55 SW Yamhill St., Ste 200
Portland, OR 97204
PH 503.222.9518
FAX 503.242.1416
www.geosyntec.com

Final Memorandum

Date:	3 March 2011
To:	Karen Keeley, USEPA Region 10
Copies to:	Mark Edens, Ecology
Prepared by:	Geosyntec Consultants
Prepared for:	The Boeing Company
From:	Brian Anderson, Carl Bach, and Lori Blair, The Boeing Company
Subject:	Addendum to Removal Action Work Plan: Long-Term Stormwater Treatment (26 January 2011) North Boeing Field Seattle, Washington

INTRODUCTION

The Boeing Company (Boeing) is working with the United States Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), City of Seattle, and King County to eliminate sources of polychlorinated biphenyls (PCBs) in stormwater discharges to Slip 4 of the Lower Duwamish Waterway (LDW). On September 29, 2010 Boeing entered into an Administrative Settlement Agreement and Order on Consent for Removal Action (ASAOC) with the EPA. The ASAOC requires that Boeing address the discharge of PCBs to Slip 4 Early Action Area through short-term and long-term stormwater treatment (STST and LTST, respectively) removal actions to meet Interim Goals for PCBs in water and solids at the point of compliance (POC). The STST system is currently installed and operational. The ASAOC requires that the LTST be installed and operating by September 30, 2011. The Interim Goal for PCBs in water is dependent on the outcome of the Slip 4 Salinity Monitoring Study which will determine if the freshwater Interim Goal (0.014 µg PCB/L) or the marine Interim Goal (0.030 µg PCB/L) will apply. The ASAOC Interim Goal for PCBs in solids is 0.1 ppm.

The Final LTST Removal Action Work Plan (RAWP) was submitted to EPA on January 26, 2011. At the request of EPA, this Addendum to the Final LTST RAWP has been prepared to present the LTST design approach, sizing options, and location rationale prior to submittal of the

Draft Pre-Design Technical Memorandum. The proposed media bed pilot study, to evaluate potential future LTST options, and schedule implications are also discussed.

PROPOSED LTST DESIGN APPROACH

It is proposed that the LTST system (Figures 1, 2, and 3) consist of the following:

- A new chitosan enhanced sand filter (CESF) system will be constructed near the King County lift station (LS431) to treat all dry weather base flows from the lift station and preferentially treat wet weather storm flows from North lateral MH130A and, as capacity allows, additional flows from the lift station. This will result in 91% treatment of onsite storm flows to MH130A (12.8 acres), and 100% treatment of on- and off-site dry weather base flows to the lift station (~106 acres on-site plus ~191 acres off-site). Additional treatment of low storm flows at the lift station will also be provided (volume percentage to be determined) when capacity is available. The preferential treatment of storm flows from MH130A is based upon data demonstrating that storm flow from this lateral has elevated PCB concentrations as compared to other laterals.

- The existing STST submersible pump at MH130A (or similar new pump, appropriately sized) will be connected to a new force main to route wet weather storm and base flows from the on-site North lateral directly to the CESF at the lift station. When capacity exists beyond that required to treat the "captured" on-site North lateral storm flows, additional storm flows from the lift station will be pumped to the CESF to take advantage of the full treatment capacity.

- Re-route off-site North lateral (41.1 acres of King County drainage) by diverting flows from a location upstream of MH178 and routing them through NBF to the lift station upstream of the CESF intake. The purpose of this will be to allow preferential treatment of on-site North lateral storm flows at the CESF near the lift station, but still allow some treatment of off-site North lateral flows (as well as other laterals) when capacity allows.
- Dry weather base flows from on-site and off-site laterals (~106 acres on-site plus ~191 acres off-site) discharging to the lift station will be pumped to the CESF, which will discharge back to the lift station vault, downstream of the CESF intake.

- A pilot study will be proposed following submittal of the Pre-Design Technical Memorandum to evaluate the potential future use of a passive biofilter or media bed in lieu of or in addition to CESF for treatment of storm flows.

It is assumed that upon startup of the CESF system at the lift station, operation of the STST system at MH130A will end as the water from MH130A will be redirected to the lift station CESF.

Figures 1 and 2 summarize the proposed flow routing for the LTST system including the North lateral re-route. Figure 3 illustrates the areas from which base and storm flows will be treated under the proposed design approach.

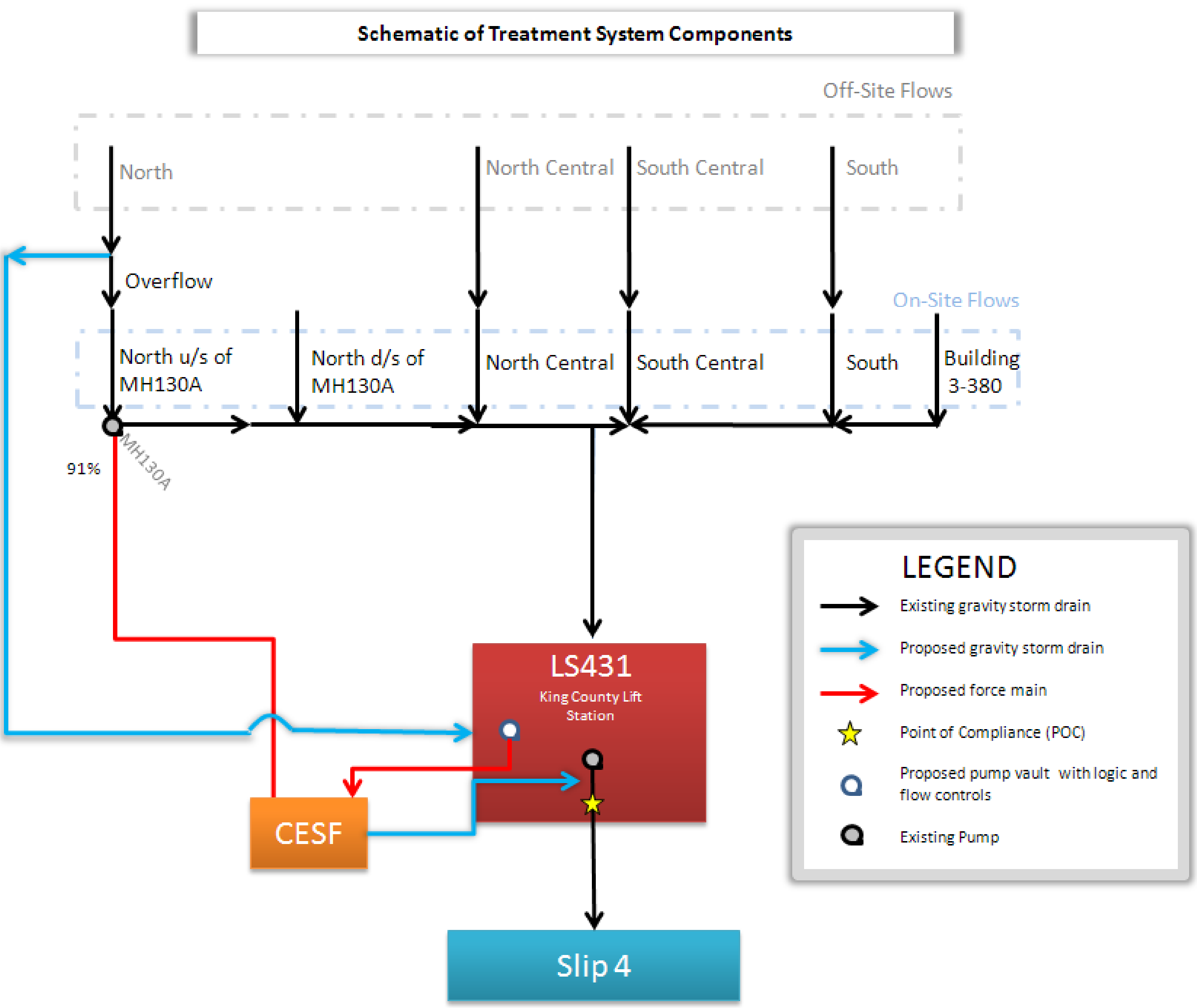


Figure 1. Proposed conceptual LTST design approach

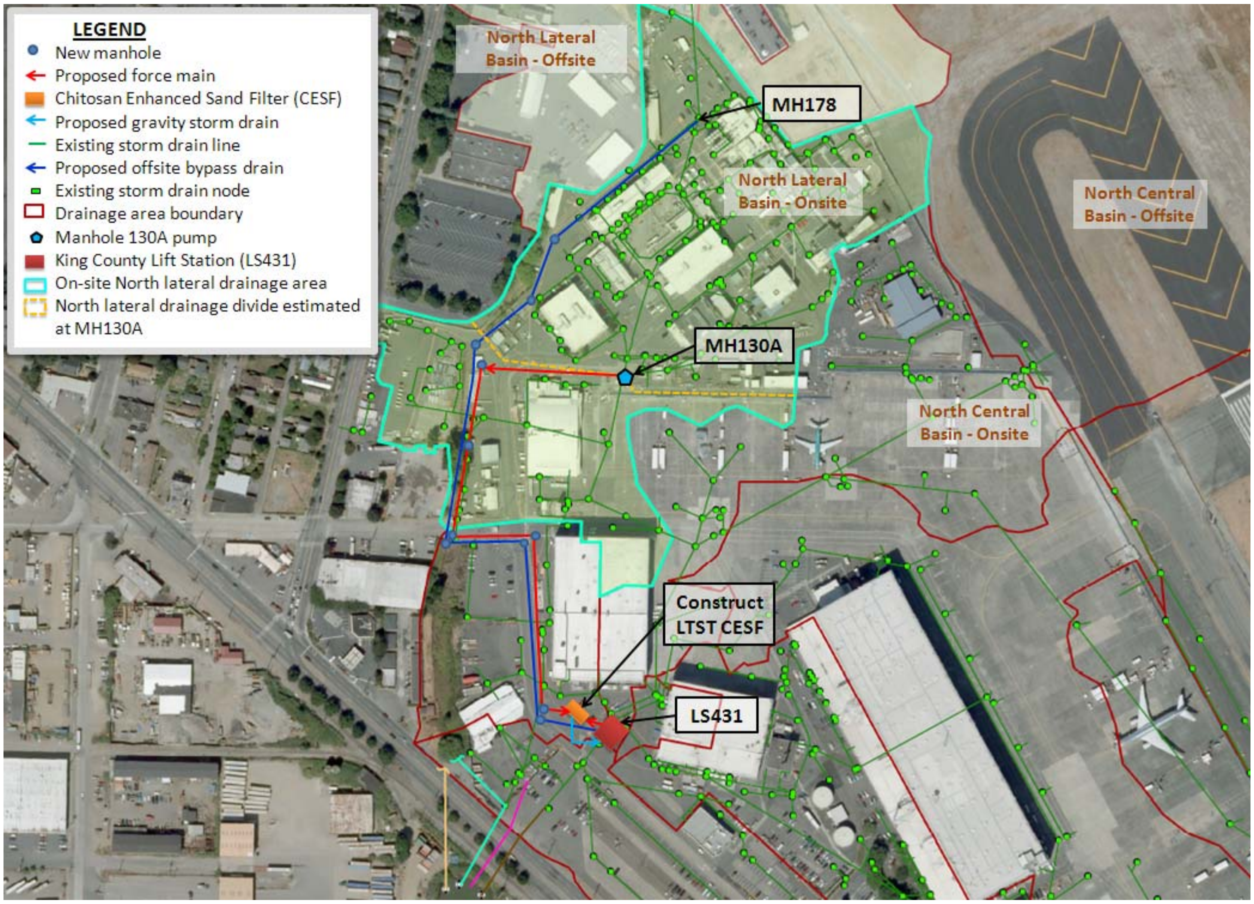


Figure 2. Proposed LTST system plan view

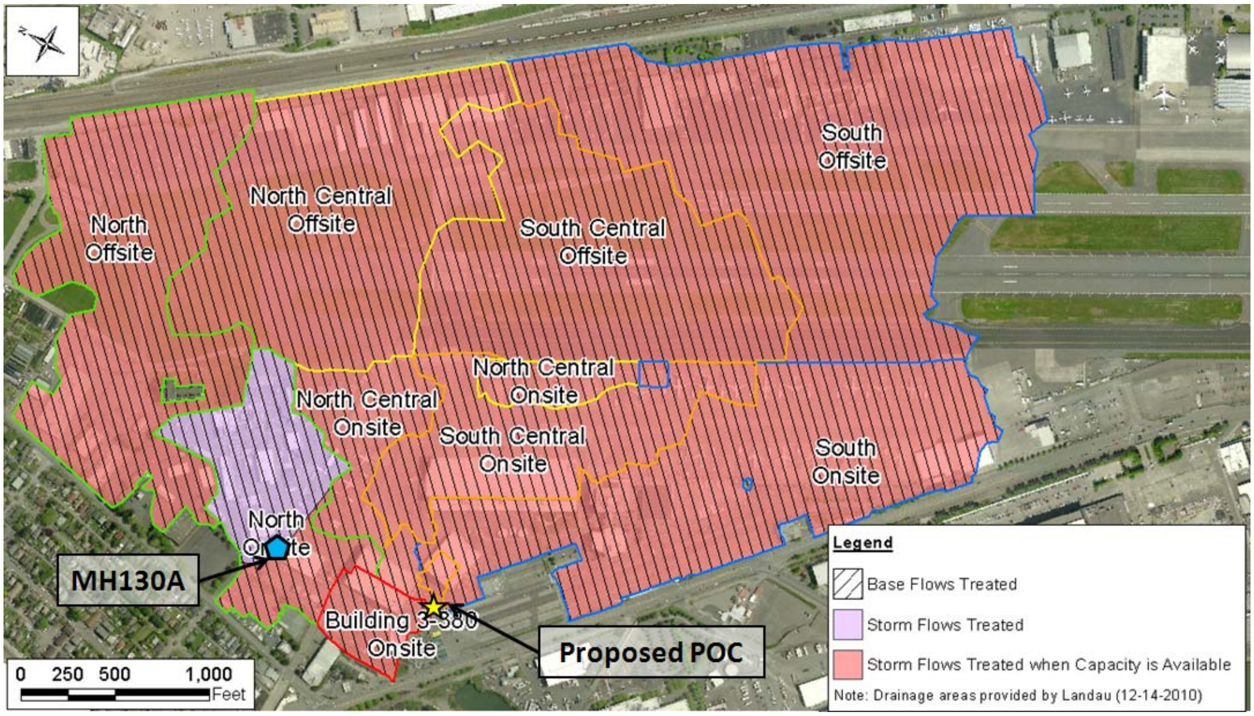


Figure 3. Areas with Storm Flow and Base Flow Treated

POINT OF COMPLIANCE

The point of compliance (POC) is to be located at the existing LS431 water/solids monitoring location. This assumes that no flow will be routed around the POC, as CESF effluent and the rerouted off-site North lateral will be discharged upstream of the POC. If this assumption is found to be invalid as design progresses, an alternate POC will be proposed to EPA for approval.

PROPOSED DESIGN APPROACH SIZING AND LOCATION RATIONALE

This sizing analysis evaluates the following fundamental questions:

- What size system would be expected to consistently meet the EPA's water Interim Goal at the lift station, while being sized to treat 91% of long-term storm runoff volumes at the lift station, and what would this system's cost-effectiveness be as compared to other sizing/configuration options? How feasible would this system be to implement given the current LTST schedule?

- How do performance (in terms of volume capture, load reduction, and frequency of compliance with water Interim Goals[1]), cost, and feasibility (in terms of land, power, and schedule requirements) vary with storage and/or treatment design flow rates?
- How do the optimal treatment system sizes (based on knee-in-the-curve analysis) perform compared to the existing STST on the low end, and the full 91% capture scenario on the high end?

Sizing Rationale

The proposed LTST system will be designed to achieve, at minimum, 91% capture and treatment of storm flows from North lateral MH130A, a drainage area that has been shown to contribute the greatest PCB concentrations and loads to the lift station. Furthermore, the proposed flow routing scheme will maximize treatment capacity utilization by pumping additional base and storm flows from the lift station as system capacity is available. This will result in 100% treatment of base flows at the lift station. Therefore minimum treatment system sizing will be set at the larger of 91% capture of MH130A storm flows and wet season lift station base flow rates. This Addendum provides an assessment of the incremental benefits to load and concentration reduction of PCBs by upsizing the rate of pumping from the lift station to the CESF. Other scenarios were also evaluated to investigate the benefit of modifying lift station pump rules, maximizing the "live" storage that exists in the lift station and storm drain system, and adding above ground storage.

The effect of treatment pump rates from the lift station vault to the CESF has been evaluated with respect to long term average volume capture using continuous simulation in EPA's Storm Water Management Model (SWMM). The SWMM model was utilized for its ability to more accurately model the hydraulics of the system, including the pump operation at the lift station as well as the configuration of the CESF. The WWHM model does not have the hydraulic routing and control logic capabilities of SWMM.

The proposed flow routing scheme, storage, and treatment rates were simulated with SWMM while assuming storage within the lift station vault only (i.e., no upstream pipe storage) and no modification to the current County pump station operating rules (limited storage scenarios).

[1] Regarding attainment of the PCB Interim Goal for solids (0.1 ppm), as presented in the Draft AKART Report (Geosyntec 2011a), the CESF is not expected to meet this low PCB solids concentration because any very fine solids that bypass or break through the filter would be expected to have roughly the same PCB solids concentration as the influent fine solids. All STST system effluent filtered solids PCB results to date support this finding. The solids Interim Goal is currently under review by EPA.

Alternative scenarios were also simulated that assumed 100,000 gallons of total storage at the lift station (to account for upstream pipe storage), above ground storage, and modified County pump rules. The feasibility of modifying the County pump rules to provide additional storage in the upstream pipe network is unknown at this time, so these alternatives are considered best case, or maximum storage scenarios, and are evaluated separately after evaluating the limited storage scenarios. Additional details of the modeling analysis, methodology, and assumptions are provided in Attachment A to this Addendum.

Figure 4 illustrates the predicted volume capture percentages at the lift station for each of the evaluated CESF treatment capacities. The intent of this analysis was to assess various CESF treatment capacities and associated volumetric percent captures of on-site and off-site storm flows. These analyses assume that runoff from North lateral MH130A (12.8 ac drainage area) is preferentially treated at the LTST CESF system, with additional flows (up to the design flows modeled) coming from the lift station (including offsite North lateral flows that are re-routed around the MH130A diversion). All predicted percent capture results presented below assume storage within the LS431 vault only (i.e., no storage within the upstream pipe network, or above or below ground supplemental storage tanks). Percent capture estimates are based on the predicted total cumulative volume treated divided by the predicted total cumulative volume discharged, based on long-term continuous simulations using SWMM. Base + storm flow percent captures are greater than storm flow only captures because 100% of base flows are treated. On-site only percent captures are greater than on + off-site captures because of the smaller drainage area and runoff volumes.

As shown, a treatment rate of approximately 9,500 gpm with no upstream pipe or above ground storage included would be required to capture approximately 91% of storm flows, which is Ecology’s sizing requirement for runoff treatment facilities (Ecology, 2005). It should be noted that the volume capture is as high as 99% if evaluating runoff from on-site areas only and the inclusion of base flows also increase the percent capture.

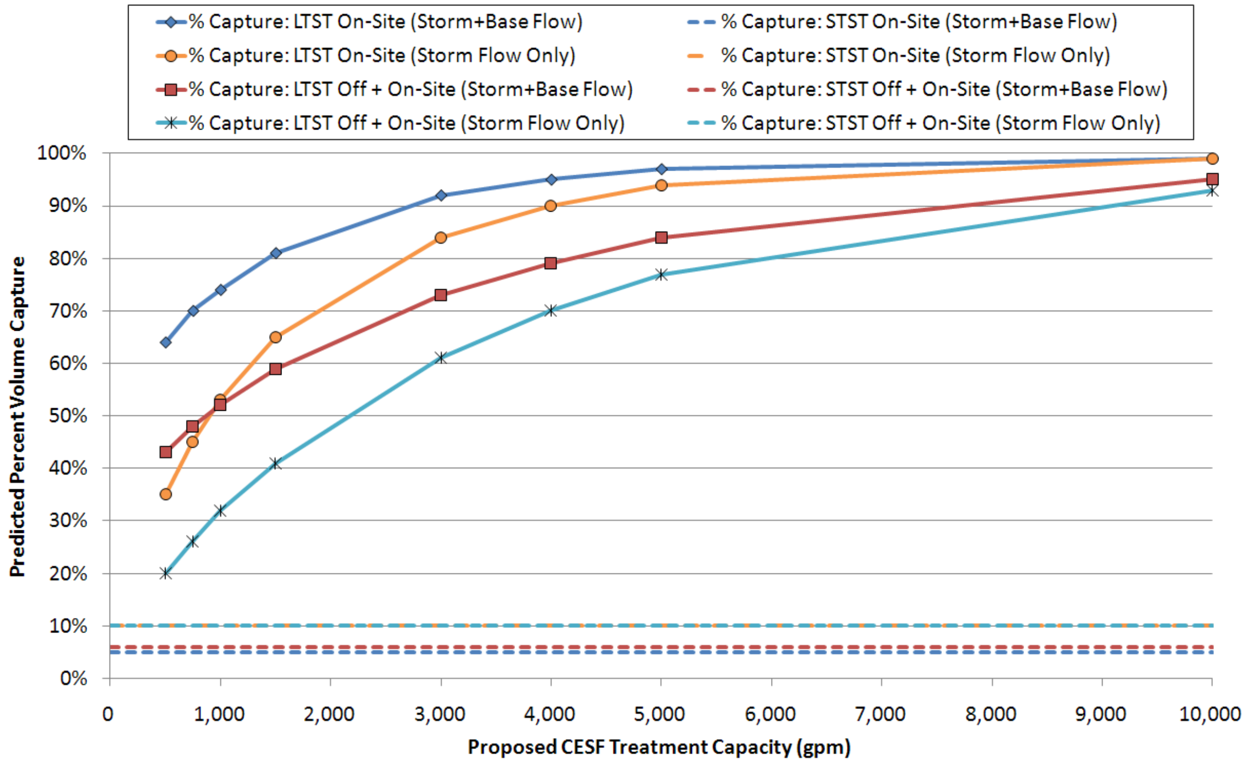


Figure 4. Predicted Percent Volume Capture (only storage in vault assumed)

PCB load reductions at the lift station were also estimated for several CESF treatment capacities based on a mass balance. Figure 5 illustrates these results. The results corresponding to the horizontal lines approximately represent the load reduction predicted for the existing STST system routing. The load reductions for the LTST treatment rates, even at 500 gpm, are predicted to be significantly higher than those for the STST because they maximize utilization of treatment system capacity, with preferential treatment of the highest concentration storm flows from MH130A first. It is important to note that while a significant increase in wet weather load reduction is predicted between the STST and the 500 gpm LTST systems, the incremental benefit is not linear and decreases as capacity increases. While a 65% PCB load reduction (39 g/yr to 13.6 g/yr) is estimated for the 500 gpm treatment rate, a system sized 19 times larger (to 9,500 gpm) is predicted to achieve a total annual load reduction of 90% (39 g/yr to 3.7 g/yr). Twenty times the treatment rate is predicted to achieve about 1.4 times the percent load removed.

The assumption that the CESF pump will be sized to treat 100% of base flows means that regardless of pump rate, it is predicted that the dry weather PCB load will be reduced from 6.7 g/yr to 0.24 g/r (96% reduction of dry weather load or 17% reduction of total annual load).

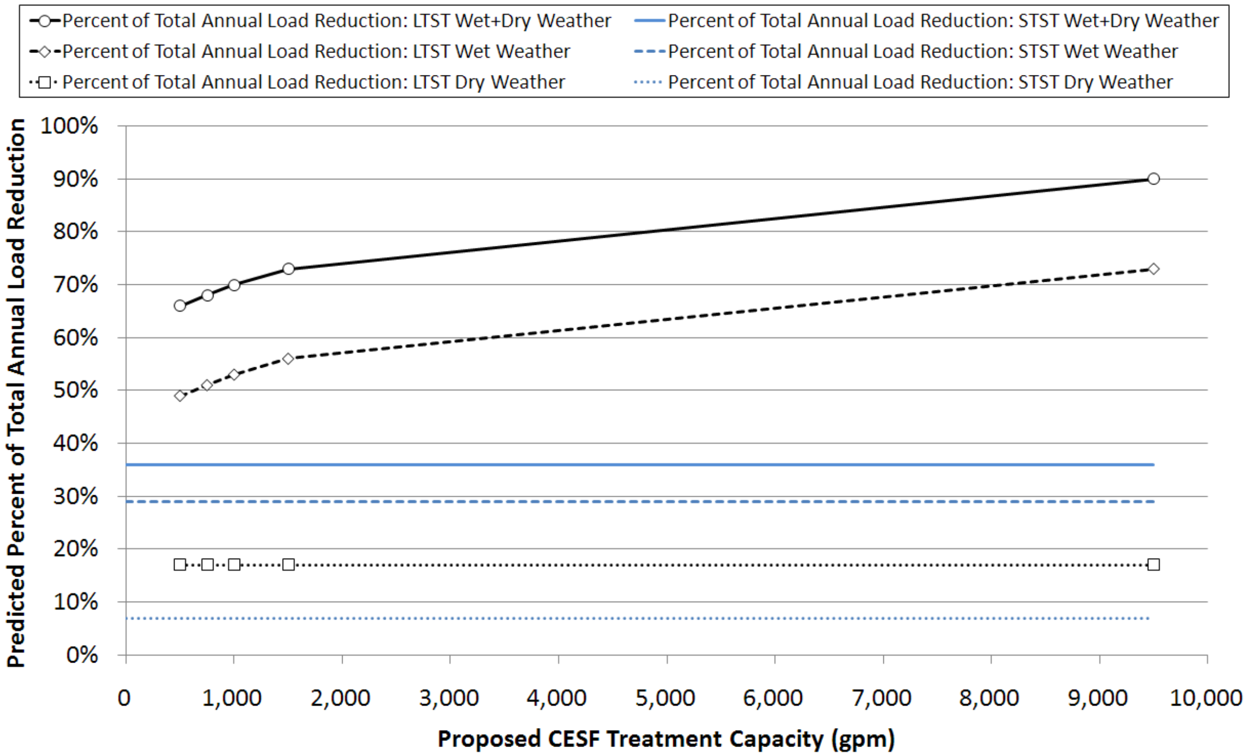


Figure 5. Predicted Percent Annual PCB Load Reduction

Modified Pump Rules and Storage Scenarios

As previously stated, additional alternatives were evaluated that accounted for up to 100,000 gallons of storage in the pipes upstream of the vault. It was found that a combination of modified pump rules and increased storage provided only a minor increase in percent capture over scenarios that only accounted for vault storage and did not modify the County's pump rules. The analysis indicated that at treatment rates as high as 1500 gpm the available pipe storage upstream of the vault is not adequate to provide a significant detention benefit in terms of increasing the volume of storm flow that can be treated by a CESF system. At 1500 gpm, the maximum percent capture of all flows from all areas is estimated to be approximately 59-62%.

To achieve higher percent captures (on the order of 91% capture), either the treatment rate must be significantly increased (as indicated in Figure 5), or additional storage must be made available. Due to site constraints, above ground tank storage may be the only feasible option. To evaluate the above ground storage scenarios that would achieve the 91% capture, the following set of assumptions and overall approach was used:

1. It was assumed the two pumps from the lift station would be intercepted / diverted to a new above ground storage unit (tank farm). The two pumps are assumed to be the two with the lowest float levels (see P1 and P2 in Attachment A figure).
2. The treatment flow rate of the CESF system for the above ground scenario was initially fixed at 1000 gpm and later adjusted to 1500 gpm to obtain percent captures that were closer to the 91% target.
3. The new above ground storage unit capacity was iteratively modeled and increased until it was determined that approximately 6 million gallons of storage would be needed to achieve 91% capture of storm flows plus base flows from all onsite and offsite areas with a 1500 gpm CESF.

Therefore, a significant amount of storage (roughly requiring twenty 50-ft diameter, 20-ft high storage tanks) would be needed to achieve 91% capture for a CESF treatment rate of 1500 gpm. Additional storage and CESF flow rate capacity combinations could be evaluated to achieve an optimal balance between treatment flow rate and storage size in order to maximize cost-effectiveness.

In summary, based on the preliminary results of the analyses presented above, it is anticipated that a predicted percent capture of 91% of the on+off-site runoff (storm and base flow) could be achieved at the lift station by either:

- A CESF system capable of 9500 gpm treatment rate with no additional storage, or
- 6 million gallons of storage with a 1500 gpm CESF system.

In either case, a significant amount of surface area of the site would be needed for either treatment systems or storage tanks if such a high percent capture was targeted.

Cost Comparison

The 20-year cost of each evaluated system, with a treatment rate ranging from 500 gpm to 9,500 gpm and no additional storage, is presented in Figure 6 (Landau, 2011a). The estimate for the 500 gpm system is based on the cost of the STST system; the costs of the higher rates of treatment have been extrapolated from the STST system. Prior to progressing on the Pre-Design Technical Memorandum it is recommend that vendor quotes and an evaluation of equipment availability be obtained for the larger systems. It should be noted that these estimated costs include only the capital cost of the CESF system equipment and the labor and materials to operate the CESF system. The listed costs do not include power costs to run the system and pumps, the design costs, land use costs, solids residual disposal costs, the cost of either the North off-site bypass line or the force main between MH130A and the CESF, or the ongoing compliance monitoring costs. Details and assumptions related to the preliminary cost estimates are provided in Attachment B.

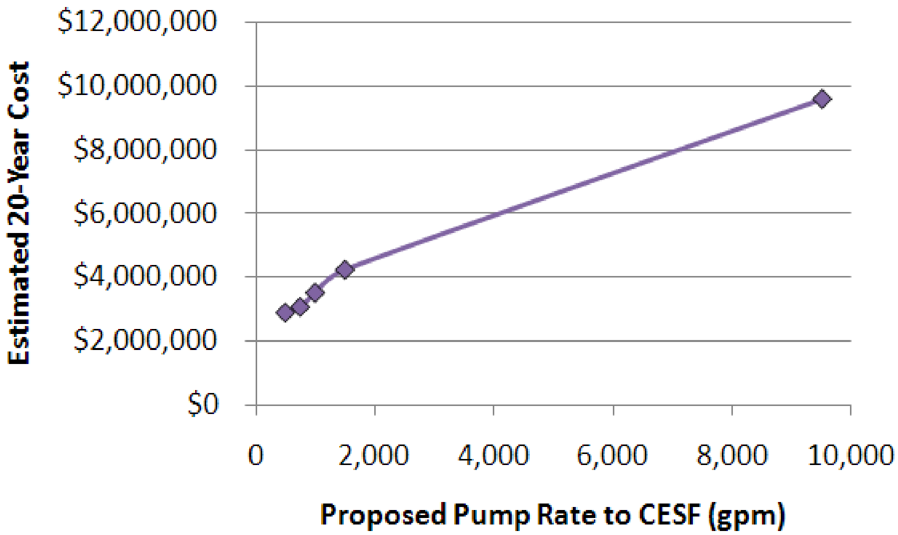


Figure 6. Estimated Annual Cost of LTST CESF Systems without Additional Storage

Land Availability

Boeing completed a recent evaluation of space that could be made available near LS431. The determination was that approximately 2,500 square feet could be made available with the removal of an existing nitrogen storage tank and associated equipment. That available space is similar to the current space occupied by the STST CESF system. Therefore, it is anticipated that a CESF system of similar size (the STST CESF system is currently set to operate at a flow rate of 575 gpm) could be accommodated at the lift station. If additional space is needed, other modifications to structures and/or parking areas may be required and additional conveyance infrastructure may need to be constructed. The 91% capture system, treating at 9,500 gpm, would require approximately 34,000 square feet nearby the lift station.

Power Availability

To run new stormwater lift station pumps and the pumps and equipment associated with the CESF treatment system at the lift station location there will be a need for 480-volt 3-phase electrical power with a minimum 125 amp service (as is currently available for the STST system). Power supply to the lift station currently exceeds that necessary minimum level in order to supply power to the four 50-horsepower (hp) lift station pumps operated by King

County. However, Boeing still needs to confirm through discussions with King County whether adequate spare power capacity would be available even during extreme storm events when all four main lift station pumps need to run.

In the event that adequate spare electrical capacity is not available at the King County lift station to run a new CESF system, then Boeing would either need to consult with Seattle City Light to increase the electrical power supply to the lift station, or power would need to be brought in from nearby Boeing operations. An alternative power supply to the lift station at NBF would require electrical load evaluations to determine a source for power and a new electrical service from the source to the lift station. Boeing is proceeding with confirmation of adequate power supply in either manner. It is anticipated that if the 9,500 gpm system were constructed, additional power would need to be brought in, as this system would likely require a 480-Volt 3-phase 1,000-amp panel.

Design, Procurement, and Construction Schedule

The current best estimate for the lead time necessary to have all necessary CESF equipment (e.g., sand filters, pumps, tanks, instrumentation, and control system) onsite after the date of purchase is 12 weeks. Therefore, for system construction to be able to begin in July 2011, ordering of the longer-lead time items would need to begin in April 2011. However, if the 9,500 gpm system were to be selected for installation it is anticipated that the lead time would need to be increased to 15 weeks, requiring ordering to start in March 2011. The need for additional power and identifying a suitable location would also likely lengthen the design and construction schedule.

LTST Design Flow Rate

Considering the still limited available stormwater monitoring data at LS431 since 2010 storm drain cleaning activities and the installation of the STST system, and considering that PCB source identification/elimination is ongoing (see ‘Continuing Source Controls’ section later in this document for a description of on-going/planned source control efforts), it is difficult to accurately predict the size of a treatment system necessary to routinely achieve the PCB Interim Goals. Further, the relationship of PCB load removal to infrastructure sizing is non-linear (e.g., twenty times the infrastructure capacity is predicted to result in about 1.4 times the percent contaminant mass removal). Finally, it is not guaranteed that even the significant 91% capture would meet the Interim Goals at the POC all the time.

For these reasons, a treatment rate of 500 to 1500 gpm is considered more appropriate for implementation at this time. In order to further refine the treatment rate, the comparative benefit of these treatment rates has been evaluated with respect to: 1) long-term average volume capture;

2) annual PCB load reduction; and 3) estimated frequency of meeting the freshwater and marine water Interim Goals in treated discharge. For all analyses, the "existing" condition is assumed to be the condition prior to STST startup. Boeing and EPA will use this information to make an informed decision about the design flow rate deemed most appropriate to meet the overall goal of protecting Slip 4 from recontamination, including meeting to the extent practical the PCB Interim Goals at the POC.

Long-Term Average Volume Capture at Lift Station

Table 2 summarizes the predicted long-term average volume capture at LS431 for off + on-site and on-site only runoff. "Runoff" includes both storm flows and wet and dry season base flows. Under existing conditions, it is assumed that no runoff to LS431 is captured or treated prior to discharging to Slip 4. If assessing on-site drainage only under proposed conditions, it is estimated that 64 to 81% (148 to 189 Mgal/yr) of the equivalent on-site runoff (~233 Mgal/yr) would be captured for treatment via CESF for the proposed 500 to 1500 gpm pumping/treatment rates evaluated. When considering all of the on and off-site runoff at the lift station, then it is estimated 43 to 59% (151 to 208 Mgal/yr) of total runoff (~352 Mgal/yr) will be captured for treatment over the long term for the same pumping/treatment rates. The highest percent capture of these pumping/treatment rates corresponds to the highest evaluated proposed pump rate (1500 gpm) from the lift station to the CESF, with the exception of the 9,500 gpm treatment rate, which is considered infeasible at this time given the available land, power, and implementation schedule constraints.

Due to uncertainties associated with the availability of storage at the lift station and the ability to alter pumping rules, these volume capture estimates may be refined as part of the Pre-Design Technical Memorandum or subsequent design submittals. Both the depth-flow rate relationship at the lift station as well as the storage capacity within the storm drain network upstream of the lift station are needed to refine these model estimates. Landau staff are currently evaluating the feasibility of collecting this additional data.

Table 2. Long-Term Average Runoff (Storm + Base Flows) Volume Capture at LS431 (assuming LS431 vault storage only)

Proposed pump rate to CESF from LS431	Existing	Proposed	
	Off + On-Site	On-Site	Off + On-Site
500 gpm	0%	64%	43%
750 gpm	0%	70%	48%
1000 gpm	0%	74%	52%
1500 gpm	0%	81%	59%
9500 gpm	0%	99%	93%

Notes
a) "On-site" includes runoff from the drainage basins on NBF property upstream of the lift station
b) "On + off-site" includes runoff from NBF and KCIA drainage basins upstream of the lift station
c) "Existing" assumes no treatment (i.e., no STST or LTST)

Annual PCB Load Reduction

The effect of various pump rates on the wet and dry weather load reduction has been estimated using a mass balance based on the proposed design approach (on-site plus off-site). As shown in Table 3, under existing conditions it is estimated that the total average annual PCB load is 6.7 g/year in dry weather (dry weather base flows) and 47 g/yr in wet weather (storm flows and wet weather base flows).

Under proposed conditions it is estimated that the dry weather load would be reduced by 96% to 0.24 g/year regardless of pump rate as all of the pumping/treatment rates evaluated would provide 100% treatment of wet and dry base flows (i.e., base flows at the lift station are estimated to be less than 500 gpm). Under proposed conditions, results suggest that the annual wet weather load could be reduced by 47% (to 24.7 g/yr) to 60% wet (to 18.6 g/yr) depending on the treatment rate selected between 500 gpm and 1500 gpm.

Table 3. Total Estimated Annual PCB Load at LS431

Proposed Pump Rate to CESF from LS431	Condition	Existing (g/yr)	Proposed (g/yr)	Load Reduction
500 gpm	Dry	6.7	0.24	96%
	Wet	32	13.3	59%
750 gpm	Dry	6.7	0.24	96%
	Wet	32	12.5	61%
1000 gpm	Dry	6.7	0.24	96%
	Wet	32	11.7	64%
1500 gpm	Dry	6.7	0.24	96%
	Wet	32	10.4	68%
9500 gpm	Dry	6.7	0.24	96%
	Wet	32	3.4	89%

Notes

a) Present annual load at LS431 calculated from filtered solids concentrations summarized in LTST RAWP Table 3 (Geosyntec 2011b), TSS (27.4 mg/L), and runoff volumes using STST RAWP (Landau 2011b) / AKART drainage areas (Geosyntec 2011a). Baseflow load at LS431 is from SAIC Final Loading Memo (2011) and proportioned between wet and dry weather using the ratio from SAIC Draft Loading Memo (2010).

b) CESF effluent assumed 0.0013 µg PCB/L

c) Proposed condition assumes off-site North lateral is rerouted to bypass MH130A, current County pump rules, CESF is sized to capture and treat 100% of both wet and dry weather base flows, and 91% of storm flows upstream of MH130A are treated via CESF.

d) “Existing” assumes no treatment (i.e., no STST or LTST)

Frequency of Meeting Water Interim Goals

The predicted frequency of meeting the water Interim Goals is evaluated below in terms of the number and proportion of wet and dry days annually. Both freshwater and marine water Interim Goals are evaluated, pending the outcome of the Salinity Monitoring Study which will determine which Interim Goal is appropriate.

There are approximately 221 dry days and 144 wet days on average per year at NBF. Under existing conditions, it estimated that the freshwater Interim Goal is exceeded 110 days per year (or 50% of dry days) and the marine Interim Goal is exceeded 0 days per year (or 0% of dry days) at the lift station (Table 4 and Figure 7). During wet weather, it is estimated that the freshwater Interim Goal is exceeded 116 days per year (or 80% of wet days) and the marine Interim Goal is exceeded 43 days per year (or 30% of wet days) at the lift station. It should be noted that these estimates are based on an extremely limited pre-STST dataset, or just two (2) base flow samples and nine (10) wet weather samples. It should also be noted that the base flow sample results were at 0.014 and 0.016 µg PCB/L, both of which are extremely close to the freshwater Interim Goal.

Under proposed conditions, by applying the predicted long-term average load reductions to the measured concentrations at the lift station, it is estimated that both the freshwater and marine Interim Goals would be exceeded 0 days per year (or 0% of dry days) at the lift station during dry weather. During wet weather, it is predicted that the freshwater Interim Goal would be exceeded 14-43 days per year (or 10-30% of wet days) and the marine Interim Goal would be exceeded 14 days per year (or 10% of wet days) at the lift station for the 500 to 1500 gpm pumping/treatment rate scenarios evaluated. As noted previously, while the 9500 gpm treatment rate is predicted to have zero exceedances of the freshwater or marine water Interim Goals, this system is considered infeasible for implementation at NBF.

A significant drop in the number of exceedances is predicted between existing conditions and the 500 gpm scenario (i.e., 110 to 0 days per year in dry weather, and 116/43 [freshwater/marine] to 43/14 [freshwater/marine] in wet weather). There appears to be no incremental benefit between 500 and 1500 gpm for meeting the marine water Interim Goals, as the number of predicted dry weather and wet weather marine exceedances are constant across all scenarios. When the freshwater water Interim Goal is assessed the number of predicted wet weather freshwater exceedances drops from 43 to 29 days per year between the 750 and 1000 gpm scenarios and drops again from 29 to 14 days per year between the 1000 and 1500 gpm scenarios. In summary, the results below, excluding the 9500 gpm scenario, suggest that for the freshwater water Interim Goals the number of predicted wet and dry weather exceedance days is minimized at 1500 gpm, but above 500 gpm, the pump/treatment rate has no impact on meeting the marine Interim Goals.

It should be noted that this is considered a conservative assessment because continuing source controls are expected to reduce concentrations over time (see details in 'Continuing Source Control' section).

Table 4. Predicted Average Number of Days per year Exceeding water Interim Goals

Proposed Pump Rate to CESF from LS431	Condition	Average days exceeding Freshwater Interim Goal (% of wet/dry days)		Average days exceeding Marine Interim Goal (% of wet/dry days)	
		Existing	Proposed	Existing	Proposed
500 gpm	Dry	110 (50%)	0 (0%)	0 (0%)	0 (0%)
	Wet	116 (80%)	43 (30%)	43 (30%)	14 (10%)
750 gpm	Dry	110 (50%)	0 (0%)	0 (0%)	0 (0%)
	Wet	116 (80%)	43 (30%)	43 (30%)	14 (10%)
1000 gpm	Dry	110 (50%)	0 (0%)	0 (0%)	0 (0%)
	Wet	116 (80%)	29 (20%)	43 (30%)	14 (10%)
1500 gpm	Dry	110 (50%)	0 (0%)	0 (0%)	0 (0%)
	Wet	116 (80%)	14 (10%)	43 (30%)	14 (10%)
9500 gpm	Dry	110 (50%)	0 (0%)	0 (0%)	0 (0%)
	Wet	116 (80%)	0 (0%)	43 (30%)	0 (0%)

Notes

a) Average number of wet and dry days calculated based on rainfall record at KBFI between Oct 1, 2006 and Sept 30, 2010.

b) Wet days are defined as calendar days with >=0.15 inches of rain in 24 hours, preceded by at least 24 hours with no greater than 0.04 inches (SAIC 2009 SAP and QAPP)

c) The number/percent of non-compliant wet days are estimated and extrapolated from a limited dataset (n = 10). Storm samples collected between 10/2009 and 6/2010.

d) The number/percent of non-compliant dry days are highly uncertain given the limited number of base flow water samples collected to date at LS431 (n = 2). Base flow samples collected 2/2010 and 6/2010.

e) “Existing” assumes no treatment (i.e., no STST or LTST)

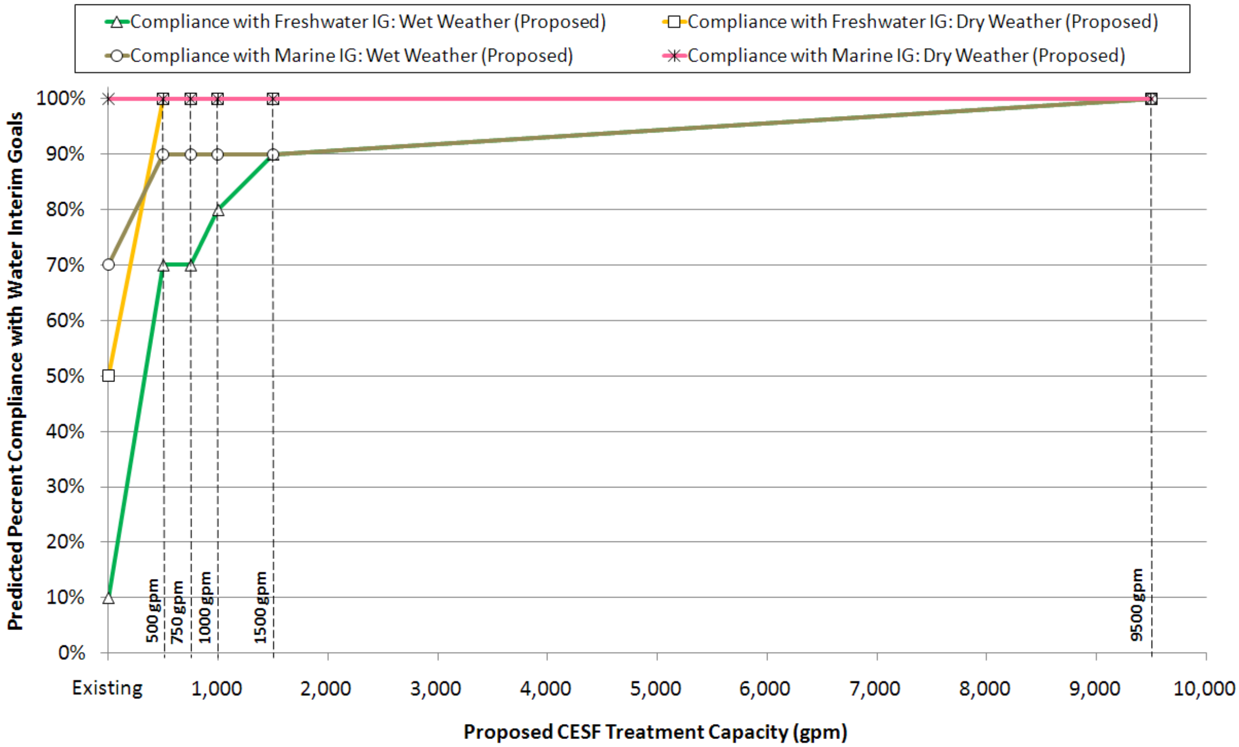


Figure 7. Predicted Number of Days in exceedance of water Interim Goals

<u>Notes</u>

a) The number/percent of compliant wet days are estimated and extrapolated from a limited dataset (n = 10). Storm samples collected between 10/2009 and 6/2010 at LS431.

b) The number/percent of compliant dry days are highly uncertain given the limited number of base flow water samples collected to date at LS431 (n = 2). Base flow samples collected 2/2010 and 6/2010 at LS431.

c) The zero flow exceedances are for the existing condition.

d) "Existing" assumes no treatment (i.e., no STST or LTST)

Treatment Volume and PCB Load Reduction Summary for Limited Storage Scenarios

Results discussed above were evaluated to compare the benefit of pumping from the lift station to the CESF at rates varying between 500 gpm and 1500 gpm, assuming existing County pump rules and no storage with the exception of the vault itself. Figure 8 summarizes these results. The predicted total annual load reduction (wet and dry loads combined) ranges from 66 to 73% for the 500 to 1500 gpm pump scenarios, respectively. This is nearly twice the predicted load reduction achieved under the current STST system operations. The equivalent on-site percent capture of combined storm and base flows ranges from 64 to 81%. It should be noted that by excluding base flows from the percent capture, the storm only percent captures are lower.

As this chart demonstrates, the incremental loading reductions predicted to occur via pump/treatment options above 500 gpm are relatively small. Tripling the pump/treatment rate from 500 gpm to 1500 gpm would result in an additional removal of about 6 percentage points of load reduction.

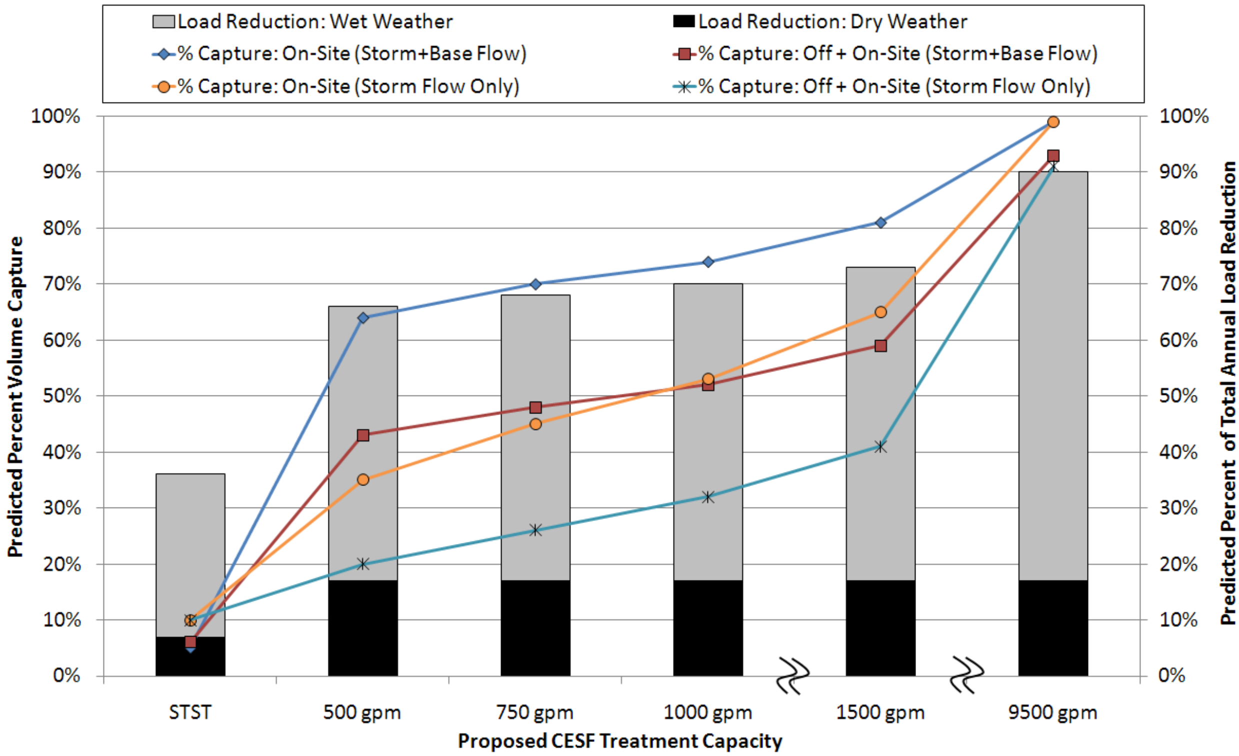


Figure 8. Predicted Percent Volume Capture and Percent Annual PCB Load Reduction

<u>Notes</u>

a) On-Site (Storm + Base Flow) = (Total volume of storm and base flow runoff captured at POC from NBF over the long term) / (Total volume of storm and base flow runoff at POC from NBF over the long term)

b) Off+On-Site (Storm+Base Flow) = (Total volume of storm and base flow runoff captured at POC from combined NBF and KCIA over the long term) / (Total volume of storm and base flow runoff at POC from combined NBF and KCIA over the long term)

c) On-Site (Storm Flow Only) = (Total volume of storm runoff captured at POC from NBF over the long term) / (Total volume of storm runoff at POC from NBF over the long term)

d) Off+On-Site (Storm Flow Only) = (Total volume of storm runoff captured at POC from combined NBF and KCIA over the long term) / (Total volume of storm runoff at POC from combined NBF and KCIA over the long term)

FINAL SIZING RECOMMENDATIONS

Based on the analysis presented above, the recommended treatment rate for an LTST CESF system is 750 gpm. The recommendation for a 750 gpm CESF treatment capacity is supported by the following weight of evidence:

1. This capacity is predicted to achieve 100% dry weather compliance with both freshwater and marine water Interim Goals.
2. This capacity is predicted to achieve approximately 70% wet weather compliance with the freshwater Interim Goal for water quality.
3. This capacity is predicted to achieve approximately 90% wet weather compliance with the marine Interim Goal for water quality.
4. This capacity is predicted to comply with the freshwater Interim Goal for water quality approximately 88% of the time during a “typical” year.
5. This capacity is predicted to comply with the marine Interim Goal for water quality approximately 96% of the time during a “typical” year.
6. This capacity is within the “knee of the curve” (or the point of diminishing returns) range for both the volume capture and load reduction curves. It is predicted that this design would achieve a 70% total annual PCB load reduction, which is nearly twice the reduction the STST is currently achieving.
7. There are significant source control efforts that are planned to continue that should result in reduced concentrations and loadings of PCBs (see below).
8. Space can be made available for this size facility near the lift station.

Boeing would construct the LTST CESF system with the option to increase capacity to 1500 gpm if needed based on compliance monitoring results. A 1500 gpm system is similarly within the “knee of the curve” and is predicted to achieve approximately 90% wet weather compliance with both the freshwater and marine water Interim Goals. This could be accomplished through the addition of another 750 gpm CESF system near the lift station, or increasing capacity with a passive biofilter or media bed to treat storm flows from MH130A following successful pilot study results.

LIFT STATION INFRASTRUCTURE

As indicated above, electrical power upgrades may be required for the CESF system at the lift station. In terms of physical infrastructure, it is currently estimated that the lift station wet vault (i.e., the subsurface inlet side of the lift station) has adequate interior dimensions and open space to allow installation of new submersible pumps that would be required to transfer water above ground and into the CESF system inlet holding tanks.

The CESF system submersible pumps would be set by level switches or level/pressure transmitters to turn on at a water elevation lower than the activation level of the four King County lift station pumps to ensure that runoff is preferentially collected for treatment. Only when the flow rate into the lift station exceeds the final selected treatment system design flow rate would the water level rise to the level at which the first King County pump turns on. It may be possible to work with the County to consider modified lift station pumping schemes similar to the maximum storage scenarios evaluated with the simulation modeling described above. Note that any resulting system would reduce pumping costs and energy use by the County pumps by reducing the volume of water currently pumped directly to Slip 4.

Stormwater collected for treatment will be pumped into aboveground settling/storage tanks, dosed with chitosan, and then pumped through the sand filters. The treated stormwater would be discharged out of the sand filters under pressure to the discharge side of the lift station and would then flow by gravity to Slip 4 in the existing storm drain pipe that exits the discharge side of the lift station.

MONITORING OF INFLUENT AND EFFLUENT

Consistent with Attachment C-1 of the ASAOC SOW, whole water and filtered solids, samples will be collected at LS431 to demonstrate compliance with the interim goals. Flow-weighted auto-composite water samples will be analyzed for PCBs and TSS (for use in the LTST performance assessment). Solids samples collected via in-line filtration will be analyzed for PCBs, TSS, particle size distribution, and PCB concentrations by particle size. Monitoring will be consistent with the effort outline in the STST and LTST RAWPs (Landau 2011b and Geosyntec 2011, respectively).

Upon LTST system start-up, whole water and filtered solids influent and effluent grab samples will be analyzed for PCBs and TSS. Whole water samples will be collected weekly and filtered solids influent and effluent samples will be collected twice monthly. Sampling is anticipated to be reduced over time after sufficient data has been collected to demonstrate the effectiveness of the treatment system. It is understood that if a second LTST system (e.g., an additional 750 gpm system) is phased in, post start-up monitoring may be longer than anticipated under the LTST RAWP.

In addition to water quality monitoring, continuous flow rates for treated base and storm flows along with by-pass and the status of the treatment systems would also be recorded and reported.

Additional detail related to monitoring will be provided in future documents to be developed specific to the LTST System. A Draft Sampling and Analysis Plan (SAP) meeting the requirements of the ASAOC SOW Section III will be developed and submitted to EPA as part of 60% Design Documents. The SAP will also include a Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP). A Draft Monitoring Plan will also be prepared, consistent with the SAP, FSP, and QAPP, and Attachment C-1 of the ASAOC SOW.

BIOFILTER MEDIA BED PILOT STUDY

A proposed biofilter/media bed pilot study would test passive LTST system designs for treating storm flows at the North lateral MH130A as an alternative, or in addition to, the active CESF system at the lift station. The overall purpose of the pilot study would be to evaluate whether a passive LTST system that includes passive settling (primary treatment) and passive filtration (secondary treatment) could consistently achieve the PCB water Interim Goals more cost-effectively. Alternatives for each (primary and secondary) stage of treatment may be investigated. Boeing will prepare a separate technical memorandum for EPA review and approval describing the proposed passive stormwater treatment pilot study design and testing program. This memorandum will include the scale, location and design parameters, preliminary testing plan, system costs, and proposed schedule. It is anticipated that this memorandum will be submittal to EPA in May 2011.

CONTINUING SOURCE CONTROLS

The following continuing source controls have been proposed for 2011:

- Additional joint compound removal in the flightline area (as recommended per the HHRA);
- Surface cleaning near blast fence where street sweeping was infeasible (as recommended per the HHRA);
- Additional sampling of surfaces for PCBs, including roof tops, and abatement of PCB containing paint;
- Completion of the cleanout of storm drain lines throughout the site (approximately 300 feet of storm drain lines remain to be cleaned);
- Excavation of soils in areas where soil or groundwater was found to contain elevated concentrations of PCBs;

- Install catch basin filter systems in targeted areas where PCB-containing construction materials (concrete joint compounds, paint particles, etc.) could enter storm drain structures; and

- Evaluation/pilot testing of a zero valent metal process for the elimination of PCBs in construction materials.

2012 PLANS

If passive treatment system pilot testing results are positive (i.e., effluent meets water and solids Interim Goals) and LTST monitoring demonstrates need for additional treatment or if passive treatment pilot testing results indicate more cost-effective treatment, then a full-scale passive treatment system may be constructed at the proposed location west of building 3-352 (southwest of 3-350) for the treatment of on-site storm flows from MH130A on the North lateral. If LTST monitoring indicates that additional treatment is not needed to meet Interim Goals and Boeing decides that potentially more cost-effective treatment alternatives are not to be pursued, then the CESF system at the lift station will continue operating as designed.

SCHEDULE REVISIONS

Due to the inclusion of this Addendum into the LTST Removal Action schedule, it is requested that the submittal dates of the Pre-Design Technical Memorandum and Pre-Final (60%) Design Document be delayed by 27 days. The impact of the requested schedule change on the LTST Removal Action schedule is illustrated in Attachment C. The schedule outlined below would still meet the overall September 2011 date for installation of the LTST system.

Approval of Final LTST Sizing

In order to proceed with the Pre-Design Technical Memorandum per the schedule below, it is requested that EPA provide Boeing written approval of the final design approach and treatment flow rate by March 6, 2011.

Pre-Design Technical Memorandum

EPA comments on Draft Addendum were received on March 1, 2011 and the Final Addendum will be submitted to EPA on March 3, 2011. The Draft Pre-Design Technical Memorandum (PDTM) will be submitted to EPA on March 18, 2011.

The Final PDTM will be submitted to EPA within 15 days from receipt of EPA comments on the Draft PDTM. Assuming a 2 week review period, it is anticipated that the Final PDTM will be submitted to EPA on April 18, 2011.

Pre-Final (60%) Design Documents

As stated in the ASAOC, the 60% Design Documents are due to EPA in the week of April 25, 2011. Given the schedule implications to this task of the delayed PDTM submittal, it is proposed that this date be extended to the week of May 2, 2011, providing 3 weeks of working time from the submittal of the Final PDTM.

Procurement of LTST System Components

In order to expedite the construction schedule, Boeing will being procuring LTST system components no later than upon submittal of the Final Pre-Design Technical Memorandum to EPA. As noted above, it is anticipated that this will be on April 18, 2011.

REFERENCES

Ecology, 2005. *Stormwater Management Manual for Western Washington. Volume V - Runoff Treatment BMPs.* Prepared by the Washington State Department of Ecology Water Quality Program.

Geosyntec Consultants, 2011a. Draft *AKART Analysis: Long-Term Stormwater Treatment. North Boeing Field*. February 9.

Geosyntec Consultants, 2011b. *Final Removal Action Work Plan: Long-Term Stormwater Treatment. North Boeing Field*. January 26.

Landau Associated, 2011a. Email transmittal of draft Estimated Costs for CESF LTST at NBF. February 22.

Landau Associates, 2011b. *Removal Action Work Plan Short-Term Stormwater Treatment, North Boeing Field, Seattle, Washington*. Prepared for The Boeing Company. January 7.

Pitt, R., & Clark, S. E., 2010. *Evaluation of Biofiltration Media for Engineered Natural Treatment Systems.* Submitted to Geosyntec Consultants as part of the Boeing SSFL Project.

SAIC, 2011. *Stormwater Contaminant Loadings to Slip 4 from KCIA SD#3/PS44 EOF (Technical Memorandum*). January 28.

SAIC, 2010. *Stormwater Contaminant Loadings to Slip 4 from KCIA SD#3/PS44 EOF (Draft Technical Memorandum*). September 15.

* * * * *

Attachments:

A. Long-Term Continuous Simulation Modeling Assumptions

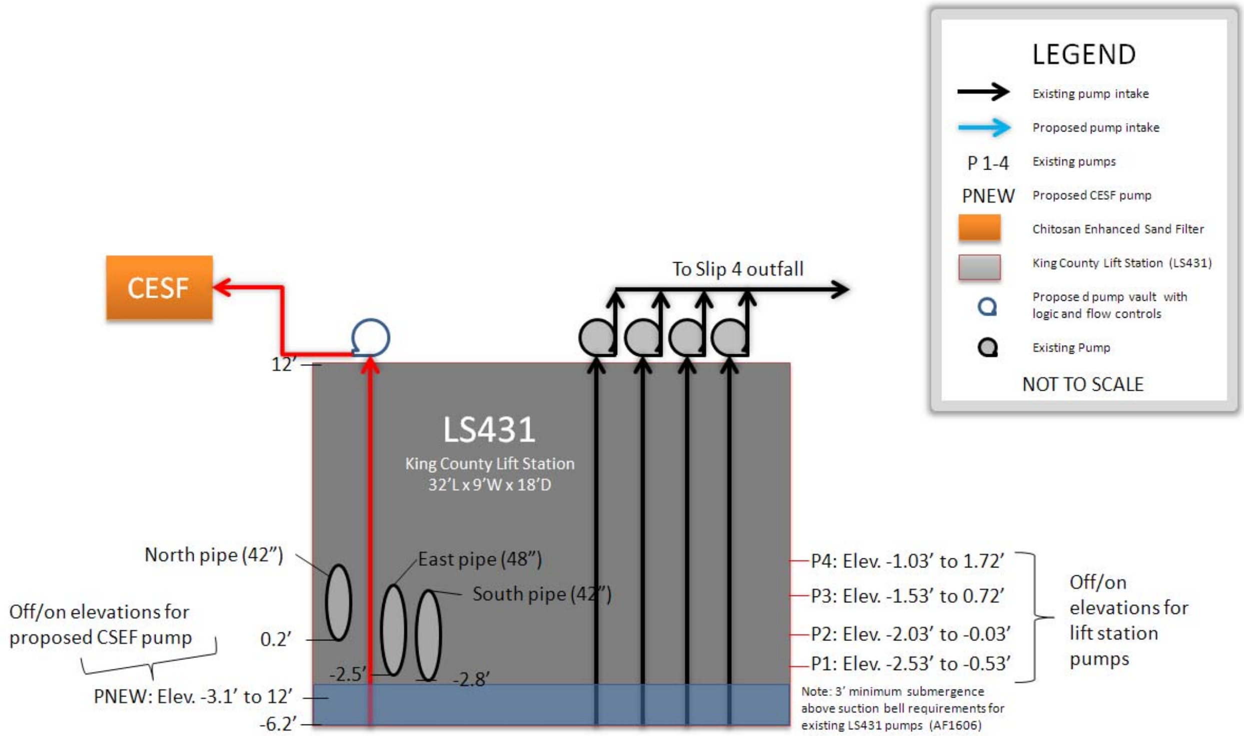
B. Estimated Costs for Chitosan Enhanced Sand Filtration

C. Revised LTST Removal Action Schedule

Attachment A

Model Assumptions and Lift Station Representation

Existing County Pump Rules and LS431 Vault Storage Only



Model Component	Model Representation and Assumptions	Justification/Rationale
Treatment Assumptions	1. Storm flows from North Lateral MH130A preferentially routed to the CESF 2. If additional capacity is available, storm plus base flows from the lift station (up to the capacity of the CESF pump) are routed to the CESF	Based on proposed treatment plan to maximize treatment of the North Lateral MH130A flows with a target of treating at least 91% of total annual volume at North Lateral MH130A
Storage at lift station (LS 431)	Vault dimensions: 32' wide x 9' long x 18' deep Proposed CESF pump operating range: Elev. -3.1' To 12' Existing LS431 pumps operating range: Elev. -2.53 to 12' Resulting available storage: 32' x 9 ' x 18' = 38,800 gals	Vault dimensions based on email correspondence with Martin Valerie at Landau Inc. (1/20/2011)
SWMM Hydrology	Rainfall Data: NCDC Seatac Airport Gage (10/1/1965 to 10/1/2005) Green-Ampt equations used to estimate continuous infiltration-runoff quantities [1]Soils: Hydrologic group C soils for pervious areas [2]Impervious areas depression storage: 0.02"	[1]Landau Associates. 2010. *Removal Action Work Plan, Short-Term Stormwater Treatment, North Boeing Field, Seattle, Washington*. Prepared for The Boeing Company.

<table>
<tr>
<td></td>
<td>[2]Pervious areas depression storage: 0.06”
[2]Slopes: 0.5%
[2]Flow path length: 500’
Wet and dry weather base flows included in analysis
Drainage Areas:
<table>
<tr><th>Drainage Area</th><th>Area (ac)</th><th>Imp (%)</th></tr>
<tr><td>North Lateral - Offsite</td><td>41</td><td>62</td></tr>
<tr><td>North Central - Offsite</td><td>43</td><td>52</td></tr>
<tr><td>South Central - Offsite</td><td>43</td><td>50</td></tr>
<tr><td>South Lateral - Offsite</td><td>65</td><td>79</td></tr>
<tr><td>North Central</td><td>15</td><td>100</td></tr>
<tr><td>South Central</td><td>22</td><td>100</td></tr>
<tr><td>South Lateral</td><td>47</td><td>100</td></tr>
<tr><td>Building 3-380</td><td>5</td><td>100</td></tr>
<tr><td>Parking Lot</td><td>7</td><td>100</td></tr>
<tr><td>North Lateral (d/s MH130)</td><td>5</td><td>90</td></tr>
<tr><td>North Lateral (u/s MH130)</td><td>13</td><td>90</td></tr>
</table>
</td>
<td>December 2010.

[2]Used as a calibration factors for matching SWMM and WWHM model results</td>
</tr>
<tr>
<td>SWMM Hydraulics</td>
<td>Hydraulics consists of pumps and storage routing. Storm drain information (e.g., slopes, invert elevations, etc.) not included, so simple direct routing employed.</td>
<td>Consistent with WWHM</td>
</tr>
<tr>
<td>Base Flows</td>
<td>Base flows were estimating by statistically smoothing the available pumping data for LS431. Average hourly flow rates were computed from the cumulative sub-hourly flow data and then twenty-four hour moving averages were computed. The minimum hourly flow rate for each day in the period of record was then estimated. The average monthly base flow was finally estimated as the average of these daily minimum values for each month. Recent Landau analysis has uncovered inaccuracies in the methods and instrumentation used to collect the data that was used for estimating base flows. Base flow estimates will be refined prior to final design and construction.

Estimated Median Monthly Base Flows at LS431(cfs)
<table>
<tr><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>0.97</td><td>0.85</td><td>0.73</td><td>0.6</td><td>0.48</td><td>0.36</td><td>0.23</td><td>0.18</td><td>0.28</td><td>0.45</td><td>0.63</td><td>0.80</td></tr>
</table>
</td>
<td>Due to on/off pump cycling the base flows are not clearly evident from the raw flow time series obtained from pumping data measured at LS431.</td>
</tr>
</table>

ATTACHMENT B: ESTIMATED COSTS FOR CHITOSAN ENHANCED SAND FILTRATION
LONG-TERM STORMWATER TREATMENT AT NORTH BOEING FIELD

CESF System	500 gpm		
	Annual Cost	20-Year Cost	Comments
Purchase price of existing CESF system	$0	$333,000	Vendor quote
System mobilization cost	$0	$30,000	Based on short-term treatment system (STST)
System startup costs	$24,000	$24,000	Based on short-term treatment system (STST)
Long-term system oversight, operation & maintenance	$25,000	$500,000	Vendor estimate plus contingency
Power cost	$9,900	$198,000	Assuming 40 hp pumps (30 kW), 50% run time with base flow, and $0.075/kW-hr
Filtered solids disposal	$7,500	$150,000	Assuming 130 Mgal/yr treated, 15 mg/L average TSS, 0.65 ppm chitosan dosage
Consumables (chitosan, lab, sand media, material replacement)	$83,000	$1,660,000	Chitosan cost at $500/Mgal, $5,000 for other materials cost
TOTAL	**$149,400**	**$2,900,000**	Total cost rounded to nearest $10,000

CESF System	750 gpm		
	Annual Cost	20-Year Cost	Comments
Capital cost of CESF system	$0	$460,000	Assuming limited economy of scale, 0.8 power scaling factor
System mobilization cost	$0	$30,000	Extrapolated based on short-term system
System startup costs	$32,000	$32,000	Assumed slightly better economy of scale (0.7 power scaling factor factor)
Long-term system oversight, operation & maintenance	$32,000	$640,000	Assumed 0.6 scaling factor due to better economy of scale for labor costs.
Power cost	$10,300	$206,000	Assuming 60 hp pumps (45 kW), 35% run time with base flow, and $0.075/kW-hr
Filtered solids disposal	$8,000	$160,000	Assuming 140 Mgal/yr treated, 15 mg/L average TSS, 0.65 ppm chitosan dosage
Consumables (chitosan, lab, sand media, material replacement)	$77,500	$1,550,000	Chitosan cost at $500/Mgal, $7,500 for other materials cost
TOTAL	**$159,800**	**$3,078,000**	

CESF System	1,000 gpm		
	Annual Cost	20-Year Cost	Comments
Capital cost of CESF system	$0	$580,000	Assuming limited economy of scale, 0.8 power scaling factor
System mobilization cost	$0	$40,000	Extrapolated based on short-term system
System startup costs	$39,000	$39,000	Assumed slightly better economy of scale (0.7 power scaling factor factor)
Long-term system oversight, operation & maintenance	$38,000	$760,000	Assumed 0.6 scaling factor due to better economy of scale for labor costs.
Power cost	$11,800	$236,000	Assuming 80 hp pumps (60 kW), 30% run time, and $0.075/kW-hr
Filtered solids disposal	$8,500	$170,000	Assuming 150 Mgal/yr treated, 15 mg/L average TSS, 0.65 ppm chitosan dosage
Consumables (chitosan, lab, sand media, material replacement)	$85,000	$1,700,000	Chitosan cost at $500/Mgal, $10,000 for other materials cost
TOTAL	**$182,300**	**$3,525,000**	

CESF System	1,500 gpm		
	Annual Cost	20-Year Cost	Comments
Capital cost of CESF system	$0	$800,000	Assuming limited economy of scale, 0.8 power scaling factor
System mobilization cost	$0	$60,000	Extrapolated based on short-term system
System startup costs	$52,000	$52,000	Assumed slightly better economy of scale (0.7 power scaling factor factor)
Long-term system oversight, operation & maintenance	$48,000	$960,000	Assumed 0.6 scaling factor due to better economy of scale for labor costs.
Power cost	$14,800	$296,000	Assuming 120 hp pumps (90 kW), 25% run time, and $0.075/kW-hr
Filtered solids disposal	$9,000	$180,000	Assuming 160 Mgal/yr treated, 15 mg/L average TSS, 0.65 ppm chitosan dosage
Consumables (chitosan, lab, sand media, material replacement)	$95,000	$1,900,000	Chitosan cost at $500/Mgal, $15,000 for other materials cost
TOTAL	**$218,800**	**$4,248,000**	

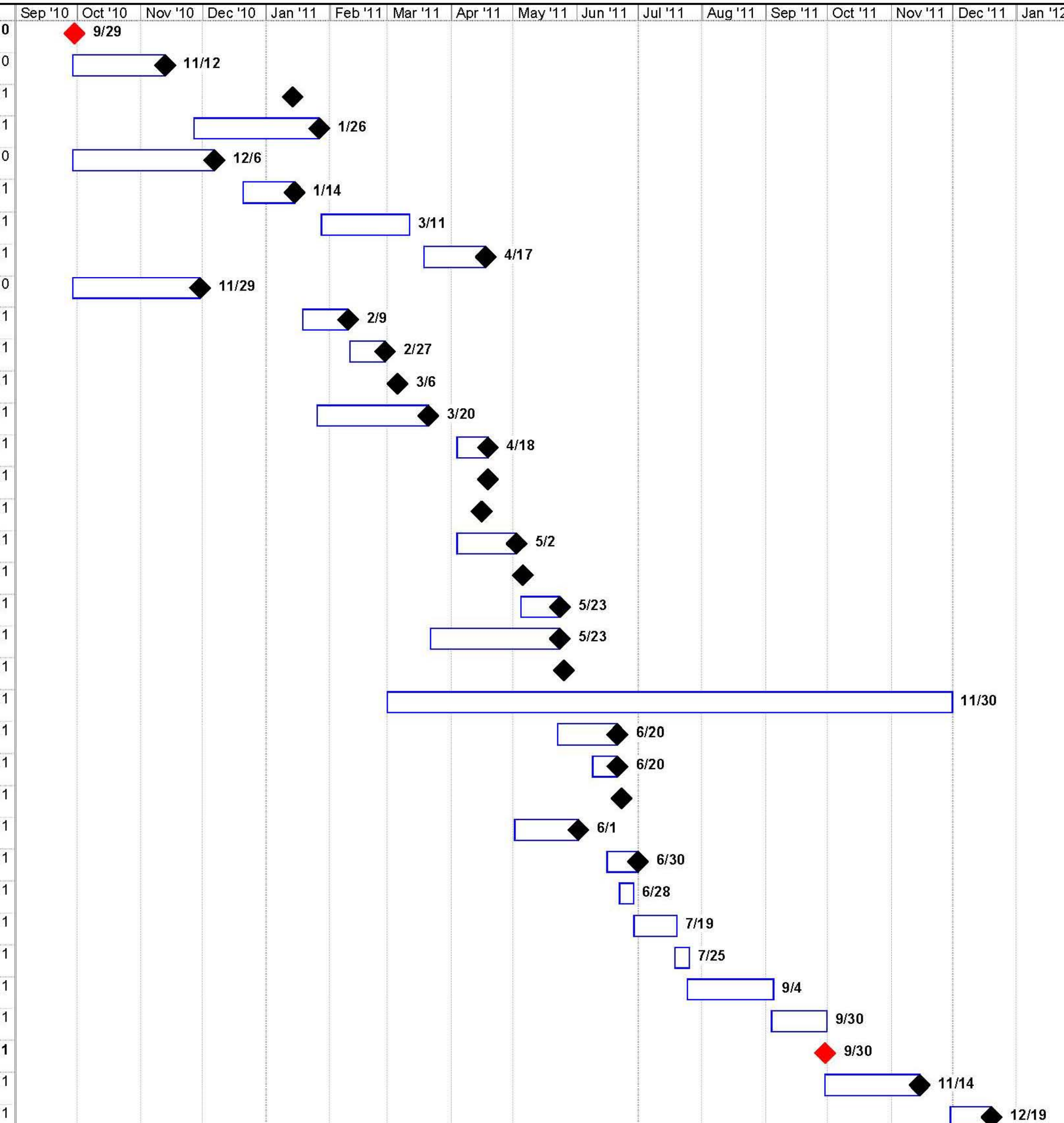
CESF System	9,500 gpm		
	Annual Cost	20-Year Cost	Comments
Capital cost of CESF system	$0	$3,500,000	Assuming limited economy of scale, 0.8 power scaling factor
System mobilization cost	$0	$200,000	
System startup costs	$190,000	$190,000	Assumed slightly better economy of scale (0.7 power scaling factor factor)
Long-term system oversight, operation & maintenance	$145,000	$2,900,000	Assumed 0.6 scaling factor due to better economy of scale for labor costs.
Power cost	$15,000	$300,000	Assuming 760 hp pumps (570 kW), 4% run time, and $0.075/kW-hr
Filtered solids disposal	$11,000	$220,000	Assuming 200 Mgal/yr treated, 15 mg/L average TSS, 0.65 ppm chitosan dosage
Consumables (chitosan, lab, sand media, material replacement)	$115,000	$2,300,000	Chitosan cost at $500/Mgal, $60,000 for other materials cost
TOTAL	**$476,000**	**$9,610,000**	

Notes:
Operational costs for the short-term system are an estimated average for the 20-yr period
Cost excludes any required modifications to the lift station or other conveyance costs.
Cost estimate excludes compliance reporting costs.
No present worth cost estimate has been made for future costs (i.e., discount factor = 0%)
Costs are for CESF system only and exclude design and consulting support

DRAFT

NBF Long-term Treatment Project Schedule

ID	Task Name	Duration	Start	Finish
1	**Effective Date of ASAOC**	**1 day**	**Wed 9/29/10**	**Wed 9/29/10**
2	Task 2. DRAFT Removal Action Work Plan: Long-term Stormwater Treatment	45 days	Wed 9/29/10	Fri 11/12/10
3	EPA RAWP Review Meeting	1 day	Thu 1/13/11	Thu 1/13/11
4	Task 2. FINAL Removal Action Work Plan: Long-term Stormwater Treatment*	61 days	Sat 11/27/10	Wed 1/26/11
5	Draft Slip 4 Salinity Monitoring Plan	69 days	Wed 9/29/10	Mon 12/6/10
6	Final Slip 4 Salinity Monitoring Plan	25 days	Tue 12/21/10	Fri 1/14/11
7	Salinity Monitoring Field Work	43 days	Fri 1/28/11	Fri 3/11/11
8	Salinity Monitoring Data Report	30 days	Sat 3/19/11	Sun 4/17/11
9	Draft AKART Analysis and Engineering Report	62 days	Wed 9/29/10	Mon 11/29/10
10	Final AKART Analysis and Engineering Report	22 days	Wed 1/19/11	Wed 2/9/11
11	Addendum to Removal Action Work Plan: Long-Term Stormwater Treatment	17 days	Fri 2/11/11	Sun 2/27/11
12	Approval of Final LTST Sizing	0 days	Sun 3/6/11	Sun 3/6/11
13	Task 3A.1. DRAFT Pre-Design Technical Memorandum	54 days	Wed 1/26/11	Sun 3/20/11
14	Task 3A.1. FINAL Pre-Design Technical Memorandum*	15 days	Mon 4/4/11	Mon 4/18/11
15	Begin procurement of major LTST system components	1 day	Mon 4/18/11	Mon 4/18/11
16	EPA Design Review Meeting	1 day	Fri 4/15/11	Fri 4/15/11
17	Task 3A.2. Pre-Final (60%) Design	29 days	Mon 4/4/11	Mon 5/2/11
18	EPA Design Review Meeting #2 (tentative)	1 day	Thu 5/5/11	Thu 5/5/11
19	Task 3A.3. 90% Design	19 days	Thu 5/5/11	Mon 5/23/11
20	Task 3B. DRAFT O&M Manual	63 days	Tue 3/22/11	Mon 5/23/11
21	EPA Design Review Meeting #3 (tentative)	1 day	Wed 5/25/11	Wed 5/25/11
22	Treatability Sampling, Media Pilot Testing, and Other Data Gap Sampling	275 days	Tue 3/1/11	Wed 11/30/11
23	Task 3A.4. 100% Design	29 days	Mon 5/23/11	Mon 6/20/11
24	Task 3B. FINAL O&M Manual	12 days	Thu 6/9/11	Mon 6/20/11
25	EPA Design Review Meeting #4 (tentative)	1 day	Wed 6/22/11	Wed 6/22/11
26	Task 3C. DRAFT Monitoring Plan for Water and Solids in Influent and Treated Effluent	31 days	Mon 5/2/11	Wed 6/1/11
27	Task 3C. FINAL Monitoring Plan for Water and Soilds in Influent and Treated Effluent*	15 days	Thu 6/16/11	Thu 6/30/11
28	Prepare and Release Bid Documents	7 days	Wed 6/22/11	Tue 6/28/11
29	Review Bids, Select Contractor, & Negotiate Contract	21 days	Wed 6/29/11	Tue 7/19/11
30	Contractor Mobilization and Material Procurement	7 days	Tue 7/19/11	Mon 7/25/11
31	Construction (incl. material delivery/installation)	42 days	Mon 7/25/11	Sun 9/4/11
32	Startup Testing	27 days	Sun 9/4/11	Fri 9/30/11
33	**Long-term Stormwater Treatment Installed and Operating**	**0 days**	**Fri 9/30/11**	**Fri 9/30/11**
34	DRAFT Removal Action/Stormwater Treatment Completion Report	46 days	Fri 9/30/11	Mon 11/14/11
35	FINAL Removal Action/Stormwater Treatment Completion Report*	20 days	Wed 11/30/11	Mon 12/19/11



Project: PW0250
Date: Fri 2/25/11

Task · Progress · Summary · External Tasks · Deadline · Split · Milestone · Project Summary · External Milestone

*Deliverable date dependent on EPA review time.
Assume 2 week EPA review for all deliverables.

Geosyntec consultants

Feb 2011

PW0250

Attachment C
Addendum to the LTST Removal Action Work Plan
North Boeing Field, Seattle, WA