Construction Stormwater Pollution Prevention Plan

Vancouver Energy
EFSEC Application for Site Certification No. 2013-01
Docket No. EF131590

Appendix K
Historical Water Sampling Data

18 March 2013

Technical Memorandum

To: Matt Graves, Port of Vancouver

From: Alan Flemming

Subject: Terminal 4 Pond Particle Size Distribution and Sample Analysis
Port of Vancouver Decant Facility
K/J 1092004*00

This technical memorandum summarizes the sampling and particle size distribution (PSD) analyses completed for the Terminal 4 stormwater pond, and presents a discussion of initial indications of the data. Four locations near the pond were sampled on 28 January 2013 and on 28 February 2013; one at the outlet (T4M) and three at the inlets (M1, 1D, 1A). In October 2012, three locations were sampled and optical/microscopic particle size distribution analyses were completed for locations T4M, M001, and 1D001. These data and the particle size distribution histograms are presented in the following pages and discussed below. The approximate sample locations and areas draining to each location are shown on Figure 1.

Table 1: Sample Points

Sample Location - Description	Approx. Drainage Area
T4M – Pond Outlet	250 acres
M1 (1M, M001) – East Side of Pond; maintenance shop, Terminal 3	120 acres
1D (1D001) – Parcel 1D; West side of pond, parking lot/laydown area	75 acres
1A – Parcel 1A; North side of Pond, Farwest Steel, new construction	55 acres

Table 2: Sample Data

Sample Point	T4M		M1		1D		1A	
Sample Date (2013)	Jan	Feb	Jan	Feb	Jan	Feb	Jan	Feb
Turbidity (NTU)	25.5	24.5	68.6	61.8	81.3	422.0	196.1	500.0
TSS (mg/L)	< 5.0	< 5.0	31.0	45	24.0	55	34.0	270
pH	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Conductivity (umhos/cm)	74.1	52	18.1	63	16.8	60	67.0	63
total Cu (µg/L)	44.7	33	123.0	120	13.3	78	27.3	57
dissolved Cu (µg/L)	18.3	14	20.7	33	3.43	6.2	3.48	4.5
% dissolved Cu	41%	42%	17%	28%	26%	8%	13%	8%
total Zn (µg/L)	87.9	54	109.0	170	47.2	320	64.6	170
dissolved Zn (µg/L)	71.1	30	62.0	110	24.8	13	< 4.0	< 4.0
% dissolved Zn	81%	56%	57%	65%	53%	4%	0%	0%
mean particle size (µm)	0.969	0.975	2.008	1.033	2.137	2.059	11.04	2.357
median part. size (µm)	0.677	0.693	1.664	0.656	1.646	0.744	2.240	1.146

Notes:

1 - Red values would exceed ISGP benchmarks.

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Abbreviations:

µg/L = micrograms per liter
µm = micron/micrometer
umhos/cm = micromho per centimeter
Mg/L = milligrams per liter
NTU = nephelometric turbidity unit
TSS = total suspended solids
Cu = copper
Zn = zinc

Turbidity and copper are the only parameters that exceeded the Industrial Stormwater General Permit (ISGP) benchmarks at the Pond outlet for these sampling events. Turbidity exceeded the benchmark by a very small amount, and that parameter may improve as the pond continues to age and construction completion reduces influent solids concentrations. Sample point M1 appears to be a significant source of copper, particularly in the dissolved fraction, which is assumed to originate from copper concentrate handling in that drainage basin.

Parcel 1A appears to be a significant source of turbidity, which is presumed to originate from construction activity. Turbidity at sample location 1A is more than twice the level at the other locations for the January sample, but Total Suspended Solids (TSS) is not significantly higher. This sample also has a higher percentage of larger particles with high surface area and high conductivity. A similar high turbidity and low TSS occurs at sample location 1D for the February sample. In any case, the pond appears to be effective at reducing both turbidity and TSS to near benchmark levels. As construction activity is reduced, turbidity in the pond effluent is anticipated to continue to improve.

The laser PSDs presented in the figures on the following pages show that the inlet and outlet samples have a high percentage of particles near the 0.5 micron (µm) size (except for sample point 1A, which has a high percentage at 0.2 µm) and near the 2.0 µm size. These particular particle size distributions may be due to coagulation and preferential settling of other size ranges, but this cannot be confirmed with the current data. Additional analysis would be required to characterize the settling behavior. It should also be noted that these particle sizes are at the bottom of the size range of settleable airborne dust which may never settle in a turbulent atmosphere unless washed out by rain. Additional characterization of airborne particulate matter at the port may be helpful in understanding contamination in the stormwater if it confirms high copper concentrations in airborne dust.

Sample point M1 has both a high total copper level and a high dissolved copper level. The other inlet samples have low dissolved copper levels and relatively low total copper levels. This sample data appears to confirm the source of copper in the pond is through sample point M1 and its watershed east of the pond. The high dissolved copper level measured at sample point M1 appears to pass through the pond with little removal, and the observed reduction in dissolved copper level at the pond outlet may be due only to dilution.

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Based on the analytical methods used in sample preparation before analysis, metals associated with particles smaller than 0.45 µm may be reported as dissolved metals because they may pass through the filter used to separate particulate from the dissolved fraction. Based on review of particle size on a volume percent (%) basis (data not presented here) for the January T4M sample, 13% of the particles by volume were less than 0.452 µm, and for the February T4M sample, 1.8% of the particles by volume were less than 0.452 µm. Approximately 40% of the copper and 70% of the zinc are reported as dissolved in these same samples. This difference between the percent of particles that are less than 0.45 µm and the percentages of dissolved metals suggests that metals reported as dissolved may be truly dissolved, and not associated with particles less than 0.45 µm.

Comparisons of the particle size distributions obtained through optical methods data generally show similar PSDs in October and January. This suggests that the particle size distributions were similar for these two sampling events. However, the optical analyses generally show much larger particle sizes than the laser analyses. For the optical analysis, the sample is shaken by hand, and then observed under a microscope. For the laser particle size distribution, the sample is circulated during the analysis by a pump operating at 1865 revolutions per minute (rpm). The larger particles observed in the optical analysis are likely to be coagulated particles that are broken apart by the pump during the laser PSD analysis. This supposition is supported by the descriptions in the Chemoptix reports. For example, the T4M sample from October includes the following description: “This particle assemblage contained large fractions of soft amalgamates with ~ 1 µm particle inclusions. Despite their poor consolidation, the amalgamates remained intact despite brisk hand-agitation. The data presented here represent the amalgamates…” Similar descriptions were included for all the October samples and most of the January samples.

Review of the laser PSD data suggests that the pond effectively removes particles larger than approximately 5 µm. This may be occurring through settling of naturally coagulated particles. However, as discussed above, the optical analyses show much larger particle amalgamates in both the pond inlets and outlet. It may be that amalgamates containing larger particles have sufficient density to settle in the pond, while those containing only finer particles do not. It also appears that no particles larger than ~ 8 µm are reaching the inlets at sample points M1 and 1D in January. This may be due to removal of larger particles by sweeping or removal in catch basin sumps or inserts. A size distribution analysis of sweeper truck waste might help confirm this last supposition. The high turbidity and high total zinc measured at sample point 1D in February may be related to the larger particles (10-20 µm) seen in this sample and may be the result of the area not having been swept recently.

On a length basis, the optical analyses of samples from locations 1D and 1A appear to be very similar in January; however, on an area basis (data not presented here), the sample from location 1A appears to have larger particles. On a length basis, the optical analysis at 1D also shows smaller particles in October. As noted above in the discussion on turbidity and TSS, and

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as indicated by its higher conductivity, the January sample from location 1A is likely to have different types of particles from the other two locations and samples.

We recommend that the port consider collecting at least one additional sample at these same locations and request the same analyses, to characterize the potential variability in stormwater influent and effluent at the Terminal 4 Pond. We also recommend the port consider characterization of the airborne dust at the port, and its copper concentration. Kennedy/Jenks Consultants (Kennedy/Jenks) can assist with developing a specific sampling plan to determine the contribution of airborne pollutants to the port's stormwater runoff if the port chooses to pursue this option.

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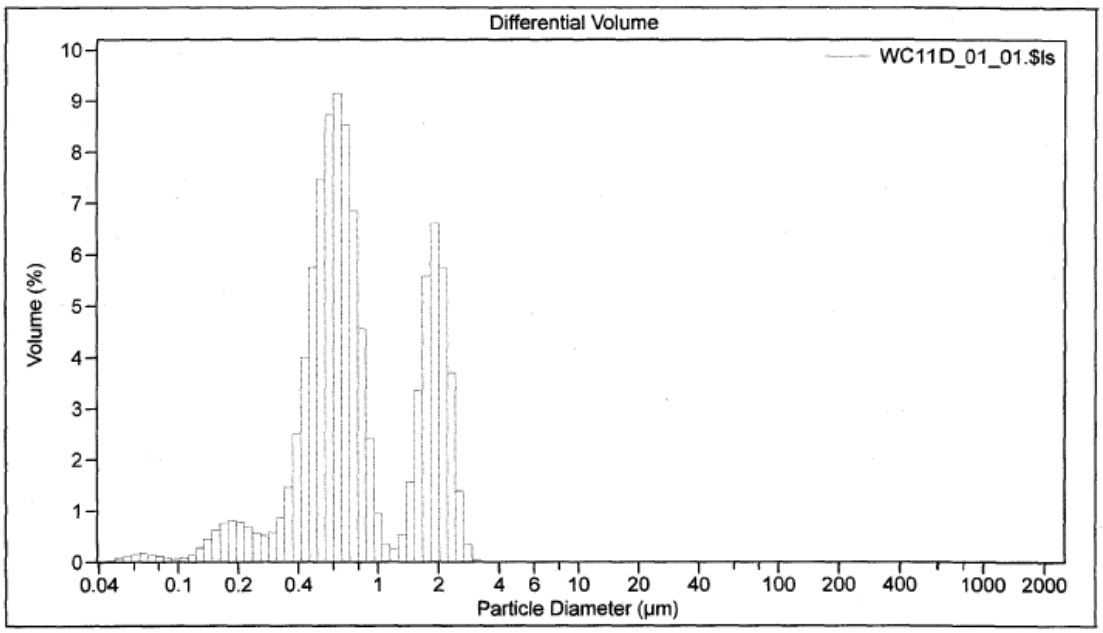
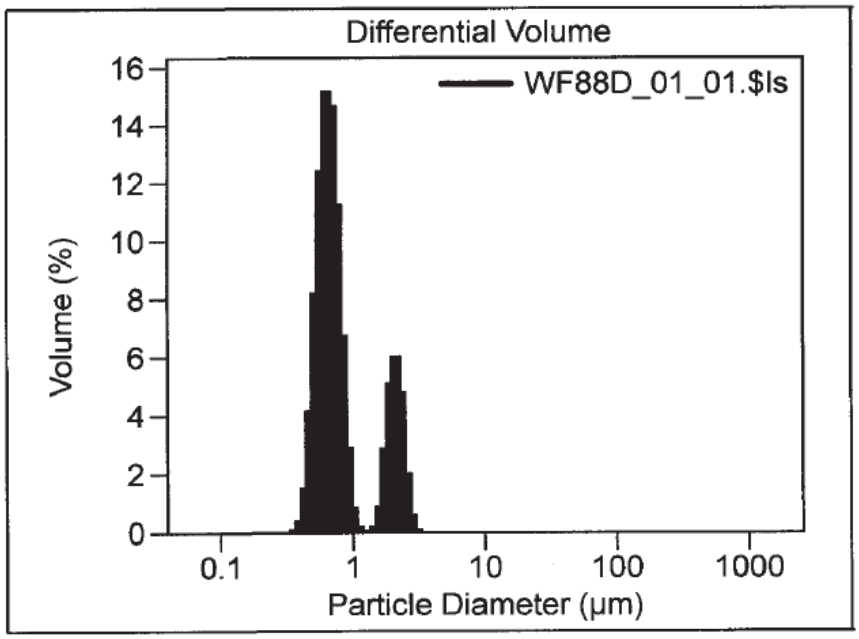
T4M – Pond Outlet
28 January 2013 top figure, 28 February 13 bottom figure, (same analysis, presentation differs)
- very similar results for two samples, bimodal at ~0.5 and ~ 2.0 µm, all < ~5.0 µm





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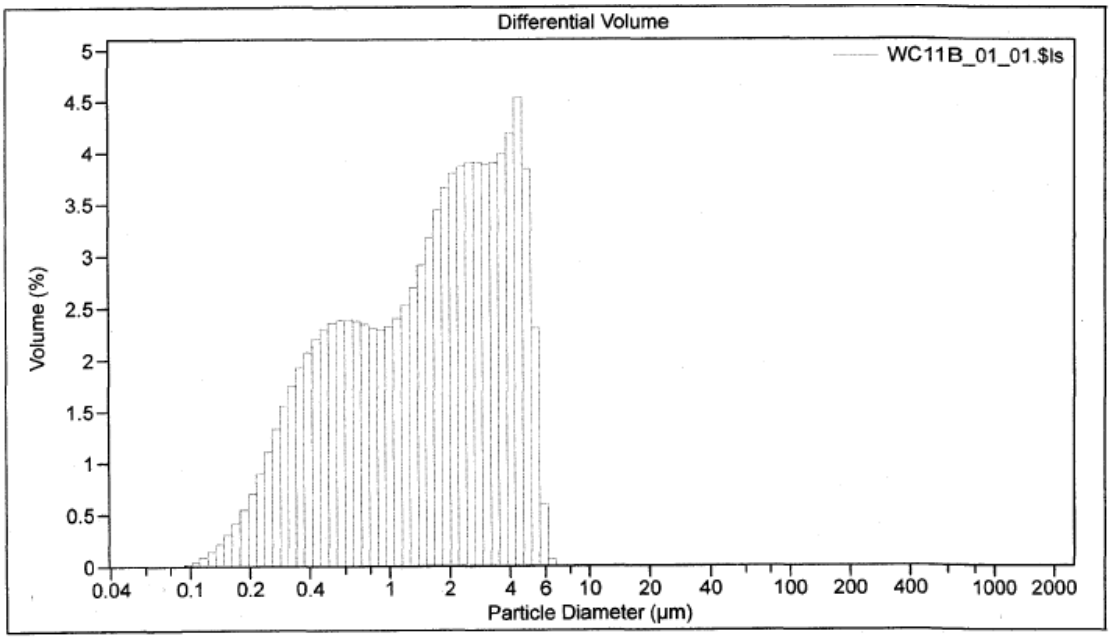
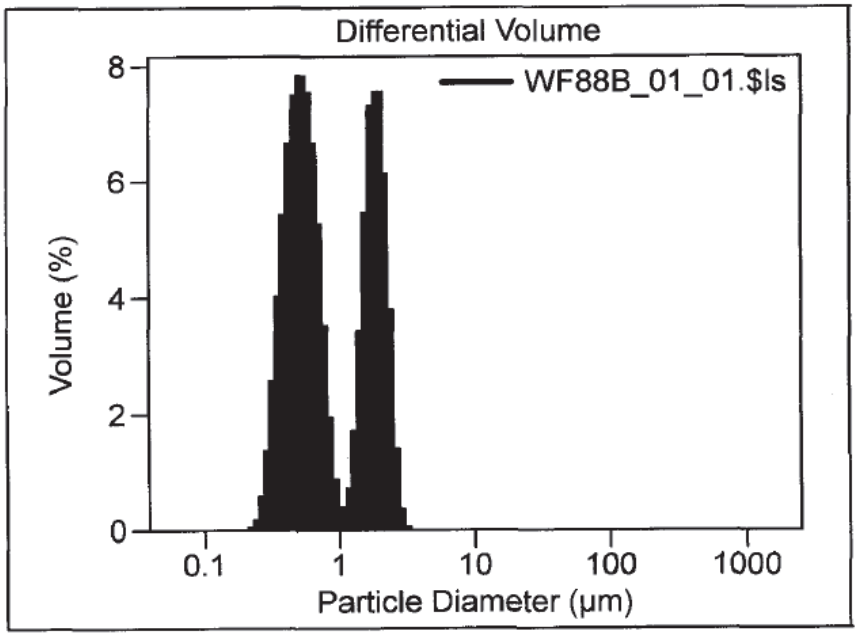
M1 – East Side of Pond; maintenance shop, Terminal 2

28 January 2013 top figure, 28 February 13 bottom figure, (same analysis, presentation differs)
- similar bimodal samples at ~0.4 and ~ 3.0 µm, all < ~6.0 µm, variability unexplained





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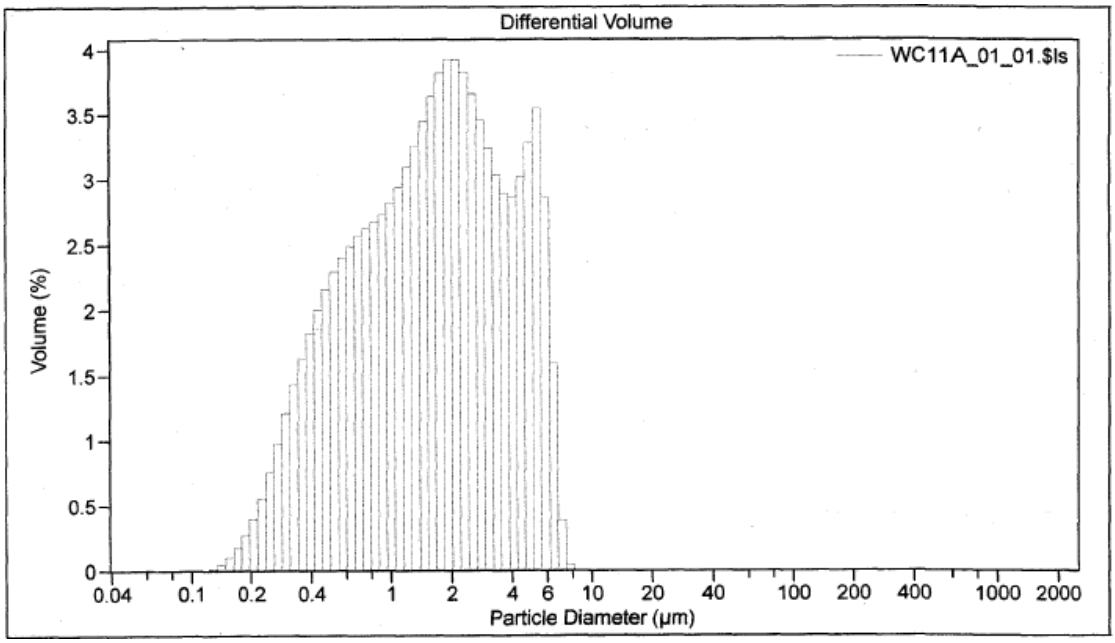
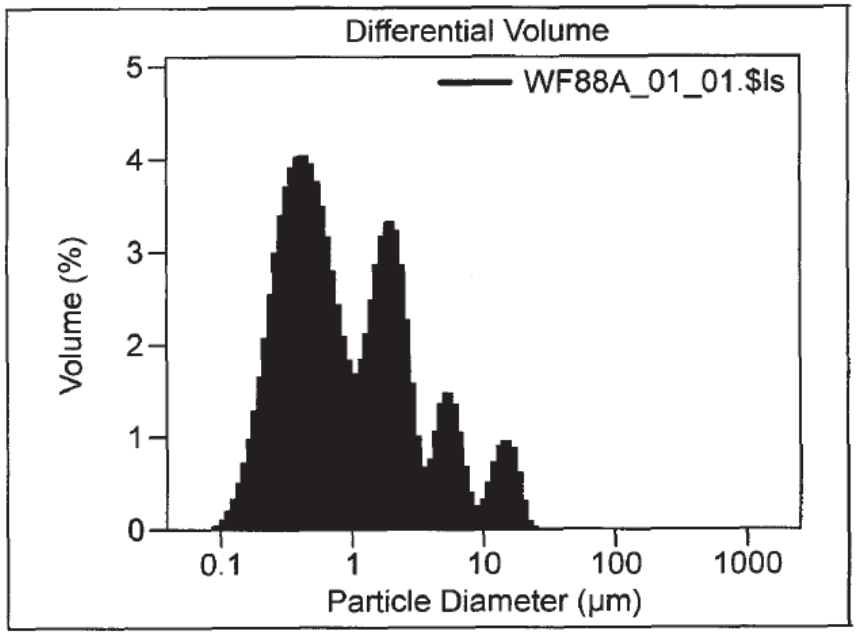
1D – Parcel 1D; West side of pond, parking lot/laydown area

28 January 2013 top figure, 28 February 13 bottom figure, (same analysis, presentation differs) - samples variable, may be due to timing of sweeping?,





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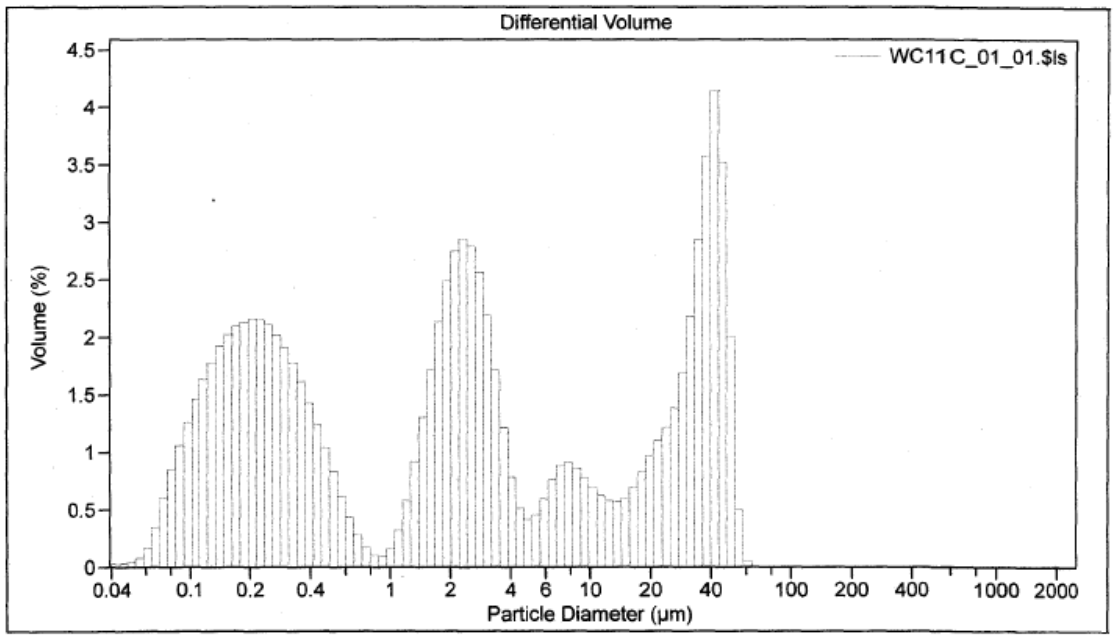
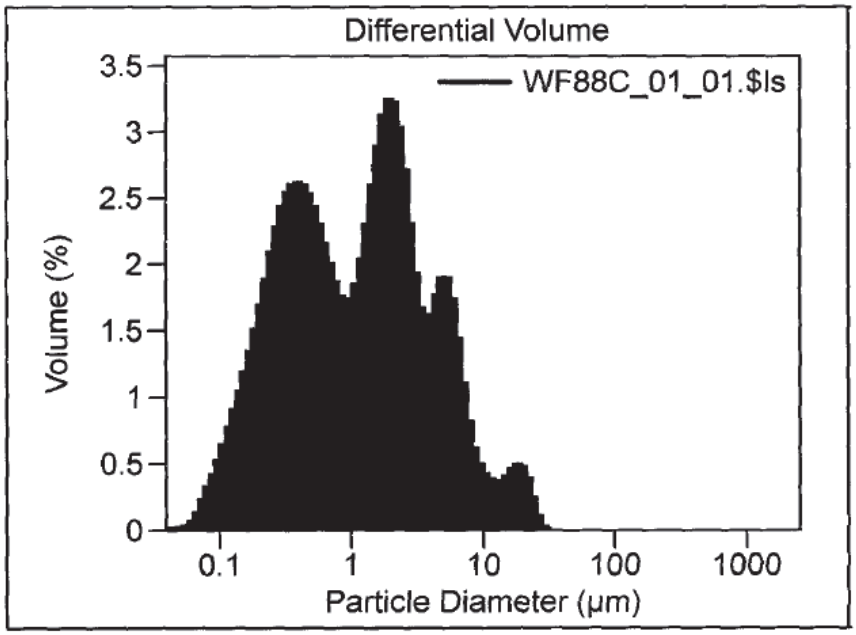
1A – Parcel 1A; North side of Pond, Farwest Steel, new construction

28 January 2013 top figure, 28 February 13 bottom figure, (same analysis, presentation differs)
- similar distributions below ~ 20 µm , ~ 40 µm particles in January may be due to construction





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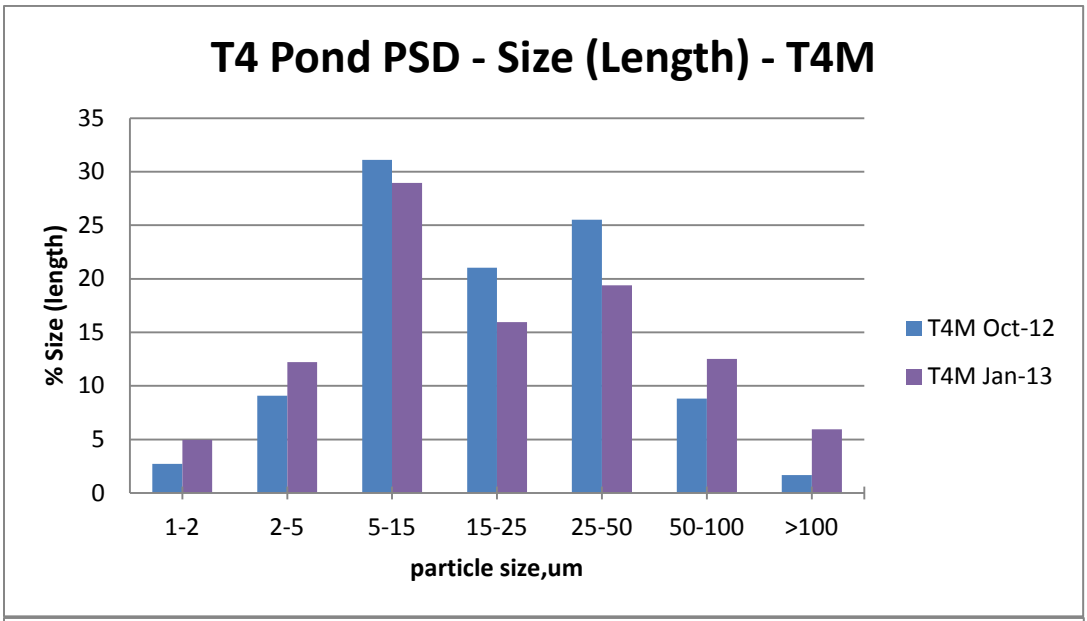
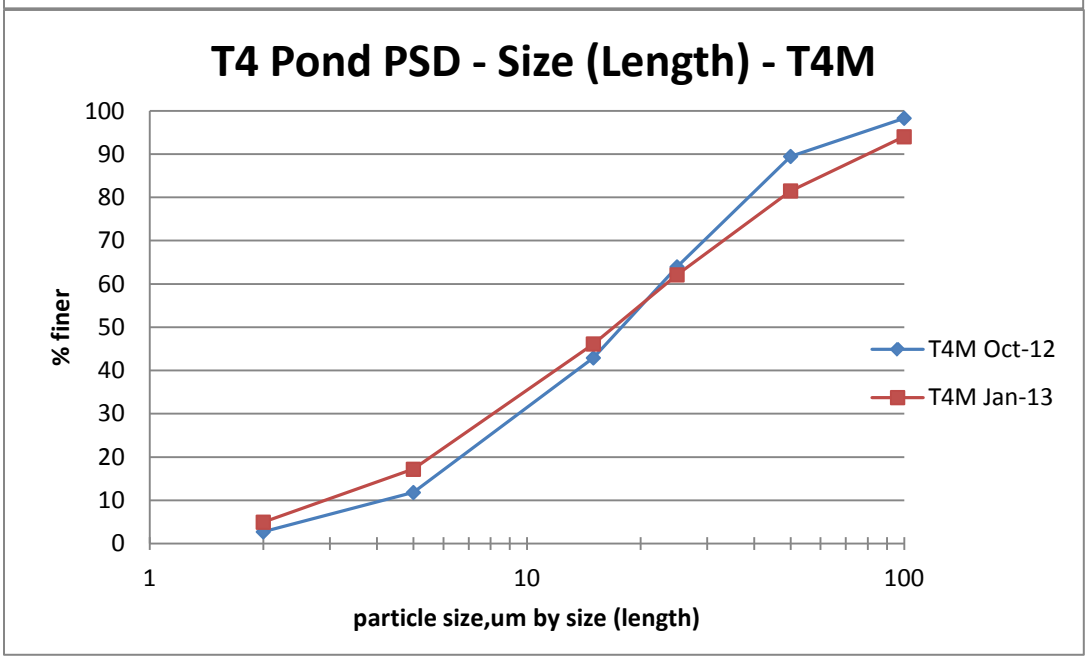
OPTICAL DATA

T4M





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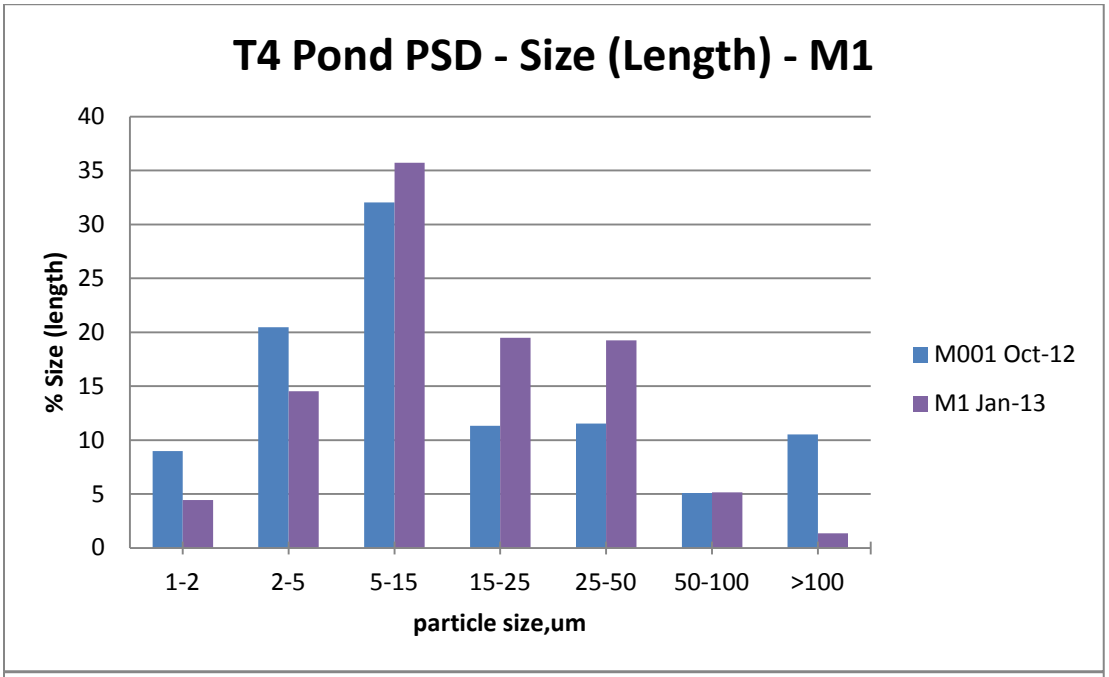
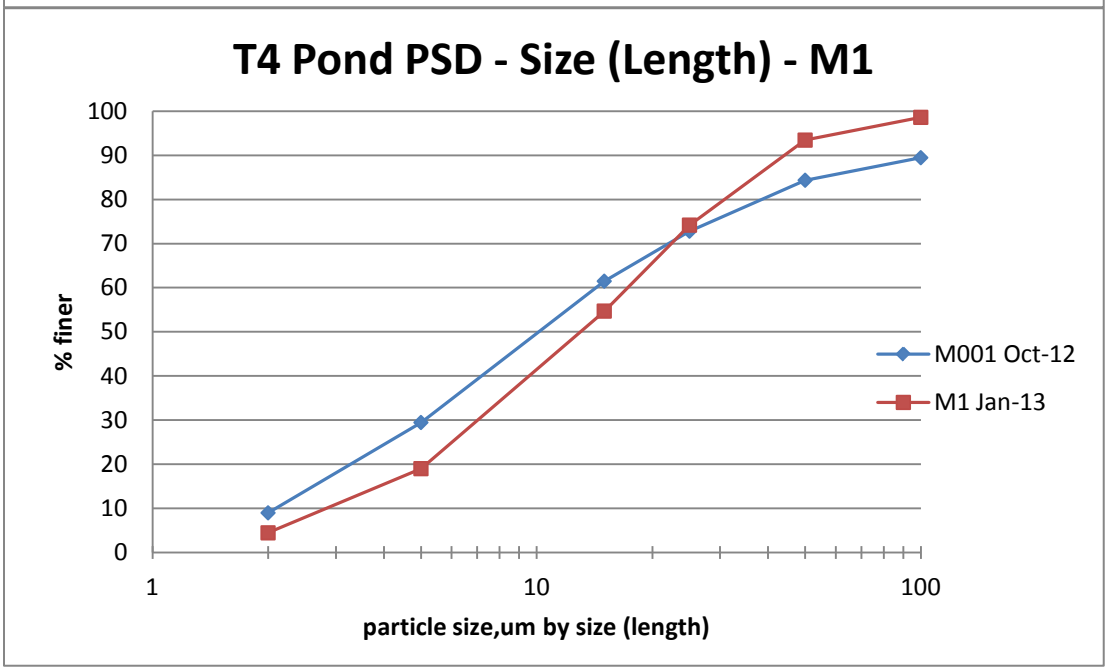
M1





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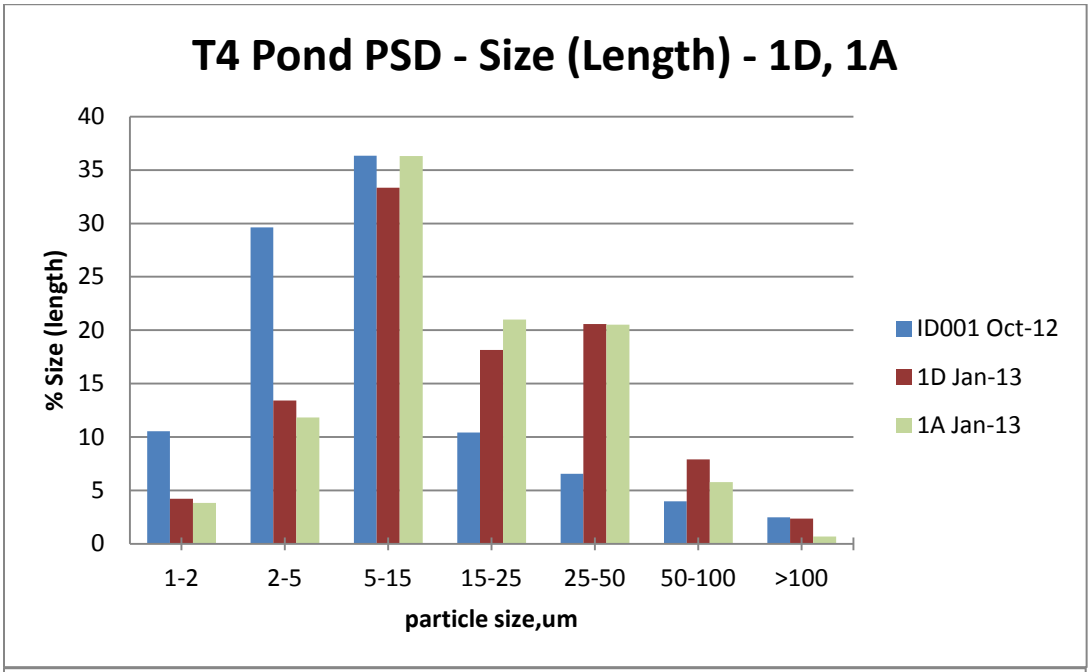
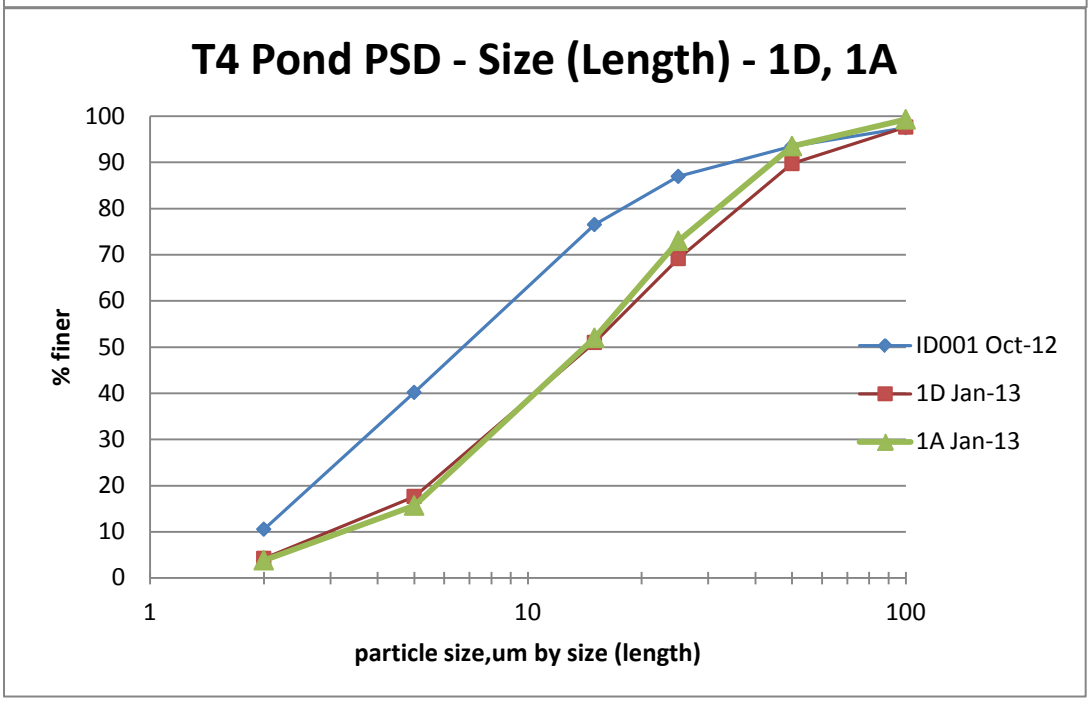
1D & 1A





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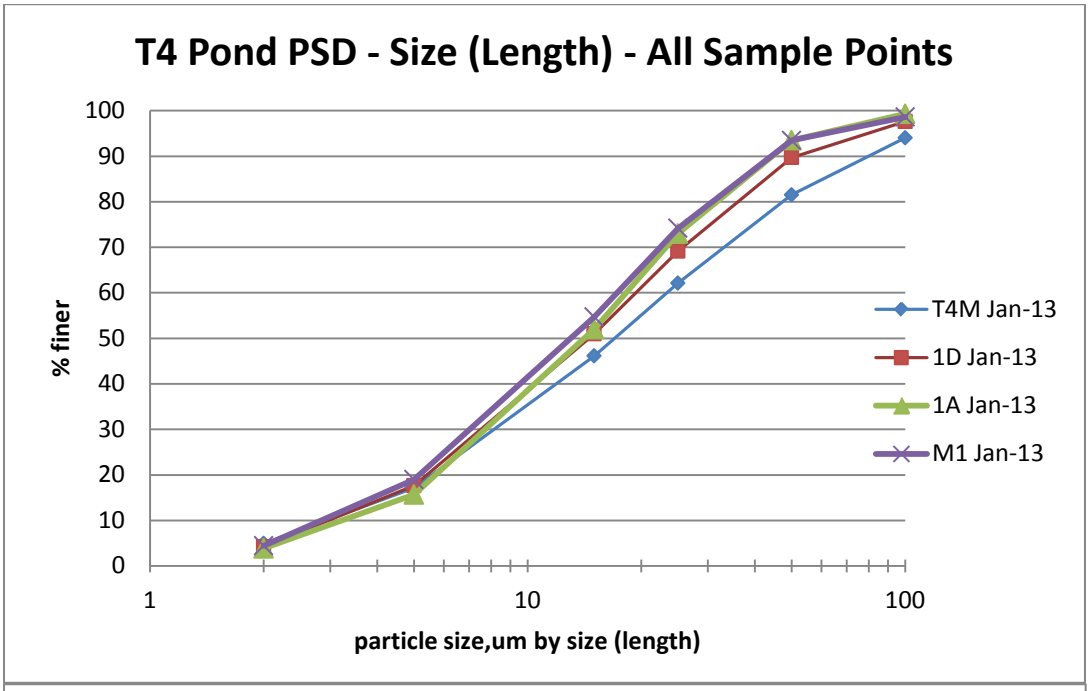
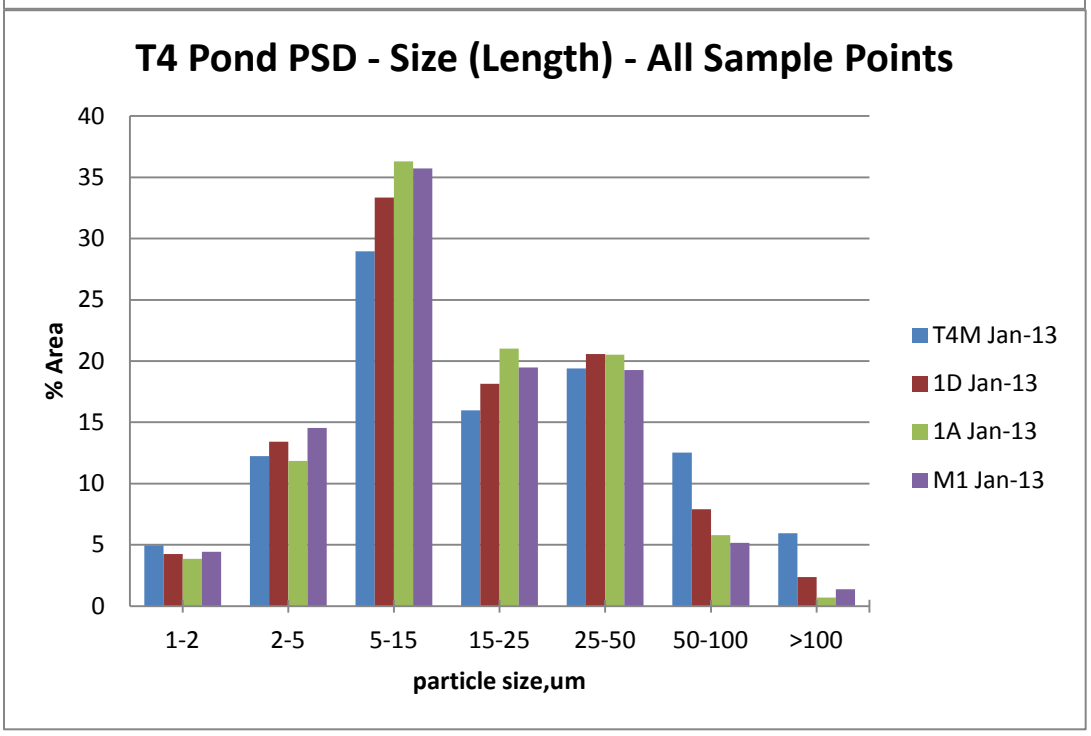
Jan 13 – All Samples





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Approximate location of sample point

Approximate subbasin boundary

TERMINAL 4 POND SAMPLING LOCATIOINS AND DRAINAGE BASINS

FIGURE 1