

GEOTECHNICAL CHALLENGES AT OWENS LAKE, CALIFORNIA

Presented by:

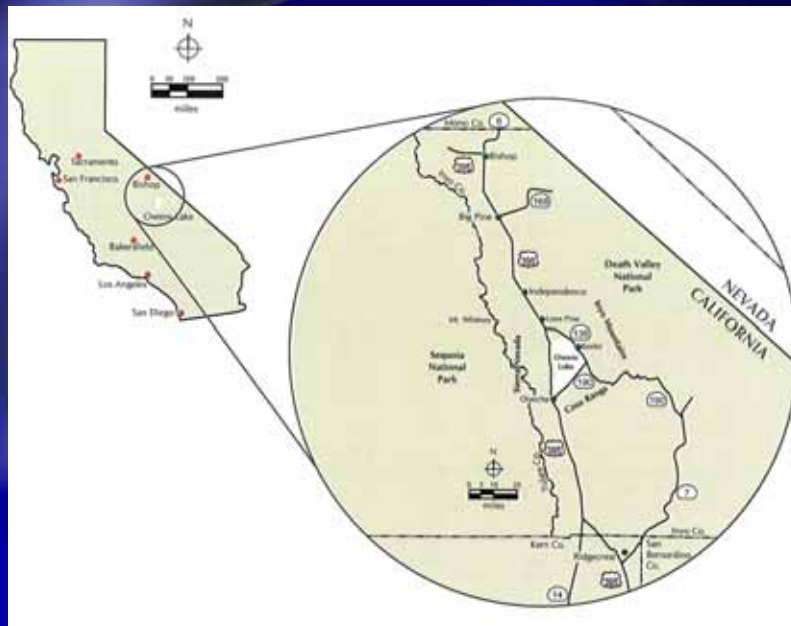
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CDM

PRESENTATION OUTLINE

- ◆ **Project Background**
- ◆ **Geotechnical Evaluation**
- ◆ **Project Challenges**
- Q & A**

SITE LOCATION



Project Background

- Lake area ~ 110 sq. miles
- Dry, salt-laden lakebed sediments are exposed to wind erosion
- Dust blowing from lakebed is a major health hazard
- Purpose of the project is long-term dust mitigation
- This is Phase 7 of work at Owens Lake

What is Particulate Matter ?

- USEPA indicator for particulate matter is PM_{10} (particulate matter ≤ 10 microns)
- $1/7^{\text{th}}$ the thickness of a human hair
- Mixture of materials including dust, smoke, soot, salts, acids, and metals
- Responsible for haze/ smog and is a health hazard
- Windblown dust is a major source of PM_{10} at Owens Lake and is carried beyond the area

EPA Standards v. Owens Lake

- **PM_{10} Standard:**
 - $150 \mu\text{g}/\text{m}^3$ for 24 hr average
 - $50 \mu\text{g}/\text{m}^3$ for annual average
- **At Owens Lake:**
 - $PM_{10} > 12,000 \mu\text{g}/\text{m}^3$ measured at Dirty Sock Well (May 2, 2001)
 - Annual PM_{10} average $\sim 157 \mu\text{g}/\text{m}^3$

A TYPICAL DUST STORM





Primary Mitigation Methods

Containment berms and ponds



Shallow flooding



Secondary or Experimental Mitigation Methods

Managed vegetation (saltgrass)



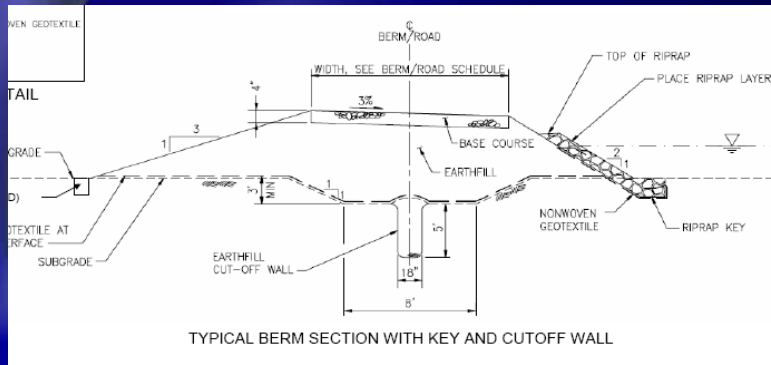
Moat and row



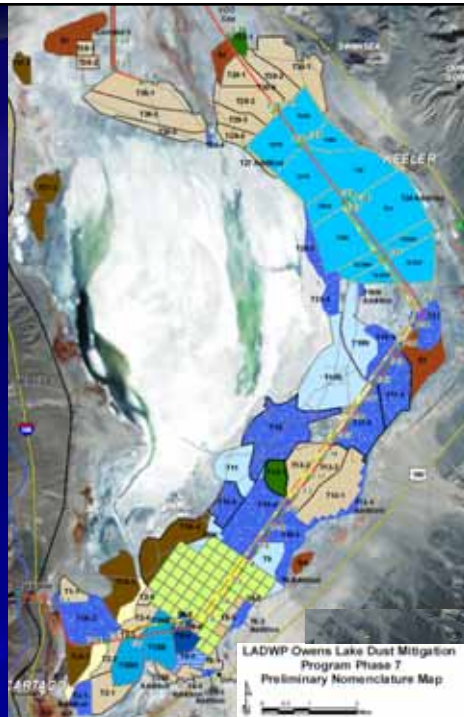
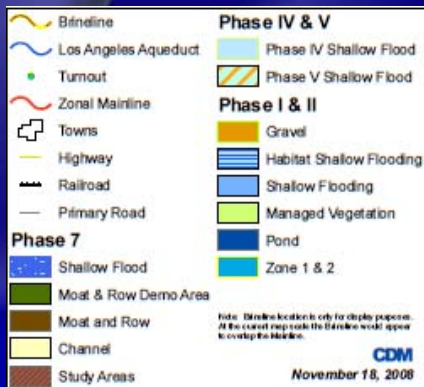
Tillage



TYPICAL SECTION



PROJECT LAYOUT

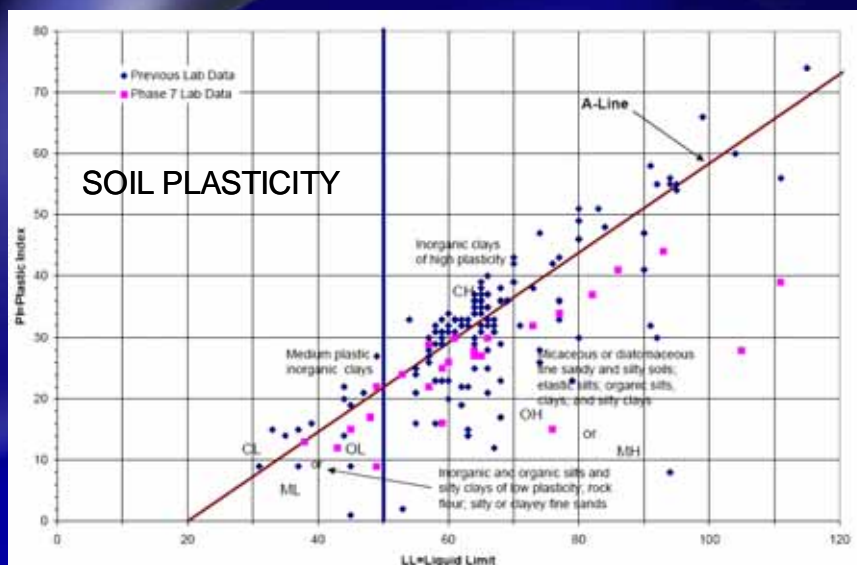


Phase 7 Subsurface Information

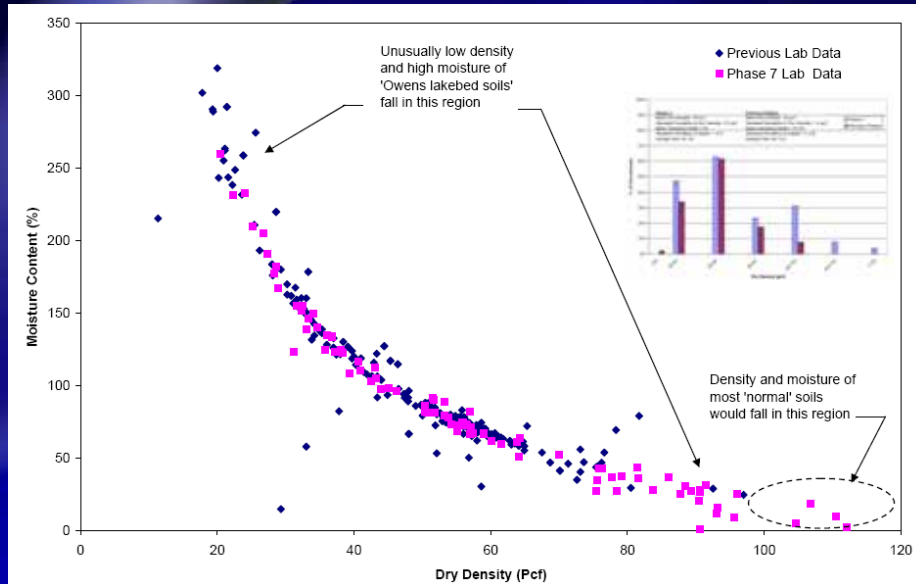
- ◆ Borings (113 new, 79 old/ nearby)
- ◆ Test Pits (53 new, 21 old/ nearby)
- ◆ Electrical Resistivity
- ◆ Borehole Permeability
- ◆ Considerations for biological, historical & archeological resources



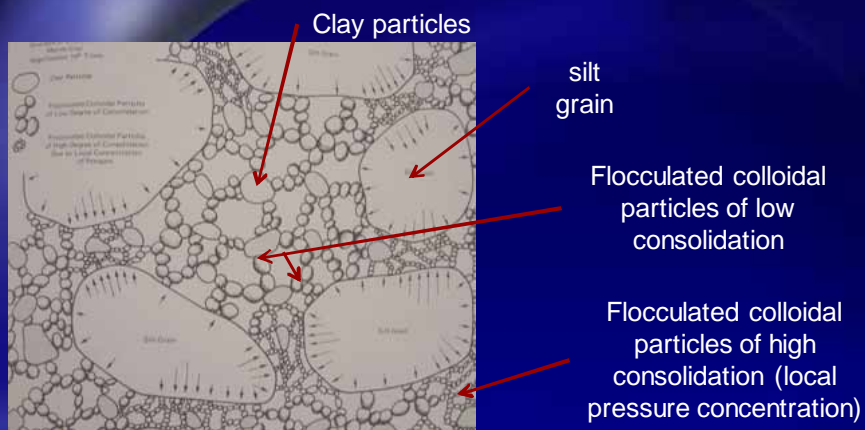
GEOTECHNICAL PROPERTIES OF OWENS LAKEBED SOILS



MOISTURE CONTENT V. DRY DENSITY



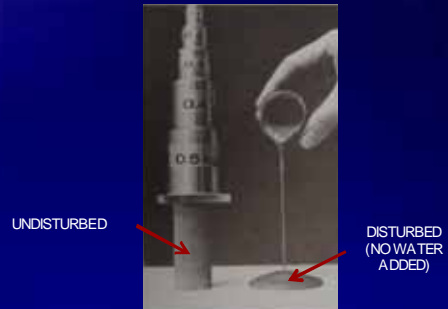
THE STRUCTURE OF UNDISTURBED SENSITIVE CLAY



- ◆ Caused by flocculated structure and salt removal
- ◆ Usually formed in a marine environment, then uplifted to land, then salt leached out by fresh water

SENSITIVE (QUICK) CLAY

- ◆ Changes from a relatively stiff condition to a liquid mass when disturbed
- ◆ Sensitive (high undisturbed strength but a low remoulded strength)
- ◆ Common in Scandinavia and Canada. Not so common in the U.S.

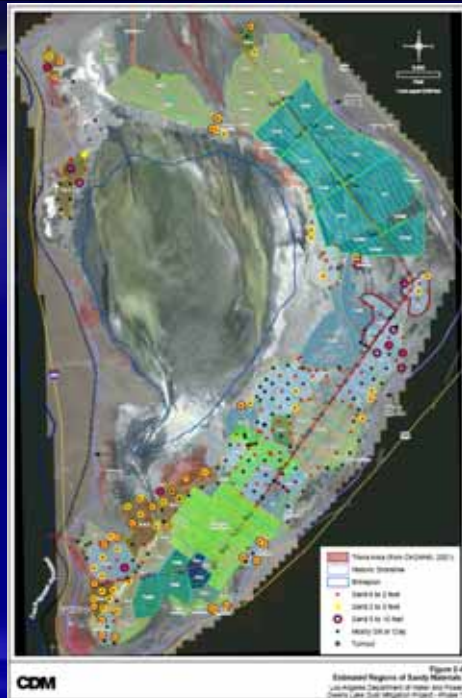


SENSITIVE CLAY AT OWENS LAKE



SAND ZONES

(generally coincide with fresh water inflow areas)



PROBLEMS IN FRESH WATER INFLOW AREAS

- ◆ These areas are generally located near the lake perimeter
- ◆ Salt leaching promotes quick clay conditions
- ◆ Construction equipment access is very difficult (sinking)
- ◆ Ground fissures, infill zones and berm under-seepage zones are more likely
- ◆ Fill placement on soft material is much harder, mud waves form easily and berms can fail
- ◆ Trench excavations are unstable
- ◆ Personnel safety is a concern (sinking)

GROUND FISSURES, INFILLS AND UNPREDICTABLE SEEPAGE ZONES



SURFACE



SUBSURFACE

FRESH WATER INFLOW AREAS AT LAKE EDGES



Geotechnical Analysis and Design Considerations

- ◆ **Analysis**
 - ◆ 3D patterns in field and lab data
 - ◆ Comparison of current and previous data
 - ◆ Delineating potential problem areas (sand, ground fissures, salt lenses)
 - ◆ Study of previous problems (berm breach, etc.)
- ◆ **Design**
 - ◆ Berm stability (slope and erosion control)
 - ◆ Settlement control (over-excavation)
 - ◆ Seepage control (key, cutoff trench, toe drain)
 - ◆ Client-driven adjustments (initial cost v. maintenance)

Considerations for Risk Management

- ◆ Low cost/ high risk (let them fail)
- ◆ Best guess option by location (based on investigation data)
- ◆ Use of add/ deduct unit pricing for bidding
- ◆ Use of Observational Method to make adjustments during construction

CONSTRUCTION EQUIPMENT CHALLENGES



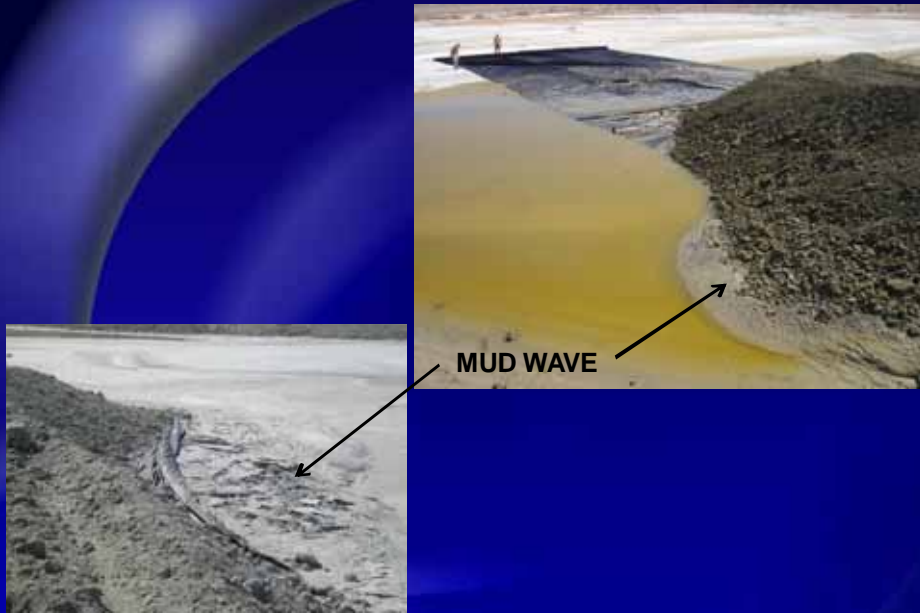




WORKING ON MATS



FILL COMPACTION CHALLENGES



DUST CHALLENGES



SALT AND CORROSION CHALLENGES



SALT LENSES AND SEEPAGE CHALLENGES



DEWATERING CHALLENGES



Water bubbling
before dewatering



DEWATERING
MOAT

RIPRAP PROTECTION CHALLENGES



FIGHTER JET CHALLENGES



PERSONNEL SAFETY CHALLENGES



NATURE HAS RETURNED



PROJECT ADMINISTRATION CHALLENGES

- ◆ Cost versus liability issues
- ◆ Specification enforcement issues
- ◆ Maintenance issues
- ◆ Multi-disciplinary issues

MIRANDA HARD HAT



QUESTIONS?

CDM

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