Interim Risk Reduction Measures for Seepage Mitigation and Stability Improvement at Laurel Mountain State Park Water Supply Impoundment

For: PITT IRISE

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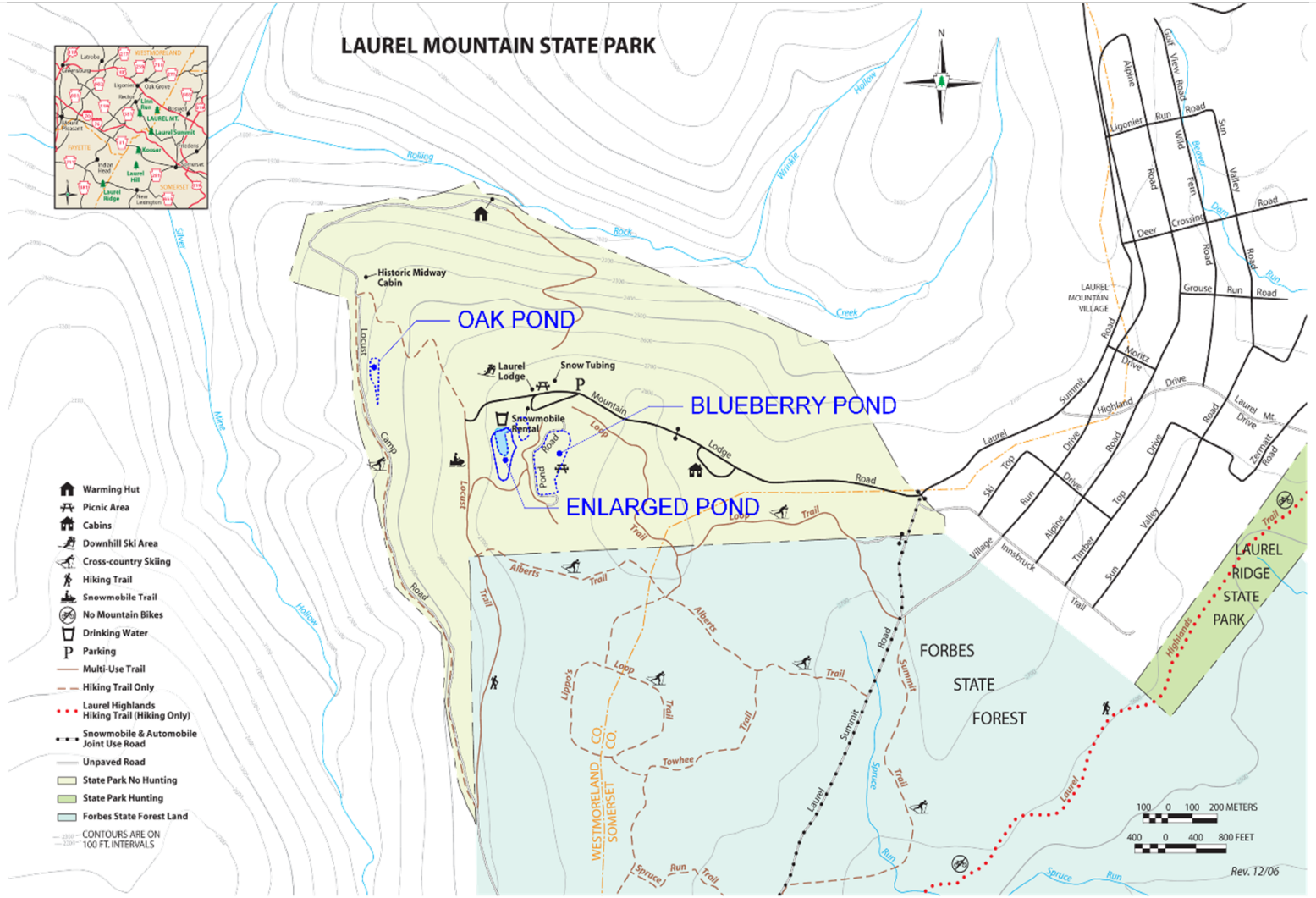
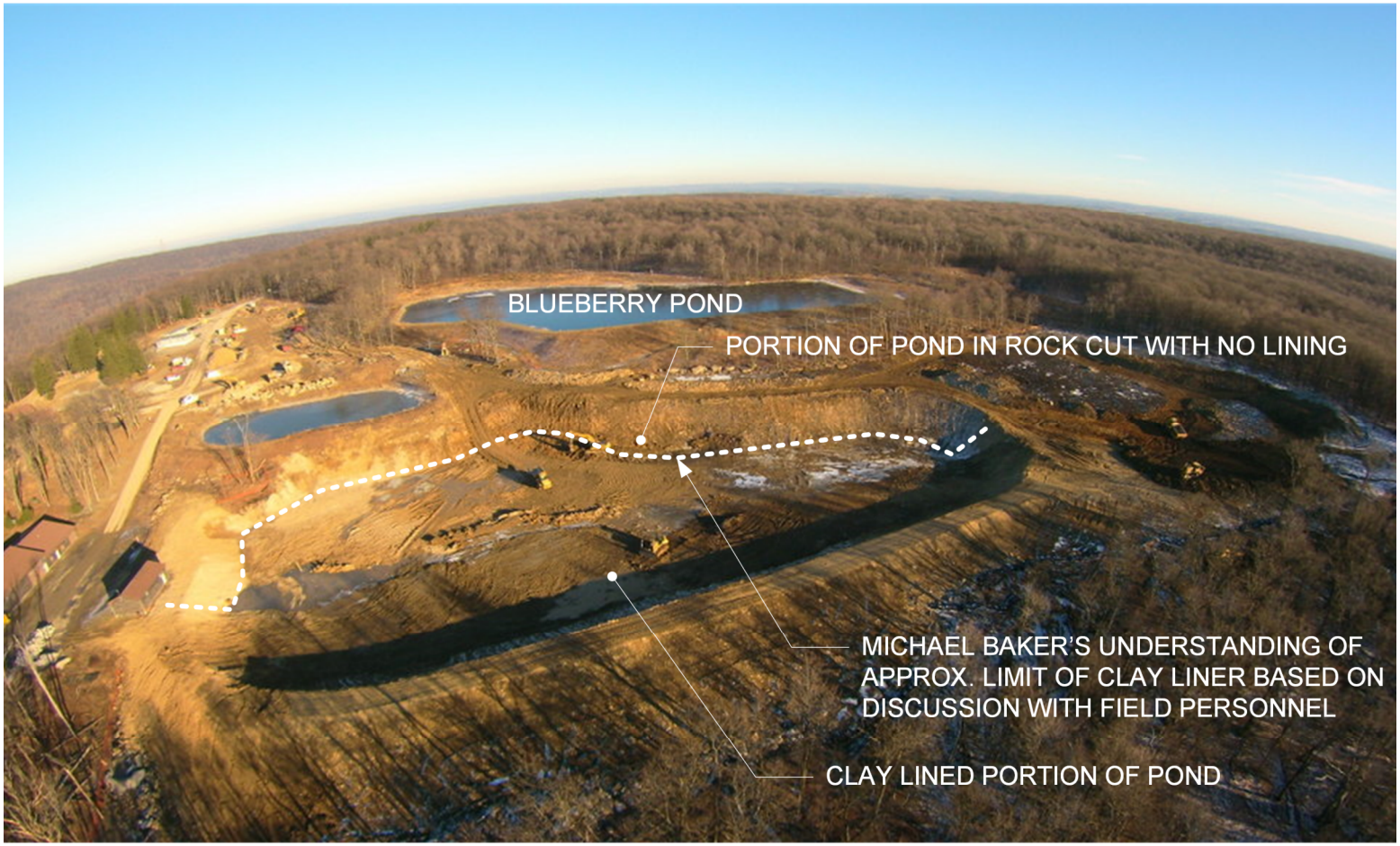
Project Site



Details of Work Completed

- Review of project records and published geologic data
- Detailed Site Reconnaissance
- Static LiDAR Survey
- Geophysical Survey including Electromagnetic (EM) Terrain Conductivity survey
- Interpretation of commercially available multispectral color infrared (4-band red/green/blue/near-infrared) hi-resolution (30 cm/pixel) satellite imagery
- Seepage and Embankment Stability Sensitivity Analysis
- Developed IRRM for construction

Review of Project Records



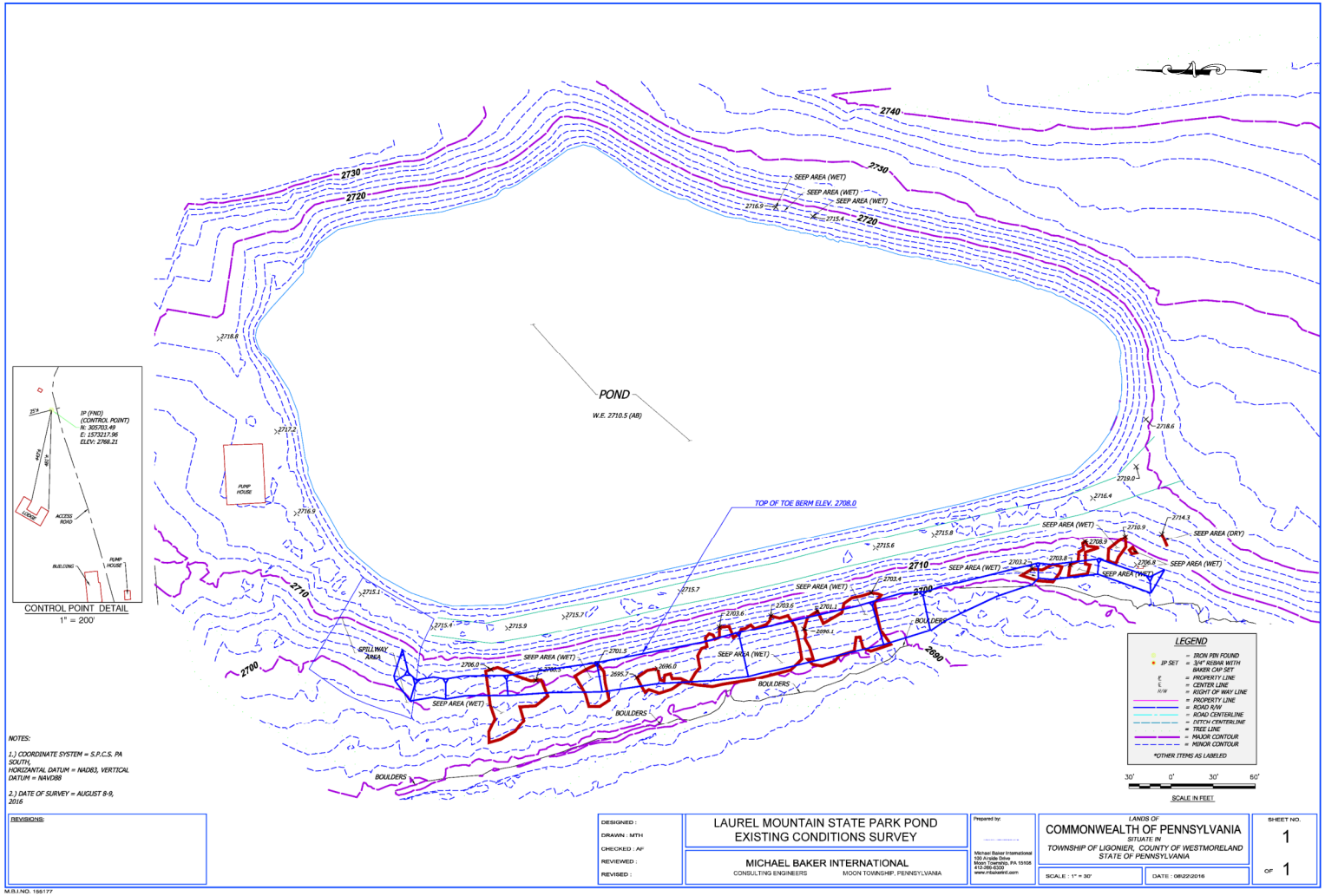
Sandstone was excavated and fractured sandstone may be exposed below the water surface near the easterly edge of the enlarged pond

Detailed Site Reconnaissance

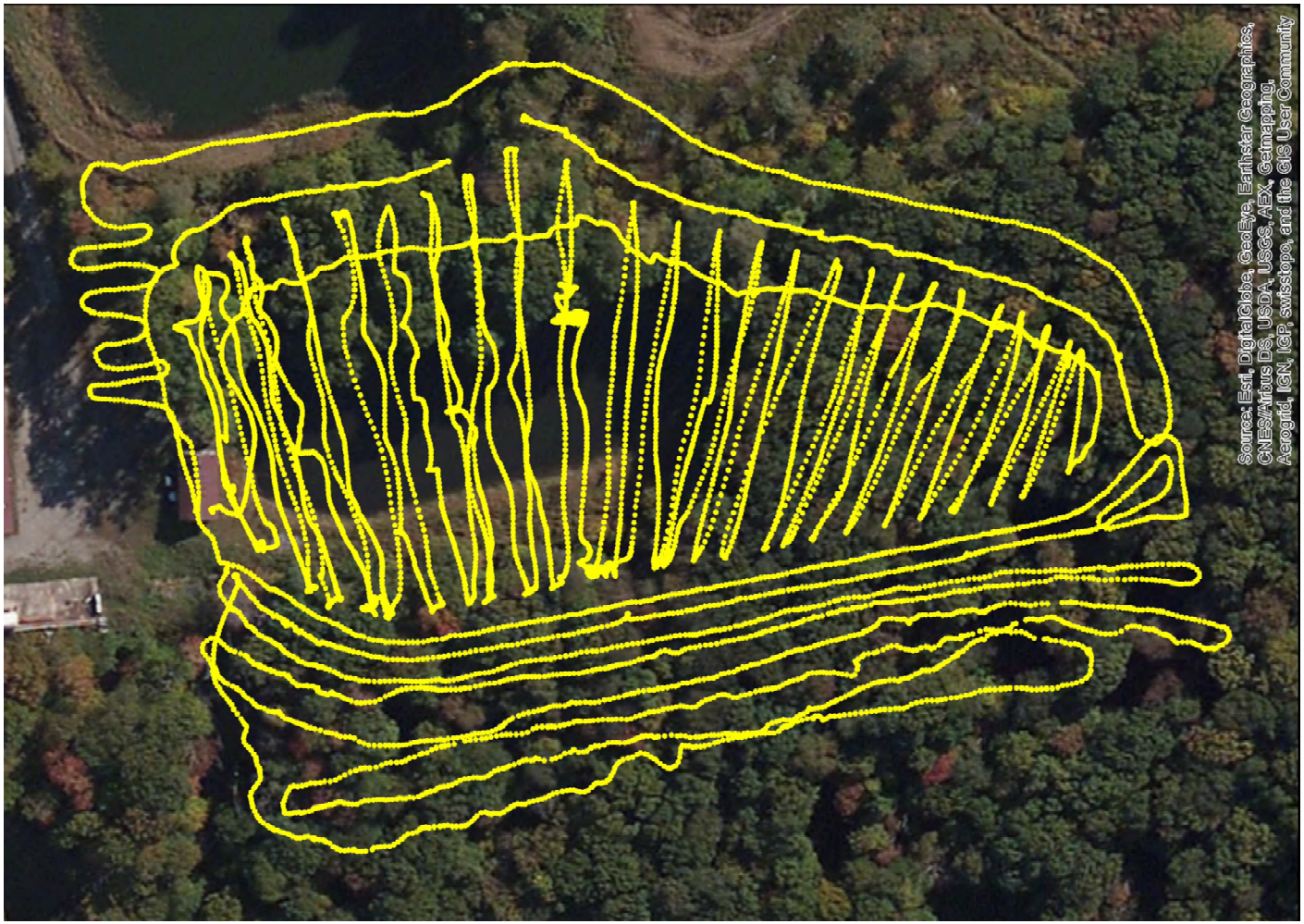
Seepage Flow:
Downstream Face of Embankment

Slumps: Observed during Site Reconnaissance

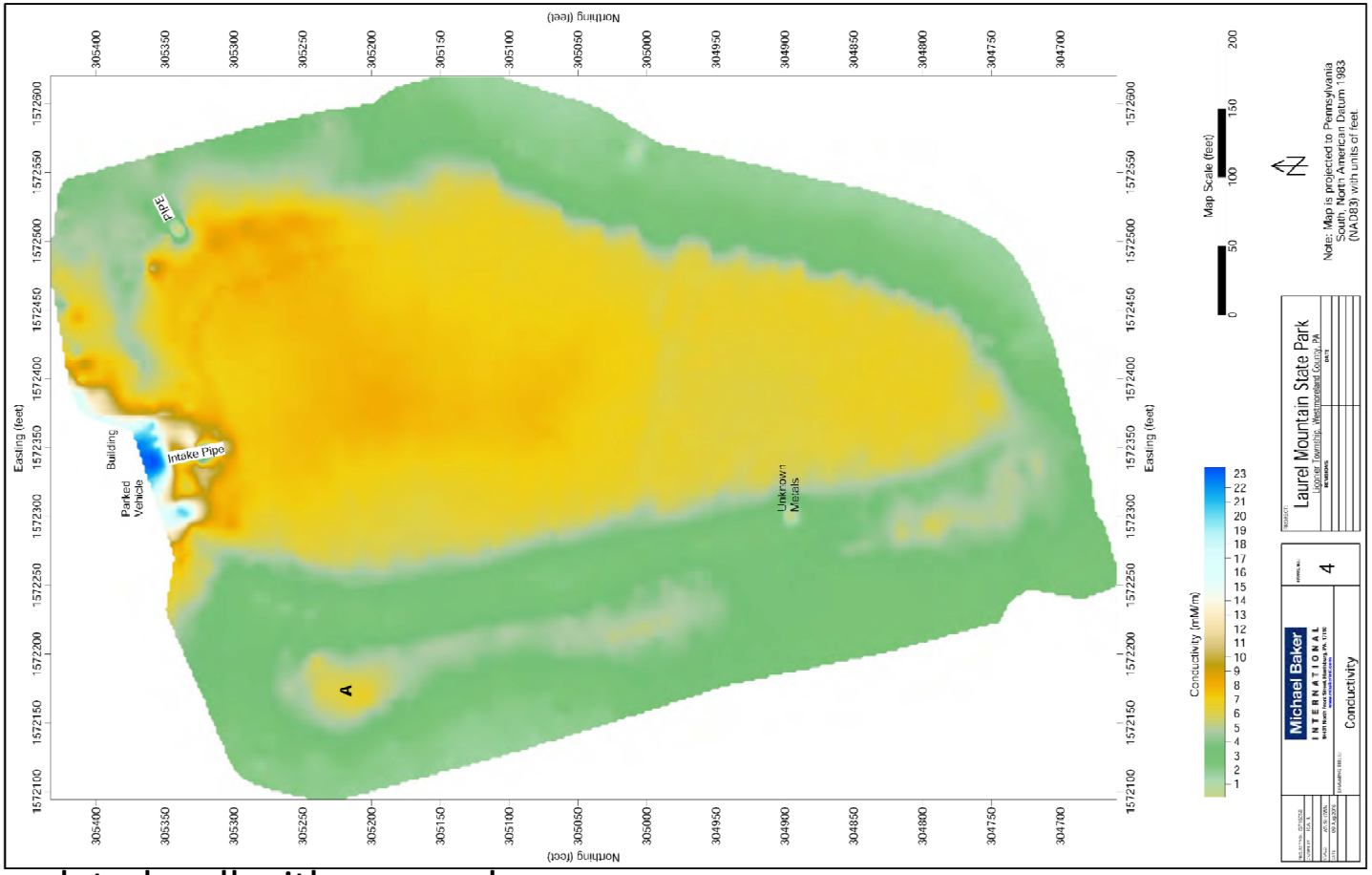
Composite Topo Plan of Site Reconnaissance Findings



Geophysical Survey -A Plan of EM Measurements



Geophysical Survey – Plan of EM Conductivity

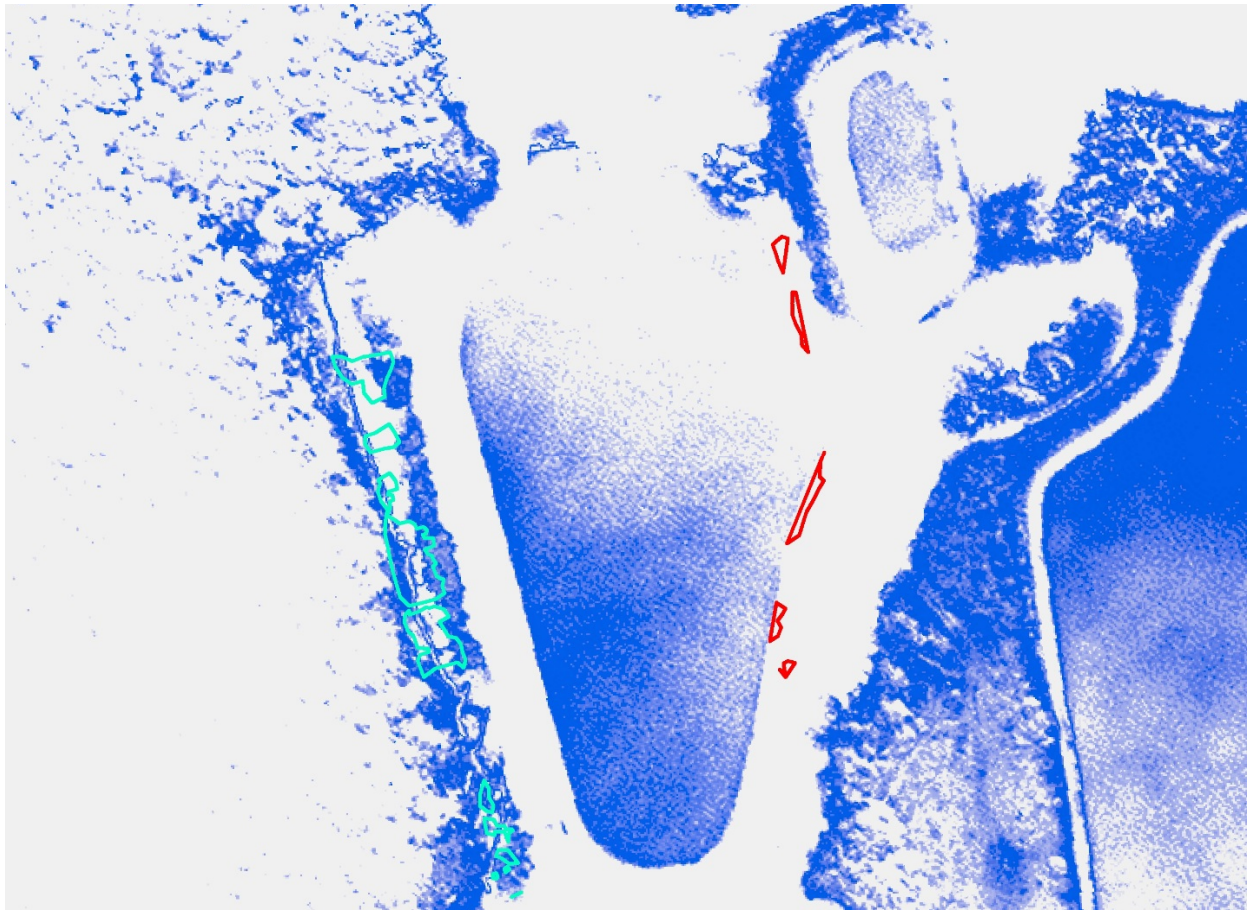


- Correlated well with mapped seepage areas
- Did not identify significant geologic anomalies which would account for why seepage would have begun to emanate

NDVI (Normalized Difference Vegetation Index), NWDI (Normalized Water Difference Index) and Density Slices

seepage was not apparent prior to pond filling

NDVI (Normalized Difference Vegetation Index), NWDI (Normalized Water Difference Index) and Density Slices



Seepage was apparent after pond filling . The red shapes were created using density slices, multiple imagery band combinations using NDVI and NWDI results.

Plausible Seepage Sources

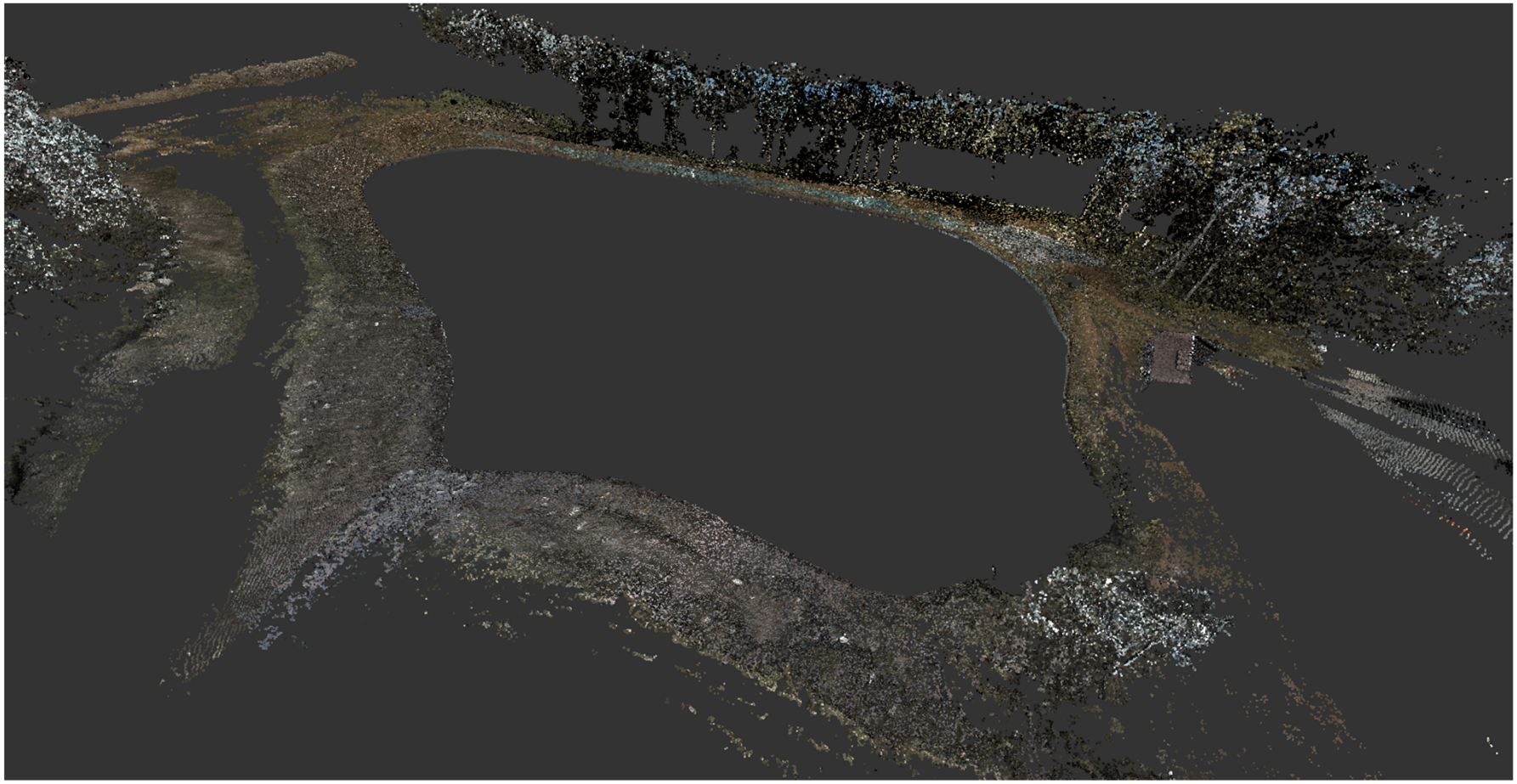
Interpretation of the infrared imagery suggests that the seepage had penetrated the dike within an approximate 2 to 3-month period after the pond was filled.

- Seepage may be emanating from the two adjacent existing ponds and flowing into the enlarged pond.

- Dike seepage is originating from the easterly edge of the clay liner, which is then flowing under the clay liner and then along a fill-lift interface within the dike embankment.

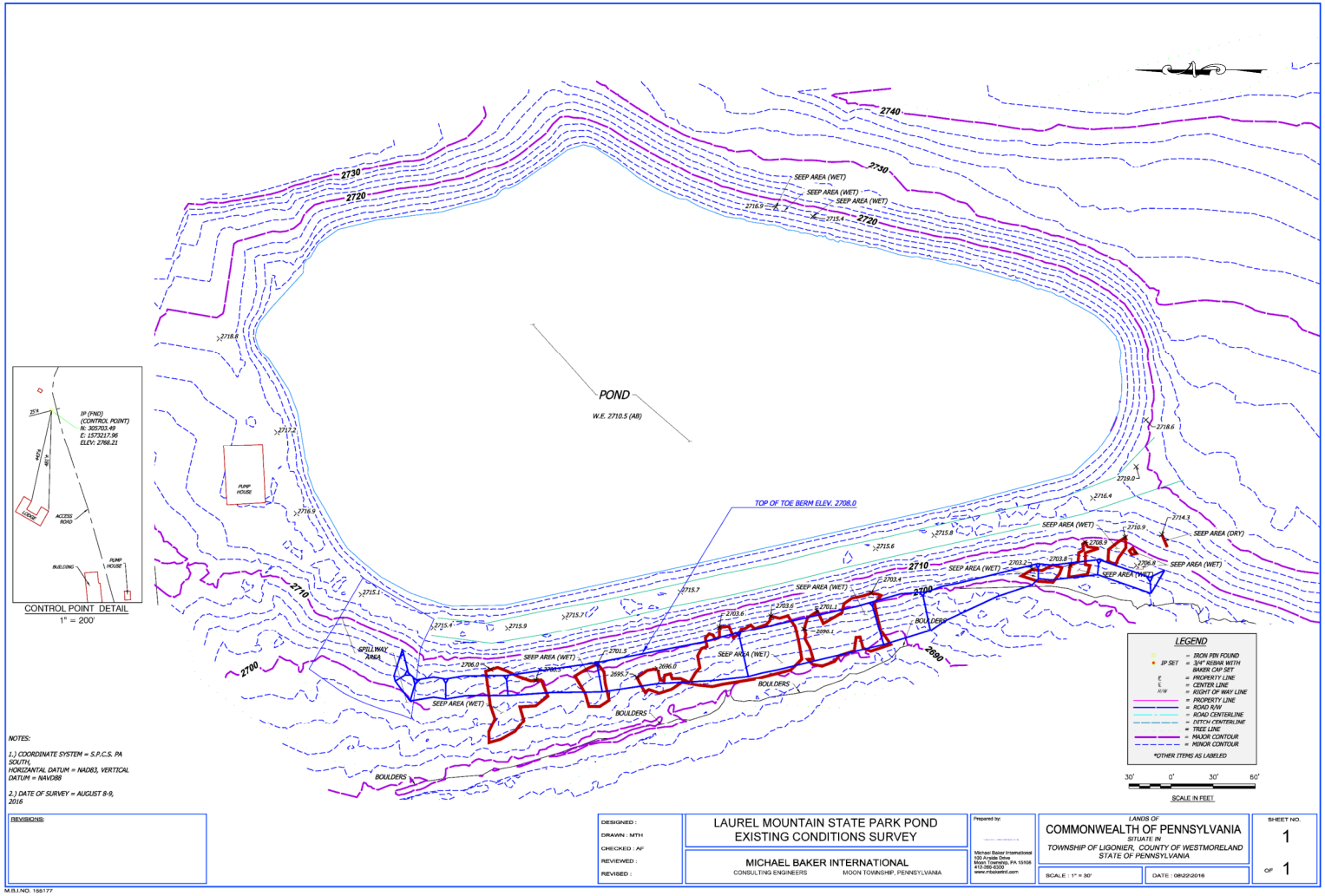
- It is possible that a portion of the seepage is migrating through open bedrock fractures and then flowing upward as underseepage below the dike.

Static LiDAR (Light Detection and Ranging)

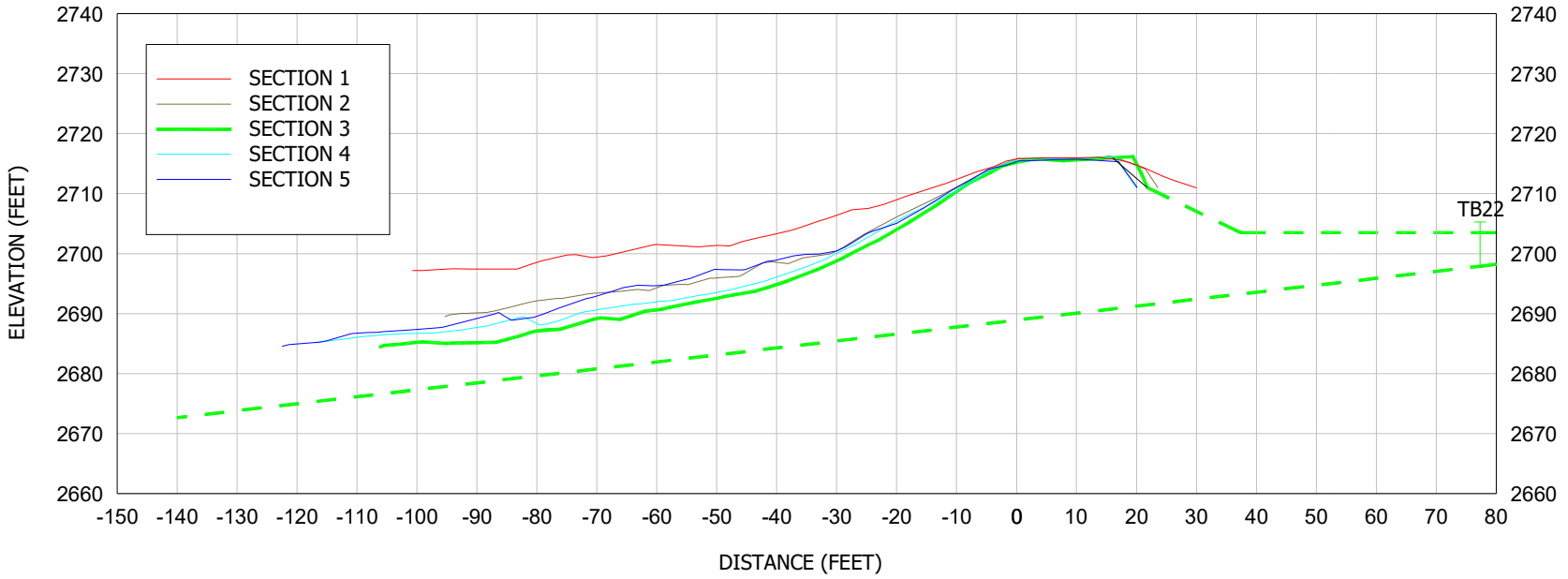


LiDAR Survey completed to map existing features, develop base plans & create seepage shape files using ArcMap

Post processed Static LiDAR in Civil 3D

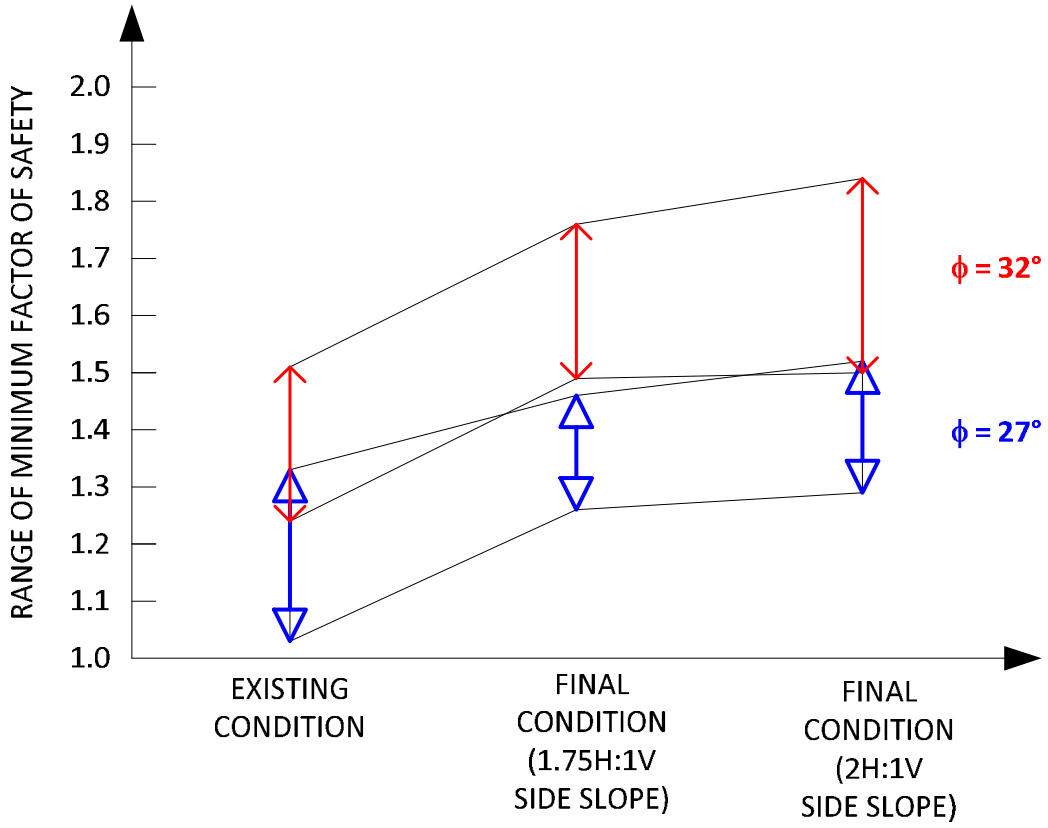


Post processed Static LiDAR in Civil 3D



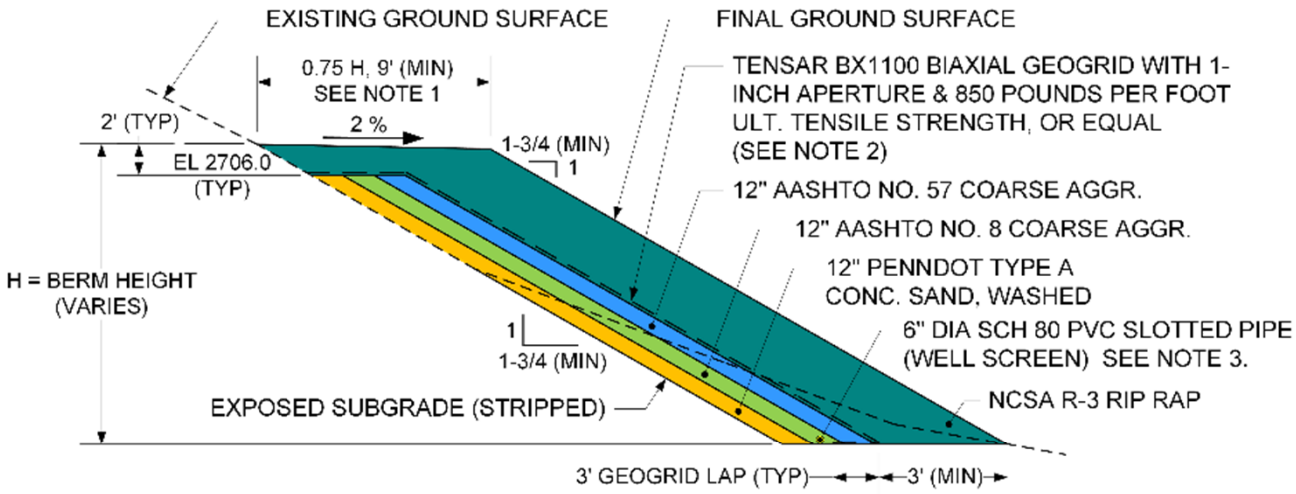
Lidar surveyed cross-sections

Sensitivity Analysis



Stability analyses were completed to assess the sensitivity and relative improvement for a variety of conditions, seepage cases, material properties and seepage toe berm geometry

Interim Risk Reduction Measures



NOTES: 1. MAINTAIN 9' MINIMUM TOP WIDTH FOR SEEPAGE TOE BERM.

2. OVERLAP GEOGRID PANELS WITH MINIMUM 2' LAP SPLICE.

3. PROVIDE WELL SCREEN WITH 6 ROWS OF 0.020" WIDE X 1.5" +/- 0.3" LONG SLOTS ON 60-DEGREE CENTERS WITH 1/4" SLOT SPACING. CONNECT WELL SCREEN TO SOLID PVC OUTLET PIPE TO MAINTAIN POSITIVE DRAINAGE.

TYPICAL SECTION – SEEPAGE TOE BERM

8 0 8 16

SCALE IN FEET

Developed plans & construction was completed to successfully implement IRRM including a seepage toe berm with 10-foot wide top width, 1.75H:1V side slope, to improve the existing slope stability factor of safety by about 20 to 30 percent.

Post-Construction

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Thank You!