Introduction to CTDOT Retaining Wall Program

NETC Topical Discussion – March 21st, 2024

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Outline

- Introduction to Geotechnical Asset Management
- Introduction to CTDOT Retaining Wall Program
- Challenges for Developing a New Asset
- Challenges and Benefits of Retaining Wall Program
- Future of GAM at CTDOT

Geotechnical Asset

Geotechnical Asset Management

Concept: Asset management is proactive approach to maintaining assets rather than a reactive approach.

Geotechnical Asset

- **Retaining walls**
- Embankments
- Slope (earth, rock)
- Subgrade

Note: CTDOT is currently focusing on **retaining wall** asset.

ment for Transportation Agencies, Volume 1: Research Overview

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP RESEARCH REPORT 903

Geotechnical Asset Management for Transportation Agencies

Volume 1: Research Overview

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Subscriber Categories
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The National Academies of
SCIENCES • ENGINEERING • MEDICINE
TRB
TRANSPORTATION RESEARCH BOARD
2019

CTDOT Retaining Wall Program

- Soils and Foundations has developed the “Retaining Wall Assessment and Inventory Guidelines”.
- Soils and Foundations developed the Retaining Wall assessment form.
- Soils and Foundations will be responsible for managing the retaining wall asset inventory and assessments.

Connecticut Department of Transportation
Retaining Wall Inventory and Assessment Guidelines

2023

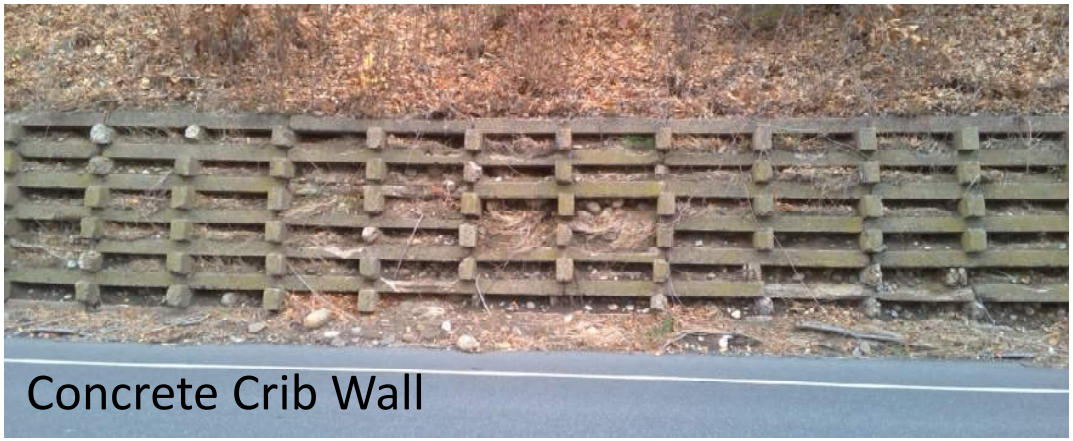
Retaining Wall Asset


Metal Bin Wall

CTDOT defines the retaining walls as "structures that provide a grade separation by retaining earth and/or rock to support roadway and other structures".

NCHRP Report 903 quantifies the retaining walls as structures with vertical face inclination of 70 degrees or steeper and exposed face of 4 feet or taller.


Masonry Wall


Concrete Crib Wall

Retaining Wall Asset

- Bridge abutments, headwalls and wingwalls, noise walls, fences and stone walls are **not** considered geotechnical asset.
- CTDOT has not adopted the minimum height for retaining walls except for concrete barrier curb walls.
- 12 Retaining Wall Types

CTDOT Retaining Wall Program

2010s Program

- Soils and Foundations provided training.
- CTDOT maintenance personnel conducted retaining wall condition rating.

2020s Program

- Soils and Foundations provided training.
- DOT Consultant Engineers are conducting retaining wall conditions rating.

Data collection

2010s Program

- In absence of smartphones, GPS equipment, etc. the retaining wall locations were collected by road numbers and mile points.
- The retaining wall locations were collected as point features.
- One of Soils and Foundations staff was tasked with data entry and conversion of route numbers/mile points to geospatial coordinates.
    - Time consuming

Data collection

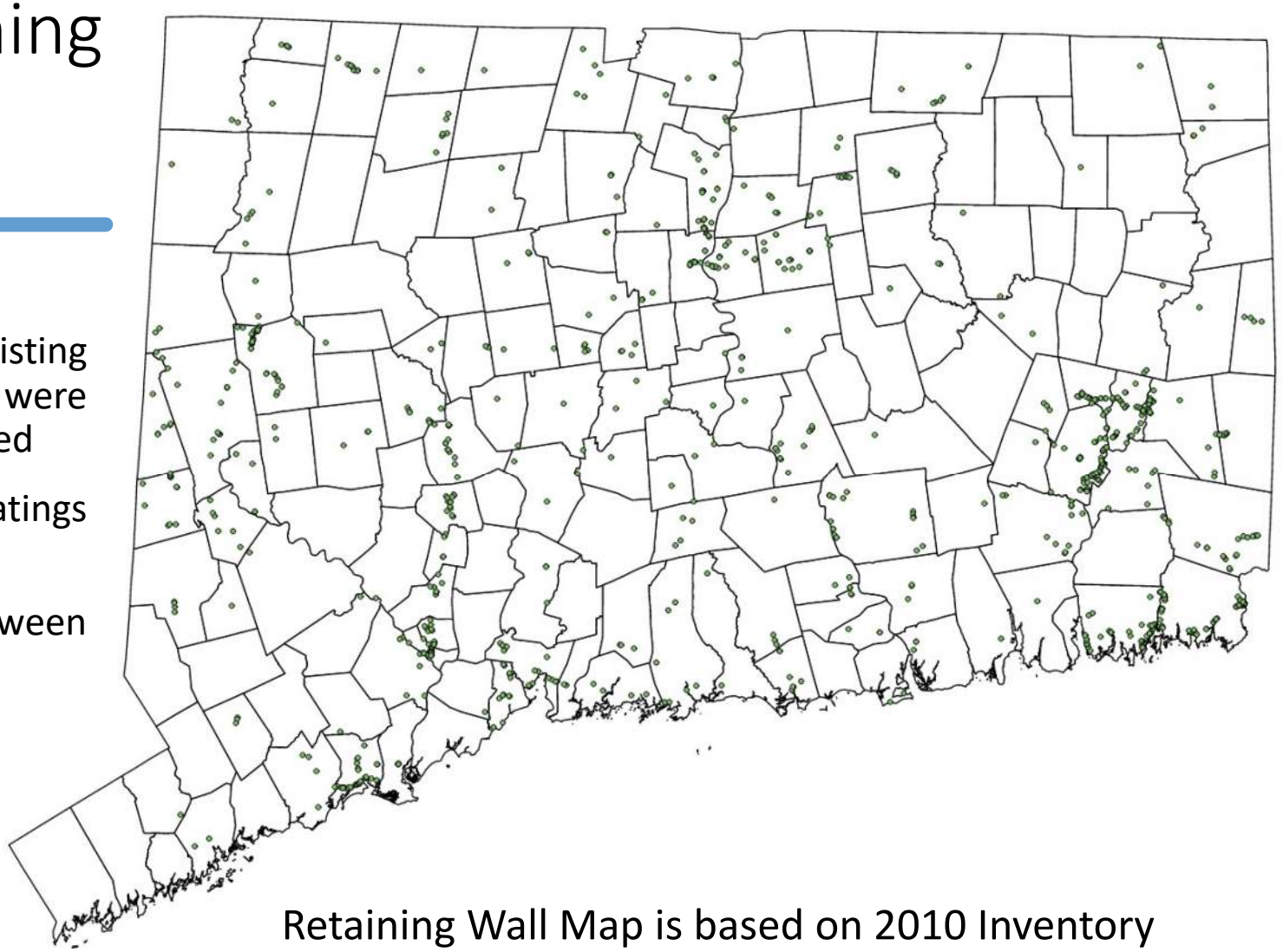
2020s Program

- With advancement of technology, the data is collected utilizing an application developed by the Department within ArcGIS Field Map Application.
- The retaining wall locations are collected as linear features.

CTDOT Retaining Wall Program

<u>2010s Outcome</u>

- Partial inventory consisting of 892 retaining walls were identified and evaluated
- The wall condition ratings were not consistent.
- Efforts varied between different facilities.

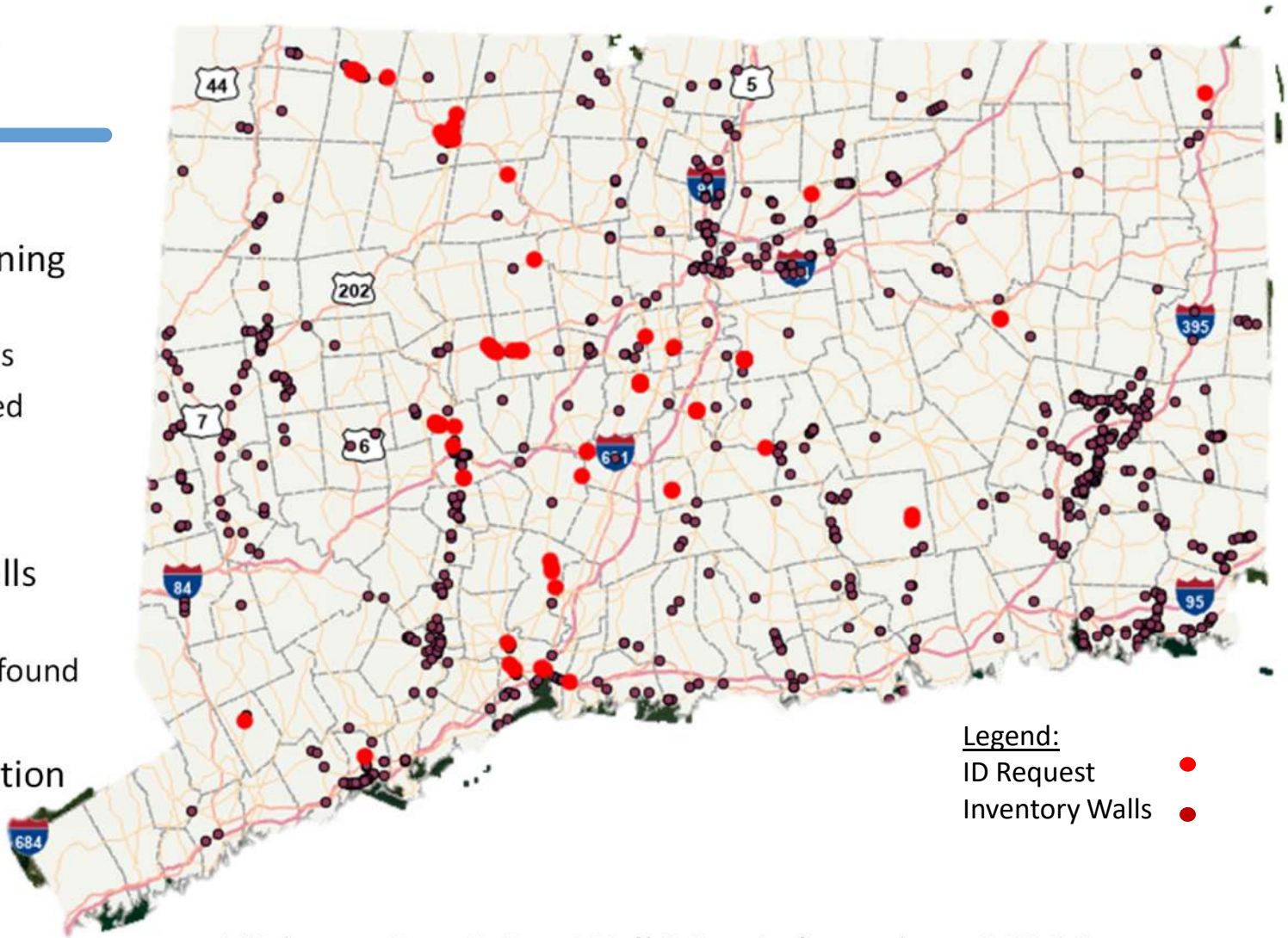


Retaining Wall Map is based on 2010 Inventory

CTDOT Retaining Wall Program

<u>2020s In Progress</u>

- Estimated 1100+ retaining walls
  - 1050 Highway Walls
    ~ 150 desk identified
  - 50+ Railroad Wall
  - ~ 50 Busway Walls
- Approximately 400 walls will be evaluated.
  - Identify the newly found walls.
- Retaining Wall Application useability.
  - Data collection

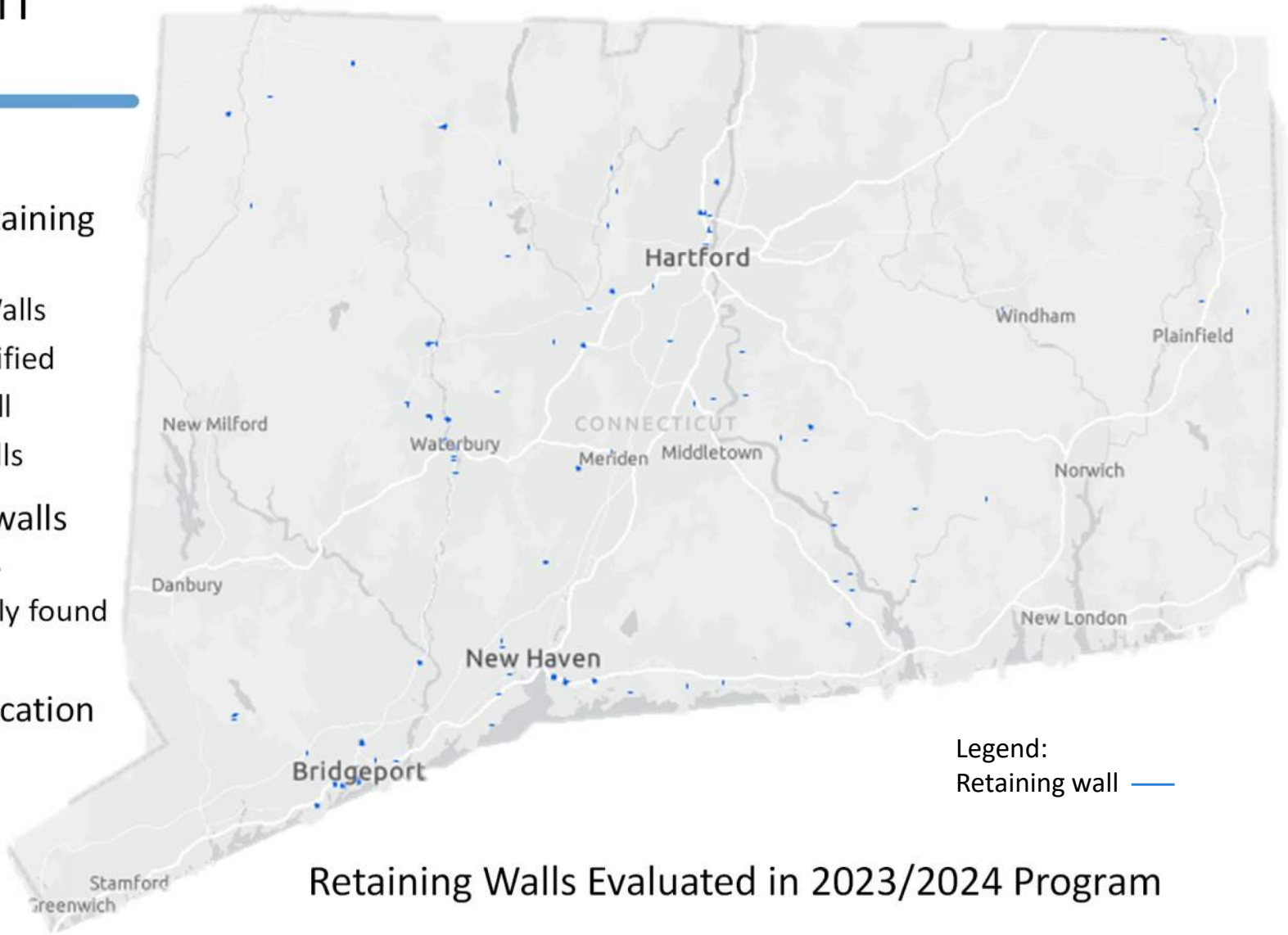


Highway Retaining Wall Map is based on 2023 Inventory

CTDOT Retaining Wall Program

2020s In Progress

- Estimated 1100+ retaining walls
  - 1050 Highway Walls
    ~ 150 desk identified
  - 50+ Railroad Wall
  - ~ 50 Busway Walls
- Approximately 400 walls are being evaluated.
  - Identify the newly found walls.
- Retaining Wall Application useability.
  - Data collection

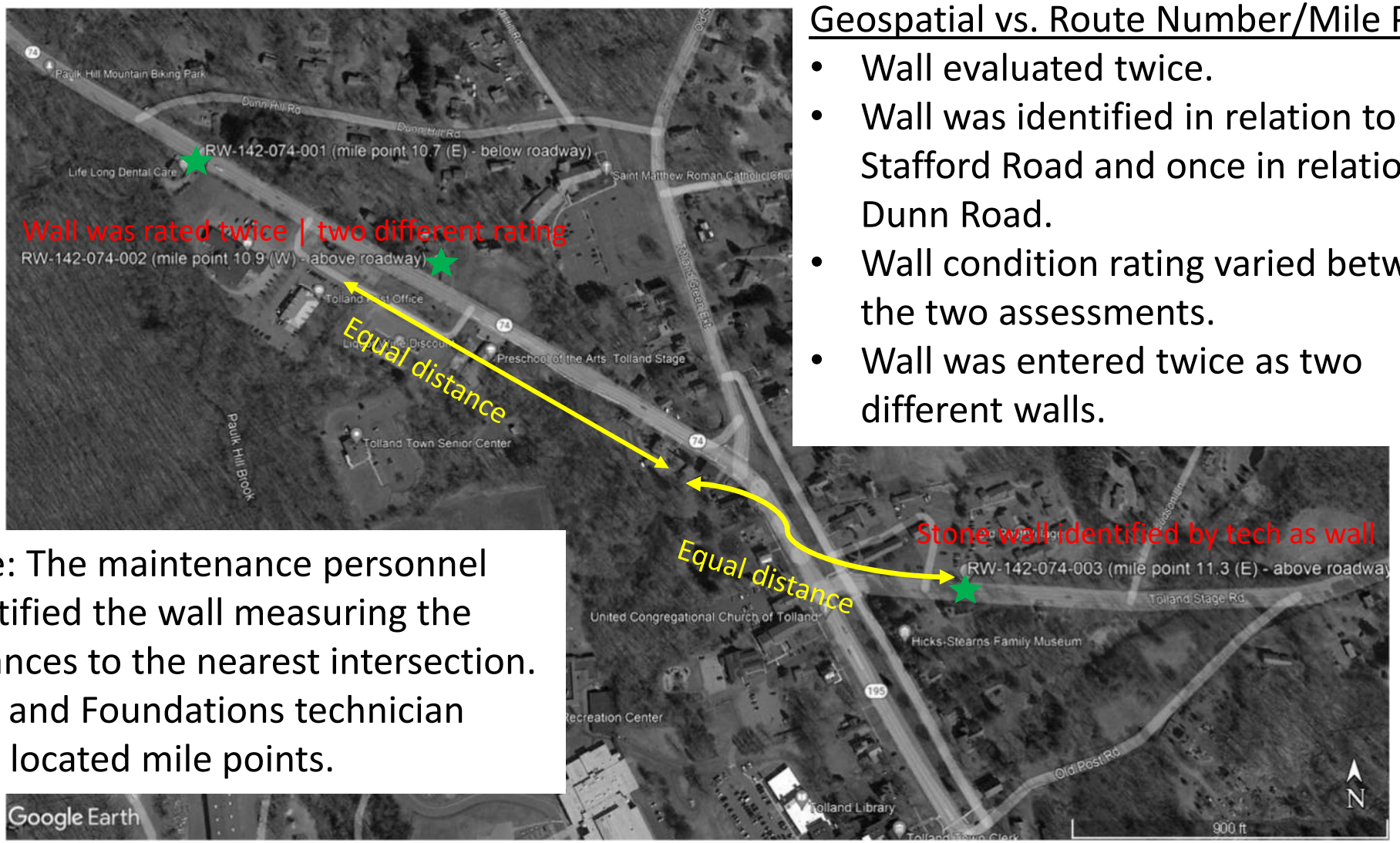


Retaining Walls Evaluated in 2023/2024 Program

Challenges

- No federal guidelines for condition rating of geotechnical assets
  - Frequency of Routine Assessment
  - Critical Condition Determination
- No official training for retaining wall evaluation
  - Inconsistent condition rating
- Service life of retaining walls and deterioration models
  - Unlike bridges and pavements dTIMS is not developed for retaining walls.
- Adequacy and Reliability of visual evaluation
- Developing the inventory for the geotechnical assets
  - Retaining Wall Identification
- Communication

Challenges – Asset Identification



Note: The maintenance personnel identified the wall measuring the distances to the nearest intersection. Soils and Foundations technician later located mile points.

Geospatial vs. Route Number/Mile Point

- Wall evaluated twice.
- Wall was identified in relation to Old Stafford Road and once in relation to Dunn Road.
- Wall condition rating varied between the two assessments.
- Wall was entered twice as two different walls.

Challenges – Asset Identification

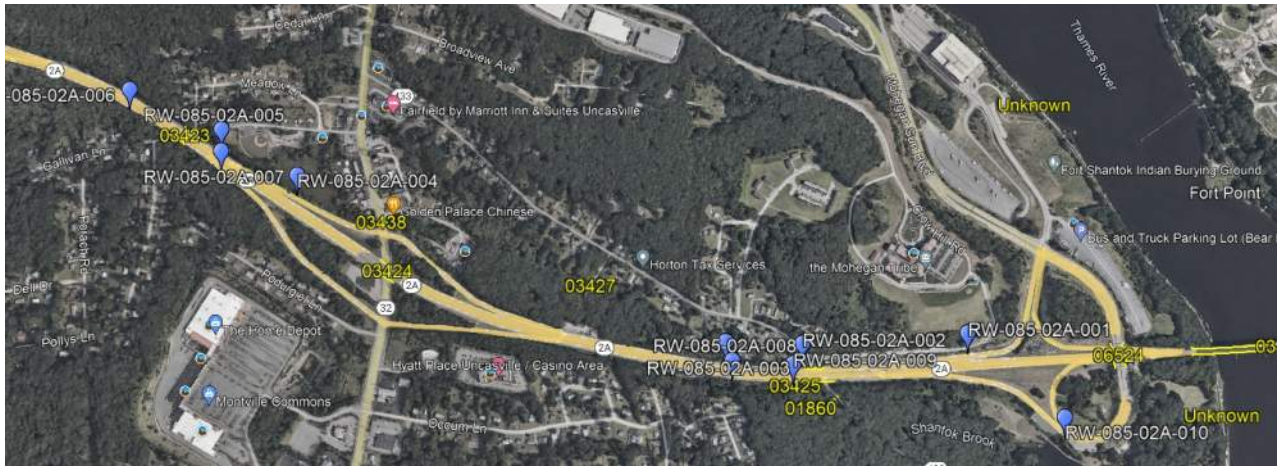
- <u>Geospatial vs. Route Number/Mile Point:</u>
- Wall Identified in relation to “Great Pond Road”.
- Wall location misidentified in 2010s.
- Field verification in 2020s.

Challenges – Inventory Development

Inventory Development:

- Field Identification
- Survey Information
- Desk Review – Plan Review and Aerial Imagery
- Desk Review – LiDAR Data

One wall was identified during field visit (2010s program)



Nine other walls were identified by plan review/ aerial imagery

Challenges – Visual Assessment

- Access
  - Walls below roadway
  - Tall walls
- Vegetation Growth
  - Walls to be evaluated during cold season
- Reliability of Visual Assessment
  - Walls with internal reinforcement such as MSE Wall, anchored walls and Soil Nails Walls
  - Walls with architectural facing

→Consider using other methods such as UAV for retaining wall evaluation

→UConn Research on “Proof of Concept for Applicability of 3D Imaging for the Inspection of Dry Masonry Retaining Walls”

Challenges – Visual Inspection | Access

Challenges – Visual Inspection
Walls with Internal Reinforcement

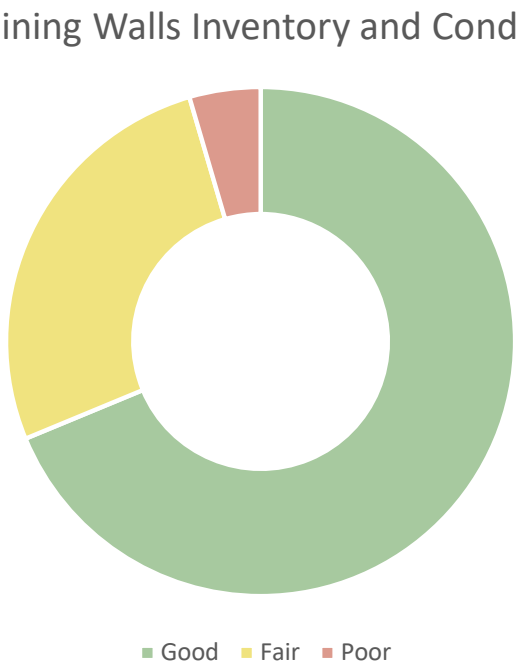
Anchored Wall with Architectural Facing

Soil Nail Wall

Mechanically Stabilized Earth Wall

Soil Nail Wall with Permanent Facing

Challenges - Condition Rating



2023 Retaining Wall Condition:
Good: 68.8%
Fair: 26.7%
Poor: 4.5%

Condition Rating Criteria:

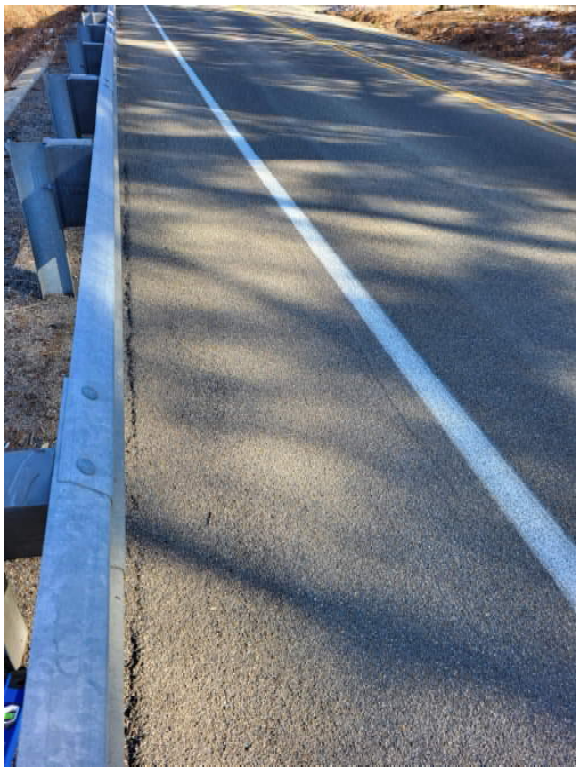
- Stability (0 to 2)
- Backfill/Settlement (0 to 2)
- Structural (0 to 2)

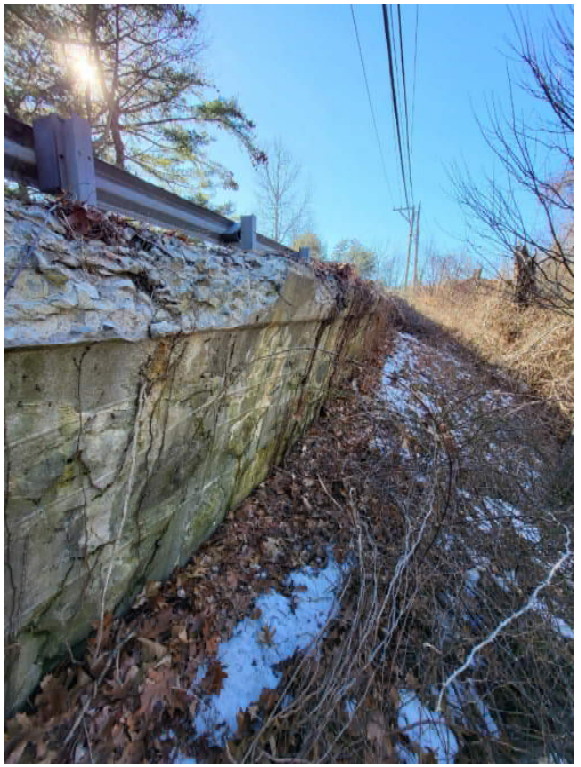
Total Condition Rating (0 to 6): sum of the three criterion

SOGR is defined as walls with total condition rating of 3 or higher.

Note: CTDOT has added the retaining wall asset to TAMP 2022.

Challenges - Condition Rating





Challenges - Condition Rating

Challenges and Benefits of GAM

RW-081-147-001: April 2023
→ Initiate a project for immediate repairs

Challenges and Benefits of GAM

RW-081-147-001: February 2024

Benefits of Developing GAM

RW-157-053-001:

- ***Metal Bin Wall***
- 2010s Total Condition Rating: 4
- 2020s Total Condition Rating: 3

RW-157-053-002

- ***Metal Bin Wall***
- 2010s Total Condition Rating: 4
- 2020s Total Condition Rating: 2

A project is proposed to be initiated to replace RW-157-053-001 and RW-157-053-002

RW-157-053-003

- ***Metal Bin Wall***
- 2010s Total Condition Rating: 3
- 2019: A ***concrete wall*** was constructed in front of this wall.
- 2020 Total Condition Rating: 6


RW-157-053-001


RW-157-053-002


RW-157-053-003

Future of GAM at CTDOT

- Utilize LiDAR to capture the remaining Retaining Wall Asset and other Geotechnical Asset.
- Utilize technologies such as UAV to evaluate the retaining wall asset.
- Routine assessment and project initiation to maintain the SOGR.
- Develop similar program for other geotechnical assets.

Questions??