# ET COVER SYSTEM IN ARID ENVIRONMENTS

## JUSTIFYING THE USE OF AN EVAPO-TRANSPIRATIVE COVER SYSTEM FOR CAPPING AN INDUSTRIAL WASTE PILE SAVES CLIENT MILLIONS

Martin E. Carlson, PE

*May 8, 2018*

CDM Smith

# PRESENTATION OUTLINE

- History Of Project
- Inert Waste Pile Issues
- Preliminary Investigation Activities
- Closure Documentation And Alternative Cap Justification
- Final Closure

# HISTORY OF PROJECT

- Located In Southern CA
- Wallboard Production Plant Operating Since 1930s
- 2.6M CY Of Waste Wallboard (<1% Of Produced Wallboard)
- Preparations For Closure Started In Early 2000s
- 100% Recycle Of Waste Wallboard Started In 2005
  - Inactive Waste Piles Require Closure Under CA Title 27

# INERT WASTE PILE ISSUES

- Public Perception (Eye Sore)
- 2.6M CY Of Inert Material
- Spread Across 80 Acres
- IMSA Contents:
  - >99% Inert Waste Wallboard (I.E., Paper And Gypsum)
  - <1% Putrescible Household Waste
- Source Of Dust Pollution

# PRELIMINARY INVESTIGATION ACTIVITIES

- Regional Weather
- Groundwater Characterization
- Solid Waste Assessment Testing
- Landfill Gas Investigation

# REGIONAL WEATHER

- Located In The Salton Basin Desert
- Average Winter Low Temperature Is 35 Deg. F.
- Average Summer High Temperature Is 110 Deg. F.
- Rains 3 To 4 Inches Per Year

# REGIONAL TOPOGRAPHY, GEOLOGY AND GROUNDWATER

- Site Elevations Range From 108’ To 117 Along Western Perimeter And 89’ To 90’ Along Eastern Perimeter
- Waste Pile Up To 136’ AMSL
- Colorado River Basin
- Regional Groundwater At Sea Level
  - ~100 Feet Below Waste Pile

# SOLID WASTE ASSESSMENT TEST

- Installed Below Bottom Of Inert Waste Pile:
  - Two Groundwater Wells
  - Three Lysimeters (15’ Below Waste)
  - Three Free-drainage Monitoring Devices (5’ Below Waste)
- Sampled Quarterly
- Analyzed For Total Metals, Volatile And Halogenated Hydrocarbons
- Results:
  - No Impacts To Groundwater
  - Landfill Materials Primarily Waste Gypsum (I.E., Calcium Sulfate)
  - Non-toxic And Unlikely To Negatively Affect Groundwater
  - Low Annual Precipitation And High Annual Evaporation Significantly Reduces Possibility Of Leachate

# LANDFILL GAS INVESTIGATION

- Putrescible Waste Decomposes And Creates Methane And Carbon Dioxide
- Gypsum Wallboard Decomposes (Generally In Wet Climates) Generates Hydrogen Sulfide

- Testing:
  - 36 Locations (22 Waste, 14 Around Perimeter)
  - Gas Probes Driven 1 To 3 Feet Into Waste Or Soil
  - Gas Samples Collected And Analyzed In The Field For Methane, Carbon Dioxide, Oxygen, Nitrogen And Hydrogen Sulfide
  - 4 Random Samples Collected And Analyzed At A Laboratory

# LANDFILL GAS INVESTIGATION

- Findings:
  - No Significant Amount Of Landfill Gas Or Hydrogen Sulfide Were Measured Either Within The Waste Or In The Surrounding
  - Potential For Any Significant Landfill Gas Generation Is HIGHLY Unlikely
- Exemption From Landfill Gas Monitoring After Closure Approved

# REGULATIONS / STAKEHOLDERS

- Final Closure Plan Developed Class III Landfill
- Title 40 CFR, Part 58 – Criteria For Municipal Solid Waste Landfill
- Title 27 CCR – Solid Waste Division
- Stakeholders:
  - California's Department Of Resources Recycling And Recovery (CalRecycle)
  - California Integrated Waste Management Board
  - California Regional Water Quality Control Board
  - Imperial County Air Pollution Control District
  - Imperial County Planning And Development Services
  - Imperial County Public Health Department (Lead Enforcement Agency)

# TITLE 27 CCR – FINAL COVER REQUIREMENTS

- Prescriptive Cover
  - Foundation Layer – 2’ Prepared Foundation
    - Geotechnically Stable Material
  - Low-hydraulic Conductivity Layer
    - Not Less Than 1-foot Of “Clean” Soil
    - Hydraulic Conductivity Less Than $1X10^{-6}$ Cm/S
  - Erosion-resistant Layer
    - Either Vegetative Layer Or Mechanical
    - 1-foot Of Soil (Capable Of Sustaining Native Plant Growth) Or 1-foot Of Rock
  - Other Requirements
    - No Ponding Areas (All Slopes Greater Than 3%)
    - Precipitation And Drainage Control Plan
    - Steeper Slopes Protected Against Erosion

# PRESCRIPTIVE FINAL COVER CONSIDERATIONS

- Foundation Layer – 2’ Prepared Foundation
  - 260,000 BCY Soil
- Low-hydraulic Conductivity Layer – 1’ Soil/Clay
  - 130,000 BCY Soil/Clay With Less Than $1X10^{-6}$ Cm/S Permeability
- Erosion-resistant Layer – 1’ Rock
  - 130,000 BCY Topsoil Or Rock
- No Ponding Areas
  - 80 Acres Of Waste (Upper And Lower Decks)
  - Both Nearly Flat
  - Needs Regraded To <3%
  - ~300,000 BCY Cut/Fill To Regrade To <3%

# ALTERNATIVE FINAL COVER

- RWQCB can allow any alternative final cover design that it finds will continue to isolate the waste from precipitation and irrigation waters AT LEAST AS WELL as would a final cover built in accordance with the prescriptive final cover

# DESIGN CONSIDERATIONS FOR ALTERNATIVE FINAL COVER

- Infiltration Reduction
- Grading and Drainage To Remove Ponding Areas
- Erosion Resistant Rock Layer
- Settlement
- Stability
- Site Security And Access

# INFILTRATION REDUCTION

- Minimize Infiltration Into Underlying Waste
- UNSAT-H To Evaluate Prescriptive And Alternative Covers
  - UNSAT-H Computes The Water Balance Of The Cover System Taking Into Account Precipitation, Infiltration, Evaporation, Soil Storage And Drainage From The Bottom Of The Cover System
- Utilized Local Rainfall Data From Wettest 10-year Period On Record (4.2 Inches Per Year From 1989 To 1998)

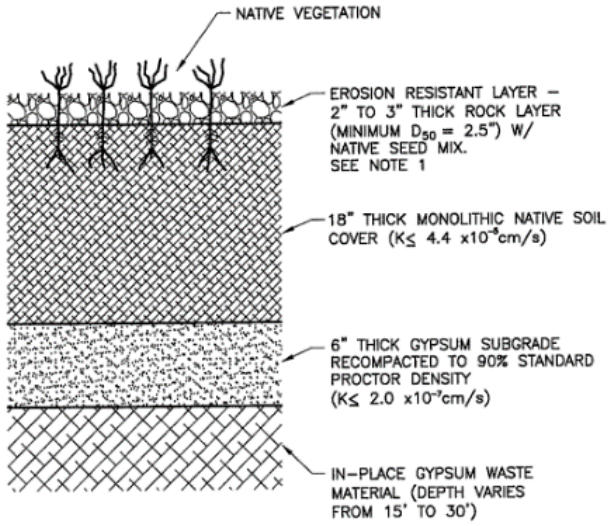
# INFILTRATION REDUCTION

- Compared Prescriptive Cover To Alternative
  - Prescriptive:
    - 1-foot Erosion Resistant Rock
    - 1-foot Soil W/Hydraulic Conductivity Of $1x10^{-6}$ Cm/S
    - 2-foot Foundation Soil W/Hydraulic Conductivity Of $2x10^{-5}$ Cm/S
  - Alternative Cover:
    - 2- To 3-inches Erosion Resistant Rock
    - 18-inches Monolithic Native Soil (On-site Soil) W/ Hydraulic Conductivity Of $4.4x10^{-5}$ Cm/S (Actual Data From On-site Soils)
    - 6-inch Gypsum Waste Regraded And Recompacted To 90% Standard Proctor W/ Hydraulic Conductivity Of $2x10^{-7}$ Cm/S
  - Potential Vegetation Negated In Model

# INFILTRATION REDUCTION

- UNSAT-H Model Results
  - Alternative Final Cover Outperforms Prescriptive Cover
  - Alternative Final Cover Allows ~37% Less Drainage From Bottom Of Cover

| Cover System | Total Precipitation Over the 10 Wettest Year Period (inches) | Total Drainage From Bottom of Cover Over the 10 Wettest Year Period (inches) | Average Annual Precipitation Over the 10 Wettest Year Period (inches) | Average Annual Drainage From Bottom of Cover Over the 10 Wettest Year Period (inches) |
|---|---|---|---|---|
| **Prescriptive** | 42.2 | 3.8 | 4.2 | 0.38 |
| **Alternative** | 42.2 | 2.4 | 4.2 | 0.24 |



# WASTE GRADING TO REMOVE PONDING AREAS

- Design:
  - Regrade Flat Decks To 1% Minimum Grades (Reduce Cut By 200K BCY)
  - Regrade All Steep Slopes Areas To Less That 5H:1V
  - Install Diversion Berms At The Top Of All 5H:1V To Intercept And Divert Flows To Rip-rap Lined Downdrain Structures
  - Perimeter Drainage Channels Conveying Stormwater Away From Waste Pile
- Title 27 section 21090.B.1.B allow portions of the final cover to be built with grades less than 3% if the discharger proposes an effective system for diverting surface drainage from laterally-adjacent areas preventing ponding in the flatter deck areas
- Stakeholders Approved The 1% Grading And Drainage System

# EROSION RESISTANT ROCK LAYER

- Design:
  - 2- To 3-inches Of Erosion Resistant Rock On Flat Slopes (<10%)
  - 3- To 4-inches Of Erosion Resistant Rock On Steeper Slopes (>10%)
  - Erosion Resistant Rock Has A D50 Of 2.5 Inches
- Hydrology Analysis To Support Use Of 2- To 3-inch Rock Layer In Lieu Of 1-foot Rock Layer
  - 100-year Storm Event
  - Rational Method For Maximum Runoff Rate
  - Safety Factor Method (Design Of Erosion Protection For Long-term Stabilization, Johnson, T.L., 2002) Utilized To Evaluate Erosional Stability Of The Minimal Erosion Resistant Rock Layer On Surface <10%
  - Erosional Stability Of The Rock Layer On Surface >10% Utilized Abt And Johnson' Method (Riprap Design For Overtopping Flow, 1991)
  - Perimeter Drainage Channels Conveying Stormwater Away From Waste Pile
- Stakeholders Approved The Use Of 2- To 3-inch Rock Layer

# ADDITIONAL DESIGN CONSIDERATIONS

- Stability
  - Maximum 5H:1V Slopes
  - Static Safety Factor Of 4.4
  - Seismic Safety Factor Of 1.86
- Settlement
  - Waste Is Inert And Not Organically Degradable
  - Majority Of Elastic Settlement Already Occurred And Compaction Of Surface Likely To Further Consolidate
  - Minimal Water Infiltration Through Alternative Final Cover
  - Annual Inspections And Maintenance Required If Settlement Occurs
- Site Security And Access
  - Access Roads Around Perimeter And Across Top Of Pile For Inspections
  - 6-foot Perimeter Fence Preventing Unauthorized Access

# ALTERNATIVE FINAL COVER COST COMPARISON

| Cover Component | Quantity | Cost | Cost Difference (Total $14M Savings) |
|---|---|---|---|
| Prescriptive_24” Foundation Layer (screened native soil) | 260,000 BCY | $6.98 / BCY | Prescriptive +$850,000 |
| Alternative_18” Monolithic Native Soil Layer (unscreened native soil) | 194,000 BCY | $4.98 / BCY | |
| Prescriptive_1’ Low-Perm Soil (Imported) | 130,000 BCY | $60 / BCY ($40/Ton) | Prescriptive +$7.6M |
| Alternative_0.5” Regraded/Compacted Waste (Onsite) | 65,000 BCY | $3.21 / BCY | |
| Prescriptive_1’ Erosion Resistant Rock (Imported) | 130,000 BCY | $55.50 / BCY ($37/Ton) | Prescriptive +$4.8M |
| Alternative_4” Erosion Resistant Rock (Imported) | 43,000 BCY | $55.50 / BCY ($37/Ton) | |
| Prescriptive_3% Minimum Slopes | 300,000 BCY | $2.10 / BCY | Prescriptive +$420,000 |
| Alternative_1% Minimum Slopes + Drainage Berms | 100,000 BCY | $2.10 / BCY | |

# CONCLUSION

- Engineered Alternative Is Appropriate Per 27 CCR 20080 Per The Following:
  - Alternative Out Performs Prescriptive Cover By Allowing 37% Less Drainage From Bottom Of Cover System
  - Prescriptive Cover System Is Unnecessarily Burdensome For This Site Given The Arid Climate And Inert Nature Of Waste
  - Cost Of The Prescriptive Cover Substantially More And Will Not Provide Better Protection Of Public Health, Safety And The Environment

# Construction Photos

# WASTE REGRADE


# WASTE REGRADE

# MONOLITHIC NATIVE SOIL COVER


# EROSION RESISTANT ROCK


# DIVERSION BERM AND DOWNDRAIN

# COMPLETED INSTALL

# QUESTIONS?

Martin E. Carlson, PE
CDM Smith Inc.
Helena, Montana 59601
(406) 441-1404