2024 YEAR IN REVIEW

ACCOMPLISHMENTS OF THE NAVY ENVIRONMENTAL SUSTAINABILITY DEVELOPMENT TO INTEGRATION PROGRAM

MISSION OF THE NESDI PROGRAM

The mission of the NESDI program is to provide solutions by demonstrating, validating and integrating innovative technologies, processes and materials; and filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Fleet readiness. The program seeks to accomplish this mission through the evaluation of cost-effective technologies, processes, materials and knowledge that enhance environmental readiness of naval shore activities.

The NESDI program is the Navy's environmental shoreside Research, Development, Test & Evaluation (RDT&E) program. The NESDI technology demonstration and validation program is sponsored by Office of the Chief of Naval Operations (OPNAV) Compliance and Mission Readiness (N4I1) and managed by the Naval Facilities Engineering Systems Command (NAVFAC) out of the Engineering and Expeditionary Warfare Center (EXWC) in Port Hueneme, CA.

AVAILABLE FOR DOWNLOAD AT:

https://epl.navfac.navy.mil/nesdi (CAC enabled)

https://exwc.navfac.navy.mil/nesdi (public site)

INTRODUCTION

Welcome to the Navy Environmental Sustainability Development to Integration (NESDI) program fiscal year (FY) 2024 Year in Review report. This year marks an important transition for the program as we bid farewell to Ken Kaempffe, who has retired after a decade of dedicated service with the NESDI program. Ken's leadership, expertise, and commitment have left an indelible mark on the program, and we sincerely thank him for his contributions.

With Ken's retirement, we are pleased to welcome Clayton Ferguson as the new Program Manager. Clayton brings extensive experience in DoD program management and transitioning emerging technologies, and we look forward to his fresh perspective, his leadership and continued success in advancing NESDI's mission.

As we move forward, NESDI remains committed to supporting the Fleet and shore installations by identifying, funding, and transitioning technologies that enhance environmental compliance and operational sustainability. We appreciate your continued engagement and look forward to another year of impactful collaboration.

A WORD FROM THE NESDI PROGRAM MANAGER

I am honored to share my first Year in Review report as the NESDI Program Manager. Taking on this role is both an exciting opportunity and a responsibility I take seriously as we continue our mission of developing and integrating solutions to address the Navy's environmental challenges.

Before joining NESDI, I managed the National Defense Center for Energy and Environment (NDCEE) program, where I worked closely with DoD stakeholders to transition emerging technologies that improved operational sustainability and readiness. My background in environmental science, research, and program management has given me a deep appreciation for the critical role NESDI plays in addressing Fleet and installation environmental needs. I am committed to building upon the program's strong foundation by continuing to support high-quality projects, fostering collaboration with stakeholders, and ensuring that NESDI-funded solutions are effectively transitioned into operational use.

The unwavering support and guidance provided by our resource sponsor, OPNAV N4I1 Compliance and Mission Readiness Division, along with the leadership and expertise of our management team and the Technology Development Working Group (TDWG), have been pivotal to NESDI's continued success. Their commitment enables us to remain responsive to emerging environmental challenges while maintaining alignment with Navy priorities.

Looking ahead, we will continue to invest in critical areas such as Per- and polyfluoroalkyl substances (PFAS) remediation, alternative coatings and maintenance materials, stormwater management, and other key environmental challenges facing the Fleet and shore installations. At the same time, we recognize the importance of optimizing our project selection and execution processes and enhancing engagement with end users to ensure the successful transition of NESDI solutions into operational practice.

As we navigate an evolving fiscal and regulatory landscape, demonstrating the value of NESDI's investments remains more important than ever. Our resource sponsor and Navy leadership recognize the impact of our work, and we must continue delivering solutions that provide tangible benefits to the warfighter while ensuring environmental compliance and stewardship.

I look forward to working alongside our dedicated team, project investigators, and stakeholders across the Navy enterprise. Together, we

will ensure that NESDI remains a vital program that supports the Navy's mission while advancing environmental sustainability and compliance. Thank you for your continued support, and I hope you find this Year in Review report to be a valuable resource, offering comprehensive insights into our projects and highlighting our continued operational excellence and success in FY24 and beyond.

Clayton (right) receiving the Army Civilian Service Commendation Medal from COL Vance Brunner (left).

Clayton Ferguson

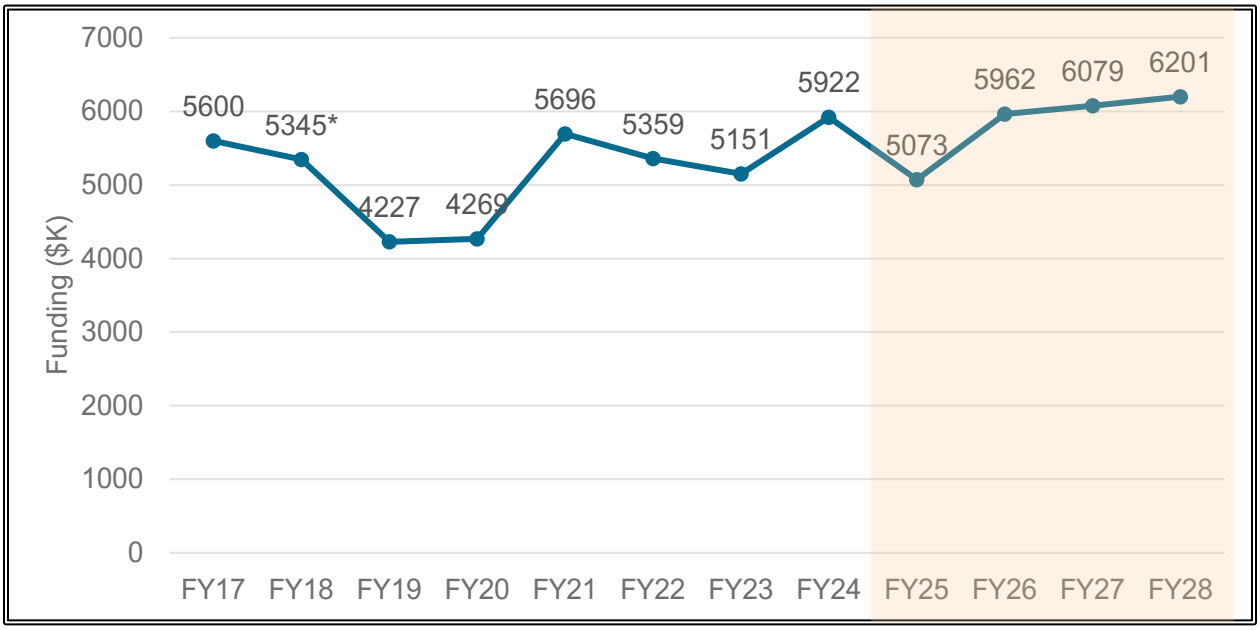
Program Manager

clayton.w.ferguson2.civ@us.navy.mil

TABLE OF CONTENTS

THE NUMBERS

Each year, the NESDI program allocates its investments based on requirements identified by end users throughout the Navy, as well as potential risks to the Navy's mission. The chart below illustrates the program's funding trajectory from fiscal year (FY) 2017 to 2024 and outlines the projected funding levels for FY26 through FY28, though future allocations may be subject to adjustment based on evolving priorities and budget considerations.



* Includes $598k Congressional funding

TYPES OF INVESTMENTS

The NESDI program encompasses a wide range of environmental research, organized into various environmental enabling capabilities (EECs; see below).

Range Sustainment

Mitigate environmental impacts and ensure efficient use of Navy training and testing ranges (e.g., long term fate of munitions constituents, Recycling Material Potentially Presenting Explosive Hazard (MPPEH), etc.)

Ship-to-Shore Interface

Management of hazardous materials offloading to shore (e.g., Ballast collection and treatment, oil skimming technologies, etc.)

Weapon System Sustainment

Aircraft and ship sustainment environmental challenges impacting *contested logistics* and enhancing operational resilience (e.g., Zn-Ni as a cadmium substitute, hexavalent chromium replacements, etc.)

Air & Port Operations

Enhance air and port operations for Fleet readiness (e.g., multi-cchemical detection systems, monitoring and remediation of Navy sediment sites near pier, etc.)

Regulatory & Base Operations

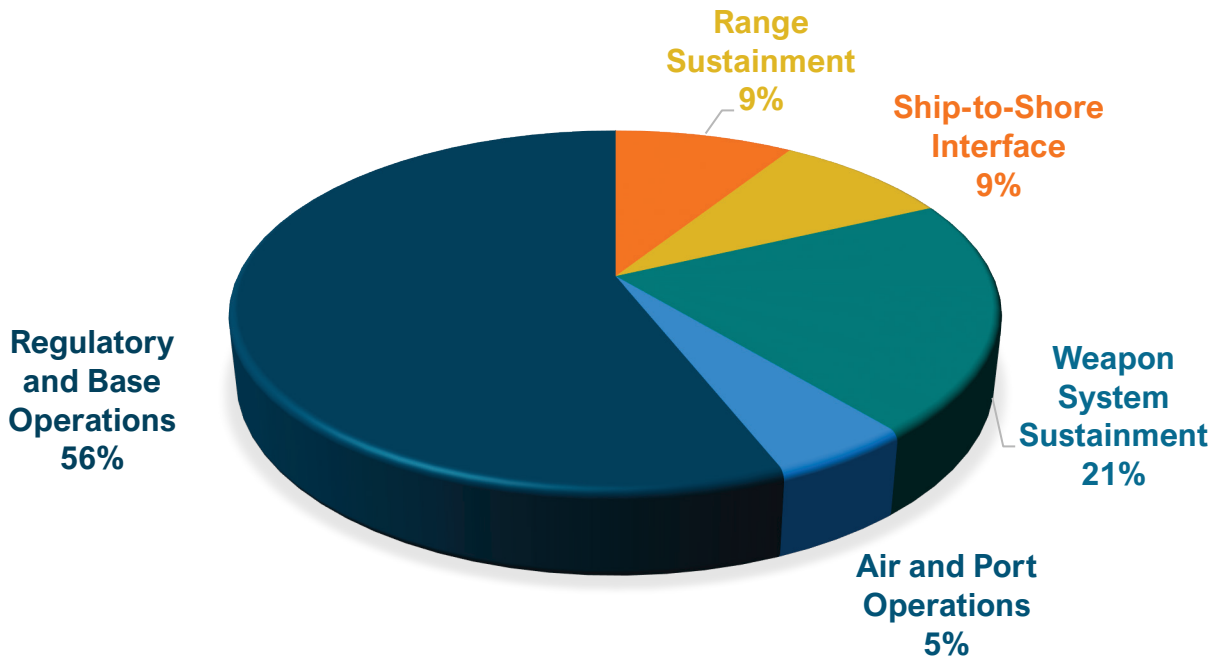
Development of cost-effective methods for managing environmental compliance (e.g., improved storm water runoff, detection and remediation of PFAS, etc.)

TYPES OF INVESTMENTS (CONTINUED)

As shown in the pie chart below, the NESDI portfolio over the past 15 years—since the launch of the website—has been largely focused on regulatory compliance and base operations. This category tackles key environmental challenges such as PFAS impacts, stormwater management, and vapor intrusion (VI), positioning NESDI as a leader in addressing both current and emerging chemicals of concern, including PFAS, microplastics, and heavy metals.

Additionally, NESDI projects focus on hazardous material/waste management, best management practices (BMPs) for vapor intrusion, and enhanced stormwater compliance at installations. The program also supports improved aircraft and ship sustainment solutions that promote safety and environmental sustainability by minimizing exposure to hazardous substances such as cadmium, hexavalent chromium, and cyanide compounds, as well as addressing materials potentially presenting explosive hazards (MPPEH).

Each EEC represents a critical focus area where the program drives innovation to address the Navy's environmental and operational challenges. The following definitions provide further insight into these capability areas and their role in supporting mission readiness and regulatory compliance.



NESDI CUSTOMERS

Our primary customers are Navy personnel, whose ability to effectively perform their duties is often impacted by environmental constraints. These constraints can arise from a variety of factors, including regulatory requirements, environmental protection standards, and the need to balance operational effectiveness with sustainability. NESDI delivers solutions that help mitigate these challenges, ensuring compliance while maintaining operational efficiency and fleet/Warfighter readiness.

Fleet Maintenance Personnel

Fleet Readiness Centers & Shipyards

Testing & Training Range Personnel

Members of Environmental Working Groups and Media Teams

Regional, Field Activity, & Installation Environmental Program Managers

CNO N4I1 Leadership & NAVFAC Headquarters

THE NESDI PROGRAM PROCESS

Each year, the NESDI program executes a four-phase process to identify Navy needs and transition viable solutions into operations and training activities. Throughout this process, the program's targeted customers —including need submitters, end users, technical authorities and other stakeholders — provide valuable input to develop meaningful needs, support the ongoing execution of individual projects, and help to ensure the successful integration of resultant technologies and other innovations.

FY24 NESDI PROCESS	
Needs	
Needs submitted	29
Needs approved	14
Proposals	
Pre-proposals submitted	11
Full proposals submitted	5
Projects	
Projects launched	5
% of Needs that become projects	17%

For FY24, this process began in August of 2023, when 29 Needs were received. After navigating the NESDI program process, and considering funding allotments, 5 new start projects were launched in FY24 as part of this process.

Key Dates:

→ *Full proposals due – 10 March 2025*

→ *In Progress Reviews – Spring 2025*

→ *FY26 Projects selected – Late Summer 2025*

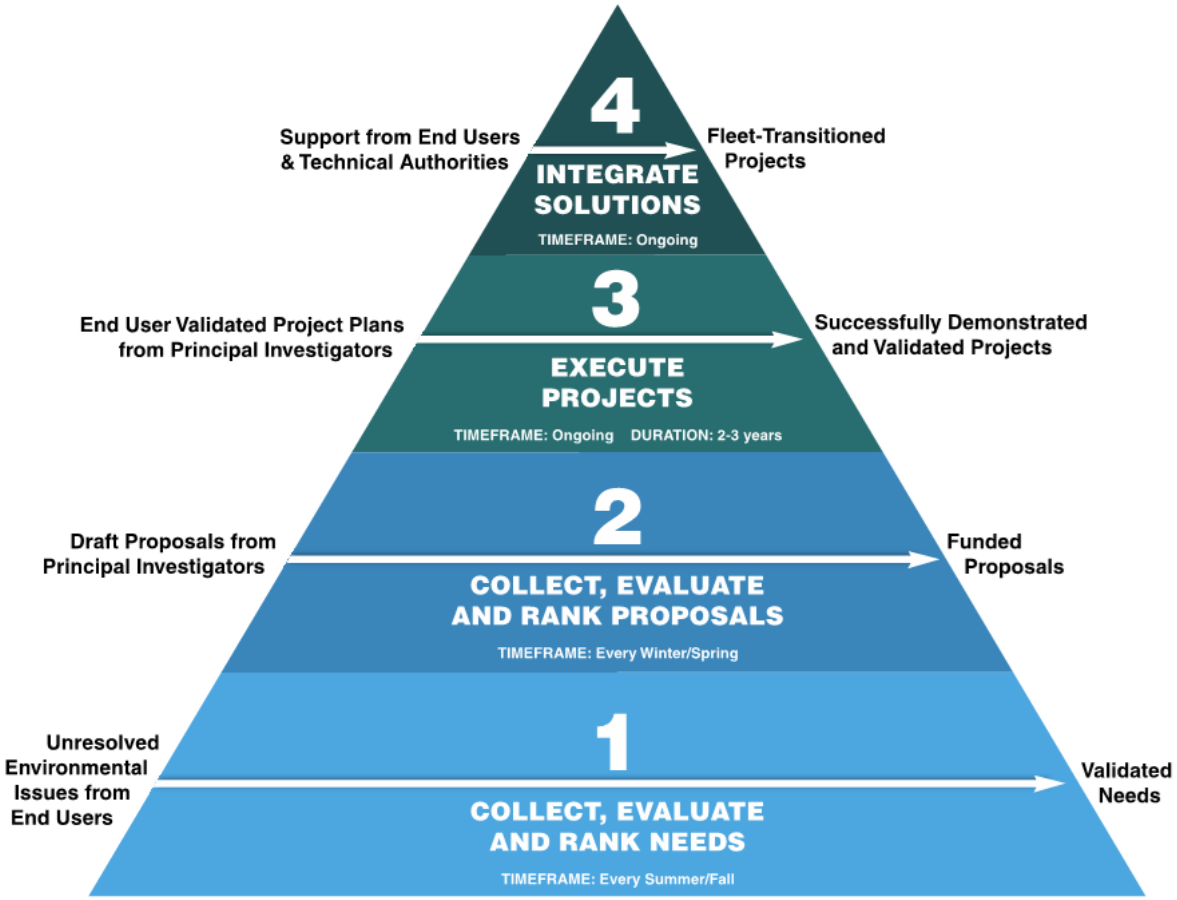
→ *Needs due for FY27 cycle – 01 August 2025*

Full NESDI schedule available on the CAC enabled website:

https://epl.navfac.navy.mil/nesdi

THE NESDI PROGRAM PROCESS (CONTINUED)

At the end of FY24, NESDI managed 46 ongoing projects and awarded 11 "new starts" which will gain momentum over the next year. This includes six projects that were approved in FY23 for a phased start in FY24. These new projects focus on key environmental challenges, including autonomous coastal monitoring systems, aluminum coating materials for reduced heavy metal exposure, passive samplers for PFAS detection for source identification, and alternative media for treatment of biological wastewaters.



PROJECT METRICS

NESDI's success continues to be measured primarily at the project level, tracking key milestones such as the development of publications, presentations, patents, and Cooperative Research and Development Agreements (CRADAs). These metrics, systematically recorded on the NESDI website, provide a comprehensive overview of the program's impact. The data below highlights NESDI's sustained contributions to environmental sustainability and mission readiness across the Navy.

FY24 METRICS	
Peer-reviewed publications	**2**
Patents Disclosures/Applications	**4**
Conference presentations	**23**

Peer-Reviewed Publications

A primary method by which our NESDI scientists disseminate their work is through peer-reviewed publications, such as those highlighted below.

Project No. 593: Evaluating Potential Effects to Marine Biota from Small-scale Legacy Radioactive Objects, led by EXWC scientist Nikki Andrzejczyk, Ph.D., supported the publication of a manuscript in the journal Science of the Total Environment. The journal prioritizes studies with a connected, multi-sphere approach, and field-based or methodologically innovative lab research.

S.E. Donaher, S. Estes, R.P. Dunn, A.K. Gonzales, B.A. Powell, and N.E. Martinez. 2024. Site- and species-specific metal concentrations, mobility, and bioavailability in sediment, flora, and fauna of a southeastern United States salt marsh. Science of the Total Environment. DOI: 10.1016/j.scitotenv.2024.171262

Project No. 572: Flexible Under Pier Sediment Assessment, led by NIWC scientist Jessica Carilli, Ph.D., published research on a simple and cost-effective solution developed to map generalized, georeferenced bathymetry underneath piers using an uncrewed surface vessel (USV). Her work was published in IEEE Journal of Oceanic Engineering, a journal focusing on science, engineering, and technology that pertains to all bodies of water, from concept design through to operational systems.

J.E. Carilli, R.A. Guazzo and A.R. Rodriguez. 2024. Applying an Uncrewed Surface Vessel to Measure Under-Pier Bathymetry. IEEE Journal of Oceanic Engineering. DOI: 10.1109/JOE.2024.3360515

Patents

The NESDI program is also committed to advancing innovation through the development and introduction of patents. Several NESDI-funded technologies are described below.

In FY24, Dr. Channing Bolt of NIWC Pacific submitted a patent disclosure for the "*In Situ* Leachate Assessment Dome" (NESDI Project No. 603) and the patent application was submitted and is currently awaiting review. The Dome system determines *in situ* leach rates on a variety of surfaces such as hulls, coated panels, and copper alloy materials used in aquaculture, to determine environmental loadings.

Mr. Denis Acosta of NAVFAC EXWC has a Continuation in Part (CIP) application for the LIPPS technology (NESDI Project No. 583). This is an update to a patent previously submitted (US 10899633 B1) on a modular porous swale filtration system that is an efficient and cost-effective apparatus that can remove chemicals of concern and suspended solids from storm water runoff.

First developed during NESDI Project No. 578, managed by Mr. Nick Hayman of NIWC Pacific, the Sorbent Onsite Testing Apparatus (SOTA) was submitted for patent application in FY24 (application #18/496,861). His technology will allow for on-site sorbent selection for the remediation of PFAS impacted groundwater.

Mr. Brandon Swope of NIWC Pacific, submitted an updated patent disclosure for a previously awarded patent (US 20220213677 A1) for the In-Pipe Storm Water Filter technology that was developed under Project No. 576. This technology is for filtering stormwater in an outfall pipe by removing and reducing particles and/or chemicals of concern.

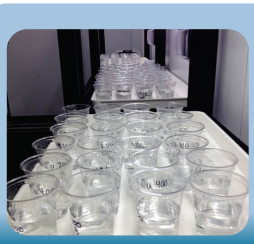
Presentations

One of the means for communicating the successes of our NESDI scientists and their efforts is through scientific presentations. Several presentations were delivered over the past year, and a few highlighted ones are described below.

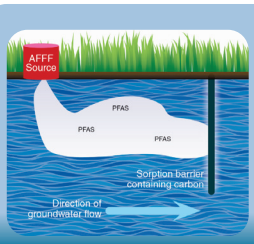
EXWC scientist, Hunter Klein, led a presentation of his NESDI Project (Project No. 607: Artificial Intelligence for Environmental Compliance) at a Federal Remediation Technologies Roundtable (FRTR) at the USEPA headquarters in Washington D.C. This meeting explored applications of artificial intelligence (AI) and machine learning (ML) concepts to provide advanced chemicals of concern plume characterization and predictive modeling, and improved cleanup efficiency at cleanup sites.

NAVAIR scientist, Patrick Fedick, Ph.D., presented at multiple universities over the past year describing advancements made on his NESDI project (Project No. 605: 3D-Printed Cone Spray Ionization Mass Spectrometry for the Rapid, Low-Cost and In-Situ Detection and Mapping of PFAS in Soil). Both faculty members and graduate students received this information, with the presentations offering valuable opportunities to not only share ongoing research conducted by Dr. Fedick, but also guide aspiring scientists on how to engage with research at the Naval Air Warfare Center Weapons Division and the NESDI program.

NIWC scientist, Molly Colvin, presented the successes of her NESDI project to both Puget Sound Naval Shipyard stakeholders and the USEPA Region 10 NPDES/CERCLA Taskforce (Project No. 595: Demonstration of a Signal Activated Bottom Lander Trap). Her presentation offered an overview of the development and application of a tiered approach for predicting sediment impacts from industrial point source discharges, utilizing the NESDI-funded technology that Ms. Colvin managed.



NIWC scientist, Nick Hayman, led several presentations highlighting his important work on NESDI Project No. 601: Chronic Toxicity and Bioaccumulation Evaluation of Multiple PFAS for Benthic and Pelagic Species Relevant to Marine Ecological Risk Assessment. These presentations were delivered at various venues, including the Society of Environmental Toxicology and Chemistry (SETAC), the Department of Defense (DoD) Innovation Symposium, and a DoD-hosted PFAS-specific symposium. The audiences for these presentations included academics, industry professionals, regulatory bodies, and DoD and Navy stakeholders.

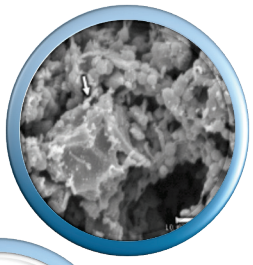


EXWC scientist, Tony Danko, Ph.D., led two presentations of his NESDI Project (Project no. 569: Field Demonstration of Colloidal Activated Carbon for In-situ Sequestration of Per- and Polyfluoroalkyl Substances). One presentation was given at the Battelle Sediments Conference which is a forum for sharing results among public- and private-sector organizations. The second presentation was delivered to the NAVFAC Base Realignment and Closure (BRAC) Program.

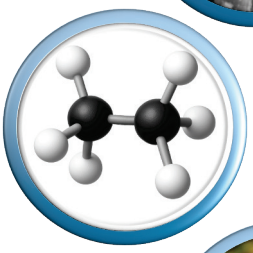
2024 "NEW START" PROJECTS

The NESDI program launched eleven "new start" projects this past year. This includes six projects that were approved in FY23 for a phased start in FY24.

(Click on image to link directly to project description)

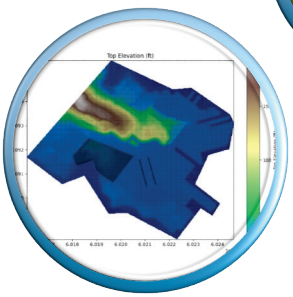


Project No. 625 - Innovative Solution for Passive Management of Low-Risk Light Non-Aqueous Phase Liquid (LNAPL) Sites by Biochar-Enhanced Natural Source Zone Depletion

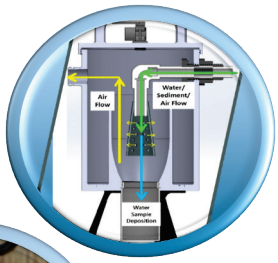


Project No. 626 - Evaluation of the Mechanisms Driving Persistence of Low Concentrations of Chlorinated Ethenes and Ethanes at Legacy Bioremediation Sites

Project No. 627 - Autonomous Multi-Sensor Coastal Site Monitoring System



Project No. 628 - Evaluation of Resiliency of Coastal Environmental Restoration Sites from the Impacts of Natural Hazards



Project No. 629 - Assessing emerging chemicals of concern and loading from Navy industrial surfaces

Project No. 630 - Passive Samplers for Improved PFAS Source Identification

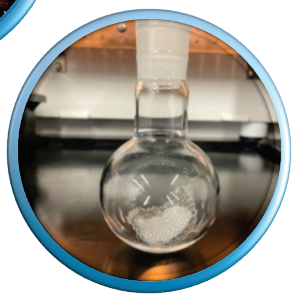
(Click on image to link directly to project description)

Project No. 631 - *Ex-Situ* Stabalization of PFAS-Impacted Soils and Sediments

Project No. 632 - PFAS Sensor Multi-Site Field Demonstration

Project No. 633 - Aerobic Granular Sludge-based Biological Wastewater Treatment Innovation to Reduce Impacts from Extreme Storm Flow

Project No. 634 - Aluminum Conversion Coating Materials as a Trivalent Chromium Post-Treatment for IVD and Cadmium Coatings



Project No. 635 - Boron Nitride Nano-Photocatalyst Membrane Filters for the Degradation of Aqueous PFAS to CO_2 and Fluoride

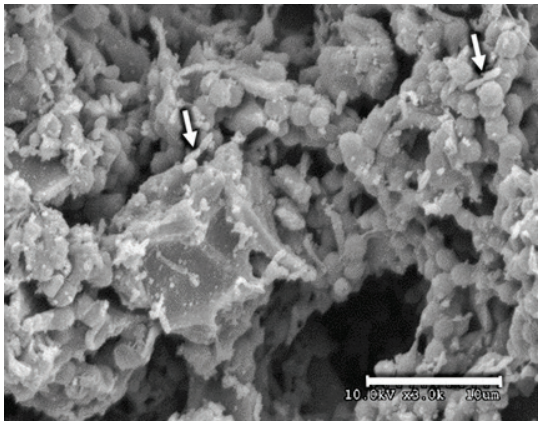
Fact sheets for the news starts are available online at:
https://exwc.navfac.navy.mil/nesdi

The following FY24 new start projects represent NESDI’s latest efforts to address critical operational and environmental challenges across the Navy. Each initiative is designed to deliver practical, fleet-ready solutions that enhance efficiency, sustainability, and compliance. Below is a brief overview of each project, highlighting its objectives and expected impact.

Innovative Solution for Passive Management of Low-Risk Light Non-Aqueous Phase Liquid (LNAPL) Sites by Biochar-Enhanced Natural Source Zone Depletion (Project no. 625)

PRINCIPAL INVESTIGATOR: Jovan Popovic, Ph.D., EXWC

The Navy manages numerous sites impacted by light non-aqueous phase liquids (LNAPL). While active recovery methods are currently used, they are not a cost-effective long-term solution, prompting the search for passive alternatives. This project aims to demonstrate the use of engineered biochar from biowaste to enhance natural source zone depletion (NSZD) of LNAPL. Goals include identifying key biochar properties, developing standardized field protocols, and quantifying the potential reduction in remediation time and costs.



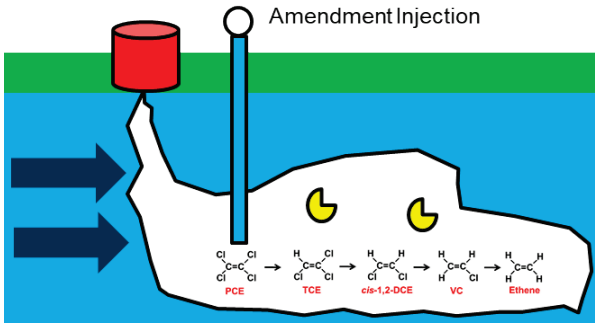
Scanning Electron Microscope (SEM) image of biochar with surface-localized, iron-respiring microbes participating in electron transfer interactions with the biochar material. (Photo credit: Jovan Popovic, PhD)

Evaluation of the Mechanisms Driving Persistence of Low Concentrations of Chlorinated Ethenes and Ethanes at Legacy Bioremediation Sites (Project no. 626)

PRINCIPAL INVESTIGATOR: Tony Danko, Ph.D., EXWC

The project aims to determine why certain harmful chemicals (such as 1,2-Dichloroethylene or Vanadium (IV) carbide, and chloroethane) are persistent at impacted sites, especially looking at how different forms of sulfur impact the reductive dechlorination of chlorinated volatile

organic compounds (CVOCs). The goal is to create a decision matrix to help Navy RPMs assess whether continued bioremediation is feasible or if alternative remedies are needed.



Graphic of impacted groundwater site with transformation pathway of CVOCs using bioaugmentation (amendment injection of dechlorinating bacteria). (Image credit: Tony Danko, PhD)

Autonomous Multi-Sensor Coastal Site Monitoring System (Project no. 627)

PRINCIPAL INVESTIGATOR: Leslie Bolick, Ph.D., NIWC Pacific

This project will develop and demonstrate an unmanned aerial vehicle (UAV) coastal monitoring system that uses multiple sensors to remotely gather data and collect information from underwater sensors. By combining remote sensing and geospatial analysis, the system will deliver accurate, up-to-date information on site conditions, including coastal ecosystem data. The goal is to improve natural resources management while reducing costs and risks compared to traditional on-site monitoring.

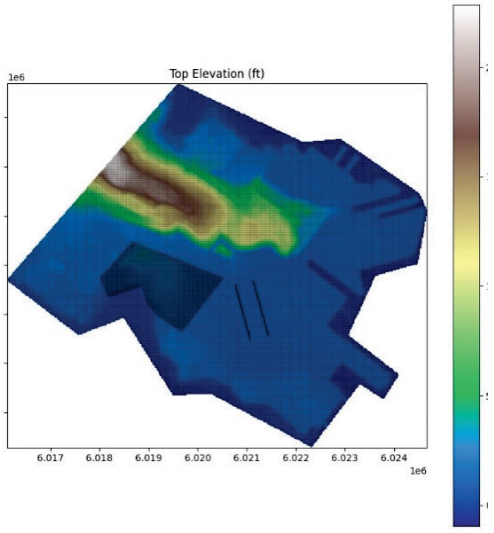
UAVs can access coastal sites more efficiently and generate higher quality data for near-shore and coastal site monitoring. (Photo credit: Leslie Bolick, PhD)

Evaluation of Resiliency of Coastal Environmental Restoration Sites from the Impacts of Natural Hazards (Project no. 628)

PRINCIPAL INVESTIGATOR: Erika Beyer, EXWC

The objective of this project is to develop a monitoring and computer modeling framework that will reliably predict the impact of changing coastal and groundwater conditions on Navy environmental restoration (ER) sites undergoing long-term groundwater and soil monitoring. Using a combination of long-term monitoring and computer models that track groundwater flow and the movement of particles underground, we will determine whether water will flow primarily horizontally or vertically in areas with residual

chemicals of concern. This will give the installation's environmental managers the tools they need to understand and visualize potential future risks.

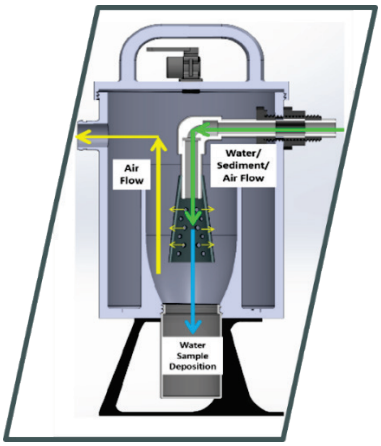


Preliminary model mapping potential groundwater flow at a near-shore installation. (Image credit: Erika Beyer)

Assessing emerging chemicals of concern and loading from Navy industrial surfaces (Project no. 629)

PRINCIPAL INVESTIGATOR: Nick Sarracco, NIWC Pacific

Water managers at Navy industrial facilities need reliable tools to accurately identify and measure chemicals destined for effluent streams and subsequently receiving water bodies. These discharge points are regulated under the Clean Water Act (CWA), and the Navy anticipates that CWA permit guidelines will soon include labile microplastics, which have a significant impact on water bodies. The objective of this project is to demonstrate and validate reliable sampling techniques and technology along with analytical methods to assess the potential chemicals loading associated with tire-wear particles (TWP) prior to these materials entering into the storm drain system.



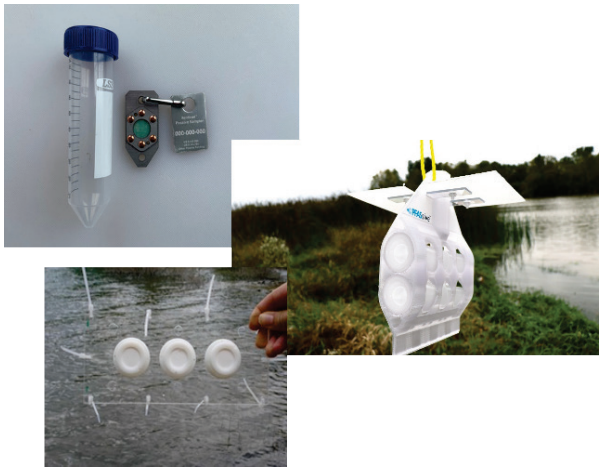
Schematic image of the water vacuum sampling system (WRASSE) for the collection of samples for determination of chemical loading on impervious surfaces. (Image credit: Nick Sarracco)

Passive Samplers for Improved PFAS Source Identification (Project no. 630)

PRINCIPAL INVESTIGATOR: Nick Hayman, NIWC Pacific

The Navy needs to identify per- and polyfluoroalkyl substances (PFAS) sources to prioritize treatment and optimize required funding at PFAS impacted sites. PFAS fingerprinting is a promising approach, but the required data quality for accurate fingerprinting (e.g. minimum

detection limits, number of PFAS detected) is challenging to meet with traditional sampling strategies, especially with regards to sampling in the vadose zone (areas of soil/sediment located above the groundwater table). This effort aims to demonstrate and evaluate promising PFAS passive sampling technologies for monitoring the vadose zone.



A variety of passive samplers for the detection of PFAS will be evaluated (Photo credit: Nick Hayman)

Ex-Situ Stabilization of PFAS-Impacted Soils and Sediments (Project no. 631)

PRINCIPAL INVESTIGATOR: Jovan Popovic, Ph.D., EXWC

The pervasive use of PFAS across municipal, military, and industrial spaces, including fire-fighting activities using aqueous firefighting foam (AFFF), has resulted in extensive impacts in soils and sediment, which act as long-term sources of impacts to stormwater, surface water, and groundwater. Stabilization and/or solidification (S/S) methods have been shown to be a practicable, cost-efficient remediation method for remediation of chemicals of concern compared to alternatives such as disposal in non-hazardous or hazardous waste landfills, but the application of S/S for PFAS remediation has yet to be fully evaluated. This project's objective is to demonstrate the S/S remediation technique, for ex-situ treatments of PFAS-impacted soils and sediments.

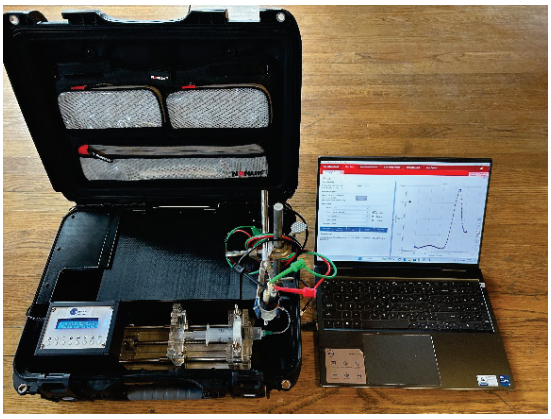
Soils/sediments from Navy facilities will be fully characterized and tests will evaluate effectiveness of amendments. (Image credit: AI generated)

PFAS Sensor Multi-Site Field Demonstration (Project no. 632)

PRINCIPAL INVESTIGATOR: Ramona Iery, Ph.D., EXWC

Current field screening tools can assess conventional chemicals of concern in groundwater and surface water, but not PFAS, limiting quick and cost-effective site assessments. While EPA Method 1633 provides

reliable detection for PFAS, it is costly and takes upwards of 4-6 weeks to realize results. A field screening tool for PFAS would save the Navy time and money on investigations, remediation, and long-term monitoring. This NESDI project aims to validate 2Witech Solutions' PFAS screening system, and to test its effectiveness in real-world conditions for faster and cheaper PFAS assessments.



PFAS Analyzer by 2wiTech Solutions that will be field demonstrated for in situ detection of PFAS. (Photo credit: Ramona lery, PhD)

Aerobic Granular Sludge-based Biological Wastewater Treatment Innovation to Reduce Impacts from Extreme Storm Flow (Project no. 633)

PRINCIPAL INVESTIGATOR: Hunter Klein, EXWC

The primary cause of exceedances in a wastewater treatment facility’s (WWTF) secondary effluent discharge limits during high inflow events, typically caused by extreme storms, is hydraulic overload or "washout" of mixed-liquor suspended solids from the aeration process, overwhelming the secondary clarifiers. The goal of this effort is to demonstrate that a combined AGS (Anoxic-Growth Sludge) and MBR (Membrane Bioreactor) wastewater treatment system can handle high flow events from extreme wet weather without washout of the necessary biological material, ensuring the effluent meets secondary discharge limits. Successful demonstration of this system will provide the DoD with an effective, robust and efficient way of treating wastewater and avoiding washout during peak influent flows.

Wastewater treatment facility (WWTF) at Joint Base Pearl Harbor-Hickam (JBPHH) will be the demonstration site for this effort. (Photo credit: NAVFAC HI Fact Sheet- July 2020)

Aluminum Conversion Coating Materials as a Trivalent Chromium Post-Treatment for IVD and Cadmium Coatings (Project no. 634)

PRINCIPAL INVESTIGATOR: Josh Walles, NAVAIR

Current processes utilized for protecting Navy assets can include Aluminum Ion Vapor Deposition (IVD) and Cadmium Electroplating. However, these processes need a special post-treatment to improve corrosion resistance which uses carcinogenic hexavalent chromium compounds. The objective of this project is to optimize and demonstrate the use of trivalent chromium for post-treatment. Successful performance demonstrations will allow for implementation and transition to these alternatives for a more human health and environmentally friendly method without sacrificing performance.

Vacuum chamber used for IVD processes. (Photo credit: Josh Walles)

Boron Nitride Nano-Photocatalyst Membrane Filters for the Degradation of Aqueous PFAS to CO_2 and Fluoride (Project no. 635)

PRINCIPAL INVESTIGATOR: Patrick Fedick, Ph.D., NAVAIR

Recent studies highlight the significant downstream challenges of remediating PFAS through incineration. Many emerging PFAS remediation technologies are either expensive or only focus on PFAS separation, leaving the chemicals intact. This project aims to optimize a photocatalytic degradation system to break down PFAS into CO_2 and inorganic fluoride across various PFAS-impacted waste streams, such as impacted drinking water, saltwater, bilge water, and AFFF concentrates. Successful completion of this effort will enable efficient PFAS remediation across a wide array of waste streams with built in on-line analytics.

Flow reactor that will be used in the demonstration of photocatalytic degradation of PFAS. (Photo credit: Patrick Fedick, PhD)

FY24 PROJECT ACCOMPLISHMENTS

In this section of the Year in Review report, we highlight the projects that realized notable accomplishments over the course of this fiscal year.

A word from the PM:

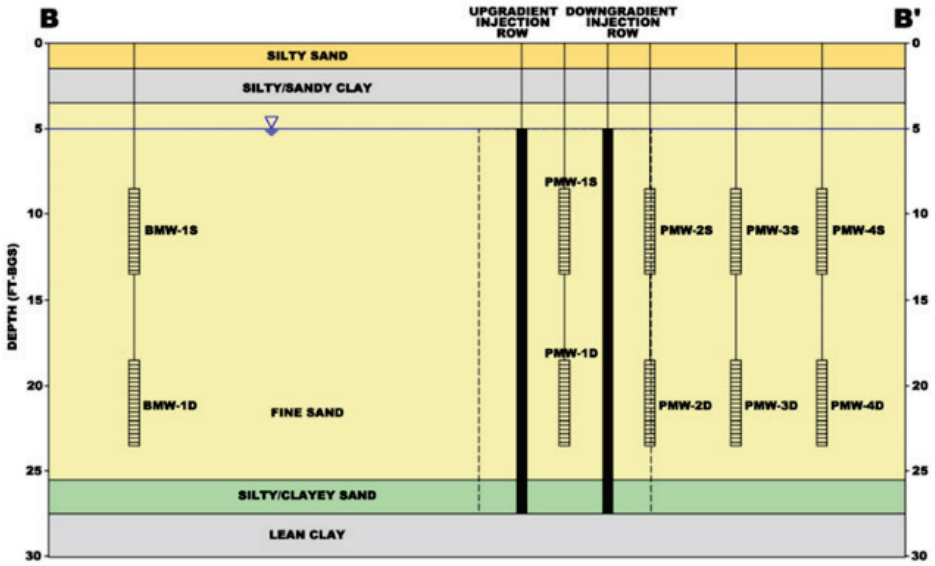
Although I am still relatively new to the program, I have already encountered several project accomplishments that have greatly impressed me. Their achievements highlight the exceptional expertise and technical advancements within the NESDI program. The progress made in these areas is truly remarkable, and it's clear that a great deal of skill and innovation has been applied to reach such milestones. In particular, I would like to emphasize the outstanding efforts of the following projects, which not only align with the program's mission but also exemplify the impactful work that is advancing our objectives and contributing to the Navy's environmental sustainability.

Field Demonstration of Colloidal Activated Carbon for In Situ Sequestration of Per- and Polyfluoroalkyl Substances (Project no. 569)

PRINCIPAL INVESTIGATOR: Tony Danko, Ph.D., NAVFAC EXWC

PFAS chemicals have impacted DoD sites largely through their use in aqueous film-forming foams (AFFF), and transport of PFAS into soil, vadose zone and groundwater as well transformation products have impacted over 750 groundwater wells to date. Several ex-situ remediation methods exist for aqueous solutions, but in situ remediation approaches for groundwater sites are lacking. The objective of this project is to demonstrate and validate the field application of colloidal activated carbon for *in situ* remediation and reduction of further PFAS plume expansion.

In the past year, this project has proven through field demonstrations that colloidal activated carbon injected into a PFAS-impacted aquifer can significantly reduce concentrations with up to 96.8% reduction in the



Schematic of injection (black bars) and sampling (hashed bars) sites at a PFAS impacted site. (Image credit: Tony Danko, PhD)

shallow screened zone and a 96.3% reduction in a deep screened zone. It proved that the colloidal activated carbon could capture long-chain PFAS *in situ* for groundwater, helping to mitigate plume expansion.

These results showcase the progress of these methods and technologies that can support site assessments and remedial investigations, ultimately reducing costs associated with long term site management.

In-Pipe Stormwater Treatment System (Project no. 576)

PRINCIPAL INVESTIGATOR:
Brandon Swope, NIWC Pacific

Stormwater best management practices (BMPs) are important to help ensure safety, environmental protection and regulatory compliance in shipyards and are typically separate from existing drainage infrastructure. However, BMPs can potentially take up precious space at shipyards, creating logistical challenges and limiting space for other mission essential activities in the shipyard. The objective of this effort was to evaluate the efficacy of a novel in-pipe treatment system to aid stormwater permit compliance while not interfering with any top-side activities. Investigators successfully demonstrated, validated and then transitioned a newly commercialized version of the in-pipe stormwater BMP, I-Stub, to the Puget Sound Naval Shipyard where multiple units are being deployed throughout the shipyard for stormwater control. A few design modifications were made to further optimize the system and a revised patent for the system (U.S.

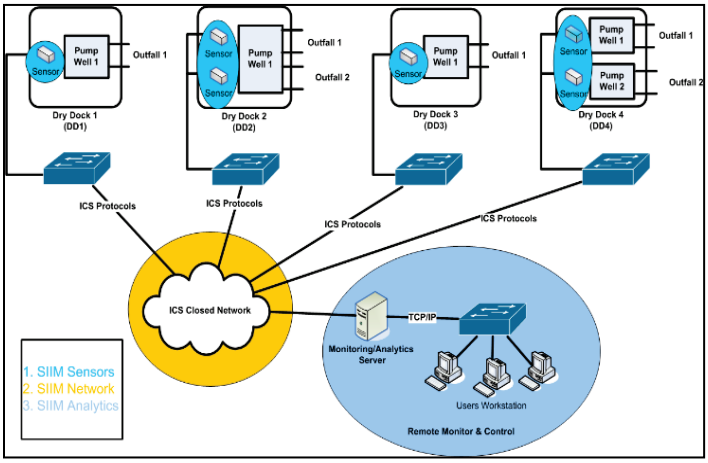
patent no. 11459744) was submitted this past year.

Deployment of I-Stub units within stormwater conveyance system at Puget Sound Naval Shipyard. (Photo credit: Brandon Swope)

Sensor Interface and Infrastructure for Monitoring (SIIM) (Project no. 582)

PRINCIPAL INVESTIGATOR: Lewis Hsu, Ph.D. / Henry Au, NIWC Pacific

Navy environmental program managers ensure waste and discharges from Navy facilities meet legal standards. At many locations, workers manually monitor waste quality, which is time-consuming and resource intensive. While requirements vary by facility and agency, accurately gathering waste data is a common challenge. Investigators for this project have developed an integrated approach with sensors allowing for near real-time monitoring of outfalls and other dry-dock operations. In this past year, the project team was able to opportunistically deploy sensors and infrastructure to support monitoring while the cruise ship Pride of America was docked at the Pearl Harbor Naval Shipyard (PHNS). These efforts monitored for discharge exceedances and ensured compliance with monitoring requirements. Once this effort is complete, PHNS intends to assume responsibility for the equipment and ongoing maintenance of the technology.



Schematic of SIIM network including sensors, network infrastructure and ultimately the remote monitoring and controls stations at the shipyard environmental offices. (Image credit: Henry Au)

Low-Profile Integrated Porous Pretreatment Swale (LIPPS) (Project no. 583)

PRINCIPAL INVESTIGATOR: Denis Acosta, NAVFAC EXWC

This project has made significant strides this past year with site excavation and the installation of

this advanced BMP for stormwater runoff capture and treatment at Puget Sound Naval Shipyard (PSNS). Industrial stormwater discharges often contain heavy metals and other chemicals of concern, which, if released into nearby water bodies, can pose environmental risks and negatively affect operational readiness due to non-compliance with regulatory standards. The LIPPS technology features a porous concrete swale that, once fully installed, will capture surface debris and allow runoff to percolate through to a site-customized media bed below. This media bed effectively treats the stormwater runoff before it enters the existing stormwater conveyance system. While other BMPs, such as bioswales (planted areas), can also address stormwater runoff, the LIPPS system offers distinct advantages. It is specifically designed to withstand industrial vehicle traffic in high-traffic areas and preserve valuable space in environments where land is limited. This innovative solution provides an effective and durable approach to managing stormwater in such critical settings.

Installation of LIPPS at PSNS for the capture and treatment of stormwater runoff. (Photo credit: Denis Acosta)

Development and Implementation of Methods to Reduce Sealant Waste in Fleet/Depot Level Operations (Project no. 580)

PRINCIPAL INVESTIGATOR: Diane Kleinschmidt, NAVAIR

Sealants are important materials for maintaining not only naval aircraft, but also weapons and support equipment. An aspect of the issue is that sealants often have short shelf lives, and by the time they reach their expiration date, they may still be perfectly usable. Manufacturer shelf life is not necessarily an accurate measure of the "condition" of the material, resulting in large volumes of material being scrapped unnecessarily. This NESDI project developed test protocols and models to assess sealant conditions

and determine shelf-life expectancy. This effort has enabled Fleet maintainers to extend the shelf life of polysulfide and polythioether sealants by an additional three months, regardless of storage temperature. This extension not only reduces hazardous waste but also enhances the readiness and availability of fleet assets, significantly improving operational efficiency.

Sailor applies sealant to the leading edge of a wing panel of a P-3C Orion. (Photo credit: Petty Officer 2nd Class Julian R. Moorefield)

Integrated Analytical Approach to Transition from Active to Passive Treatments at Munitions Sites (Project no. 596)

PRINCIPAL INVESTIGATOR: Tony Danko, Ph.D., NAVFAC EXWC

The Navy has numerous sites where munitions constituents (MCs), such as RDX, need remediation and more than 70 pump and treat systems ("P&T") currently in use for cleanup activities. However, these are costly to operate and maintain and are increasingly inefficient. Newer, passive methods include proteomics/bio-stimulation to enhance monitored natural attenuation (MNA), which is much more cost-effective. This NESDI effort worked with site managers at Naval Base Bangor to expand upon a list of potential RDX-degrading microorganisms using metagenomic sequencing. Naturally abundant microorganisms were found in groundwater wells and microcosm studies confirmed RDX degradation was biologically driven. It also confirmed there is a high likelihood of RDX degradation currently going on at the site. These findings support a case to cease P&T activities through the Record of Decision (ROD) Amendment (RODA) process, potentially providing significant cost savings to the Navy.

Unexploded ordinance (UXO) can leak munitions constituents such as RDX into groundwater leading to the need for remediation. (Photo credit: Cpl. Breanna L. Weisenberger)

Evaluating Potential Effects to Marine Biota from Small-scale, Legacy Radioactive Objects (Project no. 593)

PRINCIPAL INVESTIGATOR: Nicolette Andrzejczyk, Ph.D., NAVFAC EXWC

Discrete radioactive particles are small, often microscopic, materials that can occasionally be found in the marine environment at Department of Navy sites. These particles typically originate from items aboard Navy ships, such as radium-painted dials or paint chips, either discarded accidentally or prior to regulations requiring special handling. This project was initiated to assess the potential impact of small-scale radioactive objects, such as those containing radium, on marine biota in areas relevant to the U.S. Navy. Over the past fiscal year, the project team has developed a comprehensive geochemical model that accurately describes the behavior of radium at remediation sites, including the leach rates from these items. Site managers will ultimately be able to use this model to predict radium concentrations in soils, sediments, and waters, as well as establish toxicity thresholds. This will provide the Navy with additional tools to evaluate risk levels and make informed decisions regarding disposal strategies.

Radium painted dials like the one on this ship's clock can contain small, usually microscopic, radioactive particles and are sometimes found in the marine environment at Department of Navy locations. (Photo Credit: Compliments of Currents magazine)

Demonstration of a Signal Activated Bottom Lander Trap – SABL (Project no. 595)

PRINCIPAL INVESTIGATOR: Molly Colvin, NIWC Pacific

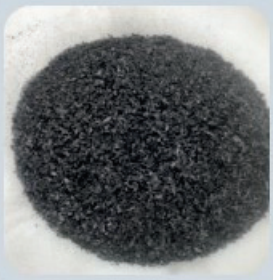
Determining the sources of impacted sediments from chemicals of concern in coastal bays and harbors is complex and sites identified for remediation often face recontamination due to various environmental factors. Currently, most impacted sediment sites use passive, diver-deployed sediment traps to capture particles as they settle to the seafloor, which are limited as they cannot differentiate between depositions from specific

events (e.g., storms, dredging, ship activities). This NESDI project successfully developed and demonstrated a robust, multi-sample sediment trap known as the signal activated bottom lander, or SABL, which can be deployed/recovered without diver assistance and when paired with real-time water quality sensors, can be triggered remotely to capture discrete deposition events. Following successful NESDI-funded demonstrations at both Naval Base San Diego (NBSD) and Puget Sound Naval Shipyard (PSNS), the SABL has transitioned to PSNS for further monitoring efforts to support NPDES stormwater compliance and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites. Better data generated from the SABL translates into more informed strategies for mitigation and intervention for site managers, as well as a deeper understanding of the long-term environmental impact of sediment transport.

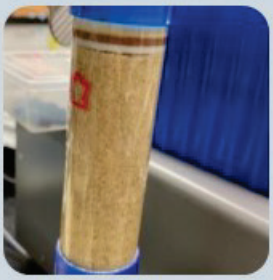
Deployment of the SABL adjacent to an outfall at PSNS for the duration of a storm season. (Photo credit: Molly Colvin)

PROJECT CLOSEOUTS

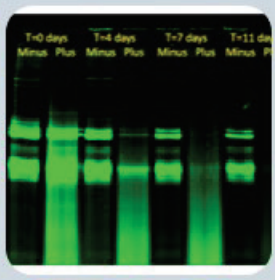
In FY24, we successfully closed out seven NESDI projects, each of which demonstrated significant impact and innovation. The completion of these projects not only advanced the NESDI mission but also contributed to improving operational efficiencies, enhancing environmental sustainability, and supporting the overarching goals of the NESDI program. For additional information regarding any of the projects listed below, please contact the NESDI Program.



Project No. 560
- Lewis Hsu, Ph.D., NIWC Pacific
- Biochar Adsorption for Dry Dock Effluent



Project No. 577
- Ben Rhiner, NAVFAC EXWC
- Demonstrating the Use of a Novel, Hybrid Polyelectrolyte/ Hydrophilic Polymer for In-situ PFAS Treatment Applications

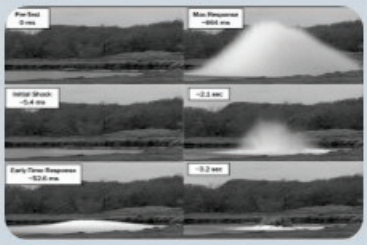


Project No. 579
- Tony Danko, Ph.D., NAVFAC EXWC
- In-situ Biodegradation of 1,4-Dioxane and Chlorinated Solvent Mixtures in Dilute Plumes

Project No. 590
- Kami Carter, NAVAIR FRC-SE
- Dry Ice Paint Removal and Cleaning

Project No. 591
- Joey Trotsky, NAVFAC EXWC
- Locating and Quantifying Groundwater Surface Water Connections Using Distributed Temperature Sensing

Project No. 588
- Ron Gauthier, NIWC Pacific
- Effluent Copper Quantification by Optical or Voltametric Detection and Analysis



Project No. 592
- Alexa Hairabedian, NAVFAC EXWC
- Demonstration of the Robust Caisson Structure to Reduce Blast Effects from Underwater Blow-In-Place

FOR MORE INFORMATION

For more information about the operation of the NESDI program, contact Clayton Ferguson, the NESDI program manager, or members of the TDWG.

Name	Command	Phone	Email
Ferguson, Clayton (Program Manager)	NAVFAC EXWC	805-982-2572	clayton.w.ferguson2.civ@us.navy.mil
Bixler, Christy	CNIC HQ	202-685-9313	christy.d.bixler.civ@us.navy.mil
Colvin, Molly (Communications)	NIWC Pacific	619-553-2788	marienne.a.colvin.civ@us.navy.mil
Cronkrite, Ellen	NAVFAC EXWC	805-982-1971	ellen.cronkrite2.civ@us.navy.mil
Earley, Pat	NIWC Pacific	619-553-2768	patrick.j.earley.civ@us.navy.mil
Harre, Karla	NAVFAC EXWC	805-982-2636	karla.j.harre.civ@us.navy.mil
Henning, Jeff	NAVSUP	717-605-2861	jeffrey.a.henning.civ@us.navy.mil
Hertel, Bill	NAVSEA NSWC Carderock	301-227-5259	william.m.hertel4.civ@us.navy.mil
Rotty, Lisa	NAVSEA HQ	202-781-2376	Lisa.rotty.civ@us.navy.mil
Webb, Tom	NAVFAC EXWC	805-982-2574	thomas.h.webb.civ@us.navy.mil
Webber, Cindy (Deputy Program Manager)	NAVAIR NAWC China Lake	760-939-2060	cynthia.k.webber.civ@us.navy.mil
Youngers, Luzmarie	NAVAIR FRCSE	904-790-6382	luzmarie.youngers.civ@us.navy.mil

OPNAV N4I1 participation and oversight by Rachel Methvin.

HTTPS://EPL.NAVFAC.NAVY.MIL/NESDI (*CAC ENABLED*)

HTTPS://EXWC.NAVFAC.NAVY.MIL/NESDI (*PUBLIC SITE*)