RICHMOND LANDFILL STUDY
PRELIMINARY REPORT

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Richmond Landfill study :
preliminary report.

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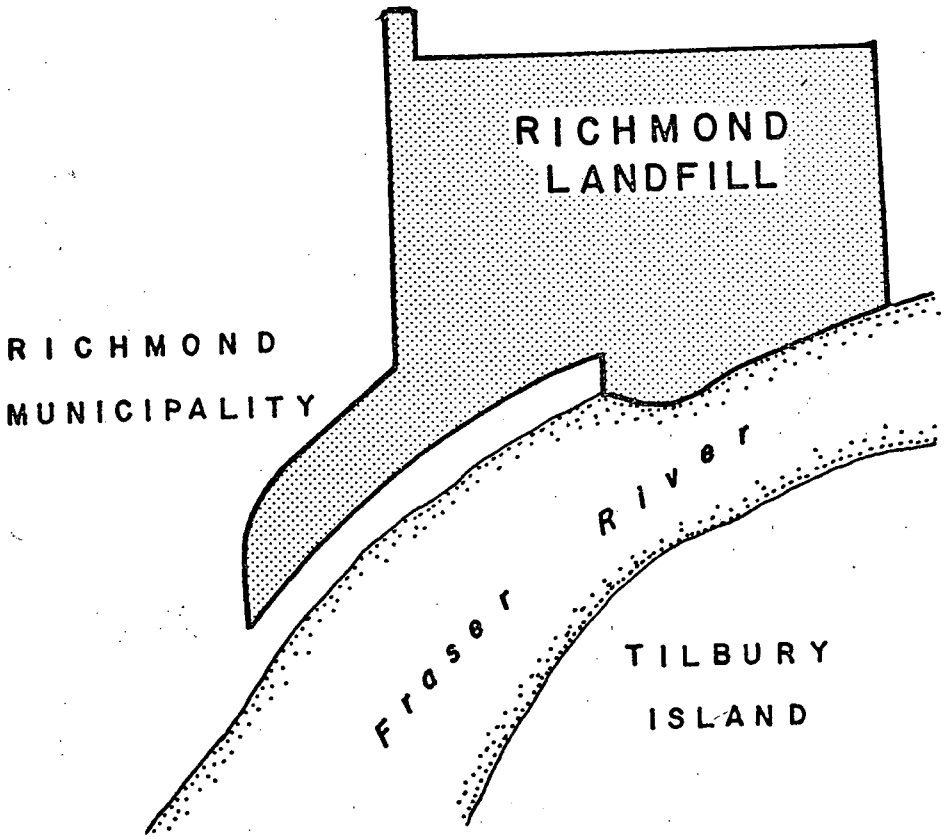
PRELIMINARY REPORT



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1.0 INTRODUCTION

One of the major problems associated with solid waste landfilling is the production of leachates. This problem is particularly acute in areas of high rainfall such as the Greater Vancouver area of British Columbia. The migration of leachate to surface and groundwaters is a serious pollution problem. Determining the magnitude of the pollution problem requires a thorough evaluation of the landfill operation and the hydrogeological setting.

2.0 RICHMOND LANDFILL

2.1 Site

The Richmond Landfill site (Figure 2.1) located in the Municipality of Richmond and owned by the Fraser River Harbour Commission, is a proposed development site for an industrial park and port facility. The site, shown in Figure 2.2, was acquired from the Municipality of Richmond who operated it as a municipal dump. The site, presently operated by a private contractor, is the point of discharge for the Municipality of Richmond municipal waste, as well as a large proportion of contract disposal waste for the Greater Vancouver area. The active site presently involves 365 acres. However, two additional 300 acre parcels of land recently acquired separately by the FRHC and the

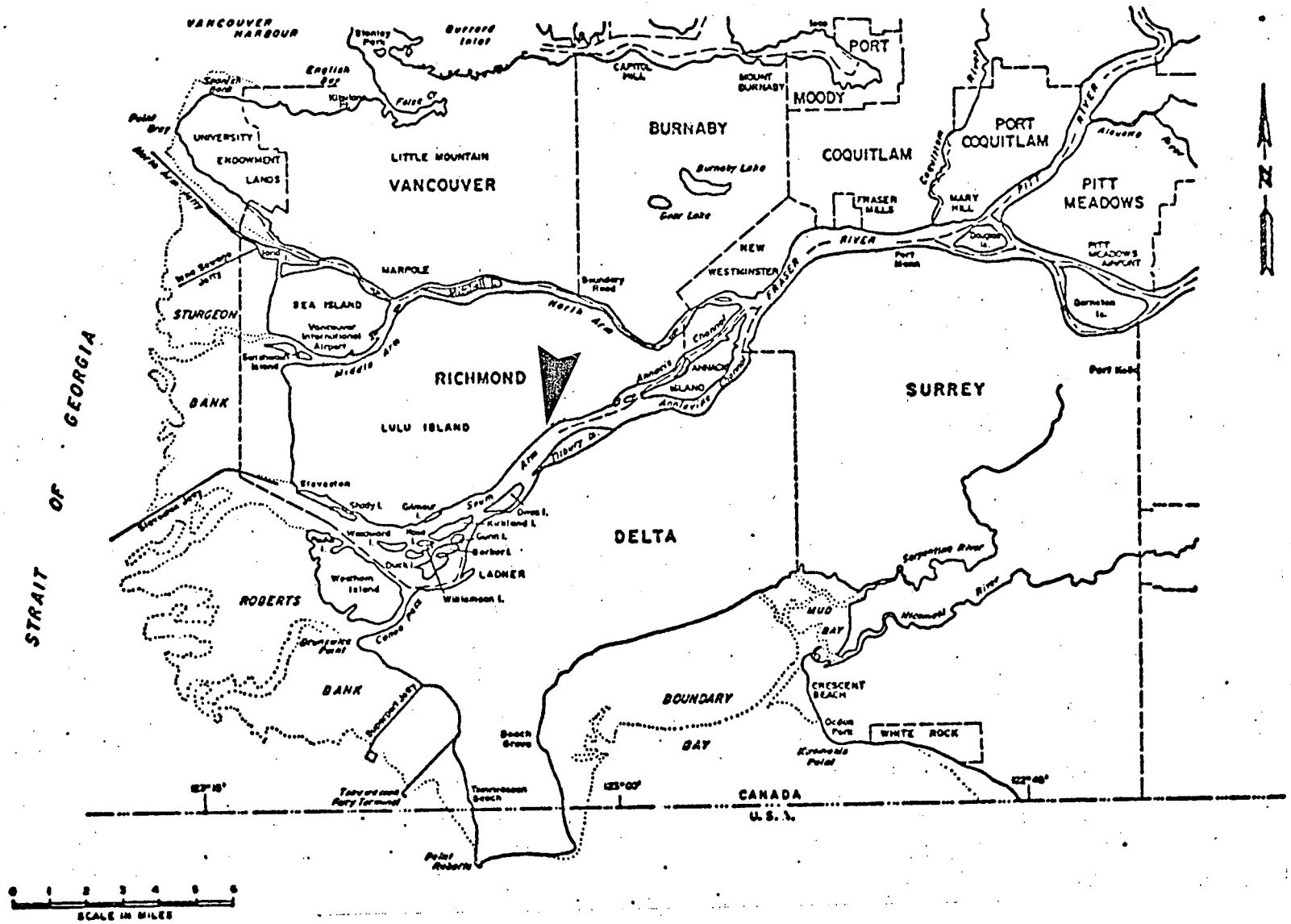


Figure 2.1 Site Location Map

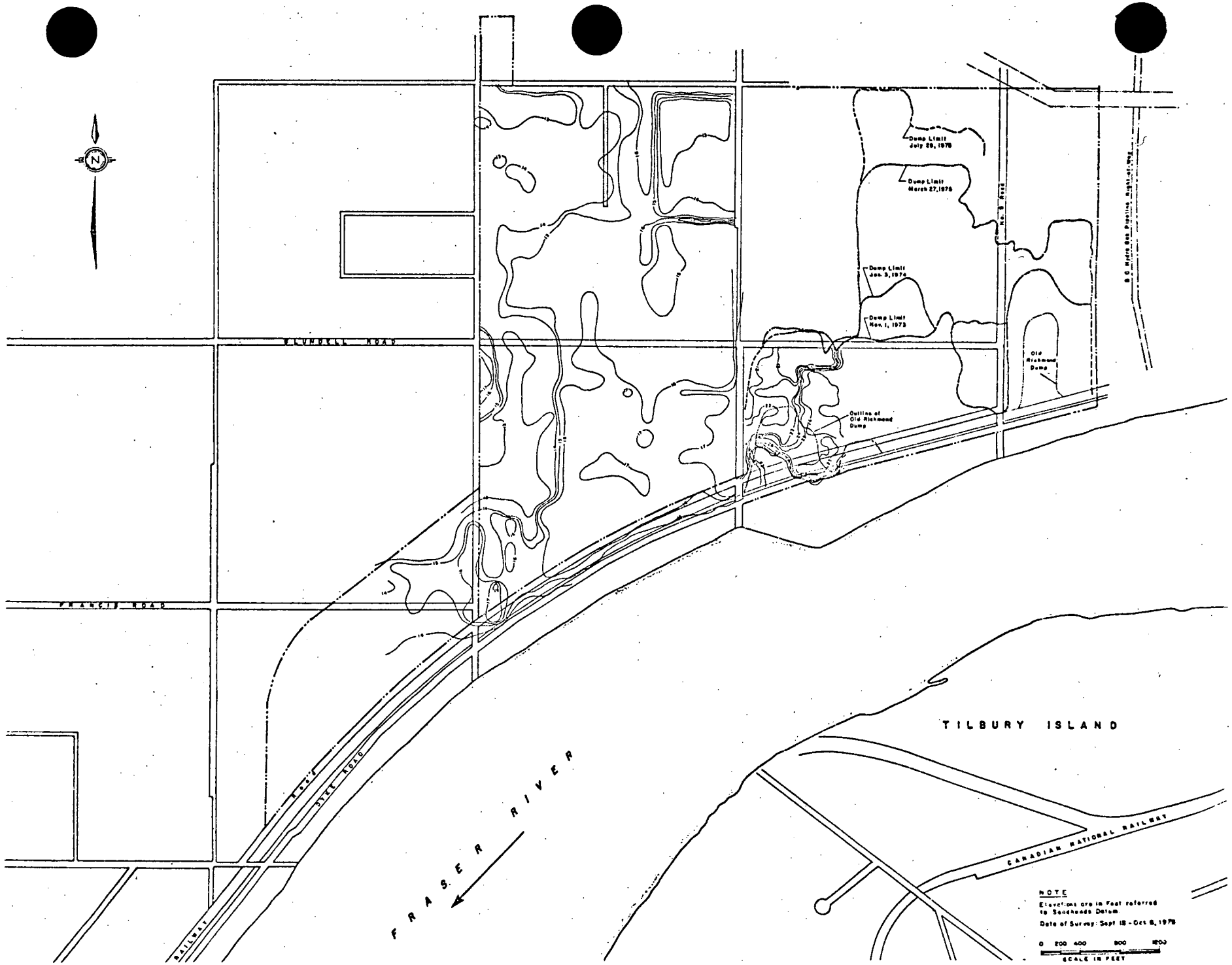


Figure 2.2 Richmond Landfill Site

landfill operators, appears destined for landfilling as well. The resultant site, shown in Figure 2.3, would be the second largest landfill site in British Columbia, second only to the City of Vancouver landfill site.

2.2 Study Impetus

The landfill is located on a peat bog with a high water table. As a result, landfill leachate discharges to surface drainage ditches which, in turn, discharge to the Fraser River. The Federal Activities Pollution Abatement Group became involved as a result of resident complaints of leachate in local agricultural ditches. The landfill is not not regulated by the Provincial Pollution Control Branch.

2.3 Site Operation

The landfill operation is generally controlled by specifications laid down by the Department of Public Works which have been determined by future development loading requirements. Basically, the operation involves construction of putrescible cells on a demolition wood waste mattress. The cover material used is sand, dredged and stockpiled twice per year. Figure 2.3 shows the site development plan. The

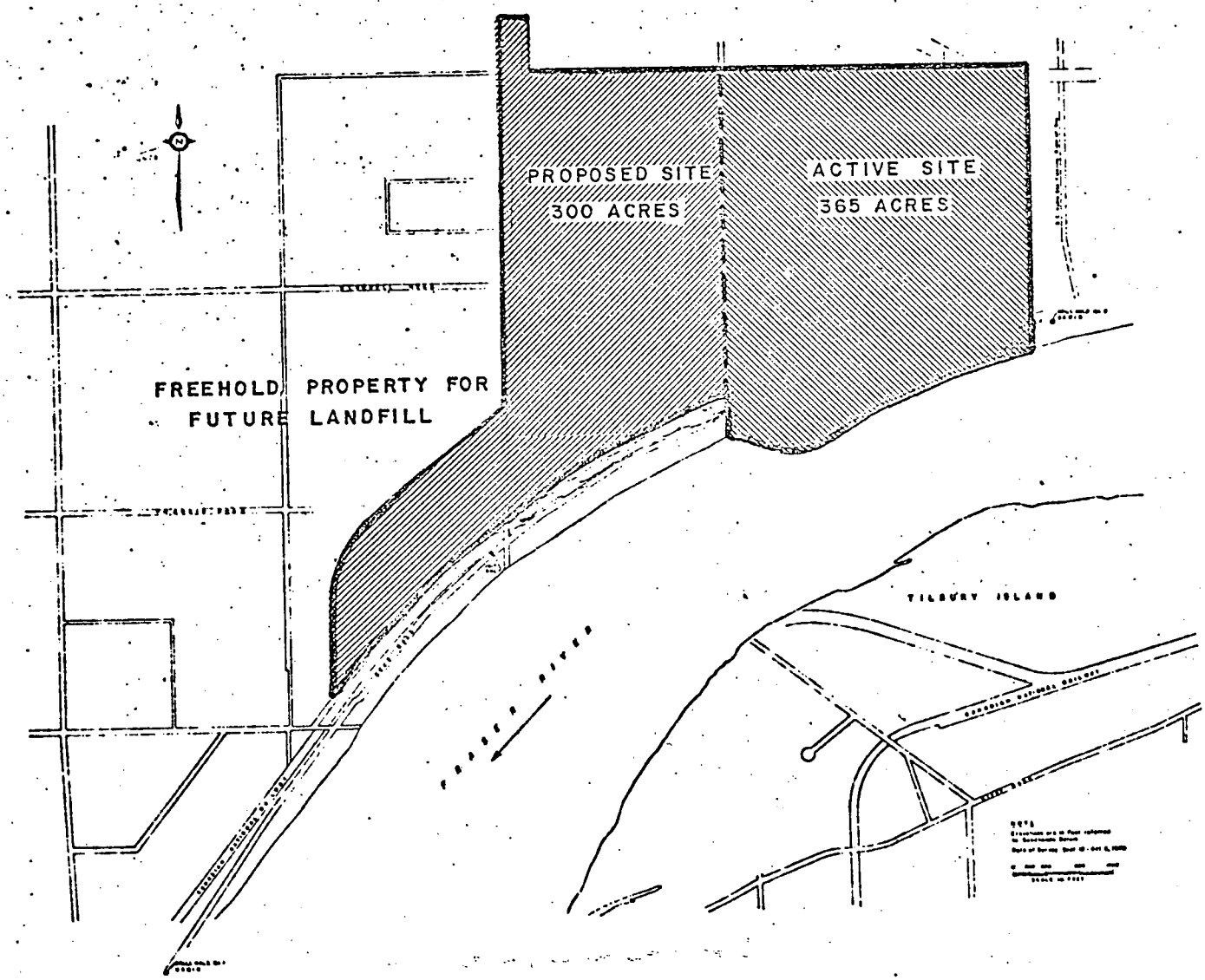


Figure 2.3 Active and Proposed Landfill Area

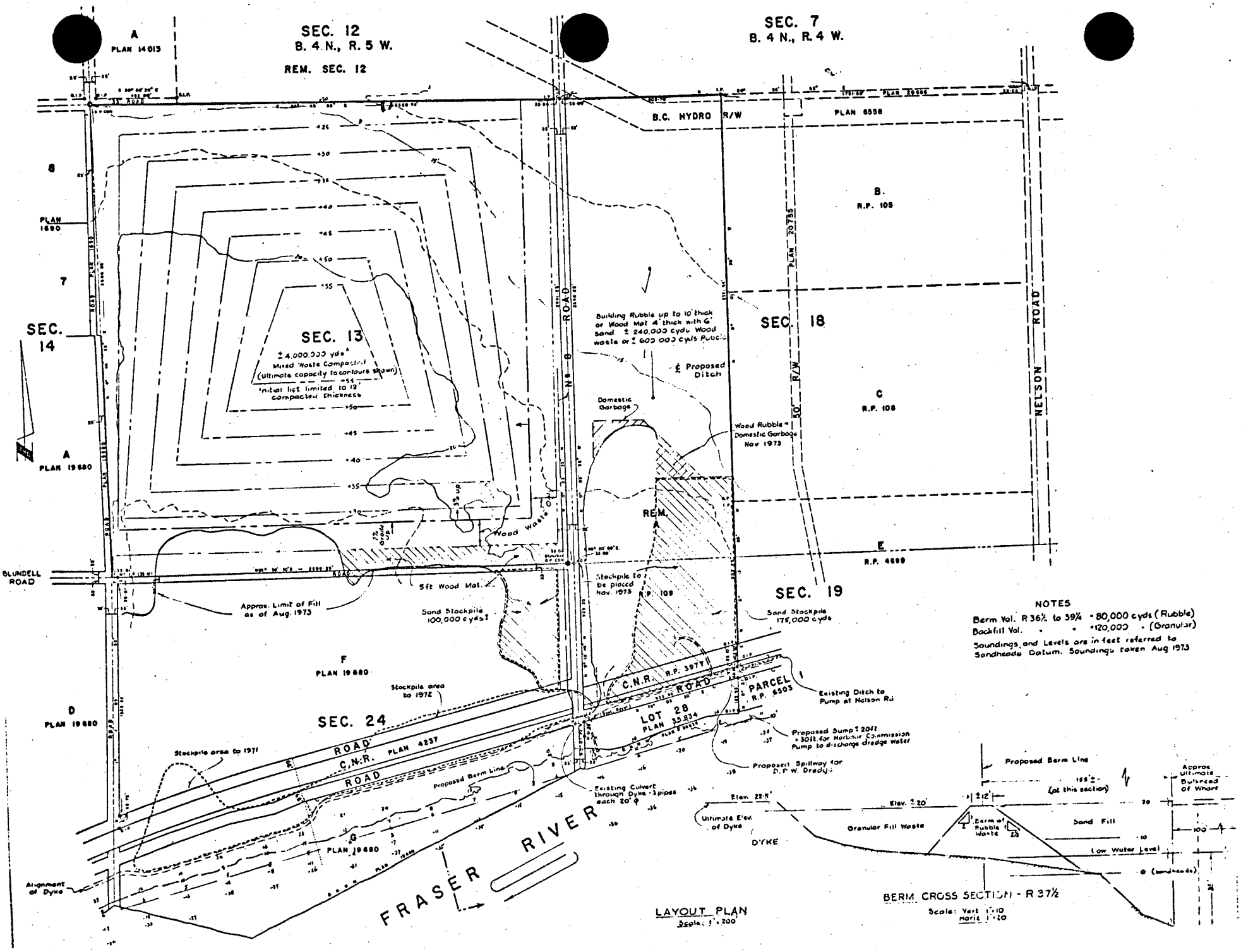


Figure 2.3 Site Development Plan

rate of site filling is approaching 50 acres per year. Drainage ditches have been cut in the site to direct all drainage directly to the Fraser River. However, due to peat failure of the ditch walls, dredging, or high river level, the ditches are frequently blocked off, resulting in a reversal of ditch flow to adjacent agricultural ditches.

3.0 STUDY OBJECTIVE

The main goal of the Richmond Landfill assessment study is to identify and quantify the environmental impacts resulting from the landfill operation. Although the surface flow of toxic leachates entering the Fraser River has been previously addressed by monitoring studies, no detailed evaluation had been carried out on any of the several landfills located in a similar geological setting as to the sub-surface movement of leachates and the potential for contamination of the underlying aquifer. Consequently, it was decided to carry out a comprehensive evaluation involving investigation of the sub-surface geology by collating past bore hole information and the installation of piezometer and monitoring wells for hydrogeological and sub-surface water chemistry investigations. Additional and confirming geological information was obtained in conjunction with the well installations. The general study format is attached as Appendix 1.

4.0 STUDY IMPLICATIONS

As mentioned, the study is intended to identify environmental impacts resulting from the existing landfill operation. To this end, it is anticipated that recommendations would be formulated with respect to the materials disposed, methods of handling, drainage alterations and possible applications of leachate collection and treatment systems.

It is also anticipated that the study findings have implications on the future direction to be taken in the development of the additional land acquisitions. In this regard, the study findings will provide useful input to the environmental screening process of this land acquisition.

As well, the Richmond Landfill site is located in the flood plain of the Fraser River with a geologic setting common to many other major landfill sites in the Lower Fraser Valley. Consequently, the study will have a broader implication due to the anticipated application of the study results to the investigation of these other sites.

5.0 STUDY TEAM

Due to the many facetted aspects required of any landfill study and in order to further develop an in-house capability

in evaluating landfills, it was decided that the study shoud be carried out in-house, utilizing the specialized services of other agency personnel and consultant specialists.

The team directly involved in the study includes two Federal Activities Pollution Abatement Group engineers, a site technician and a UBC professor, both hired on personal services contracts, and a hydrogeologist from the Hydrology Research Division of Inland Waters Directorate.

The on-site bore hole and well drilling work was carried out over a four month period by the Ministry of Transport soils lab personnel at no cost to the Environmental Protection Service.

6.0 STUDY APPROACH

In order to develop a predictive model of the sub-surface leachate migration, it is necessary to define the complete hydrogeologic setting and monitor the sub-surface water chemistry.

6.1 Geologic Setting

From previous geologic investigations on the Richmond Landfill site, there was considerable bore hole data available. This data was plotted to show the site stratigraphy. The preliminary geologic

setting developed indicated the site was situated on peat and overlying deltaic deposits of clays, silts and sands. The most interesting aspect of the geologic setting was its undulating stratigraphic units. Peats ranged in thickness between 5 and 20 feet, and the clay layer between the peats and silt-sands ranged from 2 to 20 feet.

Previous predictive models of leachate movement had indicated a continuous stratigraphy with surface ditch interception of almost the total leachate flow. However, the geologic setting,determined from the preliminary evaluation of the geologic data, indicated that there were significant highs and lows. This, coupled with the known compressibility of peat resulting from the landfill loading, indicated that interception of all the leachate by surface ditches may not occur. Hence, a thorough understanding of the hydrogeology was required.

6.2 Hydrogeological Investigations

Based on the known geology, a drilling program was initiated to provide further bore hole information, and install monitoring wells for static/piezometric groundwater level measurement and water chemistry sampling.

The wells were located so as to provide hydrological and water chemistry monitoring at the base of the garbage, in the peats and below the clays. The location layout is shown in Figure 6.1. A sub-clay control well was also located approximately .5 miles to the east of the landfill site. Figure 6.2 shows the geologic profile of the site. The well construction, consisting of 3 inch dia. pvc pipe (to allow for level recorder float) and a 2 foot x 2 inch dia. well screen, slotted and wrapped with fibreglass tape is shown in Figure 6.3, and the well installation procedure in Figure 6.4. To date 22 wells, including the control well, have been installed.

7.0 PRELIMINARY FINDINGS

7.1 Hydrogeology

From the limited evaluation of the preliminary static level measurements to date, the following tentative conclusions have been drawn:

1. There are three independent aquifers underlying the site:
   a) a raised or mounded localized water table, resulting from the garbage lifts; this garbage water table responds directly to rainfall with a 5 hour lag period;

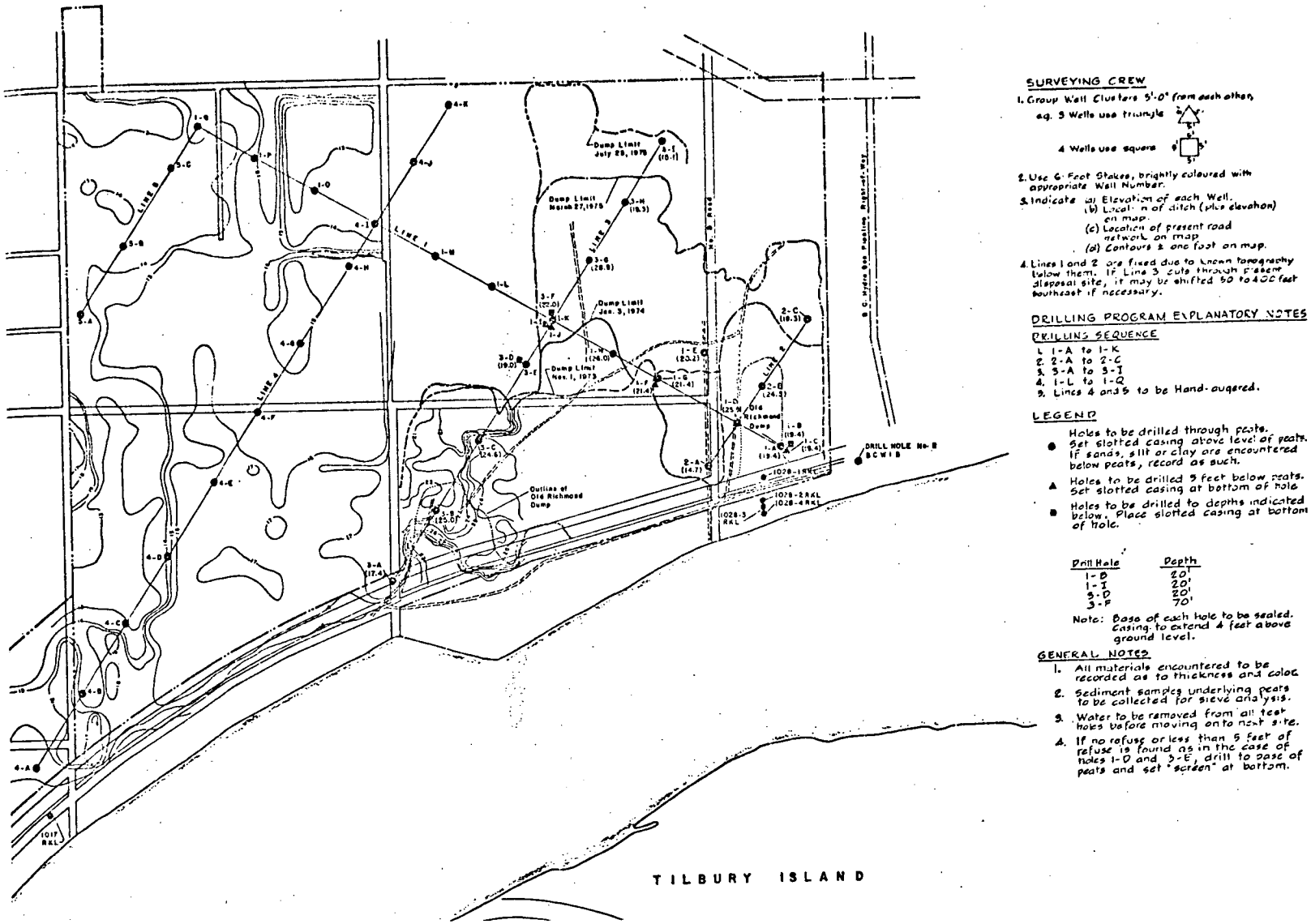


Figure 6.1 Well Location Plan

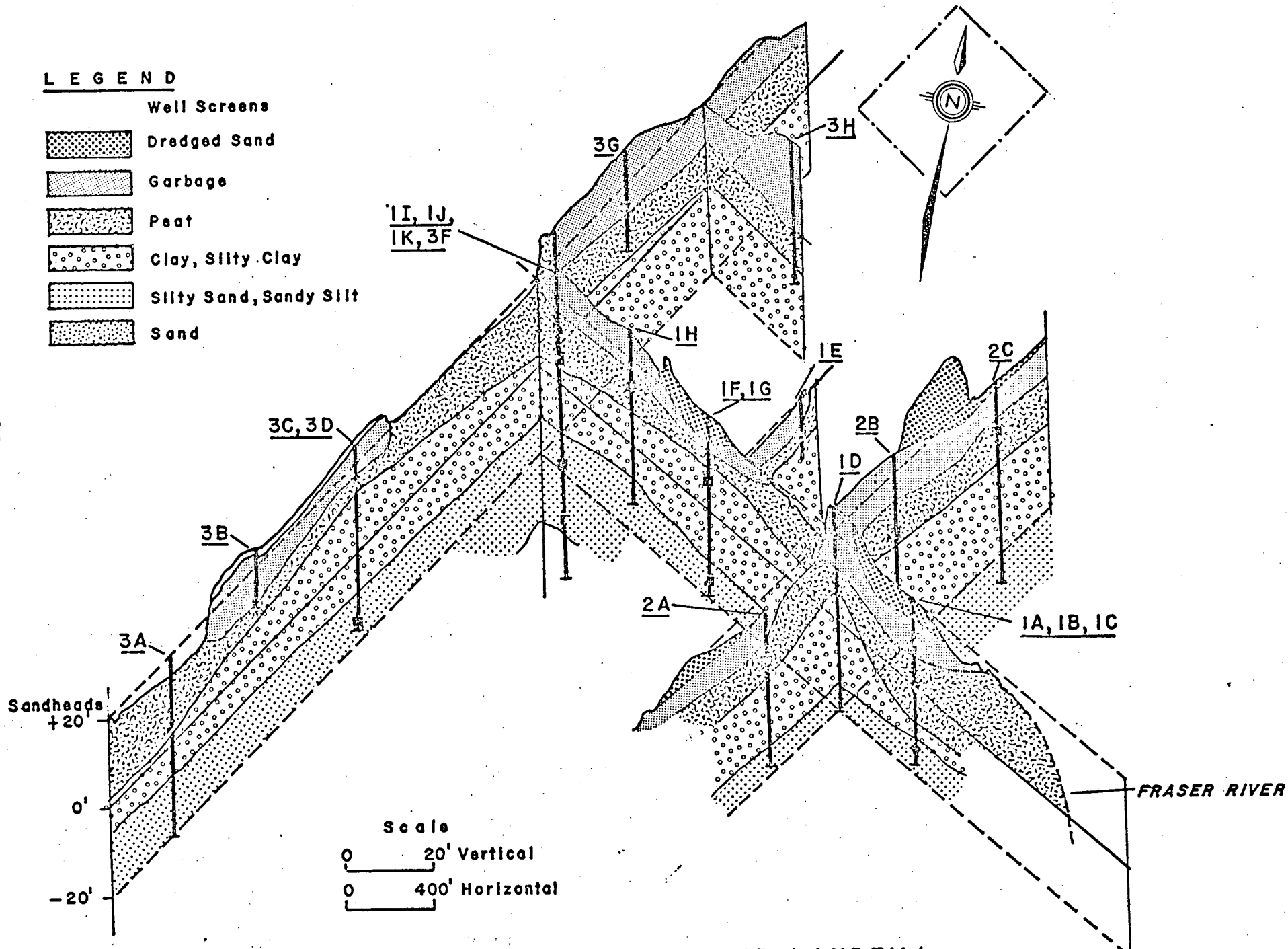


FIGURE 6.2 GEOLOGICAL PROFILE - RICHMOND LANDFILL

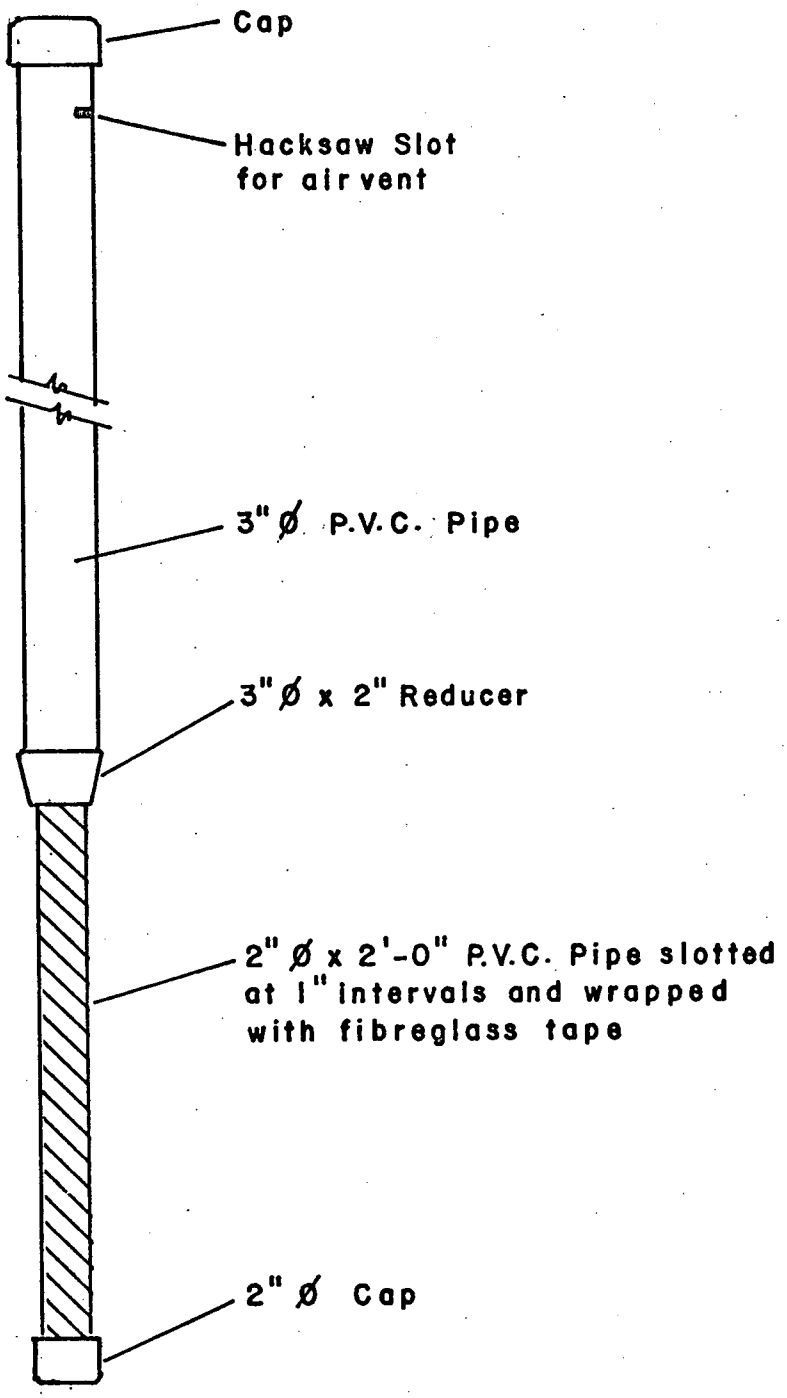
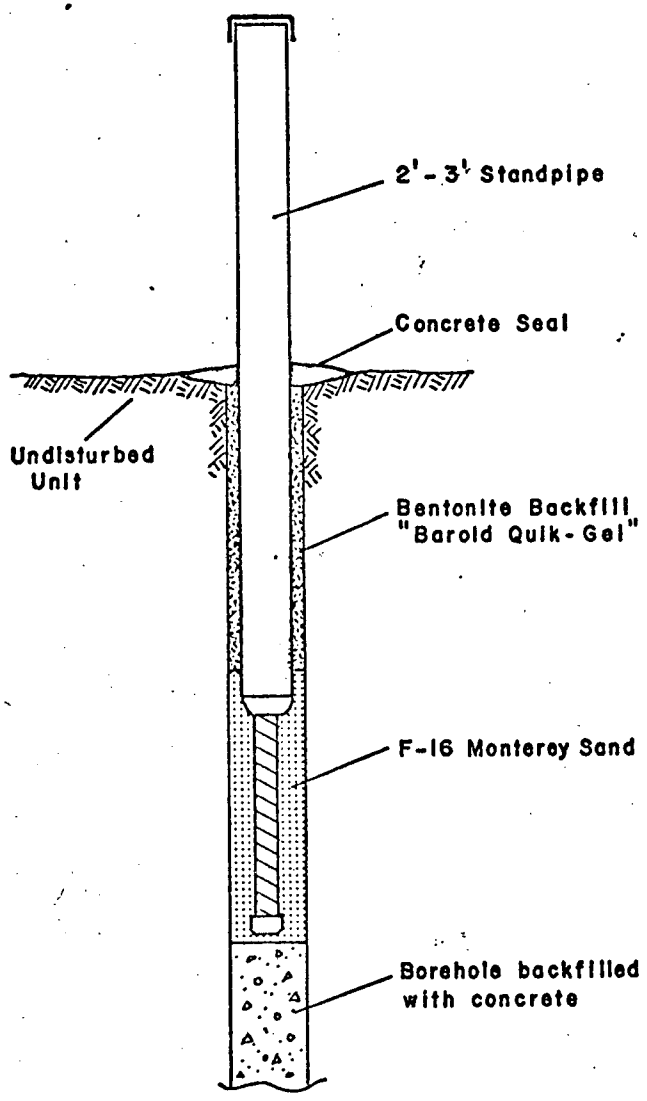


Figure 6.3

PIEZOMETER CONSTRUCTION



PIEZOMETER INSTALLATION

Well Placement:

1. The well screen unit is attached to the 3" dia. well casing and rinsed with clean water.
2. A beaker of F-16 Monterey sand is put down the drillers casing to cushion the foot of the bore hole.
3. The well casing is lowered into the drillers casing forced down with clean water added to aid sinking and the well case capped.
4. F-16 Monterey sand is poured down the casing annulus to provide a sand pack around the well screen.
5. The drillers casing is pulled and bentonite mud (Baroid Quik-Gel) is added.
6. Depending on the well location, pre-mix cement is added at the ground surface around the stand-pipe.

Figure 6.4 Well Installation Procedure

b) a confined aquifer in the underlying peats due to compression of the peat surface by the garbage lift;

c) underlying aquifer in the deltaic materials which responds to fluctuations in the Fraser River.

2. The clay unit appears to be continuous throughout the site. Therefore, it is unlikely that there could be an interconnection between the upper two and lower aquifers.

3. The lower aquifer flow gradient is northwest towards the north arm of the Fraser River and parallel to the mainstem.

7.2 Water Chemistry

Two sets of samples have been collected from the monitoring wells for water chemistry analysis following a two month development period. The generalized findings are as follows:

- the underlying aquifer water appears uncontaminated (to be confirmed by control well which is yet to be sampled);

- the peat aquifer water due to the compression caused impermeable interface typical of peat water;

- the garbage aquifer, as expected, is contaminated.

The above conclusions are only preliminary as the static levels and water chemistry monitoring has just been initiated. The complete monitoring of the entire site for an extended period involving varying precipitation and Fraser River level, is hoped to provide a complete hydrogeologic picture as it relates to the sub-surface leachate movement.

8.0 FURTHER STUDY REQUIREMENTS

8.1 Surface Hydrology

This aspect of the study is extremely complex to quantify due to the dynamic nature of the controlling factors,i.e. daily and seasonal fluctuation in Fraser River level, constant drainage ditch blockage, sand cover dredging operation. Nevertheless, the surface hydrology is considered of extreme importance in the overall development of the desired predictive model. Consequently, it is hoped to proceed with developing methods by which to quantify this aspect.

8.2 Site Operation

The site operation in terms of the amount, type and location of waste disposal must be precisely quantified.

8.3 Surface Discharge of Leachates

Need for:

- drainage modification
- collection
- treatment

9.0 SUMMARY

The Richmond Landfill Study involves a complex set of interacting variables. The basic hardware for the necessary hydrogeological studies is now in place. The hydrogeological/water chemistry data, together with surface hydrology and site operation information will enable development of a predictive model on leachate movement in peat bog landfills.

This information will provide the input for assessment of any present or future operational requirements necessary to minimize the impact of the Richmond Landfill on the receiving environment. As well, it is anticipated that the study results will be useful in developing an overall understanding of landfilling peat bogs.

Appendix 1

RICHMOND LANDFILL STUDY FORMAT

A. BACKGROUND INFORMATION

1. History - general history of site when operated by municipality of Richmond and period from take over to present under Richmond Landfill operation.

2. Site Specifications - requirements as laid down by DPW and the Fraser River Harbour Commission for cell composition, final grade, elevations, etc.

3. Terms of agreement - details of agreement under which Richmond Landfill Ltd. operate site, i.e. excluded materials, etc.

4. Management - details of contractual arrangement between Richmond Landfill Ltd. and dischargers, records of vehicles entering site, etc.

B. FILL INFORMATION

1. Quantities and Qualities - estimate of volume and proportion of materials discharged.

2. Depth of daily cells.

3. Depth of cover.

4. Cover materials.

5. Special Disposal Procedures, i.e. waste oils and solvent disposal, international waste, tires, dead animals

6. General day-to-day operation.

C. DISPOSAL ENVIRONMENT

1. Climatic data.

2. Soils information (test hole logs).

3. Site hydrology and hydrogeology.

D. INTERACTION OF 'B' and 'C'

1. Leachate outlets and flow rate.

2. Effect of leachate on river, i.e. background water, analyses, sediment sampling.

3. Ion exchange capacity of leachate influenced and non-influenced soil.

E. ALTERNATIVES AND FUTURE CONSIDERATIONS

1. Continuing monitoring program.

2. Leachate treatment - attenuation by peat filtration, aeration, etc.

3. Recommendation along the lines of management procedures and materials exclusion.

4. Consideration of gas venting requirements if impermeable layer planned for completed site.