APPENDIX K

Geotechnical Investigation Report

PAVEMENT DESIGN REPORT

DERRY ROAD (Regional Road 7)
TRANSPORTATION CORRIDOR IMPROVEMENTS

From Milborough Town Line (Regional Road 24) to west of McNiven Road

July 22, 2010

Submitted to:

R and R Associates Inc.

and

The Regional Municipality of Halton
Transportation Services Division

ARA Project Number: 000548

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July 22, 2010

DERRY ROAD (REGIONAL ROAD 7)
FROM MILBOROUGH TOWN LINE (REGIONAL ROAD 24)
TO WEST OF McNIVEN ROAD
CITY OF BURLINGTON
TRANSPORTATION CORRIDOR IMPROVEMENTS
ENVIRONMENTAL STUDY

THE REGIONAL MUNICIPALITY OF HALTON

Submitted to:

R and R Associates Inc.

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EXECUTIVE SUMMARY

Applied Research Associates Inc. (ARA) was retained by the Regional Municipality of Halton to provide pavement engineering services in support of the Derry Road (Regional Road 7) Transportation Corridor Improvements Environmental Assessment Study (EA Study). The study limits for the EA study extends from Milborough Town Line (Regional Road 24) to McNiven Road, while the investigation limits of this report extended from Milborough Town Line to west of McNiven Road in the City of Burlington, Ontario. This corridor improvement study was initiated to improve the structural and capacity deficiencies of Derry Road, in an attempt to meet regional design standards.

It is understood that the roadway will likely remain as a two-lane facility; however, platform widening will be required from the existing 3.3 m through lanes with no shoulders, to 3.65 m through lanes with 2.5 m shoulders. Furthermore, some minor horizontal alignment improvements are anticipated as part of this study. The purpose of this assignment was to determine the current condition of the existing in-place pavements at tie-in locations, and assess the subgrade conditions that would affect the proposed corridor improvements.

The pavement surface on Derry Road was found to be in relatively very good condition, with almost no distresses. Similarly, Milborough Line and McNiven Road were also found to be in good condition; however, the pavement surface on McNiven Road appeared to be surface treatment. Although currently in good condition, the flexible pavement section on Derry Road was generally considered to be structurally deficient to support the anticipated future traffic loadings.

In consideration of the structural deficiencies, and the thin granular base/ subbase of the existing pavement structure, full reconstruction of the existing pavement section should be considered. Based on the parameters presented above, new minimum pavement designs were developed. After consideration of the anticipated traffic volumes, the following pavement structure will be required.

50 mm	Superpave 12.5 FC1
70 mm	Superpave 19
150 mm	Granular A Base
300 mm	Granular B Subbase

This report provides preliminary recommendations for the rehabilitation/widening of Derry Road.

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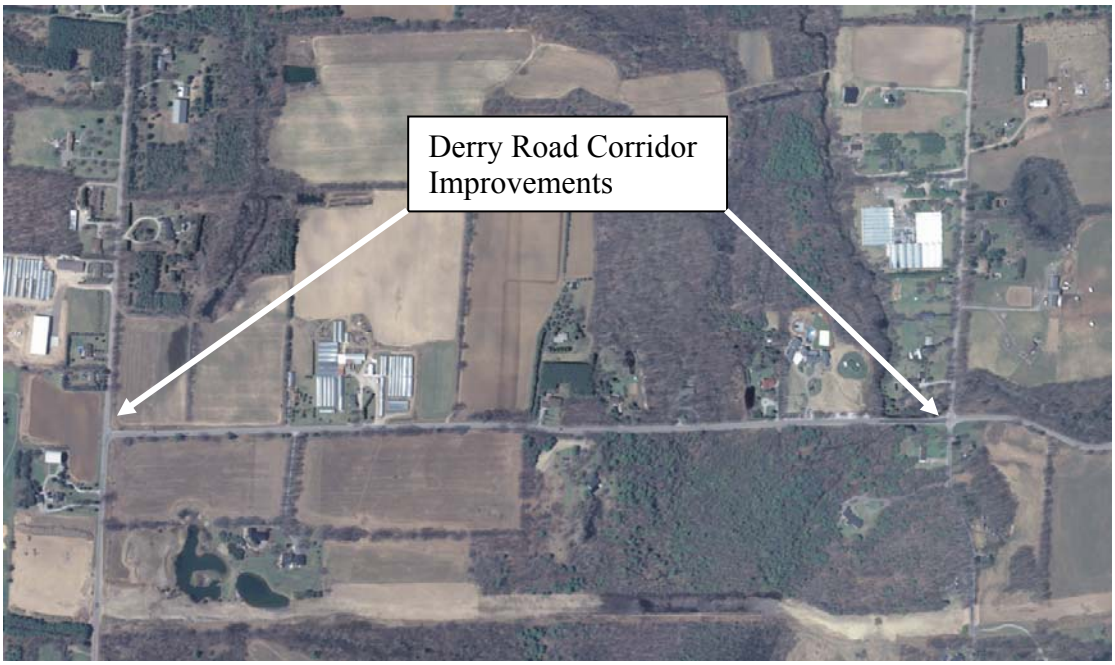
THE REGIONAL MUNICIPALITY OF HALTON



1.0 INTRODUCTION

Applied Research Associates Inc. (ARA) was retained by the Regional Municipality of Halton to provide pavement engineering services in support of the Derry Road (Regional Road 7) Transportation Corridor Improvements Environmental Assessment Study (EA Study). This corridor improvement study was initiated to improve the structural and capacity deficiencies of Derry Road, in an attempt to meet regional design standards.

The Halton Region Transportation Master Plan (2007 Update) has identified the need to improve Derry Road (Regional Road 7) from Milborough Town Line (Regional Road 24) to McNiven Road, in the City of Burlington. The Derry Road corridor within the study limits is functionally designated as a Major Arterial roadway. The subject section of roadway is approximately 1.4 km long.

It is understood that the roadway will likely remain as a two-lane facility; however, platform widening will be required from the existing 3.3 m through lanes with no shoulders, to 3.65 m through lanes with 2.5 m shoulders. Furthermore, some minor horizontal alignment improvements are anticipated as part of this study.

The ARA scope of work for this assignment included:

- An evaluation of the functional adequacy of the existing pavement,
- A subsurface investigation to confirm the as-built pavement thickness,
- Identification of bedrock locations along the existing roadway, and
- Development of an appropriate rehabilitation strategy to support future traffic loading.

2.0 INVESTIGATION METHODOLOGY

The field work component of this assignment examined the as-built pavement conditions along Derry Road. The investigation limits of this report extended from Milborough Town Line to west of McNiven Road. Boreholes were also advanced on both Milborough Town Line and McNiven Road to determine the existing thickness for tie in purposes. The investigation comprised the following tasks:

- A pavement surface condition survey to determine the location, extent, and severity of pavement distresses.
- Boreholes advanced to determine both the type and thickness of the existing pavement structure components, as well as the subgrade and groundwater conditions at the site.
- Laboratory classification testing of the granular road base and subgrade soils.

The pavement surface condition survey was carried out on October 1st, 2009. The survey consisted of an examination of the pavement surface noting the condition of the pavement and identifying areas of visual pavement distress and distortion. The survey was completed in general accordance with the *MTO Manual for Condition Rating of Flexible Pavements for Municipalities.* Photographs of typical pavement conditions are provided in Appendix A.

The geotechnical work for this investigation was carried out on November 9th, 2009 and comprised 4 pavement cores and 8 boreholes advanced to a depth of 1.5 m below existing grade. The boreholes were advanced using a track-mounted drill rig equipped with continuous flight solid stem augers, supplied and operated by Malone's Soil Samples Company Ltd. A member of ARA's technical staff provided full-time supervision of the drilling operations. The pavement cores have been logged and photographed, and are provided in Appendix B. The borehole logs summarizing the field work have been provided in Appendix C.

Representative samples of the granular base/subbase and subgrade materials encountered in the boreholes were retained for detailed visual examination and laboratory classification testing. Routine laboratory testing consisted of grain size analysis and moisture content determination. All laboratory test results are presented in Appendix D.

3.0 PHYSIOGRAPHIC SETTING

The site lies within the physiographic region known as the Peel Plain, *The Physiography of Southern Ontario, 3rd edition, L.J. Chapman and D.F. Putnam*. The underlying geological material of the Peel Plain consists of a variety of soil types. The soils are primarily comprised of tills, containing large amounts of clay and limestone with sandy areas near stream valleys. The frost penetration depth for the area is estimated to be 1.2 m.

4.0 SITE CONDITIONS

The intersection of Derry Road and Milborough Town Line was assumed to be Station 0+000, with chainage increasing in an easterly direction. Offset distances were referenced from the centreline of Derry Road.

4.1 Condition Survey

The pavement surface was found to be in very good condition, with few distresses. We suspect that the roadway was likely resurfaced within the last few years. Similarly,

Milborough Town Line and McNiven Road were also found to be in good condition. The pavement on McNiven Road appears to have been surface treated.

Photographs illustrating the visual condition of the pavement are presented in Appendix A.

4.2 Subsurface Conditions

Based on the results of the geotechnical field investigation, the as-built construction of Derry Road was found to comprise flexible pavement underlain by sandy silt / silty sand subgrade soils. A total of two pavement cores, and six boreholes were advanced on Derry Road, with an additional borehole on each of the two cross roads. A summary of the pavement structure thickness are provided in the table below.

Table 4.1. Pavement Structure Summary

Station	Direction	Thicknesses (mm)			Underlying Material
		Asphalt	Granular Base/ Subbase	Total	
Derry Road					
0+100	EB	80	470	550	Br Si(y) Sa Tr Gr
0+300	WB	100	320	420	Br Si(y) Sa
0+600	EB	120	580	700	Br Si(y) Sa Tr Gr
0+930	WB	90	310	400	Br Si(y) Sa Tr Gr
1+200	EB	150	100	250	Br Si(y) Sa Tr Cl
1+420	EB	180	120	300	Blk Si Tr Org
Milborough Line					
0+030	NB	160	100	260	Br F Sa(y) Si
McNiven Road					
0+020	NB	140	860	1000	Br Si(y) Sa Tr Cl

From Milborough Line to approaching McNiven Road, the pavement thickness on Derry Road varied with asphalt measurements from 80 to 120 mm, underlain by a crusher run limestone granular base and a crushed sand and gravel subbase. The thickness of the granular base was found to vary from 70 to 150 mm, while the thickness of the granular subbase varied from 170 to 450 mm.

Boreholes advanced beyond McNiven Road (Station 1+200 and 1+420) found thicker asphalt, in the range of 150 and 180 mm, respectively. However the granular base/subbase was found to be significantly less, with measurements of 100 and 120 mm.

The grain size analysis of selected granular base/subbase samples indicated that all of the samples were slightly finer than the OPSS Gradation requirements for Granular A, with as much as 19 percent passing the 75 μm sieve. We suspect that the auger sampling

procedure may have contributed to some breakdown of material, which would have increased the percentage of fines.

Underlying the pavement structure, the subgrade comprised brown sandy silt / silty sand, with traces of clay. Laboratory test results found the subgrade soil to be non-plastic. The in-situ moisture contents typically varied from 8 to 10 percent, however, localized wet areas were encountered with moisture contents as high as 21 percent. Based on the grain size distribution, the subgrade soils were considered to have low potential for frost susceptibility.

4.3 Groundwater Conditions

On completion of drilling, no free water was encountered at any of the borehole locations. From Milborough Town Line to McNiven Road, the subgrade soils were typically dry to moist. The regional groundwater table is considered to be lower than the depth investigated.

5.0 ENGINEERING CONSIDERATIONS

The Regional Municipality of Halton is considering infrastructure improvements within the project limits. These improvements are aimed to improve both traffic flow and safety in this corridor.

The structural adequacy of the existing pavement structure was evaluated to determine the suitability to support the anticipated future traffic loading. The designs were completed in accordance with the AASHTO *Guide for the Design of Pavement Structures, 1993*.

Key inputs for the pavement design include; subgrade support, pavement layer material types and thickness, current and projected traffic data including heavy vehicle volumes and distributions and consideration of the roadway classification and utilization. The input parameters used for design were selected based on recommended values provided in the MTO publication *Adaptation and Verification of the AASHTO Design Guide for Ontario Conditions* (MI-183). Details on the input data used for the pavement designs are given in the following sections.

5.1 Traffic Loading

The following traffic data was estimated based on the existing Average Annual Daily Traffic (AADT) information provided by R and R Associates, Inc. The traffic data is summarized in Table 5.1.

Table 5.1. Traffic Data

Road	2008 AADT	2021 AADT	2031 AADT
Derry Road	3,250	4,630	6,220
Cars (%)	97.2	96.0	96.0
Small Trucks (%)	1.2	2.0	2.0
Medium Trucks (%)	1.0	1.0	1.0
Heavy Trucks (%)	0.6	1.0	1.0

Based on the projected traffic volumes presented in Table 5.1, the growth rate from 2008 to 2031 was calculated to be about 2.9 percent. Also, anticipating that the corridor construction may not occur in the immediate future, a 2011 AADT of 3,550 was extrapolated and will be used as the initial traffic volume for pavement design.

The truck class distribution, and respective truck factors, used for this analysis is summarized in Table 5.2. The truck factors for Derry Road were estimated from Table 3-3 of the MTO publication MI-183.

Table 5.2. Assumed Truck Class Distribution

Truck Class	Truck Distribution	Truck Factor
Small Trucks (%)	50 %	0.47
Medium Trucks (%)	25 %	1.65
Heavy Trucks (%)	25 %	4.33

The AASHTO pavement design methodology measures the damaging effect of traffic loading using the concept of equivalent single axle loads (ESAL's). An ESAL is defined as an 80 kN single axle load. The projected traffic loading over a 20-year design period for Derry Road was calculated to be 1,150,000 ESALs, assuming a 50/50 directional split in traffic.

5.2 Pavement Structural Adequacy

To determine the structural adequacy of the existing pavement structure, a new pavement design was developed based on the roadbed soil support characteristics, along with the anticipated future traffic volume over a 20-year design period. The following inputs were chosen for calculation of the required structural number (SN_{des}) for flexible pavements based on the AASHTO methodology:

- Design ESAL's = 1,150,000
- Design period = 20 years
- Initial serviceability, Pi = 4.4
- Terminal serviceability, Pt = 2.2
- Subgrade resilient modulus = 40 MPa
- Reliability level, R = 90 percent
- Overall standard of deviation, S0 = 0.49
- HMA layer coefficient, ai = 0.42
- Granular A layer coefficient, ai = 0.14
- Granular B layer coefficient, ai = 0.09
- Drainage coefficient for all layers, mi = 1.0

In accordance with the 1993 AASHTO *Guide for Design of Pavement Structures*, and based on the estimated in-situ subgrade strength, along with the anticipated traffic loading over a 20-year design period, the SN_{des} for Derry Road was calculated to be 94 mm.

To determine the structural adequacy of the pavement, the effective structural number (SN_{eff}) is compared to the SN_{des} calculated above. If SN_{eff} is greater than SN_{des}, the pavement is considered to be structurally adequate.

Based on the as-built flexible pavement thickness presented in Table 4.1, and using structural layer coefficients for resurfacing existing pavements, the SN_{eff} was calculated for the existing pavement sections. The following layer coefficients were used:

- Existing hot mix asphalt in good condition 0.35
- Existing Granular Base/Subbase 0.10

The SN_{eff} was calculated and compared with the SN_{des} as presented in Table 5.3. Where existing pavement sections were considered to be structurally deficient, a minimum asphalt structural overlay thickness was determined.

The flexible pavement sections on Derry Road were generally considered to be structurally deficient to support the anticipated future traffic loadings.

Table 5.3. Structural Adequacy - Calculated SN_{eff} vs. SN_{des}

Station	Thickness (mm)		SN_{eff} (mm)	SN_{des} (mm)	Adequate	Min HMA Overlay (mm)
	HMA	Base				
Derry Road						
0+100	80	470	75	94	No	45
0+300	100	320	67	94	No	64
0+600	120	580	100	94	Yes	-
0+930	90	310	62.5	94	No	75
1+200	140	100	59	94	No	83
1+420	180	120	75	94	No	45

5.3 Rehabilitation of the Existing Pavement

The existing pavement is considered to be structurally inadequate to support the anticipated future traffic loading. Although the existing pavements are currently considered to be in good condition, it is expected that the pavement structure will deteriorate at an increased rate due to the structural deficiencies.

In consideration of the structural deficiencies, and the thin granular base/ subbase of the existing pavement structure, full reconstruction of the existing pavement section should be considered. Utilizing the same roadway and subgrade parameters detailed above, new minimum pavement designs were developed. Based on the anticipated traffic volumes, the following pavement structure will be required.

120 mm	HMA
150 mm	Granular A Base
300 mm	Granular B Subbase

Prior to the placement of the new pavement structure, the existing pavement platform should be pulverized (Full Depth In-Place Reclamation), and reused as granular subbase material. Pulverizing of the existing roadway should be carried out in accordance with OPSS 330, *Construction Specification for In-Place Reclamation of Bituminous Pavement and Underlying Granular*.

It is noted that the structural analysis of Derry Road was completed using the pavement layer thickness measured at the borehole locations. It is recommended that FWD testing be completed during the detailed design to the effective structural number of the in-place pavement structure. The results of the FWD testing can be compared to the required design structural number to ensure that reconstruction of the existing pavement structure remains to be the most practical alternative.

6.0 RECOMMENDATIONS

Although preliminary design drawings are currently being prepared, it is understood that the corridor between McNiven Road and Milborough Town Line (Regional Road 24) will likely remain as a two-lane facility, with a platform widening from the existing 3.3 m through lanes, with no shoulders, to 3.65 m through lanes with 2.5 m partially paved shoulders.

6.1 Rehabilitation of Derry Road

The recommended rehabilitation of existing pavement structure on Derry Road will comprise full reconstruction, with the placement of:

50 mm	Superpave 12.5 FC1
70 mm	Superpave 19
150 mm	Granular A Base
300 mm	Granular B Subbase

The existing pavement structure should be pulverized (Full Depth In-Place Reclamation), with the pulverized material reused as granular subbase material.

6.2 New Shoulder Design

The recommended pavement structure for the partially paved shoulders shall consist of:

50 mm	Superpave 12.5 FC1
70 mm	Superpave 19
150 mm	Granular A Base
300 mm	Granular B Subbase

Beyond the paved portion of the shoulder, the new shoulder shall consist of granular material, with a recommended pavement structure of:

270 mm	Granular A Base
300 mm	Granular B Subbase

6.3 Transition Treatments

Smooth transitions will be required where the new pavement meets the existing pavement at the limits of the work project. Under no circumstances should feather-edge joints be allowed.

At the ends of the work project, the tie-ins at the existing pavement should be cold planed to a depth of 50 mm, full width, to ensure that the new surface course can be placed flush with the top of the existing pavement surface. A tack coat should be utilized whenever a new asphalt layer is placed on cold, or existing, asphalt courses and at all tie-ins and vertical surfaces.

When transitioning the various pavement sections at each leg of the intersections, it is important that smooth grade transitions are maintained through the intersection. This would include minor adjustments to both the milling and paving thickness to match grades. Changes in asphalt thickness can be done with either the surface course (SP 12.5 FC1), or with the SP 19 binder layer, however, layer thicknesses must still remain within the layer tolerances for each material. Paving tolerances for the SP 12.5 FC1 layer must remain between 35 and 60 mm, while the paving thickness for the SP 19 layer must remain between 50 and 75 mm.

6.4 Pavement Drainage

Pavement life is a function of a number of factors, including drainage. Provision must be made to ensure that water drains out of the pavement structure. This can be achieved by ensuring that the subgrade is crowned with positive drainage towards the edge of shoulders and that all ditches are of sufficient depth.

All new ditch construction shall be as per OPSD 200.010. For design purposes, ditch depth = d +0.5 m, where d = thickness of the pavement structure. All ditches should also be constructed to tie-in with the adjacent drainage patterns.

6.5 Materials

6.5.1 New Construction Materials

All HMA materials should meet the requirements of the Regional Municipality of Halton Specifications for Hot Mix Asphalt Paving, Materials, Sampling, and Testing and be compacted to at least 97 percent of the Marshall density. PG 64-28 asphalt cement is recommended for all mixes.

It is our understanding, that Halton Region has recently encountered problems with the use of Superpave Mix designs and has decided to resort back to Marshall Mix designs for all Halton Region projects. Should the Region elect to use Marshall asphalt mixtures for this project, comparable mixes include an HL3 (HS) mix to replace the SP 12.5FC1 surface course, and an MDBC to replace the SP 19 mm.

All granular base and subbase materials should meet the requirements of OPSS 1010 and be compacted to at least 100 percent of the standard Proctor density.

6.5.2 Recycling Existing Materials

The existing asphalt materials can be pulverized and recycled into granular subbase materials, provided gradation specifications are met.
Recycled asphalt pavement (RAP) can also be used in the new binder course asphalt mix. In accordance with Region of Halton specification requirements, PG 58-34 asphalt cement will be required for RAP mixes containing in excess of 20 percent of RAP materials.

7.0 CLOSURE

The recommendations provided in this report are for the use of the Regional Municipality of Halton, and their design engineers. It is very important to point out that if traffic estimates, and hence, traffic loadings vary significantly from the predicted value, the recommendations for pavement construction and rehabilitation will change accordingly.

It is recommended that a supplemental detailed investigation and assessment (including FWD testing) be carried out prior to designing the proposed long term corridor improvements of Derry Road. Details of the investigation and the recommendations given in this report are considered to be complete. However, should any questions arise, please do not hesitate to contact our office.

Sincerely,
Applied Research Associates, Inc.

Mark Popik, M.Eng., P.Eng.
Senior Engineer

8.0 REFERENCES

American Association of State Highway and Transportation Officials, *AASHTO Guide for the Design of Pavement Structures-1993*, Washington, DC, 1993.

Hajek, J. et al., *Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions*, Materials Engineering and Research Office (MERC) Pavements and Foundations Section, March 2001.

Ontario Ministry of Transportation, *Pavement Design and Rehabilitation Manual*, SDO-90-01, 1990.

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APPENDIX A

Photographs of Typical Pavement Conditions

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APPENDIX A
Derry Road Transportation Corridor Improvements
Photographs of Typical Pavement Features

	**Photograph 1** **Derry Road** **Station 0+000** Looking eastward from the intersection with Milborough Town Line.
	**Photograph 2** **Derry Road** **Station 0+300** Looking eastward.

APPENDIX A
Derry Road Transportation Corridor Improvements
Photographs of Typical Pavement Features

	**Photograph 3** **Derry Road** **Station 0+600** At borehole location, looking eastward.
	**Photograph 4** **Derry Road** **Station 0+930** Looking eastward.

APPENDIX A
Derry Road Transportation Corridor Improvements
Photographs of Typical Pavement Features

	**Photograph 5** **Derry Road** **Station 1+000** Approaching the intersection of McNiven Road, looking eastward.
	**Photograph 6** **Derry Road** **Station 1+420** Looking eastward.

APPENDIX A
Derry Road Transportation Corridor Improvements
Photographs of Typical Pavement Features

	**Photograph 7** **Milborough Line** On the northbound approach to Derry Road.
	**Photograph 8** **McNiven Road** On the southbound approach to Derry Road.

APPENDIX B

Core Logs and Photographs

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APPENDIX B
Derry Road Transportation Corridor Improvements
Core Logs and Photographs

Core Photograph 1
Derry Road
Station 0+930 WB Lane

Surface	40
Binder	50
Total	**90 mm**

Core Photograph 2
Derry Road
Station 1+200 EB Lane

Surface	30
Surface	40
Surface	30
Surface*	40
Total	**140 mm**

Note: * - layer may be comprised of multiple surface treatment layers.

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APPENDIX C

Borehole Logs

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APPENDIX C
Derry Road Transportation Corridor Improvements
Borehole Logs

DERRY ROAD

0+100 EB 1 m Lt OEP D 0

0	- 80	Asph		
80	- 550	CRL		
550	- 1000	Br Si(y) Sa Tr Gr		dry
1000	- 1500	Br Si(y) F Sa		dry
		w @ 1.3 m	=	8%

0+300 WB 1 m Lt OEP D 0

0	- 100	Asph		
100	- 250	CRL		
250	- 420	Br Cr Sa and Gr		moist
		4.75 mm	=	46%
		75 µm	=	16%
420	- 1000	Br Si(y) Sa		dry
1000	- 1500	Br F Sa		dry
		w @ 1.3 m	=	10%

0+600 EB 1 m Lt OEP D 0

0	- 120	Asph		
120	- 700	CRL		
700	- 1500	Br Si(y) Sa Tr Gr		dry
		w @ 1.1 m	=	8%

0+930 WB 1 m Lt OEP D 0

0	- 90	Asph		
90	- 160	CRL		
160	- 400	Br Cr Sa and Gr		moist
400	- 750	Br Si(y) Sa Tr Gr		moist
750	- 1000	Br Si(y) Sa Tr Cl		dry
1000		NFP		

1+200 EB 1 m Lt OEP D 0

0	- 140	Asph		
140	- 250	Br Cr Sa and Gr		
250	- 1500	Br Si(y) Sa Tr Cl		dry

1+420 EB 1 m Lt OEP D 0

0	- 180	Asph		
180	- 300	Br-Blk Cr Si(y) Sa and Gr		
300	- 600	Blk Si Tr Org		
600	- 1000	Br Si(y) Sa		moist
1000	- 1500	Br Si(y) Sa		wet
		w @ 1.3 m	=	21%

MILBOROUGH LINE

0+030 NB 1 m Rt OEP D 0

0	- 160	Asph		
160	- 260	Br Cr Sa and Gr		
260	- 1500	Br F Sa(y) Si		dry
		w @ 880 mm	=	8%

McNIVEN ROAD

0+020 NB 1 m Lt OEP D 0

0	- 140	Asph		
140	- 200	Br Cr Sa and Gr		
200	- 1000	Br Sa and Gr		dry
		4.75 mm	=	59%
		75 µm	=	19%
1000	- 1500	Br Si(y) Sa Tr Cl		wet
		w @ 1.3 m	=	21%
		4.75 mm	=	90%
		75 µm	=	37%
		4.7 µm	=	10%

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APPENDIX D

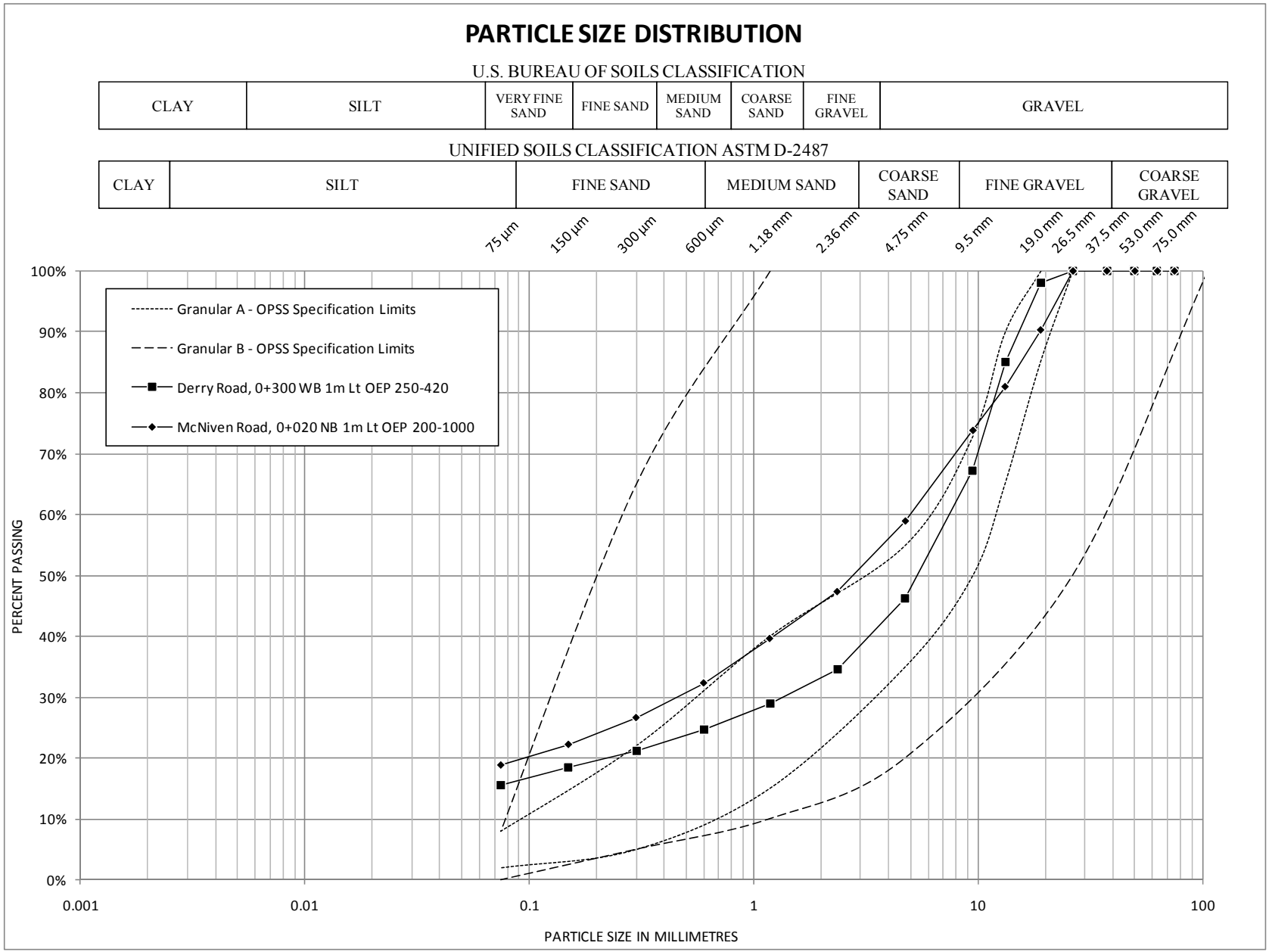
Laboratory Test Results

APPENDIX D
Derry Road Transportation Corridor Improvements
Laboratory Test Results

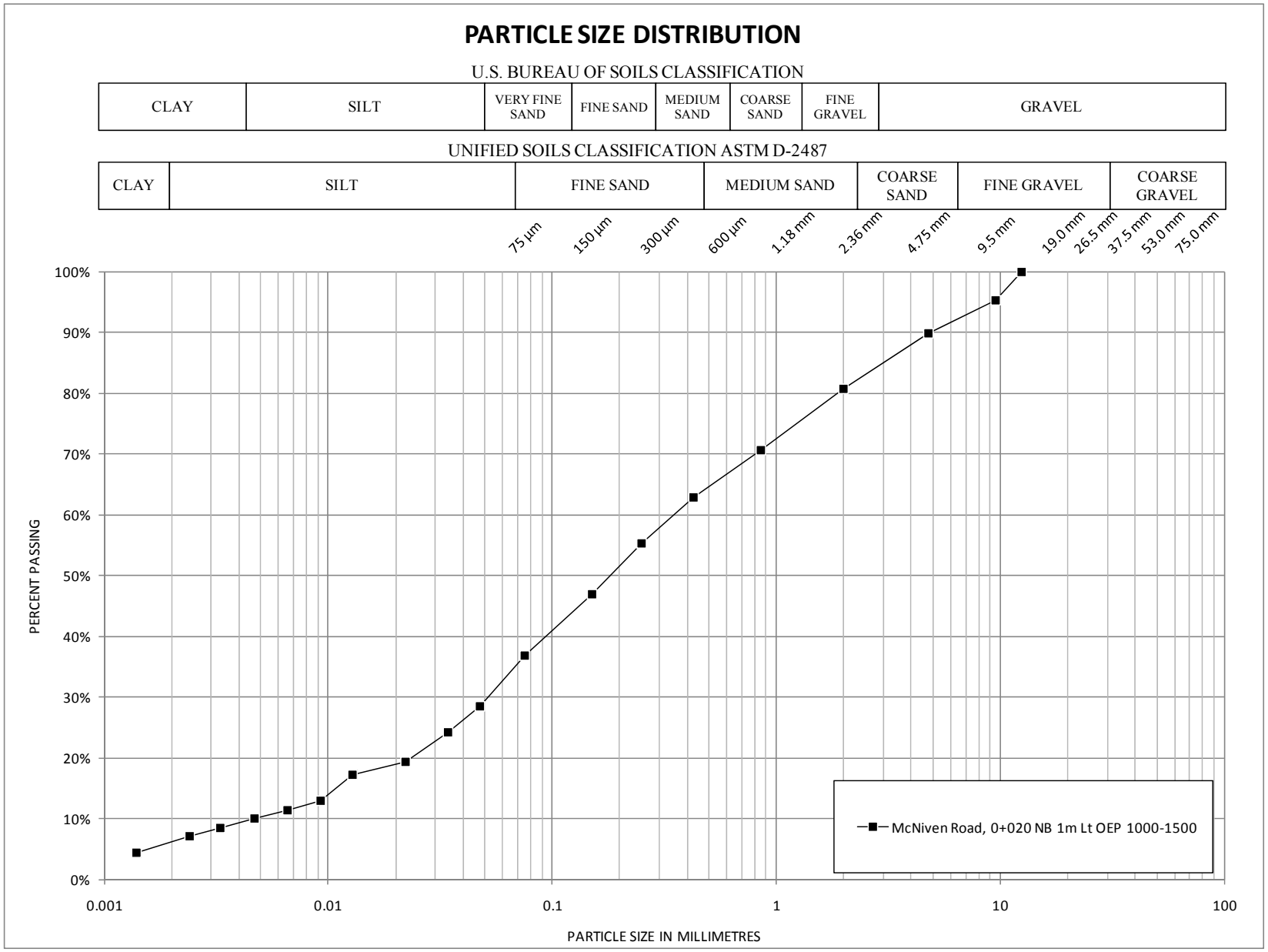
Station	Direction	Depth (mm)			Field Classification	Percent Passing (%)	
						4.75 mm	75 µm
Derry Road							
0+300	WB	250	-	420	Br Cr Sa and Gr	46	16
McNiven Road							
0+020	NB	200	-	1000	Br Sa and Gr	59	19

Station	Direction	Depth (mm)			Field Classification	Percent Passing (%)			Si & VFS	Water Content (%)	Frost Susceptibility	Soil Erodibility Factor, K
						4.75 mm	75 µm	5 µm				
McNiven Road												
0+020	NB	1000	-	1500	Br Si(y) Sa Tr Cl	90	37	10	27	21	LSFH	0.20

APPENDIX D
Derry Road Transportation Corridor Improvements
Laboratory Test Results



APPENDIX D
Derry Road Transportation Corridor Improvements
Laboratory Test Results



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