The Technical Challenges of Exploration and Excavation at the Money Pit, Oak Island, Nova Scotia

Presentation by
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SNC-Lavalin Inc., Montreal
to
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Massachusetts Institute of Technology
Cambridge, MA
January 28, 2008

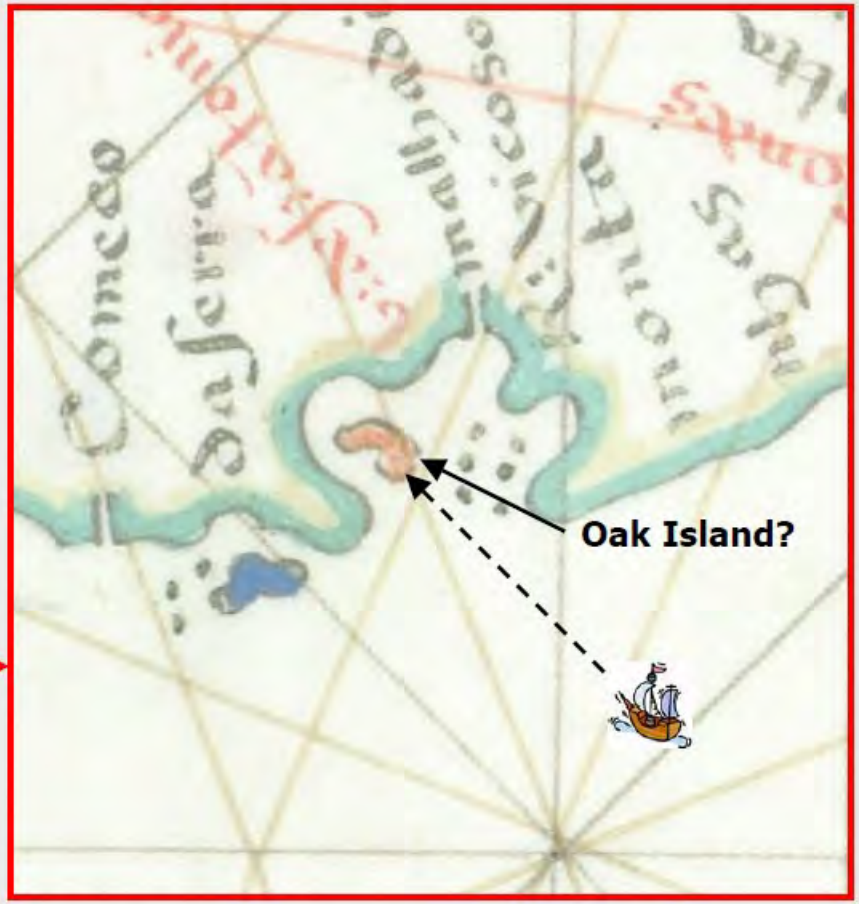
Oak Island 1986

Outline of Presentation

1. Introduction
2. Geological, Geotechnical and Hydrogeological Conditions
3. Archaeological Findings at Money Pit from 1967
4. Search by Ron Aston 1999 to 2001 (North Carolina)
5. Search by Petter Amundsen 2003 (Norway)
6. Main Theories
7. Challenges for Exploration at the Money Pit
8. Challenges for Excavations within the Money Pit

Location of Oak Island, Nova Scotia

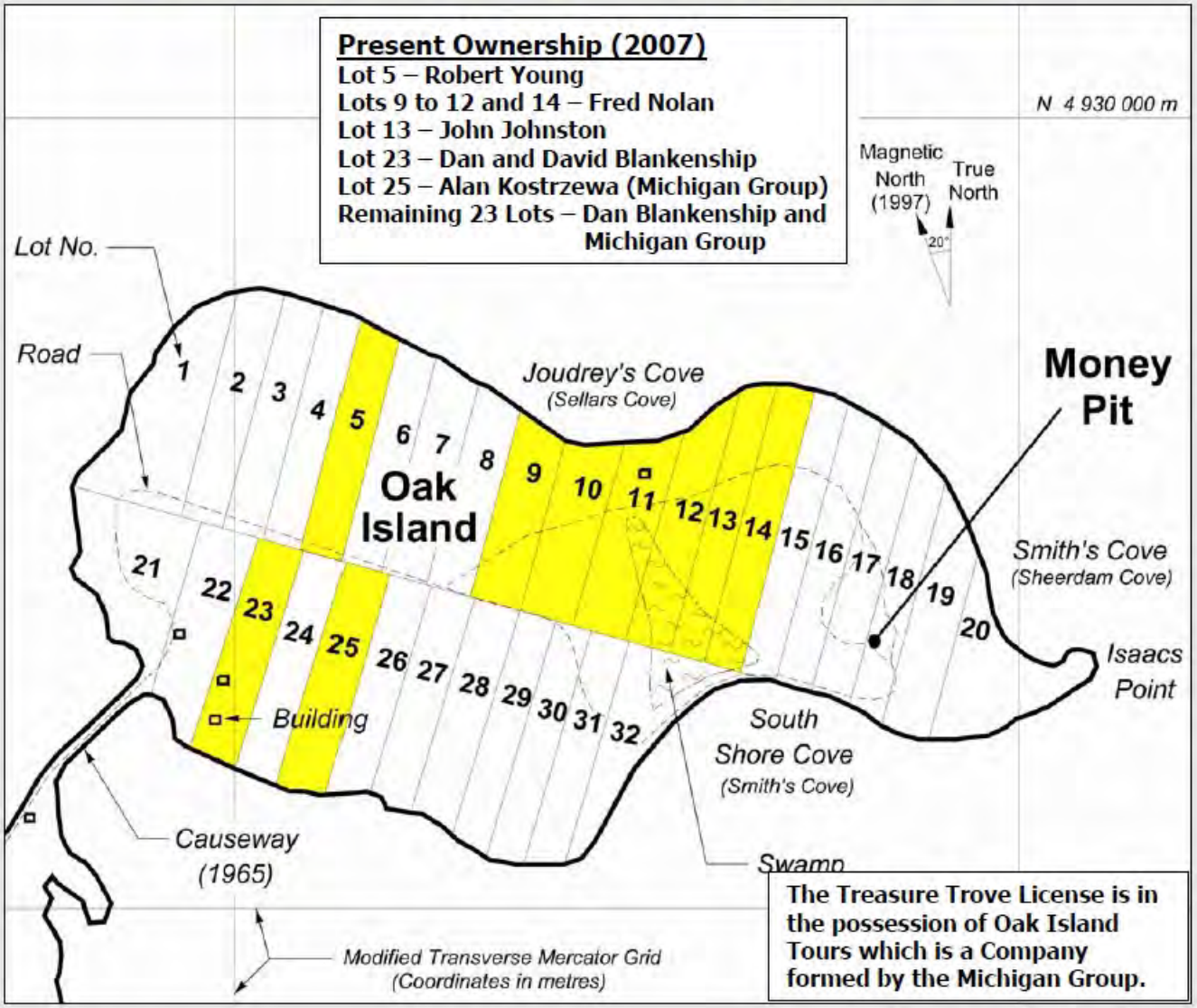
Oak Island in the 1500s?



Bartolomeu Velho Map 1560 (Portuguese)

In the 1500s, during the Portuguese voyages of discovery, islands in the New World were seeded with livestock and crops to have fresh supplies for future voyages. (Vigneras 1973)

Oak Island Lot Distribution



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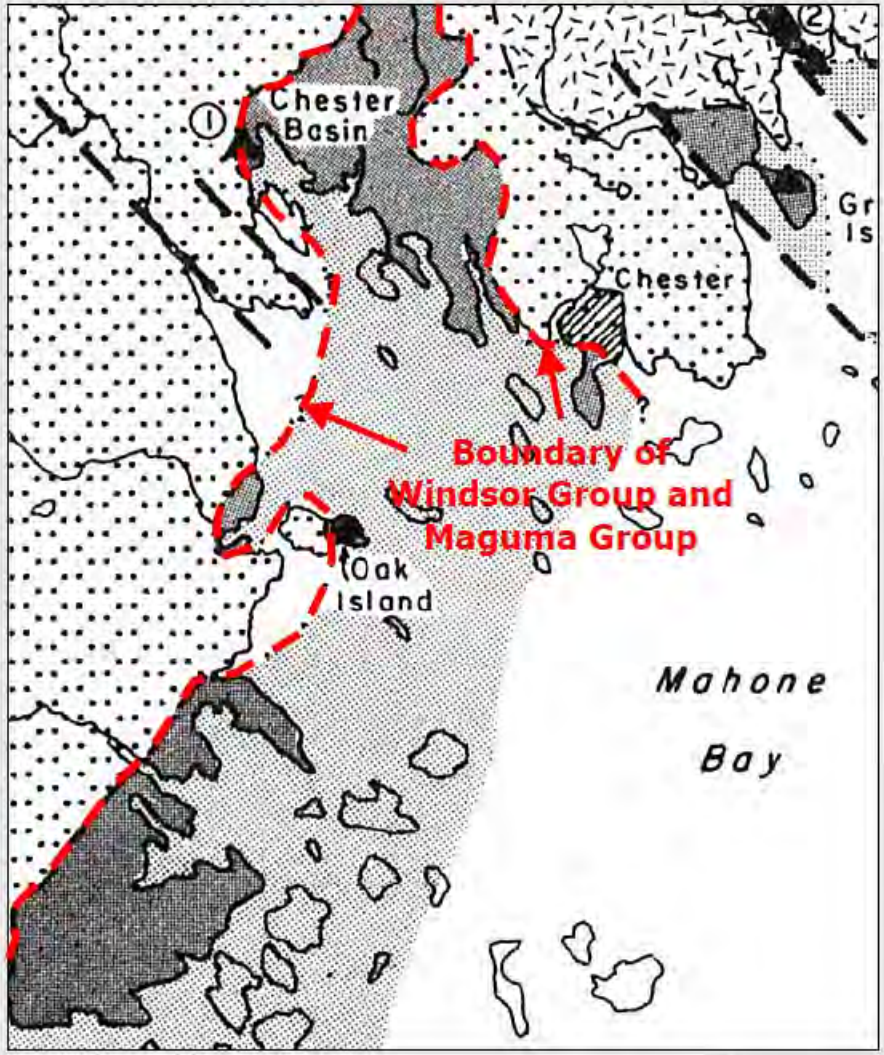
Bedrock Geology Western Mahone Bay



LEGEND

EARLY CARBONIFEROUS

WINDSOR GROUP

Limestone, gypsum, shale; possible submarine extent indicated

DEVONIAN

Undivided granitic rocks

CAMBRO-ORDOVICIAN

MEGUMA GROUP

Undivided slate, metasiltstone and meta-greywacke of the Goldenville and Halifax Formations

Geological boundary, dotted in submarine areas

② ▲ *Bedrock locality cited in text*

Quarry in bedrock

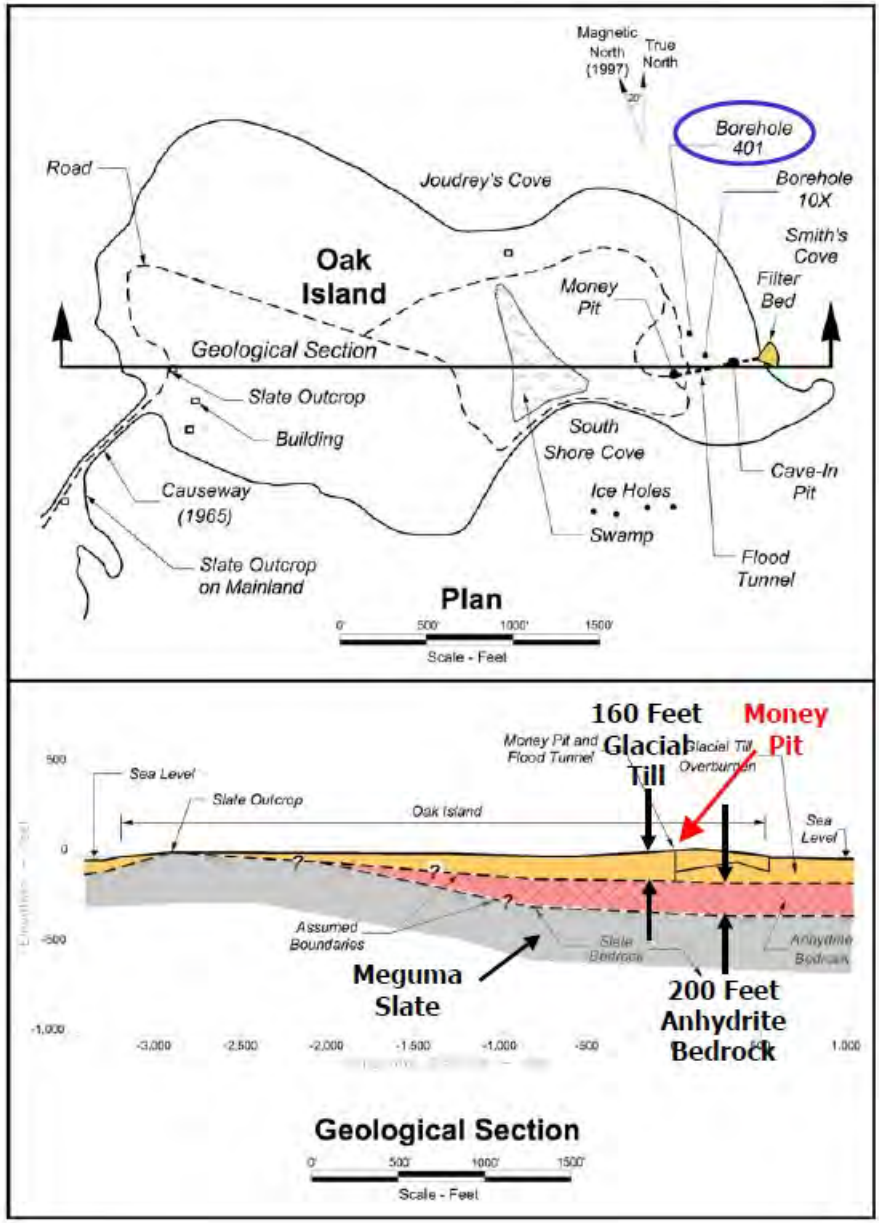
Diamond-drill hole(s)

Fault, (known, and/or inferred)

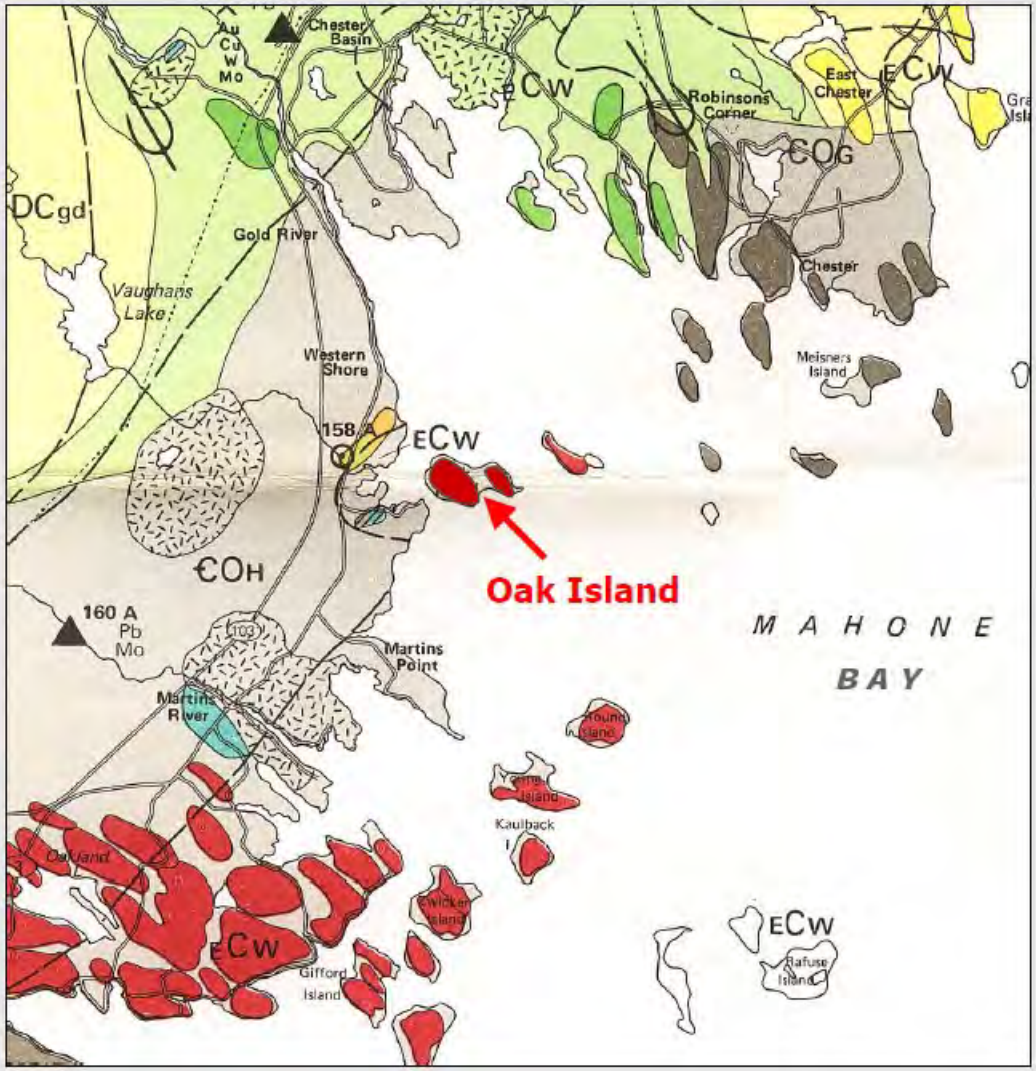
Geology modified after Sage (1954) Cameron (1956) and Taylor (1969). Submarine extension of boundaries in north-eastern Mahone Bay modified after Barnes (1976).

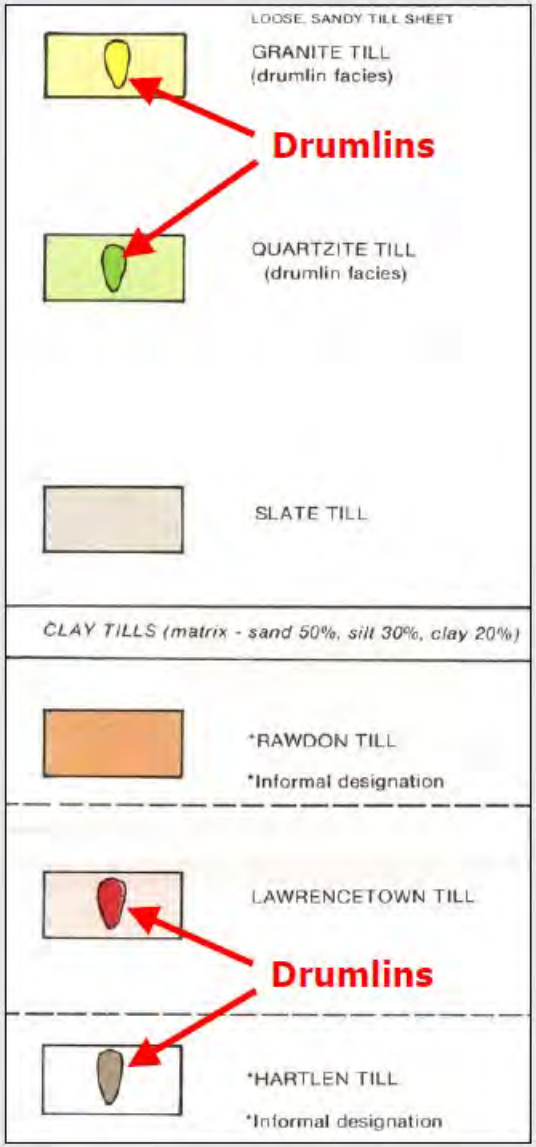
Ref: Giles 1981

Geological Section of Oak Island



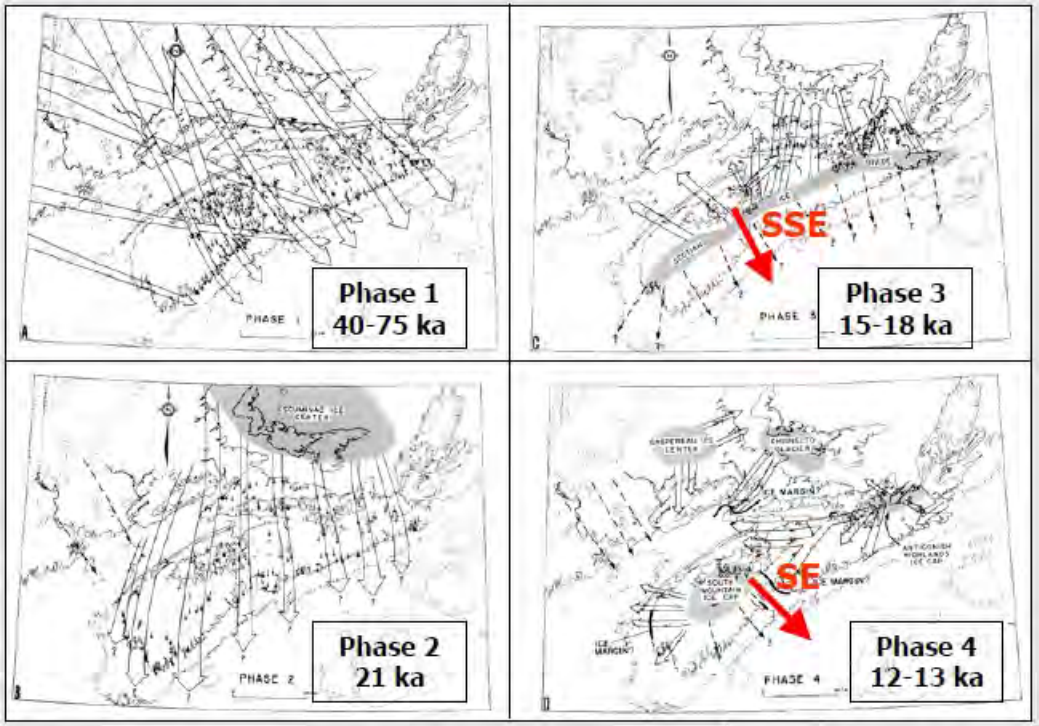
Surface Geology and Drumlins Western Mahone Bay

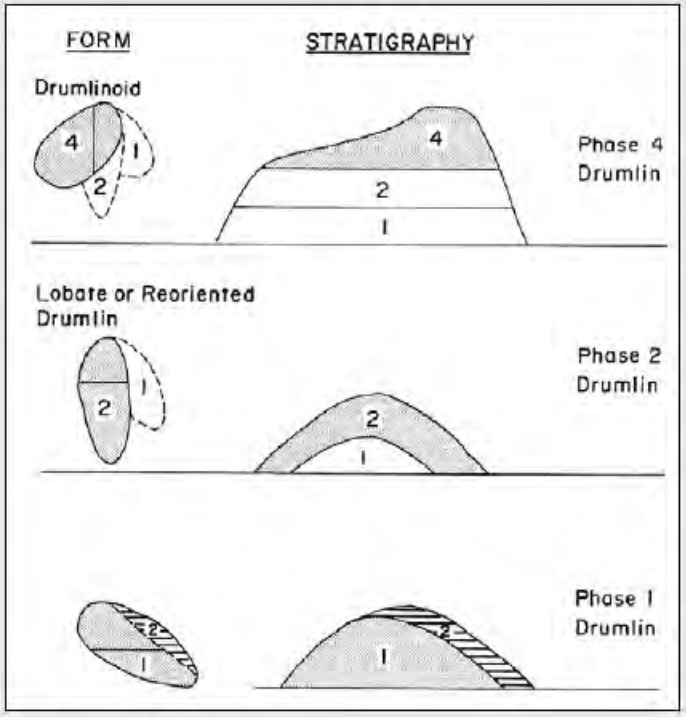




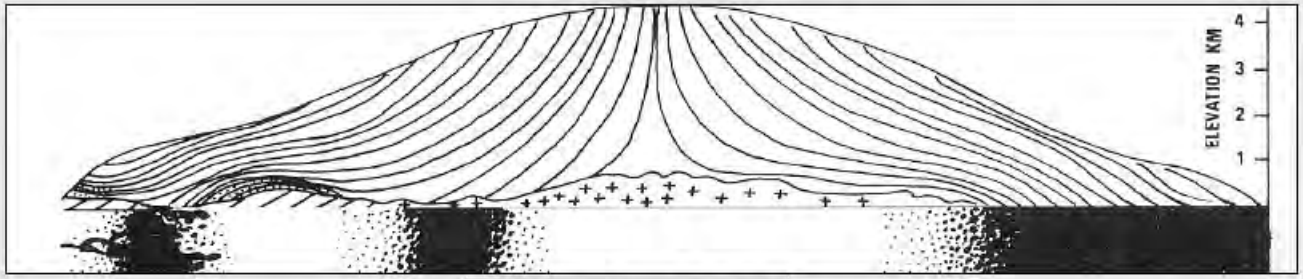
Ref: Stae and Fowler 1981

Glacial Phases and Effect on Drumlin Formation



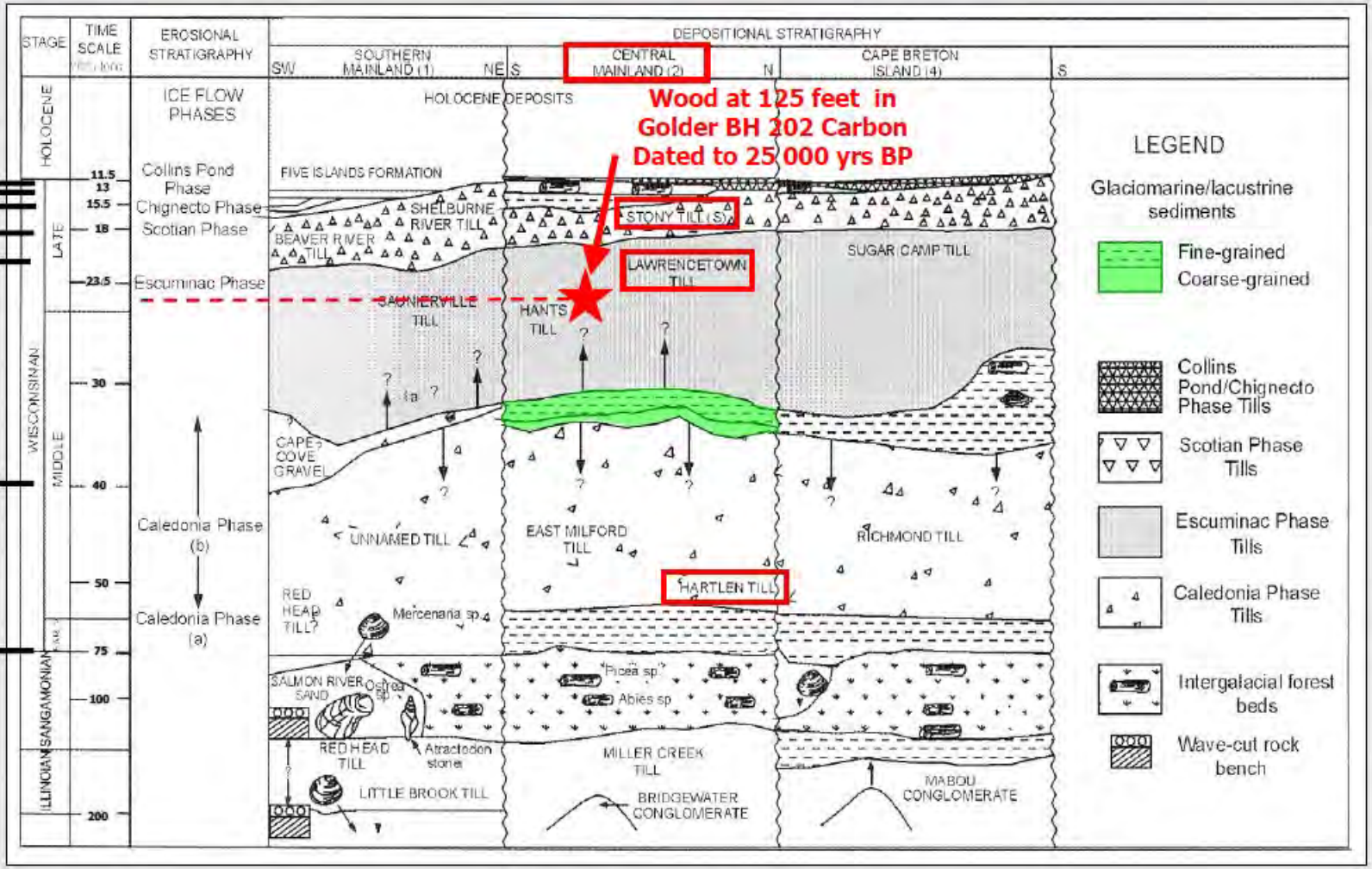


Ref: Stae and Brown 1989



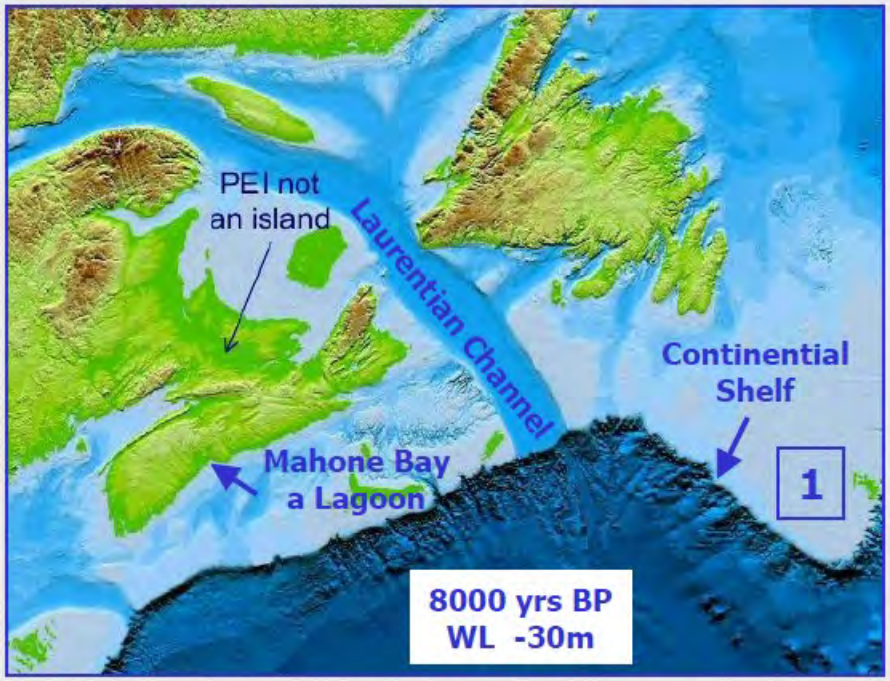
Ref: Eyles 1983

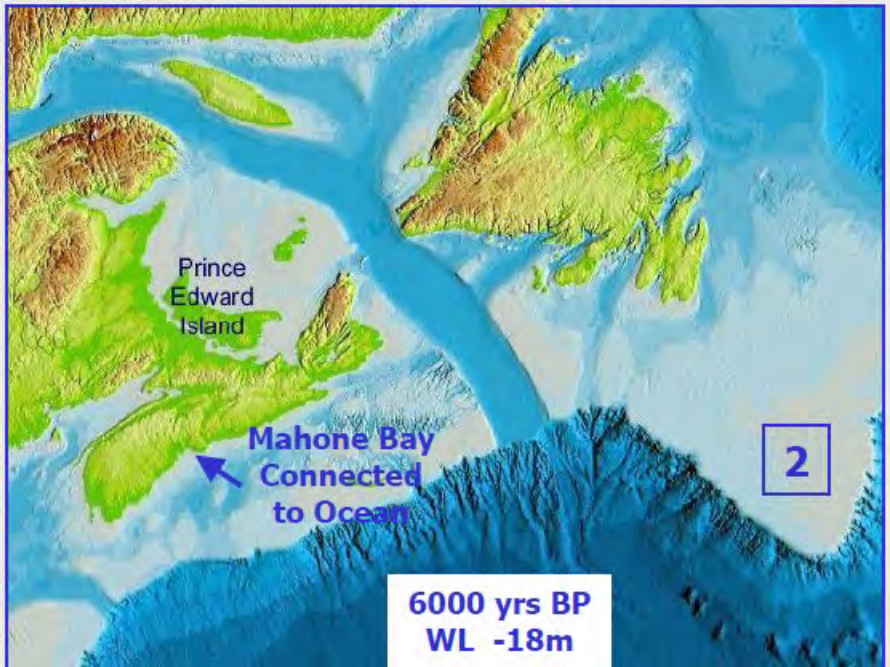
Chart of Glacial Deposition in Nova Scotia

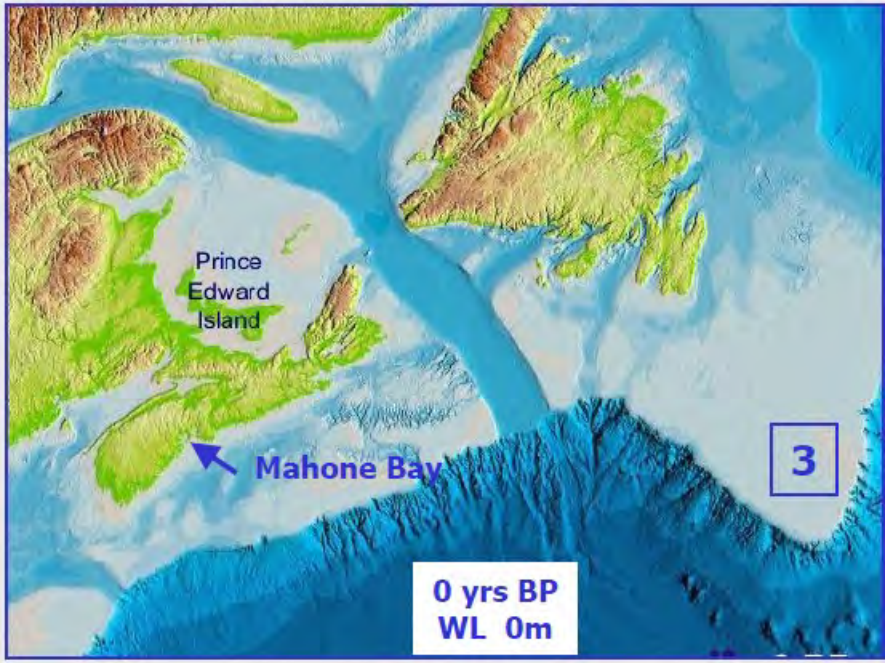


Ref: Stae 2004

Land Submergence with Rise in Sea Level

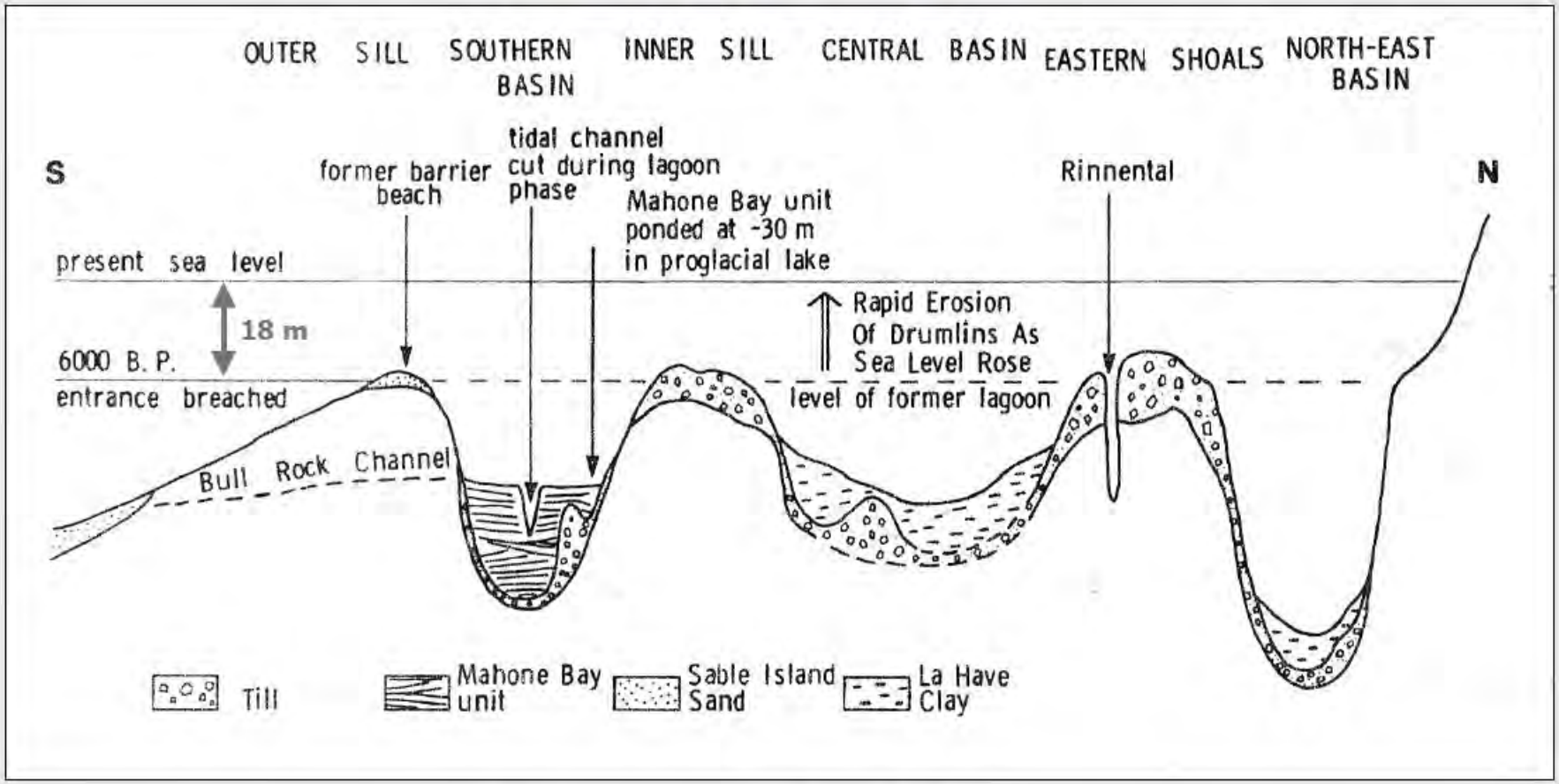






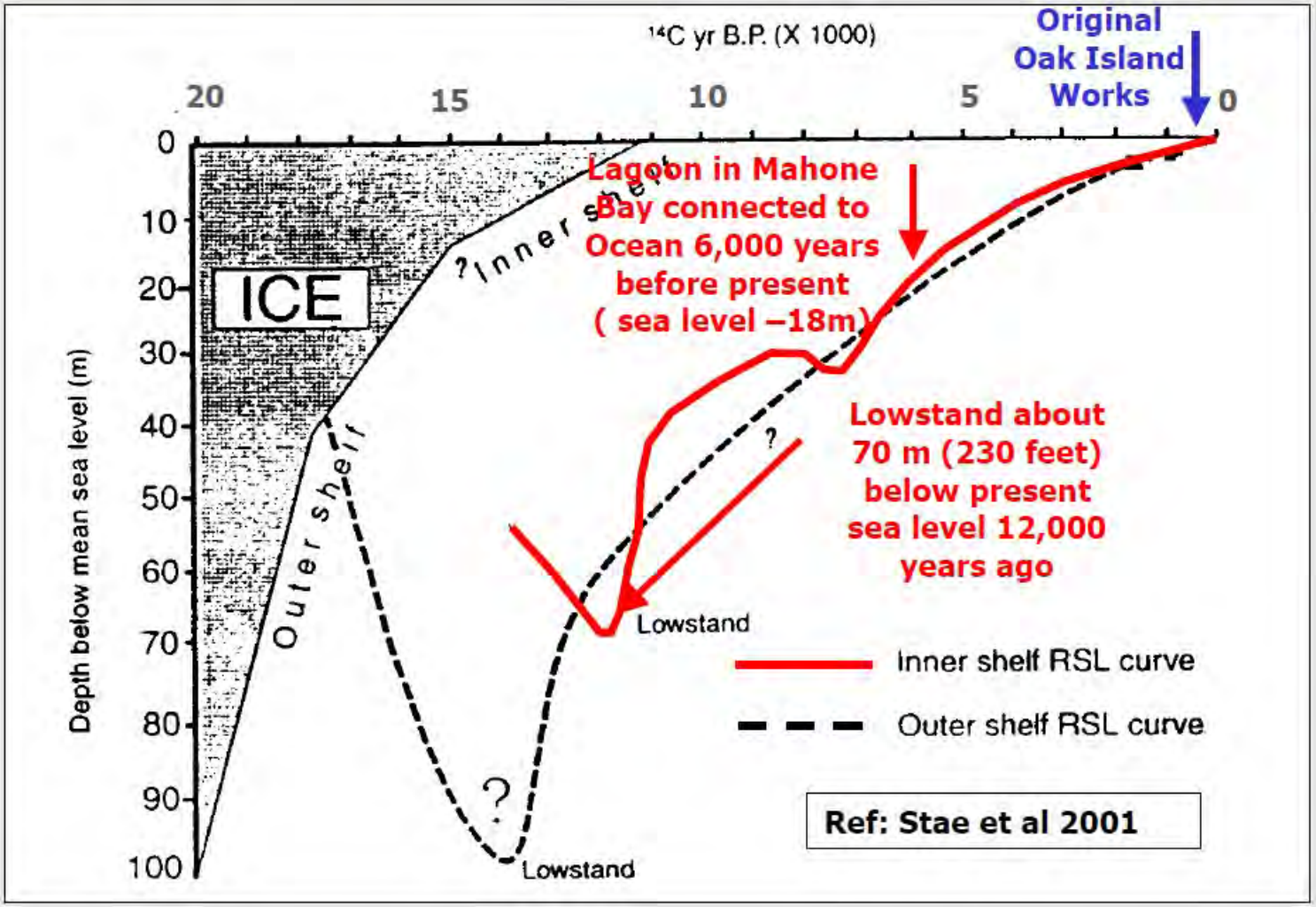
Ref: Daigle 2005

Connection of Mahone Bay to Ocean 6000 Years BP

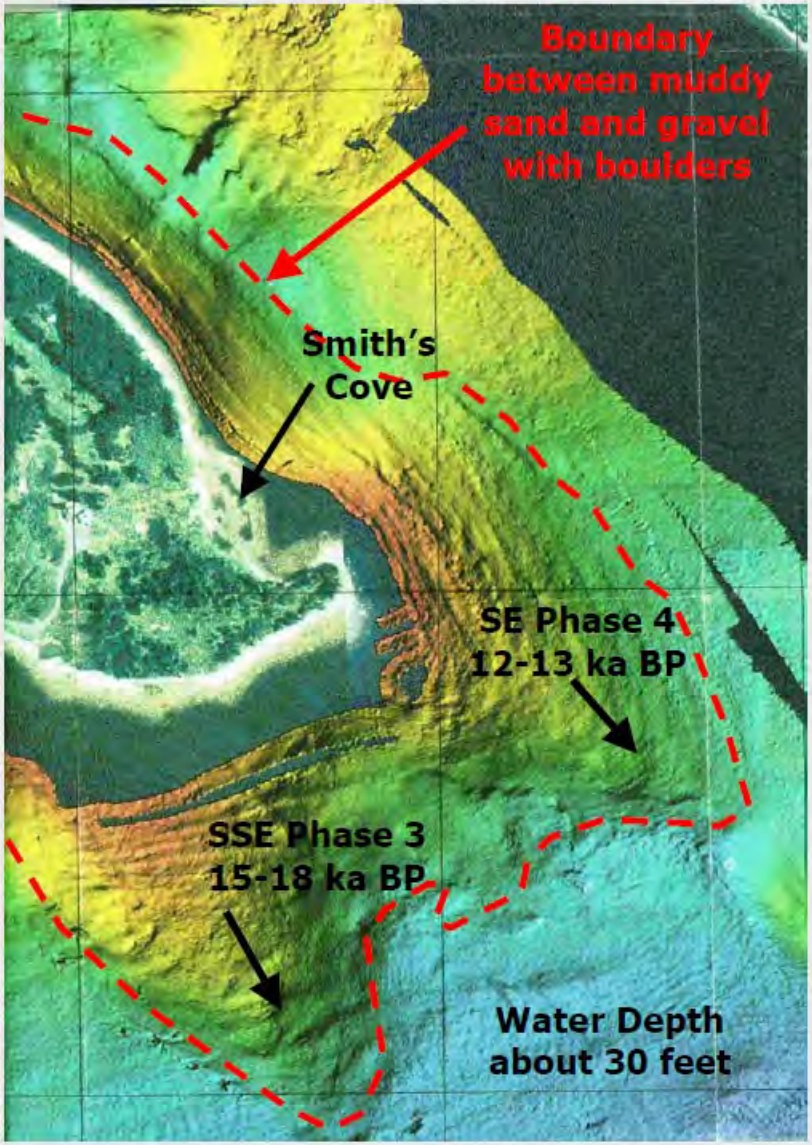


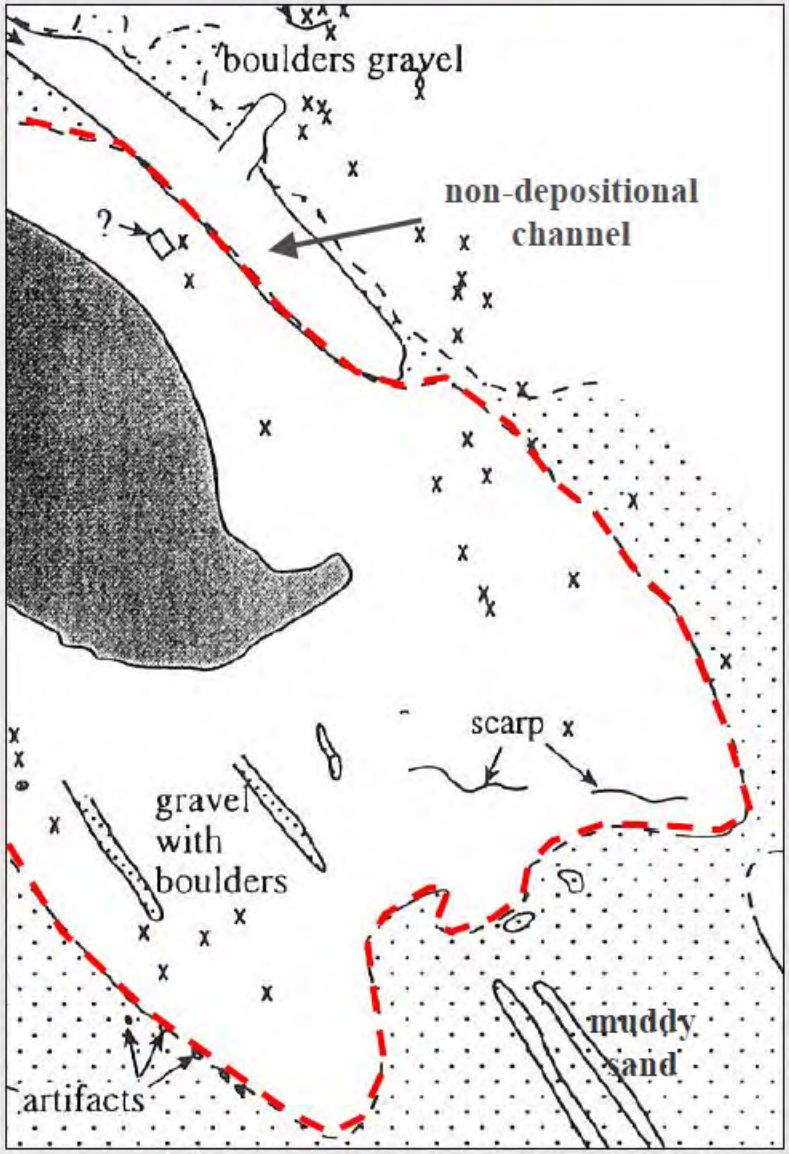
Ref: Barnes and Piper 1978

Relative Sea Level Curve for Atlantic Canada



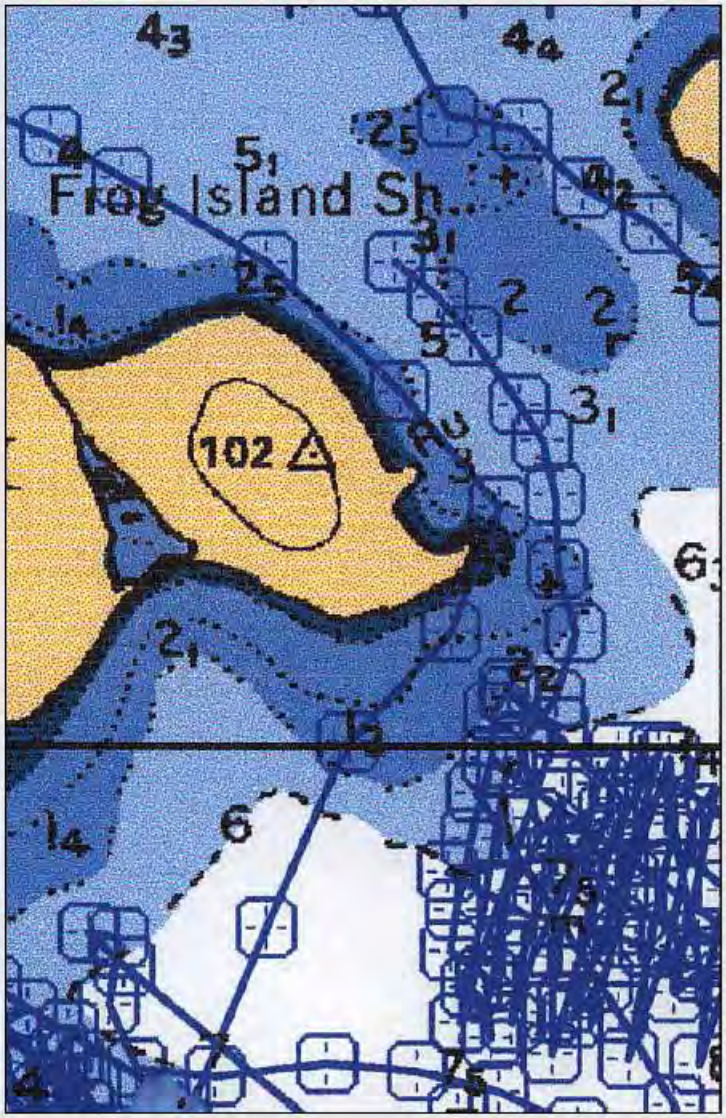
Mutlibeam Bathymetry at Oak Island July 1996

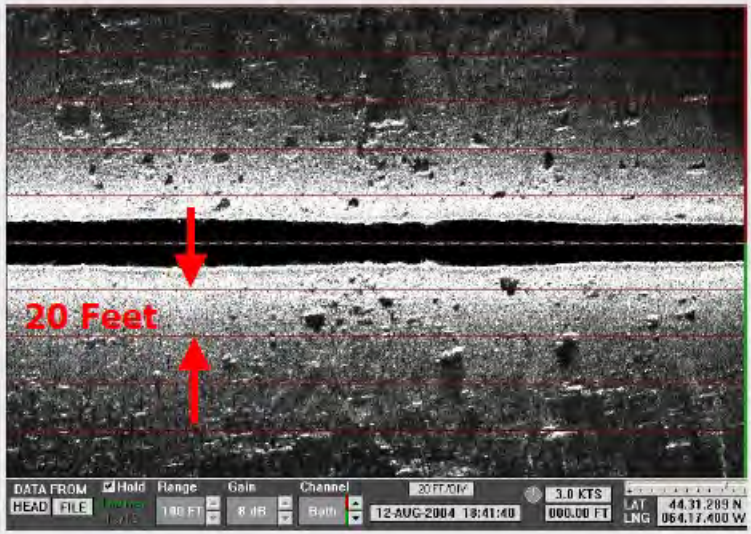


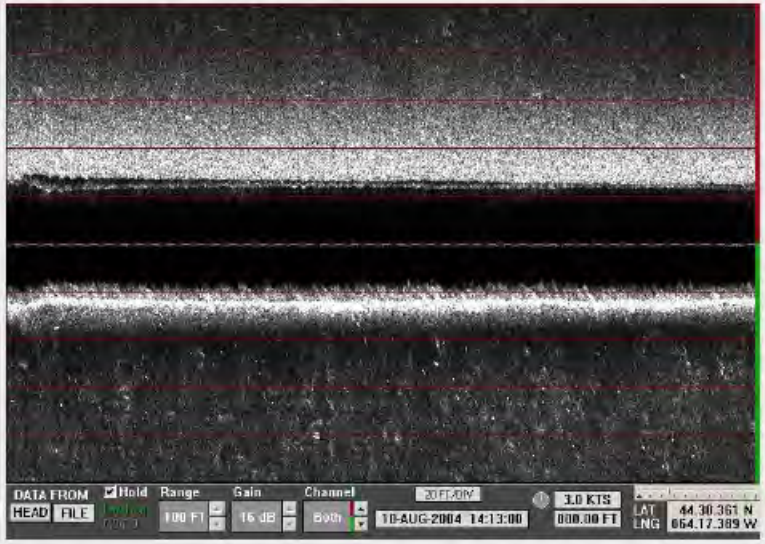


Ref: Fader and Courtney 1998

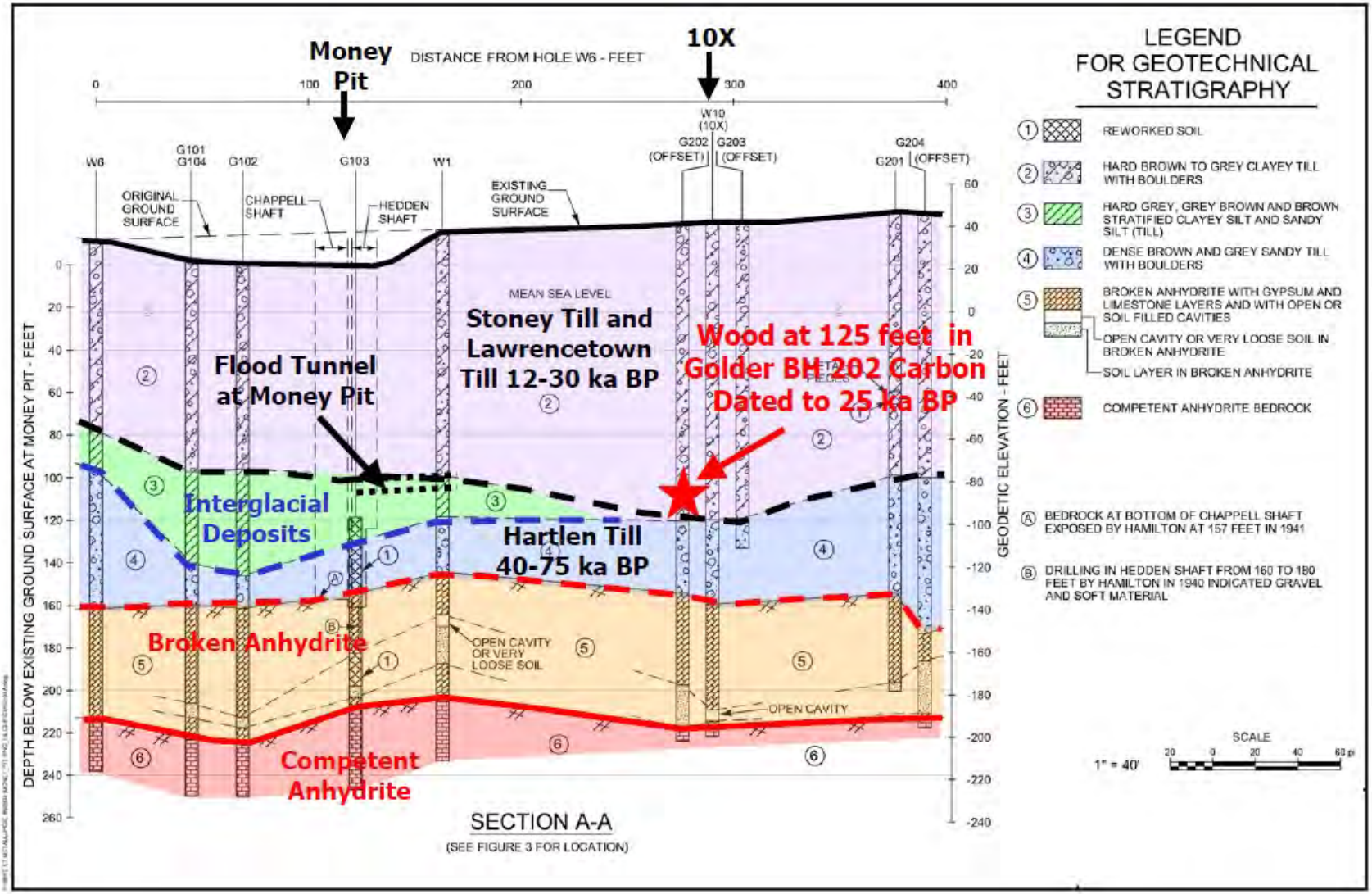
Side Scan Survey by Dave Delaney Aug 05







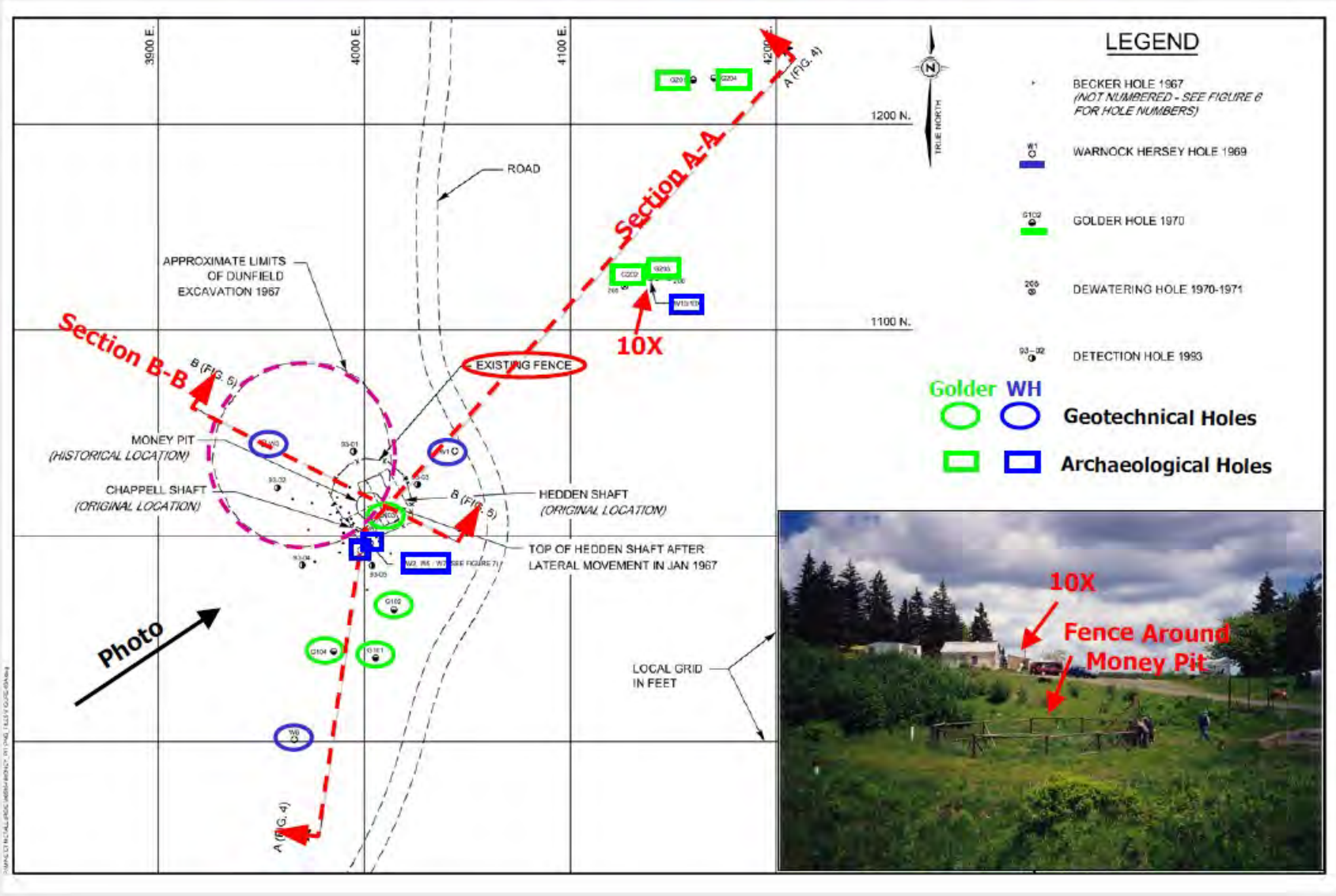
Geological Profile at Money Pit and 10X



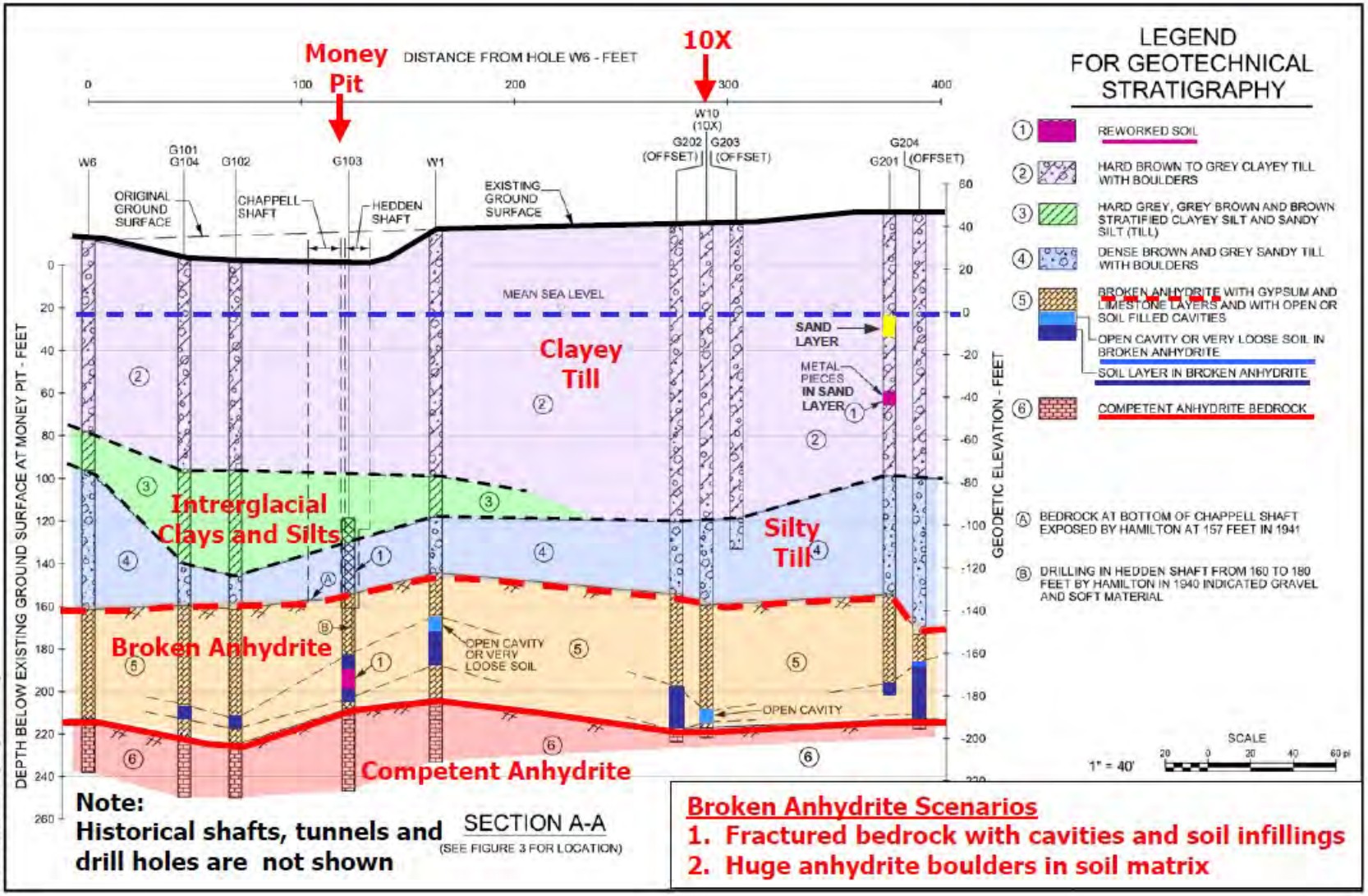
Geotechnical Investigations at the Money Pit

1. Becker Drilling 1967
2. Warnock Hersey 1969
3. Golder Associates 1970
4. Detection Program Drilling 1993

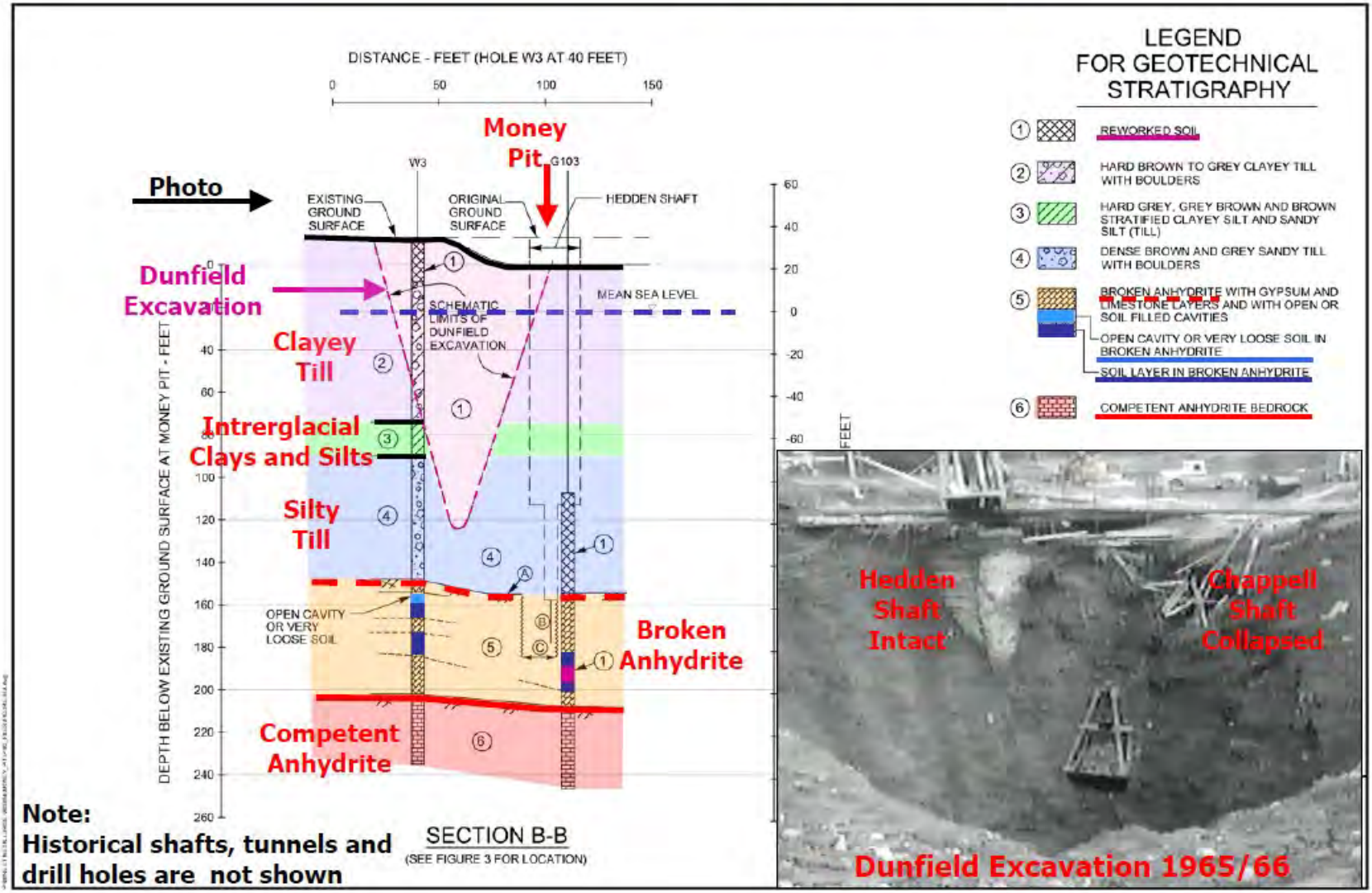
Plan of Exploration Boreholes



Geotechnical Section A-A at Money Pit and 10X



Geotechnical Section B-B at Money Pit and Dunfield Excavation



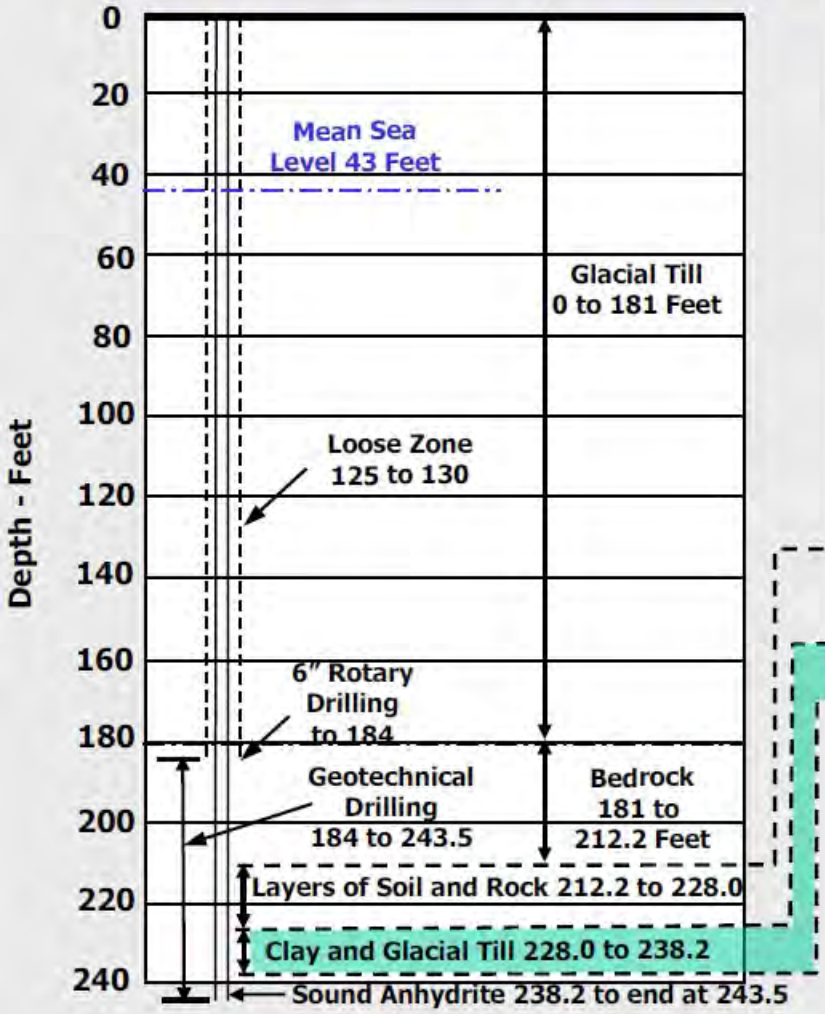
Note:
Historical shafts, tunnels and drill holes are not shown

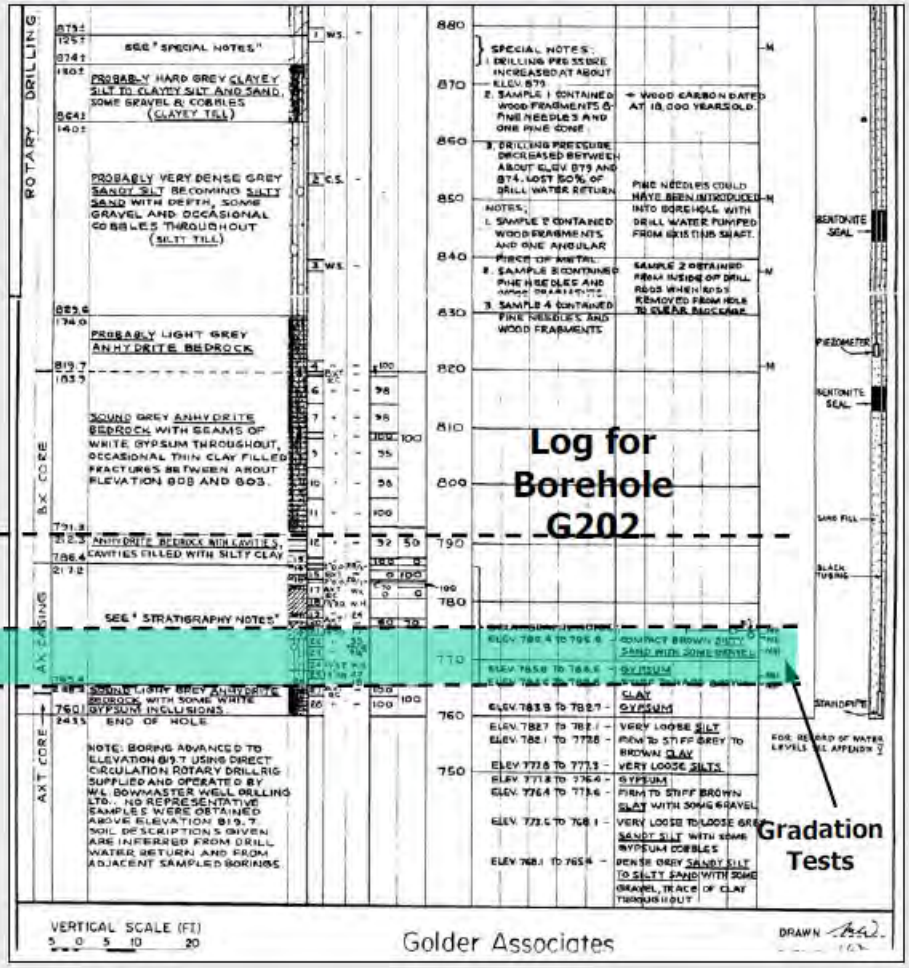
Depth of Cavity/Soil Zones in Broken Anhydrite

Hole No	Distance and Direction from Money Pit (Feet)	Anhydrite Thickness Above Zone (Feet)	Depth of Cavity/Soil Zone Within Anhydrite (Feet)				Thickness of Zone (Feet)	Anhydrite Thickness Below Zone (Feet)
			Cavity	Cavity or Loose Soil	Loose Soil	Dense Soil		
W1	50 NE	20	-	181 - 186	186 – 195?	195? – 204 N=58	24	46
W3	61 NW	5	166 – 170	-	170 – 178		12	70 Inc Soil Layer
		8	-	-	186 - 197		11	51
W5	19 S	8	-	-	180 - 206		26	4
W6	120 SSW	No cavities or soil zones encountered in broken anhydrite						
W7	17 S	15	-	-	180 - 209		29	9
10X	176 NE	50	230 - 235	-	-	-	5	26
G101	73 S	53	-	-	-	217 – 227 N>100	10	23
G102	50 S	52	-	-	-	214 – 219 N=61, 58	5	22
G103	10 E	28	-	-	185 – 200 Reworked	200 – 205 N>100	20	43
G104	72 SSW	47	-	-	-	209 – 216 N=41, 67	7	36
G202	174 NE	43	-	-	217 – 238 Ft		21	5
G204	267 NE	13	211 - 213	-	213 - 217	217 – 236 N=34-100	23	7

Note: Twelve geotechnical and archaeological holes extended into the broken anhydrite. Eleven of the 12 holes encountered cavity/soil zones in the broken anhydrite.

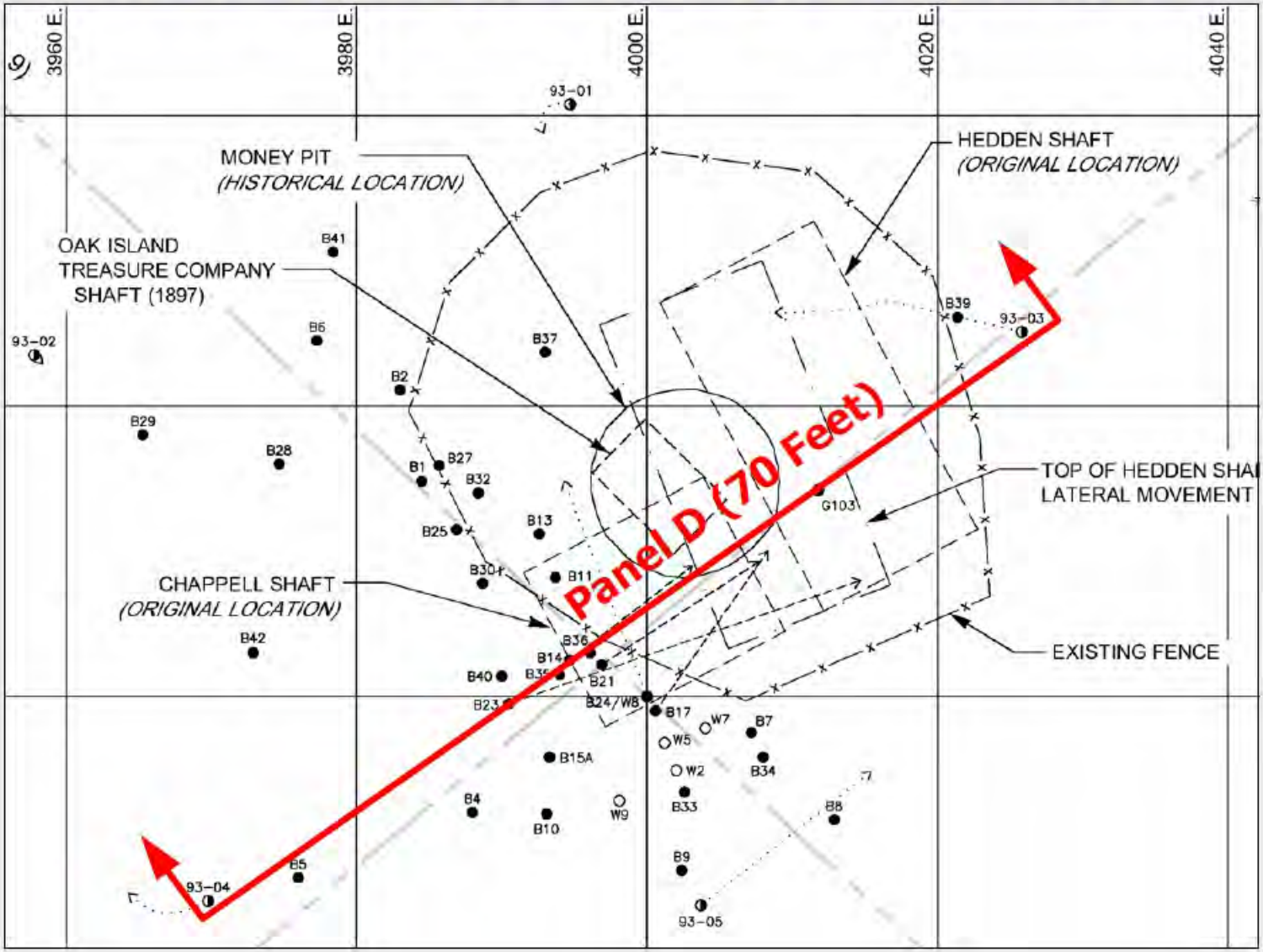
Gradation Test Samples of Soil Infilling Golder Hole G202 Located 3 Feet West of Hole 10



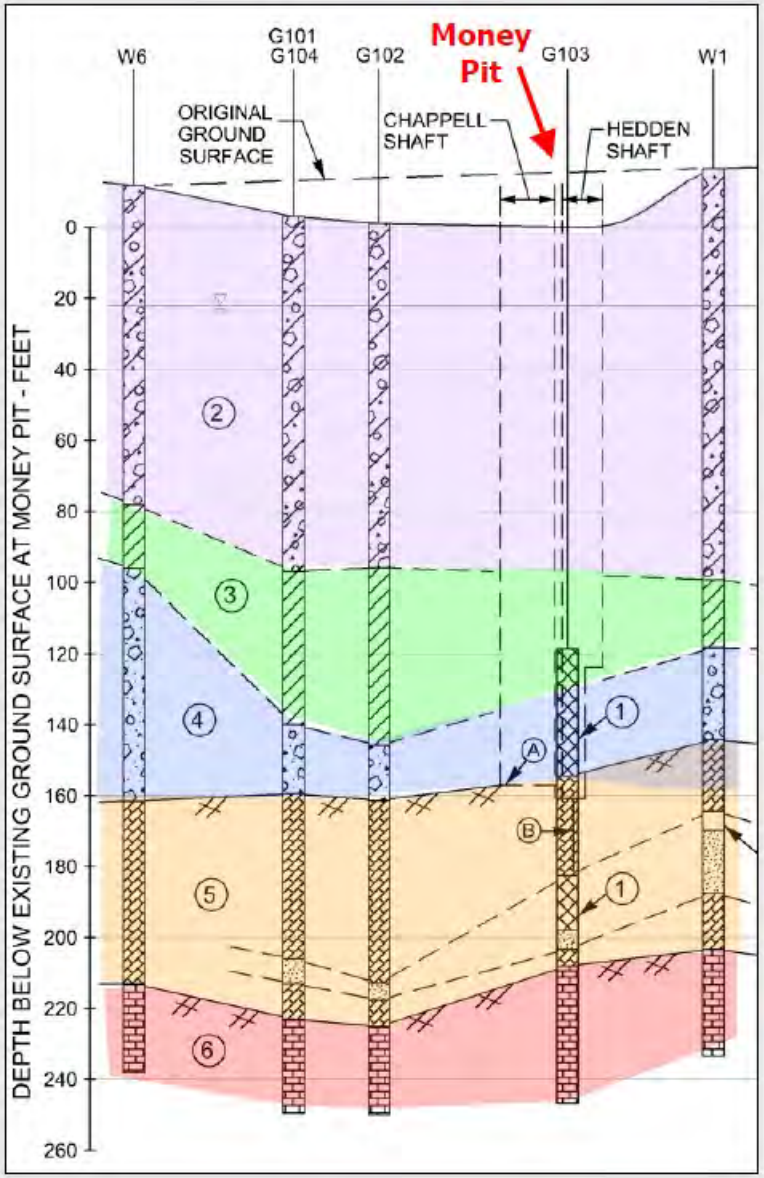


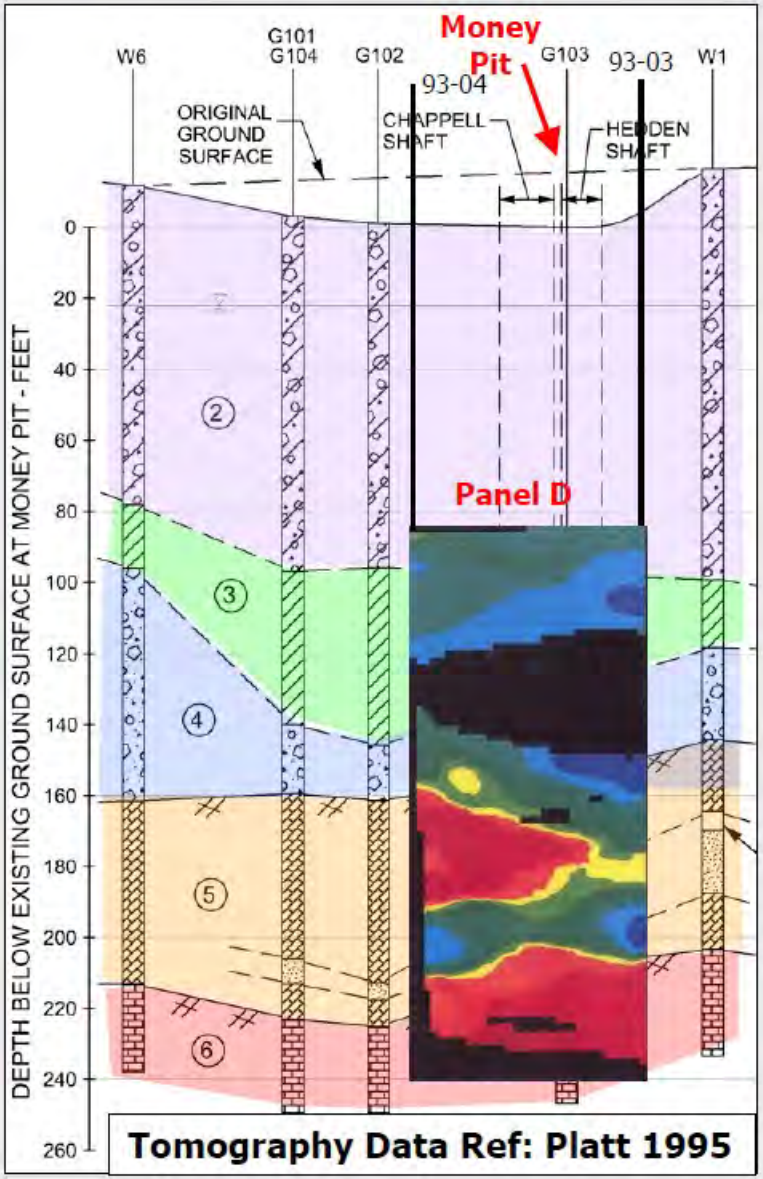
Ref: Golder 1971

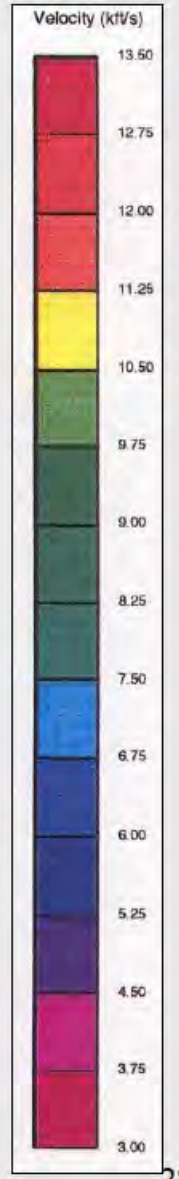
Plan of Cross Hole Tomography Panel D



Profile of Tomography Results for Panel D







Plan of Woods Hole Tidal Hydrogeology Testing in July 1995