GEOCRES No:
31G5-156E18

Golder Associates Ltd.

1796 Courtwood Crescent
Ottawa, Ontario, Canada K2C 2B5
Telephone (613) 224-5864
Fax (613) 224-9928

SERIES II

(4)

INTERIM REPORT
ON

GROUNDWATER LEVEL AND PRECISE SETTLEMENT MONITORING PROPOSED HIGHWAY 416 LYNWOOD SUBDIVISION W.P. 121-87-00 DISTRICT 9 (OTTAWA) NEPEAN, ONTARIO

Submitted to:

Ministry of Transportation Ontario
355 Counter Street
Postal Bag 4000
Kingston, Ontario
K7L 5A3

DISTRIBUTION:

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December 1992

921-2158

Golder Associates Ltd.

1796 Courtwood Crescent
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December 23, 1992 921-2158

Ministry of Transportation Ontario
355 Counter Street
Postal Bag 4000
Kingston, Ontario
K7L 5A3

Attention: Mr. B. E. Ruck, Area Manager
Engineering and Right of Way Office

RE: GROUNDWATER LEVEL AND PRECISE SETTLEMENT MONITORING
PROPOSED HIGHWAY 416
LYNWOOD SUBDIVISION
W.P. 121-87-00-DISTRICT 9 (OTTAWA)
NEPEAN, ONTARIO

Dear Sirs:

This letter presents the results of groundwater level and precise settlement monitoring carried out in the Lynwood subdivision in Nepean, Ontario (see Key Plan, Figure 1). The purpose of the present monitoring is to determine the seasonal fluctuation in the groundwater levels in the subdivision and what effect this has on the residential structures, in advance of the groundwater level lowering for the proposed Highway 416 cut adjacent to the subdivision.

PROCEDURE

Groundwater Level Monitoring

Groundwater levels were obtained in piezometers installed in some of the boreholes advanced previously by Golder Associates both in the subdivision and along the proposed Highway 416 alignment. A list of these piezometers along with the groundwater elevations obtained during May, June, July, August, September and October, 1992 are provided in the attached Table 1. The locations of the piezometers are shown on Figure 2.

To provide additional piezometric information in the area between 250 and 500 metres from Cedarview Road, three additional piezometers, numbered P1, P2, and P3, were installed at the locations shown on the Site Plan, Figure 2 during October 1992. The results of the groundwater level monitoring at these locations during November 1992 are provided in Table 1.

Graphical presentations of the groundwater levels in the piezometers installed in the silty clay, sand, and glacial till and bedrock are provided on Figures 4, 5, and 6, respectively.

Precise Settlement Monitoring

Fifteen temporary benchmarks were established on selected houses and buildings in the subdivision by Golder Associates and Annis O'Sullivan Vollebekk Ltd., Ontario Land Surveyors. Authorization to access the properties was obtained through discussion with the owners on July 24 and 28, 1992. Verbal descriptions of the temporary benchmarks are given in Table 2 and the locations of these points in plan are shown on Figure 3.

The field survey equipment used met the specifications for second order levelling networks. Elevation differences were determined with a parallel plate micrometer attachment for reading on an invar (temperature sensitive) rod. Backsight and foresight distances were identical on any set up and kept to less than 50 metres. Second order specifications allow misclosures of up to 0.004 metres to 0.011 metres, depending on the length of the loop. The actual misclosure for the loops was less than 0.004 metres in each case.

A primary benchmark was established on the CN railway overpass on Richmond Road next to the subdivision. The Geodetic elevation of the top of bolt on the bridge was established as 87.310 metres, using National Capital Commission (NCC) benchmark number 019680022 having a published elevation of 86.136 metres.

The results of the elevation surveys are given in the reports from Annis O'Sullivan Vollebekk Ltd. dated September 1 and November 11, 1992 provided in Appendix A. A summary of the precise settlement surveys is provided in Table 2. It was noted that the survey results of August 18 to 20, which was carried out some three weeks after the first survey, yielded elevations that agreed with the first set of measurements within 2 millimetres. As such, the elevations from the July 28 and 29 and August 18 to 20, 1992 observations are considered completely satisfactory and are used as base (datum) elevations.

DISCUSSION OF PIEZOMETER AND PRECISE SETTLEMENT RESULTS

The groundwater level monitoring in standpipes sealed into the silty clay, sand, glacial till, and bedrock showed fluctuations of less than about 0.5 metres between May and November, 1992. Although there is normally a seasonal drop in groundwater levels around mid summer to September, the monitoring data show relatively constant groundwater levels during this period. This was likely due to the unusually wet summer experienced this year.

The differences in the elevations of the settlement points during October range from 0 to 5 millimetres (average of 2.1 at 15 settlement points). These differences fall within the attainable accuracy of the levelling process. There has been no significant movement of the monitoring points between July/August 1992 and October 1992. This is consistent with the observed groundwater conditions during this period.

We trust that this interim report presents an adequate summary of the groundwater level and settlement data obtained to date. Should you have any questions concerning this information please contact the undersigned.

Yours truly,

GOLDER ASSOCIATES LTD.

A.F. Chevrier, P.Eng.
Associate

AFC:dc
RDC10

Attachments:

Tables 1 and 2
Figures 1 to 5
Appendix A

TABLE 1

SUMMARY OF GROUNDWATER LEVELS

Piezometer Number	Soil Description at Depth of Piezometer	Date of Reading							
		May 4/92	June 8/92	July 6/92	July 15/92	Aug. 13/92	Sept. 10/92	Oct. 19/92	Nov. 12/92
88-5	Silty Clay	85.68	85.51	85.71	-	85.65	85.62	85.57	-
88-6	Silty Clay	87.57	87.27	87.50	-	87.28	87.34	87.34	-
89-2B	Silty Clay	85.94	85.75	85.79	-	85.73	85.68	85.60	-
89-6A	Silty Clay	86.35	86.14	86.44	-	86.09	86.20	86.21	-
89-6B	Sand	85.83	86.04	86.15	-	86.00	86.00	85.88	-
89-6C	Bedrock	83.26	82.81	82.89	-	82.93	83.03	82.93	-
89-7	Sand	86.40	86.85	86.72	-	86.63	86.66	86.52	-
89-8	Sand	88.20	87.95	87.97	-	87.70	87.90	87.89	-
89-9	Sand	86.87	86.62	86.53	-	86.51	86.47	86.56	-
90-27	Silty Clay	86.30	86.48	86.45	-	86.35	86.35	86.33	-
90-31	Glacial Till	84.43	84.08	84.10	-	84.08	84.14	84.08	-
90-33	Silty Clay	88.25	87.88	87.85	-	88.00	87.99	87.98	-
90-34	Silty Clay	84.99	84.75	84.62	-	84.92	84.96	84.84	-
90-36	Silty Clay	85.48	85.13	85.09	-	85.26	85.32	85.23	-
90-38	Glacial Till	83.33	82.88	82.82	-	82.92	83.08	83.11	-
90-W4	Bedrock	-	-	-	84.53	84.31	84.36	83.36	-
90-W26	Bedrock	-	-	-	82.18	82.84	82.99	82.84	-
90-W29A	Sand	-	-	-	86.50	86.46	86.43	86.39	-
90-W29B	Bedrock	-	-	-	85.20	84.96	84.99	84.90	-
90-W19	Bedrock	-	-	-	79.52	79.54	79.60	79.45	
P1	Glacial Till	-	-	-	-	-	-	-	86.15
P2	Silty Clay	-	-	-	-	-	-	-	87.32
P3	Silty Clay	-	-	-	-	-	-	-	85.85

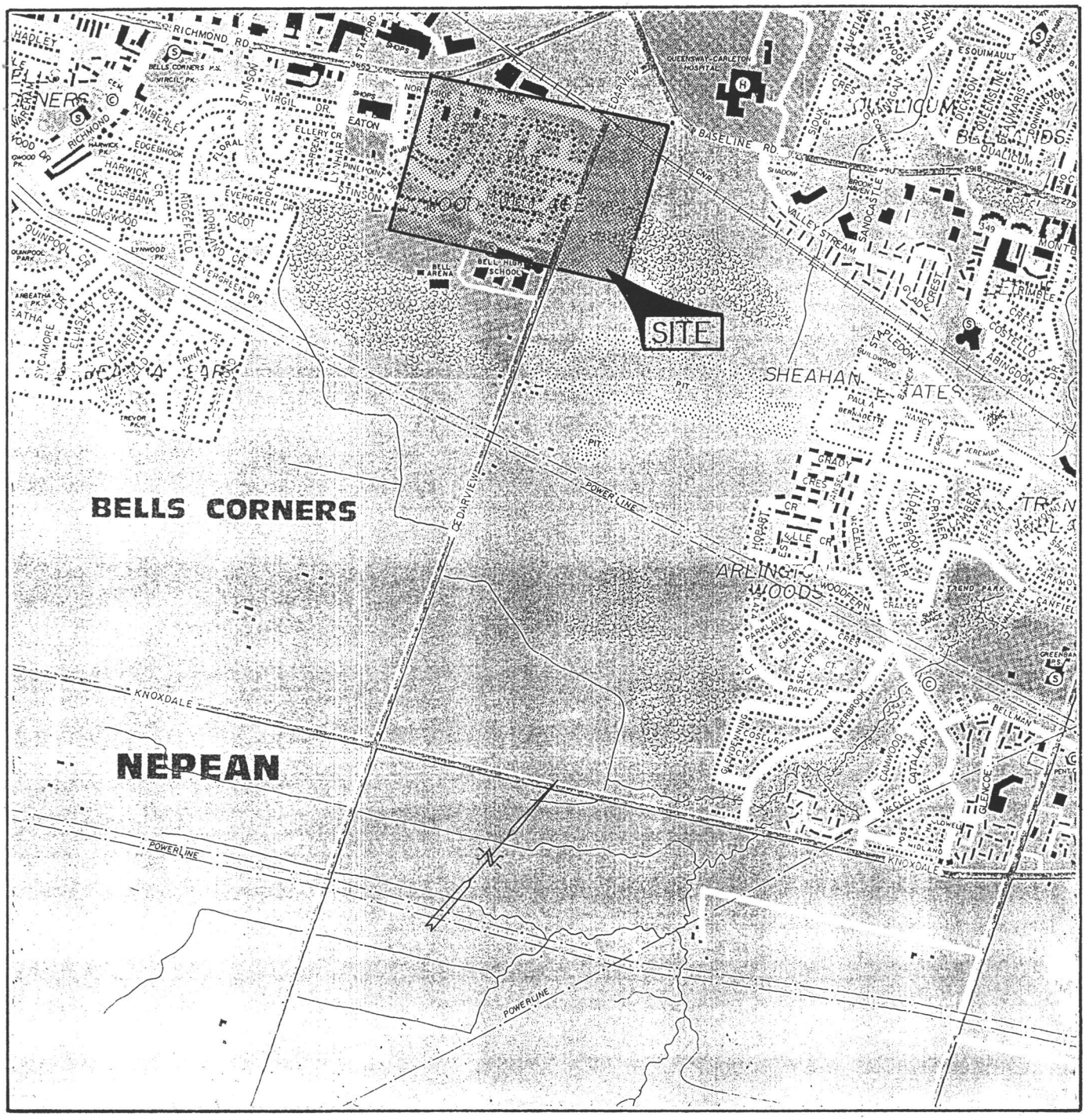
TABLE 2

SUMMARY OF PRECISE SETTLEMENT MONITORING DATA

Monitoring Point	Location	Datum Elevation (metres) July 28-29 and August 18-20, 1992	Elevation/Change in Elevation (metres) October 27-29, 1992
1	Bell High School, library window ledge	98.294	98.289 (-0.005)
2	34 Cedarview Drive, bottom brick, northeast corner	90.105	90.103 (-0.002)
3	2 Grangemill Avenue, bottom brick, northwest corner	88.967	88.963 (-0.004)
4	8 Cedarview Drive, bottom brick, southeast corner	88.260	88.255 (-0.005)
5	13 Domus Crescent, bottom brick, southeast corner	87.773	87.773 (0.000)
6	12 Dante Avenue, bottom brick, southeast corner	88.343	88.345 (+0.002)
7	1 Redfield Avenue, bottom brick, northeast corner	89.261	89.257 (-0.004)
8	62 Foothills Drive, bottom brick, southeast corner	89.772	89.771 (-0.001)
9	43 Foothills Drive, top of first course of Anglestone, southwest corner	89.733	89.733 (0.000)
10	22 Foothills Drive, bottom brick, chimney	89.272	89.274 (+0.002)
11	17 Foothills, bottom brick, southwest corner	88.273	88.273 (0.000)
12	Strip Mall, Foothills Drive at Northside Road, bottom brick, northeast corner	87.510	87.511 (+0.001)
13	Northeast corner of Post Office, Larkspur Drive at Northside Road	88.451	88.449 (-0.002)
14	11 Thorncliffe, bottom brick, southwest corner	88.658	88.656 (-0.002)
15	33 Larkspur Drive, bottom brick, southwest corner	89.470	89.469 (-0.001)

KEY PLAN

FIGURE 1
WP 121-87-00



SCALE 1:18,500

SPECIAL NOTE
THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT

Date DEC. 21, 1992
Project 921-2158

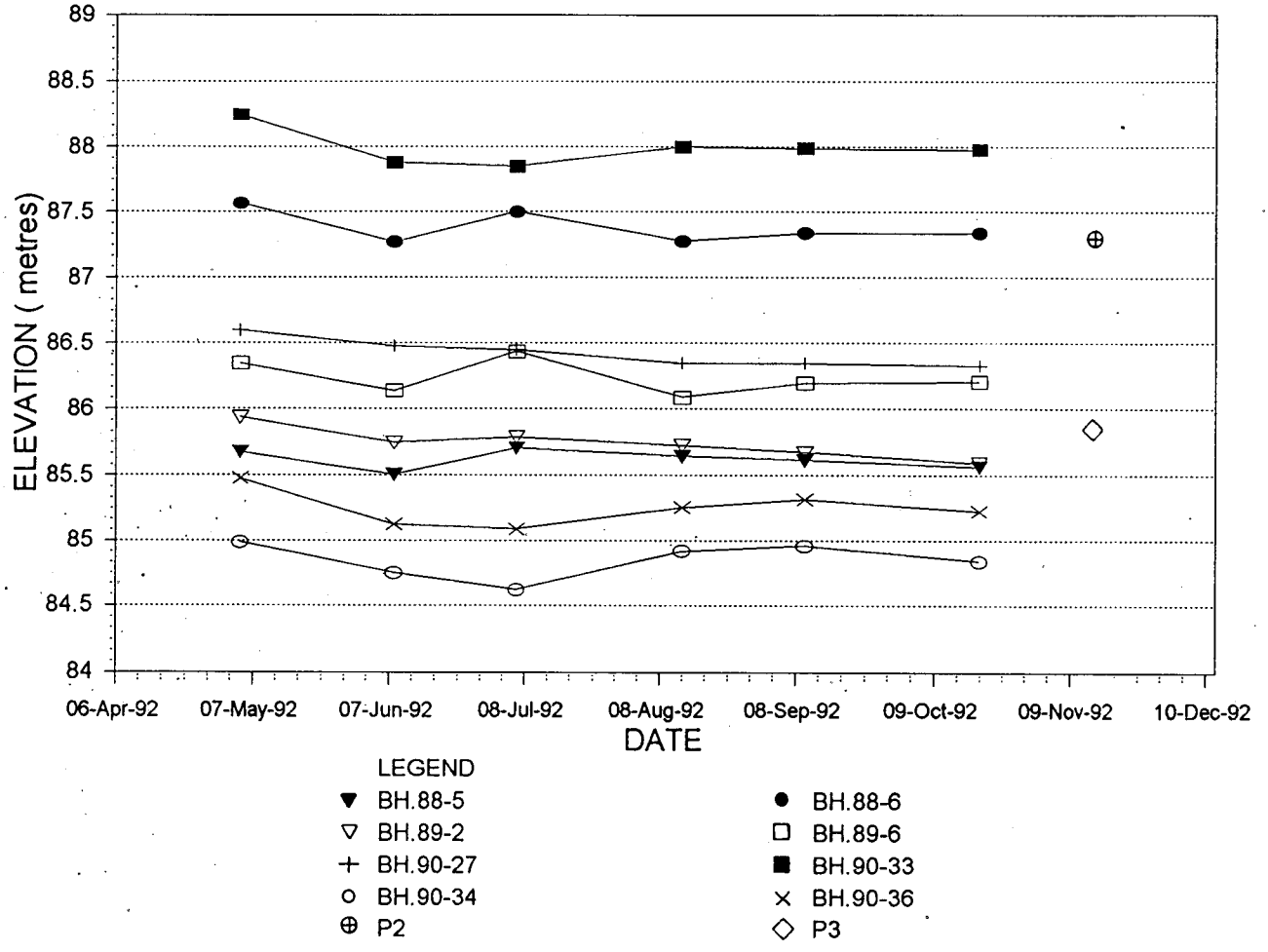
Golder Associates

Drawn JC
Chkd. DC

GROUNDWATER LEVEL DATA

May to November 1992 (Silty Clay)

FIGURE 4



Date DEC. 23, 1992

Project 921-2158

Golder Associates

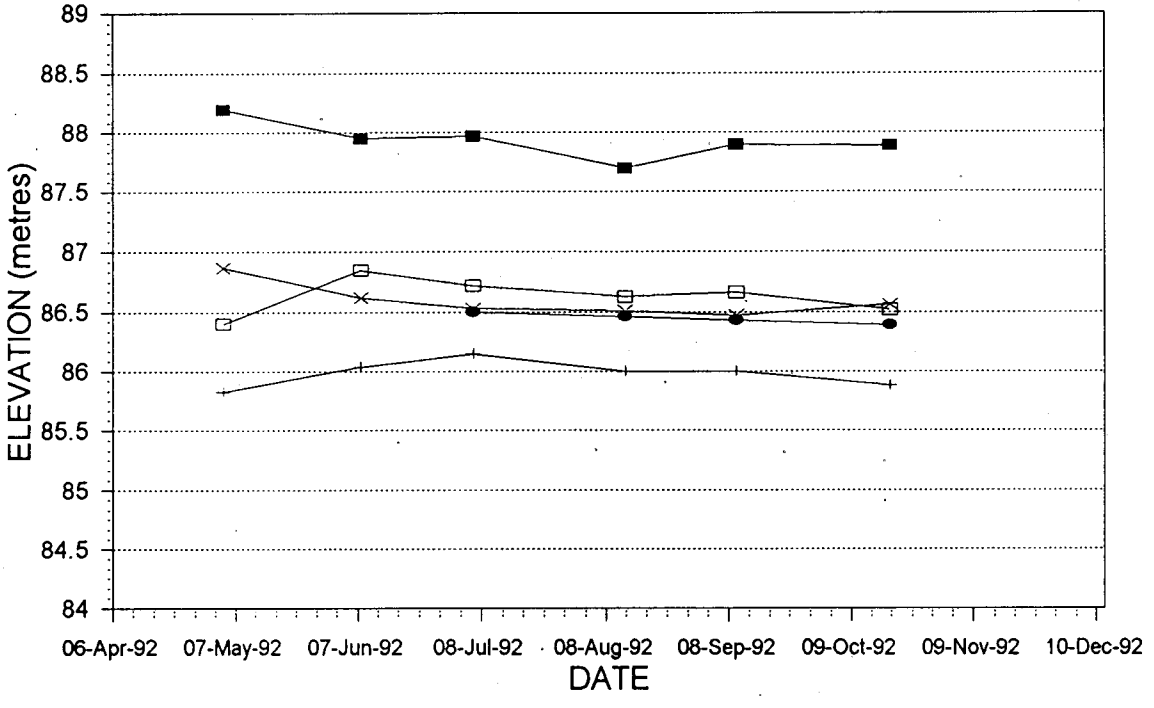
Drawn JC

Chkd. AC

GROUNDWATER LEVEL DATA

May to November 1992 (Sand)

FIGURE 5



LEGEND

- + BH.89-6B
- ■ BH.89-8
- ● BH.90-W29A
- □ BH.89-7
- × BH.89-9

Date DEC. 23, 1992

Project 921-2158

Golder Associates

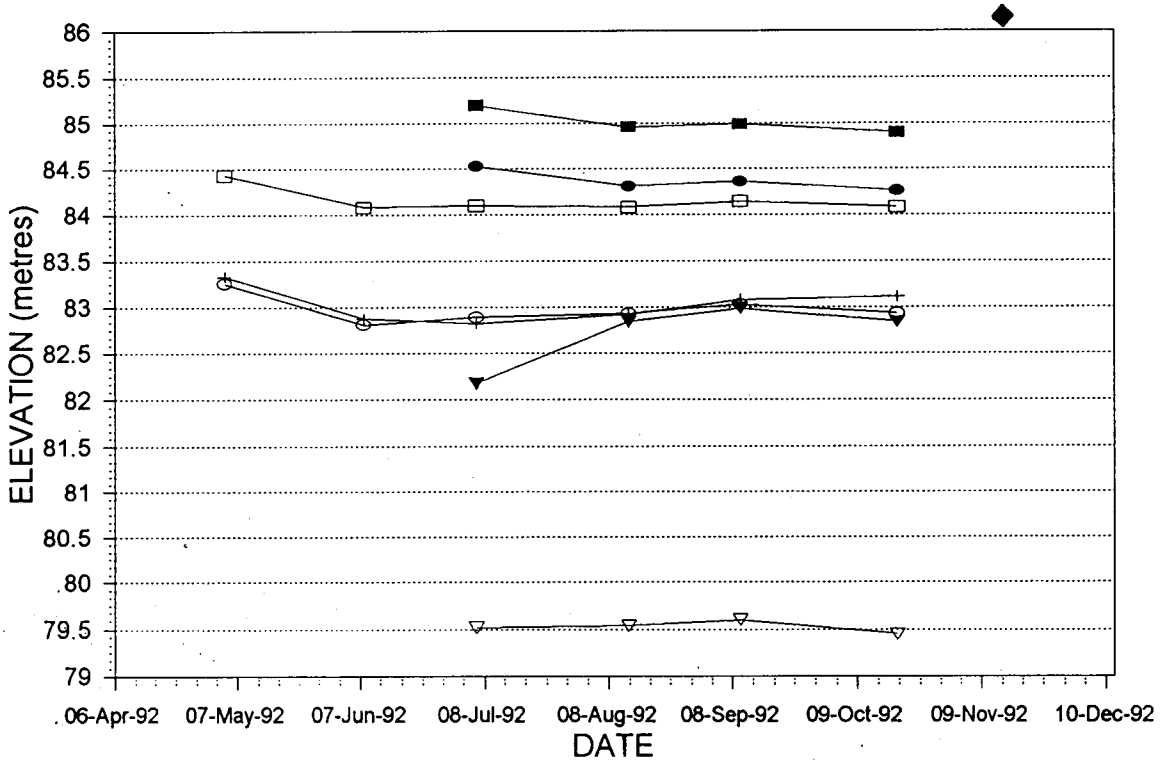
Drawn JC

Chkd. AC

GROUNDWATER LEVEL DATA

May to November 1992 (Glacial Till & Bedrock)

FIGURE 6



LEGEND

- BH.89-6C
- BH.90-31
- BH.90-W26
- BH.90-W19
- BH.90-38
- BH.90-W4
- BH.90-W29B
- P1

Date DEC. 23, 1992

Project 921-2158

Golder Associates

Drawn JC

Chkd. AC

APPENDIX A

REPORTS FROM ANNIS O'SULLIVAN VOLLEBEK LTD. LETTERS OF SEPTEMBER 1 AND NOVEMBER 11, 1992

ANNIS, O'SULLIVAN, VOLLEBEKK LTD.

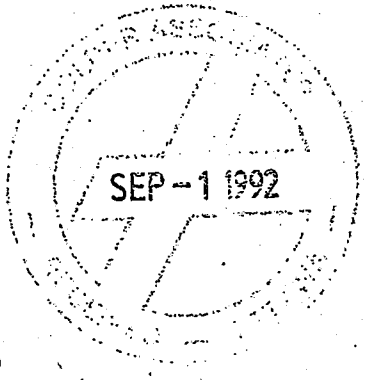
ONTARIO LAND SURVEYORS
ARPENTEURS GÉOMÈTRES DE L'ONTARIO

MEMBERS

G.D. Annis, O.L.S.
E.H. Herweyer, O.L.S.
E.M. Lancaster, O.L.S., C.L.S.
V.A. Shelp, O.L.S.
D.R. Vollebekk, O.L.S.
S.A. Tischart, O.L.S.
B.J. Lynch, O.L.S.

REPLY TO: Nepean

September 1, 1992



Golder Associates
1796 Courtwood Crescent
OTTAWA, Ontario
K2C 2B5

Attn: Mr. Andrew Chevrier

Re: Bells Corners Elevations
Client: Ministry of Transportation of Ontario

Dear Sir:

A brief summary of the project to date, a survey report and a listing of the elevations on the monitoring points are enclosed, together with our invoice for same. I trust these meet with your approval.

We have incorporated temporary benchmarks (fire hydrants, valve covers, spikes in hydro poles, etc.) as turning points in our level loops. Although none of these points has the stability of the houses, we will keep track of their elevations as a source of secondary information. The definition of these points is subject to an error of approximately 0.01 metres.

We will present future data in a tabular format showing changes in elevation for the fifteen monitoring points. A secondary table showing changes in the temporary benchmarks will be presented, if warranted. I expect we will not be able to determine elevation changes caused by seasonal de-watering until next year. This past summer has been wet - the weather and construction schedule next year will dictate our ability to demonstrate any effects of seasonal de-watering.

Please call me should you require any further information at this time.

Yours truly,

E. H. Herweyer
Ontario Land Surveyor

EHH/red
Encl.

14 Concourse Gate, Suite 500
NEPEAN, Ontario K2E 7S6
Telephone (613) 727-0850
Fax (613) 727-1079

3809 St-Joseph Blvd., Unit 3, R.R. 2
ORLÉANS, Ontario K1C 1T1
Telephone (613) 830-8630
Fax (613) 830-8395

225 Rue Industriel, P.O. Box 579
EMBRUN, Ontario K0A 1W0
Telephone (613) 443-3364
Fax (613) 443-3229

DIARY - BELLS CORNERS ELEVATIONS

1992

July 24	Ed Herweyer and Andrew Chevrier locate preferred buildings for monitoring.
July 28	Ed Herweyer and John Brunton (AOV Field Crew Chief) meet with owners of houses chosen for monitoring. Owners generally pleased with idea that monitoring was being undertaken. All owners were against fixing a bolt into their foundation for monitoring purposes - corners were then chosen based on definition and accessibility.
July 28, 29	Field survey completed. A primary benchmark was established on the railway bridge in the event that the geodetic benchmark (NCC monument 019680022) is disturbed. The assumption made is that the railway bridge is piled to bedrock and not susceptible to the effects of de-watering.
August 6, 7	Check survey note reductions, analyse information, determine elevation differences.
August 18-20	Complete second elevation run through the monitoring points.
August 24, 25	Check survey note reductions, analyse information, determine elevation differences.
August 28, 31	Preparation of initial report.

SURVEY AND ADJUSTMENT REPORT - BELLS CORNERS ELEVATIONS

All field survey equipment meets specifications for second order levelling networks. Elevation differences were determined with a micrometer attachment for reading an invar (temperature sensitive) rod. Backsight and foresight distances were identical on any set up and kept to less than fifty metres.

Redundancy in our measurements allowed the analysis of five complete loops. Each loop contained misclosures of a smaller magnitude than allowable under second order specifications; on this project, second order specifications allow misclosures of up to 0.004 metres to 0.011 metres depending on the length of the loop. Actual misclosures for the loops are less than 0.004 metres in each case.

The second set of measurements obtained from August 18 to 20, 1992 yielded elevations that agreed with the first set of measurements within 0.002 metres.

I have chosen to accept the elevations determined from the first set of observations as the base elevations that future observations will be compared with. The second set of observations did not have the same redundancy as the first set of observations; nevertheless, the second set does confirm that the first set of elevations as shown on the List of Benchmarks are completely satisfactory and reliable.

LIST OF BENCHMARKS

Control Points

NCC Geodetic 019680022 - 91.353 metres
Primary Benchmark - top of bolt, railway overpass - 87.310 metres

Monitoring Points

No.	Location	Elevation
1.	Bell High School, library window ledge	98.294
2.	34 Cedarview Drive, bottom brick, NE corner	90.105
3.	1 Grangemill Avenue, bottom brick, NW corner	88.967
4.	8 Cedarview Drive, bottom brick, SE corner	88.262
5.	13 Domus Crescent, bottom brick, SE corner	87.773
6.	12 Dante Avenue, bottom brick, SE corner	88.343
7.	1 Redfield Avenue, bottom brick, NE corner	89.261
8.	62 Foothills Drive, bottom brick, SE corner	89.772
9.	43 Foothills Drive, top of first course of angel stone, SW corner	89.733
10.	22 Foothills Drive; bottom brick, chimney	88.272
11.	17 Foothills Drive, bottom brick, SW corner	88.273
12.	Strip Mall, Foothills Drive at Northside Road, bottom brick, NE corner	87.510
13.	NE corner of Post Office, Larkspur Drive at Northside Road	88.451
14.	11 Thorncliffe, bottom brick, SW corner	88.658
15.	38 Larkspur Drive, bottom brick, SW corner	89.470

921-2158

ANNIS, O'SULLIVAN, VOLLEBEKK LTD.

ONTARIO LAND SURVEYORS
ARPENTEURS GÉOMÈTRES DE L'ONTARIO

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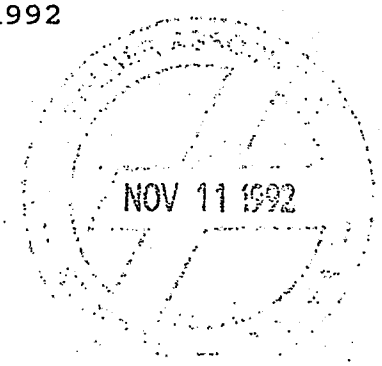
D.R. Vollebekk, O.L.S.
S.A. Tischart, O.L.S.
B.J. Lynch, O.L.S.

REPLY TO: Nepean

November 11, 1992



Golder Associates
1796 Courtwood Crescent
OTTAWA, Ontario
K2C 2B5

Attn: Mr. Andrew Chevrier

Re: Bells Corners Elevations
Client: Ministry of Transportation of Ontario

Dear Sir:

The following list describes the control points and the points being monitored for any changes in elevations.

Control Points

NCC Geodetic 019680022 - 86.136 metres
Primary Benchmark - top of bolt, railway overpass - 87.310 metres

Monitoring Points

No.	Location	Elevation
1.	Bell High School, library window ledge	98.294
2.	34 Cedarview Road, bottom brick, NE corner	90.105
3.	2 Grangemill Avenue, bottom brick, NW corner	88.967
4.	8 Cedarview Road, bottom brick, SE corner	88.260
5.	13 Domus Crescent, bottom brick, SE corner	87.773
6.	12 Dante Avenue, bottom brick, SE corner	88.343
7.	1 Redfield Avenue, bottom brick, NE corner	89.261
8.	62 Foothills Drive, bottom brick, SE corner	89.772
9.	43 Foothills Drive, top of first course of angel stone, SW corner	89.733

No.	Location	Elevation
10.	22 Foothills Drive; bottom brick, chimney	89.272
11.	17 Foothills Drive, bottom brick, SW corner	88.273
12.	Strip Mall, Foothills Drive at Northside Road, bottom brick, NE corner	87.510
13.	NE corner of Post Office, Larkspur Drive at Northside Road	88.451
14.	11 Thorncliff Place, bottom brick, SW corner	88.658
15.	38 Larkspur Drive, bottom brick, SW corner	89.470

These elevations are the base datum derived from two distinct level loops surveyed in August, 1992. The present survey was completed on October 27 and 29, 1992. These elevation values and the differences from the previous readings are correlated in the enclosed table. The elevations and differences will allow you to easily determine increments of movement and the overall movement, if any.

The largest difference between the present elevations and the datum elevations is 0.005 metres - this falls within the attainable accuracy of the levelling process. There has been no conclusive movement of the monitoring points between surveys.

I trust this is the information you require at this time.

Yours truly,

E. H. Herweyer
Ontario Land Surveyor

EHH/red
Encl.

BELLS CORNERS ELEVATIONS - CITY OF NEPEAN, REGIONAL MUNICIPALITY OF OTTAWA-CARLETON

Monitoring Points	Datum Elevation (August, 1992) (Metres)	Elevations/Changes from Previous Elevations (Metres)	
		Oct.27&29, 1992	
1. Bell High School, Cedarview Road	98.294	98.289 -0.005	
2. 34 Cedarview Road	90.105	90.103 -0.002	
3. 2 Grangemill Avenue	88.967	88.963 -0.004	
4. 8 Cedarview Road	88.260	88.255 -0.005	
5. 13 Domus Crescent	87.773	87.773 0.000	
6. 12 Dante Avenue	88.343	88.345 +0.002	
7. 1 Redfield Avenue	89.261	89.257 -0.004	
8. 62 Foothills Drive	89.772	89.771 -0.001	
9. 43 Foothills Drive	89.733	89.733 0.000	
10. 22 Foothills Drive	89.272	89.274 +0.002	
11. 17 Foothills Drive	88.273	88.273 0.000	
12. Strip Mall, Foothills Drive at Northside Road	87.510	87.511 +0.001	
13. Post Office, Larkspur Drive at Northside Road	88.451	88.449 -0.002	
14. 11 Thorncliff Place	88.658	88.656 -0.002	
15. 38 Larkspur Drive	89.470	89.469 -0.001	

Prepared by: ANNIS, O'SULLIVAN, VOLLEBEKK LTD.
November 11, 1992

LOCATION OF PIEZOMETERS

FIGURE 2

RICHMOND ROAD

BASELINE ROAD

CN RAIL LINE

CEDARVIEW ROAD

90-W19

90-W4

90-W26

90-W29A, W29B

89-2B

90-31

89-9

88-5

90-27

89-7

90-36

90-38

89-6A, 6B, 6C

90-34

89-8

88-6

P1

P2

P3

90-33

STRIP MALL

CANADA POST BUILDING

BELL HIGH SCHOOL

EAST POND

WEST POND

CENTRELINE PROPOSED HIGHWAY 416

PROPOSED NBL

PROPOSED SBL

PROPOSED CEDARVIEW ROAD REALIGNMENT

PIT SABLIÈRE

SENTIER DE BICYCLETTE

BICYCLE PATH

SPORTS TRACK

Yard Cour

BLEACHERS STADE PISTE DE SPORTS

LEGEND

PIEZOMETER LOCATION IN PLAN

SCALE 1 : 2000

SPECIAL NOTE
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Date DEC. 22, 1992
Project 921-2158

Golder Associates

Drawn JC
Chkd

LOCATION OF PRECISE SETTLEMENT MONITORING POINTS

FIGURE 3

RICHMOND ROAD

BASELINE ROAD

CN RAIL LINE

CEDARVIEW ROAD

CENTRELINE PROPOSED HIGHWAY 416

PROPOSED NBL

PROPOSED SBL

PROPOSED CEDARVIEW ROAD REALIGNMENT

#1 #2 #3 #4 #5 #6 #7 #8 #9 #10 #11 #12 #13 #14 #15

CANADA POST BUILDING

BELL HIGH SCHOOL

BLEACHERS
TRIBUNE
PISTE DE SPORTS

SPORTS TRACK

Yard
Cour

EAST POND

WEST POND

PIT
SABLIÈRE

SENTIER DE BICYCLETTE

BICYCLE PATH

BROUSSAILLE ET

LEGEND

▲ PRECISE SETTLEMENT MONITORING POINT IN PLAN

SCALE 1 : 2000

SPECIAL NOTE
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Date DEC. 22, 1992
Project 921-5158

Golder Associates

Drawn JC
Chkd