APPENDIX G

1962 MDOT SEISMIC REPORT ON I-96 BY MR. D. N. HART

OFFICE MEMORANDUM

MICHIGAN
STATE HIGHWAY DEPARTMENT
JOHN C. MACKIE, COMMISSIONER

May 4, 1962

To: Mr. R. L. Greenman
Assistant Testing and Research Engineer

From: G. O. Kerkhoff

Subject: Report of Seismic and Boring Survey
I-96, Grand Rapids Area
Butterworth Road to Fulton Street
Control Section 41029D

Transmitted for your distribution are copies of the subject report. This survey was made on survey centerline of that section of the proposed roadway overlying the old mined area of the Grand Rapids Gypsum Company. Mr. D. N. Hart, Geologist, not only supervised the seismic survey, but also made an underground inspection of the Gypsum mine beneath the proposed roadway. His comments on underground conditions are most revealing.

Survey results indicate that subsurface conditions are complex. The top of the bedrock surface is irregular. In places it is masked by overburden materials having similar texture and seismic velocity.

Interpretation of our findings show that the mined area beneath the roadway has caved in the past and is actively caving at present. While none of this caving within proposed right of way is evident at the surface, there are many exhibits of cone shaped subsidence resulting from collapse of old mine workings.

Your attention is directed to Mr. Hart's conclusions that the proposed roadway overlying the Gypsum mine is in a potentially unstable area. We concur with these conclusions.

OFFICE OF TESTING AND RESEARCH

G. O. Kerkhoff

G. O. Kerkhoff
Head of Soils Section
Testing Laboratory Division

GOK:DFM:PL

ATL
cc: W. W. McLaughlin (4)
C. S. Lundberg
N. C. Jones
A. E. Matthews
J. G. Hautala
K. R. Rock
Project Engineer
C. J. Olsen
D. F. Malott

REPORT OF SEISMIC AND BORING SURVEY

I-96, Grand Rapids, Butterworth Road to Fulton Street
Control Section 41029D
May 4, 1962

This report presents the results of a seismic and boring survey on the above Project. The intended purpose of this survey was to provide bedrock depth data beneath the proposed I-96 roadway crossing the Grand Rapids Gypsum Company Property. This survey was run under the direct supervision of Mr. D. N. Hart, Geologist.

The area encompassed by this survey lies entirely upon morainic deposits associated with the Valparaiso Morainic System. The complex soil structure and accompanying rugged surface relief encountered during this survey are typical of morainic glacial deposits.

Figure I of this report shows a General Location Plan of the survey area. The position of seismic shotholes, seismic traverse traces, and correlation boreholes with respect to survey centerline are illustrated. The random orientation of many of the seismic traverses was necessary in order to avoid excessive terrain corrections and various cultural obstacles. Caved mine roof areas shown on the location plan do not reflect their presence at the ground surface by observable ground subsidences. No observable ground subsidence was discovered in the areas traversed by this survey.

Figures II and III depict the subsurface character and structure, along survey centerline from Station 434+90 to 462+00, as inferred from

geophysical and boring data. In general, the subsurface here is characterized by thick Clay and Loam Glacial Till deposits overlying Shale and Gypsum Bedrock of varying hardness. The Clay and Loam Till contains lenses of dry and saturated granular soil. A considerable surface deposit of sandy soil is present from Station 447 to Station 462, survey centerline. Seismic data at Stations 452 and 454, survey centerline, indicates the presence of a depression in the Hard Shale Bedrock surface which may extend down, or nearly down to the mine roof. The presence of this depression above an area of indicated extensive mine roof caving may be more than coincidental.

Figure IV illustrates a cross sectional interpretation of subsurface character and structure along a random traverse extending 1,650 feet West of Station 458, survey centerline. The primary reason for this traverse was to compare the results of seismic soundings conducted over mined and unmined areas. Results indicate generally that partial removal of Gypsum Bedrock by mining and the associated fracturing, by blasting operations of overlying and adjacent bedrock layers can be detected by seismic velocity measurements in this area.

During the conduct of this survey, the writer had the opportunity to personally examine portions of the Gypsum mine underlying the proposed roadway and other parts of the mine not within the proposed roadway. The portion of underground workings immediately below Stations 460 to 462, survey centerline, were found to be free of caving conditions and water. However, when attempts were made to examine the mine workings from Stations

444 to 459, survey centerline, the writer encountered caved mine roof and water of sufficient depth to discourage further investigations of this area. In addition to the foregoing, mine workings not within the proposed roadway were examined where the mine roof had completely collapsed. Large amounts of yellow sand and cobble gravel were found filling the mine workings at these points. The ground surface above these caved areas is marked by many funnel-shaped depressions, some of which are 40 or 50 feet in diameter and as deep as 25 feet. The writer also observed the effects of mine floor heaving and mine pillar collapse due to swelling or slaking of soft shale beds.

In conclusion, the writer believes that mine roof conditions under much of the proposed I-96 roadway lying over the mined area are unstable. This is not to imply that the mine under the proposed roadway is on the verge of complete immediate collapse. It is to indicate, however, that progressive deterioration of the mine roof rock is underway at this location. The material above the Hard Shale Bedrock at Station 454, survey centerline, should be investigated in detail. This should be done by a deep core boring, as this location could easily become a focal point of possible future mine roof collapse.

OFFICE OF TESTING AND RESEARCH

D. N. Hart

D. N. Hart
Supervisor of Seismic Survey
Sub-Unit
Testing Laboratory Division

FIELD LOG OF CONTINUOUS FLIGHT AUGER AND WASH BORINGS

I-96, Grand Rapids, Butterworth Road to Fulton Street
Control Section 41029D

MDU Boring B-1, Station 434+90, Survey Centerline

0 - 2	feet	Brown Loam
2 - 6.5	feet	Plastic Brown Clay
6.5 - 9	feet	Soft Dark Gray Shale
9 - 10	feet	Firm Dark Gray Shale
10 - 12	feet	Very Hard Drilling - Probable Limestone Lense
12 - 15	feet	Probable Soft Weathered Shale
15 - 22.5	feet	Hard Drilling - Probable Firm Shale
22.5 - 26+	feet	Very Hard Drilling - Probable Shale. No Recovery from 10 to 26 feet due to Enlarged Borehole

Test Hole No. 7, Wash Boring, Station 30 feet Left of Station 436+08, Survey Centerline

0 - 0.5	feet	Topsoil
0.5 - 3.5	feet	Stiff Yellow Sandy Clay
3.5 - 4.5	feet	Stiff Yellow and Gray Mottled Clay
4.5 - 7	feet	Moderately Compact Yellow Medium Sand with Heavy Trace of Clay
7 - 9	feet	Stiff Gray Sandy Pebbly Clay
9 - 12	feet	Hard Gray Sandy Pebbly Clay
12 - 14	feet	Stiff Gray Sandy Pebbly Clay
14 - 22+	feet	Stiff Yellow Sandy Pebbly Clay

MDU Boring B-2, Station 440, Survey Centerline

0 - 1	feet	Brown Sandy Loam Topsoil
1 - 4	feet	Yellow Fine to Very Fine Sand
4 - 8	feet	Yellow Fine Sand
8 - 13	feet	Yellow Fine Sandy Loam
13 - 21	feet	Yellow Fine Sand
21 - 25	feet	Firm Reddish-Brown Pebbly Clay Loam
25 - 36.5	feet	Hard Brown Pebbly Clay Loam
36.5 - 38	feet	Gravelly Sandy Loam
38 - 45	feet	Fine to Medium Loamy Sand
45 - 50	feet	Firm Gray Pebbly Sandy Clay Loam
50 - 53+	feet	Very Hard Gray Pebbly Sandy Clay Loam

MDU Boring B-3, Station 442, Survey Centerline

0	- 16	feet	Yellow Sandy Loam
16	- 19	feet	Firm Reddish-Brown Silty Clay
19	- 24	feet	Firm Grayish-White Pebbly Sandy Clay Loam
24	- 28	feet	Firm Grayish-Brown Pebbly Sandy Clay Loam
28	- 31	feet	Brown Sandy Loam
31	- 38+	feet	Firm Gray Pebbly Sandy Clay Loam

MDU Boring B-4, Station 446, Survey Centerline

0	- 4	feet	Brown Loamy Fine Sand
4	- 5	feet	Yellow Fine Sand
5	- 7	feet	Yellow Fine Sand with Clay Lenses
7	- 12.5	feet	Brown Loamy Fine Sand with Occasional Pebble
12.5	- 20	feet	Plastic Brown Pebbly Sandy Clay
20	- 25.5	feet	Firm Brown Clay
25.5	- 31	feet	Harder Drilling - No Recovery - Probable Stiff Stiff Gray Clay or Loam
31	- 41	feet	Easy Drilling - Recovered Saturated Gray Fine to Very Fine Sand
41	- 48+	feet	Hard Drilling - Recovered Stiff Dark Gray Clay on Bottom Auger. This Material has Color very Similar to Shale Recovered from MDU Boring B-1, Station 434+90, Survey Centerline. Water Level in Borehole 12.0 feet

MDU Boring B-5, Station 448, Survey Centerline

0	- 17	feet	Yellow Fine to Medium Sand
17	- 17.5	feet	Cobbles - Very Difficult to Penetrate - May be Embedded in Hard Loam Soil
17.5	-	feet	Refusal

MDU Boring B-6, Station 450, Survey Centerline

0	- 4	feet	Yellow Fine Sand
4	- 18	feet	Yellow Fine Sand
18	- 29	feet	Yellow Sandy Loam
29	- 37	feet	Yellow Fine Sand
37	- 41	feet	Firm Brown Pebbly Sandy Clay Loam
41	-	feet	Refusal - Cobbles and Hard Clay

MDU Boring B-7, Station 455, Survey Centerline

0	- 4	feet	Yellow Very Fine Sand
4	- 17	feet	Yellow Fine Sand
17	- 23	feet	Brown Fine Sand
23	- 32	feet	Yellow Loamy Sand
32	- 33	feet	Firm Brown Sand Clay Loam
33	- 35+	feet	Firm Gray Pebbly Sandy Clay Loam

MDU Boring B-8, Station 458, Survey Centerline

0	- 6	feet	Soft Brown Sandy Clay
6	- 7	feet	Saturated Gray Sand
7	- 16	feet	Saturated Yellowish-Brown Pebbly Sand
16	- 24	feet	Firm Gray Clay
24	- 30	feet	Harder Drilling - Recovered Hard Gray Loam on Bottom Auger
30	-	feet	Refusal - Water Level in Borehole 3.0 feet

MDU Boring B-9, Station 1,100 feet West of Station 458, Survey Centerline

0	- 6	feet	Brown Loam and Clay Loam
6	- 36	feet	Yellow Fine Sand
36	- 40	feet	Yellow Pebbly Fine to Medium Sand
40	- 51	feet	Yellow Gravelly Medium Sand
51	- 53+	feet	Hard Drilling - Probable Hard Gray Loam - No Recovery

Note: Plan view and cross-sections not included in this report. SJV