OTT-2-27.18
EMERGENCY LANDSLIDE REPAIR

Doug Rogers, P.E.
District 2, Planning & Engineering
District Geotechnical Engineer
DISCOVERY OF LANDSLIDE

- November 2017 received an email from ODOT Ottawa County Manager.
- Crack in the edge of pavement.
- County was placing barrels as precaution for motorcycles.
DISCOVERY OF LANDSLIDE - NOVEMBER 9, 2017
LANDSLIDE LOCATION
LANDSLIDE LOCATION, STATE ROUTE 2, OTTAWA COUNTY
LANDSLIDE LOCATION

EASTBOUND SR 2 TRAFFIC

USE: SR 59 SOUTH TO US 6/28
EAST TO US 6, TAKE US 6 EAST TO SR 2.

★ = LOCATION OF ROAD CLOSURE
→ = DIRECTION OF DETOUR
DISCOVERY OF LANDSLIDE NOVEMBER 16, 2017
DISCOVERY OF LANDSLIDE, NOVEMBER 16, 2017
DISCOVERY OF LANDSLIDE, NOVEMBER 16, 2017
ODOT quickly evaluated funding options.

The District consulted with OGE on a path to develop an emergency construction plan.
On November 30, 2017, I contacted both Curt Roupe (TTL) and Tom Morman (Stantec). I received a commitment to the project and proposals back quickly. ODOT provided advanced authorization on December 4, 2017.
OTT-2-27.18 LANDSLIDE

- TTL was drilling and installing inclinometers within the week of authorization.
- Stantec prepared to survey the landslide site as ODOT began clearing the brush.
Objective was to determine the depth and extent of the landslide.

TTL - Team: David Vovak, Curt Roupe, Kate Hennicken

Stantec Team: Tomorman, Steve Shadix, Eric Kistner, Mike Strudlevant and Paul Durham
OTT-2-27.18 LANDSLIDE INVESTIGATION

- TTL - 9 Soil Borings - 40’ (soil), 15’ (bedrock)
- TTL - Placed 3 inclinometers in a line from the mid-slope to the edge of the pond.
OTT-2-27.18 LANDSLIDE INVESTIGATION

- Stantec - Survey and develop existing cross sections at 25’ spacing
- Stantec/TTL - Develop Cost-based alternatives to repair the landslide
- Stantec - Deliver an Emergency Plan set for low bid to sell and reconstruct before Memorial Day.
OTT-2-27.18 LANDSLIDE INVESTIGATION

- TTL Lab - LOI Testing, Consolidated-Undrained (CU’) tests with pore water measurements.
- Direct shear testing
- Unconfined Compression tests on soil and rock.
- Geophysical - Electrical Resistivity Testing (added late)
### OTT-2-27.18 - SOIL BORINGS

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<th>ELEV. 585.7</th>
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<td>HARD, BROWN/GRAY, SANDY SILT, LITTLE CLAY AND GRAVEL, DAMP</td>
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</tbody>
</table>
o During drilling voids were encountered.

o Original construction plans show natural sinkholes in this area.

o Gypsum mine remediation about 1 mile from this location
OTT-2-27.18 - RESISTIVITY TESTING

[Diagram showing a resistivity testing setup with various markers and annotations, including project north orientation, grid coordinates, andNotes: AGI SuperSALT R1 w/ 56 electrodes + milisolt Dipo-Dipole array, 6 ft & 7 ft electrode spacing. Transient positioning per Trimble GeoXT GPS system with Zephyr antennas. All North State Plane geographic coordinates (feet). Survey dates: December 20 & 21, 2017. Locations of site, aerial survey ER transacts and interpreted features are approximate.]

DRAFT/PRELIMINARY

Scale: 1" = 40 ft
OTT-2-27.18 - RESISTIVITY TESTING

A) ER-1: Electrical Resistivity Transect Inversion Model
(toe of embankment)

B) ER-3: Electrical Resistivity Transect Inversion Model
(mid-slope of embankment)

DRAFT/PRELIMINARY

Notes:
- AGI SuperSting w/56 electrodes + resistivity
- Dipole-Dipole array, 6" & 14" min electrode spacing
- EarthImager Ver 2.4.4 ER inversion program
- Survey dates: December 2016-21, 2017
- Boring info provided by TLA
- Refer to Figure 1 for ER transect locations

Dipole-dipole array: Min electrode spacing: 6 ft
Model iterations: 5; RMS Error 2.66%; Norm L2: 0.79

Dipole-dipole array: Min electrode spacing: 6 ft
Model iterations: 4; RMS Error 2.66%; Norm L2: 0.79

Low resistivity - silt and clay embankment fill (wet to saturated)
Low Intermediate resistivity zone - possible voided, deteriorated or soil filled conduit
Low to Intermediate resistivity - silt and clay embankment fill (saturated to wet)
Intermediate Resistivity - silt and clay with sand lenses (saturated)
Intermediate to High Resistivity - Dolomite bedrock

Intermediate to High Resistivity - Dolomite bedrock
E) ER-4: Electrical Resistivity Transect Inversion Model (mid-slope)

**DRAFT/PRELIMINARY**

- **Low Resistivity**: gravel roadway fill
- **Low Resistivity - silt and clay embankment fill (wet to saturated)**
- **Intermediate to high Resistivity - silt and clay with sand lens (saturated)**
- **Dolomite**: low/intermediate resistivity zone - possible voided, deteriorated or soil filled conduit
- **B-002-1-17 (mid-slope inclinometer)**
- **B-002-2-17 (no-e-slope inclinometer)**

**Notes:**
- APD SuperDip w/ 56 electrodes + roll cable
- Dipole-Dipole array
- 64 ft electrode spacing
- EarthImager Ver. 2.4.4 SR Inversion program
- Survey dates: December 20 & 21, 2017
- Refer to Figure 1 for ER transect location
OTT-2-27.18 - INCLINOMETER READINGS
1. Shear Key - Dig out with Rock Replacement
2. Drilled Shaft Wall at Mid-Slope
3. Drilled Shaft Wall at Toe of Slope
OTT-2-27.18 - EXISTING CONDITION

Material
Embarkment (Drained)
Lacustrine (Drained)
Lacustrine Failure (Drained)
Glacial Till (Drained)
Bedrock

Unit Weight (pcf)
130
135
135
135
-

Phi (deg)
23
20
10.7
26
-

Cohesion (psf)
50
25
0
200
Impenetrable

Traffic Load = 250 psf

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.
OTT-2-27.18 - ROCK SHEAR KEY

Slope Stability Analysis – FS = 1.40

<table>
<thead>
<tr>
<th>Material</th>
<th>Unit Weight (pcf)</th>
<th>Phi (deg.)</th>
<th>Cohesion (psf)</th>
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<td>23</td>
<td>50</td>
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<td>Proposed Embankment (Drained)</td>
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<td>25</td>
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<td>Lacustrine Failure (Drained)</td>
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<tr>
<td>Glacial Till (Drained)</td>
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<td>200</td>
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<td>Failed Soil (Drained)</td>
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<tr>
<td>Dumped Rock (Drained)</td>
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<td>Impenetrable</td>
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<tr>
<td>Bedrock</td>
<td>-</td>
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</table>

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

Traffic Load = 250 psf
OTT-2-27.18 - UA SLOPE
**OTT-2-27.18 - COST COMPARISON**

Alt 1: $2.2M  Alt 2: $3.5M  Alt. 3: $2.2M

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<tr>
<th>Estimated Alternative Cost</th>
<th>Shear Key (Dig Out) Alternative 1</th>
<th>Drilled Shaft Wall @ Mid-Slope Alternative 2</th>
<th>Drilled Shaft Wall @ Toe of Slope Alternative 3</th>
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<td>Comparison</td>
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<td>1.59</td>
<td>1.00</td>
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| Right of Way impact        | Proposed ditch extends beyond right of way into drainage easement at east end of project. | Toe berm required which may extend beyond right of way limits into drainage easement at east end of project. | Proposed ditch extends beyond right of way into drainage easement at east end of project. |
| Wetland impact             | None anticipated                   | None anticipated                            | None anticipated                             |
| Requires excavation below elevation of lake water level | Yes. Shear key may require dewatering. | No                                          | No                                           |

Note: This estimate is for comparison of alternatives only and does not represent total construction cost of the project.
TYPICAL BENCHING DETAIL
Plan package sent to District, processed and sent to Columbus for Estimating - to sell as Emergency Type C project.
CONSTRUCTION - OTT-2-27.18
OTT-2-27.18 TIMELINE SUMMARY

- ODOT Maintenance 1st notices crack in the pavement mid-November 2017
- Landslide accelerates by the end of November resulting in closure of westbound SR 269 exit ramp.
OTT-2-27.18 TIMELINE SUMMARY

- ODOT received assistance from Stantec and TTL starting December 4, 2017.
- Design Team provided Preliminary Design on January 12, 2018.
OTT-2-27.18 TIMELINE SUMMARY

- ODOT received plan package and sent to Columbus February 15, 2018.
- Project Sale March 22; Project Award March 29, 2018
- Low Bidder Independence Excavating $3,322,667.50
QUESTIONS

Thank you TTL and Stantec!