VOLUME 4

FRONTIER STONE, LLC
PROPOSED FRONTIER STONE QUARRY

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January 29, 2014

APPENDIX 3

- Soils Description
- Fields Logs

Bombay Series

The Bombay series consists of deep, nearly level to gently sloping, moderately well drained soils on glacial till plains. These soils formed in glacial till derived from sandstone and limestone.

In a representative profile the surface layer is dark grayish brown fine sandy loam 8 inches thick. The subsurface layer is 2 inches of brown fine sandy loam. The subsoil is 22 inches thick. In sequence downward, it is 4 inches of brown to dark brown, friable fine sandy loam; 7 inches of mottled brown to dark brown, firm fine sandy loam; 6 inches of mottled yellowish brown, firm fine sandy loam; and 5 inches of mottled reddish brown, firm loam. The substratum is reddish brown, firm loam.

A temporary high water table is perched above the substratum in spring and during other wet periods. Permeability is moderate in the subsoil and moderately slow in the substratum. Available water capacity is moderate. The capacity of these soils to supply nitrogen is medium, and the capacity to supply phosphorus and potassium is low to medium. Seasonal wetness and moderately slow permeability in the substratum are the main limitations in farming and in town and country planning.

Representative profile of Bombay fine sandy loam, 3 to 8 percent slopes, in a cultivated area 50 feet west of Kenyonville Road, three-eighths of a mile north of Eagle Harbor-Knowlesville Road, 300 feet north of cemetery, in the town of Gaines:

Ap—0 to 8 inches, dark grayish brown (10YR 4/2) fine sandy loam; moderate, medium to fine, granular structure; friable; many roots; many fine pores; less than 5 percent coarse fragments; slightly acid; abrupt, smooth boundary.

A2—8 to 10 inches, brown (7.5YR 5/4) fine sandy loam; moderate, medium, granular structure; friable; many roots; many fine pores; less than 5 percent coarse fragments; slightly acid; clear, wavy boundary.

B&A—10 to 14 inches, brown to dark brown (7.5YR 4/4) fine sandy loam; weak, fine, subangular blocky structure parting to weak, thin, platy; friable; common roots; common fine pores with clay linings; light gray (10YR 7/2) ped coats 1 to 2 millimeters thick; 10 percent coarse fragments; neutral; gradual, smooth boundary.

B21t—14 to 21 inches, brown to dark brown (7.5YR 4/4) fine sandy loam; common, medium, distinct, strong brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure parting to weak, thin, platy; firm; common roots; common fine pores with clay linings; clay films on 15 percent of ped faces; few clay linings in pores; 10 percent coarse fragments; neutral; clear, wavy boundary.

B22t—21 to 27 inches, yellowish brown (10YR 5/4) fine sandy loam; common, medium, distinct, brownish yellow (10YR 6/6) mottles; weak, fine, subangular blocky structure parting to weak, thin, platy; firm; few pores; few patchy clay films on ped faces; 5 percent coarse fragments; neutral; abrupt, wavy boundary.

B3—27 to 32 inches, reddish brown (5YR 4/3) loam; few, medium, prominent, brownish yellow (10YR 6/6) mottles; weak, fine, subangular blocky structure parting to weak, thin, platy; firm; 15 percent coarse fragments; neutral; smooth boundary.

C—32 to 50 inches, reddish brown (5YR 4/3) loam; moderate, medium, platy structure; firm; 15 percent coarse fragments; calcareous; moderately alkaline.

Thickness of the solum and depth to carbonates range from 30 to 40 inches. The content of coarse fragments ranges from 10 to 20 percent in the solum and from 10 to 25 percent in the C horizon. Reaction ranges from medium acid to neutral in the solum and from neutral to moderately alkaline in the C horizon.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2. The A2 horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. It ranges from fine sandy loam to loam.

The B&A horizon has interfingering A2 material surrounding peds as coatings 1 to 2 millimeters thick in hue of 10YR, value of 6 or 7, and chroma of 2 or 3. The B horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam or fine sandy loam. The Bt horizon has clay films that coat 10 to 30 percent of the ped surfaces.

The C horizon has the same color and texture ranges as the B horizon.

Bombay soils are commonly near or are similar to Madrid, Massena, Hilton, and Appleton soils. They formed in material similar to that of the well drained Madrid soils and somewhat poorly drained Massena soils. Bombay soils are similar to Hilton soils, but have a coarser textured B horizon. They have a coarser textured B horizon and are better drained than Appleton soils.

BoB—Bombay fine sandy loam, 3 to 8 percent slopes. This gently sloping soil has the profile described as representative of the series. It is on till plains in many parts of the county. Areas are oblong and range from less than 5 to about 50 acres in size.

Included with this soil in mapping are nearly level Bombay or Massena soils in drainageways or depressions and gently sloping Madrid soils in higher, drier areas. Near Fancher are a few areas where the soil is moderately deep over reddish silt and clay lacustrine deposits, and north of West Barre, areas where the soil is moderately deep over silt and fine sand. Near West Shelby are areas of soils that have a fragipan.

Runoff is medium, and the hazard of erosion is moderate. The seasonal high water table, the moderate hazard of erosion, and the moderately slow permeability are the main limitations. In most areas this soil responds well to tile drainage and to lime and fertilization. It is suited to most crops grown in the county, including cherries. Artificial drainage, however, is needed for crops that require good drainage. Contour planting, stripcropping, and diversions help to control runoff and reduce the risk of erosion. Capability unit IIe-2; woodland suitability group 2o1.

Cayuga Series

The Cayuga series consists of deep, gently sloping, moderately well drained to well drained soils on lake deposits in till plains. These soils formed in lacustrine silt and clay underlain by glacial till.

In a representative profile the surface layer is dark grayish brown silt loam 8 inches thick. The subsurface layer is 4 inches of mottled brown silt loam. The subsoil is 13 inches of reddish brown, firm silty clay. The substratum is firm, glacial till. The upper 7 inches is mottled brown loam, the next 17 inches is brown gravelly fine sandy loam, and the lower 11 inches is brown gravelly loam.

A seasonal high water table is perched above the slowly permeable substratum for brief periods in spring, especially in the lesser sloping areas. Available water capacity is high. The capacity to supply nitrogen and phosphorus is medium, and the capacity to supply potassium is high. Slight seasonal wetness, slow permeability, and the moderate hazard of erosion are the main limitations in farming and in town and country planning.

Representative profile of Cayuga silt loam, 2 to 6 percent slopes, in a cultivated area, 500 feet west of Drake Island Road and 50 feet north of Gillete Road, in the town of Barre:

Ap—0 to 8 inches, dark grayish brown (10YR 4/2) silt loam; weak, fine, subangular blocky structure; friable; many fine roots; 2 percent coarse fragments; medium acid; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) silt loam; common, medium, distinct, strong brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable; common fine roots; common fine pores; 2 percent coarse fragments; medium acid; clear, wavy boundary.

B2t—12 to 25 inches, reddish brown (5YR 4/4) silty clay; moderate, medium, blocky structure; firm; few fine roots; common fine pores; continuous, thin, reddish brown (5YR 4/3) clay films on ped faces with thicker linings in pores; grayish brown (10YR 5/2) silty ped coats 1 millimeter thick in upper 3 to 4 inches; 2 percent coarse fragments; slightly acid; clear, smooth boundary.

IIC1—25 to 32 inches, brown (7.5YR 5/4) loam; few, fine, faint, strong brown (7.5YR 5/6) mottles; weak, thick, platy structure; firm; few fine roots; few fine pores; 10 percent coarse fragments; neutral; clear, wavy boundary.

IIC2—32 to 49 inches, brown (10YR 5/3) gravelly fine sandy loam; massive; firm; few fine pores; 20 percent coarse fragments; calcareous; moderately alkaline; abrupt, smooth boundary.

IIC3—49 to 60 inches, brown (10YR 5/3) gravelly loam; weak, medium, platy structure; firm; 20 percent coarse fragments; calcareous; moderately alkaline.

Thickness of the solum ranges from 20 to 36 inches. Depth to carbonates ranges from 20 to 40 inches. Reaction ranges from medium acid to neutral. The content of coarse fragments ranges from 10 to 50 percent in the C horizon.

The Ap horizon has hue of 7.5YR to 2.5Y, value of 3 or 4, and chroma of 2 to 4. The A2 horizon has hue of 10YR, value of 4 to 6, and chroma of 2 or 3.

The Bt horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 3 or 4. It ranges from heavy silty clay loam to silty clay.

The C horizon has hue of 10YR to 5YR, value of 4 or 5, and chroma of 3 or 4. It ranges from fine sandy loam to silt loam.

Cayuga soils formed in the same kind of parent material and are in the same drainage sequence as the somewhat poorly drained Churchville soils and the poorly drained Barre soils. They are better drained and are on thinner clay deposits than Odessa or Rhinebeck soils.

CcB—Cayuga silt loam, 2 to 6 percent slopes. This gently sloping soil is on glacial till deposits that have a lacustrine cap 20 to 36 inches thick. Areas are oblong and generally less than 25 acres in size.

Included with this soil in mapping are areas of other Cayuga soils where slope is less than 2 percent or more than 6 percent. Also included are areas of Churchville, Odessa, and Rhinebeck soils in depressions and along drainageways, areas of Ontario or Hilton soils on knolls, areas where the clay cap is thinner than 20 inches, and south of Clarendon, areas of similar soils that are moderately deep over shale or limestone.

Runoff is medium, and the hazard of erosion is moderate. Slow permeability and the moderate hazard of erosion are the main limitations. This soil is well suited to most crops grown in the county. Cover crops and green manure crops along with contour planting and contour stripcropping help to reduce runoff and erosion. Capability unit IIe–5; woodland suitability group 2o1.

Churchville Series

The Churchville series consists of deep, nearly level and gently sloping, somewhat poorly drained soils on thin lake deposits on till plains. These soils formed in lacustrine silt and clay underlain by glacial till.

In a representative profile the surface layer is dark grayish brown silt loam 9 inches thick. The subsoil is 13 inches of mottled reddish brown, firm silty clay. The upper part of the substratum is mottled reddish brown, very firm silty clay loam. The lower part is mottled reddish brown, firm loam.

A seasonal high water table is generally perched above the slowly permeable subsoil. The substratum is also slowly permeable. Available water capacity is moderate. The capacity of these soils to supply nitrogen and phosphorus is medium. The capacity to supply potassium is medium to high. The seasonal high water table and the slow permeability are the main limitations in farming and in town and country planning.

Representative profile of Churchville silt loam, 2 to 6 percent slopes, in hay, 150 yards south of N.Y. 31 (Telegraph Road), 50 feet west of Taylor Hill Road, in the town of Ridgeway:

Ap—0 to 9 inches, dark grayish brown (10YR 4/2) silt loam; weak, medium and fine, granular structure; friable; many roots; slightly acid; abrupt, smooth boundary.

B21t—9 to 15 inches, reddish brown (5YR 4/3) silty clay; common, medium, distinct, strong brown (7.5YR 5/6) mottles; moderate, coarse prisms parting to moderate, medium, subangular blocky structure; firm; common roots; common pores; coatings of reddish gray (5YR 5/2) silty material 1 to 2 millimeters thick on peds in upper part; thin, dark reddish gray (5YR 4/2) clay films on 50 percent of peds; less than 2 percent coarse fragments; neutral; clear, smooth boundary.

B22t—15 to 22 inches, reddish brown (5YR 4/3) silty clay; common, fine, faint, yellowish red (5YR 4/6) and reddish gray (5YR 5/2) mottles; moderate, coarse prisms parting to moderate, medium, blocky structure; firm; common roots; common pores with clay linings; dark reddish gray (5YR 4/2) coats and thin continuous clay films on peds; less than 2 percent coarse fragments; neutral; clear, smooth boundary.

C1—22 to 29 inches, reddish brown (5YR 4/3) silty clay loam; many, medium, distinct, yellowish red (5YR 4/6) mottles; moderate, medium, platy structure; very firm; few roots; less than 5 percent coarse fragments; calcareous; moderately alkaline; abrupt, wavy boundary.

IIC2—29 to 52 inches, reddish brown (5YR 5/3) loam; common, medium, faint, yellowish red (5YR 5/6) mottles; massive; firm; 15 percent coarse fragments; calcareous; moderately alkaline.

Thickness of the solum ranges from 20 to 36 inches. Depth to carbonates ranges from 18 to 36 inches. The content of coarse fragments ranges from none to less than 2 percent. Reaction ranges from slightly acid in the upper part of the solum to mildly alkaline in the lower part.

The Ap horizon has hue of 10YR to 2.5YR, value of 3 to 5, and chroma of 2 or 3.

The B horizon has hue of 10YR to 2.5YR, value of 4 or 5, and chroma of 2 to 4. Texture ranges from silty clay loam to clay. Thin patchy to continuous clay films are on both vertical and horizontal ped faces.

The C1 horizon is similar to the B horizon in color and texture. It is discontinuous, has platy structure, and is calcareous.

The IIC horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. The texture is loam or silt loam. The content of coarse fragments ranges from 10 to 35 percent.

Churchville soils are commonly near or are similar to Cayuga, Barre, Odessa, and Rhinebeck soils. They formed in similar deposits and are in the same drainage sequence as the well drained to moderately well drained Cayuga soils and the poorly drained Barre soils. They formed in thinner clayey deposits than Odessa and Rhinebeck soils.

ChA—Churchville silt loam, 0 to 2 percent slopes. This nearly level soil has a profile similar to the one described as representative of the series, but it has more mottles nearer the surface. It is in glacial lake areas that are near areas of glacial till. Areas are irregularly shaped and range from less than 5 to more than 50 acres in size.

Included with this soil in mapping are areas where the surface layer is silty clay loam and small areas of wetter Barre, Lakemont, and Madalin soils in depressions and drainageways. Also included are small areas of better drained Cayuga, Schoharie, and Cazenovia soils on knolls and a few areas where stones are on the surface and in the profile.

Runoff is slow, and the hazard of erosion is slight. The seasonal high water table and the slow permeability are the main limitations.

If surface drainage is adequate, this soil is well suited to hay and grain crops. If artificially drained, it is suited to grapes, apples, and pears. It is not so well suited to cherries, peaches, and many vegetables even under artificial drainage, because of the fine textured subsoil. Surface drainage, such as land shaping, is generally more effective than tile systems because of the slowly permeable subsoil. Capability unit IIIw-2; woodland suitability group 3w1.

Odessa Series

The Odessa series consists of deep, nearly level to gently sloping, somewhat poorly drained soils on glacial lake plains. These soils formed in reddish colored silt and clay lacustrine sediment.

In a representative profile the surface layer is very dark grayish brown silt loam 8 inches thick. The upper 9 inches of the subsoil is mottled brown, firm silty clay loam. The lower 24 inches is mottled reddish brown, firm silty clay. The substratum is mottled dark reddish gray and brown to dark brown, stratified silt and clay.

A seasonal high water table is generally perched above the slowly permeable subsoil. The substratum is slowly to very slowly permeable. Available water capacity is moderate to high. The capacity of these soils to supply nitrogen is high, but release is slow in spring when the soil is wet. The capacity to supply phosphorus is medium and potassium high. The seasonal high water table, the slow to very slow permeability, and the high content of silt and clay are the main limitations in farming and in town and country planning.

Representative profile of Odessa silt loam, 0 to 2 percent slopes, in an idle area one-half mile south of East Shelby-West Barre Road, 50 feet east of Shelby-Barre Town Line Road, in the town of Barre:

Ap—0 to 8 inches, very dark grayish brown (10YR 3/2) silt loam; gray to light brownish gray (10YR 6/2) when dry; weak, medium, granular structure; friable; many roots; slightly acid; abrupt, smooth boundary.

B21t—8 to 17 inches, brown to dark brown (7.5YR 4/4) silty clay loam; common, medium, distinct, strong brown (7.5YR 5/6) mottles; weak, coarse prisms parting to moderate, medium, angular blocky structure; firm; common roots; common fine pores with clay linings; pinkish gray (7.5YR 6/2) silty films on peds in upper part; thin; dark brown to brown (7.5YR 4/2) clay films on ped surfaces in lower part; slightly acid; clear, wavy boundary.

B22t—17 to 29 inches, reddish brown (5YR 4/3) silty clay; common, fine, distinct, yellowish red (5YR 4/8) and few, fine, faint, brown (7.5YR 5/2) and pinkish gray (7.5YR 6/2) mottles; moderate, coarse prisms parting to moderate, medium, angular blocky structure; firm; few roots; common fine pores with clay linings; dark brown to brown (7.5YR 4/2), thin, continuous clay films on ped surfaces; neutral; clear, wavy boundary.

B3—29 to 41 inches, reddish brown (5YR 5/4) silty clay; common, medium, distinct, yellowish brown (10YR 5/6) mottles; weak, medium, angular blocky structure; firm; calcareous; mildly alkaline; clear, smooth boundary.

C—41 to 50 inches, dark reddish gray (5YR 4/2) and brown to dark brown (7.5YR 4/2) stratified silt and clay; common, medium, distinct, yellowish brown (10YR 5/6) mottles; moderate, medium, platy structure; firm; calcareous; moderately alkaline.

Thickness of the solum ranges from 20 to 45 inches. Depth to carbonates ranges from 17 to 40 inches. Depth to bedrock is more than 4 feet. The content of coarse fragments ranges from 0 to 5 percent.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2.

The B horizon has hue of 7.5YR to 2.5YR, value of 4 or 5, and chroma of 2 to 4. High chroma mottles range from common to many in ped interiors. Ped surfaces are dominantly 2 chroma or less. The texture ranges from silty clay loam to silty clay. Clay films are on 10 to 40 percent of both vertical and horizontal ped faces. Reaction ranges from slightly acid to mildly alkaline in the lower part.

The C horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is silty clay loam, silty clay, or varved silt, clay, and very fine sand.

Odessa soils are commonly near or are similar to Schoharie, Lakemont, Rhinebeck, and Madalin soils. They formed in similar material and are in the same drainage sequence as the moderately well drained to well drained Schoharie soils and poorly drained to very poorly drained Lakemont soils. Odessa soils are redder in the lower part of the B horizon than Rhinebeck and Madalin soils.

OdA—Odessa silt loam, 0 to 2 percent slopes. This nearly level soil has the profile described as representative of the series. It is on glacial lake deposits that are dominantly silt and clay. Areas are narrow and finger shaped or irregularly shaped and range from about 5 to more than 100 acres in size.

Included with this soil in mapping are areas where the surface layer is silty clay loam. Also included are areas of Schoharie or Cayuga soils on knolls and on small, better drained spots and areas of Lakemont or Fonda soils in depressions and along drainageways. In a few areas are Rhinebeck soils, which are browner in the lower part of the subsoil, and in some areas are Churchville soils, which are similar to the Odessa soil but are moderately deep over glacial till. Small areas where gravel, stones, or sand is in the surface layer are indicated by spot symbols on the soil map.

Runoff is slow, and the hazard of erosion is slight. A seasonal high water table, the slow to very slow permeability, and the high silt and clay content are the main limitations.

This soil responds well to surface drainage. Tile generally is less effective. The soil crusts or forms hard clods if cultivated when wet. Unless artificially drained, it is best suited to short-season crops, hay, pasture, and trees. If adequately drained, it can be used for most crops commonly grown in the area. Additions of organic matter are needed to maintain soil tilth. Capability unit IIIw-2; woodland suitability group 3w1.

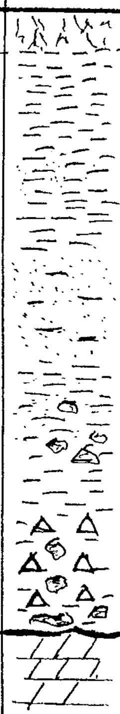
CONTINENTAL PLACER INC.

GEOLOGIC AND ENVIRONMENTAL SERVICES

Client FRONTIER PARTNERS LLC
Project ZELASNY FARM EXPLORATION
Location SHELBY, N.Y.

Logged by JR. HELLERT Date Logged 8/15/05 -
Drilling Co. SJB DRILLING SERVICES, INC
Driller RON
Started 8-15-05 Finished

Hole 1-05
Depth
Elev.
Core Dia. SPOON/NQ

FORMATION	Member	Zone/Unit	Graphic Log 1" = 10	Depth	Descriptive Log ROCK TYPE: color; grain size; texture; bedding; minerals; remarks, etc.	Angle of Bedding to Core	% Core Recovery
GLACIAL OVERBURDEN				0	SOIL - 2-3'± — LOAM		
					5-7' CLAY, with silt, red, semi plastic - dry 5-7-10-15		
					NOTE: HOLE CONVERTED TO OBSERVATION WELL		
				10	10'-12' CLAY, minor silt, red, plastic - slightly moist 2-2-6-7 INITIAL H_2O IN AUGERS - 8'		
				15	15'-17' SILT/VERY FINE SAND, buff-red, moist - rock fragment 2-6-9-9		
				20	20-22' SILT & CLAY, red-buff, scattered stone fragments -moist 6-5-15-12		
				25	25'-27' CLAY & ROCK FRAGMENTS 35-40-50 (2") - sampling difficult - boulder or bedrock (Boulder)		
				30	30'-32' TILL, clay with rock fragments, reddish-gray - SPOON BOUNCING		
				35	35'-37' TILL & ROCK FRAGMENTS SAMPLING DIFFICULT - SPOON BOUNCING		
LOCKPORT					38' - BEDROCK		
				40			
					CASING GROUTED 2' INTO TOP OF ROCK		
				50			

Hole No. 1-05

HOLE 2-05

0 – 33.5

4.5

0-33.5 OVERBURDEN

33.5–66.7 OAK ORCHARD

66.7 – 105 E

105 – 120 D_2-D_1 members

120 – 130 C memb

130 – 139 – GASPORT

139 – 153.8 DeCew

HOLE 3-05

0 – 27' overburden

27 – 67.6 OAK ORCHARD

E 67.6 – 105.5

D_1-D_2 105 – 115

C 115 – 121

121' – 135.5' GASPORT

135.5 – DeCew

HOLE 5-05

Lift		Depth	Unit	Member	Thickness
		0-23	OVERBURDEN		
LIFT 1	48'	23-71'	OAK ORCHARD MEMBER		48'
		71-101'	E UNIT	GOAT ISLAND MEMBER 55'	30'
		101-107'6"	D_2		6.5'
LIFT 2	61.5	107'6"-114'6"	D_1		7'
		114'6"-126	C		11.5'
		126-132'6"	B	GASPORT MEMBER	6.5'
LIFT 3	7'	132'6"-139'6"	DeCew Member		7'
		139'6"-161	ROCHESTER SHALE FORMATION		116.5'

HOLE 4-05

0-36.5 OVERBURDEN

36.5-79.0 OAK ORCHARD

79-109.45 E - GOAT ISLAND

109.45-112.45 D_2

112.45-121 D_1

121-131.5 C

131.5-138.2 GASPORT B

138.2-150 DeCew (arbitrary)

APPENDIX 4

- Groundwater Study
- Johnston Groundwater Study
- Alpha Geoscience Groundwater Study
- Water Quality Analyses

CONTINENTAL PLACER INC.

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APPENDIX 4

GROUNDWATER ASSESSMENT

Proposed Frontier Stone LLC Quarry
Town of Shelby, New York

Prepared December 2007
Revised March 2008
Revised January 2011
Revised November 19, 2012

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1.0 INTRODUCTION

This report presents data and findings resulting from the performance of a 72-hour pumping test on a 6-inch diameter bedrock well on the Zelazny property south of Fletcher Chapel Road in the Town of Shelby, New York. Continental Placer Inc. (CPI) was retained by Frontier Stone LLC to perform the pumping test. Frontier Stone LLC has applied to place a stone quarry on the Zelazny property and the pumping test was performed to help assess potential impacts from quarry dewatering.

Five wells had been installed on the proposed quarry site to obtain water level measurements and allow aquifer testing. These wells are designated PW-1, MW-1, DH 1-05, DH 4-05, and DH 5-05. PW-1 and MW-1 were installed in March 2007 and the other three were installed in 2005. Another well, an actively pumped Zelazny barn well, was also utilized for monitoring during the pump test. Figure 4-1 shows the locations of these wells. Table 4-1 summarizes the construction characteristics of the wells.

Table 4-1
General Construction Details of Wells Monitored During 72-Hour Test

Well ID	Distance from PW-1 (feet)	Grade Elevation (feet amsl)	Diameter (inches)	Depth to Bedrock (feet)	Well Depth (feet)	Aquifer
PW-1	0	633.24	6	27	200	Lockport
MW-1	200	634.22	6	22	155	Lockport
DH 1-05	1800	633.66	4	38	162	Lockport
DH 4-05	1050	641.54	4	34.5	160	Lockport
DH 5-05	1640	626.26	4	18	146	Lockport
Barn Well	1700	656.94	6	?	55	Lockport

Static groundwater elevation data (provided in Table 4-2) show that the groundwater flow is generally southward across the site. A site specific groundwater elevation contour map is provided as Figure 4.2.

Table 4-2
Static Groundwater Depths and Elevations
Proposed Frontier Stone Quarry

Well ID	5/4/2005		9/7/2005		11/28/2005		4/3/2007		6/4/2007		6/21/2007		9/16/2008		10/27/2008	
	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)
PW-1							4.18	629.06	7.61	625.63	9.3	623.94	11.22	622.02	9.6	623.64
MW-1							7.96	626.26	9.81	624.41	11.05	623.17	12.09	622.13	10.5	623.72
DH 1-05	6.3	627.36	11	622.66	6.26	627.40	4.76	628.90	6.32	627.34	7.65	626.01	8.85	624.81	7.2	626.46
DH 4-05	14.6	626.94	21.1	620.44	13.4	628.14	15.39	626.15	17.62	623.92	18.9	622.64	20.25	621.29	18.6	622.94
DH 5-05[1.]	flowing		4.5	621.77	flowing								1.64	624.63	flowing	
DH 5-05[2.]							3.21	628.09	4.61	626.69	5.77	625.53			27.9	
Barn Well									28.55	628.39	27.85	629.09	29.68	627.26	24.05	629.04

1. The measuring point elevation was 626.27 at the top of the steel casing without casing extension.
2. Measuring point elevation was 631.3 with 5.03 ft added to the top of the steel casing to measure the level when flowing.

2.0 PURPOSE

The purpose of this pumping test was to assess the hydrogeologic conditions at the site and allow an assessment of potential drawdown due to dewatering associated with the proposed quarry. The specific objectives of the pumping test included the following:

1. Assess general yield of Lockport Formation at the site.
2. Conduct a 72-hour pumping test.
3. Evaluate aquifer response data collected during the pumping test to determine estimates of aquifer characteristics.
4. Evaluate extent and magnitude of groundwater level declines during the pumping test.
5. Provide hydraulic data for use in predictive assessments of long-term quarry dewatering.
6. Identify areas that may be potentially impacted by the future quarry dewatering.

3.0 72-HOUR PUMP TEST

On Monday, April 2, 2007, CPI and Frey Well Drilling (Frey) personnel mobilized to the site. Frey installed a submersible pump in PW-1 with a totalizing flow meter on the discharge pipe, and briefly pumped the well at the pumps' maximum rate of 124 gpm in preparation for a Tuesday, April 3, 2007 72-hour pumping test start-up.

In further preparation for the 72-hour pumping test, data-logging pressure transducers were also set on April 2, 2007 to monitor pre-test groundwater levels in four wells, which were PW-1, MW-1, DH 1-05, and DH 4-05. Setting the transducers on Monday permitted the collection of approximately 20 hours of background water level trends prior to the test. On Tuesday, April 3, 2007 another transducer was placed in the Zelazny cattle barn well immediately south of Fletcher Chapel Road.

On Tuesday morning, April 3, 2007, the background groundwater level data were downloaded from the wells with transducers and the transducers were re-set to log water level changes during the pumping test (with more frequent readings at the start of the test and less frequent as the test progressed, then more frequent readings when the pump was shut off). Manual measurements were also collected from each of the wells prior to starting the pump.

At 11:00 AM the pump was started in PW-1. The initial pumping rate was 124 gpm. But as the water level decreased in the pumping well, the pumping rate slowly declined to slightly more than 121 gpm, which occurred after approximately 12 hours of start-up. The test was completed and the pump shut down at 11:00 AM on April 6, 2007, and water levels in the pumping well and monitoring wells with transducers were monitored throughout the weekend of April 7th. Water level recovery in monitoring well (DH5-05) was manually monitored for 8 hours following pump shut down.

The water pumped from PW-1 was discharged to a drainage ditch approximately 190 feet south of the well. Figure 4-3 shows the drainage flow path of the pumping test discharge water.

4.0 PUMPING TEST RESULTS

The groundwater level response from the 72-hour pumping test and recovery period were utilized to provide estimates of aquifer hydraulic properties, and to assess effects on groundwater levels due to pumping. The groundwater level plots for PW-1 and the five monitoring wells (MW-1, DH 1-05, DH 4-05, DH 5-05, and the Zelazny barn well) are provided in Appendix A. These plots depict groundwater level changes prior to the test (background), during the pumping test, and after the pumping test (recovery).

Semi-logarithmic plots of the drawdown during and after the tests are also provided in Appendices B and C, which were used to estimate aquifer hydraulic properties and interpret aquifer conditions. The tabulated groundwater level data are provided as Appendix D. The following describes the findings from the pumping test and the calculated aquifer hydraulic parameters.

The drawdown observed in the 6-inch diameter, 200-foot deep production well (PW-1) after pumping 72-hours at 124 to 121 gpm was 11.7 feet. The drawdown observed in the monitoring well closest to PW-1 (MW-1) at the end of the test was 7.59 feet, and that in the well farthest from PW-1 (DH 1-05) at the end of the test was 7.06 feet. Table 4-3 summarizes the final drawdown and recovery for all the wells.

According to the NYSDEC Recommended Pump Test Procedures for Water Supply Applications, (Appendix 10, TOGS 3, 2.1), stabilized drawdown must be displayed before the end of the test, and is defined as a water level that has not fluctuated by more than plus or minus 0.5 foot for every 100 feet of water in the well over a five hour period. For PW-1 the pre-pumping water column was approximately 200 feet prior to the start of the pumping test. For this water column, drawdown would be considered stabilized if it did not fluctuate more than 1.0 foot. Stabilized drawdown occurred in PW-1 during the 72-hour test with only an additional 0.05 feet of drawdown being realized during the last 24-hours of pumping.

A recharge boundary was observed to have reduced the drawdown affect (change in slope in the semi-log drawdown versus time plots in Appendix B) after approximately 11 hours of pumping. The groundwater temperature however remained consistent (50.5°F or 10.3°C) throughout the pumping portion of the test, which suggests no surface water recharge impacts. Between 24 and 48 hours after the pump was shut down, the water level recovered to 86% or greater of pre-test levels in all the wells. Table 4-3 shows the percent recovery for the production well and the monitoring wells.

Aquifer parameters were estimated from the time versus drawdown graphs for PW-1, MW-1, DH 1-05, DH 4-05, and DH 5-05; these plots are provided in Appendices B and C. The estimates of transmissivity (T) and storativity (S) computed from the drawdown data are shown on Table 4-4. As shown on Table 4-4, the transmissivity values ranged from 1005 to 1168 feet^2/day, which are considered moderately high values. The 10^{-5} storativity values indicate a confined aquifer system.

Table 4-3
Summary of Pumping Test Recovery - April 2 through April 9, 2007
Frontier Stone, LLC

		Recovery Drawdown				Percent Recovery[3]			
Well ID	Drawdown at End of Pumping Test (feet)	8 hours	24 hours	48 hours	70 hours	8 hours	24 hours	48 hours	70 hours
PW-1	11.70	3.27	1.68	1.47	1.33	72%	86%	87%	89%
MW-1	7.59	1.62	0.93	-0.28	-0.45	77%	88%	104%	106%
DH 1-05	7.06	1.65	0.06	-0.29	-0.29	77%	99%	104%	104%
DH 4-05	6.70	1.75	0.14	-0.32	-0.41	74%	98%	105%	106%
DH 5-05[1]	6.88	1.99	na	na	-0.36	71%	na	na	111%
Barn Well[2]	5.86/2.9	1.65	3.48/0.36	0.23/-0.04	-0.16	43%	86%	101%	106%

1. Water level measurements for DH 5-05 were not made over the weekend of April 7th because the water in the casing, and above ground surface, froze. The drawdown shown for the 70 hour reading was actually measured after the ice was removed from the well casing, which was approximately 74 hours after PW-1 pumping ceased.
2. The barn well was operating on and off throughout the test and during recovery. The larger drawdown values were measured at the designated time interval (i.e., 24 hours, 48 hours) but these drawdown values are influenced by pumping in that well. The smaller drawdown values shown were measured within a half hour of the designated time interval, when barn well pumping had less of an effect on the water level in that well. The percent recoveries for the barn well were calculated using the smaller drawdown values.
3. Recoveries greater than 100% show that water levels rose higher than pre-test levels.
4. na = not available

Table 4-4

Aquifer Hydraulic Properties Determined from 72-Hour Pumping Test

Frontier Stone, LLC

Well Name	Drawdown		Recovery	
	T (ft^2/day)	S	T (ft^2/day)	S
PW-1	1005	--	1168	--
MW-1	1054	7.40E-04	1108	6.91E-04
DH 1-05	1005	1.31E-05	1081	1.40E-05
DH 4-05	1081	4.14E-05	1138	3.87E-05
DH 5-05	1054	1.47E-05	1351	1.25E-05
Geometric Mean	1039	4.95E-05	1166	4.65E-05

5.0 RESIDENTIAL WELL SURVEY

Although most residences along Fletcher Chapel Road are serviced with public water several still have water wells. A residential well survey was provided, with stamped envelopes addressed to CPI, to 16 residences along Fletcher Chapel Road and Sour Springs Road. Three responses were returned and one empty envelope was returned. The depth of all three of the respondents' wells are 'shallow', with the deepest being 47 feet; one is a dug well of unknown depth. Table 4-5 summarizes the well information obtained from the residential well survey and discussions with the residents. The surveys that were returned are provided in Appendix E.

Table 4-5
Neighboring Residential Well Access and Information Questionnaire Summary
Frontier Stone, LLC

Name	Address	Well	Municipal Water	Survey Given	Survey Returned	Well Installation Date	Well Depth (feet)	Well Diameter (inches)	Pump Setting (feet)	Notes
Fuller	11646 Fletcher Chapel Road	Yes	Yes	Yes	No	NA	65	NA	NA	Well is 65' deep, good quantity, only uses for watering plants and lawn
Fuller	11666 Fletcher Chapel Road	Yes	Yes	Yes	No	NA	NA	NA	NA	Survey given to female occupant, no information known about well
	Fletcher Chapel Road	Yes	Yes	Yes	No	NA	NA	NA	NA	Survey given to female occupant, no information known about well
Charanis	11687 Fletcher Chapel Road	Yes	No	Yes	No	NA	NA	NA	NA	Nobody home, survey left in door
Zelazny	11763 Fletcher Chapel Road	Yes	Yes	Yes	No	NA	NA	NA	NA	Survey given to female occupant. Zalazny has a well at their residence on the north side of Fletcher Chapel Road and one at their cow barn on the south side of Fletcher Chapel Road.
Dieter	11854 Fletcher Chapel Road	Yes	No	Yes	No	NA	NA	NA	NA	Has well, not hooked up to municipal water
	11863 Fletcher Chapel Road	Yes	?	Yes	No	NA	NA	NA	NA	No one home, survey left in door
Hooker	11875 Fletcher Chapel Road	Yes	No	No	No	NA	NA	NA	NA	Sign on door says residences have moved; house appears vacant.
Hooker	11881 Fletcher Chapel Road	Yes	No	Yes	No	NA	NA	NA	NA	
Seitz	11891 Fletcher Chapel Road	Yes	Yes	No	NA	NA	NA	NA	NA	New house, no well; no survey provided
Outterson	11924 Fletcher Chapel Road	Yes	?	Yes	Yes	1994	47	6	42	Survey given to male occupant
Bacon	11947 Fletcher Chapel Road	Yes	?	Yes	No	NA	NA	NA	NA	Survey given to female occupant, no information known about well
Wilson	11946 Fletcher Chapel Road	Yes	Yes	Yes	Yes			36		
Dunn	11985 Fletcher Chapel Road	No	Yes	Yes	No	NA	NA	NA	NA	New house, no well
Taylor	12001 Fletcher Chapel Road	Yes	Yes	Yes	No	NA	NA	NA	NA	Survey given to female occupant, no information known about well
Longcore	5278 Sour Spring Road	Yes	No	Yes	No	NA	21	NA	NA	Well is 21' deep, good quality, quantity
Luthart	5283 Sour Spring Road	Yes	No	Yes	Yes	1987	36	6	28	Well is 36' deep, sulfur water

NA = Information not available.
? = Municipal hook-up not confirmed.

6.0 EVALUATION OF PUMPING TEST RESULTS AND PROPOSED DEWATERING

The primary water bearing zone in PW-1 was at a depth interval of 56 to 89 feet below grade, which is the depth interval where Frey installed the pump for the pumping test. No significant water bearing zones were identified shallower or deeper than this zone. This fracture zone appears to be bedding planes in the Lockport Dolomite that are present in all site wells. This bedding plane aquifer is overlain and underlain by relatively more competent rock and the rock is overlain by a clayey overburden. The overburden across the site ranges in thickness from 18 to 38 feet. The overburden is comprised of silty clay, which impedes infiltration.

The groundwater levels responded quickly (within two minutes) to pumping in the pumping well and all the monitoring wells (but not the Zalazny barn well), which is characteristic of confined aquifer conditions as demonstrated by the calculated 10^{-5} storativity values. During the pumping test, the groundwater levels lowered more (6 to 7 feet) in the site monitoring wells than in the Zelazny barn well (<3 feet). This is because the site monitoring wells are deeper and directly intercept the 56 to 89 foot deep primary water-bearing bedding plane zone and this zone is under confined conditions. The shallow barn well (that did not encounter the 56 to 89 foot deep bedding plane zone) exhibited less drawdown (<3 feet), which indicates the shallow bedrock has a subdued hydraulic connection with the deeper 56 to 89 foot bedding plane zones.

The conclusion that there is a subdued hydraulic connection between the shallow barn well and the other monitoring wells can further be substantiated by reviewing the groundwater elevation drawdown in each of the wells monitored during the pumping test. Table 4-6 below shows the time required to achieve one foot and two feet of drawdown in each of the monitoring wells and the barn well during the pumping test, and the final drawdowns at the end of the test.

As shown, one foot of drawdown occurred in wells DH-1-05, 4-05, and 5-05 within 30 minutes of the start of pumping but it took approximately three hours (180 minutes) to achieve a foot of drawdown in the shallow barn well, even with that well actively pumping during the test. Likewise, to achieve two feet of drawdown required 70 to 80 minutes in the 'DH' monitoring wells while it took more than 300 minutes to achieve this drawdown in the shallow barn well. Further, the DH4-05 well is farther from the pumping well than the barn well and it exhibited drawdowns sooner than the barn well and at greater magnitudes. Lastly, the total drawdown caused by the pumping test at the end of the test was significantly less in the barn well (<3 feet) than in the other monitoring wells (6 to 7 feet). This obviously demonstrates a much greater hydraulic connection between the deeper monitoring wells than with the shallower barn well. If there was a greater hydraulic connection with the shallow bedrock, then the drawdown observed at the barn well would have been similar to the other wells.

Table 4-6
Drawdown Comparisons between Monitored Wells during Pumping Test
Frontier Stone, LLC

Well ID	Distance from PW-1 (feet)	Grade Elevation (feet asml)	Depth (feet)	Time to 1-foot Drawdown (minutes)	Time to 2-foot Drawdown (minutes)	Final Drawdown at 4320 minutes (feet)
PW-1	0	633.24	200	<0.5	<0.5	11.70
MW-1	200	634.22	155	8	35	7.58
DH 1-05	1100	633.66	162	25	75	7.06
DH 4-05	1800	641.54	160	25	70	6.70
DH 5-05	1640	626.26	146	20	70	6.88
Barn Well	1700	656.94	55	180	340	<3.0

Note: The barn well was actively pumping. Drawdown due to the pumping of the barn well was neglected and drawdown due to the pumping test estimated.

The bedrock is overlain by more than 15 feet of low-permeability silty clay till. This overburden material serves as a hydraulic barrier that will prevent quarry dewatering from affecting surface water features. Also, once the 56 to 89 foot water-bearing bedding plane zone is exposed by the mine the confined nature of this zone will be relieved in the vicinity of the mine and drawdown at distance from the quarry will diminish.

It is well established in groundwater literature that drawdown from pumping a confined aquifer affects a much larger area than drawdown from pumping in an unconfined aquifer (Groundwater and Wells prepared by Fletcher G. Driscoll, 1986). This is due to the fact that the water in an unconfined aquifer is at atmospheric pressure while the water in a confined aquifer is at pressures greater than atmospheric pressures. Water flow from an unconfined aquifer is controlled by gravity drainage while that from a confined aquifer is controlled by the pressure imposed on the confined aquifer materials (by compression from overlying strata and distant recharge zones). When water is withdrawn from an unconfined aquifer, the aquifer materials lose saturated thickness, which limits the areal affect of pumping. When water is withdrawn from a confined aquifer, the aquifer materials remain saturated allowing the pressure drop (drawdown) to extend to greater distances within the aquifer. As a result, once a confined zone has been breached by a mine the confining pressure will be relieved in proximity to the mine and mine dewatering effects will be controlled by unconfined gravity drainage, which does not extend as far into the aquifer as it would if it were confined conditions (due to gravity versus pressure driven flow conditions). Figure 4-4, prepared by the United States Geological Survey (USGS), illustrates the differences in drawdown between an unconfined and confined with the same hydraulic properties and pumping stress.

Most of the water pumped during the pumping test was from the deep 56 to 89 foot bedding plane zone. This is where most of the mine dewatering water is expected to be derived. Noticeable dewatering is not expected to occur until the quarry is deepened to that level. Prior to mining down to the 56 to 89 foot below grade level, dewatering is not expected to impose noticeable water level declines in existing wells. Once the 56 to 89 foot deep bedding plane water-bearing zone is encountered by the mine, the dewatering has the potential to lower water levels in existing wells. However, it appears that most residential wells surrounding the site are shallower than a 56 to 89 foot bedding plane zone. Since the shallow bedrock wells have a weak hydraulic connection with the deep 56 to 89 zone and the low permeability of the unconsolidated overburden impedes vertical recharge, the lowering of the groundwater elevation is not expected to be significant and is not expected to deplete yields of the existing wells, or dewater surface water features (streams, wetlands).

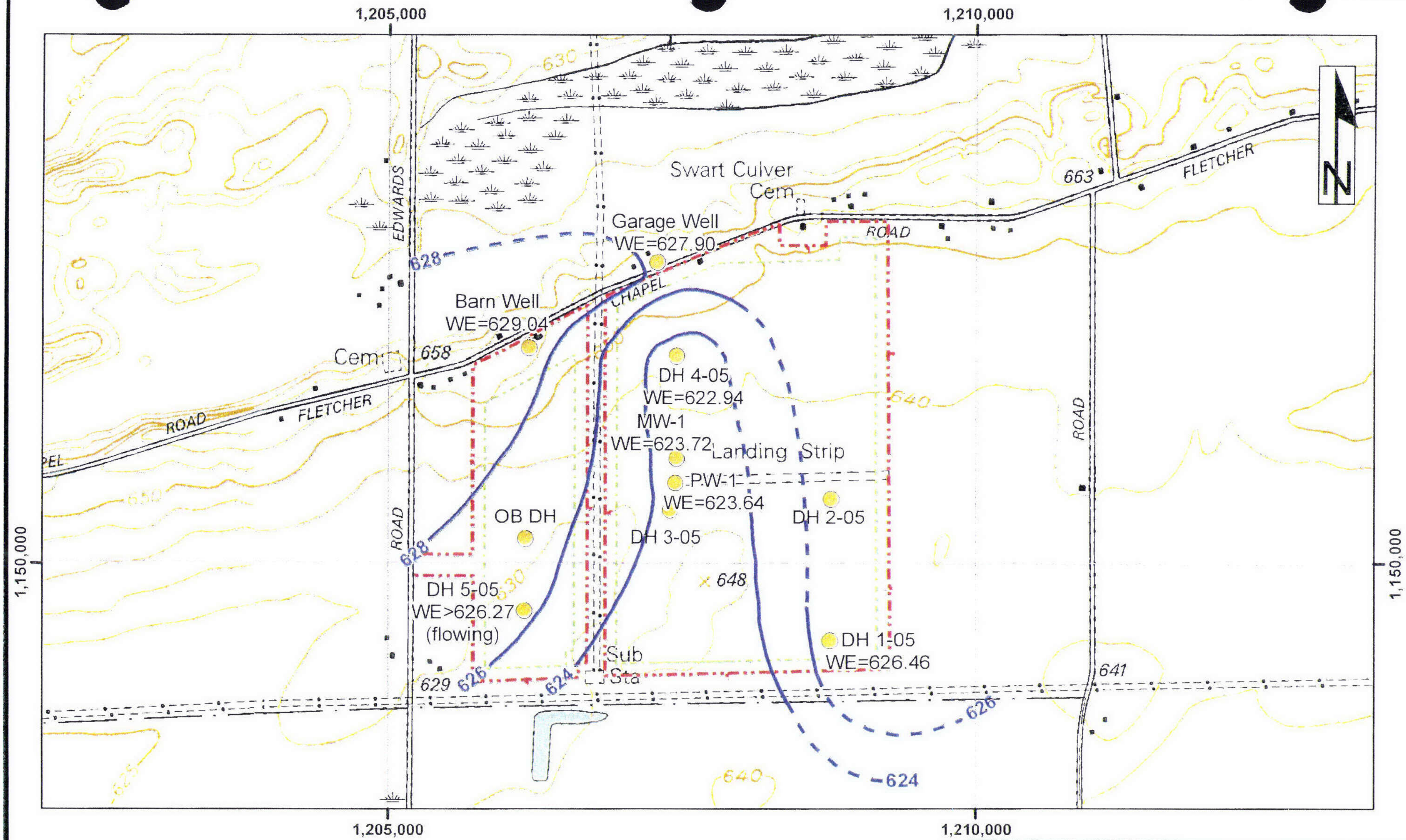
Assuming maximum groundwater contributions of 500 gpm and precipitation contributions of 100 gpm, the projected dewatering rates are expected to range from 150,000 gallons per day (gpd) to less than 1,000,000 gpd.

FIGURES

Continental Placer Inc.

Figure 4-1
Well Location Map
Frontier Stone LLC
Frontier Stone Quarry

Source: USGS Knowlesville Quadrangle
7.5 min Series
Scale: 1"=2000'



Legend

Monitoring Well

DH 4-05
WE=Ground Water Elevation

Property Boundary

Life of Mine Boundary

Ground Water Elevation Contour

Notes:
-NYS Department of Transportation Raster Quadrangle
(Portions of the Knowlesville and Medina quadrangles).

0 1,200 2,400 Feet

ALPHA GEOSCIENCE

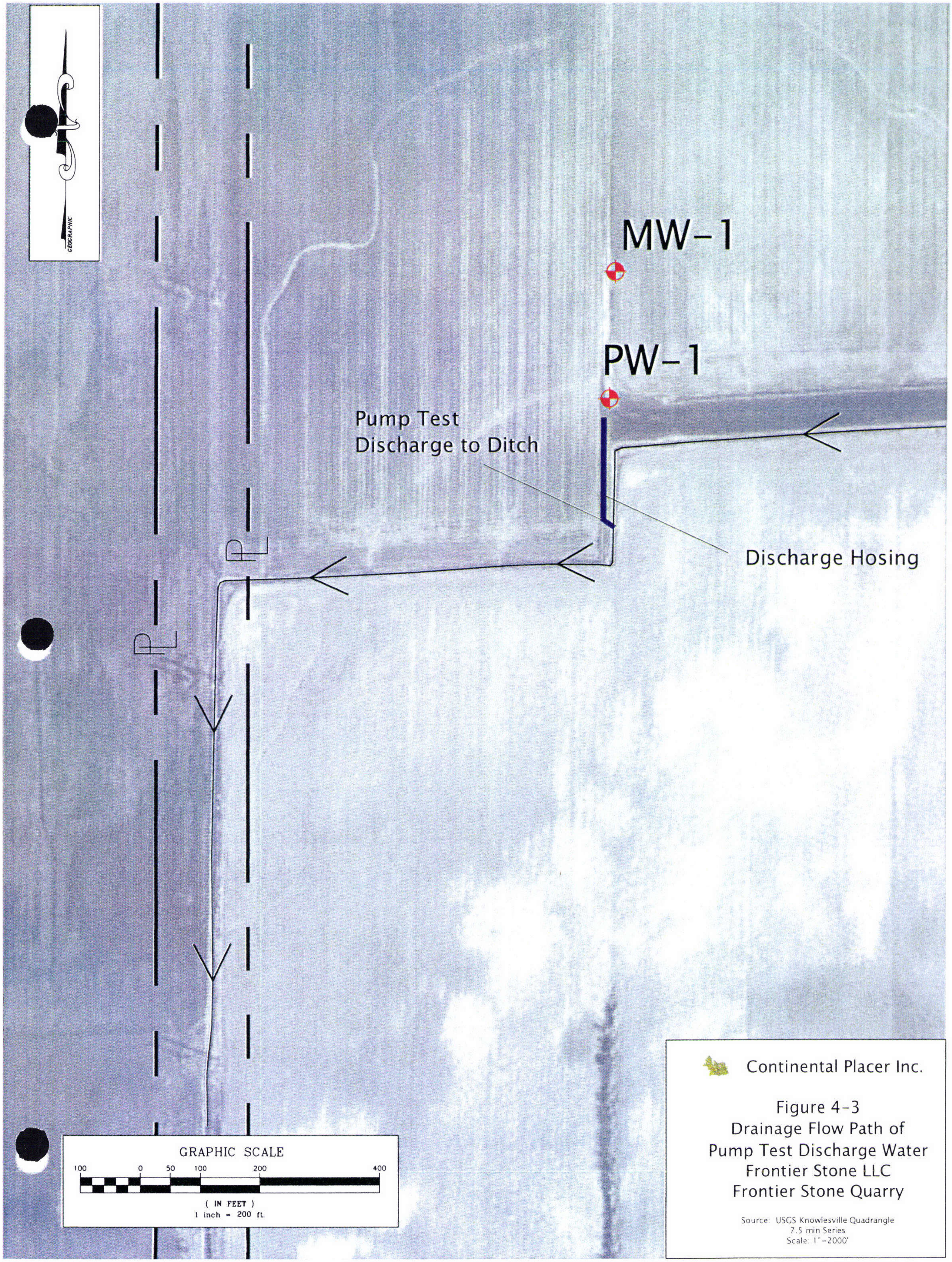
Alpha Proj. No. 08122

FIGURE 4-2

GROUND WATER CONTOUR MAP
ALTERNATIVE A
October 27, 2008

Frontier Stone Quarry
Frontier Stone LLC
Town of Shelby
Orleans County, New York

Map Document: (Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Groundwater Contours.mxd)



Continental Placer Inc.

Figure 4-3
Drainage Flow Path of
Pump Test Discharge Water
Frontier Stone LLC
Frontier Stone Quarry

Source: USGS Knowlesville Quadrangle
7.5 min Series
Scale: 1"=2000'

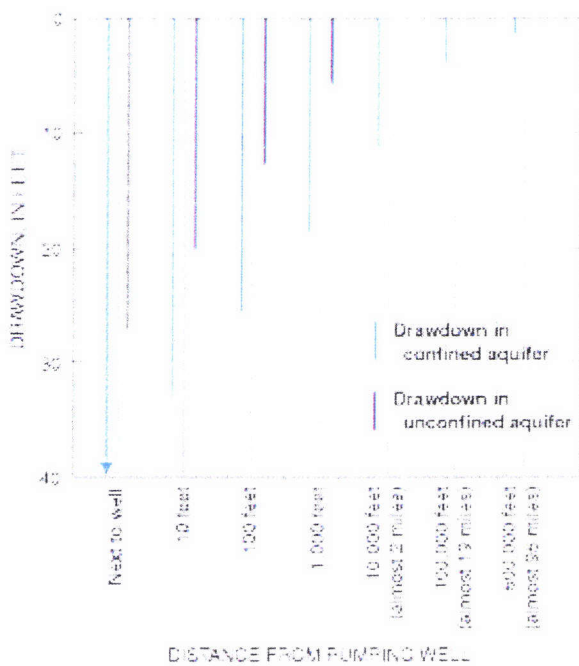


Figure 4-4 - Comparison of Drawdown between Confined vs Unconfined Aquifer
Source: http://pubs.usgs.gov/circ/circ1186/html/boxa.html

APPENDIX A

Groundwater Level Plots

Before, During, and After 72-Hour Pumping Test

Figure A1
Groundwater Levels in Pumping Well (PW-1)
Before, During, and After 72-Hour, 121-124 GPM Pumping Test on PW-1
April 2 through April 9, 2007

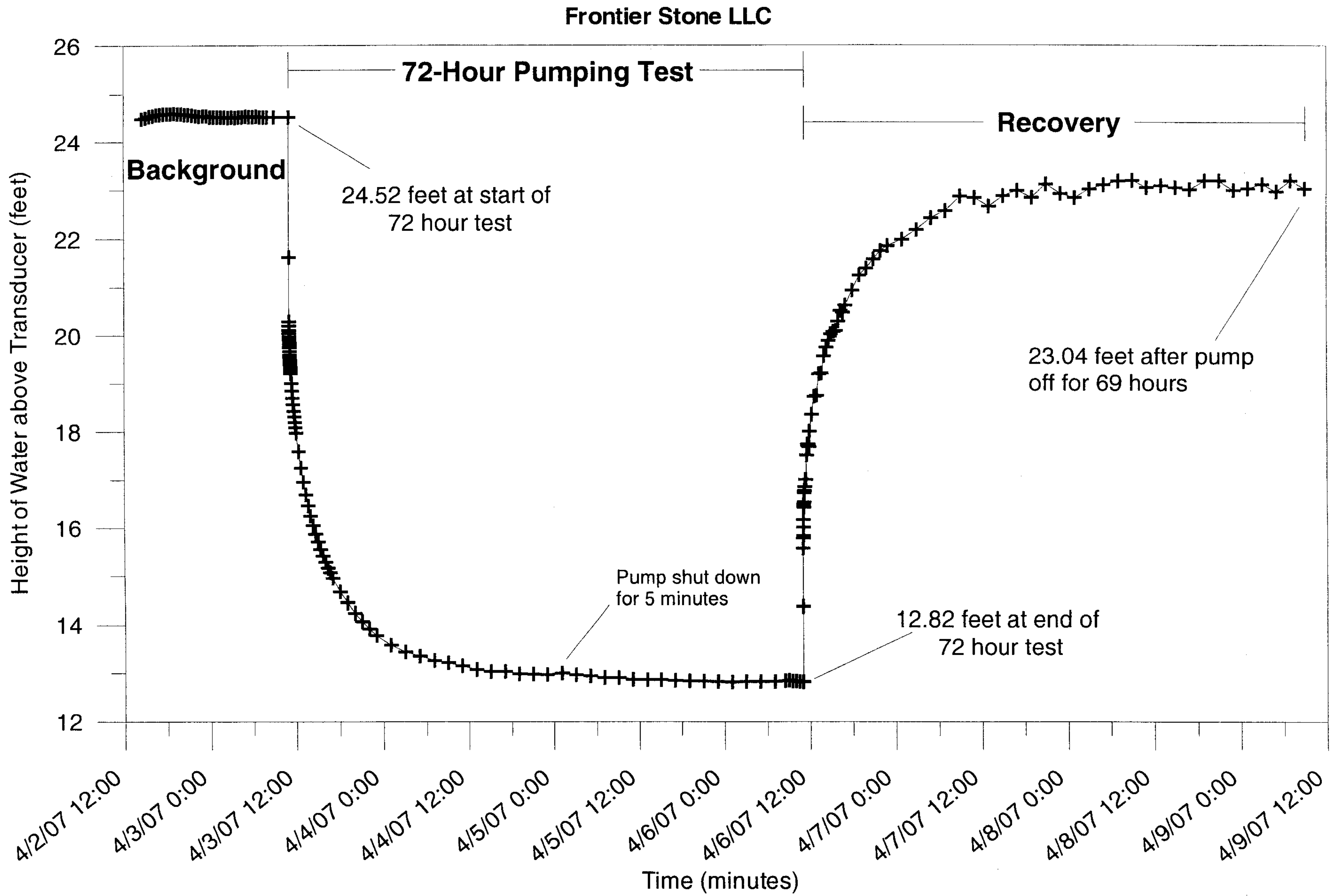


Figure A2
Groundwater Levels in Monitoring Well 1 (MW-1)
Before, During, and After 72-Hour, 121-124 GPM Pumping Test on PW-1
April 2 through April 9, 2007

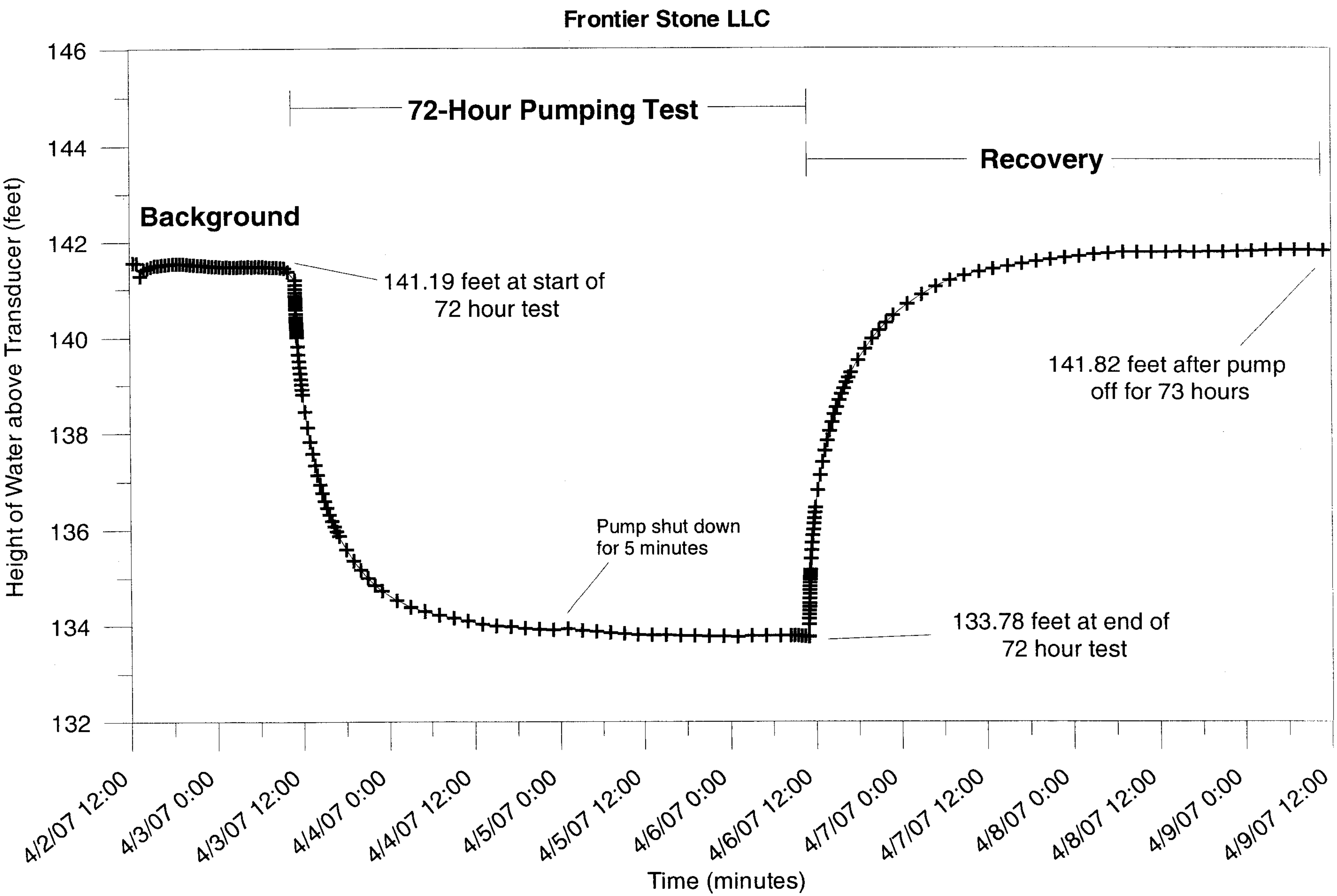


Figure A3
Groundwater Levels in Well DH 4-05
Before, During, and After 72-Hour, 121-124 GPM Pumping Test on PW-1
April 2 through April 9, 2007

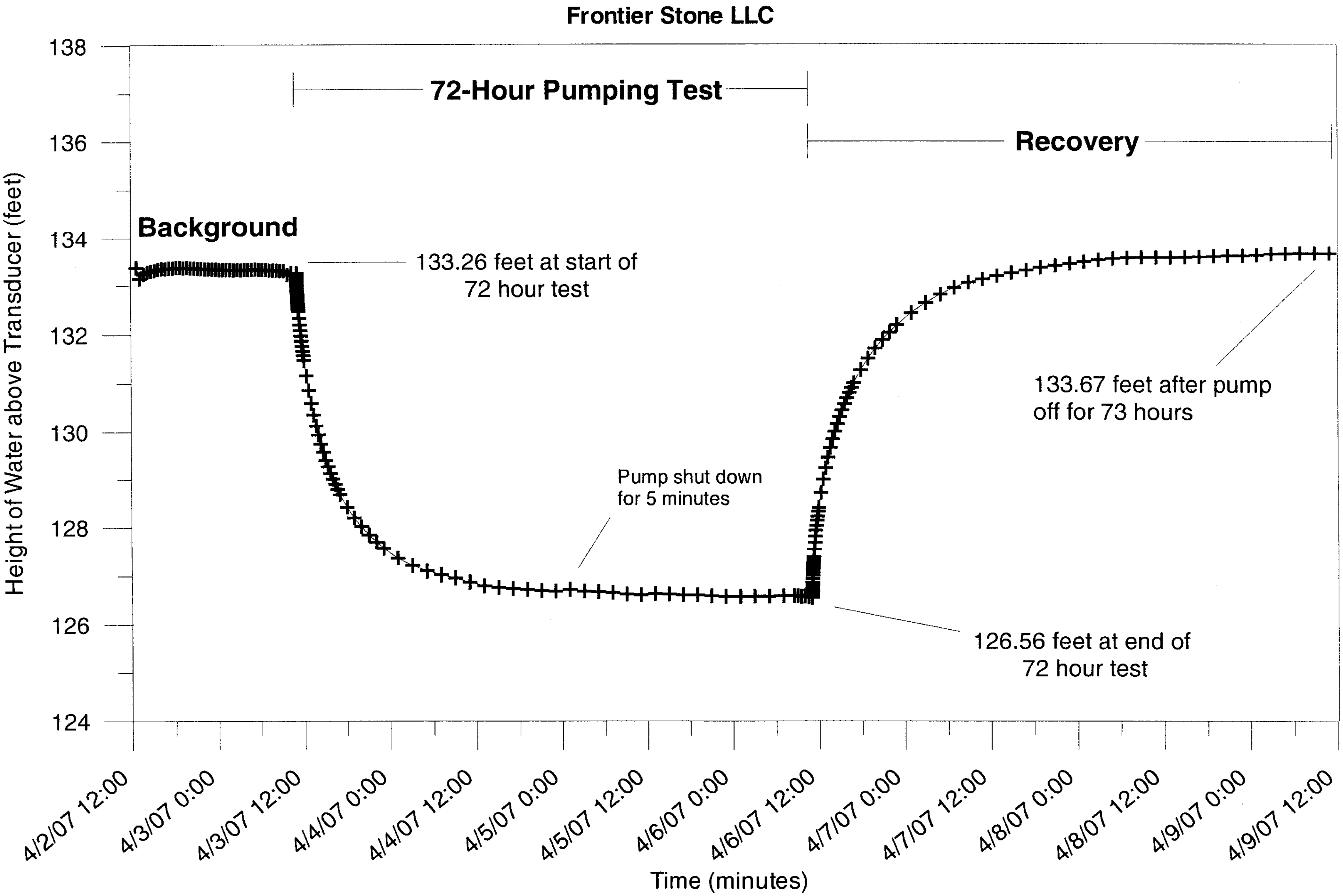


Figure A4
Groundwater Levels in DH 1-05
Before, During, and After 72-Hour, 121-124 GPM Pumping Test on PW-1
April 2 through April 9, 2007

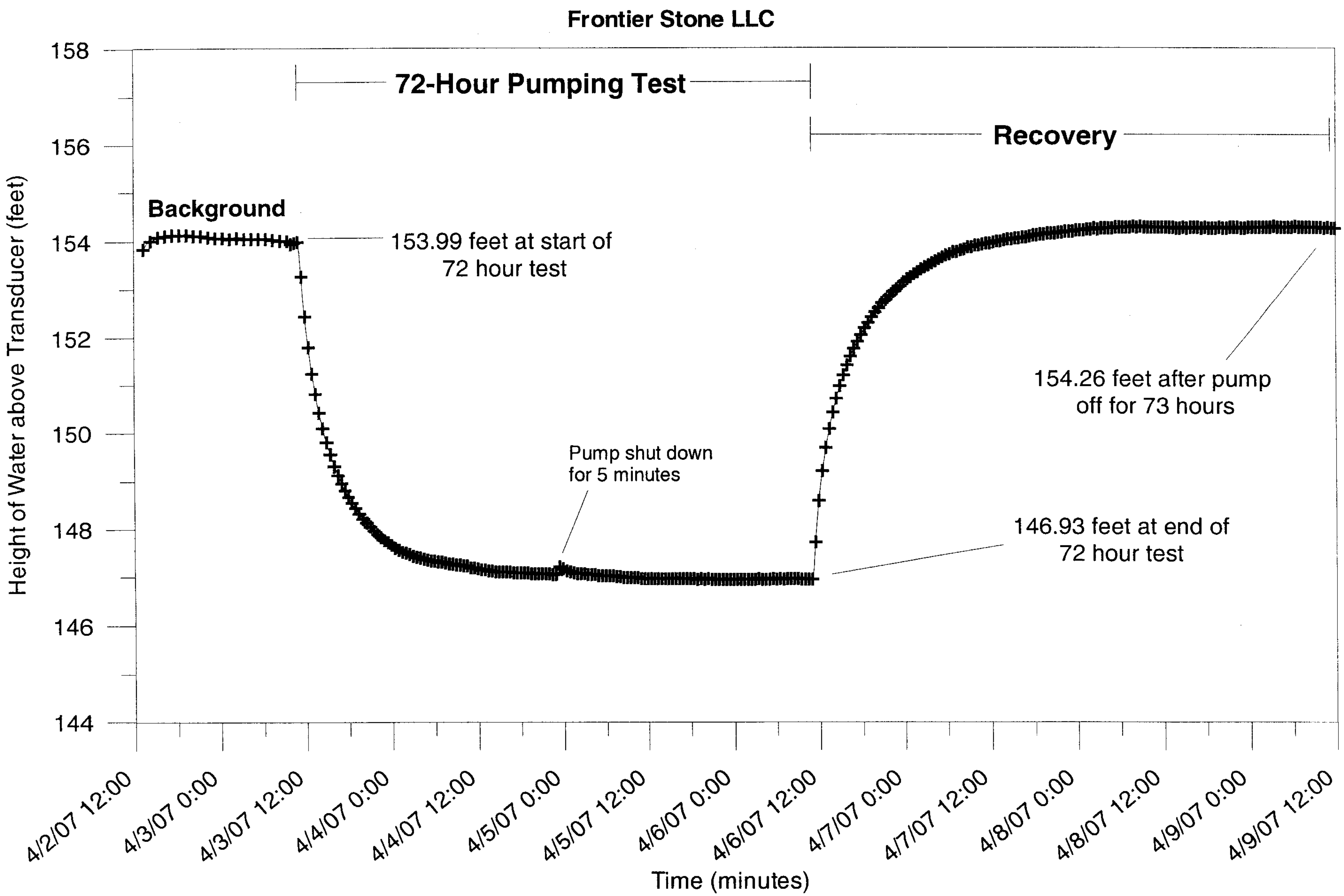


Figure A5
Groundwater Levels in Well DH 5-05
Before, During, and After 72-Hour, 121-124 GPM Pumping Test on PW-1
April 2 through April 9, 2007

Frontier Stone LLC

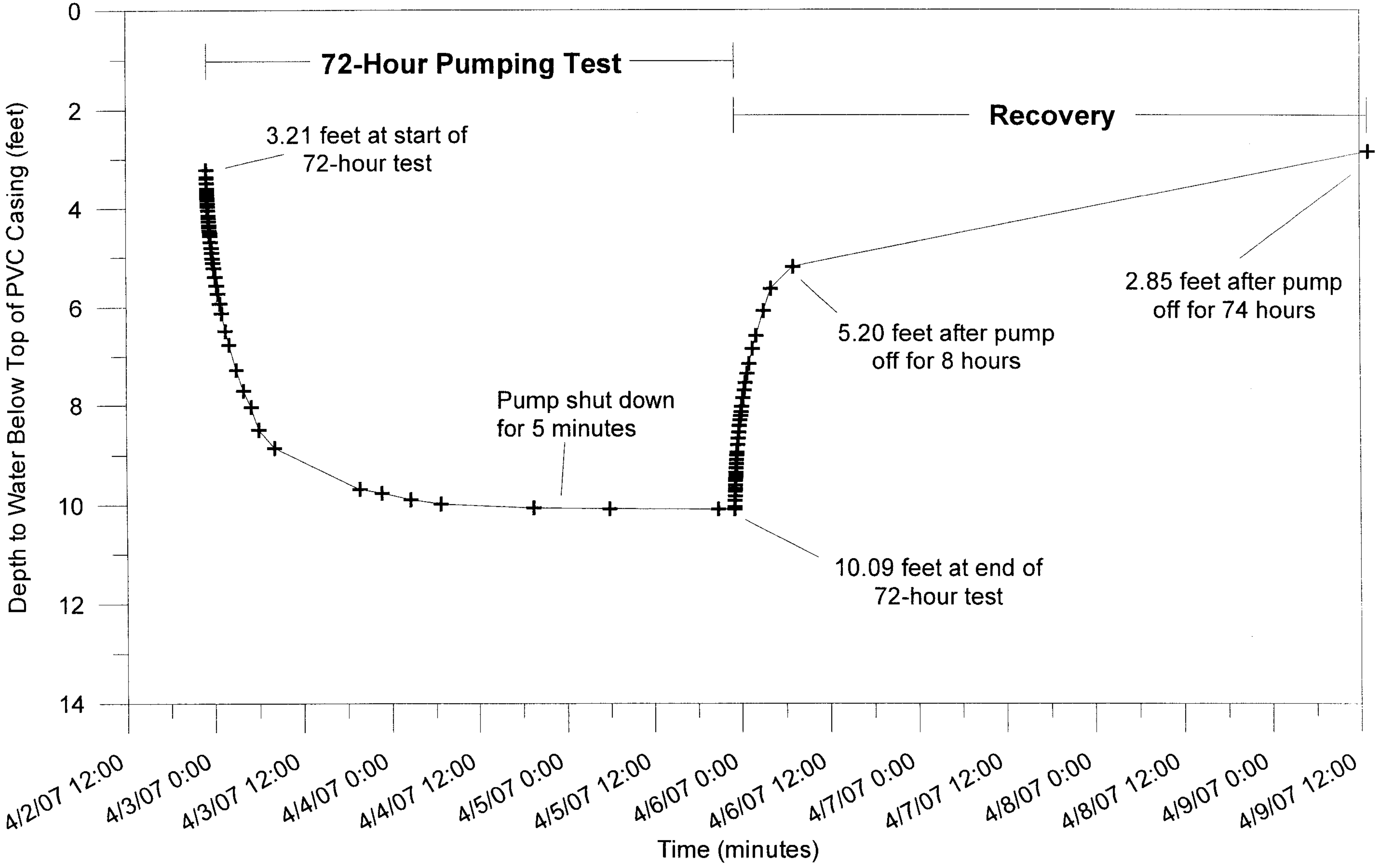
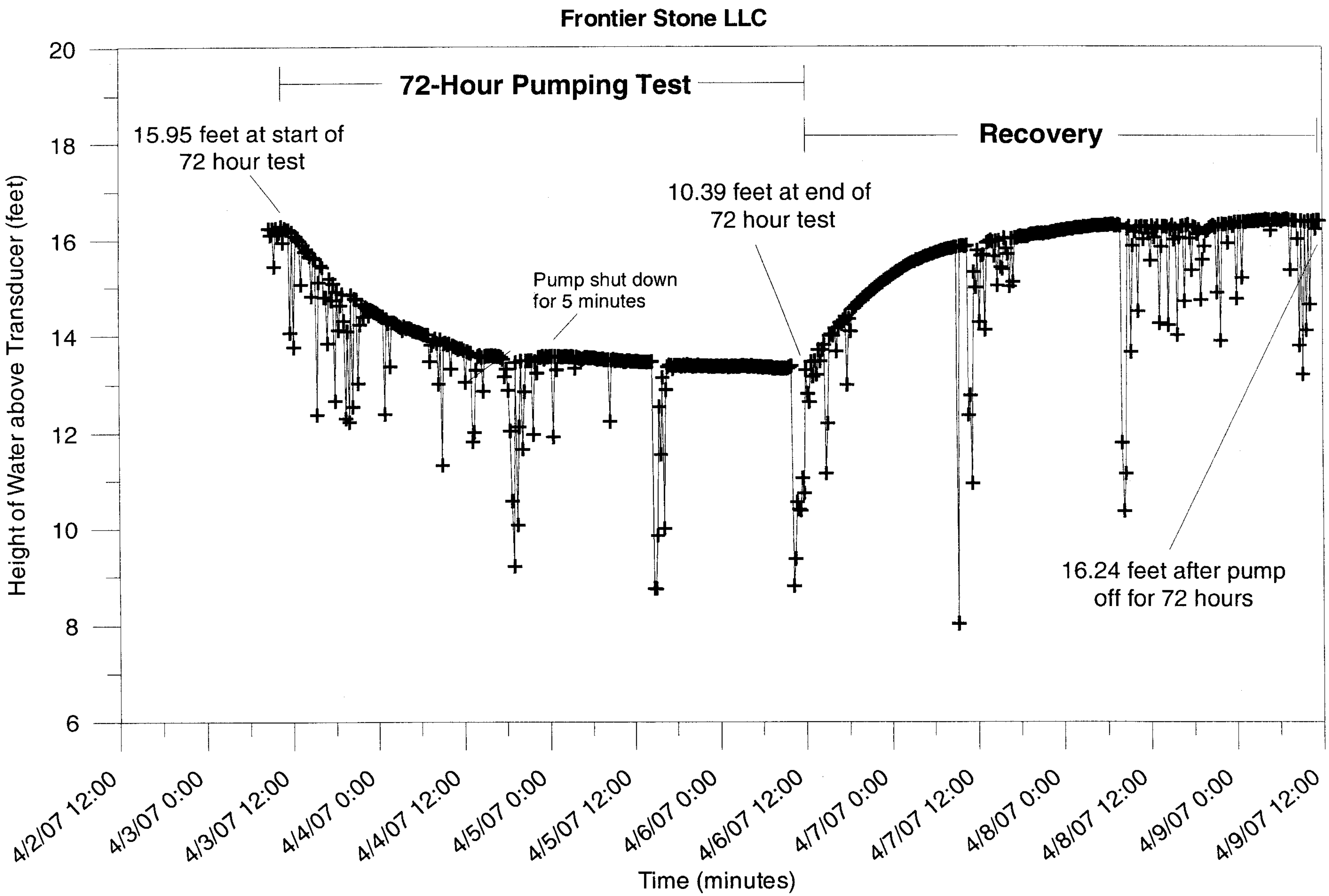


Figure A6
Groundwater Levels in the Zelasny Barn Well (BW-1)
Before, During, and After 72-Hour, 121-124 GPM Pumping Test on PW-1
April 2 through April 9, 2007



APPENDIX B

Semi-Logarithmic Drawdown versus Time Plots

Figure B1
Transducer Drawdown versus Time in Pumping Well (PW-1)
During 72-Hour, 121-124 GPM Pumping Test in PW-1
April 2 through April 9, 2007

Frontier Stone LLC

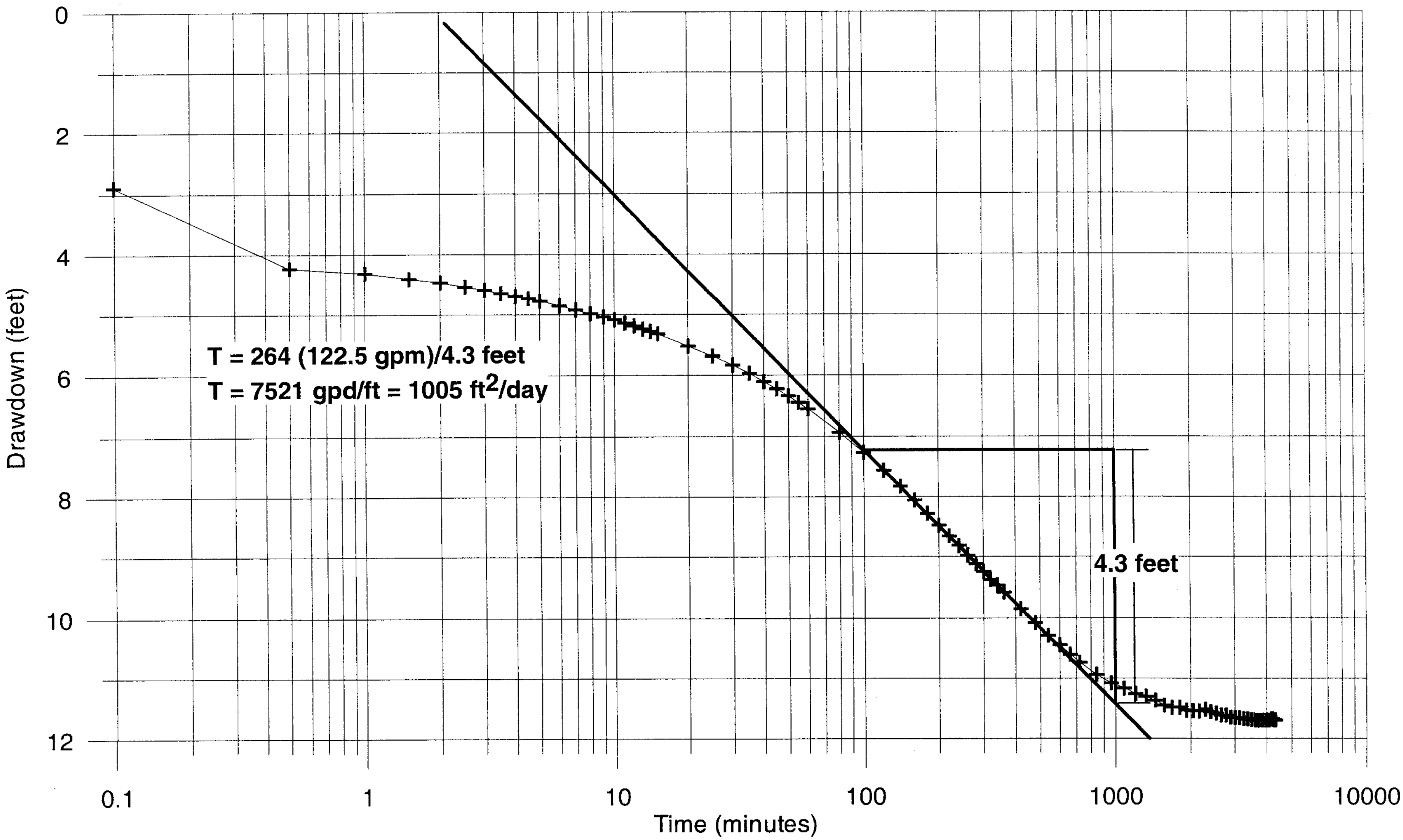


Figure B2
Transducer Drawdown versus Time in Monitoring Well 1 (MW-1)
During 72-Hour, 121-124 GPM Pumping Test in PW-1
April 2 through April 9, 2007

Frontier Stone LLC

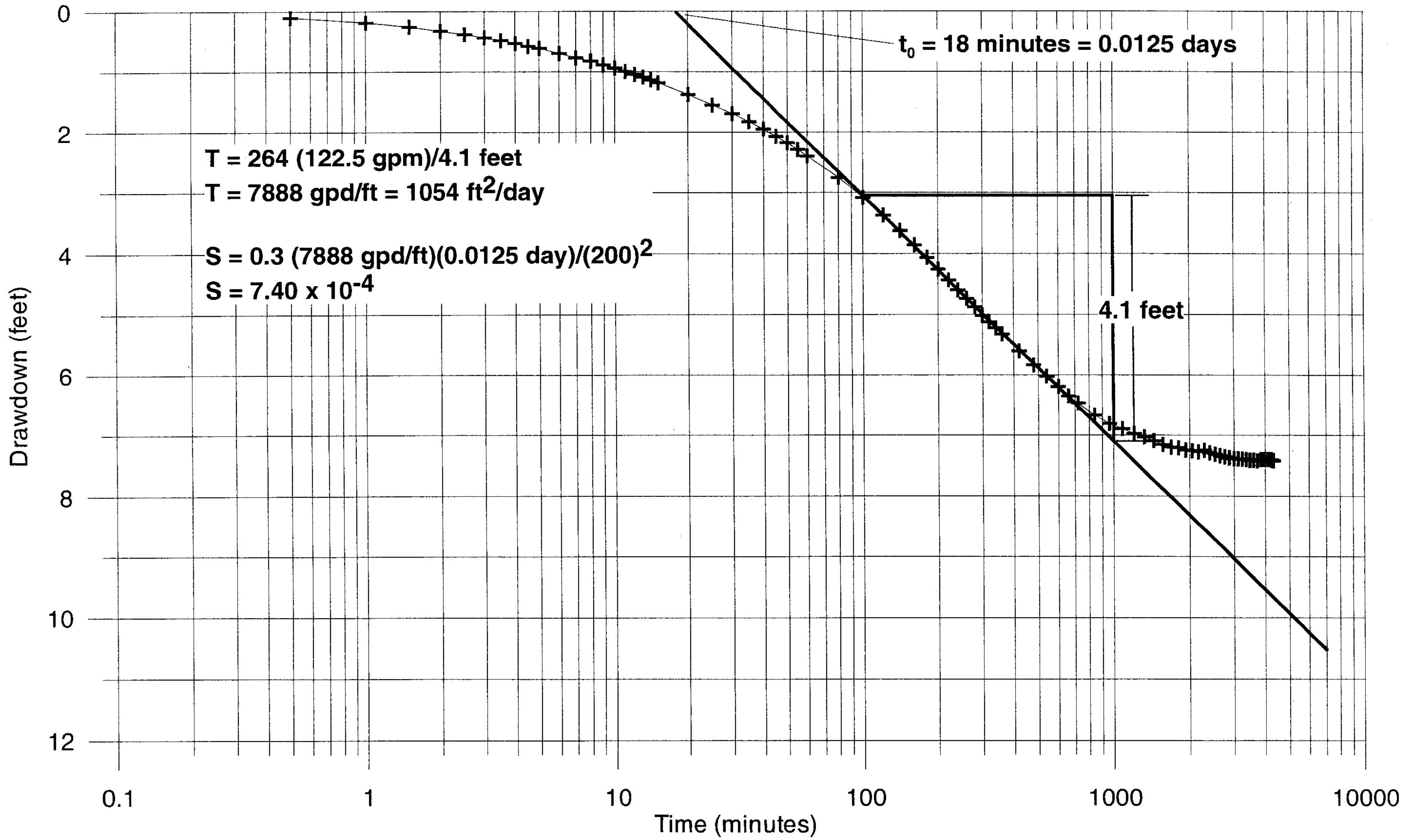


Figure B3
Transducer Drawdown versus Time in DH 4-05
During 72-Hour, 121-124 GPM Pumping Test in PW-1
April 2 through April 9, 2007

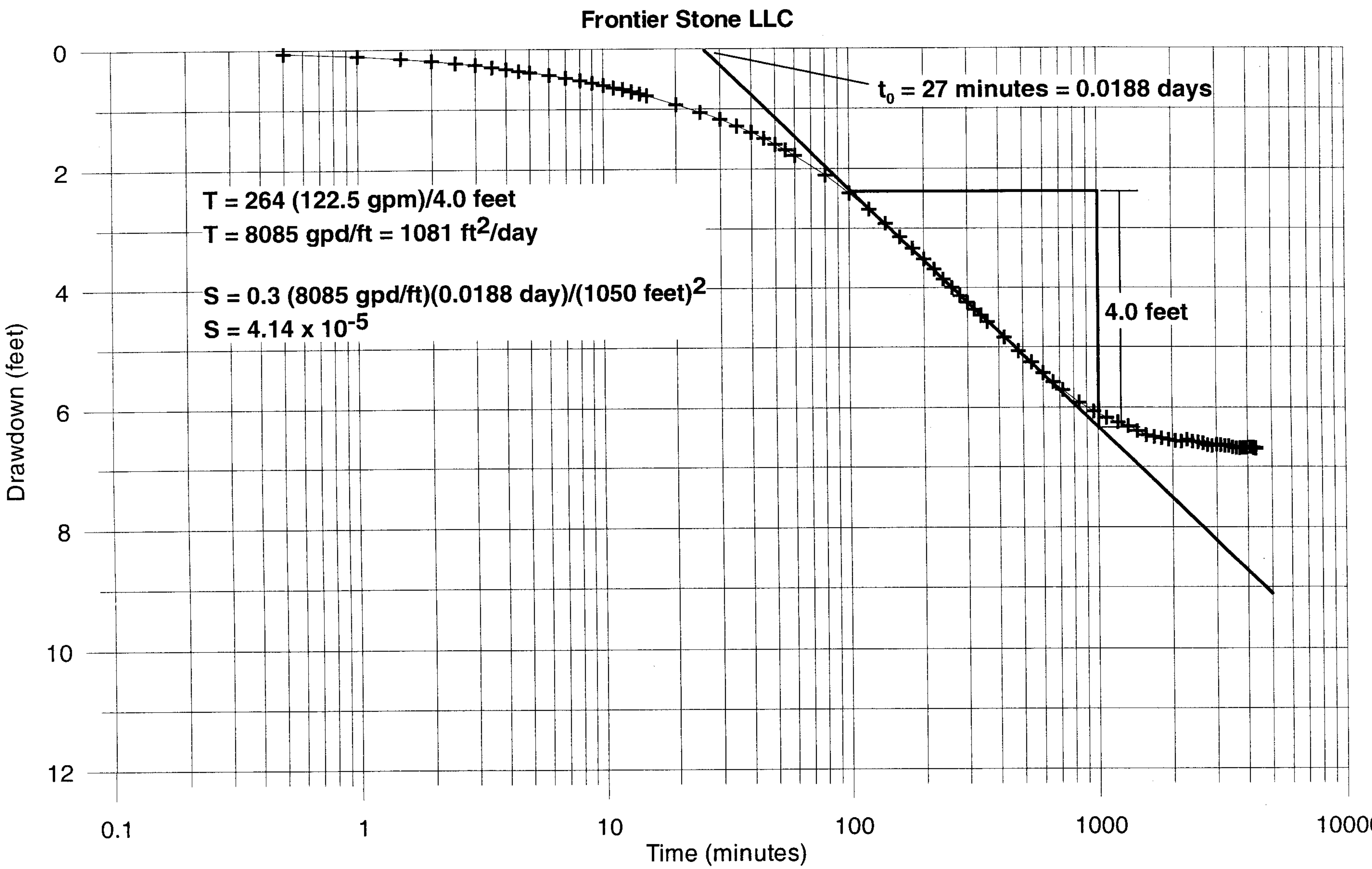


Figure B4
Transducer Drawdown versus Time in DH 1-05
During 72-Hour, 121-124 GPM Pumping Test in PW-1
April 2 through April 9, 2007

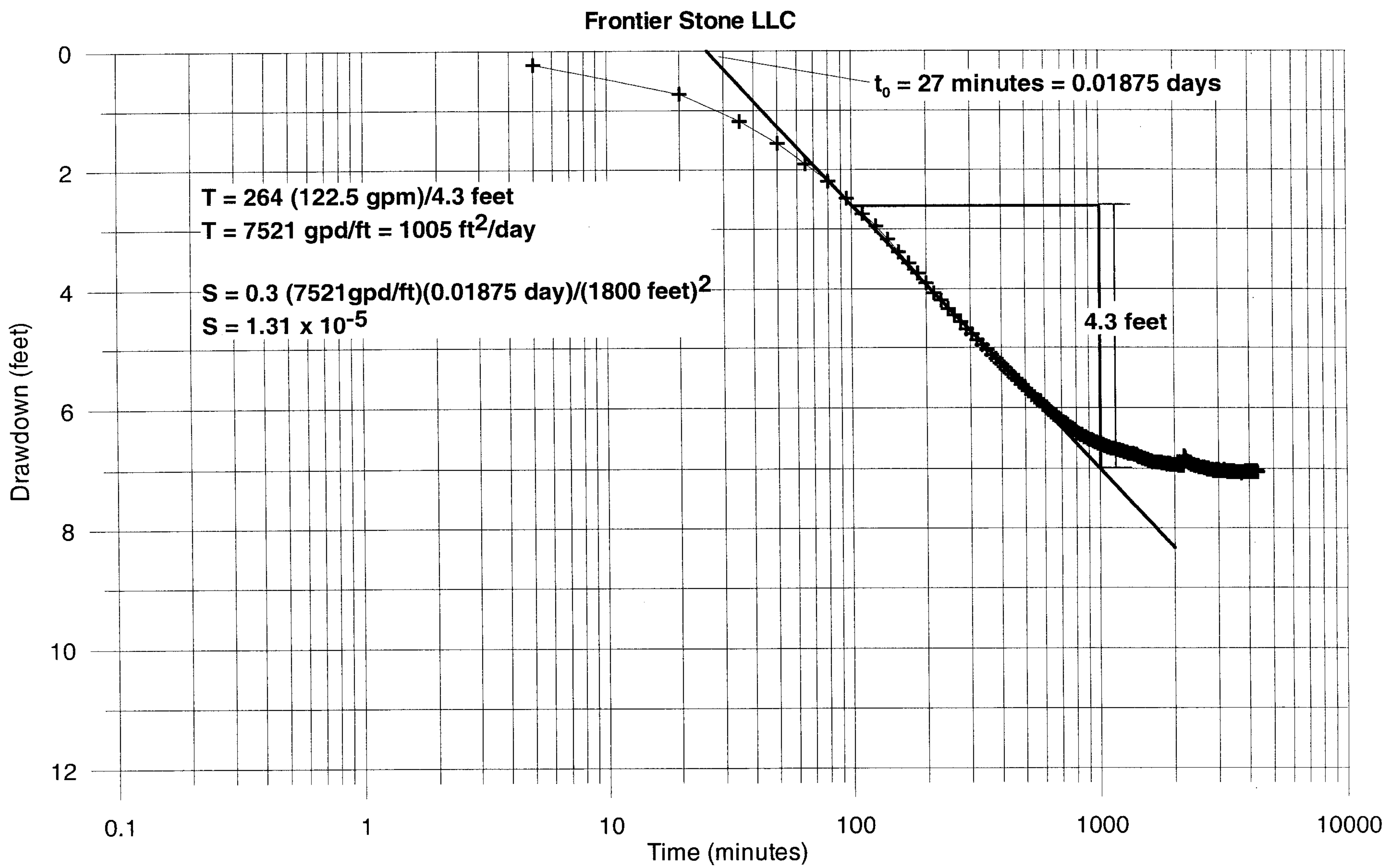
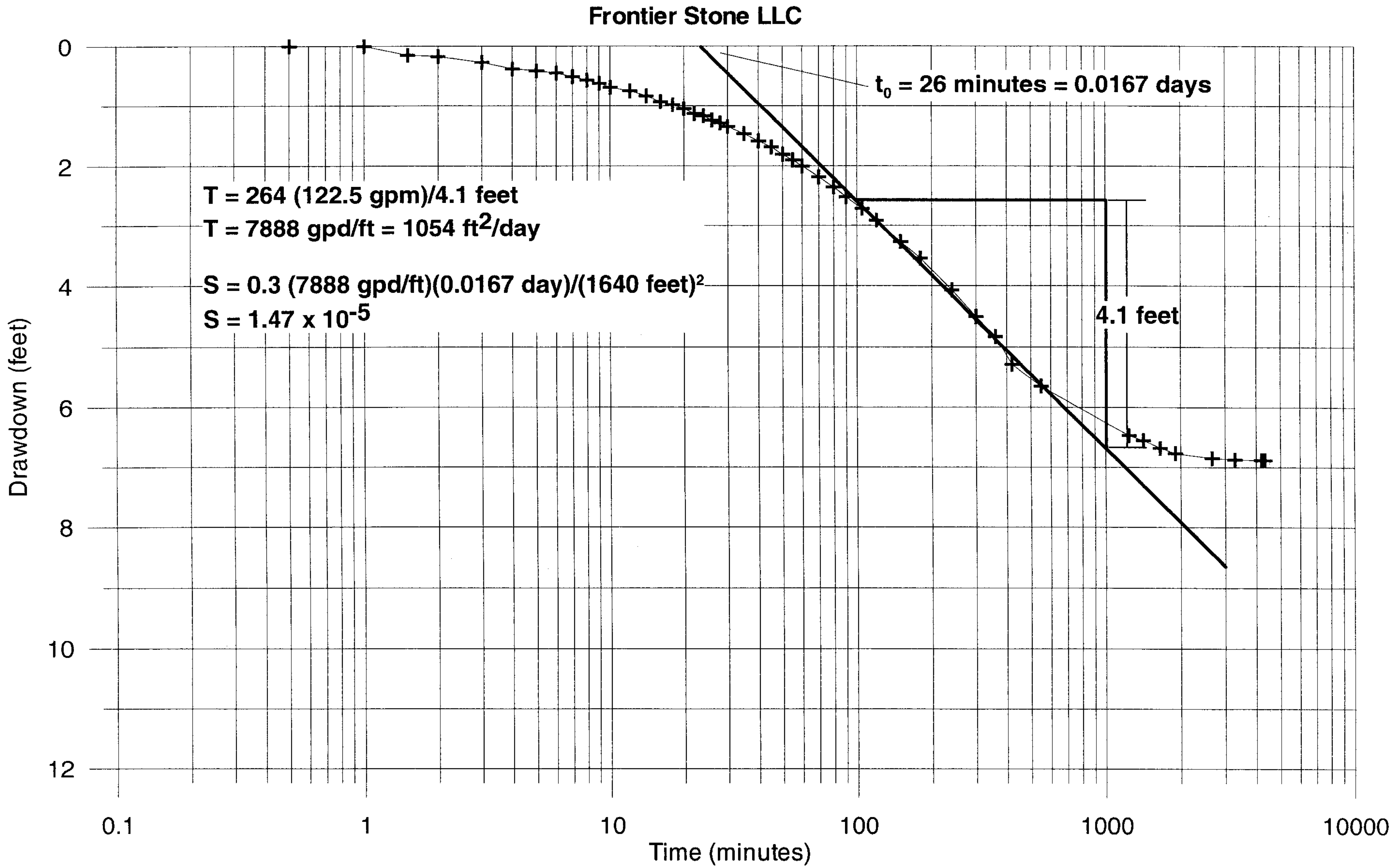


Figure B5
Drawdown versus Time in DH 5-05
During 72-Hour, 121-124 GPM Pumping Test in PW-1
April 2 through April 9, 2007



APPENDIX C

Semi-Logarithmic Recovery versus Time Plots

Figure C1
Transducer Recovery versus Time in Pumping Well 1 (PW-1)
After 72-Hours of Pumping in PW-1
April 6 through April 9, 2007

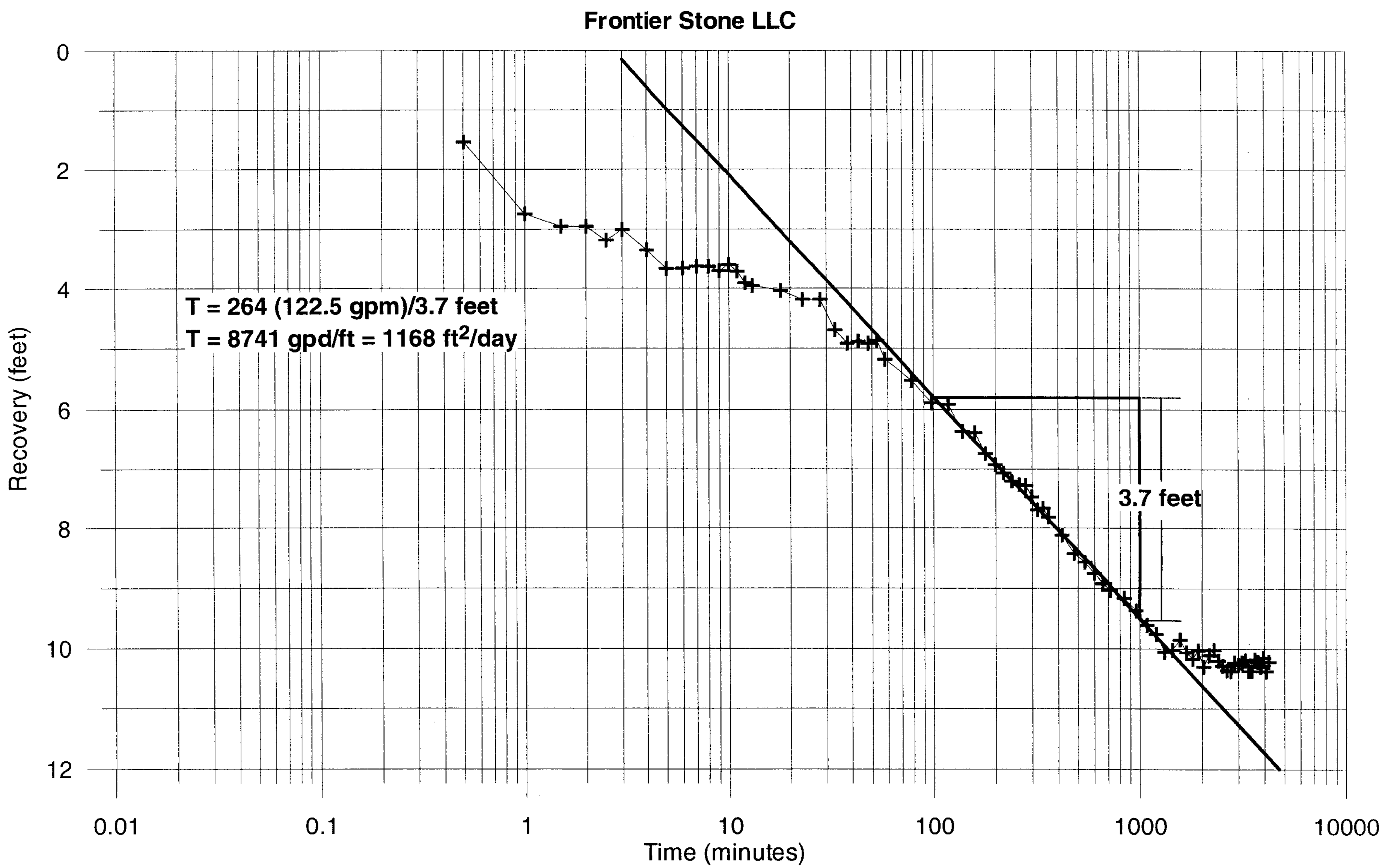


Figure C2
Transducer Recovery versus Time in MW-1
After 72-Hours of Pumping in PW-1
April 6 through April 9, 2007

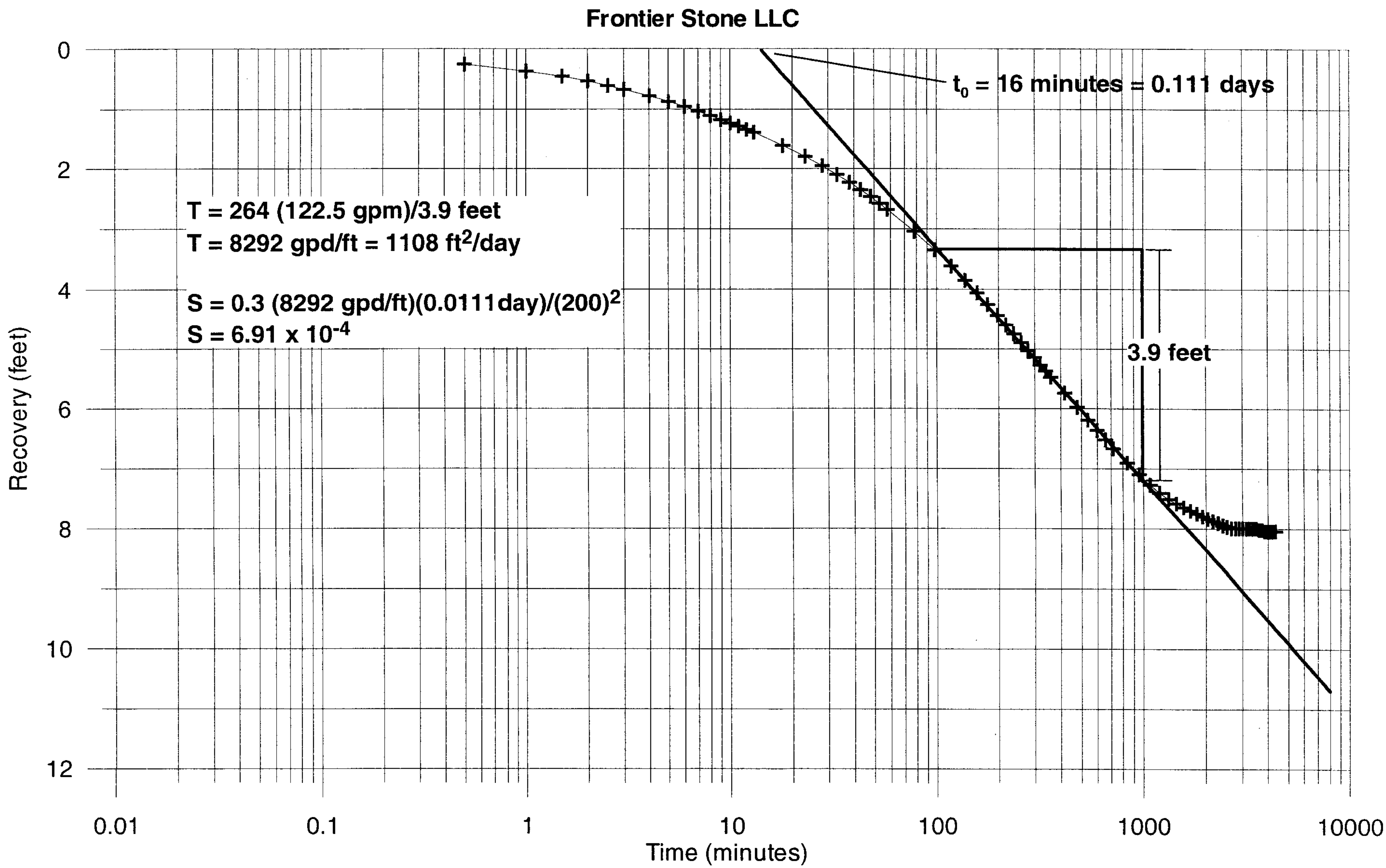


Figure C3
Transducer Recovery versus Time in DH 4-05
After 72-Hours of Pumping in PW-1
April 6 through April 9, 2007

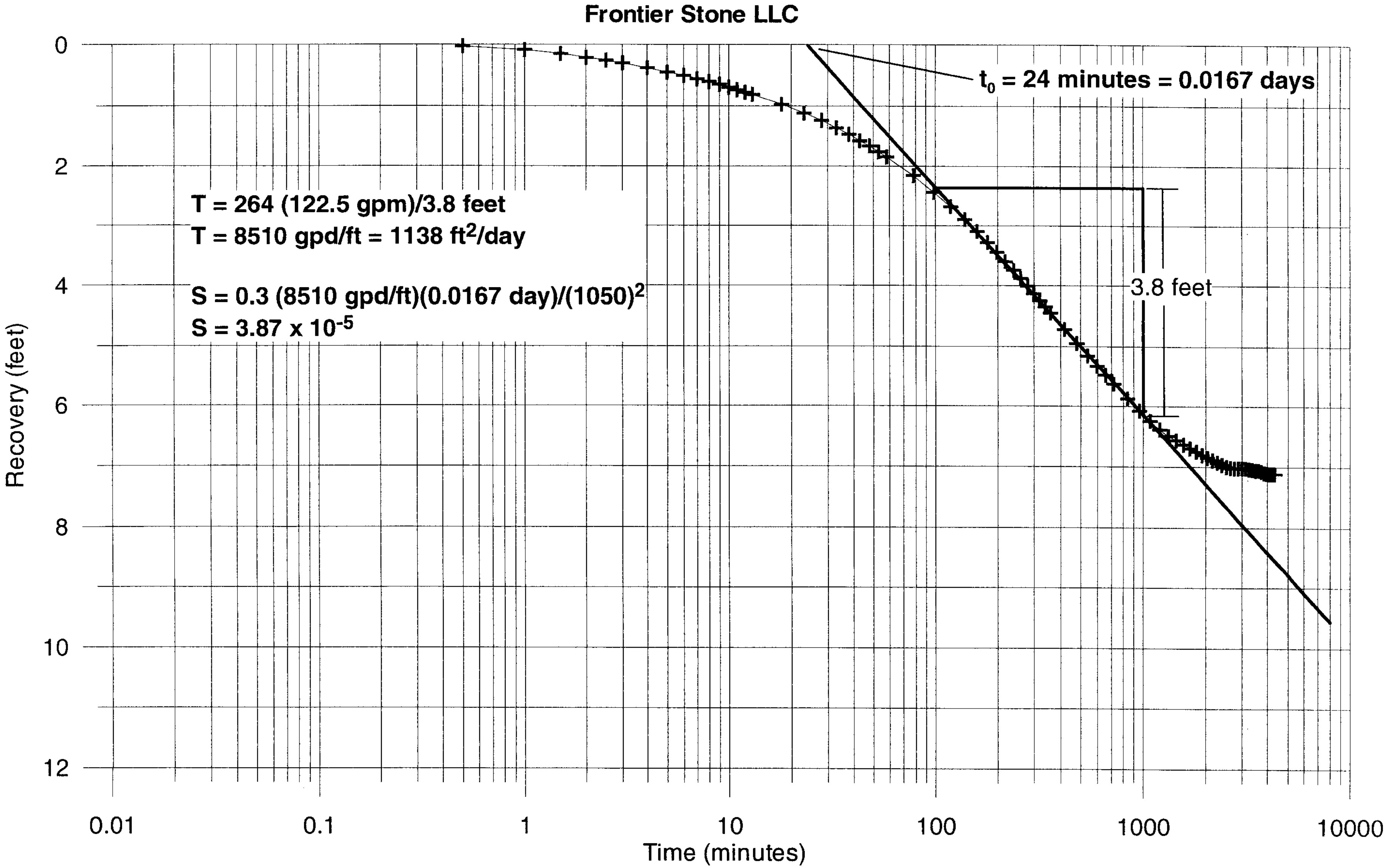


Figure C4
Transducer Recovery versus Time in DH 1-05
After 72-Hours of Pumping in PW-1
April 6 through April 9, 2007

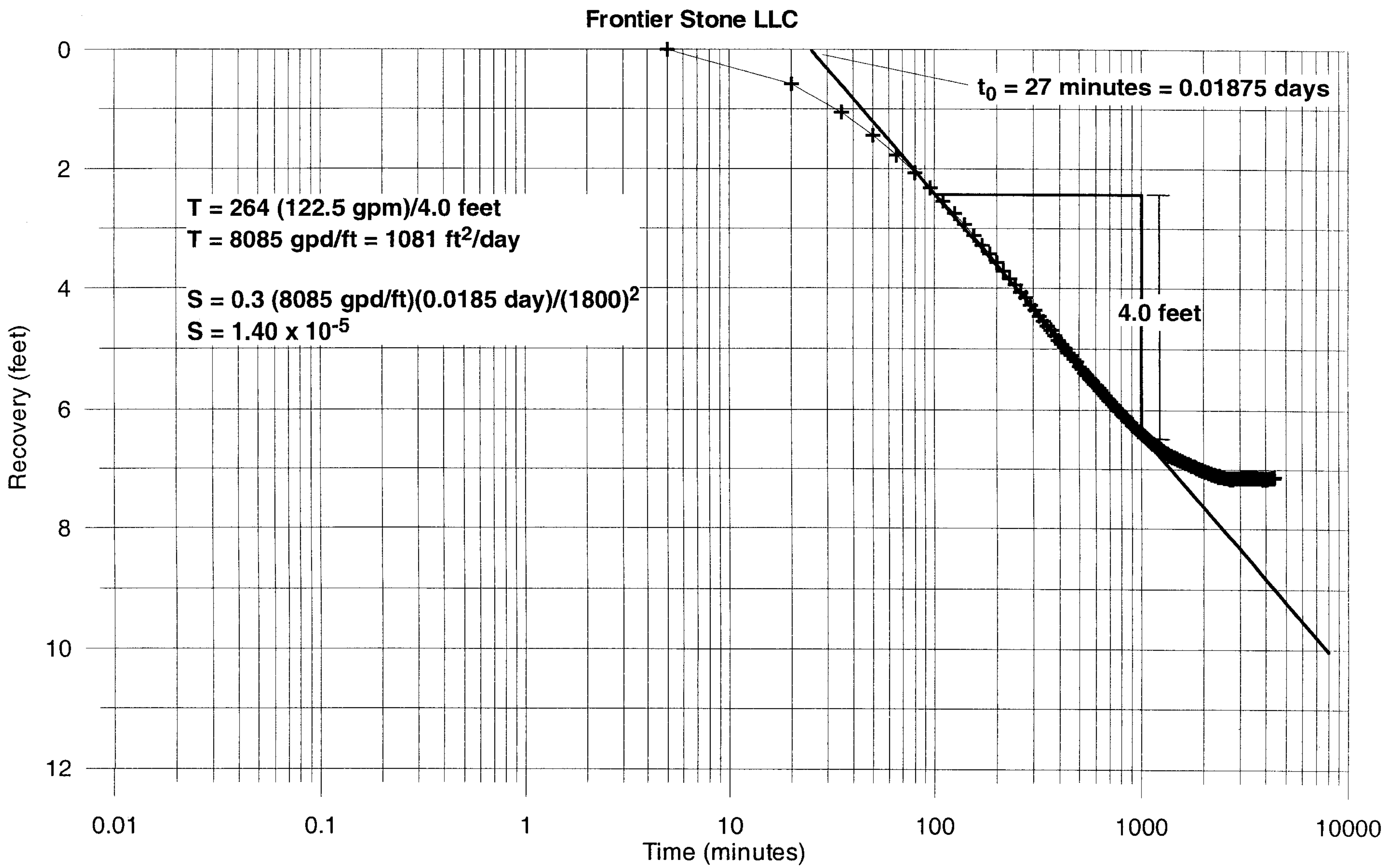
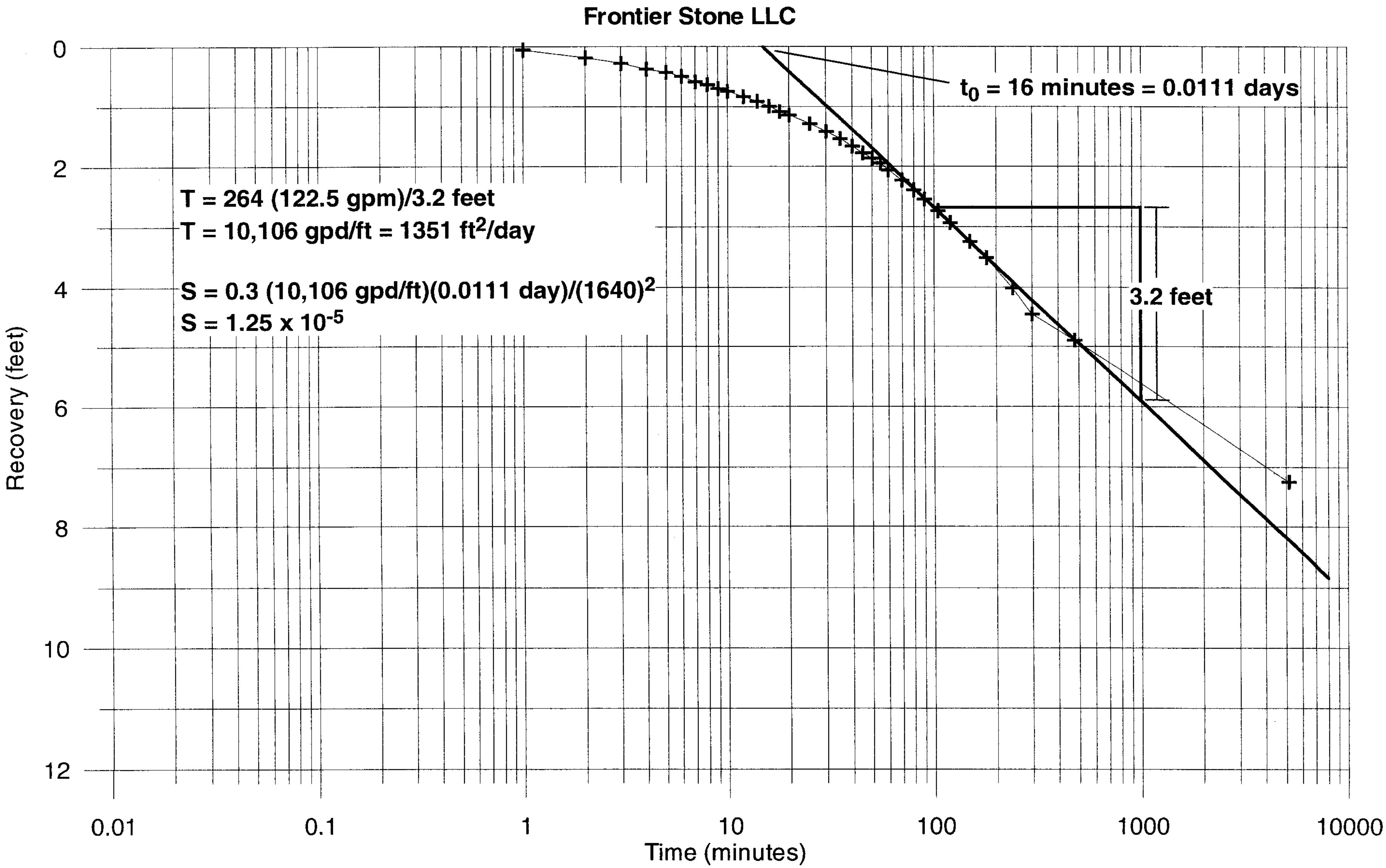


Figure C5
Transducer Recovery versus Time in DH 5-05
After 72-Hours of Pumping in PW-1
April 6 through April 9, 2007



APPENDIX D

Tabulated Groundwater Levels
During 72-Hour Pumping Test

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 1 of 4
Well Name: PW-1
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Transducer Data

Project: Zelasny - Frontier Stone LLC
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
	10:37 AM	-23	24.52			
April 3, 2007	11:00 AM	0	21.629	2.891		Static Level
	11:00 AM	0.5	20.293	4.227		Pumping at PW-1 starts
	11:01 AM	1	20.208	4.312		at 11:00AM
	11:01 AM	1.5	20.115	4.405		
	11:02 AM	2	20.053	4.467		
	11:02 AM	2.5	19.983	4.537		
	11:03 AM	3	19.928	4.592		
	11:03 AM	3.5	19.874	4.646		
	11:04 AM	4	19.827	4.693		
	11:04 AM	4.5	19.789	4.731		
	11:05 AM	5	19.75	4.77		
	11:06 AM	6	19.672	4.848		
	11:07 AM	7	19.602	4.918		
	11:08 AM	8	19.54	4.98		
	11:09 AM	9	19.486	5.034		
	11:10 AM	10	19.439	5.081		
	11:11 AM	11	19.385	5.135		
	11:12 AM	12	19.338	5.182		
	11:13 AM	13	19.284	5.236		
	11:14 AM	14	19.245	5.275		
	11:15 AM	15	19.206	5.314		
	11:20 AM	20	19.004	5.516		
	11:25 AM	25	18.841	5.679		
	11:30 AM	30	18.693	5.827		
	11:35 AM	35	18.561	5.959		
	11:40 AM	40	18.421	6.099		
	11:45 AM	45	18.305	6.215		
	11:50 AM	50	18.188	6.332		
	11:55 AM	55	18.08	6.44		
	12:00 PM	60	17.971	6.549		
	12:20 PM	80	17.59	6.93		
	12:40 PM	100	17.257	7.263		
	1:00 PM	120	16.962	7.558		
	1:20 PM	140	16.698	7.822		
	1:40 PM	160	16.465	8.055		
	2:00 PM	180	16.247	8.273		
	2:20 PM	200	16.045	8.475		
	2:40 PM	220	15.867	8.653		
	3:00 PM	240	15.704	8.816		
	3:20 PM	260	15.548	8.972		
	3:40 PM	280	15.409	9.111		
	4:00 PM	300	15.284	9.236		
	4:20 PM	320	15.16	9.36		
	4:40 PM	340	15.067	9.453		
	5:00 PM	360	14.951	9.569		
April 3, 2007	6:00 PM	420	14.671	9.849		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 2 of 4
Well Name: PW-1
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Transducer Data

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 3, 2007	7:00 PM	480	14.446	10.074		
	8:00 PM	540	14.236	10.284		
	9:00 PM	600	14.073	10.447		
	10:00 PM	660	13.918	10.602		
	11:00 PM	720	13.786	10.734		
April 4, 2007	1:00 AM	840	13.584	10.936		
	3:00 AM	960	13.444	11.076		
	5:00 AM	1080	13.359	11.161		
	7:00 AM	1200	13.266	11.254		
	9:00 AM	1320	13.219	11.301		
	11:00 AM	1440	13.157	11.363		
	1:00 PM	1560	13.079	11.441		
	3:00 PM	1680	13.041	11.479		
	5:00 PM	1800	13.041	11.479		
	7:00 PM	1920	12.994	11.526		
	9:00 PM	2040	12.986	11.534		
	11:00 PM	2160	12.979	11.541		
April 5, 2007	1:00 AM	2280	13.01	11.51		
	3:00 AM	2400	12.971	11.549		
	5:00 AM	2520	12.947	11.573		
	7:00 AM	2640	12.916	11.604		
	9:00 AM	2760	12.916	11.604		
	11:00 AM	2880	12.878	11.642		
	1:00 PM	3000	12.87	11.65		
	3:00 PM	3120	12.87	11.65		
	5:00 PM	3240	12.854	11.666		
	7:00 PM	3360	12.847	11.673		
	9:00 PM	3480	12.839	11.681		
	11:00 PM	3600	12.831	11.689		
April 6, 2007	1:00 AM	3720	12.823	11.697		
	3:00 AM	3840	12.831	11.689		
	5:00 AM	3960	12.831	11.689		
	7:00 AM	4080	12.831	11.689		
	8:28 AM	4168	12.847	11.673		
	8:58 AM	4198	12.854	11.666		
	9:28 AM	4228	12.839	11.681		
	9:58 AM	4258	12.839	11.681		
	10:28 AM	4288	12.831	11.689		
	10:58 AM	4318	12.831	11.689		
	10:58 AM	4318.5	12.831	11.689		
	10:59 AM	4319	12.831	11.689		
	10:59 AM	4319.5	12.831	11.689		
	11:00 AM	4320	12.823	11.697		Pump shut down at
	11:00 AM	4320.5	14.368	10.152		11:00 AM
	11:01 AM	4321	15.564	8.956	0	Recovery
April 6, 2007	11:01 AM	4321.5	15.773	8.747	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 3 of 4
Well Name: PW-1
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Transducer Data

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 6, 2007	11:02 AM	4322	15.773	8.747	0	
	11:02 AM	4322.5	16.006	8.514		
	11:03 AM	4323	15.828	8.692		
	11:04 AM	4324	16.169	8.351		
	11:05 AM	4325	16.488	8.032		
	11:06 AM	4326	16.48	8.04		
	11:07 AM	4327	16.449	8.071		
	11:08 AM	4328	16.449	8.071		
	11:09 AM	4329	16.526	7.994		
	11:10 AM	4330	16.418	8.102		
	11:11 AM	4331	16.534	7.986		
	11:12 AM	4332	16.728	7.792		
	11:13 AM	4333	16.775	7.745		
	11:18 AM	4338	16.86	7.66		
	11:23 AM	4343	17.008	7.512		
	11:28 AM	4348	17.008	7.512		
	11:33 AM	4353	17.513	7.007		
	11:38 AM	4358	17.73	6.79		
	11:43 AM	4363	17.699	6.821		
	11:48 AM	4368	17.738	6.782		
	11:53 AM	4373	17.684	6.836		
	11:58 AM	4378	17.994	6.526		
	12:18 PM	4398	18.344	6.176		
	12:38 PM	4418	18.716	5.804		
	12:58 PM	4438	18.74	5.78		
	1:18 PM	4458	19.19	5.33		
	1:38 PM	4478	19.206	5.314		
	1:58 PM	4498	19.563	4.957		
	2:18 PM	4518	19.749	4.771		
	2:38 PM	4538	19.889	4.631		
	2:58 PM	4558	20.029	4.491		
	3:18 PM	4578	20.083	4.437		
	3:38 PM	4598	20.099	4.421		
	3:58 PM	4618	20.293	4.227		
	4:18 PM	4638	20.51	4.01		
	4:38 PM	4658	20.479	4.041		
	4:58 PM	4678	20.627	3.893		
	5:58 PM	4738	20.938	3.582		
	6:58 PM	4798	21.248	3.272		
	7:58 PM	4858	21.396	3.124		
	8:58 PM	4918	21.582	2.938		
	9:58 PM	4978	21.753	2.767		
	10:58 PM	5038	21.854	2.666		
April 7, 2007	12:58 AM	5158	21.986	2.534		
	2:58 AM	5278	22.188	2.332		
April 7, 2007	4:58 AM	5398	22.429	2.091	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 4 of 4
Well Name: PW-1
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Transducer Data

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	**Comments**
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 7, 2007	6:58 AM	5518	22.576	1.944	0	
	8:58 AM	5638	22.871	1.649		
	10:58 AM	5758	22.84	1.68		
	12:58 PM	5878	22.669	1.851		
	2:58 PM	5998	22.879	1.641		
	4:58 PM	6118	22.988	1.532		
	6:58 PM	6238	22.848	1.672		
	8:58 PM	6358	23.12	1.4		
	10:58 PM	6478	22.926	1.594		
April 8, 2007	12:58 AM	6598	22.84	1.68		
	2:58 AM	6718	23.019	1.501		
	4:58 AM	6838	23.104	1.416		
	6:58 AM	6958	23.182	1.338		
	8:58 AM	7078	23.198	1.322		
	10:58 AM	7198	23.05	1.47		
	12:58 PM	7318	23.089	1.431		
	2:58 PM	7438	23.05	1.47		
	4:58 PM	7558	23.011	1.509		
	6:58 PM	7678	23.19	1.33		
	8:58 PM	7798	23.19	1.33		
	10:58 PM	7918	22.996	1.524		
April 9, 2007	12:58 AM	8038	23.035	1.485		
	2:58 AM	8158	23.12	1.4		
	4:58 AM	8278	22.972	1.548		
	6:58 AM	8398	23.198	1.322		
April 9, 2007	8:58 AM	8518	23.035	1.485	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 1 of 4
Well Name: MW-1
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Transducer Data

Project: Zelasny - Frontier Stone LLC
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
	10:00 AM	-60	141.371			
April 3, 2007	11:00 AM	0	141.192	0.179		Static Level
	11:00 AM	0.5	141.09	0.281		Pumping at PW-1 starts
	11:01 AM	1	141.005	0.366		at 11:00AM
	11:01 AM	1.5	140.934	0.437		
	11:02 AM	2	140.864	0.507		
	11:02 AM	2.5	140.809	0.562		
	11:03 AM	3	140.755	0.616		
	11:03 AM	3.5	140.708	0.663		
	11:04 AM	4	140.661	0.71		
	11:04 AM	4.5	140.614	0.757		
	11:05 AM	5	140.583	0.788		
	11:06 AM	6	140.497	0.874		
	11:07 AM	7	140.427	0.944		
	11:08 AM	8	140.372	0.999		
	11:09 AM	9	140.31	1.061		
	11:10 AM	10	140.255	1.116		
	11:11 AM	11	140.201	1.17		
	11:12 AM	12	140.154	1.217		
	11:13 AM	13	140.107	1.264		
	11:14 AM	14	140.06	1.311		
	11:15 AM	15	140.014	1.357		
	11:20 AM	20	139.818	1.553		
	11:25 AM	25	139.647	1.724		
	11:30 AM	30	139.506	1.865		
	11:35 AM	35	139.374	1.997		
	11:40 AM	40	139.249	2.122		
	11:45 AM	45	139.124	2.247		
	11:50 AM	50	139.015	2.356		
	11:55 AM	55	138.905	2.466		
	12:00 PM	60	138.796	2.575		
	12:20 PM	80	138.437	2.934		
	12:40 PM	100	138.11	3.261		
	1:00 PM	120	137.821	3.55		
	1:20 PM	140	137.571	3.8		
	1:40 PM	160	137.337	4.034		
	2:00 PM	180	137.134	4.237		
	2:20 PM	200	136.939	4.432		
	2:40 PM	220	136.76	4.611		
	3:00 PM	240	136.596	4.775		
	3:20 PM	260	136.455	4.916		
	3:40 PM	280	136.315	5.056		
	4:00 PM	300	136.182	5.189		
	4:20 PM	320	136.073	5.298		
	4:40 PM	340	135.971	5.4		
	5:00 PM	360	135.87	5.501		
April 3, 2007	6:00 PM	420	135.589	5.782		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 2 of 4
Well Name: MW-1
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Transducer Data

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 3, 2007	7:00 PM	480	135.355	6.016		
	8:00 PM	540	135.168	6.203		
	9:00 PM	600	134.996	6.375		
	10:00 PM	660	134.84	6.531		
	11:00 PM	720	134.723	6.648		
April 4, 2007	1:00 AM	840	134.52	6.851		
	3:00 AM	960	134.38	6.991		
	5:00 AM	1080	134.294	7.077		
	7:00 AM	1200	134.216	7.155		
	9:00 AM	1320	134.161	7.21		
	11:00 AM	1440	134.099	7.272		
	1:00 PM	1560	134.036	7.335		
	3:00 PM	1680	133.997	7.374		
	5:00 PM	1800	133.982	7.389		
	7:00 PM	1920	133.95	7.421		
	9:00 PM	2040	133.935	7.436		
	11:00 PM	2160	133.919	7.452		
April 5, 2007	1:00 AM	2280	133.943	7.428		
	3:00 AM	2400	133.904	7.467		
	5:00 AM	2520	133.88	7.491		
	7:00 AM	2640	133.857	7.514		
	9:00 AM	2760	133.841	7.53		
	11:00 AM	2880	133.818	7.553		
	1:00 PM	3000	133.81	7.561		
	3:00 PM	3120	133.81	7.561		
	5:00 PM	3240	133.802	7.569		
	7:00 PM	3360	133.794	7.577		
	9:00 PM	3480	133.786	7.585		
	11:00 PM	3600	133.786	7.585		
April 6, 2007	1:00 AM	3720	133.771	7.6		
	3:00 AM	3840	133.794	7.577		
	5:00 AM	3960	133.794	7.577		
	7:00 AM	4080	133.794	7.577		
	8:28 AM	4168	133.794	7.577		
	8:58 AM	4198	133.794	7.577		
	9:28 AM	4228	133.794	7.577		
	9:58 AM	4258	133.786	7.585		
	10:28 AM	4288	133.779	7.592		
	10:58 AM	4318	133.779	7.592		
	10:58 AM	4318.5	133.771	7.6		
	10:59 AM	4319	133.779	7.592		
	10:59 AM	4319.5	133.771	7.6		
	11:00 AM	4320	133.779	7.592		Pump shut down at
	11:00 AM	4320.5	134.028	7.343		11:00 AM
	11:01 AM	4321	134.145	7.226	0	Recovery
April 6, 2007	11:01 AM	4321.5	134.231	7.14	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 3 of 4
Well Name: MW-1
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Transducer Data

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 6, 2007	11:02 AM	4322	134.309	7.062	0	
	11:02 AM	4322.5	134.387	6.984		
	11:03 AM	4323	134.45	6.921		
	11:04 AM	4324	134.559	6.812		
	11:05 AM	4325	134.653	6.718		
	11:06 AM	4326	134.738	6.633		
	11:07 AM	4327	134.817	6.554		
	11:08 AM	4328	134.887	6.484		
	11:09 AM	4329	134.957	6.414		
	11:10 AM	4330	135.012	6.359		
	11:11 AM	4331	135.066	6.305		
	11:12 AM	4332	135.121	6.25		
	11:13 AM	4333	135.168	6.203		
	11:18 AM	4338	135.394	5.977		
	11:23 AM	4343	135.573	5.798		
	11:28 AM	4348	135.73	5.641		
	11:33 AM	4353	135.878	5.493		
	11:38 AM	4358	136.003	5.368		
	11:43 AM	4363	136.127	5.244		
	11:48 AM	4368	136.237	5.134		
	11:53 AM	4373	136.354	5.017		
	11:58 AM	4378	136.455	4.916		
	12:18 PM	4398	136.814	4.557		
	12:38 PM	4418	137.118	4.253		
	12:58 PM	4438	137.392	3.979		
	1:18 PM	4458	137.626	3.745		
	1:38 PM	4478	137.836	3.535		
	1:58 PM	4498	138.031	3.34		
	2:18 PM	4518	138.211	3.16		
	2:38 PM	4538	138.375	2.996		
	2:58 PM	4558	138.523	2.848		
	3:18 PM	4578	138.671	2.7		
	3:38 PM	4598	138.804	2.567		
	3:58 PM	4618	138.921	2.45		
	4:18 PM	4638	139.046	2.325		
	4:38 PM	4658	139.147	2.224		
	4:58 PM	4678	139.249	2.122		
	5:58 PM	4738	139.514	1.857		
	6:58 PM	4798	139.756	1.615		
	7:58 PM	4858	139.967	1.404		
	8:58 PM	4918	140.138	1.233		
	9:58 PM	4978	140.294	1.077		
	10:58 PM	5038	140.443	0.928		
April 7, 2007	12:58 AM	5158	140.677	0.694		
	2:58 AM	5278	140.872	0.499		
April 7, 2007	4:58 AM	5398	141.044	0.327	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 4 of 4
Well Name: MW-1
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Transducer Data

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 7, 2007	6:58 AM	5518	141.176	0.195	0	
	8:58 AM	5638	141.278	0.093		
	10:58 AM	5758	141.356	0.015		
	12:58 PM	5878	141.418	-0.047		
	2:58 PM	5998	141.473	-0.102		
	4:58 PM	6118	141.527	-0.156		
	6:58 PM	6238	141.574	-0.203		
	8:58 PM	6358	141.613	-0.242		
	10:58 PM	6478	141.652	-0.281		
April 8, 2007	12:58 AM	6598	141.683	-0.312		
	2:58 AM	6718	141.722	-0.351		
	4:58 AM	6838	141.746	-0.375		
	6:58 AM	6958	141.769	-0.398		
	8:58 AM	7078	141.769	-0.398		
	10:58 AM	7198	141.769	-0.398		
	12:58 PM	7318	141.769	-0.398		
	2:58 PM	7438	141.777	-0.406		
	4:58 PM	7558	141.769	-0.398		
	6:58 PM	7678	141.777	-0.406		
	8:58 PM	7798	141.777	-0.406		
	10:58 PM	7918	141.793	-0.422		
April 9, 2007	12:58 AM	8038	141.8	-0.429		
	2:58 AM	8158	141.816	-0.445		
	4:58 AM	8278	141.824	-0.453		
	6:58 AM	8398	141.824	-0.453		
	8:58 AM	8518	141.824	-0.453		
April 9, 2007	10:58 AM	8638	141.816	-0.445	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 1 of 4
Well Name: DH 4-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project	Zelasny - Frontier Stone
Location	Fletcher Chapel Road, Shelby, New York
Hydrologist	William Miller

Production Well

Well No.	PW-1	Size	6-Inch Diameter
Screen Size	Open-Hole/Bedrock	Screen Length	Open Hole 40 to 195 feet
Pump Setting	75 feet	Aquifer	Lockport Limestone Bedrock
Date Drilled	March 20, 2007	Drilled By	Frey Well Drilling
Flow Measurement	121-124 gallons per minute		
Measuring Point	Top of PVC drop pipe		

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 3, 2007	11:00 AM	0	133.263	0		Static Level
	11:00 AM	0.5	133.202	0.061		Pumping at PW-1 starts
	11:01 AM	1	133.155	0.108		at 11:00AM
	11:01 AM	1.5	133.109	0.154		
	11:02 AM	2	133.07	0.193		
	11:02 AM	2.5	133.032	0.231		
	11:03 AM	3	133.001	0.262		
	11:03 AM	3.5	132.962	0.301		
	11:04 AM	4	132.931	0.332		
	11:04 AM	4.5	132.9	0.363		
	11:05 AM	5	132.877	0.386		
	11:06 AM	6	132.831	0.432		
	11:07 AM	7	132.784	0.479		
	11:08 AM	8	132.738	0.525		
	11:09 AM	9	132.699	0.564		
	11:10 AM	10	132.66	0.603		
	11:11 AM	11	132.614	0.649		
	11:12 AM	12	132.591	0.672		
	11:13 AM	13	132.552	0.711		
	11:14 AM	14	132.514	0.749		
	11:15 AM	15	132.483	0.78		
	11:20 AM	20	132.336	0.927		
	11:25 AM	25	132.204	1.059		
	11:30 AM	30	132.088	1.175		
	11:35 AM	35	131.973	1.29		
	11:40 AM	40	131.872	1.391		
	11:45 AM	45	131.772	1.491		
	11:50 AM	50	131.671	1.592		
	11:55 AM	55	131.578	1.685		
	12:00 PM	60	131.486	1.777		
	12:20 PM	80	131.161	2.102		
	12:40 PM	100	130.859	2.404		
	1:00 PM	120	130.589	2.674		
	1:20 PM	140	130.349	2.914		
	1:40 PM	160	130.125	3.138		
	2:00 PM	180	129.932	3.331		
	2:20 PM	200	129.746	3.517		
	2:40 PM	220	129.576	3.687		
	3:00 PM	240	129.406	3.857		
	3:20 PM	260	129.267	3.996		
	3:40 PM	280	129.128	4.135		
	4:00 PM	300	129.012	4.251		
	4:20 PM	320	128.896	4.367		
	4:40 PM	340	128.796	4.467		
	5:00 PM	360	128.687	4.576		
April 3, 2007	6:00 PM	420	128.425	4.838		

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 2 of 4
Well Name: DH 4-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 3, 2007	7:00 PM	480	128.2	5.063		
	8:00 PM	540	128.015	5.248		
	9:00 PM	600	127.837	5.426		
	10:00 PM	660	127.69	5.573		
	11:00 PM	720	127.559	5.704		
April 4, 2007	1:00 AM	840	127.35	5.913		
	3:00 AM	960	127.203	6.06		
	5:00 AM	1080	127.095	6.168		
	7:00 AM	1200	127.018	6.245		
	9:00 AM	1320	126.956	6.307		
	11:00 AM	1440	126.871	6.392		
	1:00 PM	1560	126.801	6.462		
	3:00 PM	1680	126.77	6.493		
	5:00 PM	1800	126.747	6.516		
	7:00 PM	1920	126.724	6.539		
	9:00 PM	2040	126.701	6.562		
	11:00 PM	2160	126.693	6.57		
April 5, 2007	1:00 AM	2280	126.724	6.539		
	3:00 AM	2400	126.693	6.57		
	5:00 AM	2520	126.678	6.585		
	7:00 AM	2640	126.662	6.601		
	9:00 AM	2760	126.631	6.632		
	11:00 AM	2880	126.616	6.647		
	1:00 PM	3000	126.639	6.624		
	3:00 PM	3120	126.631	6.632		
	5:00 PM	3240	126.616	6.647		
	7:00 PM	3360	126.616	6.647		
	9:00 PM	3480	126.593	6.67		
	11:00 PM	3600	126.577	6.686		
April 6, 2007	1:00 AM	3720	126.577	6.686		
	3:00 AM	3840	126.585	6.678		
	5:00 AM	3960	126.585	6.678		
	7:00 AM	4080	126.593	6.67		
	8:28 AM	4168	126.593	6.67		
	8:58 AM	4198	126.593	6.67		
	9:28 AM	4228	126.577	6.686		
	9:58 AM	4258	126.585	6.678		
	10:28 AM	4288	126.569	6.694		
	10:58 AM	4318	126.569	6.694		
	10:58 AM	4318.5	126.562	6.701		
	10:59 AM	4319	126.562	6.701		
	10:59 AM	4319.5	126.562	6.701		
	11:00 AM	4320	126.562	6.701		Pump shut down at
	11:00 AM	4320.5	126.585	6.678		11:00 AM
	11:01 AM	4321	126.647	6.616	0	Recovery
April 6, 2007	11:01 AM	4321.5	126.708	6.555	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 3 of 4
Well Name: DH 4-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 6, 2007	11:02 AM	4322	126.77	6.493	0	
	11:02 AM	4322.5	126.817	6.446		
	11:03 AM	4323	126.863	6.4		
	11:04 AM	4324	126.94	6.323		
	11:05 AM	4325	127.01	6.253		
	11:06 AM	4326	127.064	6.199		
	11:07 AM	4327	127.118	6.145		
	11:08 AM	4328	127.165	6.098		
	11:09 AM	4329	127.211	6.052		
	11:10 AM	4330	127.257	6.006		
	11:11 AM	4331	127.296	5.967		
	11:12 AM	4332	127.342	5.921		
	11:13 AM	4333	127.373	5.89		
	11:18 AM	4338	127.536	5.727		
	11:23 AM	4343	127.682	5.581		
	11:28 AM	4348	127.806	5.457		
	11:33 AM	4353	127.93	5.333		
	11:38 AM	4358	128.03	5.233		
	11:43 AM	4363	128.139	5.124		
	11:48 AM	4368	128.224	5.039		
	11:53 AM	4373	128.324	4.939		
	11:58 AM	4378	128.409	4.854		
	12:18 PM	4398	128.718	4.545		
	12:38 PM	4418	128.997	4.266		
	12:58 PM	4438	129.236	4.027		
	1:18 PM	4458	129.453	3.81		
	1:38 PM	4478	129.654	3.609		
	1:58 PM	4498	129.839	3.424		
	2:18 PM	4518	130.001	3.262		
	2:38 PM	4538	130.156	3.107		
	2:58 PM	4558	130.303	2.96		
	3:18 PM	4578	130.442	2.821		
	3:38 PM	4598	130.566	2.697		
	3:58 PM	4618	130.689	2.574		
	4:18 PM	4638	130.805	2.458		
	4:38 PM	4658	130.906	2.357		
	4:58 PM	4678	131.006	2.257		
	5:58 PM	4738	131.277	1.986		
	6:58 PM	4798	131.509	1.754		
	7:58 PM	4858	131.717	1.546		
	8:58 PM	4918	131.888	1.375		
	9:58 PM	4978	132.042	1.221		
	10:58 PM	5038	132.189	1.074		
April 7, 2007	12:58 AM	5158	132.436	0.827		
	2:58 AM	5278	132.637	0.626		
April 7, 2007	4:58 AM	5398	132.807	0.456	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 4 of 4
Well Name: DH 4-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 7, 2007	6:58 AM	5518	132.947	0.316	0	
	8:58 AM	5638	133.055	0.208		
	10:58 AM	5758	133.124	0.139		
	12:58 PM	5878	133.194	0.069		
	2:58 PM	5998	133.256	0.007		
	4:58 PM	6118	133.31	-0.047		
	6:58 PM	6238	133.364	-0.101		
	8:58 PM	6358	133.41	-0.147		
	10:58 PM	6478	133.449	-0.186		
April 8, 2007	12:58 AM	6598	133.488	-0.225		
	2:58 AM	6718	133.526	-0.263		
	4:58 AM	6838	133.557	-0.294		
	6:58 AM	6958	133.573	-0.31		
	8:58 AM	7078	133.58	-0.317		
	10:58 AM	7198	133.58	-0.317		
	12:58 PM	7318	133.58	-0.317		
	2:58 PM	7438	133.588	-0.325		
	4:58 PM	7558	133.596	-0.333		
	6:58 PM	7678	133.604	-0.341		
	8:58 PM	7798	133.619	-0.356		
	10:58 PM	7918	133.619	-0.356		
April 9, 2007	12:58 AM	8038	133.634	-0.371		
	2:58 AM	8158	133.658	-0.395		
	4:58 AM	8278	133.665	-0.402		
	6:58 AM	8398	133.673	-0.41		
	8:58 AM	8518	133.673	-0.41	0	
April 9, 2007	10:58 AM	8638	133.673	-0.41		

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 1 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Transducer Data

Project: Zelasny - Frontier Stone LLC
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 3, 2007	10:50 AM	-10	153.988	0		Static Level
	11:05 AM	5	153.761	0.227		Pumping at PW-1 starts
	11:20 AM	20	153.266	0.722		at 11:00AM
	11:35 AM	35	152.812	1.176		
	11:50 AM	50	152.44	1.548		
	12:05 PM	65	152.089	1.899		
	12:20 PM	80	151.8	2.188		
	12:35 PM	95	151.512	2.476		
	12:50 PM	110	151.243	2.745		
	1:05 PM	125	151.037	2.951		
	1:20 PM	140	150.81	3.178		
	1:35 PM	155	150.603	3.385		
	1:50 PM	170	150.418	3.57		
	2:05 PM	185	150.253	3.735		
	2:20 PM	200	150.087	3.901		
	2:35 PM	215	149.922	4.066		
	2:50 PM	230	149.798	4.19		
	3:05 PM	245	149.654	4.334		
	3:20 PM	260	149.551	4.437		
	3:35 PM	275	149.427	4.561		
	3:50 PM	290	149.303	4.685		
	4:05 PM	305	149.221	4.767		
	4:20 PM	320	149.116	4.872		
	4:35 PM	335	149.035	4.953		
	4:50 PM	350	148.952	5.036		
	5:05 PM	365	148.87	5.118		
	5:20 PM	380	148.806	5.182		
	5:35 PM	395	148.725	5.263		
	5:50 PM	410	148.663	5.325		
	6:05 PM	425	148.601	5.387		
	6:20 PM	440	148.54	5.448		
	6:35 PM	455	148.478	5.51		
	6:50 PM	470	148.436	5.552		
	7:05 PM	485	148.374	5.614		
	7:20 PM	500	148.313	5.675		
	7:35 PM	515	148.271	5.717		
	7:50 PM	530	148.209	5.779		
	8:05 PM	545	148.168	5.82		
	8:20 PM	560	148.127	5.861		
	8:35 PM	575	148.106	5.882		
	8:50 PM	590	148.044	5.944		
	9:05 PM	605	148.003	5.985		
	9:20 PM	620	147.962	6.026		
	9:35 PM	635	147.92	6.068		
	9:50 PM	650	147.879	6.109		
April 3, 2007	10:05 PM	665	147.858	6.13		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 2 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 3, 2007	10:20 PM	680	147.817	6.171		
	10:35 PM	695	147.797	6.191		
	10:50 PM	710	147.755	6.233		
	11:05 PM	725	147.735	6.253		
	11:20 PM	740	147.714	6.274		
	11:35 PM	755	147.673	6.315		
	11:50 PM	770	147.652	6.336		
April 4, 2007	12:05 AM	785	147.631	6.357		
	12:20 AM	800	147.59	6.398		
	12:35 AM	815	147.57	6.418		
	12:50 AM	830	147.549	6.439		
	1:05 AM	845	147.549	6.439		
	1:20 AM	860	147.508	6.48		
	1:35 AM	875	147.508	6.48		
	1:50 AM	890	147.486	6.502		
	2:05 AM	905	147.466	6.522		
	2:20 AM	920	147.466	6.522		
	2:35 AM	935	147.446	6.542		
	2:50 AM	950	147.425	6.563		
	3:05 AM	965	147.425	6.563		
	3:20 AM	980	147.403	6.585		
	3:35 AM	995	147.404	6.584		
	3:50 AM	1010	147.384	6.604		
	4:05 AM	1025	147.384	6.604		
	4:20 AM	1040	147.363	6.625		
	4:35 AM	1055	147.362	6.626		
	4:50 AM	1070	147.342	6.646		
	5:05 AM	1085	147.342	6.646		
	5:20 AM	1100	147.322	6.666		
	5:35 AM	1115	147.32	6.668		
	5:50 AM	1130	147.322	6.666		
	6:05 AM	1145	147.322	6.666		
	6:20 AM	1160	147.301	6.687		
	6:35 AM	1175	147.301	6.687		
	6:50 AM	1190	147.301	6.687		
	7:05 AM	1205	147.281	6.707		
	7:20 AM	1220	147.281	6.707		
	7:35 AM	1235	147.281	6.707		
	7:50 AM	1250	147.26	6.728		
	8:05 AM	1265	147.26	6.728		
	8:20 AM	1280	147.26	6.728		
	8:35 AM	1295	147.239	6.749		
	8:50 AM	1310	147.239	6.749		
	9:05 AM	1325	147.239	6.749		
	9:20 AM	1340	147.238	6.75		
April 4, 2007	9:35 AM	1355	147.239	6.749		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 3 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 4, 2007	9:50 AM	1355	147.219	6.769		
	10:05 AM	1370	147.219	6.769		
	10:20 AM	1385	147.219	6.769		
	10:35 AM	1400	147.198	6.79		
	10:50 AM	1415	147.177	6.811		
	11:05 AM	1430	147.177	6.811		
	11:20 AM	1445	147.177	6.811		
	11:35 AM	1460	147.157	6.831		
	11:50 AM	1475	147.157	6.831		
	12:05 PM	1490	147.157	6.831		
	12:20 PM	1505	147.136	6.852		
	12:35 PM	1520	147.136	6.852		
	12:50 PM	1535	147.136	6.852		
	1:05 PM	1550	147.114	6.874		
	1:20 PM	1565	147.115	6.873		
	1:35 PM	1580	147.115	6.873		
	1:50 PM	1595	147.115	6.873		
	2:05 PM	1610	147.095	6.893		
	2:20 PM	1625	147.095	6.893		
	2:35 PM	1640	147.095	6.893		
	2:50 PM	1655	147.095	6.893		
	3:05 PM	1670	147.095	6.893		
	3:20 PM	1685	147.095	6.893		
	3:35 PM	1700	147.095	6.893		
	3:50 PM	1715	147.095	6.893		
	4:05 PM	1730	147.095	6.893		
	4:20 PM	1745	147.095	6.893		
	4:35 PM	1760	147.074	6.914		
	4:50 PM	1775	147.074	6.914		
	5:05 PM	1790	147.073	6.915		
	5:20 PM	1805	147.074	6.914		
	5:35 PM	1820	147.074	6.914		
	5:50 PM	1835	147.074	6.914		
	6:05 PM	1850	147.054	6.934		
	6:20 PM	1865	147.074	6.914		
	6:35 PM	1880	147.074	6.914		
	6:50 PM	1895	147.074	6.914		
	7:05 PM	1910	147.054	6.934		
	7:20 PM	1925	147.054	6.934		
	7:35 PM	1940	147.054	6.934		
	7:50 PM	1955	147.054	6.934		
	8:05 PM	1970	147.054	6.934		
	8:20 PM	1985	147.054	6.934		
	8:35 PM	2000	147.054	6.934		
	8:50 PM	2015	147.054	6.934		
April 4, 2007	9:05 PM	2030	147.054	6.934		

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 4 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 4, 2007	9:20 PM	2045	147.054	6.934		
	9:35 PM	2060	147.033	6.955		
	9:50 PM	2075	147.052	6.936		
	10:05 PM	2090	147.052	6.936		
	10:20 PM	2105	147.033	6.955		
	10:35 PM	2120	147.032	6.956		
	10:50 PM	2135	147.033	6.955		
	11:05 PM	2150	147.033	6.955		
	11:20 PM	2165	147.198	6.79		
	11:35 PM	2180	147.177	6.811		
	11:50 PM	2195	147.157	6.831		
April 5, 2007	12:05 AM	2210	147.115	6.873		
	12:20 AM	2225	147.115	6.873		
	12:35 AM	2240	147.095	6.893		
	12:50 AM	2255	147.095	6.893		
	1:05 AM	2270	147.074	6.914		
	1:20 AM	2285	147.074	6.914		
	1:35 AM	2300	147.074	6.914		
	1:50 AM	2315	147.054	6.934		
	2:05 AM	2330	147.054	6.934		
	2:20 AM	2345	147.054	6.934		
	2:35 AM	2360	147.054	6.934		
	2:50 AM	2375	147.054	6.934		
	3:05 AM	2390	147.033	6.955		
	3:20 AM	2405	147.033	6.955		
	3:35 AM	2420	147.033	6.955		
	3:50 AM	2435	147.033	6.955		
	4:05 AM	2450	147.033	6.955		
	4:20 AM	2465	147.033	6.955		
	4:35 AM	2480	147.033	6.955		
	4:50 AM	2495	147.012	6.976		
	5:05 AM	2510	147.012	6.976		
	5:20 AM	2525	147.012	6.976		
	5:35 AM	2540	147.012	6.976		
	5:50 AM	2555	147.012	6.976		
	6:05 AM	2570	147.012	6.976		
	6:20 AM	2585	147.012	6.976		
	6:35 AM	2600	147.012	6.976		
	6:50 AM	2615	147.011	6.977		
	7:05 AM	2630	146.992	6.996		
	7:20 AM	2645	146.992	6.996		
	7:35 AM	2660	146.992	6.996		
	7:50 AM	2675	146.992	6.996		
	8:05 AM	2690	146.992	6.996		
	8:20 AM	2705	146.971	7.017		
April 5, 2007	8:35 AM	2720	146.992	6.996		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 5 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 5, 2007	8:50 AM	2720	146.971	7.017		
	9:05 AM	2735	146.971	7.017		
	9:20 AM	2750	146.971	7.017		
	9:35 AM	2765	146.971	7.017		
	9:50 AM	2780	146.971	7.017		
	10:05 AM	2795	146.971	7.017		
	10:20 AM	2810	146.971	7.017		
	10:35 AM	2825	146.971	7.017		
	10:50 AM	2840	146.95	7.038		
	11:05 AM	2855	146.95	7.038		
	11:20 AM	2870	146.95	7.038		
	11:35 AM	2885	146.95	7.038		
	11:50 AM	2900	146.95	7.038		
	12:05 PM	2915	146.971	7.017		
	12:20 PM	2930	146.95	7.038		
	12:35 PM	2945	146.95	7.038		
	12:50 PM	2960	146.95	7.038		
	1:05 PM	2975	146.971	7.017		
	1:20 PM	2990	146.95	7.038		
	1:35 PM	3005	146.95	7.038		
	1:50 PM	3020	146.95	7.038		
	2:05 PM	3035	146.95	7.038		
	2:20 PM	3050	146.95	7.038		
	2:35 PM	3065	146.95	7.038		
	2:50 PM	3080	146.95	7.038		
	3:05 PM	3095	146.95	7.038		
	3:20 PM	3110	146.95	7.038		
	3:35 PM	3125	146.971	7.017		
	3:50 PM	3140	146.95	7.038		
	4:05 PM	3155	146.95	7.038		
	4:20 PM	3170	146.95	7.038		
	4:35 PM	3185	146.95	7.038		
	4:50 PM	3200	146.95	7.038		
	5:05 PM	3215	146.95	7.038		
	5:20 PM	3230	146.95	7.038		
	5:35 PM	3245	146.93	7.058		
	5:50 PM	3260	146.95	7.038		
	6:05 PM	3275	146.95	7.038		
	6:20 PM	3290	146.95	7.038		
	6:35 PM	3305	146.95	7.038		
	6:50 PM	3320	146.93	7.058		
	7:05 PM	3335	146.95	7.038		
	7:20 PM	3350	146.95	7.038		
	7:35 PM	3365	146.95	7.038		
	7:50 PM	3380	146.93	7.058		
April 5, 2007	8:05 PM	3395	146.95	7.038		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 6 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 5, 2007	8:20 PM	3410	146.95	7.038		
	8:35 PM	3425	146.95	7.038		
	8:50 PM	3440	146.93	7.058		
	9:05 PM	3455	146.93	7.058		
	9:20 PM	3470	146.93	7.058		
	9:35 PM	3485	146.93	7.058		
	9:50 PM	3500	146.93	7.058		
	10:05 PM	3515	146.93	7.058		
	10:20 PM	3530	146.93	7.058		
	10:35 PM	3545	146.93	7.058		
	10:50 PM	3560	146.93	7.058		
	11:05 PM	3575	146.93	7.058		
	11:20 PM	3590	146.93	7.058		
	11:35 PM	3605	146.93	7.058		
	11:50 PM	3620	146.93	7.058		
April 6, 2007	12:05 AM	3635	146.93	7.058		
	12:20 AM	3650	146.93	7.058		
	12:35 AM	3665	146.93	7.058		
	12:50 AM	3680	146.93	7.058		
	1:05 AM	3695	146.909	7.079		
	1:20 AM	3710	146.93	7.058		
	1:35 AM	3725	146.93	7.058		
	1:50 AM	3740	146.93	7.058		
	2:05 AM	3755	146.93	7.058		
	2:20 AM	3770	146.93	7.058		
	2:35 AM	3785	146.93	7.058		
	2:50 AM	3800	146.93	7.058		
	3:05 AM	3815	146.93	7.058		
	3:20 AM	3830	146.95	7.038		
	3:35 AM	3845	146.95	7.038		
	3:50 AM	3860	146.93	7.058		
	4:05 AM	3875	146.95	7.038		
	4:20 AM	3890	146.93	7.058		
	4:35 AM	3905	146.93	7.058		
	4:50 AM	3920	146.93	7.058		
	5:05 AM	3935	146.93	7.058		
	5:20 AM	3950	146.95	7.038		
	5:35 AM	3965	146.93	7.058		
	5:50 AM	3980	146.93	7.058		
	6:05 AM	3995	146.95	7.038		
	6:20 AM	4010	146.95	7.038		
	6:35 AM	4025	146.95	7.038		
	6:50 AM	4040	146.93	7.058		
	7:05 AM	4055	146.95	7.038		
	7:20 AM	4070	146.95	7.038		
April 6, 2007	7:35 AM	4085	146.95	7.038		

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 7 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 6, 2007	7:50 AM	4100	146.95	7.038		
	8:05 AM	4115	146.93	7.058		
	8:20 AM	4130	146.95	7.038		
	8:35 AM	4145	146.95	7.038		
	8:50 AM	4160	146.95	7.038		
	9:05 AM	4175	146.95	7.038		
	9:20 AM	4190	146.93	7.058		
	9:35 AM	4205	146.93	7.058		
	9:50 AM	4220	146.93	7.058		
	10:05 AM	4235	146.95	7.038		
	10:20 AM	4250	146.93	7.058		
	10:35 AM	4265	146.93	7.058		
	10:50 AM	4280	146.93	7.058		
	11:05 AM	4295	147.136	6.852		Pumping in PW-1 ceased at 11:00 AM
	11:20 AM	4310	147.714	6.274		
	11:35 AM	4325	148.189	5.799		
	11:50 AM	4340	148.581	5.407		
	12:05 PM	4355	148.911	5.077		
	12:20 PM	4370	149.2	4.788		
	12:35 PM	4385	149.448	4.54		
	12:50 PM	4400	149.675	4.313		
	1:05 PM	4415	149.881	4.107		
	1:20 PM	4430	150.067	3.921		
	1:35 PM	4445	150.253	3.735		
	1:50 PM	4460	150.418	3.57		
	2:05 PM	4475	150.562	3.426		
	2:20 PM	4490	150.707	3.281		
	2:35 PM	4505	150.851	3.137		
	2:50 PM	4520	150.975	3.013		
	3:05 PM	4535	151.078	2.91		
	3:20 PM	4550	151.202	2.786		
	3:35 PM	4565	151.284	2.704		
	3:50 PM	4580	151.407	2.581		
	4:05 PM	4595	151.491	2.497		
	4:20 PM	4610	151.594	2.394		
	4:35 PM	4625	151.677	2.311		
	4:50 PM	4640	151.759	2.229		
	5:05 PM	4655	151.821	2.167		
	5:20 PM	4670	151.904	2.084		
	5:35 PM	4685	151.986	2.002		
	5:50 PM	4700	152.048	1.94		
	6:05 PM	4715	152.11	1.878		
	6:20 PM	4730	152.193	1.795		
	6:35 PM	4745	152.234	1.754		
	6:50 PM	4760	152.296	1.692		
April 6, 2007	7:05 PM	4775	152.337	1.651		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 8 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 6, 2007	7:20 PM	4790	152.42	1.568	0	
	7:35 PM	4805	152.461	1.527		
	7:50 PM	4820	152.523	1.465		
	8:05 PM	4835	152.564	1.424		
	8:20 PM	4850	152.605	1.383		
	8:35 PM	4865	152.647	1.341		
	8:50 PM	4880	152.709	1.279		
	9:05 PM	4895	152.729	1.259		
	9:20 PM	4910	152.771	1.217		
	9:35 PM	4925	152.812	1.176		
	9:50 PM	4940	152.853	1.135		
	10:05 PM	4955	152.894	1.094		
	10:20 PM	4970	152.936	1.052		
	10:35 PM	4985	152.977	1.011		
	10:50 PM	5000	152.998	0.99		
	11:05 PM	5015	153.039	0.949		
	11:20 PM	5030	153.059	0.929		
	11:35 PM	5045	153.101	0.887		
	11:50 PM	5060	153.142	0.846		
April 7, 2007	12:05 AM	5075	153.163	0.825		
	12:20 AM	5090	153.204	0.784		
	12:35 AM	5105	153.225	0.763		
	12:50 AM	5120	153.245	0.743		
	1:05 AM	5135	153.266	0.722		
	1:20 AM	5150	153.307	0.681		
	1:35 AM	5165	153.328	0.66		
	1:50 AM	5180	153.348	0.64		
	2:05 AM	5195	153.39	0.598		
	2:20 AM	5210	153.41	0.578		
	2:35 AM	5225	153.431	0.557		
	2:50 AM	5240	153.452	0.536		
	3:05 AM	5255	153.493	0.495		
	3:20 AM	5270	153.493	0.495		
	3:35 AM	5285	153.514	0.474		
	3:50 AM	5300	153.534	0.454		
	4:05 AM	5315	153.555	0.433		
	4:20 AM	5330	153.575	0.413		
	4:35 AM	5345	153.596	0.392		
	4:50 AM	5360	153.617	0.371		
	5:05 AM	5375	153.637	0.351		
	5:20 AM	5390	153.658	0.33		
	5:35 AM	5405	153.679	0.309		
	5:50 AM	5420	153.699	0.289		
	6:05 AM	5435	153.699	0.289		
	6:20 AM	5450	153.72	0.268		
April 7, 2007	6:35 AM	5465	153.741	0.247	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 9 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 7, 2007	6:50 AM	5480	153.761	0.227		
	7:05 AM	5495	153.761	0.227		
	7:20 AM	5510	153.761	0.227		
	7:35 AM	5525	153.782	0.206		
	7:50 AM	5540	153.802	0.186		
	8:05 AM	5555	153.823	0.165		
	8:20 AM	5570	153.823	0.165		
	8:35 AM	5585	153.844	0.144		
	8:50 AM	5600	153.864	0.124		
	9:05 AM	5615	153.864	0.124		
	9:20 AM	5630	153.864	0.124		
	9:35 AM	5645	153.885	0.103		
	9:50 AM	5660	153.906	0.082		
	10:05 AM	5675	153.906	0.082		
	10:20 AM	5690	153.906	0.082		
	10:35 AM	5705	153.926	0.062		
	10:50 AM	5720	153.926	0.062		
	11:05 AM	5735	153.926	0.062		
	11:20 AM	5750	153.947	0.041		
	11:35 AM	5765	153.947	0.041		
	11:50 AM	5780	153.947	0.041		
	12:05 PM	5795	153.968	0.02		
	12:20 PM	5810	153.968	0.02		
	12:35 PM	5825	153.968	0.02		
	12:50 PM	5840	153.988	0		
	1:05 PM	5855	153.988	0		
	1:20 PM	5870	153.988	0		
	1:35 PM	5885	154.009	-0.021		
	1:50 PM	5900	154.009	-0.021		
	2:05 PM	5915	154.009	-0.021		
	2:20 PM	5930	154.03	-0.042		
	2:35 PM	5945	154.03	-0.042		
	2:50 PM	5960	154.03	-0.042		
	3:05 PM	5975	154.03	-0.042		
	3:20 PM	5990	154.05	-0.062		
	3:35 PM	6005	154.05	-0.062		
	3:50 PM	6020	154.05	-0.062		
	4:05 PM	6035	154.071	-0.083		
	4:20 PM	6050	154.071	-0.083		
	4:35 PM	6065	154.071	-0.083		
	4:50 PM	6080	154.071	-0.083		
	5:05 PM	6095	154.071	-0.083		
	5:20 PM	6110	154.091	-0.103		
	5:35 PM	6125	154.091	-0.103		
	5:50 PM	6140	154.112	-0.124		
April 7, 2007	6:05 PM	6155	154.112	-0.124		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 10 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 7, 2007	6:20 PM	5480	154.112	-0.124	0	
	6:35 PM	5495	154.112	-0.124		
	6:50 PM	5510	154.133	-0.145		
	7:05 PM	5525	154.133	-0.145		
	7:20 PM	5540	154.133	-0.145		
	7:35 PM	5555	154.133	-0.145		
	7:50 PM	5570	154.153	-0.165		
	8:05 PM	5585	154.153	-0.165		
	8:20 PM	5600	154.153	-0.165		
	8:35 PM	5615	154.153	-0.165		
	8:50 PM	5630	154.153	-0.165		
	9:05 PM	5645	154.174	-0.186		
	9:20 PM	5660	154.174	-0.186		
	9:35 PM	5675	154.174	-0.186		
	9:50 PM	5690	154.174	-0.186		
	10:05 PM	5705	154.174	-0.186		
	10:20 PM	5720	154.195	-0.207		
	10:35 PM	5735	154.195	-0.207		
	10:50 PM	5750	154.195	-0.207		
	11:05 PM	5765	154.195	-0.207		
	11:20 PM	5780	154.195	-0.207		
	11:35 PM	5795	154.215	-0.227		
	11:50 PM	5810	154.215	-0.227		
April 8, 2007	12:05 AM	5825	154.215	-0.227		
	12:20 AM	5840	154.215	-0.227		
	12:35 AM	5855	154.215	-0.227		
	12:50 AM	5870	154.215	-0.227		
	1:05 AM	5885	154.236	-0.248		
	1:20 AM	5900	154.236	-0.248		
	1:35 AM	5915	154.236	-0.248		
	1:50 AM	5930	154.236	-0.248		
	2:05 AM	5945	154.236	-0.248		
	2:20 AM	5960	154.257	-0.269		
	2:35 AM	5975	154.257	-0.269		
	2:50 AM	5990	154.236	-0.248		
	3:05 AM	6005	154.257	-0.269		
	3:20 AM	6020	154.257	-0.269		
	3:35 AM	6035	154.257	-0.269		
	3:50 AM	6050	154.257	-0.269		
	4:05 AM	6065	154.257	-0.269		
	4:20 AM	6080	154.257	-0.269		
	4:35 AM	6095	154.257	-0.269		
	4:50 AM	6110	154.257	-0.269		
	5:05 AM	6125	154.277	-0.289		
	5:20 AM	6140	154.277	-0.289		
April 8, 2007	5:35 AM	6155	154.277	-0.289	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 11 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 8, 2007	5:50 AM	6170	154.277	-0.289	0	
	6:05 AM	6185	154.277	-0.289		
	6:20 AM	6200	154.277	-0.289		
	6:35 AM	6215	154.277	-0.289		
	6:50 AM	6230	154.277	-0.289		
	7:05 AM	6245	154.277	-0.289		
	7:20 AM	6260	154.277	-0.289		
	7:35 AM	6275	154.277	-0.289		
	7:50 AM	6290	154.298	-0.31		
	8:05 AM	6305	154.277	-0.289		
	8:20 AM	6320	154.277	-0.289		
	8:35 AM	6335	154.277	-0.289		
	8:50 AM	6350	154.298	-0.31		
	9:05 AM	6365	154.298	-0.31		
	9:20 AM	6380	154.277	-0.289		
	9:35 AM	6395	154.277	-0.289		
	9:50 AM	6410	154.277	-0.289		
	10:05 AM	6425	154.277	-0.289		
	10:20 AM	6440	154.277	-0.289		
	10:35 AM	6455	154.277	-0.289		
	10:50 AM	6470	154.277	-0.289		
	11:05 AM	6485	154.277	-0.289		
	11:20 AM	6500	154.277	-0.289		
	11:35 AM	6515	154.277	-0.289		
	11:50 AM	6530	154.277	-0.289		
	12:05 PM	6545	154.277	-0.289		
	12:20 PM	6560	154.277	-0.289		
	12:35 PM	6575	154.277	-0.289		
	12:50 PM	6590	154.277	-0.289		
	1:05 PM	6605	154.277	-0.289		
	1:20 PM	6620	154.277	-0.289		
	1:35 PM	6635	154.277	-0.289		
	1:50 PM	6650	154.257	-0.269		
	2:05 PM	6665	154.257	-0.269		
	2:20 PM	6680	154.257	-0.269		
	2:35 PM	6695	154.257	-0.269		
	2:50 PM	6710	154.277	-0.289		
	3:05 PM	6725	154.277	-0.289		
	3:20 PM	6740	154.257	-0.269		
	3:35 PM	6755	154.257	-0.269		
	3:50 PM	6770	154.277	-0.289		
	4:05 PM	6785	154.257	-0.269		
	4:20 PM	6800	154.277	-0.289		
	4:35 PM	6815	154.277	-0.289		
	4:50 PM	6830	154.277	-0.289		
April 8, 2007	5:05 PM	6845	154.277	-0.289	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 12 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 8, 2007	5:20 PM	6860	154.257	-0.269	0	
	5:35 PM	6875	154.277	-0.289		
	5:50 PM	6890	154.277	-0.289		
	6:05 PM	6905	154.277	-0.289		
	6:20 PM	6920	154.257	-0.269		
	6:35 PM	6935	154.257	-0.269		
	6:50 PM	6950	154.257	-0.269		
	7:05 PM	6965	154.257	-0.269		
	7:20 PM	6980	154.257	-0.269		
	7:35 PM	6995	154.257	-0.269		
	7:50 PM	7010	154.277	-0.289		
	8:05 PM	7025	154.277	-0.289		
	8:20 PM	7040	154.257	-0.269		
	8:35 PM	7055	154.257	-0.269		
	8:50 PM	7070	154.257	-0.269		
	9:05 PM	7085	154.277	-0.289		
	9:20 PM	7100	154.277	-0.289		
	9:35 PM	7115	154.257	-0.269		
	9:50 PM	7130	154.277	-0.289		
	10:05 PM	7145	154.257	-0.269		
	10:20 PM	7160	154.277	-0.289		
	10:35 PM	7175	154.257	-0.269		
	10:50 PM	7190	154.257	-0.269		
	11:05 PM	7205	154.257	-0.269		
	11:20 PM	7220	154.257	-0.269		
	11:35 PM	7235	154.277	-0.289		
	11:50 PM	7250	154.277	-0.289		
April 9, 2007	12:05 AM	7265	154.277	-0.289		
	12:20 AM	7280	154.277	-0.289		
	12:35 AM	7295	154.277	-0.289		
	12:50 AM	7310	154.277	-0.289		
	1:05 AM	7325	154.277	-0.289		
	1:20 AM	7340	154.277	-0.289		
	1:35 AM	7355	154.277	-0.289		
	1:50 AM	7370	154.277	-0.289		
	2:05 AM	7385	154.277	-0.289		
	2:20 AM	7400	154.277	-0.289		
	2:35 AM	7415	154.277	-0.289		
	2:50 AM	7430	154.277	-0.289		
	3:05 AM	7445	154.277	-0.289		
	3:20 AM	7460	154.298	-0.31		
	3:35 AM	7475	154.298	-0.31		
	3:50 AM	7490	154.277	-0.289		
	4:05 AM	7505	154.277	-0.289		
	4:20 AM	7520	154.277	-0.289		
April 9, 2007	4:35 AM	7535	154.277	-0.289	0	

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 13 of 13
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 9, 2007	4:50 AM	7550	154.277	-0.289	0	
	5:05 AM	7565	154.277	-0.289		
	5:20 AM	7580	154.277	-0.289		
	5:35 AM	7595	154.277	-0.289		
	5:50 AM	7610	154.277	-0.289		
	6:05 AM	7625	154.298	-0.31		
	6:20 AM	7640	154.298	-0.31		
	6:35 AM	7655	154.298	-0.31		
	6:50 AM	7670	154.277	-0.289		
	7:05 AM	7685	154.277	-0.289		
	7:20 AM	7700	154.277	-0.289		
	7:35 AM	7715	154.277	-0.289		
	7:50 AM	7730	154.277	-0.289		
	8:05 AM	7745	154.277	-0.289		
	8:20 AM	7760	154.277	-0.289		
	8:35 AM	7775	154.277	-0.289		
	8:50 AM	7790	154.277	-0.289		
	9:05 AM	7805	154.277	-0.289		
	9:20 AM	7820	154.277	-0.289		
	9:35 AM	7835	154.277	-0.289		
	9:50 AM	7850	154.277	-0.289		
	10:05 AM	7865	154.277	-0.289		
	10:20 AM	7880	154.257	-0.269		
	10:35 AM	7895	154.277	-0.289		
	10:50 AM	7910	154.277	-0.289		
	11:05 AM	7925	154.257	-0.269		
	11:20 AM	7940	154.257	-0.269		
	11:35 AM	7955	154.277	-0.289		
	11:50 AM	7970	154.257	-0.269		
April 9, 2007	12:05 PM	7985	154.257	-0.269		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 1 of 13
Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Transducer Data

Project: Zelasny - Frontier Stone LLC
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 3, 2007	11:00 AM	0	16.248	0		Static Level
	11:15 AM	15	16.226	0.022		Pumping at PW-1 starts
	11:30 AM	30	16.224	0.024		at 11:00AM
	11:45 AM	45	14.063	2.185		
	12:00 PM	60	16.169	0.079		
	12:15 PM	75	13.764	2.484		
	12:30 PM	90	16.083	0.165		
	12:45 PM	105	16.023	0.225		
	1:00 PM	120	15.986	0.262		
	1:15 PM	135	15.059	1.189		
	1:30 PM	150	15.902	0.346		
	1:45 PM	165	15.757	0.491		
	2:00 PM	180	15.814	0.434		
	2:15 PM	195	15.744	0.504		
	2:30 PM	210	15.662	0.586		
	2:45 PM	225	14.812	1.436		
	3:00 PM	240	15.634	0.614		
	3:15 PM	255	15.603	0.645		
	3:30 PM	270	12.374	3.874		
	3:45 PM	285	15.109	1.139		
	4:00 PM	300	15.464	0.784		
	4:15 PM	315	15.422	0.826		
	4:30 PM	330	14.792	1.456		
	4:45 PM	345	14.792	1.456		
	5:00 PM	360	13.839	2.409		
	5:15 PM	375	15.18	1.068		
	5:30 PM	390	14.726	1.522		
	5:45 PM	405	15.079	1.169		
	6:00 PM	420	12.663	3.585		
	6:15 PM	435	14.905	1.343		
	6:30 PM	450	14.114	2.134		
	6:45 PM	465	14.623	1.625		
	7:00 PM	480	14.859	1.389		
	7:15 PM	495	14.304	1.944		
	7:30 PM	510	12.297	3.951		
	7:45 PM	525	14.088	2.16		
	8:00 PM	540	12.22	4.028		
	8:15 PM	555	14.837	1.411		
	8:30 PM	570	12.54	3.708		
	8:45 PM	585	14.76	1.488		
	9:00 PM	600	14.744	1.504		
	9:15 PM	615	13.02	3.228		
	9:30 PM	630	14.229	2.019		
	9:45 PM	645	14.641	1.607		
	10:00 PM	660	14.385	1.863		
April 3, 2007	10:15 PM	675	14.586	1.662		

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 2 of 13
Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 3, 2007	10:30 PM	690	14.559	1.689		
	10:45 PM	705	14.409	1.839		
	11:00 PM	720	14.53	1.718		
	11:15 PM	735	14.513	1.735		
	11:30 PM	750	14.491	1.757		
	11:45 PM	765	14.475	1.773		
April 4, 2007	12:00 AM	780	14.455	1.793		
	12:15 AM	795	14.414	1.834		
	12:30 AM	810	14.394	1.854		
	12:45 AM	825	14.392	1.856		
	1:00 AM	840	12.39	3.858		
	1:15 AM	855	14.332	1.916		
	1:30 AM	870	14.253	1.995		
	1:45 AM	885	13.365	2.883		
	2:00 AM	900	14.268	1.98		
	2:15 AM	915	14.271	1.977		
	2:30 AM	930	14.251	1.997		
	2:45 AM	945	14.229	2.019		
	3:00 AM	960	14.191	2.057		
	3:15 AM	975	14.171	2.077		
	3:30 AM	990	14.11	2.138		
	3:45 AM	1005	14.187	2.061		
	4:00 AM	1020	14.149	2.099		
	4:15 AM	1035	14.145	2.103		
	4:30 AM	1050	14.149	2.099		
	4:45 AM	1065	14.13	2.118		
	5:00 AM	1080	14.094	2.154		
	5:15 AM	1095	14.09	2.158		
	5:30 AM	1110	14.07	2.178		
	5:45 AM	1125	14.074	2.174		
	6:00 AM	1140	14.055	2.193		
	6:15 AM	1155	14.039	2.209		
	6:30 AM	1170	14.019	2.229		
	6:45 AM	1185	14.019	2.229		
	7:00 AM	1200	14.019	2.229		
	7:15 AM	1215	13.466	2.782		
	7:30 AM	1230	13.806	2.442		
	7:45 AM	1245	13.878	2.37		
	8:00 AM	1260	13.936	2.312		
	8:15 AM	1275	13.839	2.409		
	8:30 AM	1290	13.006	3.242		
	8:45 AM	1305	13.914	2.334		
	9:00 AM	1320	11.317	4.931		
	9:15 AM	1335	13.834	2.414		
	9:30 AM	1350	13.852	2.396		
April 4, 2007	9:45 AM	1365	13.813	2.435		

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531

Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 4, 2007	10:00 AM	1380	13.832	2.416		
	10:15 AM	1395	13.319	2.929		
	10:30 AM	1410	13.793	2.455		
	10:45 AM	1425	13.773	2.475		
	11:00 AM	1440	13.755	2.493		
	11:15 AM	1455	13.72	2.528		
	11:30 AM	1470	13.735	2.513		
	11:45 AM	1485	13.735	2.513		
	12:00 PM	1500	13.698	2.55		
	12:15 PM	1515	13.048	3.2		
	12:30 PM	1530	13.676	2.572		
	12:45 PM	1545	13.641	2.607		
	1:00 PM	1560	13.636	2.612		
	1:15 PM	1575	11.813	4.435		
	1:30 PM	1590	12.009	4.239		
	1:45 PM	1605	13.295	2.953		
	2:00 PM	1620	13.57	2.678		
	2:15 PM	1635	13.59	2.658		
	2:30 PM	1650	13.551	2.697		
	2:45 PM	1665	12.859	3.389		
	3:00 PM	1680	13.568	2.68		
	3:15 PM	1695	13.586	2.662		
	3:30 PM	1710	13.584	2.664		
	3:45 PM	1725	13.588	2.66		
	4:00 PM	1740	13.588	2.66		
	4:15 PM	1755	13.572	2.676		
	4:30 PM	1770	13.59	2.658		
	4:45 PM	1785	13.57	2.678		
	5:00 PM	1800	13.572	2.676		
	5:15 PM	1815	13.553	2.695		
	5:30 PM	1830	13.517	2.731		
	5:45 PM	1845	13.161	3.087		
	6:00 PM	1860	13.315	2.933		
	6:15 PM	1875	12.879	3.369		
	6:30 PM	1890	12.04	4.208		
	6:45 PM	1905	10.571	5.677		
	7:00 PM	1920	9.21	7.038		
	7:15 PM	1935	13.445	2.803		
	7:30 PM	1950	10.073	6.175		
	7:45 PM	1965	12.119	4.129		
	8:00 PM	1980	13.48	2.768		
	8:15 PM	1995	11.659	4.589		
	8:30 PM	2010	12.85	3.398		
	8:45 PM	2025	13.485	2.763		
	9:00 PM	2040	13.487	2.761		
April 4, 2007	9:15 PM	2055	13.485	2.763		

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 4 of 13
Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 4, 2007	9:30 PM	2070	13.489	2.759		
	9:45 PM	2085	11.965	4.283		
	10:00 PM	2100	13.471	2.777		
	10:15 PM	2115	13.233	3.015		
	10:30 PM	2130	13.548	2.7		
	10:45 PM	2145	13.551	2.697		
	11:00 PM	2160	13.57	2.678		
	11:15 PM	2175	13.517	2.731		
	11:30 PM	2190	13.57	2.678		
	11:45 PM	2205	13.553	2.695		
April 5, 2007	12:00 AM	2220	13.57	2.678		
	12:15 AM	2235	13.575	2.673		
	12:30 AM	2250	11.913	4.335		
	12:45 AM	2265	13.572	2.676		
	1:00 AM	2280	13.298	2.95		
	1:15 AM	2295	13.57	2.678		
	1:30 AM	2310	13.567	2.681		
	1:45 AM	2325	13.554	2.694		
	2:00 AM	2340	13.567	2.681		
	2:15 AM	2355	13.569	2.679		
	2:30 AM	2370	13.565	2.683		
	2:45 AM	2385	13.56	2.688		
	3:00 AM	2400	13.569	2.679		
	3:15 AM	2415	13.556	2.692		
	3:30 AM	2430	13.333	2.915		
	3:45 AM	2445	13.556	2.692		
	4:00 AM	2460	13.541	2.707		
	4:15 AM	2475	13.525	2.723		
	4:30 AM	2490	13.509	2.739		
	4:45 AM	2505	13.527	2.721		
	5:00 AM	2520	13.547	2.701		
	5:15 AM	2535	13.551	2.697		
	5:30 AM	2550	13.534	2.714		
	5:45 AM	2565	13.538	2.71		
	6:00 AM	2580	13.544	2.704		
	6:15 AM	2595	13.542	2.706		
	6:30 AM	2610	13.527	2.721		
	6:45 AM	2625	13.513	2.735		
	7:00 AM	2640	13.513	2.735		
	7:15 AM	2655	13.515	2.733		
	7:30 AM	2670	13.518	2.73		
	7:45 AM	2685	13.498	2.75		
	8:00 AM	2700	13.502	2.746		
	8:15 AM	2715	13.502	2.746		
	8:30 AM	2730	12.226	4.022		
April 5, 2007	8:45 AM	2745	13.489	2.759		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 5 of 13
Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 5, 2007	9:00 AM	2760	13.511	2.737		
	9:15 AM	2775	13.474	2.774		
	9:30 AM	2790	13.498	2.75		
	9:45 AM	2805	13.484	2.764		
	10:00 AM	2820	13.482	2.766		
	10:15 AM	2835	13.484	2.764		
	10:30 AM	2850	13.458	2.79		
	10:45 AM	2865	13.46	2.788		
	11:00 AM	2880	13.482	2.766		
	11:15 AM	2895	13.484	2.764		
	11:30 AM	2910	13.465	2.783		
	11:45 AM	2925	13.469	2.779		
	12:00 PM	2940	13.467	2.781		
	12:15 PM	2955	13.473	2.775		
	12:30 PM	2970	13.467	2.781		
	12:45 PM	2985	13.451	2.797		
	1:00 PM	3000	13.453	2.795		
	1:15 PM	3015	13.458	2.79		
	1:30 PM	3030	13.456	2.792		
	1:45 PM	3045	13.453	2.795		
	2:00 PM	3060	13.456	2.792		
	2:15 PM	3075	13.458	2.79		
	2:30 PM	3090	13.46	2.788		
	2:45 PM	3105	8.748	7.5		
	3:00 PM	3120	8.737	7.511		
	3:15 PM	3135	9.848	6.4		
	3:30 PM	3150	12.535	3.713		
	3:45 PM	3165	11.541	4.707		
	4:00 PM	3180	13.138	3.11		
	4:15 PM	3195	9.991	6.257		
	4:30 PM	3210	12.885	3.363		
	4:45 PM	3225	13.356	2.892		
	5:00 PM	3240	13.389	2.859		
	5:15 PM	3255	13.391	2.857		
	5:30 PM	3270	13.318	2.93		
	5:45 PM	3285	13.38	2.868		
	6:00 PM	3300	13.386	2.862		
	6:15 PM	3315	13.391	2.857		
	6:30 PM	3330	13.381	2.867		
	6:45 PM	3345	13.368	2.88		
	7:00 PM	3360	13.39	2.858		
	7:15 PM	3375	13.372	2.876		
	7:30 PM	3390	13.399	2.849		
	7:45 PM	3405	13.379	2.869		
	8:00 PM	3420	13.383	2.865		
April 5, 2007	8:15 PM	3435	13.359	2.889		

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 6 of 13
Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 5, 2007	8:30 PM	3450	13.377	2.871		
	8:45 PM	3465	13.37	2.878		
	9:00 PM	3480	13.39	2.858		
	9:15 PM	3495	13.374	2.874		
	9:30 PM	3510	13.376	2.872		
	9:45 PM	3525	13.372	2.876		
	10:00 PM	3540	13.372	2.876		
	10:15 PM	3555	13.376	2.872		
	10:30 PM	3570	13.363	2.885		
	10:45 PM	3585	13.376	2.872		
	11:00 PM	3600	13.361	2.887		
	11:15 PM	3615	13.363	2.885		
	11:30 PM	3630	13.369	2.879		
	11:45 PM	3645	13.369	2.879		
April 6, 2007	12:00 AM	3660	13.367	2.881		
	12:15 AM	3675	13.369	2.879		
	12:30 AM	3690	13.356	2.892		
	12:45 AM	3705	13.371	2.877		
	1:00 AM	3720	13.376	2.872		
	1:15 AM	3735	13.354	2.894		
	1:30 AM	3750	13.358	2.89		
	1:45 AM	3765	13.376	2.872		
	2:00 AM	3780	13.358	2.89		
	2:15 AM	3795	13.374	2.874		
	2:30 AM	3810	13.362	2.886		
	2:45 AM	3825	13.36	2.888		
	3:00 AM	3840	13.374	2.874		
	3:15 AM	3855	13.378	2.87		
	3:30 AM	3870	13.376	2.872		
	3:45 AM	3885	13.376	2.872		
	4:00 AM	3900	13.362	2.886		
	4:15 AM	3915	13.362	2.886		
	4:30 AM	3930	13.38	2.868		
	4:45 AM	3945	13.362	2.886		
	5:00 AM	3960	13.365	2.883		
	5:15 AM	3975	13.365	2.883		
	5:30 AM	3990	13.345	2.903		
	5:45 AM	4005	13.362	2.886		
	6:00 AM	4020	13.343	2.905		
	6:15 AM	4035	13.34	2.908		
	6:30 AM	4050	13.345	2.903		
	6:45 AM	4065	13.347	2.901		
	7:00 AM	4080	13.34	2.908		
	7:15 AM	4095	13.345	2.903		
	7:30 AM	4110	13.325	2.923		
April 6, 2007	7:45 AM	4125	13.318	2.93		

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 7 of 13
Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 6, 2007	8:00 AM	4140	13.327	2.921		
	8:15 AM	4155	13.325	2.923		
	8:30 AM	4170	13.325	2.923		
	8:45 AM	4185	13.321	2.927		
	9:00 AM	4200	13.323	2.925		
	9:15 AM	4215	13.323	2.925		
	9:30 AM	4230	13.323	2.925		
	9:45 AM	4245	13.347	2.901		
	10:00 AM	4260	13.371	2.877		
	10:15 AM	4275	8.796	7.452		
	10:30 AM	4290	9.355	6.893		
	10:45 AM	4305	10.54	5.708		
	11:00 AM	4320	10.389	5.859		PW-1 pumping ceased at 11:00 AM
	11:15 AM	4335	10.367	5.881		
	11:30 AM	4350	11.048	5.2		
	11:45 AM	4365	10.728	5.52		
	12:00 PM	4380	13.288	2.96		
	12:15 PM	4395	12.803	3.445		
	12:30 PM	4410	12.629	3.619		
	12:45 PM	4425	13.455	2.793		
	1:00 PM	4440	13.153	3.095		
	1:15 PM	4455	13.472	2.776		
	1:30 PM	4470	13.191	3.057		
	1:45 PM	4485	13.693	2.555		
	2:00 PM	4500	13.463	2.785		
	2:15 PM	4515	13.695	2.553		
	2:30 PM	4530	13.798	2.45		
	2:45 PM	4545	11.138	5.11		
	3:00 PM	4560	12.186	4.062		
	3:15 PM	4575	13.988	2.26		
	3:30 PM	4590	14.021	2.227		
	3:45 PM	4605	13.986	2.262		
	4:00 PM	4620	14.144	2.104		
	4:15 PM	4635	13.664	2.584		
	4:30 PM	4650	14.16	2.088		
	4:45 PM	4665	14.259	1.989		
	5:00 PM	4680	14.219	2.029		
	5:15 PM	4695	14.303	1.945		
	5:30 PM	4710	14.382	1.866		
	5:45 PM	4725	12.983	3.265		
	6:00 PM	4740	14.332	1.916		
	6:15 PM	4755	14.083	2.165		
	6:30 PM	4770	14.532	1.716		
	6:45 PM	4785	14.565	1.683		
	7:00 PM	4800	14.6	1.648		
April 6, 2007	7:15 PM	4815	14.66	1.588		

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 8 of 13
Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	**Comments**
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 6, 2007	7:30 PM	4830	14.681	1.567	0	
	7:45 PM	4845	14.719	1.529		
	8:00 PM	4860	14.765	1.483		
	8:15 PM	4875	14.787	1.461		
	8:30 PM	4890	14.829	1.419		
	8:45 PM	4905	14.841	1.407		
	9:00 PM	4920	14.892	1.356		
	9:15 PM	4935	14.925	1.323		
	9:30 PM	4950	14.947	1.301		
	9:45 PM	4965	14.987	1.261		
	10:00 PM	4980	15.015	1.233		
	10:15 PM	4995	15.046	1.202		
	10:30 PM	5010	15.072	1.176		
	10:45 PM	5025	15.092	1.156		
	11:00 PM	5040	15.138	1.11		
	11:15 PM	5055	15.16	1.088		
	11:30 PM	5070	15.18	1.068		
	11:45 PM	5085	15.202	1.046		
April 7, 2007	12:00 AM	5100	15.244	1.004		
	12:15 AM	5115	15.266	0.982		
	12:30 AM	5130	15.294	0.954		
	12:45 AM	5145	15.325	0.923		
	1:00 AM	5160	15.343	0.905		
	1:15 AM	5175	15.367	0.881		
	1:30 AM	5190	15.389	0.859		
	1:45 AM	5205	15.427	0.821		
	2:00 AM	5220	15.446	0.802		
	2:15 AM	5235	15.466	0.782		
	2:30 AM	5250	15.49	0.758		
	2:45 AM	5265	15.508	0.74		
	3:00 AM	5280	15.53	0.718		
	3:15 AM	5295	15.534	0.714		
	3:30 AM	5310	15.578	0.67		
	3:45 AM	5325	15.576	0.672		
	4:00 AM	5340	15.594	0.654		
	4:15 AM	5355	15.614	0.634		
	4:30 AM	5370	15.638	0.61		
	4:45 AM	5385	15.658	0.59		
	5:00 AM	5400	15.66	0.588		
	5:15 AM	5415	15.675	0.573		
	5:30 AM	5430	15.699	0.549		
	5:45 AM	5445	15.699	0.549		
	6:00 AM	5460	15.721	0.527		
	6:15 AM	5475	15.739	0.509		
	6:30 AM	5490	15.743	0.505		
April 7, 2007	6:45 AM	5505	15.759	0.489	0	

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 9 of 13
Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 7, 2007	7:00 AM	5520	15.781	0.467		
	7:15 AM	5535	15.781	0.467		
	7:30 AM	5550	15.801	0.447		
	7:45 AM	5565	15.805	0.443		
	8:00 AM	5580	15.821	0.427		
	8:15 AM	5595	15.821	0.427		
	8:30 AM	5610	15.825	0.423		
	8:45 AM	5625	15.843	0.405		
	9:00 AM	5640	15.843	0.405		
	9:15 AM	5655	8.032	8.216		
	9:30 AM	5670	15.867	0.381		
	9:45 AM	5685	15.879	0.369		
	10:00 AM	5700	15.877	0.371		
	10:15 AM	5715	15.859	0.389		
	10:30 AM	5730	15.885	0.363		
	10:45 AM	5745	12.361	3.887		
	11:00 AM	5760	12.77	3.478		
	11:15 AM	5775	10.935	5.313		
	11:30 AM	5790	15.312	0.936		
	11:45 AM	5805	14.986	1.262		
	12:00 PM	5820	15.781	0.467		
	12:15 PM	5835	14.27	1.978		
	12:30 PM	5850	15.666	0.582		
	12:45 PM	5865	15.686	0.562		
	1:00 PM	5880	14.109	2.139		
	1:15 PM	5895	15.942	0.306		
	1:30 PM	5910	15.964	0.284		
	1:45 PM	5925	15.992	0.256		
	2:00 PM	5940	15.959	0.289		
	2:15 PM	5955	15.65	0.598		
	2:30 PM	5970	15.974	0.274		
	2:45 PM	5985	15.027	1.221		
	3:00 PM	6000	15.988	0.26		
	3:15 PM	6015	15.412	0.836		
	3:30 PM	6030	15.375	0.873		
	3:45 PM	6045	16.038	0.21		
	4:00 PM	6060	15.822	0.426		
	4:15 PM	6075	15.699	0.549		
	4:30 PM	6090	15.009	1.239		
	4:45 PM	6105	16.027	0.221		
	5:00 PM	6120	15.1	1.148		
	5:15 PM	6135	16.043	0.205		
	5:30 PM	6150	16.036	0.212		
	5:45 PM	6165	16.062	0.186		
	6:00 PM	6180	16.08	0.168		
April 7, 2007	6:15 PM	6195	16.064	0.184		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 10 of 13
Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 7, 2007	6:30 PM	6210	16.073	0.175	0	
	6:45 PM	6225	16.067	0.181		
	7:00 PM	6240	16.071	0.177		
	7:15 PM	6255	16.101	0.147		
	7:30 PM	6270	16.117	0.131		
	7:45 PM	6285	16.117	0.131		
	8:00 PM	6300	16.123	0.125		
	8:15 PM	6315	16.128	0.12		
	8:30 PM	6330	16.145	0.103		
	8:45 PM	6345	16.128	0.12		
	9:00 PM	6360	16.145	0.103		
	9:15 PM	6375	16.121	0.127		
	9:30 PM	6390	16.148	0.1		
	9:45 PM	6405	16.143	0.105		
	10:00 PM	6420	16.145	0.103		
	10:15 PM	6435	16.163	0.085		
	10:30 PM	6450	16.17	0.078		
	10:45 PM	6465	16.167	0.081		
	11:00 PM	6480	16.192	0.056		
	11:15 PM	6495	16.194	0.054		
	11:30 PM	6510	16.196	0.052		
	11:45 PM	6525	16.211	0.037		
April 8, 2007	12:00 AM	6540	16.2	0.048		
	12:15 AM	6555	16.211	0.037		
	12:30 AM	6570	16.231	0.017		
	12:45 AM	6585	16.231	0.017		
	1:00 AM	6600	16.233	0.015		
	1:15 AM	6615	16.233	0.015		
	1:30 AM	6630	16.251	-0.003		
	1:45 AM	6645	16.257	-0.009		
	2:00 AM	6660	16.255	-0.007		
	2:15 AM	6675	16.257	-0.009		
	2:30 AM	6690	16.255	-0.007		
	2:45 AM	6705	16.277	-0.029		
	3:00 AM	6720	16.275	-0.027		
	3:15 AM	6735	16.275	-0.027		
	3:30 AM	6750	16.282	-0.034		
	3:45 AM	6765	16.282	-0.034		
	4:00 AM	6780	16.299	-0.051		
	4:15 AM	6795	16.304	-0.056		
	4:30 AM	6810	16.301	-0.053		
	4:45 AM	6825	16.299	-0.051		
	5:00 AM	6840	16.304	-0.056		
	5:15 AM	6855	16.301	-0.053		
	5:30 AM	6870	16.301	-0.053		
April 8, 2007	5:45 AM	6885	16.321	-0.073	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 11 of 13
Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 8, 2007	6:00 AM	6900	16.301	-0.053	0	
	6:15 AM	6915	16.321	-0.073		
	6:30 AM	6930	16.326	-0.078		
	6:45 AM	6945	16.326	-0.078		
	7:00 AM	6960	16.299	-0.051		
	7:15 AM	6975	16.299	-0.051		
	7:30 AM	6990	16.321	-0.073		
	7:45 AM	7005	16.299	-0.051		
	8:00 AM	7020	11.792	4.456		
	8:15 AM	7035	10.356	5.892		
	8:30 AM	7050	11.145	5.103		
	8:45 AM	7065	16.233	0.015		
	9:00 AM	7080	16.281	-0.033		
	9:15 AM	7095	13.658	2.59		
	9:30 AM	7110	15.88	0.368		
	9:45 AM	7125	16.171	0.077		
	10:00 AM	7140	16.272	-0.024		
	10:15 AM	7155	14.492	1.756		
	10:30 AM	7170	16.268	-0.02		
	10:45 AM	7185	16.29	-0.042		
	11:00 AM	7200	16.017	0.231		
	11:15 AM	7215	16.274	-0.026		
	11:30 AM	7230	16.274	-0.026		
	11:45 AM	7245	16.133	0.115		
	12:00 PM	7260	15.565	0.683		
	12:15 PM	7275	16.294	-0.046		
	12:30 PM	7290	16.054	0.194		
	12:45 PM	7305	16.228	0.02		
	1:00 PM	7320	16.29	-0.042		
	1:15 PM	7335	14.25	1.998		
	1:30 PM	7350	15.858	0.39		
	1:45 PM	7365	16.283	-0.035		
	2:00 PM	7380	16.288	-0.04		
	2:15 PM	7395	16.272	-0.024		
	2:30 PM	7410	14.213	2.035		
	2:45 PM	7425	16.219	0.029		
	3:00 PM	7440	16.307	-0.059		
	3:15 PM	7455	16.014	0.234		
	3:30 PM	7470	16.224	0.024		
	3:45 PM	7485	14.006	2.242		
	4:00 PM	7500	16.054	0.194		
	4:15 PM	7515	16.285	-0.037		
	4:30 PM	7530	16.292	-0.044		
	4:45 PM	7545	14.7	1.548		
	5:00 PM	7560	16.301	-0.053		
April 8, 2007	5:15 PM	7575	16.321	-0.073	0	

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531

Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 8, 2007	5:30 PM	7590	16.034	0.214	0	
	5:45 PM	7605	15.358	0.89		
	6:00 PM	7620	16.277	-0.029		
	6:15 PM	7635	16.259	-0.011		
	6:30 PM	7650	16.123	0.125		
	6:45 PM	7665	16.217	0.031		
	7:00 PM	7680	14.729	1.519		
	7:15 PM	7695	15.585	0.663		
	7:30 PM	7710	15.869	0.379		
	7:45 PM	7725	16.18	0.068		
	8:00 PM	7740	16.202	0.046		
	8:15 PM	7755	16.259	-0.011		
	8:30 PM	7770	16.283	-0.035		
	8:45 PM	7785	16.303	-0.055		
	9:00 PM	7800	16.263	-0.015		
	9:15 PM	7815	14.882	1.366		
	9:30 PM	7830	16.323	-0.075		
	9:45 PM	7845	13.891	2.357		
	10:00 PM	7860	16.332	-0.084		
	10:15 PM	7875	16.323	-0.075		
	10:30 PM	7890	16.325	-0.077		
	10:45 PM	7905	15.937	0.311		
	11:00 PM	7920	16.347	-0.099		
	11:15 PM	7935	16.347	-0.099		
	11:30 PM	7950	16.29	-0.042		
	11:45 PM	7965	16.371	-0.123		
April 9, 2007	12:00 AM	7980	14.757	1.491		
	12:15 AM	7995	16.371	-0.123		
	12:30 AM	8010	16.375	-0.127		
	12:45 AM	8025	15.197	1.051		
	1:00 AM	8040	16.382	-0.134		
	1:15 AM	8055	16.366	-0.118		
	1:30 AM	8070	16.386	-0.138		
	1:45 AM	8085	16.388	-0.14		
	2:00 AM	8100	16.384	-0.136		
	2:15 AM	8115	16.397	-0.149		
	2:30 AM	8130	16.386	-0.138		
	2:45 AM	8145	16.413	-0.165		
	3:00 AM	8160	16.388	-0.14		
	3:15 AM	8175	16.415	-0.167		
	3:30 AM	8190	16.415	-0.167		
	3:45 AM	8205	16.408	-0.16		
	4:00 AM	8220	16.432	-0.184		
	4:15 AM	8235	16.417	-0.169		
	4:30 AM	8250	16.417	-0.169		
April 9, 2007	4:45 AM	8265	16.201	0.047	0	

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 13 of 13
Well Name: Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 9, 2007	5:00 AM	8280	16.413	-0.165	0	
	5:15 AM	8295	16.419	-0.171		
	5:30 AM	8310	16.437	-0.189		
	5:45 AM	8325	16.415	-0.167		
	6:00 AM	8340	16.415	-0.167		
	6:15 AM	8355	16.384	-0.136		
	6:30 AM	8370	16.421	-0.173		
	6:45 AM	8385	16.435	-0.187		
	7:00 AM	8400	16.439	-0.191		
	7:15 AM	8415	16.419	-0.171		
	7:30 AM	8430	15.359	0.889		
	7:45 AM	8445	16.415	-0.167		
	8:00 AM	8460	16.404	-0.156		
	8:15 AM	8475	16.399	-0.151		
	8:30 AM	8490	16.027	0.221		
	8:45 AM	8505	13.794	2.454		
	9:00 AM	8520	16.408	-0.16		
	9:15 AM	8535	13.208	3.04		
	9:30 AM	8550	16.38	-0.132		
	9:45 AM	8565	14.107	2.141		
	10:00 AM	8580	16.404	-0.156		
	10:15 AM	8595	14.64	1.608		
	10:30 AM	8610	16.393	-0.145		
	10:45 AM	8625	16.411	-0.163		
	11:00 AM	8640	16.235	0.013		
	11:15 AM	8655	16.413	-0.165		
April 9, 2007	11:30 AM	8670	16.409	-0.161		

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 1 of 2
Well Name: DH 5-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 3, 2007	11:00 AM	0.5	3.21	0		Static Level
	11:01 AM	1	3.21	0		Pumping at PW-1 starts
	11:01 AM	1.5	3.36	0.15		at 11:00AM
	11:02 AM	2	3.38	0.17		
	11:03 AM	3	3.48	0.27		
	11:04 AM	4	3.59	0.38		
	11:05 AM	5	3.62	0.41		
	11:06 AM	6	3.66	0.45		
	11:07 AM	7	3.72	0.51		
	11:08 AM	8	3.78	0.57		
	11:09 AM	9	3.83	0.62		
	11:10 AM	10	3.9	0.69		
	11:12 AM	12	3.96	0.75		
	11:14 AM	14	4.04	0.83		
	11:16 AM	16	4.14	0.93		
	11:18 AM	18	4.19	0.98		
	11:20 AM	20	4.26	1.05		
	11:22 AM	22	4.34	1.13		
	11:24 AM	24	4.38	1.17		
	11:26 AM	26	4.45	1.24		
	11:28 AM	28	4.5	1.29		
	11:30 AM	30	4.56	1.35		
	11:35 AM	35	4.68	1.47		
	11:40 AM	40	4.8	1.59		
	11:50 AM	50	4.9	1.69		
	11:55 AM	55	5.02	1.81		
	12:00 PM	60	5.11	1.9		
	12:10 PM	70	5.21	2		
	12:20 PM	80	5.39	2.18		
	12:30 PM	90	5.56	2.35		
	12:45 PM	105	5.72	2.51		
	1:00 PM	120	5.92	2.71		
	1:30 PM	150	6.12	2.91		
	2:00 PM	180	6.48	3.27		
	3:00 PM	240	6.76	3.55		
	4:00 PM	300	7.28	4.07		
	5:00 PM	360	7.71	4.5		
	7:00 PM	420	8.04	4.83		
	9:08 PM	548	8.86	5.65		
April 4, 2007	7:34 AM	1234	9.68	6.47		
	10:35 AM	1415	9.76	6.55		
	2:34 PM	1654	9.89	6.68		
	6:00 PM	1900	9.98	6.77		
April 5, 2007	8:23 AM	2663	10.06	6.85		
	5:45 PM	3285	10.08	6.87		
April 6, 2007	8:44 AM	4184	10.09	6.88		

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 2 of 2
Well Name: DH 5-05
Test: 72-Hour Test
Test Date: April 3-6, 2007

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 6, 2007	10:58 AM	4318	10.09	6.88		
	11:00 AM	4320	10.09	6.88		Pump shut down at
	11:01 AM	4321	10.04	6.83		11:00 AM
	11:02 AM	4322	9.91	6.7		Recovery
	11:03 AM	4323	9.82	6.61		
	11:04 AM	4324	9.72	6.51		
	11:05 AM	4325	9.67	6.46		
	11:06 AM	4326	9.6	6.39		
	11:07 AM	4327	9.51	6.3		
	11:08 AM	4328	9.46	6.25		
	11:09 AM	4329	9.4	6.19		
	11:10 AM	4330	9.35	6.14		
	11:12 AM	4332	9.26	6.05		
	11:14 AM	4334	9.18	5.97		
	11:16 AM	4336	9.1	5.89		
	11:18 AM	4338	9.01	5.8		
	11:20 AM	4340	8.95	5.74		
	11:25 AM	4345	8.8	5.59		
	11:30 AM	4350	8.67	5.46		
	11:35 AM	4355	8.55	5.34		
	11:40 AM	4360	8.42	5.21		
	11:45 AM	4365	8.31	5.1		
	11:50 AM	4370	8.22	5.01		
	11:55 AM	4375	8.14	4.93		
	12:00 PM	4380	8.03	4.82		
	12:10 PM	4390	7.86	4.65		
	12:20 PM	4400	7.7	4.49		
	12:30 PM	4410	7.55	4.34		
	12:45 PM	4425	7.36	4.15		
	1:00 PM	4440	7.16	3.95		
	1:30 PM	4470	6.85	3.64		
	2:00 PM	4500	6.58	3.37		
	3:00 PM	4600	6.08	2.87		
	4:00 PM	4700	5.64	2.43		
April 6, 2007	7:00 PM	5000	5.2	1.99		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 1 of 1
Well Name: PW-1
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Hand Measurements

Project: Zelasny - Frontier Stone LLC
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 2, 2007	2:26 PM		4.18			Static Level
April 3, 2007	8:03 AM		4.05			Pumping at PW-1 starts
April 4, 2007	11:01 AM		16.9	12.85		at 11:00AM
April 4, 2007	5:35 PM		18.2	14.15		
April 5, 2007	7:35 AM		15.23	11.18		
April 6, 2007	8:04 AM		15.44	11.39		Pump shut down at 11:00 AM
April 6, 2007	3:30 PM		7.58	3.53		Recovery
April 9, 2007	10:21 AM		4.58	0.53		

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 1 of 1
Well Name: MW-1
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Hand Measurements

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 2, 2007	12:04 PM		7.96			
April 3, 2007	7:07 AM		8.09			
April 4, 2007	10:53 AM		15.51	7.42		
April 5, 2007	7:40 AM		15.77	7.68		
April 5, 2007	5:28 PM		15.83	7.74		
April 6, 2007	8:13 AM		15.83	7.74		Pump shut down at
April 6, 2007	3:25 PM		10.91	2.82		11:00 AM
April 9, 2007	11:02 AM		7.78	-0.31		Recovery

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 1 of 1
Well Name: DH 1-05
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Hand Measurements

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 2, 2007	1:17 PM		4.76			
April 3, 2007	7:46 AM		4.63			
April 4, 2007	9:31 AM		11.37	6.74		
April 5, 2007	1:50 PM		11.66	7.03		
April 6, 2007	9:22 AM		11.66	7.03		Pump shut down at 11:00 AM
April 9, 2007	12:08 PM		4.26	-0.37		Recovery

CONTINENTAL PLACER INC.

26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 1 of 1
Well Name: DH 4-05
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Hand Measurements

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 2, 2007	12:33 PM		15.39			
April 3, 2007	7:10 AM		15.53			
April 4, 2007	10:51 AM		21.99	6.46		
April 5, 2007	7:49 AM		22.25	6.72		
April 5, 2007	5:32 PM		22.29	6.76		
April 6, 2007	8:29 AM		22.32	6.79		Pump shut down at
April 6, 2007	3:18 PM		18.49	2.96		11:00 AM
April 9, 2007	11:22 AM		15.24	-0.29		Recovery

CONTINENTAL PLACER INC.
26 Computer Drive West
Albany, New York 12205

PUMPING TEST FIELD DATA

Project Number: 629-01-05-2531
Sheet: 1 of 1
Well Name: Zelasny Barn Well (BW-1)
Test: 72-Hour Test
Test Date: April 3-6, 2007
Measurement Type: Hand Measurements

Project: Zelasny - Frontier Stone
Location: Fletcher Chapel Road, Shelby, New York
Hydrologist: William Miller

Production Well

Well No.: PW-1
Screen Size: Open-Hole/Bedrock
Pump Setting: 75 feet
Date Drilled: March 20, 2007
Flow Measurement: 121-124 gallons per minute
Measuring Point: Top of PVC drop pipe

Size: 6-Inch Diameter
Screen Length: Open Hole 40 to 195 feet
Aquifer: Lockport Limestone Bedrock
Drilled By: Frey Well Drilling

	TIME		WATER LEVEL		RATE	Comments
DATE	ACTUAL	ELAPSED (min)	DEPTH (feet)	DD (feet)	GPM	
April 3, 2007	8:35 AM		26.62			
April 4, 2007	10:46 AM		27.98	1.36		
April 5, 2007	7:18 AM		28.22	1.6		
April 6, 2007	2:33 PM		29.07	2.45		Pump shut down at 11:00 AM
April 9, 2007	11:44 AM		25.51	-1.11		Recovery

APPENDIX E

Completed Residential Well Survey Forms

Residential Well Survey
Frontier Stone (Shelby, NY) Quarry Area

Name: Eugene M. Outterson

Address: 11924 Fletcher Chapel RD Medina, NY.

Resident at this Address Since: 1985

Date House Built: 1890 - Remodeled Completely 1985

Location of Well Relative to Your House: east side of House

Driller Who Installed Your Well: Keppler Well Drilling

Date of Well Installation: 1994

Diameter of Well: 6"

Depth of Well: 47 FT

Does the Well have a Screen or is it Open-Hole: —

Type of Pump used in Well: Deep Well

Depth to Pump or Pump Intake in Well: 42 FT

Depth to Water: 14 FT 7"

Depth to Bedrock and Formation: ?

Has the Well ever Gone Dry? NO

Has the Well ever Lost Yield? NO

Has the Water ever had Problems with Turbidity/Discoloration? NO

Has the Water ever had any Problems with Chemistry/Taste? Hard water

Has the Water ever had any Problems with Bacteria? NO

Is a Water Treatment System in Place? NO

If so, What Type?

Would You Allow Us to Measure the Water Level in Your Well? yes with Reservations. I must be with you when you do it, you must give me written copy of what you do & any Results, also must sign all papers at the time.

Additional Comments: What Type of Test will you be doing on air quality do To dust & air born material from Quarry Operation. Also what noise level test To be take & Recorded & compaired To operation with a Farm Tractor or Farm machinery.

I am requesting information & reply from you on the above questions 4-5-07

Thank You for Your Assistance

Eugene M Outterson

March 28, 2007

Residential Well Survey
Frontier Stone (Shelby, NY) Quarry Area

Name: Bertie Avis Wilson

Address: 11946 Fletcher Chapel Rd

Resident at this Address Since: 1969

Date House Built: 1800's

Location of Well Relative to Your House: East of house

Driller Who Installed Your Well: hand dug when house was built

Date of Well Installation: don't Know

Diameter of Well: 3 ft,

Depth of Well: don'T Know

Does the Well have a Screen or is it Open-Hole: open hole with sTone over

Type of Pump used in Well:

Depth to Pump or Pump Intake in Well: pump is in basemenT

Depth to Water: don'T Know

Depth to Bedrock and Formation: don'T Know

Has the Well ever Gone Dry? NoT in my Life-time

Has the Well ever Lost Yield? No

Has the Water ever had Problems with Turbidity/Discoloration? No

Has the Water ever had any Problems with Chemistry/Taste? No

Has the Water ever had any Problems with Bacteria? No

Is a Water Treatment System in Place? I have City water now

If so, What Type? Town of Shelby

Would You Allow Us to Measure the Water Level in Your Well? yes

Additional Comments: Never had problems water level has always been high even when others well were Low

Thank You for Your Assistance

Residential Well Survey
Frontier Stone (Shelby, NY) Quarry Area

Name: Paul D. Luthart

Address: 5283 Sour Springs Rd. Medina

Resident at this Address Since: 6/?/88

Date House Built: 6/?/88

Location of Well Relative to Your House: Front yard

Driller Who Installed Your Well: Paul Bailey PH# 585-589-9254

Date of Well Installation: 5/?/88

Diameter of Well: 6"

Depth of Well: 36'

Does the Well have a Screen or is it Open-Hole: Open Hole

Type of Pump used in Well: ~~[illegible]~~ Submersible

Depth to Pump or Pump Intake in Well: 28'

Depth to Water: ~~[illegible]~~ 33'

Depth to Bedrock and Formation: ?

Has the Well ever Gone Dry? NO

Has the Well ever Lost Yield? NO

Has the Water ever had Problems with Turbidity/Discoloration? NO

Has the Water ever had any Problems with Chemistry/Taste? yes

Has the Water ever had any Problems with Bacteria? NO

Is a Water Treatment System in Place? yes

If so, What Type? Culligan water System

Would You Allow Us to Measure the Water Level in Your Well? yes.

Additional Comments: water is a little Bit on the Sulfer side.

Doug Bower of AlBEON Ny installed Pump.

Thank You for Your Assistance

March 28, 2007

HYDROGEOLOGIC INVESTIGATION OF THE PROPOSED FRONTIER STONE QUARRY, TOWN OF SHELBY, NEW YORK

Prepared for:

Continental Placer, Inc.
II Winners Circle
Albany, New York

December 19, 2012

ALPHA
GEOSCIENCE

ALPHA
GEOSCIENCE

Geology

Hydrology

Remediation

Water Supply

HYDROGEOLOGIC INVESTIGATION OF THE PROPOSED FRONTIER STONE QUARRY, TOWN OF SHELBY, NEW YORK

Prepared for:

Continental Placer, Inc.
II Winners Circle
Albany, New York

Prepared by:

Alpha Geoscience
679 Plank Road
Clifton Park, New York

December 19, 2012

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TABLES

FIGURES

APPENDICES

PLATES

1.0 INTRODUCTION

This report presents the results of a hydrogeologic investigation of the proposed Frontier Stone Quarry and surrounding area. The proposed quarry is located adjacent to the south side of Fletcher Chapel Road and to the north side of the National Grid property in the Town of Shelby, Orleans County, New York (Figure 1). The National Grid property is a 100 foot strip between the quarry property line and the Iroquois National Wildlife Refuge. This analysis was conducted at the request of Continental Placer, Inc. (CPI) of Albany, New York on behalf of Frontier Stone, LLC, who is the quarry applicant.

The primary objectives of this investigation were to assess the existing surface water and ground water systems and to interpret the impacts on those systems by the quarry at the end of Phase I and when it reaches its maximum vertical and lateral extent. The secondary objectives of the investigation were to assess the potential quarry impacts on local ground water resources (wells and springs) and surface water resources (primarily the Iroquois National Wildlife Refuge).

2.0 METHODS

The primary and secondary objectives were met through:

- a literature review,
- site reconnaissance,
- core analysis,
- a hydrogeologic analysis,
- a water budget analysis, and
- a water quality assessment

2.1 Literature Review

The literature reviewed during this analysis included the hydrogeologic portions of a Draft Environmental Impact Statement (DEIS) previously prepared and submitted by CPI (2008). The DEIS contains elevation, location and water level data for several on-site wells and two local water supply wells. The DEIS also contains the results of a residential well survey and water level data (water level drawdown data) for a 72-hour pumping test conducted by CPI in April of 2007.

Published literature on the geology and hydrogeology of the region was also reviewed in addition to the DEIS. This information includes the bedrock geologic map of New York (Rickard and Fisher, 1970), the surficial geologic map of New York (Cadwell, 1988), and the hydrogeology of the Lockport Formation (Johnston, 1964; Miller and Kappel, 1987). This geologic and hydrogeologic information provides the fundamental framework for the occurrence and movement of ground water in the quarry area. This information was supplemented by a review of the Orleans County soil survey (Higgins at al., 1977).

2.2 Site Reconnaissance

Reconnaissance of the site and surrounding area was conducted by Alpha Geoscience (Alpha) and CPI personnel on September 16, 2008. This reconnaissance included water level measurements in the on-site wells and two residential wells, an inspection and water level measurements in Oak Orchard Creek and in the National Iroquois Wildlife Refuge (Wildlife Refuge), and hand auguring of soils in the Wildlife Refuge. The reconnaissance activities also included measuring the elevation of off-site features by CPI using a Global Positioning System (GPS).

2.3 Core Analysis

The core was logged by Alpha to identify and record the presence of potential water bearing fractures. CPI logged the geology from the cores; consequently, a geologic description of the cores was not included as part of the logging by Alpha.

2.4 Hydrogeologic Analysis

The hydrogeologic analysis involved assessing the geologic and water level data to determine the relationship between the water table and bedrock aquifers and to create a regional ground water elevation contour map representing existing conditions. The ground water contour map was used to determine elevation and orientation of the piezometric surface in the bedrock beneath the site and surrounding area, to interpret the direction of ground water flow and to identify the local recharge and discharge areas for the bedrock aquifer. The core data were used to define the aquifer zone within bedrock and to define the lower limit of the aquifer.

The core data, CPI pumping test data and the regional ground water contour map of existing conditions were used to develop a ground water contour map that represents the bedrock piezometric conditions anticipated to exist when the quarry is at its maximum extent. This map of projected ground water elevations (piezometric surface) around the future quarry defines the extent of drawdown and the area that is projected to contribute ground water inflow to the quarry at the end of mining. This contour map, along with hydrogeologic cross sections, show the magnitude and extent of projected ground water level drawdown around the quarry at the end of mining. The ground water contours for future conditions (end of mining) also provided the basis for establishing ground water inflow rates for the intermediate condition at the end of Phase I.

2.5 Water Budget Analyses

The water budget analyses address the key issues of how surface water flow to the Wildlife Refuge will change as the quarry is developed. A water budget analysis representing existing conditions was conducted to determine the average annual surface water flow that reaches the wetlands from the contributing surface water basins.

A second water budget analysis was conducted to represent conditions when the quarry is at its maximum areal and vertical extent. This analysis was conducted to determine how the annual flow to the refuge is changed by removal of a portion of the surface water basins and replacing that loss with water that will be pumped from the quarry into the drainage network that feeds the refuge. This quarry water will consist of direct precipitation and ground water inflow. This second water budget entails determining the rates of direct precipitation and ground water inflow to the quarry.

A third water budget analysis was undertaken to represent the intermediate stage between existing conditions and the final stage. The end of Phase I was selected since the Phase I quarry will be used for storage to help control pumping rates as the quarry expands during subsequent phases. The Phase I water budget utilized the same approach as the end of mining analysis.

2.6 Water Quality Assessment

Water samples were collected from two of the site wells and from surface water at the site and Schoolhouse Marsh, which was identified as Marsh Creek on the analytical reports. These samples were analyzed for selected water quality parameters and the results were assessed for potential impacts to the surface water bodies receiving discharge from the mine.

3.0 RESULTS

3.1 Geology

The Lockport Dolomite is the unit that will be mined at the Frontier Stone Quarry. This unit is overlain by approximately 30 feet (ft) of unconsolidated glacial deposits at the site (see hydrogeologic logs in Appendix A). The glacial deposits at the quarry site and in the surrounding area consist of glaciolacustrine silt and clay; either a lodgement till or till moraine that contain a mixture of clay, silt, sand and boulders; and kame deposits composed of sand and gravel. The distribution of these deposits is shown on Plate 1. Plate 1 was modified from the published regional scale surficial geology map (Cadwell, 1988) by conducting a geomorphic analysis, reviewing the county soil survey (Higgins et al, 1977), and including contributions by Mr. John Hellert of CPI who has direct experience exploring for sand and gravel in the area.

Two soil probes were hand augered into the shallow subsurface near the wetlands in the Wildlife Refuge to check the mapped surficial geology in that critical area. The locations of the probes are indicated as GPS waypoints FS8 and FS13 on Plate 1, and the logs of those probes are provided in Appendix B. The probes encountered a varved silt and clay in the shallow subsurface. This confirmed that the glaciolacustrine unit shown on Plate 1 extends beneath the Wildlife Refuge and is expected to lie beneath the areas within the refuge that are identified as swamp deposits on the published surficial geology map (Cadwell, 1988).

The bedrock geology at the site is shown on cross section A-A' and B-B' (Plate 2), and the cross section locations are shown on Plate 1. The orientation of the bedrock units and depth of overburden were provided by CPI, and the overburden details and ground water data were added by Alpha. The cross sections show that the primary bedrock geological units consist of the

Lockport Formation underlain by the Rochester shale. The rock units strike N78°E with a dip of 0.44° (approximately 7.7 ft per 1000 ft (40.7 ft per mile)) to the southeast. A strike of N88°E and apparent dip of 0.42° SSE (approximately 7.4 ft per 1000 ft (39.1 ft/mile)) was calculated by Alpha while developing regional cross sections (see attachments A and B in Appendix C). The local dip provided by CPI and dip calculated by Alpha are consistent with a dip of 5.7 ft per 1000 ft (30 ft per mile) provided by Johnston (1964) for the region, which contains the site.

The closest outcrop of the Lockport Formation is in the bed of Oak Orchard Creek in the reach between stations FS4 and FS3, which are marked on Plate 1. The rock is blocky when weathered and has a well defined joint pattern with a primary set oriented N10°E and a secondary set oriented S70°E as measured at station FS3.

3.2 Hydrogeology

The primary objective of the investigation was met by first defining the existing hydrogeologic conditions. The existing hydrogeologic conditions establish the framework that dictates how the surface water and ground water hydrology will be affected by the mine.

3.2.1 Existing Hydrogeologic Conditions

The existing hydrogeologic conditions were established through an analysis of water level data, an analysis of the core log data, observations made during site reconnaissance and the review of the literature. The water level data are provided in Table 1, and additional data on well depths and casing stickups are provided on Table 2. The measuring point elevations on Table 1 for the wells were provided by CPI from a survey they conducted on October 27, 2008.

The water level data span the period from May 2005 through October 2008 and include six on-site wells, two off-site wells (Barn and Garage wells) and surface water features. The water levels in all of the wells represent the piezometric conditions in the bedrock. The Barn well lies in a vault below ground; consequently, could be subject to flooding. The lack of water in the vault during the measurements precludes any effects on water levels by surface water at the time the levels were measured.

A single round of surface water level measurements was made during the site reconnaissance on September 16, 2008 (Table 1). Additional surface water elevation data for the Wildlife Refuge were provided by Mr. Thomas Roster, Refuge Manager. These data are for Ringneck Marsh, Schoolhouse Marsh and Center Marsh. The marsh data are contained in Appendix D, and the marsh locations are identified on Plate 1.

3.2.1.1 Aquifers

The available data indicate that the hydrogeologic system can be subdivided into a shallow water table aquifer in the glacial overburden and a deeper, confined to semi-confined bedrock aquifer. Observations during site reconnaissance and review of the county soil survey (Higgins, 1977) indicate many of the soil types, particularly those overlying the glaciolacustrine deposits, have a seasonal high water table. The water table in these soil types often remains near the surface for long periods of time. Drainage ditches, which were observed during site reconnaissance are necessary to draw down the water table for cultivation. The hydrogeologic report by Johnston (1964) also confirms the local presence of an aquifer in the glacial deposits. Johnston reported two dug wells in the glacial till along Fletcher Chapel Road, approximately 2300 and 3700 ft from the northeast corner of the quarry, respectively.

The well data (Table 1) indicate that the water level in the rock is several feet below the land surface at all locations except for DH5-05 where the water was flowing over the top of the casing on several occasions. The casing at DH5-05 is 2.06 ft above ground. These results show that the bedrock aquifer is confined by the 30 ft thick glacial overburden. The data also show that the hydraulic pressures in the bedrock aquifer are artesian and at times are above the land surface at DH5-05.

The Lockport Formation is the bedrock aquifer at the site. Ground water in this unit, like most other layered bedrock aquifers, is contained within, and flows along, openings in the rock. The most common openings in the Lockport Formation consist of bedding plane joints, vertical joints and small cavities from which gypsum has been dissolved (Johnston, 1964). Johnston reports that the vertical fractures are generally concentrated in the top 10 to 15 ft of the rock, the gypsum dissolution cavities also disappear rapidly with depth, and the near-horizontal bedding plane fractures do not occur much below 100 ft.

According to Johnston (1964), the bedding plane partings are the dominant water bearing zone near Niagara Falls. All of the same water bearing/transmitting zones reported by Johnston are apparent in the rock cores from the site (Appendix A). The analysis of the site cores shows that the horizontal fractures are most common and are concentrated near the top of the rock. No indications of water bearing zones were observed in the cores below a depth that ranged between 56 and 89 ft. These results indicate that ground water storage and flow in the rock occurs near the top of the rock, and the base of the aquifer ranges between 56 and 89 ft below land surface.

3.2.1.2 Ground Water Flow

Ground water flow is from areas of high hydraulic pressure, which are typically recharge areas in the topographically higher terrain, to areas of low hydraulic pressure, which are typically at discharge areas in the topographically lower terrain. Contour maps of the ground water elevation data are effective tools for showing directions of ground water flow and identifying the recharge and discharge areas.

Ground water elevation (piezometric) contour maps were generated specifically for the on-site wells, the garage well and the barn well using the October 27, 2008 data. The barn well and garage well depths are not known, but they are assumed to be tapping the bedrock aquifer based on the drawdown influence from the pumping test of April 2007. These two wells likely penetrate the main productive bedrock fractures near the top of the rock.

Contouring of the October 27, 2008 data yielded two alternate solutions. Alternative A (Figure 2) results in north-south oriented low hydraulic pressure zone in the middle of the site with ground water flow to the south and Alternative B (Figure 3), which results in an east-west oriented trough with flow to the west. Alternative A makes more hydrogeologic sense due to the north-south oriented joint set measured at station FS3 and due to the observation that the flow direction follows the general topographic slope and bedrock dip toward potential discharge zones to the south.

A regional piezometric contour map of existing conditions was drawn based on the Alternative A model using the September 16, 2008 water level data (Plate 3). The map was developed using the surface water elevation data to aid in projecting (inferring) the ground water contours in the vicinity of the likely ground water discharge zones. The map shows the north-south low hydraulic pressure trough within the site and an overall ground water flow toward Oak Orchard Creek to the south. The map shows that the recharge areas are within the upland till moraine along Fletcher Chapel Road and within the kame sand and gravel deposits and till-covered highland areas north of Fletcher Chapel Road. Oak Orchard Creek to the south, west and northwest is the dominant zone of discharge. The map also shows that the ground water elevations are below the surface water elevations in the area of the Center Marsh, Schoolhouse Marsh and Ringneck Marsh. This indicates that those marshes are not sustained by ground water discharges from the bedrock aquifer.

Springs are another point of discharge for the aquifer system. Springs were investigated during the field reconnaissance and found to be relatively rare. The local road identified as Sour Spring Road (see Plate 3) implies the presence of a mineralized spring associated with a bedrock discharge. According to Mr. Chester Zelazny, who has lived in the area his entire life, mineralized water was encountered at location FS2, and a hotel was built to take advantage of the mineralized water. According to Mr. Zelazny, that well was the source of the Sour Spring Road name. The site of the hotel is still evident but the structures are no longer visible at the site.

The field reconnaissance also resulted in the discovery of two springs, which are located at stations FS5 and FS6 (Plate 1). These springs represent bedrock discharges from the aquifer system on the northwest side of Oak Orchard Creek. No springs were observed during reconnaissance in the Wildlife Refuge and no other private property was accessed; however, Mr. Zelazny is not aware of any other springs in the area. Johnston (1964) reported a spring emanating from a sandy glacial till on the west side of Oak Orchard Creek, approximately 1200 ft south of the FS4 location.

3.2.2 Future Hydrogeologic Conditions

The water levels (piezometric surface) in the bedrock aquifer will be drawn down adjacent to the quarry as it is developed, then return close to the original levels once mining is completed and the quarry fills with water. The greatest potential drawdown could occur when the quarry is at its maximum vertical and lateral extent. Knowledge of the existing hydrogeologic conditions was used to project the extent of this drawdown and to assess the changes to the hydrologic balance in the neighboring Wildlife Refuge.

The projected drawdown at the quarry face, as shown on Plate 2, is based on the knowledge of elevation of the base of aquifer around the quarry face and that a seepage face will form on the quarry wall up from the base of the aquifer. The base of the aquifer is defined as the depth of the deepest water bearing openings observed in the cores. The base of the aquifer was established on the quarry face by projecting the elevation of the deepest water bearing opening in each core to the closest part of the quarry face.

The extent of the seepage face up from the base of the aquifer is assumed to be one-third of the distance from the aquifer base to the existing piezometric surface (ground water elevation contours) shown on Plate 3. The calculations to determine the height of the seepage face are provided in Appendix E. A seepage face height of one third is considered conservative since actual seepage faces in the Lockport and other similar rocks are often one-half or greater. Figure 4 illustrates a seepage face in the Lockport Dolomite provided on the front cover of Mr. Johnston's publication (1964).

The projection of the ground water elevations outward from the seepage face into the surrounding region relies on the knowledge gained from the existing ground water contour map (Plate 3), the pumping test results, and drawdowns reported near the Niagara Power Project (Johnston 1964). These sources of information provide empirical data on the ground water pressure gradients that can be sustained around the quarry.

The gradients derived from the aquifer system, when stressed by drawdowns near the Niagara Power Project and during the on-site pumping test, have value in developing a sustainable drawdown curve. The stabilized drawdown near the excavation for the power project exhibited average gradients of 0.017 ft/ft (Johnston, 1964). Steeper gradients, which appear to be as high as 0.053 ft/ft, were mapped in some local areas by Miller and Kappel (1987) adjacent to the Niagara Power Project. A slightly lower maximum gradient of 0.0077 ft/ft occurred during the on-site pumping test as illustrated on a contour map of the water level elevation at the end of the April 2007 pumping test (Figure 5).

The projected piezometric surface around the Quarry was drawn under the assumption that the slightly steeper gradient of 0.017 ft/ft can be sustained in the first few hundred feet adjacent to the quarry and level out to the flatter gradients at further distances from the quarry. The resulting drawdown is shown on both Plate 2 and Plate 4. Both the existing and future elevations of the piezometric surface are shown on the cross sections (Plate 2).

The piezometric surface will return close to the existing elevation after mining is completed and the quarry fills with water to form two lakes. The water levels in the lakes are anticipated to be at an approximate elevation of 625 ft with a fluctuation of ± 2.0 ft. These estimated lake levels and fluctuations are based on average water levels from the monitoring wells within the quarry footprint for the monitoring periods from April 2007 through October 2008 (water level data is included in Table 1). These measurements include both the seasonal high and low levels.

3.3 Water Budget Analyses

The proposed Frontier Stone quarry lies within the surface water drainage system that contributes to the Wildlife Refuge. The quarry excavation will reduce the amount of direct runoff by catching all the direct precipitation that falls in the quarry excavation; however, the direct precipitation and ground water that enters the quarry will be pumped out to the drainage system that feeds into the Wildlife Refuge. The purpose of the water budget analyses is to quantify the net change in water contribution to the Wildlife Refuge so that the relative impacts can be assessed and impact mitigation strategies, as necessary, can be developed.

The water budget analyses were developed by first defining the existing surface water drainage basins that contain the quarry site. The average annual runoff for these existing basins was estimated to develop a baseline of current flow conditions. The baseline provides the basis for assessing the net change that will be brought about by quarrying. A second water budget was undertaken to assess the relative impacts to neighboring surface water bodies for the worst case condition, which is represented by the quarry at the end of the life of the mine when the quarry is at its maximum areal and vertical extent. This water budget is based on the assumption that all the water entering the quarry through precipitation (minus evaporation) and ground water inflow must be discharged.

A third water budget was undertaken to represent conditions at the end of Phase 1. This analysis was undertaken due to the plan to minimize the impacts from the final mine dimensions by using the Phase 1 quarry to store water during the subsequent phases. This storage will allow the operator to reduce and spread out the pumping discharge in a manner that relieves downstream impacts. The Phase 1 impacts to surface water were evaluated due to the potential that the impacts at the end of this phase may represent the maximum effects on surface water.

3.3.1 Analysis of Runoff Rates from Existing Drainage Basins

The proposed quarry straddles two surface water drainage basins, which are identified as Basin 1 and Basin 2 on Figure 6. Basin 1 contains most of the quarry site and drains into Schoolhouse Marsh by flow in an agricultural ditch across the site and through a ditch and culvert within the adjacent National Grid property. Basin 2 encompasses the eastern limit of the quarry site and drains into Center Marsh. The basin outlines were established by an initial topographic review by Alpha with subsequent modifications adapted from field confirmation by TES in the summer of 2010 and subsequent adjustments by CPI during the storm runoff analysis (HydroCad).

Average runoff rates, in gallons per minute (gpm), were calculated for each basin. These runoff rates are determined by assigning a runoff coefficient for each soil type within each respective basin, multiplying that coefficient by the average annual precipitation and multiplying the total area covered by each respective soil type. The runoff coefficients are a product of soil characteristics, topographic slope and land use (Landphair and Motloch, 1985). The average annual rainfall was derived from the closest National Oceanic and Atmospheric Administration (NOAA) weather monitoring station that provides average annual rainfall and monthly temperature. The nearest station is at Albion, which is 9.5 miles to the northeast of the site. The data from the Albion station are provided on Table 3.

The contribution to each basin from the surface water bodies, which include the two named marshes, is equivalent to direct precipitation minus direct evaporation. Direct evaporation for the area is approximately 26.8 inches (Linsley et al, 1982). This leaves a net runoff equivalent of 8.98 inches for the water bodies.

The soil types, individual runoff coefficients, soil areas and calculated runoff rates are provided on Table 4. These results show that Basin 1 consists of 403.3 acres and is anticipated to have an average runoff rate of 185.33 gpm. Basin 2 occupies 463.2 acres and has an estimated average runoff rate of 190.19 gpm.

3.3.2 Water Budget Analysis – Future Conditions at Maximum Quarry Size

3.3.2.1 Surface Drainage System at Maximum Quarry Size

The future surface water drainage system will be modified by excavating two quarries, as shown on the figures and plates, with a combined total area of 213.7 acres that lie in portions of Basins 1 and 2. These excavations effectively remove portions of surface water runoff from both basins; however, the direct precipitation to the quarry and the ground water inflow to the quarry will be pumped out of the active quarry areas. The net effect on the water balance is that Basin 2 will simply be reduced by removal of some of the soil areas, while Basin 1 will include the addition of the quarry precipitation and ground water inflow, as well as a reduction of surface water runoff from the excavated area.

Mining of the eastern quarry (Phase 2) will commence after completion of Phase 1 in the western quarry. The Phase 1 quarry will be used as a water storage reservoir for water pumped from Phases 2, 3 and 4. Water will be pumped from the western quarry to surface water Basin 1 as needed and in a controlled manner; however, this water budget analysis for the full quarry size was conducted under the conservative assumption that all of the incoming water to both quarries must be removed.

The revised surface water drainage basin configurations are shown on Figure 7, and the water budget analysis results are provided on Tables 5 and 6. The estimate of the volume of quarry discharge is subdivided into the contribution from direct precipitation and the contribution from ground water inflow. The calculation of direct precipitation is relatively simple and is equivalent to precipitation minus evaporation. The estimate of ground water inflow is much more complex and requires a more complex water budget analysis.

3.3.2.2 Future Ground Water Inflow to the Mine at the Maximum Quarry Size

The water budget analysis for ground water inflow is predicated on the concept that the rate of ground water inflow within the zone of ground water contribution around the quarry must be in balance with the rate of recharge within the zone of contribution. The zone of contribution is marked on Plate 4. Recharge to the bedrock from areas where the overburden is glaciolacustrine is limited by the low vertical hydraulic conductivity of that glacial unit. The recharge rates to the bedrock, where the soils are underlain by more permeable sand and gravel deposits and glacial till, are controlled by the combined effects of runoff and evapotranspiration. Recharge for these more permeable units must be equal to direct precipitation minus both runoff and evapotranspiration. Evapotranspiration is the combination of direct evaporation from the land surface and plant transpiration.

The first step in this water budget analysis was to determine the land area where glaciolacustrine silt and clay is the predominant deposit overlying the bedrock aquifer. This is important because the low, vertical, hydraulic conductivity of the silt and clay, at depth, limits ground water recharge to the underlying bedrock aquifer. The area covered by glaciolacustrine silt and clay, within the future ground water recharge area for the proposed mine, was determined by using the regional surficial geology map, the Orleans County Soil Survey (Soil Survey), soil boring data, geomorphology, and topography. Plate 1 shows the area interpreted to be dominated by silty and clayey glaciolacustrine deposits within the future zone of ground water contribution.

Recharge in the areas where bedrock is overlain by glaciolacustrine silt and clay is governed by the equation $Q = KiA$, where Q is the discharge rate in ft^3/minute, K is the vertical hydraulic conductivity in ft/min, i is the vertical gradient in ft/ft, and A is cross sectional area in ft^2. A typical vertical K value for glaciolacustrine silt and clay is 2.0 x 10^{-8} ft/min (1.0 x 10^{-8} cm/sec). The gradient is anticipated to range from 1.0 ft/ft where ground water has been drawn below the top of the rock (base of the glaciolacustrine overburden) to less than 0.1 ft/ft at the limits where ground water drawdown from the quarry is at a minimum. A value of 0.6 ft/ft is assumed to be representative. The value for area (A) is assumed to be unity (1.0 ft^2) to get a recharge per unit area of 1.2 x 10^{-8} ft^3/min, which is equivalent to 8.8 x 10^{-8} gpm per ft^2. This rate was applied in Table 5 to the total area covered by glaciolacustrine silt and clay deposits.

The water budget analysis was then used to determine the amount of ground water inflow to the mine from the remaining areas not described as glaciolacustrine silt and clay. This was done by grouping the many soil types within the remaining ground water recharge area into soil associations as defined in the Soil Survey. The Soil Survey contains a general soil map of the soil associations within the County and defines a soil association as "a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils of one association may occur in another, but in a different pattern." The general soil map is a useful guide in managing a watershed as it pares down the multitude of soils into a manageable number of soil associations.

Alpha prepared a local map of the soil associations within the ground water recharge area (Figure 8). The map is based on the general soil map in the Soil Survey, with modifications based on local topography, detailed mapping in the Soil Survey, and local knowledge of the soils based on drilling. Most of the soils that are described as having formed in silty or clayey glaciolacustrine sediments were grouped together as "glaciolacustrine" and assigned the previously described recharge rate. The soil associations formed in glacial till may also include some areas of glaciolacustrine silt and clay at the edge of the mapped areas, where the silty or clayey soil cover is thin and overlies glacial till.

Soil properties, such as the runoff coefficient and soil moisture storage, were assigned to each of the soil associations on Figure 8. The values represent weighted averages of the properties for each soil type belonging to the association. The weighted averages are based on the sums of the individual soil areas that comprise each association within the future ground water recharge area to the mine.

Detailed water budget analyses were performed on each soil association. These analyses, which are provided in Appendix F, are based on the premise that soil moisture requirements must be satisfied before recharge to ground water can occur. The net effect is that most recharge occurs when plants are dormant and temperatures are lower so that evapotranspiration no longer creates a negative soil moisture value. A summary of the recharge for the various soil types is provided on Table 5 along with the percolation through the glaciolacustrine and the water body contribution. The resulting percolation rates range between 5.75 and 8.74 inches per year. The percolation rates for most of the area that is not above glaciolacustrine deposits are consistent with percolation (recharge) rates of between 5 and 6 inches per year estimated for the area near the Niagara Power Project (Miller and Kappel, 1987).

The total volume of ground water inflow to the proposed quarry at its maximum extent is estimated to enter at an average rate of 770.98 gpm (Table 5). This ground water inflow, combined with a direct precipitation of 395.0 gpm and removal by evaporation at a rate of 177.70 gpm, yields an annualized average pumping rate of 988.28 gpm (Table 6). Combining this quarry pumping rate with the remaining surface water drainage area outside of the quarry (95.25 gpm) results in a total, potential, future flow through Basin 1 of 1083.53 gpm (Table 6). This flow is 898.20 gpm greater than the existing flow of 185.33 gpm.

Basin 2 will yield an average surface water flow of 179.75 gpm (Table 6). This represents a reduction of 10.44 gpm from the existing condition. These flows provided by Basin 1 and 2 represent average flows that are based on total annual average flows; however, actual inflow to the quarry will vary seasonally and during storm events.

3.3.3 Water Budget Analysis – Future Phase 1 Condition

The water budget analysis for Phase 1 represents the point in mining where the Phase 1 quarry has reached its maximum size (11.6 acres) and depth. The relatively small footprint of the Phase 1 quarry lies entirely within Basin 1, (Figure 9); consequently, there will be no impact to surface water flow through Basin 2. The smaller size of the quarry will also draw ground water from a much smaller area as shown on Figure 10.

The Phase 1 water budget analysis resulted in an average ground water inflow rate of 251.04 gpm into the quarry (Table 7). This ground water inflow combined with a direct precipitation of 21.44 gpm and removal by evaporation at a rate of 8.03 gpm yield an annualized average pumping rate of 264.45 gpm (Table 8). Combining this quarry pumping rate with the remaining surface water drainage area outside of the quarry (180.55 gpm) results in a total, potential, future Phase 1 flow of 445.00 gpm through Basin 1 (Table 8). This flow is 259.67 gpm greater than the existing flow of 185.33 gpm.

The forgoing Phase I quarry ground water inflow rate of 251.04 gpm is an average annual rate. The actual inflows will vary seasonally with the highest is the spring and the lowest in the late summer. The maximum inflow is anticipated to occur in March.

The maximum quarry discharge from Phase I is estimated to be approximately 385.6 gallons per minute (gpm) (see Water Budget Summary Table (Table 9) for comparisons with average annual and monthly specific discharge rates). This estimated maximum is derived for March of the last year of Phase I mining. The estimate is based on the plan to pump continuously throughout the year (including the winter months) and under the assumption that all the precipitation during December, January and February will accumulate as a snow pack that is assumed to melt during the month of March. This spring snow melt would be pumped out of the quarry along with the direct precipitation and ground water inflow during the month. It is also assumed that there will be no evaporation in March. The assumption of accumulated snow pack and lack of evaporation results in a conservatively high discharge rate since snow melt and evaporation (sublimination) will occur during the winter months. The calculation of the components (snowmelt, direct precipitation, and ground water inflow) that comprise the maximum discharge rate is explained in the following paragraphs.

The average precipitation for the months of December, January and February is 3.14, 2.64 and 2.07 inches, respectively (Table 3). These monthly totals are the rainfall equivalents of the snow that is assumed will accumulate in the quarry. These average values are 30-year averages for the period for 1971 to 2000. The total accumulated precipitation equivalent of 7.85 inches (December through February) in the 11.6 acre Phase I quarry would require an average pumping rate of 55.4 gpm if completely discharged in March.

The direct precipitation for the month of March is assumed to be the normal monthly rainfall of 2.8 inches. This is also from the Albion 2 NE station (Table 3). A March rainfall of 2.8 inches into the 11.6 acre quarry, without evaporation, equates to a rate of 19.8 gpm (see Water Budget Summary Table (Table 9) for comparisons).

Ground water inflow for the year enters the Phase I quarry at an average rate of 251.04 gpm for a total accumulation of 131,946,624 gallons. It is anticipated that the flow will actually be uneven with a greater percentage in the spring months and much less during the late summer. It is anticipated that 10.5% (13,854,395.5 gallons) will enter the quarry in March. This is based on more than a year's worth of monthly spring flow (ground water discharge) measurements that Alpha conducted on springs at another location in New York. A ground water inflow of 13,854,395.5 gallons in March equates to an average March discharge rate of 310.4 gpm (Table 9).

The total average pumping rate for March is conservatively anticipated to be equivalent to the combined snow melt (55.4 gpm) direct precipitation (19.8 gpm), and ground water inflow (310.4 gpm). The addition of these rates yields an average quarry discharge rate of 385.6 gpm. This average March discharge represents the maximum rate for the Phase I quarry.

3.4 Water Quality Assessment

Water samples were collected by CPI from two on-site wells, one on-site surface water body and from Schoolhouse Marsh (also identified as Marsh Creek). One of the well samples was collected from the discharge hose connected to the Barn well (see Figure 2 for well locations). Another well sample was taken from the discharge from flowing artesian well DH5-05. The on-site surface water sample was collected from the drainage ditch (Zelazny Field) crossing the site. The "Marsh Creek" sample was collected from Schoolhouse Marsh at a location on the upstream side of the Wier at the dike. These samples were collected in 2010 on the dates provided on Table 10. Both ground water samples were submitted to Adirondack Environmental Services for analysis of the parameters provided on Table 10. The surface water samples were submitted to Test America for analysis of the parameters indicated on Table 10.

The analytical results, which are summarized on Table 10 and included in Appendix G, show that the ground water is suitable for potable purposes, though some parameters indicate aesthetic issues. For example, iron in the deep well (DH5-05) is slightly above the New York State drinking water standard. The iron standard of 0.3 mg/L has been set due to the staining that 0.3 mg/L and higher can cause to household fixtures. The level of 0.351 mg/L in the deep well is exceeded by both surface water samples.

The total dissolved solids (TDS) in the Barn well was at 652 mg/L, which is slightly above the EPA standard of 500 mg/L. There is no drinking water standard for TDS in New York. A value of 652 is also an aesthetic value that is tied to taste, but does not pose a threat to the environment. All the rest of the parameters, including sulfate, are well within the drinking water standards and pose no environmental threat to surface water or the refuge.

4.0 DISCUSSION OF POTENTIAL IMPACTS AND MITIGATION

4.1 Ground Water Drawdown Impacts and Mitigation

The hydrogeologic analysis indicates that measurable drawdown in the bedrock aquifer (Lockport Dolomite) could extend as far as 7,000 ft from the quarry face, and that discharges to surface water flowing into the adjacent Wildlife Refuge through Basin 1 could be increased to approximately 1083.53 gpm from the current 185.33 gpm when the quarry is at its maximum areal and vertical extent. These estimated drawdown and discharge values are conservatively high and are greater than impacts observed at similar quarries within the Lockport Formation elsewhere in New York. It is our opinion that the actual extent of drawdown around the proposed Frontier Stone Quarry and the ground water inflows at the proposed quarry will be less than projected in this report. The basis for this opinion is discussed more fully in the following paragraphs.

The projected drawdown out to 7,000 ft from the Frontier Stone quarry could affect private bedrock wells along Fletcher Chapel Road, Sour Spring Road and Southwood Road. The water level drawdown analysis shows that water levels in the Lockport could be drawn down below the top of the rock at distances of between 2100 and 4800 ft from the quarry limit when the quarry has reached its maximum extent. These projected maximum drawdowns are illustrated on Plate 2. This maximum represents a theoretical condition when all phases have been mined and no water is retained in any of the phases. This is an extreme condition that will never occur since the initial phases will be allowed to fill with water before completion of the final phase. The water retained in the quarry phases will raise the water levels in the adjacent aquifer system; consequently, the maximum projected drawdown impacts will never occur.

Regardless of the fact that the maximum projected drawdown will not occur, an analysis was provided to show maximum impacts if the quarry was dewatered when all phases have been quarried. The drawdown analysis provided on Plate 2 in the Alpha report shows that the drawdown is essentially zero at 7000 ft from the quarry face. The drawdown is anticipated to be less than 1.0 ft at Route 63 at a distance of 6,000 ft. This shows that there will be no impact to the wells along Route 63.

The areas of highest potential impact are concentrated near the mine perimeter within the area that is essentially defined by Sour Spring Road, the southern end of Edwards Road, the southern end of Bigford Road, Southward Road and Fletcher Chapel Road. The section of Fletcher Chapel Road of interest extends westward 1000 ft from the intersection with Sour Spring Road and 1500 ft east of the intersection with Southward Road. Figure 11 shows the previously described roads and the location of residential streets and wells that were investigated by Continental Placer, Inc. (CPI). The maximum drawdown will occur along Fletcher Chapel Road, adjacent to the mine, where water levels could decline approximately 40 ft. This should not be considered an impact to these residents, or for any residents along Fletcher Chapel, since a municipal water line extends along Fletcher Chapel Road.

The locations of greatest potential concern are for the residents along Sour Spring Road, which are identified as well numbers 16 and 17 on Figure 11. Well Nos. 16 and 17 could experience maximum drawdowns of 33 and 26 ft, respectively. It is unlikely that this maximum potential impact will ever occur since the relatively small Phase I quarry is located closest to those residents. This part of the quarry will be used to store water while the rest of the quarry is expanded. This approach will minimize drawdown during mining of subsequent phases.

The well on Southward Road, which is No. 19 on Figure 11, could experience a maximum mine related drawdown of 34 ft. This well has the greatest chance to experience impacts due to dewatering of the eastern phases of quarrying. Maximum drawdowns of 25 ft are anticipated as worst case impacts at the southern end of Edwards and Bigford Roads. These impacts along Southward, Edwards and Bigford Roads, along with the wells on Sour Spring Road, will need to be monitored and mitigated if the water supplies are compromised. A monitoring plan will be prepared to provide early warning of drawdown near these existing wells. The plan will include a well survey to obtain information about wells in potential impact areas; however, these surveys are dependent on cooperation from each well owner.

A recent publication by the U.S. Geological Survey (USGS) (Kappel and Jennings; 2012) provides sufficient supplemental information to assess potential impacts to the Oak Orchard Acid Springs. Although the exact locations of the Oak Orchard Acid Springs were not provided by the USGS, they revealed that the springs are in the eastern half of the refuge near Oak Orchard Creek, and the water quality from the springs is relatable to the shales of the Salina Group.

The location of the springs near Oak Orchard Creek, within the eastern half of the refuge, places the springs within the discharge zone of the bedrock aquifer system. The discharge zone interpretation is consistent with the analyses by both Alpha and the USGS. The assessment by the USGS that the water quality indicates a Salina shale source is also consistent with the springs being in the vicinity of the creek. A north-south cross section (see Section A-A' on Attachments A and B in Appendix C) shows that the basal portion of the Salina Group underlies the area occupied by Oak Orchard Creek. If the Acid Springs are on the south side of the creek, such as near USGS hole GS-286 (see Cross Sections in Appendix C), then there would be nearly 30 feet of the Salina Group above the Lockport Group.

The regional geologic cross sections represented on Attachment A (Appendix C) were derived from a combination of oil and gas well data (wells 5008, 5117, and 4730), USGS wells (OL-37, OL-42 and GS-286), and site wells (DH 2-05 and DH 5-05). The oil and gas well data are available in a publication by Van Tyne and Jorgensen, (1972). The USGS well data are provided in Kappel and Jennings (2012).

The thickness of the Lockport Group provided on the north-south section (A-A' in Appendix C) is based on a thickness of 155 feet derived from well 5117. None of the other available well data provided a complete section; however, a thickness of 155 is consistent with observations by CPI in their work in the region and is consistent with the general thickness that can be approximated from the outcrop. An apparent dip of 0.42° (7.4 ft/1000 ft) and strike of N 88'E were calculated by correlating the base of the Lockport Group between wells 5117, GS-286 and DH 5-05. The result is similar to the east-west (N90° E) strike and dip to the south at 0.351° derived from the elevation of the contact between the Gasport and Decew Formations at wells 2-05 (498.0 ft amsl), 4-05 (503.34 ft amsl) and 5-05 (493.76 ft amsl) provided by CPI. This contact at the base of the Gasport is a sharper, more well defined contact than the base of the Lockport Group.

The north-south cross section (A-A' in Appendix C) shows that there are approximately 35 ft of the Salina Group rock above the Lockport Group at the GS-286 well location. This projection from the cross section is consistent with the gamma log for GS-286 in the Kappel and Jennings (2012) publication that shows a similar thickness of apparent shaley material in the upper part of a unit identified in the USGS report as the Guelph Formation. It is also consistent with the Bedrock Geology of New York State – Niagara Sheet, which indicates Oak Orchard Creek, near well GS-286, is underlain by Salina Group shale. The reassignment of the upper part of the rock to the Salina Group at GS-286 is also consistent with the observation that the USGS has an interpreted thickness of more than 170 ft at GS-286 for the Lockport. This is thicker than the typical Lockport Group in the area.

The sulfide and other constituents contained in the Acid Springs are also consistent with water coming from the Vernon Formation and overlying Syracuse Formation of the lower part of the Salina Group. The USGS suggests the source is pyrite; however, the ubiquitous anhydrite within the Salina Group is a more likely source. Ground water flow on the south side of the creek is upward through the Salina Group and toward the discharge zones along the creek, and; likewise, the flow on the north side of the creek is upward primarily through the Lockport and toward the discharge zones along the creek. The worst case drawdown analysis completed by Alpha for the proposed quarry shows that the quarry induced drawdown will not extend to the discharge zones along Oak Orchard Creek. The use of the initial phases of the quarry for water storage during the later phases will prevent the drawdown from reaching the Acid Springs even under the worst case derived from the pumping test. It is apparent that there will be no drawdown impacts or disruption of flow from the ground water flow system associated with the acid springs.

The relative significance of projected impacts is addressed by a survey of wells within 4,000 ft of the center of the proposed quarry that was conducted by CPI and presented in the DEIS (2008). Those results are summarized on Table 11 and the well locations are shown on Figure 11. The survey revealed that several of the residences along Fletcher Chapel Road have wells; however, a municipal water line also exists along the road; and many of the residences, even those with wells, are connected to the system. A few wells are also located along Sour Spring Road and Southwood Road.

The potential impacts to the wells along Sour Spring and Southwood Roads will be tracked during mining by a ground water monitoring program that will be initiated at the start of mining. The program will consist of measuring water levels in existing site monitoring wells PW-1, MW-1, DH1-05, DH4-05, the Barn well, the Garage well, and four sets of new monitoring wells. Previous wells DH 2-05, 3-05 and 5-05 and OB DH either no longer exist or will be destroyed during initial mining in Phase I.

Each of the four new monitoring well sets will consist of a shallow overburden well set above the top of the rock and a deep well (approximately 150 ft deep) in the rock. The shallow well will be constructed by setting a 10 foot screen at the base of the overburden and casing to the land surface. The deep well will be cased to the top of the rock and left as an open rock hole to 150 ft. The well sets will be placed between the property line and quarry limit at locations between the quarry and residential wells of concern. One of these will be in the southwest corner of Phase I to address the residential wells identified as 16 and 17 on Alpha Figure 11. Another set will be placed in the northwest corner to address wells at the southern end of Edwards Road. A third set will be placed in the northeast corner to address wells at the southern end of Bigford Road. The fourth set will be east of previous well DH 2-05 to address the residential well on Southward Road that is identified as No. 19 on Figure 11. There will be no need to install the northeastern and eastern well sets until mining commences in the phases east of the power line. The existing wells will be sufficient until that time. The locations of all new monitoring wells will be submitted for review and approval by the NYSDEC prior to installation.

Ground water monitoring will consist of measuring water levels every two months during the first two years of mining. The frequency will be reduced to quarterly thereafter. Annual monitoring reports will be submitted to the NYSDEC at the end of each calendar year for five years. Reporting will cease after five years; however, the applicant will maintain a database of quarterly measurements throughout the life of the mine.

A well mitigation agreement has been provided by the applicant to address those wells that are impacted by mining. The resolution of impacts along Fletcher Chapel Road can be resolved quite easily by connecting the impacted residences to the municipal water supply. Other solutions, such as deepening wells, may be applicable if residents along Southwood Road and Sour Spring Road experience a mine related loss of water. Drawdowns may be experienced along Tibbits Road; however, those drawdowns should not drop the water below the overlying confining layer, and a sufficient quantity of water is expected to be available to wells.

Portions of the Wildlife Refuge also overlie sections of the bedrock aquifer that may experience ground water level drawdowns. The overlying portions of the refuge include Schoolhouse Marsh, Center Marsh, and a portion of Ringneck Marsh. The hydrogeologic analysis shows that this drawdown will have no impact on these marshes or any other area within the Wildlife Refuge due to the thick, low permeability, glaciolacustrine silt and clay overlying the bedrock. This lack of anticipated impact is supported by the observation that the existing water levels (hydraulic pressures) in the bedrock are below the water levels in the marshes, which are likely coincident with the shallow water table described in the soil survey. The lack of detrimental drawdown impacts under the current conditions is due to the very low percolation rates through the low-permeability silty and clayey glaciolacustrine deposits that effectively perch the wetlands at the land surface.

4.2 Surface Water Impacts and Mitigation

An initial water budget analysis was conducted for the maximum quarry size to assess the potential impacts to surface water if no mitigation was undertaken to control quarry discharge rates. This analysis for the full development yields a small reduction of 10.44 gpm of flow through Basin 2 and an increase of 898.20 gpm (increase from 185.33 gpm to 1083.53 gpm) of flow through Basin 1. These changes will be mitigated by using the Phase 1 quarry for storage and to control pumping discharge rates; consequently, it may be more reasonable to assess the potential impact from discharge when the Phase 1 quarry is at its maximum size, prior to its use for water storage.

An analysis of the water budget for the Phase 1 quarry at its maximum size yielded no change to Basin 2, since the Phase 1 quarry is contained entirely within Basin 1. The mining of the Phase 1 quarry is calculated to result in an increase of 259.67 gpm through Basin 1 (ground water plus precipitation). This is an increase from the existing flow through of 185.33 gpm to 445.0 gpm.

The water budget analyses provide average annual discharges in gallons per minute; however, the historical runoff from the site to the refuge varies seasonally and as the result of individual storm events. The maximum discharge to the agricultural ditch within the mine site will occur toward the end of Phase 1 due to the need to maintain a dry quarry. The discharge will be less thereafter due to the ability to use Phase 1 and the subsequent completed phases for water storage.

The average annual discharge from the Phase I quarry (264.45 gpm) includes 251.04 gpm of ground water inflow plus 8.03 from direct precipitation. The ground water inflow rate of 251 gpm represents an annual average ground water discharge based on a water budget derived from average monthly rainfall from the nearby Albion 2 NE NOAA weather monitoring station. The actual monthly discharges during Phase I will vary seasonally with the highest in March and the lowest in September (see Table 9 for comparisons). The average discharge from ground water in March, toward the end of Phase I mining, is anticipated to be approximately 310.4 gpm. The average ground water discharge of Phase I in September is projected to be approximately 183.3 gpm. The long-term ground water discharge during these months will be less than 310.4 gpm due to the flow reducing effects of using the completed quarry phases for water storage

The potential impact of this discharge to downstream receptors only needs to be addressed for Basin 1, since there will be no changes to flow in Basin 2 during Phase I. The existing, average discharge from Basin 1 is 185.33 gpm (see Table 4). The average Basin 1 runoff coefficient is approximately 0.25 when the entire 403.3 acres of various soil types and open water bodies are considered together. The runoff from the meltdown of the accumulated winter snow pack combined with March rainfall yields 2.66 inches for Basin 1 using the 0.25 runoff coefficient. This yields an existing average March runoff rate of 653.13 gpm for the basin.

The reduction of Basin 1 from 403.3 acre to 391.7 acres by creation of the Phase I quarry will reduce the March runoff from the undisturbed Basin 1 to 633.75 gpm. The total future maximum flow from Basin 1 is projected to be 1019.35 gpm (combined 385.6 gpm discharge from the quarry and the 633.75 gpm runoff from the undisturbed portion of Basin 1). The 1019.35 gpm rate is 366.22 gpm greater than the existing discharge rate through Basin 1 for the period of maximum discharge.

September is the month when water levels are at their seasonal low and the associated inflow to the quarry will be at a minimum. The average quarry pumping rate in September, at the end of Phase 1, is anticipated to be 197.34 gpm. This discharge rate is based on a ground water inflow rate of 183.26 gpm, direct precipitation of 27.2 gpm, and evaporation of 13.12 gpm. The ground water inflow rate is estimated from spring flow measurements made by Alpha at another site in New York that yielded 6% of the annual flow during September. The average September precipitation is 3.73 inches, and the average evaporation rate is estimated to be 1.8 inches. This evaporation rate for September is equivalent to 6.8% of the annual quarry floor evaporation rate of 13.4 inches per year used in Table 8. The 6.8% figure comes from monthly pan evaporation data provided for Aurora, New York (Farnsworth, et al., 1982).

The Hydro CAD analysis conducted by Continental Placer Inc. and provided in the DEIS has shown that natural storm events in the existing drainage basin produce runoff that, without the quarry, ranges from 4,331 gpm for a 2-year storm event to 65,130 gpm for a 25-year storm event. These variations will not change as a result of the project. Runoff and precipitation/snowmelt, which are captured by the quarry, can be returned to the agricultural drainage ditch and directed toward the refuge as it always has done. The only impact to runoff as the result of the project will be the addition of the ground water inflow to the quarry. At maximum build out of Phase 1, this annualized, average ground water addition is only 251 gpm.

The average ground water inflow of 251 gpm with expected seasonal variations is very small when compared to the natural storm water runoff values of 4,331 gpm and 65,130 gpm for the 2-year and 25-year storm events, respectively. This small addition of ground water to natural drainage can be attenuated by controlled retention within the quarry and (or) in adjacent proposed ponds. The actual volume of retention and related need for discharge could be reduced if the quarry site owner uses the retained water for irrigation of agricultural fields during the dry season. Thus the ground water impact to natural drainage can be minimized even using maximum build out figures. Drainage from subsequent mine phases can be controlled as desired by using the mined out Phase 1 as an immense retention area. The water also can be held in the quarry during seasonal periods as needed to maintain desirable hydraulic conditions in the marsh habitats. The retention of water in the western quarry may also reduce potential drawdown to the west.

The idea of using the initial phases to store water and reduce pumping rates is an effective plan because it allows the opportunity to pump at uniform rates, it reduces the ground water inflow rates by reducing the effective size of the dewatered portion of the quarry, it diminishes the ground water drawdown effects on the surrounding aquifers, and it reduces the total dissolved solids (TDS) content of the discharge water. The plan would be to maintain pumping at 250 gpm after completion of Phase 1. The Phase 1 quarry will slowly accumulate water. The rate of ground water inflow will decline slowly and evaporation will increase gradually in the Phase I quarry while the contribution from Phase II will increase slowly from near zero as it is quarried. Pumping from the Phase I and Phase II quarry at a rate of 250 gpm will provide excess capacity when large precipitation events require the transfer of large volumes from the Phase II area to the Phase I quarry. The maintenance of a continuous pumping rate of 250 gpm throughout the life of the mine should be sufficient to maintain the excess capacity necessary to store storm events and slow the rate of quarry filling.

The aforementioned potential drawdown and quarry discharge estimates for the maximum quarry size, and even for the Phase1 quarry size, are considered to be an extreme, worse-case scenario that is not consistent with observed conditions at other quarries and excavations into the Lockport Formation. The water level drawdowns around most quarries develop steeper gradients that are more comparable the 0.053 ft/ft indicated on the piezometric mapping in the Lockport Dolomite by Miller and Kappel (1987), and the drawdown influences are generally less than 0.5 miles out from the quarry face as observed by Miller and Kappel for the Niagara Power Project. The drawdown around quarries in the same formation have exhibited similar limited impacts. For example, the drawdown at the Shelby Crushed Stone quarry has not shown drawdown in a monitoring well approximately 50 ft from the quarry face (CPI, 2008). The Clarendon Quarry, approximately 13 miles east of the site, is another example where minimal impacts have occurred in a well approximately 500 ft from an existing quarry (CPI, 2008).

The discharge rates are also considered to represent a worse-case scenario due to the fact that a smaller extent in the drawdown around the quarry will result in a smaller area of ground water capture (area of ground water contribution). The area of ground water drawdown and the ground water capture zone may also be further reduced when the western excavation is being used as a storage reservoir. This usage will maintain the ground water levels along the western edge of the quarry at high levels; consequently, the total drawdown, gradients and inflow from the western side will be reduced.

5.0 CONCLUSIONS

This hydrogeologic investigation was conducted on behalf of Frontier Stone, LLC to address potential impacts to ground water and surface water resources by the development of the Frontier Stone Quarry in the Town of Shelby, Orleans County, New York. The investigation was performed by conducting reconnaissance of the site, surrounding area and the Iroquois National Wildlife Refuge; analyzing rock cores; measuring water levels in on-site wells and at nearby surface water bodies; interpreting the existing piezometric surface (bedrock water levels); projecting the changes in the piezometric surface (water level drawdowns) as the result of mining; and assessing the changes between the existing and future water budget for the mine site and surrounding area as the result of the creation of the mine excavation. The following are the conclusions from this analysis.

- The aquifer system consists of a shallow water table aquifer in the glacial overburden and a deeper semi-confined aquifer in the underlying bedrock.

- The bedrock aquifer consists of the fractured Lockport Dolomite, which is the unit that will be mined by the proposed quarry.

- The Lockport Dolomite is a confined to semi-confined aquifer that contains and transmits water through fractures that consist of bedding plane partings, vertical joints, and openings created by gypsum dissolution.

- The water bearing fractures in the Lockport Dolomite are concentrated near the top of the rock (30 to 45 ft below the land surface), and these fractures are not apparent below the base of the aquifer between 56 and 89 ft below the land surface.

- Ground water flow in the region containing the mine site is from the upland recharge areas, which originate in the topographically high areas along and north of Fletcher Chapel Road; toward the discharge zones, which are generally within the topographically low areas along Oak Orchard Creek to the south, west and northwest of the mine site.

- Drawdown of the piezometric surface (water levels) in the bedrock aquifer have been projected out as far as 7,000 ft from the quarry face, when the quarry is at its maximum vertical and lateral extent.

- The water wells in the area, within 4,000 ft from the center of the quarry, are primarily bedrock wells and most of these are along Fletcher Chapel Road.

- Water supplies along Fletcher Chapel Road can be mitigated by connecting those adversely impacted to the municipal water line that lies along the road.

- Any wells along Southwood Road and Sour Spring Road, that are impacted, likely can be mitigated by drilling slightly deeper wells to provide more well storage.

- The Wildlife Refuge will not be impacted by ground water drawdown by the quarry. This conclusion is predicated on the observations that the water levels in the wetlands are associated with the shallow water table, that a thick (30 ft) deposit of underlying, low permeability, silt and clay isolate the wetlands from the bedrock aquifer, and that the water levels in the bedrock are already below the levels in the wetland; consequently, any potential drawdown has already occurred naturally.

- There will be a change in the volume of surface water discharge to the Wildlife Refuge through the two surface water drainage basins that originate at the mine site (Basin 1 and Basin 2).

- The surface water discharge to Basin 1 is projected to increase from the current estimated average rate of 185.33 gpm to a future rate of 1083.53 gpm if all the water is removed from the quarry at its maximum vertical and lateral extent at the end of mining of all phases. The effect of this increase can be controlled by first excavating the Phase 1 quarry west of the powerline, which divides the quarry site, then using the Phase 1 quarry as a water retention basin while mining the eastern quarry. Water discharged into Basin 1 from the Phase 1 quarry will be pumped on a continuous year round basis to maintain a steady discharge. The rate can be changed seasonally in a controlled manner in coordination with the Wildlife Refuge.

- Surface water drainage Basin 2, which provides water to Center Marsh, is projected to have a potential decrease in average flow from the current 190.19 gpm to a projected flow of 179.75 gpm. While not expected to be detrimental to the wetlands, this slight decrease can be ameliorated, if necessary, by directing some water from the quarry discharge to Basin 2.

- The use of the Phase 1 quarry for storage and discharge control will minimize the surface water impacts from the quarry when it is at its maximum size. The Phase 1 quarry, at its maximum extent, is a more realistic time period to assess potential surface water impacts. The Phase 1 water budget indicates that there will be no impact to Basin 2 flow at that time, and the Basin 1 discharge could increase to 445.00 gpm from the current rate of 185.33 gpm.

- There will be no water quality impacts to surface water by the water discharge from the quarry.

- The quarry will fill with water to an elevation of approximately 625.0 ft (± 2.0 ft) after mining has ceased and reclamation has been completed.

References

Cadwell, D.H., 1988, Surficial Geologic Map of New York, Niagara Sheet, New York State Museum – Geological Survey, Map and Chart Series #40.

CPI, 2008, Draft Environmental Impact Statement for a Mined Land Use Plan Mining Permit, Frontier Stone, LLC Proposed Frontier Stone Quarry, Town of Shelby, MLR #80823, DEC #8-3436-00033/00001, April 4, 2008.

Farnsworth et al, 1982, Evaporation Atlas for the Continuous 48 United States, NOAA Technical Report NWS 33; U.S. Department of Commerce, Washington D.C., 26 p.

Higgins, B.A., Puglia, P.S.; and Yoakum, T.D., 1977, Soil Survey of Orleans County, New York, United States Department of Agriculture, Soil Conservation Service in Cooperation with Cornell University Agricultural Experiment Station, 138 p.

Johnston, R.H., 1964, Ground Water in the Niagara Falls Area, New York, with Emphasis on the Water-Bearing Characteristics of the Bedrock, U.S. Geological Survey and the State of New York Conservation Department Water Resources Commission, Bulletin GW-53, 93p.3

Kappel, W.M. and Jennings, M.B., 2012, Water Resources of the Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York, 2009-2010, U.S. Geological Survey, Scientific Investigation Report, 2012-5027, 53 p.

Kreidler, W.L., Van Tyne, A.M., Jorgensen, K.M., 1972, Deep Wells in New York State, Bulletin No. 418A, New York State Museum and Science Services, 334 p.

Landphair, H.C., Motloch, J.L., 1985, Site Reconnaissance and Engineering, Elsevier Science Publishing Co., Inc., New York, New York, 248 p.

Linsley, R.K., Kohler, M.A., and Paulhus, J. L. H., 1982, Hydrology for Engineers, McGraw-Hill Book Company, New York, New York, 508 p.

Miller, T.S., Kappel, W.M., 1987, Effect of Niagara Power Project on Ground-Water Flow in the Upper Part of the Lockport Dolomite, Niagara Falls Area, New York, U.S. Geological Survey, Water-Resources Investigations Report 86-4130, 31 p.

Rickard, L.V. and Fisher, D.W., 1970, Geologic Map of New York, Niagara Sheet, New York State Museum and Science Service, Map and Chart Series No. 15.

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TABLES

TABLE 1
Static Groundwater Depths and Elevations
Frontier Stone Quarry

			5/4/2005		9/7/2005		11/28/2005		4/3/2007		6/4/2007		6/21/2007		9/16/2008		10/27/2008	
Well ID	Location Description	Measuring Point Elevation	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)	Depth to Water (feet)	Elevation (feet)
PW-1		633.24							4.18	629.06	7.61	625.63	9.3	623.94	11.22	622.02	9.6	623.64
MW-1		634.22							7.96	626.26	9.81	624.41	11.05	623.17	12.09	622.13	10.5	623.72
DH 1-05		633.66	6.3	627.36	11	622.66	6.26	627.40	4.76	628.90	6.32	627.34	7.65	626.01	8.85	624.81	7.2	626.46
DH 4-05		641.54	14.6	626.94	21.1	620.44	13.4	628.14	15.39	626.15	17.62	623.92	18.9	622.64	20.25	621.29	18.6	622.94
DH 5-05		[1] 626.27	flowing	>626.27	4.5	621.77	flowing	>626.27							1.64	624.63	flowing	>626.27
DH 5-05		[2] 631.3							3.21	628.09	4.61	626.69	5.77	625.53				
Barn Well		656.94									28.55	628.39	27.85	629.09	29.68	627.26	27.9	629.04
Garage Well		651.95									28.46	623.49	25.3	626.65	25.91	626.04	24.05	627.90
FS-1	Sour Springs Rd Bridge Abutment	[4] 620													5.8	614.20		
FS-3	Harrison Rd Bridge	617.89													15.23	602.66		
FS-4	Dunlop Rd Bridge	[3] 622.10													17	605.10		
FS-5															3.73			
FS-7	Culvert Top on Powerline, South End	625.30													1.58	623.72		
FS-10	Marsh Creek Overlook Wetland, top of angle iron on top of slide boards, South side	624.02													2.76	621.26		
FS-11	Job Corp Dike Weir	623.05													1.67	621.38		
FS-12	Sour Springs Rd Culvert Top	623.77													2.2	621.57		
Staff Gauge	Schoolhouse Marsh															622.3		
Staff Gauge	Located @ FS-11															~621.75		
Ringneck Marsh		620.94																

1. The measuring point elevation was 626.27 at the top of the steel casing without casing extension.
2. Measuring point elevation was 631.3 with 5.03 ft added to the top of the steel casing to measure the level when flowing.
3. The measuring point is the metal rail which is 1.67 ft above the top of the concrete bridge edge.
4. Estimated from topographic map contour elevation of 620 ft relative to mean sea level.

TABLE 2
Well Data
Frontier Stone Quarry

Well	Elevation Top of Casing (ft rmsl)	Casing Stickup (ft)	Well Depth (ft)	Casing Depth (ft)	Casing Size (inches)	Well Type
PW-1	633.24	3.93	195	40	6	open rock hole
MW-1	634.22	3.98	195	40	6	open rock hole
DH1-05	633.66	1.25	160	38	6	open rock hole
DH4-05	641.54	4.49	151.5	36.7	6	open rock hole
DH5-05	626.27	2.06	161	23	6	open rock hole
Barn well	656.94	1.47	unknown	unknown	6	bedrock
Garage well	651.95	2.82	unknown	unknown	6	bedrock

TABLE 3

Frontier Stone
Monthly Temperature and Precipitation Normals
Albion 2 NE Station 1971-2000

Month	Temperature (°F)
January	24.5
February	26.4
March	35
April	46.7
May	58.6
June	67.7
July	72.4
August	70.4
September	63.2
October	51.9
November	40.6
December	30.1
Average	**49.0**

Month	Precipitation (inches)
January	2.64
February	2.07
March	2.80
April	3.12
May	2.97
June	3.56
July	2.56
August	3.16
September	3.73
October	2.84
November	3.19
December	3.14
Total	**35.78**

TABLE 4
Water Budget Analysis - Existing Conditions
Frontier Stone Quarry

	SOIL ID	DESCRIPTION	Acres	Precip. (in)	Runoff Coef.	Runoff (in)	Runoff (gpm)
BASIN 1	AnB	Appleton silt loam, 3 to 8 percent slopes	7.7	35.78	0.36	12.88	5.12
	BoB	Bombay fine sandy loam, 3 to 8 percent slopes	27.3	35.78	0.27	9.66	13.62
	Ca	Canandaigua silt loam, nearly level	8.4	35.78	0.19	6.80	2.95
	CcB	Cayuga silt loam, 2 to 6 percent slopes	27.1	35.78	0.32	11.45	16.03
	Cg	Cheektowaga fine sandy loam, nearly level	3.6	35.78	0.17	6.08	1.13
	ChA	Churchville silt loam, 0 to 2 percent slopes	55.9	35.78	0.26	9.30	26.86
	CmB	Collamer Silt Loam, 2 to 6 percent slopes	2.3	35.78	0.32	11.45	1.36
	CoB	Colonie loamy fine sand, 0 to 6 percent slopes	3.8	35.78	0.18	6.44	1.26
	Cs	Cosad loamy fine sand, 0 to 2 percent slopes	14.5	35.78	0.19	6.80	5.09
	FH	Fluvaquents and Humaquepts, ponded	19.8	35.78	0.1	3.58	3.66
	HbB	Hilton loam, 3 to 8 percent slopes	5.1	35.78	0.32	11.45	3.02
	Lk	Lakemont silty clay loam, nearly level	36.1	35.78	0.19	6.80	12.68
	MdB	Madrid fine sandy loam, 3 to 8 percent slopes	3.8	35.78	0.27	9.66	1.90
	MdC	Madrid fine sandy loam, 8 to 15 percent slopes	25.8	35.78	0.36	12.88	17.17
	OdA	Odessa silt loam, 0 to 2 percent slopes	119.8	35.78	0.23	8.23	50.93
	OnB	Ontario loam, 3 to 8 percent slopes	22.9	35.78	0.32	11.45	13.54
	W	Water (Precip - Evap = 8.98 inches)	19.4	8.98	1	8.98	9.00
			403.3 acres				**185.33 gpm (Basin 1)**

	SOIL ID	DESCRIPTION	Acres	Precip. (in)	Runoff Coef.	Runoff (in)	Runoff (gpm)
BASIN 2	AnB	Appleton silt loam, 3 to 8 percent slopes	2.5	35.78	0.36	12.88	1.66
	BoB	Bombay fine sandy loam, 3 to 8 percent slopes	16.4	35.78	0.27	9.66	8.18
	Ca	Canandaigua silt loam, nearly level	14.9	35.78	0.19	6.80	5.23
	CeB	Cazenovia Silt Loam, 3 to 8 percent slopes	0.9	35.78	0.36	12.88	0.60
	Cg	Cheektowaga fine sandy loam, nearly level	37.2	35.78	0.17	6.08	11.69
	ChA	Churchville silt loam, 0 to 2 percent slopes	37.8	35.78	0.26	9.30	18.17
	ClB	Claverack loamy fine sand, 0 to 6 percent slopes	7.1	35.78	0.17	6.08	2.23
	CmB	Collamer silt loam, 2 to 6 percent slopes	4.1	35.78	0.32	11.45	2.43
	Cs	Cosad loamy fine sand, 0 to 2 percent slopes	53.7	35.78	0.19	6.80	18.86
	ElB	Elnora loamy fine sand, 0 to 6 percent slopes	34.2	35.78	0.19	6.80	12.01
	FH	Fluvaquents and Humaquepts, ponded	0.6	35.78	0.1	3.58	0.11
	Lk	Lakemont silty clay loam	43.7	35.78	0.19	6.80	15.35
	Ma	Madalin silt loam; nearly level	1.8	35.78	0.19	6.80	0.63
	MdB	Madrid fine sandy loam, 3 to 8 percent slopes	4.4	35.78	0.27	9.66	2.20
	MdC	Madrid fine sandy loam, 8 to 15 percent slopes	11.4	35.78	0.36	12.88	7.59
	OdA	Odessa silt loam, 0 to 2 percent slopes	155.8	35.78	0.23	8.23	66.24
	W	Water (Precip - Evap = 8.98 inches)	36.7	8.98	1	8.98	17.03
			463.2 acres				**190.19 gpm (Basin 2)**

TABLE 5
Water Budget Summary for Ground Water Accumulating in the Proposed Quarry
Frontier Stone Quarry

Soil Association	% of Project Area	Acreage	Percolation Rate (in/yr)	Annualized Total Perc. Rate (gpm)	Total Runoff (in/yr)	Total Runoff (gpm)	Total AET (in/yr)	Total AET (gpm)	Precipitation inches/yr	Precipitation gpm
1. Ontario-Hilton	18.723%	1050.7	5.75	311.87	11.13	603.88	18.91	1026.26	35.78	1942.01
3. Bombay-Madrid	10.924%	613.0	5.93	187.73	10.52	333.15	19.33	612.18	35.78	1133.07
5. Hilton-Appleton	3.570%	200.3	6.59	68.24	10.80	111.80	18.38	190.25	35.78	370.29
9. Sun-Massena	0.638%	35.8	7.94	14.68	9.30	17.20	18.54	34.26	35.78	66.14
15. Elnora-Colonie	3.326%	186.6	8.74	84.25	6.78	65.40	20.26	195.27	35.78	344.92
27. Howard	5.139%	288.4	5.91	87.99	10.71	159.54	19.16	285.45	35.78	532.99
Glaciolacustrine (includes ponds)	57.533%	3228.4	0.0742	12.38						
Ponds (not on glaciolacustrine)	0.148%	8.3	8.98	3.84	0.00	0.00	26.80	11.46	35.78	15.30
	100.000%	5611.5		770.98						

TOTAL PERCOLATION TO GROUND WATER RECHARGE AREA (ground water inflow to mine) =	**405,227,088**	**gal/year**	(770.98 gpm)
TOTAL DIRECT PRECIPITATION TO 213.7-ACRE QUARRY =	**207,612,000**	**gal/year**	(395.00 gpm)
Total Inflow to Mine =	**612,839,088**	**gal/year**	(1165.98 gpm)

TOTAL ANNUAL RAINFALL = 35.78"

Notes:

Glaciolacustrine area assigned "perc rate"of 8.8 x 10^{8}gpm/ft^{2}

Assume no runoff from ponds

Shallow Lake Evaporation =

26.8"/yr (Linsley,Kohler and Paulhus, 1982)

Z:\projects\2008\08121 - 08140\08122- Frontier Stone\Water Budget\Recharge.xls\Total Inflow to Mine (rev)

TABLE 6
Water Budget Analysis - Future Conditions at its Maximum Size
Frontier Stone Quarry

BASIN 1

SOIL ID	DESCRIPTION	Acres	Precip. (in)	Runoff Coef.	Runoff (in)	Runoff (gpm)
AnB	Appleton silt loam, 3 to 8 percent slopes	7.7	35.78	0.36	12.88	5.12
BoB	Bombay fine sandy loam, 3 to 8 percent slopes	13.1	35.78	0.27	9.66	6.54
Ca	Canandaigua soils	8.4	35.78	0.19	6.80	2.95
CcB	Cayuga silt loam, 2 to 6 percent slopes	11.9	35.78	0.32	11.45	7.04
Cg	Cheektowaga fine sandy loam	3.6	35.78	0.17	6.08	1.13
ChA	Churchville silt loam, 0 to 2 percent slopes	12.9	35.78	0.26	9.30	6.20
CoB	Colonie loamy fine sand, 0 to 6 percent slopes	3.8	35.78	0.18	6.44	1.26
FH	Fluvaquents and Humaquepts, ponded	19.8	35.78	0.10	3.58	3.66
Lk	Lakemont silty clay loam	31.1	35.78	0.19	6.80	10.92
MdB	Madrid fine sandy loam, 3 to 8 percent slopes	3.8	35.78	0.27	9.66	1.90
MdC	Madrid fine sandy loam, 8 to 15 percent slopes	25.8	35.78	0.36	12.88	17.17
OdA	Odessa silt loam, 0 to 2 percent slopes	31.3	35.78	0.23	8.23	13.31
OnB	Ontario loam, 3 to 8 percent slopes	15.3	35.78	0.32	11.45	9.05
W	Water (Precip - Evap = 8.98 inches)	19.4	8.98	1.00	8.98	9.00
		207.9 Acres		TOTAL RUNOFF=		**95.25 gpm**

Mine

	Acres	Precip. (in)	Evap. (in)	Inflow (gpm)
Direct precipitation to mine	213.7	35.78		395.00
Ground water inflow to mine				770.98
	Acres		**Evap. (in.)**	**Outflow (gpm)**
Evaporation from Eastern Quarry floor (assume 50% of average annual evaporation from a shallow pond)	170.7		13.4	118.17
Evaporation from Western Quarry pond	43.0		26.8	59.53
Net Flow From Mine (Precip +GW - Evap) =				**988.28**

Surface water runoff (95.25) + Net Mine Discharge (988.28 gpm) = **1083.53 gpm**
(Total Outflow from Basin 1

BASIN 2

SOIL ID	DESCRIPTION	Acres	Precip. (in)	Runoff Coef.	Runoff (in)	Runoff (gpm)
AnB	Appleton silt loam, 3 to 8 percent slopes	2.5	35.78	0.36	12.88	1.66
BoB	Bombay fine sandy loam, 3 to 8 percent slopes	12.1	35.78	0.27	9.66	6.04
Ca	Canandaigua silt loam, nearly level	14.9	35.78	0.19	6.80	5.23
CeB	Cazenovia Silt Loam, 3 to 8 percent slopes	0.9	35.78	0.36	12.88	0.60
Cg	Cheektowaga fine sandy loam, nearly level	37.2	35.78	0.17	6.08	11.69
ChA	Churchville silt loam, 0 to 2 percent slopes	40.2	35.78	0.26	9.30	19.32
ClB	Claverack loamy fine sand, 0 to 6 percent slopes	7.1	35.78	0.17	6.08	2.23
CmB	Collamer silt loam, 2 to 6 percent slopes	6.4	35.78	0.32	11.45	3.79
Cs	Cosad loamy fine sand, 0 to 2 percent slopes	39.4	35.78	0.19	6.80	13.84
ElB	Elnora loamy fine sand, 0 to 6 percent slopes	34.2	35.78	0.19	6.80	12.01
FH	Fluvaquents and Humaquepts, ponded	0.6	35.78	0.10	3.58	0.11
Lk	Lakemont silty clay loam	43.7	35.78	0.19	6.80	15.35
Ma	Madalin silt loam; nearly level	1.8	35.78	0.19	6.80	0.63
MdB	Madrid fine sandy loam, 3 to 8 percent slopes	4.4	35.78	0.27	9.66	2.20
MdC	Madrid fine sandy loam, 8 to 15 percent slopes	11.4	35.78	0.36	12.88	7.59
OdA	Odessa silt loam, 0 to 2 percent slopes	140.1	35.78	0.23	8.23	59.56
OnB	Ontario loam, 3 to 8 percent slopes	1.5	35.78	0.32	11.45	0.89
W	Water (Precip - Evap = 8.98 inches)	36.7	8.98	1.00	8.98	17.03
		435.1 Acres		TOTAL RUNOFF =		**179.75** gpm

(outflow from Basin 2)

TABLE 7
Water Budget Summary for Water Accumulating in the Quarry at End of Phase I Mining
Frontier Stone Quarry

Soil Association	% of Project Area	Acreage	Percolation Rate (in/yr)	Annualized Total Perc. Rate (gpm)	Total Runoff (in/yr)	Total Runoff (gpm)	Total AET (in/yr)	Total AET (gpm)	Precipitation inches/yr	Precipitation gpm
1. Ontario-Hilton	20.892%	332.0	5.75	98.55	11.13	190.82	18.91	324.29	35.78	613.66
3. Bombay-Madrid	20.521%	326.1	5.93	99.86	10.52	177.22	19.33	325.66	35.78	602.74
5. Hilton-Appleton	0.000%	0.0	6.59	0.00	10.80	0.00	18.38	0.00	35.78	0.00
9. Sun-Massena	0.000%	0.0	7.94	0.00	9.30	0.00	18.54	0.00	35.78	0.00
15. Elnora-Colonie	4.588%	72.9	8.74	32.91	6.78	25.55	20.26	76.28	35.78	134.74
27. Howard	3.430%	54.5	5.91	16.63	10.71	30.15	19.16	53.95	35.78	100.73
Glaciolacustrine (includes ponds)	50.570%	803.6	0.0742	3.08						
Ponds (not on glaciolacustrine)	0.000%	0.0	8.98	0.00	0.00	0.00	26.80	0.00	35.78	0.00
	100.000%	1589.1		251.04						

TOTAL PERCOLATION TO GROUND WATER RECHARGE AREA (ground water inflow to mine) =	**131,946,624 gal/year**	(251.04 gpm)
TOTAL DIRECT PRECIPITATION TO 11.6-ACRE PHASE I QUARRY =	**11,268,864 gal/year**	(21.44 gpm)
Total Inflow to Mine =	**143,215,488 gal/year**	(271.37 gpm)

TOTAL ANNUAL RAINFALL = 35.78"

Notes:

Glaciolacustrine area assigned "perc rate"of 8.8 x 10^{-8}gpm/ft^2

Assume no runoff from ponds

Shallow Lake Evaporation =

26.8"/yr (Linsley,Kohler and Paulhus, 1982)

TABLE 8
Water Budget Analysis - Future Conditions at End of Phase 1 Mining
Frontier Stone Quarry

	SOIL ID	DESCRIPTION	Acres	Precip. (in)	Runoff Coef.	Runoff (in)	Runoff (gpm)
BASIN 1	AnB	Appleton silt loam, 3 to 8 percent slopes	7.7	35.78	0.36	12.88	5.12
	BoB	Bombay fine sandy loam, 3 to 8 percent slopes	27.3	35.78	0.27	9.66	13.62
	Ca	Canandaigua soils	8.4	35.78	0.19	6.80	2.95
	CcB	Cayuga silt loam, 2 to 6 percent slopes	27.1	35.78	0.32	11.45	16.03
	Cg	Cheektowaga fine sandy loam	3.6	35.78	0.17	6.08	1.13
	ChA	Churchville silt loam, 0 to 2 percent slopes	55.9	35.78	0.26	9.30	26.86
	CmB	Collamer silt loam, 2 to 6 percent slopes	2.3	35.78	0.32	11.45	1.36
	CoB	Colonie loamy fine sand, 0 to 6 percent slopes	3.8	35.78	0.18	6.44	1.26
	Cs	Cosad loamy fine sand	14.5	35.78	0.19	6.80	5.09
	FH	Fluvaquents and Humaquepts, ponded	19.8	35.78	0.10	3.58	3.66
	HbB	Hilton loam, 3 to 8 percent slopes	5.1	35.78	0.32	11.45	3.02
	Lk	Lakemont silty clay loam	34.1	35.78	0.19	6.80	11.98
	MdB	Madrid fine sandy loam, 3 to 8 percent slopes	3.8	35.78	0.27	9.66	1.90
	MdC	Madrid fine sandy loam, 8 to 15 percent slopes	25.8	35.78	0.36	12.88	17.17
	OdA	Odessa silt loam, 0 to 2 percent slopes	110.2	35.78	0.23	8.23	46.85
	OnB	Ontario loam, 3 to 8 percent slopes	22.9	35.78	0.32	11.45	13.54
	W	Water (Precip - Evap = 8.98 inches)	19.4	8.98	1.00	8.98	9.00
			391.7 Acres		TOTAL RUNOFF=		**180.55 gpm**

Mine		Acres	Precip. (in)		Inflow (gpm)
	Direct precipitation to western quarry	11.6	35.78		21.44
	Ground water inflow to western quarry (from Table 7)				251.04
		Acres		Evap. (in.)	Outflow (gpm)
	Evaporation from western quarry floor (assume 50% of average annual evaporation from a shallow pond)	11.6		13.4	8.03
	Net Flow From Mine (Precip +GW - Evap) =				264.45

Surface water runoff (180.55) + Net Mine Discharge (264.45 gpm) = **445.00 gpm**
(Total Outflow from Basin 1)

	SOIL ID	DESCRIPTION	Acres	Precip. (in)	Runoff Coef.	Runoff (in)	Runoff (gpm)
BASIN 2	AnB	Appleton silt loam, 3 to 8 percent slopes	2.5	35.78	0.36	12.88	1.66
	BoB	Bombay fine sandy loam, 3 to 8 percent slopes	16.4	35.78	0.27	9.66	8.18
	Ca	Canandaigua silt loam, nearly level	14.9	35.78	0.19	6.80	5.23
	CeB	Cazenovia Silt Loam, 3 to 8 percent slopes	0.9	35.78	0.36	12.88	0.60
	Cg	Cheektowaga fine sandy loam, nearly level	37.2	35.78	0.17	6.08	11.69
	ChA	Churchville silt loam, 0 to 2 percent slopes	37.8	35.78	0.26	9.30	18.17
	ClB	Claverack loamy fine sand, 0 to 6 percent slopes	7.1	35.78	0.17	6.08	2.23
	CmB	Collamer silt loam, 2 to 6 percent slopes	4.1	35.78	0.32	11.45	2.43
	Cs	Cosad loamy fine sand, 0 to 2 percent slopes	53.7	35.78	0.19	6.80	18.86
	ElB	Elnora loamy fine sand, 0 to 6 percent slopes	34.2	35.78	0.19	6.80	12.01
	FH	Fluvaquents and Humaquepts, ponded	0.6	35.78	0.1	3.58	0.11
	Lk	Lakemont silty clay loam	43.7	35.78	0.19	6.80	15.35
	Ma	Madalin silt loam; nearly level	1.8	35.78	0.19	6.80	0.63
	MdB	Madrid fine sandy loam, 3 to 8 percent slopes	4.4	35.78	0.27	9.66	2.20
	MdC	Madrid fine sandy loam, 8 to 15 percent slopes	11.4	35.78	0.36	12.88	7.59
	OdA	Odessa silt loam, 0 to 2 percent slopes	155.8	35.78	0.23	8.23	66.24
	W	Water (Precip - Evap = 8.98 inches)	36.7	8.98	1	8.98	17.03
			463.2 Acres		TOTAL RUNOFF =		**190.19 gpm**

(outflow from Basin 2)

TABLE 9
WATER BUDGET SUMMARY TABLE
Frontier Stone Quarry

	Average Annual Flow Rate	Average March Flow Rate	Average July Flow Rate	Average September Flow Rate
Surficial Drainage from Existing Basin 1	185.33	653.13	157.0	236.37
Surficial Drainage from the Unmined Area of Basin 1 at End of Phase 1 Mining	180.55	633.75	152.48	229.58
Ground Water Inflow from the Mine at the Full Development of the Phase 1 Quarry	251.04	310.40	186.21	183.26
Direct Precipitation into the mine at the Full Development of the Phase 1 Quarry	21.44	75.20	18.06	27.20
Evaporation from the mine for the Full Development Phase 1 Quarry	8.03	0.0	9.03	13.12
Quarry Discharge at Full Development of the Phase 1 Quarry	264.45	385.60	195.24	197.34
Total Future Discharge from Basin 1 at Full Development of the Phase 1 Mine	445.0	1019.35	347.72	426.92
Increase in the flow to Basin 1 after the Full Development of Phase 1	259.67	366.22	190.72	190.55

Notes: All discharges are in gallons per minute.
The existing Basin 1 area is 403.3 acres.
The unmined area will be reduced to 391.7 acres by the addition of the 11.6 acre Phase 1 quarry.
All the March discharges include the melt of accumulated snow for December, January and February.
Snow melt is imbedded in the direct precipitation of 75.20 gpm in the Future Phase 1 direct precipitation that is comprised of 19.8 gpm of March precipiation plus 55.4 gpm of snow melt.

TABLE 10

Frontier Stone
Analytical Results in mg/L
Ground Water and Surface Water

	Well DH5-05 (Deep Well)	Barn Well (Shallow Well)	Zelazny Field (Drainage Ditch)	Marsh Creek (Schoolhouse Marsh)	Drinking Water Standard	Surface Water Standards
Total Hardness (as $CaCO_3$)	395	491	70	101		
Barium	0.087	0.058	0.0818	0.0248	2.0[1]	
Iron	0.351	0.118	6.41	0.741	0.3[1,2]	
Manganese	<0.020	0.042	0.102	0.135	0.3[1,2]	
Chloride	28.5	78.0	13.2	23.4	250[1]	
Sulfate	104	138		ND<5.0	250[1]	
Sulfide	0.18	<0.10		ND<0.10		
Nitrate			0.0391	0.0615	10[1]	
pH	7.3	7.1	7.61	7.95	6.5 - 8.5[3]	
Total Dissolved Solids	490	652	261	130	500[3]	
Total Suspended Solids	2.5	7.0	102	8	10[1]	
Sample Date	4/14/2010	4/14/2010	10/5/2010	8/4/2010		

Notes:

1) Drinking water standard in New York State Public Health Law Section 225, Subpart 5-1
2) The combined standard for Iron and Mangense is 0.5 mg/L
3) USEPA secondary drinking water standards

Z:\projects\2008\08121 - 08140\08122 - Frontier Stone\Reports\2011 Final Hydro Report\Tables\Table 10 Analytical Results

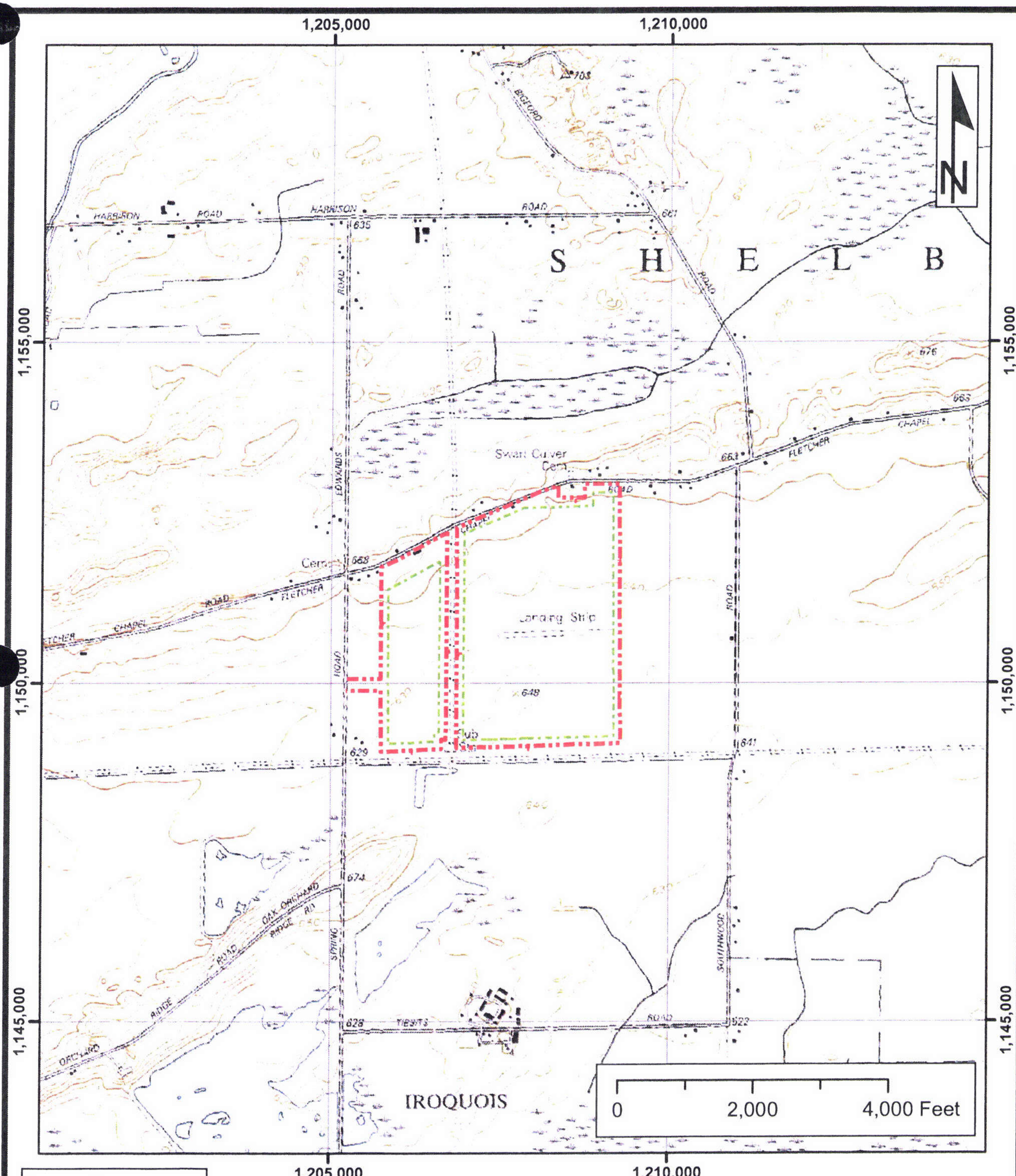
TABLE 11
Residential Well Data
Frontier Stone Quarry

Well Number	Name	Address	Well	Municipal Water	Survey Given	Survey Returned	Well Installation Date	Well Depth (feet)	Well Diameter (inches)	Pump Setting (feet)	Notes
1	Fuller	11646 Fletcher Chapel Road	Yes	Yes	Yes	No	NA	65	NA	NA	Well is 65' deep, good quantity, only uses for watering plants and lawn
2	Fuller	11666 Fletcher Chapel Road	Yes	Yes	Yes	No	NA	NA	NA	NA	Survey given to female occupant, no information known about well
3		Fletcher Chapel Road	Yes	Yes	Yes	No	NA	NA	NA	NA	Survey given to female occupant, no information known about well
4	Charanis	11687 Fletcher Chapel Road	Yes	No	Yes	No	NA	NA	NA	NA	Nobody home, survey left in door
5	Zelasny	11763 Fletcher Chapel Road	Yes	Yes	Yes	No	NA	NA	NA	NA	Survey given to female occupant. Zelasny has a well at their residence on the north side of Fletcher Chapel Road and one at their cow barn on the south side of Fletcher Chapel Road
6	Dieter	11854 Fletcher Chapel Road	Yes	No	Yes	No	NA	NA	NA	NA	Has well, not hooked up to municipal water
7	Schultz	11863 Fletcher Chapel Road	Yes	?	Yes	No	NA	NA	NA	NA	No one home, survey left in door
8	Hooker	11875 Fletcher Chapel Road	Yes	No	No	No	NA	NA	NA	NA	Sign on door says residences have moved; house appears vacant
9	Hooker	11881 Fletcher Chapel Road	Yes	No	Yes	No	NA	NA	NA	NA	
10	Seitz	11891 Fletcher Chapel Road	Yes	Yes	No	NA	NA	NA	NA	NA	New house, no well; no survey provided
11	Outterson	11924 Fletcher Chapel Road	Yes	?	Yes	Yes	1994	47	6	42	Survey given to male occupant
12	Bacon	11947 Fletcher Chapel Road	Yes	?	Yes	No	NA	NA	NA	NA	Survey given to female occupant, no information known about well
13	Wilson	11946 Fletcher Chapel Road	Yes	Yes	Yes	Yes			36		
14	Dunn	11985 Fletcher Chapel Road	No	Yes	Yes	No	NA	NA	NA	NA	New house, no well
15	Taylor	12001 Fletcher Chapel Road	Yes	Yes	Yes	No	NA	NA	NA	NA	Survey given to female occupant, no information known about well
16	Longcore	5278 Sour Spring Road	Yes	No	Yes	No	NA	21	NA	NA	Well is 21' deep, good quality, quantity
17	Luthart	5283 Sour Spring Road	Yes	No	Yes	Yes	1987	36	6	28	Well is 36' deep, sulfur water
18	Luxon	11599 Fletcher Chapel Road	Yes	?	?	?	?	?	?	?	
19	Christ	5232 Southwoods Road	Yes	?	?	?	?	?	?	?	
20	Dumoy	5174 Edwards Road	Yes	?	?	?	?	?	?	?	

NA = Information not available.
? = Municipal hook-up not confirmed.

Copied from DEIS (CPI, 2008)

FIGURES

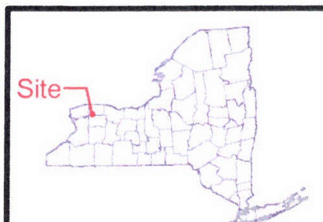


Legend

Property Boundary

Life of Mine Boundary

Notes:
-NYS Department of Transportation Raster QuadranglePortions of the Knowlesville and Medina quadrangles).
-Elevations are shown in feet above mean sea level.
-Contour interval is ten feet (Knowlesville quadrangle) and five feet (Medina quadrangle).



ALPHA GEOSCIENCE
Alpha Proj. No. 08122

FIGURE 1

SITE LOCATION MAP

Frontier Stone Quarry
Frontier Stone LLC
Town of Shelby
Orleans County, New York

Map Document: (Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Site Location Map.mxd)
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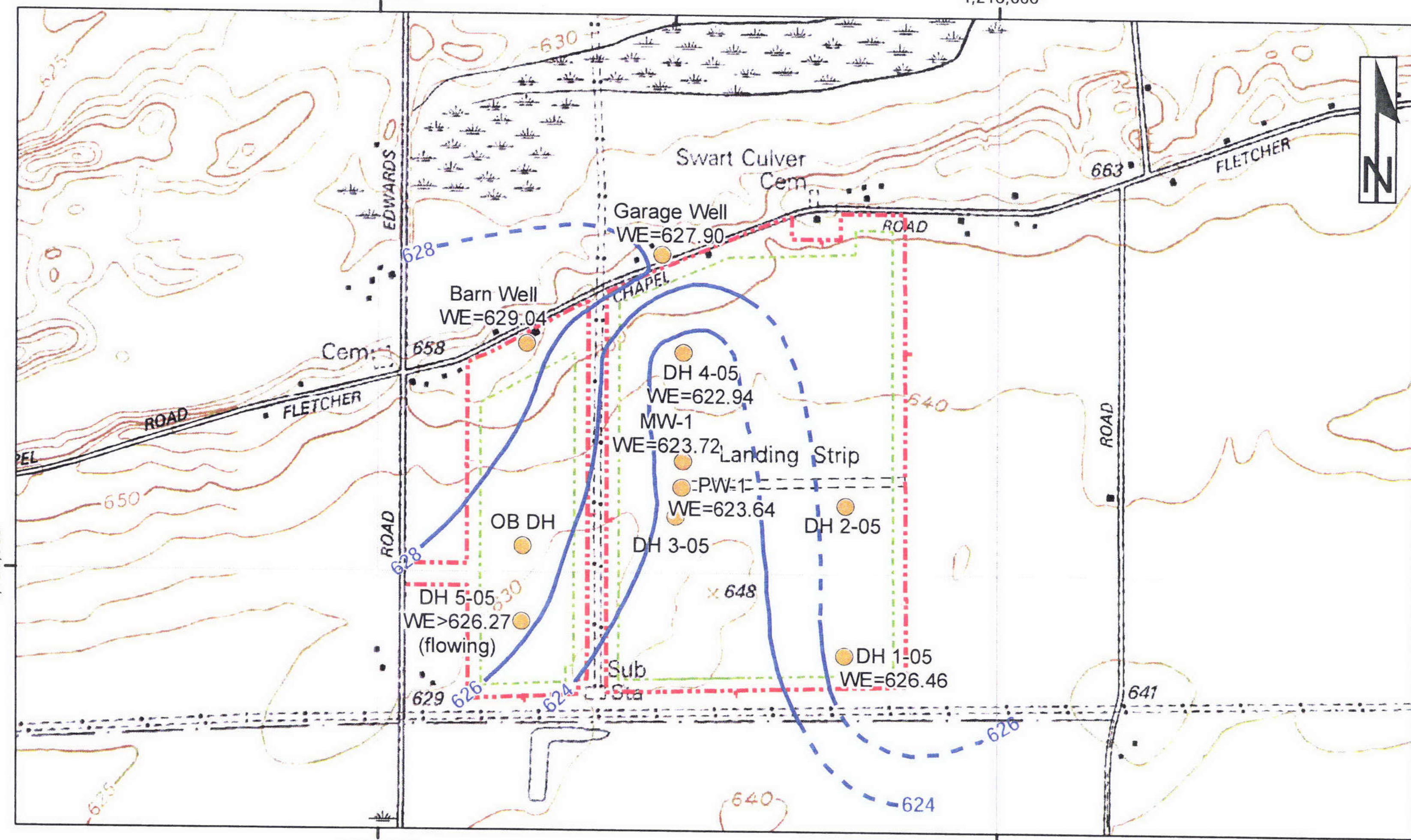

Legend

Monitoring Well

DH 4-05
WE=Ground Water Elevation

Property Boundary

Life of Mine Boundary

Ground Water Elevation Contour

Notes:
-NYS Department of Transportation Raster Quadrangle
(Portions of the Knowlesville and Medina quadrangles).

0 1,200 2,400 Feet

ALPHA GEOSCIENCE

Alpha Proj. No. 08122

FIGURE 2

GROUND WATER CONTOUR MAP
ALTERNATIVE A
October 27, 2008

Frontier Stone Quarry
Frontier Stone LLC
Town of Shelby
Orleans County, New York

Map Document: (Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Groundwater Contours.mxd)
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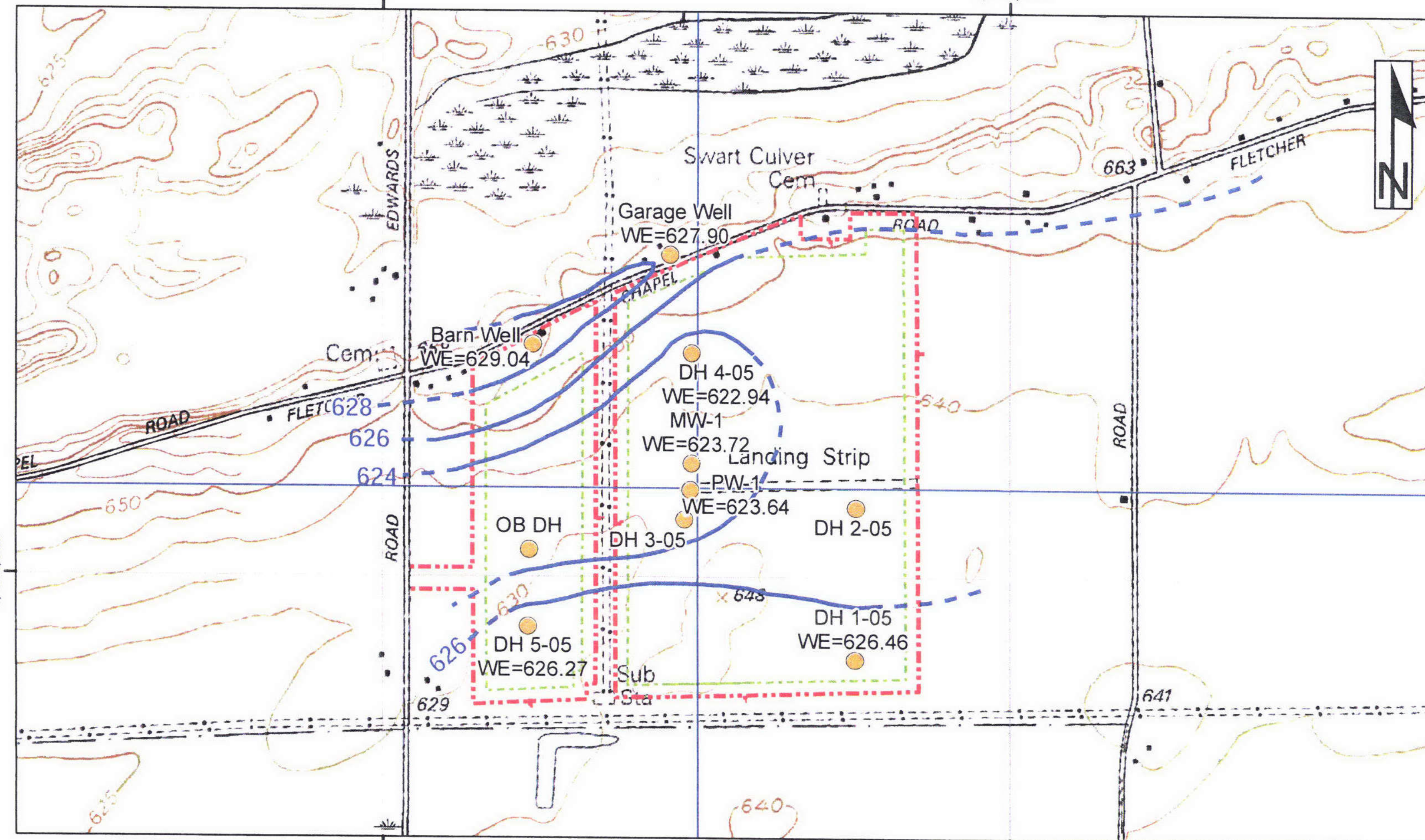

Legend

Monitoring Well

DH 4-05

WE=Groundwater Elevation

Cross Sections

Property Boundary

Life of Mine Boundary

Ground Water Elevation Contour

Notes:
- NYS Department of Transportation Raster Quadrangle (Medina and Knowlesville quadrangles)

0 1,200 2,400 Feet

ALPHA GEOSCIENCE

Alpha Proj. No. 08122

FIGURE 3

GROUND WATER CONTOUR MAP
ALTERNATIVE B
October 27, 2008

Frontier Stone Quarry
Frontier Stone LLC
Town of Shelby
Orleans County, New York

Map Document: (Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Groundwater Contours-B.mxd)
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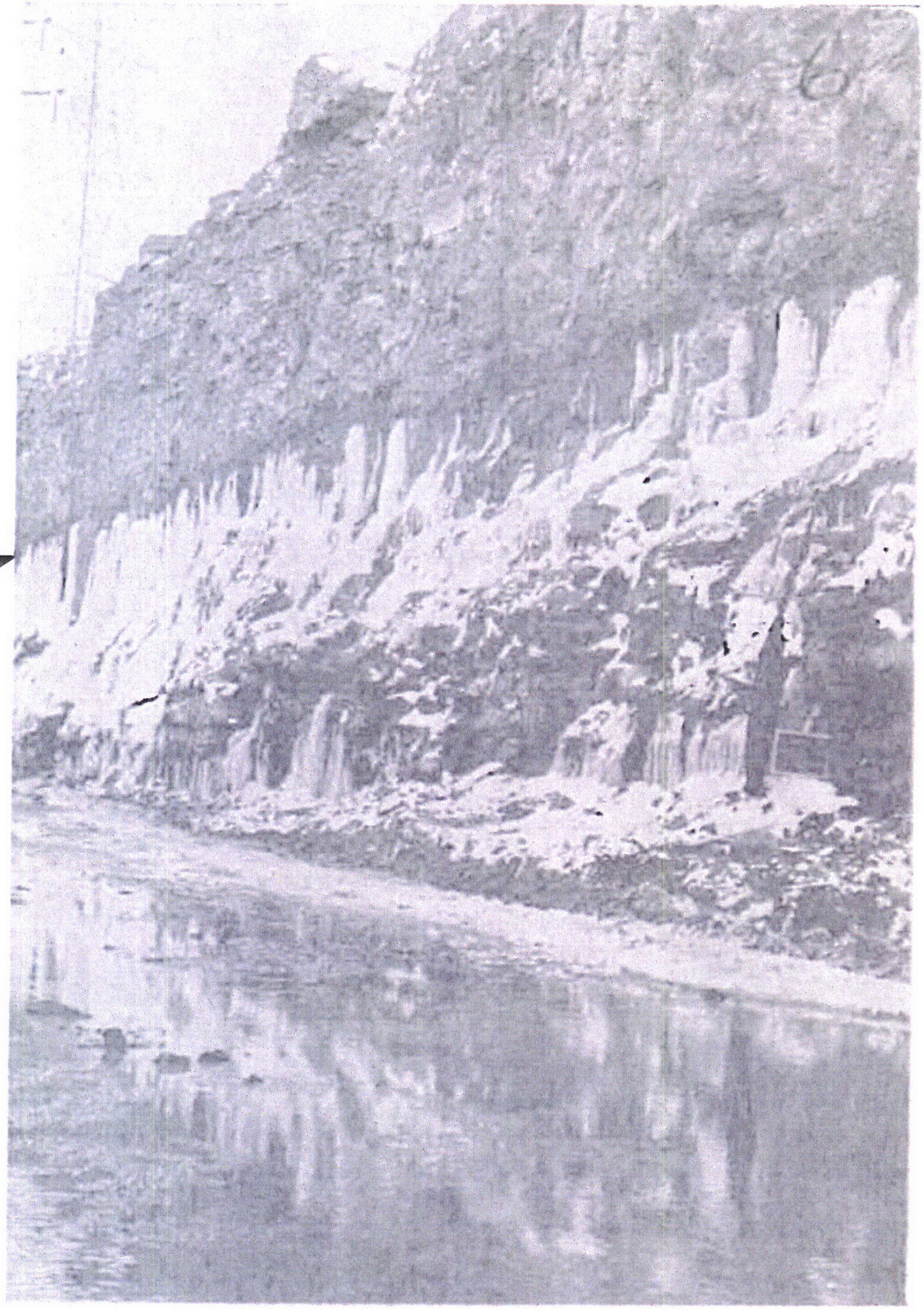


Source:
Copy of the Cover of Johnston, (1964)

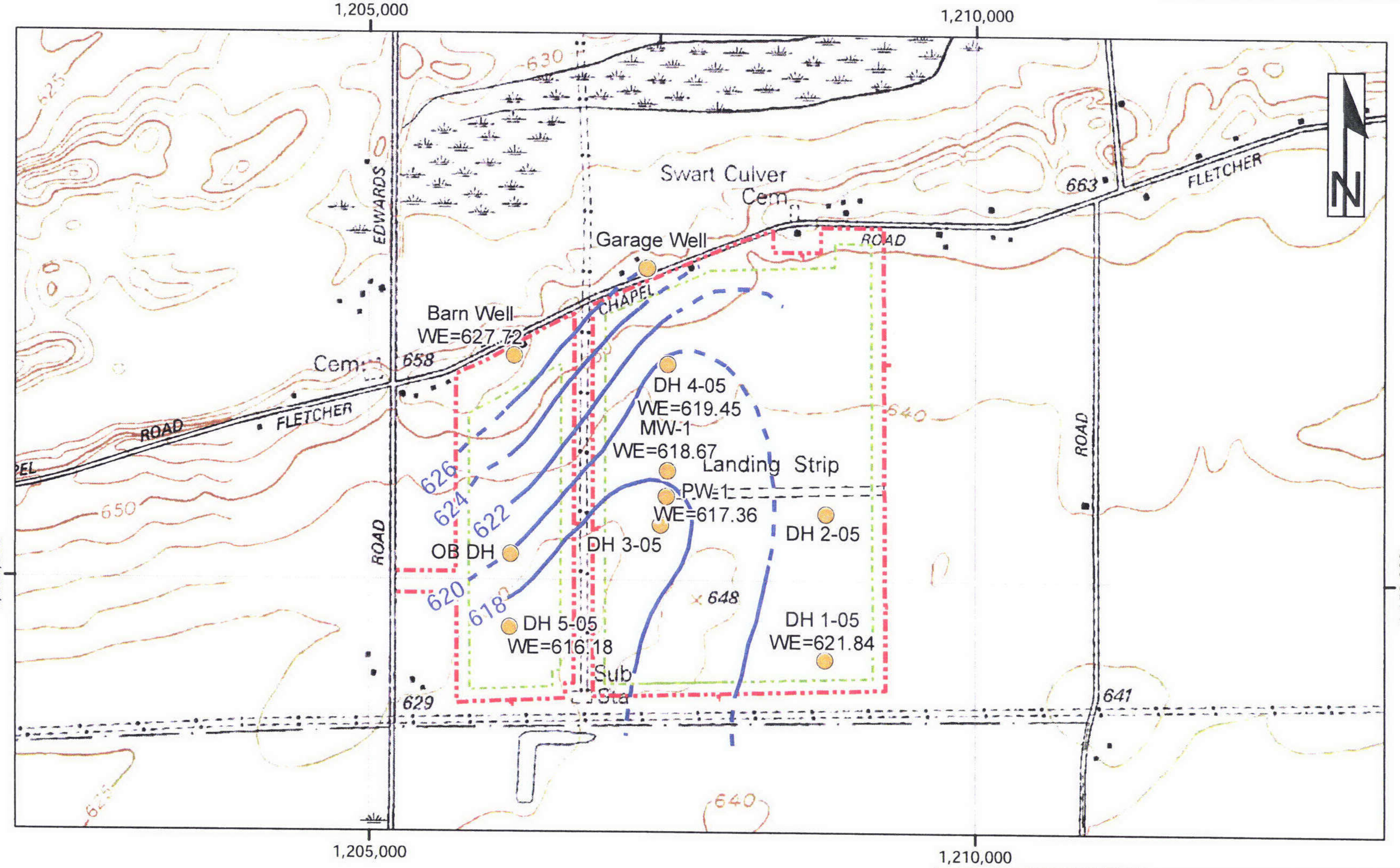
Picture shows seepage from bedding joints in the Lockport Dolomite

ALPHA GEOSCIENCE
Alpha Proj. No. 08122

FIGURE 4

Representative Seepage Face in Lockport Dolomite

Frontier Stone Quarry
Frontier Stone LLC
Town of Shelby
Orleans County, New York



Legend
Monitoring Well
DH 4-05
WE=Ground Water Elevation
Property Boundary
Life of Mine Boundary
Ground Water Elevation Contour

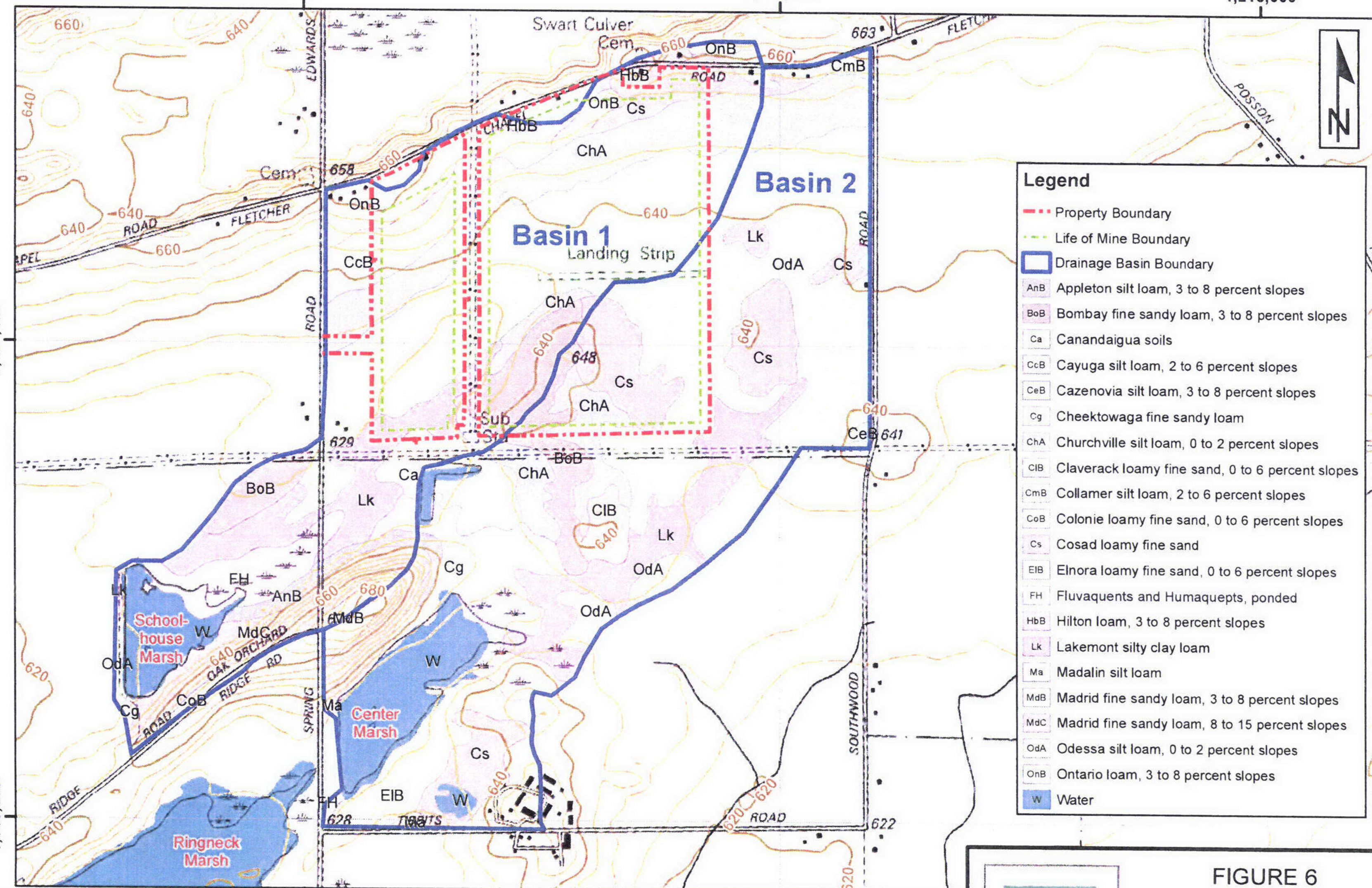
Notes:
- NYS Department of Transportation Raster Quadrangle (Medina and Knowlesville quadrangles).

0 1,200 2,400 Feet

ALPHA GEOSCIENCE
Alpha Proj. No. 08122

FIGURE 5
72 HR PUMPING TEST-4/3/2008
DRAWDOWN CONTOUR MAP
At the End of the Test on 4/6/2008
Frontier Stone Quarry
Frontier Stone LLC
Town of Shelby
Orleans County, New York

Map Document: (Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Groundwater Contours-72hr Drawdown.mxd)
12/29/2008 -- 2:47:47 PM



1,210,000

Notes:
- Basemap - NYS Department of Transportation Raster planimetric layer (Knowlesville and Medina quadrangles)
- Topographic contours based on New York State Digital Elevation Models (DEM). U.S. Geological Survey.
- Water features based on USDA Soil Survey and orthoimagry (1994-1999), NYS Office of Cyber Security & Critical Infrastructure Coordination.
- Soil Survey Geographic (SSURGO) database for Orleans County New York, U.S. Department of Agriculture, Natural Resources Conservation Service.

0 1,500 3,000 Feet

ALPHA GEOSCIENCE
Alpha Proj. No. 08122

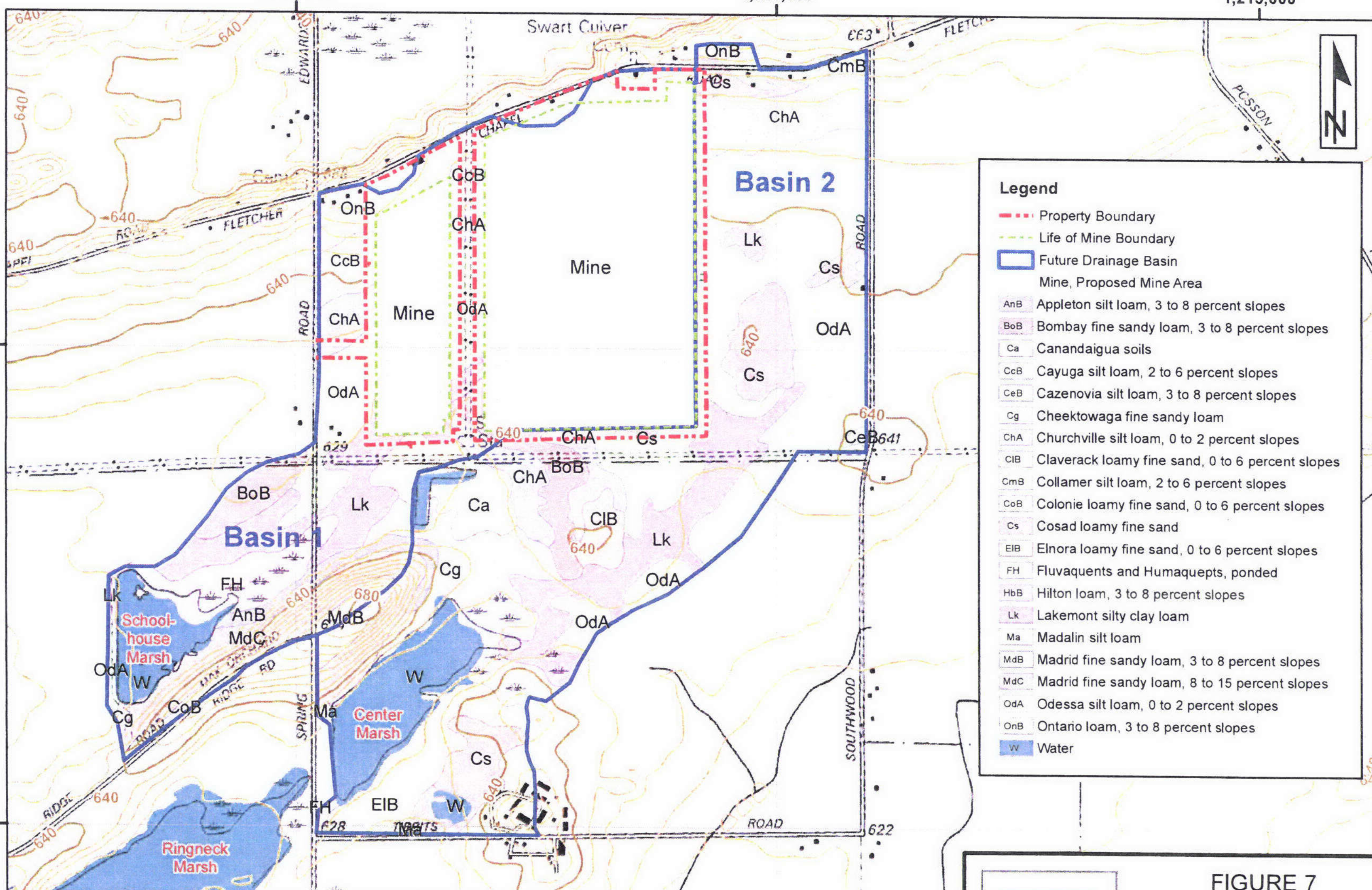
FIGURE 6

EXISTING SURFACE WATER DRAINAGE BASINS

Frontier Stone Quarry
Frontier Stone LLC

Town of Shelby
Orleans County, New York

Path: Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Existing Drainage Basin.mxd
Date Saved: 2/18/2011 11:38:14 AM



Notes:
- Basemap - NYS Department of Transportation Raster planimetric layer (Knowlesville and Medina quadrangles)
- Topographic contours based on New York State Digital Elevation Models (DEM). U.S. Geological Survey and modified by Alpha Geoscience.
- Water features based on USDA Soil Survey and orthoimagry (1994-1999), NYS Office of Cyber Security & Critical Infrastructure Coordination.
- Soil Survey Geographic (SSURGO) database for Orleans County New York, U.S. Department of Agriculture, Natural Resources Conservation Service and modified by Alpha Geoscience.

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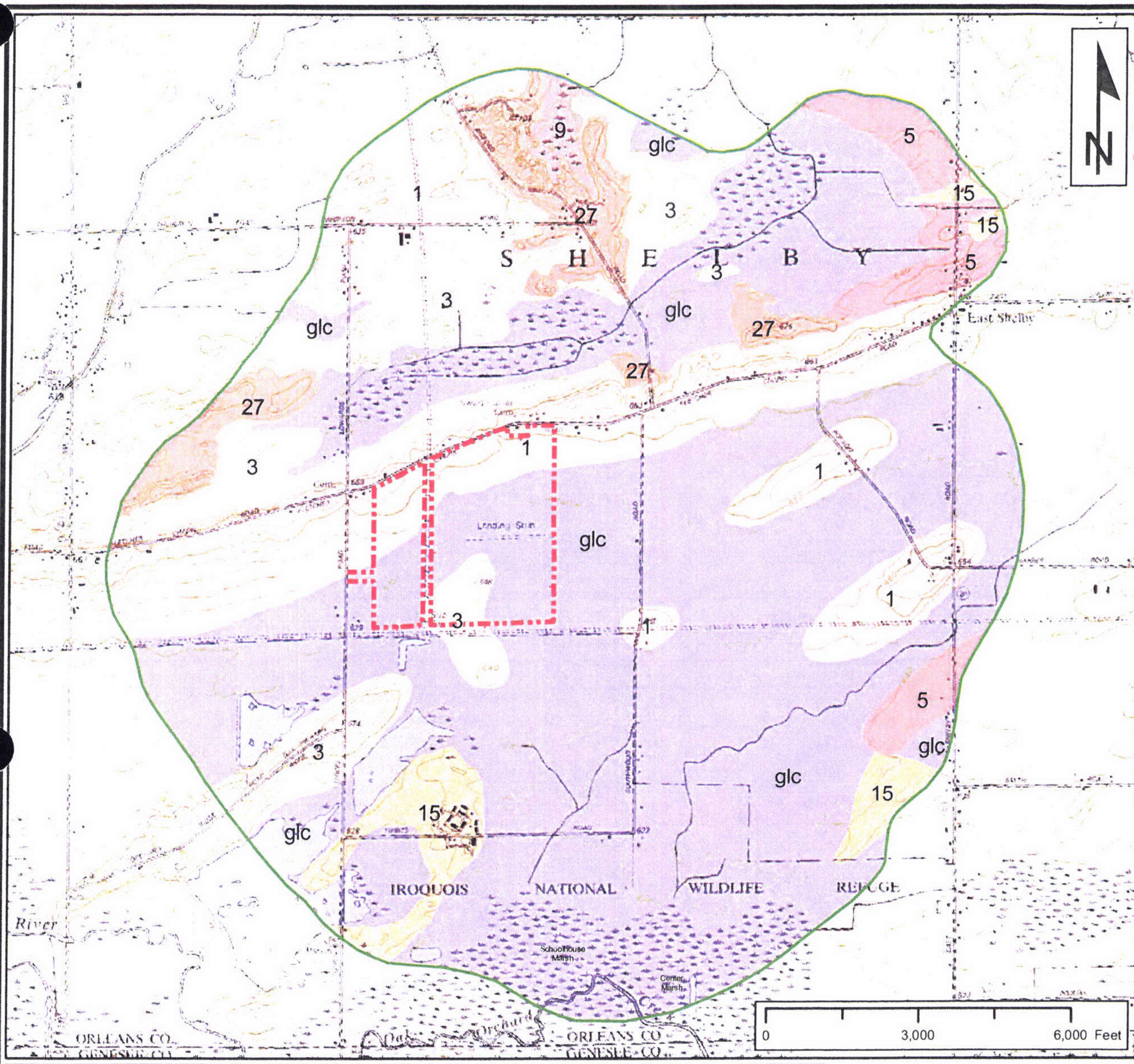
Alpha Proj. No. 08122

FIGURE 7
FUTURE SURFACE WATER DRAINAGE BASINS

Frontier Stone Quarry
Frontier Stone LLC

Town of Shelby
Orleans County, New York

Path Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Regional Map_with soils.mxd
Date Saved 2/18/2011 11 32 06 AM



Legend

Area of Groundwater Contribution

Property Boundary

Soil Associations Primarily Formed in Glacial Till

- 1 Ontario-Hilton Association
- 3 Bombay-Madrid Association
- 5 Hilton-Appleton Association
- 9 Sun-Massena Association

Soil Associations Primarily Formed in Sandy Deltaic and Glaciolacustrine Sediments

- 15 Elnora-Colonie Association

Soil Associations Primarily Formed in Gravelly and Sandy Glacial Outwash

- 27 Howard Association

Soils Formed Primarilly in Silty or Clayey Glaciolacustrine Sediments

- glc Glaciolactrine

Soil Association		Total Area (acres)
1	Ontario-Hilton	1,050.65
3	Bombay-Madrid	615.96
5	Hilton-Appleton	200.73
9	Sun-Massena	35.78
15	Elnora-Colonie	191.47
27	Howard	288.44
glc	Glaciolacustrine	3,228.43
	Total	5,611.47

Notes:
-NYS Department of Transportation Raster Quadrangle (Medina and Knowlesville quadrangles)
-The total area shown for the soil associations include the pond acreage.

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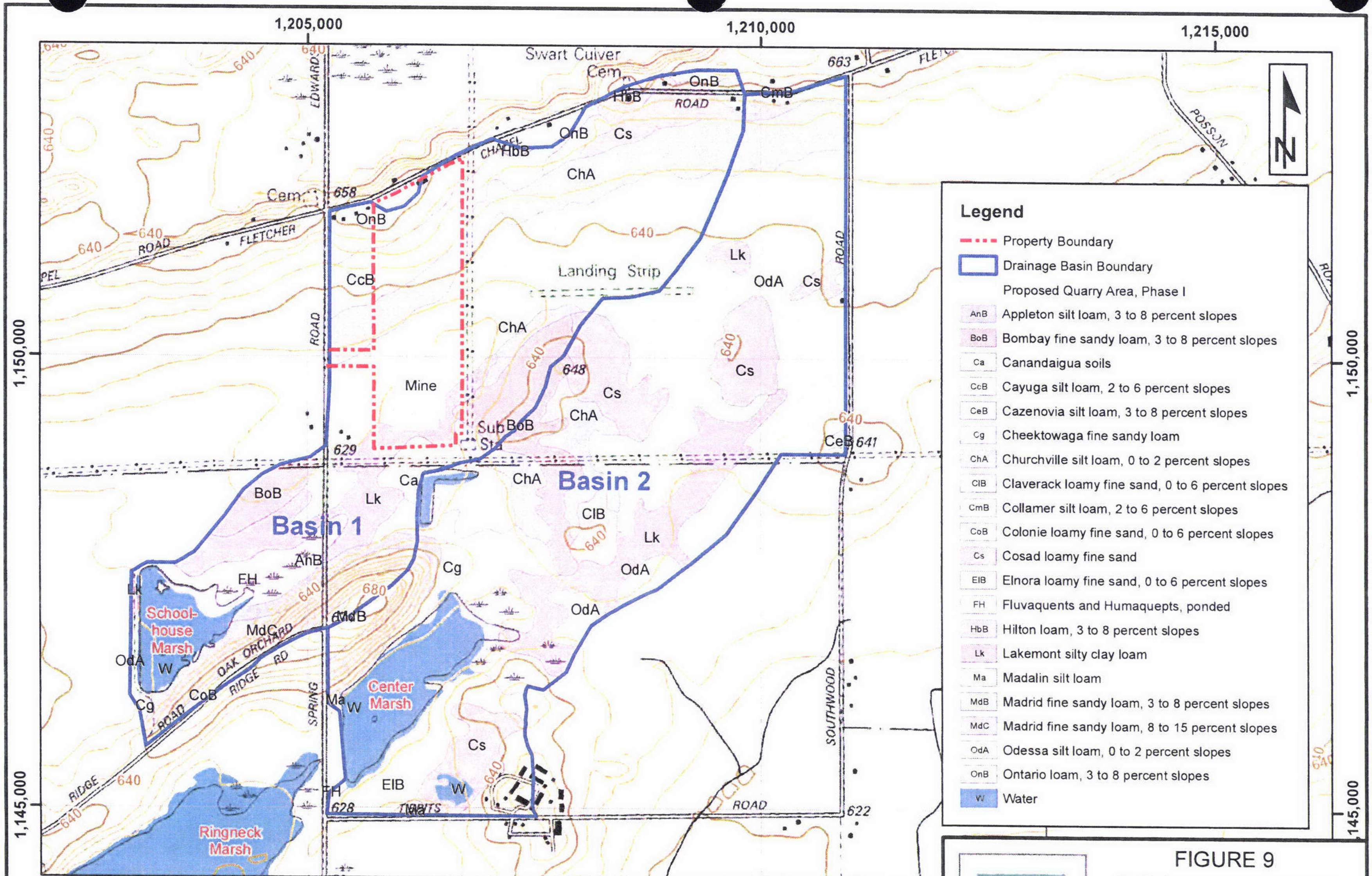
Alpha Proj. No. 08122

FIGURE 8

Map of Soil Associations

Frontier Stone Quarry
Frontier Stone LLC
Town of Shelby
Orleans County, New York

Map Document: (Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Regional Map-surficial geo area of Contribution_8.5x11.mxd)
12/29/2008 -- 2:23:37 PM



Notes:
- Basemap - NYS Department of Transportation Raster planimetric layer (Knowlesville and Medina quadrangles)
- Topographic contours based on New York State Digital Elevation Models (DEM). U.S. Geological Survey and modified by Alpha Geoscience.
- Water features based on USDA Soil Survey and orthoimagry (1994-1999), NYS Office of Cyber Security & Critical Infrastructure Coordination.
- Soil Survey Geographic (SSURGO) database for Orleans County New York, U.S. Department of Agriculture, Natural Resources Conservation Service and modified by Alpha Geoscience.

0 1,500 3,000 Feet

1,210,000

ALPHA GEOSCIENCE
Alpha Proj. No. 08122

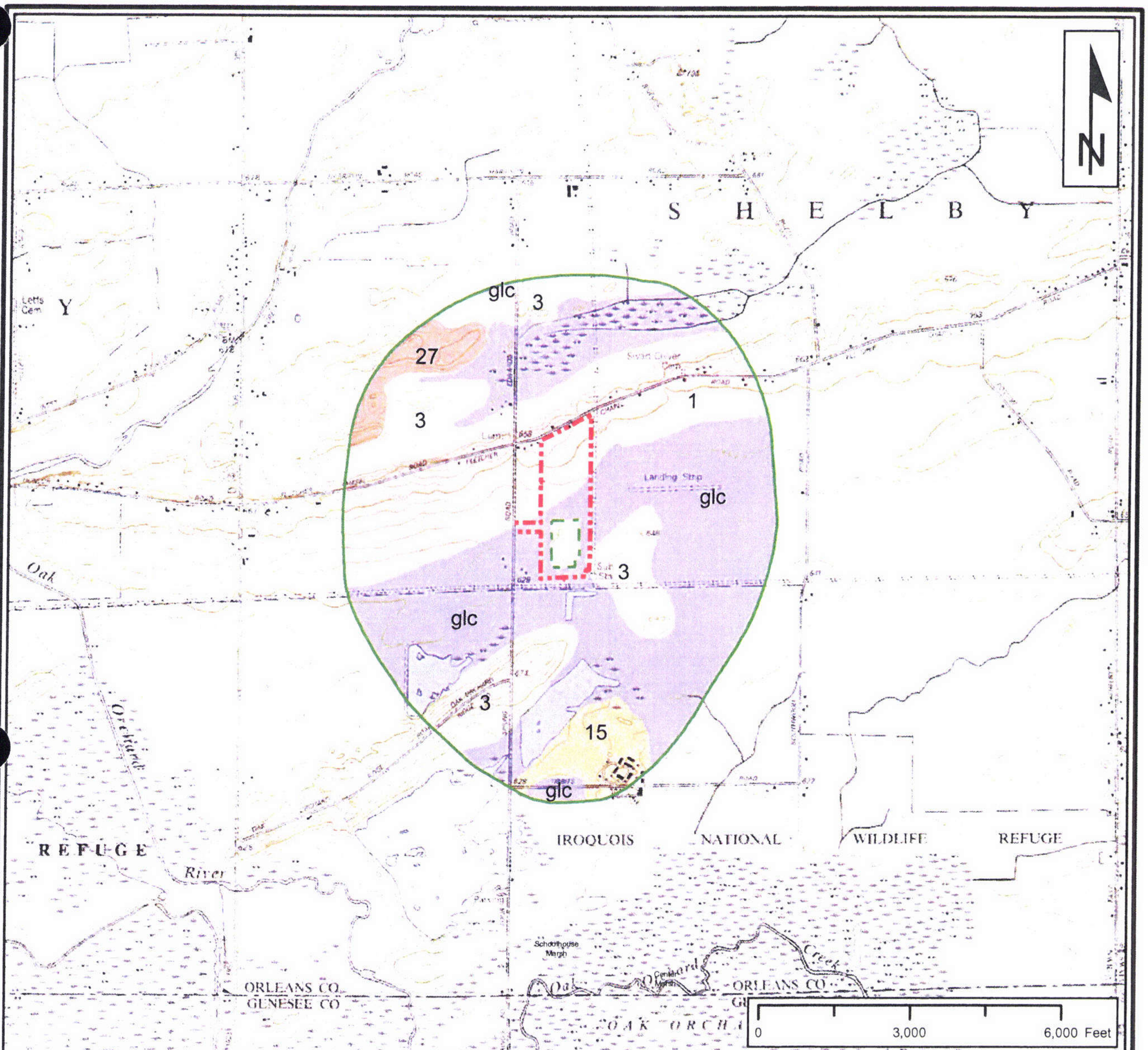
FIGURE 9

FUTURE SURFACE WATER DRAINAGE BASINS AT THE END OF PHASE 1 MINING

Frontier Stone Quarry
Frontier Stone LLC

Town of Shelby
Orleans County, New York

Path: Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Future_Soils_Phasel.mxd
Date Saved: 2/18/2011 11:05:34 AM



Legend

- Area of Groundwater Contribution
- Property Boundary
- Phase I Quarry Area

Soil Associations Primarily Formed in Glacial Till

1 Ontario-Hilton Association

3 Bombay-Madrid Association

Soil Associations Primarily Formed in Sandy Deltaic and Glaciolacustrine Sediments

15 Elnora-Colonie Association

Soil Associations Primarily Formed in Gravelly and Sandy Glacial Outwash

27 Howard Association

Soils Formed Primarilly in Silty or Clayey Glaciolacustrine Sediments

glc Glaciolactrine

Soil Association		Total Area (acres)
1	Ontario-Hilton	332.0
3	Bombay-Madrid	326.1
15	Elnora-Colonie	72.9
27	Howard	54.5
glc	Glaciolacustrine	803.6
Mine	Phase I Quarry	11.6
	Total	1,600.7

Notes:
-NYS Department of Transportation Raster Quadrangle (Medina and Knowlesville quadrangles)
-The total area shown for the soil associations include the pond acreage.

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Alpha Proj. No. 08122

FIGURE 10
Map of Soil Associations
Phase 1

Frontier Stone Quarry
Frontier Stone LLC
Town of Shelby
Orleans County, New York

Path: Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Regional Map-surficial geo area of Contribution_Phase-I_8.5x11.mxd
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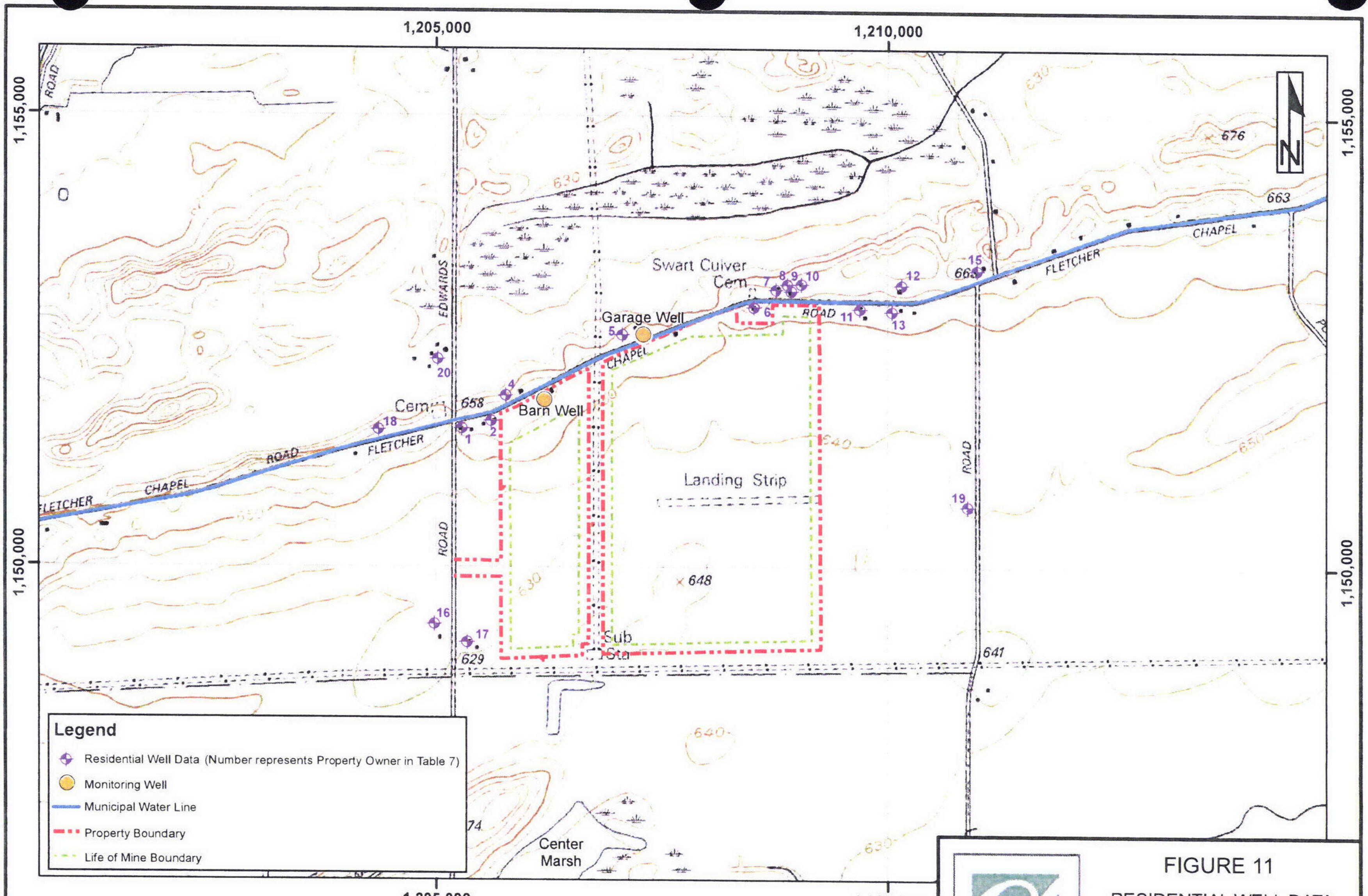

Notes:
- Basemap - NYS Department of Transportation Raster Quadrangle (1:24,000 scale - UTM Zone 18, NAD 83). Portions of the Knowlesville and Medina quadrangles are shown.
- Topographic contours are shown in feet above mean sea level
- Contour intervals are 10 feet (Knowlesville quadrangle) and 5 feet (Medina quad).
- Grid shown is New York State Plane West (NAD 83) feet.

ALPHA GEOSCIENCE
Alpha Proj. No. 08122

FIGURE 11

RESIDENTIAL WELL DATA

Frontier Stone Quarry
Frontier Stone LLC

Town of Shelby
Orleans County, New York

Path: Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Residential Well Data.mxd
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APPENDIX A

Hydrogeologic Logs of Rock Cores

Alpha Geoscience 679 Plank Road Clifton Park, New York 12065	**HYDROGEOLOGIC LOG**	**Boring ID: 1-05** Page 1 of 3

Project Number/Name: 08122/ Frontier Stone — Location: Town of Shelby, New York

Drilling Contractor/Personnel: NA

Geologist/Inspector: Sam Gowan — Start/ 8/11/2008 Finish Date: 8/12/2008

Drilling Equip/Method: Mud Rotary — Size/Type of Bit: NX

Sampling Method: Core — Well Installed? Yes

Elevation/Ground Surface: 632.41 ft

Depth to Ground Water from Ground Surface (Date): NA

REMARKS: Log of potential water bearing fractures and zones. Geology logged by CPI

Depth (Ft)	DESCRIPTION
	0 - 38 ft Overburden (see CPI Log)
40	40.7 ft Horizontal Fracture, reddish brown, mud stained
	40.7 - 41.5 ft Vertical Fracture, irregular
	41.9 ft Parting, mud caked, break along stylolites
	44.5 ft Horizontal fracture, mud caked
45	45.1 - 46.2 ft Porous, vuggy zone; readily passes water; rock is gray to weathered brown
	46.2 - 48.3 ft Slightly porous and vuggy
	48.3 - 56.9 ft Scattered, small, discontinuous vugs
50	
55	
	56.9 - 57.2 ft Very porous, vuggy zone; readily passes water; slightly weathered
60	

Alpha Geoscience
679 Plank Road
Clifton Park, New York 12065

HYDROGEOLOGIC LOG

Boring ID. 1-05

Project Number/Name: 08122/ Frontier Stone

Location: Town of Shelby, NY

Depth (Ft)	DESCRIPTION
65	
	67.0 ft Irregular horizontal fracture; slightly weathered
	67.5 - 67.6 ft Vuggy, porous, weathered zone
	Vuggy, porous character diminishes and ends by 79.0 ft
70	
75	
80	
	82.0 - 82.1 ft Horizontal, weathered, shaley zone
85	85.4 - 85.1 ft Horizontal, shaley zone; broken; unweathered; fresh break
	89.0 ft Irregular fracture break, unweathered; appears to be a fresh surface
90	

Alpha Geoscience 679 Plank Road Clifton Park, New York 12065	HYDROGEOLOGIC LOG	Boring ID. 1-05 Page 3 of 3

Project Number/Name: 08122/ Frontier Stone   Location: Town of Shelby, NY

Depth (Ft)	Scale Change / DESCRIPTION
	93.4 - 96.2 ft Start of vuggy limestone; fresh; unweathered; does not pass water
	96.2 - 96.6 ft Coarse, open, vuggy zone; fresh; unweathered; does not pass water; with vertical fractures healed with calcite
	96.6 - 99.5 ft Calcite field vugs and calcite healed fractures; unweathered
	99.5 - 160 ft Scattered, fresh, core breaks along irregular, dark stylolites and shale laminae
110	
130	
150	
	T.D. 160 ft No water bearing zones observed below 82.1 ft
170	

ALPHA GEOSCIENCE
Alpha Geoscience
679 Plank Road
Clifton Park, New York 12065

HYDROGEOLOGIC LOG

Boring ID: 2-05

Project Number/Name: 08122/ Frontier Stone
Location: Town of Shelby, New York

Drilling Contractor/Personnel: NA

Geologist/Inspector: Sam Gowan
Start/ 8/12/2008
Finish Date: 8/12/2008

Drilling Equip/Method: Mud Rotary
Size/Type of Bit: NX

Sampling Method: Core
Well Installed? No

Elevation/Ground Surface: 632.0 ft

Depth to Ground Water from Ground Surface (Date):

REMARKS: Log of potential water bearing fractures and zones. Geology logged by CPI

Depth (Ft)	DESCRIPTION
	0 - 33.5 ft Overburden (see CPI)
35	35.0 - 35.9 ft Interval of large vugs; with brown granular minerals bordering vugs; apparent slight weathering
	35.9 - 36.2 ft Large open vugs; badly broken zone; with some brown weathered zones; likely passes water
	36.2 - 38.0 ft Interval of small to medium vugs; apparent weathering in large vugs
40	
	42.6 ft Horizontal fracture zone; slightly weathered
	43.5 ft Horizontal fracture zone; slightly weathered
	43.5 - 44.4 ft Interval of small to medium vugs; slight weathering on larger vugs
45	45.2 - 45.6 ft Porous zone; passes water through core; horizontal to oblique fractures at 45.6 ft; slightly weathered
50	

ALPHA GEOSCIENCE Alpha Geoscience 679 Plank Road Clifton Park, New York 12065	**HYDROGEOLOGIC LOG**	**Boring ID. 2-05** Page 2 of 3

Project Number/Name: 08122/ Frontier Stone   Location: Town of Shelby, NY

Depth (Ft)	DESCRIPTION
	53.3 - 55.5 ft Scattered small to medium vugs; with apparent weathering associated with large vugs
55	
	57.6 ft Apparent horizontal fracture zone; with apparent brown weathering penetrating rock
	57.7 ft Apparent horizontal fracture zone; with apparent weathering
	57.9 - 58.0 ft Large vug; with apparent weathering of surrounding rock
60	
65	
	66.6 - 66.7 ft Interval of fine, irregular fractures; fresh; unweathered
70	
	71.8 - 75.4 ft Widely scattered horizontal fracture zones in platy, shale lenses; fresh; unweathered
75	
80	

ALPHA GEOSCIENCE	Alpha Geoscience 679 Plank Road Clifton Park, New York 12065	**HYDROGEOLOGIC LOG**	**Boring ID. 2-05** Page 3 of 3

Project Number/Name: 08122/ Frontier Stone

Location: Town of Shelby, NY

Depth (Ft)	DESCRIPTION Scale change
	88.0 ft Horizontal fracture zone, irregular and in a carbonaceous lense; slight reddish brown oxidation on surface; slightly weathered penetration in adjacent rock
100	100.8 - 103.6 ft Interval of numerous small to medium vugs; fresh; unweathered
120	
140	
160	T.D. 160.5 ft No apparent water bearing zones below 88.0 ft

Alpha Geoscience
679 Plank Road
Clifton Park, New York 12065

HYDROGEOLOGIC LOG

Boring ID: 3-05

Project Number/Name: 08122/ Frontier Stone — Location: Town of Shelby, New York

Drilling Contractor/Personnel: NA

Geologist/Inspector: Sam Gowan — Start/ 8/12/2008 Finish Date: 8/12/2008

Drilling Equip/Method: Mud Rotary — Size/Type of Bit: NX

Sampling Method: Core — Well Installed? No

Elevation/Ground Surface: 629.0 ft

Depth to Ground Water from Ground Surface (Date):

REMARKS: Log of potential water bearing fractures and zones. Geology logged by CPI

Depth (Ft)	DESCRIPTION
	0 - 27.0 ft Overburden (see CPI log)
	28.2 ft Horizontal fracture; slightly weathered
	28.8 - 30.0 ft Vertical fracture; slightly weathered on surface
30	
	33.7 - 36.1 ft Scattered, small to large vugs; with weathering in large vugs toward the base of the interval
35	
	39.6 ft Large vug, weathered
	39.9 - 41.4 ft Porous with scattered medium to large vugs; passes water; slightly weathered in borders of larger vugs
40	
45	

ALPHA GEOSCIENCE	Alpha Geoscience 679 Plank Road Clifton Park, New York 12065	**HYDROGEOLOGIC LOG**	**Boring ID. 3-05** Page 2 of 3

Project Number/Name: 08122/ Frontier Stone   Location: Town of Shelby, NY

Depth (Ft)	DESCRIPTION
	45.5 ft Large vug; unweathered
	47.3 ft Large vug; unweathered
50	
	52.8 - 56.0 ft Scattered large vugs; with oxidation penetrating surrounding rock at 54.3 and 55.9 ft
55	
60	
65	
70	70.5 - 145.5 ft Core breaks at carbonaceous lenses, irregular surfaces, fresh and unweathered
75	

Alpha Geoscience 679 Plank Road Clifton Park, New York 12065	HYDROGEOLOGIC LOG	Boring ID. 3-05 Page 3 of 3

Project Number/Name: 08122/ Frontier Stone   Location: Town of Shelby, NY

Depth (Ft)	DESCRIPTION Scale change
95	
115	
135	
155	T.D. 153.8 ft No apparent water bearing zones below 55.9 ft

Alpha Geoscience
679 Plank Road
Clifton Park, New York 12065

HYDROGEOLOGIC LOG

Boring ID: 4-05

Project Number/Name: 08122/ Frontier Stone | Location: Town of Shelby, New York

Drilling Contractor/Personnel: NA

Geologist/Inspector: Sam Gowan | Start/ 8/12/2008 Finish Date: 8/12/2008

Drilling Equip/Method: Mud Rotary | Size/Type of Bit: NX

Sampling Method: Core | Well Installed? Yes

Elevation/Ground Surface: 637.05 ft

Depth to Ground Water from Ground Surface (Date):

REMARKS: Log of potential water bearing fractures and zones. Geology logged by CPI.

Depth (Ft)	DESCRIPTION
	0 - 36.5 ft Overburden (see CPI log)
35	
	36.7 - 37.0 ft Large open vugs; unweathered
	37.0 - 40.1 ft Interval of numerous small vugs; unweathered; fresh
40	40.1 - 40.2 ft Vuggy; porus; weathered; passes water slowly
	40.2 - 42.2 ft Scattered small to medium sized vugs; weathered halos around larger vugs
	42.2 - 42.3 ft Horizontal interval of weathered, sandy rock; with fine horizontal fractures
45	
	46.3 ft Vug; slightly weathered halo around vug
	46.5 - 55.8 ft Scattered vugs; with slight weathering in rock surrounding vugs
50	

ALPHA GEOSCIENCE

Alpha Geoscience
679 Plank Road
Clifton Park, New York 12065

HYDROGEOLOGIC LOG

Boring ID. 4-05

Project Number/Name: 08122/ Frontier Stone

Location: Town of Shelby, NY

Depth (Ft)	DESCRIPTION	
55	55.8 - 56.3 ft	Interval of large vugs; brown, weathered rock around opening
	56.9 - 57.0 ft	Weathered, vuggy lense; with vertical fracture in interval and extending below; fractures filled with calcite
	57.0 - 62.0 ft	Scattered small to medium sized vugs; with apparent brown, weathering surrounding larger vugs
60		
65		
70		
75	75.5 - 76.3 ft	Scattered, large vugs; with brown, fine granular mineral bordering vug; apparent weathering
80		

HYDROGEOLOGIC LOG

Boring ID. 4-05

Project Number/Name: 08122/ Frontier Stone

Location: Town of Shelby, NY

Depth (Ft)	DESCRIPTION
	Scale change
	86.5 ft Large vug; with brown minerals in vug; vug does not penetrate core width and surrounding rock is fresh and unweathered
	91.5 - 91.7 ft Large, unweathered vug
	96.3 - 99.7 ft Medium to small vugs; fresh; unweathered
	99.7 ft Core breaks on horizontal, black stylolites and laminae; fresh, unweathered surfaces
100	
120	
140	
	T.D. 151.5 ft
	No apparent water bearing zones below 76.3 ft
160	

Alpha Geoscience 679 Plank Road Clifton Park, New York 12065	**HYDROGEOLOGIC LOG**	**Boring ID: 5-05** Page 1 of 3

Project Number/Name: 08122/ Frontier Stone — Location: Town of Shelby, New York

Drilling Contractor/Personnel: NA

Geologist/Inspector: Sam Gowan — Start/ 8/11/2008 Finish Date: 8/12/2008

Drilling Equip/Method: Mud Rotary — Size/Type of Bit: NX

Sampling Method: Core — Well Installed? Yes

Elevation/Ground Surface: 624.21 ft

Depth to Ground Water from Ground Surface (Date):

REMARKS: Log of potential water bearing fractures and zones. Geology logged by CPI

Depth (Ft)	DESCRIPTION
	0 - 23.0 ft Overburden (see CPI log)
	23.4 ft Core break; mud caked
	24.6 ft Horizontal fracture; irregular; slightly weathered
25	24.6 - 27.4 ft Lightly vuggy; with occasional vertical fractures; with slightly oxidized/weathered zones
	27.4 - 27.5 ft Very porous; brown; oxidized zone
30	30.4 - 30.6 ft Vertical fracture; reddish brown iron stain on surface
35	
	35.4 ft Very porous, vuggy zone; brown; weathered; readily passes water
	36.0 - 37.5 ft Slightly porous, vuggy zone; brown, weathered rinds around larger vugs
40	

ALPHA GEOSCIENCE	Alpha Geoscience 679 Plank Road Clifton Park, New York 12065	**HYDROGEOLOGIC LOG**	**Boring ID. 5-05** Page 2 of 3

Project Number/Name: 08122/ Frontier Stone — Location: Town of Shelby, NY

Depth (Ft)	DESCRIPTION
	41.0 - 41.4 ft Slightly vuggy zone with brown weathering halo around larger vugs
	41.3 ft Irregular horizontal fracture at black laminated zone; brown weathered zone bordering fracture
45	
	45.2 - 46.7 ft Vuggy zone; slightly porous
	46.7 ft Scattered vugs; vertical fractures and horizontal core breaks along stylolites and black laminae; fresh unweathered surfaces
50	
	51.9 ft Large, weathered vug; brown; loose, weathered grains in vug
	53.0 - 53.7 ft Vuggy zone; weathered porous rock around vugs; vugs readily pass water
	54.3 - 55.0 ft Vertical joint; unweathered rock on exposed surface
55	
	56.5 - 56.6 ft Vug; with radiating fractures out from opening; calcite precipitated on surface; halo of brown, weathered rock bordering vug
	56.6 - 57.9 ft Interval of scattered vugs extending across core; weathered, halo around vugs
	57.9 - 65 ft Less vuggy; scattered horizontal fractures along stylolites and black laminae; fresh, unweathered surfaces on fractures; scattered vertical fractures healed with calcite; vugs are slightly weathered, but do not penetrate through core
60	
65	
70	

ALPHA GEOSCIENCE	Alpha Geoscience 679 Plank Road Clifton Park, New York 12065	HYDROGEOLOGIC LOG	**Boring ID. 5-05** Page 3 of 3

Project Number/Name: 08122/ Frontier Stone   Location: Town of Shelby, NY

Depth (Ft)	DESCRIPTION Scale change
	86.0 ft Horizontal fracture; irregular stylolite; fresh, unweathered surface
	86.0 - 161 ft Scattered horizontal fractures on stylolites and black laminae; all fresh, unweathered surfaces
90	
110	
	126.0 - 131 ft Zone of numerous small vugs; fresh; unweathered; interval does not pass water
130	
150	
	T.D. 161 ft
	No apparent water bearing zones below 57.9 ft

APPENDIX B

Soil Sampling Logs

SOIL SAMPLING LOG

Alpha Geoscience
679 Plank Road
Clifton Park, New York 12065

ALPHA GEOSCIENCE

Soil Probe No. 1
Job No. 08122

DATE/TIME STARTED: 9/16/2008/ 14:15
DATE/TIME COMPLETED: 9/16/2008/ 15:15
PROJECT: Frontier Stone
SURFACE ELEVATION: NA
DATUM: NA
WATER ELEVATION: NA

SITE: Iroquois National Wildlife Refuge
CONTRACTOR: NA
EQUIPMENT: Hand Auger
INSPECTOR: Sam Gowan/Trevor Gowan
John Hellert

DEPTH	DESCRIPTION OF SOIL		COMMENTS
	0 - 0.6'	Dk Brown, Organic Silt; with roots; moist	FS-8 = GPS Location
1.0	0.6 - 1.1'	Lt Brownish Grey silty clay with some very fine sand, mottled with yellowish brown to reddish brown; moist	S-1 - sample retained 0.6' - 1.0'
2.0	1.1 - 2.1'	with Trace sand	
3.0	2.1 - 3.5'	Lt brown Gray, clay; little silt with yellowish brown and reddish brown mottling, moist	
4.0	3.5 - 5.7'	Reddish Brown, Clayey Silt; with streaks of Lt yellowish gray silt	likely varved
5.0			S-2 - sample retained 3.7' - 4.2'
6.0		Total Depth 5.7 ft	
7.0			
8.0			
9.0			
10.0			

Proportions Used: Trace=0-10% Little=10-20% Some=20-35% And-35-50%

SOIL SAMPLING LOG

Alpha Geoscience
679 Plank Road
Clifton Park, New York 12065

ALPHA GEOSCIENCE

Soil Probe No. 2
Job No. 08122

DATE/TIME STARTED: 9/16/2008/ 16:30
DATE/TIME COMPLETED: 9/16/2008/ 17:30
PROJECT: Frontier Stone
SURFACE ELEVATION: NA
DATUM: NA
WATER ELEVATION: NA

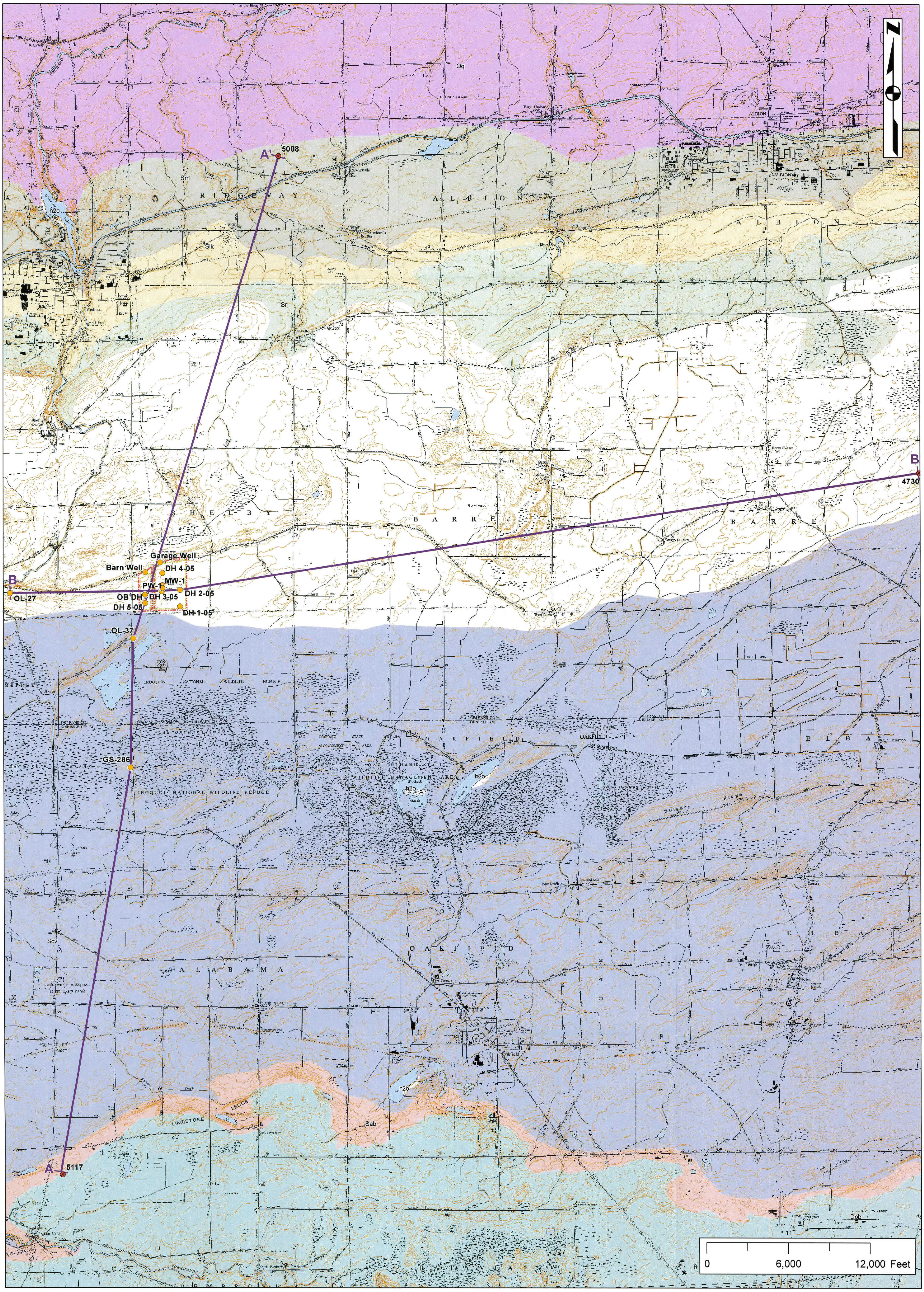
SITE: Iroquois National Wildlife Refuge
CONTRACTOR: NA
EQUIPMENT: Hand Auger
INSPECTOR: Sam Gowan/Trevor Gowan

DEPTH	DESCRIPTION OF SOIL		COMMENTS
	0 - 0.9'	Brown Silt, organic with roots and organic debris; moist	FS-13 = GPS Location
1.0	0.9 - 2.0'	Lt Gray to brown silt, mottled with Lt gray and reddish brown; moist	
2.0	2.0 - 4.7'	Lt Gray to reddish brown clayey silt, mottled; moist	2.0 - 4.7 May be varved with light gray red reddish brown, varved structure destroyed by sampling
3.0			S-1 - sample retained 2.2' - 2.7'
4.0			
5.0	4.7 - 6.2'	Reddish Brown Clayey silt, with interlayered with Lt gray silt with Little very fine sand, moist	4.7 to 6.2 apparent varves
6.0			S-2 - sample retained 4.7' - 5.2'
		Total Depth 6.2 ft	
7.0			
8.0			
9.0			
10.0			

Proportions Used: Trace=0-10% Little=10-20% Some=20-35% And-35-50%

APPENDIX C

Regional Geologic Cross Sections



Legend

- Monitoring Well
- Deep Drill Hole
- Regional_X-Sections
- Property Boundary
- Life of Mine Boundary

Bedrock Geology

Onondaga Formation
- Dob, Onondaga Limestone

Salina Group
- Sab, Akron Dolostone
- Scv, Camillus and Vernon Shales

Clinton Group (Lockport Formation)
- Sl, Guelph Dolostone
- Sr, Decew Dolostone
- Sik, Irondequoit Limestone

Medina Group
- Sm, Thorold Sandstone
- Oq, Queenston Formation

Notes:
-NYS Department of Transportation Raster Quadrangle
-Elevations are shown in feet above mean sea level.
-Bedrock Geology of New York State - Niagara Sheet. New York State Museum GIS Dataset based on Map and Chart Series 15. Publication_Date: 7/19/1999

ALPHA GEOSCIENCE
Alpha Proj. No. 08122

ATTACHMENT A

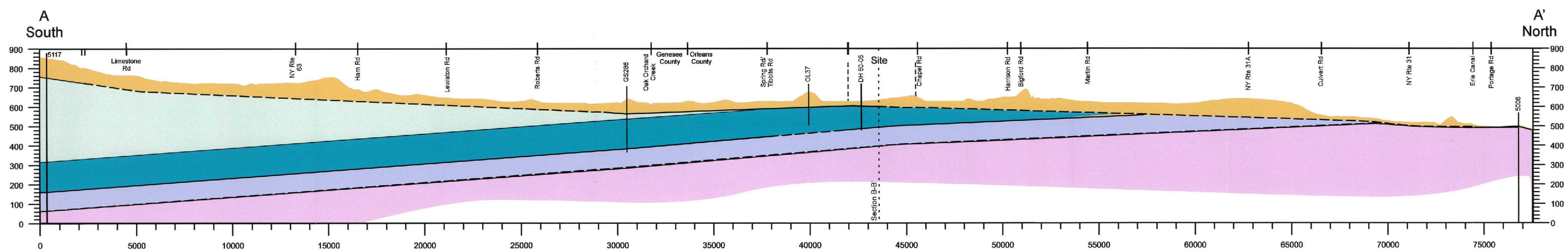
GEOLOGIC CROSS SECTION LOCATIONS

Frontier Stone LLC
Frontier Stone Quarry

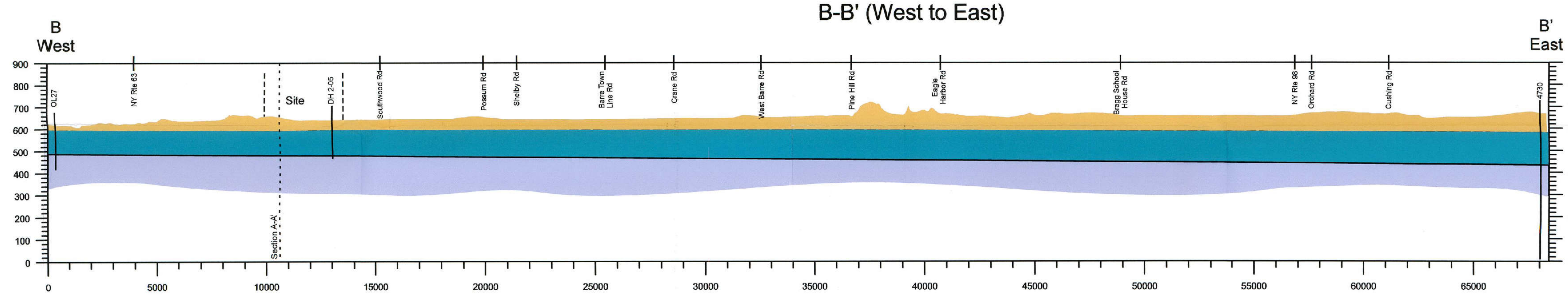
Town of Shelby
Orleans County, New York

Map Document: (Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Regional Cross Section Map.mxd)
8/22/2008 -- 2:00:55 PM

A-A' (South to North)



B-B' (West to East)



LEGEND

Glacial Overburden

Bedrock Geology

Salina Group

Lockport Formation

Rochester Fm

Medina Fm

STRIKE = N 88° E
Apparent Dip = 0.42° SSE
(5117 to GS286, top of Rochester)
~7.4 FT per 1000 FT

300
SCALE
(feet)
0
3000

ALPHA
GEOSCIENCE
Project No. 08122

ATTACHMENT B

GEOLOGIC CROSS SECTIONS

FRONTIER STONE LLC
FRONTIER STONE QUARRY

Town of Shelby, Orleans County, New York

08122 - Frontier Stone\Cross-Sections\Cross-Section.cvx

APPENDIX D

Water Level Data Provided by the U.S. Fish and Wildlife Service

Note: The tabulated water level data provided in Appendix D are exactly as provided by the U.S. Fish and Wildlife Service. The initials b.g. represent "below gage" and the initials d.d. represent "draw down".

Schoolhouse Marsh Water Levels
Year: 2002

Date	*Water Level*
3-Jan	621.0
17-Jan	621.1
29-Jan	621.0
1-Feb	621.1
9-Feb	621.0
15-Feb	621.1
28-Feb	621.5
1-Mar	621.5
8-Mar	622.4
18-Mar	622.5
4-Apr	622.7
15-Apr	622.8
25-Apr	622.3
29-Apr	622.5
3-May	622.4
14-May	624.0
30-May	623.4
3-Jun	623.4
13-Jun	623.3
1-Jul	623.2
15-Jul	622.9
29-Jul	622.8
1-Aug	622.7
19-Aug	622.1
30-Aug	621.8
3-Sep	621.7
15-Sep	621.7
27-Sep	621.6
30-Sep	621.7
1-Oct	621.7
18-Oct	621.6
28-Oct	621.6
1-Nov	621.6
14-Nov	621.7
29-Nov	622.2
6-Dec	622.4
17-Dec	623.0

Schoolhouse Marsh Water Levels
Year: 2003

Date	*Water Level*
2-Jan	623.3
7-Jan	623.4
30-Jan	623.4
4-Feb	623.4
28-Feb	623.5
5-Mar	623.5
31-Mar	623.5
1-Apr	623.5
18-Apr	623.5
30-Apr	623.3
2-May	623.4
19-May	624.0
2-Jun	623.8
12-Jun	623.8
19-Jun	623.3
27-Jun	623.2
3-Jul	623.2
21-Jul	623.0
31-Jul	623.0
15-Aug	623.1
2-Sep	623.0
15-Sep	622.9
1-Oct	622.9
8-Oct	622.5
15-Oct	622.5
30-Oct	622.6
3-Nov	622.7
17-Nov	622.7
20-Nov	622.9
1-Dec	624.0
30-Dec	624.0

Schoolhouse Marsh Water Levels
Year: 2004

Date	*Water Level*
15-Mar	623.9
30-Mar	623.5
16-Apr	623.3
5-May	620.8
19-May	d.d.
21-May	620.6
7-Jun	d.d.
14-Jun	d.d.
30-Jun	d.d.
16-Jul	d.d.
30-Jul	d.d.
16-Aug	d.d.
1-Sep	d.d.
13-Sep	621.0
14-Sep	620.9
15-Sep	620.9
21-Sep	620.8
30-Sep	620.7
15-Oct	620.6
1-Nov	620.8
15-Nov	621.4
30-Nov	622.4
16-Dec	623.1

Schoolhouse Marsh Water Levels
Year: 2005

Date	*Water Level*
12-Jan	623.1
18-Jan	623.5
21-Mar	623.0
28-Mar	623.5
15-Apr	623.3
27-Apr	623.4
2-May	623.6
16-May	623.6
1-Jun	623.4
15-Jun	623.4
1-Jul	623.2
15-Jul	623.0
1-Aug	622.8
15-Aug	622.7
1-Sep	623.0
15-Sep	622.8
12-Oct	623.2
24-Oct	623.6
1-Nov	623.8
15-Nov	623.8
1-Dec	623.6
15-Dec	623.4
30-Dec	623.7

Schoolhouse Marsh Water Levels
Year: 2006

Date	*Water Level*
17-Jan	621.1
2-Feb	623.5
21-Feb	623.9
8-Mar	623.8
24-Mar	624.2
11-Apr	623.4
11-Apr	624.2
4-May	624.1
25-May	624.1
16-Jun	623.9
12-Jul	623.8
28-Jul	624.2
18-Aug	624.1
5-Sep	624.3
18-Sep	624.5
6-Oct	624.4
20-Oct	624.6
2-Nov	624.4
17-Nov	624.7
29-Nov	623.9
4-Dec	624.6
18-Dec	624.5

Schoolhouse Marsh Water Levels
Year: 2007

Date	*Water Level*
8-Jan	624.9
11-Jan	624.7
2-Apr	624.8
11-Apr	624.7
23-Apr	624.6
16-May	624.5
30-May	624.5
12-Jun	624.2
22-Jun	624.2
6-Jul	623.9
23-Jul	623.7
6-Aug	623.4
16-Aug	623.3
31-Aug	623.2
22-Sep	623.0
29-Sep	623.0
6-Oct	623.0
26-Oct	623.2
8-Nov	623.2
12-Dec	624.4

Schoolhouse Marsh Water Levels
Year: 2008

Date	*Water Level*
2-Jan	624.8
15-Jan	624.9
4-Feb	624.3
19-Feb	624.6
18-Mar	624.3
10-Apr	624.3
14-May	623.3
27-May	623.3
11-Jun	622.8
24-Jun	622.9
7-Jul	622.9
21-Jul	622.8
24-Jul	622.8
4-Aug	622.4
11-Aug	622.5
28-Aug	622.3
3-Sep	622.3
15-Sep	622.3
1-Oct	622.2
16-Oct	622.3
24-Oct	622.6
27-Oct	623.0

Water Levels 2003-2008

Center Marsh			Ringneck
Date		Water Level	
3-Jan	624.2		621
17-Jan	624.7		621.3
29-Jan	624.9		621.4
1-Feb	625		621.4
15-Feb	625.4		621.5
28-Feb	625.5		621.4
1-Mar	625.5		621.4
8-Mar	625.6		621.5
18-Mar	625.9		621.7
4-Apr	626.2		622
15-Apr	626.4		622
2-May	625.1		622.1
14-May	624.5		622.2
30-May	624.1		621.6
3-Jun	624.1		621.6
13-Jun	624		621.4
1-Jul	623.9		621.3
15-Jul	623.5		621
29-Jul	623.4		620.9
1-Aug	623.5		623.3
19-Aug	623.3		620.5
3-Sep	623		620.4
15-Sep	623		620.3
30-Sep	623.1		620.3
1-Oct	623.1		620.3
18-Oct	623		620.3
28-Oct	623		620.3
1-Nov	623		620.3
14-Nov	623		620.3
29-Nov	623.4		620.6
6-Dec	623.5		620.7
17-Dec	623.8		620.7

Center Water Control Structure Elevation at Base: 621.3

Center Marsh			Ringneck
Date		Water Level	
2-Jan	624		620.9
7-Jan	624.1		621
30-Jan	624.1		621
4-Feb	624.1		621
11-Feb	624.1		
28-Feb	624.1		621.1
5-Mar	624.1		621.2
10-Mar	624.1		
12-Mar			621.2
17-Mar	624.1		
21-Mar	624.3		621.4
26-Mar	624.2		
31-Mar	624.5		621.6
1-Apr	624.5		621.6
18-Apr	624.9		621.4
30-Apr	625.1		621.3
2-May	624.8		621.4
8-May	624.8		
19-May			624
22-May	624.1		
2-Jun	624.1		623.8
12-Jun	624.1		621.7
19-Jun			621.6
27-Jun	623.8		621.6
3-Jul	623.8		621.6
21-Jul	623.7		621.3
31-Jul	623.6		620.5
12-Aug			620.1
15-Aug	623.5		620
2-Sep	623.5		619.9
15-Sep	623.7		619.9
1-Oct	623.7		619.9
15-Oct	623.7		619.9
3-Nov	623.8		620
17-Nov	624.1		620.3
1-Dec	624.8		620.7
15-Dec	624.7		620.9

Center Water Control Structure Elevation at Base: 621.3

Center Marsh		Ringneck
Date	Water Level	
12-Jan	no data	no data
20-Jan	no data	no data
2-Feb	no data	no data
26-Feb	no data	no data
1-Mar	no data	no data
15-Mar	624.5	621.5
16-Apr	625.7	621.6
5-May	624.9	621.5
19-May	624	621.4
7-Jun	624	621.5
14-Jun	624	621.3
16-Jul	623.9	621.3
30-Jul	624	621.3
16-Aug	624	621.4
1-Sep	624	621.4
15-Sep	624.1	621.7
5-Oct	623.8	621.3
15-Oct	623.7	621.2
1-Nov	623.7	621.2
15-Nov	623.9	621.3
16-Dec	624.5	621.5

Center Water Control Structure Elevation at Base: 621.3

Center Marsh		Ringneck
Date	Water Level	
12-Jan	625.2	621.6
18-Jan	625.3	621.5
2-Feb	no data	no data
26-Feb	no data	no data
18-Mar	625.2	no data
28-Mar	625.5	no data
15-Apr	624.5	621.5
25-Apr	624.2	621.6
2-May	624.1	621.3
16-May	623.5	621
1-Jun	623.5	620.8
15-Jun	623	620.9
1-Jul	draw down	620.6
15-Jul	d.d.	620.4
1-Aug	d.d.	620.3
15-Aug	d.d.	620.1
1-Sep	d.d.	620.4
15-Sep	d.d.	620.2
12-Oct	d.d.	620.4
24-Oct	d.d.	620.5
1-Nov	d.d.	620.6
15-Nov	623.9	620.7
1-Dec	624.5	621
15-Dec	624.5	621
30-Dec	624.6	621.1

Center Water Control Structure Elevation at Base: 621.3

Center Marsh		Ringneck
Date	Water Level	
17-Jan	624.6	621.1
2-Feb	624.5	
21-Feb	625.1	621.5
6-Mar	625.1	621.4
24-Mar	625.4	
11-Apr	625.5	621.6
4-May	624.7	621.4
25-May	624.4	621.4
16-Jun	623.8	621.3
12-Jul	below gauge	621.1
1-Aug	b.g.	621.5
18-Aug	b.g.	621.4
5-Sep	b.g.	621.5
18-Sep	b.g.	
6-Oct	b.g.	621.7
2-Nov	b.g.	622
17-Nov	b.g.	622
18-Dec	624.8	622

Center Water Control Structure Elevation at Base: 621.3

Center Marsh		Ringneck
Date	Water Level	
8-Jan	625	621.8
11-Apr	625	621.7
23-Apr	624.6	621.7
15-May	d.d.	621.6
12-Jun	d.d.	620.7
22-Jun	d.d.	620.5
6-Jul	d.d.	620.3
23-Jul	d.d.	620.2
6-Aug	d.d.	620
16-Aug	d.d.	619.9
22-Sep	d.d.	619.9
29-Sep	d.d.	619.9
6-Oct	d.d.	619.9
26-Oct	d.d.	619.8
8-Nov	d.d.	619.8
12-Dec	622.5	620.4
28-Dec	622.4	

Center Water Control Structure Elevation at Base: 621.3

	Center Marsh		Ringneck
Date		Water Level	
2-Jan	622.4		
15-Jan	623.4		620.9
4-Feb	623.7		621.1
19-Feb	624.6		621.4
18-Mar	625.4		621.5
25-Mar	625.5		
10-Apr	625.2		622
15-May	624.6		621.7
27-May	624.5		621.6
11-Jun	624.4		621.5
24-Jun	624.5		621.6
7-Jul	624.7		621.6
21-Jul	623		621.9
24-Jul	621.9		622.9
4-Aug	622		621.6
11-Aug	622.1		621.8
3-Sep	below gauge		621.4
15-Sep	below gauge		621.4
1-Oct	below gauge		621.3

Center Water Control Structure Elevation at Base: 621.3

APPENDIX E

Seepage Face Height Calculations

Seepage Face Height Calculations
Frontier Stone
(Based on 9/16/08 Water Level Data)

DH1-05

Base of Aquifer = 632.41 ft surface Elevation – 82.1 ft to deepest fracture
= 550.31 ft amsl
Water Level at face near DH1-05 = 624.1 ft amsl
Seepage face = 1/3 of saturated thickness above aquifer base
Top of Seepage Face = ((624.1 – 550.31) ÷ 3) + 550.31 = 574.91 ft amsl

DH2-05

Aquifer Base = 632.0 ft surface elevation – 88.0 ft to deepest fracture
= 544.0 ft amsl
Water Level near DH2-05 = 624.83 ft amsl
Top of Seepage Face ((624.83 – 544) ÷ 3) + 544 = 570.95 ft amsl

DH3-05

Aquifer Base = 629.0 ft surface elevation – 55.9 ft to deepest fracture
= 573.10 ft amsl
Water Level = 623.2 ft amsl
Top of Seepage Face = ((623.2 – 573.10) ÷ 3) + 573.10 = 589.8 ft amsl

DH4-05

Aquifer Base = 637.05 ft surface elevation – 76.3 ft deepest fracture
= 560.75 ft amsl
Water Level = 624.0 ft amsl
Top of Seepage Face = ((624.0 – 560.75) ÷3) + 560.75 = 581.83 amsl

DH5-05

Aquifer Base = 624.21 ft surface elevation – 57.9 ft to deepest fracture
= 566.31 amsl
Water Level = 624.38 amsl
Top of Seepage Face = (624.38 – 566.31) ÷ 3 + 566.31 = 585.67 ft amsl

APPENDIX F

Water Budget Analyses for Soil Associations

Frontier Stone

Water Budget Analysis

#1. Ontario-Hilton Association

Month	Temp °C	Precip. P (mm)	C_r	Runoff (mm)	Infiltration (mm)	Monthly Heat Index	Annual Heat Index I	Unadjusted Monthly PE (mm)	Unadjusted Daily PE (mm)	Mean Possible Monthly Duration of Sunlight (12-hr units)	Adjusted Monthly PE (mm)	Infilt-PET (mm)	Σ Neg. Infilt. (mm)
Jan	***-4.17***	***67.06***	***0.3110***	20.85	46.20	***0.00***	45.04	0.00	0.00	***24.3***	0.00	46.20	0.00
Feb	***-3.11***	***52.58***	***0.3110***	16.35	36.23	***0.00***	45.04	0.00	0.00	***24.6***	0.00	36.23	0.00
Mar	***1.67***	***71.12***	***0.3110***	22.12	49.00	***0.19***	45.04	4.89	0.16	***30.6***	4.83	44.18	0.00
Apr	***8.17***	***79.25***	***0.3110***	24.64	54.60	***2.10***	45.04	33.18	1.11	***33.6***	37.16	17.44	0.00
May	***14.78***	***75.44***	***0.3110***	23.46	51.98	***5.16***	45.04	67.80	2.19	***37.8***	82.67	-30.69	-30.69
Jun	***19.83***	***90.42***	***0.3110***	28.12	62.31	***8.05***	45.04	96.64	3.22	***38.4***	123.70	-61.39	-92.08
Jul	***22.44***	***65.02***	***0.3110***	20.22	44.80	***9.71***	45.04	112.17	3.62	***38.7***	140.03	-95.22	-187.30
Aug	***21.33***	***80.26***	***0.3110***	24.96	55.30	***8.99***	45.04	105.51	3.40	***36***	122.53	-67.22	-254.53
Sep	***17.33***	***94.74***	***0.3110***	29.46	65.28	***6.57***	45.04	82.16	2.74	***31.2***	85.45	-20.17	-274.69
Oct	***11.06***	***72.14***	***0.3110***	22.43	49.70	***3.32***	45.04	47.79	1.54	***28.5***	43.94	5.76	0.00
Nov	***4.78***	***81.03***	***0.3110***	25.20	55.83	***0.93***	45.04	17.40	0.58	***24.3***	14.09	41.74	0.00
Dec	***-1.06***	***79.76***	***0.3110***	24.80	54.95	***0.00***	45.04	0.00	0.00	***23.1***	0.00	54.95	0.00
	9.42	***908.81***		***282.61***	626.20	45.04		567.53			654.39		
		35.78	Inches	***11.13***	Inches								

Soil Moisture Storage (ST) in millimeters *108.136*

Lattitude = 43° 17'

Month	Soil Moisture Storage (mm)	Δ Soil Moisture Storage (mm)	AET (mm)	Water Defecit (PET-AET) (mm)	Perc (mm)	Perc (in)
Jan	108.14	0.00	0.00	0.00	46.20	1.82
Feb	108.14	0.00	0.00	0.00	36.23	1.43
Mar	108.14	0.00	4.83	0.00	44.18	1.74
Apr	108.14	0.00	37.16	0.00	17.44	0.69
May	80.35	-27.79	79.77	2.90	0.00	0.00
Jun	44.35	-36.00	98.30	25.40	0.00	0.00
Jul	17.65	-26.71	71.51	68.52	0.00	0.00
Aug	9.21	-8.44	63.74	58.78	0.00	0.00
Sep	7.57	-1.63	66.91	18.53	0.00	0.00
Oct	13.34	5.76	43.94	0.00	0.00	0.00
Nov	55.08	41.74	14.09	0.00	0.00	0.00
Dec	108.14	53.06	0.00	0.00	1.90	0.07
			480.26	174.13	*145.94*	
			18.91	Inches	***5.75***	Inches

Total Runoff	**11.126**	inches
Total AET	**18.908**	inches
Total Perc.	**5.746**	inches
	35.780	inches

Frontier Stone

Water Budget Analysis

#3. Bombay-Madrid Association

Month	Temp °C	Precip. P (mm)	C_r	Runoff (mm)	Infiltration (mm)	Monthly Heat Index	Annual Heat Index I	Unadjusted Monthly PE (mm)	Unadjusted Daily PE (mm)	Mean Possible Monthly Duration of Sunlight (12-hr units)	Adjusted Monthly PE (mm)	Infilt-PET (mm)	Σ Neg. Infilt. (mm)
Jan	**-4.17**	**67.06**	**0.2940**	19.72	47.34	**0.00**	45.04	0.00	0.00	**24.3**	0.00	47.34	0.00
Feb	**-3.11**	**52.58**	**0.2940**	15.46	37.12	**0.00**	45.04	0.00	0.00	**24.6**	0.00	37.12	0.00
Mar	**1.67**	**71.12**	**0.2940**	20.91	50.21	**0.19**	45.04	4.89	0.16	**30.6**	4.83	45.38	0.00
Apr	**8.17**	**79.25**	**0.2940**	23.30	55.95	**2.10**	45.04	33.18	1.11	**33.6**	37.16	18.78	0.00
May	**14.78**	**75.44**	**0.2940**	22.18	53.26	**5.16**	45.04	67.80	2.19	**37.8**	82.67	-29.41	-29.41
Jun	**19.83**	**90.42**	**0.2940**	26.59	63.84	**8.05**	45.04	96.64	3.22	**38.4**	123.70	-59.86	-89.27
Jul	**22.44**	**65.02**	**0.2940**	19.12	45.91	**9.71**	45.04	112.17	3.62	**38.7**	140.03	-94.12	-183.39
Aug	**21.33**	**80.26**	**0.2940**	23.60	56.66	**8.99**	45.04	105.51	3.40	**36**	122.53	-65.86	-249.26
Sep	**17.33**	**94.74**	**0.2940**	27.86	66.89	**6.57**	45.04	82.16	2.74	**31.2**	85.45	-18.56	-267.82
Oct	**11.06**	**72.14**	**0.2940**	21.21	50.93	**3.32**	45.04	47.79	1.54	**28.5**	43.94	6.99	0.00
Nov	**4.78**	**81.03**	**0.2940**	23.82	57.20	**0.93**	45.04	17.40	0.58	**24.3**	14.09	43.11	0.00
Dec	**-1.06**	**79.76**	**0.2940**	23.45	56.31	**0.00**	45.04	0.00	0.00	**23.1**	0.00	56.31	0.00
	9.42	**908.81**		**267.22**	641.59	45.04		567.53			654.39		
		35.78	Inches	**10.520**	Inches								

Lattitude = 43° 17'

Soil Moisture Storage (ST) in millimeters *114.33*

Month	Soil Moisture Storage (mm)	Δ Soil Moisture Storage (mm)	AET (mm)	Water Defecit (PET-AET) (mm)	Perc (mm)	Perc (in)
Jan	114.33	0.00	0.00	0.00	47.34	1.86
Feb	114.33	0.00	0.00	0.00	37.12	1.46
Mar	114.33	0.00	4.83	0.00	45.38	1.79
Apr	114.33	0.00	37.16	0.00	18.78	0.74
May	87.38	-26.95	80.21	2.46	0.00	0.00
Jun	50.56	-36.82	100.66	23.04	0.00	0.00
Jul	21.39	-29.17	75.08	64.95	0.00	0.00
Aug	11.72	-9.67	66.34	56.19	0.00	0.00
Sep	9.89	-1.83	68.71	16.73	0.00	0.00
Oct	16.87	6.99	43.94	0.00	0.00	0.00
Nov	59.99	43.11	14.09	0.00	0.00	0.00
Dec	114.33	54.34	0.00	0.00	1.96	0.08
			491.01	163.38	*150.58*	
			19.331	Inches	**5.928**	Inches

Total Runoff	**10.520**	inches
Total AET	**19.331**	inches
Total Perc.	**5.928**	inches
	35.78	inches

Frontier Stone

Water Budget Analysis

#5. Hilton-Appleton Association

Month	Temp °C	Precip. P (mm)	C_r	Runoff (mm)	Infiltration (mm)	Monthly Heat Index	Annual Heat Index I	Unadjusted Monthly PE (mm)	Unadjusted Daily PE (mm)	Mean Possible Monthly Duration of Sunlight (12-hr units)	Adjusted Monthly PE (mm)	Infilt-PET (mm)	Σ Neg. Infilt. (mm)
Jan	-4.17	67.06	0.3019	20.25	46.81	0.00	45.04	0.00	0.00	24.3	0.00	46.81	0.00
Feb	-3.11	52.58	0.3019	15.88	36.70	0.00	45.04	0.00	0.00	24.6	0.00	36.70	0.00
Mar	1.67	71.12	0.3019	21.47	49.65	0.19	45.04	4.89	0.16	30.6	4.83	44.82	0.00
Apr	8.17	79.25	0.3019	23.93	55.32	2.10	45.04	33.18	1.11	33.6	37.16	18.16	0.00
May	14.78	75.44	0.3019	22.78	52.66	5.16	45.04	67.80	2.19	37.8	82.67	-30.01	-30.01
Jun	19.83	90.42	0.3019	27.30	63.12	8.05	45.04	96.64	3.22	38.4	123.70	-60.58	-90.58
Jul	22.44	65.02	0.3019	19.63	45.39	9.71	45.04	112.17	3.62	38.7	140.03	-94.64	-185.22
Aug	21.33	80.26	0.3019	24.23	56.03	8.99	45.04	105.51	3.40	36	122.53	-66.50	-251.72
Sep	17.33	94.74	0.3019	28.61	66.14	6.57	45.04	82.16	2.74	31.2	85.45	-19.31	-271.03
Oct	11.06	72.14	0.3019	21.78	50.36	3.32	45.04	47.79	1.54	28.5	43.94	6.42	0.00
Nov	4.78	81.03	0.3019	24.47	56.56	0.93	45.04	17.40	0.58	24.3	14.09	42.47	0.00
Dec	-1.06	79.76	0.3019	24.08	55.67	0.00	45.04	0.00	0.00	23.1	0.00	55.67	0.00
	9.42	908.81		274.41	634.40	45.04		567.53			654.39		
		35.78	Inches	10.80	Inches								

Lattitude = 43° 17'

Soil Moisture Storage (ST) in millimeters: 86.804

Month	Soil Moisture Storage (mm)	Δ Soil Moisture Storage (mm)	AET (mm)	Water Defecit (PET-AET) (mm)	Perc (mm)	Perc (in)
Jan	86.80	0.00	0.00	0.00	46.81	1.84
Feb	86.80	0.00	0.00	0.00	36.70	1.44
Mar	86.80	0.00	4.83	0.00	44.82	1.76
Apr	86.80	0.00	37.16	0.00	18.16	0.71
May	60.31	-26.49	79.15	3.51	0.00	0.00
Jun	28.92	-31.39	94.52	29.18	0.00	0.00
Jul	9.17	-19.75	65.14	74.89	0.00	0.00
Aug	4.09	-5.08	61.11	61.42	0.00	0.00
Sep	3.24	-0.85	66.99	18.46	0.00	0.00
Oct	9.65	6.42	43.94	0.00	0.00	0.00
Nov	52.12	42.47	14.09	0.00	0.00	0.00
Dec	86.80	34.68	0.00	0.00	20.99	0.83
			466.92	187.46	167.48	
			18.38	Inches	6.59	Inches

Total Runoff	10.803	inches
Total AET	18.383	inches
Total Perc.	6.594	inches
	35.780	inches

Frontier Stone

Water Budget Analysis

#9. Sun-Massena Association

Month	Temp °C	Precip. P (mm)	C_r	Runoff (mm)	Infiltration (mm)	Monthly Heat Index	Annual Heat Index I	Unadjusted Monthly PE (mm)	Unadjusted Daily PE (mm)	Mean Possible Monthly Duration of Sunlight (12-hr units)	Adjusted Monthly PE (mm)	Infilt-PET (mm)	Σ Neg. Infilt. (mm)
Jan	-4.17	67.06	0.26	17.43	49.62	0.00	45.04	0.00	0.00	24.3	0.00	49.62	0.00
Feb	-3.11	52.58	0.26	13.67	38.91	0.00	45.04	0.00	0.00	24.6	0.00	38.91	0.00
Mar	1.67	71.12	0.26	18.49	52.63	0.19	45.04	4.89	0.16	30.6	4.83	47.80	0.00
Apr	8.17	79.25	0.26	20.60	58.64	2.10	45.04	33.18	1.11	33.6	37.16	21.48	0.00
May	14.78	75.44	0.26	19.61	55.82	5.16	45.04	67.80	2.19	37.8	82.67	-26.84	-26.84
Jun	19.83	90.42	0.26	23.51	66.91	8.05	45.04	96.64	3.22	38.4	123.70	-56.78	-83.63
Jul	22.44	65.02	0.26	16.91	48.12	9.71	45.04	112.17	3.62	38.7	140.03	-91.91	-175.54
Aug	21.33	80.26	0.26	20.87	59.40	8.99	45.04	105.51	3.40	36	122.53	-63.13	-238.67
Sep	17.33	94.74	0.26	24.63	70.11	6.57	45.04	82.16	2.74	31.2	85.45	-15.34	-254.01
Oct	11.06	72.14	0.26	18.76	53.38	3.32	45.04	47.79	1.54	28.5	43.94	9.44	0.00
Nov	4.78	81.03	0.26	21.07	59.96	0.93	45.04	17.40	0.58	24.3	14.09	45.87	0.00
Dec	-1.06	79.76	0.26	20.74	59.02	0.00	45.04	0.00	0.00	23.1	0.00	59.02	0.00
	9.42	908.81		236.29	672.52	45.04		567.53			654.39		
		35.78	Inches	9.30	Inches								

Lattitude = 43° 17'

Soil Moisture Storage (ST) in millimeters: 72.14

Month	Soil Moisture Storage (mm)	Δ Soil Moisture Storage (mm)	AET (mm)	Water Defecit (PET-AET) (mm)	Perc (mm)	Perc (in)
Jan	72.14	0.00	0.00	0.00	49.62	1.95
Feb	72.14	0.00	0.00	0.00	38.91	1.53
Mar	72.14	0.00	4.83	0.00	47.80	1.88
Apr	72.14	0.00	37.16	0.00	21.48	0.85
May	48.64	-23.49	79.32	3.35	0.00	0.00
Jun	21.13	-27.51	94.42	29.28	0.00	0.00
Jul	5.48	-15.65	63.77	76.26	0.00	0.00
Aug	2.17	-3.31	62.71	59.82	0.00	0.00
Sep	1.73	-0.44	70.55	14.90	0.00	0.00
Oct	11.17	9.44	43.94	0.00	0.00	0.00
Nov	57.04	45.87	14.09	0.00	0.00	0.00
Dec	72.14	15.09	0.00	0.00	43.93	1.73
			470.79	183.60	201.74	
			18.53	Inches	7.94	Inches

Total Runoff	9.3028	inches
Total AET	18.5348	inches
Total Perc.	7.9423	inches
	35.7799	inches

Frontier Stone | **Water Budget Analysis** | **#15. Elnora-Colonie Association**

Month	Temp °C	Precip. P (mm)	C_r	Runoff (mm)	Infiltration (mm)	Monthly Heat Index	Annual Heat Index I	Unadjusted Monthly PE (mm)	Unadjusted Daily PE (mm)	Mean Possible Monthly Duration of Sunlight (12-hr units)	Adjusted Monthly PE (mm)	Infilt-PET (mm)	Σ Neg. Infilt. (mm)
Jan	-4.17	67.06	0.19	12.71	54.34	0.00	45.04	0.00	0.00	24.3	0.00	54.34	0.00
Feb	-3.11	52.58	0.19	9.97	42.61	0.00	45.04	0.00	0.00	24.6	0.00	42.61	0.00
Mar	1.67	71.12	0.19	13.48	57.64	0.19	45.04	4.89	0.16	30.6	4.83	52.81	0.00
Apr	8.17	79.25	0.19	15.03	64.22	2.10	45.04	33.18	1.11	33.6	37.16	27.06	0.00
May	14.78	75.44	0.19	14.30	61.13	5.16	45.04	67.80	2.19	37.8	82.67	-21.53	-21.53
Jun	19.83	90.42	0.19	17.15	73.28	8.05	45.04	96.64	3.22	38.4	123.70	-50.42	-71.95
Jul	22.44	65.02	0.19	12.33	52.69	9.71	45.04	112.17	3.62	38.7	140.03	-87.33	-159.28
Aug	21.33	80.26	0.19	15.22	65.05	8.99	45.04	105.51	3.40	36	122.53	-57.48	-216.77
Sep	17.33	94.74	0.19	17.96	76.78	6.57	45.04	82.16	2.74	31.2	85.45	-8.67	-225.44
Oct	11.06	72.14	0.19	13.68	58.46	3.32	45.04	47.79	1.54	28.5	43.94	14.52	0.00
Nov	4.78	81.03	0.19	15.36	65.66	0.93	45.04	17.40	0.58	24.3	14.09	51.57	0.00
Dec	-1.06	79.76	0.19	15.12	64.63	0.00	45.04	0.00	0.00	23.1	0.00	64.63	0.00
	9.42	908.81		172.32	736.49	45.04		567.53			654.39		
		35.78	Inches	6.78	Inches								

Soil Moisture Storage (ST) in millimeters: 92.77

Lattitude = 43° 17'

Month	Soil Moisture Storage (mm)	Δ Soil Moisture Storage (mm)	AET (mm)	Water Defecit (PET-AET) (mm)	Perc (mm)	Perc (in)
Jan	92.77	0.00	0.00	0.00	54.34	2.14
Feb	92.77	0.00	0.00	0.00	42.61	1.68
Mar	92.77	0.00	4.83	0.00	52.81	2.08
Apr	92.77	0.00	37.16	0.00	27.06	1.07
May	72.68	-20.09	81.22	1.45	0.00	0.00
Jun	41.05	-31.63	104.91	18.78	0.00	0.00
Jul	15.26	-25.79	78.48	61.54	0.00	0.00
Aug	7.95	-7.30	72.35	50.18	0.00	0.00
Sep	7.21	-0.74	77.52	7.92	0.00	0.00
Oct	21.73	14.52	43.94	0.00	0.00	0.00
Nov	73.30	51.57	14.09	0.00	0.00	0.00
Dec	92.77	19.47	0.00	0.00	45.17	1.78
			514.51	139.88	221.98	
			20.26	Inches	8.74	Inches

Total Runoff	**6.784**	inches
Total AET	**20.256**	inches
Total Perc.	**8.739**	inches
	35.78	inches

Frontier Stone — **Water Budget Analysis** — **#27. Howard Association**

Month	Temp °C	Precip. P (mm)	C_r	Runoff (mm)	Infiltration (mm)	Monthly Heat Index	Annual Heat Index I	Unadjusted Monthly PE (mm)	Unadjusted Daily PE (mm)	Mean Possible Monthly Duration of Sunlight (12-hr units)	Adjusted Monthly PE (mm)	Infilt-PET (mm)	Σ Neg. Infilt. (mm)
Jan	***-4.17***	***67.06***	***0.2993***	20.07	46.98	***0.00***	45.04	0.00	0.00	***24.3***	0.00	46.98	0.00
Feb	***-3.11***	***52.58***	***0.2993***	15.74	36.84	***0.00***	45.04	0.00	0.00	***24.6***	0.00	36.84	0.00
Mar	***1.67***	***71.12***	***0.2993***	21.29	49.83	***0.19***	45.04	4.89	0.16	***30.6***	4.83	45.00	0.00
Apr	***8.17***	***79.25***	***0.2993***	23.72	55.53	***2.10***	45.04	33.18	1.11	***33.6***	37.16	18.36	0.00
May	***14.78***	***75.44***	***0.2993***	22.58	52.86	***5.16***	45.04	67.80	2.19	***37.8***	82.67	-29.81	-29.81
Jun	***19.83***	***90.42***	***0.2993***	27.07	63.36	***8.05***	45.04	96.64	3.22	***38.4***	123.70	-60.34	-90.15
Jul	***22.44***	***65.02***	***0.2993***	19.46	45.56	***9.71***	45.04	112.17	3.62	***38.7***	140.03	-94.47	-184.62
Aug	***21.33***	***80.26***	***0.2993***	24.03	56.24	***8.99***	45.04	105.51	3.40	***36***	122.53	-66.29	-250.91
Sep	***17.33***	***94.74***	***0.2993***	28.36	66.38	***6.57***	45.04	82.16	2.74	***31.2***	85.45	-19.06	-269.98
Oct	***11.06***	***72.14***	***0.2993***	21.59	50.54	***3.32***	45.04	47.79	1.54	***28.5***	43.94	6.60	0.00
Nov	***4.78***	***81.03***	***0.2993***	24.25	56.77	***0.93***	45.04	17.40	0.58	***24.3***	14.09	42.68	0.00
Dec	***-1.06***	***79.76***	***0.2993***	23.87	55.88	***0.00***	45.04	0.00	0.00	***23.1***	0.00	55.88	0.00
	9.42	***908.81***		***272.05***	636.77	45.04		567.53			654.39		
		35.78	Inches	***10.71***	Inches								

Lattitude = 43° 17'

Soil Moisture Storage (ST) in millimeters ***111.05***

Month	Soil Moisture Storage (mm)	Δ Soil Moisture Storage (mm)	AET (mm)	Water Defecit (PET-AET) (mm)	Perc (mm)	Perc (in)
Jan	111.05	0.00	0.00	0.00	46.98	1.85
Feb	111.05	0.00	0.00	0.00	36.84	1.45
Mar	111.05	0.00	4.83	0.00	45.00	1.77
Apr	111.05	0.00	37.16	0.00	18.36	0.72
May	83.86	-27.18	80.04	2.63	0.00	0.00
Jun	47.51	-36.36	99.71	23.99	0.00	0.00
Jul	19.51	-27.99	73.55	66.48	0.00	0.00
Aug	10.45	-9.06	65.30	57.23	0.00	0.00
Sep	8.73	-1.72	68.10	17.35	0.00	0.00
Oct	15.34	6.60	43.94	0.00	0.00	0.00
Nov	58.02	42.68	14.09	0.00	0.00	0.00
Dec	111.05	53.03	0.00	0.00	2.86	0.11
			486.72	167.66	*150.04*	
			19.16	Inches	***5.91***	Inches

Total Runoff	**10.710**	inches
Total AET	**19.162**	inches
Total Perc.	**5.907**	inches
	35.78	inches

Includes areas designated as gravel pits

APPENDIX G

Analytical Test Results

Adirondack Environmental Services, Inc

Date: *29-Apr-10*

CLIENT:	Continental Placer	Client Sample ID:	Shallow
Work Order:	100415044	Collection Date:	4/14/2010 2:00:00 PM
Reference:	Shelby, NY /	Lab Sample ID:	100415044-001
PO#:		Matrix:	WATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
HARDNESS SM 2340B (Prep: SW3010A - 4/16/2010)						Analyst: KH
Total Hardness (As CaCO3)	491	5		mg/L	1	4/28/2010
ICP METALS E200.7 (Prep: SW3010A - 4/16/2010)						Analyst: KH
Barium	0.058	0.010		mg/L	1	4/28/2010 1:10:00 PM
Iron	0.118	0.050	B	mg/L	1	4/28/2010 1:10:00 PM
Manganese	0.042	0.020		mg/L	1	4/28/2010 1:10:00 PM
ANIONS BY ION CHROMATOGRAPHY E300						Analyst: SH
Chloride	78.0	1.00		mg/L	1	4/22/2010
Sulfate	138	2.00		mg/L	1	4/22/2010
PH SM4500 H B						Analyst: LS
pH	7.1	1.0	H	pH Units	1	4/15/2010
SULFIDE SM4500 S2 D						Analyst: PL
Sulfide	< 0.10	0.10		mg/L	1	4/21/2010
TOTAL DISSOLVED SOLIDS SM2540C						Analyst: PL
TDS (Residue, Filterable)	652	5	H	mg/L	1	4/22/2010
TOTAL SUSPENDED SOLIDS SM2540 D						Analyst: CJ
TSS (Residue, Non-Filterable)	7.0	1.0		mg/L	1	4/16/2010

Qualifiers:
- ND - Not Detected at the Reporting Limit
- J - Analyte detected below quanititation limits
- B - Analyte detected in the associated Method Blank
- X - Value exceeds Maximum Contaminant Level
- S - Spike Recovery outside accepted recovery limits
- R - RPD outside accepted recovery limits
- T - Tentitively Identified Compound-Estimated Conc.
- E - Value above quantitation range

Adirondack Environmental Services, Inc

Date: *29-Apr-10*

CLIENT:	Continental Placer	**Client Sample ID:**	Deep
Work Order:	100415044	**Collection Date:**	4/14/2010 2:00:00 PM
Reference:	Shelby, NY /	**Lab Sample ID:**	100415044-002
PO#:		**Matrix:**	WATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
HARDNESS SM 2340B (Prep: SW3010A - 4/16/2010)						Analyst: **KH**
Total Hardness (As CaCO3)	395	5		mg/L	1	4/28/2010
ICP METALS E200.7 (Prep: SW3010A - 4/16/2010)						Analyst: **KH**
Barium	0.087	0.010		mg/L	1	4/28/2010 1:15:00 PM
Iron	0.351	0.050	B	mg/L	1	4/28/2010 1:15:00 PM
Manganese	< 0.020	0.020		mg/L	1	4/28/2010 1:15:00 PM
ANIONS BY ION CHROMATOGRAPHY E300						Analyst: **SH**
Chloride	28.5	1.00		mg/L	1	4/16/2010
Sulfate	104	2.00		mg/L	1	4/23/2010
PH SM4500 H B						Analyst: **LS**
pH	7.3	1.0	H	pH Units	1	4/15/2010
SULFIDE SM4500 S2 D						Analyst: **PL**
Sulfide	0.18	0.10		mg/L	1	4/21/2010
TOTAL DISSOLVED SOLIDS SM2540C						Analyst: **PL**
TDS (Residue, Filterable)	490	5	H	mg/L	1	4/22/2010
TOTAL SUSPENDED SOLIDS SM2540 D						Analyst: **CJ**
TSS (Residue, Non-Filterable)	2.5	1.0		mg/L	1	4/16/2010

Qualifiers:
- ND - Not Detected at the Reporting Limit
- J - Analyte detected below quanititation limits
- B - Analyte detected in the associated Method Blank
- X - Value exceeds Maximum Contaminant Level
- S - Spike Recovery outside accepted recovery limits
- R - RPD outside accepted recovery limits
- T - Tentitively Identified Compound-Estimated Conc.
- E - Value above quantitation range

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

Continental Placer, Inc.
11 Winners Circle
Albany, NY 12205

Work Order: RTJ0791

Zelazny Field

Project: Frontier Stone - ~~Marsh Creek~~ Shelby

Project Number: [none]

Received: 10/06/10

Reported: 10/18/10 10:59

Executive Summary - Detections

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RTJ0791-01 (Sample One - Water)						**Sampled: 10/05/10 17:30**		**Recvd: 10/06/10 13:15**		
Total Metals by EPA 200 Series Methods										
Barium	0.0818		0.0020	0.0005	mg/L	1.00	10/07/10 21:35	MxM	10J0411	200.7
Iron	6.41		0.050	0.019	mg/L	1.00	10/07/10 21:35	MxM	10J0411	200.7
Manganese	0.102		0.0030	0.0002	mg/L	1.00	10/07/10 21:35	MxM	10J0411	200.7
General Chemistry Parameters										
Chloride	13.2		1.00	0.46	mg/L	1.00	10/07/10 09:21	KLD	10J0595	4500-CL E
Total Hardness	70.0		2.00	0.525	mg/L	1.00	10/09/10 11:14	LRM	10J0763	2340C
Nitrate	0.0391	J	0.0500	0.0110	mg/L-N	1.00	10/06/10 18:18	Lacha	10J0455	4500-NO3-F
pH	7.61		NR	0.00	SU	1.00	10/06/10 16:33	LRM	10J0431	4500-H+ B
Total Dissolved Solids	261		10.0	4.0	mg/L	1.00	10/08/10 14:35	JME	10J0631	2540C
Total Suspended Solids	102		4.0	4.0	mg/L	1.00	10/07/10 15:52	RJF	10J0540	2540D

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Continental Placer, Inc.
11 Winners Circle
Albany, NY 12205

Work Order: RTH0433

Project: Frontier Stone - Marsh Creek Shelby
Project Number: [none]

Received: 08/05/10
Reported: 08/16/10 14:43

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RTH0433-01 (MARSH CREEK#1 - Water)						**Sampled: 08/04/10 07:30**		**Recvd: 08/05/10 11:30**		
Total Metals by EPA 200 Series Methods										
Barium	0.0248		0.0020	0.0003	mg/L	1.00	08/08/10 03:00	DAN	10H0385	200.7
Iron	0.741		0.050	0.019	mg/L	1.00	08/08/10 03:00	DAN	10H0385	200.7
Manganese	0.135		0.0030	0.0002	mg/L	1.00	08/08/10 03:00	DAN	10H0385	200.7
General Chemistry Parameters										
Chloride	23.4		1.00	0.46	mg/L	1.00	08/10/10 11:02	RJF	10H0673	4500-CL E
Total Hardness	101	D08	4.00	1.05	mg/L	2.00	08/10/10 09:29	JME	10H0675	2340C
Nitrate	0.0615		0.0500	0.0110	mg/L-N	1.00	08/05/10 16:34	JFR	10H0410	4500-NO3-F
pH	7.95	HFT	NA	0.00	SU	1.00	08/05/10 18:45	JFR	10H0419	4500-H+ B
Total Dissolved Solids	130		10.0	4.0	mg/L	1.00	08/06/10 13:45	JME	10H0480	2540C
Total Suspended Solids	8.0		4.0	4.0	mg/L	1.00	08/09/10 11:50	KLD	10H0615	2540D
Sulfate	ND		5.0	1.5	mg/L	1.00	08/10/10 10:05	RJF	10H0671	D-516-90
Sulfide	ND		0.100	0.0520	mg/L	1.00	08/10/10 13:00	RJF	10H0689	4500-S D

PLATES

0 2,400 4,800 Feet

Legend

- Waypoints (Data Location from 9/16/2008 Site Reconnaissance)
- Monitoring Well and/or Core Hole
- DH 1-05
- Cross Sections
- Property Boundary
- *Life of Mine Boundary*

Surficial Geology (Interpreted from Soils & Topography)

- Recent deposits of silt and fine sand (alluvium)
- Sand and gravel deposits (glacial outwash, kames, or glaciolacustrine sand)
- Silty and clayey deposits (glaciolacustrine, typically varved; includes swamp deposits)
- Till - variable texture (boulders to silt; deposition beneath glacial ice)
- Till moraine - more variably sorted than till; deposition adjacent to glacial ice.

Notes:
-NYS Department of Transportation Raster Quadrangle (Portions of the Knowlesville and Medina quadrangles).
-Elevations are shown in feet above mean sea level.
-Contour interval is ten feet (Knowlesville quadrangle) and five feet (Medina quadrangle).

ALPHA GEOSCIENCE
Alpha Proj. No. 08122

PLATE 1

SURFICIAL GEOLOGIC MAP

Frontier Stone Quarry
Frontier Stone LLC

Town of Shelby
Orleans County, New York

Map Document: (Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Regional Map-surficial geo edited.mxd)
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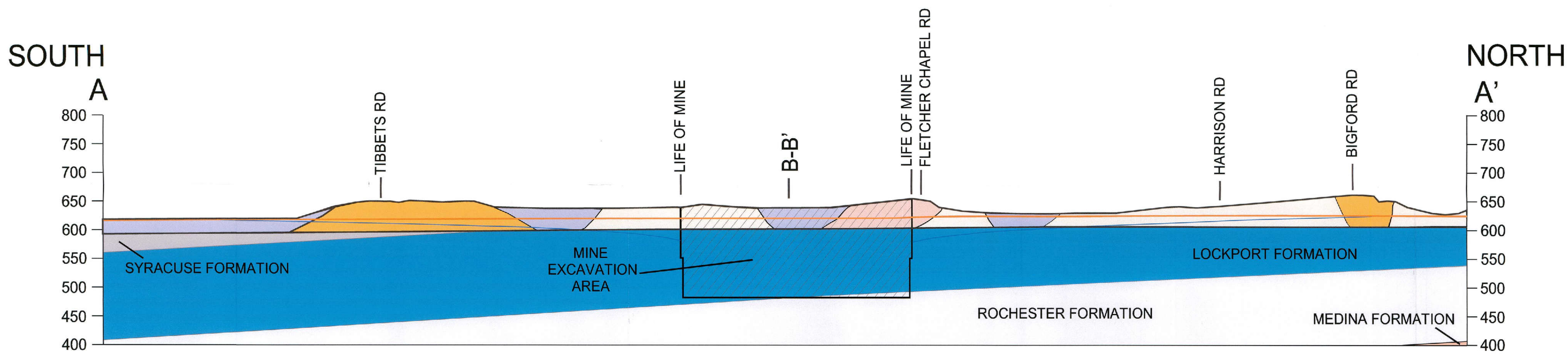

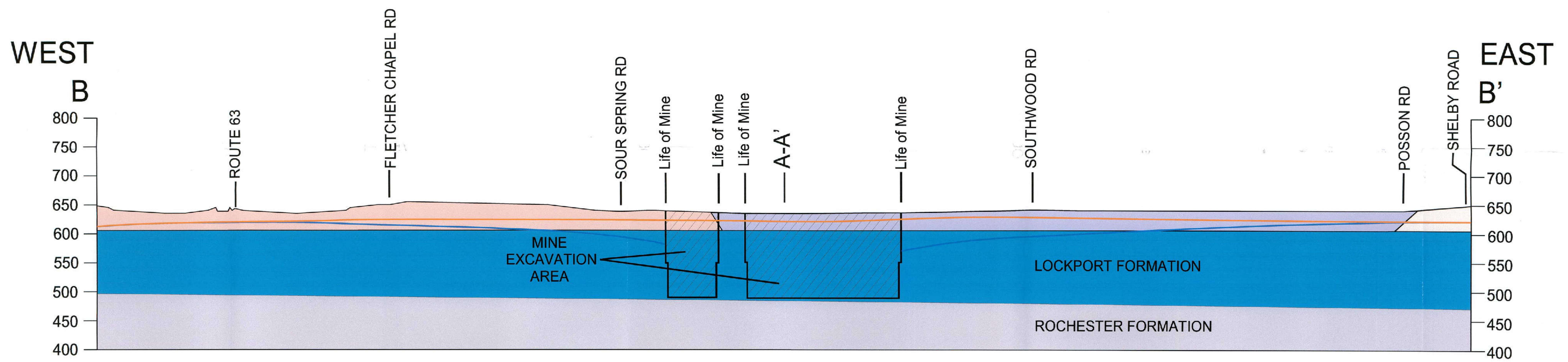

BEDROCK GEOLOGY

- Syracuse Fm
- Lockport Fm
- Rochester Fm
- Medina Fm

STRIKE = N 78° E
DIP = .44° SE
~7.7 FT per 1000 FT

GLACIAL OVERBURDEN

- Recent deposits of silt and sand (alluvium)
- Sand and gravel deposits (glacial outwash, kames, glaciolacustrine sand)
- Silty and clayey deposits (glaciolacustrine, typically varved; includes peat and swamp deposits
- Till - variable texture (boulders to silt; deposition beneath glacial ice)
- Till moraine - more variably sorted than till; deposition adjacent to glacial ice

Existing Ground Water Elevation (based on 9/16/08 Water Level Data, See Plate 3)
Future Ground Water Elevation

SCALE (feet)
100
50
0
400 800

ALPHA GEOSCIENCE
Project No. 08122

PLATE 2

GEOLOGIC CROSS SECTIONS

FRONTIER STONE LLC
FRONTIER STONE QUARRY

Town of Shelby, Orleans County, New York

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Legend

- ▲ Waypoints (9/16/2008)
- ● Monitoring Well
- GW-Contours-9-16-08
- Property Boundary
- Life of Mine Boundary
- Direction of Ground Water Flow

Notes:
-NYS Department of Transportation Raster Quadrangle (Portions of the Knowlesville and Medina quadrangles).
-Elevations are shown in feet above mean sea level.
-Contour interval is ten feet (Knowlesville quadrangle) and five feet (Medina quadrangle).

0 2,400 4,800 Feet

MEDINA KNOWLESVILLE
NYSDOT 7.5 Minute Quadrangle Index

Orleans County
Detail Area

ALPHA GEOSCIENCE
Alpha Proj. No. 08122

PLATE 3
REGIONAL BEDROCK PIEZOMETRIC SURFACE
Existing Conditions
September 16,2008

Frontier Stone Quarry
Frontier Stone LLC

Town of Shelby
Orleans County, New York

Map Document: (Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Regional MapGroundwater.mxd)
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Legend

- Waypoints (9/16/2008)
- Monitoring Well
- Ground Water Elevation Contours
- Direction of Ground Water Flow
- Property Boundary
- Life of Mine Boundary
- Limit of the Zone of Ground Water Contribution to the Proposed Quarry

Notes:
-Future Condition based on drawdown at the Proposed Quarry on September 16, 2008, using Existing Groundwater Elevation Data (Plate 3) as the Initial Condition
-NYS Department of Transportation Raster Quadrangle (Portions of the Knowlesville and Medina quadrangles).
-Elevations are shown in feet above mean sea level.
-Contour interval is ten feet (Knowlesville quadrangle) and five feet (Medina quadrangle).

0 2,400 4,800 Feet

MEDINA KNOWLESVILLE
NYSDOT 7.5 Minute Quadrangle Index

Orleans County
Detail Area

ALPHA GEOSCIENCE
Alpha Proj. No. 08122

PLATE 4

REGIONAL BEDROCK PIEZOMETRIC SURFACE
Future Condition

Frontier Stone Quarry
Frontier Stone LLC

Town of Shelby
Orleans County, New York

Map Document: (Z:\projects\2008\08121 - 08140\08122- Frontier Stone\GIS\Regional Map Future Groundwater.mxd)
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GROUND WATER IN THE NIAGARA FALLS AREA, NEW YORK

With Emphasis on the Water-Bearing Characteristics of the Bedrock

BY
RICHARD H. JOHNSTON
GEOLOGIST
U. S. GEOLOGICAL SURVEY

STATE OF NEW YORK
CONSERVATION DEPARTMENT
WATER RESOURCES COMMISSION

BULLETIN GW-53
1964

GROUND WATER IN THE NIAGARA FALLS AREA, NEW YORK

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1964

LOCKPORT DOLOMITE

Character and extent

The Lockport Dolomite is the uppermost bedrock formation in about one-third of the Niagara Falls area. Its outcrop area extends from the Niagara escarpment on the north to the southern boundary of the area covered by this report except in two small areas that may be underlain by the Salina Group. (See plate 3.) One of these areas is in the vicinity of the hamlet of Nashville and the other is in the extreme southeast corner. Because of a lack of rock outcrops in these areas the position of the contact between the Lockport and the Salina cannot be accurately determined. However, the Salina Group is not discussed as a separate water-bearing unit in this report because at most only a few feet of it occurs in the area. Continuous exposures of the Lockport are found along the gorge of the Niagara River and along the Niagara escarpment. The formation is about 150 feet thick in the southern part of the area but has been eroded to a thickness of only about 20 feet along the escarpment (pl. 2). The excellent exposures at Niagara Falls (fig. 5), where the Lockport forms the lip of the Falls, are shown in many geology textbooks as a classic example of flat-lying sedimentary rocks. Throughout most of the remainder of the area, which is relatively flat, the Lockport is concealed by a thin cover of glacial deposits.

As its name implies, the Lockport Dolomite consists mainly of dolomite; however, the formation also includes thin beds of limestone and shaly dolomite near the base. The Lockport consists of five lithologic types which, from top to bottom, are:

(a) brownish-gray, coarse- to medium-grained dolomite, locally saccharoidal with thin intervals of curved bedding (algal structures).

(b) gray to dark-gray, fine-grained dolomite, containing abundant carbonaceous partings.

(c) tannish-gray, fine-grained dolomite.

(d) light-gray, coarse-grained limestone containing abundant crinoid fragments (Gasport Limestone Member).

(e) light-gray shaly dolomite, laminated in part (DeCew Limestone Member of Williams, 1919).

Fisher (1960) divides the Lockport Dolomite into six units based on fossils as well as rock types. An excellent discussion of the stratigraphy of the

Lockport, including measured sections in the Niagara Falls area, is given in the recent thesis by Zenger [1].

The detailed breakdowns by Fisher and Zenger, although helpful for geologic mapping and correlating the Lockport with rocks of similar age elsewhere, are not necessary in descriptions of the water-bearing properties of the formation. For this purpose the Lockport is subdivided as follows (figure 5 and table 1): (1) upper and middle parts of the Lockport, and (2) lower part of the Lockport, including the Gasport Limestone Member and DeCew Limestone Member of Williams (1919).

Most of the beds in the Lockport are described as either "thick" (1 foot to 3 feet) or "thin" (1 inch to 1 foot). However, massive beds up to eight feet thick and very thin beds (1/4 to 1 inch) occur within the formation. The bedding is generally straight, but curved bedding occurs in some places in the upper part of the formation. The curved bedding is caused by dome-shaped algal structures called "stromatolites" (Zenger, p. 140). These reefs (bioherms), which occur as lens-like masses up to 50 feet across and 10 to 20 feet thick, contain no bedding.

Gypsum (calcium sulfate) is common in the Lockport, occurring chiefly as small irregularly shaped masses (commonly 1/2 to 5 inches in diameter) and as selenite. Sulfide minerals, particularly sphalerite (zinc sulfide), galena (lead sulfide), and pyrite (iron sulfide) occur as particles disseminated throughout the formation.

Water-bearing openings

Types.--Ground-water occurs in the Lockport Dolomite in three types of openings: (1) bedding joints which constitute at least seven important water-bearing zones, (2) vertical joints, and (3) small cavities from which gypsum has been dissolved. Of these, the bedding joints are the most important and transmit nearly all the water moving through the formation. The three types of openings were observed in the dewatered excavations for the conduits of the Niagara Power Project. (See the description of the power project in the Introduction and the location of the conduits in figure 3.) The rock faces along the four-mile length of the conduits provided an unequaled opportunity to study water-bearing openings in the entire stratigraphic thickness of the Lockport and to observe the lateral extent of these openings for a few thousand feet. At the time the observations were made (July - August 1960), approximately one-third of the length of the conduits was available for inspection by the writer.

1/ Zenger, D. H., 1962, Stratigraphy of the Lockport Formation (Silurian) in New York State: Unpublished doctoral thesis, Cornell University.

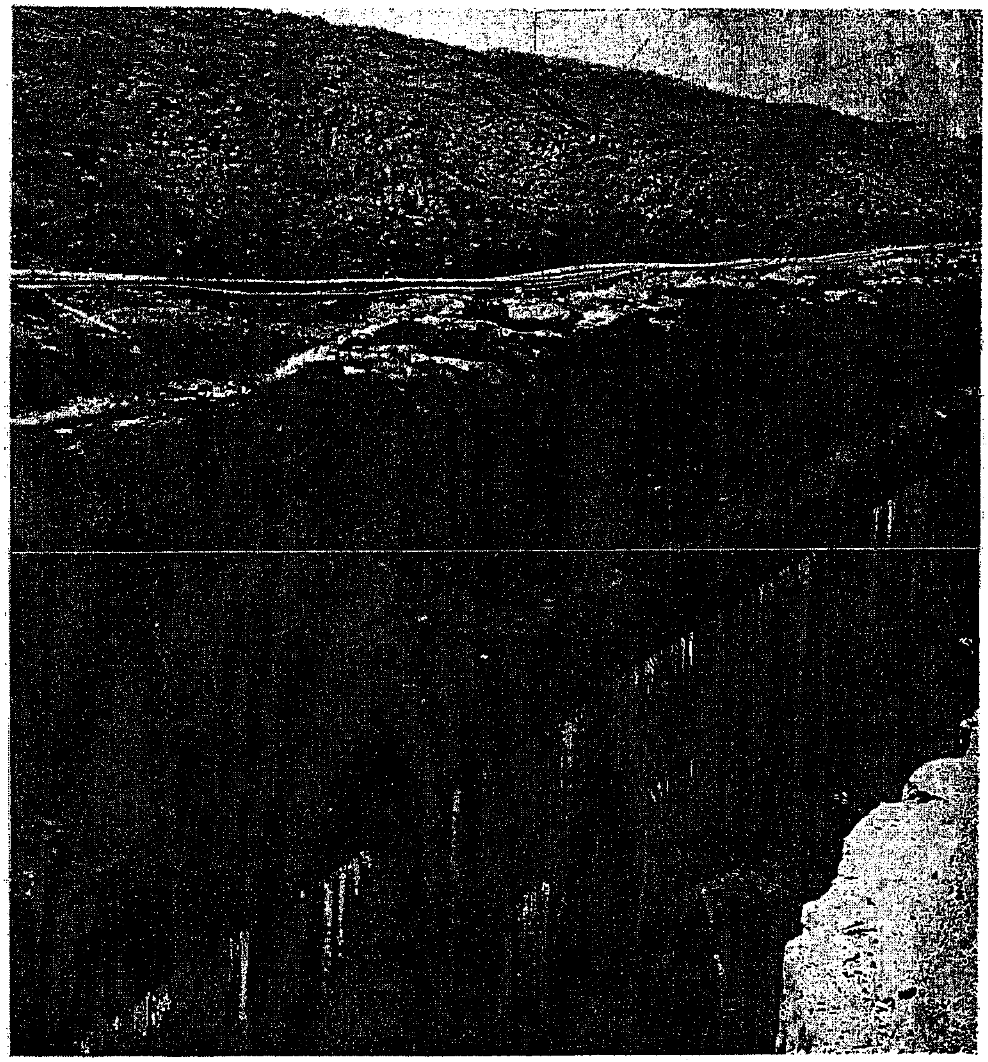


Figure 7.--Seepage from bedding joints in the Lockport Dolomite.
View is of east wall of conduit number 1,
looking south from Porter Rd. bridge.
(Photograph by the Power Authority
of the State of New York.)

Vertical joints, excluding those mentioned above which are associated with open bedding joints in thin-bedded intervals, are not important water-bearing openings in the Lockport, except within the top few feet of rock. Two prominent sets of vertical joints exist in the Niagara Falls area; one set oriented N. 65° E. and the other N. 30° W. These joints are fractures in the rock which must be widened by solution before they can become effective water-bearing openings. Such widening is apparent in outcrops of the Lockport. For example, open vertical joints are particularly

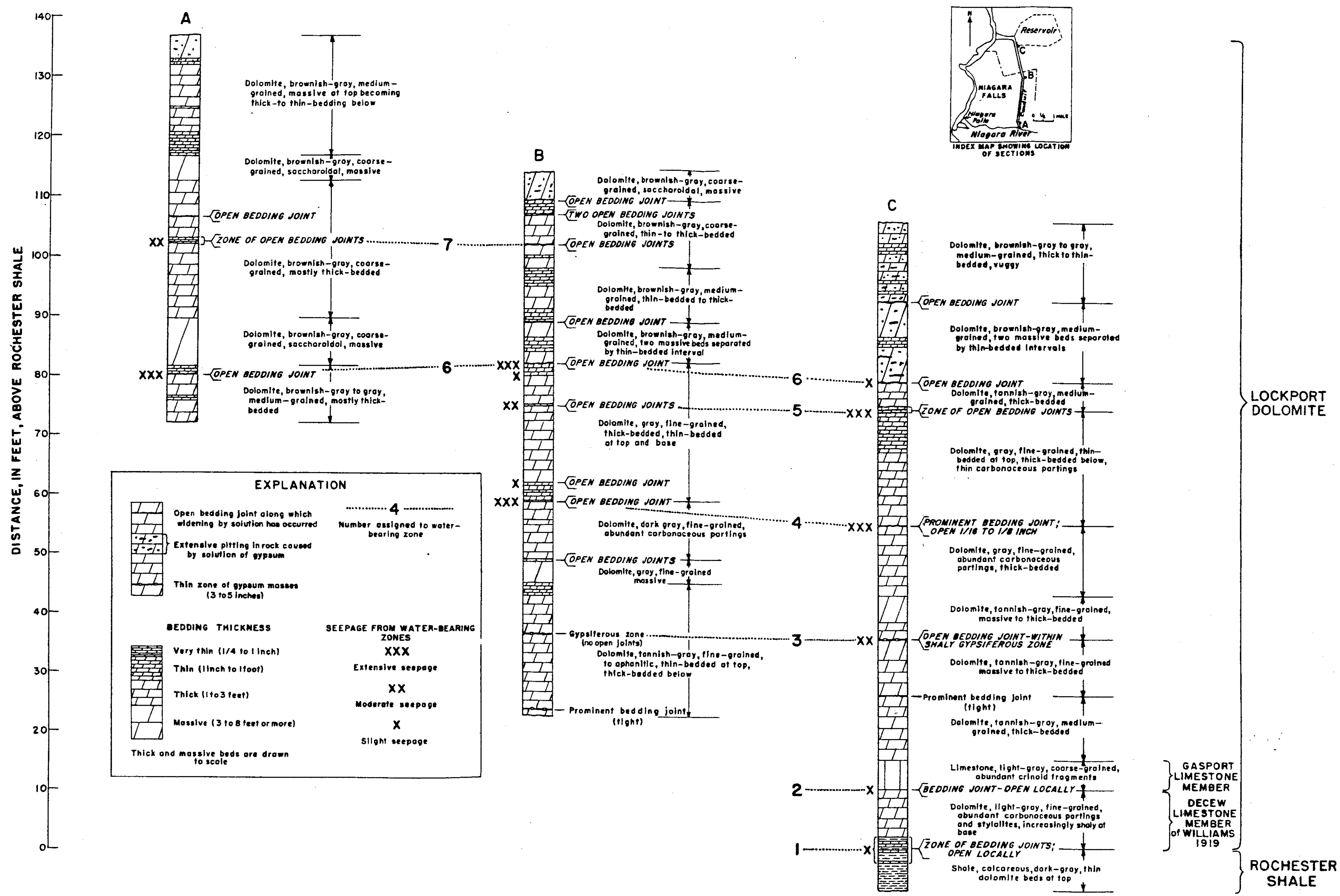


Figure 8.--Sections showing position of water-bearing zones in the Lockport Dolomite in the vicinity of Niagara Falls.

prominent in the rock cliffs of the Niagara River Gorge and the Niagara escarpment. The width of these joints in many areas exceeds several inches. However, in fresh exposures of the Lockport, such as the conduit excavations, vertical joints are tight and often not apparent to the eye except in the upper few feet of the rock.

Cavities formed by solution of gypsum occur in the Lockport Dolomite. These cavities range in size from 1/16 inch or less to 5 inches but are generally less than one inch in size. The cavities are formed by the dissolving of gypsum by percolating ground water, and there is a complete range in the development of cavities from voids containing no gypsum to pin-point openings in gypsum nodules. The cavities are most abundant in the top 10 to 15 feet of rock but they also occur along water-bearing zones in the lower part of the rock (for example, water-bearing zone 3, section C, fig. 8). In the upper part of the rock, the abundance of cavities locally gives a vuggy appearance to the dolomite.

The cavities in the Lockport resulting from solution of gypsum increase the ability of the Lockport to store water (porosity) but probably have little effect on the water-transmitting ability of the formation. This is because the water-transmitting ability (or permeability) is dependent upon the size of the continuous openings rather than the size of isolated openings. Thus, the relatively thin but continuous bedding joints determine the permeability of the Lockport rather than the larger but isolated cavities resulting from solution of gypsum.

The character and interrelationships of the three types of water-bearing openings described above result in two distinct sets of ground-water conditions in the Lockport Dolomite: (1) a moderately permeable zone at the top of rock, generally 10 to 15 feet thick, characterized by both vertical and bedding joints that have been widened by solution and by gypsum cavities, and (2) the remainder of the formation consisting of seven permeable zones (composed of bedding joints) surrounded by essentially impermeable rock.

Areal extent.--Relatively little is known about the areal extent of the seven water-bearing zones in the Lockport Dolomite, except as observed in the conduits (fig. 8). Many of the individual bedding joints tend to "pinch out" laterally, and be replaced by adjacent joints in the same zone. Such "pinching out" of joints transmitting water was observed in the conduits. Observations in the conduits and data from wells suggest that a few of the zones may persist for tens of miles. The water-bearing zones of greatest areal extent are those which occur at distinct lithologic breaks in the formation. Zone 1, occurring at the base of the Lockport (fig. 8), is frequently reported to be a water-bearing zone by drillers throughout the area. Zone 2, which occurs at the contact between coarse-grained limestone (Gasport Member) and shaly dolomite (DeCew Limestone Member of Williams, 1919) is the source of most of the springs along the Niagara escarpment. Other water-bearing zones, not located at contacts between distinct lithologic units, probably tend to pinch out within a few miles. In summary, at any point in the area, a number of water-bearing zones parallel to bedding exist in the Lockport. All such zones, however, are not necessarily equivalent to the seven water-bearing zones observed in the conduit excavations at Niagara Falls.

It was also noted in the conduit excavations that there were places, even along the most prominent water-bearing zones, where no seepage was occurring. Many such places doubtless represent natural supports for the overlying rock because no extensive horizontal opening below the earth's surface can exist for any great distance. Little is known either about the nature or the size of these support areas or the distance between them. The available data suggest, however, that they encompass an area of at least a few square feet and are separated by a few tens of feet. It may be expected that with depth the size of the supports increases and the distance between them decreases.

The occurrence of ground water principally in zones parallel to bedding is probably characteristic of flat-lying Paleozoic carbonate rocks in many other places. This type of occurrence was reported by Trainer and Salvas (1962, p. 42) in the Beekmantown Dolomite near Massena, N. Y. They observed that "... The openings which are horizontal or gently dipping, and most of which are probably joints or other fractures parallel to the bedding of the rocks, are wider and more numerous than the steeply dipping openings." Although the Beekmantown Dolomite is of an older geologic age than the Lockport, certain similarities exist between the two formations: (1) both units consist of indurated Paleozoic dolomite and limestone; (2) both units are gently dipping, neither having been subjected to extensive folding and faulting which would result in the development of more prominent vertical joints or fractures associated with faulting; (3) both units were subjected to scouring by ice during glaciation within the last 10,000 to 15,000 years and thus, the extensive solution features common to limestones and dolomites in unglaciated areas have not had time to develop. It seems probable that any flat-lying carbonate rock, possessing the characteristics just stated, will contain ground water principally within joints parallel to bedding.

Origin of water-bearing openings.--The origin and the sequence of development of both the vertical joints and bedding joints are of considerable importance in developing an understanding of the occurrence of water in bedrock. Although it was not possible to investigate the origin or the development during this study, speculations based on fundamental principles of geology, especially regarding the origin of the bedding joints, may be worthwhile.

It is widely recognized that joints are formed by forces which tend to pull the rock apart (tension joints) or slide one part of the rock past an adjacent part (shear joints); see, for example, the discussion by Billings (1954, p. 115). The vertical joints were probably formed by a combination of tension and shear forces during or following the folding of the Appalachian Mountains about 200 million years ago. The bedding joints represent tension fractures that formed as a result of expansion of the rock in a vertical direction during more recent geologic time. The Lockport as recently as 200 million years ago was doubtless buried under thousands of feet of other rocks in the Niagara Falls area just as it is at the present time in the southern part of New York State. During the erosion of the overlying rocks the Lockport expanded vertically. The expansion caused fracturing to occur along bedding planes which are natural planes of weakness in the rock and which are approximately parallel to the land surface. Vertical joints, being at right angles to the land surface were little affected by the removal of the overlying rock.

The bedding joints may have been further expanded by stresses produced in the rock during the recession of the glaciers 10 to 15 thousand years ago. The melting of several thousand feet of ice was doubtless accompanied by an expansion of the rock. This expansion either resulted in an enlargement of existing bedding-plane openings or the formation of new openings along other bedding planes.

In recent geologic times, chemical solution of the rock has widened both the vertical and bedding joints. In the already well-developed openings along bedding joints, slight widening by solution has occurred to depths of 100 feet or more. Enlargement of vertical joints, in contrast, is generally restricted to the upper 10 to 15 feet of rock. Cavities formed by solution of gypsum exist where water moving along joints in the Lockport came into contact with gypsum. Gypsum is much more soluble than dolomite; thus, openings formed by the solution of gypsum are wider than other openings along joints. Water moving down vertical joints has dissolved the gypsum to a depth of about 15 feet leaving irregularly-shaped cavities, and water moving along bedding joints has dissolved gypsum to depths of at least 70 feet.

Water-bearing characteristics

Ground water exists in the Lockport Dolomite under artesian, semi-artesian, and unconfined conditions. Unconfined conditions occur where the water table is the upper surface of the zone of saturation within an aquifer. The water table in an unconfined aquifer moves freely upward as water is added to storage, or downward as water is taken from storage. In contrast, an artesian aquifer contains water which is confined by an overlying impermeable bed and which is under sufficient pressure to rise above the top of the aquifer. The level to which water in an artesian aquifer will rise forms an imaginary surface which is called a piezometric surface. Water levels in artesian aquifers change in response to pressure changes on the aquifer rather than to changes in the amount of water stored in the aquifer.

Both artesian and water-table conditions exist in the Lockport. However, artesian conditions predominate. Figure 9 illustrates the occurrence of both artesian and water-table conditions in the Lockport. The wells shown in the diagram are cased through the clay and silt, but are open holes in the bedrock. A packer is installed in each well which tapped water at two or more distinct levels. The packers make possible the measurement of two distinct water levels in each well; a water level above the packer reflecting conditions in the upper part of the rock and a water level below the packer reflecting conditions in the lower part of the rock.

In the upper part of the rock, either artesian or water-table conditions may exist locally. The clay and silt overlying the Lockport are less permeable than the rock and thus act as a confining bed. Artesian conditions exist where the water in the Lockport has sufficient head to rise above the bottom of the overlying clay and silt. In contrast, unconfined (or water-table) conditions exist where the water level occurs within the fractured upper part of the rock, as at well 309-901-5 in figure 9. Locally a 'washed till" or dirty gravel zone occurs just above the top of rock. In these

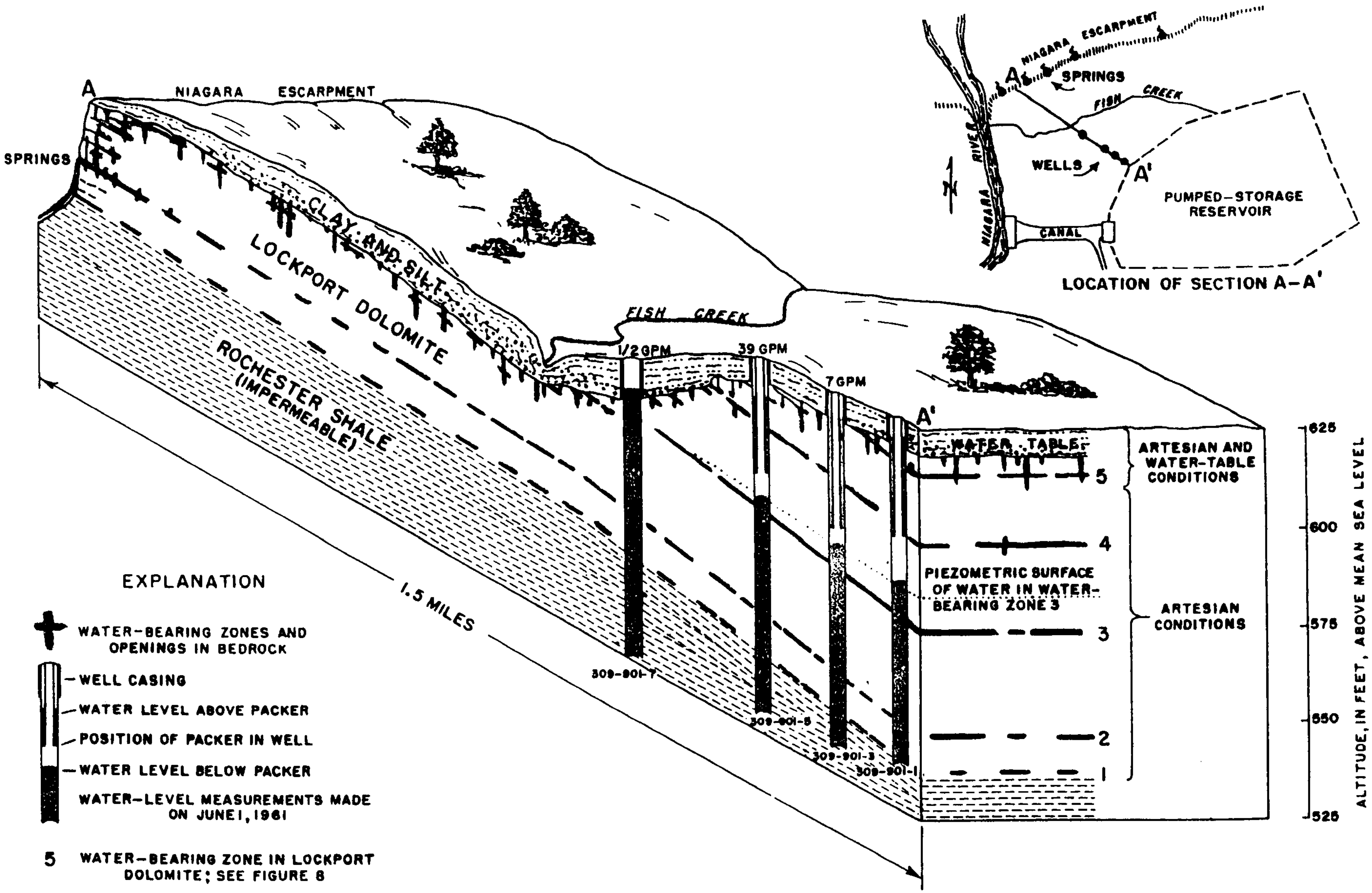


Figure 9.--Block diagram showing the occurrence of ground water in the Lockport Dolomite.

localities good connection probably exists between the bedrock and the overlying till or gravel, and the upper part of the rock and washed till zone together form a continuous semi-confined aquifer.

In the lower part of the rock, artesian conditions occur exclusively. The seven water-bearing zones in the Lockport are surrounded by essentially impermeable rock and therefore act as separate and distinct artesian aquifers. The hydraulic nature of the water-bearing zones was observed during the drilling of observation wells in the vicinity of the Niagara Power Project. These wells, whose locations are shown in plate 1, were drilled to observe the effects of the reservoir on ground-water levels in the area. The piezometric level for each successively lower water-bearing zone is lower than for the zone just above it in most of the wells. The reasons for this will be discussed in the section entitled "Ground-Water Movement and Discharge." During construction, the water level in the wells progressively declined in a steplike sequence as the wells were drilled deeper--that is, when a well had been drilled through the uppermost water-bearing zone, the water level in the well remained approximately at a constant level until the next lower zone was penetrated, at which time the water level abruptly declined to the piezometric level of the next lower zone. The difference between the piezometric levels of any two water-bearing zones is large, and in some places is comparable to the distance between zones. If no packer is installed in a well tapping two water-bearing zones, the upper zone will continue to drain into the well indefinitely. This condition exists in a few of the power project observation wells. In these wells the sides of the well remain wet from the level of the upper zone down to the water level in the well. The nature of the water-bearing zones as described above substantiates the reports by drillers and others of "finding water and losing it" in a well, or of wells with "water running in the top and out the bottom." These phenomena occur in some wells tapping two or more water-bearing zones in the Lockport Dolomite.

A well drilled into the Lockport may penetrate several water-bearing zones, but only one of the zones may be hydraulically effective at the site of the well. This is the case for wells 309-901-1, 3, and 5 shown in figure 9. These wells are open below the packers to zones 1, 2, and 3. However, because the water levels observed below the packers in these three wells apparently represents the piezometric surface of zone 3, zones 1 and 2 are not believed to contain effective openings at the sites of the wells. A well also may be drilled through the section occupied by several zones and not be open to any of them. For example, well 309-901-7 shown in figure 9, is apparently open only to the weathered zone at the top of rock.

Yield and specific capacity of wells

The yield of a well in the Lockport Dolomite depends mainly upon which water-bearing zone or zones are penetrated and the degree to which the bedding joints comprising the zones are open to the well. Near the top of rock, the number of open vertical joints and gypsum cavities penetrated may also be important. The average yield of 56 wells tapping the upper and middle parts of the Lockport (which includes water-bearing zones 4 through 7) is 31 gpm (gallons per minute). In contrast, 15 wells penetrating only the lower 40 feet of the Lockport (which includes water-bearing zones 1, 2, and 3) have an average yield of 7 gpm. The yields of individual wells range from less than 1 gpm to 110 gpm. (These figures do not include a few exceptionally high yield wells which obtain water by induced infiltration from the Niagara River and which are discussed in a following paragraph.) Wells tapping the same water-bearing zone may have different yields. For example, wells 309-901-3 and 309-901-5, which are 500 feet apart and tap water-bearing zones 1 through 4 (fig. 9) yielded 7 gpm and 39 gpm, respectively, before the packers were installed. The bedding joints comprising the water-bearing zones are thus more open at well -5 than at well -3.

Increases in yield during drilling in the Lockport Dolomite occur abruptly rather than gradually. As drilling proceeds through the rock, relatively little increase in the yield of a well will be observed until a water-bearing zone is tapped. At that time a marked increase in yield usually occurs. For example, during the drilling of well 308-901-7, the bailing rate abruptly increased from 12 to 50 gpm when water-bearing zone 5 was tapped. During the drilling of well 308-900-21, three distinct increases in yield were observed. The yield, which was 3 gpm at 17 feet (water-bearing zone 7), increased to 9 gpm at 22 feet (an open vertical? joint or solution cavity?) and abruptly increased to 30 gpm at 34 feet (water-bearing zone 6).

Wells in an area about a half mile wide adjacent to the Niagara River above the falls have substantially higher yields than wells elsewhere in the area. The higher yields in this area are caused by two conditions: (1) the Lockport Dolomite is thickest in the area, and (2) more importantly, conditions are favorable for the infiltration of water from the Niagara River. The greater thickness of the Lockport provides the maximum number of water-bearing zones to supply water to the wells. The Niagara River provides an unlimited source of recharge to the water-bearing zones.

Evidence that a substantial part of the water pumped is supplied by induced infiltration from the Niagara River is indicated by the high yields, which exceed 2,000 gpm at some wells, and the chemical character of the water. The chemical composition of the water in well 304-901-6 (which has been pumped at 2,100 gpm) is more similar to Niagara River water than "typical" ground water in the Lockport. (See the following discussion of the chemical character of water and figure 11.) Similar infiltration of Niagara River water into the bedrock at Tonawanda, N. Y., a few miles south of Niagara Falls, was described by Reck and Simmons (1952, p. 19-20).

Infiltration from the river can occur where pumping has lowered ground-water levels below river level to such an extent that a hydraulic gradient is created between the river and the wells. The amount of the infiltration depends on the gradient and the nature of the hydraulic connection between the river and Lockport. The hydraulic connection is controlled by the character of the river bottom. Throughout most of its length in the Niagara Falls area the bottom of the river is covered by a layer of unconsolidated deposits including both till and clay and silt. This layer was found to be from 10 to 20 feet thick in the vicinity of the Niagara Falls water-system intake. (See logs 304-900-i and -j in figure 19.) In the section of the river occupied by rapids, extending a half mile or more above the falls, the bottom has been scoured clean by the river. Where the layer of unconsolidated deposits is present its low permeability greatly retards infiltration. Where the layer is thin or absent infiltration can readily occur.

One of the most striking features in plate 2 is that all wells yielding more than 1,000 gpm are located in a narrow band that intercepts the river about two miles east of the falls. This band trends in a northeasterly direction roughly parallel to one of the two major directions of vertical jointing. Thus, the very high yields may be caused by a greater abundance of vertical joints within the band of high-yielding wells. Vertical joints provide avenues through which water could readily move from the river downward to the bedding joints comprising the water-bearing zones in the Lockport Dolomite.

Wells in the Lockport Dolomite are almost always adequate for domestic needs of a few gallons per minute. Supplies of 50 to 100 gpm, which are adequate for commercial uses and small public supplies, can be obtained in much of the area underlain by the upper part of the Lockport (pl. 2). Large supplies (over 1,000 gpm), as previously noted, are available only in a small area adjacent to the Niagara River.

Wells inadequate for domestic needs are occasionally reported. All wells that are perennially inadequate are located near the Niagara escarpment and therefore tap only the lowest and least permeable water-bearing zones (1, 2, and 3) in the Lockport. Throughout the area a few shallow wells that derive nearly all their water from a single water-bearing zone become inadequate during the summer and autumn of some dry years. Such is the case with well 308-853-1. This well is 27 feet deep and reportedly obtained over 50 gpm from a water-bearing zone 17 feet below land surface. During the drought in 1960, this zone was dewatered as the water table declined in the fall of the year, and the yield of the well quickly declined to less than 1 gpm. The inadequacy of some wells in the Lockport Dolomite can normally be overcome by deepening the well until it penetrates one or more lower water-bearing zones.

Information on the specific capacity of a well is more meaningful than a simple statement of yield. The specific capacity is the yield per unit drawdown, generally expressed as gallons per minute per foot of drawdown. For example, well 307-903-1 was pumped at 20 gpm with 54 feet of drawdown which indicates a specific capacity of 0.37 gpm per foot. The yield and the drawdown for a number of wells in the Lockport are shown in plates 2 and 3. These data must be used with care as they apply only so long as no part of the formation is dewatered.

As water-bearing zones in the Lockport are dewatered, the specific capacity declines. The decline in specific capacity caused by dewatering a water-bearing zone is shown by the data obtained during a pumping test on well 309-859-1. This well was pumped at 2.2 gpm with 5.0 feet of drawdown for 70 minutes--specific capacity of 0.44 gpm per foot. After 70 minutes, water-bearing zone 3 was partially dewatered and a drawdown of 8.2 feet was required to maintain the pumping rate of 2.2 gpm. This indicates a specific capacity of 0.27 gpm per foot. At the time the well was drilled, it was bailed at 3 gpm with a drawdown of about 60 feet. Thus, during the bailing the entire 42 feet of Lockport penetrated by the well was dewatered. The specific capacity of the well with the Lockport dewatered is 0.07 gpm per foot (3 gpm with 42 feet of drawdown) compared to 0.44 gpm per foot with no dewatering.

Permeability, transmissibility, and storage coefficients

Permeability (P), transmissibility (T), and storage (S) coefficients are terms used to describe the ability of an aquifer to transmit water and to release water from storage. These three terms are called aquifer constants. The coefficient of permeability is defined as the rate of flow of water in gallons per day through a cross-sectional area of the aquifer of one square foot under a unit hydraulic gradient (1 foot vertical drop for each 1 foot of horizontal distance) at a temperature of 60°F. The coefficient of transmissibility is the rate of flow, at the prevailing water temperature, in gpd (gallons per day), through a 1-foot-wide vertical strip of aquifer extending the full saturated height of the aquifer under a unit hydraulic gradient. The term transmissibility was introduced by Theis (1935) to describe the water-transmitting capacity of an aquifer as a whole. It can be seen from the definitions of transmissibility and permeability stated above, that the coefficient of transmissibility is equal to the coefficient of permeability multiplied by the saturated thickness of an aquifer. The coefficient of storage is defined as the volume of water an aquifer releases from or takes into storage per unit surface area (such as per square foot) of the aquifer per unit change in head normal to that surface (Ferris and others, 1962, p. 74).

Values for T and S given in this report were obtained from pumping tests in the field. Values for P of the Lockport Dolomite obtained from laboratory tests would be highly misleading because of the water-bearing characteristics of the formation. A sample of unjointed rock from the Lockport would give an extremely low value for P. In contrast, a rock sample collected at a water-bearing zone, and therefore containing open bedding joints, would give a very high value for P. Values for T obtained from analysis of pumping-test data are composite figures for the Lockport which average the very low permeability of unjointed rock with the very high permeability of the water-bearing zones. The values for T obtained from pumping-test data, therefore, more truly describe the water-transmitting ability of the formation as a whole.

The two methods most widely used to analyze pumping-test results for T and S are the Thiem and the Theis methods. Both methods are applications of Darcy's law, which states that the quantity of water discharged through porous material varies directly with the permeability, hydraulic gradient, and cross-sectional area through which the discharge occurs. The Thiem equation is used to analyze tests in which equilibrium conditions have been reached; that is, when the drawdown of water levels has stabilized in both the pumping well and observation wells. The Theis equation does not require that equilibrium conditions be reached. A thorough discussion of both methods, including the assumptions on which each are based, is given in a recent report on the theory of aquifer test (Ferris and others, 1962). The following discussion of transmissibility and storage coefficients of the Lockport Dolomite does not require familiarity with the methods used in analyzing pumping tests, although such knowledge would be helpful.

Table 3 lists the values for T and S obtained from seven aquifer tests in the Lockport Dolomite. Five of the seven tests were conducted by Geological Survey personnel assisted by personnel of Uhl, Hall & Rich, consulting

Table 3.--Summary of aquifer tests in the Lockport Dolomite

Pumping well	Observation wells	Date of test	Pumping rate (Q), (gallons per minute)	Transmissibility (T) (gallons per day per foot)	Storage coefficient (S)	Saturated thickness (feet)	Duration of test	Remarks
304-901-2	304-901-1 304-901-3	July 1947	1,740	68,000	---	136	--	Thiem formula applied to stabilized drawdown in two observation wells. Yield of well partly supplied by induced recharge from Niagara River. Observation wells located 11 and 550 ft from pumping well at approximately same distance from river as pumping well. Pumping-test data supplied by E. I. du Pont de Nemours & Co.
305-900-1	2 observation wells, unnumbered	Nov. 4-7, 1958	950	17,000	---	140	74 hours	Pumping rate at start of test was 1,100-1,200 gpm. Pumping rate stabilized at 950 gpm with 82 ft of drawdown after 66 hrs. Thiem formula applied to stabilized drawdown in two observation wells 400 and 600 ft away. Yield of well probably partly supplied by induced recharge from Niagara River. Pumping-test data supplied by Layne-New York Co., Inc.
308-900-15	308-900-1	Nov. 21-22, 1961	5.5	900	.00003	17	12 hours	Theis plots of drawdown and recovery show recharging boundary (Niagara Power Project Reservoir).
308-900-16	---	May 10, 1962	3.2	700	---	36	1½ hours	Recovery measured in closed-off flowing well. Theis recovery formula applied to recovery of water level.
309-859-1	309-859-2 309-859-3	Nov. 4, 1960	2.2	1,000	.0003	38	3½ hours	Values of T and S calculated from drawdown of water level in observation well 309-859-2. Value of T declined from 1,000 to 130 as Lockport was dewatered during test. Full discussion of this test, utilizing the Theis method of analysis, given in text.
309-859-2	309-859-1 309-859-3	Oct. 11, 1960	2.2	330	.00001	42	2 hours	Values for T and S calculated from drawdown of water level in observation well 309-859-1. Excellent match on Theis type curve. Value of T is representative for lower part of Lockport.
Dewatered conduit excavations	308-900-1 308-900-3 308-900-7 308-900-9	Oct.-Nov. 1960	1,000 (variable from 760 to 1,190)	2,300	---	110	2 months	An average of 1,000 gpm was pumped to keep an 18,000-foot-long section of conduit excavations dewatered. Darcy equation was used to calculate T; gradient was calculated from wells to conduits. Value of T is probably most representative value for Lockport as a whole.

engineers for the Niagara Power Project. Two of the tests were conducted by private companies, as noted in table 3, and aquifer constants were calculated from the reported pumping-test data.

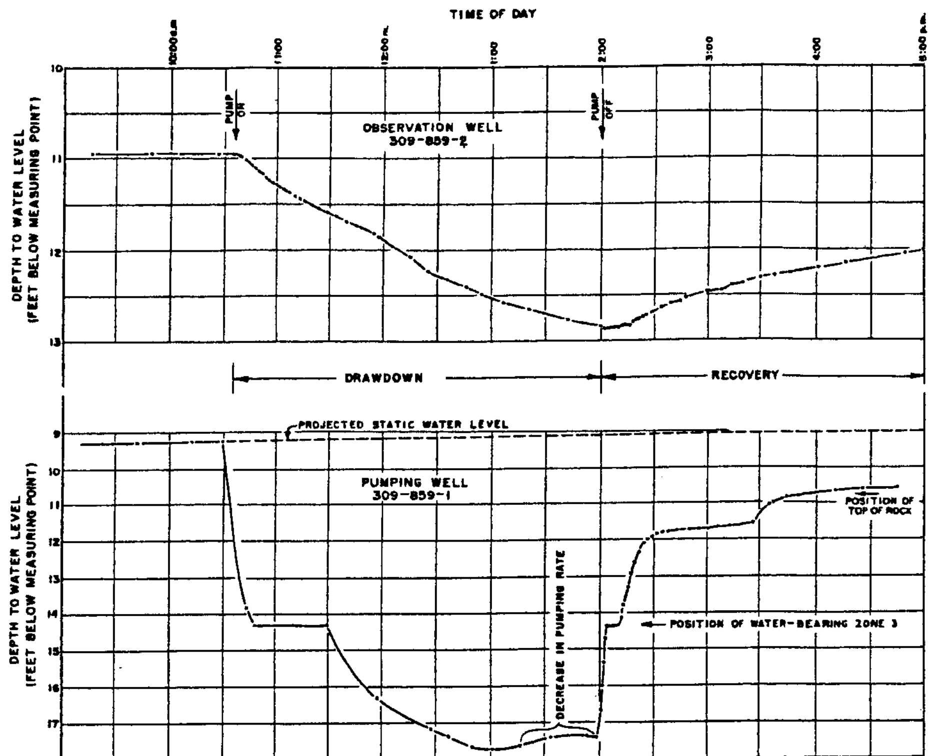
The coefficient of transmissibility of the Lockport Dolomite, as shown in table 3, ranges from 330 gpd per foot to 68,000 gpd per foot. The value of T of 2,300 gpd per foot derived from an analysis of data from the conduit excavations is probably the most representative value for the Lockport as a whole. This value, as noted in table 3, was obtained from a test which considered an 18,000-foot-long section of dewatered conduit excavations as a well. An average of 1,000 gpm of water was pumped to keep this section of conduits dewatered during a two-month period in 1960 (the conduits had been dewatered at that time for approximately 2 years). By measuring water levels in wells adjacent to the conduits, the gradients that supplied the 1,000 gpm to the conduits were calculated. Application of the average gradient (0.017 foot per foot) and the pumping rate of 1,000 gpm to the Darcy equation gave a T of 2,300 gpd per foot. This analysis assumes that the observation wells, which were 2,000 to 3,600 feet from the conduits, indicate the regional gradient toward the conduits and not the water level of specific water-bearing zones. However, at best, the value for T is only approximate.

The highest value of T, that of 68,000 gpd per foot, represents the optimum water-transmitting ability of the Lockport Dolomite. Well 304-901-2, which gave this value, fully penetrates the entire thickness of the Lockport, and during drilling reportedly tapped six distinct water-bearing zones (graphical log shown in fig. 18). This well is located 200 feet from the Niagara River and is partly supplied by induced recharge from the river.

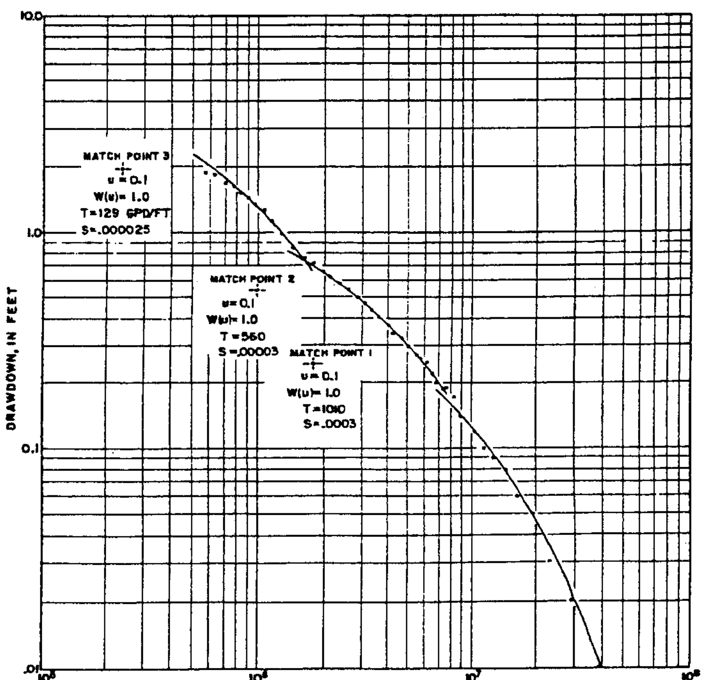
The lowest value for T listed in table 3, 330 gpd per foot, was obtained from a well which penetrates the lower 40 feet of the Lockport. This low value for T is believed to be representative of the lower part of the formation which contains the least permeable water-bearing zones.

The values for coefficient of storage listed in table 3 range from 0.00001 to 0.0003. These values are typical of artesian aquifers whose values for S range from about 0.000001 to 0.001 (Ferris and others, 1962, p. 76). In contrast, the S for water-table aquifers generally falls between 0.01 and 0.30.

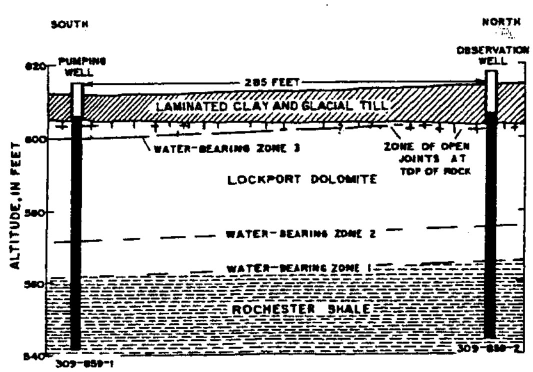
The results of the pumping test on well 309-859-1 give values of T and S for the Lockport Dolomite, and also indicate the relative water-transmitting ability of individual water-bearing openings. This test also provides indirect evidence that the Lockport Dolomite, as observed visually in the conduit excavations, consists of relatively impermeable rock within which are a few highly permeable water-bearing openings. Figure 10 shows a section through well 309-859-1 (pumped well) and well 309-859-2 (observation well). As can be seen in the section, both wells penetrate water-bearing zones 1 and 2, and the zone of open joints near the top of rock. The pumping well is known to tap water-bearing zone 3; the observation well may or may not tap zone 3, but is probably hydraulically connected to the zone via joints at the top of rock. Well 309-859-1 was pumped at the rate of 2.2 gpm for 3 1/2 hours. Water-level measurements were made frequently in the observation well and sporadically in the pumped well during the test. A graphical plot



DRAWDOWN AND RECOVERY OF WATER LEVELS IN OBSERVATION WELL AND PUMPING WELL



TYPE-CURVE PLOT OF DRAWDOWN VERSUS r^2/t IN OBSERVATION WELL



SECTION THROUGH PUMPING WELL AND OBSERVATION WELL
(WATER LEVELS SHOWN IN WELLS ARE PRIOR TO START OF TEST)

Figure 10.--Pumping test on well 309-859-1, November 4, 1960: Water levels in pumping well and observation well, type-curve plot, and section through wells.

showing the decline and recovery of water levels during the test is shown in figure 10. A log-log plot (Theis method) of drawdown versus r^2/t for the observation well is also shown in the figure.

The degree to which individual water-bearing openings contribute water to the pumped well can be inferred by inspection of the drawdown and recovery curves in the pumped well (fig. 10). The water level in the pumped well dropped 5 feet to the level of water-bearing zone 3 during the first 20 minutes, remained stationary at this level for about 50 minutes, and then abruptly declined 3 more feet where the water level fluctuated until pumping stopped. The initial decline probably represents the time required to dewater the open joints at the top of rock, and the 50-minute interval of stabilization represents the time needed to dewater water-bearing zone 3 near the pumping well. During the last two hours of the test, a large part of the water entering the well apparently came from zones 1 and 2 plus a continuing small amount of seepage from zone 3.

The transmissibility of the Lockport was obtained by analysis of the drawdown curve for the observation well. As a result, the log-log plot of drawdown versus r^2/t (square of distance from observation well to pumping well "r" divided by time since pumping started "t") shows 3 steps (or segments). Analysis of the first segment of the curve (lower right portion) by the Theis method gives a T of 1,000 gpd per foot. This is inferred to be the T of the Lockport with no significant dewatering of the water-bearing openings. The second segment of the curve gives a T of 500 which is believed to be the transmissibility of the formation after dewatering of the jointed zone at top of rock. The third segment of the curve gives a T of 125 which represents the transmissibility after dewatering of water-bearing zone 3. The transmissibility of individual water-bearing openings contributing to the yield of the well is thus broken down as follows:

Transmissibility of jointed zone at top of rock	500 gpd per foot
Transmissibility of water-bearing zone 3	375
Transmissibility of water-bearing zones 1 and 2	125
Transmissibility of total thickness of Lockport Dolomite (38 feet) at well 309-859-2	1,000 gpd per foot

Under idealized conditions the drawdown and recovery curves should be mirror images. However, it is evident from figure 10 that the drawdown and recovery curves of both the observation and pumping wells are not identical. It may be noted that both wells failed to recover to the prepumping level. This was doubtless caused by a lack of recharge from the relatively impermeable glacial till and lake clay overlying the Lockport. Another anomaly is the fact that water-bearing zone 3 at the pumping well required 50 minutes to drain but appears to have been refilled in less than 12 minutes. A possible explanation for this anomaly is that water-bearing zone 3 at the site of the pumping well is largely supplied by vertical joints which are covered at the top of the rock by the relatively impermeable clay or till. The water could not freely drain from these joints during the test until the water level in the pumping well had declined to the level of zone 3. At that point, air could enter the zone to replace the water in the vertical joints. During recovery 12 minutes were required to replace the water in zone 3 to the point where the opening in the zone at the well was submerged. From that point on, the water in the vertical joints could be replaced only as the water level in the well rose.

Chemical character of the water

Ground water in the Lockport Dolomite is very hard and moderately to highly mineralized. The hardness and mineral content of the water makes it unsatisfactory for many uses without treatment. Chemical analyses of 60 water samples from the Lockport are listed in table 9.

The ground water in the Lockport is typically either a calcium-sulfate or a calcium-bicarbonate water. Figure 11 shows the concentrations of selected constituents in samples of ground water from the Lockport. An analysis of water from the Niagara River is shown for comparison (composite of daily samples collected Oct. 7-15, 18-20, 1958). Typical ground water from the Lockport (shown by thin solid lines) is characterized by high calcium and magnesium, and high sulfate and bicarbonate. These constituents reflect the solution of the host rock, dolomite ($Ca,Mg(CO_3)_2$), and gypsum ($CaSO_4$) by percolating ground water. Although gypsum makes up only a small part of the Lockport it is much more soluble than dolomite and, as a result, most water from the Lockport is characterized by a high sulfate content.

Two types of water which occur in the Lockport differ markedly in composition from the typical Lockport water described above. These waters are in one case much less and in the other case much more mineralized than typical water from the Lockport. The sample from well 304-901-6 (shown by a dashed line in the lower part of figure 11) is an example of the less mineralized type of water. As can be seen in figure 11, the water is intermediate in composition between typical Lockport water and water from the Niagara River (thick solid line). This well is one of several large-yield industrial wells located only a short distance from the Niagara River which are believed to obtain a substantial part of their yield by induced infiltration from the river, as discussed in the previous section.

Examples of the highly mineralized (or saline) water in the Lockport Dolomite are shown by analyses 305-900-1 and 308-901-e in the upper part of figure 11 (dashed lines). These water samples are characterized by much higher concentrations of sodium and chloride than typical water from the Lockport. The saline water samples also contain appreciably higher concentrations of calcium and sulfate than typical Lockport water. Table 9 lists a total of 22 analyses of saline water from the Lockport containing more than 2,000 ppm (parts per million) of dissolved solids. Of these, 16 show more than 500 ppm chloride.

The saline water samples listed in table 9 were collected either from wells known to penetrate the lower two water-bearing zones in the Lockport, or were collected from zones 1 and 2 at the rock face along the conduit excavations. In no case did a water sample from wells penetrating only the upper zones in the Lockport yield saline water. The saline water is thus characteristic of the lower two water-bearing zones. In an attempt to further define the chemical characteristics of water from the lower two zones in the Lockport, water samples were collected from the level of zone 1 in four wells (309-859-1, -2, and -3 and 309-901-7). Sampling was done by lowering a bottle in the wells and opening it at the estimated level of the zone. There are certain drawbacks to this method of sampling, particularly the dilution of water collected at the lower zones by less mineralized water

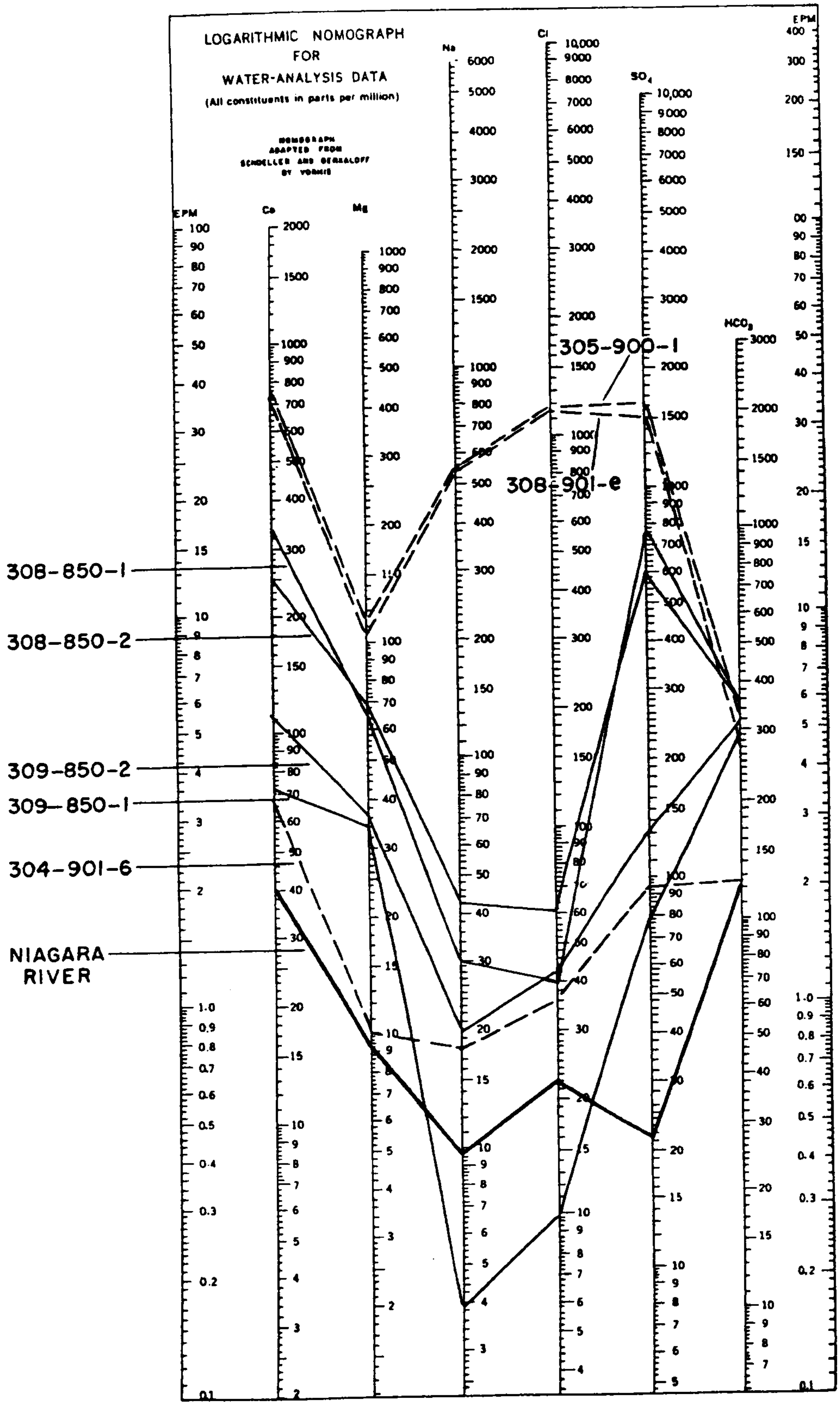


Figure 11.--Graph showing concentrations of selected chemical constituents in ground water from the Lockport Dolomite and water from the Niagara River.

moving down from the zones above. However, the results are probably accurate enough to give an indication of the chemical character of the water from zone 1. The chloride content of samples obtained at zone 1 in wells 309-859-3 and 309-901-7 were 700 and 1,170 ppm, respectively. These values compare with chloride contents of 550 and 1,140 ppm for samples 308-902-a and 308-901-e which were collected at zone 1 in the conduit excavations.

Brine [1/] was obtained from water-bearing zone 1 in wells 309-859-1 and -2. The chloride content of the water from zone 1 at wells 309-859-1 and -2 was 123,000 and 11,200 ppm, respectively. These water samples are the most highly mineralized waters collected from bedrock wells in the Niagara Falls area and are similar in chemical composition to many oil-field brines (Levorsen, 1956, p. 310-311). Such highly mineralized water can remain undiluted close to the land surface only if the water is effectively isolated from the zone of circulating ground water. Thus, water-bearing zone 1 in the Lockport at the site of wells 309-859-1 and -2 may be isolated from the remainder of the ground-water reservoir. The geologic structure causing the isolation is not known. Two possible explanations are: (1) water-bearing zone 1 is tightly sealed off in the direction of ground-water movement by a fault, or (2) the brine is contained in a small reef near the base of the Lockport that was penetrated by the well. Faulting of zone 1 on the downdip side of wells 309-859-1 and -2 might provide an effective dam behind which the brine could be trapped. The brine, being more dense than the water normally found in the Lockport, would tend to remain against the fault "dam" rather than flow around it. However, the existence of such a fault trap is highly conjectural because faulting, except for minor displacements of 1 to 2 feet, is not known in the Niagara Falls area. The reef hypothesis assumes that connate water has been trapped inside the reef since the reef formed at the time of deposition of the Lockport, some 300 million years ago. This hypothesis assumes that the reef be bounded on all sides by impermeable rock which effectively sealed the connate water inside. Although small reefs do occur locally in the Lockport, it is probably unlikely that such reefs could be completely isolated from circulating ground water in the Lockport throughout the long interval of time involved.

The chloride content of 60 samples from the Lockport Dolomite listed in table 9 varies from 3 to 123,000 ppm. However, the chloride analyses fall into two distinct groupings; those samples with less than 100 ppm (33 of 60) and those samples with more than 500 ppm chloride (17 of 60). The break between the two groupings of samples further points out the two types of water just discussed. A chloride content of less than 100 ppm is characteristic of the typical Lockport water. Chloride contents of more than 500 ppm are characteristic of the saline water from the zones 1 and 2 in the Lockport as mentioned above. The two brine samples with extremely high chloride contents are local exceptions of unknown origin as explained above. The

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[1/] By definition (Krieger, Hatchett, and Poole, 1957, p. 5), a brine has a dissolved-solids content of more than 35,000 ppm. The water samples obtained from water-bearing zone 1 at wells 309-859-1 and -2 show a dissolved-solids content of 198,000 and 21,000 ppm, respectively. For convenience in this report, both are referred to as brine.

chloride content of many shallow wells in the Lockport may be increased by pollution from septic tanks or road salting.

All water in the Lockport Dolomite is characteristically very hard. The range in hardness (excluding the two brine samples) is from 120 to 2,660 ppm and averages 960 ppm. Softening of this water is desirable or necessary before the water can be used for many purposes.

Hydrogen sulfide, locally termed "sulfur water" or "black water," is found in about one-third of the wells in the Lockport. The presence of hydrogen sulfide (H_2S) in water is objectionable because it imparts a "rotten egg" odor and taste to the water. Chlorination or aeration is used to remove H_2S. No definite areal pattern was ascertained for the occurrence of H_2S. In general, deeper wells are more likely to yield water with H_2S; however, there are many exceptions.

The dissolved-solids content of water from the Lockport Dolomite (excluding the two brine samples) ranges from 299 to 5,000 ppm and averages 1,400 ppm. These concentrations are higher than those contained in water of most municipal systems. Water having dissolved-solids concentrations greater than 1,000 ppm usually has a detectable mineral taste, but is not necessarily injurious to health.

The chemical quality of the water in the Lockport Dolomite in the area surrounding the pumped-storage reservoir (fig. 3) was investigated to determine if filling the reservoir had changed the chemical quality of the ground water. It was theorized that if the Niagara River water in the reservoir infiltrated into the Lockport it would tend to dilute the more mineralized water in the formation. It was also thought that the increased head in the upper part of the Lockport resulting from infiltration of the reservoir water would tend to decrease the amount of saline water entering a well from the lower zones of the Lockport. To determine if changes in quality did occur, a series of water samples were collected for analysis from four flowing relief wells drilled into the Lockport immediately outside of the reservoir. The dominant chemical constituents in these water samples are listed in table 4.

Two limitations must be considered in interpreting the analyses listed in table 4: (1) the wells were not drilled until after flooding of the reservoir had taken place, thus some slight changes in chemical composition may have already occurred prior to the start of sampling, and (2) the chemical composition of the ground water in the Lockport may vary seasonally, and these variations, if they exist, are not known because sampling was not done for a year prior to flooding. In spite of these limitations, certain conslusions may be drawn from the analyses. The following changes in the chemical composition of water in the Lockport near the reservoir took place: (1) there was a slight decrease in the sulfate and dissolved solids content in all four wells, (2) there was no consistent change in chloride content or hardness (well 309-900-9 showed a marked decrease in chloride), and (3) there was a noticeable increase in bicarbonate.

Sulfate is probably one of the most important constituents for indicating the arrival at the wells of the less mineralized water from the reservoir. However, the decrease in the sulfate content observed in all

Table 4.--Chemical analyses of ground water from flowing wells in the Lockport Dolomite near the pumped-storage reservoir

Well number	Date sampled	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Calcium, magnesium hardness (as $CaCO_3$)	Dissolved solids
308-900-16	4/13/62	318	1,120	65	1,410	2,200
	5/14/62	320	1,070	58	1,380	2,130
	7/ 6/62	320	1,060	54	1,500	2,090
	11/14/62	364	1,030	50	1,500	2,010
309-858-3	4/13/62	200	318	91	535	896
	5/14/62	188	305	104	528	875
	7/ 6/62	237	315	120	570	883
	11/14/62	320	262	120	578	805
309-858-4	4/13/62	162	277	48	443	687
	5/14/62	141	250	41	387	640
	7/ 6/62	154	210	40	380	562
	11/14/62	228	156	48	350	457
309-900-9	4/13/62	365	1,300	590	1,860	3,490
	5/14/62	396	1,380	790	2,100	3,900
	7/ 9/62	409	1,260	670	1,990	3,560
	11/14/62	424	1,260	148	1,620	2,360

four wells listed in table 4 is probably not of sufficient magnitude (except possibly in well 309-858-4) to clearly indicate the arrival of river water at the wells. The chloride content of the water is probably not as reliable an indicator of a change in chemical quality as the sulfate content because the chloride content is more subject to variation resulting from manmade causes such as road salting and pollution from septic tanks. Thus, small changes in chloride content may be the result of manmade activities rather than movement of water from the reservoir. A sharp decline in chloride content, however, such as that observed at well 309-900-9, may reflect the effect of the reservoir. The high chloride content originally observed in the well probably was caused by saline water moving up the well from the lower water-bearing zones in the Lockport. The sharp decline in chloride content may reflect either (1) the increased head in the upper part of the Lockport which greatly reduced the amount of saline water entering the well from lower zones or (2) the arrival at the well of "fresher" water from the reservoir.

The increase in bicarbonate content may at first appear anomalous. However, such an increase is, in fact, to be expected as a result of reservoir flooding. The water from the reservoir contains approximately 125 ppm bicarbonate. (See analysis of Niagara River water in figure 11.) In contrast, rain water, which is the normal source of recharge to the Lockport Dolomite, contains much less bicarbonate, possibly only a few parts per million. However, the ability of the reservoir water to dissolve dolomite, and thus to increase its bicarbonate content, is roughly equal to the dissolving ability of rain water. This results from the fact that the ability of water to dissolve dolomite and limestone is largely dependent upon its carbon-dioxide content which is roughly equal in both rain water and the reservoir water. Because of this, water infiltrating into the Lockport from the reservoir has a "headstart" of 125 ppm bicarbonate. Therefore, an increase in bicarbonate content, such as that observed in the four wells listed in the preceding table, may represent the arrival at the wells of water from the reservoir.

Table X
Ground Water Quality Testing Results
Proposed Frontier Stone Quarry
Town of Shelby, New York

Well	Date Sampled	Barium mg/l	Iron mg/l	Manganese mg/l	Hardness as $CaCO_3$ mg/l	TDS mg/l	TSS mg/l	pH SU	Sulfide mg/l	Sulfate mg/l	Chloride mg/l
Garage Well	May 11, 2012	0.036	2.7	0.080 B	310	370	4	8.17	<0.10►	41	97
Hole DH-4-98 (DH4-05)	May 11, 2012	0.29	0.63	0.025 B	690	420	42	7.70	<0.10►	84	46
MW-1	May 11, 2012	0.040	6.9	0.032 B	420	420	10	7.48	0.37►	120	18
PW-1	May 11, 2012	0.027	1.8	0.019 B	480	630	<4.0	7.42	0.6►	220	26
Hole DH 1-05	May 11, 2012	0.046	0.55	0.020 B	500	600	39	7.60	0.64►	220	7.7
Deep (DH5-05)	April 14, 2010	0.087	0.351	<0.020	395	490	2.5	7.3	0.18	104	28.5
Shallow (Barn)	April 14, 1010	0.058	0.118	0.042	491	652	7	7.1	<0.10	138	78
NYSDEC GWS		2.0	0.3*	0.3*	NS	500	NS	>6.5, <8.5	NS	250	250
NYSDEC Class C Surface Water Standard		NS	NS	NS	NS	500	NS	>6.5, <8.5	NS	NS	NS

Notes:
1) mg/l = milligrams per liter
2) SU = standard pH units
3) NYSDEC GWS = New York State Department of Environmental Conservation Ground Water Standards (NS = No standard).
4) * = NYSDEC GWS for the sum of iron and manganese = 0.5 mg/l.
5) B = Compound was found in the blank and the sample.
6) ►= Sulfide data from sampling on June 8, 2012.

Adirondack Environmental Services, Inc

Date: *29-Apr-10*

CLIENT:	Continental Placer	**Client Sample ID:**	Shallow BARN WELL
Work Order:	100415044	**Collection Date:**	4/14/2010 2:00:00 PM
Reference:	Shelby, NY /	**Lab Sample ID:**	100415044-001
PO#:		**Matrix:**	WATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
HARDNESS SM 2340B						Analyst: **KH**
(Prep: SW3010A - 4/16/2010)						
Total Hardness (As CaCO3)	491	5		mg/L	1	4/28/2010
ICP METALS E200.7						Analyst: **KH**
(Prep: SW3010A - 4/16/2010)						
Barium	0.058	0.010		mg/L	1	4/28/2010 1:10:00 PM
Iron	0.118	0.050	B	mg/L	1	4/28/2010 1:10:00 PM
Manganese	0.042	0.020		mg/L	1	4/28/2010 1:10:00 PM
ANIONS BY ION CHROMATOGRAPHY E300						Analyst: **SH**
Chloride	78.0	1.00		mg/L	1	4/22/2010
Sulfate	138	2.00		mg/L	1	4/22/2010
PH SM4500 H B						Analyst: **LS**
pH	7.1	1.0	H	pH Units	1	4/15/2010
SULFIDE SM4500 S2 D						Analyst: **PL**
Sulfide	< 0.10	0.10		mg/L	1	4/21/2010
TOTAL DISSOLVED SOLIDS SM2540C						Analyst: **PL**
TDS (Residue, Filterable)	652	5	H	mg/L	1	4/22/2010
TOTAL SUSPENDED SOLIDS SM2540 D						Analyst: **CJ**
TSS (Residue, Non-Filterable)	7.0	1.0		mg/L	1	4/16/2010

Qualifiers:

ND - Not Detected at the Reporting Limit

J - Analyte detected below quanititation limits

B - Analyte detected in the associated Method Blank

X - Value exceeds Maximum Contaminant Level

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

T - Tentitively Identified Compound-Estimated Conc.

E - Value above quantitation range

Adirondack Environmental Services, Inc

Date: *29-Apr-10*

CLIENT:	Continental Placer	**Client Sample ID:**	Deep DRILL HOLE 5-05
Work Order:	100415044	**Collection Date:**	4/14/2010 2:00:00 PM
Reference:	Shelby, NY /	**Lab Sample ID:**	100415044-002
PO#:		**Matrix:**	WATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
HARDNESS SM 2340B						Analyst: **KH**
(Prep: SW3010A - 4/16/2010)						
Total Hardness (As CaCO3)	395	5		mg/L	1	4/28/2010
ICP METALS E200.7						Analyst: **KH**
(Prep: SW3010A - 4/16/2010)						
Barium	0.087	0.010		mg/L	1	4/28/2010 1:15:00 PM
Iron	0.351	0.050	B	mg/L	1	4/28/2010 1:15:00 PM
Manganese	< 0.020	0.020		mg/L	1	4/28/2010 1:15:00 PM
ANIONS BY ION CHROMATOGRAPHY E300						Analyst: **SH**
Chloride	28.5	1.00		mg/L	1	4/16/2010
Sulfate	104	2.00		mg/L	1	4/23/2010
PH SM4500 H B						Analyst: **LS**
pH	7.3	1.0	H	pH Units	1	4/15/2010
SULFIDE SM4500 S2 D						Analyst: **PL**
Sulfide	0.18	0.10		mg/L	1	4/21/2010
TOTAL DISSOLVED SOLIDS SM2540C						Analyst: **PL**
TDS (Residue, Filterable)	490	5	H	mg/L	1	4/22/2010
TOTAL SUSPENDED SOLIDS SM2540 D						Analyst: **CJ**
TSS (Residue, Non-Filterable)	2.5	1.0		mg/L	1	4/16/2010

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quanititation limits
B - Analyte detected in the associated Method Blank
X - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
T - Tentitively Identified Compound-Estimated Conc.
E - Value above quantitation range

Detection Summary

Client: Continental Placer Inc.
Project/Site: Shelby

TestAmerica Job ID: 480-19955-1

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Client Sample ID: GARAGE WELL

Lab Sample ID: 480-19955-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Barium	0.036		0.0020	0.00070	mg/L	1		6010B	Total/NA
Iron	2.7		0.050	0.019	mg/L	1		6010B	Total/NA
Manganese	0.080	B	0.0030	0.00040	mg/L	1		6010B	Total/NA
Chloride	97		0.50	0.28	mg/L	1		300.0	Total/NA
Sulfate	41		10	1.7	mg/L	5		300.0	Total/NA
Hardness as calcium carbonate	310		4.0	1.1	mg/L	1		SM 2340C	Total/NA
Total Dissolved Solids	370		10	4.0	mg/L	1		SM 2540C	Total/NA

Analyte	Result	Qualifier	RL	RL	Unit	Dil Fac	D	Method	Prep Type
pH	8.17		0.100	0.100	SU	1		9040B	Total/NA
Total Suspended Solids	4.0		4.0	4.0	mg/L	1		SM 2540D	Total/NA

Client Sample ID: HOLE DH-4-98

Lab Sample ID: 480-19955-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Barium	0.29		0.0020	0.00070	mg/L	1		6010B	Total/NA
Iron	0.63		0.050	0.019	mg/L	1		6010B	Total/NA
Manganese	0.025	B	0.0030	0.00040	mg/L	1		6010B	Total/NA
Chloride	46		0.50	0.28	mg/L	1		300.0	Total/NA
Sulfate	84		10	1.7	mg/L	5		300.0	Total/NA
Hardness as calcium carbonate	690		4.0	1.1	mg/L	1		SM 2340C	Total/NA
Total Dissolved Solids	420		10	4.0	mg/L	1		SM 2540C	Total/NA

Analyte	Result	Qualifier	RL	RL	Unit	Dil Fac	D	Method	Prep Type
pH	7.70		0.100	0.100	SU	1		9040B	Total/NA
Total Suspended Solids	42		4.0	4.0	mg/L	1		SM 2540D	Total/NA

Client Sample ID: MW-1

Lab Sample ID: 480-19955-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Barium	0.040		0.0020	0.00070	mg/L	1		6010B	Total/NA
Iron	6.9		0.050	0.019	mg/L	1		6010B	Total/NA
Manganese	0.032	B	0.0030	0.00040	mg/L	1		6010B	Total/NA
Chloride	18		0.50	0.28	mg/L	1		300.0	Total/NA
Sulfate	120		10	1.7	mg/L	5		300.0	Total/NA
Hardness as calcium carbonate	420		4.0	1.1	mg/L	1		SM 2340C	Total/NA
Total Dissolved Solids	420		10	4.0	mg/L	1		SM 2540C	Total/NA

Analyte	Result	Qualifier	RL	RL	Unit	Dil Fac	D	Method	Prep Type
pH	7.48		0.100	0.100	SU	1		9040B	Total/NA
Total Suspended Solids	10		4.0	4.0	mg/L	1		SM 2540D	Total/NA

Client Sample ID: PW-1

Lab Sample ID: 480-19955-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Barium	0.027		0.0020	0.00070	mg/L	1		6010B	Total/NA
Iron	1.8		0.050	0.019	mg/L	1		6010B	Total/NA
Manganese	0.019	B	0.0030	0.00040	mg/L	1		6010B	Total/NA
Chloride	26		0.50	0.28	mg/L	1		300.0	Total/NA
Sulfate	220		10	1.7	mg/L	5		300.0	Total/NA
Hardness as calcium carbonate	480		4.0	1.1	mg/L	1		SM 2340C	Total/NA
Total Dissolved Solids	630		10	4.0	mg/L	1		SM 2540C	Total/NA

Analyte	Result	Qualifier	RL	RL	Unit	Dil Fac	D	Method	Prep Type
pH	7.42		0.100	0.100	SU	1		9040B	Total/NA

Detection Summary

Client: Continental Placer Inc.
Project/Site: Shelby

TestAmerica Job ID: 480-19955-1

Client Sample ID: HOLE DH-1-05

Lab Sample ID: 480-19955-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Barium	0.046		0.0020	0.00070	mg/L	1		6010B	Total/NA
Iron	0.55		0.050	0.019	mg/L	1		6010B	Total/NA
Manganese	0.020	B	0.0030	0.00040	mg/L	1		6010B	Total/NA
Chloride	7.7		0.50	0.28	mg/L	1		300.0	Total/NA
Sulfate	220		10	1.7	mg/L	5		300.0	Total/NA
Hardness as calcium carbonate	500		4.0	1.1	mg/L	1		SM 2340C	Total/NA
Total Dissolved Solids	600		10	4.0	mg/L	1		SM 2540C	Total/NA

Analyte	Result	Qualifier	RL	RL	Unit	Dil Fac	D	Method	Prep Type
pH	7.60		0.100	0.100	SU	1		9040B	Total/NA
Total Suspended Solids	39		4.0	4.0	mg/L	1		SM 2540D	Total/NA

Client: Continental Placer Inc. Job Number: 480-21070-1

General Chemistry

Client Sample ID: **DH-1**

Lab Sample ID: 480-21070-4 Date Sampled: 06/08/2012 1227
Client Matrix: Water Date Received: 06/08/2012 1405

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Sulfide	0.064	J	mg/L	0.052	0.10	1.0	SM 4500 S2 D

Analysis Batch: 480-68186 Analysis Date: 06/12/2012 1246

Client: Continental Placer Inc. Job Number: 480-21070-1

General Chemistry

Client Sample ID: **DH-4**

Lab Sample ID: 480-21070-1 Date Sampled: 06/08/2012 1104
Client Matrix: Water Date Received: 06/08/2012 1405

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Sulfide	ND		mg/L	0.052	0.10	1.0	SM 4500 S2 D

Analysis Batch: 480-68186 Analysis Date: 06/12/2012 1246

Client: Continental Placer Inc.

Job Number: 480-21070-1

General Chemistry

Client Sample ID: **MW-1**

Lab Sample ID: 480-21070-2
Client Matrix: Water

Date Sampled: 06/08/2012 1130
Date Received: 06/08/2012 1405

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Sulfide	0.37		mg/L	0.052	0.10	1.0	SM 4500 S2 D

Analysis Batch: 480-68186 Analysis Date: 06/12/2012 1246

Client: Continental Placer Inc. Job Number: 480-21070-1

General Chemistry

Client Sample ID: **PW-1**

Lab Sample ID: 480-21070-3 Date Sampled: 06/08/2012 1200
Client Matrix: Water Date Received: 06/08/2012 1405

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Sulfide	0.60		mg/L	0.052	0.10	1.0	SM 4500 S2 D

Analysis Batch: 480-68186 Analysis Date: 06/12/2012 1246

General Chemistry

Client Sample ID: **GARAGE WELL**

Lab Sample ID: 480-21070-5 | Date Sampled: 06/08/2012 1250

Client Matrix: Water | Date Received: 06/08/2012 1405

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Sulfide	ND		mg/L	0.052	0.10	1.0	SM 4500 S2 D

Analysis Batch: 480-68186 Analysis Date: 06/12/2012 1246

APPENDIX 5

- **Air Monitoring Data**

2011 Region 8 Air Quality Data

Description of Region 8 Air Monitoring Stations				
Site No	Station	County	Address	Parameters
0701-05	Elmira	Chemung	Sullivan St., Water Treatment Plant	O_3, SO_2
2701-22	Rochester 2	Monroe	Yarmouth Road. RGE Substation	CO, O_3, SO_2, $PM_{2.5}$, Lead(PM_{10}), Toxics
5001-04	Pinnacle	Steuben	8301 Anderson Road, Pinnacle State Park	CO, O_3, SO_2, $PM_{2.5}$
5863-01	Williamson	Wayne	4440 Ridge Road	O_3

Sulfur Dioxide - Continuous Pulsed Fluorescence

Annual Averages 2001 through 2011 Annual Arithmetic Mean (ppb) - Primary Standard (12 month average not to exceed 30 PPB *)												
Station	Site No.	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Elmira	0701-05	3.70	3.66	4.06	3.31	3.18	3.12	3.29	2.80	2.01	2.08	1.65
Rochester	2701-08	7.57	5.22	5.43	(6.47)	xx	xx	xx	xx	xx	xx	xx
Rochester Downtown	2701-01	5.96	5.16	5.42	(6.17)	xx	xx	xx	xx	xx	xx	xx
Rochester 2	2701-22	--	--	--	(4.50)	4.20	4.18	4.06	2.91	2.54	2.19	(1.15)
Pinnacle	5001-04	--	--	--	--	--	--	1.73	1.67	1.04	0.63	0.71

Comparison Between NYS Ambient Air Quality and Ambient Air Quality Standards for Calendar Year 2011

Station	Site No.	One Hour Averages average of 99th percentile for last 3 years not to exceed 75 PPB *							3-Hour Block Averages Maximum not to exceed 500 PPB more than once per calendar year *			24 Hour Averages Maximum not to exceed 140 PPB more than once per calendar year *	
		Observations		99th Percentile, PPB				Obs.	Highest Values, PPB		Obs.	Highest Values, PPB Midnight - Midnight	
		Total Obs.	% Avail	2011	2010	2009	3-yr avg	Total	1st	2nd	Total	1st	2nd
Elmira	0701-05	8,322	95	11.0	11.0	16.0	13	2,746	11.8 [02/12, 05]	10.9 [02/12, 02]	349	7.1 [12/19]	6.5 [12/09]
Rochester 2	2701-22	6,723	76	22.0	25.0	24.0	24	2,125	17.0 [07/12, 23]	15.6 [11/30, 20]	263	5.5 [12/12]	4.4 [04/24]
Pinnacle	5001-04	8,168	93	14.8	13.7	19.4	16	2,592	16.1 [02/05, 02]	15.3 [02/05, 05]	345	7.4 [02/11]	6.8 [02/05]

Footnotes for Region 8 sulfur dioxide data:
(Annual Means in parentheses are based on less than 75% available data)
*New York and Federal Ambient Air Quality Standard
[Date of Occurrence, Hour]
+ Denotes a contravention of NYS/Federal AAQS

Inhalable Particulates (PM_{10}) - Wedding Sampler or R&P Model 2025 Sampler

Annual Averages 2001 through 2011 Annual Arithmetic Mean (µg/m3)

Station	Site No.	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	3 Yr Exp Val
Rochester 2 (R&P)	2701-22	--	--	--	--	--	--	15	13	13	13	11	12

Comparison Between NYS Ambient Air Quality and Ambient Air Quality Standards for Calendar Year 2011

Station	Site No.	24-Hour Concentrations - µg/m^3							# of Days > 150 µg/m^3 - Not to exceed an expected avg of one per year during the last 3 years *						
		Total Obs.	Maximum		2nd Max.		3rd Max.		2009		2010		2011		Exp Avg
			Value	Date	Value	Date	Value	Date	Mea	Est	Mea	Est	Mea	Est	
Rochester 2 (R&P)	2701-22	54	43	06/08	26	08/19	26	07/20	0	0.0	0	0.0	0	0.0	0.0

Footnotes for Region 8 PM_{10} data:
(Annual Means in parentheses are based on less than 75% available data)
*New York and Federal Ambient Air Quality Standard
[Date of Occurrence]
+ Denotes a contravention of NYS/Federal AAQS

Inhalable Particulates ($PM_{2.5}$) - Rupprecht & Patashnick Sampler

Comparison Between NYS Ambient Air Quality and Ambient Air Quality Standards for Calendar Year 2011 (Average of last 3 years= annual means not to exceed 15 µg/m3 *; and average of 98th percentile for last 3 years not to exceed 35 µg/m3 *, changed from 65 µg/m3 on 12/17/06)

Station	Site No.	Total Obs.	Maximum Values			98th Percentile				Quarterly Averages, 2011				Annual Mean			
			1st	2nd	3rd	2011	2010	2009	3-yr avg	1st	2nd	3rd	4th	2011	2010	2009	3-yr avg
Rochester 2 (F)	2701-22	91	29.8 [09/03]	25.3 [06/08]	23.0 [12/14]	25.3	23.4	22.2	24	9.2	(10.0)	10.2	7.4	9.2	8.4	7.6	8.4
Rochester 2 (T)	2701-22	268	24.6 [09/03]	23.0 [09/02]	21.3 [02/17]	17.1	23.2	18.3	20	8.0	5.5	7.2	6.5	6.8	7.3	6.9	7.0
Pinnacle (F)	5001-04	104	23.8 [09/03]	20.4 [07/11]	20.4 [08/07]	20.4	21.4	17.5	20	6.5	6.1	9.9	5.5	7.0	7.3	6.9	7.1

Footnotes for Region 8 $PM_{2.5}$ data:
(Annual Means in parentheses are based on less than 75% available data)
F = Federal Reference Method
T = TEOM (Tapered Element Oscillating Microbalance) not for Standards determination
* Federal Ambient Air Quality Standard
+ Denotes a contravention of Federal AAQS

Carbon Monoxide - Continuous Non-Dispersive Infrared

Annual Averages 2001 through 2011Annual Arithmetic Mean (ppm)

Station	Site No.	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Rochester	2701-08	0.4	0.4	0.5	(0.5)	xx	xx	xx	xx	xx	xx	xx
Rochester Downtown	2701-01	0.5	0.5	0.5	(0.5)	xx	xx	xx	xx	xx	xx	xx
Rochester 2	2701-22	--	--	--	(0.5)	0.5	0.5	0.4	0.3	0.4	0.4	(0.2)
Pinnacle	5001-04	--	--	--	--	--	--	--	--	--	0.16	0.16

Comparison Between NYS Ambient Air Quality and Ambient Air Quality Standards for Calendar Year 2011

Station	Site No.	One-Hour Average Maximum not to exceed 35 PPM more than once per calendar year *						Running 8-Hour Average (Non-Overlapping) Maximum not to exceed 9 PPM more than once per calendar year *					
		Observations			Highest Values, PPM>			Observations		Highest Values, PPM			
		Total Obs.	% Avail	>35 PPM	1st	2nd	3rd	Total	> 9 PPM	1st	2nd	3rd	Days > 9 PPM
Rochester 2	2701-22	6,183	71	0	1.2 [12/12, 21]	1.2 [12/12, 20]	1.1 [02/16, 21]	5,878	0	1.0 [02/17, 01]	0.9 [12/12, 23]	0.7 [02/05, 01]	0
Pinnacle	5001-04	8,044	92	0	.35 [01/26, 07]	.33 [02/25, 07]	.33 [01/26, 04]	8,173	0	.31 [02/01, 15]	.30 [02/25, 08]	.30 [01/26, 10]	0

Footnotes for Region 8 carbon monoxide data:
(Annual Means in parentheses are based on less than 75% available data)
*New York and Federal Ambient Air Quality Standard
[Date of Occurrence, Hour]
+ Denotes a contravention of NYS/Federal AAQS (Note: 9 PPM standard is not exceeded unless 8-hour avg > 9.4 PPM)

Ozone - Continuous UV Light Absorption

Annual Averages 2001 through 2011 Annual Arithmetic Mean (ppm)												
Station	Site No.	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Elmira	0701-05	.026	.027	.024	.024	.025	.024	.027	.024	.025	.027	.027
Rochester	2701-08	.026	.028	.025	(.025)	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Rochester 2	2701-22	B	B	--	(.019)	.023	.024	.026	.026	.024	.028	.026
Pinnacle	5001-04	B	B	--	B	--	.034	.036	.032	.030	(.035)	.034
Williamson	5863-01	.029	.032	.032	.029	.029	.029	.033	.031	.031	.032	.023

Comparison Between NYS Ambient Air Quality and Ambient Air Quality Standards for Calendar Year 2011

Station	Site No.	One Hour Averages							4th Highest Daily Maximum 8-Hour Average- Not to exceed an avg of 0.075 ppm during the last 3 years, changed from 0.08 ppm on 5/27/08*			
		Observations			Highest Values, PPM							
		Total Obs.	% Avail	>.12 PPM	1st	2nd	3rd	4th	2009	2010	2011	Avg
Elmira	0701-05	8,318	95	0	.074 [06/08, 15]	.071 [07/11, 15]	.071 [07/17, 13]	.069 [06/07, 12]	.066 [04/27]	.067 [09/24]	.065 [06/09]	.066
Rochester 2	2701-22	6,658	76	0	.081 [07/17, 14]	.076 [07/02, 14]	.073 [07/23, 14]	.072 [07/18, 15]	.059 [04/27]	.072 [04/02]	.066 [06/07]	.065
Pinnacle	5001-04	8,210	94	0	.074 [05/26, 15]	.074 [07/02, 15]	.074 [07/11, 18]	.072 [05/12, 15]	.062 [05/20]	.068 [09/02]	.067 [06/01]	.065
Williamson (Operated 03/30 - 11/10)	5863-01	5,139	95	0	.081 [07/17, 15]	.068 [07/18, 15]	.067 [07/21, 20]	.066 [07/23, 14]	.061 [06/25]	.071 [07/06]	.058 [06/08]	.063

Footnotes for Region 8 ozone data:
(Annual Means in parentheses are based on less than 75% available data)
*Federal Ambient Air Quality Standard
[Date of Occurrence, Hour]
+ Denotes a contravention of Federal AAQS

Lead - PM_{10} Samplers

Annual Geometric Means ($\mu g/m^3$) 2001 through 2011

Station	Site No.	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Rochester (PM10)	2701-22	--	--	--	--	--	--	.002	.003	.002	.002	.002

Comparison Between NYS Ambient Air Quality and Ambient Air Quality Standards for Calendar Year 2011

Station	Site No.	24-Hour Concentrations - ug/m^3								Three Month Rolling Averages Maximum not to exceed 0.15 ug/m^3, effective beginning 1/1/13 * (the old standard of 1.5 ug/m^3 will remain in force until that date)		
		Total Obs.	% Avail	Maximum		2nd Max.		3rd Max.		Highest Values, ug/m3		
				Value	Date	Value	Date	Value	Date	2009	2010	2011
Rochester 2 (PM_{10})	2701-22	54	89	0.006	09/18	0.005	10/12	0.004	06/08	0.002	0.003	0.002

Footer for Region 8 lead data:
(Annual Means in parentheses are based on less than 75% available data)
*Federal Ambient Air Quality Standard
+ Denotes a contravention of Federal AAQS

2011 Region 9 Air Quality Data

Information for Region 9 Air Monitoring Stations				
Site No	Station	County	Address	Parameters
0601-04	Dunkirk	Chautauqua	Wright Park Drive	O_3, SO_2
0675-01	Westfield	Chautauqua	8150 Hardscrabble Road	O_3, SO_2, $PM_{2.5}$
1401-18	Buffalo	Erie	185 Dingens St	CO, SO_2, NO_2, $PM_{2.5}$
1451-03	Amherst	Erie	450 Maple Road	O_3, NO_2
1472-13	Grand Island Blvd	Erie	520 Grand Island Blvd	$PM_{2.5}$, Toxics
1472-14	Brookside Terrace	Erie	192 Brookside Terrace West	SO_2, $PM_{2.5}$
3102-25	Niagara Falls	Niagara	Frontier Ave & 55th Street	CO, SO_2, $PM_{2.5}$, Toxics
3120-02	Middleport	Niagara	3825 North Hartland Road	O_3

Sulfur Dioxide - Continuous Pulsed Fluorescence

Annual Averages 2001 through 2011 Annual Arithmetic Mean (ppb) - Primary Standard (12 month average not to exceed 30 PPB *)												
Station	Site No.	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Buffalo	1401-18	7.16	5.78	5.47	3.35	3.73	2.78	2.70	2.34	1.74	1.50	2.01
Tonawanda	1472-04	9.68	10.79	8.89	7.87	5.83	3.93	4.29	xxx	xxx	xxx	xxx
Brookside Terrace	1472-14	--	--	--	--	--	--	(2.80)	2.83	2.10	1.83	3.43
Niagara Falls	3102-25	3.52	3.68	3.56	2.73	2.63	2.48	2.79	2.13	1.58	1.53	2.74
Westfield	0675-01	4.76	4.11	4.26	3.49	3.49	2.70	2.74	2.51	1.73	1.32	1.22
Dunkirk	0601-04	8.37	7.46	6.69	5.31	4.32	3.13	3.27	2.67	2.55	1.54	1.72

Comparison Between NYS Ambient Air Quality and Ambient Air Quality Standards for Calendar Year 2011

Station	Site No.	One Hour Averages - Average of 99th percentile for last 3 years not to exceed 75 PPB *						3-Hour Block Averages - Maximum not to exceed 500 PPB more than once per calendar year *			24 Hour Average - Maximum not to exceed 140 PPB more than once per calendar year *		
		Observations		99th Percentile, PPB				Obs.	Highest Values, PPB		Obs.	Highest Values, PPB Midnight - Midnight	
		Total Obs.	% Avail	2011	2010	2009	3-yr avg	Total	1st	2nd	Total	1st	2nd
Buffalo	1401-18	8,149	93	22.4	15.0	20.0	19	2,678	21.2 [02/16, 14]	18.2 [02/16, 23]	339	9.1 [02/16]	7.8 [02/11]
Brookside Terrace	1472-14	8,381	96	28.9	30.6	36.6	32	2,763	42.2 [10/07, 14]	29.8 [02/13, 11]	347	10.5 [10/07]	9.6 [07/17]
Niagara Falls	3102-25	8,656	99	12.3	16.3	21.3	17	2,850	12.1 [02/05, 11]	11.9 [12/13, 11]	363	8.1 [12/13]	7.4 [02/05]
Westfield	0675-01	8,659	99	17.1	15.4	24.3	9	2,849	17.4 [10/08, 05]	16.4 [02/05, 11]	365	10.9 [02/05]	8.9 [12/12]
Dunkirk	0601-04	8,660	99	25.8	30.0	46.2	34	2,847	37.1 [02/02, 17]	26.6 [02/18, 23]	365	10.1 [02/05]	9.1 [02/02]

Footnotes for Region 9 sulfur dioxide data:
(Annual Means in parentheses are based on less than 75% available data)
*New York and Federal Ambient Air Quality Standard
[Date of Occurrence, Hour]
+ Denotes a contravention of NYS/Federal AAQS

Inhalable Particulates (PM_{10}) - Wedding Sampler or R&P Model 2025Sampler

Annual Averages 2001 through 2011 Annual Arithmetic Mean (µg/m3)													
Station	Site No.	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	3 Yr Exp Val
Niagara Falls (W)	3102-25	18	17	17	17	xx	xx	xx	xx	xx	xx	xx	xx
Niagara Falls (R&P)	3102-25	--	--	--	20	24	21	21	22	17	15	(14)	15
Westfield (W)	0675-01	14	12	12	11	xx	xx	xx	xx	xx	xx	xx	xx

Comparison Between NYS Ambient Air Quality and Ambient Air Quality Standards for Calendar Year 2011														
Station	Site No.	24-Hour Concentrations - µg/m³							# of Days > 150 µg/m³ - Not to exceed an expected avg of one per year during the last 3 years *					
		Total Obs.	Maximum		2nd Max.		3rd Max.		2009		2010		2011		Exp Avg
			Value	Date	Value	Date	Value	Date	Mea	Est	Mea	Est	Mea	Est	
Niagara Falls (R&P)	3102-25	84	34	07/11	32	07/23	31	07/17	0	0.0	0	0.0	0	0.0	0.0

Footnotes Region 9 PM_{10} data:
(Annual Means in parentheses are based on less than 75% available data)
* Federal Ambient Air Quality Standard
Mea=Measured
Est=Estimated
W=Wedding Sampler
R&P=R&P Model 2025 Sampler
+ Denotes a contravention of Federal AAQS

Inhalable Particulates ($PM_{2.5}$) - Rupprecht & Patashnick Sampler

Comparison Between NYS Ambient Air Quality and Ambient Air Quality Standards for Calendar Year 2011 (Average of last 3 years= annual means not to exceed 15 µg/m3 *; and average of 98th percentile for last 3 years not to exceed 35 µg/m3 *, changed from 65 µg/m3 on 12/17/06)

Station	Site No.	Total Obs.	MaximumValues			98th Percentile				Quarterly Averages, 2011				Annual Mean			
			1st	2nd	3rd	2011	2010	2009	3-yr avg	1st	2nd	3rd	4th	2011	2010	2009	3-yr avg
Buffalo (F)	1401-18	329	29.3 [06/08]	26.4 [07/18]	25.9 [02/24]	24.6	27.9	24.3	26	10.2	9.2	10.9	8.0	9.6	10.0	9.6	9.7
Buffalo (T)	1401-18	353	30.1 [06/08]	26.0 [09/03]	25.8 [07/18]	22.0	28.6	21.1	24	7.7	8.0	10.5	9.4	8.9	10.1	9.8	9.6
Lackawanna (F)	1402-14	xx	xx	Xx	xx	Xx	30.2	23.9	xx	xx	xx	xx	xx	xx	10.2	9.5	xx
Grand Island Blvd (T)	1472-13	288	28.8 [06/08]	27.8 [07/18]	26.7 [07/21]	24.8	30.9	23.5	26	10.4	8.3	11.0	9.7	9.9	11.4	10.3	10.5
Brookside Terrace (T)	1472-14	264	30.9 [06/08]	28.6 [07/18]	26.9 [05/31]	23.5	29.6	20.7	25	6.8	8.4	11.3	10.2	9.2	9.4	8.8	9.1
Niagara Falls (F)	3102-25	72	23.0 [09/03]	19.9 [07/11]	19.7 [07/17]	19.9	24.8	21.7	22	8.0	---	9.9	6.2	8.1	8.3	8.7	8.4
Niagara Falls (T)	3102-25	350	35.2 [09/03]	32.0 [07/18]	30.6 [06/08]	26.8	25.5	19.9	24	8.8	8.7	12.2	10.5	10.1	9.3	9.2	9.5
Westfield (F)	0675-01	115	29.5 [09/03]	23.1 [06/08]	21.6 [07/17]	21.6	23.5	17.0	21	7.0	6.9	10.4	5.0	7.3	7.6	7.4	7.4

Sampling at 1402-14 was terminated on 12/31/10.
Footnotes for Region 9 $PM_{2.5}$ data:
(Annual Means in parentheses are based on less than 75% available data)
* Federal Ambient Air Quality Standard
F = Federal Reference Method
T = TEOM (Tapered Element Oscillating Microbalance) not for Standards determination
+ Denotes a contravention of Federal AAQS.

Carbon Monoxide - Continuous Non-Dispersive Infrared

Annual Averages 2001 through 2011 Annual Arithmetic Mean (ppm)

Station	Site No.	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Niagara Falls	3102-25	0.3	0.4	0.4	0.2	0.2	0.2	0.2	0.3	0.3	0.3	(0.4)
Buffalo	1401-18	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.4
Brookside Terrace	1472-14	--	--	--	--	--	--	0.4	(0.3)	xx	xx	xx

Comparison Between NYS Ambient Air Quality and Ambient Air Quality Standards for Calendar Year 2011

Station	Site No.	One-Hour Average Maximum not to exceed 35 PPM more than once per calendar year *						Running 8-Hour Average (Non-Overlapping) - Maximum not to exceed 9 PPM more than once per calendar year *					
		Observations			Highest Values, PPM			Observations		Highest Values, PPM			
		Total Obs.	% Avail	> 35 PPM	1st	2nd	3rd	Total	> 9 PPM	1st	2nd	3rd	Days > 9 PPM
Niagara Falls	3102-25	5,193	59	0	2.1 [04/13, 06]	1.9 [04/12, 14]	1.9 [04/12, 15]	5,213	0	1.9 [04/13, 10]	1.8 [04/12, 23]	1.1 [10/30, 07]	0
Buffalo	1401-18	7,661	87	0	1.8 [12/13, 03]	1.6 [11/23, 19]	1.6 [12/13, 04]	7,682	0	1.5 [12/13, 10]	1.3 [12/03] 06]	1.3 [12/13, 02]	0

Footnotes for Region 9 carbon monoxide data:
(Annual Means in parentheses are based on less than 75% available data). [Date of Occurrence, Hour]
*New York and Federal Ambient Air Quality Standard
+ Denotes a contravention of NYS/Federal AAQS (Note: 9PPM standard is not exceeded unless 8-hour avg > 9.4 PPM)

APPENDIX 6

- **Vegetation and Wildlife Resources Report and Impact Analysis of Ecological Resources**

VEGETATION AND WILDLIFE RESOURCES
AND
IMPACT ANALYSIS OF ECOLOGICAL RESOURCES

PROPOSED SHELBY MINE

TOWN OF SHELBY
ORLEANS COUNTY, NEW YORK

Prepared for:

FRONTIER STONE, LLC
4172 East Lake Road
Wilson, New York 14172

Prepared by:

TERRESTRIAL ENVIRONMENTAL SPECIALISTS, INC.
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Phoenix, New York 13135

Revised January 2014
July 2011

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OVERVIEW

Terrestrial Environmental Specialists, Inc. (TES) was contracted by Continental Placer to perform environmental studies on property currently used for agricultural purposes in the Town of Shelby, Orleans County, New York. The 268-acre site is proposed to be used for a quarry.

TES prepared a Vegetation and Wildlife Resources Report of the Shelby Quarry site (TES 2007b) describing the baseline conditions at the site. TES prepared an Impact Analysis of Ecological Resources Shelby Quarry Site (TES 2007c). After comments from the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Fish and Wildlife Service (USFWS), a Supplement to Ecological Resources Report (TES 2009b) was written.

Since these reports were prepared, the NYSDEC provided additional comments and requests (Bimber 2009) based on a review of the draft Environmental Impact Statement. As a result of the comments, additional field surveys were performed on the proposed quarry site and the surrounding areas, including the Iroquois National Wildlife Refuge. TES has incorporated the 2010 field work and responses to comments in the 2011 report.

The NYSDEC sent additional comments after another review of the draft Environmental Impact Statement (Bimber 2011). The USFWS also provided additional comments (Roster 2012). In response to those comments, TES conducted a breeding bird survey on Oak Orchard Ridge Road and Sour Springs Road. TES incorporated the 2012 field work and responses to comments in this report.

TES has prepared this updated Vegetation and Wildlife Resources and Impact Analysis of Ecological Resources Report to combine these previous reports with updated data in one volume. Chapter 1 provides the baseline vegetation and wildlife information. Chapter 2 provides the impact analysis of the proposed quarry on the ecological resources described in Chapter 1.

Potential wetland resources and water quality issues are addressed in a separate wetland delineation report (TES 2007a) and Wetlands Impact Assessment Report (TES 2009a). Based on additional comments and requests, the Wetlands Impact Assessment Report was updated (TES 2013). Specific descriptions of the wetland resources and potential impacts can be found in those reports.

CHAPTER 1 – VEGETATION AND WILDLIFE RESOURCES

1.1 INTRODUCTION

Terrestrial Environmental Specialists, Inc. (TES) was contracted by Continental Placer Inc. to perform environmental studies on the property currently used for agriculture in the Town of Shelby, Orleans County, New York. The site (*hereafter* the Shelby Quarry site) is approximately 268 acres in size (Figure 1), and is proposed to be used for a quarry. The current property owner has had the site in agricultural production for over fifty years.

Common vegetation and wildlife resources, as well as endangered species were addressed in this study. This report documents the results of the background information review, agency contacts, and field surveys for these resources on the site. The initial field investigation was performed in November, 2006. Two winter site visits (December 2006 and February 2007) were conducted to determine whether the short-eared owl was wintering on the site. An investigation for wildlife species during the breeding season was performed on May 31 and June 1, 2007. Follow-up visits were conducted in 2008 and 2010.

TES visited the Shelby Quarry site on August 25, September 16, and October 23, 2008. On September 16, 2008 TES walked on the Iroquois National Wildlife Refuge (INWR) adjacent to the Shelby Quarry site and drove the proposed truck route on Oak Orchard Road and stopped at the waterfowl viewing areas.

In response to NYSDEC comments, TES visited the Shelby Quarry site on April 29, June 17, and July 13, 2010. As requested by the NYSDEC, TES conducted a breeding bird survey in the area of the refuge adjacent to the proposed quarry on June 17, 2010 with a follow-up survey on July 13, 2010. Lastly, TES also conducted a breeding bird survey adjacent to Oak Orchard Ridge Road and Sour Springs Road on May 31, 2012.

1.2 METHODS

1.2.1 Background Information

Prior to the field investigation at the site, TES assembled and reviewed available background information. This information included:

- the New York State Department of Transportation (NYSDOT) Topographic map (Knowlesville and Medina quadrangles) (Figure 1);
- the New York State Department of Environmental Conservation (NYSDEC) New York State Freshwater Wetlands map (Figure 2);
- the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) map (Figure 3);
- the Orleans County Soil Survey map prepared by the U.S. Soil Conservation Service (currently Natural Resources Conservation Service) (Figure 4);
- the New York State Stream Classification Map (Figure 5);
- the Federal Emergency Management Agency (FEMA) Flood Insurance Rate map (Figure 6); and

- a 2005 aerial photograph obtained from the New York State GIS Clearinghouse (Figure 7).

These background resource maps were developed into figures and are presented after the text of the report.

Background information on amphibians and reptiles known to be in the vicinity of the site were obtained from the New York State Herpetological Atlas Project. Distribution maps of species recorded from 1990 to 1998, by topographic quadrangle, are available on the NYSDEC website. Data from this source are presented in Table 1 in Appendix C.

TES reviewed bird data from a variety of published sources. These data are presented in Appendix D. Breeding bird information for the vicinity of the site is available from the New York State Breeding Bird Atlas Project. Breeding bird data were collected in 5 km x 5 km "blocks" from 1980 to 1985, and again from 2000 to 2005 and are provided in Table D-1. This information is also available on the NYSDEC website.

Early winter bird data were obtained from the Christmas Bird Count. The source of this data is a Christmas Bird Count sponsored by the National Audubon Society. Data from 2003 through 2009 are presented in Table D-2.

Short-eared owl information was obtained from the Buffalo Ornithological Society database. This information includes visual sighting data of short-eared owl from the Iroquois National Wildlife Refuge and the Town of Shelby from 1968 to 2010. Data from this source are presented in Table D-3.

1.2.2 Agency Contacts

Contact was made with the United States Fish and Wildlife Service (USFWS) and the New York Natural Heritage Program (NYNHP) requesting available information on endangered, threatened, rare, and special concern plants and animals, and significant habitats and communities on the site and in the vicinity (see Appendix A for correspondence).

1.2.3 Field Surveys

Field surveys of the Shelby Quarry site were conducted on November 9, 2006; December 13, 2006; February 20, 2007; May 31, 2007; June 1, 2007; August 25, 2008; September 18, 2008; October 23, 2008; April 29, 2010; June 17, 2010; and July 13, 2010. The background information maps and aerial photograph assisted in the initial identification of vegetation types and were used in the field reviews of the site. The intent of these field surveys was to assess the site and surrounding areas for common plant and animal species, as well as listed species.

Vegetation data were collected on November 9, 2006 to produce a vegetation cover type map. Vegetation cover types were characterized by the dominant plant species, and all plant species observed on the site were recorded. Scientific nomenclature for plant species follows *A Checklist of New York State Plants* (Mitchell and Tucker 1997).

Off-site vegetation cover types were cover mapped by aerial photograph interpretation and field verified on June 17, 2010 and July 13, 2010. This information was used to prepare a vegetation cover map for an area that extended 3,500 feet from the proposed quarry.

All on-site habitats were walked and records kept of wildlife seen or heard on the site. Wildlife sign (scat, tracks, and nests) was also recorded.

An on-site breeding bird survey was performed on May 31 and June 1, 2007. This breeding bird survey utilized the meander method to walk the entire site and record breeding birds by cover type. An off-site breeding bird survey was performed on June 17, 2010 by a TES biologist on the Iroquois National Wildlife Refuge (INWR) directly south of the site. A follow-up survey was conducted by two TES biologists on July 13, 2010. TES used 10-minute point counts to collect these data following standardized protocols (Ralph *et al.* 1993). TES listened and observed birds in the time interval from 0 to 3 minutes and from 3 minutes to 10 minutes. Birds were recorded in a distance interval of 0 to 50 meters, greater than 50 meters, and in a fly-over category. Birds were recorded from sunrise to four hours past sunrise to capture the optimum singing period. TES established point counts in representative cover types within INWR. In addition, TES recorded birds seen or heard after the point counts while walking to the next count location. On May 31, 2012, TES used the 10-minute point counts protocol to conduct an additional breeding bird survey adjacent to Oak Orchard Ridge Road and Sour Springs Road.

A short-eared owl survey and winter bird survey was conducted on December 13, 2006 and February 20, 2007. A short-eared owl survey was also performed on May 31, 2007. The short-eared owl winter survey included late afternoon to dusk surveys at the proposed quarry site. During the winter surveys, TES also assessed a known short-eared owl roost site on Posson Road.

TES walked the entire site during the afternoon of December 13, 2006 to determine whether any short-eared owls were roosting on the site. Fletcher Chapel Road is higher in elevation than the proposed Shelby Quarry site. TES biologists set up two spotting scopes (Kowa TSN-2 and Celestron) on Fletcher Chapel Road with a view of the entire site. TES waited until past dusk to determine whether any short-eared owls would fly from roost sites. On February 20, 2007, TES repeated this search method.

TES visited Posson Road to look for short-eared owls from the roadside. TES visited this location in the afternoon and again in the evening on December 13, 2006 and February 20, 2007.

1.3 RESULTS

1.3.1 General Site Description

The site is located east of Sour Spring Road, south of Fletcher Chapel Road, and west of South Wood Road in the Town of Shelby, Orleans County, New York (Figures 1 and 7). The site consists of two parcels separated by a National Grid overhead electric line. Elevations on the site range from approximately 650 feet mean sea level (msl) to 630 feet msl, sloping to the southwest (Figure 1). Surrounding land uses in the vicinity of the site are primarily agricultural and rural residential. A National Grid substation and overhead electric transmission line right-of-way border the site to the south. South of the transmission line right-of-way is the INWR.

The NYSDEC freshwater wetlands map (Figure 2) does not show any wetlands on the site, although Wetland OK-1 occurs on the INWR property south of the site. The NWI map (Figure 3) does not show any wetlands on the site. Next to the southeastern boundary of the site, a wetland is mapped as palustrine, forested, broad-leaved deciduous, seasonal (PFOIC).

The Orleans County soil survey map (Figure 4) produced by the U.S. Soil Conservation Service (currently Natural Resources Conservation Service) shows Odessa silt loam, Churchville silt loam, Cayuga silt loam, Bombay fine sandy land, Cosad loamy fine sand, and Lakemont silty clay loam as the dominant soil series on the site. There are several other soil series on the site.

The Stream Classification map prepared by the NYSDEC does not show any streams on the site (Figure 5). The Flood Insurance Rate map shows that the site is outside the 500-year floodplain (Figure 6).

1.3.2 INWR

Figure 1 shows the location of the proposed Shelby Mine relative to the Iroquois National Wildlife Refuge, Oak Orchard WMA, and Tonawanda WMA. The Oak Orchard WMA is two miles from the proposed quarry site and the Tonawanda WMA is four miles from the proposed quarry site. INWR is separated from the proposed quarry site by the National Grid electric line right-of-way.

The INWR is a nearly 11,000-acre wetland complex that is managed as wildlife habitat, particularly for migrating waterfowl (USFWS 2011). Open water, wet meadow, emergent wetland, scrub-shrub wetland, deciduous forest wetland, scrub-shrub upland, deciduous forest upland, and mixed deciduous forest are the cover types located in proximity to the project site. Much of the land appears to be abandoned from active agricultural use within the last 50 to 60 years. In September 2010, the USFWS released *"Iroquois National Wildlife Refuge Draft Comprehensive Conservation Plans and Environmental Assessment*" (USFWS 2010). This document provides baseline information regarding the refuge and provides a proposed management plan for the next 15 years. Current habitat conditions on the INWR are shown on Figure 9. Regional land use adjacent to INWR is shown on Figure 10. In September 2011, the USFWS released the "Iroquois National Wildlife Refuge Comprehensive Conservation Plan". The Refuge is adjacent to the Oak Orchard and Tonawanda Wildlife Management Areas (WMAs). Together, these three properties comprise an area of approximately 19,000 acres.

1.3.3 Vegetation

Vegetation cover types found on the site are shown on Figure 7, with the acreage of each cover type presented in Table 1. A list of the common plant species noted in each cover type is provided in Table 2.

Off-site vegetation cover types were added to Figure 8 based on a request by the NYSDEC (Bimber 2009). Agricultural uses are the dominant cover types surrounding the site to the north, east, west, and southwest. A large complex of deciduous forest wetland is located north of Fletcher Chapel Road between agricultural areas and residences. A wide mixture of cover types are found on the INWR to the south and includes deciduous forest upland and wetland, scrub-shrub upland and wetlands, wet meadow, emergent wetland and open water.

1.3.3.1 Uplands

Based on the TES mapping (Figure 7), uplands represent a total of 267 acres or 99 percent of the site (Table 1). Almost all of the upland area is agricultural cropland (Table 1 and Figure 7). Each upland vegetation/land use type is described in the following text.

Agricultural Cropland

Agricultural cropland areas represent about 263 acres or 98 percent of the site (Table 1 and Figure 7). In 2006, crops grown on the site were soybeans, corn, and wheat. In the field where wheat was grown, a cover crop of red clover was planted after the wheat was harvested. In 2007, all the fields were planted in corn or soybean. In 2010, the fields were planted in corn and soybeans. Herbaceous weed species were also common in these fields. Weed species included: amaranth, wild carrot, common milkweed, and panic grass.

Open Field

Open field represented only about 2 acres or 0.9 percent of the site (Table 1 and Figure 7). The area shown as open field was previously used as an airplane landing strip. It is frequently mowed. Common plant species noted in this community included: tall fescue, sedge, white clover, common dandelion, narrow-leaf plantain, lamb's quarters, ox-eye daisy, and wild carrot.

Scrub-Shrub Upland

Scrub-shrub upland covered 2 acres or 0.7 percent of the site (Table 1 and Figure 7). Six scattered areas of scrub-shrub upland are found on the site. These areas consist of rock piles and hedgerows. Low-growing woody species and scattered young trees characterized this community. Common woody plants noted in the scrub-shrub community included gray dogwood and common buckthorn. Herbaceous plants were sparse and only included raspberry and wild strawberry. Trees present in this community included white oak, bur oak, American elm, black walnut, Scot's pine, and eastern cottonwood.

1.3.3.2 Wetlands

As previously indicated, potential wetlands on the site were formally delineated and are described in detail in a separate wetland delineation report (TES 2007a). A description of the wetland communities and the plant species are presented in this report. A jurisdictional determination was issued by the U.S. Army Corps of Engineers on July 20, 2011.

Based on the vegetation cover map (Figure 7), there is approximately 0.7 acre of agricultural ditches on the site (Table 1). The ditches drain the agricultural areas. The characteristics of the agricultural ditches are described in the following section. Information collected in the wetland delineation plots were used to prepare these descriptions.

Agricultural Ditches

The ditches run from west to east across the site, as well as along the eastern boundary and the southeastern portion of the site (Figure 7). These ditches cover 0.7 acres or 0.3 percent of the site (Table 1). Willow was found in the shrub layer. Rice cut grass, broad-leaf cattail, bluegrass, broad-leaf water plantain, reed canary grass, and smartweed were common in the ground layer.

1.3.4 Wildlife

Wildlife species were assessed using available information and field surveys. Field surveys were performed in November and December 2006; and February, May, and June 2007; August, September, and October 2008; and April, June, and July 2010.

1.3.4.1 Amphibians and Reptiles

Appendix Table C-1 provides a list of amphibians and reptiles recorded in the Knowlesville quadrangle from 1990 to 1998 during the New York State Herpetological Atlas Project. The table illustrates the variety of amphibians and reptiles found in the vicinity of the site. The area of the quadrangle encompasses many more vegetation types, especially wet areas and undisturbed areas, than are found on the Shelby Quarry site.

No reptiles were seen during the field survey. The lack of cover could account for the lack of sightings of snakes, although common species such as the eastern milksnake and common gartersnake could be present in the shrub habitats. American toad, green frog, northern leopard frog, and pickerel frog were observed during the field efforts (Table 3). Common amphibian species likely occur in the ditches on the site.

1.3.4.2 Birds

A combined list of breeding birds from the Breeding Bird Atlas Project from 1980 to 1985 and 2000 to 2005 from the site vicinity are presented in Appendix Table D-1. The area covered to construct this table was a 5 km x 5 km "block", which contained the study area. This large area obviously contains a greater variety of vegetation cover types, especially large wetlands and large blocks of forest, than are found on the site. The table illustrates the variety of bird species in the Town of Shelby.

Appendix Table D-2 provides a list of bird species observed during the Oak Orchard Christmas Count from 2003 until 2009. The count circle consists of a 7.5-mile radius, with the center of the circle within the Oak Orchard Wildlife Refuge. Christmas Bird Count data provide a snapshot of birds in the vicinity of the project site and their relative abundance. Based on data provided by the National Audubon Society Christmas Bird Count, short-eared owls occur almost annually in the Oak Orchard count circle. They were recorded in four of the last seven years.

TES performed field surveys for birds in late fall 2006. A breeding bird survey was conducted in late spring 2007 at the site (Table 4). Additional field visits were conducted in 2008 and 2010. Table 3 shows all birds recorded on the proposed Shelby Quarry site. These surveys assessed migratory and resident birds. Results of the November 2006 to July 2010 surveys and the spring 2007 surveys are presented in Tables 3 and 4, respectively. TES also conducted winter surveys to search for short-eared owl use on the site.

The majority of the site consists of agricultural croplands and these areas were used by many species of birds, but not exclusively by any of these species. Red-winged blackbird, European starling, common grackle, American crow, northern harrier, American goldfinch, wild turkey, and American robin are birds typical of agricultural croplands with scattered shrubs, such as are on the site. The snow bunting was also observed on this site; its typical habitat is the Arctic tundra but it winters on windswept grasslands. Horned lark, American pipit, brown-headed cowbird, Canada goose, and mourning dove were all species that were only found in the agricultural cropland cover type.

The open field habitat on the site is quite small, and four birds were observed in this cover type. European starling, Savannah sparrow, common grackle, and northern harrier were found in this cover type on the site.

A few small scrub-shrub upland areas were present on the site. Typical nesting species in this habitat include catbird, American goldfinch, common yellowthroat, and American robin. Other species, such as American crow, blue jay, downy woodpecker, and common grackle, would use this habitat for foraging.

On May 31 and June 1, 2007, TES conducted a field survey for breeding birds. Table 4 lists the bird species by cover type observed on the Shelby Quarry site. The site is primarily cropland (planted in corn in 2007, 2008, and 2010). Three species of birds nest in this type of habitat: killdeer, horned larks, and Savannah sparrows. Savannah sparrows were observed in all cover types on the site. Other bird species use croplands for feeding. These include Canada goose, rock pigeons, American crow, European starling, and red-winged blackbird. Barn swallows and tree swallows were observed foraging in the airspace over the site.

Savannah sparrow was the only species observed using the small open field area. The small scrub-shrub upland areas, which include a few trees, provided habitat for several species of birds often associated with edge habitat. These included several species of sparrow and the indigo bunting. Savannah sparrow was the only species observed using the ditch cover type. Canada goose tracks were seen in the dry mud of the wet meadow.

TES observed a female harrier foraging on the site on November 9, 2006. On December 13, 2006, a male and female were foraging on the site. The use of the site by northern harriers for foraging suggests the presence of suitable prey items such as meadow voles. The potential for nesting by northern harriers on the site is extremely low, due to the use of 98 percent of the site for active agricultural uses. A female northern harrier was observed foraging above the corn field on June 17, 2010. A nest search was conducted on July 13, 2010 and no northern harrier nest was found on the site.

The wet meadow/ditch habitats on the site are small and linear. A northern harrier was noted flying over the agricultural ditches on November 9, 2006. The northern harrier prefers marshes, wet meadows, swamps, and requires open country for hunting.

1.3.4.3 Iroquois National Wildlife Refuge Birds

TES conducted a breeding bird survey in the vegetation communities immediately south of the proposed Shelby Quarry in the INWR on June 17, 2010. Approximate location of each point count is shown on Figure 10. Data were recorded by cover type and are presented in Table 5A.

The breeding bird survey sampled scrub-shrub upland, deciduous forest upland, mixed forest upland, open water, emergent wetland, wet meadow, scrub-shrub wetland, and deciduous forest wetland habitats. Emergent wetland, wet meadow, scrub-shrub wetland, and deciduous forest wetland cover types contained the greatest number of species per 10-minute point count. Species numbers ranged from eight in an open water point count to a high of eighteen species in an emergent wetland. Upland communities contained a low of three species in the deciduous forest upland to a maximum of nine species in the scrub-shrub upland and mixed forest upland cover types.

Species recorded in scrub-shrub upland included catbird, yellow warbler, chestnut-sided warbler, and red-winged blackbird. Black-capped chickadee, ovenbird, and rose-breasted grosbeak occurred in deciduous forest upland. Least flycatcher, great-crested flycatcher, black-capped chickadee, white-breasted nuthatch, and brown creeper were documented in mixed forest upland.

Mallard, Virginia rail, blue-gray gnatcatcher, yellow warbler, song sparrow, swamp sparrow, and red-winged blackbird were recorded in emergent wetlands. Eastern kingbird, rose-breasted grosbeak, song sparrow, swamp sparrow, red-winged blackbird, and brown-headed cowbird were recorded in scrub-shrub wetlands. Eastern wood peewee, great-crested flycatcher, wood thrush, American robin, blue-winged warbler, scarlet tanager, and rose-breasted grosbeak occurred in deciduous forest wetlands.

Species recorded were those expected in the area based on the existing habitat and data collected during the available breeding bird surveys (Appendix Table D-1).

Migratory waterfowl could use the open water pond on the refuge. Songbirds and raptors may also use the habitats on INWR for resting or foraging during migratory periods.

1.3.4.4. Oak Orchard Ridge Road and Sour Springs Road Bird Survey

TES conducted a breeding bird survey adjacent to Oak Orchard Ridge Road and Sour Springs Road on May 31, 2012. TES utilized 10-minute point counts to collect these data. Location of these ten point counts are shown on Figure 15. Data were recorded by cover type and are presented in Table 5B.

At breeding bird sampling point 10, TES recorded cerulean warbler, hooded warbler, and scarlet tanager. This sample point included a small forested woodlot north of Oak Orchard Ridge Road. It should be noted that this location was not a forest interior habitat. During this early morning breeding bird survey, background noise from Route 63 was noticeable at breeding bird locations 1 through 5, 9, and 10.

1.3.4.5 Mammals

Table 3 lists the species of mammals observed on the Shelby Quarry site. The list primarily includes medium to large-sized animals. There are likely other species of small mammals, such as shrews, moles, voles, and mice that are present on the site, especially in the agricultural and shrub areas.

Woodchucks were abundant in the agricultural cropland and open field areas of the site. They prefer to live along fence rows or heavily vegetated gullies or stream banks. The shrub areas provide this type of habitat. The woodchuck's diet is only herbaceous with a preference for field crops such as clover and alfalfa. Evidence of coyote and white-tailed deer were found in all cover types throughout the site.

1.3.5 Endangered and Threatened and Special Concern Species

The USFWS and the New York Natural Heritage Program (NYNHP) were contacted to obtain records of endangered, threatened, rare, or special concern plants and animals, and significant habitats on or in the vicinity of the site (see Appendix A for correspondence). Literature sources and field surveys were also used to assess the site for listed species.

1.3.5.1 Plants

The USFWS letter (Appendix A) indicated that no federally-listed or proposed endangered or threatened plant species under their jurisdiction are known to exist on site in the project vicinity.

The NYNHP had no records of known occurrences of state-listed plants, significant natural communities, or significant habitats on or in the vicinity of the site.

No endangered, threatened, or rare plant species or communities were noted by TES during the field surveys of the site.

1.3.5.2 Wildlife

Seven listed bird species are known from the vicinity of the project site. Short-eared owl is an endangered species. Bald eagle, northern harrier, and Henslow's sparrow are threatened species. Osprey, Horned lark and Cerulean Warbler are special concern species. Short-eared owl was specifically mentioned by the NYNHP. Some of the species identified during the bird surveys (e.g., wood thrush, blue-winged warbler, hooded warbler) are on the Partners in Flight (PIF) Species of Continental Importance list. This list includes species that the PIF identified as having "the greatest range-wide concern and which are in most need of conservation attention." One of the main purposes of PIF is to "keep common birds common" (USFWS 2010). Neither the wood thrush, hooded warbler, or blue-winged warbler is a state-listed endangered, threatened, or special concern species. The wood thrush has a continent-wide population of 14,000,000 birds and concern for this species occurs primarily in its wintering habitats. Hooded warbler is on the "additional stewardship species" list whose population trends are stable or unknown and are not currently threatened. Blue-winged warbler is listed due to low population size. Blue-winged warbler hybridizes with golden-winged warblers. This tendency poses one of the greatest threats to golden-winged warbler viability. The proposed quarry is not expected to affect these three species.

Bald Eagle

The USFWS indicated the potential for bald eagle (*Haliaeetus leucocephalus*) to occur within the proposed project area because it was observed nesting approximately 4 miles from the proposed project area at the INWR. Bald eagle is a state-listed threatened species. Bald eagle was delisted by the USFWS, but it is still a protected species. In comments dated March 1, 2012, the INWR reports that there are a total of four known bald eagle nest sites within the INWR and the adjoining Oak Orchard and Tonawanda Wildlife Management Areas.

Bald eagles range over almost all of North America, from Alaska and Canada down into northern Mexico (USFWS 2006). They have greatly expanded their presence in New York State since the NYSDEC eagle restoration program. According to the NYSDEC, occupied nesting pairs numbered 145 in 2008 with 134 breeding pairs (Nye 2008). The bald eagle has been delisted from the Endangered Species Act due to the recovery of this species.

The following summarizes important habitat components for the species. This information was obtained from the USFWS website. Bald eagles live 15 to 25 years in the wild and usually mate for life. Large nests, often 4 to 6 feet wide and up to 1,000 pounds, are generally built in the tops of large trees near rivers, lakes, or marshes. The main diet of bald eagles is fish. They will also feed on waterfowl, rabbits, turtles, and other small animals. In the winter, they gather near open water where fish and waterfowl are abundant.

Bald eagles prefer an environment of tall, mature trees, clean water, and quiet solitude for nesting (USFWS 2006). The majority of the site is agricultural and is treeless, with no large open waterbodies. Therefore, no potential nesting habitat for bald eagle exists on the proposed Shelby quarry site.

There is little mature forested habitat in the immediate vicinity of the site. Other surrounding land uses are largely agricultural or residential. The forested areas south of the site on the INWR are young second-growth stands that presently do not contain any super canopy trees that are preferred nesting locations for bald eagles. Center Marsh is the nearest impoundment to the proposed quarry site, although water levels are manipulated by the USFWS, Center Marsh did not always contain water during our study period. Without water this area does not provide optimum eagle nesting habitat. Center Marsh might provide nesting bald eagle habitat in the future when the trees grow larger. However, even if future nesting habitat developed, operation of the quarry would not affect the establishment of an eagle nest at Center Marsh. The areas of potential future nest locations at Center Marsh are more than 1,500 feet from the southern quarry boundary.

Cerulean Warbler

The cerulean warbler (*Dendroica cerulean*) is a species of special concern by the NYSDEC. Cerulean warbler declines are linked to declines in wintering habitats. No cerulean warblers were recorded on the proposed quarry site or in the INWR immediately south of the site. During the 2012 breeding bird survey, one cerulean warbler was recorded on Oak Orchard Ridge Road at breeding bird point count location 10.

Short-eared Owl

The NYNHP indicated the potential for short-eared owl (*Asio flammeus*) to occur on or in the immediate vicinity of the project site. They recommended an evaluation of the site as potential habitat for short-eared owl. Short-eared owls are state-listed as endangered species.

In New York, short-eared owls prefer salt marshes, hayfields, fallow farm fields, and pastures (NYNHP 2006). Much of the information on short-eared owls is reviewed in this publication. The following summarizes important habitat components for the species.

Short-eared owls typically roost on the ground, under low shrubs or in conifers during the day. Nests are often built on dry ground near bushes and close to water. They may also choose to roost in tall grasses. Short-eared owls hunt by flying low over open areas like the northern harrier. Their diet includes small mammals and small birds. Short-eared owls are also known to frequent mines and quarries (Holt and Leasure 2006).

Short-eared owls occur in New York primarily during the winter months. Winter surveys for short-eared owls were conducted on December 13, 2006 and February 20, 2006. No short-eared owls were observed on the site during the winter surveys. TES was present on the site during two afternoons and stayed past sundown to determine whether any short-eared owls roosted or foraged on the site. TES did not observe any short-eared owls on the site. While there is potential for short-eared owls to forage on the site, it is unlikely that short-eared owls use the site for roosting during the winter months or for breeding.

On May 31, 2007 another field survey was conducted to see if there were any short-eared owls present on the site. During nesting season, short-eared owls hunt day and night, thus any short-eared owls using the Shelby mine site would have been fairly conspicuous. No short-eared owls were seen on the site or in the vicinity of the site.

The Buffalo Ornithological Society maintains a database of bird records. TES reviewed that database and selected records from the Town of Shelby or the nearby Oak Orchard Wildlife Management Area (Appendix Table D-3), as these data show short-eared owls being regular winter visitors to the Town of Shelby. A well-known winter roost site is located on Posson Road, which is approximately 1.2 miles east of the site. The area on Posson Road in which these owls overwinter is in the USDA conservation reserve program. This land is fallow and is dominated by grasses and herbaceous plant species. TES visited this roost site on two days during the 2006-2007 winter season, but did not locate any short-eared owls. Short-eared owls were found on Posson Road in late December 2006 and early January 2007 (Genesee Birds listserve). These short-eared owls are winter visitors from Canada. Occasionally, in a year with high meadow vole populations, short-eared owls will breed in the area.

Northern Harriers

Northern harrier (*Circus cyaneus*) is a state-threatened bird species in New York State. They utilize open habitats for breeding and foraging. There are extensive foraging habitats for northern harrier in the vicinity of the project site. A regional land use map that was prepared by the USFWS is provided, and it shows extensive open field and agricultural areas in the nearby vicinity for foraging northern harriers (Figure 10).

TES observed northern harriers on three occasions, two occurrences were outside the breeding season. Due to the intensive agricultural nature of the site, northern harriers would utilize off-site areas for breeding where they would not be disturbed by agricultural practices. In 2010, a female northern harrier was recorded flying and foraging on the site. Nesting habitat does not exist for northern harrier on the site.

Horned Lark

Horned larks (*Eremophila alpestris*) were present in the cropland areas on the site. This species is listed by the State of New York as a species of Special Concern. On April 29, 2010 this species was recorded and are nesting on the site. The species occurs in open areas with bare ground or short grass. Despite being listed as Special Concern, horned larks are a "fairly common breeder locally in western and central New York…" (Andrle and Carroll 1988).

Henslow's Sparrow

No Henslow's sparrow (*Ammodramus henslowii*) was recorded on the site or in the INWR immediately south of the site. Successional open field habitat required for nesting was not present. The closest nesting record for this species was ¾ mile west from the site recorded in 2001 (Roster 2008).

Osprey

Osprey (*Pendion haliaetus*) is a special concern species in New York State. TES observed one osprey fly over the site on July 13, 2010 and one was recorded on the INWR during the 2012 breeding bird survey. The diet of the osprey is primarily fish. There are no open water ponds on Shelby Quarry site for osprey to feed. According to the landowner, Chet Zelazny, an osprey built a nest on the National Grid transmission tower closet to the INWR in 2013.

1.4 SUMMARY

Terrestrial Environmental Specialists, Inc. (TES) was contracted by Continental Placer Inc. to perform biological surveys of the 268-acre Shelby Quarry site located in the Town of Shelby, Orleans County, New York. The surveys included assessments of common plants and animals, upland and wetland cover types, and endangered and threatened species. Descriptions of the characteristic plants and animals of each cover type on the site are provided. Contacts were made to state and federal agencies for listed species and field searches of the site were performed by TES botanists and wildlife biologists.

About 267 acres or 99 percent of the site is upland, nearly all of which is agricultural cropland. Open fields and scrub-shrub uplands occur in small sections throughout the site.

No state-regulated wetlands are mapped on or near the site. Three agricultural ditches totaling approximately 0.7 acre or 0.3% of the site were delineated. These ditches drain uplands. A jurisdictional determination was issued by the U.S. Army Corps of Engineers on July 20, 2011. No stream or floodplain was associated with this site.

Plants and animals characteristic of the region were found on the site. Descriptions of the common species are provided.

Endangered, threatened, and rare plant and animal species were assessed. This assessment included contacts with state and federal agencies, literature reviews, and field surveys. No listed plant species were reported by state and federal agencies as occurring in the area. None was found on the site. The USFWS requested an assessment of the potential for bald eagles to occur on the site. Based on the agricultural nature of the site with open fields and no open water habitat, bald eagles are not expected to occur on the site. The NYNHP also requested an assessment of the potential for short-eared owls to occur on the site. TES conducted winter and breeding season short-eared owl surveys and did not locate any on the site. This species is not expected to winter or breed on the site. Northern harriers utilized the site for foraging. However, breeding habitat is lacking due to the active agricultural use of the site. No other state or federal listed endangered or threatened animal species was found on the site.

Horned lark, a state-listed species of Special Concern was found on the site. Although it is so listed, it is a common species in agricultural areas.

The NYSDEC requested a breeding bird survey on the INWR and a description of nearby cover types. TES conducted a breeding bird survey using point counts in representative cover types on the northern portion of the refuge in proximity to the proposed quarry. Our results found an assemblage of birds typical for the cover types and corresponding to results from the New York State Breeding Bird Atlas.

TES mapped the vegetation cover types within 3,500 feet of the proposed quarry. Agricultural uses are the dominant cover types surrounding the site to the north, east, west, and southwest. Deciduous forest wetlands are found north and south of the site. A mixture of deciduous forest upland and wetland, scrub-shrub wetland, wet meadow, emergent wetland, and open water cover types are found in the neighboring INWR.

1.5 REFERENCES

Andrle, R. F. II, and J. R. Carroll (eds). 1988. The Atlas of Breeding Birds in New York State. Cornell University Press. Ithaca, NY.

AOU. 1998. Check-list of North American birds. 7th Edition. American Ornithologists' Union. Washington, D.C.

Bimber, D. 2011. Response Letter to Draft Environmental Impact Statement. December 8, 2011. Avon, NY.

Bimber, D. 2009. NYSDEC Response Letter to Draft Environmental Impact Statement. December 22, 2009. Avon, NY.

Buehle, D. A. 2000. Bald Eagle. BNA No. 506 The Birds of North America Online. American Ornithologists' Union and Cornell Laboratory of Ornithology. Ithaca, NY.

Crother, B. I. (ed.) 2000. Scientific and Standard English Names of Amphibians and Reptiles of North America north of Mexico, with Comments Regarding Confidence in Our Understanding. SSAR Herpetological Circular 29.

Fernald, M. L. 1950. Gray's manual of botany, 8th Edition. American Book Company. New York, NY.

Gleason, H. A. 1952. The new Britton and Brown illustrated flora of the United States and adjacent Canada (3 vols.). Hafner Press. New York, NY.

Gleason, H. A. and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada, 2nd Ed. The New York Botanical Garden. Bronx, NY.

Holt, D. W. and S. M. Leasure. 2006. Short-eared Owl. BNA No. 62. The Birds of North America Online. American Ornithologists' Union and Cornell Laboratory of Ornithology. Ithaca, NY.

MacWhinten, R. R. and K. L. Bildstein. Northern Harrier. BNA 210. Birds of North America. American Ornithologists' Union and Cornell Laboratory of Ornithology. Ithaca, NY.

McGowan, K. J. and K. Corwin (eds.). 2008. The Second Atlas of Breeding Birds in New York State. Cornell University Press. Ithaca, NY.

Menzel, M.A., J. M. Menzel, T. C. Carter, W. M. Ford, and J. W. Edwards. 2001 Review of the Forest Habitat Relationships of the Indiana Bat (*Myotis sodalis*). USDA Forest Service, Northeastern Research Station. General Technical Report. NE-284.

Mitchell, R. S. and G. C. Tucker. 1997. Revised checklist of New York State plants. Contribution to a flora of New York State checklist IV. Bulletin No. 490. New York State Museum. Albany, NY.

New York Natural Heritage Program. 2006. Online Conservation Guide for *Asio flammeus*. Available from: http://www.acris.nynhp.org/guide.php?id=6949. Accessed November 27th, 2006.

Nye, P. E. New York State Bald Eagle Report 2008. Available from: http://dec.ny.gov/docs/wildlife_pdf/baea2008.pdf. Accessed July 2010.

Ralph C. John, Geupel, G. R.; Pyle, P., Martin, T. F., DeSante, D. F. 1993. Handbook of Field Methods for Monitoring Landbirds. Gen. Tech. Rep PSW-GTR-144. Pacific Southwest Research Station, Forest Service. U.S. Department of Agriculture. Albany, CA.

Roster, T. P. 2012. USFWS Response Letter to Draft Environmental Impact Statement. March 1, 2012. Basom, NY.

Roster, T. P. 2008. USFWS Henslow's Sparrow information response. October 16, 2008. Basom, NY.

TES. 2007a. Wetland Delineation Report, Terrestrial Environmental Specialists, Inc., Phoenix, NY.

TES. 2007b. Vegetation and Wildlife Resources of the Shelby Quarry Site. Terrestrial Environmental Specialists, Inc., Phoenix, NY.

TES. 2007c. Impact Analysis of Ecological Resources Shelby Quarry Site. Terrestrial Environmental Specialists, Inc., Phoenix, NY.

TES. 2009a. Wetlands Impact Assessment. Terrestrial Environmental Specialists, Inc., Phoenix, NY.

TES. 2009b. Supplement to Ecological Resources Report Proposed Shelby Mine Site. Terrestrial Environmental Specialists, Inc., Phoenix, NY.

TES. 2011. Wetland Impact Assessment. Terrestrial Environmental Specialists, Inc., Phoenix, NY.

USFWS. 2006. Online Bald Eagle: Recovery. Biologue. Available from: http://www.fws.gov/midwest/eagle/recovery/biologue.html. Accessed January 26th, 2007.

USFWS. 2011. Iroquois National Wildlife Refuge Comprehensive Conservation Plan. USFWS, Basom, NY.

USFWS. 2010. Iroquois National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment. USFWS, Basom, NY.

USSCS. 1981. Soil Survey of Orleans County, New York. U.S.D.A. Soil Conservation Service in Cooperation with Cornell University Agricultural Experiment Station.

Whitaker, J. O., Jr. and W. J. Hamilton, Jr. 1998. Mammals of the Eastern United States. Cornell University Press. Ithaca, NY.

Young, S. M. and T. W. Weldy. (eds.). 2006. New York rare plant status list: May 2006. New York Natural Heritage Program. Albany, NY.

CHAPTER 2 – IMPACTS TO ECOLOGICAL RESOURCES

2.1 INTRODUCTION

This section of the report incorporates the Impact Analysis Report (TES 2007e) and the impact portions of the Supplement to Ecological Resources Report (TES 2009b) previously prepared with additional information to answer questions in the NYSDEC letter (Bimber 2009).

The sections included in this chapter follow those included in the prior reports; they are: Impacts to Ecological Resources; Endangered, Threatened and Special Concern Species; Proposed Mitigation Measures; Indirect and Operation Impacts to Ecological Resources; Farmland Soils; Noise and Blasting; Background Information; Literature Review; Potential Impacts and Mitigation; Truck Traffic; Dust; Recreational Use; and a Summary.

The Shelby quarry site is primarily occupied by agricultural cropland. The current owner has had the site in agricultural production for over fifty years. A few hedgerows and agricultural ditches also occur on the site.

Based on the Mined Land Use Plan, the mining excavation area will total about 174 acres, with a total of 219 acres affected by the mining activity. Mining will occur in phases. Phase 1 covers a 11.6-acre area to be mined in the southwest corner of the site. Overburden from Phase 1 will be placed in the Phase 4 area on the northeastern portion of the site. Including the overburden area, the first phase of the project will affect a total of about 31 acres or 14% of the site. Future mining activities will affect 86% of the site. Market conditions will determine the length of time prior to the excavation of the Phase 2 and Phase 3 areas. The life of the mine is expected to be 75 years. Due to the life of the mine, it is expected that the Phase 2 area would not be mined for a minimum of 20 years after the mine is in production. Phase 3 area will not be excavated for at least 50 years.

2.2 IMPACTS TO ECOLOGICAL RESOURCES

Impacts to ecological resources were assessed based on the baseline studies performed by Terrestrial Environmental Specialists, Inc. (TES) and the proposed Mined Land Use Plan. The baseline studies included a wetland delineation and report (TES 2007a) and a vegetation and wildlife study and report (TES 2007b). These studies have been updated by field work performed in 2008 and 2010 as presented in Chapter 1. The vegetation and wildlife study included an assessment of common plants and animals, as well as endangered, threatened, rare, and special concern species. Resident and migratory fauna are described in the report.

Impacts to wetland/water resources on-site and adjacent to the site were assessed in TES (2007c and 2009a). After additional hydrological and water quality assessments, this assessment report was revised, with the wetland/water resource impacts updated in TES (2011).

Impacts to on-site habitats were assessed by overlaying the proposed mining plan onto the vegetation/land use cover map, which is presented as Figure 12. Acreage of each vegetation/habitat type to be affected by each proposed mining phase were calculated and are presented in Table 6. These values differ slightly from those presented on the mine plan because of inclusion of the access roads and mapping differences. The total area of 219 acres to be affected over the projected 75-year life of mine consists of 214 acres of agricultural cropland, 1.8 acres of scrub-shrub uplands/hedgerows, 2.5 acres of open field, and 0.7 acre of agricultural ditches (Table 6 and Figure 12). During Phase 1 of mining, all impacts are in active agricultural areas. Phase 2 would affect the following vegetation cover types: active agriculture, scrub-shrub upland, open field, and drainage ditches (Figure 12).

As indicated in the baseline vegetation and wildlife resources report (TES 2007b), essentially the entire site is in agricultural production. Agricultural use includes a crop rotation of corn, soybeans, and small grains with a winter cover crop of clover after harvest. As a result of the active agricultural use of the site, there is limited wildlife use of the site. Although wildlife use is limited in the agricultural areas, there will be a sequential reduction of this cover type over 75 years as a result of the project and a corresponding reduction in wildlife populations that use this cover type.

Breeding birds that use the agricultural portions of the site as residents include: savannah sparrow, killdeer, rock pigeon, European starling, song sparrow, and horned lark. This agriculture habitat will be reduced as the project progresses.

Mammal species that use the agricultural portions of the site include: white-tailed deer, raccoon, coyote, woodchuck, and small mammals, such as meadow vole. Except for woodchuck and small mammals, these mammals use the site as only a portion of their home ranges. There will be a minor reduction in habitat for these species.

Four amphibians: northern leopard frog, northern green frog, American toad, and pickerel frog, were located on the site within a drainage ditch. There are limited habitats, especially breeding habitats, on-site for terrestrial amphibians and reptiles due to the agricultural nature of the site, and the impact to populations of these species will be minimal.

The site does not provide habitat for avian species that use contiguous forest interior habitats. There are limited on-site habitats that contain trees and shrubs. TES did record migratory bird use by species that prefer open field habitats. These species included snow bunting, American tree sparrow, and European starling.

The existing value of the site to fauna is limited, because nearly all the site is used and managed as agricultural cropland. There is nothing unique or unusual about the habitats on the site. Nonetheless, there will be a reduction of this type of habitat with the project. Impacts to resident and migratory fauna from the project will occur, but are expected to be minor. Of these minor impacts, most would be from the reduction of habitat. Direct mortality to individual organisms would likely be limited to small mammals and possibly a few nesting birds.

Habitat fragmentation impacts would not be expected from this project. Agricultural cropland is a very common cover type in the area and the habitat is such that impacts to it will not result in indirect wildlife use impacts to adjacent cover types. There is very limited semi-aquatic habitat on the site (agricultural ditches) and impacts to amphibian species that use these habitats will be minor. Future development of lakes on the site would eventually create habitat for such species.

Invasive species habitat is not expected to increase with the proposed project. Agricultural cropland, which currently covers most of the site, provides habitat for weed species, some of which are considered invasive.

The site is agricultural cropland and private land with limited hunting opportunities. As a result, the proposed project is not expected to impact hunting opportunities. Waterfowl hunting on the nearby wildlife refuge is not expected to be affected by the project. Some geese may use the site for loafing and feeding after crops are harvested. While this habitat will be reduced as a result of the project, future lake development in the quarry areas would provide benefits to waterfowl species.

2.3 ENDANGERED, THREATENED, AND SPECIAL CONCERN SPECIES

State and federally listed plant and animal species were assessed for the site as part of the initial vegetation and wildlife resources survey (TES 2007b) and several subsequent surveys presented in Chapter 1. Contact was made with the New York Natural Heritage Program (NYNHP) and the U.S. Fish and Wildlife Service (USFWS) for known records of listed species for the area. Short-eared owl (state listed as endangered) was recorded as occurring in the area by the NYNHP. Searches were made on the site for short-eared owl and other listed species at various times during the year.

No listed plant species was recorded in the vicinity of the site and no such listed species were noted by TES. As a result, no impact will occur to listed plant species.

As indicated, searches were made for short-eared owl during winter and spring. Two other listed species were noted on the site during field surveys; these two species are horned lark and northern harrier. Bald eagles were reported by the USFWS prior to their delisting from the federal Endangered Species Act. Impacts to each of these species are discussed in the following text.

2.3.1 Horned Lark

Horned lark breeds on the site and is state-listed as a species of Special Concern. Special Concern species could be at risk of becoming "threatened" in New York State.

Horned lark is a common breeding bird in the agricultural areas of New York State. There has been a decline in the number of breeding bird atlas blocks in which this species was reported between the 1980 and the 2000 breeding bird atlas. However, this decline may be attributed to the abandonment of agricultural fields and successional changes in habitat. Although there would be a reduction in habitat for this species with the project, such reduction is not expected to affect the species on a regional level.

2.3.2 Northern Harrier

Northern harrier is a state-listed threatened species in New York State. Its numbers are declining as agricultural areas (primarily hayfields) are abandoned and successional changes eliminate habitat. The northern harrier is considered to be *"nomadic: densities in breeding and* *non-breeding seasons vary in respond to local changes in prey availability"* (MacWhirter and Bildstein 1996).

Northern harrier was noted foraging on the site during fall, winter, and summer surveys. Nesting habitat does not exist on the site for this species, therefore, the site is not occupied habitat.

Northern harriers forage over large areas. Home range is a term used to describe the foraging area. For northern harrier, *"Home range in breeding season averages vary considerably among sites owing to differences in food supply and habitat" 170-115,000 ha median 260 ha* (420 acres to 37,065 acres median 650 acres) (MacWhirter and Bildstein 2008). Females forage closer to the nest than males do. Males are known to hunt 6 miles from the nest. Home ranges increase by a factor of greater than 2.5 as the nesting period progresses.

This species would have less agricultural habitat in which to forage after mining has occurred. The decline in agricultural foraging habitat would occur gradually over time. However, there is extensive open farmland surrounding the site for this species to forage (Figure 10). Once mining occurs there will be sparse vegetation in the mine that could support small mammals that are a preferred food source for northern harrier.

2.3.3 Short-eared Owl

The NYSDEC Natural Heritage Program reports the presence of short-eared owl from the vicinity of the site during the winter months. While no short-eared owls were found on site during the TES surveys, they have been reported from nearby locations (Table D-3). A known short-eared owl roost is located on Posson Road. According to NYSDEC biologist Jenny Landry, a maximum of 8 short-eared owls were observed on Posson Road during the winter of 2010 to 2011 (J. Landry, pers. comm.). Short-eared owls are known to forage in *"large open areas within wood lots, stubble fields, fresh and saltwater marshes, weedy fields, dumps, gravel pits, rock quarries, and shrub thicket"* (Holt and Leasure 2008). Nesting habitat does not exist for this species on the site and the project is not expected to impact this species.

The proposed quarry will not be active during the winter months when short-eared owls overwinter in the area. Development of the proposed quarry site will not cause any adverse impact to short-eared owls.

2.3.4 Bald Eagle

Bald eagles are a known nesting species at INWR. The closest nest sites are approximately 4 and 6 miles from the site. There is no essential habitat for the bald eagle on the project site. No adverse modification of bald eagle habitat will occur from the quarry development.

2.3.5 Henslow's Sparrow

Henslow's sparrow was a known nesting species at INWR. The closest nest site was approximately ¾ of a mile from the site based on records from 2001 (Roster 2008). There is no essential habitat for the Henslow's sparrow on the project site. No adverse modification of Henslow's sparrow habitat will occur from the quarry development.

2.3.6 Cerulean Warbler

The cerulean warbler is a species of special concern by the NYSDEC. No cerulean warblers were recorded on the proposed quarry site or in the INWR immediately south of the site. There is no essential habitat for the Cerulean Warbler on the project site. No adverse modification of Cerulean Warbler habitat will occur from the quarry development.

2.3.7 Osprey

The osprey is listed as a species of special concern by the NYSDEC. According to the landowner, Chet Zelazny, an osprey (*Pandion haliaetus*) in 2013 has built a nest on the National Grid transmission tower closest to the INWR. Osprey are known to build nests on tall, man-made structures. Osprey is also a known breeder on the INWR. There is no essential habitat for the osprey on the proposed quarry site. The osprey may select another nest location after quarry operations start.

2.4 PROPOSED MITIGATION MEASURES

Best management practices, such as erosion and sediment control, and a stormwater management plan are proposed as part of the plans. Areas developed as berms from overburden material will be seeded and restored. These practices will help minimize impacts.

As previously discussed, the proposed quarry will be developed in phases over an expected life of 75 years. Phases that are not to be developed until future years will remain in agricultural use. This approach will minimize impacts over time.

Three farm ditches occur on the site. The three ditches on site total approximately 0.7 acre, and are agricultural drainage ditches draining only upland areas, such as the airport runway and agricultural fields, and do not carry a permanent flow of water. A jurisdictional determination was issued by the Buffalo District of the Corps on July 20, 2011.

A reclamation plan is proposed for the quarry. The plan basically involves developing the quarry areas into lakes after the mining is complete. The lakes will be fairly deep, but will include a 50-foot perimeter of shallow water less than 5 feet deep. The lakes will provide habitat for fauna, especially waterfowl. Portions of the shallow fringe will develop into a wetland area. If the entire 50-foot perimeter shallow develops into a wetland, it will represent approximately 18 acres.

2.5 INDIRECT AND OPERATION IMPACTS TO ECOLOGICAL RESOURCES

Indirect and operational impacts to ecological resources can include changes in faunal use of adjacent habitat because of removal of habitats on site and noise/activity (including blasting) from the project. Alterations in surface water by a project can also affect adjacent communities in certain circumstances.

The Shelby site is essentially all agricultural cropland habitat. Standard agricultural activities, such as plowing, planting, herbicide/pesticide application, and harvesting, occur in these areas on a regular basis. The site is located just north of the INWR. An overhead electric line right-of-way separates the site from the refuge property. Mining operations on the site are not expected to affect the wildlife use of adjacent habitats, including those on the INWR. Wildlife generally becomes acclimated to activity and noise, including such activity related to a mining operation and this is discussed in the following sections. Considering the current nature of the site, wildlife use impacts to adjacent habitats from mining activity is expected to be minimal.

There are no streams or other waterbodies on the site. A few farm ditches do occur. The ditch along the eastern site boundary will not be affected by the proposed project. The site generally slopes to the south towards the INWR. However, the northern boundary of the site is at the edge of the drainage area. As a result, there is essentially no surface water contributed from off-site areas onto the site.

In the initial phase of quarry development, it is anticipated that it potentially will add water to the system and may slightly increase the wetland area. The influence of pump-out water will be ameliorated in future phases of quarry development, as the initial quarry phase will be available for water storage. As more fully discussed in TES (2011), changes to down-drainage wetlands are projected to be very minor in consideration of the following: estimated additions from pump-out water, large size of wetlands in the down-drainage area, and the fact that water levels in these wetlands are controlled and manipulated by the USFWS for management purposes.

2.6 FARMLAND SOILS

The site is currently in agricultural production. The site has 64 acres of mapped soils that are considered prime farmland soils and 9.3 acres that are considered farmland of statewide importance (Figures 4 and 13).

Prime farmland is "land best suited for producing food, feed, forage, fiber, and oil seed crops". It "has the soil quality, growing season, and moisture supply needed to produce sustained high yield of crops economically when treated and managed." This definition is provided by the United States Department of Agriculture.

Farmland of statewide importance is of lesser importance to agricultural production than prime or unique farmland. This soil classification applies to soils that do not meet prime farmland criteria. Farmland of statewide importance have limitations due to seasonal wetness, erodability, or some other shortcoming.

Impacts to important farmland soils from the project are presented in Table 7 and Figure 13. Approximately 42 acres of prime farmland soil and 5 acres of farmland soil of statewide importance will be impacted over the projected 75-year life of the project.

2.7 NOISE AND BLASTING

2.7.1 Background Information

Sound is measured as sound pressure level and is expressed in relative logarithmic units called decibels (dB). Sounds differ in frequency, perceived as pitch. Frequency is measured in cycles per second [or Hertz (Hz)]. Sounds also differ in duration. For example, equipment sounds can be constant, while blasting are extremely short. Sound exposure level is defined as sound exposure over 1 second (SEL). Noise monitors record the equivalent continuous sound level (Leg) and a day-night sound level.

Sounds fade as they travel in air from the source to a receiver. Sound is dissipated by distance as indicated on Table 8 and Figure 14. Low-frequency sound is transmitted farther than high frequency sound. Factors that affect sound transmission include temperature, humidity, terrain, wind conditions, and vegetation.

Blasting is a technique commonly employed in mining to fracture rock and loosen material for excavation. Blasting is a well-planned and well-orchestrated practice that, if executed properly, is an efficient and relatively unobtrusive manner for obtaining mineral resources. The U.S. Bureau of Mines (USBM) has established a set of guidelines and best management practices to ensure the safety and efficiency of blasting, and to limit its impacts on the surrounding area. State natural resources agencies have their own regulations regarding blasting procedures.

In general, blasts are planned so that as much of the energy as possible is used to fracture the rock; however, some energy is dissipated beyond the detonation site. Some released energy travels into the surrounding area along the ground and through the air. Waves of energy that travel along the ground are called ground vibrations and waves of energy that travel through the air are called airblast.

Noise and vibrations that result from blasting can potentially affect wildlife. Loud abrupt noises can startle animals, causing them to flush from a perch, leave a foraging area, or abandon a nest. This can result in increased energy expenditure, reduced foraging time, and lowered reproductive output. There is concern that vibrations could negatively impact ground-nesting birds. However, the projected level of noise and vibrations from the proposed quarry including blasting are similar to levels from existing farming activity and natural events (thunder). The potential impact and mitigation of the projected noise and vibration are fully addressed in Section 2.7.3.

2.7.2 Literature Review

Although, research into avian hearing ability is ongoing, some studies have shown that most birds may not have "extraordinary acoustical acuity". Surprisingly, small songbirds are not particularly sensitive to high frequency sounds. In comparison, humans can hear fainter sounds than most birds at most frequencies, and humans are more sensitive to small changes in the frequency and intensity of sounds (Gill 1995).

Also, the frequency range of good hearing is narrower in birds than in mammals (Gill 1995). Frequencies that are audible to birds range from a low of 40 Hz in the budgerigar (*Melopsittacus undulates*) to a high of 29,000 Hz in the chaffinch (*Fringilla coelebs*). Most birds are sensitive to sounds in the frequency range of 1,000 to 5,000 Hz, which is equivalent to the top two octaves of the piano (Podulka, Rohnbaugh, and Bonney eds. 2004).

While little research has been conducted regarding the effects of mine-related blasting on wildlife, a number of studies have examined the effects of noise and vibration from military training on wildlife, particularly raptors and grassland birds. Military activities that have equivalent effects (e.g., noise, vibration) to mine blasting are exploding bombs and missiles from fixed-wing aircraft, gunfire and explosions from artillery (airborne and substrate-borne). The disturbances caused by these activities are also similar to noises and vibrations that result from construction, and even a naturally-occurring disturbance, thunder (USACE 1996).

Three studies of avian species using military training ranges have shown that, despite expectations, blasting and firing activities had little effect on abundance, behavior, and nesting success. Schueck *et al.* (2001) observed raptors at the Snake River Birds of Prey National Conservation Area in Idaho, where military training activities occur. The results of this study indicated that there was no significant difference between raptor counts on training days versus counts on non-training days. There was, however, a difference in counts within training days, based on the type of activity occurring. Fewer raptors were observed on days when firing activities occurred. This is in contrast to training days when bivouacking, tank preparation, and convoy traffic were the primary sources of disturbance. However, some other studies have shown that raptors changed their behavior as a result of bivouacking and vehicle traffic.

While behavior was altered for some raptors (e.g., hawks, eagles, falcons) on training days, it was only in years of low prey abundance. In years of abundant prey, raptor behavior was not significantly different. Behavioral changes observed were flushing from perches, expansion of home ranges, and higher soaring. While other hawks, eagles, and falcons did have some behavioral modifications, northern harriers did not alter their behavior in response to military training activities (Schueck *et al.* 2001). Northern harriers are thought to benefit from military training in that these types of activities flush small rodents, which are the main prey for this species (Jackson *et al.* 1997).

A separate study of prairie falcons (*Falco mexicanus*) at Snake River examined potential effects of blasting on nesting behaviors. Blasting activities occurred in association with a dam reconstruction project and as a result of an experimental blasting regimen that was conducted for the purposes of this study. In both treatments, blasting occurred much more frequently than is expected for the proposed mine project in the Town of Shelby. At the site of the dam reconstruction project, one blast occurred each day at a distance of 560 – 1000m from prairie falcon nests and at the experimental blasting site, three blasts were conducted at three-hour intervals, every other day for 60 days. Despite exposure to this very intensive blasting, the behavior of incubating and brooding prairie falcons was not significantly altered (Holthuijzen *et al.* 1990).

At Fort Benning in Georgia, a study was initiated to examine the effects of noise and vibration on red-cockaded woodpeckers (*Picoides borealis*), a federally-endangered species, living near sites of active military training. A significant percentage of the remaining red-cockaded woodpecker populations exist on or in the vicinity of military installations. Recordings of noise and vibration levels were taken at sites of active woodpecker clusters, both where training was actively occurring as well as at areas that were relatively free of disturbance. Observations were made throughout the nesting season (1994-1996), and reproductive variables (e.g., numbers of eggs, number of nestlings, number of adults, return rates of adults feeding young, and masses of nestlings or adults) were measured. The results of this study indicated that there were that there was no significant difference between noise and vibration levels at training sites versus levels at non-training sites. However, it was noted that noise and vibration levels near some clusters may have been lower due to the large size of the training range and the distance of the cluster to the impact point. An important conclusion of this study was that the reproductive success of red-cockaded woodpeckers near training sites was not significantly impacted (Doresky *et al.* 2001).

In each of the three military studies discussed above, habituation to disturbance is mentioned as a possible explanation for lower than expected disturbance to wildlife. One source of disturbance that is particularly disruptive is low-flying aircraft. In a number of studies, some raptor species (e.g., red-tailed hawk and bald eagle) have been shown to become tolerant of these types of disruptions. Stalmaster and Kaiser (1997) showed that wintering bald eagle became habituated to helicopters; however, the nesting season is particularly sensitive time for most raptors and therefore, the birds are more likely to be disturbed during this period.

2.7.3 Potential Impacts and Mitigation

Noise from quarry operations fall into three major categories: Operation of heavy machinery to remove the overburden, operation of crushing equipment, and blasting. Sound measurements were made at three receptor sites located 1,400 feet to 3,700 feet from the proposed location of the process plant. The distance from the process plant to the refuge boundary is approximately 1,400 feet. The distance from the edge of excavation to the refuge boundary is approximately 600 feet. Sounds in an active quarry range from 50 dbA to over 75 dbA based on the sample data.

The primary factor in determining the magnitude of the impacts of a blast (both noise and vibration) is the distance from the blast site. Therefore, it is important to maintain sufficient distance from a blast site to a sensitive ecological resource. Another way to minimize the effects of blasting on the surrounding area is through the use of buffers. Allaire (1978) recommends a minimum of a 100-meter buffer from mining operations, and where ground nesting birds occur, a buffer of more than 100 meters. As currently proposed, mining operations will not occur closer than 600 feet from the INWR.

The timing of overburden removal could affect wildlife. The removal of overburden prior to blasting to remove the rock could take several months (Hellert, pers. comm.). During this operation, an excavator is proposed to be used. Peak activities at INWR are during waterfowl migration periods. These periods range from mid-September through December and again from early March through late April. Critical periods for waterfowl breeding is from April through July.

Henslow's sparrows have been reported on the INWR and a concern was expressed about disturbance to the species (Roster, Appendix A). Grassland surveys conducted by Dr. Norment of SUNY Brockport on July 4, 2001 found a Henslow's sparrow in the open field area east of NYS Route 63 at their survey point #8 (Roster Appendix A). Other Henslow's sparrow locations on the refuge were just east of Salt Works Road in the southwestern corner of the INWR.

The closest Henslow's sparrow location was 4,000 feet from the proposed mine. Due to this large distance from the mine, vibrations from blasting would be dissipated before reaching Dr. Norment's INWR survey point #8 (Figure 14). No recent Henslow's sparrows have been reported from this location. Henslow's sparrows have demonstrated the ability to adjust to noise and vibrations. For example, one of the largest populations of Henslow's sparrows in New York State occured on Ft. Drum in proximity to live fire training activities (Krebs 2002).

Disturbance by sounds from the operating quarry will be minimal in comparison to bomb blasts and gunfire on active military ranges. Blasting will occur once or perhaps twice per week. Vibrations from the blasting would be felt 1,200 feet into INWR. This is an insignificant impact. Other quarry sounds will be limited in their dispersion distance. As shown in the studies cited in this report, animals have the ability to habituate to loud noises. Based on noise measurements by Continental Placer the mining noises reduce to the current ambient noise level within 350 feet of the INWR boundary. Blasting will attenuate at a distance of 500 feet in the INWR. Noise from blasting is similar to a clap of thunder and lasts less than a second in duration. As a result, noise from the quarry would not affect resident or migrating wildlife on INWR.

Buffering can also be accomplished using vegetation and by creating berms. To mitigate potential noise impacts, the applicant plans to construct berms 30-50 feet in height (See cross-sections in the Draft Environmental Impact Statement). Construction of the berm occurs during the first phase of quarry development and is a temporary impact likely limited to the first year of quarry work. The construction of the berm is designed to minimize off-site noise impacts. These berms will limit the extent to which both noise and vibration dissipate into the surrounding area.

The applicant also proposes to minimize the effects of blasting by following USBM guidelines, optimizing efficiency of blasts such that the majority of energy from the blast will break the rock, with a minimal amount of energy being dissipated into the surrounding areas. Noise and vibration will also be minimized by using timing delays to sequence the blasting. Blasting is going to occur during the middle of the day when ambient noise is greatest and on days when cloud cover is limited so that reflection of blast noise is limited.

2.8 TRUCK TRAFFIC

Truck traffic will exit from the site south onto Sour Spring Road and then proceed west onto Oak Orchard Ridge Road. Truck traffic will then turn south onto State Highway 63, which bisects the refuge. The Frontier Stone Quarry is anticipated to generate approximately 30 one way trips per hour with eight to ten trucks entering and exiting the site during the peak hours, based on 220 working days per year, 8-hour shift day, and an average truck capacity of 25 tons. Under a "worst case" scenario, it would generate approximately 30 truck trips per hour. Fletcher Chapel Road has been identified as an alternative for site access.

One of the most cited scientific papers related to vehicular traffic and effects on breeding birds is Reijnen R. *et al.* (1995). This study, conducted in the Netherlands, found reductions in breeding density in deciduous and conifer forests next to roads due to noise. However, the traffic volumes examined were 10,000 cars per day and 60,000 cars per day. Based upon this study, the proposed increase in traffic volumes along the proposed Sour Spring Road access, or the identified Fletcher Chapel Road alternative, would not cause significant noise disturbance to breeding birds. The threshold for disturbance has been established by the current road traffic and since volumes will not increase significantly, there should be no effect on wildlife.

Impacts to wildlife crossing these roads should be minor as the increase in traffic is minimal. In addition, it should be noted that the roadway is on the fringe of the Refuge for only about 1 mile, as compared to traffic along Route 63, which bisects the Refuge and which is about 6,000 feet west of the proposed project. The annual average daily traffic volume on Route 63 is approximately 3,700 or about 29 times the proposed average traffic volume associated with the project. This traffic is immediately adjacent to the field in which Henslow's sparrows were noted in 2001. Route 63 was present before the INWR was established. TES has no clear indication that Henslow's sparrow has been documented nesting in this field in recent years. TES conducted a breeding bird survey next to the Sour Springs Road and Oak Orchard Ridge Road on May 31, 2012 (see results presented in attached Table 5B and Figure 15). Representative nesting bird species found in multiple communities in those habitats include: Eastern kingbird, red-winged blackbird, common yellowthroat, American robin, and song sparrow. These species were recorded next to the road despite considerable ambient noise from Route 63. Thus, it appears that traffic has not had a notable impact despite the fact that Route 63 bisects the Refuge. Similarly, observations of wildlife usage near highways of much greater traffic volume indicate that the proposed increase in truck traffic volumes would not affect wildlife usage in the habitats adjacent to the roadways in the INWR.

2.9 DUST

In the mining process, emission of particulate matter (i.e., dust) can result from blasting, crushing/processing, and truck traffic along unpaved mining roads. Depending on wind direction, speed, and particle size, particulate matter has the potential to disperse. In this area, the prevailing wind is from the west and southwest, thus limiting opportunities for dust to disperse towards the Refuge. Dust that is generated from a mining operation (e.g., via truck traffic) is termed fugitive dust. Because dust can pose a threat to human health, federal and state regulations are in place to control the amount of particulate matter released into the air. Dust control measures are strictly enforced by the NYSDEC based on requirements to obtain an Air Facility Registration Certificate.

A number of methods exist for mitigating the effects of dust and airborne particulate matter dispersing from mining operations. The method to control dust at the source (i.e., where the activity is occurring) is through watering. Watering consists of spraying the surface of the ground with water to prevent dry particles from becoming airborne. In the DEIS for the Shelby Mine, watering has been indicated as the primary method for controlling fugitive dust. In addition, the construction of berms and planting vegetation will reduce wind erosion and dispersal of particulates. Reduction of particulates was noted at a limestone quarry in India by planting a 40 m greenbelt of trees (Chaulya *et al.* 2000).

In order to limit particulate emissions, Frontier Stone will employ Good Operating Practices. These techniques include limiting the amount of disturbed surfaces, water spraying the aggregate materials, and watering roads. The applicant proposes using field conveyors rather than haul trucks, which will limit the amount of particulates emitted from driving the trucks, as well as combustion emissions and noise associated with use of the haul trucks. Processing equipment will operate under a NYSDEC permit and therefore will be subject to applicable Federal and State air pollution regulations.

2.10 SUMMARY

Impacts to ecological resources were assessed within this chapter. The site of the proposed quarry consists of active agricultural uses. This farm has been in operation for over 50 years by the current landowner. There will be a reduction in agricultural habitat from development of the quarry. This will reduce available habitat for species such as horned lark, killdeer, and Savannah sparrow.

There are no endangered or threatened wildlife species nesting on the site. The horned lark, a special concern species, is a known nester. Northern harriers were noted foraging over the site. Development of this site would not cause an adverse impact to northern harriers as they are known to forage over hundreds of acres. Short-eared owls are known to occupy a winter roost over one mile from the site. The quarry operation will not be active in the winter when these birds are present. Short-eared owls are known to use quarries for foraging opportunities. No adverse impact to short-eared owls will occur.

Indirect impacts to off-site resources is expected to be minor. Background information related to noise and blasting was provided. Blasting will occur once or twice a week. Blasting will attenuate at a distance of 500 feet in the INWR. Noise from blasting is similar to a clap of thunder and lasts less than a second in duration. Noise and vibration will be dissipated by a berm on the perimeter of the quarry and by the distance from the operation. Sounds generated by the quarry will reduce to the current ambient background noise within 350 feet of the INWR border and 1,000 feet for vibrations. No effect will occur to Henslow's sparrows which nested approximately 4,000 feet west of the proposed quarry.

The proposed project truck traffic volumes will be minimal when compared to existing traffic on Route 63 which bisects the Refuge and carries 3,700 vehicles per day. The proposed increase in traffic volumes along the proposed Sour Spring Road access, or the identified Fletcher Chapel Road alternative, would not cause significant noise disturbance to breeding birds. The threshold for disturbance has been established by the current road traffic and since volumes will not increase significantly, there should be no effect on wildlife.

Dust is regulated by the NYSDEC and control measures are strictly enforced based on Air Facility Restriction Certificate. Good operating practices will be employed to control fugitive dust emissions.

2.11 REFERENCES

Allaire, P.N. 1978. Effects on avian populations adjacent to an active strip-mine site. pp.232-240 in Symposium on surface mining and fish/wildlife needs in the eastern United States, West Virginia University and U. S. Fish and Wildlife Service. 386 pp.

Chaulya, S.K., M.K. Chakrabarty, and R.S. Singh. 2001. Air Pollution Modeling for a Proposed Limestone Quarry. Water, Air, and Soil Pollution 126: 171-191.

Doresky, J., K. Morgan, L. Ragsdale, and H. Townsend. 2001. Effects of Military Activity on Reproductive Success of Red-cockaded Woodpeckers. Journal of Field Ornithology 72(2): 305-311.

Gill, F. 1995. Ornithology Second Edition. W.H. Freeman & Company. New Paltz, NY.

Holthuijzen, A. M., W. G. Eastland, A. R. Ansell, M. N. Kochert, R. D. Williams, and L.S. Young. 1990. Effects of Blasting on Behavior and Productivity of Nesting Prairie Falcons. Wildlife Society Bulletin 18: 270-281.

Jackson, J.A., B.J. Schardien, and T.H. McDaniel. 1977. Opportunistic Hunting of a Marsh Hawk on a Bombing Range. Journal of Raptor Research 11(4): 86.

Krebs, R. 2002. The Breeding Ecology of, and Effects of Military Activity on, the Henslow's Sparrow at For Drum, New York. Masters Thesis State University of New York at Brockport. Brockport, NY.

Larkin, R.P., L.L. Pater, and D.J. Tazik. 1996. Effects of Military Noise on Wildlife: A Literature Review. U.S. Army Corps of Engineers Technical Report 96/21. 107 pp.

Ohio Department of Natural Resources. Undated. Blasting in Ohio's Quarries and Surface Coal Mines. Ohio Department of Natural Resources Division of Mineral Resources Management. Website: ohiodnr.com.

Podulka, S., R. W. Rohnbaugh, Jr., and R. Bonney (Eds.). 2004. The Cornell Laboratory of Ornithology's Handbook of Bird Biology. Second Edition. Cornell University Press, Ithaca, NY.

Reijnen, R., R. Fopper, C. Ter Braak, and J. Thissen. 1995. The effects of car traffic on breeding bird populations in woodland. III Reduction of density in relation to the proximity of main roads. Journal of Applied Ecology 32: 187-202.

Schueck, L.S., J. M. Marzluff, and K. Steenhof. Influence of Military Activities on Raptor Abundance and Behavior. The Condor 103: 606-615.

Stalmaster, M.V. and J.L. Kaiser. 1997. Flushing Responses of Wintering Bald Eagles to Military Activity. Journal of Wildlife Management 61(4): 1307-1313.

TES. 2007a. Wetland Delineation Report, Terrestrial Environmental Specialists, Inc., Phoenix, NY.

TES. 2007b. Vegetation and Wildlife Resources of the Shelby Quarry Site. Terrestrial Environmental Specialists, Inc., Phoenix, NY.

TES. 2007c. Impact Analysis of Ecological Resources Shelby Quarry Site. Terrestrial Environmental Specialists, Inc., Phoenix, NY.

TES. 2009a. Wetlands Impact Assessment. Terrestrial Environmental Specialists, Inc., Phoenix, NY.

TES. 2009b. Supplement to Ecological Resources Report Proposed Shelby Mine Site. Terrestrial Environmental Specialists, Inc., Phoenix, NY.

TES. 2011. Wetland Impact Assessment. Terrestrial Environmental Specialists, Inc., Phoenix, NY.

TABLES

Table 1.

Acreage of Vegetation/Land Use Cover Types, Proposed Shelby Quarry Site

Vegetation/Land Use Type	Acreage	% of Total Site
Agricultural Cropland	263.0	98.1%
Open Field	2.3	0.9%
Scrub-Shrub Upland	2.0	0.7%
Ditches	0.7	0.3%
Total	268.0	100.0%

Table 2.

Plant Species Noted at the Proposed Shelby Quarry Site

TREES		**VEGETATION COVER TYPES**[a]			
Scientific Name[b]	**Common Name**	**AC**	**OF**	**SSU**	**WM/D**
Fraxinus pennsylvanica	Green Ash			X	
Juglans nigra	Black Walnut			X	
Pinus sylvestris	Scot's Pine			X	
Populus deltoides	Eastern Cottonwood			X	
Quercus alba	White Oak			X	
Quercus macrocarpa	Bur Oak			X	
Ulmus americana	American Elm			X	X

SHRUBS		**VEGETATION COVER TYPES**[a]			
Scientific Name[b]	**Common Name**	**AC**	**OF**	**SSU**	**WM/D**
Cornus foemina ssp.*racemosa*	Gray Dogwood			X	
Cornus sericea	Red Osier Dogwood			X	X
Lonicera tatarica	Tartarian Honeysuckle			X	
Malus sp.	Apple			X	
Rhamnus cathartica	Common Buckthorn				
Rhus hirta	Staghorn Sumac			X	
Salix sp.	Willow			X	X

HERBACEOUS		**VEGETATION COVER TYPES**[a]			
Scientific Name[b]	**Common Name**	**AC**	**OF**	**SSU**	**WM/D**
Agrostis sp.	Bluegrass		X		
Alisma plantago-aquatica	Broad-leaf water plantain			X	
Amaranthus sp.	Amaranth	X	X		
Arctium sp.	Burdock	X	X		
Asclepias syriaca	Common milkweed	X	X	X	
Aster novae-angliae	New England aster		X	X	
Aster sp.	Aster	X	X	X	X
Bidens sp.	Beggar-ticks				X
Carex sp.	Sedge		X	X	X
Chenopodium album	White goosefoot	X	X		
Cirsium arvense	Canada thistle	X	X	X	
Cirsium sp.	Thistle	X	X		
Cyperus esculentus	Yellow nut grass	X	X	X	X
Dactylis glomerata	Orchard grass	X	X		
Daucus carota	Wild carrot	X	X		
Dipsacus follonum	Teasel	X	X	X	

[a] Vegetation cover types are as follows: AC = Agricultural Cropland, OF = Open Field, SSU = Scrub-Shrub Upland, and WM/D = Wet Meadow/Ditch.
[b] Scientific nomenclature follows Mitchell and Tucker (1997).

Table 2. (cont.)

HERBACEOUS		VEGETATION COVER TYPES[a]			
Scientific Name[b]	**Common Name**	**AC**	**OF**	**SSU**	**WM/D**
Eleocharis sp.	Spikerush				X
Erigeron sp.	Daisy	X	X		
Festuca sp.	Fescue	X	X	X	
Fragaria virginiana	Strawberry		X	X	
Glycine max	Soybean	X			
Juncus effusus	Soft rush				X
Leersia oryzoides	Rice cutgrass				X
Leucanthemum vulgare	Ox-eye daisy	X	X		
Lolium arundinaceum	Tall fescue	X	X		
Malva neglecta	Mallow	X	X		
Panicum sp.	Panic grass	X	X		X
Phalaris arundinacea	Reed canary grass	X	X		X
Phragmites australis	Common reed				X
Phytolacca americana	Pokeweed			X	
Plantago lanceolata	Narrow-leaf plantain	X	X		
Poa sp.	Bluegrass	X	X	X	
Polygonum sp.	Smartweed	X	X		X
Potentilla simplex	Old field cinquefoil	X	X		
Ranunculus sp.	Buttercup	X	X		
Rubus ideaus	Raspberry			X	
Rubus occidentalis	Black raspberry			X	
Setaria faberri	Giant foxtail	X			
Setaria sp.	Foxtail	X	X		
Setaria viridis	Green foxtail	X			
Solanum dulcamara	Deadly nightshade			X	
Solidago canadensis	Canada goldenrod	X	X		
Spiraea alba	Meadowsweet			X	
Taraxacum officinale	Common dandelion	X	X	X	
Trifolium pratense	Red clover	X	X		
Trifolium repens	White clover	X	X		
Typha angustifolia	Narrow-leaf cattail				X
Typha latifolia	Broad-leaf cattail				X
Verbascum thapsus	Mullein	X	X		
Vitis sp.	Grape			X	
Zea mays	Corn	X			

Table 3.

Wildlife Observations on the Proposed Shelby Quarry Site 2006 - 2010

AMPHIBIANS	
Common Name[(a)]	**Scientific Name**
Eastern American Toad	*Anaxyrus americanus*
Green frog	*Rana clamitans*
Northern leopard frog	*Rana pipiens*
Pickerel frog	*Rana palustris*

BIRDS	
Common Name[(b)]	**Scientific Name**
Canada Goose	*Branta canadensis*
Wild Turkey	*Meleagris gallopavo*
Great Blue Heron	*Ardea herodias*
Turkey Vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Northern Harrier	*Circus cyaneus*
Red-tailed Hawk	*Buteo jamaicensis*
Killdeer	*Charadrius vociferus*
Rock Pigeon	*Columba livia*
Mourning Dove	*Zenaida macroura*
Downy Woodpecker	*Picoides pubescens*
Northern Flicker	*Colaptes auratus*
Eastern Kingbird	*Tyrannus tyrannus*
Red-eyed Vireo	*Vireo olivaceus*
Blue Jay	*Cyanocitta cristata*
American Crow	*Corvus brachyrhynchos*
Horned Lark	*Eremophila aldestris*
Tree Swallow	*Tachycineta bicolor*
Barn Swallow	*Hirundo rustica*
Black-capped Chickadee	*Poecile atricapillus*
American Robin	*Turdus migratorius*
Gray Catbird	*Dumetella carolinensis*
Northern Mockingbird	*Mimus polyglottos*
European Starling	*Sturnus vulgaris*
American Pipit	*Anthus rubescens*
Pine Warbler	*Dendroica pinus*
American Tree Sparrow	*Spizella arborea*

[(a)] Common and scientific names according to Crother (2000), and updates through 2003.
[(b)] Common and Scientific names according to AOU (1998) and supplements through 2008.

Table 3. (cont.)

BIRDS	
Common Name[b]	**Scientific Name**
Field Sparrow	*Spizella pusilla*
Savannah Sparrow	*Passerculus sandwichensis*
Song Sparrow	*Melospiza melodia*
Dark-eyed Junco	*Junco hyemalis*
Snow Bunting	*Plectrophenax nivalis*
Indigo Bunting	*Passerina cyanea*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
Brown-headed Cowbird	*Molothrus ater*
American Goldfinch	*Carduelis tristis*

X = Observed reacting to habitat, f.o. = flyover, non-breeding on site

MAMMALS	
Common Name[c]	**Scientific Name**
Eastern cottontail	*Sylvilagus floridanus*
Woodchuck	*Marmota monax*
Coyote	*Canis latrans*
Raccoon	*Procyon lotor*
White-tailed deer	*Odocoileus virginianus*

[b] Common and Scientific names according to AOU (1998) and supplements through 2008.
[c] Common and scientific names according to Whitaker and Hamilton (1998).

Table 4.

Birds Observed on the Proposed Shelby Quarry Site during the 2007 Breeding Bird Survey*

BIRDS		**VEGETATION COVER TYPES[a]**			
Common Name[b]	**Scientific Name**	**A/C**	**OF**	**SSU**	**WM/ DITCH**
Canada Goose	*Branta canadensis*	X			X
Great Blue Heron	*Ardea herodias*	f.o.			
Turkey Vulture	*Cathartes aura*	f.o.			
Red-tailed Hawk	*Buteo jamaicensis*	f.o.			
Killdeer	*Charadrius vociferus*	X			
Rock Pigeon	*Columba livia*	X			
Red-eyed Vireo	*Vireo olivaceus*			X	
American Crow	*Corvus brachyrhynchos*	X			
Horned Lark	*Eremophila aldestris*	X			
Tree Swallow	*Tachycineta bicolor*	X			
Barn Swallow	*Hirundo rustica*	X			
European Starling	*Sturnus vulgaris*	X			
Pine Warbler	*Dendroica pinus*			X	
Field Sparrow	*Spizella pusilla*			X	
Savannah Sparrow	*Passerculus sandwichensis*	X	X	X	X
Song Sparrow	*Melospiza melodia*			X	
Indigo Bunting	*Passerina cyanea*			X	
Red-winged Blackbird	*Agelaius phoeniceus*	X			
American Goldfinch	*Carduelis tristis*	f.o.			

*Breeding bird survey May 31 and June 1, 2007.

X = Observed reacting to habitat, f.o. = flyover, non-breeding on site.

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[a] Vegetation Cover Types: A/C – Agriculture/Cropland, OF – Open Field, SSU – Scrub-Shrub Upland, WM/Ditch – Wet Meadow/Ditch.

[b] Common and Scientific names according to AOU (1998) and supplements through 2006.

Table 5A.

Birds Recorded Per 10-Minute Point Count on the Iroquois National Wildlife Refuge

Town of Shelby

Cover Type:	SSU	DFU	MFU	OW	EW	WM	SSW	DFW
Great blue heron *Ardea herodias*					0.50			
Turkey Vulture *Cathartes aura*	1.00							
Mallard *Anas platyrhynchos*					3.00			
Virginia rail *Rallus limicola*					0.50			
Downy woodpecker *Picoides pubescens*						1.00		
Eastern wood-pewee *Contopus virens*						1.00		0.50
Least flycatcher *Empidonax minimus*			1.00					
Great crested flycatcher *Myiarchus crinitus*			1.00					1.00
Eastern kingbird *Tyrannus tyrannus*							1.00	
Blue jay *Cyanocitta cristata*					0.50			
American crow *Corvus brachyrhynchos*	2.00		2.00		1.50	1.00	22.00	4.00

Table 5A. **(cont.)**

Cover Type:	SSU	DFU	MFU	OW	EW	WM	SSW	DFW
Black-capped chickadee *Parus atricapillus*		1.00	5.00		1.50	2.00		
White-breasted nuthatch *Sitta carolinensis*			1.00		1.00			
Brown creeper *Certhia americana*			1.00					
Blue-gray gnatcatcher *Polioptila caerulea*					0.50			
Wood thrush *Hylocichla mustelina*	2.00					1.00	1.00	1.00
American robin *Turdus migratorius*				2.00	1.00		4.00	0.50
Gray catbird *Dumetella carolinensis*	2.00			2.00			1.00	
European starling *Sturnus vulgaris*					26.00		3.00	
Blue-winged warbler *Vermivora pinus*								1.00
Yellow warbler *Dendroica petechia*	6.00			3.00	0.50	2.00	2.00	
Chestnut-sided warbler *Dendroica pensylvanica*	1.00			1.00			1.00	
Ovenbird *Seiurus aurocapillus*		1.00	2.00					

Table 5A. **(cont.)**

Cover Type:	SSU	DFU	MFU	OW	EW	WM	SSW	DFW
Common yellowthroat *Geothlypis trichas*	2.00				2.50	2.00		1.50
Hooded warbler *Wilsonia citrina*			1.00					
Scarlet tanager *Piranga olivacea*								0.50
Rose-breasted grosbeak *Pheucticus ludovicianus*		1.00			0.50	1.00	1.00	0.50
Indigo bunting *Passerina cyanea*						1.00		
Field sparrow *Spizella pusilla*						1.00		
Song sparrow *Melospiza melodia*				3.00	1.00	4.00	1.00	
Swamp sparrow *Melospiza georgiana*					1.00		1.00	
Red-winged blackbird *Agelaius phoeniceus*	2.00			4.00	1.50	1.00	5.00	
Common grackle *Quiscalus quiscula*						2.00		
Brown-headed cowbird *Molothrus ater*					0.50		1.00	
Baltimore oriole *Icterus galbula*				1.00				

Table 5A. **(cont.)**

Cover Type:	SSU	DFU	MFU	OW	EW	WM	SSW	DFW
American goldfinch *Carduelis tristis*	3.00		2.00	4.00	0.50	5.00	3.00	0.50
Total Number of Species:	9	3	9	8	18	14	14	10
Number of 10 Minute Samples:	1	1	1	1	2	1	1	2
Total Number of Birds Per 10 Minute Sample:	21.00	3.00	16.00	20.00	44.00	25.00	47.00	11.00

Table 5B.

Birds Recorded Per 10-Minute Point Count
Adjacent to Oak Orchard Ridge Road and Sour Springs Road
Town of Shelby

Cover Type:	SSU	DFU	OF	AG	EW
Great blue heron *Ardea herodias*	6.00		1.00		
Great egret *Casmerodius albus*	0.50		0.50		
Turkey Vulture *Cathartes aura*					1.00
Canada goose *Branta canadensis*	1.00				
Wood duck *Aix sponsa*	1.00				
Mallard *Anas platyrhynchos*	1.00		1.00		
Osprey *Pandion haliaetus*	0.50				
Killdeer *Charadrius vociferus*				1.00	1.00
Ring-billed gull *Larus delawarensis*		0.25			
Red-bellied woodpecker *Melanerpes carolinus*		0.25			

Table 5B. (cont.)

Cover Type:	SSU	DFU	OF	AG	EW
Downy woodpecker *Picoides pubescens*		0.25			1.00
Eastern wood-pewee *Contopus virens*		0.50			
Willow flycatcher *Empidonax traillii*	0.50		1.50		1.00
Great crested flycatcher *Myiarchus crinitus*	0.50	0.25			
Eastern kingbird *Tyrannus tyrannus*	0.50	0.25	1.00		
Tree swallow *Tachycineta bicolor*	2.00		1.50		
Blue jay *Cyanocitta cristata*	1.00				
American crow *Corvus brachyrhynchos*	1.00	0.75			1.00
Black-capped chickadee *Parus atricapillus*		0.25			
White-breasted nuthatch *Sitta carolinensis*		0.25			
Marsh wren *Cistothorus palustris*					2.00
American robin *Turdus migratorius*	1.00	0.50	1.00		3.00

Table 5B. (cont.)

Cover Type:	SSU	DFU	OF	AG	EW
Gray catbird *Dumetella carolinensis*	0.50	0.25			
European starling *Sturnus vulgaris*				19.00	
Red-eyed vireo *Vireo olivaceus*		0.75			
Yellow warbler *Dendroica petechia*		1.75	1.00		3.00
Chestnut-sided warbler *Dendroica pensylvanica*	1.00				
Cerulean warbler *Dendroica cerulea*		0.25			
American redstart *Setophaga ruticilla*	0.50				
Common yellowthroat *Geothlypis trichas*	4.50	1.25	2.00		1.00
Hooded warbler *Wilsonia citrina*		0.50			
Scarlet tanager *Piranga olivacea*		0.25			
Northern cardinal *Cardinalis cardinalis*		0.50			1.00
Rose-breasted grosbeak *Pheucticus ludovicianus*		0.25	0.50		1.00

Table 5B. (cont.)

Cover Type:	SSU	DFU	OF	AG	EW
Indigo bunting *Passerina cyanea*	0.50		0.50		
Chipping sparrow *Spizella passerina*	0.50		1.00	2.00	
Field sparrow *Spizella pusilla*			1.00		
Savannah sparrow *Passerculus sandwichensis*			1.00	1.00	
Song sparrow *Melospiza melodia*	1.50	0.75	1.50		1.00
Swamp sparrow *Melospiza georgiana*	0.50				4.00
Bobolink *Dolichonyx oryzivorus*	1.00		1.50		1.00
Red-winged blackbird *Agelaius phoeniceus*	2.00	0.25	1.00	3.00	7.00
Common grackle *Quiscalus quiscula*	1.50			1.00	
Brown-headed cowbird *Molothrus ater*	1.00	0.75	0.50	6.00	
Baltimore oriole *Icterus galbula*		0.25		1.00	
American goldfinch *Carduelis tristis*			2.50		

Table 5B. (cont.)

Cover Type:	SSU	DFU	OF	AG	EW
Total Number of Species:	25	23	19	8	15
Number of 10 Minute Samples:	2	4	2	1	1
Total Number of Birds Per 10 Minute Sample:	31.50	11.25	21.50	34.00	29.00

Table 6.

Cover Type Impacts by Phase on the Proposed Shelby Quarry Site

Cover Type[a]	Impact by Mining Phase (in acres)				Totals
	1	2	3	4	
AC	31.06	79.11	89.71	14.45	214.33
SSU	-	1.60	0.19	-	1.79
DITCH	-	0.70	-	-	0.91
OF	-	2.54	-	-	2.54
Totals	31.06	84.16	89.90	14.45	219.57

[a] Cover types are as follows: AC – Agricultural Cropland, SSU – Scrub-Shrub Upland, DITCH – Ditch, and OF – Open Field.

Table 7.

Important Farmland Soils on the Proposed Shelby Quarry Site

Prime Farmland Soils[a]	**Impact by Mining Phase (in acres)**				**Totals**
	1	**2**	**3**	**4**	
BoB	0.04	19.28	-	-	19.32
CcB	0.35	-	6.87	9.42	16.64
HbB	-	-	0.53	-	0.53
OnB	-	-	3.54	2.37	5.91
Total	0.39	19.28	10.94	11.79	42.40
Farmland Soil of Statewide Importance	**1**	**2**	**3**	**4**	**Totals**
Ca	0.09	-	-	-	0.09
Lk	4.94	0.47	-	-	5.41
Total	5.03	0.47	-	-	5.50

[a] Soils are as follows: BoB – Bombay fine sandy loam, 3 to 8 percent slopes; Ca – Canandaigua soils; CcB - Cayuga silt loam, 2 to 6 percent slopes; HbB – Hilton loam, 3 to 8 percent slopes; Lk - Lakemont silty clay loam; OnB – Ontario loam, 3 to 8 percent slopes.

Table 8.[1]

Quarry Noise Worst Case Scenarios on the Proposed Shelby Quarry Site

- Active mining along southern property perimeter
    - Processing plant in operation
    - Loader activity and primary crusher in pit floor
    - Blast hold drilling rig in operation along southern limit of excavation area

- Assume 20'± berm along southern affected area boundary

PROJECTED SOUND LEVELS*

Location	Sound Levels (dBA)
at Property Line (pL)	64.8
200' from pL	58.8
400' from pL	47.8
800' from pL	40.8
1600' from pL	33.8
3200' from pL	27.8

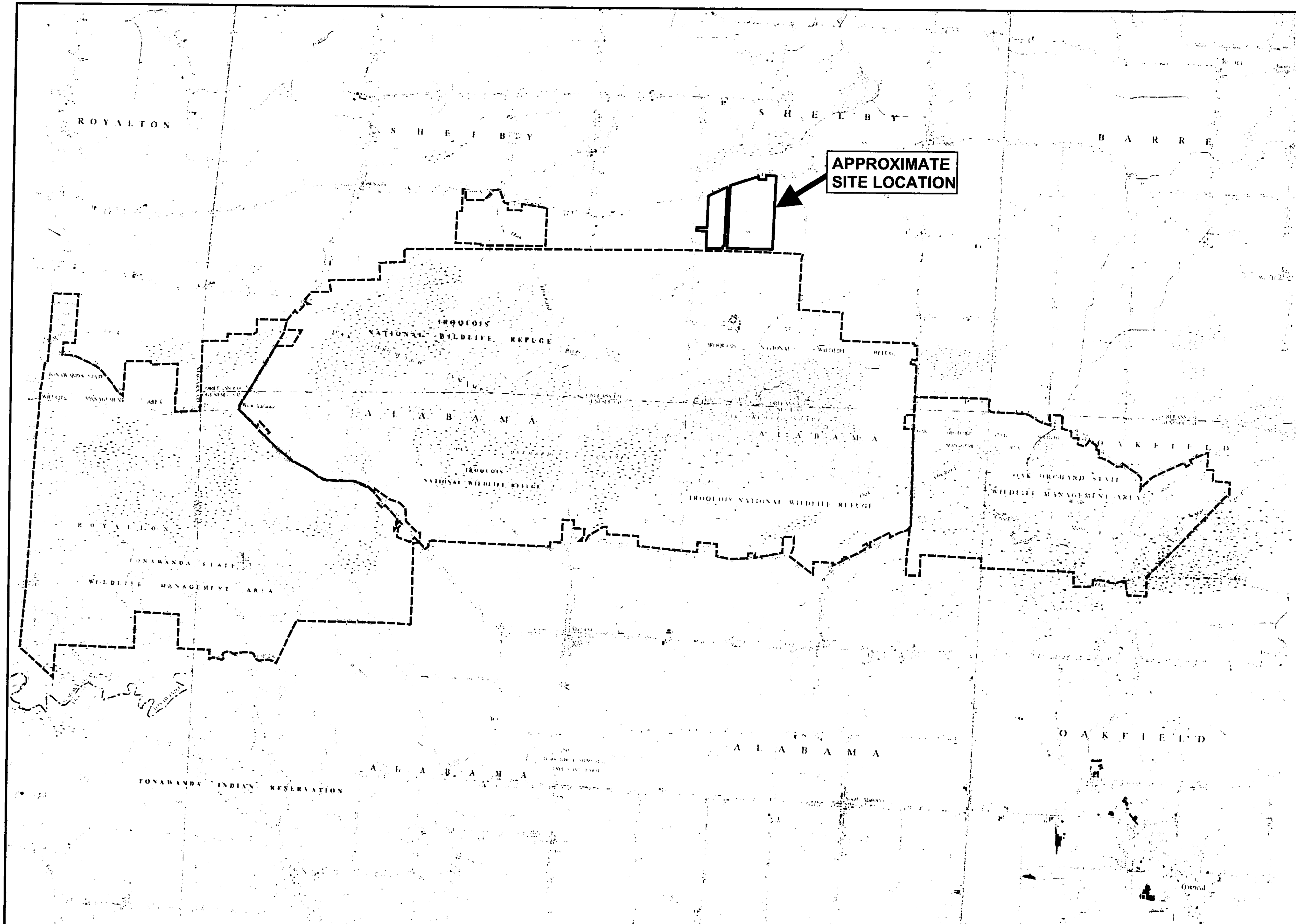
*based upon attenuation by distance and vegetation

- Current ambient at or near pL 50.5 dBA without farm activity

- Closest building of Iroquois Job Corps Center is about 3200'. Ambient here is 55.3 dBA

[1]Source for Table 8 – Continental Placer Inc.

FIGURES



NORTH

0 2500' 5000'

APPROXIMATE SCALE IN FEET

Aerial Photograph obtained from NYS GIS Clearinghouse 2002

Figure Prepared by Terrestrial Environmental Specialists, Inc.

Figure 1.

Site Location

TES File: CON-3197\3197-wildlife-refuge-2.dsf\8-20-10

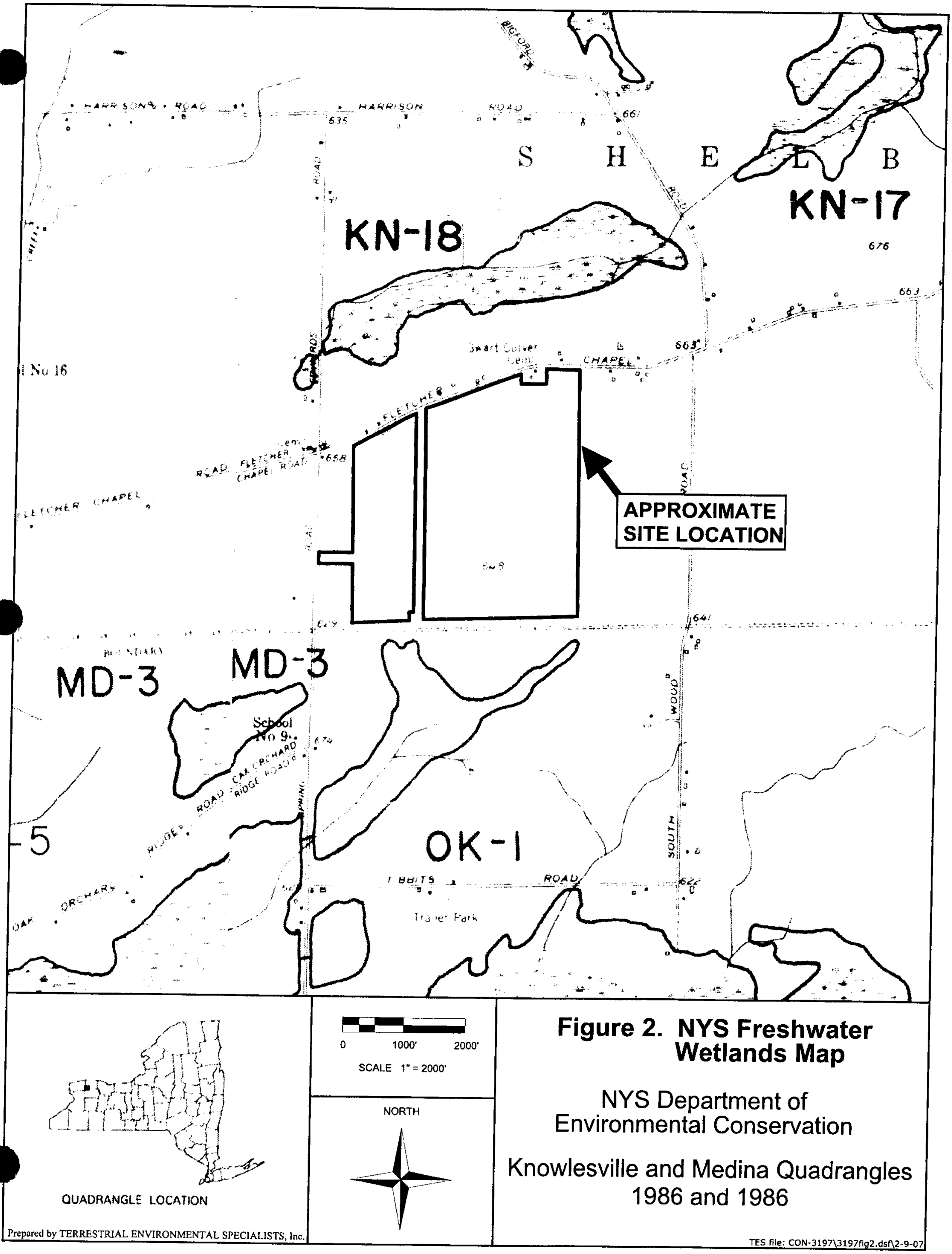


Figure 2. NYS Freshwater Wetlands Map

NYS Department of Environmental Conservation

Knowlesville and Medina Quadrangles 1986 and 1986

Prepared by TERRESTRIAL ENVIRONMENTAL SPECIALISTS, Inc.

TES file: CON-3197\3197fig2.dsf\2-9-07

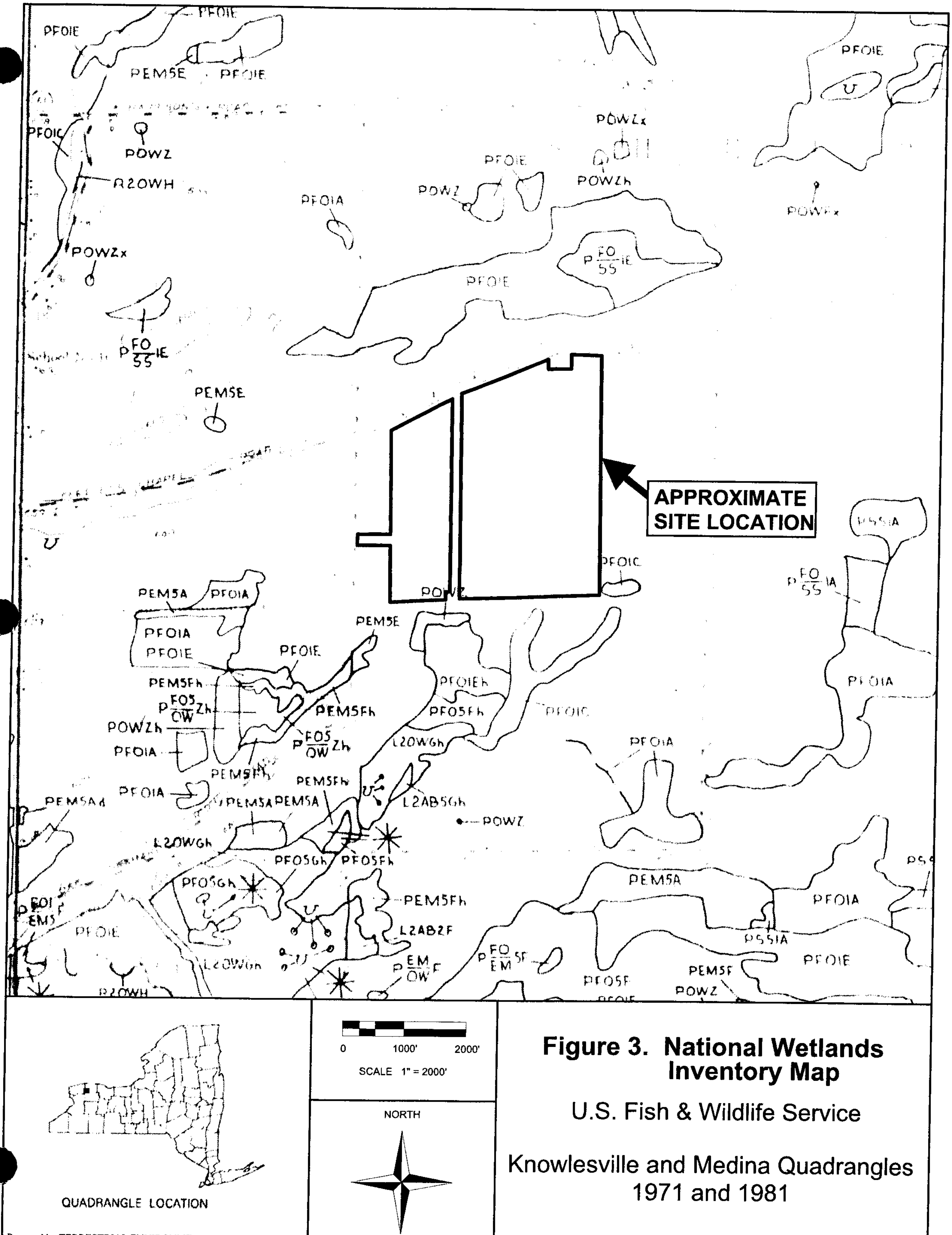


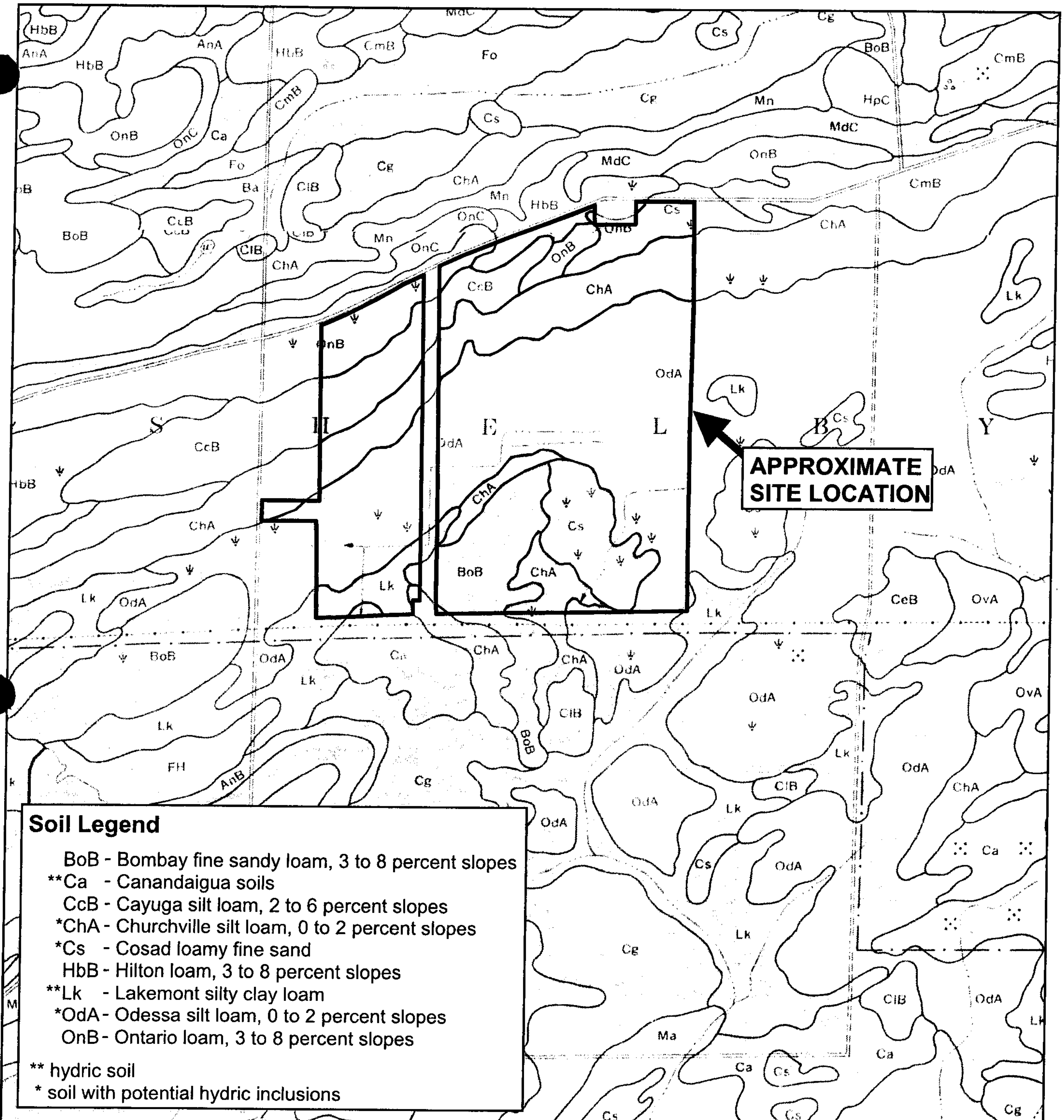
Figure 3. National Wetlands Inventory Map

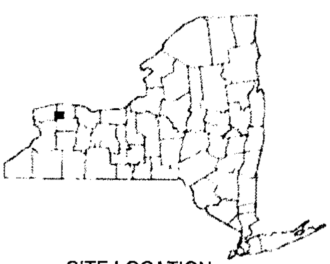
U.S. Fish & Wildlife Service

Knowlesville and Medina Quadrangles
1971 and 1981

Prepared by TERRESTRIAL ENVIRONMENTAL SPECIALISTS, Inc.

TES file: CON-3197\3197fig3.dsf\2-9-07





0 660' 1320'

SCALE 1" = 1320'

NORTH

Figure 4. Soil Survey Map

U.S. Soil Conservation Service

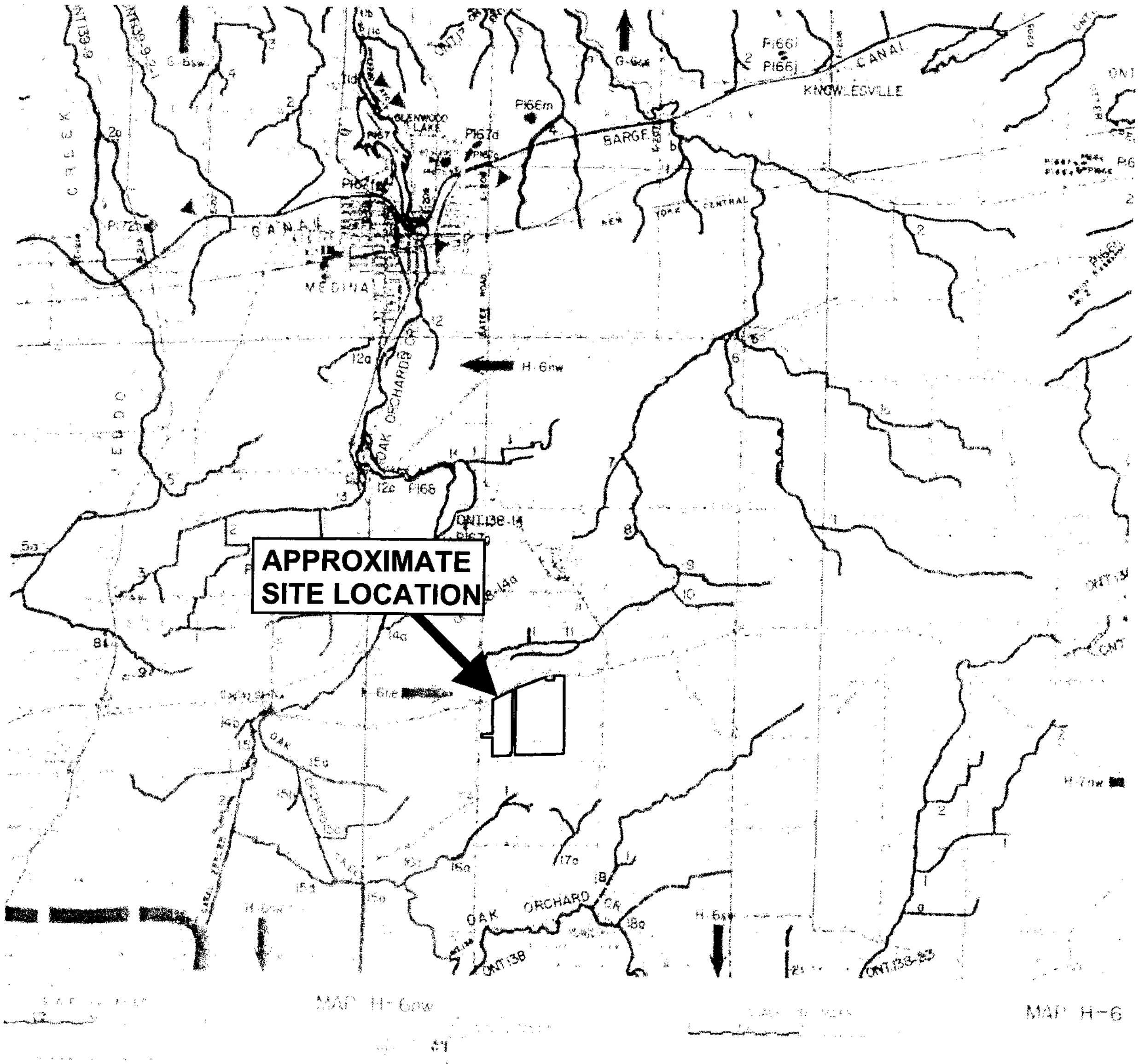
Orleans County Soil Survey

1977

Sheets 36 and 42

Prepared by TERRESTRIAL ENVIRONMENTAL SPECIALISTS, Inc.

TES file: CON-3197\3197fig4.dsf/2-9-07



Item No.	Waters Index Number	Name	Description	Map Ref. No.	Class	Standards

No streams present on site.

Title 6 NYCRR, Chapter X
Article 9, Part 847.9 (1992)

Map H-6nw
Map H-6ne

0 4000' 8000'
SCALE 1" = 8000'

NORTH

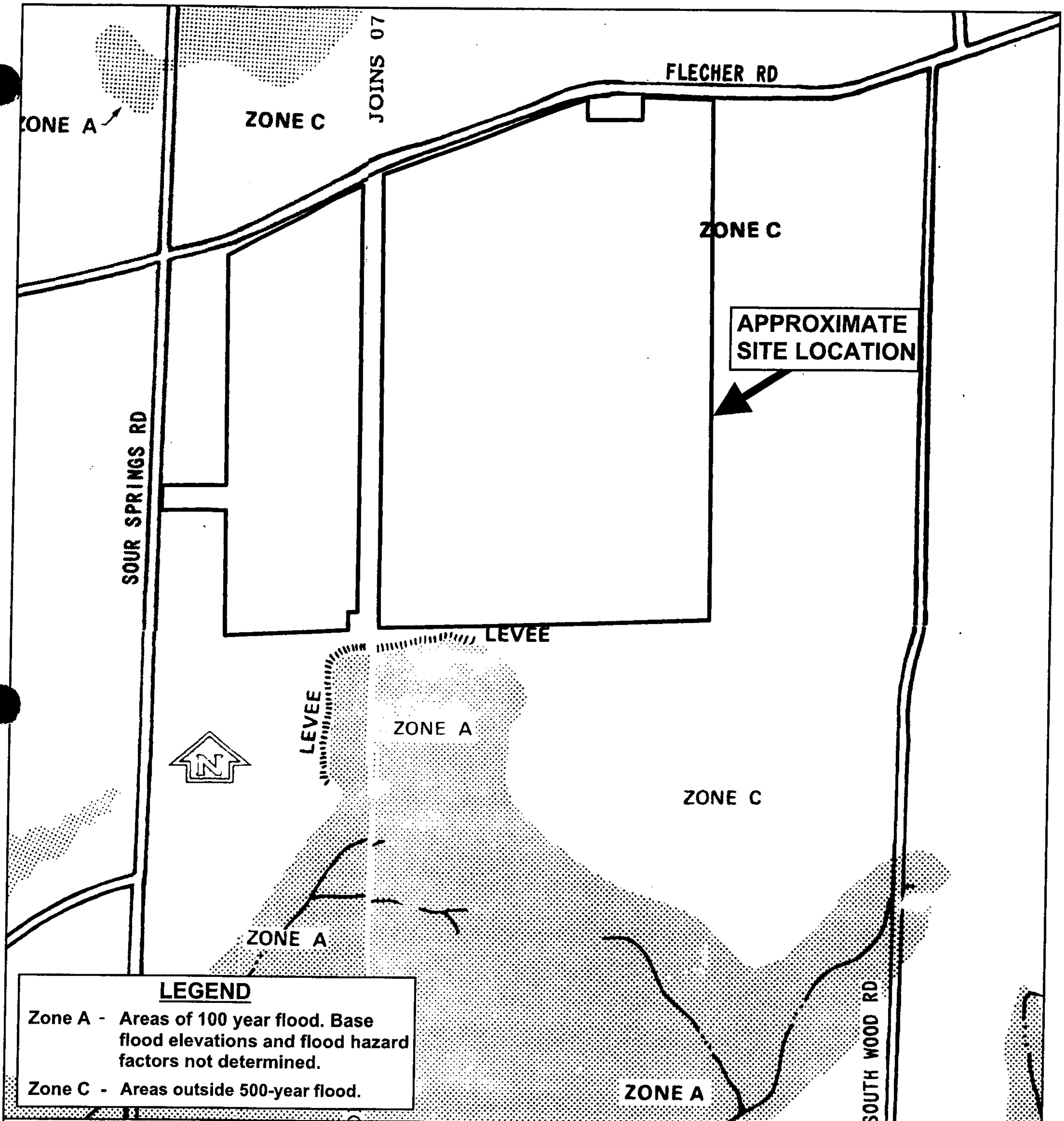
Figure 5. Stream Classification Map

NYSDEC

Knowlesville and Medina Quadrangles

Prepared by TERRESTRIAL ENVIRONMENTAL SPECIALISTS, Inc.

TES file: CON-3197\3197fig5.dsf\2-9-07



Panel Numbers:

361258B

(Effective Date 12/23/83)

0 500' 1000'

SCALE 1" = 1000'

NORTH

Figure 6. Flood Insurance Rate Map

Federal Emergency Management Agency

Town of Shelby, NY

Prepared by TERRESTRIAL ENVIRONMENTAL SPECIALISTS, Inc.

TES File: CON-3197\3197fig6.dsf\2-9-07

LEGEND

AC - Agricultural Cropland
OF - Open Field
SSU - Scrub-Shrub Upland
WM - Wet Meadow/Emergent (Ditches)

NORTH

0 200' 400'

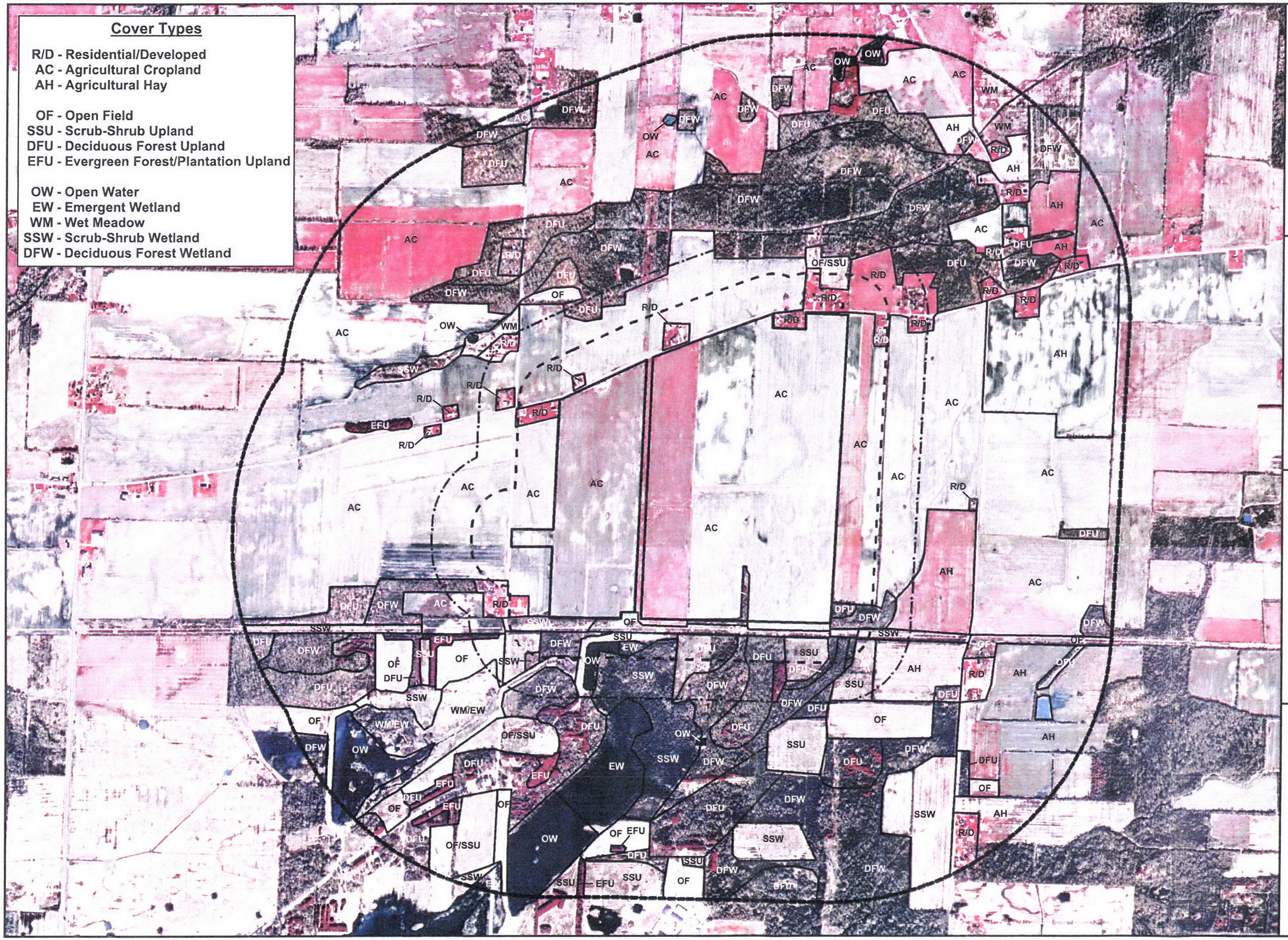
APPROXIMATE SCALE IN FEET

Aerial Photograph obtained from NYS GIS Clearinghouse 2005

Prepared by Terrestrial Environmental Specialists, Inc.

Figure 7.
Vegetation/Land Use Cover Map

TES File: CON-3197\3197covertype.dsf\2-9-07



Legend

Site Boundary
500' Buffer
1,000' Buffer
3,500' Buffer

NORTH

0' 600' 1200'
APPROXIMATE SCALE IN FEET

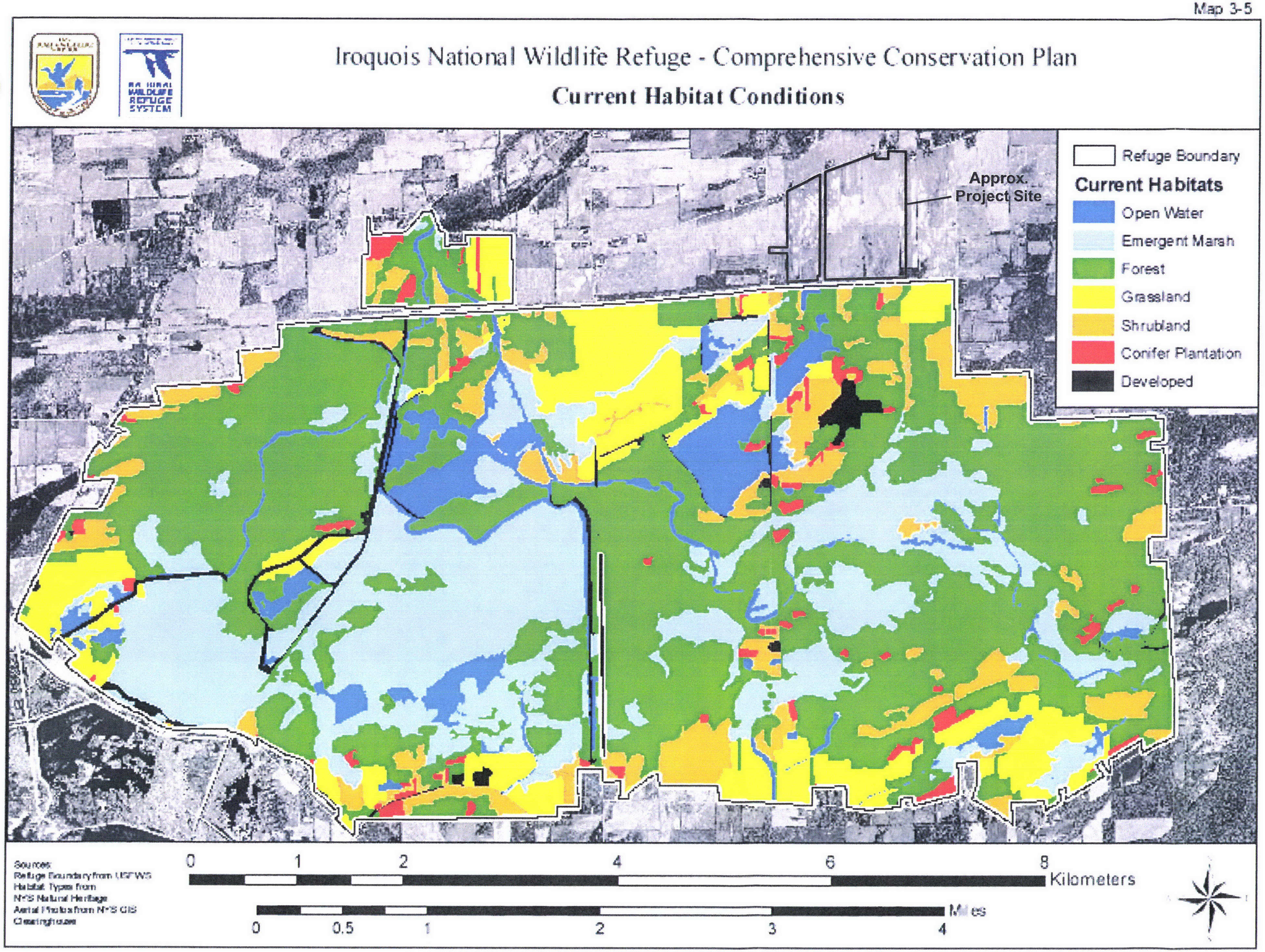
Figure Prepared by Terrestrial Environmental Specialists, Inc.

Aerial Photographs obtained from NYS GIS Clearinghouse 1994 -1999

Figure 8.

Vegetation/Land Use Cover Types, on and in the Vicinity of the Proposed Shelby Quarry Site

TES File: CON-3197\3197-aerial-cover.dsf\9-30-10



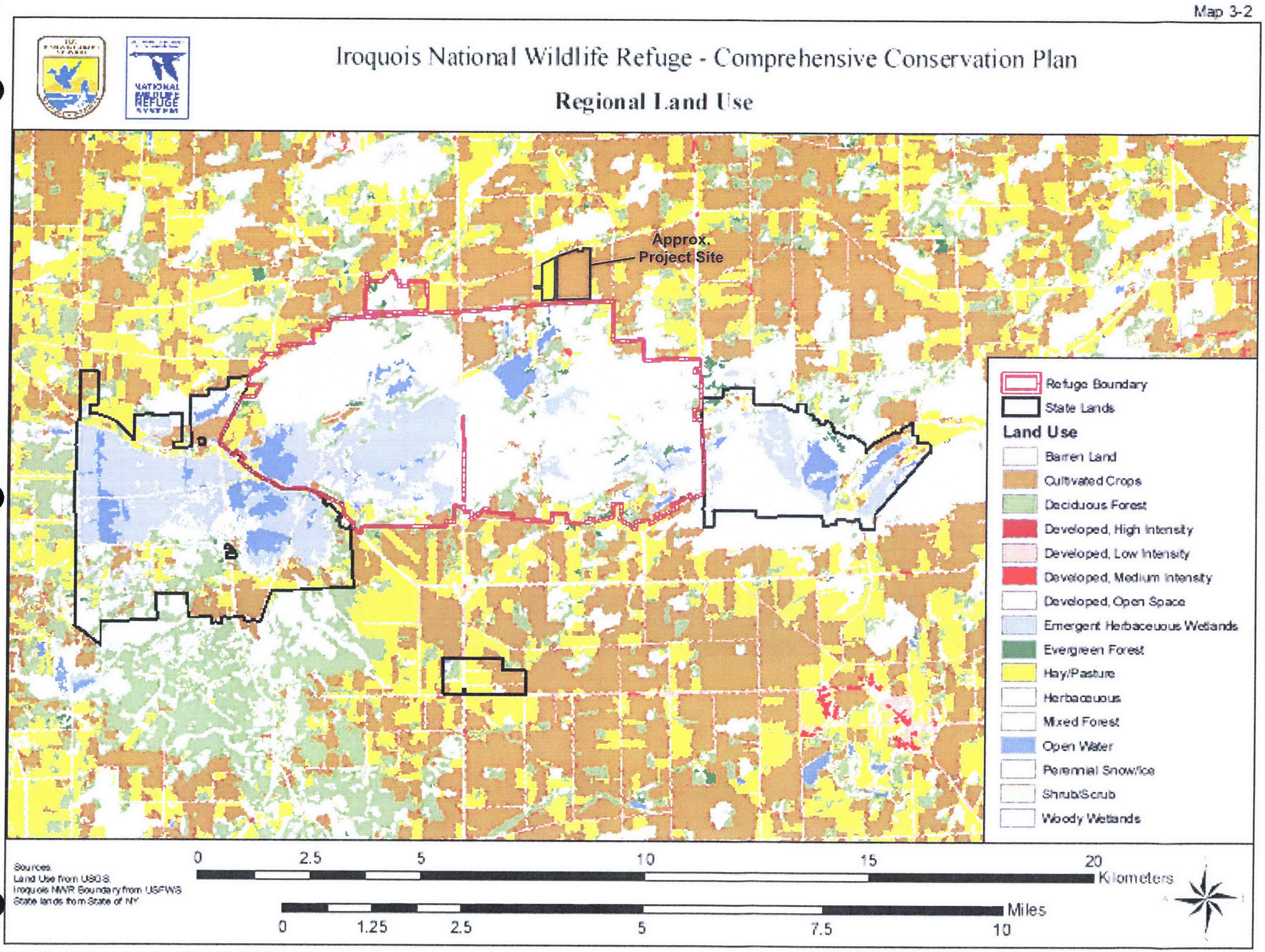
Base Map taken unaltered from Iroquois National Wildlife Refuge *Draft Comprehensive Conservation Plan and Environmental Assessment*

September 2010

****Project site added by TES, Inc.***

Figure 9.

Current Habitat Conditions Iroquois National Wildlife Refuge



Base Map taken unaltered from Iroquois National Wildlife Refuge *Draft Comprehensive Conservation Plan and Environmental Assessment*

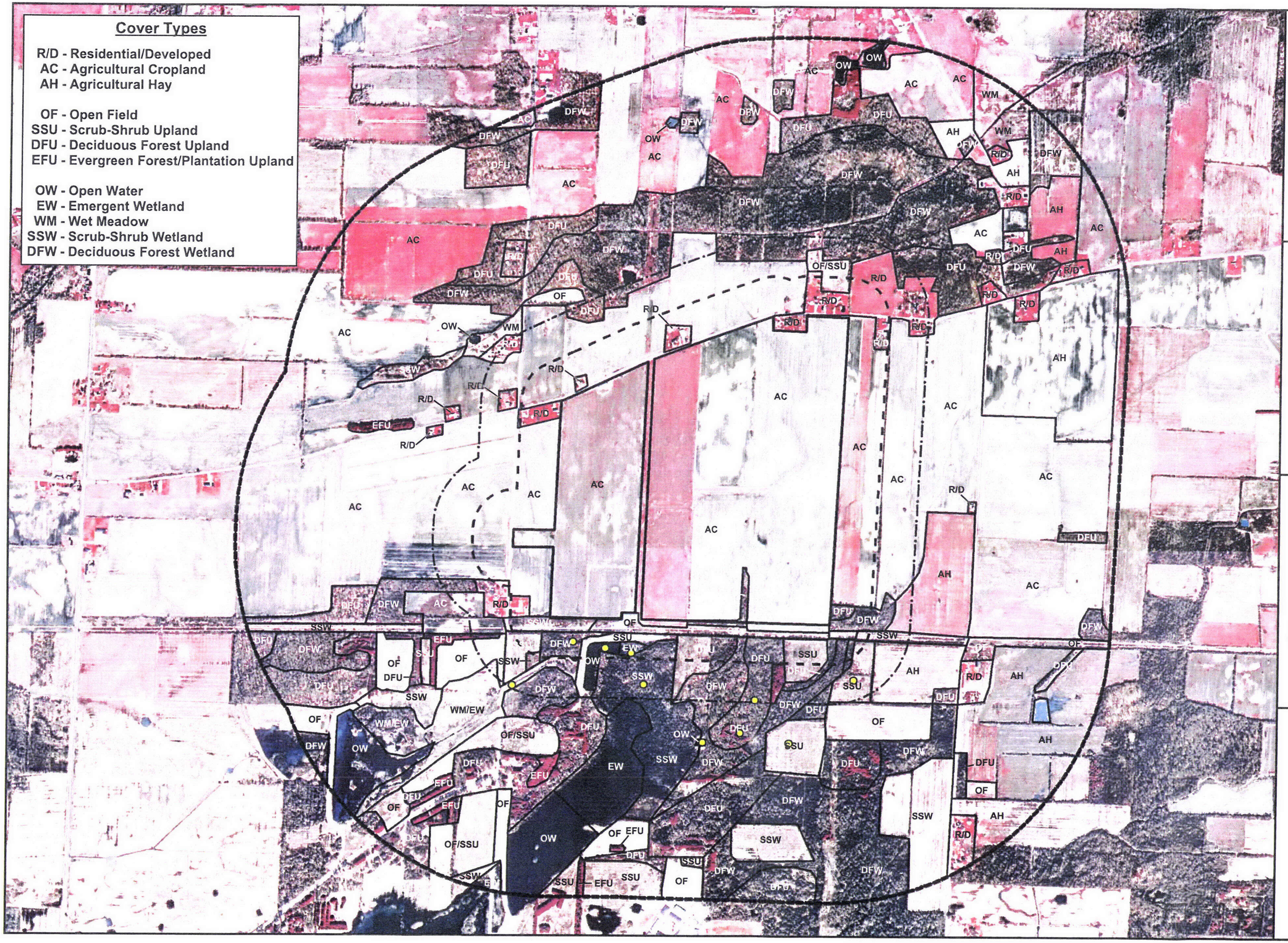
September 2010

****Project site added by TES, Inc.***

Figure 10.

Regional Land Use

CON-3197/3197-RegionalLandUse.dsf/3-22-11



Legend

Site Boundary

500' Buffer

1,000' Buffer

3,500' Buffer

Point Count Locations

NORTH

0' 600' 1200'

APPROXIMATE SCALE IN FEET

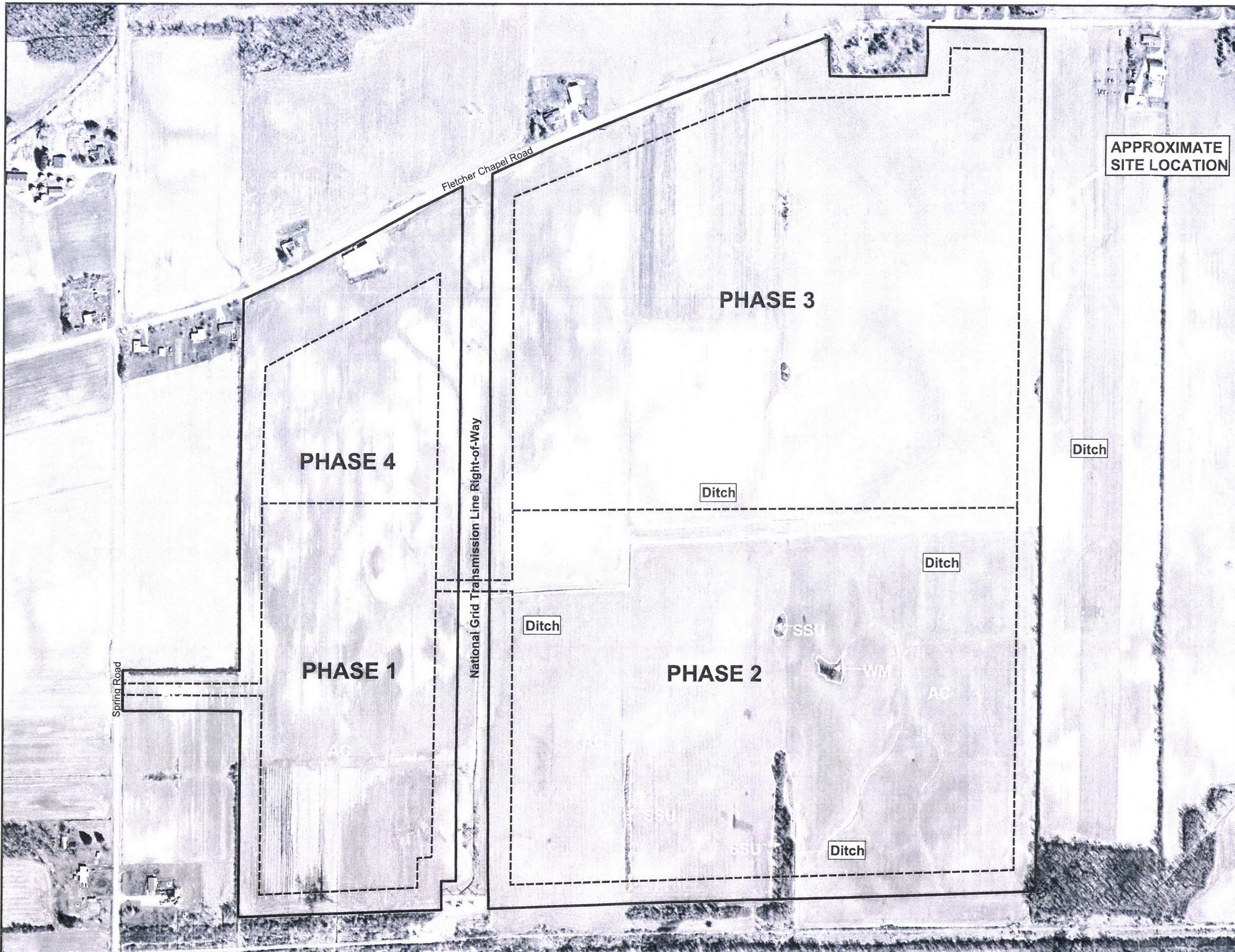
Figure Prepared by Terrestrial Environmental Specialists, Inc.

Aerial Photographs obtained from NYS GIS Clearinghouse 1994 -1999

Figure 11.

Approximate Breeding Bird Point Count Locations on Iroquois National Wildlife Refuge

TES File: CON-3197\3197-aerial-bird.dsf\2-16-11



LEGEND

AC - Agricultural Cropland
OF - Open Field
SSU - Scrub-Shrub Upland
WM - Wet Meadow/Emergent (Ditches)

NORTH

0 200' 400'

APPROXIMATE SCALE IN FEET

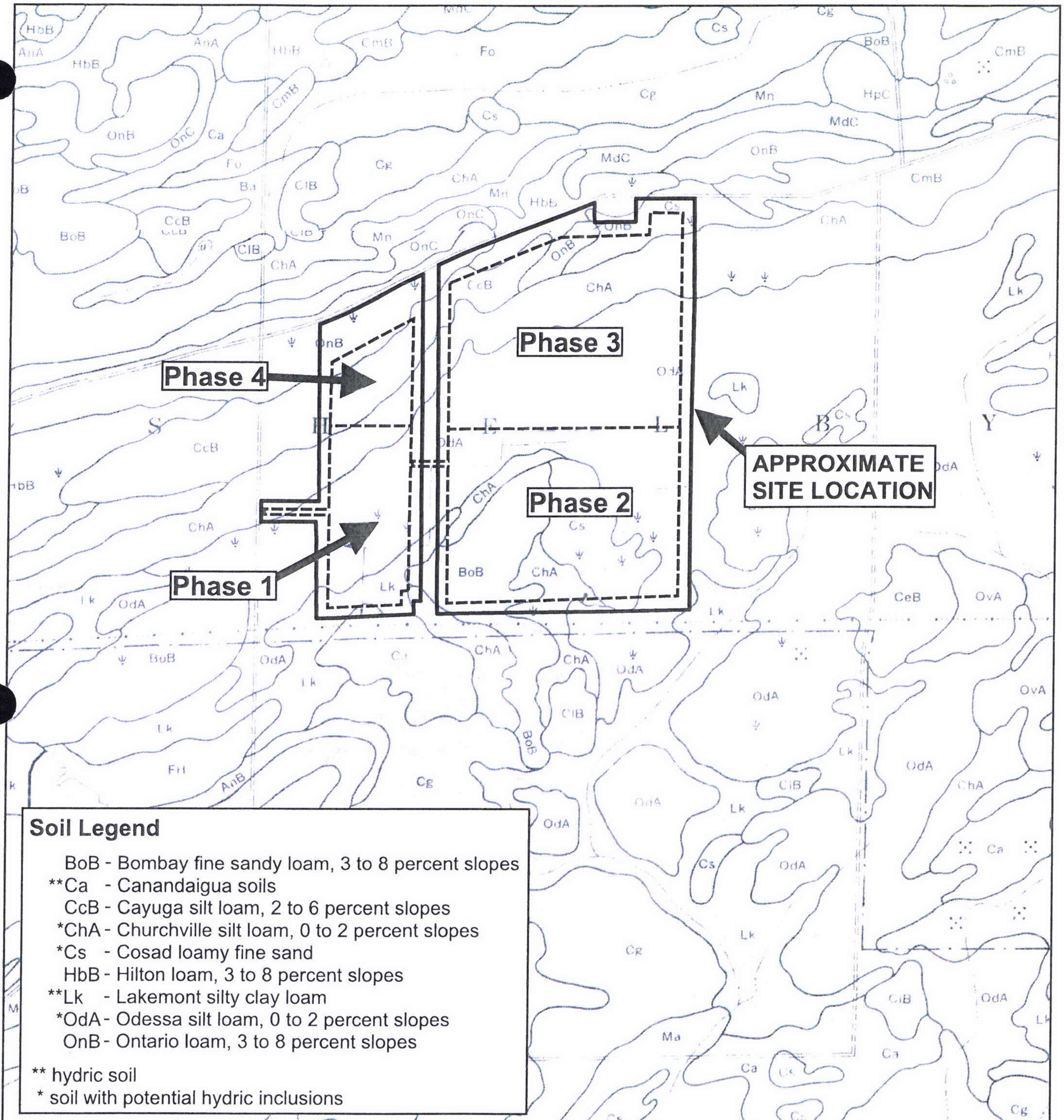
Aerial Photograph obtained from NYS GIS Clearinghouse 2005

Prepared by Terrestrial Environmental Specialists, Inc.

Figure 12.

Vegetation/Land Use Cover Map with Mining Phases, Shelby Quarry Site

TES File: CON-3197\3197covertype-wphases.dsf\8-19-10



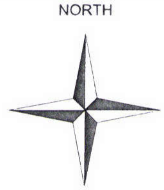
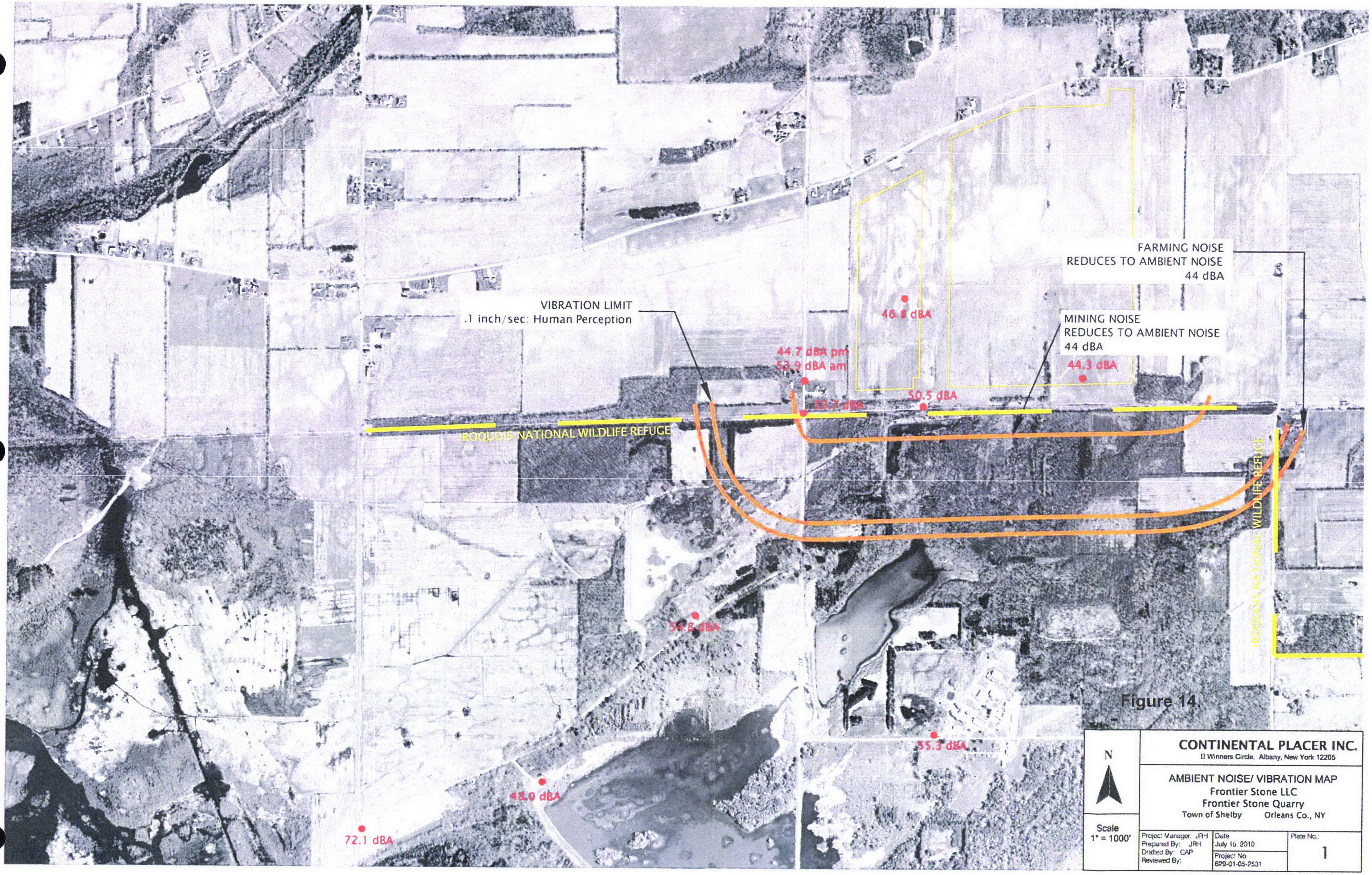


Figure 13. Soil Survey Map with Mining Phases

U.S. Soil Conservation Service
Orleans County Soil Survey
1977
Sheets 36 and 42

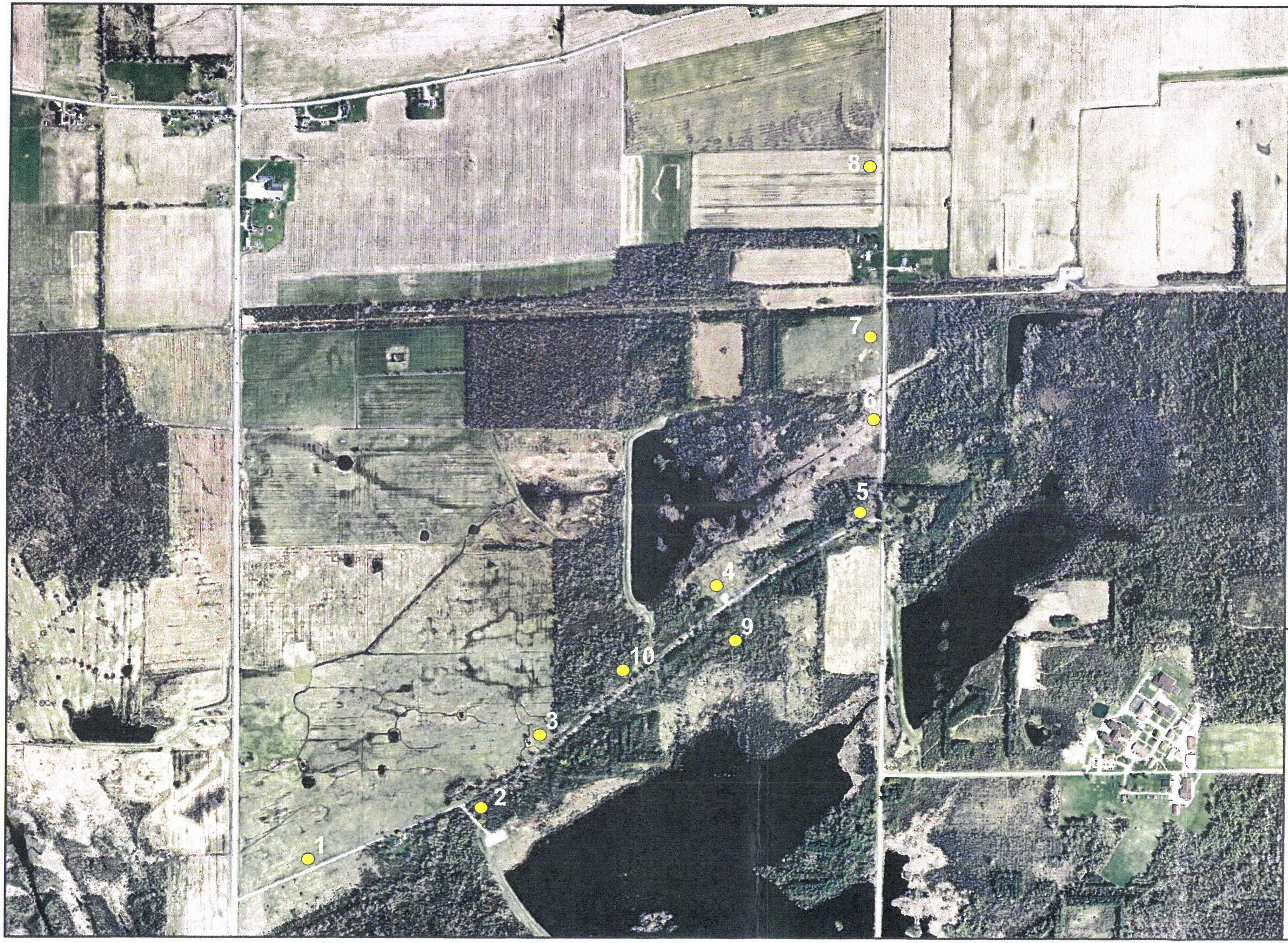
Prepared by TERRESTRIAL ENVIRONMENTAL SPECIALISTS, Inc.

TES file: CON-3197\3197Soils-wphases.dsf/2-17-11



FARMING NOISE
REDUCES TO AMBIENT NOISE
44 dBA
VIBRATION LIMIT
.1 inch/sec: Human Perception
46.8 dBA
MINING NOISE
REDUCES TO AMBIENT NOISE
44 dBA
44.7 dBA pm
53.9 dBA am
44.3 dBA
53.7 dBA
50.5 dBA
IROQUOIS NATIONAL WILDLIFE REFUGE
IROQUOIS NATIONAL WILDLIFE REFUGE
54.8 dBA
55.3 dBA
48.0 dBA
72.1 dBA
N
Scale
1" = 1000'
CONTINENTAL PLACER INC.
II Winners Circle, Albany, New York 12205
AMBIENT NOISE/ VIBRATION MAP
Frontier Stone LLC
Frontier Stone Quarry
Town of Shelby Orleans Co., NY
Project Manager: JRH
Prepared By: JRH
Drafted By: CAP
Reviewed By:
Date
July 15 2010
Project No:
629-01-05-2531
Plate No.:
1

Figure 14.



NORTH

0' 400' 800'

APPROXIMATE SCALE IN FEET

Aerial Photograph obtained from NYS GIS Clearinghouse 2010

Figure Prepared by Terrestrial Environmental Specialists, Inc.

Figure 15.

Location of Breeding Bird Point Count Locations on Oak Orchard Ridge Road and Sour Springs Road

TES File: CON-3197\3197-Aerial-BreedingBirdPlots.cdr\7-23-12

APPENDIX A - Correspondence

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Iroquois National Wildlife Refuge
1101 Casey Road
Basom, NY 14013

October 16, 2008

Bernard Carr
Terrestrial Environmental Specialist, Inc.
23 County Route 6, Suite A
Phoenix, New York 13135

Dear Mr. Carr;

Enclosed please find information that you requested on Henslow's sparrows on Iroquois National Wildlife Refuge. We have searched our data for the past ten years and these are the records that we have. I believe the information is self explanatory, however, if you need any clarification please give me a call. Note that this is only information as it pertains to the refuge, it does not cover any area beyond our boundary. You will need to contact Dr. Chris Norment at SUNY Brockport to determine if he might have any additional information.

I will still try to get you references on noise disturbance, etc to birds, however, if you go onto "Google Scholar" I have found several references from published journals.

Give me a call if you need anything further. I can be reached at 585.948.5445, ext 202.

Sincerely,

Thomas P. Roster
Refuge Manager

Enclosure

Iroquois National Wildlife Refuge

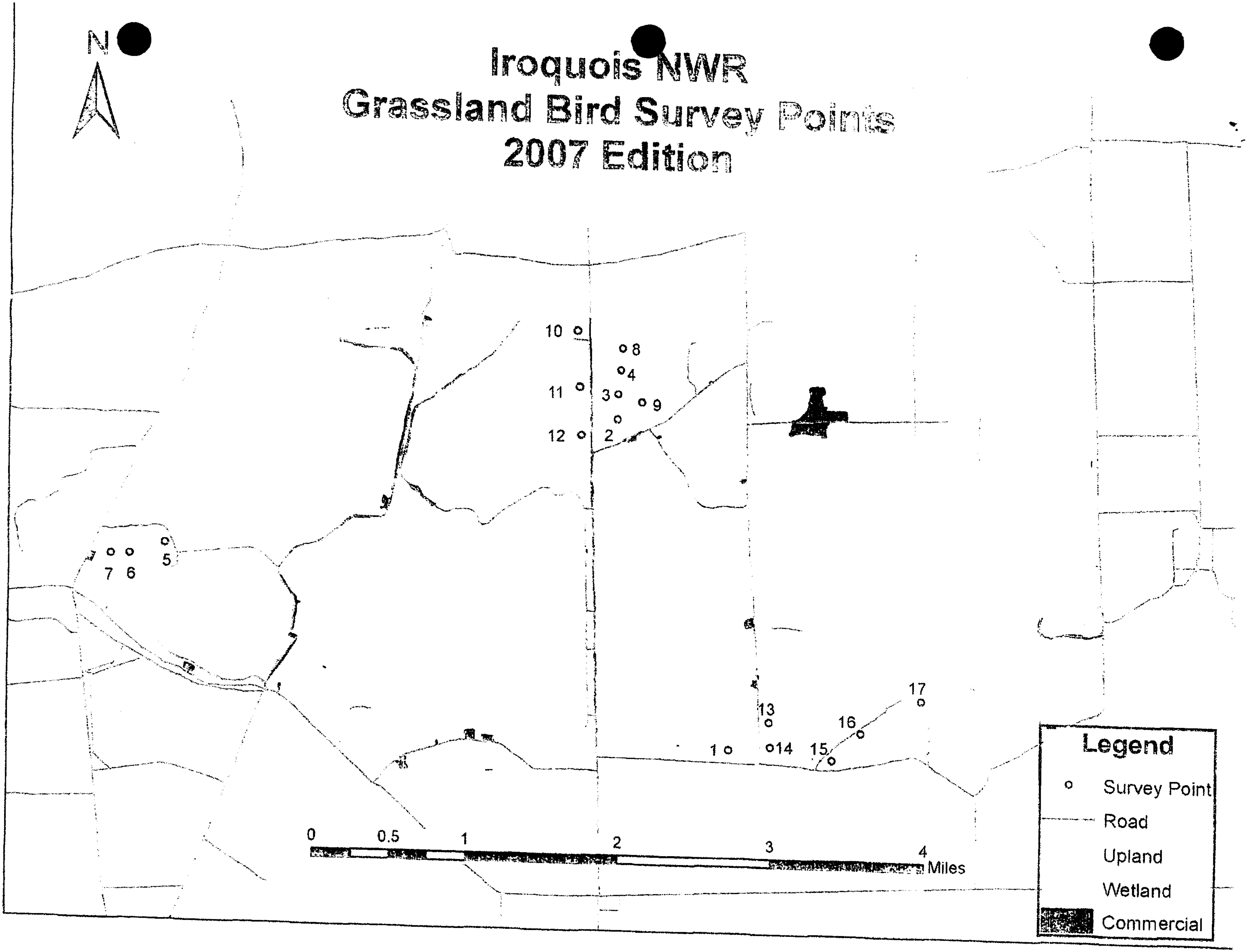
Henslow's Sparrows found during grassland surveys

Date	Point	Number Found
7/4/2001	GR6	2
7/4/2001	GR8	1
6/12/2002	GR6	1
7/7/2002	GR7	1

Henslow's Sparrows found during independent research; Dr. Norment, SUNY Brockport

Date	Location	Number Found
6/5/2001	I Plot	2
6/5/2001	Q Plot	1
7/17/2002	Q Plot	2

Iroquois NWR
Grassland Bird Survey Points
2007 Edition



Iroquios NWR
Grassland Survey Points (UTM Coordinates)

Datum = NAD 83

POINT	LONG	LAT
1	713694	4776429
2	712499	4779930
3	712507	4780199
4	712532	4780458
5	707742	4778494
6	707375	4778376
7	707172	4778374
8	712551	4780691
9	712761	4780120
10	712062	4780872
11	712094	4780273
12	712112	4779754
13	714119	4776734
14	714135	4776471
15	714780	4776347
16	715087	4776638
17	715715	4776999

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Iroquois National Wildlife Refuge
1101 Casey Road
Basom, NY 14013

June 26, 2008

David L. Bimber
Deputy Regional Permit Administrator
NYSDEC – Region 8
6274 East Avon-Lima Road
Avon, New York 14414 - 9519

RE: Draft Environmental Impact Statement
Frontier Stone, LLC, Shelby Quarry
DEC 8-3436-00033/00001 MLR 80823

Dear Mr. Bimber;

The Iroquois National Wildlife Refuge is in receipt of Draft Environmental Impact Statement (EIS) for a Mined Land Use Plan Mining Permit, Volumes 1, 2, and 3 for Frontier Stone, LLC Proposed Frontier Stone Quarry, Town of Shelby. You have requested that we review to determine whether or not the concerns of the Iroquois NWR have been addressed in the dEIS.

In an April 27, 2006 letter from you to John Hellert, Continental Placer, Inc., item #11 indicated that "The wildlife assessment needs to be significantly expanded and must clearly identify impacts to the nearby Iroquois National Wildlife Refuge. The assessment must include habitat impacts related to blasting, hydrology, noise, dust, and other potential environmental issues."

We feel the applicant has fallen short on meeting this requirement requested by the Department of Environmental Conservation. We believe this because the applicant states in several areas that there will be no impact on Iroquois NWR refuge resources, yet they offer no supporting evidence to back up these statements. They conducted no studies in the area of the proposed quarry to determine impacts to adjacent habitats and wildlife and it appears that they did not do a review of the literature regarding potential impacts of mining and truck traffic on wildlife and wildlife habitat. The potential impacts to wildlife and Iroquois NWR habitats as well as public recreation are either not mentioned or quickly dismissed with regard to blasting, other mine noise, dust, and road traffic.

There is little or no mention of the potential impacts of water, sediment, and pollutant discharge on Iroquois NWR wetlands and wildlife. Water discharge discussion focuses on storm events and doesn't discuss the constant pumping of groundwater seeping into the quarry and what pollutants may be contained in that pumped water.

The cumulative impacts section is only a few sentences and there is no mention of what effort they put into gathering the information. Cumulative impact assessments need to identify any past, present and reasonable foreseeable future impacts. It is common knowledge in the area that a proposed wind farm is sited just south of Iroquois NWR. At a minimum the 50+ wind turbines and the quarry will reduce to some degree the available feeding habitat for Canada geese and puddle ducks. Moreover, both projects will cause some disturbance to many species of wildlife. The wind farm project is only one of any number of potential impacts that may currently, or in the future, be affecting the area.

The applicant states that there will be no impact to Threatened and Endangered species, but any reduction in the quality of the adjacent Iroquois NWR habitats (i.e., disturbed areas from noise or hydrological change) will potentially make these areas unusable to some wildlife for the next 75 years. Lack of known use of the area by Threatened and Endangered species, or any other species, should not be an invitation to make currently usable habitat unusable for decades.

We see no evidence of correspondence between the applicant and Mr. Peter Nye, Endangered Species Biologist for NYSDEC, even though the USFWS suggested, in one of their correspondences with the applicant, that Mr. Nye be contacted.

Below are specific comments by volume.

Volume I:

- Page 2 states "All identified potential impacts resulting from the activities associated with the proposed mine will be satisfactorily mitigated". We feel that the potential impacts have not been properly researched and identified and that no mitigation for any wildlife impacts has been offered.

- Page 90 states that Figure 11 illustrates the drawdown contours as a result of the 72-hour pump test and that the "drawdown has created a cone of depression that theoretically extends several thousand feet". However, on page 102 when discussing the Dewatering Impacts on Wetlands, the applicant states that "quarry dewatering will not produce a significant cone of depression". We find these statements to be contradictory and confusing.

- Page 47 the data the applicant presents to support their claim that "...a typical stone processing facility is an insignificant contributor to ambient concentrations of particulate matter" is from a quarry that operated approximately 4 days/week, 4 hours/day. On page 7 the applicant states that this proposed facility will operate 12 hours/day for 5 days/week and 6 hours/day for 1 day/week, over 4 times the operating time of the study facility. Based on this information, we feel that the applicant's suggestion that the proposed facility will be an insignificant contributor of particulate matter is unfounded.

- Page 53 in the Threatened and Endangered Species section states "There is little forested habitat in the vicinity of the site. Surrounding land uses are largely agricultural or residential". The area of Iroquois NWR immediately adjacent to the site is a mix of forest, shrubland and wetland. There is clearly a significant amount of forested habitat adjacent to the sight and since the refuge is approximately 25% of the adjacent property line, wildlife habitat and public recreation should also be listed as a surrounding land use.

- Several areas of the document state that wildlife on Iroquois NWR will not be impacted by the quarrying operation; Page 106 – "The proposed site totally avoids the Iroquois National Wildlife Refuge and will have no impacts to the vegetation and wildlife there"; Page 163 – "… no significant impacts will occur to wildlife outside the project area"; Volume 3 Section 7A Page 4 – "Mining operations on the site are not expected to affect the wildlife use of adjacent habitats, including those on the Iroquois National Wildlife Refuge". However, the applicant offers no data to support these claims. Several studies have shown that blasting and traffic can have a significant affect on wildlife populations.

- Page 154 states that "If the project site was not farmed, the only alternative would be residential development…". This site could also be used as open space and in fact Iroquois NWR has asked the landowner if he would be willing to sell the land to be incorporated into the refuge. The landowner declined.

- Page 139 states that "Where serenity and quiet are especially important, an exterior design level of 57 dBA (L_{eq}) is recommended". Serenity and quiet are especially important to many refuge visitors. However, the blast guidelines at the top of page 169 that the applicant says it will conform to appear to be well above the 57 dBA level.

Volume 2:

- Page 9, Question 8 of the Environmental Assessment Form asks "Is the proposed action compatible with adjoining/surrounding land uses within ¼ mile?" The applicant selected the answer Yes. We feel that this proposed action could be in conflict with refuge uses and these conflicts have not been adequately addressed in the dEIS.

Volume 3:

Section 6 Vegetation and Wildlife Resources of the Shelby Quarry Site

- The contractor visited the site only two days in winter and two days in summer. We feel this level of survey may be inadequate to accurately determine use by Threatened and Endangered Species, particularly short-eared owls which have been previously seen in the area.

- Vegetation surveys were conducted on November 9, well after the growing season and likely too late in the year to detect all vegetation species.

- The number of species detected during wildlife surveys was relatively low. However, both northern harrier (state threatened) and horned lark (state special concerned) were seen using the project site during wildlife surveys. Therefore, the applicants statement on page 106 of volume 1 that "Field studies confirmed that wildlife of special concern such as the endangered short-eared owl are not found on site, nor was there suitable breeding habitat" is inaccurate. Not only were listed species found, but the level of survey effort was likely inadequate to confirm or deny if any particular species is regularly found at that site.

Section 7 Wetland Delineation Report

- Figure 8 Shows all ditches at the site as being delineated except for the ditch on the southwest side of the site which drains into Iroquois NWR. This is also the ditch that the applicant proposes to pump their stormwater. Why is this ditch not on this map?

- Section 14, 4.1 and 4.6 discusses the potential for pollutants from the aggregate stone, however, particulate matter is the only pollutant mentioned. What other pollutants might be extracted with the stone?

- The entire basis for the applicants Stormwater Pollution Prevention Plan seems to be what they refer to as "Good Housekeeping Practices". While these are all good ideas, there are no specifics on where, when, how these practices will be implemented.

- Additionally, the monitoring requirements for the discharge of water from the site are unacceptable being as that discharge flows onto Iroquois NWR. The applicant says that there will be "Quarterly Visual Monitoring" of the discharge ditch. This seems to amount to no more than a cursory look at the water in the ditch. No analysis is required. What's more, if the applicant does find visual evidence of contamination in the ditch, their response is simply to remedy the problem at the facility. No mention is made of contacting DEC or the downstream landowner (in this case, Iroquois NWR).

- If appears that the only requirement for a laboratory analyzed water sample is <u>one</u> sample per year. Considering the potential for contamination from the facility as well as the fragile nature of the downstream habitats, we feel that a much more comprehensive sampling program is appropriate. Multiple samples, collected and analyzed by independent contractors should be required.

- Additionally, we see no mention of the potential downstream impacts of the groundwater that will need to be constantly pumped from the facility. We feel that this water has the potential to negatively affect the habitats on Iroquois NWR through the introduction of chemical contaminants and suspended solids and by changing the pH of refuge waters.

These comments and information are being provided to you at your request to please review the dEIS. We asked the U.S. Geological Survey to review and comment on the hydrology section. I will forward those to you. Additionally, we will review the dEIS again when appropriate and open for review as part of the State Environmental Quality Review Act process. Please be informed, that additional comments may be provided by our agency under other legislation such as the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) or the Fish and Wildlife Coordination Act (48 Stat.401, as amended; 16 U.S.C.661 *et seq.*) these are comments from the refuge since we are an adjacent land manager.

Thanks for the opportunity to comment on the draft EIS and for keeping the refuge informed on the dEIS process. I welcome the opportunity to discuss these comments with you as needed. If you need anything further I can be reached at 585.948.5445 ext 202.

Sincerely,

Thomas P. Roster
Refuge Manager

C-AN-3177

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3817 Luker Road
Cortland, NY 13045

October 25, 2006

RECEIVED 10-27-06

Ms. Megan Caves
Environmental Technician
Terrestrial Environmental Specialists, Inc.
23 County Route 6, Suite A
Phoenix, NY 13135

Dear Ms. Caves:

This is in regards to your September 8, 2006, letter requesting information on the presence of Federally-listed endangered or threatened species in the vicinity of a 292-acre site located east of Spring Road in the Town of Shelby, Orleans County, New York.

The bald eagle (*Haliaeetus leucocephalus*) is a Federally- and State-listed threatened species observed nesting approximately 2 miles from the proposed project area at Iroquois National Wildlife Refuge. Please visit our website for more information on bald eagles.*

Except for the potential for the bald eagle and occasional transient individuals, no other Federally-listed or proposed endangered or threatened species under our jurisdiction are known to exist in the project impact area. In addition, no habitat in the project impact area is currently designated or proposed "critical habitat" in accordance with provisions of the Endangered Species Act (ESA) (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*). Should project plans change, or if additional information on listed or proposed species or critical habitat becomes available, this determination may be reconsidered. The most recent compilation of Federally-listed and proposed endangered and threatened species in New York is available for your information.* Until the proposed project is complete, we recommend that you check our website every 90 days from the date of this letter to ensure that listed species presence/absence information for the proposed project is current.*

The above comments pertaining to endangered species under our jurisdiction are provided as technical assistance pursuant to the ESA. This response does not preclude additional U.S. Fish and Wildlife Service (Service) comments under other legislation.

The bald eagle is listed as threatened by the State of New York. The information requested above should be coordinated with both this office and with the New York State Department of Environmental Conservation (NYSDEC). The NYSDEC contact for the Endangered Species Program is Mr. Peter Nye, Endangered Species Unit, 625 Broadway, Albany, NY 12233 (telephone: [518] 402-8859).

For additional information on fish and wildlife resources or State-listed species, we suggest you contact the appropriate NYSDEC regional office(s) and the New York Natural Heritage Program Information Services.*

Since wetlands, ponds, and/or streams may be present, you may want to utilize the National Wetlands Inventory (NWI) maps as an initial screening tool.* However, they may or may not be available for the project area. Please note that while the NWI maps are reasonably accurate, they should not be used in lieu of field surveys for determining the presence of wetlands or delineating wetland boundaries for Federal regulatory purposes. Online information on the NWI program and digital data can be downloaded from Wetlands Mapper, http://wetlands.fws.gov/mapper_tool.htm.

Work in certain waters of the United States, including wetlands and streams, may require a permit from the U.S. Army Corps of Engineers (Corps). If a permit is required, in reviewing the application pursuant to the Fish and Wildlife Coordination Act, the Service may concur, with or without recommending additional permit conditions, or recommend denial of the permit depending upon potential adverse impacts on fish and wildlife resources associated with project construction or implementation. The need for a Corps permit may be determined by contacting the appropriate Corps office(s).* In addition, should any part of the proposed project be authorized, funded, or carried out, in whole or in part, by a Federal agency, such as the Corps, further consultation between the Service and that Federal agency pursuant to the ESA may be necessary.

Thank you for your time. If you require additional information please contact Robyn Niver at (607) 753-9334. Future correspondence with us on this project should reference project file 61644.

Sincerely,

RECEIVED 10-27-06

David A. Stilwell
Field Supervisor

*Additional information referred to above may be found on our website at: http://www.fws.gov/northeast/nyfo/es/section7.htm

cc: NYSDEC, Avon, NY (Env. Permits)
NYSDEC, Albany, NY (Endangered Species; Attn: P. Nye)
NYSDEC, Albany, NY (Natural Heritage)
FWS, Iroquois NWR, Basom, NY

New York State Department of Environmental Conservation
Division of Fish, Wildlife & Marine Resources
New York Natural Heritage Program
625 Broadway, 5th floor, Albany, New York 12233-4757
Phone: (518) 402-8935 • **FAX:** (518) 402-8925
Website: www.dec.state.ny.

Denise M Sheehan
Commissioner

October 4, 2006

RECEIVED 10-10-06

Megan Caves
Terrestrial Environmental Specialists
23 County Rte 6, Suite A
Phoenix, NY 13135

Dear. Ms. Caves:

In response to your recent request, we have reviewed the New York Natural Heritage Program database with respect to an Environmental Assessment for a proposed 292-acre Commercial Development - Shelby Site, #3197, area as indicated on the map you provided, located in the Town of Shelby, Orleans County.

Enclosed is a report of rare or state-listed animals and plants, significant natural communities, and other significant habitats, which our databases indicate occur, or may occur, on your site or in the immediate vicinity of your site. The information contained in this report is considered sensitive and may not be released to the public without permission from the New York Natural Heritage Program.

The presence of rare species may result in this project requiring additional permits, permit conditions, or review. For further guidance, and for information regarding other permits that may be required under state law for regulated areas or activities (e.g., regulated wetlands), please contact the appropriate NYS DEC Regional Office, Division of Environmental Permits, at the enclosed address.

For most sites, comprehensive field surveys have not been conducted; the enclosed report only includes records from our databases. We cannot provide a definitive statement on presence or absence of all rare or state-listed species or significant natural communities. This information should not be substituted for on-site surveys that may be required for environmental impact assessment.

Our databases are continually growing as records are added and updated. If this proposed project is still under development one year from now, we recommend that you contact us again so that we may update this response with the most current information.

Sincerely,
Tara Seoane
Tara Seoane, Information Services
NY Natural Heritage Program

Enc.
cc: Reg. 8, Wildlife Mgr.
Peter Nye, Endangered Species Unit, Albany

4

NY Natural Heritage Program, NYS DEC, 625 Broadway, 5th Floor, Albany, NY
12233-4757
(518) 402-8935

...s report contains SENSITIVE information that may not be released to the public without permission from the NY Natural Heritage Program.
...fer to the User's Guide for explanations of codes, ranks and fields.
...ocation maps for certain species and communities may not be provided if 1) the species is vulnerable to disturbance, 2) the location and/or extent is not precisely known, and/or 3) the location and/or extent is too large to display.

Natural Heritage Report on Rare Species and Ecological Communities

4

RECEIVED 10-10-06

RDS

Asio flammeus (wintering area)

Short-eared Owl	NY Legal Status:	Endangered	NYS Rank:	S2; Imperiled	Office Use 11099
	Federal Listing:		Global Rank:	G5; Demonstrably secure	
	Last Report:	**	EO Rank:	**	ESU
	County:	Genesee, Orleans, Niagara			
	Town:	Shelby, Barre, Alabama, Royalton			
	Location:	Shelby Fields			
	Directions:	The birds were observed in fields north of the Iroquois National Wildlife Refuge, the Tonawanda Wildlife Management Area, and the Oak Orchard Wildlife Management Area, in the town of Shelby.			
	General Quality and Habitat:	**For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager or NYS DEC Endangered Species Unit at 518-402-8859.			

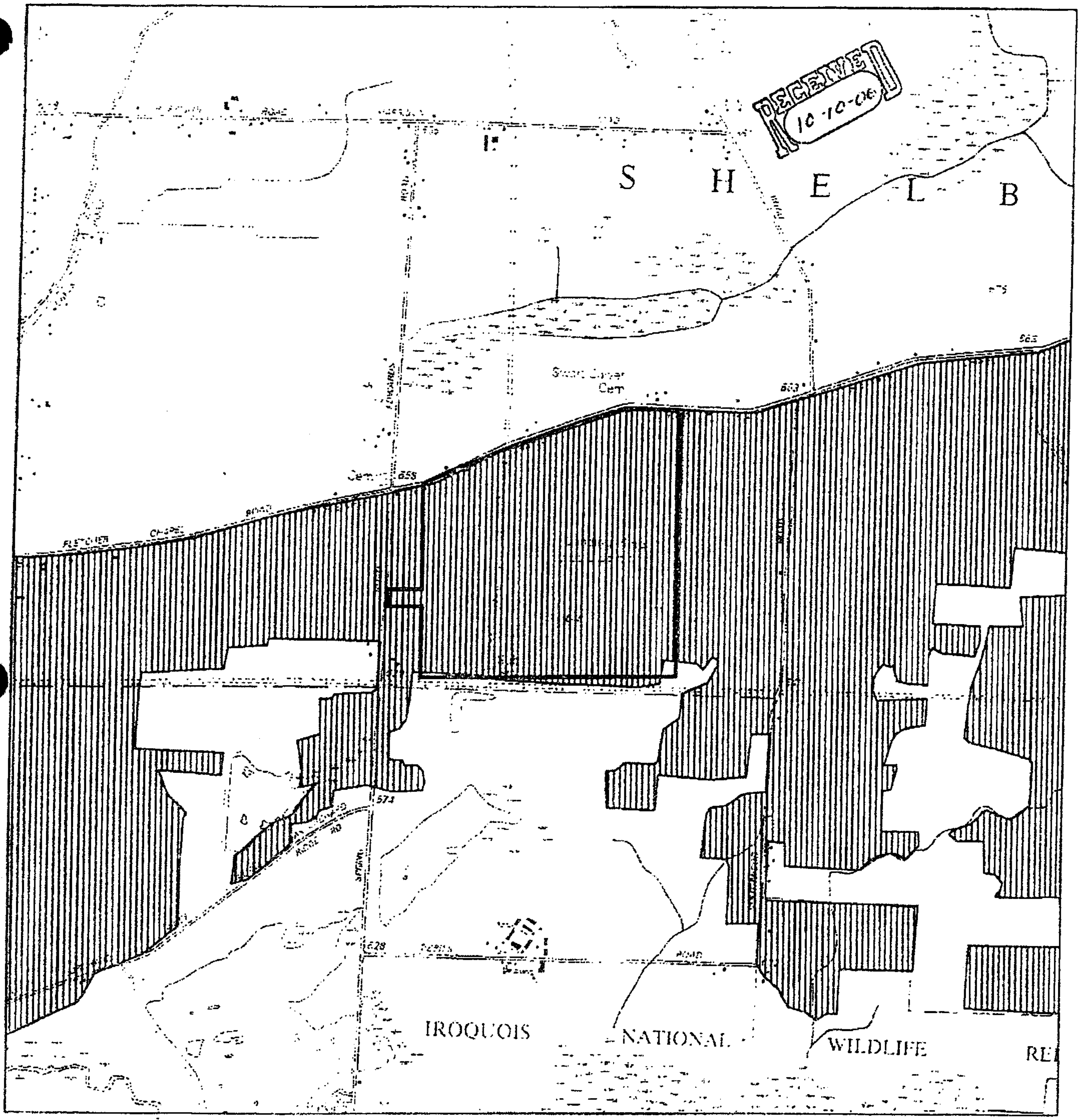
Asio flammeus (breeding area)

Short-eared Owl	NY Legal Status:	Endangered	NYS Rank:	S2; Imperiled	Office Use 11106
	Federal Listing:		Global Rank:	G5; Demonstrably secure	
	Last Report:	**	EO Rank:	**	ESU
	County:	Niagara, Orleans, Genesee			
	Town:	Shelby, Barre, Alabama, Royalton			
	Location:	Shelby Fields			
	Directions:	The birds were observed in fields north of the Iroquois National Wildlife Refuge, the Tonawanda Wildlife Management Area, and the Oak Orchard Wildlife Management Area, in the town of Shelby.			
	General Quality and Habitat:	**For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager or NYS DEC Endangered Species Unit at 518-402-8859.			

Records Processed

Natural Heritage Map of Rare Species and Ecological Communities

Prepared October 3, 2006 by NY Natural Heritage Program, NYS DEC, Albany, NY



Legend

Project Site

NY Natural Heritage Program Database Records*

Animal

1:24,000

0 0.15 0.3 0.6 0.9 Miles

*The locations that are displayed are considered sensitive and cannot be released to the public without permission.

USERS GUIDE TO NY NATURAL HERITAGE DATA

New York Natural Heritage Program, 625 Broadway, 5th Floor, Albany, NY 12233-4757 phone: (518) 402-8935

NATURAL HERITAGE PROGRAM: The NY Natural Heritage Program is a partnership between the NYS Department of Environmental Conservation (NYS DEC) and The Nature Conservancy. Our mission is to enable and enhance conservation of rare animals, rare plants, and significant communities. We accomplish this mission by combining thorough field inventories, scientific analyses, expert interpretation, and the most comprehensive database on New York's distinctive biodiversity to deliver the highest quality information for natural resource planning, protection, and management.

DATA SENSITIVITY: The data provided in the report are ecologically sensitive and should be treated in a sensitive manner. The report is for your in-house use and should not be released, distributed or incorporated in a public document without prior permission from the Natural Heritage Program.

EO RANK: A letter code for the quality of the occurrence of the rare species or significant natural community, based on population size or area, condition, and landscape context.

A-E = Extant: A=Excellent, B=Good, C=Fair, D=Poor, E=Extant but with insufficient data to assign a rank of A-D.
F = Failed to find. Did not locate species during a limited search, but habitat is still there and further field work is justified.
H = Historical. Historical occurrence without any recent field information.
X = Extirpated. Field/other data indicates element/habitat is destroyed and the element no longer exists at this location.
U = Extant/Historical status uncertain.
Blank = Not assigned.

LAST REPORT: The date that the rare species or significant natural community was last observed at this location, as documented in the Natural Heritage databases. The format is most often YYYY-MM-DD.

NY LEGAL STATUS – Animals:

Categories of Endangered and Threatened species are defined in New York State Environmental Conservation Law section 11-0535. Endangered, Threatened, and Special Concern species are listed in regulation 6NYCRR 182.5.

E - **Endangered Species**: any species which meet one of the following criteria:
- Any native species in imminent danger of extirpation or extinction in New York.
- Any species listed as endangered by the United States Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

T - **Threatened Species**: any species which meet one of the following criteria:
- Any native species likely to become an endangered species within the foreseeable future in NY.
- Any species listed as threatened by the U.S. Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

SC - **Special Concern Species**: those species which are not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York. Unlike the first two categories, species of special concern receive no additional legal protection under Environmental Conservation Law section 11-0535 (Endangered and Threatened Species).

P - **Protected Wildlife** (defined in Environmental Conservation Law section 11-0103): wild game, protected wild birds, and endangered species of wildlife.

U - **Unprotected** (defined in Environmental Conservation Law section 11-0103): the species may be taken at any time without limit; however a license to take may be required.

G - **Game** (defined in Environmental Conservation Law section 11-0103): any of a variety of big game or small game species as stated in the Environmental Conservation Law; many normally have an open season for at least part of the year, and are protected at other times.

NY LEGAL STATUS – Plants:

The following categories are defined in regulation 6NYCRR part 193.3 and apply to NYS Environmental Conservation Law section 9-1503.

E - **Endangered Species**: listed species are those with:
- 5 or fewer extant sites, or
- fewer than 1,000 individuals, or
- restricted to fewer than 4 U.S.G.S. 7 ½ minute topographical maps, or
- species listed as endangered by U.S. Dept. of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11.

T - **Threatened**: listed species are those with:
- 6 to fewer than 20 extant sites, or
- 1,000 to fewer than 3,000 individuals, or
- restricted to not less than 4 or more than 7 U.S.G.S. 7 and ½ minute topographical maps, or
- listed as threatened by U.S. Department of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11

R - **Rare**: listed species have

- 20 to 35 extant sites, or
- 3,000 to 5,000 individuals statewide

V - **Exploitably vulnerable**: listed species are likely to become threatened in the near future throughout all or a significant portion of their range within the state if causal factors continue unchecked.

U - **Unprotected**, no state status.

FEDERAL STATUS (PLANTS and ANIMALS): The categories of federal status are defined by the United States Department of the Interior as part of the 1974 Endangered Species Act (see Code of Federal Regulations 50 CFR 17). The species listed under this law are enumerated in the Federal Register vol. 50 no. 188, pp. 39526 - 39527. The codes below without parentheses are those used in the Federal Register. The codes below in parentheses are created by Heritage to deal with species which have different listings in different parts of their range, and/or different listings for different subspecies or varieties.

(blank) = No Federal Endangered Species Act status.
LE = Formally listed as endangered.
LT = Formally listed as threatened.
C = Candidate for listing.
LE,LT = Formally listed as endangered in part of its range, and as threatened in the other part; or, one or more subspecies or varieties is listed as endangered, and the others are listed as threatened.
LT,PDL = Populations of the species in New York are formally listed as threatened, and proposed for delisting.

GLOBAL AND STATE RANKS (animals, plants, ecological communities and others): Each element has a global and state rank as determined by the NY Natural Heritage Program. These ranks carry no legal weight. The global rank reflects the rarity of the element throughout the world and the state rank reflects the rarity within New York State. Infraspecific taxa are also assigned a taxon rank to reflect the infraspecific taxon's rank throughout the world. ? = Indicates a question exists about the rank. Range ranks, e.g. S1S2, indicate not enough information is available to distinguish between two ranks.

GLOBAL RANK:

G1 - **Critically imperiled** globally because of extreme rarity (5 or fewer occurrences), or very few remaining acres, or miles of stream) or especially vulnerable to extinction because of some factor of its biology.
G2 - **Imperiled** globally because of rarity (6 - 20 occurrences, or few remaining acres, or miles of stream) or very vulnerable to extinction throughout its range because of other factors.
G3 – **Vulnerable**: Either rare and local throughout its range (21 to 100 occurrences), or found locally (even abundantly at some of its locations) in a restricted range (e.g. a physiographic region), or vulnerable to extinction throughout its range because of other factors.
G4 - **Apparently secure** globally, though it may be quite rare in parts of its range, especially at the periphery.
G5 - **Demonstrably secure** globally, though it may be quite rare in parts of its range, especially at the periphery.
GH - Historically known, with the expectation that it might be rediscovered.
GX - Species believed to be extinct.

NYS RANK:

S1 - **Critically Imperiled**: Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making it especially vulnerable in New York State.
S2 - **Imperiled**. Typically 6 to 20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State
S3 - **Vulnerable**: Typically 21 to 100 occurrences, limited acreage, or miles of stream in New York State.
S4 - Apparently secure in New York State.
S5 - Demonstrably secure in New York State.
SH - Historically known from New York State, but not seen in the past 15 years.
SX - Apparently extirpated from New York State

SxB and SxN, where Sx is one of the codes above, are used for migratory animals, and refer to the rarity within New York State of the breeding (B)populations and the non-breeding populations (N), respectively, of the species.

TAXON (T) RANK. The T-ranks (T1 - T5) are defined the same way as the Global ranks (G1 - G5), but the T-rank refers only to the rarity of the subspecific taxon
T1 through T5 - See Global Rank definitions above
Q - Indicates a question exists whether or not the taxon is a good taxonomic entity

Terrestrial Environmental Specialists, inc.
23 COUNTY ROUTE 6, SUITE A, PHOENIX, NY 13135
(315) 695-7228 FAX: (315) 695-3277 E-MAIL: tesinc@alltel.net

September 8, 2006

Mr. David A. Stilwell, Field Supervisor
U.S. Fish and Wildlife Service
3817 Luker Road
Cortland, New York 13045

Re: Endangered and Threatened Species
Town of Shelby, Orleans County, NY
TES File No. 3197

Dear Mr. Stillwell:

Terrestrial Environmental Specialists, Inc. (TES) is collecting background environmental information for a site in the Town of Shelby. Orleans County, New York. The study area is approximately 292 acres in size. The site is currently an unused land parcel. The property is located just east of Spring Road and south of Fletcher Chapel Road. I have enclosed a copy of the NYSDOT topographic map (Knowlesville and Medina Quadrangles) with the approximate study area outlined. The coordinates for the approximate center of the study area are **43N 09' 32"** latitude, and **78W 21' 34"** longitude.

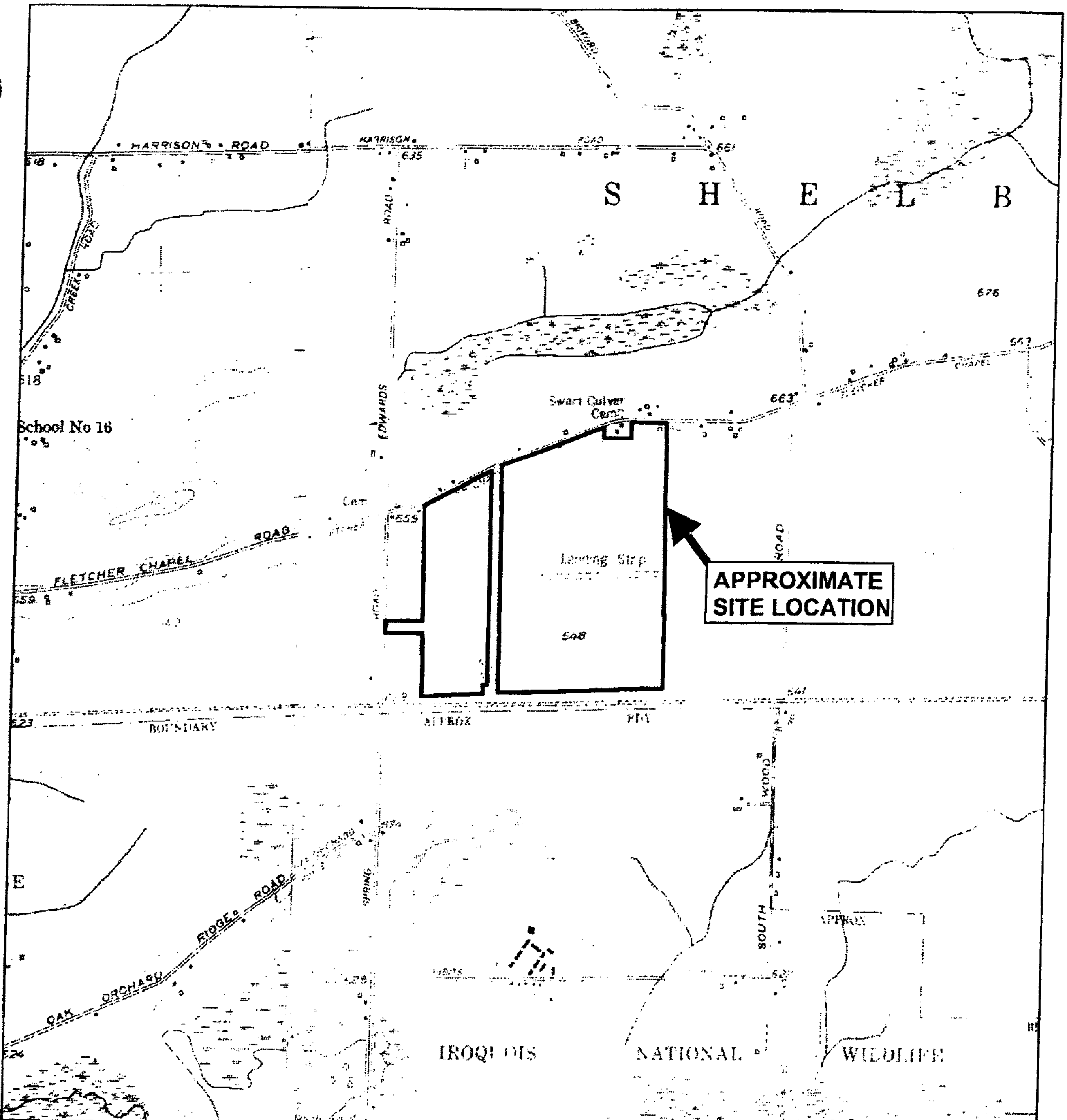
We looked on the USFWS website for potential endangered/threatened species possibly located near or in our project area and found one potential species occurring in Orleans County. Therefore, we are requesting that you respond in writing regarding the presence of any known occurrences of federal listed (or proposed for listing) endangered/threatened species located within the study area. TES is also contacting the NYS Department of Environmental Conservation Natural Heritage Program regarding the presence of state-listed endangered and threatened species and significant habitats. If you need additional information or have any questions, please contact me. Thank you.

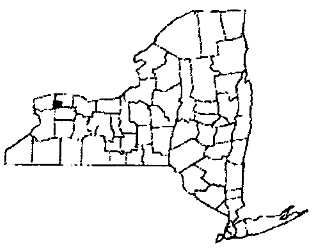
Sincerely,

TERRESTRIAL ENVIRONMENTAL SPECIALISTS, INC.

Megan Caves
Environmental Technician

mmc
Enclosures





QUADRANGLE LOCATION

0 1000' 2000'

SCALE 1" = 2000'

NORTH

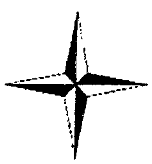


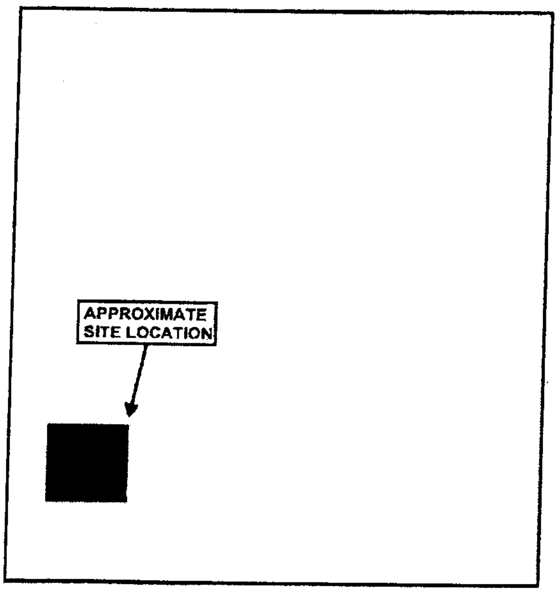
Figure 1. Site Location

NYS DOT Topographic Map

Knowlesville and Medina Quadrangles
1981 and 1976

Prepared by TERRESTRIAL ENVIRONMENTAL SPECIALISTS, Inc

TES file: CON-3197\3197fig1.dsf\2-9-07



Medina Quadrangle

Terrestrial
Environmental
Specialists, inc.
23 COUNTY ROUTE 6, SUITE A, PHOENIX, NY 13135
(315) 695-7228 FAX: (315) 695-3277 E-MAIL: tesinc@alltel.net

September 8, 2006

Ms. Jean Petrusiak
NYSDEC Wildlife Resources Center-Information Services
New York Natural Heritage Program
625 Broadway, 5th Floor
Albany, NY 12233-4757

Re: State-listed Endangered/Threatened Species and Significant Habitats
Town of Shelby, Orleans County, NY
TES File No. 3197

Dear Ms. Petrusiak:

Please find enclosed a Data Request Form for significant and state-listed endangered/threatened species for a site located in the Town of Shelby, Orleans County, New York. I have also included a NYSDOT topographic map (Knowlesville and Medina Quadrangles) with the approximate site location outlined. Please respond in writing regarding the presence of any known occurrences of state-listed (or proposed for listing) endangered/threatened species located within or near the site boundary.

If you need additional information or have any questions, please contact me. Thank you.

Sincerely,

TERRESTRIAL ENVIRONMENTAL SPECIALISTS, INC.

Megan Caves
Environmental Technician

mmc
Enclosures

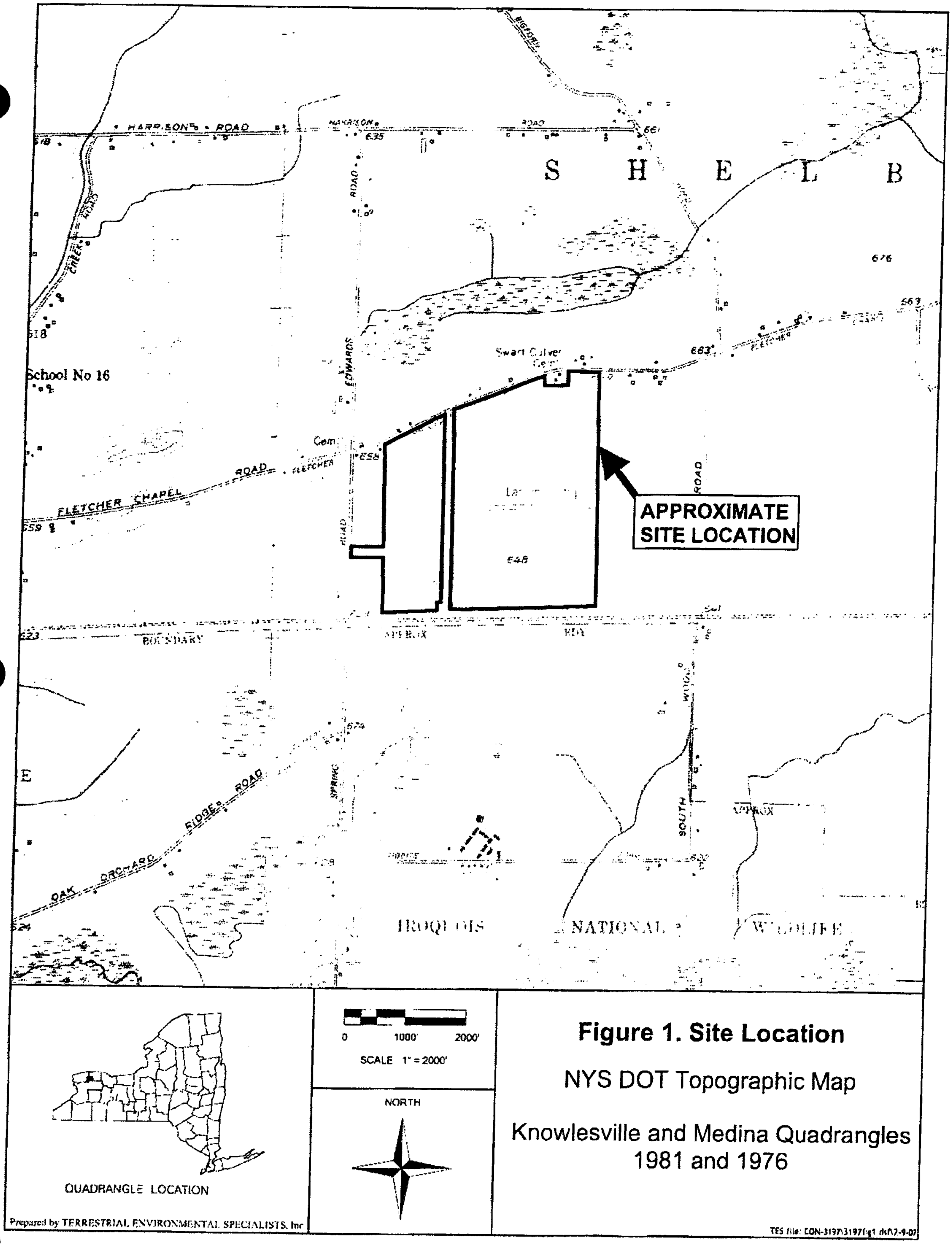


Figure 1. Site Location

NYS DOT Topographic Map

Knowlesville and Medina Quadrangles
1981 and 1976

Prepared by TERRESTRIAL ENVIRONMENTAL SPECIALISTS, Inc

TES file: CON-3197\3197fig1.dsf\2-9-07

New York State Department of Environmental Conservation
Division of Fish, Wildlife & Marine Resources
Wildlife Resources Center ~ New York Natural Heritage Program
700 Troy-Schenectady Road, Latham, New York 12110-2400
Phone: (518) 783-3932 FAX: (518) 783-3916

John P. Cahill
Commissioner

DATA REQUEST FORM: Please complete one form per project or activity.

Requestor: Megan Caves

Organization: Terrestrial Environmental Specialists, Inc.

Address: 23 County Route 6 Suite A

City: Phoenix State: NY Zip: 13135

Phone: (315) 695-7228 Fax: (315) 695-3277

Signature of Requestor: Megan Caves

1. Title of Project: Shelby site

2. Site Location:
Town(s): Shelby
County(ies): Orleans
USGS Topographic 7 ½ ' Quad Name(s): Knowlesville, Medina

3. Describe the current and past use of the site (e.g. commercial, agricultural land, forest, roadway, etc.):
past: agricultural
current: agricultural

4. Is this project subject to SEQR review? X Yes ___ No
If yes, who is the Lead Agency? Unknown
Address of Lead Agency:

5. Proposed Project or Activity. Please check one. If you want to give additional details, you may do so on the lines below or in an accompanying letter.

- ___ Residential Development
- ___ Municipal or County Planning/Zoning
- ___ Assessment for Conservation
- ___ Potential Land Purchase (to be used for:)
- ___ Other:
- ✓ Commercial Development
- ___ Utility (electric, water, sewer)
- ___ Cellular/Communications Tower
- ___ Industrial Development

(OVER)

7. **In which** of the following documents do you expect to use Heritage data:

____Environmental Impact Statement
____Environmental Assessment Form
____Conservation Plan
____Research Report
____Other: ______________________________

____Phase I Assessment
____State Wetlands Permit Application
_X_Management Plan
____Remedial Site Investigation

Please check below which data you are requesting:

_X_Standard Rare Species/Natural Communities Report

______Breeding Bird Atlas Data

Be sure to enclose a copy of a 7 ½ minute USGS topographical map with the project site clearly marked.

The "User's Guide to New York Natural Heritage Data" and "NYS Department of Environmental Conservation Division of Environmental Permits Regional Offices" will be sent with each request. Frequent requestors: Check here if you DO NOT need a copy of these: _X_

Heritage Office Use Only

Date Processed: __________ Processed By: ________

Export File Name(s): ______________________________

Quadname/Quadcode: __________________ Dot #s: ______________________________

BBA Blocks: ______________________ SigHab: ______________________

Report: ____IR1____IR2____IR1Area____IR2Area____IRHAZWASTE____Other__________

Data______ No Data______

Coastal Management Program? _____ (Check if yes.)

Copy:

__________Regional Wildlife Manager(s)
__________Regional Fisheries Manager(s)
__________Regional Bureau of Habitat(s)

____Peter Nye (Endangered Species Unit)
____Pat Festa (Bureau of Fisheries)
____Lead Agency

Other: ______________________________

APPENDIX B - Photographs

Field Photos taken 11/9/2006

Looking west across cornfield on site.

Looking east along open field (former landing strip).

Looking north along Scrub-Shrub Upland in southern portion of site.

Looking west at wetland ditch between cornfield and soybean field.

APPENDIX C - Herpetological Atlas Data

Appendix Table C-1.

Amphibians and Reptiles in the Vicinity of the Proposed Shelby Quarry Site

SALAMANDERS			
Standard English Name[a]	**Scientific Name**	**ATLAS[b]**	**STATUS[c]**
Jefferson Salamander	*Ambystoma jeffersonianum*	ADJ	
Red-spotted Newt	*Notophthalmus v. viridescens*	IN	
Blue-spotted Salamander	*Ambystoma laterale*	ADJ	
Eastern Red-backed Salamander	*Plethodon cinereus*	IN	
Northern Slimy Salamander	*Plethodon glutinosus*	ADJ	

TOADS AND FROGS			
Standard English Name	**Scientific Name**	**ATLAS**	**STATUS**
Eastern American Toad	*Bufo a. americanus*	IN	
Gray Treefrog	*Hyla versicolor*	IN	
Northern Spring Peeper	*Pseudacris c. crucifer*	IN	
Western Chorus Frog	*Pseudacris triseriata*	ADJ	
American Bullfrog	*Rana catesbeiana*	IN	
Northern Green Frog	*Rana clamitans melanota*	IN	
Wood Frog	*Rana sylvatica*	IN	
Northern Leopard Frog	*Rana pipiens*	IN	
Pickerel Frog	*Rana palustris*	ADJ	

TURTLES			
Standard English Name	**Scientific Name**	**ATLAS**	**STATUS**
Eastern Snapping Turtle	*Chelydra s. serpentina*	IN	
Spotted Turtle	*Clemmys guttata*	ADJ	SPEC
Wood Turtle	*Glyptemys insculpta*	ADJ	
Eastern Painted Turtle	*Chrysemys p. picta*	IN	

SNAKES			
Standard English Name	**Scientific Name**	**ATLAS**	**STATUS**
Northern Watersnake	*Nerodia s. sipedon*	IN	
Northern Brownsnake	*Storeria d. dekayi*	ADJ	
Common Gartersnake	*Thamnophis sirtalis*	IN	
Eastern Milksnake	*Lampropeltis t. triangulum*	IN	
Smooth Greensnake	*Liochiorophis vernalis*	ADJ	
Black Ratsnake	*Elaphe o. obsoleta*	IN	

(a) Common and scientific names according to Crother (2000), and updates through 2003.
(b) IN = Recorded in Knowlesville quadrangle, ADJ = Recorded in at least one adjacent quadrangle during the Herpetological Atlas Project. Based on interim distribution maps (1990-1998).
(c) SPEC = state special concern.

APPENDIX D - Breeding Bird Atlas, Christmas Count Bird Data, and Buffalo Ornithological Society Data

Appendix Table D-1.

Breeding Birds in Atlas Block 2278C in the Town of Shelby, Orleans County, New York

BIRDS **English Name**[(a)]	**Scientific Name**	**1980-1985 ATLAS**[(b)]	**2000-2005 ATLAS**[(b)]
Pied-billed Grebe	*Podilymbus podiceps*	CON	-
American Bittern	*Botaurus lentiginosus*	PRO	PRO
Least Bittern	*Ixobrychus exilis*	PRO	POS
Great Blue Heron	*Ardea herodias*	POS	POS
Great Egret	*Ardea alba*	-	PRO
Turkey Vulture	*Cathartes aura*	CON	CON
Canada Goose	*Branta canadensis*	CON	CON
Wood Duck	*Aix sponsa*	CON	CON
Gadwall	*Anas strepera*	CON	PRO
American Wigeon	*Anas americana*	PRO	PRO
Mallard	*Anas platyrhynchos*	CON	CON
Blue-winged Teal	*Anas discors*	CON	-
Green-winged Teal	*Anas crecca*	POS	PRO
Hooded Merganser	*Lophodytes cucullatus*	CON	CON
Osprey	*Pandion haliaetus*	-	CON
Northern Harrier	*Circus cyaneus*	POS	PRO
Cooper's Hawk	*Accipiter cooperii*	CON	PRO
Red-shouldered Hawk	*Buteo lineatus*	CON	-
Red-tailed Hawk	*Buteo jamaicensis*	CON	CON
American Kestrel	*Falco sparverius*	CON	PRO
Ring-necked Pheasant	*Phasianus colchicus*	CON	CON
Ruffed Grouse	*Bonasa umbellus*	CON	-
Wild Turkey	*Meleagris gallopavo*	CON	CON
Virginia Rail	*Rallus limicola*	CON	PRO
Sora	*Porzana carolina*	PRO	POS
Common Moorhen	*Gallinula chloropus*	CON	PRO
American Coot	*Fulica americana*	POS	-
Killdeer	*Charadrius vociferus*	CON	CON
Spotted Sandpiper	*Actitis macularia*	-	CON
Upland Sandpiper	*Bartramia longicauda*	-	CON
Wilson's Snipe	*Gallinago delicata*	POS	POS
American Woodcock	*Scolopax minor*	CON	CON
Rock Pigeon	*Columba livia*	PRO	PRO
Mourning Dove	*Zenaida macroura*	CON	CON
Black-billed Cuckoo	*Coccyzus erythropthalmus*	PRO	POS
Yellow-billed Cuckoo	*Coccyzus americanus*	PRO	PRO
Eastern Screech-Owl	*Megascops asio*	CON	PRO

(a) English and scientific names according to AOU (1998) and supplements through 2006.
(b) Recorded in Block 2278C in 1980-1985 and 2000-2005. - = Not Recorded, CON = Confirmed Breeder, PRO = Probable Breeder, POS = Possible Breeder.

Appendix Table D-1. (cont.)

BIRDS English Name[a]	Scientific Name	1980-1985 ATLAS[b]	2000-2005 ATLAS[b]
Great Horned Owl	*Bubo virginianus*	CON	PRO
Northern Saw-whet Owl	*Aegolius acadicus*	-	POS
Common Nighthawk	*Chordeiles minor*	-	PRO
Barred Owl	*Strix varia*	CON	-
Ruby-throated Hummingbird	*Archilochus colubris*	PRO	POS
Belted Kingfisher	*Ceryle alcyon*	CON	CON
Red-headed Woodpecker	*Melanerpes erythrocephalus*	PRO	PRO
Red-bellied Woodpecker	*Melanerpes carolinus*	CON	POS
Downy Woodpecker	*Picoides pubescens*	PRO	CON
Hairy Woodpecker	*Picoides villosus*	PRO	POS
Northern Flicker	*Colaptes auratus*	CON	PRO
Pileated Woodpecker	*Dryocopus pileatus*	POS	CON
Eastern Wood-pewee	*Contopus virens*	CON	PRO
Alder Flycatcher	*Empidonax alnorum*	CON	PRO
Willow Flycatcher	*Empidonax traillii*	PRO	PRO
Least Flycatcher	*Empidonax minimus*	PRO	POS
Eastern Phoebe	*Sayornis phoebe*	CON	CON
Great Crested Flycatcher	*Myiarchus crinitus*	CON	CON
Eastern Kingbird	*Tyrannus tyrannus*	CON	CON
White-eyed Vireo	*Vireo griseus*	-	PRO
Yellow-throated Vireo	*Vireo flavifrons*	CON	POS
Warbling Vireo	*Vireo gilvus*	CON	PRO
Red-eyed Vireo	*Vireo olivaceus*	CON	CON
Blue Jay	*Cyanocitta cristata*	CON	PRO
American Crow	*Corvus brachyrhynchos*	CON	CON
Horned Lark	*Eremophila alpestris*	PRO	PRO
Purple Martin	*Progne subis*	CON	CON
Tree Swallow	*Tachycineta bicolor*	CON	CON
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	-	PRO
Bank Swallow	*Riparia riparia*	-	POS
Barn Swallow	*Hirundo rustica*	CON	CON
Black-capped Chickadee	*Poecile atricapillus*	CON	CON
Tufted Titmouse	*Baeolophus bicolor*	-	POS
White-breasted Nuthatch	*Sitta carolinensis*	CON	CON
Brown Creeper	*Certhia americana*	CON	PRO
Carolina Wren	*Thryothorus ludovicianus*	PRO	-
House Wren	*Troglodytes aedon*	CON	PRO
Winter Wren	*Troglodytes troglodytes*	PRO	-
Sedge Wren	*Cistothorus platensis*	PRO	PRO
Marsh Wren	*Cistothorus palustris*	CON	PRO
Golden-crowned Kinglet	*Regulus satrapa*	-	PRO
Blue-gray Gnatcatcher	*Polioptila caerulea*	CON	PRO

Appendix Table D-1. (cont.)

BIRDS English Name[a]	Scientific Name	1980-1985 ATLAS[b]	2000-2005 ATLAS[b]
Eastern Bluebird	*Sialia sialis*	POS	CON
Veery	*Catharus fuscescens*	CON	PRO
Wood Thrush	*Hylocichla mustelina*	CON	PRO
American Robin	*Turdus migratorius*	CON	CON
Gray Catbird	*Dumetella carolinensis*	CON	CON
Northern Mockingbird	*Mimus polyglottos*	-	POS
Brown Thrasher	*Toxostoma rufum*	PRO	-
European Starling	*Sturnus vulgaris*	CON	CON
Cedar Waxwing	*Bombycilla cedrorum*	CON	PRO
Blue-winged Warbler	*Vermivora pinus*	PRO	PRO
Golden-winged Warbler	*Vermivora chrysoptera*	PRO	-
Brewster's Warbler	*Vermivora pinus x v. chrysoptera*	-	POS
Yellow Warbler	*Dendroica petechia*	CON	CON
Cerulean Warbler	*Dendroica cerulea*	CON	PRO
American Redstart	*Setophaga ruticilla*	CON	CON
Prothonotary Warbler	*Protonotaria citrea*	CON	POS
Ovenbird	*Seiurus aurocapilla*	PRO	-
Northern Waterthrush	*Seiurus noveboracensis*	PRO	-
Mourning Warbler	*Oporornis philadelphia*	CON	POS
Common Yellowthroat	*Geothlypis trichas*	CON	CON
Yellow-breasted Chat	*Icteria virens*	-	PRO
Scarlet Tanager	*Piranga olivacea*	CON	-
Eastern Towhee	*Pipilo erythrophthalmus*	PRO	-
Chipping Sparrow	*Spizella passerina*	CON	CON
Field Sparrow	*Spizella pusilla*	CON	PRO
Vesper Sparrow	*Pooecetes gramineus*	POS	-
Savannah Sparrow	*Passerculus sandwichensis*	PRO	POS
Henslow's Sparrow	*Ammodramus henslowii*	PRO	-
Song Sparrow	*Melospiza melodia*	CON	CON
Swamp Sparrow	*Melospiza georgiana*	PRO	PRO
Northern Cardinal	*Cardinalis cardinalis*	CON	CON
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	CON	PRO
Indigo Bunting	*Passerina cyanea*	CON	PRO
Bobolink	*Dolichonyx oryzivorus*	CON	PRO
Red-winged Blackbird	*Agelaius phoeniceus*	CON	CON
Eastern Meadowlark	*Sturnella magna*	CON	POS
Common Grackle	*Quiscalus quiscula*	CON	CON
Brown-headed Cowbird	*Molothrus ater*	CON	PRO
Baltimore Oriole	*Icterus galbula*	CON	CON
Purple Finch	*Carpodacus purpureus*	-	POS
American Goldfinch	*Carduelis tristis*	CON	PRO
ouse Sparrow	*Passer domesticus*	CON	POS

Table D-2.

Early Winter Birds in the Vicinity of the Proposed Shelby Quarry Christmas Bird Count Oak Orchard[(a)]

Species	2003	2004	2005	2006	2007	2008	2009
Snow Goose *Chen caerulescens*				1			
Cackling Goose *Branta hutchinsii*				1		1	1
Ross's Goose *Chen rossi*	1						
Canada Goose *Branta canadensis*	6440	968	671	28000	439	1026	3396
Tundra Swan *Cygnus columbianus*	13			9			
Wood Duck *Aix sponsa*		1		2			
Gadwall *Anas strepera*				32			
American Wigeon *Anas americana*	1						26
American Black Duck *Anas rubripes*	82	3	1	79	75	115	158
Mallard *Anas platyrhynchos*	1108	30	308	1464	188	454	1427
Northern Pintail *Anas acuta*	1			18		65	1
Green-winged Teal *Anas crecca*				2			
Ring-necked Duck *Aythya collaris*				11			
Hooded Merganser *Lophodytes cucullatus*				3			
Common Merganser *Mergus merganser*				5		50	
Ring-necked Pheasant *Phasianus colchicus*	4	2	1	1		13	5
Ruffed Grouse *Bonasa umbellus*	2				3		1
Wild Turkey *Mealagris gallopavo*		87			81	39	
Great Blue Heron (Blue form) *Ardea herodias*	20	3	2	10	3	5	7

[(a)] National Audubon Society (2002). The Christmas Bird Count Historical Results [On Available http://www.audubon.org/bird/cbc (Access date: 2-7-07)].

Table D-2. (cont.)

Species	2003	2004	2005	2006	2007	2008	2009
Bald Eagle *Haliaeetus leucocephalus*	5	2	2	7	3	2	3
Northern Harrier *Circus cyaneus*	21	2	5	2	2	4	4
Sharp-shinned Hawk *Accipiter striatus*	2	5	3	4	5	3	4
Cooper's Hawk *Accipiter cooperii*	2	4	9	9	4	2	4
Red-shouldered Hawk *Buteo lineatus*							1
Red-tailed Hawk *Buteo jamaicensis*	91	67	79	58	80	47	67
Rough-legged Hawk *Buteo lagopus*	10	3	1	3	2		
American Kestrel *Falco sparverius*	9	8	17	12	14	6	10
American Coot *Fulica americana*	1			7			
Ring-billed Gull *Larus delawarensis*	618	71	31	62	239	29	133
Herring Gull *Larus argentatus*	2	11	4	16	2	23	21
Great Black-backed Gull *Larus marinus*			2		8	10	6
Rock Pigeon *Columba livia*	378	315	538	283	451	257	386
Mourning Dove *Zenaida macroura*	350	544	955	723	606	334	515
Eastern Screech-Owl *Megascops asio*	11	17	9	5	13	3	25
Great Horned Owl *Bubo virginianus*	12	3	1	1	8		16
Snowy Owl *Bubo scandiacus*							
Barred Owl *Strix varia*							4
Long-eared Owl *Asio otus*							1
Short-eared Owl *Asio flammeus*	8	6			3		2
Northern Saw-whet Owl *Aegolius acadicus*	2						1
Belted Kingfisher *Ceryle alcyon*	3		1	4		1	2
ed-bellied Woodpecker *Melanerpes carolinus*	68	56	72	28	53	49	60

Table D-2. (cont.)

Species	2003	2004	2005	2006	2007	2008	2009
Yellow-bellied Sapsucker *Sphyrapicus varius*			1				
Downy Woodpecker *Picoides pubescens*	103	140	153	83	114	75	126
Hairy Woodpecker *Picoides villosus*	43	23	22	40	25	15	38
Northern (Yellow-shafted) Flicker *Colaptes auratus*	46	8	36	9	25	43	15
Pileated Woodpecker *Dryocopus pileatus*	6	3	13	8	7	6	10
Northern Shrike *Lanius excubitor*	6	2	6	1	8	6	2
Blue Jay *Cyanocitta cristata*	144	182	215	130	209	180	139
American Crow *Corvus brachyrhynchos*	551	386	694	424	673	425	621
Horned Lark *Eremophila alpestris*	39	480	27	139	13	60	32
Black-capped Chickadee *Poecile atricapillus*	427	459	475	352	406	255	400
Tufted Titmouse *Baeolophus bicolor*	15	18	8	13	30	16	32
Red-breasted Nuthatch *Sitta canadensis*	2	7	7	5	10	6	8
White-breasted Nuthatch *Sitta carolinensis*	76	67	118	68	62	51	81
Brown Creeper *Certhia americana*	19	9	8	6	10	14	18
Carolina Wren *Thryothorus ludovicianus*	1	1		1		1	2
Winter Wren *Troglodytes troglodytes*		1					
Golden-crowned Kinglet *Regulus satrapa*	1	13	8	5	5	1	17
Eastern Bluebird *Sialia sialis*	26	8	9	25	33	22	10
Hermit Thrush *Catharus guttatus*			1				
American Robin *Turdus migratorius*	137	4	152	255	47	121	6
Gray Catbird *Dumetella carolinensis*						3	
Northern Mockingbird *Mimus polyglottos*			4				2
European Starling *Sturnus vulgaris*	2653	1296	7500	2358	3566	5489	2509

Table D-2. (cont.)

Species	2003	2004	2005	2006	2007	2008	2009
Cedar Waxwing *Bombycilla cedrorum*	16	39	145	20		103	28
Yellow-rumped Warbler *Dendroica coronata*				2	7	6	
Eastern Towhee *Pipilo erythrophthalmus*			1				
American Tree Sparrow *Spizella arborea*	421	922	530	189	740	193	351
Field Sparrow *Spizella pusilla*	2			1			
Savannah Sparrow *Passerculus sandwichensis*		1					
Song Sparrow *Melospiza melodia*	14	19	23	2	7	11	7
Swamp Sparrow *Melospiza georgiana*	22	17	6		4	11	8
White-throated Sparrow *Zonotrichia albicollis*	29	8	73	14	38	19	7
White-crowned Sparrow *Zonotrichia leucophrys*		3	1		5	1	
Dark-eyed (Slate-colored) Junco *Junco hyemalis*	212	312	412	143	715	247	159
Lapland Longspur *Calcarius lapponicus*		8			1	3	
Snow Bunting *Plectrophenax nivalis*	165	972	2082	60	531	25	99
Northern Cardinal *Cardinalis cardinalis*	87	192	157	146	209	141	93
Red-winged Blackbird *Agelaius phoeniceus*	123	1	3		21	2	157
Yellow-headed Blackbird *Xanthocephalus xanthocephalus*					1		
Rusty Blackbird *Euphagus carolinus*						2	2
Brewer's Blackbird *Euphagus cyanocephalus*							1
Common Grackle *Quiscalus quiscula*						57	1
Brown-headed Cowbird *Molothrus ater*	168		54		3	4	29
Pine Grosbeak *Pinicola enucleator*					11		
Purple Finch *Carpodacus purpureus*	8	3	3			2	
House Finch *Carpodacus maxicanus*	153	104	114	112	285	110	55

Table D-2. (cont.)

Species	2003	2004	2005	2006	2007	2008	2009
White-winged Crossbill *Loxia leucoptera*						24	
Common Redpoll *Carduelis flammea*	4		12		21		2
Pine Siskin *Carduelis pinus*		2	1	1		4	
American Goldfinch *Carduelis tristis*	265	328	376	350	463	453	262
House Sparrow *Passer domesticus*	848	908	917	565	1577	536	669

Table D-3.[a]

Short-Eared Owl Records in the Vicinity of Proposed Shelby Quarry

Year	Month	Day	Birds Observed	Location
1968	January	21	1	Iroquois NWR
1969	March	29	2	Iroquois NWR
1970	November	14	1	Iroquois NWR
1970	December	15	1	Iroquois NWR
1971	November	27	1	Shelby Township
1971	November	30	3	Shelby Township
1974	January	19	1	Iroquois NWR
1974	October	29	1	Iroquois NWR
1975	April	3	2	Iroquois NWR
1982	November	15	2	Iroquois NWR
1987	February	14	2	Iroquois NWR
1987	December	7	9	Shelby Township
1987	December	14	11	Shelby Township
1988	January	10	3	Shelby Township
1988	February	10	8	Shelby Township
1988	March	1	11	Shelby Township
1988	March	11	10	Shelby Township
1988	June	24	1	Shelby Township
1988	July	4	4	Shelby Township
1989	March	19	1	Shelby Township
1990	January	27	16	Iroquois NWR
1990	February	13	3	Iroquois NWR
1998	January	31	4	Shelby Township
1998	December	13	4	Shelby Township

[a] Buffalo Ornithological Society Noteworthy Records Database for Short-eared Owl derived from submission to the Prothonotary.

Table D-3 (cont.)

Year	Month	Day	Birds Observed	Location
1999	March	12	5	Shelby Township
1999	March	28	9	Shelby Township
1999	November	11	1	Shelby Township
2000	January	30	1	Shelby Township
2000	February	19	1	Shelby Township
2000	December	10	2	Shelby Township
2002	November	24	3	Shelby Township
2003	March	1	1	Iroquois NWR
2003	March	23	1	Iroquois NWR
2003	December	12	8	Shelby Township
2004	January	11	2	Shelby Township
2004	December	11	3	Shelby Township
2005	April	3	3	Shelby Township
2005	April	17	4	Shelby Township
2006	April	2	1	Shelby Township
2007	January	14	4	Shelby Township
2008	March	2	2	Shelby Township
2008	December	16	3	Shelby Township
2009	December	27	2	Shelby Township
2010	November	22	3	Shelby Township
2010	November	25	2	Shelby Township
2010	December	27	2	Shelby Township