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Accelerated VOC Source Investigation Pairing SCAPS/MIP with EPA Triad, Marine Corp Base Camp Pendleton, California *Karen Collins, Anteon Corp./US Navy PWC*
http://www.triadcentral.org/ref/doc/6_Karen_rev.pdf (2.31 MB)

Advancing Best Management Practices: Applying the Triad Approach in the Superfund Program
Charles Sutfin, James Woolford, USEPA
http://www.triadcentral.org/ref/ref/documents/Triad_Policy_Memo.pdf (1.68 MB)

Applying the Concept of Effective Data to Environmental Analyses for Contaminated Sites *USEPA EPA/542-R-01-013*
http://www.triadcentral.org/tech/documents/effective_data.pdf (238.35 KB)
This issue paper provides detail in support of the article "Managing uncertainty in environmental decisions" that was published in the October 1, 2001 issue of Environmental Science & Technology. It addresses topics related to data quality and how field analytical methods may significantly improve the quality of environmental data by permitting better management of sampling uncertainties.

Assessing Contractor Capabilities for Streamlined Site Investigations *USEPA*
<http://www.triadcentral.org/ref/ref/documents/ContractorCap.pdf> (203.46 KB)

Assessment of Sampling Error Associated with Collection and Analysis of Soil Samples at a Firing Range Contaminated with HMX *Jenkins, T.F., Walsh, M.E., Thorne, P.G., Thiboutot, S., Ampleman, G., Ranney, T.A., et al.*
http://www.triadcentral.org/tech/documents/SR97_22.pdf (588.21 KB)
Spatial heterogeneity in explosives concentrations within surface soils was studied at an active antitank firing range. Heterogeneity of HMX concentrations was large on both short- and mid-range scales and this factor dominated the overall uncertainty associated with site characterization. Relatively minor uncertainties were due to analytical error. A colorimetric field method provided concentration estimates for HMX that were in excellent agreement with laboratory results.

Assessment of Sampling Error Associated with Collection and Analysis of Soil Samples at Explosives-Contaminated Sites *Jenkins, T.F., Grant, C.L., Brar, G.S., Thorne, P.G., Ranney, T. A., & Schumacher, P.W.*
http://www.triadcentral.org/tech/documents/SR96_15.pdf (474.91 KB)
Short-range heterogeneity in contaminant concentrations was shown to be very high for surface soils at explosives-contaminated (TNT, DNT and ammonium picrate) sites. Total error was dominated by sampling error, whether characterization was done using on-site or laboratory analysis. Results from colorimetric methods were in excellent agreement with laboratory results. Composite sampling can improve the reliability of statistical estimates of average concentrations.

Brownfields Technology Primer: Requesting and Evaluating Proposals That Encourage Innovative Technologies for Investigation and Cleanup *USEPA*
<http://www.triadcentral.org/tech/documents/rfpfinal.pdf> (1.45 MB)
Brownfields Technology Primer: Requesting and Evaluating Proposals That Encourage Innovative Technologies for Investigation and Cleanup – USEPA 542-R-01-005. The Brownfields Technology Support Center prepared this primer to assist site owners, project managers, and others preparing requests for proposals (RFP) to solicit support in conducting activities to investigate and clean up contaminated sites. The primer is not a general guidance document on preparing RFPs for the investigation and cleanup of sites. Rather, it is specifically intended to assist those individuals in writing specifications that encourage contractors and technology vendors (both referred to as contractors in this document) to propose options for using innovative characterization and remediation technologies at brownfields sites. The primer also provides information, from a technology perspective, to guide review teams in their evaluations of proposals and the selection of qualified contractors.

Building A Second-Generation Data Quality Model *Deana Crumbling, USEPA*
http://www.triadcentral.org/ref/doc/4_Deana.pdf (1.62 MB)

The Business of Making a Lab Field-Portable *Crume, Craig*

<http://www.triadcentral.org/tech/documents/crumeetaarticle.pdf> (833.99 KB)

This published article reviews the challenges, strategies, and successes of performing analyses in the field, which entails more than just operating the equipment.

Case Study Abstract: Wenatchee Tree Fruit Research and Extension Center (WTFREC) Test Plot, Wenatchee, Washington (MS Word)

http://www.triadcentral.org/tools/case/documents/Tree_Fruit_Project_example.doc (72 KB)

Case Study Abstract: Wenatchee Tree Fruit Research and Extension Center (WTFREC) Test Plot, Wenatchee, Washington (PDF)

http://www.triadcentral.org/tools/case/documents/Tree_Fruit_Project_example.pdf (67 KB)

A Catalyst for Maturing Remediation Practice *Deana Crumbling, Joel Hayworth, Robert Johnson, and Marlene Moore*

<http://www.triadcentral.org/ref/doc/RemediationCatalystPostprint.pdf> (124.05 KB)

Chemical Quality Assurance for Hazardous, Toxic and Radioactive Waste (HTRW) Projects *USACE*

<http://www.triadcentral.org/tech/documents/entire.pdf> (380.83 KB)

This USCAE manual provides specific guidance, procedures, criteria, and tools for chemical implementation of the U. S. Army Corps of Engineers (USACE) HTRW Quality Assurance (QA) Program to ensure analytical data generated for all projects meet the criteria prescribed by the technical project planning (TPP) team.

Clarifying DQO Terminology Usage to Support Modernization of Site Cleanup Practice *USEPA*

EPA/542-R-01-014

<http://www.triadcentral.org/tech/documents/dqo.pdf> (188.86 KB)

This issue paper discusses the concepts behind the terminology associated with EPA's Data Quality Objectives process, and explains how those concepts can be used to support systematic improved project planning and innovative strategies and technologies.

Comparing Field Portable X-Ray Fluorescence (XRF) to Laboratory Analysis of Heavy Metals in Soil *Shelsky, S., NITON Corporation*

<http://www.triadcentral.org/tech/documents/sshelsky02.pdf> (103.59 KB)

Quality assurance protocols for using XRF in the field usually require splits between field and fixed lab analysis. The comparability of XRF data with fixed lab data varies with site conditions, soil composition, and sample preparation. Poor correlation often arises from the introduction of error in the confirmatory sample splitting and sample handling procedures, and which may be misinterpreted as a deficiency of the field method.

Conceptual Food Chain Model for Bound Brook Corridor (MS Excel) *USEPA*

http://www.triadcentral.org/tools/concept/documents/OU4CSM/Section_8_PCSM_Figures_8-4.xls (90 KB)

Conceptual Food Chain Model for Bound Brook Corridor (PDF) *USEPA*

http://www.triadcentral.org/ref/ref/documents/OU4CSM/Section_8_PCSM_Figures_8-4.pdf (16.97 KB)

Conceptual Site Model Checklist (MS Word)

http://www.triadcentral.org/tools/concept/documents/CSM_Checklist.doc (62 KB)

Conceptual Site Model Checklist (PDF)

http://www.triadcentral.org/ref/ref/documents/CSM_Checklist.pdf (62.13 KB)

Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Waste (HTRW) Projects *USACE*

<http://www.triadcentral.org/tech/documents/em1110-1-1200.pdf> (1.20 MB)

This USACE manual describes developing a CSM, which is a primary Triad product to support defensible decisions and cost-effective remedial designs. The CSM is a description of a site and its environment that encompasses what is known and what needs to be known in order to make project decisions. It describes sources and receptors and the interactions that link these to estimate risk and design risk reductions strategies. It assists the project team to plan data collection and remediation activities, interpret data, and communicate with other parties.

Construction and Usage History of Structures at the Cornell Dubilier Electronics Facility (PDF)
http://www.triadcentral.org/ref/ref/documents/OU4CSM/TABLE_1-1.pdf (53.31 KB)

Contracting Option Award Decision Flow Process (PDF)
<http://www.triadcentral.org/ref/ref/documents/Fairbankscontractflowchart.pdf> (39.12 KB)

cVOC Decision Tool Pilot Test (MS Excel)
http://www.triadcentral.org/ref/ref/documents/cVOC_Decision_Tool_Pilot_Test_Example.xls (888 KB)

cVOC Decision Tool Rev.00a (MS Excel)
http://www.triadcentral.org/tools/decision/documents/cVOC_Decision_Tool_-_Rev00a.xls (839 KB)
The objective of this project was to develop and test a decision tool and process to support responsible decision-making regarding alternative remedial approaches at sites containing groundwater contaminated with cVOCs. The cVOC Remediation Decision Tool (cVOC Tool) has been designed specifically to be useful at sites with any type of ongoing treatment, and to give fair consideration of all types of alternatives, including EA and MNA.

A Data Integration Framework to Support Triad Projects *James Mack, New Jersey Institute of Technology; Deana Crumbling, USEPA; Fred Ellerbusch, NJIT*
http://www.triadcentral.org/ref/doc/Data_Integration_Winter_Remediation_Preprint.pdf (175.59 KB)

Decision Logic Diagram (PDF)
<http://www.triadcentral.org/ref/ref/documents/Fairbanksdecisiondiagram.PDF> (15.54 KB)

Decision Logic Flowchart (PDF)
<http://www.triadcentral.org/ref/ref/documents/NorthRiverdecisionflowchart.pdf> (12.8 KB)

Decision Tool for Groundwater Cleanup of Chlorinated Solvent Plumes at DOE Sites
USDOE/Geomatrix
http://www.triadcentral.org/ref/ref/documents/cVOC_Decision_Tool_Final_Report_92906.pdf (1.30 MB)

DRAFT Best Management Practices Inventory for Triad Elements (MS Word)
http://www.triadcentral.org/tools/using/documents/Best_Practices_Inventory.doc (180 KB)

DRAFT Best Management Practices Inventory for Triad Elements (PDF)
http://www.triadcentral.org/tools/using/documents/Best_Practices_Inventory.pdf (40 KB)

Driftwood Bay RRS Site, Alaska (MS PowerPoint)
<http://www.triadcentral.org/tools/concept/documents/driftwoodCSMpresent.ppt> (4.16 MB)

Driftwood Bay RRS Site, Alaska (PDF)
<http://www.triadcentral.org/ref/ref/documents/driftwoodCSMpresent.pdf> (3.19 MB)

DUBILIER ELECTRONICS SUPERFUND SITE, South Plainfield, Middlesex County, NJ, May 2006 (PDF) *USEPA/Tetra Tech BC, Inc.*
http://www.triadcentral.org/tools/concept/documents/OU4CSM/CSM_Report_5-06_v03.pdf (486 KB)

East Palo Alto Case Study: Pesticide Investigation using the Triad Approach *Deana Crumbling, USEPA and Lily Lee, USEPA Region 9 Brownfields Program*
http://www.triadcentral.org/ref/doc/7_Deana-Lily.pdf (1.51 MB)

Enhanced Access Penetration System (EAPS) *USDOE*
http://www.triadcentral.org/tech/documents/enhanced_dp_evaluation_report.pdf (1.74 MB)
The Enhanced Access Penetration System (EAPS) drills through refusals to extend penetration depth. EAPS consists of four major components: (1) a Wireline CPT/Gas sampling probe and wireline soil and groundwater sampling system, (2) a small diameter air rotary drilling system, (3) environmental sensors that are used to detect and characterize contamination in both real and near-real time, and (4) an integral drill spoils collection and filtration system.

EPA Observational Economy Series, Volume 1: Composite Sampling *USEPA*
<http://www.triadcentral.org/ref/ref/documents/composite.pdf> (913.16 KB)

EPA Observational Economy Series, Volume 2: Ranked Set Sampling USEPA

<http://www.triadcentral.org/ref/ref/documents/rankedset.pdf> (972.41 KB)

Evaluation of Commercial Enzyme Immunoassays for the Field Screening of TNT and RDX in Water

USACE CRREL Special Report 94-14

http://www.triadcentral.org/tech/documents/SR97_32.pdf (115.98 KB)

The accuracy and precision of kits for TNT and RDX determinations in well water samples were compared with results obtained using EPA Method 8330 (HPLC). Careful consideration must be given to interferences that may be present and unique for each application.

Evolving Conceptual Site Models (CSMs) in Real-time for Cost Effective Projects Kira Lynch, USACE, Seattle District

http://www.triadcentral.org/ref/doc/3_Kira.pdf (7.79 MB)

Example of a Conceptual Site Model and Site Summary

<http://www.triadcentral.org/ref/ref/documents/DelawareCSMplanningtoolforBFredevelopmentscopingmtg.pdf> (545 KB)

The purpose of the Conceptual Site Model and Site Summary (CSM-SS) document is to provide a single document where all the information about the site can easily be reviewed and used for decision making at any stage of the project.

Example Scope of Work: Phase I Environmental Site Assessment and Systematic Project Planning (MS Word)

http://www.triadcentral.org/tools/contracting/documents/ExampleSOW_PhaseI_SPP.doc (88 KB)

Example Scope of Work: Phase I Environmental Site Assessment and Systematic Project Planning (PDF)

http://www.triadcentral.org/tools/contracting/documents/ExampleSOW_PhaseI_SPP.pdf (36 KB)

Expedited Site Characterization USDOE EM-0420

<http://www.triadcentral.org/tech/documents/itsr77.pdf> (248.13 KB)

The principal elements of expedited site characterization (ESC) are a field investigation conducted by an integrated team working in the field; analysis, integration, and initial validation of characterization data as they are obtained in the field; and a dynamic work plan that enables the team to take advantage of new insights from recent data to adjust the work plan in the field. This report describes several ESC case studies where ESC was used to delineate contaminant plumes, verify hydrogeological site models, and delineate hydrologic systems at landfills, petroleum release sites, radioactive sites, manufactured gas plant (MGP) sites, and grain storage facilities.

Facilitating Brownfields Transactions Using Triad and Environmental Insurance Bryn Woll, Marsh;

James Mack, NJIT; Fred Ellerbusch, NJIT; James R. Vetter, Marsh

http://www.triadcentral.org/ref/doc/Remediation_preprint_Triad-Insurance.pdf (131.32 KB)

Facility Property (OU2) circa 2002 Cornell-Dubilier Electronics Superfund Site USEPA/Tetra Tech BC, Inc.

[http://www.triadcentral.org/tools/concept/documents/OU4CSM/Cornell_Figure_1-2_\(Site%20Map\).pdf](http://www.triadcentral.org/tools/concept/documents/OU4CSM/Cornell_Figure_1-2_(Site%20Map).pdf)

(1.06 MB)

Fairbanks Old City Landfill, Alaska (MS Powerpoint) US Army Corps of Engineers

<http://www.triadcentral.org/tools/concept/documents/CSMpresentfnsb.ppt> (22.90 MB)

Fairbanks Old City Landfill, Alaska (PDF) US Army Corps of Engineers

<http://www.triadcentral.org/ref/ref/documents/CSMpresentfnsb.pdf> (1.16 MB)

Federal Register:Corrective Action for Releases From Solid Waste Management Units at Hazardous Waste Management Facilities; Proposed Rule USEPA

<http://www.epa.gov/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf> (265.92 KB)

Field Demonstration of On-Site Analytical Methods for TNT and RDX in Ground Water *Craig, H., G. Ferguson, A. Markos, A. Kusterbeck, L. Shriver-Lake, T. Jenkins, and P. Thorne*
<http://www.triadcentral.org/tech/documents/craig.pdf> (936.19 KB)

The conference paper describes the performance of eight commercially-available and emerging colorimetric, immunoassay, and biosensor on-site analytical methods for explosives 2,4,6-trinitrotoluene (TNT) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in ground water and leachate at 2 military Superfund sites.

Field Sampling and Selecting On-Site Analytical Methods for Explosives in Soil *USEPA EPA/540/R-97/501*

<http://www.triadcentral.org/tech/documents/explosiv.pdf> (267.93 KB)

This issue paper provides guidance to project managers regarding field sampling and on-site analytical methods for detecting and quantifying secondary explosive compounds in soils.

Field Sampling and Selecting On-Site Analytical Methods for Explosives in Water *USEPA EPA/600/S-99/002*

<http://www.triadcentral.org/tech/documents/water.pdf> (245.51 KB)

This issue paper provides guidance to project managers on field sampling and selecting on-site analytical methods for detecting and quantifying secondary explosive compounds in water.

Floodplain Boundaries for OU4 (PDF) *USEPA/Tetra Tech BC, Inc.*

http://www.triadcentral.org/ref/ref/documents/OU4CSM/2-2_topo_with_floodplain_%28final%29.pdf (3.16 MB)

A Glucose Tolerance Test And The Environmental Restoration Program *Jim Holley*

http://www.triadcentral.org/ref/doc/Holley_Essay.pdf (18.23 KB)

Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers *Yeskis, D. and Zavala, B.*

http://www.triadcentral.org/tech/documents/gw_sampling_guide.pdf (630.72 KB)

This EPA Ground Water Forum issue paper discusses how to choose the optimal sampling method and equipment for collecting ground water samples and describes how differences in personnel, procedures, and equipment can all lead to variability in data results.

Guidance for Monitoring at Hazardous Waste Sites: Framework for Monitoring Plan Development and Implementation *USEPA*

<http://www.triadcentral.org/ref/ref/documents/oswerdirective9355jan04.pdf> (363.16 KB)

Guidance on the Use of Passive-Vapor-Diffusion Samplers Full Report *USGS (Peter E. Church, Don A. Vroblesky, and Forest P. Lyford)*

<http://www.triadcentral.org/tech/documents/wri024186.pdf> (9.23 MB)

This document describes the use of polyethylene-membrane passive-vapor-diffusion samplers for detecting and identifying volatile organic compounds (VOCs) in bottom sediments of surface-water bodies in areas of ground-water discharge. Nine example applications demonstrate utility for understanding contaminant distributions and ground-water-flow patterns in discharge areas for CSM development and design of further characterization activities.

A Guideline for Dynamic Workplans and Field Analytics: The Keys to Cost-Effective Site Characterization and Cleanup *Albert Robbat, Jr., Tufts University and USEPA*

<http://www.triadcentral.org/tech/documents/dynwkpln.pdf> (653.86 KB)

The document was prepared by the Tufts' Center for Field Analytical Studies and Technologies to help federal and state regulators, site owners and their consulting engineers, and remediation companies understand what is involved in constructing and carrying out a dynamic workplan using field analytical instrumentation in an adaptive sampling and analysis program for expediting the site investigation process.

Guidelines for Preparing SAPs Using Systematic Planning and PBMS *Lesnik, B., & Crumbling, D. M.*

<http://www.triadcentral.org/tech/documents/etasaparticle.pdf> (276 KB)

This article discusses how a properly designed sampling and analysis plan (SAP) will address the greatest sources of decision uncertainty, which often stems from sampling issues. Stringent laboratory requirements do not address this major cause of erroneous project decisions, but careful planning and increased sampling density using cheaper analytical technologies can.

Gy Sampling Theory in Environmental Studies Gerlach, R.W., Dobb, D.E., Raab, G.A., & Nocerino, J.M.
http://www.triadcentral.org/tech/documents/gerlach_sampling_article.pdf (222.63 KB)

The heterogeneous particulate nature of soil samples can cause wide variability in analytical results if the subsampling and sample splitting procedures used are not carefully selected and controlled. This study demonstrates the ability of riffle splitting to minimize subsampling error, whereas grab subsampling, even after mixing, produced the worst data quality. Sampling variability was at least two orders of magnitude worse than the analytical method variability in this study.

Historical Aquatic Sampling Stations (PDF) USEPA/Tetra Tech BC, Inc.
http://www.triadcentral.org/ref/ref/documents/OU4CSM/3-3_aquatic_historical_locations_%28final%29.pdf (250.36 KB)

Historical Terrestrial Biota Sampling Area (PDF) USEPA/Tetra Tech BC, Inc.
http://www.triadcentral.org/ref/ref/documents/OU4CSM/Figure_3-4_Historical_terrestrial_Sampling_Area_%28Final%29.pdf (243.89 KB)

Implementing Systematic Project Planning - Checklist (PDF) US Army Corps
http://www.triadcentral.org/ref/ref/documents/Triad_Systematic_Planning_Checklist_Oct06_.pdf (88.56 KB)

Implementing Systematic Project Planning - Writeup (PDF) US Army Corps
http://www.triadcentral.org/ref/ref/documents/Triad_Systematic_Planning_Checklist_Oct06_writeup.pdf (113.93 KB)

Implementing Systematic Project Planning (MS Word) US Army Corps
[http://www.triadcentral.org/tools/systematic/documents/Triad_Systematic_Planning_Checklist\(Oct06\).doc](http://www.triadcentral.org/tools/systematic/documents/Triad_Systematic_Planning_Checklist(Oct06).doc) (53 KB)

Improving Decision Quality: Making the Case for Adopting Next-Generation Site Characterization Practices Crumbling, D.M., J. Griffith, and D.M. Powell
<http://www.triadcentral.org/tech/documents/spring2003v13n2p91.pdf> (266.65 KB)

This published article argues that for the site cleanup industry to advance technically, over-simplified paradigms must give way to next-generation models that are built on current scientific understanding. The scientific defensibility of individual projects must be maintained at the same time as characterization and cleanup costs are lowered. The United States Environmental Protection Agency (EPA) offers the Triad Approach as an alternative paradigm to foster highly defensible, yet extremely cost-effective reuse decisions.

Improving Laboratory Performance Through Scientific Subsampling Techniques Ramsey, C.A., & Shuggs, J.
<http://www.triadcentral.org/tech/documents/etasubsamplingarticle.pdf> (84.59 KB)

Subsampling must be performed correctly to ensure data representativeness. This published article describes some of the basic scientific principles that should be part of any subsampling protocol, whether performed in a fixed laboratory or as part of on-site analysis.

Improving Sampling, Analysis, and Data Management for Site Investigation and Cleanup USEPA
<http://www.triadcentral.org/ref/ref/documents/2004triadfactsheeta.pdf> (125.2 KB)

Improving Site Investigation: A guide for property owners, buyers and sellers, attorneys, bankers, insurance representatives, and their environmental consultants
<http://www.triadcentral.org/ref/ref/documents/ImprovingSIFinalBrochure.pdf> (383.47 KB)

In Search of Representativeness Evolving the Environmental Data Quality Model Crumbling, D.M.
<http://www.triadcentral.org/tech/documents/dcrumbling.pdf> (108.08 KB)

This article asserts that data representativeness is fundamental to data quality, yet the data quality model for contaminant data remains focused on analytical methods to the neglect of strategies to accommodate environmental heterogeneity. Advancing technology enables the cost-effective, high density, adaptive sampling needed to assure data representativeness, supporting a next generation data quality model that explicitly manages sampling uncertainties.

Innovations in Site Characterization Case Study: Site Cleanup of the Wenatchee Tree Fruit Test Plot Site Using a Dynamic Work Plan (PDF) USEPA
http://www.triadcentral.org/tools/case/documents/TF_case_study.pdf (500 KB)

Introduction to 3-D Mapping Techniques (Presenter: Timothy Shields, Anteon Corp./US Navy PWC)
http://www.triadcentral.org/ref/doc/5_Intro_to_3-D_Mapping_Tech.pdf (6.54 MB)

Is the Triad Approach Really Something New? Deana Crumbling, USEPA
http://www.triadcentral.org/ref/doc/1_Deana.pdf (319.9 KB)

Johnson Controls, Fullerton, CA (MS Powerpoint) US Army Corps of Engineers
<http://www.triadcentral.org/tools/concept/documents/Fullerton-CSMpresent.ppt> (5.70 MB)

Johnson Controls, Fullerton, CA (PDF) US Army Corps of Engineers
<http://www.triadcentral.org/ref/ref/documents/Fullerton-CSMpresent.pdf> (2.83 MB)

Land Use within OU4 (PDF) USEPA/Tetra Tech BC, Inc.
http://www.triadcentral.org/ref/ref/documents/OU4CSM/2-8_landuse_%28Final%29.pdf (230.83 KB)

Lowering the Cost of our Environmental Liabilities: Implementing the Triad Approach Tillman, N., & Sohl, J.; Columbia Technologies
<http://www.triadcentral.org/tech/documents/WhitePaperonLoweringCostswithTriad.pdf> (203.75 KB)
White paper on Triad and its ability to produce cost savings.

Making Data Meaningful: A Guide to Writing Stories About Numbers United Nations
http://www.triadcentral.org/ref/ref/documents/making_data_meaningful_%28un_booklet%29.pdf (501.3 KB)

Management and Interpretation of Data Under a Triad Approach - Technology Bulletin USEPA
<http://www.triadcentral.org/ref/ref/documents/epa542f07001.pdf> (716.39 KB)

Managing Decision Uncertainty Loren Walker
http://www.triadcentral.org/ref/doc/UMASS_Triad_article.pdf (288.69 KB)

The Maturing of the Triad Approach: Avoiding Misconceptions Deana M. Crumbling, Joel S. Hayworth, Bradley A. Call
<http://www.triadcentral.org/ref/doc/Fall04RemediationArticlePostprint.pdf> (193.75 KB)

NJDEP Wetlands of OU4 (PDF) USEPA/Tetra Tech BC, Inc.
http://www.triadcentral.org/ref/ref/documents/OU4CSM/2-4_njdep_wetlands_%28Final%29.pdf (349.57 KB)

North River Remote Relay Station, AK (PDF)
<http://www.triadcentral.org/ref/ref/documents/NorthRiverCSMpresent.pdf> (3.86 MB)

NWI Wetlands of OU4 (PDF) USEPA/Tetra Tech BC, Inc.
http://www.triadcentral.org/ref/ref/documents/OU4CSM/Figure_2-3_NWI_wetlands_%28Final%29.pdf (250.6 KB)

October 2001 Issue of Environmental Science and Technology Crumbling, D.M. et al
<http://www.triadcentral.org/tech/documents/oct01est.pdf> (575 KB)

The article argues that using field analytical technologies in the context of a dynamic work plan and careful management of sampling, analytical, and decision uncertainties can significantly bring down the costs of contaminated site investigations and cleanups, while improving confidence in project decisions.

OU4 Historical Reach Sampling Segments (PDF) USEPA/Tetra Tech BC, Inc.
http://www.triadcentral.org/ref/ref/documents/OU4CSM/Figure_3-2_reaches_%28final%29.pdf (253.65 KB)

An Overview of Methods for Evaluating the Attainment of Cleanup Standards for Soils, Solid Media, and Groundwater, EPA Volumes 1, 2, and 3 USEPA
<http://www.triadcentral.org/tech/documents/overview.pdf> (1.06 MB)

If appropriate to the CSM, statistical tests may aid decisions that the cleanup of a contaminated site complete. These 4 documents cover the ways classical statistics may be used.

Performance Based Criteria: A Panel Discussion
<http://www.triadcentral.org/ref/doc/Homsher.pdf> (3.76 MB)

Pictorial Conceptual Site Model for Bound Brook Corridor (PDF) USEPA/Tetra Tech BC, Inc.
http://www.triadcentral.org/ref/ref/documents/OU4CSM/Cornell_Figure_8-1_Pictorial_PCSM.pdf (2.66 MB)

Preliminary Action Specific ARARs and TBCs (PDF)
http://www.triadcentral.org/ref/ref/documents/OU4CSM/Table_1-3.pdf (83.11 KB)

Preliminary Conceptual Site Model for Operable Unit 4 of the CORNELL DUBILIER ELECTRONICS SUPERFUND SITE, South Plainfield, Middlesex County, NJ, May 2006 (PDF) USEPA/Tetra Tech BC, Inc.
http://www.triadcentral.org/ref/ref/documents/OU4CSM/CSM_Report_5-06_v03.pdf (585.14 KB)

Preliminary Contaminant Specific ARARs and TBCs (PDF)
http://www.triadcentral.org/ref/ref/documents/OU4CSM/Table_1-2.pdf (37.15 KB)

Preliminary Ecological Conceptual Site Model (PECSSM) (MS Excel)
http://www.triadcentral.org/tools/concept/documents/OU4CSM/Section_8_PCSM_Figures_8-3.xls (94 KB)

Preliminary Ecological Conceptual Site Model (PECSSM) (PDF)
http://www.triadcentral.org/ref/ref/documents/OU4CSM/Section_8_PCSM_Figures_8-3.pdf (46.4 KB)

Preliminary Human Health Conceptual Site Model (PHHCSM) for the Bound Brook Corridor (MS Excel)
http://www.triadcentral.org/tools/concept/documents/OU4CSM/Section_8_PCSM_Figures_8-2.xls (94 KB)

Preliminary Human Health Conceptual Site Model (PHHCSM) for the Bound Brook Corridor (PDF)
http://www.triadcentral.org/ref/ref/documents/OU4CSM/Section_8_PCSM_Figures_8-2.pdf (67.02 KB)

Preliminary Location Specific ARARs and TBCs (PDF)
http://www.triadcentral.org/ref/ref/documents/OU4CSM/Table_1-4.pdf (49.38 KB)

Quality Assurance Guidance for Conducting Brownfields Site Assessments USEPA
<http://www.triadcentral.org/ref/ref/documents/brwnfdqa.pdf> (1.37 MB)

Radiological False Positives in Environmental Soil and Groundwater Data from Commercial Laboratories Kubilius, Walter et al.
<http://www.triadcentral.org/tech/documents/KubiliusRadiologicalFalsePositivesReprint.pdf> (254.35 KB)
This reprint explores the frequency and causes for radiological false positives arising from alpha spectroscopy, gamma spectroscopy, and liquid scintillation analyses of environmental media.

Rapid Site Assessment Applied to the Florida Department of Environmental Protection's Dry Cleaning Solvent Cleanup Program Applegate, J.L. and D.M. Fitton
<http://www.triadcentral.org/tech/documents/1997fldscparticle.pdf> (2.36 MB)
The FL DEP's Dry clean Solvent Cleanup Program (DSCP) developed an innovative program to address site assessment and cleanup of contaminated dry cleaning facilities. This paper describes legislative, administrative and technical aspects of the program that permit drastic reductions in the time and costs associated with assessing soil and groundwater contamination for this site type.

A Rationale for the Assessment of Errors in the Sampling of Soils USEPA
<http://www.triadcentral.org/ref/ref/documents/rationale.pdf> (498.02 KB)

RCRA in Focus: Construction, Demolition, and Renovation EPA
http://www.triadcentral.org/tech/documents/RCRA_Guide_for_CD_Materials.pdf (1.33 MB)
The purpose of this document is to provide an overview of the regulatory and waste disposal issues associated with building construction and demolition or renovation.

RCRA, Superfund & EPCRA Hotline Training Module: Introduction to Superfund Accelerated Cleanup Model USEPA
<http://www.epa.gov/superfund/contacts/sfhotline/sacm.pdf> (134.89 KB)

Reference Manual on Scientific Evidence, 2nd Edition *Federal Judicial Center*

http://www.triadcentral.org/tech/documents/Fed_Jud_Center_Paper_on_Scientific_Evidence.pdf (1.98 MB)

This second edition of the *Reference Manual on Scientific Evidence* furthers the goal of assisting federal judges in recognizing the characteristics and reasoning of "science" as it is relevant in litigation. It sheds light on the utility and defensibility within the courtroom of results from "alternative" analytical and/or measurement technologies deployed as part of a Triad project

Regional Geology for OU4 (PDF) *USEPA/Tetra Tech BC, Inc.*

http://www.triadcentral.org/ref/ref/documents/OU4CSM/2-6_regional_geology_%28Final%29.pdf (323.15 KB)

The Relationship between SW-846, PBMS, and Innovative Analytical Technologies *USEPA EPA/542-R-01-015*

<http://www.triadcentral.org/tech/documents/sw-846.pdf> (158.21 KB)

This issue paper explores and dispels the common misconception that EPA policy restricts data generation at contaminated sites to analytical methods appearing in SW-846 or the CLP.

A Review of Emerging Sensor Technologies for Facilitating Long-Term Ground Water Monitoring of Volatile Organic Compounds *USEPA*

<http://www.triadcentral.org/ref/ref/documents/542r03007.pdf> (593.82 KB)

Road Map to Understanding Innovative Technology Options for Brownfields Investigation and Cleanup, Third Edition *USEPA*

<http://www.triadcentral.org/ref/ref/documents/roadmap3rded.pdf> (2.45 MB)

The Road Map includes an index of more than 150 resources identifying potential technology options available at each of the basic phases involved in the characterization and cleanup of Brownfields sites and connects those steps with available resources. Appendices in the Road Map include a list of common contaminants found at typical Brownfields sites, a detailed guide to common environmental terms and acronyms, and a list of state and EPA points of contact.

Sample Handling Strategies for Accurate Lead-in-Soil Measurements in the Field and Laboratory

Shefsky, S., NITON Corporation

<http://www.triadcentral.org/tech/documents/ssshefsky01.pdf> (103.33 KB)

This paper focuses on the importance of fundamental error, a statistical consequence of particulate sampling. We discuss in quantitative terms the significance of fundamental error on the measurement of paint chip contaminated soils near a 400 ppm action level. On the basis of error estimates, we recommend that sample handling protocols control particle related errors by ensuring adequate sample size and sample definition, and by accomplishing sufficient particle size reduction and homogenization before subsampling. We discuss particle related errors and their effect on laboratory, field, and in-situ analytical methods. We recommend that quality assurance protocols aim to determine the overall measurement quality by evaluating error at all stages from sampling and sample handling through analysis.

Sample Systematic Planning Advisor Scope of Work (MS Word)

http://www.triadcentral.org/tools/contracting/documents/Sample_Systematic_Planning_Advisor_SOW.doc (45 KB)

Sample Systematic Planning Advisor Scope of Work (PDF)

http://www.triadcentral.org/tools/contracting/documents/Sample_Systematic_Planning_Advisor_SOW.pdf (24 KB)

Sample Systematic Planning Meeting Agenda (MS Word)

http://www.triadcentral.org/tools/systematic/documents/Systematic_Planning_Mtg_Agenda.doc (62 KB)

Sample Systematic Planning Meeting Agenda (PDF)

http://www.triadcentral.org/ref/ref/documents/Systematic_Planning_Mtg_Agenda.pdf (62.71 KB)

Site Characterization for Explosives Contamination at a Military Firing Range Impact Area *USACE CRREL Special Report 94-14*

http://www.triadcentral.org/tech/documents/SR98_09.pdf (234.22 KB)

This report recommends site characterization techniques based on a study performed at Fort Ord. A major problem for site characterization was the large spatial heterogeneity present. Composite samples were effective for providing representative samples at the scale of 5X5-m² size grids. A colorimetric on-site method gave reliable results for HMX, relative to SW846 Method 8330. No currently available on-site method for RDX was found to be adequate in the presence of much higher concentrations of HMX.

Site Map (PDF) *USEPA/Tetra Tech BC, Inc.*

http://www.triadcentral.org/ref/ref/documents/OU4CSM/Cornell_Figure_1-2_%28Site%20Map%29.pdf (1.01 MB)

Soil Sampling Quality Assurance User's Guide, 2nd Edition *USEPA*

<http://www.triadcentral.org/ref/ref/documents/soilsamp.pdf> (1.64 MB)

Soil Series for OU4 (PDF) *USEPA/Tetra Tech BC, Inc.*

http://www.triadcentral.org/ref/ref/documents/OU4CSM/2-7_soils_%28Final%29.pdf (359.71 KB)

Study of Five Discrete Interval-Type Groundwater Sampling Devices *USACE, CRREL*

http://www.triadcentral.org/tech/documents/CRREL_GW_Sampler_Study.pdf (1.83 MB)

This report describes tests of five relatively new groundwater-sampling depth-discrete devices (the Kabis, HydraSleeve, Discrete Interval, Pneumo-Bailer, and USGS Passive Diffusion Bag [PDB] samplers) for a variety of analytes, including volatile organics, explosives, pesticides, and metals.

Summary of Recent Improvements in Methods for the Study of Contaminated and Potentially Contaminated Sites *USEPA/Tetra Tech BC, Inc.*

<http://www.triadcentral.org/ref/ref/documents/whtpaper.pdf> (240.3 KB)

Summary of the Triad Approach *Deana M. Crumbling, USEPA*

<http://www.triadcentral.org/ref/doc/triadsummary.pdf> (38.01 KB)

Summary Table for Data Needs Assessment (PDF)

http://www.triadcentral.org/ref/ref/documents/OU4CSM/Table_8-1_Data_Needs.pdf (32.31 KB)

Superfund & NJDEP Contaminated Sites and Historic Sites (PDF) *USEPA/Tetra Tech BC, Inc.*

http://www.triadcentral.org/ref/ref/documents/OU4CSM/Cornell_figure3-1_%28Final%29.pdf (3.06 MB)

Surficial Geology of OU4 (PDF) *USEPA/Tetra Tech BC, Inc.*

http://www.triadcentral.org/ref/ref/documents/OU4CSM/2-5_surficial_geology_%28Final%29.pdf (486.73 KB)

Technical and Regulatory Guidance for the Triad Approach: A New Paradigm for Environmental Project Management *Interstate Technology & Regulatory Council*

<http://www.triadcentral.org/ref/ref/documents/SCM-1.pdf> (1.09 MB)

Technology Quick Reference Sheet Forms (MS Word)

http://www.triadcentral.org/tools/case/documents/TQRS_form_template.doc (35 KB)

Technology Quick Reference Sheet Forms (PDF)

http://www.triadcentral.org/tools/case/documents/TQRS_form_template.pdf (27 KB)

Topographic Base Map for OU4 (PDF) *USEPA/Tetra Tech BC, Inc.*

http://www.triadcentral.org/ref/ref/documents/OU4CSM/Figure_2-1_topo_%28final%29.pdf (3.20 MB)

Triad Approach to Managing the Uncertainty in Environmental Data *Deana Crumbling, USEPA*

<http://www.triadcentral.org/tech/documents/CrumblingNEMC2004proceedings.pdf> (447.72 KB)

This article, published in the The 20th Annual National Environmental Monitoring Conference Proceedings (<http://nemc.us>) discusses the importance of conceptual site models and data representativeness when addressing environmental decision-making uncertainty.

Triad Case Study: Former Small Arms Training Range *Gwyn Puckett and Travis C. Shaw U.S. Army Corps of Engineers*

<http://www.triadcentral.org/ref/doc/ShawTriadCaseStudypreprint.pdf> (200.37 KB)

Triad Case Study: Marine Corps Base Camp Pendleton *Adrienne V. Saboya, Karen G. Collins, and Timothy Shields*

http://www.triadcentral.org/ref/doc/Winter_04_Remediation_Preprint_Navy_Case_Study.pdf (1.43 MB)

Triad Case Study: Rattlesnake Creek *Robert L. Johnson, Lisa A. Durham Argonne National Lab, U.S. Army Corps of Engineers*

http://www.triadcentral.org/ref/doc/TriadCaseStudy_RattlesnakeCreek.pdf (183.14 KB)

Triad Project Profile Submission Form (MS Word) USEPA

http://www.triadcentral.org/tools/case/documents/Triad_Project_Profile_Submission_Form.doc (155 KB)

Triad Project Profile Submission Form (PDF) USEPA

http://www.triadcentral.org/tools/case/documents/Triad_Project_Profile_Submission_Form.pdf (126 KB)

Triad Saves \$109K on cleanupnews: Three Petroleum Sites *Deana Crumbling, Office of Superfund Remediation Technology Innovation*

<http://www.triadcentral.org/ref/doc/cleanup21s2.pdf#page=5> (103.89 KB)

Triad Speeds Cleanup of Lead- Contaminated Firing Range Soil *Deana Crumbling, OSRTI*

<http://www.triadcentral.org/ref/doc/cleanup25.pdf#page=4> (327.12 KB)

Triad Technology News and Trends - July 2004 Issue USEPA

<http://www.triadcentral.org/ref/doc/TriadTechTrends04update.pdf> (798.12 KB)

Triad Training, EPA National Site Assessment Symposium, San Diego, June 28, 2004 *Deana Crumbling, USEPA*

http://www.triadcentral.org/ref/doc/9_Deana.pdf (243.02 KB)

Triad's Systematic Planning Process *Adrienne Saboya, US Navy PWC Environmental Dept.*

http://www.triadcentral.org/ref/doc/2_Adrienne.pdf (205.06 KB)

UFP-QAPP Fillable Workbook

http://www.triadcentral.org/ref/ref/documents/UFP-QAPP_MSWord_Workbook.doc (480 KB)

Uncertainties for which Sampling Is Not Required (MS Word)

http://www.triadcentral.org/tools/dealing/documents/North_River_Non-sampling_Uncertainty_Wksht_061004.doc (99 KB)

Uncertainties for which Sampling Is Not Required (PDF)

http://www.triadcentral.org/ref/ref/documents/North_River_Non-sampling_Uncertainty_Wksht_061004.pdf (41.78 KB)

Uncertainties for which Sampling Is Required (MS Word)

http://207.86.51.85/triadcentral/tools/dealing/documents/North_River_Sampling_Uncertainty_Wksht_061004.doc (54 KB)

Uncertainties for which Sampling Is Required (PDF)

http://www.triadcentral.org/ref/ref/documents/North_River_Sampling_Uncertainty_Wksht_061004.pdf (66.26 KB)

USACE Sample Collection and Preparation Strategies for Volatile Organic Compounds in Solids

USACE

<http://www.triadcentral.org/tech/documents/sampling.pdf> (60.25 KB)

This "Strategies" document guides sample collection and handling procedures that minimize VOC losses from solid samples. The USACE document supplements existing guidance provided in SW-846 Method 5035, and addresses selected aspects of sample collection, handling, preparation, and shipment. A decision tree is also provided to guide the selection of high-level and low-level sample preservation methods.

Introduction to 3-D Mapping Techniques (Presenter: Timothy Shields, Anteon Corp./US Navy PWC)
http://www.triadcentral.org/ref/doc/5_Intro_to_3-D_Mapping_Tech.pdf (6.54 MB)

Is the Triad Approach Really Something New? Deana Crumbling, USEPA
http://www.triadcentral.org/ref/doc/1_Deana.pdf (319.9 KB)

Johnson Controls, Fullerton, CA (MS Powerpoint) US Army Corps of Engineers
<http://www.triadcentral.org/tools/concept/documents/Fullerton-CSMpresent.ppt> (5.70 MB)

Johnson Controls, Fullerton, CA (PDF) US Army Corps of Engineers
<http://www.triadcentral.org/ref/ref/documents/Fullerton-CSMpresent.pdf> (2.83 MB)

Land Use within OU4 (PDF) USEPA/Tetra Tech BC, Inc.
http://www.triadcentral.org/ref/ref/documents/OU4CSM/2-8_landuse_%28Final%29.pdf (230.83 KB)

Lowering the Cost of our Environmental Liabilities: Implementing the Triad Approach Tillman, N., & Sohl, J.; Columbia Technologies
<http://www.triadcentral.org/tech/documents/WhitePaperonLoweringCostswithTriad.pdf> (203.75 KB)
White paper on Triad and its ability to produce cost savings.

Making Data Meaningful: A Guide to Writing Stories About Numbers United Nations
http://www.triadcentral.org/ref/ref/documents/making_data_meaningful_%28un_booklet%29.pdf (501.3 KB)

Management and Interpretation of Data Under a Triad Approach - Technology Bulletin USEPA
<http://www.triadcentral.org/ref/ref/documents/epa542f07001.pdf> (716.39 KB)

Managing Decision Uncertainty Loren Walker
http://www.triadcentral.org/ref/doc/UMASS_Triad_article.pdf (288.69 KB)

The Maturing of the Triad Approach: Avoiding Misconceptions Deana M. Crumbling, Joel S. Hayworth, Bradley A. Call
<http://www.triadcentral.org/ref/doc/Fall04RemediationArticlePostprint.pdf> (193.75 KB)

NJDEP Wetlands of OU4 (PDF) USEPA/Tetra Tech BC, Inc.
http://www.triadcentral.org/ref/ref/documents/OU4CSM/2-4_njdep_wetlands_%28Final%29.pdf (349.57 KB)

North River Remote Relay Station, AK (PDF)
<http://www.triadcentral.org/ref/ref/documents/NorthRiverCSMpresent.pdf> (3.86 MB)

NWI Wetlands of OU4 (PDF) USEPA/Tetra Tech BC, Inc.
http://www.triadcentral.org/ref/ref/documents/OU4CSM/Figure_2-3_NWI_wetlands_%28Final%29.pdf (250.6 KB)

October 2001 Issue of Environmental Science and Technology Crumbling, D.M. et al
<http://www.triadcentral.org/tech/documents/oct01est.pdf> (575 KB)
The article argues that using field analytical technologies in the context of a dynamic work plan and careful management of sampling, analytical, and decision uncertainties can significantly bring down the costs of contaminated site investigations and cleanups, while improving confidence in project decisions.

OU4 Historical Reach Sampling Segments (PDF) USEPA/Tetra Tech BC, Inc.
http://www.triadcentral.org/ref/ref/documents/OU4CSM/Figure_3-2_reaches_%28final%29.pdf (253.65 KB)

An Overview of Methods for Evaluating the Attainment of Cleanup Standards for Soils, Solid Media, and Groundwater, EPA Volumes 1, 2, and 3 USEPA
<http://www.triadcentral.org/tech/documents/overview.pdf> (1.06 MB)
If appropriate to the CSM, statistical tests may aid decisions that the cleanup of a contaminated site complete. These 4 documents cover the ways classical statistics may be used.

Performance Based Criteria: A Panel Discussion
<http://www.triadcentral.org/ref/doc/Homsher.pdf> (3.76 MB)