

A vertical photograph of a waterfall cascading over rocks, positioned on the left side of the slide.

CH2MHILL

VE and Environmental Stewardship in the Private Sector: Selenium Reduction of a Coal Mining Operation in British Columbia to Benefit Fish Habitat

Presented to
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A photograph of a waterfall cascading over rocks, with water splashing and creating white foam. The scene is set in a natural, wooded environment.

VE Study for Coal Mining Company

Undisclosed Coal Co. (not CH2M HILL)

**A diversified resource company
committed to responsible
mining and mineral
development with major
business units focused on
copper, steelmaking coal, zinc
and energy**

Coal Mining Company: Committed to Environmental Stewardship, Mining Operations in British Columbia

Undisclosed Coal Co. (not CH2M HILL)

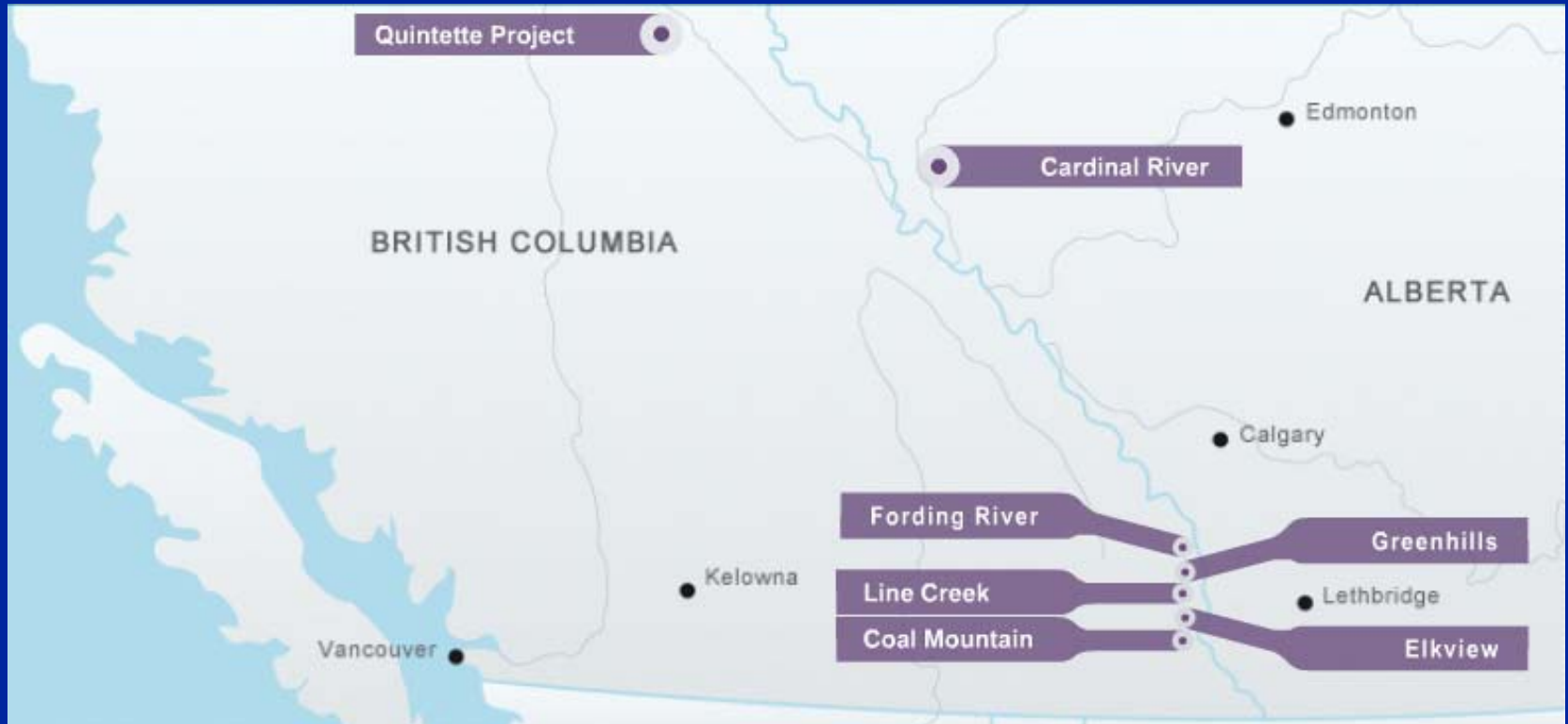


A photograph of a waterfall cascading over rocks, with water splashing and creating white foam. The background is dark and rocky.

VE Study Regarding Coal Company's Line Creek Operation

- **Line Creek operation located approx 25 km North of Sparwood in SE British Columbia**
- **Line Creek supplies steelmaking and thermal coal to a variety of international and domestic customers**
- **Line Creek consists of 8,183 hectares of coal lands of which approx 2,267 hectares have been mined or are scheduled for mining**
- **Current annual production capacities of the mine and preparation plant are approx 3.2 and 3.5 million tonnes of clean coal, respectively. At 2011 production rates Line Creek has an estimated remaining reserve life of approx 23 years.**

Line Creek Steelmaking Coal Mining Operation, SE British Columbia



A photograph of a waterfall cascading over rocks, with water splashing and creating white foam. The background is a lush green forest.

VE Study

- **VE Study of the West Line Creek (WLC) Selenium Active Water Treatment Facility (SAWTF) project located in Sparwood, British Columbia**
- **VE Study Conducted by CH2M HILL Canada for Coal Company, January 2012**
- **VE Study Conducted at Preliminary Engineering phase of design, on SAWTF Phases I and II**
- **Purpose of the VE Study was to Identify Potential Cost Saving Alternatives and Functional Enhancements to the Project**
- **VE Study was Voluntary by Coal Co. and CH2M HILL**

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Project Description

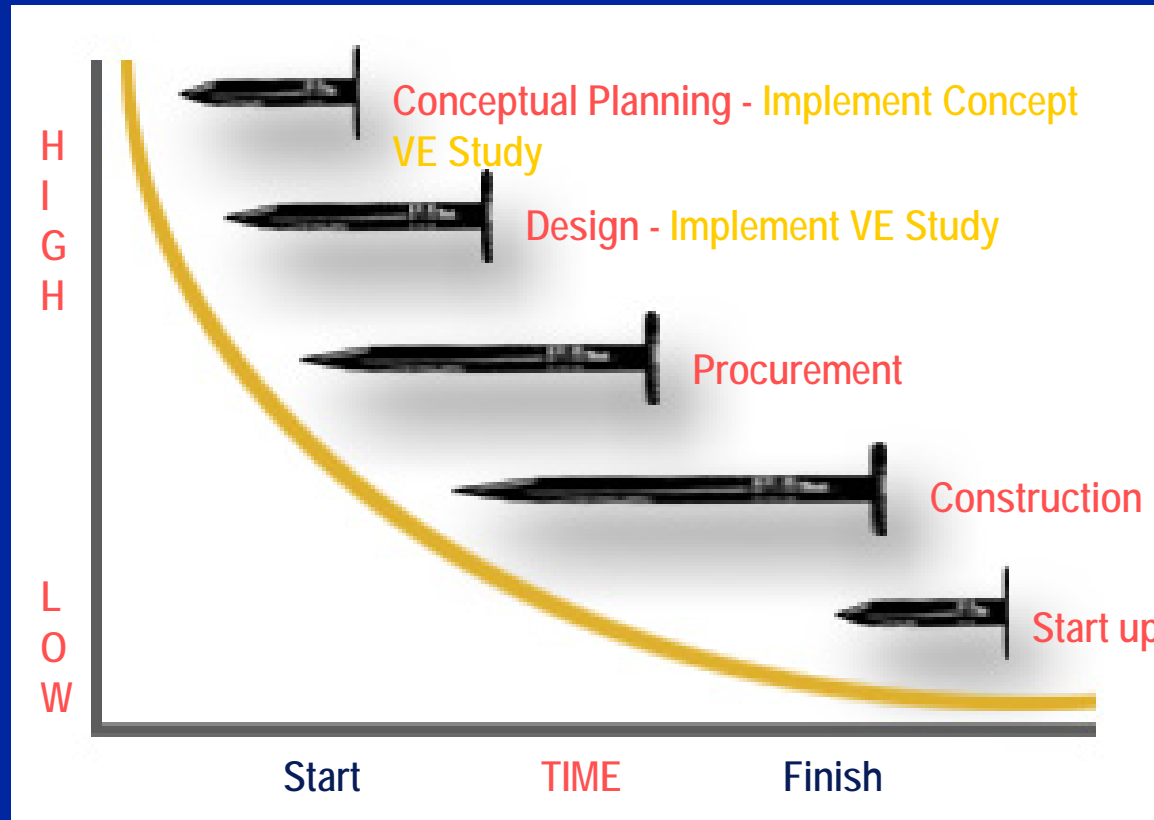
- **Ongoing Mining Operations from Line Creek Operations have Resulted in Undesirable Levels of Selenium in Nearby Elk Creek from Surface Mine Runoff**
- **High Selenium Concentrations are Believed to be Unhealthy for Fish Habitat**
- **Cooperative Effort with Coal Co., Ministry of Environment, Community, First Nations have Endorsed a Treatment Facility for Selenium Reduction**
- **First of Its Kind Facility; If Successful, Technology will be Replicated at Other Coal Mining Operations**

A photograph of a waterfall cascading over rocks, with water splashing and creating white foam. The background is a deep blue gradient.

Project Description - Continued

- **Proposed Selenium Active Water Treatment Facility (SAWTF) at Line Creek Operation**
 - Treatment of Surface Mine Runoff
 - EA Goal for Phase I Treatment Facility Design/Construction from 2011 through 2014, for Modest Selenium Reduction
 - Future Phase II will Double the Surface Runoff Treatment and Associated Selenium Reduction by 2018
 - A Third Phase at Another Creek Location will Remove an Additional Quantity of Selenium in this Area, by 2022
 - Project Estimate Concurrence for Phases I and II at Time of VE Study

When and Why to Use Value Engineering

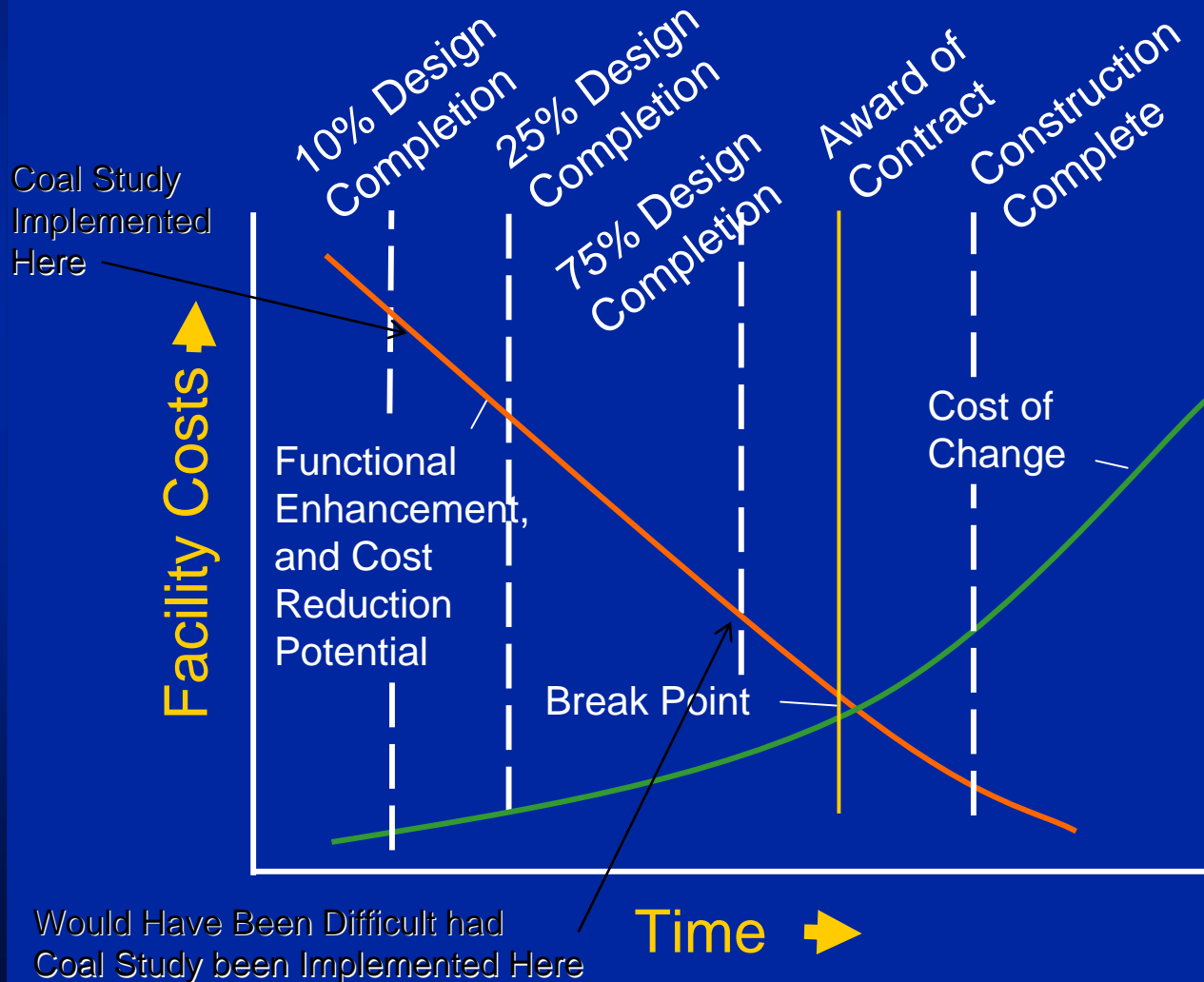


VE is a proven methodology that enhances function and reduces cost

VE early in design gains Project Team's acceptance of appropriate alternative

VE at Mid-Design reduces cost without impacting function

Opportunities for Improvement During Facility Life Cycle



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Value Engineering at Concept Design Phase

- **VE at Concept Design Differs from Traditional VE at Early to Mid Design**
- **VE at Concept Design focuses on Function**
- **$V = F/C$**
- **VE at Concept Design is Collaborative with Design and Owner and Objective VE Representatives**
- **Requires Owner's Belief in and Support of the VE Process, to Achieve Beneficial Results**

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Value Engineering Study Employed the Following Steps

- **Pre-Study Planning**
- **Information**
 - Coal Co. and Design Team's Overviews
 - Team Focus Q/A
 - Functional Analysis
 - Establishment of Alternative Evaluation Criteria
- **Creative (Brainstorming)**
- **Analysis and Ranking of Concepts**
 - Pass/Fail of Alternative Solutions
 - Screening of Alternative Concepts
- **Development and Refinement of Concepts**
- **Presentation**
- **Implementation**

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Value Engineering Team

- **Technical Professionals**

- Project Manager, Selenium Reduction Technology
- Third-Party Design Review, Selenium Reduction Technology
- (2) Process Engineers (Objective)
- Senior Consultant/Quality Manager
- Assistant Project Manager
- Design Manager
- Assistant Design Manager
- Construction Manager
- VE Team Leader

- **Coal Co.**

- Project Director for Selenium Reduction
- Project Manager

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Value Engineering Team

- **Design Representatives (Providing Part-Time Input during VE study)**
 - Lead Civil Engineer
 - Process Mechanical Engineer
 - Process Design Engineer
 - Mechanical Engineer
 - Architect
 - Structural Engineer
 - Electrical Engineer
 - Instrumentation & Control Engineer
 - Electrical Lead Engineer
 - Intake/Outfall Civil Engineer
 - Cost Estimator
- **Overall VE Team: 12 full time + 11 part time**

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Information Phase – Problem Statement

- **Recognition of Biologists' Concerns Regarding Negative Effects of High Levels of Selenium on Aquatic Life**
- **Quantity Reduction Goals for Selenium Removal in the Line Creek Operation (Elk Creek Drainage)**
- **Schedule Goals for Project Implementation for Phases I and II**
- **Cost Goals for Delivery of Phases I and II for Selenium Active Water Treatment Facility**

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Information Phase – Cost Model, Risks

- **High Cost Areas**

- Process Treatment Equipment
- Building and Cranes
- Structural
- Site Civil
- Generator Set and Electrical

- **Project Risks**

- Funding Cycle
- Permitting from Various Agencies
- Meeting Schedule Milestones
- Technical Risk of Implementing a New Treatment Process (piloted but not implemented on a large scale until now)

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Information Phase – Expected Outcomes

- **Optimal Value Solutions to Meet Water Treatment Requirements**
- **Verification of Process Stream in PE Design**
- **Validation of Major Current Design Assumptions**
- **Address Goal for Cost Reduction without Compromising Functional Integrity**
- **Separate High Priority Recommendations from Other Recommendations**
- **Ideas to Help Remain on Schedule**

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Information Phase – Functional Analysis

- **Higher Order Functions**
 - Improve Environment
 - Improve Water Quality
 - Sustain Business
- **Basic and Secondary Functions**
 - Remove Selenium
 - Measure Flow
 - (Many functions process by process for 20 major components)
- **FAST Diagram Developed (Proprietary)**
- **Compliments from Team on Communications**



Criteria for Evaluation of Plant Process for Selenium Reduction Proposals

Criterion	Priority
• Phase I Optimization	High
• Phase II Implementability	High
• Project Delivery	High
• Ease and Consistency of Future Operations	High
• Coal Co's Acceptance	High
• Regulatory Endorsement	High
• Schedule Compliance	High
• Initial Cost Saving Potential	High
• Future O&M Cost Saving Potential	Moderate
• Future Phase II Impact	Moderate

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Creative, Analysis, Development Phases

- **Brainstormed 94 ideas**
 - Process by Process
 - Area by Area
 - Project Delivery
- **Passed 22 Cost-Saving Ideas for Development**
- **Observations; Ideas Not-Proposed; Failed Ideas**
 - 36 Observations for Design Issue or General Topic
 - 21 Ideas Studied but Not Proposed
 - 15 Failed Ideas

A vertical strip on the left side of the slide shows a close-up of a waterfall cascading over dark, mossy rocks. The water is white and frothy as it falls.

Proposal Development Process

- 1. Prepare a proposal title**
- 2. Identify advantages and disadvantages**
- 3. Prepare narratives discussing the idea compared to the base design**
- 4. Prepare supporting sketches (if applicable)**
- 5. Calculate potential initial cost savings, including life cycle cost calculations as appropriate**
- 6. Conclude whether the idea should be advanced by the VE team based on calculations**

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Cost Saving Proposals

- **Facility (Building) Layout**
- **Process Layout**
- **Civil/Site Layout**
- **Equipment Type**
- **Accepted Savings: \$18 million**

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Observations

- **Process Equipment**
- **Construction Methods**
- **Design Standards**
- **Deferral of Some Standby Equipment to Phase II**

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Sampling of Accepted Proposals from VE Study

- **Replace Pile and Precast Slab/Beam Foundation Option with Mat Slab Option**
- **Adjustment to Phasing of the Process Reactors**
- **Point Access to Tops of Tanks vs. Continuous Platforms and Walkways**
- **Adjustment to Water Heating Infrastructure for Economy**
- **Use Onsite Material for Fill vs. Imported Fill**
- **Alternative Electrical Feed to Facility from Overhead Line vs. Greater Extent of Ductbank**
- **Revision to Fuel Type for Emergency Generators**
- **Revision to Sump Pump Design for Economy**
- **Revisions to Certain Pump Types for Economy**

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Immediate Design Tasks Following VE Study

- Completed Preliminary Engineering (PE) Layouts of Phase I and Phase II Processes for the SAWTF
- Validated the Scope of Accepted VE Proposals of Approx. \$18 million into the Revised Design at PE Phase
- Prepared a New Detailed “Class 4” Cost Estimate
- Validated that Phase I and Future Phase II Costs Meet Coal Co’s Requirements for Project Funding
- Design Team Given “Green Light” for Final Design of Phase I to Remain on Schedule

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VE Study Results

- **Initial Cost Savings of Approx. \$18+ M, with ROI of At Least 150-to-1, for Coal Co's Phase I SAWTF**
- **Significant Future Reduction to O&M Costs, Resulting in Higher Life Cycle Cost Savings**
- **VE Results Satisfy the Functional Requirement of Selenium Removal from the Environment, within Coal Co's Budget**
- **Demonstrated Success in Phase I SAWTF will Result in Additional Plants at Other Coal Mining Operations**

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Value Engineering Balances Cost, Reliability, and Performance Issues

VE is a proven management technique that uses a systematic approach to identify the best functional balance between the cost, reliability and performance of a product or project to meet the owner's objectives

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Summary

- **With Proper Endorsement/Implementation of Value Engineering, the VE Methodology Results in Consensus Among the Owner and Design Team**
- **VE is a Methodical and Documented Effort Demonstrating Due Diligence and Results to Withstand Public Scrutiny and Board Oversight**
- **VE Sets Stage for Further Design, Freer of Challenges**
- **VE Demonstrates Value in the Private Sector Too !!**
- **VE Results Satisfy the Functional Requirement of Selenium Removal from the Environment, thus Benefiting Aquatic Life in the Elk Creek Drainage Area of British Columbia**
- **Q/A**