APPENDIX XII

Kingston Pumping Station Requirements and Cost Estimates (Final)

1.0 PUMPING STATION PUMPING EQUIPMENT

The existing pumping stations in the Kingston sewage collection system are in varying stages of operation from full operation, to those requiring minor repairs, to those requiring major repairs, to those that are totally inoperative. The collection system average sewage flows and peak flows have now been calculated on the basis of the 1992 Population Projections to the year 2015, which results in many of the lift stations being eventually required to pump peak sewage flows for which the stations were not originally designed.

In the case of several small stations servicing limited area and local subdivisions there will be very little change in flows and construction required at these stations consists of refurbishment, replacing inoperable equipment and general renovation of the stations, without major changes.

In the case of several other stations, the peak flows are significantly different from the design peak flows of the stations. These stations have been examined with the intention of determining what changes are required for the year 2015 and what changes are required in the earlier stages of the collection system. The solutions outlined vary in each case however, in general the need is for replacing inoperable equipment and general renovation, with replacement of some major items of equipment, with equipment of a larger capacity.

There are other stations such as Darling St. and Nanse Pen, which will have very large increases in flow, where complete replacement or construction of additional pumping stations is necessary.

Existing lift stations are of various types from wet pit stations with submersible pumps, to stations with self-priming centrifugal pumps, to wet well/dry well type stations with vertical non-clog type pumps. Most intermediate sized and large sized stations have manual bar screens, comminutors and stand by generators. Most of the smaller wet pit stations do not have comminutors or manual bar screens, however they do have standby generators.

In a number of stations problems have been reported, with comminutor equipment which grinds incoming sewage so that pumps are able to better pump the sewage. Comminutors are always a high maintenance type of equipment because of the debris material often carried in the sewage and because of the large variations in sewage flows that comminutors encounter in continuous operation.

Also this equipment is always in the "wet" area of the station which can sometimes be totally flooded, and is always in that part of the station in which it is most difficult for operators to perform regular maintenance.

If there are grit removal facilities and coarse screens upstream, comminutor life will be lengthened and maintenance will be reduced.

If there are no comminutors in operation ahead of sewage pumps, then some extra wear and tear must be expected on the pumping equipment. Several possibilities for improvement are considered and include.

1. Replacement and/or repair of existing comminutors, including improvement of grit removal and screening.
2. Removal of comminutors completely and installation of grinder or crusher type pumps.
3. Removal of comminutors completely and installation of bar racks or screens either hand cleaned type or mechanically cleaned type.
4. Installation of bar racks or screens upstream from comminuters.

In addition to improvement to the grinding and screening of sewage the type of pumps in use in each station is variable and where changes in pump type are practical or possible these changes are considered. Wet pit stations with submersible pumps have been left as wet pit stations and where new pumps are warranted these are necessarily submersible pumps. Similarly where self priming type Gorman-Rupp pumps are in use pumping from a wet pit, we have considered replacing the existing pumps, where necessary, with similar self priming pumps.

In the wet well/dry well type pumping stations where new pumps or replacement pumps are required these will be replaced with pumps with non-clog type impellers and the use of "torque-flow" and/or bladeless type impellers pumps are in some cases considered. These type pumps are designed for improved non-clogging service, they are more expensive than standard non-clog pumps however they are also less efficient than standard non-clog pumps. Also considered are patented crusher type pumps however these also are less efficient than standard non-clog units.

All of the existing pumping stations have been designed as complete stations and changes in the basic design are now very difficult. A pumping station with an installed comminutor system is very difficult to change and without very good reasons, improvements should include replacement of existing equipment with the best available equipment of a similar type.

The experience of operation and maintenance staff will provide invaluable assistance at the detailed design stage which may include some of the following:

1. Improvements to hand raked bar screen layouts/design, addition of basket type screens to small stations.
2. Improvements to comminutor equipment such as channel design, motor enclosures, access.
3. Improvements to ventilation systems.
4. Recommendations regarding pump impeller types in use and proposed.
5. Pump seal systems.
6. Pump motor enclosures.
7. Liquid level control systems.
8. Equipment handling facilities such as hoists.
9. Standardization in pump stations, to improve maintenance.

In specific wet well/dry well locations where problems with screening and grinding have been encountered the use of patented pump strainers systems should be considered at the detail design stage. For these systems sewage enters the discharge side of the pump when the pump is stopped and solids are trapped in a patented strainer while water flows to the pump. When the pump starts on liquid level control the water flushes out the trapped solid matter on the strainer. This type of system may be practical for wet well/dry well type stations, and is referred to here as a flush clean system.

For discussion purposes the pumping stations have been classified in accordance with the following:

Large	-	12 mgd and over (8000 gpm)
	-	wet well/dry well type
Intermediate	-	600 to 8000 gpm
	-	wet well/dry well type or wet well type
Small	-	180 to 600 gpm
	-	wet well type with submersible or self priming pumps

1.1 INTERMEDIATE PUMPING STATIONS (Revised June 1993)

There are several intermediate pumping stations in the existing and proposed Kingston systems.

Existing intermediate pumping stations	6
Intermediate pumping stations under construction	1
Proposed intermediate pumping stations	3

1. Cooreville Gardens

Built 1983, 2 pumps at 750 gpm each, pump motors 40 Hp each.

This is a wet well type pumping station with 2 self priming pumps and a standby generator. The Cooreville station pumps sewage from the Washington Gardens area to the Nanse Pen Pumping Station and was originally designed for peak sewage flow of 750 gpm. This pump station will stay in operation throughout Phase I and II.

Projected peak sewage flow (1992):

- Stage 1 - 750 gpm
- Stage 2 (year 2015) - 750 gpm

Requirements:
Install manual cleaning screens ahead of pumps and repair valves, as well as general servicing.

Capital Cost:

Stage 1		$31,000

Annual Operation and MainteNanse Cost:

Stage 1 & Stage 2:		
Labour & Material		700
Power Demand		900
Power Consumption		5,200
	Total	$6,800

2. Eastern Industrial (New Port East)

Built 1975, 3 pumps at 620 gpm each but station has been out of operation for some time.

This a a wet well/dry well type station designed for vertical non-clog pumps. This station is designed to pump sewage into gravity trunk sewers leading to the Central Industrial Pump Station, however the existing pump station is completely out of service and requires all new equipment.

Projected peak sewage flow (1992):

- Stage 1 - 2750 gpm
- Stage 2 - 2750 gpm

When the Eastern Industrial pumping station is required it is necessary to install 3 new pumps having a capacity of 2750 gpm (2 pumps) plus one standby pump. Included are the following new items:

- manual bar screens 2;
- pumps/motors 3;
- standby generator 1;
- power supply;
- motor control centre;
- wiring/lighting;
- liquid level controls;
- miscellaneous metal;
- general building refurbishment;
- wet well hoist;
- piping & valves;
- site security and improvements;
- sump pumps; and
- ventilation system.

Capital Cost:

Stage 1:

New equipment in existing pump station	$355,000

Annual Operation and Maintenance Cost:

Stage 1 and Stage 2:

Labour & Material		2,500
Power Demand		900
Power Consumption		6,300
	Total	$9,700

3. Duhaney Park

Built 1963, 3 pumps 1000 gpm each, with 40 Hp motors.

This is a wet pit type of pumping station with self priming pumps which discharge to the gravity sewage collection system. The generator as well as 1 pump are out of operation.

Projected peak sewage flow (1992):

- Stage 1 - 2000 gpm
- Stage 2 - 2000 gpm

When the purchase of a third pump is considered, detail design will include evaluation of the sewage flow into Duhaney Park to determine whether the pump size should be changed. Generator size must be checked at this time.

Refurbishment

- one new pump c/w piping
- standby generator 150 kW - complete overhaul

Capital Cost:

Stage 1:

- One new 40 Hp submersible pump, overhaul standby power system and general pump station servicing $50,000.

Annual Operation and Maintenance Cost:

Stage 1 and Stage 2:

Labour & Material		1,800
Power Demand		1,900
Power Consumption		12,600
	Total	$16,300

4. Central Industrial (New Port West)

Built 1975, 4 pumps at 900 gpm each (also reported as 4190 gpm capacity). This is a wet well/dry well type pumping station with vertical non-clog pumps.

The Central Industrial Pumping Station receives sewage pumped from the existing Eastern Industrial Station and from the proposed Western Industrial Station and pumps to the Greenwich Plant.

The existing pumps are not all working and there is no standby system.

Projected peak sewage flow (1992):

- Stage 1 - 2730 gpm
- Stage 2 - 6060 gpm

The peak flows in Stage 1 into this pumping station will be 2730 gpm which is close to the stations designed capacity with 900 gpm per pump, and in the ultimate stage the design flow will be 6060 gpm.

Refurbishment for Stage 1 consists of:

- 4 new sewage pumps/motors;
- 1 new sump pump;
- building renovations;
- new power supply, motor control centre and wiring; and
- new standby generator - 120 kW.

For Stage 2 a new pump station is required. This will be a wet well/dry well type with 4 pumps at 50 hp each with a station capacity of 3330 gpm. Also a new 24" force main will be required.

Capital Cost:

Stage 1:

Refurbish existing pump station c/w standby system	$345,000

Stage 2:

Construct new pump station to be used with the existing station	$1,350,000

Annual Operation and Maintenance Cost:

Stage 1:

Labour & Material		2,400
Power Demand		3,500
Power Consumption		27,000
	Total	$32,900

Stage 2:

Labour & Material		5,400
Power Demand		7,000
Power Consumption		60,000
	Total	$72,400

5. Western Industrial Pumping Station

This station is proposed to pump from the industrial area to the gravity sewers leading to the Central Industrial Pumping Station.

A wet well dry well type station with standby generator is proposed.

Projected peak sewage flows (1992):

- Stage 1 - not required
- Stage 2 - 1850 gpm

Proposed station:

- wet well dry well type;
- 3 pumps 1850 gpm total;
- 1 standby pump;
- wet well with manual bar screens;
- no comminutor;
- flush-kleen type non-clog pump system;
- pump motors 25 Hp.; and
- standby generator 75 kW.

Capital Cost:

Stage 2:

New pump station		$800,000

Annual Operation and Maintenance Cost:

Stage 2:

Labour & Material		1,700
Power Demand		1,200
Power Consumption		9,800
	Total	$12,700

6. Riverton Pumping Station

This proposed pumping station will pump sewage collected in the Riverton Area west of Sandy Gully and in the area along Riverton Blvd east of Sandy Gully. Sewage will be pumped via force main to the Greenwich Siphon System.

The proposed pumping station is a wet well/dry well type with vertical non-clog sewage pumps and originally the proposed capacity was 4500 gpm.

Projected peak sewage flow (1992):

- Stage 1 - not required
- Stage 2 - 2750 gpm

Proposed station:

- wet well/dry well type;
- 2 pumps at 2750 gpm total;
- 1 standby pump;
- wet well with manual bar screens;
- no comminutor;
- flush kleen system or vortex type pumps;
- pump motors 50 Hp; and
- standby generator 100 kW.

Capital Cost:

Stage 2:

New pumping station		$1,000,000

Annual Operation and Maintenance Cost:

Stage 2:

Labour & Material		2,500
Power Demand		2,300
Power Consumption		18,000
	Total	$22,800

7. Hanover Street

Under Construction 1992.

This is a wet well/dry well type station with an ultimate design capacity of 6730 gpm. The wet well capacity is 3500 cubic feet and the force main is a 1374 foot long 20"ø main discharging to the Darling Street Pump Station.

Projected peak sewage flow (1992):

- Stage 1 - 2950 gpm
- Stage 2 - 2950 gpm

This station is under construction and is presently designed for peak sewage flows of 6730 gpm, although installed pumping capacity is estimated to be 4600 gpm.

Annual Operation and Maintenance Cost:

Stage 1 and Stage 2:

(Based on assumption that there are 3 - 30 hp pumps. Projected peak sewage flows are now 2950 gpm rather than 4600 gpm)

Labour & Material		2,700
Power Demand		1,400
Power Consumption		10,300
	Total	$14,400

8. Rae Town

Proposed pumping station to pump sewage collected in the Rae Town area to the Hanover Street Pumping Station. This station was originally planned as a wet well type station with 3 submersible pumps and with a design peak flow of 1900 gpm. The actual pump capacity as reported in November 1992 is 860 gpm at 12.5 ft. This proposed design peak flow is revised as follows.

Projected peak sewage flow (1992):

- Stage 1 - not required
- Stage 2 - 1480 gpm

Proposed station:

- 3 submersible pumps - 1480 gpm (15 Hp each);
- 1 standby submersible pump 15 Hp;
- no comminutor;
- manually raked bar screens; and
- standby generator 60 kW.

Capital Cost:

Stage 2:

Complete Refurbishment		$100,000

Annual Operation and Maintenance Cost:

Stage 2:

Labour & Material		1,300
Power Demand		1,000
Power Consumption		6,600
	Total	$8,900

9. Barneds

Proposed pumping station.

This proposed pumping station is intended to pump sewage collected in the Barneds area and to pump via force main to the proposed Eastern Trunk Sewer. Previously the intended capacity was 1040 gpm, however this will now be as follows.

Projected peak sewage flow (1992):

- Stage 1 - not required
- Stage 2 - 850 gpm

A wet pit type pumping station with submersible pumps was proposed.

Proposed:

- 2 submersible pumps (850 gpm) 15 Hp each;
- 1 standby pump 15 Hp;
- no comminutor;
- manually raked bar screens; and
- standby generator 60 kW.

Capital Cost:

Stage 2:	$480,000

Annual Operation and Maintenance Cost:

Stage 2:

Labour & Material		800
Power Demand		700
Power Consumption		3,900
	Total	$5,400

10. Seaview Gardens (Hunts Bay)

This is an intermediate pump station that serves a small area south of Spanish Town Road near Hunts Bay Road. Population served is approximately 13,500 and capacity is 1300 gpm, however, the projected capacity is 1385 gpm.

This pump station has 2 - 100 horse power pumps and 2 - 50 Hp pumps plus a 320 KW Generator. The existing forcemain to Greenwich is 18" diameter.

The pump station is in need of major repairs:

- no pumps working
- generator not working
- MCC has flooding problems

Project peak flow (1992):

- Stage 1 - 1385 gpm
- Stage 2 - 1385 gpm

Proposed:

1. Change the discharge to pump via existing 18" forcemain to the Greenwich siphon near Sandy Gully.
2. Pump capacity will not change, however discharge head will be different (pumping to the siphon).
3. Four new pumps at 800 gpm with 20 Hp motors.
4. Overhaul standby generator.
5. Overhaul sump pumps, seal water system.
6. Install new emergency overflow to Sandy Gully.
7. Modify piping as required to pump to new discharge point.

Capital Cost:

Stage 1: $430,000

Because of the poor condition of the pump station and the need for new pumps, the cost of refurbishment is relatively high. In addition, the pump station is periodically flooded, and a new pump station has been estimated to cost $520,000. This would provide the pump capacity required, with screening facilities, and with standby power, and will avoid flooding problems. The costs of the new station have been entered into the cost summaries.

Capital Cost:

Stage 1:	$520,000

Annual Operation and Maintenance Cost:

Stage 1 and Stage 2:

Labour & Material		1,200
Power Demand		1,400
Power Consumption		8,900
	Total	$11,500

1.2 SMALL PUMPING STATIONS

There are several small pumping stations within the existing Kingston sewage collection system. Most of these pump stations were designed to serve limited area type developments such as condominium projects or other small area developments. Some of these stations are combined with small treatment plants which will be abandoned when the trunk and gravity sewers are extended. In such cases the pumping stations will be abandoned. In other cases the small pumping stations serve low areas which will still require the pump stations to remain in service.

Small pumping stations with self priming pumps are not built with comminutors in them and generally they are without screens. At the time of refurbishing the pump station, each station will be reviewed to determine if screens are necessary, if there is room for them and if they will help station operation. A removable basket type screen will be installed, where possible.

When a pumping station is no longer needed, as the collection system trunk sewers are extended, there are costs associated with bypassing the pumping station. In each case when a station will be taken out of service, a capital cost allowance of $10,000 is included for piping changes. This does not include removal of the pump station or restoration of the site.

1. Tunbridge

Built 1980, 2 pumps at 250 gpm and 7.5 Hp each.

This is a wet well type pumping station with self priming pumps. This station serves a limited area East of Molynes Road at Constant Springs Gully. Together with Queensborough Pumping Station, an area of approximately 48 acres is serviced.

Discharge is to the gravity sewer system leading to Nanse Pen Pumping Station.

Tunbridge Pumping Station will remain in operation in the Flow West System however it is not yet known if sewage flows to the station will change appreciably by the year 2015.

Tunbridge is in operation however the standby generator has been removed.

Requirements:

1. For existing sewered system Stage 1 - replace standby generator with a 25 kW unit.
2. For service to year 2015 - assume no change in capacity is required.

Capital Cost:

- Replace standby power system and service complete pump station $28,000.

Annual Operation and Maintenance Cost:

Stage 1 and Stage 2:

Labour & Material		400
Power Demand		200
Power Consumption		1,000
	Total	$1,600

2. Queensborough

Built 1981, 2 pumps at 400 gpm each, with 5 Hp motors.

This is a wet well type station with self priming pumps, that serves a limited area of the sewer system, pumping to the gravity sewer system and to Nanse Pen Pumping Station. Together with Tunbridge Pumping Station an area of 48 acres is serviced.

This station is expected to remain in operation, however the ultimate capacity is uncertain at this time. This station is in operation however the standby generator has been removed.

Requirements:

1. Replace the standby generator with a 16 kW unit.

Capital Cost:

- Replace standby power system and check out complete operation $17,000.

Annual Operation and Maintenance Cost:

Stage 1 and Stage 2:

Labour & Material		400
Power Demand		100
Power Consumption		700
	Total	$1,200

3. Glendale

Built 1982.

Capacity of this station is not certain. This is a wet well type pumping station that pumps from a 50 acre area to the Hughenden Sewage Treatment Plant.

When the gravity sewage collection system is extended and reaches the Hughenden area the existing sewage treatment plant will be abandoned, and the Glendale sewage pumping station will also be abandoned if the area can be sewered by gravity sewer.

If necessary the existing pumping station, which is presently operating, although the standby generator does not operate, will be refurbished and kept in operation.

Requirements:

Stage 1 - replace standby generator, assumed to be 16 kW.
Stage 2 - determine if the station can be abandoned. If not determine design flows and replace pumping equipment.

Capital Cost:

- Replace standby power system and service complete pump station $16,000.
- Stage 2 - allowance for deleting from system $10,000.

Annual Operation and Maintenance Cost:

Stage 1:

Labour & Material		400
Power Demand		100
Power Consumption		700
	Total	$1,200

4. Queensbury

Built 1979, 2 pumps at 400 gpm with 5 Hp motors.

This is a wet well type pumping station with self priming pumps. It is in operation however there is no standby system. The Queensbury Pumping Station serves and 18 acre area and pumps into the Nanse Pen System.

Projected peak sewage flow.
Stage 1 - 400 gpm
Stage 2 (year 2015) - uncertain but will likely not exceed 500 gpm

Requirement:
Stage 1 - provide a standby generator - 16 kW.

Capital Cost:

- Replace standby power system and service complete pump station $16,000.

Annual Operation and Maintenance Cost:

Stage 1 and Stage 2:

Labour & Material		400
Power Demand		100
Power Consumption		700
	Total	$1,200

5. Calabar Mews

Two pumps.

This pumping station which serves an area of approximately 5.4 acres originally pumped to a Calabar Mews sewage treatment plant, which has now been abandoned. The pump station is operational, with no standby power and now pumps to the Dunrobin Court Pump Station. This is a wet well type station with two self priming pumps.

If the gravity sewer is extended to this area at sufficient depth the Calabar Mews Station will be abandoned, however this station will be required until Phase I of the sewage collection and transmission system is built.

For Stage 1 provide standby power approximately 16 kW.

Capital Cost:

- Provide standby power system and complete station servicing and refurbishing $16,000.
- Phase 2 - allowance for deleting from the system $10,000.

Annual Operation and Maintenance Cost:

Stage 1:

Labour & Material		400
Power Demand		100
Power Consumption		700
	Total	$1,200

6. Dunrobin Court

Built in late 1980's.

This is a small wet well type station with 2-4" self priming pumps and a 45 kVa generator.

The Dunrobin Court Pumping Station pumps from a 9 acre area into the existing gravity sewers on Constant Spring Road and is presently in full operation.

No work is required at this station at the present time.

Annual Operation and Maintenance Cost:

Stage 1 and Stage 2:

Labour & Material		400
Power Demand		100
Power Consumption		700
	Total	$1,200

7. Ivy Green Mews

Built 1978.

This is a wet well type pumping station with 2 self priming pumps.

Ivy Green Mews pumping station pumps to gravity sewers on Half Way Tree Road. There is no standby generator and one pump is missing its motor. Emergency overflow is to an absorption pit. This pumping station is within the area of Phase I sewage collection and transmission and may not be required after Phase I is built.

Requirement:

- repair existing pump; and
- provide standby generator, assumed to be 16 kW for up to 5 Hp motors.

Capital Cost:

- For present operation provide standby power system, provide one new pump motor and refurbish pump station $20,000.
- Allowance for deletion, later $10,000.

Annual Operation and Maintenance Cost:

Stage 1:

Labour & Material		400
Power Demand		100
Power Consumption		700
	Total	$1,200

8. Stadium Gardens

This is a wet well type station with 2 self priming pumps.

The stadium Gardens pump station pumps to a manhole in the existing gravity sewer system. This pumping station is within the area of the Phase 1 sewage collection and transmission, and may not be required when Phase 2 is built. The standby generator requires servicing, however the 2 pumps are in operation.

Requirements:

- overhaul the emergency generator.

Capital Cost:

- For present operation overhaul generator and service the pumping station $9,000.
- Allowance for deletion of pump station from the system $10,000.

Annual Operation and Maintenance Cost:

Stage 1:

Labour & Material		400
Power Demand		100
Power Consumption		700
	Total	$1,200

9. Mountain Terrace

Built 1969.

This is a small wet well type station with 2-7.5 Hp pumps with a capacity of 250 gpm each pump. Mountain Terrace pumping station will be required at least until Phase I is in operation.

This pump station pumps sewage from a area of approximately 3.0 acres to a manhole in the gravity collection system, however its standby generator does not operate.

Requirement:

- provide new generator 25 kW.

Capital Cost:

- Provide new standby power system and refurbish station $28,000.
- Phase 2 - allowance for deletion of this station $10,000.

Annual Operation and Maintenance Cost:

Stage 1:

Labour & Material		400
Power Demand		200
Power Consumption		1,000
	Total	$1,600

10. Nannyville

This is a small pump station that serves an area east of Mountain View Road and South of the National Stadium Park. This station may be abandoned when trunk sewers are extended to this area, which is expected to be in Phase 2. It is reported that this pump station is not operating, however, new pumps are presently being purchased.

Requirement:

- service pump station as necessary and repair existing 6.8 kVA generator.

Capital Cost:

- For present operation allow $5,000.
- Phase 2 - allowance for deletion of this pump station from the system $10,000.

Annual Operation and Maintenance Cost:

Stage 1:

Labour & Material		400
Power Demand		100
Power Consumption		700
	Total	$1,200

11. Barbican Mews

The Barbican Mews pump station pumps sewage into the Barbican Mews Sewage Treatment Plant.

When gravity trunk sewers are extended to the Barbican Mews area, the existing sewage treatment plant and pump station will be taken out of service. The Barbican Mews area is within the area to be serviced in Phase I of the sewage collection and transmission system.

The area served is approximately 5 acres.

Requirement:

- service pumps as necessary.

Capital Cost:

- For present operation and servicing allow $5,000.
- For later deletion from the system allow $10,000.

Annual Operation and Maintenance Cost:

Stage 1:

Labour & Material		400
Power Demand		100
Power Consumption		700
	Total	$1,200

12. New Haven

Two pumps - submersible type.

This station is a small station with 2 submersible pumps that pumps collected sewage into the Duhaney Pump Station system which in turn pumps to Nanse Pen Pump Station. This pump station will be required and is presently in operation.

Requirement:

- general servicing.

Capital Cost:

- Allow $5,000.

Annual Operation and Maintenance Cost:

Stage 1 and Stage 2:

Labour & Material		400
Power Demand		100
Power Consumption		700
	Total	$1,200

1.3 LARGE SEWAGE PUMPING STATIONS (Revised June 1993)

There are large sewage pumping stations at Darling Street and at Nanse Pen.

1. Nanse Pen Pump Station

Nanse Pen was designed to pump sewage via 30" forcemain to the Greenwich Plant.

Built 1985, 3 pumps at 3140 gpm each, with space provided for 5 pumps.

This is a wet well/dry well pumping station with a total capacity as designed 11000 gpm, however only three pumps out of the 5 planned have been installed. It was originally planned that there would be 2 - 30" force mains, and one has been built to Greenwich.

The existing Nanse Pen Pumping Station has been designed to pump sewage to the Greenwich Sewage Treatment Plant, however in the Flow West System the role of the Nanse Pen Pumping Station will be changed as it will pump sewage to the distribution chamber of the Soapberry Lagoon.

With reference to the schematics of the Flow West and Flow East Systems, Nanse Pen originally received sewage from the existing Hunts Bay Pump Station and from the Upper West District which includes Duhaney Park. It was also intended that the Riverton East Pump Station would pump from the Riverton Trunk System to Nanse Pen.

In the Flow West Scheme flows from the upper West District continue to be collected at Nanse Pen. These flows include Duhaney Park, New Haven, Queensbury and Cooreville Gardens Pump Stations. The future Riverton Station will pump directly to the Greenwich syphon and the Hughenden Station will continue to pump to Nanse Pen. Inflow to Nanse Pen will be greatly increased as follows:

Nanse Pen was designed for a peak flow of 11,000 gpm. Peak flows are now projected to be:

- Stage 1 - 13,820 gpm
- Stage 2 - 28,520 gpm

The installed pumping capacity at Nanse Pen is approximately 5,500 gpm (pumping to Greenwich).

The existing Nanse Pen pumps were selected to pump 11,000 gpm with two - 30" force mains to Greenwich (12,300 feet) and a static head of 57 feet.

The Nanse Pen pumps will now be pumping sewage to Soapberry lagoons which will be 11,800 feet of a single 30" force main with the static head with operation of a single force main reduced to 27 feet. This change in length and reduction in static head will have the effect of holding the capacity of the new and existing pumps to approximately 11,000 gpm. Before new pumps are added the pump curves and efficiencies of existing pumps will be verified.

To accommodate increased peak sewage flows of 13,820 gpm Stage 1 and 28,520 gpm Stage 2, the following changes are proposed.

Stage 1 - Existing Pump Station

- complete the 30" diameter force main to the lagoon
- refurbish 3 existing pumps - 150 hp each
- add 2 new pumps - 150 hp each
- peak flow will be 11,000 gpm or 15.8 mgd

Stage 2 - New Pump Station (at total capacity at end of Stage 2 - 17,520 gpm)

- construct new 42" diameter force main to the lagoon
- construct new pump station beside existing pump station
- install 2 pumps - 9,000 gpm each (one pump is standby only) (150 hp)
- peak flow (new station) 9,000 gpm or 13.0 mgd
- total capacity of 2 stations at end of Stage 1 - 28.8 mgd

Addition of Pumps to New Pump Station

- install 3 new pumps to bring total capacity of new station to 17,520 gpm or 25.3 mgd
- total capacity of 2 stations at end of Stage 2 - 41.1 mgd

Capital Cost:

Stage 1:

Refurbish pump station (3 pumps)	$191,000
Add 2 new pumps and piping	274,000
Sub-Total	465,000
Construct new pump station with 2 pumps installed	3,363,000
Total Stage 1	**$3,828,000**

Stage 2:

Add 3 new pumps and piping	690,000
Total Stage 2	**$690,000**

Annual Operation and Maintenance Cost:

Stage 1:

Labour & Material	12,300
Power Demand	17,400
Power Consumption	163,400
Total Stage 1	**$193,100/year**

Stage 2:

Labour & Material	25,600
Power Demand	27,800
Power Consumption	302,700
Total Stage 2	**$356,100/year**

2. Darling Street

Built 1972, modified 1985 - emergency pumps added.

Darling Street Pump Station

The existing Darling Street Pump Station presently receives sewage flows from the Low Level Trunk Sewer, and pumps this sewage to the existing Western Sewage Treatment Plant. The Darling Street pump station consists of a wet well/dry well type pump station with 2 comminutors and 3 vertical shaft sewage pumps, and a standby generator set. Also there is an addition to the Darling Street Pump Station consisting of an emergency pump station with pumps that pump from the wet well to the force main.

Problems with the existing station include an unsafe old existing brick wet well through which all incoming sewage passes, and which because of its age should be replaced. The existing comminutors in the pump station wet well are out of service, and both the wet well and dry wells are poorly ventilated and are in an unsafe condition. The emergency pump station is presently the only working part of the station for pumping the sewage to Western Plant.

Flows incoming to the Darling Street Pump Station will be increased by the connection of the proposed Eastern Trunk Sewer, and by completion of the Hanover Street pumping station which pumps sewage to the Harbour Street Trunk Sewer.

The existing Darling Street pump station design flow is reported to be 5,550 gpm, however, the Stage 1 projected peak sewage flow is 5,020 gpm. The Stage 2 projected peak sewage flow is 10,260 gpm.

The Darling Street Pump Station Capacity will have to be increased from the existing sewage flow of approximately 5550 gpm to the ultimate sewage flow of 10,260 gpm. The site is constricted in that the old existing brick pump station structure must be saved, while the capacity of Darling Street Pump Station is increased.

The new Harbour Street Trunk Sewer replaces the existing trunk sewer leading to Darling Street from the east, and the new Harbour Street trunk is at a higher elevation than the old trunk.

Elevations are:

Existing Low Level Trunk	-	at old wet well -	minus 16.0 feet (will be abandoned)
New Harbour Street Trunk	-	at old wet well -	minus 10.47 feet
Proposed Eastern Trunk	-	at old wet well -	Approx. 10.0 feet (minus)

The wet well of the existing Darling Street Pump Station was designed to accommodate the existing low level trunk which is 6 feet deeper than both the new Harbour Street Trunk and the proposed Eastern Trunk. The older, deeper sewer will be abandoned.

The existing pump station has several serious problems, despite the fact that the concrete appears to be structurally sound.

1. The old brick wet well may be a danger and is no longer considered acceptable.
2. The wet well of the pump station is very deep, is poorly ventilated, has deteriorated steel railings etc.
3. The pump well or dry well is not well ventilated, and is dangerous to enter. The steel work within it is corroded and unsafe.
4. The pumps are not operable.

The emergency pump station which is separate from the Darling Street Dump Station has only one of its two pumps operating.

The Darling Street Pump Station is vital to the operation of the initial stages of the collection system since it will pump sewage from the existing trunk sewer, by-passing the old Western Plant and pumping all flows to Greenwich. In the first stages of the system the Hanover Street Pump Station will be put in operation and this will further increase flows to Darling Street.

Darling Street Pump Station will be made capable of pumping 5020 gpm immediately, and by the year 2015 must pump 10,260 gpm.

There are alternatives to be considered such as:

1. Abandon existing facilities and build a completely new station south of the existing site.
2. Make major renovations and use the existing pump station for up to 10,260 gpm.
3. Abandon existing facilities, and build a completely new station on the same site.
4. Make some renovations to enable use of this station for a limited time, and build a new station later.

The accumulation of sand and grit and the removal of it is a problem because of the old trunk sewer and the depth of the wet well. These problems are expected to be less severe when the new trunk sewers are in place however some problems can be expected due to the increases in flows.

Alternative 1 - abandon existing pump station and build new pump station south of the existing.

This would require that land approximately 200 feet from the existing station be obtained for the new station. Trunk sewers and forcemains can be revised to suit the new site. The advantage of this alternative is that new screening facilities can be included in the pump station and the larger pumps can be included. This alternative includes in the wet well:

- manual bar screens
- mechanically cleaned bar screens/or comminuters (approximately similar costs)
- large wet well volume to match pumps
- convenient wet well access and hoist for removal of debris

In the dry area are included:

- 4 - 125 HP vertical non-clog pumps
- 1 - 125 HP standby unit
- seal water system
- pump control system
- proper ventilation and access
- hoist for pump removal
- standby power generator
- washroom
- office and parts storage space

Stage 1 includes 3 of the 5 pumps while Stage 2 includes addition of 2 more pumps. With this alternative, as with all of the alternatives, the existing 21" forcemain will be extended to Greenwich as a 24" forcemain and later the forcemain will be twinned by addition of a 24" forcemain from Darling St. to Greenwich.

Alternative 2 - make major renovations and continue to use the existing pump station.

Because the existing wet well is a major problem, the following approach was used.

Construct a new Screening Structure which is upstream from the old brick wet well. The Screening Structure would contain manual bar screens, mechanically cleaned bar screens or comminuters, hoist for removal of debris, wet well capacity beneath the screening channels, good access and open ventilation. This chamber is then connected to the existing pump station wet well which will have improved access and ventilation, but no equipment or screens in it. The dry well area of the existing pump station would be completely refurbished with good access, ventilation and with new pumps. Because of limited space for multiple pumps, it is proposed that 3 new 200 HP pumps be installed. Stage 1 includes 1 pump plus 1 standby pump while Stage 2 includes addition of the third pump.

Also included are structural changes to accommodate the pumps, a new standby power system and new valves and piping.

The advantage of this alternative is that no new land is needed, however, the site is very restricted, the existing pump station is small and this alternative depends upon the existing wet well and dry well being structurally sound.

Alternative 3 was ruled out because of the difficulty of pumping the sewage during construction.

Alternative 4 was ruled out because the renovations required are very expensive, and would only serve for about 10 years.

Alternative 1 was entered into the estimate summary although the cost was higher. Alternative 2 could not be recommended at this time because of the possible structural problems and because the existing structure would be very strained to contain the larger pumps, valves and piping. If this alternative were built, there would be no possible increase in capacity possible in the future.

Capital Cost:

Alternative 1:

Stage 1		$3,154,000
Stage 2		253,000
	Total	$ 3,407,000

Alternative 2:

Stage 1		$2,494,000
Stage 2		210,000
	Total	$2,704,000

Annual Operation and Maintenance Cost (Alternative 1):

Stage 1:

Labour & Material		4,500
Power Demand		5,800
Power Consumption		45,000
	Total	$55,300

KINGSTON HARBOUR ENVIRONMENTAL PROJECT
COLLECTION AND TRANSMISSION COSTS

	$JAMAICAN
COST 1	211,248,047
COST 2	223,211,606
COST 3A	91,553,095
COST 3B	86,590,354
COST 4	227,784,906
COST 5	225,838,067
COST 6	82,498,174
COST 7	77,589,456
COST 8	53,392,130
COST 10	47,197,588
COST 11	77,989,724
COST 12	40,434,988
COST 13	82,142,576
COST 14	92,456,499
COST 15	292,452,983
COST 16	109,499,727
COST 17	139,045,866
COST 19	174,369,510
COST 20	39,769,956
COST 22	74,354,800
COST 23	95,377,121
COST 24	258,157,434
COST RIVERTON	218,267,396
COST WESTERN IND.	134,196,400
COST CENTRAL IND.	96,389,800
COST EASTERN IND.	35,392,500
COST RAE TOWN	23,322,000
COST BARNED'S	35,916,400
MIDLEVEL DIVERSION	1,800,000
SUBTOTAL	$3,348,239,103

FORCE MAINS/SYPHONS	$295,867,638

TOTAL SEWER COSTS	$3,644,106,741

TRUNK: COST 1

SIZE (MM)	LENGTH (M)	DEPTH (M)	NO. MANHOLES	COST FACTOR	OPEN TRENCH INSTALLATION PRICE/M	MATERIAL/RESTORE OPEN TRENCH PRICE/M	MANHOLE OPEN TRENCH UNIT PRICE	CLOSED SHEETING INSTALLATION PRICE/M	MATERIAL/RESTORE CLOSED SHEETING PRICE/M	MANHOLE CLOSED SHEETING UNIT PRICE	TOTAL PART A
250	366	1.8	4	1.0	788	1338	13000				$830,116
300	396	2.4	4	1.0	820	1585	15500				$1,014,380
450	335	2.4	4	1.0	964	2713	15500				$1,293,795
525	1372	3.0	15	1.0	1004	3540	19000				$6,519,368
600	914	4.6	10	1.4				2385	3966	14500	$6,821,770
675	518	3.0	6	1.8				2080	5157	17400	$4,715,118
			0								$0
			0								$0
			0								$0
			0								$0
			0								$0
			0								$0
			0								$0
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			0								$0
			0								$0
			0								$0
			0								$0
									TOTAL PART A		$21,194,547

STUDY AREA	AREA (ACRES)	STEET SEWER COST/ACRE	LATERAL COST/ACRE	TOTAL PART B
G3	136	166400	35100	$27,404,000
B1	177	236600	54600	$51,542,400
B2	58	236600	54600	$16,889,600
C4	257	236600	53300	$74,504,300
C5	68	236600	53300	$19,713,200
				$0
				$0
				$0
				$0
		TOTAL PART B		$190,053,500

TOTAL COSTS	$211,248,047

TRUNK 1

NOVEMBER, 1993

TRUNK: COST 2

SIZE (MM)	LENGTH (M)	DEPTH (M)	NO. MANHOLES	COST FACTOR	OPEN TRENCH INSTALLATION PRICE/M	MATERIAL/RESTORE OPEN TRENCH PRICE/M	MANHOLE OPEN TRENCH UNIT PRICE	CLOSED SHEETING INSTALLATION PRICE/M	MATERIAL/RESTORE CLOSED SHEETING PRICE/M	MANHOLE CLOSED SHEETING UNIT PRICE	TOTAL PART A
675	229	4.5	3	1.0	1634	5327	3400				$1,604,269
750	511	6.1	6	1.0	2400	5983	4600				$4,311,313
900	731	5.5	8	1.0	2438	7243	41500				$7,408,811
1050	1463	4.5	16	1.2	1798	8388	3400				$15,482,613
			0								$0
			0								$0
			0								$0
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			0								$0
			0								$0
			0								$0
									TOTAL PART A		$28,807,006

STUDY AREA	AREA (ACRES)	STEET SEWER COST/ACRE	LATERAL COST/ACRE	TOTAL PART B
G4	58	166400	35100	$11,687,000
H8	143	166400	41600	$29,744,000
H3	281	166400	41600	$58,448,000
H9	51	166400	41600	$10,608,000
H2	147	166400	41600	$30,576,000
C2	184	236600	53300	$53,341,600
				$0
				$0
				$0
		TOTAL PART B		$194,404,600
		TOTAL COSTS		$223,211,606

TRUNK 2

NOVEMBER, 1993

TRUNK: COST 3A

SIZE (MM)	LENGTH (M)	DEPTH (M)	NO. MANHOLES	COST FACTOR	OPEN TRENCH INSTALLATION PRICE/M	MATERIAL/RESTORE OPEN TRENCH PRICE/M	MANHOLE OPEN TRENCH UNIT PRICE	CLOSED SHEETING INSTALLATION PRICE/M	MATERIAL/RESTORE CLOSED SHEETING PRICE/M	MANHOLE CLOSED SHEETING UNIT PRICE	TOTAL PART A
300	793	2.4	9	1.0				1296	1431	23200	$2,371,311
375	92	2.4	1	1.0				1322	1947	23200	$323,948
450	92	2.4	1	1.0				1381	2543	23200	$384,208
600	793	4.5	9	1.0				2385	3966	43804	$5,430,579
675	823	4.5	9	1.0				2474	5157	43804	$6,674,549
			0								$0
			0								$0
			0								$0
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			0								$0
			0								$0
									TOTAL PART A		$15,184,595

STUDY AREA	AREA (ACRES)	STEET SEWER COST/ACRE	LATERAL COST/ACRE	TOTAL PART B
G10	241	166400	35100	$48,561,500
G7	111	166400	35100	$22,366,500
G5	27	166400	35100	$5,440,500
				$0
				$0
				$0
				$0
				$0
				$0
		TOTAL PART B		$76,368,500
		TOTAL COSTS		$91,553,095

TRUNK 3A

NOVEMBER, 1993

TRUNK: COST 3B

SIZE (MM)	LENGTH (M)	DEPTH (M)	NO. MANHOLES	COST FACTOR	OPEN TRENCH INSTALLATION PRICE/M	MATERIAL/RESTORE OPEN TRENCH PRICE/M	MANHOLE OPEN TRENCH UNIT PRICE	CLOSED SHEETING INSTALLATION PRICE/M	MATERIAL/RESTORE CLOSED SHEETING PRICE/M	MANHOLE CLOSED SHEETING UNIT PRICE	TOTAL PART A
375	732	2.4	8	1.0	926	2117	15500				$2,351,476
450	214	2.4	2	1.0	964	2713	15500				$817,878
			0								$0
			0								$0
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			0								$0
			0								$0
			0								$0
									TOTAL PART A		$3,169,354

STUDY AREA	AREA (ACRES)	STEET SEWER COST/ACRE	LATERAL COST/ACRE	TOTAL PART B
G9	325	166400	35100	$65,487,500
G8	89	166400	35100	$17,933,500
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		TOTAL PART B		$83,421,000
		TOTAL COSTS		$86,590,354

TRUNK 3B

NOVEMBER, 1993