ITEM	11
MANAGER'S REPORT NO.	40
COUNCIL MEETING	

RE: LANDFILL GAS MIGRATION MITIGATION - STRIDE AVENUE

MUNICIPAL MANAGER'S RECOMMENDATION:

1. THAT the recommendations of the Director Engineering be adopted.

* * * * * * *

TO: MUNICIPAL MANAGER 1988 MAY 24

FROM: DIRECTOR ENGINEERING

SUBJECT: LANDFILL GAS MIGRATION MITIGATION - STRIDE AVENUE

RECOMMENDATIONS:

1. **THAT** the Corporation install a permanent barrier against methane gas migration across the entire north boundary of the Stride Landfill, as more particularly discussed in this report and as shown on the plan included with Attachment #5 of this report.

2. **THAT** the engineering consulting firm of E. H. Hanson and Associates Limited be retained under an engineering agreement to provide engineering design, project managemement, field supervision, field testing, construction, and monitoring of a methane control system at the Stride Landfill (Edmonds Town Centre South), all as more fully described in this report, using the hourly rates submitted and an estimated total cost of $117,000.

S U M M A R Y

The Corporation has a responsibility to provide an acceptable landfill gas migration mitigation system at the Stride Landfill site. Impending adjacent land development proposals make it imperative that a system be installed to protect the future citizens in the area as well as to protect the Corporation.

R E P O R T

1. INTRODUCTION

The Edmonds Town Centre South Plan (Attachment #1) was adopted by Council on 1987 July 13. This Plan, which provides for residential development in the vicinity of the Stride Landfill site, noted that a study of landfill gas migration in the area had been completed and that parts of Sites 10, 13, 14, 15 and 16 were affected. It was also noted that the installation of methane gas migration barriers adjacent to the old landfill site would

(Cont'd.)

be necessary, and should be undertaken by the Municipality in the early phases of development in the area.

Rezoning and subdivision applications for residential development in the area have now been in process for some time. Four rezonings and residential developments have been proposed for specific sites, all located in the area north of the Stride Avenue/Mission Avenue Parkway intersection. Of these proposals, only one (Rezoning Reference #14/88) includes a small area of land identified as affected by landfill gas migration. One of the prerequisites established for the finalization of the subject rezoning is confirmation that any potential problem in this regard has been resolved, and that the site can be developed with no hazard.

The purpose of the present report is to provide further information regarding the proposed installation of landfill gas migration mitigation measures and to recommend that this project now be undertaken.

2. NATURE OF LANDFILL GAS

Landfill-generated methane has become a serious environmental and public safety concern. In recent decades, sanitary landfills became the common replacement for the older technique of open-pit burning of garbage. The intent was to reduce emissions and accessibility to vermin and disease-carrying insects. This benefit was achieved but not without some penalty; one drawback is the odorous gas produced through biological digestion of the buried waste; refuse which is organic and subject to decomposition from anaerobic splitting of proteins by bacteria and fungi is said to be putrescible. The primary components of the gas are carbon dioxide (40%), methane (55%), with the remaining 5% made up of air and odorous components. When landfills were selected, they were usually located ample distances away from residential areas; however, over the life of landfills, the separation distance is nearly always diminished through continuing encroachment of urban development.

Methane is explosive in a range from 5% to 15% concentration in air. Since the concentration at the Stride Landfill is usually above 40%, the gas must pass through the explosive range as it migrates to a surface. Explosions and fires have occurred at landfills; an explosion occurred at the Stride Landfill during construction of a new storm sewer to serve the ALRT Maintenance Center. Until recently, intensive land development has not been a complication in the Stride Avenue area.

3. STRIDE AVENUE LANDFILL OPERATION AND GAS PRODUCTION

The Stride Avenue landfill is an older refuse disposal site in comparison to many other Lower Mainland landfills. It is believed to have been used as disposal grounds since approximately 1910 but it was not until 1964 that all of Burnaby's refuse was directed to the landfill site. Operations as a municipal landfill ceased in 1970 and, in the past 18 years, it has been used primarily for disposal of non-putrescible waste such as earth excavation and catch basin and ditch cleanings. The other major function it served well for the past 18 years was in providing a place for Burnaby residents to dispose of their garden waste and tree prunings.

(Cont'd.)

Despite the age of the refuse in the landfill, considerable amounts of methane are produced below the cover of earth fill. To complicate the hazard, landfill gas generated at Stride Avenue is uncharacteristically odorless. Normally, landfill gas contains sufficient sulphurous compounds to provide some measure of advance warning of its presence before reaching explosive levels; it is thought that the degradable components which produce sulphides are expended first or leached out by percolating water and thereafter relatively odorless gas results.

During 1985 and 1986, landfill gas was extracted and used as a fuel to support high temperature burning of garden wastes in an experimental incinerator. Over 8-hour periods of continuous burning, gas quality was maintained above the 50 percent level with extraction rates of approximately 500 cubic meters per hour. The maintenance of a 50 percent level of gas quality output is exceptional.

4. SITE CHARACTERISTICS

Edmonds Town Centre South is bounded by the Byrne Creek ravine, the Sky Train line and Marine Drive. Drawing D-1 (Attachment # 2) shows an overall plan of the area together with the proposed development changes.

Topographically, the area is moderately rolling in the north but steeply graded in the south especially nearing the ravine and Marine Way. The Stride Landfill, which is located on the eastern edge of the area, was formed by the gradual filling of a ravine during the preceding eight decades. In some instances, the indigenous gravels were quarried prior to refilling the old ravine. Accurate records of what materials were placed and when are not available but some information was available regarding the sequence of filling based on the recollections of key personnel. It is safe to say, however, that the Landfill area contains up to 25 meters in depth of imported material. Much of this material is putrescible and is therefore in a continuing state of bio-degradation. Typically, this material is considered unstable as a foundation for either roads or structures. The new land use plan recognizes the limitations of the landfill site and it has accordingly been designated as open space. It will be necessary in the future, however, to construct the Byrne/10th Avenue major road connector across the middle of the landfill area. Based on historical data in combination with drill hole logs, ISOPAC contours have been developed to illustrate the depth of fill material throughout the site. This ISOPAC is shown on drawing D-2 (Attachment # 3).

The surficial geology of the area consists of alluvial sands, gravels and silts; some hard till has been identified. Perched water tables and springs are apparent in the area.

In terms of migration, the porous sands and gravels are very susceptible to methane movement. Methane movement has been detected in other locations along gravel seams which can create problems at remote points from the landfill; similarly, however, the porous media enhances the operation of active control systems, which suggest that a gas extraction system should have a wide circle of influence to withdraw gas at the source as well as to counteract underground methane movements.

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5. METHANE GAS HAZARDS AND CONTROL AT STRIDE LANDFILL

Landfill gas control at Stride Landfill has been the topic of reports by E. H. Hanson and Associates Limited in 1981 and an update conducted in 1984. E. H. Hanson and Associates Limited are a firm of highly-skilled consulting engineers, specializing in solid waste management, biogas utilization, and other forms of innovative engineering. 145

A report, completed in 1987, was instigated in light of new land development proposals placed before Council in early 1986. The proposal calls for significant re-routing of roads in the area known as Edmonds Town Centre South and the subsequent rezoning of lands to accommodate higher density residential developments. This development plan represents an important departure from historical land usage; more importantly, the new development will bring closer contact between the underground gases and Burnaby residents. The protection of the public from migrating methane and specific control mechanisms to achieve this end is the objective of this Council report.

To carry out the investigative work, the field testing program proceeded in stages. The first stage involved new surface tests and a drilling program to determine whether gas migration limits were stable, advancing, or receding. Once stage one results were analysed, a second stage was undertaken to check the relative feasibility of specific control systems.

In the course of this work, various investigative techniques were implemented, including two separate drilling programs, surface testing with shallow bar probes and controlled gas-extraction testing at permanent wells. This work was carried out over a suitable length of time and over periods of seasonal changes with significant variations in temperatre and barometic pressures which allowed the determination of the extent of the hazard with increased confidence, since it is known that gas migration zones fluctuate with changing climatic conditions.

Determining the degree of hazard associated with methane calls for calculation of reasonable approximations of the amount of methane generated and identification of the migration boundaries and channels.

The amounts of refuse-generated methane at the landfill are calculated on the basis of actual rates of extraction during previous utilization programs and from site monitoring and testing. A system of extracting gases for fuel was installed in 1985 for operation of a pit burner for garden waste; eight fuel wells were drilled under this program and gas was extracted over extensive periods of time.

In the latest program undertaken in 1987, 19 holes were drilled, cased and logged throughout their depth. Many of these wells were then subjected to extraction tests to determine rates of production and concentration of methane in the ground. In addition to these new holes, we have used data from numerous other holes drilled in previous investigative programs.

During gas extraction programs, detailed results were recorded on the concentrations of methane and quantity of gases withdrawn from the ground. The results of these tests are included in the full report.

Drawing F-1 (Attachment # 4) shows the extent of refuse fill and gas migration limits based on the combined results of all previous testing programs during the past 6 years as well as more recent work done in 1986/1987.

The explosive range of methane (5 to 15% in air) needs to be emphasized. Concentrations at the landfill are usually above 40%, while at the migration limits are at or below 1%. The gas must therefore pass through the explosive range within the migration boundaries.

The migration limits represent the maximum extent of lateral travel that has been detected in any one test. From time to time, specific areas would be free of gas even though that area would be subject to methane hazard at some time. It is prudent to assume that the hazard exists at all times and to take appropriate precautions based on that assumption.

The maximum possible distance of lateral movement of gas through the soil is not fully understood. In real terms it is known that the gas will follow the most porous route and emerge at the first available vent. The total distance that gas will travel is controlled by underground pressures, surface sealing at the landfill and the nature of the porous seam being followed. It is possible for landfill gas to emerge and to create serious unexpected hazards if no controls are implemented. Winter conditions can be especially hazardous during periods of surface freezing. With surfaces sealed as a result of icing, the gas can be forced into the nearest underground structure or can be driven to further limits in its attempt to seek a vent. A full copy of the most recent Hanson report, which contains a description of the work undertaken, the presentation of findings, and recommended mitigation measures is available for perusal in the Director Engineering's Office.

6. INDICATED MITIGATION MEASURES

Initially, building-specific measures were considered for protection against gas migration into buildings and attendant hazards to occupiers. These would have been incorporated into the building design and would have included the installation of gas detection and alarm systems or active systems which would automatically turn on blowers or other protection devices.

Upon further reflection, it was concluded that methane control mechanisms installed in a building could impact on its value merely by acknowledging the possible presence of landfill gas. It was also acknowledged that private systems of this type often do not receive the level of maintenance that is needed to keep them in the condition required to remain effective. Accordingly, it was decided that the best solution would be to provide at-source protection to the development areas by prevention of offsite gas migration. The cost of this protection would be minimal in comparison to the value of the new developments being created in the area. In any event, the Corporation has really no choice but to acknowledge the presence of the methane gas and to assure that the mitigation of its possible harmful consequences are managed in the best possible way.

Mitigative measures should be designed to provide absolute hazard protection for the development areas. Natural or artificial barriers have a controlling effect on gas migration. Water tables and dense clay layers will

(Cont'd.)

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substantially prevent the passage of gases. It should be noted, however, that an absolute gas barrier is virtually impossible to achieve; even quite dense material will allow detectable seepage in the parts per million range. However, methane concentrations in this range do not constitute health or fire hazard and are merely a part of nature.

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Once barriers are in place and the migration source blocked, the gas will dissipate by diffusion. Changes in atmospheric pressure will assist in the process and will slowly dilute concentrations of methane as air is forced in and out of porous soils. If the process is left entirely to natural forces, we expect the dilution to non-explosive levels to occur within about three months. Traces of methane will probably remain in the parts per million range for at least a year. Once methane levels drop to 1%, construction can proceed without restriction.

Some permanent offsite wells could be used to hasten the natural process by either forcing air into lower strata or extracting from the migration zone. These wells would provide advance data on the effectiveness of the barrier; if assistance of a vacuum extraction system is required, it should be evident within the first month after construction. Once construction is completed, regular monitoring should be done to test the effectiveness of the barrier. If after several weeks of testing it can be shown to be effective, the frequency of tests can be adjusted and eventually terminated. Specific courses of action should be self-evident after each test period.

7. POSSIBLE GAS UTILIZATION

The force which motivates offsite gas migration is methane production created from bio-degrading components of the fill. Since most of the landfill surface is sealed with several feet of compacted earth the produced gas is seeking an offsite vent. Reducing the pressures at the landfill would help control offsite migration; to that end any utilization of the gas should be seen as a benefit to the surrounding area. The amount of energy available may not be sufficient to entice an offsite user to extract the gas but it may be possible to combine utilization of gas with some other possible use on-site or on a nearby site.

Some alternatives have been examined with regard to waste disposal at the site. It is not reasonable, however, to expect that burning even in an enclosed burner, could continue once residential developments begin to close in on the site. Therefore, it is pertinent that some other gas-using alternatives should be considered that would possibly be compatible within the area, on a long-term basis. This subject will be given further consideration.

8. NEED FOR CONSULTING SERVICES

E. H. Hanson and Associates Limited have provided consulting engineering services for the Corporation specifically regarding landfill gas control at the Stride Landfill. Through drilling tests and methane monitoring, the Company has been able to plot the configuration of the methane migration and has been able to develop a conceptual design of a system that would provide at-source protection to the Edmonds Town Centre South development area by prevention of offsite gas migration.

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The Company is foremost in the field of Biogas detection, measurement, control, extraction, and use. In addition to the work at Stride Landfill, the Company has provided its services to many other landfill owners who faced the same situation Burnaby faces at Stride in terms of protection of persons and property, avoidance of liability, and in some cases the extraction and sale/use of the gas in off-site locations. In the latter respect, the Company has developed a very successful program of gas extraction from a landfill for the District of Matsqui with the gas being utilized to provide a complete heating system for an agroplex building. On another project, the Company designed and built a very successful gas extraction system for the Richmond Landfill, with the gas being transported by pipe to a major cement manufacturer's plant located some two miles away from the landfill where the gas contributes a significant proportion of the plant's total energy requirements.

The company is also well-experienced in providing "hands - on" installation services which allows them to do a part of the critical installation work while carrying out professional supervision services. This aspect of the Company's operation is cost-effective for the client as well as assuring a better installed system.

The Company is considered by the Director Engineering to be innovative and unique in its field and he has no hesitation in recommending that the Company be retained to provide its services to the Corporation for this very critical project. Particularly in light of the fact that the work is highly specialized and sensitive in nature, it is essential that the final design and installation segment of the work be handled by the same firm that performed all preliminary work.

It is also essential that the same firm continue to monitor and interpret new data on gas migration in its relationship to the same data collected in the past in order to maximize the credibility of extrapolations and predictions as to future gas behavior. In other words, a continuum of professional engineering accountability is an indispensable ingredient in work of this nature.

E. H. Hanson and Associates Limited has submitted a proposal dated 1988 April 08 to provide its professional services for this project which forms Attachment # 5 of this report. As is done for all such assignments, the progress is monitored by Engineering Department staff who must be satisfied as to time expended prior to making payment for services rendered.

9. ESTIMATED COSTS AND FUNDING OF PROJECT

The proposal received from E. H. Hanson and Associates Limited includes not only an estimate of the cost of the engineering services which would be provided by the Company but also provides an estimate of actual construction costs (see Attachment # 5).

The estimated total cost of the project, then, is:

Construction (including barrier, gas collector, and relocation of a portion of storm and sanitary sewer)	$505,000
Engineering services, including some direct assembly of components	$117,000
Estimated Total Cost	$622,000

(Cont'd.)

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All work done by contract will follow normal Municipal procedures prescribed for that activity.

Funding in an amount sufficient to meet the total estimated cost is provided for in the 1988 Capital Budget in Land Assembly and Development, Code 60-70-33. The Director Engineering has confirmed this fact with the Director Finance.

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10. CONCLUSIONS

1. Methane gas is produced in large quantities at the Stride Avenue landfill. Previous extraction testing and fuel utilization projects suggest that 4,800 cubic meters per day of methane is produced at the portion east of the 14th Avenue extension and 2,000 cubic meters per day on the westerly portion.

2. Methane has been detected over the entire surface of the landfill as shown in the shaded area of drawing D-1. (Attachment # 2). In all cases, the concentration should be considered potentially hazardous to enclosed structures or to personnel working on excavations.

3. Offsite migration of methane is occurring to some extent at all boundaries. The most significant migration occurs across the northerly boundaries, generally in uphill directions. Detectable migration limits have been noted on Drawing F-1. (Attachment # 4). The porous sands and gravels, typical of the area, are good conduits for migrating gas. Some advancement of the migration limits has occurred since the 1984 testing program.

4. In terms of the proposed zoning areas (see Attachment # 1 and Drawing F-1 Attachment # 4), methane migration encroaches on proposed residential sites areas 10, 13, 14, 15, and 16. Gas migration has encroached onto the Corporation-owned lot on 12th Avenue but has not encroached onto the privately-owned adjacent lots on 12th Avenue.

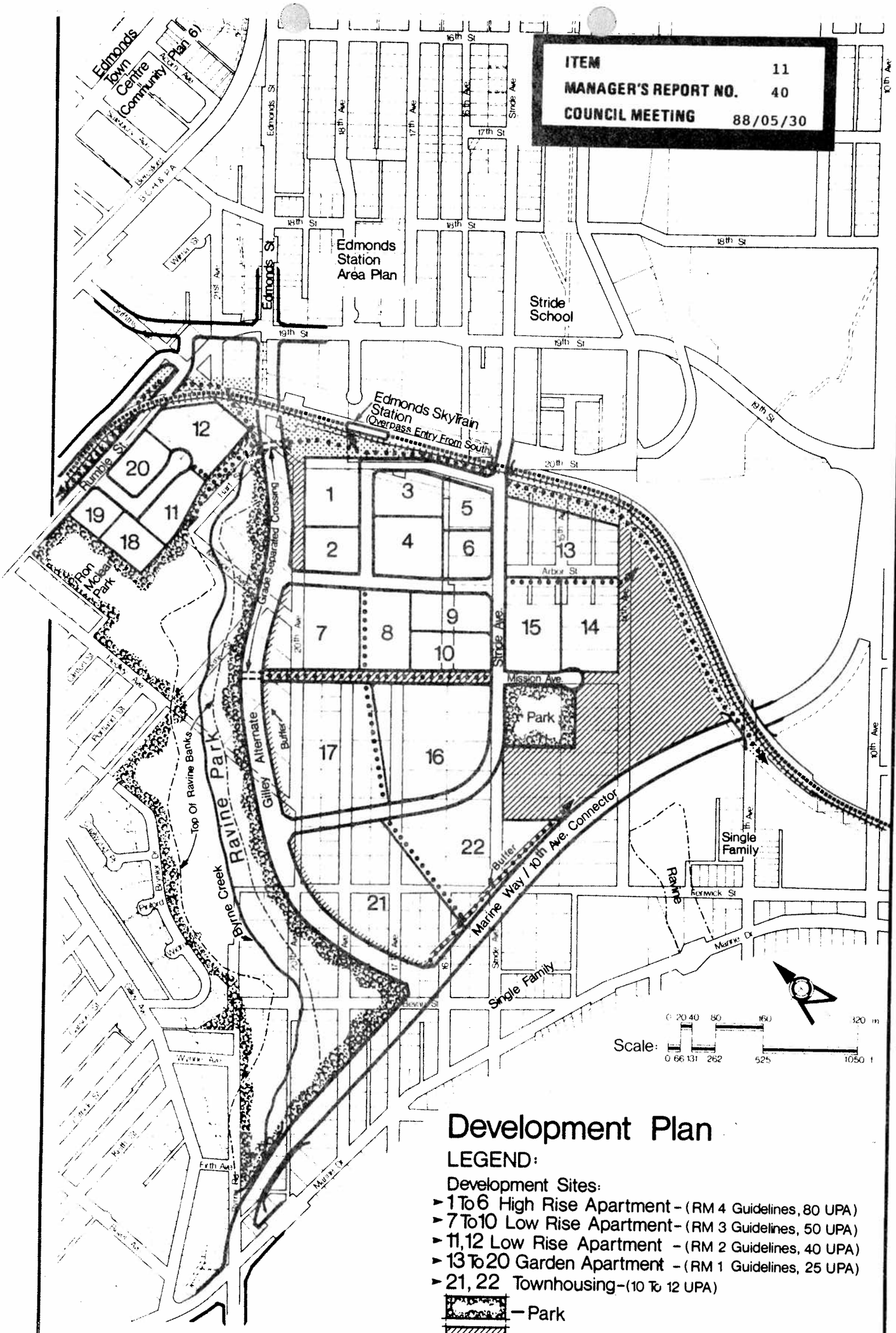
11. RECOMENDATIONS

It is recommended that the Corporation install a permanent barrier against methane gas migration across the entire north boundary of the Stride Landfill, as more particularly discussed in this report and as shown on the plan included with Attachment # 5 of this report.

It is also recommended that E. H. Hanson and Associates Limited be retained under an engineering agreement to provide engineering design, project management, field supervision, field testing, construction, and monitoring of a methane control system at the Stride Landfill (Edmonds Town Centre South), all as more fully described in this report, using the hourly rates submitted and an estimated total cost of $117,000.

DIRECTOR ENGINEERING

EEO:dp
encl.
cc: Municipal Solicitor
Director Planning & Building Inspection
Purchasing Agent
Director Finance
Chief Public Health Inspector



Development Plan

LEGEND:

Development Sites:

- 1 To 6 High Rise Apartment - (RM 4 Guidelines, 80 UPA)
- 7 To 10 Low Rise Apartment - (RM 3 Guidelines, 50 UPA)
- 11, 12 Low Rise Apartment - (RM 2 Guidelines, 40 UPA)
- 13 To 20 Garden Apartment - (RM 1 Guidelines, 25 UPA)
- 21, 22 Townhousing - (10 To 12 UPA)

— Park

— Open Space

— B.C. Parkway

150

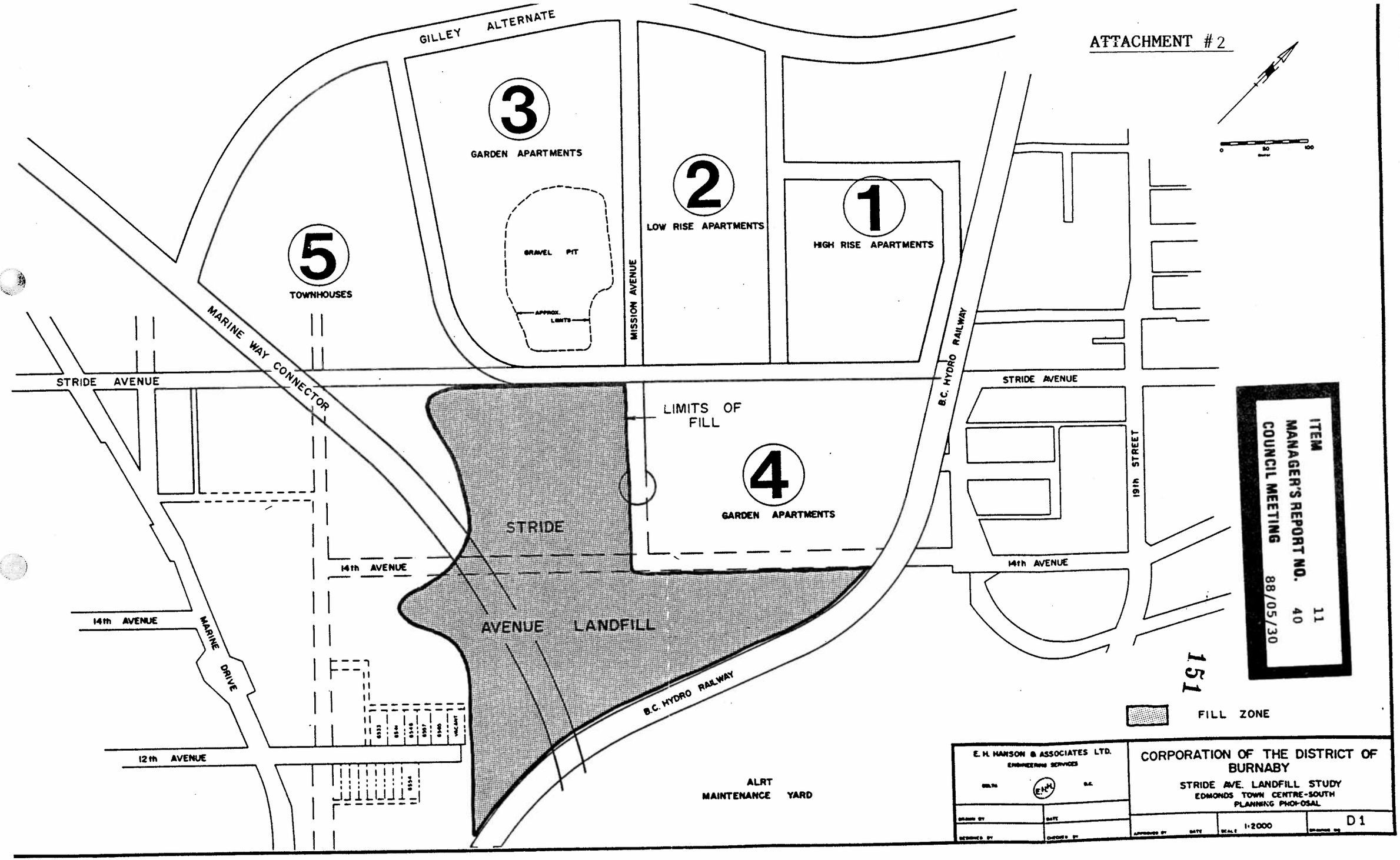
····· — Walkways, Trails

Adopted 1987.July.13

Edmonds Town Centre – South

ATTACHMENT #1

ATTACHMENT #2



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E. H. HANSON & ASSOCIATES LTD.
ENGINEERING SERVICES

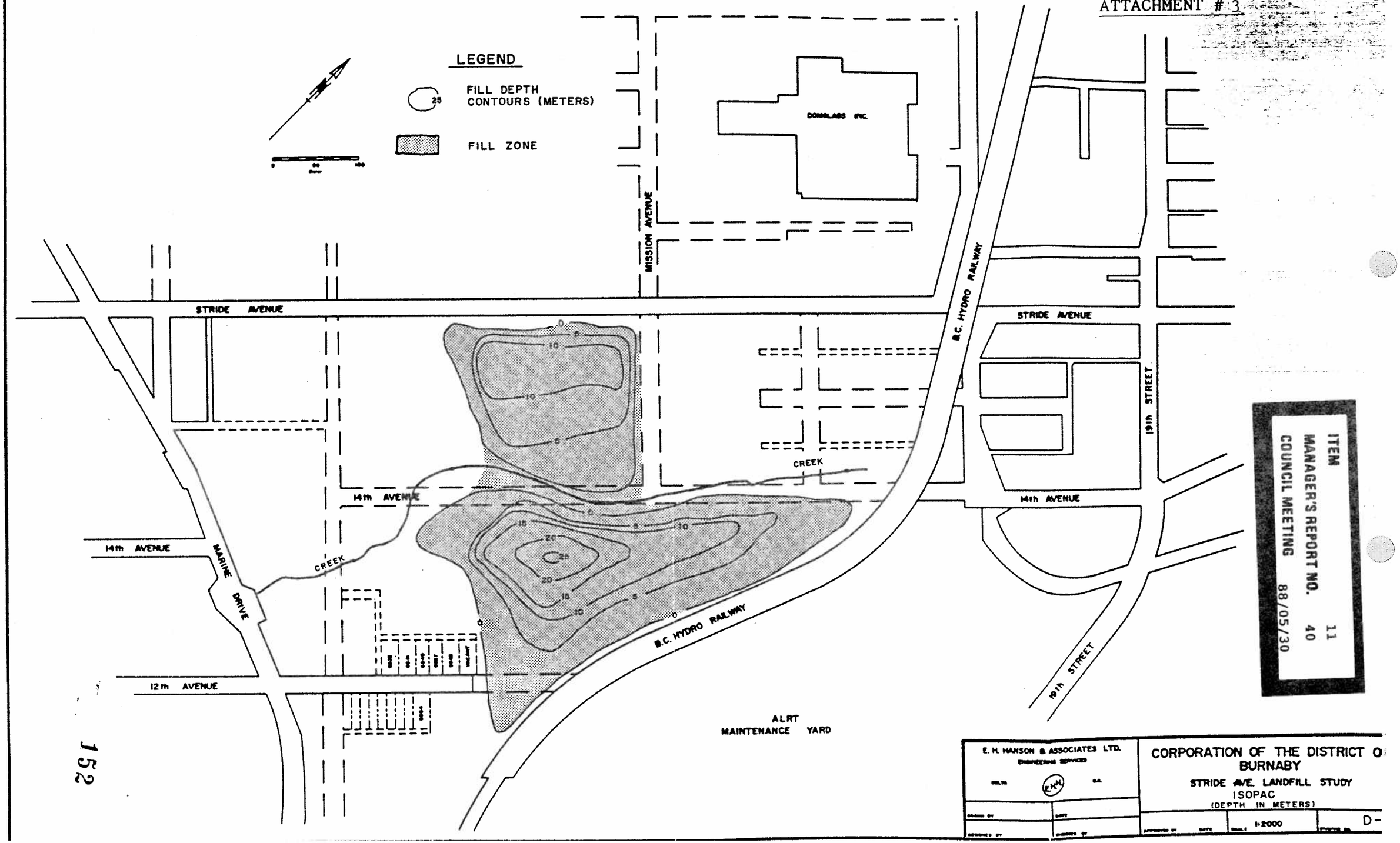
CORPORATION OF THE DISTRICT OF BURNABY

STRIDE AVE. LANDFILL STUDY
EDMONDS TOWN CENTRE-SOUTH
PLANNING PROPOSAL

SCALE 1:2000

D1

ATTACHMENT # 3



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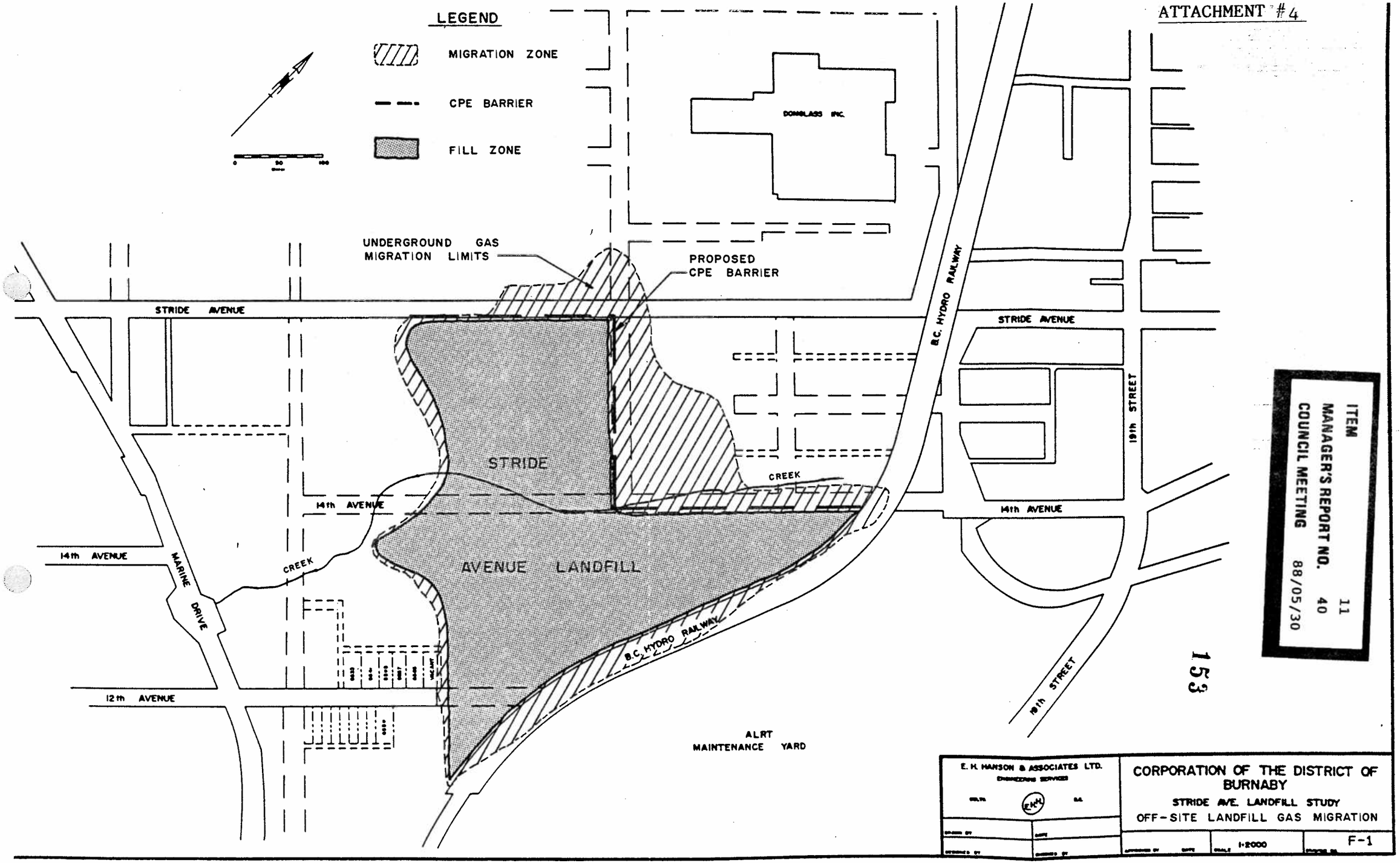
E. H. HANSON & ASSOCIATES LTD.
ENGINEERING SERVICES

CORPORATION OF THE DISTRICT O
BURNABY
STRIDE AVE. LANDFILL STUDY
ISOPAC
(DEPTH IN METERS)

SCALE 1:2000

D-

ATTACHMENT #4



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E. H. HANSON & ASSOCIATES LTD.
ENGINEERING SERVICES

CORPORATION OF THE DISTRICT OF BURNABY
STRIDE AVE. LANDFILL STUDY
OFF-SITE LANDFILL GAS MIGRATION

SCALE 1:2000
F-1

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E.H. Hanson & Associates Ltd.

Engineering Services

Suite #4, 7550 River Road
Delta, B.C. V4G 1C8
Phone: (604) 946-0111

- Innovative Engineering
- Biogas Utilization
- Solid Waste Management
- Land Development

RECEIVED IN
ENGINEERING DEPT.
F - Edmonds Town Ctr
APR 12 1988

Refer to	Noted
EEO	

April 8, 1988

Corporation of the
District of Burnaby
4949 Canada Way
Burnaby, B.C.

Attention: Mr. E.E. Olson, P.Eng.

Re: Engineering design, project management, field supervision, field testing, construction and monitoring of Edmonds Town Centre methane control system.

Dear Sir:

Pursuant to our previous report we would like to submit engineering cost estimates to undertake the work required on the above project.

We propose to undertake the engineering and project management on an hourly basis at the following rates:

Principal Engineer	$73.50/hour
Senior Engineer	$63.00/hour
Junior Engineer	$52.50/hour
Senior Technician	$42.00/hour
Technician	$26.25/hour

In light of changes in methane control technology we suggest that technical and management functions and contractual components be upgraded. Accordingly we are submitting a more detailed outline of activities than previously described. These activities are as follows and the costs given are our best estimates based on the above quoted hourly rates and current construction costs.

<u>Engineering, Project Management & Post Construction Monitoring</u>

1. Preliminary field surveys, assembly of legal drawings, preparation of base plans, cross-section and profile surveys and checking of all underground utilities conflicts. Flow testing of selected wells to confirm flow and influence data from original report.

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$16,400.00

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2. Engineering design of control barriers including review and design co-ordination with other authorities such as Hydro, gas, water, etc. Alternative cost estimates and discussion and review with senior municipal staff. Preparation of final construction drawings.

$33,600.00

3. Preparation of Tender documents, Specifications and review of submitted bids. Detail discussions with short listed contractors, recommendation for award and execution of contract documents.

$ 5,000.00

4. Close field supervision including setting out of the works, continuous inspection of barrier construction, review of progress certificates and issuance of final completion certificates.

$20,000.00

5. Preparation of design, tender, documents, staking and field supervision for relocation of sanitary and storm sewers along with gas traps for each utility.

$20,000.00

6. Post construction system monitoring and reporting including flow checks at all permanent off-site and on-site wells. Final recommendation of requirements for secondary active controls.

$22,000.00

Total $117,000.00

.../3

CONSTRUCTION CONTRACTS

We have re-examined our original cost estimates as submitted in the report issued January 1987 and wish to submit the following update. Since the writing of our report it is apparent that development has been planned and construction in the area will proceed in the near future. This being the case it would be appropriate to have in place a permanent barrier at the entire northern perimeter rather than consider a partial barrier on Stride and Mission Avenue only. Our estimate therefore includes all the work necessary to construct a barrier from Stride Avenue to the ALRT tracks at 14th Ave.

Our estimate includes the cost of ancillary work to re-route a section of sanitary sewer that traverses the ROW at 14th. Also included is the extension of the existing 900 mm sewer to Mission Avenue which presently terminates at 14th and Arbor St. Gas traps are also included so that portions of these utilities where connections are to be made to service the new development will be isolated from the landfill gas producing areas. The gas barrier will then remain intact when service connections are made. The attached sketch illustrates the extent of the work.

CONSTRUCTION COST ESTIMATES

ITEM	AMOUNT
Construction of 650 M of 30 mil CPE Barrier 7 M Deep c/w 100 m polyethylene Collector	$420,000.
Construction of 900 mm Storm Sewer and 300 mm Sanitary Sewer on 14th Ave. (Approx. 100 M each)	$ 85,000.
Total	$505,000.

The above is based upon normal consultant - contractor arrangements for heavy construction items such as trenching, etc., with our company acting as consultants and project managers but additionally undertaking some "on-hands" assembly work for appropriate portions of the system.

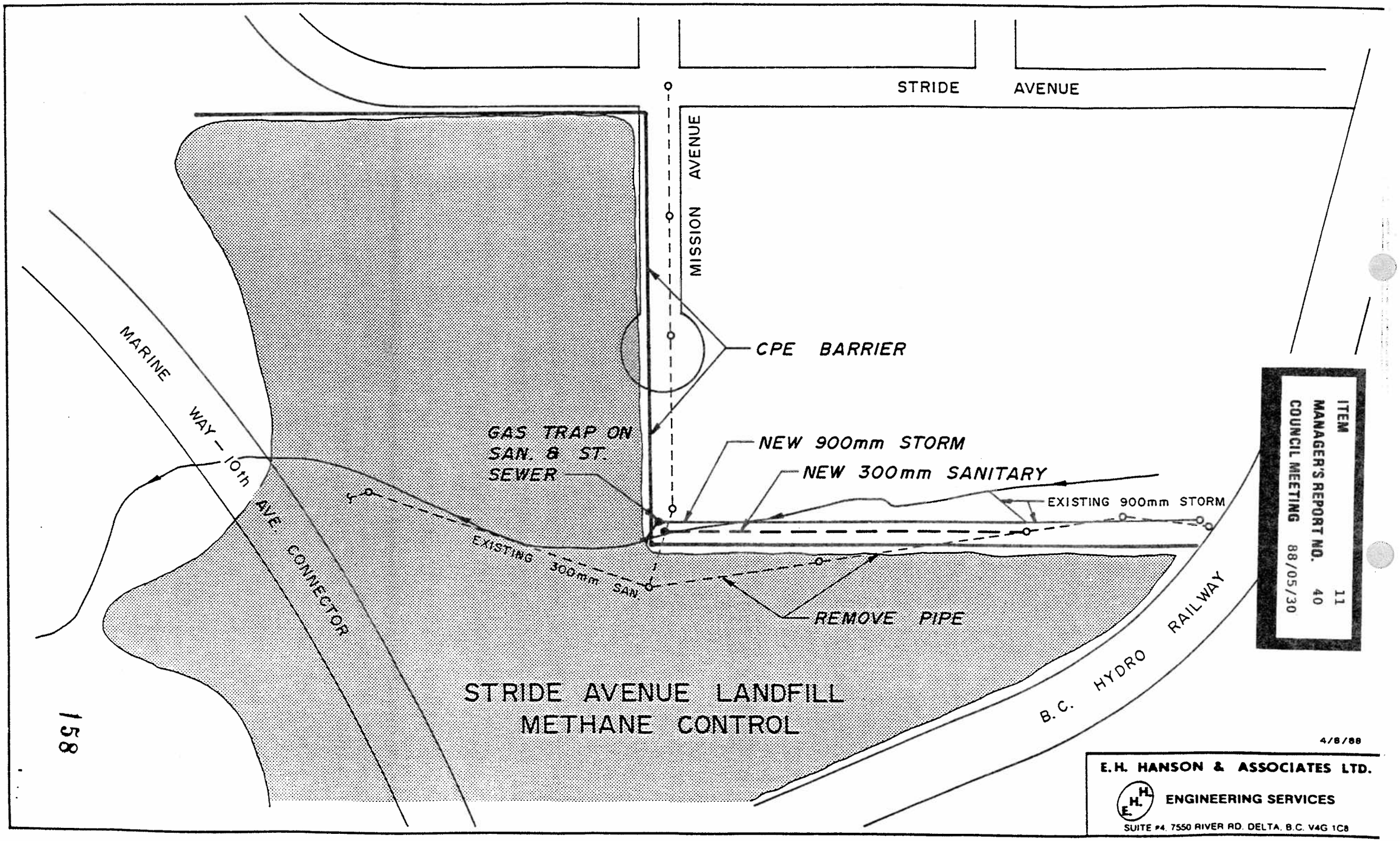
The estimates contained in this submission do not include a back-up system in the event that additional mitigating actions are required as described in our original report.

We look forward to working with you and your staff on this interesting and innovative project and we are willing to commence work within 1 week of your authorization.

Yours truly,

E.H. HANSON & ASSOCIATES LTD.

E.H. Hanson, P.Eng.
President


STRIDE AVENUE
MISSION AVENUE
CPE BARRIER
GAS TRAP ON SAN. & ST. SEWER
NEW 900mm STORM
NEW 300mm SANITARY
EXISTING 900mm STORM
EXISTING 300mm SAN.
REMOVE PIPE
MARINE WAY - 10th AVE. CONNECTOR
B.C. HYDRO RAILWAY
STRIDE AVENUE LANDFILL
METHANE CONTROL
ITEM 11
MANAGER'S REPORT NO. 40
COUNCIL MEETING 88/05/30
4/8/88
E.H. HANSON & ASSOCIATES LTD.
ENGINEERING SERVICES
SUITE #4, 7550 RIVER RD. DELTA, B.C. V4G 1C8