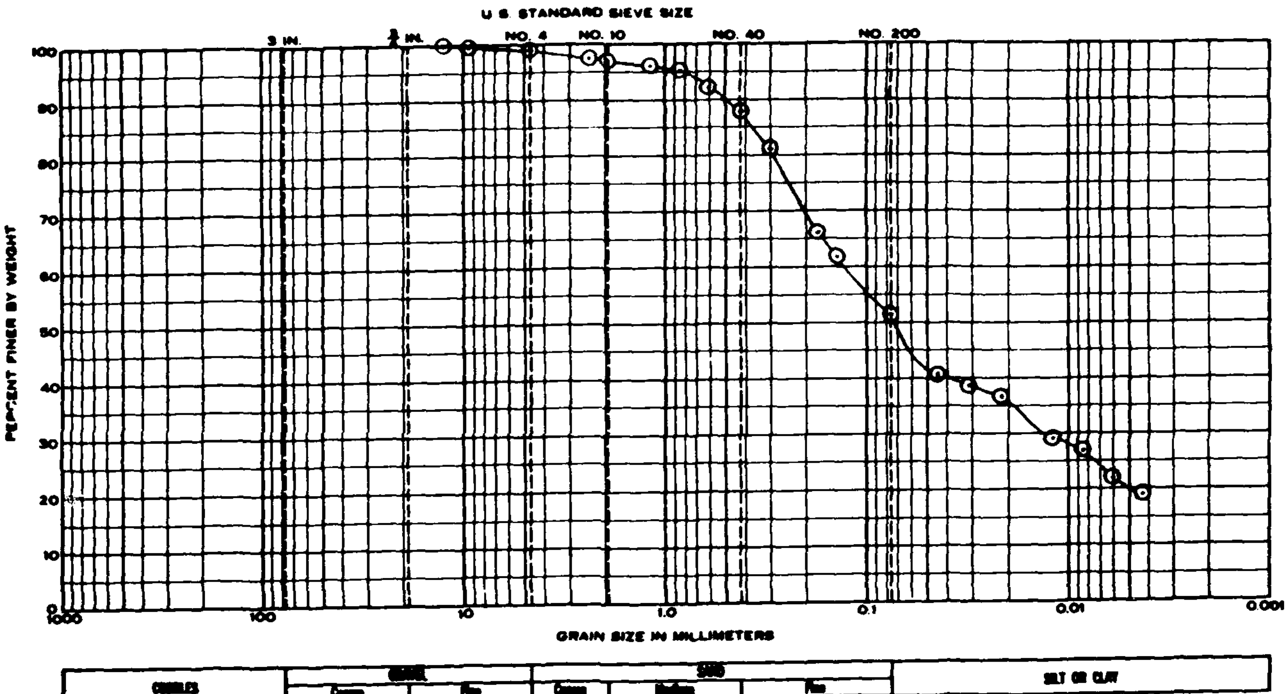
GRADATION CURVES

Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. DC-78-10

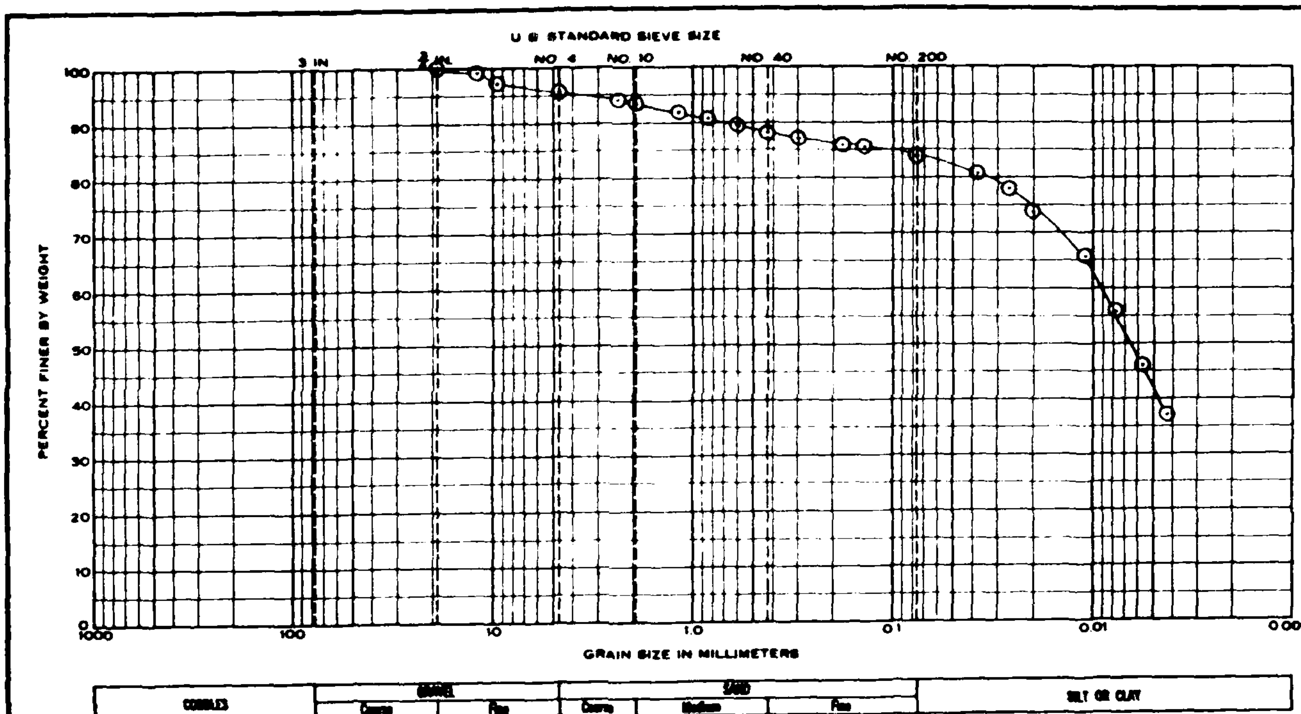
Date July, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
Jar #3	9.0'-10.5'	Light brownish grey, sandy, clayey silt	18.2	25	19	6	
		Unified Class.: CL-ML					

GRADATION CURVES

Project	Big Creek Flood Control Project, Cleveland, Ohio
Area	
Boring No.	DC-78-10
Date	July, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #4	4.5'-6.0'	Grey, silty clay w/a trace of sand	16.1	37	23	14
		Unified Class.: CL				

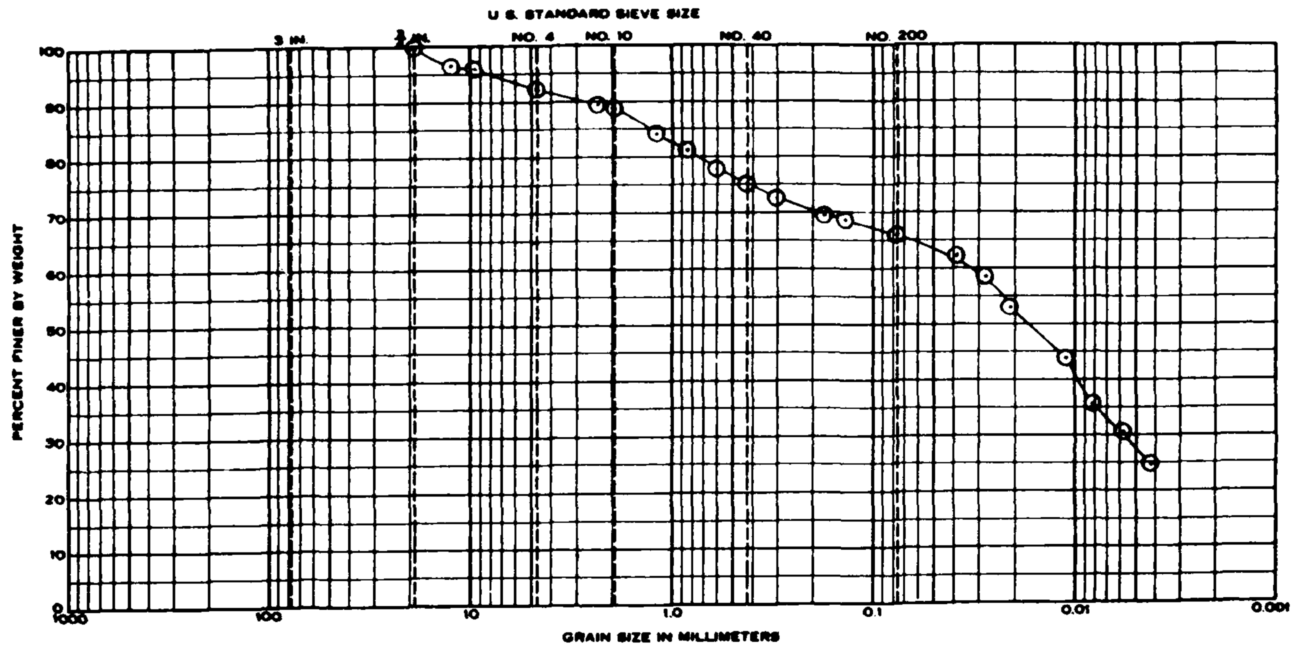
GRADATION CURVES

Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. DC-78-11

Date July, 1978



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #6	7.5'-9.0'	Dark grey, sandy, clayey silt	39.0	44	30	14
		Unified Class.: ML				

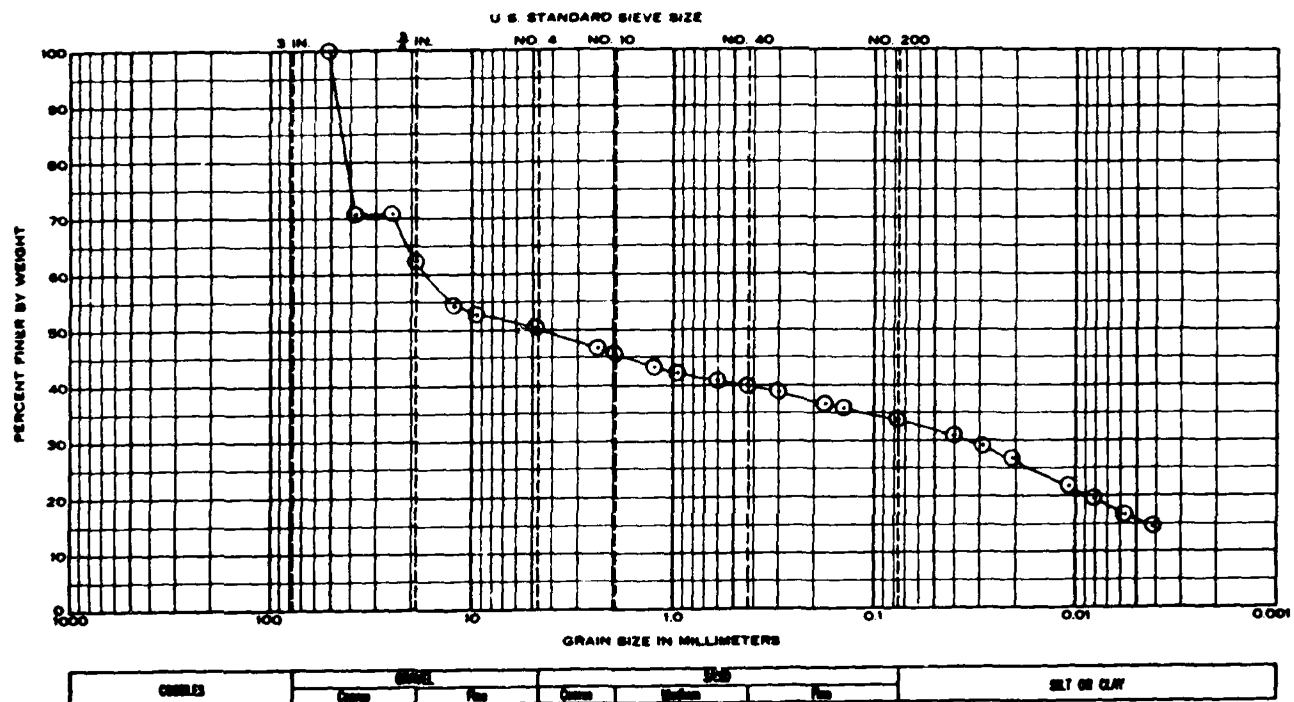
GRADATION CURVES

Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. DC-78-12

Date July, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #7	9.0-10.5'	Grey shale fragments mixed some sand, silt, and clay	15.7	31	20	11
		Unified Class.: GC				

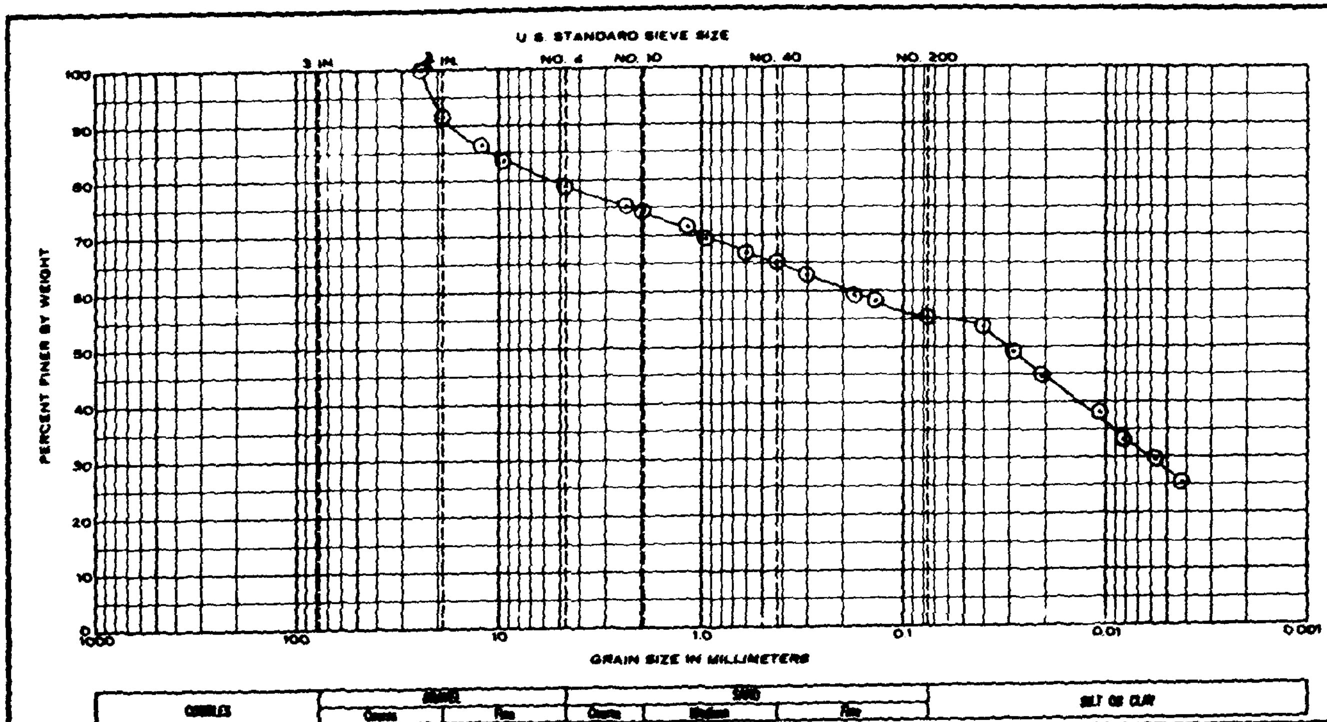
Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. DC-78-12

Date July, 1978

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #25	36.0' - 37.5'	Grey, silty clay w/some sand and gravel	15.4	32	22	10
		Unified Class.: CL				

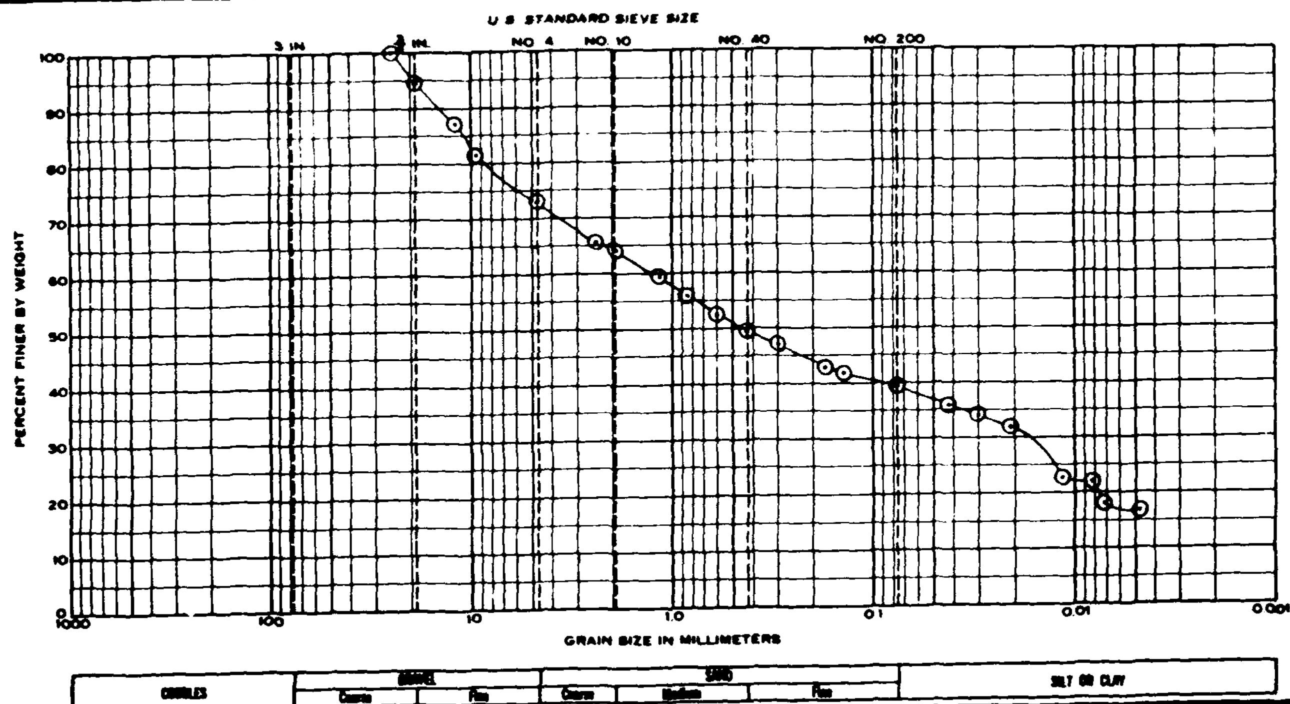
GRADATION CURVES

Project: Big Creek Flood Control Project, Cleveland, Ohio

Area:

Boring No. DC-78-13

Date: July, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
Jar #26	37.5' - 39.0	Light brown, silty, clayey, fine- to coarse-grained sand w/some gravel	19.2	30	19	11	
		Unified Class.: SC					

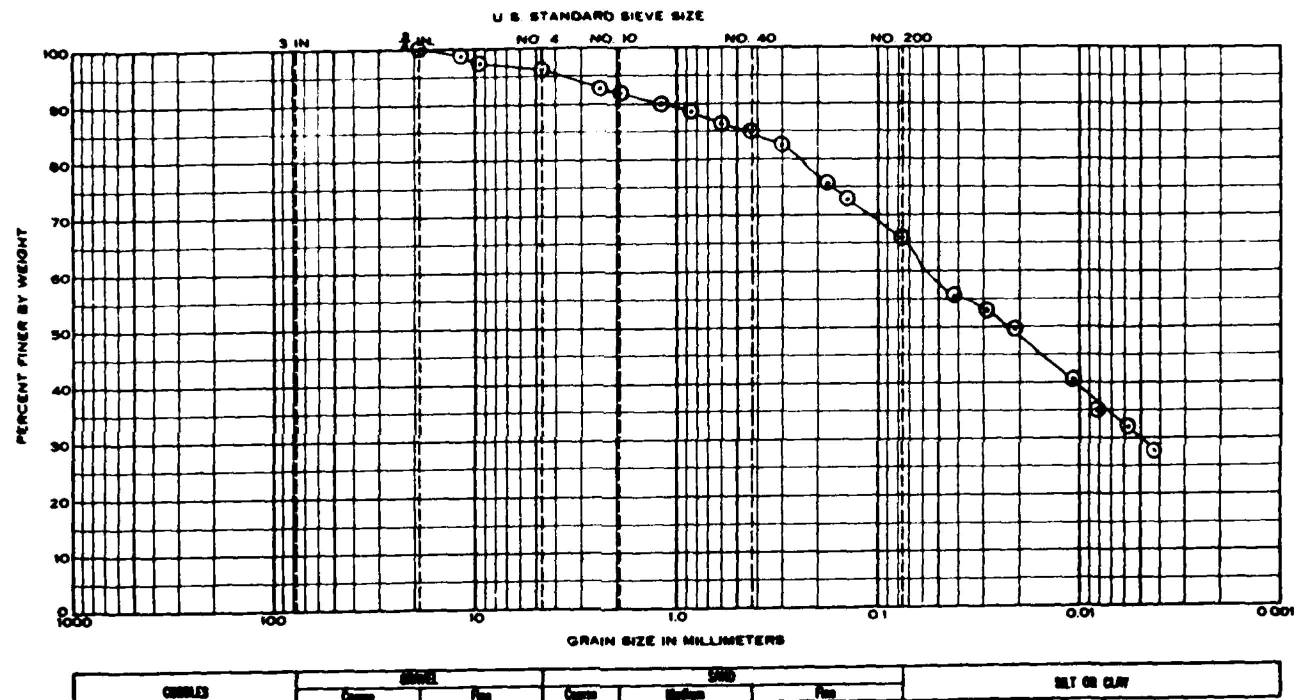
GRADATION CURVES

Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. D-78-13

Date July, 1978



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #5	6.0'-7.5'	Light brown, sandy silty clay	15.7	30	20	10
		Unified Class.: CL				

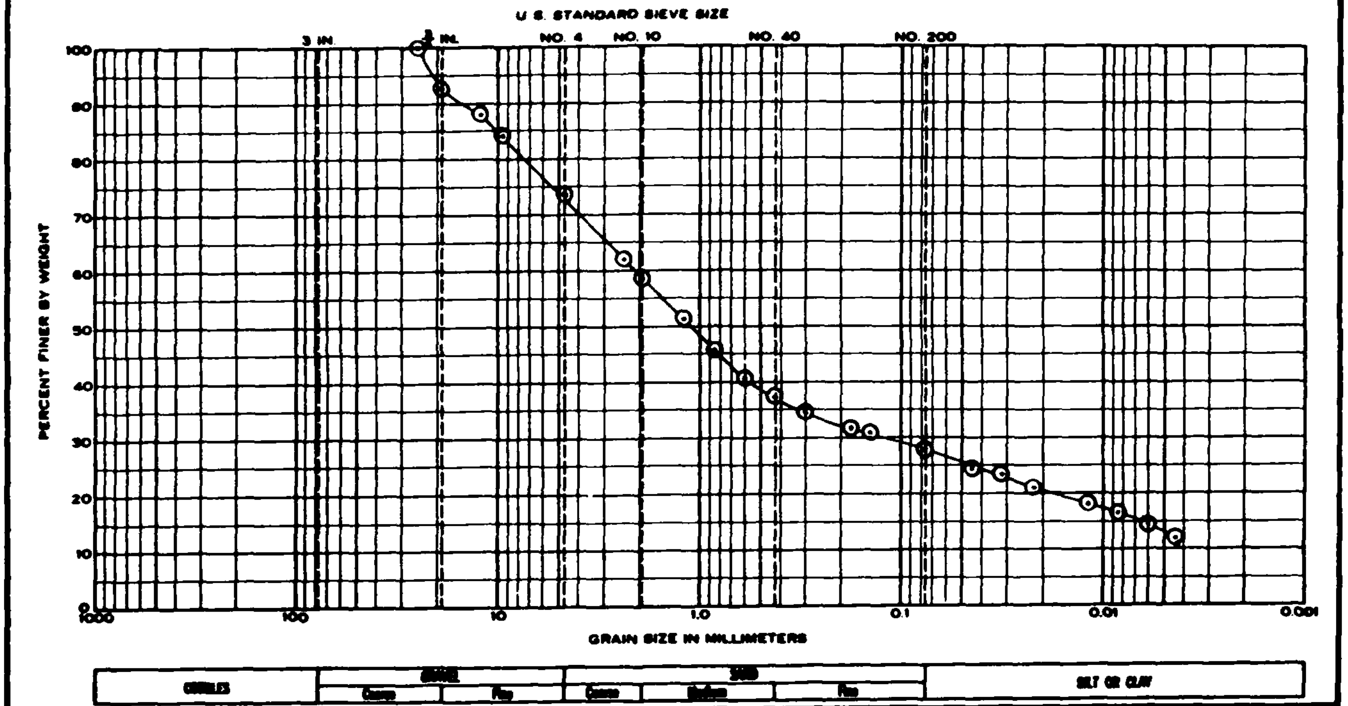
Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. D-78-20

Date July, 1978

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
Jar #10	13.5-15.0'	Greyish brown, medium- to coarse-grained sand w/ some silt, clay, and rock fragments	8.1	27	19	8
			Unified Class.: SC			

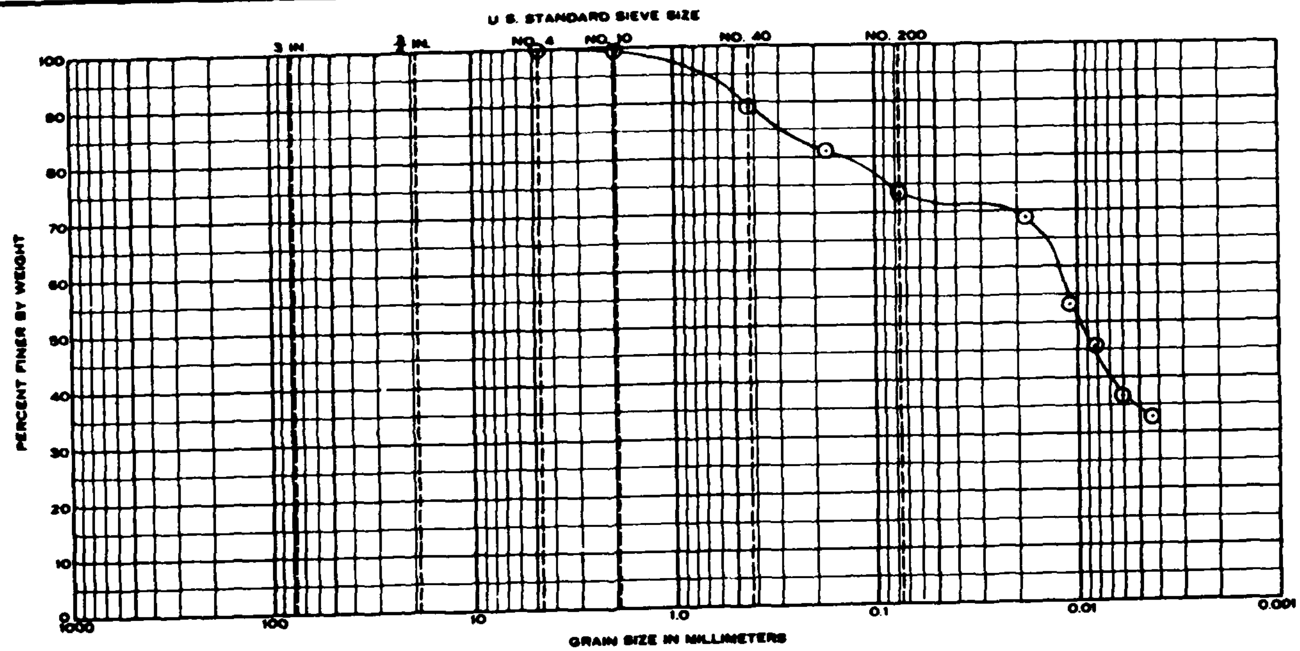
Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. D-78-20

Date July, 1978

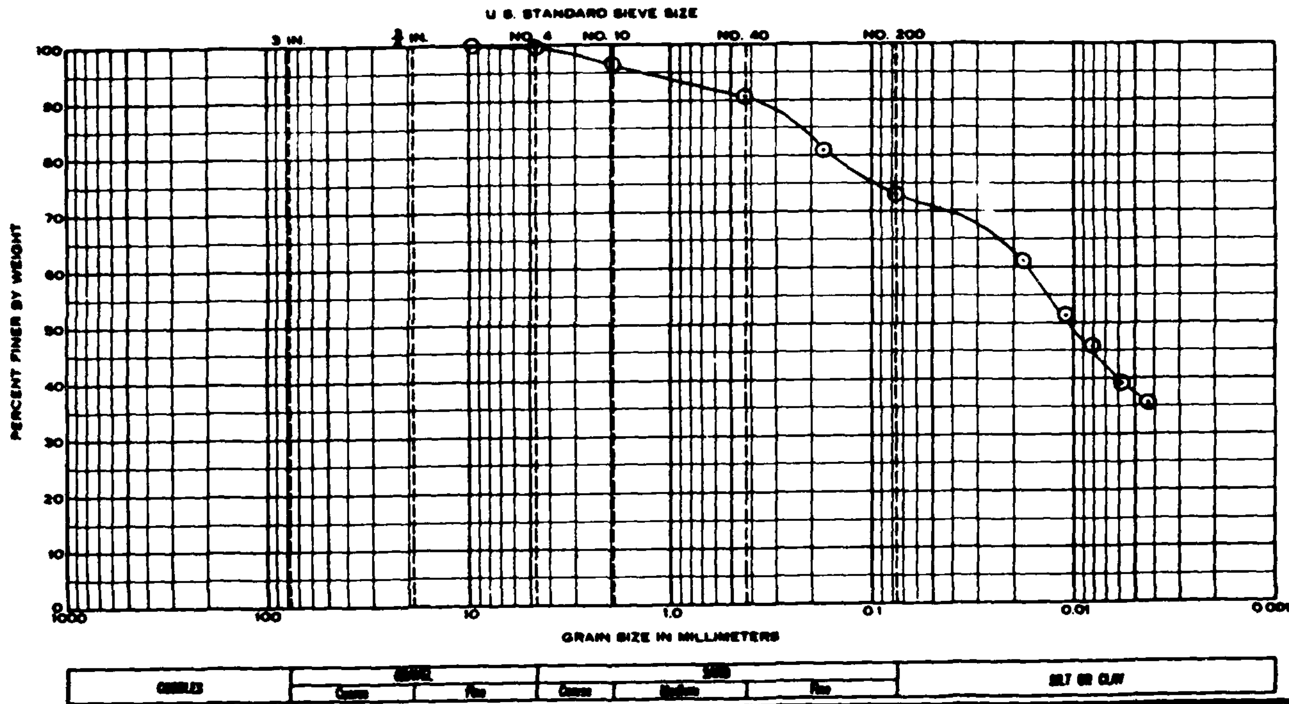
GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	Spec. Gravity
Shelby Tube #1	2.0-4.0	Brown, sandy, clayey silt	32.4	41	28	13	2.64
		Unified Class.: ML					

Project	Big Creek Flood Control Project, Cleveland, Ohio
Area	
Boring No.	U-78-5A
Date	September, 1978

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	Spec. Gravity
Shelby Tube #1	3.0-4.0	Brown, sandy, silty clay	21.4	30	19	11	2.69
		Unified Class.: CL					

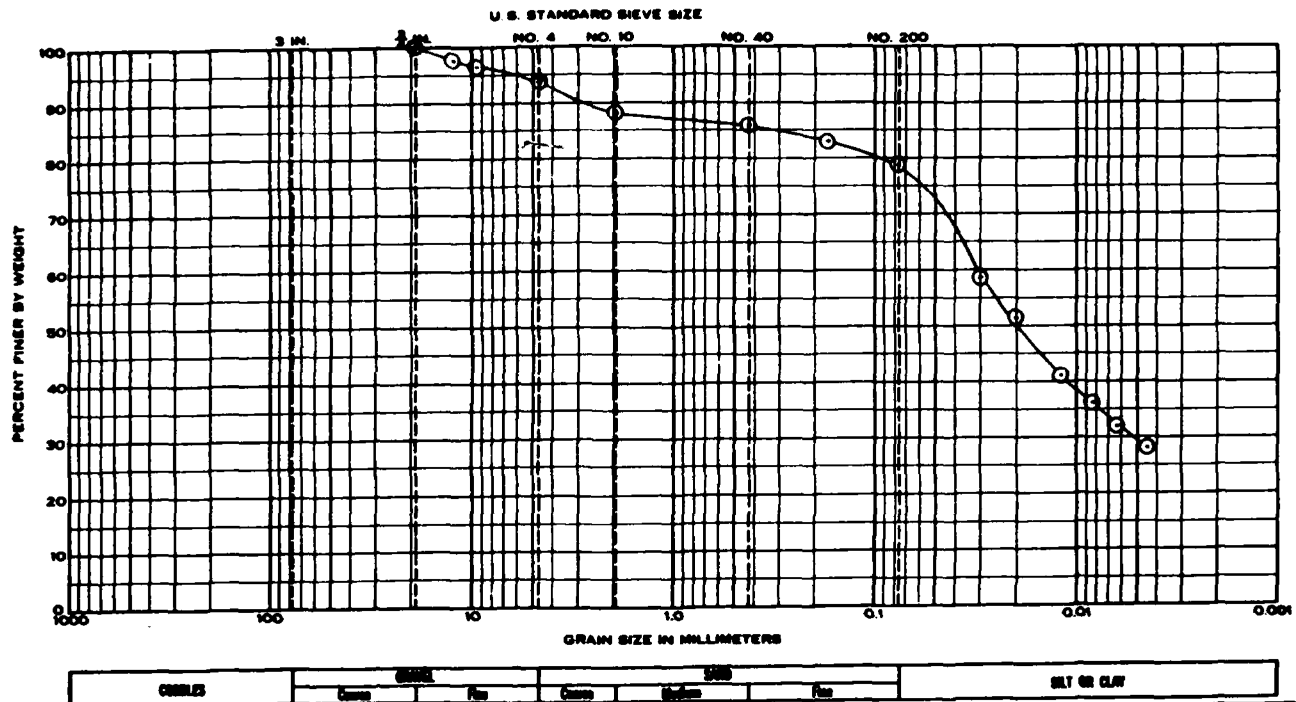
Project Big Creek Flood Control Project, Cleveland, Ohio

Area

Boring No. U-78-6A

Date September, 1978

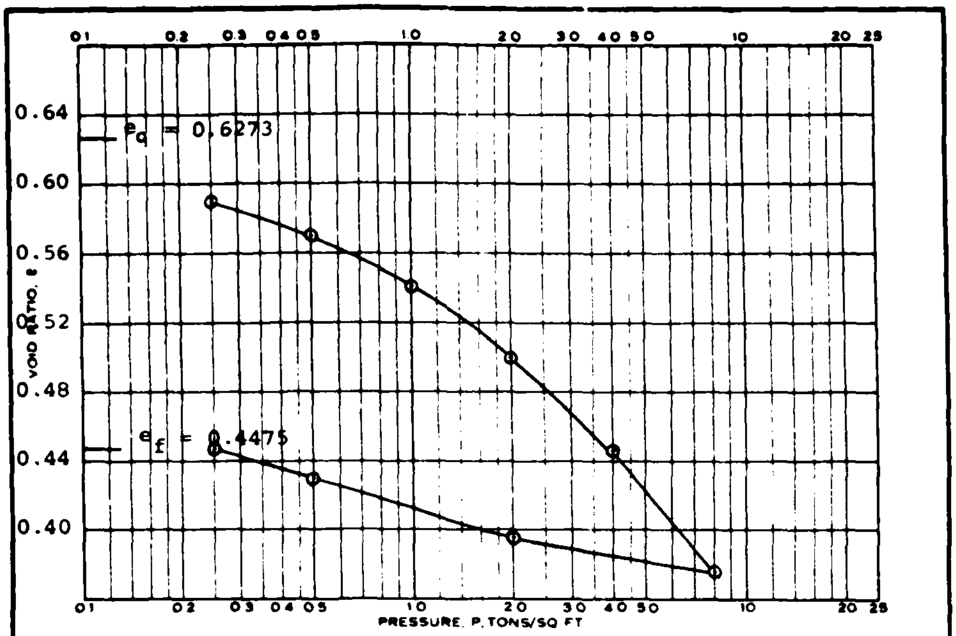
GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	Spec. Gravity
Shelby	4.0-5.0	Brown, silty clay	21.1	29	21	8	2.72
Tube		w/some sand					
#1							
		Unified Class.: CL					

Project	Big Creek Flood Control Project, Cleveland, Ohio
Area	
Boring No.	U-78-20A
Date	September, 1978

GRADATION CURVES



TEST DATA

Type of Specimen: Undisturbed

Overburden Pressure, P_o: 0.17 Tons/Sq Ft

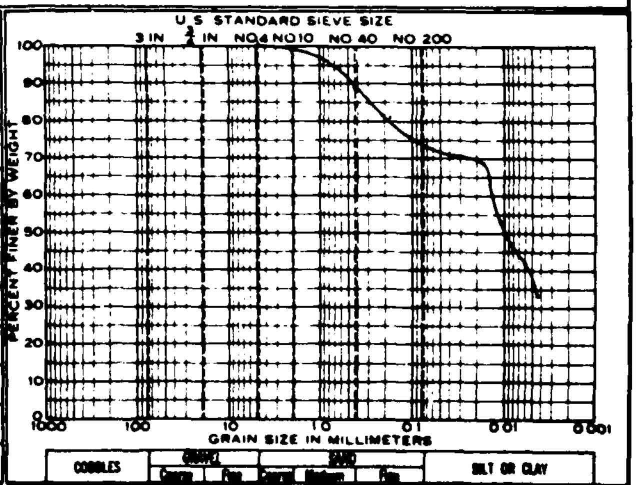
Precons'l Pressure, P_c: 1.95 Tons/Sq Ft

Compression Index, C_c: 0.23

Permeability at Initial e

K_{20} ______ x 10⁻ Cm/Sec Ft/Min

Initial Ht. 1.253 in.	Diam. 4.44 in.
Initial Saturation, S_o %	92.6
Final Saturation, S_f %	100
Initial Dry Density Lbs/Cu Ft	101.1
Initial Water Content, W_o %	22.0



Remarks:

Classification: ML

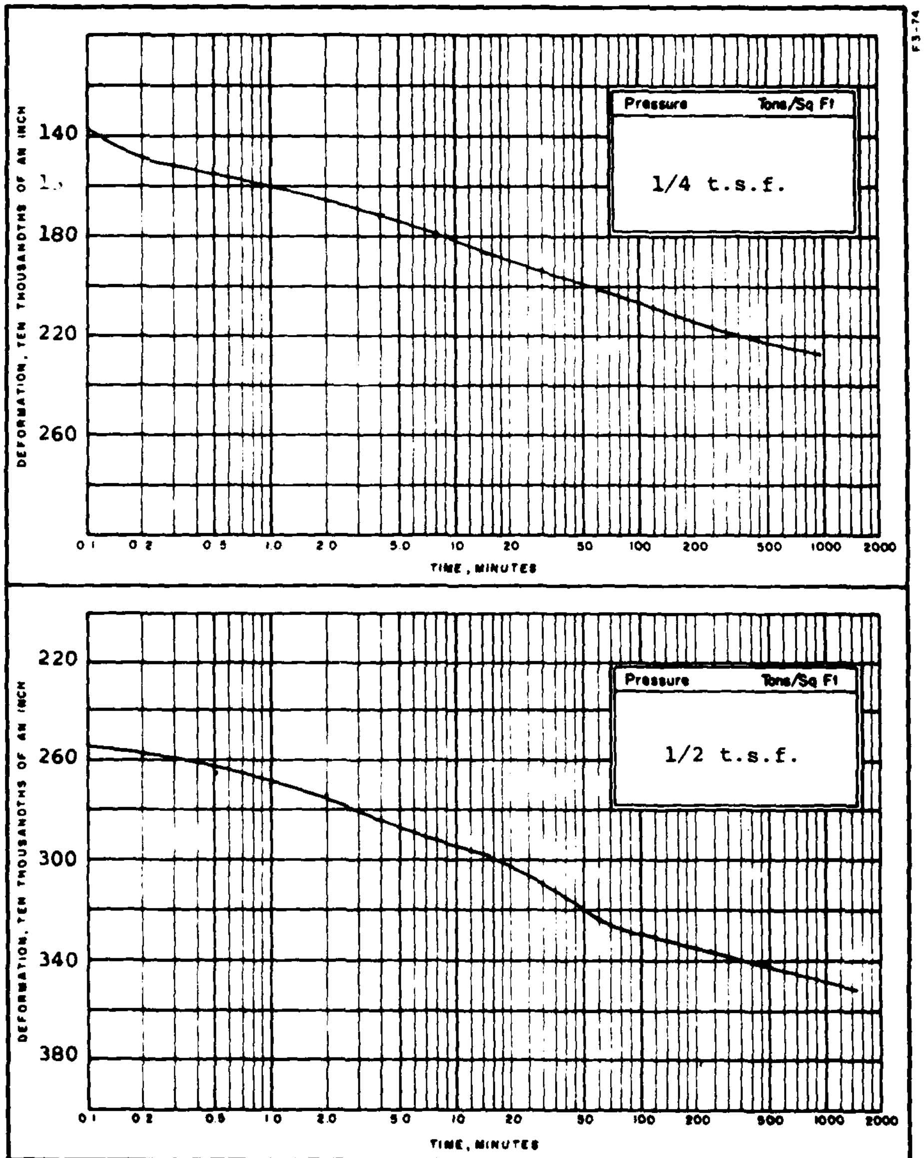
LL 41	G 2.64
PL 28	D_{10}

Project: Big Creek Flood Control Project
Cleveland, Ohio

Area:

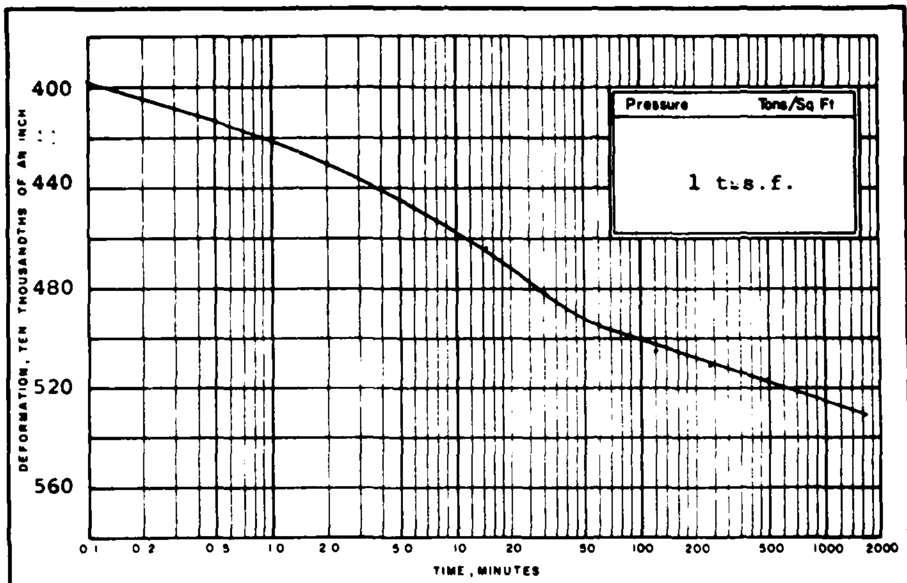
Boring No. U-78-5A	Sample No. Shelby Tube #1
Elev or Depth 2.0' - 4.0'	Date September, 1978

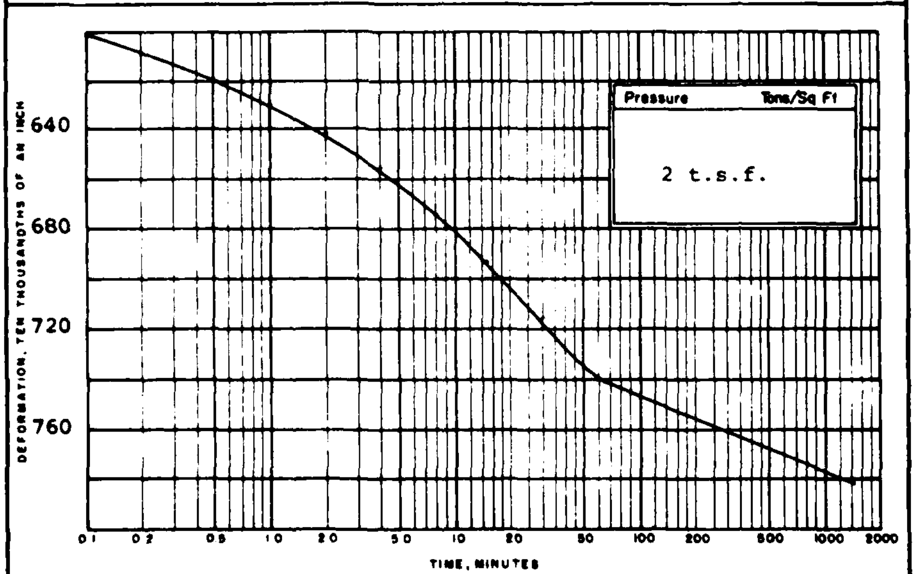
CONSOLIDATION TEST REPORT



Project Big Creek Flood Control Project			
Area Cleveland, Ohio			
Boring No. U-78-5A	Sample No. ST-1	Elev or Depth 2.0'-4.0'	Date Sept., 1978

CONSOLIDATION TEST-TIME CURVES

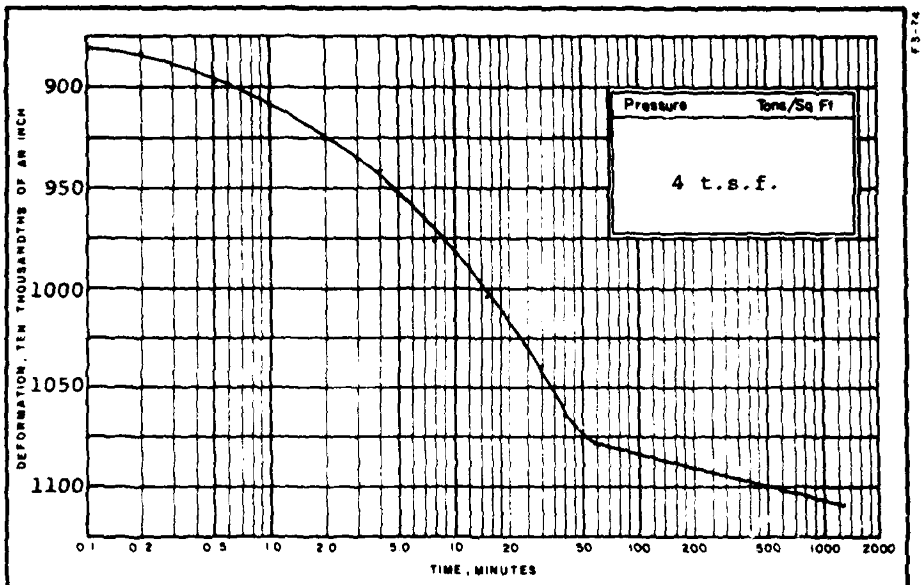


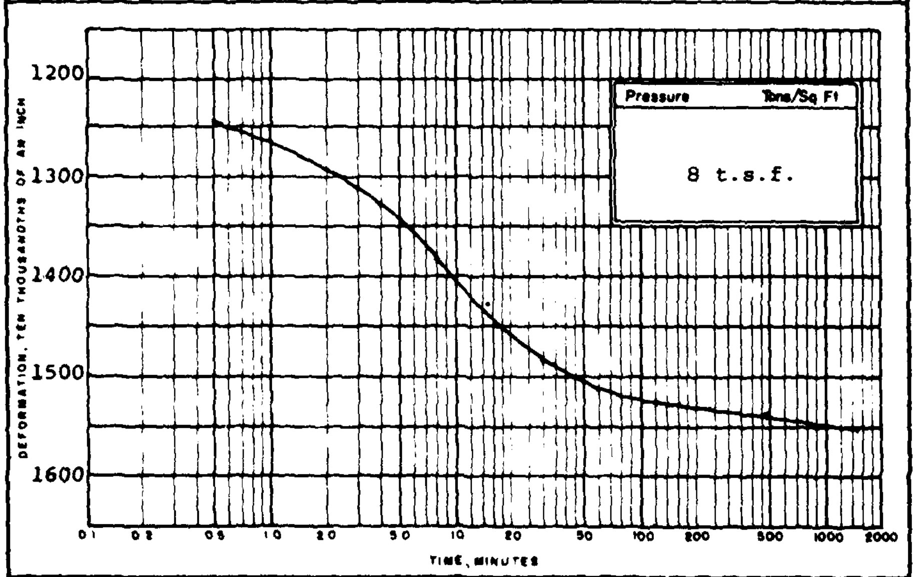


Project	Big Creek Flood Control Project
Area	Cleveland, Ohio

Boring No. U-78-5A	Sample No. ST-1	Elev or Depth 20'-40'	Date Sept., 1978

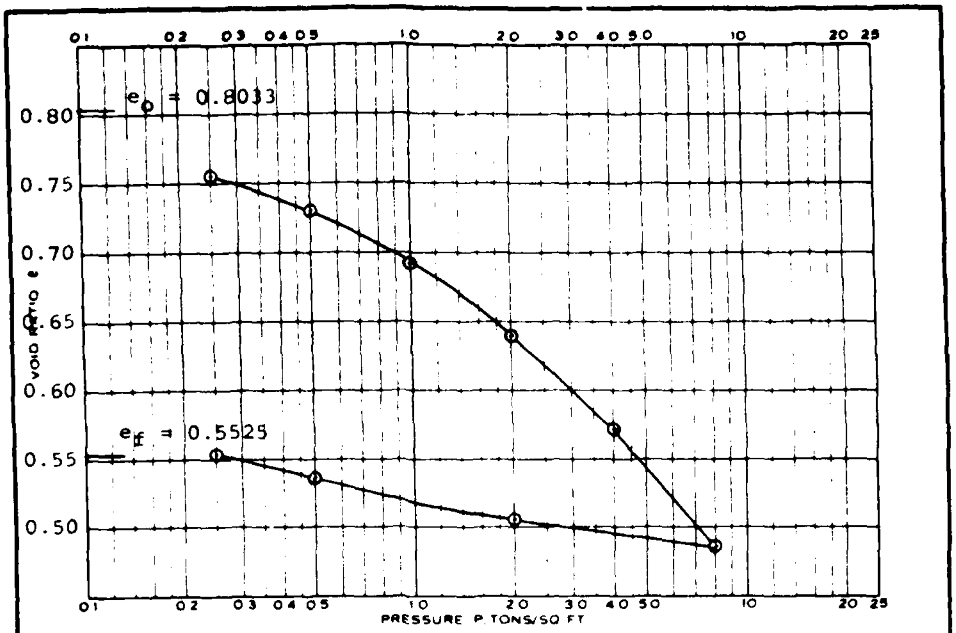
CONSOLIDATION TEST-TIME CURVES



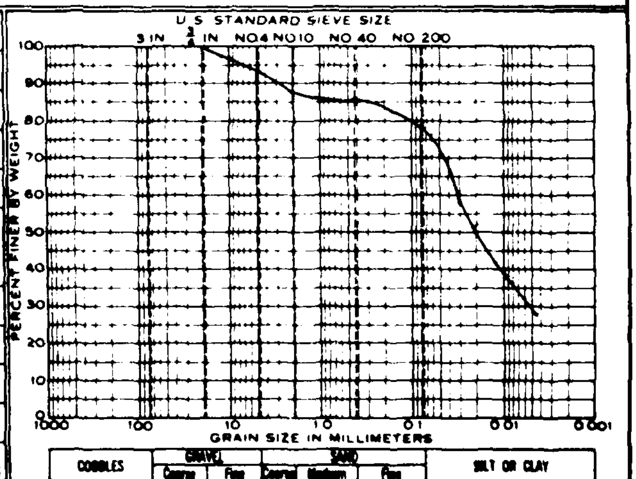


Project Big Creek Flood Control Project			
Area Cleveland, Ohio			
Boring No U-78-5A	Sample No. ST-1	Elev or Depth 2.0'-4.0'	Date Sept., 1978

CONSOLIDATION TEST-TIME CURVES



TEST DATA	
Type of Specimen	Undisturbed
Overburden Pressure, P_o	0.28 Tons/Sq Ft
Preconsol Pressure, P_c	1.95 Tons/Sq Ft
Compression Index, C_c	0.28
Permeability at Initial e K_{20} ____ x 10	Cm/Sec Ft/Min
Initial Ht 1.253 in.	Diam 4.44 in.
Initial Saturation, S_o %	87.4
Final Saturation, S_f %	100
Initial Dry Density Lbs/Cu Ft	94.0
Initial Water Content, W_o %	25.8



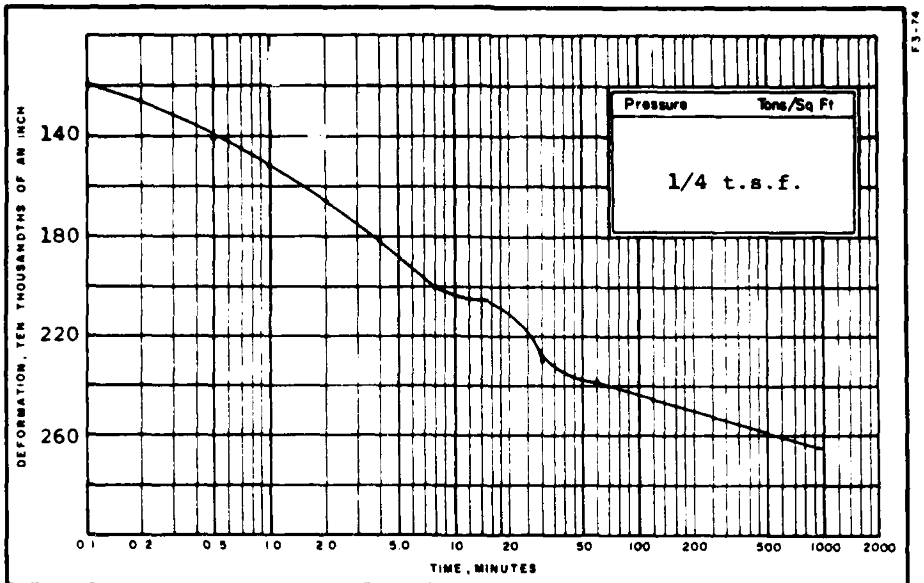
Remarks:

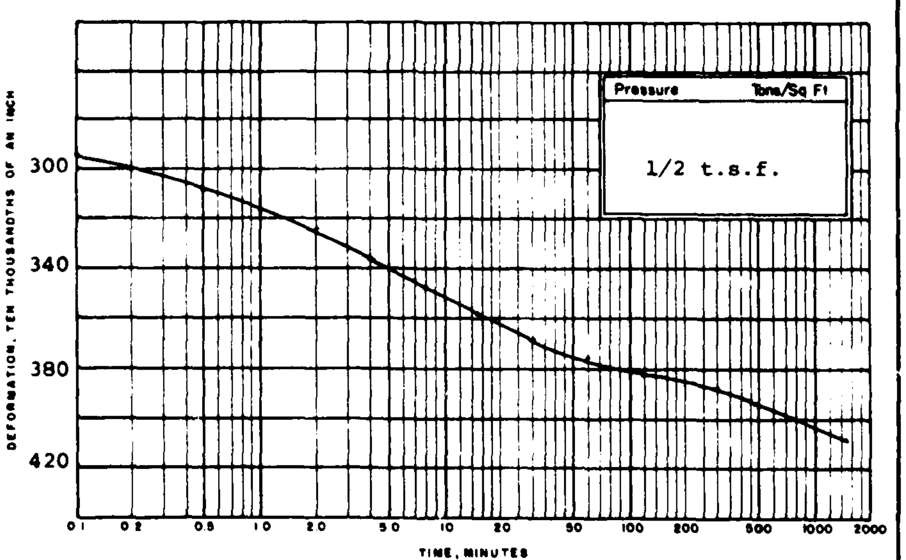
Classification CL

LL	29	G_s	2.72
PL	21	D_{10}	

Project	Big Creek Flood Control Project Cleveland, Ohio
Area	
Boring No. U-78-20A	Sample No. Shelby Tube #1
Elev or Depth 4.0' - 5.0'	Date September, 1978

CONSOLIDATION TEST REPORT





Project Big Creek Flood Control Project

Area Cleveland, Ohio

Boring No. U-78-20A | Sample No. ST-1 | Elev or Depth 4.0'-5.0' | Date Sept., 1978

CONSOLIDATION TEST-TIME CURVES

AD-A102 431 CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT F/6 13/2
BIG CREEK FLOOD CONTROL PROJECT, CLEVELAND, OHIO. PHASE II. GEN--ETC(U)
FEB 79

UNCLASSIFIED NL

4 of 4

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DATE FILMED

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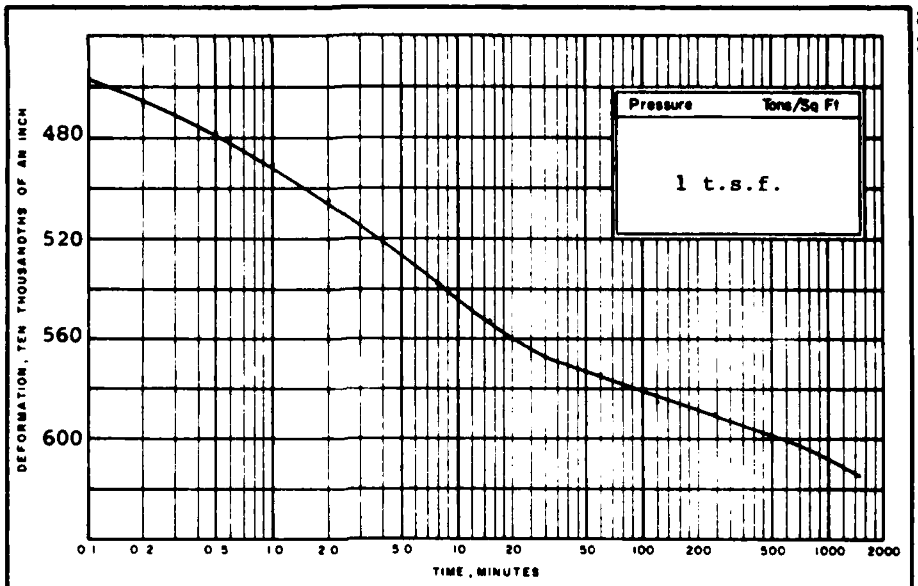
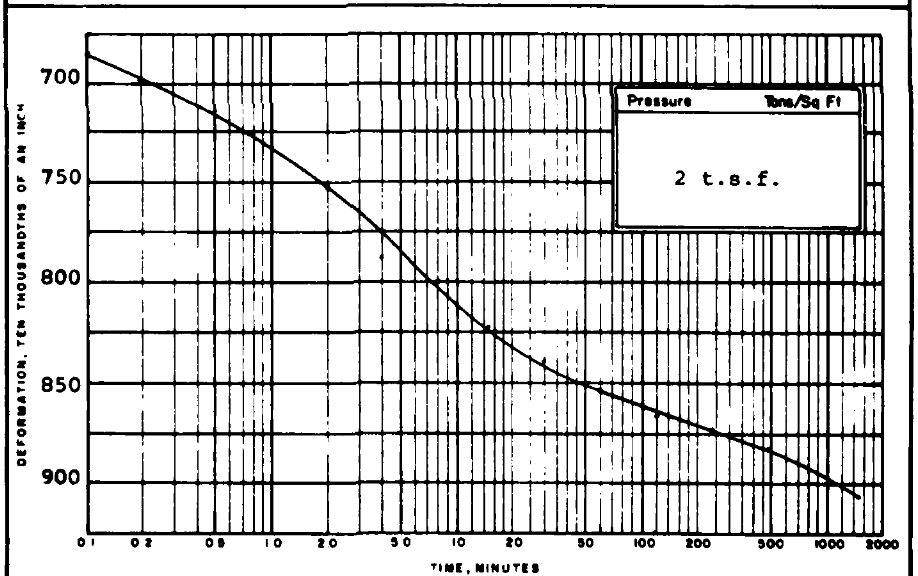
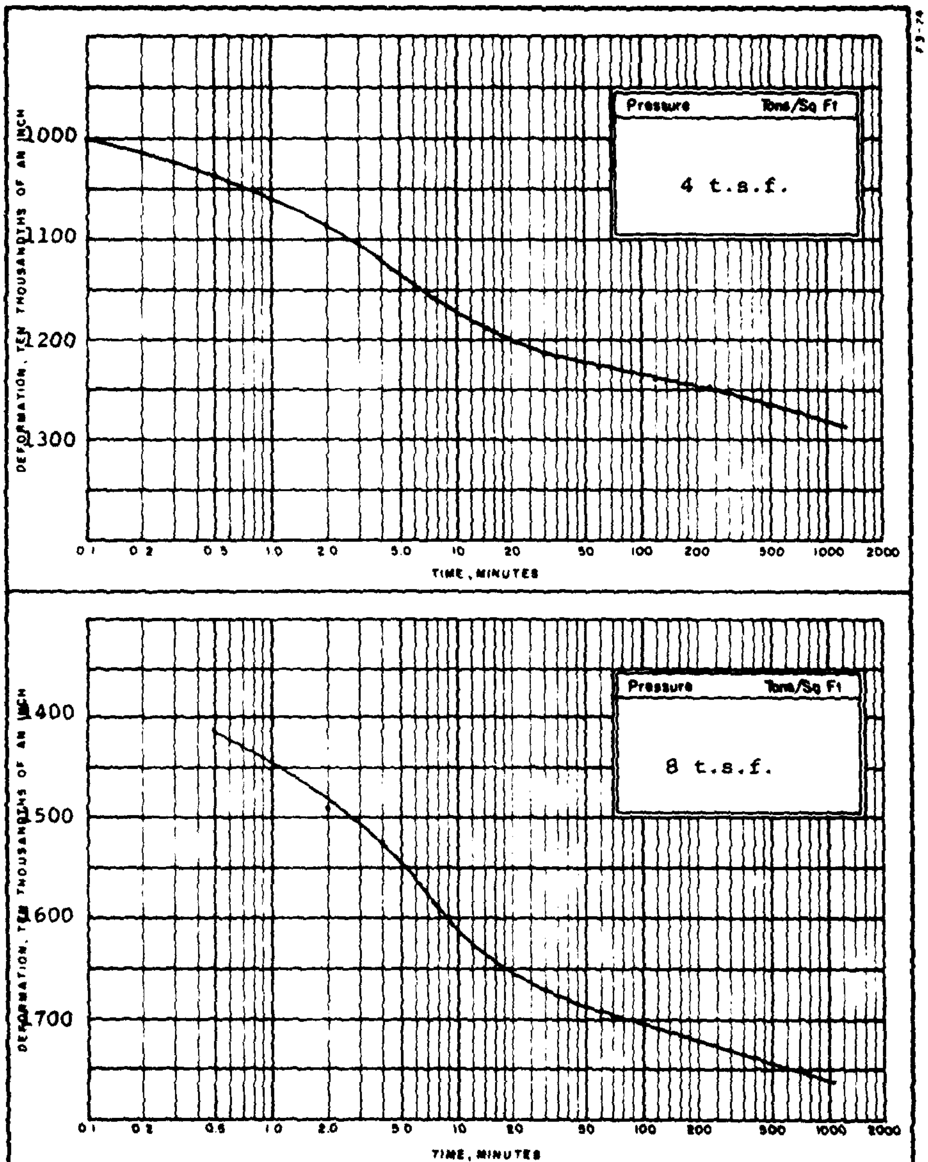




Project	Big Creek Flood Control Project						
Area	Cleveland, Ohio						
Boring No.	U-78-20A	Sample No.	ST-1	Elev or Depth	4.0'-5.0'	Date	Sept., 1978

CONSOLIDATION TEST-TIME CURVES

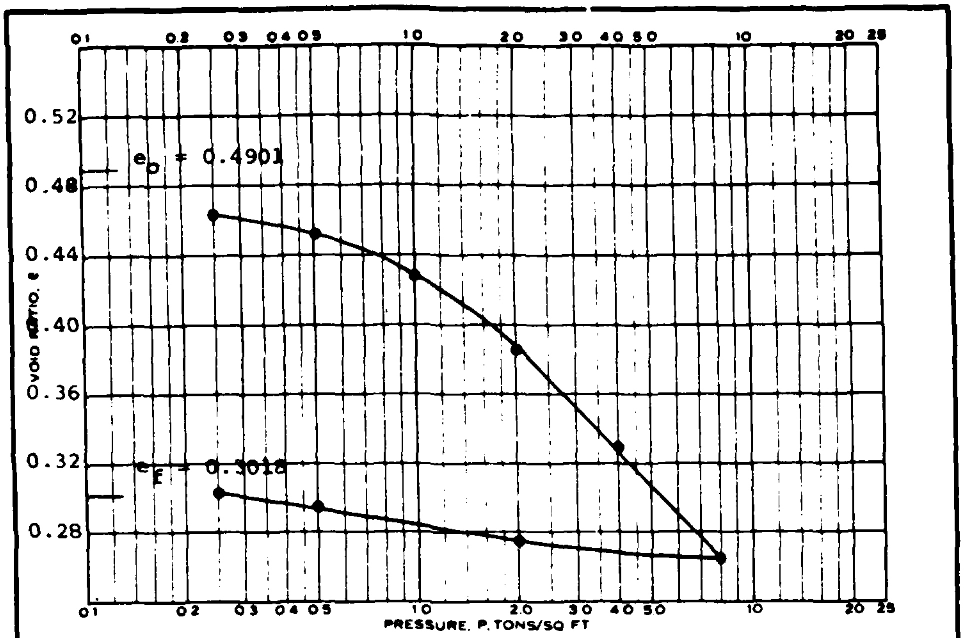


Project Big Creek Flood Control Project

Area Cleveland, Ohio

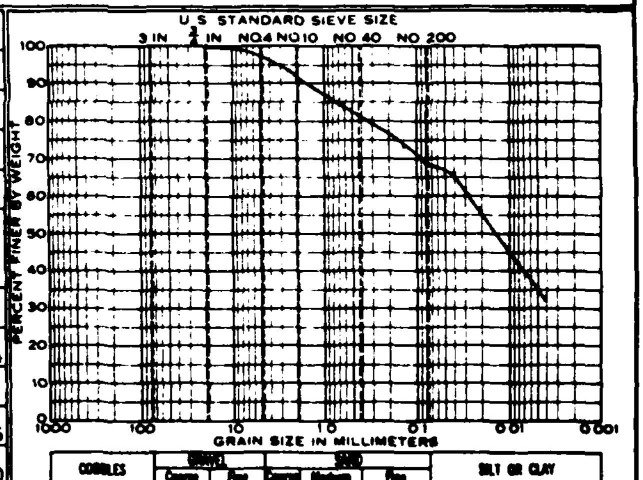
Boring No. U-78-20A	Sample No. ST-1	Elev or Depth 4.0'-5.0'	Date Sept., 1978

CONSOLIDATION TEST-TIME CURVES



TEST DATA

Type of Specimen	Remolded
Overburden Pressure, P_o	-- Tons/Sq Ft
Preconsol Pressure, P_c	1.70 Tons/Sq Ft
Compression Index, C_c	0.21
Permeability at Initial e	K_{20} ______ x 10⁻ Cm/Sec ______ Ft/Min
Initial Ht. 1.253 in.	Diam. 4.44 in.
Initial Saturation, S_o %	71.4
Final Saturation, S_f %	100
Initial Dry Density Lbs/Cu Ft	112.5
Initial Water Content, W_o %	13.0



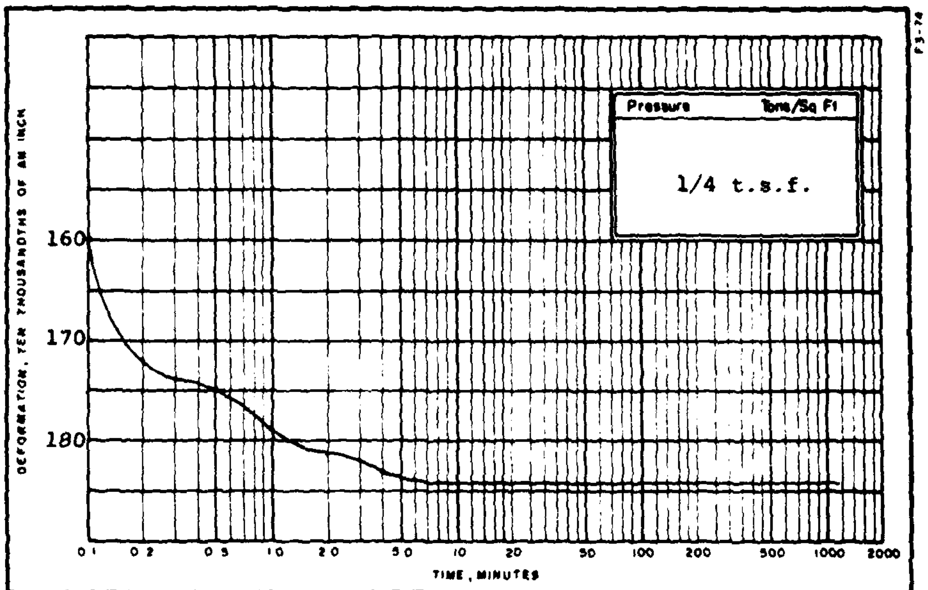
Remarks: Composite sample was formed by combining Bag Nos. 2A, 3A and 4A.

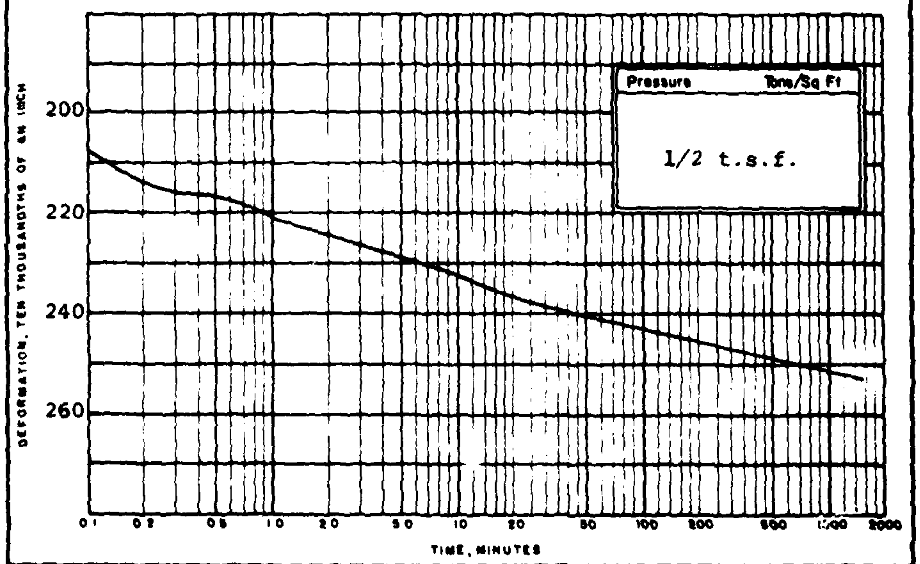
Classification CL

LL 28	G 11
PL 17	D_{10}

Project	Big Creek Flood Control Project Cleveland, Ohio
Area	
Boring No. A-78-3	Sample No. Composite
Elev or Depth 1.5' - 7.5'	Date September, 1978

CONSOLIDATION TEST REPORT

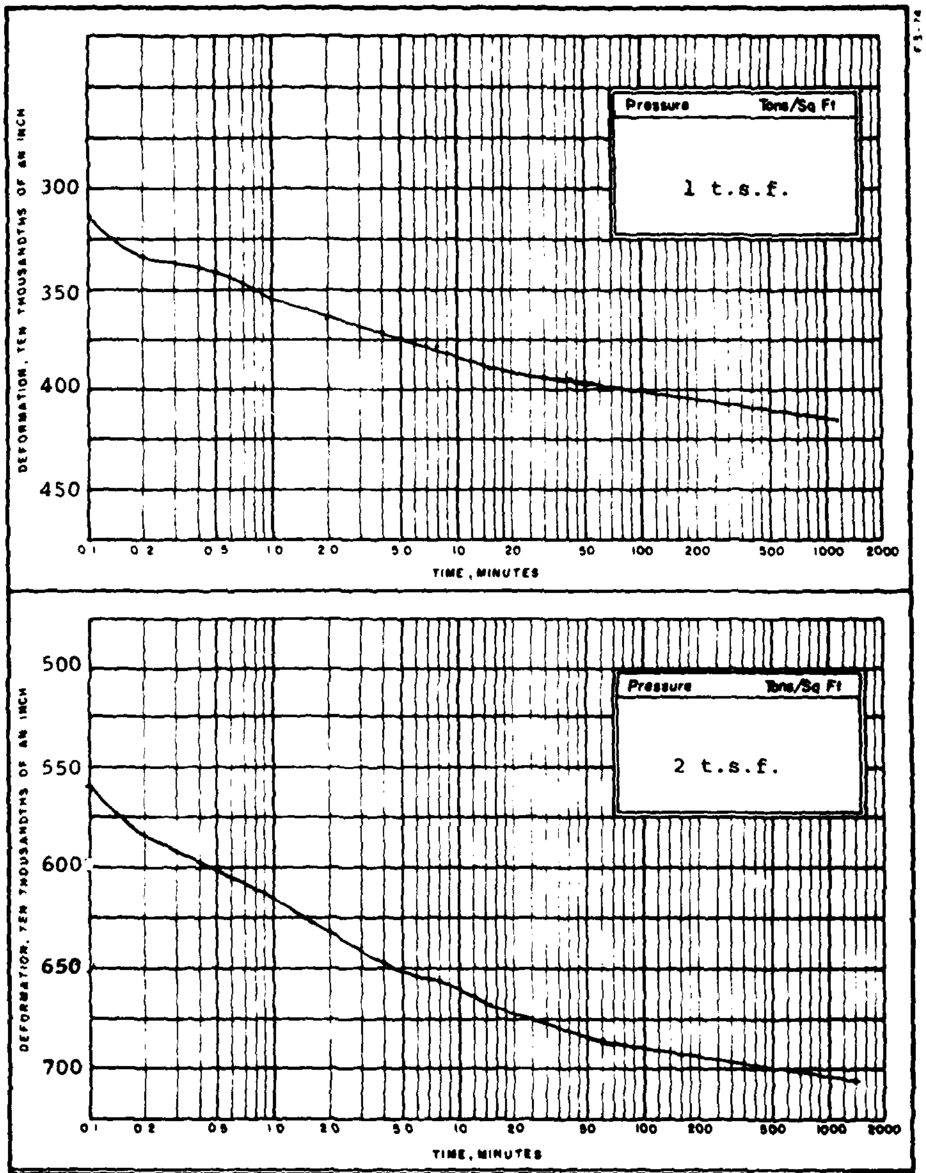




Project	Big Creek Flood Control Project
Area	Cleveland, Ohio

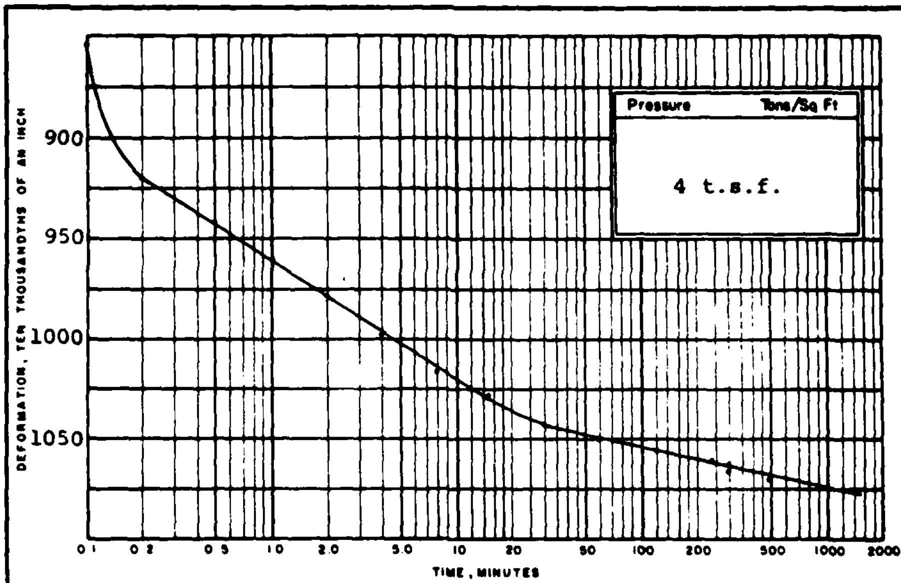
Boring No.	Sample No.	Elev or Depth	Date
A-78-3	Composite	1.5'-7.5'	Sept., 1978

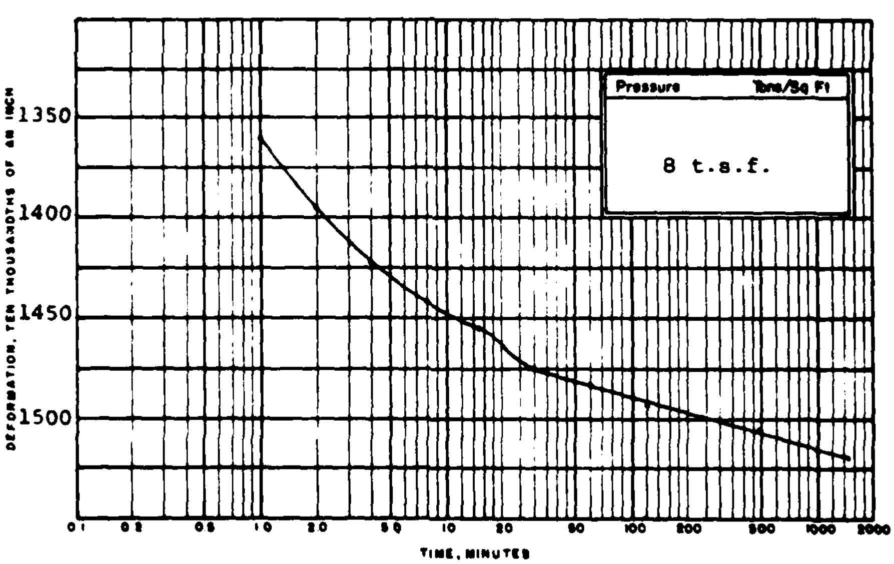
CONSOLIDATION TEST-TIME CURVES



Project	Big Creek Flood Control Project		
Area	Cleveland, Ohio		
Boring No. A-78-3	Sample No. Composite	Elev or Depth 1.5'-7.5'	Date Sept., 1978

CONSOLIDATION TEST-TIME CURVES





Project	Big Creek Flood Control Project
Area	Cleveland, Ohio

Boring No.	Sample No.	Elev or Depth	Date
A-78-3	Composite	5'-7.5'	Sept., 1978

CONSOLIDATION TEST-TIME CURVES

UNCONFINED COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No.:	U-78-5A	Type of Sample:	Undisturbed
Sample No.:	Shelby Tube #1	Specimen Size:	2.8" dia. by 5.6" high
Depth:	2.0' - 4.0'		

Unified Soil
Classification: ML

TEST DATA

Type of Test: Unconfined Compression (Controlled Strain)

Specimen Number	1
Wet Density - p.c.f.	113.7
Dry Density - p.c.f.	85.9
Moisture Content - %	32.4
Saturation - %	93.5
Compressive Strength - t.s.f.	0.283
Strain at Failure - %	8.93
Type of Failure	Bulging

Note:

The strain rate was 0.02" per minute.

September, 1978

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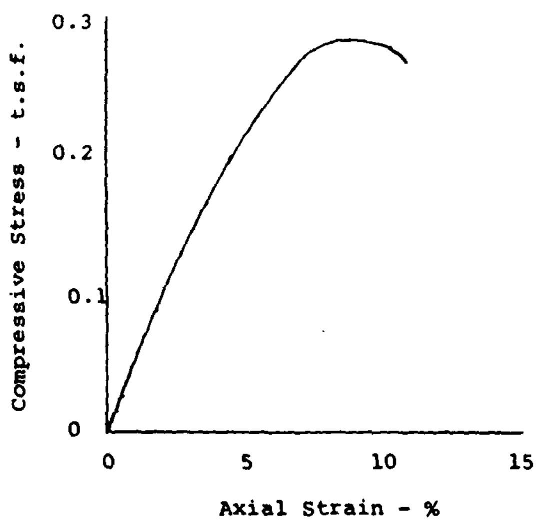
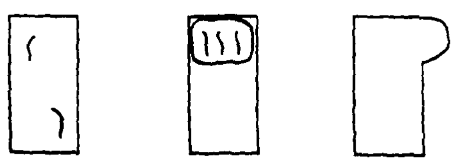
UNCONFINED COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No.: U-78-5A
Sample No.: Shelby Tube #1
Depth: 2.0' - 4.0'





Failure Sketch

September, 1978

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UNCONFINED COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No.:	U-78-6A	Type of Sample:	Undisturbed
Sample No.:	Shelby Tube #1	Specimen Size:	2.8" dia. by
Depth:	3.0' - 4.0'		5.6" high

Unified Soil
Classification: CL

TEST DATA

Type of Test: Unconfined Compression (Controlled Strain)

Specimen Number	1
Wet Density - p.c.f.	120.7
Dry Density - p.c.f.	99.4
Moisture Content - %	21.4
Saturation - %	83.9
Compressive Strength - t.s.f.	0.546
Strain at Failure - %	4.46
Type of Failure	High-Angle Shear

Note:

The strain rate was 0.02" per minute.

September, 1978

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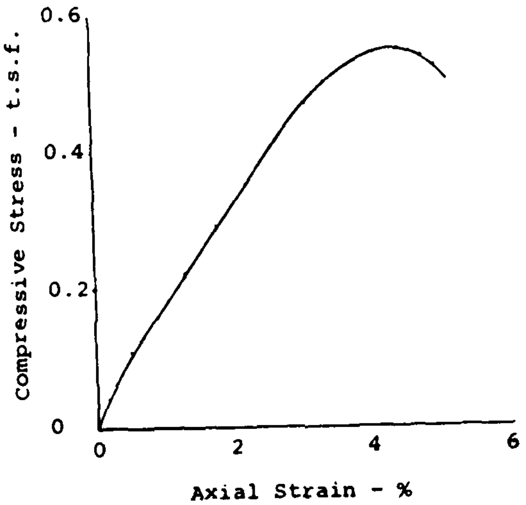
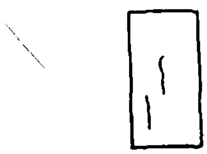
UNCONFINED COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No.: U-78-6A
Sample No.: Shelby Tube #1
Depth: 3.0' - 4.0'





Failure Sketch

September, 1978

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UNCONFINED COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No.:	U-78-20A	Type of Sample:	Undisturbed
Sample No.:	Shelby Tube #1	Specimen Size:	2.8" dia. by 5.6" high
Depth:	4.0' - 5.0'		

Unified Soil Classification: CL

TEST DATA

Type of Test: Unconfined Compression (Controlled Strain)

Specimen Number	1
Wet Density - p.c.f.	124.2
Dry Density - p.c.f.	102.6
Moisture Content - %	21.1
Saturation - %	88.0
Compressive Strength - t.s.f.	0.436
Strain at Failure - %	10.18
Type of Failure	Bulging

Note:

The strain rate was 0.02" per minute.

September, 1978

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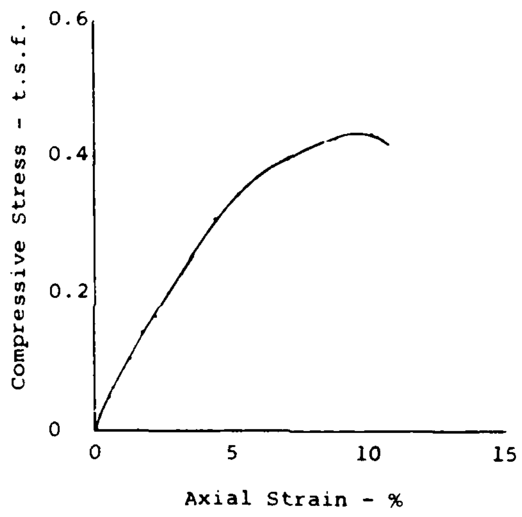
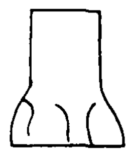
UNCONFINED COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No.: U-78-20A
Sample No.: Shelby Tube #1
Depth: 4.0' - 5.0'





Failure Sketch

September, 1978

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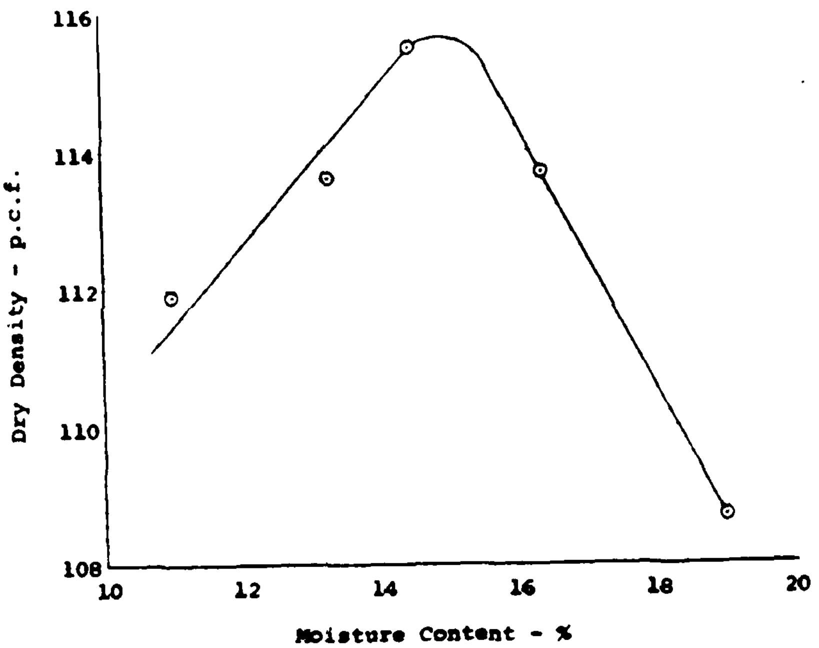
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

STANDARD COMPACTION TEST REPORT

Boring Nos.: A-78-1 & A-78-2
Sample No.: Composite
Depth: - - -
Unified Soil
Classification: CL



Maximum Dry Density: 115.6 p.c.f.
Optimum Moisture Content : 14.9 %

September, 1978

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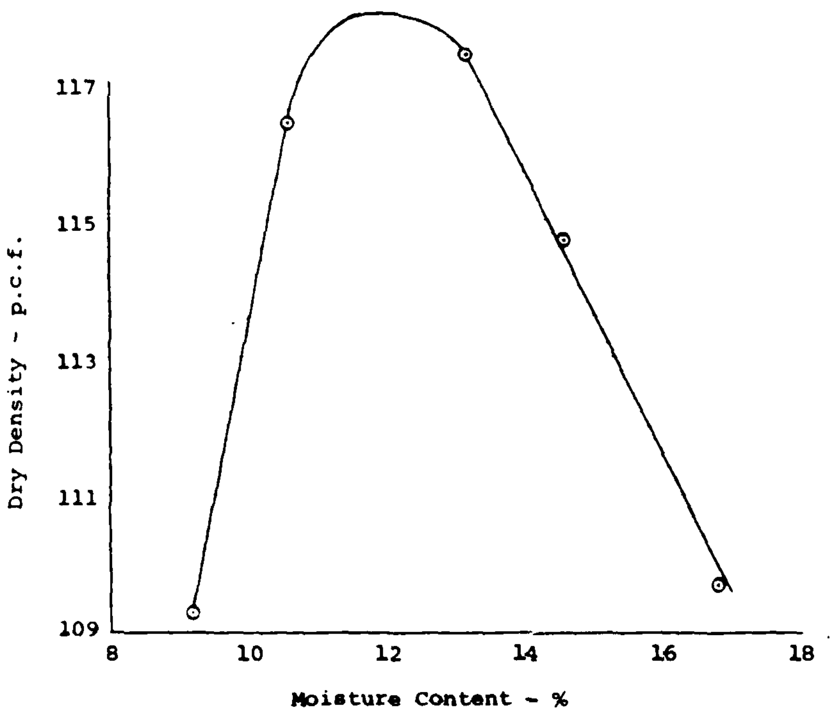
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

STANDARD COMPACTION TEST REPORT

Boring No.: A-78-3
Sample No.: Composite
Depth: 1.5' - 7.5'
Unified Soil
Classification: CL



Maximum Dry Density: ~~118.0~~ p.c.f.
Optimum Moisture Content: 11.9 %

September, 1978

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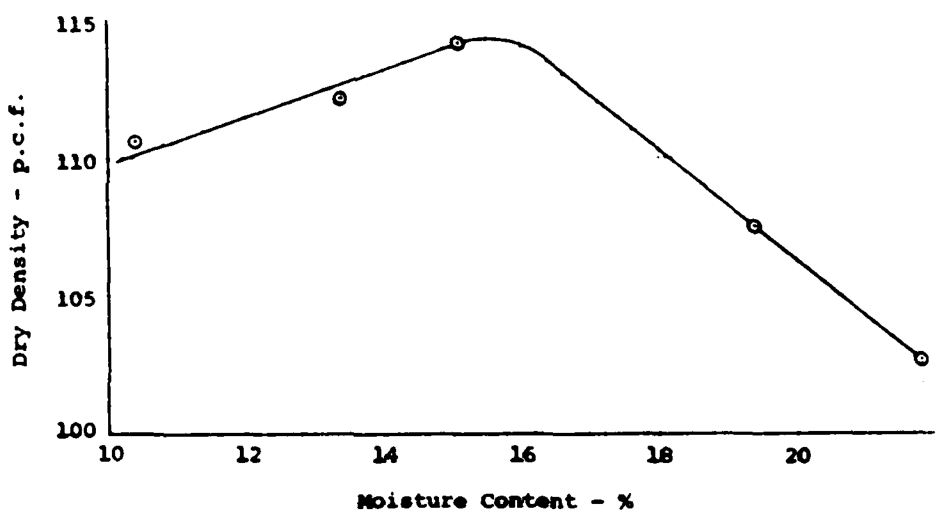
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

STANDARD COMPACTION TEST REPORT

Boring Nos.: DC-78-4, 6, 9 & 21
Sample No.: Composite
Depth: - - -
Unified Soil
Classification: CL



~~Maximum Dry Density: 114.3 p.c.f.~~
Optimum Moisture Content: 15.5 %

September, 1978

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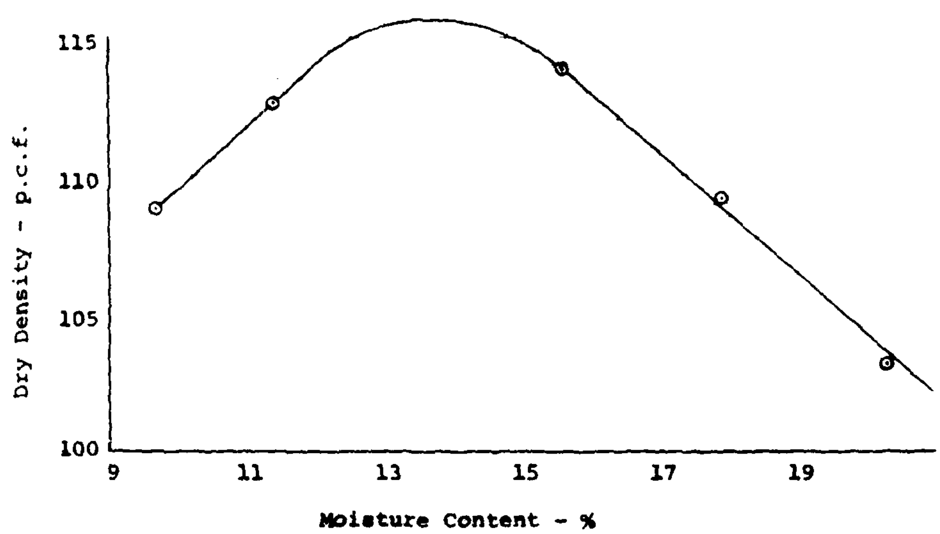
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

STANDARD COMPACTION TEST REPORT

Boring Nos.: DC-78-3, 18 & 20
Sample No.: Composite
Depth: - - -
Unified Soil
Classification: CL



~~Maximum Dry Density: 115.7 p.c.f.~~
Optimum Moisture Content: 13.7 %

September, 1978

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BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

SUMMARY OF NATURAL MOISTURE CONTENT
DETERMINATIONS FOR
LABORATORY TEST ORDER NO. 3

Boring No.	Sample No.	Depth	Natural Moisture Content (%)
A-78-1	2	1.5' - 3.0'	21.1
A-78-1	3	3.0' - 5.0'	24.3
A-78-2	4	5.0' - 7.0'	18.6
A-78-3	2	1.5' - 3.0'	15.1
A-78-3	3	3.0' - 5.0'	20.9
A-78-3	4	5.0' - 7.5'	14.2
D-78-13	2	1.5' - 3.0'	17.1
D-78-13	12	16.5' - 18.0'	31.3
D-78-13	21	30.0' - 31.5'	27.4
DC-78-4	3	3.0' - 4.5'	19.0
DC-78-4	4	4.5' - 6.0'	18.1
DC-78-4	5	6.0' - 7.5'	19.6
DC-78-4	6	7.5' - 9.0'	17.4
DC-78-6	3	3.0' - 4.5'	20.5
DC-78-6	4	4.5' - 6.0'	20.5
DC-78-6	5	6.0' - 7.5'	16.5
DC-78-6	6	7.5' - 9.0'	14.7
DC-78-6	7	9.0' - 10.5'	13.3
DC-78-9	3	3.0' - 4.5'	25.9
DC-78-21	2	1.5' - 3.0'	25.1
DC-78-21	3	3.0' - 4.5'	26.6
DC-78-3	6	7.5' - 9.0'	26.6
DC-78-3	7	9.0' - 10.5'	17.2
DC-78-3	9	12.0' - 13.5'	21.7
DC-78-3	11	15.0' - 16.5'	22.7
DC-78-18	4	4.5' - 6.0'	36.8
DC-78-18	5	6.0' - 7.5'	33.2

September, 1978

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Boring No.	Sample No.	Depth	Natural Moisture Content (%)
DC-78-20	3	3.0' - 4.5'	18.3
DC-78-20	4	4.5' - 6.0'	25.5
DC-78-20	6	7.5' - 9.0'	24.9
DC-78-20	7	9.0' - 10.5'	21.5
DC-78-20	8	10.5' - 12.0'	24.0
DC-78-20	9	12.0' - 13.5'	23.9
DCU-78-24	Shelby Tube #1	3.0' - 5.0'	22.4
DC-78-2	4	4.5' - 6.0'	22.8
DC-78-5	3	3.0' - 4.5'	19.2
DC-78-5	5	6.0' - 7.5'	19.0
DC-78-5	6	7.5' - 9.0'	15.0
DC-78-7	2	1.5' - 3.0'	20.3
DC-78-7	4	4.5' - 6.0'	22.3
DC-78-7	6	7.5' - 9.0'	20.3
DC-78-7	9	12.0' - 13.5'	24.8

September, 1978

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TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring Nos.:	A-78-1 & A-78-2	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

TEST DATA

Type of Test: Consolidated - Undrained (Controlled Strain)

Specimen Number	1	2	3
Cell Pressure - t.s.f.	1.00	2.00	4.00
Initial Dry Density - p.c.f.	106.4	105.7	106.2
Initial Moisture Content - %	18.7	18.1	18.9
Initial Saturation - %	85.5	81.3	85.9
Final Dry Density - p.c.f.	106.7	106.4	107.4
Final Moisture Content - %	19.8	20.6	20.4
Final Saturation - %	91.2	94.1	95.6
Principal Stresses at Failure			
Total Major - t.s.f.	3.806	5.145	7.403
Total Minor - t.s.f.	1.000	2.000	4.000
Strain At Failure - %	15.0	15.0	15.0
Type of Failure	Bulging	Bulging	Bulging

Notes: 1. The strain rate was 0.02" per minute.

2. The specimen failure was assumed to coincide with the peak deviator stress or, in a situation where there is no peak deviator stress, to coincide with the deviator stress at 15% axial strain.

September, 1978

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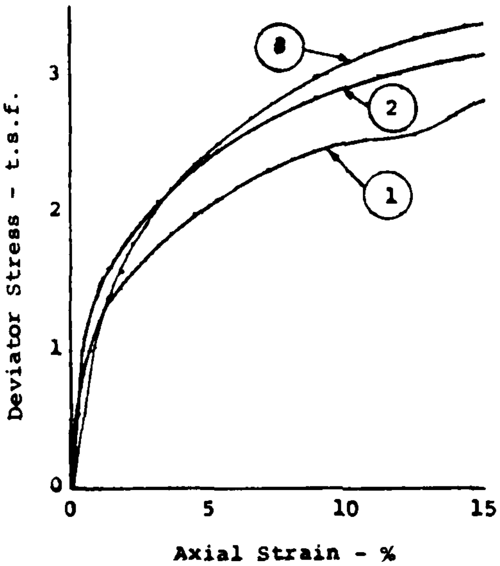
TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
~~CLEVELAND, OHIO~~

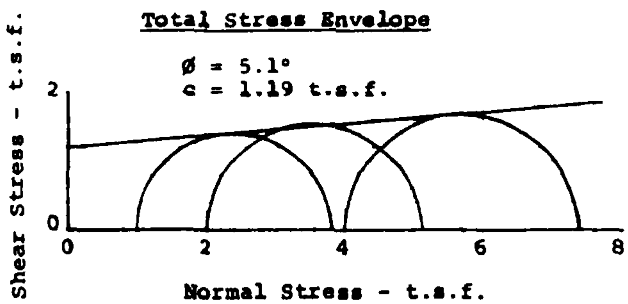


Consolidated - Undrained Test (Controlled Strain)

Boring Nos.: A-78-1 & A-78-2

Sample No.: Composite

Depth: - - -



September, 1978

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TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

RESULTS OF FALLING-HEAD PERMEABILITY TESTS PERFORMED ON TRIAXIAL SPECIMENS

Boring Nos.:	A-78-1 & A-78-2	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

Specimen No.	Cell Pressure* (t.s.f.)	Coefficient of Permeability, k_{20}, at 20° C. (cm/sec)
1	1.0	6.09×10^{-8}
2	2.0	5.68×10^{-8}
3	4.0	2.97×10^{-8}

* The falling-head permeability tests were performed after the specimens had been allowed to fully consolidate under the applied cell pressure.

September, 1978

F. T. Kitlinski & Associates, Inc.
Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No.:	A-78-3	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

TEST DATA

Type of Test: Consolidated - Undrained (Controlled Strain)

Specimen Number	1	2	3
Cell Pressure - t.s.f.	1.00	2.00	4.00
Initial Dry Density - p.c.f.	111.1	110.5	110.9
Initial Moisture Content - %	16.8	16.6	16.1
Initial Saturation - %	88.5	86.0	84.3
Final Dry Density - p.c.f.	112.1	110.8	111.9
Final Moisture Content - %	22.9	24.4	22.7
Final Saturation - %	100	100	100
Principal Stresses at Failure			
Total Major - t.s.f.	2.513	4.846	9.334
Total Minor - t.s.f.	1.000	2.000	4.000
Strain at Failure - %	15.0	15.0	15.0
Type of Failure	Bulging	Bulging	Bulging and High-Angle Shear

Notes: 1. The strain rate was 0.02" per minute.

2. The specimen failure was assumed to coincide with the peak deviator stress or, in a situation where there is no peak deviator stress, to coincide with the deviator stress at 15% axial strain.

September, 1978

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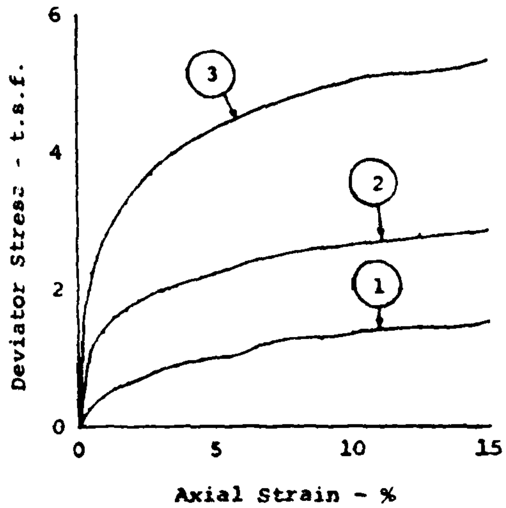
TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

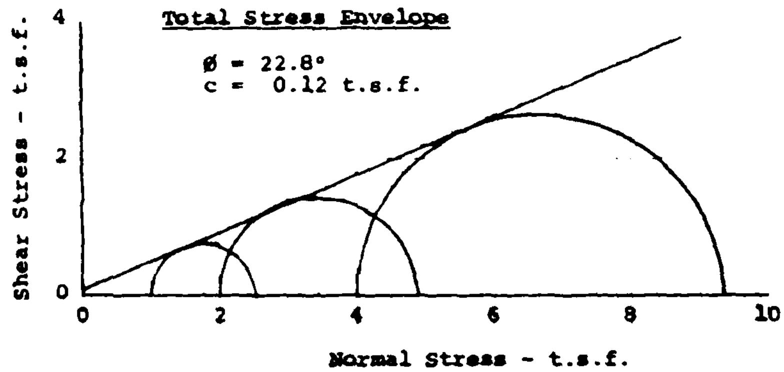


Consolidated - Undrained Test (Controlled Strain)

Boring No.: A-78-3

Sample No.: Composite

Depth: - - -



September, 1978

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TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

RESULTS OF FALLING-HEAD PERMEABILITY
TESTS PERFORMED ON TRIAXIAL SPECIMENS

Boring No.:	A-78-3	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

Specimen No.	Cell Pressure* (t.s.f.)	Coefficient of Permeability, k_{20}, at 20° C. (cm/sec)
1	1.0	2.51×10^{-8}
2	2.0	5.27×10^{-8}
3	4.0	4.89×10^{-8}

* The falling-head permeability tests were performed after the specimens had been allowed to fully consolidate under the applied cell pressure.

September, 1978

F. T. Kitlinski & Associates, Inc.
Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring Nos.:	DC-78-4, 6, 9 & 21	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

TEST DATA

Type of Test: Consolidated - Undrained (Controlled Strain)

Specimen Number	1	2	3
Cell Pressure - t.s.f.	1.00	2.00	4.00
Initial Dry Density - p.c.f.	100.3	100.9	99.9
Initial Moisture Content - %	21.9	20.2	21.9
Initial Saturation - %	89.0	83.3	88.1
Final Dry Density - p.c.f.	100.0	101.3	100.6
Final Moisture Content - %	23.8	23.7	25.3
Final Saturation - %	95.9	98.7	100
Principal Stresses at Failure			
Total Major - t.s.f.	2.652	4.408	7.762
Total Minor - t.s.f.	1.000	2.000	4.000
Strain at Failure - %	15.0	14.3	15.0
Type of Failure	Bulging	Bulging and High-Angle Shear	Bulging and High-Angle Shear

Notes:
1. The strain rate was 0.02" per minute.
2. The specimen failure was assumed to coincide with the peak deviator stress or, in a situation where there is no peak deviator stress, to coincide with the deviator stress at 15% axial strain.

September, 1978

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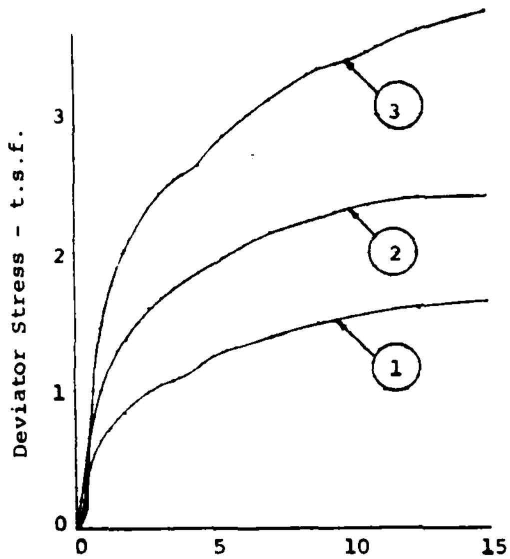
Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

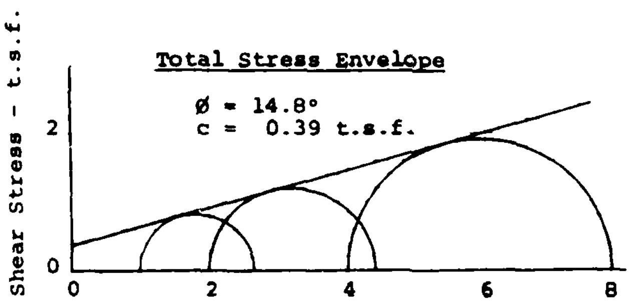


Consolidated - Undrained Test (Controlled Strain)

Boring Nos.: DC-78-4, 6, 9, & 21

Sample No.: Composite

Depth: - - -



September, 1978

F. T. Kitlinski & Associates, Inc.
Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

RESULTS OF FALLING-HEAD PERMEABILITY TESTS PERFORMED ON TRIAXIAL SPECIMENS

Boring Nos.:	DC-78-4, 6, 9 & 21	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

Specimen No.	Cell Pressure* (t.s.f.)	Coefficient of Permeability, k_{20}, at 20° C. (cm/sec)
1	1.0	4.10×10^{-8}
2	2.0	7.69×10^{-8}
3	4.0	4.60×10^{-8}

* The falling-head permeability tests were performed after the specimens had been allowed to fully consolidate under the applied cell pressure.

September, 1978

F. T. Kitlinski & Associates, Inc.
Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring Nos.:	DC-78-3, 18 & 20	Type of Sample:	Remolded
Sample No.	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

TEST DATA

Type of Test: Consolidated - Undrained (Controlled Strain)

Specimen Number	1	2	3
Cell Pressure - t.s.f.	1.00	2.00	4.00
Initial Dry Density - p.c.f.	102.4	103.6	102.4
Initial Moisture Content - %	20.4	19.0	20.9
Initial Saturation - %	86.4	82.9	88.5
Final Dry Density - p.c.f.	102.8	103.3	103.0
Final Moisture Content - %	28.2	23.7	26.0
Final Saturation - %	100	100	100
Principal Stresses at Failure			
Total Major - t.s.f.	3.189	4.528	7.523
Total Minor - t.s.f.	1.000	2.000	4.000
Strain at Failure - %	15.0	14.3	15.0
Type of Failure	Bulging	Bulging	Bulging

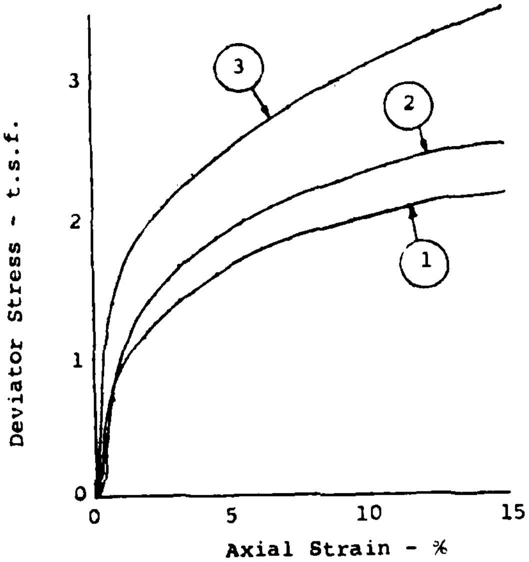
Notes:
1. The strain rate was 0.02" per minute.
2. The specimen failure was assumed to coincide with the peak deviator stress or, in a situation where there is no peak deviator stress, to coincide with the deviator stress at 15% axial strain.

September, 1978

F. T. Kitlinski & Associates, Inc.
Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

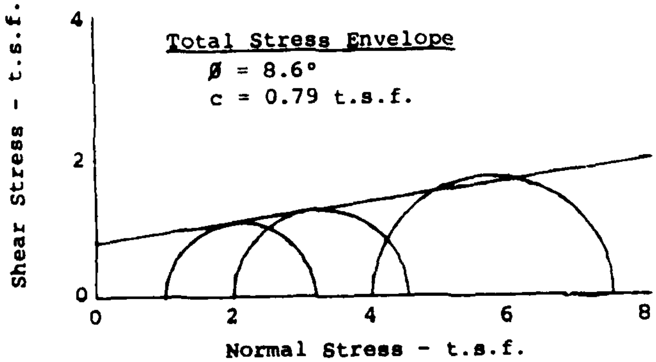


Consolidated- Undrained Test (Controlled Strain)

Boring Nos.: DC-78-3, 18 & 20

Sample No.: Composite

Depth: - - -



September, 1978

F. T. Kitlinski & Associates, Inc.
Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

RESULTS OF FALLING-HEAD PERMEABILITY TESTS PERFORMED ON TRIAXIAL SPECIMENS

Boring Nos.: DC-78-3, 18 & 20
Sample No.: Composite
Depth: - - -

Type of Sample: Remolded
Specimen Size: 2.8" dia. by 5.6" high

Unified Soil Classification: CL

Specimen No.	Cell Pressure* (t.s.f.)	Coefficient of Permeability, k_{20}, at 20° C. (cm/sec)
1	1.0	1.23×10^{-8}
2	2.0	2.31×10^{-8}
3	4.0	2.17×10^{-8}

* The falling-head permeability tests were performed after the specimens had been allowed to fully consolidate under the applied cell pressure.

September, 1978

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TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring Nos.:	DC-78-2, 5 & 7	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil
Classification: CL

TEST DATA

Type of Test: Consolidated - Undrained (Controlled Strain)

Specimen Number	1	2	3
Cell Pressure - t.s.f.	1.00	2.00	4.00
Initial Dry Density - p.c.f.	88.0	84.3	84.9
Initial Moisture Content - %	32.8	37.9	38.2
Initial Saturation - %	95.3	100	100
Final Dry Density - p.c.f.	88.9	84.9	85.2
Final Moisture Content - %	34.8	34.6	40.6
Final Saturation - %	100	93.5	100
Principal Stresses at Failure			
Total Major - t.s.f.	1.180	2.634	5.366
Total Minor - t.s.f.	1.000	2.000	4.000
Strain at Failure - %	15.0	15.0	15.0
Type of Failure	Bulging	Bulging	Bulging

Notes: 1. The strain rate was 0.02" per minute.

2. The specimen failure was assumed to coincide with the peak deviator stress or, in a situation where there is no peak deviator stress, to coincide with the deviator stress at 15% axial strain.

September, 1978

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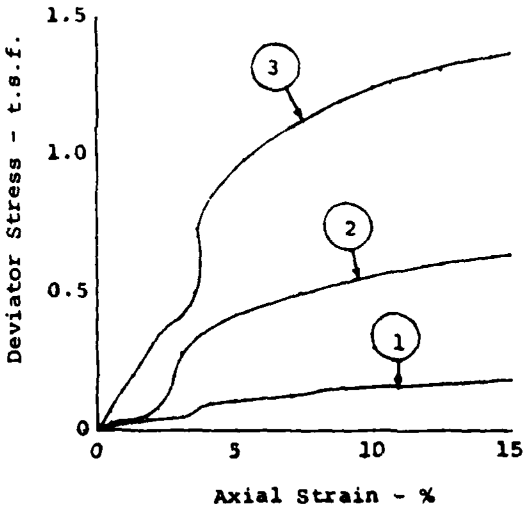
Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
~~CLEVELAND, OHIO~~

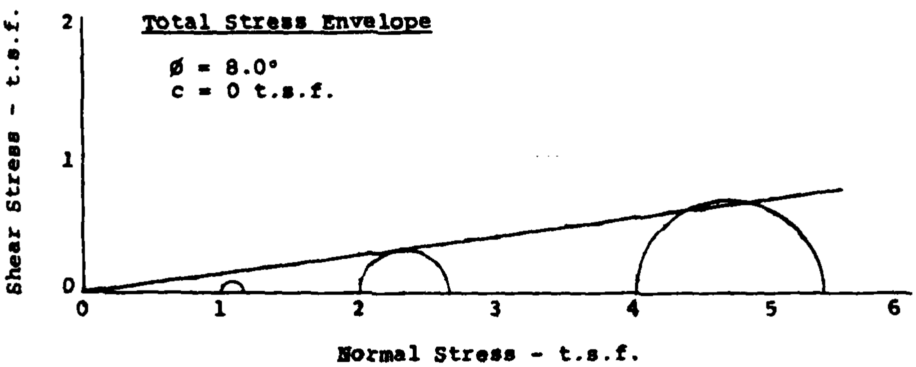


Consolidated - Undrained Test (Controlled Strain)

Boring Nos.: DC-78-2, 5 & 7

Sample No.: Composite

Depth: - - -



September, 1978

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TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

RESULTS OF FALLING-HEAD PERMEABILITY
TESTS PERFORMED ON TRIAXIAL SPECIMENS

Boring Nos.:	DC-2, 5 & 7	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

Specimen No.	Cell Pressure* (t.s.f.)	Coefficient of Permeability, k_{20}, at 20° C. (cm/sec)
1	1.0	1.63×10^{-7}
2	2.0	7.11×10^{-8}
3	4.0	1.26×10^{-8}

* The falling-head permeability tests were performed after the specimens had been allowed to fully consolidate under the applied cell pressure.

September, 1978

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Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring Nos.:	A-78-1 & A-78-2	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

TEST DATA

Type of Test: Unconsolidated - Undrained (Controlled Strain)

Specimen Number	1	2	3
Cell Pressure - t.s.f.	1.00	2.00	4.00
Initial Dry Density - p.c.f.	109.0	109.2	107.8
Initial Moisture Content - %	18.2	18.9	18.6
Initial Saturation - %	88.9	92.7	88.1
Final Dry Density - p.c.f.	110.0	110.3	108.6
Final Moisture Content - %	17.3	17.9	17.8
Final Saturation - %	86.7	90.4	86.0
Principal Stresses at Failure			
Total Major - t.s.f.	3.149	4.249	6.189
Total Minor - t.s.f.	1.000	2.000	4.000
Strain at Failure - %	15.0	15.0	15.0
Type of Failure	Bulging	Bulging	Bulging

Notes:
1. The strain rate was 0.02" per minute.
2. The specimen failure was assumed to coincide with the peak deviator stress or, in a situation where there is no peak deviator stress, to coincide with the deviator stress at 15% axial strain.

September, 1978

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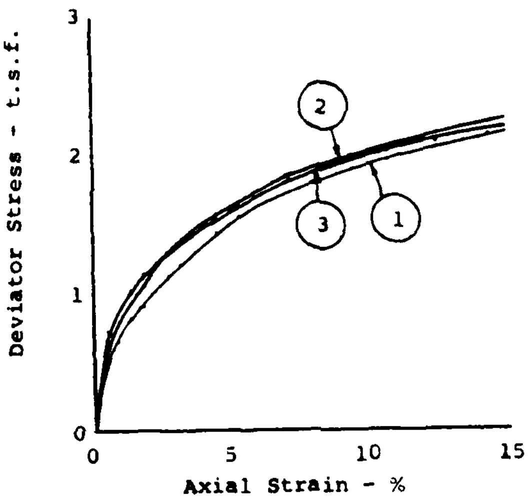
Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

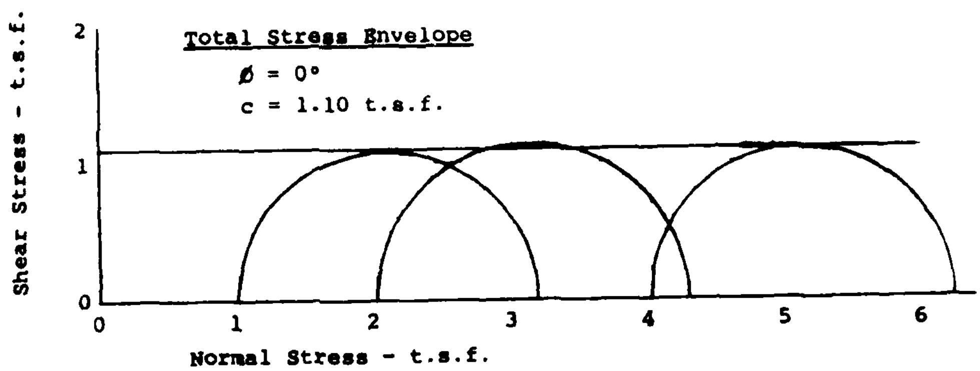


Unconsolidated - Undrained Test (Controlled Strain)

Boring Nos.: A-78-1 & A-78-2

Sample No.: Composite

Depth: - - -



September, 1978

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TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No.:	A-78-3	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

TEST DATA

Type of Test: Unconsolidated - Undrained (Controlled Strain)

Specimen Number	1	2	3
Cell Pressure - t.s.f.	1.00	2.00	4.00
Initial Dry Density - p.c.f.	114.2	113.2	113.5
Initial Moisture Content - %	14.5	15.5	14.8
Initial Saturation - %	83.0	86.4	83.1
Final Dry Density - p.c.f.	113.3	114.5	113.8
Final Moisture Content - %	15.6	14.3	14.9
Final Saturation - %	87.1	82.5	84.4
Principal Stresses at Failure			
Total Major - t.s.f.	2.950	5.662	8.160
Total Minor - t.s.f.	1.000	2.000	4.000
Strain at Failure - %	15.0	15.0	15.0
Type of Failure	Bulging	Bulging	Bulging

Notes: 1. The strain rate was 0.02" per minute.

2. The specimen failure was assumed to coincide with the peak deviator stress or, in a situation where there is no peak deviator stress, to coincide with the deviator stress at 15% axial strain.

September, 1978

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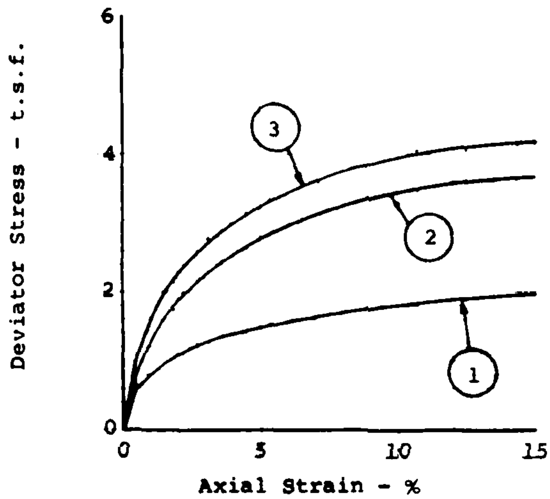
TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

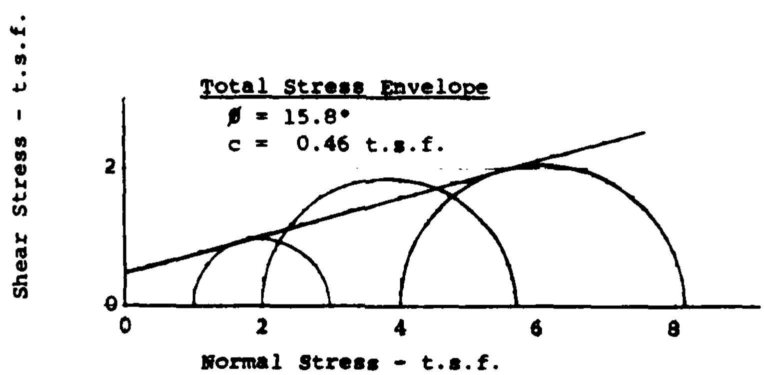


Unconsolidated - Undrained Test (Controlled Strain)

Boring No.: A-78-3

Sample No.: Composite

Depth: - - -



September, 1978

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TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring Nos.:	DC-78-4, 6, 9 & 21	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

TEST DATA

Type of Test: Unconsolidated - Undrained (Controlled Strain)

Specimen Number	1	2	3
Cell Pressure - t.s.f.	1.00	2.00	4.00
Initial Dry Density - p.c.f.	101.7	100.8	100.3
Initial Moisture Content - %	21.7	22.3	22.4
Initial Saturation - %	91.3	91.7	91.0
Final Dry Density - p.c.f.	101.6	101.7	100.8
Final Moisture Content - %	21.9	21.3	21.9
Final Saturation - %	91.9	89.6	90.1
Principal Stresses at Failure			
Total Major - t.s.f.	2.493	3.712	5.811
Total Minor - t.s.f.	1.000	2.000	4.000
Strain at Failure - %	15.0	15.0	15.0
Type of Failure	Bulging	Bulging	Bulging

Notes: 1. The strain rate was 0.02" per minute.

2. The specimen failure was assumed to coincide with the peak deviator stress or, in a situation where there is no peak deviator stress, to coincide with the deviator stress at 15% axial strain.

September, 1978

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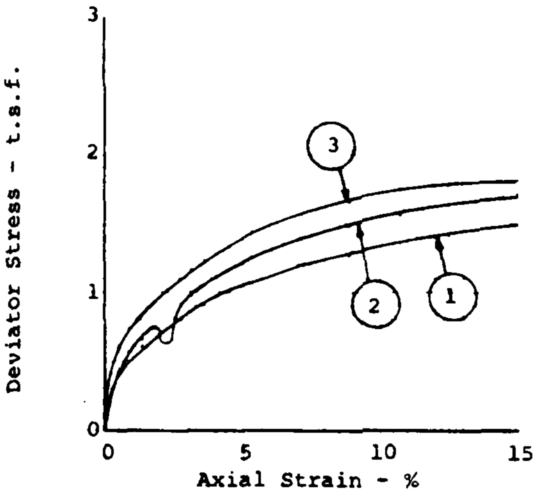
TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

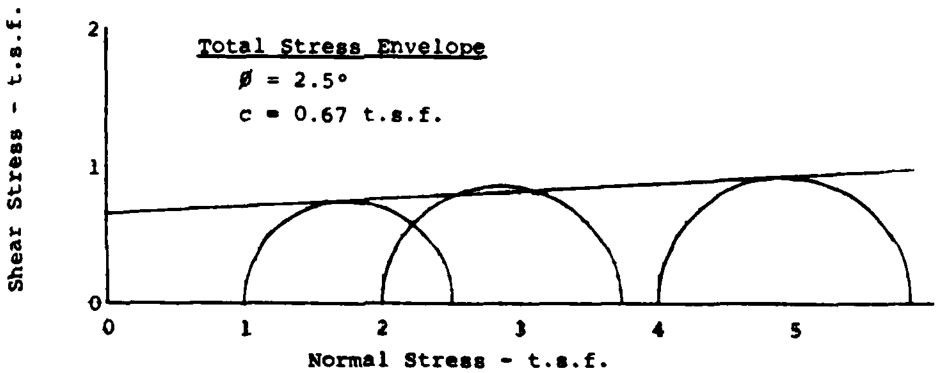


Unconsolidated - Undrained Test (Controlled Strain)

Boring Nos.: DC-78-4, 6, 9 & 21

Sample No.: Composite

Depth: - - -



September, 1978

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Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring Nos.:	DC-78-3, 18 & 20	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

TEST DATA

Type of Test: Unconsolidated - Undrained (Controlled Strain)

Specimen Number	1	2	3
Cell Pressure - t.s.f.	1.00	2.00	4.00
Initial Dry Density - p.c.f.	100.2	102.4	103.9
Initial Moisture Content - %	23.0	21.9	21.6
Initial Saturation - %	92.1	92.7	95.0
Final Dry Density - p.c.f.	101.6	102.5	104.3
Final Moisture Content - %	21.5	21.9	21.4
Final Saturation - %	89.2	92.9	95.1
Principal Stresses at Failure			
Total Major - t.s.f.	2.366	2.949	4.858
Total Minor - t.s.f.	1.000	2.000	4.000
Strain at Failure - %	15.0	15.0	15.0
Type of Failure	Bulging	Bulging	Bulging

Notes:
1. The strain rate was 0.02" per minute.
2. The specimen failure was assumed to coincide with the peak deviator stress or, in a situation where there is no peak deviator stress, to coincide with the deviator stress at 15% axial strain.

September, 1978

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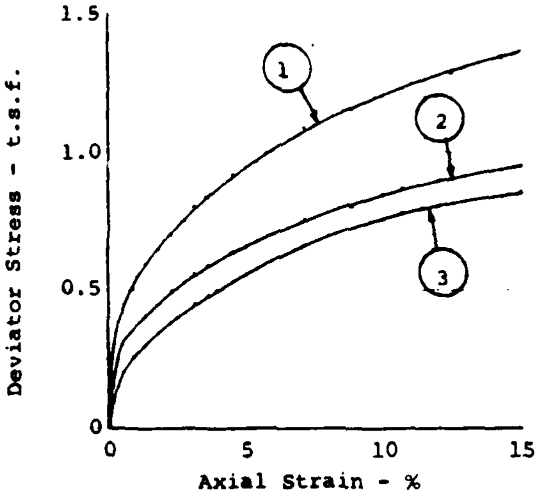
TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

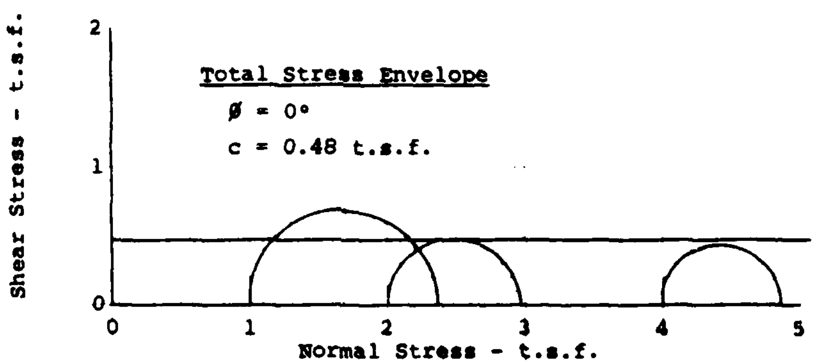


Unconsolidated - Undrained Test (Controlled Strain)

Boring Nos.: DC-78-3, 18 & 20

Sample No.: Composite

Depth: - - -



September, 1978

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Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring Nos.:	DC-78-2, 5 & 7	Type of Sample:	Remolded
Sample No.:	Composite	Specimen Size:	2.8" dia. by 5.6" high
Depth:	- - -		

Unified Soil Classification: CL

TEST DATA

Type of Test: Unconsolidated - Undrained (Controlled Strain)

Specimen Number	1	2	3
Cell Pressure - t.s.f.	1.00	2.00	4.00
Initial Dry Density - p.c.f.	88.9	86.8	87.8
Initial Moisture Content - %	31.4	35.2	33.0
Initial Saturation - %	93.2	99.5	95.4
Final Dry Density - p.c.f.	87.2	88.6	89.0
Final Moisture Content - %	34.1	32.5	31.4
Final Saturation - %	97.3	95.8	93.4
Principal Stresses at Failure			
Total Major - t.s.f.	1.170	2.180	4.240
Total Minor - t.s.f.	1.000	2.000	4.000
Strain at Failure - %	15.0	15.0	15.0
Type of Failure	Bulging	Bulging	Bulging

Notes: 1. The strain rate was 0.02" per minute.

2. The specimen failure was assumed to coincide with the peak deviator stress or, in a situation where there is no peak deviator stress, to coincide with the deviator stress at 15% axial strain.

September, 1978

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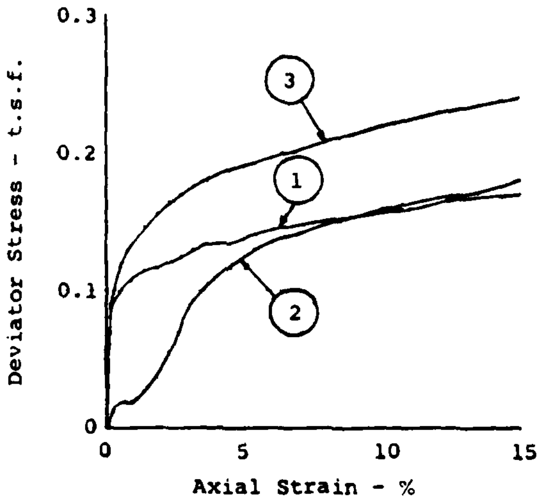
Harrisburg, Pennsylvania

TRIAXIAL COMPRESSION TEST REPORT

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

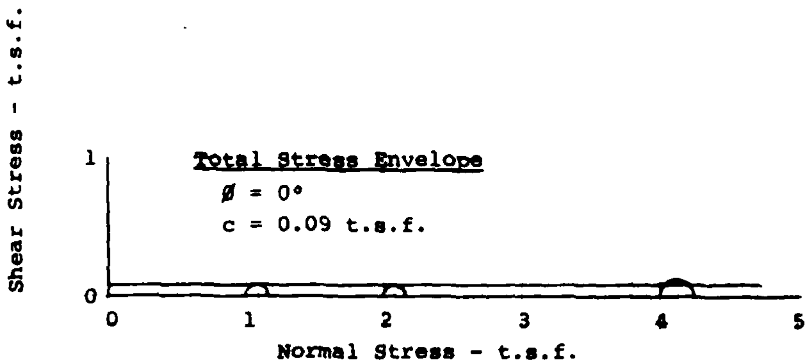


Unconsolidated - Undrained Test (Controlled Strain)

Boring Nos.: DC-78-2, 5 & 7

Sample No.: Composite

Depth: - - -



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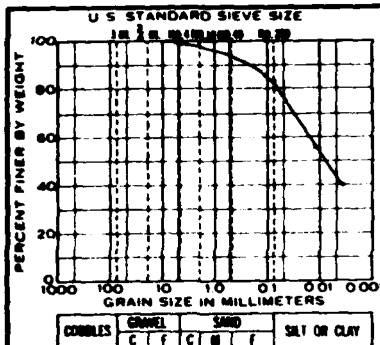
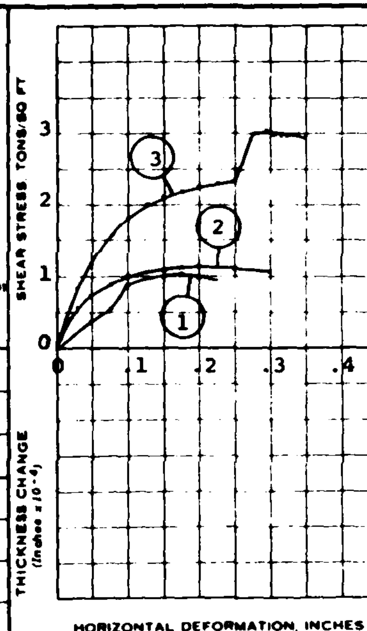
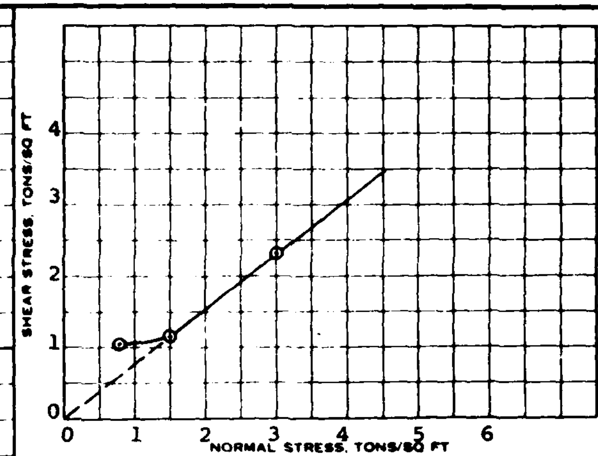


Classification	CL			
LL 32	G 2.72			
PL 20	D_{10}			
Test No.	1	2	3	
Initial Water Content, W_o %	16.5	16.5	16.5	
Dry Density Lbs/Cu Ft	110.1	113.5	105.8	
Void Ratio, e_o	0.54	0.49	0.59	
Saturation, S_o %	83.2	90.9	76.4	
Duration of Test (min)	4.5	6	7	
WC after Test, W_f %	20.0	19.5	11.0	
Normal Stress, σ T/SqFt	0.75	1.50	3.00	
Max Shear Stress, τ T/SqFt	1.02	1.11	2.31	



Type of Test: Strain - Control	Type of Specimen: Remolded
Consolidated	3.00 in. square
Drained	0.494 in. thickness

SHEAR VALUES	Ø	TAN Ø	C, T/SQ FT
Maximum	37.8	0.775	0
Ultimate			



Remarks:

Specimen was flooded after being placed in the shear box.

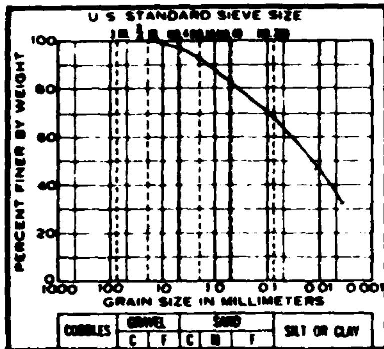
0.75 tsf - 0.0965" of consolidation
1.50 tsf - 0.1932" ditto
3.00 tsf - 0.1518" ditto

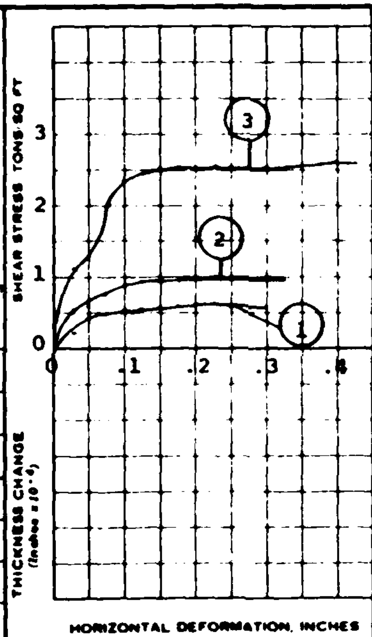
Project: Big Creek Flood Control Project
Cleveland, Ohio

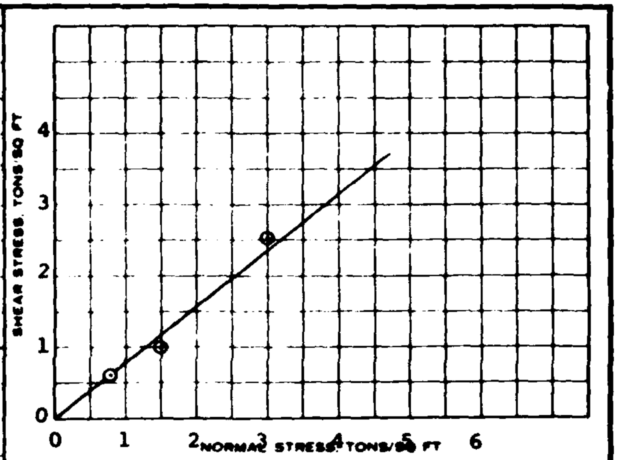
Area

Boring No. A-78-1 & A-78-2	Sample No. Composite
Elev or Depth ---	Date October, 1978

DIRECT SHEAR TEST REPORT







Classification	CL			
LL 28	G 2.69			
PL 17	D_{10}			
Test No.	1	2	3	
Initial Water Content, W_o %	15.7	15.7	15.7	
Dry Density Lbs/CuFt	110.9	110.9	110.9	
Void Ratio, e_o	0.51	0.51	0.51	
Saturation, S_o %	82.6	82.6	82.6	
Duration of Test(min)	6	6.5	9	
WC after Test, W_f %	18.8	18.1	17.3	
Normal Stress, σ T/SqFt	0.75	1.50	3.00	
Max. Shear Stress, τ T/SqFt	0.60	0.99	2.53	

Type of Test: Strain-Control, Consolidated, Drained	Type of Specimen: Remolded
	3.00 in. square
	0.494 in. thickness

SHEAR VALUES	φ	TAN φ	C, T/SQ FT
Maximum	38.2	0.788	0
Ultimate			

Remarks:

Specimen was flooded after being placed in the shear box.

0.75 tsf - 0.1208" of consolidation
1.50 tsf - 0.1396" ditto
3.00 tsf - 0.1768" ditto

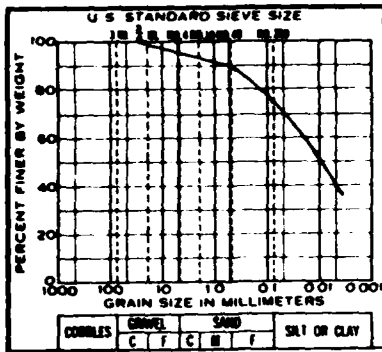
Project: Big Creek Flood Control Project

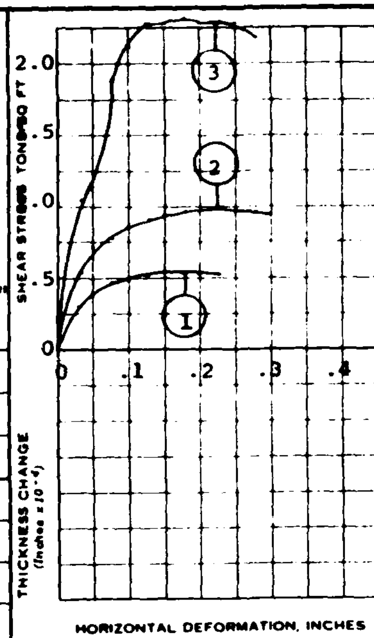
Cleveland, Ohio

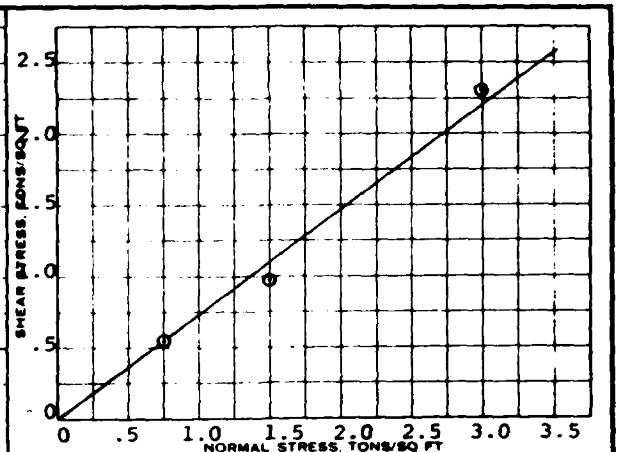
Area

Boring No. A-78-3	Sample No. Composite
Elev or Depth ---	Date October, 1978

DIRECT SHEAR TEST REPORT







Classification CL

LL 31	G 2.66		
PL 19	D_{10}		
Test No.	1	2	3
Initial Water Content, W_o %	21.9	21.9	21.9
Dry Density Lbs/CuFt	113.7	113.7	113.7
Void Ratio, e_o	0.46	0.46	0.46
Saturation, S_o %	100	100	100
Duration of Test (min)	4.5	6	5.5
WC after Test, W_f %	21.1	20.9	19.9
Normal Stress, σ T/SqFt	0.75	1.50	3.00
Max Shear Stress, τ T/SqFt	0.54	0.98	2.31

Type of Test: Strain - Control, Consolidated Drained

Type of Specimen: Remolded, 3.00 in. square, 0.494 in. thickness

SHEAR VALUES	ø	TAN ø	C, T/SQFT
Maximum	36.3	0.735	0
Ultimate			

Remarks:
Specimen was flooded after being placed in the shear box.

0.75 tsf - 0.1197" of consolidation
1.50 tsf - 0.1426" ditto
3.00 tsf - 0.1252" ditto

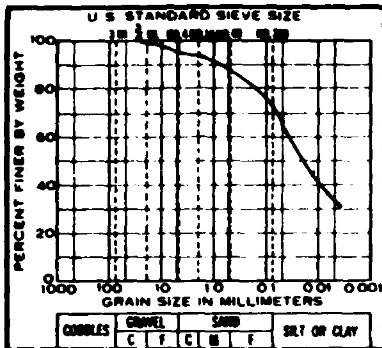
Project: Big Creek Flood Control Project, Cleveland, Ohio

Area

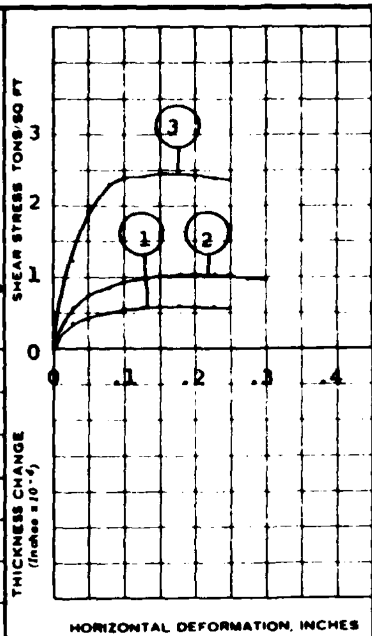
Boring No. DC-78-4, 6, 9 & 21 — Sample No. Composite

Elev or Depth --- — Date October, 1978

DIRECT SHEAR TEST REPORT

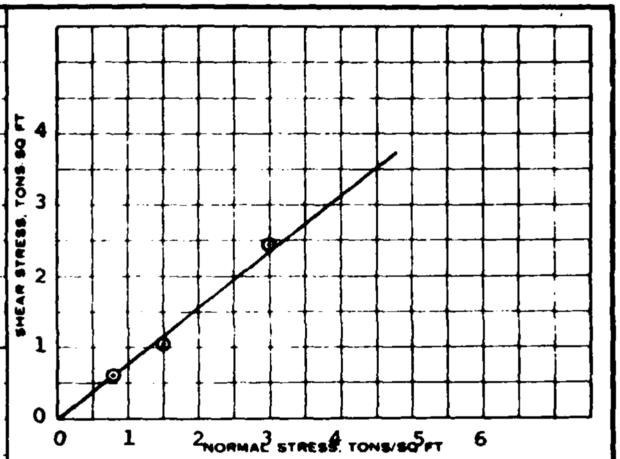


Classification	CL			
LL 31	G 2.68			
PL 20	D_{10}			
Test No.	1	2	3	
Initial Water Content, W_o %	21.5	21.5	21.8	
Dry Density Lbs/CuFt	114.2	114.2	114.2	
Void Ratio, e_o	0.46	0.46	0.46	
Saturation, S_o %	100	100	100	
Duration of Test (min)	5	6	5	
WC after Test, W_f %	22.0	21.7	21.5	
Normal Stress, σ T/SqFt	0.75	1.50	3.00	
Max. Shear Stress, τ T/SqFt	0.60	1.03	2.45	



Type of Test: Strain - Control	Type of Specimen: Remolded
Consolidated	3.00 in. square
Drained	0.494 in. thickness

SHEAR VALUES	Ø	TAN Ø	C, T/SQ FT
Maximum	38.0	0.780	0
Ultimate			



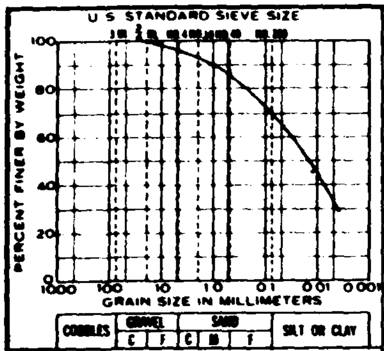
Remarks:

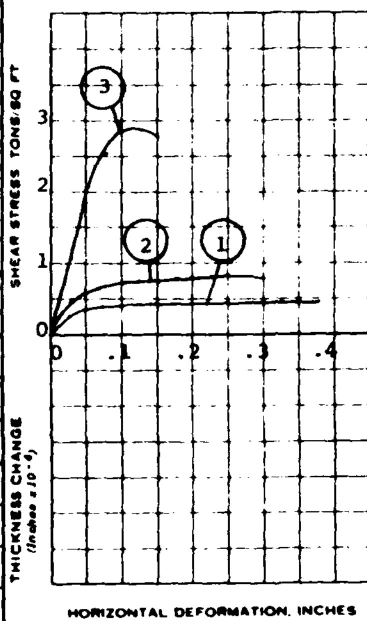
Specimen was flooded after being placed in the shear box.

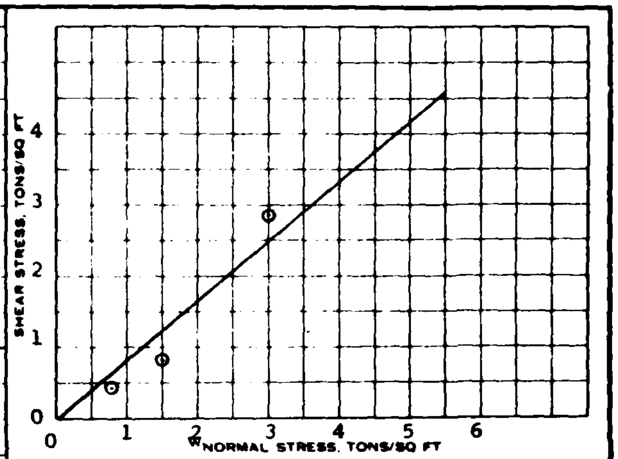
0.75 tsf - 0.1120" of consolidation
1.50 tsf - 0.1682" ditto
3.00 tsf - 0.1801" ditto

Project	Big Creek Flood Control Project Cleveland, Ohio
Area	
Boring No. DC-78-3, 18 & 20	Sample No. Composite
Elev or Depth ---	Date October, 1978

DIRECT SHEAR TEST REPORT







Classification	CL		
LL 29	G 2.74		
Pl 20	D_{10}		

Test No.	1	2	3
Initial Water Content, W_0 %	32.0	32.0	32.0
Dry Density Lbs/CuFt	86.0	86.0	86.0
Void Ratio, e_0	0.99	0.99	0.99
Saturation, S_0 %	89.0	89.0	89.0
Duration of Test (min)	7.5	6	3
WC after Test, W_f %	28.8	27.2	26.9
Normal Stress, σ T/SqFt	0.75	1.50	3.00
Max Shear Stress, τ T/SqFt	0.42	0.81	2.86

Type of Test: Strain - Control

Consolidated

Drained

Type of Specimen: Remolded

3.00 in. square

0.494 in. thickness

SHEAR VALUES	ø	TAN ø	C, T/SQ FT
Maximum	39.7	0.830	0
Ultimate			

Remarks:

Specimen was flooded after being placed in the shear box.

0.75 tsf - 0.0637" of consolidation
1.50 tsf - 0.0732" ditto
3.00 tsf - 0.1005" ditto

Project Big Creek Flood Control Project

Cleveland, Ohio

Area

Boring No. DC-78-2, 5 & 7

Sample No. Composite

Elev or Depth ---

Date October, 1978

DIRECT SHEAR TEST REPORT

SUMMARY OF
FIELD SOIL PERMEABILITY TEST RESULTS

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No. DC-78-17

Depth (ft.)	Applied Head (ft.)	Flow (gpm)	Coefficient of Permeability, k (cm/sec)
1.5	1.0	0	0

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Harrisburg, Pennsylvania

SUMMARY OF
FIELD SOIL PERMEABILITY TEST RESULTS

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No. DC-78-18

Depth (ft.)	Applied Head (ft.)	Flow (gpm)	Coefficient of Permeability, k (cm/sec)
1.5	1.5	0.000260	1.53×10^{-5}
3.0	3.0	0.0000781	6.89×10^{-6}
4.5	4.5	0.000573	1.12×10^{-5}
6.0	5.1	0.00729	1.26×10^{-4}
7.5	5.1	0.00964	1.67×10^{-4}
9.0	5.1	0.00938	1.62×10^{-4}
9.7	5.1	0.0191	3.30×10^{-4}

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Harrisburg, Pennsylvania

SUMMARY OF
FIELD SOIL PERMEABILITY TEST RESULTS

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No. DC-78-19

Depth (ft.)	Applied Head (ft.)	Flow (gpm)	Coefficient of permeability, k (cm/sec)
0.0-3.0	0.5	0.01875	4.24×10^{-4} cm/sec

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SUMMARY OF
FIELD SOIL PERMEABILITY TEST RESULTS

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No. D-78-20

Depth (ft.)	Applied Head (ft.)	Flow (gpm)	Coefficient of Permeability, k (cm/sec)
0.0 - 3.0	1.5	0.275	2.07×10^{-3}
3.0 - 6.0	4.5	0.392	9.85×10^{-4}
6.0 - 9.0	7.5	0.100	1.51×10^{-4}
9.0 - 12.0	10.5	0.0229	2.47×10^{-5}
12.0 - 15.0	12.0	Could Not Fill Hole	

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Harrisburg, Pennsylvania

SUMMARY OF
FIELD SOIL PERMEABILITY TEST RESULTS

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

Boring No. DC-78-21

Depth (ft.)	Applied Head (ft.)	Flow (gpm)	Coefficient of Permeability, k (cm/sec)
0.0-3.0	1.25	0.01875	1.70×10^{-4}
3.0-6.0	2.5	0.003125	1.41×10^{-5}

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Harrisburg, Pennsylvania

F. T. KITLINSKI & ASSOCIATES
REPORT ON HYDRAULIC PRESSURE TESTING

Boring No. DC-78-18
Sheet No. 1 of 1
Date 6-16-78

Project Location Big Creek Flood Control Project Cleveland, Ohio Project No. 78-03-2613
Boring Location N 650,138 E 216,044 Elev. Top of Boring 620.2
Driller G. Mellott No. of Meter

PART I DATA ON FLOW TEST

Section of hole tested								Meter Readings			
Depth		Elevation		Press. Gage Lbs./ Sq.In.	Time Started	Time Stopped	Time Minutes	At Start of Test c.f.	At End of Test c.f.	Total C.F. Water Used	C.F. Water Per Min.
From	To	From	To								
13.0	18.0				Could not seat packers due to						
12.0	17.0				highly fractured bedrock.						

PART II HOLDING TEST - MAXIMUM PRESSURE 50 p.s.i.

Data on Pressure				Time on Each 10 lb. Drop				
Section of hole tested				Gage pressure at test intervals from				
Depth		Elevation		50-40 lb.	40-30 lb.	30-20 lb.	20-10 lb.	10-0 lb.
From	To	From	To	(or higher pressures if necessary)				
13.0	18.0				Could not seat packers due			
12.0	17.0				to highly fractured bedrock.			

DESCRIPTION OF OPERATIONS AND GENERAL INFORMATION:
Elev. Top Rock
Bottom Boring

REMARKS:

Kenneth R. Noble
Inspector's Signature

DATE
FILMED

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