Final Report: Task B2

Cleaner Production/EMS Audits of Two Industrial Facilities

Institutional Strengthening for Enhanced Environmental Management of Kingston Harbour

Component B

Improving the Environmental Performance of Industries Discharging to Kingston Harbour

Report Prepared for
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Table of Contents

Section 1 EXECUTIVE SUMMARY

This report presents our findings for the second of four tasks of Component B of the Inter-American Development Bank funded project that addresses the improvement of the environmental performance of industries discharging trade effluent into Kingston Harbour, Jamaica.

The objectives of this task were to:

1. Select and audit two facilities as models for improving industrial environmental performance through applying a combination of cleaner production measures and adopting an Environmental Management System (EMS).
2. Conduct an initial environmental review (IER) which is one of the key steps in developing an EMS and which can be viewed as a detailed environmental audit.
3. Identify opportunities for cost savings, process efficiency improvements, and waste reduction and provide associated preliminary cost estimate.
4. Provide the basis for the selected firms to adopt an EMS over time.
5. Delineate NEPA's monitoring and reporting requirements

The two industrial facilities were selected based on information collected in task B1. Criteria for the selection were reviewed and approved by NEPA and were applied to the 55 facilities identified in Task B1. The two facilities selected were J Wray and Nephew Limited located on Spanish Town Road in Kingston and Trade Wind Citrus Limited located in Bog Walk, St. Catherine.

The companies were advised of their selection by NEPA and the information requirements and work plan for the audits were provided to the companies in advance of meetings held with the management team of both facilities. The work plan was discussed and confirmed during the initial meetings. Both management teams were very helpful and assigned senior staff personnel to accompany us during the visit and to provide detailed information about their facilities. Additional information was also requested that was later forwarded to our office. During our information gathering, we also provided each company with proposed solutions to some immediate concerns and minor issues. There was generally consultative transfer of know–how both in environment wastewater treatment as well as water use management and specific process operations.

At the end of a two-day initial environmental review of each facility, a brief Power Point presentation was given to management of our findings outlined the areas of concern and the direction we were taking to complete the audit. These presentations were developed as the Terms of Reference for the completion of the audit.

The operations were characterized in terms of unit operations that generated trade effluent and their inputs and outputs. These were benchmarked against processes in similar industries. The benchmarking identified opportunities for improvement in terms of more efficient operation, the use of better (more cost effective) alternatives, reduced effluent loading etc.

The audit was documented in two ways: the typical development audit report and the preparation of a case study (or success story) that documented the changes that are recommended (technology, process improvement and pollution control as the case may be), the cost estimates involved and the benefits to the environment and to the bottom line. It is

suggested that such case studies be publicized by NEPA (e.g., posted on the NEPA web site) so that they can serve as examples to other industries.

As a component of this task the plant personnel was advised on NEPA's regulatory requirements (monitoring, reporting, and preparation of compliance plans) as provided in the NEPA (proposed) regulations. This will be valuable to the companies in implementing a full-blown EMS and conforming to the regulations.

The main outputs from the audits which will be of value to the company, and can serve as models for other companies, were;

- Initial Environmental Review (IER) Report;
- Outline and costing of the Pollution Prevention/Cleaner Production/Pollution Control Programme;
- Delineation of NEPA's monitoring and reporting requirements;
- A blueprint for the implementation of an EMS at each facility

Section 2 INTRODUCTION

As a part of project activities supporting industrial enforcement by NEPA, two facilities were selected as models for improving industrial environmental performance through applying a combination of cleaner production measures and adopting an Environmental Management System (EMS). These two facilities were J Wray and Nephew Limited (JWN) and Trade Wind Citrus Limited (TWC).

Our first activity was to select the two industrial facilities to be audited. We worked closely with NEPA in reviewing the output from Task B1 and other reports on the industries which discharge wastewater that impacts Kingston Harbour. The information compiled for Task B1 was analysed to identify facilities likely to have common waste water treatment processes and also similar production processes. These were used to identify the potential for pollution prevention/cleaner production processes to devise pollution control measures. The selection criteria included pollution load, the numbers of industries with similar processes and the complexity of the operation. A key consideration in the selection was how useful the results and experience of the audit will be to other industries.

The second activity was to conduct the initial environmental review (IER). We conducted the review along the lines of an EMS development audit. Meetings were held with the management team, Terms of Reference were developed and agreed, the audits were conducted and closing meetings were held. During the conduct of the review the environmental aspects were identified which are one of the bases for the development of an EMS.

During the review we examined the unit operations at each of the two facilities to determine opportunities for pollution prevention, cleaner production and pollution control. The operations were characterized in terms of inputs and outputs and benchmarked against similar processes in identical industries. The benchmarking identified opportunities for improvement in terms of more efficient operation, the use of better (more cost effective) alternatives, reduced effluent loading etc.

During our review we advised plant personnel on how to satisfy NEPA's regulatory requirements (monitoring, reporting, and preparation of compliance plans) as required in the NEPA (proposed) regulations.

The main outputs from the audits were:

- Initial Environmental Review (IER) Report;
- Outline and costing of the Pollution Prevention/Cleaner Production/Pollution Control Programme;
- Delineation of NEPA's monitoring and reporting requirements;
- A blueprint for the implementation of an EMS at each facility

Section 3 OBJECTIVES

The objectives for this task were to:

Provide an Initial Environmental Review (IER) Report based on the audit of two facilities;

Outline and costing of Pollution Prevention/Cleaner Production/ Pollution Control Programme;

Delineation of NEPA's monitoring and reporting requirements;

Provide a blueprint for the implementation of an EMS at each Facility

Section 4 BACKGROUND & FACILITIES SELECTION

Prior to the commencement of the audit, we obtained available information on the EAST - US AID project for all companies that discharge into Kingston Harbour and set-up a matrix to select facilities that would serve as models to other facilities discharging into Kingston Harbour.

EAST Audits Review

We obtained from the Jamaica Manufacturers' Association (JMA) a list of their member companies that were included in the EAST project. Seven companies completed EAST audits and five others (including J Wray and Nephew) planned to undertake but have not yet conducted the audits. The audit reports that were completed were not available for review since they were confidential.

Overview of Facilities in the Study Area

Criteria used for the initial selection of facilities were those facilities that a) are potentially licensable under the proposed Wastewater and Sludge Regulations, and b) discharge trade effluent that lead directly or indirectly into Kingston Harbour via gullies, sewers, rivers (Rio Cobre, Fresh River/Salt River/Duhaney Rivers) or underground aquifers. The proposed regulations prescribe a limit of 4,000,000litres/yr (1,056,800 U.S. gallons/yr) above which facilities are required to obtain a licence. Facilities that discharge toxic pollutants that pose threats to human health or the environment may also be required to obtain a licence even though the discharge may be below the prescribed limit. Since information on the annual volumes of trade effluent discharges was limited but water use information over a recent three-month period was readily available, the latter was used as the basis for identifying facilities in the study area.

Some 125 facilities that discharge trade effluent directly or indirectly into Kingston Harbour were initially identified of which 70 were eliminated based on telephone calls, a review of information available at NEPA and our knowledge of industries in the study area. There were 47 facilities that were likely to require a trade effluent licence and 8 with unknown or uncertain water use but which have activities that could trigger a trade effluent licence.

Information was obtained from 39 of the 55 industrial facilities in Kingston, St. Andrew and St. Catherine based on responses to questionnaires and site visits.

The majority of facilities (31) were located in the western parts of Kingston and St. Andrew (KSA West) which includes the Spanish Town Road and adjacent areas and 7 facilities in the KSA East area (Rockfort and Windward Road areas). There were 11 facilities in the St. Catherine South (Spanish Town, Twickenham Park and surrounding areas) and 6 facilities in St. Catherine North (Bog Walk/Ewarton).

The majority of facilities (30) were engaged in the manufacture of food products and beverages followed by those facilities (13) that manufacture chemicals and chemical products.

Only 4 facilities in the downtown and Bell Road areas discharged into the National Water Commission (NWC) sewer system and the remainder discharged into gullies, roadside drains, streams or the underground that eventually lead to the Harbour. There were 2 facilities in St. Catherine South that discharged some of their effluent into irrigation canals.

There were 25 facilities that had some type of on-site system to treat some or all of their trade effluent of which 13 currently (within the past year) monitored the effectiveness of the treatment system to determine compliance with NEPA Trade effluent standards. At the other 8 facilities with some type of treatment system, monitoring was not current or was done at irregular intervals. There were 15 facilities without any wastewater treatment system, of which 5 currently made scheduled measurements of trade effluent. The status of treatment systems at the remaining 19 facilities was unknown.

Process Used to Select Two Facilities for Audit

In order to establish the rationale for the selection of the two facilities, nine criteria were established that were carefully examined. The two facilities that were selected fulfilled the required criteria. The criteria included: BOD content (contaminant load), nature of the discharge (direct or indirect discharger), waste water treatable by conventional technologies, willingness to participate, serve as a model for other facilities, room for improvement, multiple facility benefit and a facility where the cost of implementation will not have detrimental economic effect.

A spreadsheet was prepared with a list of the criteria and names of the plant facilities. A number ranging from 1 to 10 was given to each facility with 1 being the lowest (not satisfying the requirements) and 10 complete satisfaction. The BOD content was based on (actual load for the facility /load for the facility with the highest load) ×10; this heavily weighs the facilities with high loads. For direct dischargers, facilities having sewers were given a score of zero and others were given a score of 10. Scores for wastewater treatable by conventional technologies were done based on the type of company and the type of contaminants found in the wastewater. The contaminants were biological, domestic or industrial. Room for improvement was established based on the concentration data. Scores given for willingness to participate were done based on the completion of the questions that were asked in the interviews, companies that did not complete the questionnaire were given a score of zero. The capability of a facility to serve as a model depends on the uniqueness of the facility; unique facilities were given a lower score.

The facilities were then ranked based on the total score. The two highest ranking facilities indicate those that best satisfy the requirements and consequently these facilities were selected.

Section 5 INITIAL ENVIRONMENTAL REVIEW (IER)

The reviews were conducted on a 2-day per facility basis. On Day 1, each review involved a meeting with management and a meeting with the engineers. This was followed by discussions and gathering of information regarding the plant (site plan), process flow

diagrams, unit operation design flow, wastewater data and reports (water balance and treatability reports), material safety data sheets (MSDS), sewage treatment information and drainage information. Preceding this gathering of information, a plant tour was made for each facility to fully understand the operations and identify areas of concern. On Day 2, testing and sampling were done, and treatability tests were conducted and conclusions and remarks were given in a presentation at the end of the day.

In our review we identified opportunities for effluent reduction, contaminant loadings reduction, cost savings, process efficiency improvements, and general waste reduction. In addition, we provided discussions on the basis to adopt an EMS over time.

J Wray and Nephew Limited

Observations

J. Wray & Nephew Ltd. is located on two properties – to the north and south sides of Spanish Town Road. The premises on the north side of the Spanish Town Road house the rum stores, a well and a reverse osmosis plant. The premises on the south side, 234 Spanish Town Road, have a winery, bottling lines for rum cream and the Tia Maria plant (on the east side). Tia Maria plant accounts for approximately 16% manufacturing. The typical water usage in 2004: 655,000 L/month for blending hall, 2,924,000 L/month for L.A.B. ,879,700 L/month for P.E.W. #4, 1,968,100 L/month for production offices & FGW, 891,177 L/month for north complex, 1,286,800 L/month for east complex and 1,803,893 L/month for other areas.

The company is classified in the International System for Industrial Classification (ISIC) as 1551. They manufacture bottled rums, bulk rums, liqueurs and wines. It has an annual capacity of 26-million L/yr.

Raw materials used for production include, just to name a few: ethanol, sucrose, milk derivatives, fructose, flavours, ammonium phosphate, quaternary ammonium compounds, sodium hydroxide, hydrochloric acid, caramel and carbon based sanitizers.

Industrial wastewater is generated from vat cleaning and general housekeeping operations. Products and other materials enter the wastewater streams from spillages and washing operations.

Domestic sewage flows by gravity to a sewage pumping station from where it is pumped to a package aerobic treatment plant. Only wastewater from the sewage pumping station is treated before discharge.

Base wine bottoms sludge is transported via tankers to two (2) bio-digesters which are located adjacent to the sewage pumping station. The tankers that are used to transport bottoms to the digesters hold approximately 7,570 L (2000 gallons) and five of these tankers are drained and washed per day.

The volume of base wine bottoms sludge is approximately 37,500 L/month. This sludge is pre-treated in the enzyme aerobic bio-digester before it is gradually bled off to the sewage pumping station. It is finally treated along with the domestic sewage in the aerobic sewage plant before discharge. A cesspool emptier removes the waste solids from the sewage plant on a regular basis. (See Appendix B for process flow diagram for J Wray and Nephew).

The rum vats are washed and steamed, the wash down process takes about twenty minutes at approximately 37.5 L/min (10 gpm). We estimated that the Line 1 pump capacity is 200 L/min (52.8 gpm) and Line 5 pump capacity is 100 L/min (26.4 gpm) delivering approximately 12,000 L of base wine bottoms to the digesters. It is then diluted down with approximately 6,000 L of city water to get the alcohol concentration down to a level for the enzymes to work effectively; it is then charged with Duzyme enzymes and aerated. The digester is aerated through a sparger at the bottom of the tank. Each digester is 18,000 L. The feed BOD is 40,950 mg/L or 491.4 kg/batch. Dilution is down to 27,300 mg/L BOD at day 0. After 10 days the BOD is down to approximately 9,180 mg/L. The treated sludge is then bled into the sewage pumping station at approximately 60 L/h (15.8 gpm) and further treated in the packaged activated sludge plant before discharge to the environment.

The wastewater streams are from the Bottling Hall (Wash down) (Drain S1), Blending Hall and RO plant (Drain S2), Winery and LAB (Drain S3), Sewage Plant (Drain S4) and the Estate Industry operation (Drain S5).

The sampling points referred to the J. Wray & Nephew Group (Estate Industries Ltd.) wastewater streams are North complex – RO discharge manhole and North complex drain to the Spanish Town Rd. The sampling points referred to the J. Wray & Nephew Ltd. wastewater streams are Bottling Hall (Wash down) (Drain S1) and Sewage influent.

Grab samples that were taken from a few wastewater streams during our audit are presented below:

S1 for Bottling hall	=	603/583 mg/L BOD	2,500 mg/L COD
S2 for Blending hall	=	513 mg/L BOD	8,200 mg/L COD

The RO effluent had TDS 2,200 mg/L.

No composite sampling was done.

The Bottling hall uses Maxim plate filters to filter Vodka after it is treated with carbon. This drain is high in Vodka content and has carbon particles which settle out in the open trench.

Diatomaceous earth is used during fining of the wine. Because of the diatomaceous earth the wine from the base wine or ginger wine bottoms cannot be reused.

We had discussions about an anaerobic plant and JWN suggested that they would not entertain the additional risk of having flammable gases along with their flammable alcohol products.

Sewage Treatment Plant (STP)

The sewage treatment plant is a packaged activated sludge plant having capacity of 95,000 L/day (25,000 gpd) for feed of 350 mg/L BOD. It is able to treat approximately 33.25 kg/day BOD. Chlorine tablets are used for disinfection at the STP. The flow to the STP is unsteady because the feed is from the pump station that is operated on level control. Periodically 18000 L (4750 gal) of liquid waste in each batch is released slowly from Bio Digesters to the pump station and pumped to the sewage treatment plant. About 165 kg/batch BOD shock load influences the operation of the STP.

Analysis of J Wray and Nephew

We observed that the major problematic wastewater streams are the Base Wine Bottoms to the Digester, the Ginger Wine Bottoms Sludge and the General Housekeeping wastewater. The problems and recommendations associated with the J Wray and Nephew facility are indicated below.

Problems/Recommendations

High Alcohol Content of Base Wine Bottoms Feed to Digesters

The process of dilution of Base Wine Bottoms could be changed. The alcohol content has to be reduced from 15% to less than 5% for the enzymes to work properly. We recommend that instead of using city water to dilute the base wine bottoms before digestion that plant may use wastewater for the dilution. This will reduce the amount of water used and also reduce the total volume of effluent. This can be accomplished by installing a sump with a pump on the wastewater drain flowing pass the bio-digesters. The pump would be used to pump wastewater into the digesters to dilute the base wine bottoms.

Inefficient Water Usage to Wash Down and Clean Vats

Collect the first 5 minutes of wash down by using the existing wash down pumps to pump wastewater to tanker trucks for transfer to holding tank for the digester and reuse first rinse in process either in lower grade product or in the same product (first wash is the diluted product).

Ginger Wine Bottoms

The Ginger Wine bottoms sludge is a major problem because the bottoms do not flow in the drains; it builds up in the drains and must be washed down. Bentonite clay is added to the vat for the wine to clarify. After the clay has settled the wine is drawn off from the side nozzle and filtered to produce the wine. After all the wine is drawn off, the bottoms are transferred to another vat, which keeps the bottoms for another process, and more wine is recovered from the bottoms. At the final step the ginger wine bottoms sludge is gradually dumped in the drain and is discharged to the gully at the back of the plant.

Since the digesters are aerated through spargers at the bottom of the tank, there is a legitimate concern that the ginger wine bottoms sludge would clog up the spargers in the digesters. This is the reason why the Ginger Wine bottoms sludge is not currently treated.

Since the BOD for the Ginger Wine bottoms is very high and the pH is very low, it would require dilution by other wash water streams before going to a treatment system. Currently, these bottoms are not treated and are discharged directly to the gully. The main problem is that the bottoms do not flow easily in the trenches and they have to be washed down constantly to move it along the trench. This uses a lot of wash water. It is our opinion that the Ginger Wine bottoms could be easily screened using an internal rotary screen to remove the heavy settable material. This material can then be compacted a grape press such as a Vincent Press and this heavy sludge can be sent to a landfill or used in animal feed.

The use of a centrifugal and vacuum filter to thicken the ginger wine sludge for disposal was discussed. The ginger sludge was disposed of in a landfill but vagrants were harvesting the ginger hence it was stopped. The possibility of it being harvested again will start once the

sludge is disposed of at the landfill site - this is because it is almost all ginger except for the bentonite from the fining process which makes it contaminated and not edible.

The screened bottoms can further settle by using an inclined plate separator to thicken the sludge and a vacuum filter used to further dewater the sludge from the inclined plate separator. The cake from the filter will be combined with the cake from the Grape Press and disposed of.

At this stage the Ginger Wine bottoms effluent should be added with the base wine bottoms and treated by enzymes in the bio-digesters.

Shock loadings on existing treatment system

The domestic sewage load is 33 kg BOD/day and the Biodigesters would produce 165 kg BOD/day. That means over five times the BOD load. In order to optimise the use of the STP there is a need for an equalization tank to maintain a steady feed to it. Usually the digesters are not drained if the STP cannot take the load. The equalization tank would allow for a steady discharge of the digesters and would allow the digesters to be available for service more than it is now

Product samples and Laboratory Drain

It is our understanding that the product samples that are used in the laboratory are discharged into a drain that leads directly to the environment. If this is the case we would recommend collection and disposal of the samples or discharge of the samples into the domestic sewers leading to the STP, where it would be treated before discharge to the environment.

Best Management Practices

We also observed the following areas where best management practices could be adopted:

Leaks from pumps, lines and etc.

Elimination of product leakages by establishing the proper O& M procedures is highly recommended.

Tank rinsing procedures

Rinsing procedures should be established as follow: to take most products out, then clean in place (CIP). The purpose is to reduce water use. Also we recommend evaluating CIP - automatic clean in place in order to reduce chemicals use, reduce water use, better cleaning of tanks and all production lines,

Combined streams in production/processing drains

Separate production/processing drains from rainwater to try treating the streams in some other way. Also there could be an effort made to separate comparatively clean wastewater from dirty wastewater. For example: to separate wastewater streams from storm water streams, extend drain pipes and lay them in the open trenches, then have central collection sumps in the south east corner and install a small treatment system. Alternatively, install a sump with a pump station that pumps the wastewater back to activated sludge plant or to the bio-digesters.

Ineffective hose nozzles

The use of hoses with spring nozzles, automatic shut-off hoses would reduce wash water. A spray ball valve could also be used. The spray ball is a simple yet a highly effective device for the internal washing of process and storage tanks. A spray ball, powered by the cleaning fluid, generates a high-pressure spray to clean every vessel. There is only one moving part and there is no maintenance whatsoever.

Keeping wastes off the floors and out of the drains

Dry clean up before water washing. Instead of draining the waste some of it could be collected in the tank for disposal.

These recommendations will be carefully examined and a feasible method of controlling possible contamination to the Kingston Harbour will be determined. With the adaptation of the Best Management Practices the most practicable solution can be achieved more easily.

Trade Winds Citrus Limited

Observations

Trade Winds Citrus Limited is located in Bog Walk, St Catherine. On south-east and south-west sides the facility is bordered by the Rio Cobre. The premises include main manufacturing building, cool rooms, administrative buildings, tractors / machinery repair workshop, generator room, motor vehicle repair station. The typical annual water usage is 227,000,000 L/yr, 80% of which is used in the products. (See process flow diagram appendix C).

The company is classified in the Standard Industrial Classification (ISIC) as 1554. They produce packages of fresh fruits, frozen juice concentrates, fresh juices and drinks. Juice concentrate is produced during the season from December to June from fresh oranges. This concentrate is then used all year to blend a variety of fruit drinks. Trade Winds Citrus produces approximately 5000 drums of frozen juice concentrate every year and 22,710,000 L (6,000,000 gallons) of fresh juices. The company employs about 80-100 employees (high number stands for season job) in 2 production shifts a day.

Raw materials used include various fruit concentrates, sugar, sorbic acid, sodium benzoate, caustic soda, stabilizers, phosphoric acid, citric acid and mallic acid.

Trade wastewater is generated from oranges washing, barometric condensers effluent, vessels and machinery cleaning and general housekeeping operations. Products and other materials enter the wastewater streams from spillages and washing operations.

Domestic sewage is treated by solids separation from the waste flow in conventional septic tanks. Then sanitary effluent combines with some trade wastewater streams and flows to ponds system or straight to Rio Cobre River.

Sewage Treatment Plant (STP)

Wastewater is treated in three (3) large sedimentation ponds connected in series. They sample at the influent to pond, effluent from the pond, upstream of the river and downstream of the river. Discharge point from the ponds is located downstream of drains

from Jamaica Citrus Growers (JCG) facilities and Nestle manufacturing plant into the Rio Cobre River.

Analysis of Trade Winds Citrus Limited

The possibility of Trade Winds Citrus providing treatment on their site for wastewaters from Nestle and Jamaica Citrus Growers was discussed. At the moment company is not interested in such option.

We observed that the major wastewater streams are from the caustic wash cycles, storm water combined sewers, oily water discharge system, general wash water and house keeping water.

Problems/Recommendations

Inefficient Use of Caustic & Water

This happens due to the wash down and cleaning of Process Vessels. It is recommended that to collect wastewater of the first 5 minutes of wash down. Then by using pumps to pump first wash wastewater to a tank for neutralization before discharging it to the sewer. Transfer the spent caustic to the tank for reuse.

Oily Water Discharge

The waste oil collection appears to be manual and spillages on the ground will wash down into the storm sewers and eventually into the river.

Install an API separator on final discharge for storm water runoff from the facility in oily area. Collect, reuse or dispose of floating oil. Collect and dispose of oily solids and retain oil spills.

Caustic Spills

Install a temporary caustic neutralization system. The caustic tank needs to be in a contained area so that caustic spills do not enter the drains.

Barometric Condenser Water Discharge

Plant should investigate the possibility of diverting of the barometric condenser water from discharging into the trade effluent system directly to Rio Cobre River.

Storm Water Management

Increase Capacity of pond by diverting storm water from pond. Treat storm water before discharge and/or use one pond for storm water treatment.

Wastewater Treatment System

Extend the aeration lagoon for nutrient control (like phosphates). The size and capacity of extended aeration system need to be determined.

Best Management Practices

It is also advised that some of the following best management practices be adopted:

Leaks from pumps, lines and etc.

Elimination of product leakages by establishing the proper O& M procedures is highly recommended.

Vessels rinsing procedures

Re-evaluate CIP system. Total flow is 26,679,344 L (7,048,704 gals) per year. Rinsing procedures should be established as follow: to take most products out, then clean in place (CIP). The purpose is to reduce water use. Also we recommend implementation of automatic clean in place to reduce chemical use, reduce water use, better cleaning of vessels and all production lines.

Combined streams in production/processing drains

Separate production/processing drains from rainwater to try treating the streams in some other way. Also there could be an effort made to separate comparatively clean wastewater from dirty wastewater. For example: to separate wastewater streams from storm water streams, extend drain pipes and lay them in the open trenches, then have central collection sumps.

Ineffective hose nozzles

The use of hoses with spring nozzles, automatic shut-off hoses would reduce wash water. A spray ball valve could also be used. The spray ball is a simple yet a highly effective device for the internal washing of process and storage tanks. A spray ball, powered by the cleaning fluid, generates a high-pressure spray to clean every vessel. There is only one moving part and there is no maintenance whatsoever.

Keeping wastes off the floors and out of the drains

Dry clean up before water washing. Instead of draining the waste some of it could be collected in the tank for disposal.

We noticed that there were some minor issues that need to be addressed. They include the broken water main in front of the canteen and the chlorination of the well water supply. (A feedback control system is required and the installation of a chlorine monitor).

Section 6 MONITORING

Trade effluent should be monitored in order to ensure that it would not have any harmful effects on the environs. The monitoring of trade effluent will prevent the introduction of detrimental and possible combustible substances being introduced to sewage treatment plants or to the surroundings and finally Kingston Harbour. Monitoring effluent will also permit the industrial sludge to be managed or treated to allow safe transportation, reuse and/or disposal.

The frequency and extent of monitoring should depend on the loading of the trade effluent, the consistency of the effluent and the potential for unfavourable impacts by the trade effluent upon water quality. As a minimum all licensees must measure the volumes of trade effluent discharged or released into the environment or to a sewage treatment plant. The total volume of wastewater discharged and the nature of the industry will be used to determine the parameters monitored and the minimum frequency for monitoring. Additional monitoring requirements may be specified as conditions of the license for example; more frequent monitoring would be required in cases where trade effluent standards are exceeded and/or to determine the effectiveness of measures to reduce pollutant loadings.

J Wray and Nephew Limited Monitoring

Existing Monitoring

J Wray and Nephew Ltd currently monitor the trade effluent at least quarterly. There are four different trade effluent and storm water streams that are currently being monitored. Two stages of effluent treatment are being done on domestic sewage and base wine bottoms. Enzyme treatment in an aerobic digester is used to pre-treat base wine bottoms before final treatment in a package aeration plant. The base wine bottoms sludge that is generated (37,500 litres/month) is currently being treated in an enzyme aerobic digester then to the sewage plant. The trade effluent and storm water that are discharged go straight via an outfall into the gully to the west of the facility; this effluent does not go the National Water Commissions' sewer but eventually finds its way to Kingston Harbour. The estimated average flow rate of the trade effluent (for the year 2003) is 7.9 ML/month at the south drain, 0.6 ML/month at the east drain and is negligible at the north drain. The current parameters that are being monitored on a quarterly basis are as follows:

pH, Colour, Coliform-faecal, Coliform Total, Temperature, BOD, COD, Detergents, NO_3, Oil and grease, PO_4, Sulphate, TDS and TSS.

Routine Monitoring Requirements

J Wray and Nephew should follow the routine monitoring requirements for facilities in the International Standard Industrial Classification Code grouping 1551 as specified in the draft regulations. This group is for the distilling rectifying and blending of spirits, ethyl alcohol production from fermented materials. The requirements for this group states that the frequency for all monitoring activities at the facility should take place on a monthly basis and the parameters that are to be monitored should include: BOD, COD, TSS, NO_3, PO_4 and temperature.

Methods for measurement or estimation of the volumes of trade effluent discharged or released into the environment must be made using methods as specified in the Trade Effluent and Industrial Sludge Guideline Document. (See appendix)

Sample collection methods

Samples that are collected on a monthly basis must be collected using: grab samples, flow proportional composite collection techniques, time proportional sampling or a minimum of four grab samples, provided the methods yield a representative sample of effluent being discharged.

All sampling techniques and pollution analyses used for compilation of data required to be submitted in connection with the license under these regulations shall be performed in accordance with the techniques or methods prescribed in Schedule 6 (See appendix)

There is already good access to all sampling points

Reporting and record keeping

No later than May 31, each year, all licensees are required to make annual reports to NEPA on the amounts of the pollutants that are being discharged in the previous calendar year. The reports are to be made using the forms in Schedule 8 (See appendix)

Within 24 hours of incident or spill, the owner or operator must report to the Authority any incident or spill where trade effluent exceeds or is likely to cause an ambient water quality standard to be exceeded. Incident reporting must be made using the form from Schedule 11 (see appendix)

Licensees shall make reports to NEPA as specified in License conditions. Reports of sampling and monitoring must be made according to protocols specified in the Trade effluent and Industrial Sludge Guidelines Document. (See appendix)

Licensees must maintain all sampling and monitoring information for at least five years.

Records of sampling and monitoring information may be kept in paper or electronic form provided that complete records in either format (including all data, drawings, maps etc.) are maintained.

Recommendations /Conclusion

J Wray and Nephew is currently monitoring BOD, COD, TSS, NO_3 and PO_4 on a quarterly basis, however based on the requirements for the category in which they fall, it is required that they also monitor waste water flow volumes and temperature. All of these parameters should be monitored on a monthly instead of quarterly basis. It is also recommended that all the other parameters that are being monitored continue to be monitored on a quarterly basis even though these parameters are not required to be monitored by the regulations.

Trade Winds Citrus Limited

Existing Monitoring

To our understanding Trade Winds Citrus has only sampled the trade effluent once upon NEPA's request. The type of trade effluent treatment that is being used is three sedimentation ponds of varying depth. The treated trade effluent and storm water that is discharged goes directly into the Rio Cobre. The estimated average flow rate of the trade effluent (for the year 2003) is 204,000,000 L/annum.

Routine Monitoring Requirements

Trade Winds Citrus should follow the routine monitoring requirements outlined by the for the ISIC category in which they fall (ISIC 1554). The requirement for this category states that the frequency for all activities at the facility should take place on a monthly basis and the parameters that are to be monitored should include: pH, COD, TSS, oil and grease.

Methods for measurement or estimation of the volumes of trade effluent discharged or released into the environment must be made using methods as specified in the Trade Effluent and Industrial Sludge Guideline Document. (See appendix)

Sample collection methods

Samples that are collected on a monthly basis must be collected using: grab samples, flow proportional composite collection techniques, time proportional sampling or a minimum of four grab samples, these methods will provide a representative sample of effluent being discharged.

All sampling techniques and pollution analyses used for compilation of data required to be submitted in connection with the license under these regulations shall be performed in accordance with the techniques or methods prescribed in Schedule 6 (See appendix)

The owner or operator of the facility must maintain access to all sampling points. The owner should also provide access to authorized officers to licensed facilities to inspect, sample, and conduct enforcement activities under these regulations. NEPA may also utilize a minimum of four grab samples to determine non compliance with trade effluent standards or non-compliance with pre-treatment standards.

Reporting and record keeping

No later than May 31, each year, all licensees shall make annual reports to NEPA on the amounts of the pollutants that are being discharged in the previous calendar year. The reports are to be made using the forms in Schedule 8 (See appendix)

Within 24 hours of incident or spill, the owner or operator must report to the Authority any incident or spill where trade effluent exceeds or is likely to cause an ambient water quality standard to be exceeded. Incident reporting must be made using the form from Schedule 11 (see appendix)

Licensees shall make reports to NEPA as specified in License conditions. Reports of sampling and monitoring must be made according to protocols specified in the Trade effluent and Industrial Sludge Guidelines Document. (See appendix)

Licensees must maintain all sampling and monitoring information for at least five years.

Records of sampling and monitoring information may be kept in paper or electronic form provided that complete records in either format (including all data, drawings, maps etc.) are maintained.

Recommendations /Conclusion

During the initial environmental review we observed that the pH was high at the entrance to the sedimentation ponds. However, at this point we also observed that there was some flow going directly to the river at the storm water gate. Trade Winds should monitor flow, pH, COD, TSS, oil and grease content of the effluent that is discharged from the sedimentation ponds as well as at the storm water bypass gate.

Section 7 EMS STRATEGY

Jamaica's centrepiece of environmental legislation, the NRCA Act, 1991 is the primary legislative instrument with regard to licensing of activities affecting the environment. Section 4 (2) of the Act, clearly facilitates the use of EMS. For instance Section 4 (2) (h) facilitates the Authority entering into appropriate agreements with enterprises. In addition, under the NRCA (Permits & Licenses) Regulations, 1996, persons granted licenses are required to keep all records of the operation including any environmental monitoring for a period of not less than ten years. Elements of the Act are useful tools for promoting the use of EMS.

Environmental management systems provide organizations of all types with a structured framework for:

1. Assessing the organization's environmental impacts,

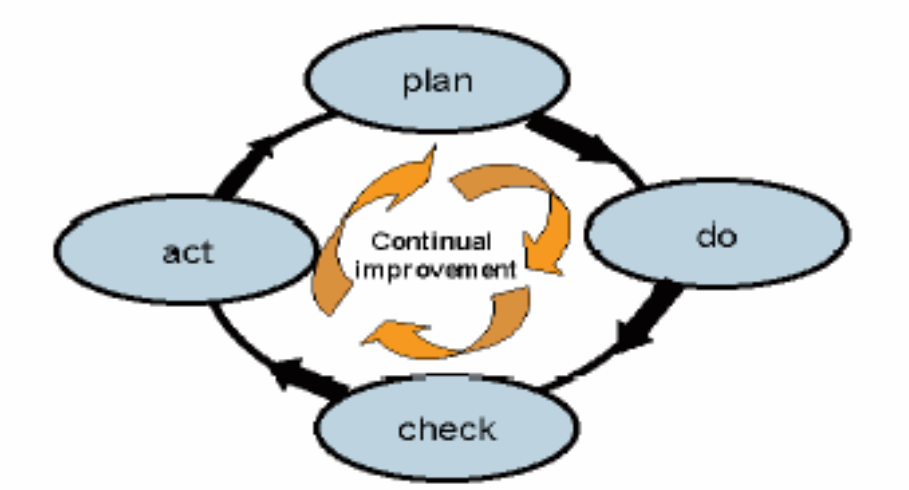
2. Establishing policies along with measurable, goals, objectives, and programs for reducing these impacts,
3. Checking and taking corrective action to ensure the EMS is meeting its goals, and
4. Periodically having top management review the system to ensure continual improvement.

An EMS is not a substitute for meeting regulatory requirements, but can enable an organization to both perform at levels beyond the minimum levels established for compliance and address environmental impacts, such as noise and odour, that may not be regulated. Finally, an EMS provides a way for an organization to continually manage and integrate its environmental obligations for all its programs and projects. EMS can and do provide a wide array of benefits to organizations: reduced costs, improved environmental performance, significantly enhanced internal communication, and better relations with communities and regulators.

Successful implementation of EMS requires both a sustained commitment of time and resources and sustained top management support. However the benefits of the system far outweigh the costs.

An Environmental Management System (EMS) is a set of management processes and procedures that allow an organization to analyse, control and reduce the environmental impact of its activities, products and services, and operate with greater efficiency and control. An EMS is appropriate for all kinds of organizations of varying sizes in both the public and private sectors.

The EMS is built on ISO14001's Plan-Do-Check-Act (P-D-C-A) model and is designed to help systematically identify, control and monitor environmental issues.



This P-D-C-A model will lead to continual improvement based upon:

Planning: identifying the environmental impacts ("footprint") of your organization's operations and services, tracking and following legal requirements, setting environmental goals, and establishing programs (i.e., action plans) to achieve your goals.

Implementing or "Do": defining and communicating EMS roles and responsibilities, developing operating procedures and written programs to manage significant environmental aspects, training contractors and staff, developing methods to manage documents and records, and establishing emergency response procedures to prevent and respond to environmental incidents.

Checking and Corrective Action: monitoring and measuring key environmental parameters and your EMS objectives to assess environmental performance, conducting internal reviews of your EMS, and ensuring that specified practices are followed.

Management Review and Act: review by top management to ensure that your EMS is working as intended and is effective in meeting your environmental goals. Making critical course corrections, resource allocation, and strategic planning to ensure that your organization remains on the path to continual improvement.

Environmental Management System includes:

- Defining roles and responsibilities
- Identifying and prioritising environmental impacts
- Setting measurable objectives and targets
- Verifying and establishing operational controls
- Monitoring and measuring activities and progress
- Seeking continual improvement as part of a review cycle

EMS does not direct an organization to meet certain discharge or emission limits. It does describe the internal framework that should be in place (e.g., policies, procedures, training, communication, documentation) to have a proactive system to manage environmental issues. An EMS does not tell an organization how or what to manage. That is up to the organization. An EMS defines the critical management elements and operational controls that must be in place and followed to control the impact an organization has on the environment. Environmental Management System is designed to be applicable to all types of organizations and facilities: large and small private companies and public organizations.

An EMS is made up of 17 elements that are common to most models. Here is a brief snapshot of what is needed under each one:

Environmental policy - Develop a statement of your organization's commitment to the environment. Use this policy as a framework for planning and action. The policy is a direct reflection of the fundamental values of your organization.

Environmental aspects - Identify environmental attributes of your products, activities and services. Determine those that could have significant impact on the environment.

Legal and other requirements - Identify and ensure access to relevant laws and regulations, as well as other requirements (trade association, local government initiatives, etc.) that your organization must meet and follow.

Objectives and targets - Establish environmental goals for your facility, consistent with your policy, environmental impacts, and the views of interested parties.

Environmental management program - Create plans of action necessary to achieve your objectives and targets.

Structure and responsibility — Establish roles and responsibilities for environmental management and provide appropriate resources.

Training, awareness and competence - Ensure that employees are trained and capable of carrying out their environmental responsibilities under the EMS.

Communication - Establish processes for internal and external communications on environmental management issues.

EMS documentation (EMS Manual) - Maintain information on your organization's EMS. Define, be consistent, and provide an overview of your EMS's key policies, procedures, and related documents.

Document control - Ensure effective management of procedures and other system documents.

Operational control - Identify, plan and manage your operations and services in line with your policy, priority environmental issues, and objectives and targets.

Emergency preparedness and response - Identify potential emergencies and develop procedures for preventing and responding to them.

Monitoring and measurement - Monitor your key activities and track performance.

Nonconformance and corrective and preventive action - Identify and correct problems and prevent their recurrence.

Records - Maintain and manage (access, retention, disposition) EMS records (training, audits, performance, etc.).

EMS audit - Periodically verify, internally and/or through a third-party that your EMS is operating as intended.

Management review - Assess your organization's EMS with an eye toward continual improvement.

Getting Ready To Implement EMS

Environmental Policy

The **Purpose** of this EMS element is to:

- Ensure that your organization's management establishes an environmental policy that defines your facility's environmental vision and goals, and that the policy is communicated and understood by all employees and applicable contractors and vendors.

The **Results** of this EMS element are:

- An approved environmental policy (EMS Document) that is implemented and understood throughout your organization.
- Firm management commitment to EMS implementation.
- Communication of the environmental policy throughout your organization and its availability to the public.

Before you Begin this EMS element:

- Determine where your EMS will be applied ("fence line").
- Consider defining your organization's impact on the environment and setting your environmental goals before finalizing your environmental policy.

Legal and Other Requirements

The **Purpose** of this EMS element is to:

- Identify, track, and communicate your organization's legal and other requirements.

The **Results** of this EMS element are:

- A system procedure (EMS document) that identifies, tracks, and communicates your Legal and Other Requirements.
- A list (EMS record) of applicable environmental laws and other requirements.

Before you Begin this EMS element:

- Identify environmental regulatory information relevant to your organization.
- Obtain information regarding other environmental requirements relevant to your organization.

Environmental Aspects and Impacts

The **Purpose** of this EMS element is to:

- Identify and rank the environmental aspects and impacts of your facility.

The **Results** of this EMS element are:

- A list/table (EMS record) of the activities, environmental aspects and environmental impacts of your facility.
- Significance criteria (EMS record) for ranking your priority environmental impacts.
- A system procedure (EMS document) for environmental aspect and impact identification and significance determination.

Before you Begin this EMS element:

- Draft your environmental policy.
- Complete your legal and other requirements procedure and requirements list.

Setting Objectives & Targets and Establishing EMPs

The **Purpose** of this EMS element is to:

- Identify environmental goals (objectives and targets) that address your facility's significant environmental impacts.
- To establish and maintain environmental management programs (action plans) for achieving your organization's objectives and targets.

The **Results** of this EMS element are:

- Environmental objectives and targets that are documented and communicated.
- EMPs (action plans) for meeting your environmental objectives and targets.

Before You Begin this EMS element:

- Complete your significant aspects and impacts analysis.

Training, Awareness, and Competence

The **Purpose** of this EMS element is to:

- Identify and track environmental and EMS training requirements.

The **Result** of this EMS element is:

- A system procedure/plan (EMS document) that identifies and tracks your environmental and EMS training needs.

Before you Begin this EMS element:

- Acquire knowledge on your organization's current training programs and methods.
- Complete your environmental aspect and impact assessment and determine significance.

Internal and External Communication

The **Purpose** of this EMS element is to:

- Define and implement a procedure for identifying and communicating with internal and external interested parties regarding your EMS process and environmental management activities and approaches.

The **Results** of this EMS requirement are:

- An approved procedure(s) (EMS Document) for internal and external communication.
- A record of communications (EMS Record) with external interested parties.
- A record of your decision (EMS Record) on ways to communicate significant aspects to external interested parties.

Before you Begin this EMS element:

- Complete your significant environmental aspects analysis.
- Identify what and how you currently communicate both internally and externally.

Document Control and Records Management

The **Purpose** of this EMS element is to:

- Write or modify your document control procedures to ensure documents are managed and kept up to date.

- Write or modify your records management procedures to ensure that all records are tracked and maintained.

The **Results** of this EMS element are:

- A document control procedure (EMS Document) for assuring that EMS procedures, work instructions, manuals, and policies are available at locations where they apply; and that they are periodically reviewed, are current, accurate, complete, and effective.
- A records management system (EMS Document) for assuring that all records required to support your organization's EMS are identified, controlled and accessible.

Before you Begin this EMS element:

- Consider your organization's current document and records management control procedures and tools.

Operational Control

The **Purpose** of this EMS element is to:

- Define and implement a procedure for controlling (procedures, work instructions, manuals, etc.) the significant operations and services, objectives and targets, and compliance requirements of your organization.

The **Results** of this EMS element are:

- Documented methods to control (e.g., procedures, work instructions, maintenance manuals, etc.) operations and services that affect your facility's significant environmental aspects, objectives and targets, and compliance requirements.

Before you Begin this EMS element:

- Complete your significant environmental aspects analysis.

Emergency Preparedness and Response

The **Purpose** of this EMS element is to:

- Establish or modify emergency preparedness and response procedures/plans that address the potential for and response to accidents and emergency situations.

The **Result** of this EMS element is:

- Verification that your organization's emergency preparedness and response procedure(s)/plan(s)
- (EMS Document) are effective in relation to the significant environmental aspects and objectives and targets of your organization.

Before you Begin this EMS element:

- Complete your significant environmental aspects analysis.

Monitoring and Measurement

The **Purpose** of this EMS element is to:

- Monitor and measure the performance of your EMS, including your significant aspects, objectives and targets, legal compliance and operational controls.

The **Result** of this EMS element is:

- A procedure (EMS Document) to control monitoring and measurement activities that affect your significant environmental aspects and compliance requirements.

Before You Begin this EMS element:

- Complete your significant aspects and impacts analysis.

EMS Internal Auditing

The **Purpose** of this EMS element is to:

- Establish an effective EMS internal audit program to continually evaluate and improve your EMS system.

The **Results** of this EMS element are:

- An EMS audit procedure (EMS Document) that covers scope, frequency, methods and responsibilities.
- A mechanism for EMS internal audit results (EMS Record) to be reported to management for the purpose of management review.
- An EMS Internal Audit Schedule/Plan that covers all elements of the EMS requirements.
- A group of trained EMS internal auditors identified and available to conduct EMS internal audits.
- Internal audit documentation, including checklists, reporting documents (e.g., an internal audit report), and summary documents (EMS Records) to review and follow-up on the results of audits.

Before you Begin this EMS element:

- Implement all elements of your EMS.
- Conduct EMS employee awareness and understanding training for all staff to prepare them for the internal audit process.

Nonconformance and Corrective and Preventative Action

The **Purpose** of this EMS element is to:

- Implement a Corrective and Preventative Action (improvement) process that will identify and manage problems identified in your EMS.

The **Results** of this EMS requirement are:

- A Non-conformance and Corrective and Preventive Action procedure (EMS Document), that identifies, tracks and closes out corrective and preventative actions.
- Corrective and Preventative Action Reports (EMS Records).

Before you Begin this EMS element:

- Develop formal (e.g., audits) and non-formal (e.g., employee suggestions) methods to identify non-conformances or areas that require improvement within your EMS.

Management Review

The **Purpose** of this EMS element is to:

- Establish a management review system to check the effectiveness and adequacy of the EMS.

The **Results** of this EMS element are:

- Identification and confirmation of a group of key management level personnel who will attend scheduled management review sessions.
- Development of a management review procedure (EMS Document) that addresses the requirements of the EMS and is appropriate and effective to your organization's operations and services.
- Establishment of a schedule, agenda, and meeting notes (EMS Record) for your management reviews.

Before you Begin this EMS element:

- Establish an EMS internal audit and corrective action system.
- Establish all elements of your EMS.

Water and Waste Reduction Program

The primary environmental aspects of non-alcoholic beverages industries involve water use and wastewater discharge from products and washing, chemical use in cleaning, and management of scrap and solid waste.

The most significant environmental impacts in this industry are from water pollution and packaging disposal. There are many technical reports on treatment of wastewater from beverage production. There are relatively few reports on cleaner production available. Primary solutions include process measurement and control, water recycling, chemical substitution and reduction, energy efficiency, and new product development using waste materials. The industry associations and leading companies provide extensive information on their packaging including use of environmentally improved designs, recycling systems and technologies.

The table on the following page lists solutions to reduce waste and pollution in non-alcoholic beverage production. Company environmental programs should demonstrate that these options have been considered thoroughly.

Solutions to Increase Efficiency and Reduce Waste in Beverage Production Companies

raw materials cleaning:	consider alternatives to batch wise bath immersion such as: - water recycling/reuse - spray washing - counter current washing
cleaning of equipment	consider: - non-stick surfaces to reduce contamination - dry cleaning before water washing - automatic detection of product/water interfaces - effective spray nozzles - automatic shut-off hoses - optimised "clean-in-place" technology recycle detergents/rinses product/vessel-specific programming - optimisation of "hygiene" shutdowns - optimisation of product changeovers
provision of services	*steam:* examine losses and potential for condensate recovery *vacuum:* consider recycling seal water or use of dry vacuum pumps *cooling water:* consider automatic blow down, reducing loads by process changes, and using alternative means of cooling
operation of hygiene stations:	*examine:* - exact cleaning requirements - tap water pressures - forms of tap head (spray etc) - automatic shut-off of water supply

To reduce plant problems based on the EMS concept of waste prevention:

1. Provide education on water use and waste load;
2. Detailed evaluation of the plant for problem areas;

3. Evaluate plant processes;
4. Promote the use of advanced cleaning techniques;
5. Provide solution for waste recovery and utilization;
6. Enhance waste pretreatment.

A simple concept as keeping wastes off the floors and out of the drains will save company many thousands of dollars per year and reduce strain on the treatment plant. Most of the changes made to reduce water use and waste might cost the company little or nothing. Simply focusing employee awareness and management emphasis on the problem prevented carelessness - a costly trait for any business. Common-sense approaches to cleanup, such as using trays beneath machines to catch spillage, picking up spillage before hosing down the floors, and placing screens over drains, were used at little cost. Awareness of the serious problems caused by reckless water use and product waste cost the company nothing but the time needed to educate employees thoroughly. After all new procedures had been implemented and preliminary training completed, it was found necessary to conduct a detailed training course for each line. A successful pollution prevention program requires frequent retraining to keep employees focused and vigilant.

The maintenance crew regularly upgrades equipment parts, seals all leaks, tightens nuts and bolts, and replaces containment trays as needed to prevent spills.

To keep employees aware of the need for waste reduction and focused on preventing pollution.

In Summary

An EMS can help you to comply with regulations more consistently and effectively. It also can help you identify and capitalize on environmental opportunities that go beyond compliance.

EMSs have been implemented by organizations ranging in size from a couple of dozen employees to many thousands of employees. The elements of an EMS are flexible by design to accommodate a wide range of organizational types and sizes.

A commitment to preventing pollution is a cornerstone of an effective EMS and should be reflected in an organization's policy, objectives and other EMS elements.

An EMS will not result in more or less stringent legal compliance obligations. But an EMS should improve your efforts to comply with legal obligations, and, in some cases, may lead to more flexible compliance requirements.

The concept of continual improvement assumes that no organization is perfect. While an EMS should help your organization to improve compliance and other measures of performance, this does not mean that problems will never occur. However, an effective EMS should help you "find, fix, and prevent" these problems and prevent them from recurring.

ISO 14001 is an internationally recognized standard for the environment. It provides a systems approach patterned after a model of plan, do, check and act. ISO 14001 is one of a

series of Environmental Standards developed by the International Organization for Standardization. The ISO 14001 standard includes all of the elements needed to develop an environmental management system in an organization.

An EMS provides tools to help manage your organization's environmental impacts efficiently and effectively and to improve the impact of an organization's environmental "footprint." Public organizations who have implemented an EMS have realized the following benefits:

- Cost savings
- Reduced risk to the environment and employee
- Increased operational efficiency
- Positive external relations and public image
- Improved communication
- Improved public relations

It is important to realize that developing and implementing an EMS requires an investment of time and effort. Along the way there can be hurdles such as: difficulty managing organizational change, lack of top management visibility and involvement, lack of public awareness and understanding, maintaining momentum (especially at the frontline), and political uncertainties.

Whether you have a quality management system, asset management system, or any other management system, an EMS is compatible and can be integrated with any systems type approach. For example, procedural methods for handling operational and environmental records and providing training are universal and should integrate well. Furthermore, the process of identifying environmental and operational priorities, setting targets and checking progress on those targets will be very similar in any management systems approach.

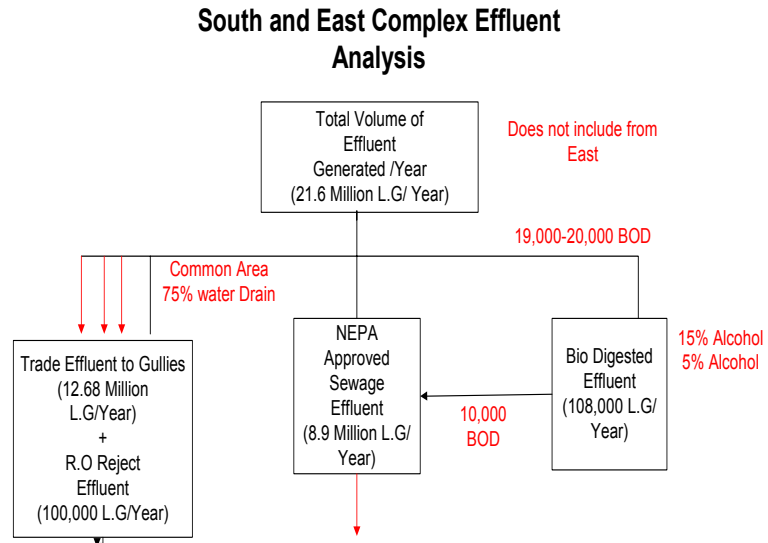
APPENDICES

Appendix A. THE CRITERIA SHEET FOR SELECTION OF THE FACILITIES

Selection Criteria
Date: October 18,2004
Project: NEPA, Kingston Harbour

	1	2	3	4	5	6	7	8	9		
	Criteria										
Plant name	Serve as a model for other facilities, consequen unique facility is excluded/given low score of	Willing to participate in study all the way thro implementation. Pepsi & Red Stripe excluded of their plans	A high contaminant load	A direct discharger	If not a direct discharger, any facility dischargi the sewers leading to a sewage treatment facili excluded, except if high contaminant load and pretreatment would be needed to meet sewer u limits	Room for improvement	which would allow for knowledge to be transp other similar facilities.	Must be a facility where the cost of implement not have detrimental economic effects.	Multiple facility benefit	Total Score	Rank
Trade Winds Citrus Limited	**10**	**10**	**5**	**10**	**10**	**8**	**9**	**10**	**5**	**77**	**1**
Estate Industries Ltd (J Wray& Nephew group) east complex Drain 5	**9**	**10**	**1**	**10**	**10**	**10**	**9**	**9**	**5**	**73**	**2**
Jamaica Citrus Growers ltd	8	10	3	10	10	10	10	10	0	71	3
Red Stripe Brewing	10	1	3	10	10	10	10	10	5	69	4
Bernard Lodge Division S1	1	10	8	10	10	8	10	10	0	67	5
Pepsi Glass Line	10	1	1	10	10	10	10	10	5	67	5
Caribbean Broilers	5	8	10	0	10	10	10	10	0	63	6
Caribbean Products ltd	5	8	0	10	10	10	10	10	0	63	6
Nestle Jamaica Ltd.	7	9	0	10	8	6	9	9	5	63	6
Petrojam Limited	5	10	0	10	10	6	10	10	0	61	7
Industrial Chemical Co JA Ltd. (alum)	8	8	0	10	8	8	8	8	0	58	8
Tanners Ltd	5	7	0	10	9	9	9	9	0	58	8
Berger Paint Jamaica Ltd.	7	8	0	10	8	8	8	8	0	57	9
Grace Food Processors (canning) Ltd.	4	8	0	10	8	7	7	7	0	51	10
Shirhome Chemical Corporation	7	8	0	10	5	5	8	8	0	51	10
Content Agricultural Products ltd. (Jamaica Boilers)	5	5		10	10	10	5	5	0	50	11
Spike Industries	5	10	0	10	8	6	5	5	0	49	12
Abbatoirs/City Butchers	5	5	0	0	10	10	9	9	0	48	13
Caribbean Foods Ltd. Chas E	9			10	2	9	9	9	0	48	13
Jamaica Ethanol Processing Ltd	8	5	0	10	3	5	8	8	0	47	14
Caribbean pacific Alchohol Co. Ltd	8	5	0	10	2	5	8	8	0	46	15
Wakefield Industries Limited	5	5	0	10	8	8	5	5	0	46	15
Industrial Gases Ltd.	3	6	0	10	6	8	6	6	0	45	16
Big City Brewing Company Ltd	8	8	0	0	6	6	8	8	0	44	17
Carrearas Group Limited (CGL)	8	5	0	10	2	3	8	8	0	44	17
Jamaica Biscuit Company	6	6	0	10	3	5	6	6	0	42	18
Sherwyn Williams (WI) ltd.	7	5	0	10	5	5	5	5	0	42	18
Federated Pharmaceuticals	8		0	10		5	9	9	0	41	19
Musson(Jamaica) ltd	8	5	0	10		8	5	5	0	41	19
WallenFord Coffee Company	5		0	10	8	8	5	5	0	41	19
HD Hopwood & Co. ltd	5	5	0	10	5	5	5	5	0	40	20
Dairy Industried (JA) Ltd.	6	6	0	10	2	3	6	6	0	39	21
Caribbean Cement Company Limited	1	7	0	10	2	4	7	7	0	38	22
Jamaica Drink Co. Ltd. (Wisynco Group)	8		0	10	5	5	5	5	0	38	22
JPS Co. Rockfort	5	5	0	10	3	5	5	5	0	38	22
Lasco	8		0	10	5	5	5	5	0	38	22
Shell Rockford jetty	5	5	0	10	5	3	5	5	0	38	22
Windalco (Ewarton)	2	1	0	10	2	4	9	9	0	37	23
JPS Co. Hunts Bay	4	4	0	10	4	6	4	4	0	36	24
Smith& stewart Distributors Ltd.	5		0	10	5		8	8	0	36	24
Jamaica Private Power Company	5		0	10	3	5	6	6	0	35	25
Ramson	8			10			8	8	0	34	26
Electric Arc. (Jamaica) Ltd.	3		0	10	5	5	5	5	0	33	27
Omni Industries ltd./thermoplastics	3			10	3	5	6	6	0	33	27

Appendix B. PROCESS FLOW DIAGRAM FOR J WRAY AND NEPHEW

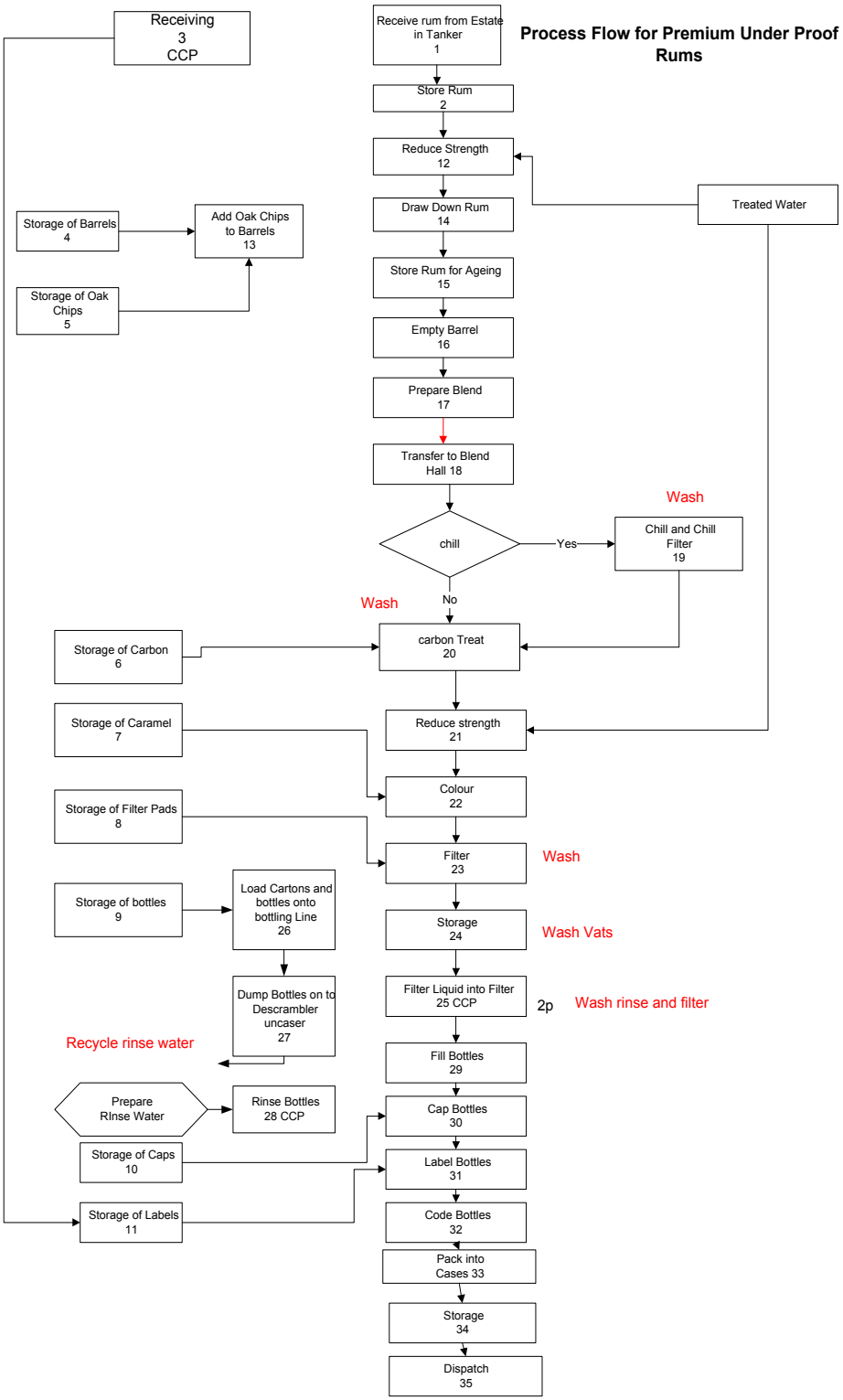


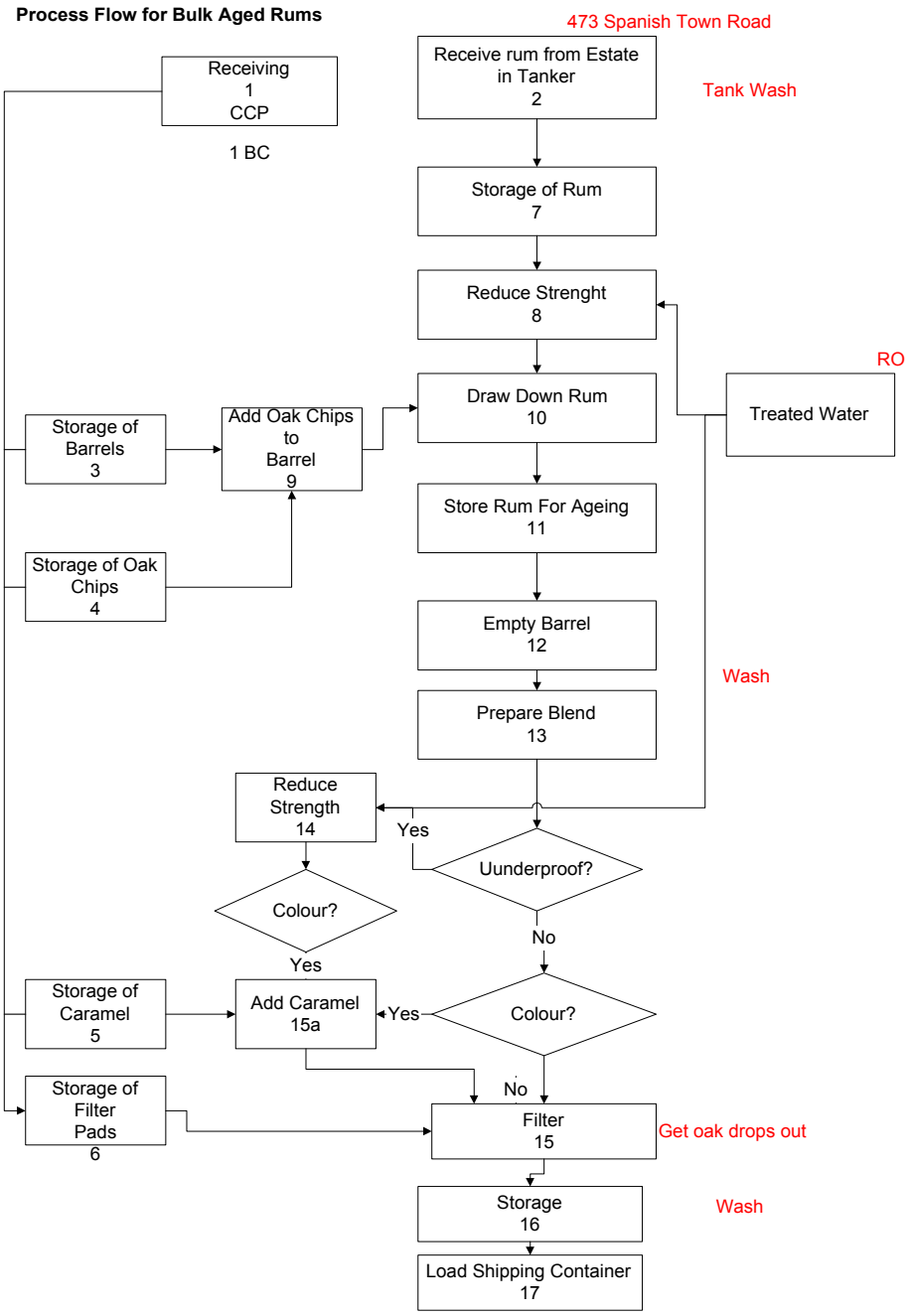
Parameter	Average Daily Load	NEPA Standard
Bottling Hall's Drain	**Mg/l**	**Mg/l**
Biochemical oxygen Demand (BOD)	550	30
Chemical oxygen Demand	2790	<100
Dissolved Oxygen (DO)	2.2	>4
Total Dissolved Solids (TDS)	330	1000
Total Suspended Solids (TSS)	26	30
Chloride	32	300
Nitrate	7	5
Phosphate	9.2	5
Sulphate	40	250
Oil and Grease	6	10
Copper	10µg/L	100 µg/L
Iron	8910 µg/L	3000 µg/L
Lead	<1 µg/L	100 µg/L
Zinc	50 µg/L	1500 µg/L

Annual Cost of Operating Aerobic Digesters

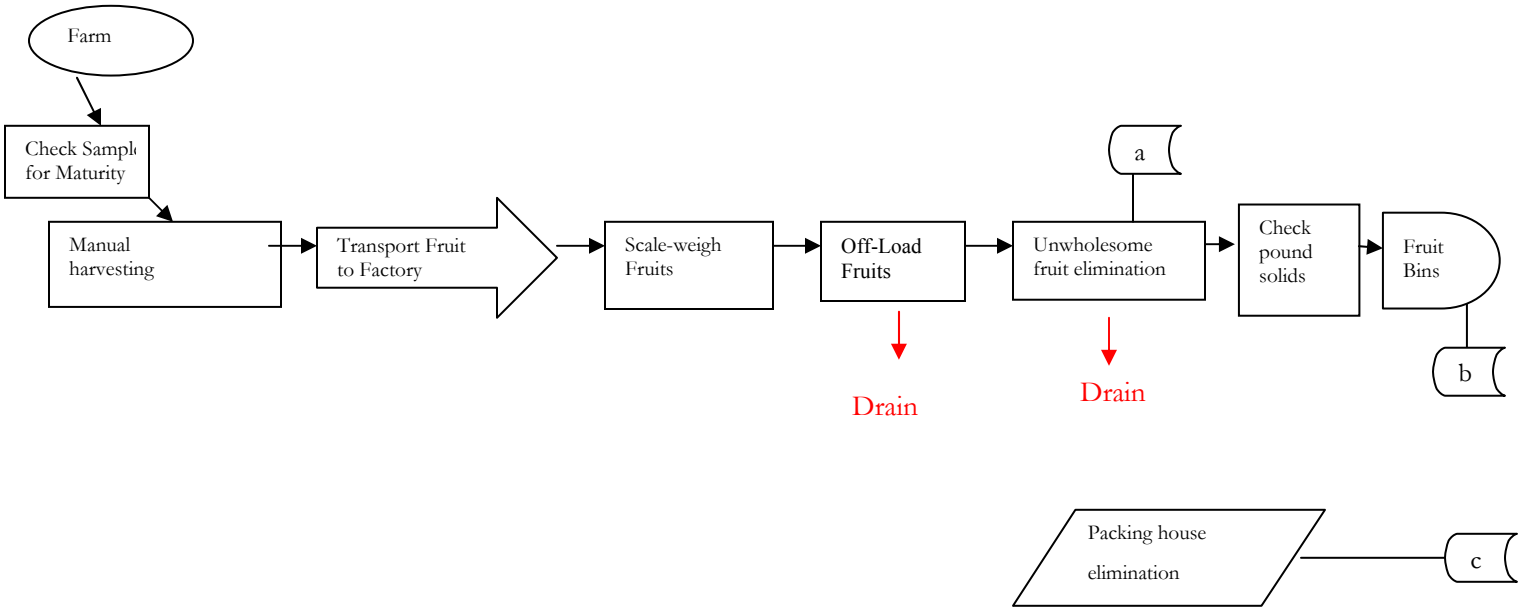
Items	Annual Usage	Cost
Enzymes	36Kg	$101,000.00
Blower (Energy)	7.5H	$230,000.00
Manual Labour		$120,000.00

Total $ 451,000.00


Process Flow for Premium Under Proof Rums
Receiving 3 CCP
Receive rum from Estate in Tanker 1
Store Rum 2
Reduce Strength 12
Draw Down Rum 14
Treated Water
Storage of Barrels 4
Add Oak Chips to Barrels 13
Storage of Oak Chips 5
Store Rum for Ageing 15
Empty Barrel 16
Prepare Blend 17
Transfer to Blend Hall 18
Wash
chill
Yes
Chill and Chill Filter 19
No
Wash
Storage of Carbon 6
carbon Treat 20
Storage of Caramel 7
Reduce strength 21
Colour 22
Storage of Filter Pads 8
Filter 23
Wash
Storage of bottles 9
Load Cartons and bottles onto bottling Line 26
Storage 24
Wash Vats
Dump Bottles on to Descrambler uncaser 27
Filter Liquid into Filter 25 CCP
2p
Wash rinse and filter
Recycle rinse water
Fill Bottles 29
Prepare RInse Water
Rinse Bottles 28 CCP
Cap Bottles 30
Storage of Caps 10
Label Bottles 31
Storage of Labels 11
Code Bottles 32
Pack into Cases 33
Storage 34
Dispatch 35


Process Flow for Bulk Aged Rums
473 Spanish Town Road
Receiving
1
CCP
1 BC
Receive rum from Estate in Tanker
2
Tank Wash
Storage of Rum
7
Reduce Strenght
8
RO
Draw Down Rum
10
Treated Water
Storage of Barrels
3
Add Oak Chips to Barrel
9
Store Rum For Ageing
11
Storage of Oak Chips
4
Empty Barrel
12
Wash
Prepare Blend
13
Reduce Strength
14
Yes
Uunderproof?
Colour?
No
Yes
Storage of Caramel
5
Add Caramel
15a
Yes
Colour?
No
Storage of Filter Pads
6
Filter
15
Get oak drops out
Storage
16
Wash
Load Shipping Container
17

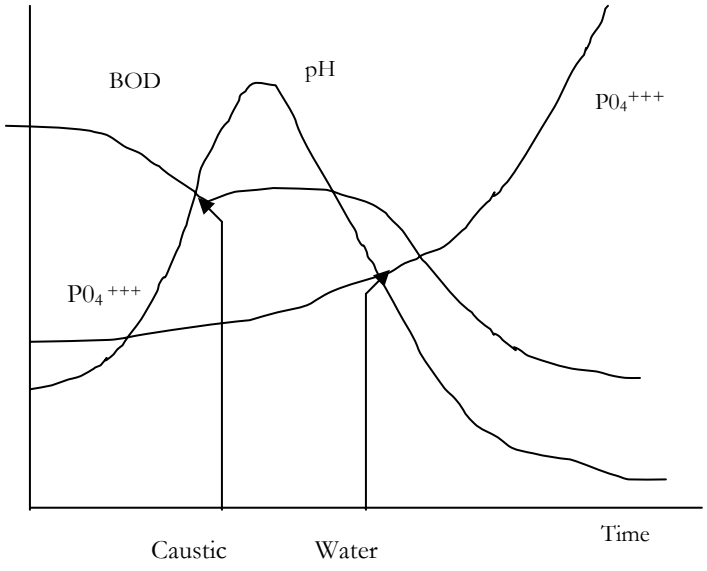
Appendix C. TRADE WINDS CITRUS PROCESS FLOW DIAGRAM

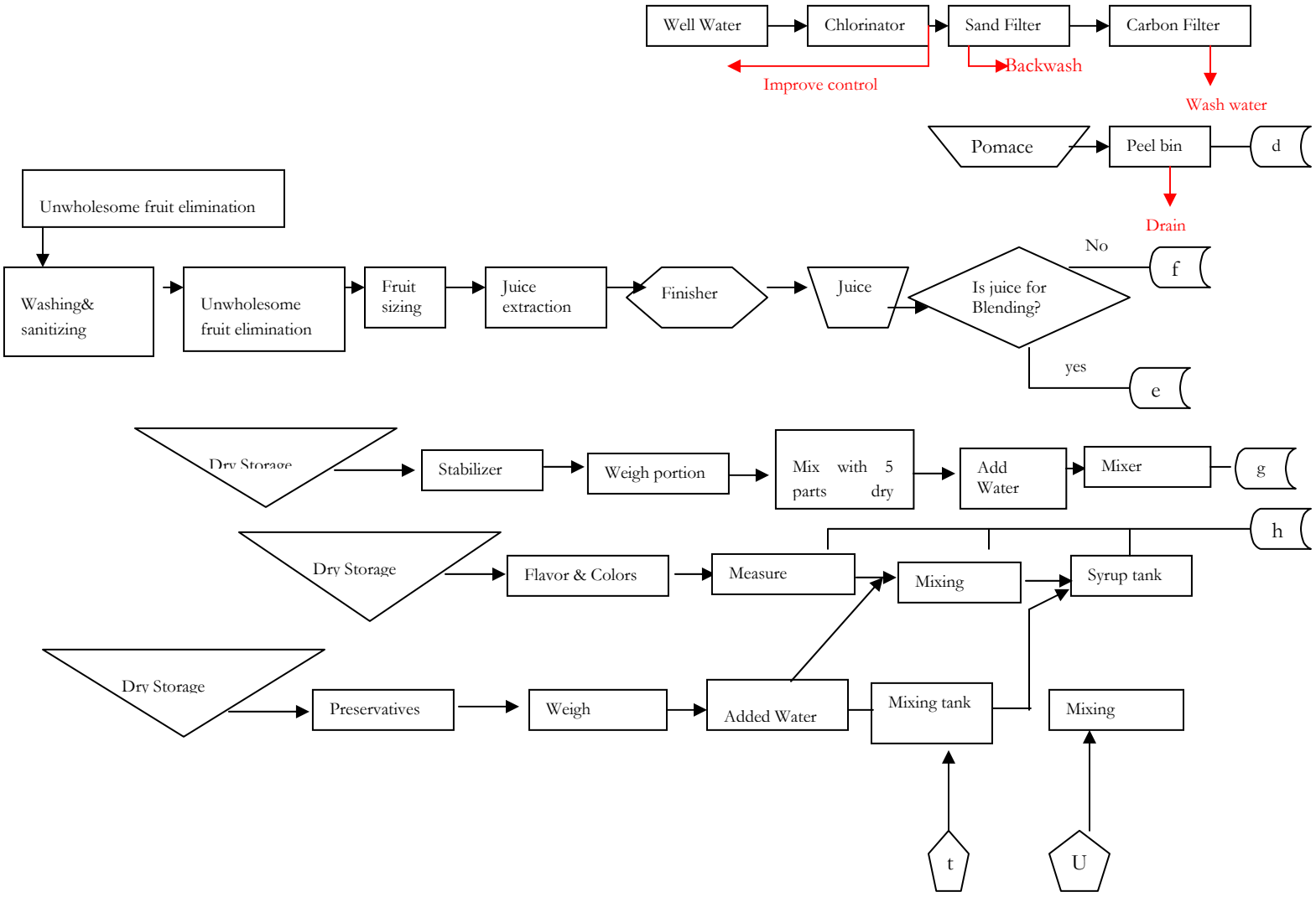


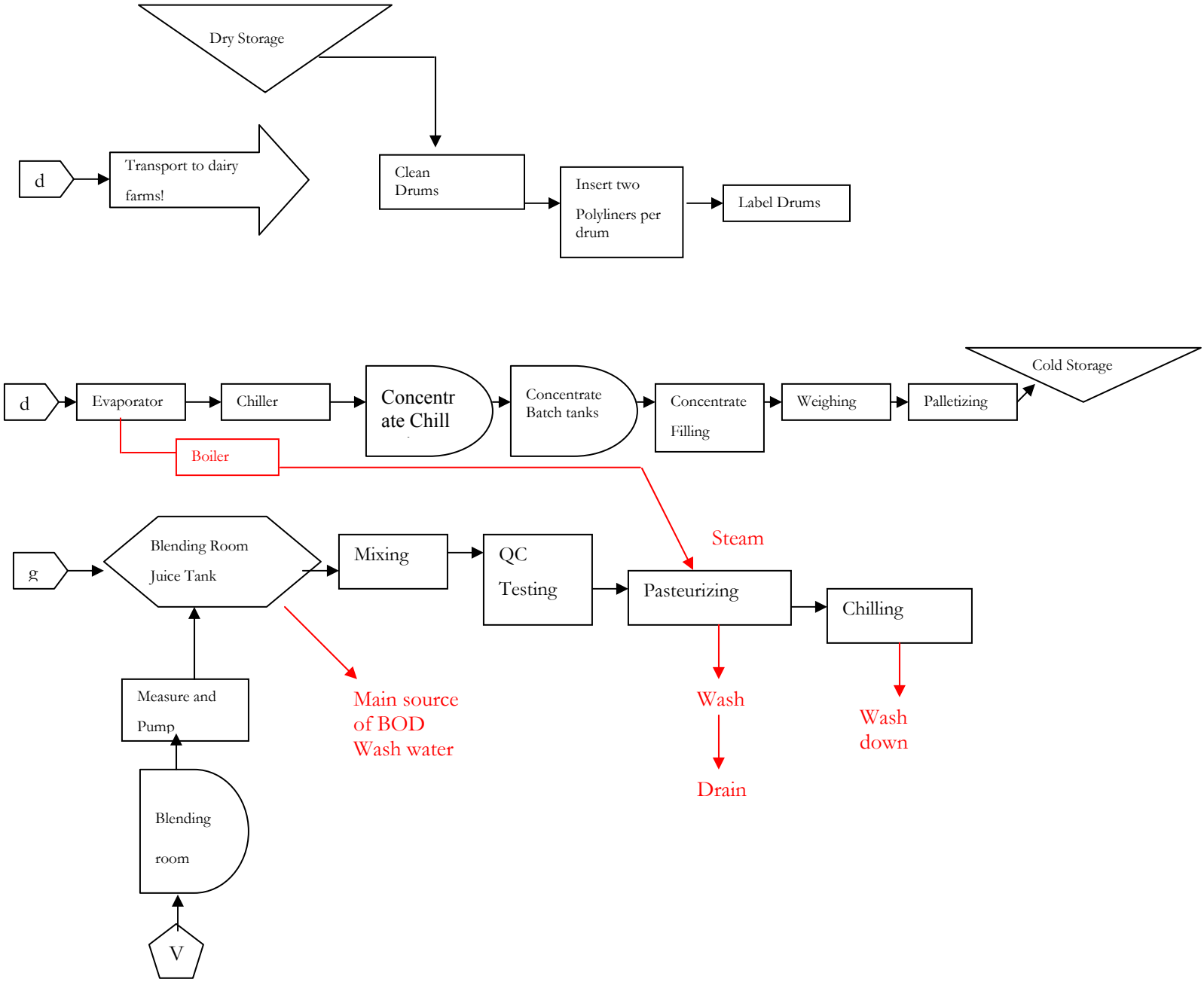
Clean up Cycle (NOTES)

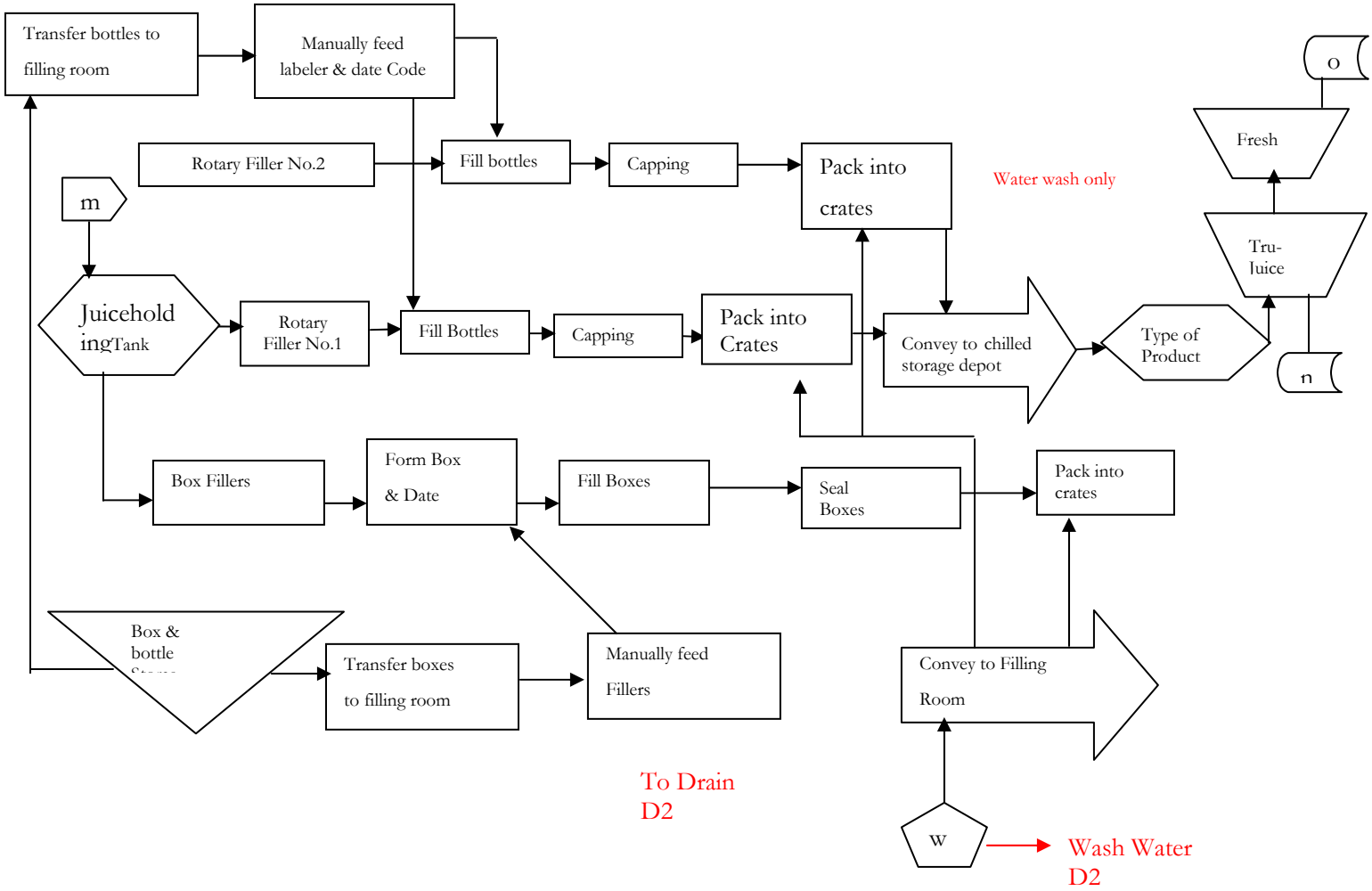
1. Water Rinse- High BOD
2. Hot Caustic Cycle- High pH & High BOD
3. Cold Water Rinse- High pH & low BOD
4. Final Rinse-neutral + $P0_4^{+++}$

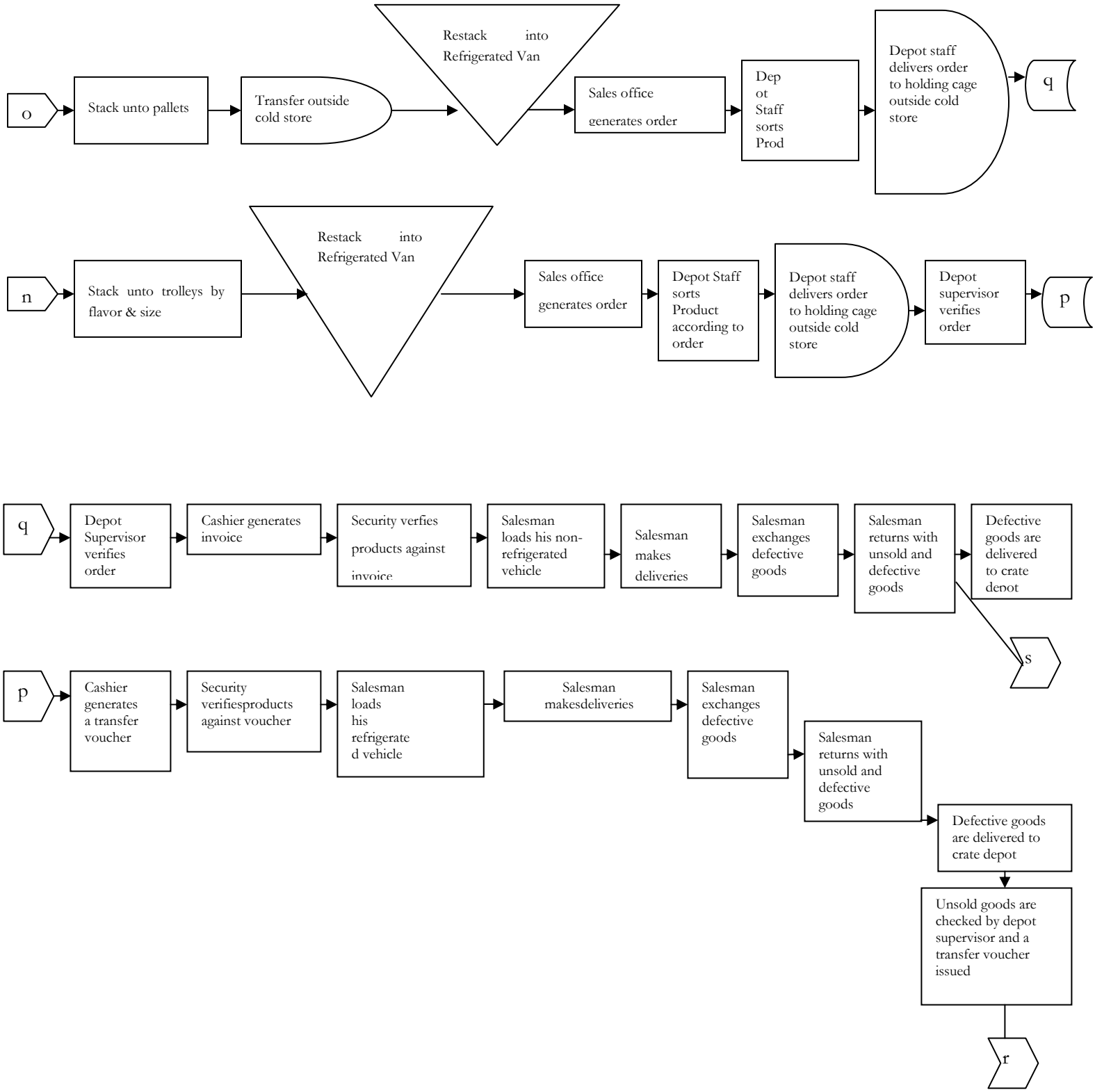
Blending Room- 16 hours per day always continuously working to D1
Filling Room- 10 hours then wash at the end of shift drains to D2

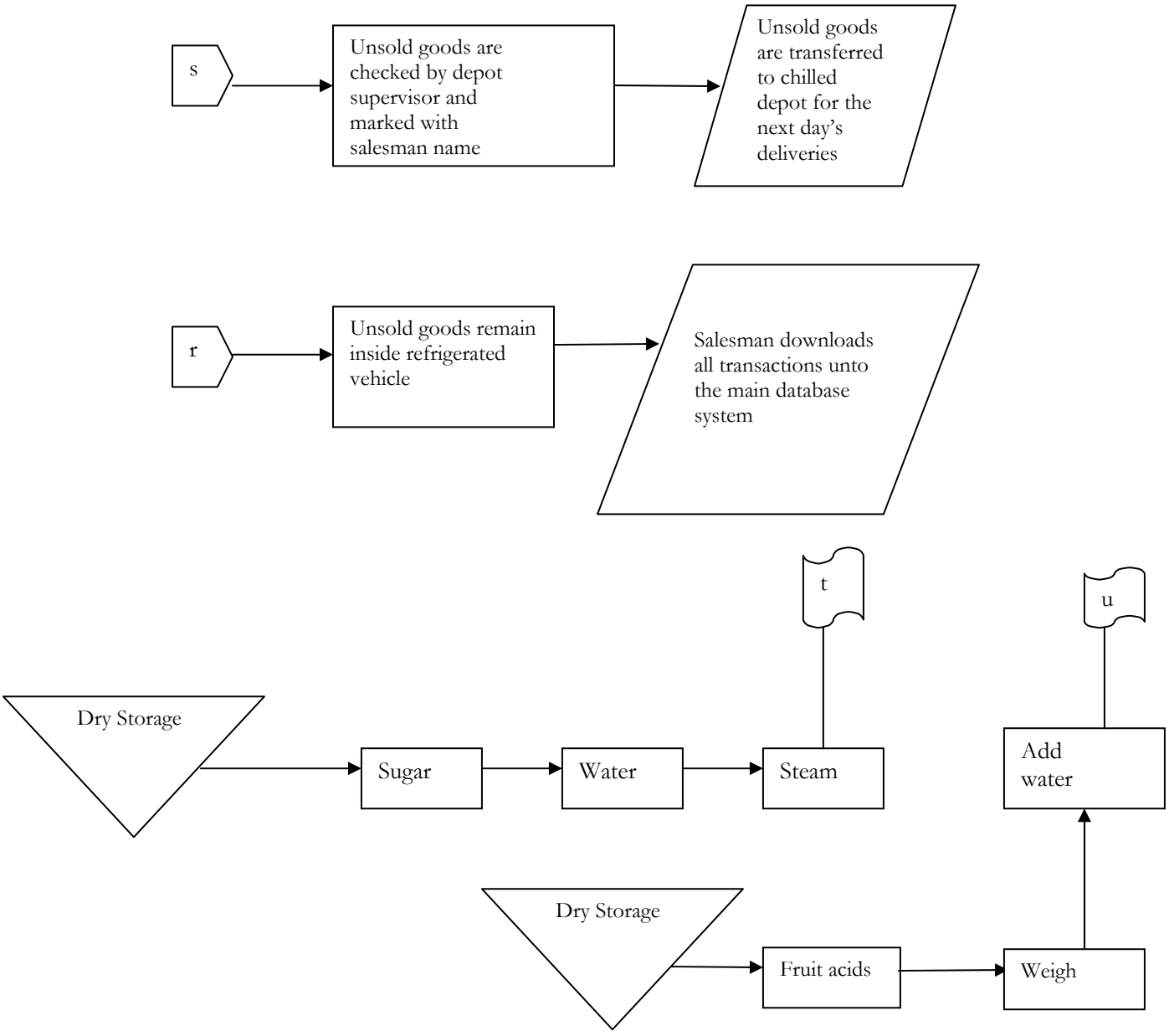


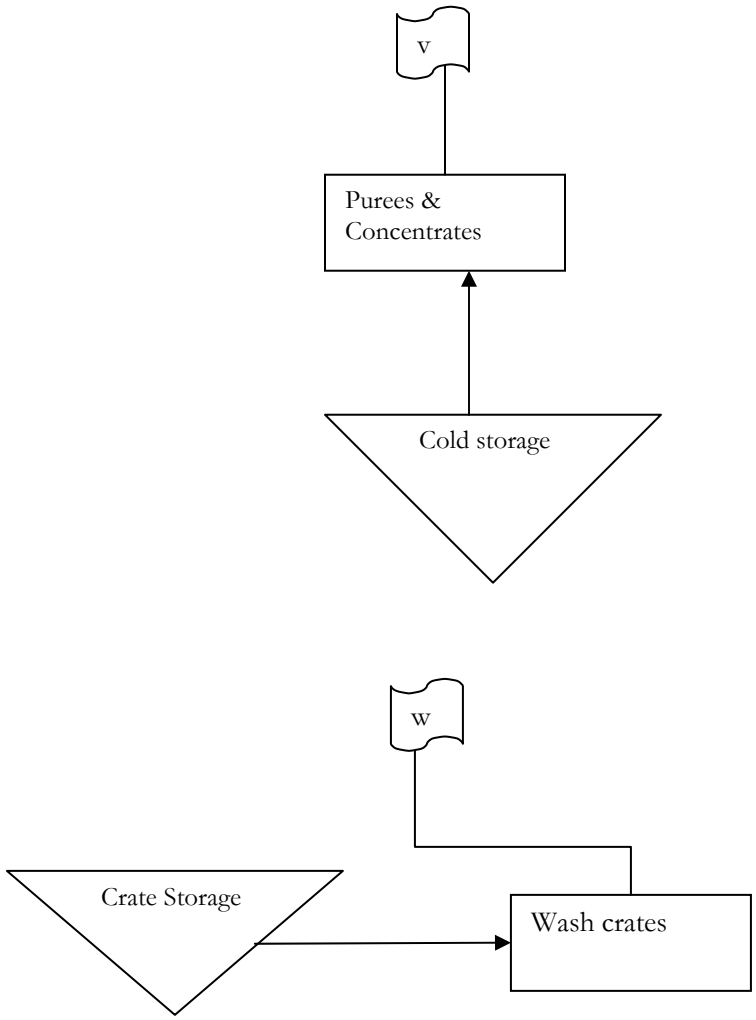

Well Water
Chlorinator
Sand Filter
Carbon Filter
Improve control
Backwash
Wash water
Pomace
Peel bin
d
Drain
Unwholesome fruit elimination
Washing& sanitizing
Unwholesome fruit elimination
Fruit sizing
Juice extraction
Finisher
Juice
Is juice for Blending?
No
f
yes
e
Dry Storage
Stabilizer
Weigh portion
Mix with 5 parts dry
Add Water
Mixer
g
h
Dry Storage
Flavor & Colors
Measure
Mixing
Syrup tank
Dry Storage
Preservatives
Weigh
Added Water
Mixing tank
Mixing
t
U


Dry Storage
d
Transport to dairy farms!
Clean Drums
Insert two Polyliners per drum
Label Drums
d
Evaporator
Chiller
Concentrate Chill
Concentrate Batch tanks
Concentrate Filling
Weighing
Palletizing
Cold Storage
Boiler
Steam
g
Blending Room Juice Tank
Mixing
QC Testing
Pasteurizing
Chilling
Measure and Pump
Main source of BOD Wash water
Wash
Drain
Wash down
Blending room
V


Transfer bottles to filling room
Manually feed labeler & date Code
Rotary Filler No.2
Fill bottles
Capping
Pack into crates
Water wash only
o
Fresh
m
Tru-luice
Juicehold ingTank
Rotary Filler No.1
Fill Bottles
Capping
Pack into Crates
Convey to chilled storage depot
Type of Product
n
Box Fillers
Form Box & Date
Fill Boxes
Seal Boxes
Pack into crates
Box & bottle
Transfer boxes to filling room
Manually feed Fillers
Convey to Filling Room
To Drain D2
w
Wash Water D2


o
Stack unto pallets
Transfer outside cold store
Restack into Refrigerated Van
Sales office generates order
Dep ot Staff sorts Prod
Depot staff delivers order to holding cage outside cold store
q
n
Stack unto trolleys by flavor & size
Restack into Refrigerated Van
Sales office generates order
Depot Staff sorts Product according to order
Depot staff delivers order to holding cage outside cold store
Depot supervisor verifies order
p
q
Depot Supervisor verifies order
Cashier generates invoice
Security verfies products against invoice
Salesman loads his non-refrigerated vehicle
Salesman makes deliveries
Salesman exchanges defective goods
Salesman returns with unsold and defective goods
Defective goods are delivered to crate depot
s
p
Cashier generates a transfer voucher
Security verifiesproducts against voucher
Salesman loads his refrigerate d vehicle
Salesman makesdeliveries
Salesman exchanges defective goods
Salesman returns with unsold and defective goods
Defective goods are delivered to crate depot
Unsold goods are checked by depot supervisor and a transfer voucher issued
r


s
Unsold goods are checked by depot supervisor and marked with salesman name
Unsold goods are transferred to chilled depot for the next day's deliveries
r
Unsold goods remain inside refrigerated vehicle
Salesman downloads all transactions unto the main database system
t
u
Dry Storage
Sugar
Water
Steam
Add water
Dry Storage
Fruit acids
Weigh


V
Purees &
Concentrates
Cold storage
W
Crate Storage
Wash crates

Appendix D. TRADE EFFLUENT AND INDUSTRIAL SLUDGE GUIDELINE

TRADE EFFLUENT STANDARDS

(Extracted from the Jamaican National Trade Effluent Standards 1995)

PARAMETER	STANDARD LIMIT
Ammonia /Ammonium	1.0 mg/l
Barium	5.0 mg/l
Beryllium	0.5 mg/l
Boron	5.0 mg/l
Calcium	No Standard
Chloride	300 mg/l
Colour	100 TCU
Detergent	15 mg/l or <0.015 kg/ 1000 kg product
Fluoride	3.0 mg/l
Iron	3.0 mg/l
Magnesium	No standard
Manganese	1.0 mg/l
Nitrate (as Nitrate and Nitrite)	10 mg/l
Oil and grease	10 mg/l or <0.01kg/ 1000 kg product
pH	6.5 – 8.5
Phenols	0.1 mg/l
Phosphate	5.0 mg/l
Sodium	100 mg/l
Sulphate	250 mg/l

1

Sulphide	0.2 mg/l
TDS	1000 mg/l
Temperature	2 °C +/- average ambient temperature
TOC	100 mg/l
TSS	All times <150 mg/l Monthly average 50 mg/l
Heavy Metals	
Arsenic	0.5 mg/l
Cadmium	0.1 mg/l
Chromium	1.0 mg/l
Copper	0.1 mg/l
Cyanide (Free HCN) (Total CN)	0.1 mg/l 0.2 mg/l
Lead	0.1 mg/l
Mercury	0.02 mg/l
Nickel	1.0 mg/l
Selenium	0.5 mg/l
Silver	0.1 mg/l
Tin	No standard
Zinc	1.5 mg/l
Total Heavy Metals	2.0 mg/l

2

STREAM LOADING

BOD_5	< 30 mg/l
COD	< 0.1kg/ 1000kg product or < 100 mg/l
DO	> 4 mg/l

BACTERIOLOGY

Total Coliform	< 500 MPN/ 100ml
Feacal Coliform	<100 MPN/ 100ml

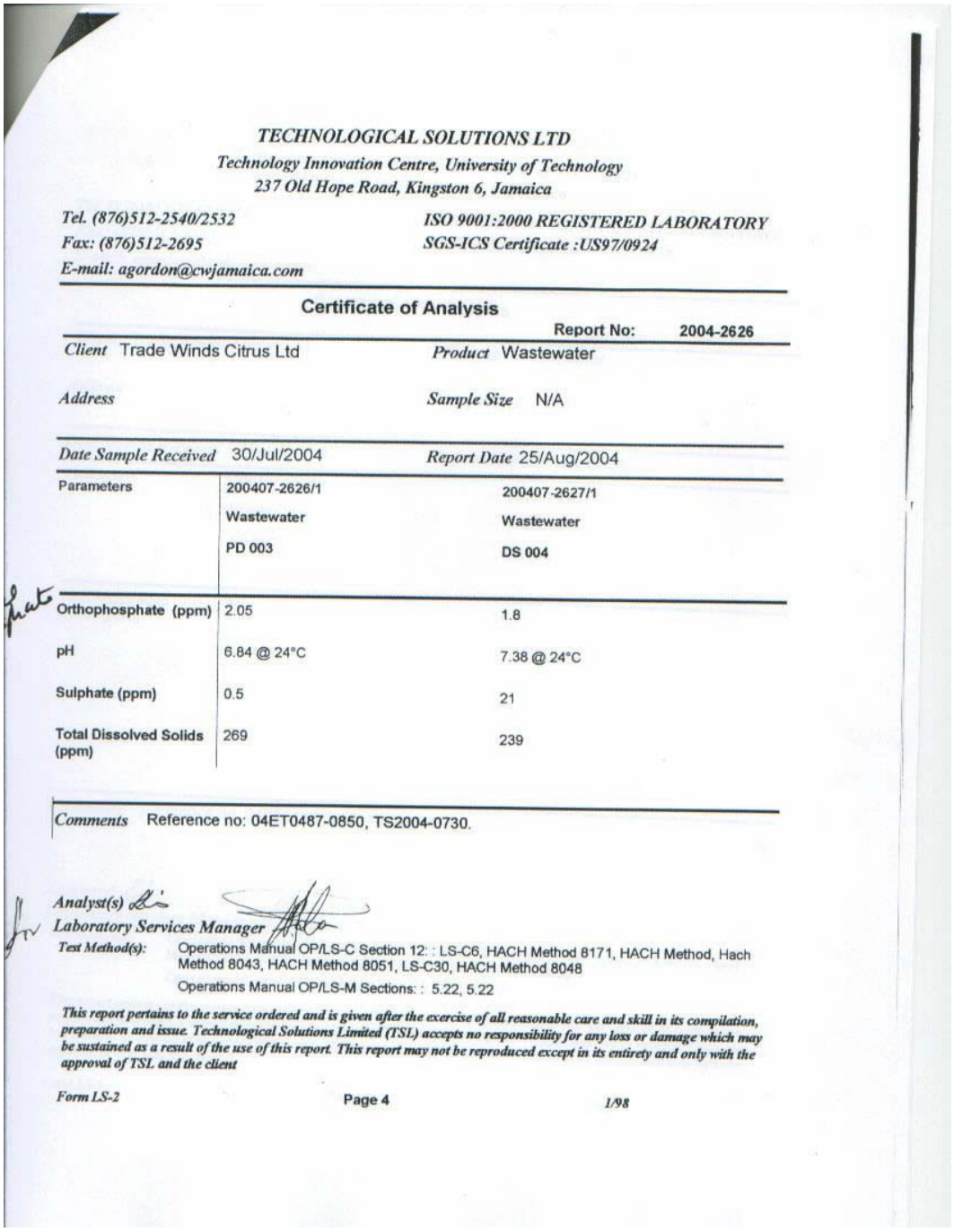
ACRONYMS FOR PARAMETRS USED IN STANDARDS

BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DO	Dissolve Oxygen
MPN	Most Probable Number
TCU	Total Colour Unit
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TSS	Total Suspended Solids

FURTHER CLARIFICATION

Nitrates	Refers to nitrogen in nitrates and nitrites
Phosphates	Refers to phosphorous in phosphates
pH	Measures acidity or alkalinity
Residual Chlorine	Where natural treatment systems are designed to reduce coliform levels without the use of chlorine then the residual chlorine criteria would not apply

3



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ISO 9001:2000 REGISTERED LABORATORY
SGS-ICS Certificate :US97/0924

Certificate of Analysis

Report No: 2004-2626

Client Trade Winds Citrus Ltd — *Product* Wastewater

Address — *Sample Size* N/A

Date Sample Received 30/Jul/2004 — *Report Date* 25/Aug/2004

Parameters	200407-2626/1 Wastewater PD 003	200407-2627/1 Wastewater DS 004
Orthophosphate (ppm)	2.05	1.8
pH	6.84 @ 24°C	7.38 @ 24°C
Sulphate (ppm)	0.5	21
Total Dissolved Solids (ppm)	269	239

Comments Reference no: 04ET0487-0850, TS2004-0730.

Analyst(s)
Laboratory Services Manager

Test Method(s): Operations Manual OP/LS-C Section 12: : LS-C6, HACH Method 8171, HACH Method, Hach Method 8043, HACH Method 8051, LS-C30, HACH Method 8048
Operations Manual OP/LS-M Sections: : 5.22, 5.22

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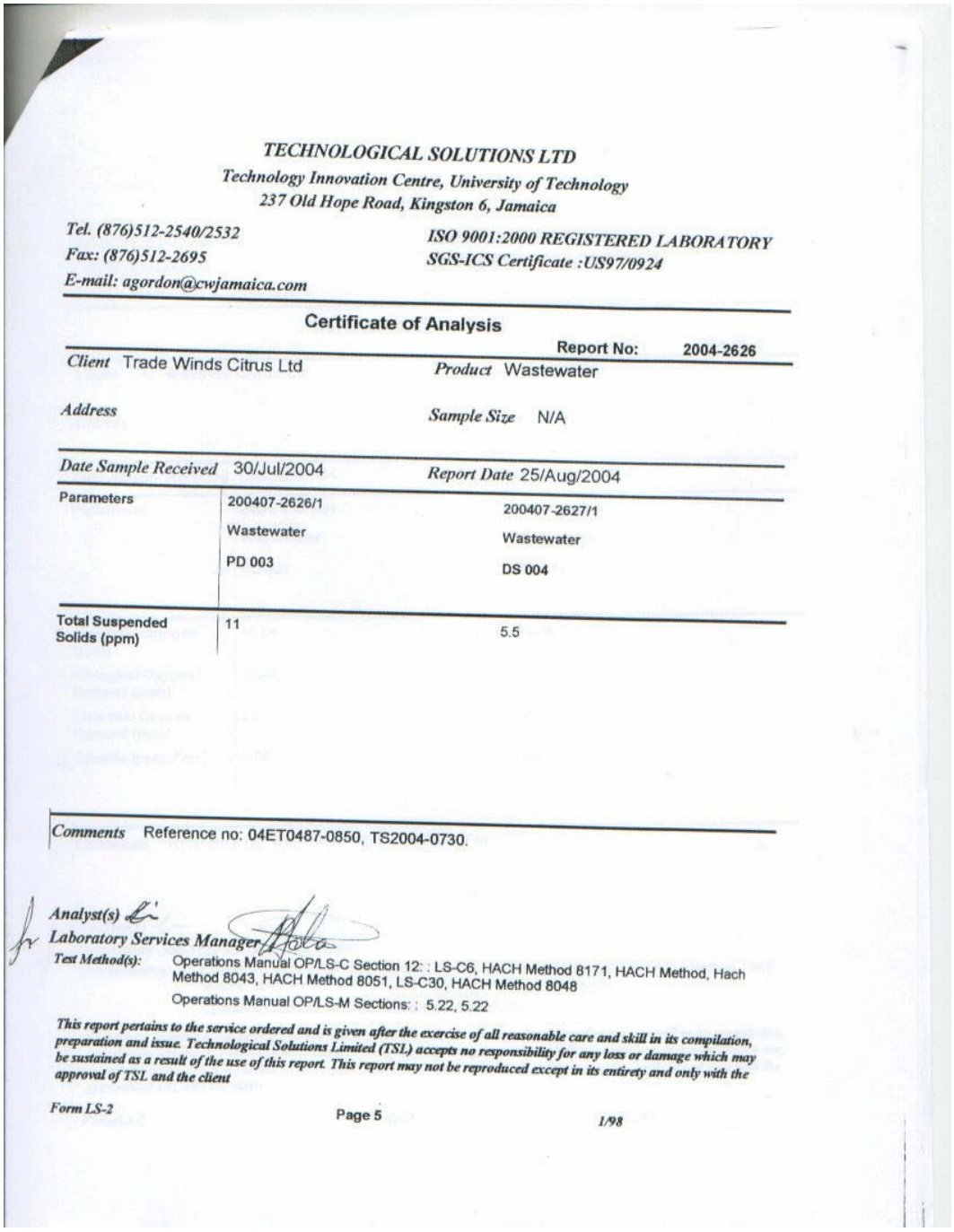
Form LS-2 Page 4 *1/98*



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Client Trade Winds Citrus Ltd — *Product* Wastewater

Address — *Sample Size* N/A

Date Sample Received 30/Jul/2004 — *Report Date* 25/Aug/2004

Parameters	200407-2626/1 Wastewater PD 003	200407-2627/1 Wastewater DS 004
Total Suspended Solids (ppm)	11	5.5

Comments Reference no: 04ET0487-0850, TS2004-0730.

Analyst(s)
Laboratory Services Manager

Test Method(s): Operations Manual OP/LS-C Section 12: : LS-C6, HACH Method 8171, HACH Method, Hach Method 8043, HACH Method 8051, LS-C30, HACH Method 8048
Operations Manual OP/LS-M Sections: : 5.22, 5.22

Form LS-2 Page 5 *1/98*

Schedule 8a Annual Reporting Form – Trade Effluent Discharge Fees and Loadings

1. Date:____/__/__ Yyyy/mm/dd	2. Reporting Year:_____ (Note this is for the calendar year)	3. Date Received _____ yyyymmdd
	4. Amount of discharge fees enclosed J$ _____ Note: The annual report (for the calendar year preceding the year in which the application is made) must be submitted when making the initial application for a licence. Discharge fees are **not** payable when the initial application is made. Discharge fees are payable when each subsequent annual report is submitted. Derive amount from item 7 inthis schedule.	Amount of discharge fees included J$_____ How was payment made Cheque ☐ Money order ☐ Draft ☐ Other (specify) ☐ Is calculation of discharge fee correct Calculation verified by:

5. Name, location and permit and licence numbers for the facility

Name of facility:_____

Location of facility:_____

NRCA Permit No.:_____ NRCA Licence No.:_____

6. Discharge Fees

Pollutant	Fee* per tonne in trade effluent	Fee J$/ tonne	Tonnes discha-rged	Discharge Fee
BOD	1.50			
COD#	3.00			
Caustic soda #	50.00			
Total N	5.00			
Total P	5.00			
Oil and grease	5.00			
TSS	1.50			
Total heavy metals (As, Cd, Cr, Cu, Pb, Hg, Se, Zn)	100.00			
Fecal coliform				
(a) 1 000 to 5 000 organisms per 100 ml	10.00			
(b) 5 000 to 20 000 organisms per 100 ml	20.00			
(c) more than 20 000 organisms per 100 ml	30.00			
Total Discharge Fees				
Total incentive from Item 7 in Schedule 8c				
7. Net Discharge Fee				

Second column to be deleted when fees are fixed in J$

** Fees for Total coliform are$/1,000,000 litres*

[The inclusion of caustic soda is being reviewed pending assessment of method to estimate discharges.]

8. Estimate of average flow rate of trade effluent

Average annual flow rate of trade effluent or

Monthly flow rate (litres). If the flow rate is not available, use monthly water usage

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
	Dec	YR____		____	____	____	____	____	____	____
	____	____	____	____	___					

9. Annual releases

PARAMETER	Annual average concentration	Number of samples	Number of samples above standard	Annual loading (tonnes)
Biological oxygen demand (BOD)				
Chemical Oxygen Demand (COD)				
pH				
Caustic Soda (as NaOH)				
Faecal Coliform				
Nitrate as NO_3				
Phosphate as PO_4				
Oil and grease				
Total suspended solids (TSS) (maximum monthly average)				
Temperature				
Total Coliform				
Total dissolved solids (TDS)				
Total suspended solids (TSS) maximum daily average				
Ammonia/ammonium measured as NH_4				
Barium				
Beryllium				
Boron				
Calcium				
Chloride				
Colour				
Cyanide (free)				
Cyanide (Total as CN)				
Detergent				
Dissolved oxygen (DO)				
Fluoride				
Iron				
Magnesium				
Manganese				
Phenols				
Sodium				

PARAMETER	Annual average concentration	Number of samples	Number of samples above standard	Annual loading (tonnes)
Sulphate				
Sulphide				
Total organic carbon (TOC)				
Trace Metals: Zinc Lead Cadmium Arsenic Chromium Copper Mercury Nickel Selenium Silver Tin Total Heavy Metals				

[The inclusion of caustic soda is being reviewed pending assessment of method to estimate discharges.]

10. Number of reportable incidents

11. Community activities

Schedule 8b Annual Reporting Form – Industrial Sludge

1. Date:_____ _ Yyyy/mm/dd	2. Reporting Year:_____ _	3. Date Received _____ yyyy/mm/dd

4. Name, location and permit and licence numbers for the facility

Name of Plant:_____

Location of Plant:_____

NRCA Permit No.:_____ NRCA Licence No.:_____

5. Annual release of industrial sludge

Type of sludge	Amount of sludge generated in year	Stored on Site at year end	Transferred off-site	Other (specify)
Non-Hazardous				
Hazardous				

J Wray and Nephew

Products	Bottled Rums		
	Bulk Rums		
	Liqueurs		
	Wines		
Process Description	(not available)		
Products (annual production	Annual capacity production		
Bottled Rums	15 mil litres pa		
Bulk Rums	3.03 Mil Litres pa		
Liqueurs	0.5 mil litres pa		
Wines	7 mil litres pa		
Raw materials	Rums, Primarily ethanol		
	Sucrose		
	Milk derivatives		
	Fructose		
	flavours		
	Ammonium Phosphate and Quaternary Ammonium compounds		
	Sodium Hydroxide, Hydrochloric Acid		
	Caramel		
	Chlorine based sanitizers		
Sources of Water			
National Water Commission	Yes		
Own Well	Yes		
Other (specify)			
Water usage	South	North	East
Typical monthly water use (litres/year) (NWC)	8,282,741	30,000	777,244
Typical monthly water use (litres/month) (Other than NWC)	1,070,000	26000	
Trade Effluent Treatment			
Type of Waste Water Treatment	Anaerobic treatment - NO		
	Aerobic treatment- YES		
	Impoundments- NO		
	Screening-NO		
	Settling-NO		
	Other-NO		
Generation of industrial sludge	yes		
Approximate volume or weight of sludge per month	37500 litres/month		
how and where do u dispose of sludge	Treat in aerobic digester then sewage plant, cesspool emptier removes the solids		

Trade Winds Citrus Limited Bog walk P.O. St Catherine

Products	Drums of frozen concentrate
	Gallons of juices
Process Description	Using fresh oranges in season (Dec - June) to prepare concentrate. All year round using concentrate to blend a variety of fruit drinks
Products (annual production capacity in tonnes or other metric units)	Annual capacity production
Frozen concentrate	5000 drums
Gallons of juices	6,000,000
Raw materials	Various fruit concentrates
	Sugar
	Sorbic acid
	Sodium Benzoate
	Caustic soda
	stabilizers
	Phorphoric Acid
	Citric Acid
	Mallic Acid
Sources of Water	other than NWC and own well
Water Usage	
Typical Annual water use (litres/year) (Other than NWC)	227000000- 80% water goes to product
Typical monthly water use (litres/month) (Other than NWC)	18,916,667
Trade Effluent Treatment	
Type of Waste Water Treatment	Anaerobic treatment- NO
Impoundments	Aerobic treatment- YES
	Impoundments- YES
	Screening-
	Settling-
	Other- Three ponds of varying depth
Generation of industrial sludge	yes
Approximate volume or weight of sludge per month	Solid waste from peeling orange- 45% weight
how and where do u dispose of sludge	In a box. Each box weighs 90lbs and process
	500,000-600,000 boxes annually. All sold for animal feed
Effluent discharged	Rio Cobre
Storm water discharged (Discharge points crossing property boundary are to be precisely located during subsequent site visit)	River
Flow of all trade effluent in Litres in the year 2003	
Avg. Monthly Flow	204,000,000 l/annum
How often do you monitor trade effluent	never
How many different trade effluent and storm water streams do you monitor	will do influent, effluent and upstream and downstream

Figure 1 Map Showing the Locations of Facilities in the Study Area

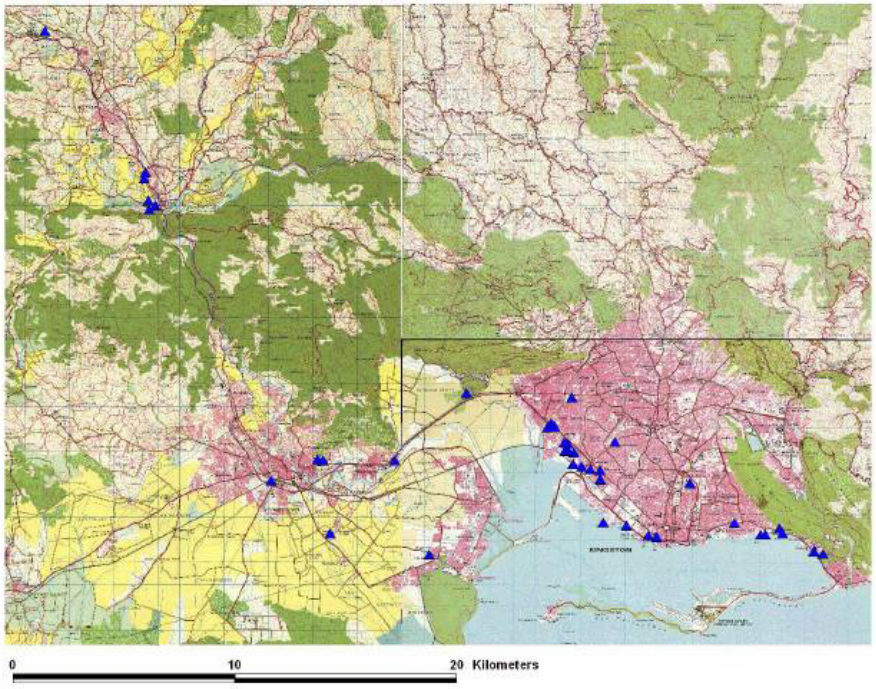

Table 2-1 Facilities that Discharge Trade Effluent into Kingston Harbour - Geographic Distribution

Location	Count
Kingston & St. Andrew – West (Spanish Town Rd, Downtown, Washington Blvd, Hagley Park Rd, Arnold Rd)	31
Kingston & St. Andrew – East (Windward Road/Rockfort)	7
St. Catherine - South (Spanish Town & vicinity)	11
St. Catherine – North (Bog Walk/Ewarton)	6
Total	55

v

Figure 2-1 Map Showing the Locations of Facilities in the Study Area

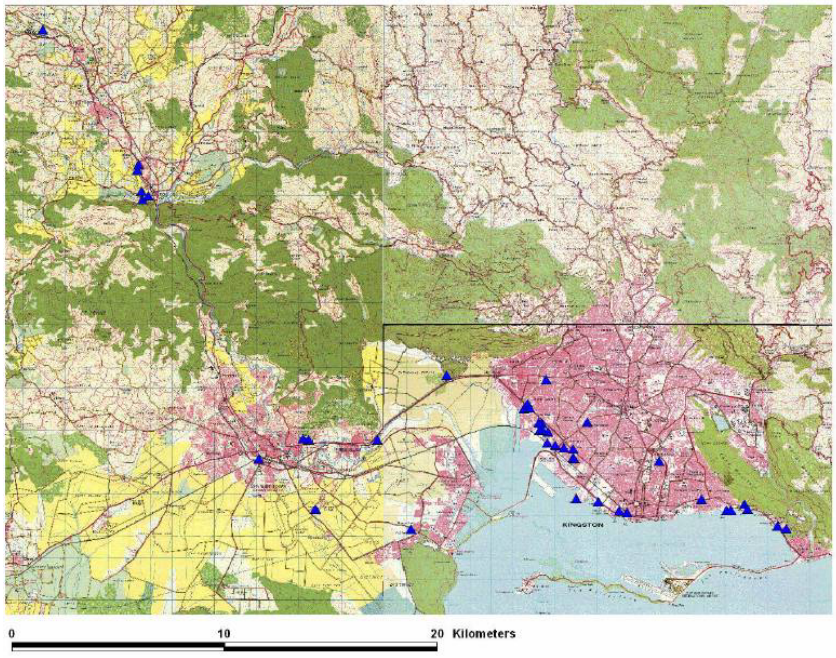

Table 2-2 Facilities that Discharge Trade Effluent into Kingston Harbour - Distribution by 2-Digit ISIC Code

Main 2 digit ISIC Code	Count	Description
15	30	Manufacture of food products and beverages
16	1	Manufacture of tobacco products
19	1	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
23	1	Manufacture of coke, refined petroleum products and nuclear fuel
24	13	Manufacture of chemicals and chemical products
25	1	Manufacture of rubber and plastics products
26	1	Manufacture of other non-metallic mineral products
27	1	Manufacture of basic metals
28	2	Manufacture of fabricated metal products, except machinery and equipment
29	1	Manufacture of machinery and equipment n.e.c.
40	3	Electricity, gas, steam and hot water supply
Total	55	

n.e.c. Not elsewhere classified

Table 2-3 Facilities in the Study Area that Manufacture Food Products and Beverages (ISIC Code 15) and chemicals and chemical products (ISIC Code 24)

ISIC Code	Count	Description
1511	3	Production, processing and preserving of meat and meat products
1513	5	Processing and preserving of fruit and vegetables
1514	1	Manufacture of vegetable and animal oils and fats
1520	1	Manufacture of dairy products
1531	1	Manufacture of grain mill products
1541	1	Manufacture of bakery products
1542	1	Manufacture of sugar
1544	1	Manufacture of macaroni, noodles, couscous and similar farinaceous products
1549	3	Manufacture of other food products n.e.c.
1551	4	Distilling, rectifying and blending of spirits; ethyl alcohol production from fermented materials
1553	2	Manufacture of malt liquors and malt
1554	7	Manufacture of soft drinks; production of mineral waters
Subtotal Code 15	30	
2411	3	Manufacture of basic chemicals, except fertilizers and nitrogen compounds
2422	4	Manufacture of paints, varnishes and similar coatings, printing ink and mastics
2423	3	Manufacture of pharmaceuticals, medicinal chemicals and botanical products
2424	3	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
Subtotal Code 24	13	

Table 2-4 Facilities that Discharge Trade Effluent into Kingston Harbour - Distribution by Type of On-Site Treatment Technology

On-Site Treatment Technology	Number of Facilities
Aerobic System	2
Anaerobic treatment	5
Impoundments	1
Screening	
API separator	4
Settling	3
Other	
Custom Chemical treatment/sludge separation	6

Table 2-5 Estimates of Loadings from Sewage Treatment Plants in the Study Area

Location	Region#	Capacity (10^6 L/d)	Concentration (mg/L)		Loading (Tonnes)	
			BOD*	COD *	BOD*	COD*
Greenwich T/Works	KSA	52.80	76.1	182	1,467	3,508
Greenwich T/Works	KSA	52.80	584	1,751	11,245	33,736
Western T/Works	KSA	22.00	76.1	182	611	1,461
Western T/Works	KSA	22.00	584	1,751	4,686	14,057
Greater Portmore	Portmore	13.60	102	305	505	1,515
Independence City	Portmore	13.26	109.2	368	528	1,781
Bridgeport	Portmore	7.60	96.6	342	268	949
Bridgeport	Portmore	7.60	268	949	743	2,632
Greater Portmore A	Portmore	6.81	12.6	53	31.3	132
Greater Portmore B	Portmore	6.81	18.6	70	46.2	174
Greater Portmore A	Portmore	6.81	31.3	132	77.7	327
Greater Portmore B	Portmore	6.81	46.2	174	115	432
Ensom City Housing	Spanish Town	3.80	35.7	125	49.5	173
Ensom City Housing	Spanish Town	3.80	44.4	133	61.6	185
Eltham Park	Spanish Town	2.30	4.4	10	3.69	8.4
Horizon Park	Spanish Town	1.90	27	38	18.7	26.4
Elletson Flats	KSA	1.10			-	-
Twickenham Park	Spanish Town	0.95	0.1	5	0.03	1.73
Hamilton Gardens	Portmore	0.76	9.4	52	2.61	14.4
Hamilton Gardens	Portmore	0.76	4.44	13.3	1.23	3.69
Angels Estate	Spanish Town	0.68	55	88	13.7	21.9
Dela Vega City	Spanish Town	0.50	34	77	6.21	14.1
Boone Hall	KSA	0.40	9.6	20.7	1.39	2.99
Lime Tree Grove	Spanish Town	0.38	18	31	2.50	4.30
Whitehall Avenue	KSA	0.35	127	478	16.4	61.4
Ebony Vale	Spanish Town	0.27	26.9	91	2.65	8.97
Ebony Vale	Spanish Town	0.27	3.15	9.46	0	0.93
Barbican Mews	KSA	0.26	15	37.7	1.45	3.63
College Green	KSA	0.26	79.7	196	7.68	18.89
Grove Manor	KSA	0.25	12.5	35	1.12	3.15
Acadia	KSA	0.22	112	323	9.01	25.9
Hughenden	KSA	0.15	6.4	15	0.36	0.84
Caymanas Gardens	Portmore	0.10	31.8	136	1.18	5.06
Total (high)		-			18,051	54,887
Total (low)					3,554	9,801

KSA – Kingston and St. Andrew

* The mean COD/BOD ratio for measurements was 3.0 excluding one outlier. Entries in red are based on assumed values: BOD and COD concentration data for Greenwich T/Works were assumed to be the same as that for Western T/Works and missing COD concentrations were assumed to be 3.0 times the BOD values.

Figure 2-5 Map Showing Locations of Monitoring and Discharge Points for Facilities in Kingston & St. Andrew East B

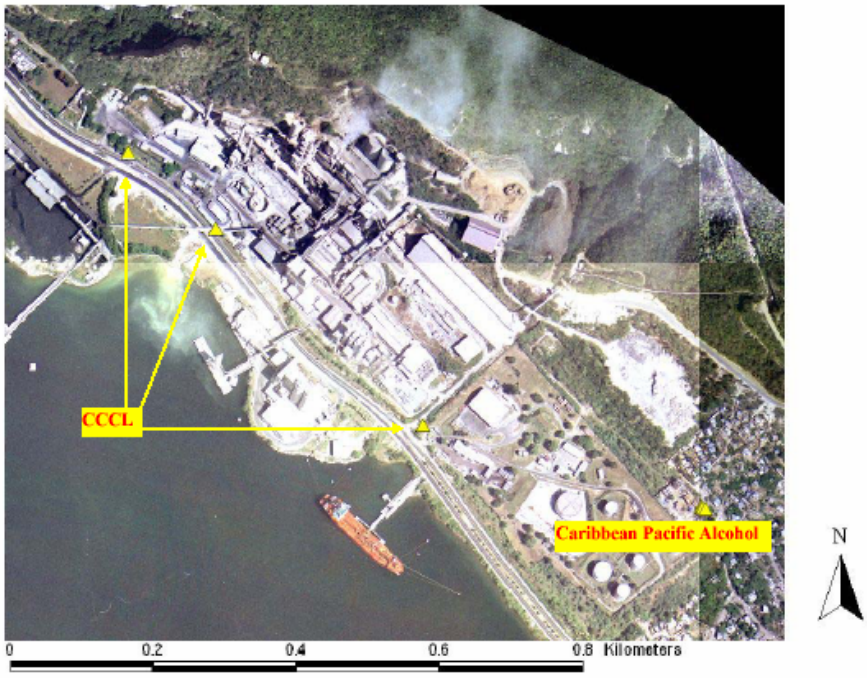

Figure 2-4 Map Showing Locations of Monitoring and Discharge Points for Facilities in Kingston & St. Andrew East A

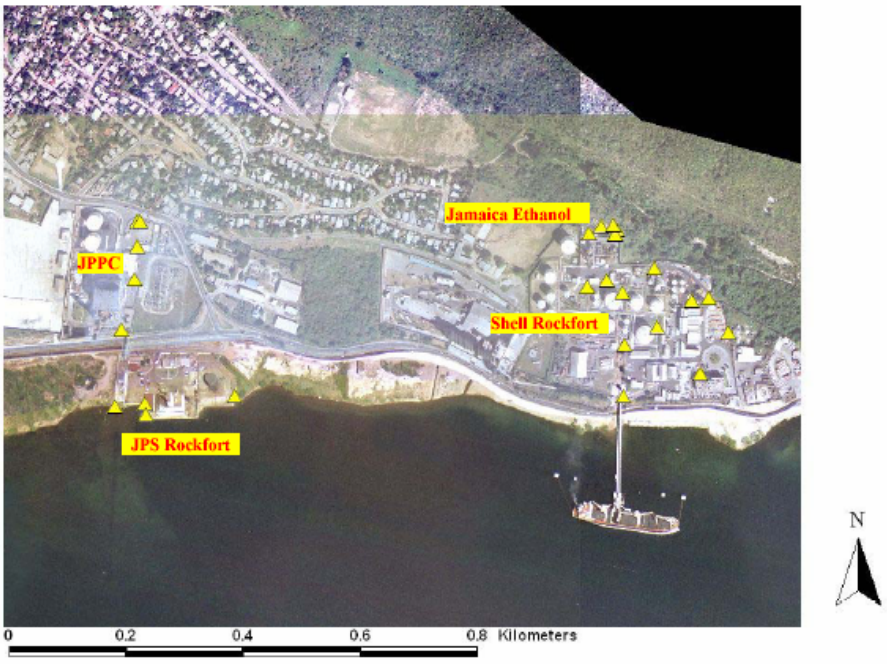

Figure 2-7 Map Showing Locations of Monitoring and Discharge Points for Facilities in Kingston & St. Andrew West B

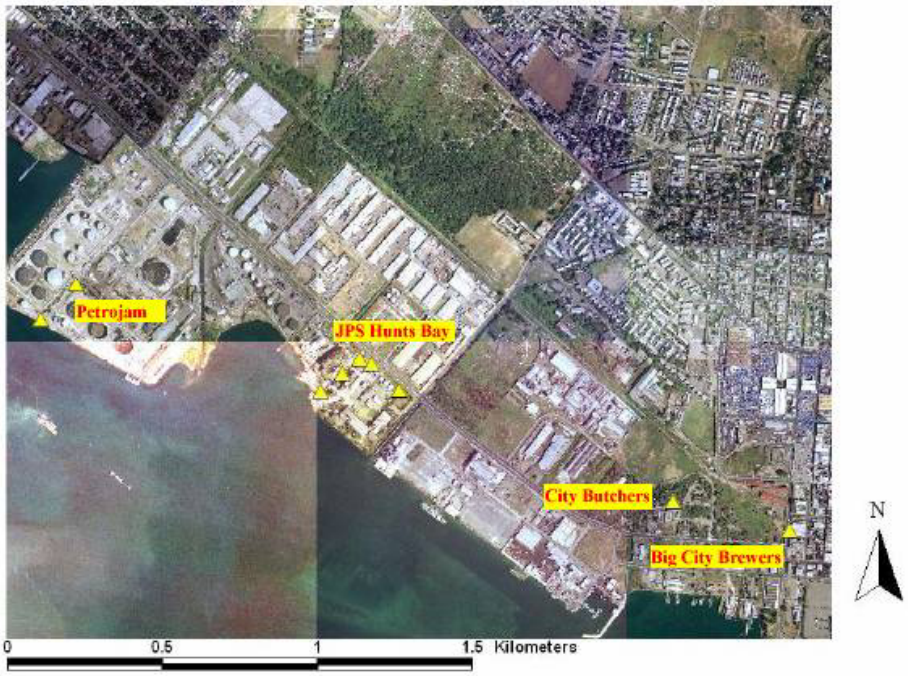

Figure 2-8 Map Showing Locations of Monitoring and Discharge Points for Facilities in Kingston & St. Andrew West C

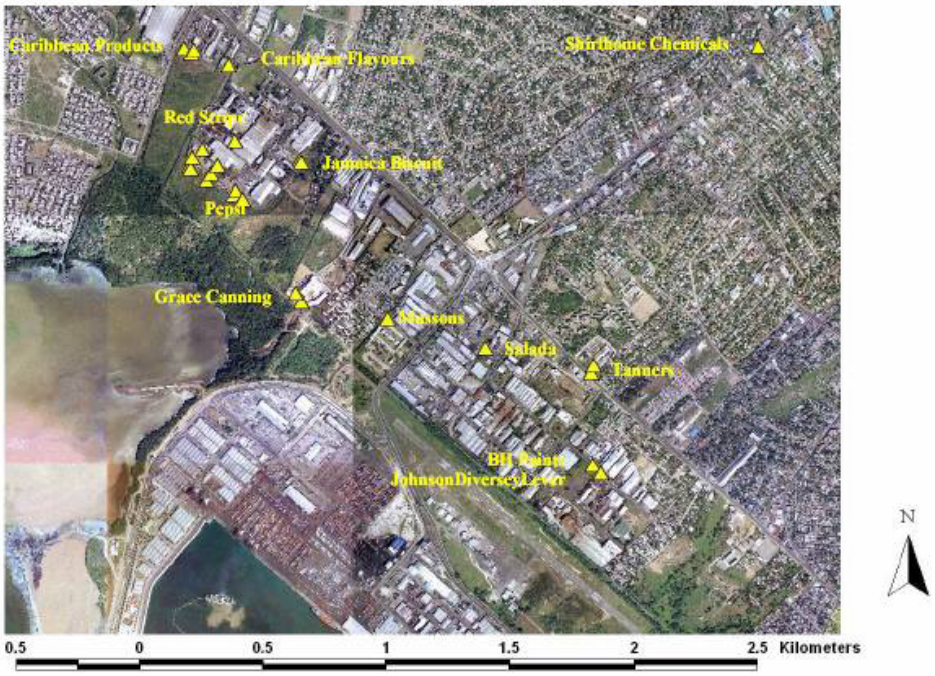

Figure 2-10 Map Showing Locations of Monitoring and Discharge Points for Facilities in St. Catherine – South

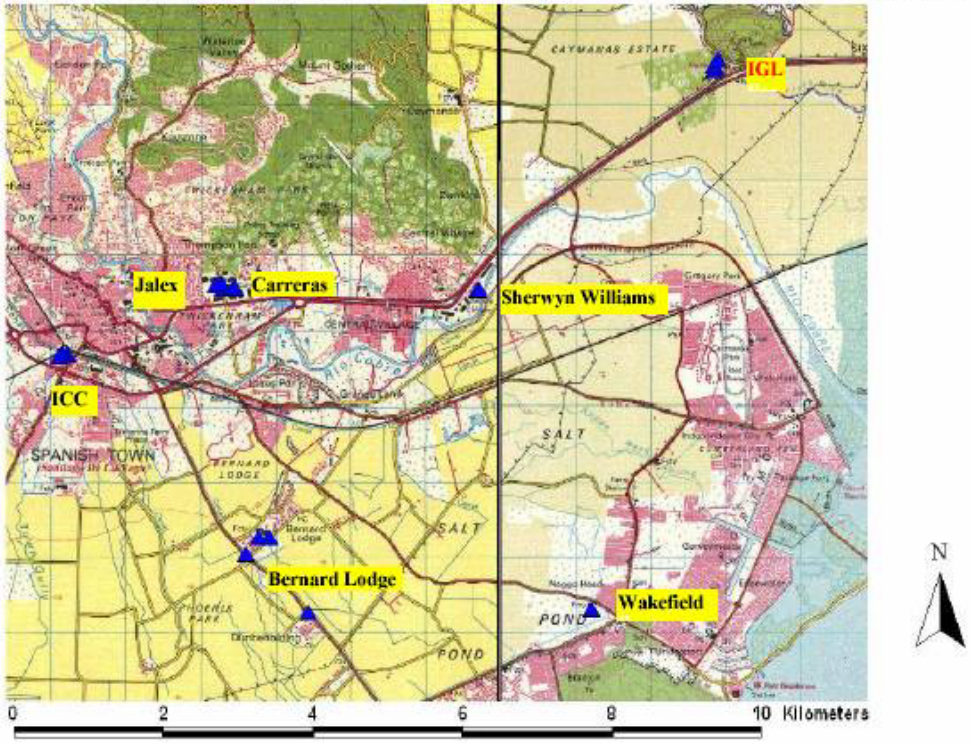

Figure 2-11 Map Showing Locations of Monitoring and Discharge Points for Facilities in St. Catherine – North

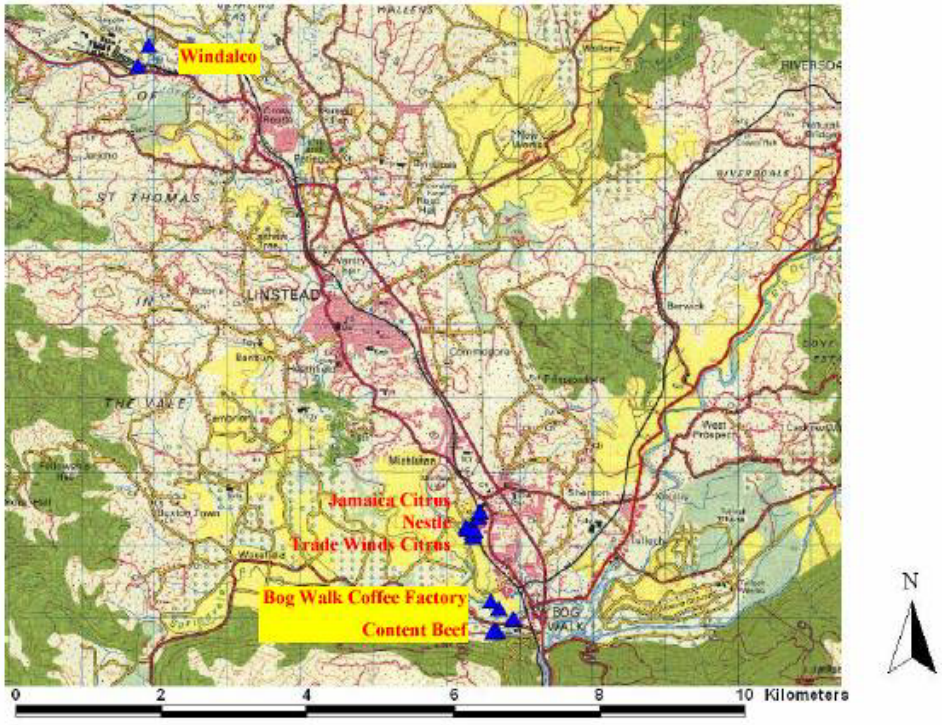

Table 3-1 Summary of Recommended Training Courses and Examples of the Type of Adaptation Needed

Module	Description	Adaptation Needed (preliminary)
Overview of Trade Effluent & Industrial Sludge Regulations	Overview of the regulation	Yes (e.g., greater focus on industry/licensees)
Workshop to receive applications and determine completeness	Overview of regulations and step-by-step procedure to review applications for completeness. Develop protocol based on a checklist as workshop output	Yes (e.g., preparation of the applications and the use of checklist, …)
Processing of licence applications for Trade Effluent & Industrial Sludge Regulations	Overview of regulations and step-by-step procedures for the technical review of applications.	Not required
Preparation and submission of licence applications for Trade Effluent & Industrial Sludge Regulations	Overview of regulations and step-by-step procedure to submit applications. Technical requirements for each item in application	Yes (e.g., focus on preparation of application and annual reports)
Workshop on compliance plans and licence conditions	Overview of regulations and procedures and information requirements for specifying licence conditions and approval of compliance plans	Yes (e.g., similar but from licensees perspective. Refer to modules on pollution prevention and pollution control methods and especially time and costs for conceptualisation, design, implementation)
Monitoring of trade effluent and Reporting requirements	Sampling techniques for trade effluent and industrial sludge. Record keeping requirements for licensees	Yes (e.g., similar. Emphasis on flow monitoring and its importance, flow measurement techniques)
Compliance and Pollution Prevention	Overview of regulations especially offences, reporting requirements. Strategies for site visits, assurance of evidence Strategies for stakeholder engagement, developing codes of practice, best practices	Yes (e.g., from the perspective of the licensee)
Data Management	Analysis and compilation of incident, complaint, and annual reports for preparation of pollutant release and transfer register (PRTR) report	Yes (e.g., especially emphasis on record keeping and reporting)

Table 3-2 Summary of Strategies to Develop a Monitoring Programme for Kingston Harbour

Component	Strategy / Programme description
Identify data users	Identify internal and external suppliers and users of data in the public and private sectors (e.g., NEPA staff/branches, STATIN, WRA, Port Authority, JBI, JMA, KSCA, Ministry of Water
Develop criteria for establishing monitoring priorities (Bases for deployment of resources for various monitoring objectives)	
Determine monitoring characteristics	
Monitoring locations Surface Facilities	 Identify suitable locations upstream (2) and downstream of the industrial sources in the Bog Walk (2) and Ewarton (one) areas of the Rio Cobre. Review other monitoring activities (e.g., NWC monitoring of drinking water sources in the Rio Cobre, WRA stream flow and other monitoring) Licensed facilities. Selection of facilities to be monitored to be based on risk management approach (see text box)
Parameters to be monitored Sampling and analytical methods Quality assurance and quality control requirements Frequency of monitoring Types of samples	Parameters included in regulations Methods specified in regulations Standard laboratory QA/QC procedures. Include documentation and routine reporting of QA/QC activities Participate in laboratory inter-comparison studies Establish standard frequency for tracking surface water quality. Note frequency for Rio Cobre and Kingston Harbour should fit within and be compatible with national programme for watershed monitoring Grab samples for surface. For trade effluent base sampling on consistency of streams monitored
Data management	Develop a database consistent with NEPA's AMANDA system. The system should allow entry and retrieval of all information and data related to monitoring. In the case of water quality reports, the annual reporting forms in the draft regulations specify the information and data requirements. The validation monitoring conducted by NEPA should compile similar information
Data assessment and interpretation	Use standard assessment techniques (comparison with standards, averages, distribution of data, plots etc.)

Table 3 2 Summary of Strategies to Develop a Monitoring Programme for Kingston Harbour (Cont'd)

Reporting	NEPA to provide routine internal reports regarding compliance issues and use data for annual reporting (PRTR, Environmental Statistics, supply to other data users in agreed formats or make raw data available to users so they can perform their own analyses
Determine monitoring priorities	Develop a risk management based strategy in which the discharges are ranked by the product of the flow, concentration and a pollutant weighting index. Examples of such an index are the Chimiotox index[6], the U.S. EPA toxic pollutant weighting index[7] or the weighting used in the New South Wales[8] or derivable from the British Columbia waste management regulations[9].
Estimation of the monitoring costs (logistics, resources (instrumentation available, etc.)	Estimate costs based on numbers of samples, cost/sample, logistics costs etc.

Facilities Considered for Potential Discharge into Kingston Harbour: Assigned categories, Status of Information Obtained from Telephone Calls, Visits and Questionnaires

Category	Company Name	Address	Parish	Water Use m3/y	ISIC	Status of Information
A	Food Ingredients Ltd.	13 Diamond Avenue	Kingston 11	5859.18	1514	Contacted. Unable to arrange site visit. Questionnaire sent
A	Grace Food Processors (Canning) Ltd	2-6 Twickenham Close	Kingston 11	142391.7	1513	Site visited. Questionnaire completed. No pollutant concentration data
A	H D Hopwood & Co Ltd	3 Carifta Avenue	Kingston 11	5404	2423	Contacted. Unable to arrange site visit. Questionnaire sent
A	Industrial Chemical Co Ja Ltd	Windsor Road	Spanish Town	30000	2411	Site visited. Questionnaire completed
A	Industrial Gases Ltd. (Ferry)	Ferry	St. Catherine	35745.54	2411	Site visited. Questionnaire completed
A	J. Wray & Nephew Group (Estate Industries Ltd.)	232 Spanish Town Road 234 and 473 Spanish Town Road	Kingston 11	7085.52	1551	Site visited. Questionnaire completed
A	J. Wray & Nephew Ltd.	234 Spanish Town Road	Kingston 11	93247.26	1551	Site visited. Questionnaire completed
A	Jalex Manufacturing Co. Ltd.	Twickenham Park, P. O. Box 721	Spanish Town	10174.08	2892	Site visited. Questionnaire completed. No pollutant concentration data
A	Jamaica Biscuit Company Ltd.	206 Spanish Town Road	Kingston 11	10900.8	1541	Site visited. Questionnaire completed
A	Jamaica Citrus Company	Bog Walk P.O.	St. Catherine	588643	1554	Site visited. Questionnaire completed
A	Jamaica Ethanol Processing Ltd	Rockfort	Kingston 2	8748	1551	Site visited. Questionnaire completed
A	Jamaica Private Power Company	100 Windward Road	Kingston 2	23027.94	4010	Contacted. Questionnaire sent. Data obtained from other sources
A	JPS Hunts Bay	100 Windward Road	Kingston 2	9629.04	4010	Site visited. Questionnaire completed. No pollutant concentration data
A	JPS Rockfort	Marcus Garvey Drive	Kingston 11	63072000	4010	Site visited. Questionnaire completed. No pollutant concentration data
A	LASCO DISTBRS LTD	White Marl	St. Catherine	5495.82	1549	Contacted. Unable to arrange
						site visit
A	Mussons (Jamaica) Ltd.	178 Spanish Town Road	Kingston 11	16941.66	2424	Site visited. Questionnaire completed
A	Nestle Jamaica Ltd.	Bog Walk P.O.	St. Catherine	NA	1549	Site visited. Questionnaire completed
A	Omni Industries Ltd./Thermoplastics	Twickenham Park, P.O. Box 680	Spanish Town	18134.02992	2520	Contacted. Unable to arrange site visit
A	Pepsi-Cola Jamaica Bottling Co. Ltd.	214 Spanish Town Road	Kingston 11	365000	1554	Site visited. Questionnaire completed
A	Petrojam Ltd.	96 Marcus Garvey Drive	Kingston 11	49825.74	2320	Site visited. Questionnaire completed
A	Red Stripe	214 Spanish Town Road	Kingston 11	1825000	1553	Site visited. Questionnaire completed
A	Roberts Products Co. Ltd.	7 Norwich Avenue 82B Waltham Park??	Kingston 11	5495.82	1513	Contacted. Questionnaire sent. Unable to arrange site visit
A	Salada Foods Jamaica Ltd.	20 Bell Road	Kingston 11	16815.19138	1513	Site visited. Questionnaire completed. No pollutant concentration data
A	Shell Rockfort Jetty	236 Windward Road	Kingston 2	77142.06335	2914	Site visited. Questionnaire completed
A	Sherwin Williams (W.I.) Ltd.	White Marl, Spanish Town	White Marl, Spanish Town	2004	2422	Site visited. Questionnaire completed. No pollutant concentration data
A	Shirlhome Chemicals Corp.	78c, e & f Hagley Park Road	Kingston 11	360	2422	Site visited. Questionnaire completed
A	Smith & Stewart Distributors Ltd.	3-7 McArthur Avenue	Kingston 11	10370.8667	1544	Contacted. Unable to arrange site visit
A	Spike Industries Ltd.	99 Windward Road	Kingston 2	12968.57897	1554	Site visited. Questionnaire completed. No pollutant concentration data
A	Tanners	259 Spanish Town Road	Kingston 11	14988.6	1911	Site visited. Questionnaire completed

Category	Company Name	Address	Parish	Water Use m3/y	ISIC	Status of Information
A	Trade Winds Citrus Ltd.	Bog Walk P.O.	St. Catherine	6813	1554	Site visited. Questionnaire completed. Pollutant concentration data obtained specially for this study
A	Wakefield Juices	Lot # 7, Naggo Head Industrial Estate	P.O. Box 191, Bridgeport P.O.	11173.53575	1554	Site visited. Questionnaire completed. No pollutant concentration data
A	Windalco (Ewarton)	Ewarton P.O.	St. Catherine	1802698.5	2720	Data from Section 17 reports
B	Caribbean Flavours & Fragrances Ltd.	226 Spanish Town Road	Kingston 11	908.4	1549	Site visited. Questionnaire completed
B	Cosmetic International Ltd.	455 Spanish Town Road	Kingston 11	3606.823581	2424	Contacted. Unable to arrange site visit
B	Electric Arc (Jamaica) Ltd. Welding Industries	Twickenham Park Industrial Estate,	Spanish Town	1478.697756	2899	Contacted. Unable to arrange site visit
B	Facey Commodity Company Limited Bottling	61 Newport Blvd	Kingston	NA	1549	Contacted. Unable to arrange site visit
B	Federated Pharmaceuticals Ltd.	1 Bell Road	Kingston 11	1226.34	2423	Contacted. Unable to arrange site visit Data obtained from Section 17 data
B	Jamaica Drink Co. Ltd. (Wisynco Group)	P.O. Box 367, WISYNCO Complex	White Marl, Spanish Town	181.68	1554	Contacted. Unable to arrange site visit
B	JohnsonDiverseyLever Jamaica Ltd.	8 Bell Road	Kingston 11	363.36	2411	Site visited. Questionnaire completed. No pollutant concentration data
B	P. A. Benjamin Mfg. Co. Ltd. (ICD Group Ltd.)	95-97 East Street	Kingston	1978.257809	2423	Contacted. Unable to arrange site visit
B	Solomon Armstrong & Co.	17 Chancery Lane	Kingston	NA	1513	Contacted. Unable to arrange site visit

Facilities Considered for Potential Discharge into Kingston Harbour: Facilities Eliminated From Consideration

Category	Company Name	Address	Parish	*Water Use m3/y*
x	Air Jamaica Ltd.	72-76 Harbour Street	Kingston	#N/A
x	AlChem Ltd (Chemco Ltd)	26 Collins Green Road	Kingston 5	30.28
x	Antilles Chemicals Co. Ltd.	96 Marcus Garvey Drive	Kingston 15	1368.794545
x	Arc Systems Ltd.	14 Bell Road	Kingston 11	1408.02
x	B. W. Manufacturing Company	14-20 Beckford Street	Kingston	136.26
x	Barco Caribbean Ltd.	1 Weymouth Close	Kingston 20	142.5428949
x	Beal Industries Ltd.	2 Bell Road	Kingston 11	#N/A
x	Boss Furniture Company Ltd.	112e Church Street	Content Gap	799.2960845
x	C. A. Industries Ltd.	55 Barry Street	Kingston	#N/A
x	Cap-Pack Solutions Ltd.	7-9 Norman Road	Kingston CSO	14352.72
x	Carnaud Metal Box (Ja.) Ltd.	196 Spanish Town Road	Kingston 11	841.4214859
x	Chem-Quip Water Treatment Ltd.	16 - 18 Bell Road	Kingston 11	114.6098
x	Coates Brothers	9 Nanse Pen Close, PO Box 317	Kingston 11	166.54
x	Cocoa Cola	693 Spanish Town Road	Kingston 11	9735.02
x	Colgate Palmolive Co. (Ja.) Ltd.	216 Marcus Garvey Drive	Kingston 11	2588.94
x	Consumer Packaging Ltd.	76 Marcus Garvey Drive	Garmex Freezone	1914.224201
x	Containers Company Ltd.	9 Bell Road	Kingston 11	393.64
x	Cremo	Newport West	Kingston 11	#N/A
x	Crooks Greve Co. Ltd.	110 Hagley Park Road	Kingston	539.524857
x	Desonel Mfg. Co. Ltd.	LOJ Complex, 7-9 Norman Road	Kingston	3596.83238
x	Diamond Paints Ltd.	67 Waltham Park Rd	Kingston 11	72
x	Edgechem Jamaica Ltd.	18 Carifta Avenue,	Nanse Pen Industrial Estate	1771.38
x	ESSO Standard Oil	75-77 Marcus Garvey Drive	Kingston 11	#N/A
x	Factories Corporation Of Jamaica Ltd.	1 King Street	Kingston	#N/A
x	Flavorlan Ltd.	2 Olympic Way	Kingston 11	96
x	General Packaging Co. Ltd.	14 Riverton Boulevard	P.O. Box 19	159.8592169
x	Graymill Engineering Ltd.	104 Hagley Park Road	Kingston 11	2.497800266
x	Hardware & Lumber Ltd	697 Spanish Town Road	Kingston 11	7539.72
x	Heart/Garmex	76 Marcus Garvey Drive	Kingston	1900.07
x	Henkel Chemicals (Caribbean)	36 Red Hills Road	Kingston 10	10.82380114
x	IGL Spanish Town Road	593-595 Spanish Town Road	Kingston 11	7176.36
x	J & E Industries Ltd.	4-6a Norman Road	Kingston 16	#N/A
x	Jamaica Alcohol	Marcus Garvey Drive	Kingston	#N/A
x	Jamaica Broilers Group Ltd. (Processing Plant)	Spring Village	St. Catherine C.S.O.	#N/A
x	Jamaica Feeds	3 Felix Fox Blvd	Kingston 11	#N/A
x	Jamaica Fibreglass Prods. Ltd.	11 Ashenheim Road	Kingston 11	30.80620325
x	Jamaica Flour Mills	209 Windward Road	Kingston 2	8342.652882
x	Jamaica Grain & Cereals Ltd. (Seprod Group)	3 Felix Fox Boulevard	P.O. Box 271, GPO	#N/A
x	Jamaica Packaging Industries Ltd.	214 Spanish Town Road	Kingston 11	#N/A
x	JP Foods (formerly Trinjam)	0	St. Thomas	492
x	KEM PRODUCTS LTD (also CEK Jamaica Ltd)	68 Riverton Blvd	Kingston 11	#N/A
x	Konvertra Limited	93 Port Royal Street	Kingston	227.1
x	LASCO FOODS LTD	38 1/2 Red Hills Rd	Kingston 10	#N/A
x	Ledermode Ltd. (Tanners)	259 Spanish Town Road	Kingston 11	105.98
x	Mcintosh Group Of Companies MCINTOSH BEDDING/SEALY	585-591 Spanish Town Road	Kingston 11	#N/A
x	Norman Manley International Airport	0	Kingston	#N/A
x	Oriental Packing Ltd.	237 Tower Street	Kingston	#N/A
x	Paper Processors Ltd.	214 Marcus Garvey Drive	Kingston 11	#N/A
x	Petroleum Company Of Jamaica Ltd.	695 Spanish Town Road	Kingston 11	4496.58
x	Phoenix Printery Ltd.	141 East Street	Kingston	37.85
x	Plastic Containers Ltd. (Lascelles Group)	2e Ashenheim Road	Kingston 11	#N/A
x	Produce to Products Ltd	2 Salt Hill Road	Content Gap	#N/A
x	Quality Chemicals Ltd.	237 Marcus Garvey Drive	Kingston	#N/A
x	Roto Plastics (Jamaica) Ltd.	Lot #7, Twickenham Park	Spanish Town,	#N/A
x	SEPROD	3 Felix Fox Blvd	Kingston CSO	37.85
x	SEPROD (Jamaica Grains and Cereals)	0	Kingston	#N/A

Category	Company Name	Address	Parish	*Water Use m3/y*
x	Serge Island Dairies Ltd. (ICD Group Ltd.)	95-97 East Street	Kingston	#N/A
x	Serv-Wel Industries Ltd.	8-10 Ashenheim Road	Kingston	5115.494941
X	Starfish Oils	7 Norman Road, LOJ Complex, Unit 30, P.O. Box 9080	Kingston	#N/A
X	Steinhol Chemicals Limited	12-14 Wellworth Avenue, P.O. Box 427(Off Diamond Road),	Kingston	1226.34
X	Sun Island Jamaica	45 Molynes Road	Kingston 10	399.6480422
X	Tank-Weld Civil Engineers & Bldg Contrs	27 Seaward Drive	Kingston	#N/A
X	Therapedic (Carib.) Ltd. (Morgan's Industries Group)	P.O. Box 52, Bridgeport P.O.	St. Catherine	#N/A
X	Tropicair Limited	227 ½ Marcus Garvey Drive	Kingston	#N/A
X	Tropical Battery	14 Ashenheim Road	Kingston 11	454.2
X	Tropical Metal Products Ltd	18 Westport Avenue	Kingston	58.28200616
X	United Plastics Co Ltd.	4 Olympic Way	Kingston	120.7270128
X	Van Leer (Jamaica) Ltd.	279 Spanish Town Road	Kingston	85.75780906