consulting engineers
& scientists

An Approach to Assess and Manage Risk of Chloride Migration to Elkwater Lake

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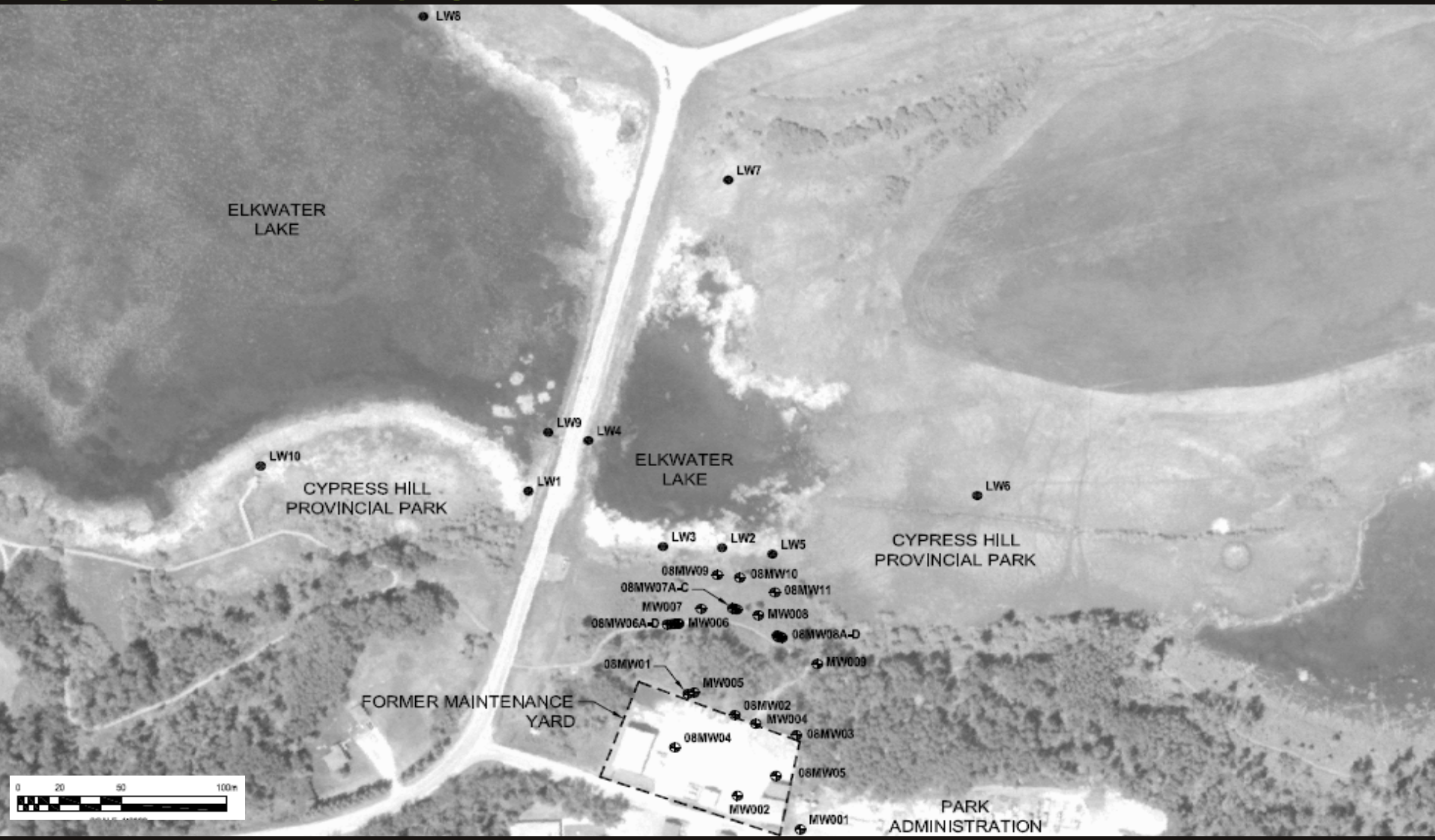
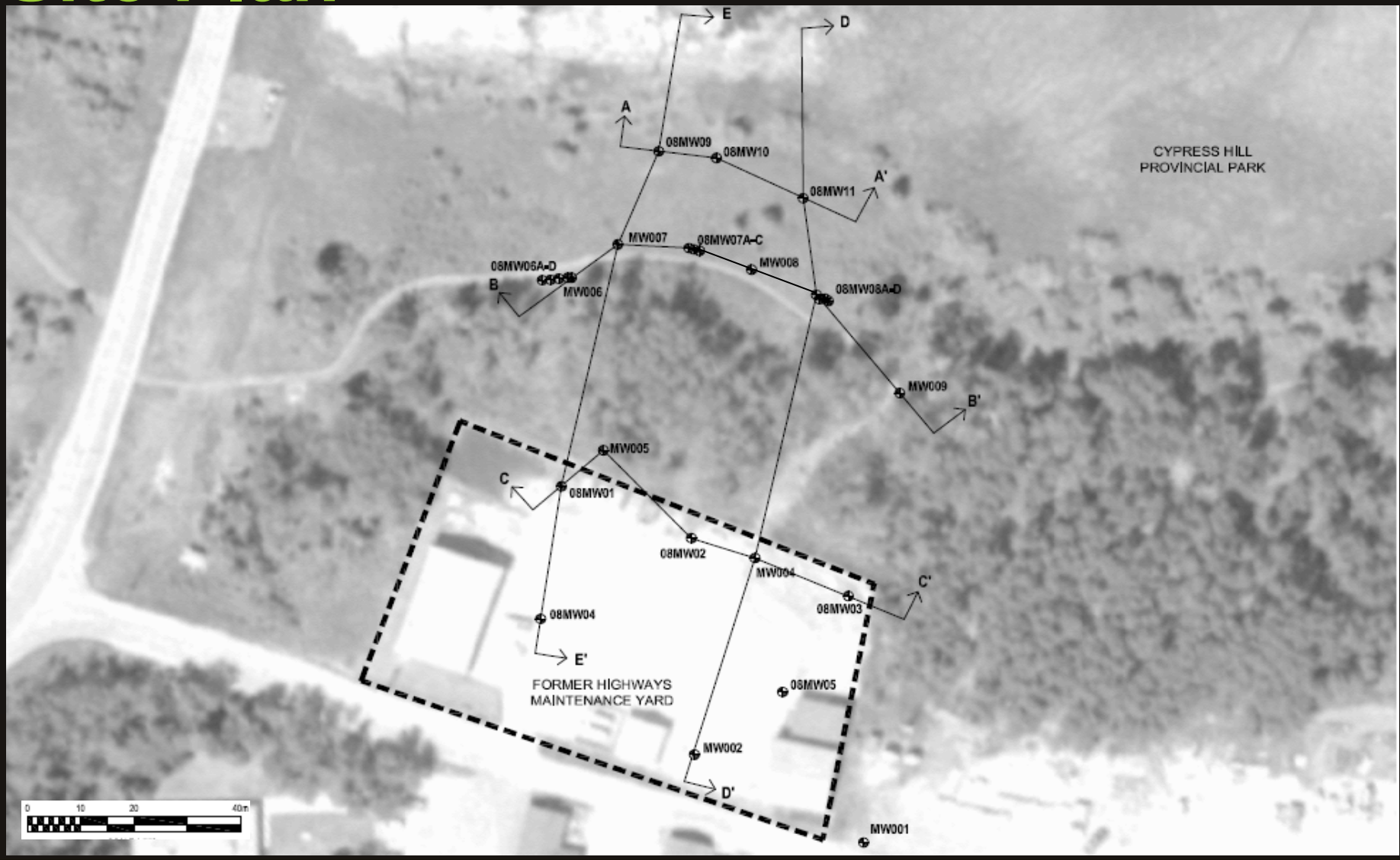
Outline

- Background and Risk Management Issues
- Purpose and Scope
- Subsurface Conditions
- Chloride Migration to Elkwater Lake – Modeling
- Benthic and Geotechnical Results
- Remedial Alternatives
- Activities to be Undertaken

Site Location



Site Plan


E
D
A
08MW09
08MW10
CYPRESS HILL
PROVINCIAL PARK
08MW11
A'
MW007
08MW07A-C
08MW06A-D
MW008
B
MW006
08MW08A-D
MW009
B'
MW005
C
08MW01
08MW02
MW004
C'
08MW03
08MW04
E'
FORMER HIGHWAYS
MAINTENANCE YARD
08MW05
MW002
D'
MW001
0
10
20
40m

Historical Salt Issues

- Used as a salt storage since 1960s
- Noted sead and stressed vegetation between the storage yard and the lake in 1970s
- Remediation works in 1997
  - Removed salt storage
  - Removed underground storage tanks (USTs) and
  - Removed impacted soils near the northwest corner
  - Covered salt storage surface area partially by an asphalt pad; and
  - Constructed a runoff containment pond; and

Risk

- Salt leached from the on-site soil to the groundwater = zone of chloride-rich groundwater
- Salt concentrations in the groundwater exceeded potable drinking water and the protection of freshwater aquatic life (FAL) guidelines
- The affected groundwater was discharging into the small embayment on Elkwater Lake
- Needed to assess the risk to the water quality of the lake

Risk Management Issues (2007)

- Preferred alternative = combine pathway control and passive remedial action (allow groundwater to discharge into the lake)
- Assumes:
  - Prior salt storage removal has already improved the situation on site (worst case of groundwater quality had already been experienced), and
  - disruption of the site = greater impact on the lake and shoreline (highly disruptive to the wildlife habitat along the shoreline)

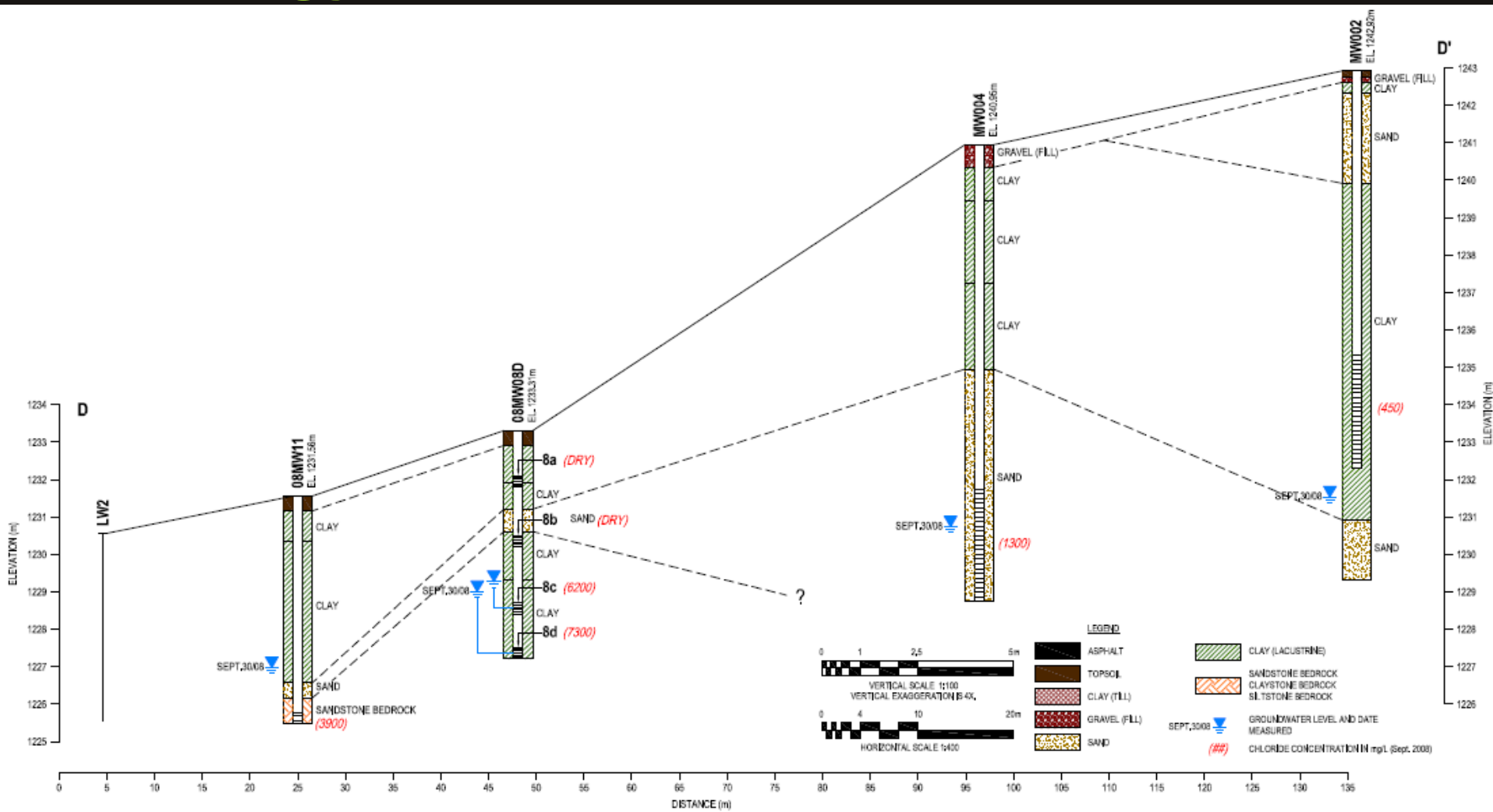
Additional Assessment - Purpose

- Assess the feasibility of controlling subsurface pathways of chloride migration
- Evaluate chloride loading to the groundwater and migration to the lake
- Confirm that the conditions used to create the RMP were valid by monitoring the lake and groundwater quality and benthic habitat and application of a model assessing the chloride migration to the lake.

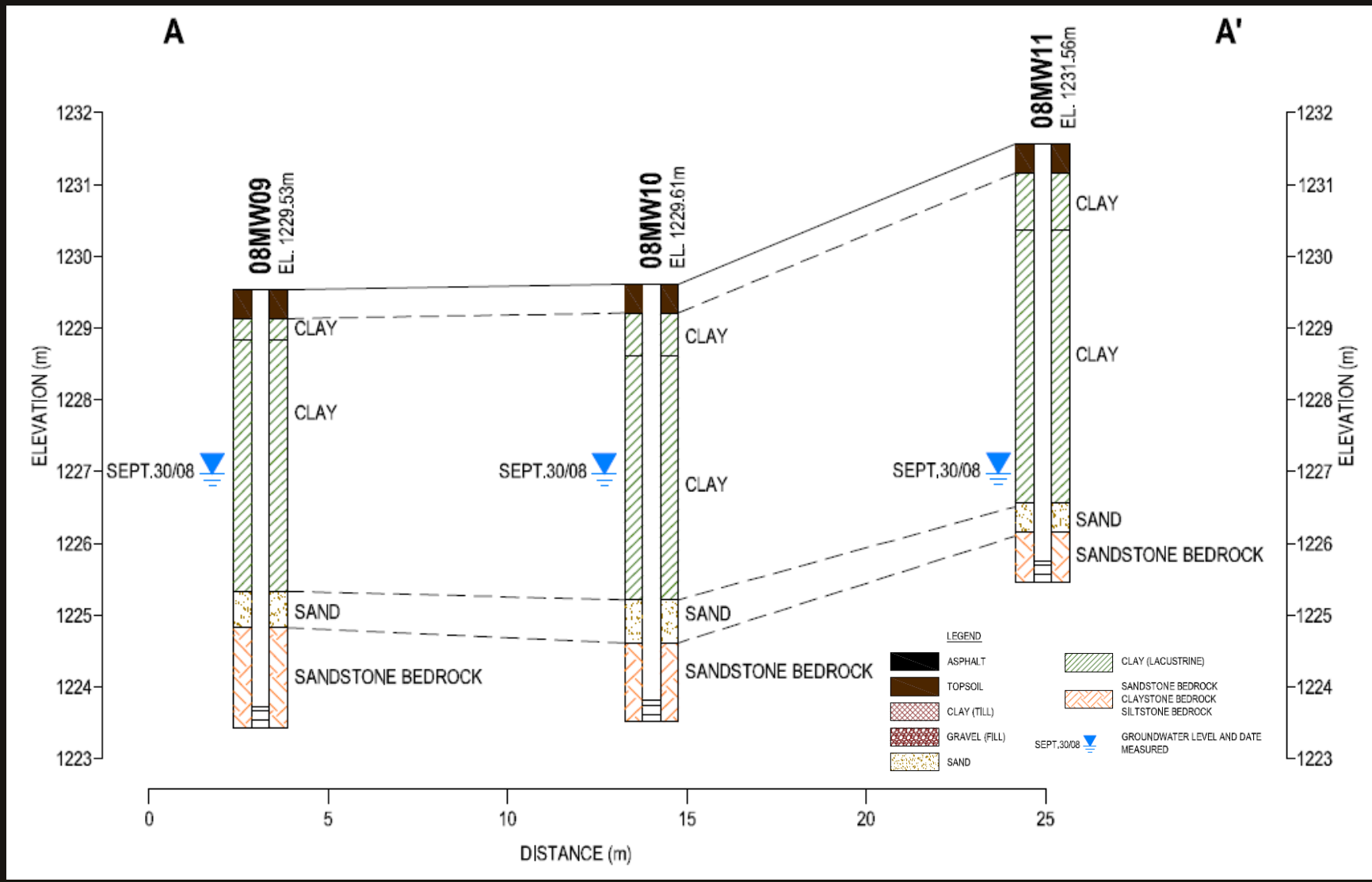
Additional Assessment - Scope

- Hydrogeological Investigations
- Groundwater Modeling
- Geotechnical Assessment
- Benthic Survey
- Assess Remediation Alternatives

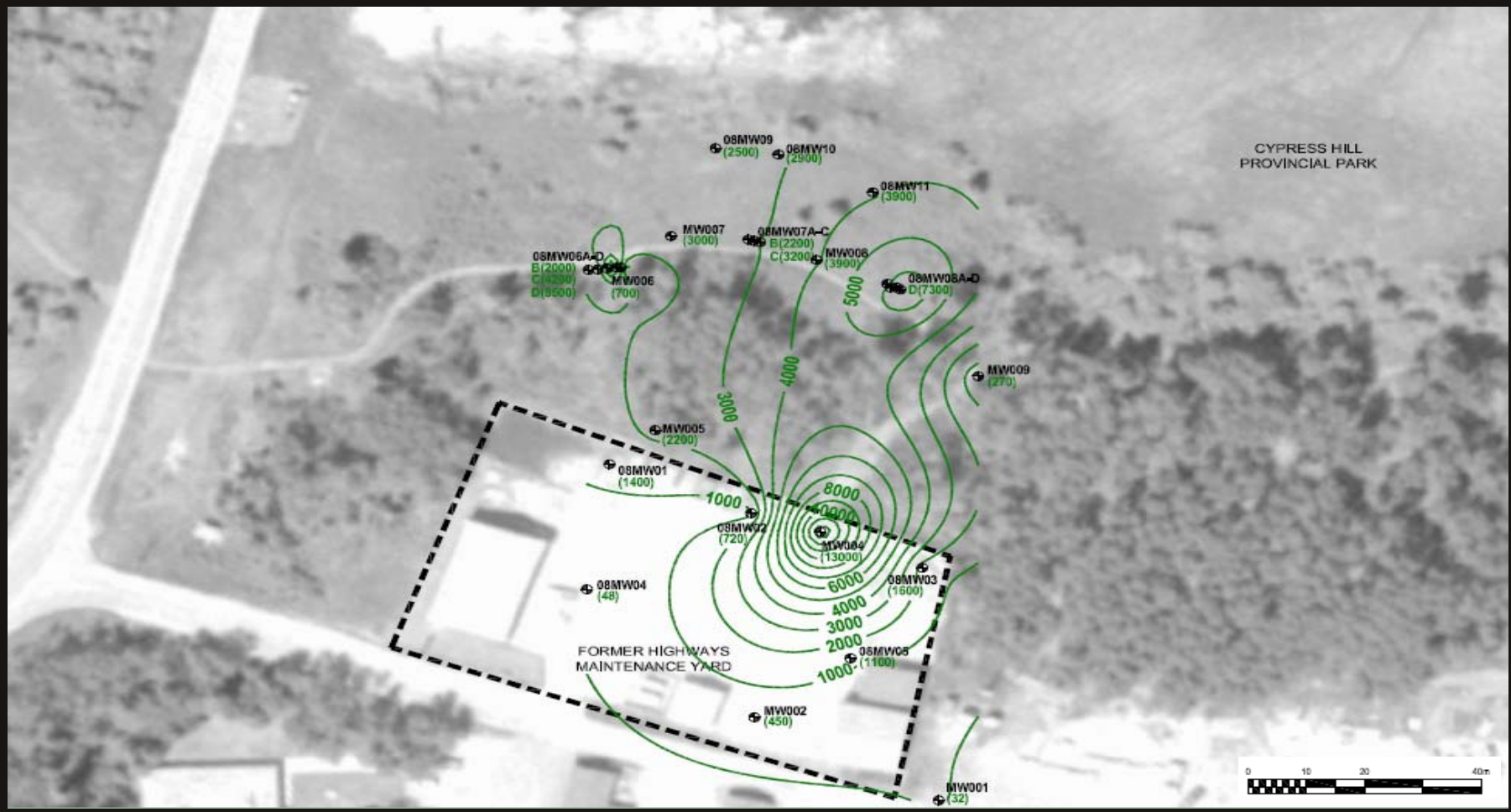
Hydrogeological Assessment - Lithology



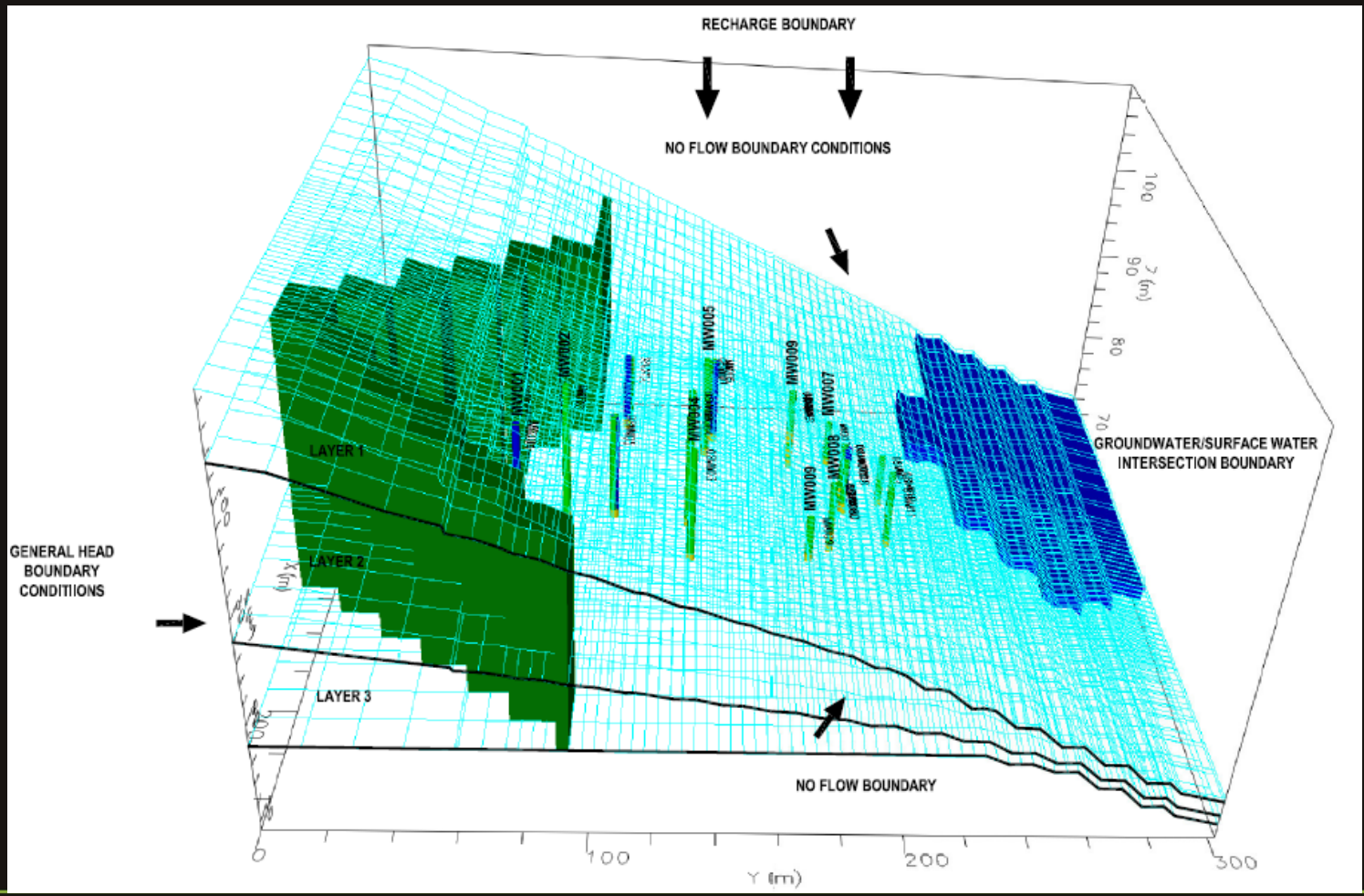
Subsurface Conditions



Hydrogeological Assessment - Chloride Distribution



Chloride Migration to Elkwater Lake – Modeling



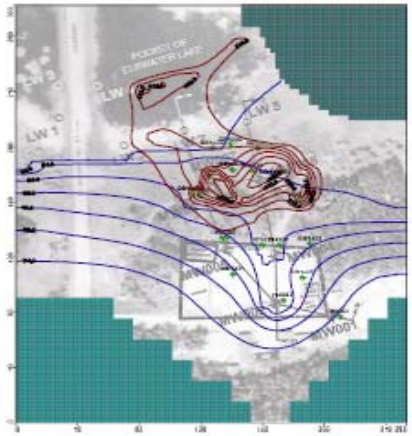
Chloride Migration to Elkwater Lake

3 Scenarios:

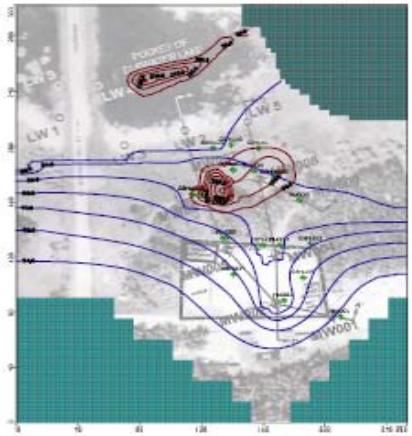
1. No cover on the salt affected soil on the yard
2. Impervious subsurface within the salt storage yard
3. Impervious layer (asphalt) covering the salt affected soil

Chloride Migration to Elkwater Lake – Modeling (Scenario 1)

LAYER 2



1 YEAR

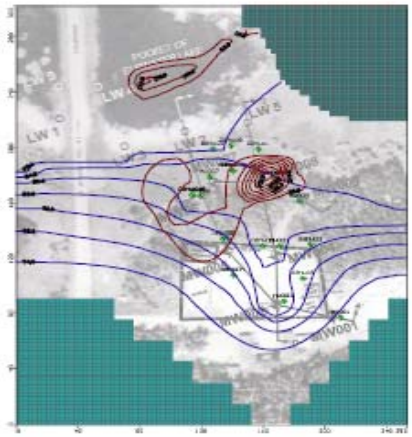


3 YEARS

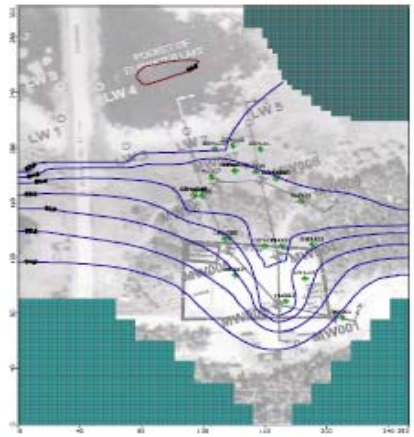
5 YEARS

LAYER 3

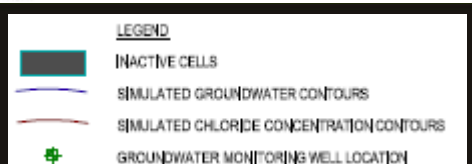
1 YEAR



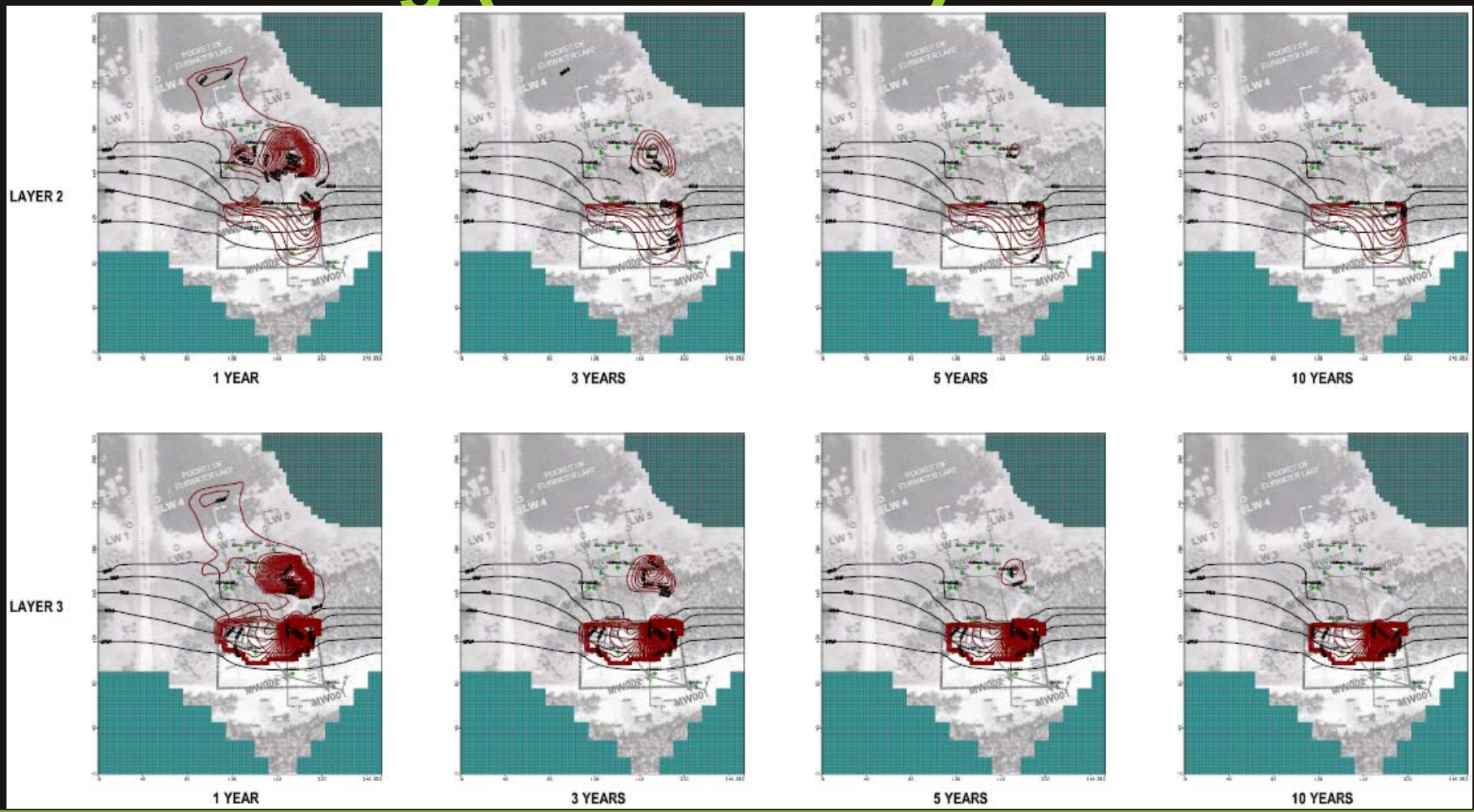
3 YEARS



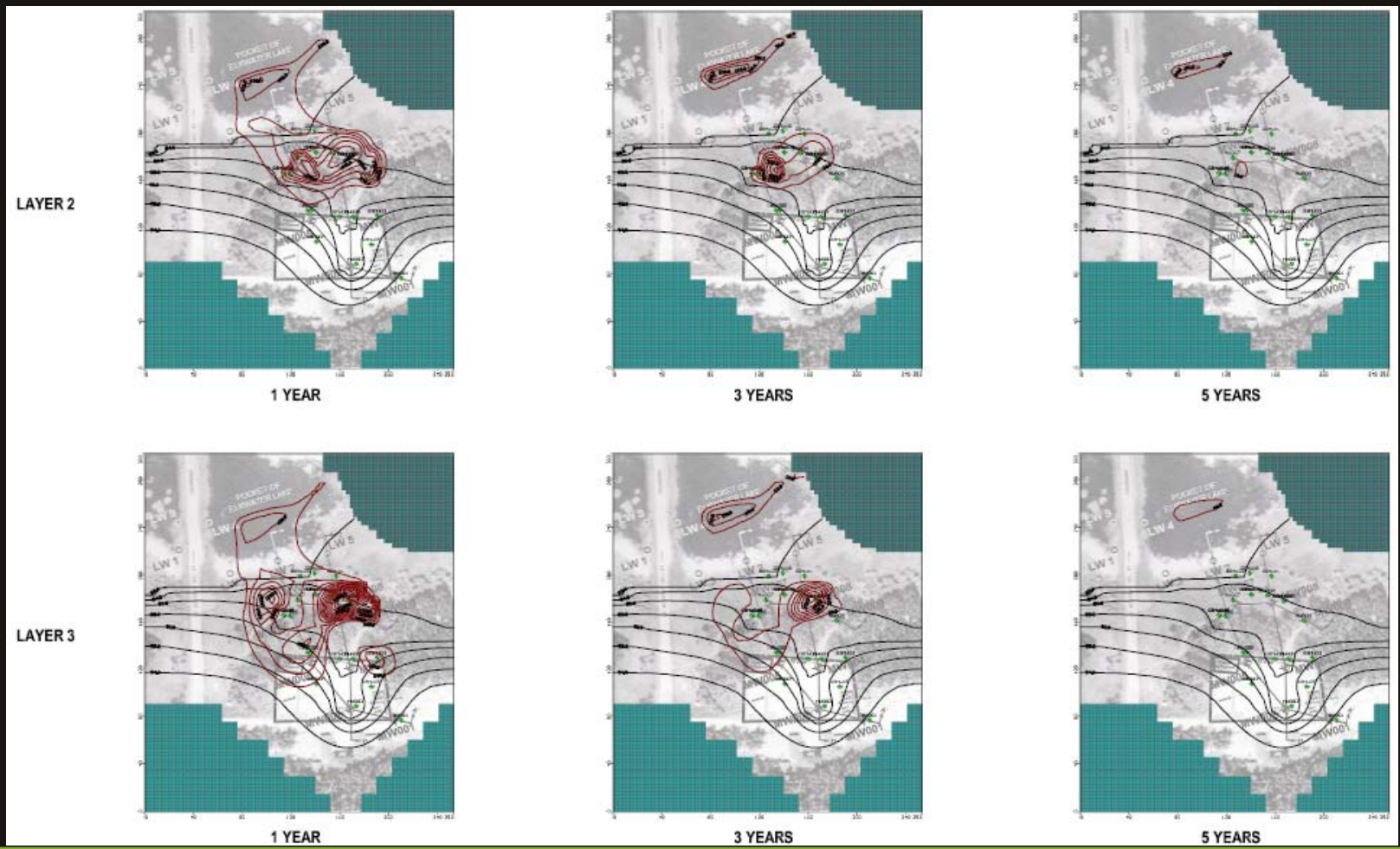
5 YEARS



Chloride Migration to Elkwater Lake – Modeling (Scenario 2)



Chloride Migration to Elkwater Lake – Modeling (Scenario 3)



Chloride Migration to Elkwater Lake

- Allowing infiltration to dilute the chloride reduces the concentration reaching the lake
- Rapid decline in concentration over a period of 5 to 10 years
- All scenarios predict concentration in the groundwater close to the lake greater than the guidelines for water quality protection
- It is uncertain the worst case scenario of discharge has occurred or will occur
- Leaching from soil not accounted for

Benthic Assessment

- Ecology of Elkwater Lake has not been affected by groundwater flowing from the site
- Controlled discharge to lake considered acceptable since benthic habitat not considered to be adversely affected by chloride-rich groundwater

Geotechnical Assessment

- Control salt migration to Elkwater Lake by:
  - extraction wells or an interceptor trench to collect the affected groundwater; and
  - impermeable barrier to block the flow of groundwater towards the lake.

Geotechnical Challenges

- Constructing interceptor trench or impermeable wall 12 m deep (keyed into bedrock) would create a large ground disturbance, considerable silt fencing and surface erosion control
- Ground disturbance raised concerns for protection of nesting area along the shoreline of the lake requiring work only in late summer to early winter

Remedial Alternatives

- capping of the salt affected soil at the yard

  - would prevent further chloride loading to the groundwater

  - but concentrations still greater than criteria at the Lake

Remedial Alternatives (Cont.)

- interceptor trenches or barrier walls

Will be costly :

  - sloped ground and soft soils
  - ground disturbance in a sensitive area of the park
  - construction in a time of the year that makes work difficult

Remedial Alternatives (Cont.)

- electro-kinetic methods to extract salt from the groundwater and move salt from the soil porewater to collect in wells

  - No massive ground disturbance close to Lake habitat

  - A controlled discharge to the lake considered acceptable since benthic habitat not considered to be adversely affected by chloride-rich groundwater (less stringent criteria may be developed)

Activities to be Undertaken

- Vertical delineation of chlorides
- Delineation towards west
- Determine hydraulic conductivities of subsurface material upgradient of shoreline

Questions

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