

# Lakeshore Restoration Design

*Natural Shoreland Erosion Control Certification - 2025*

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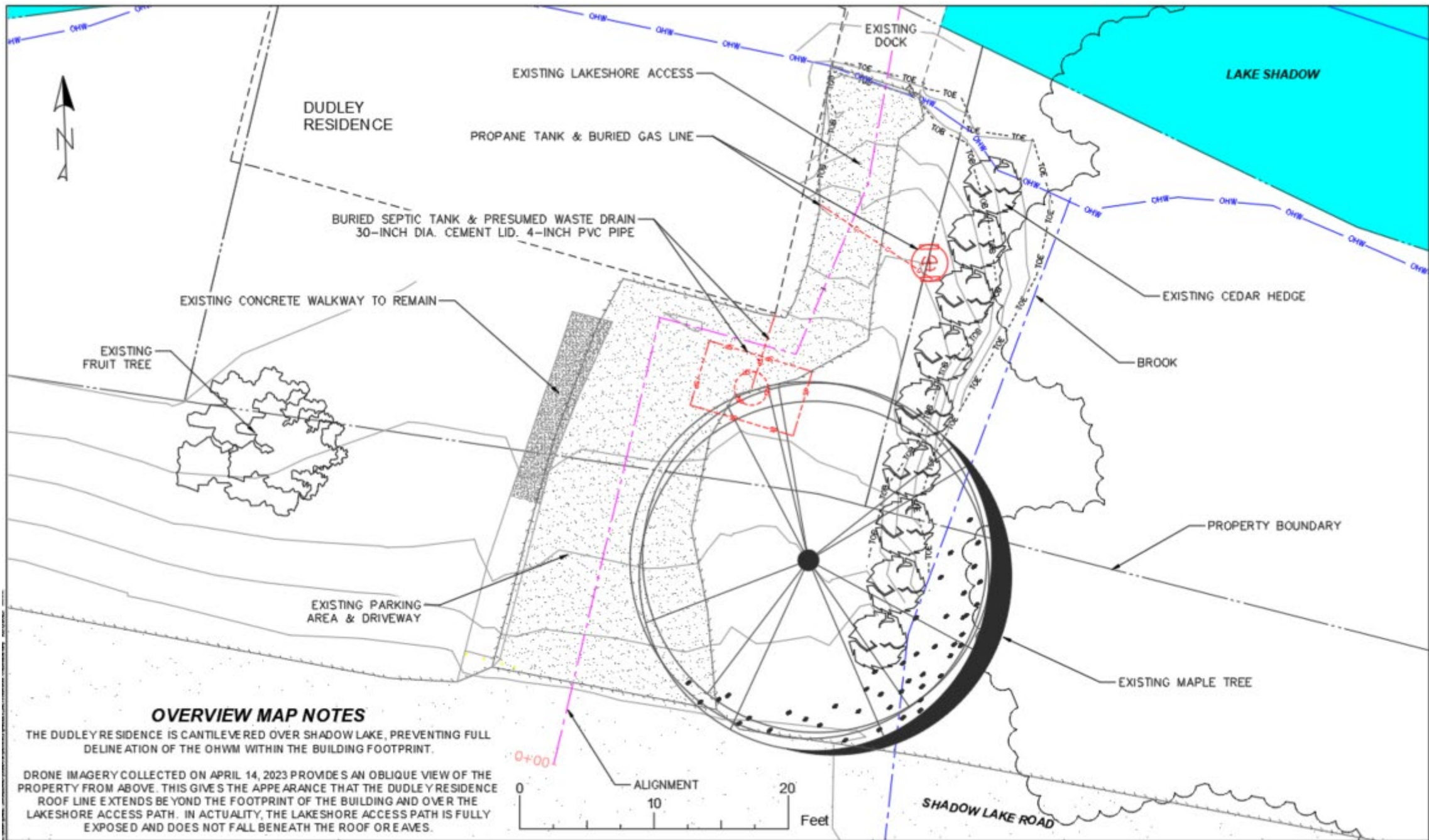


**WINDENWATER<sub>LLC</sub>**



# Site Survey

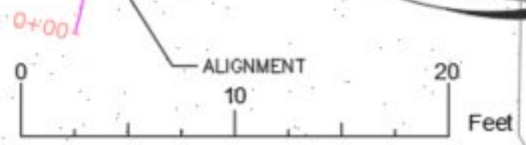
- Ordinary High-Water mark (OHW)
- Mean Low Water (MLW)
- Water surface elevation (WSE)
- Existing utilities (gas, electric, septic, cable, etc.)
- Drainage infrastructure (culverts, gutters, etc.)
- Cross-section(s) of bank/shoreline
- Soil texture & other relevant properties
- Existing vegetation, tree canopy line, gardens, etc.
- Edge of roads, driveways, sidewalks, etc.
- Building footprints, patios, pathways, etc.
- Property boundary markers (if visible)
- Survey plat (if available)
- Potential access routes
- Invasive species, potential wetlands, etc.
- Aerial & ground photos

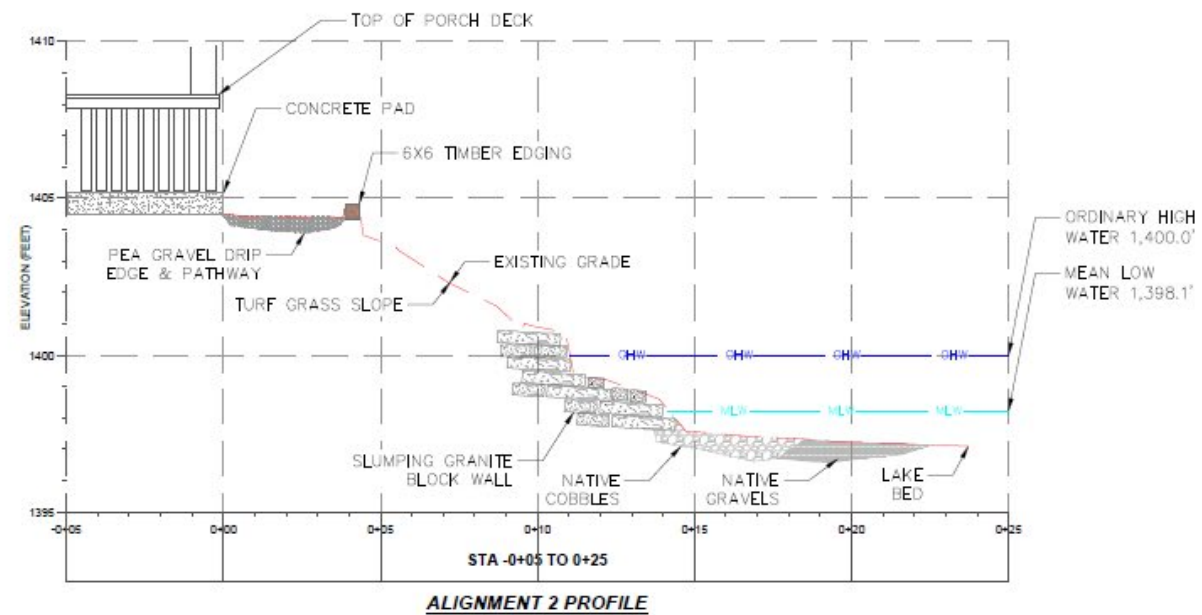
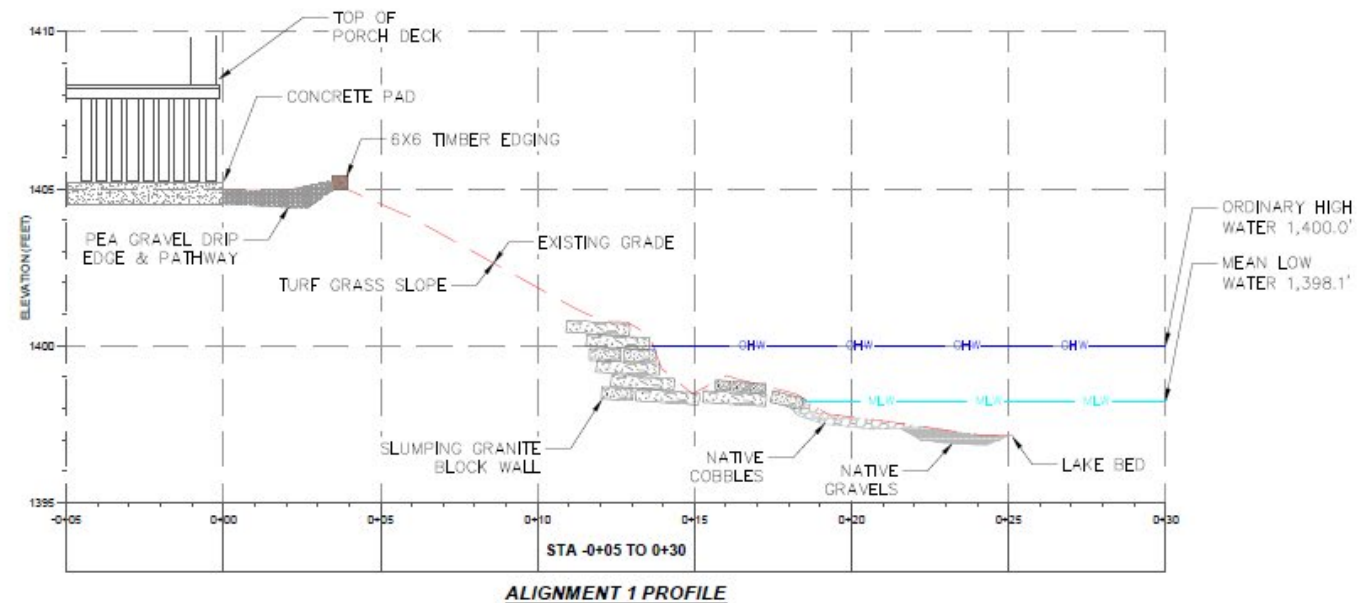


**OVERVIEW MAP NOTES**

THE DUDLEY RESIDENCE IS CANTILEVERED OVER SHADOW LAKE, PREVENTING FULL DELINEATION OF THE OHWM WITHIN THE BUILDING FOOTPRINT.

DRONE IMAGERY COLLECTED ON APRIL 14, 2023 PROVIDES AN OBLIQUE VIEW OF THE PROPERTY FROM ABOVE. THIS GIVES THE APPEARANCE THAT THE DUDLEY RESIDENCE ROOF LINE EXTENDS BEYOND THE FOOTPRINT OF THE BUILDING AND OVER THE LAKESHORE ACCESS PATH. IN ACTUALITY, THE LAKESHORE ACCESS PATH IS FULLY EXPOSED AND DOES NOT FALL BENEATH THE ROOF OR EAVES.





**SHADOW LAKE PROJECT**  
**2025**

*A house on Shadow Lake was plagued by runoff & sedimentation from the road...*



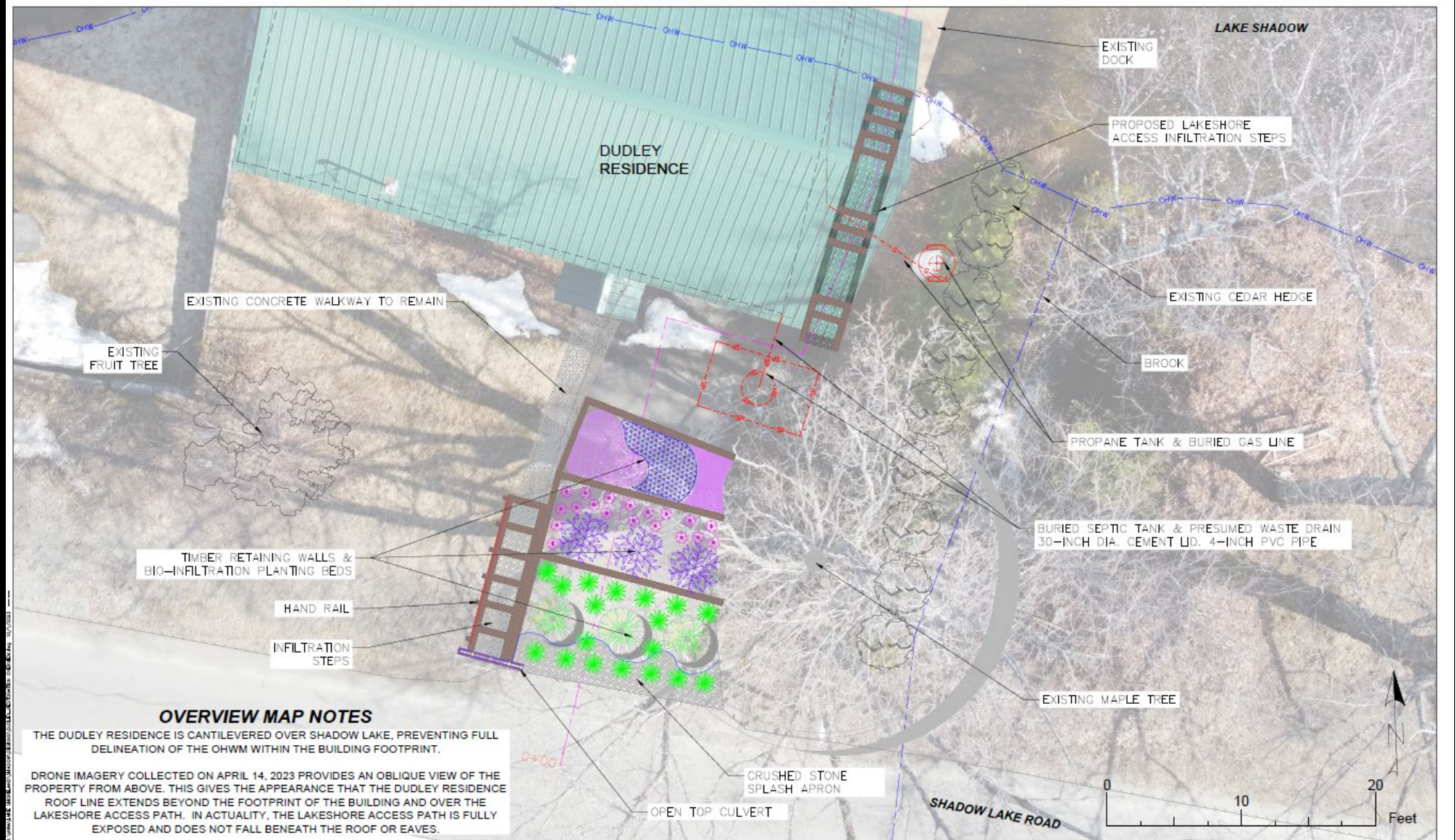
*...and the landowners were willing to give up their asphalt parking area & lakeshore access to address the issue.*







# Design Plans

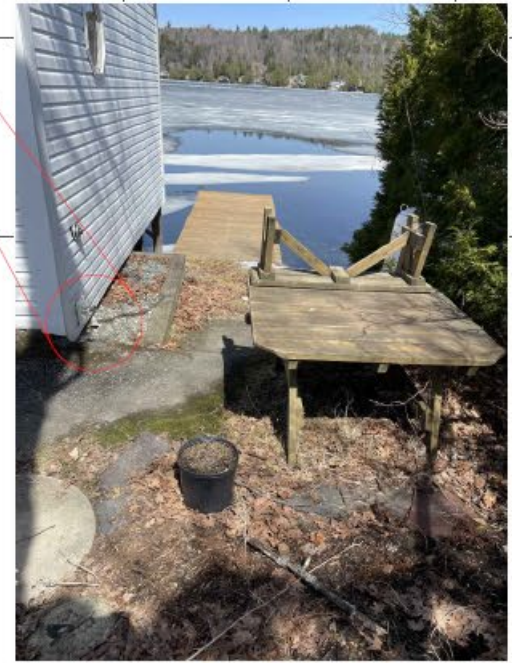
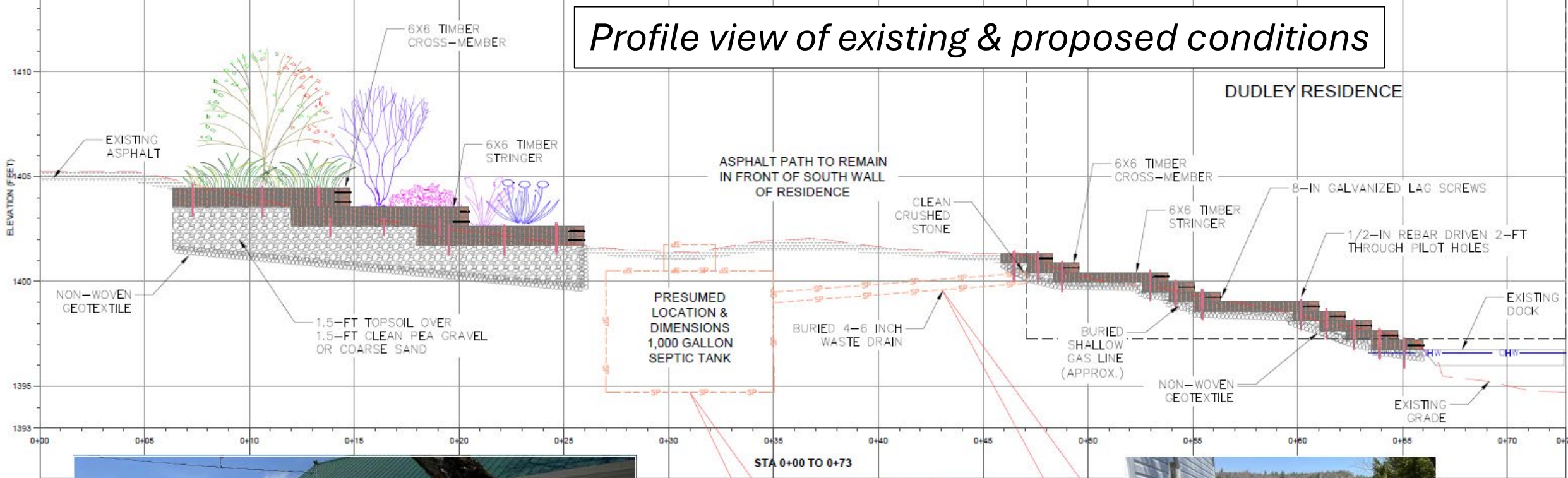


DUDLEY PROPERTY - SHADOW LAKE SHORELAND RESTORATION PROJECT  
October 1, 2023

## RESTORATION OVERVIEW MAP



# Profile view of existing & proposed conditions



## Site Conditions:

- 0.25-acre drainage area; 50% pervious, 50% impervious
- 1-in, 24-hour WQv (ideal scenario)
- NRCS → Cabot silt loam, but not the case! *very stony, sandy loam*
- 1ft sandy loam below (native material)
- BMP dimensions (area & depths of each substrates)
- Substrate porosity (pore space) and permeability (infiltration)

## Design Parameters:

- **WQv = 0.0198 acre-feet**
- 2 ft gravel, 8in sand, 6in topsoil (biofiltration beds)
- 6in gravel (infiltration steps)
- porosity factors of 0.5, 0.4, & 0.1
- 8ft/day permeability
- No ponding depth/volume
- 1 day drain time
- Underdrain to prevent overtopping of biofiltration beds
- Depth to seasonal high groundwater table

## Storage (Pore) Volume

1. Gravel = 280.5 ft<sup>3</sup>
2. Sand = 99 ft<sup>3</sup>
3. Topsoil = 12 ft<sup>3</sup>
4. Front Steps = 12.125 ft<sup>3</sup>
5. Lakeshore Steps = 20 ft<sup>3</sup>

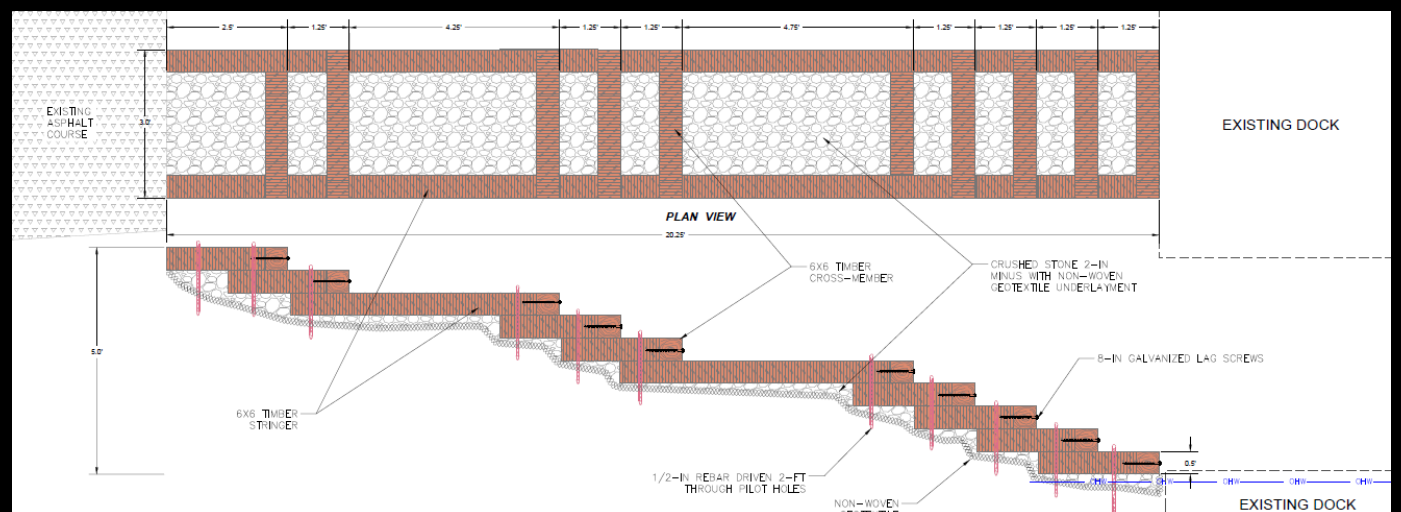
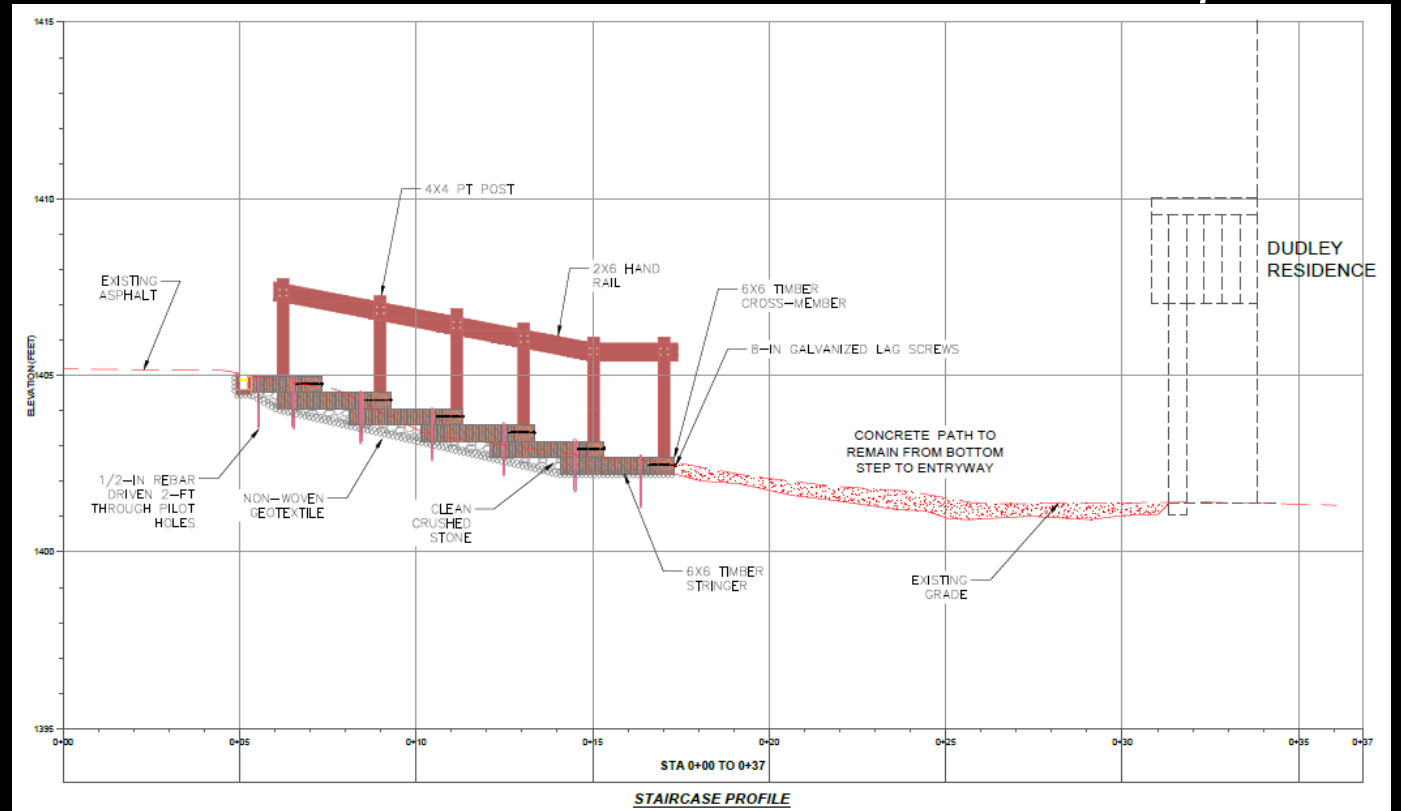
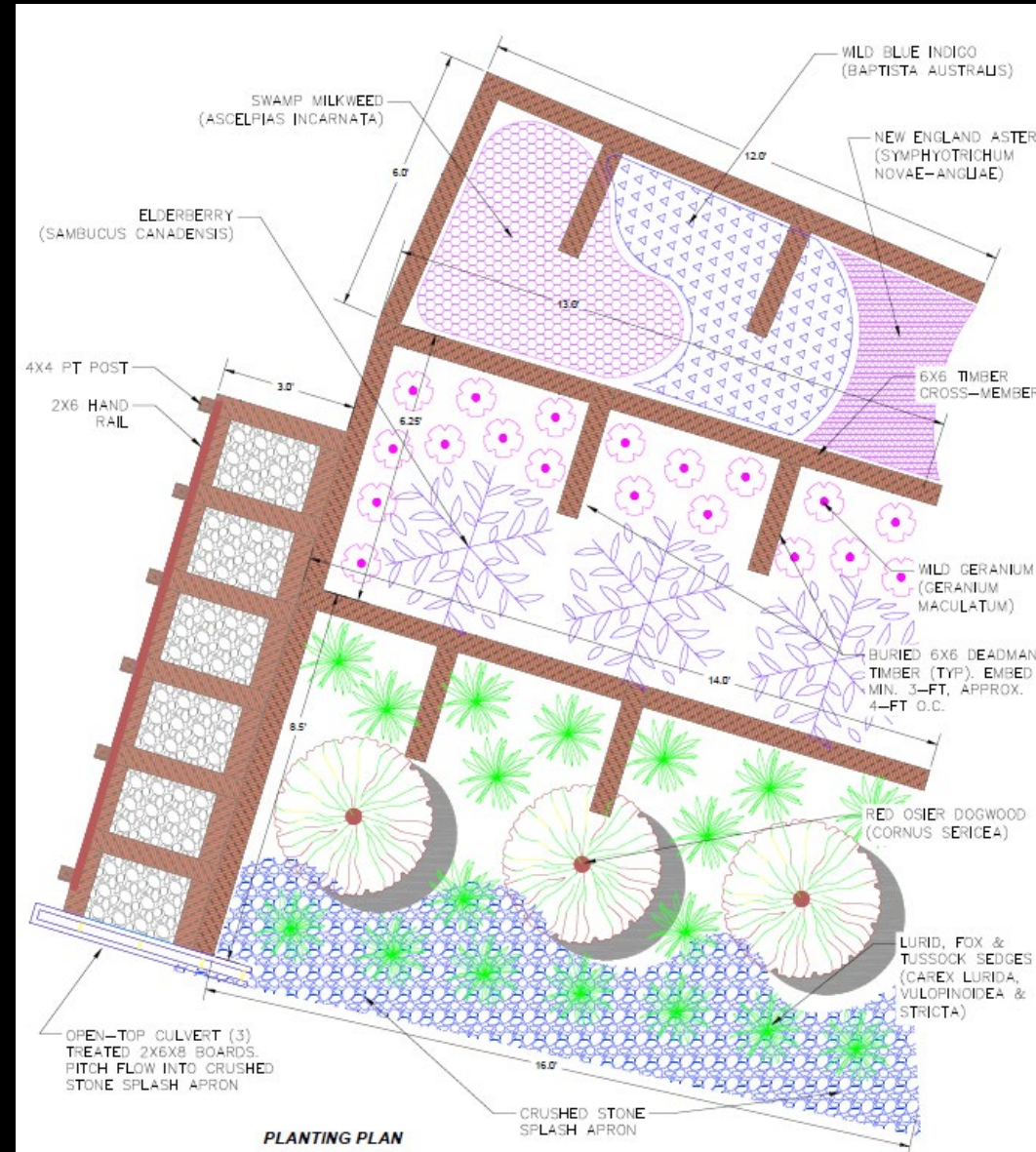
**Total = 423.63 ft<sup>3</sup>**  
**0.0097 acre-feet**

*\*Treating ~½ the WQv in a tight space!*

Water Quality Volume Provided by STP		Response	Attachment location
18*	What is the Treatment Volume the Bioretention filter bed will be sized to accommodate and treat? (Question 5)	0.0198	
19	What is the depth of the filter bed? (2-4 feet) $d_f$ (ft)	3	
20	What is the coefficient of permeability of the filter media? $k$ (ft/day)	8	
21	What is the average height of water above the filter bed? $h_v$ (ft)	0.1	
22	What is the design filter bed drain time? ( $\leq 2$ days) $t_d$ (days)	1	
23*	Required minimum surface area of the filter bed $A_f$ (ft <sup>2</sup> )	104	
24	Design filter bed area $A_f$ (ft <sup>2</sup> )	410	
25	Is the Bioretention storage volume, including the storage volume above the filter bed, volume in any upstream pre-treatment practice, as well as within the filter media, > 75% of the design WQv or $T_v$ (as applicable)?	<input type="radio"/> Yes <input checked="" type="radio"/> No	
26*	Storage Volume (acre feet). This will be entered on the eNOI. (ac-ft)	0.0103	Enter this on the eNOI
Treatment Volume Calculation- Bioretention with Underdrain		Response	Attachment location
27*	What is the surface area of the filter bed/ swale bottom? $A_f$ (ft <sup>2</sup> )	370	
28*	What is the depth of media beneath the underdrain invert? (ft)	3	
29*	What is the porosity of the media beneath the underdrain invert? porosity	0.4	
30*	Treatment Volume $T_v$	444	ft <sup>3</sup>
31*	Treatment Volume $T_v$	0.0102	ac-ft

# Profile views of access & infiltration steps

## Plan view w/ planting schedule



*The driveway was removed to depth of 3'...*



*...then backfilled with 24" drainage stone & 6" septic sand.*

*The timber beds & infiltration steps were installed...*



*...and another 6" of topsoil was placed for planting media.*

*Runoff from the road & uphill neighbors...*



*...enters the beds via a stone inlet & infiltration trench.*

*Beds were keyed into a maple tree & perennial garden...*



*...and an underdrain lies beneath the infiltration bed.*



*No more  
driveway!*





*Stable, safe,  
aesthetic, &  
functional  
access to the  
shoreline!*





## Cost Opinion

- Crew Labor = \$18,000
- Materials = \$4,833
- Plants = \$1,340
- Excavation + Hauling = \$3,200
- Utility Locate = \$1,000
- Oversight = \$1,200

**\$31,765.00**

*\*included 25% contingency*

## Actuals

- Crew Labor = \$13,242
- Materials = \$2,264.82
- Plants = \$882.72
- Excavation + Hauling = \$3,000
- Utility Locate = \$750
- Oversight = \$1,200

**\$21,339.54**

## Tips for Lakeshore Projects

1. Limited access & dense development
2. Soils, soils, soils!! Often too hydric or shallow for infiltration practices
3. Will the project require clearing vegetation or working below the OHWM? → permits!!
4. Consistently more expensive than other project types
  - Hardscaping (e.g., stone, pavers, concrete, asphalt, etc.)
  - Specialty equipment (e.g., ditch witch, micro-excavators, power wheelbarrows, etc.)
5. Watch out for “zones of mystery” in the designs!
6. Dig Safe! And don't hesitate to hire private utility locate services!
  - Septic tanks, Gas lines, Buried & overhead wires, Mystery pipes & cables
7. Permitting
  - Slow in Summer months. Lakeshore Encroachment, Shoreland, & Army Corps (+ Cultural?!)
8. Small but critical maintenance items!
  - Leaf litter, road grit, gunk, perforated pipes, cleanout wyes, etc.
9. Turbidity curtain installation on Friday before construction begins
10. Mobilization, staging, prep & excavation start on Monday; Hand crew comes in on Tuesday
11. Services agreements are important