Occurrence of 6PPD-quinone in Environmental Waters

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6PPD-quinone, a degradation product of the widely used tire rubber antioxidant 6-phenyl-1,3,5-triazine-2,4-dione (6PPD), has recently garnered significant attention due to its environmental prevalence and toxicity. Initially discovered in the late 20th century, 6PPD reacts with ozone and other oxidative agents, leading to the breakdown of the original compound in the environment and formation of 6PPD-quinone. Toxicity studies have revealed that 6PPD-quinone poses significant risks to aquatic organisms. It is highly toxic to coho salmon (Oncorhynchus kisutch), causing acute mortality at low concentrations (LC50= 0.8 μg/L). The toxicity level has raised substantial concerns about the broader ecological impacts on other fish species and aquatic life. 6PPD-quinone is relatively stable in aqueous environments, leading to its persistence in water bodies. Its hydrophobic nature suggests particulate matter and sediments can adsorb it, potentially leading to long-term environmental contamination and bioaccumulation in aquatic organisms. Preliminary findings led to recognition of 6PPD-quinone as a ubiquitous pollutant in aquatic ecosystems and identification of its link with “urban runoff mortality syndrome”. To assess the environmental occurrence, fate, and transportation of 6PPD-quinone, we developed an analytical method with liquid chromatography-tandem mass spectrometry (LC-MS/MS) in 2021 and USEPA published a draft method in December 2023. Our method allows precise quantification of 6PPD-quinone at concentrations 400x lower than its LC50 value in environmental waters while meeting with QA/QC acceptance criteria of USEPA method. Here, we present this sensitive, robust, and quick measurement method along with its application to monitor urban runoff. Our preliminary results and occurrence data in the literature indicate that the concentration of 6PPD-quinone may reach at levels higher than its LC50 value for coho salmon especially in regions with high vehicular traffic.

Title: Field evaluation of a reactive amendment and thin protective capping in a legacy gold mine tailing impacted wetland to reduce environmental risks of arsenic (As) and mercury (Hg)

Authors: E.E.V. Chapman[1], D. M. Lewis[1], H. Gavel[1], L. MacDonald[1], E. Udoh[1], B. Knockwood[1], L. Hill[1], L. Phillips[1], K. Kerr[1], S. Sequeira[1], and L.M. Campbell[1]

[1] Saint Mary's University, Halifax, NS

In Nova Scotia, abandoned legacy gold mine sites still present severe issues associated with arsenic (As) and mercury (Hg) contaminated tailings. The project presented here is a collaboration between Saint Mary's University (SMU), University of Regina, St Barbara, Strum Consulting, and Integral Consulting. Using a combination of interdisciplinary (geochemistry, ecotoxicology, hydrology, ecology) laboratory and field studies we are working to develop an in-situ risk management strategy for contaminated wetlands in historical gold mining districts. Research at SMU has confirmed that sediment samples from wetlands in historical gold mining districts are extremely contaminated, toxic to aquatic invertebrates, and that contaminants are bioaccumulating in tolerant invertebrates and amphibians at the sites. Cost-effective innovative remediation strategies that can be used to manage the risk of both As and Hg, and that can also ensure that wetland characteristics are retained and improved are needed. Specifically, this project involves development and evaluation of a non-intrusive reactive amendment and thin protective capping (RAPC) application for highly contaminated gold mine tailing impacted wetlands. From 2020-2023 this research was mostly laboratory based, but in the summer of 2023, a 15-month interdisciplinary field-based experiment was initiated to assess the success of our reactive amendment and protective capping approach in an actual contaminated wetland area. The reactive amendment (zero valent iron: ZVI-CC-1200 from Connelly GPM Inc., approximate thickness of 1 cm), and protective capping (made up of silica sand, zeolite, bentonite, and ZVI with an approximate thickness of 2.5 cm) were applied to modeled ecosystem enclosures; "mesocosms" at the contaminated wetland Muddy Pond in the Waverley gold mining district. Mesocosm enclosures were also installed at a clean wetland reference site in Second Lake. This experiment will continue until November 2024 and will include several separate research projects to evaluate how well our application can reduce the mobility, toxicity, and bioavailability of As and Hg in wetlands impacted by legacy gold mine tailings. This includes monitoring of concentrations and forms of contaminants in porewater, surface water, sediment, and biota; assessment of plant growth/health; evaluation of invertebrate toxicity and changes in microbial communities in treated and untreated mesocosms, as well as hydrology of the wetland area and erosion resistance of treatments. The overall interdisciplinary project outline and methodology will be presented here, together with some preliminary results and conclusions.

Title: Long-term stability of a zerovalent iron treatment to decrease mobility of arsenic (As) and mercury (Hg) in a legacy gold mine tailing impacted wetland with changing biogeochemical conditions

Authors: David M. Lewis[1], Emily Chapman[1], Logan Phillips[1], Heidi Gavel[1], Bradley Knockwood[1], Lauren MacDonald[1], Enobong Udoh[1], Kaitlyn Kerr[1], Joyce McBeth[2], Linda Campbell[1]
[1] Saint Mary's University, Halifax, Nova Scotia
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Laboratory based short duration pilot tests with zero-valent iron (ZVI) have shown promising results in reducing the bioavailability, toxicity, and mobility of arsenic (As) and mercury (Hg) in legacy gold mine tailing impacted wetland sediment and water. However, the long-term effectiveness and stability of this chemically reactive amendment material within a legacy tailing-impacted wetland has yet to be confirmed. In the summer of 2023, the Dynamic Environment and Ecosystem Health (DEEHR) research group at Saint Mary's University (SMU) installed treated (combinations of ZVI and a thin protective capping material) and untreated 50 cm diameter plots, or "mesocosms" at a wetland area impacted by historical mining activities within the Waverley gold mining district, and untreated mesocosms at a clean reference wetland site. The project presented here investigated the geochemistry of As and Hg within those mesocosms over a year with the aim to assess the stability of the treatment with changing biogeochemical conditions. As and Hg speciation was assessed in wetland surface water, and porewater, during the different seasons, and at locations with different redox conditions. In addition, diffusive gradient thin films (DGTs) samplers were also deployed in the fall, one year post treatment, to investigate potentially bioavailable fractions of As and Hg through the different layers of sediment and treatment. At this time sediment cores were also collected and sampled to determine bulk concentrations of elements within the different layers of the sediment and the mineralogy within the treatment and the wetland sediment. Sediment samples were analyzed using the benchtop micro-X-Ray Fluorescence (microXRF) and Scanning Electron Microscope (SEM) at Saint Mary's University (SMU). Additional analysis will be completed at the Canadian Light Source (CLS) to determine speciation of As and Fe within the solid forms. Available results from the seasonal porewater sampling as well as other preliminary conclusions on the effectiveness of the ZVI treatment over time will be presented at the conference.

Title: Using native plants to assess the effectiveness of a remediation strategy at reducing the bioavailability and toxicity of contaminants in wetlands impacted by legacy gold mine tailings

Authors: E. Udoh[1], E.E.V. Chapman[1], H. Gavel[1], L. MacDonald[1], B. Knockwood[1], L. Phillips[1], K. Kerr[1], S. Sequeira[1] and L.M. Campbell[1]

[1]Saint Mary's University, Halifax, N.S.

As a result of historical gold mining activities which took place between 1800 and 1940, there are high concentrations of arsenic (As) and mercury (Hg) in the water and sediment of numerous wetlands of Nova Scotia (NS). Elevated levels of As and Hg in these wetland ecosystems have the potential to impact biodiversity, growth and health of plants. With this project we investigated if a reactive amendment and thin protective capping (RAPC) application can reduce toxicity and bioavailability of As and Hg to plants growing in these wetlands. A three-month laboratory bench test was first completed to assess if seeds of Pickerelweed (*Pontederia cordata*) could germinate in As and Hg contaminated wetland sediment, RAPC treated contaminated wetland sediment, and control sediment, and if RAPC treatments reduce toxicity of sediment to Pickerelweed. To increase environmental realism, once the laboratory test was completed, a field experiment was initiated at a contaminated wetland site impacted by historical gold mining. The purpose of this test was to determine if RAPC treatment is safe for existing contaminant tolerant plants (*Juncus balticus* and *Equisetum fluviatile*), and if treatments can improve and promote growth of native sensitive species not currently present in the contaminated area of the wetland. Preliminary results from both tests have revealed that RAPC treatments do not impact existing plant survival and promote germination, growth, and health of sensitive native plant species like Pickerelweed, aiding the natural recovery of wetlands. Results and methods, and preliminary conclusions of this project will be presented during the conference.

Title: Freshwater Mussels (*Pyganpdon cataracta*) as bioindicators of contaminants and effectiveness of in-situ remediation strategy for gold mine tailing contaminated wetlands.

Authors: L. MacDonald[1], L.M. Campbell[1] , E.E.V. Chapman[1], H. Gavel[1], D. M. Lewis[1], E. Udoh[1], B. Knockwood[1], L. Phillips[1], K. Kerr[1], and S. Sequeira[1]
[1] Saint Mary's University, Halifax, NS

The Dynamic Ecosystem and Environmental Health Research group (DEEHR) at Saint Mary's University is developing an in-situ reactive amendment and protective capping application to reduce the bioavailability, toxicity, and mobility of As and Hg in wetland ecosystems impacted by historical gold mining activities. The project presented here uses Eastern Floater mussels (*Pyganodon cataracta*) as representative macro invertebrates to study the impact the amendment may have on mussels, and to test if the treatment reduces the toxicity and bioavailability of Hg and As to invertebrates. Freshwater mussels are long lived, semi-sedentary, filter feeders that provide an accurate representation of the health of an ecosystem. Due to this, they are often used as bioindicators for ecotoxicology studies. In this experiment, mussels were exposed both in the laboratory and in the field to contaminated sediment, contaminated sediment treated with reactive amendment (R), contaminated sediment treated with reactive amendment and protective capping (RAPC), and uncontaminated reference sediment. Contaminated sediment used in this study is from Muddy Pond, a gold mine impacted wetland in Waverly, Nova Scotia, and the reference sediment is from Second Lake, a clean wetland site in Sackville, Nova Scotia. To assess the effect of the contaminated sediment and treatments on mussels, mussel survival as well as behaviour was monitored using high frequency non-invasive valvometers to determine percentage of time mussels spent open and filtering. This study also determined subcellular health biomarkers, such as oxidative stress and total protein concentration which were measured in gill tissue. Concentrations of Hg and As in gill and visceral mass were also determined. Preliminary results indicate amendments improve survival rates of mussels exposed to the contaminated sediment. Mussels exposed to R and RAPC had decreased As concentration in both the visceral mass and gills compared to the untreated contaminated sediment. Oxidative stress was elevated in mussels exposed to contaminated sediment and reduced in mussels exposed to the RAPC treatment. Finally, preliminary valvometry results indicate there is a difference in behaviour in mussels exposed to the different treatments, with mussels exposed to contaminated sediment demonstrating higher rates of closures than mussels exposed to the reference and RAPC treatments.

Title: Examining the effectiveness of a reactive amendment protective capping (RAPC) in reducing bioaccumulation of mercury and arsenic in *Hyalella azteca*

Authors: H. Gavel[1], E.E.V. Chapman[1], K. Kerr[1], L. Phillips[1], B. Knockwood[1], E. Udoh[1], S. Sequeira[1], D.M. Lewis[1], L. Hill[1], L. MacDonald[1], and L.M. Campbell[1]

[1]Saint Mary's University, Halifax, Nova Scotia

Throughout Nova Scotia, between the 1860's to the 1940's many wetlands were used as landfills for arsenic (As) and mercury (Hg) contaminated goldmine tailings. These tailings still remain and pose a threat to human and wildlife health. Research at Saint Mary's University (SMU) has confirmed that some aquatic invertebrates are able to survive the high concentrations of As and Hg in these wetland areas and could play a role in the transfer of these contaminants from sediment into aquatic and terrestrial food webs. The purpose of this project was to assess bioaccumulation of As and Hg in a laboratory reared caged ecologically relevant amphipod species; *Hyalella azteca* at a contaminated wetland site in the Waverley gold mining district, and to determine if a reactive amendment (zerovalent iron) and protective capping application (silica sand, zeolite, bentonite and zero valent iron) could reduce this bioaccumulation. *H. azteca* were exposed to treated and untreated field mesocosms at the contaminated site and at a clean reference site for 7 days in August of 2024. To retrieve the small invertebrates at the end of the test from the mesocosm enclosures, *H. azteca* were deployed in cages constructed of 16-oz wide mouth polypropylene jars with holes drilled into the side, top, and bottom of each cage. 500-um nitex mesh was adhered to the holes using aquarium silicone to prevent organism escape and allow adequate exposure to contaminants and treatments. Each mesocosm enclosure received three cages with 56 adult *H. azteca* each. At the end of the test, *H. azteca* were retrieved and analyzed for metal(loid)s using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and a Direct Mercury Analyzer 80 (DMA-80). Results for the *H. azteca* cage experiment are pending but will be presented at the conference with preliminary conclusions.

Title: Investigating hydrology and sediment erosion rates at a legacy tailing impacted wetland site with and without a reactive amendment and protective capping (RAPC) application

Authors: K. Kerr[1] , E.E.V. Chapman[1], H. Gavel[1], L. MacDonald[1], D. Foster[2], S. McWilliams[3], C. Jones[3] and L.M. Campbell[1]

[1]Saint Mary's University, Halifax, Nova Scotia
[2]Strum Consulting
[3]Integral Consulting

Aquatic ecosystems downstream of historical gold mine districts in Nova Scotia are showing elevated Hg and As concentrations in water and sediment samples, suggesting contaminated tailing materials are eroding and contaminants are being transported from where they were originally deposited. The project presented here will assess the hydrology and water budget for a typical wetland site; "Muddy Pond" that was used as tailing deposit location within the Waverley legacy goldmine area and determine the amount of contaminated surface sediment that could be eroding and moving out of this system yearly. In addition, the project will investigate the success of Reactive Amendment and Protective Capping (RAPC) material in reducing that transport from the wetland. First, a water budget will be developed for the contaminated wetland site. This will provide information on how much water is flowing to downstream bodies of water yearly, and what typical flow conditions at the site are like. A SEDflume apparatus will be used to simulate various flow rates over aged (12 months) RAPC treated and untreated sediment cores extracted from the contaminated wetland site. Since the RAPC treatment could compact over time when in the field, a freshly RAPC treated core will also be tested for erosion rates to understand how RAPC erodes when initially applied. The SEDflume device will be used to determine critical sheer stress points and bottom current measures in which sediment could become resuspended and assess whether the RAPC reduces erosion and transport of contaminants. This project is planned to start in the Fall of 2024, so data collection is yet to commence. Methods and experimental outline will be presented for this conference.

Title: Removal efficiency of dissolved As and As(III) by different amendments in contaminated water and sediment collected from a legacy gold mine tailings impacted wetland

Authors: L. Phillips[1], E.E.V. Chapman[1], D.M. Lewis[1], H. Gavel[1], L. MacDonald[1], B. Knockwood[1], E. Udoh[1], S. Sequeira[1] , L.M. Campbell[1]

[1]Saint Mary's University, Halifax, Nova Scotia

To reduce the mobility of arsenic (As) in Nova Scotian wetlands impacted by historical gold mining waste, the Dynamic Environment & Ecosystem Health Research (DEEHR) team at SMU is developing a reactive amendment – protective capping (RAPC) treatment. This wetland treatment utilizes zero valent iron (ZVI) as it's reactive amendment, which aids in reducing As mobility by adsorption onto the outer iron oxide layer of ZVI, forming a strong surface complex, or by co-precipitation with iron hydroxide formed in-situ from iron corrosion. To assess the efficiency of the ZVI treatment in reducing As mobility compared with other potential amendments and materials, six other amendments often used for controlling metall(oid) contamination were evaluated alongside the ZVI amendment in a batch experiment. The amendments included a nano zero valent iron (nZVI)/zeolite composite, biochar, iron oxide (magnetite), apatite (rock phosphate), organic amendment (kelp meal), and lime (dolomite). Each amendment was tested in triplicates, each with 40 g (dry weight) of tailings sediment and ~240 mL water gathered from a contaminated wetland area, for a total of 24 samples. Samples were agitated on a shaker table over five days. Eight sets of water samples were taken at intervals of 0, 1, 2, 4 ,8 ,24, 48, and 120 hours respectively. The samples were centrifuged and filtered to remove suspended sediment and then preserved. All samples were analyzed for dissolved As, and As(III). Results indicate that ZVI was by far the most effective amendment at arsenic removal, supporting the choice of ZVI as the reactive amendment portion of the RAPC treatment. As content in the ZVI treated water samples averaged 1.2 µg/L for both dissolved As and As(III) analyses after 5 days, compared to the untreated control averaging 800 µg/L and 150 µg/L respectively. The nZVI/zeolite composite, dolomite, and biochar were moderately effective at reducing dissolved As and As(III) over the time tested. However, the organic amendment we tested (kelp meal) resulted in a dramatic increase in dissolved As in the water samples, averaging 7100 µg/L. This implies that organic matter increases As mobility, rather than decreasing it, proving it to be an ineffective wetland amendment under the conditions of the batch experiment.

Title: Bioaccumulation of mercury (Hg) and arsenic (As) in amphibians and fish inhabiting wetland areas in Nova Scotia contaminated with historical gold mine tailings

Authors: S. Sequeira[1], B. Knockwood[1], D. McAlpine[2], G. Jongsma[2] and L.M. Campbell[1]

[1] Saint Mary's University, Halifax, NS
[2] New Brunswick Museum, Saint John, NB

Wetlands in Nova Scotia (NS) have been contaminated by mercury (Hg) and geogenic arsenic (As), the waste products of gold mining during the 1800s. These elements have since remained in the environment, bioaccumulating in benthic species and transferring to organisms occupying higher trophic levels. Amphibians are particularly susceptible to contamination due to their aquatic lifestyle and their permeable skin. This study, as part of the legacy gold mine tailings research conducted by the Dynamic Environment and Ecosystems Health Research (DEEHR) team, will examine the bioaccumulation of mercury (Hg) and arsenic (As) in amphibians and small fish present at distinct legacy gold mine tailing sites within the districts of Waverley, Goldenville, and Montague as well as numerous reference sites. Following the euthanization of specimens collected via hand netting and minnow traps, their tissue was extracted and dried for Hg and As analysis. Results from these analyses are expected in October. A previous study conducted by the DEEHR group in 2022 found significantly higher concentrations of Hg in tadpoles analyzed from Montague at 12.24 ± 5.02 mg/kg compared to the reference site at 0.89 ± 1.01 mg/kg. The need to determine the extent of contamination in NS and document the biodiversity at these heavily polluted sites was further reinforced by a recent study that found the emerging pathogen *Batrachochytrium dendrobatidis* (Bd), that has caused significant declines in amphibian species around the world, to be suppressed by environmental metals present at concentrations amphibians can withstand. Thus, in collaboration with the New Brunswick Museum, frogs were swabbed for Bd. This project will improve our understanding of the impact of historical gold mining on aquatic life.

The Implementation of a Combined Remedial Approach: A Broadening of Perspectives

Author: K Davidson

Contaminated sites and their remediation often require a multi-tiered approach to meet site objectives. Every site is unique in terms of the contaminant of concern, local geology, and existing infrastructure, and therefore requires a dynamic approach to remediate.

The key to a successful program is comprehensive planning and the continued assessment of the site conditions, as they change throughout the duration of the remediation. This presentation reviews the process listed below in detail and aims to broaden the industry's perspective on the current remedial approach.

A combined remedial approach incorporates the following:

- Preliminary site assessment: review of historical site data.
- Establishment of site characterization programs: high-resolution site characterization, monitoring well installations, and borehole/sediment sampling.
- Comprehensive review of the site characterization data.
- Evaluation, selection and proposal of remedial solutions.
- Incorporation of pilot testing events to assess technology feasibility.
- Implementation of the selected remedial solution: the continued optimization of this technology.
- Continue monitoring of the technology's efficiency.
- Adjustment of the technology to meet the project's objective: implementation of a new remedial solution if required (based on modified site dynamics).

The incorporation of a combined remedial approach has been proven to be an effective method to successfully meet site objectives. This often results in significant cost savings and the potential for a reduced remedial timeline for the remediation of contaminated sites.

As the site dynamics continually change throughout the project's lifetime, the remedial method must be equally adapted.

Presentation Title: Quality Control Samples, Report Interpretation, and Use

Authors: Michael Doucet [1]
[1] ALS Canada, Halifax, NS

Many contaminated sites professionals are quite experienced in receiving analytical results and interpreting if they pass a particular guideline or criteria, or not. However, many professionals may not understand what laboratory processes are involved in evaluating the quality of the results prior to issuing the report. ALS is an international testing firm with locations in Dartmouth and Fredericton. ALS will present on what components of the laboratory results professionals should be reviewing to evaluate if the results meet their internal quality requirements. ALS will primarily speak to common quality control type samples that often include method blanks, duplicates, laboratory control samples, matrix spikes surrogates and reference material. ALS will include the purpose of the sample, how the laboratory uses the data, and how the operator should be considering these results. ALS will also discuss data quality objectives and compliance – how does the laboratory typically manage quality control results that fall outside the control limits. ALS will also review other important quality control items that are evaluated for compliance like adherence to analysis holding time that is specific for each analysis, the type of bottle the sample was collected in, and quality control sample frequency.

Abstract Submission for ARC2024

Researcher: Ross Dwyer

Presentation Title: Evaluating the State of the Coast and Policy Recommendations for Prince Edward Island

Organization: Canadian Centre for Climate Change and Adaptation, University of Prince Edward Island

Type: Presentation (30 minutes)

Themes: Marine/Coastal Protection and Restoration, Policy and Regulations, Climate Change and Adaptation

Abstract: Prince Edward Island's (PEI) unique coastline, which spans over 3,000 km in length, is under threat from both natural and societal stressors. Effectively managing the coast requires an understanding of the often-conflicting demands and their implications. Without a clear vision for how and where coastal development will be permitted in the future, planning for the impacts of coastal hazards, and safeguarding the Island's beaches for future generations will not be possible.

Commissioned by the PEI Department of Environment, Energy and Climate Action, and completed in November 2023, the PEI State of the Coast Report 2023 (PEI SCR) provides an overview of the current conditions of PEI's coastline, highlighting the state of both natural and human systems. The PEI SCR identifies the conditions under which natural coastal processes and coastal development intersect, where ecosystems are vulnerable, and where built systems are at risk.

Building off the PEI SCR, the Interim Coastal Policy Recommendations Report describes actionable steps for Government including new policies, regulations, strategic plans, and programs; to adapt to the risk the Island's coastline faces from extreme weather events, rising sea levels, erosion and flooding.

The purpose of this presentation is to examine the State of the Coast and Policy recommendations report in detail, highlighting areas such as the rate of shoreline protection through the Shoreline Structures Inventory and the complicated process and policy recommendations when dealing with non-conforming conditions and potential provincial buy-out policies. This presentation aims to build awareness of the current coastal policies, while examining alternative strategies and adaptation measures for PEI's coast.

Non-technical Influences on a Proposed Dartmouth Cove NS Infilling Project

Author: Cameron Ells, P.Eng. Cameron Consulting Inc. Halifax NS.

Bedrock displaced by multiple projects in the Halifax NS area sometimes includes pyritic slate. When exposed to wet – dry cycles of rain, the runoff becomes acidic and problematic for the environment. When displaced pyritic slate stays in salt water, there are no wet – dry cycles, and acid is not generated. In 2014, displaced pyritic slate was used as fill in water adjacent to a Port of Halifax container pier, and under what are now Kings Wharf buildings across the harbor in Dartmouth.

The Dartmouth Cove site is a pre-Confederation property where property ownership extends below low tide into the harbour. Past industrial land uses environmentally impacted the soil and marine environment. Recent inactive land use corresponded with a relative increase in marine life activity. There are residential properties close to the site. A commercially active rail line and parallel community walking trail – with easement rights – are by one side of the property. Development agreements on nearby properties will result in multiple multistory mixed use buildings.

The proposed Dartmouth Cove project includes infilling part of the privately owned water lot with displaced pyritic slate bedrock. Future site development plans after infilling are uncertain (e.g. multi-story mixed used buildings?).

Non-technical challenges include some apparent uncertainty on a) applicable municipal, provincial and federal jurisdictions, authority and approvals; b) the clarity, predictability, and reliability of the applicable project approval processes; and c) the sometimes varying limitations among jurisdictions, on the property owner in making decisions about their property.

Currently elected local municipal, provincial and federal representatives have taken actions intended to stop the Dartmouth Cove infilling project proposal approval process. A federal Minister rescinded the Project proposal approval by departmental technical staff who reviewed the detailed application. This was based on an additional review of the potential impact on the current activities of a neighbour.

This case study reviews the interests, motivations, actions, and effectiveness on influencing the proposed project a) by the neighbours opposed to the proposal; b) the locally elected representatives and staff; and c) the property owner - project proponent.

Property rights and land use decision making by the owner is limited and not absolute, although that varies with the applicable jurisdiction. The influence by others on property owners' decision making also varies with applicable jurisdictions. That may be due to planning restrictions, perceived uncertain potential environmental impacts, and the preferences of others in the community.

With a federal component, this may have Canada-wide interest.

Title: Examining the effectiveness of a reactive amendment protective capping (RAPC) in reducing bioaccumulation of mercury and arsenic in *Hyalella azteca*

Authors: H. Gavel[1], E.E.V. Chapman[1], K. Kerr[1], L. Phillips[1], B. Knockwood[1], E. Udoh[1], S. Sequeira[1], D.M. Lewis[1], L. Hill[1], L. MacDonald[1], and L.M. Campbell[1]

[1]Saint Mary's University, Halifax, Nova Scotia

Throughout Nova Scotia, between the 1860's to the 1940's many wetlands were used as landfills for arsenic (As) and mercury (Hg) contaminated goldmine tailings. These tailings still remain and pose a threat to human and wildlife health. Research at Saint Mary's University (SMU) has confirmed that some aquatic invertebrates are able to survive the high concentrations of As and Hg in these wetland areas and could play a role in the transfer of these contaminants from sediment into aquatic and terrestrial food webs. The purpose of this project was to assess bioaccumulation of As and Hg in a laboratory reared caged ecologically relevant amphipod species; *Hyalella azteca* at a contaminated wetland site in the Waverley gold mining district, and to determine if a reactive amendment (zerovalent iron) and protective capping application (silica sand, zeolite, bentonite and zero valent iron) could reduce this bioaccumulation. *H. azteca* were exposed to treated and untreated field mesocosms at the contaminated site and at a clean reference site for 7 days in August of 2024. To retrieve the small invertebrates at the end of the test from the mesocosm enclosures, *H. azteca* were deployed in cages constructed of 16-oz wide mouth polypropylene jars with holes drilled into the side, top, and bottom of each cage. 500-um nitex mesh was adhered to the holes using aquarium silicone to prevent organism escape and allow adequate exposure to contaminants and treatments. Each mesocosm enclosure received three cages with 56 adult *H. azteca* each. At the end of the test, *H. azteca* were retrieved and analyzed for metal(loid)s using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and a Direct Mercury Analyzer 80 (DMA-80). Results for the *H. azteca* cage experiment are pending but will be presented at the conference with preliminary conclusions.

Acadian diaspora connections to Nova Scotia dykeland and tidal wetland landscapes

Authors: Alexandre Legault[1, 2] and Kate Sherren[1]

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Presenter: Alexandre Legault

Abstract: French settlers first arrived in Mi'kma'ki in the early seventeenth century. To increase agricultural production, their descendants (the Acadians) drained the Bay of Fundy's tidal wetlands using dykes and aboiteaux. From 1755 to 1758, thousands of Acadians were deported to British colonies and Europe, forming what is now known as the Acadian diaspora. Today, approximately 364 km of Acadian dykes remain in New Brunswick and Nova Scotia. The Nova Scotia Department of Agriculture does not currently possess the ability to maintain and raise all the dykes to withstand the projected effects of a changing climate. Several coastal adaptation options have been proposed in Nova Scotia, including managed dyke realignment, which combines coastal retreat and tidal wetland restoration. The purpose of this research is to determine whether members of the Acadian diaspora (1) remain culturally linked to the Bay of Fundy dykelands, (2) are beneficiaries of ecosystem services provided by the Bay of Fundy dykelands, and (3) are stakeholders in climate adaption decisions in the Bay of Fundy region. Acadian diasporans were interviewed and surveyed at Grand-Pré National Historic Site and at the *Congrès mondial acadien*'s expo in August 2024. Results indicate that Acadians residing in the homeland (*Acadie*) attribute more value to dykes for keeping people safe (regulating service) than diasporans living outside the homeland. French speakers overwhelmingly value dykes to protect their legacy and affirm Acadian identity and diasporans living outside the homeland value tidal wetlands significantly more than their homeland counterparts. Yet, Acadians are heavily divided over whether they believe they are stakeholders in managed dyke realignment decisions in the Bay of Fundy. Although no significant difference in stakeholdership was detected between Acadians living in and Acadians living beyond the homeland, participants' language of preference was a strong indicator.

Title: Long-term stability of a zerovalent iron treatment to decrease mobility of arsenic (As) and mercury (Hg) in a legacy gold mine tailing impacted wetland with changing biogeochemical conditions

Authors: David M. Lewis[1], Emily Chapman[1], Logan Phillips[1], Heidi Gavel[1], Bradley Knockwood[1], Lauren MacDonald[1], Enobong Udoh[1], Kaitlyn Kerr[1], Joyce McBeth[2], Linda Campbell[1]
[1] Saint Mary's University, Halifax, Nova Scotia
[2] University of Regina, Regina, Saskatchewan

Laboratory based short duration pilot tests with zero-valent iron (ZVI) have shown promising results in reducing the bioavailability, toxicity, and mobility of arsenic (As) and mercury (Hg) in legacy gold mine tailing impacted wetland sediment and water. However, the long-term effectiveness and stability of this chemically reactive amendment material within a legacy tailing-impacted wetland has yet to be confirmed. In the summer of 2023, the Dynamic Environment and Ecosystem Health (DEEHR) research group at Saint Mary's University (SMU) installed treated (combinations of ZVI and a thin protective capping material) and untreated 50 cm diameter plots, or "mesocosms" at a wetland area impacted by historical mining activities within the Waverley gold mining district, and untreated mesocosms at a clean reference wetland site. The project presented here investigated the geochemistry of As and Hg within those mesocosms over a year with the aim to assess the stability of the treatment with changing biogeochemical conditions. As and Hg speciation was assessed in wetland surface water, and porewater, during the different seasons, and at locations with different redox conditions. In addition, diffusive gradient thin films (DGTs) samplers were also deployed in the fall, one year post treatment, to investigate potentially bioavailable fractions of As and Hg through the different layers of sediment and treatment. At this time sediment cores were also collected and sampled to determine bulk concentrations of elements within the different layers of the sediment and the mineralogy within the treatment and the wetland sediment. Sediment samples were analyzed using the benchtop micro-X-Ray Fluorescence (microXRF) and Scanning Electron Microscope (SEM) at Saint Mary's University (SMU). Additional analysis will be completed at the Canadian Light Source (CLS) to determine speciation of As and Fe within the solid forms. Available results from the seasonal porewater sampling as well as other preliminary conclusions on the effectiveness of the ZVI treatment over time will be presented at the conference.

Presentation Title: Salt Marsh Restoration in the Southwest Nova Scotia: Mavillette Beach and Abrams River.

Authors: Jeremey Lundholm[1] (presenter), J. Graham[1], T. Bowron[1], D. van Proosdij[2], and B. Pett[3],

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Abstract: Located in Southwest Nova Scotia, the Mavillette and Abrams River Restoration Projects were undertaken by Nova Scotia Public works (NSPW, formerly NSTIR) in 2018 to restore two large salt marshes through the replacement of undersized tidal crossings. Both sites have a history of anthropogenic modification, tidal regimes on the order of 5 m, and unique flora associated with their locations in southwest NS. While both wetlands are large, their morphologies, exposure and sediment characteristics differ substantially, as do the tidal crossings implemented at the sites. Five-year post-restoration and 1-year pre-restoration monitoring programs were implemented at each site to track the efficacy of the tidal wetland restoration, with paired reference sites monitored concurrently to establish a reference condition. The programs focus on hydrology, vegetation, sediment and soil, and geospatial characteristics. At the conclusion of the monitoring program both sites showed shifts in habitat extent and characteristics towards reference conditions, but neither had reached parity and were still in states of transition. This presentation will explore how each restoration progressed over the five-year post-restoration monitoring period (2019-2023) and potential drivers for similarities and differences between the two sites and other salt marsh restorations in the region.

Title: Freshwater Mussels (*Pyganpdon cataracta*) as bioindicators of contaminants and effectiveness of in-situ remediation strategy for gold mine tailing contaminated wetlands.

Authors: L. MacDonald[1], L.M. Campbell[1] , E.E.V. Chapman[1], H. Gavel[1], D. M. Lewis[1], E. Udoh[1], B. Knockwood[1], L. Phillips[1], K. Kerr[1], and S. Sequeira[1]
[1] Saint Mary's University, Halifax, NS

The Dynamic Ecosystem and Environmental Health Research group (DEEHR) at Saint Mary's University is developing an in-situ reactive amendment and protective capping application to reduce the bioavailability, toxicity, and mobility of As and Hg in wetland ecosystems impacted by historical gold mining activities. The project presented here uses Eastern Floater mussels (*Pyganodon cataracta*) as representative macro invertebrates to study the impact the amendment may have on mussels, and to test if the treatment reduces the toxicity and bioavailability of Hg and As to invertebrates. Freshwater mussels are long lived, semi-sedentary, filter feeders that provide an accurate representation of the health of an ecosystem. Due to this, they are often used as bioindicators for ecotoxicology studies. In this experiment, mussels were exposed both in the laboratory and in the field to contaminated sediment, contaminated sediment treated with reactive amendment (R), contaminated sediment treated with reactive amendment and protective capping (RAPC), and uncontaminated reference sediment. Contaminated sediment used in this study is from Muddy Pond, a gold mine impacted wetland in Waverly, Nova Scotia, and the reference sediment is from Second Lake, a clean wetland site in Sackville, Nova Scotia. To assess the effect of the contaminated sediment and treatments on mussels, mussel survival as well as behaviour was monitored using high frequency non-invasive valvometers to determine percentage of time mussels spent open and filtering. This study also determined subcellular health biomarkers, such as oxidative stress and total protein concentration which were measured in gill tissue. Concentrations of Hg and As in gill and visceral mass were also determined. Preliminary results indicate amendments improve survival rates of mussels exposed to the contaminated sediment. Mussels exposed to R and RAPC had decreased As concentration in both the visceral mass and gills compared to the untreated contaminated sediment. Oxidative stress was elevated in mussels exposed to contaminated sediment and reduced in mussels exposed to the RAPC treatment. Finally, preliminary valvometry results indicate there is a difference in behaviour in mussels exposed to the different treatments, with mussels exposed to contaminated sediment demonstrating higher rates of closures than mussels exposed to the reference and RAPC treatments.

Ecological Restoration in Degraded Eastern Canada Sites Using Four Early-Successional Species Using a Factorial of Site-Preparation Treatments: Mortality, Growth and Elevated CO_2 Treatments.

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The study was conducted on three sites which are part of 7,000 ha that have been largely barren for 25-years on Base Gagetown, New Brunswick. Three site-preparation treatments, straw (S), Meri-Crusher (MC), and coarse woody debris (CWD) in 2 x 2 x 2 factorial, testing four early-successional deciduous species: *Betula papyrifera*, (white birch, WB) *B. populifolia* (Gray birch, GB), *Alnus viridis* ssp. *crispa*, (Green alder, GA) and *A. incana* ssp. *rugosa* (speckled alder, SA) were examined for mortality and growth. Mortality was assessed summer 2021, winter 2022, and spring frost heave 2022. Greatest causes of mortality were frost heave followed by summer drought. When treatments were combined in any way, mortality dropped significantly indicative of an additive effect. GB had the greatest overall first year (2021) height growth, followed by GA, SA, and WB, respectively. After two years, overall stem dry mass had very large genus and species differences. Site preparation treatments also had large magnitude effects. When site preparation treatments were combined, alders stem mass experienced some synergistic effects, while birches had additive effects. These experimental results are informing prescriptions for large-scale ecological restoration. In addition, some results will be presented from growing these species under ambient and elevated CO_2 treatments.

The use of a nature-based approach and realignment for Route 207 at Lawrencetown Beach, Nova Scotia

Gabby Mauti, CBCL Limited

Abstract: A study was conducted to identify a long-term solution for the west bend of Route 207 along Lawrencetown Beach, Nova Scotia. Lawrencetown Beach is a popular beach park close to the Halifax-Dartmouth urban area. Its exposure to long Atlantic swells combined with wave break points make it a prime surfing destination in Atlantic Canada. The west bend of Route 207 is located along the shore and suffers increasing impacts from coastal storm surge and wave overtopping, requiring frequent road closures impacting traffic and emergency vehicle access. Post-storm maintenance is performed regularly and generally involves clearing gravel washouts and re-instating an ad-hoc armourstone seawall that fronts the section of the road closest to the ocean.

The proposed solution includes the realignment of Route 207 back to a safe distance from the ocean. A nature-based approach will be applied by restoring the beach through cobble nourishment and installing a vegetated dune buffer. Nature-based solutions are measures that mimic natural system processes to provide flood and erosion mitigation, while delivering a suite of environmental and other societal co-benefits. This solution was determined to be the most sustainable option to protect the road from flooding and to reduce maintenance requirements. Additionally, this solution will provide climate resiliency, preserve the ecological value, and maintain its recreational amenities, including access to prime surfing conditions.

To develop the proposed design, a coastal assessment was conducted based on flood levels and erosion risks. Coastal modelling was conducted to investigate waves and extreme water levels, which were used to determine the required road elevation that will be safe from future storms and sea level rise. Future shoreline alignments were developed based on projected erosion and stable beach alignments for various erosion scenarios. An envelope of road realignment was developed based on various sea level rise scenarios. Based on this analysis, the road realignment was selected, and a cross-section was developed including the cobble nourishment with the vegetated dune buffer. The cobble-sand beach will be free to evolve with storms and long-term sea level rise.

Monitoring the remediation of arsenic-polluted mine sites using sensor-based geochemical time series analysis

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Mine wastes stored at historical and current mine sites frequently contain significant quantities of mobile toxic heavy metals. These sites require ongoing treatment and monitoring to prevent environmental damage to adjacent ecosystems and remediate the environmental damage and contamination caused by mining activity. Long-term environmental monitoring programs are typically described in site operating plans and rely on offsite lab analysis of effluent and sediment samples for both long-term geochemical characterization and evaluating the effectiveness of remediation treatments. The need for these costly and labour-intensive monitoring programs can outlast the mine life by decades, creating a significant burden for site operators and governments alike.

Recent advances in sensor technology and miniaturization of computing components have led to the widespread adoption of passive sensor instruments for environmental monitoring applications. Here, we will present a pilot study in which a passive remediation technique was used to remove As in tailings from the Montague gold mine and monitored using in situ sensors. Tailings sediment cores were collected to construct a series of column bioreactors equipped with ion-selective electrodes for Fe(II) and As(III). The sediments were treated with either zero-valent iron (ZVI), ZVI + reactive capping, or untreated as a control.

The onset of chemically mediated ZVI treatment was indicated by increased pH and reduced redox potential in the columns with treatments. Efficient removal of As was observed, representing 81.8% for ZVI, 97.8% for ZVI + reactive capping and 21.3 % for the control. Analysis of the 2Hz time series collected from the Fe(II) and As(III) electrodes revealed systematic and dramatic differences in the correlation characteristics of each type of time series: control (scaling exponent, $\alpha = 1.20$), ZVI ($\alpha = 0.94$), and ZVI + reactive capping ($\alpha = 0.69$). The As(III) saw a similar pattern with control ($\alpha = 1.30$), ZVI ($\alpha = 1.20$) and ZVI/reactive capping($\alpha = 0.72$).

These persistent differences in correlation strength consistently identified the different biogeochemical processes operating in each bioreactor independent of other analytical methods. This study demonstrates the potential for sensor-based measurements as an effective alternative to monitor the remediation of mine-impacted sediments. This study is the first successful demonstration of the utility of sensor-based passive approaches to monitor a remediation process in real time. These instruments may be installed and left in situ for months without requiring service or maintenance, reducing the need for on-site personnel.

Abstract

Mining industry has significant economic contribution towards the province's economic growth, though the environmental threat a mining operation might pose cannot be ignored. The environmental consequences vary from soil toxicity affecting plant growth and disrupting microorganism habitats to water contamination through erosion and mining wastes. This project is focused on the reclamation of the largest open-pit copper mine-site in Canada, the Highland Valley Copper Mine (HVC). Highland Valley Copper (HVC) is required to conduct reclamation research on the Highland Tailings Storage Facility (TSF) as part of the site M-11 operating permit. Land reclamation aims to build and enrich the soil to encourage the establishment of plant and animal communities. One of the practical approaches in mining land reclamation is to cover the tailings (fine grained mine wastes) with a subsoil/topsoil surface to promote vegetation and ecosystem development. Various types of amendments can help facilitate this process. Organic amendments can provide the soil with the necessary organic material and carbon source for re-activating the nutrient cycle. The establishment of native plant communities is an increasing target for mine closure plans, especially as the role of Indigenous communities becomes central to mine operation and closure in BC. This study provides valuable insights on the use of organic amendments on the topsoil of the tailings and the plantation of native plants by both seeding and planting seedlings to carry out a successful ecosystem restoration process and mine reclamation.

Keywords: tailing storage facility, mine reclamation, amendments, tailings, ecosystem restoration, native plants

Making Room for Wetlands 2.0: Managed realignment and tidal wetland restoration in Nova Scotia's dykelands

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The practice of re-introducing, where feasible, tidal flow to dykelands and the restoration of tidal wetland habitat has been identified as a viable adaptation method to current and future hazards associated with climate change. Building upon the successful implementation of managed dyke realignment and the restoration of 30 ha of tidal wetland habitat in the first iteration of the *Making Room for Wetlands* (*MRFW*) project (2017-2022), *MRFW 2.0* is being implemented in four tidal river estuaries in the Bay of Fundy, Nova Scotia, Canada. Sites for dyke realignment, habitat restoration and/or drainage improvements are being selected in collaboration with the Nova Scotia Department of Agriculture, following a comprehensive dyke vulnerability assessment, and builds upon over two decades of collaboration and experience in tidal wetland restoration. Many sites have historical and cultural significance to both the Mi'kmaq and Acadian peoples and are known to support culturally important species incluing plamu (Atlantic Salmon), punamu (Atlantic Tomcod) and ka't (American Eel). The project will improve the resilience of surrounding communities, infrastructure, and agricultural lands by re-establishing room for the natural migration of wetlands and reducing flood and erosion risks. This presentation will provide an overview of the *MRFW* project and associated goals, the integration of two-eyed seeing into the project framework, and will describe the development of best practices for managed realignment and tidal wetland restoration in these areas.

The Restoration of Freshwater Wetland Ecosystems, Nova Scotia: Wetland Compensation Case Studies

Author: Sarah Scarlett, Restoration Lead, Strum Consulting, Halifax NS

The Nova Scotia Wetland Conservation Policy and Wetland Alteration Approval process requires that all impacts to wetlands (direct removal or indirect loss of functions) be compensated for to offset the loss of wetland area and/or functional services. In Nova Scotia, wetland compensation can include the restoration, enhancement, creation and/or expansion of wetland habitat. The policy defines restoration as "the re-establishment of previously existing wetland and its functions and services by human intervention at a site where a wetland no longer exists or exists only in a highly degraded state". Strum Consulting has worked with Nova Scotia Environment and Climate Change since 2016 to support wetland compensation efforts throughout the province. Case studies will showcase a variety of freshwater wetland restoration, enhancement and creation projects completed between 2016 and 2023, and ongoing. Site design and goals range based on project specific factors (e.g., restoration vs. creation), but generally aim to return or establish wetland ecosystem processes within defined site-specific parameters for success. As with these case studies, the primary objective is commonly the establishment of wetland hydrology, characteristic of the target wetland type, pre-disturbance conditions and/or restoration objectives. Specific vegetation communities, species or habitat types may be targeted to support certain objectives or important wetland functions (e.g., species-at-risk habitat). In the Maritimes, extreme weather events are becoming increasingly common. Restoring or enhancing the natural functions, notably water retention abilities, of degraded wetland ecosystems not only have increasingly important ecological benefits but human benefits as well.

Presentation Title: Restoring Piping Plover Habitat Using Multiple Nature-Based Solutions.

Authors: Katie Sonier[1] (presenter), K. Ellis[1], D. Proosdij[2], J. Graham[1], and Tony Bowron[1]

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Abstract: Located in North-Eastern Canada near Shippagan, New Brunswick, the Shippagan project is leveraging salt marsh creation and sand engine (aka sand motor) techniques to increase resiliency for the Chaisson Office spit and surrounding communities. The barrier spit has been altered and degraded by more than a century of human activity, including recent dredging of the navigable channel entering the Shippagan Gully, and is being increasingly impacted by climate change and sea-level rise. To address these habitat losses and to improve the climate resiliency of the overall site, the project utilizes a holistic approach to integrate coastal protection, habitat restoration, and improved regional understanding. Restoration techniques used included: the removal of old seawalls to restore tidal flow and aeolian sand transport pathways; beach creation by way of Atlantic Canada's first sand engine; dune and wetland restoration through road reduction/removal; and installation of a salt marsh with sill. Several monitoring and research initiatives are associated with project, including a fifteen-year monitoring program (regulatory requirement), five-year post-graduate scientific research program, and a 3-year research project which will augment and build on the NRC-led Nature-Based Infrastructure for Coastal Resilience project. The first three years of monitoring have showed that the sand engine is functioning more quickly than predicted; that elevations are stable and plant survivorship over the first growing season are high in the created marsh; diversity and health of the restored marsh has improved; and that overall, there has been a shift in habitat conditions to those more closely matching a nearby control site. Most promisingly, in both 2022 and 2023 the site saw the successful nesting and fledging of Piping Plover - for the first time in nearly 20 years.

Title: Reclaiming the Touquoy Gold Mine

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Touquoy Gold Mine was in commercial operation from March 2018 until November 2023, serving as a significant economic driver for the local communities and the Province of Nova Scotia. During the operational phase of mining and processing, the operation supported over 200 direct employees. On March 28th, 2024, the site officially transitioned to Reclamation and Closure phase.

This presentation will give a brief overview of the mining operations from historic mining to the closure of the Touquoy Mine Operations. It will discuss the initial reclamation plans which were presented in 2011 to the Department of Energy and Mines (now the Department of Natural Resources and Renewables) and Noval Scotia Environment (now Nova Scotia Environment and Climate Change). The presentation will also outline revisions to the reclamation plan made by Atlantic Mining NS Inc (AMNS) over the interceding years, review of reclamation the process and sequence, and detailing the ongoing efforts in collaboration with global experts with reclamation studies and closure designs to facilitate the best reclamation outcome for the site.

Highlights of recent completed projects and initiatives in restoring the Touquoy site will be presented. Examples will include completion of technical studies and relevant findings, re-vegetation projects and construction of critical closure components.

The goal is to give attendees a comprehensive overview of the reclamation progress and a snapshot of the status of the Touquoy Gold Mine.

Wetland Vulnerability Study

Brayden Thomas – Strum Consulting, Halifax, NS

McCallum Environmental (now Strum Consulting) supported Nova Scotia Department of Public Works to complete a secondary wetland compensation project associated with wetland alterations of the Highway 102 Aerotech Connector Project. The objective of the study was to create a GIS-based tool to analyze and evaluate wetland vulnerabilities within the Shubenacadie Watershed, and to identify wetlands that could be considered for wetland management opportunities (restoration, enhancement, protection, etc.). Field-based assessments were completed in 2023 to gather field observations of wetland vulnerabilities and stressors to calibrate and validate the GIS modelling techniques utilized within the Study. The model output provided a shapefile of predicted wetland polygons with a series of attributes related to its vulnerability to a set of 10 potential proximal and tertiary land use stressors. The wetlands are ranked out of a possible 10 points for their current vulnerability baseline condition based on the predictive model.

Wave characteristics and Longshore sediment transport in connection with dredged material disposal at Chiasson office spit, Shippagan, New Brunswick, Canada.

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Abstract

The research focuses on understanding the hydrodynamic and sediment transport processes along Chiasson office spit, Shippagan, New Brunswick, Canada after the strategic placement of 165,000 m^3 of dredged sand and gravel material (Figure 1). The utilization of dredged material will serve as a pivotal role in the beach nourishment in this region, marking a novel approach to restoring piping plover habitat. This innovative approach is not only addressing the coastal erosion concerns but also highlights the potential for beneficial use of dredged sediment to support habitat restoration for an endangered species. A field measurement program was conducted in Shippagan, involving the use of wave spotter buoy and acoustic Doppler current profiler (ADCP) to measure nearshore wave parameters and velocities at intervals through the water column in water depths of approximately 10m. Additionally, water level measurements were simultaneously recorded at two locations using water-level loggers (Figure 2). The collected data are being used to calibrate and validate a Delft3D numerical model [1], which will be used to simulate hydrodynamics and sediment transport in the study area. In this study, will use flow and wave modules to understand the propagation of waves from open water to the coast and their interaction with tides in the nearshore. This approach aids in understanding hydrodynamic conditions and sediment movement along the coast.

The outcome of the study will offer valuable insights into the large-scale beach nourishment in cold climates, which is crucial for informing future sediment-based Nature-Based Solutions (NBS). The unique environmental conditions, including temperature variations, winter weather cycles and seasonal changes, can significantly influence sediment dynamics and coastal morphological adjustments in such regions. Therefore, studying these factors in the context of the Shippagan beach nourishment project can offer valuable insights into the effectiveness and adaptability of sediment-based NBS in cold climate conditions.

References

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Title: Using native plants to assess the effectiveness of a remediation strategy at reducing the bioavailability and toxicity of contaminants in wetlands impacted by legacy gold mine tailings

Authors: E. Udoh[1,] E.E.V. Chapman[1], H. Gavel[1], L. MacDonald[1], B. Knockwood[1], L. Phillips[1], K. Kerr[1], S. Sequeira[1] and L.M. Campbell[1]

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As a result of historical gold mining activities which took place between 1800 and 1940, there are high concentrations of arsenic (As) and mercury (Hg) in the water and sediment of numerous wetlands of Nova Scotia (NS). Elevated levels of As and Hg in these wetland ecosystems have the potential to impact biodiversity, growth and health of plants. With this project we investigated if a reactive amendment and thin protective capping (RAPC) application can reduce toxicity and bioavailability of As and Hg to plants growing in these wetlands. A three-month laboratory bench test was first completed to assess if seeds of Pickerelweed (*Pontederia cordata*) could germinate in As and Hg contaminated wetland sediment, RAPC treated contaminated wetland sediment, and control sediment, and if RAPC treatments reduce toxicity of sediment to Pickerelweed. To increase environmental realism, once the laboratory test was completed, a field experiment was initiated at a contaminated wetland site impacted by historical gold mining. The purpose of this test was to determine if RAPC treatment is safe for existing contaminant tolerant plants (*Juncus balticus* and *Equisetum fluviatile*), and if treatments can improve and promote growth of native sensitive species not currently present in the contaminated area of the wetland. Preliminary results from both tests have revealed that RAPC treatments do not impact existing plant survival and promote germination, growth, and health of sensitive native plant species like Pickerelweed, aiding the natural recovery of wetlands. Results and methods, and preliminary conclusions of this project will be presented during the conference.

Presentation Title: Three years of Monitoring at the Truro-Onslow Dyke Realignment and Tidal Wetland Restoration Project.

Authors: Kayla Williams[1] (presenter), J. Graham[1], T. Bowron[1], D. van Proosdij[2], R. Mulligan[3], and B. Pett[4],

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Abstract: Globally, the practice of re-introducing tidal flow to former dykelands and restoring tidal wetland habitat has been identified as a viable adaptation method to current and future risks associated with climate change. Located at the confluence of the North and Salmon Rivers near the town of Truro, the Onslow-North River Marshland provides an important opportunity to demonstrate the environmental and social benefits of a large-scale strategic dyke realignment project, as well as the benefits of a multidisciplinary and multi-stakeholder approach to tidal wetland restoration. Carried out in collaboration with the NS Department of Agriculture (NSDA), NS Public Works, and the Onslow-North River Marsh Body, this project included the construction of two sections of new dyke, a new aboiteau and the restructuring of the agricultural ditch network to create a foundation for a new hybrid tidal creek network, and the hydrodynamic modeling of dyke breach scenarios. A six-year monitoring program was initiated to establish baseline conditions at the stie and track restoration efficacy. The old dyke was decommissioned and tidal flow re-introduced to the site in the fall of 2021, and the third year of post-construction monitoring was carried out in the summer of 2024. Flooding by higher high tides resulting in with high levels of sedimentation throughout the site have increased elevations and created favorable conditions for vegetation and fish communities. Following three years of monitoring, the site has shifted towards a tidal-fresh marsh community with a functioning tidal creek network.