Introduction

Mission

St. Juliens Creek Annex (SJCA) began operations as a naval facility in 1849. The annex was one of the largest ammunition depots in the United States involving wartime transfer of ammunitions to various other naval facilities. Specific ordnance operations and processes conducted at SJCA included stockpiling explosives for use in projectiles, manufacturing mines, assembling small caliber guns and ammunition, storing torpedoes, filling shells, and testing ordnance. SJCA has also provided non-ordnance services, including degreasing; operation of paint shops, machine shops, vehicle and locomotive maintenance shops, pest control shops, battery shops, print shops, electrical shops, boiler plants, wash racks, and potable water and salt water fire-protection systems; fire-fighter training; and storage of oil and chemicals.

The facility is currently a non-contiguous property to Norfolk Naval Shipyard. The current primary mission of SJCA is to provide a radar-testing range and administrative and warehousing facilities for nearby Norfolk Naval Shipyard and other local naval activities. SJCA also provides light industrial shops and storage facilities for several tenant commands; including Defense Logistics Agency; Space and Naval Warfare Systems Command, Fleet Logistics Norfolk; Naval Undersea Warfare Center Detachment; and a cryogenics school. Over 700 personnel, including 5 military officers, 30 military enlisted (plus 26 students), 407 civil servants, and 308 contractors work within SJCA to support its mission.

Size and Environmental Setting

SJCA occupies approximately 490 acres, including 407 acres of land, 14 acres of marsh, and 69 acres of surface water.

Geographical Setting

SJCA is in the Atlantic Coastal Plain within the Tidewater Region of southeast Virginia (Figure 1).

The Southern Branch of the Elizabeth River and St. Juliens Creek, which are part of a tidal estuary system in the Chesapeake Bay watershed, define the eastern and southern boundaries of SJCA, respectively. Blows Creek flows through the center of SJCA and drains into the Southern Branch of the Elizabeth River.

Political Setting

SJCA is in the 4th congressional district of Virginia. The facility is within the independent City of Chesapeake and is bounded on the north by the City of Portsmouth.

Figure 1 - St. Juliens Creek Annex

Economic Setting

The City of Chesapeake is one of the largest 100 cities in the country and is located within the Hampton Roads Metropolitan Statistical Area. The unemployment rate has traditionally been below the national average. The largest portion of the workforce is employed in education/welfare, professional business services, and retail trade, accommodation and food services, and health care and welfare services.

Community Setting

The land use immediately surrounding SJCA is primarily residential, with smaller areas of commercial, industrial, and public use. The Southern Branch of the Elizabeth River is home to a number of industries that use the water body for shipping. Both the Southern Branch of the Elizabeth River and St. Juliens Creek are used for boating and recreational fishing.

Background

Program Summary

SJCA was added to the National Priorities List (NPL) in July 2000 as a result of former operations conducted at the base that resulted in environmental impacts. Fifty-nine potentially contaminated Installation Restoration (IR) and Munitions Response sites, solid waste management units (SWMUs), and areas of concern (AOCs) have been identified for evaluation based on the previous assessments and investigations (Figure 2).

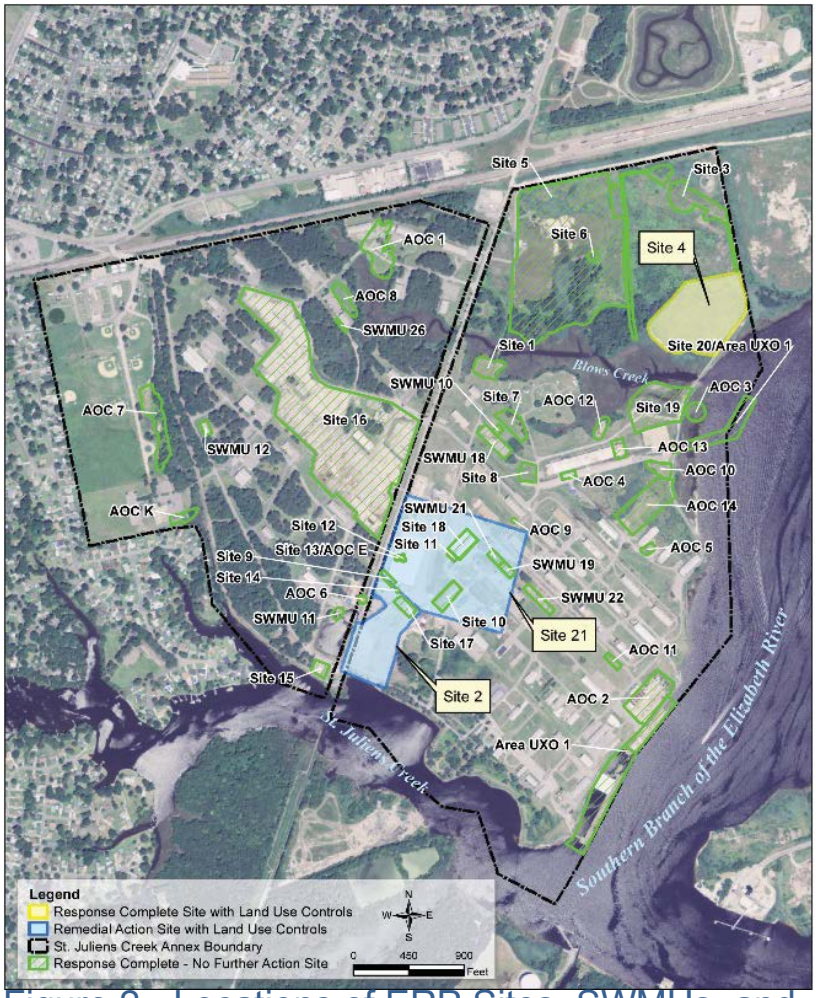

Figure 2 - Locations of ERP Sites, SWMUs, and

Three IR sites (Sites 2, 4, and 21) are currently active in the Environmental Restoration (ER) Program. Fifty-six sites, SWMUs, and AOCs have been determined to require no further action under the ER Program following desktop audits, site inspections, and/or removal actions.

Challenges

The key challenge for the SJCA ER Program during this achievement period was development of a final Record of Decision (ROD) for the facility in order to achieve the Construction Complete milestone

Organization, Staffing, and Management Approach

Following inclusion of SJCA on the NPL, the ER Program Partnering Team was chartered to streamline closure of ER

sites by using consensus-based site management strategies following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. The Team consists of representatives from Navy Facilities Engineering Command (NAVFAC), United States Environmental Protection Agency (USEPA), Virginia Department of Environmental Quality (VDEQ), and NAVFAC's contractor, CH2M HILL, Inc. The Team is supported by technical, contracting, and legal professionals and NAVFAC's Remedial Action (RA) contractors, CB&I and Sovereign. The Team has developed "guidelines" to provide a framework for implementation of the SJCA ER Program and meets approximately every 2 months to set schedules with interim milestones and develop site strategies.

SJCA ER Program Partnering Team Mission Statement

Using principles of partnering and the CERCLA process, the St. Juliens Creek Annex Team shall seek to protect human health and the environment. The sites will be addressed, and ultimately de-listed, through innovative, streamlined, consensus-based strategies in a cost-effective, proactive manner.

St Js Rocks!

Community Involvement Programs

A Restoration Advisory Board (RAB) was established for the SJCA ER Program in 1999 to educate the community about ER activities at SJCA and encourage community involvement in the decision-making process. The SJCA RAB is co-chaired by a NAVFAC representative and a community member. The RAB meets twice a year to keep the RAB members informed of ongoing activities. Members are notified of upcoming meetings by email and mail, and the meetings are advertised in the local newspaper.

Agreements, Plans, and Associated Documents

The SJCA ER Program has multiple agreements and plans to guide management of the CERCLA program. Below is a list of key agreements and plans.

Table 1. Key Agreements and Plans

Agreement/ Plan	*Latest Version*
Federal Facility Agreement	Jul-2004
Community Involvement Plan	Mar-2015
Five-Year Review	May-2015
Site Management Plan	Dec-2016

Below is summary of the ER Program milestone documents that have been completed for SJCA.

Table 2. Milestone Documents Completed

Document	*Number Completed*
Record of Decision	6
Remedial Action Completion Report	1
Interim Remedial Action Completion Report	2
Five-Year Review	2
Preliminary Closeout Report	1

Summary of Accomplishments

Accelerated Environmental Cleanup

Construction Complete Milestone Achievement:
In May 2016, the ROD for the final site under investigation was signed. The Preliminary Closeout Report was signed in July 2016, two months ahead of schedule, signifying Construction Complete for the facility. The site-wide construction complete milestone is achieved when

physical construction of all cleanup actions are complete, all immediate threats have been addressed, and all long-term threats are under control for all portions of the site. SJCA is only the third Navy facility in the Mid-Atlantic region to achieve Construction Complete milestone. A ceremony was held in August 2016 to commemorate the milestone (Photo 1).

Photo 1 - SJCA Construction Complete Ceremony

IR Site 2 RA Optimization:
A RA was initiated at Site 2, Waste Disposal Area B, in 2012 to address potential risks to human and ecological receptors from exposure to waste and contaminants in shallow aquifer groundwater, soil, sediment, and surface water. The RA includes a soil cover, limited excavation, enhanced reductive dechlorination (ERD) (through emulsified vegetable oil [EVO] injections), monitored natural attenuation, land use controls, and a contingency permeable reactive barrier. RA-Construction was completed in 2014, at which time the RA-Operation phase was initiated. The RA-Operation phase includes groundwater monitoring to evaluate remedy effectiveness and additional EVO injections, as needed. Evaluation of RA-Operation phase groundwater data collected in January 2015 identified high concentrations of chlorinated volatile organic compounds (VOCs) extending further downgradient and into a deeper portion of the shallow aquifer than previously known. Therefore, the need for additional EVO injections was identified. The second phase of EVO injections was optimized by conducting a pre-design investigation in 2015 to refine the target treatment area, as opposed to making overly conservative assumptions on the size of the treatment area. Results of the investigation led to a reduction in the size of the injection area by 50 percent.

IR Site 21 RA Optimization:
A RA was initiated at Site 21, Industrial Area, in 2011 to address potential risks to human receptors from exposure to contaminants in shallow aquifer groundwater. The RA consists of in situ chemical reduction and ERD (as EVO injections) in the shallow aquifer groundwater and land use controls. RA-Construction was completed in 2012, at which time the RA-Operation phase was initiated. The RA-Operation phase includes groundwater monitoring to evaluate remedy effectiveness, storm water monitoring to evaluate whether groundwater with contaminants at concentrations of concern are migrating offsite through the storm drain system, vapor intrusion (VI) monitoring to evaluate whether the RA or changes in building conditions have resulted in potential unacceptable inhalation risks or explosive hazards, and additional EVO injections, as needed.

In 2015, a decision strategy was developed and implemented to optimize the initial RA-Operation phase monitoring approach. From the initial monitoring well network of 30 wells being sampled semi-annually for constituent of concern (COC) VOCs, indicator parameters, and arsenic: 4 wells have been removed from the monitoring network, 3 wells were reduced to

annual COC VOCs and arsenic monitoring, and 4 wells were reduced to annual arsenic monitoring only. The optimization has resulted in an approximate 30 percent analytical cost savings and the savings will increase over time.

In 2015, the RA-Operation phase VI monitoring approach was optimized to avoid unnecessary costs. After multiple rounds of data collection and the resulting refinement of the conceptual site model, it was determined the trigger for collection of indoor air samples was overly conservative. Therefore, a more representative trigger was established which has resulted in less sampling. Since the revisions, no indoor air sample collection has been required.

IR Site 4 Optimization:
A RA was conducted at Site 4, Landfill D, in 2005 to address potential risks to human and ecological receptors from exposure to waste and contaminants in soil and sediment. The RA consists of a soil cover with removal of wetland debris, removal of the eastern drainage ditch, and land use controls. Completion of the RA achieved the RA objectives and therefore, Response Complete for the site. Although no unacceptable risks associated with groundwater were identified in the ROD, nine voluntary post-ROD groundwater monitoring events were conducted to evaluate the site's impact on groundwater quality to confirm no potential future releases will pose unacceptable risk. The groundwater data were evaluated in the 2015 Five-Year Review. The Five-Year Review concluded the voluntary groundwater data indicate the landfill contents have not resulted in a release and/or mobilization of contaminants in the shallow aquifer groundwater. Based on the results of the groundwater evaluation and because groundwater monitoring is not needed to assess the protectiveness of the remedy and meet the RA objectives, discontinuation of the groundwater monitoring at the site was identified, and agreed to, as an area for optimization in the Five-Year Review. The decision is in accordance with the *Considerations for Developing Long-Term Monitoring Plans for Unpermitted Navy Landfills in Virginia* (Virginia-Navy Tier 2, 2014).

Innovative Technology Demonstration/Validation and Implementation

Site 2 Pre-Phase II EVO Injection Design Investigation:
The investigation conducted to refine the treatment area for the second phase of EVO injections utilized real-time, high resolution characterization tools. It consisted of conducting hydraulic profiling tool/electrical conductivity (HPT/EC) logging to evaluate the complex site lithology and potential preferential pathways, and collecting direct-push technology (DPT) groundwater samples and analyzing them in the field and at an offsite laboratory to evaluate select VOC concentrations in the target treatment area.

The combined HPT/EC is a real-time technology characterization tool used to evaluate changes in subsurface hydraulics/conductivity with depth. The HPT/EC is contained within a single probe which was driven into the ground using DPT (Photo 2). The output includes EC, HPT pressure, and flow rate vs depth (Photo 3).

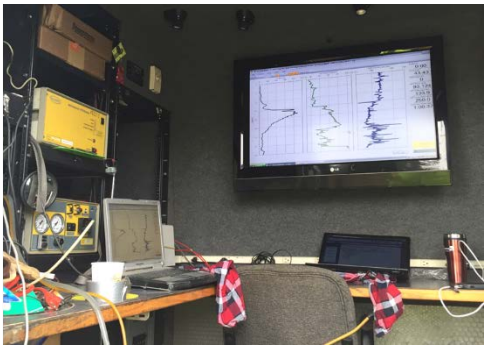

Photo 2 - HPT/EC Tool Use Photo 3 – HPT/EC

In general, high EC readings indicate clayey lithology and high HPT pressures indicate low permeability lithology. At each borehole where HPT/EC logging was conducted, three to four dissipation tests were conducted to approximate the absolute hydrostatic pressure. The dissipation test data were used in conjunction with the HPT pressures and flow rates to calculate corrected HPT pressure data and estimated hydraulic conductivity data with depth.

There are various clay and silt layers within the shallow aquifer and underlying confining unit at Site 2. To avoid creating potential pathways for contaminant migration to the deeper aquifer, a Direct Image Grout Sub tool was used in conjunction with HPT/EC probe to allow the borehole to be grouted from the bottom up as the DPT rods were pulled.

Groundwater samples were collected following identification of more impermeable layers identified by the HPT/EC logging. The samples were collected for analysis using the FROG-4000 portable gas chromatograph (GC) for select VOC COCs, to support decisions in the field. The FROG-4000 analytical instrument was developed by Defiant Technologies to analyze VOCs in water, air, and soil (Photo 4). Because the FROG-4000 is relatively new, split groundwater samples were submitted to an offsite laboratory for verification. Although groundwater samples were unable to be analyzed at the beginning of the investigation by the field GC due to technical difficulties, the problem was later resolved to the satisfaction of the project team. Following resolution of the technical difficulties, the FROG-4000 was able to effectively estimate concentrations of the CVOCs trichloroethene (parent compound) and cis-1,2-diochlorethene. This data was used to help select secondary (step-out and step-in) sampling locations while in the field. However, due to the earlier technical difficulties and because the FROG-4000 was unable to estimate vinyl chloride concentrations with reasonable certainty, additional verification samples were submitted to the off-site laboratory to meet the investigation objectives.

Photo 4 - FROG-4000

Partnerships Addressing Environmental Restoration Issues between DoD and other Entities

Through the partnering process, NAVFAC worked with the USEPA and VDEQ to develop a closeout strategy for IR Site 5 during the achievement period after several years of investigation, completion of a removal action, and disagreement on the path forward for groundwater. Through the partnering process, NAVFAC was able to meet with the regulators to discuss the groundwater concerns which resulted in limited additional investigation. Following the additional investigation, NAVFAC was able to reach consensus with the regulators for no further action for the site and the ROD was signed in 2016. As a result, 23 acres were returned to the facility for use without land restrictions.

NAVFAC continued to foster a positive relationship with the community during the achievement period by meeting with the RAB, updating the Community Involvement Plan, and identifying ways to enhance meaningful community involvement. The RAB meetings were held on a regular basis to ensure the community members were informed of the ongoing activities. The strongest attendance in the history of the RAB during the FY 2015 and FY 2016 site visits.

Photo 5 - May 2016 RAB Site Visit

Positive feedback was received from the RAB members during the achievement period, including the following from the RAB community co-chair, "In the 14 plus years that I have been the community co-chair for the St. J's RAB, I have always been impressed with the way each and every one of you have conducted the meetings and on-site visits. The St. J's RAB has been on track every step of the way and has accomplished what it set out to do. I've seen a lot of good things happening over here." The following actions were implemented during the achievement period to enhance the relationship with the community:

- A brief about the ER Program at SJCA was provided to the City Council
- RAB meetings were announced in additional media outlets
- Revisions were made to the SJCA ER Program public Web site to be more informative and user friendly
- A simplified version of the SJCA ER Program fact sheet was developed

Reducing Risk to Human Health and the Environment

IR Site 21 Groundwater Remediation:
The most recent RA-Operation phase groundwater monitoring results (2015) indicate significant contaminant reduction. The overall VOC plume area has been reduced by approximately 50 percent, from approximately 7.3 acres before the RA to approximately 3.5 acres. The plume area of the primary COC, trichloroethene, has been reduced by 96 percent from approximately 7.3 acres to approximately 0.3 acre (Figure 3).

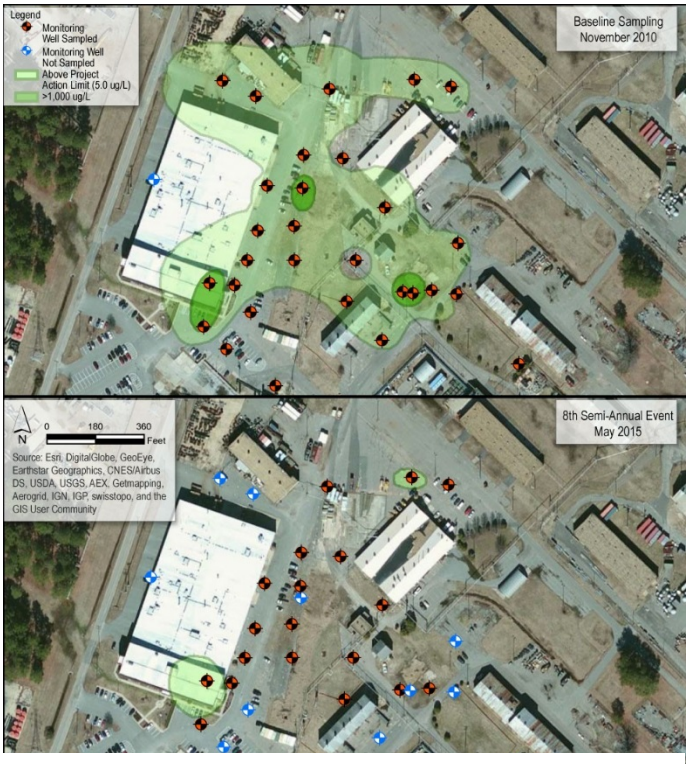

Figure 3 - Reduction in Trichloroethene in Site

IR Site 2 Groundwater Remediation:
The most recent RA-Operation phase groundwater monitoring results (2015) indicate significant contaminant reduction. Concentrations of the primary COC, trichloroethene, have decreased in 50 percent of the monitoring wells being sampled. Additionally, inclusion of

bioaugmentation in the groundwater remedy has prevented substantial generation of toxic daughter products in the groundwater.

Green Remediation

A green and sustainable remediation strategy was incorporated into the remedial design and RA work plan drafted in FY 2016 for the second phase of ERD injections at IR Site 2. The strategy includes implementing sustainability considerations through best management practices. Potentially applicable best management practices for the injections were identified and include conducting green and sustainable remediation field chartering, reduction of fuel usage and mobilizations, use of local field supplies, and distribution of electronic deliverables that do not require printing or shipping. The best management practices will be reviewed prior to site mobilization, while implementing the injections, and during post-injection activities.