FRASER RIVER ACTION PLAN

Technical Pollution Prevention Guide for Dry Bulk Terminals in the Lower Fraser Basin

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TECHNICAL POLLUTION PREVENTION GUIDE FOR DRY BULK TERMINALS IN THE LOWER FRASER BASIN

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Prepared for:

Enviromnent Canada
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ABSTRACT

This guide gives a brief description of the dry bulk terminal sector and identifies environmental issues unique to this industry. It then provides a study methodology to enable plant operators to carry out a disinterested internal review of possible sources of pollution within their own facilities. Lastly, the document offers suggestions to the industry for the development of pollution prevention programs.

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RÉSUMÉ

Ce guide fournit un bref aperçu du secteur des terminaux pour vrac solide et identifie les problèmes environnementaux typiques à cette industrie. II offre ensuite un méthodologie d'étude afin que les exploitants d'installations soient en mesure d'effectuer un examen interne impartial des sources de pollution possibles à l'intérieur de leurs propres installations. Finalement, ce document présente à l'industrie des suggestions concernant l'élaboration de programmes de prévention de la pollution.

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Acknowledgments

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This pollution prevention plan development guide is developed based on pollution prevention and related documents from Environment Canada and United States Environmental Protection Agency. It contains information compiled from several publications including:

Facility Pollution Prevention Guide, United State Environmental Protection Agency, EPA/600/R-92/088, May 1992.

Guide for Best Management Practices for British Columbia Dry Bulk Terminals, BIEAP Technical Report No. 04, Burrard Inlet Environmental Action Program (BIEAP).

Guide of Storm Water Best Management Practices for Selected Industrial Sectors in the Lower Fraser Basin, (Phase 1 Report, Phase 2 Report), Environment Canada.

Reference Workbook: Pollution Prevention Plan, (Draft, December, 1994), Environment Canada.

1º Introduction

In recent years, governments, companies, and individuals have come to accept that minimizing or avoiding the creation of pollutants and wastes can be more effective in protecting the environment than treating them after they have been created. This source control waste management approach is called pollution prevention.

Pollution prevention is not a new idea. Many manufacturers in North America have already implemented programs to minimize the creation of pollutants at the source. In the early 70's, 3M (Minnesota Mining and Manufacturing) initiated the 3P (Pollution Prevention Pays) Program to provide cash incentive to employees for feasible pollution prevention measures.

The shift in emphasis towards adopting pollution prevention measures by the private sector has been prompted by the continuing increases of waste treatment/disposal costs, promulgation of laws and regulations limiting waste disposal options, and civil/criminal liability. Many companies have found that an effective waste management program that effect waste reduction is a sound business practice in today's manufacturing environment. Companies with improved and effective waste management practices are more likely to be low cost producers by:

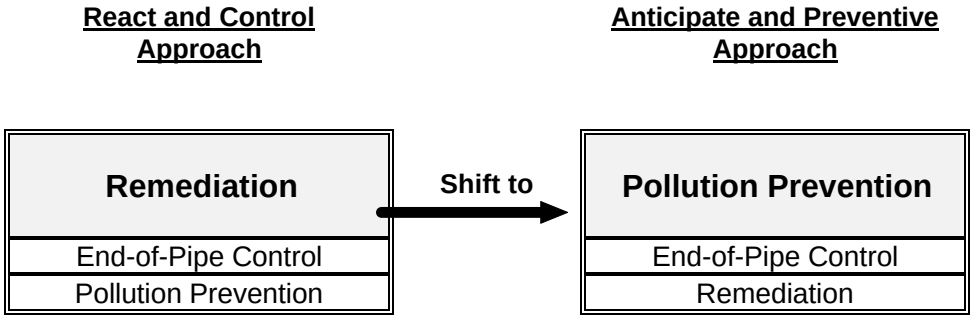
- Minimizing waste treatment costs
- Avoiding expensive disposal costs
- Lowering raw material and/or manufacturing costs.

Many governments have also recognized the positive merits of implementing pollution prevention to minimize the creation of pollutants and lessen the potential threats to human health or the environment. In the United States, environmental regulatory agencies have enacted legislation requiring companies to implement pollution prevention or waste minimization.

Environmental policy in Canada has also begun to shift emphasis from a "control the release of pollutant" policy to pollution prevention. At the federal and provincial levels, strategies are being developed to promote the implementation of pollution prevention practices.

Figure 1.1 presents the environmental protection strategies for the traditional "react and control" approach and the emerging "anticipate and preventive" approach proposed by Environment Canada National Office of Pollution Prevention.

Figure 1.1 Shifting Emphasis for Environmental Protection



As illustrated by Figure 1.1, the environmental protection framework consists of three types of control strategies. These three control strategies are:

- Remediation
- End-of-Pipe Control
- Pollution Prevention.

The traditional "react and control" approach emphasizes the role of remediation in the protection of the environment followed by end-of-pipe control and pollution prevention.

Historically, the react and control approach to environmental protection has been evolved to address the end-of-pipe performance-based environmental regulations imposed by governmental agencies. With the react and control approach, regulated pollutants from pointed source discharges have been reduced substantially. However, large quantities of non-regulated pollutants are still being discharged to the environment posing substantial future environmental liability. Furthermore, the react and control approach failed to control pollutants from non-point pollution sources.

The emerging "anticipate and preventive" approach emphasizes pollution prevention as the predominant strategy for protecting the environment. By avoiding or minimizing the generation of pollutants in the first place, the remaining two strategies, control and remediation, can therefore be de-emphasized.

In November 1993, the Canadian Council of Ministers of the Environment (CCME) confirmed in *A National Commitment to Pollution Prevention* that

"minimizing or avoiding the creation of pollutants and wastes can be more effective in protecting the environment than treating them, or cleaning them up after they have been created. This approach, called *pollution prevention*, is needed to secure a safe and healthy environment and a sound and prosperous economy. It is a key component of environmental protection and sustainable development."

To advance pollution prevention, member governments of CCME have agreed to undertake the following actions:

- Make pollution prevention the priority;
- Develop and implement government action plans for pollution prevention, and encourage the development of action plans by other sectors;
- Review legislation, regulations and policy as appropriate, and harmonize approaches to pollution prevention;
- Test and implement economic instruments that will help achieve pollution prevention;
- Educate the public about pollution prevention, and train relevant groups in the technical aspects of pollution prevention;
- Recognize and promote successful pollution prevention initiatives; and
- Develop practical tools, such as guidelines and codes of practice, to enable people to deliver pollution prevention at an operational level.

In support of the CCME pollution prevention initiatives, the British Columbia Ministry of Environment, Lands and Parks, and the Fraser Pollution Abatement Office have taken steps to encourage industries to reduce pollutants discharged to the environment. To promote pollution prevention among governmental agencies and regulated communities, Environment Canada (Industrial Programs Section, EP, Vancouver) has proposed to develop pollution prevention guides for selected industrial sectors in British Columbia Lower Mainland. These guides are designed to assist plant operators in the development of broad-based pollution prevention programs.

The following guide has been developed for the dry bulk terminal operation in the Lower Fraser Basin.

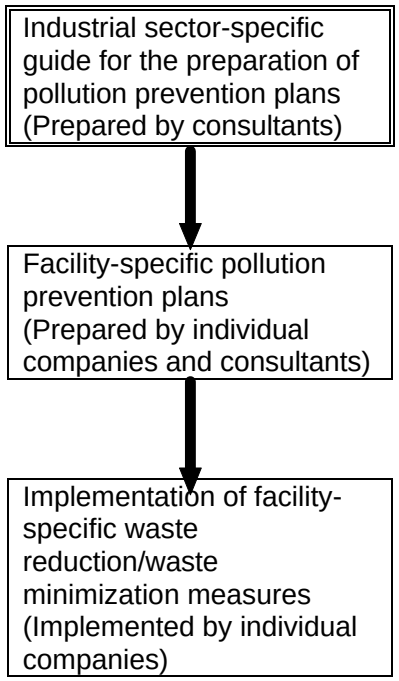
2º Objective

The objective of this guide is to provide bulk terminal personnel with a methodology to develop appropriate pollution prevention plans.

The guide contains detailed process and waste stream information, and waste reduction and waste minimization measures. Using the methodology and information presented in the guide, site-specific pollution prevention plans can be developed for individual bulk terminals. The benefits of the plan would be realized with the implementation of the site-specific waste reduction/minimization measures as developed in the pollution prevention plan.

The basic components of a pollution prevention program is illustrated in Figure 2.1.

Figure 2.1 Relationship of Pollution Prevention Components



3º Pollution Prevention Concept And Benefits

3.1 Definition of Pollution Prevention

Pollution prevention is defined by Environment Canada National Office of Pollution Prevention as:

"The use of processes, practices, materials or energy that avoid or minimize the creation of pollutants and wastes without creating or shifting new risks to communities, workers, consumers or the environment."

As defined, pollution prevention emphasizes source reduction measures for all wastes generated at production areas. It requires a multi-media (air, water, solid waste, and energy) approach which encompasses reduction in air emissions, wastewater discharges, and solid waste. Pollution prevention involves the application of management practices, product changes, and modifications of manufacturing processes that eliminate or reduce the use of hazardous and non-hazardous materials, energy, water, or other resources.

Presented in Table 3.1 are examples of source reduction measures, product changes and process changes, that are classified as pollution prevention measures because they reduce the amount of waste created during production.

Table 3.1 Examples of Pollution Prevention Measures - Source Reduction and Process Changes

Method	Example Pollution Prevention Measures
Product Changes	• Product reformulation and redesign for less environmental impact • Increase product life
Input Material Changes	• Materials or feedstock substitution • Avoid or minimize the use of toxic materials • Substitution with less toxic materials
Technology Changes	• Redesign equipment layout to minimize loses • Change to mechanical stripping/cleaning to minimize solvent usage • Increase automation/improved equipment to improve operating efficiencies • Process/technology modification • Install equipment to reduce energy consumption
Best Management Practices	• Improve operator training • Improve operation & maintenance procedures • Improve housekeeping practices • Eliminate sources of leaks • Improve inventory control to minimize disposal of outdated materials • Implement segregation of flows to minimize cross-contamination and to facilitate reuse and/or recycling

Traditional waste management by end-of-pipe control treats the wastes after they have been generated. It is a single medium approach designed to address performance-based environmental regulations.

Presented in Table 3.2 are examples of the traditional approach to environmental protection that are not pollution prevention measures.

Table 3.2 Examples of Traditional Pollution Control Measures - Not Pollution Prevention Measures

Method	Example Traditional Pollution Control Measures
Recycling Outside of the Waste Generating Process	• Off-site reuse and recycling • Waste exchanges • Off-site reclamation
Waste Treatment	• Physical, chemical, and biological treatment • Evaporation • Incineration • Solidification/stabilization
Disposal	• Discharge to the receiving environment • Discharge through sewers • Landfill • Waste processing facility

3.2 Benefits of Pollution Prevention

With the continuing increase of performance-based regulations, the traditional end-of-pipe single medium approach generally results in increasingly complex treatment technologies that inevitably push up compliance costs. Furthermore, it often simply transfers pollutants from one medium to another. In contrast, pollution prevention can more effectively and efficiently address multi-media impacts by using source reduction measures. Pollution prevention encourages creative pollution control efforts thereby minimizing non-production related capital and operational costs.

By minimizing the amounts of waste generated at the source, a pollution prevention approach leads to many benefits. These benefits include:

- Reduced waste treatment and disposal costs
- Improved business efficiency and profitability
- Improved company image
- Reduced regulatory compliance costs
- Reduced future cleanup costs
- Reduced future risk of liability
- Reduced risk to workers and to the community.

3.3 Environmental Management Hierarchy

Notwithstanding the many benefits inherent in pollution prevention measures, these measures alone will not eliminate all pollution in the environment. Traditional waste management methods are still needed and should not be excluded from a comprehensive environmental protection program.

As such, Environment Canada National Office of Pollution Prevention in the "anticipate and prevent" strategy recognizes pollution prevention a the first step in a hierarchical approach for the protection of the environment. Other waste treatment techniques including recycling, treatment, and disposal are lower in priority.

Table 3.3, presented below, illustrates the priority of pollution prevention within the environmental management hierarchy.

Table 3.3 Hierarchical Structure of Environmental Management

Waste Management Approach	Implementation Priority	Management Method	Example Applications
Pollution Prevention Measures	1 (Highest)	• Source Reduction	• Modify product to eliminate solvent
	2	• On-site Reuse Recycling	• Capture and return vapor to process
Traditional End-of-pipe Treatment Methods	3	• Off-site Reuse Recycling	• Solvent recovery at an off-site facility
	4	• Material and/or Energy Recovery	• Boiler for energy recovery
	5	• Residual Waste Management	• Land disposal

As illustrated by Table 3.3, the highest priorities are assigned to preventing pollution through source reduction and reuse, or closed-loop recycling. Other non-pollution prevention measures such as traditional end-of-pipe treatment methods are ranked lower in the implementation priority.

4º Industry Profile

4.1 Industry Description

The dry bulk terminal operations contain facilities classified under the Standard Industrial Classification (SIC) codes 4711 (Grain Elevator), and 4551 (Marine Cargo Handling Industry). These establishments primarily engaged in activities directly related to marine cargo handling from the time cargo arrives at shipside, dock, pier, terminal, staging area, or in-transit area until cargo loading or unloading operations are completed. Included in this industry are establishments primarily engaged in the transfer of cargo between ships and barges, trucks, trains, pipelines, and wharves. Dry bulk terminal operations are included in these two industrial categories.

In the Lower Fraser Basin, the Port of Vancouver is comprised of twenty-eight (28) cargo and marine related terminals. Most are located in the inner harbour, extending from the Lion's Gate Bridge, and encircling the north and south shore of Burrard Inlet. These terminals handle close to 3,000 foreign vessel calls each year from 90 nations. Most facilities are privately owned and most operate on land leased from the Vancouver Port Corporation.

Among the 28 cargo and marine related terminals in the Lower Fraser Basin, six (6) terminals handle gains and five (5) terminals handle a wide range of dry bulk materials.

Table 4.1 provides a listing of the grain elevators and dry bulk terminals and the types of commodities handled.

Table 4.1 Grain Elevators and Dry Bulk Terminals in the Lower Fraser Basin

SIC	Classification	Terminals	Commodities
4711	Bulk Terminals: Agricultural	Alberta Wheat Pool Foot of Cassiar Vancouver, B.C.	Handles and cleans grains
		Saskatchewan Wheat Pool 801 Low Level Road North Vancouver, B.C.	Handles and cleans grains
		United Grain Growers Foot of Vernon Vancouver, B.C.	Handles and cleans grains
		Pioneer Grain Terminal Ltd. 375 Low Level Road North Vancouver, B.C.	Handles and cleans grains
4711	Other Cargo Facilities	Coastal Containers 2525 Commission Street Vancouver, B.C.	Specializes in transferring specialty grains from trucks and rail cars to containers for export
		Columbia Containers Ltd. 2775 Commission Street Vancouver, B.C.	Specializes in transferring specialty grains from trucks and rail cars to containers for export
4551	Bulk Terminals: Coal	Westshore Terminals Ltd. Roberts Bank Delta, B.C.	Largest coal handling facility on the North American west coast
		Neptune Bulk Terminals Canada Ltd. 1001 Low Level Road North Vancouver, B.C.	Handles coal, potash, feed pellets, chemical fertilizer, canola oil, and phosphate rock
4551	Bulk Terminals: Mineral	Pacific Coast Terminals 2701 Esplanade Street Port Moody, B.C.	Handles sulphur, ethylene glycol and styrene monomer
		Vancouver Wharves Ltd. 1995 West 1st Street North Vancouver, B.C.	Handles sulphur, potash, pulp and paper, ore concentrates and methanol
4551	Forest Product Terminals	Fibreco Export Inc. 1209 McKeen Avenue North Vancouver, B.C.	Largest woodchip terminal in North America

4.2 Dry Bulk Materials

As shown in Table 4.1, bulk terminals in the Lower Fraser Basin handle a wide variety of commodities. The chemical and physical characteristics of these materials, especially flowability, abrasiveness, friability, lump size, and corrosiveness may dictate the material handling practices and environmental management practices at the terminals. For example, moisture or oxidation effects from exposure to the weather may degrade product quality thus requiring enclosed conveying and storage. Corrosive characteristics may dictate the structural materials for conveying and storage.

Table 4.2 summarizes the commodity characteristics important in material handling

Table 4.2 Dry Bulk Commodity Characteristics

Commodity	Characteristics											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Urea	1	Fine/Granular	43-46	Free	Non	Yes	Very	Mildly	Yes	No	No	No
Potash	1	Fine/Granular	70-75	Free	Non/Mildly	Yes	Very	Very	Yes	No	Y/N	No
Fertilizer	2	Granular	50-55	Free	Non	No	Very	Mildly	Yes	No	No	No
Alfalfa Pellets	2	Granular	41-43	Free	Non	Yes	No	No	Yes	No	No	No
Grains	2	Fine	45-50	Free	Mildly	Yes	No	No	Yes	Yes	Yes	No
Wood Chips	2	Irregular	10-30	Sluggish	Non	No	Very	No	Yes	Yes	Yes	Yes
Coal	3	Granular	45-55	Free	Non	No	No	Mildly	Yes	Yes	No	No
Sulphur	3	Granular	50-60	Free	Non	No	No	Very	Yes	Yes	No	No
Phosphate Rock	3	Lumpy	75-85	Free	Mildly to Very	No	No	No	Yes	No	No	No
Metal Concentrates	4	Fine	70-150	Free	Very	No	No	Mildly	No	No	No	No
Cement Aggregates	5	Granular	90-100	Free	Mildly	No	No	No	No	No	No	No
Salt (Coarse)	5	Granular	45-55	Free	Average	Yes	Very	Very	Yes	No	No	No

1. Sub-Category (Type)
2. Size
3. Average Bulk Density (lb/ft3)
4. Flowability
5. Abrasiveness
6. Contaminable & Degradable
7. Hygroscopic
8. Corrosive
9. Dust or Fume Emissions
10. Explosive Dust
11. Very Light and Fluffy (may be wind swept)
12. Interlock or Mat to Resist Digging

The commodities have been classified in terms of the dry bulk commodity categories identified in the *Best Management Practice Guide for British Columbia Dry Bulk Terminals.* This commodity classification allows the evaluation of wastewater/storm water treatment processes in terms of the limiting pollutant parameters in the effluent.

For the commodities under consideration, the effluent pollutant parameters of concern are:

- pH
- Solids (dissolved, colloidal, non-colloidal)
- Biochemical Oxygen Demand (BOD_5)
- Ammonia nitrogen
- Metals (dissolved).

By treating and/or controlling the limiting pollutant parameter in the effluent, it is anticipated that other pollutants will be in compliance with the permit conditions or will be in compliance with only minor process modifications.

The following table, Table 4.3, summarizes the dry bulk commodities on the basis of the effluent pollutant parameters.

Table 4.3 Categories for Dry Bulk Commodities

Commodity Sub-Categories (Type)	Products
1. Agricultural Commodities (Low Suspended Solids)	Urea Potash
2. Agricultural Commodities (High Suspended Solids)	Fertilizers Alfalfa Pellets Grains Wood Chips
3. Industrial Commodities (Low Dissolved Metals)	Sulphur Coal
4. Industrial Commodities (High Dissolved Metals)	Mineral Concentrates
5. Industrial Commodities (Miscellaneous)	Cement Aggregates Cement Salt

4.3 Process/Handling Operations

The general operations of bulk terminals include:

- Unloading - Bulk commodities arrive at the terminal in rail cars, trucks, barges, or ships. When possible, some commodities are loaded directly to waiting vessels.
- Conveying/Storage - After unloading, depending on the properties of the materials, requirement for weather protection, and the environmental requirements, the commodities are stored in either closed or covered areas, storage tanks, or in open stockpiles.
- Loading - From the storage area, the commodities are transferred to waiting vessels, barges, trucks, or rail cars.

Figures 4.1 - 4.5 outline the typical process flow schematics for the bulk commodities being handled by dry bulk terminal operations in the Lower Fraser Basin.

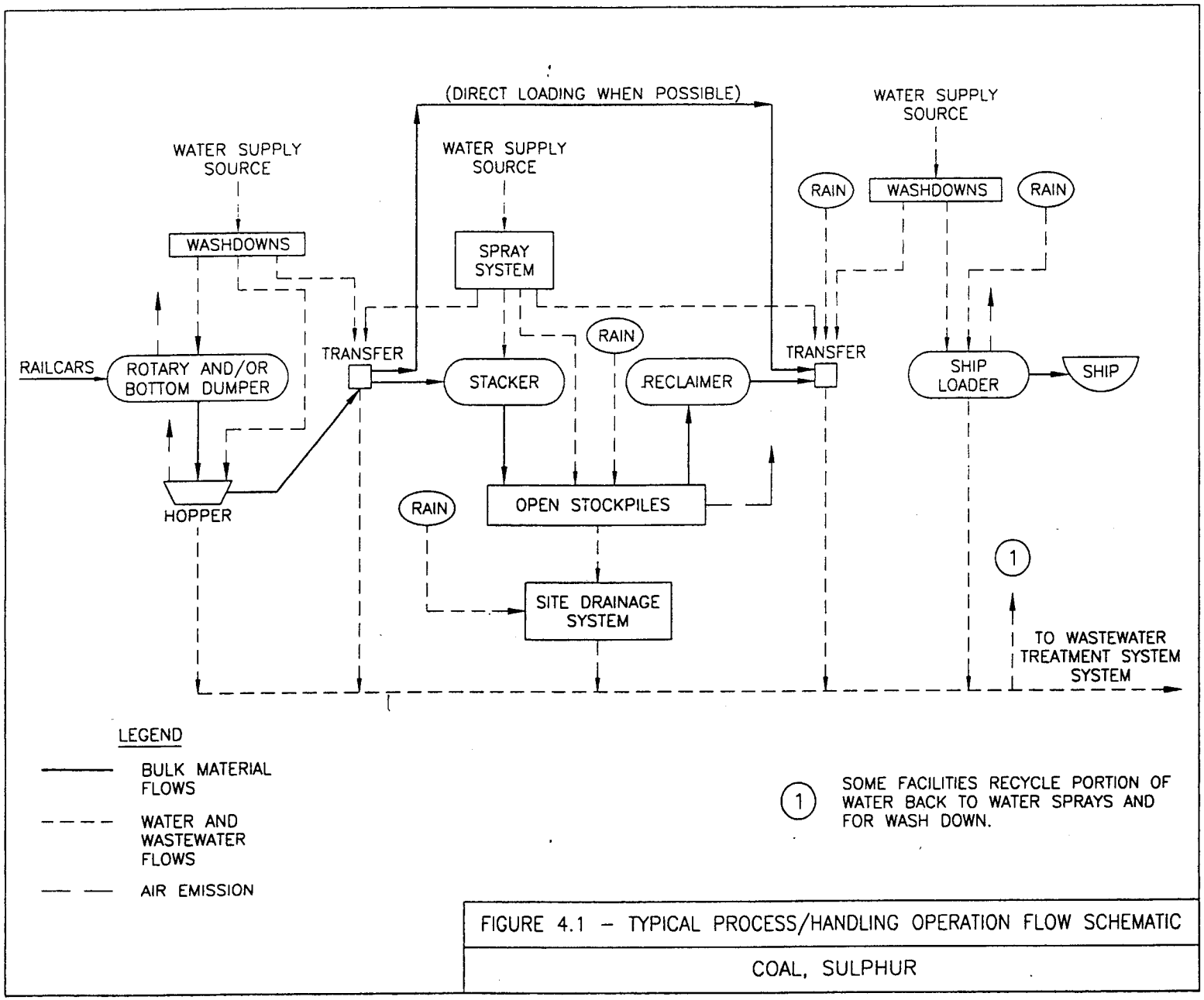


FIGURE 4.1 – TYPICAL PROCESS/HANDLING OPERATION FLOW SCHEMATIC

COAL, SULPHUR

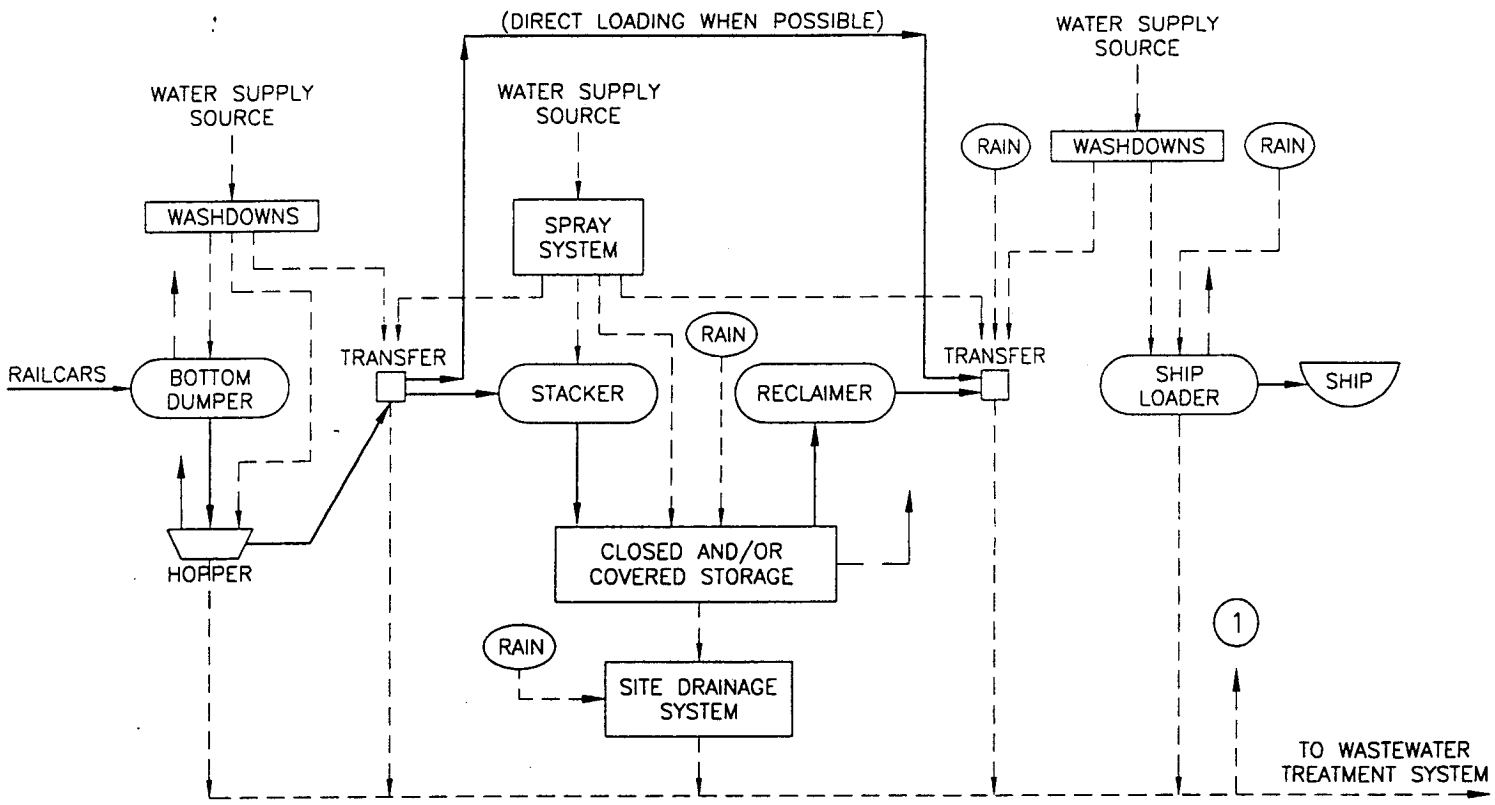


FIGURE 4.2 – TYPICAL PROCESS/HANDLING OPERATION FLOW SCHEMATIC

ALFALFA PELLETS, FERTILIZER, UREA, POTASH

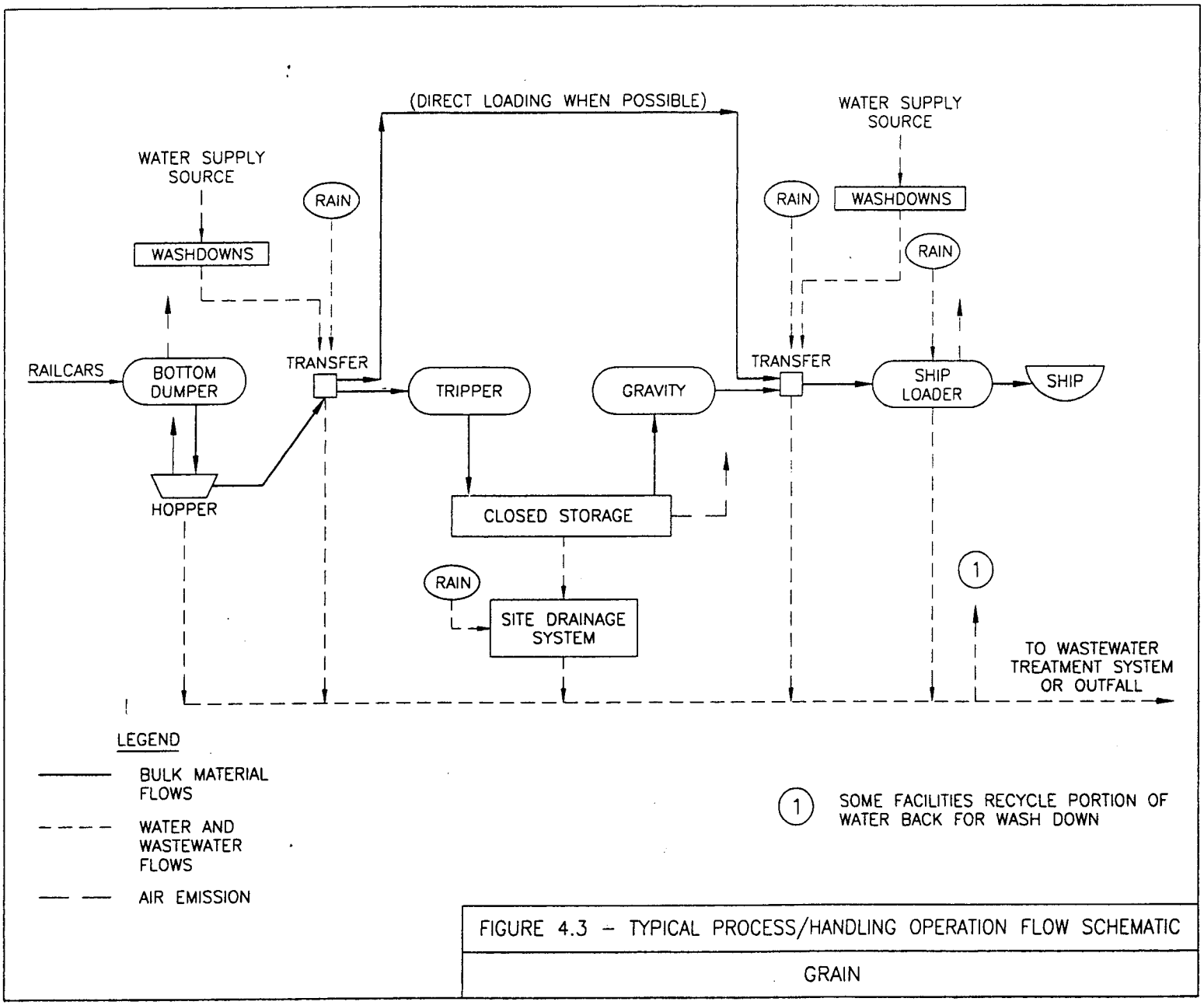


FIGURE 4.3 – TYPICAL PROCESS/HANDLING OPERATION FLOW SCHEMATIC

GRAIN

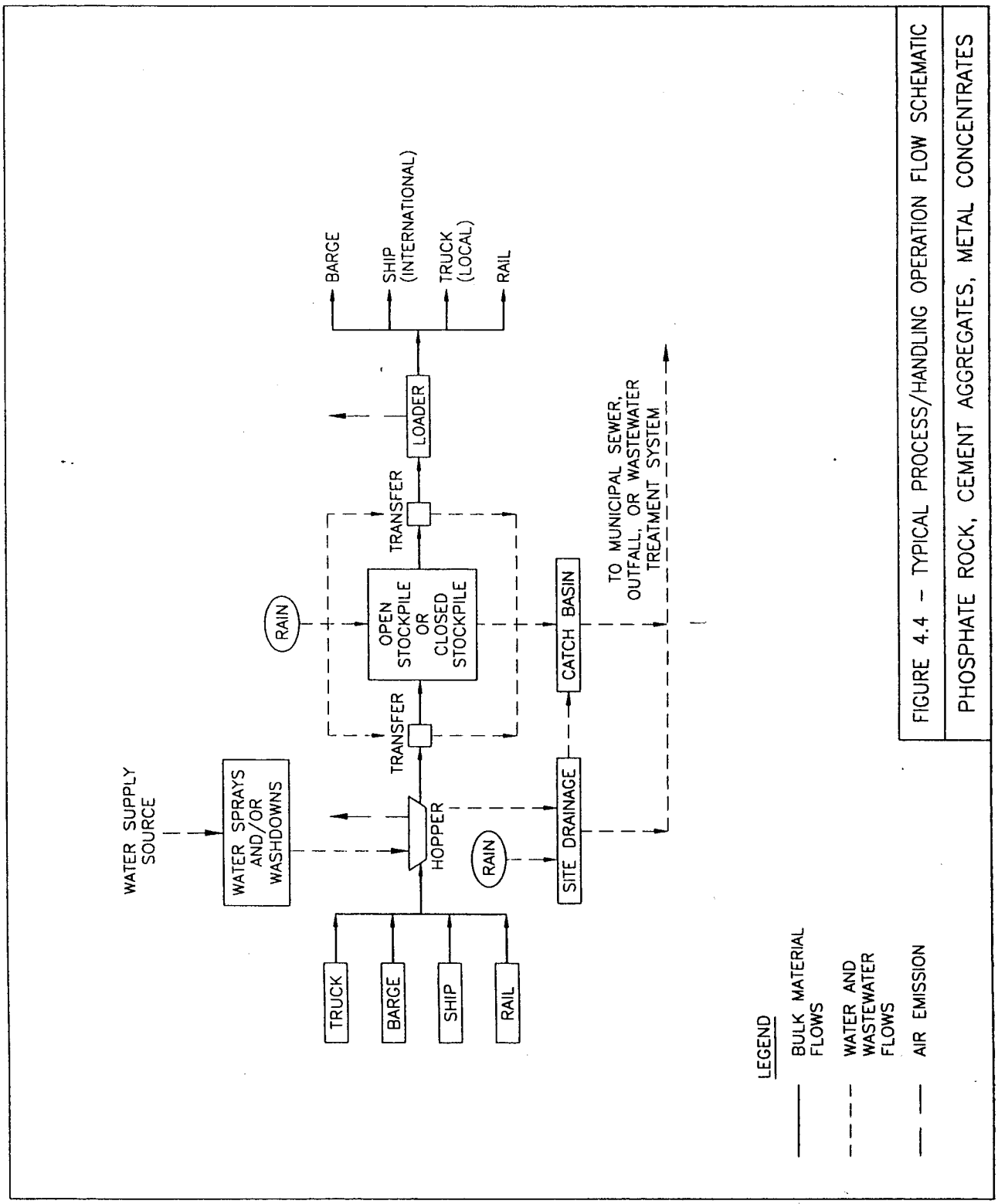


FIGURE 4.4 – TYPICAL PROCESS/HANDLING OPERATION FLOW SCHEMATIC

PHOSPHATE ROCK, CEMENT AGGREGATES, METAL CONCENTRATES

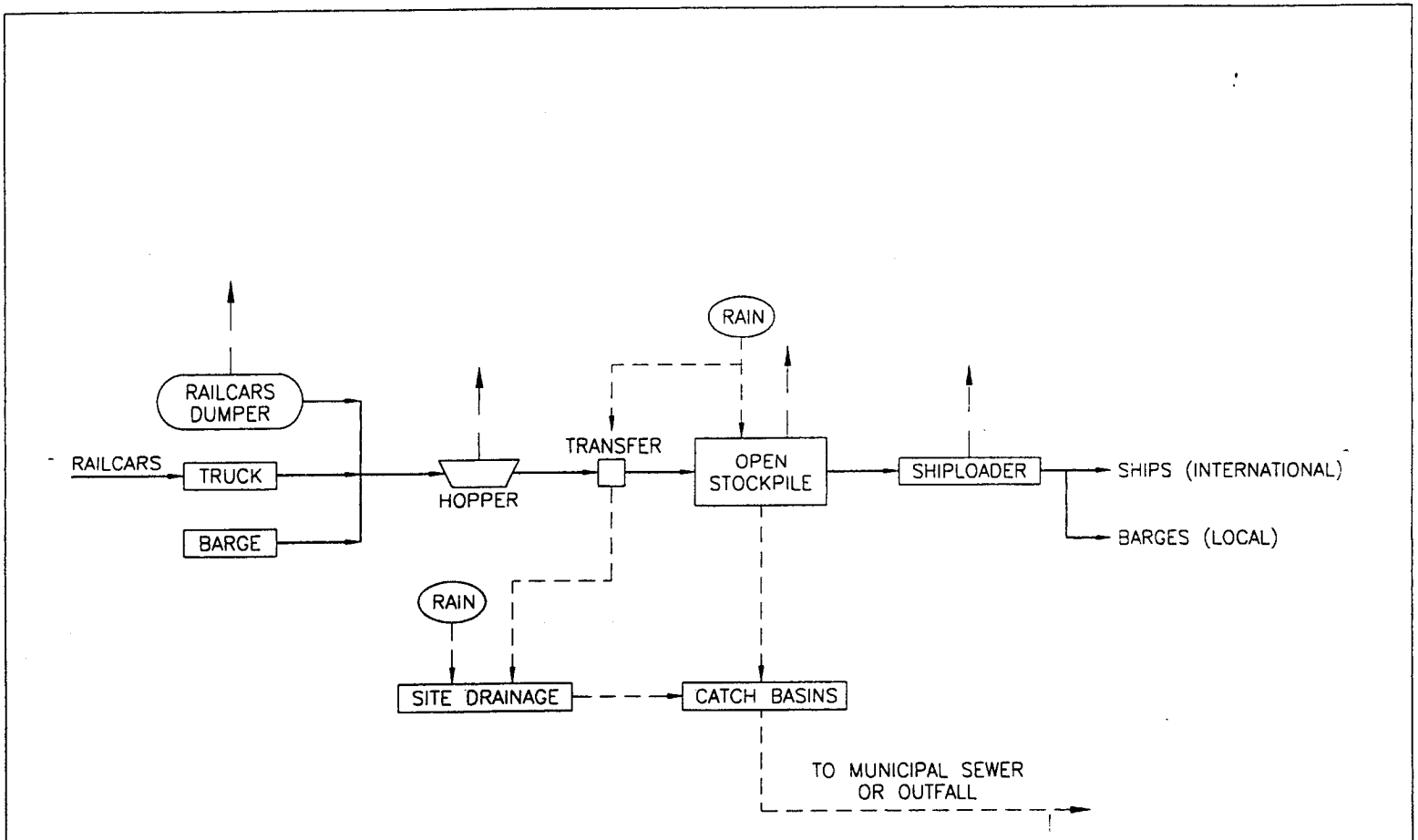


FIGURE 4.5 – TYPICAL PROCESS/HANDLING OPERATION FLOW SCHEMATIC

WOOD CHIPS

4.3.1 Transportation

Commodities arrive in a number of different forms and modes of transport, the most common being:

- Railcars
- Trucks
- Barges
- Ships.

The choice of transport depends on market requirements and economics.

Bulk containers may either be open or closed. Generally the effect of the weather on the commodities governs the choice. For example, high value commodities such as metal concentrates which are relatively resistant to weathering may be shipped in open containers. In contrast, low cost items such as Portland cement which must be protected from the elements must be shipped in closed containers.

In addition to the effect of the weather on the products, the product physical properties will determine the suitability of containers. These physical properties include:

- Ease of flow
- Corrosiveness
- Sensitivity to contamination.

Railcars

Typically, the majority of commodities being shipped through a bulk terminal arrive in railcars. There are three basic designs:

- Covered with bottom unloading ports
- Open with bottom unloading ports
- Open without unloading ports.

Table 4.4 presents the most common railcar designs:

Table 4.4 Railcar Designs

Rail Cars	Characteristics	Commodities
Gondola Cars	Open or with removable covers Used on long routes Used for materials that do not flow easily from hopper bottom cars For products that must be kept dry or are hygroscopic and can present a dust problem during transport Preferred in cold climates where the bulk commodities can freeze in the cars and will not flow during unloading	Coal Sulphur Mineral Concentrates
Special Gondola Cars	Rear swinging gates	Wood chips
Hopper Cars	Bottom dump gates Appropriate for products that have good flow characteristics and are not subject to clogging Higher initial capital costs than gondola cars and higher operating and maintenance costs associated with the dump gates	Coal Aggregates Coarse ore
Tank Cars	Bottom dump gates	Grains Potash Fertilizers

4.3.2 Unloading

Equipment selection is determined by:

- Type of vehicle used in transport
- Compatibility of the product with other products stored at the terminal
- Throughput of the product.

The following types of unloading equipment are used in the Lower Mainland.

Dumpers

Rotary Dumpers

Rotary dumpers can be designed to handle unit trains and/or individual rail cars.

A unit train rotary dumpers inverts railcars singly or in pairs. The dumpers rotates the cars about their couplings making it possible to empty the rail cars without disconnecting them from the rest of the train. A clamp holds the railcar in place as it is inverted over a receiving pit. From the pit, the product is fed onto conveyors and into the next processing step.

A random car rotary dumper inverts rail cars singly or in pairs after they have been disconnected from the train.

Rotary dumpers are used for gondola rail cars at facilities that have significant throughput of either a single product or compatible products.

The rotary dumper is typically located in an enclosed building to protect the equipment and to contain dust created during dumping.

The complete train or set of rail cars generally moved through the dumper by mechanical positioners (indexers) controlled by the dumper operator.

Bottom Dumpers

Bottom dumping is used for hopper bottom rail cars and road trucks. The vehicle is positioned over the pit and the gates are opened either manually or mechanically allowing the product to flow into the hopper and onto the next process step. Vibrators are often provided to initiate flow through the gates.

End Dumpers

End dumpers can be used for dumping special gondola cars with swinging end doors located and also for standard road trucks. The vehicle is positioned on the dumpers and held in place while one end of the dumper unit is raised. The product is collected in an appropriately located receiving hopper and onto the next process step.

Grab Unloading Equipment

Grab Bucket Unloader

Grab unloaders utilize grab buckets hoisted by cranes or other lifting equipment which remove the product from the carrier and move it to a receiving hopper. These types of unloading systems can generate significant spillage if not maintained and operated correctly. Product spillage may be minimized by providing regular equipment maintenance and by locating the unloading point near the receiving point.

Spillage on land can be contained on land by providing impermeable pavement and curbing. Transferring the product over water requires the provision of drop sheets or spill trays. The drop sheets and spill trays must be checked regularly to remove excessive build up of bulk products which can cause structural failure and/or spillage of the collected material.

Dust emissions are hard to contain because bucket type unloaders are not located in an enclosed structure. Available dust control measures are dust collection and dust suppression in the receiving hopper.

Ship Gear

Ships gears are defined as on-board lifting devices. Grabs hoisted by ship gear can be used to transfer products from the holds into hoppers located on the dock. Similar to shore based grab unloaders, spillage and dust emissions can be a problem.

Continuous Unloading Equipment

Continuous unloaders are used to unload barges and ships. Although, must less common, they can also be used to unload rail cars or trucks.

Continuous unloading equipment has less spillage than the grab unloaders because the unloaders remain located over the commodity source and feed an enclosed conveyor.

Bucket Wheel Unloaders

Bucket wheel unloaders are used for unloading products such as ores and coals from barges and ships. The product is picked up by buckets attached to the outer rim of a rotating wheel and transferred to a bucket elevator or other elevating device contained in a vertical leg leading up to the unloading boom. Conveyor systems transport the product from the vertical leg to its destination.

Dust emissions from the bucket wheel system will occur at the transfer locations. Spillage occurring at the bucket wheel is not of concern as the material will fall back onto the pile. Spillage at the transfer locations and under the conveyor belt.

Bucket Elevator Unloaders

Bucket elevators operate on a principle similar to bucket wheels and can be used to unload similar products. A single bucket elevator is used to reclaim the product and elevate it to the boom conveyor.

Dust emission and spillage potential for bucket elevator unloaders is similar for bucket wheel unloaders.

Screw Unloaders

Screw unloaders utilize an auger positioned inside a pipe to reclaim and lift the product to the boom conveyor. Screw unloaders are typically used for unloading products with smaller grain sizes from trucks, rail cars, barges, or ships.

Dust emission and spillage are minimal as system are enclosed.

Pneumatic Unloaders

pneumatic unloaders are used for unloading powders, e.g., cement and grains. Pneumatic unloaders can be used for unloading trucks, rail cars, barges or ships. The product is picked up by vacuum and carried to a storage or transfer point where the product is discharged.

Dust at the discharge area is a concern since air must be allowed to escape without carrying any suspended particles with it. Cyclones, scrubbers and baghouses are commonly used to remove suspended solids from the air discharge.

Self Unloading Carriers

Self unloading ships and barges are also used for bulk products. Products are reclaimed inside the carrier by gravity or mechanical means and transported to the ship side via conveyors. Product is generally transferred directly to a shore based receiving hopper and conveyor system.

Mobile Equipment

Mobile equipment can be used to unload from rail cars, trucks and barges. In addition to unloading, it can also be used to perform other functions within the terminal. However, it can generate significant amounts of spillage and dust.

Front End Loaders

Front end loaders are used for unloading barges and rail cars. When unloading barges, the loader must drive down a ramp onto the barge and scoop up product. The loader then reverses up the ramp to the receiving point. Unloading rail cars is done in a similar manner.

Backhoes

Concentrate gondola cars are unloaded by backhoes located above the rail line and transfer the product to receiving hoppers.

4.3.3 Conveying

Commodities arriving at a dry bulk terminal must be transferred from the receiving area to a point where it can be stored, utilized, or transferred to the next transport vehicle. This is typically done by a system of conveyors.

Belt Conveyors

Belt conveyors are used to convey most of the commodities handled by terminals in the Lower Fraser Basin. Belt conveyors are commonly used to convey large volumes of materials and large travel distances. A belt conveyor consists of a flexible belt supported on rollers and is typically powered by an electric motor. The electric motor transmits power to the conveyor belt through a pulley or series of pulleys normally located near the head of the conveyor. Conveyor belts are generally made of a rubber compound matrix reinforced with either fabric or steel cord.

Screw Conveyors

Screw conveyors or augers are used for moving smaller volumes of material over relative short distances. They are used primarily for relatively free flowing commodities such as grain and hogfuel.

Pneumatic Conveyors

Pneumatic conveyors are used for handling fine dry products such as cement, wood chips, and grain. The handling rates are low when compared to the capacity of belt conveyors.

4.3.4 Storage and Reclaim

Depending on the volumes handled, material characteristics, and the environmental requirements, commodities may be stored in open, covered or enclosed piles, or placed in storage silos awaiting shipment.

Open Storage Piles

For commodities which can be stacked in the open, a combination of stackers, reclaimers, or stacker/reclaimers are used to form and reclaim storage piles. Storage piles for some commodities such as wood chips are formed by flingers or blowers. Open stockpiles are susceptible to wind and rain. Controlling dust emissions and water runoff are the primary concerns.

Front end loaders or bulldozers are used to form or increase the size of storage piles and during reclaim.

Covered and Enclosed Storage Piles

Covers or enclosures are used to store commodities requiring protection from wind and rain. Enclosed storage piles are typically stacked from conveyors running under

the roof of the structure. For large stockpiles, scrapers reclaimers, gravity feeders, and front end loaders are also used to reclaim the product. Front end loaders or gravity feeders are used to reclaim small enclosed storage piles.

Silos

Silos are used for commodities that have good flow characteristics and will not hang up during reclamation. Commodities stored in silos are delivered by conveyor systems and are reclaimed either by gravity feeders located at the based of the silo.

4.3.5 Loading for Transport

Trucks, trains, barges and ships are all used in transporting commodities from dry bulk terminals.

4.3.6 Current Material Handling Practices

Table 4.5 summarizes the current practices and operational approaches utilized by terminals and industrial operations in the handling of the listed dry bulk commodities.

Table 4.5 Current Material Handling Practices for Terminals in the Lower Fraser Basin

Commodity	Type	Material Handling Practices	
Urea	1	Transport:	Rail cars
		Unloading:	Bottom dump tank cars
		Storage:	The material is hygroscopic and tends to set up over time. Generally the product bypasses storage and is transshipped directly
		Loading:	Shiploader
Potash	1	Transport:	Rail cars
		Type:	Red - Mined, contains iron, granular (mixtures of red and white particles) White - Manufactured powder
		Unloading:	Bottom dump, tank cars into receiving hoppers and utilizes belt conveyors to storage
		Storage:	Red - Enclosed, A-frames or silos White - Enclosed silos due to dust, low angles of repose and high flowability
		Loading:	Shiploader
		Dust Control:	White - Dust collection systems and dust control at shiploader
		Concerns:	Corrosion problem if it is wet White - Corrosion of steel structures Potash handling system is usually made of wood to avoid corrosion Cross contamination of the white potash with red potash
Fertilizer	2	Transport:	Rail cars
		Unloading:	Bottom dump, tank cars into receiving hoppers and utilizes belt conveyors to storage
		Storage:	Enclosed silos
		Loading:	Shiploader
		Dust Control:	Dust collection systems and dust control at shiploader

Table 4.5 Current Material Handling Practices for Terminals in the Lower Fraser Basin

Commodity	Type	Material Handling Practices
Agricultural Products	2	Types: Peas, lentils, alfalfa pellets, corn, etc. Transport: Trucks or covered rail cars Storage: No on-site storage, products transshipped directly to waiting vessels Loading: Shiploader, mobile equipment, fixed conveyor, or pneumatic system Dust Control: Can not utilize moisture suppression Conveying systems must account for special physical properties. For example, peas tend to roll back and spill off the belts Concerns: High conveyor transfer heights and long drops into ships cause product degradation Conveying capacities limited by product characteristics
Grains	2	Transport: Rail cars Unloading: Bottom dump tank cars and received through hoppers below track level Grain is sampled and weighted upon arrival, reducing handling rates Conveying: Elevators Storage: Traditionally stored in concrete silos, can also stored in steel silos Loading: Shiploader, high spout, silo/gravity, fixed conveyor, or pneumatic system Dust Control: Dust generation is a major concern and is controlled by collection rather than suppression Dust is collected by air suction and baghouses Explosion hazard exits when dust concentrations exceed specific levels
Wood Chips	2	Transport: Rail cars, trucks and barges Unloading: Mobile equipment, gravity, grab, or rotary dumper Storage: Open stockpiles Loading: Pneumatically by belt or drag conveyor or by mobile equipment Utilize trimmers or flingers for vessel loading to distribute the product within the hold Pneumatic systems are expensive to operate and are generally used less frequently in most modern systems
Coal	3	Transport: Open gondola rail cars Unloading: Rotary dumpers Storage: Open stockpiles Reclaim: Bucket wheel stacker reclaimers, bulldozer Loading: Shiploader Dust Control: Crusting agents are used to prevent dust emissions during transport Water is used for dust suppression Spill collection at shiploader to prevent coal dropping into water
Sulphur	3	Transport: Open top gondola rail cars Unloading: Rotary dumper Storage: Open stockpiles Loading: Shiploader Dust Control: Foam and water sprays Wet scrubbers for dust collection; sulphur dust is potentially explosive
Phosphate Rock	3	Transport: Ships Unloading: Utilizes ships gear into shore-based hoppers Storage: Enclosed storage Loading: Silo/gravity, mobile equipment, or fixed conveyor system
Mineral Concentrates	4	Transport: Ships, rail cars, and trucks Unloading: Rail car unloading by backhoes Trucks unloading by bottom dumping Vessels unloading by grab unloader Storage: Enclosed storage, A-frame structures utilizing overhead trippers Loading: Shiploader, mobile equipment, or fixed conveyor system Reclaim: Mobile equipment Dust Control: Water is used for dust suppression

Table 4.5 Current Material Handling Practices for Terminals in the Lower Fraser Basin		
Commodity	**Type**	**Material Handling Practices**
Cement	5	Transport: Ships, barges, trucks Unloading: Self-unloading tank trucks, ships, and barges Conveying: Sealed pneumatic conveyors Enclosed belt conveyor Storage: Enclosed silos Loading: Silo/gravity, fixed conveyor, or pneumatic system Dust Control: None for enclosed system
Cement Aggregates	5	Transport: Ships, barges, trucks Unloading: Self-unloading barges End-dump trucks Storage: Open stockpiles Loading: Silo/gravity or fixed conveyor system Dust Control: Water is used for dust suppression
Salt (Coarse)	5	Transport: Ships and barges Unloading: Utilize either grab unloaders, self-unloading ships, or mobile equipment Storage: Open stockpiles Loading: Mobile equipment or fixed equipment Dust Control: Not a problem Concern: Equipment must be designed and maintain to minimize corrosive

4.4 Pollutants

The commodities handled by different bulk terminals vary widely. The type and quantity of pollutants produced vary both with the size of the terminal and the commodity. In general, the major pollutants from dry bulk terminal operations are:

- Fugitive dust
- Commodity spillage
- Oil, lubricant, chemical spillage
- Wastewater/storm water.

4.4.1 Fugitive Dust

Wind blown dust from stockpiles of bulk materials during dry and windy weather is a major problems in some terminals. Fugitive dust emissions may affect air qualities in surrounding areas. Settled dust, if not recovered, may ultimately affect the water quality in the receiving water.
Dust is generated throughout the material handling operation, from:

- Loading/unloading
- Conveying
- Stacking/reclaiming
- Storage.

Among these sources, the largest amount of dust is generated from wind erosion of open storage piles.

Dust emissions may be classified into:

- Diffuse sources
- Point sources.

Diffuse sources include drifting from open storage piles, transport installation, and emissions due to leakage. Dust from diffuse sources show scattering of particle sizes.

Point sources consist of discharges from exhaust fans and air emission control systems. Dust particles from point sources are relatively small with limited scattering.

4.4.2 Commodity Spillage

Similar to fugitive dust emissions, spillage occurs throughout the material handling operation. Spillage is an inherent problem of belt conveyors where large amount of spillage occurs at conveyor transfers and hoppers, and along the length of conveyor belts.

Spilled materials on the ground, if not removed, are flushed into storm or wastewater sewers during rain storms.

Dripping and spills from conveyors that are above open water and shiploaders may be significant sources of contaminants in the receiving water and/or the sediment.

4.4.3 Oil, Lubricant, Chemical Spillage

Most dry bulk terminals maintain a fueling station and a machine shop to service vehicles and equipment. Hazardous chemicals, such solvents and caustic may also be stored/used for the repair shops and/or waste treatment purposes. Spilled lubricants and chemicals, if not properly collected, are flushed into storm or wastewater sewers during storm events.

4.4.4 Wastewater/Storm Water

Wastewaters are generated from washdown of transfer systems, transfer area and from air emission control systems. Wastewaters generated are either discharged to the city sewers or to on-site treatment plant.

In a bulk terminal where the material handling equipment is outside and not protected from the weather, settled dust and spilled materials are flushed by storm water into the collection system. Depending on the storm water management practice implemented at the terminal, the contaminated storm water may be treated prior to discharging to the receiving water. In addition to dust and spillage, open storage pile is another source of contaminants in the storm water.

The wastewater/storm water characteristics are dependent on the dry bulk materials handled at the terminal. For the dry bulk materials considered in this report, the pollutant parameters of concern are:

- pH
- Solids (dissolved, colloidal, non-colloidal)
- BOD_5 (total, dissolved)
- Ammonia nitrogen
- Metals (dissolved)

Table 4.6 presents a summary of the dry bulk commodity wastewater/storm water characteristics.

Table 4.6 Dry Bulk Commodity Wastewater Parameter Matrix

		Solids			BOD_5		Metals	
Commodity	**pH**	**Dissolved**	**Colloidal**	**Non-colloidal**	**Total**	**Dissolved**	**Total**	**Dissolved**
Agricultural								
Urea	high	high	low	low	low	low	high	low
Potash	high	high	low	low	N/A	N/A	low	low
Fertilizers	high	high	high	high	N/A	N/A	high	low
Special Agr. Products	N/A	high	high	high	high	low	N/A	N/A
Grains	N/A	high	high	high	high	low	N/A	N/A
Wood Chips	low	high	low	high	high	high	N/A	low
Industrial								
Sulphur	low	low	high	high	N/A	N/A	low	low
Coal	low	low	high	high	N/A	N/A	low	low
Mineral Concentrates	low	high	high	high	N/A	N/A	high	high
Cement Aggregates	high	low	high	high	N/A	N/A	low	low
Salt	high	high	low	low	N/A	N/A	low	low

N/A - Not Applicable

4.5 Air Pollutant and Wastewater Controls

Dry bulk terminals have implemented various control and treatment systems for the control of air pollutant emissions and wastewater pollutant discharges. The following sections describe the various air and wastewater management methods for dry bulk terminal operations.

4.5.1 Prevention and Control of Dust Emission and Spillage

Dust emissions and spillage can be controlled by:

- Prevention
- Control
- Suppression.

1. Dust Prevention

Conveyor belt cleaning systems are used to minimize dust generation and spillage of materials at transfer points.

Belt Scrapers

Belt scrapers are used to remove material that has adhered to the conveyor belt once the belt has past the discharge point. Belt scraper blades are fabricated out of a number of different materials including stainless steel, rubber, plastics, and ceramics. The material used is governed by the properties of the commodity being handled and the speed of the conveyor belt.

Air Knives

Air knives are an alternative to conventional scraper blades. They are used to dry the belt and to remove loose wet material from conveying wet products. Air knifes requires a high volume blower or connection to compressed air.

Rotary Belt Cleaners

Rotary belt cleaners work on the same principle as air knifes but make use of an air turbine located under the return belt to blow compressed air directly onto the belt. Air expanding out of the pressure zone creates air streams that remove the material from the belt.

Brushes

Stationary and rotary brushes are used to remove material from conveyor belts. Different bristle types are used depending on the properties of the material being removed.

Belt Washing

Belt washing is used in combination with belt scrapers/brushes for the removal of material from conveyor belts. Although belt washes maintenance is relatively high, it is used in situation where spillage must be kept to an absolute minimum.

Steam Washes

Steam washes are used to clean belts before switching to another product. Steam is blasted onto the belt loosening material adhering to the belt. Rotary brushes are used to remove any loosened material from the belt.

Belt Turnovers

Belt turnovers are used on the return belt runs of long conveyors to remove material adhered to the return belt. The belt is run through a series of rollers arranged in a spiral configuration along the axis of the conveyor rotating conveyor return belt until it is inverted. At the tail end of the conveyor, a similar system returns the belt to its original position.

Belt Treatments

Belt treatments are used in combination with scrapers and belt washes on conveyor belts that carry sticky products. They are applied to the belt to reduce the amount of material adhering to the return side of the belt.

Collecting Devices and Enclosures

Collecting devices are used under belts where it is not possible or practical to remove the material from the return conveyor belt. These devices cover a wide range of devices including flat pans located under the main or return belt run and conveyors beneath the return run to pick up the spillage.

Pans are typically located just below the return idlers and collect material falling from the conveyor belt. Material collected on the are removed by water sprays to sumps located along the conveyor.

Spillage conveyor is located beneath the primary conveyor to catch any spillage and redirect them back to the material flow. The spillage conveyor does not need to extend the full length of the primary conveyor because the majority of spillage occurs near the head end of the belt.

Conveyor enclosures are used for conveyors carrying dusty or moisture sensitive material or those exposed to high winds. Spillage from the conveyor is contained and is cleaned up by hosing down or vacuuming the interior of the conveyor tube or enclosed gallery.

2. Dust Control

Dust control systems are used to control dust emissions for compliance with standards or limits. The control system is usually designed to provide time for the dust to settle without having it escape. Air suctions are placed at null points in the building where air is drawn only carrying a minimum amount of dust. This design requires a smaller filtration system and also lowers the internal air pressure causing a net inflow of air, reducing fugitive dust emissions.

The type of air emission control system is determined by the properties of the commodity being handled. Typical systems are:

- Venturi scrubbers
- Cyclone scrubbers
- Baghouses.

Venturi Scrubber

In the venturi scrubber, dust laden gases are passed through a venturi tube where low-pressure water is added at the throat of the venturi. Dust is removed by impacting on the scrubber collector surfaces. The wetted particles and spray droplets are collected in a cyclone spray separator. Venturi scrubbers have very high collection efficiencies for very fine particles.

Cyclone Scrubber

A cyclone-type scrubber features a tangential inlet to a cylindrical body with internal vanes to accentuate the cyclonic action. The internal vanes act as impingement and collection surfaces. The dust laden gas and water droplets enter at the bottom of the scrubber. The scrubbing liquid and particles run down the walls and out of the bottom of the scrubber; the scrubbed gas leaves through the top. The removal efficiency is proportional to the velocity of the gas stream.

Baghouse

Fabric filter is applicable for fine particles where high removal efficiency is required. The fabric is usually made into bags of tubular or envelop shape. The entire structure housing the bags is called the baghouse.

Filter fabrics used to remove dust and fumes are usually woven with relatively large open spaces, sometimes 100 microns or larger in size. Small particles are captured and retained on the filter cloth by interception, impingement, diffusion, gravitational settling and electrostatic attraction. Once a cake of dust is accumulated on the cloth, further collection is accomplished by sieving as well as the previously mentioned mechanisms. Periodically the accumulated dust is removed for disposal.

3. Dust Suppression

Dust suppression reduces the tendency of the commodity to create dust by agglomerating small particles that otherwise would become airborne dust.

Dust suppression generally utilizes water or special solutions. During unloading, conveying, stacking and reclaiming operations, water is injected into the material stream to prevent the formation of dust or sprayed into the area to settle airborne dust. Fine mist sprays are used to reduce water consumption, treatment and disposal requirements. Special dust suppressing agents are used for water sensitive commodities.

Dust from products such as sulphur and grain can be potentially explosive if they are not handled correctly. To handle sulphur, a dust suppressant foam is added to the material on the belt to prevent the formation of dust particles. To avoid explosion, wet scrubbers are used to handle sulphur dust emissions.

4.5.2 Wastewater Treatment

The are two sources of contaminated wastewater from bulk terminals. The first source is the wastewater generated from washdown of transfer systems, transfer area, and from air emission control systems. The second source of contaminated water is commodity laden storm water.

The wastewater/storm water treatment processes for the various dry bulk commodities can be classified in terms of the rate limiting pollutant parameters:

- pH
- Solids (dissolved, colloidal, non-colloidal)
- BOD_5 (total, dissolved)
- Ammonia nitrogen
- Metals (dissolved)

Presented below is a summary of the wastewater treatment technologies used in dry bulk terminal operations.

1. pH

The pH of the wastewater/storm water from sulphur and mineral concentrates operations is below the general pH for discharge to the city sewer (5.5) or to the receiving water (6.5). Caustic soda (NaOH) is used to raise the pH of the effluent to comply with permit limits.

2. Solids

Solids in wastewater/storm water can be divided into non-colloidal solids and colloidal solids. Wastewater/storm water from terminals handling specialty agricultural products (peas, lentils, alfalfa pellets, corn, etc.), grains, sulphur, and cement aggregates are classified as non-collodial; and wastewater/storm water from coal terminals can be classified as colloidal.

Non-colloidal Solids

There are two general methods for the removal of non-colloidal solids from wastewater/storm water. For industrial commodities such as sulphur and cement aggregates, sedimentation ponds are commonly used. Physical separation such as microscreens and belt filtration are used in addition to sedimentation ponds for the removal of agricultural solids from the wastewater/storm water.

Colloidal Solids

Conventional methods such as gravity settling or physical separation are not applicable for wastewater/storm water from coal handling operations. Wastewater from coal handling operations contains colloidal particles that requires the addition of chemicals to effect removal. Inorganic electrolytes (alum) and polymers are added to the wastewater to form settleable particles which are then removed using gravity settling. This treatment method is commonly called flocculation/coagulation.

3. BOD_5

Wastewater/storm water from bulk terminals handling agricultural commodities can contain high levels of organic contaminants measured as biochemical oxygen demand. The BOD_5 contaminant is associated with the agricultural solids. Through microbial actions, these agricultural solids are solubilized thus releasing the contaminants into the liquid phase. The treatment cost to remove BOD_5 in the liquid phase is higher than the treatment cost to remove BOD_5 in the solid phase.

To minimize treatment cost, wastewater treatment system is designed to remove the BOD_5 while it is still associated with the agricultural solids. Common physical separation such as microscreens or belt filtration are used to remove major portion of the BOD_5 prior to discharge to the city sewer.

4. Ammonia Nitrogen

For the commodities under consideration, only urea and fertilizers contribute to the ammonia loadings to the wastewater/storm water. Ammonia in the wastewater can be removed either by biological nitrification or air/steam stripping. These removal technologies are not applicable for the dry bulk terminal operation environment. Currently, ammonia containing wastewater is discharged to municipal wastewater treatment works for removal.

5. Metals

Wastewater/storm water from terminals handled mineral concentrates contains high levels of metals. The types of metals depend on the mineral concentrates.

Metals are removed by chemical precipitation using lime or caustic soda followed by gravity settling. Commonly, caustic soda is used to raise the pH of the wastewater to precipitate the dissolved metals as relatively insoluble metal hydroxides. Minimal solubility for cupric, lead and zinc oxides are in the pH range of 9.0 to 10.3.

4.5.3 Storm Water Management

Dry bulk terminals have implemented many storm water control measures to minimize the impacts of contaminated storm water to the receiving water. These control measures are commonly called best management practices and is defined as physical, structural, and/or managerial practices, that when used either singly or in combination, prevent, or reduce pollution of storm water.

There are many types of best management practices, and in general they can be classified into two groups:

- Source control
- Runoff control/treatment.

Presented in the followings are storm water best management practices implemented by terminals in the Lower Fraser Basin.

1. Source Control

Source control BMPs include:

- Regular maintenance of the bulk material handling area
- Regular maintenance of the storm water conveyance system
- Provide roofs over storage and working areas
- Provide secondary containment for fuel, oils, and liquid chemicals
- Segregate the storm water.

Regular Maintenance of the Bulk Material Handling Area

Airborne dust and spillage are the major sources of contaminants in the storm water. A significant amount of the bulk materials can accumulated on loading/unloading areas and at conveyor transfer points. Spilled materials are reclaimed either by front end loaders for large spills or by dry sweeping or washdown for small spills.

Regular Maintenance of the Storm Water Conveyance System

Several terminals have constructed drainageways and catchbasins for conveying storm water offsite. Settled bulk materials are regular removed to minimize the loading to the treatment plant and to maintain storage capacity.

Provide Roofs over Storage and Working Areas

Roofs or enclosed structures are designed to keep rain from coming into contact with the commodities and terminal related activities. Many terminals have provided roofs/enclosed structures for commodity storage and certain material handling areas. However, the impetus for was to maintain product qualities/specifications. Nevertheless, the roofs/enclosed structures minimized the contamination of the storm water due to dust emissions, and storage pile leachate.

Provide Secondary Containment for Fuel, Oils, and Liquid Chemicals

Secondary containment structure is designed to:

- Contain the spilled materials
- Facility cleanup
- Prevent storm water contamination.

Segregate the Storm Water

Storm water segregation is implemented for terminals handling bulk commodities with different wastewater discharge requirements. For example, storm water containing high suspended solids is treated on-site and storm water containing high organic pollutants is discharged to the city sewer system for treatment.

2. Runoff Control/Treatment

Runoff control/treatment BMPs include:

- Site grading and curbing
- Catchbasins/detention ponds
- Storm water treatment.

Site Grading and Curbing

Site grading and curbing is used to prevent:

- Pooling of the storm water
- Off site migration of contaminated storm water to the receiving water
- Co-mixing of segregated flows.

Catchbasins/Detention Ponds

Catchbasins/detention ponds are designed to remove particulate pollutants by gravity settling. They are effective only for the larger size fractions and for the non-colloidal fraction. Colloidal particulates require the addition of coagulants for settling.

Storm Water Treatment

Contaminated storm water is often combined with process wastewater and routed to on-site wastewater plant for treatment. Treatment methodology depends on the characteristics of the pollutants.

4.6 Environmental Requirements

Air emissions and wastewater/storm water discharges for many dry bulk terminal operations are regulated by environmental agencies.

The discharge of air contaminants is regulated by the Greater Vancouver Regional District (GVRD). Vancouver Port Authority is the regulating agency for air emissions from grain terminals.

The discharge of wastewater/storm water is regulated either by the Greater Vancouver Regional District for discharges to city sewers or by the Ministry of Environment, Lands and Parks (MOELP) for discharges to the receiving waters.

4.6.1 Air Emissions

The Greater Vancouver Regional District regulates air discharges from:

- Coastal Containers Ltd.
- Columbia Container Ltd.
- Fibreco Export Inc.
- Neptune Bulk Terminals Canada Ltd.
- Pacific Coast Terminals
- Vancouver Wharves Ltd.
- Westshore Terminals Ltd.

Air discharges from the four grain terminals are under the jurisdiction of the Vancouver Port Authority.

Presented in the followings are information complied from GVRD air discharge permits.

1. Discharge Limit

In general, there are three major types of air emission limits for these facilities and they are:

- General Site Restrictions

  All facilities are prohibit to discharge air contaminant(s) from any single source or combination of sources pass the property boundary.

- Opacity Limits

  Dust emissions from stockpiles, conveying systems, ship holds are generally given opacity limit of 20%.

  Dust emissions from baghouses and scrubber exhausts are limited to 10% opacity.

- Particulate Matter

  Air discharges from baghouses and scrubbers are assigned particulate matter limit. For baghouses, discharges are generally limited to 50 mg/m^3. Scrubbers are limited to 120 mg/m^3.

2. Bylaw Fee

Facilities regulated under the provisions of the GVRD Air Quality Management Bylaw No. 725 are charged a bylaw fee. The annual fee is assessed based on the following fee schedule:

- PM $60/tonne
- NOx $60/tonne
- SOx $60/tonne
- VOC $60/tonne
- Other $60/tonne
- CO $1/tonne

For 1995, the Bylaw fee is limited to $150,000 per year. This fee limit will be lifted in 1996.

3. Potential Air Emissions

Presented in the following sections are the potential air emission sources from grain terminals and dry bulk terminals.

Grain Terminals

For grain terminals, the potential air emission sources are:

- Baghouse exhausts
- Grain dryer exhausts
- Loading of marine vessels.

Dry Bulk Terminals

For dry bulk terminals, the potential air emissions sources are:

- Scrubber exhausts from dumper operations
- Conveyor transfer areas
- Baghouse exhausts from offloading operations
- Open stockpiles
- Loading of marine vessels.

4.6.2 Wastewater/Storm Water Discharges

Of the eleven (11) dry bulk terminals in the Lower Fraser Basin, only four terminals have wastewater discharges that are regulated by either GVRD or MOELP.

These four terminals and the regulatory agencies are presented in Table 4.7.

Table 4.7 Regulated Wastewater Facilities

Regulatory Agency	Terminal
GVRD	Pacific Coast Terminals
MOELP	Neptune Bulk Terminals Canada Ltd.
	Vancouver Wharves Ltd.
	Westshore Terminals Ltd.

Depending on the types of wastewater treatment on-site, the wastewater discharge permit may contain limits for the following pollutants:

- Flow
- pH

  pH of the discharge is generally limited to the range of 6 - 10.

- Total Suspended Solids

  For facilities discharging to the receiving water, the pollutant total suspended solids is generally limited to 50 - 75 mg/L.

  For facilities discharging to the city sewer, the pollutant total suspended solids is limited to 600 mg/L.

- Dissolved Metals

  Facilities discharging metal containing wastewater will need to comply dissolved metal limits. The dissolved metal limits are generally in the range of 0.2 mg/L to 1 mg/L.

- Toxicity

  Selected effluent streams are required to comply a whole effluent 96 hour LC_{50} toxicity limit.

4.6.3 Current Wastewater Management Practices

Table 4.8 summarizes the current wastewater management practices for the listed dry bulk commodities.

Table 4.8 Dry Bulk Terminal - Current Wastewater Management Practices

Commodity	Type	Wastewater Management Practices
Urea	1	Wastewater discharged to city sewer
Potash	1	Wastewater discharged to city sewer
Fertilizer	2	Wastewater discharged to city sewer
Agricultural Products	2	Pretreatment with screening and belt filtration and is discharged to city sewer
Grains	2	None
Wood Chips	2	None
Coal	3	Wastewater is treated by coagulation/flocculation and is discharged to the receiving water
Sulphur	3	Wastewater is treated by gravity settling and pH neutralization and is discharged to the city sewer
Phosphate Rock	3	Wastewater is discharged to the city sewer
Mineral Concentrates	4	Wastewater is treated by caustic soda to remove metals and is discharged to the receiving water
Cement Aggregates	5	None
Salt (Coarse)	5	None

5º Procedures for the Development of Pollution Prevention Plans

Presented in Table 5.1 is an overview of the pollution prevention assessment program.

Table 5.1 Pollution Prevention Plan Development Overview

Step	Task	Task Description
1	Organize Program	• Select team members to develop pollution prevention plan • Develop pollution prevention/reduction goals • Identify potential obstacles • Prepare the program plan • Obtain funding
2	Background Information	• Develop industry/facility profile
3	Environmental Review	• Compile facility data • Conduct site inspection • Identify potential pollution prevention options • Organize pollution prevention options • Rank pollution prevention options • Prioritize pollution prevention options
4	Feasibility Assessment	• Conduct feasibility assessment • Prepare and review the assessment report
5	**Write Pollution Prevention Plan**	• **Write the facility Pollution Prevention Plan**
6	Implement Pollution Prevention Plan	• Select projects for implementation • Obtain funding • Implement the selected projects
7	Measuring Pollution Reduction Progress	• Monitor pollution prevention progress

5.1 Step 1 - Organize Program

Task 1.1: Select Team Members to Develop Pollution Prevention Plan

Select team members for the development of the pollution prevention plan. The study team members should have substantial technical, business, and communication skills as well as thorough knowledge of your company.

The areas of expertise to consider include:

- Management
- Engineering
- Quality control
- Operation and maintenance
- Accounting and purchasing
- Legal
- Health and safety
- Environmental.

Task 1.2: Develop Pollution Prevention/Reduction Goals

Identify the scope and objectives/goals of the pollution prevention plan. The goals serve to focus effort and build consensus. The goal should be:

- Well-defined
- Meaningful to all employees
- Challenging and achievable
- Flexible and adaptable.

Task 1.3: Identify Potential Obstacles

The study team needs to identify potential obstacles for pollution prevention options. The obstacles vary from facility to facility.

For dry bulk terminals, potential obstacles are primarily technical and economic in nature. For existing terminals, many pollution prevention options are either economically or technically unfeasible.

Task 1.4: Prepare the Program Plan

The program should contain all of the elements described above. A schedule containing realistic target dates for each stage of the study should be included in the program plan.

Task 1.5: Obtain Funding

The study program may require collection and analysis of samples. In addition to the sampling/analysis cost, some facility may find it necessary to retain a consultant to perform some aspects of the study program. These costs will need to be considered in the planning of the program. The company may need to allocate funding prior to the start-up of the study program.

Output: A Pollution Prevention Program Plan

5.2 Step 2 - Background Information

Task 2: Develop Industry/Facility Profile

The industry/facility profile is a characterization of the various industries within the industrial sector and the industrial facility under consideration. The profile should contain information on raw materials, processes, waste materials and waste management practices for the industry and the specific facility. The information may assist the team in selecting study areas and in identifying pollution prevention options.

For the dry bulk terminal operation, the facility profile should contain information on:

- Types and quantity of dry bulk material(s) handled
- Material handling system
- Storage system
- Air emission sources
- Air pollutant characteristics
- Air pollutant management/control practices
- Wastewater and storm water sources
- Wastewater and storm water characteristics
- Wastewater and storm water management/control practices
- Fuel, lubricant, and chemical storage
- Environmental permit requirements and performance.

Review published literature to develop background information on material handling process, air emissions and wastewater/storm water management methods, and storm water best management practices practiced by other dry bulk terminals.

The industry background information can be compiled from:

Best Management Practice Guide for British Columbia Dry Bulk Terminal, Burrard Inlet Environmental Action Program (BIEAP) Technical Report No. 04, July 1993.

Bulk Loading Terminals Environmental Audits, Norecol Environmental Consultants Ltd., March 1992.

Guide for the Best Management Practices - Storm Water Management for Selected Industrial Sectors in the Fraser Basin, PCA Consultants Ltd., March 1995.

Output: A Industrial/Facility Profile of Your Dry Bulk Terminal

5.3 Step 3 - Environmental Review

The purpose of environmental review is to identify all waste streams, their sources and the costs of treatment and disposal. The information is then used to identify areas of opportunity for pollution prevention. The environmental review program is designed to provide a focus for consideration of pollution prevention and to minimize data collection and pollution prevention evaluation costs.

Task 3.1: Compile Facility Data

The tasks for the environmental review program are:

- Plant data collection
- Site inspection
- Identification of pollution prevention potentials
- Development of prioritization criteria
- Prioritization of pollution prevention potentials.

In an all-media approach, identify the air emissions and wastewater/storm water sources and quantify the loadings to the receiving environment. Identify the costs of dust control, air pollution control systems, and wastewater treatment or disposal.

The data requirements for the facility data compilation program are presented in Table 5.2.

Table 5.2 Environmental Review - Plant Data Compilation Program

Category	Facility-Specific Information
Dry Bulk Materials	• Volume of commodity handled • General shipment schedule • Active Ingredients or Components of Concern
Unloading	• Dust control system • Dust emission rate • Operating Schedule/Periods • Site cleanup method
Conveying	• Dust control system • Dust emission rate • Quantity of spillage • Site cleanup method • Wastewater treatment/disposal method
Storage	• Storage method • Dust control system
Loading for Transport	• Dust control method • Dust emission rate • Spillage control method • Quantity of spillage
Fuel, Lubricants, Chemicals	• Quantity of materials • Spill prevention and cleanup method
Wastewater/Storm Water Management Practices	• Wastewater/storm water treatment method • Quantity of wastewater • Quantity of contaminated storm water
Environmental Permit Requirements	• Air emission sources and Bylaw Fee

Table 5.2 Environmental Review - Plant Data Compilation Program	
Category	**Facility-Specific Information**
	• Air emission source test data • Wastewater sources • Wastewater discharge data

For this environmental review, compile these data from existing sources. Reserve any extensive and costly data collection programs for detailed assessment.

Examples of existing and readily available data sources are presented in Table 5.3.

Table 5.3 Plant Data Compilation Program - Data Sources	
Category	**Facility-Specific Information**
Dry Bulk Materials	• Shipment manifests
Loading/Unloading Conveying/Storage	• Equipment list and specifications • Equipment layouts and logistics • Vendor/supplier data sheets • Operating manuals and process description • Operator data logs
Fuel, Lubricants, Chemicals	• Purchasing records • Equipment specifications
Storm Water Management Practices	• Site plans and elevation plans
Environmental Permit Requirements	• Air emission permit • Wastewater discharge permit • Laboratory records • Environmental audit reports • Waste shipment manifests

Worksheets A-1 to A-5, presented in Appendix A, will assist in identifying the data requirements and in organizing the compiled data. These worksheets are generic to dry bulk terminal operations. Some customization will be needed to develop facility-specific worksheets.

Use the site-specific data and prepare terminal flow diagrams showing:

- Types and quantities of all dry bulk materials handled
- Sources/locations and quantities of dust emissions
- Sources/locations and quantities of commodity spillage
- Sources/locations, quantities and characteristics of wastewater/storm water.

Output: Completed Data Worksheets, Dry Bulk Materials and Waste Materials Mass Balances, and Terminal Material Handling and Waste Flow Diagrams

Task 3.2: Conduct Site Inspection

The mass balance calculations and flow diagrams should be reviewed to ensure correctness. A thorough and detailed site inspection of the targeted process areas will also need to be conducted to identify operating parameters and other factors that were missing or poorly documented. The site inspection will assist in developing understanding of the terminal operations and thereby identifying pollution prevention opportunities.

Presented in Table 5.4 are guidelines for preparing and conducting site inspection.

Table 5.4 Site Inspection Guidelines

Pre-inspection Activities	• Evaluate data complied along with mass balance calculations and flow diagrams to gain familiarity with the targeted processes and to identify additional data requirement. • Review existing documents such as operators' manuals and purchasing and shipping records. • Prepare an inspection agenda that identify the targeted processes and the data requirement. • Schedule the inspection to coincide with operations of targeted processes.
On-site Inspection Activities	• Monitor the material handling process from the point where bulk commodities enter the terminal to the point where commodities and wastes exit. • Identify all suspected sources of dust emissions and spills. Dust and spill sources to inspect include the loading/unloading, conveying, and stacking/reclaiming. • Monitor the material handling process to identify unmeasured or undocumented releases of wastes. • Interview operators in the targeted material handling process areas to identify operating parameters and dust and spill reduction opportunities. • Evaluate the general conditions of the material handling equipment. • Examine housekeeping practices throughout the facility. • Check for spillage and leaks at the equipment/vehicle maintenance area. • Check waste storage area for proper waste segregation. • Photograph or videotape the targeted material handling areas.
Post-inspection Activities	• Update mass balance calculations and flow diagrams with new or correct information. • Conduct follow-up site inspections to collect additional data or to clarify questions identified during data analysis.

Output: Updated Worksheets, Mass Balances, and Terminal Flow Diagrams

Task 3.3: Identify Potential Pollution Prevention Options

The worksheets (Worksheet B-1 to B-3) presented in Appendix B are designed to assist dry bulk terminals in systematically evaluating waste generating sources and in identifying pollution prevention options.

The worksheets are organized into three (3) sections:

- Storm water best management practices
- Material handling system
- Wastewater/storm water collection/treatment.

A no response will indicate a potential area to implement pollution prevention measures.

Output: A Listing of Pollution Prevention Options

Task 3.4: Organize Pollution Prevention Options

After completing the Pollution Prevention Potential Assessment Worksheets, the assessment team should organize the identified waste minimization options ("no" responses) within the environmental management hierarchy.

The environmental management hierarchy is presented below.

1. Source reduction
2. On-site reuse and recycling
3. Off-site reuse and recycling
4. Material and/or energy recovery
5. Residual waste management

This organization emphasizes the evaluation and implementation of source reduction pollution prevention options. Other non-pollution prevention waste management options will be assigned lower priorities in evaluation and implementation.

In the dry bulk terminal environment, the major sources of pollution and associated pollutants are:

- Vehicle and equipment maintenance (fuel, lubricants, chemicals)
- Material handling system (fugitive dust)
- Site cleanup (washwater).

Because spillage of fuel, lubricants, or chemicals usually incur high cleanup costs and legal liabilities, pollution prevention options for these materials should receive higher priorities. Other sources that are lower in potential environmental and safety liabilities should be lower in ranking.

Presented in Table 5.5 is the recommended organization of pollution sources/pollution prevention options for the dry bulk terminals.

Table 5.5 Recommended Organization of Pollution Sources

Waste Management Approach	Relative Order	Pollution Sources (Pollutants)	Example of Selected Pollution Prevention Options
Source Reduction (Storm Water Best Management Practices)	1 (Highest)	• Fuel, lubricants, chemicals storage • (gasoline, diesel, oil and grease, solvents, chemicals)	• Secondary containment structure • Inspect and contain leaks and repair the source • Develop spill prevention and emergency cleanup plan
		• Loading/unloading of liquid materials • (gasoline, diesel, oil and grease, solvents, chemicals)	• Pave and grade area to contain spills • Implement tank filling procedures to prevent spills and overfilling
		• Vehicle/equipment maintenance • (oil and grease, solvents)	• Pave and grade area to contain contaminated storm water
		• General site • (oil and grease, dry bulk materials)	• Pave and grade site to segregate contaminated storm water from un-contaminated storm water
Source Reduction (Material Handling System Best Management Practices)		• Dry bulk unloading • (dry bulk materials)	• Enclose unloading operation to minimize fugitive dust emissions
		• Conveying • (dry bulk materials)	• Remove material from the return conveyor belt with belt scrapers or belt wash to minimize product spillage • Regularly clean up spilled product to minimize contamination of storm water
		• Storage • (dry bulk materials)	• Pave and slope the open stockpile area to minimize pooling of water and leaching of products • Enclosed the storage area
		• Loading for transport	• Install and maintain proper belt cleaning equipment to remove products adhered to the belt

Table 5.5 Recommended Organization of Pollution Sources (Continued)

Waste Management Approach	Relative Order	Pollution Sources (Pollutants)	Example of Selected Pollution Prevention Options
On-site Reuse and Recycling		• Conveying	• Implement site cleanup before each product change to reclaim uncontaminated products for future use
		• Storage	• Construct primary settling basins to collect washwater and runoff close to stockpiles allowing reclaim of uncontaminated products for future use
Off-site Reuse and Recycling		• Wastewater/storm water treatment	• Construct treatment system to reclaim products for off-site use
Waste Management		• Storm water	• Collect contaminated storm water for treatment
		• Material handling	• Implement best available technology for dust emissions
		• Wastewater/storm water treatment	• Implement best available technology for wastewater/storm water treatment

Output: A Listing of Pollution Prevention Options Organized within the Environmental Management Hierarchy

Task 3.5 Rank Pollution Prevention Options

Rank the pollution prevention options, organized in accordance with the environmental management hierarchy, with respect to the implementation costs. Pollution prevention options that do not require significant capital expenditures should be evaluated and implemented first.

Low cost pollution prevention options are usually best management practices. Examples of these low cost options are:

- Improve operation & maintenance procedures
- Improve housekeeping practices
- Implement flow/material segregation.

Output:	**A Listing of Pollution Prevention Options Ranked with Respect to the Implementation Costs**

Task 3.6 Prioritize Pollution Prevention Options

Prioritize the list of identified potential pollution prevention areas/options that require significant capital expenditures. Low cost options such as best management practices that should be implemented first should not be included in this screening process.

The Weighted Sum Method or a similar quantitative method may be used to rank the identified potential process areas and waste streams. This method first assigns a weighting factor for each of the selection criteria in relation to their importance. Each waste stream is then rated on each criterion. Finally, the rating of each waste stream for a particular criterion is multiplied by the weight of the criterion. The waste stream's overall rating is the sum of the products of rating times the weight of the criteria.

Presented in Table 5.6 is an example of the weighted sum method for prioritizing waste streams or process areas for detailed pollution prevention assessment.

Table 5.6 Weighted Sum Method for Prioritizing Waste Streams or Process Areas

Waste Stream Prioritizing Criteria	Relative Weight (W)	Score Option 1 (S1)	Weighted Score Option 1 (WxS1)	Score Option 2 (S2)	Weighted Score Option 2 (WxS2)	Score Option 3 (S3)	Weighted Score Option 3 (WxS3)
Environmental Regulations Compliance	9	2	18	5	45	5	45
Hazardous Properties of the Waste	5	10	50	2	10	2	10
Impacts to Environment/Public Health	5	5	25	2	10	2	10
Quantity of Waste Generated	10	10	100	10	100	5	50
Waste Treatment/Disposal Costs	10	10	100	10	100	5	50
Potential Future Liability Reduction	7	10	70	3	21	2	14
Other Waste Management Potential	5	2	10	10	50	10	50
Safety of Employees	8	8	16	3	24	2	16
Sum of Criteria Scores ($\Sigma(W \times S)$)			389		360		245

The above example uses a scale of 0 to 10 for ranking each of the criteria and waste stream in relation to their importance with 0 for low and 10 for high. For this example, Stream 1 rates the highest with a score of 389. Stream 2's score is 360 and Stream 3's score is 245. In this case, if resources are limited, Stream 1 should be selected for the detailed phase of the assessment, for the identification of pollution prevention options.

The waste stream prioritizing criteria presented in the table are appropriate for the dry bulk terminal environment. However, each terminal should develop a set of facility-specific selection criteria to rank pollution prevention options.

Presented in Table 5.7 are some of the criteria that need to be considered when selecting potential pollution prevention areas.

Table 5.7 Typical Criteria for Selecting and Prioritizing Process Areas and Waste Streams for Detailed Assessment

Regulatory	• Compliance with current and anticipated environmental regulations • Required chemicals to be banned or phased out by governmental regulations • Potential environmental and safety liability • Hazardous properties of the waste (including toxicity, flammability, corrosivity, and reactivity)
Material Handling	• Potential for removing bottlenecks • Potential recovery of valuable dry bulk commodities • Maintaining dry bulk commodity quality • Compatibility of the new equipment, or procedures with current mode of operations • Additional labor requirement • Impact to current operation during system implementation • Minimizing wastewater discharges • Reducing or alternate energy use • Potential impacts to other receiving environments
Waste Management	• Costs of waste management (pollution control, treatment, and disposal) • Quantity of waste • Potential for removing bottlenecks • Potential for implementing on-site reuse or recycling
General	• Safety hazards to employees • Impact to public health

Output: A Prioritized List of Pollution Prevention Options

5.4 Step 4 - Conduct Feasibility Assessment

The objective of feasibility assessment is to evaluate appropriate pollution prevention options for implementation. based on the prioritized list identified in the environmental review program, These pollution prevention options should be evaluated to ensure that they are technically, environmentally, and economically feasible.

Task 4.1: Conduct Feasibility Assessment

To maximize available resources, emphasis should be focused initially on the high priority waste streams or material handling areas. Lower priority waste streams or process areas should also be evaluated but implementation may be executed at a later stage.

A. Technical Evaluation

Technical evaluation for complex pollution prevention options, equipment or process related options, may require detailed study to determine applicability and for developing final design. For these types of options, equipment, labor, waste disposal costs should be compiled either based on published data or vendor quotations to be used to determine economic feasibility. Pollution prevention options that were determined to be without technical merits should be eliminated or removed from further consideration.

B. Environmental Evaluation

Technically viable pollution prevention options should be evaluated with respect to a set of environmental criteria. These environmental criteria should be selected to ensure no adverse environmental impacts as a result of implementing the reduction measure.

Example environmental criteria include:

- Effect on other process areas or waste streams
- Risk of pollutant transfer to other media
- Energy consumption.

C. Economic Evaluation

After consideration of the technical and environmental criteria, economic analysis should be conducted for the selected pollution prevention options. The economic analysis should seek to compare the total costs of the current practice to the total costs of the pollution prevention alternative.

For pollution control activities, regulatory compliance and oversight costs must be included in the analysis. Other regulatory (environmental, health and safety) related costs, that are often allocated to overhead rather directly to the pollution production areas, include report writing, data collection, regulatory research, and permit fees. If these costs are not correctly accounted for, the benefits of pollution prevention can be underestimated.

To ensure complete accounting of all environmental related expenses and intangible costs and benefits, pollution prevention options should be evaluated using the Total Cost Assessment accounting method developed by USEPA. This assessment method modifies the standard accounting system to improve the competitiveness of prevention-oriented investments.

There are four elements of Total Cost Assessment:

- Expanded cost inventory;
- Extended time horizon;
- Use of long-term financial indicators; and
- Direct allocation of costs to processes and products.

Presented in Table 5.8 are costs and other factors that should be considered in using the Total Cost Assessment approach in economic evaluation of pollution prevention options.

Table 5.8 Total Cost Assessment		
Expanded Cost Inventory	**Direct Costs**	Capital Expenditures • Buildings • Equipment and installation • Utility connections • Project engineering Operation and Maintenance Expenses or Revenue • Labor • Waste disposal • Water and energy • Value of recovered commodity
	Indirect Costs	Administrative costs Regulatory compliance costs • Permitting • Record keeping and reporting • Monitoring manifesting Insurance Workman's compensation On-site waste management On-site pollution control Equipment operation
	Liability Costs	Penalties Fines Personal injury Property damage Natural resources damage cleanup costs
	Less-Tangible Benefits	Improved product quality Enhanced company image Reduced health maintenance costs Increased productivity due to improved employee relationships Improved relationships with regulators
Expanded Time Horizon	Because many of the liability and less-tangible benefits of pollution prevention will occur over a long period of time, therefore economic assessment for pollution prevention projects should be based on a long time frame.	
Long-Term Financial Indicators	The financial indicators should meet the following criteria: • Account for all cash flows during the project • The time value of money Acceptable indicators meeting these criteria include: Net Present Value of an investment, Internal Rate of Return, and Profitability Index.	
Direct Allocation of Costs	Single Pool Concept	Distribute the benefits and costs of pollution prevention across all products and services. A general overhead or administrative cost is included in all transactions.
	Multiple Pool Concept	Distribute the benefits and costs of pollution prevention at the department of other operating unit level.
	Service Center Concept	Distribute the benefits and costs of pollution prevention to only those activities that are directly responsible.

Output: A Listing of Technically, Environmentally, and Economically, Feasible Pollution Prevention Options

Task 4.2: Prepare and Review the Assessment Report

Prepare a report containing the results of the Feasibility Assessment Program. This report should include:

- Proposed pollution prevention options
- Option screening results
- Feasibility analysis results.

Output: Detailed Assessment Program Report

5.5 STEP 5 - WRITE POLLUTION PREVENTION PLAN

Task 5: Write the Facility Pollution Prevention Plan

The facility pollution prevention plan will include part or all of the following elements:

- A written policy articulating management and corporate support for the pollution prevention plan and a commitment to implement planned activities and achieve established goals.
- The scope and objectives of the pollution prevention plan. Scope includes the facilities, or processes that the plan will cover.
- A description of the facility including:

  Types and quantity of dry bulk material(s) handled
  Material handling system
  Storage system
  Environmental permit requirements.
- An industry/facility profile characterizing the various operations within the dry bulk terminal industrial sector and the facility under consideration.
- A plan to perform an environmental review or a summary of review results, including:

  Air emission sources
  Air pollutant characteristics
  Air pollutant management/control practices
  Wastewater and storm water sources
  Wastewater and storm water characteristics
  Wastewater and storm water management/control practices
  Fuel, lubricant, and chemical storage
  Environment permit requirement and performance.
- A plan to perform a detailed assessment or a summary of assessment results, including:

  Facility-specific criteria for prioritizing candidate processes and waste streams for pollution prevention projects
  Criteria for prioritizing pollution prevention options
  Prioritized listing of feasible pollution prevention options.
- A selection of pollution prevention options to be implemented. For each selected options, the process area(s) it affects should be identified, and estimates of the amount of the reduction of the wastes specified.

- A five year implementation schedule which presents the planned pollution prevention implementation activities for each of the five calendar years following the completion of the pollution prevention plan.

Presented in Appendix C is an example pollution prevention plan format for dry bulk terminal operations.

5.6 STEP 6 - IMPLEMENT POLLUTION PREVENTION PLAN

Task 6.1: Select Projects for Implementation

The company executives, with inputs from the study team, will need to make final decisions on which projects will be implemented. The decision on the implementation schedule will also be made at this point.

Projects that are do not require a significant capital expenditure should be selected and implemented first.

Low cost pollution prevention projects are largely related to management practices. Examples of these best management practices are:

- Improve operation & maintenance procedures
- Improve housekeeping practices
- Improve inventory control
- Develop/improve spill prevention plans.

Capital expenditure projects should be selected based on the priority listing. An implementation schedule should be developed in consideration of the overall budget.

Task 6.2: Obtain Funding

The company will need to allocate funding for capital expenditure projects. Funding for lower ranking projects may be delayed until subsequent capital budgeting periods.

Task 6.3: Implement the Selected Projects

Implement projects according to the program schedule.

Best management practice projects may require changes in company policies and employee training programs.

For projects that involve equipment modification or new equipment, the implementation program generally include the following steps:

- Planning
- Design/engineering
- Procurement
- Construction
- Operator training.

Output: Implemented Selected Pollution Prevention Options

5.7 STEP 7 - MEASURING POLLUTION REDUCTION PROGRESS

The objective of pollution prevention progress assessment is to conduct quantitative evaluation of pollution reduction after implementation. The information is then used by terminal staff in evaluating pollution prevention successes and failures and to guide future pollution prevention implementation efforts. The results of the evaluation may also identify new pollution prevention options.

Task 7: Monitor Pollution Prevention Progress

Collect data to quantify the pollution reduction progress. Examples waste reduction monitoring parameters are:

- Quantity of dust emission
- Quantity of recovered commodity
- Quantity of commodity disposed off site
- Quantity of wastewater/storm water treated
- Reduction on waste toxicity.

Normalize the pollution reduction data to the economic level. Define the plant's economic level as:

- Total hours the process operated
- Annual dry bulk commodity throughput.

Prepare an annual pollution reduction progress report to document and track the facility's efforts. The report should contain information on:

- Progress toward the reduction goals
- Pollution prevention options implemented
- Material handling process or other areas affected
- Changes in throughput level
- Quantity of waste reduced/recycled/treated
- Problems encountered during implementation of pollution prevention options.

Output: An Annual Pollution Reduction Progress Report

6 Economic Analysis - Case Study

6.1 Introduction

This section presents an economic analysis of the benefits and penalties of using best available technologies in achieving pollution prevention. The economic analysis was conducted using the case study approach.

This case study considers the disposal or treatment of wastewater and contaminated storm water generated from the handling of agricultural commodities such as alfalfa pellets, hay cubes, or peas. The sources of wastewater and contaminated storm water are:

- Air scrubbers
- Conveyor belt washing
- Storm water run-on
- General housekeeping/site cleanup.

Due to the fines and organic nature of the dry bulk commodities, wastewater and contaminated storm water from this type of dry bulk operations are expected to be high in total suspended solids (TSS) and biochemical oxygen demand (BOD_5). Available wastewater data indicate TSS concentrations range from 1,000 mg/L to 6,000 mg/L and BOD_5 concentrations range from 600 mg/L to 1,500 mg/L.

The Greater Vancouver Sewerage and Drainage District (GVSDD) is considering increasing the sewer discharge rates for industrial dischargers. The proposed sewer discharge rates were to be based on the strength (organic and solid concentrations) in the industrial wastewater.

The objective of this case study is to determine the best alternative for the disposal or treatment of the process wastewater and contaminated storm water. The pollution prevention options will be evaluated based on the following criteria using the Weighted Sum Method:

- Compliance with environmental regulations
- Compliance with anticipated environmental regulations
- Future environmental liability
- Waste treatment/disposal cost
- Potential for reuse/recycling of waste materials

6.2 Pollution Prevention Options

The case study evaluates three disposal/treatment options. The three options are:

1. Treatment by physical separation and gravity settling; discharge to the Greater Vancouver Sewerage and Drainage District (GVS&DD).
2. Option 1 with an additional sludge belt press; discharge to the GVS&DD.
3. Option 1 with additional sludge belt press and biological treatment; discharge to the receiving water.

Presented in Figures 6.1 - 6.3 are the wastewater treatment process schematics for these three options.

6.3 Case Study Assumptions

Presented in the following sections are the assumptions used for this case study.

6.3.1 Existing Pollution Prevention Measures

The case study assumes the hypothetical dry bulk terminal has implemented pollution prevention measures to minimize the volume of the wastewater/storm water and the quantity of solids discharged to the receiving environment. Examples of these pollution prevention measures include:

Unloading

Dry bulk commodities are delivered by rail cars equipped with bottom-dump hoppers and unloaded in the dumper pits. Wet scrubbers are used to control dust emissions from the dumper building. The scrubber water is collected and sent to the treatment facility.

Conveying

Dry bulk commodities are transferred to storage or vessels via a conveyor system. The conveyor system has incorporated return belt cleaning brushes and hopper with aprons to minimize spills along the length of the conveyor system and at loading locations. Wet scrubbers are used to control dust emissions at transfer points. The scrubber water is collected and sent to the treatment facility.

The conveyor system is washed prior to changing to a different commodity. The washwater is collected and sent to the treatment facility.

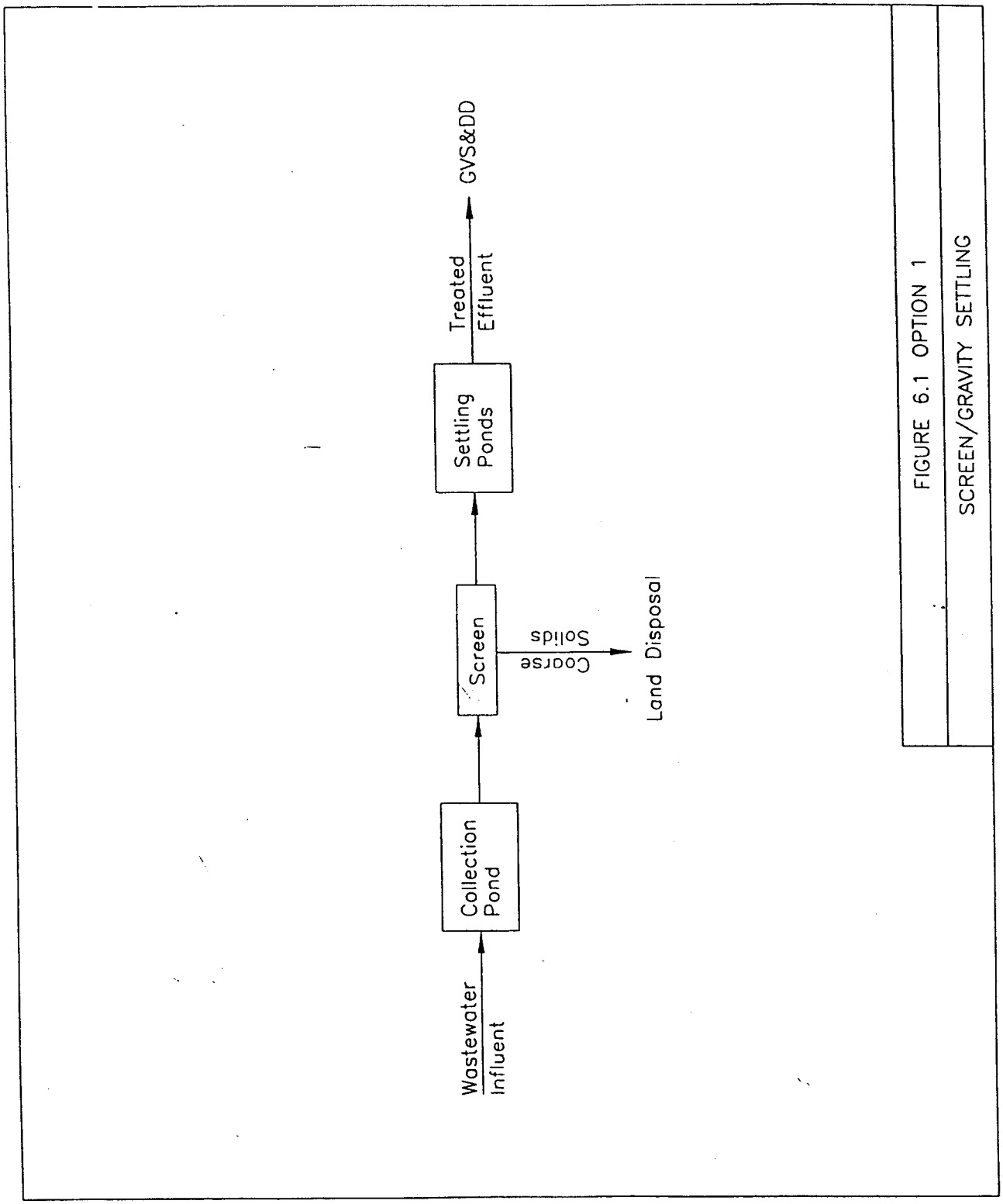


FIGURE 6.1 OPTION 1

SCREEN/GRAVITY SETTLING

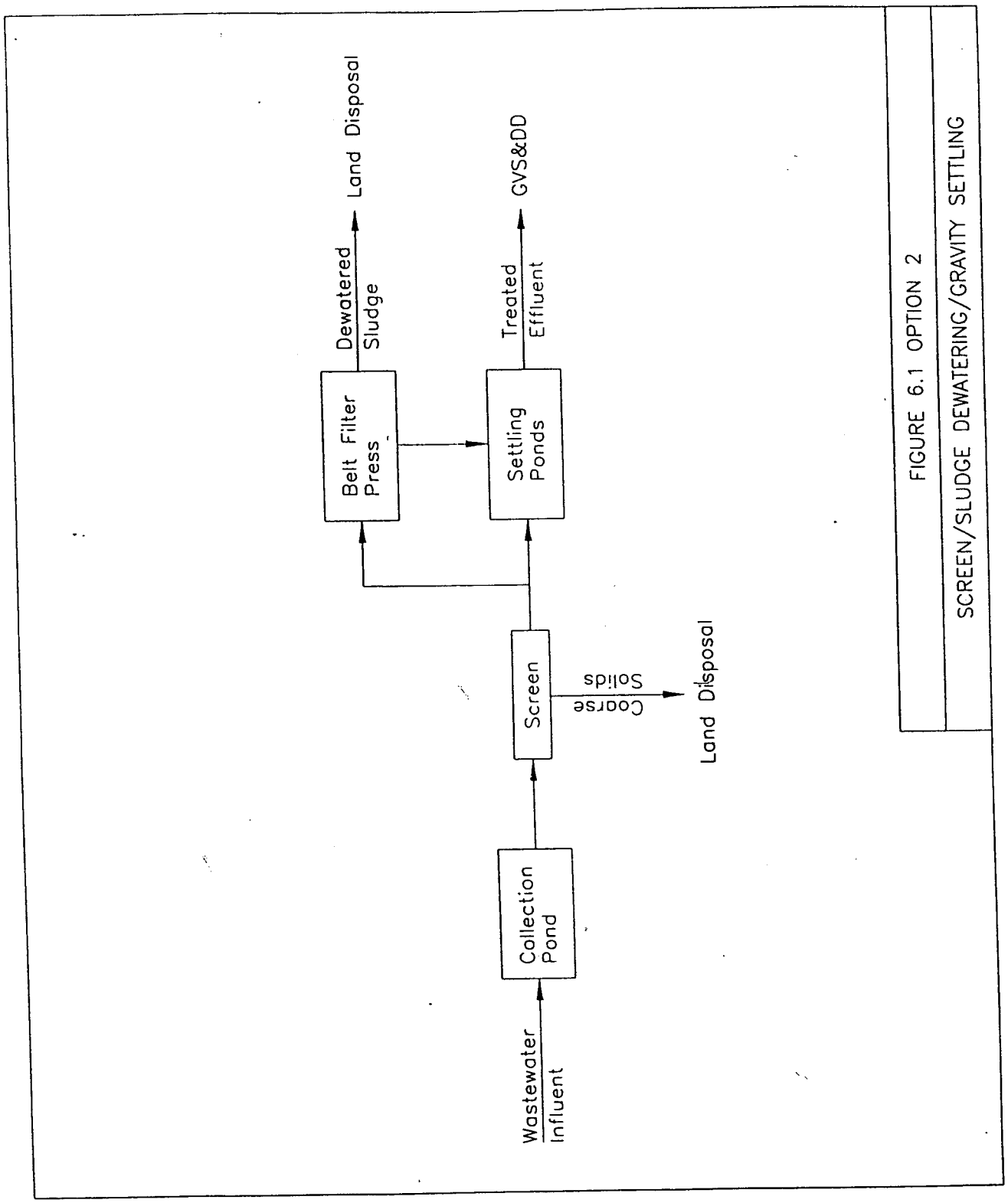


FIGURE 6.1 OPTION 2

SCREEN/SLUDGE DEWATERING/GRAVITY SETTLING

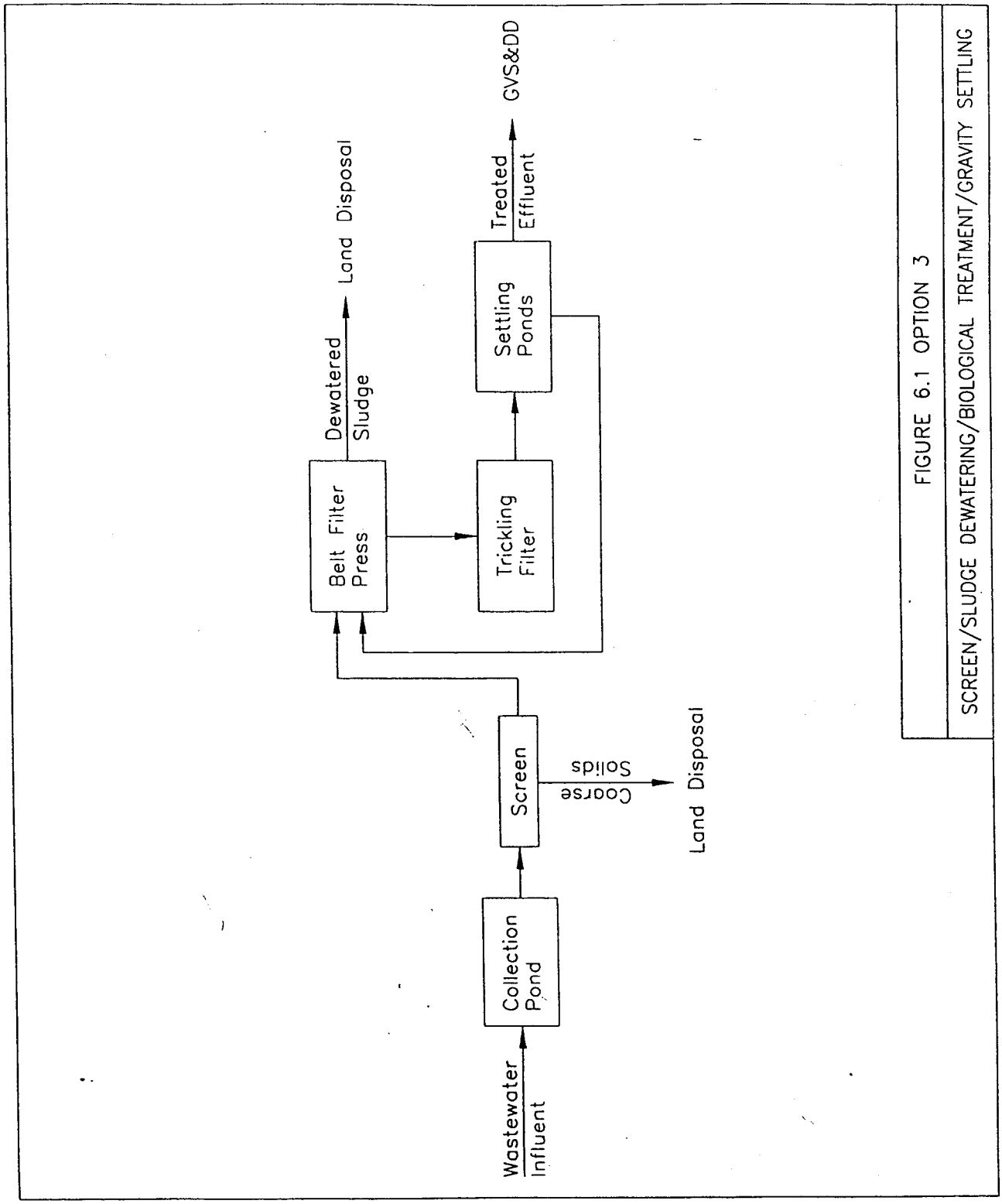


FIGURE 6.1 OPTION 3

SCREEN/SLUDGE DEWATERING/BIOLOGICAL TREATMENT/GRAVITY SETTLING

Loading for Transport

Shiploaders are equipped with choke feeders to minimize spillage of dry bulk commodities at dockside.

Storm Water Management Practices

The site is curbed and bermed along the shoreline to capture contaminated storm water. Contaminated storm water is collected and sent to the treatment facility.

General Housekeeping

The spilled products are shoveled or picked up by mechanical equipment. Washdown is used only when it is impractical to continue cleaning by dry methods.

6.3.2 Wastewater Characteristics

The case study assumes that total suspended solids and biochemical oxygen demand are the two pollutants of concern. Presented in Table 6.1 are the design wastewater influent and effluent characteristics for the three pollution prevention options to be considered for this economic analysis

Table 6.1 Design Wastewater Characteristics

Parameter	Influent	Option 1 Effluent	Option 2 Effluent	Option 3 Effluent
Operating Period	24-hr/day, 360 days/year			
Flow (m^3/day)	1000	1000	1000	1000
Total Suspended Solids (mg/L)	6000	400	100	30
Biochemical Oxygen Demand (mg/L)	1500	500	350	30

6.3.3 Wastewater Discharge Fee

The case study assumes wastewater discharge fees are calculated based on the amount
of pollutants discharged.

Discharge to GVS&DD

For wastewater discharges to the GVS&DD, the proposed discharge fee schedule (Sewerage and Drainage Committee, 6/11/1992) is used to calculate the discharge fees.

The wastewater volume fee is based on the City of North Vancouver sewer rate.

Presented in Table 6.2 is the combined wastewater fee schedule for discharges to the GVS&DD.

Table 6.2 Fee Schedule for Discharges to the GVS&DD

Parameter	Rate
Flow (m^3)	$0.1962
Total Suspended Solids (kg)	$0.27
Biochemical Oxygen Demand (kg)	$0.13

Discharge to the Receiving Water

For wastewater discharges to the receiving water, B.C. Regulation 299/92 Contaminant Fee Schedule is used to calculate the discharge fees.

Presented in Table 6.3 is the Contaminant Fee Schedule for discharges to the receiving water.

Table 6.3 Discharge Fee Schedule for Discharges to the Receiving Water

Parameter	Rate
Total Suspended Solids (tonne)	$9.20
Biochemical Oxygen Demand (tonne)	$13.90

6.3.4 Cost Estimating Information

The construction costs and operation and maintenance costs used in the pollution prevention cost analysis are derived from the following sources:

- *Technical Report: Operation and Maintenance Costs for Municipal Wastewater Facilities*, United States Environmental Protection Agency, Office of Water Program Operations, September 1981, 430/9-81-004.
- *Handbook of Biological Wastewater Treatment, Evaluation, Performance, and Cost,* Henry H. Benjes, Jr., Garland STPM Press, 1980.
- In-house Lower Mainland construction cost data.

6.4 Option 1

Option 1 represents the base option. This option consists of an existing wastewater treatment plant using physical separation and gravity settling for the removal of suspended solids. The expected post-treatment effluent concentration for TSS is 400 mg/L and for BOD_5 is 500 mg/L (Table 6.1).

For the agricultural commodities under consideration, the biochemical oxygen demand is related to the total solids concentration. Therefore, it is expected that by removing the suspended solids from the wastewater, the biochemical oxygen demand will then be reduced accordingly.

Presented in the Table 6.4 is a summary of the annual operation costs for this option. The assumptions used for the cost calculation are:

- Wastewater discharge fees (Table 6.2)
- Maintenance labor cost (32 man-hours/week @ $65.00/hour)
- Sludge pumping equipment rental cost (8 hours/week @ $125.00/hour).

The maintenance labor cost is associated with conveyor belt washing, site cleanup, and cleaning/maintenance of the gravity settling system. The sludge pumping equipment rental cost is associated with the cleaning/maintenance of the gravity settling system.

Table 6.4 Option 1 - Annual Cost

Item	Annual Cost
Wastewater Discharge Fees - GVS&DD	
• Wastewater Volume	$71,613
• Total Suspended Solids	$39,420
• Biochemical Oxygen Demand	$23,725
Gravity Settling System Maintenance Labor	$108,160
Pumping Equipment Rental	$52,000
Total	$294,918

The total annual cost for Option 1 is estimated to be $290,000.

6.5 Option 2

Option 2 incorporates a sludge dewatering belt press to the existing wastewater treatment plant (Option 1). The expected post-treatment effluent concentration for TSS is 100 mg/L and for BOD_5 is 350 mg/L (Table 6.1).

The installed cost of the belt press is estimated to be $750,000.

The advantages of mechanical sludge dewatering include:

- Elimination of sludge pumping equipment rental cost
- Reduction in maintenance cost for the gravity settling system
- Reduction in wastewater discharge fees
- Compliance with proposed regulatory requirements.

Presented in Table 6.5 is a summary of the annual operation costs for this option. The assumptions used for the cost analysis are:

- Wastewater discharge fees (Table 6.2)
- Gravity settling system maintenance labor cost (24 man-hours/week @ $65.00/hour)
- Belt press annual capital recovery cost (10% interest, 10-year life)
- Belt press O&M cost (labor, power, polymer, materials & supplies) (@ $0.13/kg of solids removed)
- Total suspended solids removed (@ 110,000 kg/year).

Table 6.5 Option 2 - Annual Cost

Item	Annual Cost
Wastewater Discharge Fees - GVS&DD	
• Wastewater Volume	$71,613
• Total Suspended Solids	$9,855
• Biochemical Oxygen Demand	$16,608
Gravity Settling System Maintenance Labor	$81,120
Belt Press Capital Recovery	$122,025
Belt Press Operation and Maintenance	$14,300
Total	$315,521

The total annual cost for Option 2 is estimated to be $320,000

6.6 Option 3

Option 3 incorporates a sludge dewatering belt press and a trickling filter biological treatment to the existing wastewater treatment plant. The expected post-treatment effluent concentration for TSS is 30 mg/L and for BOD_5 is 30 mg/L (Table 6.1).

A two-stage trickling filter system is required to reduce the BOD_5 concentration from 350 mg/L to 30 mg/L. A BOD_5 concentration of 30 mg/L is normally required by regulatory agencies for direct discharge to the receiving water.

The proposed two-stage trickling system consists of two 16-meter (53-foot) diameter, 2.5-meter (8-foot) deep rock filters. The installed cost of this system is estimated to be $900,000.

The advantages of mechanical sludge dewatering and biological treatment include:

- Elimination of sludge pumping rental cost
- Reduction in maintenance cost for the gravity settling system
- Reduction in wastewater discharge fees
- Direct discharge of wastewater in the absence of city sewer connection

Presented in Table 6.6 is a summary of the annual operation costs for this option. The assumptions used for the cost analysis are:

- Wastewater discharge fees (Table 6.2)
- Gravity settling system maintenance labor cost (24 man-hours/week @ $65.00/hour)
- Belt press annual capital recovery cost (10% interest, 10-year life)
- Belt press O&M cost (labor, power, polymer, materials & supplies) (@ $0.13/kg of total suspended solids removed)
- Total suspended solids removed (@ 135,000 kg/year)
- Trickling filter annual capital recovery cost (10% interest, 20-year life)
- Trickling filter O&M cost (labor, power, materials & supplies) (@ $0.23/kg of biochemical oxygen demand removed)
- Biochemical oxygen demand removed (@ 117,000 kg/year).

Table 6.6 Option 3 - Annual Cost

Item	Annual Cost
Wastewater Discharge Fees - Receiving Water	
• Wastewater Volume	none
• Total Suspended Solids	$100
• Biochemical Oxygen Demand	$152
Gravity Settling System Maintenance Labor	$81,120
Belt Press Capital Recovery	$122,025
Belt Press Operation and Maintenance	$17,550
Trickling Filter Capital Recovery	$105,759
Trickling Filter Operation and Maintenance	$26,910
Total	$353,616

The total annual cost for Option 3 is estimated to be $350,000.

6.7 Selection of Pollution Prevention options

This section presents the application of the Weighted Sum Method for the selection of the best alternative.

The facility-specific selection criteria used are:

- Compliance with environmental regulations
- Compliance with anticipated environmental regulations
- Future environmental liability
- Waste treatment/disposal cost
- Potential for reuse/recycling of waste materials.

Presented in the followings are the weighting factors and the option scores assigned for these selection criteria.

6.7.1 Compliance with Environmental Regulations

Weighting Factor

This is an important criteria and is assigned a maximum weighting factor of 10 on a scale of 1 to 10.

Criterion Score

The GVS&DD Sewer Use Bylaw No. 164 limits the discharge of wastes into sewers and drains. The Bylaw contains effluent limits for the following categories: pH waste, oil and grease waste, suspended solids waste, specified waste, and BOD waste.

For the two pollutants evaluated in this case study, total suspended solids and biochemical oxygen demand, the GVS&DD discharge limits are:

- Total Suspended Solids - 600 mg/L
- Biochemical Oxygen Demand - 500 mg/L.

Because of variability in the influent wastewater characteristics, Option 1 may not be able to consistently comply with these discharge limits. Therefore, Option 1 is assigned a score of 8 for this criterion.

The addition of sludge dewatering allows Option 2 and Option 3 to consistently comply with the these discharge limits. Both Option 2 and Option 3 are assigned a maximum score of 10 for this criterion.

6.7.2 Compliance with Anticipated Environmental Regulations

Weighting Factor

In the future, GVS&DD may institute more restrictive effluent limits for dischargers. Any pollution prevention options should also be evaluated in terms of future environmental regulations. Because of the unknown nature of future environmental regulations, this criterion is assigned a weighting factor of 8.

Criterion Score

Option 1 can not consistently meet current regulatory requirements. It is not expected to comply fully with more restrictive effluent limits that may be established in the future. Option 1 is assigned a score of 2 for this criterion.

Option 2 and Option 3 can be expected to comply with future effluent limits. Both options are assigned a score of 8 for this criterion.

6.7.3 Potential Future Liability Reduction

Weighting Factor

Due to the nature of the operation, transshipment of agricultural products, the potential future liability of wastewater/contaminated storm water from this terminal is limited. This criterion is assigned a lower weighting factor of 5.

Criterion Score

Option 1 can not consistently meet current regulatory requirements. These effluent discharge violations may represent future sources of legal liabilities. Option 1 is given a score of 1 for this criterion.

Option 2 and Option 3 are in compliance with current effluent limits. In the absence of effluent discharge violations, both options are assigned a score of 8 for this criterion.

6.7.4 Waste Treatment/Disposal Cost

Weighting Factor

Cost is an important consideration in any pollution prevention projects. The cost criterion is assigned a maximum weighting factor of 10.

Criterion Score

Option 1 has an annual operating cost of $290,000. This is the least cost option and is assigned a score of 10.

Option 2 has an annual operating cost of $320,000. This is the middle cost option and is assigned a score of 7.

Option 3 has an annual operating cost of $350,000. This is the highest cost option and is assigned a score of 5.

6.7.5 Potential for Reuse/Recycling of Waste Materials

Weighting Factor

The waste generated should be recycled for beneficial purposes rather than disposed of in landfills. This criterion is assigned a weighting factor of 5.

Criterion Score

Option 1 requires additional on-site dewatering/drying prior to transport off-site to be used as soil supplements. Because of this dewatering/drying requirement, Option 1 is assigned a score of 2 for this criterion.

Option 2 and Option 3 generate a drier sludge which can be directly shipped off-site to be used as soil supplements. Both of these options are assigned a score of 8 for this selection criterion.

6.7.6 Weighted Sum Method Summary

Table 6.7 presents a summary of the Weighted Sum Method analysis for the three options.

Table 6.7 Weighted Sum Method for Prioritizing Waste Streams or Process Areas

Waste Stream Prioritizing Criteria	Relative Weight (W)	Score Option 1 (S1)	Weighted Score Option 1 (WxS1)	Score Option 2 (S2)	Weighted Score Option 2 (WxS2)	Score Option 3 (S3)	Weighted Score Option 3 (WxS3)
Compliance with Environmental Regulations	10	8	80	10	100	10	100
Compliance with Anticipated Environmental Regulations	8	2	16	8	64	8	64
Potential Future Liability Reduction	5	1	5	8	40	8	40
Waste Treatment/Disposal Cost	10	10	100	7	70	5	50
Potential for Reuse/Recycling of Waste Materials	5	2	10	8	40	8	40
Sum of Criteria Scores ($\Sigma(W \times S)$)			211		314		294

Among the three options, Option 2 rates the highest with a score of 314. Option 3's score is 294 and Option 1's score is 211. For the treatment/disposal of the wastewater and contaminated storm water, Option 2 is the preferred pollution prevention option.

7º Selected Bibliography

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Guide of Storm Water Best Management Practices for Selected Industrial Sectors in the Lower Fraser Basin, (Phase 1 Report, Phase 2 Report).

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Reference Workbook: Pollution Prevention Plan(Draft, December, 1994)

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Sewer Use Bylaw No. 164.

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"Source Control Program - 1992 Discharge Fees", Memo from Sewerage and Drainage Committee to Administration Board, June 11, 1992.

Handbook of Biological Wastewater Treatment, Evaluation, Performance, and Cost, Henry H. Benjes, Jr., Garland STPM Press, 1980.

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Appendix A - Pollution Prevention Environmental Review Worksheets

Pollution Prevention Environmental Review Worksheets **Worksheet A-1** **Facility Information**	
Prepared by:	Date:
General Facility Information	
Parent Organization Name: Address: City: Province/Postal Code: Telephone: Lead Person:	Subject Facility Name: Address: City: Province/Postal Code: Telephone: Lead Person:
Facility Production Information	
SIC Code(s) (post PRIMARY in No. 1) 1. 2. 3. 4. Commodity Handled: Quantity Handled (previous calendar year): Schedule of Operation: Seasonal Operating Schedule:	
Regulatory Information (check all that apply)	
• Wastewater Permit	Permit No.
• Air Permit	Permit No.
• Solid Waste Permit	Permit No.
• Special Waste Permit	Permit No.
• Other (please list)	Permit No.

Pollution Prevention Environmental Review Worksheets **Worksheet A-2** **Bulk Commodity Information**		
Prepared by: Date:		
Operations	Description	
	Commodity 1	Commodity 2
Bulk Commodity Name		
Commodity Sub-Categories 1. Agricultural (low TSS) 2. Agricultural (high TSS) 3. Industrial (low metals) 4. Industrial (high metals) 5. Industrial (miscellaneous)		
Annual Throughput (Past Year)		
Delivery Mode		
Unloading Mode		
Conveying System		
Storage Mode		
Loading Mode		

Pollution Prevention Environmental Review Worksheets **Worksheet A-3** **Material Handling Information**		
Prepared by:	Date:	
	Description	
Attribute	Commodity 1	Commodity 2
Unloading		
Unloading System/Method		
Unloading Area Open/Enclosed		
Operating Schedule		
Dust Control System		
Dust Emission Rate		
Site Cleanup Method		
Conveying		
Conveying System		
Open/Enclosed		
Belt Speed		
Belt Cleaning System		
Dust Control System		
Dust Suppression System		
Dust Emission Rate		
Spillage Locations		
Spillage Quantities		
Wastewater Volume		
Wastewater Disposal Method		
Storage		
Storage Method		
Dust Control System		
Dust Suppression System		
Dust Emission Rate		
Storm Water Volume		
Storm Water Disposal Method		

Pollution Prevention Environmental Review Worksheets **Worksheet A-3 (Continue)** **Material Handling Information**		
Prepared by:	Date:	
	Description	
Attribute	Commodity 1	Commodity 2
Loading for Transport		
Loading System/Method		
Dust Control System		
Dust Suppression System		
Dust Emission Rate		
Spillage Locations		
Spillage Quantities		
Site Cleanup Method		

Pollution Prevention Environmental Review Worksheets **Worksheet A-4** **Waste Management Information**	
Prepared by:	Date:
Attribute	Description
Maintenance Shop	
Types and Quantities of Fuel	
Fuel Storage System	
Quantity of Oil	
Waste Oil Disposal Method	
Waste Coolant Disposal Method	
Types and Quantities of Chemicals	
Chemical Storage Method	
Type and Quantities of Solvents	
Solvent Disposal Methods	
Spill cleanup Method	
Wastewater/Storm Water Management Practices	
Treatment System	
Discharge Volume	
Final Discharge Point	
Storm Water BMPs	
Environmental Permit Requirements	
Air Emission Permit Limits	
Air Emission Data	
Air Emission Bylaw Fee	
Wastewater Permit Limits	
Wastewater Discharge Data	
Sewer Fee	

Pollution Prevention Environmental Review Worksheets **Worksheet A-5** **Cost Information**	
Prepared by:	Date:
Attribute	Cost
Dust	
Dust Control Equipment	
Dust Control Operating and Maintenance	
Dust Suppression	
Spillage	
Spillage Cleanup	
Wastewater/Storm Water	
Treatment System	
Treatment Operating and Maintenance	
Storm Water BMPs	
Storm Water BMPs Operating and Maintenance	
Indirect Costs	
Environmental Administrative	
Regulatory Compliance	
Waste Disposal	

Appendix B - Pollution Prevention Potential Assessment Worksheets

Pollution Prevention Potential Assessment Worksheets **Worksheet B-1**	**Storm Water Best Management Practices**
Prepared by: Date:	
Fuel/Lubricant/Chemical Storage	
Above-Ground Storage Tank	
Surrounded by secondary containment structure. Containment volume is the larger of either 10 percent of the volume of all tanks or 110 percent of the volume of the largest tank. The floor within the containment is covered with an impervious surface to prevent ground water contamination in the event of spills. Double-wall tanks maybe used in place secondary containment	• yes • no
Overfill protection on storage tanks.	• yes • no
Oil/water separator for treating petroleum contaminated storm water runoff.	• yes • no
Regular cleaning of oil/water separator	• yes • no
During the wet season, accumulated storm water is released frequently.	• yes • no
Secure the designed storage area to prevent unauthorized person accessing storage tanks and causing spills.	• yes • no
Segregate and store incompatible or reactive materials in separate containment areas to prevent the mixing of chemicals should spills occur.	• yes • no
Regular inspect all containers for deterioration and leakage. Inspect the lids of drums to ensure they are in place and properly secured. Immediately contain leaks and repair the source.	• yes • no
Use drip pans for opened tanks/drums to contain minor spills and drips during transfer.	• yes • no
Develop spill prevention and emergency cleanup plan.	• yes • no
	• yes • no
Loading and Unloading of Liquid Materials	
The loading/unloading area is paved with Portland cement concrete and graded to prevent run-on of uncontaminated storm water from adjacent areas.	• yes • no
Loading/unloading docks are designed so that spills that are not completely retained can be discharged to the city sewer, process treatment, or a dead-end sump.	• yes • no
Drip pans are placed at locations where spillage may occur such as hose connections, hose reels, and filler nozzles. Drip pans should also be used when making and breaking connections.	• yes • no
Implement tank filling procedures to prevent spills and overfills.	• yes • no

Pollution Prevention Potential Assessment Worksheets **Worksheet B-1 (Continue)**	**Storm Water Best Management Practices**
Prepared by: Date:	
Vehicle/Equipment Maintenance/Washing	
Vehicle/Equipment Maintenance	
The area should be paved with Portland cement concrete and graded to prevent storm water runoff and the run-on of uncontaminated storm water from adjacent areas.	• yes • no
Oil/water separator for treating petroleum contaminated storm water runoff.	• yes • no
Regular cleaning of oil/water separator.	• yes • no
Waste solvents are properly disposed by registered waste hauler.	• yes • no
Vehicle/Equipment Washing	
The vehicle and equipment washing areas are enclosed to prevent the entry of precipitation and contain the wash water.	• yes • no
Outdoor vehicle and equipment washing areas are paved with Portland cement concrete and graded to prevent storm water run-on from adjacent areas and to contain the wash water. Wash water is discharged to the city sewer or to oil/water separators or detention ponds.	• yes • no
General Housekeeping	
Regularly use front end loaders and vacuum sweepers to reclaim spilled commodities. Washdown is minimized.	• yes • no
Conduct daily inspection of the terminal for leaks and immediately repair the source.	• yes • no
Regularly inspect and clean catchbasins and drainage inlets to ensure proper operation. Catchbasins should be cleaned if the depth of deposits are equal to or greater than 1/3 of the depth from the basin to the invert or the lowest pipe into or out of the basin.	• yes • no
Storm Water Flow Segregation	
The terminal is graded or curbed to prevent the runoff of contaminated storm water and the run-on of uncontaminated storm water from adjacent areas. Uncontaminated storm water and storm water runoff from rooftops may be discharged to the storm drain below the treatment system or directly to the receiving water.	• yes • no
Contaminated storm water is collected and sent to runoff treatment.	• yes • no
The open stockpile areas are paved and sloped to minimize the pooling of water and leaching of the commodities. A minimum slope of 1.5 percent is recommended to minimize the pooling of storm water.	• yes • no
The conveyor corridor, transfer points, and loading/unloading areas are graded to minimize dispersion and to improve sweeping and washdown.	• yes • no
Areas requiring washdown are paved and curbed to contain the washwater from reaching storm drains. The washwater is conveyed to runoff treatment.	• yes • no

Pollution Prevention Potential Assessment Worksheets	
Worksheet B-2	**Material Handling System**
Prepared by: Date:	
Unloading	
Dumpers	
End dumpers are used only for low dust potential products such as wood chips and aggregates.	• yes • no
The dumper is enclosed with minimum sized openings.	• yes • no
Provide flexible screens, drapes, or air curtains to minimize dust escaping.	• yes • no
Control interior dust levels by scrubbers or baghouses.	• yes • no
Regularly clean baghouse fabric filter to maintain high removal efficiency.	• yes • no
Mobile and Grab	
The unloading area is paved to reduce vehicle vibrations.	• yes • no
Regularly clean up spilled products to minimize dust creation.	• yes • no
Spray water onto the unloading area to suppress dust.	• yes • no
Install hopper down draft collection systems or water mists at the receiving hopper to collect and suppress dust created during the dumping process.	• yes • no
Stop operation during windy conditions.	• yes • no
Conveying	
Belt Conveyors	
Use proper belt speeds for the products being conveyed.	• yes • no
Use slower belt speeds for dusty materials. Higher belt speeds can cause higher dust emissions and spillage.	• yes • no
Use water or dust suppression agents along the transfer points of the conveyors to minimize dust generation.	• yes • no
Install dust collectors at transfer points.	• yes • no
Regular reclaim spilled materials using sweepers or front end loaders.	• yes • no
Remove material from the return conveyor belt with belt scrapers or belt wash.	• yes • no
Install dripping tray underneath the conveyor to catch spills and drippings.	• yes • no
Enclosed the conveyor system.	• yes • no

Pollution Prevention Potential Assessment Worksheets **Worksheet B-2 (Continue)**	**Material Handling System**
Prepared by: Date:	
Storage/Reclaim	
Open Stockpiles	
Minimize free falling of products during stacking.	• yes • no
Use telescopic chutes or choke feeders where they are consistent with the flow rates and products.	• yes • no
Use water sprays for dust suppression.	• yes • no
Use short duration, low level, localized sprinklers to increase surface moisture content.	• yes • no
Use high mast, continuous, area sprays utilizing the wind to distribute mists to maintain stockpile moisture levels.	• yes • no
Coordinate water addition with weather forecasts to minimize the water volume and to prepare for upcoming windy conditions.	• yes • no
Use crusting agents such as latex for products not compatible with water or extended storage duration.	• yes • no
Use water sprays to increase the moisture content during reclaiming.	• yes • no
Install wind breaking nets around piles to minimize the effect of prevailing winds on open piles.	• yes • no
	• yes • no
Covered/Enclosed Stockpiles	
Control indoors dust levels with fabric filters (baghouses). As a guide, the filtering velocity ranges from 15 to 100 $m^3/hr/m^2$ of cloth area. For fine dust removal, use lower filtering velocity (10 to 20 $m^3/hr/m^2$).	• yes • no
	• yes • no
Clean filter bags periodically to maintain high removal efficiency and to reduce pressure loss.	• yes • no
Loading for Transport	
Rail car and Truck Loading	
Use telescoping chutes to load products to minimize spillage and reduce the free fall height of the product to decrease dust emissions.	• yes • no
Shiploading - Landside	
Install and maintain proper belt cleaning equipment to remove products adhered to the belt.	• yes • no
Enclosed conveyors leading up to the shiploading to eliminate dust emissions.	• yes • no
Incorporate pans under conveyors for new shiploaders to collect spillage. It may not be feasible to add pans to existing shiploaders due to structural and physical limitations.	• yes • no

Pollution Prevention Potential Assessment Worksheets	
Worksheet B-2 (Continue)	**Material Handling System**
Prepared by: Date:	
Loading for Transport	
Shiploading - Shipside	
Install telescoping chutes or coke feeders to control product flow and minimizes wind effects. They are not always practical with high flow rates.	• yes • no
Maintain proper moisture content for moisture sensitive products such as coal and sulphur to minimize dust generation.	• yes • no
Create a water fog in the ships hatch to settle dust particles for non-moisture products.	• yes • no
Cover the hatch during loading or install dust collection or dry dust suppression system for products that must remain dry.	• yes • no

Pollution Prevention Potential Assessment Worksheets				
Worksheet B-3				**Wastewater/Storm Water Collection/Treatment**
Prepared by:	Date:			
Recovery of Spilled Material				
Provide separation and recovery of spilled material close to the source of spillage.	• yes	• no		
Construct primary settling basins to collect washdown water and runoff from open stockpiles close to the area where the material is being handled.	• yes	• no		
If acceptable, return materials recovered from the primary settling basins to stockpiles.	• yes	• no		
Wastewater Treatment				
Segregate washwater from areas that handled different products to provide optimal waste treatment.	• yes	• no		
Convey contaminated storm water to wastewater treatment plant or to the city sanitary sewer system.	• yes	• no		
Install catchbasins at various locations along the drainageways to allow the bulk of the solids to settle to minimize the loading to the wastewater treatment plant.	• yes	• no		
Implement best available technology for the treatment of wastewater.	• yes	• no		

Appendix C - Pollution Prevention Plan

Pollution Prevention Plan

(1) Facility Pollution Prevention Policy:

Facility Name: _____

Management Policy:
Write a management policy expressing support for planning and a commitment to implement planned activities and achieve established goals.

Scope and Objectives:
Identify the facilities and/or processes to be covered by the plan. State the objectives to be achieved through planning and implementation.

Management Signature:
The owner, chief executive officer, or other person with the authority to commit management to the plan must sign the plan.

Prepared by: **Date:**

Pollution Prevention Plan

(2) Facility Information:

General Facility Information	
Parent Organization Name: Address: City: Province/Postal Code: Telephone: Lead Person:	Subject Facility Name: Address: City: Province/Postal Code: Telephone: Lead Person:
Facility Production Information	
SIC Code(s) (post PRIMARY in No. 1) 1. 2. 3. 4. Manufacturing Processes: Product or Service: Production or Service Level(s) (previous calendar year): Schedule of Operation: Seasonal Operating Schedule:	
Regulatory Information	
• Liquid (Effluent) Waste Permit	Permit No.
• Air Permit	Permit No.
• Solid Waste Permit	Permit No.
• Special Waste Permit	Permit No.
• Other (please list)	Permit No.

Pollution Prevention Plan

(3) Facility Profile:

Write a facility profile describing the terminal operations. The facility profile should contain information on:

- Types and quantity of dry bulk material(s) handled
- Material handling system
- Storage system
- Air emission sources
- Characteristics of air pollutants
- Air management practices
- Wastewater and storm water sources
- Characteristics of wastewater and storm water
- Wastewater and storm water management practices
- Fuel, lubricant, and chemical storage
- Environmental permit requirements and performance.

Drawings and flow diagrams that describe the facility, material handling process, air emission control systems, and wastewater/storm water treatment process should also be included in the facility profile.

Pollution Prevention Plan

(4) Summary of the Environmental Review:

1. List each source of dust emission and product spillage.

Location	Product Type	Estimated Quantity	Disposed or Recycled
Unloading			
Conveying			
Storage			
Loading for Transport			

2. List each source of wastewater and contaminated storm water.

Location	Estimated Volume	Pollutant Concentration	Discharge Point
Unloading			
Conveying			
Storage			
Loading for Transport			

3. List each Waste Material which contain hazardous substances or active agents of concern.

Waste Material	Amount Produced	Hazardous Substances or Active Agents	Amount of Hazardous Substances or Active Agents	Generating Area

Current and Past Pollution Prevention Activities:
Describe any reduction, recycling, storm water BMPs, and treatment activities currently underway at the facility.

Describe any hazardous substance use or hazardous waste reduction activities already completed. If possible, estimate the reductions achieved and the implementation cost and any cost saving achieved.

Pollution Prevention Plan

(5) Prioritized Potential Pollution Prevention Areas/Options:

Locations/Areas	Ranking	Potential Pollution Prevention Options	Media air/water/solids
Storm Water Best Management Practices			
Fuel/Lubricant/Chemical	1		
	2		
	3		
Vehicle/Equipment Maintenance/Washing	1		
	2		
	3		
General Housekeeping	1		
	2		
	3		
Storm Water Flow Segregation	1		
	2		
	3		
Material Handling System			
Unloading	1		
	2		
	3		
Conveying	1		
	2		
	3		
Storage/Reclaim	1		
	2		
	3		
Loading for Transport	1		
	2		
	3		
Wastewater/Storm Water Collection/Treatment			
Recovery of Spilled Material	1		
	2		
	3		
Wastewater Treatment	1		
	2		
	3		
Other Areas			
	1		
	2		
	3		
	4		
	5		

Pollution Prevention Plan

(6) Proposed Pollution Prevention Options:

List the proposed prioritized feasible pollution prevention options. For each option, the process(s) it affects should be identified, and estimates of the amount of the reduction in pollutants generated or discharged.

Option Category	Locations Areas	Pollution Prevention Options	Media (air, water, solids)	Pollutant Reduction
Source Reduction				
On-site Reuse				
Off-site Reuse				
Material and/or Energy Recovery				
Residual Waste Management				

Pollution Prevention Plan

(7) Five-Year Pollution Prevention Implementation Plan:

1. Develop a schedule for implementing the pollution prevention options selected. Indicate when, in the next five years, the options or phases of options will be implemented. Provide an expected completion date if implementation will take longer than five year.

Pollution Prevention Options	Estimated Implementation Date (month/year)					
	Year 1	Year 2	Year 3	Year 4	Year 5	Later

2. Provide estimates of the total costs and benefits to be realized from implementing the selected pollution prevention options over the five year life of the plan.

Pollution Prevention Options	Estimated Total Costs and Benefits (costs/savings)					
	Year 1	Year 2	Year 3	Year 4	Year 5	Later