

REINHOLD ENVIRONMENTAL Ltd.



2019 NO_x-Combustion-CCR Round Table Presentation

February 11 & 12, 2019, in Salt Lake City, Utah / Hosted by PacifiCorp

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CCR Impoundment Mapping & Modeling

Maximizing Beneficial Use

February 11, 2019

2019 NOx-Combustion-CCR/PCUG Conference

Reinhold Environmental

Salt Lake City, UT



Agenda

CCR Impoundment Closure Options

CCP Harvesting for Beneficial Use

EVS to Maximize Beneficiation

Case Study

CCR Impoundment

PROBLEM

Closure triggers are upon us...

*Headlines, Lawsuits, Bad News...
Or is it?*

- ✓ Maintain leverage
- ✓ Negotiate on your terms
- ✓ Understand your value
- ✓ Close the beneficial use “gap”

Closure of CCR Surface Impoundments

ALTERNATIVES



1 CLOSURE BY REMOVAL



2 CLOSE IN PLACE

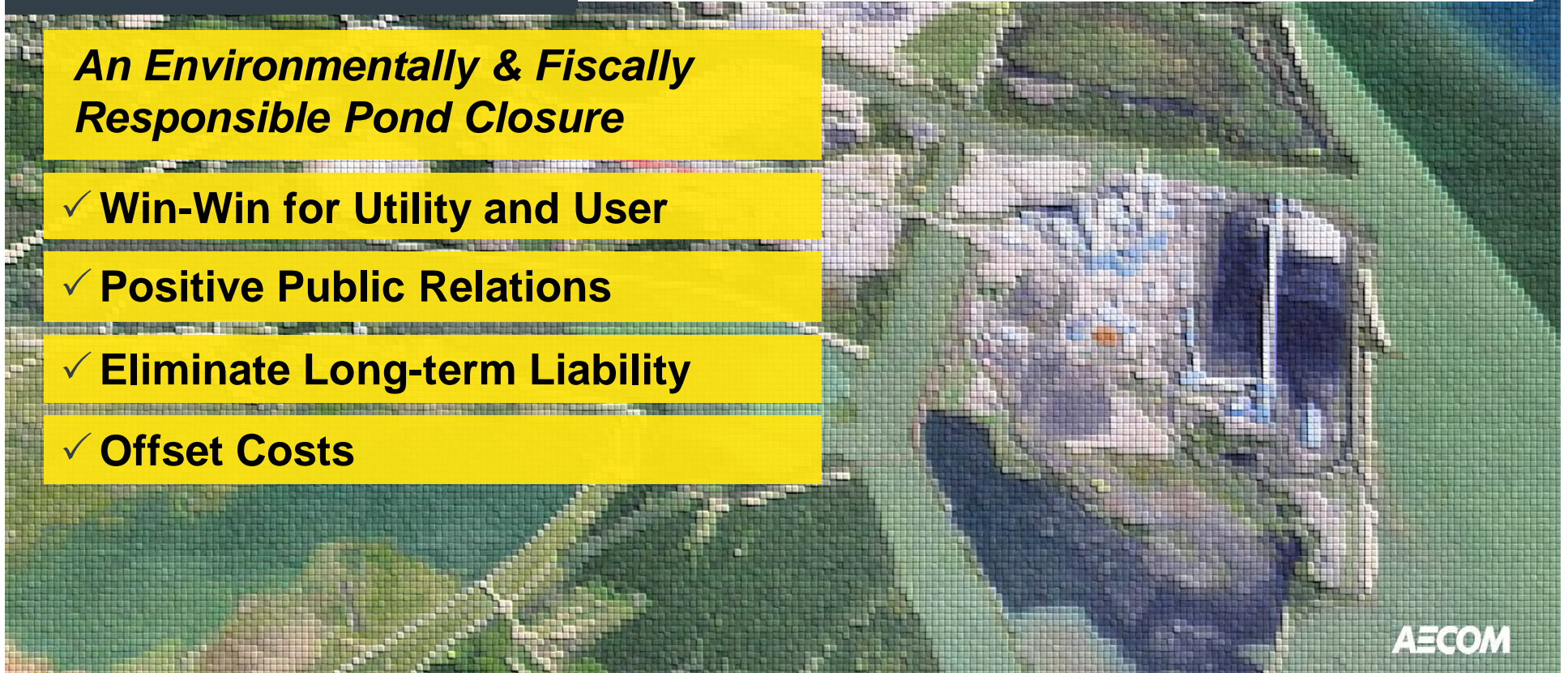
Closure by Removal

SOLUTION

Harvest & Beneficial Use of Pond Ash

An Environmentally & Fiscally Responsible Pond Closure

- ✓ Win-Win for Utility and User
- ✓ Positive Public Relations
- ✓ Eliminate Long-term Liability
- ✓ Offset Costs



Harvesting & Beneficial Use

KEY CONSIDERATIONS

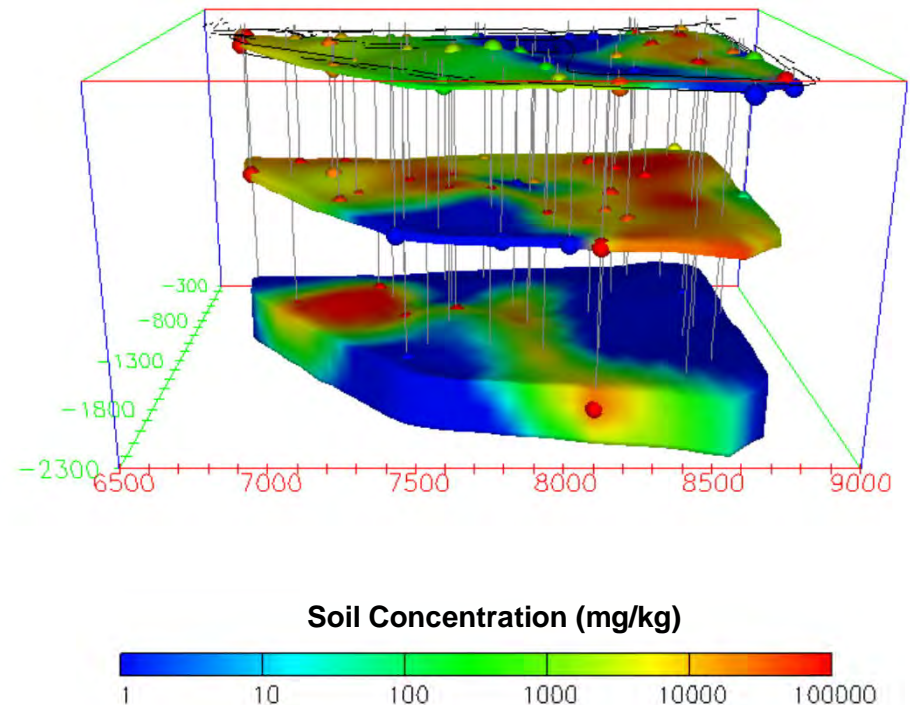
- » QUANTITY OF MATERIAL
How much?
- » QUALITY OF MATERIAL
Is it useable? Can it be made useable?
- » HISTORY OF MATERIAL
Variability? Precedence?
- » LOGISTICS
Local /regional users,
transportation logistics
- » VALUE
vs disposal



A Tool For Addressing These Considerations

ENVIRONMENTAL VISUALIZATION SYSTEM (EVS)

- » 3D VISUALIZATION & ANIMATION PACKAGE
- » ANALYZES INPUT DATA TO CONSTRUCT A MULTIDIMENSIONAL VARIOGRAM BEST FIT TO THE DATASET
- » USES KRIGING (REGRESSION), RECOGNIZED BY THE EPA AS THE BEST/STANDARD MEANS OF INTERPOLATING/ EXTRAPOLATING MEASURED DATA
- » USED HEAVILY IN GROUNDWATER REMEDIATION TO ILLUSTRATE CONTAMINATION & GEOLOGICAL FORMATIONS



A Tool For Addressing These Considerations

WHAT IS KRIGING?

- » KRIGING IS AN ADVANCED GEOSTATISTICAL PROCEDURE THAT GENERATES AN ESTIMATED SURFACE FROM A SCATTERED SET OF POINTS
- » BASED ON STATISTICAL MODELS THAT INCLUDE AUTOCORRELATION PROVIDING A MEASURE OF THE ACCURACY OF THE PREDICTIONS
- » KRIGING IS MOST APPROPRIATE WHEN YOU KNOW THERE IS A SPATIALLY CORRELATED DISTANCE OR DIRECTIONAL BIAS IN THE DATA. IT IS OFTEN USED IN SOIL SCIENCE AND GEOLOGY

$$\hat{Z}(s_0) = \sum_{i=1}^N \lambda_i Z(s_i)$$

where:

$Z(s_i)$ = the measured value at the i th location

λ_i = an unknown weight for the measured value at the i th location

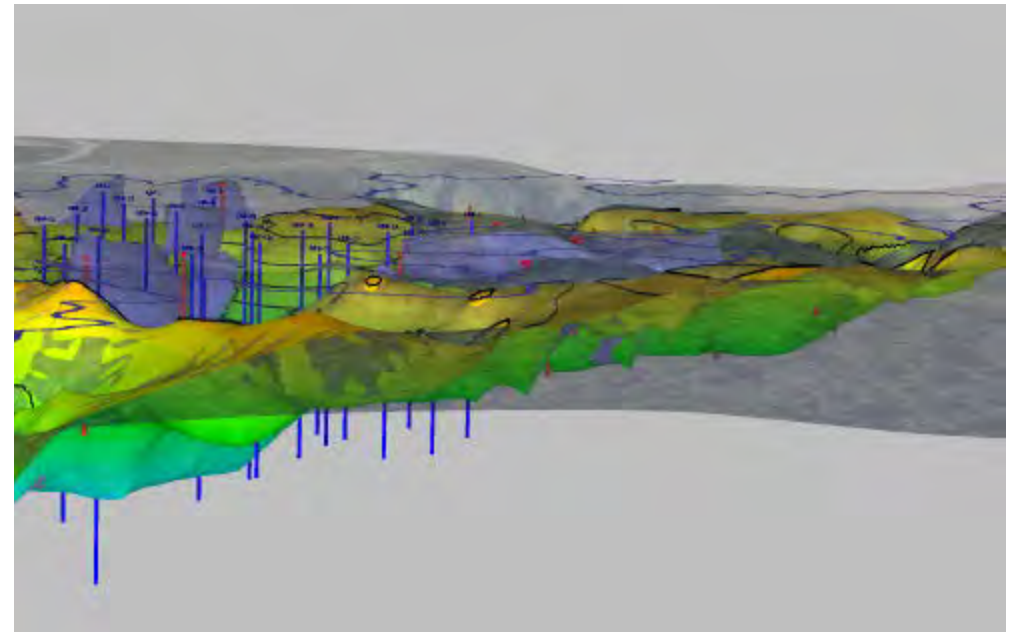
s_0 = the prediction location

N = the number of measured values

Maximizing the Quantity/Quality of CCP for Use

VALUE OF EVS

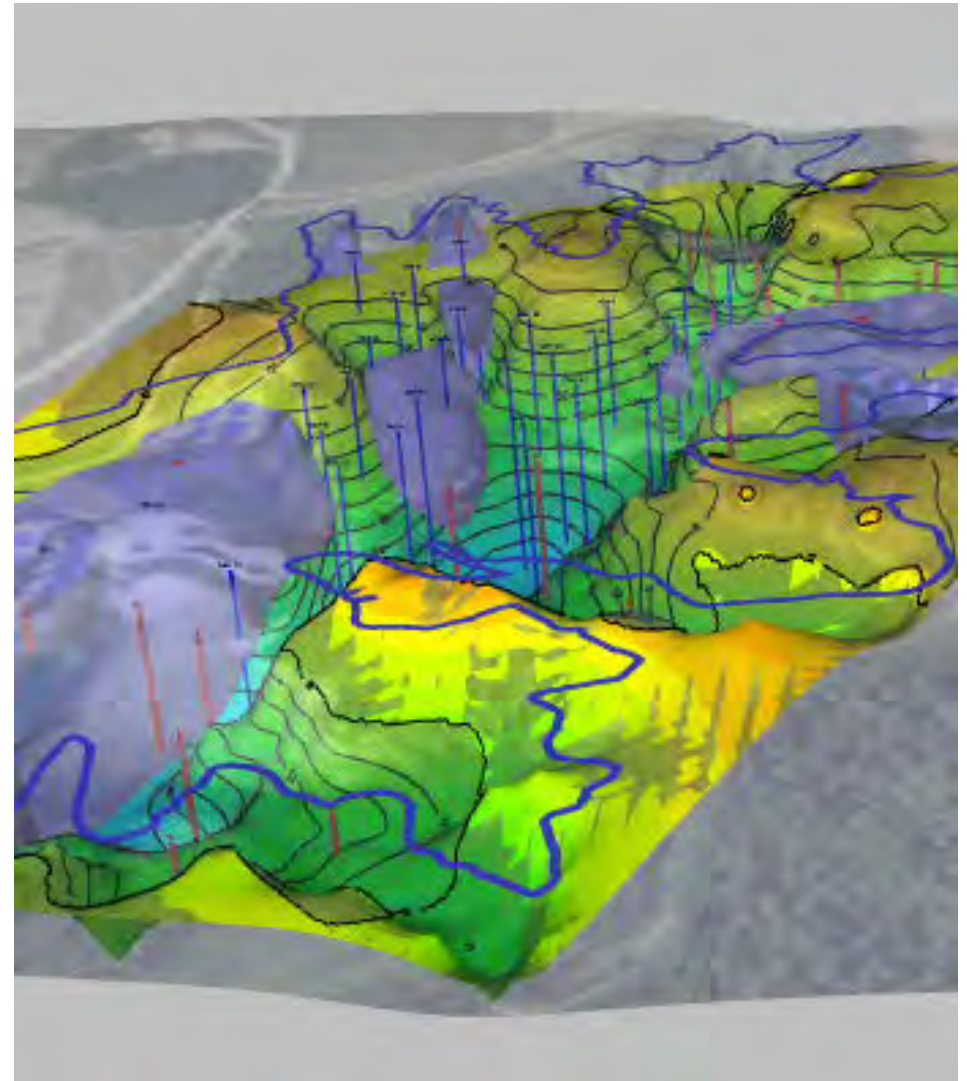
- » WITH SELECT SAMPLING AND ANALYSIS OF KEY CONSTITUENTS & CONTAMINANTS, CREATES A 3D MAP OF AN ENTIRE IMPOUNDMENT
- » ALLOWS FOR AN ESTIMATION OF THE AMOUNT OF MATERIAL THAT:
 - CAN BE USED AS-IS
 - REQUIRES ADDITIONAL PROCESSING
 - REQUIRES DISPOSAL
- » PROVIDES VALUE INPUT TO COST MODELS
- » FACILITATES DEVELOPMENT OF AN EXCAVATION PLAN DESIGNED TO MAXIMIZE THE QUANTITY & QUALITY OF CCP FOR BENEFICIAL USE



How to use EVS

KEY STEPS

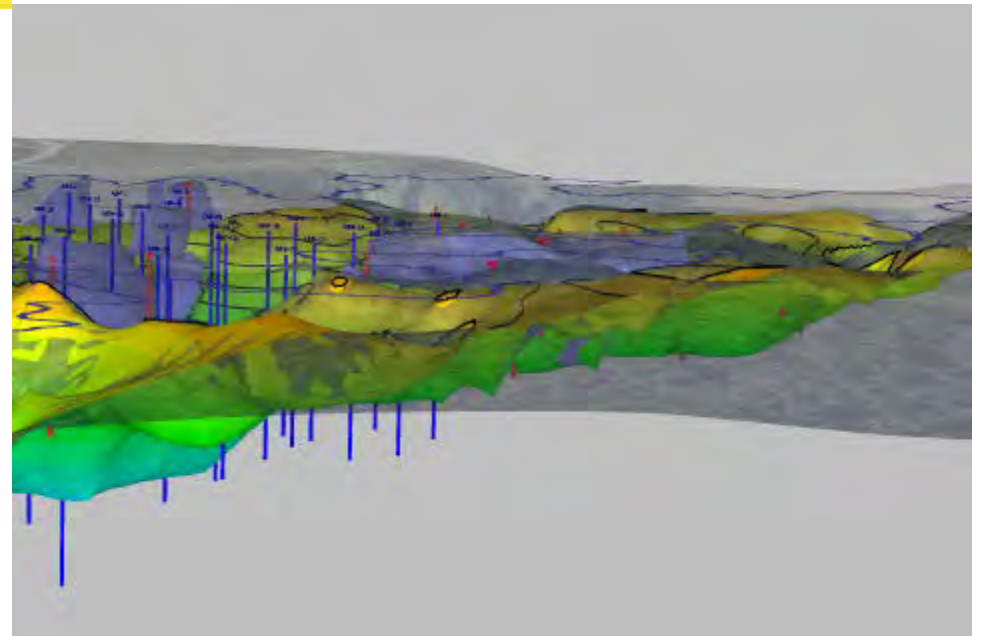
1. DEVELOP A 3D REPRESENTATION OF THE SURFACE IMPOUNDMENT
2. DEVELOP & EXECUTE A SAMPLING AND ANALYSIS PLAN
3. SAMPLE ALONG THE LENGTH OF EACH BORING AND ANALYZE FOR CONSTITUENTS OF IMPORTANCE
4. INPUT DATA FOR REGRESSION ANALYSIS
5. GENERATE MODEL RESULTS SHOWING THE QUANTITY & LOCATION OF IN-SPEC & OFF-SPEC CCP
6. DEVELOP CONCLUSIONS FROM THE DATA



Case Study: Midwest Power Plant Ash Pond

KEY CONSIDERATIONS

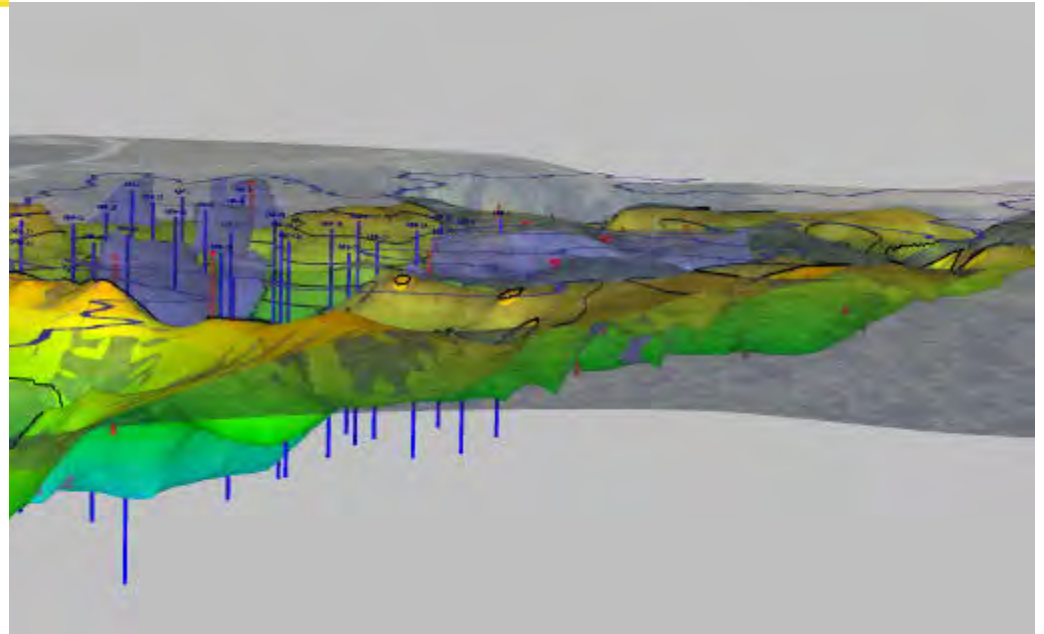
- » QUANTITY OF MATERIAL
Estimated @ 6MM tons
- » QUALITY OF MATERIAL
Not fully known
- » HISTORY OF MATERIAL
Burned coal from same seam 40+yrs
10+ yrs production ash beneficially used
- » LOGISTICS
Cement kiln down river
- » OPTIONS CONSIDERED
 - CIP: \$1X MM w/ LT Liability
 - CBR (landfill): \$2.4X MM w/ LT Liability
 - CBR (BU): \$TBD w/ encapsulation



Case Study: Midwest Power Plant Ash Pond

DETERMINING QUALITY

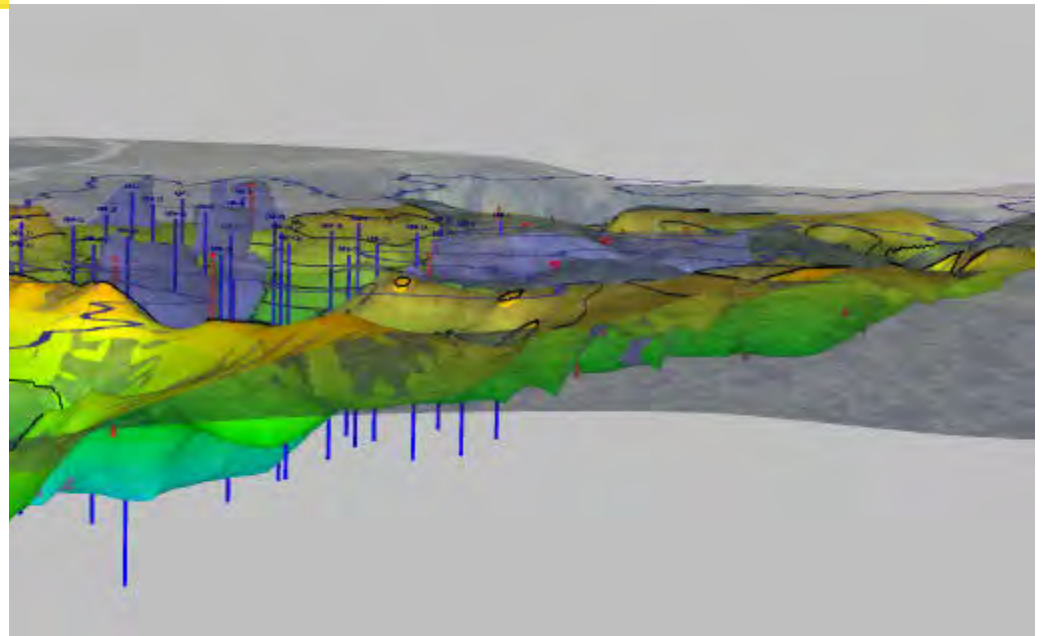
- » COMPLETED EVS
- » 50% OF THE CCP IS MARKETABLE AS IS
- » 25% OF CCP IS MARKETABLE THROUGH ADDITIONAL PROCESSING (BLENDING)
- » RAN FINANCIAL PRO-FORMAS FOR ALL OPTIONS CONSIDERED
- » WEIGHED THE RESULTS AGAINST THE COST OF LT MONITORING & THE POTENTIAL FOR FUTURE REMEDIATION / EXCAVATION



Case Study: Midwest Power Plant Ash Pond

FINDINGS

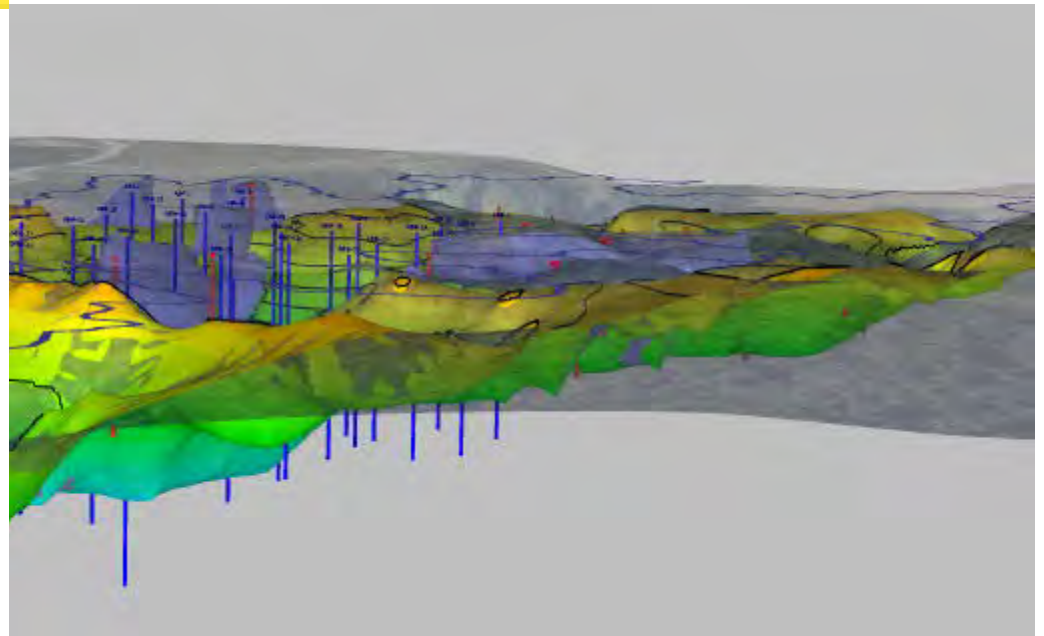
- » COST OF CBR W/ BENEFICIAL USE BETWEEN THAT OF CIP AND TRADITIONAL CBR
- » CLOSES THE GAP ENOUGH TO JUSTIFY THE ELIMINATION OF MONITORING & LT LIABILITY
- » ARRIVES AT AN APPROACH PLEASING TO THE SURROUNDING COMMUNITY
- » WITH EVS, PERMITS A PROACTIVE APPROACH TO EXCAVATION THAT COULD RESULT IN A GREATER % OF THE OVERALL CCP BEING MARKETABLE



Helpful Considerations

LESSONS LEARNED

- » ENGAGE STATE AND PERMIT AUTHORITIES EARLY
- » UNDERSTAND STATE CbR EXPECTATIONS
- » MANAGE SCHEDULE WITHIN REGULATIONS
- » UNDERSTAND BENEFICIAL USE OPTIONS
- » ENGAGE SPECIFIC END USERS EARLY
- » PERMITTED AND COMPLIANT ALTERNATIVE DISPOSAL



AECOM

Thank You

