CREATING AND DELIVERING BETTER SOLUTIONS

# Effectiveness of a Salt Leaching Cell for Treatment and Conservation of Salt-Impacted Soils at a Remote Site

Presented at: Remtech 2007


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# Previous Remtech Presentation, 2005



- Discussed overall goals and drivers.
- Stakeholder meeting to identify receptors.
- Restrictions from remote site location.
- Remediation alternatives assessed.
- Groundwater modeling to predict potential impacts to a nearby creek.

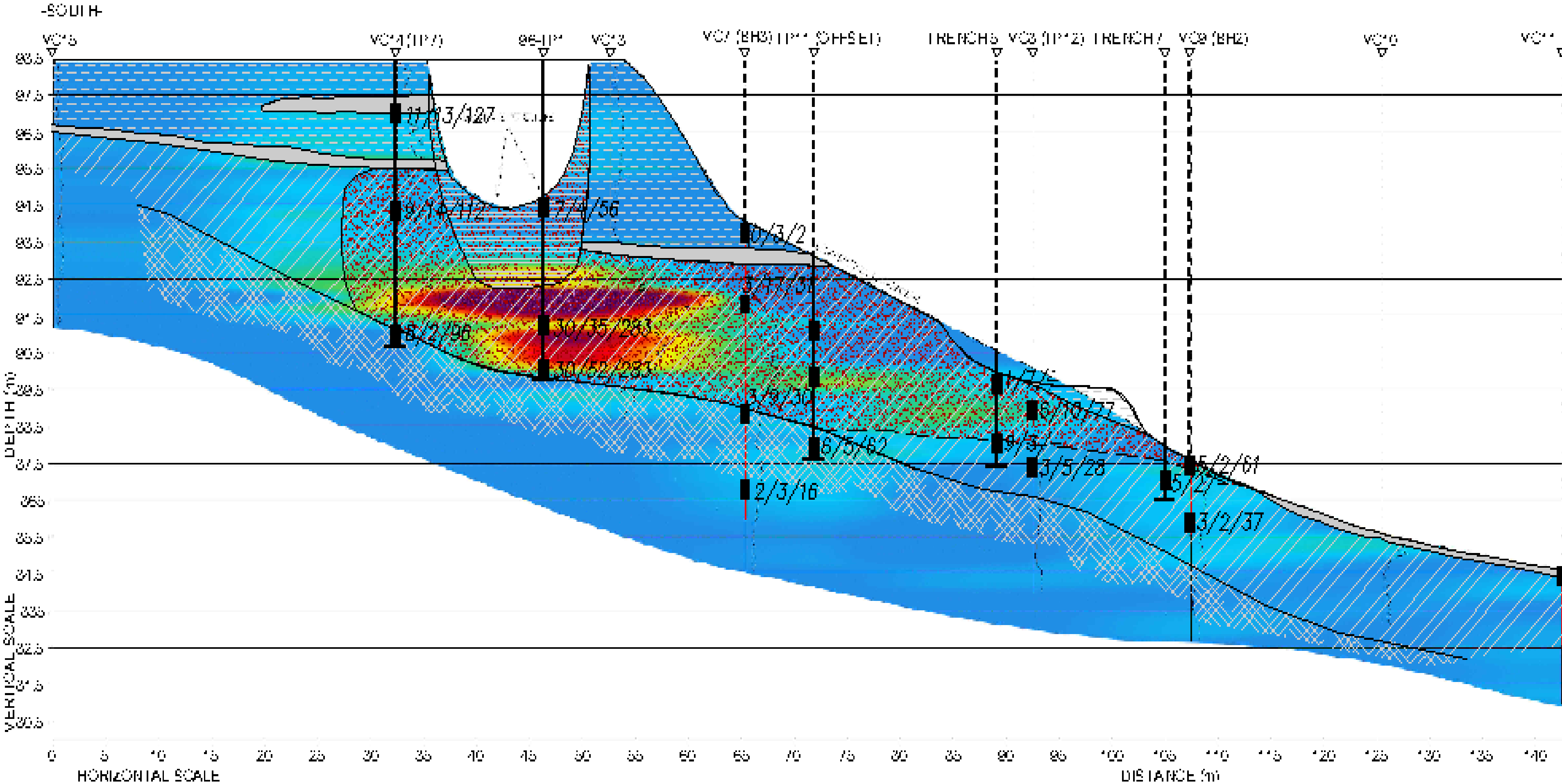
# Initial Contaminant Conditions



- Total Petroleum Hydrocarbon (PHC) concentrations in soil ranged from 2,880 mg/kg to 78,000 mg/kg.
- Chloride concentrations in soil ranged from 0 mg/kg to 2,500 mg/kg.
- EC ranged from <3 dS/m to 32 dS/m and SAR ranged from <4 to a maximum of 52.

# Initial Salt Concentrations






Initial proposed remedial plan was thermal desorption for hydrocarbon treatment, with some biotreatment on lesser contaminated materials, and risk assessment for post-treated salts.

# Thermal Desorption (TD)



- EUB would not approve TD unless salts were also treated.
- TD requires less space than biotreatment.
- Treats PHCs but not salts.
- Treatment vs. disposal preferred for conservation of the soil resource on-site.

# Benchscale Test for Salt Leaching



- Benchscale required because of uncertainty whether thermal desorption would affect the availability of salts in the soils to leach.
- Initial TDU material had an EC of 11.87 dS/m and SAR of 5.3.
- Assessed whether salts could be removed, whether calcium amendment was required and affect of bulk density.
- Conclusions:
  - Salts can be leached to meet remediation objectives;
  - No calcium amendments are necessary; and
  - The lighter the bulk density, the better.

# Salt Leaching Concentrations After Thermal Desorption

**Total Thermal Desorbed Material = 43,000 tonnes or 28,000 m$^3$**

**(at a bulk density of 1.5 g/cc and moisture content of 11.3%)**

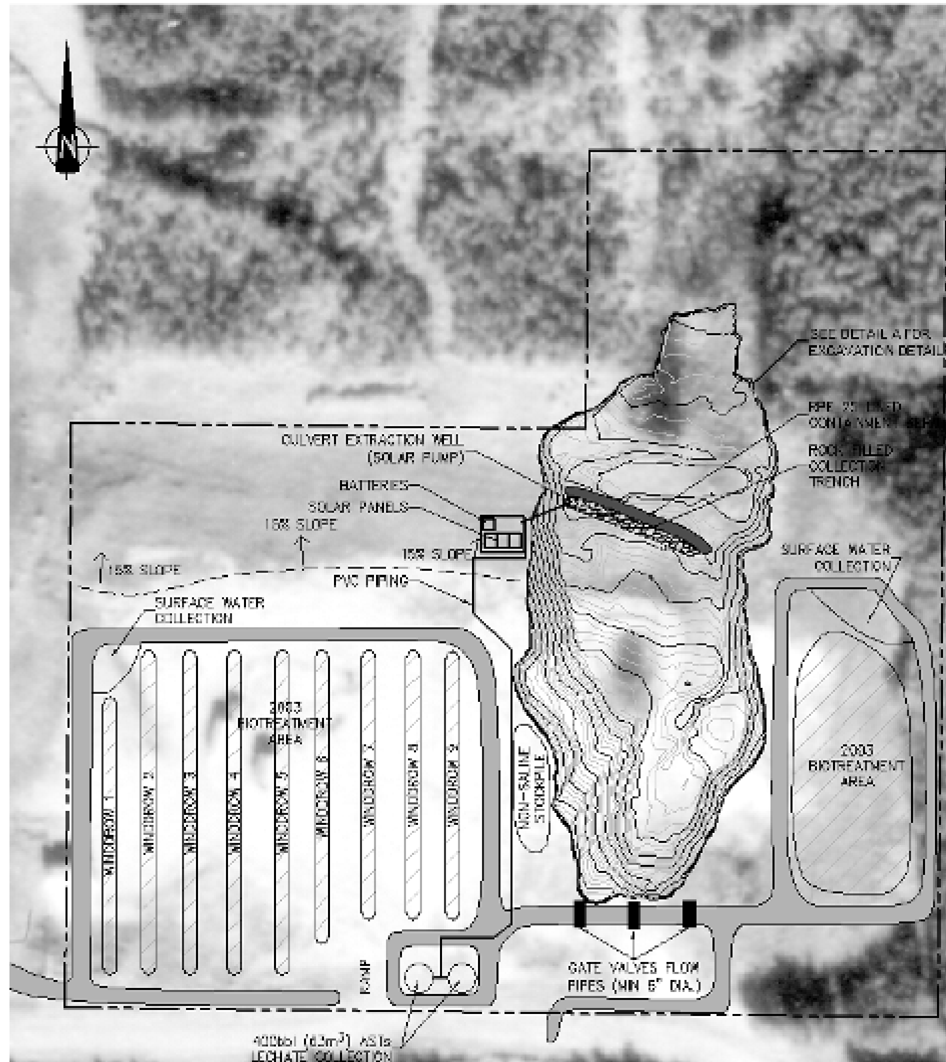
| Treatment | Material No. | Weight (Tonnes) | Salinity and Sodicity Characteristics | | | |
|---|---|---|---|---|---|---|
| | | | No. of Samples | EC (dS/m) Mean | No. of Samples | SAR Mean |
| Thermal Desorption | 1 | 26,400 | 28 | **6.33*** | 28 | **5.35** |
| | 2 | 6,200 | 7 | **4.50** | 7 | **4.20** |
| | 3 | 1,725 | 3 | 1.67 | 3 | 1.3 |
| | 4 | 8,690 | 8 | **4.73** | 8 | **4.98** |
| Bio-treatment | 5 | 18,500 | 13 | 1.88 | 12 | 2.83 |
| Total | 1 to 5 | 61,515 | 59 | **3.82** | 58 | 3.73 |

*** Mean chlorides were 1500 mg/L (680 mg/kg)**

# Salt Leaching Cell Design



- Captured Surface Water for Leaching.
- Constructed Leaching cell in flare pit excavation.
- Recovered Leachate in collection trench with solar powered pumping system.



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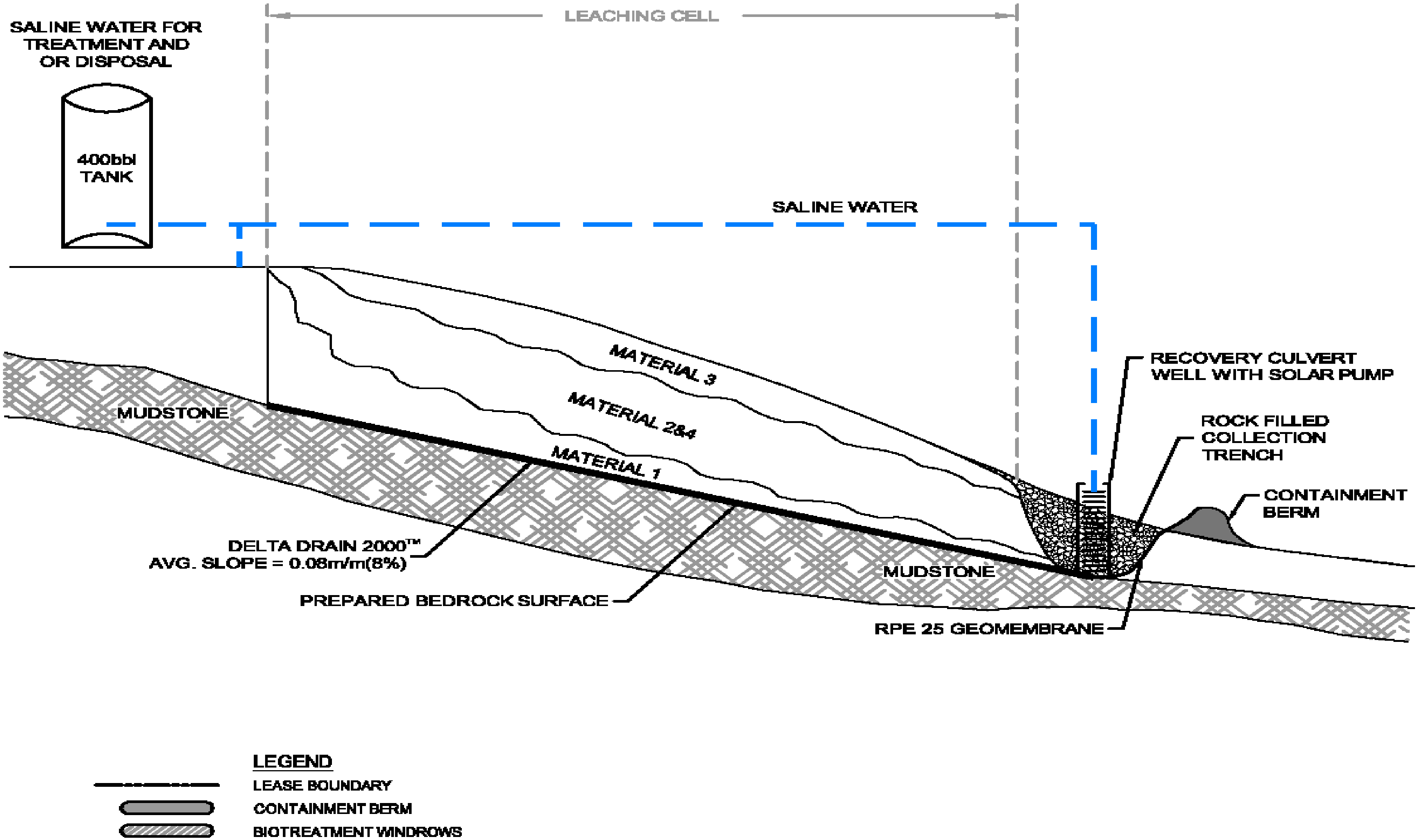
# Salt Leaching Cell Design





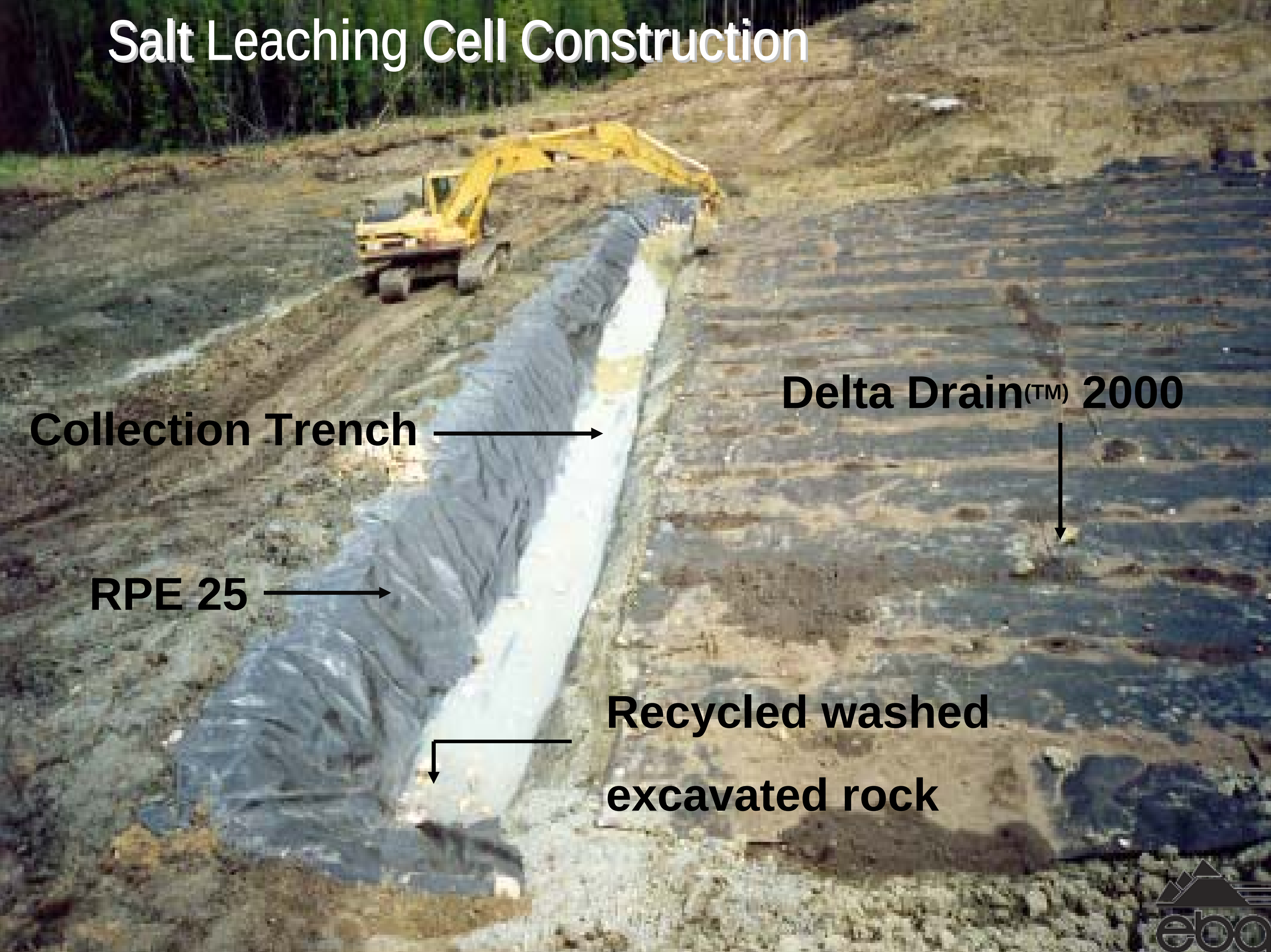
# Salt Leaching Cell Design



- Constructed to maximize leaching capacity.
- Collection of leachate downgradient.
- Solar electrical system pumped leachate upslope to treatment:
  - low maintenance costs;
  - low energy usage; and
  - reduced potential for additional fuel spills.
- Water disposal and treatment options were:
  - disposal by injection well (70 km away);
  - reverse osmosis or other treatment; and
  - recycled on site.

# Construction of Salt Leaching Cell




Salt Leaching Cell Construction
Delta Drain(TM) 2000
Collection Trench
RPE 25
Recycled washed
excavated rock

# Reverse Osmosis



- Pilot Test by Candesal Mobile Treatment Unit
  - Pilot test chosen to determine maximum efficiency of recirculation through RO.
- Water needed prefiltration prior to reverse osmosis for maximum membrane efficiency.
- During pilot 95% of water was recycled; during treatment 86% was recycled.

# Water Handling and Treatment



Water Handling and Treatment

- 2003 - Pilot with Reverse Osmosis
- 2004 -Treatment with Reverse Osmosis
- 2005 to 2006 – Water Management System

Total Water Volume Recovered from Leaching Recovery Well and Treated = 2,335 $m^3$

# Soil Surface Management

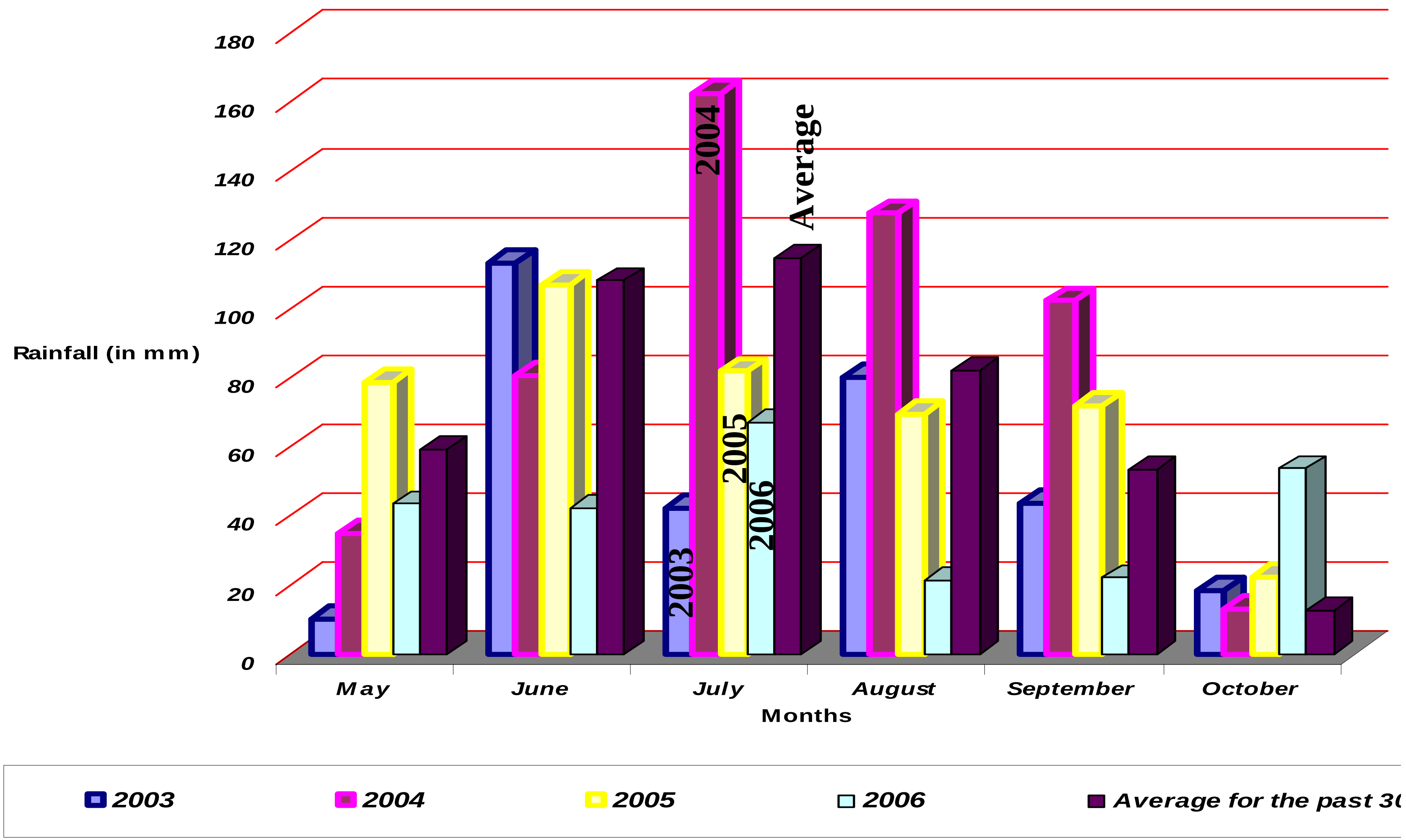


- Erosion control berms.
- Roughen surface regularly.
- Surface revised winter 2005 to enhance water movement to lower soils.

# Water Supply Issues



## Localized Drought in 2005 and 2006 affected water supply

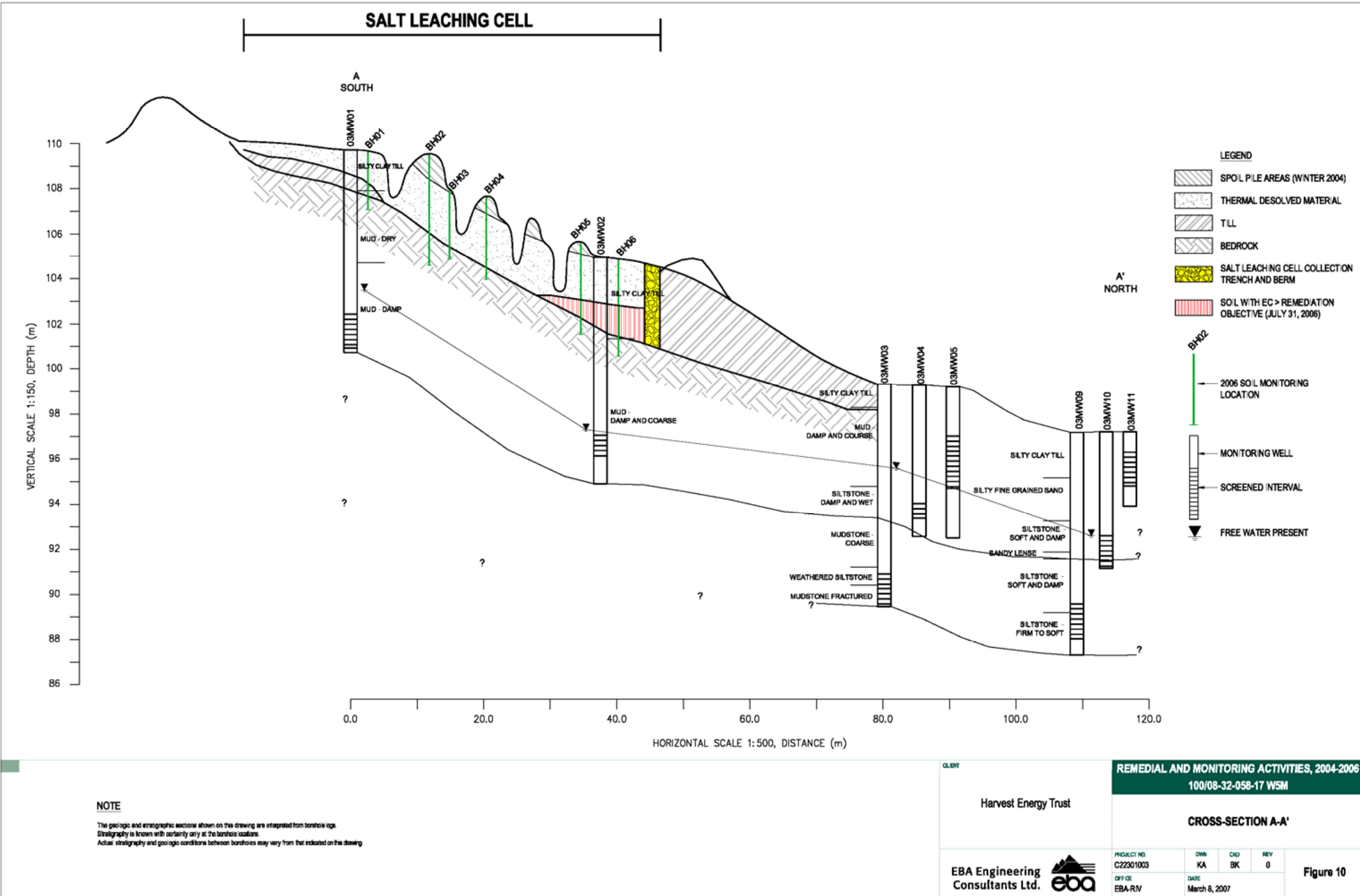


# Soil Monitoring Results



- Soils were monitored Oct 2004 and Aug 2006 with two lower slope positions re-sampled in Oct 2006.
- In 2004, upper soils were treated but lower soils were not.
- 2006 Monitoring results found the following:
  - EC meets "Good" quality subsoil on 97% to 98% of the volume; the other 2-3% are below 1.5 m depth in the leachate collection area and are "Fair" quality.
  - SAR meets "Good" quality to an average depth of 1.3 m or approximately 35% of the volume; below this they are "Fair" quality.
- Post reclamation, these soils will be beneath an additional one to four metres of "Good" quality subsoil

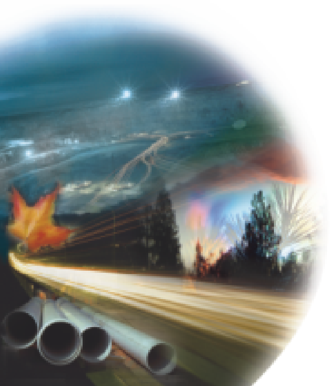
# Cross Section



# Summary



- Salt leaching was effective in reducing salt concentration in soils to meet “Good” quality.
- To meet the EC target, 45% of the chlorides in the soils were removed.
- Soils were conserved allowing them to remain on-site as a useful resource.
- ASRD, the lead regulatory agency, has accepted the remedial report and allowed reclamation to proceed.



# Interesting Notes



- Thermal Desorption using Nelson Environment's (NER) re-hydrating system actually granulated the soils, changing the Particle Size Analysis from a clay loam to a sandy loam. Through leaching and time, the granules have degraded, leaving a current texture of loam.
- Removal of sodium is slower than the chloride, which is to be expected since sodium sorbs onto the cation exchange complex; whereas, chloride is very soluble in water.
- Management of soil dispersion potential and managing the delivery of the water to lower soils were critical for success of salt removal.

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