The Port
OF PORT TOWNSEND
SERVING ALL OF JEFFERSON COUNTY

August 6, 2018

Mr. Kevin Hancock
WA Department of Ecology
Water Quality Program
PO Box 47775
Olympia, WA 98504-7775

Via Email: KEVIN.HANCOCK@ECY.WA.GOV

RE: Administrative Order #13279

Dear Mr. Hancock:

Thank you for the letter dated June 20, 2018. As you are aware, the Port installed new stormwater treatment components in the fall of 2017. We concur that the two samples collected between December 2017 and April 2018 exceed the permit benchmarks. We also concur that the Port must do more to meet the conditions of the permit in order to support our shared goals for clean water.

Towards that end, the Port has been working with Landau Associates regarding additional stormwater treatment and management practices. Please find attached a Technical Memorandum regarding a proposed approach.

I would also like to follow up on Mr. Doenges' suggestion that we schedule a meeting sometime in the near future to discuss the Port's actions for the upcoming wet season.

Please contact Ms. Sue Nelson, snelson@portofpt.com, to arrange this meeting at your soonest convenience.

I look forward to meeting with you and other Ecology staff.

Respectfully,

Sam Gibboney
Executive Director

Technical Memorandum

TO: Sam Gibboney, Executive Director, Port of Port Townsend

FROM: Joe Kalmar, PE, and Katie Saltanovitz, PE

DATE: August 3, 2018

RE: **Work Plan for Stormwater Pre-Treatment using Chitosan**
Port of Port Townsend Boat Haven Work Yard
Port Townsend, Washington
Project No. 0304007.070

Introduction

This technical memorandum summarizes a work plan for implementing stormwater treatment improvements at the Port of Port Townsend (Port) Boat Haven Work Yard, specifically through addition of a new pre-treatment process using the natural coagulant chitosan. The media filtration installed in 2017 at the boatyard is effective in reducing the concentrations of copper and zinc in stormwater through filtration of suspended solids and through adsorption of the dissolved form of the metals. The filtration media is known to be less effective at filtering out very fine particulate suspended solids, such as those less than 10 microns (µm) in diameter, and the metals attached to those small particles. Stormwater sampling following the installation of new filtration media at the Work Yard has shown reduction of metals concentrations but still not consistently below the benchmark values in the Boatyard General Permit. The necessary improvements are identified to be improved pollutant source control (e.g., through additional application of new clean gravel surface in areas subject to erosion) and improved coagulation/filtration of fine particulates.

A coagulant is a compound that acts to bind small suspended particles together such that they can be more readily settled or filtered from water. Chitosan is a natural non-toxic coagulant derived from crab shell, which has been demonstrated to be effective for reduction of suspended solids and turbidity in construction site stormwater. Treatment for stormwater using chitosan has had General Use Level Designation (GULD) by the Washington State Department of Ecology (Ecology) for many years and has also been implemented for stormwater treatment at a number of industrial facilities since 2011. The more common GULD process for use of chitosan is in a liquid form as chitosan acetate. However, the use of chitosan acetate typically requires an automated advanced control system to properly dose the chitosan and to avoid overdosing.

Another form of stormwater treatment using chitosan that has been employed for many years is passive dosing of chitosan in the form of chitosan lactate solid, which offers the benefits of avoiding potential issues of spilling or overdosing the chitosan and avoiding the need for expensive automation and controls. The use of chitosan lactate is proposed to be pilot-tested at the Work Yard to be demonstrated as a safe and effective media filtration pre-treatment improvement to reduce small particulate suspended solids and the associated metals from Work Yard stormwater.

We understand that the Port received a response letter from Ecology in June 2018 that requested the Port undertake additional actions to improve stormwater treatment performance to meet Boatyard Permit benchmark values in the 2019-2020 monitoring year. The implementation of chitosan pre-treatment as described in this work plan was previously discussed as a potential contingency action in the 2017 engineering report (LAI 2017)[1] and is one additional action that would be expected to improve stormwater treatment effectiveness, in combination with the ongoing replacement of worn gravel areas that the Port has already begun, which will improve pollutant source control through reduced erosion of impacted surface soil into stormwater.

Treatability Tests

Dungeness Environmental Solutions, Inc. (DESI) conducted treatability testing in its laboratory in April 2018, using samples of untreated site stormwater that were collected on April 16, 2018 by the Port's consultant, Marc Horton, from the pump chambers of Vaults 1, 2, and 4. DESI treated the water by adding 5 parts per million (ppm) of chitosan lactate, in a dry form, to jars containing the sample during agitation with a magnetic stirrer. The chitosan was added directly into the water and mixed at high agitation (~120 rpm) for 1 minute, followed by slow mixing (~40 rpm) for 5 minutes. The treated sample was then allowed to settle for 10 minutes before a turbidity reading was taken. In this case filtration was not used. The post-treatment results were as follows:

- Vault 1: 16.4 nephelometric turbidity units (NTU; turbidity before treatment: 76 NTU)
- Vault 2: 15.1 NTU (turbidity before treatment: 194 NTU)
- Vault 4: 7.86 NTU (turbidity before treatment: 44 NTU).

Landau Associates, Inc. (LAI) also conducted laboratory tests in July 2018 using site stormwater from the same collection date. LAI poured the stormwater through a chitosan lactate packet and then immediately into a soil media column, to simulate the effect of the existing onsite media filters. These tests also showed potential to achieve a similar turbidity reduction (compared to the 10-minute settling time) following the additional of chitosan lactate. However, due to the long hold times for the site stormwater prior to the July testing (and natural biological coagulation of solids over that time), the initial and final turbidity results were not felt to be as representative of site conditions as the treatability tests done by DESI in April 2018.

The bench-scale testing demonstrates that chitosan lactate has the potential to substantially reduce the turbidity of the work yard stormwater, following either settling or filtration. Because particulate metals are associated with turbidity, it is reasonable to expect that reducing the turbidity will also effectively reduce the copper and zinc in the treated stormwater.

[1] LAI. 2017. Level Three Response Engineering Report, Port Townsend Boat Haven Boatyard, Port Townsend, Washington. Landau Associates, Inc. June 2.

Proposed Pilot Testing

Based on the results of the treatability testing, LAI proposes that the Port implement a limited pilot-scale test of the passive chitosan lactate addition in order to determine if a turbidity reduction can be achieved under field conditions, similar to what was shown in the laboratory testing. The two locations LAI recommends for pilot testing are the Aquip® media filter units at Vault 1 and Vault 2. These units have a pumped inflow, where the passive chitosan gel pack (cartridge) can be mounted within a force main so that chitosan will be added to the stormwater before the stormwater enters the Aquip unit. The chitosan cartridges are designed to fit within a 4-inch-diameter section of flexible hose or piping, with a total length of 6 feet. Following the 6-foot cartridge, another 30 to 60 seconds of mixing time would be provided by adding an additional length of pipe prior to discharge into the Aquip unit. Based on the design flow rates, it is estimated that 15 feet of 12-inch-diameter piping would provide sufficient mixing and added contact time with the passively dissolved chitosan before entering the inlet chamber of the Aquip unit, and then the main filter.

Because of how the Aquip units are plumbed, there is very little chance the units could bypass any chitosan-treated water that had not passed through the filter media. The only high-flow bypass on the Aquip units is above the top of the filter bed, which would bypass only if the entire media bed were plugged. The regular maintenance and inspection of the Aquip units will make an emergency overflow very unlikely, and an overflow bypass of the Aquip filter media has not been previously observed by Port staff.

Even in the unlikely event that chitosan-treated water were to bypass the filter, the dissolved chitosan would not be free to affect aquatic organisms (such as adhering to fish gills), because it would encounter other soil particles within the stormwater conveyance piping, and bind to those particles, before discharging to Outfall A. Once the chitosan is bound to a soil particle, it would be unavailable to bind to aquatic species.

Residual chitosan test kits (visual colorimetric test) are also commercially available. As part of the pilot testing, the Port will routinely test treated stormwater for residual chitosan and record those results.

Cost

The initial capital cost of implementing the pilot testing at the two Aquip units is approximately $6,000. This includes purchasing up to 10 chitosan filter socks, a residual chitosan testing kit, and the additional piping and fitting needed to create the contact chamber and mixing zone at the inlet to both Aquip units. It also includes about 16 hours of LAI staff support to assist with startup of the pilot test. LAI assumes that Port staff would install the piping and chitosan cartridges, and that the Port would not need to hire an outside contractor to complete the work. Assuming the chitosan pre-treatment is eventually expanded to the remaining four treatment units, we estimate an additional $11,000 cost for the piping, fittings, and about 20 hours of consultant time.

The ongoing annual capital cost of operating and maintaining the full chitosan pre-treatment system (all six treatment units) is approximately $11,000, which includes replacing the chitosan cartridges (weekly or biweekly at some units during periods of rain) and purchasing refills for the residual testing kit. This estimate is based on the assumption that chitosan pre-treatment would be implemented at all six treatment locations (media filtration swales and the two Aquip units), and that the chitosan lactate cartridges would require replacement about every 100,000 gallons of treated water, at an expected passive dosing rate of about 1 ppm. Actual site conditions, including precipitation volume and pumping rates, could affect this cost.

In addition to the operating and maintenance cost of the system, LAI estimates that the Port may require additional consultant support to assist with troubleshooting, testing, or reporting. We estimate for planning purposes that an annual on call support budget of $5,000 would be sufficient to cover those tasks related to the treatment system specifically. The table below presents a summary of projected costs.

Item	Cost
Pilot testing – materials (piping and cartridges)	$3,500
Pilot testing – consultant support	$2,500
Pilot testing subtotal	*$6,000*
Full implementation – materials (piping only)	$8,000
Full implementation – consultant support	$3,000
Full implementation subtotal	*$11,000*
Total implementation costs	**$17,000**
Annual O&M Cost – cartridge replacement	$11,000
Annual O&M – consultant support	$5,000
Total Annual O&M costs	**$16,000**

Schedule

LAI recommends that the Port procure materials and begin construction of the passive chitosan system at the two Aquip units by early September 2018. Assuming there is sufficient precipitation in late September or October 2018, the pilot testing could be conducted during the first two or three rain events of the fall.

Following successful completion of the pilot testing, LAI would submit a summary of pilot testing results along with a formal request to Ecology to expand from a limited pilot test to full-scale application at the Work Yard. Upon Ecology approval, chitosan pre-treatment could be expanded to all six of the onsite stormwater media filtration units.

Please feel free to contact us if you have questions or would like to further discuss this proposed stormwater treatment approach or the details of pilot testing work plan.

LANDAU ASSOCIATES, INC.

Katie Saltanovitz, PE
Senior Associate

Joe Kalmar, PE
Principal

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