




















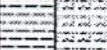





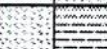

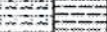




Hydrodynamics Sample/Geology Log								Page 1 of 12				
Borehole name/ID: Mortimer #1			Location: 41° 40' 50.58" N, 93° 59' 58.49" W			Logged by: David Merritt			Date 07/17/10			
Key: Drilling Action E: Even, Smooth C: Crunchy I: Intermittently Rough r: Slightly Rough R: Moderately Rough R: Very Rough				Calcium Content N: Non-calcareous S: Slightly Calcareous M: Moderately Calcareous V: Very Calcareous				Tuff  Plutonic  Lava  Metamorphic  Limestone  Dolomite  Gypsum  Conglomerate  Siltstone  Coal 			Driller: Grosch Drilling Company	
Run #	Depth Top	Depth Bot	Drill time (min)	Sample Type	Drilling Action	RQD	Calc. Content	Log Notes	Date	Graphic		
	33	40		Cuttings	E	n/a	V	12 1/4" button bit: Clay, soft, lt. yellowish brown to grayish brown, minor fine to coarse sand.	07/16/10			
	40	50		Cuttings	E	n/a	V	As above, but stiffness increased, with minor gravel to 15mm				
	50	60		Cuttings	E	n/a	V	Sand fraction increasing to ~30%, moderately stiff.				
	60	70		Cuttings	E	n/a	M	Sandy clay, moderately stiff, grayish brown to very dark gray, sand fraction medium to coarse, angular, comprised of quartz and rock fragments.				
	70	80		Cuttings	E	n/a	M	As above.				
	80	90		Cuttings	E	n/a	S	As above.				
	90	100		Cuttings	E	n/a	S	Clay, soft, very dark gray, minor silt.				
	100	110		Cuttings	E	n/a	N	Pennsylvanian: Clay, soft, weak red, minor to rare silt or fine sand.				
	110	120		Cuttings	E	n/a	N	Clay, soft, gray to reddish gray, minor sand, rare carbonaceous shale.				
	120	128		Cuttings	E	n/a	S	As above, with rare reddish brown shale.				
	128	145		Cuttings	E	n/a	S	Sand, very fine, moderately well sorted, weakly indurated, subangular to angular, gray.				
	145	150		Cuttings	E	n/a	S	Clay, soft, weak red, sandy.				
	150	160		Cuttings	E	n/a	S	Sand, medium to very fine, poorly sorted, weakly indurated, subangular to angular, gray.				
	160	175		Cuttings	E	n/a	S	As above, but average grain size increased, displaying upward fining sequence. Rare pyrite particle aggregates.				
	175	182		Cuttings	E	n/a	N	Carbonaceous shale/siltstone, friable, weakly indurated, black to dark gray, rare orange-brown coating on some parting surfaces, rare crystalline pyrite.				
	182	190		Cuttings	E	n/a	S	Sand, medium to very fine, poorly sorted, weakly indurated, subangular to angular, gray.				
	190	200		Cuttings	E	n/a	S	Shale/clay interbedded with siltstone or very fine sandstone. Clay is soft, gray. Siltstone is weakly indurated, very dark gray, platy.				
	200	210		Cuttings	E	n/a	N	Sandstone, very fine, very dark gray, weakly indurated, with minor shale, gray to black. Rare pyrite grains.				
	210	220		Cuttings	E	n/a	N	Shale/siltstone, weakly indurated, platy, black to very dark gray, with minor sand, very fine, weakly indurated, gray, and soft gray clay.				
	220	230		Cuttings	E	n/a	N	As above, but slight increase in sand fraction				
	230	240		Cuttings	E	n/a	N	Sand, interbedded light and dark fragments, very fine, very dark gray to gray, weakly indurated to unconsolidated, with minor shale, very dark gray to black.				
	240	250		Cuttings	E	n/a	N	Siltstone and shale, dark gray to very dark gray, weakly indurated, platy. Shale is very stiff clay, soapy feel.	07/16/10			



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Hydrodynamics Sample/Geology Log – Continuation

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Borehole name/ID

Mortimer #1

Logged by: D. Merritt

Date

07/20/10

Run #	Depth Top	Depth Bot	Drill time (min)	Sample Type	Drilling Action	RQD	Calc. Content	Log Notes	Date	Graphic
	250	260		Cuttings	E	n/a	S	Sandstone, fine to very fine, gray to dark gray, moderately indurated, thin-bedded, with shale, dark gray, weakly indurated. Rare pyrite. Sand reacts weakly to HCl.	07/16/10	
	260	270		Cuttings	E	n/a	N	Siltstone and shale, gray to dark gray, weakly to moderately indurated, platy, with rare chert pebbles, rounded, reddish brown.		
	270	282		Cuttings	E	n/a	N	Sand, medium to very fine, gray to dark gray, thin-bedded, primarily quartz, subangular to angular, moderately sorted. Minor clay, rare pyrite.	07/17/10	
	282	310		Cuttings	E	n/a	S	Siltstone, dark gray to very dark gray, weakly indurated, platy.		
	310	320		Cuttings	E	n/a	N	Shale, very dark gray, moderately indurated, platy, minor medium to fine sand.		
	320	340		Cuttings	E	n/a	S	Shale and clay, dark gray, shale fraction is platy, moderately indurated, clay is soft to moderately stiff.		
	340	355		Cuttings	E	n/a	S	As above, but clay decreases.		
	355	370		Cuttings	I, R		V	St. Louis: Silt and fine sand, gray to dark gray, poorly indurated, interbedded with angular limestone, light gray to gray to light reddish gray, hard, sandy to micritic texture, and shale, dark gray, platy.		
	370	380		Cuttings	I, R	n/a	V	As above, but siltstone fraction decreases.		
	380	390		Cuttings	I, R	n/a	V	Limestone and shale, limestone is predominantly fine-grained, and hard, ranging from light reddish gray to dark reddish brown. Shale is dark gray, poorly indurated, platy.		
	390	400		Cuttings	I, r	n/a	V	As above, with traces of sandy matrix. Limestone textures observed include sandy, oolitic, and micritic.		
	400	410		Cuttings	I, r	n/a	V	Siltstone/shale fraction decreases to <10%. Limestone texture and color ranges as above. Rare pyrite.		
	410	420		Cuttings	C	n/a	V	As above, with trace medium sandstone, subangular to subrounded, quartz grains, light gray, weakly indurated.		
	420	430		Cuttings	I, r	n/a	M	Warsaw: Sandstone, fine, dark gray, to very fine, gray, weakly indurated, with minor gray sandy to micritic limestone. Sandstone does not react to HCl. Rare pyrite.		
	430	440		Cuttings	I, r	n/a	M	Sandstone, fine to very fine, reddish gray to dark reddish gray, with weakly to moderately indurated, moderate calcite cement. Abundant very light gray to white chalcedony and clear crystalline quartz fragments. Minor clay.		
	440	450		Cuttings	E	n/a	M	Shale, dark greenish gray, weak, noncalcareous, with minor dolomite, very dark gray, angular, fine-grained, and rare sandstone, fine to very fine, weakly indurated. Occasional fragments of light gray to white chalcedony and clear crystalline quartz.		
	450	470		Cuttings	E	n/a	M	Keokuk: Dolomite, sandy, dark reddish gray to weak red, with occasional veins/concretions of light grayish pink, botrioidal argillized masses. Rare fragments of white chalcedony.		
	470	480		Cuttings	E	n/a	M	As above, but decrease in argillized inclusions. Colors are predominantly dark reddish gray (Munsell 7.5R 3/1) and dark gray (N4).	07/18/10	



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Hydrodynamics Sample/Geology Log – Continuation

Borehole name/ID		Mortimer #1						Logged by: D. Merritt	Date	07/27/10
Run #	Depth Top	Depth Bot	Drill time (min)	Sample Type	Drilling Action	RQD	Calc. Content	Log Notes	Date	Graphic
	480	490		Cuttings	E	n/a	M	Keokuk (continued): Dolomite, sandy, dark reddish gray to weak red. Rare fragments of white chalcedony.	07/18/10	
	490	510		Cuttings	E	n/a	M	As above, with increase in clear crystalline quartz clusters. Rare inclusions of light grayish pink, argillized masses, rare calcite fossil fragments.		
	510	520		Cuttings	E	n/a	M	As above, with rare dark reddish brown chert and very dark gray platy shale. Slight increase in HCl reactivity.		
	520	530		Cuttings	l, r	n/a	M	Dolomite, sandy, mostly fine-grained, dark reddish gray. Rare clear crystalline quartz, white to light gray chalcedony. Rare yellow brown chert.		
	530	550		Cuttings	E	n/a	S	#####	07/23/10	
	550	560		Cuttings	E	n/a	S	As above, with possible increase in clear crystalline quartz face sizes and abundance. Rare white to light gray chalcedony.	07/24/10	
	560	570		Cuttings	E	n/a	S	Sandstone/dolomite, light gray to white, abundant crystalline quartz fragments. Fragment size decreasing significantly.		
	570	580		Cuttings	E	n/a	S	Sandstone/shale, interbedded. Sandstone is mostly white to clear quartz, shale is gray to dark greenish gray. Minor tabular fragments of possible selenite. Trace pyrite.		
	580	590		Cuttings	E	n/a	S	As above, but smaller chip sizes may indicate greater washout of shale fraction. Recovery is mostly sand and quartz crystals with minor gypsum.		
	590	600		Cuttings	E	n/a	S	As above, but shale fraction increased. Shale is gray to dark greenish gray.		
	600	610		Cuttings	E	n/a	M	Shale/sandstone, fine to very fine, shale is gray, slightly calcareous, sandy, weakly indurated. Sandstone is light gray to light pinkish gray, hard. Minor crystalline quartz, selenite, trace of white to light yellowish gray chalcedony.		
	610	620		Cuttings	E	n/a	V	Gilmore City: Limestone/Sandstone, limestone is light yellowish gray, oolitic. Sandstone is white to yellowish gray, mostly quartz. Minor chalcedony, white to light gray.		
	620	630		Cuttings	E	n/a	V	As above, but decrease in sand to minor fraction.		
	630	638		Cuttings	E	n/a	V	Limestone, light yellowish brown to yellowish gray, grainstone, with embedded fossil fragments, oolites not observed.		
	638	650		Cuttings	E	n/a	M	Hampton: Dolomite, gray to dark purplish gray, with minor light gray, crystalline, fine to medium grained, possible embedded fossil casts, minor dark gray shale.		
	650	695		Cuttings	E	n/a	M	As above, but decrease in shale to trace. Trace of crystalline quartz, trace chalcedony. Crystal size increases downhole, reactivity to HCl decreases downward.	07/24/10	



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Hydrodynamics Sample/Geology Log – Continuation

Borehole name/ID		Mortimer #1						Logged by: D. Merritt	Date	07/27/10
Run #	Depth Top	Depth Bot	Drill time (min)	Sample Type	Drilling Action	RQD	Calc. Content	Log Notes	Date	Graphic
	695	710		Cuttings	E	n/a	S	Dolomite, crystalline, ranging from reddish gray to dark reddish gray to light gray. Minor clear crystalline quartz in clusters and single crystal forms. Trace of pyrite.	07/24/10	
	710	728		Cuttings	E	n/a	M	Maple Mill: Dolomite, crystalline, ranging from reddish gray to dark reddish gray, with minor shale, weakly indurated, gray to light greenish gray. Abundant fragments of clear crystalline quartz clusters, massive quartz, appearing as fracture or cavity lining material. Minor light gray calcite. Trace of platy selenite.		
	728	750		Cuttings	E	n/a	S	Shale, mixed bedded shale and unconsolidated clay. Bedded shale is weakly indurated, gray to dark purplish gray. Clay is light greenish gray to light bluish gray, stiff, plastic. Minor interbedded dolomite, fine grained, dark reddish purple.		
	750	775		Cuttings	E	n/a	S	As above, but decreasing dolomite fraction downhole.		
	775	785		Cuttings	E	n/a	S	Shale, weakly indurated, gray to dark purplish gray. Unconsolidated clay decreasing compared to previous sample..		
	785	805		Cuttings	E	n/a	S	Shale, sandy, light gray to dark purplish gray. Darker fraction increases downward. Mostly bedded, with minor plastic clay. Minor interbedded sand with clay cement. Rare white chalcedony, some with fine laminations.		
	805	850		Cuttings	E	n/a	V	Lime Creek: Limestone, gray to light gray to light grayish tan, mostly grainstone. Minor shale, dark purplish gray to light greenish gray, well indurated.		
	850	880		Cuttings	E	n/a	V	As above, but shale decreases. Limestone fragments primarily platy, thin bedded, minor micritic textures.	07/25/10	
	880	915		Cuttings	E	n/a	V	As above, with minor white microcrystalline quartz fragments, possibly fracture or cavity filling. Rare white crystalline calcite fragments.		
	915	930		Cuttings	E	n/a	M	Cedar Valley: Dolomite, dark reddish gray to pale grayish tan, grainstone to finely crystalline, with minor clear, white, or pale grayish brown fragments of quartz fracture filling, and rare pale white limestone or calcite fracture fill. Trace of pyrite.		
	930	940		Cuttings	E	n/a	M	Dolomite, pale grayish tan or greenish gray to dark reddish gray. Fine-grained, micritic, with rare sandy fragments. Most fragments are platy, thin. Rare white chalcedony and clear quartz. Trace of pyrite.		
	940	950		Cuttings	l, r	n/a	M	Dolomite as above, with minor interbedded gray clayey shale and white argillized zones, rarely seen as cement.		
	950	960		Cuttings	l, r	n/a	M	#####		
	960	970		Cuttings	l, r	n/a	S	As above, but decreasing dolomite fraction.	07/25/10	



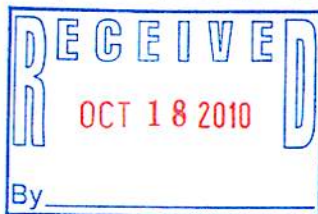
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Hydrodynamics Sample/Geology Log – Continuation								Page 5 of 12		
Borehole name/ID		Mortimer #1			Logged by: D. Merritt			Date	07/27/10	
Run #	Depth Top	Depth Bot	Drill time (min)	Sample Type	Drilling Action	RQD	Calc. Content	Log Notes	Date	Graphic
	970	980		Cuttings	E	n/a	M	Cedar Valley (Cont): Shale, sandy, moderately indurated, greenish gray to gray, with minor moderately calcareous gray clay, interbedded with light gray fine-grained dolomite and minor light gray fine sandstone with subrounded quartz grains.	07/25/10	
	980	990		Cuttings	E	n/a	M	Dolomite, light gray to gray, crystalline, with gray to greenish gray sandy shale. Minor plastic clay. Abundant crystal clusters of quartz and dolomite, some have fracture-face boundaries of one side. Fragments mostly tabular, platy.		
	993	995		Cuttings	E	n/a	M	<i>NOTE: Spot sample from ~993', mostly coarse crystals of dolomite and quartz, reflecting major speedup in drilling rate. Possible mineralized fracture zone.</i>		
	990	1000		Cuttings	E	n/a	S	Dolomite, light gray to gray, crystalline, platy. Crystal sizes increased relative to above interval. Minor shale, dark gray, reddish black, dark brownish red, thin bedded, weakly indurated. Minor clusters of clear crystalline quartz, appearing as possible fracture fill material.		
	1000	1010		Cuttings	E	n/a	S	As above, but shale fraction decreases, decrease in crystal size and decrease in crystalline quartz.		
	1010	1030		Cuttings	E	n/a	M	Dolomite, gray to reddish gray, crystalline. Rare reddish black shale, selenite, and crystalline quartz. Rare white argillized zones, sometimes occurring as matrix to dolomite fragments.		
	1030	1040		Cuttings	E	n/a	M	Dolomite, gray to reddish brown, crystalline, platy. Rare reddish black shale, bluish gray shale, selenite, and crystalline quartz. Rare white argillized fragments.	07/26/10	
	1040	1050		Cuttings	E	n/a	M	As above, but increase in dark reddish brown dolomite, dark gray shale.		
	1050	1090		Cuttings	E	n/a	M	Dolomite, crystalline, platy to massive, colors range from gray to pale tan to reddish brown. Minor shale, weakly to well indurated, ranging from dark reddish brown to light greenish gray. Rare argillized matrix enclosing smaller fragments of dolomite.		
	1090	1110		Cuttings	E	n/a	M	Dolomite, crystalline to sandy, grain size fine to very fine, colors range from gray to pale tan to reddish brown to weak red. Coarsest fraction is most reactive to HCl. Minor shale, gray to reddish gray, weakly indurated, slightly calcareous. Rare argillization matrix.		
	1110	1120		Cuttings	E	n/a	S	Dolomite, crystalline, colors range from reddish brown to dark reddish gray, minor gray weakly indurated shale, white argillized fragments, rare crystalline quartz with fracture-face surfaces.		
	1120	1130		Cuttings	E	n/a	S	As above, but with presence of dark reddish brown shale. Crystalline quartz fracture coating material recovered with dolomite fragments attached.		
	1130	1140		Cuttings	E	n/a	S	As above, but shale decreased. Fine-grained fragments are thin and platy, coarser grained is massive.	07/26/10	



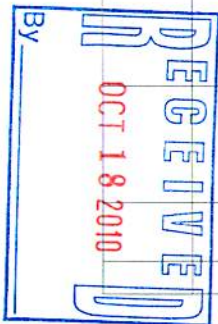
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Hydrodynamics Sample/Geology Log – Continuation									Page 6 of 12	
Borehole name/ID		Mortimer #1			Logged by: D. Merritt				Date	07/27/10
Run #	Depth Top	Depth Bot	Drill time (min)	Sample Type	Drilling Action	RQD	Calc. Content	Log Notes	Date	Graphic
	1140	1150		Cuttings	E	n/a	S	Cedar Valley (Cont.): Dolomite, crystalline, colors ranging from light gray to gray to reddish gray. Most fragments tabular, platy, with one or more flat surfaces. Abundant white to very light gray argillic fragments, soft, crumbly.	07/26/10	
	1150	1170		Cuttings	E	n/a	M	Dolomite, crystalline, light gray to reddish gray. Tabular, platy. Rare bluish gray and dark reddish gray shale, very light gray sandy shale. Rare white to light gray argillic fragments.		
	1170	1180		Cuttings	E	n/a	S	#####		
	1180	1190		Cuttings	E	n/a	S	Shale/Dolomite: Shale is weakly indurated, predominantly light gray and light bluish gray with minor gray. Dolomite is primarily pinkish white and gray, with minor dark reddish gray. Rare white to very light gray argillic fragments.		
	1190	1200		Cuttings	E	n/a	S	As above, but increase in dolomite fraction. Rare crystalline quartz fracture/cavity fill material.		
	1200	1210		Cuttings	E	n/a	S	Dolomite/Shale as above. Gray crystalline fraction is predominant. Rare platy gypsum fragments.		
	1210	1230		Cuttings	E	n/a	S	Dolomite/Shale as above. Increase in argillic fragments.		
	1230	1250		Cuttings	E	n/a	S	Dolomite/Shale as above.		
	1250	1260		Cuttings	E	n/a	S	As above, but increase in shale fraction, with additional reddish gray/weak red thin bedded sandy soft shale.	07/27/10	
	1260	1280		Cuttings	E	n/a	S	Dolomite/Shale, dolomite crystalline to micritic, color pinkish white and gray, with minor dark reddish gray. Shale is weakly indurated, predominantly light gray and light bluish gray with minor gray and rare dark reddish brown, sandy to clayey. Abundant white to very light gray argillic fragments. Minor crystalline to milky quartz fracture or cavity fill material.		
	1280	1310		Cuttings	E	n/a	S	Dolomite, crystalline, colors ranging from weak red to reddish gray to light gray. Most fragments tabular, platy, with one or more flat surfaces. Minor shale, weakly indurated, sandy to clayey, predominantly light gray, light bluish gray to dark reddish gray. Rare white to very light gray argillic fragments, rare gypsum as selenite, rare milky to crystalline quartz.		
	1310	1320		Cuttings	E	n/a	S	As above, but increase in shale fraction.		
	1320	1350		Cuttings	E	n/a	S	As above, but shale fraction is clayey to silty, weakly indurated, light gray to light greenish gray		
	1350	1360		Cuttings	E	n/a	S	Shale/Dolomite: Shale is moderately indurated, light gray and light bluish gray. Dolomite is primarily pinkish white and gray, with minor dark reddish gray. Rare white to very light gray argillic fragments.	07/27/10	



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Hydrodynamics Sample/Geology Log – Continuation								Page 7 of 12		
Borehole name/ID		Mortimer #1		Logged by: D. Merritt				Date	07/30/10	
Run #	Depth Top	Depth Bot	Drill time (min)	Sample Type	Drilling Action	RQD	Calc. Content	Log Notes	Date	Graphic
	1360	1370		Cuttings	E	n/a	S	Wapsipinicon: Dolomite, crystalline, light gray to grayish tan. Fragments generally tabular. Minor shale, gray, soft, clayey. Rare white to very light gray argillic fragments, soft, crumbly. Trace selenite.	07/27/10	
	1370	1395		Cuttings	E	n/a	S	As above, but increase in gypsum as selenite, and abundant white to light gray chalky argillized fragments.		
	1395	1410		Cuttings	E	n/a	S	As above, but with decrease in selenite and white argillaceous fragments.		
	1410	1425		Cuttings	E	n/a	M	Gower: Dolomite, crystalline, light gray to grayish tan. Fragments generally tabular. Minor shale, gray to dark gray, soft, clayey. Trace of dark reddish brown chert.		
	1425	1435		Cuttings	E	n/a	M	Maquoketa (Neda member): Shale, soft, plastic, reddish brown.		
	1435	1455		Cuttings	E	n/a	S	Brainard member: Shale, soft, plastic, bluish gray, to gray, interbedded with weakly indurated, clayey to slightly sandy shale.		
	1455	1478		Cuttings	E	n/a	S	Shale, weakly indurated, dark gray to dark greenish gray shale, clayey to slightly sandy. Rare quartz fracture coating minerals, tabular, thin. Trace pyrite.		
	1478	1520		Cuttings	E	n/a	S	Fort Atkinson member: Dolomite, crystalline to sandy, light gray to gray, tabular to thin-bedded, with minor gray to dark gray clayey shale. Rare selenite, quartz, and yellowish brown chert. Trace pyrite.	07/28/10	
	1520	1595		Cuttings	E	n/a	S	Dolomite, crystalline to micritic, reddish gray to pinkish gray to brown. Tabular, with flat parting surfaces. Minor shale, dark gray to light greenish gray, clayey, weakly indurated. Rare crystalline quartz as fracture coating, gypsum as selenite, and yellow brown to dark reddish brown chert. Trace pyrite.		
	1595	1615		Cuttings	E	n/a	M	Clermont: Dolomite, crystalline, white to light gray, with rare gray. Minor shale, dark gray to light bluish gray, soft, clayey. Trace pyrite.		
	1615	1630		Cuttings	E	n/a	S	Elgin: Dolomite, coarsely crystalline, white; most chips are fragments of larger individual crystals, white. Less coarse crystals are light gray. Minor light gray to pale tan sandstone, fine to very fine. Minor shale, dark reddish gray to greenish gray, soft, clayey, trace of dark reddish brown chert.		
	1630	1705		Cuttings	E	n/a	S	Dolomite, micritic to crystalline, light grayish brown to white. Color becomes more evenly grayish brown downhole. Minor shale, gray to reddish gray, sandy, moderately indurated, or light pale green, soft, clayey. Rare chert, white to very light gray. Trace of pyrite.		
	1705	1780		Cuttings	E	n/a	S	Galena: Dolomite, crystalline, reddish brown to dark reddish gray. Minor shale, grayish green to dark reddish brown, soft, clayey. Rare chert, gray to dark reddish brown. Trace of selenite, trace grayish brown sandstone.		
	1780	1830		Cuttings	E	n/a	S	As above, but decrease in reddish brown chert fragments. Chert is mostly gray to light gray. Decrease in sandstone.	07/29/10	
	1830	1850		Cuttings	E	n/a	S	As above, but increase in dark reddish brown shale.	07/29/10	



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Hydrodynamics Sample/Geology Log – Continuation								Page 8 of 12		
Borehole name/ID Mortimer #1				Logged by: D. Merritt				Date 07/31/10		
Run #	Depth Top	Depth Bot	Drill time (min)	Sample Type	Drilling Action	RQD	Calc. Content	Log Notes	Date	Graphic
	1850	1860		Cuttings	E	n/a	S	Galena (continued): Dolomite, crystalline, reddish brown to dark reddish gray. Minor shale, grayish green to dark reddish brown, soft, clayey. Rare chert, gray to light gray.	07/29/10	
	1860	1870		Cuttings	E	n/a	S	Dolomite, crystalline, reddish brown to dark reddish gray. Minor shale, dark greenish gray to dark reddish brown, soft, clayey. Rare chert, gray to light gray. Rare selenite.		
	1870	1926		Cuttings	E	n/a	S	#####		
	1926	1959		Cuttings	E	n/a	N	St. Peter Sandstone: Sandstone, white to very light gray, quartz, fine to very fine, poorly sorted, rounded to subrounded, uncemented. Rare grayish green shale, soft, clayey. Pyrite.		
	1959	1990		Cuttings	E	n/a	S	#####		
	1990	2000		Cuttings	E	n/a	S	#####		
	2000	2080		Cuttings	E	n/a	S	Dolomite as above, predominant color is pale yellowish brown to light gray, texture predominantly microcrystalline to micritic.		
	2080	2130		Cuttings	E	n/a	M	Dolomite as above, but with sand, clear to light gray, rounded, very fine, uncemented.	07/30/10	
	2130	2180		Cuttings	E	n/a	S	Note: Bit change to 7 7/8" button bit. Dolomite, crystalline to micritic, mostly fine grained to microcrystalline, light gray to pale yellowish brown, fragments tabular, to chunky. Minor sandstone, fine to very fine, rounded to subrounded, variably matrix to grain supported, quartz in siliceous matrix. Minor shale, light greenish gray to grayish green, soft, clayey. Rare chert, dark reddish gray to light gray. Rare pyrite.	07/31/10	
	2180	2190		Cuttings	E	n/a	S	As above, with increase in sand and soft shale.		
	2190	2200		Cuttings	E	n/a	S	Increase in crystal size, sparry, very pale grayish pink.		
	2200	2857.8		NA				No samples recovered, Franconia inferred at 2477' based on e-logs.		



72600

Hydrodynamics Sample/Geology Log – Continuation									Page 9 of 12	
Borehole name/ID				Mortimer #1				Logged by: D. Merritt		Date 08/29/10
Run #	Depth Top	Depth Bot	Drill time (min)	Sample Type	Drilling Action	RQD	Calc. Content	Log Notes	Date	Graphic
1	2857.8	2860.9	31	PQ Core	E	100%	M	#####	08/26/10	
2	2860.9	2868.6	30	PQ Core	E	100%	M	As above, but below 2864.0' minor brown (7.5YR 5/3) wavy/bioturbated beds with matrix of silty claystone to siltstone to ~7cm thick, slightly more reactive to HCl than surrounding dolomite. Beds bordered by darker, possibly glauconitic coatings. At 2868.0', beds take the form of distorted, flattened clasts with rims of very dark gray to black grains.	08/26/10	
3	2868.6	2879.2	32	PQ Core	E	100%	M	#####	08/26/10	
4	2879.2	2888.6	31	PQ Core	E	100%	M	Eu Claire as above, sandy dolomite with minor interbedded sandstone/sandy claystone. From 2879.0' – 2879.3', near-vertical incipient fracture with partial coating.	08/26/10	
5	2888.6	2898.8	31	PQ Core	E	96%	M/S	#####	08/26/10	



72600

Hydrodynamics Sample/Geology Log – Continuation									Page 10 of 12	
Borehole name/ID				Mortimer #1			Logged by: D. Merritt			Date 08/31/10
Run #	Depth Top	Depth Bot	Drill time (min)	Sample Type	Drilling Action	RQD	Calc. Content	Log Notes	Date	Graphic
6	2898.8	2908.6	30	PQ Core	E	88%	N	#####	08/26/10	
7	2908.6	2918.4	43	PQ Core	E	63%	N	#####	08/26/10	
8	2918.4	2928.6	55	PQ Core	E	49%	N	Sandstone as above, general increase in porosity and increased sorting downward, decrease in number and thickness of shale beds. Brachiopod fossils rare, fragmented, . From 2927.1' grain size and cementation increases downward to 2928.3'.	08/27/10	
9	2928.6	2938.8	34	PQ Core	E	94%	N	From 2928.6' – 2929.1', shale bed, gray (5Y 5/1), laminar, bisected by white (N8) medium, moderately well sorted, well cemented, subrounded sandstone. Similar shale beds at 29230.2' and 2930.6, separated by sandstone as above'. Bed at 2930.2 overlain by pebble layer comprised of shale/siltstone clasts. Brachiopod fossils fragmented, rare, not observed below 2930.0'. From 2931.5', sandstone color varies from light yellowish brown (10YR 6/4) to brown (7.5YR 5/3) to light brown (7.5YR 6/3) to white (N8), with darker intervals fine to very fine, well sorted, angular to subangular. White and light brown intervals are medium to coarse, poorly sorted, crossbedded. From 2931.7' – 2933.4', shale stringers, greenish gray (5BG 5/1) interbed with sandstone. From 2937.3', sandstone is brown (7.5YR 5/3), poorly sorted, very fine to medium, crossbedded, but coarsening downward to 2938.4', becoming fine again.	08/27/10	





72600

Hydrodynamics Sample/Geology Log – Continuation									Page 11 of 12	
Borehole name/ID Mortimer #1						Logged by: D. Merritt			Date	08/31/10
Run #	Depth Top	Depth Bot	Drill time (min)	Sample Type	Drilling Action	RQD	Calc. Content	Log Notes	Date	Graphic
10	2938.8	2948.6	41	PQ Core	E	100%	N	Sandstone as above, crossbedded, poorly sorted, very fine to medium, with coarse beds appearing cyclically below 2941.5'. Coarse grains are mostly quartz, subrounded, fine sand predominantly angular, quartz with possible glauconite and clay or felsics. Color varies from white (N8) to gray (N6) to dark brown (7.5YR 3/3). Porosity and cementation variable. Rare shale stringers, greenish gray (5BG 5/1) at 2942.2' and 2945.2'. Abrupt color/textural contacts at 2941.5' and 2946.9'.	08/27/10	
11	2948.6	2958.9	41	PQ Core	E	87%	N	Sandstone as above, general variations in color and grain size as described above. From 2954.2', rare claystone/shale beds, 1-2cm thick, dark reddish gray (5YR 4/2). At 2956.0' and 2956.6', shale/siltstone beds, light gray(5YR 7/1) .overlain by reddish gray (5YR 5/2) claystone. From 2958.0', color is light gray (10YR 7/1).	08/27/10	
12	2958.9	2968.6	43	PQ Core	E	86%	N	Sandstone, fine to coarse, poorly sorted, crossbedded, color ranges from light gray (10YR 7/1) to pinkish gray (7.5YR 7/2) to brown (10YR 5/3). Coarse grains are mostly quartz, subrounded, fine sand predominantly angular, quartz with possible glauconite and clay or felsics. From 2965.8' – 2966.2', fine sandstone is interbedded with shale stringers, greenish gray (5BG 5/1).	08/28/10	
13	2968.6	2979.1	64	PQ Core	R	68%	N	Sandstone, mostly medium to coarse, poorly to moderately well sorted, subrounded to subangular, crossbedded. Grains are predominantly quartz, visible porosity increased relative to above intervals. Color is predominantly light gray (10YR 7/2) to brown (7.5YR 5/2). Cementation weak to moderate, core parts easily. From 2973.4' – 2973.8', interval is very fine, poorly sorted, well cemented, reddish brown (2.5YR 5/4) grading upward to pink (7.5YR 7/4), atop an abrupt erosional contact with underlying interval. At 2978.9', erosional contact with very fine, laminar, pinkish gray to brown (7.5YR 1/6/2 – 5/2) bed ~3cm thick.	08/28/10	
14	2979.1	2988.6	69	PQ Core	E	91%	N	#####	08/28/10	



72600

Hydrodynamics Sample/Geology Log – Continuation									Page 11 of 12	
Borehole name/ID Mortimer #1					Logged by: D. Merritt				Date	08/31/10
Run #	Depth Top	Depth Bot	Drill time (min)	Sample Type	Drilling Action	RQD	Calc. Content	Log Notes	Date	Graphic
15	2988.6	2991.6	24	PQ Core	E	80%	N	Sandstone, white, medium to coarse, poorly sorted, faintly crossbedded. At 2989.3' angular ripup clasts of underlying siltstone overlie contacts with precambrian.	08/28/10	
	2989.5							Precambrian Upper Red Clastics: Siltstone/claystone, dark reddish gray (5YR 4/2), faintly mottled. Fracture from 2990.5' – 2990.8', clay coated, 40° from vertical, slickensides parallel to fracture face.	08/28/10	



Stored Energy project ended

3:12 PM, Jul 28, 2011 | by Dan Piller | 5 Comments

Des Moines Register

Categories: Green Fields: Agriculture and Alternative Energy

Dallas Center — After spending more than \$8 million on surveys and tests that showed land west of Dallas Center to be unable to hold pressurized air for energy use, the Iowa Stored Energy Park voted Thursday to end its five-year effort to develop one of the world's few systems to store energy for electricity.

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Results of two geological tests showed underground formations unable to hold sufficient pressured air from nearby wind farms that would later be released to power an electric generator to provide electricity to the grid during peak hours.

The tests surprised promoters of the project, primarily Iowa's municipal utilities and the Iowa Power Fund, which thought that the presence of a decades-old natural gas underground storage cavern in nearby Redfield would signify the geological worthiness of the formations under Dallas County.

"This is a disappointment, but it is why we do due diligence," said John Bilsten of Algona, chairman of the Stored Energy Board and also a member of the board of the Iowa Power Fund, which two

years ago approved a \$3.2 million state grant to help fund the research.

Bilsten described the failed tests as “the biggest disappointment” of the Power Fund, which was ended by Gov. Terry Branstad that year after its formation by former Gov. Chet Culver. The Power Fund was authorized to spend up to \$100 million over four years on various alternative and renewable energy projects.

The bulk of that Power Fund money, plus \$3.8 million in federal funds and \$1.4 million from municipal utilities in Iowa, Minnesota and the Dakotas, went to drill three test wells west of Dallas County near Iowa Highway 44.

The research money would be just the beginning of what was planned to be a \$400 million project that would include a newly-constructed electric generator that would tie into the state’s electric grid. Municipal utilities would have first call on the reserve electricity, which would be generated by air converted from electricity from wind farms, compressed into air and stored underground, then released back into the generator to be re-converted back to electricity.

The stored energy project was envisioned as one answer to a problem that has long vexed electric utilities; that electricity cannot be stored. Because it is used in real time, electricity’s wholesale price is subject to wild swings, as experienced a decade ago in California and less spectacularly in other areas.

Minneapolis consultant Robert Schulte, who acted as director for the stored energy project, said much of the interest and attention in electricity storage now has swung toward large batteries, some the size of trucks, that are being tested.

For more news about Iowa agriculture and energy click here for the Register’s Green Fields page on Facebook.