REGIONAL SANITARY LANDFILL

REPORT

SEPTEMBER 10, 1975

REVISED NOVEMBER 14, 1975

THE METROPOLITAN SERVICE DISTRICT
527 SW HALL STREET
PORTLAND, OREGON

INTRODUCTION

The Metropolitan Service District (MSD) is near implementation of a regional solid waste management and resource recovery plan which has been in development for over 3 years. In the forseeable future, sanitary landfills will be an essential element of the solid waste management and resource recovery plan. The Service District should assure area residents that an accurate, honest and exhaustive effort has been made to locate and develop those landfill sites which will provide the lowest long term costs and least detrimental disposal methods.

Considerable preliminary research and speculation has been expended in searching out feasible landfill sites. Using readily available information, this report attempts to prioritize those sites previously investigated and recommends a strategy for undertaking the investigative and design work required to develop one or two additional regional landfill sites.

FINDINGS AND RECOMMENDATIONS

The following findings and recommendations result from the material developed in this report and comments and discussions since circulation:

Findings:

1. Previous consultant's reports analyzing over 50 potential landfill sites suggest that the following nine sites have technical feasibility. These sites are:

Cipole - Washington County
Alford - Clackamas County
Santosh - Columbia County
Sandy Delta - Multnomah County
Hayden Island - Multnomah County
Burlington - Multnomah County
Durham Gravel Pits - Washington County
Frank's - Washington County
Division Street Gravel Pits

2. Landfilling of milled residue and milled refuse such as will occur in the MSD proposed Solid Waste Management Plan offers new opportunities and advantages and gives greater feasibility to certain sites than if they were landfilled with raw refuse.

3. Although controversy exists, utilization of worked out gravel pits for milled residue and nonprocessible sites has significant merits. The following gravel pits, in addition to those mentioned in finding #1, should receive further consideration for these purposes:

Barton Pit
Crosswhite
Columbia Sand and Gravel
Gresham Sand and Gravel
Nash Gravel Pit

Oregon Asphalt Paving
Rogers Construction Co.
Waybot Gravel Pit
Yett Gravel Pit

4. If solid waste flows to existing demolition sites are interrupted, it appears that operators and owners of such sites may be adversly impacted.

5. From an economic standpoint, Hayden Island is a superior landfill site for refuse from the North Portland Station. Burlington, Division Street Gravel Pits, and Santosh in that order, offer economic advantages not available at the other sites.

6. The economically superior landfill site for the south processing station is the Division Street Gravel Pits. Alford, the Durham Gravel Pits, Cipole, and the Sandy Delta, in that order complete the economic ranking for the south processing center.

Staff Recommendations

1. Existing landfills should be kept in operation as long as technically and socially possible.

2. Unless a severe lack of processible waste quantities at the proposed processing station occurs, there should be no interruption of the flow of solid wastes currently directed to existing demolition sites.

3. Processible wastes should not be accepted at new demolition sites commencing operation after January 1, 1976, unless there are unforeseen changes to the MSD Solid Waste Program.

4. On a future date as circumstances dictate, staff should accomplish the action tasks set forth in the implementation section of this report to develop a regional landfill site.

REPORT ORGANIZATION

If the selection and acquisition of landfill sites involved only economic decisions or only political decisions, choosing the required landfill site would be much simpler. Finding and developing an acceptable site, however, requires a combination of criteria and an undetermined mixture of factual and emotional judgements.

For purposes of this report, the required inputs will be categorized into the following headings:

1) Technical and environmental factors
   a) characteristics of the material to be landfilled
   b) sources and transporation factors
   c) characteristics of proposed sites
2) Economic factors
3) Socio-political factors

Several additional reports have been generated which more or less address each of these factors and which tend to shape our present attitudes towards closing existing landfills and developing new sites. As a common reference point, several of these previous reports are acknowledged and briefly summarized.

Technical parameters of the refuse material such as quantities generated and required landfill capacities are developed. Technical and environmental factors for available sites identified from previous reports are defined. The economic aspects of the technical and environmental factors are amplified. Finally, jurisdictional differences, political considerations and zoning and land use aspects of acceptable sites are discussed.

The final section of this report will attempt to develop a strategy for implementation of a regional landfill site.

EARLIER REPORTS DEALING WITH SANITARY LANDFILL SITES

A brief summary of early research and reports followed by generalized MSD staff findings:

Report on Refusal Disposal for Portland, Oregon, by Black and Veach Consulting Engineers, August, 1968.

The purpose of this report was to evaluate existing disposal facilities and disposal costs and determine alternate methods and sites for refuse disposal. The principal refuse disposal alternatives considered included filling surrounding gravel pits, developing disposal sites at Multnomah Channel, the Sandy River Delta, downstream lowlands, central incineration, and maintaining the present site (St. John's). The gravel pits have subsequently been developed into demolition sites. The downstream lowlands refered to areas downstream on the Columbia River as far as 70 miles from Portland.

The following recommendations from that report seem significant; the City should convert the existing dump to a sanitary landfill; the gravel pits should be used in conjunction with existing disposal methods, the "county, metropolitan, state, or other governmental agency acquire, as soon as possible, the excellent sanitary landfill sites in the Portland Metropolitan area and reserve them for future refuse disposal needs," and that scales be installed as soon as possible.

Study of Sanitary Landfill Sites for Washington County, Oregon, prepared by Clark and Groff Engineers, Inc., January, 1970.

The objective of this study was to develop a solution for the interim operation of a sanitary landfill or landfills until Portland Metropolitan waste disposal could be explored and implemented. Some 20 sites in Washington County were analyzed using

available topographical, geological, and physical parameters. Each of the 20 sites were compared to a computer analysis optimizing collection haul costs. For the six sites considered most acceptable, development and operation costs were estimated. From a technical and economic point of view, a site adjacent to the north of the Tile Flat Road at the intersection of Clark Hill Road was recommended as the best location. Clark and Groff also suggested development of a subsidy to private collectors for unequal haul costs. Transfer stations were judged not feasible for distances less than 20 miles. Regional solutions had the disadvantage of transporting county wastes greater distances, although certain advantages were pointed out.

Report on Sanitary Landfill and Refuse Disposal Costs for Portland, Oregon, by Black and Veach, May, 1970.

This report is mentioned only because it provides reference to Portland's greater committment to the St. John's Landfill, and conversion of the open dump to an acceptable sanitary landfill.

The Final Report on the Portland Sanitary Landfill Hydrogeological Studies, by Stevens, Thompson and Runyan, Inc. October, 1972.

Addresses technical and environmental challenges imposed upon the City.

Metropolitan Service District Solid Waste Management Action Plan, by COR-MET, April, 1974.

Chapters 9 and 14 and appendices C, K, L, and P specifically deal with disposal sites in the MSD study area. In March, 1975, a summary report on potential landfill sites was prepared by COR-MET. The March analysis identifies six specific sites: Cipole, in Washington County; Alford, in Clackamas County; Santosh, in Columbia County; Sandy Delta, in Multnomah County; Hayden Island, in Multnomah County; and Burlington, in Multnomah County.

These specific sites are based on a composite of the site evaluations done by the COR-MET staff and the COR-MET Landfill Rating Group. These six sites represent the basis for this report.

Preliminary Engineering Design For Phased Expansion of the St. John's Sanitary Landfill, Volumes I and II, by Stevens, Thompson and Runyan, Inc., June, October, 1974.

Early in 1974, the City announced intentions of expanding the St. John's Landfill by distributing an Environmental Assessment for Blind Slough Filling and Drainage Improvements. The expansion plan calls for:

1) Phased expansion in 20-50 acre increments;
2) Construction of access roads to relieve traffic on Columbia Blvd;
3) Construction of dikes and other pollution control devices;
4) Protection of the environment including protection of tree stands and replanting certain areas;
5) Future development of park and recreational areas;
6) Development of a fixed shore line and general improvement to Smith Lake.

Report and Recommendation of the City Planning Commission Concerning St. John's Expansion, April, 1975.

The City of Portland Planning Commission recommends the following:

1) Granting a permit for continued operation of the St. John's Landfill for five years, based on a "Finger Bay Concept".
2) The landfill be permitted to reach a height of 80ft. MSL.
3) The landfill be turned over to recreational or open space uses at the completion of each phase.
4) That the existing landfill site and proposed expansion area be rezoned from M1 and F2 to a farm and forest zone.

Interoffice Memo to E.A. Schmidt, Department of Environmental Quality from H.R. Sweet, Hydrogeologist, August, 1973.

COR-MET proposed a number of sites to the State. A preliminary appraisal of these sites suggest certain reservations the Department of Environmental Quality maintains. Cipole, for instance, was given number one priority in the COR-MET analysis; however, DEQ feels that the potential for groundwater contamination at this site is reasonably high. A more acceptable site from a technical and environmental standpoint might be areas adjacent to Frank's in Washington County.

Durham Gravel Pit Study, by Washington County Department of Planning

This report recommends that the Durham Pit site be identified as Washington County's possible primary solid waste disposal site. The report further recommends that Washington County utilize solid waste to rehabilitate the site for an intensive urban use.

A Viewpoint of the Solid Waste Industry, sponsored by the Tri-County Solid Waste Management Council and prepared by Stevens, Thompson and Runyan, Inc., February, 1974.

This plan suggests various modifications to the alternative B concept of the MSD Action Plan. One of the stated primary concerns of the solid waste industry is the lack of a landfill site in Washington County. The Frank's site satisfies the short term needs of the Industry, and should be utilized as a processible site. In order to meet certain long term needs of the east Portland area, processed wastes could be used for land reclamation at one or more of the gravel pits in the general vicinity.

MSD Staff Findings With Regard to Previous Research

1) Based on others' research, the following potential landfill sites or alternatives should be given consideration:
   a) the Sandy River Delta
   b) Cipole
   c) Alford

d) Santosh

e) Sandy Delta

f) Hayden Island

g) Durham Pits

2) Additional evidence should be introduced in this report to further consider areas adjacent to Frank's and possible reclamation of gravel pits in East Portland.

3) A best guess at this time is for closure of St. John's Landfill by 1980.

TECHNICAL AND ENVIRONMENTAL CONSIDERATIONS

The technical and environmental considerations which will be considered in this section of the report may be separated into distinct subsections. These subsections include 1) characteristics of the material to be landfilled, 2) sources and transportation factors, and 3) characteristics of proposed sites.

Landfill Material Considerations

Resource recovery, under MSD's Solid Waste Management Plan, will be accomplished through shredding of all incoming solid waste and the mechanical removal of certain constituents of the waste stream. In the preparation of the MSD plan, the MSD staff has become convinced of the desireability of shredding municipal refuse prior to disposal in urban areas.

The distinction between unprocessed or non-shredded refuse, and processed or shredded refuse should be carefully explained.

Traditional Solid Waste Landfilling

This is an engineering method of disposing of solid wastes on land, accomplished by spreading wastes in thin layers, compacting to the smallest practical volume, and covering with soil each working day in a manner that protects the environment. Sanitary landfilling is not only an acceptable and economic method of solid waste disposal, it is also an excellent way to make otherwise unsuitable or marginal land valuable.

Solid wastes deposited in a landfill, degrade chemically and biologically to produce solid, liquid and gaseous products. Some factors affecting degradation are the heterogeneous character of the wastes, their physical, chemical and biological properties, the availability of oxygen and moisture within the fill, temperature, microbial populations and type of synthesis. Since the

solid wastes usually form a very heterogeneous mass of nonuniform size and variable composition and other factors are complex, variable, and difficult to control, it is not possible to accurately predict contaminant quantities and production rates.

Groundwater or infiltrating surface water moving through solid waste can produce leachate, a solution containing dissolved and finely suspended solid waste matter and microbial waste products. Composition of leachate is important in determining its potential effects on the quality of nearby surface water and groundwater. Contaminants carried in leachate are dependent on solid waste composition and on the simultaneously occuring physical, chemical, and biological activities within the fill.

Milled Residue Landfilling

This offers certain advantages over traditional solid waste landfilling. Landfilling in Oregon is limited by several unique technical and social parameters, including a high annual rainfall, a shortage of acceptable landfill sites, and strong public support for environmental safeguards. The shredding of solid waste prior to disposal offers the following advantages over conventional unprocessed landfills:

1) Accelerated chemical and biological decomposition of shredded refuse, resulting in more rapid stabilization of reclaimed land and return to productive uses;

2) Landfill operations and maintenance costs are reduced due to the ease of handling and compacting shredded refuse;

3) The increased density of properly landfilled shredded refuse extends landfill life dramatically and increases feasability of utilizing smaller sites;

4) Shredded refuse landfills are aesthetically acceptable and produce no objectionable odors. Milled refuse landfills

could become acceptable neighbors in residential areas;

5) Vectors cannot breed or live on shredded refuse;

6) Litter problems from blowing paper and plastic are virtually nonexistant;

7) The unique characteristics of milled refuse indicate that cover material may not be required in many locations. Even if cover is required, 20 to 30 percent of the quantity used for a conventional landfill will accomplish the same purpose on a shredded refuse fill;

8) Shredded refuse without cover reaches "mature" decomposed state with less leachate generation much quicker than unshredded refuse;

9) As a result of the shredding process, an indirect benefit accrues to landowners adjoining landfill sites. Heavy public and collector traffic will be directed to the processing facility and large infrequent transfer vehicle trips will substantially reduce traffic traditionally associated with landfilling sites.

For further reference and substantiation of these listed advantages, a "Technical Appendix" is included following the text of this report.

Landfilling of Non-Processable Wastes

Non-processable wastes are defined as wastes that cannot be handled by transfer stations, mills, compactors or other solid waste processing systems. Building materials and rubble resulting from construction, remodeling, repair, and demolition operations form the major portion of non-processable wastes. It will be necessary to continue in the MSD solid waste system what is now known as a demolition site. The function of the demolition site will be

significantly different from its present function of accepting all non-food and non-tire wastes from the public. Where the public has utilized demolition sites for satisfying their need to dispose of wastes produced in cleaning out the attic, the garage and their yard and lawn clippings, this function will be performed by the MSD processing facility.

By their nature, non-processable wastes are not attractive to flies, rodents or birds and therefore are more acceptable as fill material at locations that might be inappropriate for ordinary wastes. It is possible that large quantities of the solid waste stream now thought of as non-processable may be economically recycled at some future date. Concrete can be run through rock crushers, asphalt can often be reused, and rubber may find application in building, highway or other heavy construction. Along with substantial variability in building demolition activity, prediction of non-processable landfill requirements will be a guess at best.

In summary, a portion of the waste stream will require landfilling under MSD's Solid Waste Management Plan. The material to be landfilled differs considerably from the solid waste landfilling which goes on now. For this reason, landfilling sites which previously could not be considered have potential in the MSD system.

Source Locations and Transportation Factors

The MSD Plan includes four or five future distinct elements. Near the end of 1977, the first processing station near Rossman's landfill in Oregon City and a transfer station in East Washington County will become functional. Near the end of 1979 the second processing station in North Portland will commence operations.

Currently, there are two landfills in the metropolitan area which accept food wastes from all private collectors and the public. A third landfill, Frank's, accepts food wastes from those private collectors within Frank's franchised area. In addition, there are

currently at least nine other landfill sites in the metropolitan area. By 1980, it is estimated that all of these sites which currently accept the public will have reached the limits of their operational plan and will be closed. After these sites are closed, new demolition sites will be allowed to accept only non-processable wastes.

After 1980, the Metropolitan Service District should be made up of the separate elements listed in the table below.

TABLE 1

ELEMENTS OF MSD SOLID WASTE PLAN

ELEMENT	LOCATION	TYPE OF MATERIAL ACCEPTED	MATERIAL ACCEPTED FROM
1. Processing Station #1	Near Rossman's Landfill	All processable wastes	All public and private collectors
2. Processing Station #2	In North Portland	All processable wastes	All public and private collectors
3. Transfer Station	In East Washington County	All processable wastes	All public and private collectors
4. Milled refuse landfill	Location undetermined	Shredded milled refuse	Processing station transport vehicles only
5. Demolition sites	Location undetermined	All non-processable wastes	All public and private collectors

Possibly, a milled refuse landfill could be utilized as a demolition site. Demolition quantities are less predictable than processable waste quantities and the origin of these wastes defy the level of analysis of this report. Processable wastes delivered to the transfer station will be transported to one of the two processing stations. The solid waste will be shredded and approximately 65% or more of the solid waste stream will be separated and sold.

The remainder (35%) will need to be landfilled.

The table below shows the projected volume of landfill requirements needed to meet service district needs through 1990. St. John's landfill is assumed to close by January 1, 1980 while Rossman's is projected to remain open until 1983. The table below projects the following assumptions:

1) 50% of the refuse generated in the Metropolitan area is processed at the south processing center and 50% of the refuse is processed at the north processing center.
2) The compacted in place solid waste density of a milled refuse landfill site is 1250 lbs. per cubic yard.
3) The solid waste to cover ratio for milled refuse is 8 to 1.
4) Residue percentage to be landfilled is 35% of total refuse generated.

TABLE 2
LANDFILL VOLUME REQUIREMENTS

YEAR	TOTAL REFUSE SEPARATED (TONS)	RESIDUE TONNAGE (TONS)	VOLUME LANDFILLED (cubic yds)	VOLUME LANDFILLED (acre feet)
1980	791,400	138,495*	221,590	137
1981	812,800	142,240*	227,585	141
1982	834,500	146,040*	233,665	145
1983	856,800	299,880	479,800	298
1984	879,100	307,685	492,300	305
1985	902,100	315,735	505,175	313
1986	925,100	323,785	518,060	321
1987	945,000	330,750	529,200	328
1988	973,300	340,655	545,050	338
1989	997,600	349,160	558,660	346
1990	1,022,300	357,805	572,490	355

* 50% of residue tonnage filled at Rossman's until 1983. Rossman's life could be extended past 1983 by reduced volume because of processing and resource recovery.

The residue material generated by the north and south processing centers will be transported to one or more regional landfill sites. Various transportation modes could be available to haul the residue. The primary method anticipated is highway transportation. The following table quantifies the distance and travel restrictions involved. This table will be used in subsequent sections of the report to project the economic locational advantages of each site.

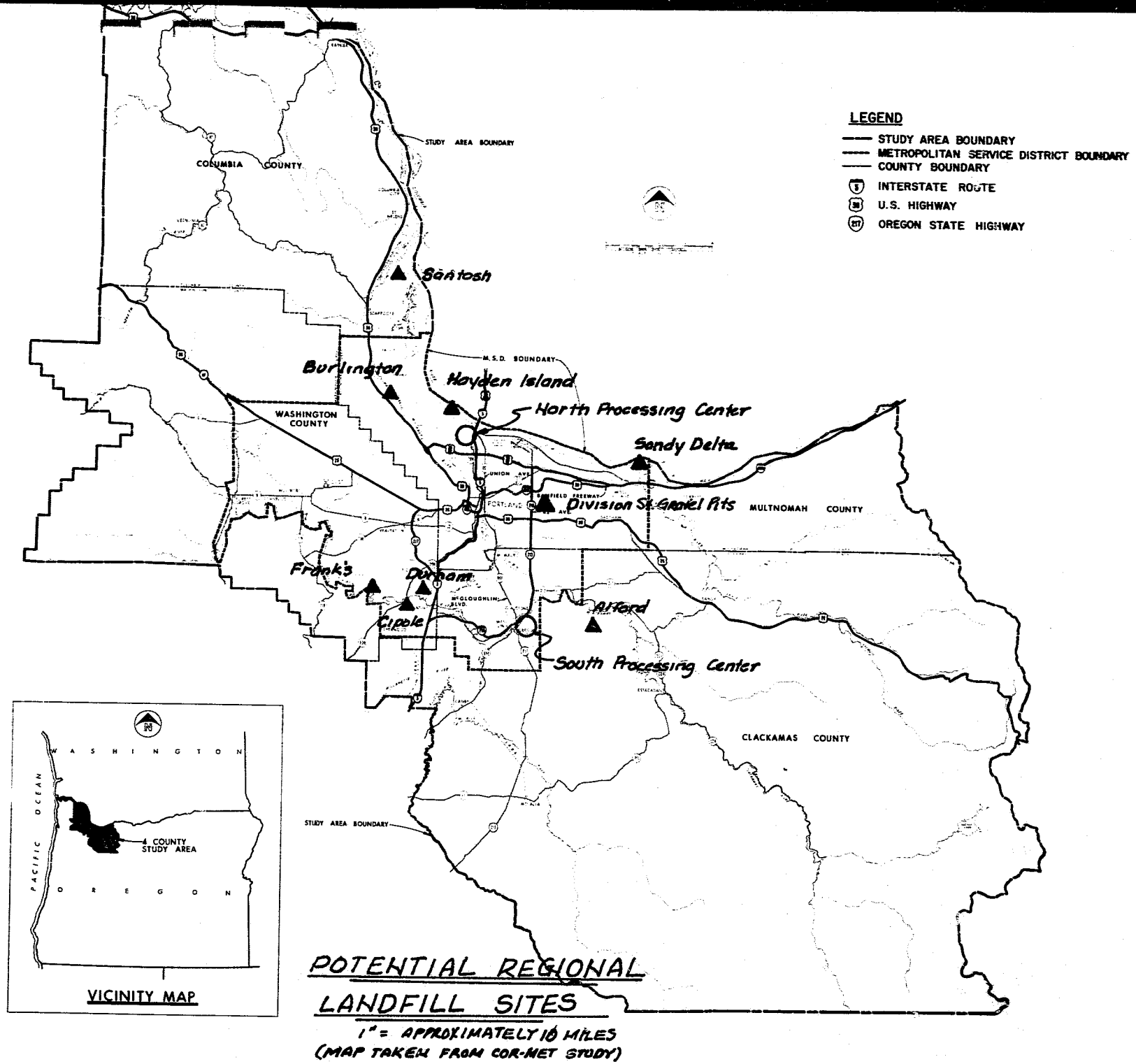
TABLE 4

REFUSE CENTER TO LANDFILL SITE DISTANCES

LANDFILL SITE	SOUTH PROCESSING CNTR.			NORTH PROCESSING CNTR.		
	50mph roadway (MILES)	35mph or less roadway (MILES)	TOTAL (MILES)	50mph roadway (MILES)	35mph or less roadway (MILES)	TOTAL (MILES)
1. Sandy Delta	21.2	1.2	22.4	20.3	1.6	21.9
2. Hayden Is.	22.4	2.2	24.6	0.6	3.6	4.2
3. Burlington	28.4	1.0	29.4	4.5	4.5	9.0
4. Alford	2.6	7.9	10.5	19.6	9.3	28.9
5. Cipole	11.1	3.0	14.1	16.5	4.4	20.9
6. Santosh	43.0	1.0	44.0	4.5	9.0	13.5
7. Durham Gravel Pits	12.6	1.0	13.6	15.0	2.0	17.0
8. Division Gravel Pits	9.0	0.8	9.8	12.7	2.0	14.7

Characteristics of Proposed Sites

Utilizing research done by others, the following table has been compiled to compare the relative physical features of each site. The physical features represented in this table will be used to project economic advantages of each site in subsequent sections of this report.



POTENTIAL REGIONAL LANDFILL SITES

1" = APPROXIMATELY 10 MILES

(MAP TAKEN FROM COR-MET STUDY)

One additional site is discussed in this section because of emphasis in previous reports. Frank's has been rejected from consideration for reasons outlined in the MSD Solid Waste Management Action Plan.

1. "The Frank site is a nonconforming prior land use, and the Washington County Planning Commission has indicated opposition to any expansion of the site.
2. "In 1973, the owner of the site attempted to expand his facilities and was denied a permit by the County Planning Commission.
3. "The present DEQ and County permits specifically exclude all additional site users by stating that only the commercial collection trucks serving Frank's franchised area shall use the site.
4. "Traffic volume on Beef Bend Road leading to the site is already a problem, and expanded use of the site by additional haulers would increase the traffic loads.
5. "The site has a relatively small capacity.
6. "The filling of the site has only marginal land reclamation value."

An early draft of this report considered only one metropolitan area gravel pit, the Durham Gravel Pit in Washington County, and generated some criticism. The criticism appears justifiable in that there are a large number of gravel pits within the metropolitan area that could benefit significantly from reclamation by sanitary landfill.

The physical features of these gravel pits are similar to the Durham Gravel Pits and the Division Street Gravel Pits and should be expanded in this report. Although there may be other sites available, MSD recognizes the sites shown in Table 6 on the following page. Not enough research is available to develop all of the characteristics included in Table 5 , "Physical Features of Landfill Sites".

TABLE 6

GRAVEL PITS - CLACKAMAS, EAST MULTNOMAH COUNTY

COR-MET DESIGNATION	LOCATION	SITE	SURROUNDING LAND USES	LIMITATIONS & COMMENTS
CLACKAMAS COUNTY-				
1. Barton Pit	6 Mi. NW Estacada	25a	farming - park	small size, land reclamation potential.
2. Crosswhite	6641 SE Johnson Creek Blvd.	33a	res, commercial, vacant	small size, residential areas land reclamation potential
MULTNOMAH COUNTY-				
3. Columbia Sand & Gravel	122nd NE San Rafael	9a	res, school playground	small size, residential area
4. Gresham Sand & Gravel	195th - 190th Division-Stark	8a	generally res, except for gravel operations	owner intends to mine below water table - Vance Pit land-fill on the north.
5. Nash Gravel Pit	Culley Blvd.-Columbia Blvd.	24a	industrial, commercial	land reclamation potential
6. Oregon Asphalt Paving	155th & SE Main	20a	residential, school playground	land reclamation potential
7. Portland Sand & Gravel	10717 SE Division	35a	residential, park, school, commercial	land reclamation potential
8. Rogers Construction Co.	190th near Gresham Sand & Gravel	53a	residential, housing, gravel operations	land reclamation potential
9. Waybo Gravel Pit	NE Killingsworth off 82nd	15a	commercial, residential, small gravel pit	land reclamation potential residential, small size
10. Yett Gravel Pit	Cully Blvd. - NE Portland Hwy.	42a	warehouse, gravel. limited residential	land reclamation potential

Because of the general geology associated with most of these gravel pits, there is significant potential for groundwater pollution by a landfill application. A good landfill site is located at least 8 to 10 feet above the high groundwater table, and is separated by some kind of impermeable strata. Gravel, rock and sand are usually highly permeable, and therefore the gravel pit sites offer no protection against leachate infiltration and contamination of metropolitan groundwater. The groundwater in East Multnomah County appears to constitute a substantial portion of acquifiers furnishing drinking water to specific areas of metropolitan Portland. Groundwater movements are sufficiently complex that it is extremely difficult to defend against lawsuits aimed against possible groundwater pollutant sources.

From a strictly technical point of view, methods of capturing the leachate generated from sanitary landfilling are certainly available. Costly, but technically feasible, methods of monitoring leaks in impermeable boundaries are also available.

The close-in location of these gravel pits is a distinct advantage transportation wise. The location, however, is usually more visible to the public and many of the sites are situated in residential areas. To move into the sites, bring them up to grade, and move out quickly are essential objectives.

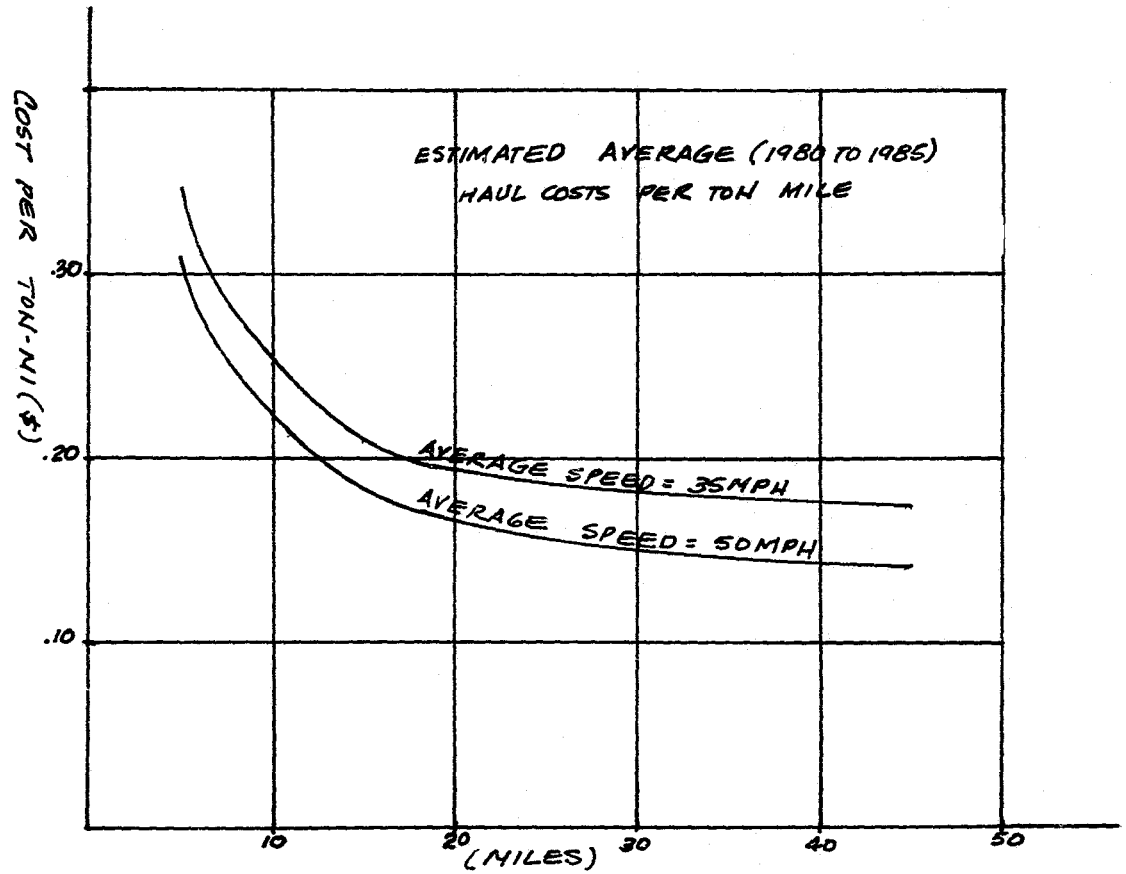
These physical features of the gravel pit sites will be given separate consideration in the economic sections of this report.

ECONOMIC IMPLICATIONS

The locational and physical features summarized in the previous section are more definable in terms of their economic impact on developmental or operating costs.

Locational Factors

Table 7 attempts to quantify the locational aspects of each of the potential sites. The residue quantities produced at the north and south processing centers are summed for the five year period from 1980 to 1985. It is assumed that Rossman's will take residue from the south processing center until 1983. The five year quantity for the north processing center is 888,460 tons and for the the south processing center, 461,680 tons. These tonnages together with the distances generate haul costs to the potential landfill site. The haul cost assumptions are derived from information generated during the COR-MET report. The following graph has been used to determine haul costs for each of the sites involved.


ESTIMATED AVERAGE (1980 TO 1985)
HAUL COSTS PER TON MILE
COST PER TON-MI ($)
.30
.20
.10
AVERAGE SPEED = 35MPH
AVERAGE SPEED = 50MPH
10
20
30
40
50
(MILES)

These costs, the distances shown in the previous section (Table 4), and the tonnages described above, combine to generate the following tables of haul costs. These costs have no actual significance other than for comparative purposes among the alternative sites generated.

T A B L E 7

ESTIMATED FIVE YEAR (1980-1985) HAUL COSTS

FOR POTENTIAL LANDFILL SITES

I. Total haul costs from both processing centers to:

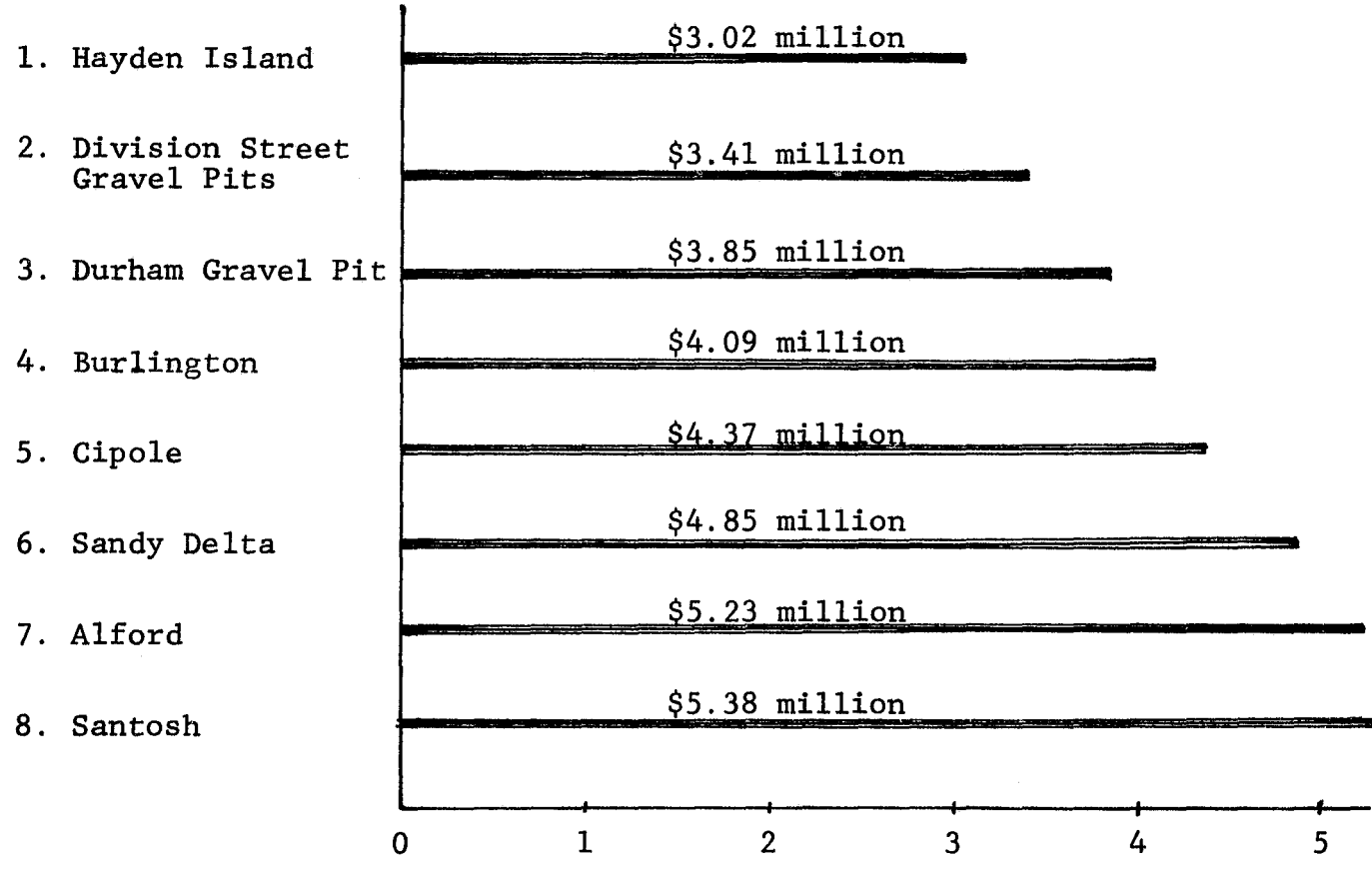
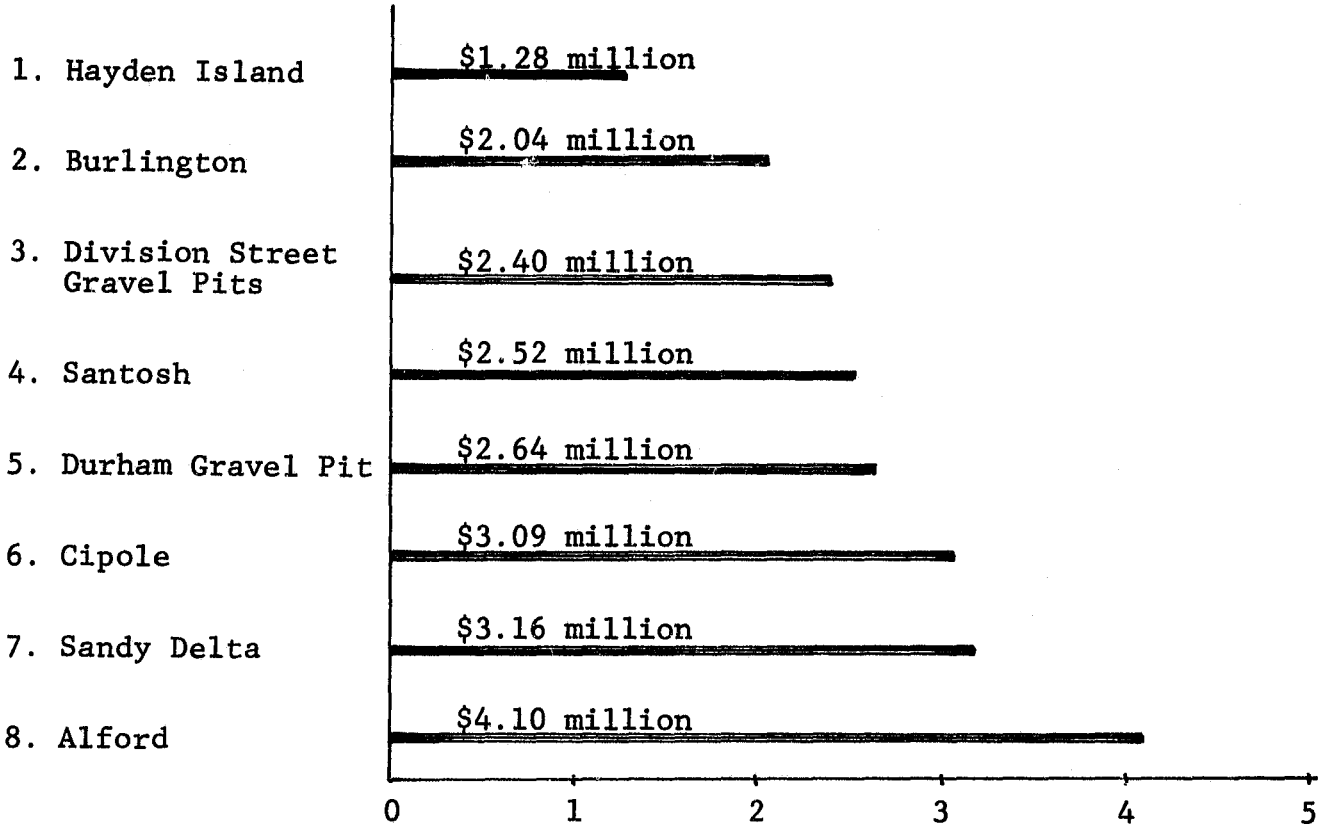
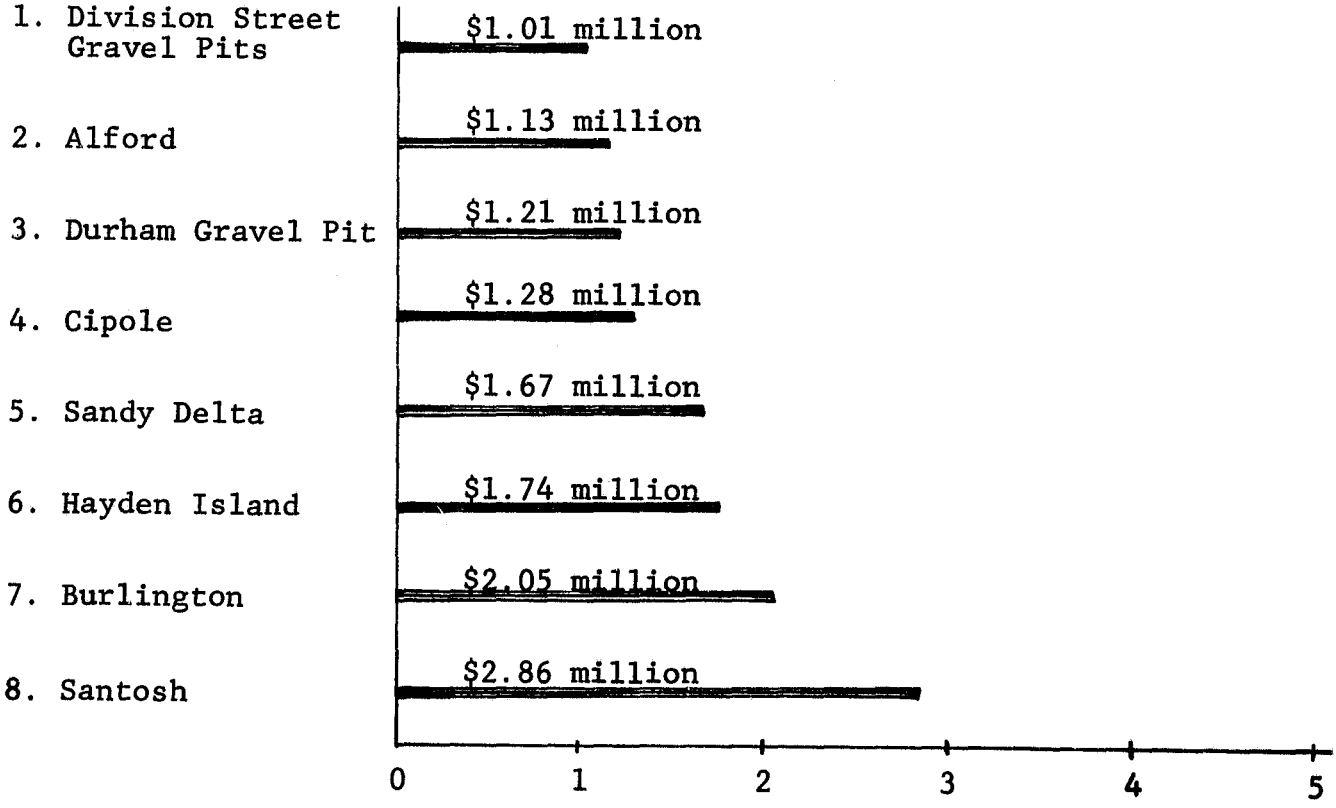


TABLE 7 continued

II. **Haul costs** from north processing center to:



III. Haul costs from south processing center to:



Physical Features

The physical features shown in the previous sections translate to certain economic considerations.

1. The capacity in cubic yards can be compared to the acreage utilized as a measure of land area efficiency.

2. The land area efficiency, however, should consider the cost of developing each site. These costs are developed by considering unique features of each site.

   a) Screening problems differ from site to site;
   b) For certain sites, more clearing prior to filling is required. For instance, the Durham Pits have been partially cleared as a result of gravel operations there;
   c) For sites in the flood plain, dikes and pumping have to be considered;
   d) For certain sites, off site drainage needs to be rerouted through or around the site;
   e) For certain sites, leachate not only needs to be recovered, but probably treated, due to groundwater contamination potential;
   f) In order to recover leachate or to protect the groundwater from leachate infiltration, site sealing materials are required. The availability of site sealing material differs from site to site;
   g) The availability of cover material is substantially different from site to site;
   h) Certain sites take on new economic value if they can be filled to match surrounding grades, i.e. the Division Street Gravel Pit.

By assigning rough costs to each of these site characteristics, the following general cost of development per million cubic yard capacity projections were developed:

TABLE 8 - COST OF DEVELOPMENT

	$/million cubic yd.	$
1) Santosh	90,000	(540,000)
2) Sandy Delta	115,000	(5,750,000)
3) Cipole	120,000	(1,080,000)
4) Alford	130,000	(455,000)
5) Hayden Island	130,000	(3,770,000)
6) Durham Gravel Pits	150,000	(397,500)
7) Burlington	115,000 to 165,000	(?)
8) Division St. Gravel Pits	200,000	945,000

The costs of developing more specific data to eliminate the uncertainty represented by these numbers does not appear to be justified at this time. The differences from site to site can be justified logically in addition to the previous numeric evaluation.

1. Santosh - All flood plain sites are burdened with the problem of controlling flood waters which involves diking. Santosh is the only site which appears to have on site diking and cover materials potentially impermeable enough for use. Because of lack of down-stream sources or dilution potential, leachate treatment is not specified.

2. Sandy Delta - Certain economies of scale appear to be available. The Sandy Delta site has the greatest available acreage and the second highest capacity to acreage ratio. In order to achieve these economies of scale, a more sizable capital outlay appears to be required to "tie up" the site because of the additional acreage involved.

3. Cipole - The Cipole site is not completely within the flood plain.

For this reason, less diking is required and in spite of higher potential for groundwater contamination and associated control costs, this compares favorably with the other sites involved.

4. Alford - The cost of developing the Alford site is substantially affected by the assignment of funds to defray potential access problems. The site is proposed to be utilized for gravel operations initially. For gravel operations to be successful, access problems should be solved prior to the sanitary landfill useage. If the access problem were eliminated, on site cover material and site sealing material would make this site extremely attractive.

5. Hayden Island - Hayden Island offers the same kind of economies of scale offered by the Sandy Delta site. Diking costs are slightly higher due to somewhat lower elevations but the main problem is the question of access. A substantial amount of money has been included as a developmental cost for this site. It is doubtful, though, that the traffic problem could be sufficiently reduced by construction of new roads on the island itself or improvements to existing exits. Major expenditures by others is a remote possibility.

6. Durham Gravel Pits - The Durham Gravel Pits offer a distinct advantage the other sites do not. This site is mainly publically owned and offers the greatest potential conversion to industrial property. A reclamation factor has been included as offsetting the developmental cost of this site. The main problem involves potential groundwater pollution. This potential can be mitigated by careful leachate recovery and treatment and/or development of alternate water sources to replace existing wells.

7. Burlington and Division Street Gravel Pits - Proper evaluation of these sites is difficult due to insufficient soils information.

Although no specific analysis has been performed for the gravel pits except for the Durham Gravel Pits and the Division Street Gravel

Pits, similar economics exist for each site. Control of leachate will not only be costly but may generate larger indirect expenses. For instance, it would be extremely difficult for the DEQ or MSD to approve sites where the potential for groundwater contamination exists. It might be possible, however, to utilize bonds or performance guarantees of the operator to insure that possible groundwater contamination problems could be corrected if they occur. Site investigation, surveys and research, engineering costs, design, and environmental impact analysis would certainly exceed present levels.

What appear to be excessive risks and costs need to be compared against the benefits derived from reclaiming these gravel sites, and savings in transportation costs. There is some probability that risks and costs involved may be more than private enterprise is willing to take on. There is also some likelihood that if no one is willing to commit to application of untested technology, reclamation through landfilling should be eliminated from further consideration.

The resulting differences in developmental costs for each site are not nearly as significant as the transportation costs. The table below develops a 5 year amortized site development cost which can be compared to the transportation costs previously developed. The following assumptions are used.

1. Every site can be amortized over a 20 year period at any realistic interest rate (10%). A lower interest rate will simply give a lower annual cost.

2. Using a 20 year amortization period, 10% interest rate, and summing the interest factor for 5 years results in a total 5 year amortization of 0.6 of the total cost.

3. As calculated for haul costs, 888,460 tons will be generated at the north processing center and 461,680 tons will be generated at the south processing center. These tonnage figures translate

to a landfill requirement of 1.43 million cubic yards from the north processing center and .74 million cubic yards from the south processing center.

T A B L E 9

ESTIMATED
5 YEAR SUM OF AMORTIZED DEVELOPMENT COSTS
FOR LANDFILLED RESIDUE

SITE	SUM OF 5 YR. AMORTIZED COSTS $/1 million cu.yds.	SUM OF 5 YEAR AMORTIZED COSTS		
		North Generating Station ($)	South Generating Station ($)	Both Generating Sta. ($)
1) Santosh	54,000	77,220	39,960	117,180
2) Sandy Delta	69,000	98,670	51,060	149,730
3) Cipole	72,000	102,960	53,280	156,240
4) Alford	78,000	115,540	57,720	169,260
5) Hayden Island	78,000	111,540	57,720	169,260
6) Durham Gravel Pits	90,000	128,700	66,600	195,300
7) Burlington	99,000	141,570	73,260	214,830
8) Division Street Gravel Pits	120,000	171,600	88,900	260,500

Adding the estimated 5 year sum of amortized development costs to the estimated 5 year totals for haul costs has no impact on the ranking established by proximity of the landfill site to the generating source. In other terms, the total cost of landfilling residue can be thought of as being comprised of at least three components which are:

1. Landfill operating costs
2. Hauling costs to the landfill
3. Cost of developing a landfill

The analysis used in this report shows that hauling costs to the landfill are in the order of ten to twelve times as important as the cost of developing the site.

Findings With Regard To Economic Implications

1. Technical and environmental landfill site problems suggested by previous studies for the sites under consideration in this report appear to have feasible solutions.

2. With regard to the sites analyzed in this report, locational factors are significantly more important than developmental factors and generate the following landfill site priorities:

RESIDUE GENERATED BY NORTH PORTLAND PROCESSING CENTER	RESIDUE GENERATED BY SOUTH PORTLAND PROCESSING CENTER
1. Hayden Island	1. Division St. Gravel
2. Burlington	2. Alford
3. Division St. Gravel Pits	3. Durham Gravel Pits
4. Santosh	4. Cipole
5. Durham Gravel Pits	5. Sandy Delta
6. Cipole	6. Hayden Island
7. Sandy Delta	7. Burlington
8. Alford	8. Santosh

JURISDICTIONAL DIFFERENCES, POLITICAL CONSIDERATIONS, ZONING, AND LAND USE ASPECTS

Any landfill proposal would require approval from several jurisdictions and agencies. The following types of approval agencies may be involved:

1. Land use approvals - City or county planning agencies, governing bodies, citizens (individuals and groups), and other interest groups;

2. Technical approvals - Department of Environmental Quality, State Engineer, Department of Geology and Mineral Institutes, Division of Lands, Waterway Management and Army Corps of Engineers.

Land Use Approval Problems

It is doubtful, even under the most favorable conditions, that any land use involving solid waste will receive the qualified support of its nearest neighbors. As pointed out in previous sections of this report, the landfilling of milled refuse differs from the landfilling of unprocessed solid waste in the following ways:

1. If used only for milled refuse and not demolition wastes, traffic using the site will be mainly large tractor trailer vehicles. Each processing center would generate approximately 20 trips daily which is considerably less than the 800-1000 peak day trips generated by a conventional type of landfill. If a milled refuse site were also utilized for accepting non-processable wastes from the public, trip generation rates would be higher; perhaps in the order of 200-300 vehicles per day. In both cases, the traffic nuisance level of a milled refuse landfill or a demolition landfill after 1980 will be considerably lower.

2. Problems associated with blowing paper and litter should be considerably less due to the nature of milled refuse or non-processable waste, reduction in delivery trips, and controlled delivery methods.

3. Vectors and other pests should be eliminated or controlled for the same reasons as (2) above.

Even though these three milled refuse landfilling differences can be demonstrated, it will take a well developed information program to convince the public.

Technical Approval Problems

The main problem in receiving technical approval of any site will focus on demonstrating to the approval agency that the landfill proposal is in the best interest of the public, and the natural and physical environment will not be subject to significant deterioration.

The State Engineers Office and Department of Environmental Quality will be hard-pressed to approve a site in which some potential for water supply contamination exists. The only safe course of action is to deny approval.

Certain considerations appear to exist, however, which may support undertaking risks to solve more pressing problems. The question of land reclamation of gravel pit sites is a real problem. As long as the business sector can economically justify reclaiming these gravel pit sites, they need to demonstrate that the risks involved through reclamation by landfill are less than the value of the benefits to be accomplished. It would seem reasonable that in certain cases an operator would need to guarantee that he could be responsible for contamination of private water supplies.

If the business community is unable to justify the costs and risks involved, it will be up to the public to determine through land use action, permitting procedures, and legislation, the importance of

reclaiming the gravel pits, and the level of public risks to be undertaken.

In order to correctly balance the many interests and issues involved it is necessary for the Department of Environmental Quality, the State Engineers Office, MSD and other approval agencies to determine what could be done, if anything, to make it technically acceptable to reclaim gravel pits through landfilling of milled refuse. At the same time, it is necessary for private citizens, planning groups, and county and city governments to provide input to determine the benefits to be gained through reclamation of these sites.

Other Comments

In addition to these generalizations, more explicit comments offered by various agencies have been expressed and are mentioned here:

1. The City of Portland and North Portland would probably be adamantly opposed to any North Portland site (Hayden Island). Council members stated that they have taken care of more than their share of garbage. Although milled refuse should be publically more aesethic, and traffic generation reduced, landfills are likely to invoke adverse feelings for a long time.

2. The Department of Environmental Quality has expressed at least two concerns:

   a. The Sandy River Delta site is within the flight approach of Troutdale Airport. The Federal Aviation Administration is not likely to approve such a site because landfills attract large quantities of birds which are a serious flight hazard.

   b. The potential groundwater contamination problems associated with the Cipole site and Durham Gravel Pits suggest only a limited potential for DEQ approval.

Further, the Department of Environmental Quality's stand on any particular landfill is one of examining available evidence. What has often been termed rejection of a particular site is often simply a request for more technical data to assure that degradation of the environment will not occur.

3. The Washington County Planning staff supports the use of the Durham Gravel Pits as a regional landfill.

4. The Washington County Planning staff strongly resists siting any landfill within the flood plain.

5. Multijurisdictional review for any site within the flood plain is established by statute. It would be necessary to obtain a Corps of Engineers permit for any site developed in the flood plain. Non-flood plain sites are likely to come under the review of the State Department of Mining and Geology. Any potential site is likely to go through a review process lasting several years.

6. The Burlington site has previously been evaluated and rejected by the Environmental Quality Commission.

IMPLEMENTATION OF A REGIONAL LANDFILL SITE

Prior to the actual implementation of any regional landfill sites, a number of tasks will need to be performed. This section suggests those tasks and an orderly and efficient manner for performing them.

Pre-Action Tasks

On-going management of MSD Solid Waste Plan - MSD will maintain records of landfill utilization and estimate landfill capacity's to determine when action should be initiated for securing new sites.

Monitoring and developing technology - MSD will undertake research and collect data to analyze specific environmental impacts of handling and landfilling milled residue, shredded refuse, and unprocessed refuse. Methods for leachate containment, recovery, and treatment will be monitored and research will be undertaken as financing allows.

Monitoring unusual and specific needs - MSD should establish and maintain a list of demolition contractors, industry using demolition sites, demolition site operators, and owners of potential demolition sites. MSD should make an effort to contact these people and make them aware of the proposed MSD Solid Waste Management Plan, and how they may be impacted.

Public information program - Through utilization of the findings and data included in this report and continual updating of information, MSD should be able to present a consistent and continuing program for finding and developing new sites as required.

Action Tasks

Phase I - Notification of local jurisdictions, interested agencies and industry - Prior to undertaking any additional specific sanitary landfill site work, MSD should contact groups and organizations which are impacted by selection of a particular site. MSD may choose to solicit

various kinds of proposals to develop specific tasks in each of the subsequent phases, and in the public notification process, or may choose to perform the required work using MSD staff. An initial survey of local attitude should be used to complement work undertaken.

Phase II - Development of preliminary engineering and environmental impacts - Work performed in this phase should consist of geological reconaissance and subsurface water quality investigations, preliminary cost estimates and analysis of alternatives, traffic, nuisance, and land use impacts, and an economic impact statement using cost benefit analysis.

Phase III - Public hearings on preliminary engineering and environmental assessments - MSD should utilize the preliminary engineering and environmental assessment to obtain conditional approvals of approving agencies, final land use approvals, and comments from all interested parties. In addition, public hearings should be conducted.

Phase IV - Final engineering and obtaining necessary permits - The final engineering on specific sites should be completed and the required final technical approvals obtained from the Department of Environmental Quality, the State Engineers Office, the Corps of Engineers and others as required.

Phase V - Construction and commencement of operations - During the construction phase, public information programs should be utilized to advise the general population of the extent and nature of the new landfills.

The pre-action tasks outlined are a part of the MSD Solid Waste Plan and should be borne mainly by MSD. The action tasks could be performed and financed by MSD, private industry, or a combination of both, as needs and circumstances dictate.

PHYSICAL FEATURES OF PROPOSED LANDFILL SITES

SITE LOCATION	LIMITATIONS / UNUSUAL FEATURES	EXISTING USE / FUTURE USE	OWNER / ACREAGE	SCREENING / CAPACITY EST.	SURFACE WATER DRAINAGE	GROUND WATER CONTAMINATION POTENTIAL	COVER MATERIAL AVAILABILITY	ACCESS
1. Sandy Delta Sec. 24, T1N R3E Sec. 19, T1N R4E	1. Previously defeated by well organized citizens lobby. 2. FAA concerns	Undeveloped / ?	Reynolds Aluminum / 1400 acres	Limited screening along 80N req'd / 50 million cubic yds.	Diking req'd for high velocity discharges of Sandy River (flood plain)	High, however, no consumptive uses. Site lining required.	Import required	Off 80N Good access
2. Hayden Island Sec. 19, 28, 29 30, 33, T2N R1E		Undeveloped / Park or open space	Numerous Private Owners	Limited screening req'd. / 29 million cubic yds.	Considerable diking required with pumping (flood plain)	Site lining required.	Import required	Serious problem; Only existing access through Jantzen Beach Shopping Center
3. Burlington Sec. 17, 20, 21, 28, T2N, R1W	1. Rejected by EQC previously.	Undeveloped / ?	Burlington Northern Inc. / 200 acres	? / 3 million cubic yds.	Flood plain; Diking required with pumping.	Site lining required.	Import required	Off US 30; Fairly good.
4. Alford Sec. 29, 30 T2S, R3E	1. Impact on Clear Creek. 2. Mining operations.	Unused; mining site proposed. (Gravel) / Park	Bob Alford / 400 acres 150-200 (landfill)	Site somewhat remote / 3-4 million cubic yds.	Considerable surface drainage required around site.	Estimated to be fairly low.	Available on site.	Access over rural roads. Not designed for truck traffic.
5. Cipole Sec. 22 T2S, R1W	1. Local water supplies. 2. Wash. County approval difficult 3. Flood plain.	Unused; flood plain gravel pits / Light industrial	Leveton Thompson Indus; Barstad & Albertson / 315 acres	? / 9 million cubic yds.	Local drainage little problem. Flood plain, requires diking.	Fairly high potential; Site lining required.	Low permeability Cover material needs to be imported.	Off 99W Good access
6. Santosh Sec. 29, T4N, R1W	1. Existing landfill.	Existing landfill site. / Recreational area.	Santosh Properties, Inc. / 280 acres	? / 6 million cubic yds.	Diking required with pumping. (flood plain)	Fairly low.	Available on site.	3 miles off US 30 Other modes available.
7. Durham Gravel Pits Sec. 13, T2S R1W	1. Not all owned by County.	Gravel Pits / "Intensive Urban use"	Washington County / 70 acres	Screening required / 2.5-2.8 million cubic yds.	Local drainage only. No serious problem.	High	Import required	Directly off I-5 Excellent

PHYSICAL FEATURES OF PROPOSED LANDFILL SITES

SITE LOCATION	LIMITATIONS UNUSUAL FEATURES	EXISTING USE / FUTURE USE	OWNER / ACREAGE	SCREENING / CAPACITY EST.	SURFACE WATER DRAINAGE
1. Sandy Delta Sec. 24, T1N R3E Sec. 19, T1N R4E	1. Previously defeated by well organized citizens lobby. 2. FAA concerns	Undeveloped / ?	Reynolds Aluminum / 1400 acres	Limited screening along 80N req'd / 50 million cubic yds.	Diking req'd f high velocity discharges of Sandy River (flood plain)
2. Hayden Island Sec. 19, 28, 29 30, 33, T2N R1E		Undeveloped / Park or open space	Numerous Private Owners / 740 acres	Limited screening req'd. / 29 million cubic yds.	Considerable diking require with pumping (flood plain)
3. Burlington Sec. 17, 20, 21, 28, T2N, R1W	1. Rejected by EQC previously.	Undeveloped / ?	Burlington Northern Inc. / 200 acres	? / 3 million cubic yds.	Flood plain; Diking require with pumping.
4. Alford Sec. 29, 30 T2S, R3E	1. Impact on Clear Creek. 2. Mining operations.	Unused; mining site proposed. (Gravel) / Park	Bob Alford / 400 acres 150-200 (landfill int)	Site somewhat remote / 12 million cubic yds.	Considerable surface draina required aroun site.
5. Cipole Sec. 22 T2S, R1W	1. Local water supplies. 2. Wash. County approval difficult 3. Flood plain.	Unused; flood plain gravel pits / Light industrial	Leveton Thompson Indus; Barstad & Albertson / 315 acres	? / 9 million cubic yds.	Local drainage little problem Flood plain, requires dikin
6. Santosh Sec. 29, T4N, R1W	1. Existing landfill.	Existing landfill site. / Recreational area.	Santosh Properties, Inc. / 280 acres	? / 6 million cubic yds.	Diking require with pumping. (flood plain)
7. Durham Gravel Pits Sec. 13, T2S R1W	1. Not all owned by County.	Gravel Pits / "Intensive Urban use"	Washington County / 70 acres	Screening required / 2.5-2.8 million cubic yds.	Local drainage only. No serious problem.
8. Division Street Gravel Pit.	1. Local water supplies could be contaminated	Gravel Pits / ?	Multnomah Land Reclamation, Inc. / 32 acre	Screening required / 4+ million cubic yards	No known problem

ICAL FEATURES OF PROPOSED LANDFILL SITES

OWNER / ACREAGE	SCREENING / CAPACITY EST.	SURFACE WATER DRAINAGE	GROUND WATER CONTAMINATION POTENTIAL	COVER MATERIAL AVAILABILITY	ACCESS
Reynolds Aluminum 1400 acres	Limited screening along 80N req'd 50 million cubic yds.	Diking req'd for high velocity discharges of Sandy River (flood plain)	High, however, no consumptive uses. Site lining required.	Import required	Off 80N Good access
Numerous Private Owners 740 acres	Limited screening req'd. 29 million cubic yds.	Considerable diking required with pumping (flood plain)	Site lining required.	Import required	Serious problem; Only existing access through Jantzen Beach Shopping Center
Burlington Northern Inc. 200 acres	? 3 million cubic yds.	Flood plain; Diking required with pumping.	Site lining required.	Import required	Off US 30; Fairly good.
Bob Alford 400 acres 150-200 (landfill int)	Site somewhat remote 12 million cubic yds.	Considerable surface drainage required around site.	Estimated to be fairly low.	Available on site.	Access over rural roads. Not designed for truck traffic.
Leveton Thompson Indus; Barstad & Albertson 315 acres	? 9 million cubic yds.	Local drainage little problem. Flood plain, requires diking.	Fairly high potential; Site lining required.	Low permeability Cover material needs to be imported.	Off 99W Good access
Santosh Properties, Inc. 280 acres	? 6 million cubic yds.	Diking required with pumping. (flood plain)	Fairly low.	Available on site.	3 miles off US 30 Other modes available.
Washington County 70 acres	Screening required 2.5-2.8 million cubic yds.	Local drainage only. No serious problem.	High	Import required	Directly off I-5 Excellent
Multnomah Land Reclamation, Inc. 32 acre	Screening required 4+ million cubic yards	No known problem	High	Some cover material available	Good access.