

**FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGH EMBANKMENTS AND SWAMPS
ARMOUR TOWNSHIP STA 25+075 TO STRONG TOWNSHIP STA 11+275
HIGHWAY 11 FOUR LANING
BURK'S FALLS TO SOUTH RIVER, ONTARIO
G.W.P. 759-93-00**

Geocres Number: 31E-227

**Report to
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June 30, 2005
File: 19-1423-12

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual information obtained from a foundation investigation at the proposed locations of high embankments and swamps along the proposed Highway 11 mainline alignment extending from Armour Township, Sta. 25+075 at the south end to Strong Township, Sta. 11+275 at the north limit covered by this report. The report also addresses high embankments and swamp crossings on the ramps for Pevensy Road and Stirling Creek Road Interchange.

The purpose of the investigation was to explore the subsurface conditions at sites where embankments higher than 6 m or swamp crossings are proposed, and based on the data obtained, to provide a borehole location plan, borehole logs, stratigraphic profile and cross-sections and a written description of the subsurface conditions. Assessment of embankments less than 6 m in height is not included in this assignment.

Thurber carried out the investigation as a sub-consultant to Marshall Macklin Monaghan (MMM), under the Ministry of Transportation Ontario (MTO) Agreement Number 5005-A-000188.

2 SITE DESCRIPTION

This report addresses the portion of the proposed Highway 11 Mainline extending approximately 2 km from about 900 m south of the northern boundary of Armour Township at the south limit to the existing intersection of Highway 11 and Stirling Falls Road the north end. The proposed alignment proceeds from Armour Township north into Strong Township and generally runs parallel to the existing Highway 11 alignment, and will incorporate the existing highway into the NBL south of Stirling Creek Road. North of Stirling Creek Road new mainline alignment is proposed to the east of the existing Highway 11.

The site is located in the physiographic area known as the Laurentian Highlands of the Canadian Shield which generally consists of undulating terrain with uplands areas comprised of bedrock



outcrop or overburden soils comprised of granular outwash or basal till of variable thickness. Swamps or lakes are commonly present in the lowlying areas. The proposed alignment is located on undulating terrain with vertical relief less than 20 m. The terrain generally slopes gently downwards towards the Stirling Creek valley located west of the alignment.

Drainage in the surrounding areas is typically moderately well developed and is comprised of small streams which flow generally westwards into Stirling Creek.

The majority of the land along this section of the proposed alignment is undeveloped forested land with some localized industrial development (borrow pits) west of the alignment near the southern limits of the project.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this portion of the project were carried out between July 16, 2002 and February 17, 2004. The site investigation consisted of drilling and sampling a total of 72 boreholes and 21 Dynamic Cone Penetration Tests (DCPT) to depths ranging from 0 to 13.7 m. A summary of boreholes drilled at the various portions of the project are summarized below:

	Boreholes	DCPT
Highway 11 Mainline	51	11
Hwy 11/Stirling Interchange Ramps	21	10

The median centreline location and stations were surveyed and staked in the field by Marshall Macklin Monaghan (MMM) prior to commencing drilling operations. The borehole and DCPT locations were established in the field by Thurber personnel based on the staked median centreline or approach ramp centreline as applicable. The boreholes are labelled based on the individual station and offset for each alignment. Property access, site preparation and utility clearances were carried out by Thurber prior to any drilling being carried out. The locations of the boreholes are shown on the attached "Borehole Locations and Soil Strata Drawings" found in Appendices A through D. The site plans, topography and proposed height of embankments shown on the drawings were provided by MMM, dated May 2004.

The drilling, sampling and in-situ testing operations were carried out by All-Terrain Drilling of Waterloo, Ontario and George Downing Estate Drilling of Port Hawkesbury, Ontario. The boreholes were advanced by CME 75 drill rigs mounted on Nodwell tracked carriers using hollow stem and solid stem auger techniques. Disturbed samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in most overburden soils. Where cohesive layers exhibiting lower strength were encountered, in-situ vane shear tests or thin-walled tube samples were collected.

Dynamic Cone Penetration Tests (DCPT) were carried out at the toe of fill locations (alternating intermediate stations) to obtain a continuous profile in the upper portion of the deposit. The DCPT tests were carried out by continuous penetration of a 50 mm diameter steel cone (60 degree) driven by a standard SPT hammer. The DCPT profiles are shown on the borehole logs in the Appendices A through D.

The drilling and sampling operations were supervised on a full time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and the recovered disturbed and undisturbed samples and processed the samples for transport back to Thurber's Oakville laboratory.

Upon completion of drilling and sampling, standpipe piezometers were installed in select boreholes. Piezometer construction generally utilized of 19 mm diameter Schedule 40 PVC pipe with 1.5 m long slotted tips installed near the bottom of the boreholes. The piezometers installations were backfilled with a sand filter pack extending from the bottom of the hole to at least 0.3 m above the top of the screen and bentonite clay seal (holeplug) were placed above the filter sand. A second bentonite seal was placed just beneath the ground surface. The interval between the bentonite seals was backfilled with cuttings and bentonite. Boreholes without a piezometer were backfilled using bentonite and drill cuttings.

The Record of Borehole logs, "Borehole Locations and Soil Strata" drawings, and laboratory test result summaries are included in each of the separate appendices as shown below:

- Appendix A Hwy 11 Mainline, Armour Township, Sta. 25+075 to 25+175
- Appendix B 422 Stirling Creek Road/Pevensey Road Interchange
- Appendix C Hwy 11 Mainline, Strong Township, Sta. 10+225 to 10+745
- Appendix D Hwy 11 Mainline, Strong Township, Sta. 11+075 to 11+225

4 **LABORATORY TESTING**

All recovered soil samples were returned to Thurber's laboratory where they were subjected to visual identification and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets in the Appendices as described in the preceding section.

Selected samples were subjected to gradation analysis (sieve test) and Atterberg Limit testing.

5 **DESCRIPTION OF SUBSURFACE CONDITIONS**

A general description of the stratigraphy at each of the swamps and where high fills are proposed is given in the following sections. Details of the soil stratigraphy encountered are presented in the Record of Boreholes sheets in Appendices A through D. Where specific information is required reference should be made to the Record of Borehole sheets in the Appendices.

5.1 Highway 11 Mainline Embankment, Armour Sta. 25+075 to 25+175

The Highway 11 Mainline in Armour Township between Sta. 20+075 and 20+175 will consist of a new four-lane section supported by an embankment which is generally 6 to 8 m in height. The SBL will cross a topographic depression containing a small creek. The NBL will be located over the existing Highway 11 embankment.

The soils encountered in the boreholes drilled along this portion of the alignment generally consist of topsoil or peat layer overlying outwash sand, overlying a very hard layer, which resulted in auger refusal (inferred bedrock or cobbles and boulders).

Peat or Topsoil

A 0.2 m thick layer of peat or topsoil was encountered at the ground surface in the boreholes.

The peat or topsoil layer is described as fibrous peat or sandy topsoil. The deposit was typically dark brown to black in colour.

Outwash Sand

At most locations the surficial topsoil and peat layers were underlain by a deposit comprised primarily of sand. The composition of this unit was variable ranging from silty sand; to sand and silt mixtures, to sand trace silt or gravelly sand. The minor constituents noted in the samples included: trace to some gravel and occasional cobbles and boulders. The sand fraction was typically fine to medium grained. The thickness of this deposit varies from 1.5 to 4.0 m.

The deposit was typically brown in colour with occasional grey zones noted in areas with higher fines content.

SPT N-values in this deposit range from 12 to 47 indicating a compact to dense condition. Some higher SPT N-values ($>100/0.1\text{m}$) were noted near the lower boundary of this unit where cobbles, boulder or refusal conditions were encountered.

The moisture content of disturbed samples collected from this unit varied from 4 to 20%.

The results of grain size analyses conducted on samples from this unit are summarized in Figures A1 through A4 in Appendix A and on the Record of Borehole sheets.

Groundwater

Observations of groundwater conditions during drilling and measurements of water levels in the piezometer indicate that the depth to the groundwater table generally varies from near the ground surface (Elev 320 m) to about 1 to 2 m below the ground surface (Elev 318m). The groundwater levels are expected to vary seasonally and with heavy precipitation events.

5.2 422 Stirling Creek Road/ Pevensey Road Interchange

The proposed interchange of Highway 11 and 422 Stirling Creek /Pevensey Road has five separate areas where embankments higher than 6 m are proposed. These areas are summarized in Table 1 below:

Location	Embankment Height (m)	Embankment Base Width (m)
▪ west structure approach	6-7.5	53
▪ east structure approach	6-9.5	59
▪ N-EW Ramp north end	6-8.5	110
▪ E-N Ramp	6-10	47
▪ N-EW Ramp (south end)/ W-S Ramp/E-S Ramp	5-7	45

TABLE 1: RAMP EMBANKMENT LOCATIONS

Several of the ramps converge onto a single embankment and are therefore considered as only one location. The north end of the N-EW Ramp converges with the Highway 11 mainline embankment near Sta. 10+350 to Sta. 10+430 and is described along with the Mainline in the following section of this report

The native soils encountered in the boreholes along this portion of the alignment are variable mixtures of sand, silt and sand with some gravel. Surficial topsoil and fill deposits were encountered overlying the native deposits at some boreholes.

5.2.1 West Approach Embankment, 422, Sta. 9+900 to 9+950

The west approach to structure 422, Sta. 9+900 to 9+950 is generally founded on a deposit of sand interbedded with layers of sand and gravel or occasional layers of silt. This sequence is overlain by a discontinuous layer of topsoil. Auger refusal was encountered at one borehole indicating that the deposit is underlain by boulders or bedrock at this location (422 9+900 R0.5). The characteristics of each of these units are described below.

Topsoil

A layer of topsoil was encountered at one borehole location. The thickness of this deposit varied from 0 to 0.2 m. The topsoil layer is described as brown topsoil, with occasional rootlets

Sand

The sand unit was interbedded with the sand and gravel unit described in the following section. The thickness of the sand layers encountered in the boreholes varied from 0.7 to

1.7 m where interbedded with the sand and gravel and greater than 6 m thick where the gravel layers were not encountered.

This sand is generally described as fine grained sand, trace silt to silty, trace gravel. The deposit is brown in colour. The SPT N-values generally ranged from 11 to 22 indicating compact conditions, but SPT values of 45 and 84 were also recorded indicating very dense to very dense conditions locally.

The moisture content of the disturbed samples varied from 3 to 11%.

The results of the gradation analyses for this deposit are summarized in Figure B8 through B10 in Appendix B.

Sand and Gravel

The sand and gravel unit was interbedded with the sand unit described in the preceding section. The thickness of the sand and gravel layers encountered in the boreholes varied from 0.5 to 1.5 m.

This sand and gravel is generally described as sand and gravel varying to sand, gravelly, trace silt. The gravel fraction is generally fine to medium grained. The deposit is brown in colour, but becomes grey below about 5.8 m depth (326.4 m Elev.). The SPT N-values generally ranged from 11 to 27 indicating compact conditions, but SPT values of 50/75mm were also recorded indicating very dense conditions locally.

The moisture content of the disturbed samples varied from 5 to 10%.

The results of the gradation analyses for this deposit are summarized in Figure B11 in Appendix B.

Silt Layers

Interbedded layers of silt were encountered within the sand unit described above in two boreholes. The thickness of these layers encountered at the borehole locations varied from 0.7 m to 1.4 m.

The silt layers are described as silt, trace sand to sandy, trace to some clay, trace gravel. The deposit is cohesionless and is brown in colour. The deposit has SPT N-values of 6 to 15 indicating loose to compact conditions. The moisture content of this unit varies from 16 to 24%.

Groundwater

Observations of groundwater conditions during drilling indicate that the groundwater table is generally deeper than 5.8 m below ground surface (Elev 326.4 m). The groundwater levels are expected to vary seasonally and with heavy precipitation events.

5.2.2 East Approach Embankment, 422 Sta. 10+050 to 10+100

The subsurface conditions encountered at the boreholes drilled for the East Approach to the Stirling Creek Structure and the W-N Ramp , Sta. 25+465 to 25+475 generally consist of the following sequence:

- topsoil and fill
- Upper silty sand to sandy silt
- Silt
- Lower silty sand
- Sand

Topsoil and Fill

A discontinuous topsoil layer was encountered varying in thickness from 0 to 500 mm at the borehole locations. The topsoil is typically dark brown in colour.

At borehole 422-3 approximately 500 mm of sandy topsoil was encountered over 1 m of fill. The fill was comprised of a mixture of topsoil and silt.

A surface layer of sand and gravel fill was encountered in the boreholes drilled through the side road. The thickness of the sand and gravel varied from 0.5 to 0.9 m at the borehole locations. The deposit is generally brown in colour. Due to the relatively thin nature of this deposit, N-values were not obtained for this unit. The moisture content of the samples recovered varied from 6 to 8%.

Upper Silty Sand to Sandy Silt

A layer of silty sand to sandy silt was encountered underlying the soils described above in four boreholes (422 Sta. 10+100 L5, 422W-N 25+465 R18, 422W-N 25+473 R3 and 422-4). The thickness of this unit varied from 0.3 to 1.7 m.

The deposit is described in the borehole logs as silty sand to sandy silt trace gravel. The sand is fine-grained. Occasional clay layers were noted at some boreholes. The deposit is brown in colour. The SPT N-values ranged from 2 to 14 generally indicating loose to compact conditions. An N-value of greater than 100 was also encountered indicating the presence of coarse gravel. The moisture content of samples from this unit varied from 20% to 28%.

Silt

All boreholes encountered a layer of silt below the materials described above. The thickness of the silt layer varies from 2.6 to greater than 5.6 m. The underside of the silt layer varies from 325.4 to 329.8 m elevation.

This deposit is described as silt, trace sand to sandy, trace to some clay, trace gravel. The deposit is cohesionless, laminated and is brown in colour. The deposit has SPT N-values of 5 to 17 indicating loose to compact conditions. The moisture content of this unit varies from 24 to 36%. The results of the gradation analyses for this deposit are summarized in Figures B3 and B4 in Appendix B.

Lower Silty Sand to Sandy Silt

A lower silty sand to sandy silt deposit was encountered beneath the silt unit described above in all boreholes, except 422W-N, Sta. 25+473 and 422 Sta. 10+100. The thickness of the silty sand varies from 2.6 to 4.2 m

This deposit is described as silty sand, sand some silt, or sandy silt. The deposit is cohesionless and is brown to grey in colour. The deposit has SPT N-values of 11 to 23 indicating compact conditions. The moisture content of this unit varies from 10 to 18%.

Sand

A sand deposit was encountered beneath the aforementioned lower silty sand deposit where the borehole extended below 6 m depth (borehole No. 422-3). The sand was encountered below 7.2 m depth (Elev 323 m) and was 11.9 m thick.

The sand deposit is described as fine-grained sand, trace to some silt, becoming fine to coarse grained sand with some gravel and occasional cobbles below 13.5 m depth. The deposit is brown in colour with occasional oxide stain. SPT N-values ranged from 6 to >100 indicating loose to very dense conditions. The moisture content of samples recovered from this unit varied from 10% to 23%.

Groundwater

Observations of groundwater conditions during drilling indicate the presence of perched groundwater at about Elev 330 m on the east end of the proposed embankment (422 10+100) and a deeper groundwater zone at about Elevation 319.8 m at the west end of the site (422-3). The groundwater levels are expected to vary seasonally and with heavy precipitation events.

5.2.3 E-N Ramp Embankment, Sta. 10+046 to 10+275

The subsurface conditions encountered at the boreholes drilled for the E-N Ramp generally consist of the following sequence:

- topsoil and fill
- Silt to mixture of silt and sand
- Silty sand to sand trace silt

Topsoil and Fill

A discontinuous topsoil layer was encountered varying in thickness from 50 mm to 300 mm at the borehole locations. The topsoil is typically dark brown in colour and often contains rootlets

Fill was encountered at borehole No. 422E-N, 10+125 L27 drilled through the existing Highway 11 alignment. The fill was comprised of pavement structure consisting of layers of asphalt, sand and gravel, and sand trace silt to a depth of 1.5 m below ground surface.

Silt to Mixture of Silt and Sand

A layer of silt varying to sandy silt or to a mixture of silt and sand was encountered in all boreholes underlying the soils topsoil and fill soils described above. Where the boreholes penetrated the underside of this unit, the thickness of this unit varied from 1.3 to 7.0 m.

The deposit is described in the borehole logs as silt, trace sand trace to some clay, as sandy silt trace gravel or as a mixture of silt and sand. Occasional layers of clayey silt or silty sand from 0.6 to 0.8 m thick were also noted in this unit. The sand is fine-grained. The deposit is generally brown in colour, but grey zones were also noted occasionally. The SPT N-values ranged from 5 to 124 generally indicating loose to compact conditions. The moisture content of samples from this unit varied from 18% to 30% with one lower value of 4% noted.

The results of the gradation analyses for this deposit are summarized in Figures B3, B4, B5 and B6 in Appendix B.

Silty Sand to Sand

A silty sand to sand deposit was encountered beneath the silt unit described above in the deeper boreholes. The thickness of the silty sand to sand unit was not measured since all of the boreholes terminated in this unit.

This deposit is described as silty sand, to sand trace to some silt. The sand fraction is fine-grained. The deposit is brown in colour. The deposit has SPT N-values of 4 to 46 indicating loose to dense conditions. The moisture content of disturbed samples recovered from this unit varies from 10 to 22%.

Groundwater

Observations of groundwater conditions during drilling and in piezometers installed in some boreholes indicate the presence of groundwater at about 5.3 m depth below ground surface (Elev 318.8 m). The groundwater levels are expected to vary seasonally and with heavy precipitation events.

5.2.4 N-EW Ramp/W-S Ramp/E-S Ramp

The subsurface conditions encountered at the boreholes drilled for the embankment which is to support the N-EW, W-S and E-S Ramps (Sta. 9+975 to 10+050 on N-EW Ramp) generally consist of the following sequence:

- Topsoil
- Sand and Gravel (discontinuous)
- Sandy silt
- Silty clay to clayey silt
- Lower Silt and Sand

Topsoil

A topsoil layer was encountered at most boreholes varying in thickness from 150 mm to 300 mm at the borehole locations. The topsoil is typically brown in colour and often contains rootlets and some sand.

Sand and Gravel

A discontinuous, localized zone of sand and gravel was encountered only at Borehole No. 422 N-EW 10+025 CL extending from the surface to 1.8 m depth. This unit is described as sand and gravel trace silt and is brown in colour. SPT N-values varied from 46 to >100 indicating dense to very dense conditions. The moisture content of the sample was 4 %.

Sandy Silt

A layer of sandy silt was encountered in most boreholes, except 422 N-EW 10+025 CL and 422 N-EW 10+050 CL, underlying the topsoil described above. The thickness of this unit varied from 1.2 to 2.0 m at the borehole locations.

The deposit is described in the borehole logs as sandy silt trace to some clay or as silt some sand. The deposit is cohesionless and is brown in colour. The SPT N-values ranged from 23 to 81 generally indicating compact to very dense conditions. The moisture content of samples from this unit varied from 10% to 18%.

The results of the gradation analyses for this deposit are summarized in Figures B3 and B5 in Appendix B.

Silty Clay to Clayey Silt

A silty sand to sand deposit was encountered beneath the silt unit described above in most boreholes except No. 422 N-EW 9+999 R21.5 where a deposit of fine grained sand some silt was encountered. Two boreholes extended below the lower boundary of this unit

where the thickness was found to vary from from 2.7 m to 4.4 m. The other boreholes indicated that the thickness exceeds 4.5 m at some locations

This deposit is described as silty clay to clayey silt, trace to some sand. Occasional laminated structure was noted at some locations. The deposit is brown in colour. The deposit has SPT N-values of 6 to 25 indicating firm to hard consistency. The physical indices testing results indicate that the plastic Index (PI) varies from 10 to 14 and the liquid limit (LL) varies from 28 to 33 indicating low plasticity. The moisture content of disturbed samples recovered from this unit varies from 24 to 38%.

Lower Silt and Sand

An underlying layer of silt and sand was encountered beneath the soils described above at three locations. The thickness of this deposit is not known as the boreholes terminated in this unit.

This unit is variable in composition with the descriptions in the borehole records varying from silt to silt and sand, trace clay to layers of silt, some sand interbedded with fine grained sand, trace silt. The deposit is brown in colour. The SPT N-values in this deposit varied from 19 to 34 indicating compact conditions. The moisture content of disturbed samples recovered from this deposit varied from 3 to 22 %.

Groundwater

Observations of groundwater conditions during drilling and in the piezometer installed in borehole No. 422 W-S 10+362.5 R21.4 indicate the presence of groundwater at about 5.6 to 5.8 m depth below ground surface (Elev 322.4 to Elev 322.6 m). The groundwater levels are expected to vary seasonally and with heavy precipitation events.

5.3 Hwy 11 Mainline Embankment, Strong Township, Sta. 10+225 to 10+745

The Highway11 Mainline in Strong Township between Sta. 10+225 and 10+745 will consist of a new four-lane section with additional NBL acceleration lane, merging E-N ramp and N-EW ramp all supported by an embankment which will exceed 6 m in height at where the alignment crosses two stream gullies. The locations of these two low-lying areas are roughly from Sta 10+225 to 10+600 and from Sta. 10+700 to 10+750. The proposed height of fill in these areas generally varies from 6 to 15 m in height.

The soils encountered in the boreholes drilled along the portion of the alignment from Sta. 10+225 to 10+450 generally consist of topsoil or existing pavement and embankment overlying variable outwash deposits comprised of sand with interbedded gravel, silt and silty sand layers. The thickness of the overburden materials was highly variable ranging from auger refusal at 1.9 m depth (indicating the presence of boulders or bedrock) to depths exceeding the maximum depth of investigation (13.7 m).

Along the portion of the mainline in the low-lying area, from Sta. 10+700 to 10+745, a deposit of clayey silt was encountered in most boreholes, except for borehole 10+700 R13.75 which was drilled adjacent to the stream where sand with sand and gravel layers was encountered to a depth of 6.5 m where refusal on boulders or bedrock was encountered.

Topsoil

A layer of topsoil was encountered at most borehole locations. At the borehole locations, the thickness of the topsoil layer varied from 0 m to 300 mm. A 700 mm thick layer of buried topsoil was encountered beneath the pavement structure at Borehole 10+250 L5.5.

Pavement and Fill

Several of the boreholes were drilled through the existing Highway 11 and encountered pavement structure consisting of layers of asphalt, sand and gravel and silty sand fill. The thickness of the pavement structure generally varied from 400 mm to 600 mm, but thicknesses up to 1.5 m of combined pavement and granular fill were encountered.

Sand to Silty Sand with Interbedded Gravelly Sand and Silt Layers

In all boreholes described above, a deposit of sand to silty sand was encountered beneath the topsoil and pavement layers. The sand was interbedded with layers of gravelly sand, mixtures of sand and gravel, or silt layers/ laminations. The thickness of the whole deposit varied from a minimum of 1.7 m to more than 13.7 m with the interbedded layers varying from 1.4 to 3.4 m in thickness.

The deposit is typically brown in colour, with occasional grey colour or oxide stains noted in some areas. The variation of SPT N-values and moisture content of the disturbed samples recorded in this unit are indicated in the following table.

	Moisture Content	SPT N-Values (blows/300mm)	Condition
▪ Sand, trace to some silt	2-25 %	5-32	Loose to compact
▪ Silty Sand to Silt and Sand	2-23 %	4-34	Loose to compact
▪ Silt, some sand to silty	14-25 %	11-18	Compact
▪ Gravelly Sand to Sand and Gravel	3-19 %	23 to >100	Compact to very dense

Clayey Silt

The clayey silt deposit was encountered in two boreholes between Sta. 10+700 and 10+745 to a maximum depth of 6.4 m, and was underlain by sand or boulders or bedrock (auger refusal). This deposit is described as silt, clayey, trace sand with occasional cobbles or boulders. The unit is grey in colour. The SPT N-values varied from 9 to 26 indicating stiff to very stiff consistency. The moisture content of disturbed samples from this unit is 15 to 32 %. The clayey silt has low plasticity.

The results of the laboratory testing for the units above are summarized in Figures C1 to C6, in Appendix C.

Groundwater

Observations of groundwater and soil moisture conditions during drilling indicate that the groundwater table is generally 0.3 m to 5.2 m below the ground surface., indicating that the water-table surface varies at the borehole locations from Elev 321.8 m to Elev 312.7 m. The lower elevations generally corresponding to the low-lying areas contain surface water features (streams, ponds). The groundwater levels are expected to vary seasonally and with heavy precipitation events.

5.4 Hwy 11 Mainline Embankment, Strong Township, Sta. 11+075 to 11+225

The Highway 11 Mainline in Strong Township between Sta. 11+075 and 11+225 will consist of a new four-lane section supported by an embankment with a proposed height of fill varying from 6 to 9.5 m and a base width of 70 to 80 m

The soil encountered in the boreholes drilled along this portion of the alignment generally consists of topsoil overlying discontinuous areas of fill which in turn rest on a deposit of silty sand varying to a mixture of silt and sand. The silty sand deposit also contains zones of sand with little fines content. The thickness of the overburden materials was highly variable ranging from auger refusal at 1.7 m depth (indicating the presence of boulders or bedrock) to depths exceeding the maximum depth of investigation of 8.2 m.

Topsoil

A layer of topsoil was encountered at all borehole locations in this area. At the borehole locations, the thickness of the topsoil layer varied from 0 to 850 mm. The topsoil typically is typically brown to dark brown in colour. The average topsoil thickness based on the borehole data is 400 mm.

Fill

At borehole 11+200 L40 drilled near the existing Highway 11, fill was encountered beneath the topsoil layer extending to a depth of 1.4 m below ground surface. The fill is

described as sand and gravel, trace silt and is brown in colour. The SPT test resulted in an N-value of 11 indicating a compact condition. The thickness of this deposit

Silty Sand to Sand and Silt Mixture

The deposit comprised of silty sand varying to a mixture of silt and sand was encountered in most boreholes. The thickness of this unit varied from 0.9 m to greater than 5.3 m.

This unit is described in the borehole logs as silty sand to mixture of sand and silt, trace gravel, trace rock fragments. The sand fraction is typically fine grained. The colour is typically brown with occasional areas of red-brown or black stain noted. The SPT N-values generally range from 3 to 20 indicating very loose to compact conditions, but values of >100 were obtained where gravel, rock fragments or underlying bedrock was encountered.

The results of the laboratory testing for the units above are summarized in Figures D1 to D3, in Appendix D.

Sand, trace silt

Several zones of sand with lower fines content were encountered lying above or below the silty unit described above. The thickness of these sand layers varied from 0.5 to greater than 5.2 m.

This unit is described in the borehole logs as sand, trace silt, trace gravel to gravelly, with occasional cobbles. The sand fraction is typically fine grained. The deposit is typically brown in colour, but varies from dark brown to grey in some locations. SPT N-values of 3 to 27 were typically recorded, indicating very loose to compact conditions. Extreme N-values >100 were encountered where gravel, cobbles or the underlying bedrock was encountered.

The results of the laboratory testing for the units above are summarized in Figures D4, in Appendix D.

Groundwater

Observations of groundwater and soil moisture conditions during drilling indicate that the groundwater table is generally 2.4 m to 3.0 m below the ground surface., indicating that the water-table surface varies at the borehole locations from Elev 309 m to Elev 311.0 m. The groundwater levels are expected to vary seasonally and with heavy precipitation events.

Direction of fieldwork and report preparation by:

S.M. Sather, P.Eng.,
Senior Geotechnical Engineer

Report reviewed by:
P.J. Branco, P.Eng.,
Review Engineer

FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGH EMBANKMENTS AND SWAMPS
ARMOUR TOWNSHIP STA 25+075 TO STRONG TOWNSHIP STA 11+275
HIGHWAY 11 FOUR LANING
BURKES FALLS TO SOUTH RIVER, ONTARIO
G.W.P. 759-93-00

Geocres Number: 31E-227

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

6 INTRODUCTION

This report presents interpretation of the geotechnical data in the factual report and presents foundation design recommendations where embankment heights exceed 6 m or swamp crossings have been proposed.

The discussion and preliminary recommendations presented in this report are based on our understanding of the project and on the factual data obtained in the course of the investigation.

7 ENGINEERING ANALYSIS METHODOLOGY

7.1 General

The project information, including plan and profile of the proposed alignments dated May 2004, utilized in the engineering analysis was provided by MMM. For the purpose of analysis and reporting the proposed embankments and swamp crossings along the proposed Highway 11 alignment, interchange ramps and other highway alignments have been treated separately. A summary of the various segments is provided below:

- Hwy 11 Mainline, Armour Township, Sta. 25+075 to 25+175
- 422 Stirling Creek Road/Pevensey Road Interchange
- Hwy 11 Mainline, Strong Township, Sta. 10+225 to 10+745
- Hwy 11 Mainline, Strong Township, Sta. 11+075 to 11+225

The major factors governing foundation design of the proposed embankments include:

- Proposed embankment geometry (height, slope angle, footprint, etc)
- Embankment material type (earthfill, Select Subgrade Material -SSM or rockfill)
- Extent and thickness of surficial organic soils



- Thickness and engineering properties of underlying mineral soils
- Depth to competent layer (bedrock or dense gravel)
- Groundwater conditions

The geotechnical analysis summarized in this report includes assessment of the global stability of different embankment geometries and material types for both short and long term conditions. Assessment of immediate elastic foundation settlement was also carried out. The locations where each analysis was carried out are summarized in Table 8.3.

7.2 Design Options

Several design options are available for reducing settlement and improving stability during embankment construction including peat removal, preloading, staged construction, and wick drains. The subsurface conditions encountered during the site investigation along the assessed portion of Highway 11 and the Pevensey/Stirling Road Interchange will allow conventional embankment design methods to be utilized. The estimated stability and settlements associated with conventional embankment construction are presented in the following section.

7.3 Stability and Settlement Analyses

The stability analyses were carried out using limit equilibrium methods by the commercially available slope stability program "GSLOPE" developed by Mitre Software Inc. Bishop's modified method of slices was used in the analyses. Based on consideration of the risk involved and past experience with highway embankment design and monitoring of embankment performance, a Factor of Safety (FS) of 1.3 is considered appropriate to maintain embankment stability and control deformations during construction. A FS of 1.3 is considered acceptable for assessment of global embankment stability on granular soils for long and short term conditions. For embankments founded on cohesive soils, a minimum FS of 1.5 is recommended for long term conditions.

Immediate foundation settlements due to compression of the non-cohesive soils have been estimated based on the methods described in the CHBDC, 2000 Commentary Section C6.6.3.6.

7.4 Seismic Considerations

The following seismic parameters have been used in design

▪ Velocity Related Seismic Zone	1
▪ Zonal Velocity Ratio	0.05
▪ Acceleration Related Seismic Zone	2
▪ Zonal Acceleration Ratio	0.1

In accordance with the CHBDC, the soil profile type at this site is classified as Type I (less than 60 m of stable sand, gravel or stiff clay), which according to Table 4.4.6.1 of the CHBDC is associated with a Site Coefficient of 1.0. A peak horizontal ground acceleration (PHA) of 0.11g, where g is the acceleration due to gravity, has therefore been used in this analysis. This PHA value corresponds to a probability of exceedance of 10% in 50 years.

7.4.1 Stability

Stability of the embankments under seismic loading was assessed by carrying out a pseudo-static analysis using the parameters above. The pseudo-static analysis considers the application of the PHA to the soil mass on a non-softening foundation to assess the embankment stability. This assumption is considered reasonable given the subsurface conditions encountered at sites where the potential for liquefaction is low. The results of the analysis indicate that FS greater than 1.0 under seismic loading, indicating an acceptable level of stability. Small movements or local toe failure may be associated with these conditions, but are expected to be easily repairable.

7.4.2 Liquefaction Potential

Several of the proposed embankments will be constructed on loose to compact cohesionless soils overlying bedrock. A review of the subsurface conditions at each site, including presence of cohesionless deposits, the depth to water-table, SPT values and fines content at each site was carried out to provide a cursory assessment of the likelihood of liquefaction for each site. The results are summarized in the Table 8.3. A more detailed assessment of liquefaction potential is recommended where moderate potential for liquefaction is noted, but this is beyond the scope of this assignment.

8 EMBANKMENT DESIGN

8.1 General

The generalized subsurface conditions for proposed embankments along portions of mainline alignment and ramps higher than 6 m are summarized in Table 8.1.

Representative areas were selected for stability and settlement analysis based on the soil information and areas exhibiting low shear strength.

Assessment of stability and settlement for embankments lower than 6 m height is beyond the scope of this report and is not included in this assessment.

The subsurface conditions encountered at the various embankment locations generally consist of compact, cohesionless deposits of silt, sand or mixtures of silt and sand. Deposits of stiff to very stiff, clayey silt to silty clay were also encountered in localized areas. The depth to groundwater typically varies from near the ground surface in the low-lying areas containing surface water features (streams or ponds) to 10 m depth at other locations. A summary of general soil conditions is included in Table 8.1.

Several alternatives were considered in preparing the embankment design to address potential embankment stability and settlement. Design options include lightweight fill, wick drains, subexcavation, preload and surcharging.

8.2 Peat and Topsoil Removal

It is standard procedure in MTO projects to subexcavate peat and topsoil deposits from within the embankment footprint if the underlying mineral soil will be encountered within 6 m of the ground surface. The foundation is then backfilled with rock or granular fill. For peat thickness of less than 6 m, this method is an economical and efficient method of improving stability during construction and minimizing the potential for large post-construction settlements. Where the peat thickness is greater than 6 m, construction becomes more costly and overland construction with surcharging may then be the preferred option.

Within the project limits addressed in this report, the depth of peat and organic soils encountered at the boreholes is generally less than 850 mm thick. It is therefore recommended that all peat and topsoil be subexcavated from within the proposed fill footprint. The foundation area should be backfilled with rock or granular backfill as described in the following section. Where standing water is encountered, placement of compaction of granular backfill will not be feasible and coarse rockfill material is recommended.

Peat and topsoil layers will be saturated under seasonal conditions. Dewatering of large areas with conventional pumping methods may be impractical and subexcavation in the wet would be required in this case.

Table 8.2 provides a summary of the anticipated average depth of stripping for peat and topsoil removal along the proposed alignments. The depth of stripping is based on the average thickness of organics noted at the borehole locations. Stripping depths may vary from that noted in the table at locations between the boreholes.

In the stability and settlement analyses summarized below it has been assumed that the organic and peat layers have been removed and replaced with granular backfill as appropriate.

8.3 Stability Analysis

Separate analyses were carried out for both short term (undrained) and long term (effective stress) and seismic conditions using the following variables:

- Earth fill embankment slopes 2H:1V
- Rock fill embankment slopes 1.25H:1V

The stability analyses indicate that short and long term stability will be adequate for all sites where high fills are proposed. The analyses indicate a FS greater than 1.3 for short term conditions and greater than 1.5 for long term conditions.

8.4 Settlement Analysis

8.4.1 Foundation Settlements

A settlement analysis was carried out using stresses calculated for two-dimensional embankment loading configurations on an elastic foundation. Input parameters were developed based on correlations between SPT N-values measured at the site and elastic parameters.

The result of the settlement analyses are summarized in Table 8.3 following the text of the report. The settlements correspond to the centre of the proposed embankment section. The estimates vary as shown below:

Hwy 11 Mainline	40 mm to 250 mm
Sterling Bridge Approaches	40 mm
Hwy 422 Ramps	40 to 130 mm

The larger values of predicted settlement are associated with high embankments overlying deep deposits of relatively loose saturated soils, such as near Hwy 11 Mainline Sta. 10+480.

Foundation settlements are expected to be short term with the majority of the settlement occurring during construction and the remainder should be essentially complete 3 months of completion of the embankment.

It is expected that the settlement rate can be accommodated within the expected construction schedule and therefore special measures to accelerate the settlement will not be required. However, an operational constraint should be included in the contract

preventing the placement of the granular base layer earlier than 3 months following the completion of embankment construction.

8.4.2 Embankment Settlement

The estimated settlement of embankments constructed of rock fill or compacted earth fill will be 0.5% of the embankment height. The majority of this settlement is expected to occur within one to two years following completion of the embankments. Settlement of rock fill may continue for longer periods at decreased rates.

Additional settlement may occur if fine-grained material is placed over coarse materials such as rock fill. The interface of rock fill with overlying granular material should be chinked with finer material to remove voids and create a uniform surface.

8.5 Liquefaction Analysis

The results of the assessment of embankment foundations liquefaction is summarized in Table 8.3. Areas assigned a moderate potential for liquefaction should be subject to a more detailed liquefaction assessment. Areas that have low potential for liquefaction do not require further assessment.

8.6 Embankment Construction

8.6.1 Embankment Construction Over Swamps

A small beaver pond is present near Strong, Sta. 10+500 for the NBL and E-N ramps.

Where appropriate, construction of new embankments over swamp or beaver ponds should be carried out in accordance with OPSS 209, "Construction Specification for Embankments Over Swamps", dated March 1998, and with specific reference to OPSD 203.010, "Embankments Over Swamps, New Construction".

For backfilling of subexcavation below the water-table or in swamps where surface water may be seasonally present above the ground surface, it is recommended that rock fill or coarse granular materials (Granular B) be used.

Migration of fine-grained soil may occur where fine-grained soil overlays coarser material, such as rock fill, within an embankment. To prevent this occurrence the upper surface of the rock fill should be of progressively finer material and should be properly chinked to provide a uniform, void-free surface. Earthfill containing >50% fine-grained sand or silt should not be placed directly over rock fill.

8.6.2 Embankments

Embankment construction should be carried out in accordance with OPSS 206, as amended by Special Provision "Amendment to OPSS 206, December 1993", dated November 2002.

Earth fill may consist of granular materials and Select Subgrade Material (SSM) in compliance with Special Provision 110F13, "Amendment to OPSS 1010, March 1993".

Earth fill used for construction of embankments should be placed in regular lifts and compacted in accordance with Special Provision NO. 105S10.

Benches, 2 m minimum in width, are required along embankment slopes at 8 m maximum vertical intervals in earth and 10 m maximum vertical intervals in rock. The benches should extend the length of the embankment where the height exceeds 6 m. The benches should be sloped outwards at 3% to promote surface drainage and reduce infiltration.

Earth fill embankments slopes must be provided with erosion protection in accordance with Special Provision SP572SO1.

8.6.3 Tie-in to Existing Embankments

The proposed embankments will incorporate the existing 2-lane Highway 11 embankment at some locations. The depth of stripping and subexcavation required in these areas is generally expected to be less than 1 m. However, conditions may vary between boreholes and deeper excavations may be required. For excavations deeper than 1 m, the base of any subexcavation, must not encroach towards an existing embankment beyond a set-back line extending at 2H:1V down from the crest of the embankment. Shoring should be provided where subexcavation is required inside of this set-back line. An item for shoring should be allowed for in the contract.

9 CONSTRUCTION CONCERNS

During construction, a qualified Geotechnical staff should be retained to observe activities related to embankment construction and advise the Contract Administrator on construction concerns or issues related to embankment stability or settlement.

Potential construction concerns to be highlighted are shown below, but the concerns are not necessarily limited to this list:

- Inspection and confirmation that all organics and peat materials within the proposed embankment footprints are sub-excavated and replaced with approved backfill.
- Inspection where subexcavation deeper than 1 m is proposed at the toe of existing highway embankments.

Engineering analysis and report preparation by:

S.M. Sather, P.Eng.,
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Report reviewed by:
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Review Engineer

**HWY 11 FOUR LANE
EMBANKMENTS AND SWAMPS
ARMOUR 25+075 to STRONG 11+275**

ALIGNMENT		Offset	Embankment Height (m)	Peat/ topsoil thickness (m)	Depth to Firm Bottom (m)	Soil Type (m)	Depth to Groundwater (m)
Hwy/Ramp	Station						
HWY 11-Armour Tp	25+075 ~ 25+150	SBL	4.3 - 7.9	0.2	0.2	Sand/Sand and Silt	0 - 1.5
		CL	4	0.2	0.2		
HWY 11 - Strong Tp	10+225 ~ 10+450	SBL	5.6 ~ 11.0	0.11	0.1	Fill/Sand/silty sand	0 - 5.0
		CL	3.5 ~ 13.4	0.11	0.1	Fill/Sand/Silty sand	0 - 3.0
		NBL	6.2 ~ 12.3	0.11	0.1	Sand/Silty sand	0 - 4.4
HWY 11 - Strong Tp	10+680 ~ 10+750	CL	3.2	-	-	Clayey silt/sand	0.3
		NBL	6.0 ~ 9.2	-	-	Clayey silt/sand	0.3
Stirling Bridge - west approach	422, 9+900 ~ 9+950	CL	6.0 ~ 8.0	0 ~ 0.1	0.1	sand/gravel & sand	>5.8
Stirling Bridge - east approach	422, 10+050 ~ 10+100	CL	6.0~9.6	0 ~ 0.3	0.3	Silt/Silty sand/Sand	3.7 ~ 10.2
E-N Ramp	422, 10+046 ~ 10+275	CL	6.0 ~ 10.2	0 ~ 0.3	0.3	Silt/Silty sand/Sand	5.4
N-EW/W-S/E-S Ramp	20+800 ~ 20+900	CL	3.8 ~ 8.4	0 ~ 0.3	0.3	Clay/Silt/Sand	4.6 ~ 5.8
HWY 11 - Strong Tp	11+175 to 11+225	SBL	4.5 ~ 9.4	0.1 ~ 0.8	0.8	Silt & Sand/Sand	2.5 ~ 3.0
		CL	4.2 ~ 6.5	0 ~ 0.1	0.1	Silt & Sand/Sand	2.5 ~ 3.0

**TABLE 8.1
SUMMARY OF EMBANKMENT AND
SITE CONDITIONS**

SBL = South Bound Lane
NBL = North Bound Lane
CL = Median

HWY 11 - Four Laning
Embankments and Swamps
Armour 25+075 to Strong 11+275

ALIGNMENT		Offset	Embankment Height (m)	Average Stripping Depth (mm)
Hwy/Ramp	Station			
HWY 11-Armour Tp	25+075 ~ 25+150	SBL	4.3 ~ 7.9	200
		CL	4	200
HWY 11 - Strong Tp	10+225 ~ 10+450	SBL	5.6 ~ 11.0	100
		CL	3.5 ~ 13.4	100
		NBL	6.2 ~ 12.3	100
HWY 11 - Strong Tp	10+680 ~ 10+750	CL	3.2	-
		NBL	6.0 ~ 9.2	-
Stirling Bridge - west approach	422, 9+900 ~ 9+950	CL	6.0 ~ 8.0	100
Stirling Bridge - east approach	422, 10+050 ~ 10+100	CL	6.0 ~ 9.6	300
E-N Ramp	422, 10+046 ~ 10+275	CL	6.0 ~ 10.2	150
N-EW/W-S/E-S Ramp	20+800 ~ 20+900	CL	3.8 ~ 8.4	150
HWY 11 - Strong Tp	11+175 to 11+225	SBL	4.5 ~ 9.4	400
		CL	4.2 ~ 6.5	400

TABLE 8.2
ESTIMATED STRIPPING DEPTH

HWY 11 - Four Laning
Embankments and Swamps
Armour 25+075 to Strong 11+275

ALIGNMENT		Site Factor	Embankment Height (m)	Factor of Safety	Foundation Settlement (mm)	Liquefaction Potential
Hwy/Ramp	Station					
HWY 11-Armour Tp	25+075 ~ 25+150	1.0	5	>1.5	40	low
HWY 11 - Strong Tp	10+225 ~ 10+500	1.2	14.5	>1.5	250	moderate
HWY 11 - Strong Tp	10+680 ~ 10+750	1.0	9.2	>1.5	80	low
Stirling Bridge - west approach	422, 9+900 ~ 9+950	1.0	8	>1.5	40	low
Stirling Bridge - east approach	422, 10+050 ~ 10+100	1.0	9.6	>1.5	40	low
E-N Ramp	422, 10+046 ~ 10+275	1.0	10.2	>1.5	130	low
N-EW/W-S/E-S Ramp	20+800 ~ 20+900	1.0	3.8 ~ 8.4	>1.5	40	low
HWY 11 - Strong Tp	11+175 to 11+225	1.0	9.4	>1.5	120	moderate

Notes: Factor of Safety are minimum calculated for both short and long term conditions.
FS > 1.3 is required for embankments on cohesionless foundations
Settlements are expected to be complete within 3 months following embankment construction

TABLE 8.3
GEOTECHNICAL EMBANKMENT DESIGN

Appendix A
Hwy 11 Mainline, Armour Township, Sta. 25+075 to 25+175

RECORD OF BOREHOLE No A25+075 L18.75

1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION Armour Township, ST. 25+075, O/S 18.75L ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 17.07.02 - 17.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)				
						20	40	60	80	100	20	40	60				
0.0	PEAT, fibrous																
0.2	Dark Brown to Black Wet		1	SS	24												
	Silty SAND, fine grained		2	SS	25												
	Compact to Very Dense Brown Wet		3	SS	50/												
2.6	END OF BOREHOLE AT 2.62 m. AUGER REFUSAL AT 2.62 m ON PROBABLE BEDROCK OR BOULDER.																

RECORD OF BOREHOLE No A25+125 L17.0

1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION Armour Township, ST. 25+125, O/S 17L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 16.07.02 - 16.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
0.0	PEAT, fibrous Dark Brown to Black																
0.2	Wet SAND, fine to medium grained, some gravel, trace silt, occasional cobbles Very dense Brown		1	SS	50/ .125												
			2	SS	50/0												
1.7	END OF BOREHOLE AT 1.68 m. AUGER REFUSAL AT 1.68 m ON PROBABLE BEDROCK OR BOULDER.																

+³, X³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No A25+125 L18.75 1 OF 1 METRIC

G.W.P. 742-93-00 LOCATION Armour Township, ST. 25+125, O/S 18.75L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 16.07.02 - 16.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	W P	W	W L		
0.0	PEAT and ORGANICS																
0.2	SAND, fine to very fine grained, trace silt, occasional cobbles Very dense Brown Moist		1	SS	50/ .125												
			2	SS	50/0.0												
1.8	END OF BOREHOLE AT 1.75m. AUGER REFUSAL, POSSIBLE BEDROCK AT 1.75m.																


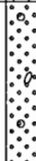
+³, x³: Numbers refer to
Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No A25+150 L49.0

1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION Armour Township, ST. 25+150, O/S 49.0L ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 17.07.02 - 17.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
							○ UNCONFINED + FIELD VANE					WATER CONTENT (%)					
							● QUICK TRIAXIAL × LAB VANE										
							20	40	60	80	100	20	40	60			
0.0	PEAT, fibrous																
0.2	Dark Brown to Black Wet SAND, fine to medium grained, trace silt Compact Brown Wet		1	SS	24												
1.4	SAND and SILT, fine grained, trace gravel, trace clay Compact to Very Dense Grey Wet		2	SS	23												4 50 43 3
	boulder at 2.44 m		3	SS	50/ .050												
3.1	Gravelly SAND, fine to coarse grained, some silt, occasional cobbles Compact to very dense Brown Wet occasional boulders at 3.20m augers grinding at 4.11 m		4	SS	28											23 65 12 (SI+CL)	
			5	SS	50/ .100												
4.1	END OF BOREHOLE AT 4.11 m. AUGER REFUSAL AT 4.06 m ON PROBABLE BEDROCK OR BOULDER.																

+³ . x³ : Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No A25+150 L2.0

1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION Armour Township, ST. 25+125, O/S 2.0L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
 DATUM Geodetic DATE 16.07.02 - 16.07.02 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W P	W		
						20	40	60	80	100						
0.0	DCPT from surface.															
4.0	END OF DCPT AT 4.01 m. CONE REFUSAL AT 4.01 m ON PROBABLE BEDROCK OR BOULDER.															

ONTM/T4 2312 ARMOUR.GPJ 10/02/05

RECORD OF BOREHOLE No A25+175 L18.75 1 OF 1 METRIC

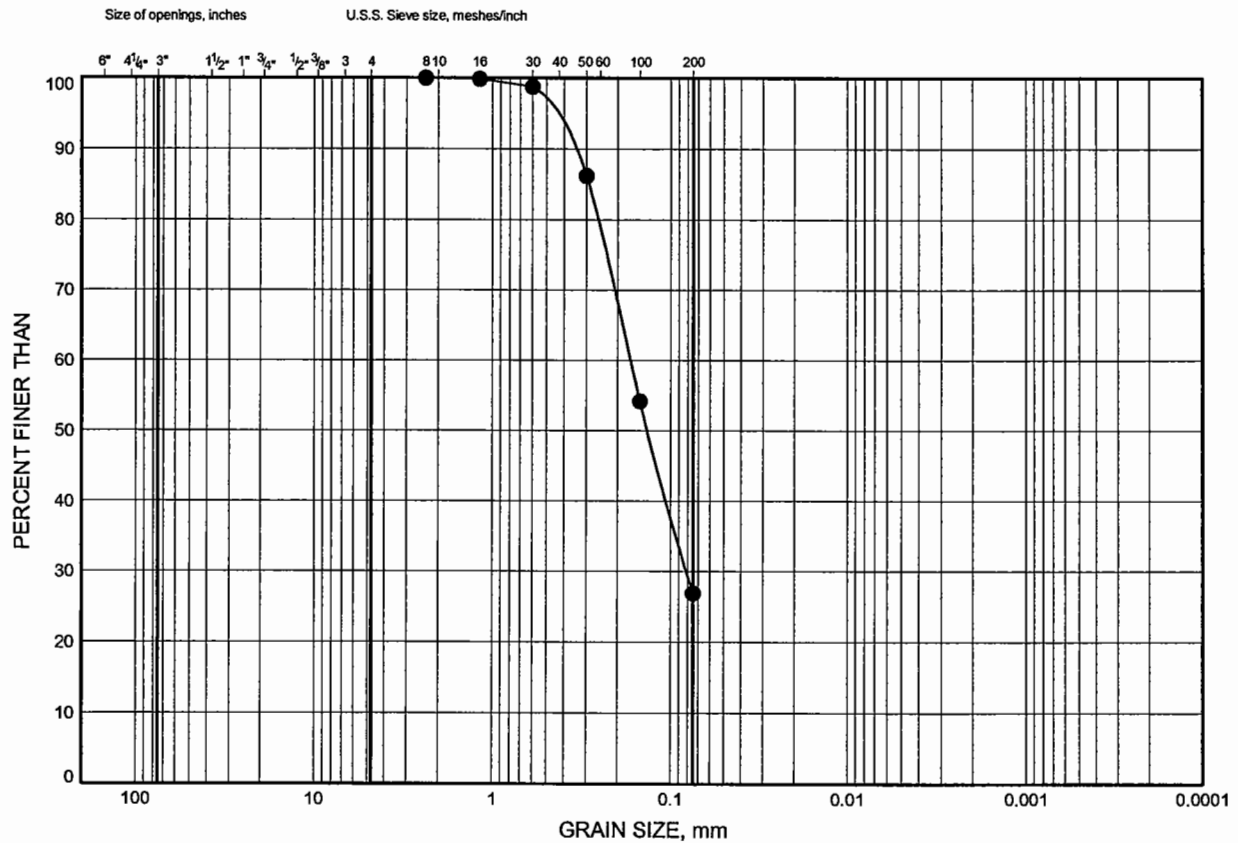
G.W.P. 742-93-00 LOCATION Armour Township, ST. 25+175, O/S 18.75L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 16.07.02 - 16.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								WATER CONTENT (%)					
0.0	Sandy TOPSOIL												
0.2	SAND, fine to medium grained, trace silt, trace gravel Compact Brown Dry to Moist		1	SS	28								8 86 6 (SI+CL)
1.5	SAND, fine to coarse grained, some gravel, trace silt Compact Brown Dry to Moist wet at 2.29m		2	SS	47								
			3	SS	12								
			4	SS	20								
3.8	END OF BOREHOLE AT 3.81 m. AUGER REFUSAL AT 3.81 m ON PROBABLE BEDROCK OR BOULDER. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH (m) 07/17/02 1.79 06/20/03 1.51												

Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE A1

Silty Sand



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	A25+075	L18.75	1.07

Date September 2004
Project 742-93-00

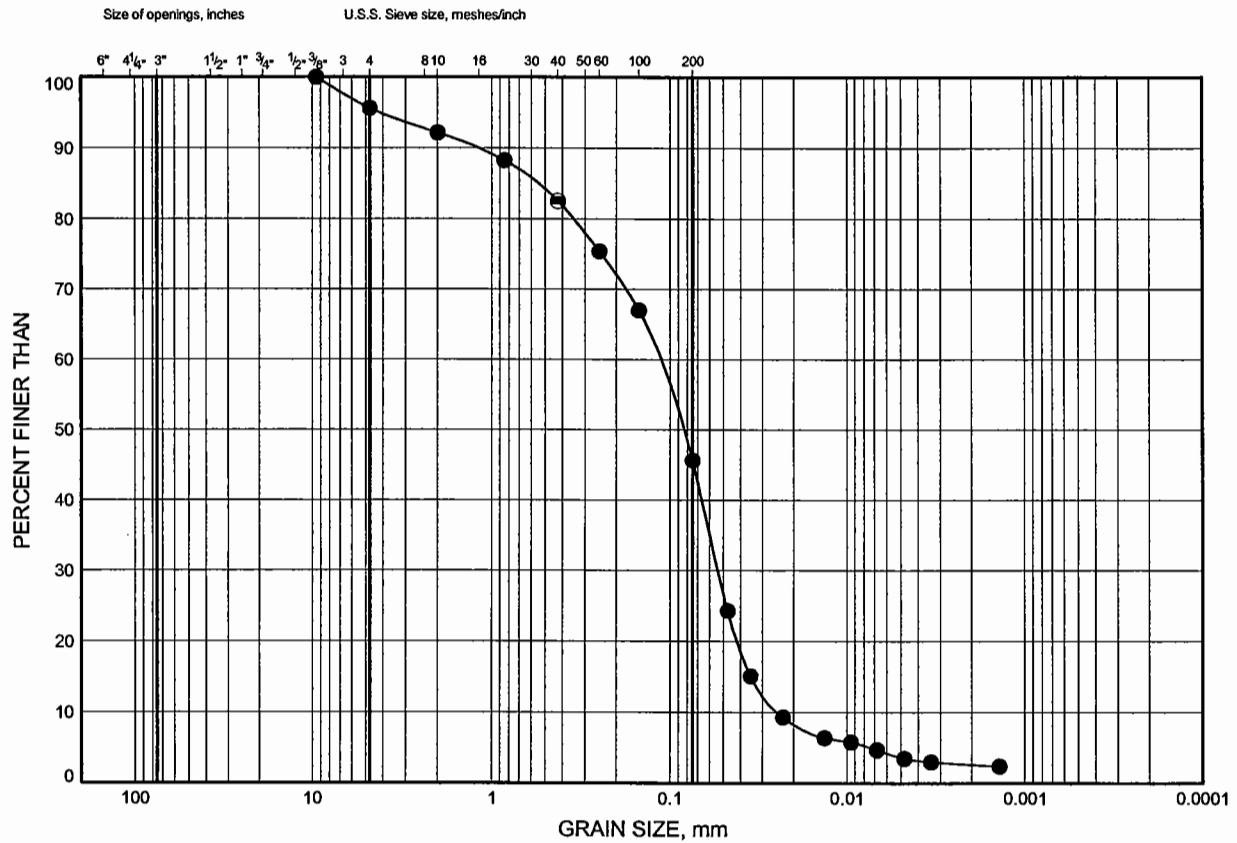


Prep'd WM
Chkd. JL

Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE A2

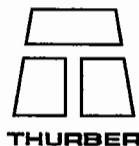
Sand and Silt



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	A25+150 L49.0	1.83	

Date September 2004
Project 742-93-00

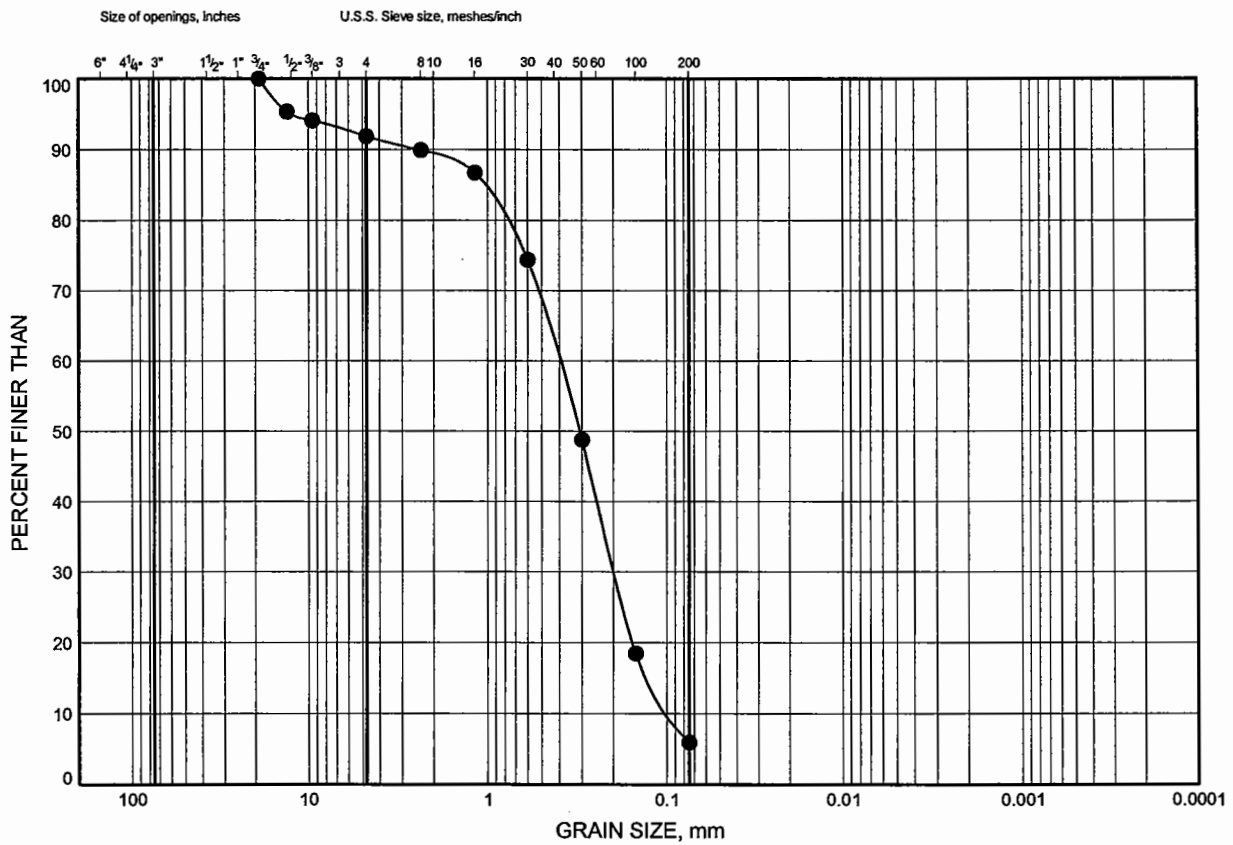


Prep'd WM
Chkd. JL

Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE A3

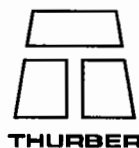
Sand



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	A25+175 L18.75	1.07	

Date September 2004
Project 742-93-00



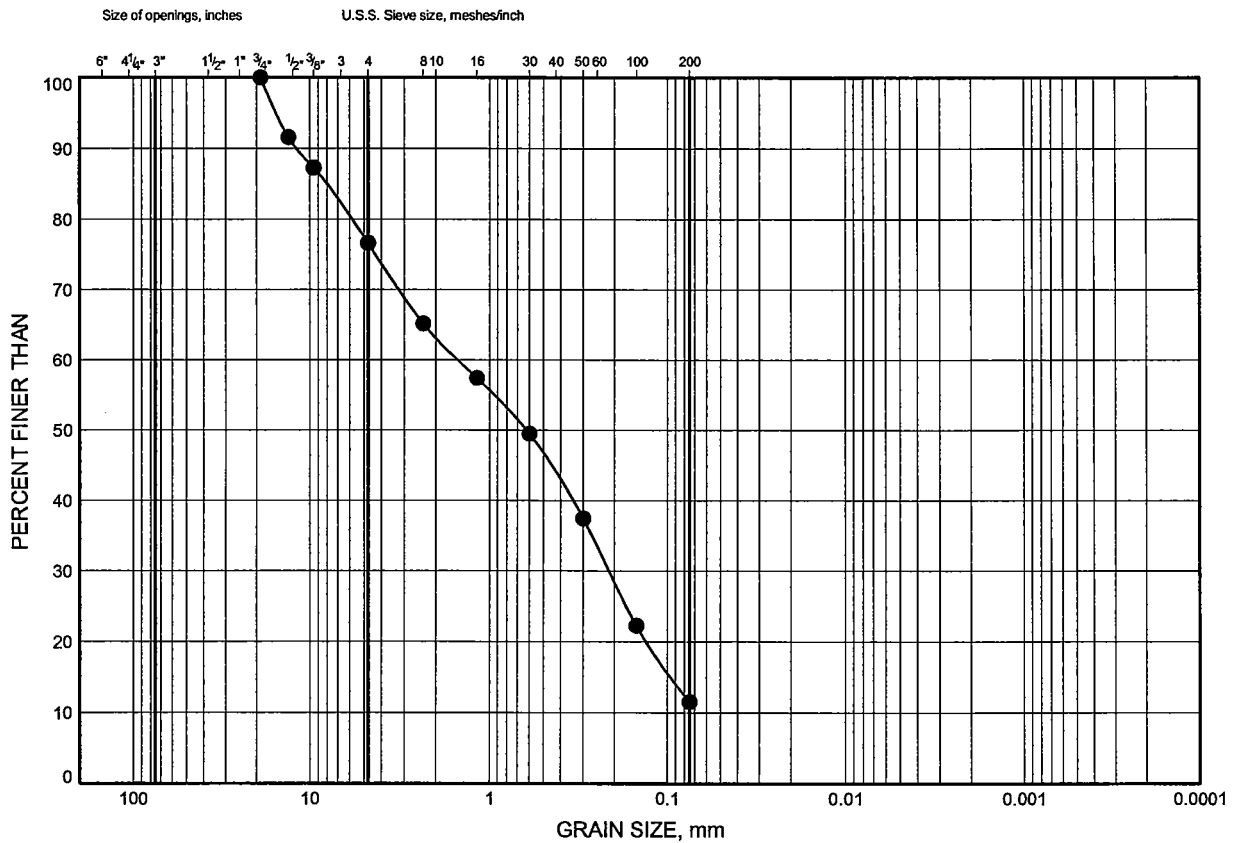
Prep'd WM
Chkd. JL

Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE A4

Gravelly Sand

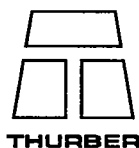


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	A25+150 L49.0	3.35	

Date September 2004

Project 742-93-00



THURBER

Prep'd WM

Chkd. JL

Appendix B
422 Stirling Creek Road/Pevensey Road Interchange Ramps

RECORD OF BOREHOLE No 422 9+900 R0.5

1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 Stirling Creek Rd. ST. 9+900, O/S 0.5R ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 29.07.03 - 29.07.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N° VALUES			20	40	60	80	100					
0.0	SAND and GRAVEL Compact Brown Dry to Moist		1	SS	11												
1.5	SAND, fine to medium grained, trace to some gravel, trace silt Compact Brown Dry to Moist		2	SS	12												6 89 5 (SI+CL)
			3	SS	22												
3.0	SAND and GRAVEL, trace silt Compact Brown Moist		4	SS	22												41 55 4 (SI+CL)
4.1	SAND, fine grained, trace silt Compact Brown Moist		5	SS	13												
5.8	SAND and GRAVEL, trace silt Very Dense Grey Wet		6	SS	50/ .075												
6.6	END OF BOREHOLE AT 6.55 m. AUGER REFUSAL AT 6.55 m ON BEDROCK OR BOULDER. BOREHOLE OPEN TO 5.74 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

+ 3, X 3: Numbers refer to
Sensitivity

20
15 0.5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 9+950 R1.5 1 OF 1 METRIC

W.P. 742-93-00 LOCATION 422 Stirling Creek Rd. ST. 9+950, O/S 1.5R ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 29.07.03 - 29.07.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
					20 40 60 80 100					20 40 60							
WATER CONTENT (%)																	
GR SA SI CL																	
0.0	SAND and GRAVEL Brown																
0.5	SAND, fine grained, trace silt Compact Brown Dry to Moist		1	SS	14												
1.5	SILT, trace sand, trace clay Loose Brown Moist		2	SS	6											0 5 90 5	
2.2	SAND, fine grained, trace to some silt Compact Brown Moist to Dry		3	SS	13												
			4	SS	11												
			5	SS	16											0 90 10 (SI+CL)	
			6	SS	17												
			7	SS	11												
8.2	END OF BOREHOLE AT 8.23 m. BOREHOLE OPEN TO 7.32 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 9+967 L31

1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 Stirling Creek Rd. ST. 9+967, O/S 31L ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 28.11.02 - 28.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	TOPSOIL with rootlets													
0.1	Brown Sandy SILT		1	GS										
0.7	Brown Moist Silty SAND, fine grained, trace gravel Very Dense		1	SS	86									
1.5	Brown Dry to Moist SAND, fine grained, some silt Dense to Compact		2	SS	45									
			3	SS	24									
			4	SS	16									
3.7	END OF BOREHOLE AT 3.66 m. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.													

+³, x³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 9+975 R24.2 1 OF 1 METRIC

W.P. 742-93-00 LOCATION 422 Stirling Creek Rd. ST. 9+975, O/S 24.2R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY WM
 DATUM Geodetic DATE 28.11.02 - 28.11.02 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE									"N" VALUES
0.0	DCPT from surface.						<p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED + FIELD VANE</p> <p>● QUICK TRIAXIAL × LAB VANE</p> <p>20 40 60 80 100</p>						
4.3	END OF DCPT AT 4.27m.												

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

RECORD OF BOREHOLE No 422 10+050 L4

1 OF 2

METRIC

W.P. 742-93-00 LOCATION 422 Pevensey Rd. ST. 10+050, O/S 4L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 30.07.03 - 30.07.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	SAND and GRAVEL Brown													
0.9	Sandy SILT Loose Brown Moist		1	SS	5									
1.5	SILT, trace clay, trace sand, trace gravel Compact to Loose Brown Moist to Wet		2	SS	14									
			3	SS	7									
			4	SS	6									0 2 92 6
			5	SS	9									
5.6	Silty SAND, fine grained Compact Brown Wet to Dry		6	SS	11									
			7	SS	18									0 75 25 (SI+CL)
			8	SS	18									
9.8	END OF BOREHOLE AT 9.75 m.													

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 10+050 L4

2 OF 2

METRIC

W.P. 742-93-00 LOCATION 422 Pevensey Rd. ST. 10+050, O/S 4L ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 30.07.03 - 30.07.03 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
	BOREHOLE OPEN TO 8.84 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	20 40 60					

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

+³ × 3³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 10+073 L26.3 1 OF 1 METRIC

W.P. 742-93-00 LOCATION 422 Pevensey Rd. ST. 10+073, O/S 26.3L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
 DATUM Geodetic DATE 03.12.02 - 03.12.02 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa	WATER CONTENT (%)	W _p	W		
0.0							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60					
3.7	END OF CONE TEST AT 3.66m.												

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

RECORD OF BOREHOLE No 422 10+100 L5

1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 Pevensey Rd. ST. 10+100, O/S 5L ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 30.07.03 - 30.07.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE										W P W W L		
								● QUICK TRIAXIAL × LAB VANE												
						20	40	60	80	100	20	40	60							
0.0	SAND and GRAVEL Brown																			
0.5	Silty SAND, fine grained Compact Brown Moist trace clay layers from 1.45 m		1	SS	14															
			2	SS	15															
2.2	Sandy SILT, trace clay Compact Brown Moist		3	SS	10															
3.0	SILT, some clay, trace sand laminated Firm Grey Wet to Moist		4	SS	5															
			5	SS	5															
			6	SS	5															
7.2	SILT, trace clay, trace sand Loose Grey Moist		7	SS	9															
8.2	END OF BOREHOLE AT 8.23 m. BOREHOLE OPEN TO 4.57 m AND WATER LEVEL AT 3.70 m UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																			

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

+³, x³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 W-N 25+470 L25 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 W-N Ramp, ST. 25+470, O/S 25L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
 DATUM Geodetic DATE 30.07.03 - 30.07.03 CHECKED BY JL

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
							20	40	60	80	100						
0.0	DCPT from surface.																
6.7	END OF DCPT AT 6.71m.																

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 W-N 25+465 R18 1 OF 1

METRIC

W.P. 743-93-01 LOCATION 422 W-N Ramp, ST. 25+465, O/S 18R ORIGINATED BY MF
HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
DATUM Geodetic DATE 26.11.03 - 26.11.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								20	40	60	80	100						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										
								20	40	60	80	100						
0.0	TOPSOIL Dark Brown		1	SS	2	▽												
0.3	Silty SAND, fine grained, some organics																	
0.6	Brown Sandy SILT, trace clay Compact to Loose Brown Moist		2	SS	17													
	occasional sand layers from 1.5 m		3	SS	14													
			4	SS	19													0 30 65 6
			5	SS	8													
4.1	SAND, fine grained, some silt Compact Brown Dry to Moist		6	SS	23												0 80 20 (SI+CL)	
5.6	Silty SAND, fine grained Dense Brown Wet		7	SS	31													
6.7	END OF BOREHOLE AT 6.71 m. BOREHOLE OPEN TO 4.57 m AND WATER LEVEL AT 4.57 m UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																	

ONTMT4_422STIRLING & PEVENSEY-1.GPJ 23/09/04

RECORD OF BOREHOLE No 422 W-N 25+473 R3 1 OF 1

METRIC

W.P. 743-93-01 LOCATION 422 W-N Ramp, ST. 25+473, O/S 3R ORIGINATED BY MF
HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
DATUM Geodetic DATE 26.11.03 - 26.11.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								○ UNCONFINED + FIELD VANE										
								● QUICK TRIAXIAL × LAB VANE										
							WATER CONTENT (%)											
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT											
							W _P W W _L											
							20 40 60 80 100											
							20 40 60 80 100											
							20 40 60											
0.0	TOPSOIL Dark Brown Sandy SILT, trace clay Very Loose to Compact Brown Wet		1	SS	1	▽												
0.0																		
			2	SS	11													
1.4	Silty CLAY, trace sand Stiff Grey Wet		3	SS	12													
			4	SS	9													
			5	SS	14													
4.6	SILT, some clay, trace sand Stiff Grey Wet		6	SS	8													
5.6	Sandy SILT Compact Grey Wet		7	SS	21													
6.7	END OF BOREHOLE AT 6.71m. BOREHOLE OPEN TO 4.57 m AND WATER LEVEL AT 4.57 m UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																	

ONTMT4 422STIRLING & PEVENSEY-1.GPJ 23/09/04

+ 3, x 3: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 N-EW 9+975 CL 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 N-EW Ramp, ST. 9+975, CL ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 26.11.02 - 26.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
							20 40 60 80 100					20 40 60					
							20 40 60 80 100					20 40 60					
0.0	TOPSOIL																
0.2	Brown SILT, some sand, some clay Dense Brown Dry to Moist		1	SS	34												
1.5	Clayey SILT, some sand Very Stiff Brown Moist		2	SS	17												
2.2	Silty CLAY, trace sand Firm to Stiff Brown Moist		3	SS	6												
			4	SS	7												
			5	SS	6												
			6	SS	9												
6.7	END OF BOREHOLE AT 6.71m. BOREHOLE OPEN AND DRY ON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 N-EW 9+999 R21.5 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 N-EW Ramp, ST. 9+999, O/S 21.5R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 27.11.02 - 27.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
0.0	TOPSOIL, some rootlets Brown													
0.3	Sandy SILT Dense Brown Dry to Moist		1	SS	48									
1.5	SAND, fine grained, some silt Dense to Compact Brown Dry to Moist		2	SS	30									
			3	SS	17									
			4	SS	11									0 86 14 (SI+CL)
			5	SS	16									
6.4	SILT and SAND, trace clay Compact Brown Dry to Moist		6	SS	19									0 45 50 4
6.7	END OF BOREHOLE AT 6.71 m. BOREHOLE OPEN TO 6.71 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.													

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

+³ × 3³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 N-EW 10+008 L17.11 of 1

METRIC

W.P. 742-93-00 LOCATION 422 N-EW Ramp, ST. 10+008, O/S 17.1L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
 DATUM Geodetic DATE 26.11.02 - 26.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
0.0	DCPT from surface.							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60					
4.3	END OF DCPT AT 4.27 m.													

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

RECORD OF BOREHOLE No 422 N-EW 10+025 CL 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 N-EW Ramp, ST. 10+025, CL ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 26.11.02 - 26.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	SAND AND GRAVEL, trace silt Very Dense Brown		1	GS										No Recovery in SS#1
			1	SS	50/ 0.075									
1.8	Silty CLAY, some sand Stiff Brown		2	SS	46									0 13 63 23
			3	SS	14									
			4	SS	8									
			5	SS	13									No Recovery in SS#5
5.2	END OF BOREHOLE AT 5.18 m. BOREHOLE OPEN TO 5.18 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.													

RECORD OF BOREHOLE No 422 N-EW 10+350 CL 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 N-EW Ramp, ST. 10+350, CL ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 28.11.02 - 28.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100					WATER CONTENT (%)						
											20	40	60				
0.0	ASPHALT mixed with SAND and GRAVEL		1	GS													
			1	SS	50/												
1.0	END OF BOREHOLE AT 0.99 m. AUGER REFUSAL AT 0.99 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.				.075												

ONTM14 422STIRLING & PEVENSEY, GPJ 23/09/04

RECORD OF BOREHOLE No 422 N-EW 10+375 L17.31 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 N-EW Ramp, ST. 10+375, O/S 17.3L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 28.11.02 - 28.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	ASPHALT mixed with SAND and GRAVEL		1	GS										
0.8	SAND, fine grained, trace silt Dark Brown Moist		2	GS										
			1	SS	50/									
1.7	END OF BOREHOLE AT 1.72 m. AUGER REFUSAL AT 1.72 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.				.050									

+³, x³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 N-EW 10+375 R15 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 N-EW Ramp, ST. 10+375, O/S 15R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 30.07.03 - 30.07.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N° VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
0.0	ASPHALT													
0.1	SAND and GRAVEL Brown													
0.7	END OF BOREHOLE AT 0.69 m. AUGER REFUSAL AT 0.69 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 0.69 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.													

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

RECORD OF BOREHOLE No 422 N-EW 10+400 R2 1 OF 1

METRIC



W.P. 742-93-00 LOCATION 422 N-EW Ramp, ST. 10+400, O/S 2R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 30.07.03 - 30.07.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
								○ UNCONFINED	+	FIELD VANE							
								● QUICK TRIAXIAL	×	LAB VANE							
								20	40	60	80	100					
0.0	ASPHALT																
0.1	SAND and GRAVEL																
	Brown																
0.4	SAND, fine grained, trace to some silt																
	Compact to Loose																
	Brown																
	Dry to Moist		1	SS	12												
			2	SS	10												
			3	SS	9												
3.0	SAND and GRAVEL																
	Compact																
	Brown																
	Dry to Moist		4	SS	50/												
3.2	END OF BOREHOLE AT 3.20 m.																
	AUGER REFUSAL AT 3.20 m ON																
	PROBABLE BEDROCK OR																
	BOULDER.																
	BOREHOLE OPEN TO 3.20 m AND																
	DRY UPON COMPLETION.																
	BOREHOLE BACKFILLED WITH																
	DRILL CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 422 N-EW 10+430 L3 1 OF 1

METRIC

W.P. 743-93-01 LOCATION 422 N-EW Ramp, ST. 25+430, O/S 3L ORIGINATED BY MF
 HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 26.11.03 - 26.11.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N° VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE										● QUICK TRIAXIAL × LAB VANE		
								20	40	60	80	100	20	40	60			20	40	60
0.0	SAND, fine grained, some silt, some gravel Compact Brown Moist (FILL)		1	SS	10												14 67 19 (SI+CL)			
			2	SS	22															
			3	SS	21															
			4	SS	11															
3.0	SAND, fine grained, some gravel, trace silt Dense to Compact Brown Moist to Wet		5	SS	34															
			6	SS	23															
	some gravel, occasional cobbles from 7.2 m		7	SS	27												18 75 7 (SI+CL)			
			8	SS	76/ 229															
8.0	END OF BOREHOLE AT 8.0 m. BOREHOLE OPEN TO 8.0 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																			

ONTMT4 422STIRLING & PEVENSEY-1.GPJ 23/09/04

+³, ×³: Numbers refer to Sensitivity

20
15
10
5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 E-S 10+349 L1 1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION 422 E-S Ramp, ST. 10+349, O/S 1L ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 27.11.02 - 27.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
WATER CONTENT (%)					20 40 60												
0.0	TOPSOIL Brown																
0.3	Clayey SILT, some sand Hard Brown Dry to Moist		1	SS	55												0 16 65 19
			2	SS	32												
2.2	Silty CLAY, trace sand Very Stiff To Stiff Brown Moist to Wet		3	SS	20												
			4	SS	11												0 7 64 29
	Laminated from 4.57 m		5	SS	12												
5.2	END OF BOREHOLE AT 5.18 m. BOREHOLE OPEN TO 5.18 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 422 E-S 10+350 R28.2 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-S Ramp, ST. 10+350, O/S 28.2R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
 DATUM Geodetic DATE 26.11.02 - 26.11.02 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
0.0	DCPT from surface.												
4.9	END OF DCPT AT 4.88 m.												

RECORD OF BOREHOLE No 422 E-S 10+351 L11.1 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-S Ramp, ST. 10+351, O/S 11.1L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 27.11.02 - 27.11.02 CHECKED BY JL


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	Sandy TOPSOIL, some rootlets Brown													
0.3	Sandy SILT, some clay Very dense Brown Dry to Moist (ML) (non plastic)		1	SS	53									
			2	SS	81									0 27 59 14
			3	SS	53									
3.0	Silty CLAY, trace sand, laminated Stiff Brown Wet		4	SS	9									0 9 61 30
			5	SS	9									
			6	SS	15									
6.7	END OF BOREHOLE AT 6.71 m. BOREHOLE OPEN TO 6.71 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.													

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

RECORD OF BOREHOLE No 422 E-S 10+450 L19.1 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-S Ramp, ST. 10+450, O/S 19.1L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
 DATUM Geodetic DATE 25.11.02 - 25.11.02 CHECKED BY JL




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								WATER CONTENT (%)	
								20	40	60	80	100					
0.0	DCPT from surface.																
4.1	END OF DCPT AT 4.11 m.																

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

RECORD OF BOREHOLE No 422 E-S 10+450 R20.3 1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION 422 E-S Ramp, ST. 10+450, O/S 20.3R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 28.11.02 - 28.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								20 40 60 80 100										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
							WATER CONTENT (%)					20 40 60						
0.0	TOPSOIL with rootlets Brown Sandy SILT, some clay, trace gravel Compact Brown Moist																	
0.1			1	GS														
			1	SS	15													2 27 54 17
1.5	SAND, fine grained, some gravel, trace silt Compact Brown Dry to Moist		2	SS	15													
2.2	Gravelly SAND, trace silt Compact Brown Dry to Moist		3	SS	27												12 82 6 (SI+CL)	
			4	SS	24													
3.7	END OF BOREHOLE AT 3.66 m. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																	

RECORD OF BOREHOLE No 422 E-S 10+452 L1 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-S Ramp, ST. 10+452, O/S 1L ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 26.11.02 - 26.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	Sandy TOPSOIL with rootlets													
0.2	Brown SAND, fine grained, trace silt Compact Brown Dry to Moist		1	SS	22									
			2	SS	11									0 95 5 (SI+CL)
			3	SS	13									
			4	SS	11									
4.0	SAND, medium to coarse grained, some gravel Loose Brown Dry to Moist		5	SS	7									
5.9	END OF BOREHOLE AT 5.94 m. AUGER REFUSAL AT 5.94 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN AND DRY ON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.													

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 E-N 10+046 R3 1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+046, O/S 3R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 03.12.02 - 03.12.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	TOPSOIL with rootlets (150 mm)													
0.2	Brown SILT, trace clay, trace sand Dense to Compact Brown Moist		1	SS	46									
			2	SS	10									
			3	SS	11									0 5 84 11
3.1	Clayey SILT, some sand Very Stiff Brown Wet		4	SS	15									
3.7	Silty SAND, fine grained Loose to Compact Brown Dry to Moist		5	SS	9									No Recovery in SS#5
			6	SS	18									0 61 39 (SI+CL)
6.7	END OF BOREHOLE AT 6.71 m. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.													

ONTMT4 422STIRLING & PEVENSEY.GPJ 10/02/05

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 E-N 10+099 L1.5 1 OF 1

METRIC




G.W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+099, O/S 1.5L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 28.11.02 - 28.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)	
								20 40 60 80 100								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
							20 40 60 80 100					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _P W W _L				
0.0	TOPSOIL, with rootlets Brown SILT, trace sand, trace clay Compact Brown Dry to Moist															
0.1			1	SS	20											
			2	SS	15											0 1 90 10
			3	SS	15											
3.2	Sandy SILT, trace clay Compact Brown Dry to wet		4	SS	18										0 27 67 6	
3.7	END OF BOREHOLE AT 3.66 m. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.															

RECORD OF BOREHOLE No 422 E-N 10+125 L27 1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+125, O/S 27L ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
DATUM Geodetic DATE 29.07.03 - 29.07.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
								○ UNCONFINED	+	FIELD VANE										
								● QUICK TRIAXIAL	x	LAB VANE										
							20	40	60	80	100		20	40	60					
0.0	ASPHALT																			
0.1	SAND and GRAVEL																			
0.3	Brown (FILL) SAND, fine grained, trace silt Compact Brown Dry to Moist		1	SS	25															
1.5	Silty SAND, fine grained Compact Brown Moist		2	SS	16															
2.3	SILT, trace clay, trace sand Loose to Compact Grey Moist		3	SS	5															
			4	SS	7												0 3 89 8			
			5	SS	16															
5.2	END OF SAMPLING AT 5.18 m. DCPT started at 5.18 m.																			
7.6	END OF DCPT AT 7.62 m. BOREHOLE OPEN TO 4.27 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS AND PATCHED WITH ASPHALT AT SURFACE.																			

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 E-N 10+131 R23.5 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+131, O/S 23.5R ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
DATUM Geodetic DATE 28.11.02 - 28.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
0.0	DCPT from surface.																
3.7	END OF DCPT AT 3.66 m.																

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

+ 3, × 3: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 E-N 10+150 CL 1 OF 2

METRIC

G.W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+150, CL ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
 DATUM Geodetic DATE 28.11.02 - 28.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
0.0 0.1	TOPSOIL Brown Sandy SILT, trace clay Loose to Dense Brown Dry to Moist		1	SS	7									
			2	SS	30									
2.1	Silty SAND, fine grained, trace clay Compact to Loose Brown Dry to Wet		3	SS	24									
			4	SS	18									
			5	SS	5									
			6	SS	9									
7.6	END OF SAMPLING AT 7.62 m. SAND HEAVING IN AUGERS. DCPT started at 7.62 m.													
9.8	END OF DCPT AT 9.75 m.													

ONTMT4 422STIRLING & PEVENSEY.GPJ 10/02/05

Continued Next Page

+ 3, X 3: Numbers refer to
Sensitivity

20
15-5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 E-N 10+150 CL 2 OF 2

METRIC

G.W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+150, CL ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
 DATUM Geodetic DATE 28.11.02 - 28.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		
							20	40	60	80	100						
	Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) 20/06/03 5.34 14/08/03 5.27																

ONTMT4 422STIRLING & PEVENSEY.GPJ 10/02/05

RECORD OF BOREHOLE No 422 E-N 10+250 CL 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+250, CL ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 29.11.02 - 29.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>							<div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div><div>W P W W L</div></div>		
0.0	Sandy TOPSOIL, with rootlets Brown Sandy SILT, trace clay Compact Brown Dry to Moist																
0.1			1	SS	16												
1.4	SAND, fine grained, trace to some silt Dense to Compact Brown Dry to Moist		2	SS	46												
			3	SS	40												
			4	SS	30												
3.7	END OF BOREHOLE AT 3.66 m. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 422 E-N 10+275 R18.751 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+275, O/S 18.75R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 18.07.02 - 18.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	TOPSOIL Brown													
0.3	SILT, trace sand, trace clay Compact to Loose Brown Moist		1	SS	14									
			2	SS	6									0 5 91 4
			3	SS	18									
3.1	Sandy SILT, fine grained Compact to Loose Brown Moist to Wet		4	SS	12									
			5	SS	15									
			6	SS	8									
7.3	Silty SAND, fine grained, trace gravel Loose to Compact Brown Wet		7	SS	9									
			8	SS	12									1 74 26 (SI+CL)
9.8	END OF BOREHOLE AT 9.75 m.													

ONTMT4 422STIRLING & PEVENSEY.GPJ 23/09/04

+³, ×³: Numbers refer to
Sensitivity

20
15 10 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 E-N 10+300 R1 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+300, O/S 1R ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 29.11.02 - 29.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									

+³ . ×³: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 E-N 10+325 R18 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+325, O/S 18R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
 DATUM Geodetic DATE 29.11.02 - 29.11.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
0.0	DCPT from surface.												
4.3	END OF DCPT AT 4.27 m.												

RECORD OF BOREHOLE No 422 E-N 10+350 CL 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+350, CL ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 02.12.02 - 02.12.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								20	40	60	80	100			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							
								20	40	60	80	100			
								WATER CONTENT (%)							
								20	40	60					
0.0	TOPSOIL														
0.1	Brown														
	SAND, fine grained, trace silt		1	SS	26										
	Compact		2	SS	16										
	Brown		3	SS	15										
	Dry to Moist	4	SS	15											
3.7	END OF BOREHOLE AT 3.66 m. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.														

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RECORD OF BOREHOLE No 422 E-N 10+406 CL 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+406, CL ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 02.12.02 - 02.12.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0 0.1	TOPSOIL Brown Sandy SILT Compact Brown Dry to Moist		1	SS	16									
1.5	SAND, fine grained, some silt Compact Brown Dry to Wet		2	SS	24									
			3	SS	20									
			4	SS	17									
3.7	END OF BOREHOLE AT 3.66 m. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.													0 87 13 (SH+CL)

+ 3, X 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 422 E-N 10+425 R19.3 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+425, O/S 19.3R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
 DATUM Geodetic DATE 02.12.02 - 02.12.02 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
0.0	DCPT from surface.						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	20 40 60					
2.9	END OF DCPT AT 2.89 m.												

RECORD OF BOREHOLE No 422 E-N 10+448.5 R0.5 1 OF 1

METRIC

W.P. 742-93-00 LOCATION 422 E-N Ramp, ST. 10+448.5, O/S 0.5R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 02.12.02 - 02.12.02 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
						○ UNCONFINED	+	FIELD VANE								
						● QUICK TRIAXIAL	×	LAB VANE								
						20	40	60	80	100						
0.0	TOPSOIL															
0.2	Brown SAND, fine grained, trace silt Dense to Compact Brown Dry to Wet		1	SS	38											
			2	SS	25											
			3	SS	15											
			4	SS	14											
3.7	END OF BOREHOLE AT 3.66 m. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.															

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

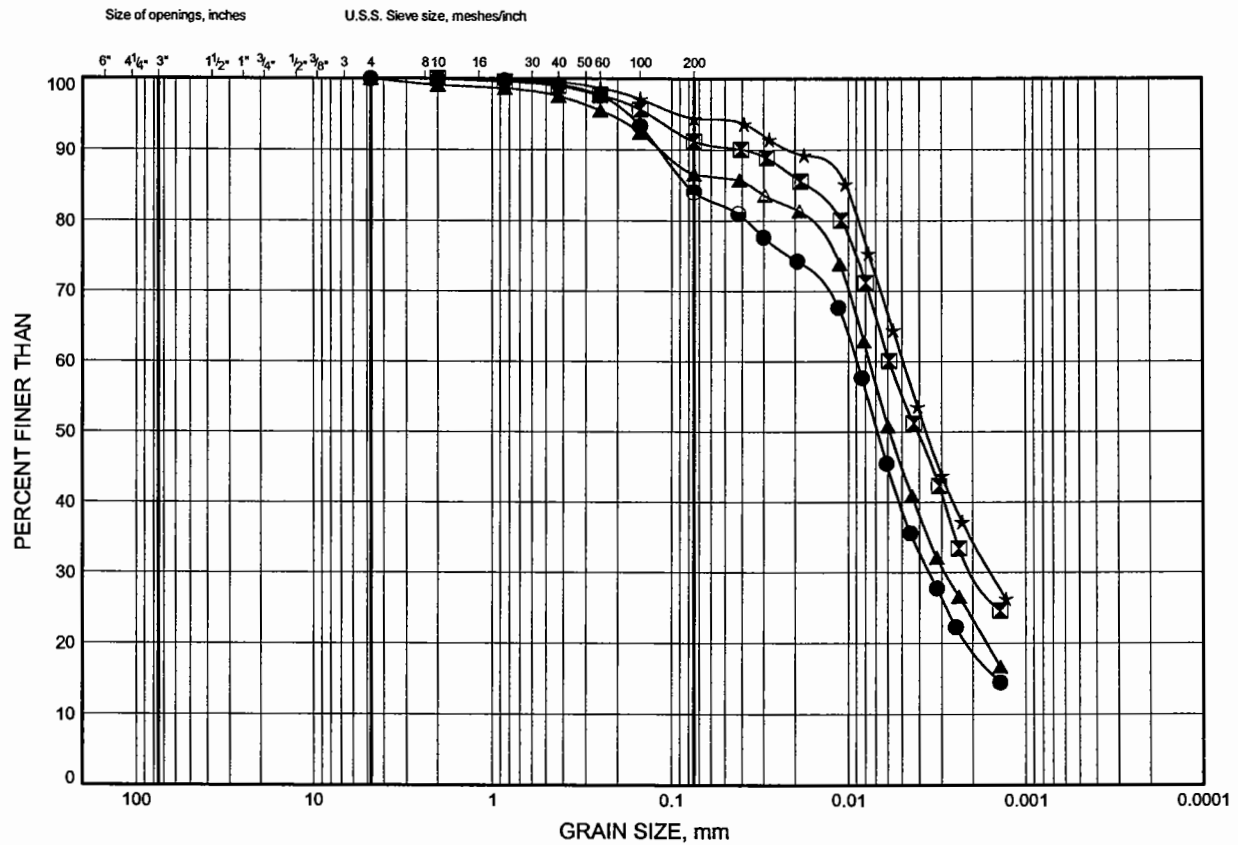
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						WATER CONTENT (%)
								20 40 60 80 100						
0.0	Sandy TOPSOIL Brown		1	GS										
0.3	Sandy SILT, trace to some clay Very Dense to Compact Brown Dry to Moist		1	SS	57									
			2	SS	23									
2.2	Silty CLAY, trace to some sand Very Stiff to Firm Brown Moist		3	SS	17									
			4	SS	14									
			5	SS	6									
5.6	SILT, trace to some clay Brown		1	TW	PH									
6.4	END OF BOREHOLE AT 6.35 m. BOREHOLE OPEN TO 6.35 m AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) 20/06/03 5.60 14/08/03 5.79													

+ 3, x 3: Numbers refer to Sensitivity

Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE B1

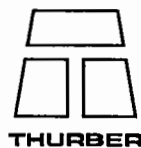
Silty Clay



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	422 E-S 10+349 L1	1.83	
⊠	422 E-S 10+351 L11.1	3.35	
▲	422 N-EW 10+025 CL	2.59	
★	422 N-EW 9+975 CL	3.35	

Date September 2004
Project 742-93-00

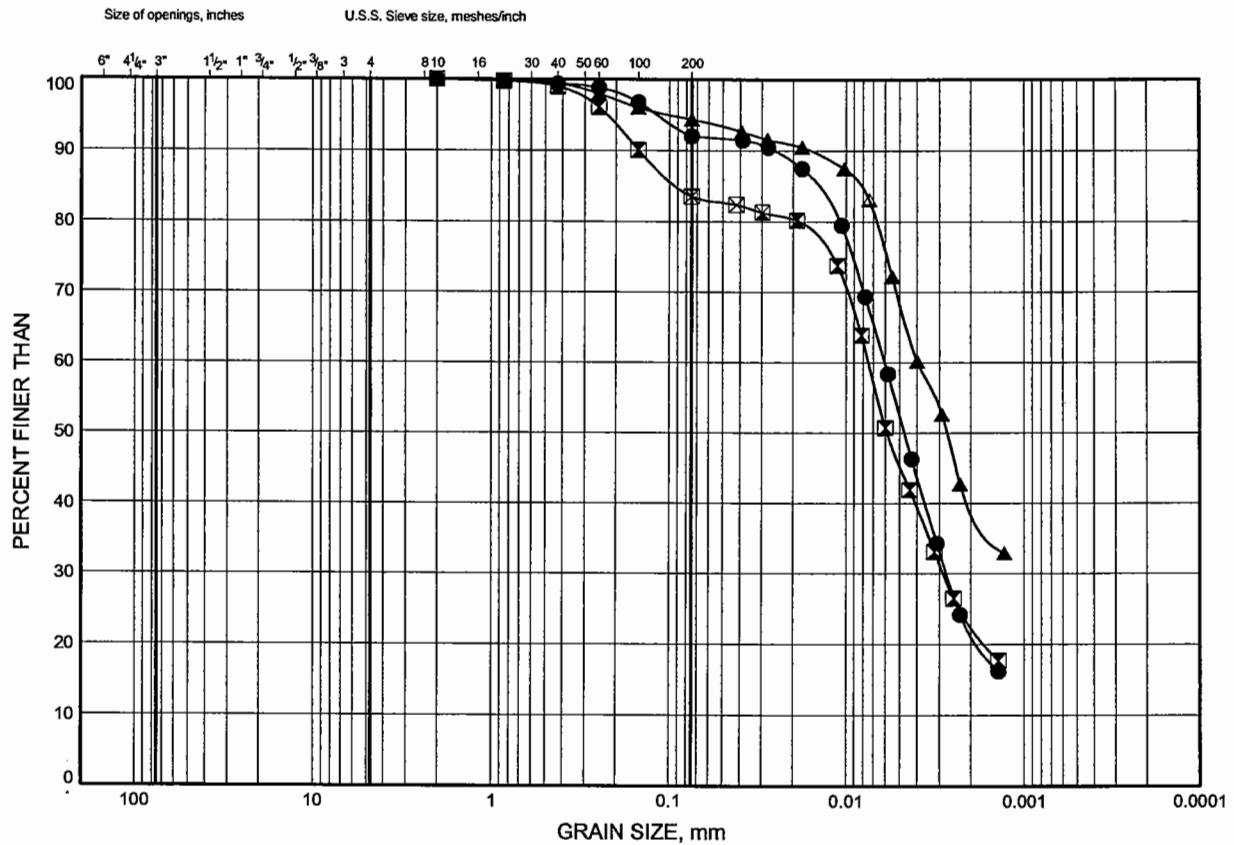


Prep'd WM
Chkd. JL

Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE B2

Silty Clay

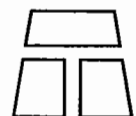


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	422 W-N 25+473 R3	1.83	
◻	422 W-S 10+360.5 L2	2.59	
▲	422 W-S 10+362.5 R21.4	4.88	

Date September 2004

Project 742-93-00



THURBER

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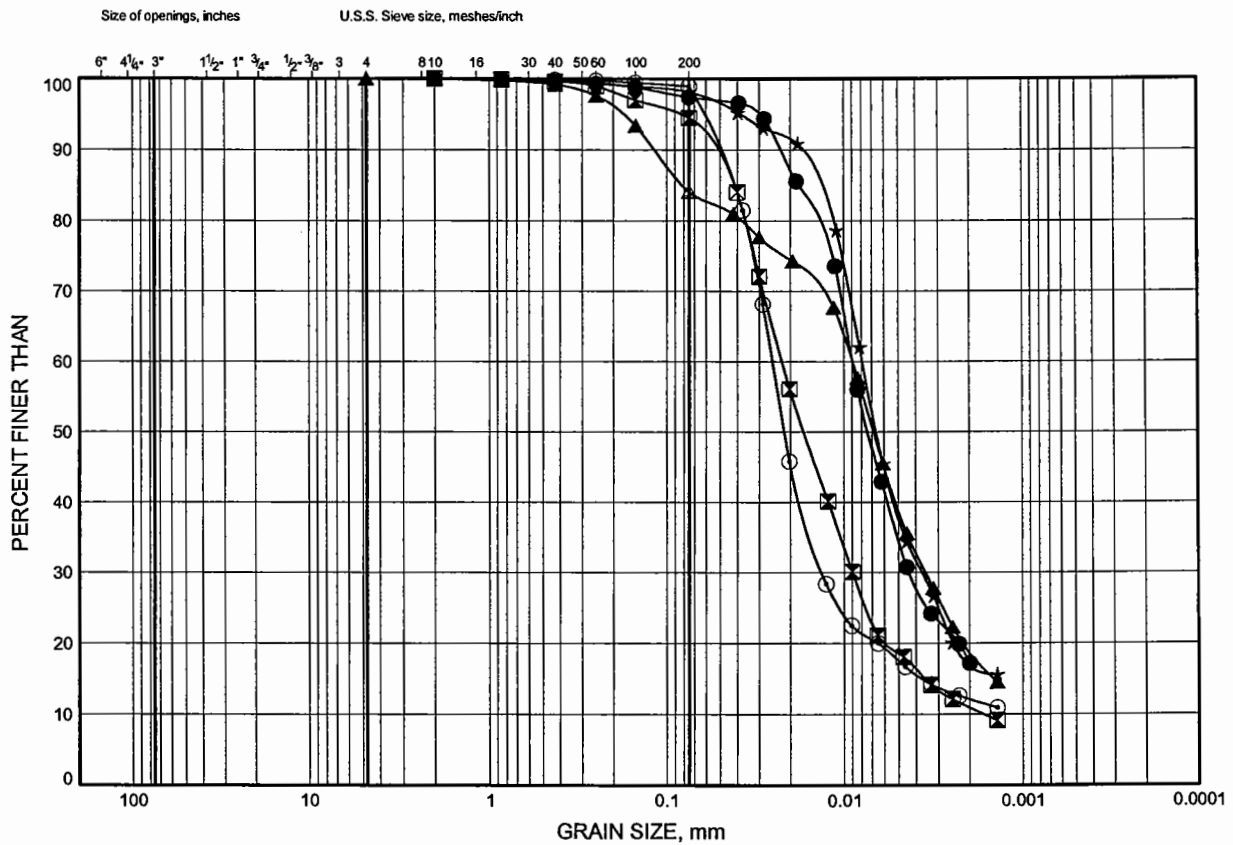
Chkd. JL

Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE B3

Silt, some clay



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	422 10+100 L5	4.88	
⊠	422 E-N 10+046 R3	2.59	
▲	422 E-S 10+349 L1	1.83	
★	422 N-EW 10+050 CL	1.83	
⊙	422 W-N 25+473 R3	4.88	

Date September 2004
Project 742-93-00

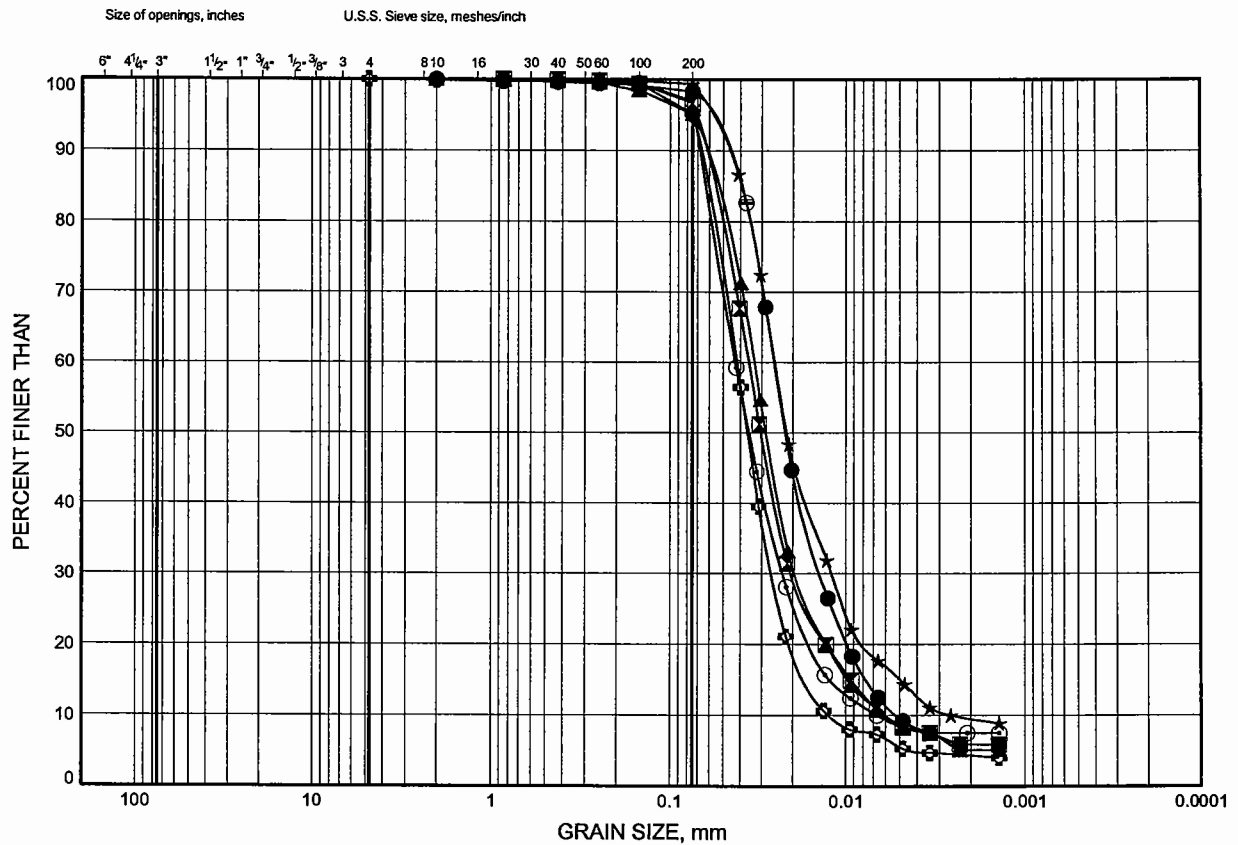


Prep'd WM
Chkd. JL

Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE B4

Silt

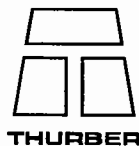


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	422 10+050 L4	3.35	
⊠	422 10+100 L5	7.92	
▲	422 9+950 R1.5	1.83	
★	422 E-N 10+099 L1.5	1.83	
⊙	422 E-N 10+125 L27	3.35	
⊛	422 E-N 10+275 R18.75	1.83	

Date September 2004

Project 742-93-00



Prep'd WM

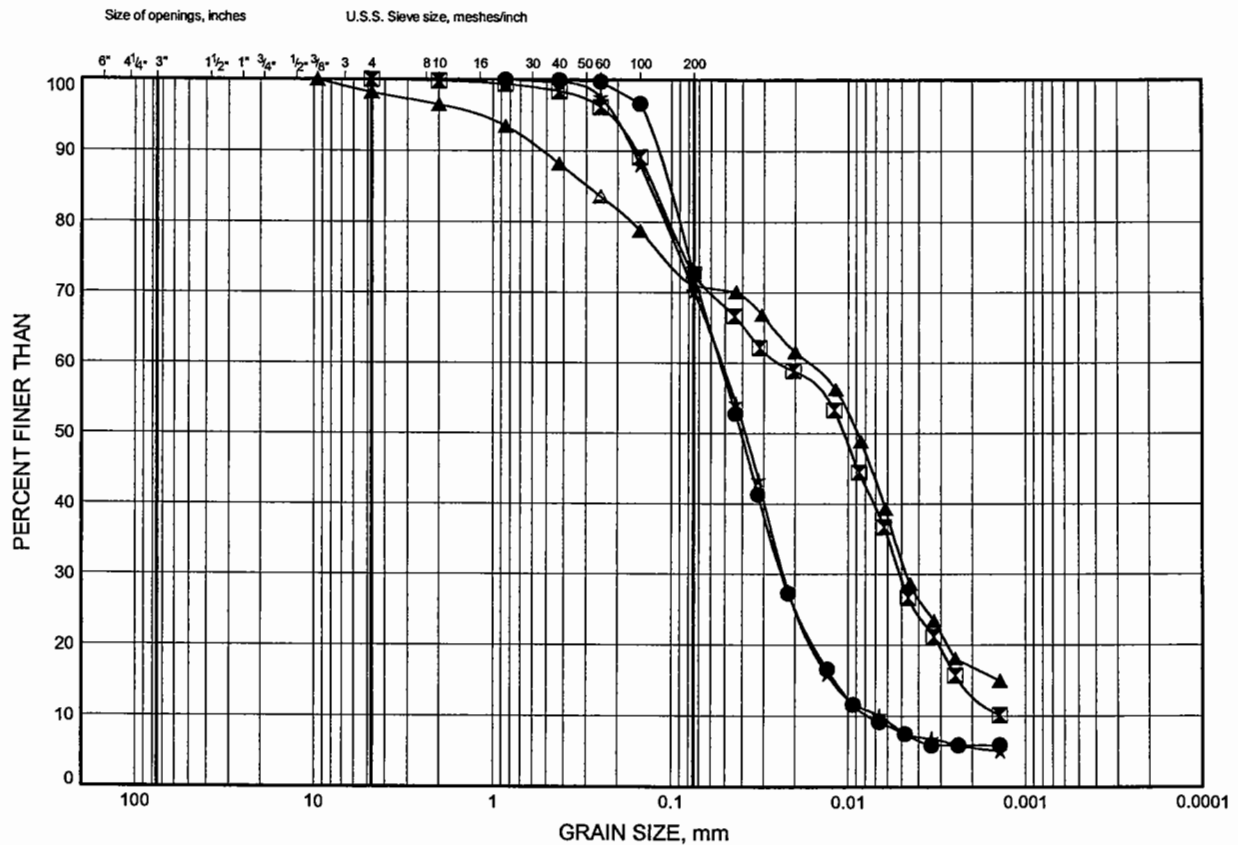
Chkd. JL

Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE B5

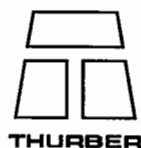
Sandy Silt



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	422 E-N 10+099 L1.5	3.35	
◻	422 E-S 10+351 L11.1	1.83	
▲	422 E-S 10+450 R20.3	1.07	
★	422 W-N 25+465 R18	2.59	

Date September 2004
Project 742-93-00

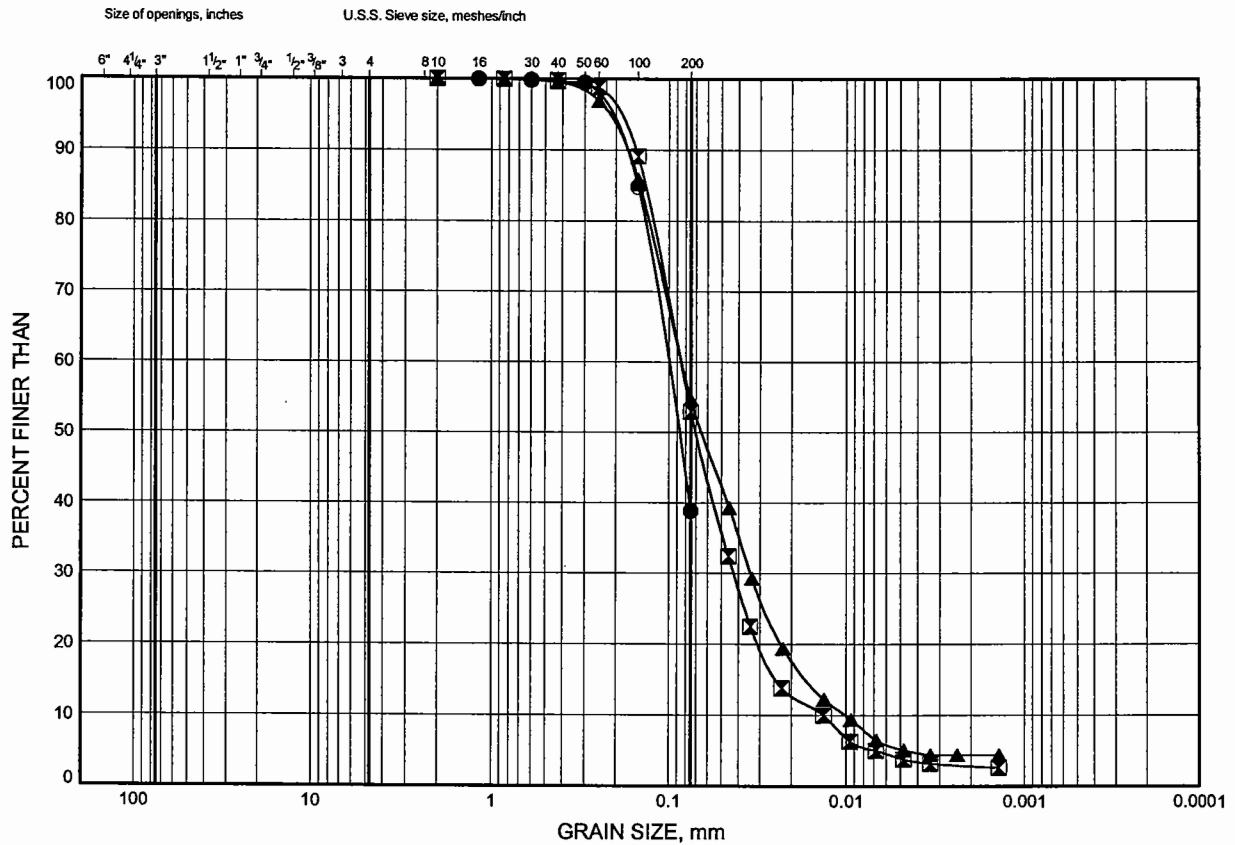


Prep'd WM
Chkd. JL

Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE B6

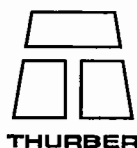
Sand and Silt



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	422 E-N 10+046 R3	6.40	
⊠	422 E-N 10+225 R20	1.83	
▲	422 N-EW 9+999 R21.5	6.50	

Date September 2004

Project 742-93-00



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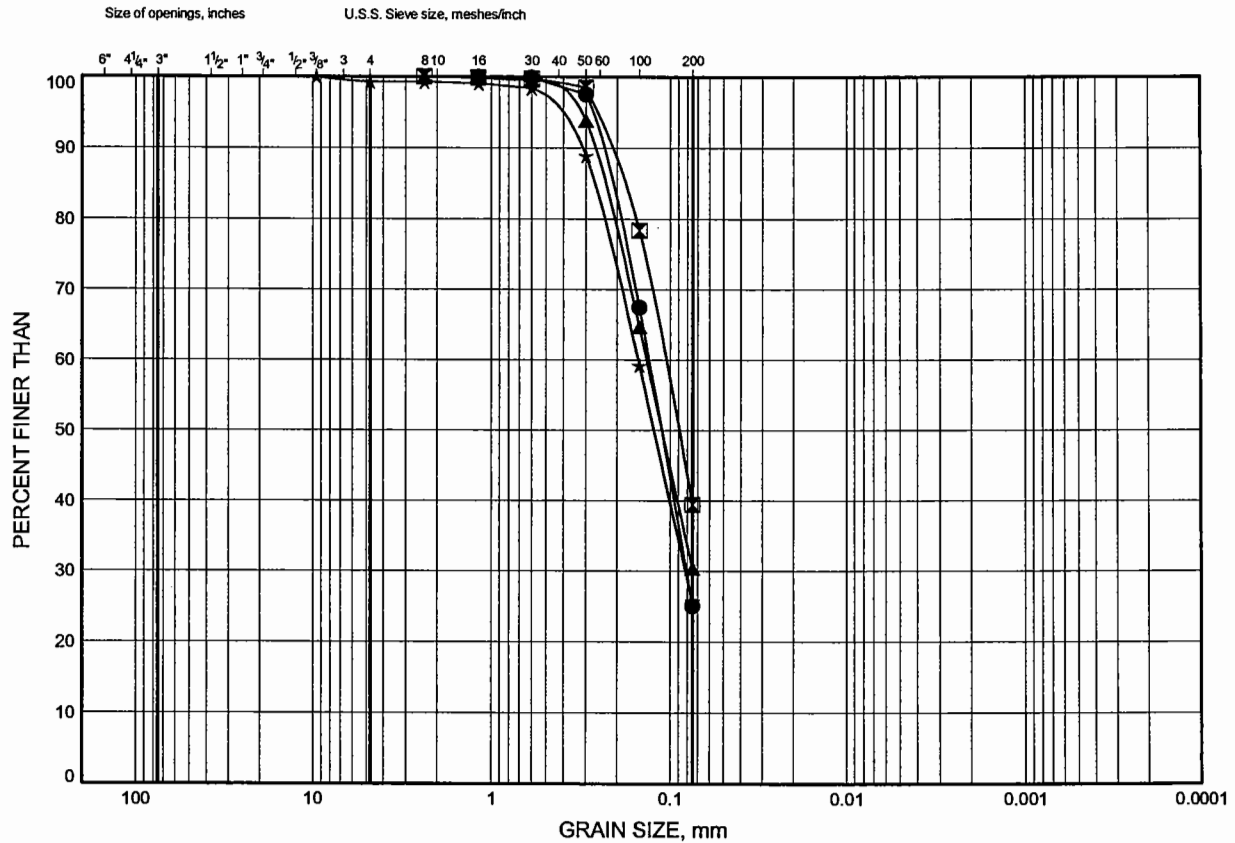
Chkd. JL

Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE B7

Silty Sand

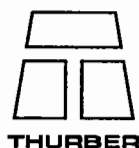


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	422 10+050 L4	7.92	
⊠	422 E-N 10+150 CL	3.35	
▲	422 E-N 10+225 R20	6.40	
★	422 E-N 10+275 R18.75	9.45	

Date September 2004

Project 742-93-00



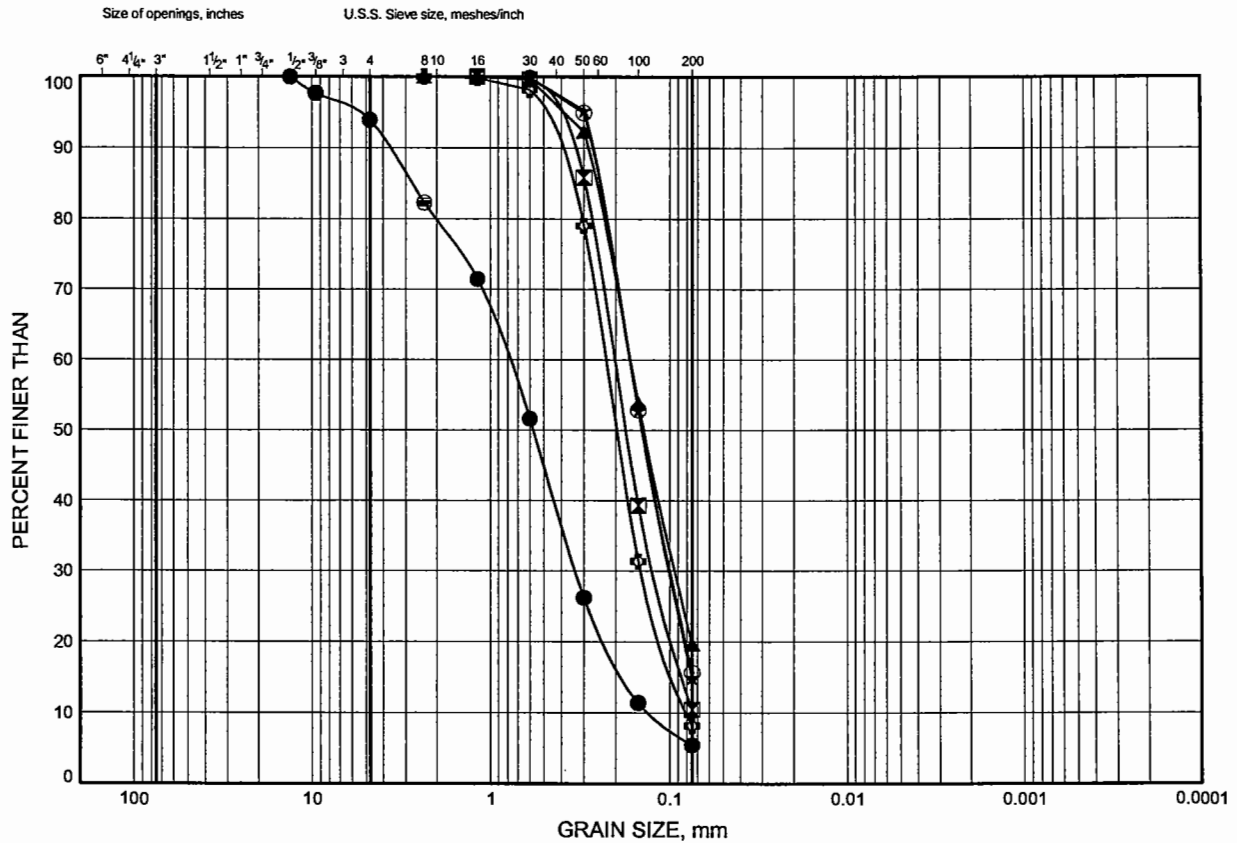
Prep'd WM

Chkd. JL

Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE B8

Sand

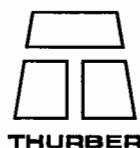


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	422 9+900 R0.5	1.83	
⊠	422 9+950 R1.5	4.88	
▲	422 9+967 L31	1.83	
★	422 E-N 10+250 CL	1.83	
⊙	422 E-N 10+300 R1	1.83	
⊛	422 E-N 10+325 L22	1.83	

Date September 2004

Project 742-93-00



Prep'd WM

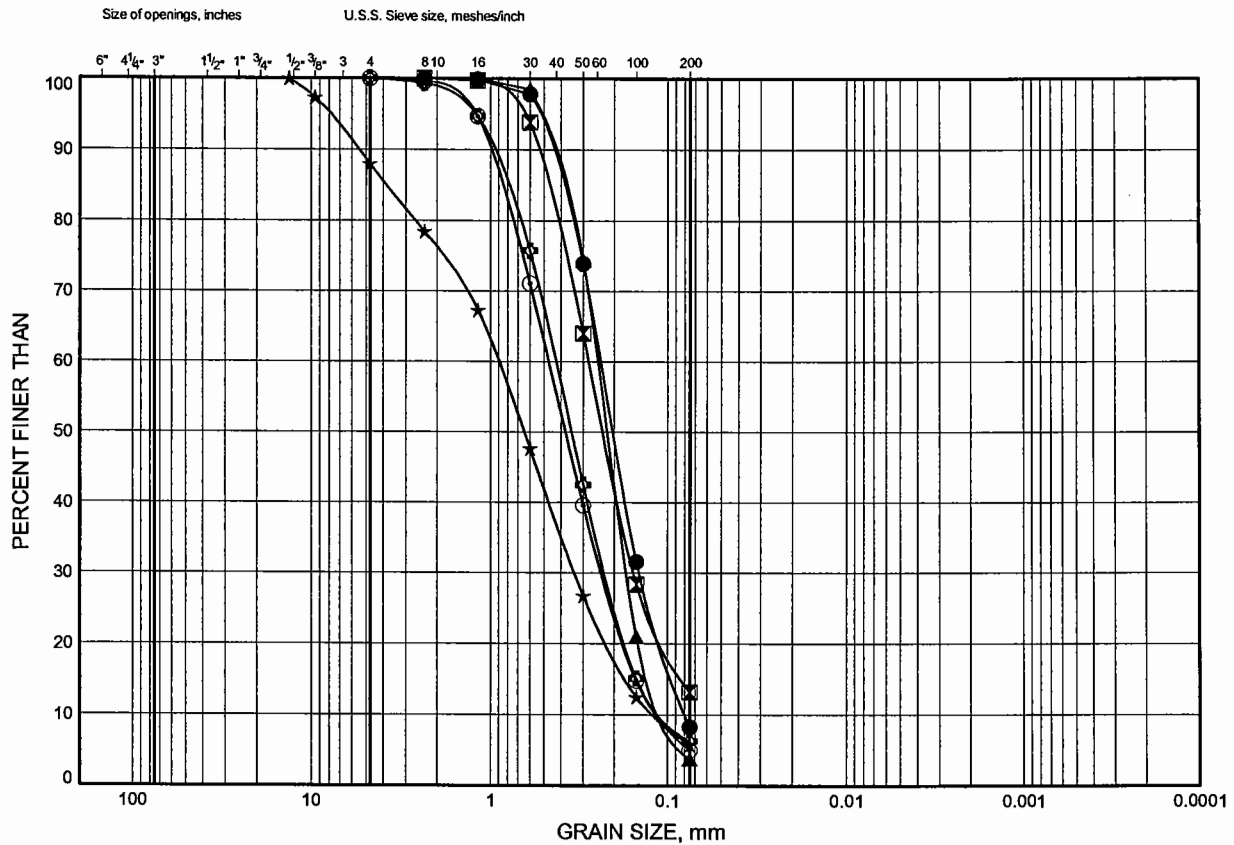
Chkd. JL

Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE B9

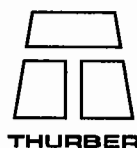
Sand



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	422 E-N 10+350 CL	2.59	
⊠	422 E-N 10+406 CL	2.59	
▲	422 E-N 10+448.5 R0.5	2.59	
★	422 E-S 10+450 R20.3	2.59	
⊙	422 E-S 10+452 L1	1.83	
⊕	422 N-EW 10+050 CL	4.88	

Date September 2004

Project 742-93-00



Prep'd WM

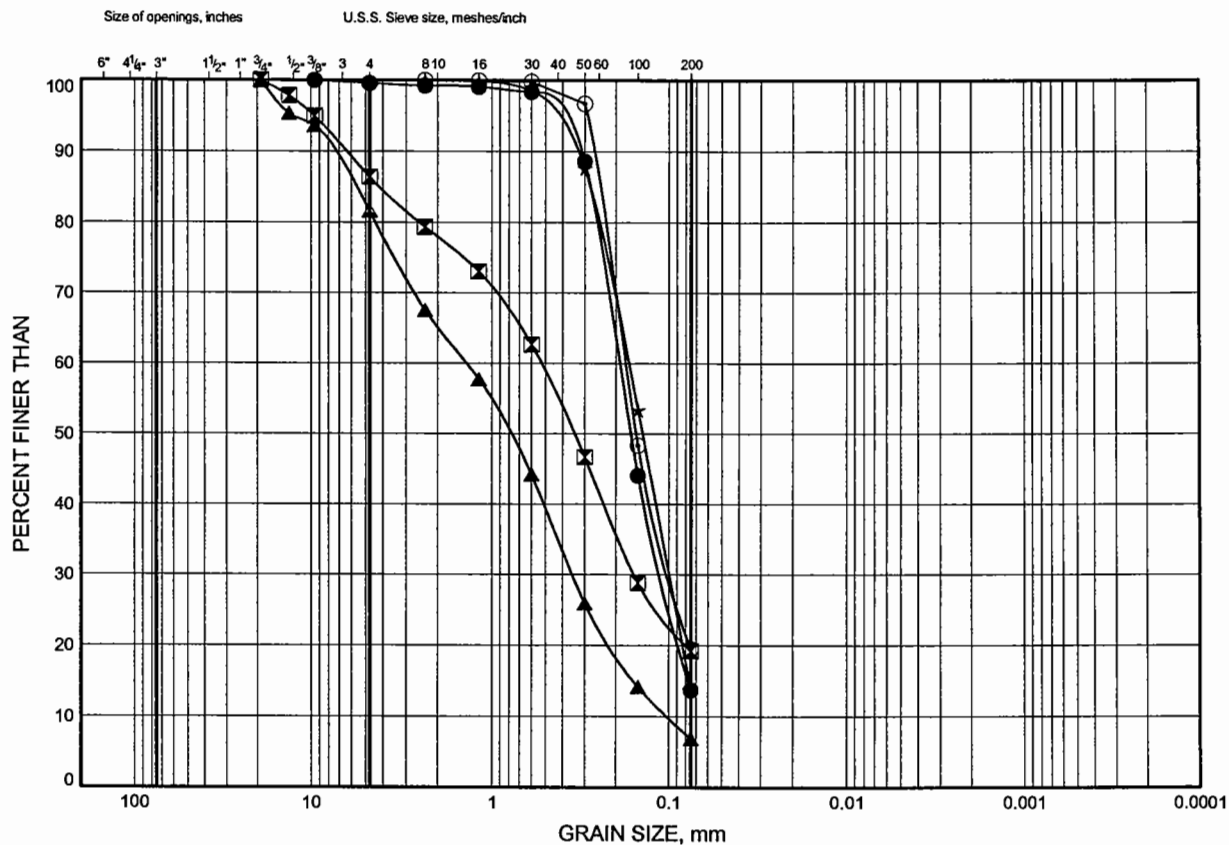
Chkd. JL

Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE B10

Sand



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	422 N-EW 10+400 R2	1.83	
⊠	422 N-EW 10+430 L3	1.83	
▲	422 N-EW 10+430 L3	6.40	
★	422 N-EW 9+999 R21.5	3.35	
⊙	422 W-N 25+465 R18	4.88	

Date September 2004

Project 742-93-00



Prep'd WM

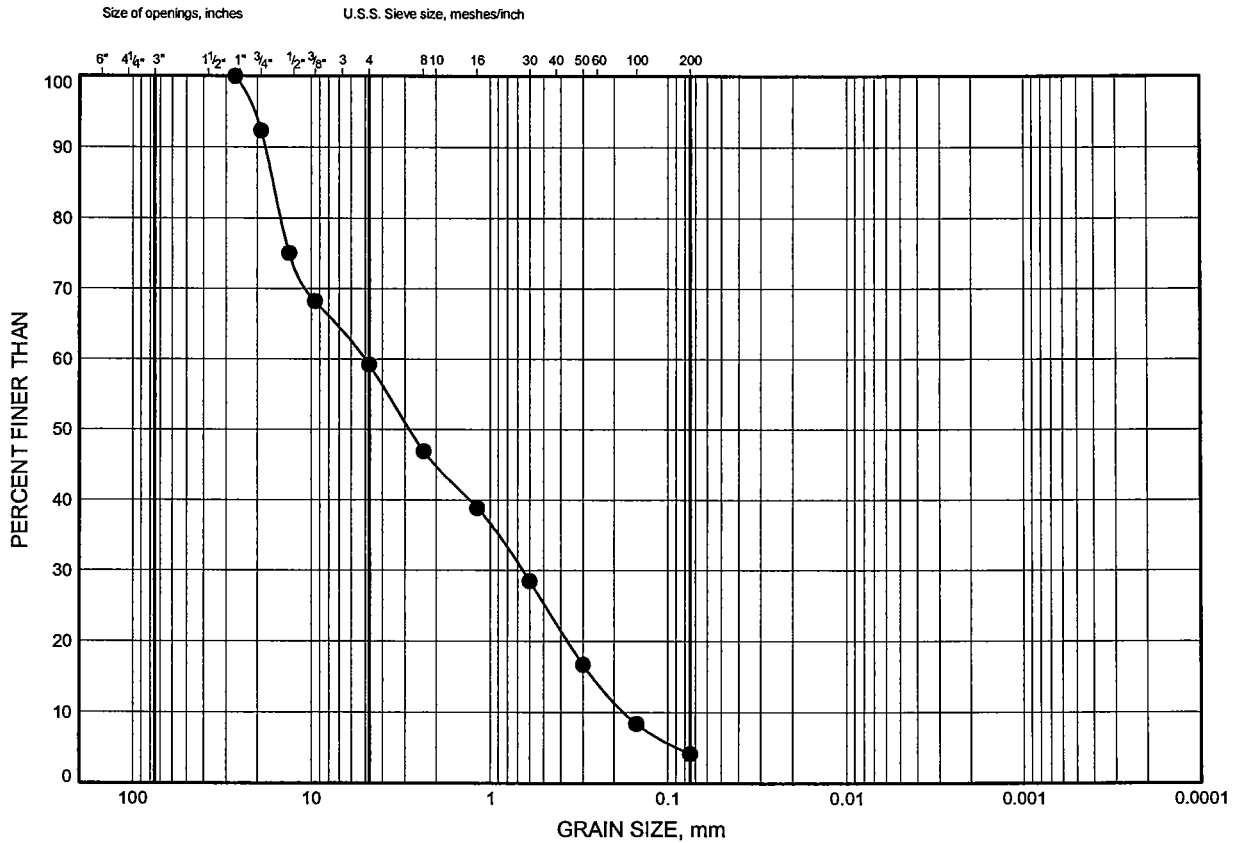
Chkd. JL

Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE B11

Sand and Gravel

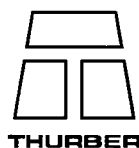


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	422 9+900 R0.5	3.35	

Date September 2004

Project 742-93-00



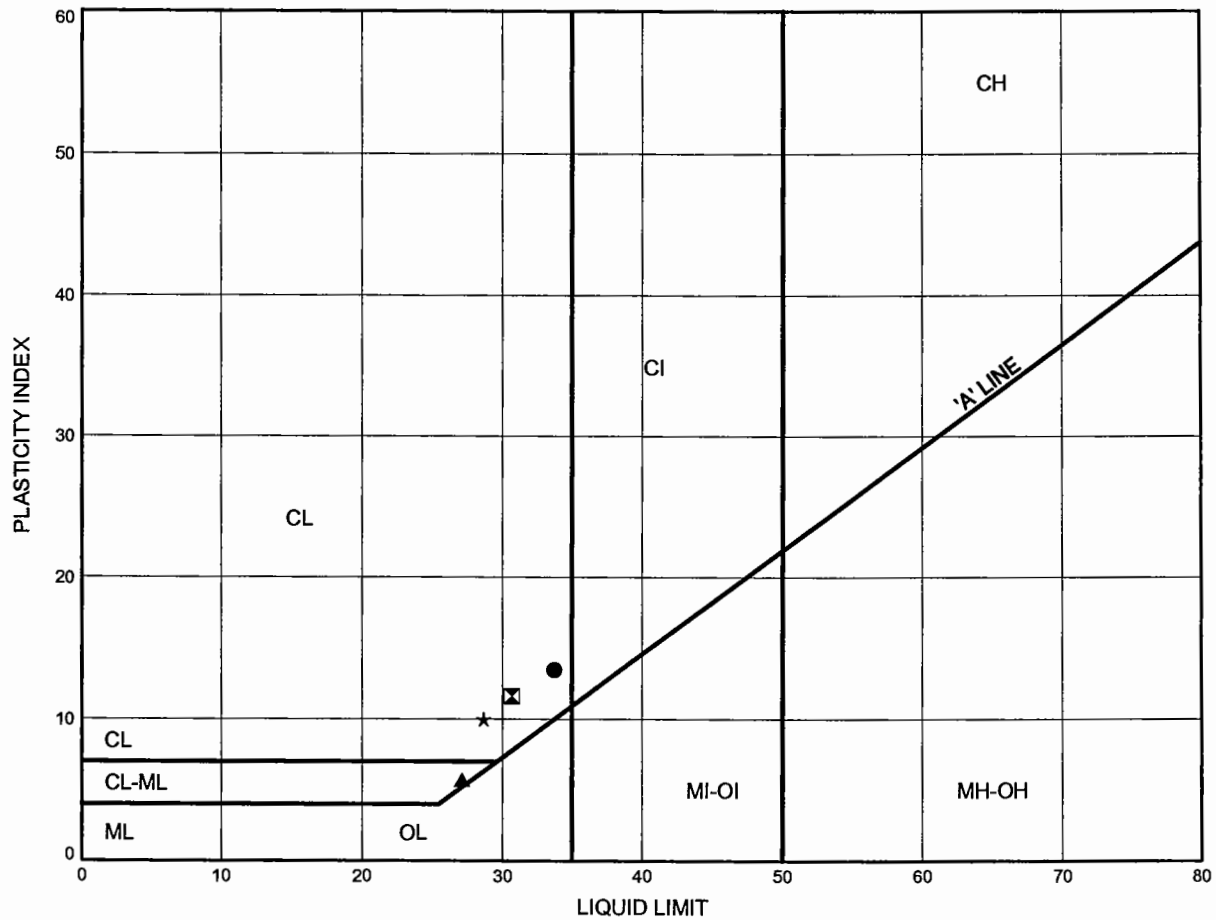
Prep'd WM

Chkd. JL

Hwy 11 Four Laning

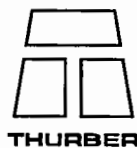
ATTERBERG LIMITS TEST RESULTS

FIGURE B12



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	422 E-S 10+351 L11.1	3.35	
⊠	422 N-EW 9+975 CL	3.35	
▲	422 W-N 25+473 R3	1.83	
★	422 W-S 10+362.5 R21.4	4.88	

Date September 2004
 Project 742-93-00



Prep'd WM
 Chkd. JL

Appendix C
Highway 11 Mainline, Strong Township, Sta. 10+225 to 10+745

RECORD OF BOREHOLE No S 10+225 L18.75 1 OF 1 METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+225, O/S 18.75L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MF/SS
 DATUM Geodetic DATE 23.07.02 - 23.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20 40 60 80 100							20 40 60		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							W P W W L		
0.0	TOPSOIL																
0.1	SAND, fine grained, trace silt Brown																
0.5	SILT, some fine grained sand, occasional gravel Compact Brown Dry to Moist		1	SS	11												
			2	SS	6												
1.8	SAND, fine grained Loose to compact Brown Damp																
			3	SS	11												
3.1	Silty SAND, some gravel, trace clay Compact Brown Wet some gravel/boulders from 3.66m to 4.17m augers grinding from 3.66m to 4.17m		4	SS	20									11 51 36 2			
4.2	END OF BOREHOLE AT 4.17m. AUGER REFUSAL AT 4.17 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 2.90 m AND WATER LEVEL AT 2.37 m UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No S 10+225 R30

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+225, O/S 30R ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MF/SS
DATUM Geodetic DATE 18.07.02 - 18.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _P W W _L			WATER CONTENT (%)			
0.0	TOPSOIL													
0.2	SILT and SAND, fine grained, trace clay Compact Brown Dry to Moist		1	SS	19									0 44 53 3
			2	SS	17									
			3	SS	12									
3.1	Silty SAND, fine grained Compact to Loose Brown Dry to Moist		4	SS	10									
			5	SS	14									
			6	SS	7									0 77 23 (SI+CL)
	Compact		7	SS	13									
8.2	END OF BOREHOLE AT 8.23 m. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.													

ONTMT4 2312STRONG(52).GPJ 14/09/04

RECORD OF BOREHOLE No S 10+250 L5.5

1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION Strong Township, ST. 10+250, O/S 5.5L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 30.07.03 - 30.07.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
0.0	ASPHALT																
0.1	SAND and GRAVEL (FILL)																
0.6	Silty SAND, some topsoil Compact Brown Dry to Moist (FILL)		1	SS	11												
1.5	Sandy TOPSOIL, occasional rootlets Loose Dark brown Dry to Moist		2	SS	9												
2.2	SAND, trace silt, trace gravel Compact Brown Moist		3	SS	17												1 92 7 (SI+CL)
3.0	END OF BOREHOLE AT 2.97 m. AUGER REFUSAL AT 2.97 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 2.97 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																

+ 3, X 3: Numbers refer to
Sensitivity

20
15 10 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 10+250 R42

1 OF 2

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+250, O/S 42R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MF/SS
 DATUM Geodetic DATE 17.07.02 - 17.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	TOPSOIL													
0.1	Silty SAND, fine grained Compact to Loose Brown Dry to Wet		1	SS	25									
			2	SS	13									
			3	SS	10									
			4	SS	8									
			5	SS	10									
			6	SS	11									
			7	SS	6									
9.1	Sandy SILT, fine grained Compact Grey Wet		8	SS	15									
9.8	END OF BOREHOLE AT 9.75m.													

ONTMT4 2312STRONG(52),GPJ 17/09/04

Continued Next Page

+³ . X³ : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

METRIC

W.P.	<u>742-93-00</u>	LOCATION	<u>Strong Township, ST. 10+250, O/S 42R</u>	ORIGINATED BY	<u>DP</u>
HWY	<u>11</u>	BOREHOLE TYPE	<u>Hollow Stem Augers</u>	COMPILED BY	<u>MF/SS</u>
DATUM	<u>Geodetic</u>	DATE	<u>17.07.02 - 17.07.02</u>	CHECKED BY	<u>JL</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100	W _P	W		
	SAND HEAVING INSIDE OF AUGERS						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				kN/m ³	GR SA SI CL

ONTMT4 2312STRONG(52).GPJ 17/09/04

+³, ×³: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 10+275 L18.75

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+275, Q/S 18.75L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MF/SS
 DATUM Geodetic DATE 23.07.02 - 23.07.02 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									
						20	40	60	80	100							
0.0 0.1	TOPSOIL Gravelly SAND, well graded, some silt Compact to Very dense Brown Damp some gravel/boulders from 1.07m to 1.88m		1	SS	14												
			2	SS	50/ .050												
1.9	augers grinding END OF BOREHOLE AT 1.88 m. AUGER REFUSAL AT 1.88 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 1.52 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																

+³, ×³: Numbers refer to
Sensitivity

20
15-5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 10+275 R21.25 1 OF 1 METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+275, O/S 21.25R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MF/SS
 DATUM Geodetic DATE 18.07.02 - 18.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	TOPSOIL													
0.3	SAND, fine grained, trace silt Compact Brown Dry to Moist		1	SS	24									
1.5	Silty SAND, fine grained, trace clay Compact Brown Dry to Moist		2	SS	21									
			3	SS	15									
			4	SS	18									0 60 37 3
4.3	SAND, fine grained, some silt Compact Brown Wet		5	SS	11									0 84 16 (SI+CL)
			6	SS	12									
			7	SS	15									
8.2	END OF BOREHOLE AT 8.23 m. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.													

ONTMT4 2312STRONG(52).GPJ 17/09/04

RECORD OF BOREHOLE No S 10+293 L40

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+293, O/S 40L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY MF/SS
 DATUM Geodetic DATE 23.07.02 - 23.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
0.0	DCPT from surface.																
5.3	END OF DCPT AT 5.28 m. CONE REFUSAL AT 5.28 m ON PROBABLE BEDROCK OR BOULDER.																

RECORD OF BOREHOLE No S 10+300 CL

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+300, CL ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 29.07.03 - 29.07.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
0.0	ASPHALT																
0.1	SAND and GRAVEL																
0.5	SAND, fine grained, trace silt, trace gravel Compact Brown Dry to Moist		1	SS	20												
			2	SS	26												8 87 5 (SI+CL)
2.2	END OF BOREHOLE AT 2.21 m. AUGER REFUSAL AT 2.21 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 1.98 m AND DRY TO UPON COMPLETION . BOREHOLE BACKFILLED WITH DRILL CUTTINGS AND PATCHED WITH ASPHALT AT SURFACE. (TRY 2ND ATTEMPT AT S 10+302 L1)																

+³, ×³: Numbers refer to
Sensitivity




20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 10+302 L1

1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION Strong Township, ST. 10+302, O/A 1L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 29.07.03 - 29.07.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
					20	40	60	80	100	20	40	60					
0.0	ASPHALT																
0.1	SAND and GRAVEL (FILL)																
0.6	SAND, fine grained, trace silt, occasional gravel Brown Dry to Moist																
			1	SS	50												
2.5	END OF BOREHOLE AT 2.47 m. AUGER REFUSAL AT 2.47 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 2.47 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS AND PATCHED WITH ASPHALT AT SURFACE.																

+³, x³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 10+325 L22.25 1 OF 1 METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+325, O/S 22.25L ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MF/SS
DATUM Geodetic DATE 23.07.02 - 23.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20	40	60	80	100		
								UNCONFINED + FIELD VANE						
								QUICK TRIAXIAL x LAB VANE						
								20	40	60	80	100		
								WATER CONTENT (%)						
								20	40	60				
0.0	TOPSOIL													
0.2	SAND, fine grained, trace to some silt Loose Grey Moist		1	SS	8									
1.5	SAND, fine grained, trace silt Compact Brown Wet		2	SS	14									
2.2	Silty SAND, trace gravel, trace clay, occasional black organic silt Very Dense to Compact Grey Wet		3	SS	50/ .150									3 66 28 4
2.9	some gravel/boulders from 2.59m to 2.90m, hit boulder at 2.9m augers grinding from 2.59m to 2.90m END OF BOREHOLE AT 2.90 m. AUGER REFUSAL AT 2.90 m ON PROBABLE BEDROCK OR BOULDER. AUGER WALKED 0.51 m TOWARDS SOUTH EAST. BOREHOLE OPEN TO 1.40 m AND WATER LEVEL AT 1.27 m UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE. Note: TRY 2nd ATTEMPT AT S10+323 L 22.25													

RECORD OF BOREHOLE No S 10+323 L22.25 1 OF 1 METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+323, O/S 22.25L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 23.07.02 - 23.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
0.0	Augered to 3.05 m without sampling. no grinding from 0 m to 3.05 m													
3.1	Silty SAND , trace gravel, trace clay, occasional black organic silt Compact Grey Wet		1	SS	18									
4.0	Heavy grinding from 3.35 m to 3.96 m <u>Probable gravel, cobbles or boulders</u> END OF BOREHOLE AT 3.96 m. AUGER REFUSAL AT 3.96 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 1.76 m WATER LEVEL AT 1.45 m UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.													

RECORD OF BOREHOLE No S 10+325 R18.75 1 OF 1 METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+325, O/S 18.75R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test (DCPT) COMPILED BY MF/SS
 DATUM Geodetic DATE 22.07.02 - 22.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE										○		
								● QUICK TRIAXIAL × LAB VANE												
						20	40	60	80	100	20	40	60							
0.0	SAND, fine grained, trace silt Brown Dry																			
0.9	Silty SAND, fine grained, some gravel Loose to Compact Brown Dry to Moist occasional silt clasts from 0.91m to 1.45m thin silt laminations		1	SS	4															
			2	SS	8															
			3	SS	12															
			4	SS	12															
			5	SS	72															
4.4	SAND, fine grained, some gravel and cobbles, trace silt Very Dense Brown to Grey Wet augers grinding from 4.57m to 5.49m																			
5.5	END OF BOREHOLE AT 5.49 m. AUGER REFUSAL AT 5.49 m. DCPT STARTED AT 5.49 m TO CONFIRM REFUSAL MATERIAL. CONE REFUSAL AT 5.49 m ON PROBABLE BEDROCK OR BOULDER. WATER LEVEL AT 4.27 m DURING INVESTIGATION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																			

RECORD OF BOREHOLE No S 10+348 L6

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+348, O/S 6L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 29.07.03 - 29.07.03 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa	WATER CONTENT (%)	W _p	W		
0.0	ASPHALT												
0.1	SAND and GRAVEL (FILL)												
0.5	SAND, fine grained, some silt, trace gravel Compact Brown Dry to Moist		1	SS	21								
			2	SS	14								
	Moderate to heavy grinding from 2.44 m to 2.74 m		3	SS	15								5 76 19 (SI+CL)
3.1	END OF BOREHOLE AT 3.10 m. AUGER REFUSAL AT 3.10 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 2.9 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS AND PATCHED WITH ASPHALT AT SURFACE.												

RECORD OF BOREHOLE No S 10+350 R50

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+350, O/S 50R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MF/SS
 DATUM Geodetic DATE 18.07.02 - 18.07.02 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
0.0	TOPSOIL												
0.3	SANO, fine grained, trace silt Loose to Compact Brown Dry to Wet		1	SS	18								
			2	SS	11								
			3	SS	12								0 92 8 (SI+CL)
			4	SS	7								
			5	SS	10								
			6	SS	15								
			7	SS	8								0 96 4 (SI+CL)
8.2	END OF BOREHOLE AT 8.23m. SAND HEAVING IN AUGERS. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.												

ONTMT4 2312STRONG(52).GPJ 17/09/04

RECORD OF BOREHOLE No S 10+374 R18.75 1 OF 1 METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+374, O/S 18.75R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test (DCPT) COMPILED BY MF/SS
 DATUM Geodetic DATE 19.07.02 - 19.07.02 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%) W _p W W _L				
0.0	TOPSOIL															
0.1	SAND, fine grained, trace to some silt Compact Brown Dry	1	SS	25												
		2	SS	13												
		3	SS	14												
	Very dense	4	SS	50/ .025												
3.2	Gravelly SAND, well graded, some silt, occasional cobbles and boulders Dense Brown Moist Augers grinding from 3.23 to 3.66m. Augers grinding from 4.57 to 5.33m.	5	SS	31												30 58 12 (SI+CL)
		6	SS	50/ .025												
6.6	END OF BOREHOLE AND DCPT AT 6.35 m. SAND HEAVING IN AUGERS DCPT STARTED AT 6.10 m TO CONFIRM REFUSAL MATERIAL. CONE REFUSAL AT 6.55 m ON PROBABLE BEDROCK OR BOULDER. WATER LEVEL AT 5.18 m DURING INVESTIGATION.															

ONTMT4 2312STRONG(62).GPJ 17/09/04

1 OF 1

METRIC

W.P.	742-93-00	LOCATION	Strong Township, ST. 10+375, O/S 16.75L	ORIGINATED BY	DP
HWY	11	BOREHOLE TYPE	Hollow Stem Augers	COMPILED BY	SS
DATUM	Geodetic	DATE	29.07.03 - 29.07.03	CHECKED BY	JL

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No S 10+400 R7

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+400, O/S 7R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY MF/SS
 DATUM Geodetic DATE 22.07.02 - 22.07.02 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
0.0	DCPT from surface.						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	20 40 60					
9.9	END OF DCPT AT 9.91m.												

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 10+418 L18.75 1 OF 1 METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+418, O/S 18.75L ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 29.07.03 - 29.07.03 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _P	W	W _L		
0.0	ASPHALT							20	40	60	80	100					GR SA SI CL
0.1	SAND and GRAVEL (FILL)																
0.4	Silty SAND, fine to very fine grained, trace clay, occasional iron oxide staining Dense to Compact Brown Dry to Moist Compact to Loose		1	SS	34												
			2	SS	11												
			3	SS	6												0 64 36 (SI+CL)
			4	SS	10												
4.0	Gravelly SAND, fine to medium grained, trace silt Compact to dense Brown Moist Becoming grey		5	SS	23												29 65 6 (SI+CL)
			6	SS	45												
6.9	END OF BOREHOLE AT 6.86 m. AUGER REFUSAL AT 6.86 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 5.18 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS AND PATCHED WITH ASPHALT AT SURFACE.																

ONTMT4 2312STRONG(52).GPJ 14/09/04

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 10+425 R31.75 1 OF 2 METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+425, O/S 31.75R ORIGINATED BY DP
HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test (DCPT) COMPILED BY MF/SS
DATUM Geodetic DATE 24.07.02 - 24.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
0.0 0.1	TOPSOIL Sandy SILT Compact Brown Moist		1	SS	18											
1.5	SAND, trace silt Compact Brown Moist iron oxide staining from 1.52m to 2.13m wet at 2.59m loose at 3.05m compact at 4.57m		2	SS	23											
			3	SS	16											
			4	SS	7											
			5	SS	13											
			6	SS	17											
			6.7	END OF SAMPLING AT 6.71m. SAND HEAVING IN AUGERS DCPT STARTED AT 6.71 m.												

Continued Next Page

+³, x³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 10+425 R31.75 2 OF 2 METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+425, O/S 31.75R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test (DCPT) COMPILED BY MF/SS
 DATUM Geodetic DATE 24.07.02 - 24.07.02 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa	WATER CONTENT (%)	W _p	W		
							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60					
11.4	END OF DCPT AT 11.43 m. BOREHOLE OPEN TO 2.44 m AND WATER LEVEL AT 1.83 m UPON COMPLETION.												

RECORD OF BOREHOLE No S 10+450 R48.5 1 OF 2 METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+450, O/S 48.5R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY MF/SS
 DATUM Geodetic DATE 22.07.02 - 22.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
0.0	DCPT from surface.												

ONTMT4_2312STRONG(52).GPJ 14/09/04

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 10+450 R48.5

2 OF 2

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+450, O/S 48.5R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY MF/SS
 DATUM Geodetic DATE 22.07.02 - 22.07.02 CHECKED BY JL

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
13.7	END OF DCPT AT 13.72m.																

ONTMT4 2312STRONG(52).GPJ 14/09/04

RECORD OF BOREHOLE No S 10+451 R5

1 OF 2

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+451, O/S SR ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test (DCPT) COMPILED BY MF/SS
 DATUM Geodetic DATE 23.07.02 - 23.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
							20	40	60	80	100	WATER CONTENT (%) 20 40 60					
0.0	SAND, fine grained, trace silt, occasional iron oxide staining Reddish Brown																
0.6	SAND, fine grained, occasional silt clasts Compact Brown Dry to Moist occasional gravel at 1.52m		1	SS	19												
			2	SS	12												
2.2	Gravelly SAND, medium grained, trace silt Compact Brown Dry to Wet		3	SS	18												
			4	SS	12												
4.1	SAND, medium grained, occasional gravel Compact Brown Wet		5	SS	11												
5.2	END OF SAMPLING AT 5.18m. SAND HEAVING IN AUGERS DCPT STARTED AT 5.18 m.															24 73 3 (SI+CL)	

Continued Next Page

+³, X³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 10+451 R5

2 OF 2

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+451, O/S 5R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test (DCPT) COMPILED BY MF/SS
 DATUM Geodetic DATE 23.07.02 - 23.07.02 CHECKED BY JL


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
								20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
13.7	END OF DCPT AT 13.72m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH (m) 07/23/02 3.10 06/20/03 3.06												

RECORD OF BOREHOLE No S 10+725 L2.5

1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION Strong Township, ST. 10+725, O/S 2.5L ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MF/SS
 DATUM Geodetic DATE 24.07.02 - 24.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W P W W L					
							20	40	60	80	100	20	40	60				
0.0	Silty SAND Brown																	
0.6	Clayey SILT, trace sand Stiff to Very Stiff Grey Moist		1	SS	26													
			2	SS	10													
			3	SS	16													
			4	SS	10													
			5	SS	24													
	Heavy grinding at 3.7m, boulder encountered																	
6.1	END OF BOREHOLE AT 6.10 m. AUGER REFUSAL AT 6.10 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																	

ONTMT4 2312STRONG(52).GPJ 10/02/05

RECORD OF BOREHOLE No S 10+725 R46.5

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 10+725, O/S 46.5R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY MF/SS
 DATUM Geodetic DATE 27.07.02 - 24.07.02 CHECKED BY JL


SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)			
0.0	DCPT from surface.													
6.0	END OF DCPT AT 6.02m. CONE REFUSAL AT 6.02 m ON PROBABLE BEDROCK OR BOULDER.													

ONTMT4 2312STRONG(52).GPJ 14/09/04

RECORD OF BOREHOLE No S 10+745 R15.75 1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION Strong Township, ST. 10+745, O/S 15.75R ORIGINATED BY DP
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MF/SS
 DATUM Geodetic DATE 25.07.02 - 25.07.02 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
							20 40 60 80 100					20 40 60					
0.0	Silty SAND Brown																
0.6	Clayey SILT, trace sand Stiff to Very Stiff Grey Moist		1	SS	20												
			2	SS	9												
			3	SS	11												
			4	SS	9												
			5	SS	15												
6.4	SAND, fine to coarse grained, trace gravel Compact Brown Moist		6	SS	11												
6.7	END OF BOREHOLE AT 6.71 m. BOREHOLE OPEN TO 5.79 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS TO SURFACE.																

+³, ×³: Numbers refer to
Sensitivity

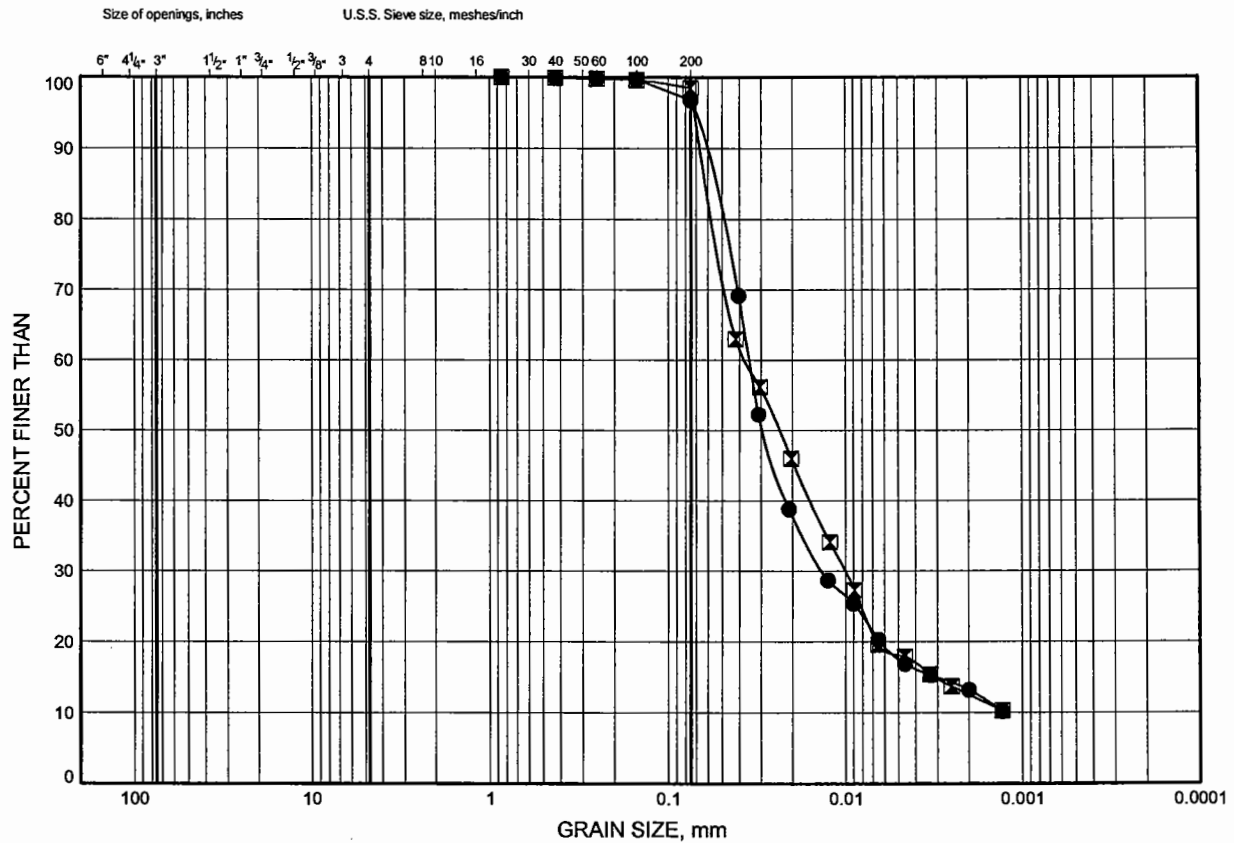
20
15
10

(%) STRAIN AT FAILURE

Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE C1

Silt

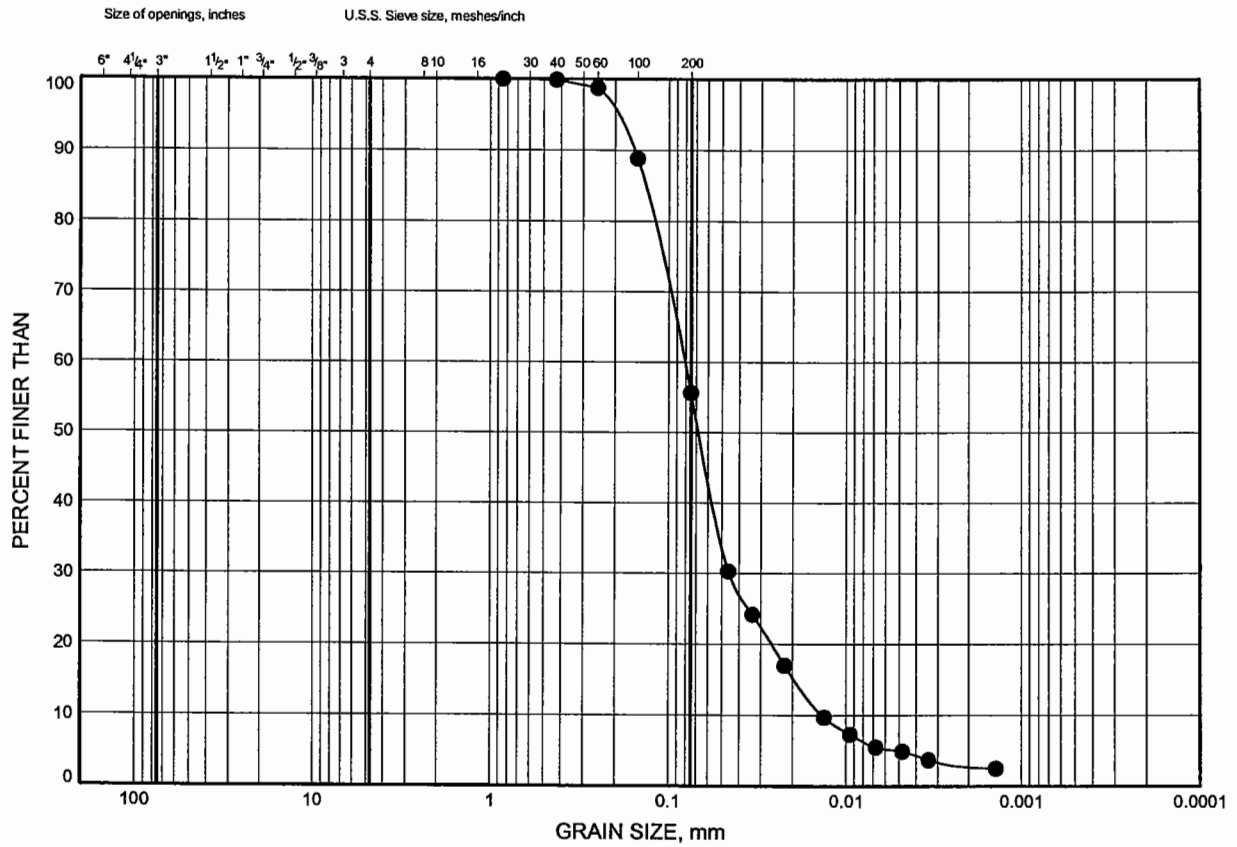


Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE C2

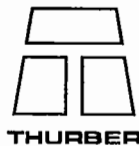
Silt and Sand



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	S 10+225 R30	1.83	

Date September 2004
Project 742-93-00

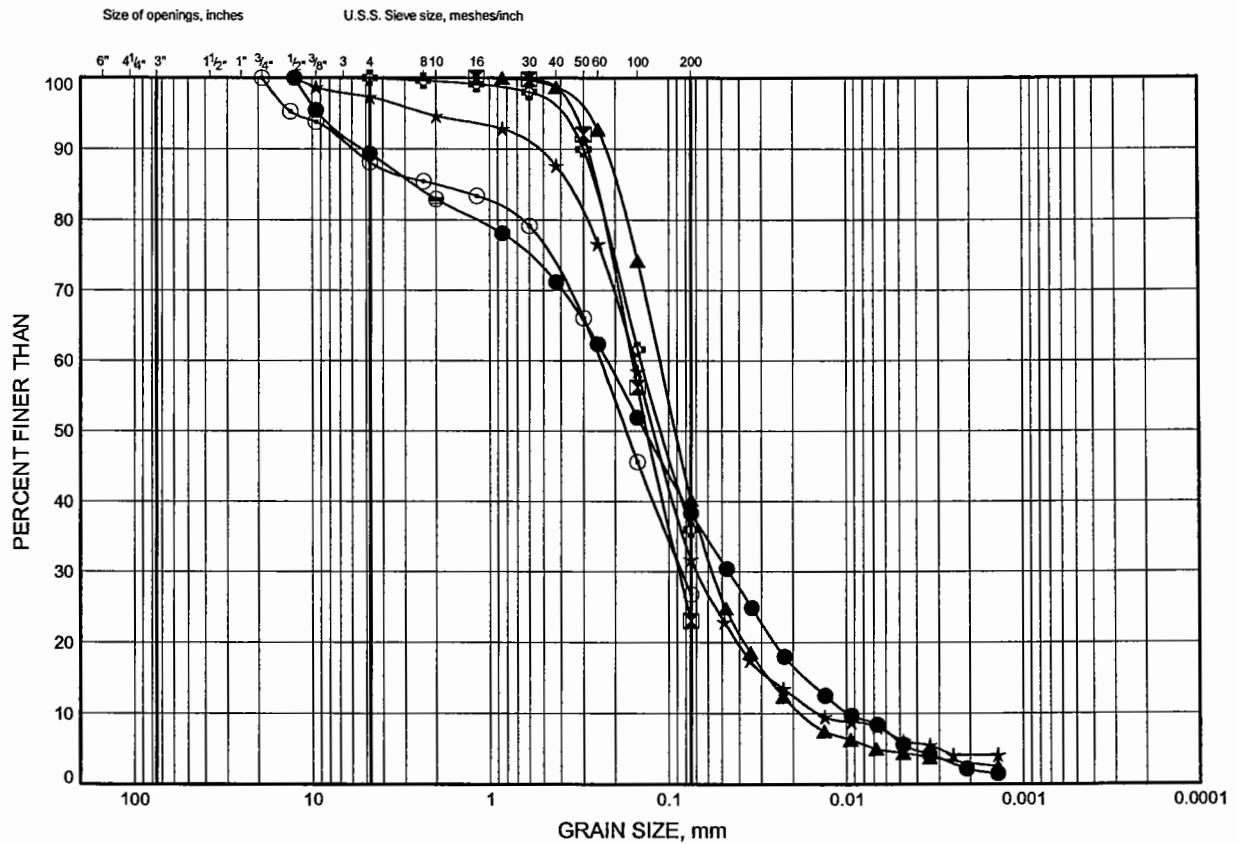


Prep'd WM
Chkd. JL

Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE C3

Silty Sand

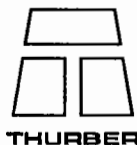


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	S 10+225 L18.75	3.35	
⊠	S 10+225 R30	6.40	
▲	S 10+275 R21.25	3.35	
★	S 10+325 L22.25	2.59	
⊙	S 10+325 R18.75	2.59	
⊞	S 10+418 L18.75	2.59	

Date September 2004

Project 742-93-00



THURBER

Prep'd WM

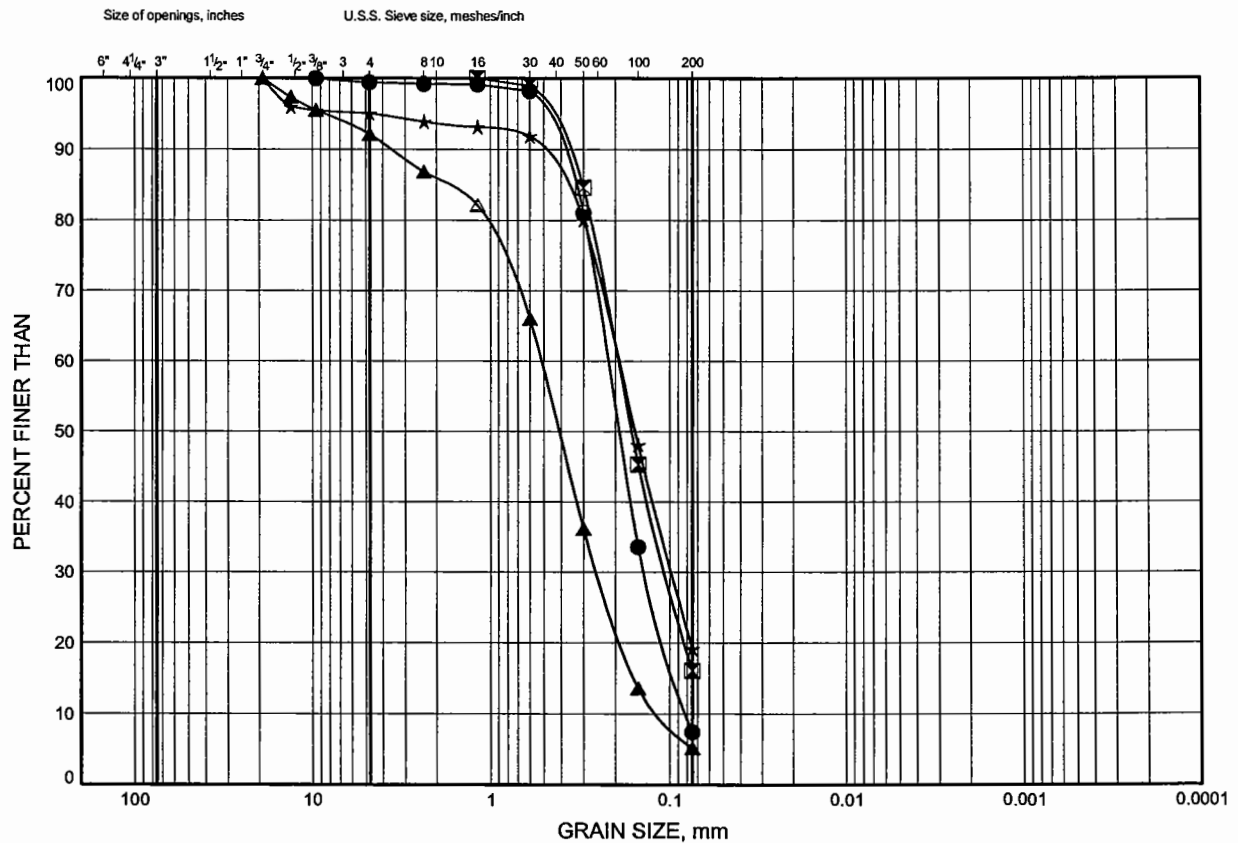
Chkd. JL

Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE C4

Sand



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	S 10+250 L5.5	2.59	
⊠	S 10+275 R21.25	4.88	
▲	S 10+300 CL	1.83	
★	S 10+348 L6	2.59	

Date September 2004

Project 742-93-00



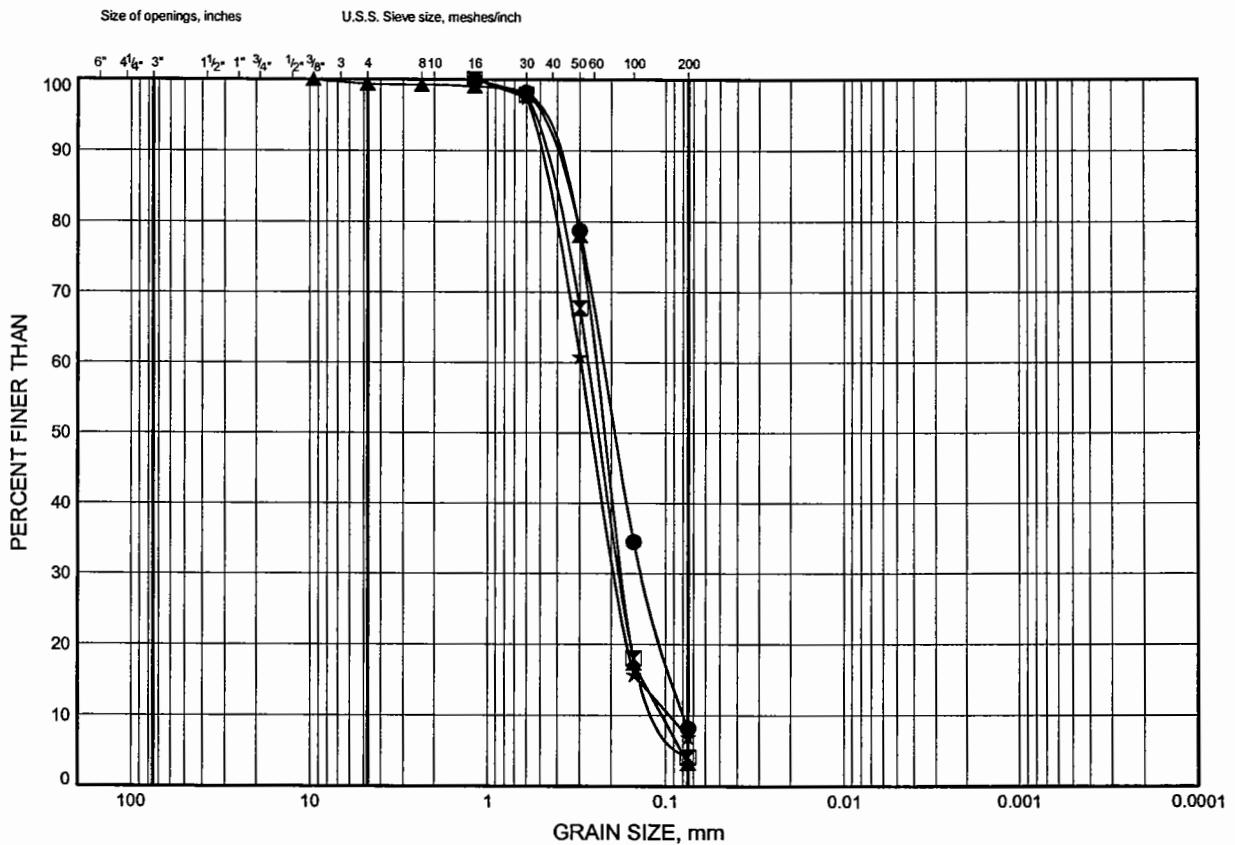
Prep'd WM

Chkd. JL

Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

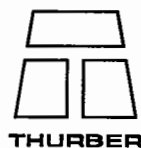
FIGURE C5

Sand



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	S 10+350 R50	2.59	
⊠	S 10+350 R50	7.92	
▲	S 10+375 L16.75	2.59	
★	S 10+425 R31.75	1.83	

Date September 2004
Project 742-93-00



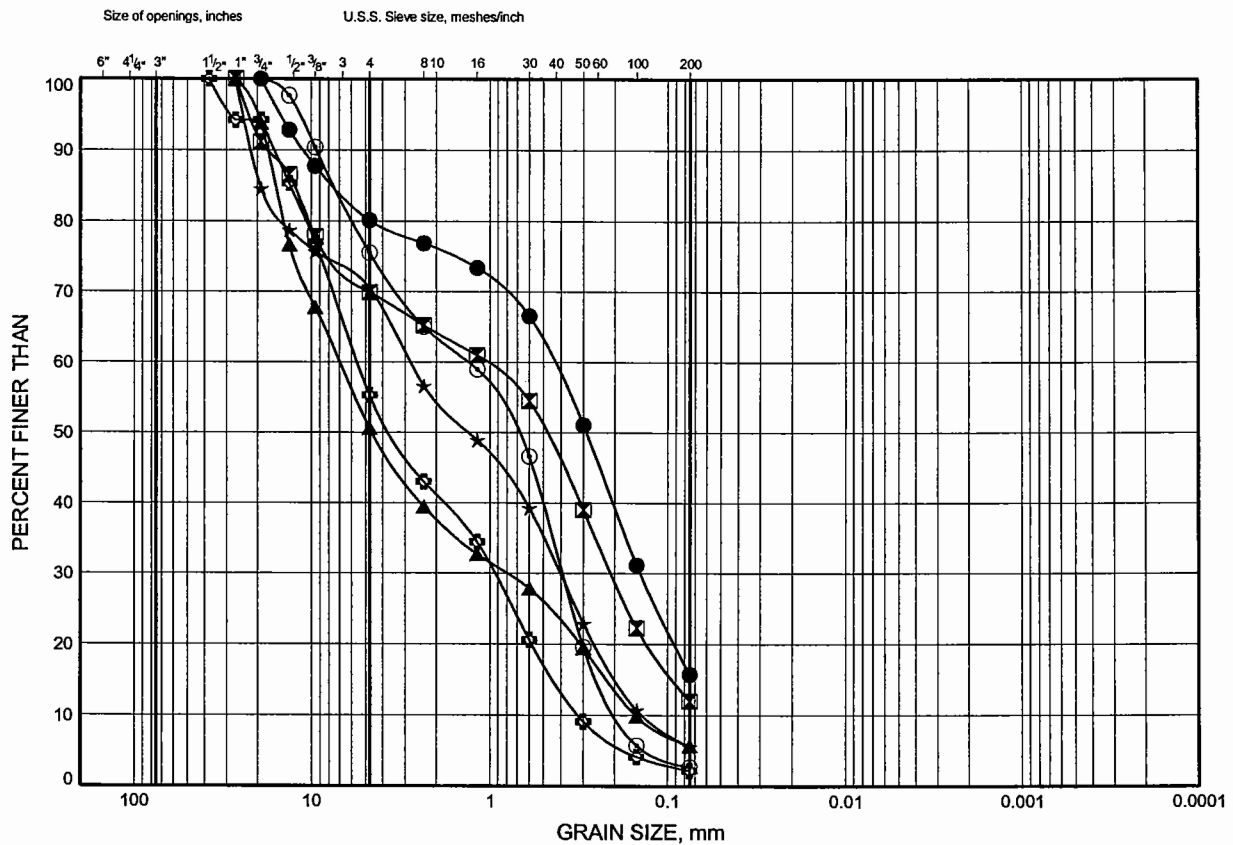
Prep'd WM
Chkd. JL

Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE C6

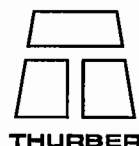
Gravelly Sand to Gravel and Sand



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	S 10+275 L18.75	1.07	
⊠	S 10+374 R18.75	4.88	
▲	S 10+400.5 L58.5	2.59	
★	S 10+418 L18.75	4.88	
⊙	S 10+451 R5	2.59	
⊕	S 10+700 R13.75	2.59	

Date September 2004
Project 742-93-00



Prep'd WM
Chkd. JL

Appendix D
Highway 11 Mainline, Strong Township, Sta. 11+075 to 11+225

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No S 11+075 L18.75

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 11+075, O/S 18.75L ORIGINATED BY MF
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 17.02.04 - 17.02.04 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)				
							20	40	60	80	100	W _P	W	W _L			
0.0	TOPSOIL Dark Brown																
0.8	Silly SAND, fine grained Compact to Very Loose Brown Dry to Wet		1	SS	12								○				
			2	SS	19								○				
			3	SS	10								○				
			4	SS	5								○				
			5	SS	3								○				
			6	SS	3								○				
6.6	SAND, medium to coarse grained, trace silt Very Loose Brown Wet																
7.2	END OF BOREHOLE AT 7.16 m. AUGER REFUSAL AT 7.16 m ON PROBABLE BEDROCK OR BOULDER. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m)																

ONTMT4 2312STRONG(52).GPJ 11/09/04

+ 3 . × 3 : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 11+075 R15

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 11+075, O/S 15R ORIGINATED BY MF
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 17.02.04 - 17.02.04 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa 20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%) 20 40 60 W _p W W _L				
0.0	TOPSOIL Dark Brown																
0.6	Silty SAND, fine grained Loose to Compact Brown Dry to Moist		1	SS	7												
			2	SS	20												
	Boulder from 2.28 m to 2.44 m		3	SS	50/												
2.7	END OF BOREHOLE AT 2.74 m. AUGER REFUSAL AT 2.74 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 2.44 m AND WATER LEVEL AT 2.44 m UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.																

+³, x³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 11+075 R35

1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION Strong Township, ST. 11+075, O/S 35R ORIGINATED BY MF
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 17.02.04 - 17.02.04 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								20 40 60 80 100										
0.0	TOPSOIL Dark Brown																	
0.3	Silty SAND, fine grained, occasional rock fragments Very Dense Brown Dry to Moist		1	SS	50/ .100													
1.2	SAND, medium to coarse grained, trace silt, occasional cobbles Very Dense Brown Moist		2	SS	50/ .150													
1.7	END OF BOREHOLE AT 1.68 m. AUGER REFUSAL AT 1.68 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 1.68 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.																	

RECORD OF BOREHOLE No S 11+120 L18.75

1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION Strong Township, ST. 11+120, O/S 18.75L ORIGINATED BY MF
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 17.02.04 - 17.02.04 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
								20	40	60	80	100								
0.0	TOPSOIL Dark Brown																			
0.6	SAND and SILT, fine grained Compact to Loose Brown Dry to Moist Becoming Wet below 1.5 m		1	SS	10									○						
			2	SS	17									○						
			3	SS	8									○			0 61 39 (SI+CL)			
			4	SS	12									○						
4.3	Gravelly SAND, medium to coarse grained, trace silt, occasional cobbles Compact Brown to Grey Wet		5	SS	27									○						
5.3	END OF BOREHOLE AT 5.33 m. AUGER REFUSAL AT 5.33 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 3.05 m AND WATER LEVEL AT 3.05 m UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.																			

+³, ×³: Numbers refer to
Sensitivity


20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No S 11+150 L5

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 11+150, O/S 5L ORIGINATED BY MF
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 17.02.04 - 17.02.04 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)				
								20 40 60 80 100										20 40 60				
								○ UNCONFINED + FIELD VANE														
								● QUICK TRIAXIAL x LAB VANE														
								20 40 60 80 100					20 40 60									
0.0	TOPSOIL Dark Brown SAND, fine grained, trace silt Compact Dark Brown to Brown Dry to Moist																					
0.1			1	SS	23																	
			2	SS	14																	
			3	SS	50/																	
					.050																	
2.4	END OF BOREHOLE AT 2.44 m. AUGER REFUSAL AT 2.44 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 2.44 m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.																					

0 94 6
(SI+CL)

RECORD OF BOREHOLE No S 11+175 L10

1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION Strong Township, ST. 11+175, O/S 10L ORIGINATED BY MF
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 16.02.04 - 16.02.04 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	W _P	W	W _L	WATER CONTENT (%)		
0.0	TOPSOIL													
0.2	Dark Brown SILT and SAND, fine grained Loose Brown Dry to Moist		1	SS	7									0 38 60 3
1.5	SAND, fine grained, trace silt, occasional iron oxide staining Compact to Loose Brown Dry to Wet		2	SS	12									
			3	SS	6									
			4	SS	4									
			5	SS	9									0 96 4 (SI+CL)
			6	SS	5									
6.7	END OF BOREHOLE AT 6.71 m. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m)													

ONTMT4 2312STRONG(52).GPJ 10/02/05

RECORD OF BOREHOLE No S 11+200 L40

1 OF 1

METRIC

G.W.P. 742-93-00 LOCATION Strong Township, ST. 11+200, O/S 40L ORIGINATED BY MF
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 16.02.04 - 16.02.04 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								20 40 60 80 100						
								20 40 60 80 100						
								20 40 60 80 100						
								20 40 60 80 100						
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RECORD OF BOREHOLE No S 11+150 L40

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 11+150, O/S 40L ORIGINATED BY MF
HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM
DATUM Geodetic DATE 17.02.04 - 17.02.04 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _P	W	W _L		
0.0	DCPT started at 1.22 m																
3.3	END OF DCPT AT 3.25 m. CONE REFUSAL AT 3.25 m ON PROBABLE BEDROCK OR BOULDER.																

ONTMT4 2312STRONG(52).GPJ 11/09/04

RECORD OF BOREHOLE No S 11+225 L20

1 OF 1

METRIC

W.P. 742-93-00 LOCATION Strong Township, ST. 11+225, O/S 20L ORIGINATED BY MF
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 16.02.04 - 16.02.04 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20	40	60	80	100								
								○ UNCONFINED	+	FIELD VANE										
								● QUICK TRIAXIAL	×	LAB VANE										
								20	40	60	80	100								
0.0	TOPSOIL Dark Brown																			
0.3	SAND, fine grained, trace silt, trace gravel Very Loose to Compact Brown Dry to Wet		1	SS	3															
			2	SS	9															
			3	SS	10															
			4	SS	13															
4.1	SAND and SILT, fine grained Loose Brown Wet		5	SS	4															
			6	SS	9															
			7	SS	6															
8.2	END OF BOREHOLE AT 8.23 m. BOREHOLE OPEN TO 3.05 m AND WATER LEVEL AT 3.05 m UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.																			

+ 3, × 3: Numbers refer to
Sensitivity

20
15
10
5
0
(%) STRAIN AT FAILURE

FIGURE D1

Size of openings, inches

U.S.S. Sieve size, meshes/finch

6" 4 1/4" 3" 1 1/2" 1" 3/4" 1/2" 3/8" 3 4 8 10 16 30 40 50 60 100 200

PERCENT FINER THAN


100 90 80 70 60 50 40 30 20 10 0

GRAIN SIZE, mm

100 10 1 0.1 0.01 0.001 0.0001

COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	S 11+175 L10	1.07	



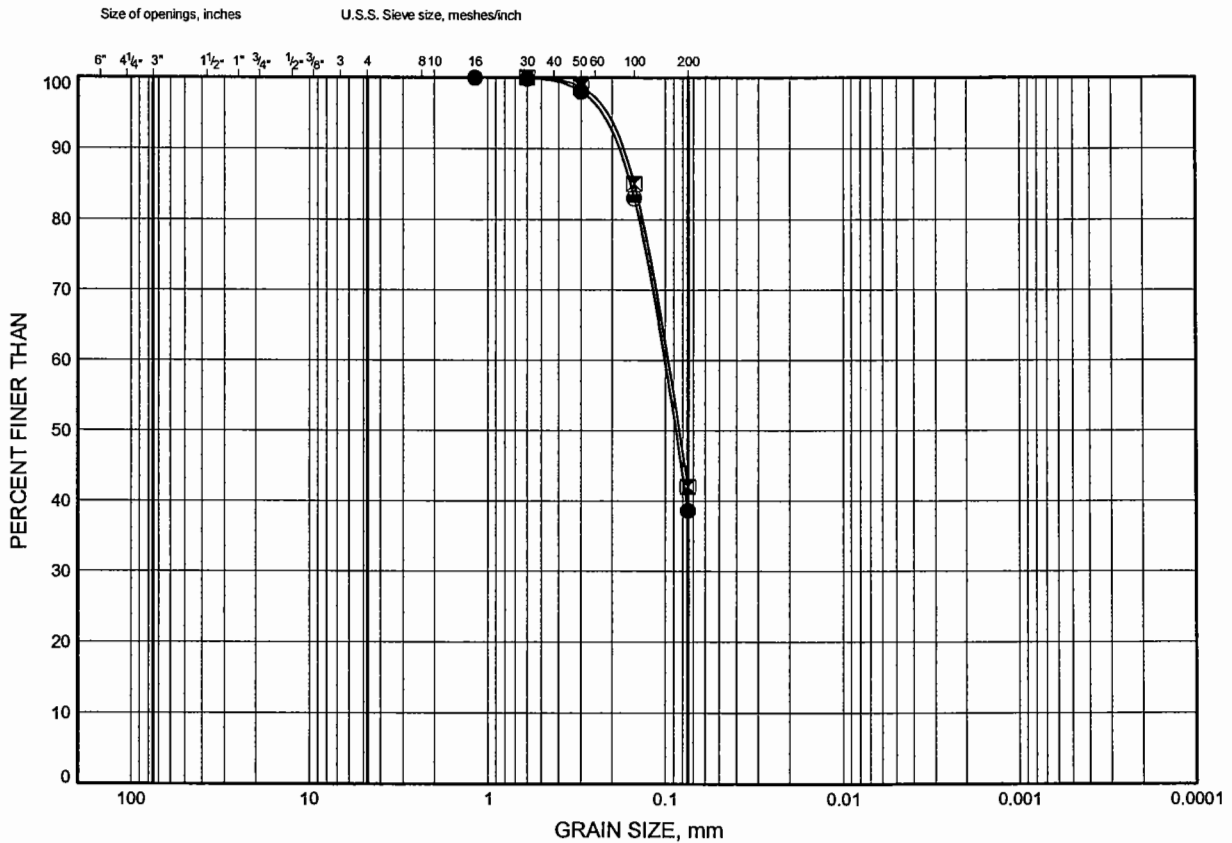
Chkd. JL.....

Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE D2

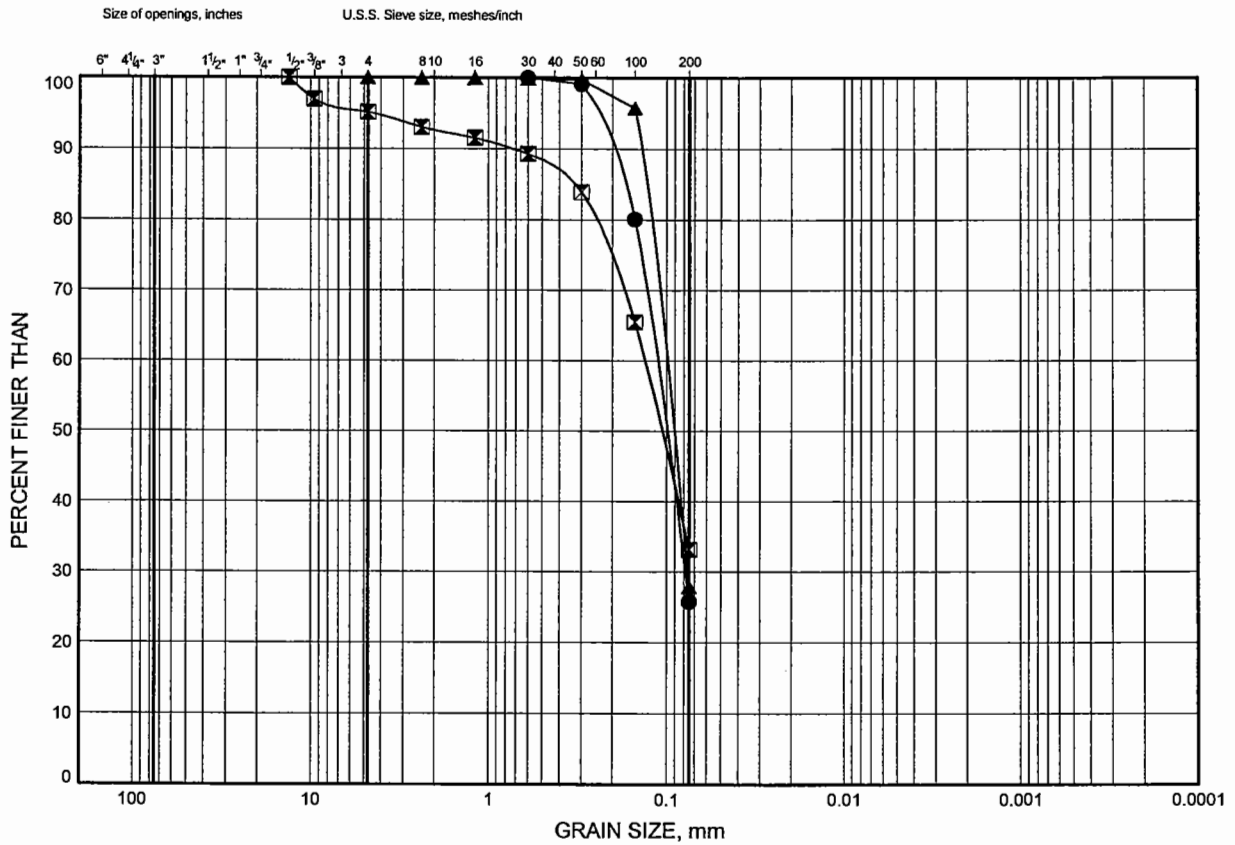
Sand and Silt



Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE D3

Silty Sand



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	S 11+075 L18.75	3.35	
◻	S 11+200 L40	3.35	
▲	S 11+200 L40	6.40	

Date September 2004

Project 742-93-00



Prep'd WM

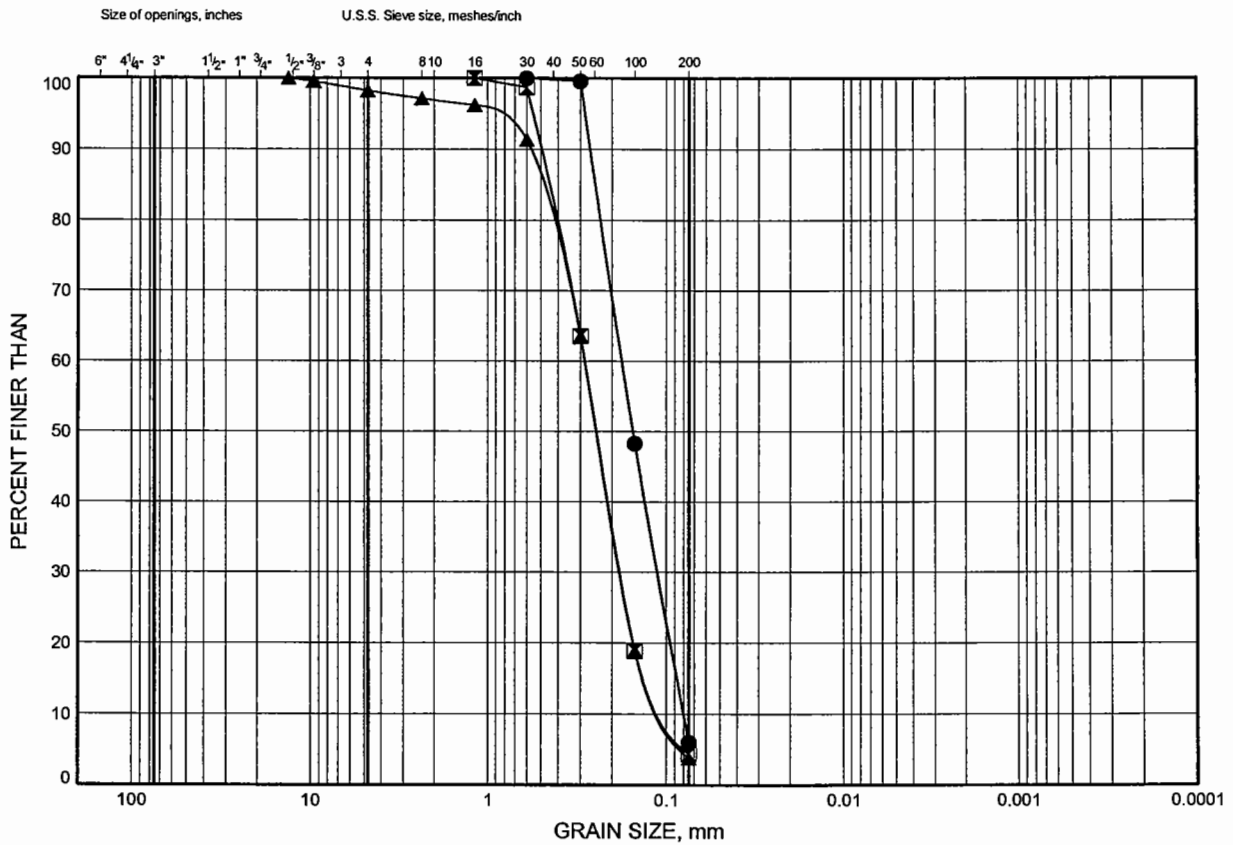
Chkd. JL

Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE D4

Sand

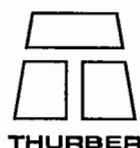


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	S 11+150 L5	1.83	
⊠	S 11+175 L10	4.88	
▲	S 11+225 L20	2.59	

Date September 2004

Project 742-93-00



Prep'd WM

Chkd. JL