



Mr. Richard McCoy, P.E., Air National Guard and  
Mr. Jim Colmer, P.E., BB&E  
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# **REMEDIAL PROCESS OPTIMIZATION: A SUSTAINABLE REMEDIATION APPROACH**

# Overview

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- Air National Guard's (ANG) Green and Sustainable Remediation (GSR) Policy (December 2009)
- ANG's implementation of GSR
  - GSR Case Studies and Tools

# ANG Policy



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- Evaluate GSR in all phases of remediation
  - Include GSR discussion in all deliverables
- Implement GSR opportunities that prove to be cost effective and socially responsible
  - Return on Investment (ROI) shows payback within expected duration of remediation
  - Community acceptance
- Conduct GSR evaluations on sites under Remedial Action Operations (RAO) as part of Remedial Process Optimization (RPO) activities

# What is RPO?



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- RPO is a tool by which the Air Force evaluates the status of remediation processes at sites across the United States
- Primary Goals:
  - Ensure protection of human health and environment
  - Control Risk
  - Improve cleanup efficiency (cost and time)
    - Adaptive management approach
    - **GSR evaluation & implementation**

# GSR Evaluation



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- Identifies opportunities to improve GSR parameters of existing remedies
  - Energy efficiency
  - Decrease air emissions (including CO<sub>2</sub>)
  - Minimize material use and wastes generated
  - Minimize water use and maximize water reuse
  - Minimize soil and habitat disturbance
  - Improve long-term stewardship
- Ensure protection of human health and the environment

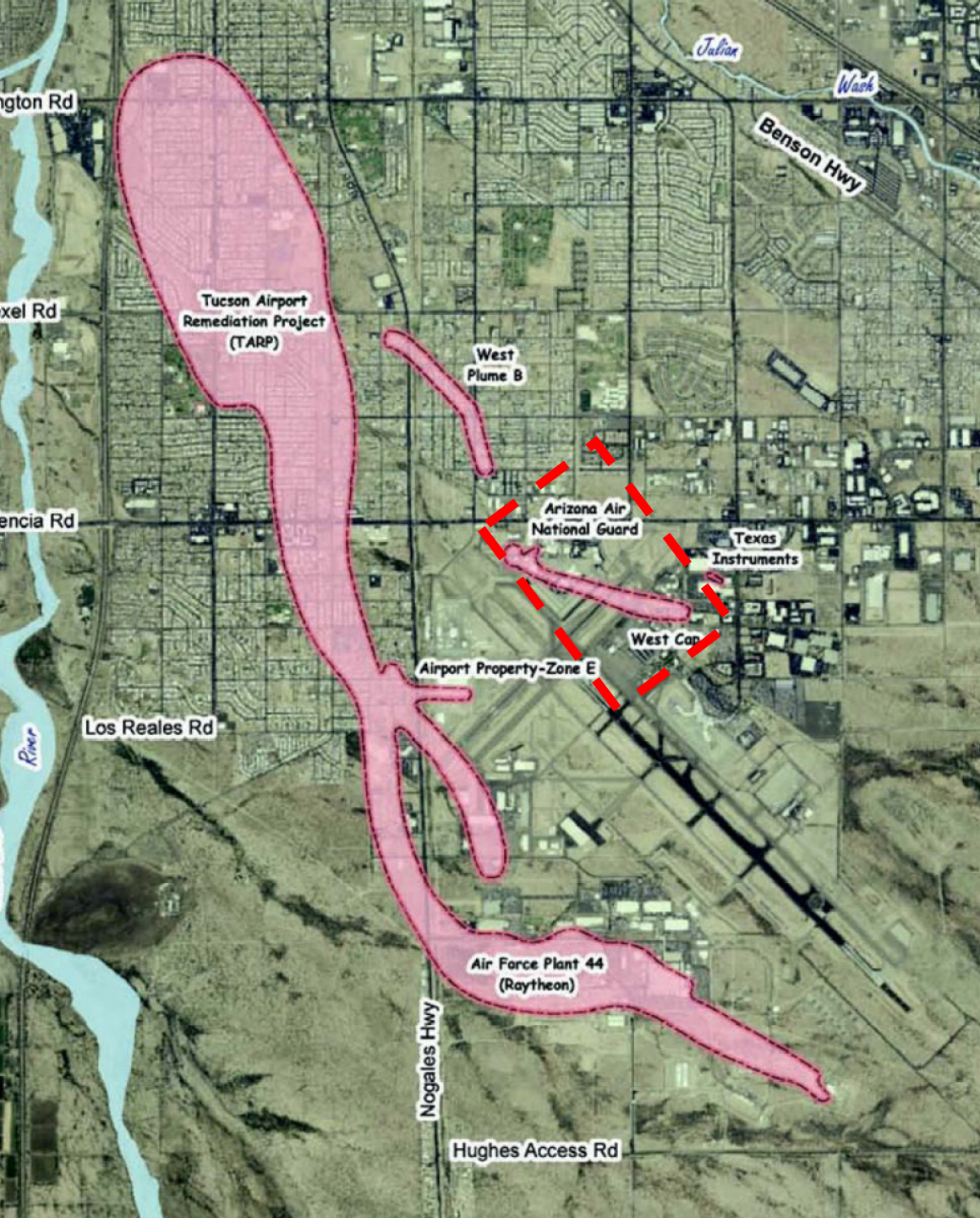
# Case Study

## Tucson, ANGB

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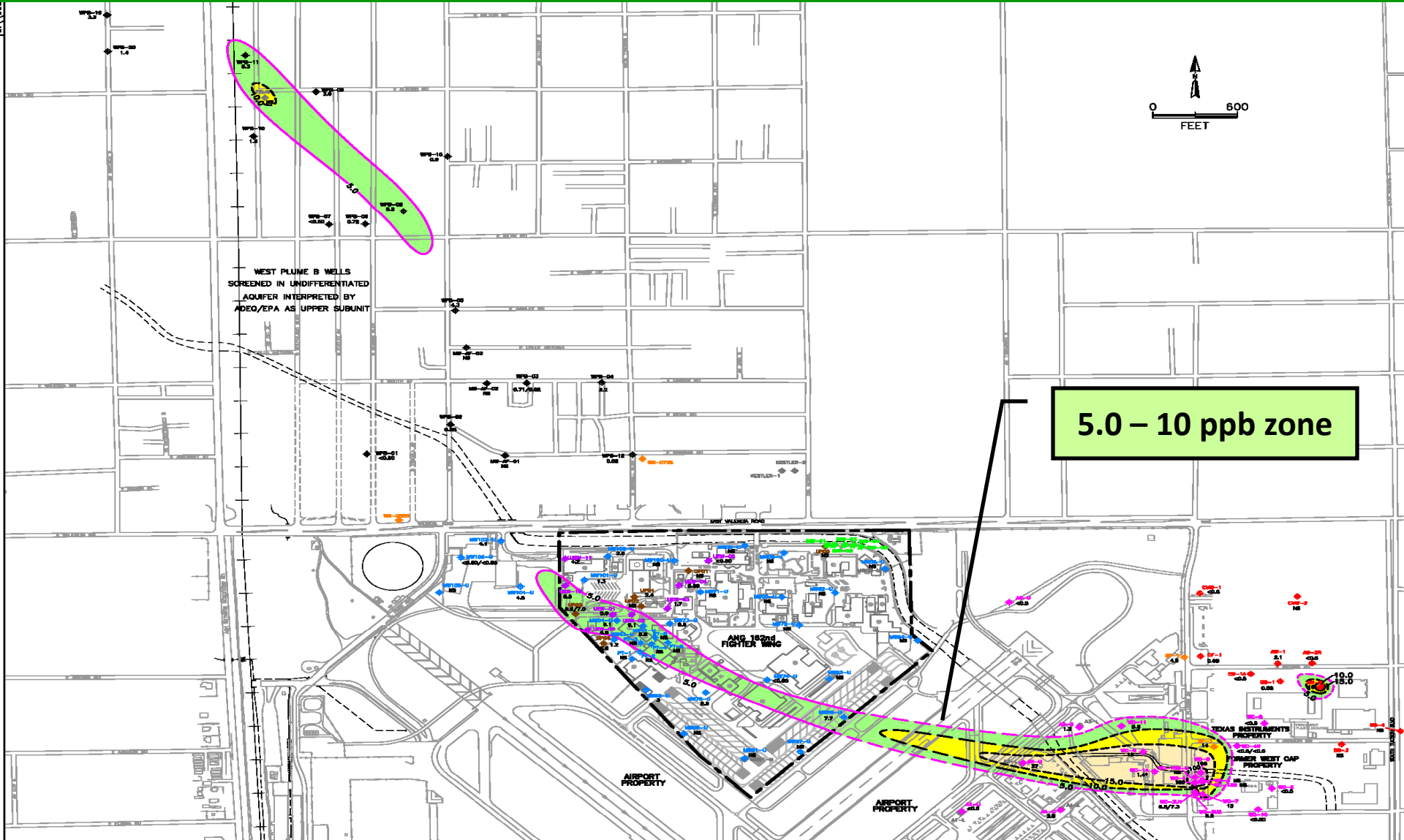
- Arizona Air National Guard, 162<sup>nd</sup> Fighter Wing, Tucson, Arizona
  - Portion of the Tucson International Airport Area Superfund Site
  - Primary chemical of concern - TCE
  - Record of Decision (ROD)
    - Remedy Groundwater Extraction, Treatment, and Recharge System (GWETRS)
    - Groundwater capture and control
- Community Setting
  - Engaged Community
  - Tucson water treatment infrastructure





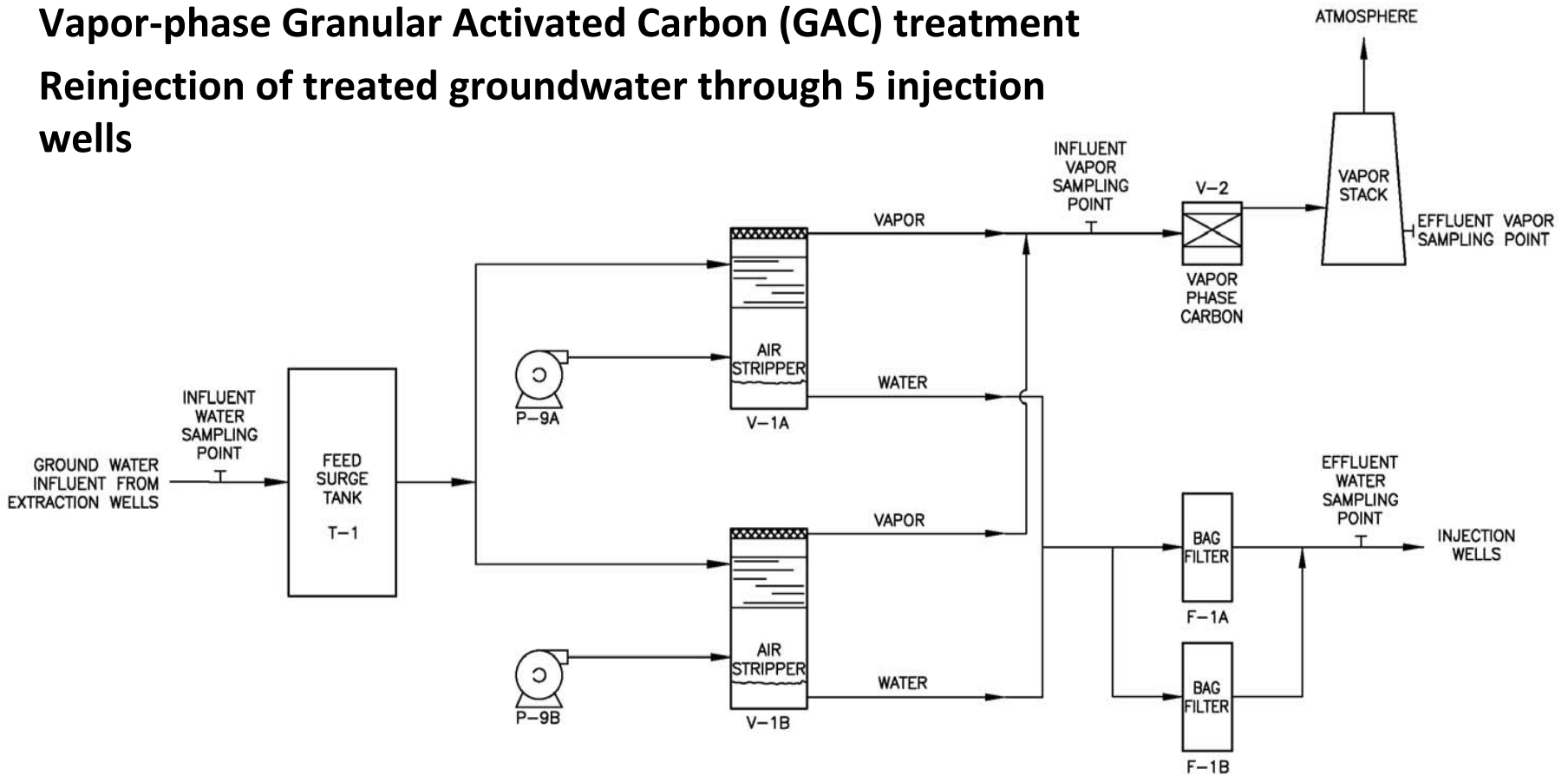
# Tucson International Airport Authority Superfund Site

# Plume B Area




# Tucson System Details

- 15 Groundwater extraction pumps
- Pretreatment with sequestering agent
- Two air strippers
- Vapor-phase Granular Activated Carbon (GAC) treatment
- Reinjection of treated groundwater through 5 injection wells



# Tucson System Metrics



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- 1997 – 2008
  - Captured 658M gallons and removed ~ 35 lb TCE (3 gallons)
- 2008
  - Influent < 5  $\mu\text{g/L}$  (MCL) 10 months of the year
  - Average monthly energy consumption 22K (kilowatt-hours) kWh or 265K kWh per year (2.34% base annual consumption)
  - 249 metric tons  $\text{CO}_2$  equivalents emitted based on energy use
  - 14 metric tons  $\text{CO}_2$  based on transportation

# Tucson Key Findings

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- Significant energy usage from non-contributing equipment
- Large CO<sub>2</sub> mass emitted/mass contaminant removed
- Significant material use & waste from long-term monitoring (LTM) routines
  - Nearly 9 miles of polyethylene tubing
- Significant groundwater mounding caused by reinjection
- More cost effective opportunity to use solar power if energy demand reduced



# Tucson Substantive Recommendations



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- Based on continuation of GWETRS operations
  - Energy (reductions of over 50%)
    - Discontinue use of non-contributing equipment
    - Replace air strippers with liquid-phase GAC
    - Remove vapor-phase treatment due to low concentrations
  - Material use & waste minimization
    - Initiate passive diffusion bag (PDB) validation study

# Tucson ANG Today



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- Presented GSR evaluation findings to USEPA in August 2009
- January 2010 - USEPA presented the potential for discontinuation of the ANG treatment system in favor of In-Situ Chemical Oxidation (ISCO) and Monitored Natural Attenuation (MNA) at the Unified Community Advisory Board (UCAB)
- April 2010 - Meetings with USEPA to discuss MNA ROD Amendment

# Case Study

## Burlington, ANGB

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- Vermont Air National Guard, 158<sup>th</sup> Fighter Wing, Burlington, Vermont
  - Five active sites with cleanup underway
  - Primary chemicals of concern
    - Chlorinated solvents
    - Petroleum constituents
    - Free product (JP-4, JP-8)
  - AFCEE Sustainable Remediation Tool
    - Site 2



# Burlington System Details

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- Two operating Multi-Phase Extraction (MPE) Systems with product recovery and catalytic oxidation (CATOX) vapor treatment
- Bioventing System
- Pump and Treat (discharge to the City of Burlington Treatment Works)
- Soil Vapor Extraction (SVE)



# Burlington System Metrics

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- Contaminants removed
  - Pounds of CO<sub>2</sub> equivalents emitted per pound of contaminant removed (energy use only)
    - Site 1 P&T ~ 4,400
    - Site 2 SVE ~ 276
    - Site 3 MPE ~ 256
    - Site 4 Bioventing ~ 63
    - Site 5B MPE ~ 400
  - Electricity consumption
    - 946 mega-watt hours annually (20% of entire installation energy usage)
  - Free product removal
    - 38,200 pounds over system lifetimes
  - Tailpipe emissions
    - Approximately 40 metric tons per year (all sites)



# Burlington Key Findings

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- Significant tailpipe emissions and material use from monitoring activities (sampling containers)
- Significant tailpipe emissions from use of remote vendors/suppliers (laboratories, disposal facilities)
- Considerable energy expended in operating systems
- Installation has robust Energy Management Program, but limited monitoring of remediation systems

# Burlington Substantive Recommendations

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- Use of PDBs for groundwater monitoring
  - Reduction in material usage
- Use of local/regional vendors and suppliers
  - To the extent practicable to reduce tailpipe emissions
- Installation of energy management devices
  - Improve energy tracking and isolation of energy draw
- Replace CATOX units (70 kW demand) with vapor-phase GAC
  - Significant energy reduction



# SRT – Burlington

## Site 2

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- Comparison between AFCEE SRT output and ANG GSR evaluation result

AFCEE SRT Site 2 Output	ANG GSRE Site 2 Output
150 Tons CO <sub>2</sub> e emitted	147 Tons CO <sub>2</sub> e emitted
260 lbs CO <sub>2</sub> e emitted/lb contaminant removed	276 lbs CO <sub>2</sub> e emitted/lb contaminant removed

- SRT Benefits (ANG Trial)
  - Simple to use – widely accepted platform
  - Offers flexibility of using average or site-specific data
  - Screening or detailed analysis of sustainability parameters
  - Engineering and cost references are reliable
  - ANG GSRE results quickly reproduced

# Questions & Contact Information

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Mr. McCoy, ANG/A7OR, (301) 836-8541,  
mccoy@ang.af.mil



Mr. Jim Colmer, P.E.; (248) 489-9636,

jcolmer@bbande.com