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REPORT ON

UPGRADING THE SEWAGE WORKS
OF THE
TOWN OF ALEXANDRIA
TO MEET THE
PROVINCE OF ONTARIO WATER MANAGEMENT OBJECTIVES

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Prepared for

THE ONTARIO MINISTRY OF THE ENVIRONMENT

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ACKNOWLEDGEMENTS

The Ontario Ministry of the Environment has provided significant input and direction in the preparation of this report. Waste surveys established existing loads and sewage characteristics. The Waste Water Treatment Section provided guidance in establishing treatment efficiencies for the various processes considered, in the choice of treatment processes. The contribution of Mm. S.A. Black, W. Lewandowksi and Mrs. I. Wile is gratefully acknowledged.

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ABBREVIATIONS

km	kilometre
L/s	litres per second
IGM	Imperial gallons per minute
ha	hectares
BOD_5	biochemical oxygen demand
kg/day	kilograms per day
lbs/day	pounds per day
m^3/s	cubic metres per second
HP	horsepower
mg/L	milligrams per litre
IGCD	Imperial gallons per capita per day
L/c/d	litres per capita per day
L/d	litres per day
M.O.E.	Ministry of the Environment

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REPORT SUMMARY

Recent investigations by the Ministry of the Environment have shown that the treated municipal sewage effluent has characteristics which exceed the Provincial Water Management Objectives. The excesses are in the BOD_5, suspended solids, phosphorous, ammonia and hydrogen sulfide concentrations.

This report summarizes the existing conditions which affect the effluent quality. The principal factors are: 1) high BOD_5 loads from Consoltex (Consolidated Textiles has an agreement allowing it to discharge 2000 lbs./d of BOD_5); 2) higher than expected BOD_5 loads from Carnation Foods (160 lbs/d expected vs. an observed average of up to 1000 lbs/d); 3) high ammonia concentrations in the Consoltex waste; 4) hydrogen sulfide in the effluent during periods of ice cover over the lagoon.

In considering improvements, future growth was kept in mind. Population growth was limited by the available water supply in the Garry River. This was obtained from the "Garry River Management Report - 1980" prepared for the Raisin River Conservation Authority, as being 60 L/s. This was converted to a maximum population of 5918 and an assumed nominal increase of 10% in industrial hydraulic flows was allowed for. Additional industrial growth could be accommodated at the expense of the projected population growth. The biological loads were adjusted to reflect recently observed concentrations.

On the basis of the above, the following design criteria were developed:

Ultimate population		5918
Average daily hydraulic sewage flow		7273 m^3/d
Peak hydraulic sewage flow		218 L/s
BOD_5 loads:	Consoltex	909 kg/d
	Carnation Foods	361 kg/d
	Graham's Creamery (equivalent)*	41 kg/d
	Domestic	457 kg/d
	New industry	118 kg/d
	TOTAL	1886 kg/d

* presently closed

A number of complete and partial treatment processes were reviewed for potential solutions: annual retention lagoons; seasonal retention lagoons with spray irrigation on lands; BOD_5 reductions at source; aerated lagoons with polishing ponds and artificial wetlands; biological nitrification - denitrification; breakpoint chlorination; air stripping; ion exchange; reduction of ammonia at source. Of these, extended aeration (biological nitrification - denitrification) and aerated lagoons with pond and wetlands were concluded as viable solutions. BOD_5 reduction at source was considered as a means of possibly reducing capital and operating costs.

The report concluded that wetlands cannot regularly reduce the characteristics to below the Provincial guideline objectives while extended aeration will. The capital operating cost difference between the two is substantial, however. In view of this data, the Ministry concluded that the Provincial guideline objectives for the Delisle River could not be relaxed and that, therefore, the only acceptable solution was pre-treatment in the existing aerated lagoon followed by an extended aeration process and then followed by polishing in the existing pond. Low level aeration before outletting into the receiving stream has been included. However, in the light of recent research data, the Ministry suggests delaying this item until operation of the improved treatment process confirms its need.

The Ministry subsequently instructed to assess the major components of the sewage collection system, ie. the trunk sewer outletting to the main pumping station, the pumping stations and the forcemain.

The report concludes that part of the trunk sewer capacity has to be increased in order to avoid sewage overflows to the Garry River under design hydraulic peak flow conditions. Equally, major renovations are required to the main pumping station. A thorough waterhammer analysis of the forcemain will be necessary at design time to determine the proper surge control method.

REPORT ON

UPGRADING THE SEWAGE WORKS OF THE TOWN OF ALEXANDRIA TO MEET THE PROVINCE OF ONTARIO WATER MANAGEMENT OBJECTIVES

1. INTRODUCTION

The Town of Alexandria (population 3500) is an industrialized municipality situated in the Province of Ontario's most easterly tip, approximately half way between Cornwall and Hawkesbury and some 80 km east of Ottawa. The Town operates its sewage collection system but the sewage treatment works are presently operated by the Ministry of the Environment on its behalf. A recent study by the Ministry of the effects of the present treated sewage effluent on the Delisle River, the receiving stream, concluded that improvements are required to the treatment works to reduce phosphorous, ammonia and hydrogen sulphide concentrations in the effluent to acceptable Provincially set levels. Phosphorous is a nutrient which enhances plant growth in the receiving stream and the contribution of ammonia and hydrogen sulfide is highly toxic to aquatic life.

On October 28, 1982, the Ministry, with the Town's approval, retained J.L. Richards & Associates Limited to summarize available data and assist them in the various alternative solutions which could practically meet the Provincial Water Management Objectives. The following report therefore contains significant input and direction by the Ministry.

In February 1984, the Ministry subsequently expanded the terms of the study to assess the existing pumping stations, forecmains and gravity trunk sewers and to recommend improvements in order to minimize sewage overflows in the centre of the Town of Alexandria.

2. EXISTING WORKS

a) Sanitary Sewer System

The Town is presently served with separate sanitary and storm sewer systems. The Town does not, however, have a by-law enforcing the separation of sewage in buildings and the result is that many buildings in existence prior to the construction of the separated sewer systems still have perimeter foundation drainage tiles, flat roof rain water leaders, etc. draining into the sanitary sewer system. The effect is that hydraulic flows vary with climatic conditions and sometimes overflows to the Garry River occur.

Overflow points exist at four locations: at the main sewage pumping station; and in the collector sewer at Bishop Street (one overflow), and at Dominion Street (two overflows) (see Dwg. #82-7428-1).

All sanitary sewage is received at the main pumping station located next to the golf course on St. Paul Street (at the intersection with the Canadian National Railway tracks). The dual sewage pumps are reportedly rated at 109 L/s (1443 IGM) operating singly and 156 L/s (2062 IGM) operating in parallel.

There is another secondary sewage pumping station at the north end of Bishop Street which serves a very small area of the Town. Data on the pumps is almost non-existent.

b) Sewage Treatment Works

At present, the treatment system consists of one aerated facultative lagoon (1.2 ha or 3 acres) followed by three conventional facultative lagoons operated in series (5.5, 5.18, 6.47 ha, or 13.6, 12.8, 16 acres respectively). The aerated cell was designed for a BOD_5 loading of 1364 kg/day (3000 lbs/day) and uses 3 - 15 hp fixed mechanical aerators to provide the necessary oxygen requirements for proper biological treatment.

The treated effluent from the conventional cells is discharged into a drainage ditch which outlets into the Delisle River.

The Ministry of the Environment operates the treatment works for the Town of Alexandria and has staff on site generally three days per week and otherwise as required.

3. DELISLE RIVER

a) General

The Delisle River at Alexandria forms part of the Raisin Region Conservation Area. It flows easterly from its source in Glengarry County into the St. Lawrence River near Lake St. Francis. The Town of Alexandria's sewage treatment facilities discharge to the Delisle River, just downstream of the point of entry of the Garry River. The latter supplies the Town with its potable water requirements.

b) Flows

The Delisle River drainage area upstream of the sewage outfall is 150 km^2. Flows vary considerably at different times of the year, ranging from 30 m^3/s in the springtime to occasional zero flows at the height of the summer. However, if certain recommendations from a recent water management report for the Garry River (made for the Raisin Region Conservation Authority) are implemented, a base flow of 30 L/s (0.03 m^3/s) would be ensured in the Delisle River at the point of the sewage effluent discharge.

c) Water Quality

In an MOE study entitled "An Outfall Assessment of Sewage Treatment Facilities at the Town of Alexandria", which was tabled in September, 1981, a water quality survey of the Delisle River revealed that "marked changes in the water quality occur with the introduction of the lagoon effluent". The report recommended that additional treatment of the sewage effluent be carried out to reduce the treated sewage effluent characteristics to levels below the Provincial objectives.

4. TOWN OF ALEXANDRIA WATER SUPPLY

The Town of Alexandria draws its potable water supply from the Garry River. In a recent study (April, 1980) entitled "Raisin Region Conservation Authority - Garry River, Water Management Report", it was concluded that "the reliable water supply for the Town of Alexandria is approximately 60 L/s". This supply is in addition to the 30 L/s which is to overflow the Loch Garry dam to provide a base flow to the Delisle River (item 3b above). The report also recommends raising the Loch Garry level by 0.3 metres which "would provide 1.3 million cubic metres of (additional) storage ... about one year's water consumption".

5. INDUSTRIAL BIOLOGICAL LOADS

a) Recent History

Around 1976, the MOE was finding that the three conventional facultative lagoons were unable to provide adequate biological treatment for the Town sewage because of the high BOD_5 concentrations contributed by the local industries, particularly from Consoltex (Consolidated Textiles Ltd.). As a result, an aerated facultative lagoon was constructed upstream of the three conventional cells and three 15 HP mechanical aerators were installed on a fixed platform. The aerators were sized for oxygen transfers based on the following BOD_5 loads:

Consoltex	909 kg/d	(2000 lbs BOD_5 per day)
Carnation Foods Ltd.	72.7 kg/d	(160 lbs BOD_5 per day)
Graham Creamery	40.9 kg/d	(90 lbs BOD_5 per day)
Domestic sewage (4411 pop. @ 0.17 lbs/cap/day)	340.9 kg/d	(750 lbs BOD_5 per day)
	1364 kg/d	(3000 lbs BOD5 per day)

Significant changes in these contributions have taken place since that time.

b) **Waste Surveys**

Three separate waste surveys (August, 1982, February 1985 and April 1985) by the MOE analyzed the industrial sewage characteristics of Carnation Foods, Consoltex and Graham's Creamery (now closed). Two of the surveys compared the industrial sewage characteristics to those of the sewage entering the sewage treatment facilities. These comparisons are shown in Tables I, II and III.

Although a two-day waste survey of 24-hour composite samples is not conclusive in itself, two observations are of particular interest (refer to the data in Table I):

i. The highest BOD_5 concentrations and loads are presently occurring from the Carnation plant, as opposed to Consoltex. It is realized however, that due to the present economic conditions, Consoltex is not operating fully at this time. Irregardless of this, Consoltex does have an agreement with the Town, which allows it to discharge up to 909 kg (2000 lbs) of BOD_5 per day. With regards to Carnation Foods, past surveys showed that their BOD_5 load is substantially more than allowed for in the 1976 design. In 1982, Carnation's BOD_5 loading was generally 454 kg (1000 lbs), every second day (refer to MOE Cornwall District office letter of November 25, 1982). More recent surveys (1985) showed average loadings of 361 kg/d. For design purposes, an extended aeration plant would need to be designed on a daily Carnation load of 454 kg (1000 lbs) and other components (ponds, marshes, etc.) could be designed on 361 kg/d (500 lbs/day), unless equalization means are effected.

ii. Over 50% of the ammonia loading in the raw sewage appears to be contributed by Consoltex. Data is, however, not conclusive.

6. PROVINCIAL WATER MANAGEMENT GOALS FOR THE DELISLE RIVER

a) Policy

The MOE Technical Support section has established that the Delisle River falls under Policy 2 of the Provincial Water Management Guidelines "Areas with Water Quality not meeting the objectives". This policy requires that "all reasonable and practical measures (shall) be taken to reduce waste loadings". Deviations may be allowed in exceptional cases where:

- objectives are not attainable because of natural background water quality, or because of irreversible man-induced conditions, or

- achieving the objective would result in substantial and widespread adverse economic and social impact, or

- suitable treatment techniques are not available.

b) Practical Objectives

The Ministry has translated the above policy requirement into the following objectives for the treated sewage effluent:

i. maximum BOD_5 concentrations of 15 mg/L;
ii. maximum suspended solids concentrations of 15 mg/L;
iii. maximum phosphorous concentrations of 1 mg/L;
iv. maximum un-ionized ammonia (NH_3) concentrations of 0.02 mg/L;
v. maximum hydrogen sulfide (H_2S) concentrations at 0.002 mg/L.

The first three are nutrients which enchance the growth of algae in the river which consequently eutrophies the river. Ammonia is also a nutrient but in addition, it is toxic to aquatic life. Hydrogen sulfide is highly toxic to aquatic life.

7. SOURCE AND EXTENT OF PROBLEMS WITH EXISTING TREATMENT WORKS

a) Hydraulic Sewage Flows

Average daily sewage flows over the last few years is 5566 m^3/d (1.22 MGD). For an existing population of 3500, the average per capita per day flow is 1609 L/d (354 IGCD). Industry, however, is a heavy contributor to these flows (1861 m^3d or 410,000 IGD). Hence, the true domestic average is 1077 L/d (237 IGCD). This is high compared to the Province-wide domestic average daily water consumption of 458 L/d (101 IGCD).

Some of the likely sources of excessive flows are infiltration and inflow. With regards to the latter, as many as 45 commercial buildings with flat roofs are known by the Town to be connected to the sanitary sewer system. Statistical data on daily sewage flows is provided from Ministry records. The sewage discharged into the lagoon is measured at the main (No. 1) sewage pumping station by means of a magnetic flow meter equipped with a 7-day chart recorder and flow totalizers. These totalizers are read every 3 - 4 days and the total flow is averaged over the period. A more accurate determination of the daily flows could be obtained by analyzing the 7-day flow charts. When overflows occur, only the length of time is recorded and there is no way of knowing the amount of overflow to the Garry River that actually occurs. Where overflows have been observed, they have always, with one exception, been during Spring run-off when the dilution is high and the polluting effect minimal and of short duration.

Attempts were made in the Fall of 1982 to isolate and measure the sewage flows daily by means of V-notch weirs placed throughout the system. The results of the readings were inconsistent and a solid pattern between dry and wet weather flows could not be established.

Consoltex is reportedly using large amounts of cooling water (from 200,000 - 300,000 IGD), which is subsequently discharged into the sanitary sewer system and treated as sewage waste. Consoltex has confirmed an average use in the order of 250,000 IGD. Experiments are presently underway to reclaim or delete these waters. If successful, some 200,000 IGD of sewage flows could be eliminated. Alternatively, a sewer could be constructed to redirect these waters to Mill Pond and thus be eliminated from treatment.

b) **Biological Loads** (BOD_5)

The greater portion of the biological waste loading in the Town's sewage comes from the two major industries in Town: Consoltex and Carnation Foods. Based on the recent waste surveys and signed agreements, the following existing loads apply:

	Peak Single Day	Average Day
Consoltex	909 kg/d (2000 lbs/day)	909 kg/d (2000 lbs/day)
Carnation Foods	931 kg/d (2055 lbs/day)	361 kg/d (745 lbs/day)
Plus - Domestic Sewage		

Although the BOD_5 in the present treated effluent sometimes meets the design objective of 15 mg/L (25 mg/L from mid-September to mid-June), MOE sampling results show a general range of 10 to 40 mg/L. This inconsistency and the higher values are considered by the Ministry of the Environment as not meeting the Provincial objective.

c) **Suspended Solids** (S.S.)

Generally, the results are similar to the BOD_5 results. The Ministry considers that the present system does not meet the objective.

d) **Phosphorous** (TP)

Facilities to effectively reduce the total phosphorous concentrations in the treated effluent have recently been installed at the existing sewage works. The MOE reports treated effluent concentrations less than the objective of 1.0 mg/L.

e) Ammonia (NH_3)

The calculations for determining un-ionized ammonia take into account both the pH of the sewage and the ambient liquid temperature at the treatment works. From the information gathered from local sources (MOE staff, weather records), the total ammonia concentrations under various conditions in the Alexandria sewage are such that the treated effluent fails to meet the Provincial objective at least 67% of the time. The latest MOE industrial waste survey also indicates that over 50% of the ammonia in the waste water is contributed by Consolidated Textiles.

f) Hydrogen Sulfide (H_2S)

Due to the ice formation over the liquid surface of the lagoons during winter periods, hydrogen sulfide forms at these times and is present in the effluent at a higher concentration than the objective of 0.002 mg/L. In the latter years (1982 - 84), H_2S levels greater than 2 mg/L have been consistently observed by the Ministry during the latter part of the winter.

g) Industrial Effluent Quality

Except for Consoltex, which has an agreement with the Town on the amount of BOD_5 it can discharge into the municipal sewage system, there are no municipal by-laws or agreements regulating the quality of the industrial effluents discharging into the Town system.

8. DESIGN CRITERIA

The following criteria have been derived for the sole purpose of establishing design criteria for the sewage treatment works and the major components of the collection systems. Variations could be made by the Town (eg. sacrifice future population growth for industrial growth) providing the total flows and loads are not exceeded.

a) **Population**

The major limiting factor to the growth of the Town of Alexandria appears to be its available potable water supply. As noted previously, this has been established by the Raisin Region Conservation Authority as 60 L/s (1,141,800 IGD) in its "Garry River Management Report - 1980". The same report recommends that the Loch Garry water level, the supply source of the Alexandria water treatment plant, be raised by 0.3 metre to ensure an impounding water storage of 1.3 x $10^6 m^3$, or "about a year's supply". On that basis, it is proposed to utilize the 60 L/s supply as an average daily supply, with the peak demands being satisfied from the impounding storage. Based on the above and assuming an average daily domestic consumption per capita of 454 L/d (100 IGCD), the following maximum population (or its equivalent) has been calculated:

Available water supply	5184 m^3/d	1,141,800 IGD
Less existing industrial demand	1861 m^3/d	410,000 IGD*
Less nominal industrial growth	182 m^3/d	40,000 IGD
Less water required for back-washing filters	454 m^3/d	100,000 IGD
Available water existing (3500) and future population	2687 m^3/d	591,800 IGD

Maximum Alexandria population (assuming 454 L/d/c or 100 IGCD) = 5918.

* From Town and MOE records. Could be reduced by 200,000 - 300,000 IGD if Consoltex cooling water is redirected to Mill Pond and consequently increase the maximum population by 2,000 - 3,000.

b) **Hydraulic Sewage Flows**

Over the past years, the Ministry has collected the following average daily sewage flows data:

Year	MIGD	m^3/d
1983	1.17	5308
1982	1.15	5230
1981	1.34	6090
1980	1.16	5270
1979	1.30	5910
Average over 5 yrs.	1.22	5566

The Ministry Operations Branch has also accumulated data from which they consider that industrial flows are approximately 35% of the total sewage flow. This represents, at present, approximately 410,000 IGD (1861 x 10^3/d), a figure which appears to be re-confirmed by the industrial waste sewage survey. Some 250,000 IGD of the above is reportedly cooling water for Consoltex. A substantial reduction of sewage flows could be affected if redirection or reclamation is carried out.

As noted previously, there is no conclusive evidence as to the extent of sewage overflows to the Garry River, but indications are that the occurences are mainly during major Spring run-off and storms where dilution is maximized and pollution is minimized.

The average daily domestic sewage flow can therefore be estimated as follows:

Present population and industrial flow	5630 m^3/d	1,220,000 IGD
Future population 2418 @ 454 L/d (100 IGCD)	1098 m^3/d*	241,800 IGD
Future industrial flow	182 m^3/d*	40,000 IGD
Future backwash water into sanitary sewer	454 m^3/d	100,000 IGD
TOTAL	7364 m^3/d	1,601,800 IGD

* At the time of finalization of this report, the Town of Alexandria had applied to the Ministry of the Environment for approval to construct services for an industrial park.

For sizing the main sewage pumping station, forcemain and trunk sewer, three separate approaches were considered:

a) Using the hydraulic capacity of the existing gravity trunk sewer as the design basis:

The latter consists of a 530 mm (21 inch) diameter sewer having a slope of 0.11% (capacity 150 L/s or 5.3 cfs) and a 615 mm (24 inch) diameter sewer having a slope of 0.10% and a capacity of 207 L/s (7.3 cfs).

b) Using ten times the dry weather flows:

From the Ministry's available Utility Monitoring Records, the three lowest months of sewage flow for 1981 - 83 were as follows:

Year	Month	Flow
1981	January	4.33×10^3 m^3/d
1981	July	4.56×10^3 m^3/d
1981	October	4.54×10^3 m^3/d
1982	January	3.95×10^3 m^3/d
1982	July	3.35×10^3 m^3/d
1982	October	4.11×10^3 m^3/d
1983	July	3.35×10^3 m^3/d
1983	August	3.42×10^3 m^3/d
1983	September	3.32×10^3 m^3/d
Average dry weather flow =		3.88×10^3 m^3/d or 45 L/s

The Consoltex cooling water could account for 10 - 15 L/s of the above.

Therefore, 10 x D.W.F. = 300 to 450 L/s

c) Using the design hydraulic sewage flows:

The previously noted flows are re-arranged as follows:

	Consoltex Cooling Water Not Redirected	Consoltex Cooling Water Redirected to Mill Pond
Present population (3500) average flow	(1.22 MIGD less 0.41 MIGD industrial) = 810,000 IGD	(1.22 MIGD less 0.41 MIGD industrial) = 810,000 IGD
Future population: Flow: Subtotal:	(2418 @ 100 IGCD) = 242,000 IGD 1,052,000 IGD	(4418 @ 100 IGCD) = 442,000 IGD 1,252,000 IGD
Harmon peaking factor: $\left(1 + \frac{14}{4 + P}\right)$	(Total pop = 5918) = 3.18	(Total pop = 7918) = 3.05
Peak domestic flows	3,345,400 IGD	3,818,600 IGD
Present and future average industrial flow	(410,000 + 40,000) = 450,000	(410,000 - 200,000 + 40,000) = 250,000
Industrial Flow Peaking Factor	1.5	1.5
Estimated Peak Industrial Flow	675,000 IGD	375,000 IGD
Backwash water (100,000 IGD) assuming holding tank to discharge into sewers over 18 hours equals to equivalent of:	133,300 IGD	133,300 IGD
TOTAL ESTIMATED PEAK FLOW	4,153,700 IGD (218 L/s)	4,326,900 IGD (227 L/s)

The above volumes are approximately equivalent to five times dry weather flows, as calculated above.

d) It was noted that the capacity of the existing 615 mm gravity sewer and the design peak hydraulic sewage flows are very close.

In the light of the above, a peak hydraulic sewage flow of 218 L/s was considered as the most appropriate design basis on which to assess and design the above-noted components of the system.

c) BOD_5 Loads

In discussions with the Ministry, the latter has indicated that industrial BOD_5 is expected to remain essentially as is. As noted previously, a nominal 10% increase was allotted for industrial growth. Therefore, the following design BOD_5 loadings are proposed:

Source	Average Day Load	
Consoltex	909 kg/d	(2000 lbs/d)
Carnation Foods	361 kg/d	(794 lbs/d)
Equivalent allowance for Graham's Creamery (recently closed)	41 kg/d	(90 lbs/d)
Domestic sewage 5920 @ .17 lbs/cap/day	457 kg/d	(1006 lbs/d)
Industrial growth 10% present loads	118 kg/d	(206 lbs/d)
TOTAL	1886 kg/d	(4096 lbs/d)

With a daily flow of 1.602 MIGD, the BOD_5 concentration will be 256 mg/L. If concentrations are higher than expected, growth will be reduced accordingly or additional treatment will be required.

d) Typical Raw Sewage Characteristics

Table IV represents the considerable variation in the present sewage characteristics, from month to month. These values were extracted from available Ministry data (Operations Branch).

Based on this data and typical domestic sewage concentrations provided by the Ministry's Research Branch, the following design sewage characteristics are proposed:

BOD_5: see clause 8(c)			256 mg/L
Suspended Solids:	Average present load 128 mg/L x 1.22 MIGD	= 1562 lbs/d	
	Future population 2420 @ 0.17 lbs/cap/d	= 411 lbs/d	
	Industrial growth 40,000 IGD @ 300 mg/L	= 120 lbs/d	
	TOTAL	= 2093 lbs/d for 1.602 MGD	130 mg/L
NH_3:	Average present load 10.67 mg/L x 1.22 MGD	= 130 lbs/d	
	Future population 2420 @ 40 mg/L @ 100 IGCD	= 97 lbs/d	
	Industrial growth (estimated) 6 mg/L @ 40,000 IGD	= 2 lbs/d	
	TOTAL	= 229 lbs/d for 1.602 MGD	14.29 mg/L
TP:	Average present load 3.5 mg/L x 1.22 MGD	= 42.7 lbs/d	
	Future population 2420 @ 6 mg/L @ 100 IGCD	= 14 lbs/d	
	Industrial growth 3.5 @ 40,000 IGD	= 1.4 lbs/d	
	TOTAL	= 58.1 lbs/d for 1.602 MGD	3.6 mg/L

(Since Consoltex changed their process in 1983, Ministry records show P level has dropped to 3.5 mg/L.)

9. PHOSPHOROUS REMOVAL

Phosphorous removal is required regardless of the solution considered. This work has been carried out by the Ministry separately. The treatment will conform to the concept selected. The Ministry has determined that alum is the chemical best suited to precipitate and remove phosphorous from the Alexandria sewage.

10. TREATMENT SOLUTIONS CONSIDERED

A number of solutions have been considered for rectifying the existing problems. The advantages and disadvantages of each are detailed herein.

a) Partial Treatment Solutions

All of the following treatments remove one or more of the undesireable sewage characteristics, but not all of them. The system would need to be combined with another treatment in order to achieve reduction of all components.

i. Breakpoint Chlorination of Lagoon Effluent

This method is quite effective in removing nitrogen and hydrogen sulphide. It also provides a disinfected effluent. It has a low capital cost.

A number of serious disadvantages do however exist: chemical pH adjustment would be required; because of the addition of chemicals, the total dissolved solids would increase substantially and could affect the balance of the river water; there would be an obnoxious and potentially dangerous chlorinous odour that forms from the formation of nitrogen trichlorides; there would be a potential formation of chlorinated organics, a matter which is presently of serious concern to the Ministry.

The disadvantages and complications far outweigh the benefits and therefore the Ministry considers this alternative impractical for the Town of Alexandria.

ii. **Air Stripping**

This is a simple process for ammonia removal with a low cost. It consists of raising the pH around 11, forming and reforming water droplets in a stripping tower and providing air - water contact by circulating air in the tower. However, there are potential environmental impacts: it is noisy; it pollutes the air and the washout of ammonia from the atmosphere can find its way back to the aquatic environment. Finally, it is impractical in low temperature areas as the process is sensitive to temperature variations.

Removal of BOD_5 and suspended solids is still required. This alternative is discarded as impractical for this situation.

iii. **Ion Exchange**

The process is highly effective in removing nitrogen with the use of selected zeolites and is insensitive to temperature variations. It is, however, costly and requires a complex automatic control system. The total dissolved solids concentrations are also substantially increased.

Pilot tests would have to be carried out with the specific waste water in order to design a properly effective system.

The Ministry considers that full time supervision of operations would be necessary. At present, the existing treatment works are inspected every 3 - 4 days.

Additional treatment works would be required for removal of BOD_5 and suspended solids.

The capital and operating costs are such that this alternative is not recommended.

iv. **Reduction of Ammonia at the Source**

A Ministry industrial waste water survey revealed that 50% of the ammonia reaching the Alexandria treatment facilities is contributed by Consolidated Textiles. Even if this ammonia concentration were reduced at the source, the remaining concentrations reaching municipal works has been calculated to be sufficiently high that ammonia removal would still be required at the municipal treatment works.

The end result would be reduction of ammonia at two locations. Treatment for removal of BOD_5 and suspended solids would also be required.

It is estimated that economies are not effected and the alternative is not recommended.

v. **Sewage and Clearwater Separation Inside Buildings**

This alternative, by itself, could only reduce the hydraulic load on the treatment works. However, to be effective in reducing the size of the treatment works, this alternative needs to be carried out in conjunction with biological reductions at the source. Also, the extent of hydraulic flow reduction obtainable is uncertain because it is not possible to distinguish between sewer infiltration and surface inflow without much further study.

b) **Complete Treatment Solutions**

i. **Annual Retention Lagoons**

The advantage is definitely positive in that there would be no pollution of the Delisle River during low or moderate flow periods. The lagoon contents would be discharged during the spring run-off when the assimilative capacity of the river is at its peak, thereby minimizing the pollution effect. Some 530 acres of land would be required for these lagoons.

The most serious drawback is the absence of suitable land around the existing facilities necessitating a complete relocation of the facilities. This solution is substantially more expensive than a mechanical plant. New land purchases, an extension of force main to the lagoon, improvements to the pumping station and massive earth work are estimated to total over $5,500,000.00.

The cost of this alternative is excessive and this solution is not recommended.

ii. **Spray Irrigation of Lands combined with Retention Lagoons**

This type of treatment is seasonal in this part of the country. A six to nine month retention pond would still be required for the winter period. Soil characteristics are unfavourable for spray irrigation and huge areas of land would be needed for spray areas and buffer areas. Assuming a spraying rate of 8 inches (200 mm) per season (as was the case for Lansdowne, Ontario, where clay soils were encountered), approximately 1300 acres of land would be required for spraying. In addition, a total of 300 acres would also be required for the retention lagoons.

This alternative is estimated at over $3.5 million and is considered impractical for the Town of Alexandria.

iii. **Biological Reduction at Source and Improvements at Municipal Treatment Works**

There are two chief sources of BOD_5 loading: Consoltex and Carnation Foods. With regards to the latter, its BOD_5 contribution varies considerably and averages 361 kg/d.

The highest contribution is, however, from Consoltex. The construction of an aeration cell (92 m x 92 m) at the Consoltex site could reduce the BOD_5 loads entering the municipal sewer system from 909 kg/d to 364 kg/d. The existing aerators at the treatment works could be relocated at this site. The overall effect of these works could be a slight reduction in aeration basin size and a reduction of power requirements. A preliminary comparison of the capital and operating costs indicates an annual reduction in cost of $5 - 10,000,00 could be effected.

Provincial subsidy could be available for the works at Consoltex if the overall savings could be substantiated.

Denitrification would still be required at the municipal treatment system.

iv. **Aerated Facultative Lagoon with Polishing Pond and Marshland**

The Ministry of the Environment has successfully experimented with this system in Listowel. Details of that facility are provided in Section 12. The system effectively reduces BOD_5, suspended solids and ammonia. It has low capital and operating costs. The main disadvantage is that it seems to periodically fail to reduce the treated sewage effluent to the provincial guideline levels.

v. **Biological Nitrification - Denitrification**

The process recommended by the Ministry for this type of treatment would consist of constructing an extended aeration between the existing aerated cell and the waste stabilization ponds, as described in Section 11. The system is very effective in reducing BOD_5, suspended solids and ammonia.

It is effective year round but costly.

c) **Summary**

Of all the complete alternatives considered, only two appeared viable and practical: a biological nitrification - denitrification process or an aerated facultative lagoon combined with a polishing pond and a marshland.

11. BIOLOGICAL NITRIFICATION - DENITRIFICATION: THE SUTTON EXPERIENCE

It 1981-82, the Wastewater Treatment Section of the Pollution Control Planning Branch of the Ministry of the Environment experimented with the Sutton water pollution control plant to see whether a biological nitrification - denitrification system could successfully control ammonia and hydrogen sulfide in the treated effluent as well as reducing the BOD_5 and suspended solids concentrations. The treatment system consisted of an extended aeration plant followed by a facultative lagoon used as a polishing pond.

The results of the experiment were quite good. Furthermore, the Ministry (discussions with W. Lewandowski) indicated that this process could be utilized for the Alexandria sewage treatment works and that the treatment efficiencies observed in Sutton could be applied to Alexandria, regardless of the variations in the concentrations on the incoming flow. Tables V to VII show how the efficiencies achieved at Sutton could be expected to reduce the Alexandria raw sewage concentrations of BOD_5, suspended solids, phosphorous and ammonia. It will be noted that the ammonia objective is expected to be exceeded marginally in July and August (0.023 vs. 0.020 mg/l) and substantially more in June (0.05 mg/l of un-ionized NH_3 vs. objective of 0.02 mg/l).

The Ministry Waste Water Treatment Section also recommended that low level aeration, at the rate of 1.5 kg of oxygen per kg of BOD_5 present in the polishing pond, be introduced near the outlet of the pond so that hydrogen sulfide may be eliminated from the effluent discharging to the Delisle River during the periods of ice cover over the lagoon. Recent Ministry research on similar undertakings appear to indicate that such low level aeration may not be needed. Further operating data will confirm the necessity of this system in Alexandria.

The Ministry's experience in Sutton has been that the following factors play the major role in nitrification and control of ammonia:

- long aeration and retention times;
- uniform mixing of suspended solids;
- high sludge solids content in the process.

In the case of Alexandria, a relatively low cost modification to the existing system can be effected. The existing aeration cell can be retained for pre-treatment and BOD_5 equalization, a new extended aeration process constructed, and the existing waste stabilization ponds used to polish the effluent. Erosion protection of the earth cell berm will be required to protect against wave action. Protection against freezing can be effected in the same manner that was successfully carried out in Sutton, ie. a removable floating styrofoam cover over the extended aeration process.

Preliminary sizes for the components of an extended aeration plant are shown in Table VIII.

12. AERATED FACULTATIVE LAGOON WITH POLISHING POND AND MARSHLANDS: THE LISTOWEL EXPERIENCE

The use of artificial wetlands for year round treatment of sewage has been under study in Ontario since 1979. The Wastewater Treatment Section of the Pollution Control Planning Branch of the Ministry of the Environment tried a number of different marsh systems in Listowel, Ontario, ("Sewage Effluent Treatment in an Artificial Marshland" by S.A. Black, J. Wibe, G. Miller). The results of the experiment led to the development of certain guidelines in the design and use of artificial wetlands in Ontario (Design and Use of Artificial Wetlands). In the case of Alexandria, the Ministry has determined that the most appropriate arrangement would be the Type 3 system (from the Listowel experiment), which consists of marshlands receiving sewage treated by a facultative lagoon. It was further recommended that low level aeration, applied at the rate of 1.5 kg oxygen per kg BOD_5, be introduced near the outlet of the lagoon so as to reduce hydrogen sulfide in the final effluent. Finally, the Ministry (discussions with S. Black and I. Wile) stated that the treatment efficiencies obtained in Listowel could be expected to be reached with the Alexandria sewage. As data was not extensive, the Ministry was uncertain as to the efficiency with smaller than recommended wetland areas. However, it was thought that the same efficiency could possibly be achieved with a reduced area. Tables IX to XI show how the Listowel type 3 system is estimated to reduce the Alexandria concentrations.

Based on these expected efficiencies, it appears that this treatment process would not be capable of meeting the Provincial objectives at all times for Alexandria; the BOD_5, suspended solids and ammonia limits are expected to be exceeded several times per year. Furthermore, the land available for marshland use is considerably less than that required by the current guidelines, ie. 35% of recommended area (suggested criterion is for a maximum hydraulic loading of 200 $m^3/ha/d$). As noted above, the Ministry of the Environment Wastewater research branch is of the opinion that data is presently insufficient for a proper assessment of the effect of smaller marshes on treatment efficiencies. However, under a reduced area as noted above, and with present state of the art, it is probable that the Provincial objectives would be exceeded more often than illustrated in the above-noted tables.

13. ESTIMATED COST OF IMPROVEMENTS TO THE TREATMENT WORKS

Costs are based on current 1984 prices. An escalation factor of 10% per year should be added to cover future inflation.

Alternative 1 - Extended Aeration Process - Polishing Pond complete with Low Level Aeration

Replace connecting piping between cells	$ 38,500.00
New earth aeration basin (earth berm construction, outlet chamber, etc.)	$ 71,500.00
Sedimentation tank (13.4 m x 30.5 m) supplied and installed	$ 220,000.00
Removable insulation for frost protection of process	$ 10,000.00
Extended aeration and sedimentation equipment, supplied and installed	$ 825,000.00
Low level aeration equipment in pond, supplied and installed	$ 66,000.00
	$1,231,000.00
Miscellaneous - 3%	$ 36,900.00
	$1,267,900.00
Land Acquisition -	Nil
Engineering fees - design, supervision and on-site inspection - 15%	$ 190,200.00
Phosphorous removal	$ 35,500.00
	$1,493,600.00

Alternative 2 - Aerated Cell - Polishing Pond complete with Low Level Aeration - Marshlands

Aerated Cell - (existing)		---
Pond - (existing)		---
Low level aeration equipment in pond, supplied and installed		$ 66,000.00
Marshes		
Cleaning out lagoon bottom	$ 5,500.00	
Cattail planting - labour 80 man-days	$ 5,500.00	
Earth bearm channels - 30,000 lf @ $2.50/lf	$ 82,500.00	
Outlets	$ 6,600.00	
	$100,100.00	$ 100,000.00
		$ 166,000.00
Miscellaneous -		$ 29,000.00
		$ 195,000.00
Engineering fees - design, supervision, on-site inspection - 15%		$ 29,000.00
=		$ 224,000.00

If sufficient land is acquired add:

land acquisition -	$ 33,000.00	
extra channels and cattail planting -	$275,000.00	
	$308,000.00	
Total for Recommended Marshland Area:		$532,000.00

14. ASSESSMENT OF AND RECOMMENDED IMPROVEMENTS TO THE EXISTING PUMPING STATION AND FORCEMAIN

a) Sewage Forcemain

Under the present arrangement, sewage is pumped through approximately 215 m of 300 mm (12 inch) diameter and 560 m of 350 mm (14 inch) diameter asbestos-cement pressure pipe to the existing treatment works.

The preliminary hydraulic calculations assessing the existing forcemain under present and proposed conditions are shown in Table XIII. In view of the fact that the forcemain has more than one pipe size and an intermediate high point in its system profile, it is intended to carry out a thorough waterhammer analysis of the sewage forcemain system at the time of final design in order that the proper waterhammer control system is incorporated in the construction. Surge tanks, surge suppressors, controlled valves, etc. will be considered at that time.

b) Station Wet Well

Based on the previously noted design flows and current design practices, a wet well storage equivalent to approximately 15% of the peak flow pump capacity, ie. 0.15 x 218 L/s = 32.7 m^3 (1155 c.f.) should be provided.

Presently, there are two wet wells; the original having a volume of 4.67 m^3, and the more recent one having a volume of 16.84 m^3. By eliminating the original wet well and constructing a new wet well of identical dimensions to the remaining one, the desired wet well capacity can be obtained.

c) Station Dry Well

The existing dry well station was constructed around 1962. The original pumps were upgraded in 1978 with larger motors. A further upgrading of these pumps is no longer possible and new larger pumps will be required. The dry well is presently overcrowded under the existing conditions and such a piping re-arrangement will be impractical.

It is proposed to construct a new pumping station, complete with a building for standby power. The Ministry's Regional Operation staff have indicated that a submersible type station would be preferred. A thorough economic analysis will be carried out at final design to determine whether a submersible or a wet well/dry well station is more cost effective.

d) **Bishop Street Secondary Sewage Pumping Station**

This pumping station has low dry weather flows. One observed flow, which Town Officials considered typical, was measured as 1.31 L/s. Although the station has an overflow pipe, it is reported that overflows have never occurred except in circumstances of loss of hydro power.

The only proposed improvements to this station are: (a) provision of a dual electric/gas driver for one of the pumps in order to eliminate overflows, and (b) installation of a remote alarm system which will signal high sewage levels and/or pump failure.

15. ESTIMATED COST OF IMPROVEMENTS TO MAIN PUMPING STATION AND COLLECTOR SEWER

Costs are based on current 1984 prices. An escalation factor of 10% per year should be added to cover future inflation.

Wet well, dry well installation	$110,000.00
Generator and control building	$ 40,000.00
Mechanical and electrical work (pumps, controls, generator, piping, wiring, etc.)	$200,000.00
	$350,000.00
Twinning of 450 mm diameter collector sewer	$ 40,000.00
	$390,000.00
Engineering fees - design, supervision and on-site inspection - 15%	$ 58,000.00
TOTAL	$448,000.00

16. PROVINCIAL GRANTS

Under the current Provincial grant structure, for populations of 3500, the Ministry of the Environment provides financial assistance by means of subsidies of about 60% of the cost of construction of an eligible project.

It is important to note that an application for subsidy must be made and a conditional technical approval certificate be issued by the Ministry before the latter determines the eligibility and the rate of subsidy of a project.

17. OPERATING COSTS

Because of the larger electrical units, power costs will increase substantially with an extended aeration process (this could be as much as $20,000.00 more per year). Labour and maintenance costs will also be significantly larger, in the order of $10 - $15,000.00/year.

18. OBSERVATIONS

As a result of the study, the following observations are made:

1. The extended aeration system apparently reduces the wastewater characteristics to below the Provincial objectives more consistently and reliably than the marshland concept considered herein. The extended aeration system is also the more expensive solution.

2. The marshland treatment concept as applied in Alexandria has two drawbacks: (a) due to a lack of available land, the amount of marsh channel that can be provided is substantially less than what is recommended; (b) the Provincial limits for ammonia will be regularly exceeded at certain times of the year.

3. The existing 525 mm diameter trunk sewer, from the centre of town to the developed limit, has a hydraulic capacity less than the future projected design flows (150 L/s vs. 218 L/s). Surcharging and overflowing will likely occur in the Garry River at peak design flow conditions.

4. As the project consists mainly of upgrading an existing biological treatment and the sewage pumping station, it may fall under an environmental assessment class approval and thus avoid the necessity for a hearing. A screening process will, however, likely be required in order to obtain comments from involved agencies. The request for a hearing exemption should also be submitted immediately.

19. CONCLUSIONS AND RECOMMENDATIONS

1. With regards to the high hydraulic flows, the extent of inflow to the sanitary sewer system from building storm sewer connections could not be ascertained. However, a longterm program should be established in order to, a) monitor the sewage flows and overflows and, b) to disconnect the obvious illegal connections, particularly the ones serving roofs.

2. The Town should pass an industrial waste by-law regulating the quality and control of the sewage to be discharged in the municipal sewage system by all contributing industries.

3. An application for a conditional Ministry of the Environment technical approval certificate as well as a request for subsidy consideration should be immediately prepared and submitted as soon as this report is adopted.

4. There exists a large difference in cost between the extended aeration and the marshland concepts. The Ministry of the Environment was requested to assess the effect of the treated effluent from each system on the assimilative capacity and the aquatic life of the Delisle River. The Ministry concluded that: a) the marsh system cannot provide acceptable efficiencies, (b) periodic excesses of the Provincial objectives will result in serious adverse effects on the river, and (c) the available data "indicates that further work with respect to development of an artificial marsh, beyond possible conversion of surplus lagoon capacity, would not be sufficient value to warrant the cost." In the light of the above, therefore, the recommended process is initial treatment in the existing aerated lagoon, followed by an extended aeration process followed by a polishing pond having low level aeration. The pros and cons of mechanical aeration vs. a compressed air system will be assessed at the time of final design. It is further recommended that this process be operated for some time before a decision is made as to the need of the low level aeration system.

5. If Consoltex does not proceed with its cooling water reclamation programme, construction of a sewer to redirect these waters to Mill Pond should be considered. Power cost savings at the pumping station and at the treatment site could be achieved by smaller pump and aeration motors.

6. Routine sampling of industrial flows and concentrations is recommended so as to confirm same prior to final design of the treatment works.

7. It is considered that the existing aerated lagoon will also serve as a flow equalization tank to equalize the BOD_5 loads from the Carnation plant.

8. The capacity of the existing 525 mm diameter sanitary sewer running generally along the Garry River from Main Street to the easterly Town limits (Sanfield Road) should be reinforced by constructing a 450 mm diameter sewer parallel to it. The total capacity of the two pipes should give a total capacity of 218 L/s for the trunk sewer from centre town to the pumping station.

9. The backwash water at the Town's filtration plant should ultimately be discharged into the sanitary sewage system for subsequent treatment. In order to prevent overloading of the sewer system, a 680,000 L (150,000 IG) holding tank should be constructed and installed with pumps capable of discharging the backwash waters in the sewer over an 18 hour period.

10. Modify the existing main pumping station to suit the new design flows as follows:

    a) Expand the wet well by twinning the recent #1 wet well and eliminating the original #2 wet well (total capacity = 1190 c.f. or 25 m^3).

    b) Install two (2) new sewage pumps, each having a pumping capacity of 218 L/s, complete with flow measuring device. Drawing #82-7428-4 shows a typical arrangement.

    c) At the time of design, a thorough analysis of waterhammer should be carried out to determine the extent and type of surge control required at the station.

11. At the Bishop Street secondary sewage pumping station, reinstate the remote alarm system and install a gas powered driver on one of the pumps to provide an emergency means of standby power.

20. SUMMARY

1. Converting the present system to an aerated cell with a low level aerated polishing pond and channelled marshlands was considered as possibly being the most economical treatment solution. However, based on the available data, the Ministry of the Environment concluded that the marsh system could not provide a consistent level of acceptable treatment efficiency and that this would result in serious adverse effects on the receiving stream. This system was therefore rejected.

2. The recommended sewage treatment is pre-treatment in the existing aerated lagoon followed by an extended aeration process and followed by effluent polishing and phosphorous removal in the existing oxidation pond. It is recommended that the proposed low level aeration be installed only if operational experience confirms the need for it.

3. Improvements to the existing collection system are recommended, ie. increased capacity to part of the trunk sewer, and improved capacity to the main pumping station and forcemain.

TABLE I

ALEXANDRIA INDUSTRIAL WASTE SEWER SURVEY
AUGUST 10-11-12, 1982

	Aug.	FLOW L/d / IG/d	Suspended Solids			BOD			COD			NH			P			TKN		
			mg/L	kg/d	lb/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/
A	11	22,700 / 5,000	265	7	15.4	290	7.6	16.8	923	24.3	53.5	.25	.007	.015	21	.55	1.2	7.5	.2	.4
	12	25,305 / 5,560	145	3.68	8.1	290	7.3	16.1	383	9.7	21.3	.20	.005	.01	65	1.6	3.6	65	1.64	3.
B	11	183,750 / 40,420	300	55	121	1950	358	788	2964	550	1198	.20	.04	.08	62	11.4	25.1	33	6.1	13.
	12	237,000 / 52,128	335	79	175	2050	486	1068	--	--	--	.25	.05	.10	90	21.3	46.9	35	8.3	18.
C	11	1,827,500 / 402,000	40	73.1	161	110	201	442	445	813	1789	60	110	241	22	40.2	88	65	118	26
	12	1,860,000 / 409,000	60	112	245	120	223	490	774	1439	3166	70	130	286	8.6	16	35	65	121	26
D	11	4,065,500 / 894,300	75	305	670	170	691	1520	199	809	1780	50	203	447	11	45	98	40	162	35
	12	4,511,500 / 992,420	70	315	694	98	442	972	314	1416	3116	60	271	596	11	50	109	41	185	40

A - Graham's Creamery
B - Carnation Food Ltd.
C - Consoltex
D - S.T.P. Influent

SOURCE: Ministry of the Environment

TABLE II

ALEXANDRIA INDUSTRIAL WASTE SEWER SURVEY
FEBRUARY 27, 28, 1985 AND MARCH 1, 1985

		FLOW	Suspended Solids			BOD			COD			NH			P			TKN		
		L/d / IG/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/d
B	Feb. 26 27	97,000 / 21,337	1180	114	251	2613	253	558	5045	489	1078	32	3.1	6.8	50	4.9	10.8	125	12.1	26.7
B	27 28	97,000 / 21,337	553	53.6	118	2488	241	531	4125	400	882	22.3	2.2	4.9	50	4.9	10.8	156	15.1	33.3
B	Mar. 1 2	97,000 / 21,337	318	30.8	68	275	26.7	58.9	1172	114	251	29	2.8	6.2	50	4.9	10.8	125	12.1	26.7
C	Feb. 26 27	1,464,000 / 322,000	84	123	271	219	321	708	973	1424	3139	7.6	11.1	24.5	1.3	1.9	4.2	30	44	97
C	27 28	1,427,000 / 314,000	50	71	157	239	341	752	880	1256	2769	6.9	9.8	21.6	1.3	1.9	4.2	22	31	68
C	Mar. 1 2	1,405,000 / 309,000	59	83	183	173	243	536	753	1058	2332	3.2	4.5	9.9	1.5	2.1	4.6	17.5	25	5[illegible]

B - Carnation - trickling filter operates from May to November only.

C - Consoltex

SOURCE: Ministry of the Environment

TABLE III

ALEXANDRIA INDUSTRIAL WASTE SEWER SURVEY
APRIL 23 AND 24, 1985

		FLOW	Suspended Solids			BOD			NH			P			TKN		
		L/d / IG/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/d	mg/L	kg/d	lb/d
B	Apr. 23	216,800 / 47,700	1870	405	893	4300	932	2055	14	3	6.6	58	12.6	28	58	12.6	28
	24	122,700 / 27,000	640	79	174	1900	233	514	14	1.7	3.7	15	1.8	4.0	25	3.1	6.8
C	Apr. 23	1,529,000 / 336,250	65	99	218	200	428	944	39	60	132	1.0	1.5	3.3	53	81	179
	24	1,740,000 / 382,680	66	115	254	300	522	1151	35	61	134	1.0	1.7	3.7	53	92	203
D	Apr. 23	6,491,000 / 1,428,000	80	519	1144	140	909	2004	10	65	143	2.6	16.9	37	18	117	258
	24	6,491,000 / 1,428,000	58	376	829	135	876	1931	11	71	157	2.0	13.0	29	19	123	271

B - Carnation Foods
C - Consoltex
D - STP Influent

SOURCE: Ministry of the Environment

TABLE IV

ALEXANDRIA SEWAGE

PRESENT TYPICAL RAW SEWAGE CHARACTERISTICS

Period - 1979 to 1982, based on samples* collected at 2 week intervals by MOE

MONTH	BOD mg/L Highest	BOD mg/L Lowest	BOD mg/L Average of all Samples	SS mg/L Highest	SS mg/L Lowest	SS mg/L Average of all Samples	TP mg/L Highest	TP mg/L Lowest	TP mg/L Average of all Samples	NH_3 mg/L
January	232	79	155.5	232	60	146	18	7.6	12.8	11
Feb.	563	85	324	212	90	151	20	10	15	22
March	161	67	114	137	76	106.5	18.7	8.5	13.6	7.9
April	279	46	162.5	158	100	129	9	4.7	6.8	4.9
May	225	58	141.5	125	92	108.5	12	7.2	9.6	10.8
June	270	39	154.5	162	42	102	10	9.4	9.7	10
July	191	46	118.5	288	74	181	12	9.8	10.9	6.5
August	100	54	77	165	46	105.5	16	6	11	13
Sept.	132	44	88	185	72	128.5	19	10	14.5	8.4
October	149	67	108	250	72	161	20	7	13.5	9.3
Nov.	218	122	170	165	104	134.5	17	10	13.5	8.6
Dec.	84	79	81.5	108	65	86.5	13	11	12	
AVERAGE			141.25			128			11.91**	10.67

** Recent change in chemicals by Consoltex has reduced TP loadings to 7.1 mg/L

* Sampling alternates between grab sample and 24-hour composite sample.

TABLE V

ALEXANDRIA SEWAGE
EXTENDED AERATION - POLISHING POND

EXPECTED TREATMENT EFFICIENCIES

BOD_5 AVERAGE

MONTH	RAW SEWAGE mg/l	EXTENDED AERATION % EFFIC.	SECONDARY EFFLUENT mg/l	POND % EFFIC.	FINAL EFFLUENT	EFFLUENT OBJECTIVE mg/l
						15
January	238	97	7	66	2.4	
February	238	92	19	85	2.9	
March	238	92	19	84	3	
April	238	85	35.7	67	11.8	
May	238	96	9	—	8.1	
June	238	97	8	—	8	
July	238	97	8	—	8	
August	238	97	8	—	8	
September	238	97	8	—	8	
October	238	97	8	—	8	
November	238	95	11.9	0	11.9	
December	238	93	16.7	66	5.5	

NOTE: Sutton experiment treatment efficiencies transposed to Alexandria sewage to reflect expected treatment efficiencies with Alexandria sewage.

TABLE VI

ALEXANDRIA SEWAGE
EXTENDED AERATION - POLISHING POND

EXPECTED TREATMENT EFFICIENCIES

SS AVERAGE

MONTH	RAW SEWAGE mg/l	EXTENDED AERATION % EFFIC.	SECONDARY EFFLUENT mg/l	POND % EFFIC.	FINAL EFFLUENT	EFFLUENT OBJECTIVE mg/l
January	150	98	3	60	1.2	15
February	150	85	22.5	30	15.75*	
March	150	90	15	80	3	
April	150	80	30	60	12	
May	150	85	22.5	30	15.75*	
June	150	90	15	33	10	
July	150	96	6	33	4	
August	150	96	6	33	4	
September	150	96	6	33	4	
October	150	96	15	33	10	
November	150	85	22.5	50	11.3	
December	150	80	30	85	4.5	

NOTE: Sutton experiment treatment efficiencies transposed to Alexandria sewage to reflect expected treatment efficiencies with Alexandria sewage.

* Objective expected to be exceeded.

TABLE VII

ALEXANDRIA SEWAGE
EXTENDED AERATION - POLISHING POND

EXPECTED TREATMENT EFFICIENCIES

NH_3

MONTH	RAW SEWAGE mg/l	POND % EFFIC.	FINAL EFFLUENT	AVERAGE pH	AVERAGE T°C	NH FACTOR	EFFLUENT UN-IONIZED NH mg/L	EFFLUENT OBJECTIVE mg/L
								0.02
January	14.24	95	0.7	7.5	0	.0026	0.0018	
February	14.24	95	0.7	7.5	0	.0026	0.0018	
March	14.24	95	0.7	7.3	2	.0030	0.0021	
April	14.24	94	0.854	7.4	5	.0039	0.0033	
May	14.24	99	0.143	9.0	13	.19	0.0272*	
June	14.24	95	0.7	8.5	18	.10	0.07 *	
July	14.24	95	0.7	8.3	20	.075	0.0525*	
August	14.24	95	0.7	8	19	.038	0.0266*	
September	14.24	95	0.7	7.3	15	.0062	0.00434	
October	14.24	95	0.7	7.5	8	.005	0.0035	
November	14.24	96	0.57	7.5	0	.0026	0.001482	
December	14.24	98		7.5	0	.0026		

* Objective expected to be exceeded.

Note: Sutton experiment treatment efficiencies transposed to Alexandria sewage to reflect expected treatment efficiencies with Alexandria sewage.

TABLE VIII

TOWN OF ALEXANDRIA

SEWAGE TREATMENT PLANT IMPROVEMENTS

PRELIMINARY SIZING OF EXTENDED AERATION PLANT WITH NITRIFICATION OCCURRING

MOE DESIGN CRITERIA (from MOE Guidelines for the Design of Water and Sewage Treatment Works)

Organic loading: 7 - 10 g $BOD_5/m^3/hr$

Aeration tank minimum detention time: 15 hrs

Return sludge rate: 50 - 200%

Oxygen requirements: 1.5 kg O_2/kg BOD_5 + 4.6 kgO_2/kg TKN

Solids retention time: 15 days

Maximum surface settling rate, settling tank: 35 $m^3/m^2/d$

Mechanical aerator, for uniform M.L.V.S.S. mixing: 16 - 25 W/m^3 of aeration tank.

Aeration Basin

Design BOD_5 load: 1886 kg (4096 lbs/day). Aeration cell has 70% BOD_5 removal efficiency.

Design BOD_5 load at aeration basin: 30% of 4096 = 1229 lbs/d or 558 kg/d

Design hydraulic flow - average day: 7273 m^3/d (1.602 MIGD)

Aeration Basin requirements (BOD_5) $= \frac{558 \text{ kg/d}}{24 \text{ hrs}} \times \frac{1}{0.01 \text{ kg/m}^3\text{/hr}} = 2325 \text{ m}^3$

Aeration Basin depth = 3 m

Aeration Basin area = 2325 ÷ 3 = 775 m^2 (approximately 27.5 m x 27.5 m)

Aeration Basin requirements (Hydraulic Flow):

$$\frac{7273 \text{ m}^3}{\text{d}} \times \frac{15}{24} = 4546 \text{ m}^3$$ 4546 Hydraulic Flow rules

Aeration Basin Actual detention time = 15 hrs 15 required

Mechanical aerator: @ 25 W/m^3 x 4546 m^3 = 113.7 kW (for uniform MLVSS mixing)
@ 16 W/m^3 x 4546 m^3 = 72.7 kW (for uniform MLVSS mixing)

Settling basin requirements: 7273 m^3/d ÷ 35 $m^3/m^2/d$ = 208 m^2

TABLE IX

ALEXANDRIA SEWAGE
AERATED CELL - POLISHING POND - MARSHLANDS

EXPECTED TREATMENT EFFICIENCIES

BOD_5 AVERAGE

MONTH	RAW SEWAGE mg/l	AERATED CELL AND WSP % EFFIC.	WSP EFFLUENT mg/L	MARSH EFFIC.	FINAL EFFLUENT mg/L	EFFLUENT OBJECTIVE
						15 mg/l
January	238	93%	16.7	.63	6.16	
February	238	89%	26.2	.55	11.78	
March	238	81%	45.22	.56	19.9 *	
April	238	95%	11.0	.38	7.38	
May	238	88%	28.56	.86	4.0	
June	238	54%	109.5	.62	41.6 *	
July	238	91%	21.4	Ø	21.4 *	
August	238	76%	57.12	.17	47.41*	
September	238	93%	16.7	.72	4.66	
October	238	91%	21.4	.87	2.8	
November	238	96%	9.5	.80	1.9	
December	238	76%	21.4	.57	9.2	

* Objective expected to be exceeded.

Note: Listowel System III experiment treatment efficiencies transposed to Alexandria sewage to reflect expected treatment efficiencies with Alexandria sewage.

TABLE X

ALEXANDRIA SEWAGE
AERATED CELL - POLISHING POND - MARSHLANDS

EXPECTED TREATMENT EFFICIENCIES

SS AVERAGE

MONTH	RAW SEWAGE mg/1	AERATED CELL AND WSP % EFFIC.	WSP EFFLUENT mg/1	MARSH EFFIC.	FINAL EFFLUENT mg/1	EFFLUENT OBJECTIVE
						15 mg/1
January	150	.795	30.7	.33	20.1	*
February	150	.82	27	—	27	*
March	150	.625	56.25	.36	36	*
April	150	.87	19.5	.62	7.4	
May	150	.535	69.8	.73	18.8	*
June	150	.805	29.25	.52	14	
July	150	.81	29.25	—		
August	150	.75	37.5	.44	21	*
September	150	.71	43.5	.41	25.67	*
October	150	.875	18.75	.52	9	
November	150	.865	19	.75	4.75	
December	150	.79	31.5	.70	9.45	

* Objective expected to be exceeded.

Note: Listowel System III experiment treatment efficiencies transposed to Alexandria sewage to reflect expected treatment efficiencies with Alexandria sewage.

TABLE XI

ALEXANDRIA SEWAGE
AERATED CELL - POLISHING POND - MARSH TREATMENT

NH_3

MONTH	RAW SEWAGE mg/1	WSP EFFLUENT** mg/L	MARSH EFFIC.	FINAL EFFLUENT mg/L	AVERAGE PH	AVERAGE T°C	EFFLUENT UN-IONIZED NH_3	EFFLUENT OBJECTIVE
								0.02
January	14.24	16	.29	11.4	75	0	0.03	*
February	14.24		.26		75	0	0.03	*
March	14.24	11	.9	1.1	7.3	2	0.0003	
April	14.24	5.4	.48	2.8	7.4	5	0.011	
May	14.24	4.8	.80	1.0	9.0	13	0.19	*
June	14.24	3.9	.51	1.9	8.5	18	0.19	*
July	14.24	4.9	.40	2.9	8.3	20	0.22	*
August	14.24	5.6	.12	4.9	8	19	0.186	*
September	14.24	1.65	.94	0.1	7.3	15	0.0038	
October	14.24	3.2	.97	0.1	7.5	8	0.0006	
November	14.24	1.8	.99.5	0.01	7.5	0	0.00005	
December	14.24	6.9	.50	3.4	7.5	0	0.0088	

* Objective expected to be exceeded.

** Existing effluent concentrations.

NOTE: Listowell System III experiment treatment efficiencies transposed to Alexander's sewage to reflect expected treatment efficiencies with Alexander's sewage.

TABLE XII

ALEXANDRIA SEWAGE TREATMENT

PRELIMINARY SIZING OF MARSHLANDS

DESIGN PARAMETERS

Length to width ratio of marshland ditch: 20 : 1

Design hydraulic loading of marshland ditch: 200 m^3/ha/day

MARSH REQUIREMENT

Hydraulic flow (average day): 7.273×10^3 m^3/d

Required marsh = $7.273 \times 10^3 \div 200 = 36.4$ ha

Available land for marsh:

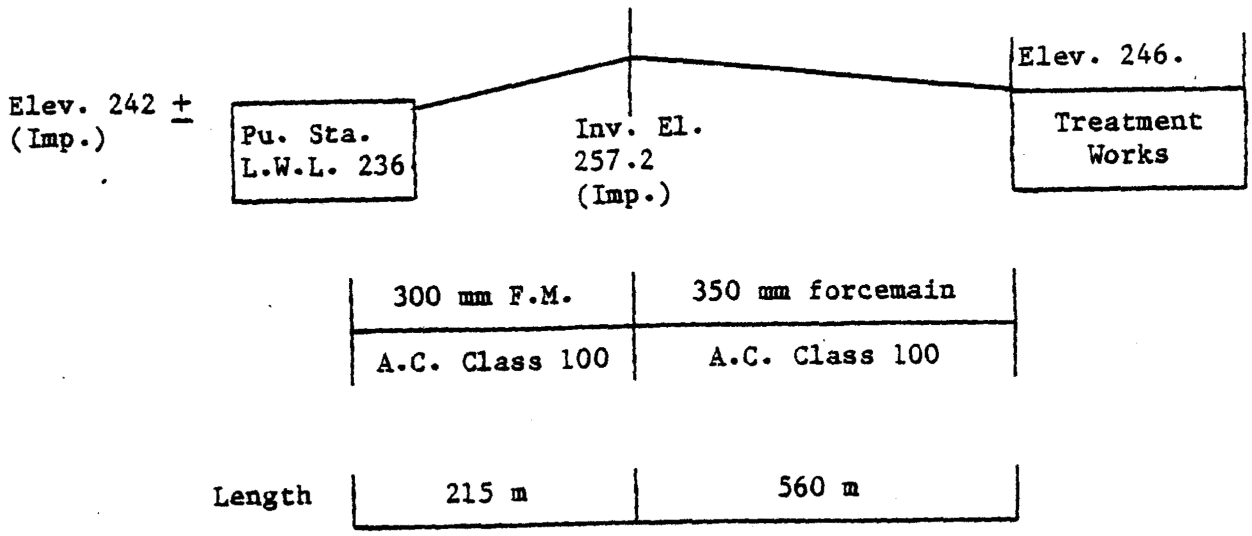
1 cell ('B')	5.18 ha	
1 cell ('C')	6.47 ha	
Vacant Land	2.02 ha	
	13.67 ha	36.4 ha

TABLE XIII

ALEXANDRIA MAIN SEWAGE PUMPING STATION

PRELIMINARY ASSESSMENT OF HYDRAULIC CONDITIONS

EXISTING ARRANGEMENT

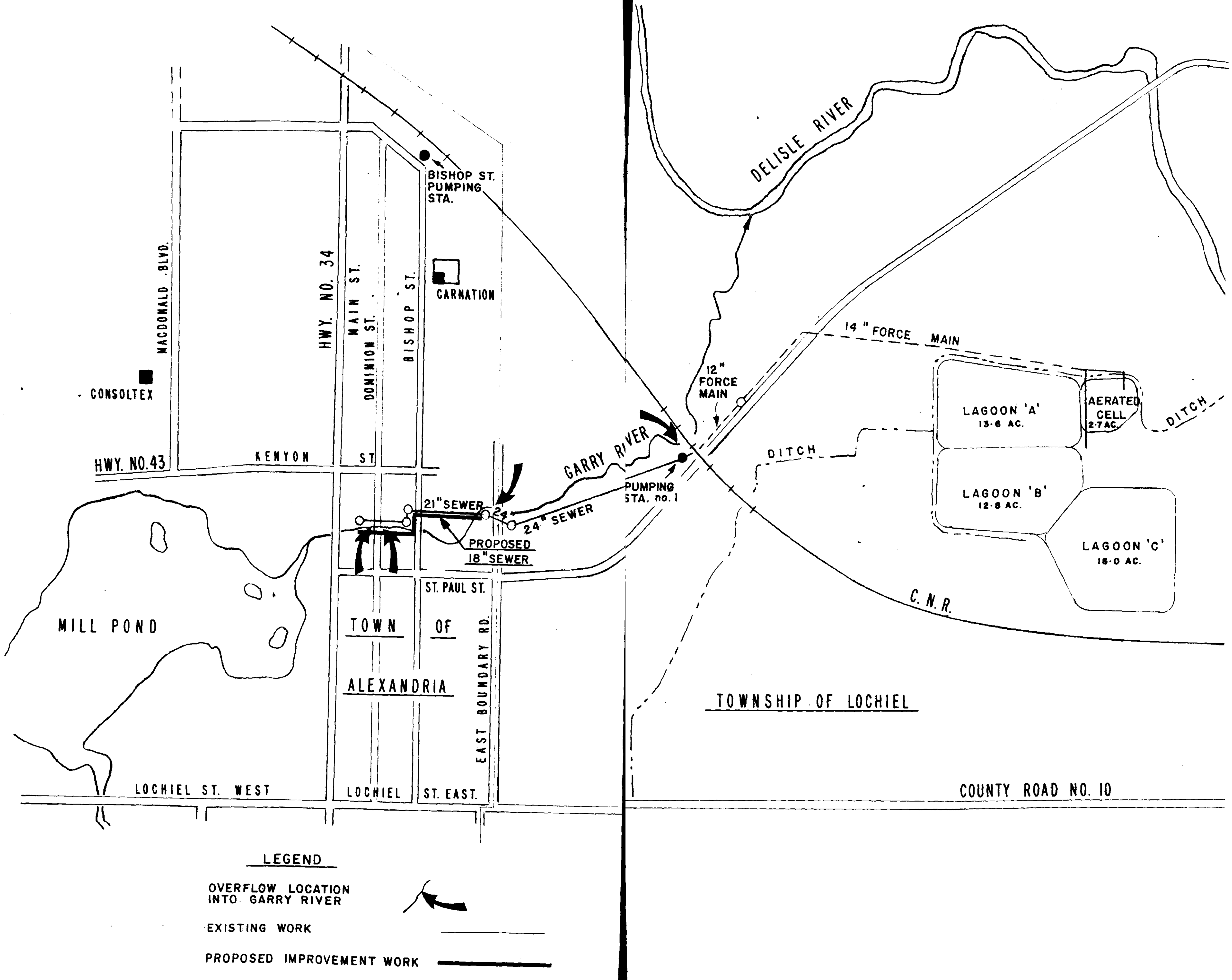


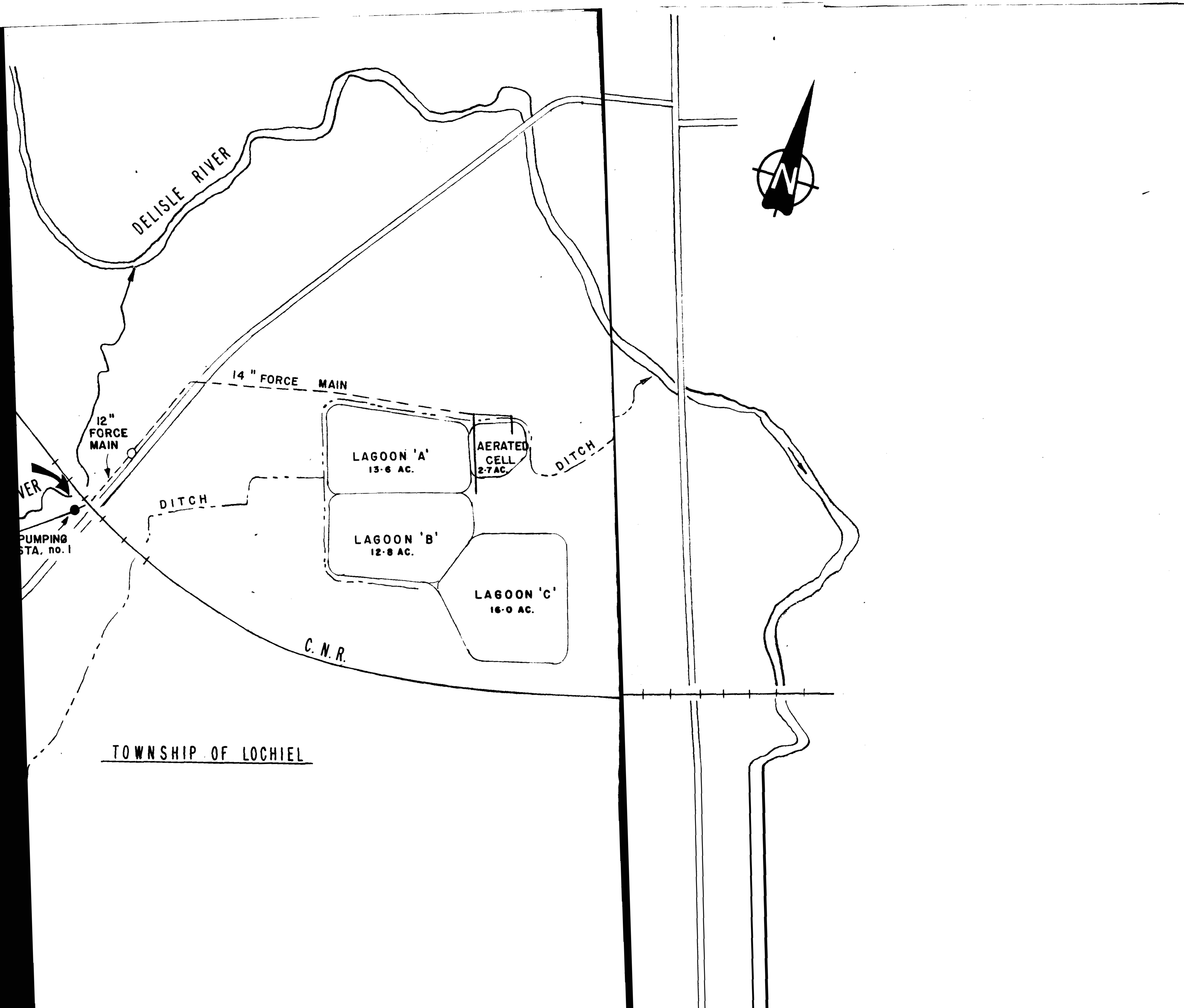
PROPOSED ARRANGEMENT

Install air release valve at high point and a waterhammer control system.

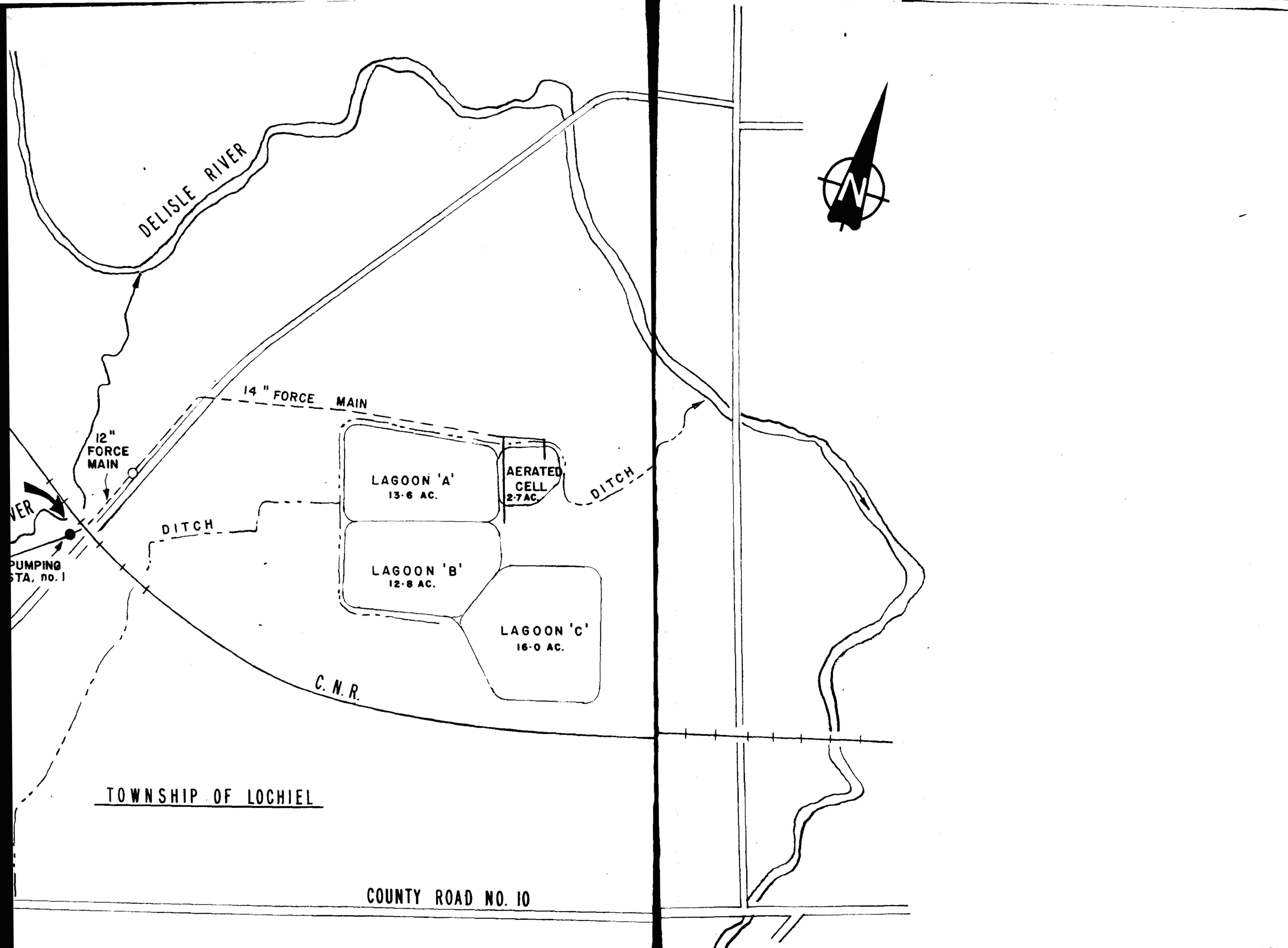
Estimated Total Dynamic Head, in feet.

Static Head - Discharge Point	246.0	
Low Suction Liquid Level	236.0	
		10.0 ft.
Friction @ Q = 218 L/s for 300 mm A.C.		17.41
350 mm A.C.		20.16
Allowance for bends		3.50
Allowance for miscellaneous losses and residual head		5.00
TOTAL ESTIMATED DYNAMIC HEAD (TDH)		56.1 ft.


DELISLE RIVER
BISHOP ST. PUMPING STA.
CARNATION
MACDONALD BLVD.
HWY. NO. 34
MAIN ST.
DOMINION ST.
BISHOP ST.
CONSOLTEX
14" FORCE MAIN
12" FORCE MAIN
LAGOON 'A' 13·6 AC.
AERATED CELL 2·7 AC.
DITCH
HWY. NO.43
KENYON ST
GARRY RIVER
PUMPING STA. no. 1
21" SEWER
24"
24" SEWER
PROPOSED 18" SEWER
LAGOON 'B' 12·8 AC.
LAGOON 'C' 16·0 AC.
ST. PAUL ST.
MILL POND
TOWN OF ALEXANDRIA
EAST BOUNDARY RD.
C. N. R.
TOWNSHIP OF LOCHIEL
LOCHIEL ST. WEST
LOCHIEL ST. EAST.
COUNTY ROAD NO. 10
LEGEND
OVERFLOW LOCATION INTO GARRY RIVER
EXISTING WORK
PROPOSED IMPROVEMENT WORK

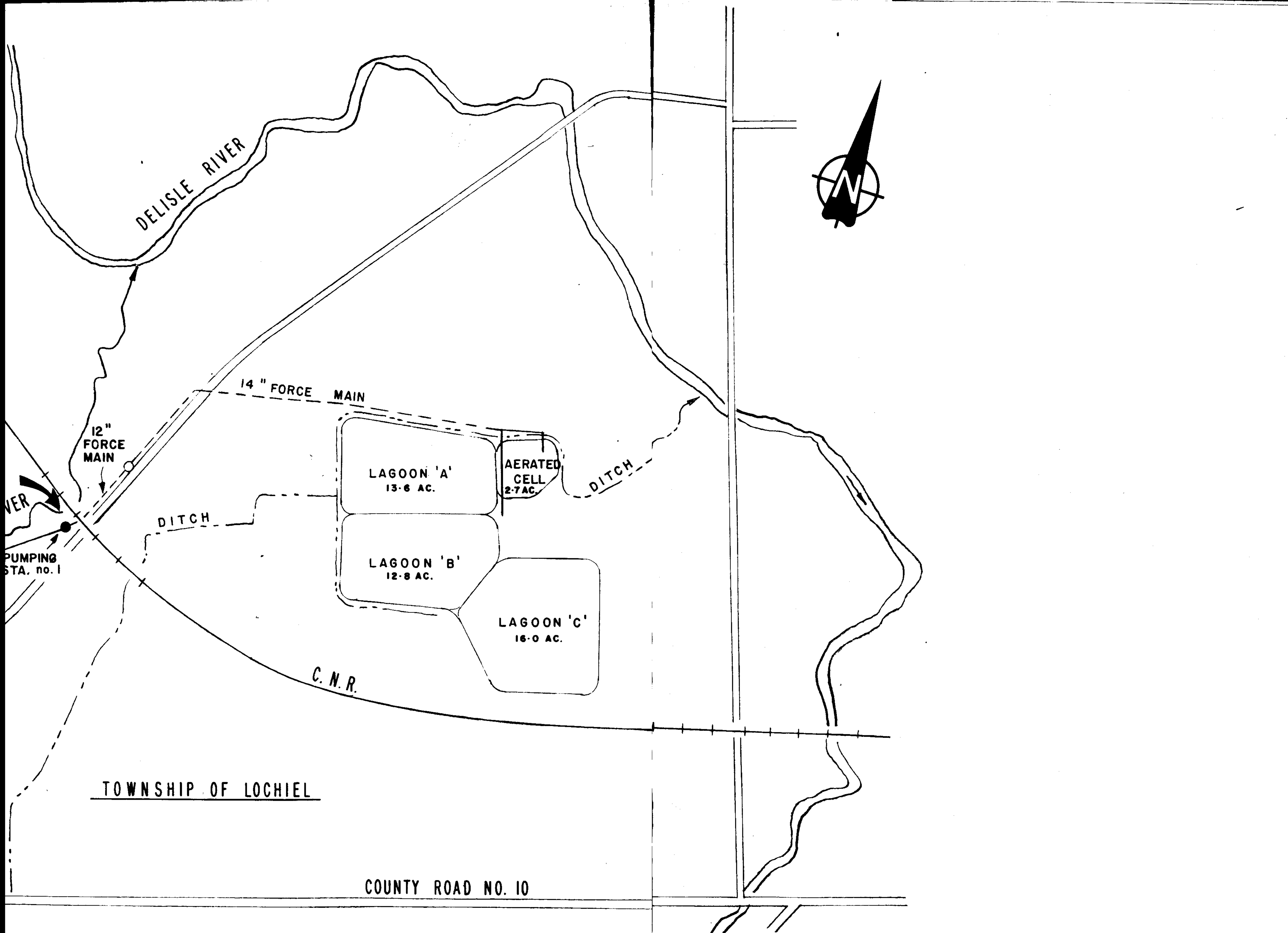


N
DELISLE RIVER
14" FORCE MAIN
12" FORCE MAIN
LAGOON 'A'
13.6 AC.
AERATED CELL
2.7 AC.
DITCH
LAGOON 'B'
12.8 AC.
LAGOON 'C'
16.0 AC.
DITCH
PUMPING STA. no. 1
C.N.R.
TOWNSHIP OF LOCHIEL



ONTARIO MINISTRY OF THE ENVIRONMENT

UPGRADING THE SEWAGE WORKS

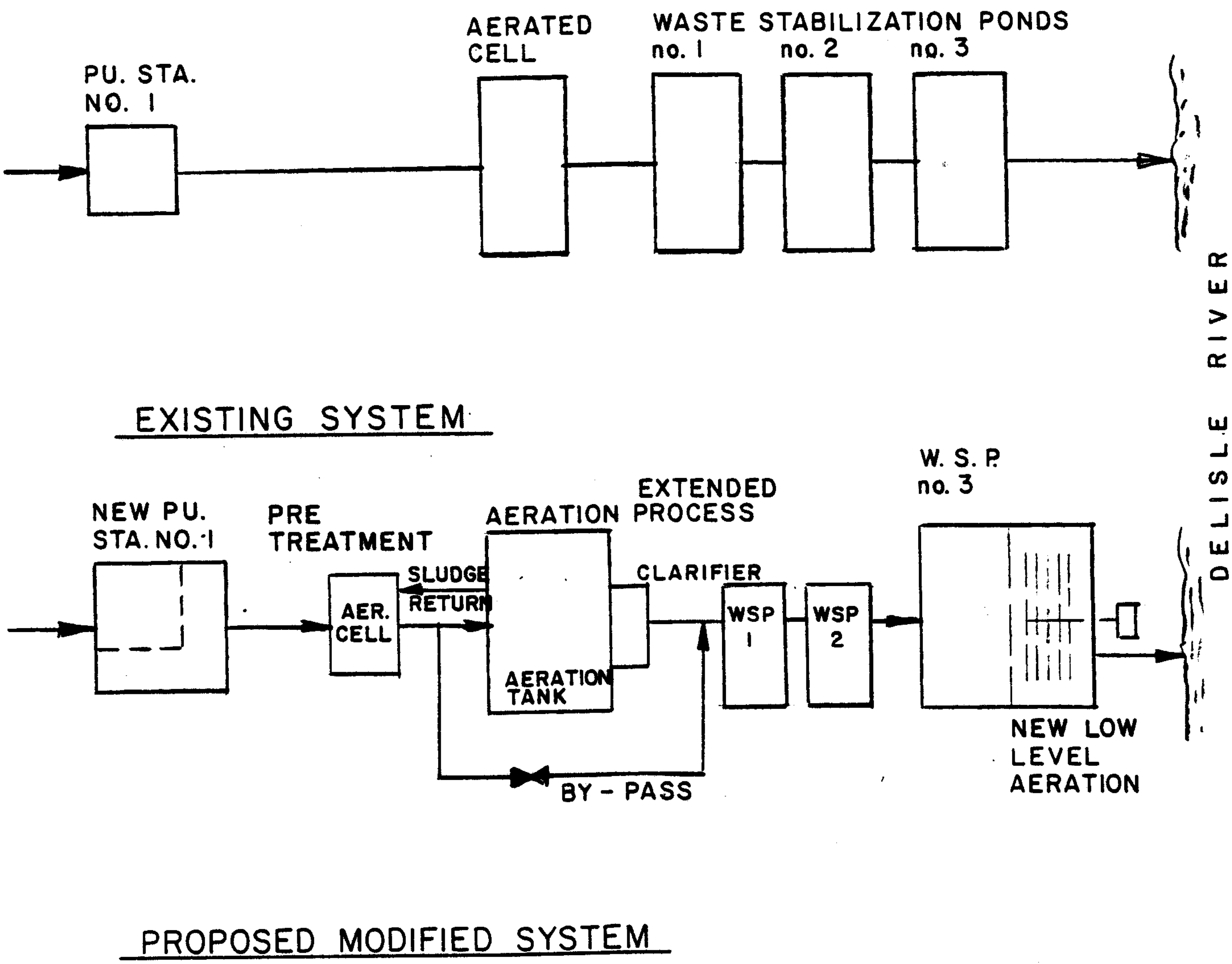


ONTARIO MINISTRY OF THE ENVIRONMENT

UPGRADING THE SEWAGE WORKS
TOWN OF ALEXANDRIA

GENERAL PLAN SHOWING EXTENSION WORK UNDER CONSIDERATION

SCALE 1"= 700' NOV. 1984 DWG. no. 82 – 7428 – 1



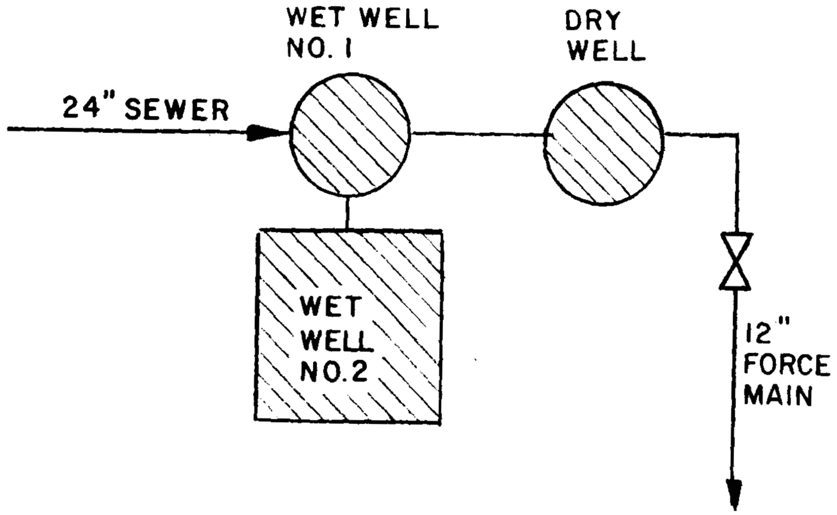
ONTARIO MINISTRY OF THE ENVIRONMENT

UPGRADING THE SEWAGE WORKS
TOWN OF ALEXANDRIA

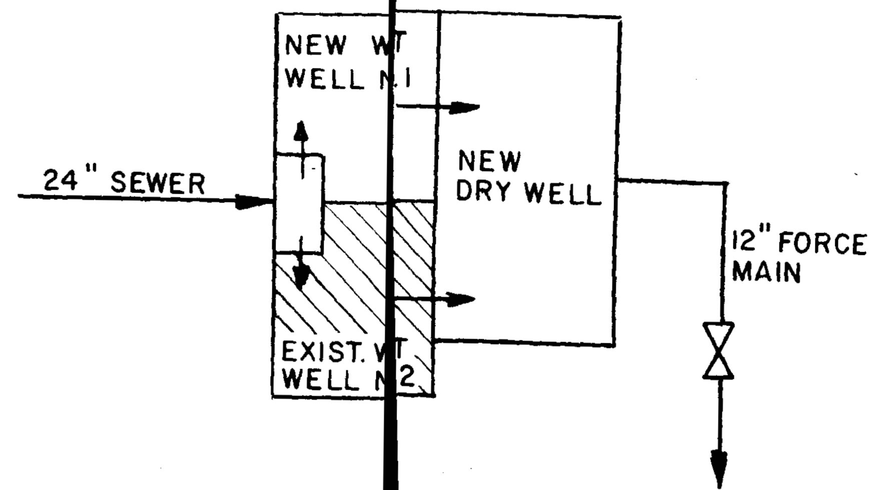
FLOW DIAGRAM

PROPOSED MODIFICATION TO EXISTING TREATMENT WORKS

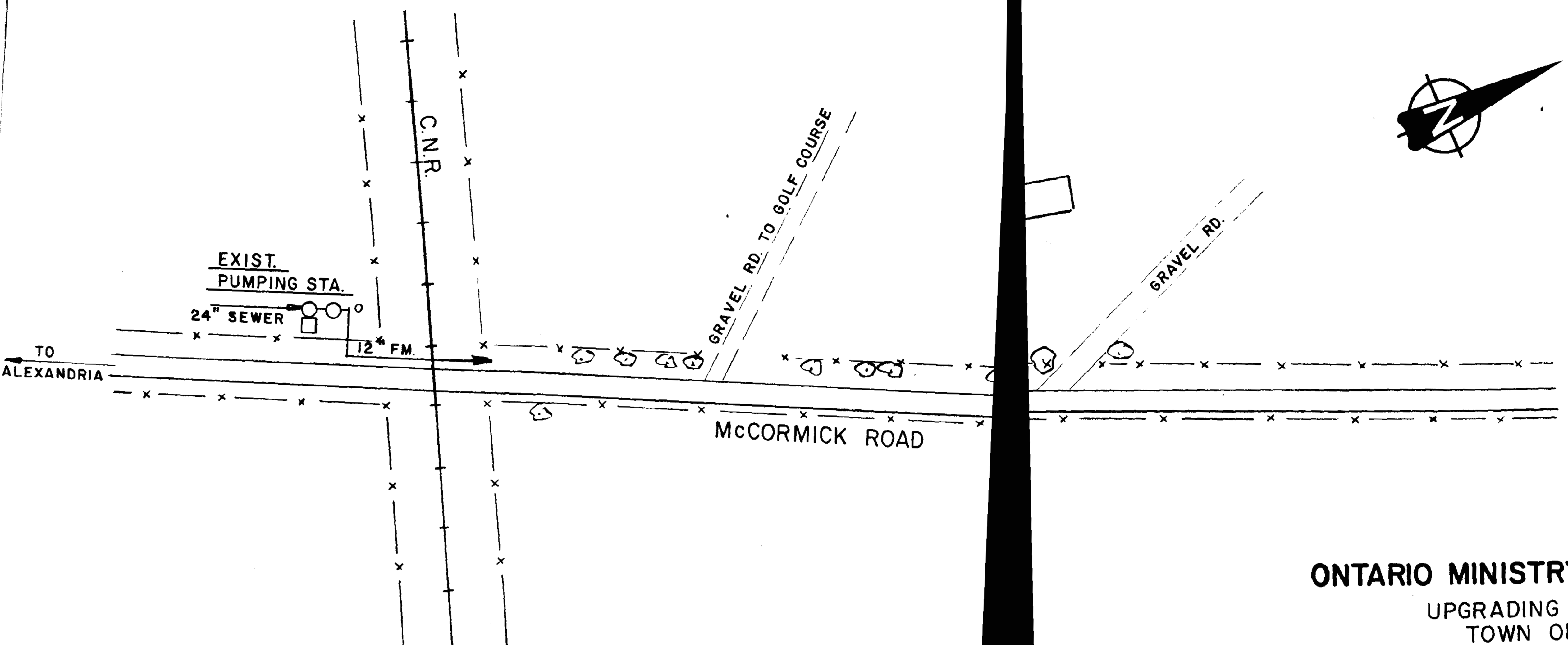
N. T. S. NOV. 1984 DWG. no. 82 - 7428 - 2



EXISTING ARRANGEMENT



PROPOSED WORKS

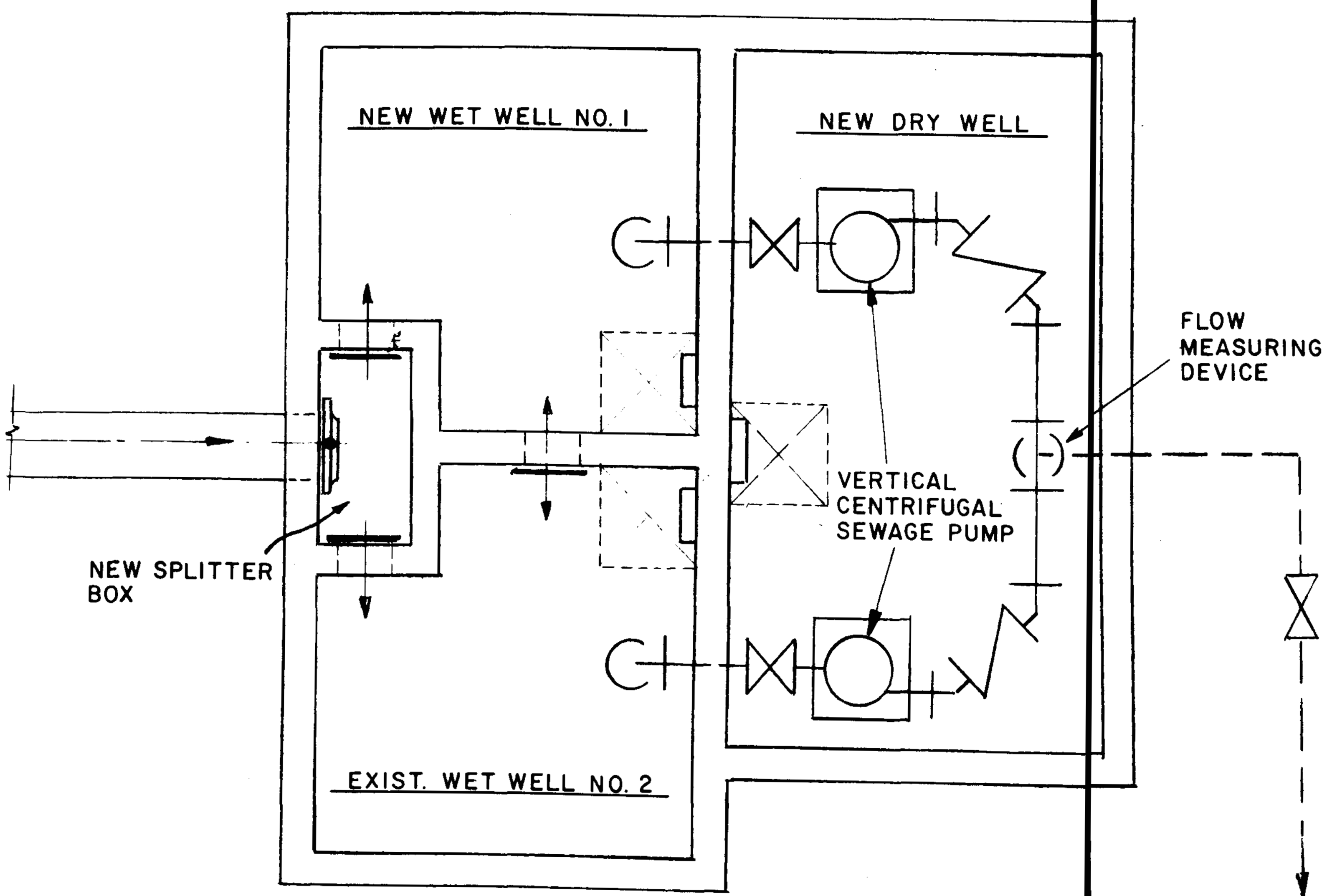


ONTARIO MINISTRY OF THE ENVIRONMENT

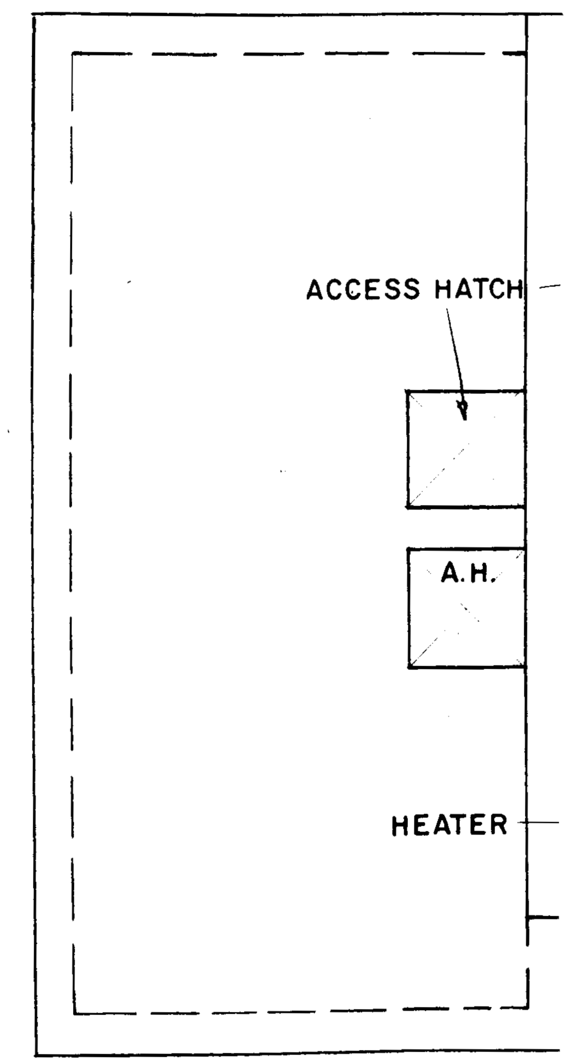
UPGRADING THE SEWAGE WORKS
TOWN OF ALEXANDRIA

PROPOSED IMPROVEMENTS TO MAIN PUMPING STATION

SCALE 1" = 100' NOV. 1984 DWG. no. 82 - 7428 - 3



LOWER LEVEL



UPPER LEVEL

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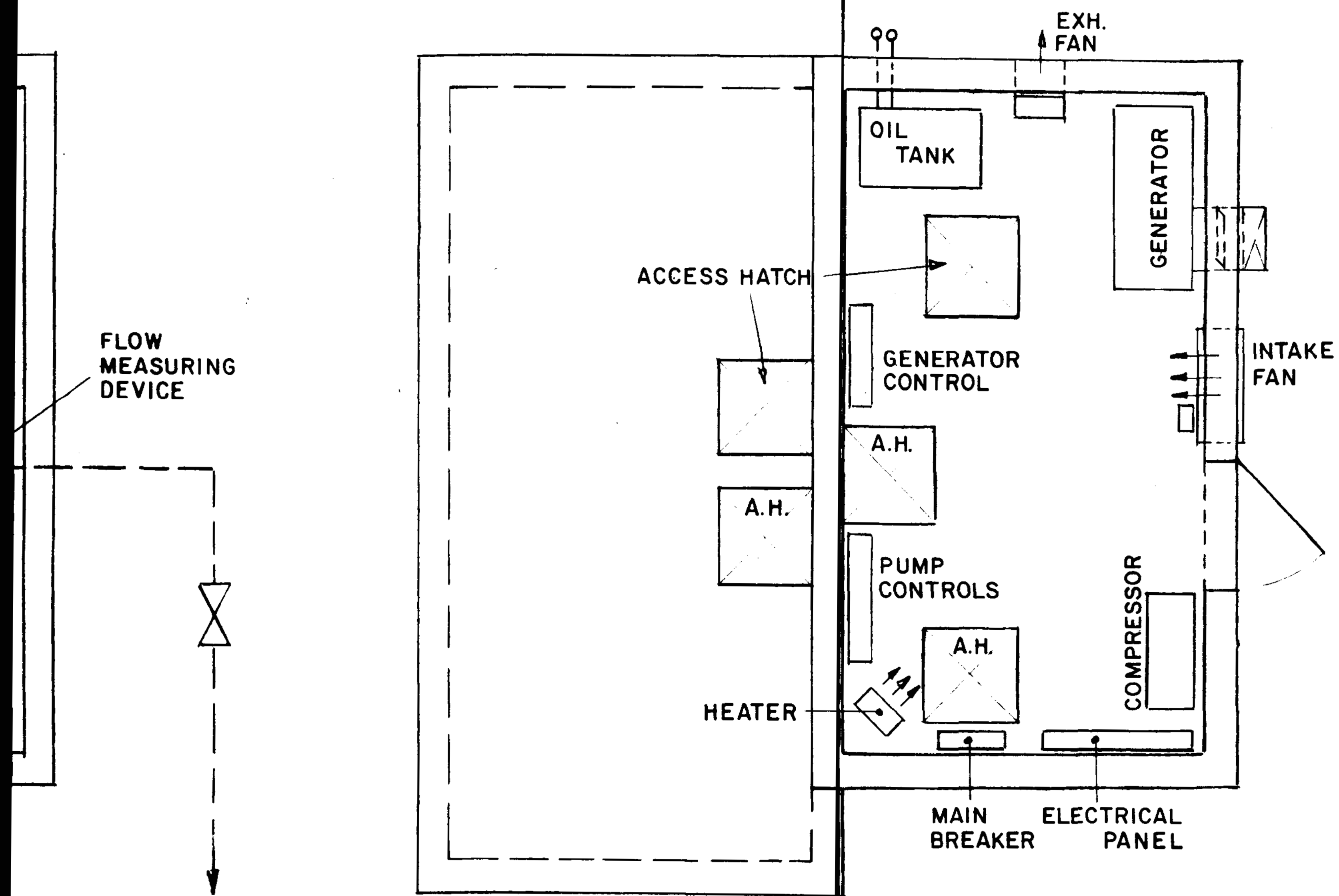
TOW

DETAILS OF PROPOSED I

N. T. S.



UPPER LEVEL

ONTARIO MINISTRY OF THE ENVIRONMENT

UPGRADING THE SEWAGE WORKS
TOWN OF ALEXANDRIA

DETAILS OF PROPOSED IMPROVEMENTS TO MAIN PUMPING STATION

N.T.S. NOV. 1984 DWG. no. 82 - 7428 - 4