DIRECT TRANSFER COAL FACILITY

WATER MANAGEMENT PLAN

SUBMITTED Oct 15, 2013

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1.0 INTRODUCTION

1.1 Objective

To provide a description of the Water Management Systems proposed to service the Fraser Surrey Docks Direct to Barge (DTB) coal transfer facility.

1.2 General Description of Proposed Water Management Systems

The water systems at the proposed Fraser Surrey Docks DTB coal terminal will include three components: fresh water, coal drainage wastewater and recycled water:

1. FRESH WATER from the City of Surrey water system used to provide clean water for dust suppression:
    a. high volume sprays for barge-wet down
    b. fine misting sprays at coal transfer points and dumper
    c. Equipment and pavement wash downs.

2. COAL DRAINAGE WASTEWATER will be collected from the process areas (reference drawings below) and, as much as possible, recycled. In heavy rainfall events there will a surplus of coal drainage wastewater which will have to be collected, treated and discharged from the site. Three options for discharging the surplus wastewater are being investigated:

    a. Option A – discharge to the Metro Vancouver sanitary sewer system. This is the preferred option because it poses the least risk to the environment and has been discussed with stakeholders during the consultation process. The predicted water quality will meet the quality limits of the sanitary system.

    b. Option B – discharge to the onsite storm drainage system, which ultimately discharges to the Fraser River and which we understand will require discharge permits from PMV and the Ministry of Environment. This option will likely require the use of chemical agents to reduce the suspended solids content prior to discharge.

    c. Option C – discharge to the ground (i.e. infiltration field). This option will likely require the use of chemical agents to reduce the suspended solids content prior to discharge. Discharge permits will likely be required from PMV and the Ministry of Environment.

    Option A is the preferred option with Option B and Option C being secondary options should Option A not be achieved. Option A is FSD’s preferred option due to the potential environmental sensitive nature of the latter two options.

3. RECYCLED WATER is coal drainage wastewater which has undergone some primary settlement in one of two constructed settlement ponds and can be used to flush out the dumper, wash the railcars after dumping and sprayed onto the conveyor belts to mitigate any potential dust generation.

2.0 WASTEWATER MANAGEMENT

2.1 Wastewater Management Objectives

The primary objective is to design and operate an efficient, effective system with negligible impact on the environment. To meet this objective, the following strategies will be employed:

1. Contain and treat all wastewater within the process area (reference drawings below) before discharge to the Metro Vancouver sanitary sewer system (Option A) or, in the alternative, to the local storm drainage system (Option B) or to the ground (Option C).

2. Ensure that all discharged wastewater consistently meets Metro Vancouver relevant criteria for relevant criteria (e.g. Schedule B – Restricted Wastes) before discharge to the sanitary sewer system or, in the alternative, criteria established by the provincial Ministry of the Environment before discharge to the local storm drainage system. Option C, disposal to ground, is not subject to regulatory approval by Metro Vancouver. It is subject to provincial permitting processes, if the discharge meets the definition of effluent under the Environmental Management Act. Approval from the land owner, Port Metro Vancouver, will be required, and possibly the Provincial Ministry of the Environment via the *Waste Discharge* Regulation.

3. Minimize the amount of wastewater that needs to be treated and discharged by <u>recycling</u> as much as possible for use in dumper flushing, railcar wash system, and application to the coal on conveyor belts and at transfer points.

2.2 Wastewater Sources- Process Areas

Process areas are those areas of the site which may accumulate surface coal on the surface due to normal railcar unloading ("dumping") and barge loading activities. Drainage in the process areas is collected separately from the overall site drainage system as it may potentially contain coal particles and is technically considered as a wastewater. This drainage wastewater may be produced by washing down equipment and paved areas or, by surface runoff during rainfall events.

The Fraser Surrey Docks coal handling system will have two interconnected process areas each with its own drainage collection system as shown on attached sketch drawings 2113-SK002 P5 (Option A for disposal), 2113-SK003 P3 (Option B for disposal) and 2113-SK004 P1(Option C for disposal).). Process areas and drainage collection systems are identical for all three options.

These drawings depict the proposed wastewater management system(s) in a plan view and in schematic flow diagrams. The drainage collection system for the defined process areas are designed to work with existing drainage infrastructure and site contours to the greatest degree possible. Some pavement milling, overlay and catch basin (CB) relocations may be required to completely separate the process drainage collection areas from the existing site storm drainage system. The extent of the repaving and CB relocations will be determined after the proposed infrastructure for DTB facility has been installed and surveyed.

As shown on the drawing(s), the process areas are:

1. The <u>dumper process area</u> includes the dumper and receiving shed, railcar wash, train indexer, conveyors and surrounding paved surface. Wastewater generated

in this area will be directed to the Dumper Area Settling Pond, either by overland flow or by pump. The settling pond will reduce the suspended solids i.e. coal particles by gravity settling so that the wastewater can be recycled to flush out the dumper, wash railcars and for spraying onto the conveyor belts and transfer points. However during heavy rain events there will be a surplus of wastewater which will need be pumped to the Loading Area Settling Pond for further settling and discharge to the Metro Vancouver Sanitary Sewer (Option A) or to the site storm drainage system (Option B), or to the ground (Option C).).

2. The loading process area includes conveyors, the barge loader, and surrounding paved surfaces. Wastewater generated in this area is directed to the Loading Area Settling Pond. This wastewater can be pumped back to the Dumper Area Settling Pond if there is a shortage of recycled water at that location. As shown on the Schematic on Plan 2113-SK002 Rev 3, the same pipe will be used for transferring wastewater between the Loading Area Settling Pond and the Dumper Area Settling Pond in either direction.

2.3 Treatment and Discharge of Coal Drainage Wastewater

Coal drainage wastewater can be a dilute slurry. The *suspended solids* content of the slurry i.e. the amount of coal in the solution could vary widely depending upon the source and the flow rate, but can be in the range of 800 mg/litre or parts per million (ppm) to 5000 ppm or occasionally higher. (By way of illustration, a coal slurry with a suspended solids content of 800 ppm is .08% coal and 99.92% water by weight.)

Excess coal drainage wastewater i.e. a surplus over that usable as recycled water, will need to be treated and discharged from the site. Three options exist for the discharge.

2.4 Option A – Discharge to Metro Vancouver Sanitary Sewage System

(See Sketch Plan 2113-SK002 Rev P5)

The primary and preferred option is to discharge surplus coal drainage wastewater to the Metro Vancouver Sanitary Sewer under a Waste Discharge Permit in accordance with the Greater Vancouver Sewerage & Drainage District Sewer Use Bylaw No. 299, 2007. The bylaw sets limitations on the characteristics of the wastewater to be discharged including a maximum suspended solids content ≤600 ppm (unless a permit for Restricted Waste is obtained).

The permit will also stipulate the maximum rate at which wastewater can be discharged to the sanitary sewer. This is an important consideration for the proposed Fraser Surrey Docks as heavy rainfall events will generate large volumes of wastewater albeit with lower suspended solids content.

Annual fees are associated with the permit based upon volumes discharged. There are also stringent sampling and recording requirements.

Sampling and metering of the settled wastewater will be done downstream of the submersible pump in the Loading Settlement Pond in a small enclosure at a location to be finalized.

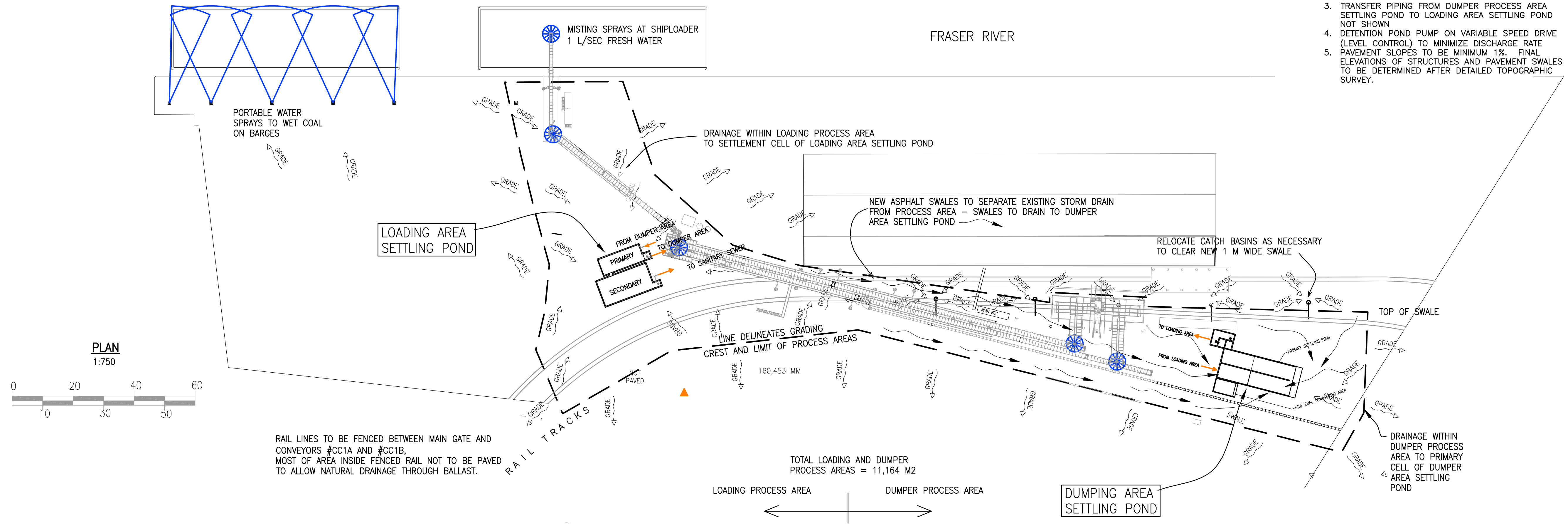
Fraser Surrey Docks LP

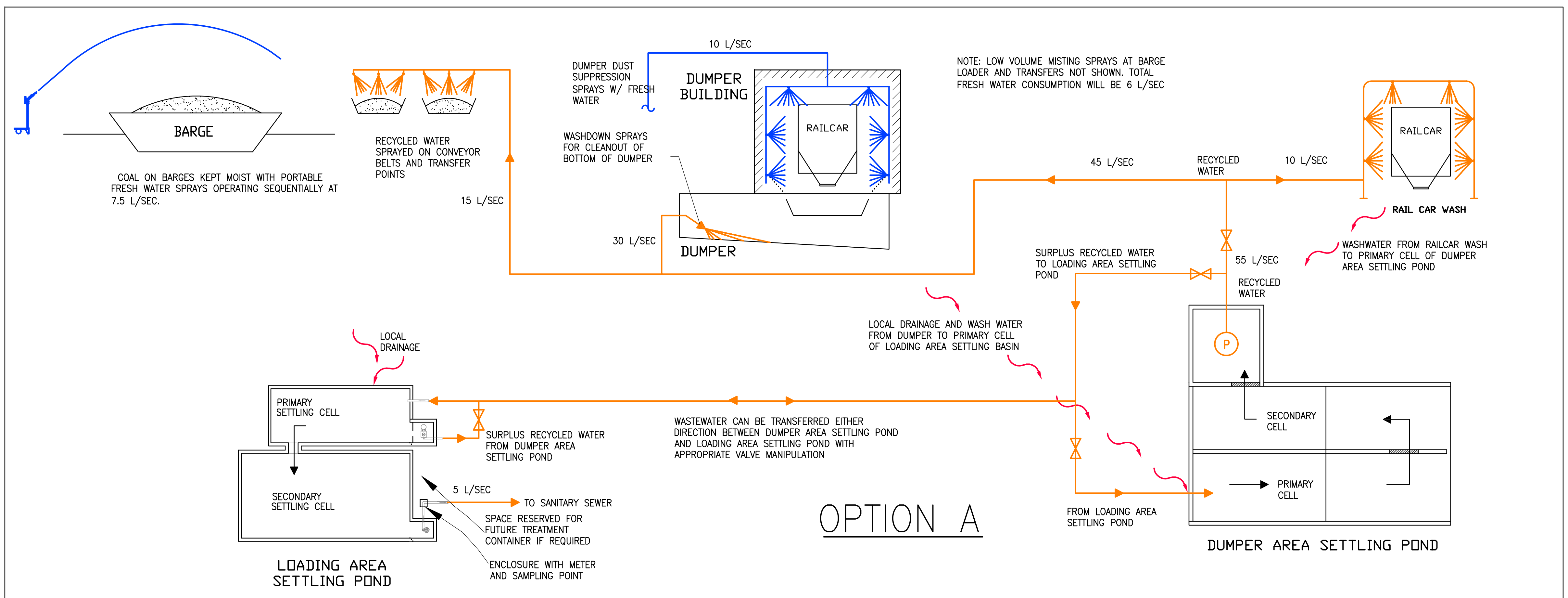
drawn in inches

Direct to Coal Barge Coal Project

NOTES

1. DRAWING IS FOR CONCEPTUAL DESIGN ONLY
2. RECYCLE PIPING AT DUMPER PROCESS AREA NOT SHOWN
3. TRANSFER PIPING FROM DUMPER PROCESS AREA SETTLING POND TO LOADING AREA SETTLING POND NOT SHOWN
4. DETENTION POND PUMP ON VARIABLE SPEED DRIVE (LEVEL CONTROL) TO MINIMIZE DISCHARGE RATE
5. PAVEMENT SLOPES TO BE MINIMUM 1%. FINAL ELEVATIONS OF STRUCTURES AND PAVEMENT SWALES TO BE DETERMINED AFTER DETAILED TOPOGRAPHIC SURVEY.





REFERENCE DRAWINGS

DRAWING NUMBER	REV.
PMV WMP Document	

NO.	BY	DATE	DESCRIPTION
P5	DS	OCT14/13	DISCHARGE RATE REDUCED
P4	DS	SEP03/13	STOCKPILE DELETED
P3	DS	JUN19/13	RIVER WATER DELETED
P2	DS	JUN05/13	SCHEMATIC ADDED
P1	CV	MAY06/13	ISSUED FOR REVIEW

REVISION

SEAL:

DATE:

CONSULTANT:

Omni ENGINEERING INC.

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CLIENT:

FRASER SURREY DOCKS LP
Pacific Rim Stevedoring Ltd.

PROJECT:

FRASER SURREY DOCKS LP
PROPOSED COAL LOADOUT FACILITY
WATER MANAGEMENT SYSTEM

DRAWING TITLE:

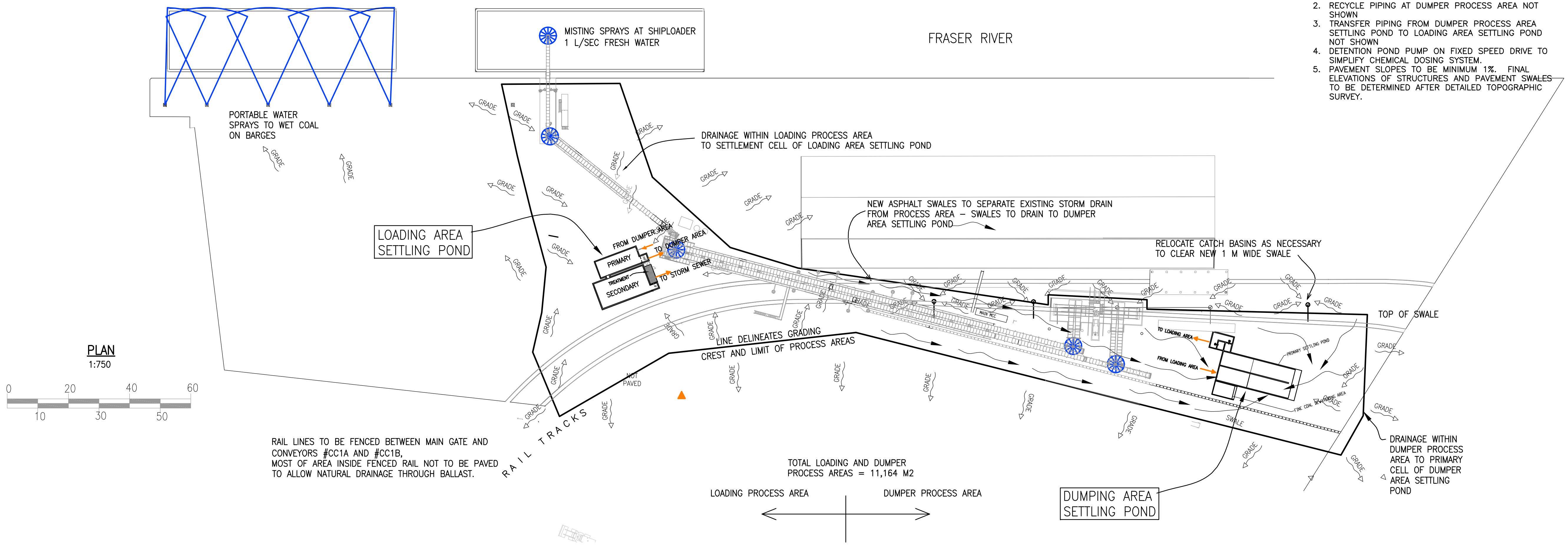
GENERAL ARRANGEMENT – OPTION A
DISCHARGE TO SANITARY SEWER

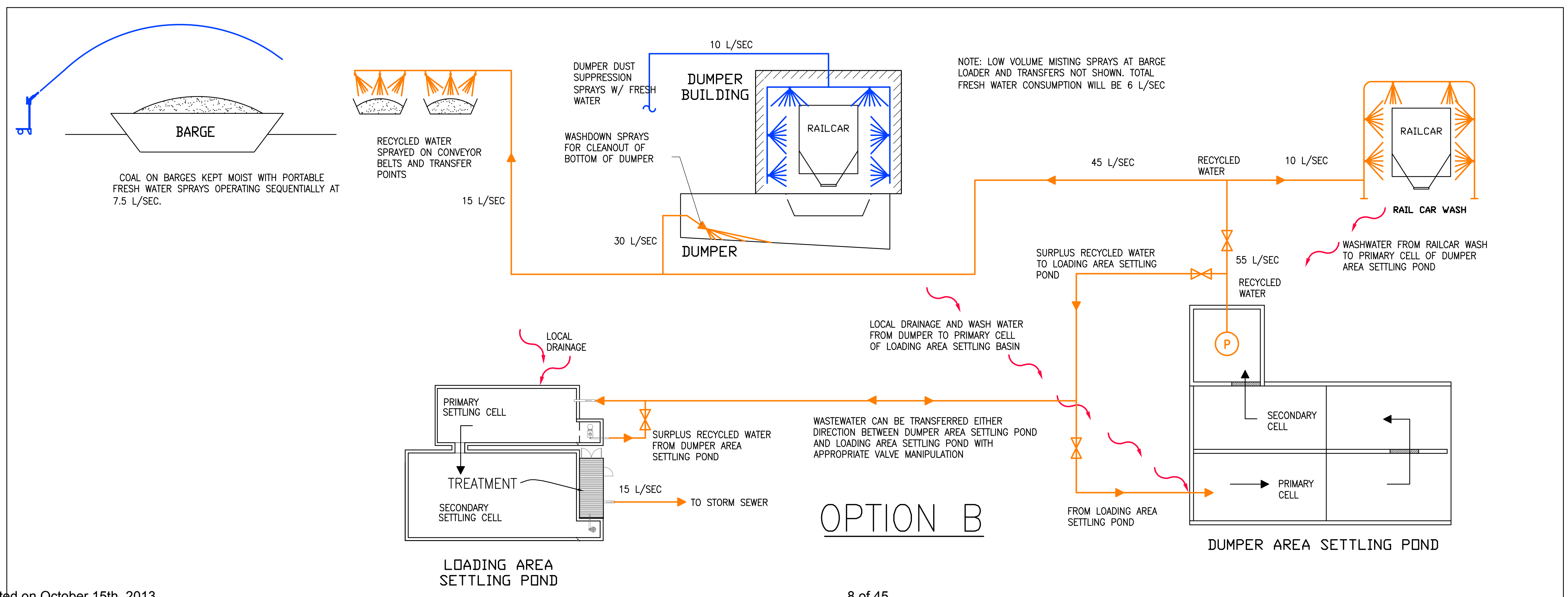
ENGINEER: DS		DATE:	JUN13/13
DESIGN BY: DS		SCALE:	AS SHOWN
DRAWN BY: DS		ACAD FILE NO:	2113
DRAWING NUMBER:	2113–SK002	REVISION NUMBER:	P5

Filename: Z:\Omni Projects\2113 Fraser Surrey Docks – Dust Suppression\Omni Drawings\2113 Water Management Schematics.dwg – SK002
Last Saved: Oct. 15/13 8:37am Plotted: Oct. 15/13

NOTES

1. DRAWING IS FOR CONCEPTUAL DESIGN ONLY
2. RECYCLE PIPING AT DUMPER PROCESS AREA NOT SHOWN
3. TRANSFER PIPING FROM DUMPER PROCESS AREA SETTLING POND TO LOADING AREA SETTLING POND NOT SHOWN
4. DETENTION POND PUMP ON FIXED SPEED DRIVE TO SIMPLIFY CHEMICAL DOSING SYSTEM.
5. PAVEMENT SLOPES TO BE MINIMUM 1%. FINAL ELEVATIONS OF STRUCTURES AND PAVEMENT SWALES TO BE DETERMINED AFTER DETAILED TOPOGRAPHIC SURVEY.





REFERENCE DRAWINGS	
DRAWING NUMBER	REV.
PMV WMP Document	

NO.	BY	DATE	DESCRIPTION
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P2	JW	AUG29/13	STOCK PILE DELETED
P1	DS	JUN18/13	ISSUED FOR REVIEW

REVISION

SEAL:

DATE:

CONSULTANT:

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Pacific Rim Stevedoring Ltd.

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FRASER SURREY DOCKS LP
PROPOSED COAL LOADOUT FACILITY
WATER MANAGEMENT SYSTEM

DRAWING TITLE:
GENERAL ARRANGEMENT – OPTION B
DISCHARGE TO STORM SEWER

ENGINEER:	DS	DATE:	JUN13/13
DESIGN BY:	DS	SCALE:	AS SHOWN
DRAWN BY:	DS	ACAD FILE NO:	2113
DRAWING NUMBER:	2113-SK003	REVISION NUMBER:	P3

Filename: Z:\Omni Projects\2113 Fraser Surrey Docks – Dust Suppression\Omni Drawings\2113 Water Management Schematics.dwg – SK003
Last Saved: Oct. 15/13 8:37am Plotted: Oct. 15/13

Fraser Surrey Docks LP

Direct to Coal Barge Coal Project

NOTES

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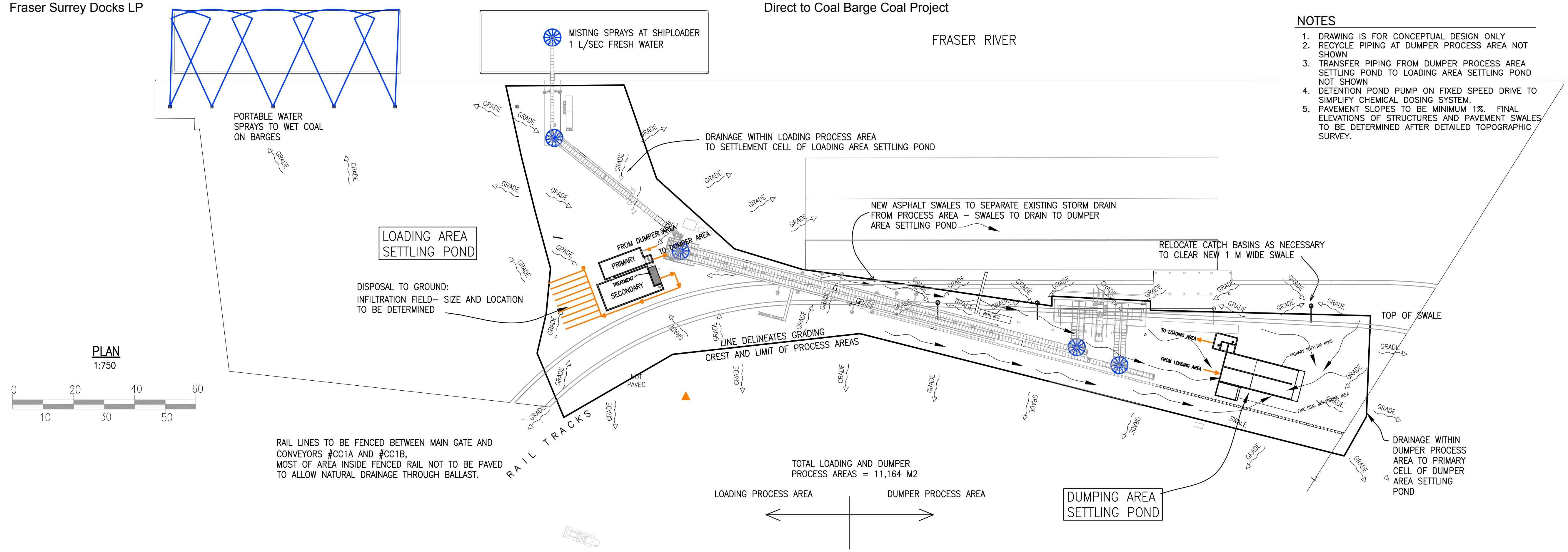
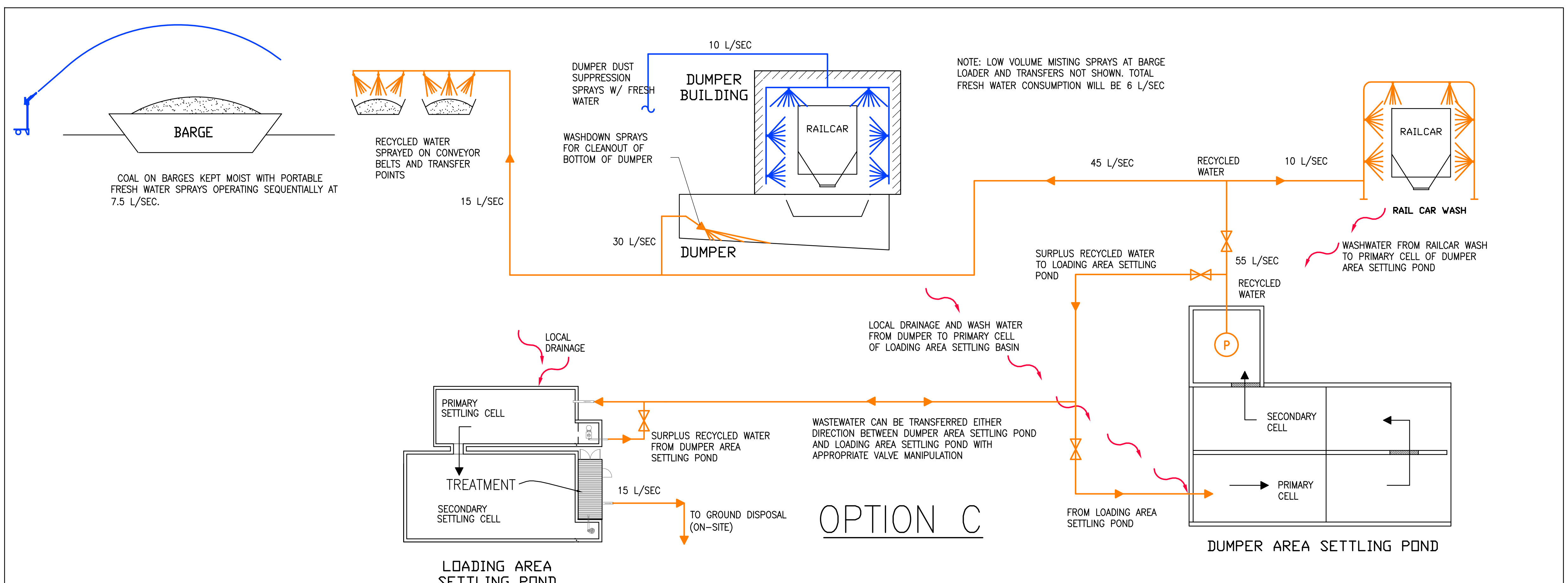
3. TRANSFER PIPING FROM DUMPER PROCESS AREA SETTLING POND TO LOADING AREA SETTLING POND NOT SHOWN
4. DETENTION POND PUMP ON FIXED SPEED DRIVE TO SIMPLIFY CHEMICAL DOSING SYSTEM.
5. PAVEMENT SLOPES TO BE MINIMUM 1%. FINAL ELEVATIONS OF STRUCTURES AND PAVEMENT SWALES TO BE DETERMINED AFTER DETAILED TOPOGRAPHIC SURVEY.





Submitted on October 15th, 2013

REFERENCE DRAWINGS	
DRAWING NUMBER	REV.
PMV WMP Document	

NO.	BY	DATE	DESCRIPTION
P1	DS	OCT14/13	ISSUED FOR REVIEW

REVISION

SEAL:

DATE:

CONSULTANT:

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Pacific Rim Stevedoring Ltd.

PROJECT:
FRASER SURREY DOCKS LP
PROPOSED COAL LOADOUT FACILITY
WATER MANAGEMENT SYSTEM

DRAWING TITLE:
GENERAL ARRANGEMENT – OPTION C
DISPOSAL TO GROUND

ENGINEER:	DS	DATE:	OCT14/13
DESIGN BY:	DS	SCALE:	AS SHOWN
DRAWN BY:	DS	ACAD FILE NO:	2113
DRAWING NUMBER:	2113–SK004	REVISION NUMBER:	P1

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Last Saved: Oct. 15/13 8:37am Plotted: Oct. 15/13

FSD, with the assistance of Omni Engineering Inc. and Triton Environmental, has submitted an application and additional supporting information to Metro Vancouver for a Waste Discharge Permit.

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2.5 Option B – Discharge to Site Storm Drainage System

(See Sketch Plan SK003 Rev P3)

If a permit to discharge to the Metro Vancouver Sanitary Sewage System cannot be obtained, one alternative is to treat and discharge to the local site storm drainage system which discharges into the Fraser River. A permit would be required from the provincial Ministry of the Environment under the *Waste Discharge Regulation* of the Environmental Management Act and discharge requirements to the Fraser River will be more stringent than those for discharge to the sanitary sewer. Discharge criteria and monitoring requirements will be permit specific and, as a minimum, the following limits are anticipated:

1. Total Suspended Solids less than 50 parts per million
2. Total Oil and Grease less than 10 parts per million
3. pH 6.5 to 9.0

Due to the low specific gravity of coal (SG 1.4) and the small diameter of the coal particles, there is some potential that coagulants / flocculants may be required to meet the requirement of less than< 50 ppm TSS.

Chemical treatment systems such as this are in place at two other coal terminals (Westshore Terminals LP and Neptune Bulk Terminals) in the Vancouver area. The chemical agents required and the technology to apply them are well established and reliable. It is anticipated that a provincial effluent permit application process would be lengthy (potentially threatening the viability of the project). The process would include but not be limited to pre-application meetings with the Ministry and completion of a Technical Assessment[1]; the latter requiring information on detailed site design and operations, non-product outputs (air contaminants, effluents and refuse), human health and ecological risk assessments, Total Costs Assessment (TCA), receiving environment characterization, discharge characterization (relative to guidelines and legal standards), modeling, cumulative impact assessment and proposed monitoring programs. The effluent discharge permitting process would also require its own stakeholder consultation.

2.6 Option C – Discharge to Ground

(See Sketch Plan SK004 Rev P1)

Discharge to the ground into an infiltration field is an alternative that is under consideration. As long as it can be established that the discharge is not an environmental or health hazard, there may be no requirement for a permit from the provincial Ministry of the Environment. The process of establishing that the discharge is not an environmental issue however may prove to be

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[1]Potential application requirements discussed with Mr. Chor, Surrey MOE, Senior Environmental Protection Officer. Technical assessment requirements outlined in GUIDANCE ON APPLICATIONS FOR PERMITS UNDER THE *ENVIRONMENTAL MANAGEMENT ACT* –
TECHNICAL ASSESSMENT. http://www.env.gov.bc.ca/epd/waste_discharge_auth/guidance/pdf/assessment.pdf

difficult until real field data can be collected. Chemical and infiltration capacity analyses will be required to determine if this option will work. Approval for discharge to ground will be required from the federal landowner, Port Metro Vancouver. Suspended solids content of the wastewater will be reduced before discharge to a level acceptable to PMV. The intent is not only to limit the accumulation of coal particles in the ground but also to prevent blinding of the soil which would shorten the life of the disposal system. It is anticipated that a provincial effluent permit application process, should it be required, would be lengthy (potentially threatening the viability of the project). The process would include but not be limited to pre-application meetings with the Ministry and completion of a Technical Assessment[1]; the latter requiring information on detailed site design and operations, non-product outputs (air contaminants, effluents and refuse), human health and ecological risk assessments, Total Costs Assessment (TCA), receiving environment characterization, discharge characterization (relative to guidelines and legal standards), modeling, cumulative impact assessment and proposed monitoring programs. The effluent discharge permitting process would also require its own stakeholder consultation.

2.7 Settling Ponds Option A (Discharge to Sanitary Sewer)

In order to meet the Metro Vancouver limitation of ≤600 ppm suspended solids, it is proposed to reduce the suspended solids content of the wastewater by simple gravity settling in two settling ponds to be constructed on the site; Dumper Area and Loading Area Settling Ponds.

1) <u>Dumper Area Settling Pond</u>

The majority of coal accumulation occurs during the dumping process and the railcar washing. The Dumper Area Settling Pond is designed as a relatively large two celled structure to handle a relatively high volume of coal slurry wastewater. It will include a recycle pump to direct the settled wastewater to flush out the dumper, supply the railcar wash and/or to the Loading Area Settling Pond when there is a surplus of wastewater.

2) <u>Loading Area Settling Pond</u>

Coal accumulation in the Loading Process Area will be much less than in the Dumper Process Area. This is the wastewater detention basin prior to discharge point to the Metro Vancouver Sanitary Sewer so consideration has to be given to the rate at which the settled wastewater is released to the sanitary sewer. Accordingly, there will be a relatively large detention pond with a submersible pump controlled by a variable speed drive (reference drawing). This pump will speed up or slow down depending on the level of water in the detention basin, thus ensuring that treated wastewater is not discharged to the sanitary sewer at a higher rate than necessary. The volume of the retention basin will be large enough to limit the maximum rate at which the pump needs to operate based upon the 10 year return period, 24 hour storm event. The detention basin will also act as a secondary settling cell to ensure that the suspended solids content of the discharged effluent meets the Metro Vancouver limit of 600 ppm.

Coal solids will accumulate in the Loading Area Settling ponds and their designed volume is enough for solids accumulation without the requirement for frequent clean-out. The ponds will be

[1]Potential application requirements discussed with Mr. Chor, Surrey MOE, Senior Environmental Protection Officer. Technical assessment requirements outlined in GUIDANCE ON APPLICATIONS FOR PERMITS UNDER THE *ENVIRONMENTAL MANAGEMENT ACT* –
TECHNICAL ASSESSMENT. http://www.env.gov.bc.ca/epd/waste_discharge_auth/guidance/pdf/assessment.pdf

wide enough to allow access for a front end loader when clean-out is required. Preliminary sizing for the both the Dumper Area and Loading area settling pops is 15m x 30m x 3 m deep. A ramp will be provided at one end for front end loader access. Details of construction are to be finalized but are expected to resemble the pond shown below.

1.0 Typical Primary/Secondary Settling Pond under construction

2.8 Settling Ponds Option B (Discharge to Storm Sewer)

The Dumper Area Settling Pond for Option B will be identical to that proposed for Option A. However the Loading Area Settling Pond will be somewhat different:

1. A treatment building will be included to dilute and inject the chemical agents required to reduce suspended solids to acceptable levels (likely ≤50 ppm)

2. There will be a primary gravity settling cell prior to the chemical injection which will:
    a. collect local drainage
    b. act as a transfer point from and to the Dumper Area Settling Pond
    c. have a fixed rate pump to direct excess wastewater to the treatment building where a coagulant and a flocculent will be injected

3. A secondary settling cell where the coal fines in the treated wastewater will settle out prior to discharge to the storm sewer.

Final design details will be governed by MOE and PMV permit requirements.

2.9 Settling Ponds Option C (Discharge to Ground)

It is anticipated that the settling ponds for Option C will likely be identical to those proposed for Option B. This will however be determined by requirements from MOE and PMV.

2.10 Reducing Suspended Solids Content by Gravity Settling

The vertical velocity i.e. the settling rate of any particle in a liquid is determined by Stokes Law (see Appendix A) which takes into account:

- particle diameter
- particle specific gravity
- viscosity of the liquid
- specific gravity of the liquid

Coal has low specific gravity (typically SG 1.4) vs. mineral aggregates (typically SG 2.7). The particle diameter of a coal sample is illustrated by a particle size distribution curve and available information on the Powder River Basin coal to be loaded out indicates a relatively large percentage of fine (small diameter) particles. The combination of low specific gravity and small particle diameter will result in low settling velocities and the settling ponds have to be sized accordingly though it should be possible to achieve a suspended solids content ≤600 ppm at the discharge from the site without the use of chemical agents.

If it becomes necessary to discharge to the local storm drainage system, chemical agents will be required to reduce the suspended solids content to ≤50 ppm. The chemical agents are a coagulant which neutralizes the negative electrical charge on coal particles and a polymer flocculent which attracts the neutralized particles. The net result is to cause the coal particles to agglomerate resulting in a larger diameter mass and increased settling velocity in accordance with Stokes Law.

2.11 Treated Discharge Water Quality

Laboratory analyses were conducted on 600 mg/L solutions of Power River Basin (PRB) coal and water to evaluate potential metals, polycyclic aromatic hydrocarbons (PAH), volatile organic compounds (VOC), sulphate and phenols concentrations in wastewater generated onsite. These analyses were completed to evaluate water quality based on potential residence times in the treatment system and included samples collected from 600 mg/L solutions that sat for one and two weeks respectively, prior to extraction for metals, sulphate and organics analyses. These results are summarized below in Table 1 and demonstrate a limited number of metals and organics were detected (Table 1, Appendix 1). None of the detected parameters were above available Schedule B-Restricted Waste Criteria for discharge to sanitary sewer.

Table 1. **Detected parameters – 600 mg/L PRB coal and water solutions**

Parameter	Units	Detection limit	< 2 mm Coal @ 600 mg/L - 1 WEEK	< 2 mm Coal @ 600 mg/L - 1 WEEK (agitated)	< 2 mm Coal @ 600 mg/L - 2 WEEK	< 2 mm Coal @ 600 mg/L - 2 WEEK (agitated)	GVSD&D Restricted waste criteria
			17-Sep-13	17-Sep-13	24-Sep-13	24-Sep-13	
			Water	Water	Water	Water	
pH	pH units	0.01	7.15	7.12	7.36	7.06	5.5 to 10.5
Aluminum, total	mg/L	0.05	<0.05	0.21	<0.05	0.42	50
Barium, total	mg/L	0.05	<0.05	0.28	<0.05	0.37	-
Copper, total	mg/L	0.002	<0.002	<0.002	<0.002	0.003	2
Iron, total	mg/L	0.1	<0.1	0.2	<0.1	0.5	10
Magnesium, total	mg/L	0.1	<0.1	0.1	<0.1	0.2	-
Manganese, total	mg/L	0.002	<0.002	0.003	<0.002	0.007	5
Sodium, total	mg/L	0.2	0.9	1	1.1	1.3	-
Strontium, total	mg/L	0.01	<0.01	0.04	<0.01	0.07	-
Benzo (a) pyrene	ug/L	0.01	<0.01	0.01	<0.01	<0.01	-
Phenanthrene	ug/L	0.1	<0.10	0.17	<0.10	<0.10	-
Total PAH	ug/L	-	n/d	0.18	n/d	n/d	50
Chloroform	ug/L	1	6.2	5.6	6.2	6.5	-
Methylene chloride	ug/L	3	<3.0	6.8	<3.0	<3.0	-

In the event discharge to sanitary sewer is not possible, FSD would complete additional analyses consistent with the provincial effluent permit application process, including but not limited to pre-application meetings with the Ministry and the Technical Assessment[1]; with the latter requiring information on detailed site design and operations, non-product outputs (air contaminants, effluents and refuse), human health and ecological risk assessments, Total Costs Assessment (TCA), receiving environment characterization, discharge characterization (relative to guidelines and legal standards), modeling, cumulative impact assessment and proposed monitoring programs. The provincial effluent discharge permitting process would also require stakeholder consultation.

2.12 Monitoring of Discharge Water Quality

Please refer to Appendix C.

2.13 Discharge Rates

Discharge to the sanitary sewer or the storm sewer or to the ground will be determined primarily by rainfall, as discussed below. Average discharge rates will be quite low but the peak run off flow rate caused by a very heavy rainfall event has to be accommodated. For example, it is conventional practice to use a ten year return period IDF (Intensity Duration Frequency) curve for the design of relatively small storm drainage areas such as the Fraser Surrey Docks process areas. The closest and most relevant rainfall gauge data is at Vancouver International Airport (See Appendix B). The Rational Method, although somewhat simplistic, is also an appropriate and conservative methodology for this application whereby:

Q =CIA where

Q = Volume of runoff, in cubic meters (m^3)

C = Concentration factor. In this case we have a mixture of paved surfaces and the emergency coal stockpile, 0.8 used.

I = rainfall intensity mm/hr for the time period under consideration (as read from the IDF curve)

A = Area. In this case the total area of the Dumper Process Area, Loading Process Area 11,164 m^2.

As runoff accumulates it either has to be temporarily stored ("detained") or discharged from the site. The amount of detention storage required will depend upon the rate at which it can be discharged from the site. The following table illustrates a typical scenario for this site where the maximum discharge rate has arbitrarily set at a 5 L/sec (80 US gpm) which would be perhaps applicable to Option A – Discharge to the sanitary sewer. The resulting storage required is approximately 338.3 m^3.

[1]Potential application requirements discussed with Mr. Chor, Surrey, Senior Environmental Protection Officer. Technical assessment requirements outlined in GUIDANCE ON APPLICATIONS FOR PERMITS UNDER THE *ENVIRONMENTAL MANAGEMENT ACT* – TECHNICAL ASSESSMENT. http://www.env.gov.bc.ca/epd/waste_discharge_auth/guidance/pdf/assessment.pdf

TABLE 2 Stormwater Accumulation for 10 year rain event

Time Minutes	mm/hr IDF curve	mm	c	area m^2	volume runoff m^3	pump L/sec	volume discharge m^3	volume stored m^3
5	55	4.6	0.9	11164	46.1	5	1.5	44.6
10	40	6.7	0.9	11164	67.0	5	3	64.0
15	31	7.8	0.9	11164	77.9	5	4.5	73.4
20	28	9.3	0.9	11164	93.8	5	6	87.8
30	22	11.0	0.9	11164	110.5	5	9	101.5
40	19	12.7	0.9	11164	127.3	5	12	115.3
60	15	15.0	0.9	11164	150.7	5	18	132.7
120	11	22.0	0.9	11164	221.0	5	36	185.0
480	6	48.0	0.9	11164	482.3	5	144	338.3
600	4.8	48.0	0.9	11164	482.3	5	180	302.3
720	4.1	49.2	0.9	11164	494.3	5	216	278.3
1440	2.9	69.6	0.9	11164	699.3	5	432	267.3

Note that the table above illustrates the discharge rate required for the extreme rainfall event. The average discharge rate will be much lower than this. As noted in a previous section of this document, the discharge pump will vary its discharge rate to match the incoming flow rate for Option A.

Discharge to the storm drain or infiltration field (options B and C) would not be restricted for flow rates. However the chemical injection systems work best with a constant flow rate. A suitable flow rate would be 15 L/sec. When the table above was reworked with a pump rate of 15 L/sec, the required storage was only 113m^3

3.0 CITY OF SURREY WATER REQUIREMENTS

3.1 Uses

Water will be drawn from the existing site water system for:

1. Spraying on loaded barges for dust suppression.
2. Misting sprays at dumper and transfers. Recycled water cannot be used for this purpose as it would clog the very fine misting nozzles.
3. Site and equipment wash downs
4. Spraying on emergency coal stockpile (infrequent) for dust suppression

3.2 Volumes Required

Maximum Daily Volume and Flow rate based upon extreme dry windy weather and coal in emergency stockpile area:

Estimated Maximum Daily Volume	562 m^3
Estimated Maximum Flow Rate	18.5 L/sec (295 US gpm)

Annual Volumes required based upon maximum terminal throughput of 4 million tonnes per year and an average moisture increase due to dust suppression water of 1%

Estimated Annual Volume	40,000 m^3
Estimated Average Day Volume	110 m^3

3.3 Overspray from Barge Sprays

FSD is proposing to use the municipal water supply for onsite dust suppression. The bulk of this water will be maintained onsite for treatment and subsequent re-use. However, some non-recycled water will be used during barge loading (at the barge loader) and some will be applied to the coal in loaded barges before they leave the Berth. Fine misting sprays (capacity of 1 L/s) would be used at the barge loader and up to five (5) portable spray units (e.g. Big Guns® or similar) would be used on the loaded barges (see Drawing Option A – Discharge to Sanitary Sewer). Note that watering the loaded barges would not be necessary year round; but would be required to varying degrees during drier conditions. Spray frequency and duration can be controlled by a PLC program to minimize the risk of excessive water use.

The portable spray units can be modified with respect to position and angle to control spray dispersion. However, there is some potential for overspray into the surrounding environment when the units are in use at the loaded barges. Overspray from the mister used at the barge loader itself may occur during windy conditions.

The municipal water supply contains a chlorine residual (≤ 1 mg/L) to inhibit bacterial growth in the distribution lines (Ministry of Environment, 1999)2. Chlorine can impact water quality and aquatic life depending on the nature of the receiving environment, the chlorine concentration and the duration of exposure to chlorine. The maximum BC Approved Water Quality Guidelines for chlorine in freshwater and estuarine environments are 0.1 mg/L and 0.04 mg/L respectively (Ministry of Environment, 1999). The Canadian Council of the Minister of the Environment (CCME) has established guidelines for reactive chlorine species in freshwater (0.0005 mg/L) and chlorine produced oxidants in marine water (0.0005 mg/L)3.

Chlorine is reactive and volatile, and when present in water, will readily convert to a gas when exposed to open air. Chlorine has a boiling point of -34.04 °C; and is a gas under environmental conditions (HSDB 2009) (ATSDR, 2010)4. Chlorine gas dissolves in water (7.3 g/L at 20 °C) and immediately converts to hypochlorous acid (HOCl) and chloride (Cl-) at typical environmental pH levels (ATSDR, 2010). Because chlorine is reactive, it is short lived in the environment. Chlorine quickly reacts with organic and inorganic matter and is converted almost immediately once it dissolves in water. Chlorine in the air is broken down via photolysis and its half-life in lower atmosphere is measured in minutes (ATSDR, 2010).

Given these characteristics, the use of municipal water for dust suppression at the barges is not expected to negatively affect Fraser River water quality. The chlorine is expected to be converted and / or broken down through direct contact with the coal; and through exposure to the open air through pressurized discharge from the nozzles on the misting spray and portable gun units.

Prior to coal being delivered onsite, FSD will conduct in situ and analytical chlorine testing in the Fraser River before and after the mobile spray and barge loader misting units are installed and

[2] Ministry of Environment. Ambient Water Quality Criteria for Chlorine. Overview Report. December 15, 1989

[3] Canadian Water Quality Guidelines for the Protection of Aquatic Life. REACTIVE CHLORINE SPECIES

[4] ATSDR. Toxicological Profile. Chlorine. November 2010.

operational. The results will be used to determine if some level of de-chlorination (e.g. application of sodium thiosulphate - $Na_2S_2O_3$) may be required for use on the dust suppression water supply. Additional testing will be conducted once the site is fully operational and the mister and mobile spray units are in use for coal dust suppression. At this writing we understand non-detect results for in situ analyses of chlorine will be acceptable to the Port in the context of the operating site.

4.0 DUST SUPPRESSION BY WATER SPRAYS:

4.1 Location of Dust Suppression Water Sprays

1. Railcar Dumper – misting sprays which produce very small droplets to knock any fugitive dust out of the air plus larger nozzle sprays to wet coal as it is being dumped. The misting sprays will use fresh water (necessary to avoid nozzle clogging). The large nozzle sprays will use *recycled water* (see following section).

2. Railcar Wash – after dumping the railcars will pass under a spray arch to wash off any residual coal which otherwise could generate dust on their return journey. The spray arch will use recycled water.

3. Spray bars on conveyor- the surface of the coal on the conveyor belts will be wetted with recycled water.

4. Transfers will have misting sprays, similar to the dumper, using fresh water.
   Barge loader will have fine misting nozzles to mitigate dust generated by falling coal. These will be supplied with fresh water.

5. Coal Barges – After loading, the coal barges will be wetted down by Big Guns on the dock which will be supplied with fresh water. The requirement to wet down the barges will likely not be necessary during the wet winter months. Spraying frequency and duration will be controlled by a PLC program to minimize risk of excessive water application

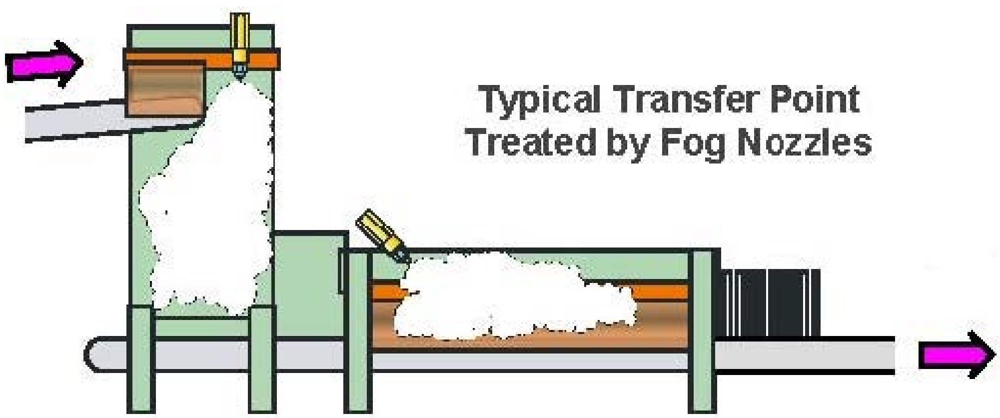
2.0 Portable Water Spray in Operation

The sprays can be relocated to suit the configuration of a coal pile and the prevailing wind direction

3.0 Railcar Wash in Operation

4.1.1 Transfer Misting Sprays:

The location of the sprays at the transfer and surge bin will be both at the incoming point (the head box) and outgoing end (tail end of conveyor).



4.0 Typical transfer point fogging arrangement

4.1.2 Dumper Sprays

The dumper building will have fine misting sprays along its length and at the outgo and inlet end of the building to act as dust curtain (continuous operation).

5.0 Typical Dumper Misting Sprays

There will also be wet down nozzles which will operate at conclusion of dumping operation for 20 seconds (to be confirmed after operating experience). They will have relatively large nozzles using recycled water to provide the volume of water required for this purpose:

APPENDIX A

Stokes Law

Vancouver International Airport Idf Curve

STOKES LAW:

$$V_c = \frac{g\,(P_s - P_w)\ d^2}{18\,\upsilon}$$

Vc = terminal velocity of a particle

g = gravitational acceleration **9.8 m/sec^2**

P_s = Density of Solids - usually taken as **2000** kg per m3

P_w = Density of Water – **1000** kg per m3 (ignoring temperature effects)

d^2 = diameter of particle in meters squared Example 15 microns = **225 x 10^{-12} m^2**

υ = Absolute viscosity of water. The general value of water is 1 centipoise which is equivalent to $\frac{.001 \text{ Newton – second}}{m^2}$

Be careful here as viscosity of water is temperature sensitive. At 20 degrees C it is about one centipoise but at 5 degrees C it increases to around 1.5 A good value to use is **.0015** as most of our work concerns cold winter conditions

Sample Calculation

$$V_c = \frac{g\,(P_s - P_w)\ d^2}{18\,\upsilon}$$

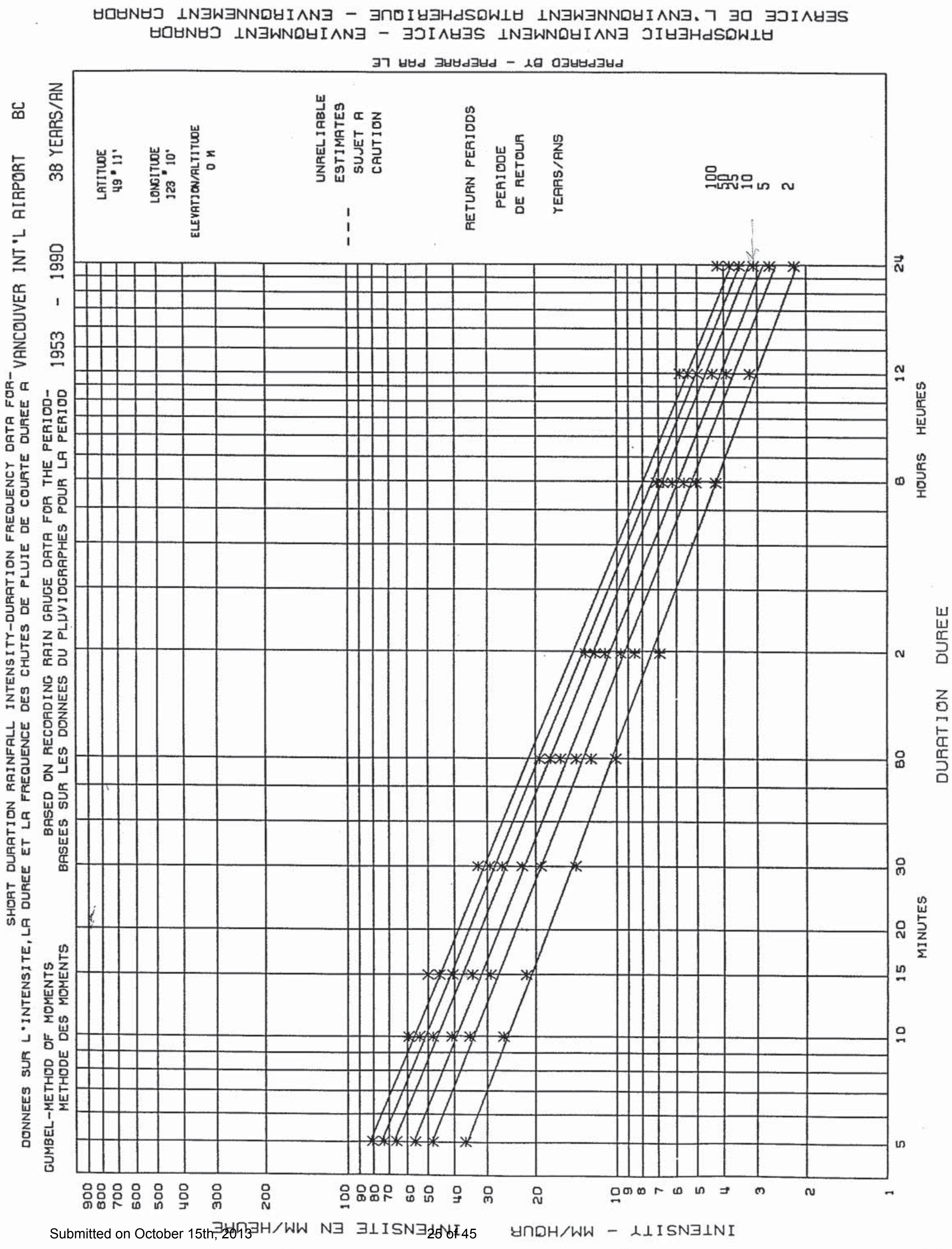
$$= \frac{\mathbf{9.8\ m/sec^2 \times (2000 - 1000)\ kg/m^2 \times 225 \times 10^{-12}\ m^2}}{\mathbf{18 \times .0015\ Newton\ seconds/m^2}}$$

= .000081 m/sec

=.081 mm/sec

This is a good typical value to use. Other particle velocities will be in proportion to the square of their diameter versus 15 microns

Note that strictly speaking Stokes Law is only valid for Reynolds Numbers 100 to 100,000


SERVICE DE L'ENVIRONNEMENT ATMOSPHERIQUE - ENVIRONNEMENT CANADA
ATMOSPHERIC ENVIRONMENT SERVICE - ENVIRONNEMENT CANADA
PREPARED BY - PREPARE PAR LE
SHORT DURATION RAINFALL INTENSITY-DURATION FREQUENCY DATA FOR- VANCOUVER INT'L AIRPORT BC
DONNEES SUR L'INTENSITE, LA DUREE ET LA FREQUENCE DES CHUTES DE PLUIE DE COURTE DUREE A
BASED ON RECORDING RAIN GAUGE DATA FOR THE PERIOD- 1953 - 1990 38 YEARS/AN
BASEES SUR LES DONNEES DU PLUVIOGRAPHES POUR LA PERIOD
GUMBEL-METHOD OF MOMENTS
METHODE DES MOMENTS
LATITUDE 49° 11'
LONGITUDE 123° 10'
ELEVATION/ALTITUDE 0 M
UNRELIABLE ESTIMATES
SUJET A CAUTION
RETURN PERIODS
PERIODE DE RETOUR
YEARS/ANS
100
50
25
10
5
2
INTENSITY - MM/HOUR
INTENSITE EN MM/HEURE
DURATION DUREE
MINUTES
HOURS HEURES
5 10 15 20 30 60 2 6 12 24
900 800 700 600 500 400 300 200 100 90 80 70 60 50 40 30 20 10 9 8 7 6 5 4 3 2 1

APPENDIX B

Information on Dust Suppression Sprays

APPENDIX B – DESIGN OF THE WATER SPRAYS

Water is used for dust suppression in two different ways:

1. WETDOWN COAL STOCKPILE AND LOADED BARGES: To keep coal piles wet and prevent the generation of dust by wind. This is done with large nozzle sprinklers such as the Nelson Big Gun which have specifically been designed for this purpose. They are similar to agricultural sprinklers but have a higher trajectory (43 degrees) which is approximately the angle of repose of a coal pile. The nozzles have a very large orifice, up to 1.2", to provide a high volume of water and long throw. Droplet size is not critical. Coal is to some degree hydrophobic and care has to be taken to limit the duration of the sprays to avoid a pile washout and/or excessive runoff.

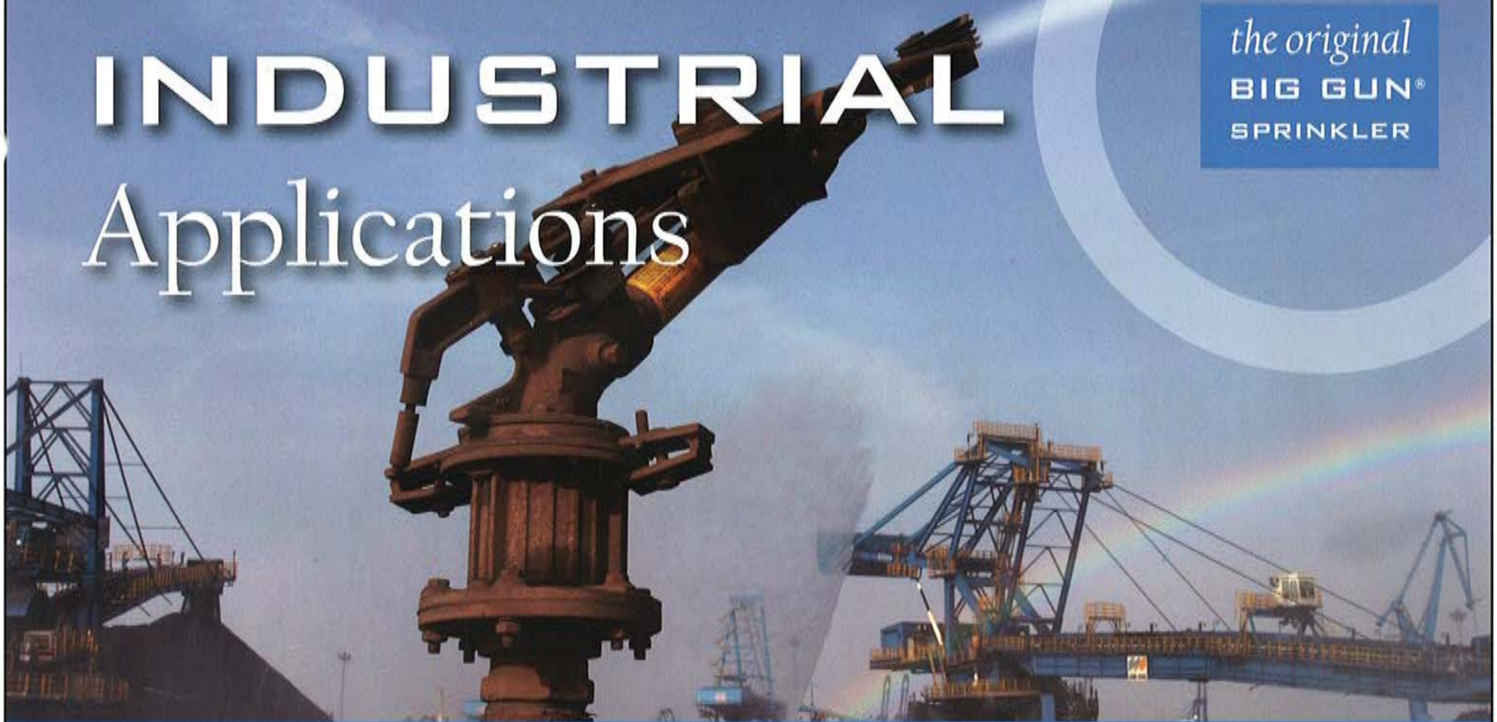
   Design of the wet down system will include the selection of appropriate sized Big Gun sprays, layout to provide full coverage and a PLC control system to sequence them and to avoid overspraying.

2. MISTING NOZZLES To capture fugitive airborne dust. This requires nozzles with very fine orifices to produce small droplets which will capture the fine dust particles. The volumes of water required are minimal. Spraying Systems company " Whirljet" nozzles will be installed in the dumper, at the transfers and at the shiploader for this purpose. The piping to the nozzles is small diameter and it is relatively easy to relocate the misting nozzles if operating experience indicates some particularly troublesome locations.

   The following pages contain some general information on both types of water sprays.

INDUSTRIAL Applications

the original BIG GUN® SPRINKLER



Why choose a Nelson Big Gun®

- The **Nelson name** is synonymous with the best quality available.
- **Heavy-duty construction** ensures long wear life & reliability.
- **Greatest range of options.** Full & part-circle sprinklers available in a variety of trajectory, nozzle & coating options.
- **Valve combinations available** for maximum system efficiency.
- **Easy to operate, maintain and repair** with readily available parts and documentation.

Advantages for Industrial Applications

- Efficient dust suppression.
- High volume in short time.
- Rugged durability in dirty & corrosive conditions.
- Large nozzles less likely to plug, filtration requirements minimal.
- All ball bearings are sealed.

NELSON
WWW.NELSONIRRIGATION.COM

IT'S THE ONE FOR THE JOB

Nelson Big Gun® sprinklers are ideal for a wide range of industrial applications. With a full range of models available (see *The Original Big Gun®* brochure), flow rates of 30-1200 GPM (6.8-275 m^3/hr) can be achieved with maximum uniformity to match a variety of needs.

MINING DUST SUPPRESSION

The rugged durability of Nelson Big Gun® sprinklers make them a favorite for dust suppression. Big Guns are preferred because of the ability to move a large amount of water in a short time. The large nozzle is less likely to plug and the filtration requirements are minimal. All bearings on the gun are sealed ball bearings. Some sprinklers are mounted on high towers in order to throw over the piles. Alternatively, a high trajectory Big Gun sprinkler (fixed 43° and adjustable 15-45° models available) can achieve the necessary stream height to reduce tower height and clear the top of the piles.

SPECIAL OPTIONS:

ANODIZED, POWDER COATED AND STAINLESS STEEL BIG GUNS® for sprinkling with corrosive waters.

COUNTER BALANCE KIT for operation of the Big Gun® with a tilted riser.

WEDGE INSERT for modified trajectory.

HEAVY DUTY BRONZE BRAKE for operation in environments with airborne, abrasive, dust particles (100 Series only).

BIG GUN® PERFORMANCE FOR 43° MODELS

R = Radius of Throw; **H** = Maximum Stream Height; **rH** = Distance from Big Gun to Maximum Stream Height

(See *The Original Big Gun*® brochure or www.nelsonirrigation.com for performance information of 24° models.)

SR75DS TAPER RING NOZZLE — 43° TRAJECTORY (U.S. UNITS - RADIUS IN FEET)

	0.4″				0.45″				0.5″				.55″				.6″				.65″				.7″				.75″				.8″			
PSI	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH
30	—	—	—	—	—	—	—	—	37	66	28	49	45	66	30	50	55	69	30	51	64	72	31	55	75	76	32	56	87	78	33	58	99	80	34	60
40	27	62	30	49	35	67	31	50	43	71	31	52	52	75	33	53	63	79	33	56	74	82	35	61	87	85	35	63	98	89	37	64	112	92	39	66
50	30	67	31	50	39	72	32	52	48	78	32	54	59	81	34	56	70	85	36	60	83	88	39	64	95	92	42	67	109	96	43	68	123	99	45	71
60	33	70	32	52	42	77	33	55	53	82	33	59	64	87	35	62	77	92	38	63	91	95	43	67	104	99	46	70	120	102	47	71	136	106	48	73
70	36	73	33	54	45	81	33	58	57	87	34	62	69	92	37	66	83	97	43	69	98	101	46	72	113	106	49	75	129	108	50	76	147	113	52	78
80	39	76	34	58	49	86	36	62	61	93	37	66	74	97	41	70	89	102	45	73	105	107	48	77	121	111	52	80	138	114	53	81	158	118	55	83

SR75DS TAPER RING NOZZLE — 43° TRAJECTORY (METRIC UNITS - RADIUS IN METERS)

	10.2 mm				11.4 mm				12.7 mm				14.0 mm				15.2 mm				16.5 mm				17.8 mm				19.1 mm				20.3 mm			
kg/cm²	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH
2.50	—	—	—	—	7.6	23	9.2	14	9.4	24	9.5	15	11.4	26	9.7	15	13.6	27	9.9	16	16.0	28	10.2	17	18.5	30	10.3	18	21.1	31	10.7	19	24.0	32	11.5	20
3.00	6.6	23	9.2	15	8.3	25	9.5	15	10.3	26	9.7	16	12.4	28	10.1	16	14.9	29	10.4	17	17.6	30	11.0	19	20.3	31	11.0	19	23.1	33	11.6	20	26.3	34	12.2	21
3.50	7.1	24	9.5	15	9.0	26	9.8	16	11.1	28	9.8	16	13.4	29	10.4	17	16.1	31	11.0	18	19.0	31	11.9	20	21.9	33	12.8	20	25.0	34	13.1	21	28.4	36	13.7	22
4.00	7.6	25	9.6	15	9.6	26	9.8	16	11.9	29	9.9	17	14.4	30	10.5	18	17.2	32	11.3	19	20.3	33	12.2	20	23.4	35	13.2	21	26.7	36	13.4	21	30.4	37	14.1	22
4.50	8.1	26	9.7	16	10.2	28	9.9	16	12.6	30	10.0	17	15.2	32	10.7	18	18.3	33	11.7	19	21.5	35	12.6	20	24.8	37	13.5	21	28.4	38	13.8	22	32.3	39	14.4	22
5.00	8.5	26	10.1	16	10.8	29	10.1	18	13.3	32	10.4	19	16.1	33	11.3	20	19.3	35	13.1	21	22.7	36	14.0	22	26.1	38	14.9	23	29.9	39	15.2	23	34.0	41	15.8	24
5.50	8.9	27	10.4	18	11.3	31	11.0	19	13.9	33	11.3	20	16.9	35	12.5	21	20.2	36	13.7	22	23.8	38	14.6	24	27.4	40	15.9	24	31.3	41	16.1	25	35.7	42	16.8	25
6.00	9.3	28	10.7	19	11.8	31	11.9	20	14.6	34	12.2	21	17.6	36	13.7	23	21.1	37	14.3	24	24.8	39	15.3	25	28.6	41	16.8	26	32.7	42	17.0	26	37.2	43	17.7	27

SR100DS TAPER BORE NOZZLE — 43° TRAJECTORY (U.S. UNITS - RADIUS IN FEET)

	0.6″				0.65″				0.7″				.75″				.8″				.85″				.9″				1.0″			
PSI	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH
50	74	98	36	59	87	108	40	65	100	117	44	71	115	120	44	72	130	123	46	75	150	125	46	76	165	129	47	78	204	136	48	82
60	81	102	39	63	96	109	44	68	110	121	47	74	126	124	48	75	143	127	49	77	164	131	49	79	182	133	50	81	224	140	51	85
70	88	105	43	68	103	114	47	73	120	125	50	79	136	128	51	81	155	131	53	83	177	133	54	85	197	138	55	87	243	144	56	91
80	94	111	46	74	110	119	49	79	128	129	53	84	146	132	54	86	165	135	56	88	189	138	56	90	210	142	59	92	258	149	60	97
90	100	118	49	79	117	123	52	83	135	133	56	87	155	136	57	90	175	139	59	93	201	143	60	94	223	146	62	95	274	153	64	99
100	106	120	51	82	123	128	54	87	143	137	58	92	163	140	59	93	185	143	61	95	212	148	62	98	235	150	65	101	289	157	67	105
110	111	122	52	84	129	132	56	89	150	141	60	94	171	144	62	96	195	147	64	98	222	151	65	100	247	154	67	103	304	162	69	108
120	115	124	53	85	135	135	56	90	157	145	61	95	179	148	63	99	204	151	65	103	232	155	67	105	258	159	69	107	320	166	71	111

SR100DS TAPER BORE NOZZLE — 43° TRAJECTORY (METRIC UNITS - RADIUS IN METERS)

	15.2 mm				16.5 mm				17.8 mm				19.1 mm				20.3 mm				21.6 mm				22.9 mm				25.4 mm			
kg/cm²	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH
3.5	15.6	30	11	18	18.3	33	12	20	21.0	36	13	22	24.1	37	14	22	27.5	38	14	23	31.5	38	14	23	34.8	39	14	24	42.8	42	15	25
4	18.0	31	12	19	21.1	33	13	21	24.6	37	14	22	27.8	38	14	23	31.2	38	15	23	36.2	40	15	24	40.4	40	15	25	49.5	42	15	26
5	20.1	32	13	21	23.6	35	14	23	27.5	38	15	24	31.2	39	16	25	34.9	40	16	26	40.5	41	17	26	45.2	42	17	27	55.6	44	17	28
6	22.1	35	15	24	25.9	37	16	25	30.1	40	17	26	34.3	41	17	27	38.2	42	18	28	44.5	43	18	28	49.5	44	19	29	60.5	46	19	30
7	23.8	37	16	25	27.9	39	17	27	32.5	42	18	28	37.0	43	18	28	41.3	44	19	29	48.0	45	19	30	53.5	46	20	31	65.5	48	21	32
8	25.5	38	16	26	29.7	41	17	27	34.8	44	18	29	39.4	45	19	30	44.1	46	20	31	51.2	47	20	31	57.2	48	21	32	70.2	50	21	33

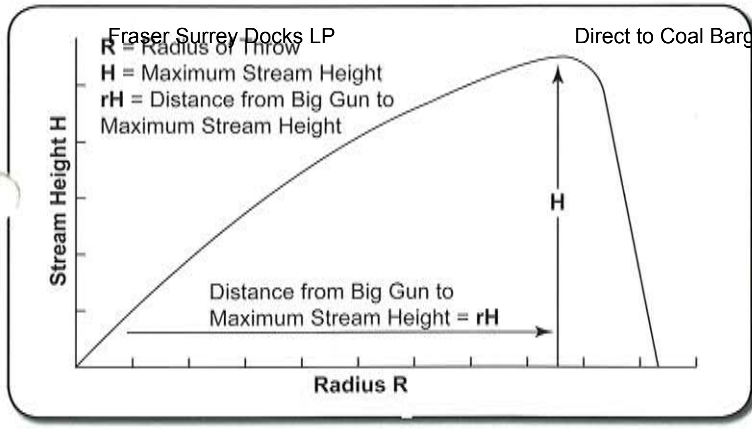
SR150DS TAPER BORE NOZZLE — 43° TRAJECTORY (U.S. UNITS - RADIUS IN FEET)

	0.7″				0.8″				0.9″				1.0″				1.1″				1.2″				1.3″			
PSI	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH	GPM	R	H	rH
50	100	117	44	71	130	123	46	75	165	129	47	78	205	136	48	82	255	140	49	[illegible]	300	149	50	90	[illegible]	153	51	93
60	110	121	47	74	143	127	49	77	182	133	50	81	225	140	51	85	275	145	52	[illegible]	330	154	53	94	[illegible]	157	54	96
70	120	125	50	79	155	131	53	83	197	138	55	87	245	144	56	91	295	151	57	[illegible]	355	158	59	100	[illegible]	161	60	101
80	128	129	53	84	165	135	56	88	210	142	59	92	260	149	60	97	315	162	61	[illegible]	380	163	64	106	[illegible]	167	65	112
90	135	133	56	87	175	139	59	93	223	146	62	95	275	153	64	99	335	165	65	[illegible]	405	168	68	109	[illegible]	171	70	114
100	143	137	58	92	185	143	61	96	235	150	65	101	290	157	67	105	355	167	68	[illegible]	425	172	71	113	[illegible]	176	73	116
110	150	141	60	94	195	147	64	98	247	154	67	103	305	162	69	108	370	172	70	[illegible]	445	176	74	118	[illegible]	180	76	121
120	157	145	61	97	204	151	65	103	258	159	69	107	320	166	71	111	385	177	72	[illegible]	465	180	77	122	[illegible]	183	79	123

SR150DS TAPER BORE NOZZLE — 43° TRAJECTORY (METRIC UNITS - RADIUS IN METERS)

	17.8 mm				20.3 mm				22.9 mm				25.4 mm				27.9 mm				30.5 mm				33.0 mm			
kg/cm²	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH	M³/H	R	H	rH
3.5	23.0	36	13	22	29.8	38	14	23	37.8	39	14	24	46.9	42	15	25	57.1	43	15	26	68.3	46	15	28	80.1	47	16	28
4	24.6	37	14	22	31.9	38	15	23	40.5	40	15	25	50.1	42	15	26	61.0	44	16	27	73.0	47	16	28	85.7	48	16	29
5	27.5	38	15	25	35.7	40	16	26	45.2	42	17	27	56.0	44	17	28	68.2	47	18	30	81.7	49	18	31	95.8	50	19	32
6	30.1	40	17	26	39.1	42	18	28	49.5	44	19	29	61.3	46	19	30	74.7	50	19	32	89.5	51	20	33	105	52	21	35
7	32.5	42	18	28	42.2	44	19	29	53.5	46	20	31	66.3	48	21	32	80.7	51	21	34	96.6	53	22	35	113	54	22	36
8	36.9	44	18	29	45.1	46	20	31	57.2	48	21	32	70.8	50	21	33	86.3	53	22	36	103	54	23	37	121	55	24	37

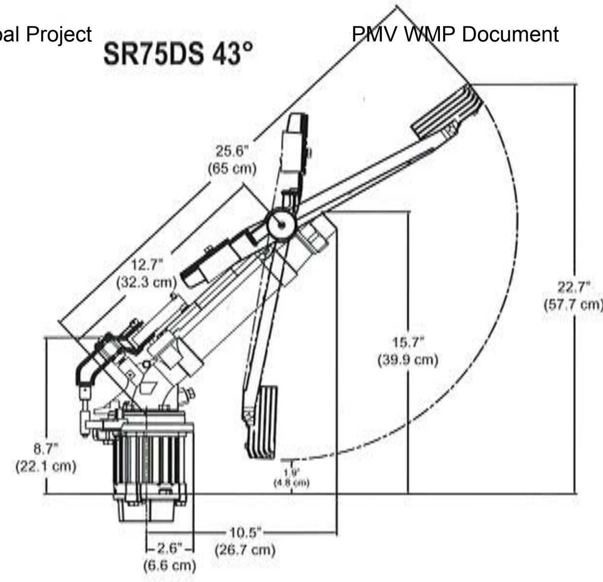
Big Gun® Performance data has been obtained under ideal test conditions and may be adversely affected by wind, poor hydraulic entrance conditions or other factors. Test riser height of 3 feet (0.91 meters) above measurement surface. No representation regarding droplet condition, uniformity, application rate, or suitability for a particular application is made herein.



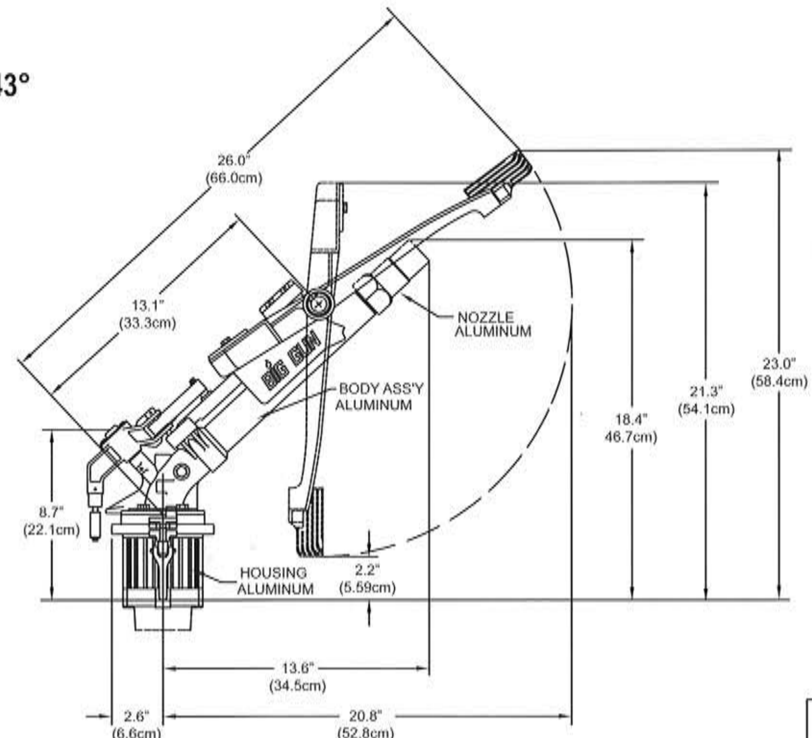
NOTE: The rotation speed of the gun is an important factor in some dust control applications. In general the rotation of the gun is 2-3 minutes when the mid-range pressure and nozzle are used. Drive arm speed adjustment can increase the rotation speed to twice as fast if more frequent wetting is wanted. A full circle Big Gun has ½ the water application rate of a half circle Big Gun with the same nozzle. The half circle Big Gun will pass over a specific location twice as often as a full circle Big Gun.

Contact the factory for information on the SRA100, SRA150 and the 12° Wedge Kit.

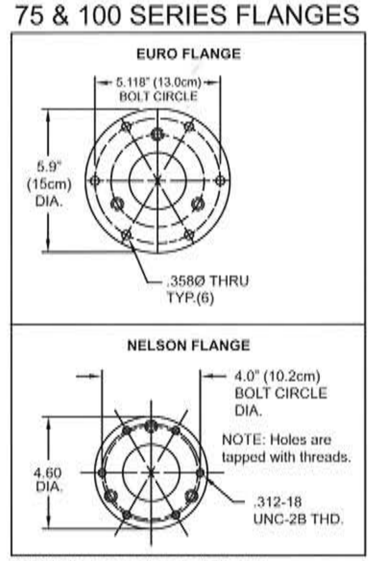
SR75DS 43°



SR100DS 43°

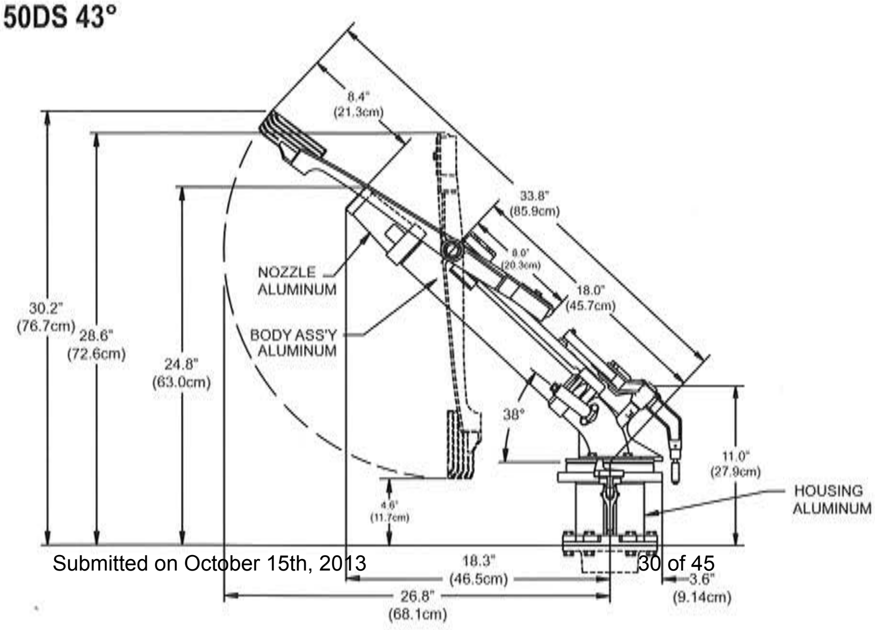


75 & 100 SERIES FLANGES

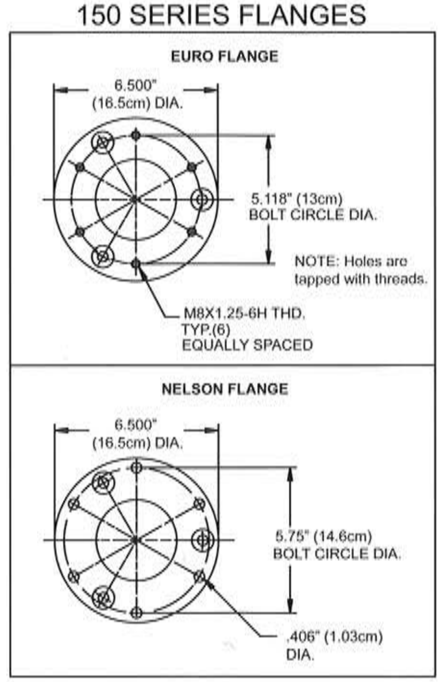


ANSI Flange option not shown.

SR150DS 43°



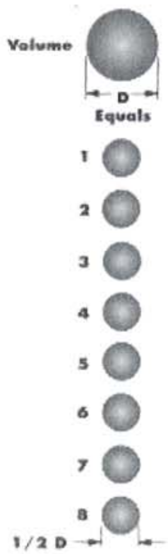
150 SERIES FLANGES



ANSI Flange option not shown.

Understanding drop size and the role it plays in your dust suppression application

Many important factors determine the overall effectiveness of a dust suppression spray nozzle. One of these factors is drop size, and understanding drop size and its role in nozzle performance will help you select the best spray nozzle for your application.



The volume of one large drop equals the volume of eight drops with diameters one-half the size of the large drop.

What is drop size?

Drop size is a by-product of atomization. The process of atomization begins by forcing liquid through a nozzle. The potential energy of the liquid, along with the geometry of the nozzle, causes the liquid to emerge as small ligaments. These ligaments then break up further into very small "pieces," which are usually called drops, droplets, or liquid particles.

Each spray provides a range of drop sizes; this range is referred to as drop size distribution. The drop size distribution is dependent on the nozzle type and will vary significantly from one nozzle type to another.

The importance of drop size in dust suppression stems from the role it plays in Airborne (Fugitive) Dust Knockdown. Once dust particles become airborne the dust reduction application becomes one of capturing, knocking down, or scrubbing many of the particles from the air or gas.

Studies have shown that dust-capturing efficiency depends strongly on the ratio of spray drop size to dust particle size. Dust particles in the range of 2 to 3 microns were best captured with drop of about 100 times the size of the dust particles. For capturing much larger size dust particles, a drop size of approximately the same size or somewhat larger than the particle size would be adequate.

The drop size required for a specific application has an important effect on nozzle selection. Generally, air atomizing nozzles provide the finest drop size followed by hollow cone, flat fan, and full cone nozzles. The range of drop size and a relative comparison between Spraying Systems Co. nozzle drop sizes are represented in Data Sheet 13911-1. The importance of nozzle selection was also emphasized in another U.S. Bureau of Mines (NIOSH) study. In this study, it was shown that full cone and flat fan nozzles were two-thirds as effective as hollow cone nozzles in dust knockdown applications.

For more information on dust particle size and drop size, Spraying Systems Co. nozzle drop size comparison, or the U.S. Bureau of Mines (NIOSH) Study, contact your local Spraying Systems Co. sales engineer. Your sales engineer will be pleased to provide you with a copy of our "Engineer's Practical Guide to Drop Size". This handy reference tool offers an up-close look at drop size instrumentation, statistics and terminology, and more.

You'll also find the U.S. Bureau of Mines (NIOSH) Study to be a valuable source for technical information on dust knockdown performance of spray nozzles, the characteristics of particles and particle dispersions, and the relative comparison between Spraying Systems Co. nozzle drop sizes.

COMPARATIVE DROP SIZE DATA					
Drop Size Range Microns* Median Volume Diameter	Comparative Subject In Drop Size Range	Time For Drop To Fall 10 Ft. In Seconds	Drift In 3 MPH Wind 10 Ft. Fall Feet	No. of Drops Per Sq. In. If Applied At Rate of 1 Gal Per Acre	Nozzle Group No.*** Nozzle Types And Sizes Generally Falling In Given Drop Size Range
Below .001	Molecular Dimensions				
.001 To 0.1	Smoke	**			
0.1 To 1.0	Fumes	**			
2 To 5	Dry Fog	25400 4070	112000 18000	144060000 9220000	
10 To 40	Wet Fog	1020 64	4500 280	1152500 18000	I
50 To 100	Misty Rain	40 11	175 48	9200 1152	II
200 To 400	Light Rain	4.2 1.9	19 8	144 18	III
500 To 1000	Moderate Rain	1.6 1.1	7 5	9 1	IV
1000 To 2000	Intense Rain	1.1 0.9	5 4	1 21 Per Sq Ft	V
2000 To 5000	Heavy Rain	0.9 0.85	4 3.5	21 Per Sq Ft 1-1/3 Per Sq Ft	VI

Note: *One micron equals 1/25400 of an inch.

**Below 0.1 micron, drops are suspended in air due to molecular shock (Brownian Motion).

***See following pages for listing of Nozzle Group Nos., Nozzle Nos., and pressure ranges.

WhirlJet® SPRAY NOZZLES

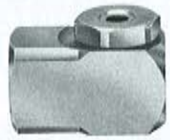
STANDARD ANGLE
SMALL CAPACITY

A

removable cap
⅛"-¾" NPT or BSPT (F)

AX

removable cap/slope-bottom design
⅛"-¾" NPT or BSPT (F)

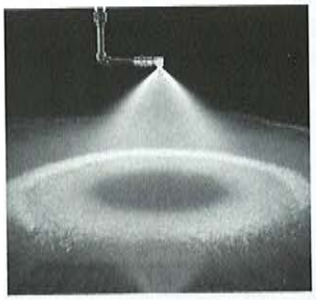


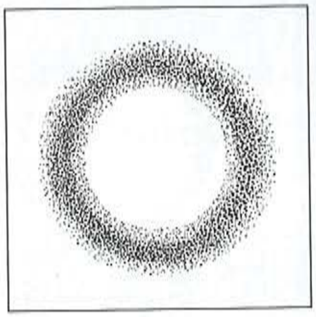
B

removable cap
⅛"-¾" NPT or BSPT (M)

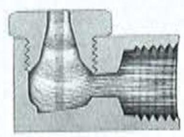
BX

removable cap/slope-bottom design
⅛"-¾" NPT or BSPT (M)





DESIGN FEATURES



Standard WhirlJet spray nozzles feature a hollow cone spray pattern with a ring-shaped impact area and spray angles of 40° to 90°.

They produce a uniform distribution of small to medium-sized droplets over a wide range of flow rates and pressures.

WhirlJet nozzles produce excellent results in applications requiring good atomization of liquids at lower pressures... especially where quick heat transfer or effective air-borne droplet impingement is required.

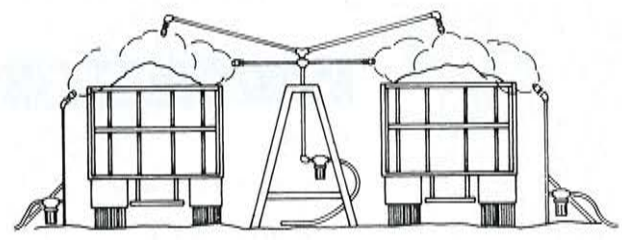
WhirlJets also provide an important benefit with their large and unobstructed flow passages, which minimize or eliminate clogging.

A and B series small capacity WhirlJet spray nozzles are precision-machined from solid bar stock to exacting internal proportions. They have removable caps and the original design WhirlJet whirlchamber.

AX and BX series small capacity slope bottom WhirlJets feature the same uniform spray distribution and precision two-piece bar stock construction as the A and B series...plus the added advantage of the longer-life slope bottom design...to reduce the "drilling effect" of the fluid vortex in the whirlchamber.

COMMON APPLICATIONS

- Washing gas and air to remove fly ash and other products of combustion
- Gas cooling
- Water cooling
- Metal treating
- Product degreasing
- Suppression and control of fugitive dust
- Brine spraying
- Water aerating



DUST CONTROL

ACCESSORIES

Split-Eyelet Connector	Pressure Gauge	Adjustable Ball Fittings	124 Strainer	Other Accessories
				• Pressure Regulators • Control Valves • Solenoid Valves • Swivel Connectors **SEE SECTION G FOR COMPLETE INFORMATION.**

PERFORMANCE DATA

Nozzle Inlet Conn. NPT or BSPT	NOZZLE TYPE STANDARD (F) Conn. A	(F) Conn. AX	(M) Conn. B	(M) Conn. BX	Capacity Size	Body Inlet Diam. Nom. Inches	Orifice Diam. Nom. Inches	CAPACITY (gallons per minute) 3 psi	5 psi	10 psi	15 psi	20 psi	30 psi	40 psi	60 psi	80 psi	100 psi	SPRAY ANGLE 7 psi	20 psi	80 psi
1/8	●	●	●	●	0.5	1/32	3/64			.05	.06	.07	.09	.10	.12	.14	.16		58°	69°
	●	●	●	●	1	1/16	1/16			.10	.12	.14	.17	.20	.24	.28	.31		64°	76°
	●	●	●	●	2	5/64	5/64		.14	.20	.25	.28	.35	.40	.48	.56	.63	52°	61°	69°
	●	●	●	●	3	3/32	3/32		.21	.30	.37	.42	.52	.60	.73	.85	.95	52°	64°	77°
	●	●	●	●	5	1/8	1/8	.27	.35	.50	.61	.70	.86	1.0	1.2	1.4	1.6	56°	67°	76°
	●	●	●	●	8	5/32	5/32	.44	.57	.80	.98	1.1	1.4	1.6	2.0	2.3	2.5	56°	65°	70°
	●	●	●	●	10	11/64	11/64	.55	.71	1.0	1.2	1.4	1.7	2.0	2.5	2.8	3.2	55°	65°	72°
1/4	●	●	●	●	1	1/16	1/16			.10	.12	.14	.17	.20	.24	.28	.31		53°	67°
	●	●	●	●	2	5/64	5/64			.20	.25	.28	.35	.40	.48	.56	.63		62°	71°
	●	●	●	●	3	3/32	3/32		.21	.30	.37	.42	.52	.60	.73	.85	.95	51°	65°	78°
	●	●	●	●	5	9/64	9/64	.27	.35	.50	.61	.70	.86	1.0	1.2	1.4	1.6	63°	73°	79°
	●	●	●	●	8	5/32	5/32	.44	.56	.80	.98	1.1	1.4	1.6	2.0	2.3	2.5	61°	69°	73°
	●	●	●	●	10	3/16	11/64	.55	.71	1.0	1.2	1.4	1.7	2.0	2.5	2.8	3.2	63°	70°	74°
	●	●	●	●	15	15/64	13/64	.82	1.1	1.5	1.8	2.1	2.6	3.0	3.7	4.2	4.7	63°	71°	72°
3/8	●	●	●	●	5	9/64	1/8	.27	.35	.50	.61	.70	.86	1.0	1.2	1.4	1.6	64°	73°	79°
	●	●	●	●	8	11/64	5/32	.44	.56	.80	.98	1.1	1.4	1.6	2.0	2.3	2.5	62°	70°	74°
	●	●	●	●	10	13/64	11/64	.55	.72	1.0	1.2	1.4	1.7	2.0	2.4	2.8	3.1	64°	72°	75°
	●	●	●	●	15	15/64	7/32	.82	1.1	1.5	1.8	2.1	2.6	3.0	3.7	4.2	4.7	64°	72°	74°
	●	●	●	●	20	9/32	1/4	1.1	1.4	2.0	2.4	2.8	3.5	4.0	4.9	5.6	6.3	63°	70°	74°
	●	●	●	●	25	19/64	19/64	1.4	1.8	2.5	3.1	3.5	4.3	5.0	6.1	7.1	7.9	63°	70°	74°
	●	●	●	●	30	21/64	5/16	1.6	2.1	3.0	3.7	4.2	5.2	6.0	7.3	8.5	9.5	63°	70°	74°
	●		●		15-30.1	15/64	5/16	1.3	1.6	2.3	2.8	3.2	4.0	4.6	5.6	6.5	7.3	40°	50°	54°
	●		●		25-30.1	19/64	5/16	1.5	2.0	2.8	3.4	4.0	4.8	5.6	6.9	8.0	8.9	40°	47°	51°
	●		●		50-50.1	11/32	3/8	2.7	3.5	5.0	6.1	7.1	8.7	10.0	12.3	14.2	15.8	40°	47°	50°
	●		●		50-50.3	11/32	3/8	2.7	3.5	5.0	6.1	7.1	8.7	10.0	12.3	14.2	15.8	72°	76°	78°
1/2	●	●	●	●	25	3/8	1/4	1.4	1.8	2.5	3.1	3.5	4.3	5.0	6.1	7.1	7.9	63°	66°	71°
	●	●	●	●	30	3/8	19/64	1.6	2.1	3.0	3.7	4.2	5.2	6.0	7.3	8.5	9.5	67°	71°	75°
	●	●	●	●	40	3/8	23/64	2.2	2.8	4.0	4.9	5.7	6.9	8.0	9.8	11.3	12.6	72°	76°	78°
	●	●	●	●	50	3/8	7/16	2.7	3.5	5.0	6.1	7.1	8.5	10.0	12.3	14.2	15.8	74°	79°	82°
	●	●	●	●	60	3/8	33/64	3.3	4.3	6.0	7.3	8.5	10.4	12.0	14.7	17.0	19.0	77°	82°	86°
3/4	●	●	●	●	40	1/2	5/16	2.2	2.8	4.0	4.9	5.7	6.9	8.0	9.8	11.3	12.6	70°	73°	74°
	●	●	●	●	50	1/2	3/8	2.7	3.5	5.0	6.1	7.1	8.5	10.0	12.3	14.2	15.8	72°	75°	77°
	●	●	●	●	60	1/2	7/16	3.3	4.3	6.0	7.3	8.5	10.4	12.0	14.7	17.0	19.0	74°	76°	79°
	●	●	●	●	70	1/2	1/2	3.8	5.0	7.0	8.5	9.9	12.1	14.0	17.1	19.8	22.0	76°	79°	83°
	●	●	●	●	80	1/2	9/16	4.4	5.7	8.0	9.8	11.3	13.8	16.0	19.6	23.0	25.0	78°	82°	84°
	●	●	●	●	90	1/2	37/64	4.9	6.4	9.0	11.0	12.7	15.6	18.0	22.0	25.0	29.0	81°	84°	84°
	●	●	●	●	100	1/2	5/8	5.5	7.1	10.0	12.2	14.1	17.3	20.0	25.0	28.0	32.0	83°	86°	86°
	●	●	●	●	110	1/2	43/64	6.0	7.8	11.0	13.5	15.5	19.0	22.0	27.0	31.0	35.0	85°	88°	88°
	●	●	●	●	120	1/2	23/32	6.6	8.5	12.0	14.7	17.0	21.0	24.0	29.0	34.0	38.0	87°	90°	90°

Standard Materials			
●	●	●	●
●	●	●	●
●	●	●	●
●	●	●	●
●	●	●	

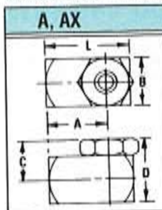
Material Code
no material code = Brass
I = Mild Steel
SS = 303 Stainless Steel
316SS = 316 Stainless Steel
PVC = Polyvinyl Chloride

INTERMEDIATE CAPACITIES—Caps are interchangeable for in-between capacities within each pipe size group... write for Data Sheets 3055, 3986 and 3987.
Spray Dimension Data... write for Data Sheets 15350 and 15362.

DIMENSIONS & WEIGHTS

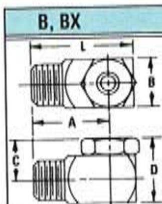
Based on largest/heaviest version of each type.

A, AX



A, AX	A	B	C	D	L	Net Weight oz.
1/8 A, AX	11/16"	5/8"	15/32"	25/32"	1"	1½
1/4 A, AX	7/8"	3/4"	17/32"	29/32"	1¼"	2¾
3/8 A, AX	1 1/32"	7/8"	11/16"	1⅛"	1 15/32"	4¼
1/2 A, AX	1⅜"	1⅛"	27/32"	1 13/32"	1 15/16"	8¾
3/4 A, AX	1 9/16"	1¼"	15/16"	1 9/16"	2 3/16"	11
3/8 A-30.1	31/32"	3/4"	3/4"	1⅛"	1 11/32"	4
3/8 A-50.1	31/32"	3/4"	27/32"	1 7/32"	1 11/32"	3¾
3/8 A-50.3	31/32"	3/4"	11/16"	1 1/16"	1 11/32"	3¾

B, BX



B, BX	A	B	C	D	L	Net Weight oz.
1/8 B, BX	7/8"	5/8"	15/32"	25/32"	1 3/16"	1½
1/4 B, BX	1"	3/4"	17/32"	29/32"	1⅜"	2½
3/8 B, BX	1⅛"	7/8"	11/16"	1⅛"	1 9/16"	4
1/2 B, BX	1⅜"	1⅛"	27/32"	1 13/32"	1 15/16"	7
3/4 B, BX	1⅝"	1¼"	15/16"	1 9/16"	2¼"	10¾
3/8 B-30.1	1⅛"	3/4"	3/4"	1⅛"	1½"	3¾
3/8 B-50.1	1⅛"	3/4"	27/32"	1 7/32"	1½"	3½
3/8 B-50.3	1⅛"	3/4"	11/16"	1 1/16"	1½"	3½

ORDERING INFORMATION

STANDARD SPRAY NOZZLE

1/4	A	-	SS	10
Inlet Connection Pipe Size	Nozzle Type		Material Code	Capacity Size

C 3
GENERAL PURPOSE
HOLLOW CONE

APPENDIX C

Water and Sediment Monitoring Program

8971 Beckwith Road
Richmond, BC V6X 1V4
Phone 604 279 2093
Fax 604 279 2047

V5, September 2013
Reference: 4419

Jurgen Franke, P.Eng.
Fraser Surrey Docks LLP
Director of Engineering & Maintenance
11060 Elevator Rd
Surrey, BC, V3V 2R7

Re: Proposed water and sediment quality monitoring programs for the operating temporary coal offloading facility at Fraser Surrey Docks (FSD), Surrey BC

1.0 Introduction

This document outlines a proposed operations phase water and sediment quality monitoring program for the temporary coal offloading facility at Fraser Surrey Docks, (FSD) in Surrey, BC.

2.0 Water quality monitoring

Storm water and dust suppression waters will typically be collected, treated and re-used in the system, although the offsite discharge of some treated water may be required during heavy rain events.

A water quality monitoring program will be used to confirm and evaluate the function of the onsite water collection and treatment system. A site-specific treatment system is under design and at a minimum, routine pH adjustment and solids removal are anticipated during operations. The design contemplates two discharge options, both under strict permit approval guidelines. Option A involves discharge to Metro Vancouver's Sanitary while Option B involves a discharge of treated runoff to the storm sewer system / Fraser River.

2.1 Pre-construction water quality sampling

In preparation for a discharge permit (Sanitary sewer or Storm sewer), pre-construction sampling followed by a water treatment system test will be needed; with analytical sampling reflective of Schedule 5 - Restricted Wastes, Greater Vancouver Sewerage and Drainage District (GVS&DD) Sanitary Sewer Use Bylaw 299. Sampling parameters will include:

- Biochemical Oxygen Demand (BOD)
- pH (*in situ* and analytical)
- Phenols (chlorinated / non-chlorinated)
- Sulphate
- Total and dissolved metals
- Total suspended solids (TSS)
- Volatile Organic Compounds (VOC)
- Oil & Grease

2.2 Operational water quality monitoring

For Options A and B, a water quality monitoring program will be used to confirm and evaluate the function of the onsite water collection and treatment system. At a minimum, routine pH adjustment and solids removal (for a discharge to sanitary) are anticipated during operations. This will require some combination of a buffering agent to raise the pH and flocculent injection in association with tank storage to settle the suspended solids. We recommend a combination of field sampling (in-situ) and laboratory analyses be conducted on the treated discharge, with daily in-situ measurements of pH, conductivity and turbidity when the treatment system is running. These parameters can be measured in the field with hand held meters or using autosamplers, and can be used to quickly identify treatment system malfunction and / or maintenance needs. The monitoring data will be maintained in a database to evaluate system performance on an ongoing basis. Monthly confirmatory analytical samples of the treated discharge are also recommended - emphasizing pH, total suspended solids (TSS) and turbidity (Table 1).

Table 1. Monitoring program for Option A – discharge to sanitary sewer

Parameter	Frequency (in-situ)	Frequency (analytical)
conductivity	Daily	Monthly
pH	Daily	Monthly
turbidity	Daily	Monthly
TSS	-	Monthly

A provincial effluent discharge permit to the storm sewer / Fraser River (Option B) will specify the parameters and the frequency of sampling for each parameter in the treated discharge and the Fraser River receiving environment. The monitoring program would be developed in the context of anticipated discharge water quality, discharge volumes and the dilution capacity of the receiving environment.

NOTE: In addition to the parameters listed above, pre-operations chlorine testing will be conducted on the sprinkler systems used for dust suppression. These systems will make use of the municipal water supply; which contains residual chlorine. FSD proposes to collect *in situ* and analytical chlorine samples in the Fraser River while the sprinklers are running to ensure chlorine levels are below detection. *In situ* and analytical chlorine sampling will also be conducted once the site is operational to confirm sprinkling strategies are not resulting in detectable chlorine in the Fraser. We recommend daily *in-situ* sampling for the first month the sprinklers are actively in use for onsite dust suppression. Depending on these preliminary results, once weekly sampling thereafter would likely be sufficient for monitoring purposes.

3.0 Sediment quality monitoring

Given the dust and spill control measures proposed for the facility, coal is not expected to accumulate in abundance in the sediments at or around the FSD during operations. However, FSD is proposing a twice yearly sediment survey to collect samples for particle size analyses, total organic carbon (TOC) and % coal content. The following program is recommended:

- Samples will be collected twice annually, including once in September at the tail end of freshet and then once in February, the latter timeframe corresponding with some of the lowest average discharge rates at the closest non-tidal Water Survey of Canada station in the Fraser River (Fraser River at Agassiz-08MF035) for which more recent data are available (into the 1990s)
    - Samples collected in September will reflect sediment conditions after peak freshet in the river (June / July) and would provide a yearly, site-specific basis for comparison with the winter samples
    - The winter timeframe reflects a ≥6 month period after peak freshet and would be an optimal time for evaluating the highest potential coal particle accumulations in local sediments

- Surface sediment grab samples would be collected from 10 evenly distributed locations (following a grid pattern) at Berth 2 where the paired barges will be loaded
    - We recommend collecting a full set of samples prior *to* operations to describe the pre-project conditions in the barge loading area
    - The first set of *operational* samples are recommended for the February following the start of operations
    - Samples will be sent to CARO Analytical and the UBC Mining Laboratory for particle size analyses, % coal content and %TOC

These data would be used to track potential coal accumulations in the vicinity of the barge loading area throughout the operations phase of the project. Additional samples may be collected outside of the immediate barge loading areas depending on the results from samples collected at the 10 onsite locations during the operational phases.

4.0 Closing

If you have any questions, comments or concerns about this letter please contact the undersigned at 604-790-6915, 604-279-2093 or kgraf@triton-env.com

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APPENDIX 1: SUMMARY OF SEPTEMBER 2013 METALS, PAH, VOC,SULPHATE AND PHENOLS RESULTS

Parameter	Units	Detection limit	< 2 mm Coal @ 600 mg/L - 1 WEEK	< 2 mm Coal @ 600 mg/L - 1 WEEK	< 2 mm Coal @ 600 mg/L - 2 WEEK	< 2 mm Coal @ 600 mg/L - 2 WEEK	GVSD&D Restricted waste criteria
			17-Sep-13	17-Sep-13	24-Sep-13	24-Sep-13	
Sulfate	mg/L	1	<1.0	<1.0	<1.0	<1.0	1500
pH	pH units	0.01	7.15	7.12	7.36	7.06	5.5 to 10.5
Hardness, Total (Total as CaCO3)	mg/L	-	<5.0	<5.0	<5.0	<5.0	-
Aluminum, total	mg/L	0.05	<0.05	0.21	<0.05	0.42	50
Antimony, total	mg/L	0.0010	<0.001	<0.001	<0.001	<0.001	-
Arsenic, total	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	1
Barium, total	mg/L	0.05	<0.05	0.28	<0.05	0.37	-
Beryllium, total	mg/L	1.00E-03	<0.001	<0.001	<0.001	<0.001	-
Bismuth, total	mg/L	1.00E-03	<0.001	<0.001	<0.001	<0.001	-
Boron, total	mg/L	0.04	<0.04	<0.04	<0.04	<0.04	50
Cadmium, total	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.2
Calcium, total	mg/L	2	<2	<2	<2	<2	-
Chromium, total	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	4
Cobalt, total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	5
Copper, total	mg/L	0.002	<0.002	<0.002	<0.002	0.003	2
Iron, total	mg/L	0.1	<0.1	0.2	<0.1	0.5	10
Lead, total	mg/L	1.00E-03	<0.001	<0.001	<0.001	<0.001	1
Lithium, total	mg/L	0.0010	<0.001	<0.001	<0.001	<0.001	-
Magnesium, total	mg/L	0.1	<0.1	0.1	<0.1	0.2	-
Manganese, total	mg/L	0.002	<0.002	0.003	<0.002	0.007	5
Mercury, total	mg/L	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.05
Molybdenum, total	mg/L	0.0010	<0.001	<0.001	<0.001	<0.001	1

Nickel, total	mg/L	0.002	<0.002	<0.002	<0.002	<0.002	2
Phosphorus, total	mg/L	0.2	<0.2	<0.2	<0.2	<0.2	-
Potassium, total	mg/L	0.2	<0.2	<0.2	<0.2	<0.2	-
Selenium, total	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	1
Silicon, total	mg/L	5	<5	<5	<5	<5	-
Silver, total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	1
Sodium, total	mg/L	0.2	0.9	1	1.1	1.3	-
Strontium, total	mg/L	0.01	<0.01	0.04	<0.01	0.07	-
Sulfur, total	mg/L	10	<10	<10	<10	<10	-
Tellurium, total	mg/L	0.002	<0.002	<0.002	<0.002	<0.002	-
Thallium, total	mg/L	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Thorium, total	mg/L	1.00E-03	<0.001	<0.001	<0.001	<0.001	-
Tin, total	mg/L	0.002	<0.002	<0.002	<0.002	<0.002	-
Titanium, total	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Uranium, total	mg/L	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Vanadium, total	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	-
Zinc, total	mg/L	0.04	<0.04	<0.04	<0.04	<0.04	3
Zirconium, total	mg/L	1.00E-03	<0.001	<0.001	<0.001	<0.001	-
2-Chlorophenol	ug/L	0.2	<0.2	<0.2	<0.2	<0.2	-
3 & 4-Chlorophenol	ug/L	0.3	<0.3	<0.3	<0.3	<0.3	-
2,3-Dichlorophenol	ug/L	0.2	<0.2	<0.2	<0.2	<0.2	-

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Parameter	Units	Detection limit	< 2 mm Coal @ 600 mg/L - 1 WEEK	< 2 mm Coal @ 600 mg/L - 1 WEEK	< 2 mm Coal @ 600 mg/L - 2 WEEK	< 2 mm Coal @ 600 mg/L - 2 WEEK	GVSD&D Restricted waste criteria
			17-Sep-13	17-Sep-13	24-Sep-13	24-Sep-13	
2,4 & 2,5-Dichlorophenol	ug/L	0.2	<0.2	<0.2	<0.2	<0.2	-
2,6-Dichlorophenol	ug/L	0.2	<0.2	<0.2	<0.2	<0.2	-
3,4-Dichlorophenol	ug/L	0.2	<0.2	<0.2	<0.2	<0.2	-
3,5-Dichlorophenol	ug/L	0.2	<0.2	<0.2	<0.2	<0.2	-
2,3,4-Trichlorophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
2,3,5-Trichlorophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
2,3,6-Trichlorophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
2,4,5-Trichlorophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
2,4,6-Trichlorophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
3,4,5-Trichlorophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
2,3,4,5 & 2,3,5,6-Tetrachlorophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
2,3,4,6-Tetrachlorophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
Pentachlorophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
Phenols (chlorinated)	ug/L	-	n/d	n/d	n/d	n/d	50
Phenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
2-Methylphenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
3 & 4-Methylphenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
2,4-Dimethylphenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
2-Nitrophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
4-Nitrophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
2,4-Dinitrophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
2-Methyl-4,6-dinitrophenol	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-

Phenols (non chlorinated)	ug/L	-	n/d	n/d	n/d	n/d	1000
Acenaphthene	ug/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Acenaphthylene	ug/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Acridine	ug/L	0.1	<0.10	<0.10	<0.10	<0.10	-
Anthracene	ug/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Benzo (a) anthracene	ug/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Benzo (a) pyrene	ug/L	0.01	<0.01	0.01	<0.01	<0.01	-
Benzo (b) fluoranthene	ug/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Benzo (g,h,i) perylene	ug/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Benzo (k) fluoranthene	ug/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Chrysene	ug/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Dibenz (a,h) anthracene	ug/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Fluoranthene	ug/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Fluorene	ug/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Indeno (1,2,3-cd) pyrene	ug/L	0.05	<0.05	<0.05	<0.05	<0.05	-
Naphthalene	ug/L	0.3	<0.30	<0.30	<0.30	<0.30	-
Phenanthrene	ug/L	0.1	<0.10	0.17	<0.10	<0.10	-
Pyrene	ug/L	0.1	<0.10	<0.10	<0.10	<0.10	-
Quinoline	ug/L	0.1	<0.10	<0.10	<0.10	<0.10	-
Total PAH	ug/L	-	n/d	0.18	n/d	n/d	50
Benzene	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	100

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			17-Sep-13	17-Sep-13	24-Sep-13	24-Sep-13	
Bromodichloromethane	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
Bromoform	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
Carbon tetrachloride	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
Chlorobenzene	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
Chloroethane	ug/L	2	<2.0	<2.0	<2.0	<2.0	-
Chloroform	ug/L	1	6.2	5.6	6.2	6.5	-
Dibromochloromethane	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
1,2-Dibromoethane	ug/L	0.3	<0.3	<0.3	<0.3	<0.3	-
Dibromomethane	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
1,2-Dichlorobenzene	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	-
1,3-Dichlorobenzene	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
1,4-Dichlorobenzene	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
1,1-Dichloroethane	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
1,2-Dichloroethane	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
1,1-Dichloroethene	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
cis-1,2-Dichloroethene	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
trans-1,2-Dichloroethene	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
1,2-Dichloropropane	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
cis-1,3-Dichloropropene	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
trans-1,3-Dichloropropene	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
Ethylbenzene	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
Methyl tert-butyl ether	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
Methylene chloride	ug/L	3	<3.0	6.8	<3.0	<3.0	-

Styrene	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
1,1,2,2-Tetrachloroethane	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
Tetrachloroethene	ug/L	1	<1.0	<1.0	<1.0	<1.0	50
Toluene	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
1,1,1-Trichloroethane	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
1,1,2-Trichloroethane	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
Trichloroethene	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
Trichlorofluoromethane	ug/L	1	<1.0	<1.0	<1.0	<1.0	-
Vinyl chloride	ug/L	2	<2.0	<2.0	<2.0	<2.0	-
Xylenes (total)	ug/L	2	<2.0	<2.0	<2.0	<2.0	-