Environmental Footprint Reduction through Remedy Optimization

Federal Remediation Technologies Roundtable (FRTR) Meeting

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Purpose

- Examine the role of optimization and environmental footprint reduction by analyzing the following:
  - Historic optimization recommendations
  - Recent optimization recommendations
  - Recent Green & Sustainable Remediation (GSR) recommendations

- *Notes:*
  - *This presentation focuses on optimization recommendations for cost reduction and site closure*
  - *Optimization provides other benefits (e.g., improvements in protectiveness) that are not discussed here*

Outline

- Definitions
  - Environmental Footprint Reduction
  - Optimization
- Case Studies
  - Historic Optimization Recommendations
  - Recent Optimization Recommendations
  - GSR Evaluation Recommendations
- Conclusions

DEFINITIONS

Environmental Footprint Reduction

- The environmental footprint of a remedy can be described by a series of environmental metrics. Consider the following metrics used by the Army:
  - Energy Use & Percent of Energy from Renewable Resources
  - Emission of Greenhouse Gases,
  - Emission of Criteria Air Pollutants
  - Hazardous or Toxic Air Pollutants
  - Potable Water and Other Water Use
  - Refined/Unrefined Materials Use
  - Percentage of Materials from Recycled or Reused Sources
  - Non-Hazardous/Hazardous Waste Generation & Percentage
  - Potential waste that is recycled or reused
  - Land Transferred for Beneficial Use
  - Existing Ecosystem Destruction
  - Time Frame for Land Reuse
  - Flexibility and Breadth of Options for Site Reuse

Environmental footprint reduction is <u>improvement</u> in these metrics

Definition of Optimization

EPA Working Definition Spring 2011

Systematic site review by a team of independent technical experts, at any phase of a cleanup process, to identify opportunities to improve remedy protectiveness, effectiveness and cost efficiency, and to facilitate progress toward site completion.

Environmental Footprint Reduction Using Best Management Practices (BMPs)

- Various parties are developing lists of "green" BMPs. The Army has over 50 BMPs in eight categories specifically targeted to environmental footprint reduction.

BMP Category	Example
Planning	Use teleconferences instead of meetings
Characterization and/or Remedy Approach	Establish trigger points to change technologies
Energy/Emissions - Transportation	Reduce the number of trips for personnel
Energy/Emissions - Equipment Use	Use alternative fuel options when possible
Materials & Off-Site Services	Use materials from recycled/reused material
Water Resource Use	Use treated water for beneficial purposes
Waste Generation, Disposal, & Recycling	Consider on-site treatment over off-site disposal
Land Use, Ecosystems, & Cultural Res.	Minimize disturbances to land

The Army has sustainability BMPs in other categories

Environmental Footprint Reduction from Optimization

- Traditional optimization targets protectiveness, cost-reduction, technical improvement, and site closure

- Environmental footprints are often tied to non-labor costs, and reductions in cost often lead to reductions in the environmental footprint
  - Materials use and transportation
  - Electricity use
  - Waste generation and disposal
  - Laboratory analysis

- Optimization benefits from independent remedial expertise. Typical questions often include…
  - Do we have the right conceptual site model (CSM)?
  - Is our sampling focused on evaluating remedy performance?
  - Are our design criteria appropriate for current conditions?
  - Is the remedy appropriate given the CSM?
  - What else can provide the same function?

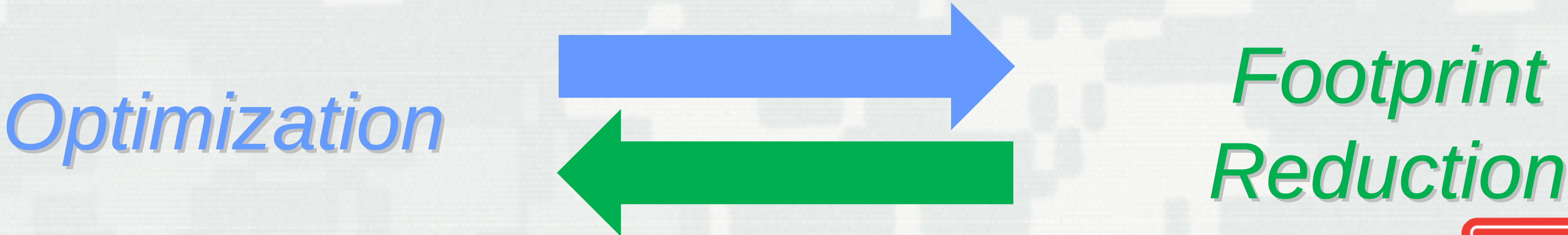
- Environmental footprints may also be reduced by accelerated site closure

Take Home Point

- There is a lot of overlap and synergy between environmental footprint reduction and optimization

- ***Optimization*** results in ***footprint reduction***… you might as well quantify and document the significant benefits

- ***Footprint reduction*** can lead to ***optimization,*** but remedial expertise is needed



Questions to Consider

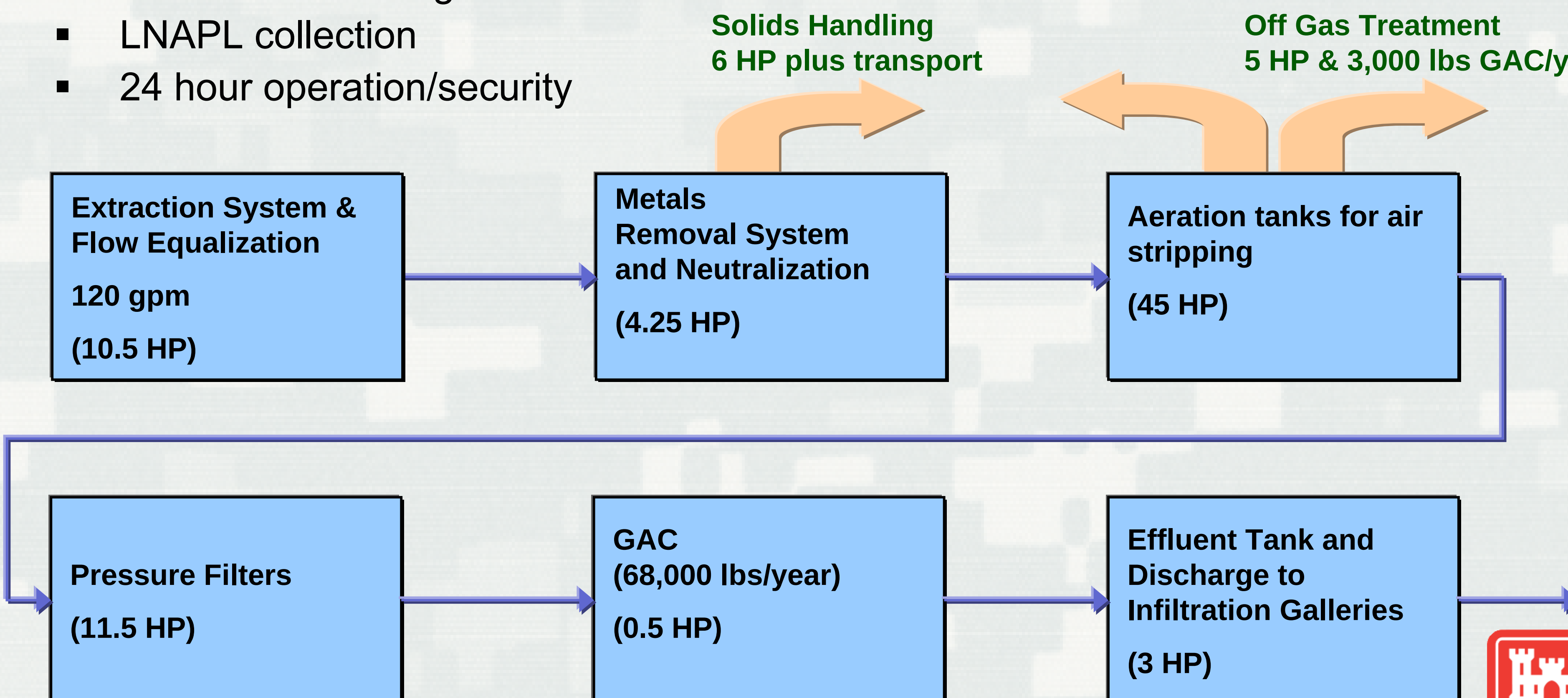
- Case studies will be discussed in the next few slides. Consider the following questions:
  - Do optimization and BMPs give the same footprint reduction results?
  - What areas of expertise are required for providing meaningful footprint reduction suggestions?
  - What is the importance of an independent perspective in considering opportunities for footprint reduction?
  - What is the “optimal” approach to identifying opportunities for footprint reduction?

CASE STUDIES:

Historic Optimization #1 (2001)

- Extraction rate: 120 gpm
- Primary COCs: arsenic, PAHs, and various VOCs
- Process monitoring
- LNAPL collection
- 24 hour operation/security

Existing Treatment Process



Average motor horsepower indicated in parentheses

Historic Optimization #1 Recommendations

Actual Recommendations and Effects on Cost and Energy Footprint

Example Recommendation	Estimated Annual Cost Savings	Affect on Energy Footprint
Reduce number of process samples	$600,000	1,800 MMBtu***
Reduce security	$144,000	70 MMBtu
Automate system, reduce operator labor	$1,260,000	200 MMBtu
Do not solidify LNAPL for disposal	$30,000	<10 MMBtu
Dispose of solids as non-haz. waste	$7,200	80 MMBtu
Replace aeration tanks with efficient air stripper	$30,000	650 MMBtu
Change filter media/improve solids removal	$50,000	620 MMBtu

**** Footprint conversion factor used to calculate energy use is an estimate*

Historic Optimization #2 (2001)

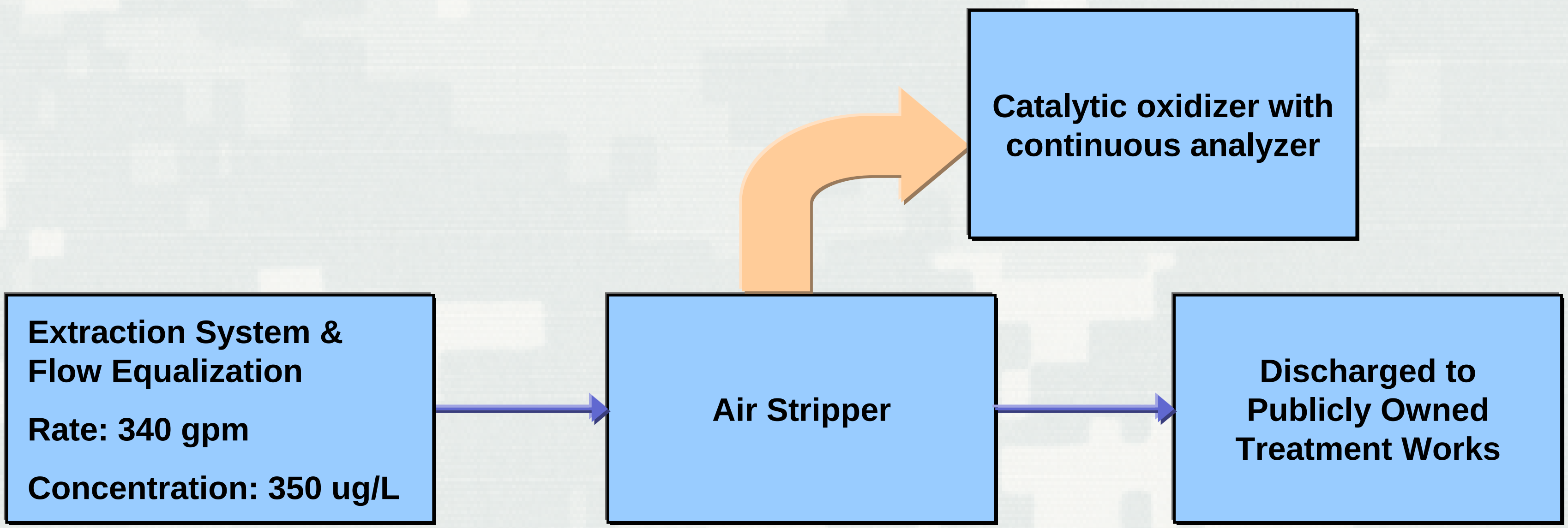
- Former dry cleaner site
  - P&T system to contain/remediate groundwater
  - SVE system with 50 HP blower with to address soils
  - SVE condensate treated with GAC and discharged to sewer
  - Localized area of high concentrations under building

Historic Optimization #2 Recommendations

- Example recommendations resulting in footprint reduction
  - Combine operation of OU1 and OU2
  - Replace SVE blower with a smaller, more efficient unit
  - Measure SVE well parameters to optimize SVE performance (i.e., pulse operation or operate wells on a rotating basis)
  - Treat SVE condensate with air stripper rather than GAC
  - Investigate use of air sparging
  - Develop an exit strategy for P&T system

Recent Optimization #1 (2010)

- Water treatment plant that treats VOCs



Recent Optimization #1 Recommendations

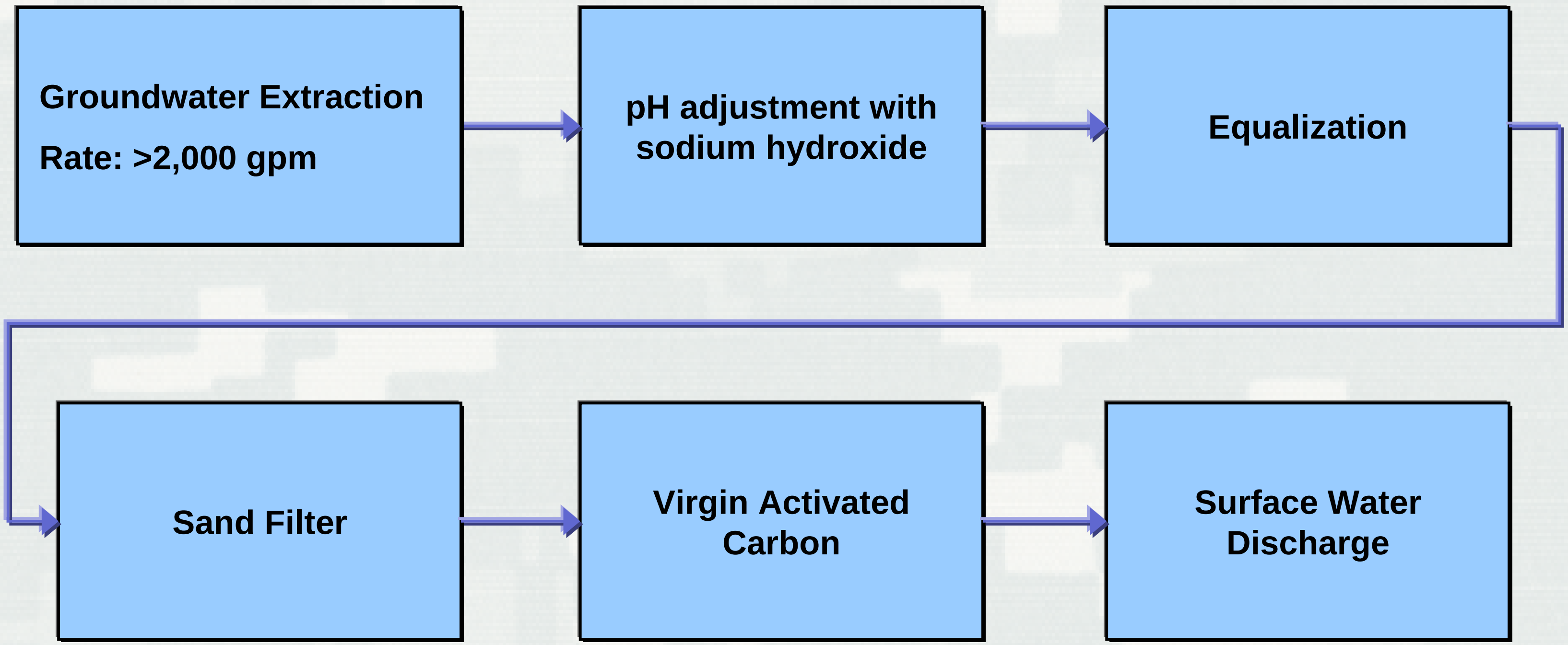
- Example recommendations resulting in footprint reduction
  - Discontinue use of the continuous analyzer
  - Discontinue off-gas treatment with the catalytic oxidizer
  - Reduce frequency of VOC monitoring of influent and extraction wells
  - Revisit POTW discharge standards and evaluate potential to eliminate need for pre-treatment with air stripping
  - Evaluate potential for discharging extracted water directly to the central treatment plant

Recent Optimization #1 – Recommendation Detail

Recommendation	
Eliminate catalytic oxidizer for treatment of air-stripper off-gas	
Basis for Recommendation	
• Non-treated air is within installation air permit levels • Would eliminate a 25 HP blower and the use of approximately 900 mcf/month of natural gas	
Resources Conserved	
• Total energy use declines by ~12,544 MMBtu per year (32%) • GHG emissions decline by ~1,048 metric tons of CO2e per year (31%) • Criteria air pollutant emissions decline by ~13 metric tons per year (48%)	
Qualitative Cost Impact Over 5 Years	**Level of Up-Front Investment**
Saves ~$400,000 over 5 years	Negligible

Recent Optimization #2 (2010)

- Water treatment plant for explosives in extracted groundwater



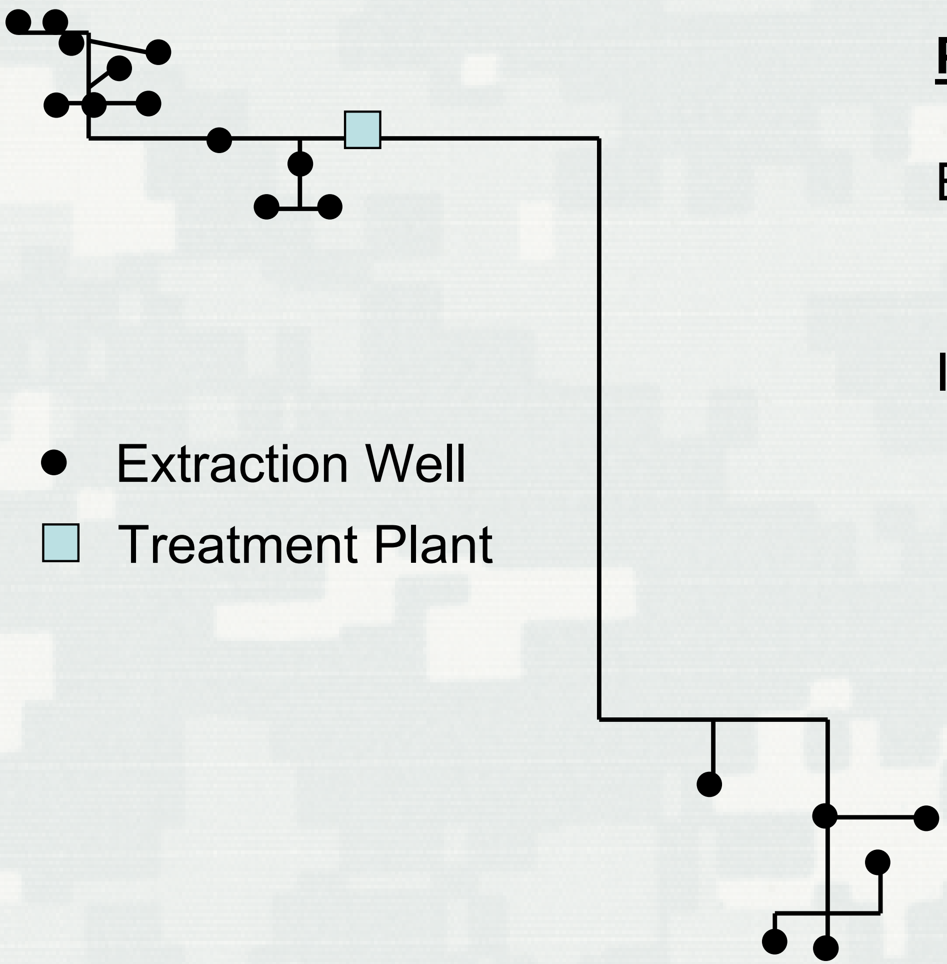
Recent Optimization #2 Recommendations

- Modify metals and cyanide monitoring at treatment plant influent
- Argue to discontinue pH adjustment because low pH is natural for the region
- Use treated water for beneficial purposes (e.g., irrigation)
- Adjust pH with crushed limestone instead of sodium hydroxide
- Use custom reactivated carbon on a trial basis
- Use treated effluent instead of potable water to wet new activated carbon
- Use variable frequency drive (VFD) for effluent pump
- Considerations for climate control and lighting
- Considerations for renewable energy

Recent Optimization #2 – Recommendation Detail

Recommendation	
Use limestone for pH control	
Basis for Recommendation	
• Sodium hydroxide is added to adjust pH prior to discharge • Crushed limestone could provide adequate pH adjustment at a lower cost	
Resources Conserved	
• Total energy use declines by ~4,800 MMBtu per year (22%) • GHG emissions decline by ~250 metric tons of CO2e per year (17%) • Use unrefined materials in place of refined materials	
Qualitative Cost Impact Over 5 Years	**Level of Up-Front Investment**
Saves ~$100,000 per year	<$10,000

GSR Evaluation #1



P&T System

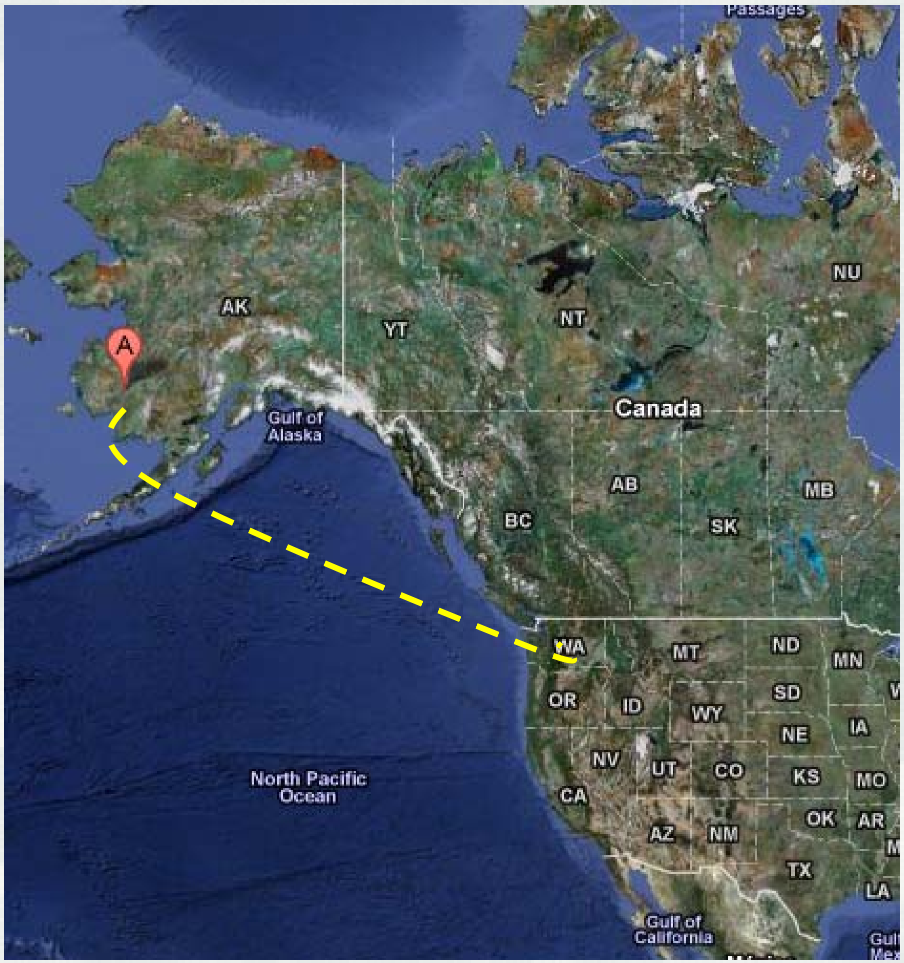
Extraction Rate:
3,000 gpm

Influent TCE:
25 ug/L

GSR Evaluation #1 – Example Recommendation

GSR BMP	
??? Use appropriate remedy approach based on site conditions ???	
Recommendation	
Use two separate P&T systems rather than one centrally located treatment plant, plus include VFDs for extraction pumps	
Basis for Recommendation	
Eliminates ~20,000 ft of piping and associated materials and equipment. Lowers electrical use due to reduced pumping head plus use of VFDs. Provides greater treatment flexibility. Requires an extra building and some duplicate equipment.	
Resources Conserved	
Reduces footprints over remedy lifetime (30 years) such as:	
• Energy – 120,000 MMBtu • CO_2e – 10,000 metric tons	• NOx – 20 metric tons • SOx – 30 metric tons
Estimated Costs/Savings	
Up-Front Savings ~$609,500	Payback Period: Immediate
Annual Savings ~$27,000/yr	Lifecycle Savings ~$1,100,000 NPV

GSR Evaluation #2



Soil excavation with off-site disposal

•Contaminant of concern is diesel fuel

•Approximately 120 cubic yards of excavated soil

•Off-site disposal to Oregon via barge, truck, and rail

•Site only accessible by boat and aircraft

GSR Evaluation #2 – Example Recommendation

GSR BMP
Consider on-site treatment and re-use of soil instead of off-site disposal
Recommendation
Assess the feasibility of on-site biological treatment in place of excavation and off-site disposal for soil remedy
Basis for Recommendation
Substantially reduces environmental footprint and cost. Particularly applicable for remote sites (such as the specific pilot project) which require lengthy trips to off-site disposal.
Resources Conserved
Reduces footprints by the following amounts: • Energy – 16,000 MMBtu • CO_2e – 1,300 metric tons • Criteria Pollutants – 143 metric tons (~99%) • Waste disposal in landfill – 173 tons (100%)
Estimated Costs/Savings
Estimated savings for Remedial Action is ~$230K

CONCLUSIONS

Conclusions

- Many historic optimization recommendations could lead to footprint reductions equal to or greater than footprint reductions from recent GSR recommendations
- Recent optimization recommendations benefit from increased attention to footprint reduction and a quantitative footprint of the remedy
- GSR recommendations benefit from footprint quantification
- Many GSR recommendations require remedial expertise beyond knowledge of BMPs.
  - Some of expertise can from the site team
  - Added benefit from an independent remedial expert

Conclusions

- Potential footprint reduction approach

Site team footprints remedy to identify large contributors

- Most familiar with remedy information
- Gain perspective by analyzing remedy in this manner

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Site team considers list of footprint reduction BMPs

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Independent evaluation by team with remedial expertise

- Full benefit of optimization
- Optimization team can use existing remedy footprint information to facilitate analysis of additional opportunities for footprint reduction

Questions?
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