

# **Mine Water Treatment Strategies at Resolution Copper Mining and the Eagle Project**

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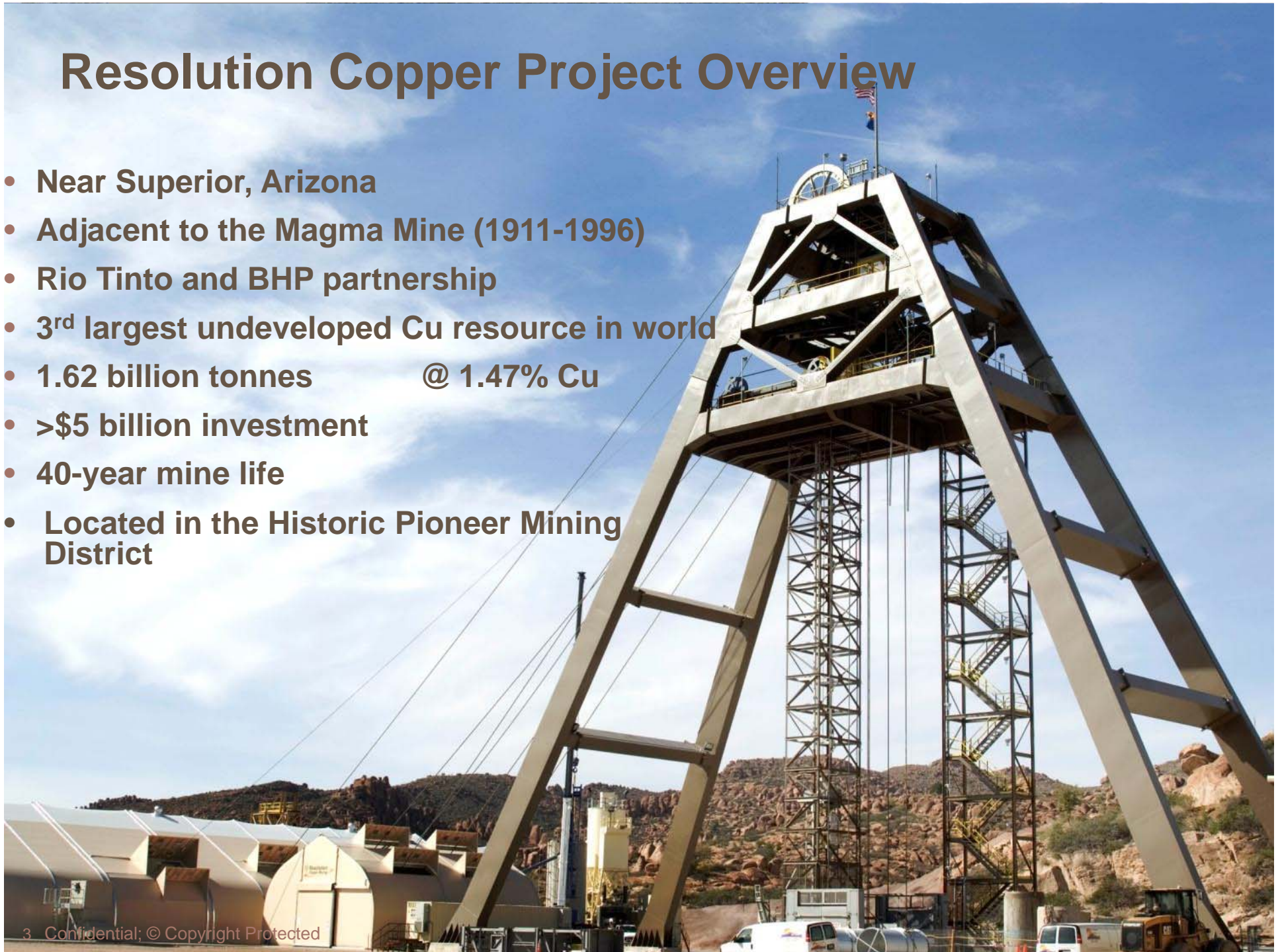
Kristin Mariuzza, Eagle Development Project

## OVERVIEW

- Project Introductions
- Regulations that govern project design
- Water Treatment Design
- Water Management

# Resolution Copper Project Overview

- Near Superior, Arizona
- Adjacent to the Magma Mine (1911-1996)
- Rio Tinto and BHP partnership
- 3<sup>rd</sup> largest undeveloped Cu resource in world
- 1.62 billion tonnes @ 1.47% Cu
- >\$5 billion investment
- 40-year mine life
- Located in the Historic Pioneer Mining District





## Resolution Copper Water Treatment

- Required for dewatering old Magma Mine workings adjacent to new work areas
  - Safety of shaft sinking-exploration activities
- Historic Treatment (pre -1996)
  - Onsite ponds
  - AZPDES requirement only
- Present Day
  - Over 2.5 billion gallons to dewater (2008)
  - New HDS treatment process: Lime (pH) and Soda Ash (prevent scaling)
  - AZPDES and Aquifer Protection Permits (APP) for discharges and solids storage ponds
  - Treats to Aquifer Quality Limits and surface water standards
  
  - **Reverse Osmosis required for gypsum removal if discharging to nearby creek**
  - **Looked for alternative, beneficial use of water**

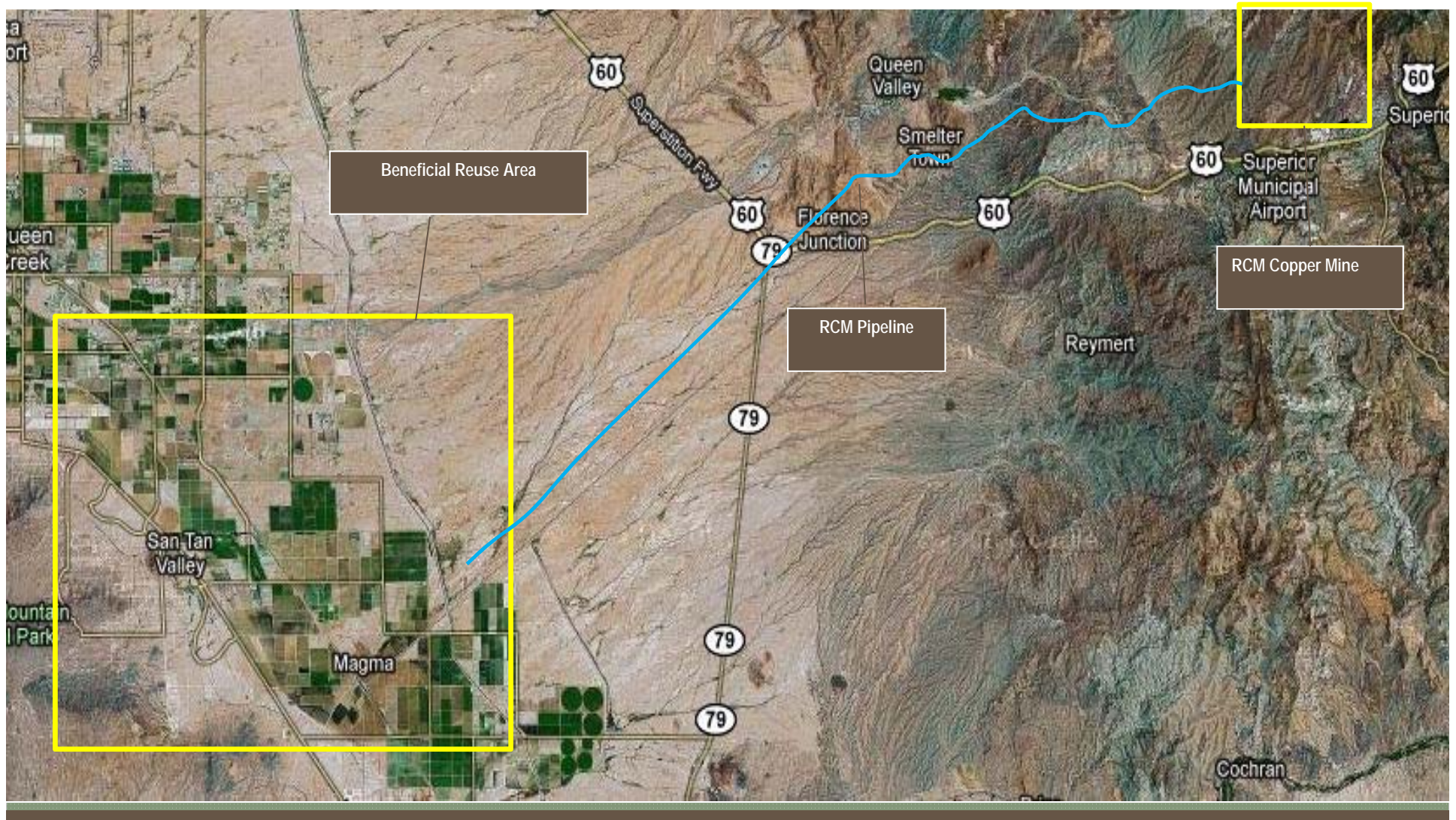
# Water Treatment Objectives

- Dewater existing underground copper mine
- Beneficially use the treated water in a cooperative effort





- **Goal:** remove water from existing copper mine (2009)







## Project Cooperators



- Resolution Copper Mining, LLC (RCM)
  - Supply water and support sampling efforts



- New Magma Irrigation and Drainage District (NMID)
  - Facilitate land access and communicate with RCM
  - 6 cooperating growers



- University of Arizona (UA)
  - Provide laboratory services and quality control of data

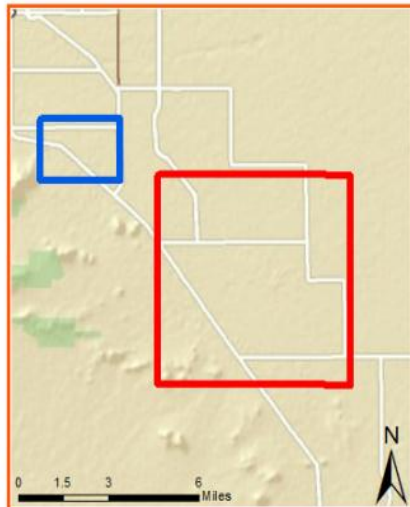
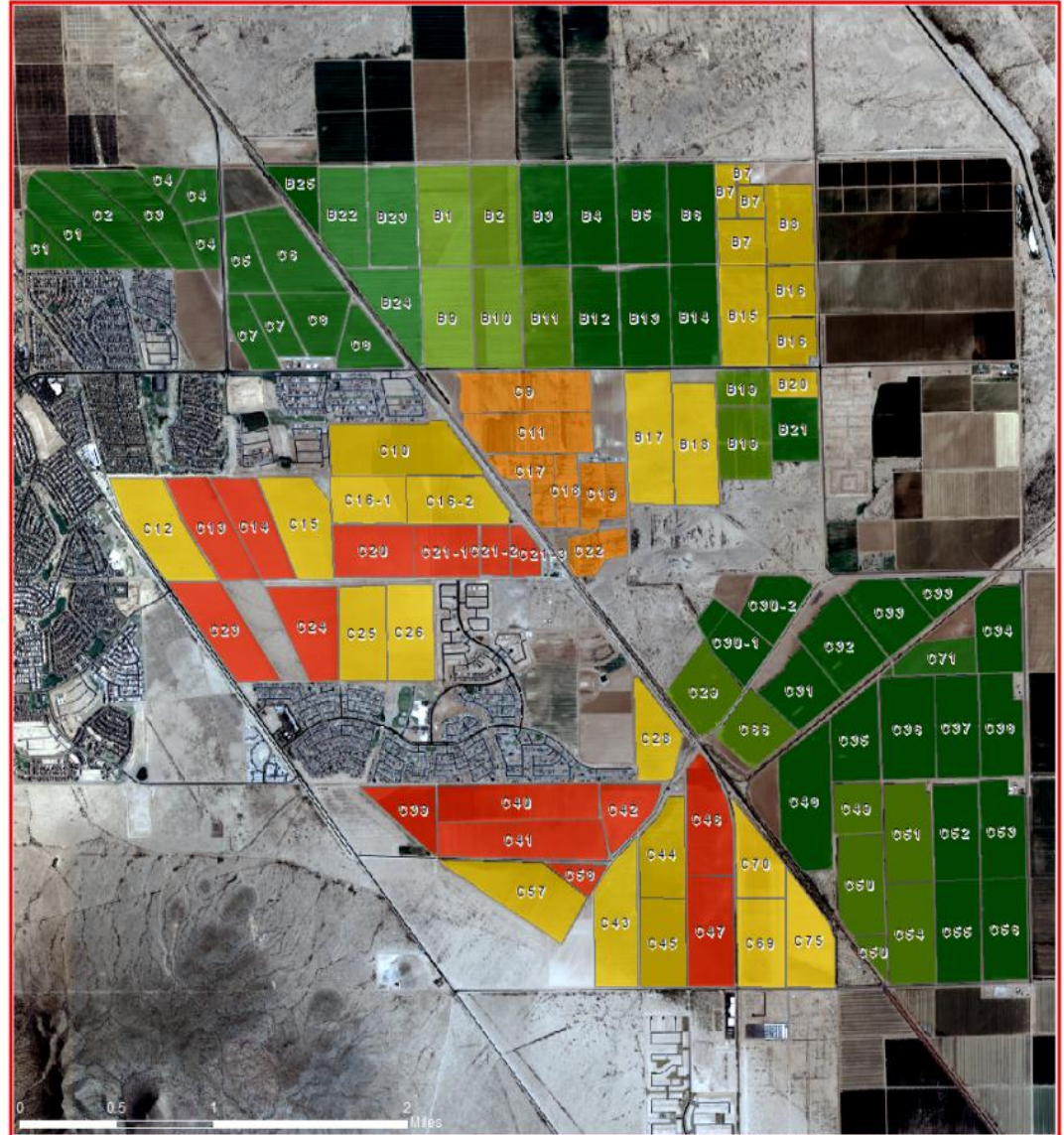
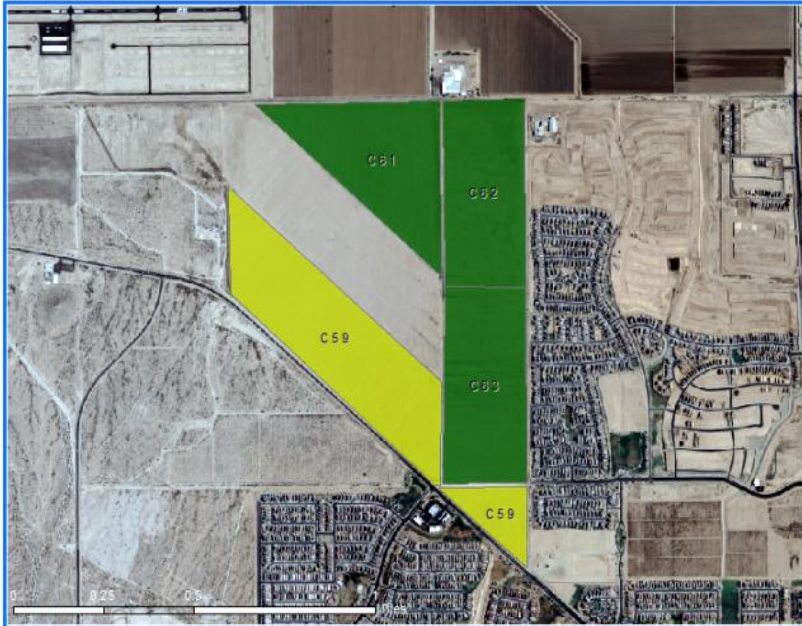


- NewFields Agricultural & Environmental Resources
  - Coordinate and conduct sampling and reporting efforts and facilitate grower communication

# 5,200 acres; 68+ fields

## RESOLUTION COPPER PROJECT FIELDS

2011 Crop Types







## Monitoring Approach

Sample Type		Sampling Frequency		
		<i>Continuous</i>	<i>Monthly</i>	<i>Quarterly</i>
<i>Water</i>	<i>Grab</i>		X	X
	<i>In Situ Probe</i>	X		
<i>Soil</i>	<i>0-12" &amp; 12-24" sample depths</i>			X*
<i>Plant</i>	<i>Tissue</i>			X*

- Water probes measure pH, specific conductance and temperature
- Water grab samples measure salinity and nutrient related constituents monthly.
- Soil samples measure salinity and nutrient levels quarterly and metals annually.
- Plant tissue samples measure salinity and nutrient levels quarterly, depending on crop growth cycles, and metals annually.



# NMIDWQ Water Quality Web Site

OVERVIEW

MAP

DATA

GRAPH

STATS

PANEL

GO LIVE

FORUM

TurnoutC\_Site

- Up Temp
- Up Sp Cond
- Up TDS
- Up pH
- Vlt Temp
- Vlt Sp Cond
- Vlt TDS
- Vlt pH
- DN Temp
- DN Sp Cond
- DN\_TDS
- DN\_pH
- C Flowmeter

TurnoutB\_Site

- B Temp

SELECT ALL

GO

DAY

WEEK

MONTH

YEAR

05/12/2011



05/19/2011



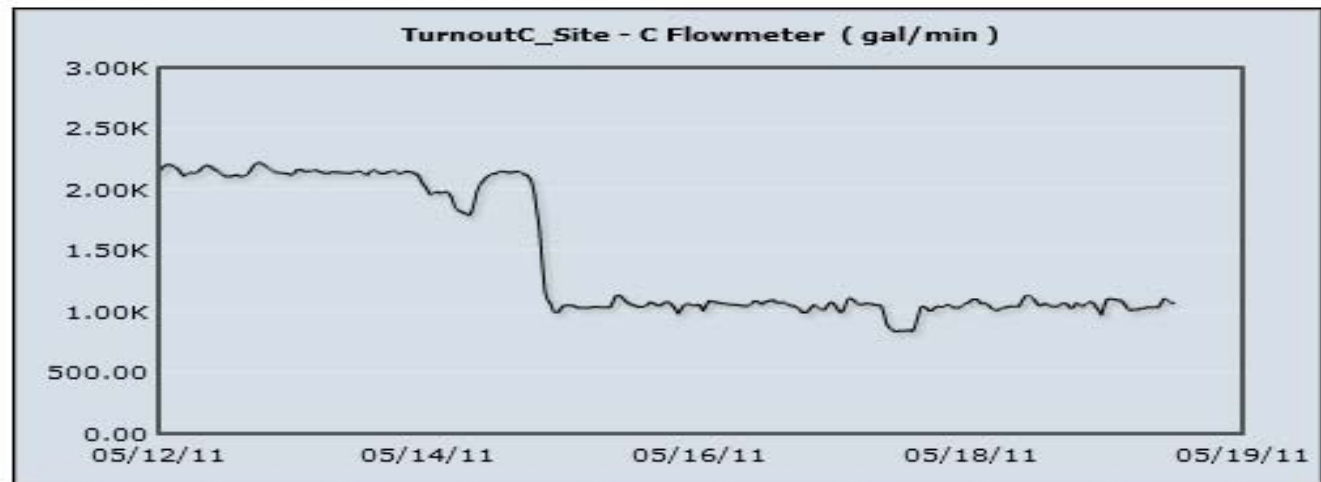
ADMIN LOGIN



Min Y Value

Max Y Value

Go



Min Y Value

Max Y Value

Go

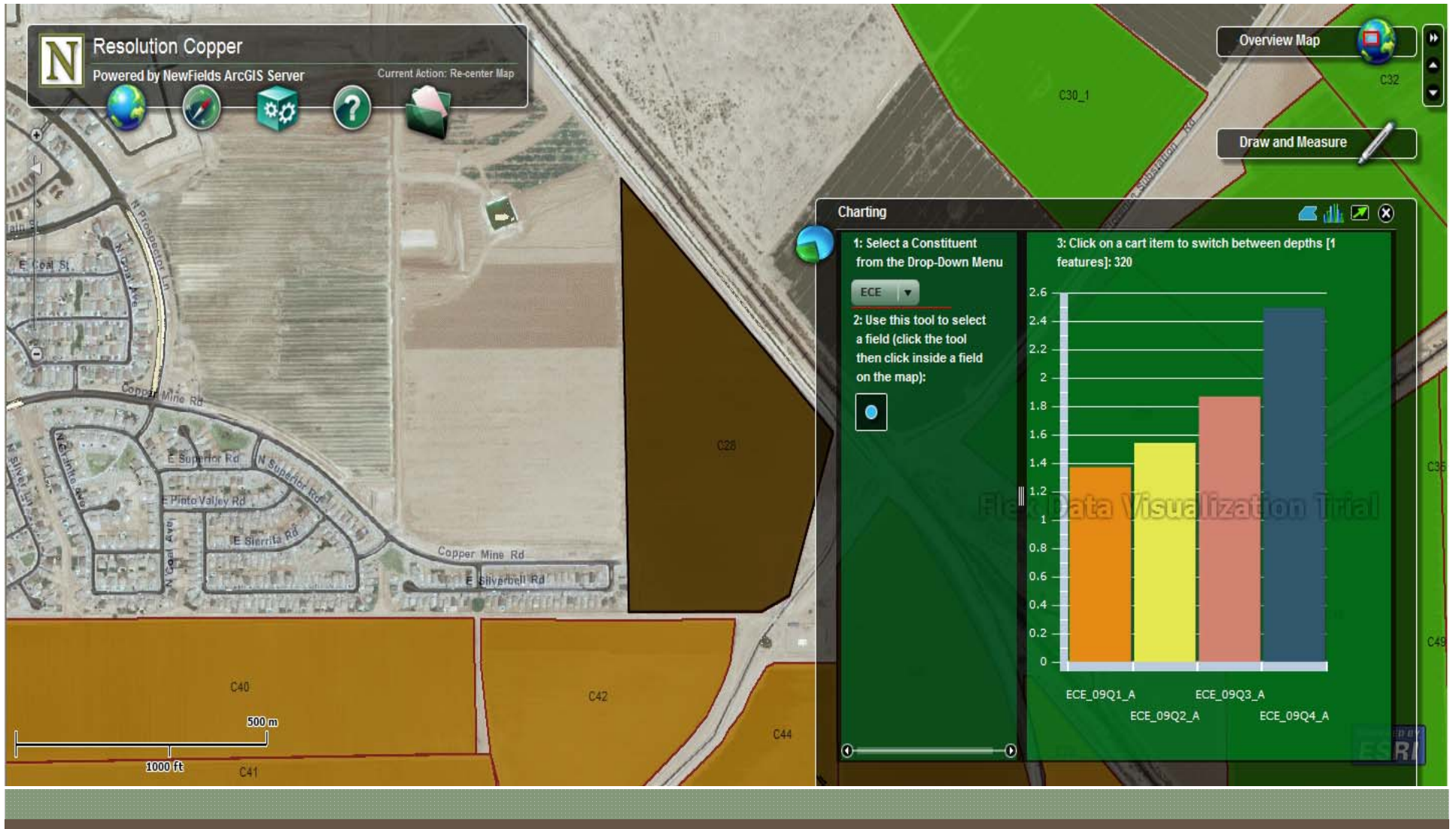
POWERED BY NEXSENS TECHNOLOGY



## Web Mapping Application

- Allows stakeholders to view Project data related to soil salinity
  - View Project infrastructure
  - View field information
  - Access Project documents
  - Chart trends for soil constituent
- Facilitates rapid, visual representation of key constituents to ensure project goals concerning agricultural production are being met
- Used frequently during grower meetings to spatially and temporally compare each grower's data
  - Intended to be made available to each grower once login information is established

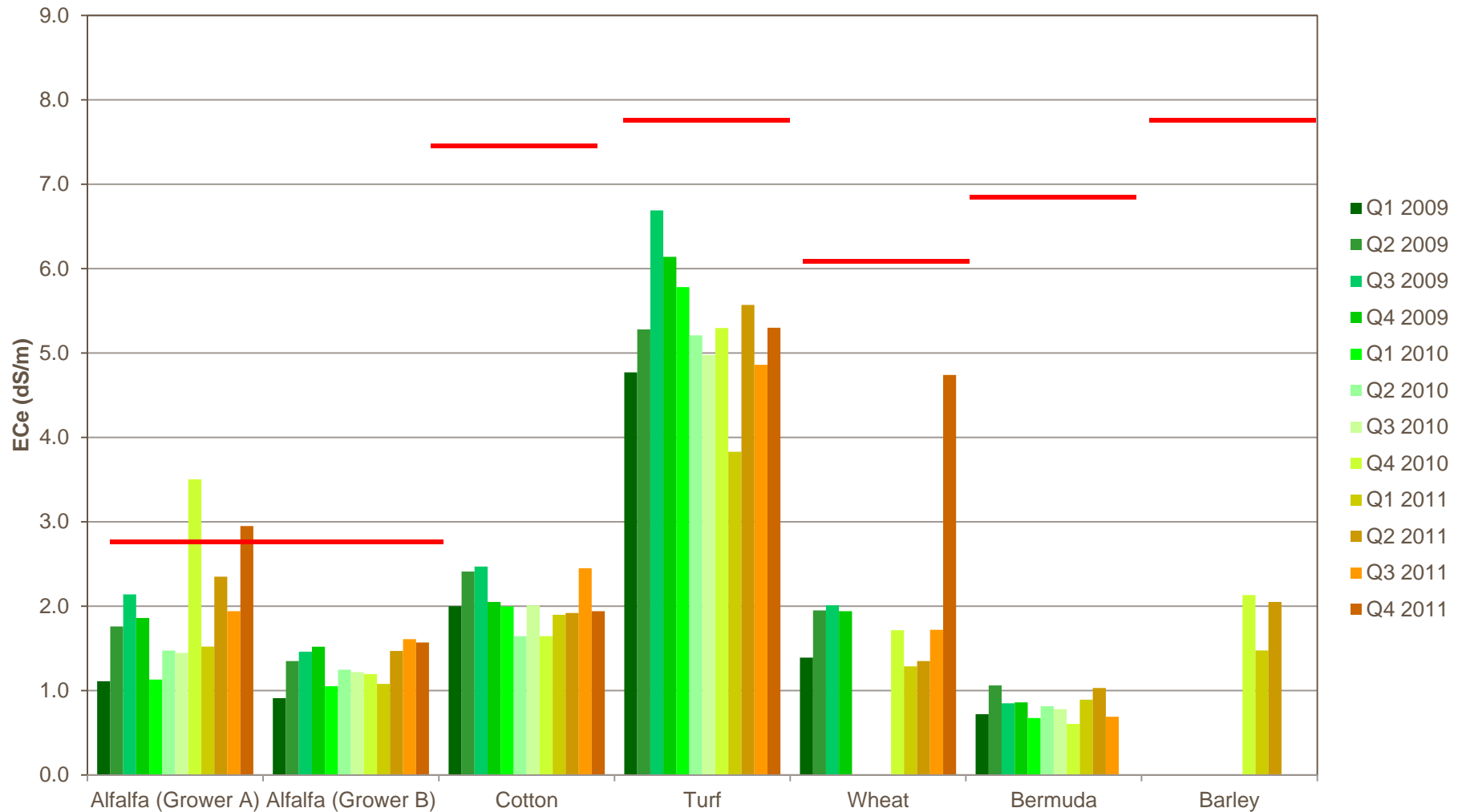
# Web Mapping Application





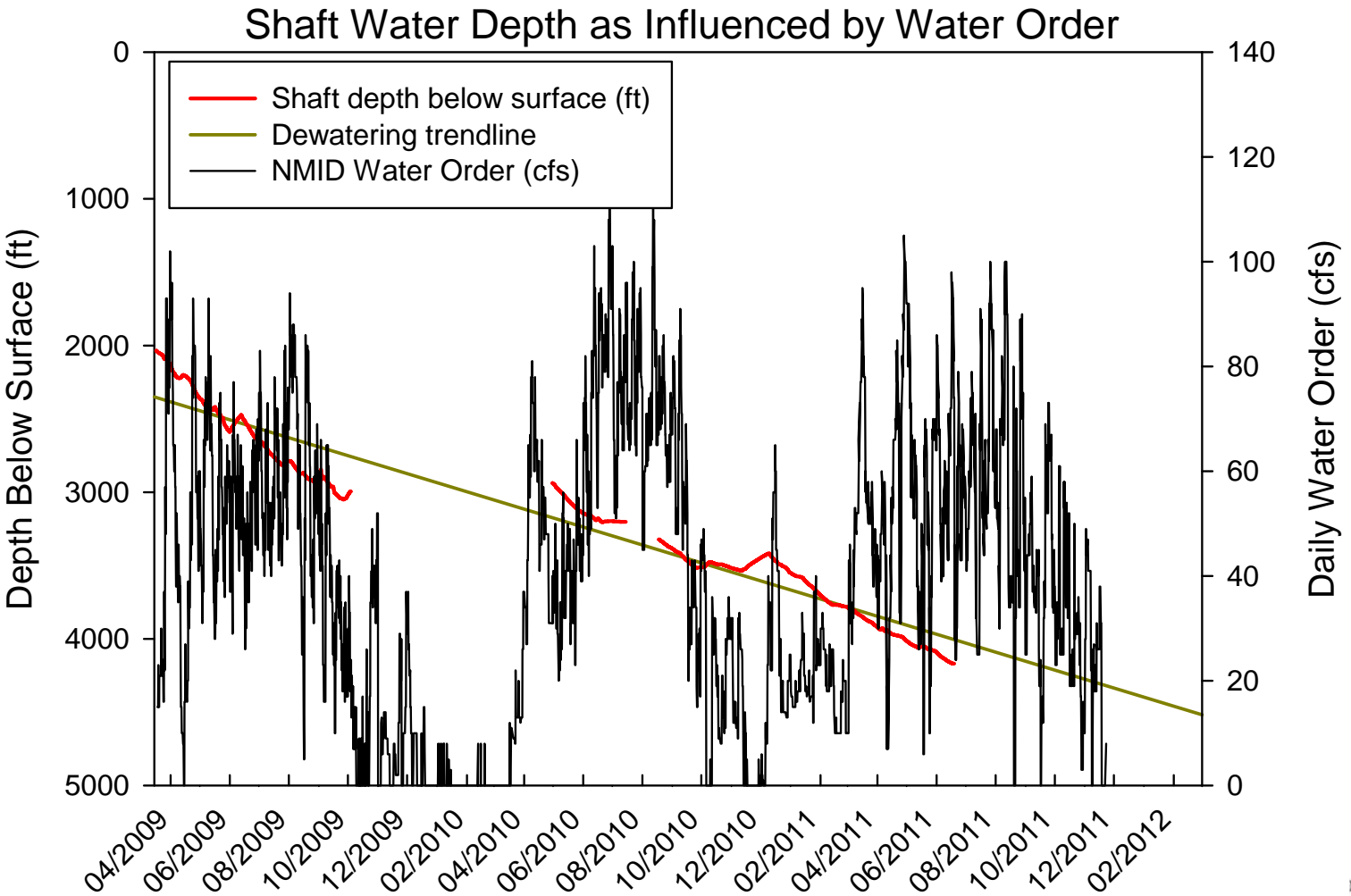
## Results: Soil Salinity 0-12"

- Crop productivity has not been impacted





# Results: Dewatering, over 2B gallons to date





## Communication with Growers

- Semi-Annual meetings with growers prior to each sampling event
  - Discuss field conditions and recent field operations
  - Ensure all farm staff are aware of our activities
  - Share data



## Results

- Nutrient and metal levels for the water, soil and plant tissue samples have all fallen within acceptable, expected ranges.
- Environmental health and agricultural productivity have remained unaffected.
- Soil salinities (gypsum) have increased slightly, as expected, but have not affected crop yield.





## Lessons Learned

- Daily communication is critical among all project stakeholders
- Conservative sampling and irrigation efforts throughout the project have been helpful for tracking salinity trends
- Consistency in the water treatment and regular communications have led to continued project success.





**RioTinto**



**Kennecott's Eagle Development Project**  
**Project Development and Implementation**



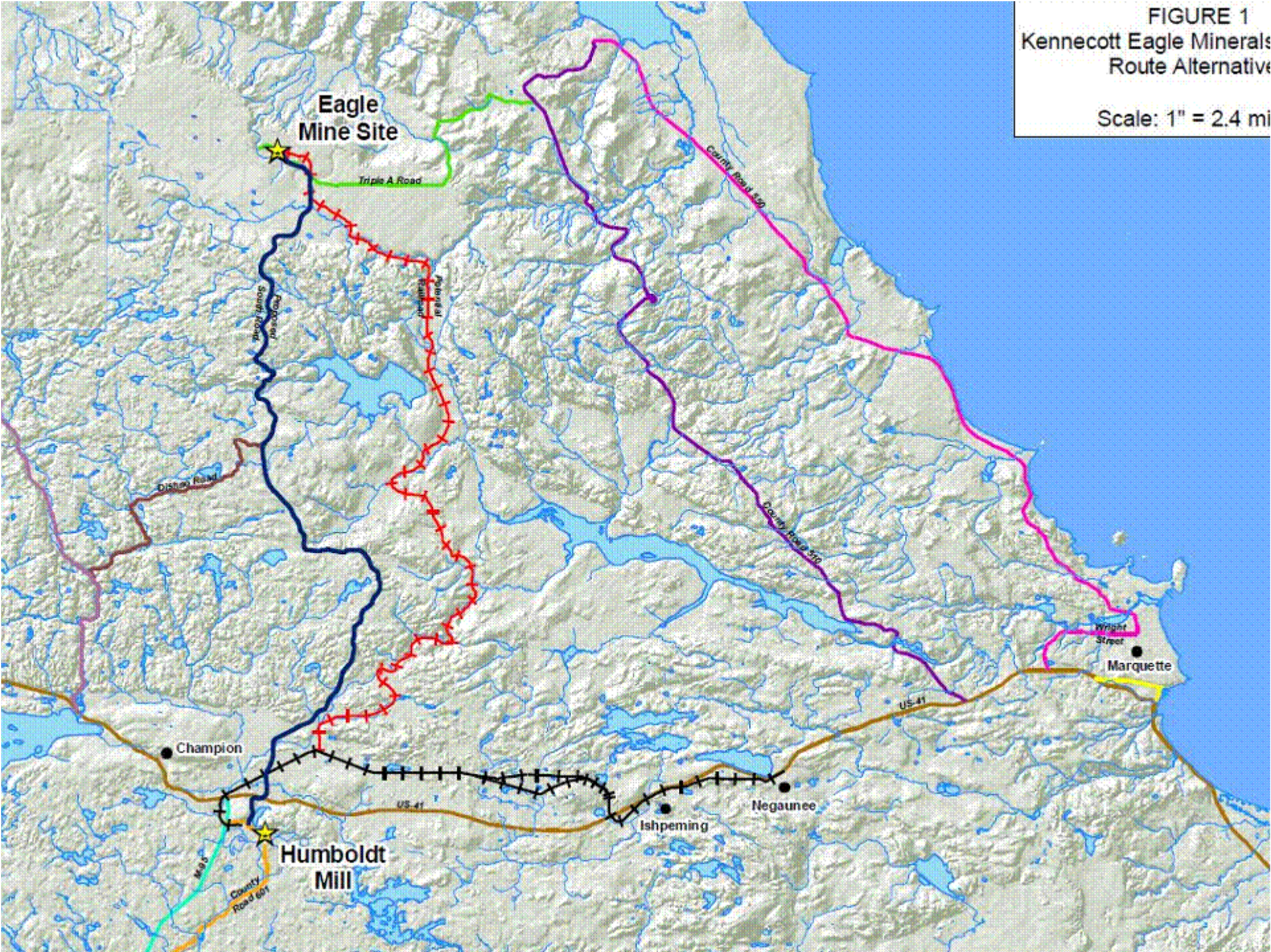
Located in the Upper Peninsula of Michigan  
Marquette County





FIGURE 1  
Kennecott Eagle Minerals  
Route Alternative

Scale: 1" = 2.4 mi



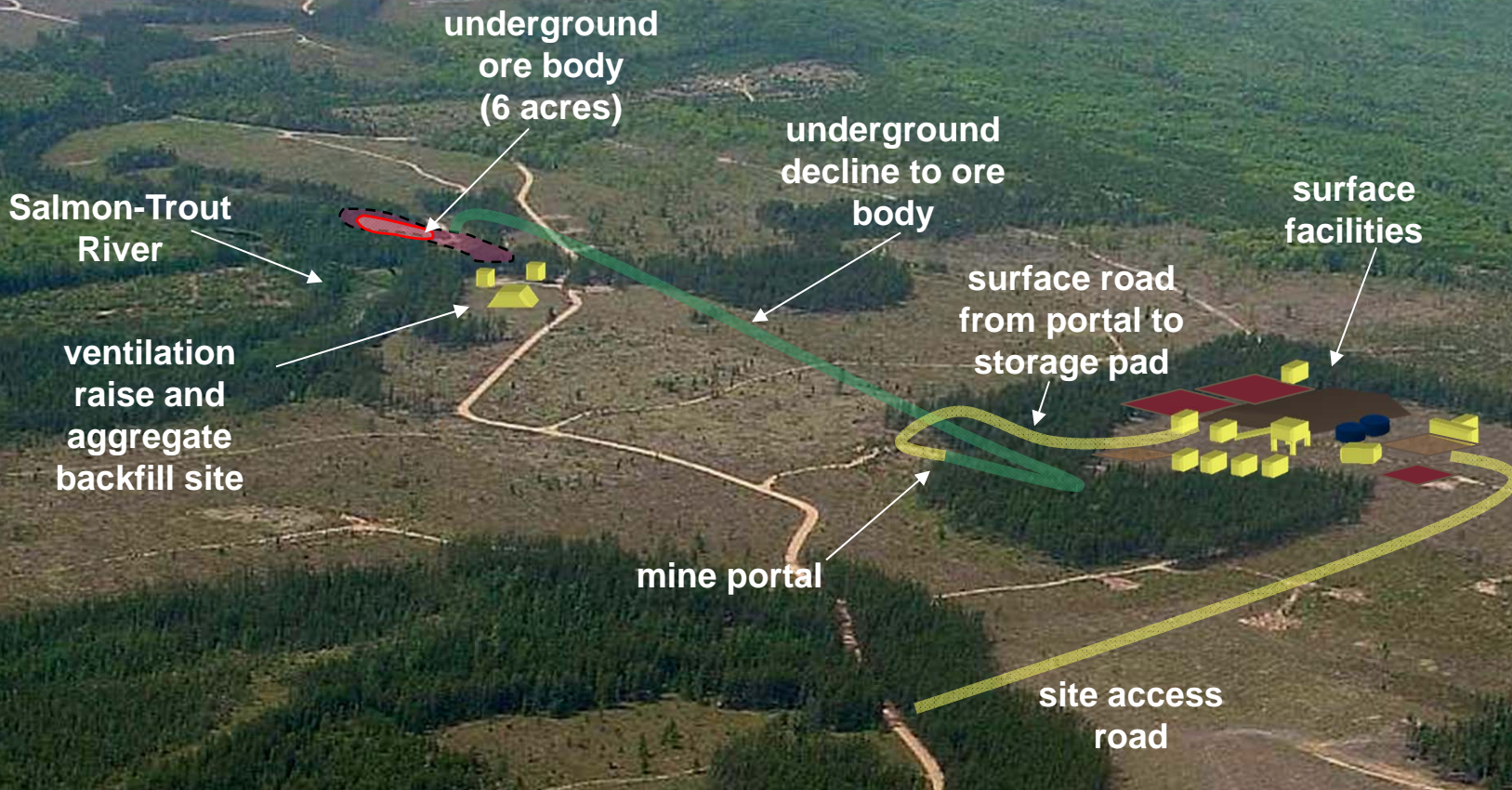




Source: Kennecott Eagle



# Mine Site Layout



Source: Kennecott Eagle





# Michigan's Environmental Regulations

- **Part 632, Nonferrous Metallic Mining Regulations, of PA 451, Natural Resources and Environmental Protection Act, of 1994.**
  - **Covers all aspects of mining and includes EIA**
- **Part 31, Water Resources Protection, of PA 451, Natural Resources and Environmental Protection Act, of 1994.**
  - **Part 22 Rules, Groundwater Quality**
  - **Part 4 Rules, Water Quality Standards**
  - **Part 8 Rules, Water Quality Based Effluent Limit Development**





# Michigan's Environmental Regulations

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## Managing Water On Site

- Waters that Receive Treatment at WTF
  - Underground Dewatering
  - Storm Water Runoff from Operations Area
  - Temporary Development Rock Storage Area
    - Industrial Landfill Equivalency
    - Leachate Collection
    - Geomembrane Cover
- Not Treated at WTF
  - Sanitary Wastewater
  - Non-Contact Storm Water

# Michigan's Environmental Regulations

- Part 31, Water Resources Protection, of PA 451, Natural Resources and Environmental Protection Act, of 1994.
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## Water On Site Governed by:

- Part 22 Rules - Groundwater Quality
  - Contact Water Basin Liner Design
  - Basis of Design for Facility and Infiltration Gallery
  - Water Discharge Application Requirements
- Part 4 Rules - Water Quality Standards
  - Antidegradation - Best Technology in Process in Treatment for BCC Mercury
- Part 8 Rules - Water Quality Based Effluent Limits
  - Low Level Metals – Designated Use Protection

*Due to groundwater venting, the state agency applied surface water discharge requirements to the venting location (groundwater seeps).*



## Final Agency Decisions

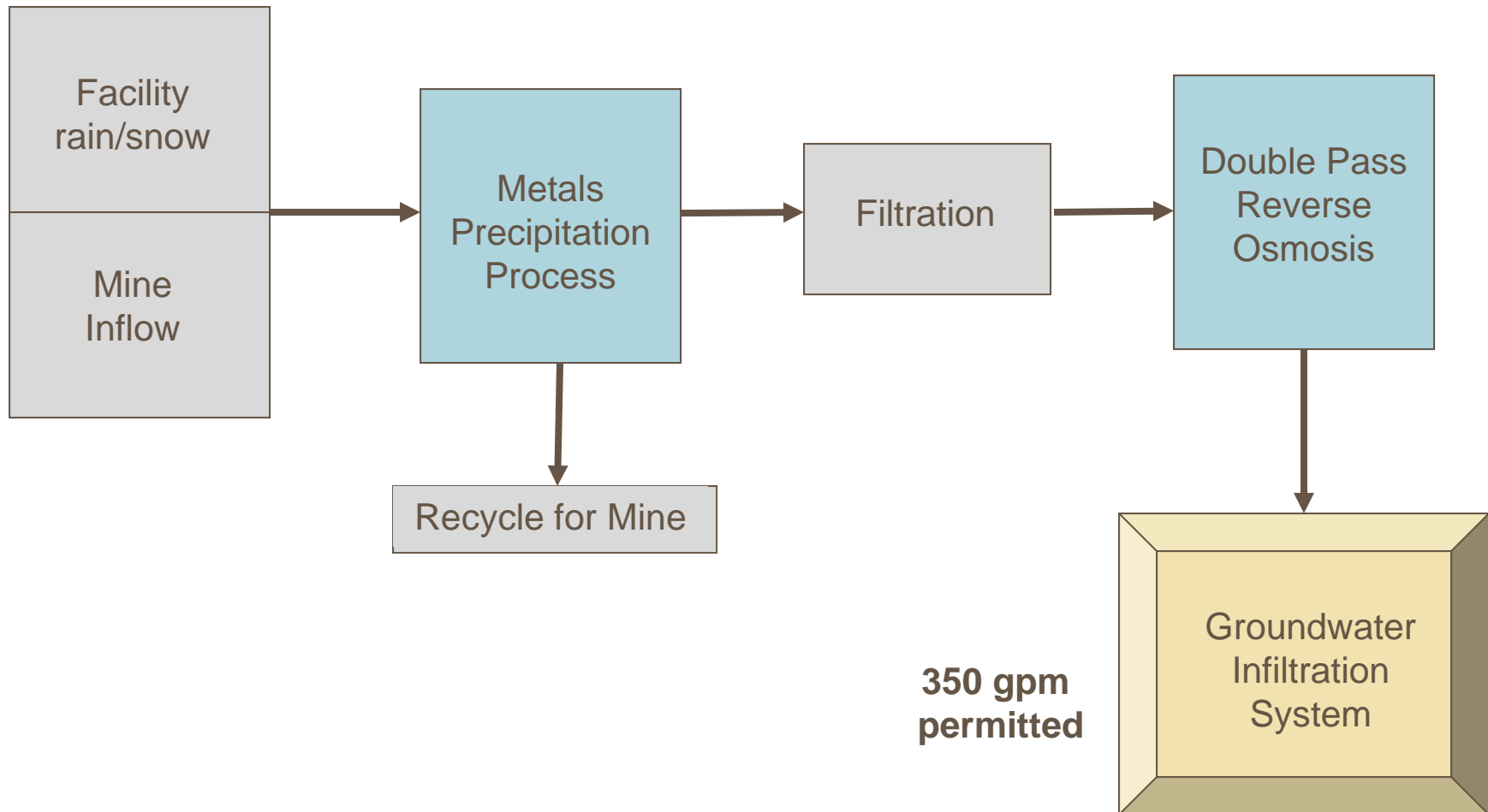
Ultimately, the State of Michigan issued a water discharge permit that included limits protective of both surface and ground water.

### Comparison of select Permit Limits and Drinking Water Standards

<b>Parameter</b>	<b>Eagle Permit Limit Monthly Average (ug/l)</b>	<b>Michigan Drinking Water Standard (ug/l)</b>
Selenium	5	50
Mercury	0.0021	2
Copper	10	1300

Compliance points are both groundwater and WTF effluent.

# Water Treatment Facility Schematic











# RioTinto



Questions are Welcome.  
Thank You.