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LiDAR and Photogrammetry Applications in Urban Watercourse Restoration

City of Toronto

Engineering and Construction Services

Jennifer Kim, Senior Project Manager (A)

March 27th, 2025



Agenda

- Watercourses in Toronto
 - History of Engineering Interventions
 - Existing Infrastructure and At-Risk Infrastructure
- Urban Watercourse Restoration in Toronto
- LiDAR and Photogrammetry Applications
 - Case Study: Slope Erosion Analysis
 - Case Study: Pre-Condition Infrastructure Assessment
 - Case Study: Post-Construction
- Future Project Integration

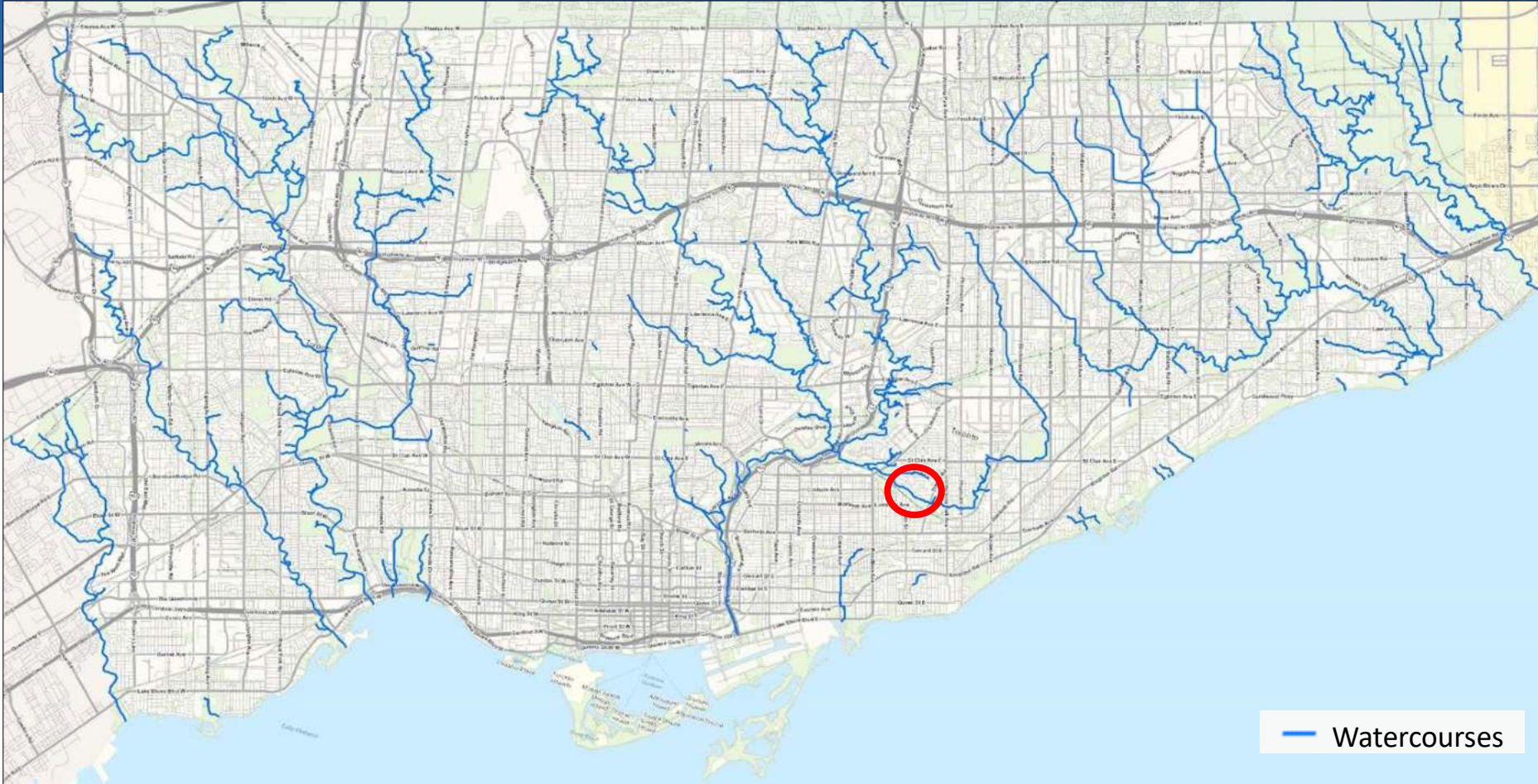
Historic Engineering Interventions on Toronto Watercourses



Taylor Massey Creek pre and post planform alteration in the 60s to accommodate sanitary sewer system.

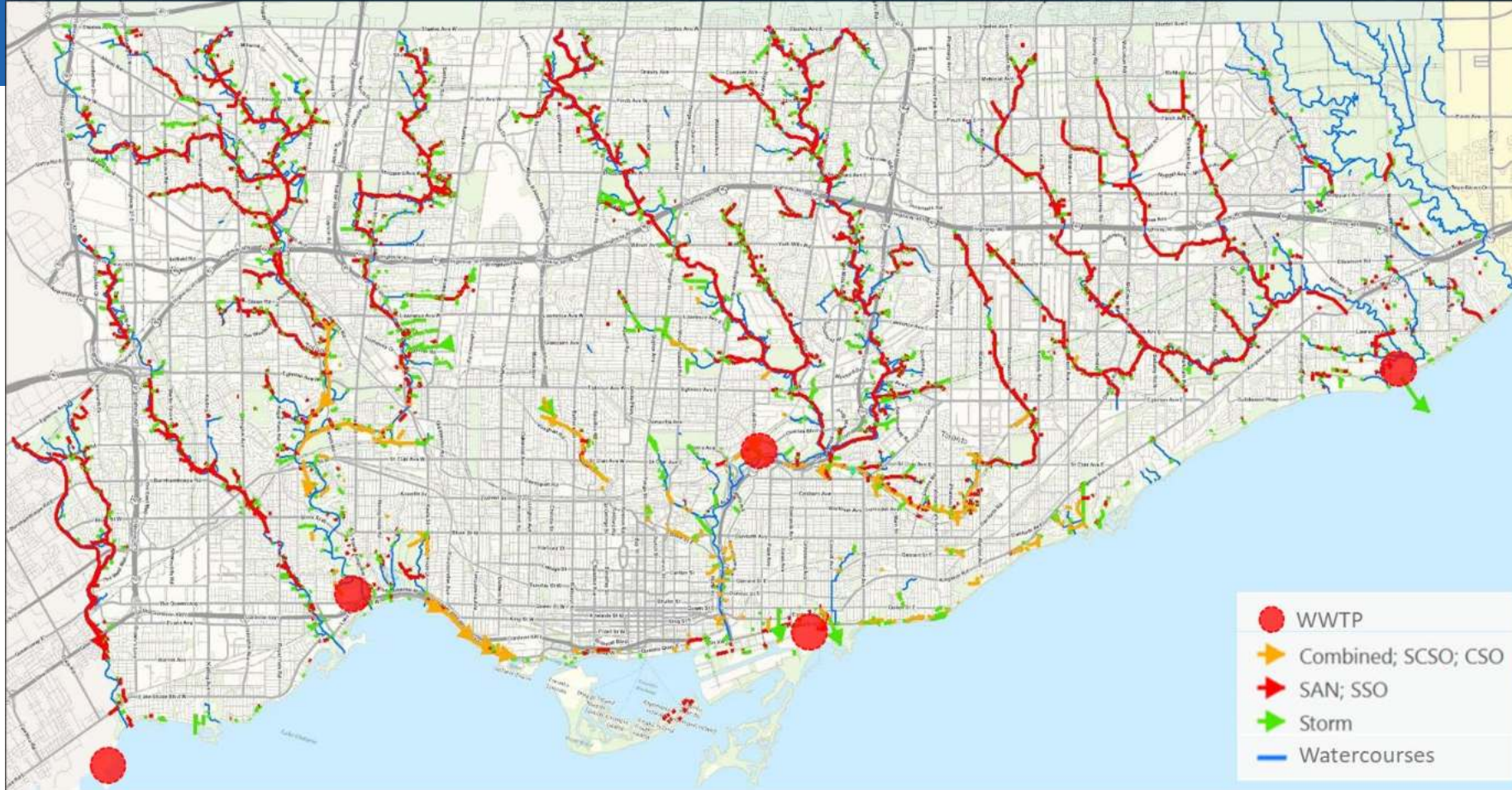
- To support growing development the installation of infrastructure in ravines, watercourse were straightened and banks stabilized, causing significant geomorphic and hydrological alterations occur.

Toronto Watercourses



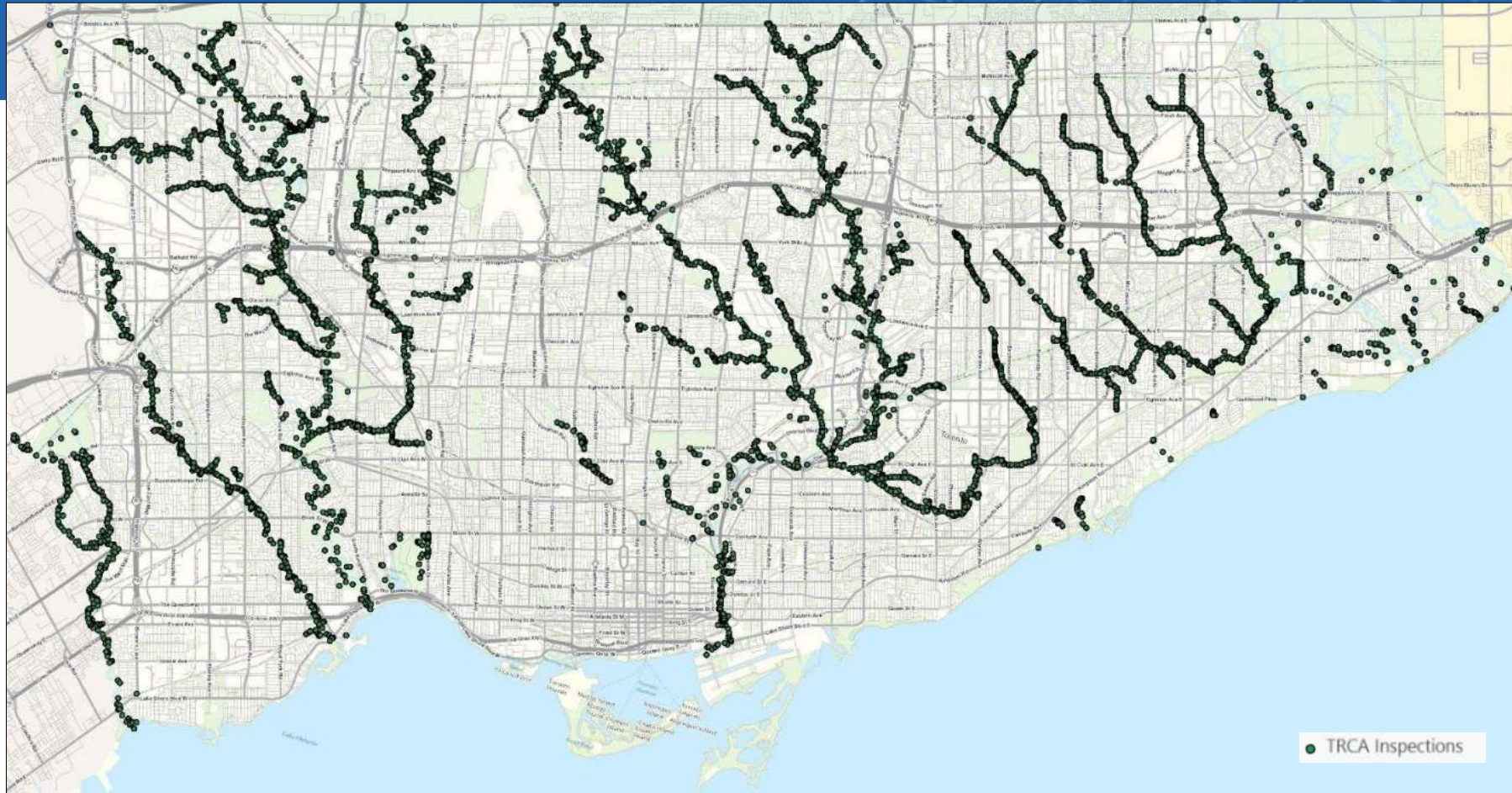
- City of Toronto has 443 km of watercourses within its geographical extents.

Existing Toronto Water Infrastructure



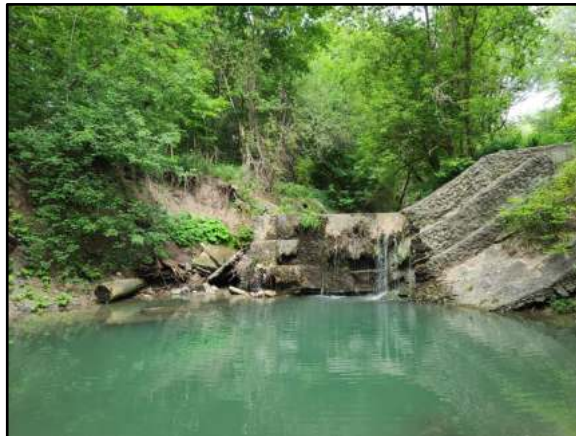
- Existing Toronto Water infrastructure totals 640 km of sewers in ravines.

Toronto Water Asset Inspections



- In total there are about 8,500 inspections, and a full cycle takes about 3 years to complete.

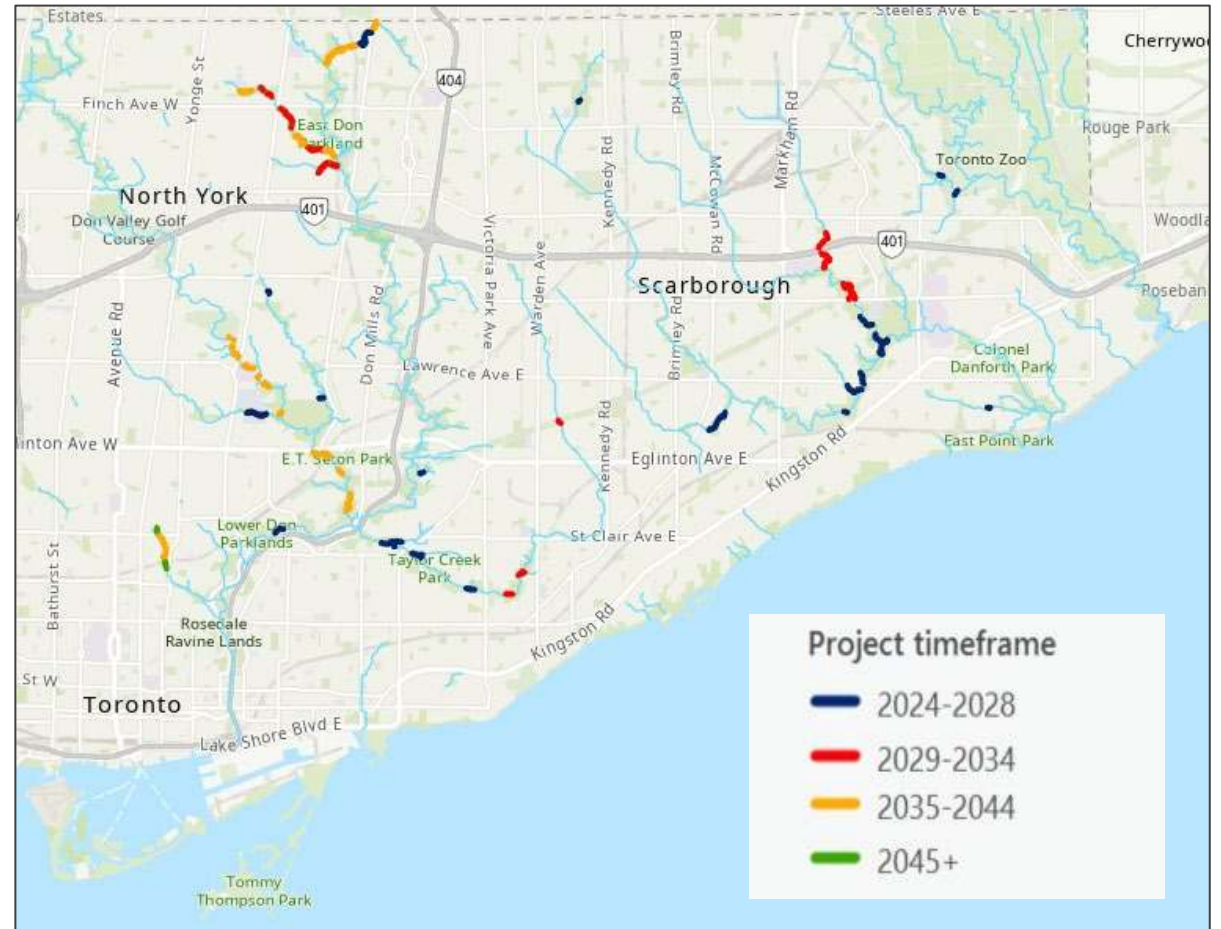
At-Risk Infrastructure



Urban Watercourse Restoration

(Processes at the CoT)

- Active and Planned projects are City wide, and in all watersheds.
- Restoration projects have been planned for implementation over the next 5 to ten years and beyond.
 - Priority identified through ongoing asset monitoring or Geomorphic Systems Master Plan recommendations.



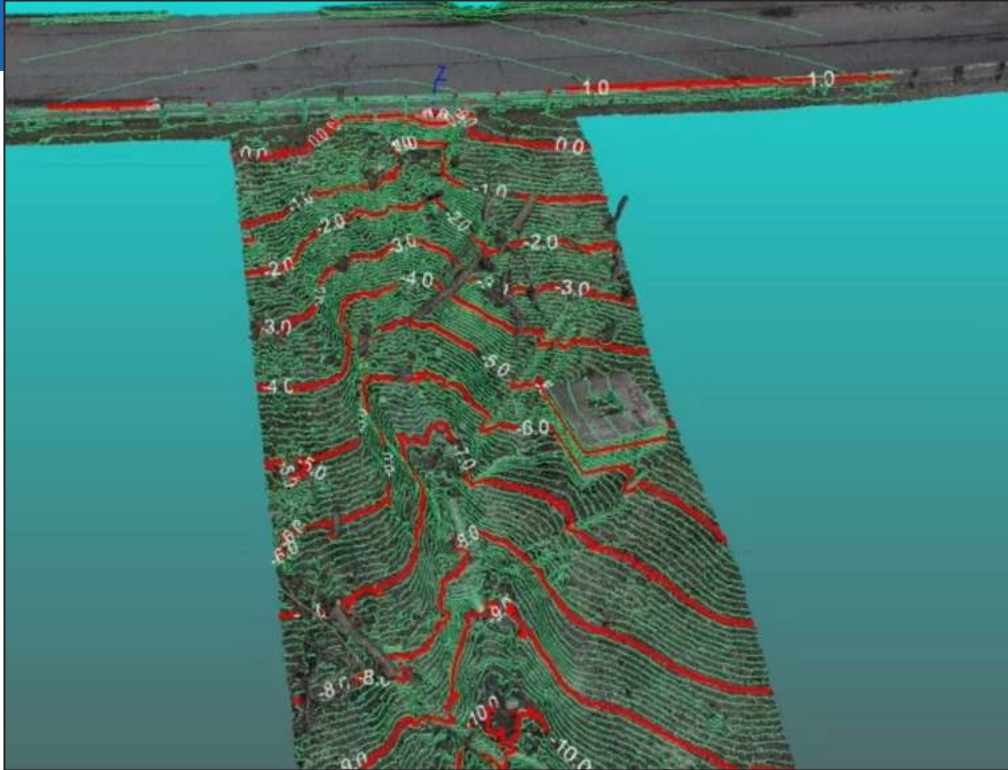
Drone Based LiDAR and Photogrammetry Applications

- Explore if LiDAR/Photogrammetry can enhance background data we provide to consulting teams
- Explore limitations of data and ensuring compatibility across platforms,
- Conduct case studies to identify ideal situations where this data would be useful (pre-design, detailed design, construction, post-construction)

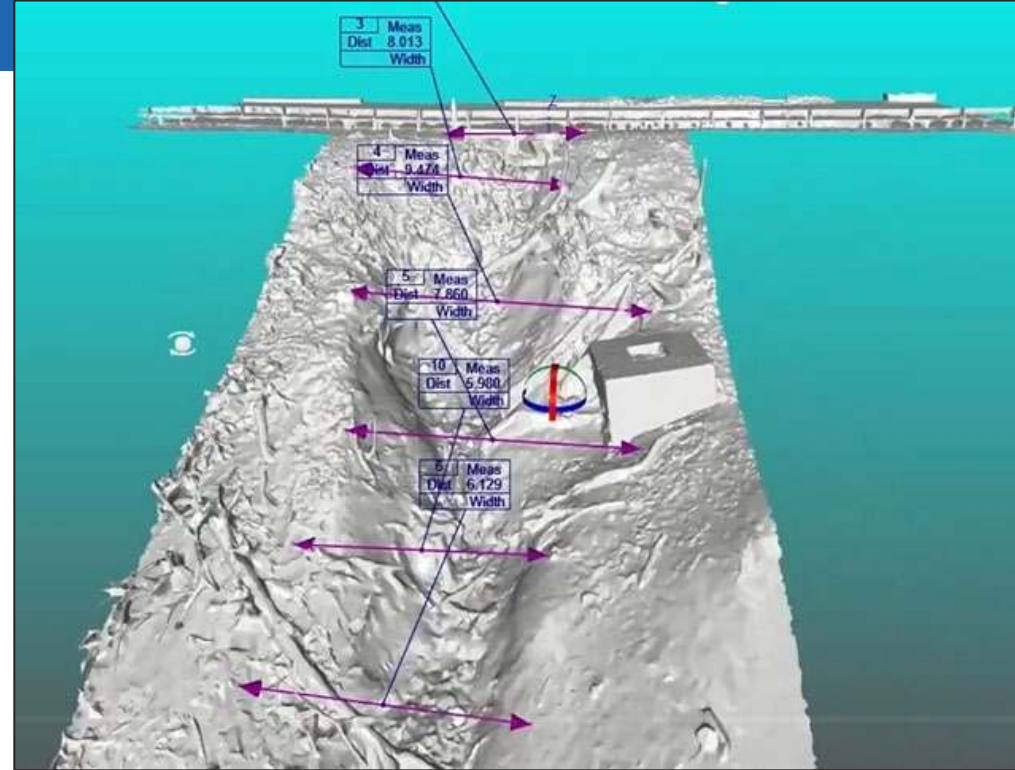


DJI Matrice 300 RTK equipped with AI capabilities for advanced autonomous flight

Case Study: Slope Erosion Analysis

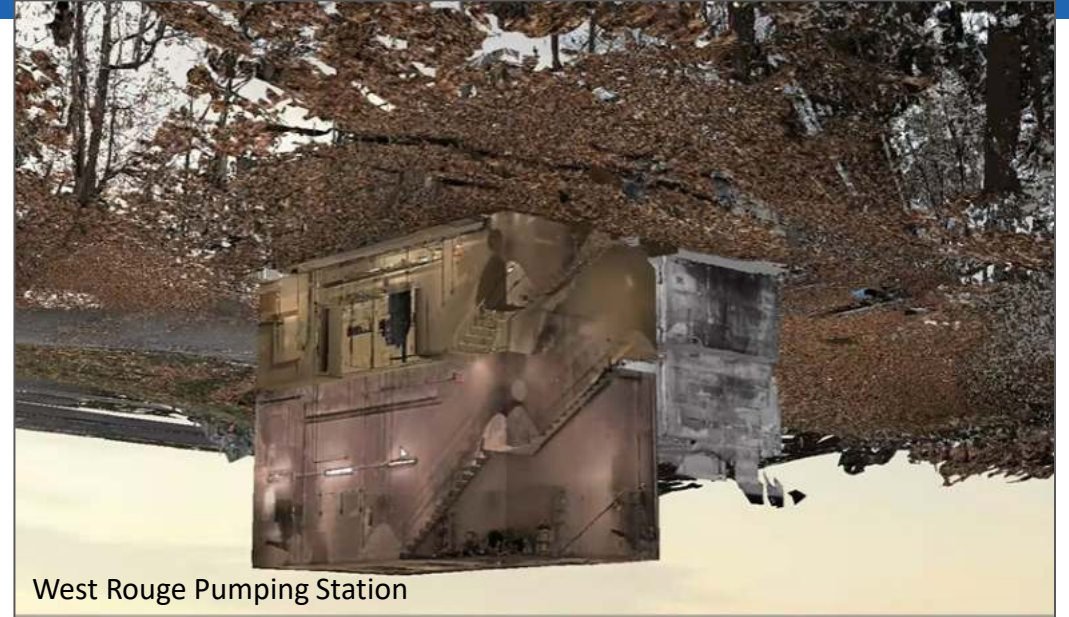


- DEM is generated by interpolating elevation data; contour lines are generated by connecting points of equal elevation.



- DTM emphasizes the terrain's contours, slopes, and features such as ridges, depressions, and potential erosion zones.

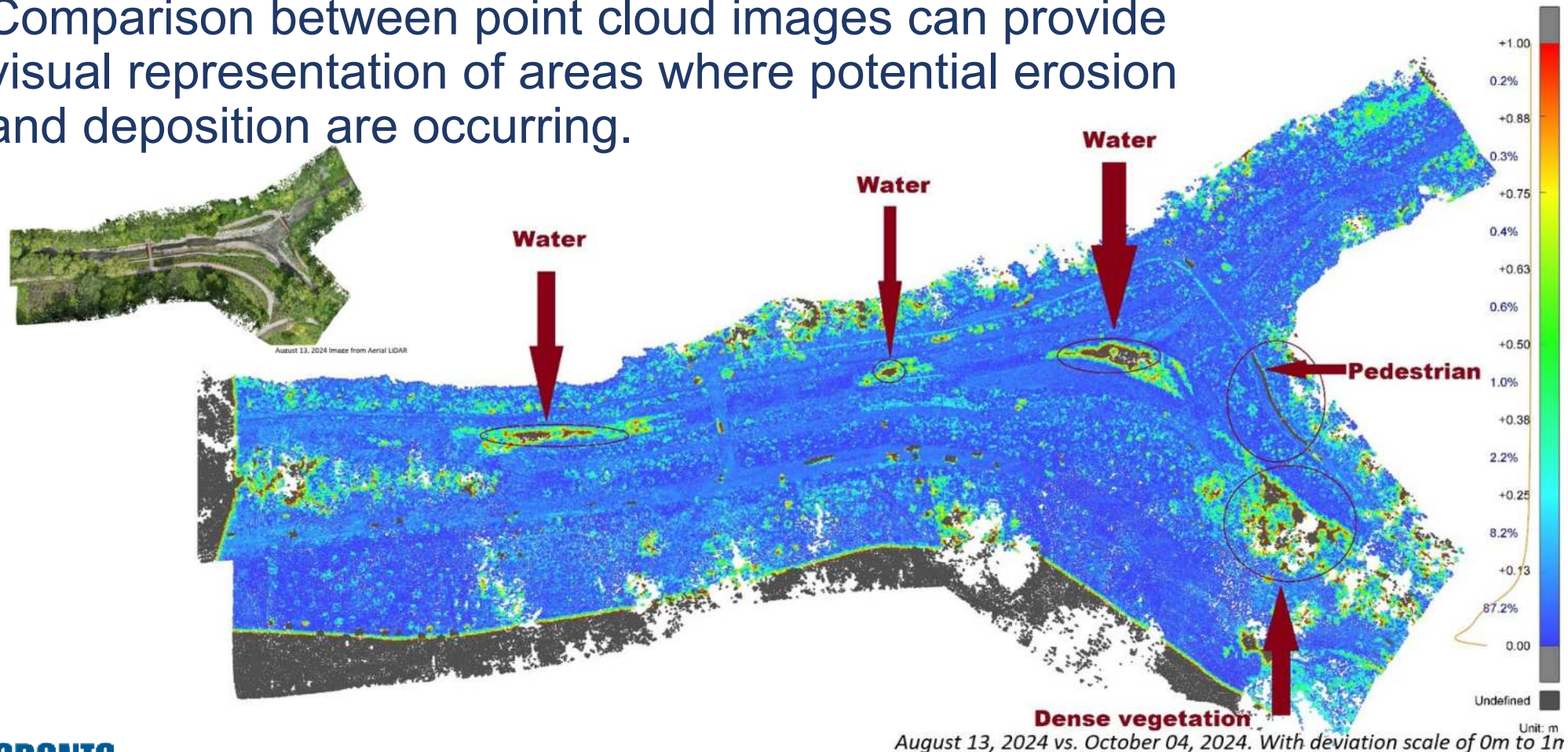
Case Study: Pre-Condition Infrastructure Assessments



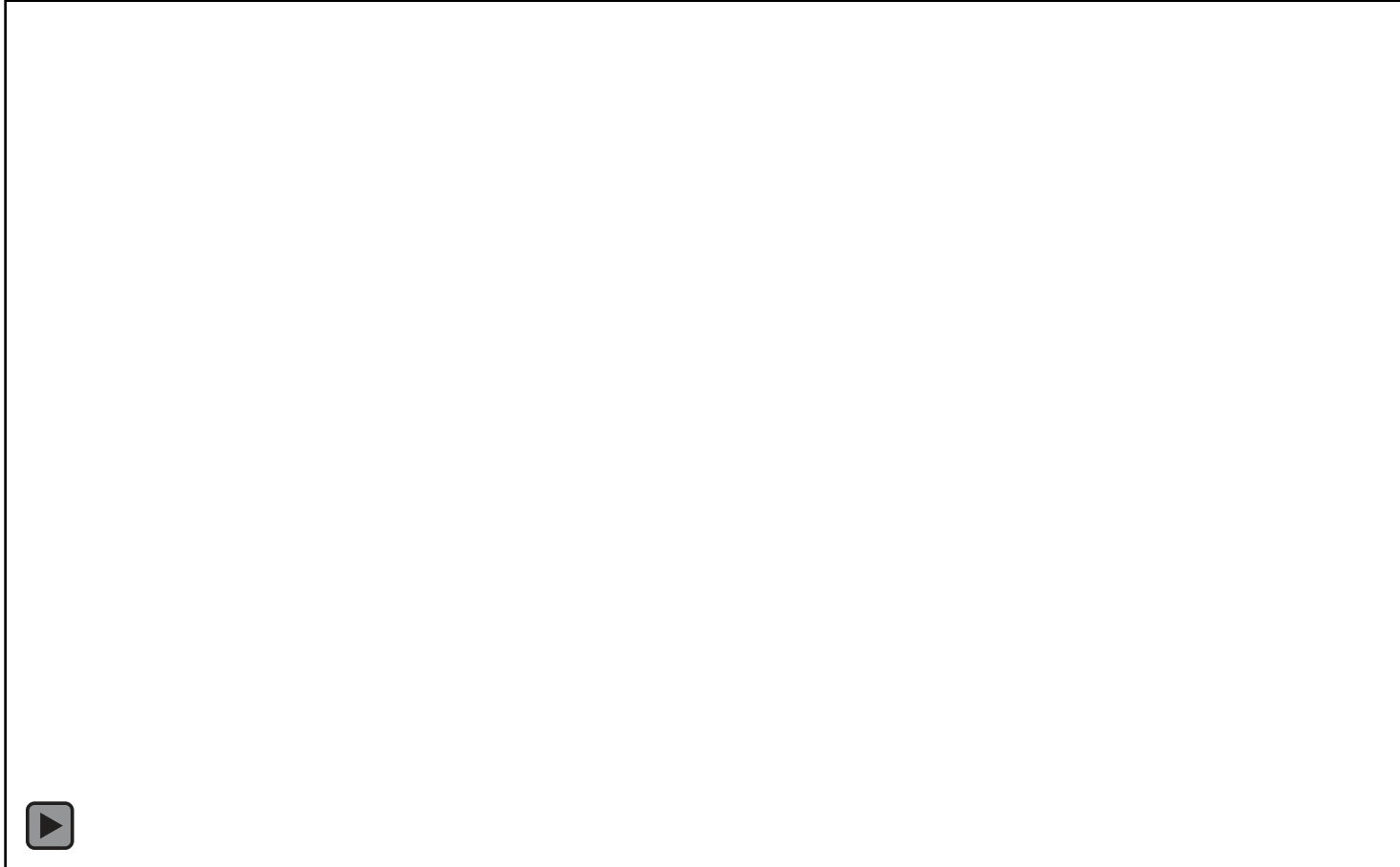
- Internal scans of existing infrastructure can aid condition assessments; detect cracks, deformation, and material degradation.
- Accurate mapping of infrastructure can aid in establishing lateral or horizontal erosion risk.

Case Study: Post Construction Monitoring

- Comparison between point cloud images can provide visual representation of areas where potential erosion and deposition are occurring.



3D Terrain Model (Post-Constriction)



Future Project Integration

- Currently, additional watercourse restoration sites are in the works to be surveyed;
 - Intent to survey a variety of project locations at various stages (pre-design, pre and post-construction, long term monitoring), to determine most effective way to utilize this information,
 - Continue to explore limitations of data and ensuring compatibility across platforms,
 - Provide data to Engineering Consultants for incorporation into study and design processes
- Review existing methodologies and ensure best management practices are maintained.

Thank-you

Questions?



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