The Owl Creek Pit Part 2: Pit Water Quality 25 years after Backfilling with Acid Generating Rock

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Agenda

- Owl Creek Mine
- Owl Creek Pit
- Owl Creek Drainage
- Owl Creek Discharge
- Owl Creek Passive Discharge
- Owl Creek Model

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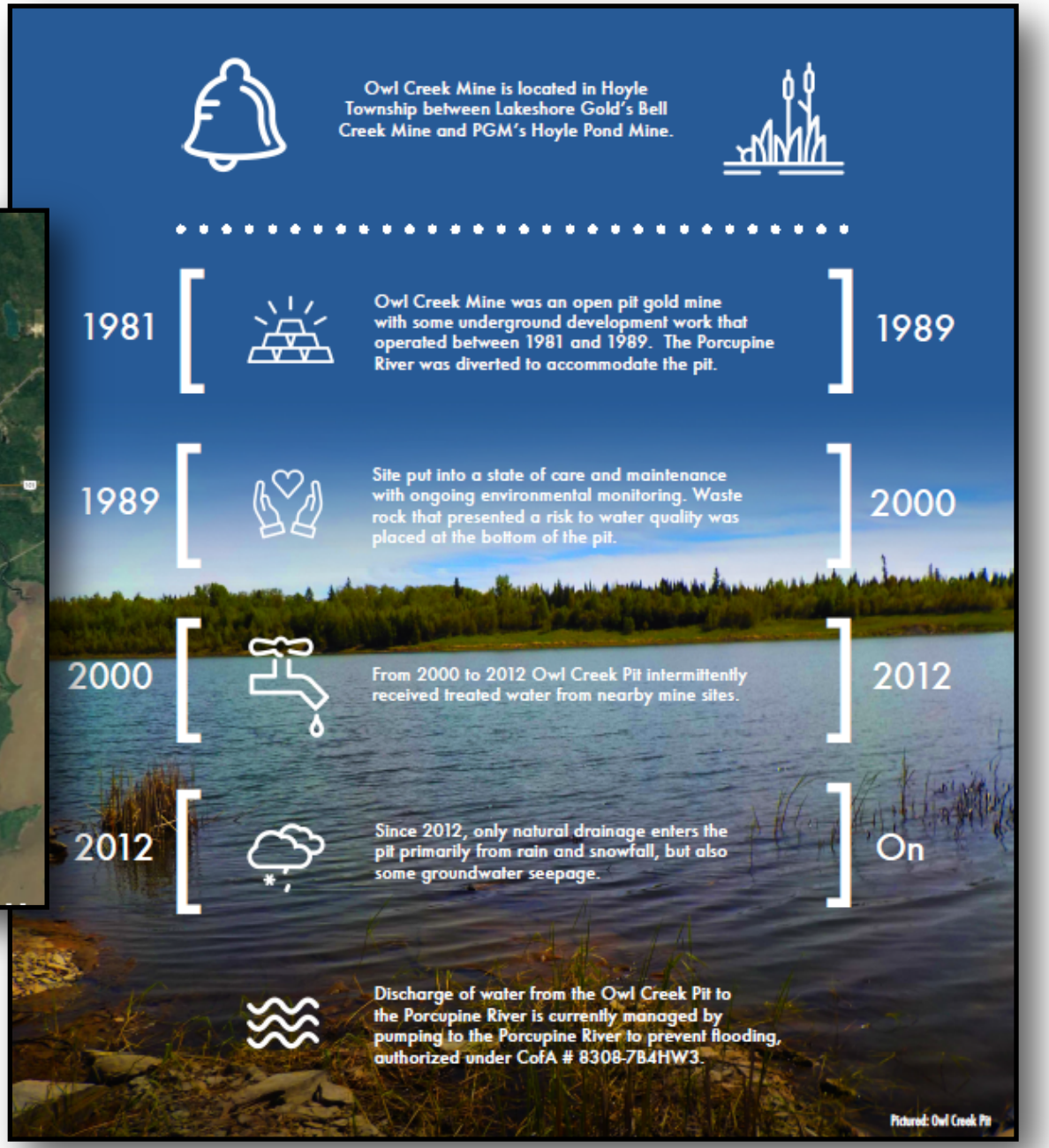
Owl Creek Mine



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Owl Creek Pit

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Owl Creek Drainage

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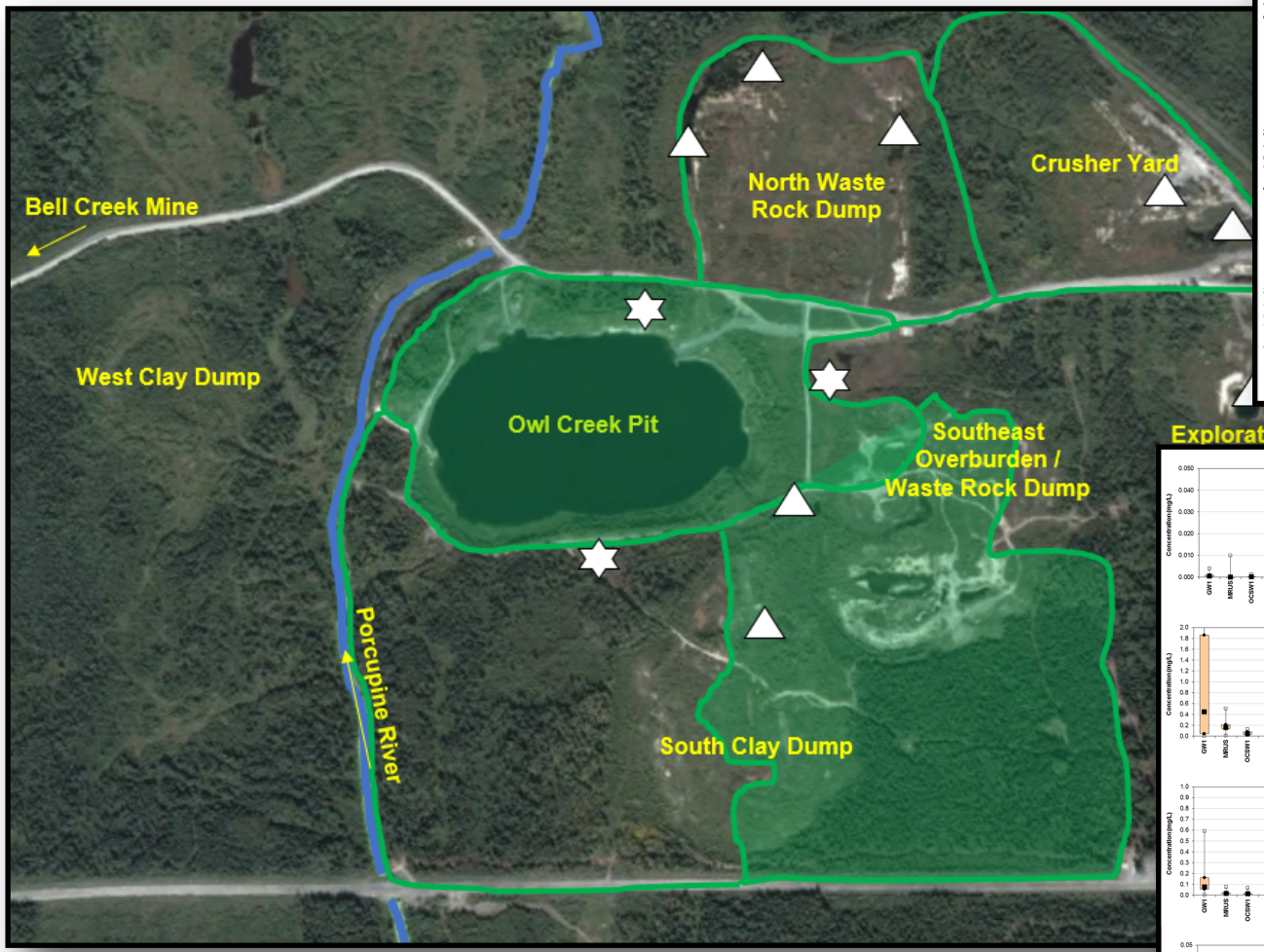
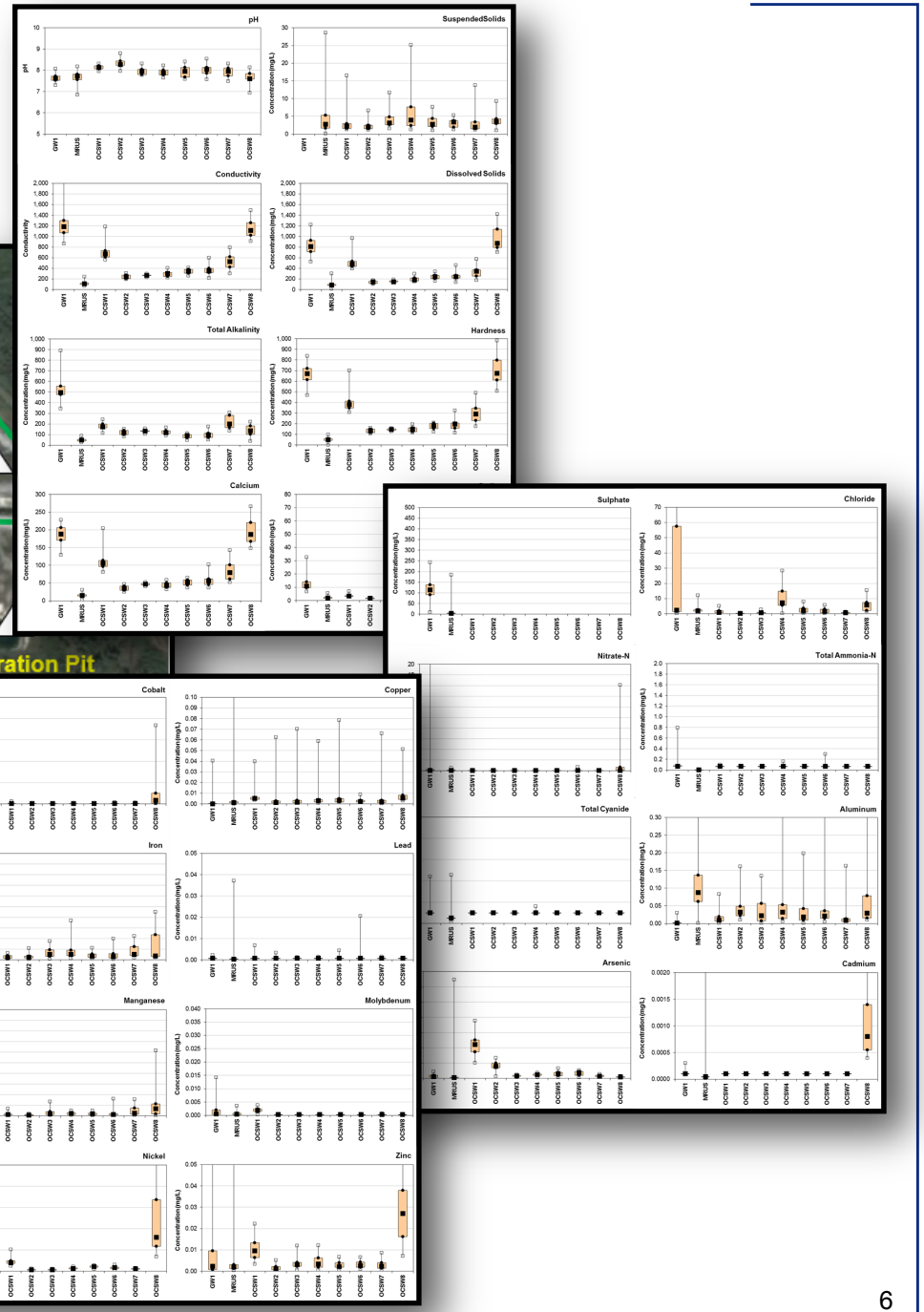
Owl Creek Drainage





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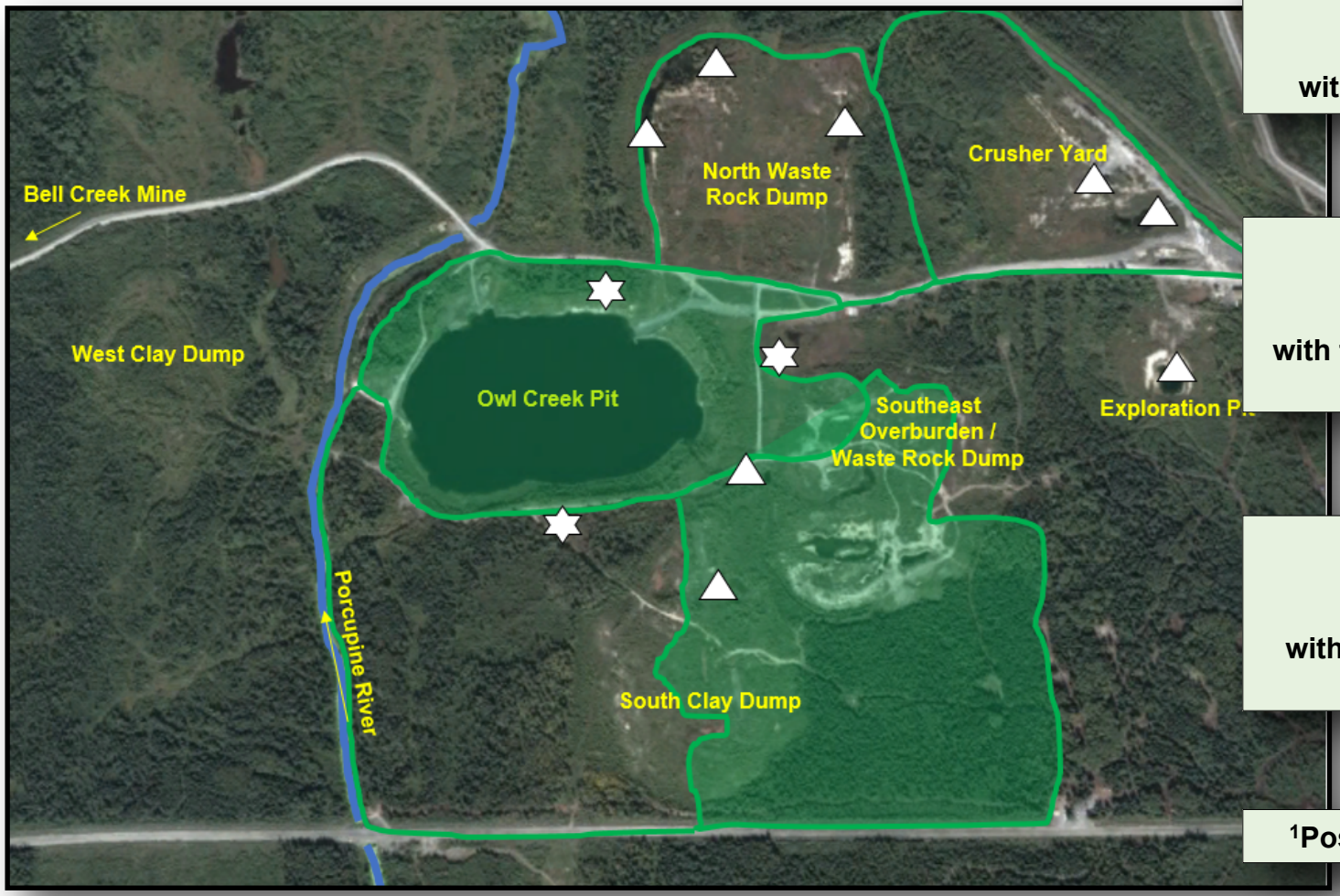
Owl Creek Drainage



Groundwater complies with the PWQO
with the possible exception[1] of cobalt, iron, zinc.

Surface drainage to pit complies with the PWQO
with the possible exception[1] of aluminum, cadmium, cobalt, copper, iron, nickel, zinc.

Surface drainage beyond pit complies with the PWQO
with the possible exception[1] of aluminum, arsenic, copper, iron at certain locations.

[1]Possible exceptions based on the 95th percentile.

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Owl Creek Discharge

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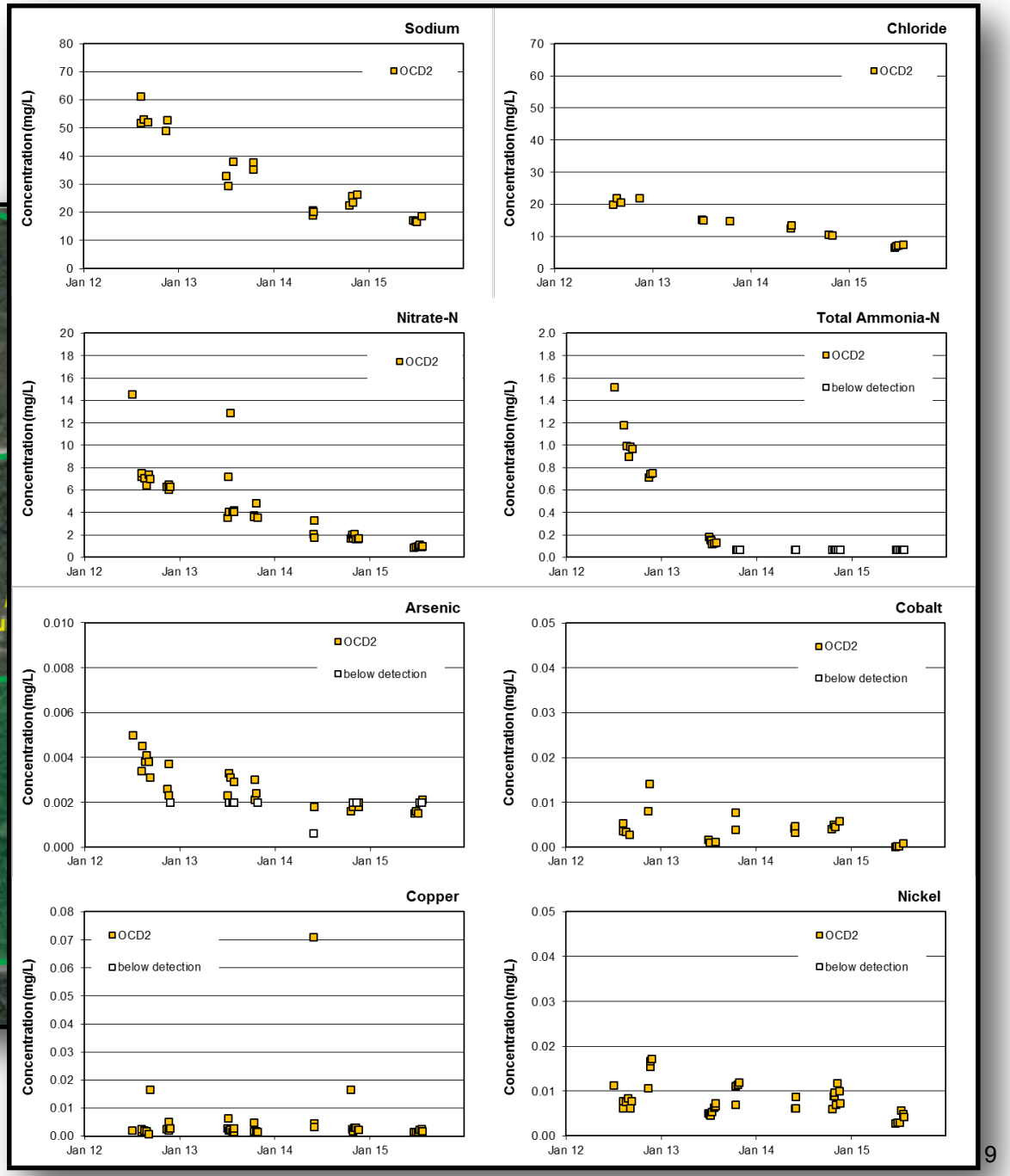
Owl Creek Discharge



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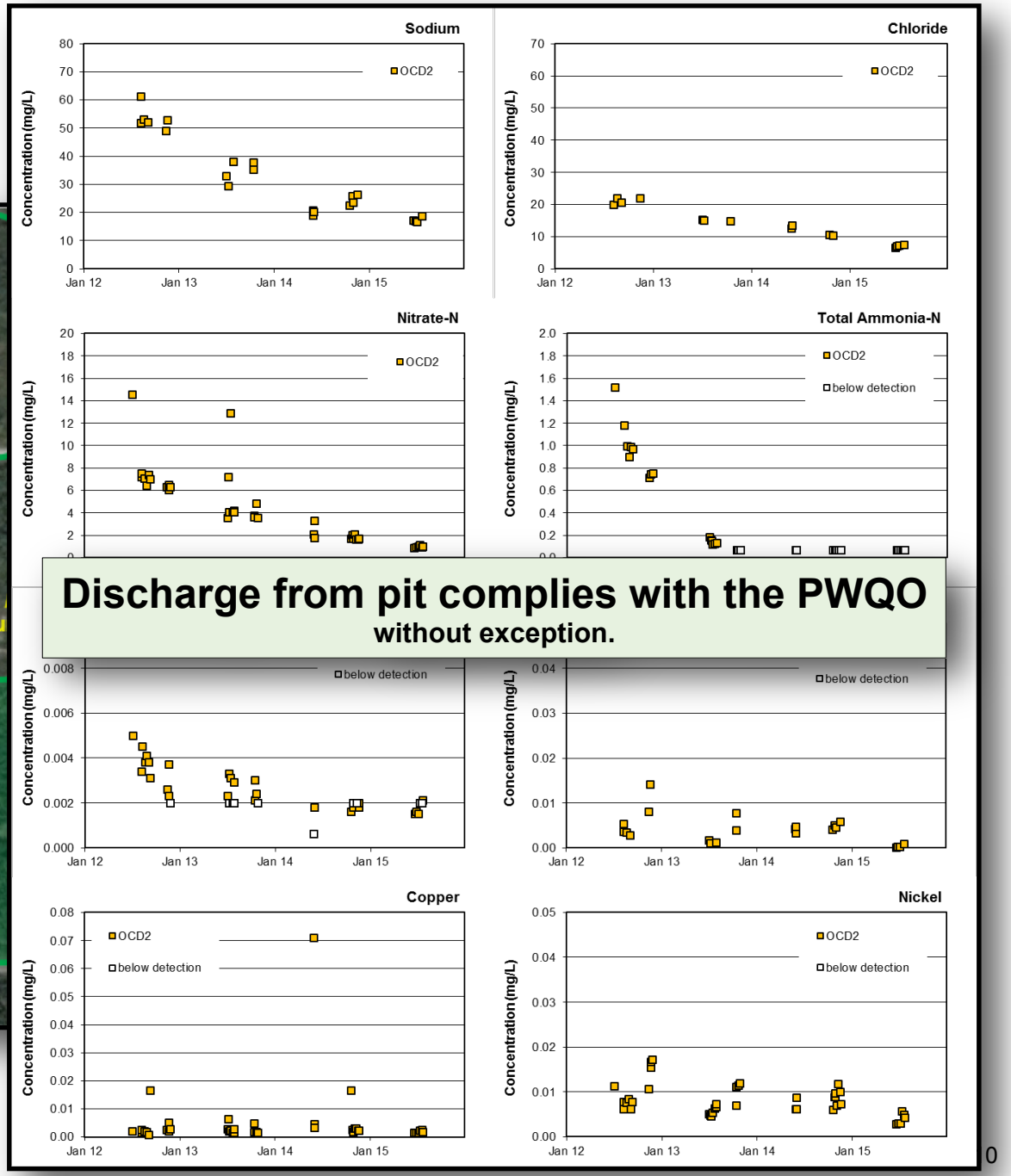
Owl Creek Discharge



Discharge from pit complies with the PWQO
without exception.

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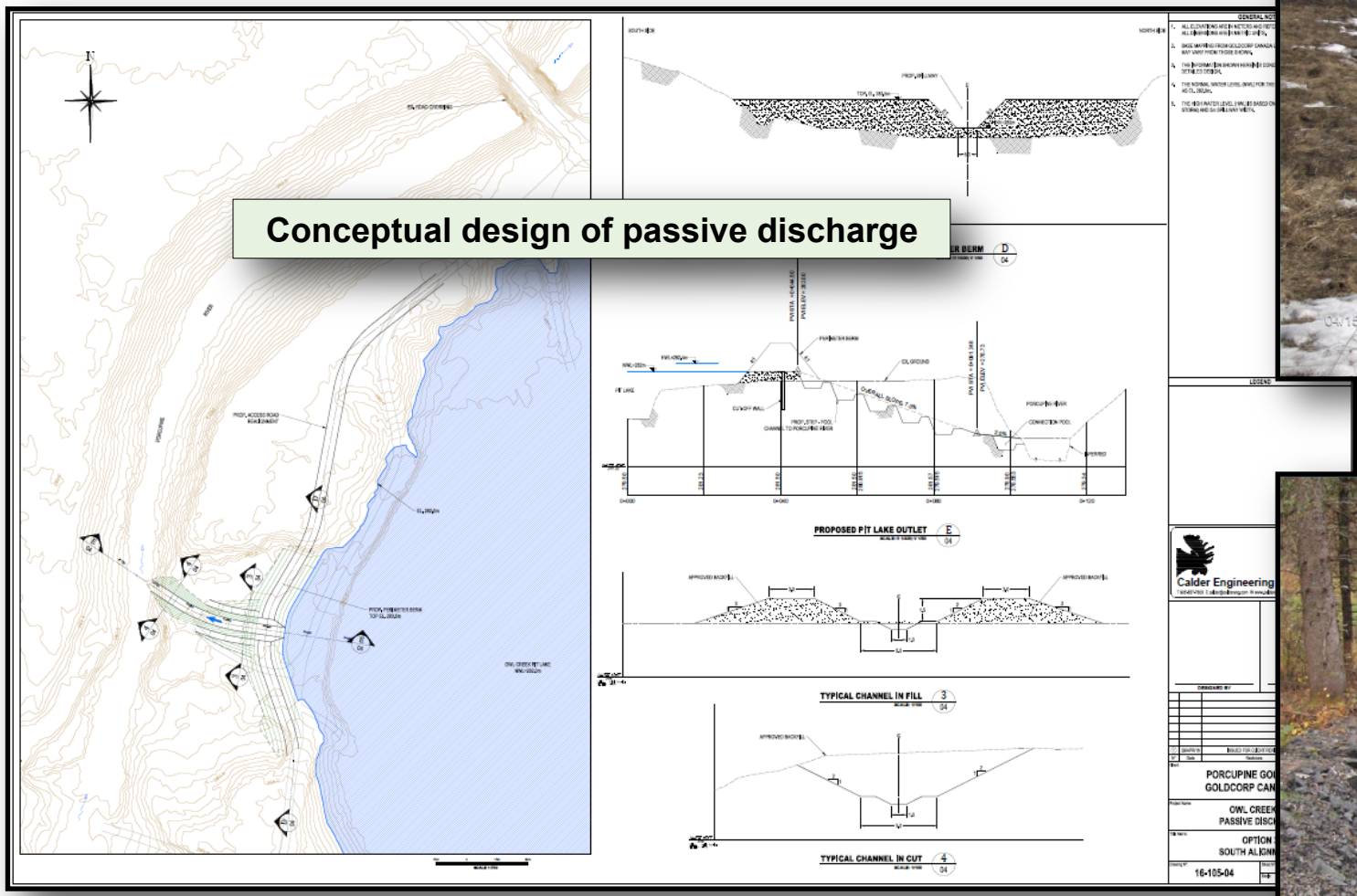
Owl Creek Passive Discharge



Conceptual design of passive discharge

Examples of passive discharge

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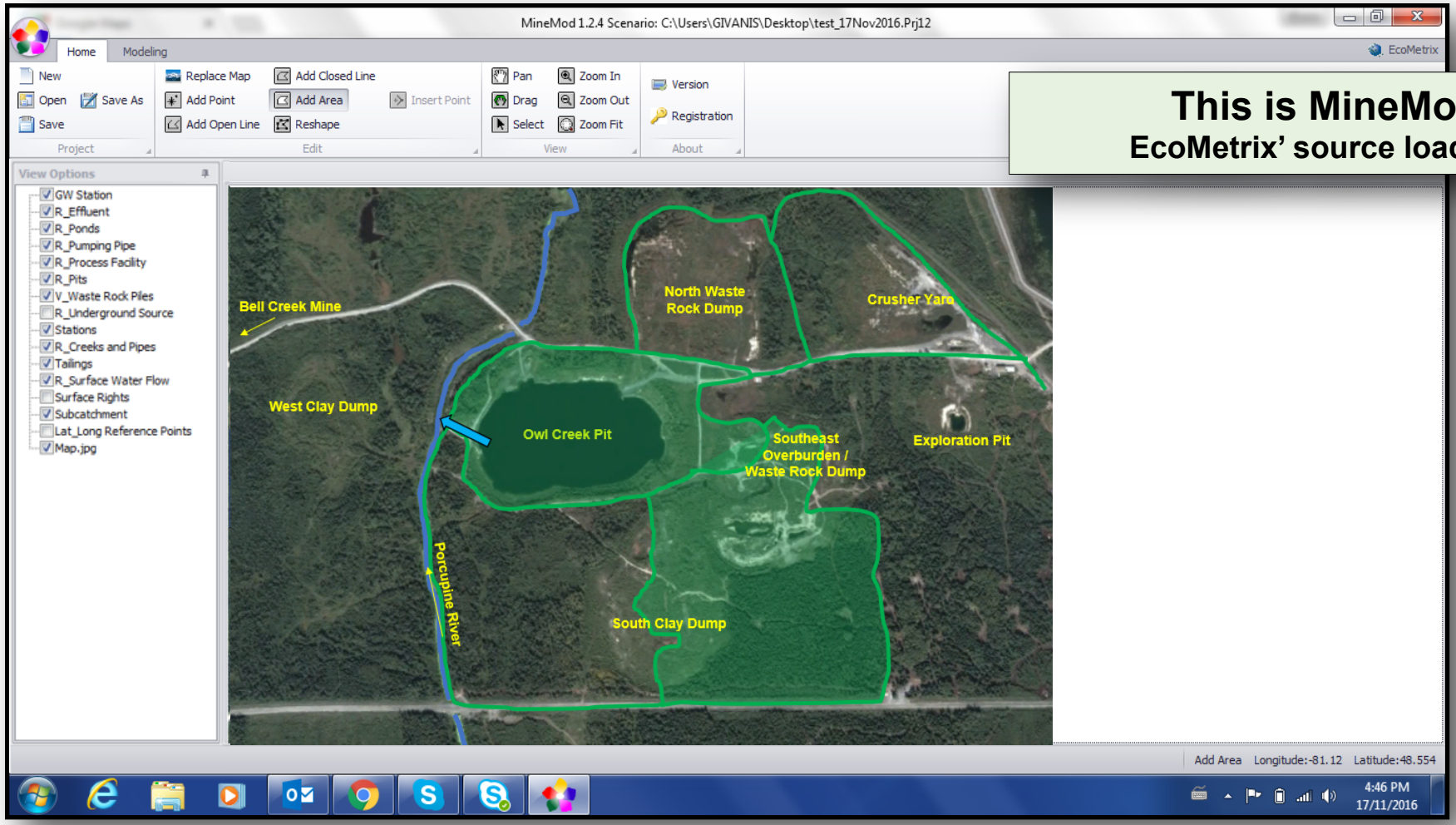
Owl Creek Model



This is MineMod™!
EcoMetrix' source load model.

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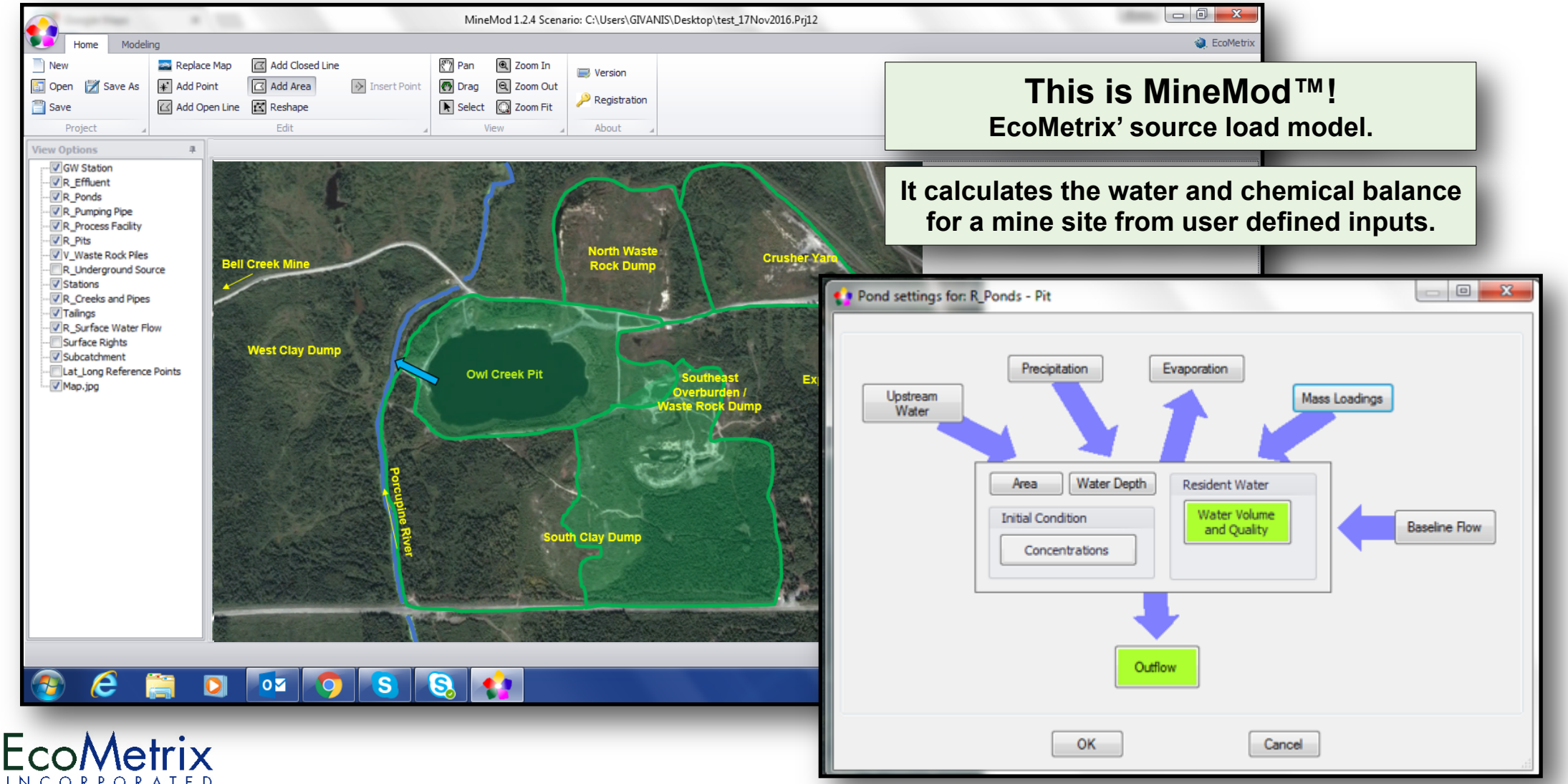
Owl Creek Model



This is MineMod™!
EcoMetrix' source load model.

It calculates the water and chemical balance for a mine site from user defined inputs.

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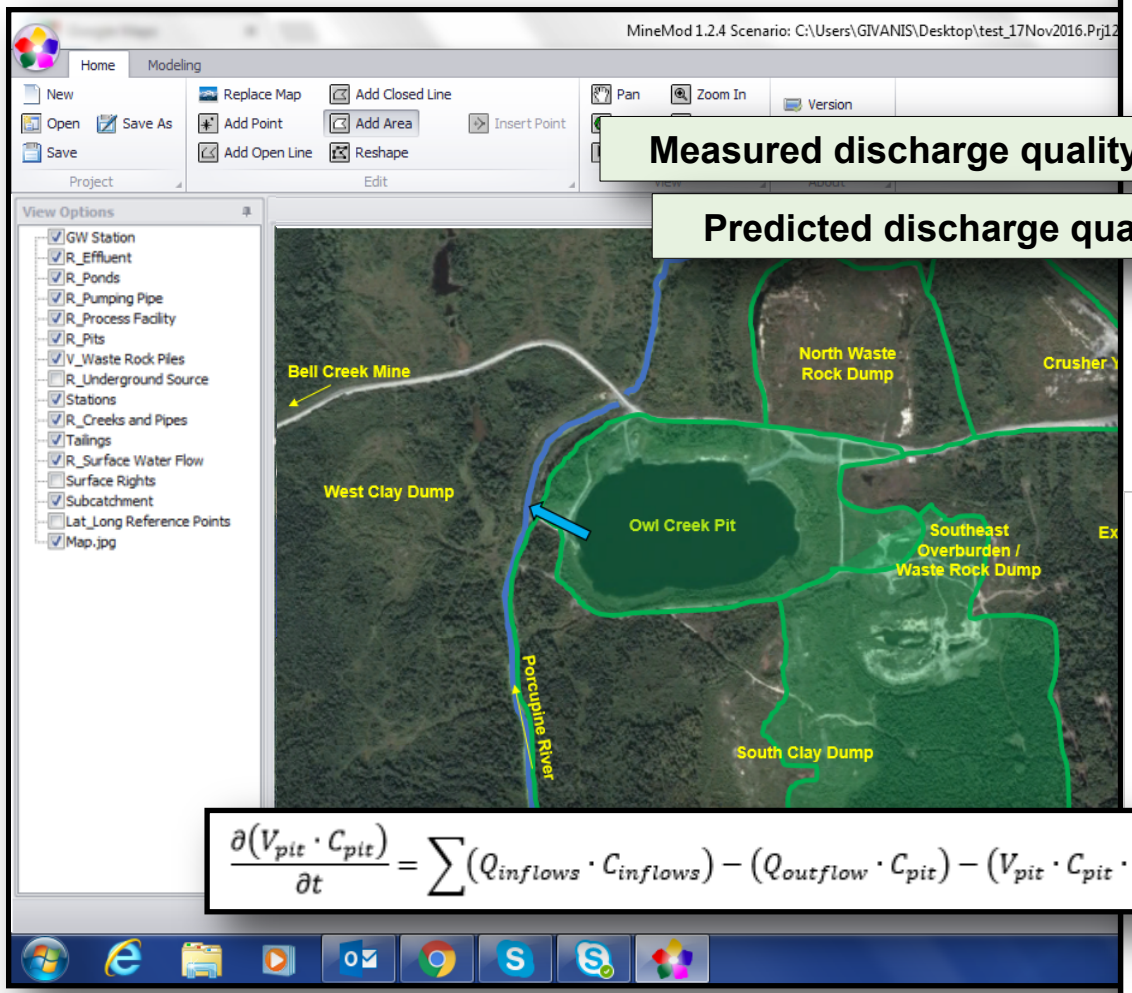
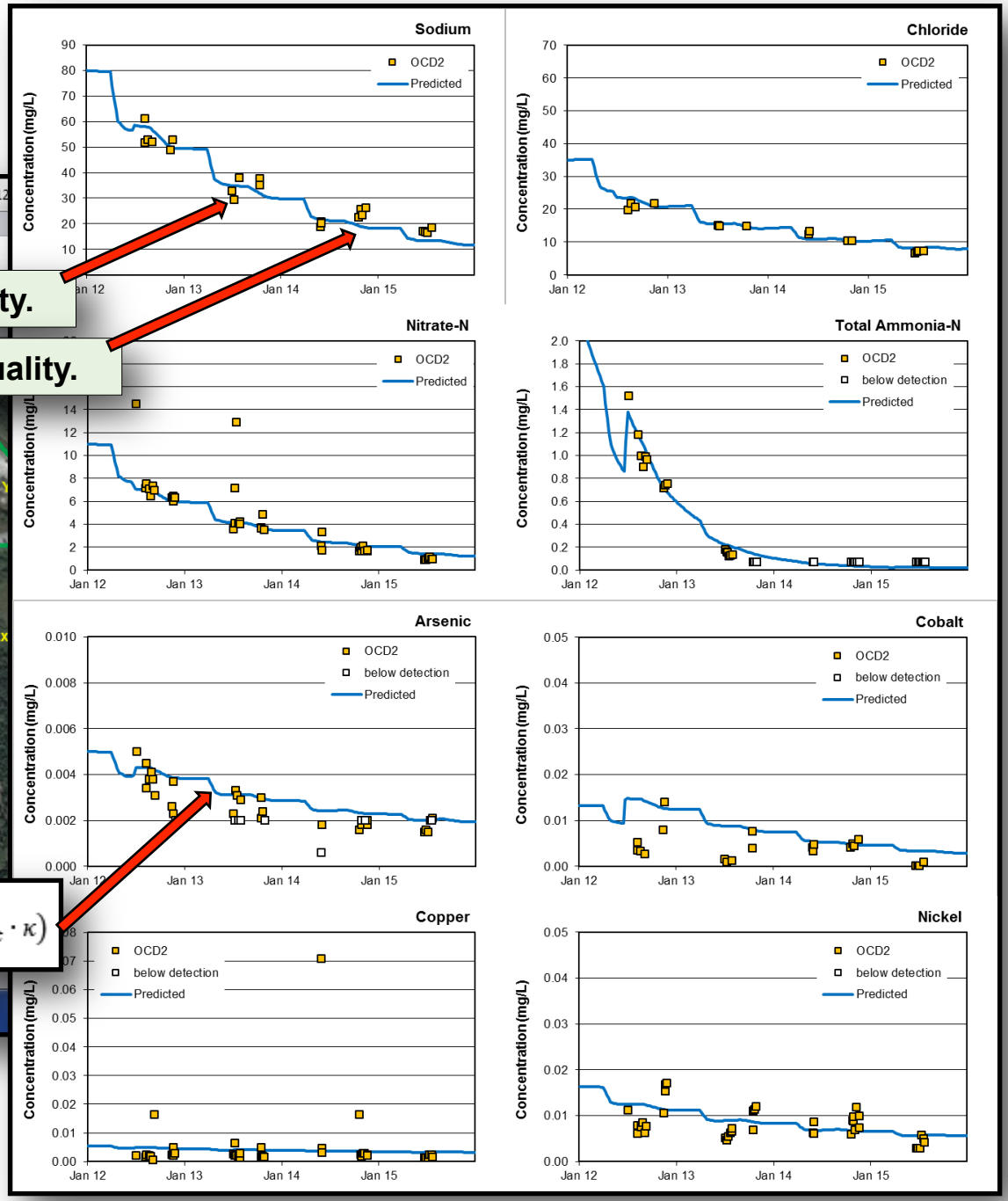
Owl Creek Model



Measured discharge quality.

Predicted discharge quality.

$$\frac{\partial(V_{pit} \cdot C_{pit})}{\partial t} = \sum(Q_{inflows} \cdot C_{inflows}) - (Q_{outflow} \cdot C_{pit}) - (V_{pit} \cdot C_{pit} \cdot \kappa)$$



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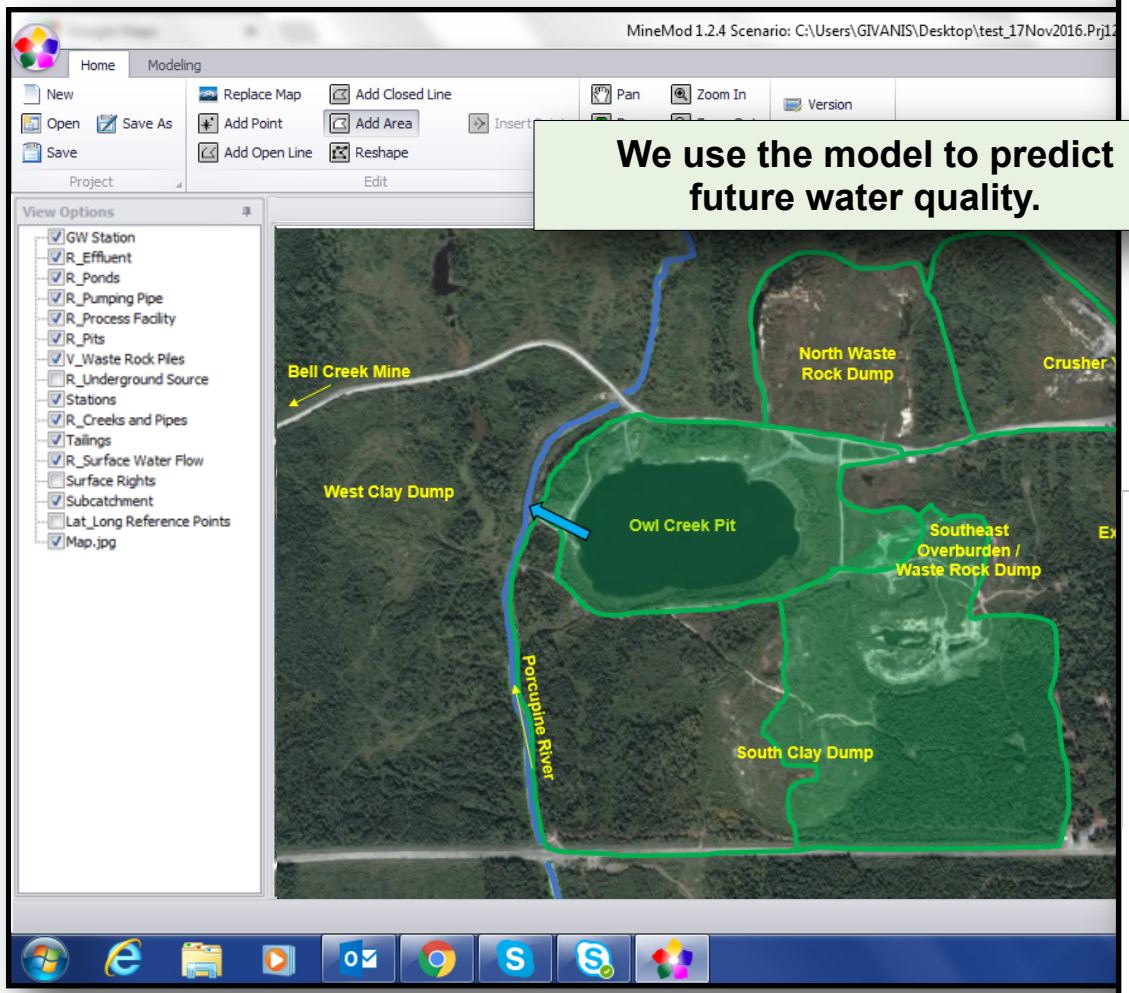
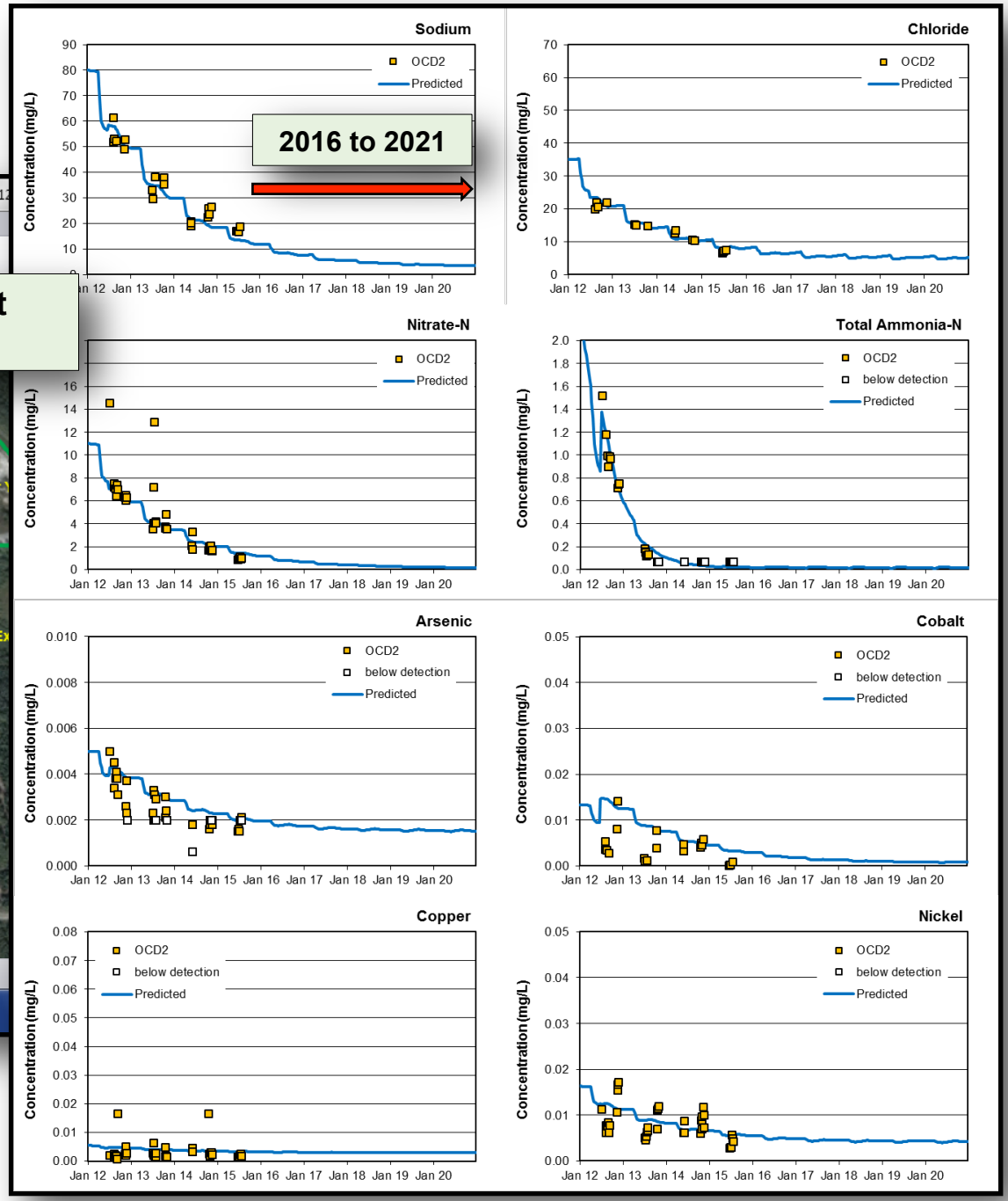
Owl Creek Model



We use the model to predict future water quality.



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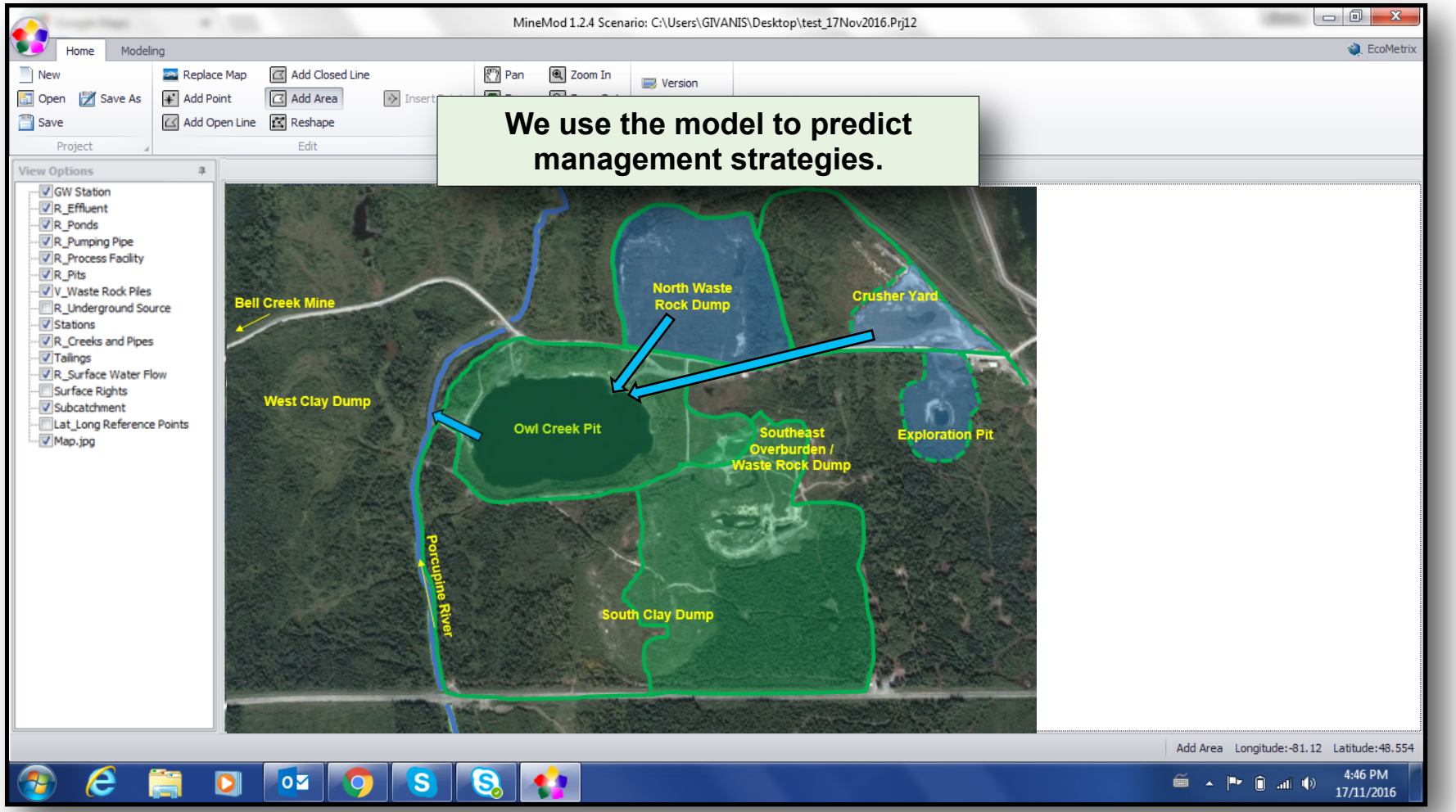
Owl Creek Model



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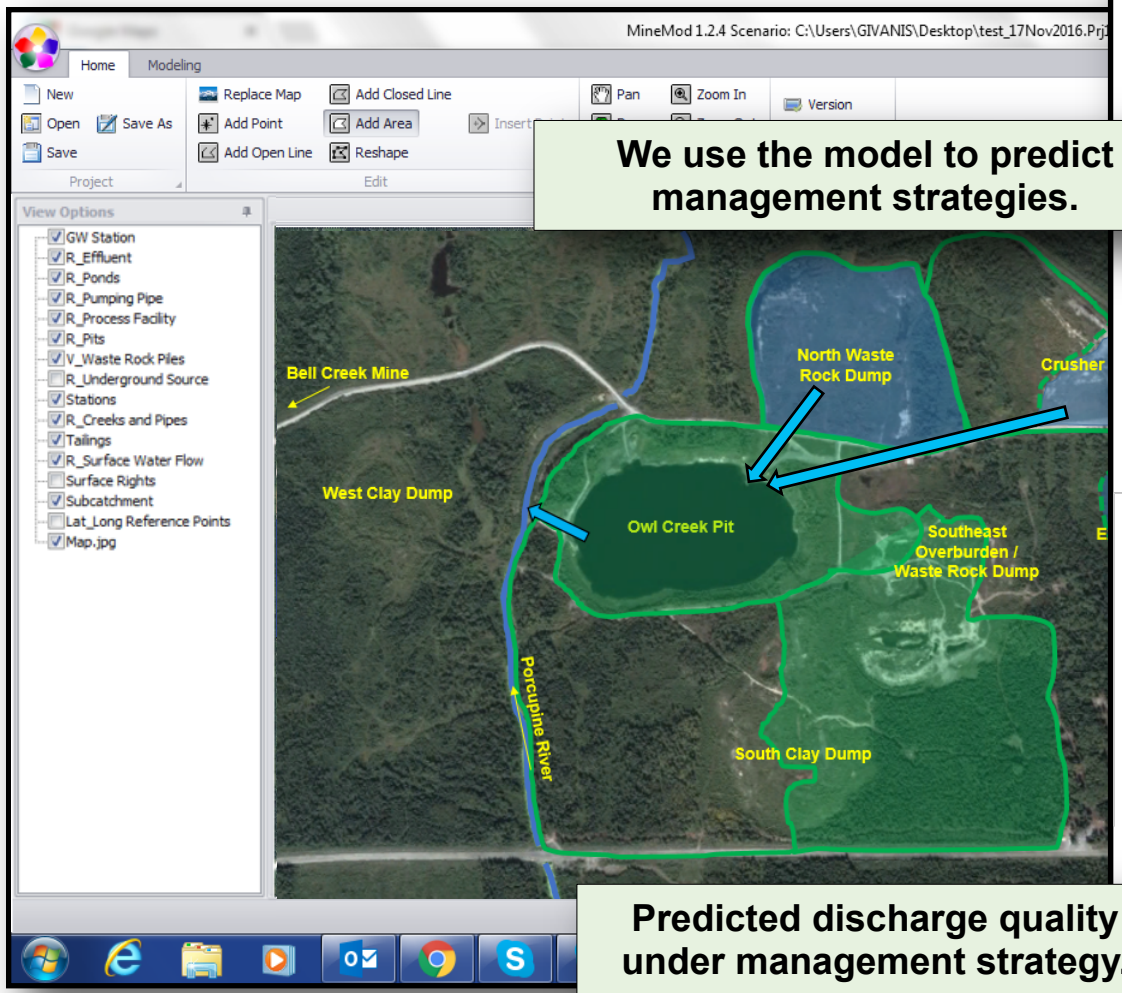
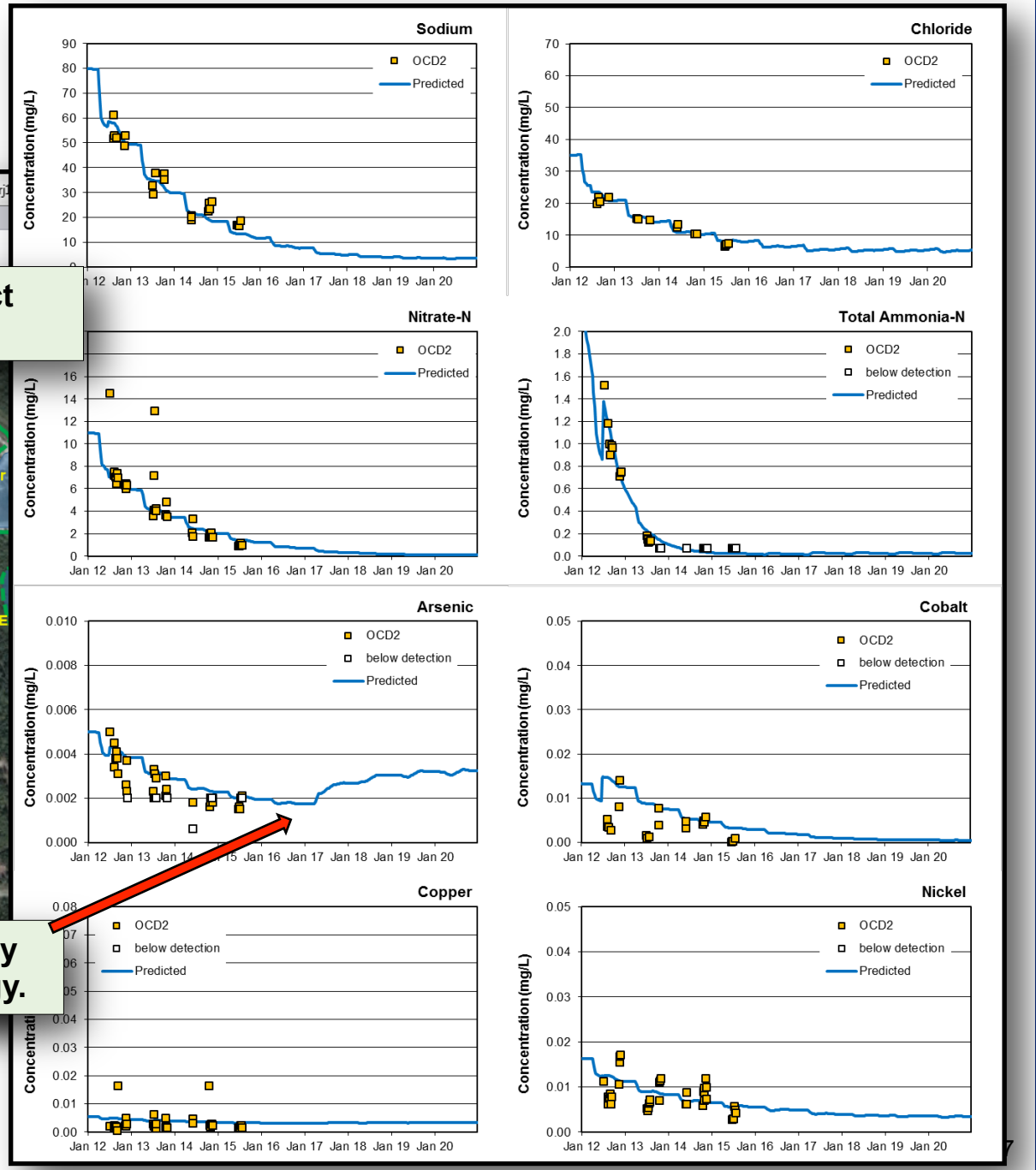
Owl Creek Model



We use the model to predict management strategies.

Predicted discharge quality under management strategy.



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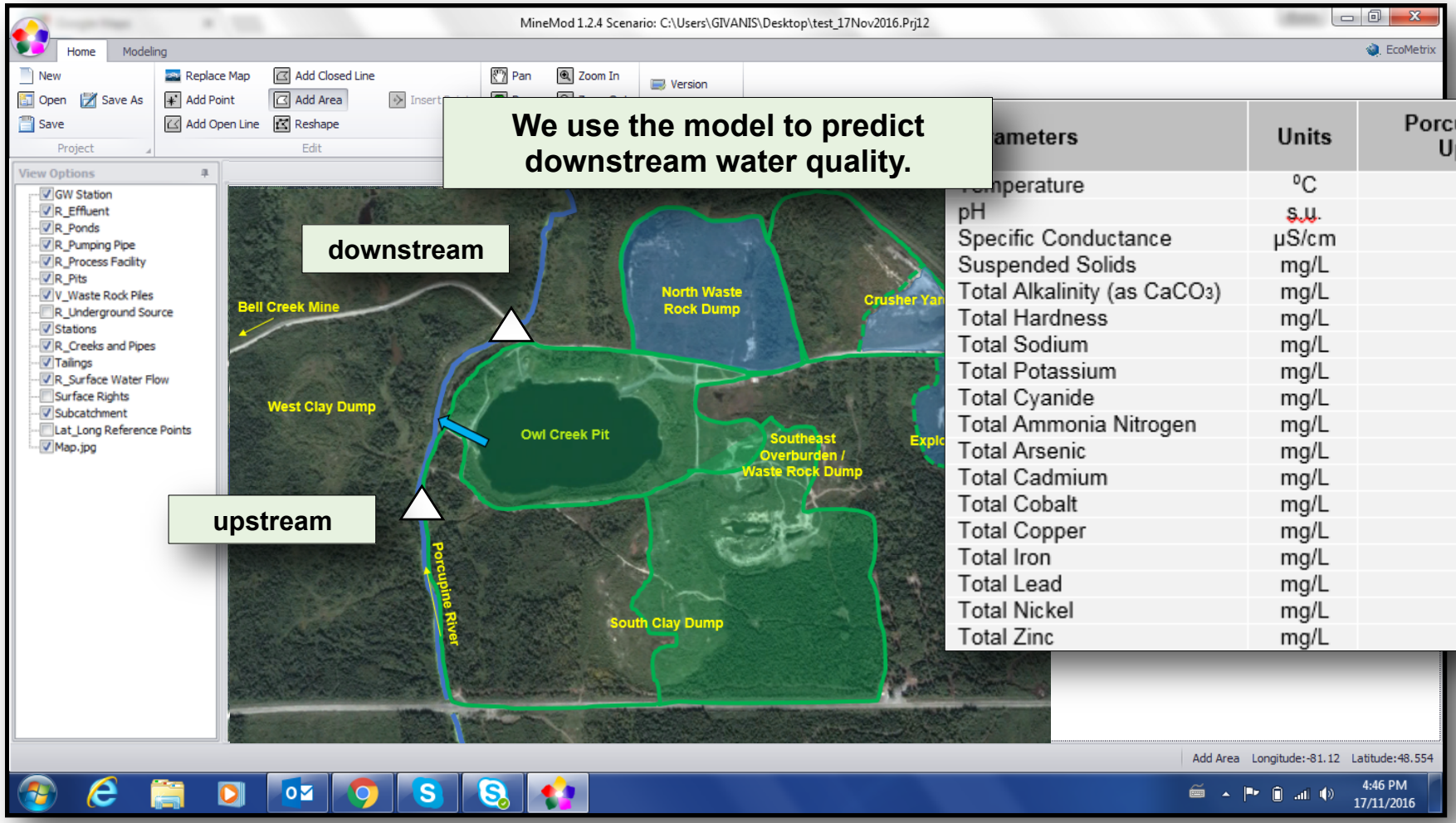
Owl Creek Model



ameters	Units	Porcupine River Upstream	Porcupine River - Downstream
mperature	°C	19.1	19.5
pH	s.u.	8.2	8.2
Specific Conductance	µS/cm	782	809
Suspended Solids	mg/L	6	6
Total Alkalinity (as $CaCO_3$)	mg/L	129	132
Total Hardness	mg/L	315	331
Total Sodium	mg/L	42.1	42.9
Total Potassium	mg/L	5.9	6.1
Total Cyanide	mg/L	<0.005	<0.005
Total Ammonia Nitrogen	mg/L	0.16	0.23
Total Arsenic	mg/L	0.017	0.016
Total Cadmium	mg/L	<0.001	<0.001
Total Cobalt	mg/L	0.012	0.011
Total Copper	mg/L	0.009	0.009
Total Iron	mg/L	0.13	0.13
Total Lead	mg/L	<0.008	<0.008
Total Nickel	mg/L	0.011	0.012
Total Zinc	mg/L	0.007	0.008

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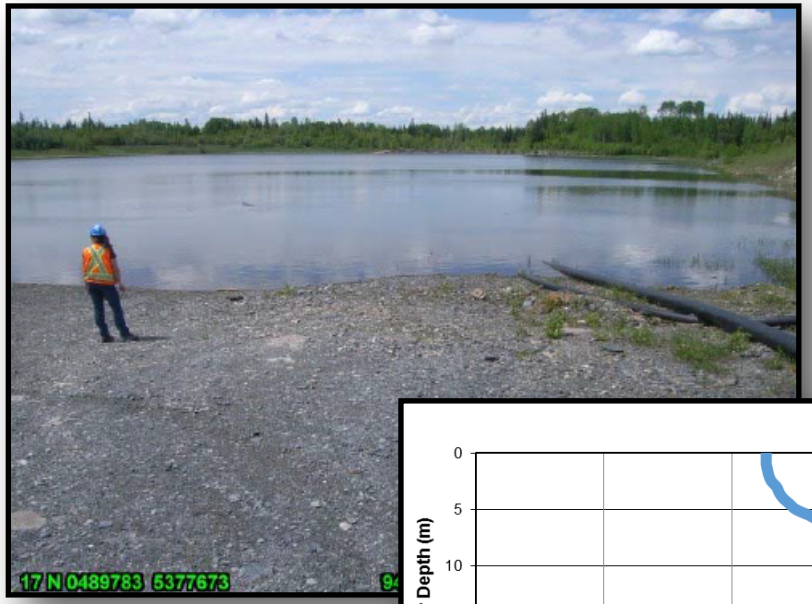
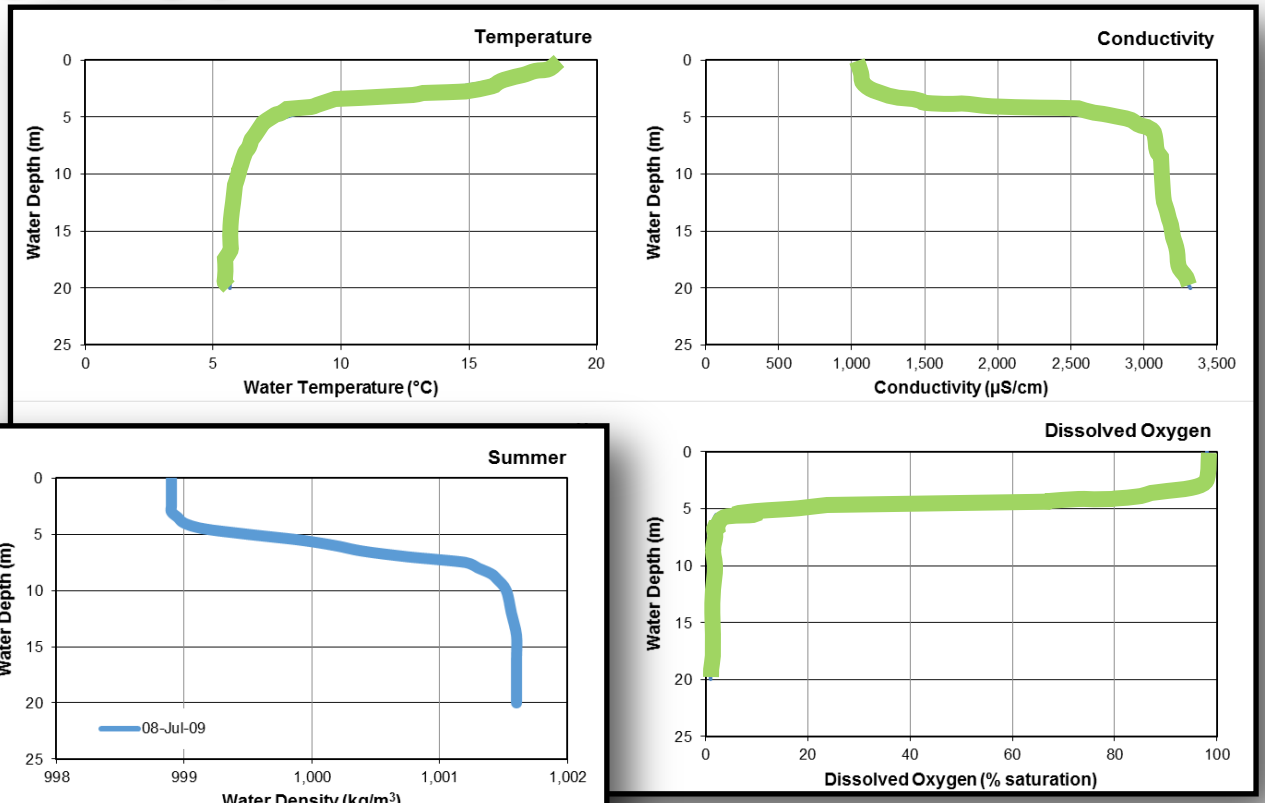
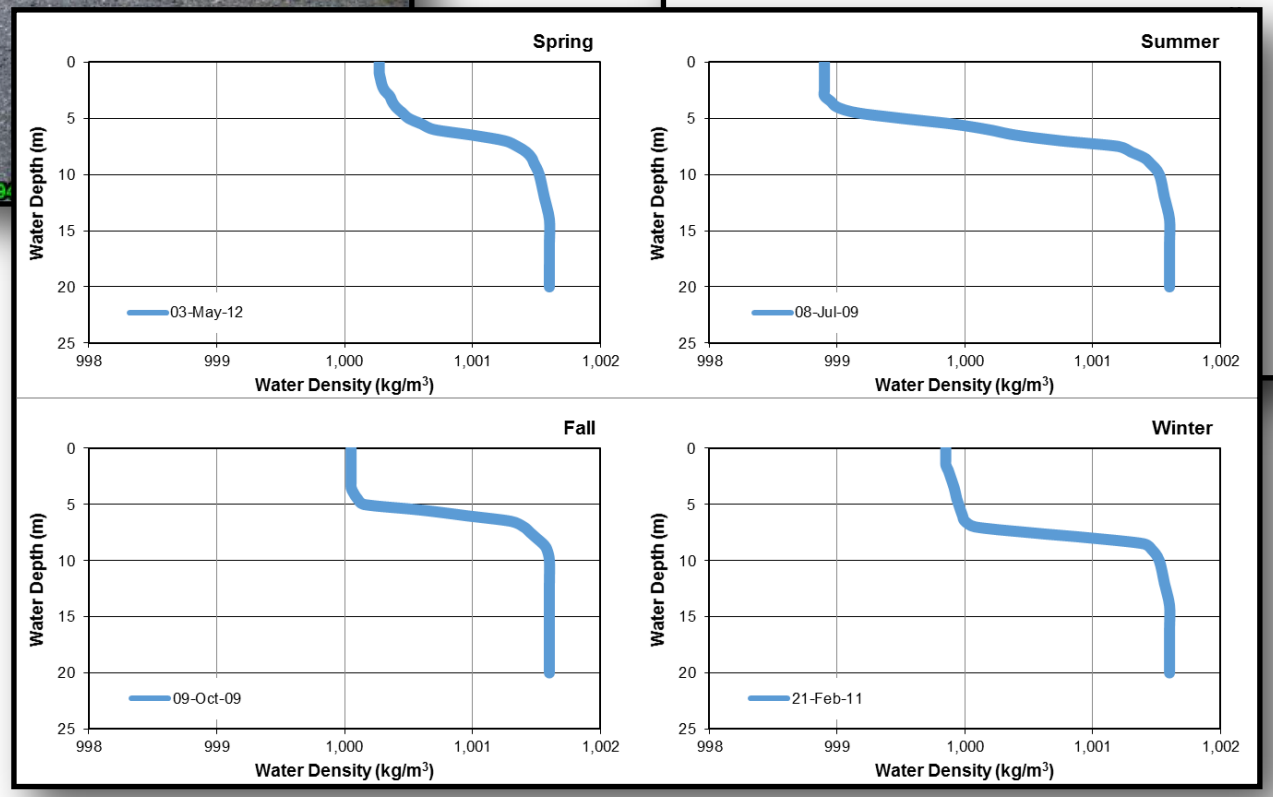
Owl Creek Vertical Profiles







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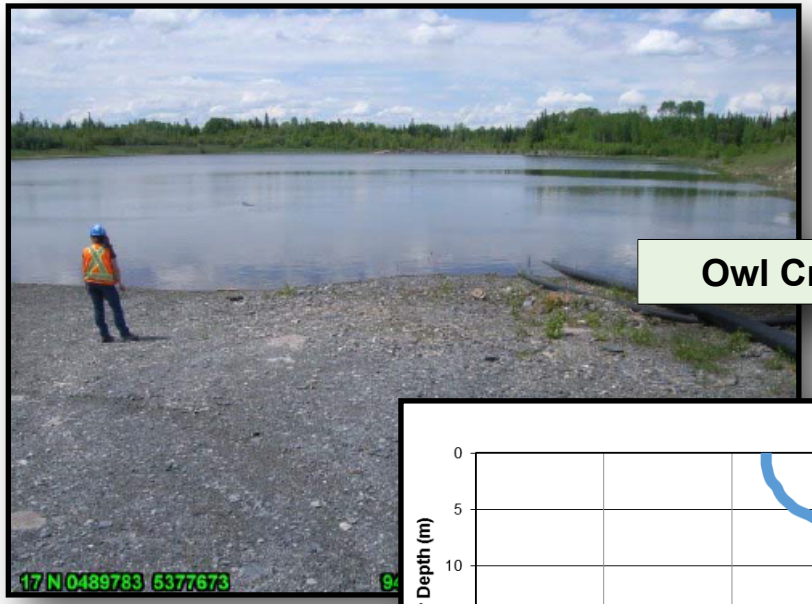
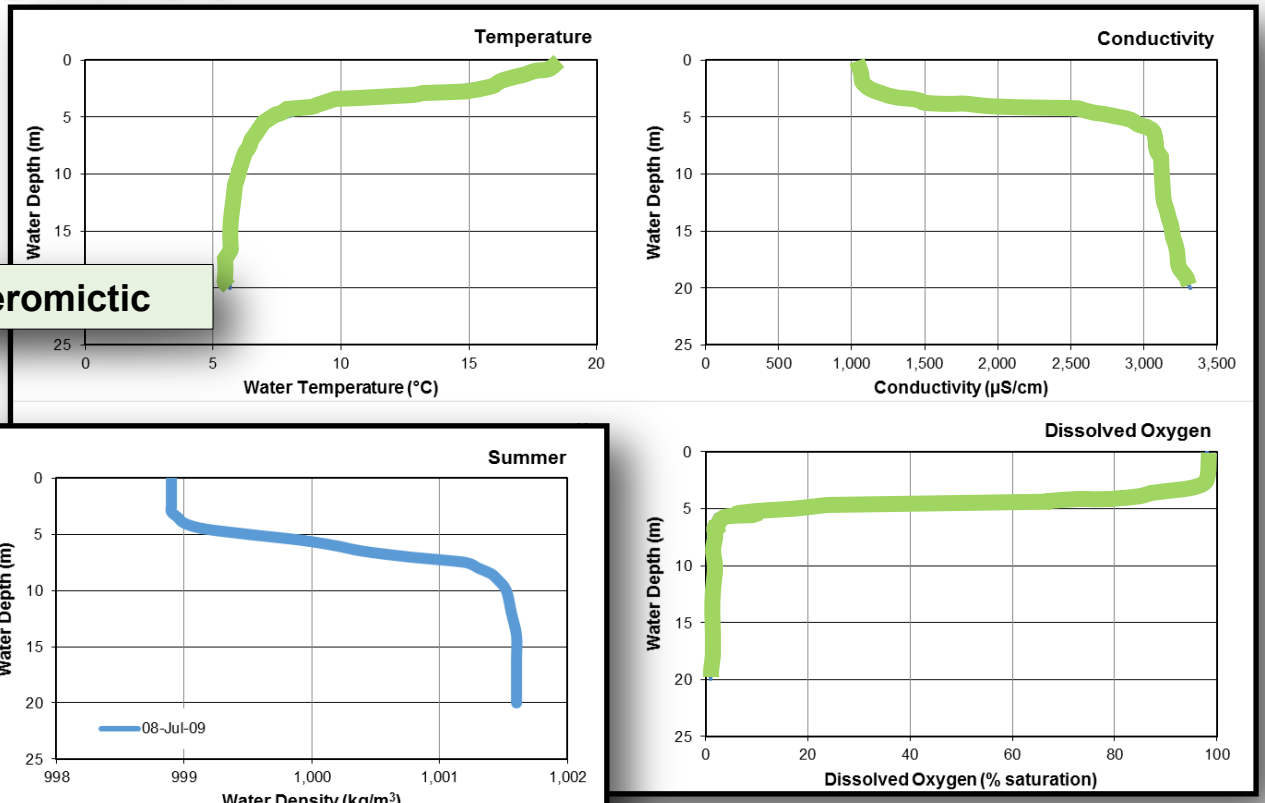
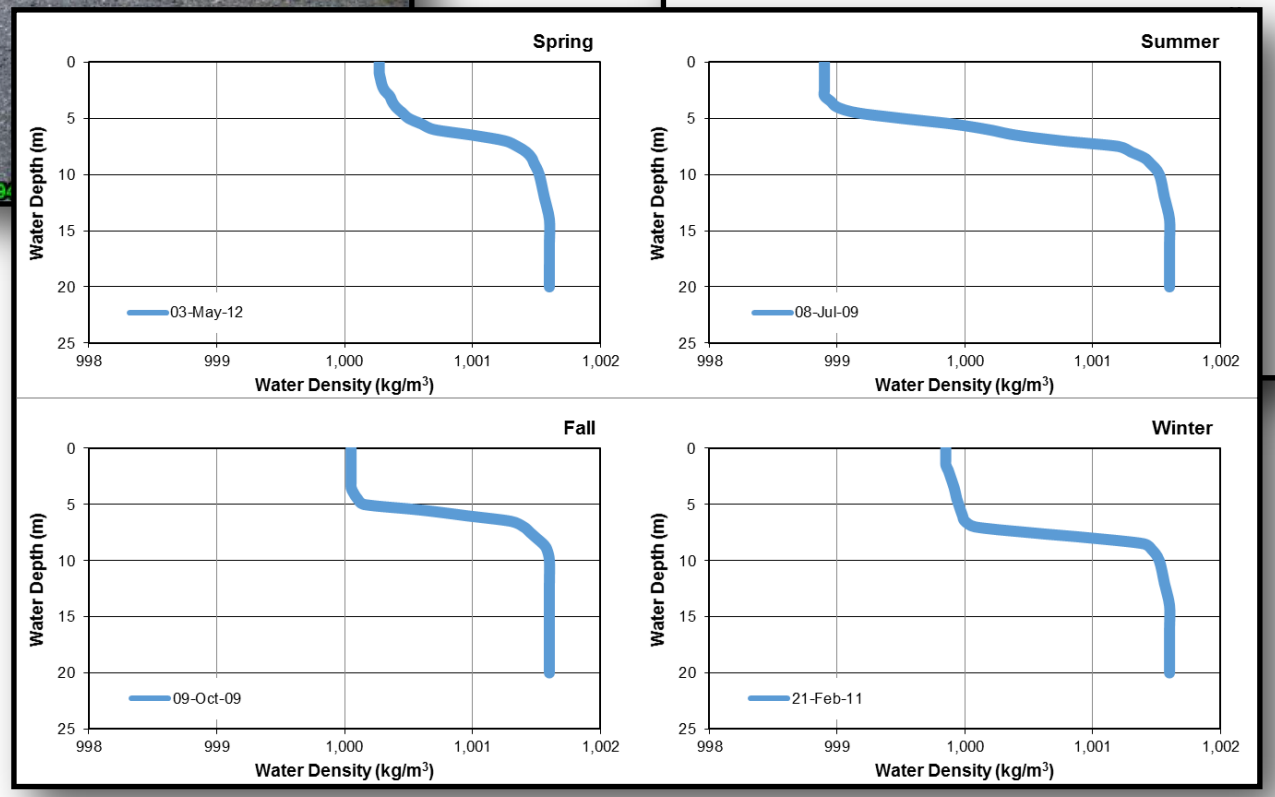
Owl Creek Vertical Profiles



Owl Creek Pit is Meromictic





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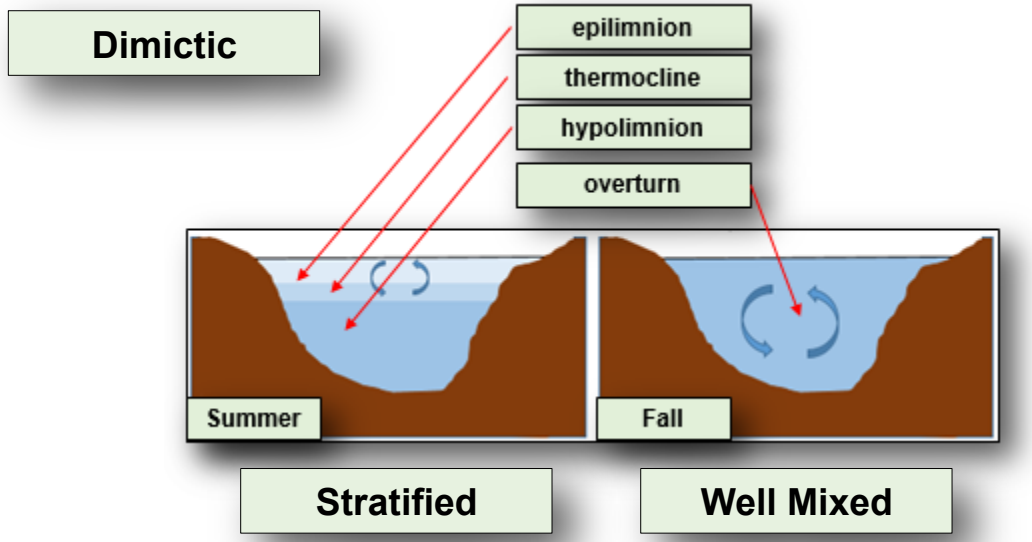
Owl Creek Vertical Profiles



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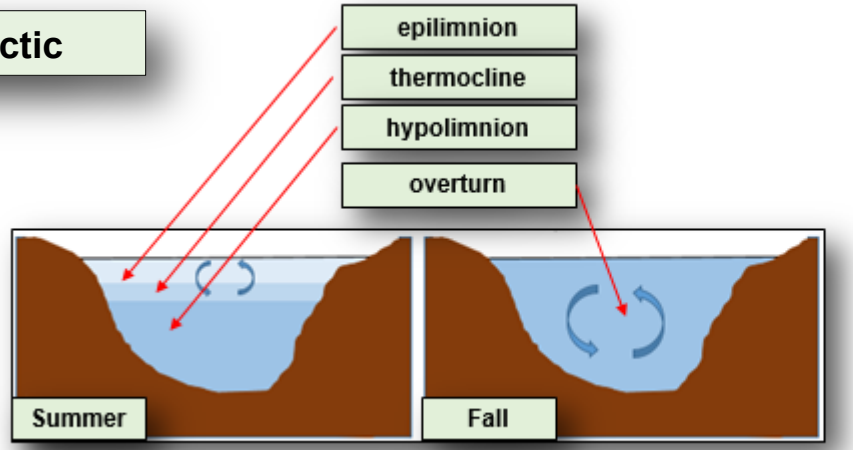
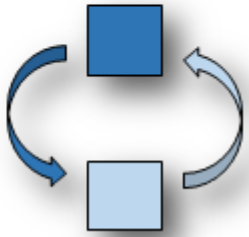
Owl Creek Vertical Profiles

Dimictic



Stratified

Well Mixed



Mixing occurs since surface is denser than bottom in spring and fall.

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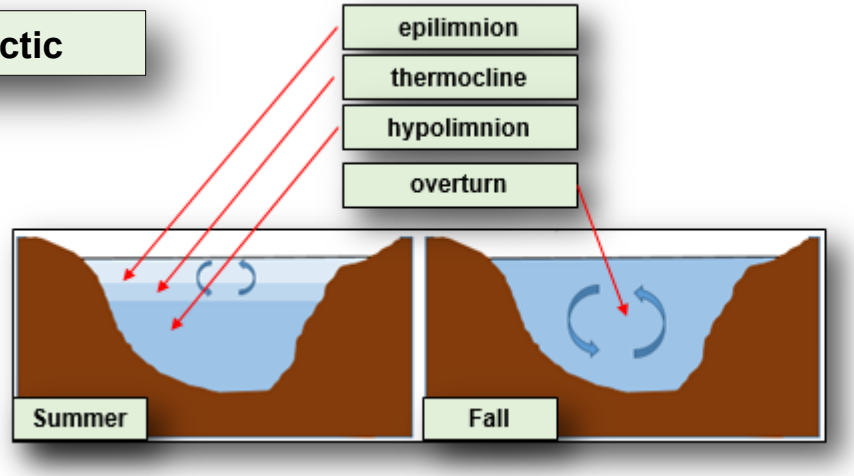
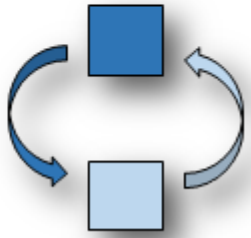
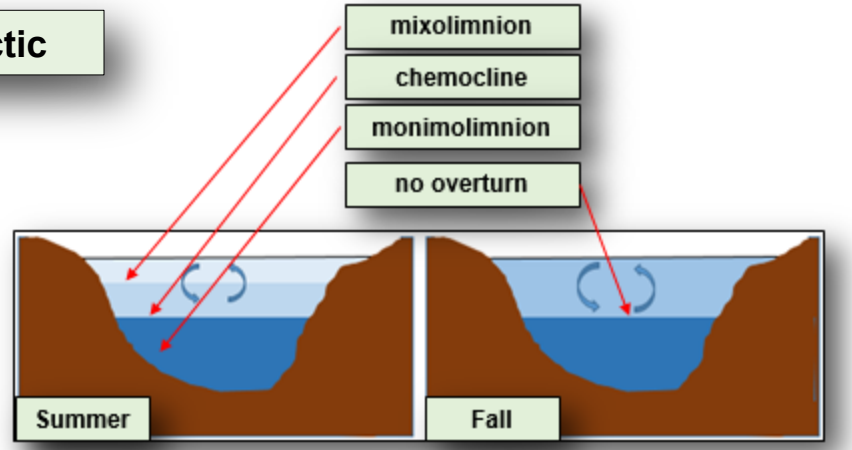
Owl Creek Vertical Profiles

Dimictic





Meromictic



Stratified **Stratified**

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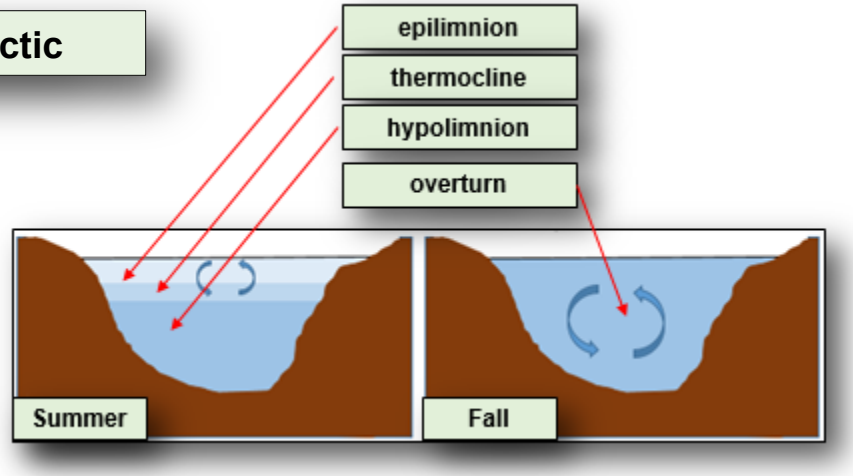
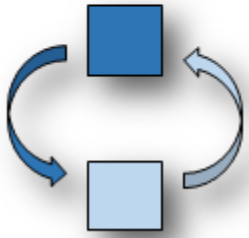
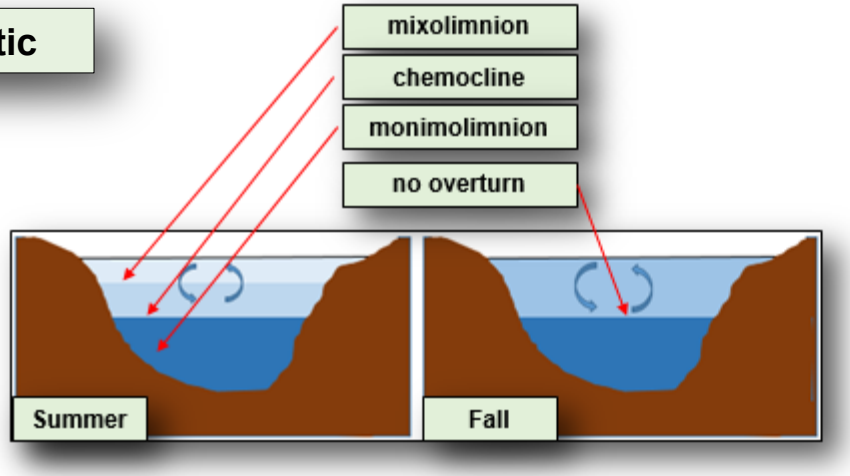
Owl Creek Vertical Profiles

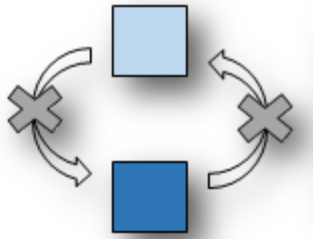
Dimictic





Meromictic





Mixing does not occur since bottom is always denser than surface.

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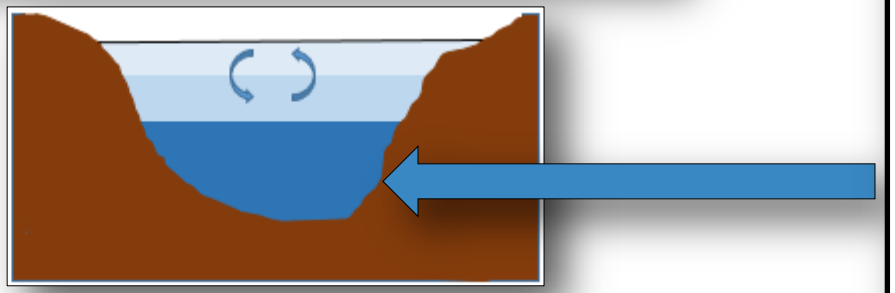
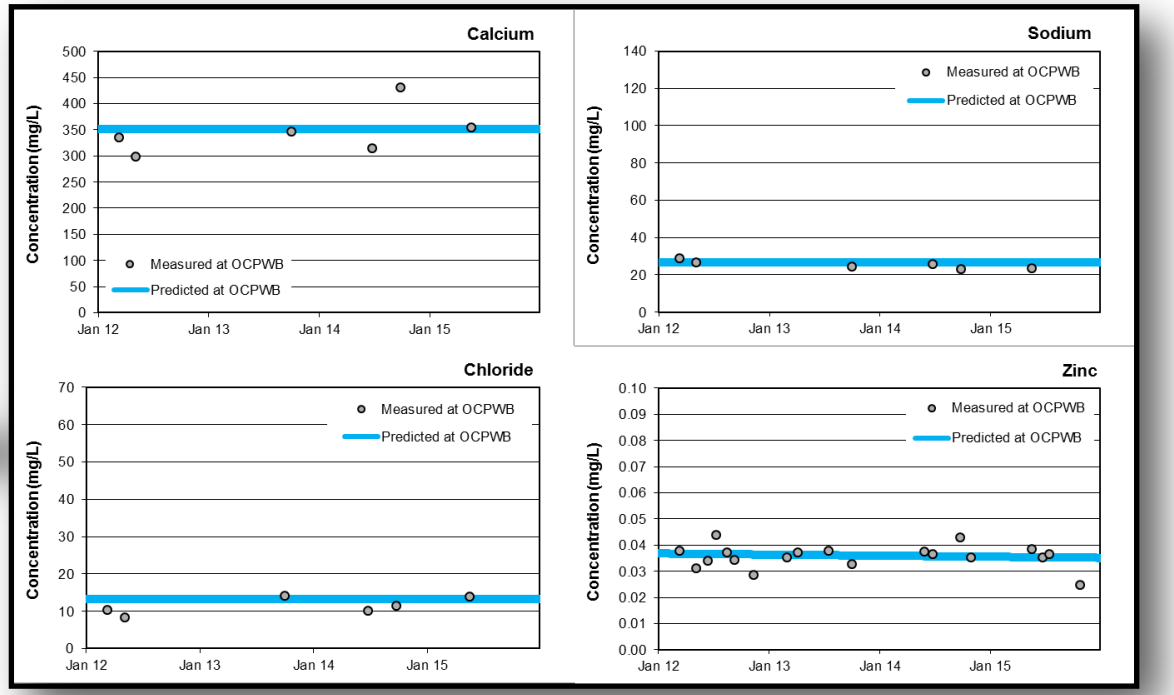
Owl Creek Bottom Layer



The concentration of various parameters remained constant over time and unrelated to other site waters.

This implies a contained volume of water within the monimolimnion.



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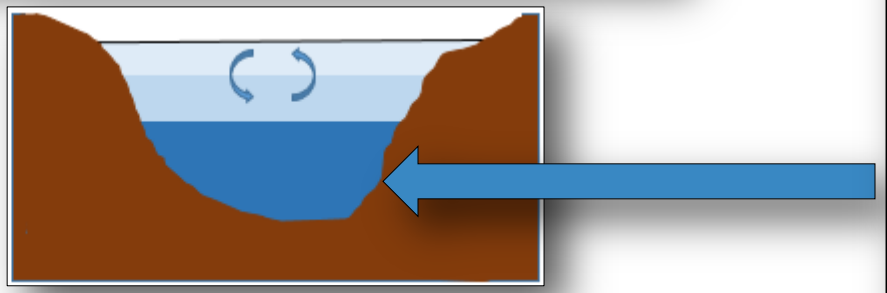
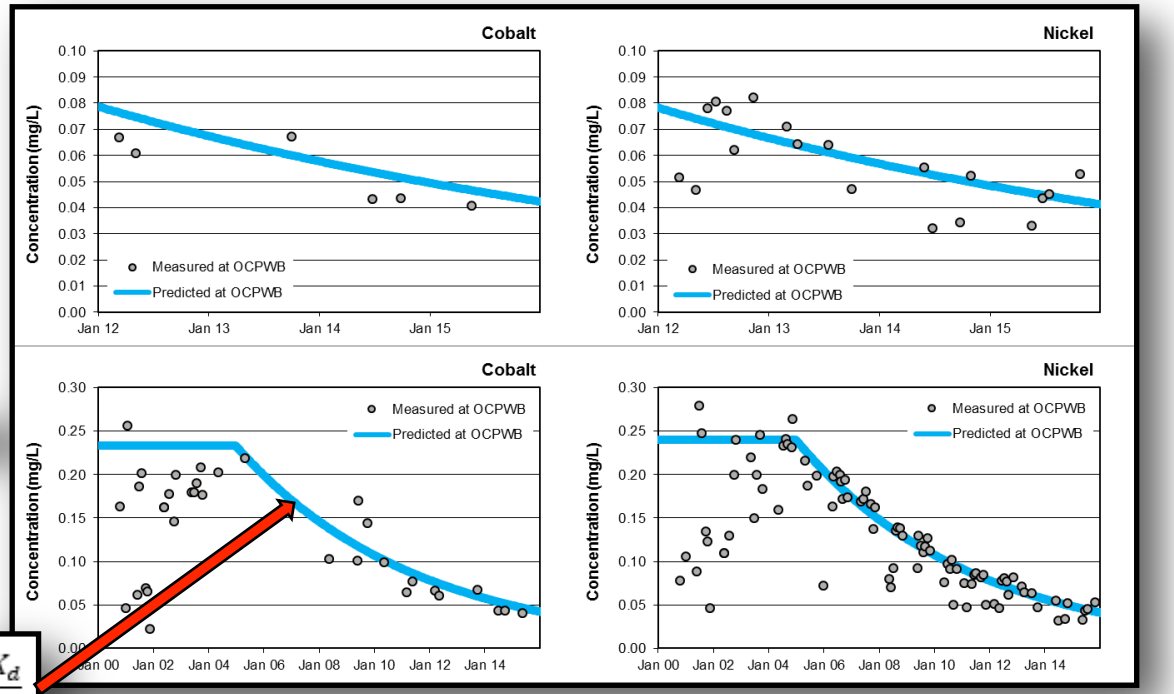
Owl Creek Bottom Layer



The concentration of a few parameters reduced over time.

This implies stripping due to sedimentation.



$$\frac{\partial C_{bot}}{\partial t} = -C_{bot} \cdot \frac{D_r \cdot \rho \cdot K_d}{z}$$

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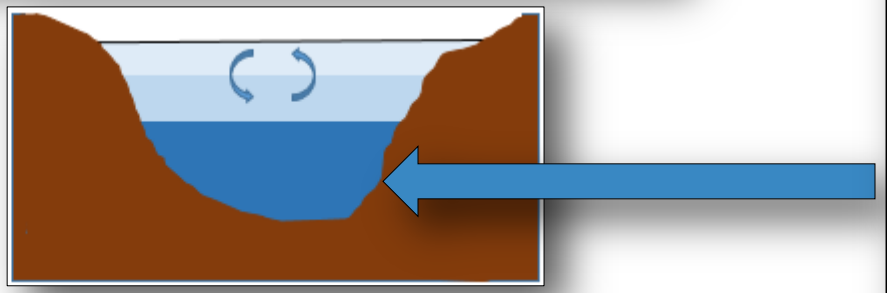
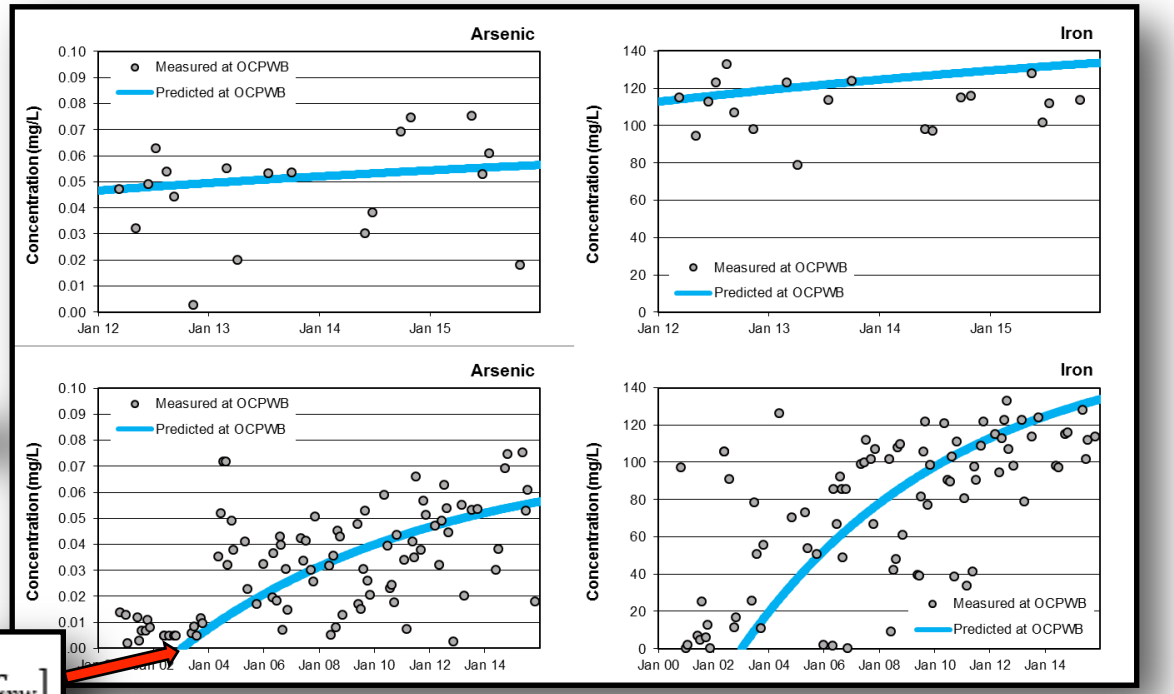
Owl Creek Bottom Layer



The concentration of a few parameters increased over time.

This implies source inputs through diffusive flux from the bottom.



$$\frac{\partial C_{bot}}{\partial t} = -\frac{k_s}{z} \cdot [(1-f) \cdot C_{bot} - C_{pw}]$$

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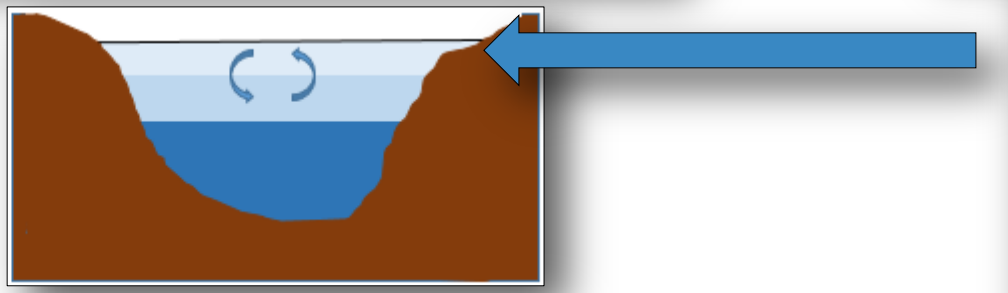
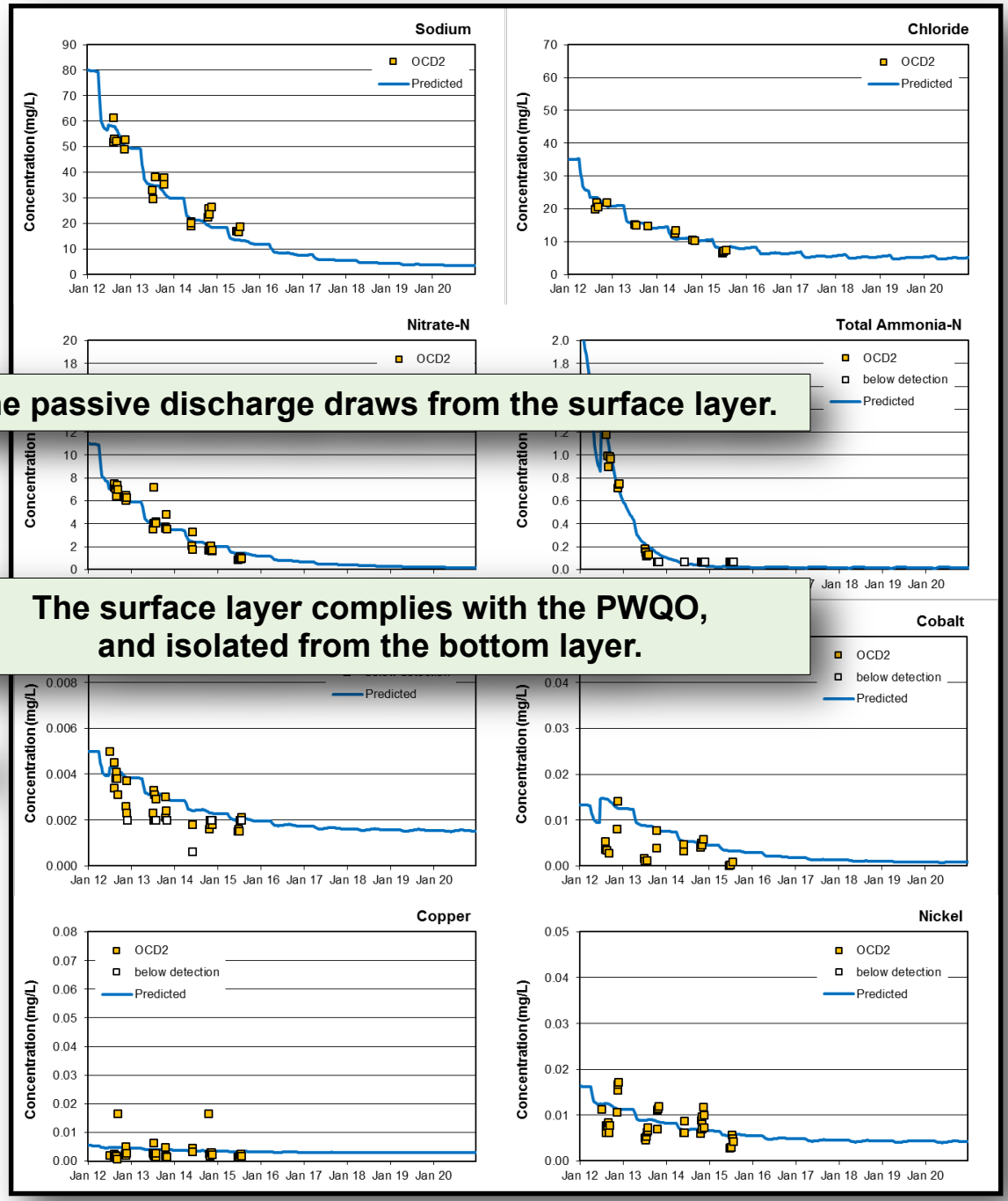
Owl Creek Discharge



The passive discharge draws from the surface layer.

The surface layer complies with the PWQO, and isolated from the bottom layer.



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Thank you

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