

66-F-251M

PORT BURWELL BRIDGE

ELGIN COUNTY

B.H. 2433
Site 5-157

66-F-251M

Preliminary Engineering Report

for

The Port Burwell Bridge

in the

County of Elgin

Introduction and Scope of Report

This brief report discusses the proposed construction of The Port Burwell Bridge in The County of Elgin.

Location

The proposed structure is located on Elgin County Road # 42 where it crosses The Big Otter Creek and the Canadian Pacific Railway line in the Village of Port Burwell.

Owner

The structure is known as The Port Burwell Bridge and is also known as Bridge # 50 in the County of Elgin Road Needs Study.

Design Data

(A) Existing Structure

The existing bridge is a steel truss, single span bridge and has the following particulars:

Construction year 1910

Total span 133'

Width of Bridge 18' plus cantilivered sidewalk

Width of Roadway 15'

(A) Existing Structure (Cont'd)

Vertical clearance 15' - 10"

Vertical clearance between soffit and water level
is 10.7 feet

Load restrictions 20 tons.

(B) Traffic

The 1964 A.A.D.T. was 1,310 vehicles per day
Estimated 1986 A.A.D.T. is 3,300 vehicles per day. Truck
movements are of particular interest because the harbour
handles coal shipments and the trucks transport the coal
from Port Burwell to other area centres resulting in heavy
truck traffic. The coal is stock-piled on both sides of
the river, but the weigh scales are located only on one
side, resulting in considerable local truck traffic over
the structure.

Future traffic projections should consider the following
factors:

- (a) An increase in tourist volumes attracted by
new developments in the beach area by the
Provincial Government.
- (b) An increase in pleasure boat facilities.
- (c) Possible future upstream developments.
- (d) An increase in coal shipments.
- (e) Normal growth of vehicles used by local
residents.

(C) Railway

The Canadian Pacific Railway line from Ingersoll terminates at Port Burwell, where it has a station with about 12 shunting tracks. These and other railway facilities are located beside the easterly shore of The Big Otter Creek and south of existing bridge. At present, there are two scheduled trains per day.

(D) Hydrology

Big Otter Creek is a slow running water course without any falls from Vienna (about 4 miles from the mouth) downstream and as such it is navigable. However, the depth of water, which decreases with the distance from the creek's mouth makes the use of this creek rather limited. Dredging carried out by The Department of Public Works allows medium sized lake boats to go upstream as far as The County Road structure which has a vertical clearance of 10.7 feet between the soffit of the present structure and the water level.

The winding Big Otter Creek has eroded a relatively wide valley and a fairly wide flood plain exists at its mouth. No unusual ice or debris problems exist. The mean water level in the creek at the proposed structure site is determined by the water level in Lake Erie which is only a short distance downstream.

(D) Hydrology (Cont'd)

The upstream drainage area is approximately 290 square miles.

Hydraulic calculations indicate a need for a waterway opening of approximately 2,700 square feet. Information and evidence of extreme flooding was obtained from local residents and from The County of Elgin and indicates a water rise of 10 feet.

Upstream structures:

- (1) 3.5 miles upstream at Vienna, Bridge on Hwy. # 19, 5 span concrete structure 10', 40', 80', 40' and 10' respectively, built about 1940 \pm 16' underside of deck to streambed.
- (2) 4.0 miles upstream at Vienna, Bridge on Highway # 19, 5 span concrete structure, 7', 40', 70', 40' and 7' respectively, built about 1940 \pm 17' underside of deck to streambed.
- (3) 4.5 miles upstream at Vienna, Elgin County Bridge # 52 steel truss, 104' span, 19.5' underside of deck to streambed. Age 40 years \pm - 2' U/S truss to H.W.L. Moved from Highway # 19 in 1947.

Soil and Terrain

The terrain in the vicinity of Port Burwell is physiographically known as The Norfolk sand plain. It is flat and about 100' above the water level of Lake Erie. This high land ends

Soil and Terrain (Cont'd)

suddenly near the shoreline of the lake which has steep and unpassable banks.

One exception is at the mouth of the winding Big Otter Creek which has eroded a relatively wide valley and carried clay, silt and sand downstream. Since the elevation of the water surface decreases at a low rate from Vienna southerly, most of the sand carried by the current is deposited at the bottom of the creek along its last few miles.

Principal land uses - The major portion of the watershed is used for farming. The largest urban municipalities in the watershed are Tillsonburg, Norwich and Otterville.

Controlled storage - There is some controlled storage at present. A recently constructed dam is located in Norwich. An older dam is located in Otterville. The Otter Creek Conservation authority has proposed a major dam at Tillsonburg which will store 7,200 acre feet of water. The Preliminary Engineering has been completed; however, the project is at a standstill.

Future change of Runoff - The Tillsonburg dam if and when it proceeds will provide a fair measure of flood control.

Degradation of streambed - Small due to slow running nature of water course at the site of the proposed structure and the proximity of Lake Erie.

Dredging - Inquiries made of The Department of Public Works indicates that no dredging is anticipated now or within the

Dredging (Cont'd)

foreseeable future in the vicinity of the proposed structure.

Ice Problems - No unusual ice problems appear to exist. Some residents have claimed that in the past when the harbour required dredging, ice blockage has occurred which resulted in upstream flooding.

Navigation - The river is navigable some distance upstream. Application will be made under The Navigable Water Protection Act for approval of the site and plan of the "work".

Depth of Scour - The maximum depth of scour is estimated to be 5 to 6 feet. The existing clay bottom and gentle gradient tends to keep the scour to a minimum.

Utilities

There are Hydro, Bell Telephone and Aylmer Malahide Telephone lines along Highway # 19 and Elgin County Road # 42. The Gas line is buried along Highway # 19, south of the intersection with County Road # 42.

A relocation of some of these utilities will be necessary. There is also a proposed water distribution system for the village which may or may not be affected by the proposed structure and new roadway alignment.

DESIGN PROPOSALS

Design Criteria For Road

1. Design A.A.D.T. = 3,300 v.p.d.
2. Design Class 3,000 and over
3. Design Speed 30 m.p.h. (urban section) and 50 m.p.h. (rural section)

Design Criteria For Road (Cont'd)

4. Vision Curves (a) Sag 500 feet
(b) Crest 600 feet
5. Minimum stopping Sight Distance 350 ft.
6. Maximum Horizontal Curvature 6.9 degrees
7. Maximum Gradient 6%
8. Shoulder Width 8 feet plus 2' or rounding
9. Surface Type - asphalt

Design Criteria for Structure

1. Width - 32 feet curb to curb with two 4' sidewalks. The width flares out to 38' curb to curb at the intersection of Kings Hwy. # 19 and County Rd. # 42
2. Loading - H20S16
3. A clearance of 22' - 6" must be provided between the top rail of C.P.R. Tracks (elevation 585) and the lowest portion of the structure
4. Supporting piers should be so located as to provide for the future construction of an additional track to the west or river side of the existing track.

Design Schemes

Various schemes were developed by the Functional Planning Section of The Department of Highways, Ontario for replacement of the existing structure. A high level structure was proposed because of:

- (a) The topography of the valley.
- (b) The desire to improve the steep approaches of Hwy. # 19
- (c) The structure eliminates an existing level crossing of the C.P.R. and Elgin County Rd. # 42.
- (d) It provides a large clearance under the structure which will allow a more diversified upstream shore development.

Alignment

As previously mentioned various alignment schemes were developed, but were rejected as being undesirable for various reasons such as:

- (1) Out-of-way travel for inter-town traffic was increased
- (2) Alignment of Hwy. # 19 remained unchanged.
- (3) The Level Railway Crossing was not eliminated
- (4) Any other considerations which affect the structure

Alignment (Cont'd)

A review of the available data suggested that the alignment as being presently proposed was the best solution to the existing problems and met all of the desired criteria.

Soil Investigations

Soil investigations were carried out by Dominion Soil Investigations Ltd. of London, Ontario. Their findings are in a report included in appendix "B" of this report.

Some of the more important aspects of the soils investigation are summarized as follows:

- (a) The 7 boreholes revealed a sub surface profile consisting of up to $18\frac{1}{2}$ feet of alluvial silt and fine sand making up the valley floor, overlying very stiff silty clay till which extends to a considerable depth.

It is recommended that the structure be supported on spread footings bearing in the clay till stratum using the maximum net soil pressures quoted in the report.

Estimates of settlement are also given for each footing. Since the proposed road grade at The Western approach to the structure is about 30 feet above the existing road grade and the area is underlain with an organic silt layer of low strength, it will be necessary to remove this layer in order to maintain the stability of the proposed embankment and prevent undue settlement.

THE PROPOSED STRUCTURE

General Requirements

Although the first requirements of a bridge are adequate capacity to meet the demands of traffic and structural strength to perform its function safely, the modern bridge should possess beauty that enhances and harmonizes with its surroundings. The best structure selected for a specific location will combine this aesthetic quality with the other essentials of strength, permanence and economy.

For reasons previously discussed, a high level structure was proposed satisfying the following specific requirements:

- (1) Provide clearance between underside of deck and normal water line to permit the passage of small crafts further upstream.
- (2) Provide 22'-6" clearance for C.P. R. Railway.
- (3) Provide room for expansion to the west side of the existing tracks for placement of an additional railway track if required.
- (4) Provide sufficient waterway opening.
- (5) The location of the west abutment is positioned so that the resulting approach fill does not encroach upon the river channel.
- (6) Placement of piers so that no blockage or constriction results in the stream channel, which would cause problems with ice, debris, boats, etc.
- (7) Placement of abutment and piers to allow building of Service Road parallel to Highway # 19.

After appropriate preliminary investigation and economic study of several solutions, the design as shown was adopted.

This design offers the following advantages:

- (1) Utilizes AASHTO-PCI Type IV concrete girders which are produced by all the prestressed concrete plants. This

(1) (Cont'd)

design utilizes the equipment, beds, and procedures of these plants to the fullest possible extent.

Each girder is pretensioned and precast, indicating quality in-plant manufacture.

(2) The length of the girders selected permit ease of transportation and erection.

(3) The use of concrete girders require minimum maintenance

Foundations

(1) The structure will be supported on spread footings bearing in the clay till stratum.

(2) Pier footings elevations allow for scour and the possibility of some future dredging.

(3) Unsuitable material at the western approach to the structure should be excavated to stable soil over the entire width of the structure prior to the placement of fill.

Slope Protection

Random placed rip-rap is proposed at the present time because of its ease of placement under water compared with other appropriate methods.

SPECIAL CONSTRUCTION FEATURES

(1) Construction of Piers

It is anticipated that the construction of cofferdams consisting of interlocking steel sheet piling will be necessary to permit unwatering and construction of the pier footings and a portion of the piers in the dry.

(2) Girders

The design expedient that limits the weight of members and makes this girder system practical for precast construction is the splice in each of the anchor spans.

The splice is located at the inflection point for dead load moment. The maximum moment at the splice is then limited to that moment due to moving live load which can be accommodated by mild steel reinforcing at the top and bottom of the section.

(2) Girders (Cont'd)

The protruding lapped bars are, therefore, encased in cast in place concrete.

All beams will be provided with end blocks to allow for adequate splicing between beams. The beams vary in depth from 4'-6" to 7'-6".

The erection procedure is incorporated in the design as follows:

1. Construct abutment and piers.
2. The anchor-cantilever beams are erected on the piers and falsework bents along with the anchor beams which are supported on the falsework bents and the abutments.
3. Then the splice joints are cast in place along with the diaphragms at the splice line.
4. When the concrete in the splices and diaphragms has reached 3,500 p.s.i., the mid span drop-in girders may be erected. Diaphragms will also be required at the mid span of the anchor beams, over the piers, at the beam seats between the haunch beams and the mid span and at the third points in the mid span.
5. After the mid span drop-in girders are erected, the deck concrete should be cast in sequence as follows:
 - (a) Sections between abutments and splices
 - (b) Section over drop-in girders
 - (c) Section over piers

Approvals Required

1. Bridge Office - Department of Highways, Ontario
2. Department of Public Works - now handled by The Department of Transport, Prescott, Ontario for approval of work under The Navigable Waters Protection Act.
3. Board of Transport Commissioners For Canada for payment from The Grade Crossing Fund for the elimination of a level crossing.
4. Co-ordination Required

It is assumed that all or a portion of Kings Hwy. # 19 will be reconstructed in conjunction with the construction of

4. Co-ordination Required (Cont'd)

The Port Burwell Bridge and Elgin County Rd. # 42.

It is suggested that a meeting be held when the preliminary design is completed to discuss the items to be paid for by the D.H.O. on the Hwy. # 19 connecting link.

One contract embracing both the reconstruction of Hwy. # 19, and The Port Burwell Bridge and County Road # 42 is expected to be called, with the division of the contract into two portions "A" and "B" which will enable separation of pertinent items and will provide a satisfactory basis for billing the Department.

Installation of a water distribution system in the village of Port Burwell is expected to take place concurrently with the reconstruction of Highway # 19. Co-ordination and liason of the road, bridge and water distribution system projects will be required.

Cost of Proposed Project

A Preliminary Cost Estimate indicates the cost of the Proposed structure and the construction of the western approaches, etc. is \$468,000.00. A complete cost breakdown is included in Appendix "A".

Construction Date

It is anticipated that construction will begin early in the Spring of 1967 and will be completed by the Fall of 1967.

APPENDIX A

COST ESTIMATE

Preliminary Cost Estimate
Port Burwell Bridge County of Elgin

Job No. 6650

October 1966

(A) Work to be performed by Contract

ITEM	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL
1.	Demolition and Removal of old structure	L.S.			\$ 4,500.00
2.	Unwatering and stream Control	L.S.			\$ 14,000.00
3.	Excavation for Structure Foundations	L.S.			\$ 5,200.00
4.	Excavation of unsuitable material under road and structure fill Sta. 387+60- Sta. 390+40	L.S.			\$ 22,500.00
5.	Backfill for structure including the construction of the west roadway approach within 100' of structure (Granular base course "A" and sand cushion excluded from this item)				\$ 40,260.00
6.	Roadwork beyond 100' of structure Sta. 371+00- 388+60 excluding the supply and placing GBC "A" and sand cushion	L.S.			\$ 35,900.00
7.	Supply and place granular base course "A"	Ton	4,000	\$ 2.50	\$ 10,000.00
8.	Supply and place sand cushion	Ton	11,300	\$ 1.00	\$ 11,300.00
9.	Reinforced Concrete	Cu.yd.	1,400	\$ 70.00	\$ 98,000.00

ITEM	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL
10.	Supply of Prestressed Concrete Girders	L.S.			\$ 73,500.00
11.	Erection of Prestressed Concrete Girders including the erection of temporary falsework bents and completing the concrete splices as detailed	L.S.			\$ 24,500.00
12.	Protective Weatherproofing	L.S.			\$ 800.00
13.	Supply and erection of Aluminium handrails (approx. 720 lin. ft.)	L.S.			\$ 17,500.00
14.	Illumination (Supply and Install)	L.S.			\$ 4,000.00
15.	Slope protection random placed rip-rap	Ton	1,220	\$ 5.50	\$ 6,710.00
16.	Supplying, stock piling, placing top soil	L.S.			\$ 2,000.00
17.	Hydraulic seeding and mulching	L.S.			\$ 700.00
18.	Erect steel beam guide rail per DD908 and DD909	Lin.Ft.	1,200	\$ 1.00	\$ 1,200.00
19.	4'-0" Concrete Side walk	Lin.Ft.	630	\$ 3.50	\$ 2,205.00
20.	Concrete curb and gutter (as per drawings)	Lin.Ft.	2,500	\$ 3.25	\$ 8,125.00
21.	Concrete set backs (DD623)	ea	4	\$150.00	\$ 600.00
22.	2'x2' Catchbasins (DD702)	ea	4	\$200.00	\$ 800.00
23.	4'x4' Ditch inlet (DD702-B)	ea	2	\$300.00	\$ 600.00
24.	Sewer Outfall Protection	L.S.			\$ 500.00

ITEM	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL
25.	Place (CIP) Sewer Pipe 18"Ø to 24"Ø	Lin.Ft.	500	\$ 3.00	\$ 1,500.00
26.	Asphalt Paving (3½" Depth)	Ton	1,300	\$ 13.00	\$ 16,900.00
Total Contract Amount					\$403,800.00

(B) Materials Supplied by the County of Elgin

1.	Reinforcing Steel 90 ton @ \$160.00				\$ 14,400.00
2.	Supply 500 Lin. Ft. Pipe 18"Ø to 24"Ø			L.S.	\$ 1,500.00
3.	Supply posts and steel beam guide rail as per D.H.O. Dwg. No. DD908, DD909			L.S.	\$ 2,500.00
4.	Frames and grates			L.S.	\$ 300.00
Total (Materials Supplied)					\$ 18,700.00

(C) Work Performed by Others

Relocation of utilities as required	L.S.	\$ 1,000.00
Property purchase County of Elgin	L.S.	\$ 2,000.00
Sub-Total		\$ 3,000.00

Summary of Costs

Part (A)	Work to be performed by Contract	\$403,800.00
Part (B)	Materials supplied by the County of Elgin	\$ 18,700.00
Part (C)	Work performed by Others	\$ 3,000.00
TOTAL COSTS		\$425,500.00
Engineering, Contingencies and Soils Investigations		\$ 42,500.00
TOTAL COSTS OF PROJECT		\$468,000.00

Note: This estimate does not include the cost of:

- (a) A service road parallel to Kings Hwy. # 19
- (b) Approaches to the east end of structure
- (c) Retaining wall parallel to Kings Hwy. # 19

Since the above items are essentially connected with the costs in the reconstruction of Kings Hwy. No. 19, no estimate has been prepared. It is assumed that most of the cost of these items will be paid for by the Ontario Dept. of Highways in connection with the reconstruction of Hwy. # 19.

County of Elgin's Share of Total Cost of Structure and Approaches

20% of the cost of structure including all applicable items within 100' of structure

20% of \$372,500.00 = \$ 74,500.00

50% of the cost of road work on County Road # 42

50% of \$95,500.00 = \$ 47,750.00

County of Elgin's share of Total Cost \$122,250.00

APPENDIX B

SOIL INVESTIGATIONS

DOMINION SOIL INVESTIGATION LIMITED

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BRANCH
369 QUEENS AVENUE
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FOUNDATION ENGINEERS

**ASSOCIATED COMPANY
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A. M. SPIRIET AND ASSOCIATES LTD.,
CONSULTING ENGINEERS,
264 WELLINGTON STREET
LONDON ONTARIO

Report on
SOIL INVESTIGATION
for
PORT BURWELL BRIDGE,
COUNTY RD 42
COUNTY OF ELGIN.

by
DOMINION SOIL INVESTIGATION LIMITED
369 Queens Avenue
LONDON ONTARIO

Reference No. 6-9-L6
October 27th, 1966

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SUMMARY

The 7 boreholes revealed a subsurface profile consisting of up to 18.1/2 feet of alluvial silt and fine sand making up the valley floor, overlying very stiff silty clay till which extends to a considerable depth.

It is recommended that the structure be supported on spread footings bearing in the clay till stratum using the maximum net soil pressures quoted in the report. Estimates of settlement are also given for each footing.

I INTRODUCTION

The soil investigation was authorized by A.M. Spriet and Associates Limited, consulting engineers, acting on behalf of the County of Elgin, and the site is located in Port Burwell where County Road 42 crosses Big Otter Creek.

It is understood that the County road will be relocated and that the new bridge will cross the creek immediately to the north of the existing steel-truss structure. The proposed structure will have 3 spans with a total span of about 360 feet. The requirements of the project were discussed with Mr. A.M. Spriet, P.Eng., who supplied the foregoing information.

The purpose of this investigation was to reveal the subsurface conditions at the pier and abutment locations and to determine the relevant soil properties for the design and construction of the new foundations.

II DISCRIPTION OF THE SITE AND GEOLOGY

The site is located in the flood plain of Big Otter Creek, several hundred feet inland from the point where the creek enters Lake Erie. The flood plain is about 50 feet wide and is bordered by higher ground rising to a point of about 30 feet above the flood plain.

The predominant soil type in this area is a glacial silty clay which is probably overlain by alluvial flood plain deposits in the valley floor.

III FIELD WORK

The field work, consisting of 7 boreholes was carried out during the period October 3 to 7, and 24, 1966, at the locations shown on Enclosure 2. The holes were advanced to the sampling depths by washboring methods and were lined with 6x size casing.

Standard Penetration Tests using a 2 inch outside diameter split-spoon sampler were performed at frequent intervals of depth, using a driving force of a 140 lb. hammer falling freely through 30 inches. The tube is first driven an initial 6 inches to allow for the presence of disturbed material at the bottom of the borehole. The number of standard blows required to drive the sampler a further 12 inches was recorded as the standard penetration resistance (or 'N' value). This test determines the relative density of granular strata and gives an indication of the consistency of cohesive strata. It also enables samples to be obtained for classification purposes.

Insitu vane shear tests, using a 4 inch long by 2 inch diameter 4 bladed vane, were performed to determine the undrained shear strength of cohesive strata.

Cont'd over....

The results of the field tests are presented on the Geotechnical Data Sheets, Enclosures 3 to 8. Elevations were referred to a benchmark, which was indicated by the client, and was described as a cut cross on the concrete sidewalk, 33.5 feet right of Station 9+02 on Highway 19. The elevation was given as 613.26 feet which is believed to be referred to the geodetic datum.

IV SUBSURFACE CONDITIONS

Detailed descriptions of the strata encountered in the boreholes are presented on the Geotechnical Data Sheets, comprising Enclosures 3 to 8, and a general picture of the soil stratigraphy is given in the form of a Subsurface Profile on Enclosure 2.

The boreholes revealed the following general ground succession:-

- (a) Organic Sandy Silt (Creek Bed Deposit). This deposit contains a high proportion of organic material and due to the organic content the material exhibits a slight cohesion. The relative density of the stratum is described as 'loose' as estimated from 'N' values ranging from 3 to 6 blows per foot.
- (b) Silty Fine Sand. This stratum contains partially decomposed roots and fragments of wood and is believed to have originated from a larger river which previously occupied the valley or the lake which may have receded to its present position. The relative density of the stratum is generally 'loose' as estimated from 'N' values ranging from 3 to 12 blows per foot.
- (c) Silty Clay (Glacial Till). The till consists of silt and clay size particles in approximately equal proportions and the absence of sand and gravel size particles is attributed to the soft nature of the parent rock. Due to the clay content, the till exhibits considerable cohesion and should be regarded as a cohesive plastic material. The plastic properties of the till were determined by Atterberg Limit and moisture content tests giving the following results:-

Liquid Limit	27% to 33%
Plastic Limit	13% to 14%
Plasticity Index	14% to 20%
Natural Moisture Content	17% to 22%
Liquidity Index	0.2 to 0.4

On the basis of these results the material can be classified according to Casagrande's Plasticity Chart as a clay of low plasticity and compressibility.

Cont'd over....

The consistency of the till can be inferred from the Liquidity Indices, the insitu vane shear tests and the Standard Penetration tests. The 'N' values range between 18 and 46 blows per foot indicating a range of consistency between 'very stiff' and 'hard'. These limits were confirmed by the vane shear tests carried out in borehole 3 which gave undrained shear strength values ranging from 2160 to 3360 p.s.f. for corresponding 'N' values of 22 to 27 blows per foot. The Liquidity Indices which relate the natural moisture content to the Consistency Limits, also confirm consistencies ranging from 'stiff' to 'very stiff'. It may therefore be assumed that the undrained shear strength of the till increases from 2000 p.s.f. to 4000 p.s.f. throughout the depth penetrated.

V GROUNDWATER CONDITIONS

Apart from borehole 4, which was put down on the east bank of the valley, groundwater levels observed in the boreholes ranged from 570.4 to 571.4.

The water level of the creek at the time the field work was carried out was at El. 570.

VI DISCUSSION AND RECOMMENDATIONS

The footing grades of the proposed structure will depend on the subsurface conditions and also on the maximum depth of scour and possibility of future dredging work which may be carried out. The last two conditions are beyond the scope of this report therefore the recommended bearing capacity values will be based on proposed footing grades indicated on the clients General Arrangement drawing.

East Abutment (Borehole 4)

The footing grade is indicated at El. 579, therefore on the basis of the borehole results, a maximum net soil pressure of 5000 p.s.f. is appropriate for the design of the footing.

The adhesion between the footing and clay till may be taken as 2000 p.s.f. and the factor of safety against horizontal sliding of the abutment should be at least 1.5.

Total settlement of the footing is estimated to be less than 1 inch.

East and West Piers (Borehole 2 and 3)

The footing grade is indicated at El. 550 which is about 10 feet below the creek bed level. A maximum net soil pressure of 8000 p.s.f. is appropriate for the design of footings at this elevation, however, if it is decided to raise the footing grade, the bearing value should be reduced proportionally to 7000 p.s.f. for a footing grade at El. 554.

Cont'd over....

Total consolidation settlement of the footings is estimated to be 1.1/2 inches.

West Abutment (Borehole 1 and 5)

The loose and compressible sandy silt and silty fine sand deposits are unsuitable for the support of the abutment footing, therefore the abutment should be supported in the silty clay till stratum.

The top of the footing should be level with, or lower than, the top of the till stratum, therefore a footing elevation at about El. 555 will be appropriate. The maximum net soil pressure which may be applied at this elevation is 8000 p.s.f. which if fully mobilized will produce a total settlement of about 1.1/2 inches.

An alternative design would be to support the abutment on piles driven into the silty clay till stratum. For preliminary design purposes, it can be assumed that a 1 foot diameter timber pile will develop a working load of 20 tons when driven 15 feet into the clay till stratum and that a 1 foot diameter tube pile will develop a working load of 40 tons when driven 33 feet into the clay till stratum.

West Approach Embankment

The proposed road grade is about 30 feet above the existing road grade therefore to maintain the stability of the proposed embankment it will be necessary to remove the organic silt layer, or provide berms to reduce the average slope of the sides of the embankment. The latter method will entail the use of an additional 30 feet of ground on each side of the embankment, therefore it would appear that removal of the organic material will be the better solution.

The organic material appears to have a maximum thickness of 12 feet at the west abutment and tapers off to negligible proportions, 100 feet west of the west abutment.

General

The recommended maximum net soil pressures incorporate a factor of safety of 3 against shear failure of the underlying soil, and the settlement predictions have been based on an assumed modulus of compressibility of the subsoil 'K' equal to 80 tons per square foot.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED



C.J.W. Atkinson
 C.J.W. Atkinson, M.Sc., P.Eng.,
 Branch Manager

Enclosures

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.

BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY	ORGANICS	BEDROCK	GROUND WATER LEVEL	DEPTH OF CAVE-IN
		COARSE	FINE	COARSE	MEDIUM	FINE						
Ø	> 8"	3"	3/4"	4.75mm	2.0	0.42	0.074	0.002	>	NO SIZE LIMIT		
U.S. Standard Sieve Size :		No.4	No.10	No.40	No.200							

SAMPLE TYPES.

AS Auger sample	RC Rock core	TP Piston, thin walled tube sample
CS Sample from casing	% Recovery	TW Open, thin walled tube sample
ChS Chunk sample	SS Split spoon sample	WS Wash sample

SAMPLER ADVANCED BY static weight : w
 " pressure : p
 " tapping : t

OBSERVATIONS MADE WHILE CORING
 Steady pressure
 No pressure
 Intermittent pressure

Washwater returns
 Washwater lost

PENETRATION RESISTANCES.

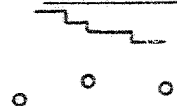
DYNAMIC PENETRATION RESISTANCE : to drive a 2" ϕ , 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot.

STANDARD PENETRATION RESISTANCE, -N- : to drive a 2" outside dia, split spoon sampler 1 foot into the ground, expressed in blows per foot.

EXTRAPOLATED -N- VALUE

The energy for the penetration resistances is supplied by a 140 lb. hammer falling 30 inches

SYMBOL :



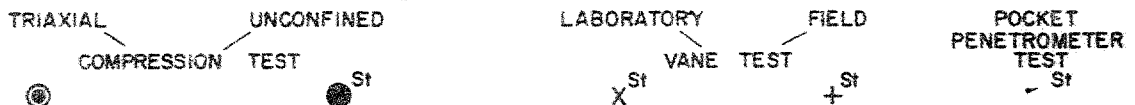
322

SOIL PROPERTIES.

W % Water content	δ^* Natural bulk density (unit weight)	k Coeff. of permeability
LL % Liquid limit	e Void ratio	C Shear strength — in terms of total stress
PL % Plastic limit	RD Relative density	ϕ Angle of int. friction — in terms of effective stress
PI % Plasticity index	C_v Coeff. of consolidation	C' Cohesion
LI Liquidity index	m_v Coeff. of volume compressibility	ϕ' Angle of int. friction

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —



Strain at failure is represented by direction of stem

20%
15%
10%
5%

St : sensitivity = $\frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$

SOIL DESCRIPTION.

COHESIONLESS SOILS :

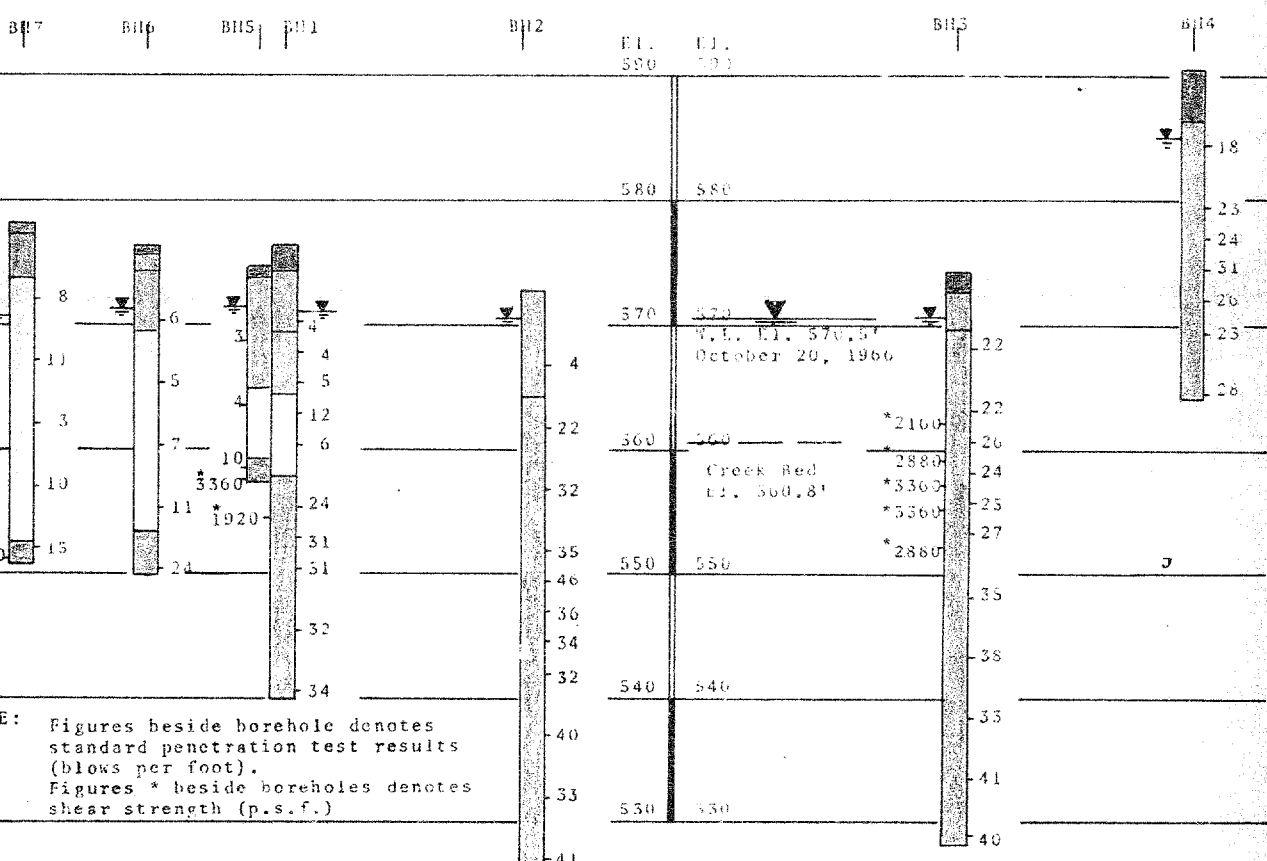
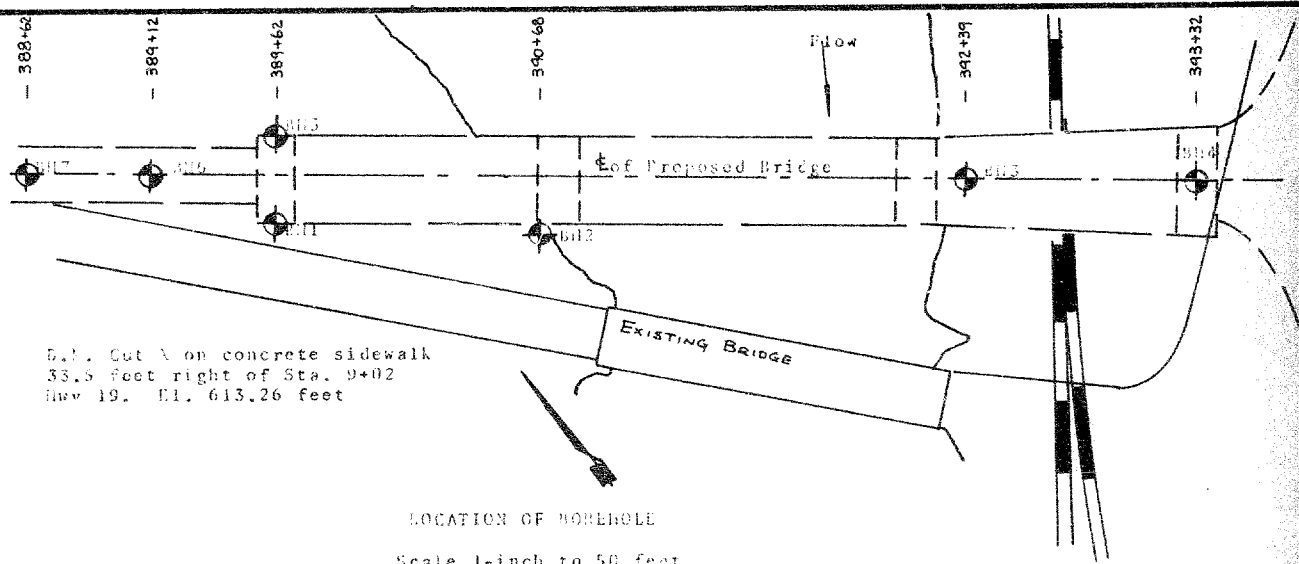
Very loose	0 - 15 %
Loose	15 - 35 %
Compact	35 - 65 %
Dense	65 - 85 %
Very dense	85 - 100 %

RD :

COHESIVE SOILS :

Very soft	less than 250
Soft	250 - 500
Firm	500 - 1000
Stiff	1000 - 2000
Very stiff	2000 - 4000
Hard	over 4000

C lbs./sq.ft.



LEGEND

- Topsoil or gravel fill
- Sandy silt fill
- Loose organic sandy silt or silty fine sand
- Loose to compact silty fine sand
- Very stiff silty clay (Glacial Till)

SUBSURFACE PROFILE

Vert. Scale 1-inch to 10 feet.

DOMINION SOIL INVESTIGATION LIMITED

GEOTECHNICAL DATA SHEET FOR BOREHOLE

OUR REFERENCE NO. 6-9-16

CLIENT: A. M. Spriet & Associates
 PROJECT: Port Burwell Bridge
 LOCATION: Port Burwell, Ontario.
 DATUM ELEVATION: Hwy. 19, Sta. 9+02, El. 613.26 feet

METHOD OF BORING: Washboring
 DIAMETER OF BOREHOLE: 8x (3-inch)
 DATE:

ENCLOSURE NO. 3

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot				CONSISTENCY water content %				REMARKS
				NUMBER	TYPE	N ₆₀ Advancement of Sampler	20	40	60	80	100	PL	W	LI	
576.3	0.0	Ground Surface													
	2.0	Gravel Fill													
		Loose black organic		1	SS	4									
570	7.0	sandy silt													
		Loose dark brown organic		2	SS	4									
565	12.0	silty fine sand		3	SS	5									
		Loose grey silty fine sand		4	SS	12									
560		containing roots		5	SS	6									
555	18.9	Very stiff greyish-brown silty clay (Glacial Till)		6	SS	24									
				7	SS	31									
550				8	SS	31									
				9	SS	32									
545				10	SS	34									
540	36.5	End of Borehole													

W. L.
El. 570.5

VERTICAL SCALE: 1 IN TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE

CH'D.

GEOTECHNICAL DATA SHEET FOR BOREHOLE . 2

OUR REFERENCE NO 6-9-L6

CLIENT: A. M. Spriet & Associates

PROJECT: Port Burwell Bridge

LOCATION: Port Burwell, Ontario.

DATUM ELEVATION: Hwy 19, Sta. 9+02, E1. 613.26 feet

METHOD OF BORING Washboring

DIAMETER OF BOREHOLE Bx (3-inch)

DATE October 3 to 7, 1966

ENCLOSURE NO 4

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot				CONSISTENCY water content %				REMARKS
				NUMBER	TYPE	N- Advance- ment of Sampler	20	40	60	80	100	PL	W	LI	
572.9	0.0	Ground Surface													
570		Loose dark brown organic sandy silt		1	SS	4									
565	8.5			2	SS	22									
560		Very stiff		3	SS	32									
555		greyish		4	SS	35									
550		brown		5	SS	46									
545		silty clay		6	SS	36									
540		(Glacial Till)		7	SS	34									
535				8	SS	32									
530				9	SS	40									
				10	SS	33									
46.5		End of Borehole		11	SS	41									

VERTICAL SCALE: 1 IN. TO

5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE

CH'D:

GEOTECHNICAL DATA SHEET FOR BOREHOLE 3. . . .

OUR REFERENCE NO. 6-9-L6

CLIENT: A. A. Spriet & Associates

PROJECT: Port Burwell Bridge

LOCATION: Port Burwell, Ontario

DATUM ELEVATION: Hwy 19, Sta. 9+02, El. 613.26 feet

METHOD OF BORING Washboring

DIAMETER OF BOREHOLE Bx (3-incl.)

DATE October 3 to 7, 1966

ENCLOSURE NO. 5

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %				REMARKS
				NUMBER	TYPE	Advance- ment of Sampler	20	40	60	80	100	PL	W	LI		

W. L.
El. 570.5

OUR REFERENCE NO. 6-9-L6

METHOD OF BORING Was boring

ENCLOSURE NO. 6.

DIAMETER OF BOREHOLE BX (3-inch)

DATE: October 3 to 7, 1966

DATUM ELEVATION: Hwy 19, Sta. 9+02, El. 613.26 feet

[illegible]

OUR REFERENCE NO. 0-9-16

GEOTECHNICAL DATA SHEET FOR BOREHOLE 5.5.6.6.

CLIENT: A. M. Spriet & Associates

PROJECT: Port Furwell Bridge

LOCATION: Port Furwell, Ontario.

DATUM ELEVATION: by 10, Sta 9+02, El. 613.26 feet

METHOD OF BORING: Washboring

DIAMETER OF BOREHOLE: 8x (3-inch)

DATE

October 20, 1966

ENCLOSURE NO. 7

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content % PL W LI	REMARKS
				NUMBER	TYPE	N ₆₀ Advancement of Sampler	20	40	60	80	100		
							SHEAR STRENGTH 100 lbs/sq ft						
							00	20	30	40	50		
574.8	0.0	Ground Surface					Borehole 5						
	1.0	Gravel Fill											
		Loose											
570		black											
		organic		1	SS	3							W. L. El. 570.5
		sandy											
565	10.0	silt.											
		Loose grey		2	SS	4							
		silty fine sand											
		containing roots											
560	15.5	Very stiff		3	SS	10							
	16.5	grey silty clay											+St=4.7
		End of Borehole											
570.4	0.0	Ground Surface					Borehole 6						
	0.7	Gravel Fill											
	2.0	Fine sand											
		Loose dark											
		grey organic		1	SS	6							W. L. El. 571.4
570	7.0	sandy silt											
		Loose											
565		grey		2	SS	5							
		silty											
		fine											
560		sand,		3	SS	9							
		trace											
		of											
555		medium		4	SS	11							
		sand.											
23.5		Very stiff grey											
		silty clay.											
550	20.9	(Glacial Till)		5	SS	24							
		End of Borehole											

VERTICAL SCALE: 1 IN. TO

FT

5

DOMINION SOIL INVESTIGATION LIMITED

MADE

CH'D

GEOTECHNICAL DATA SHEET FOR BOREHOLE ...7...

OUR REFERENCE NO. 6-9-16

CLIENT: A. M. Spriet & Associates
PROJECT: Port Burwell Bridge
LOCATION: Port Burwell, Ontario.
DATUM ELEVATION: Hwy 10, Sta D+02, L1,613.26 feet

METHOD OF BORING Washboring
DIAMETER OF BOREHOLE Bx (3-inch)
DATE October 20, 1966

ENCLOSURE NO. 8

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content % PL W LI	REMARKS
				NUMBER	TYPE	N — Advance of Sampler	20	40	60	80	100		
							SHEAR STRENGTH 100 lbs sq ft						
							10	20	30	40	50		
578.1	0.0	Ground Surface											
	0.8	Gravel Fill											
575	4.5	Black sandy silt fill											
		Loose		1	SS	8							
570		to											
		compact											
		grey		2	SS	11							
565		silty											
		fine											
		sand,		3	SS	3							
560		traces											
		of											
		decomposed		4	SS	10							
555		wood											
	25.5												
		Very stiff grey		5	SS	15							
27.5		silty clay											
		End of Borehole											

W. L.
E1,570.9

+ St=2.5

VERTICAL SCALE: 1 IN TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE

CHD