Optimization Part 2: Remedial Alternatives Analysis (RAA)

Kim Markillie
NAVFAC Pacific

Joe Rail
NAVFAC Washington

Grady May
NAVFAC Northwest

Mike Singletary
NAVFAC Southeast

Melinda Trizinsky
NAVFAC Southwest

Tom Spriggs
NAVFAC Atlantic

JAX 4/26 Mike Singletary NAVFAC SE
DC 5/2 Joe Rail NAVFAC Washington
Norfolk 5/9 Tom Spriggs NAVFAC LANT
San Diego 5/16 Melinda Trizinsky NAVFAC SW
Silverdale 5/24 Grady May NAVFAC NW
Pearl Harbor 5/31 Kim Markillie NAVFAC PAC

Presentation Overview

- ► Purpose and Applicability
- Roles and Responsibilities
- Preparation
- Submittal and Review
- RAA Template
- RAA Examples
- Summary

Purpose

- RAA review is an early and expedited optimization review of the remediation alternatives analyzed in remedy evaluation documents
- Ensure appropriate remedial alternatives are considered during remedy selection
- Reduce time and cost associated with remedy selection and site closeout
- May reveal important data gaps in Conceptual Site Model (CSM) or important issues to be considered during remedy selection
- Collaborative exchange among contractors, RPMs, and technical staff to ensure most promising remedial alternatives considered

Applicability

- Per DON Policy (2012), RAAs required for FS, EE/CA, CMS, or CAP remedy evaluation documents
- RAA requirement is included in the new OPT Policy
- Apply to all ER,N and BRAC funded sites
- *de minimis* projects exempt from RAA requirement
  - Examples: Remedy evaluation documents that involve only land use controls (LUCs) or long term monitoring (LTM)
  - RPMs need to contact their Echelon III POC to confirm whether RAA requirement can be waived

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Roles and Responsibilities

Role	Responsibility
RPM	• Accountable for installation's ER,N Program • Responsible for including contractual language for RAAs in SOW and contract • Schedule and coordinate RAA preparation, technical review, and submittal • Ultimately responsible for any changes to remedy evaluation resulting from RAA • Document remedial alternative changes based on RAA review in NORM Optimization Module
CLEAN/Other Navy Contractors	• In coordination with RPM, prepare and submit RAA as non-regulatory, interim deliverable • Prepare response to comments if directed by the RPM • Works with technical reviewer and RPM to determine if changes required in remedy evaluation document

Roles and Responsibilities (cont.)

Role	Responsibility
LANT/PAC Technical Support POCs	• Responsible for overall coordination of NAVFAC RAA efforts • Assign technical leads and review team members • Upload RAA review requests in NIRIS Technical Support Tracking System (TS2)
LANT/PAC Technical Leads/Review Teams	• Timely review of RAAs • Send comments to contractor's RAA POC and the RPM • Participate in comment resolution meetings as necessary • Upload technical comments into TS2 as "key findings"

Contracting Issues

- RAA document expected early in remedy evaluation process and historically cost between $1,000-3,000
- RAA is considered an ***internal*** Navy document for contract management purposes
- RPMs to incorporate costs related to preparation of RAAs into NORM (as part of FS, EE/CA, CMS, or CAP)
- Sample language for SOW and basic contract available in guidance document

1. Bullet #1: Historic values received from our two major CLEAN contractors, should put to bed the concept that these are outrageously expensive – only if the RPM hasn't finished the prep work does it rise to $7k. See attached emails.
2. Bullet #2: Not meant to be another regulatory review step (30 day Navy review, 30-60 day Regulatory review, Response to comments, etc)
3. Bullet #3: Also, RPMs will note RAA effort(s) in the Optimization Module w/in NORM.

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RAA Preparation

- Contractor/RPM should submit RAA at early developmental stage in the remedy evaluation process
- RAA preparation should take approximately 24 to 40 hours
- Level of detail depends on project complexity, but RAA is expected to be 4 to 6 pages of text per site, plus appendix of supporting information (e.g., CSM, tables, figures)

RAA Preparation (cont.)

- RAA preparation and review not expected to result in additional time to project
- Most information required for RAA gathered from existing documents (e.g., RI, other historic site reports)
- Review the RAA Template prior to RAA preparation
- RAAs typically prepared after CSM, RAOs, and PRGs have been developed using RAA template as a guide

RAA review by LANT or PAC POCs will take 10 business days or less

RAA Preparation (cont.)

Remedy Evaluation Document	When to Complete the RAA?
Feasibility Study (FS)	After potential treatment and disposal technologies have been screened based on their technical implementability and effectiveness
Corrective Measures Study (CMS)	After initial identification, screening, and development of the corrective measure alternatives

RAA Preparation (cont.)

Remedy Evaluation Document	When to Complete the RAA?
Engineering Evaluation/Cost Analysis (EE/CA)	After removal action objectives are finalized and identification of removal action alternatives
UST Remedy Evaluation (e.g., Corrective Action Plan [CAP])*	After the Site Characterization Report (SCR) complete

*CAPs typically have short completion timeframes so appropriate planning is required.

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RAA Submittal

- RPM or contractor's RAA POC submit RAA package (including all figures, tables, and CSM) via email to the LANT or PAC POC
- For larger RAAs (>10 MB), submit via contractor's FTP site or the NAVFAC File Transfer System (NFTS)
- LANT or PAC POC will enter a TS2 Support Request in NIRIS for tracking of RAA review

NOTE: Other file transfer systems are available, contact the LANT or PAC POC for more details.

RAA Review

- NAVFAC LANT/PAC assign lead technical reviewers
- RAA reviewers will be NAVFAC technical support personnel at LANT, PAC, ESC, or technical staff at one of the FECs
- Additional reviewers may be required based on technical complexity, specific regional regulatory issues, etc.
- Technical reviewers will have 10 business days to conduct RAA review and submit comments

RAA Review (cont.)

- Technical reviewer may request conference call to facilitate better understanding of site CSM, RAOs, etc. to improve RAA review
- Technical reviewer will review and collate comments from all reviewers and send comment package to contractor's RAA POC and the RPM

Bullet 1

The conference call does not effect the 10 day review time

Response to Comments and Document Revisions

- Project team (led by RPM) will evaluate RAA comments and the need to add, remove, or adjust remedial alternatives for detailed consideration in remedy evaluation document
- RPM is responsible for the final decision regarding the action taken on remedial alternatives based on feedback
- RPMs will coordinate with contractors to submit response to comments to technical reviewer within <u>10 business days</u>

Sharing Lessons Learned

- All RAA reviews will be stored in NIRIS Technical Support Tracking System (TS2)
- Keyword search of TS2 repository of RAA reviews to find similar contaminant issues
- Trends in reviewer comments and lessons learned will be periodically shared across NAVFAC through ER Newsletters, RITS, TIPS, ER manager meetings, ER conference, etc.
- Results of all RAA reviews recorded by RPM in NORM Optimization Module

3rd bullet

Trend reviews will be accomplished by LANT and shared in TS2

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RAA Template

- Revised RAA template in guidance document
- Additional information on CSM, RAO, TTZs required in new format
- Preparer to include other alternatives screened, but not included
- Now required to facilitate more efficient RAA preparation and review
- Microsoft Word preferred format for RAAs, but *.pdf documents also acceptable

Remedial Alternatives Analysis (RAA)

Site # – INSERT PROJECT NAME, SITE #, SWMU, ETC. HERE
BASE NAME, CITY, STATE

Indicate which remedy evaluation document this RAA supports.
Check one: ☐FS ☐EE/CA ☐CMS ☐CAP (LUST)

Conceptual Site Model (CSM)	CSM - General	Describe the CSM as indicated in the blocks below using a combination of narrative and related CSM figures as appropriate. Complexity of the information and graphics to be provided is dependent on the site complexity. 3-D CSM diagram is preferred but not necessary for less complex sites where 2-D cross section and plan view can communicate the CSM adequately. Use *Guidance for Optimizing Remedy Evaluation, Selection, and Design* (NAVFAC 2010) and the NAVFAC CSM Web Tool (http://www.ert2.org/csm) when developing conceptual site models and related remedial action objectives, remedial alternatives, technology performance objectives, and exit strategies. Use *Guidance for Planning and Optimizing Monitoring Strategies* (NAVFAC 2010) for developing and optimizing related monitoring plans.
	Previous Site Use	Provide sufficient information on site use and site history to understand sources of contamination.
	Size	Describe dimensions of the site relevant to the remedial actions being evaluated. For example, list dimensions of source area, dissolved-phase plume, soil hot spot, etc. being evaluated as part of remedy selection (approximate area in XX.XXX square feet or XXX acres).
	Previous Investigations and Remedial Actions	Briefly describe or include in a table previous investigations and remedial actions.
	Current and Potential Future Land and Resource (e.g., Groundwater) Uses	Identify all current and potential future land and resource use. Include on-site and adjacent land/resource uses, including recreational use of adjacent surface waters and the groundwater current use and classification for potential future use, to ensure appropriate RAOs are identified for the potential receptors. If the groundwater classification is based on State criteria, indicate if the State has an approved Comprehensive Groundwater Protection Plan in place. Include specific descriptors for land use – industrial, residential, recreational, mixed use, other.
	Affected Media	Describe affected media (e.g. soil, groundwater, sediment, indoor air, surface water). For soil media, describe soil types, depths of soil contamination, and other relevant information. For groundwater media, include description of TDS, redox conditions, unusual geochemistry or characteristics that impact remedy selection. For sediment/surface water, include description of surface water/sediment environment (i.e. wetland, lake,

I

Image shown is the most recent RAA Template for use by RPMs (May 2012)

RAA Template Sections

- CSM
  - Previous site use, size, previous investigations and remedial actions, Land and resource use, affected media, geology/hydrogeology, nature and extent of contamination, receptors/exposure pathway, other site constraints
- Risk Summary
  - Human health risk, ecological risk
- Contaminants of Concern (COCs)
  - Surface soil, subsurface soil, groundwater, sediment, surface water, indoor air

RAA Template Sections (cont.)

- Remedial Action Objectives (RAOs)
  - Clear and concise description of what the remedial action should accomplish
- Remediation Goals
  - Site-specific cleanup goals to meet RAOs
- Target Treatment Zones (TTZs)
  - Volume or area of site where remedial action will apply
- Other Issues to be Considered
  - Remedy Status (Interim or Final), Unrestricted Land Use Alternative Considered?, Data Gaps, Additional Documents

RAA Template Sections (cont.)

- Description of Each Alternative Evaluated
  - Describe proposed action in sufficient detail for reviewer
  - Describe each component of the remedy when treatment trains are proposed
  - Describe the exit strategy for each alternative
  - Describe long term operation and maintenance requirements
- Description of Other Alternatives Considered
  - List of technologies considered during screening and brief explanation of why these technologies were not retained

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RAA Example – SWMU 12, MCAS Beaufort

- Decision Document – CMS for groundwater impacts only
- Site Background – Former Fire Fighter Training Area (FFTA) used 1950s-'60s
- COCs – Petroleum hydrocarbons
- RAO – Prevent unacceptable risk to human receptor exposure to groundwater with COC concentrations >MCLs

SWMU 12 consisted of two approximately 30-foot diameter pits that were used four times per month for fire training exercises between 1950 and the mid 1970s.

Flammable wastes, primarily JP-4, along with motor oil, jet fuel, and solvents were poured into a pit, ignited, and then the fire was extinguished with water, chemical foam, and/or aqueous film forming foam. No visible evidence of the pits is currently present.

Groundwater contamination (VOCs and PAHs from fuel) is present primarily around the southern pit.

As part of the remedial design, additional groundwater sampling will be conducted to further delineate the groundwater contamination.

Only shallow groundwater is being addressed at SWMU 12 by this CMS. The groundwater table varies from 2 to 6 feet bgs across site depending on surface
elevation and seasonal affects. Soil types present beneath the site would be classified as silty fine sands and clayey sands with localized layers of silty clay.

Groundwater contamination is present only in the shallow aquifer (3 to approximately 23 feet bgs) around the source area (southern burn pit). No COCs were detected in deeper wells screened 25-30 feet bgs. No free product is present.

COCs - 1,2-dibromo-3-chloropropane, benzene, ethylbenzene, total xylenes, toluene, naphthalene, alpha-BHC are present in groundwater.

Risk driver- Groundwater - non-carcinogenic and carcinogenic risk estimates developed for the hypothetical future resident exposed to COPCs in groundwater do exceed EPA cancer and non-cancer risk benchmarks. These elevated risk estimates were due primarily to exposure to arsenic and iron in groundwater in the northern pit area. Benzene, 1,2-dibromo-3-chloropropane, ethylbenzene, toluene, total xylenes, arsenic, iron, and vanadium were the major contributors in the risk for groundwater in the southern pit area.

RAO is to prevent unacceptable risk to human receptors from exposure to groundwater with concentrations of COCs greater than the PRGs (Federal MCLs).

RAA Example – SWMU 12, MCAS Beaufort (cont.)

Groundwater Alternatives	Description
#1: No Action	No Action
#2: MNA and LUCs	Monitoring duration not identified, initially monitored on quarterly basis w/optimization
#3: Oxygen Release Compound (ORC®) Injections, MNA, LUCs	47,000 gal treatment volume, 2 injections, 1 year apart
#4: Ozone Diffusion, MNA, LUCs	Treatment duration based on performance objectives (e.g., asymptotic conditions)
#5: Biosparging, MNA, LUCs	Low-volume air injection to stimulate biodegradation. Treatment duration based on performance objectives (e.g., asymptotic conditions)

Alt 2 - Initiate an MNA program to track changes in COC concentrations due to natural attenuation and other possible fluctuations and determine when cleanup goals have been achieved and LUCs are no longer required. Alternative also includes LUCs to prevent exposure to contaminated groundwater.

Alt 3 - Treat 47,000 gallons in-situ by injecting an ORC compound to stimulate aerobic degradation of COCs. Two injections, 1 year apart are assumed to be required. Followed by MNA and LUCs.

Alts 4 and 5 will treat similar volume of contamination using different methods. Ozone will be generated on-site and injected into the aquifer as a gas. COCs will be chemically oxidized by the ozone. Biosparging will involve injection of atmospheric air into injection wells through sparging. Primary cleanup will be through biological oxidation under aerobic conditions with some volatile stripping of contaminants. Both will be followed by MNA and LUCs

RAA Example – SWMU 12, MCAS Beaufort (cont.)

- **RAA Review Comments and Recommendations**
  - Remove ORC alternative from list of remedial alternatives for technical reasons
  - Evaluate industrial exposure pathway for groundwater
  - Collect additional data for source zone characterization to better define target treatment zone
  - Conduct current round of sampling to optimize remedy selection
  - Sample for perfluourinated compounds (PFCs) (e.g., AFFF compounds)
- **Benefits from RAA Review**
  - Improved CSM
  - Eliminated inappropriate remedial technology and prevented later revisions of CMS

ORC was removed from consideration from this CMS because, in the technical reviewer's experience, it has proved to have limited effectiveness for aquifer treatment of petroleum hydrocarbons in strongly anaerobic (methanogenic) aquifers. ORC is a relatively expensive source of dissolved oxygen to stimulate aerobic biodegradation. Much of the oxygen produced from ORC will be wasted on the oxidation of non-productive compounds (i.e. sinks, such as dissolved iron, sulfides, methane, etc.). Numerous sites where ORC has been injected into anoxic aquifers have resulted in no meaningful impacts on the COCs. Furthermore, there is a trend in the remediation industry away from ORC and other slow release forms of oxygen for enhanced bioremediation of petroleum hydrocarbons. Bottom line- this is a highly anaerobic aquifer. Therefore, injecting an expensive source of dissolved oxygen into the aquifer has engineering feasibility issues. Cheaper sources of oxygen, such as atmospheric air, are probably more appropriate.

Human consumption of the aquifer water is unlikely. Recommended the project team develop site-specific groundwater cleanup values based on incidental contact from industrial workers as a reasonable exposure pathway as a means of comparison to human health MCLs.

Additional data collected (to be performed during the RD so as not to hold up the CMS process) are recommended to firm up the CSM and the design basis – these include a more recent round of GW sampling, additional source characterization to firm up the TTZs and sampling for PFOS/PFOA to determine if this chemical is present in groundwater.

The team implemented all recommendations on this slide with the exception of calculating risk associated with an industrial pathway and sampling for PFOA/PFOA. The team felt that the industrial pathway was reasonable but likely would not be accepted by regulators because the shallow aquifer could be considered a potential potable water source. The team had not received regulator inquiry regarding the PFOS/PFOA sampling so it was determined to considered sampling for these compounds at a later date.

RAA Example – PSC 45, NAS Jacksonville

- **Decision Document: EE/CA for soil impacts (non-time critical removal action)**
- **Site Background: Former wash rack and disposal pit area**
- **COCs: PCE, TCE in groundwater (1-10 ppb); PAHs in surface/sub-surface soil**
- **RAO:**
  - **1) Prevent unacceptable risk of direct exposure to surface soil and**
  - **2) Prevent unacceptable leaching of soil contaminants to groundwater**

Potential source of contamination (PSC) 45, the Building 200 Wash Rack former disposal pit, is located approximately 6 feet east of the Building 200 Wash Rack, a covered wash rack adjacent to Building 200. The disposal pit, a French drain design, was gravel-lined with an earthen bottom and a concrete lid approximately 4 feet in diameter. The pit was connected via an underground pipeline to an in-ground oil/water separator located beneath the Building 200 Wash Rack. The fluids in the disposal pit either leached directly into the subsurface soil, or during periods of heavy rains and an elevated water table surface, these fluids may have discharged directly into the groundwater.

Based on soil data collected in August 2009, benzo(a)pyrene and benzo(a)pyrene equivalents (BEQs) were detected from 2 to 4 feet bls at concentrations greater than the Florida Department of Environmental Protection (FDEP) Industrial direct exposure Soil Cleanup Target Levels (SCTLs) (Chapter 62-777 Florida Administrative Code [FAC]). Carbazole was also detected from 2 to 4 feet bls at a concentration greater than the FDEP Leachability to Groundwater SCTL (Chapter 62-777 [FAC]).

The COCs in subsurface soil include benzo(a)pyrene and benzo(a)pyrene equivalents (BEQs) that were detected in sample JAX45-SB01 at concentrations of 0.77 and 1.204 mg/kg, respectively. These concentrations are greater than the FDEP Industrial Direct Exposure scenario of 0.7 mg/kg. Carbazole was also detected in sample JAX45-SB01 at 0.220 mg/kg, which is greater than FDEP Leachability to groundwater scenario of 0.2 mg/kg.

RAOs are to 1) Prevent unacceptable risk to human health and the environment from direct exposure under current land use and 2) Ensure soil COCs are not leaching above FDEP SCTLs Leachability to groundwater criteria.

RAA Example – PSC 45, NAS Jacksonville (cont.)

Soil Removal Alternatives	Description
#1: No Action	No Action
#2: Soil Removal to Industrial Criteria, LUCs	Soil removal to meet industrial direct exposure criteria, soil classification and disposal, LUCs to prevent residential exposure
#3: Soil Cap, LUCs	Concrete engineered cap to prevent direct exposure and to prevent rainwater infiltration, leaching
#4: Soil Cap, Soil Removal, LUCs	Combination of soil removal and concrete capping to prevent direct exposure and leaching along with LUCs

#2 - Remove surface and subsurface soil at the AOC to direct exposure Industrial SCTLs and Leachability to Groundwater SCTLs (approximately 70 cubic yards). Soil will be removed from the surface (not including paved areas) to groundwater, to the extent structurally feasible. Numerous subsurface utilities, obstructions, and building footers exist within the AOC, which may impede removal activities. Removed soil will be characterized and disposed offsite. The excavation will be backfilled with uncontaminated fill material to grade and restored to pre-construction conditions.

#3 - Place concrete cap over the contaminated soil at the AOC to prevent direct exposure and contaminants leaching from soil to groundwater. Implement ICs for intrusive work and future site development. Implement a long-term monitoring (LTM) program (i.e., site inspections to ensure cap is maintained). 5-year reviews for 30 years.

#4 - Focused soil removal at the AOC to industrial SCTLs (approximately 70 cubic yards) where technically feasible. Soil will be removed from the surface (not including paved areas) to groundwater. Removed soil will be characterized and disposed offsite. Soil will be backfilled with clean material to grade and restored to pre-construction conditions. Place a concrete cap over select areas within the contaminated soil at the AOC to prevent contaminants leaching from soil to groundwater. Implement ICs for intrusive work and future site development. Implement a LTM program (i.e., site inspections to ensure existing cover and new concrete cap is maintained). 5-year reviews for 30 years.

RAA Example – PSC 45, NAS Jacksonville (cont.)

- RAA Review comments included
  - Eliminate non-time critical removal and address low-risk soil impacts under FS
  - Soil data indicated minimal (if any) risk due to direct exposure under industrial land use setting
  - Direct exposure soil cleanup criteria were incorrectly applied to subsurface soil
  - EPA Regional Screening Levels (RSLs) were inappropriately applied as default cleanup standards
- Benefits from RAA Review
  - Eliminated unnecessary removal action and shifted focus to completion of FS
  - Focused remedy evaluation process on appropriate risk driver (groundwater)

Based on data presented in the RAA, the technical reviewer recommended that no removal action take place other than to possibly implement LUCs and possibly cap (Alt 3). However, both of these options could wait until the final remedy is selected in the FS, which would include both soil and groundwater response actions. There did not seem to be a risk driver requiring an interim remedial action at this site.

As a summary of the soil data, there are no COCs exceeding the direct exposure (industrial) or leachability criteria for surface soil (0-2 ft bgs). For subsurface soil (2-4 ft bgs), BAP and BAP equivalents exceed the direct exposure criteria only marginally - 0.77-1.2 mg/kg compared to the 0.7 mg/kg standard. However, direct exposure is not relevant for subsurface soil due to limited exposure to soils at the 2-4 ft depth interval. Carbazole exceeds the leachability criteria in subsurface soils, but this is stretching it. The max Carbazole concentration was 0.22 mg/kg compared to the leachability standard of 0.2 mg/kg. Carbazole was not detected in groundwater so there does not appear to be a leachability issue.

During a telecon discussing the comments on the draft RAA, the project team included in their discussion on cleanup standards the need to remediate based on a comparison of soil concentrations to EPA RSLs and advocated using these as cleanup standards. EPA RSLs are not promulgated cleanup standards and are meant to serve as screening tools. Based on site-specific information and a screening risk assessment, the technical reviewer felt that risks were not great enough to conduct the non time critical removal action, but to address soil risks during the FS. Through technical direction by the COR, the project team shifted funding from the EECA to the FS and focused ERN funding on the most important risk driver at the site, which was chlorinated solvents in groundwater.

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Take-Home Points

- Navy/Marine Corps Optimization Policy requires preparation and expert review of RAA as part of optimization review
- Goal of RAA is early and expedited review of remedial alternatives to ensure appropriate and cost-effective remedies are considered during remedy selection
- RAA process is applicable throughout NAVFAC for all remedy evaluation documents (FS, EE/CA, CMS, CAP)
- RAA process has shown significant cost savings and improved remedy evaluation documents:
  - Avoiding the need to back track and reconsider alternatives
  - Early review of site risks and RAOs
  - Identification of significant data gaps, incomplete CSMs

Resources

- RAA Guidance (2012)
- RAA Template (2012)
- NAVFAC Guidance for Optimizing Remedy Evaluation, Selection, and Design (2010)
- DON Optimization Policy (2012)
- NIRIS Technical Support Tracking System (TS2)