CHAPTER 2

BACKGROUND OF THE PLANNING AREA

This chapter identifies and summarizes locational criteria for the siting of solid waste disposal facilities. It also reviews the areas of Pierce County which potentially meet the criteria of WAC 173-351 as analyzed for the siting of a county-owned municipal solid waste landfill.

The first three sections describe the characteristics of the county pertinent to siting disposal facilities, summarize the State's locational criteria found in WAC 173-304 and WAC 173-351, and identify zoning requirements for these facilities.

The fourth section summarizes the process and results of the *Pierce County Landfill Siting - Phase I: Countywide Screening Study*, published in April 1995. The Phase I study identified broad general areas with the potential for meeting the State's criteria. It included additional conservative parameters considered appropriate for a facility that was to be County-owned. The status of the Phase II study, which evaluates potential specific sites, is described in Chapter 8.

2.1 Characteristics of Pierce County

Location and geography: Pierce County is located in western Washington state, in the south Puget Sound area (see Map 2.1). Kitsap and King Counties border it to the north, Mason County and Puget Sound to the west, the Cascade Mountain Range and Yakima County to the east, and Lewis and Thurston Counties to the south.

The county's almost 1,800 square miles varies from Puget Sound lowlands in the western half of the county, to the Cascade foothills and the 14,411 foot summit of Mount Rainier in the eastern half.

Population, land use, and transportation: Pierce County is the second most populous county in Washington State, with a population close to 700,000. A little over half (56%) live in incorporated cities and towns, with the rest living in unincorporated areas.

Most residents live in the central third of the county, along the Interstate-5 corridor, in urban areas such as Tacoma, University Place, Lakewood, and Fircrest; and to the east, Puyallup, Sumner, and Bonney Lake. In addition to residences, urban areas include a variety of commercial businesses and industry, with a major port facility in Tacoma on Commencement Bay.

The western third of the county, on the Key and Gig Harbor Peninsulas along Puget Sound, is growing in population and is more suburban, with less intense commercial or heavy industry.

The eastern third and southern parts of the county are sparsely populated, with small, rural towns and communities and federally owned lands (e.g., Mount Rainier National Park). Commercial enterprises include agriculture, recreational facilities, and timber production.

Two large military bases are located in the County, Fort Lewis Army Base and McChord Air Force Base, which are adjacent to the cities of DuPont and Lakewood.

Climate and air quality: Pierce County has a west coast marine climate. Temperatures,

humidity, and winds all tend to be moderate, with cooler temperatures found in the higher elevations (above 5,500 feet). Average summer high temperatures in the lower elevations range from the upper 70's to the lower 80's (degrees F), while summer high temperatures at higher elevations average 58 degrees. Winter average temperatures at lower elevations are in the 40's, but range from the mid-30's to well below freezing at higher elevations.

Precipitation in the county varies widely, with precipitation generally increasing with elevation. In the lower elevations, average annual precipitation is about 40 inches, while at Paradise, near Mount Rainier (5,500 feet), the average is 105 inches. Most of the annual precipitation occurs between October and March, with seasonal dry spells often occurring in July and August.

In Pierce County, the U.S. Environmental Protection Agency (EPA), the Washington State Department of Ecology (DOE), and the Puget Sound Air Pollution Control Agency (PSAPCA) all regulate acceptable levels of air pollutants and emissions of contaminants.

DOE and PSAPCA maintain a network of air quality monitoring stations throughout the county which track pollutants such as particulate matter, ozone, carbon monoxide, and sulfur dioxide. Since 1970, air quality has improved significantly in Pierce County as a result of federal, state, and local efforts.

Geology and soils: Glacial activities produced much of Pierce County's geology. Glacial sediment covers the western and central portions of the county, except for steep slopes along the Puget Sound and rivers, and isolated mud flow deposits and peat bogs. The eastern Cascade foothills are bedrock covered with a thin layer of rock fragments and water borne materials.

Pierce County soils are similar to other soils found in the Puget Sound area, formed mostly of glacial till, outwash, and alluvium deposits.

Glacial till is a fine clay containing pebbles and rocks which was left behind after the melting of glaciers. It is generally highly compacted and exhibits low permeability, which affords a natural protection to groundwater from surface infiltration.

Outwash is sand and gravel that has been transported by streams of water from glaciers. It typically occurs near the surface and can be 60 feet or more in thickness, but typically less than 20 feet. It is highly permeable.

Alluvium deposits consist of sedimentary material deposited by flowing water. It consists of mud, sand, and gravel.

The central and western parts of the county have generally shallow drained soils on top of glacial till. The eastern upland soils are generally shallow and poorly drained, based on bedrock, glacial till, and outwash. County river valleys generally have the most productive soils, formed from the deepest and best drained varieties of alluvium.

Hydrology: Ground water is the sole-source of drinking water for about two-thirds of Pierce County's population. The City of Tacoma, however, gets most of its drinking water from the Green River.

The county has a number of areas where permeable soils (glacial outwash) overlay shallow aquifers which provide drinkable water for large portions of the county's population. Spills or mismanagement of wastes in these areas could result in contamination of water supplies.

Pierce County has identified nearly 2,000 wetland sites in unincorporated areas which are larger than one-quarter acre. These are

usually areas where the underlying geologic unit is of low permeability (glacial till), which is also the type of soil that Federal and State criteria favor for the siting of landfills because impervious hardpan conditions associated with glacial till inhibit drainage into underlying aquifers. Another function of wetlands, which is very important to surface water quality, is to detoxify or filter certain types of contaminants from the water.

Since wetland sites often function as groundwater recharge areas, contamination of wetlands could result in contaminated ground water. However, depending on the particular hydrogeologic conditions of an area, a specific wetland may or may not contribute to the recharge or otherwise affect major aquifer systems in the area. For this reason, areas containing wetlands are not automatically excluded from consideration for landfill siting. The specific characteristics of individual wetlands must be assessed for determining the impacts to ground and surface water.

In 1993, EPA approved designation of the Central Pierce Aquifer System as a sole-source aquifer. In this particular area, the designation is a recognition that there is a *system* of aquifers that may or may not be interconnected, as opposed to just one aquifer. For local consideration, it is an indication that site assessments need to be made for each individual project that may impact aquifers in the area. Site-specific assessments are required for landfills through the Solid Waste Permit administered by the Tacoma-Pierce County Health Department. Sole-Source Designation only provides limited Federal protection and it means only that federal financially-assisted projects proposed over the aquifer area are subject to EPA review to ensure that they do not create a significant hazard to public health.

The boundaries for the area designated by EPA extend significantly beyond the Clover-Chambers Creek (CCC) Basin originally proposed by the Tacoma Pierce County Health Department for aquifer designation. Studies have identified the CCC Basin, which is just one basin within the area, as the important aquifer within the whole area that is particularly vulnerable. As explained in the designation report, the whole designated area is geologically quite complex. The 1992 Solid Waste Plan discussed the aquifer designation and the inadvisability of siting a new landfill within the original CCC Basin boundary. For areas outside of the CCC Basin, but within the area designated by EPA, individual site characteristics -- such as soil, groundwater movement, etc. -- must be evaluated to determine potential impacts.

Map 2.1 depicts Pierce County and its cities.

Map 2.2 depicts the Clover-Chambers Creek Basin and the EPA designated area for the Central Pierce Aquifer System.

[INSERT MAP 2.1 OF PIERCE COUNTY WITH CITIES]

COUNTY MAP SHOWING PLANNING AREA AND KEY FEATURES

**[INSERT MAP 2.2 CLOVER -
CHAMBERS CREEK BASIN AND THE
EPA DESIGNATED AQUIFER]**

2.2 State Location Criteria

Two of the State's regulations apply locational criteria for solid waste disposal facilities -- WAC 173-351 for municipal solid waste landfills (MSW) and WAC 173-304 for all other landfills and solid waste handling facilities.

MSW landfills - WAC 173-351: The State of Washington's regulations governing the design and operation of landfills were revised in 1993 by WAC 173-351, *Criteria for Municipal Solid Waste Landfills.* These revised regulations supersede MSW requirements in WAC 173-304, *Minimum Functional Standards for Solid Waste Handling* (MFS). The new WAC 173-351 revisions are based on federal requirements to conform with the U.S. Environmental Protection Agency (EPA) Final Rule for Subtitle D of the Resource Conservation and Recovery Act (RCRA), *Solid Waste Disposal Facility Criteria* (40 CFR, Parts 257 and 258), and on generally accepted engineering practice.

Demonstration factors: The new rules contained in WAC 173-351 handle the variance process much differently than the MFS regulations in WAC 173-304. Demonstration factors and procedures are now clearly specified as a substantive part of the criteria, within the text of WAC 173-351.

Under the MFS regulations in WAC 173-304, landfill owners or operators could apply to the jurisdictional health department, such as the Tacoma-Pierce County Health Department, for a variance from any section of the regulations. The owner or operator could submit an application accompanied by information required by the Health Department. The Health Department would review and hold hearings on this application separate from the general landfill permit process. Criteria for variances are not included in WAC 173-304, but are maintained in a separate document, as Technical Information Memorandum 88-1, prepared by the Department of Ecology.

The revisions in WAC 173-351, incorporate a demonstration process (as opposed to a variance) as developed by the EPA in the promulgation of the Final Rules for RCRA Subtitle D (40 CFR, Part 258). WAC 173-351-100 defines a demonstration as a "showing by the [landfill] owner or operator that human health and the environment can be protected as equally as a given requirement in the regulation."

For each locational restriction (for example, siting of a landfill within the boundaries of a designated sole-source aquifer), WAC 173-351 lists relevant demonstration performance criteria rather than blanket prohibitions. These performance criteria establish an objective basis on which to determine whether the human health and environment are being preserved to the level intended by the regulation. Unlike the variance procedures, in the new demonstration performance the landfill owner or operator offers the demonstrations during the solid waste permitting process, rather than at a separate variance hearing. If during permitting, the owner or operator successfully shows how the landfill complies with the demonstration performance criteria, WAC 173-351 enables the Health Department to issue the landfill permit.

In permitting a landfill in Pierce County, the regulatory demonstration factors most likely concerned would involve wetlands and the sole-source aquifer.

Locational restrictions: RCW 70.95.165 specifies items that a municipality must consider in siting a disposal facility. The two WACs specify the standards for these criteria. The following is a summary list of

physical location restrictions as defined in WAC 173-351 for which specific demonstration performance factors must be applied. There are additional restrictions relating to design and operation, such as air emissions, cover material, capacity, climatic factors, and availability of natural soils for cover, which impact location. Please refer to WAC 173-351 or any subsequent WAC which is adopted to supersede WAC 173-351 since the following does not attempt to define all of the standards or how they are to be applied.

- Airport safety areas
- Flood plains
- Wetlands
- Critical habitat for endangered or threatened species
- Holocene fault
- Seismic impact zone
- Unstable areas
- Groundwater
- Sole-source aquifer
- Drinking water supply wells
- Surface water
- Land use
- State and National Parks

Other landfills -- WAC 173-304: The 1993 revisions to the WACs were only concerned with municipal solid waste landfills. All other types of landfills, such as inert, woodwaste, ash, or limited-purpose landfills, still must meet the criteria of WAC 173-304, *Minimum Functional Standards*. Those landspreading disposal sites, piles, or surface impoundments which are to be closed as landfills and are not used for storage or recycling also must meet these requirements. Instead of the demonstration factors process used in WAC 173-351, the variance process still applies for these facilities. It allows applicants to submit a variance request to the jurisdictional health department.

Locational standards: The following is a brief summary list of the physical locational standards as defined in WAC 173-304-130 for landfills other than municipal solid waste landfills. This list does not attempt to define or summarize all of the standards or how they are to be applied. Please refer to WAC 173-304 or any subsequent WAC which is adopted to supersede the *Minimum Functional Standards*. There are also substantial design and operating criteria which effect the locational standards.

Inert and demolition waste landfills:

- Unstable slopes

Woodwaste landfills:

- Surface water
- Down-gradient drinking water supply wells

All other landfills or facilities to be closed as landfills:

- Holocene faults
- Groundwater
- Sole-source aquifer
- Down-gradient drinking water supply wells
- Flood plains
- Surface waters
- Slope
- Cover material
- Climatic factors
- Land use
- Airport runways

- Critical habitat for endangered or threatened species of plants, fish or wildlife
- Locally-adopted comprehensive plans or zoning requirements and solid waste management plans
- Toxic air emissions

Waste-to-energy facilities: There are no specific locational criteria in WAC 173-304 for the siting of waste-to-energy facilities other than they must be in compliance with comprehensive land use plans, zoning, and comprehensive solid waste management plans. There are substantial requirements for the design and operation of these facilities. Like all solid waste facilities, they must meet state and federal air emission control requirements or other pollution prevention requirements. The locational criteria most likely to apply in Pierce County would be zoning.

2.3 Pierce County Zoning and Permitting

Both sets of locational criteria, WAC 173-304 and WAC 173-351, require compliance with land use comprehensive plans and zoning as well as the solid waste plan. Before the Tacoma-Pierce County Health Department and the Washington Department of Ecology (DOE) can issue final approval of a solid waste permit for a disposal facility, the proposed facility must be found to be in compliance with the jurisdiction's zoning code.

Because of the nature of landfills, their size, and capacity needs, it is unlikely that new landfills can be sited within incorporated cities and still meet the residential set-back requirements of the two WACs. Therefore, Table 2.3 illustrates only the zones in which disposal facilities are allowed to be located in Pierce County under Chapter 18 of the Pierce County Code. (Permitting, zoning, and enforcement is discussed in more detail in Chapter 10.)

Table 2.3 Pierce County Zoning (as of January 1999)		
Disposal Facility	**Urban Zone Classifications**	**Land Use Permit Processes**
Inert Landfills	Employment Center (commercial/industrial area)	Permitted outright[1] or as an accessory use to mineral extraction sites
	Residential - Moderate Density Single Family	As an accessory use to a mineral extraction site, it requires a Conditional Use Permit[2]. It is not allowed otherwise. If it is a publicly-owned facility, it requires a Public Facility Permit[3].
Woodwaste or demolition landfills	Employment Center	Privately-owned facilities are permitted outright. A publicly-owned facility would require a Public Facility Permit.
MSW (municipal solid waste), ash, or limited purpose landfills	Employment Center	Requires a Public Facility Permit.
Special Waste-to-Energy Facilities[4]	Employment Center	Permitted outright. Small-scale facilities under 12 tons are allowed as an accessory use.
MSW Waste-to-Energy Facilities[5]	Employment Center	Requires a Public Facility Permit
Rural Zone Classifications		
Inert Landfills	All rural residential zones, Forest Lands zone, and Agriculture Zone. Not allowed in rural commercial zones.	Conditional Use Permit required for a privately-owned facility. A Public Facility Permit required for a publicly-owned facility
Woodwaste or demolition landfills	All rural residential zones, Forest Lands zone, and Agriculture Zone. Not allowed in rural commercial zones.	Conditional Use Permit required for a privately-owned facility. A Public Facility Permit required for a publicly-owned facility
MSW, ash, or limited purpose landfills	All rural residential zones, Forest Lands zone, and Agriculture Zone. Not allowed in rural commercial zones.	Conditional Use Permit required for a privately-owned facility. A Public Facility Permit required for a publicly-owned facility
Special Waste-to-Energy Facilities	Not allowed.	A Waste-to-Energy Facility that burns under 12 tons per day and does not handle municipal solid waste can be allowed as an accessory use.
MSW Waste-to-Energy Facilities	All rural residential zones, Forest Lands zone, and Agriculture Zone. Not allowed in rural commercial zones.	Conditional Use Permit required for a privately-owned facility. A Public Facility Permit required for a publicly-owned facility

[1] A facility that is permitted outright does not require a public hearing permit review, although it must meet all other permitting requirements.

[2] A Conditional Use Permit requires a public hearing review process.

[3] A Public Facility Permit is similar to a Conditional Use Permit. It requires a public hearing review process and there are additional factors to be considered related to public ownership of the facility.

[4] As defined in zoning code, a Special Waste-to-Energy Facility is one that burns over 12 tons per day of any one material, but not municipal solid waste.

[5] As defined in zoning code, an MSW Waste-to-Energy Facility burns municipal solid waste.

2.4 Summary of the *Pierce County Landfill Siting Study - Phase I: Countywide Screening* (1995)

Purpose: The purpose of the *Landfill Siting Study, Phase I* was to determine whether a new county-owned MSW landfill site could be located in Pierce County. Under RCW 70.95.165, "each county or city siting a solid waste disposal facility shall review each potential site for conformance with the standards as set by the department [Ecology]..." The decision to move ahead on the siting process was made to comply with recommendations 8-6 and 10-1 adopted in the 1989/1992 Solid Waste Management Plan:

8-6: County Government should immediately begin the public siting process for a landfill.

10-1: The County should begin preliminary siting efforts to identify locations in the county that may be suitable for a landfill. A landfill site will be required in any solid waste management strategy the County chooses.

The siting study was also done to comply with the County Council's adoption of Ordinance #91-126 titled "*An Ordinance Reaffirming Waste Reduction and Recycling as a County Priority; Selecting a Local Landfill Option as part of an Integrated System for the Disposal of Pierce County Solid Waste and Requiring Annual Reports.*"

In order to evaluate individual sites (Phase II, described in Chapter 8), the County first had to narrow the scope of the search area. Phase I applied specific criteria in WAC 173-351 and additional conservative parameters that took into account urban growth areas, transportation problems, and political issues. It also selected larger areas for buffering than required by State or Federal governments. These additional parameters were applied because County government must be both fiscally responsible to the entire electorate and sensitive to political issues. This often results in choosing stricter criteria than those required of a private applicant under State or Federal law.

The study's process and results are summarized in this section; for further information and detailed full-color maps, please review the original document, available through Pierce County Public Works and Utilities Department, Solid Waste Division.

Process: The landfill siting study defined five phases for developing a new landfill. The first phase, summarized in this chapter, established the landfill parameters and applied countywide screening criteria to identify general areas where a suitable location might be found.

The next phase identified sites and reviewed their feasibility through a progressive screening process. If the Council chooses to pursue landfilling in-county, the final phases would be to prepare an Environmental Impact Statement, obtain permits, and then to design and construct the landfill. (For more information on the site specific screening process, see Chapter 8.)

Study parameters: Ideally a sanitary landfill sited through this study would have the following properties:

- It would conform with land use planning of the area.
- It would be easily accessible in any weather conditions to vehicles expected during the operation of the landfill.
- It would have safeguards against uncontrolled gas movement originating from the disposed solid waste.

- It would have an adequate quantity of earth cover material that is easily handled and compacted.
- It would be located in an area where the landfill's operation will not detrimentally impact environmentally sensitive resources.
- It would be large enough to accommodate the community wastes for a reasonable time interval of at least 20 years.
- It would be the most economic site available commensurate with the ultimate requirements for solid waste disposal.

Pierce County's landfill siting consultants, other County agencies, and the general public, recommended that the County's siting process for a County-owned MSW landfill include defining several engineering variables. These include such things as waste stream projections, landfill design and operation regulations, and basic design criteria. The following were used for Pierce County's siting study for a county-owned landfill. These are in addition to the State's requirements and should not be interpreted as requirements for a siting study by a private entity. Municipal project proponents, in this case Pierce County, often elect a more conservative stand on project management than required by law.

The County's landfill siting study began with determining the projected amount of waste that would be generated for disposal in Pierce County using two scenarios: 1) a landfill with a twenty-year life span for all waste in Pierce County including Tacoma, Ruston, Fort Lewis and McChord AFB, and 2) a landfill with a longer life span providing disposal capacity for waste only from Pierce County and the cities and towns using the County's system. The projections used waste disposal records and population forecasts which assumed an average annual growth rate of 2 percent. It was determined that a new landfill would need to have a total life capacity of 16.2 million tons. The figures used were conservatively high in order to identify the maximum capacity needed to serve for twenty years. Over time, the actual total tonnage will change depending upon changes in consumption patterns, recycling habits, and population growth rates. For example, the average population growth rate over twenty years could range from 1.9% to 2.3% or higher.

Using these projections, the County decided that to provide capacity for an adequate useful life, the landfill footprint (that area where garbage is disposed) would need to be approximately 260 acres.

For the initial screening of general areas for Phase I, 610 acres was used based on providing for support facilities and buffers double the size required by law.

Countywide screening criteria: The study's next step considered all the regulatory location restrictions in the WAC 173-351 (Sections 130 and 140) in developing the countywide screening and site selection criteria. It used a Geographic Information System (GIS), with data supplied by Pierce County's Information Services, the Department of Planning and Land Services, and other state and federal sources, to implement the screening criteria.

Two general types of countywide screening criteria were employed: exclusionary and suitability. First, exclusionary criteria were used to eliminate areas where landfill siting is prohibited under regulatory location restrictions or because of other development constraints. The second set of criteria, suitability indicators, illustrate both positive and negative features that describe how compatible an area may be for landfill development. Selected suitability indicators

were overlaid to guide the identification of potential site areas using a process as shown in Figure 2.4.

Figure 2.4 Overlay Process

The following section further discusses the differences between prescriptive exclusionary criteria and suitability indicators.

Exclusionary criteria: The initial objective of the countywide screening in Phase I was to eliminate unsuitable areas. Countywide regulatory exclusionary criteria were developed to implement the location restrictions specified in WAC 173-351. The exclusionary criteria used more restrictive requirements than found in State law. For instance, the County excluded areas within the 500-year flood plain. State and federal law require demonstrations only within the 100-year flood plain.

Areas meeting these exclusionary criteria were mapped, using GIS analysis, to produce a composite map.

Regulatory exclusionary criteria included:

- Airport safety areas (10,000-foot radius for jet airport runways; 5,000-foot runways for piston type)
- State and National Parks (1,000-foot buffer)
- Major surface water bodies: rivers and lakes in the Shoreline Management Plan (200-foot buffer)
- Geology in sole-source aquifer area: Vashon Outwash Gravel (Steilacoom Gravel)
- Public water supply system watersheds (200-foot buffer from land areas used as controlled watersheds for drinking water systems serving the public)
- Flood plains/volcanic hazard areas (associated with mudflows from Mt. Rainier) based on 500-year flood plains of major drainages
- Holocene fault areas (200-foot buffer; no Holocene faults identified within study area)
- Unstable areas: Severe landslide hazard (soils with steep slopes >45%)

Non-regulatory criteria: Other non-regulatory exclusionary criteria were developed based on requirements specific to, and only applicable to, the Pierce County *Landfill Siting Study* to site a County-owned landfill. These additional criteria were

developed to screen out additional areas where the County government would not consider siting an MSW landfill because of perceived political or economic impediments. These non-regulating criteria are not found within the body of state or local law. The County's consultants and others, however, recommended that as the proponent the County should take a conservative stance in screening out sites, thus reducing the number of sites and acreage which would be carried forward in the Phase II Study, and for environmental review.

The net impact of applying regulatory and non-regulatory exclusionary criteria, coupled with the Study's conservative approach, is that some potentially suitable sites that would have met the4 letter of the law were screened out of the County's study.

These criteria included:

- County boundary (study area limited to the jurisdiction of Pierce County, Washington)
- Incorporated areas (siting excluded areas within municipal boundaries)
- Urban growth area: Growth Management Act (GMA) urban growth areas and other areas planned for urban density residential development
- Cross-sound transportation (areas west of Puget Sound on the Key and Gig Harbor Peninsulas were excluded because of traffic impacts to the Narrows Bridge)
- Precipitation (siting excluded areas with high annual precipitation)
- Areas far from the central part of the County requiring long and costly waste haul.

These criteria were individually mapped and used to create Map 2.5. The shaded areas on the map were excluded from further study.

Suitability indicators: The study's countywide suitability indicators are features important to consider when siting a new landfill. Suitability indicators were based on non-exclusionary location restrictions in WAC 173-351 and other factors considered important for safe and effective landfill operation. The suitability indicators include both positive and negative factors.

The study defined such features as *regulatory demonstration factors,* and treated them as a special type of suitability criteria. For example, groundwater protection within EPA's designated sole-source aquifer boundaries was considered a regulatory demonstration factor.

Other suitability indicators - not related to regulatory requirements - were defined as descriptive. For example, soils with slopes between 30-45% would generally be undesirable for landfill development.

Both types of suitability indicators are listed below, followed by indications of whether they are positive or negative. (Please see the *Siting Study - Phase I* for further discussion of suitability indicators.)

Regulatory demonstration factors

- Wetlands: National Wetlands Inventory (NWI) wetlands. It is preferred that wetlands be avoided, however if wetlands are impacted, mitigation would be required.

  Wetland sites often occur in areas with low permeability soils (glacial till) which is the preferred hydrogeologic setting for landfill siting in Pierce County. Depending on the specific hydrogeologic conditions in a given area, wetland sites may or may not contribute to recharge or otherwise affect major aquifer systems. For this reason, areas containing wetlands

are not automatically excluded. However, if landfill development disturbs wetland sites this disturbance must be mitigated in a manner consistent with local and state requirements.

- Geologic units: Suitability related to protection of groundwater within the EPA-designated sole-source aquifer boundaries.

  Within the designated sole-source aquifer system boundaries, the physical characteristics of the geologic units were used to determine the likelihood that a site area would afford the required degree of natural groundwater protection. Locations composed primarily of the very porous Vashon Outwash (Steilacoom Gravel) would be highly vulnerable and would not likely pass the regulatory demonstration criteria. Steilacoom Gravel also composes the principal geologic unit within the Clover-Chambers Creek Basin which pinpoints the need to continue to protect this area.

  Positive suitability was indicated if the geologic unit was composed of the highly compacted Vashon Till, which contains low permeability soils compacted from the weight of the overriding glacial ice sheets. The average thickness of this unit is reported to be between 5 and 30 feet in south central Pierce County, and may locally be much thicker. Its low permeability would afford a high degree of natural groundwater protection, making potential landfill suitability high.

- Critical Habitats: State or Federally listed animal species and associated habitat (*avoidance preferred*).

- Land Cover: 1,000-foot buffer around low density developed areas (*negative suitability indicator).*

Descriptive suitability indicators

- Landslide and erosion hazard: Soils with slopes 30-45% (*negative suitability indicator).*

- Existing land use types (by 40-acre 1/16th section) (*more negative as density increases).*

- Priority habitat study areas and critical fishery rivers. The priority habitats were mapped from the Washington Department of Fish and Wildlife's Habitat Study. A 1/2 mile buffer was mapped around any known threatened or endangered species habitat and 200-foot buffer identified around streams with anadramous or listed priority fish species. These distances are considered to be moderately conservative. During the siting of a landfill, the actual buffer size needed would have to be considered on a case-by-case basis.

The Phase I study used the analytic capabilities of GIS, to identify the most important features. These features were then overlaid on a combination map of exclusionary areas and select ed suitability indicators to guide the identification of potential site areas. The most likely areas for siting a municipal landfill are those which do not fall within the exclusionary areas, have glacial or Vashon till, and have the lowest density. Phase II, which looks at specific individual sites within these areas, is described in Chapter 8.

[INSERT MAP 2.5]