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United States
Environmental Protection
Agency
Water

Region 10
1200 Sixth Avenue
Seattle WA 98101

October, 1983

EPA-10-OR-Eugene/Springfield-LANE-WWTW-83

EPA

Environmental Impact Statement

Draft

Metropolitan Wastewater Management Commission
Sludge Management Plan
Eugene-Springfield, Oregon

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION X

1200 SIXTH AVENUE

SEATTLE, WASHINGTON 98101

October 28, 1983

REPLY TO ATTN OF: M/S 443

TO: All Interested Government Agencies, Public Groups and Citizens

Enclosed for your review and comment is the Draft Environmental Impact Statement (EIS) on the Metropolitan Wastewater Management Commission (MWMC) Sludge Management Plan. The Environmental Protection Agency (EPA) has given MWMC a grant for the planning phase of this project under Section 201 of the Clean Water Act. This Draft EIS has been prepared to fulfill the requirements of Section 102(2)(c) of the National Environmental Policy Act of 1969 and implementing Agency regulations.

The availability of this EIS will be announced in the Federal Register on Friday, November 4, 1983, which will begin a 45-day review period. If you have any comments on the Draft EIS or wish to provide additional information for inclusion in the Final EIS, we would appreciate hearing from you before the close of the comment period on December 19, 1983. All comments received will be used by EPA in evaluating the effects of funding the proposed project.

Please send your comments to:

Norma Young M/S 443
Environmental Evaluation Branch
Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

A public hearing on the Draft EIS will be held on December 6, 1983 at 7:30 p.m. in the Council Chambers, City Hall, 225 North 5th, Springfield, Oregon. All interested persons are invited to attend and will have an opportunity to be heard.

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

on the

Metropolitan Wastewater Management Commission
Sludge Management Plan

EPA Project No. C-410624

Prepared by:

U. S. Environmental Protection Agency
Region 10
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Responsible Official:

Ernesta B. Barnes
Regional Administrator

Date: SEP 30 1983

ABSTRACT

The Metropolitan Wastewater Management Commission (MWMC) has received a grant from the Environmental Protection Agency (EPA) to prepare a 20-year Sludge Management Plan for the treatment and disposal of sludge generated at a new regional sewage treatment plant. The regional plant is under construction and will begin operation in 1984. It will serve both the Eugene and Springfield, Oregon, metropolitan areas. MWMC proposed an interim plan, Phase I, that would provide five years of sludge handling capability on the treatment plant site because startup of the new plant depended upon immediate handling facilities for increased sludge volumes. During Phase I sludge would be applied to agricultural lands in summer and hauled to Short Mountain landfill for disposal in winter. EPA issued a Finding of No Significant Impact on Phase I of the plan in June, 1983. This Draft Environmental Impact Statement evaluates Phase II of the MWMC Sludge Management Plan. MWMC's preferred alternative for Phase II is to move the sludge handling facilities off site. Treatment and storage lagoons would store sludge in winter; sludge would be applied to farmlands in summer. This document evaluates four alternatives and three sites, including MWMC's preferred alternative. It identifies and evaluates potential impacts of the alternatives to geology, soils, public health, surface and groundwater quality, land use, vegetation and crops, terrestrial wildlife and aquatic life. Recommended mitigation measures are also discussed.

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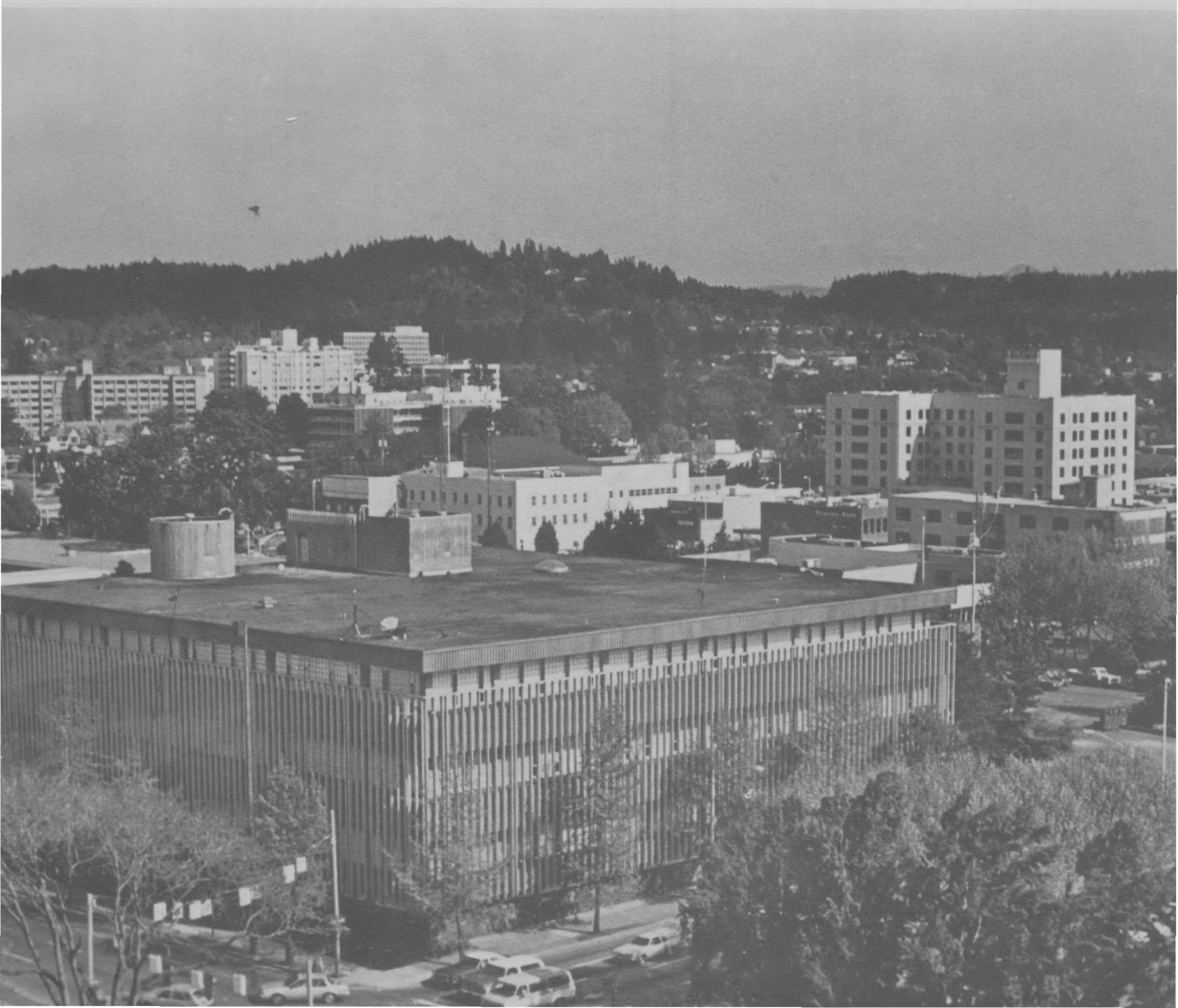


EXECUTIVE SUMMARY

(X) Draft Environmental Impact Statement
( ) Final Environmental Impact Statement

Type of Action: Administrative

Purpose and Need for Project

The Metropolitan Wastewater Management Commission (MWMC) has received funds from the U. S. Environmental Protection Agency (EPA) to plan a long-term sludge management system for the Eugene/Springfield, Oregon Regional Wastewater Treatment Plant (RWTP). These funds are administered by EPA under Section 201 of the Clean Water Act. In the future, MWMC will be applying for additional federal funds to design and construct the permanent sludge management facilities that are selected for implementation. EPA must approve the facilities plan and the grant request before design and construction of the new facilities can proceed.

The RWTP is being constructed to bring the area's wastewater discharge into compliance with the requirements of the Clean Water Act. The activated sludge treatment process designed to meet these requirements will generate nearly four times the wastewater solids produced at the existing Eugene Wastewater Treatment Plant (WTP). This volume will exceed the capacity of the existing sludge storage and disposal facilities. The RWTP is scheduled to begin full-time operation in the fall of 1984; therefore, MWMC must complete planning, design, and construction of additional sludge handling facilities in the near future.

MWMC has proposed an interim project to provide 5 years of sludge handling capacity on the RWTP site since permanent facilities cannot be completed by 1984. The EPA has conducted an environmental review of the interim plan and issued a Finding of No Significant Impact (FNSI) on July 27, 1983. The Oregon Department of Environmental Quality (DEQ) has placed the long-term MWMC project on its 1985 priority list for funding under Section 201 of the Clean Water Act. A grant request for design and construction of the permanent sludge handling facilities will be applied for as early as possible; therefore, EPA has initiated preparation of this Environmental Impact Statement (EIS) to aid in future actions on grant requests and facilities plan approval.

Role of the Environmental Impact Statement

EPA determined that granting of funds to this project would be a major federal action significantly affecting the environment. Therefore, before additional Section 201 funds for design and construction of a long-term sludge management system can be awarded to MWMC, EPA must complete an environmental review of potential impacts of the proposed project. This review must meet the requirements of the National Environmental Policy Act (NEPA). EPA has prepared this EIS to meet these NEPA requirements by evaluating the consequences of constructing and operating MWMC's proposed long-term sludge management plan.

Description of Alternatives

BACKGROUND

The cities of Eugene and Springfield, Oregon are located astride the Willamette River in the upper Willamette River Valley of west-central Oregon (Figure S-1). The Eugene/-Springfield area has a current population of over 188,000 and is a center for both agricultural and timber production in western Oregon.

There are currently two wastewater treatment plants serving the metropolitan area. Both the Eugene and Springfield WTPs are operated by the City of Eugene and both discharge secondary treated wastewater to the Willamette River. The design capacity of the Eugene plant is 17.1 million gallons per day (mgd); the Springfield plant has a 6.9 mgd capacity. The areawide water quality management plan (208 Plan) for this region has recommended combining the flows for treatment at a new RWTP at the site of the existing Eugene plant. Sludge generated at the Springfield plant is currently air-dried in both asphalt and earth-lined beds on-site; the dried sludge is used by local residents in garden and horticultural activities. The Eugene WTP sludge is stored in an on-site lagoon in the winter; in summer months, the sludge is transported to area farms for use as a crop fertilizer and soil conditioner, or sprayed on the Short Mountain Landfill to encourage cover crop growth. Current raw sludge generation rates average 40,000 gallons per month at Eugene and 13,000 gallons per month at Springfield.

INTERIM SLUDGE MANAGEMENT PLAN

Because MWMC must have expanded sludge handling facilities in place by 1984 when the RWTP is scheduled to start up, and since federal grant funds will not be available in time to construct a long-term system to meet that deadline, a phased program is being implemented. The interim plan (Phase I) that is already in progress involves purchase of mechanical dewatering equipment (centrifuges) to be used on the site of the RWTP, and additional sludge hauling equipment. Digested sludge

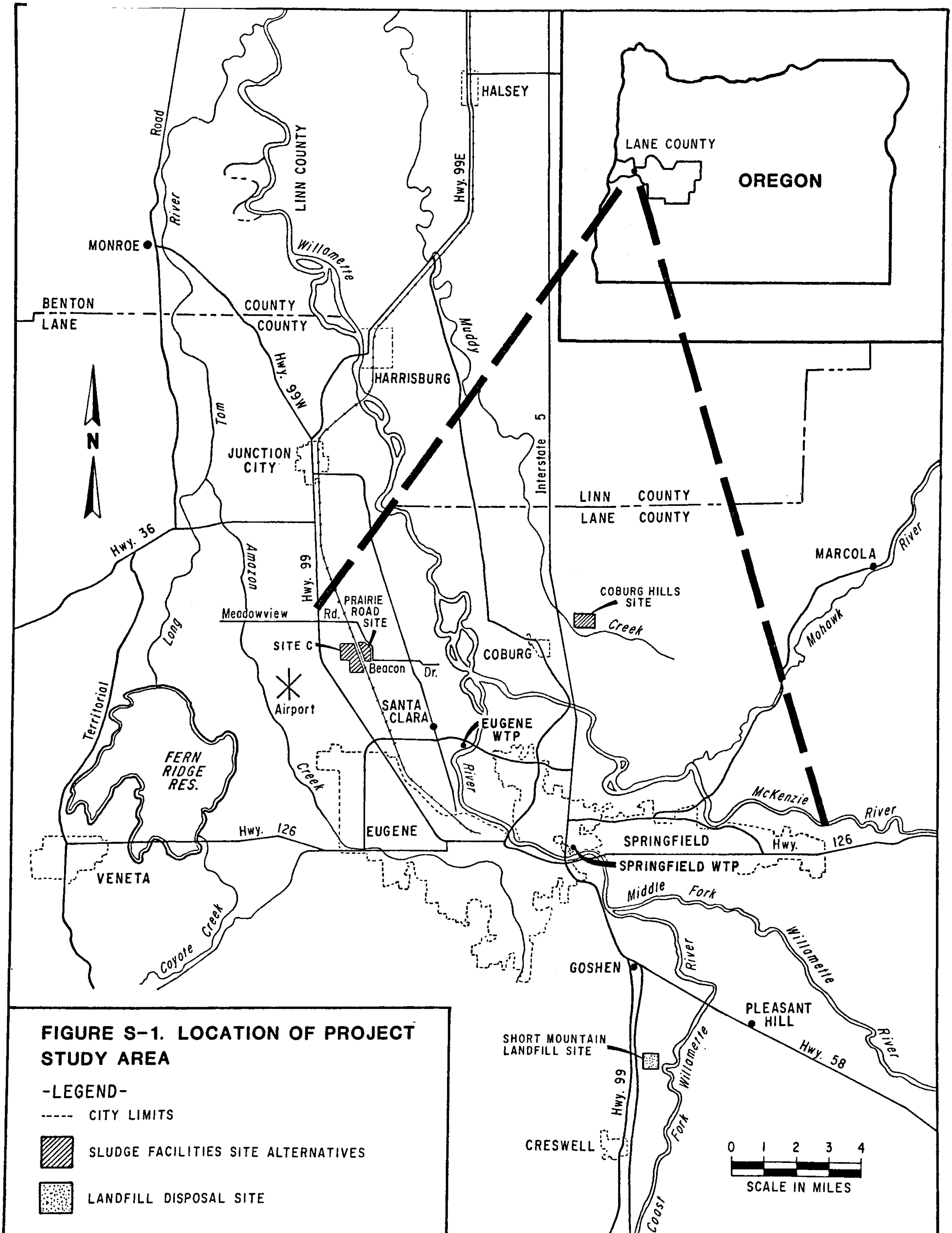


FIGURE S-1. LOCATION OF PROJECT STUDY AREA

from the RWTP will be centrifuged year-round; in the wet months of the year, the dewatered sludge will be hauled to the Short Mountain Landfill for disposal with other solid waste. In the dry months, both liquid and dewatered sludge will be hauled by trucks to agricultural land for reuse. All of the reuse sites have not been specifically identified, but they will generally be in the low-lying alluvial valley areas within 15 to 20 miles of the RWTP. It is expected that 20 percent of the dry weather volume will be applied in a liquid form and 80 percent will be mechanically dewatered or thickened before reuse. The Phase I plan is expected to handle all sludge from 1984 to 1989.

LONG-TERM SLUDGE MANAGEMENT ALTERNATIVES

The MWMC originally considered 13 base alternatives for sludge handling and disposal and a number of secondary reuse options. These were described and analyzed in the 1980 Sludge Management Program (Brown and Caldwell 1980). After several years of review and assessment, MWMC has selected a preferred long-term management plan. This EIS analyzes the preferred plan and three alternatives.

MWMC Preferred Plan (Alternative 2)

The Phase II preferred plan includes construction of facultative sludge lagoons (FSLs) and air-drying beds at an off-site location north of the city of Eugene. The preferred site has been labeled Site C (see Figure S-1). Beginning in 1990, digested sludge would be piped from the RWTP to Site C for storage in the winter and air-drying in the summer. The centrifuges purchased in Phase I would be moved to the off-site location and would provide partial mechanical dewatering before transfer to 33 acres of air-drying beds. During the dry months of the year, 20 percent of the sludge volume would be conditioned in the centrifuges and transferred directly to agricultural reuse sites. The other 80 percent would be air-dried before reuse on agricultural land. Landfill disposal would act as a back-up.

Alternative 1

Alternative 1 would be similar to the preferred plan, but the Phase I centrifuges would be abandoned in 1990 in favor of air-drying of all sludge. The sludge storage and drying would occur at an off-site location. Without the centrifuges, the air-drying bed capacity would need to be approximately 50 percent greater than Alternative 2 (a total of 50 acres). Sludge would be reused on agricultural land.

Alternative 3

Alternative 3 would retain all sludge handling and dewatering facilities on the site of the RWTP for the full 20-year planning period. By 1990 the mechanical dewatering capacity would be increased and the centrifuges would be placed in a permanent structure. Because the liquid waste stream coming from the sludge dewatering process would flow on a daily rather than an intermittent basis at selected times under this option, the RWTP wastewater treatment, sludge thickening, and sludge digestion capacity would also have to be expanded. During the winter months, dewatered sludge would go to Short Mountain Landfill; in the summer, it would go to agricultural land for reuse.

Alternative 4 (No Project)

NEPA implementation guidelines require that all EISs consider the impacts of not implementing the proposed project. In this case, No Project has been described as a failure to implement a Phase II project. After construction of the Phase I facilities, no additional sludge handling capacity would be provided for the RWTP. This implies that once sludge generation rates at the RWTP reached the capacity of the Phase I facilities, some action would have to be taken to either 1) halt increases in wastewater flows to the RWTP, or 2) initiate some acceptable means of disposing of the excess liquid sludge generated beyond 1989.

Alternative Off-Site Locations

In addition to analyzing the off-site location for sludge management facilities preferred by MWMC (Site C), this EIS considers the impacts of two alternative sites. The Prairie Road site is located immediately east of Site C, across a Southern Pacific Railroad line. The Coburg Hills site is located about 6 miles east of Site C and 3 miles north of Eugene, adjacent to Interstate 5 (Figure S-1).

ALTERNATIVES AVAILABLE TO EPA

EPA's principal roles in this project are to provide an environmental review and to administer design and construction funds available through Section 201 of the Clean Water Act. EPA has a number of options available in acting on the grant applicant's (MWMC) request for federal funding of its sludge management project. In terms of the structural configuration of processing and reuse/disposal processes, EPA could offer funds for the MWMC preferred program or some combination of processing and reuse/ disposal methods not considered in a single alternative described in the EIS or Sludge Management Program. Although this is unlikely, it could be done for environmental or economic reasons. In terms of administrative actions, after review of the facilities plan and the environmental impacts of construction of the proposed project, EPA could: 1) fund the project as described and recommended by MWMC, 2) not fund the project, 3) fund the project in stages, or 4) fund the project only after attaching certain conditions to the grant award.

These administrative actions would be in response to regulatory requirements, funding availability, environmental concerns, or some combination of all three.

If EPA determines that the project selected by MWMC is excessive in cost or would result in adverse environmental impacts which could be mitigated, it may wish to remedy these problems by placing conditions on the award of subsequent grants rather than supporting a different alternative or modifying the funding. EPA administrative procedures allow this mitigation approach and place the burden of action on the grant applicant. Grant conditions can include specific monitoring requirements, requests for supporting ordinances, or a variety of other controls on the construction and operation of sludge management facilities.

Impacts of Individual Alternatives

The environmental impacts for each project alternative are summarized in the following tables. Only the more significant impacts have been summarized. Potential mitigation measures for impacts are also listed. The mitigation measures listed are possible methods of avoiding or reducing the severity of adverse impacts. Mitigations are not necessarily those that will be implemented should a project be constructed. EPA will not be responsible for implementing all mitigations required. Local, regional, and state agencies will be called upon to initiate those mitigations that are within their respective functional capacities.

Summary Comparison of Alternatives

Four alternatives to provide long-term sludge handling and disposal for Eugene/Springfield have been investigated. Two of the options would move sludge storage and drying facilities to a location outside of the urban area and one would leave all facilities at the site of the RWTP. The fourth option would continue the present course of using an interim on-site system and would not provide a long-term sludge management solution. Three specific locations for off-site facilities have been analyzed.

Phase I of each of the four alternatives would solve the immediate need for equipment to process and dispose of the sludge that will be generated when the new Eugene/Springfield RWTP begins operation in 1984. The 5-year plan for equipment purchase and construction is identical in all four alternatives. The No Project option, however, would provide no plan beyond this first phase. The MWMC and the cities of Eugene and Springfield would be faced with a compelling need, after 1989, for an acceptable method of handling the liquid sludge generated at the

Table S-1. Summary of Impacts and Mitigation Measures - MWMC Preferred Alternative (Alternative 2)
(Centrifuges moved to off-site area; sludge stored in off-site FSLs and air-dried or mechanically dewatered)

AREA OF IMPACT	IMPACT	MITIGATION MEASURES
Groundwater Quality		
Off-site storage/drying site	o No significant increase in groundwater pollutant levels if lagoons are clay lined and surface runoff controlled. Risk of pollutant transfer greater at Prairie Road than Site C; subsurface conditions at Coburg Hills relatively unknown.	o Line FSLs with clay or similar impermeable material. o Establish groundwater monitoring network on site perimeter. o Carefully maintain and inspect FSL levels and air-drying beds. o Conduct soil explorations and permeability tests prior to construction.
RWTP site	o No significant effect.	
Short Mountain Landfill	o No significant increase in groundwater pollutant levels unless surface runoff or leachate lagoon discharge allowed to reach Camas Swale Creek.	o Expand groundwater quality monitoring system below landfill to include testing for heavy metals, pathogens, and organic toxins. o Comply with all DEQ landfill permit conditions regarding leachate collection and irrigation.
Agricultural reuse sites	o Negligible-to-slight increase in nitrate levels if sludge applied at agronomic rates on Group 2 and 3 soils; negligible increases in heavy metal and organic compound concentrations; slight increases in sodium concentrations.	o Follow the Oregon DEQ guidelines for land application of wastewater and sludge, particularly as they relate to sludge application rates. o Continue to implement the Eugene/Springfield pretreatment program to reduce heavy metals and organics at the source. o Continue to select sites with suitable soil, groundwater, and geographic features through the DEQ approval process. o Maintain a groundwater quality monitoring program at representative sludge application sites to ensure that gradual groundwater quality degradation does not occur.
Force main	o Potential for nitrate contamination of drinking water if low-level, undetected leaks occur north of Enid Station Road area on route to Site C/Prairie Road, or north of McKenzie River/I-5 junction on Coburg Hills route.	o Carefully select pipe used for force main. o Use special care in backfilling over pipe. o Pressure-test pipe after construction and at regular intervals to detect leaks.
Surface Water Quality		
Off-site storage/drying site	o Chance of minor increases in surface-water contaminants (Flat Creek tributary) at Site C during heavy rain or high groundwater periods; chances of contamination slightly greater at Prairie Road due to greater flooding threat, coarser soils; highest risk at Coburg Hills site due to presence of Muddy Creek floodplain.	o Design perimeter ditches to accommodate flows from major storm events. o Clean air-drying beds as soon as emptied in the fall. o Visually inspect lagoons and drying beds for cracks or leaks. o Retain sufficient freeboard in drying beds to handle summer storm input. o Avoid damage to drying beds from heavy equipment operation.
RWTP site	o No significant effect.	
Short Mountain Landfill	o No significant increase in surface water contamination unless surface runoff from active fill area or leachate irrigation area allowed to enter Camas Swale Creek, or leachate control lagoon allowed to overflow directly to Camas Swale Creek.	o Expand surface and groundwater monitoring systems around landfill.

Table S-1 Continued

AREA OF IMPACT	IMPACT	MITIGATION MEASURES
Agricultural reuse sites	o Decreases in the rate and level of turbidity in surface runoff from reuse sites. o Slight increases in nutrients and sodium contained in surface runoff from reuse sites; larger increases in nutrient, heavy metal and organic compound concentrations could occur if reuse areas flooded or eroded.	o Follow DEQ guidelines for selecting application sites and applying sludge. o Identify surface flooding or ponding areas on reuse sites during winter and avoid these areas during summer sludge application. o Apply sludge only during dry periods. o Monitor quality of surface water flows adjacent to sludge application sites.
Force main	o Potential for contamination of Willamette Main Stem or McKenzie River from low-level, undetected leak or major break in pipeline to Coburg Hills site; less chance of surface water contamination along route to Site C/Prairie Road.	o Design route to avoid unstable cut/fill areas. o Place pipe above 100-year flood mark at stream crossings. o Clearly mark pipeline route to avoid accidental breakage. o Periodically pressure test the force mains to detect leaks. o Develop spill response plan. o Also, see mitigations in Groundwater Quality section.
<u>Soil Character/Use</u>		
Off-site storage/drying site	o Would remove 125 (Site C, Coburg Hills) to 145 (Prairie Road) acres of agricultural land from use for minimum of 15 years; future use for food chain crops may be restricted.	o Implement mitigations suggested in Ground and Surface Water sections to reduce contamination of soils with heavy metals, organics.
RWTP site	o No significant effect.	
Short Mountain Landfill	o No significant effect.	
Force main	o No effect unless major spill occurred; future crop options could be restricted in areas of major spill.	o Implement pipe construction and surveillance mitigations contained in Surface Water Quality section.
Agricultural reuse sites	o Increase in nutrient content of soils, increasing yield of most crops. o Restrictions placed on timing of growing food chain crops, grazing of livestock. o Possible long-term restrictions on growing food chain crops if sludge applied at rates in excess of DEQ guidelines.	o Apply sludge at agronomic rates suggested by DEQ; follow DEQ sludge application timing restrictions.
<u>Public Health</u>		
Off-site storage/drying site	o Decrease in pathogen concentrations of sludge through storage, drying. o Eliminates need for winter disposal of sludge. o Potential for contamination of domestic water supplies, primarily by nitrates, if lagoon leakage occurs; risk smallest at Coburg Hills site. o Lagoons and air-drying beds may increase vector (mosquito) breeding habitat; chance of affecting humans smallest at Coburg Hills site.	o Implement mitigations suggested in Surface and Groundwater Quality sections. o Skim standing water from air-drying beds at regular intervals. o Treat standing water with mosquito oil. o Discourage growth of aquatic vegetation in lagoons.
RWTP site	o No significant effect.	
Short Mountain Landfill	o Slight risk of infection due to direct human contact by landfill users. o For risk of surface or groundwater contamination, refer to those sections above.	o Restrict public access to sludge application areas; maintain buffer strip.

Table S-1 Continued

AREA OF IMPACT	IMPACT	MITIGATION MEASURES
Agricultural reuse sites	o Hazard due to groundwater contamination minimal if coarse soil areas avoided, sludge applied at agronomic rates. o Risk of food chain uptake of contaminants eliminated if sludge applied only to non-food chain crops. o Potential health risk from direct human contact at reuse sites.	o Follow DEQ guidelines for reuse site selection. o Regularly monitor heavy metal and toxic substance content of the sludge prior to agricultural reuse. o Restrict public access at reuse sites. o Maintain buffer strips around reuse sites as required by DEQ.
Force main	o No health hazard created unless low-level leaks or major ruptures occur; see Surface and Groundwater Quality discussions for the impacts of leaks.	o Implement pipeline construction and surveillance mitigations recommended in Surface and Groundwater Quality sections.
Biological Resources		
	o No significant loss of or damage to vegetation or wildlife resources, including threatened or endangered species. o Construction of FSLs and air-drying beds will alter bird-use patterns at off-site locations, increasing fall and winter use by waterfowl and decreasing year-round use by passerine species. o Change in bird-use patterns at Site C or Prairie Road not expected to significantly increase probability of bird strikes to aircraft using Mahlon Sweet Field; use of Coburg Hills site would eliminate any chance of increase in bird strike hazard.	o Restrict growth of aquatic vegetation in FSLs o Operate FSL aerators during daylight hours to discourage waterfowl use of lagoons. o Monitor bird use of FSLs and drying beds after construction; screen ponds if significant waterfowl use occurs. o Keep on-site vegetation mowed. o Design drying beds to allow complete drainage when not in use.
Aesthetics		
Visual effects	o Change from open agricultural appearance to series of berms, ponds, and low structures at off-site facilities locations; Coburg Hills facilities highly visible from I-5; Prairie Road site highly visible from Prairie Road; Site C would have lowest visibility.	o Plant dense vegetation screen around perimeter of off-site facilities.
Odors	o Detectable odors likely to occur within 1,000 feet of FSLs/air-drying beds 10-15 days per year; detectable odor conditions may occur twice as frequently within 500 feet. Coburg Hills site would affect least population.	o Maintain and utilize FSL aeration system year-round. o Operate sludge digestion, storage, and air-drying facilities in a manner that minimizes odor generation. o If frequent odor problems occur, implement additional odor control procedures as described in EIS.
Economics of Reuse	o Economic feasibililty of agricultural reuse appears good in the near term; long-term economics also appear good, but could be affected by change in DEQ and EPA regulations and competition from other sludge reuse markets.	
Project Costs	o Total present worth cost: Site C/Prairie Road - $7,891,000 Coburg Hills - $8,292,000 o Local share of capital cost: Site C/Prairie Road - $1,770,000 o Local user costs: Site C/Prairie Road property tax/year - $2.89 in 1990 service fee/year - $5.44 in 1990 o No decrease in current market value of properties adjacent to new facilities expected; future market value unlikely to be affected unless sludge facilities improperly operated and maintained.	

Table S-1 Continued

AREA OF IMPACT	IMPACT	MITIGATION MEASURES
Land Resources		
Land use planning and zoning consistency	o Consistency of off-site facilities proposals uncertain due to current state of flux in Lane County Comprehensive Plan and Zoning Code and uncertainty as to whether proposed project fits within state solid waste management facilities definition.	o Coordinate MWMC and Lane County planning efforts in off-site facilities locations.
Land use conversion	o Use of Site C or Prairie Road would convert 80-100 acres of prime farmland to nonfarm use; Coburg Hills site not considered prime farmland. o Lane County has placed conditions on disposal of dewatered sludge in Short Mountain Landfill during winter.	
Air Quality	o No significant effect.	
Cultural Resources	o Potential impact to archeological resources from construction activity at Site C and along force main route to Coburg Hills site; presence of material on Prairie Road site unknown due to access denial.	o Obtain permission to survey Prairie Road site. o Reassess potential impacts when field surveys complete and affected areas have been more accurately delineated. o Field test archeological sites along Coburg Hills interceptor to establish site boundaries. o Coordinate further with Oregon State Historic Preservation Office prior to project design.
Energy Use	o Electrical energy consumption: 9,998,000 Kwh from 1990-2004 o Diesel fuel consumption: 6,961 gal/yr in 2004	o Utilize sludge air-drying to maximum extent possible. o Utilize sludge reuse sites as close as possible to drying site. o Purchase fuel-efficient sludge hauling equipment.

Table S-2. Summary of Impacts and Mitigation Measures - (Alternative 1)
(Centrifuges abandoned, sludge stored in off-site FSLs and air-dried)

AREA OF IMPACT	IMPACT	MITIGATION MEASURES
Groundwater Quality		
Off-site storage/ drying site	o Impact similar to that of Alternative 2 (see Table S-1).	
RWTP site	o No significant effect	
Short Mountain Landfill	o Impact similar to that of Alternative 2.	
Agricultural reuse sites	o Impact similar to that of Alternative 2.	
Force main	o Impact similar to that of Alternative 2.	
Surface Water Quality		
Off-site storage/drying site	o Threat of surface water contamination greater than that of Alternative 2 at all three off-site locations due to greater likelihood of surface runoff and flooding of site, larger acreages of air-drying beds.	o Mitigations similar to those in Surface Water Quality section of Table S-1. o Reroute surface drainage around sites.
RWTP site	o Impact similar to that of Alternative 2.	
Short Mountain Landfill	o Impact similar to that of Alternative 2.	
Agricultural reuse sites	o Impact similar to that of Alternative 2.	
Force main	o Impact similar to that of Alternative 2.	
Soil Character/Use		
Off-site storage/drying site	o Impact similar to Alternative 2 except larger acreage of soil affected (150-170 acres).	o Mitigations similar to those in Soil Character/Use section of Table S-1.
RWTP sites	o No significant effect.	
Short Mountain Landfill	o Impact similar to that of Alternative 2.	
Agricultural reuse sites	o Impact similar to that of Alternative 2.	
Force main	o Impact similar to that of Alternative 2.	
Public Health		
Off-site storage/drying site	o Impacts similar to those of Alternative 2 except larger acreage of drying beds increases potential vector breeding habitat; Site C drying beds further removed from residences along Awbrey Lane.	
RWTP site	o No significant effect.	
Short Mountain Landfill	o Impact similar to that of Alternative 2.	
Agricultural reuse sites	o Impact similar to that of Alternative 2.	
Force main	o Impact similar to that of Alternative 2.	
Biological Resources	o Impact similar to Alternative 2 except larger area of drying beds may pose slightly greater bird attraction potential.	o Mitigation measures similar to those in Biological Resources section of Table S-1.

AREA OF IMPACT	IMPACT	MITIGATION MEASURES
Aesthetics		
Visual effects	o Impacts similar to those of Alternative 2 except off-site acreage slightly larger; Site C location further removed from adjacent roads than in Alternative 2.	o Mitigation measures similar to those in Aesthetics section of Table S-1.
Odors	o Slightly greater potential for odor problems compared to Alternative 2 due to greater acreage of air-drying beds; Coburg Hills site least likely to create odor problems.	o Mitigation measures similar to those in Odors section of Table S-1.
Economics of Reuse	o Impacts similar to those of Alternative 2. (See Table S-1).	
Project Costs	o Total present worth cost: Site C/Prairie Road - $8,044,000 Coburg Hills - 8,445,000 o Local share of capital cost: Site C/Prairie Road - $1,965,000. o Local user costs: Site C/Prairie Road: Property tax/year - $3.21 in 1990. Service fee/year - 5.10 in 1990. o Property value impact similar to that of Alternative 2.	
Land Resources		
Land use planning and zoning consistency	o Impact similar to that of Alternative 2.	
Land use conversion	o Impact similar to that of Alternative 2 except prime farmland loss at Site C/ Prairie Road would be 100-120 acres.	
Air Quality	o No significant effect.	
Cultural Resources	o Impact similar to that of Alternative 2.	
Energy Use	o Electrical energy consumption: 4,496,000 Kwh from 1990-2004. o Diesel fuel consumption: 8,669 gal/yr in 2004.	o Mitigation measures similar to those in Energy Use section of Table S-1.

Table S-3. Summary of Impacts and Mitigation Measures - (Alternative 3) (Retain all sludge handling facilities on Regional Treatment Plant Site)

AREA OF IMPACT	IMPACT	MITIGATION MEASURES
Groundwater Quality		
RWTP site	o No significant effect.	
Short Mountain Landfill	o Leachate volume and leachate concentrations of NH_4+, heavy metals, and organics would increase, posing increased risk of groundwater contamination.	o Mitigations similar to those in Groundwater Quality section of Table S-1.
Agricultural reuse sites	o Impact similar to that of Alternative 2 (see Table S-1) except smaller acreage of agricultural land involved; slightly lower chance of heavy metal contamination because lower per acre application rates needed to provide desired nitrogen loads.	o Mitigations similar to those in Groundwater Quality section of Table S-1.
Surface Water Quality		
RWTP site	o No significant effect.	o Mitigations similar to those in Surface Water Quality section of Table S-1.
Short Mountain Landfill	o Continued disposal of sludge in landfill during winter would increase risk of contaminating Camas Swale Creek compared to Alternative 2, but overall risks still low.	
Agricultural reuse	o Impact similar to that of Alternative 2 except smaller acreage of agricultural land required; slightly lower chance of heavy metal contamination because lower per acre application rates needed to provide desired nitrogen loads.	o Mitigations similar to those in Surface Water Quality section of Table S-1.
Soil Character/Use		
RWTP site	o No significant effect.	
Short Mountain Landfill	o Impact similar to that of Alternative 2.	
Agricultural reuse sites	o Impact similar to Alternative 2 except smaller acreage affected; slower buildup of heavy metals at reuse sites because of higher nitrogen content compared to preferred alternative; this would extend useful life but increase acreage of reuse areas.	o Mitigations similar to those in Soil Character/Use section of Table S-1.
Public Health		
RWTP site	o No significant effect.	
Short Mountain Landfill	o Impact similar to that of Alternative 2 except long-term winter disposal of sludge in landfill could increase chances of contaminating Camas Swale Creek.	o Mitigations similar to those in Public Health section of Table S-1.
Agricultural reuse sites	o Impact similar to that of Alternative 2 except smaller acreage affected.	
Biological Resources	o No significant effect.	
Aesthetics		
Visual effects	o No significant effect.	
Odors	o Likely increase in odor complaints in the vicinity of the Eugene RWTP.	o Install effective odor control equipment on sludge centrifuge structure. o Maintain adequate retention time in sludge digesters.

Table S-3 Continued

IMPACT	AREA OF IMPACT	MITIGATION MEASURES
Economics of reuse	o Impacts similar to those of Alternative 2 (see Table S-1).	
Project Costs	o Total present worth cost: $16,366,000 o Local share of capital cost: $3,510,000 o Local user costs: property tax/year - $5.73 in 1990 service fee/year - $8.34 in 1990 o No impact on property values adjacent to facilities.	
Land Resources		
Land use planning and zoning consistency	o No apparent planning or zoning conflicts.	
Land use conversion	o No prime agricultural land loss; conditions placed on winter use of Short Mountain Landfill for sludge disposal.	
Air Quality	o No significant effect.	
Cultural Resources	o No significant effect.	
Energy Use	o Electrical energy consumption: 63,362,000 Kwh from 1990-2004 o Diesel fuel consumption: 11,166 gal/yr in 2004	o Mitigations similar to those in Energy Use section of Table S-1.

Table S-4. Summary of Impacts and Mitigation Measures - (Alternative 4 - No Project) (No Facilities Provided Beyond Phase I Sludge Disposal System)

AREA OF IMPACT	IMPACT	MITIGATION MEASURES
Groundwater Quality		
RWTP site	o No significant effect in Phase I; impact unknown beyond 1989.	
Short Mountain Landfill	o Impact similar to that of Alternative 2 during Phase I; if liquid sludge applied at landfill as Phase II remedy, significant increase in risk of groundwater contamination along Camas Swale Creek.	o Construct lagoons at landfill for winter storage of liquid sludge during Phase II.
Agricultural reuse sites	o Impact similar to that of Alternative 2 during Phase I; impact unknown beyond 1989.	
Surface Water Quality		
RWTP site	o No significant effect in Phase I; impact unknown beyond 1989.	
Short Mountain Landfill	o Impact similar to that of Alternative 2 during Phase I; if liquid sludge applied to landfill as Phase II remedy, significant increase in risk of contaminating Camas Swale Creek.	o Construct lagoons at landfill for winter storage of liquid sludge during Phase II.
Agricultural reuse sites	o Impact similar to Alternative 2 in Phase I; impact unknown beyond 1989.	
Soil Character/Use		
RWTP site	o No significant effect in Phase I; impact unknown beyond 1989.	
Short Mountain Landfill	o Impact similar to that of Alternative 2.	
Agricultural reuse	o Impact similar to that of Alternative 2 in Phase I; impact unknown beyond 1989.	
Public Health		
RWTP site	o No significant effect in Phase I; impact unknown beyond 1989.	
Short Mountain Landfill	o Impact similar to that of Alternative 2 in Phase I; risk of surface and groundwater contamination could greatly increase if liquid sludge applied to landfill in winter after 1989.	o Construct lagoons at landfill for winter storage of liquid sludge during Phase II.
Agricultural reuse sites	o Impact similar to that of Alternative 2 during Phase I; impact unknown beyond 1989.	
Biological Resources	o No significant effect in Phase I; impact unknown beyond 1989.	
Aesthetics		
Visual effects	o No significant effect in Phase I; impact unknown beyond 1989.	
Odors	o No significant effect in Phase I; impact unknown beyond 1989.	

AREA OF IMPACT	IMPACT	MITIGATION MEASURES
Economics of Reuse	o Similar to those of Alternative 2 (see Table S-1).	
Project Costs	o Total present worth cost not calculated. o Local share of capital cost: $632,000 for Phase I. o Local user costs: property tax/year - $1.03 in 1989 service fee/year - 6.08 in 1989 o No impact on property values adjacent to facilities.	
Land Resources		
Land use planning and zoning consistency	o No apparent planning and zoning conflicts in Phase I; consistency beyond 1989 unknown.	
Land use conversion	o No prime agricultural land loss in Phase I; conditions would be placed on winter use of Short Mountain Landfill for sludge disposal; Phase II impacts unknown.	
Air Quality	o No significant effect in Phase I; impact unknown beyond 1989.	
Cultural Resources	o No significant effect in Phase I; impact unknown beyond 1989.	
Energy Use	o Electrical and diesel fuel consumption identical to other alternatives in Phase I; consumption beyond 1989 unknown.	

RWTP in excess of the Phase I facilities capacity. What this solution might include is unknown.

In addition, there would not be sufficient space on the RWTP site for winter storage of increased quantities of sludge for summer agricultural application, and some off-site solution would have to be found. This might include disposal or storage at Short Mountain Landfill, or development of a separate dedicated sludge storage or disposal site. Lane County has indicated that continued winter disposal of liquid sludge would not be desirable at the landfill. With this uncertainty surrounding the mechanism for sludge disposal, it has not been possible to assess the environmental impact of Alternative 4 (No Project beyond 1989). The risks of creating public health and nuisance conditions from sludge disposal increase, however, when comprehensive planning has not been completed in advance of the need for facilities.

The other three project options provide a clear contrast in environmental effect. Construction and operation of long-term mechanical dewatering facilities at the RWTP site (Alternative 3) would create no significant land resource, aesthetic, biological, or cultural resource impacts over the 20-year project time frame. The potential for off-site public health and water quality impacts would be limited to those at the agricultural reuse sites and the Short Mountain Landfill. With winter disposal of dewatered sludge at the landfill, extra leachate and surface water control measures may be necessary to avoid public health, surface, and groundwater quality impacts downslope in Camas Swale Creek and the Coast Fork Willamette River. Approximately one-half of the sludge volumes available for reuse with Alternatives 1 and 2 would be available with Alternative 3; this would restrict the acreage that would benefit from the nutrient and soil conditioning value of the sludge. It would also limit, however, the acreage that would be placed under runoff control, access, and use restrictions by DEQ sludge management guidelines.

The land resource, aesthetic, public health, and biological resource impacts avoided by implementing Alternative 3 would be offset by considerably higher project costs and energy consumption rates. The present worth cost of Alternative 3 is more than $8 million higher than the MWMC preferred plan (Alternative 2, using Site C). The local share of capital costs would be $1.6 million dollars greater than Alternative 2. Annual electrical energy consumption for Alternative 3 would average 4,224,000 Kwh between 1990 and 2004, while Alternative 2 would require only 666,500 Kwh annually during the same time period. Diesel fuel use would be nearly twice as high annually with Alternative 3.

The two off-site facilities options (Alternatives 1 and 2) are relatively similar. Both would require purchase of agricultural land and would locate sludge storage lagoons and drying facilities in a rural setting, away from the general urban population. Because Alternative 2 would retain use of mechanical dewatering capabilities beyond the initial phase, a smaller parcel of land would be removed from agricultural use. Conditioning sludge with centrifuges would also increase the flexibility of reuse options, while decreasing the number of truck trips needed to haul a comparable portion of the sludge in a liquid form. The present worth costs and local capital costs of the two options are very similar; the local share of Alternative 2 would be about $195,000 lower than Alternative 1 because the 20-year value of the centrifuges would be grant fundable, rather than for just the initial 5 years, as would be the case with Alternative 1.

In contrast to the on-site option (Alternative 3), the two off-site facilities alternatives would create a number of impacts associated with construction and operation of FSLs and drying beds in rural farming areas. The impacts of the three site options analyzed in the EIS - Site C, Prairie Road site, and Coburg Hills site - vary somewhat, but the general implications are similar. Use of the MWMC preferred site, Site C, would remove 80-100 acres of prime agricultural land from production. It is also possible that archeological resources could be damaged or lost. With proper construction and operation of the facilities and adequate control of site drainage, there should be no significant increase in public health hazards in the area. The consistency of this land use change with state and local land use planning laws and policies, however, is uncertain due to the current state of flux in Lane County's planning for the area and differing interpretations of state solid waste management law. The proximity of the FSLs to Mahlon Sweet Field has raised concern over the threat of increased bird strike risks to airplanes using the airport.

Use of the Prairie Road site would have impacts similar to those of Site C. The facilities would be placed nearer a frequently traveled county road, however, and a larger number of property owners and residences would be affected by the facilities. The public health and bird strike risks would not be significantly different, although the periodic flooding threat would be slightly higher at Prairie Road. The chances of affecting archeological resources on the Prairie Road site are unknown.

Use of the Coburg Hills site for off-site facilities would reduce the land resource, bird strike hazard, and land use conflict effects of Alternatives 1 and 2. The site is more remote from residences and is not close to a frequently used airport. The agricultural value of the land is rated lower than either Site C or the Prairie Road site. This site, however, is more susceptible to local flooding and subsurface geologic conditions are not as well known. This could increase the risk of affecting surface and groundwater quality, but there are fewer domestic wells in the area. The chances of affecting archeological resources are greater along the Coburg Hills force main route than along the Site C/Prairie Road route. Costs and energy consumption rates would be higher if the Coburg site is used. Present worth cost estimates are $400,000 higher than Prairie Road/Site C because of the extra length of transport pipeline. The extra pumping distance would also escalate electrical energy consumption.

Public Acceptance

The MWMC sludge management planning process has been in progress since October 1977. In the 6 years that have elapsed since that beginning, there have been numerous occasions and avenues whereby public input on the course of planning has been received. While public acceptance of the evolving plan does not constitute an environmental impact of the project itself, EPA feels it is valuable to briefly describe the general reaction the public has exhibited toward the processing and reuse of sludge in the Eugene/Springfield area.

The principal avenues of public opinion on the MWMC sludge management plan have been a series of public workshops and hearings conducted in July and August 1979 on the plan environmental assessment (Brown and Caldwell 1979) and in March and June of 1983 on the interim project report (Brown and Caldwell 1982). Several citizens' advisory committees also have met throughout the planning process. Citizen committees have included the Citizens' Participation Committee, the Industrial Advisory Committee, the Sludge Advisory Committee, and finally the MWMC Advisory Committee. The MWMC Advisory Committee is an 11-member group that is still active and holds monthly open meetings. It is the citizen's forum for MWMC actions regarding sludge management planning.

EPA solicited additional public input to the project by conducting a public scoping meeting at the outset of the EIS preparation process in November 1982. The results of these numerous meetings have been published in public hearing transcripts, responsiveness summaries, meeting minutes, newspaper articles, and the MWMC newsletter. EPA has reviewed this material and a large number of letters from public agencies and local residents in order to assess public response to the project.

The public has expressed considerable concern in the majority of the letters and meeting minutes reviewed. Most of this concern has come from residents of the suburban and rural area between Junction City and the northern limits of the City of Eugene, as this is the area under primary consideration for off-site sludge handling facilities. Recently, a large number of residents in the Short Mountain Landfill area have also voiced their concern over sludge disposal at the landfill.

In contrast to the notes of concern or outright opposition, MWMC has received positive interest in the agricultural reuse aspects of its proposal from members of the farming community and from the timber industry. In response to an informational letter distributed by the Lane County Cooperative Extension Service, 22 farmland owners contacted MWMC for additional information on the availability of sludge for agricultural application. Also, in February 1981, MWMC sponsored a workshop on Sludge Utilization Opportunities in Forestry. This meeting was attended by approximately 200 representatives of both large and small timber interests in the area. As a result of the positive response, MWMC is considering a forest application demonstration project.

In summary, the MWMC sludge management proposal has met with mixed reviews from the public; strong opposition to both the location of facilities and method of reuse has been voiced by a number of residents and groups from the area immediately north of Eugene. The data and analyses presented in this EIS may answer some of the public concerns raised to date, and it is hoped that public acceptance will improve substantially through continuing public involvement in the planning, design, and implementation process.

MWMC, the Cities of Eugene and Springfield, and Lane County should continue to encourage public involvement in the development of the area's sludge management program to ensure that the resultant plan receives the widest public acceptance possible.

Coordination

Section 6.203 of the EPA procedures for implementation of the National Environmental Policy Act (Federal Register, Vol. 44, No. 216, November 6, 1979) requires that all EISs discuss the extent and results of coordination activities conducted prior to publication of EISs. This section describes the involvement of government agencies, special interest groups, and the public in general in determining the scope and content of this EIS. It also describes how, when, and where coordination efforts will continue.

Coordination efforts on the MWMC Sludge Management Program EIS began in August 1982 with publication in the Federal Register of a Notice of Intent to prepare the EIS. This was followed by an EIS scoping meeting held in Springfield, Oregon on November 17, 1982. At that meeting, approximately 60 agency personnel and interested local residents discussed the MWMC sludge management proposal and the environmental issues it was likely to raise. EPA sought guidance for the subsequent environmental investigations that it would undertake. Some of the major concerns expressed at the meeting were as follows:

- o Potential groundwater contamination and related health hazard from storage, drying, and agricultural reuse of sludge.

- o Potential health threats from leaks or breaks in the sludge pipeline.

- o Potential surface water contamination and related health hazard from sludge reuse site runoff or flooding of storage and drying sites.

- o Odor generation at the sludge storage and drying site.

- o Airborne vector health hazard at sludge storage, air-drying, and reuse sites.

- o Risk of increasing bird strike hazard in the vicinity of Mahlon Sweet Field.

- o Accumulation of pathogens or toxic materials in food chain crops grown on sludge reuse sites.

- o Increase in vector populations at sludge storage and drying site.

- o Loss or degradation of valuable agricultural land.

Since the scoping meeting, EPA has contacted a wide variety of individuals and agencies to collect background data and define project-related environmental issues. These contacts have been made in person, by phone, and by letter. In addition, EPA has participated in several MWMC Advisory Committee meetings and two public hearings on the MWMC Phase I program.

As a result of these coordination efforts, EPA focused its environmental analysis on the alternatives described in Chapter 2 and the impact areas addressed in Chapter 3. While there was no significant shift in the range of issues identified prior to the official coordination efforts, one alternative site was dropped from consideration (Four Corners) and one was added (Coburg Hills). The Four Corners site was dropped because it was learned that the City of Eugene was considering development of a portion of the site for park use. The Coburg Hills site was added because it appeared to be a feasible site that had been screened out early in facilities planning before an environmental evaluation and cost comparison analysis had been completed. In addition, its location was sufficiently isolated to minimize impacts on adjacent land uses.

This Draft EIS has been forwarded to numerous federal, state, and local agencies; special interest groups; and private citizens to act both as an informational document and as an avenue to comment on the proposed sludge management project. The distribution list is included as Appendix J. The document has been forwarded to public libraries in the Eugene/Springfield area so that all interested residents can review the potential impacts of the project.

Individuals or groups that wish to comment on the EIS may forward written comments to:

Ms. Norma Young M/S 443
U. S. Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101

A public hearing to solicit oral comments on the Draft EIS will be held by EPA on Tuesday, December 6, 1983 at 7:30 p.m. at:

City Council Chambers
City Hall
Springfield, Oregon

All oral and written comments received on the Draft EIS will be recorded and responded to in a Final EIS, which will be made available to interested individuals, groups, and agencies approximately 3 months after the public hearing.

Chapter 1

Introduction

Chapter 1

INTRODUCTION

The MWMC Sludge Management Plan

PURPOSE AND NEED FOR THE PLAN

In order to comply with the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) and the Clean Water Act of 1977 (PL 95-217), the Cities of Eugene and Springfield, and Lane County, Oregon completed an areawide water quality management plan in 1976. This plan, developed under Section 208 of PL 92-500, recommended wastewater treatment facilities that would bring the Eugene and Springfield wastewater discharges into compliance with the water quality objectives of PL 95-217. The cities' treatment plants discharge to surface waters of the United States and were not expected to be able to meet waste discharge requirements beyond 1982. The water quality management plan (208 plan) recommended construction of a single regional wastewater treatment facility for both cities at the site of the present Eugene wastewater treatment plant (WTP) (Figure S-1).

In February 1977, an agreement was signed by Eugene, Springfield, and Lane County forming the Metropolitan Wastewater Management Commission (MWMC) and authorizing the MWMC to design, construct, and operate the new regional wastewater treatment plant (RWTP). Construction of the new plant began in May 1979 and is scheduled for completion early in 1984. The MWMC also has responsibility for planning and implementing a permanent wastewater solids disposal program. In the fall of 1984, when the new RWTP is expected to go into full operation, the solids volume at the plant is expected to increase four-fold with the addition of flows from Springfield and use of an activated sludge treatment process that improves solids removal. The existing solids handling facilities at the site are not capable of accommodating this increase.

DEVELOPMENT OF THE PLAN

In October 1977, the MWMC authorized Brown and Caldwell, a consulting engineering firm, to initiate a study of long-term sludge management options for Eugene and Springfield. Brown and Caldwell's study was guided by input from MWMC and a 29-member Citizens' Participation Committee on Sludge Management. After one and one-half years of plan development, MWMC issued an environmental assessment of the early plan results (Brown and Caldwell 1979). This document was reviewed at public hearings in Junction City and Eugene in July 1979. Subsequent to this public input, further planning was undertaken. The results of over 3 years of planning were finally published in the Sludge Management Plan for the Metropolitan Wastewater Management Commission (Brown and Caldwell 1980). This plan recommended construction of a sludge force main, FSLs and air-drying beds at a location 3 miles north of Eugene between U. S. Highway 99 and the Southern Pacific Railroad line. All sludge was to be reused on agricultural land in the area. The MWMC adopted this recommended plan in early 1981.

Since the cities' adoption of the plan recommendations, implementation of the plan has been slowed by several factors. First, federal funding of the sludge management facilities was given a relatively low priority by the State of Oregon. Full funding of the long-term plan was originally scheduled in Fiscal Year 1987; this has since been moved up to 1985. Second, the EPA determined that potential impacts of the proposed project warranted a thorough environmental evaluation and disclosure to interested area residents in the form of an EIS. In response to these delays, MWMC authorized Brown and Caldwell to investigate interim sludge management measures that could be implemented in time to be available when the RWTP begins full-time operation in 1984.

After investigating a series of alternatives, Brown and Caldwell published a predesign report for a Phase I sludge management plan in December 1982 (Brown and Caldwell 1982). EPA has evaluated the proposed Phase I plan and on July 27, 1983 issued a Finding of No Significant Impact (FNSI) on the plan. Implementation of the interim Phase I plan includes purchase of mechanical dewatering equipment and sludge hauling equipment that would allow sludge to be dewatered at the RWTP site from 1984-1989. This Phase I plan is described in detail in Chapter 2.

The Environmental Impact Statement

THE ENVIRONMENTAL IMPACT STATEMENT REQUIREMENT

The MWMC will request Clean Water Act grant funds from EPA to implement its long-term sludge management plan. Before EPA approves the proposed plan and takes action on funding requests for design and construction of the long-term project, it must comply with the environmental review requirements of the National Environmental Policy Act (NEPA). This EIS addresses the significant environmental issues associated with the proposed plan, including:

- o Potential groundwater contamination at the proposed sludge processing and reuse sites.
- o Potential surface water degradation from runoff at the sludge processing and reuse sites.
- o Attraction of birds to the sludge processing site and subsequent hazard to aircraft using Mahlon Sweet Airport.
- o Public health hazards created by application of sludge to Eugene area cropland.
- o Odor and vector nuisances created at the sludge processing site.
- o Adverse effects on local property values.
- o Conversion of valuable agricultural land.
- o Degradation of local aesthetics near the sludge processing site.

These issues and others are addressed in Chapter 3 of this EIS.

ENVIRONMENTAL IMPACT STATEMENT CHRONOLOGY

The EIS was initiated in August 1982 when the Notice of Intent to prepare an EIS was listed in the Federal Register. On November 17, 1982, a public scoping meeting was conducted in Springfield, Oregon by the EIS preparation team. This was attended by both government agency personnel and interested public, and a number of issues were identified for review in the EIS. Notice of Completion of this Draft EIS, which assesses the MWMC long-range sludge management plan, was published in the Federal Register on November 4, 1983, initiating a 45-day public review of its contents and findings. A public hearing on the Draft EIS is also scheduled (see the enclosed cover letter for details). All written and oral comments received during the review period will be responded to in a Final EIS. Once the Final EIS has been completed and all environmental issues have been addressed, EPA will issue a Record of Decision on the action it will take on the MWMC Sludge Management Program and grant fund request.

ALTERNATIVES CONSIDERED IN THE EIS

In the early stages of EIS preparation, the full array of alternatives considered in the Sludge Management Program (Brown and Caldwell 1980) was reviewed. Modifications to the proposed project contained in the Predesign Report on Phase I (Brown and

Caldwell 1982) were also considered. As a result, three feasible, comprehensive sludge management options were selected for analysis of Phase II potential environmental impacts. The No-Project option (Alternative 4), which is a continuation of the Phase I sludge management system until the facilities' capacity is exhausted, is also included in this EIS.

Legal, Policy, and Institutional Considerations

EPA is required to: integrate EIS preparation with the requirements of other environmental laws and executive orders (40 CFR S1502.25; 40 CFR S6.300); identify federal permits, licenses and entitlements which must be obtained to implement an action (40 CFR 1502.25); and identify inconsistencies of an action with state and local plans and laws (40 CFR S1506.2). The federal and state environmental requirements which are relevant to either the MWMC sludge management plan or to this EIS can be found in Appendix A.

The MWMC sludge management plan must also comply with a variety of local requirements, including health department regulations, local solid waste management plans, and local land use plans. Compliance with these requirements is discussed in the text of the environmental evaluations in Chapter 3.

Existing Sludge Management Practices

The Eugene WTP is a 17.1 million gallon per day (MGD) trickling filter plant (average dry weather flow). It is operated by the City of Eugene Department of Public Works, Wastewater Management Section. Primary and secondary solids generated at the plant are thickened by either gravity or flotation thickeners prior to transfer to digesters. Solids are transferred to primary digesters which are mixed and heated. The primary sludge is then pumped to an unheated secondary digester that facilitates solids concentration (Brown and Caldwell 1980).

During the initial phase of RWTP construction on the Eugene plant site, the original sludge storage lagoon and air-drying beds were removed and a new 25 acre-foot lagoon was added. Sludge is pumped from the digesters at 2-4 percent solids and placed in this on-site lagoon. It was expected to hold all sludge generated prior to implementation of a long-term sludge management facility, but delays in that project have necessitated development of an interim sludge disposal program. Currently, sludge is pumped from the lagoon and either disposed of at the Short Mountain Landfill or spread on agricultural land (Brown and Caldwell 1980). The MWMC agricultural reuse demonstration project surface-applied approximately 4,100,000 gallons of sludge on 493 acres of cropland in 1982; 1,200,000 gallons of sludge were also surface-applied to grow cover crops at Short Mountain Landfill in 1982 (Cooper pers. comm. a).

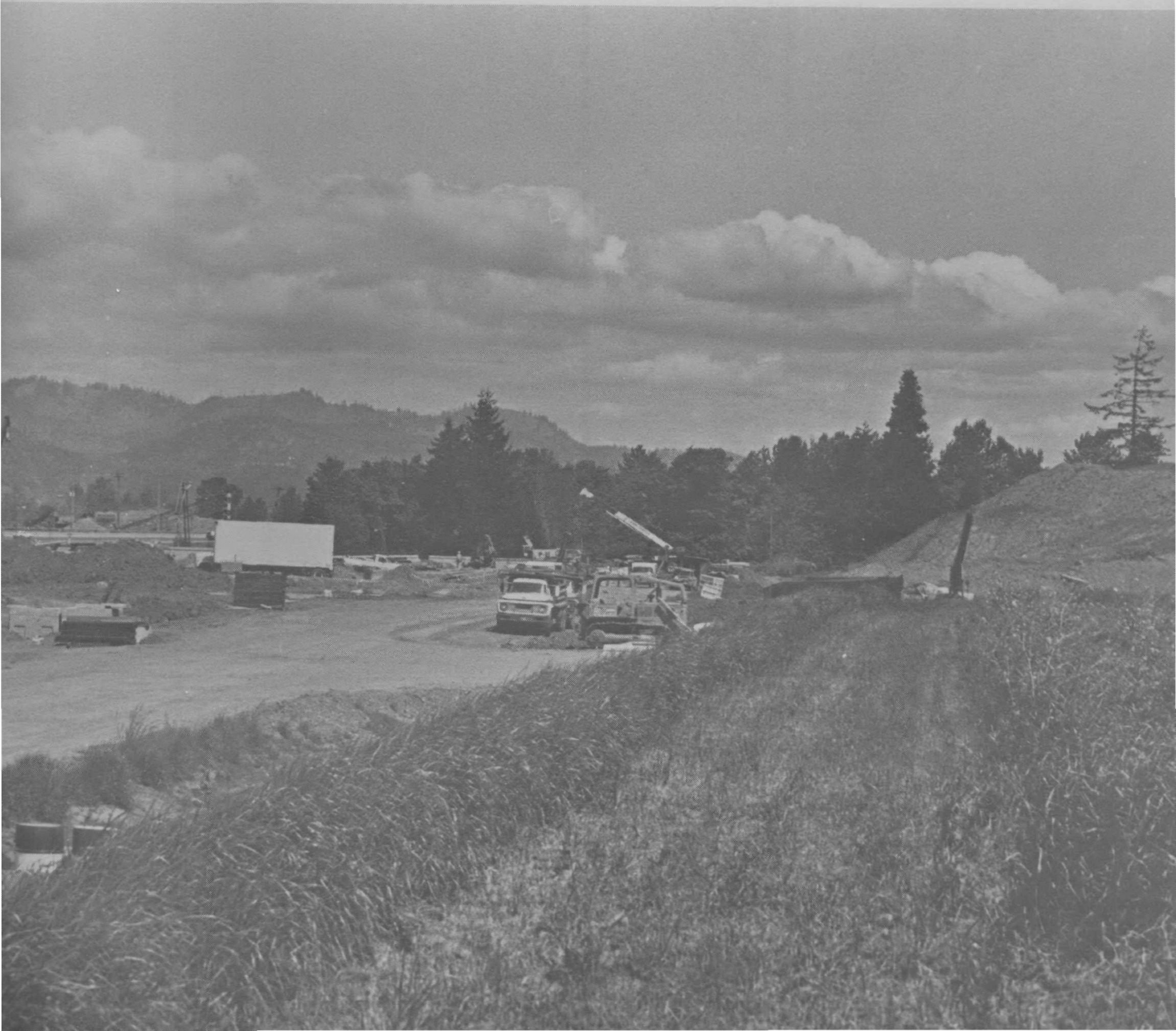
The Springfield WTP is currently operated by the City of Eugene. It is a 6.9 MGD (average dry weather flow) trickling filter plant with primary and secondary sludge digestion. All digested sludge from the Springfield plant is air-dried on-site. Two sets of air-drying beds are available. Approximately 28,800 square feet of asphalt beds are located adjacent to the digesters and 33,000 square feet of dirt-bottom beds are located outside the fenced plant site. Minimal amounts of sludge are placed in these beds during the winter; the major drying periods are late spring and early summer. When the sludge has dried, it is removed and stockpiled by a front-end loader. The entire volume of dried sludge is hauled from the plant by local residents for lawn and garden use (Brown and Caldwell 1980).

Sludge generation rates at the two plants vary throughout the year, with an extreme peak at the Eugene plant in late summer and fall due to waste flows from the Agripac vegetable processing plant. Average raw sludge volumes at the Eugene plant are around 40,000 gallons per month, with a peak often four times larger in the September canning season. Raw sludge volumes at the Springfield plant average just over 13,000 gallons per month with peaks in the spring and summer months (Vader pers. comm.). Agripac currently has its own wastewater treatment and land disposal project under construction. Once this system is completed, the extreme peaks in waste flows to the Eugene plant will be eliminated. The Agripac project is expected to be completed in 1983.

Brown and Caldwell (1980) compiled sludge quality data from 1978 for both the Eugene and Springfield treatment facilities. These data are reported in Tables B-1 and B-2 in Appendix B.

Chapter 2

Description of Sludge Management Alternatives



Chapter 2

DESCRIPTION OF SLUDGE MANAGEMENT ALTERNATIVES

This chapter presents an overview of sludge management methods, briefly describes the MWMC alternatives development and screening process, discusses the development of a two-phase plan, and describes other sludge management alternatives that are analyzed in the EIS.

Overview of Sludge Management Concepts

SLUDGE MANAGEMENT PRINCIPLES

Sewage sludge is the semi-solid material formed during the wastewater treatment process. It consists of organic and inorganic solids removed during primary treatment and organic solids removed during secondary treatment. Sewage sludge typically undergoes treatment prior to disposal or reuse to achieve volume reduction and disinfection. Following treatment, it is typically transported to a disposal or reuse site.

The sludge treatment process is designed to transform raw sludge into a more manageable form. Depending on the final usage, sludge may be thickened, digested, conditioned, dewatered, composted, dried, disinfected, and/or incinerated. Thickening increases the solids concentration, reducing the volume. Digestion stabilizes the sludge, reduces its volatile solids content, and provides some disinfection. Also, energy in the form of methane gas can be recovered using the anaerobic method of digestion. Conditioning serves to improve the sludge dewatering and may be a chemical or physical technique. Dewatering increases sludge solids content and volume, and removes a significant portion of the water contained in sludge and any dissolved constituents such as ammonium nitrate, ammonia, and potassium. Composting oxidizes part of the organic matter in sludge and can result in a drier, less odorous, and more disinfected product. Sludge disinfection removes pathogens and prevents the spread of diseases. Drying further reduces sludge moisture content and volume. Incineration greatly reduces sludge mass and volume and results in a sterile ash for disposal (EPA 1979a).

After treatment, sludge must be transported from the treatment plant to a disposal or reuse site. Transportation also may be required between the raw sludge collection point and the sludge treatment site. Common modes of transport are via truck, pipeline, barge, and train.

The final disposition of sewage sludge can include disposal or some beneficial usage. Landfilling (a disposal method) has been commonly used in the United States. Marine disposal has been essentially eliminated as a disposal system by action of the Marine Protection, Research and Sanctuaries Act. Soil reclamation, urban marketing, agricultural land application (food chain and nonfood chain crops), and forestland application are examples of beneficial reuse of sludge.

Numerous programs have been pursued to utilize the resource value of sludge. In recent years, land application programs have been operated successfully in Salem and Corvallis. Other cities such as Milwaukee and Houston have marketed successfully a dried sludge product. Although sludge products have many potential uses, opportunities for reuse are limited by certain economic factors. A brief analysis of the economics of sludge reuse in the Eugene/Springfield area is contained in Appendix G.

Sludge contains valuable nutrients and organic matter which substitute for a variety of fertilizer and soil amendment products. The form and quality of sludge, however, must meet the unique requirements of the various product markets in order to be competitive.

The nutrient requirements of agricultural markets are extensive, requiring application of large quantities of fertilizer. The relatively low nutrient concentration and slow-release nature of sludge, however, requires the application of large volumes of material to meet nutrient needs. Liquid sludge must be delivered and applied by the sewerage agency, while dewatered sludge provides some potential to share delivery and application costs. Because of public health concerns, sludge application on agricultural lands is best suited for crops not directly consumed by humans.

Forestry markets also have significant nutrient requirements. Application of sludge in all types of forest environments has increased biomass production. Established plantations show particular promise because additional management practices are minimized. Sludge use in forestlands characterized by poor soils also has demonstrated significant results. The forestry and agricultural markets provide significant opportunities for growers to reduce fertilizer costs.

The large quantity of Douglas-fir and Christmas tree sites within 25 miles of the Eugene/Springfield RWTP provides significant opportunities, not only for reuse of sludge, but also for recouping some of the costs for delivery and application. The relatively high concentration of organic matter in dewatered sludge would provide additional benefits to many forestlands with poor-textured soils.

SLUDGE MANAGEMENT APPROACHES OF UNITED STATES CITIES

The main methods for sludge disposal throughout the United States in 1982 were:

- o Incineration
- o Landfill disposal
- o Land spreading (food chain or nonfood chain cropland)
- o Distribution and marketing as fertilizer and soil amendment
- o Ocean dumping (which is being phased out)

A survey of 350 large publicly-owned treatment works (accounting for about 40 percent of the sludge produced in the United States) provided the disposal distribution shown in Figure 2-1 (Peter *in* Bledsoe 1981). With phasing out of ocean dumping, those percentages will change as alternative methods are employed. Some examples of sludge management programs used by cities throughout the United States are discussed below.

Chicago, Illinois

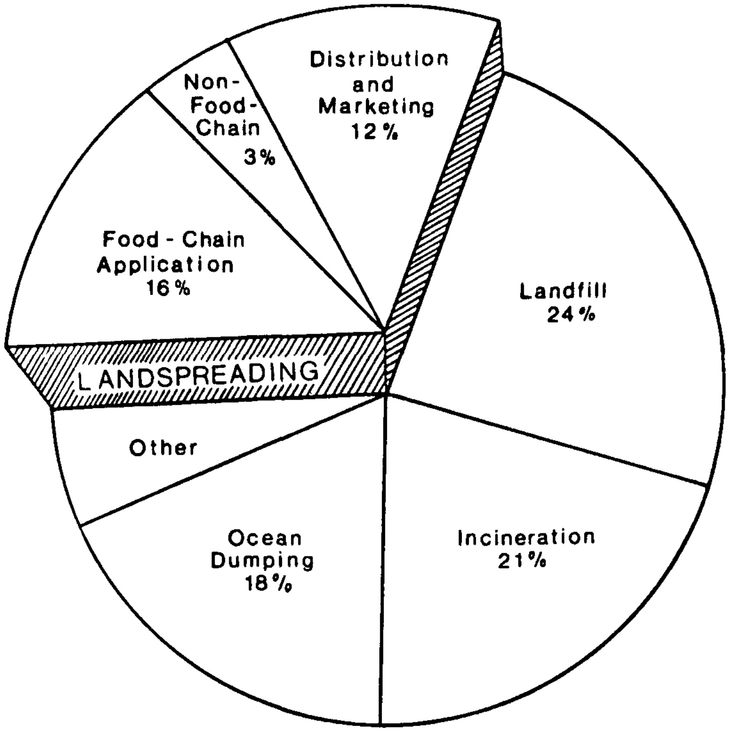
During the last 10 years, the Chicago Metropolitan Sanitary District sludge management program has consisted of reusing heat-dried, air-dried, and liquid sludge to reclaim approximately 40,000 acres of strip-mined land as compost, and as a top dressing for landfill sites. The District produces 450 dry tons of sludge per day, and presently almost all is used as a top dressing for the City of Chicago landfill or for horticultural application (Gschwin pers. comm.). Future plans include using sludge for growing nursery stock on a City-owned site north of Chicago. The soil reclamation program has been phased out for economic reasons, and the composting (NuEarth soil supplement) program has been phased out because of concerns related to heavy metals concentrations in the sludge (Gschwin pers. comm.).

Denver, Colorado

Denver uses a land application method as its primary means of disposal; landfilling is used as a backup during cold weather (EPA 1978a). Land application, employed since 1969, consists of sludge application to the land, plowing, and sowing with a forage crop 2 months following application. Cattle then graze the area. During cold weather this process cannot occur and a landfilling procedure is implemented. Sewage sludge is mixed with about 5 or 6 parts of soil and then layered on top of low areas in a landfill.

Milwaukee, Wisconsin

Milwaukee has recycled its sewage sludge as a soil conditioner since 1926. Approximately 190 dry tons per day are



THIS DIAGRAM IS COMPILED FROM DATA FROM ABOUT 350 LARGER PUBLICLY OWNED TREATMENT WORKS (POTWs) ACROSS THE UNITED STATES.

SOURCE: PETER IN BLEDSOE, 1981

FIGURE 2-1

The Distribution of Sludge According to the Method of Disposal heat-dried and packaged for marketing under the trade name of Milorganite.

Los Angeles and Orange Counties, California

Sludge management for this metropolitan area is shared by three agencies: the City of Los Angeles, the Los Angeles County Sanitation Districts, and Orange County Sanitation District. A joint management plan has been developed which calls for a combination of thermal processing with energy recovery, composting for use as a soil amendment, and landfilling. Currently, the City of Los Angeles discharges sludge to the Pacific Ocean; in 1978, it disposed of approximately 164 dry tons per day via the outfall. The Los Angeles County Sanitation Districts windrow-composts about 1,000 wet tons per day, about half of which is used as a soil amendment. The remaining compost is landfilled. Orange County Sanitation District currently disposes of its sludge at a landfill.

Tacoma, Washington

Sludge from the City of Tacoma's three primary treatment plants is anaerobically digested and then landspread. Total sludge volume is approximately 85,000 gallons per day, with the main treatment plant contributing 45,000-50,000 gallons, having a solids content of 5-6 percent. Landspreading projects have included sod farming, a topsoil product, and fertilization on local lands. Future projects planned include forest fertilization for harvest of trees as firewood, and digester gas recycling as fuel for city vehicles (Price pers. comm.).

MWMC Alternatives Development and Screening Process

DEVELOPMENT OF AN INITIAL ARRAY OF ALTERNATIVES

In developing alternatives for the MWMC project, the general handling and disposition of sludges from the liquid processing steps of wastewater treatment were divided into four components by Brown and Caldwell: processing; storage; transport; and utilization/disposal. The ultimate disposition of the sludge was determined to be the controlling factor in developing any workable combination of the four steps.

A total of 13 processing and disposal "base" alternatives were initially considered in the alternative screening process (see Figure 2-2). A base alternative was defined as a reliable sludge management system which could utilize or dispose of all of the sludge produced at the RWTP on a continuous basis. Criteria used to screen utilization/disposal options for base alternative acceptability included feasibility, reliability, environmental hazard, site availability, and cost. If an option failed to meet any one of these criteria, it was eliminated from

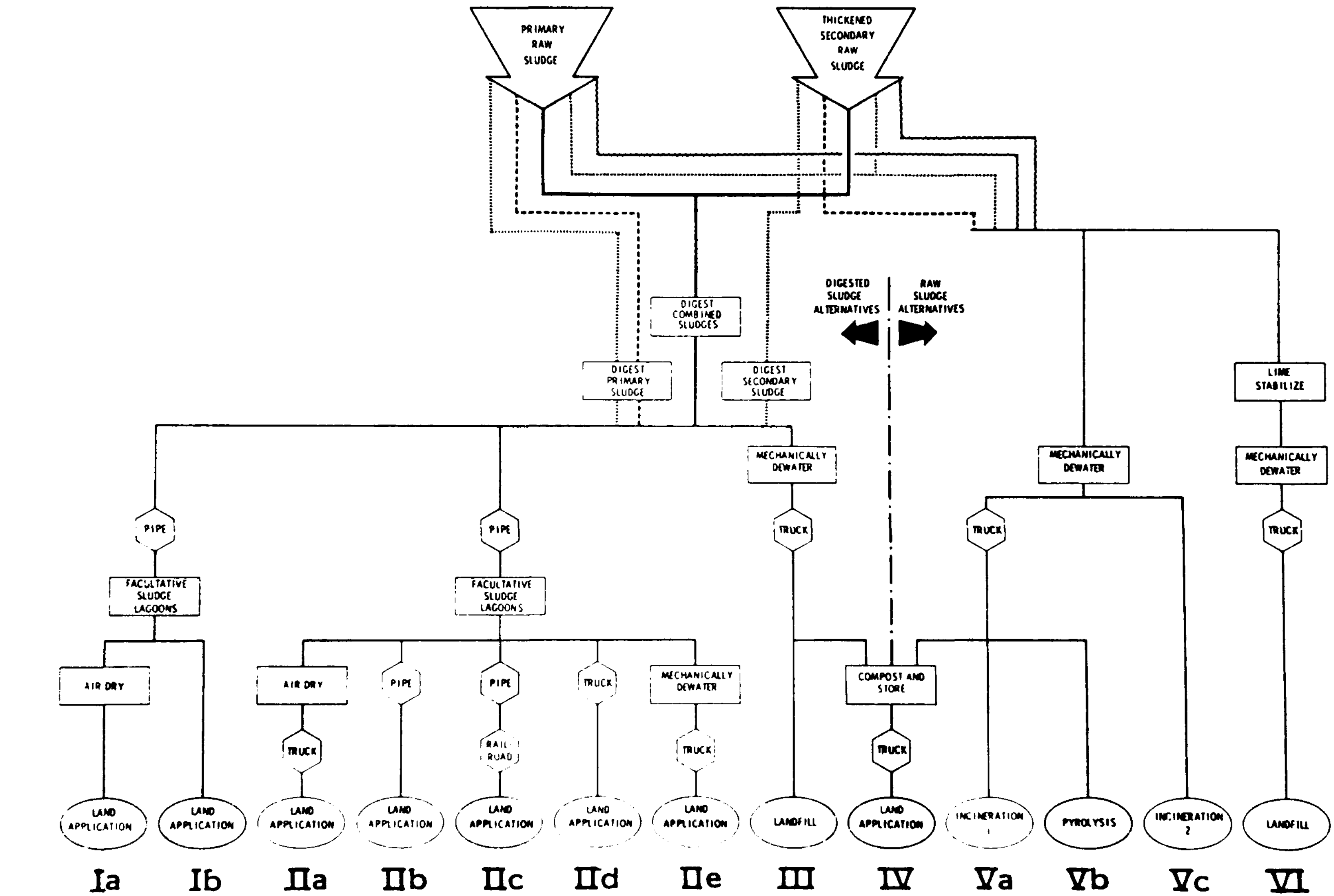


FIGURE 2-2. INITIAL ARRAY OF BASE SYSTEM ALTERNATIVES ANALYZED IN THE MWMC SLUDGE MANAGEMENT PROGRAM

SOURCE: MODIFIED FROM BROWN AND CALDWELL 1980.

further consideration. Table B-3 in Appendix B presents a matrix used for elimination of specific utilization/disposal options. The five acceptable options that resulted from the screening were dedicated land disposal (DLD), agricultural reuse on public land, landfill disposal, incineration, and pyrolysis.

After screening out processing options which were unacceptable from a technological standpoint, it was necessary to match feasible sludge stabilization options with feasible dewatering options. Five stabilization options were matched with four dewatering options. This comparison resulted in seven suitable sludge processing combinations including four digested sludge options (digest, digest/dewater, digest/air dry, and digest/dewater/compost) and three raw sludge options (dewater/-compost, dewater, and lime stabilize/dewater).

The seven acceptable sludge processing options were then matched with the five acceptable base utilization/disposal options (see Table B-4 in Appendix B). Sludge handling constraints defined which combinations were suitable. For example, simple dewatering of raw sludge was unacceptable for dedicated land disposal, agricultural reuse, or landfill disposal because of noxious odor problems.

Storage and transport needs were then considered as final components to the development of sludge management alternatives. Because winter rainfall places seasonal limits on accessibility to farmland in the Willamette Valley, and because of run-off hazards during wet winter conditions, it was determined that sludge storage would be required for all alternatives requiring land application.

Available sludge transport methods included pipeline, truck, and rail. For transport of dewatered or dried sludge, truck transport was determined to be the only feasible option since pipeline transport was not considered technically suitable and because rail transport was not considered cost-effective. For transport of liquid sludge, pipeline transport was found to be more reliable, flexible and cost-effective when compared with rail transport, and was found to have significant cost advantages over truck transport. As a result, truck transport was selected as the most suitable mode for dewatered sludge, and pipeline transport was selected as the most suitable mode for liquid sludge.

This summarizes the process in which the initial array of 13 base system alternatives were developed. No alternatives were considered that include long-term storage of sludge at the plant because the plant site has limited area. Long-term liquid sludge storage on the plant site would reduce the expansion capabilities of the plant and provide little or no buffer zone between the plant and heavily urbanized areas. Without a buffer area there would be a greater potential for odor complaints. In addition, a large amount of fill would be required to lift the

FSLs above flood stage, at the risk of seriously altering the Willamette River's flood pattern on its opposite bank.

ALTERNATIVES GIVEN FINAL ANALYSIS

The evaluation of the 13 base alternatives that had been developed resulted in the consideration of three suitable base alternatives, IIa, IIe, and III, for final analysis. These three alternatives were then combined with viable secondary reuse alternatives and the most suitable sites to develop comprehensive sludge management alternatives. Agricultural use of sludge was determined to be the best secondary reuse alternative because of the uncertainty over regulations, markets, and sludge spreading techniques associated with the other secondary alternatives (i.e., citizen giveaway, commercial topsoil amendment, and forest application). The three comprehensive sludge management alternatives selected for final analysis were:

- o Alternative IIa - Lagoon storage and air drying at Site C or the Prairie Road location; agricultural use of air-dried sludge with landfill disposal as backup.
- o Alternative IIe - Lagoon storage and mechanical dewatering at the Four Corners location; agricultural use of sludge, using half in the dewatered state and half in the liquid state; landfill disposal of mechanically dewatered sludge as backup.
- o Alternative III - Mechanical dewatering at the treatment plant with landfill disposal.

For the final analysis, these three alternatives were compared in terms of cost, environmental impact, reliability, flexibility, and program implementation. This evaluation involved rating the three alternatives within each category (details of this comparison of alternatives by evaluation category can be found in Appendix B, Table B-5).

Results of the rating showed that Alternative IIa was first in all evaluation categories with the exception of environmental impact. In that category, Alternative IIe had a higher rating because of the potential for archeological artifacts at Site C (one of the lagoon storage and air drying sites for Alternative IIa). Alternative III rated last in all categories.

Alternative IIa was eventually selected as the preferred plan by MWMC, on the recommendation of Brown and Caldwell. Alternative III had a much higher cost and was rated inferior in flexibility, reliability, implementability, and environmental impact. Alternative IIe was judged a close second to IIa, but had a higher total and local cost, would probably exhibit more severe truck traffic-related air quality and aesthetic problems, and would offer more difficulty in site acquisition. Since selection of the preferred plan, the implementation schedule has been divided into Phases I and II. Alternative IIa has been relabeled Alternative 2 in the following impact analyses. A description of the Phase I and Phase II portions of Alternative 2 follows.

The MWMC Preferred Sludge Management Program

THE PHASE I PROJECT

The MWMC is implementing its sludge management program in two phases. The facilities plan (Brown and Caldwell 1980) recommended a single phase implementation schedule, but because the full program is not scheduled for federal funding assistance until 1985, MWMC has proposed separate interim (Phase I) and long-term (Phase II) implementation steps.

A near-term Phase I project is deemed necessary because the Eugene/Springfield Regional Wastewater Treatment Plant (RWTP) is scheduled to be placed in full operation in 1984; at that time, the sludge volume produced at the treatment facility will increase from the present 28,500 gallons per day to approximately 124,000 gallons per day. Current sludge handling facilities at the site are not capable of treating, storing, and disposing of this volume. Because it is no longer possible to approve and initiate the 20-year management plan by the 1984 treatment plant start-up date, a 5-year Phase I plan (1984-1989) has been undertaken. This project is described in detail in the Predesign Report - Phase I Sludge Management System (Brown and Caldwell 1982); an abbreviated description of the Phase I project is presented below.

Sludge Generation

Wastewater will undergo activated sludge secondary treatment at the new Eugene/Springfield RWTP. The raw primary and secondary sludge by-products of this treatment will be anaerobically digested on-site. Brown and Caldwell (1982) has estimated the digested sludge production rates for 1989 (end of Phase I) and ultimate plant operation (2004); these rates are included in Table 2-1. Table 2-2 provides estimates of the concentrations of various waste constituents that are expected to be present in the sludge.

Sludge Treatment and Handling On-site

The Phase I project will include installation of two centrifuges, a sludge holding/equalization tank, polymer feed equipment, pumping facilities, and dry sludge storage hoppers adjacent to the existing sludge storage lagoon on the RWTP site (see Figure 2-3). This equipment will be used to mechanically dewater and/or condition sludge coming from the wastewater

Table 2-1. Estimated Digested Sludge Production (Phase I and Phase II)

SLUDGE LOAD PARAMETER	PHASE I SLUDGE LOADS - 1989 LB/DAY	GAL/DAY	PERCENT SOLIDS	ULTIMATE SLUDGE LOADS - 2004 LB/DAY (SOLIDS)	GAL/DAY	PERCENT SOLIDS (BY WT)
Average	32,000	132,000	2.9	49,000	200,000	2.9
Peak month	40,000	192,000	2.5	61,000	300,000	2.4
Peak week	42,000	252,000	2.0	70,000	400,000	2.1
Peak day	45,000	300,000	1.8	75,000	500,000	1.8

SOURCE: Brown and Caldwell 1982.

Table 2-2. Anticipated Constituent Concentrations in Eugene/Springfield Sludge

CONSTITUENT	CONSTITUENT CONCENTRATION, MG/KG[1] FUTURE EUGENE/ SPRINGFIELD SLUDGE[2]	TYPICAL DIGESTED MUNICIPAL SLUDGE[4] MEDIAN OF PLANTS SAMPLED	RANGE OF PLANTS SAMPLED
Arsenic	7	116	10-230
Boron	21	36	12-760
Cadmium	7	16	3-3,410
Copper	530	1,000	85-10,100
Lead	140	540	58-19,730
Mercury	7	5	0.5-10,600
Molybdenum	8	30	24-30
Nickel	240	85	2-3,520
Selenium	1	no data	-
Zinc	1,700	1,890	108-27,800
Potassium	2,150	3,000	200-26,400
Total phosphorous (%)	1.3[3]	3.0	0.5-14.3
Total nitrogen (%)	5.9[3]	4.2	0.5-17.6
Ammonia nitrogen (%)	2.3	1.6	0.01-6.8

[1] Milligrams per kilogram dry weight basis unless otherwise stated.
[2] Based on weighted average of 72 percent Eugene sludge and 28 percent Springfield sludge.
[3] Based on pilot plant data of Eugene/Springfield wastewaters.
[4] USEPA, "Municipal Sludge Management: Environmental Factors", EPA 430/9-77-004, October 1977.

NOTE: Projected metal data are based on present concentrations. Storage in a sludge lagoon will tend to concentrate these metals. This concentration, however, is assumed to be counterbalanced by the fact that the sludge from the new treatment plant will have a much higher ratio of secondary to primary sludge than at present. Secondary sludge has a much lower metal concentration than primary sludge.

SOURCE: Brown and Caldwell 1980.

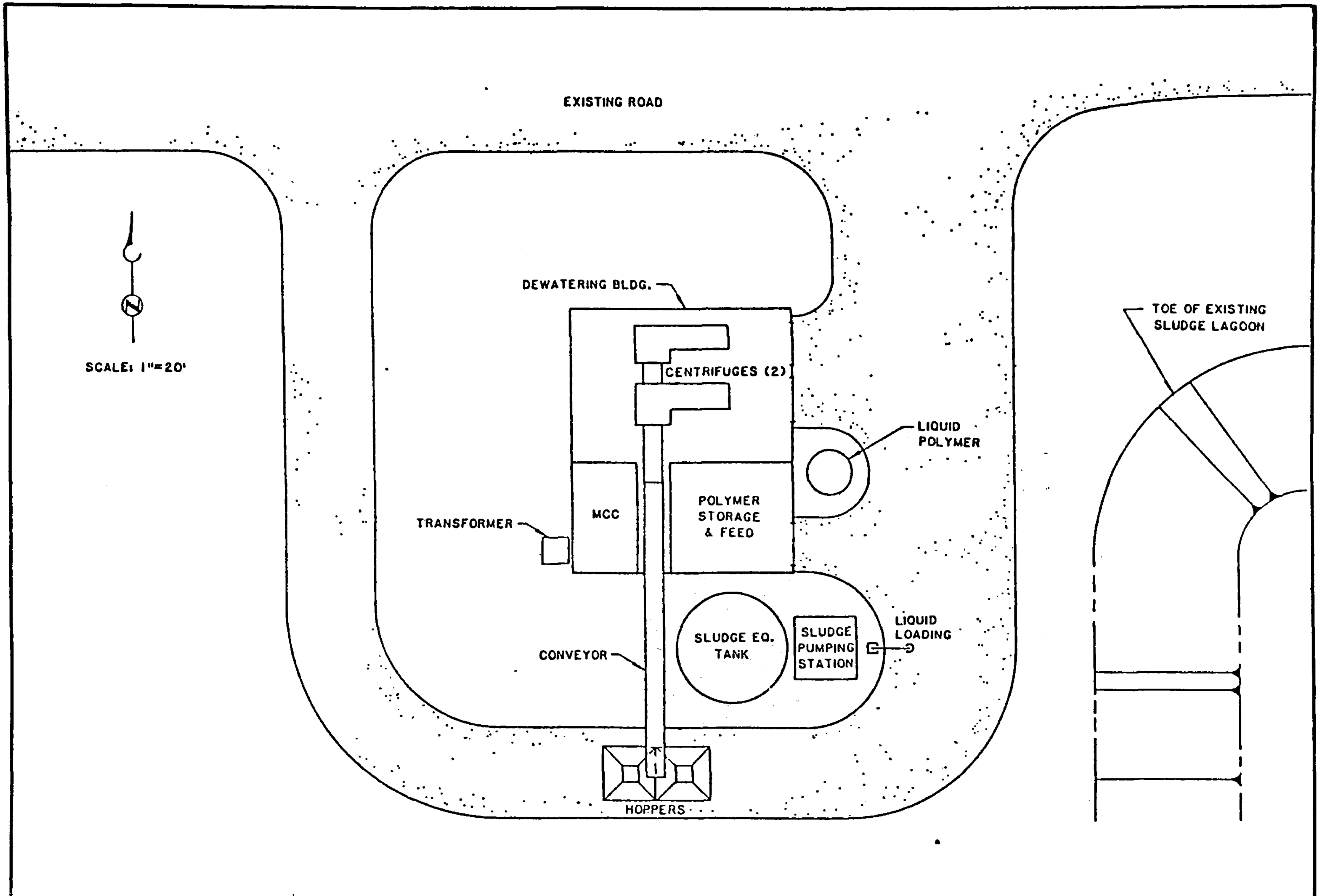


FIGURE 2-3. PRELIMINARY LAYOUT FOR THE INTERIM DEWATERING FACILITY AT THE EUGENE RWTP SITE
SOURCE: BROWN AND CALDWELL 1982

treatment process. The new equipment will be capable of operating in four distinct modes, depending upon the dewatering and conditioning needs of the plant operation at the time. A description of these four modes, taken from the Brown and Caldwell (1982) Phase I report, is presented below:

"DEWATERING DIGESTED SLUDGE. Digested sludge is fed to the centrifuge through the sludge storage tank. Alternatively, the centrifuges can be fed directly from the digesters by a digested sludge pump. As with all of the operating modes, either liquid or dry polymer can be used.

"Centrate from the process can drain by gravity to the secondary control building from where it can be pumped either to the headworks or aeration basins. The centrate can also be diverted to the sludge transfer sump and pumped either to the lagoon or to the waste-activated sludge (WAS) line from where it will flow by gravity to the dissolved air flotation (DAF) thickener.

"THICKENING DIGESTED SLUDGE. Under this mode of operation, the centrifuges are fed directly by the digested-sludge pumps with the sludge feed pumps remaining inactive. Thickened sludge flows to the transfer pump and is pumped into the thickened-sludge tank. From the storage tank, the sludge can be fed to the transport trucks either by gravity or by the sludge-loading pump. Centrate from this process flows by gravity to the secondary control building for pumping to the headworks or aeration basins.

"THICKENING WASTE-ACTIVATED SLUDGE. The sludge-dewatering facility has the capability to thicken WAS during emergency conditions when the DAF thickeners are out of service. . . . the WAS flows by gravity to the sludge feed pumps. The thickened WAS is pumped back to the digesters through the digested-sludge force main. Under this mode of operation, digested sludge can be trucked to the lagoons. Alternatively, the thickened WAS can be pumped to the storage tank and then trucked to the digesters while digested sludge is pumped to the lagoons. Centrate will flow by gravity to the secondary control complex and be pumped to the aeration basins or headworks.

"DEWATERING LAGOON-HARVESTED SLUDGE. Under this mode of operation, sludge is dredged from the lagoon to the thickened-sludge storage tank. The sludge feed pumps then feed the centrifuges. Dewatered sludge is conveyed to the hopper, while centrate can flow by gravity to the secondary control complex for pumping to the headworks or the aeration basins. The centrate can also be pumped from the sludge transfer sump to the lagoon or into the WAS line from where it will flow by gravity to the DAF thickener" (Brown and Caldwell 1982).

The end-product of these operational modes will be either a dewatered or a conditioned sludge. The thickened sludge solids concentration is expected to be about 9 percent and can be transferred directly to liquid hauling tanker trucks. Dewatered sludge coming from the centrifuge and into the dried sludge hoppers is expected to be about 20 percent solids. This material could be fed from the hoppers into dry sludge transfer trailers.

Sludge Transport

MWMC intends to purchase additional sludge hauling equipment during Phase I. This includes one front end loader for use on the RWTP site, four dry solids transport trailers (25-cubic-yard capacity each), one liquid transport trailer (5,800-gallon capacity), and three transport truck tractors. This equipment, combined with transport facilities already owned by MWMC, will allow hauling of conditioned sludge to agricultural reuse sites and transfer of dewatered sludge to the Short Mountain Landfill or to agricultural reuse sites.

During the months of heavy precipitation, normally October through March, sludge will be mechanically dewatered and hauled to Short Mountain Landfill (see Figure S-1). Assuming a peak day production of 45,000 pounds of solids in 1989 (133 cubic yards), there will be a maximum of 6 truckloads of sludge hauled daily from the RWTP to the landfill. Average daily generation and truck traffic will be 32,000 pounds and 4 trucks, respectively. For the remainder of the year, normally April through September, sludge will be either mechanically dewatered or conditioned and hauled to agricultural reuse areas. The split between liquid and dried sludge hauling during this period will vary with demand for the two forms of sludge, so the exact number of truck trips will also vary. If all sludge were hauled in a dewatered state, as in the wet months, peak day truck traffic would be six trips. If all sludge were transported in a liquid form at 9 percent solids, 16 or 17 truck trips would be needed to handle a peak day volume in 1989.

Sludge Reuse or Disposal

In the wet months of the year, dewatered sludge from the RWTP will be hauled to the Short Mountain Landfill for disposal. The trucks will deposit the dried material (20 percent solids) in the active landfill area to be mixed into the working face of the fill with other solid waste. In the Phase I design year (1989), approximately 17,300 cubic yards of dried sludge will go to the landfill. For the remainder of the year, all sludge will be hauled to agricultural reuse sites for application as a soil conditioner and fertilizer. The sludge may be hauled in a liquid or dewatered state, depending upon the crop type and the operational requirements of farmers.

Several farms are currently receiving liquid sludge from the Eugene WTP as a pilot project. Additional acreage will be added to the agricultural reuse operation when more sludge becomes available. While specific parcels have not been identified, land supporting nonfood crop production will be used as the additional reuse sites. These lands are found throughout the area, primarily on alluvial soils of the Willamette Valley and the narrower river valleys of the Coast Fork of the Willamette and McKenzie Rivers east and south of Eugene/Springfield.

It is estimated that by 1989, 1,500 acres of agricultural land will be needed to receive the dry season sludge volume generated at the RWTP (Brown and Caldwell 1980). There is an estimated 41,000 acres of nonfood cropland in Lane County, most of it within 20 miles of the RWTP. This includes seed production land and alfalfa and hay cropland (Oregon State University Extension Service 1982). Nonfood cropland in Linn County to the north may also receive Eugene/Springfield dewatered sludge. Before any new reuse site receives sludge, the Oregon DEQ will inspect it to determine its suitability under DEQ sludge reuse regulations, and a written agreement will be established between MWMC and the landowner outlining controls on application rates and farming operation procedures.

While the MWMC recommended plan for Phase I calls for agricultural reuse of the dry season sludge production, MWMC is also pursuing several other beneficial reuse options. Forestland application and use as a topsoil additive may be pursued through small-scale pilot programs in the next year (Pye pers. comm.).

THE PHASE II PROGRAM

The long-term solution to sludge management for the Eugene/-Springfield RWTP is described in the Sludge Management Program for the Metropolitan Wastewater Management Commission (Brown and Caldwell 1980). The proposal includes piping digested sludge off-site for storage in facultative sludge lagoons, air drying, and agricultural reuse of the harvested sludge. The recommended off-site location is Site C (see Figure 2-4). Since publication of the 1980 facilities plan, several modifications have been recommended for the proposed plan. Initiation of Phase I, described above, is a significant departure from the original plan in that it includes mechanical dewatering of sludge from 1984-1989. The MWMC preferred program now being considered for the 1990-2004 planning period, labeled Alternative 2 in subsequent environmental impact analyses, is described briefly below.

Sludge Generation

There will be no significant changes in the wastewater treatment process at the RWTP between the Phase I and Phase II planning periods. Sludge will continue to be anaerobically

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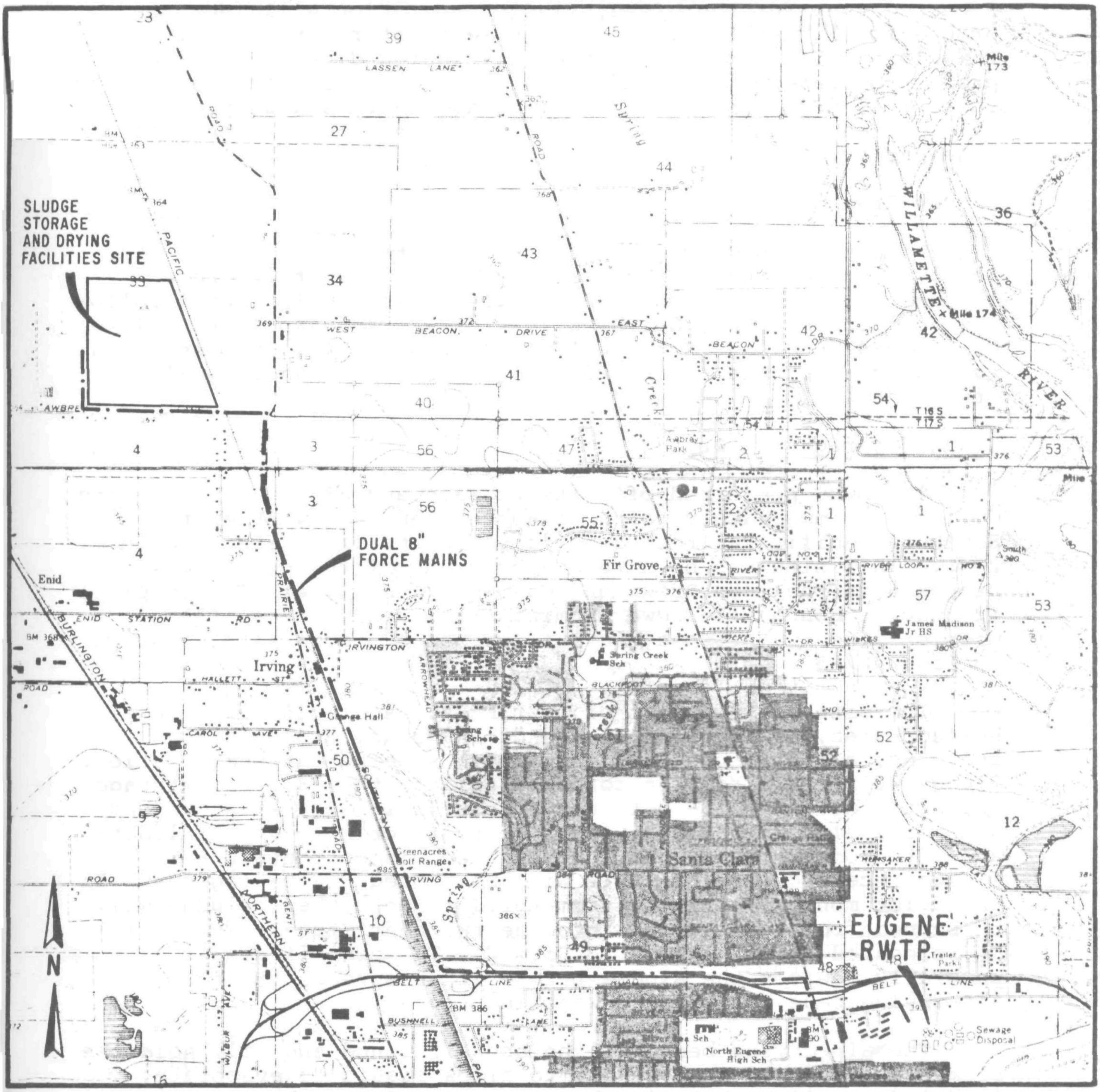


BASE MAP FROM JUNCTION CITY, COBURG, EUGENE EAST AND EUGENE WEST USGS 7 1/2' QUADS

FIGURE 2-4. LOCATION OF SLUDGE, TRANSPORT, STORAGE AND DRYING FACILITIES PROPOSED BY MWMC digested on-site; therefore, sludge generation will increase proportionally to the increases in wastewater flows received at the plant. Table 2-1 lists the anticipated digested sludge production rates at the end of Phase I (1989) and the end of the Phase II design period (2004). Average daily sludge production is expected to increase 52 percent over the 15-year Phase II time period.

Sludge Transport

Digested sludge will be transported through dual 5.5-mile-long, 8-inch-diameter force mains from the RWTP to storage lagoons at a remote site in Phase II. This pipeline will follow the Beltline Highway, Northwest Expressway and Awbrey Lane (see Figure 2-4). Sludge from the digesters will be ground and then pumped at intervals to the FSLs for storage and additional treatment.

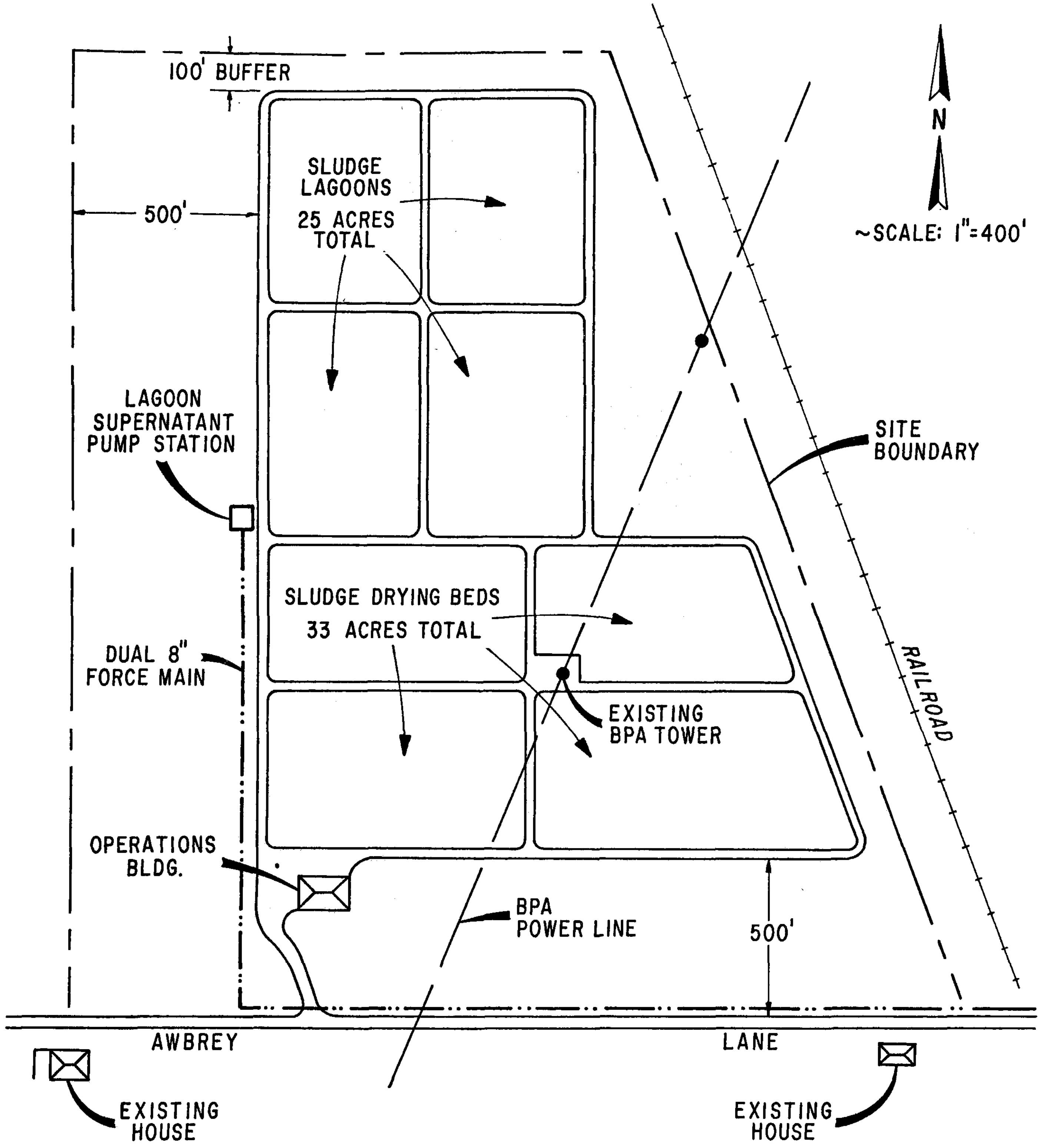
Sludge Storage and Drying

The MWMC preferred off-site storage and drying site is Site C, located immediately north of Awbrey Lane and west of the Southern Pacific Railroad line to the north of Eugene (Figure 2-4). This site has been relocated south of the position proposed in the 1980 Brown and Caldwell facilities plan to place it under a Bonneville Power Administration electrical transmission line. A proposed layout for the 125-acre site is shown in Figure 2-5.

The site will consist of four FSLs, each 6.25 acres in surface area, 33 acres of sludge drying beds, an operations building, a centrifuge building, and a supernatant pump station. Sludge will flow from the force mains into the FSLs for storage and settling. The 15-foot-deep FSLs will include aerators and will be sealed with a clay layer to restrict movement of leachate into local groundwater. During the winter months, all sludge received from the RWTP will be stored in the lagoons. In the drier months, normally from April to September, sludge will be pumped from the lagoons into the two centrifuges, which will be relocated from the RWTP to Site C. The centrifuges will partially dewater the sludge before it is spread onto the air-drying beds for final dewatering.

The air-drying beds will be asphalt lined and will hold the sludge at 8- to 12-inch depths to allow liquid to evaporate. The sludge will be held in these beds for 3-6 weeks depending on weather conditions. During that time, sludge water standing on the surface will be skimmed off and pumped back to the RWTP for additional treatment with supernatant from the FSLs. The sludge also will be mixed once or twice during the drying cycle to increase the drying rate.

Brown and Caldwell (1980) predicted that up to 20 percent of the sludge coming from FSLs would be loaded directly into



TOTAL SITE APPROXIMATELY 125 ACRES

FIGURE 2-5. MWMC PROPOSED PROJECT (ALTERNATIVE 2) FACILITIES LAYOUT AT SITE C
SOURCE: MODIFIED FROM BROWN AND CALDWELL PERS. COMM. A.

liquid transport trailers for hauling to agricultural lands rather than undergoing an air-drying step. Liquid applications are preferred for certain crops; in addition, this will allow reuse of sludge earlier in the spring than would be possible if all of the sludge were air dried. Because the plan now includes centrifuges at the off-site location, lagoon-harvested sludge with a 5 or 6 percent solids content can be conditioned to 9 percent solids in the centrifuges prior to hauling in a liquid form.

Sludge Reuse

Construction of the Phase II facilities will allow MWMC to store all sludge generated during the winter months for eventual reuse during drier months. Beginning in late spring, sludge will be removed from the FSLs, conditioned in the centrifuges, and either spread onto the air-drying beds or loaded into liquid transport trucks for hauling to agricultural lands. Liquid sludge will be applied to nonfood chain cropland either by injection or spraying on the surface as is the current practice with Eugene sludge. The bulk of the sludge (80 percent) is expected to be hauled in a dried form at about 40 percent solids for stockpiling at reuse sites and spreading with a dried sludge applicator.

Brown and Caldwell (1980) has estimated that 2,050 acres of cropland will be needed to accomplish a total reuse of the sludge load anticipated by the year 2000. While specific locations for this reuse have not been identified, MWMC had 490 acres of agricultural land in its reuse program in 1982, and MWMC/DEQ efforts have identified an additional 4,500 acres that meet the DEQ requirements for sludge reuse (Cooper pers. comm. b). These acreages all support crops that are not in the direct human food chain and are located on terrace and alluvial plain soils from the Creswell area on the south to the Harrisburg area on the north.

MWMC intends to purchase four front-end loaders, three transport truck tractors, four dry sludge trailers, one liquid sludge trailer, three flotation-tired dry sludge applicators, and one flotation-tired liquid sludge applicator to augment the transport and spreading equipment acquired during Phase I. RWTP personnel will haul and apply the sludge at agricultural reuse sites using this equipment. Application rates will be geared to meet crop fertilizer requirements and DEQ regulations; estimates range from 2-6 tons of dry solids per acre per year (Brown and Caldwell 1980).

Although equipment costs and designs for the proposed project have assumed a total agricultural reuse of the RWTP sludge, MWMC is continuing to investigate the feasibility of other reuse options. This includes forestland application and use as a topsoil additive. In addition, landfill disposal of dried sludge will be used as a backup if sufficient agricultural land is not available.

Alternatives Considered in the EIS

ALTERNATIVE 1

This alternative (the 1990 to 2004 project) would include construction of dual liquid sludge force mains, FSLs and air-drying beds at a rural, remote site. The centrifuges in use on the RWTP during Phase I would not be moved to the remote site. Sludge would be transferred directly from the FSLs to the air-drying beds without an intermediate conditioning step. The centrifuges would no longer be used. As a result, the acreage of air-drying beds would increase from the 33 acres required for the MWMC preferred plan to 50 acres.

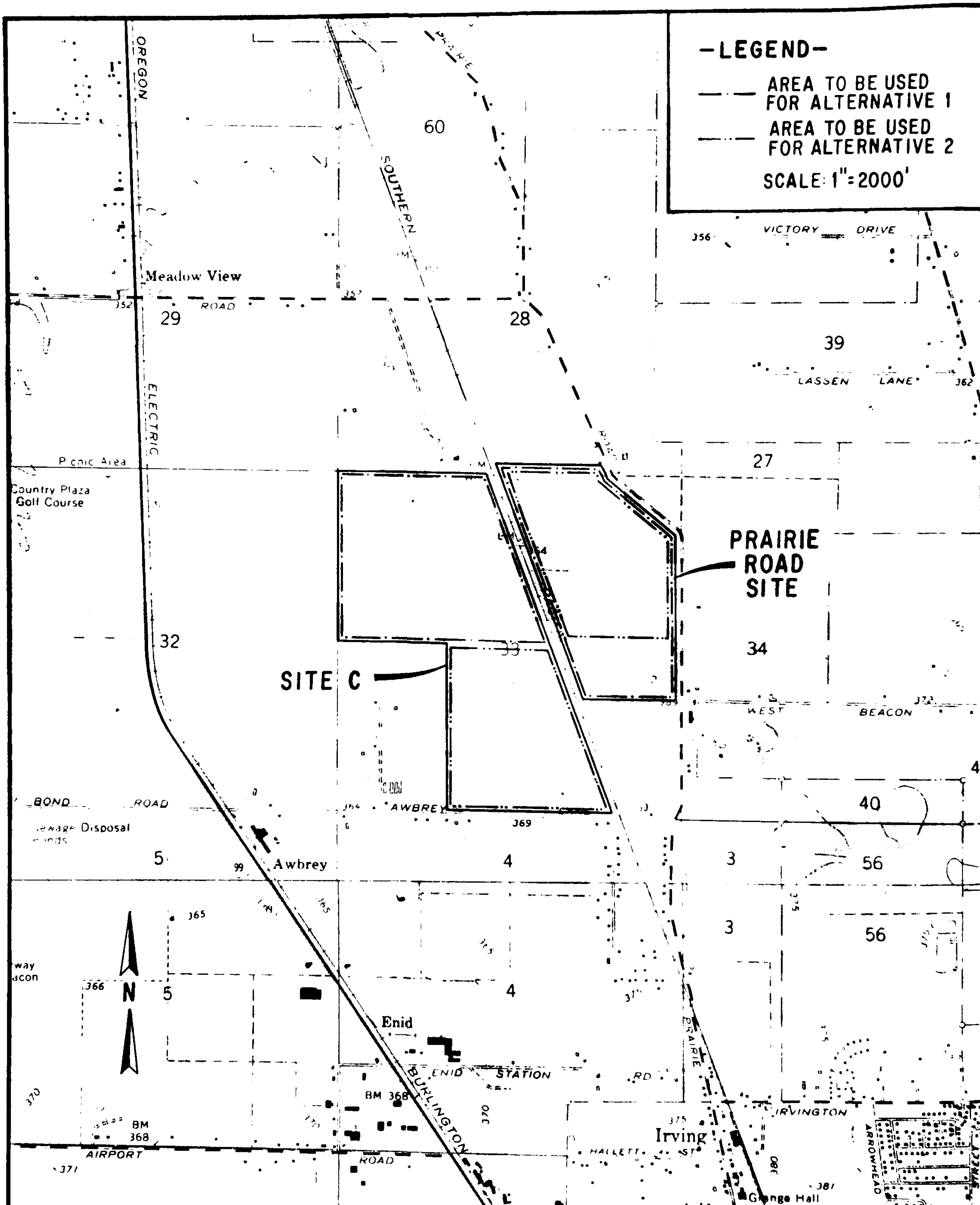
Three possible sites for the remote facilities have been considered in this EIS. Two of the sites (Site C and Prairie Road) were considered in detail by MWMC. A third site, Coburg Hills, was considered and rejected in the Sludge Management Program; it was reinstated for environmental analysis, however, after review of the original criteria used for rejection. The remoteness of the site and its apparent lack of major land use conflicts warranted a full environmental evaluation in the EIS. The locations and boundaries of these sites are shown in Figures 2-6 and 2-7 . A preliminary layout of facilities at Site C is shown in Figure 2-8.

The reuse of sludge proposed for Phase II of Alternative 1 is a continuation of the MWMC Phase I program. Sludge would be stored over the winter and air-dried during the summer, with the dried product being reused on agricultural land. Up to 20 percent of the sludge would be taken directly from the FSLs and applied to agricultural land in a liquid form. Without the mechanical dewatering capabilities, liquid sludge would contain approximately 6 percent solids rather than the 9 percent achieved through conditioning. Landfilling of dried sludge would act as a backup to the agricultural reuse scheme.

ALTERNATIVE 2

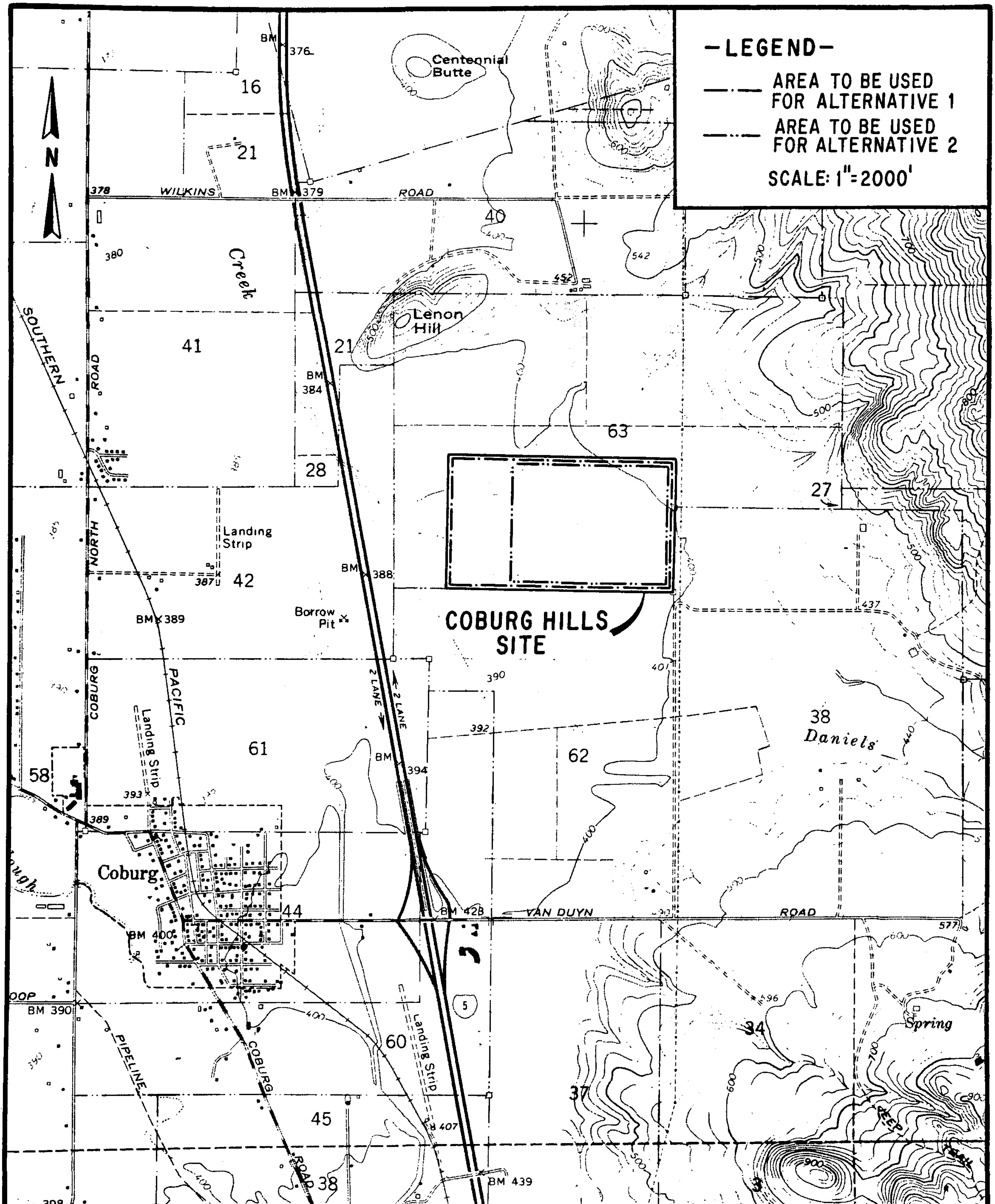
Alternative 2 is the option now preferred by the MWMC. It has been described in detail on preceding pages. The EIS has expanded the off-site locations considered, however, to include the Prairie Road and Coburg Hills sites. Potential site layouts for these locations are shown in Figures 2-9 and 2-10. The areas required for air-drying beds are slightly smaller than in Alternative 1, so the site boundaries would be altered somewhat (see Figures 2-6 and 2-7).

FIGURE 2-6. SITE C AND PRAIRIE ROAD SITE LOCATIONS AND TOPOGRAPHY



BASE FROM JUNCTION CITY USGS 7 1/2' QUAD

FIGURE 2-7. COBURG HILLS SITE LOCATION AND TOPOGRAPHY



BASE FORM COBURG USGS 7 1/2' QUAD

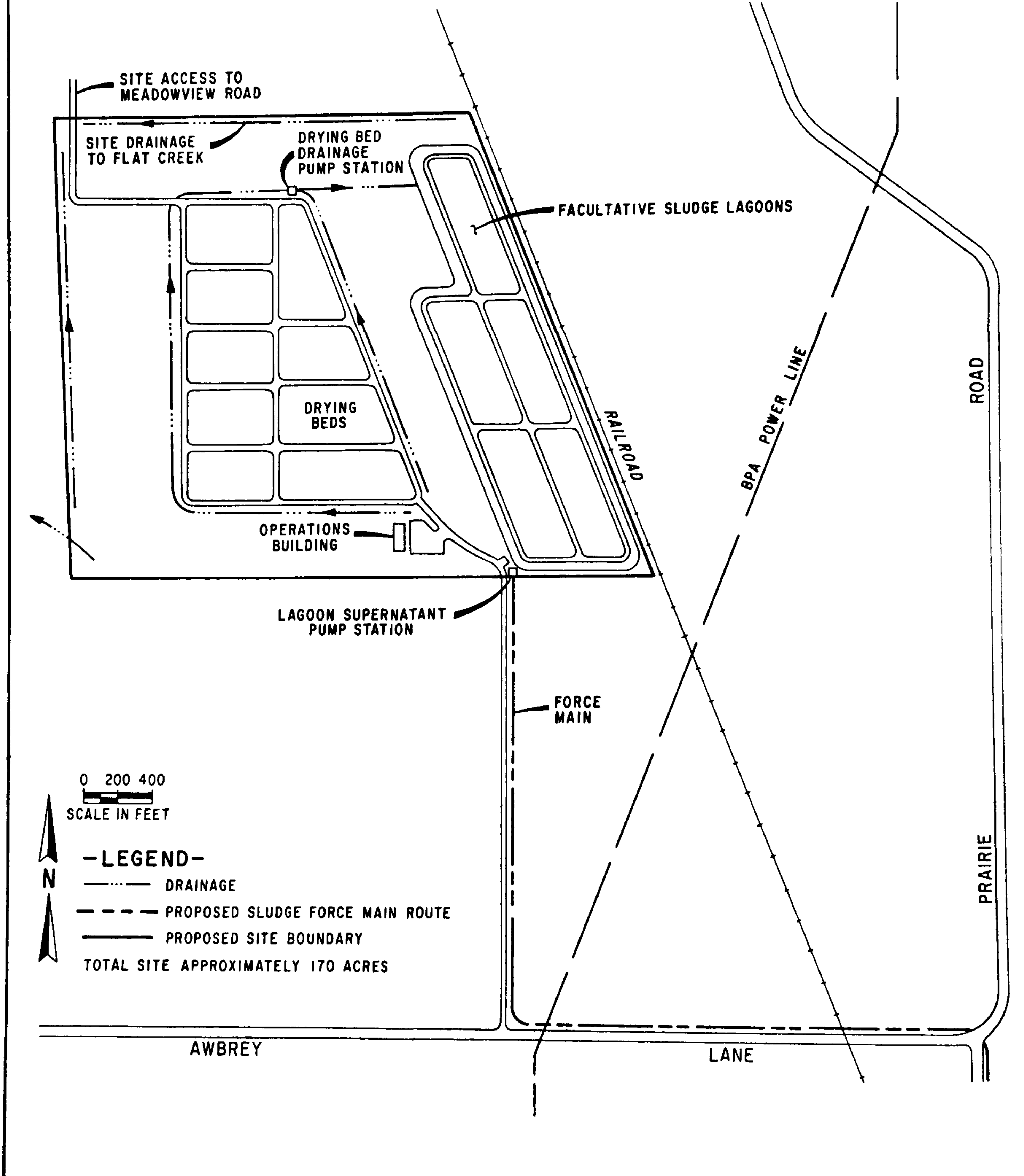


FIGURE 2-8. ALTERATIVE 1 FACILITIES LAYOUT AT SITE C

SOURCE: MODIFIED FROM BROWN AND CALDWELL 1980.

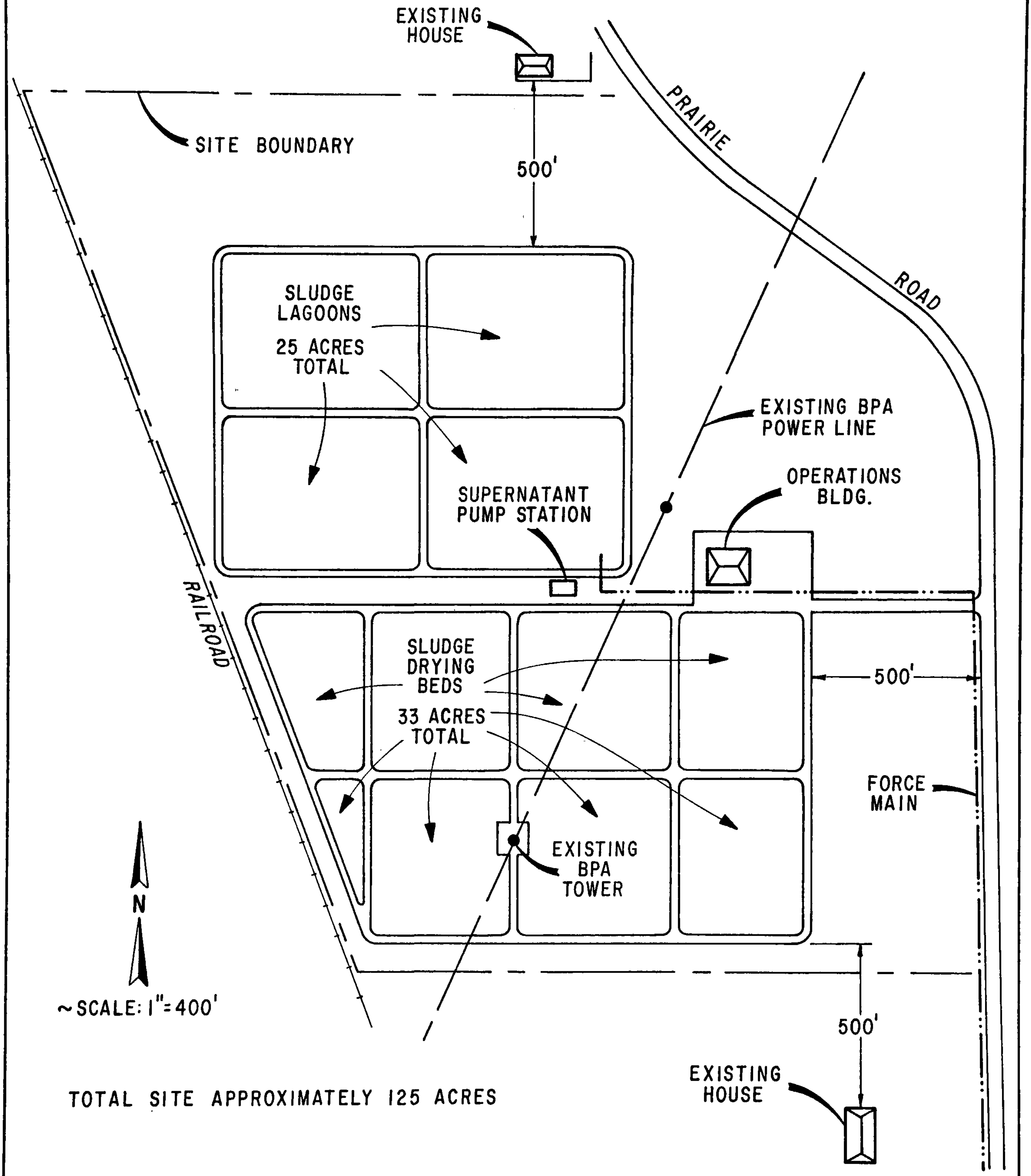


FIGURE 2-9. ALTERNATIVE 2 FACILITIES LAYOUT AT PRAIRIE ROAD SITE

SOURCE: MODIFIED FROM BROWN AND CALDWELL PERS. COMM. A.

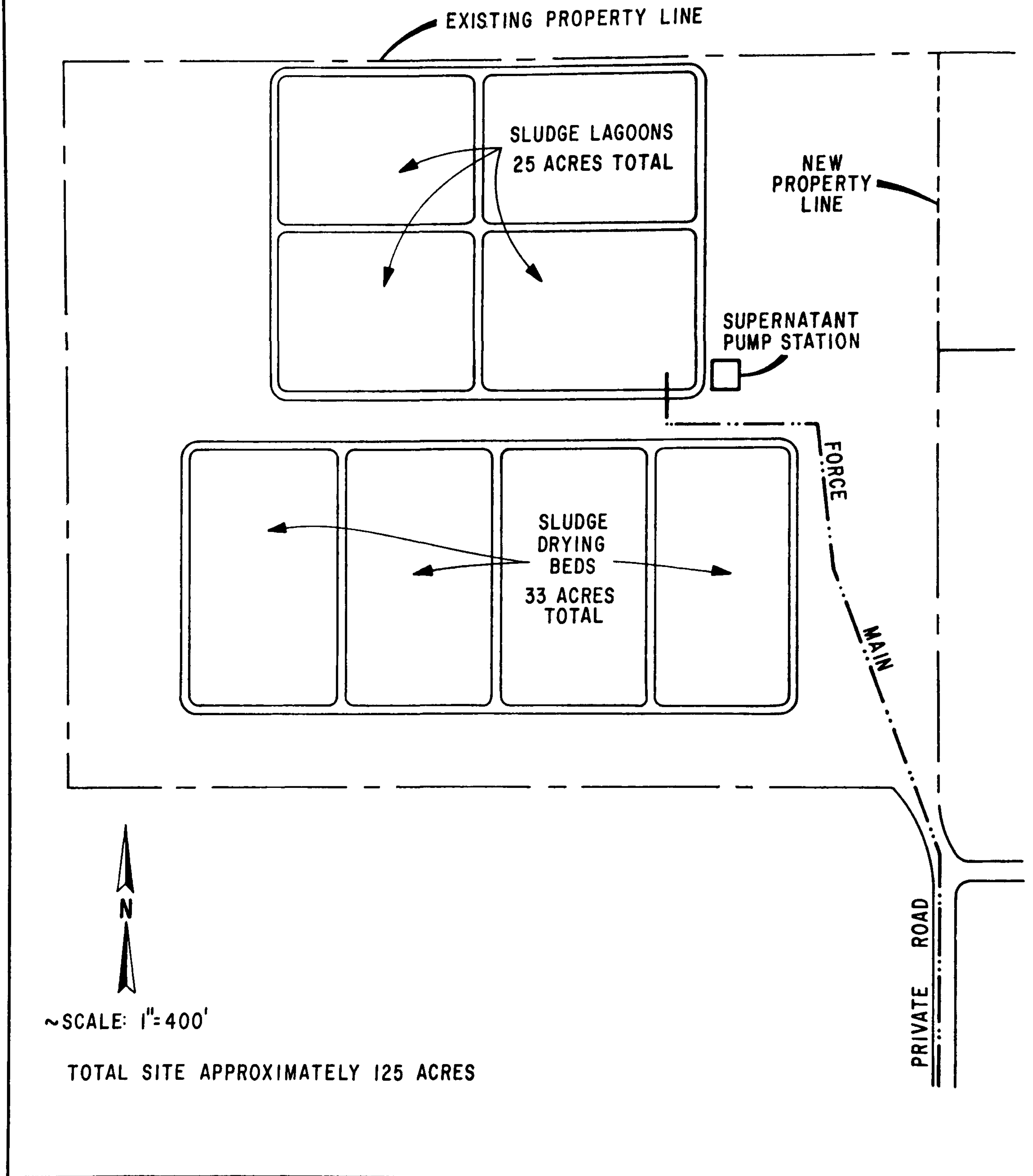


FIGURE 2-10. ALTERNATIVE 2 FACILITIES LAYOUT AT COBURG HILLS SITE
SOURCE: MODIFIED FROM BROWN AND CALDWELL PERS. COMM. A.

ALTERNATIVE 3

Under this option, the Phase I program of mechanical dewatering at the RWTP would continue into Phase II. Once the Phase I dewatering facilities had reached their capacity, additional mechanical dewatering facilities and appurtenances would be added on-site.

Brown and Caldwell (1980) has indicated that one sludge digester and one DAF thickener would have to be added to the RWTP during Phase II of this option to supply stabilization backup in the absence of FSLs. Also, two more centrifuges, a permanent dewatering building, chemical feed equipment, and appurtenances would be needed on-site. No site layout has been developed for these facilities. Stabilized sludge would be pumped directly from the digesters to the dewatering building where it would be centrifuged to approximately 20 percent solids. The sludge would then be conveyed to small storage hoppers for transfer to trucks.

During the winter months, all sludge would be dewatered and hauled to the Short Mountain Landfill for disposal. During peak day flows in the Phase II design year (2004), as much as 190 cubic yards of sludge would be hauled from the RWTP. This would require approximately eight truck trips. Assuming 50 percent of the total design year sludge was hauled to the landfill, this would be 44,800 cubic yards of material. In the summer months, the entire sludge volume would be transported by truck to agricultural reuse sites as proposed for the other project alternatives. The majority would be transported in a dewatered form (20 percent solids), but some fraction would be taken in a liquid form (3-6 percent solids). The acreage required to reuse all of the sludge would be only half of that needed for Alternatives 1 or 2. As with the other options, landfilling would act as a backup to the summer period agricultural reuse of dewatered sludge.

ALTERNATIVE 4

Alternative 4 is the no-project option. It represents a continuation of the Phase I sludge management practices previously described. The interim (Phase I) project has received federal grant funds and is being implemented by MWMC; the long-term (Phase II) project, however, would not proceed at the end of the 5-year plan. The Eugene/Springfield RWTP would continue to rely on Phase I sludge facilities indefinitely. In the absence of a planned Phase II project, MWMC would have to develop additional interim sludge handling procedures to accommodate sludge volumes in excess of the Phase I facilities' capacity, or sludge generation would have to be curtailed after 1989. A specific interim solution beyond 1989 has not been developed for this alternative.

OTHER REUSE/DISPOSAL OPTIONS

Several reuse/disposal options considered but rejected in the Sludge Management Program as base alternatives (Brown and Caldwell 1980) have been given a generic environmental analysis in this EIS. These options could replace the agricultural reuse or landfilling proposals included in the MWMC preferred program if these two options were found to be economically or environmentally less desirable.

Forest Application

The application of sludge to forestlands is a relatively new concept. Most available information derives from studies conducted in Pennsylvania, Michigan, and Washington. The greatest amount of sludge forestland application research has been accomplished at the University of Washington's Pack Forest.

Research studies have shown that sludge is suitable for application on Douglas-fir, cottonwood, poplar, and Sitka spruce, but that western hemlock, red cedar, and red alder do not respond well to sludge-amended conditions. Sludge can be applied to: 1) recently logged forestlands, 2) recently established plantations, or 3) well established forests using either spreading or spray application methods. Studies have shown that sludge must be allowed to dry for at least 6 months prior to planting seedlings on recently logged sites, but that sludge can be spray-applied over young established plantations (seedling age 5 years or older) (Washington Department of Ecology 1982). Application of sludge to established forests has been studied more than other forestland options. The methods of applying sludge proven to be the most effective to date include use of a spray application vehicle mounted with a sludge storage tank and cannon-type spray nozzle for distributing sludge up to 150 feet from the vehicle. Access roads spaced 250 feet apart allow for proper sludge coverage of each site.

The MWMC has been working with the Oregon State University Department of Forestry, the OSU Extension Service, and DEQ to develop a pilot program for forest applications of Eugene/-Springfield sludge. There is an estimated 589,000 acres of privately-owned timber within 30 miles of Eugene (Cooper pers. comm. b). This includes Christmas tree farms and commercial timberland.

Composting

Sludge composting involves the aerobic decomposition of organic constituents to a relatively stable humus-like material. While sludge is not rendered totally inert by composting, in-vessel or static aerated pile composting is considered by EPA to be a process to further reduce pathogens.

Composting can be accomplished in several ways: windrow method, aerated static pile method (individual or extended piles) or within enclosed containers (tanks). Although each technique is unique, the fundamental process is similar. Requirements include: bulking agents (such as wood chips or sawdust); internal temperature ranging from 130°F-150°F (55°C-65°C) to ensure destruction of pathogens; extended-term storage of compost; and final separation of bulking agent and compost (U. S. EPA 1979a). The composting procedure involves mixing raw or digested sludge with the bulking agent and piling the mixture in a windrow or pile or storing in an enclosed container. As the organic material decomposes, heat generated by the microorganisms will raise the temperatures in the compost pile.

Composting is common throughout much of western Europe and to a more limited extent in the United States. The compost product is normally used as a mulch, soil conditioner, or bedding material for landscaping and nursery stock.

Topsoil Amendment

The use of sludge to improve soils deficient in nutrients and organic material has received more recognition in recent years. Surface-mined land has been reclaimed using sludge in Pennsylvania, Illinois, Washington, Minnesota, and West Virginia (Sopper and Kerr 1979; Frank in Sludge Magazine 1978). In the Eugene area, MWMC has considered selling sludge to local companies that market topsoil. Most of the topsoil is a gravel mining by-product and is sold to local building contractors and landscapers (Brown and Caldwell 1980). This soil material could be increased in volume and enriched with nutrients by mixing in digested sludge prior to sale.

During the dry season, sludge would be hauled in either a liquid or dried form to the soil excavation sites and spread over the surface. The application could be accomplished by spraying, direct dumping, broadcast spreading or injection. The soil would be subsequently disced to incorporate the sludge and then hauled to its reuse site.

Dedicated Land Disposal

Dedicated land disposal (DLD) involves direct application of liquid sludge to land set aside for this sole purpose. Sludge is hauled in tanker trucks or piped directly to the DLD site where it is injected into the soil or surface-applied. Surface-applied material must be disced into the soil. Typically, a cover crop is grown on the DLD site to reduce the threat of erosion and to take advantage of the available nutrients.

Sludge application rates are higher on DLD sites than in agricultural reuse areas. This reduces the acreage requirements but creates more concern for health problems. For this reason, food chain crops are not normally grown on DLD sites. Because the cropping operation is not a major concern, the sludge application season can be extended beyond that acceptable at most agricultural reuse sites.

ALTERNATIVES INVESTIGATED AND REJECTED

A major effort in the early stages of EIS preparation was directed at investigating alternatives to the proposed Eugene/-Springfield sludge management program. The alternatives discussions prepared by Brown and Caldwell (1980, 1982) were reviewed to determine if feasible alternatives had been overlooked, and whether alternatives recommended in public meetings and hearings were investigated. As a result of this process, the above-described alternatives were selected for environmental evaluation. A brief discussion of the rationale for not including other alternatives in the EIS analysis follows.

Base Alternatives Rejected in the Sludge Management Program

EPA has reviewed and concurs with the rationale for rejecting the following base alternatives described in the Brown and Caldwell Sludge Management Program (1980):

- Alternative Ia - single-site sludge processing and land disposal.
- Alternatives IIb, IIc, and IId - remote site lagoon storage and land disposal of liquid sludge at a separate site.
- Alternatives Va and Vb - on-site mechanical dewatering and incineration or pyrolysis at a remote site, with landfill disposal of ash.
- Alternative Vc - on-site mechanical dewatering, on-site incineration, and landfill disposal of ash.
- Alternative IV - lime stabilization, mechanical dewatering, and landfill disposal.

All of these alternatives were evaluated and eliminated for any one of a number of reasons, including inordinately high costs, higher energy consumption, lack of reliability for continuous sludge service to the RWTP, increased traffic and transport costs, management coordination problems, or potentially increased odor nuisances.

Alternatives Described During Public Participation

DELTA PITS. This option would include pumping digested liquid sludge from the RWTP to a gravel quarry across Beltline Road, adjacent to the Willamette River. A detailed description of this plan has not been developed, but the proposal includes lining the gravel pits to restrict off-site migration of sludge leachate and use of the site as a permanent sludge repository. The apparent hydraulic continuity of this site with usable groundwater and its close proximity to the Willamette River make it undesirable for permanent sludge storage. It would be extremely difficult to effectively line the deep gravel pits, and repair of any leaks or cracks would also be extremely difficult. Because of the high potential for surface and groundwater contamination and subsequent public health risks, and the lack of any engineering analysis of its structural feasibility, this alternative is not considered acceptable by EPA.

SOLAR AQUACELL. The solar aquacell system is a wastewater treatment process rather than a sludge processing and disposal system. Wastewater is placed in a series of earthen lagoons with greenhouse-type covers and floating aquatic plants. The solar heating encourages year round growth of aquatic plants and invertebrates which metabolize and decompose the waste products entering the pond. The system provides for recycling of both the liquid and solid components of domestic wastewater. The solid by-products of this treatment process are normally composted; this includes the sludge and harvested aquatic plants (Serfling and Mendola n.d.). Because the proposed project is to process and dispose of waste solids only, and since a new wastewater treatment plant is already under construction, the solar aquacell system does not qualify as an alternative to the proposed action.

Alternative Locations for Off-Site Facilities

EPA reviewed all off-site facilities locations considered in Brown and Caldwell (1979, 1980). The rationale for rejection was reviewed and all sites were field inspected. As a result, the following sites were dropped from consideration in the EIS: Cone-Breeden, Green Hill, Valley River, Beacon, North McKenzie, Delta, Airport, Industrial West, Ayres, A1, A2, and B. The Four Corners site was being considered as an alternative for the EIS until it was learned that the City of Eugene parks master plan proposed that the site be purchased as a regional park. This site was also subsequently dropped. The Site C, Prairie Road, and Coburg Hill sites were retained for detailed environmental evaluation.

Project Costs

PROJECT SERVICE COSTS

Wastewater service is provided to the residents of the City of Eugene and the City of Springfield by the Lane County Metropolitan Wastewater Service District (LCMWSD). Its boundaries are similar to the city limits of the two cities. The current

LCMWSD charge for wastewater service, which includes sludge management, is $6.30 per household per month. This monthly service cost, which was recently increased from $2.30, will be used to finance the operation and maintenance of the new RWTP and sludge management facilities. The new monthly service cost will be in effect for approximately 2 years (Racette pers. comm.). The cities of Eugene and Springfield charge each household an additional $4.20 per month for wastewater service to cover their operating expenses.

To finance the new Eugene/Springfield regional wastewater treatment system, general obligation bonds were issued by the District. The local share of capital costs was estimated to be $29.5 million. All bonds have been sold, including the portion ($632,000) estimated to finance the sludge management facilities.

Bond debt service for the local share of capital costs is financed from property taxes at a rate of approximately $0.63 per $1,000 true cash value. Based on 1980 estimates of $57,150 for a median value owner-occupied home in the service district, the total annual tax burden is estimated at $36.00 per household.

COMPARATIVE COSTS OF ALTERNATIVES

The Phase II capital and annual operation and maintenance (O&M) costs are presented in Table 2-3. Alternative 2 has the lowest capital and annual O&M costs and Alternative 3 has the highest. The higher capital costs associated with Alternative 3 reflect the need for significant on-site improvements for items such as dissolved air flotation ($1.4 million), digesters ($2.72 million), centrifuge building ($2.08 million), and recycle charge ($2.5 million). Locating facilities at the Coburg Hills site increases capital and annual O&M costs for both Alternative 1 and Alternative 2.

The present worth costs of the three alternatives are shown in Table 2-4. Present worth costs of Alternative 2 are slightly lower than Alternative 1, regardless of which off-site facilities location is chosen. Alternative 3, the on-site option, is considerably more expensive than the other two alternatives.

USER COSTS

As previously stated, monthly service costs for LCMWSD wastewater service is currently $6.30 per household and will be in effect for approximately 2 years. Approximately $0.50 per month of this amount is attributable to the sludge facilities (Racette pers. comm.). After the new regional wastewater treatment and sludge management facilities have been operated for the 2 years, some adjustment in the monthly service costs is

Table 2-3. Capital Costs of Alternatives

ALTERNATIVE	PHASE II CAPITAL	PHASE II OPERATION AND MAINTENANCE
1 - Site C/Prairie Road	$ 7,858,000	$483,000
1 - Coburg Hills	8,525,000	495,000
2 - Site C/Prairie Road	7,079,000	515,000
2 - Coburg Hills	7,746,000	527,000
3 - On-site Dewatering	14,038,000	790,000
4 - No Project	Unknown	Unknown

SOURCE: Modified from Brown and Caldwell pers. comm.

Table 2-4. Present Worth Costs of Alternatives

ALTERNATIVE	PHASE II CAPITAL	OPERATION AND MAINTENANCE	TOTAL
1 - Site C/Prairie Road	$4,976,000	$3,068,000	$ 8,044,000
1 - Coburg Hills	5,291,000	3,154,000	8,445,000
2 - Site C/Prairie Road	4,527,000	3,364,000	7,891,000
2 - Coburg Hills	4,842,000	3,450,000	8,292,000
3 - On-site Dewatering	9,100,000	7,266,000	16,366,000

SOURCE: Brown and Caldwell pers. comm.

likely. Although the exact nature of future user costs is uncertain, the cost impact from implementation of Phase II facilities has been estimated and is shown in Table 2-5. Because annual O&M costs are not grant fundable, projected user costs are equivalent with and without outside funding.

The impact on property taxes from implementation of a sludge management plan also is shown in Table 2-5. Implementation of Phase II facilities is estimated to increase annual property taxes between $2.89 (Alternative 2) and $5.73 (Alternative 3) for an average priced ($57,150) home within the service district. No local share costs have been estimated for Phase II without funding because it is not known what type of project would be implemented or how much revenue could be raised locally if state and federal funding were not available.

Table 2-5. Estimated Local Costs of Phase II Sludge Management Alternatives

ALTERNATIVE	LOCAL SHARE OF CAPITAL COSTS	USER COSTS PER YEAR	
		PROPERTY TAX	OPERATION AND MAINTENANCE
1	1,965,000	3.21	5.10
2	1,770,000	2.89	5.44
3	3,510,000	5.73	8.34

SOURCE: Modified from Gould pers. comm.

Chapter 3

Affected Environment and Impacts of the Phase II Alternatives

Chapter 3

AFFECTED ENVIRONMENT AND IMPACTS OF THE PHASE II ALTERNATIVES

Introduction

This chapter discusses major environmental issues associated with the MWMC Phase II sludge management alternatives. The issues have been identified through the planning process and by discussing the project with government agency personnel, local residents, and other concerned individuals. Each subsection deals with an individual issue. The issue is identified, pertinent environmental setting data are presented or cited, the relationship of each facilities plan alternative to the issue is discussed, and mitigation measures are suggested where potentially significant adverse environmental impacts have been identified.

Groundwater Quality

DESCRIPTION OF EXISTING CONDITIONS

Regional Setting

SOILS. The soils in the study area are derived from volcanic and sedimentary rock in the Coast and Cascade Mountain Ranges, and from alluvial sediments in the Willamette Valley and its tributaries. Soil distribution in the valley follows the north-south pattern of alluvial deposition; in the foothills, the distribution follows bedrock exposure patterns.

Soils in the study area have been classified into four major groups on the basis of parent material and drainage characteristics. The distribution of the groups is shown in Figure 3-1. The first group includes soils forming on recent alluvium on the floodplains of the Willamette River and its tributaries. The second and third groups include terrace soils forming on the floor of the Willamette Valley outside the floodplain. These two groups are distinguished on the basis of topographic position and drainage; Group 2 occupies the higher positions and Group 3 the lower. The last group, Group 4, includes soils forming from volcanic and sedimentary bedrock in the foothills of the Cascade Mountains and Coast Ranges.

For this study, 27 soil types comprising the largest land area were identified within the four groups (USDA SCS 1975,

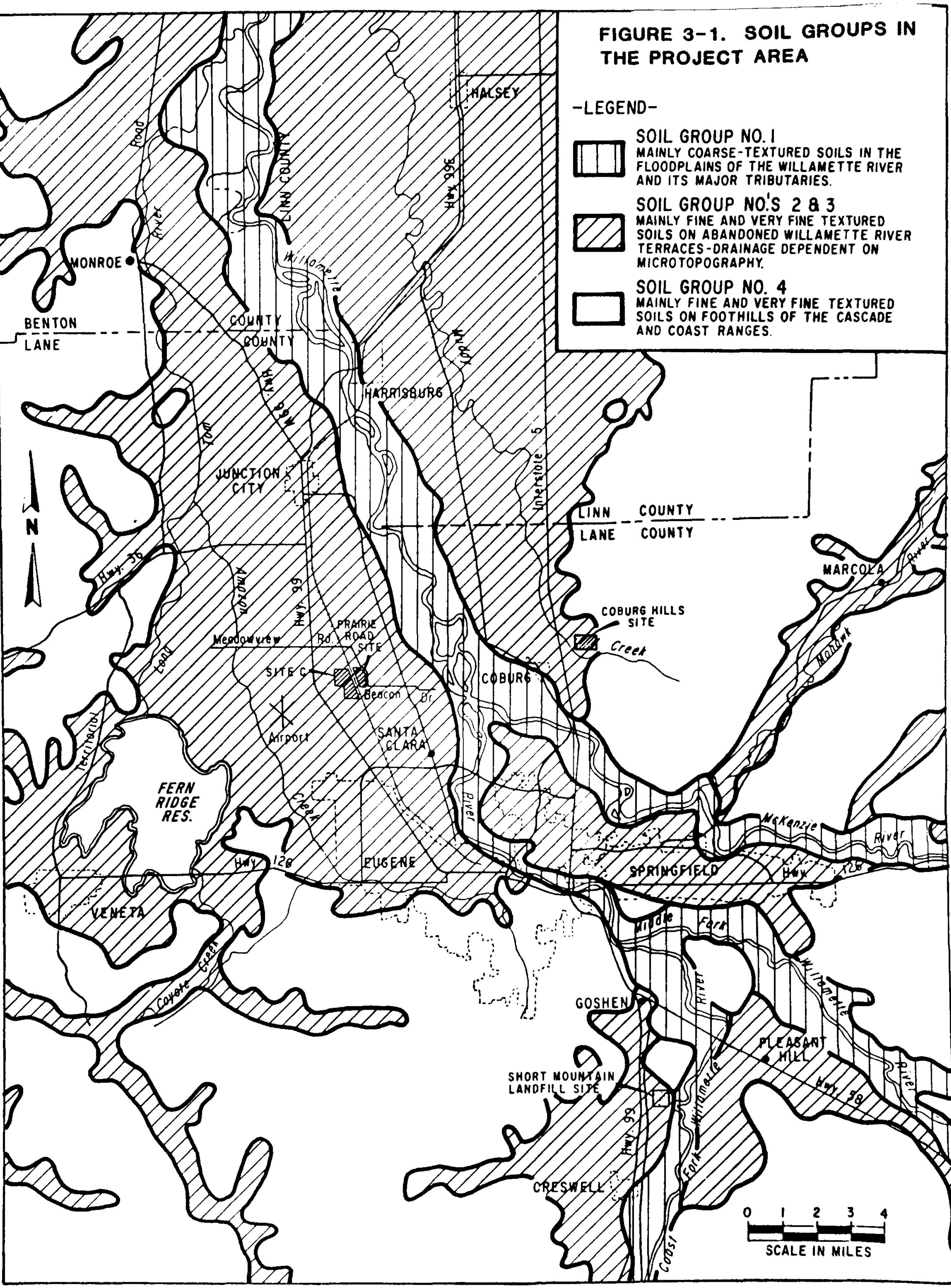


FIGURE 3-1. SOIL GROUPS IN THE PROJECT AREA
-LEGEND-
SOIL GROUP NO. 1
MAINLY COARSE-TEXTURED SOILS IN THE FLOODPLAINS OF THE WILLAMETTE RIVER AND ITS MAJOR TRIBUTARIES.
SOIL GROUP NO'S 2 & 3
MAINLY FINE AND VERY FINE TEXTURED SOILS ON ABANDONED WILLAMETTE RIVER TERRACES-DRAINAGE DEPENDENT ON MICROTOPOGRAPHY.
SOIL GROUP NO. 4
MAINLY FINE AND VERY FINE TEXTURED SOILS ON FOOTHILLS OF THE CASCADE AND COAST RANGES.
HALSEY
LINN COUNTY
MONROE
BENTON COUNTY
LANE COUNTY
HARRISBURG
JUNCTION CITY
LINN COUNTY
LANE COUNTY
MARCOLA
COBURG HILLS SITE
PRAIRIE ROAD SITE
SITE C
Meadowview Rd.
Beacon Dr
Airport
COBURG
SANTA CLARA
FERN RIDGE RES.
EUGENE
SPRINGFIELD
VENETA
GOSHEN
PLEASANT HILL
SHORT MOUNTAIN LANDFILL SITE
CRESWELL
Hwy. 99E
Hwy. 99W
Hwy. 99
Hwy. 36
Hwy. 126
Hwy. 58
Interstate 5
Willamette River
McKenzie River
Mohawk River
Middle Fork Willamette River
Coast Fork Willamette
Amazon Creek
Coyote Creek
Long Tom River
Territorial Road
N
0 1 2 3 4
SCALE IN MILES

1983). Tables 3-1 and 3-2 list selected physical and chemical characteristics, respectively, of these soils.

GEOHYDROLOGY. Geologic units in the southern Willamette Valley can be subdivided into two major groups: bedrock formations and valley alluvium (Baldwin 1981; Frank 1976). The bedrock units form both the Coast Ranges and Cascade Mountains, and they extend beneath the alluvial deposits in the Willamette Valley as shown on Figure 3-2.

Bedrock formations beneath and west of the Willamette Valley are of sedimentary and volcanic origin and consist primarily of marine sandstone, siltstone, shale, and volcanic tuff and conglomerate. To the east, these formations interfinger with nonmarine volcanic tuffs, flows, and breccias of the Western Cascades (Beaulieu et al. 1974; Baldwin 1981; Wells and Peck 1961). Localized bodies of basalt intrude bedrock throughout the area.

The alluvial deposits can also be divided into two units: Younger and Older Alluvium (Frank 1973, 1976). The Younger Alluvium coincides with the Willamette and McKenzie River floodplains and is underlain by the more extensive Older Alluvium. Both units originated through fluvial deposition and are composed of interconnected lenses of sand and gravel interspersed with fine sand, silt, and clay. The two units are distinguished chiefly by the fact that Younger Alluvium contains less silt and is not as weathered. Below a depth of 100 feet, the Older Alluvium becomes significantly more fine grained with abundant silts and clays.

Groundwater can be found in virtually all parts of the greater Eugene-Springfield area within both bedrock units and the valley alluvium. The bedrock units generally yield only small quantities of water; valley alluvium, by contrast, yields abundant quantities from a large, essentially continuous body of groundwater.

Aquifer recharge occurs principally by direct rainfall infiltration during the late fall and winter months. In the foothills and mountains, infiltration is reduced by rapid runoff on steep slopes and by relatively impermeable bedrock. The lowland valleys receive much greater infiltration by virtue of their more permeable soils and flatter slopes. The Willamette Valley is also the groundwater discharge area for adjacent highlands and thus is recharged from intermediate and deep-seated groundwater flow systems (Sweet, Edwards & Associates 1980).

A true water table condition does not generally exist in the foothill and mountain areas. Most groundwater occurs in discontinuous perched aquifers or within bedrock fractures. The distribution of groundwater is difficult to predict, although

Table 3-1. Selected Physical Characteristics of Extensive Soils in the Eugene/Springfield Study Area

Soil Series	Average Soil Texture[1]: Surface and Subsoil	Average Soil Texture[1]: Substratum	Slope (Percent)	Effective Rooting Depth (Inches)	Drainage	Average Depth to Seasonal High Water Table (Inches)	Permeability	Erosion Hazard	Runoff	Restrictive Layer (Type)
Group 1										
CAMAS	Gravelly sandy loam	Very gravelly coarse sand	0-3	12-20	Excessively drained	>72[2]	Very rapid	Slight[3]	Slow	Gravelly
CHEHALIS	Silty clay loam	Silt loam over sand and gravel	0-3	>60	Well drained	>72[2]	Moderate over very rapid	Slight[3]	Slow	Gravelly
CLOQUATO	Silt loam	Silt loam over coarse sand	0-3	40-60	Well drained	>72[2]	Moderate over very rapid	Slight	Slow	Gravelly
NEWBERG	Fine sandy loam	Stratified sandy loam and loamy sand	0-3	24-40 without irrigation	Somewhat excessively drained	>72[2]	Moderately rapid	Slight[3]	Slow	Gravelly
Group 2										
ABIQUA	Silty clay loam	Gravelly clay loam	0-3/ 3-5	>60	Well drained	>72	Moderately slow	Slight/ Moderate	Slow/ Medium	None
COBURG	Silty clay loam	Fine sandy loam	0-3	>60	Moderately well drained	18-30	Moderately slow	Slight	Slow	None
MALABON	Silty clay loam	Clay loam over sand and gravel	0-3	>60	Well drained	>72	Moderately slow	Slight	Slow	None
McALPIN	Silty clay loam	Silty clay	0-3	>60	Moderately well drained	24-36	Moderately slow	Slight	Slow	None
McBEE	Silty clay loam	Silt loam	0-3	24-36	Moderately well drained	24-36	Moderate	Moderate	Slow	None
SALEM	Gravelly silty clay loam	Very gravelly sand	0-3	20-40	Well drained	>72	Moderate	Slight	Slow	Gravelly
SALKUM	Silty clay loam	Clay with weathered gravels	2-8/ 8-16	30-50	Well drained	>72	Moderately slow to slow	Slight/ Moderate	Slow/ Medium	Dense clay
VENETA	Loam	Clay over stratified clay and sand	0-7	40-50	Moderately well drained	30-50	Slow	Slight	Slow	Dense clay
Group 3										
AMITY	Silt loam	Silty clay loam	0-3	12-24	Somewhat poorly drained	Perched 12-24	Moderately slow	Slight	Slow	Dense clay
AWBRIG	Clay	Silty clay loam	0-3	6-12	Poorly drained	Perched 0-12	Very slow	Slight	Very slow to ponded	Dense clay
BASHAW	Clay	Clay to sandy loam	0-3	6-12	Poorly drained	Perched 0-6	Very slow	Slight	Slow to ponded	Dense clay
CONSER	Silty clay	Clay over loam	0-3	12-24	Poorly drained	Perched 0-18	Slow	Slight	Slow to ponded	Dense clay

Table 3-1. Continued

Soil Series	Average Soil Texture[1]		Slope (Percent)	Effective Rooting Depth (Inches)	Drainage	Average Depth to Seasonal High Water Table (Inches)	Permeability	Erosion Hazard	Runoff	Restrictive Layer (Type)
	Surface and Subsoil	Substratum								
DAYTON	Silty clay loam	Clay	0-3	12-24	Poorly drained	Perched 0-12	Very slow	Slight	Very slow to ponded	Dense clay
NATROY	Silty clay loam	Clay over gravelly clay	0-3	12-24	Poorly drained	Perched 0-12	Very slow	Slight	Slow to ponded	Dense clay
WALDO	Silty clay loam	Clay	0-3	6-12	Poorly drained	Perched 0-6	Slow	Slight[3]	Slow to ponded	Dense clay
Group 4										
BELLPINE	Silty clay loam	Clay	3-12/ 12-20	20-40	Well drained	Perched 20-40	Slow	Moderate/ High	Medium/ Rapid	Bedrock
HAZELAIR	Silty clay loam	Clay	2-7/ 7-20	12-24	Moderately well drained	Perched 12-24	Very slow	Moderate/ High	Medium/ Rapid	Bedrock
HONEYGROVE	Silty clay loam	Clay	3-25	>60	Well drained	>60	Moderately slow	Moderate to high	Medium to rapid	None
NEKIA	Silty clay loam	Clay	2-20/ 20-50	20-40	Well drained	Perched 20-40	Moderately slow	Moderate/ High	Medium/ Rapid	Bedrock
PEAVINE	Silty clay loam	Silty clay and clay	3-30/ 30-60	20-40	Well drained	Perched 20-40	Moderately slow	Moderate/ High	Slow to medium/ Rapid	Bedrock
PHILOMATH	Cobbly silty clay	Cobbly clay	3-12/ 12-45	12-20	Well drained	Perched 12-20	Slow	Moderate/ High	Medium/ Rapid	Bedrock
RITNER	Cobbly silty clay loam	Very cobbly silty clay loam	2-12/ 12-30	20-40	Well drained	Perched 20-40	Moderately slow	Slight/ Moderate	Slow/ Medium	Bedrock
WITZEL	Very cobbly loam	Very cobbly clay loam	3-30	12-20	Well drained	Perched 12-20	Moderately slow	Moderate to high	Medium to rapid	Bedrock

NOTES: [1]Surface and subsoil refers generally to A and B horizons, respectively. Substratum refers to C horizon.

[2]During flooding events water table may be at or near surface.

[3]Erosion hazard primarily due to flooding.

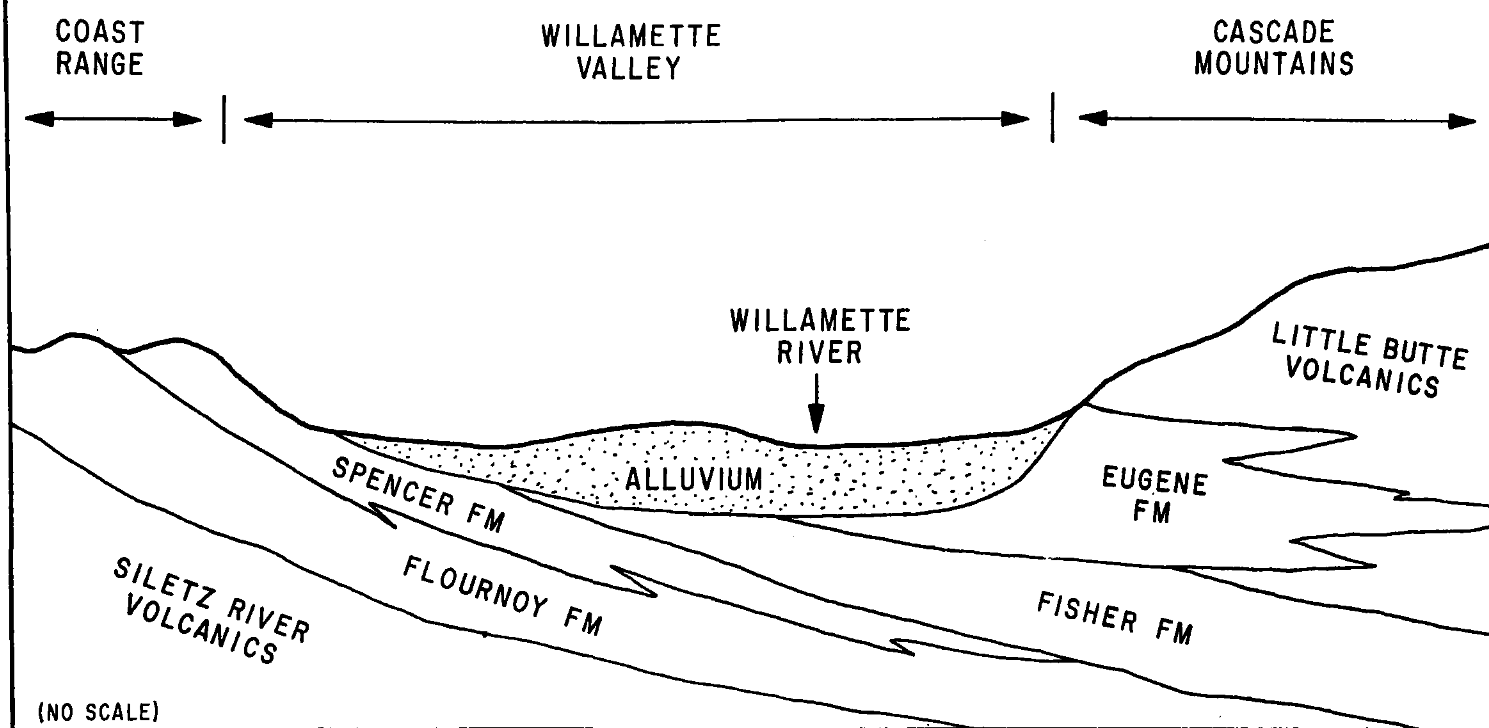
SOURCE: USDA Soil Conservation Service 1975; 1983.

Table 3-2. Selected Chemical Characteristics of Some Extensive Soils in the Eugene/Springfield Study Area

Soil Series	pH		Cation Exchange Capacity (meq/100g)		Organic Carbon (Percent)		Nitrogen (Percent)		Organic Matter (Percent)		Base Saturation (Percent)	
	Surface[1]	Subsoil[1]	Surface	Subsoil	Surface	Subsoil	Surface	Subsoil	Surface	Subsoil	Surface	Subsoil
<u>Group 1</u>												
CAMAS	5.6	6.0	22	8	1.6	.1	.15	Trace	3.7	--	88	85
CHEHALIS	6.2	6.4	28	29	2.6	1.0	.2	.07	4.2	1.8	82	91
CLOQUATO	5.9	6.4	—	—	1.6	.73	.12	.07	—	—	76	82
NEWBERG	5.9	—	18	—	1.8	—	.1	—	--	—	74	--
<u>Group 2</u>												
ABIQUA	7.1	5.5	30	40	—	--	—	—	2.1	1.6	65	40
COBURG	5.9	6.0	25	33	2.4	.2	.10	Trace	—	—	76	89
MALABON	6.4	6.2	24	28	1.8	.5	Trace	Trace	2.9	.6	77	91
SALKUM	5.5	—	16	—	5.6	—	—	—	—	--	48	—
VENETA	4.9	5.2	10	17	1.8	.4	—	—	3.1	.5	8	42
<u>Group 3</u>												
AMITY	5.6	6.0	20	30	2.2	.2	.18	.03	3.5	.2	38	80
AWBRIG	5.8	6.7	19	42	1.8	.3	.13	.08	2.8	.3	95	85
BASHAW	5.7	6.9	41	44	2.5	.7	—	—	4.2	.6	64	75
DAYTON	5.3	6.3	16	32	1.8	.2	.15	.06	4.0	.9	53	84
<u>Group 4</u>												
BELLPINE	5.4	5.0	26	24	3.5	.9	.22	.07	6.2	1.3	40	12
HAZELAIR	5.2	4.7	—	--	2.2	.5	1.1	.05	—	—	70	73
HONEYGROVE	4.8	4.7	58	41	—	--	—	--	—	—	15	9
NEKIA	5.5	5.4	24	26	2.5	.7	.20	.08	—	—	36	25
PEAVINE	5.3	4.6	—	--	3.6	.4	.25	.05	5.4	1.4	45	38
RITNER	—	--	39	35	2.7	1.2	—	—	4.6	1.9	78	81
WITZEL	--	—	40	39	3.8	1.9	.19	.13	5.2	2.9	71	78

NOTE: [1]Surface and subsoil generally refer to A and B horizons, respectively.

SOURCES: Huddleston 1982; data for Salkum and Newburg soils from Brown and Caldwell 1980.



—LEGEND—

ALLUVIUM: — RIVER SANDS AND GRAVELS WITH SILTY AND CLAYEY INTERBEDS, PLIESTOCENE AGE TO RECENT.

LITTLE BUTTE VOLCANICS: — VOLCANIC FLOWS AND TUFFS OF THE WESTERN CASCADES, OLIGOCENE AND EARLY MIOCENE AGE.

EUGENE FM: — MASSIVE TUFFACEOUS SANDSTONE AND SHALE, EOCENE AGE.

FISHER FM: — INTERBEDDED VOLCANIC TUFFS AND CONGLOMERATES, EOCENE AGE.

SPENCER FM: — MASSIVE BASALTIC TO ARKOSIC SANDSTONE, EOCENE AGE.

FLOURNOY FM: — GRADED SANDSTONE AND MUDSTONE, EOCENE AGE.

SILETZ RIVER VOLCANICS: — PILLOW BASALTS WITH INTERBEDDED TUFFS, OLIGOCENE AGE.

NOTE:
THIS CROSS-SECTION IS FOR ILLUSTRATIVE PURPOSES ONLY AND SHOULD BE USED ONLY IN CONJUNCTION WITH THE ACCOMPANYING TEXT.

FIGURE 3-2. GEOLOGIC CROSS-SECTION OF THE WILLAMETTE VALLEY some water can be found in most areas within 300 feet of the surface (Frank 1973).

Throughout the lowland valley areas, groundwater occurs in the Older and Younger Alluvium within 20 feet of the ground surface under unconfined (water table) conditions. The water table rises to near the ground surface during winter months and locally rises above it. Deeper portions of the Older Alluvium aquifer are under semiconfined conditions.

Regional groundwater flow in the alluvium is generally to the north and down-valley with a small component toward the Willamette River. The direction of local shallow flow can vary as much as 180 degrees from the regional flow direction due to variations in surface topography and subsurface sediment distribution patterns (Sweet, Edwards & Associates 1980). Groundwater in the deeper alluvium can also vary in flow direction and, in addition, has a net upward component to its flow except at the edge of the valley where recharge is occurring. The local shallow flow system is generally hydraulically isolated from the deeper flow system. Aquifer permeability and groundwater flow rates generally decrease with depth and vary between and within the Older and Younger Alluvium.

The alluvial aquifers and lowland streams are in hydraulic connection and thus have a complex dynamic relationship. In general, the aquifers are replenished by leakage from streams during periods of high river flow and depleted by the reverse process during low flow. However, this can vary locally, and Frank (1973) notes that along some stretches of the Willamette River aquifer leakage to the river occurs year-round.

A broad groundwater divide occurs along the line of the Southern Pacific Railroad from Junction City to Eugene. East of the rail line, groundwater flows northward and slightly eastward toward the Younger Alluvium and the Willamette River. West of the rail line, groundwater flows generally to the northwest and toward the Amazon Creek drainage. The depression in groundwater levels along this drainage reflects a zone of higher permeability within the Older Alluvium (Frank 1973).

GROUNDWATER USE AND QUALITY. Groundwater supplies most of the water used for domestic and agricultural purposes in the study area. Although the City of Eugene obtains its water from impoundment of surface water, almost all other municipalities and water supply systems in the area use groundwater (Lane Council of Governments [LCOG] 1975). This includes the Cities of Coburg, Springfield, and Junction City.

Groundwater quality in the alluvial aquifers is distinctly different from that in the bedrock aquifers. The former is of relatively good quality whereas the latter is more highly mineralized. This difference is illustrated in Table 3-3, which shows selected groundwater quality data for six aquifer types.

Table 3-3. Selected Groundwater Analyses

Groundwater Source	Location township/ range/section	Data Source[a]	Date	pH	EC µmhos/cm @ 25°C	TDS[c]	Si	Fe	Mn	Ca	Mg	Na	K	He>3	Co_3	SO_4	Cl	No_3[b]	B	Al	As
SHALLOW ALLUVIAL AQUIFER - WILLAMETTE VALLEY	17S/2W-26 cca2	1	3-69	7.2	--	--	42	.22	<.02	19	13.8	10	2.3	122	0	1.8	8.4	.05	--	.15	--
	16S/4W-25 ccd	1	7-69	7.2	--	--	21.9	.12	.15	--	--	--	--	--	--	2.5	--	--	--	--	--
ALLUVIAL AQUIFER - RIVER ROAD - SANTA CLARA	17S/4W-13 ccd	1	6-18-69	--	--	--	39	--	--	23	13	9.4	1.3	99	0	21	8.5	22	--	--	.00
	16S/4W-27 cbd	1	9-25-69	7.5	265	--	--	--	--	24	13	--	--	99	0	--	--	26	--	--	--
	General[d]	3	--	--	158.67	--	--	--	--	--	--	--	--	--	--	10.94	8.98	4.2	--	--	--
DEEP ALLUVIAL AQUIFER - WILLAMETTE VALLEY	15S/4W-32 cab4	1	8-27-68	8.0	--	--	25.5	.10	--	35.3	10.2	64	2.0	105	0	0.0	114	.01	--	.01	--
	17S/3W-5 aab	1	8-13-69	7.2	--	--	25	.65	--	11	4.6	11	1.0	73	0	5.2	1.5	3.8	--	--	--
	Coburg Deep Well	4	7-76	7.5	181	139	38.7	--	--	14.4	5.5	6.8	1.3	100	0	1.4	3.5	1.0	--	--	.005
FOOTHILLS OF THE WESTERN CASCADES	16S/2W-23 abd	1	8-02-69	8.2	231	177	41	.08	--	13	4.2	38	.8	161	0	.2	1.0	.0	--	--	.00
	14S/2W-31 aca	2	12-05-73	8.3	--	--	42	.04	.008	11	1.1	61	.7	163	0	26	6.9	.00	.20	--	.0
MARINE SEDIMENTARY AND VOLCANIC ROCK	18S/4W-3 cad	1	3-27-63	8.1	672	--	25	.16	.0	12	5.0	136	1.6	281	0	67	36	.8	1.3	.1	.09
	15S/3W-9 cba	2	12-04-73	7.4	2,730	1,400	37	.17	.12	220	97	150	4.6	195	0	.7	790	.00	.01	--	.001
	14S/5W-23 bcbl	2	12-03-73	7.3	2,220	1,100	23	1.00	.083	250	9.1	160	.9	105	0	8.5	630	.03	.40	--	0
MIXED ALLUVIAL AND BEDROCK AQUIFERS	13S/3W-32 ccc2	2	6-58	7.0	--	3,400	54	5.8	0	470	47	350	2.0	150	0	2.6	1,400	.07	--	--	--
	14S/3W-7 ddc	2	9-13-73	7.4	1,520	780	32	.04	.37	150	28	89	2.4	235	0	1.8	360	1.1	0	--	0
	15S/3W-6 bdd	2	12-04-73	7.7	156	120	39	.13	.033	16	5.7	9.5	1.0	77	0	4.7	7.3	.64	.007	--	.002

NOTE: All constituents in milligrams per liter (mg/l) unless otherwise noted.

SOURCES: [a]1: Frank 1973; 2: Frank 1976; 3: Sweet, Edwards & Associates, 1980 Final Tech. Report, 9/ III-2; 4: Brown & Caldwell 1980.

[b]All values are nitrate + nitrite (as N) except those from Data Source 1 which are nitrate only.

[c]Total Dissolved Solids, calculated.

[d]Values for this listing are mean values used in the groundwater modeling study of Sweet, Edwards & Associates (Data Source 3).

Groundwater in the alluvial aquifers is generally of good quality with total dissolved solids in the range of 24 to 382 milligrams per liter (mg/l) (Frank 1973). The highest quality water occurs in the Young Alluvium. Locally, nitrate concentrations exceed background levels due principally to aquifer contamination from agricultural fertilization, feedlot runoff, or septic tank drainage. Contamination has been greatest in the Santa Clara-River Road area where average nitrate concentrations are 3-12 mg/l (Sweet, Edwards & Associates 1980). The highest value recorded in this area was 70 mg/l (Brown and Caldwell 1980). Elsewhere in the study area, the maximum reported concentration was 26 mg/l (Frank 1973).

Groundwater from the sedimentary and volcanic bedrock typically contains a higher proportion of dissolved solids than does alluvial groundwater, but is still generally suitable for most uses. However, groundwater obtained from marine sedimentary rock below the valley floor is often unusable as it is highly mineralized with concentrations of sodium, calcium, and chloride. Significant concentrations of naturally occurring arsenic have also been reported for wells completed in the Fisher formation (Frank 1973; LCOG 1974, 1975).

The frequency of bacterial contamination in the alluvial and bedrock aquifers is generally low. Only a few incidents have been reported, mainly near metropolitan areas. Bacterial contamination can occur if well casings are not properly sealed against surface water infiltration or if groundwater is shallow and in close proximity to sources of bacterial contamination, such as septic systems.

<u>Regional Wastewater Treatment Plant</u>

<u>SOILS</u>. The soils on this site are composed of Newberg soils with a small area of Camas soils near the river. Newberg soils are moderately fine textured to a depth of approximately 24 inches. Below this depth, and extending below 5 feet, they are coarse textured sands and gravels. The permeability of the upper portion of the soil is moderately rapid; the lower portion is very rapid. Few plant roots penetrate below 24 inches and there is probably insufficient carbon to maintain vigorous microbial populations below the surface few inches. The soil pH in the rooting zone is between 5.5 and 6.0. The capacity of the soil to adsorb heavy metals is low to very low. Camas soils are similar to Newberg soils but are coarser textured throughout and have a shallower rooting depth.

<u>GEOHYDROLOGY</u>. The site is underlain by Younger Alluvium (Frank 1973) which consists of a surficial layer of silty sand overlying sandy gravel (CH2M Hill 1978). The silty sand unit ranges from clean fine sand to silty or clayey sand and is generally less than 15 feet thick. Groundwater levels at the site are controlled by the adjacent river level. During times of peak river flow, the groundwater table may reach the ground

surface. At other times, the groundwater table is probably never deeper than about 20 feet below the surface. Groundwater flows to the north and toward the river.

GROUNDWATER USE AND QUALITY. Water for domestic and industrial use in the area is provided by the Santa Clara or River Road Water Districts, which obtain their water from surface impoundments. As a consequence, groundwater is not used to any great extent, although some private wells may exist. Relatively high levels of nitrate and coliform bacteria exist in the shallow aquifer in the area (LCOG 1980). Chloride and sulfate are also present at moderately high levels (Sweet, Edwards & Associates 1980).

Short Mountain Landfill Site

SOILS. The soils on this site are primarily Natroy, Bashaw, Nekia, and Witzel soils. The Natroy and Bashaw soils are very fine textured with over 90 percent silt and clay to a depth of 5 feet or more. They occur on the lower elevations of the landfill site. These soils have a high cation exchange capacity (CEC) and a very high capacity to adsorb heavy metals. The fine texture also hinders water movement into and through the soil, and water will stand in depressions for long periods of time during the winter.

The Nekia and Witzel soils occur on higher portions of the site; they are fine to very fine textured (silty clay to clay) and exhibit a moderately slow to slow permeability. Both soils also have a high CEC.

GEOHYDROLOGY. The Short Mountain Landfill site is underlain by the Eugene Formation, which consists of interbedded mudstone, sandstone, and volcanic rock. The volcanic rocks appear to be intrusive into the Eugene Formation and they underlie the high ground on-site (Rittenhouse-Zeman & Associates 1976).

Clayey soils mantle the site, as described previously. These soils are thinnest (1-2 feet) on the slopes of Short Mountain and are thickest (4-8 feet) on the flat portion of the site near Camas Swale Creek.

Groundwater occurrence and movement is controlled in the upper portion of the site by volcanic rock and on the lower portion by the Eugene Formation and associated clayey soils. In both areas, surface water infiltration is restricted. On the lower part of the site, however, surface water can move downward to the groundwater table. The movement will be very slow because of low soil permeability. When the infiltrating water reaches the water table it will migrate laterally down-gradient toward the nearest groundwater discharge location. For this site, it appears that discharge occurs to either Camas Swale Creek or the Coast Fork of the Willamette River based on surface topographic conditions. These two bodies of water act as barriers to further groundwater migration. Short Mountain also acts as a barrier, since groundwater tends to move from topographically high to topographically low areas. Figure 3-3 shows the anticipated direction of shallow groundwater flow in the vicinity of the site. Groundwater movement to the northwest is also possible but unlikely.

Rittenhouse-Zeman & Associates (1976) conclude that the groundwater table is probably 10-15 feet below the surface in the vicinity of the landfill. This depth appears likely for low areas adjacent to Camas Swale Creek but may be too shallow in other areas. Water level monitoring in test borings 1, 3, and 4 over a 2-year period (see Table 3-4) indicate that the water table is 2-10 feet below the ground surface. These values are suspect since surface water may be entering the wells.

GROUNDWATER USE AND QUALITY. There are no groundwater wells on the landfill site currently in use, nor are there any wells located between the landfill and the surrounding groundwater boundaries (Camas Swale Creek and Willamette River) with the possible exception of abandoned wells (see Figure 3-3).

Data on existing groundwater quality at the site is limited and shows no apparent trend. Lane County sampled and tested three shallow wells (Wells 1, 3, and 4) for some water quality parameters, excluding bacterial counts, over a period of 2 years (Table 3-4). The first samples were taken just prior to commencement of the landfilling operation; the last were taken in December 1978. Well 3 shows the highest average levels of chloride, conductance, hardness, and turbidity. The total dissolved solids (TDS) range is between 770 and 1,120 parts per million (ppm). This is well above the recommended 550 ppm limit for drinking water (Oregon, State of 1982a). The average chloride level of 200-300 ppm also extends beyond the recommended limit of 250 ppm (Oregon, State of 1982a). Both wells 1 and 4 show much lower levels of chloride, hardness, and conductance than well 3, indicating that TDS is less. With the exception of the initial reading and that on September 9 in well 1, chloride concentrations are all less than 58 ppm.

Although the chloride levels in wells 1 and 4 are higher than would be expected for surface waters or alluvial aquifers, they are reasonable for groundwater in marine sedimentary rock. The much higher chloride level in well 3 is more difficult to explain, but could indicate surface water contamination. It is unclear whether runoff from the landfill has affected the water quality in well 3 since baseline conditions were not established.

In summary, the existing data suggest that groundwater at the site may be naturally high in chlorides and TDS. However, the data are insufficient to establish whether there has been any impact to groundwater quality due to the landfill.

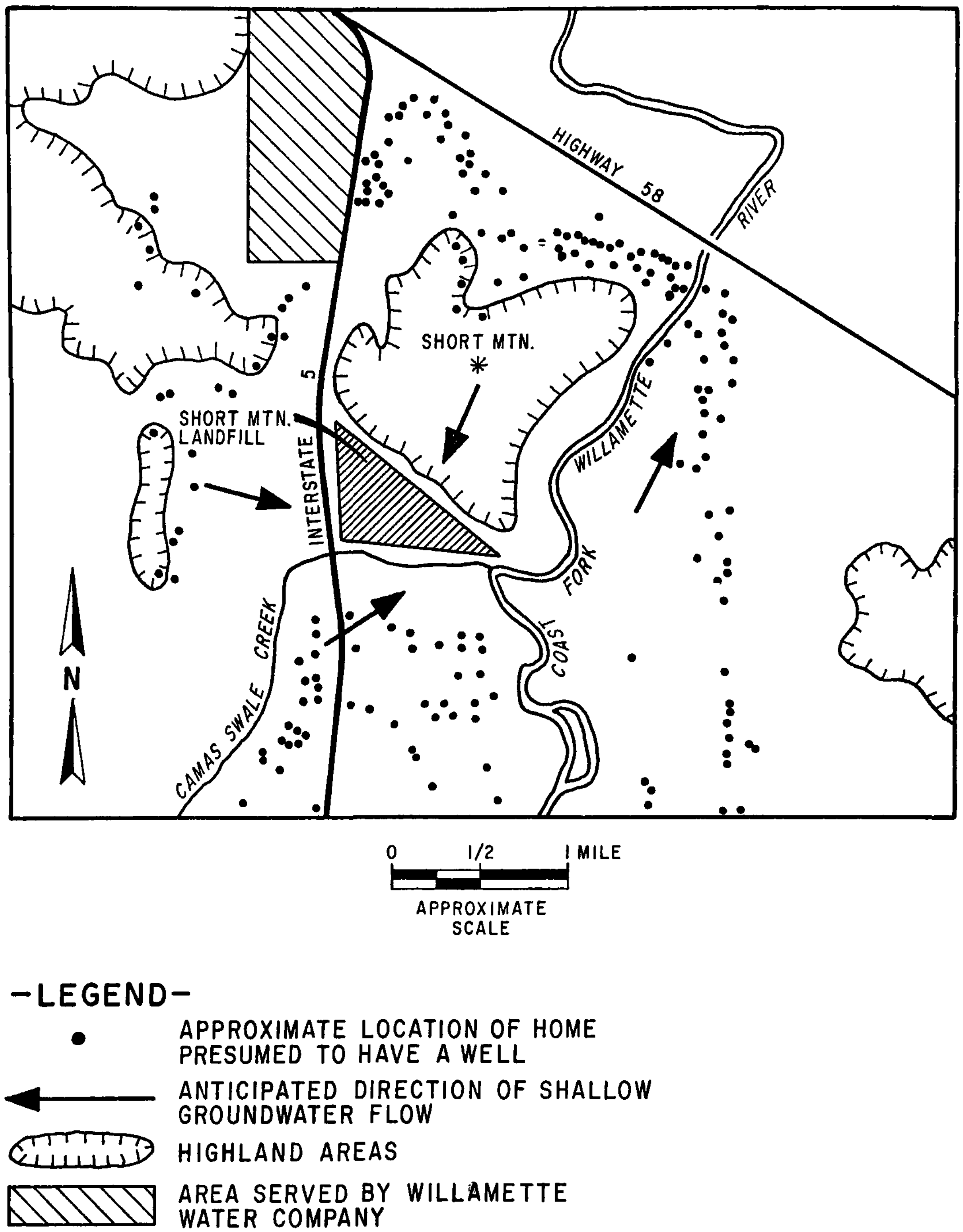


FIGURE 3-3. LOCATION OF RESIDENCES AND GENERAL DIRECTION OF GROUNDWATER MOVEMENT IN THE VICINITY OF SHORT MOUNTAIN LANDFILL

Table 3-4. Groundwater Quality Monitoring: Short Mountain Landfill[1]

	Conductance µmho/cm at 25°C	Chloride mg/l Cl^-	pH	Alkalinity mg/l $CaCo_3$	Hardness mg/l $CaCo_3$	COD mg/l	Turbidity JTU	Depth to Water[2] ft
Well 1								
8-24-76	4,430	1,496	6.9	174	1,884	58	22	4.8
6-20-77	650	58	7.2	240	211	12	2.6	4.1
9-12-77	1,320	266	7.2	247	414	12	--	7.3
1-10-78	270	5.2	6.9	146	124	13	18	2.3
3-27-78	530	16	7.2	266	240	16	4.3	1.8
7-10-78	660	46	7.2	295	271	13	8	5.3
12-04-78	258	6.1	7.6	106	87	38	6.4	---
Well 3								
8-24-76	1,920	540	7.2	299	477	23	62	4.5
6-20-77	1,220	200	7.1	376	272	17	5.2	6.8
9-12-77	1,700	322	7.4	367	337	17	--	8.1
1-10-78	970	147	7.0	371	243	18	36	4.3
3-27-78	1,110	175	7.2	414	277	14	12	4.5
7-10-78	1,470	225	7.3	309	339	16	16	6.6
12-04-78	1,550	276	7.9	376	342	17	2.8	---
Well 4								
8-24-76	630	46	7.0	298	283	9.6	22	9.2
6-20-77	510	5	6.9	224	186	4.7	2.2	10.2
9-12-77	---	--	---	---	---	---	--	---
1-10-78	100	10	6.9	48	45	12	94	2.1
3-27-78	210	5.0	7.0	114	108	9.4	26	6.8
7-10-78	260	26	7.4	139	124	8.5	14	10.7
12-04-78	133	2.6	6.8	42	43	20	3.1	---

NOTES: [1]Lane County Department of Public Works 1976-1981; note that the data are reproduced here as provided by the above-referenced source. There is some question as to whether the data reflect actual groundwater conditions or whether surface-water contamination has occurred.

[2]Distance in feet between top of plastic casing and water.

Site C/Prairie Road Site

SOILS. The soils on these sites are mainly Malabon, Coburg, and Awbrig silty clay loams. Small areas of Salem gravelly silt loam are also present. Malabon and Coburg soils are fine textured to depths of 5 feet or more and are underlain by alluvial sands and gravels. The proportion of combined silt and clay in the soil averages more than 80 percent, making permeability moderately slow to slow. Water will stand in depressions for short periods during heavy rainfall and will perch on the clayey horizon present at a depth of 15-20 inches.

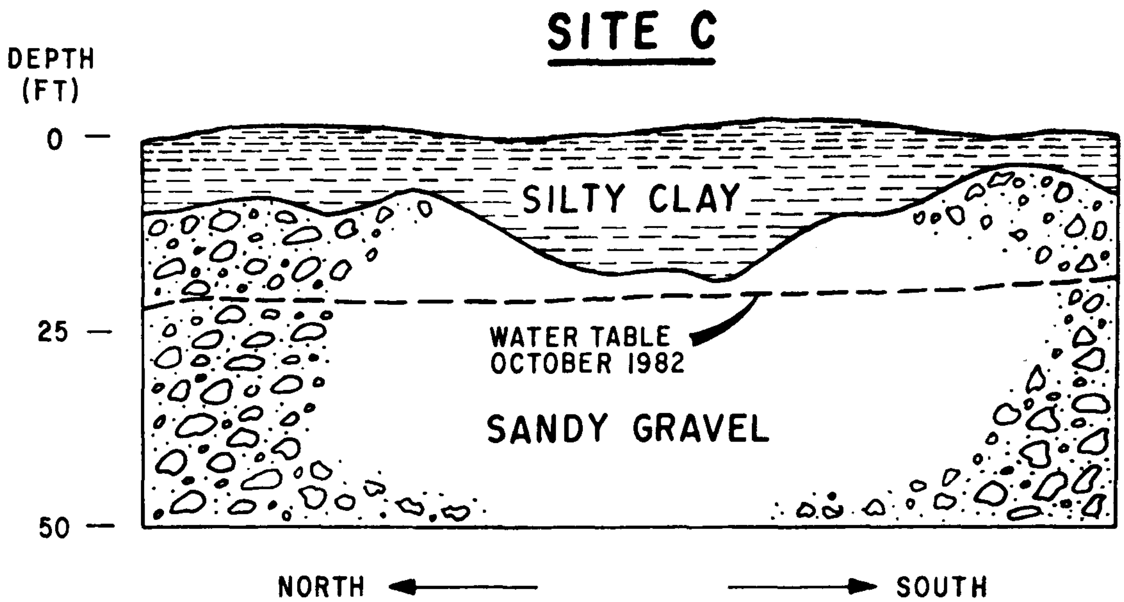
The Salem soils, present in the eastern portion of the Prairie Road site, are fine textured to a depth of about 24 inches. Below this depth the soil consists of very gravelly sand to 5 feet or more. The upper and lower portions of the soil profile have a moderate permeability and a rapid (high) to very rapid (very high) permeability, respectively. In some areas, sand and gravel occurs at the surface.

GEOHYDROLOGY. Considerable information is available on subsurface soil and groundwater conditions at Site C and the immediate vicinity. Eight groundwater monitoring wells were installed at Site C (Geotechnical Consultants, Inc. 1982) and a groundwater study was recently conducted at a property immediately east of the Prairie Road site (known as the Agripac site) by Sweet, Edwards & Associates (1982). Also, test pits were dug at Site C as part of a soil survey (Brown and Caldwell 1979) and a shallow piezometer was installed by Ted Dietz (Sweet 1978).

The Geotechnical Consultants report (1982) indicates that Site C is underlain by 4-18 feet of silty clay soil. There is no discernible pattern to the variation in thickness as shown schematically in Figure 3-4. Sand and gravel alluvium occurs beneath the surficial soils. The alluvium is part of the Older Alluvium unit, as defined by Frank (1973), and is more than 250 feet thick at the Agripac site. It is likely to have a similar thickness at Site C and the Prairie Road site.

The water table at Site C is shallow, ranging from 15-22 feet below the surface in October to at or near the ground surface in late winter and early spring (Sweet 1978; Geotechnical Consultants 1982). When near the surface, groundwater discharges to drainage swales and road ditches.

Information concerning groundwater flow is not yet available specifically for the site. However, Frank (1973) and Sweet, Edwards & Associates (1982) conclude that shallow groundwater flow in the area is to the north or northwest. Local variations in flow direction of up to 180° can occur. The zones of highest groundwater velocities (up to 300 feet per year) are expected to occur along lines of gravel deposition. Deep groundwater flow is also to the north, but has an additional upward component as a consequence of its semiconfined nature.



NOTE:
BASED ON WELL INSTALLATION DATA (GEOTECHNICAL CONSULTANTS, INC. 1982) NO HORIZONTAL SCALE

FIGURE 3-4. GEOHYDROLOGIC CROSS-SECTION OF SITE C

The confinement acts to hydraulically isolate deeper portions of the aquifer from the shallow portion; this in turn helps restrict groundwater contaminants to the shallow flow system.

GROUNDWATER USE AND QUALITY. A large number of private wells exist in the immediate vicinity of the two sites. Figure 3-5 shows some that are known. Many others probably exist, particularly in the area between Site C and Highway 99.

Groundwater is used in the area primarily for domestic and irrigation purposes. Although the Santa Clara Water District services the nearby River Road area, it does not extend to the proposed sludge management sites, as shown on Figure 3-5. The local population therefore depends exclusively on individual wells. A majority of the wells are completed in Older Alluvium and are less than 100 feet deep; yields range from 100 to thousands of gallons per minute (gpm). Most yields are greater than 100 gpm.

Results from groundwater monitoring at Site C are just now becoming available; however, a great deal of information is available concerning groundwater quality at the Agripac site and in the area south of Awbrey Lane and West Beacon Drive. These roads mark the northern boundary of a groundwater study done for LCOG in the River Road/Santa Clara (RRSC) area (Sweet, Edwards & Associates 1980).

The RRSC study showed that nitrate levels are elevated over background levels in the shallow aquifer. Average nitrate concentrations exceed 5 mg/l (as N) but are less than the EPA Primary Drinking Water Standard of 10 mg/l. The area of highest nitrate contamination, as shown in Figure 3-6, was within about 0.50 mile of Site C in 1980.

Data from the Agripac site corroborate the RRSC study findings but suggest that contamination extends further north. Sampling of five wells at the site (Sweet, Edwards & Associates 1982) found nitrate concentrations ranging from 2.5-9.3 mg/l (as N) with most values over 6 mg/l (see Table 3-5).

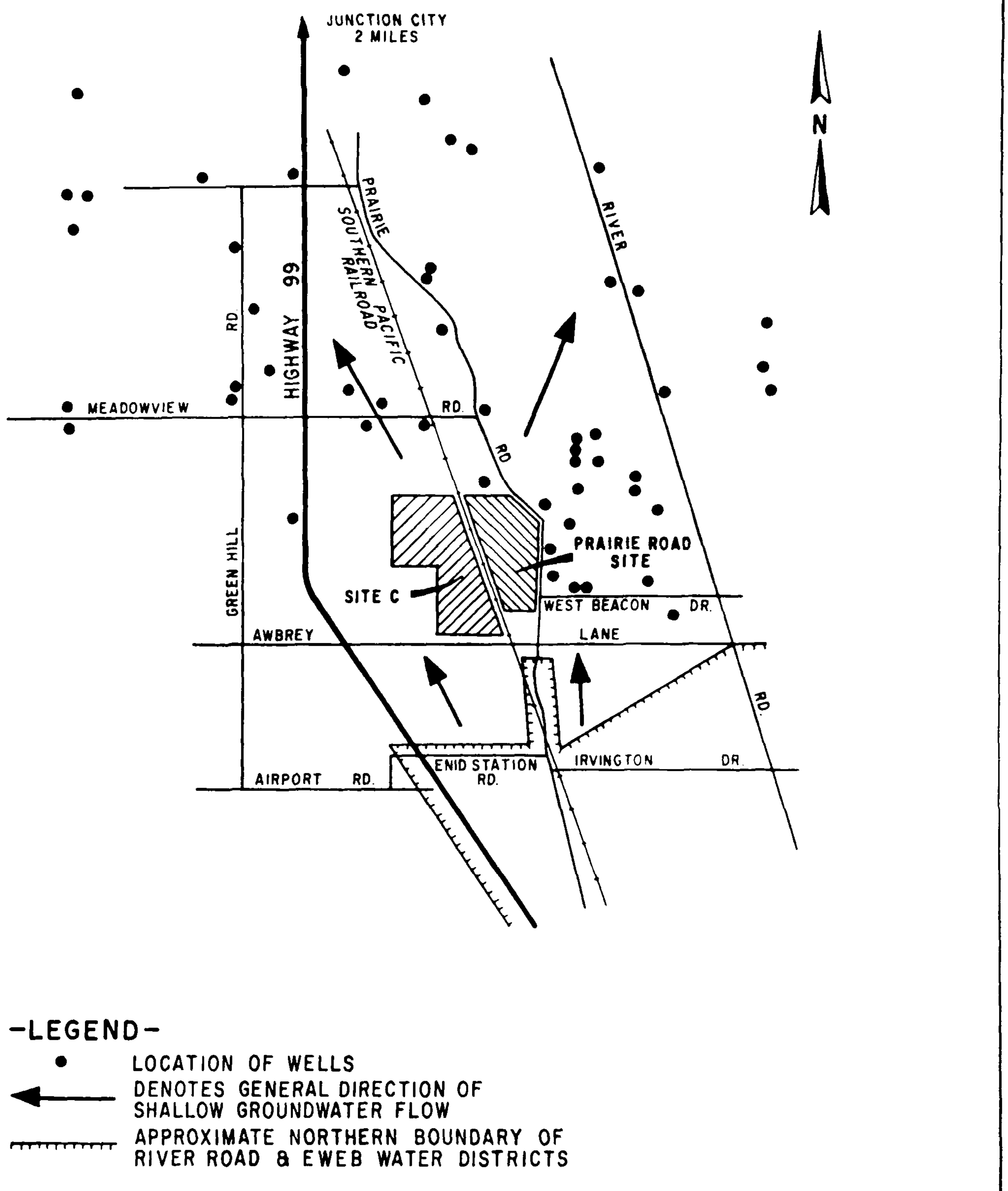


FIGURE 3-5. LOCATION OF SOME WELLS IN THE VICINITY OF SITE C AND PRAIRIE ROAD

SOURCES: FRANK & JOHNSON 1970; SWEET EDWARDS & ASSOC., 1982; SWEET, 1978

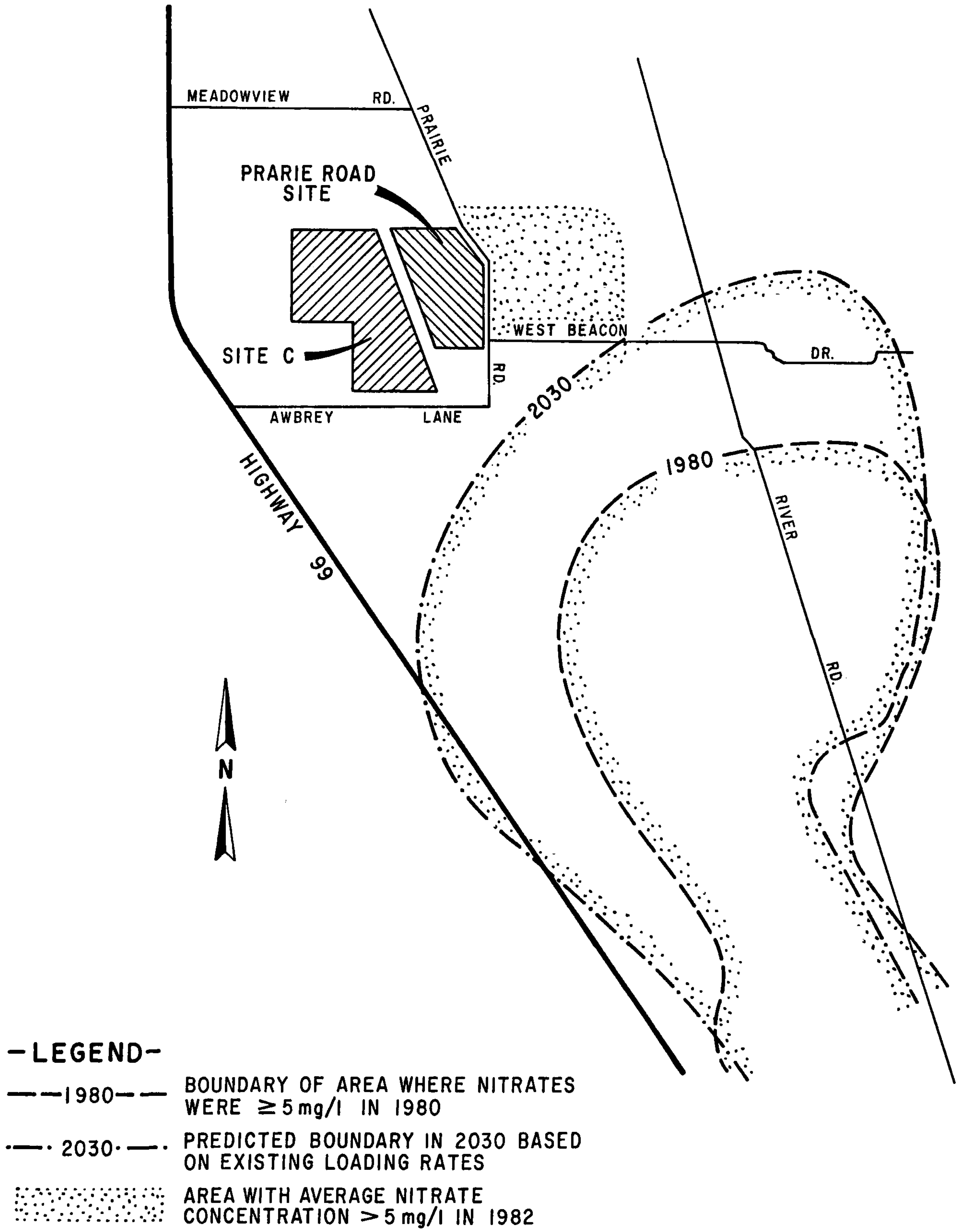


FIGURE 3-6. EXISTING AND PREDICTED NITRATE LEVELS IN GROUNDWATER SOUTH OF SITE C AND PRAIRIE ROAD

SOURCE: SWEET, EDWARDS & ASSOC., 1980 & 1982

Table 3-5. Groundwater Quality: Agripac Site[1]

WELL NUMBER	SPECIFIC CONDUCTIVITY μ/CM	NITRATE (AS N) (MG/L)	PH	TOTAL COLIFORM BACTERIA (MPN/100 ML)
2	160	2.5	7.1	-
6B	255	6.1	6.8	610
11B	760	6.0	6.8	0
13	270	4.3	6.8	0
BIV	230	9.3	6.7	64

[1] Sweet, Edwards & Associates 1982.

Several sources for the nitrate are suspected including septic drain fields, livestock wastes, and inadequate well seals (Sweet, Edwards & Associates 1980).

Based on the above data, it is reasonable to believe that the shallow groundwater at Both Site C and the Prairie Road site is also contaminated with nitrate to some degree. Other parameters, such as chloride and sulfate, were found to be elevated in the RRSC study. A similar situation probably exists at Site C and the Prairie Road site.

Coliform and fecal coliform levels in the RRSC study area are high. Fully 97 percent of the wells tested exceeded bacterial limits for drinking water on at least one test (Sweet, Edwards & Associates 1980). Laboratory analysis of three groundwater samples from the Agripac site (see Table 3-5) also showed high levels of coliform bacteria. Based on these data, it is likely that bacterial contamination is also present in the shallow aquifer at Site C and the Prairie Road site.

Coburg Hills site

SOILS. The soils at this site are composed predominantly of silt and clay and have been mapped as Bashaw soils. These soils were described previously in the section of the report regarding the Short Mountain Landfill.

GEOHYDROLOGY. Information concerning subsurface soil and groundwater conditions at the site is limited. Geologic and soils maps of the area and drillers logs (Frank 1973; Frank and Johnson 1970), indicate that there are 5 or more feet of clayey soil overlying Older Alluvium, which in turn overlies the Eugene Formation (bedrock). The Older Alluvium beneath the site is probably finer grained and more silty than in other areas of the valley because of its close proximity to the highlands. The Eugene Formation may also be partially weathered to clay. This formation is exposed at the surface in the surrounding Cascade foothills along with the volcanic rock of the Little Butte Volcanics. The depth to bedrock at the site is not known. However, near Coburg it is greater than 85 feet and at the base of the foothills is essentially zero.

Groundwater recharge occurs through direct precipitation and through runoff and groundwater discharge from the adjacent highlands (see Figure 3-7). The latter is probably more significant, considering that the site is surrounded on three sides by highland areas. Groundwater is likely to occur beneath the surficial soils in discontinuous bodies of perched water within the alluvium. These bodies are likely to be confined and under artesian pressure.

Frank (1973) showed water table contours for September 1969 and January 1970 that slope downwards to the northwest, indicating that regional groundwater flow is in that direction (see Figure 3-7). Local groundwater flow at the site probably trends more to the west, toward the City of Coburg. Groundwater flow rates in the Older Alluvium, if present, would likely be slower than in other areas of the valley, although some layers or lenses of clean sand and gravel with higher groundwater velocities may be present. Groundwater flow in the Eugene Formation at the Coburg Hills site would likely be very slow unless fracturing exists.

GROUNDWATER USE AND QUALITY. All water for domestic, irrigation, and livestock purposes in the Coburg area is obtained from wells. This includes the City of Coburg. Figure 3-7 shows some known wells near the Coburg Hills site; others may exist. West of Interstate 5, a majority of wells are completed in Older and Younger Alluvium. Some wells are deep, in excess of 200 feet, but most are less than 100 feet with many shallow wells 50 feet deep or less. In areas adjacent to or in the foothills, wells are completed in the Eugene Formation or Little Butte Volcanics.

Groundwater quality data are not readily available for the Coburg area. One analysis from a well south of Coburg (Frank & Johnson 1970) showed relatively low total dissolved solids and a normal concentration for the major ionic constituents except nitrate. The nitrate concentration was 3.8 mg/l, which is somewhat elevated compared to background concentrations.

Information concerning bacterial quality is also scarce. Bacterial levels are expected to be generally low, with isolated cases of contamination, due to the relatively low density of development in the area.

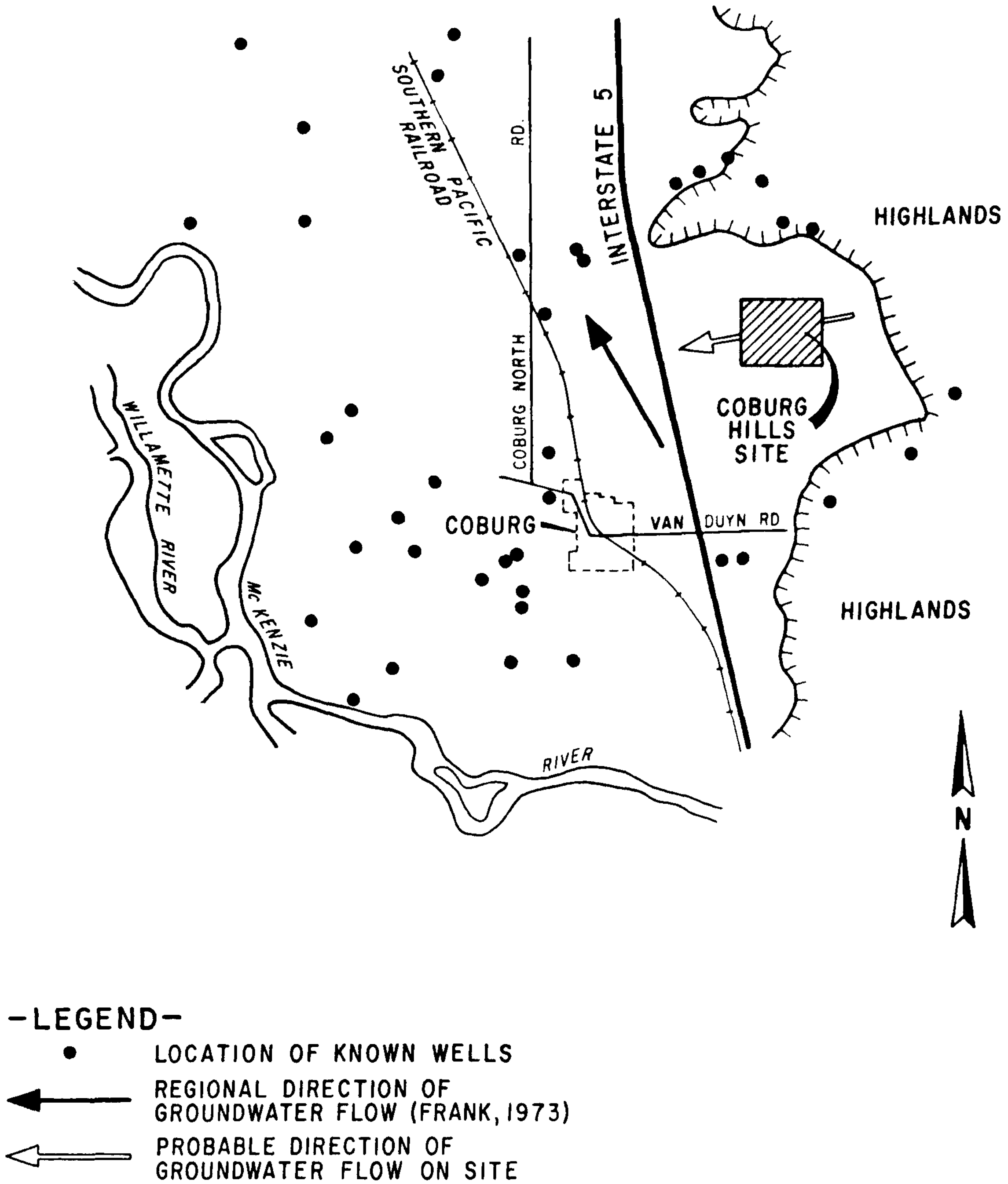


FIGURE 3-7. LOCATION OF SOME WELLS AND GENERAL DIRECTION OF GROUNDWATER FLOW IN THE VICINITY OF THE COBURG HILLS SITE

SOURCE: FRANK & JOHNSON, 1970 AND STATE OF OREGON WATER WELL REPORTS THROUGH 1982

IMPLICATIONS OF NO PROJECT (ALTERNATIVE 4)

If the No Project Alternative were implemented, sludge management after 1989 would continue to rely on the Phase I interim facilities and practices. Sludge would continue to be mechanically dewatered at the RWTP and spread on agricultural land in the dry months. During the wet months, dewatered sludge would go to the Short Mountain Landfill. The groundwater quality implications of this action cannot be accurately assessed, because it is not known what would be done with the liquid sludge eventually generated in excess of the capacity of Phase I dewatering facilities. If this material were placed in the landfill or spread on agricultural land in the winter months, the chances of affecting groundwater quality would be greatly increased over the proposed project.

IMPACTS OF ALTERNATIVE 1

This alternative involves construction of a force main and facultative sludge lagoons (FSLs) and air-drying beds at one of three possible sludge management sites. During the winter months sludge will be stored, and in the summer it will be dried and distributed to agricultural lands. Some distribution of liquid sludge is also planned, and landfill disposal of dried sludge would serve as a back-up.

Facultative storage and air-drying would have a significantly different effect on the chemical nature of the dried sludge than the mechanical dewatering which will soon be undertaken at the RWTP. During storage, organic nitrogen in the digested sludge continues to undergo anaerobic mineralization to soluble ammonium ions (U. S. EPA 1979). Some of this ammonia is lost through return of supernatant to the RWTP. After the sludge is harvested and spread to dry, the change to aerobic conditions facilitates rapid volatilization of NH_4^+ to NH_3 (gas) (King 1976). Up to 100 percent of the NH_4^+ can be lost through this process, although it is generally lower. As a result, the air-dried sludge contains a much lower percentage of available ammonia or nitrate than does mechanically dewatered sludge, and the application rates for agricultural use must be correspondingly higher to maintain the same benefits to crop production.

Another consequence of sludge stabilization in lagoons is that approximately 25 percent less sludge is produced than would be produced from the mechanical dewatering process (Brown and Caldwell 1979). This smaller volume results in a higher concentration of heavy metals and, consequently, a higher annual loading rate in agricultural reuse areas.

The following sections describe specific potential groundwater impacts along the force main routes and at the proposed disposal and air-drying sites.

Site C

Site C is located above a major, shallow water supply aquifer. Potential contamination of this aquifer with nitrogen, heavy metals, or other sludge constituents is therefore a key issue. There are three potential paths of infiltration routes as follows:

1. The base of the storage lagoons.
2. The base of the air-drying beds.
3. Infiltration of contaminated runoff.

Brown and Caldwell (1979) note that storage basins have historically been self-sealing and cite experience at the Sacramento sewage treatment facilities. The sealing occurs after only 2 or 3 months by plugging of soil pores with suspended and colloidal material, and by the formation of a mucous-like membrane at the soil-sludge interface. Prior to this self-sealing, the underlying soil conditions determine the rate of movement of sludge constituents into the groundwater table.

The lagoon floor will be composed of 6 inches of compacted clay placed over native silt and clay-rich soil. The fine textured soils in this area are from 4 to 18 feet thick, with much coarser Older Alluvium as a substrate. Because the lagoon bottom will be excavated approximately 5 feet below grade, it is possible that some portions of the lagoon bottoms will be in direct contact with the coarser subsoils rather than clay-rich layers. Where this occurs, the 6 inches of compacted clay will control the leaching of materials into the groundwater. The exact depths of natural clay material below lagoon sites will not be known until further design and soil testing is undertaken. Where 5 to 10 feet of clay-rich material underlies the lined lagoons, leachate movement would be extremely slow even if the clay liner were to crack or in some other way fail.

If sludge constituents were to escape through the bottom of the lagoons through some failure in the lining (a low probability occurrence), the rate and direction of movement would vary with the seasons. During the summer, when the groundwater table is lowest, any leachate would move vertically downward. Later, during the fall and winter, leaching would virtually cease due to a rise in the water table and subsequent decrease in down-migration of water from the surface. The most significant leaching or "washing" would occur if a liner failed in the late spring or early summer as the water table lowered.

Sludge constituents of concern, should a liner failure occur, are heavy metals, nitrogen, and organic compounds (quantities expected in Eugene sludge are listed in Table 2-2). Heavy metals are relatively insoluble, and would remain fixed in the sludge or in near-surface soils rather than percolate great distances with leachate. Consequently, they would have little or no impact on groundwater. NH_4^+ (ammonia nitrogen) and water-soluble pesticides could have some impact as they move essentially at the same rate as migrating soil water. In areas where a thick clay-rich subsoil exists, leachate movement would be slow and the dilution in the aquifer high, so groundwater would experience little increase in ammonia or pesticide levels. If the lagoon excavation intersects thin clay layers or underlying sand or gravel layers, however, considerable nitrogen and some pesticides could leach or be washed into the groundwater in the event of a liner failure. It would be useful, therefore, to avoid coarse subsurface layers when lagoons are specifically sited.

The second route for groundwater contamination is leaching through the drying beds. The possibility for this is slight, considering that the beds are planned to be floored with asphaltic concrete on a bed of gravel. Sludge leaching could occur during summer rainstorms but would not reach the soil unless the asphalt was cracked or punctured. Any leachate that did get through would be captured in the gravel and transported laterally to the perimeter ditches. The only likely circumstance in which leachate would enter the soil rather than be collected in the perimeter ditch would be if the soil immediately below the drying beds were composed of permeable sand and gravel. Since this is not the case at Site C, there is virtually no possibility of groundwater contamination from the drying beds.

The third route for impacts to groundwater is through runoff infiltration. This last category embraces a large number of potential spill and subsequent runoff events associated with the maintenance and operation of the facility. These events range from minor sludge spills to major potential leaching following a major structural or equipment failure. Major failures are only likely as a result of some catastrophic event (e.g., earthquake).

Some or all of these events could occur, but a major spill is extremely unlikely. If a small spill does occr, the more soluble sludge components, notably nitrogen as nitrate, sodium, and some pesticides, would enter runoff during rainstorms. Depending on the time of year, some of the runoff could infiltrate the ground and the rest would move off-site as surface water.

The quantity of material which infiltrates should be minor because of low soil permeability. Nitrogen which does infiltrate will be further diluted in the aquifer. Significant groundwater impacts would only be likely if a major spill occurred in an area of thin clay soil or of sandy soil; these conditions are not present on Site C.

Prairie Road Site

Soil and groundwater conditions at the Prairie Road site are essentially the same as those at Site C; potential impacts to groundwater would therefore be similar. However, sand and gravel occur at the surface on a portion of the site. These permeable soils could result in considerably greater impact to groundwater through leaching of ammonia-nitrogen and other water soluble components. Also, contaminated runoff crossing the permeable soils would infiltrate and reach groundwater at a much higher rate.

Coburg Hills Site

Plans for air-drying facilities at the Coburg Hills site are similar to those for the other two sites. However, there are important differences: 1) cuts of up to 7 feet will be required to provide level areas, and 2) subsurface soil conditions have not been explored. The importance of these two items lies in the possibility of encountering adverse soil conditions, such as a permeable sand and gravel aquifer at shallow depths. Although a highly permeable and extensive deposit of sand and gravel is unlikely, individual lenses or layers of sand or gravel under artesian pressure could be present. These layers could create construction difficulties, but would have a net upward pressure and thus serve to protect lower portions of the aquifer from contamination.

Available information suggests that the site is underlain by 5 feet or more of clay-rich soil. This soil will provide an effective barrier for infiltration and would help to prevent contamination of an underlying aquifer. The same general infiltration routes discussed previously for Site C would apply at this site.

Force Main Routes

Significant contamination of groundwater could result if leakage occurred from the force main in areas where highly permeable soils occur near the surface. Although Brown and Caldwell (1979, pg. 4-3) estimate that "even the most severe pipe break could be located and repaired within 2 days;" it could take considerably longer to locate small to moderate leaks where sludge loss is inconspicuous. Leaks of this type in sewage lines have been known to go on for months or years before being discovered. This is unlikely with the dual force main, as MWMC proposes periodic pressure testing to detect small leaks.

Contamination of groundwater would pose a threat chiefly in areas where groundwater is used for domestic supplies. The proposed pipeline route to the Coburg site passes initially through an area where water is supplied from outside sources before reaching groundwater use areas at the McKenzie River/Interstate 5 junction. From there on, there is a potential for contamination of groundwater supplies. Similarly, the proposed pipeline route to Site C or the Prairie Road site passes for the most part through areas supplied by the River Road or Santa Clara Water District. Groundwater use begins only near the end of the route at about Enid Station Road (see Figure 3-5).

In addition to contamination from leakage in groundwater use areas, contamination might also occur from leaks outside the area. This could happen if, for example, a major leak occurred south of and upgradient from Site C, and the northward-moving groundwater brought contaminated water into the area of groundwater use. This possibility should be considered since nitrate levels in the aquifer are currently at or near the EPA and Oregon state drinking water limits.

The constituents of most concern are nitrogen, pesticides, and heavy metals. The movement of heavy metals in an aquifer is not well documented but is presumed to be negligible in keeping with their low solubility. However, any metals in solution would likely remain in solution if leaked material entered a gravel unit; this would be offset, however, by more rapid dispersion. Pesticides and other organic compounds should pose little problem because of their low concentrations. Nitrogen would, however, be present in sufficient quantities, and is sufficiently soluble, to have an impact on groundwater quality.

Agricultural Land

The EPA FNSI (U. S. EPA 1983) for the MWMC Phase I sludge management project considered the groundwater quality impacts of agricultural reuse of mechanically dewatered sludge. The FNSI found that there would not be a significant threat of groundwater contamination from agricultural reuse of sludge as long as DEQ sludge reuse guidelines were followed. The FNSI cited the following in coming to this conclusion (Table 3-6):

Table 3-6. Phase I FNSI Groundwater Quality Findings

- All reuse sites would be subject to review and approval by DEQ prior to use.
- Strict DEQ monitoring requirements would be imposed on all reuse sites.
- Eugene sludge contains low concentrations of toxic organic components.
- Nitrogen application rates will be closely controlled and will not exceed commercial fertilizer application rates.
- Nitrogen concentrations in leachate will be controlled by plant uptake and will be thoroughly diluted in groundwater.

- o Pathogenic organisms will be filtered from the leachate by surface soils.

Alternative 1 would continue the agricultural reuse, but the sludge would be air-dried rather than mechanically dewatered. This change in dewatering would result in:

1. A slightly greater amount of NO_3 - available in the sludge, along with much less NH_4+. This would require a much greater application rate to provide the same quantity of available nitrogen.

2. A higher concentration of heavy metals.

3. A slightly higher concentration of sodium.

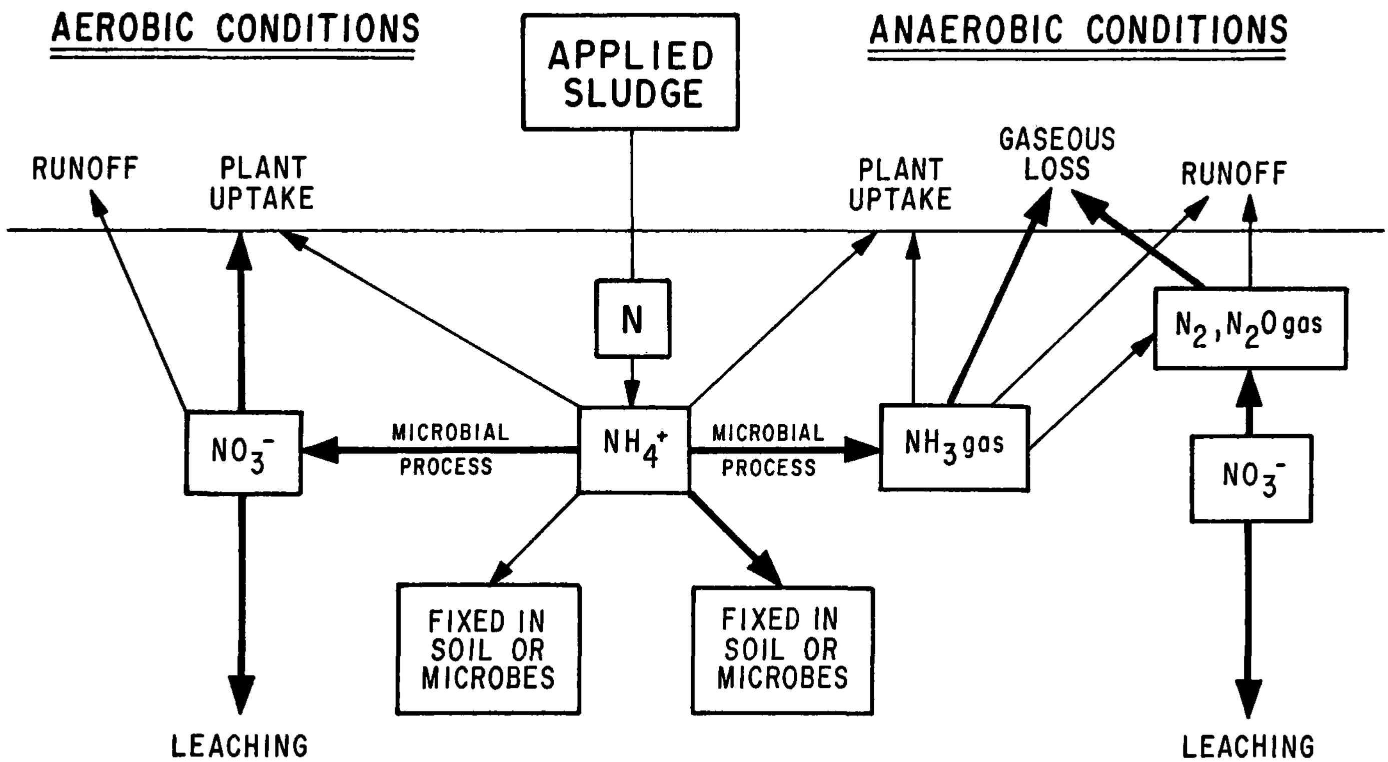
A brief discussion of the long-term groundwater quality implications of this continued agricultural application is presented below.

NITROGEN. Nitrogen as nitrate (NO_3) is potentially the most mobile chemical constituent in land applied sewage sludge, and therefore represents a significant potential impact to groundwater. When sludge is applied to land, the nitrogen undergoes a number of complex transformations in the soil. Figure 3-8 illustrates these transformations. It should be noted that although nitrogen transformations have been studied by several investigators (Epstein et al., 1978; Kelling et al. 1977; King 1976), there has been little attempt to quantitatively model these processes, except for work done by Hsieh et al. (1981). In the normal pH range of soils for this area (5.5-7.5), nitrogen is converted primarily to nitrate (NO_3), nitrogen gas (N_2), or to nitrous oxide (N_2O) depending on oxygen availability.

Under aerobic or oxidizing conditions, nitrogen in the sludge is converted to nitrate (nitrification) which can then either be immobilized by soils microbes, be taken up by plants, or enter the soil pore water (Page and Pratt 1975). The nitrate ion is highly mobile as a result of its negative charge and great solubility in water.

Under anaerobic or reducing conditions, organic nitrogen mineralizes to NH_4+. Since NH_4+ is readily held on CEC sites or immobilized by microbes, it is considerably less mobile than NO_3- and will tend to remain in the soil rather than leach. It is also available for plant uptake. Any NO_3- formed under oxidizing conditions will also tend to be denitrified to N_2 or N_2O gas under anaerobic conditions.

The nitrification process is most vigorous in the late spring and summer as oxidizing conditions improve and soil temperatures increase. Since these conditions coincide with the period of maximum plant growth, available nitrate is efficiently



NOTE:
ARROWS SHOW DIRECTION OF TRANSFORMATION. LARGE ARROWS ARE PRIMARY PATHWAYS. NOTE THAT NO_3^- IS SHOWN ON RIGHT SIDE OF DIAGRAM, ALTHOUGH IT DOES NOT FORM UNDER ANAEROBIC CONDITIONS. THE PURPOSE OF THIS IS TO ILLUSTRATE WHAT HAPPENS TO THE NITRATE FOLLOWING CONVERSION FROM AN OXIDIZING TO A REDUCING ENVIRONMENT.

FIGURE 3-8. NITROGEN TRANSFORMATIONS IN SOIL UNDER AEROBIC AND ANAEROBIC CONDITIONS utilized. During the fall and winter months, nitrate production is significantly reduced at the same time that plants are reducing their uptake. These anticipated relationships are illustrated in Figure 3-9.

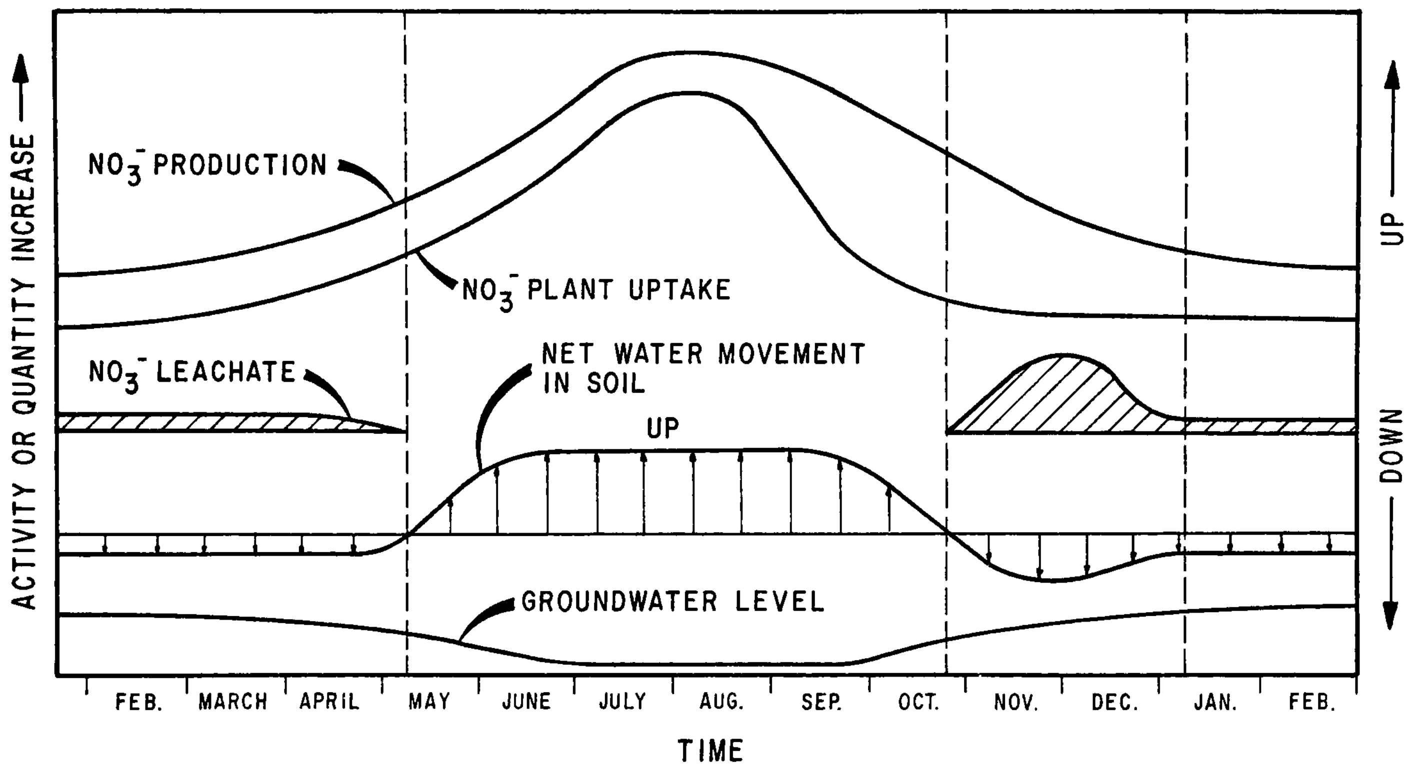
Although it is difficult to predict exactly how much nitrate will leach, it is safe to assume that it will be a small proportion of the total nitrate, on the order of 25 percent or less, since sludge application rates are geared specifically to crop nitrogen requirements. The nitrate that will leach will be that portion in excess of plant uptake and microbiological assimilation. During the summer, most of the excess nitrogen will remain near the surface because of the net upward movement of soil water (see Figure 3-9). This net upward movement is a result of high rates of evapotranspiration. Partial leaching could occur during rainy periods or through excessive irrigation. Beginning in the fall, active leaching should commence as the soil water movement reverses.

Although it seems logical to assume that leaching would occur throughout the winter months, the high groundwater table produces nearly saturated soil conditions near the surface, thus limiting the downward migration of water. The relationship is illustrated in Figure 3-9. As can be seen, the greatest leaching should occur in the short interval between the time the net downward movement of water commences and the point at which groundwater reaches its high winter level. When the groundwater lowers in the spring, it will take some of the nitrate with it. This "washing" effect may actually account for more nitrate loss than actual leaching.

The effect of nitrogen leachate of groundwater is dependent on the rate at which water can move to the groundwater (soil permeability) and the rate of dilution in the aquifer. Soil permeability is an important control since nitrate-nitrogen moves essentially at the same velocity as migrating water. The slower the migration, the longer it takes nitrogen to reach and be released into the groundwater. Group 2 and 3 soil types, which support most of the nonfood chain crops in the Willamette Valley, have relatively low permeabilities.

Where provisions of the Oregon DEQ regulations are maintained, most available nitrogen will be utilized by crop uptake and the remainder will be leached slowly to the groundwater and then diluted. The impact on groundwater should be one of a negligible to a very slight increase in nitrate concentrations.

<u>HEAVY METALS</u>. Heavy metals in sludge constitute one of the greatest potential impacts to ground and surface water quality. Soluble fractions of the metals, which include lead, cadmium, zinc, copper, nickel, mercury, and others, can enter groundwater and ultimately be captured by water wells or be discharged to surface water bodies. In either case, the concentration of metals is critical to the risk they pose.



NOTE:
ARROWS SHOW DIRECTION AND APPROXIMATE MAGNITUDE OF WATER MOVEMENT IN SOIL. NO SCALE.

FIGURE 3-9. RELATIONSHIP BETWEEN NITROGEN PRODUCTION, UPTAKE AND LEACHING THROUGH A TYPICAL YEAR

Studies by a number of workers have suggested that metal concentrations in the soil pore water are very low and that soils have a high capacity to "fix" heavy metals. Page (1974) found no movement of heavy metals below 45 cm in a field which had been irrigated with raw sewage for 70 years. Lund (1976) noted deeper migrations to 10 feet below a sewage pond. However, the pond had been in operation for 20 years and the soils were sandy. In a controlled experiment on a silt loam soil, Hinesly and Jones (1976) found that cadmium and nickel concentrations in drainage water from sewage-treated plots were no greater than background concentrations. Other investigations have obtained similar results showing low concentrations of metals in solution and little migration through the soil (Schauer, et al. 1980; Robertson et al. 1982; Emmerich et al. 1982; Sommers et al. 1979; Chang and Broadbent 1980).

Group 2 and 3 soils are well suited to the treatment (removal) of heavy metals. Although pH values are somewhat low (5.0-6.5), CEC and organic contents are high enough to readily adsorb heavy metals. For these reasons, heavy metals applied in sludge at the concentrations anticipated, should remain fixed within the sludge itself or in the near surface soils. Very low concentrations of heavy metals will migrate to the groundwater in leachate where they will be further diluted.

ORGANIC COMPOUNDS. As previously mentioned, the soil in groups 2 and 3 have high CEC and organic matter contents. These properties enable the soils to adsorb or microbiologically assimilate many complex organic compounds. For this reason, and because the sludge contains extremely low concentrations of the organic compounds tested, there should generally be insignificant impacts to groundwater under sludge application sites. Of the organic parameters tested in the Eugene/Springfield sludge, only two were detected: chlordane and 1254 PCB. Both were present in extremely low concentrations: .05 mg/kg for chlordane and .15 mg/kg for the PCB. Although the recommended EPA limit for PCB in drinking water is very low, .001 mg/l (U. S. EPA 1976c), PCB is relatively insoluble, particularly when associated with organic material. It should therefore cause little or no impact to groundwater.

Short Mountain Landfill

Landfill disposal will be utilized only as a back-up under Phase II. The volumes of sludge disposal should therefore be smaller than under the proposed interim sludge management plan, which EPA found to have no significant impact on local groundwater quality (U. S. EPA 1983).

IMPACTS OF ALTERNATIVE 2

This alternative is essentially the same as Alternative 1 except that air-drying and mechanical centrifuging would be used to dewater the sludge.

Potential impacts to groundwater at the three proposed sludge management sites would be essentially identical to those described earlier, although Alternative 2 would have a smaller acreage of drying beds and therefore less chance of a sludge leak or spill. Potential impacts along the force main route would also remain the same.

Landfill back-up under this proposal would include disposal of both air-dried and mechanically dewatered sludge. Because of the small volumes anticipated, impacts should be less than during Phase I. If agricultural application were suspended for a long time, then impacts at the landfill would be greater by virtue of greater volume. This possibility is discussed in the next section, Alternative 3.

Impacts at agricultural areas under this alternative are also similar to those described earlier. Essentially, only minor concentrations of nitrates, heavy metals, or organic compounds are expected to enter groundwater unless sludge is applied over an area with highly permeable soils or where runoff can enter well casings.

IMPACTS OF ALTERNATIVE 3

Under this alternative, permanent mechanical dewatering facilities would be constructed at the RWTP and dewatered sludges disposed of at the Short Mountain Landfill during the winter and on agricultural lands during the summer. This alternative is essentially a redesign and expansion of the interim plan now being implemented by MWMC.

Agricultural Lands

Impacts to groundwater with this alternative would essentially be the same as those described under Alternative 1.

Short Mountain Landfill

Potential groundwater impacts at the Short Mountain Landfill would be similar to those of the proposed interim plan (U. S. EPA 1983). However, as a consequence of the greater volume of disposed sludge, there would be increased nitrogen available for leaching. This greater quantity of nitrogen would be diluted in a greater volume of leachate, leaving the absolute concentration of NH_4+ in the leachate nearly the same, or only slightly greater, than from the interim plan. This also applies to the heavy metals and organic compounds in sludge.

Regional Wastewater Treatment Plant

The potential for any sludge or supernatant reaching groundwater in sufficient quantities to degrade groundwater quality at the RWTP is small, and is commensurate with the risk from any other operations of the plant.

MITIGATION MEASURES

Agricultural Lands

Potential adverse impacts to groundwater identified at agricultural utilization sites include nitrate and heavy metal contamination. Steps which can be taken to avoid contamination or major long-term problems include the following:

1. Follow the Oregon DEQ guidelines for land application of wastewater and sludge, particularly as they relate to sludge application rates.

2. Continue to implement the Eugene/Springfield pretreatment program to reduce heavy metals and organics at the source.

3. Continue to select sites with suitable soil, groundwater and geographic features through the DEQ approval process.

4. Maintain a groundwater quality monitoring program at representative sludge application sites to ensure that gradual groundwater quality degradation does not occur.

Short Mountain Landfill

At the Short Mountain Landfill, the most significant potential adverse effects would be "short circuiting" of leachate to Camas Swale Creek. The following mitigation measures have been recently adopted to reduce this possibility:

1. The groundwater quality monitoring network is being expanded downgradient from the landfill; this should include testing for heavy metals, pathogens and organic toxins.

2. Landfill surface drainage is being improved to restrict discharges to surface waters.

3. Leachate lagoon capacity is being expanded to collect all leachate during winter months for eventual irrigation on adjacent lands during the dry season.

Regional Wastewater Treatment Plant

Impacts to groundwater can occur at the treatment plant through sludge spills or pipe leaks. Mitigation measures available to reduce possible impacts include rapid cleanup of spilled material, instituting a thorough maintenance program to reduce the incidence of leaks, control of surface water on-site so that it moves to collector drains, and construction of impermeable concrete or asphalt pads with drains in areas where spill potential is highest.

Sludge Management Sites

Potential impacts to groundwater include contamination with nitrate, heavy metals, or organic compounds. Mitigation measures available for preventing or reducing infiltration include careful inspection and maintenance of the drying beds, proper construction of storage lagoon embankments, prompt cleanup of spilled sludge, careful placement and compaction of the clay-rich lagoon floors, and installation of groundwater monitoring wells to provide the warning of contamination. Also, soil explorations and soil permeability tests prior to construction can delineate areas of adverse soil conditions. This last item is particularly important for the Prairie Road site, where sand and gravel occurs at the surface, and for the Coburg site, where current knowledge of subsurface conditions is conjectural.

If contamination did occur, then other mitigation measures would be available, depending on the severity of the contamination. The first step would be to block the contaminant source, either by removing it or by repairing the malfunctioning element. Movement of contaminated groundwater could then be blocked by cut-off walls or by capture in drawdown zones generated by well pumps. If the volume of contaminated water were sufficiently small, it could be removed by pumping. Otherwise, it might be necessary to allow the contaminated water to simply disperse within the aquifer.

Force Main Routes

Groundwater which has been contaminated from pipe leakage can be rehabilitated with the same mitigative measures described in the previous section. Prevention of leaks is more difficult. Good engineering design and pipe material selection is important. Proper backfilling of trenches and inspection of pipes is helpful, especially pressure testing following construction. Pressure tests run on a periodic basis could allow for detection of leaks, but would not identify their location.

Surface Water Quality Changes

DESCRIPTION OF EXISTING CONDITIONS

Regional Setting

The central Willamette Valley contains an extensive network of lakes, creeks, sloughs, and rivers (Figure 3-10). Major rivers in the area include the Willamette main stem, Coast and Middle Forks, McKenzie, Long Tom, and Mohawk. Smaller creeks include the Amazon, Muddy, Flat, and Camas Swale. Except for the Mohawk and Mckenzie Rivers, and Camas Swale Creek, most rivers and creeks drain to the north.

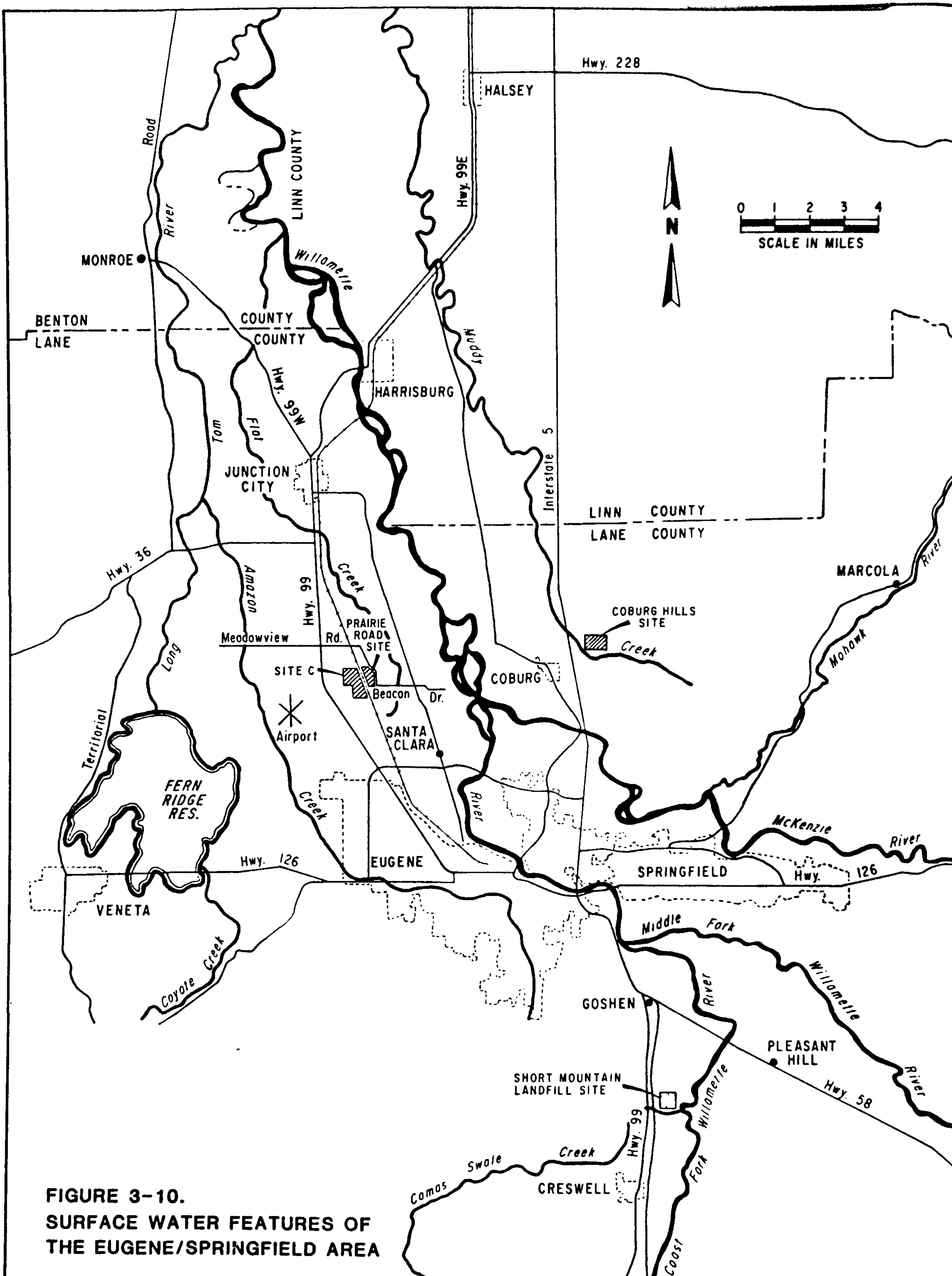


FIGURE 3-10.
SURFACE WATER FEATURES OF THE EUGENE/SPRINGFIELD AREA

Water flow of the major rivers originates primarily in the lower mountains and is influenced by precipitation and snowmelt patterns. Mean monthly flow data are presented in Table 3-7. Smaller creeks drain the alluvial bottom land between the Coast and Cascade Mountains. Flows consist of surface runoff and are augmented by high groundwater levels during the winter.

The quality of water in the area is highly variable, and has received an overall rating of acceptable to marginal by the EPA (U. S. EPA 1980). Of the major rivers, the Coast Fork Willamette has the greatest water quality problems, while the McKenzie appears to be fairly pure (Table 3-8). Point sources contribute significant quantities of pollutants to rivers. These sources include municipal sewage discharges and wood products operations. Less information is available for smaller creeks, which often receive pollutants from nonpoint sources. Agricultural runoff, septic tank failures, and channel erosion are the agents responsible for much of the pollution in creeks.

Agricultural Sites

Agricultural sites in the Eugene area are generally flat, with slopes under three percent. Drainage channels usually consist of small peripheral ditches which flow into intermittent or permanent creeks. During the summer months most of the peripheral ditches and intermittent creeks are dry, as are the agricultural fields themselves. Rare, intense summer storms may produce some surface ponding and a limited amount of runoff from the steeper sites.

During the late fall, rainfall frequencies increase and many of the fields become saturated. This occurs first on those fields which have poor drainage and no slope, such as fields underlain by Soil Group 3 (see Table 3-1). Eventually, most of the fields in the area have some water ponded on the surface. Depending on slope, soil conditions and climate, this water may work its way to a drainage ditch. In many areas, winter groundwater levels rise to or above the soil surface, increasing the quantity of surface water available for runoff. Winter flooding of low-lying areas is a common occurrence.

Little water quality information is available for runoff from agricultural sites in the Eugene area. General problems include high turbidities, bacterial contamination, and nutrient enrichment. Extensive water quality information is available for the rivers that receive runoff from agricultural sites. Some of this information is summarized in Table 3-8.

Site C/Prairie Road

Site C and the Prairie Road site are located on flat land in the upper part of the Flat Creek drainage (Figure 3-10). Drainage from Site C is handled by a small graded ditch which flows west-northwest through the site. This intermittent ditch

Table 3-7. Mean Monthly Flow for Streams of the Central Willamette Valley, 1975-1980

Stream	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Main Stem Willamette at Harrisburg	8,119	12,107	21,722	19,167	10,354	9,609	9,810	8,450	5,412	4,454	4,989	7,209
Coast Fork Willamette at Coburg	961	1,391	2,911	2,832	1,810	1,354	1,622	935	406	207	217	772
Middle Fork Willamette at Jaspar	4,078	5,127	7,735	6,364	2,223	2,364	2,587	2,408	1,826	1,710	2,168	3,810
McKenzie at Vida	2,758	4,258	6,676	5,316	3,518	3,450	3,706	3,963	2,864	2,546	2,646	2,493
Mohawk at Springfield	75	412	1,009	946	783	675	516	366	160	63	39	47
Long Tom at Monroe	806	687	1,412	1,532	717	515	323	189	60	38	64	63
Amazon Creek above diversion[1]	16	28	57	81	29	48	30	5	4	3	1	1
Coyote Creek near Fern Ridge	6	68	300	349	240	194	145	61	12	2	4	2

NOTE: All values in cubic feet per second.

[1]Data for 1980 only

SOURCE: U. S. Geological Survey

Table 3-8. Water Quality Data for Streams of the Central Willamette Valley

	Willamette at Springfield		Willamette Coast Fork at Highway 58		Willamette Middle Fork at Jaspar		McKenzie at Coburg		Long Tom Creek below Fern Ridge Dam		Amazon Creek, A-2 Channel at Golden Gardens[b]	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
pH	7.1	6.5-7.6	7.0	6.4-7.6	7.1	6.4-7.6	7.2	6.5-7.8	6.9	6.7-7.5		
Temperature (C°)	11.0	5.0-15.0	11.1	4.5-17	9.5	4.5-15	11.1	4.5-16.5	12.9	7.0-22.5	13.5	8-22
Turbidity	7.5	2.0-62.0	10.0	2.0-78.8	6.6	2.0-32.0	2.8	<1.0-24.0	19.6	5.2-55.0	7.4	2-36
DO (mg/l)/(% saturation)	10.9/ (92.7)	9.0-13.0/ (88-108)	10.4/ (88.9)	8.1-12.2/ (84-103)	13.8/ (98.4)	9.2-12.7/ (90-110)	11.2/ (101.2)	9.8-12.8/ (94-111)	10.2	8.4-11.4	9.0	5.2-16.
BOD (5 day)	0.9	0.2-2.2	1.1	0.5-2.4	0.9	<0.1-2.1	1.1	<0.1-2.4	3.4	2.0-6.9	3.3[a]	2.0-5.
$NH_3 + NH_4$ (mg/l)	0.03	<.02-.06	0.04	0.02-0.11	0.03	<0.02-0.05	0.04	<0.02-0.06	0.01		0.15	.1-.6
$NO_2 + NO_3$ (mg/l)	0.07	<.02-.34	0.12	.02-0.37	0.04	<0.2-.18	0.06	<0.02-0.34	.08	.01-2.0	1.69	.1-3.6
Phosphorus, total (mg/l)	0.044	.019-.188	0.052	.021-.101	0.041	.024-.093	0.043	.030-.072	0.058	.029-.111	0.47	.091-13
Arsenic (μg/l)	<5	<5		<5		<5		<5			55.5	54-57
Barium (μg/l)	<100	<100		<100		<100-120		<100				
Cadmium (μg/l)	<2	<1-4		<1		<1-3		<1-6				
Chromium (μg/l)		<2-<50		<2-<50		<2-<50		<2-54			10.3	1.0-19.0
Copper (μg/l)		<2-<50		<2-<50		<2-<50		<2-<50			5.1	1.0-13.
Lead (μg/l)		<10-12		<10		<10		<10	1.0	0-5.0	2.4	0-7.0
Zinc (μg/l)		<10-120		<10		<10		<10-140			22.7	3-70
Selenium (μg/l)		<5		<5		<5		<5				
Mercury (μg/l)		<0.5		<0.5-<1.0		<.5-<1.0		<.5-1.0			0.5	
Total Coliform (MPN/100 ml)	753	30->11,000	1,043	36-11,000	156	<30-2,400	233	<30-2,400	271	20-1,400		
Fecal Coliform (MPN/100 ml)	149	<30-2,400	384	<30-4,600	96	<30-2,400	84	<30-930	73	10-960	189	10-144

NOTES: All values for 1/80-12/82 unless otherwise noted.

[a]BOD 7 day

[b]Metals taken 12/79-1/81, other values variable between 4/78 and 1/81.

[c]All values 6/23/81 - 4/20/82.

SOURCE: U. S. Geological Survey STORET data.

flows into Flat Creek near Meadow View. The northern half of the Prairie Road site drains north to another tributary ditch of Flat Creek which flows east of the site. The southern half of the site drains into the ditch which passes through Site C.

During the summer, there is little or no flow in ditches draining either site and surface runoff is negligible. During the winter, all ditches usually have flow. Ponding of water is common on both sites. A severe ponding problem exists at the southern end of the Prairie Road site where water flowing northwest under the railroad tracks backs up and floods the area. Both sites are above the 100-year floodplain of the Willamette River, but may experience local flooding from tributaries of Flat Creek. No water quality data exist for drainage channels in the area. Turbidity and nutrient enrichment may be a problem.

FLAT CREEK. Flat Creek is a small Willamette River tributary that drains approximately 30 square miles of flat and gently sloping land northwest of Eugene. Flow in the creek results primarily from precipitation runoff and elevated groundwater. Although no flow records are available, flow varies between a summer low of zero and an estimated 1,250 cubic feet per second (cfs) during a 10-year flood (USDA Soil Conservation Service 1965).

The basin contains mainly agricultural land, with some residential areas in the upper watershed. Nearly all of the creek has been widened and deepened, and there are at least eight diversion and check dams to control creek flow.

Although no water quality data exist for Flat Creek, LCOG (1982) identified water quality as a potential problem. Pollution sources include a number of wood products operations, poultry farms, agricultural runoff, and failing septic tanks.

Coburg Hills Site

The Coburg Hills site is located near the confluence of Daniels and Muddy Creeks. The site drains to the west and is bounded on the south and west by drainage channels. The southern channel, as well as one that cuts across the northwest corner of the site, is fairly small and flows only during the winter. The drainage channel west of the site, Muddy Creek, may flow year-round. Ponding of water is common throughout the winter and is extensive at the west edge of the site where a bog has formed. Minor flooding of Muddy and Daniels Creeks may inundate the west edge of the site.

No flow or water quality data exist for Muddy Creek, Daniels Creek, or the small drainage channels near the site. Based on land use patterns and similar local watersheds, it would be expected that water quality problems may include turbidity and bacterial contamination from agricultural runoff. No industrial discharges occur in the Muddy or Daniels Creek basins.

Short Mountain Landfill

The Short Mountain Landfill is located near the confluence of Camas Swale Creek and the Coast Fork Willamette. Surface drainage within the landfill property consists of flow from adjacent property and that generated on the site by precipitation. Water flowing onto the site is diverted away from active fill areas by two diversion channels (Figure 3-11). These channels are designed to contain a 50-year flood and intercept runoff from areas north and west of the site. Water from these ditches flows into Camas Swale Creek.

Water generated on the site is routed through a series of permanent and temporary ditches. Permanent ditches include one draining the western and one draining the southern portion of the landfill. These two channels discharge untreated water into Camas Swale Creek about 0.2 mile above the confluence with the Coast Fork.

A series of temporary ditches are maintained around the edge of the active fill areas. These ditches are designed to contain a 2-year flood and discharge into the leachate lagoon. The leachate lagoon is equipped with an overflow spillway at the east end of the lagoon. The landfill's solid waste disposal permit prohibits discharge via this spillway except when the stability of the lagoon is threatened (Oregon DEQ 1982a). Local residents, however, report that the lagoon does overflow in extremely wet periods. Lane County is expanding the size of the leachate lagoon to ensure that no surface discharge occurs. A stagnant meander of Camas Swale Creek known as the natural lagoon is located below the leachate lagoon's overflow spillway.

Water from the leachate lagoon is sprayed on the completed and stabilized portion of the fill during summer months. Irrigation is suspended if ponding or surface runoff occurs. Any runoff from these areas would enter Camas Swale Creek via the permanent ditches. A recent revision to Short Mountain's solid waste disposal permit (#290) requires that all leachate and contaminated rain and surface water must be stored without discharge from November 1 to May 1 of each year. Lagoon walls are also sprayed with leachate to prevent drying and cracking.

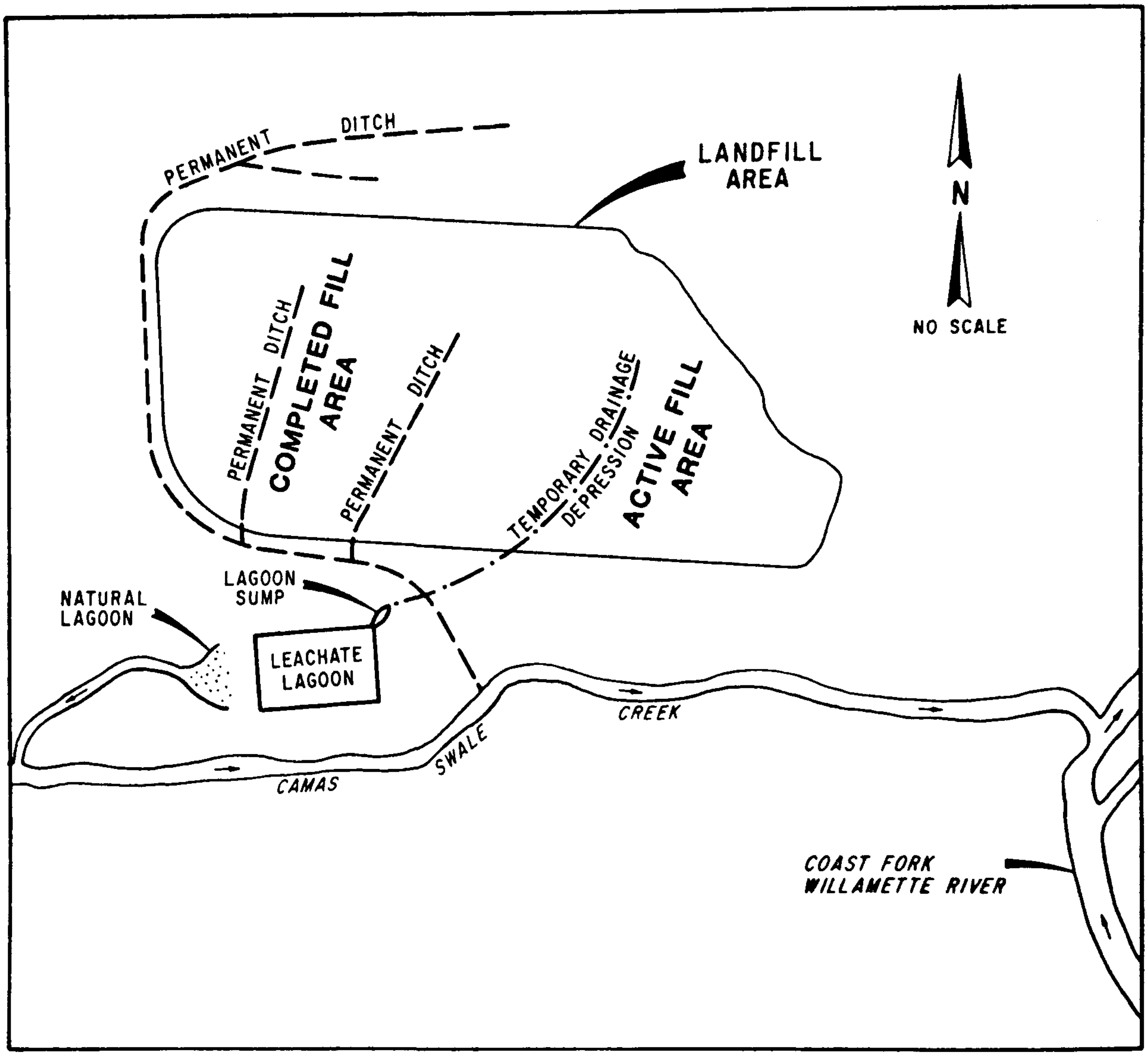


FIGURE 3-11. SURFACE DRAINAGE FEATURES AT SHORT MOUNTAIN LANDFILL

The lagoon and landfill areas are above the 500-year floodplain of Camas Swale Creek and the Coast Fork. Areas surrounding the lagoon between the landfill and Camas Swale Creek are within the 500-year floodplain.

Water quality data are available for the leachate lagoon, natural lagoon, and surface runoff from stabilized portions of the landfill (Table 3-9). The limited data for the natural lagoon suggest that turbidity, biochemical oxygen demand (BOD), ammonia, and dissolved oxygen (DO) levels present potentially severe problems. The quality of the natural lagoon appears to have been affected by the leachate lagoon. Runoff from the stabilized landfill was very turbid and contained large numbers of coliform bacteria.

Quality of water in the leachate lagoon is poor. Problems include ammonia toxicity, high BOD and coliform levels, and occasional low oxygen levels. A single testing for metals and herbicides indicated that levels of chromium, selenium, and mercury in the lagoon were above DEQ standards for the Willamette River (Oregon DEQ 1982b).

CAMAS SWALE CREEK. Camas Swale Creek drains approximately 35 square miles, south of Eugene. Flow is restricted by passage under Interstate 5, Highway 99, and the Southern Pacific Railroad bridges. Limited flow data are available for Camas Swale Creek.

Sporadic monitoring of the creek's quality has identified the following problems: high bacteria, turbidity and nutrient levels, high temperatures, and low dissolved oxygen concentrations (Table 3-9). Results of a single sampling for unionized ammonia (NH_3) indicated levels well above those recommended for waters used by fish (U. S. EPA 1976a). Major pollution sources include the discharge of sewage effluent by the City of Creswell (October-April only), agricultural runoff, and septic tank failures. No obvious trends exist between data collected above and below the Short Mountain Landfill.

COAST FORK WILLAMETTE. The Coast Fork and its major tributary, the Row River, originate in the Calapooya Mountains and drain approximately 665 square miles. Both rivers are regulated by flow control structures.

The Coast Fork has the most severe water quality problems of any major river in the area (Table 3-8). Indications of poor quality include high bacterial loadings, high turbidity levels, nutrient enrichment, and occasional low dissolved oxygen levels. The recorded three-year mean for total coliform levels is 1,043 MPN/100 ml, which is above the 1,000 MPN/100 ml mark recommended as a state standard for recreational use (LCOG 1974). Bacteria levels increase dramatically as the river passes through Cottage Grove.

Table 3-9. Surface Water Quality Data: Short Mountain Landfill Area

	Camas - Swale Creek: Above Landfill			Camas - Swale Creek: Below Landfill			Natural Lagoon	Landfill Runoff	Leachate Lagoon		
	No. of Samples	Mean	Range	No. of Samples	Mean	Range	Mean	Mean	No. of Samples	Mean	Range
pH	11	7.0	6.7-7.4	12	7.0	6.7-7.4	7.4	7.2	10	7.5	6.7-8.3
Temperature (°C)	9	10.3	2.0-19.5	11	10.8	2.5-15.0	3.0	1.0	7	10.4	4.5-21.0
Turbidity	9	20.5	8.0-45.0	9	18.2	2.0-45.0	33.0	45.0	8	20.1	3.0-54.0
DO (mg/l)/(% saturation)	8	8.4/ (82)	6.4-12.4/ (69-88)	8	9.5/ (91)	7.0-11.8/ (83-100)	5.0	11.9	5	4.2	0-7.6
BOD_7 (mg/l)	8	4.6	2.0->6.9	8	4.1	2.0-6.8	13.1	3.4	8	20.3	2.9->52
NH_3-N (mg/l)	1	0.16		2	0.28	<.05-.50	2.5	0.1	2	19.5	5-35
NO_3-N (mg/l)	1	0.98		2	0.62	.42-.82					
Arsenic (µg/l)	1	<30.0		1	<30.0				1	<30.0	
Barium (mg/l)	1	<25.0		1	<25.0				1	<25.0	
Cadmium (mg/l)	1	< 0.1		1	< 0.1				1	< 0.1	
Chromium (µg/l)	1	11.0		1	58.0				1	600.0	
Lead (µg/l)	1	8.0		1	4.0				1	12.0	
Zinc (mg/l)	1	0.1		2	0.06	<.02-.1					
Selenium (µg/l)	1	∿10.0		1	∿10				1	8.0	
Silver (mg/l)	1	< 0.5		1	< 0.5				1	< 0.5	
Mercury (µg/l)	1	<50.0		1	<50.0				1	150.0	
Total Coliform (MPN/100 ml)	9	826.0	170-2,800	9	887.0	180-2,200		3,100	9	1,570	180-4,300
Fecal Coliform (MPN/100 ml)	9	185.0	<10-600	9	110.0	10-360		100	9	195	<20-800

NOTES: Samples taken between 9-12-77 and 5-24-82.

SOURCE: Unpublished DEQ and LCOG data.

Turbidity levels increase linearly with movement downstream. This is due to the transition from gravel to clay soil, the higher concentration of point sources, and increases in urban and agricultural runoff. Slow flows, high summer temperatures, and effluent discharges combine to produce occasional low dissolved oxygen concentrations.

Nutrient enrichment has caused undesirable aesthetic conditions and algal blooms. Five wood products facilities, agricultural operations, and three sewage facilities discharge into the Coast Fork and Row Rivers (LCOG 1974).

Regional Wastewater Treatment Plant

The RWTP lies immediately west of the Willamette River in north Eugene. No major drainages are present on the site, but surface runoff from the sites readily enters the main stem of the Willamette.

Although no water quality data are available for site runoff, it is likely to be of poor quality. Runoff may encounter small sludge spills or other contaminants. The treatment plant site is on the edge of the 100-year floodplain of the Willamette River but all facilities are bermed or above the flood mark (U. S. Federal Emergency Management Agency [FEMA] 1981).

MAIN STEM WILLAMETTE. The Main Stem Willamette forms near Goshen where the Coast and Middle Forks converge. Below this confluence, the Main Stem flows through Eugene, Springfield, and the rural land to the north.

Water in the Main Stem is of moderate quality. The most serious problems are high bacterial loads and turbidity levels (Table 3-8). Total coliform bacteria counts often exceed the 1,000 MPN/100 ml level. Contamination results from the waters of the Coast Fork as well as numerous small outfalls and septic tank failures. High turbidity results from agricultural and urban runoff, riverbank gravel operations, and the Coast Fork. Main Stem water quality improves significantly when the relatively pure waters of the McKenzie dilute the flow.

IMPLICATIONS OF NO PROJECT (ALTERNATIVE 4)

The surface water quality impact of Alternative 4 would be determined by the action MWMC took to reuse or dispose of sludge generated in excess of the sludge handling facilities being constructed in Phase I. It is likely that a greater threat to surface water quality would occur under this option than the other three project alternatives because liquid sludge would probably be applied to agricultural land or the landfill for a greater portion of the year, including the wetter winter months. This is an undesirable sludge reuse/disposal approach. If wastewater volumes were allowed to increase to the point that sludge generation exceeded the capacity of the Phase I sludge facilities, it is also likely that wastewater effluent quality would gradually degrade, adversely affecting the quality of the Willamette River downstream from the RWTP.

IMPACTS OF ALTERNATIVES

Alternative 1

AGRICULTURAL APPLICATION SITES. Agricultural sludge application presents the opportunity for reuse of a valuable resource. Application to agricultural sites would have minimal impact on surface water quality if DEQ application guidelines were followed. Sludge constituents which could adversely affect the quality of surface waters, however, include:

- o sediment
- o nitrogen
- o other nutrients
- o heavy metals
- o organic toxins
- o bacterial pathogens

The likelihood that some or all of these constituents might enter surface waters from agricultural application sites would vary with drainage patterns, sludge characteristics, soil and crop conditions, and climatic variations. Contaminants could enter surface waters through runoff, erosion of contaminated particles, movement of elevated groundwater from the site, or from flooding.

The potential for surface water contamination during the summer application months is very low because of the lack of surface water near most agricultural sites. The ubiquitous nature of surface water during the winter increases the possibility of contamination. By winter, however, sludge decomposition has lowered the concentration of many potential contaminants. Because surface runoff is the most likely mechanism for transporting contaminants to surface waters, the impacts of sludge application on surface runoff are presented prior to a discussion of the above contaminants.

No detailed studies involving the effect of sludge application on runoff in the Eugene area are available. Investigators in areas with soils similar to those in the Willamette Valley have concluded that sludge decreases the quantity of water running off agricultural land (Kladivko and Nelson 1979; Kelling et al. 1977b). In heavy clay soils, sludge alleviates unfavorable structural conditions by improving pore spacing and thus increasing the water-holding capability of the soil (Kirkham 1974). Therefore, application of sludge to the agricultural land around Eugene should decrease the potential for transferring pollutants from the land to adjacent surface waters.

Erosion of sludge increases the sediment load carried by streams, which is of concern because of the existing turbidity problems in the area. However, research has shown that sludge also acts as a soil binder, increasing a soil's resistance to transport (Kirkham 1974; Kladivko and Nelson 1979). Significant reductions have been noted in both the concentration and total amount of sediment leaving a site following sludge application. Kladivko and Nelson (1979) found that surface sludge applications decreased total erosion by 95 percent compared to control fields. Erosion reduction was not quite as dramatic when sludge was incorporated into the soil. Sludge application is likely to decrease the erosion and sediment production of all soils. If an application site is flooded, sludge may reduce the total quantity of sediment leaving the site due to its binding action within the soil.

Sludge is applied to agricultural land at rates commensurate with crop nitrogen needs. Because in Alternative 1 the sludge is air-dried, it would contain less nitrogen per pound (dry weight) than mechanically dewatered sludge. The sludge would have to be applied at a greater rate, therefore, than dewatered sludge to achieve the same soil fertilization benefits. Applying a larger amount of sludge per acre would result in increased loadings of metals and organic toxins because these constituents are not removed by air-drying. Fewer acres would be needed, however, to dispose of the entire sludge volume. Although some chemical degradation of toxins may occur, and the greater amount of organic matter applied with the increased sludge loads may be able to "fix" many of the metals in the soils, the maximum sludge application rates for metals, established by DEQ, will be followed. This will probably limit soil amendment benefits of Alternative 1 somewhat.

The potential for nitrogen enrichment of surface waters during the summer is very small. This is due primarily to high nitrate uptake by plants and the small volume of surface runoff. During the fall, plant uptake decreases at a faster rate than nitrate production. This excess nitrate is available for leaching or surface runoff. If intense rains occurred during the fall, nitrates may be transported by runoff to adjacent surface waters.

During the winter, nitrate production decreases due to the anaerobic conditions brought on by surface ponding. Under these conditions, nitrate is converted to nitrogen gas, leaving only a small portion available for runoff. Surface runoff may remove organic nitrogen via erosion.

Sludge application would add phosphorus, potassium, sodium, calcium, magnesium, chlorine, and sulfur to the soil, but only small quantities of these constituents would be expected to reach surface waters. Chlorine and sulfur would be present in low concentrations in the sludge and are not expected to affect surface water quality. Sodium is highly soluble and could be expected in any surface runoff leaving application sites; first fall season rains would generate the highest concentration. Calcium and magnesium may also dissolve in runoff water or may be bound by organic polymers. Although little research has been done regarding the fate of added potassium, plant uptake would be an important factor.

Phosphorus is usually bound tightly by the organic fraction of the soil. Phosphorus losses from sludge application sites, therefore, are chiefly associated with sediment in runoff (Kladivko and Nelson 1979). Phosphorus levels in waters draining sludge sites are usually less than one part per million (Kirkham 1974). The phosphorus concentration in sediment eroded from sludge sites is significantly greater than that from control sites (Kelling et al. 1977b). This increase, however, is offset by the small amount of sediment lost from sludge sites compared to control sites. Phosphorus losses may be slightly greater from Group 2 than Group 3 soils due to their coarser texture and increased vulnerability to erosion.

The heavy metal content of Eugene sludge (see Tables B-1 and B-2 in Appendix B) is low compared to many municipal sludges. Nonetheless, EPA and DEQ have established maximum sludge application rates for lead, zinc, copper, nickel and cadmium in order to protect public health (see Table 3-10). If these application rates are not exceeded, there is little chance that the sludge reuse operation proposed by MWMC will significantly affect surface water quality.

Erosion of sediment from sludge application sites is the major pathway for metals to move from application areas to surface waters. Metals tend to bind to organic matter, clay, and iron and aluminum oxides (Williams et al. 1980). Therefore, metals contained in sludge become attached to these materials, increasing the sediment metal concentrations. At the same time, however, sludge application tends to reduce the volume of sediment leaving an agricultural site, balancing any change in the movement of heavy metals off of the site. Only a significant amount of erosion related to prolonged winter rains or flooding would be likely to contaminate surface waters with heavy metals.

The potential for surface water contamination increases if sludge is applied to a site for a number of years in succession. Leaching, plant uptake, and runoff normally remove only a small portion of the metals added to soil by sludge application. Most metals remain in the top few centimeters of soil. Because the capacity of a soil to "fix" metals may be limited (U. S. EPA 1976b), metals accumulated over a number of years may be more vulnerable to leaching or runoff loss.

Table 3-10. Annual and Total Sludge Metal Loadings Allowed on Agricultural Land

Time Period	Annual Cadmium Application Rate (kg/ha)
Present - 6/30/84	2.0
7/1/84 - 12/31/86	1.25
Beginning 1/1/87	0.5

Annual cadmium application must not exceed 0.5 kilograms per hectore (kg/ha) on land used for production of tobacco, leafy vegetables or root crops grown for human consumption.

Total Sludge Metal Loadings

	Soil Cation Exchange Capacity (meq/100 g)		
Metal	0-5	5-15	>15
	Maximum Amount of Metal (kg/ha)		
Lead	500	1,000	2,000
Zinc	250	500	1,000
Copper	125	250	500
Nickel	50	100	200
Cadmium	5	10	20

SOURCE: U. S. EPA 1977; 1978.

Sludge may contain trace amounts of a number of herbicides and pesticides. Sampling of Eugene and Springfield sludges during 1978 revealed the presence of two organic toxins: chlordane and 1254 PCB (Brown and Caldwell 1979). Chlordane is a persistent insecticide that is water soluble (Sittig 1980), while 1254 PCB is a relatively insoluble biphenyl. Both compounds are slow to decompose. Because these organic toxins are strongly adsorbed to organic matter, clay and metal oxides (Lichtenstein 1971), and are present in very small concentrations, they are unlikely to affect surface water quality adjacent to sludge application sites unless a significant amount of soil erosion or flooding occurs. Of the two compounds, chlordane is more likely to enter surface waters during flooding because it is relatively soluble.

Microbial pathogens in sludge include bacteria, viruses, and parasites. No data are available on the concentrations of these pathogens in Eugene sludge. Most pathogenic bacteria are destroyed or their populations greatly reduced by the anaerobic digestion process. The fate of viruses and parasites is less certain.

Most pathogens are readily adsorbed by soils with high clay or organic matter contents and are relatively immobile (Kirkham 1974). Mobility and longevity of pathogens are dependent on soil pH, temperature, moisture, and texture. Zenz et al. (1976) monitored virus concentrations in surface waters draining a sludge disposal site and were unable to detect levels different from control sites.

In summary, most pathogenic organisms die during digestion or immediately following land application. Like many other potential pollutants, increased quantities of pathogens in surface waters would only occur during periods of excessive erosion (Kirkham 1974). Therefore, the risk of contamination is greatest when flooding occurs. The rapid dilution by flood waters would minimize impacts.

SHORT MOUNTAIN LANDFILL. Sludge would be transported to the landfill only as a back-up under Alternative 1. Sludge volumes taken to this facility therefore would be considerably less than those proposed for the MWMC interim sludge management plan. As indicated in the interim plan FNSI (U. S. EPA 1983a), sludge disposal at the landfill is not expected to significantly affect surface water quality over the next 5 years. Back-up disposal at the landfill under Alternative 1, therefore, should also have no significant effect on surface waters.

FORCE MAIN ROUTES. Rupture or leakage of the sludge supply or supernatant return pipes could result in a significant impact on surface water quality. The severity of the impact would depend on the location and size of the leak, the time of year, and the quality of material spilled. While the probability of a major force main rupture or leak may be small, the potential exists and is therefore discussed briefly.

Although large leaks or ruptures could cause significant short-term problems, these leaks would probably be located quickly. Long-term problems could result from smaller leaks which remain undetected for a long period of time. Proposed periodic pressure testing of the project's two force mains would greatly reduce the chance of having a small leak remain undetected for a long period.

Although nearly all of the constituents found in sludge could cause adverse water quality impacts, nitrogen as ammonia or nitrate is most likely to cause a problem due to its mobility and high concentration. Nitrogen leaked from the force main would be discharged into the soil, where it could move into surface or groundwaters. Due to the complex relationship between local surface and groundwaters, it is likely that nitrogen leaked from the force main would eventually be discharged into a surface water body.

Other sludge constituents such as heavy metals, organic toxins, and microbial pathogens are less likely to enter surface waters. The majority of these potential pollutants would be bound by soil particles in the area of the leak. These constituents would enter surface waters in large quantities only if the leak was very large or occurred immediately adjacent to a water body or an area with porous soils.

The potential for surface water degradation from a leak or break in the supernatant return line (see Figure 2-4) would be greatest in the winter when the line would receive its greatest use. The flow in the line would average about 625 gallons per minute (assuming 8 hours of pumping per day), with a high BOD, large suspended solid content, and an ammonia concentration of approximately 300 mg/l (Brown and Caldwell 1980). Heavy metals and other pollutants which would not be on the lagoon's surface would not be present in great quantities in the supernatant return.

The proposed force main route to Site C and the Prairie Road site does not cross any major rivers or creeks. Runoff from areas crossed by the force main flows into Spring or Flat Creeks. Therefore, pollutants leaked from the force main would be mostly adsorbed in the soil before reaching surface waters.

The force main route to the Coburg Hills site crosses the Willamette Main Stem, the McKenzie River, and the upper portion of Muddy Creek. Due to the McKenzie's high water quality and use, any large spill that entered the river would significantly alter water quality.

<u>SITE C</u>. There are four major pathways for surface water contamination at Site C:

- Runoff from drying beds.
- Runoff from other areas within the site.
- Elevated levels of contaminated groundwater.
- Flooding.

Surface waters draining onto the site, such as the tributary to Flat Creek, would be routed around the project site (Gould pers. comm.). Water generated on the site that may come in contact with sludge or sludge residues would be collected and pumped back to the storage lagoons. Site runoff that is not likely to encounter sludge would flow untreated from the site (Gould pers. comm.).

During the summer, the asphalt drying beds would be covered with 8-12 inches of sludge. Sludge water and rainfall would be skimmed from the surface and pumped to the storage lagoons (Brown and Caldwell 1980). Overtopping of drying beds would cause sludge water to enter perimeter ditches. These ditches would surround the drying beds at an elevation below the gravel layer underlying the asphalt base of the beds. Water in these ditches would be pumped to the storage lagoons.

During the fall, the drying beds would be cleaned, with cleaning water pumped to the storage lagoons. During the winter, there would be no sludge on the drying beds and all precipitation falling on the asphalt beds would become runoff. Winter runoff could contain trace amounts of sludge constituents. This water would be monitored and released to Flat Creek drainage channels only when levels are comparable to natural stream channels (Brown and Caldwell 1980). Water that is not of comparable quality would be pumped to the lagoons.

Runoff from parking areas, work areas, and the lagoon berms would be discharged via ditches to Flat Creek tributaries. The quantity and quality of this runoff would depend on the type of surface coverage, site maintenance, and precipitation patterns. Runoff would contain lead, zinc, hydrocarbons, and other potential pollutants derived from autos and trucks. Runoff may also contain nitrates, nutrients, metals, and organics picked up as runoff encounters sludge spilled in the transfer and loading phases of the operation. Spills could also result from pipe ruptures. Contamination of surface waters from on-site sludge spills would be negligible during the summer due to the lack of surface runoff. During the winter, the likelihood of sludge spillage would be decreased because sludge would not be transferred from the lagoons to the drying beds.

Probably the greatest potential for surface water contamination at Site C would be from surfacing of contaminated groundwater. This could occur in two ways:

- o Discharge of contaminated groundwater into Flat Creek tributaries or other drainages.
- o "Recently surfaced" groundwater picking up pollutants from the project site.

The <u>Groundwater</u> section of this EIS, however, concludes that, barring a major spill, the project would have a negligible impact on groundwater quality. Therefore, discharge of polluted groundwater to surface waters is unlikely.

There is little risk of flooding. According to FEMA flood maps (1981), Site C is above the 100-year floodplain of the Willamette River. These maps identify a 200-foot-wide, 100-year floodplain on either side of the Flat Creek tributary that traverses the site. If this channel is diverted south of the site as planned, flooding impacts would be minimal. Berms around the lagoons and drying beds should also prevent flooding of site facilities. In summary, the normal operation of the facility at Site C would have a minor impact on the quality of surface waters in the area.

PRAIRIE ROAD SITE. Runoff from much of this site drains into the same Flat Creek tributary that drains Site C. On the Prairie Road site, however, this tributary is slow-flowing and more prone to overtopping its banks. This condition seems to be caused by the inadequate passage provided under the Southern Pacific Railroad tracks. Extensive diversion of this drainage channel would be necessary to keep surface water off the site.

The potential for contamination of surface waters is similar to the first two pathways outlined in the Site C discussion. Due to the presence of coarser surface soils, a greater percentage of water may infiltrate at the Prairie Road site than at Site C. This would result in less runoff and decrease the possibility of direct surface water contamination.

The coarser surface soils would make the Prairie Road site more vulnerable than Site C to surface water contamination from elevated groundwater. Groundwater would be most likely to move over the surface at the southern portion of the site. Given current conditions, the Prairie Road site is more prone to flooding than Site C. Rerouting of drainage ways and construction of berms would minimize flood impacts.

In summary, the Prairie Road site may be slightly more likely to produce adverse water quality impacts than Site C, but impacts would still be minimal.

COBURG HILLS SITE. Site facilities and contamination routes are similar to those described for Site C. Water leaving the site flows northwest into a small bog. Suspended solids, metals and other pollutants may settle out here, lessening the impact to waters downstream. Because of the uncertainty regarding subsurface soil and groundwater conditions, less is known about the impacts from elevated groundwater on this site.

The potential for flooding on this site is greater than on the other two sites. FEMA maps (1981) place the western one-third of the site within the 100-year floodplain of Muddy Creek. Extensive rerouting of drainage channels and possibly the swamp west of the site may be necessary to avoid water quality damage.

Alternative 2

Under this alternative, sludge would be mechanically dewatered and air-dried. The mechanical dewatering would allow a decrease in the number of air-drying beds.

Surface water quality impacts at Site C would be similar to those described for Alternative 1. A slight decrease in the potential for water quality degradation may result from fewer drying beds. As proposed, this alternative would not require the relocation of the Flat Creek tributary which bisects the Alternative 1 site. The increases in turbidity associated with stream relocation would therefore be eliminated.

If the Prairie Road site is chosen, the southern portion of the site would not be developed. By not developing this area, water quality impacts could be lessened significantly because extensive stream relocation would not be necessary. The area developed under this alternative is also less prone to surface ponding and flooding.

Similar reasoning applies to development of the Coburg Hills site. Alternative 2 would eliminate development of approximately 45 acres of land located at the west end of the site that would be utilized under Alternative 1. This would eliminate the rerouting of two streams necessary under the first alternative.

In summary, the surface water quality impacts at the sludge management sites of Alternative 2 would be negligible and less than those of Alternative 1. Impacts to surface waters along the force main route would be identical to those described for Alternative 1.

Impacts at the agricultural reuse sites would be similar to those described for Alternative 1. If significant quantities of mechanically dewatered rather than air-dried sludge are applied to agricultural land, the loading of heavy metals (per acre) and potential for their movement in runoff would be less than those of Alternative 1. The potential for organic toxin and pathogen contamination of surface waters would also be similar to that described for Alternative 1, but would vary, depending on the ratio of mechanically dewatered to air-dried sludge used.

Water quality impacts at the landfill would be essentially the same as those described for Alternative 1.

Alternative 3

This is essentially a continuation and expansion of the MWMC interim plan. Permanent mechanical dewatering facilities would be constructed at the RWTP and sludge would be hauled to the Short Mountain Landfill for winter disposal and to agricultural land for summer reuse.

The increased sludge volume compared to Phase I may increase the potential for spillage at the RWTP. It is doubtful, however, that enough spillage would occur to result in measurable decreases in the quality of the Willamette River. Surface water quality impacts at the agricultural reuse sites would be similar to those described for Alternative 1. Impacts at the Short Mountain Landfill would also be similar to those of the interim plan described in the EPA FNSI (U. S. EPA 1983a). The larger sludge volumes would result in increased loadings of heavy metals, nitrogen, organic toxins, and pathogens. This may increase the potential for water quality degradation, but widespread pollution is unlikely due to the leachate control measures utilized at the landfill.

MITIGATION MEASURES

Agricultural Application Sites

Potential agricultural reuse sites should be visited during the winter prior to summer application. This would allow identification of those areas where surface waters are present. Buffer zones could then be established and the necessity of rerouting of drainage ways could be investigated.

Summer application of sludge should take place only during dry periods. If possible, application should also occur when continued dry weather is expected, thus allowing maximum photochemical degradation of organic toxins and biological pathogens.

A surface water quality monitoring program should be established prior to sludge application. Monitoring of heavy metals, ammonia, nitrates, and coliform bacteria should receive top priority. If funds allow, levels of toxic organics and other biological pathogens should be monitored. Monitoring of surface water and sediment should occur due to the association of many contaminants with eroded soil or sludge particles. Monitoring should be particularly intense during the first fall rains when surface water degradation is most likely to occur.

Sludge application guidelines outlined by the DEQ (1981) should be followed.

Short Mountain Landfill

The potential for surface water degradation could be decreased by implementing the following:

- o Expand the surface water monitoring program in Camas Swale Creek to include testing for heavy metals, pathogens and, if possible, organic toxins.
- o Expand the groundwater monitoring program to determine if pollutants are moving in the groundwater from the

landfill to Camas Swale Creek. This program should be designed to determine the type and quantity of any pollutants moving through the groundwater, and to allow identification of contamination sources (i.e., lagoon, lagoon sump, landfill itself).

Force Main Routes (Alternatives 1 and 2)

Mitigation measures should be tailored to prevent leakage and could include:

- Properly design and locate the force main routes to avoid unstable areas such as cuts and fills.
- At river and stream crossings, place pipe well above the 100-year flood mark to allow passage of debris.
- Carefully place backfill over the pipe to avoid pipe damage.
- Clearly identify the pipeline route to avoid accidental rupture of the pipe by construction or utility crews.
- Periodically pressure test the force mains to detect leaks.
- Develop a spill response plan to ensure prompt and effective action in the event of a leak.

Sludge Management Sites

Of the four major pathways for surface water contamination, the first pathway, runoff from the drying beds, should provide little risk for contamination, providing perimeter ditches are operated correctly. Ditches should be lined with an erosion-resistant material and maintained regularly. Ditches should be designed to contain runoff from the drying beds even during a large storm event. Following sludge removal in the fall, the beds should be cleaned promptly and thoroughly. Cleaning should be followed by visual inspection to check for cracks. During the summer, sludge should be placed on the beds at a depth which would allow the addition of rainfall without overtopping. Machinery used for mixing and removing sludge should operate in a manner which would not harm the asphalt.

The second pathway, which is runoff from other areas within the site, provides the opportunity for a number of water quality impacts. A concrete pad equipped with a drain should be constructed adjacent to the air-drying beds where sludge handling equipment would be working. Washdown facilities should also be provided at this site to minimize spillage at other areas on the site and during transport. Water from this facility should be routed back to the storage lagoons. Lagoon walls and floors should contain a compacted clay or synthetic seal.

The third pathway for surface water contamination is via elevated groundwater levels. Contamination could be minimized by scheduling an annual site clean-up each fall following sludge removal from the drying beds. This clean-up would involve the drying beds, perimeter ditches, lagoon berms, and other areas within the site.

Mitigation measures to control the fourth pathway, flooding, would also help minimize impacts from elevated groundwater. These could include berm construction adequate to protect drying beds, perimeter ditches, transfer points, and storage lagoons.

Influence on Soil Character and Use

DESCRIPTION OF EXISTING CONDITIONS

Regional Setting and Agricultural Sites

Soils in the region are derived from volcanic and sedimentary bedrock and from alluvial (river deposited) sediments. Soil textures range from gravelly sands to heavy clays.

Soil use in the area is highly variable, with agricultural and urban land occupying the majority of the region. In 1979, approximately 60 percent of the region's lands were devoted to agricultural use (Brown and Caldwell 1979). Table 3-11 presents acreages for the major crops grown within Lane County. In general, grass seed, pasture, and hay crops occupy the most land with peppermint, beans, corn, and wheat occupying lesser amounts. Crop selection is often dictated by site drainage.

Grass seed is an important crop in Lane and Linn Counties. Rye-grass is grown for seed on clayey, river bottom sites which are often partially flooded. Few other crops can be grown on these poorly drained sites. Annual rye-grass is usually grown on slightly drier sites than perennial rye-grass because the wet sites may be damaged by the increased traffic necessary for annual cropping. Blue grass, orchard grass, and tall fescue are cultivated on soils which are slightly better drained. Many grass fields are used for grazing of sheep in the fall. Pasture and hay crops are grown on a rotation and permanent basis on a variety of moderately well drained sites.

Peppermint, corn, beans, and wheat are grown on the moderately well drained soils of alluvial bottomlands and terraces. Peppermint, corn, and beans are the primary irrigated crops.

The Groundwater Quality section of this EIS has identified four local soil groups based on parent material and drainage characteristics. The major use of each soil group is as follows:

Table 3-11. Lane County Agricultural Land Use for 1981

CROP	ACREAGE
Wheat	21,000
Barley	400
Oats	2,900
Alfalfa	1,500
Clover and grass hay	20,000
Corn (silage)	1,800
Sweet corn	4,300
Beans	3,370
Peppermint	5,000
Bentgrass	600
Tall fescue	2,000
Annual rye-grass	4,800
Perennial rye-grass	5,500
Kentucky bluegrass	100
Orchard grass	2,400
Filberts	2,810
Walnuts	150
Apples	50
Sweet cherries	325
Sour cherries	240
Peaches	60

SOURCE: Oregon State University Extension Service 1982.

Soil Group	Land Use
Group 1	Mainly agricultural, beans, corn, wheat, pasture
Group 2	Agriculture and urban, pasture, grass seed, corn, beans, peppermint
Group 3	Agriculture, pasture and rye-grass, very poorly drained
Group 4	Agriculture, timber, pasture, some row crops on flat areas

Site C/Prairie Road

Soils on these sites belong to soil Groups 2 and 3. Site C contains Malabon, Coburg (Group 2) and Awbrig (Group 3) soils, while Prairie Road contains Malabon, Coburg, Awbrig, and Salem (Group 2) soils.

Coburg soils are moderately well drained and suitable for a wide variety of crops. Low lying areas, however, may be subject to flooding and have slower drainage. Malabon soils are similar to Coburg soils but have a coarser substratum. Awbrig soils are poorly drained and experience high winter groundwater levels. The wet conditions and dense clay subsoil limits crop production to pasture and rye-grass seed. Salem soils are well drained and have a coarser surface and substrate texture than the other soils on the two sites (USDA Soil Conservation Service 1981).

Currently, these sites are used for rye-grass seed production with some pasture. No row crops are cultivated on these sites.

Coburg Hills Site

The Coburg Hills site is underlain by Group 3 soils of the Bashaw series. These soils are nearly identical to the Awbrig series described previously (USDA Soil Conservation Service 1981). Bashaw soils can support only pasture grasses and rye-grass due to the poor drainage, high winter groundwater levels, and dense clay subsoil.

Short Mountain Landfill

The Short Mountain Landfill is underlain by Group 3 and Group 4 soils of the Natroy, Bashaw, Nekia, and Witzel series. Soils on the site are heavy textured and possess high cation exchange capacities and clay contents. Soils on the lower, southern portion of the site are deep and poorly drained. The higher, northern portion of the site is underlain by the Group 4 soils. Although these soils are also heavy textured, they are slightly better drained than the Group 3 soils. Basaltic bedrock underlies these soils at depths of 1-3 feet and often creates perched water tables.

Regional Wastewater Treatment Plant

Soils underlying the treatment plant are within soil Group 1 and consist of the Newberg and Camas series. These soils possess sandy loam surface textures and are underlain by somewhat excessively drained sands and gravels.

Soil productivity and use is limited by the coarse substratum. Excessive leaching has removed much of the nitrogen and carbon (organic matter) from surface and lower soil horizons. The cation exchange capacity (ability to retain positively charged nutrients and metals) is low for both soils. Leaching has also resulted in low soil pH and a shallow rooting depth.

IMPLICATIONS OF NO PROJECT (ALTERNATIVE 4)

The effect of Alternative 4 on soil character and use cannot be assessed without knowing the specific approach MWMC would take in the absence of adequate sludge handling facilities beyond 1989. If increasing volumes of liquid sludge were trucked from the RWTP to the landfill or agricultural lands, some eventual soil degradation would be expected. It is likely that the impact of this action would be greater than those of the other three project alternatives.

IMPACTS OF ALTERNATIVES

Alternative 1

AGRICULTURAL APPLICATION SITES. Future use of sludge application sites is unlikely to change if sludge is applied at agronomic rates. Application of sludge to agricultural lands at the rates proposed would not have a major impact on soil texture, structure or pH. Slight improvements of soil stability and infiltration rate could be expected, and an increase in soil cation exchange capacity (CEC) may occur, especially if the antecedent value was low.

Long-term soil use is more likely to be altered through increases in the nutrient, heavy metal, organic toxin, and biological pathogen content of the soil. In general, significant increases in nearly all plant nutrients could be expected. The concern for nitrogen overloading and possible leaching have spawned criteria for sludge application rates based on the nitrogen requirement of the receiving crop. The EPA has established maximum food chain crop nitrogen additions based on crop requirement, residual soil nitrogen, and sludge nitrogen content. The Oregon DEQ has adopted these guidelines and applies them to all agricultural land.

Annual nitrogen additions based on these criteria are unlikely to affect the species grown or the long-term use of the soil. The additional nitrogen may even allow a wider variety of crops to be grown. Sludge is likely to increase the yield of most crops (Kirkham 1974). Increases in the yield of corn from sludge-treated fields in the Willamette Valley, for example, were nearly proportional to the sludge ammonia content in a study by Hemphill et al. (1982).

The presence of biological pathogens, organic toxins, and heavy metals in sludge has the greatest influence on future use of soils amended with sludge. DEQ (1981) has established a number of guidelines to regulate use of sludge application sites so that pathogens do not create a public health hazard. These include:

- Crops grown for direct human consumption should not be planted until 18 months after sludge application. If the edible parts will not be in contact with the sludge amended soil, or if the crop is to be treated or processed prior to marketing such that pathogen contamination is not a concern, this requirement may be waived.

- Grazing animals should not come in contact with digested sludge or effluent-treated pasture or forage until 30 days after application.

- Controlled access to sludge application sites for 12 months following a surface application is required. Access control is assumed on rural private land.

Application of sludge is unlikely to cause long-term soil use changes due to the accumulation of biological pathogens. Survival of most pathogens is greatly reduced when they are exposed to the atmosphere and competition from native microorganisms.

Organic toxins applied with the sludge are unlikely to cause a change in soil use due to their low concentration in local sludges. There are no state or federal guidelines relating to organic toxins in sludges if the concentrations of PCBs in the sludge is less than 10 mg/kg. Eugene/Springfield sludge contained 0.14 mg/kg PCB in 1978 (Brown and Caldwell 1979).

Heavy metals, therefore, present the greatest risk for potential alteration of soil use. As part of the DEQ sludge application permit, the heavy metal loading associated with sludge application is calculated. Based on this figure and the maximum allowable metal loadings (Table 3-10), the total number of years sludge can be safely applied is calculated.

Although sludge application based on these calculations would allow the production of food chain crops, it is generally recognized that certain crops are at a greater risk to metal uptake than others. In general, leafy vegetables such as spinach, chard, tobacco, and root crops take up the greatest quantity of metals. The EPA has recognized this and issued special recommendations for these crops (Table 3-10).

Of the crops grown in the Willamette Valley, the most research has been done with corn. Hemphill et al. (1982) found that corn leaf tissue zinc and cadmium content was greater for plants grown on sludge-amended soil than on control soil. Commercial fertilizers were also found to increase the tissue concentration of these metals. These authors found only slight increases in the kernel metal content. These results are consistent with other reports that cadmium increases in fruits, grain, and that other storage tissues are less than those in leaf tissues. Researchers have found that increased uptake of cadmium by beans, corn, lettuce, and chard may continue for up to 8 years after application.

Only a limited amount of research has been done with grass crops. Chaney et al. (1974) reported increases in the foliar zinc concentration of pasture grasses grown on a 24-year-old sludge disposal site. No increases in cadmium concentrations were noted. Similarly, Johnson et al. (1974) reported only increases in the zinc content of perennial grasses. Preliminary results indicate that fescue may take up slight to moderate amounts of heavy metals, including cadmium (Jackson pers. comm.).

Group 1 soils are unlikely to witness a soil use change as a result of sludge application. These soils are used primarily for food chain crops which are not planned to receive sludge. The low organic matter and clay content of these soils would not favor the retention of heavy metals or organic toxins.

Group 2 soils would be most vulnerable to soil use changes resulting from sludge application. This is due to the soils high metal retention capabilities and the wide variety of crops grown on these soils. If a change in soil characteristics such as pH or zinc content accompanied a crop change on a sludge-amended field, undesirable metal uptake could occur in some plant species.

The use of Group 3 soils is not likely to be changed by sludge application. These soils are too wet and heavy-textured to support vegetation other than pasture and rye-grass. Group 4 soils are unlikely to receive sludge due to their steep slopes and shallow depth.

FORCE MAIN ROUTES. Soil use along the force main routes would only be affected by a large leak in the sludge delivery line. The possibility of a large leak, however, is small. It is unlikely that future soil use would be affected by leaks from the supernatant return pipe. This pipe would not carry significant quantities of metals and organic toxins, which are the primary constituents which would alter soil use.

If the sludge delivery line developed a large leak, loadings of heavy metals and nitrogen could accumulate in soils above those recommended for food chain crops. Contaminants leaked from the pipe could disperse more rapidly than those surface-applied because of the lesser amounts of organic matter at the depths the pipe would be buried. Pipe burial would also limit photochemical degradation of organic toxins leaked.

SITE C. Future use of the soils at Site C would be affected primarily at the sludge lagoons and air-drying beds. The surface soils in these areas would be excavated or covered with asphalt. Long-term storage of sludge in the lagoons could also lead to some build-up of heavy metals in the surrounding soil. This would likely eliminate the possibility of growing food chain crops in this area if it were to eventually return to an agricultural use.

Soil on other portions of the site would only be affected by major sludge spillages or chronic leakage of sludge. Proper operation and maintenance of the facilities would avoid this type of contamination.

PRAIRIE ROAD SITE. Impacts to the future use of this site's soils are essentially the same as those described for Site C. The presence of coarser soil layers on this site, however, may allow contaminants to move into the groundwater and not be as readily bound by soils. The Prairie Road site, therefore, may contain fewer contaminants than Site C for the same amount of sludge spilled. This may result in fewer land use limitations in the future.

COBURG HILLS SITE. Impacts to the future use of soils on this site are essentially the same as those described for Site C.

SHORT MOUNTAIN LANDFILL. Future use of the soils at the Short Mountain Landfill would not be significantly affected by back-up disposal of sludge under this alternative, unless the sludge was applied on the surface of completed fill areas. Future use of the site will be restricted because of the long-term use of the site as a sanitary landfill. Current plans indicate that sludge going to the landfill site would be mixed with other solid waste and incorporated into the fill; it would not be applied to the surface.

Alternative 2

The soil use impacts of this alternative would be essentially the same as those described for Alternative 1, except that a smaller area of soil would be affected by construction and operation of sludge drying beds. Only 33 acres of drying beds are needed for Alternative 2; this is 17 acres less than Alternative 1.

Alternative 3

This alternative is essentially a continuation of the MWMC interim project, with no construction of off-site facilities. Impacts to the agricultural reuse sites would be similar to those described for Alternative 1. Increases in sludge volume over Phase I would result in heavier loadings of metals and toxins at the landfill. The sludge volume increase would also facilitate an increase in the quantity of land utilized for agricultural reuse of sludge.

MITIGATION MEASURES

Alternatives 1 and 2

Mitigation of soil impacts would be essentially the same for these two alternatives. At the treatment and storage sites, and along the force main route, procedures should be developed to minimize spillage or leakage of sludge onto the surface. Plans for rapid clean-up of any spills that do occur should be developed and implemented by operations staff.

At agricultural reuse sites, sludge should be applied only at the rates considered acceptable by DEQ. Application should occur at rates which maximize plant uptake of nutrients and limit the total amount of heavy metals or organic toxins which might accumulate in the surface layers of the soil. Application timing should also be geared to compliance with DEQ restrictions on grazing, public access, and growth of food chain crops.

Alternative 3

Control of sludge application rates on agricultural reuse sites would be needed for Alternative 3, as described for Alternatives 1 and 2.

Public Health Risks

INTRODUCTION

Health risks associated with municipal sewage sludge treatment, disposal, and reuse can be generally classified into two major categories: exposure to microbial pathogens and exposure to toxic chemicals. Potentially, the public could be exposed to these agents through drinking water contamination, the food chain, direct human contact, inhalation of contaminated aerosols or dust, or animal or insect vectors as carriers of contamination and disease.

Prior to treatment, municipal sewage has high concentrations of both pathogenic and nonpathogenic organisms, as well as varying concentrations of heavy metals and other toxic substances. The wastewater treatment process tends to concentrate microorganisms and other organic and inorganic particulate matter in the sludge. Heavy metals and many organic chemicals form precipitates or bind with the particulate organic matter in the waste stream. They also tend to concentrate in the sludge.

Most pathogenic microorganisms in the sludge are of human enteric origin from infected individuals served by the wastewater collection system (see Appendix C for a list of pathogens occurring in wastewater and sludge and their associated diseases). Sources of toxic substances in the sludge include industrial and commercial wastes as well as improper disposal of household pesticides, solvents, and other chemicals.

The first part of this section discusses water contamination, food chain, direct contact, and aerosol health risks. Vector-related risks are discussed separately at the end of the section.

EXISTING CONDITIONS

Sludge Treatment

Sludge produced at the Eugene and Springfield WTPs is anaerobically digested, which accomplishes several public health-related improvements including mineralization and stabilization of putrescible organic material, and destruction of many of the pathogenic organisms present in the sludge. Not all pathogens, however, are destroyed in the process (Burge & Marsh 1978; Clark et al. 1981; Miller 1973). Many toxic organic substances are also made less toxic in the process, either through volatilization or degradation. Persistent organics such as PCBs, chlorinated hydrocarbons and certain pesticides, if present, are commonly not affected by digestion and are passed through the process. Heavy metals and metal compounds are commonly converted from an oxidized to a reduced state, but are not destroyed. A portion of the organic nitrogen in the sludge is mineralized in the digester. Tables B-1 and B-2 in Appendix B indicate the concentrations of some of the more common constituents of concern found in treated sludge from the Eugene and Springfield WTPs.

There is currently no indication that sludge treatment at either the Eugene or Springfield WTPs is creating a public health hazard. Treatment plant workers are the most at risk, but plant safety measures are invoked to keep risk to a minimum.

Sludge Disposal

Eugene/Springfield sludge is currently disposed of by spreading on the land (agricultural reuse or local horticultural use) or trucking to the Short Mountain Landfill. Agricultural application is restricted to the summer months. The digested sludge is trucked to and spread on selected agricultural land in liquid form.

In the Willamette Valley around the Eugene/Springfield area there are areas of coarse, gravelly/sandy soils with very high permeability that could be potential conduits of bacterial and viral pollution to groundwater or adjacent surface waters. At the present time, a comprehensive screening procedure for selection of agricultural and forest sludge reuse sites has been adopted by MWMC which includes consideration of land constraints and soil characteristics (MWMC 1982). If these characteristics are unsuitable for protecting surface and groundwaters from microbial contamination, the site is rejected as a sludge reuse site, thus reducing the risk of microbial pathogen contamination.

In addition to potential microbial contamination of drinking water supplies, agricultural reuse may also present certain health risks from microbial contamination of food crops. The MWMC and DEQ guidelines specifically state that only nonfood chain crops should be grown on sludge-amended soils during the sludge application period, and that there should be a waiting period of at least 18 months after the last sludge application before crops for direct human consumption can be planted (MWMC 1982; Oregon DEQ 1981). If these guidelines are adhered to, the risk of infection from foodstuffs grown on sludge reuse sites is expected to be minimal.

Risk of infection from direct public contact with sludge reuse sites is also minimized by operational requirements specified in the MWMC and DEQ guidelines. "Controlled access to municipal sludge . . . application sites for 12 months following surface application is required" (Oregon DEQ 1981). Farmers and workers who will be in the fields applying the sludge should be aware of the potential risks of contamination and take appropriate measures to avoid infection.

The public health risk of exposure to aerosols or contaminated dust from agricultural reuse sites is minimal. DEQ guidelines, as well as the actual permit conditions for sludge application, establish buffer zones for sludge application and prohibit spray irrigation "when wind conditions exist that will allow aerosols to drift offsite," which should keep the risk of public exposure to aerosols during sludge application to a minimum. Obviously, direct land application of dewatered sludge or injection of liquid sludge would eliminate this risk almost entirely. Some risks of inhalation exposure may also exist during dry, dusty conditions, but these types of conditions are also very detrimental to bacterial and viral survival.

Heavy metals which have been reported in sludge from the Eugene wastewater treatment plant include lead, zinc, copper, chromium, nickel, cadmium, boron, mercury, molybdenum, selenium, aluminum, antimony, iron, and manganese (Brown and Caldwell 1980). Metals of concern to public health in drinking water supplies include arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Maximum allowable contaminant levels for drinking water have been established for each of these metals by the National Interim Primary Drinking Water Regulations as shown in Tables 3-12 and A-1 (U. S. EPA 1977a). From an aesthetic point of view, copper, iron, manganese, and zinc are also important (secondary standards exist for these constituents). These last four metals may affect taste and color, or cause staining problems in laundry if they occur at excessive concentrations in domestic water supplies (40 CFR 143).

Table 3-12. Maximum Contaminant Levels for Metals in Drinking Water
Modified from: U. S. EPA 1977a

CONTAMINANT	LEVEL, MILLIGRAMS PER LITER
Arsenic	0.05
Barium	1.
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Selenium	0.01
Silver	0.05

The heavy metals in the sludge applied to agricultural lands may accumulate in the soils, be assimilated by the plants and crops, and/or leach from the soil into the groundwater or adjacent surface waters. However, the soils in the Eugene/ Springfield area used for agricultural application of sludge are well suited for holding and precipitating heavy metals from solution, thus making them largely unavailable for leaching into the water supplies or being assimilated by the plants. This is especially true during the summer months when the soils are well aerated and the net soil moisture flow is toward the surface.

A greater risk of water contamination occurs during the wet weather months when the land may be flooded. This, coupled with the natural acidity of the Willamette Valley soils, may cause the metals to become more mobile and pose a potential risk of contaminating groundwater and adjacent surface waters. Fortunately, the metal concentrations in Eugene/Springfield sludge are relatively low and sludge application rates to agricultural lands, in terms of metal loading, are also low. In addition, the period of potential metal leaching occurs when water levels, groundwater flow and recharge rates are high, resulting in substantial dilution of any metals that might leach. The two factors of low application rates and a high dilution factor will reduce the risk of ground or surface water pollution by heavy metals. MWMC guidelines call for monitoring water supply wells near sludge reuse sites to ensure safe drinking water (MWMC 1982).

Public health risks from heavy metal exposure through the food chain are very small. The DEQ Guidelines for Land

Application of Wastewater and Sludge (Oregon DEQ 1981), as adopted by the MWMC (1982) provide very stringent controls on loading rates for heavy metals on agricultural land to protect the crops as well as livestock and people who might consume the crops. In addition, MWMC only permits application of sludge to nonfood chain crops. The sludge application rates are limited by nitrate concentration rather than heavy metals, thus providing a 100-1,000 fold safety factor in the loading of metals on agricultural land for any given year. Since metals tend to accumulate in the soil and nitrates do not, each site will also have a specific "lifespan" for reusing sludge, at which time the metals concentration in the soil will be approaching the maximum safe limit. For existing reuse sites, this lifespan varies from 65-167 years, assuming maximum allowable annual applications of sludge as determined by the DEQ guidelines (Lowenkron pers. comm.).

Build-up of either cadmium or zinc is generally the limiting factor for determination of the useful lifespan of the land for sludge applications. Excess levels of zinc in the soil can be toxic to plants, whereas excess levels of cadmium are assimilated by leafy plants and can be toxic to animals or people consuming the plants. The natural acidity of the soils in the Willamette Valley may result in metal phytotoxicity to certain sensitive plant species if metal accumulations approaching the DEQ guideline limits are permitted. The degree of phytotoxicity will depend on the total metal loading in the soils and on the acidity of the soils (Sommers 1980). Due to the much higher concentrations of zinc, as compared to cadmium in the sludge, it is unlikely that cadmium could accumulate to levels in foods considered hazardous to animals and humans. The plants would be killed by the zinc before cadmium accumulated by the plants would reach hazardous levels. Cadmium to zinc ratios of less than 0.015 will provide this safety factor (42 FR 57426 [November 2, 1977]). The cadmium/zinc ratio for Eugene sludge, as calculated from sludge application permits (Lowenkron pers. comm.) and data from Brown and Caldwell (1980), range from 0.008 to 0.002 with an average of about 0.005. This should provide adequate protection of the food chain from cadmium accumulation.

As mentioned, the application rate of sludge to agricultural land is currently limited by the nitrogen content of the sludge. The inorganic and, to some extent, the organic nitrogen in the sludge is a nutrient for plant growth. If nitrogen is applied to the land in excess of the crop requirements, nitrate nitrogen may move with water through the soil, potentially polluting groundwater or adjacent surface waters (Page and Pratt 1975). Application of sewage sludge to agricultural lands in accordance with MWMC and DEQ guidelines limits the loading of available nitrogen to that which can be utilized by the crop being grown.

EPA has established a standard of 10 mg/l for nitrate-nitrogen in drinking water (40 CFR 141). Currently, groundwater in several locations in the Eugene/Springfield area is close to or exceeds this nitrate standard. Sources of nitrate pollution other than sewage sludge include septic systems, leaky sewer systems, livestock wastes, and agricultural fertilizers. It appears that one or more of these sources is already polluting groundwater aquifers in the area.

Low concentrations of toxic organic residues have also been found in Eugene sewage sludge. These include chlordane (.05-.07 ppm) and 1254 polychlorinated biphenyl (PCB) (.14-.15 ppm) (Brown and Caldwell 1980). These substances, as well as other toxic organic residues that may be present generally, have a very low solubility in water and are not readily mobile in the soil (Dacre 1980). This combination of low solubility and low concentration results in a very low public health risk to water supplies from toxic organics on agricultural lands.

Although there may be a slight risk of food chain contamination with toxic organics after sludge application has stopped (food chain crops are not permitted during the period of sludge application), based on the evidence available, this risk would be minimal. Chlordane has a half life in soils of 2-4 years and PCBs have a half life substantially longer, resulting in a marked potential for accumulation of chlordane and PCBs in the soils over several consecutive years of sludge application (Dacre 1980). Webber et al. (1983) assessed PCB uptake by various plants at 10 different sludge treatment and application sites. For PCB concentrations and application rates similar to or higher than those reported for Eugene/Springfield, Webber found no significant difference in PCB concentrations in crops grown on sludge application sites as compared to controls. Braude et al. (1975) reported plant uptake levels for persistent organics of 5-20 percent of the levels in the soil. Occasional monitoring of crops grown on reuse sites would be prudent to ensure that levels of toxic substances do not accumulate to dangerous levels.

Landfill Disposal

The disposal of liquid sludge by spray irrigation on closed portions of the landfill has similar health risks to agricultural application except for the following:

- The risk of drinking water contamination by either microorganisms, metals, or toxic chemicals from the sludge is reduced due to the hydrologic isolation of the landfill from drinking water supplies.

- The risk of food chain contamination is virtually eliminated due to the improbability of ever using the landfill as a source of food chain crops.

- The risk of direct human contact to sludge is slightly higher due to the increased numbers of individuals that visit and use the landfill as compared to agricultural reuse areas. Strict adherence to MWMC and DEQ guidelines for sludge application, buffer zones, and controlled access and application during windy conditions is required in order to minimize this risk.

- The risk of exposure by inhalation of aerosols during spray irrigation of sludge on the landfill is slightly higher for the same reasons given for direct contact exposure.

Landfill disposal of dewatered sludge poses some special health risks. Pathogens and certain heavy metals contained in leachate may pass through the landfill more readily than through soils. Lofy et al. (1977) reported iron and lead contamination of groundwater from eight landfills receiving various quantities of sewage sludge. Landfills receiving sewage sludge only, as well as those receiving a combination of sewage sludge and refuse, were included in the study. Liquid associated with the sludge contributes to leachate from the landfill. This will increase the peak volumes of leachate, since sludge is generally landfilled during the wettest months of the year; however, the total volume of leachate from the landfill is large compared to the volume contributed by the sludge over any given period. As part of the landfill design, the leachate is collected and treated in a lagoon; it is then sprayed back over the landfill surface to encourage evaporation. Water quality in the Coast Fork Willamette River is carefully monitored to detect any degradation caused by the landfill operations. No significant effects have been reported. There are no known domestic water supplies (either wells or surface water) hydraulically linked to the landfill area, so risk to public health through drinking water contamination at the landfill is minimal.

By burying the dewatered sludge in the landfill, the risks to the public associated with microbial contamination either through contact, foodstuffs, or inhalation of aerosols is virtually nonexistent. In wet weather conditions, handling and covering the sludge may be difficult, and reasonable care should be taken to protect landfill personnel from infection due to direct exposure to the sludge.

IMPLICATIONS OF NO PROJECT (ALTERNATIVE 4)

The public health risks of the No Project Alternative are discussed in detail in the previous section on existing conditions. These conditions will be in effect for the near future. At some time in the future, however, the capacity of the Phase I centrifuges to adequately dewater the sludge prior to landfill disposal will be exceeded. This will result in excess liquid sludge being disposed of either in the landfill or in some other as yet to be determined manner.

If excess liquid sludge were disposed of in the landfill, this would increase the volume of leachate being generated.

This could, in turn, cause deterioration of water quality in the receiving streams and rivers. Deterioration of stream and river water quality could indirectly impact health through both recreational and commercial use of the waters, including fishing, swimming, and irrigation.

So far, suitable methods for disposing of liquid sludge in the Eugene/Springfield area during the wet winter months, other than those discussed as alternatives in this report, have not been identified. If the No Project Alternative were pursued, MWMC would have to address this problem some time in the future to ensure disposal of the sludge in a manner that would not contaminate drinking water supplies or otherwise adversely impact the health of the citizens of Eugene/Springfield and surrounding areas.

IMPACTS OF ALTERNATIVES

Alternative 1

Alternative 1 involves the construction of storage lagoons at one of three alternative off-site locations, pumping and storage of all sludge in the lagoons in the winter with air drying, and agricultural reuse of the sludge in the summer. The Short Mountain Landfill will serve as a back-up for disposal of air-dried sludge if agricultural land is not available. The use of the centrifuges at the treatment plant will be discontinued.

STORAGE LAGOONS.

The public health impacts of the storage lagoons include:

- Additional reduction of microbial pathogens during lagoon storage.
- Reduction or elimination of the need for sludge disposal during the winter.
- Potential of drinking water contamination from leaky lagoon.
- Potential for animal vector transmission of contamination.

Dotson (1973), in a review of the literature, reported that storage for long periods is one of the simplest methods of reducing pathogen levels in domestic sewage sludge. One study cited by Dotson (1973) reported a 99.9 percent reduction in fecal coliforms following a 30-day storage period. Gerba (1983) cited a number of studies reporting virus, bacteria, and parasite inactivation in sludge lagoons ranging from 50-100 percent. Brown and Caldwell (1980) also cited literature reporting 98-99.99 percent reduction of various bacteria in FSLs. It is safe to say that prolonged lagoon storage will significantly reduce the total number of pathogens present in the sludge. The degree of reduction is proportional to the length of retention in storage, which will vary depending on the time of year. During the summer, sludge will be removed from the lagoons faster than it is added, and during the winter no sludge will be removed.

Another beneficial impact of the sludge storage lagoons will be the elimination or reduction of the need for sludge disposal during the winter months. The health risks associated with landfilling of sludge will be reduced by summer disposal of dewatered sludge.

The sludge storage lagoons will increase the risk of groundwater contamination in the vicinity of the lagoons if the lagoons develop leaks. If properly constructed and maintained, the risk of leaks to the ground or surface waters can be greatly reduced. If leaks develop, the public health impacts could include pollution of nearby downgradient domestic water wells with microbial pathogens, heavy metals, nitrate, ammonia, and/or toxic organic chemicals. The migration of pathogens, heavy metals, ammonia, and organic chemicals will be restricted by the filtering and attenuating properties of the soils between the lagoons and the water wells. Areas with coarse gravel and sand deposits will provide less protection against migration of these contaminants than those with fine-textured soils. Nitrates are not readily attenuated and will move freely through the soils in the direction of local groundwater flow.

As pointed out in the Groundwater Quality section of this report, areas near Site C and the Prairie Road site have reported elevated nitrate concentrations and bacterial contamination in the groundwater. All reasonable attempts should be made to avoid any additional nitrate and bacterial contamination of the groundwater and to control existing sources of contamination if groundwater is going to be a continuing source of drinking water for residents in this area.

There are fewer water supply wells close to the Coburg Hills site than to Site C and Prairie Road. Existing groundwater quality information near the Coburg Hills site is limited. It is reasonable to expect continued development and use of groundwater as the primary source of water for both domestic and agricultural use in the Coburg Hills area. Due to the lower density of development in this area than at Prairie Road and Site C, the immediate public health risks from drinking water contamination at the Coburg Hills site will be less.

Contamination of surface water from the storage lagoons is unlikely except in the improbable event of a breach of the lagoon berm or indirectly via groundwater flow. All three sites are located far enough from bodies of water used for recreational purposes that the risk of exposure from recreational use is minimal, except in the case of a major breach of a lagoon berm. Surface contamination of drinking water wells is unlikely unless severe flooding of the lagoons were to occur. Even then, properly sealed and constructed wells should not be affected. Improperly constructed wells will be subject to contamination from a wide variety of sources, of which the storage lagoons are only one. More serious health threats to these water supply wells would come from flooded septic systems and leaky sewers that contain raw sewage.

AIR-DRYING BEDS. Air-drying of the sludge will further reduce the number of pathogens in the sludge. The degree of reduction will depend on the environmental conditions existing during the air-drying process and the length of the drying period. Most microbial pathogens are sensitive to dessication and direct sunlight. The thickness of the sludge layer in the drying beds will therefore affect the degree of pathogen reduction. This pathogen reduction during drying further reduces the public health risks of microbial infection and disease from exposure to the treated sludge.

Air-drying will also reduce the amount of inorganic nitrogen in the sludge by volatilization of ammonia. The drying process tends to concentrate nonvolatile substances in a given volume of sludge, including heavy metals and some toxic organics. Although some chlordane and PCBs may volatilize during the air-drying process, if present, most would remain with the solids portion of the sludge, thus increasing their concentration in the sludge.

Since the air-drying beds are proposed to be used only in the summer, and since runoff will be recycled to the lagoons or treatment plant, the risk of surface and/or groundwater contamination and the health risks associated with such contamination are minimal. There could be a marginal health risk associated with insect or animal vectors transmitting contamination from the drying beds. The degree of risk from this mode of exposure is greatly reduced due to the reduction of pathogens throughout the treatment process. For the same reasons, the health risks to workers spreading and harvesting the sludge on the drying beds are also less than are found in handling liquid or dewatered sludge.

The health impacts from the operation of the air-drying beds at the three alternate locations are all substantially the same. The proximity of Site C and the Prairie Road sites to developed areas will result in some additional risk to exposure via insect or animal vectors as compared to the Coburg Hills site.

FORCE MAIN. The force main will transfer sludge under pressure from the wastewater treatment facility to the sludge storage and treatment site. The force main should have little or no effect on the viability or concentration of any of the sludge constituents.

Health risks associated with the force main are almost entirely associated with the possibility of leaks or breaks in the pipe or at pumping stations. This could result in contamination of drinking water supplies or direct exposure of the public to digested sludge. Leaks or breaks in properly designed and constructed force mains are rare, so the risk of adverse health effects from this source is small.

Health risks of primary concern to drinking water supplies would include microbial pathogens, heavy metals, and toxic organics. The degree of risk would depend on the nature of the leak, its proximity to water wells, and the nature of the soil where the leak occurs. Fine-textured soils will assimilate and precipitate most pollutants within the first few meters. Long-term leaks and leaks within coarse, gravelly formations may migrate further and may pose a greater threat to domestic water wells.

The force mains to the Coburg Hills site would be above ground at river crossings. The pipelines to Site C/Prairie Road would be buried along their entire length. Leaks at the river crossings could result in direct public exposure to sludge at the bridges, or even in the waterways. The primary health risk of a direct exposure of this nature is infection by pathogenic microorganisms. The risks are not nearly as great as from exposure to raw sewage or sludge due to the reduction of pathogens by the wastewater treatment and anaerobic digestion processes. Leaks in sections of the force main above ground will be easily detected. Measures for control and repair should be rapidly implemented.

AGRICULTURAL REUSE OF AIR-DRIED SLUDGE. The health impacts of agricultural use of air-dried sludge are essentially the same as those for the use of liquid or mechanically dewatered sludge. Air-dried sludge will probably have a lower available nitrogen content due to volatilization of ammonia, which means heavier loading of sludge on fields will be possible before reaching the agronomic limit for nitrogen. This may result in heavier loadings of metals and toxic organics per acre of agricultural land. It also means, however, that a smaller number of acres would receive sludge. Although metals and toxic organics are not a serious health threat, the higher loading rates will tend to reduce the useful lifespan of the agricultural reuse sites due to more rapid accumulation of metals.

The higher loading rates will probably have little effect on health risks from exposure to microbial pathogens. The increased loading will be more than offset by additional pathogen attenuation during the drying process. The dried sludge will also have to be mechanically spread on the reuse sites. This will eliminate the risk of exposure to pathogens through inhalation of aerosols from spray application of sludge.

LANDFILL OF AIR-DRIED SLUDGE. Under Alternative 1, landfilling of the air-dried sludge will be used as a back-up for sludge disposal if agricultural reuse sites are not available. Landfilling the air-dried sludge will have fewer health risks than landfilling mechanically dewatered sludge. The air-dried sludge will only be landfilled during the summer months and will have a lower total liquid content, reducing the likelihood of contributing to leachate from the landfill. These factors will also facilitate handling and covering of the sludge at the landfill, thus reducing risk of accidental exposure of workers to sludge pathogens. Metal contamination in leachate will be about the same as existing conditions for similar loading, but this is not seen as a health risk due to the leachate collection and treatment system already in place at the landfill.

Alternative 2

The health impacts of Alternative 2 will be very similar to those described above for Alternative 1. The major difference will depend on the mix of air-dried vs. mechanically dewatered sludge and the amount that the drying beds will be reduced in size. Reduction in the size of the drying beds will not provide any significant additional health benefit or risk over the larger drying beds, except for possibly a slight reduction in risk of contamination by insect or animal vectors.

Alternative 3

Health effects for Alternative 3 would be a continuation of those that currently exist from landfilling of digested sludge. Long-term (20-year) winter disposal of mechanically dewatered sludge in the landfill may increase the metals concentration in the landfill leachate. This is not viewed as a significant health risk due to the proposed improvements in the leachate control and treatment system at the landfill.

MITIGATION MEASURES

Mitigation of health risks associated with sewage sludge treatment, disposal, and reuse can be accomplished by controlling the source of the risk and the level of exposure. The greatest control over pathogens is achieved in the wastewater and sludge treatment processes used at the RWTP. Risks from exposure to other sludge constituents are controlled by the careful design and operation of storage and reuse/disposal operations. In addition to the treatment, storage, and reuse/disposal techniques being proposed for the project, the following actions could further reduce the public health risks of the sludge management project:

- The groundwater and surface water quality protection measures suggested for use at the off-site storage and drying sites would also reduce health risks at these sites.

- o Strictly adhere to DEQ sludge reuse guidelines.
- o Regularly monitor the heavy metal and toxic substance content of the sludge prior to agricultural reuse.
- o Restrict public access and provide adequate buffer zones around sludge reuse sites.
- o Develop contingency plans for accidental sludge spills along roads or breaks in the sludge force mains.

VECTOR CONTROL

In any discussion of vector control, it is important to distinguish between a true vector and a nuisance organism. A vector is any organism that transmits a pathogen. In the Eugene area, mosquitoes and rats are considered the primary vectors since they can act as disease-carrying agents. Some species of mosquitoes found in this area have been known to be carriers of several diseases harmful to man, including encephalitis and malaria, and rats are potential transmitters of plague to humans. Plague is endemic in the natural sylvatic environment but transmittal to man is limited to rare instances of exposure to wild rodents and their fleas. Oregon has had several cases of plague being transmitted by ground squirrels in remote and mountainous areas but not originating from the Eugene area. Not all species of mosquitoes, nor all rats and ground squirrels, however, act as disease-carrying agents.

In contrast with vectors, a nuisance organism is an animal which is annoying or unpleasant to have around, but which is not considered a public health hazard. Such animals, including nutria, opossum, mice, gophers, flies, gnats, feral dogs and cats, and other organisms which may cause property damage (by digging, consumption of crops, etc.) or which are unpleasant in large numbers (e.g., flies), are viewed as pests by most people. Some organisms which can act as vectors also may be nuisances (e.g., mosquitoes, ground squirrels), especially around urban and suburban areas.

Description of Existing Conditions

SITE C. Site C, which currently supports annual and perennial grass seed crops (rye-grass), also supports several small mammals, most of which are considered nuisance animals, rather than true vectors. Nutria, opossum, pocket gophers, field mice, and ground squirrels all can be found on and around the site. These are burrowing mammals which are predominantly vegetarians. Nutria are aquatic mammals and will burrow in banks above the water line. They will often use drainage ditches in agricultural areas if aquatic plants are available nearby for feeding. Opossum, which are often confused with nutria, also inhabit agricultural areas and areas along streams.

Rats also are found on Site C (Dickey pers. comm.). Rats, which can act as vectors, are common inhabitants of agricultural areas. They are not present in large enough concentrations, however, to cause a public health concern.

Drainage ditches and standing water on-site provide suitable mosquito breeding habitat. The Lane County Public Health Department applies mosquito oils to drainage ditches and other areas containing standing water if mosquitoes become overabundant. The oils effectively kill the larvae and disperse after several hours. If the mosquito hatch is average (at an acceptable nuisance level) no control methods are used.

PRAIRIE ROAD. The Prairie Road site is immediately west of the Southern Pacific Railroad tracks, which separate it from Site C. Part of the Prairie Road site supports grass seed crops and part is being grazed by cattle. Wildlife, including vectors, found on this site would be virtually identical to that found on Site C.

COBURG HILLS. The Coburg Hills site is predominantly grassland with patches of trees and currently is used for grazing. Vectors which occur here would be similar to those at Site C and Prairie Road. Shallow drainage ditches traversing the Coburg Hills site provide suitable breeding habitat for mosquitoes.

There are problems with mosquito populations along the I-5 freeway west of the Coburg Hills site. Due to the flood irrigation system used by local farmers, there are large areas of standing water which provide ideal habitat for mosquito reproduction. The Lane County Public Health Department uses mosquito oils as a control method; no spraying is done in this area.

EUGENE WASTEWATER TREATMENT PLANT. According to the Lane County Public Health Department, the Eugene WTP has never caused a vector-related health problem. In the past, when evidence of rats or other rodents has been discovered, city staff has instigated control measures on its own or has hired a local private contractor to deal with the problem. Rats have posed a minor problem at times. They usually burrow under buildings or lumber piles. Traps or poisons have been used as control methods and have proven effective.

Mosquitoes have not created health problems or nuisance conditions on or around the treatment plant; there is little suitable breeding habitat on the site. Several years ago, shallow sludge drying beds were used as part of Eugene's treatment process. In the spring, when there was rainwater in the beds and temperatures were beginning to increase, black gnats hatched in these beds. The gnats, which are a nonbiting insect, remained close to the surface of the drying beds and concentrated in damp grass, mud, and other moist areas. The gnats were not considered a public health concern (Callicrate pers. comm.), but at times may have been a nuisance.

SHORT MOUNTAIN LANDFILL. Two vector organisms, mosquitoes and rats, have posed minor problems at the Short Mountain Landfill in the past but both are controllable. Mosquitoes are the main problem due to standing water which provides ideal breeding habitat. Sources of standing water include the lagoon, road edges, and a depression between the lagoon and the landfill. Water leaks through the dikes and causes ponding in the latter case. Control of the local mosquito population is accomplished by the planting of mosquito fish (*Gambusia* sp.) by the Lane County Public Health Department.

Rats are a periodic problem at the landfill but the problem is usually of short duration. When excessive numbers are discovered, control methods are implemented. Rats have not posed a problem during the last two years and are not considered a public health threat (Callicrate pers. comm.). When rats are discovered at the landfill, they are controlled by mechanical methods such as earth-moving or grading; no rodenticides are used. Because the landfill is active, solid waste material is continually being brought in, compacted, ground, and covered. The active nature of the landfill aids in the control of undesirable inhabitants such as rats.

Flies have never been a problem at the Short Mountain Landfill. Before material is brought to the landfill, it has been compacted and its moisture content reduced. Covering is also a factor in the absence of a fly problem since organic material is concealed each day.

Even though the landfill has had problems with rats and mosquitoes in the past, its remote location (away from residential areas) and current operating procedures have resulted in a lack of public health concerns. There are currently no problems with vectors at the landfill due to sludge application. During the first year of the program there was some ponding of the liquid sludge due to the application method, but a new method has been in effect for the last 2 years which has solved the problem. Ponding of liquid sludge results in standing water which may become suitable habitat for mosquitoes.

Implications of No Project (Alternative 4)

Alternative 4 would probably not alter current vector populations. No FSLs or air drying beds would be constructed. The method of sludge reuse or disposal beyond Phase I has not been identified, but it is unlikely to result in increases in vector populations.

Impacts of Alternatives 1 and 2

The FSLs required for Alternatives 1 and 2 are not expected to cause an increase in local mosquito populations, but the air drying beds could become a mosquito breeding area if standing water is held for more than a few days. The drying beds would be operational for about 5 months a year (approximately May-September), which coincides with the mosquito breeding cycle. In Lane County, the period of major mosquito activity occurs from April-October (Callicrate pers. comm.). Since the mosquito hatching cycle can be completed in as few as 5 days (under optimal conditions), standing water in the beds for any length of time will be conducive to mosquito breeding.

The size, design, and contents of the FSLs are not expected to cause increases in the local mosquito population. The upper layer (approximately 3 feet) of water in the lagoons would be aerated, thus eliminating the possibility of stable surface water conditions. Two aerators of about 3 horsepower each would be operated on each FSL (Brown and Caldwell 1980). Due to the 15-foot depth, steeply sloped sides and the impervious lining, aquatic vegetation which might serve as an egg-laying substrate should not occur.

Other insects, including flies, should not be attracted to the proposed facilities if the digestion and storage facilities function properly. Before sludge is pumped into the FSLs, it has been treated and digested, which decomposes most of the organic material. The FSLs function essentially as secondary digesters. No raw sewage (which would be high in organics) would be pumped into the lagoons.

There is already a resident population of domestic rats on and around the three potential sites for Alternatives 1 and 2 facilities, but their numbers are not extraordinary. If rats are attracted to the proposed sludge storage and drying facilities, they can be controlled with existing manpower and methodology. There is no reason, however, that rats should increase beyond existing levels at any of the off-site locations as a result of the project. The facilities will not provide improved cover or an additional food source for rats.

Although nutria are not vectors, they are discussed here due to the concerns of local residents. Nutria may be attracted to the FSLs because of the aquatic habitat. The concern over this attraction is that nutria might burrow into FSL levees and cause seepage of sludge leachate into underlying groundwater. Since this is a remote possibility, it is not considered a significant concern. The FSLs will not present a new food source to the nutria and there will be no cover vegetation on FSL perimeters. The Eugene WTP has not attracted nutria to its on-site sludge lagoons, which contain digested sludge similar to that which would be pumped into the FSLs.

Sludge from the Eugene WTP is currently applied in a liquid form to agricultural fields in the Eugene area. Alternatives 1 and 2 propose similar disposal of dried sludge during the summer months. Experience at the presently-used sites indicates that no vector-related problems are generated by this reuse method. The continuation of agricultural reuse is not expected to generate new vector problems.

Impacts of Alternative 3

Alternative 3 should not result in increases in local vector populations for two reasons: 1) mechanical dewatering techniques such as centrifuges would not be an attractant to vectors; and 2) landfill disposal of sludge and sludge reuse on agricultural land are already being used in the Eugene area with no apparent increase in vector populations.

Mitigation Measures

In order to minimize the chances of encouraging vector populations at the proposed sludge facilities sites, the following mitigation measures are suggested:

- The FSLs should be lined with a sufficient thickness of clay or vinyl to discourage animals from burrowing into the sides.
- Some type of ground cover, such as grass, should be planted on the tops of FSL dikes to prevent soil erosion and the deposition of organic material in the lagoons.
- Vegetation on the top and sides of the FSL dikes should be mowed on a regular basis to limit food or cover sources for wildlife.
- Regular checks of the FSLs should be conducted to determine whether rodents have been burrowing in or around the facilities. If any sign of activity is discovered, appropriate control methods should be implemented.
- No aquatic vegetation should be permitted to grow in the FSLs, as it could act as a substrate for egg-laying insects.
- The amount of standing water present on the air-drying beds should be minimized by whatever means available to reduce mosquito breeding habitat (draining-off of excess water is planned as part of the project); standing water should be treated with mosquito oil as often as necessary to control mosquito hatching.

Influence on Local Biological Resources

This section of the report describes the possible impacts that project construction and operation could have on vegetation and wildlife resources in the Eugene/Springfield area. The focus of the analysis is the bird strike hazard and threatened or endangered species.

DESCRIPTION OF EXISTING CONDITIONS

Site C

VEGETATION. Site C currently supports annual and perennial grass seed crops (rye-grass). Annual grass seed production also adjoins the site to the west and south with pastureland to the north. A variety of weeds and grasses underlie the fences surrounding the property.

According to the U. S. Fish and Wildlife Service (Bottorff pers. comm.), there are no listed or proposed threatened or endangered plant species occurring within the area of the proposed project. Two candidate species, Nelson's checker-mallow (*Sidalcea nelsoniana*) and Cusick's checker-mallow (*S. cusickii*), occurred historically along the Oregon Electric Railroad, west of Site C. Due to habitat conversions to agriculture and grazing, however, they are no longer found there (Soper pers. comm.).

WILDLIFE. The grassland vegetation of Site C supports a limited variety of animal life. Wildlife likely to be found on the site includes mammals such as the California ground squirrel (*Spermophilus beecheyi*), deer mouse (*Peromyscus maniculatus*), opossum (*Didelphis marsupialis*), striped skunk (*Mephitis mephitis*), as well as pocket gophers (*Thomomys* spp.), voles (*Microtus* spp.) and feral cats. Occasionally, black-tailed deer (*Odocoileus hemionus*), coyote (*Canis latrans*), and red or gray foxes (*Vulpes fulva*, *Urocyon cinereoargenteus*) may be observed on-site.

Birds utilizing Site C, primarily for foraging, include northern harriers (*Circus cyaneus*), red-tailed hawks (*Buteo jamaicensis*), American kestrels (*Falco sparverius*), ring-necked pheasants (*Phasianus colchicus*), California quail (*Callipepla californica*), killdeer (*Charadrius vociferus*), European starlings (*Sturnus vulgaris*), and scrub jays (*Aphelocoma coerulescens*). Several species of gulls may use the site during the winter months when the ground is wet. Great blue herons (*Ardea herodias*), great egrets (*Casmerodius albus*), and snowy egrets (*Egretta thula*) can be observed foraging along the drainage ditches and in areas where water has ponded.

Reptiles and amphibians which may be found on-site include the northwestern fence lizard (*Sceloporus occidentalis occidentalis*), Pacific gopher snake (*Pituophis melanoleucus catenifer*), western toad (*Bufo boreas*), and Pacific treefrog (*Hyla regilla*).

No federally listed or proposed threatened or endangered animal species are known to use this site. Bald eagles (Haliaeetus leucocephalus), which are considered by the U. S. Fish and Wildlife Service to be threatened in Oregon may occasionally be observed flying over or perched near Site C. One immature bald eagle was observed perched in a tree on the north side of Meadowview Road during a February 7, 1983 site visit. There are several bald eagle nest sites at higher elevations in the Coburg Hills area (Ferry pers. comm.).

The site topography varies from flat to gradually sloping to the northwest. Water can be found on the surface of Site C during the winter months due to high groundwater and ponding. Runoff leaves the site principally by a drainage ditch running diagonally across the site toward the northwest. This ditch, improved by farmers, is the remnant of an old intermittent stream channel. The ditch continues in a northwesterly direction after leaving the site, collects runoff from a large agricultural area, discharges to Flat Creek, and finally enters the Willamette River north of Harrisburg. There is no anadromous fishery in Flat Creek.

Prairie Road site

The vegetation and wildlife found on the Prairie Road site are similar to that of Site C. Blackberry bushes line the eastern boundary of the site (along Prairie Road), and part of the site currently is being grazed by cattle. Drainage of the southern half of the site is by the drainage ditch at the southwestern corner, which continues northwest through Site C and into Flat Creek. The northern portion of the Prairie Road site drains into the ditch along the east side of Prairie Road.

Coburg Hills site

The Coburg Hills site consists mainly of grassland which is grazed by sheep and cattle. There are a few trees on-site, mainly ash and oak. According to the U. S. Fish and Wildlife Service (Bottorff pers. comm.), there are no listed, proposed, or candidate threatened or endangered plant species occurring within the area of the proposed project.

Wildlife likely to be found on-site is similar to that of Site C and Prairie Road. On a February 6, 1983 site visit, a large flock of European starlings mixed with killdeer was observed on the ground. Great blue herons were observed along the drainage ditches. Scrub jays, dark-eyed juncos (Junco hyemalis), house finches (Carpodacus mexicanus), red-winged blackbirds (Agelaius phoeniceus), and western meadowlarks (Sturnella neglecta) were seen in the trees both on-site and along the gravel road bordering the site. Bald eagles are observed occasionally in the vicinity since there are several nest sites in the foothills east of the Coburg Hills site (Ferry pers. comm.).

Drainage ditches traverse the site and eventually carry water into Muddy Creek northwest of the site. There is no anadromous fishery in Muddy Creek.

Surrounding Area

Bird use of the area around Site C and the Prairie Road site is discussed in the following section. Bird distribution during the winter months is strongly influenced by the habitat requirements of the individual species. Bird populations, as well as weather conditions and food supplies, vary from year-to-year and even within a given season, causing continual changes in the winter bird distribution of an area. Information presented in this document is of a general nature, based on Christmas bird counts, discussions with Oregon Department of Fish and Wildlife staff, local Audubon Society members, and other knowledgeable persons.

The surrounding area, for purposes of this discussion, is bounded by Fern Ridge Reservoir on the west, Highway 126 on the south, the Willamette River on the east, and Junction City on the north. Included in this region are several small ponds, Amazon Creek, several intermittent streams, and Mahlon Sweet Field.

FERN RIDGE RESERVOIR. Fern Ridge Reservoir, completed in 1941, attracts thousands of birds, primarily waterfowl, each winter. Although there are other reservoirs in the Willamette Valley, Fern Ridge is actively managed for waterfowl by the Oregon Department of Fish and Wildlife. There is a waterfowl management area adjacent to the reservoir where such food crops as corn, sudan grass, millet, and buckwheat are planted. In the winter of 1980, a peak of approximately 19,000 birds wintered on the reservoir; approximately 15,000 birds were tallied during the winter of 1983 (Ferry pers. comm.). The reservoir covers approximately 9,000 surface acres when full; during the winter, when it is drawn down, it covers only a few hundred acres (Cleary pers. comm.).

The most common waterfowl species wintering on Fern Ridge Reservoir and in the Eugene area are mallards (*Anas platyrhynchos*), green-winged teal (*A. crecca*), northern pintail (*A. acuta*), northern shovelers (*A. clypeata*), and American wigeon (*A. americana*) (Gordon pers. comm.; Eugene Audubon Society 1981, 1982, and 1983). Other species that use the area, but in few numbers, include the ring-necked duck (*Aythya collaris*), canvasback (*A. valisineria*), American coot (*Fulica americana*), Tundra swan (*Olor columbianus*), and Canada goose (*Branta canadensis*). Some waterfowl, including geese, swans, and the American wigeon, spend the night on the reservoir but leave in the morning to feed in the management area or in agricultural fields north and northeast of Fern Ridge Reservoir (Gordon pers. comm.).

Waterfowl are most abundant in the Eugene area during the winter months, although some species such as the wood duck (*Aix sponsa*), pied-billed grebe (*Podilymbus podiceps*), common merganser (*Mergus merganser*), and mallard are year-round residents. Other avian species such as the European starling, Brewer's blackbird (*Euphagus cyanocephalus*), and red-winged blackbird (*Agelaius phoeniceus*) flock together in the winter months often concentrating in agricultural fields in groups of more than 1,000 individuals. During the summer months, these species disperse; blackbirds are found predominantly along the Willamette River and at Fern Ridge Reservoir.

PONDS. There are several small ponds in the vicinity of Site C, the Prairie Road site, and Mahlon Sweet Field that provide additional habitat for waterfowl and other water-associated species. There are two medium-sized ponds immediately north and south of the airport as well as four sewage disposal ponds just inside the clear zone of the secondary runway. Clear Lake, a long, narrow lake which lies immediately west of Merryman Road and the airport, is bordered by dense riparian vegetation (Oregon white ash, cottonwood, scrub oak, alder). It is dammed at the north end. Locations of other ponds in the area include the Oregon Electric Railroad south of Meadow View Road, Airport Road east of Green Hill Road, Meadow View Road west of Purkerson Road, and several small farm ponds scattered throughout the area.

Most of the small ponds receive some waterfowl use during the winter months, but more than about a dozen birds at any one time on any one pond would be unusual. A few resident waterfowl may nest at the more secluded and heavier vegetated ponds, such as at the two-pond complex on airport property. Species observed utilizing ponds in the study area on a February 5-7, 1983 site visit included mallards, ring-necked ducks, wood ducks, American coots, northern shovelers, and green-winged teal.

Amazon Creek, the Amazon Creek Diversion Channel, and intermittent streams in the project area may receive occasional use by waterfowl during the winter months when water levels are high. Herons and egrets use these areas for foraging with heaviest use occurring during the winter months.

MAHLON SWEET FIELD. Many species of birds use airport environments for feeding, resting and occasionally nesting. Raptors (birds of prey), gulls, blackbirds, starlings, and other ground-feeding birds are seen frequently at airports. In general, a few individual birds feeding on the grass at an airport does not pose a hazard to aircraft, but a large concentration of birds can pose a serious strike threat. Bird use of Mahlon Sweet Field is discussed in this section with an emphasis on the potential strike threat of each species.

Raptors such as northern harriers and American kestrels often can be seen foraging over the wide expanse of grassy fields separating the runways. If there is an abundant rodent population raptors might be numerous, but at most airports rodents are strictly controlled, minimizing the number of birds of prey in the airport vicinity. There is no problem with raptors at Mahlon Sweet Field; they usually occur as single individuals and do not interfere with airport operations.

Other birds, such as gulls, use the airport for resting and occasional feeding. Factors attracting gulls to airports include earthworms, which after a rain frequently attract large flocks of ring-billed (Larus delawarensis) or California (L. californicus) gulls, and the runways themselves, which may be utilized by several gull species for resting during daylight hours (Bystrak 1974). The warmth of the pavement also may be a factor in the attraction of the runways.

Large numbers of gulls often concentrate at airports, and can pose hazards to incoming and outgoing aircraft. When there are a large number of gulls on the runways at Mahlon Sweet Field, and they pose a potential strike hazard to aircraft, firecracker shells are used to disperse them. According to the airport manager at Mahlon Sweet, gulls do not represent a severe problem at Mahlon Sweet Airport and can be easily dispersed to ensure safety of aircraft upon takeoff and landing (Shelby pers. comm.).

Several years ago (1975-1976), when the Belt Line Landfill was in operation on Belt Line Road between the Southern Pacific Railroad tracks and West 11th Avenue, there was a gull problem at Mahlon Sweet Field. Large concentrations of gulls were attracted to the airport and more intense dispersal methods were used, including a propane cannon (Shelby pers. comm.). Since the closure of the Belt Line Landfill and the opening of the Short Mountain Landfill, however, the gull problem at Mahlon Sweet has subsided.

Blackbirds and starlings have been a problem at Mahlon Sweet in the past. They can pose a potential strike hazard during the winter months when they gather in large flocks. Although the largest flocks usually remain in the vicinity of the Willamette River, they occasionally congregate on airport fields. During the last 2 years, however, blackbirds and starlings have not been a major problem at the airport (Shelby pers. comm.).

Although swans do not use the airport property itself, they are mentioned here because of their importance to bird strike hazards. Because of their large size and tendency to travel in flocks, swan migration flights and daily flights to feeding areas pose a danger to aircraft. A flock of between 300 and 600 swans regularly winters in the Eugene area (Gordon pers. comm.). These birds spend the night at Fern Ridge Reservoir but leave in the early morning to feed in agricultural fields north and northeast of Junction City and Harrisburg. If a group of swans passes over Mahlon Sweet Field, all aircraft are held until they pass (Shelby pers. comm.).

IMPLICATIONS OF NO PROJECT

If the No Project alternative (Alternative 4) is chosen, existing vegetation and wildlife use at Site C, Prairie Road, and Coburg Hills would not be disturbed. The continued use of centrifuges at the RWTP site would have a minimal effect on natural resources since the site is already in a "disturbed" condition. The disposal of dried sludge at Short Mountain Landfill during the winter and the reuse of sludge on agricultural lands during the summer are already being done in Eugene with no adverse impact on the local biological resources. The reuse of sludge on agricultural land may even improve the habitat for ground-feeding birds. Sludge conditions the soil and helps to aerate it; this improves the habitat for earthworms and other invertebrates which, in turn, serve as a food source for many species of birds.

After 1989 under this option (Phase II), liquid sludge may have to be disposed of year-round by landfilling, reuse, or dedicated land disposal. The exact method to be used is unknown. If liquid sludge disposal continued through the winter months, the potential for sludge reaching surface waters and thereby adversely affecting aquatic habitats would greatly increase.

No endangered, threatened, or candidate species would likely be affected by the No Project alternative. In addition, no bird attraction problem would be created near Mahlon Sweet Field.

IMPACTS OF ALTERNATIVES

Alternative 1

This alternative includes the construction of approximately 25 acres of FSLs and 50 acres of air drying beds at one of three off-site locations - Site C, the Prairie Road site, or the Coburg Hills site. In addition to the impacts on vegetation and resident wildlife, there is the concern that the bird strike hazard at Mahlon Sweet Field might increase if the FSLs serve to attract waterfowl, and if Site C or the Prairie Road site were selected. The following impact discussion is divided into four parts; the first part discusses the effects of the project on the existing vegetation and wildlife, the second part is a discussion of the change in bird use patterns of the area due to construction of the facilities, the third part discusses the guidelines set forth by the Federal Aviation Administration (FAA) and EPA regarding the siting of solid waste disposal facilities, and the fourth part includes a discussion of the bird attraction impact as it relates to potential hazards to aircraft.

VEGETATION AND WILDLIFE. The construction of the FSLs and air drying beds as well as accompanying support facilities would result in the loss of about 170 ± acres of grassland habitat (annual and perennial grass seed crops at Site C and Prairie Road; grazing land at Coburg Hills). These areas currently are used by several wildlife species, both area residents and nonresidents. Construction activities including earth-moving, grading, increased human activity, and noise would disturb resident wildlife causing them to vacate the construction area at least temporarily. Animals that utilize the sites for foraging activities, such as northern harriers, American kestrels, and blackbirds, would have to move to other similar habitat. Some species may be able to utilize portions of the site (e.g., buffer zones) once construction is completed, depending on the amount of vegetation remaining or planted. The impacts of the project on local vegetation and wildlife would be similar for all three sites; therefore, a separate discussion is not included for each site.

No endangered, threatened, or candidate plants or wildlife would be affected by Alternative 1 (see letter from U. S. Fish and Wildlife Service in Appendix D).

CHANGE IN BIRD USE PATTERNS. The construction of the FSLs and air drying beds would alter the current bird use patterns on any of the three sites in question. Species that are attracted to the sites because of the rye-grass or grazing use may no longer use the site once the FSLs and air drying beds are installed. Other species, however, which currently do not use the sites may be attracted to the facilities (e.g., waterfowl).

The construction of four FSLs, each covering approximately 6.25 acres, may attract waterfowl, especially ducks, and other bird species such as killdeer (Charadrius vociferus) and blackbirds around the edges. The FSLs could serve three functions: 1) as a resting or loafing area for waterfowl, 2) as a source of drinking water, and 3) as a sanctuary from wind and human disturbances. There should not be a food source in the lagoons because of their impervious lining and depth (15 feet), and because the sludge would have been digested at the RWTP, decomposing most of the organic material. There would be algae in the surface layers that would utilize many of the liquid and gaseous anaerobic decomposition products, but they would not provide a significant food source. If more complex vegetation were permitted to grow in or around the FSLs, it would likely serve as an attractant to many birds, for both food and cover.

Several other wastewater treatment facilities including Sacramento, California, and Corvallis and Salem, Oregon, have sludge storage lagoons similar to those being proposed at Eugene. None of these facilities has attracted large concentrations of waterfowl (Rose, Clark, Druery pers. comm.). Ducks often use the lagoons but only a small number of individuals is present at any one time. Both Sacramento and Corvallis treatment plants are adjacent to major rivers which receive significant waterfowl use. This may contribute to the low use of the ponds by comparison.

Even though the proposed FSLs may not attract large numbers of birds, more species of birds are likely to be attracted to the FSLs than currently use the rye-grass fields on Site C and Prairie Road or the grassland at the Coburg Hills site. During a one-week study of comparative bird use between the Corvallis sludge lagoons (which are identical in design to those proposed for Eugene) and two rye-grass fields in the vicinity of Prairie Road and Beacon Drive, Talent and Jarvis (1979) found considerable differences between the number and species of birds utilizing the rye-grass fields compared to the sludge lagoons.

Species observed regularly at the Corvallis sludge lagoons during the 10 observation periods included Brewer's and red-winged blackbirds, killdeer, starlings, and sandpipers. Large flocks of Brewer's and red-winged blackbirds usually were perched on the banks of the sludge lagoons or actively feeding or drinking among the rocks near the water's edge. Shorebirds also fed at the water's edge. Other species observed infrequently and in small numbers included barn swallows, brown-headed cowbirds, cinnamon and green-winged teal, common crows, rock doves, and common snipe. Teal were observed in the lagoons while all other species utilized the edge habitat.

Species observed in or over the rye-grass fields included sparrows, starlings, barn swallows, northern harriers, blackbirds, killdeer, and ring-necked pheasants. Most birds observed in the fields were single individuals using the borders of the fields near shrubs.

Two conclusions were reached from the study by Talent and Jarvis (1979): 1) Significantly more birds use sludge lagoons than rye-grass fields, and 2) significantly more species of birds use sludge lagoons than rye-grass fields. However, these conclusions are based on data collected during a one-week period (September 24-October 1, 1979) and may not accurately reflect the year-round use of either habitat.

It is likely that the FSLs would attract a greater diversity of species, especially during the winter months, but if only a few individuals of several species used the FSLs, the total number of birds would be less than that in the grass fields at certain times of the year. For example, large flocks of gulls, starlings, blackbirds, and occasionally geese, use the fields during the winter months. Based on the use of other lagoons and small ponds in the area, it is unlikely that the FSLs would support similar numbers of birds. In addition, the sides of the

FSLs would be steeply sloped so there should not be a usable edge for feeding.

Grass fields are attractive to birds at other times of the year too. Large numbers of birds can be observed in the fields during and after harvest since many seeds are lost and fall to the ground, providing a food source. Freshly plowed fields also are attractive to birds since many invertebrates are exposed, providing a temporary food source.

Although sludge lagoons may be used by certain species of birds (i.e., ducks, killdeer), the proposed facilities are not likely to cause a major change in bird use of the local area. Waterfowl are most abundant in the Eugene area during the winter months, which coincides with the greatest amount of habitat available in the area. Aside from Fern Ridge Reservoir, which is the major attractor of waterfowl, there are many small ponds and flooded fields throughout the valley as well as the Willamette River. All provide resting and loafing habitat for waterfowl, which is predominantly what would be provided by the FSLs.

There is scattered use of other ponds in the Eugene area by waterfowl and other birds associated to some extent with water. It is likely that the FSLs would receive similar usage. Once every few years there is an extremely cold winter in the Willamette Valley which causes many of the smaller bodies of water to freeze, thereby reducing the habitat available for waterfowl. Because the FSLs would never freeze, waterfowl use during these periods probably would be higher than in nonfreezing years.

Each of the four or five FSL cells would have two brush aerators to agitate and maintain aerobic conditions on the surface of the lagoons (Brown and Caldwell 1980). Although studies have not been conducted on the effectiveness of these aerators for scaring off waterfowl, they may help to diminish the attractiveness of the lagoons to birds. Sacramento currently operates aerators in its lagoons but Corvallis no longer uses them (D. Clark pers. comm.). Neither city has had problems with large influxes of waterfowl or other birds.

Gulls should not be attracted to the FSLs since there would be no organic food source. Gulls currently are attracted to the primary clarifier at the wastewater treatment plant where there is scum and incoming raw sewage. They do not use the lagoons at the airport or the treatment plant. In a 6-month study at the Sacramento Wastewater Treatment Plant (Ermel 1979), gulls often were observed flying over the study area but only rarely were they sighted on the ground near the sludge lagoons.

The air-drying beds may be used by ducks at certain times of the year depending upon their design and drainage pattern. The drying beds would not be used during the winter; if they were allowed to collect water from winter rains, ducks and other birds might be attracted to them. Several years ago, when the City of Eugene had shallow drying beds, ducks would attempt to nest there in the spring. Water collected in the beds during the winter months and would be from 6-18 inches deep by spring. Birds also were attracted to the vegetation which grew along the sides and on top of the banks.

Some ground feeding species such as killdeer, sparrows, and blackbirds may be attracted to drying beds filled with sludge that is firm enough for birds to alight. If there are insects or other food organisms in the drying beds, some foraging activity could take place. Freshly filled beds and fairly dry beds probably would attract fewer birds since food organisms may be limited (Talent and Jarvis 1979).

Due to the lack of suitable habitat, shorebirds are uncommon in the Eugene area. Most observations are of migrating birds or casual winter visitors. The air drying beds may provide suitable habitat for small concentrations of shorebirds during migration. The majority of shorebirds, however, follow the coast during migration; fewer numbers migrate through eastern Oregon following the shallow playa lakes (Jarvis pers. comm.).

The preceding discussion on the change in bird use patterns and the attraction of waterfowl to the FSLs is applicable to the three potential off-site facilities locations. Since they are located in the same general area of the Willamette Valley and are composed of similar habitat, the proposed facilities would have similar impacts on bird use patterns at each of the three sites.

FAA AND EPA REGULATIONS. Two federal agencies, the FAA and EPA, are concerned with the siting of facilities which may pose potential bird strike hazards to aircraft. Concern has been expressed regarding the location of the FSLs and air drying beds at Site C or the Prairie Road site due to their proximity to Mahlon Sweet Field.

The FAA issued Order No. 5200.5, FAA Guidance Concerning Sanitary Landfills on or Near Airports (October 16, 1974) which states that solid waste disposal facilities have been found by study and observation to be artificial attractants of birds and, therefore, "may be incompatible with safe flight operations" when located in the vicinity of an airport. This order is included in Appendix D. Order No. 5200.5 classifies sanitary landfills as incompatible with airport operations if: 1) landfills are located within 10,000 feet of any runway used or planned to be used by turbojet aircraft; 2) landfills are located within 5,000 feet of any runway used only by piston-type aircraft; or 3) a landfill is located such that it places the runways and/or approach and departure patterns of an airport between bird feeding, water, or roosting areas. Although the proposed FSLs and air drying beds do not constitute a sanitary landfill, the FAA and EPA include sludge as a solid waste.

Although the FAA is authorized to control airport operations to reduce bird hazards to aircraft, its authority does not extend to disposal facilities outside airport boundaries which may pose such hazards. The selection of the distances specified in Order No. 5200.5 do, however, represents a reasonable determination of the danger zone around an airport. Although the disposal of solid waste within the specified distance is not prohibited, particular care must be taken to assure that no bird hazard arises.

EPA's policy on solid waste disposal facilities is stated in the Criteria for Classification of Solid Waste Disposal Facilities and Practices, published in Volume 44, No. 179 of the Federal Register dated September 13, 1979. These regulations are included in Appendix D. Paragraph 257.3-8(c), entitled Bird Hazards to Aircraft, states: "A facility or practice disposing of putrescible wastes that may attract birds and which occurs within 10,000 feet (3,048 m) of any airport runway used by turbojet aircraft or within 5,000 feet (1,524 m) of any aircraft runway used by only piston-type aircraft shall not pose a bird hazard to aircraft." These criteria are based directly on FAA Order 5200.5, which addresses that agency's policy toward sanitary landfills located near airports.

EPA defines putrescible wastes as "solid waste which contains organic matter capable of being decomposed by microorganisms and of such a character and proportion as to be capable of attracting or providing food for birds." Raw municipal sludge is considered putrescible under this definition. Sludge transported to Site C or the Prairie Road site would be anaerobically digested at the RWTP; on the site it would be stored in FSLs under clear water. Approximately 60-80 percent of the volatile solids in raw sludge are readily biodegradable. In anaerobic digestion, 60-65 percent of these putrescible solids are destroyed. Long-term storage in FSLs will stabilize about 40-50 percent of volatile solids remaining after digestion. According to Brown and Caldwell (1980), the resultant sludge will be well stabilized and composed primarily of fixed inorganic solids which are not degradable by microorganisms. EPA concurs with this contention; therefore, sludge spread on the drying beds should not be considered putrescible as defined for purposes of assessing bird attraction under 40 CFR Part 257 (Criteria for Classification of Solid Waste Disposal Facilities and Practices).

POTENTIAL HAZARDS TO AIRCRAFT DUE TO BIRD ATTRACTION. Collisions between birds and aircraft, known as bird strikes, have occurred since the earliest days of aviation. The first recorded fatality due to a bird strike occurred in 1912, when a gull became entangled in the exposed control cables of an aircraft. During the first few decades of aviation, however, bird strikes happened infrequently, did relatively little damage, were rarely reported, and were not considered serious.

In more recent times, with the introduction of new high speed aircraft powered by vulnerable turbine engines, and with the phenomenal increase in air traffic, bird strikes have evolved from a minor nuisance into a serious and costly problem (Blokpoel 1976).

Concern has been expressed by the FAA and local citizens of the Eugene area that the siting of FSLs at Site C or the Prairie Road site may pose a hazard to aircraft flying into and out of Mahlon Sweet Field. This concern is examined in the following discussion which describes, 1) the existing layout and flight patterns at Mahlon Sweet Field, 2) its bird strike history, 3) other airports in the area, 4) flight patterns of birds at similar facilities near airports, and 5) the likelihood of the proposed FSLs creating a bird hazard to aircraft.

There are two runways at Mahlon Sweet Field. Runway 16-34 is the main runway and is approximately 6,200 feet in length (Shelby pers. comm.). It is lighted with high-intensity runway lighting and has instrument runway markings. This runway handles nearly all of the turbojet aircraft for the metropolitan area.

Runway 3-21, the crosswind runway, is approximately 5,200 feet long (Shelby pers. comm.). It is lighted with medium-intensity runway lighting; it has no approach lights and no instrument landing system; therefore, its use is governed by visual flight rules. The visual approach slope indicator (VASI) lights for the crosswind runway are set at 2.5 to 3.5 degrees, which aids the pilot in determining the proper glide slope before landing. Approaching aircraft over Site C would be at an altitude of approximately 600-700 feet above Site C (Jost pers. comm.); this altitude would decrease the closer the aircraft came to the runway. Runway 3-21 is primarily used by small aircraft; it handles less than one percent of the turbojet air traffic annually and only when the major runway requires repair or when there is a strong crosswind.

If Site C were chosen, the FSLs would be located between 9,000 and 10,000 feet from the crosswind runway (3-21). The lagoons would not lie within 10,000 feet of the main runway (16-34) at Mahlon Sweet Field.

Bird strike data for Mahlon Sweet Field were acquired from the FAA office in Washington D. C. (Table 3-13).

Table 3-13. History of Bird Strikes at Mahlon Sweet Field.

9/10/78	A B-737 struck a gull on takeoff, the bird striking the aircraft nose; no damage resulted.
1/18/80	A B-737 hit a flock of gulls on takeoff; no damage.
5/15/80	A Piper Navajo encountered a flock of waterfowl at 2,500 feet at night on approach to Runway 16; minor dents to airframe.
8/17/80	A DC-9 hit a flock of starlings on landing roll; no damage.
8/21/80	A DC-9 sustained a windshield strike on takeoff; aircraft continued to LAX (Los Angeles) where windshield was changed due to stress cracking near windshield frame.
1/26/82	A B-737 hit a flock of gulls on takeoff; flight continued to PDX (Portland) where flap damage was discovered.

SOURCE: Harrison pers. comm.

These data may be incomplete because information was reconstructed from control tower reports through the FAA regional office, instead of directly from the pilots (Harrison pers. comm.). There were 6 strikes reported from 1978 through 1982; no strikes occurred in 1979 and 1981. According to the FAA (Harrison pers. comm.), however, many bird strikes are not reported, although major airlines and military pilots have mandatory reporting requirements.

There are no other airports in the vicinity of Site C or the Prairie Road site but there is a heliport (Henderson Aviation Company) located on the south side of Meadow View Road, northwest of Site C. This facility is FAA-approved and occupies approximately 3 acres. It has been in operation at that location for more than 3 years and has never had problems with birds posing a threat to its operation, although there are many small ponds in the area and, on occasion, large numbers of gulls or blackbirds in the surrounding agricultural fields.

Helicopters seldom fly at altitudes over 500 feet and usually fly much lower (about 200 feet), depending on their load (Henderson pers. comm.). When a helicopter flies south out of the heliport, its typical path is to fly east and then follow the Southern Pacific Railroad tracks south to avoid flying directly over existing housing. This railroad line separates Site C from the Prairie Road site. A helicopter would be at a minimum altitude of approximately 200 feet as it passed over either site. Facilities (FSLs and air-drying beds) at either site should not interfere with helicopter flights. Most birds that would be attracted to the FSLs are low flying species, and incoming and outgoing waterfowl are expected to avoid confrontation with helicopters.

The Coburg Hills site is not within a critical distance of any airport or heliport. Daniel's Field, owned by Western Aerial Contractors, is a small airport located approximately 9 miles north of Coburg. The Valley Flying Club operates out of Daniel's Field. Briggs Landing strip is approximately 12 miles north of Coburg and is for private use only. Neither airport is within the 5,000-foot zone specified by the FAA. There are also several small privately-owned air strips approximately 3,500-7,000 feet from the Coburg site, but these are used infrequently and only by light propeller-driven planes. Therefore, birds attracted to the FSLs or drying beds at the Coburg Hills site should not significantly interfere with local air traffic.

There have been relatively few studies to determine the flight patterns of birds around wastewater treatment facilities located near airports. A study is going to be undertaken at the Grand Forks WTP in North Dakota to monitor bird use of the lagoons, which are within 10,000 feet of a main runway and a proposed parallel utility runway at the Grand Forks International Airport (Kruger, Hormberg pers. comm.). A similar study (Ermel 1979) was conducted in Sacramento, California at the Sacramento RWTP. In this study, which lasted from July through September, bird activity was observed at 40 acres of solid storage basins (SSBs), which are similar to FSLs, and at a 30-acre water-filled borrow pit located about 2,000 feet from the SSBs. Many of the birds most frequently associated with the Sacramento SSBs were the species observed at Corvallis by Talent and Jarvis (1979). In addition to determining bird use of the area, observations were made to determine whether the bird species presented potential hazards to local aircraft.

Several observations and conclusions drawn from the Sacramento study can be used to assess the Eugene situation, since many of the bird species are identical. Most of the birds observed in the Sacramento study flew at low altitudes, rarely ascending any higher than the level of the treetops. Killdeer, sparrows, blackbirds, mourning doves, and cowbirds were always observed flying below 200 feet, often remaining close to the ground or water surface. Groups of swallows occasionally were observed at altitudes of 200 to 400 feet but generally flew low to the ground. Birds of prey (northern harriers, American kestrels, red-tailed hawks) occasionally were observed soaring at altitudes as high as 500 feet but usually flew at about 100 to 250 feet. Shorebirds generally were observed near or in the water and, when flushed, flew at relatively low levels not exceeding 500 feet.

Waterfowl observed during the study generally were on the water surface of the borrow pit. Although nearly 400 individual waterfowl (7 species) were observed at the borrow pit, only one snow goose was observed at the SSBs. When waterfowl were flushed from the water, they remained at low altitudes until they determined a flight direction. Once established, they ascended gradually to a higher altitude (between 500 and 700 feet). Groups of migrating waterfowl occasionally were observed flying over the study area at altitudes of 1,000 feet or higher.

Gulls were observed at the SSBs and borrow pit; however, most were sighted in flight as they passed over the study area. Over the 6-month study, 23 gulls were observed; only occasionally was a gull sighted on the ground near the water's edge.

It was concluded from the Sacramento study that the small birds using the SSBs and borrow pit did not present a hazard to air traffic due mainly to their size and low flight characteristics. The majority of ducks and geese observed during the study were on the water surface or in low flight around the borrow pit. These birds were not considered a hazard to local air traffic, although migrating waterfowl flying at altitudes of 1,000 + feet might present a hazard to low-flying aircraft.

Based on evidence obtained in the Sacramento study and a general knowledge of bird species and habitat in the Eugene area, it appears that the only birds that might pose a potential threat to aircraft in the vicinity of Site C and the Prairie Road site are waterfowl. Observations at other lagoons indicate that waterfowl usually stay on the water surface; however, they must also arrive and depart. It is during this flight phase that birds would be most susceptible to collisions with low-flying aircraft. Small aircraft approaching the crosswind runway at Mahlon Sweet Field would be at an altitude of approximately 600-700 feet above Site C (Jost pers. comm.). If a duck or group of ducks were ascending from the FSLs at the same time and in the same direction as a descending plane, there would be the possibility of a strike. This potential exists now due to the presence of other open water areas surrounding Mahlon Sweet Field. There is some waterfowl use of the sewage lagoons in the clear zone of the crosswind runway and there have been no problems with bird strikes. These small ponds are approximately 1,000 feet from the end of the runway; the proposed FSLs at Site C would be nearly 2 miles from the end of the runway.

In summary, there is no question that the FSLs and air-drying beds will receive some use by several species of birds, including waterfowl. The seasonality of use, bird numbers and bird species on the site will be different than at present. Only the change in waterfowl use, however, appears to be of any significance to the bird strike issue. While the incidence of waterfowl use on Site C or Prairie Road would increase slightly, the regional pattern of waterfowl activity should not be altered, except possibly during rare periods of extreme freezing when the FSLs might be the only open water in the immediate area. Therefore, it is concluded that the proposed sludge facilities at Site C or Prairie Road should not significantly increase the probability of a bird strike occurring in the vicinity of Mahlon Sweet Field, and therefore should not be considered a bird hazard to aircraft.

Alternative 2

The impacts of Alternative 2 on local biological resources would be identical to those of Alternative 1 except that a smaller acreage would be converted from grassland habitat to treatment facilities. Approximately 125 acres (145 acres in the case of the Prairie Road site) would be used and the acreage needed for the air-drying beds would be reduced from about 50 acres to 33 acres at all three sites. Since the FSLs would total 25 acres in both Alternatives 1 and 2, potential attraction of birds to the lagoons would be the same in either case. The reduction in size of the air-drying beds is not expected to have any effect.

Alternative 3

The addition of mechanical dewatering facilities at the RWTP would not have an impact on local biological resources due to the "disturbed" nature of the site. Disposal of sludge during the winter at the Short Mountain Landfill and during the summer on agricultural land is not expected to have an adverse impact.

MITIGATION MEASURES

In order to minimize the attraction of birds to the off-site sludge facilities proposed in Alternatives 1 and 2, the following mitigation measures are suggested:

- Keep weeds and grass mowed on the top and sides of FSLs to minimize their attraction to waterfowl.
- Do not allow aquatic vegetation to grow in FSLs.
- Operate aerators during daylight hours to discourage waterfowl from landing on FSLs.
- If large numbers of birds are attracted to the FSLs after construction, some type of screening, wire grid system, or netting could be installed to discourage bird use of the lagoons. This could, however, be very expensive.
- If FSLs are constructed, bird use patterns should be closely monitored. Other studies have determined that

waterfowl are attracted to wastewater oxidation ponds and stabilization lagoons (Dornbush and Anderson 1964; Willson 1975; Maxson 1978; Jarvis, Gordon, Harrison, Jones, Fountain pers. comm.) where an abundant supply of nutrients are available; few studies have been conducted at sludge lagoons where organic material has been thoroughly digested.

- Air-drying beds should be designed to allow complete draining during periods of nonuse, especially in late winter and spring. This would discourage ducks from nesting in the beds.

Land Use

This section discusses land use impacts of the various sludge management alternatives. A description and history of local land use planning activities and the State of Oregon Revised Statutes 215.203-215.273, which address agricultural land use, can be found in Appendix E. Although the issues related to land use are presented here, no definitive conclusion is made regarding conformance with local and state land use law and policy. This is because the Lane County Comprehensive Plan and Zoning Code are in a state of flux, and there are varying legal interpretations to the compatibility of sludge management facilities in agricultural land use zones.

EXISTING AND PLANNED LAND USES

All three new sites (Site C, Prairie Road and Coburg Hills) under consideration for sludge storage and handling support annual or perennial grass and are surrounded by seed crops or pastureland. Any one of them would need to comply with state planning goals and county zoning designations if selected as the preferred site for handling and processing sludge. Under the Lane County Comprehensive Plan Revision (CPR) process, all are proposed for an "Agricultural" general plan designation and EFU zoning designation (Hudzikiewicz pers. comm.). Another possible zoning designation which may be considered is a Public Facilities (PF) zone designation (Delk pers. comm.). The draft PF zone is defined as "intended to provide land for those public and semipublic functions that provide service and are by nature an intensive or unusual use not normally associated with other zoning districts."

The proposed draft Comprehensive Plan diagrams and draft zoning maps have been in the process of review by the County Planning Commission and the public (Lane County Department of Environmental Management 1982b). These maps, together with the revised plan, are expected to be adopted by the Board of County Commissioners by January of 1984. At that time, the revised plan will be submitted to the Oregon Land Conservation and Development

Commission (LCDC) for request of approval (Hudzikiewicz pers. comm.).

Site C

Site C is located in northern Lane County, north of the City of Eugene. Site C/Alternative 1, which occupies approximately 170± acres, is bounded by the Southern Pacific Railroad line on the east; Meadow View Road is located approximately 2,700 feet to the north; Awbrey Lane is located approximately 2,700 feet to the south; and the Burlington Northern Railroad line is located approximately 2,900 feet to the west. Site C/Alternative 2, which occupies 125 acres, is located just south of Site C/Alternative 1 and extends to Awbrey Lane. Its western boundary is about 1,000 feet east of a dirt road. Site C/Alternative 2 is traversed by an overhead powerline (see Figure 2-4).

Several scattered residences are in the vicinity; one is located 200 feet north of Site C/Alternative 1; several line the dirt road west of Site C/Alternative 2; and a few are located south of Awbrey Lane. Both sites are owned by a consortium of owners and are part of a larger parcel containing 600 contiguous acres (Gould pers. comm.).

According to Lane County's soil map, Site C is classified as prime farmland, intermixed with areas of unique farmland. The following types of soils found on Site C and their associated SCS Land Capability Class (Lane County Department of Environmental Management 1981a) are listed below:

Prime:

o Coburg silty clay loam	Class II
o Malabon silty clay loam	Class I

Unique:

o Awbrig silty clay loam	Class IV

As defined by the SCS Land Capability System, it is likely that much of Site C would be considered prime farmland. Although the SCS has not published a Land County soil map based on the Land Inventorying and Monitoring Memorandum (LIM) criteria, it is likely that much of Site C would be considered prime farmland since land rated as prime under the Land Capability System generally falls within the prime category under the LIM criteria.

Site C is located in an area known as the Industrial Triangle. This 1,800-acre area, which is bounded by the Burlington Railroad line to the west, the Southern Pacific Railroad line to the east, the Junction City urban growth boundary to the north, and Awbrey Lane to the south, is a controversial area with a long history of land use designations. This history is summarized below (Hudzikiewicz pers. comm.):

- o Zoned Heavy Industrial (M-3) and Light Industrial (M-2) in 1966.

- o Designated "Agricultural" in the Eugene/Springfield Area 1990 General Plan (predecessor to the Metro Area General Plan).

- o Area transferred to the Willamette-Long Tom Subarea Plan and designated "Agriculture/Industrial Reserve", defined as "land which is presently farmed but with industrial development potential in the foreseeable future" (Lane County Department of Environmental Management 1976). This designation was intended to indicate the potential for future plan designation as "industrial" (Hudzikiewicz pers. comm.).

- o Rezone recommended by County Planning Commission from M-2 and M-3 to EFU in 1977.

- o Redesignated "Special Industrial" in 1980 by Board of County Commissioners through amendment of Willamette-Long Tom Subarea Plan (Lane County Ordinance No. 763). An exception to LCDC Goal 3 was adopted based on the need for additional large, light industrial parcels in the metropolitan area. Lane County asserted that: "many high technology, light industrial firms have been interested in locating in Lane County and the Eugene/-Springfield metropolitan area, but with the exception of Spectra-Physics, these firms have decided not to locate in this area, primarily because there were no suitable sites available in the metropolitan area" (Oregon Land Conservation and Development Commission 1981b).

- o County plan amendment appealed to Oregon Land Use Board of Appeals (LUBA) by City of Eugene.

- o LCDC decided to postpone review of that portion of the Lane County Comprehensive Plan which dealt with the Industrial Triangle, due to the pending LUBA action and also since the exception to Goal 3, which had been taken for the area, relied primarily on information contained in the Metro Area General Plan, which had not yet been reviewed by LCDC.

- o Rezone to Special Industrial proposed by County; action on proposal postponed pending outcome of appeal to LUBA.

- o LCDC, in taking action on LUBA case (City of Eugene vs. Lane County), determined that the County's plan amendment lacked sufficient justification and remanded it to the Board of County Commissioners in 1981.

- o County appealed to State Court of Appeals.

- o State Court of Appeals ruled in favor of City of Eugene.

- o In acknowledgement of the request on the Metro Area General Plan, LCDC stated that "Lane County must amend Willamette-Long Tom Subarea Plan to designate the area known as the Industrial Triangle "Agricultural", and zone it consistent with Goal 3 and ORS Chapter 215 (Oregon Land Conservation and Development Commission 1981b).

The outcome of these actions is that Site C has an inconsistent General Plan and zoning designation. The Willamette-Long Tom Subarea Plan designates the area as Agricultural/Industrial Reserve, and the County zoning map shows the site to be zoned M-3.

Prairie Road Site

Prairie Road site is located just east of Site C. Prairie Road site/Alternative 1, which occupies approximately 170± acres, is bounded by the Southern Pacific Railroad line to the west and Prairie Road to the east; Meadow View is located approximately 2,700 feet to the north; and Awbrey Lane is located approximately 1,700 feet to the south. Prairie Road Site/Alternative 2 is a slightly smaller site which occupies approximately 145 acres (see Figure 2-6) (Gould pers. comm.).

Both sites contain two or three existing homes and are at least partially traversed by overhead powerlines. Several scattered homes also are located north and east of the sites. A trailer and boat storage operation is located south of the sites. Both sites have several individual owners (Gould pers. comm.).

According to Lane County's soil map, the Prairie Road site is classified as predominantly prime farmland intermixed with small areas of unique farmland. This site contains the same soils as does Site C, with the addition of Salem gravelly silt loam. This site would likely be classified primarily as prime farmland under SCS's LIM criteria due to reasons discussed previously.

The Prairie Road site is adjacent to the approved site for spray irrigation of Agripac Cannery wastewater, to be located north of West Beacon Drive. Crops will be grown on the site for uptake of nutrients. During the rainy season, the wastewater will be stored in on-site aerated lagoons (Peroutka pers. comm.).

The Prairie Road site is designated "Agriculture" in the Willamette-Long Tom Subarea Plan. The site is currently zoned EFU (Hudzikiewicz pers. comm.).

Coburg Hills Site

The Coburg Hills site is located in northern Lane County, northeast of the City of Coburg. The Coburg Hills site/Alternative 1, which occupies approximately 170± acres, is shown in Figure 2-7. The Coburg Hills site/Alternative 2 is smaller in size, occupying approximately 125 acres.

A group of mature trees is situated on the western portion of the Alternative 1 site. A private dirt road leads up to the southeastern edge of the sites. A few scattered homes are located in the surrounding area.

According to Lane County's soil map, the Coburg Hills site can be classified as unique farmland. The site contains Bashaw clay soils, which are classified as Class IV in SCS's Land Capability System. These soils are unlikely to be classified as prime farmland, according to SCS, for reasons discussed previously (see Site C description).

The Coburg Hills site is designated "Agriculture" in the Willamette-Long Tom Subarea Plan. The site is currently zoned EFU.

Regional Treatment Plant Site

The Eugene/Springfield RWTP was formerly the site of the City of Eugene treatment plant. The plant is located in the City of Eugene on River Road, just west of the Willamette River (see Figure S-1). The area in the vicinity of the plant is developed, with an apartment complex to the west, a trailer park to the south, and residences and various commercial businesses to the north along River Road. The plant is currently operated by the City of Eugene Department of Public Works.

Short Mountain Landfill Site

The 584-acre Short Mountain Landfill site is located in an unincorporated area of Lane County approximately 2.3 miles south of the Goshen interchange of I-5 and Highway 58. The landfill site is generally located in an open area bordered by I-5 on the west and Camas Swale Creek on the south. Portions of the landfill site are being considered for ultimate use as a special events park where target shooting, motor vehicle races, and similar activities could be conducted (Lane County 1980b). The landfill is operated by the Lane County Department of Public Works under a Conditional Use Permit.

Agricultural Reuse Areas

MWMC operates its sludge reuse program within a 25-mile radius, 2-hour cycle time (round trip) of the RWTP. Much of the suitable agricultural land is located in the "seedgrass belt", a 10-mile-wide strip of land located along I-5 between Harrisburg and Creswell. Since the program's inception in May 1980, MWMC has applied sludge to fescue cover on the Short Mountain Landfill and on farms raising sugar beets, mixed grass, fescue, and rye-grass in Creswell, Eugene, Junction City, and Harrisburg. In

1983, MWMC hopes to expand its agricultural reuse program by involving interested parties in Junction City and the City of Eugene (Cooper pers. comm.).

A formal procedure for selecting agricultural reuse areas was developed by MWMC staff and a DEQ representative in 1980-1981, and approved by the MWMC Commission in June 1982. A brief summary of this procedure is described below (Metropolitan Wastewater Management Commission 1982):

1. Lane County Extension Service mails MWMC's sludge information letter to a select group of potential users based on considerations such as farm size, crops grown, and distance from the RWTP.

2. Respondents contacted.

3. Initial site screening including considerations such as site access, physical constraints of land, adjacent development, crops grown, land size, distance from RWTP, and reaction of respondent to program. MWMC public information screens site.

4. Initial site observation by DEQ, Extension Service representative, and Lane County hydrogeologist.

5. Complete background research work, including completion of DEQ written work and soil and water sampling. The sludge application must comply with DEQ Guidelines for Land Application of Wastewater and Sludge (Oregon Department of Environmental Quality 1981) (see Appendix F).

6. Program implementation.

7. Postapplication water and soil sampling on repetitive use sites. Crop testing if appropriate.

IMPACTS OF ALTERNATIVES

Consistency With Land Use Designations

IMPLICATIONS OF NO PROJECT (ALTERNATIVE 4). If sludge management facilities were not expanded beyond the interim facilities of Phase I, there would be no immediate project-related change in land use and therefore no inconsistency with current land use designations. It is possible that additional short-term modifications to the MWMC sludge management system would eventually be made to handle increasing sludge volumes beyond 1989. Because the form of these changes is unknown, however, it is not possible to speculate on their consistency with land use planning in the area.

ALTERNATIVE 1. Concerning reuse of sludge on agricultural lands, no land use designation inconsistency is expected to occur, assuming DEQ guidelines for the land application of wastewater and sludge are followed. Compliance with these guidelines is expected to occur since MWMC's formal procedures for implementing the sludge reuse program incorporates the DEQ guidelines.

For the long-range project, sludge storage lagoons and air-drying beds would be established at one of three sites, Site C, Prairie Road, or Coburg Hills. In assessing the potential impacts of developing these sites, this discussion will primarily focus on the consistency of this action with local plans and zoning codes. In terms of showing consistency with the County Zoning Code, there are a few possible approaches which could be taken (Delk pers. comm.):

Site C:

- o The current M-3 zoning of Site C could be maintained. Under the existing County Zoning Code, a "sewage treatment facility" is a conditional use in the M-3 zone.

- o The site could be rezoned to EFU. Under the current Zoning Code, a solid waste disposal site approved by the governing body of a City or County or both, for which a permit has been granted by the DEQ, is a special use subject to the approval of the planning director. Compliance with ORS 459.245, which allows DEQ to issue solid waste site permits, would have to be determined before the planning director could approve the special use.

Prairie Road and Coburg Hills Sites:

- o The current EFU zoning could be maintained. Compliance with ORS 459.245 would have to be determined as discussed above.

There are two possible use designations that could be applied to the sludge facilities site if consistency with the amended zoning code EFU zone were considered. Both uses are listed as special uses, subject to the approval of a hearings official:

- o Solid waste disposal, as approved by the County and permitted by DEQ.

- o Sewage treatment facility, including sewage treatment plants, sewage sludge drying beds, and sewage pressure control stations (Delk pers. comm.). Presumably, the proposed project would fit under this definition.

State law (ORS 215.213[1][d]) lists "utility facilities necessary for public service" as an additional nonfarm use that may be permitted in EFU zones. "Utility facilities" have been interpreted to include sewage treatment plants in Menges vs. Board of County Commissioners of Jackson County (44 or App 603[1980]).

The draft version of the PF Zone which the County has been considering includes "utilities" as a permitted use. This term includes sewage treatment plants, sewage sludge drying beds, and sewage pressure control stations (Delk pers. comm.). The proposed project would presumably fit under this definition. It would be necessary to determine whether the proposed project complies with ORS Chapter 215 solid waste goals and definitions (see Appendix E).

With selection of any one of the three alternative sites (Site C, Prairie Road, or Coburg Hills), the proposed project is expected to be in conformance with County land use policies. The County maintains a policy that some agricultural land may be needed to accommodate nonfarm uses. This includes nonfarm uses defined in ORS 215.213 (see Appendix E) (Lane County 1980a).

ALTERNATIVES 2 AND 3. The land use consistency implications of Alternative 2 would be similar to those of Alternative 1 in terms of agricultural reuse of sludge and location of sludge storage facilities at the three potential off-site locations. Alternative 3 would not require an off-site sludge storage facility, but would rely on the use of agricultural land for sludge disposal.

Land Use Impacts

IMPLICATIONS OF NO PROJECT (ALTERNATIVE 4). Because Alternative 4 does not involve construction of new facilities or significant modification of existing facilities, it would have no immediate land use impacts. It is likely that some land use change would occur after 1989, however, as MWMC would need to provide some means of handling and disposing of the sludge volume produced in excess of the capacity of the Phase I facilities. The nature and significance of these changes are unknown.

ALTERNATIVE 1. Concerning use of Short Mountain Landfill as a back-up measure for summer disposal of dewatered sludge, Lane County would want to be assured, through implementation of a formal mechanism, that long-term use of the landfill would truly only be a "back-up" measure, and that MWMC would vigorously pursue their agricultural reuse program. Mechanisms, including innovative use of a fee structure, should be considered (Starr pers. comm.b.).

Establishment of off-site locations for sludge storage will require fee-title acquisition of one of the selected sites and acquisition of an easement along the force main route (see Figure

2-4). Legislation was recently introduced in Oregon which would give public condemners, such as MWMC, the right of immediate possession of property upon depositing into court the estimated just compensation for the property. Such a provision would obviate the need for public condemners to appear in a show cause hearing (Pye pers. comm.).

Conversion of one of the alternative sites to sludge storage areas will result in the loss of agricultural lands. In the case of Site C and the Prairie Road site, prime and unique agricultural lands will be lost. Assuming that Lane County currently consists of 160,000 acres of prime farmland (Lane County Department of Environmental Management 1981a), less than one percent of all County prime farmland would be lost should Site C or the Prairie Road site be developed. Development of the Coburg Hills site would not result in the loss of prime farmland.

ALTERNATIVE 2. The potential direct land use impacts of Alternative 2 are similar to those for Alternative 1, as discussed above. The land area affected, however, would be slightly smaller under Alternative 2.

ALTERNATIVE 3. Based on comments received from Lane County, it is likely that the County would be opposed to long-term disposal of dewatered sludge at Short Mountain Landfill. The County has stated that measures should be taken to ensure that disposal at the landfill is an interim measure only. The impacts related to agricultural reuse of sludge would be similar to those for Alternative 1, discussed above.

MITIGATION MEASURES

The project applicant (MWMC) should work closely with DEQ and LCDC legal staffs, and with Lane County on revision of the County's Comprehensive Plan in order to gain a clear interpretation of permitted uses within the proposed zoning for each of the alternative sites. In addition, the Lane County Public Works Department should be consulted prior to plan implementation to ensure that any approach which involves sludge disposal at Short Mountain Landfill addresses all of the County's concerns.

Cultural Resource Implications

INTRODUCTION

A cultural resources evaluation of the proposed Eugene/Springfield sludge management plan and its alternatives has been prepared by the Oregon State University Department of Anthropology. This evaluation is intended to comply with the requirements of the National Historic Preservation Act. The entire OSU report is included in Appendix H; a brief summary of the findings follows.

RESEARCH AND FIELD SURVEYS

J. A. Follansbee conducted a preliminary survey for the Eugene/Springfield sludge management project in 1978 for the MWMC. Project design has since been changed, however, requiring examination of new areas. In 1969 and 1970 the Hurd site near Coburg was excavated (White 1970), and more recent surveying and testing has been done by University of Oregon archeologists in the project vicinity (though not in the areas to be directly impacted).

For this EIS, literature investigations were conducted at Oregon State University and University of Oregon libraries. The research library at Lane County Museum was also searched for pertinent information. Materials sought were newspaper articles, photographs, diaries, journals, and other historically-oriented materials. Limited interviewing was also conducted with long-time residents of the project area. A title search of property was conducted at the Lane County Courthouse. The Oregon State Office of Historic Preservation was also contacted to determine if earlier recorded archeological sites or historic structures in the area had been listed on the National Register of Historic Places.

In March 1983, field surveys of Site C, the Coburg Hills site, and pipeline routes to these sites were conducted by "professional archeologists" from Oregon State University. The Prairie Road site was not surveyed because several landowners refused access to the property.

SURVEY FINDINGS

The proposed force main route to Site C and the Prairie Road site was surveyed and no cultural material was located. The pipeline to the Coburg Hills site, which could be constructed with implementation of either Alternatives 1 or 2, was surveyed on March 10, 1983. Two archeological sites were located along this route. One was discovered north of the McKenzie River and Armitage Park. The site, identified by fire-cracked rock and flakes, is bordered on the east by a shallow ditch and the rip-rapped I-5 bank, and on the west by the abandoned railroad embankment. It extends for several hundred meters northward and is characterized by higher density of flakes at its northern extent. The second site was found farther north on the pipeline route. This site is located between the newly constructed Roberts Street to the west and I-5 to the east. It was not determined whether the Roberts Street construction had impacted the site, but keeping pipeline work to the west in this area might avoid impacts. The site's boundaries and extent would have to be determined by subsurface testing before a more specific determination of impact could be made.

The field survey of Site C was conducted on March 10; where bare ground was exposed (along edges of the field and along the drainage ditch that bisects the field), a light scatter of flakes was found. This indicates past use of the area by the Willamette Valley native population. A possible historic site was also discovered in the northeast corner of the site, but subsequent research indicates that it has no apparent historical significance. A field survey of the Coburg Hills site located no cultural material, though ground visibility the day of the survey was poor and artifacts have been found elsewhere on the landowner's property. It is the opinion of the archeologists that the absence of cultural material was not due to the poor visibility conditions, however, because a knowledgeable field foreman in the area has found no artifacts on or near the site.

In summary, the potential for encountering and adversely affecting cultural or historic materials appears greater on the Site C off-site facilities location than the Coburg Hills site. The chances of encountering materials on the Prairie Road site are probably similar to that at Site C, but this cannot be verified without an actual field survey. Conversely, there appears to be a much greater chance of encountering cultural material along the pipeline route to the Coburg Hills site than the route to Prairie Road/Site C. Only project Alternatives 1 or 2 would be likely to affect these or other cultural materials.

RECOMMENDATIONS

The OSU archeological report made the following recommendations for protection of cultural resources:

- Prior to construction, all pipeline routes and construction zones should be flagged or otherwise delineated to provide a more specific determination of the potential for affecting discovered archeological sites.

- Permission to survey the Prairie Road locale should be obtained if that area remains an alternative.

- After surveying of the Prairie Road site, the three off-site locations should be ranked for cultural resource sensitivity; the potential for uncovering cultural materials should be considered in site selection.

- In order to avoid archeological sites along the pipeline route to Coburg Hills, the pipeline should be kept to the east; coring should also be undertaken to establish site limits.

Before EPA approves the Phase II project design, the MWMC must provide assurance that archeological resources will be protected. If the Coburg Hills site is selected, it will be necessary to assess the pipeline route when surveyed to ensure that cultural impacts are mitigated. This assessment should be conducted in cooperation with the Oregon State Historic Preservation Officer and EPA, Region 10 in Seattle, Washington.

Energy Use

DESCRIPTION OF EXISTING CONDITIONS

Currently, all digested sludge at both the Eugene and Springfield WTPs is transferred directly from sludge digesters to on-site storage or air-drying beds. There is not a significant consumption of energy that occurs prior to transport of the sludge to its ultimate reuse or disposal site. The major energy use, therefore, occurs when liquid sludge from the Eugene WTP is removed from the sludge lagoon and hauled either to Short Mountain Landfill or an agricultural reuse site.

In 1981, MWMC transported approximately 4,930,000 gallons from the Eugene WTP to off-site locations; 900,000 gallons went to Short Mountain Landfill and 4,030,000 went to three agricultural reuse sites. Based on a tanker truck capacity of 5,800 gallons and round trip haul distances of 30 miles to the landfill and 36-40 miles to the reuse sites, approximately 32,000 vehicle miles were traveled in transporting the sludge. At a fuel consumption rate of 6 miles per gallon, a total of 5,333 gallons of diesel fuel was consumed in the process.

During the next 5 years, the increase in energy consumption from sludge handling will be identical regardless of which long-term alternative is selected. Sludge coming from the digesters at the RWTP will be mechanically dewatered in the winter and the dried sludge will be transported to the Short Mountain Landfill. In the summer, it is expected that about 80 percent of the sludge volume will be mechanically dewatered and transported to agricultural reuse areas; the remainder will go to agricultural areas in a liquid form.

The electrical energy consumed in this 5-year period is estimated to be 6,314,000 kilowatt hours (Kwh) (Gould pers. comm.). This will be consumed primarily in the mechanical dewatering process. Diesel fuel consumption related to hauling the sludge off-site for reuse or disposal will jump to approximately 11,500 gallons per year by 1989. The large increase over 1981 conditions is related to the increased volume of material that must be transported.

IMPLICATIONS OF NO PROJECT (ALTERNATIVE 4)

The energy implications of No Project are unknown. If the County adds no more sludge handling facilities beyond those of Phase I, energy use should continue at a fairly constant rate until the Phase I facilities reach their capacity after 1989. Energy consumption beyond that point would depend on what sludge management action MWMC takes to accommodate increased sludge generation. If the excess liquid sludge is hauled to a reuse or disposal site, diesel fuel consumption would show some increase. Electrical energy consumption would remain fairly constant.

IMPACTS OF ALTERNATIVES

Energy consumption in Phase II (1990-2004) is extremely variable among the alternatives. Electrical energy consumption estimates prepared by Brown and Caldwell are presented in Table 3-14. Alternative 3 would consume considerably more electrical energy because all sludge would be mechanically dewatered in centrifuges. Alternative 2 would have a slightly higher energy demand than Alternative 1 for the same general reason; all sludge would be partially dewatered in the centrifuges prior to discharge to the air-drying beds.

Table 3-14. Estimated Energy Consumption of Project Alternatives

	ELECTRICAL ENERGY (KWH)	DIESEL FUEL (GAL)	
	1990-2004[1]	1989[2]	2004[2]
Alternative 1	4,496,000	11,500	8,669
Alternative 2	9,998,000	11,500	6,961
Alternative 3	63,362,000	11,500	11,166
Alternative 4	Unknown	11,500	Unknown

[1] Total consumption for the entire phase assuming off-site facilities at Site C or Prairie Road (Source: Gould pers. comm.).

[2] One-year consumption rate.

Diesel fuel consumption would also be highest for Alternative 3. All sludge would be hauled to reuse or disposal points at a relatively low solids content, ranging from 9 percent to 20 percent. This requires more truck trips. The RWTP is also a greater distance from the most likely area of reuse, north of Eugene. Therefore, haul distances are greater. Alternative 2 would require slightly less diesel fuel consumption than Alternative 1 because the 20 percent of the total annual sludge volume hauled in a liquid form would be conditioned to 9 percent solids in the centrifuge prior to hauling rather than being hauled at 6 percent solids directly from the FSLs as in Alternative 1. This reduces the number of truck trips required.

The above comparisons assume off-site facilities for Alternatives 1 and 2 would be constructed at either Site C or the Prairie Road site. If the Coburg Hills site were used, electrical energy consumption would likely increase somewhat because sludge would have to be pumped a greater distance from the RWTP. The haul distances to agricultural reuse sites could be greater or smaller, depending upon what sites are finally selected. It is likely that the overall haul distance would be greater from Coburg Hills because it is not centrally located to the grass seed growing areas of the upper Willamette Valley.

MITIGATION MEASURES

The MWMC preferred alternative (Alternative 2) does not exhibit the lowest energy demand of the alternatives considered. Total reliance on air-drying, as proposed in Alternative 1, has a much lower electrical energy consumption rate. The most effective way to reduce both electrical consumption and diesel fuel consumption is to air-dry the greatest volume of sludge possible. Energy savings achieved in this manner can be augmented by locating sludge reuse sites as close as possible to the sludge drying site. In purchasing sludge hauling equipment, MWMC should carefully review the energy efficiency of all vehicles.

Aesthetics and Odors

This section of the impact analysis discusses the two key aesthetic implications of the proposed sludge management facilities: visual changes are related to construction, and odor generation is related to operation.

VISUAL EFFECTS

Existing Conditions, Site C

Site C is flat agricultural land, currently under production for grass seed. There are no structures on the site. Flowing northwest through the site is an intermittent tributary of Flat Creek. A Bonneville Power Administration (BPA) transmission line transverses the southern portion of the site. Site C is easily visible from Awbrey Lane and the residential units north of the site. It is slightly visible from Prairie Road and from Link Drive.

Existing Conditions, Prairie Road Site

The Prairie Road Site, located between Prairie Road and the Southern Pacific Railroad line just east of Site C, is also flat agricultural land. This land is used for cattle grazing and grass seed production. There are two residences on the eastern site boundary along Prairie Road. Lowland areas on-site have surface ponded water in the wet season. Flowing northwest through the lower portion of the site is an intermittent tributary of Flat Creek. The BPA transmission line transverses the middle portion of the site from northeast to southwest. Residents of scattered farms and homes along Prairie Road and at the intersection of Prairie Road and West Beacon have a clear view of the site; persons driving along Prairie Road also can easily view the site.

Existing Conditions, Coburg Hills Site

The Coburg Hills site, located east of Interstate 5, north of Van Duyn Road and south of Lenon Hill, is flat agricultural land. The land is used for cattle grazing and grass seed production. Daniels and Muddy Creeks flow south and west of the site. These two creeks are intermittent. Two smaller intermittent drainages pass through the site. Small clusters of oak and ash trees are located throughout the area. The Coburg Hills site is easily visible from Interstate 5, Van Duyn Road and the first gravel road left off of Van Duyn Road. Residents living along the gravel road and the upland area to the north can easily view the site.

Existing Conditions, Short Mountain Landfill

Short Mountain Landfill is located east of Interstate 5 and west of the Coast Fork of the Willamette River between Goshen and Creswell. When viewed from Interstate 5, the site resembles a low plateau approximately 25 feet above surrounding terrain. The sides and top of the western end of the landfill are covered with grassy vegetation. The working face of the landfill is currently at the eastern end. Between Interstate 5 and the landfill is approximately 1,500 feet of low-growing and wetland vegetation. Camas Swale Creek flows eastward along the southern boundary of the landfill. Dense bushes and trees grow along the banks of the creek. The working face of the landfill is not currently visible from either Interstate 5 or the houses located south of the site. The vegetation along Camas Swale Creek blocks site visibility from the south.

Existing Conditions, Eugene WTP Site

The Eugene WTP is visible from River Avenue, and slightly visible from the Beltline, both located north of the plant. Between the plant and the Willamette River is a greenbelt area. Only the eastern end of the plant is visible from the river. Along the southern border, trees screen the plant from residential units. Residents living in the second floor apartments west of the plant can see the site. People living in the first floor apartments cannot see the site because of buffering vegetation. There is currently very little landscaping on-site because of the ongoing construction.

Implications of No Project (Alternative 4)

If no long-term sludge handling facilities are constructed for the RWTP, Phase I facilities would eventually be taxed beyond their capacity. As digested sludge generation began to exceed the plant's mechanical dewatering capacity, some reuse or disposal site for the excess sludge would have to be found. The visual implications of disposing of this liquid sludge cannot be determined without identification of the disposal site.

Impacts of Alternative 1

Construction of FSLs, drying beds, access roads, and operational buildings at Site C, the Prairie Road site, or the Coburg Hills site would significantly change the appearance of each of these sites. The flat agricultural land would be covered with a network of roadways, rectangular air-drying beds, and FSLs of various sizes. Drying beds are flat with a small 1 to 3-foot-high berm surrounding the asphalt bed. The FSLs would be surrounded by high earthen berms which prevent visibility of the lagoon and the surface mixing equipment.

The proposed layout of Site C is shown in Figure 2-5. The FSLs adjacent to the railroad would cover about 25 acres, and the drying beds west of the lagoons would cover about 50 acres. The earthen berm around the exterior of the FSL complex would extend at least 10 feet above grade.

When viewing Site C from either Awbrey Lane or the residential units north of the site, initially one would be able to see the FSL earthen berms, the operations buildings, and the supernatant pump station. The air-drying beds and the roadways would blend into the flat landscape. The entire site would be visible from the Southern Pacific Railroad line. The interior of the FSLs would be visible to people on passing trains. Plans for the site call for extensive landscaping along the perimeter. The intent is to develop a dense vegetation screen around the entire site that would eventually screen it from all ground level off-site views.

The location of the Prairie Road site is shown in Figure 2-6. The FSLs would cover approximately 25 acres and the drying beds would cover approximately 50 acres as at Site C. People traveling along Prairie Road would be able to easily view the drying beds, operations buildings, supernatant pump station, and the FSL earthen berms. Prairie Road is not sufficiently elevated to allow travelers to view the interior of the FSLs. Residents living along Prairie Road north and south of the site would be able to see various parts of the site depending upon their location. The entire site would be visible from the Southern Pacific Railroad line. All facilities would eventually be screened from view of passersby by a perimeter vegetation screen.

Figure 2-7 indicates the location of the Coburg Hills site. The FSLs would cover 25 acres and the drying beds would cover 50 acres. The entire site would be visible from Interstate 5.

Interstate 5 is at a higher elevation than the site, thus permitting views of the interior of the FSLs. Residents living along the gravel road and north of the site would be able to view various parts of the site depending upon their location. Generally, residents north of the site would not be able to see the majority of drying beds, because of their location behind the earthen berms surrounding the FSLs. Persons traveling along Van Duyn Road would be able to see the FSL earthen berms, the operations building, and the supernatant pump house. The drying beds and roadways would blend into the land's flat topography. Views of the site would eventually be altered as the vegetation planted along the site perimeter matured.

Discontinuing the use of centrifuges at the RWTP would not change the appearance of the site significantly unless the buildings which housed the centrifuges were removed. Their removal would lessen the density of buildings on-site.

The visual effects of applying sludge to the landfill, if this were to occur as a back-up measure, would be minimal. The sludge would be spread over the working face of the landfill with other solid waste and eventually would be covered with soil. This would not significantly change the appearance of the landfill.

Impacts of Alternative 2

The visual impacts of Alternative 2 would be somewhat different than Alternative 1 because smaller off-site acreages would be needed, compared to Alternative 1, and mechanical dewatering equipment would be relocated to the off-site location. The land area required for air-drying beds would be reduced by 17 acres (from 50 acres to 33 acres).

The proposed layout for Site C is shown in Figure 2-5. The smaller acreage requirement allows the site to be moved south of the position proposed for Alternative 1. This places the facility under a BPA electrical transmission line and immediately adjacent to Awbrey Lane. Initially, residents living across Awbrey Lane and persons driving along Awbrey Lane would be able to see the entire site except for the interior of the FSLs. The drying beds and the operations building would not be visible from residential units north of the site, because of their location behind the FSL earthen berms. The entire site would also be visible from the Southern Pacific Railroad line. As the vegetation screen along the site perimeter matured, the interior of the site would become less visible.

Figure 2-9 shows the proposed layout at the Prairie Road site. Views of this site would not change significantly from those described for Alternative 1, except that the facilities would be slightly farther from the residences located on Prairie Road at the corners of West Beacon Drive and Awbrey Lane.

The Coburg Hills site layout for Alternative 2 is shown in Figure 2-10. The acreage requirement is slightly smaller than that of Alternative 1 (by approximately 17 acres), but the visual effect would be very similar. One additional structure would be constructed on-site to house the centrifuges. The FSL berms and perimeter landscaping would provide a visual screen similar to that of Alternative 1.

Impacts of Alternative 3

Alternative 3 would have no significant visual impact. Construction would be limited to the RWTP site. A site layout for the necessary sludge thickeners, digester, and mechanical dewatering equipment has not been developed, so their locations and size are unknown. The RWTP site is already heavily developed, however, and the additional structures would not significantly alter the site's appearance. The visual effects of sludge disposal at the Short Mountain Landfill would be similar to existing conditions.

Mitigation Measures

Mitigation of visual impacts would be necessary only at the off-site locations of sludge management facilities, which are proposed for Alternatives 1 and 2. The principal mitigation, which has been recommended in the project planning documents (Brown and Caldwell 1979, 1980), is planting of a dense vegetation screen on the perimeter of the off-site facilities. This would reduce the visibility of the sludge handling facilities and retain more of the rural agricultural nature of the present setting.

If off-site facilities are placed on Site C, use of the northernmost acreage (as proposed for Alternative 1) would reduce the visual impact on residents and travelers along Awbrey Lane. This northern parcel is the least visible of the off-site locations currently being considered.

ODORS

Existing Conditions

Wastewater treatment processes have an inherent potential for generating various types of odors. These odors can at times be of such a character and intensity as to represent a serious nuisance in the area surrounding the treatment facilities. Both the Eugene and the Springfield wastewater treatment plants have at times created odor problems in their neighborhoods. The Short Mountain Landfill (used for disposal of some of the sludge from the Eugene wastewater treatment plant) also experiences occasional odor problems.

Most of the compounds producing odor problems at wastewater treatment facilities result from microbial decomposition of organic compounds. A large number of factors can alter the types of microorganisms involved and the types of decomposition products released. Sludge handling and treatment facilities are a common source of odors at wastewater treatment facilities. Settling basins, lagoons, and oxidation ponds can become odor sources, particularly if blue-green algae or actinomycete (a major group of bacteria) populations reach high levels.

Compounds associated with odor problems from wastewater treatment facilities usually involve volatile sulfur, nitrogen, or organic compounds. Sulfur compounds associated with odor problems include hydrogen sulfide, organic sulfides, and mercaptans. Nitrogen compounds associated with odor problems include ammonia, organic amines, and a wide variety of other organic nitrogen compounds. Volatile organic compounds associated with odor problems include organic acids, aldehydes, ketones, and alcohols.

As stated above, odor problems at landfill sites result from microbial decomposition of organic matter. Odor problems can occur if waste material is left uncovered for excessive periods or if gases produced by decomposition in completed landfill sections are vented to the atmosphere. Odor problems can also develop in leachate collection ponds. Odor problems at Short Mountain Landfill appear to be due primarily to the venting of landfill gases, with the leachate pond being a less frequent source of odor problems.

Odor concentrations are often reported in odor units. One odor unit represents the odor threshold of a compound. Thus, odor concentrations in odor units identify the extent of dilution needed to reduce odor intensities to the odor threshold.

Impacts of No Project (Alternative 4)

The no-project alternative is likely to result in an increased frequency and severity of odor problems at the Eugene treatment plant as wastewater and sludge facilities become overloaded. Odor problems might also increase at the Short Mountain Landfill if disposal of inadequately digested or dewatered sludge occurs as Phase I sludge handling facilities are overtaxed. Inadequate dewatering of sludge could also increase leachate production at the landfill. It is uncertain whether increased leachate production would increase the frequency of odor problems from the leachate ponds. Odor problems could also develop at sites where sludge is used as a soil amendment.

Impacts of the Proposed Project (Alternative 2)

The proposed project (Alternative 2) involves construction of 25 acres of facultative sludge lagoons, 33 acres of sludge drying beds, and agricultural use of liquid and dried sludge.

Centrifuges would be used to dewater some of the sludge. Short Mountain Landfill would be a back-up sludge disposal location.

The facultative lagoons, drying beds, centrifuges, and agricultural use sites represent potential odor sources. The frequency and severity of odor problems at these facilities is difficult to predict with any certainty. With proper operation of the wastewater treatment and sludge management facilities, serious odor problems should be an infrequent occurrence. Odor problems will develop when two processes occur simultaneously: significant quantities of odorous compounds are released into the air, and weather conditions result in reduced dispersion of odorous compounds as they are carried downwind of the odor source.

EMISSIONS OF ODOROUS COMPOUNDS. There have not been many quantitative studies of odorous compound emissions from sludge storage and drying facilities. Detailed odor studies have been performed at a wastewater treatment plant in Sacramento, California. Odors from digested sludge storage basins at that facility were attributed primarily to hydrogen sulfide and organic mercaptans (Huang et al. 1978). Odor emissions from digested sludge storage basins were measured daily over a 6-month period. Odorous compound emission rates were characterized in terms of odor units per square foot per minute. Odor emissions measured by Huang et al. (1978) spanned a range of 1.1-56.2 odor units per minute per square foot, with half the odor measurements being less than 3.8 odor units per minute per square foot.

Odor emissions from the sludge drying beds will probably be comparable to emissions from the facultative lagoons. Sludge spread on the drying beds will be more completely stabilized than the digested sludge entering the lagoons. The drying beds, however, will provide greater direct air exposure of sludge solids, especially during mixing of the drying sludge.

The centrifuge equipment will probably include odor control devices to avoid concentrated odor emissions in air ventilated from the centrifuge buildings. No specific odor control equipment has been selected yet.

Agricultural application sites should not pose a serious odor problem as long as application rates are controlled. Sludge application by injection has a lower odor potential than spray application. Tilling of surface-applied sludge into the soil will also minimize potential odor problems.

FREQUENCY OF POOR DISPERSION CONDITIONS. Dispersion of odorous emissions will be greatest during periods of strong winds or during sunny summer afternoons when there is strong solar heating of the ground (i.e., visible heat shimmers). The greatest potential for odor problems will occur during periods of light winds and low level temperature inversions. Pollutant dispersion rates under such inversion conditions are illustrated in Figure 3-12.

The U. S. Weather Service has not developed any summaries of surface temperature inversion frequency for the Eugene or Salem areas. Low level temperature inversions are, however, expected to be common during much of the year. The typical occurrence of heavy fog (visibilities less than 0.25 mile) on 50-70 days during the October-March period (National Climatic Center 1981) indicates frequent winter surface inversions lasting much of the day. Nighttime and early morning surface inversions are expected during the summer whenever skies are clear and winds are calm or light. Brown and Caldwell (1979) present data indicating nighttime surface inversions form 90 percent of the time during the fall and winter periods. Nighttime surface inversions probably occur at least 50 percent of the time during the summer.

EXPECTED FREQUENCY OF ODOR PROBLEMS. Emissions of odorous compounds will occur throughout the year, with the highest emission rates occurring when digested sludge is being pumped into the lagoons. High emission rates may also occur during addition of sludge to the drying beds. Odor problems are most likely to occur during periods of light winds and surface temperature inversions. Such weather conditions are common during nighttime and early morning hours throughout the year, and may persist all day during the fall and winter.

Odors often generate complaints when the odor concentration exceeds 5 odor units. Brown and Caldwell (1979) estimated that detectable odors would typically occur 10-15 times a year at locations 2,000 feet from the facultative sludge lagoons or drying beds. These estimates are consistent with the odor emission rates presented by Huang et al. (1978), the dispersion factors presented previously in Figure 3-12, and the expected frequency of moderately strong surface inversions. Odor problems would be about twice as frequent at locations 500 feet from the odor source. It is also possible that odors from the sludge lagoons or drying beds will be noticeable at distances exceeding 1 mile on some occasions.

There are several homes within 0.50 mile of the south, east, and west sides of Site C, with the closest home about 550 feet from the drying beds. Prevailing winds from the north during spring and summer months enhance the potential for odor problems at this site. Site C appears to have more homes within 0.50 mile of the site than either of the alternative sites. Consequently, Site C appears to have a greater potential for generating odor complaints than the other sites.

The Prairie Road site is just northwest of Site C. Homes along Awbrey Lane are more than 2,700 feet south or southwest of the site. Homes along Prairie Road are both north and south of the site, about 500 feet from the sludge lagoons or drying beds, respectively. Several other homes occur along Prairie Road

MODELING PARAMETERS	UPPER CURVE	LOWER CURVE
WIND SPEED (MPH)	2.2	2.2
STABILITY CLASS	INVERSION (F)	NEUTRAL (D)
MIXING LIMIT (FEET)	656	656
EMISSION SOURCE AREA: LENGTH (FEET)	1280	1280
WIDTH (FEET)	850	850

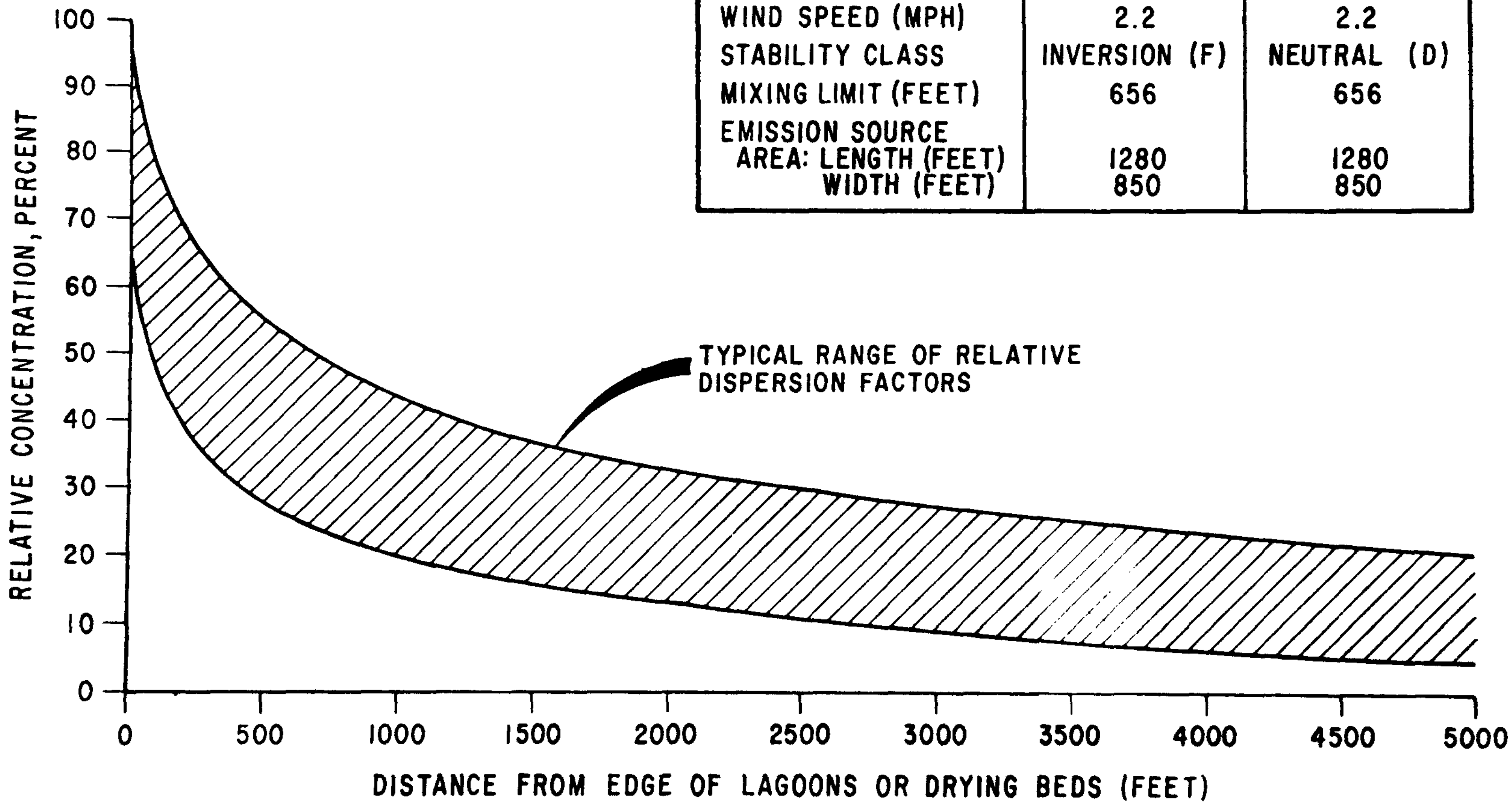


FIGURE 3-12. RELATIVE DISPERSION OF SLUDGE LAGOON OR DRYING BED EMISSIONS DURING LOW LEVEL TEMPERATURE INVERSION CONDITIONS

within 0.50 mile of the site. There are, however, fewer homes within 0.50 mile of the Prairie Road site than of Site C.

There are no homes within 1,000 feet of the Coburg Hills site, and only a few within 3,000 feet. The Town of Coburg is 1-1.50 miles south-southwest of the site. The potential for odor complaints is lower at the Coburg Hills site than at either of the alternative sites.

Impacts of Alternative 1

Alternative 1 differs from the MWMC preferred Alternative 2 by not using the Phase I centrifuges for dewatering some of the sludge. Consequently, this alternative requires about 50 acres of sludge drying beds. Facilities would be located about 2,700-3,100 feet north of Awbrey Lane at Site C, resulting in a lower potential for odor problems from this site as compared to Alternative 2 at Site C. There would still be several homes within 0.50 mile of the site.

The increased acreage of drying beds would somewhat increase the potential for odor problems at the Prairie Road and Coburg Hills sites under Alternative 1 as compared to Alternative 2. Under Alternative 1, the potential for odor complaints would probably be greatest at the Prairie Road site, slightly less at Site C, and the least at the Coburg Hills site.

Impacts of Alternative 3

Alternative 3 would involve additional sludge thickeners, digesters, and centrifuges at the RWTP site, with no off-site sludge storage or drying facilities. The lack of sufficient sludge storage lagoon capacity would require sludge disposal at the Short Mountain Landfill during the winter.

The added sludge handling and processing facilities would probably result in an increased frequency of odor complaints from areas around the RWTP site. Over the long term, sludge disposal at Short Mountain Landfill would contributed incrementally to the odor problems currently experienced at that facility.

Mitigation Measures

A number of different techniques have been used with varying success to deal with odor problems at wastewater treatment facilities and sanitary landfills. Remedial action to reduce odor problems is most successful when the nature and underlying cause of odor problems can be identified. If the odor control techniques designed into the proposed project are ineffective, some of the following control techniques should be considered to minimize off-site odor impacts.

WASTEWATER TREATMENT PLANT OPERATION. Increased sludge retention times from anaerobic digestion (added digester capacity or other operational changes) can reduce the frequency of odor problems from storage or disposal of digested sludge if the odor problems stem from inadequately stabilized sludge.

Digested sludge can also be treated to reduce odor emissions (i.e., by vacum stripping) prior to transport to sludge storage or disposal facilities. Appropriate odor controls (adsorption columns, wet scrubbers, combustion systems, etc.) are required for the odor removal facilities.

ADDED LAGOON AERATION. Aeration systems are used for odor control in two ways: preventing the development of anaerobic conditions under which odorous compounds are formed; and promoting the oxidation of soluble, odorous compounds to less objectionable compounds. The sludge loading and depth of the proposed facultative sludge lagoons make it infeasible to maintain aerobic conditions throughout the lagoons. The lagoons are designed to provide aerobic conditions near the surface of the lagoons, primarily by photosynthetic oxygen production by algae. Mechanical aeration can help maintain aerobic conditions, particularly at night when algal respiration will deplete dissolved oxygen levels.

Aeration systems may not be effective for odor control if the odorous compounds are insoluble or difficult to oxidize.

CHEMICAL OXIDATION. Hydrogen peroxide, potassium permanganate, and ozone have been used to oxidize odorous compounds to less odorous forms. Such treatments have generally been used for facilities of limited size, and may not be economically feasible for large lagoon systems. Chemical oxidation would not be effective for odor control if the problem is due to insoluble compounds or compounds which are difficult to oxidize.

SOURCE ENCLOSURE PLUS ODOR REMOVAL. Wastewater treatment facilities which become frequent sources of odor problems (i.e., sludge thickeners) are sometimes provided with covers and mechanical ventilation systems for odor control. Odorous gases are collected and transferred to odor removal facilities. Odor removal is usually accomplished by adsorption (usually on activated carbon), wet scrubbing (alkaline solutions, chemical oxidizers, etc.), or combustion. Odor problems from venting of landfill gas are often controlled by combustion (flare) systems.

The large acreage of facultative sludge lagoons and sludge drying beds will make enclosure systems economically infeasible. Enclosure of the leachate lagoon at Short Mountain Landfill is also likely to be infeasible.

MICROBIAL GROWTH CONTROL. Digested sludge could be chemically treated to inhibit subsequent microbial growth and decomposition, thus reducing subsequent odor production. Such treatments would normally involve high doses of lime (to alter sludge pH) or chlorination. Chlorination could impair agricultural use of the sludge, but lime would be beneficial to most soils in the area.

CHANGES IN MICROBIAL POPULATIONS. Lagoon odors may at times be due primarily to metabolic or decomposition products of algae or bacteria growing in lagoon waters, rather than decomposition of sludge solids. In such cases, aeration, pH adjustment, or other measures may be helpful to alter the balance of microbial populations so as to minimize odor generation.

When odors are due to hydrogen sulfide and/or mercaptans released by decomposition of sludge solids, additions of nitrate compounds will sometimes alter microbial metabolism by substituting nitrate reduction reactions for sulfur reduction. Nitrate reduction generally yields nitrous oxide and nitrogen gas as major products, neither of which pose any odor problems.

Property Value Impacts

Sludge management facilities and operations are potential sources of noise, odor, and visual impacts. To evaluate the potential effect these factors might have on property values, two important factors must be considered.

The first factor is the type of sludge management facilities to be operated; the second is adjacent land uses. Typically, residential uses are more affected by sludge management operations than other uses.

The proposed sludge management alternatives for Eugene/Springfield include on-site and off-site sludge treatment with land application of the finished sludge product. Because leaving long-term sludge handling facilities on-site (Alternative 3) would involve no further encroachment on neighborhoods surrounding the RWTP other than increased truck traffic, no impact on property values is likely. Furthermore, land application of sludge associated with this alternative, as well as with other alternatives, is unlikely to have any impact on property value. The remoteness of lands receiving sludge and the infrequency of application reduces the likelihood of potential effects on property value even in the event that objectionable odors from land application of sludge were to occur.

Some potential exists for an adverse impact on property values of residences in the vicinity of the three alternate sites proposed for off-site dewatering facilities (i.e., Site C, Prairie Road, and Coburg Hills). The proximity of residences to the dewatering facilities will result in some residents being subject to a general increase in heavy truck traffic during the summer months, an undesirable view of the facilities, and an occasional exposure to objectionable odors. Certain factors, however, suggest that a potential impact on property values is unlikely. The proposed facilities would be visually buffered by a vegetative screen, thereby minimizing potential visual impacts. With respect to noise generation from truck traffic, the proposed routes for sludge transport are presently used by agriculturally-related and commercial truck traffic. The increased noise from the proposed project is not expected to be a significant new source.

Based on conversations with staff at the local county assessors office (Cook pers. comm.), occasional odor generation, although objectionable, is not likely to affect the market values of rural properties used primarily for agricultural purposes. An investigation of the siting of sludge facilities in nearby Salem indicated no reported adverse effect on adjacent property values (Dailey pers. comm.).

It should be recognized, however, that determining the effect on the market value of properties adjacent to sludge management facilities is difficult; although it is very unlikely that the market value of adjacent property will decrease, it is possible that the value of some adjacent properties may not increase at the rate they would in the absence of sludge storage and drying facilities. Because of the variety of factors, however, which influence property values, in particular values of agricultural lands, estimating the impact of any one factor is highly speculative.

MITIGATION MEASURES

Thorough landscaping, proper operation, and regular maintenance of the proposed sludge management facilities should be undertaken to minimize the potential for visual and odor impacts on adjacent properties. This effort will decrease the likelihood that the sludge handling facilities will affect adjacent property values.

Indirect Impacts of Alternatives

INTRODUCTION

Construction of public service facilities and utilities can result in indirect as well as direct impacts on the environment. Direct effects are those that result from the physical processes of construction and operation of facilities. This can include land clearing, land use modification, construction or demolition of structures, daily operation and maintenance of facilities, and reuse or disposal of products or waste streams. The preceding sections of this chapter have discussed the potential direct effects of the project. Indirect effects are the outcome of changes in population or economic growth rates, changes in land use patterns, or changes in the patterns of natural resource consumption that are stimulated by a proposed project.

The concern in an environmental assessment of a federally-funded project is the burden on the environment imposed by additional development induced by the project. The critical decision in addressing this concern is whether the proposed project will, in itself, induce changes in economic or population growth patterns, or land use patterns.

INFLUENCE OF THE PROJECT ALTERNATIVES ON GROWTH PATTERNS

The MWMC sludge management options described as Alternatives 1, 2, and 3 should not directly alter the rate or pattern of population growth in the Eugene/Springfield area. The regional wastewater treatment facilities now under construction have been sized to service the population growth rate and pattern presently envisioned in local land use plans. The sludge management facilities proposed in these three alternatives will simply allow the wastewater treatment facilities to provide the service as planned. Any stimulus to growth in the Eugene/Springfield area will come from economic factors rather than improvements in sludge management facilities.

If a long-term solution to sludge handling and disposal is not implemented by the Cities of Eugene and Springfield, as is described in the No Project alternative, the provision of this service could have an indirect influence on local growth patterns. Without sufficient sludge processing and disposal capacity beyond 1989, it is possible that restrictions could be placed on the number of new hookups to the sewer system. This is one method of ensuring that sludge production at the RWTP does not exceed sludge handling capacity. Moratoriums of this sort would influence the rate of growth in the area, and could also affect the location of growth. Commercial and industrial development could be affected along with residential development.

In summary, it is unlikely that implementation of any of the three "action" alternatives (Alternatives 1, 2, and 3) would alter growth rates or land use patterns in the area, causing indirect impacts to the natural or socioeconomic environment. In contrast, if the No Project (Alternative 4) course of action is followed, it is possible that there would be a slowing of population and economic growth in the Eugene/Springfield area as sludge handling capacity is reached. This would not have an adverse indirect effect on the natural environment, but it could adversely affect the local economy.

Impacts of Secondary Reuse Alternatives

INTRODUCTION

Chapter 2 describes four sludge reuse/disposal options that were considered in Brown and Caldwell (1980) but were rejected as preferred base options for a number of reasons, including reliability and regulatory uncertainty. EPA felt that a generic impact analysis of these options was valuable because their potential as secondary or back-up systems to the MWMC-preferred plan appeared quite good. Since selection of its preferred plan MWMC has, in fact, continued to pursue two of these reuse options -- forest application and topsoil amendment. Brown and Caldwell (1980) recommended that these two reuse methods be pursued as supplemental to agricultural reuse.

The following pages identify some of the key areas of environmental concern that exist regarding these reuse/disposal options. Because specific use locations for these options have not been identified, the discussions are general in nature.

FOREST APPLICATION

Application of sludge to forestland in the Eugene/ Springfield area would be subject to the same DEQ permit and sludge management guidelines as agricultural land application (see Appendix F). Restrictions on slope, runoff, soil depth, buffer width, public access, and grazing use would be especially applicable to most forest application situations.

As indicated in Chapter 2, there is a large acreage of timberland in Lane County, much of it within an acceptable hauling distance from the RWTP. Some of the key limitations to this use, however, are that most large timber acreages in the area are on slopes greater than 10 percent, and agricultural reuse areas are available closer to the RWTP (Brown and Caldwell 1980). DEQ guidelines discourage surface application of liquid sludge on slopes greater than 12 percent. If the sludge is dewatered prior to application, a much larger area becomes available for application (slopes up to 20 percent); the haul distance differential could also be overcome if the sludge users would help defray the hauling costs. More specific environmental considerations relating to forestland reuse are presented below.

Water Quality

The impacts of forest application on surface water quality would vary considerably, depending on application rates and site parameters. Sludge constituents could enter surface waters via the following routes:

- o Sludge is accidentally spilled or sprayed into streams.
- o Contaminated surface water flows from the site to a stream.
- o Sludge is carried into streams via soil erosion.
- o Groundwater contamination leads to surface water contamination.

Contamination via the first route is unlikely if adequate markers designate the application site.

Considering the relatively high runoff rate of many of the forest soils in the region, it is possible that sludge could contaminate surface runoff. Sludge has been shown, however, to decrease the quantity of water flowing from a site (Kladivko and Nelson 1979; Kelling et al. 1977b). Sludge may improve both the infiltration rate and water-holding capacity of coarse soils, thus reducing runoff and the potential for water quality damage (Kirkham 1974).

Sludge constituents may enter surface waters as a result of erosion. When present in land applied sludge, heavy metals, PCBs, and biological pathogens are often adsorbed onto soil particles which are subject to erosion. The steep slopes and relatively noncohesive soils of forested regions in the area increase the possibility of erosion. Sludge may act as a soil binder, however, increasing the soil's erosion resistance. Erosion of sludge itself is unlikely. Henry and Cole (1983) found that up to 1.5 inches of dewatered sludge was stable on a forest floor at slopes up to 42 percent.

The last route of surface water contamination, via groundwater contamination, is possible due to the shallow soils in many local forest areas. Soils in the hills surrounding Eugene often have perched water tables at depths of 1-2 feet (U. S. Soil Conservation Service 1981). Groundwater at such shallow depths could easily surface along ravines and at the bottom of steep slopes. Nitrate is the contaminant most likely to reach surface waters in this manner due to its high solubility and mobility within the soil.

The mechanisms and pathways to groundwater contamination would be much the same as those in agricultural areas, especially in forested areas on relatively mild slopes near the valley floor. In steeper, mountainous areas, the shallow soil depth and occasional perched water tables could increase the likelihood of affecting groundwater. If sludge applications are limited to those rates recommended by the Oregon State Extension Service, however, nitrogen uptake by the trees can be maximized and leaching of nitrates and other sludge constituents can be minimized.

Public Health

Health risks of sludge application on forestland may include contamination of drinking water supplies, exposure by direct human contact through work or recreation, and exposure through animal or insect vectors.

Steep slopes and poor soils usually associated with forestlands near Eugene/Springfield will require careful selection of forest disposal sites and close attention to application restrictions to avoid inadvertent contamination of groundwater and surface drinking water supplies. Sludge is difficult to incorporate into forest soils and therefore may be more susceptible to surface water runoff. During all periods of the year, especially hunting season, precautions must be taken to avoid direct exposure of recreational forest users to sludge within 12 months after application. Forest use must be considered before a forest sludge disposal site is approved. The potential for infection or contamination of game and other wild animals by sewage sludge has been reported in the literature (Prestwood 1980; Love et al. 1975). This could include accumulation of metals and other toxic substances through the forest food chain and transmission of diseases, such as Giardiasis and Salmonellosis, by game animals. The actual risk of human exposure through game or other wild animals is probably very small for the general public.

Land Use Compatibility

The application of sludge on forestland in the Eugene/Springfield area would not create significant land use compatibility problems unless public forest was used. Nonforest uses are closely regulated on private timberland. If public access is allowed, however, or livestock grazing is a secondary use, the potential for public health problems related to direct contact with sludge becomes a concern. It is likely that MWMC would restrict its forest application agreements to private timber owners to avoid conflicts with nontimberland uses. On those private lands where public access or grazing was allowed, the DEQ access restrictions would have to be followed by the landowner.

It is unlikely that long-term land use restrictions would be necessary on forest application sites unless excessive application rates were used. Even with repeated applications, only those tree-growing areas that might eventually be used to grow human food chain crops would be of concern.

Soil Character and Use

Forest application of digested sludge is unlikely to alter future soil use. Forest soils are generally too thin, steep, and contain too few nutrients to support any other vegetation type. Sludge would increase the organic matter content, nitrogen content, cation exchange capacity (CEC), and water holding capacity of most forest soils. These improvements would probably increase tree growth and shorten the rotation cycle. This would allow a more intensive management effort and an increase in the site's fiber production value.

It is highly unlikely that sludge application would decrease the site's value as a timber producer. Researchers have reported that even massive applications of sludge (24,000 gallons per acre) have not caused negative impacts on Douglas-fir growth (Zasoski et al. 1977). In summary, soil character and use of forestlands would not be changed by sludge application.

COMPOSTING AND SOIL AMENDMENT

The impacts of sludge composting and subsequent use as a soil amendment are difficult to assess in the absence of a specific composting technique, site, and by product market. As described in Chapter 2, there are both enclosed and open air techniques for composting. In open air operations, the chances of off-site impacts are greatly increased compared to in-vessel composting. The land use compatibility and surface and groundwater quality issues are closely related to the site chosen. Finally, off-site impacts created by use of the sludge product depend upon the type of product developed and the type of reuse market that receives the material. This could range from use as a commercial soil amendment to free distribution in the local home and garden market. In the absence of a specific composting proposal, a general discussion of potential impacts follows.

Water Quality

Composting and reuse as a soil amendment could have adverse water quality impacts at the composting site and at the site of final destination. The quantity and quality of runoff from the compost site would depend on the type of composting as well as site characteristics. Tank or enclosed composting would have the least impact on surface water quality while pile or windrow composting would have the greatest impact.

The quantity of runoff from compost piles is usually small if they are covered because high temperatures generated result in significant evaporation. Leachate flowing from sludge compost piles has been found not to adversely affect the quality of nearby streams in a Metropolitan Seattle sludge management project (Municipality of Metropolitan Seattle,no date).

Water quality impacts at the final reuse site could occur because application rates and site selection may be uncontrolled. The composting process would destroy most of the biological pathogens and release most of the nitrogen, leaving only heavy metals and organic toxins, if present, to affect water quality. These contaminants would probably be bound to large organic molecules and could enter surface waters only through erosion.

Public Health

Composting is very effective at reducing or eliminating most pathogenic microorganisms from the sludge. Epstein and Willson (1975) reported temperatures exceeding 60°C throughout the compost pile for 9 days during 26 days of forced aeration composting. This was reported to have reduced Salmonella, fecal coliforms, and total coliforms to undetectable levels in the composted sludge. Forced aeration composting is preferred to windrow or other composting methods, especially with raw sludge, for purposes of odor control and additional pathogen destruction (Epstein & Willson 1975). The windrow method of composting digested sludge has been used satisfactorily; however, low temperature in the outer layers of the windrow may result in less efficient pathogen reduction (Epstein 1976). Burge and Millner (1980) reviewed the literature on the health aspects of composting sewage sludge. They concluded that risks of infection to normal healthy populations, including compost site workers, communities near compost sites, and people utilizing the compost, are low. The thermophilic fungus (Aspergillus fumigatus) and allergens from certain bacterial endotoxins may be a health threat through inhalation of dust from compost operations to individuals in a weakened, compromised or sensitized condition (Burge and Millner 1980). Workers at compost sites would be at the greatest risk to this type of exposure.

Health risks from using composted sludge as a soil amendment would be less than using dried, dewatered or liquid sludge due to the greater reduction of microbial pathogens. Risks from metals or toxic organics in the composted sludge should be similar to that of air dried sludge. As with air dried sludge, this does not present a significant risk to health.

Land Use Compatibility

Land use compatibility impacts would be tied closely to the site of the composting operation and whether or not it was an outdoor operation. Composting operations would typically be most compatible with industrial or agricultural land uses. If residential or commercial uses were located adjacent to the site, there could be complaints of noise, odor, or light and glare. Public health risks would also increase in residential neighborhoods. The Eugene/Springfield area includes enough industrial and agricultural land that there should be an acceptable site from a land use perspective for a composting operation.

Soil Character and Use

Under this alternative, impacts could occur at the composting site and at the final destination of the compost product. Impacts at the composting site would vary, depending on the type of composting and measures implemented to prevent movement of contaminants into underlying soil.

Enclosed tank composting would have the least impact, while pile or windrowing may allow contamination of underlying soil. Clay or asphalt beds below compost piles should prevent movement of contaminants to the soil. Movement of heavy metals, toxic organics, and nitrogen into the soil may also be limited by the small amount of leachate often generated by composting (Municipality of Metropolitan Seattle no date).

Soil use impacts at the final destination site would depend on the quantity of compost product added, exact nature of the product, and the existing soil conditions. Impacts from pathogens and nitrogen would be limited due to the removal of these constituents during composting. As with any public distribution scheme, application rates and methods would be uncontrolled. It is unlikely, however, that the product would be applied in quantities that would exceed EPA metal loading rates.

TOPSOIL AMENDMENT

The use of uncomposted sludge as a topsoil amendment is likely to be limited in scope in the Eugene area. The local market identified by MWMC is centered around the gravel extraction industry. Topsoil removed at gravel mining sites would be enriched with liquid or dewatered sludge prior to use in commercial or individual landscaping efforts. The two areas of impact would be the soil/sludge mixing site and the topsoil application site. Specific locations for these two operations have not been identified to date, although MWMC is investigating this sludge reuse option at the present time (Pye pers. comm.).

Water Quality

Significant water quality impacts could occur under this alternative due to the possibility of uncontrolled use. Impacts would vary considerably due to the wide variety of land types that may be considered for reuse. Lands needing a topsoil additive are usually low in organic matter and contain little clay. Topsoil reuse areas may be located in areas with coarse surface soils. This would increase the possibility of water quality impacts because metals, organic toxins, and biological pathogens may not have sufficient quantities of bonding agents, allowing them to move freely from the site. Thorough disking of the sludge into the soil may reduce the possibility of contact between surface waters and sludge, but may lead to groundwater contamination. Contaminated groundwater may be subsequently discharged into surface waters.

The likely reuse areas for sludge-enriched topsoil would include new residential and commercial development sites. These areas would normally be served by a piped water supply system rather than on-site wells, so leaching of sludge constituents into local groundwater would not be likely to result in a public health hazard.

Public Health

Use of sludge as an amendment to commercial topsoil would have certain health risks not associated with agricultural reuse or landfill disposal. The primary health concern would be the potential for uncontrolled use of the topsoil/sludge mixture. Although the level of pathogens in dried sludge is generally very low, risk of infection, especially to sensitive or weakened individuals, is still present. If liquid sludge were mixed with topsoil, the risk would be much greater. Use of the sludge-amended topsoil in heavy public use areas around hospitals, nursing homes, or even for residential lawns and gardens, without additional disinfection, could be considered an unacceptable level of risk. Use of the topsoil-amended sludge for growing food chain crops should have restrictions similar to those imposed on agricultural reuse sites in order to protect the public from heavy metal accumulations. The ability to control the final use and distribution of the topsoil which has been amended with sludge is important in the prevention of unacceptable health risks. An alternative to reduce the risk would be further reduction of pathogens in the sludge prior to use as a topsoil amendment by pasteurization, irradiation, or other acceptable methods as specified by EPA (40 CFR 257).

Land Use Compatibility

The acceptability of using a sludge/topsoil mix in urban areas would depend upon the degree of pathogen and odor reduction achieved prior to final use. A thoroughly dried, thoroughly mixed soil/sludge product would be compatible with most land uses, except perhaps hospitals and nursing homes as mentioned above. Residential and parkland uses would be acceptable as long as some drying and mixing control could be guaranteed. Use in cropland areas would be restricted to nonfood chain crop production sites by the DEQ sludge management regulations.

Soil Character and Use

Impacts to future soil use under this alternative could be significant if use is uncontrolled. Application of sludge at rates greater than those recommended by state and federal agencies could prevent use of the site for production of food chain crops or, in extreme cases, could place restrictions on public uses such as parks or residential development.

It is assumed that the sludge would be disked into the soil prior to relocation of the mixed product. This would reduce the photochemical degradation of organic toxins and allow these materials to accumulate. If mixed in moderate amounts, sludge would improve soil texture and nutrient content and may allow a wider range of crops or ornamental plantings to be grown, especially if the site were of poor quality initially.

DEDICATED LAND DISPOSAL

Dedicated land disposal (DLD) is not a sludge reuse alternative. It represents a substitute for both the processing and reuse or disposal of sludge beyond the initial digestion stage. Liquid sludge is transported and applied to a site permanently dedicated to sludge disposal. Because the sludge does not undergo processing beyond digestion, pathogen levels are often high and the solids content is very low. The large volumes of liquid involved create both transport and containment problems.

Water Quality

Although this alternative would result in the concentration of sludge in a relatively small area, water quality impacts could be minimized through careful site selection, disposal, and monitoring. Water quality impacts would vary depending on site parameters, sludge characteristics, and disposal rates.

Although it is not typically practiced for DLD sites, disposal of air-dried sludge would be preferred because of the low quantity of water available for runoff or percolation and the relatively low concentrations of potential pollutants. Direct surface runoff contamination could be minimized if sludge were injected into the soil at the DLD site. However, this would increase the possibility of groundwater contamination. Photochemical degradation of organic toxins would be decreased by injection. Injection, however, would expose sludge constituents to a greater quantity of bonding agents such as clay and organic matter. The risk of eventually leaching sludge constituents into underlying groundwater at DLD sites is a major limitation.

Public Health

By definition, a DLD site must be isolated hydrogeologically from any potentially useful groundwater aquifers and be designed to prevent any possibility of contamination of surface water. Site selection and design to achieve these safeguards is essential.

The primary health risk of an improperly located and designed DLD site would be potential contamination of groundwater and adjacent surface waters. Selection of a DLD site with fine textured clay-rich soils adjusted to a pH of 6.5 or above could prevent significant migration of pathogens, metals, and toxic organics to the groundwater.

Nitrate contamination is usually the primary health concern. Application rates of 38-48 dry tons per acre per year, as proposed by Brown and Caldwell (1980), are over 10 times the application rate proposed for existing agricultural reuse of sludge with surface application (Lowenkron pers. comm.). Since injection of sludge is proposed, rather than surface application, no volatilization of ammonia nitrogen would occur during application, resulting in sludge applications over 20 times the recommended agronomic loading rate for nitrogen (Oregon DEQ 1981). Much of this excess nitrogen will be nitrified and could migrate to the groundwater beneath the DLD site, resulting in unsafe levels of nitrate in downgradient drinking water supplies. This must be prevented by locating the site where the leachate cannot travel to potentially useful groundwater aquifers because of hydrogeologic barriers.

Beneficial health considerations of DLD include elimination of health risks from food chain contamination and better control over risks from direct contact, when compared to agricultural reuse, by reducing the total amount of land used and ensuring better control of site access.

Land Use Compatibility

DLD would be compatible primarily with open space and agricultural land uses. Because of the frequent and heavy applications of liquid sludge at these sites, limited public access is desirable. This is best achieved in a rural setting. Care also has to be taken in rural settings, however, to ensure that domestic water supplies and recreational surface waters are not adversely affected. Buffer strips between residential areas, surface waterways, and public use areas would be desirable to lower the risk of adversely affecting these uses.

Soil Character and Use

Dedicated land disposal of sludge would limit the future use of the site soils. Site leaching and runoff would be controlled so that a minimum of potential pollutants would leave the site.

Brown and Caldwell (1980) estimated an average sludge loading rate of 43 dry tons per acre per year for the initial and design years of a DLD site. Assuming a cadmium concentration of 7 mg/kg (Brown and Caldwell 1979), the cadmium loading rate would be 0.7 kg/ha, which is over the 0.5 kg/ha level set by the EPA for soils supporting leafy vegetable crops grown for human consumption. This loading rate would result in exceedence of the maximum cumulative cadmium standards for agricultural land within 8-33 years, depending on soil pH and CEC. Annual nitrogen additions to the site would exceed those recommended to control leaching. In summary, DLD of sludge would limit future agricultural use of the soils to nonfood chain crops on the site.

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ACRONYMS AND ABBREVIATIONS

BOD - biochemical oxygen demand
BPA - Bonneville Power Administration
Ca - calcium
CAA - Federal Clean Air Act
CEC - cation exchange capacity
CEQ - Council on Environmental Quality
CFR - code of federal regulations
cfs - cubic feet per second
CPR - comprehensive plan revision
DAF - dissolved air flotation
DEQ - Oregon Department of Environmental Quality
DLD - dedicated land disposal
DO - dissolved oxygen
EFU - exclusion farm use zone
EIS - Environmental Impact Statement
EPA - U. S. Environmental Protection Agency
ESA - Federal Endangered Species Act
FAA - U. S. Federal Aviation Administration
Fe - iron
FEMA - U. S. Federal Emergency Management Agency
FSL - facultative sludge lagoon
gal - gallon
gpd - gallons per day
gpm - gallons per minute
kg/ha - kilograms per hectare
Kwh - kilowatt hour
LIM - land inventorying and management memorandum
LCDC - Oregon Land Conservation and Development Commission
LCOG - Lane Council of Governments
LUBA - Oregon Land Use Board of Appeals
meq - milli-equivalent
MGD - million gallons per day
mg/kg - micrograms per kilogram
mg/l - milligrams per liter
MPN - most probable number
MWMC - Metropolitan Wastewater Management Commission
M-2 - light industrial zoning
M-3 - heavy industrial zoning
N - nitrogen
N_2 - nitrogen gas
N_2O - nitrous oxide
NEPA - National Environmental Policy Act
NH_3 - un-ionized form of ammonia
NH_4^+ - ionized form of ammonia
NHPA - National Historic Preservation Act
NO_3 - nitrate
NPDES - National Pollutant Discharge Elimination System
O&M - operation and maintenance
ORS - Oregon Revised Statutes

PCB - polychlorinated biphenyl
PF - public facility zoning
PL 92-500 - Federal Water Pollution Control Act
PL 95-217 - Federal Clean Water Act
RCRA - Federal Resource Conservation and Recovery Act
RRSC - River Road/Santa Clara
RWTP - regional wastewater treatment plant
SCS - U. S. Soil Conservation Service
SHPO - Oregon State Historic Preservation Office
SIP - Oregon State Implementation Plan
SSB - solids storage basin
TDS - total dissolved solids
TSCA - Federal Toxic Substances Control Act
UGB - urban growth boundary
USFWS - U. S. Fish and Wildlife Service
WAS - waste activated sludge
WDP - waste discharge permit
μg - microgram
$\geq$ - equal to or greater than

Appendix A

Legal and Regulatory Influences on the Proposed Project

LEGAL AND REGULATORY INFLUENCES ON THE PROPOSED PROJECT

Federal Requirements Relevant to Sludge Management

CLEAN WATER ACT (42 USC S1857 ET SEQ.)

The goals of the Act are to achieve "fishable, swimmable" surface waters throughout the nation by 1983, and to achieve no discharge of pollutants by 1985. Section 201 of the Clean Water Act establishes a construction grants program for municipal wastewater facilities, wherein federal grants are offered for the planning, design, and construction of publicly-owned treatment works. This funding is 75 percent (85 percent for innovative and alternative technology projects) of the eligible costs of municipal wastewater treatment plants and sludge management facilities. The MWMC sludge management plan has been funded with a Step 1 construction grant.

Section 208 of the Act establishes an areawide waste treatment management planning process; Section 208 plans must develop controls for both point and nonpoint sources of water pollution. Under Section 303 of the Act, states are required to prepare and enforce ambient water quality standards and to prepare basin plans showing how these standards will be met. The MWMC sludge management plan must be consistent with areawide and state water quality management plans.

Under Sections 401 and 402 of the Act, EPA or the states are required to issue NPDES permits for all point sources of pollution. NPDES permits for wastewater treatment plants include sludge disposal conditions where possible, thus reducing the need for separate sludge disposal permits.

Several portions of the Act relate specifically to sewage sludge management. Section 405(d) requires EPA to promulgate guidelines and regulations for sewage sludge disposal. Pursuant to both this section and requirements of the Resource Conservation and Recovery Act (RCRA), EPA has issued Criteria for the Classification of Solid Waste Disposal Facilities and Practices (Criteria) (40 CFR Part 257). The Criteria set forth specific requirements for protection of floodplains, endangered species, surface water, groundwater, sludge application to land used for production of food chain crops, disease vectors, air emissions, and safety. They regulate all land-based alternatives for sewage sludge disposal, including landfilling, nonagricultural land application, and agricultural land application. Sludge management projects implemented pursuant to the MWMC sludge management plan must be consistent with the Criteria.

Under authority of Section 405(d), EPA is also currently developing regulations (40 CFR Part 258) for the public distribution and marketing of sewage sludge-derived fertilizer products. Other portions of the Act related to sludge management include Section 307, which encourages the utilization of sludge by requiring pretreatment of industrial wastes entering publicly-owned treatment works. MWMC has implemented a pretreatment program pursuant to the Act.

THE RESOURCE CONSERVATION AND RECOVERY ACT (42 CFR 3251 ET SEQ.)

RCRA establishes national policies and programs for solid waste management, in general, and for hazardous waste management, in particular. With respect to solid waste management, the Act prohibits new open dumping sites, requires that all open dumping sites be converted to sanitary landfills or closed by 1983, and authorizes the preparation of the Criteria described above (40 CFR Part 257). The Act further provides financial assistance for the development and implementation of comprehensive state solid waste management plans, which are to include environmentally-sound disposal methods and resource recovery programs.

Subtitle C of RCRA establishes a program for comprehensive "cradle-to-grave" regulation of hazardous wastes. Municipal sludge is not listed as a hazardous waste in RCRA, but it is also not exempted from consideration as a hazardous waste. A process has been developed whereby the generators of municipal sludge can provide an analysis of sludge constituents to EPA or a designated state agency so that a determination on RCRA applicability can be reached if this is deemed necessary. To date, no municipal sludge has been designated as hazardous within EPA Region 10's jurisdiction (Oregon, Washington, Idaho, and Alaska). In Oregon, the state DEQ has been delegated authority to make these determinations. There has been no request for a RCRA applicability determination on Eugene/Springfield sludge because chemical analyses have not indicated there are unacceptably high levels of hazardous materials in the sludge. Therefore, it is not anticipated that RCRA Subtitle C regulations will affect the MWMC sludge management plan.

THE CLEAN AIR ACT (42 USC 1857 ET SEQ.)

The Clean Air Act (CAA) sets the basic framework for federal, state, and local air quality management programs. The major implementation provision of the CAA requires each state to establish and implement a plan to achieve federal ambient air quality standards within specified time frames. The resulting State Implementation Plans (SIPs) provide the regulatory programs for controlling pollutant emissions from existing and future sources. EPA procedures require the agency to consult with appropriate state and local agencies when a proposed action may have a significant effect on air quality to determine the conformity of the action with the applicable SIP (40 CFR S6.303).

The Act provides for two sets of national ambient air quality standards, primary standards (for the protection of human health) and secondary standards (for the protection of other values such as crops and materials). The Act also provides for national emissions standards for hazardous pollutants, and for new source performance standards for certain industrial categories.

Areas which exceed any federal primary air quality standard (nonattainment areas) are required by the Act to control both existing and new emission sources so as to achieve annual incremental reductions in pollutant emissions until the federal standards are met. The Act requires states to establish new source review programs for major new stationary sources and to establish a program for prevention of significant deterioration in areas that currently meet national ambient standards.

Incineration and thermal reduction of sludge must meet a number of CAA requirements. Most importantly, these alternatives must comply with SIP emission limitations, with national emissions standards for hazardous pollutants, and with new source performance standards.

SAFE DRINKING WATER ACT (42 USC 300f ET SEQ.)

This law establishes the national program for protecting drinking water supplied by municipal and industrial water suppliers. Pursuant to the Act, EPA has issued national primary drinking water standards to protect human health (40 CFR Part 143, see Table A-1). These standards are minimums to be adopted by the states and applied to municipal and industrial water suppliers. Under the Act, states with approved programs have the primary implementation and enforcement authority.

Section 1412 of the Act establishes national secondary drinking water regulations which control contaminants in drinking waters that primarily affect aesthetics. These regulations are not federally enforceable, but are intended to act as guidelines to the states. Maximum contaminant levels are identified for chloride, color, copper, corrosivity, foaming agents, iron, manganese, odor, pH, sulfate, total dissolved solids, and zinc. Excess levels of these contaminants can affect public acceptance of drinking water, and in higher concentrations, can have public health effects.

Section 1421 of the Act authorizes state underground injection control programs. The state program would apply if sludge is injected into the ground or abandoned wells or mines.

Table A-1. National Primary Drinking Water Standards

TYPE OF CONTAMINANT	NAME OF CONTAMINANT	TYPE OF WATER SYSTEM	MAXIMUM CONTAMINANT LEVEL
Inorganic Chemicals			
	Arsenic	Community	0.05 mg/l
	Barium		1.
	Cadmium		0.010
	Chromium		0.05
	Lead		0.05
	Mercury		0.002
	Selenium		0.01
	Silver		0.05
	Fluoride		
	33.7°F & below		2.4
	53.8 - 58.3		2.2
	58.4 - 63.8		2.0
	63.9 - 70.6		1.8
	70.7 - 79.2		1.6
	79.3 - 90.5	Community	1.4
	Nitrate (as N)	Community & non-community	10.
Organic Chemicals			
	Endrin	Community	0.002 mg/l
	Lindane		0.004
	Methoxychlor		0.1
	Toxaphene		0.005
	2, 4-D		0.1
	2, 4, 5-TP Silvex	Community	0.01

Total trihalomethanes (the sum of the 0.10 mg/l concentrations of bromodichloromethane, dibromochloromethane, tribromomethane [bromoform] and trichloromethane [chloroform]) 1, 2

TYPE OF CONTAMINANT	NAME OF CONTAMINANT	TYPE OF WATER SYSTEM	MAXIMUM CONTAMINANT LEVEL
Turbidity			
	Turbidity at representative entry point to distribution system	Community & non-community	1 TU monthly average and 5 TU average of two consecutive days (5 TU monthly average may apply at state option)

1. Proposed MCL (Maximum contaminant level)
2. The maximum contaminant level for total trihalomethanes applies only to community water systems which serve a population of greater than 75,000 individuals and which add a disinfectant to the water in any part of the drinking water treatment process.

TYPE OF CONTAMINANT	NAME OF CONTAMINANT	TYPE OF WATER SYSTEM	MAXIMUM CONTAMINANT LEVEL
Microbiological			
	Coliform Bacteria	Community & non-community	Membrane Filter* Coliforms shall not exceed: 1 per 100 ml, mean of all samples per month, 4 per 100 ml in more than one sample if less than 20 samples collected per month, or, 4 per 100 ml in more than 5 percent of samples if 20 or more samples are examined per month. Fermentation Tube - 10 ml Portion* Coliforms shall not be present in more than 10 percent of portions per month, not more than 1 sample may have 3 or more portions positive when less than 20 samples are examined per month, or not more than 5 percent of samples may have 3 or more portions positive when 20 or more samples are examined per month.

Table A-1 Continued

TYPE OF CONTAMINANT	NAME OF CONTAMINANT	TYPE OF WATER SYSTEM	MAXIMUM CONTAMINANT LEVEL
			Fermentation Tube - 100 c Portion* Coliforms shall not be present in more than 60 percent of the portions per month, not more than 1 sample may have all 5 portions positive when less than 5 samples are examined per month, or not more than 20 percent of samples may have all 5 portions positive when 5 or more samples are examined per month.

* If sampling rate is less than 4 per month, compliance shall be based on 3-month period unless state determines that a 1-month period shall apply.

TYPE OF CONTAMINANT	NAME OF CONTAMINANT	TYPE OF WATER SYSTEM	MAXIMUM CONTAMINANT LEVEL
Microbiological	Optional Chlorine Residual	Community & non-community	Minimum free chlorine residual throughout distribution system 0.2 mg/l. (At state option and based on sanitary survey, chlorine residual monitoring may be substituted for not more than 75 percent of microbiological samples.)
Radionuclides		Community	
Natural	Gross Alpha Activity		15 pCi/l
	Radium 226 + Radium 228		5 pCi/l
			Screening level: 1) test for Gross Alpha; 2) if Gross Alpha exceeds 5 pCi/l, test for Radium 226; 3) if Radium 226 exceeds 3 pCi/l, test for Radium 228.
Man-made	Beta particle and photon radioactivity	Community	4 millirem/year for total body or any internal organ.
			Screening level: Gross Beta Activity 50 pCi/l, tritium 20,000 pCi/l, Strontium 90 8 pCi/l. If Gross Beta exceeds 50 pCi/l, sample must be analyzed to determine major radioactive constituents present; and the appropriate organ and total body doses shall be calculated to determine compliance with the 4 millirem/year level.

THE TOXIC SUBSTANCES CONTROL ACT (15 USC 2601 ET SEQ.)

The Toxic Substances Control Act (TSCA) empowers EPA to control production and use of toxic substances. Under the Act, EPA is empowered to regulate any aspect of chemical use likely to result in an unreasonable risk of serious or widespread injury to public health or the environment. The Act prohibits the production of polychlorinated biphenyls (PCBs) after January 1979 and the distribution of PCBs in commerce after July 1979, resulting in an expected long-term decline in the PCB content of municipal sludge.

The Act also requires coordination with the CAA and Clean Water Act to restrict disposal of hazardous wastes. High concentrations of PCBs in sewage sludge would cause it to be considered a hazardous waste regulated by TSCA.

NATIONAL ENVIRONMENTAL POLICY ACT (42 USC 4321 ET SEQ.)

NEPA and regulations issued pursuant to NEPA establish policies and procedures for assuring that federal actions are consistent with the nation's environmental quality objectives. NEPA directs that, to the fullest extent possible, federal agencies are to carry out their programs in accordance with NEPA policies and procedures. NEPA's "action-forcing mechanism" requires that federal agencies prepare EISs, using a "systematic, interdisciplinary approach" to assess the impacts of "major federal actions significantly affecting the quality of the human environment."

Regulations of the Council on Environmental Quality (CEQ) (40 CFR Sections 1500-1508) and EPA (40 CFR Part 6) provide detailed requirements for implementing NEPA. Preparation of this EIS satisfies EPA's environmental impact review responsibilities under NEPA.

ENDANGERED SPECIES ACT (16 USC 1536 ET SEQ.)

Federal policies and procedures for protecting endangered and threatened species of fish, wildlife, and plants are established by the Endangered Species Act (ESA) and regulations issued pursuant to the Act. The purposes of the Act are to provide mechanisms for conservation of endangered and threatened species and the habitats upon which they depend, and to achieve the goals of international treaties and conventions related to endangered species. Under the Act, the Secretary of the Interior is required to determine which species are endangered or threatened, and to issue regulations for protection of those species.

Section 7 of the Act requires federal agencies to consult with the U. S. Fish and Wildlife Service (USFWS) in order to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or result in the adverse modification or destruction of their critical habitat. Upon determination that an endangered or threatened species may be present in the area of a proposed action, the responsible agency must conduct a biological assessment to identify how the listed species might be affected. The biological assessment may be performed as part of an environmental assessment or EIS pursuant to NEPA. EPA has undertaken Section 7 consultation for the MWMC project.

CULTURAL RESOURCE PROTECTION

A number of federal laws and regulations have been promulgated to protect the nation's historical, cultural, and prehistoric resources. These include the National Historic Preservation Act, the Archeological and Historic Preservation Act, the Archeological Resources Protection Act, and the American Indian Religious Freedom Act.

Pursuant to the National Historic Preservation Act (NHPA) (16 USC 470 et seq.), the effects of any federal or federally-assisted undertaking on historical, cultural, or archeological resources must be evaluated. An "effect" is defined as any change in the quality of the characteristics that qualify the resource for protection under the law (36 CFR 800). For properties on or eligible for the National Register of Historic Places, the responsible federal agency must consult with the State Historic Preservation Officer (SHPO) regarding any potential adverse effects on resources of historic, architectural, archeological, or cultural significance.

The Archeological and Historic Preservation Act (88 Stat., 174) and the Archeological Resources Protection Act (93 Stat. 721) safeguard historical and archeological resources from damage or loss to federally-sponsored or permitted projects, and from excavation or removal from federal and Indian lands, respectively. The American Indian Religious Freedom Act (42 USC 1776) assures that federal activities do not impair access to religious sites and will not affect ceremonial rites of American Indians.

Cultural resource protection laws have been complied with in preparing this EIS.

PROTECTION OF AGRICULTURAL LANDS

On September 8, 1978, EPA issued its policy to protect environmentally significant agricultural lands. Under this policy, EPA is required to identify the direct and indirect impacts of its actions on environmentally significant agricultural lands and to avoid or mitigate, to the extent possible, identified adverse impacts.

The CEQ issued a memorandum in 1980 emphasizing the need for determining the effects of proposed federal agency actions on prime or unique agricultural lands (45 FR 59189, September 8, 1980). Prime farmlands are to be considered a "depletable resource" and impacts to them must be evaluated in the environmental assessment process. Impacts to be evaluated include reduction in farmland productivity and conversion of farmlands to other uses.

FLOODPLAINS AND WETLANDS

Executive Order 11988 requires federal agencies, in carrying out their responsibilities, to take action to reduce the risk of flood loss; to minimize flood impacts on human safety, health, and welfare; and to restore and preserve the natural and beneficial values served by floodplains. Executive Order 11990 requires federal agencies, in carrying out their responsibilities, to take action to minimize the loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. Each agency is required to avoid undertaking or providing assistance for construction in wetlands unless the agency finds there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands.

EPA has developed procedures implementing these Executive Orders on floodplain management and wetlands protection (40 CFR 6, Appendix A). Under these procedures, EPA is required to assess floodplains and wetlands impacts of its actions, and to either avoid adverse impacts or minimize them if no practicable alternative to the action exists.

State Requirements

DEPARTMENT OF ENVIRONMENTAL QUALITY SLUDGE MANAGEMENT GUIDELINES

The Oregon DEQ has prepared Guidelines for Handling, Disposal, and Use of Sewage Sludge to regulate sewage sludge reuse and disposal within the state. These guidelines place restrictions on the location of sludge, reuse or disposal, provide site selection and approval criteria, establish monitoring and reporting requirements, and propose limitations on the build-up of certain sludge constituents in the soil. MWMC plans for agricultural reuse or landfilling of sludge must comply with the requirements of these guidelines (see Appendix F).

OREGON ADMINISTRATIVE RULES 340-61 SOLID WASTE MANAGEMENT

Oregon Administrative Rules, Chapter 340, Division 61, contains special rules pertaining to sludge disposal sites (340-61-055). The rules require a permit for all sewage sludge disposal sites unless the wastewater treatment facility which is the source of the sludge has a Waste Discharge Permit (WDP) that specifies conditions for sludge disposal.

Other state regulations, plans, and policies that have some influence on the MWMC sludge management plan are discussed in the text of the environmental evaluation in Chapter 3.

Appendix B

Project Design and Operating Data, Alternative Screening

Table B-1. Present Digested Sludge Constituent Concentrations

Sludge constituent	Mean concentration (mg/kg)[a]		Range of concentration (mg/kg)[a]		Number of samples each city[b]
	Eugene	Springfield	Eugene	Springfield	
Arsenic	7.4	5.1	5.5-10.0	4.4-5.7	5
Boron	23.9	12.8	1.1-57.0	1.7-36.0	5
Cadmium	7.7	6.1	6.0-9.6	4.2-8.2	5
Copper	474	680	348-600	538-880	5
Lead	139	131	95-208	82-256	5
Mercury	7.5	7.0	6.1-9.0	5.3-9.5	5
Molybdenum	7.2	9.2	4.1-12.0	4.6-14.0	5
Nickel	304	79	236-450	52-110	5
Selenium	0.6	0.8	0.1-2.1	0.1-2.9	5
Zinc	1,852	1,294	1,300-2,400	924-1,700	5
Aluminum	23,923	18,975	19,020-28,825	16,950-21,000	2
Antimony	104	156	66-141	99-218	2
Chromium	215	72	44-386	61-82	2
Iron	19,252	19,745	17,854-20,650	18,490-21,000	2
Manganese	374	334	337-410	303-364	2
Potassium	2,105	2,278	1,900-2,390	2,053-2,800	5
Total phosphorous	13,019	12,163	9,970-14,610	10,450-14,339	3
Total nitrogen (percent)	3.4	4.9	1.7-4.4	4.2-5.9	4
Ammonia nitrogen (percent)	1.1	1.8	0.9-1.3	1.2-2.3	4
Sodium	1,195	6,780	-	-	1
Calcium	20,590	38,980	-	-	1
Magnesium	4,528	4,576	-	-	1
Chloride[c]	16	16	-	-	1
Sulfate[c]	9.9	9.1	-	-	1
Total dissolved solids (mg/l)	773	1,688	602-944	1,240-2,564	12
Total solids (percent)	7.5	5.5	6.4-9.2	4.6-6.3	5
Volatile matter (percent)	46.3	52.3	40.1-47.7	48.1-54.3	26
pH	7.1	7.3	7.0-7.7	7.1-7.8	26
Fecal coliforms (organisms per ml)	13	2,000	10-20	500-3,500	7
Total coliforms (organisms per ml)	829	6,040	100-2,800	600-10,500	5

[a]Dry weight basis, milligrams per kilogram unless otherwise stated.
[b]All metal samples were monthly composited during the months of April through August, 1978. All other samples were grab samples during the months of April and May, 1978.
[c]Determined on supernatant, milligrams per liter.

SOURCE: Brown and Caldwell 1980.

Table B-2. Chlorinated Hydrocarbons in Existing Eugene and Springfield Sludges

Chlorinated hydrocarbon	Detection limit		Concentration in sludge mg/kg[c]		Drinking water standard mg/l[f]
	mg/kg[a]	mg/l[b]	Eugene sludge	Springfield sludge	
Aldrin	0.01	0.0006	ND[d]	ND	g
BHC isomers (includes Lindane)	0.01	0.0006	ND	ND	0.004
Technical Chlordane	0.05	0.003	0.07	0.05	0.003
Dacthal	0.01	0.0006	ND	ND	g
DDE	0.01	0.0006	ND	TD[e]	g
DDD (TDE)	0.05	0.003	ND	ND	g
DDT	0.05	0.003	ND	ND	g
Dieldrin	0.01	0.0006	ND	ND	g
Dioxin	0.05	0.003	ND	ND	g
Endrin	0.01	0.0006	ND	ND	0.0002
Heptachlor	0.01	0.0006	ND	ND	0.0001
Heptachlor epoxide	0.01	0.0006	ND	ND	0.0001
Hexachlorobenzene	0.01	0.0006	ND	ND	g
Metaoxychlor	0.1	0.006	ND	ND	0.1
PCNB	0.01	0.0006	ND	ND	g
Pentachlorophenol	0.05	0.003	ND	ND	g
Polychlorinated Biphenyls					
1242	0.01	0.0006	ND	ND	g
1254	0.01	0.0006	0.14	0.15	g
1260	0.01	0.0006	ND	ND	g
Toxaphene	1.0	0.06	ND	ND	0.005
Thiodan	0.05	0.003	ND	ND	g
TOK	0.05	0.003	ND	ND	g

[a]Detection limit of analytical methods used for this sludge analysis. Dry weight basis.
[b]Concentration limit in sludge of 6 percent solids, milligrams per liter.
[c]Composite samples from September, 1978. Three samples per week composited for entire month.
[d]ND - None detected above limits of this analysis.
[e]TD - Trace detected.
[f]Public Law 92523.
[g]No drinking water standard proposed as yet.

SOURCE: Brown and Caldwell 1980.

Table B-3. Initial Screening Matrix for Base Sludge Utilization/Disposal Options

Utilization/ disposal options	Feasibility	Reliability	Environ-mental hazard	Site availability	Cost	Acceptable for base alternative
Incineration	X	X	X	X	X	X
Pyrolysis	X	X	X	X	X	X
Bag-market as fertilizer	X	O	X	X	X	O
Agricultural land (private)	X	O	X	X	X	O
Agricultural land (public)	X	X	X	X	X	X
Forested land (private)	X	O	X	O	O	O
Forested land (public)	X	X	X	O	O	O
Give to citizens horticulture	X	O	X	X	X	O
Combine with commercial topsoil	X	O	X	X	X	O
Landfill	X	X	X	X	X	X
Dedicated land disposal	X	X	X	X	X	X

X - Acceptable as a base alternative component.

O - Unacceptable as a base alternative component.

SOURCE: Brown and Caldwell 1980.

Table B-4. Compatible Options for Sludge Processing and Utilization/Disposal

Base[a] utilization/disposal options	Sludge processing options[b]						
	Digested sludge options				Raw sludge options		
	Digest	Digest dewater	Digest air dry	Digest dewater compost	Dewater compost	Dewater	Lime stabilize dewater
Dedicated land	X	X	X	O	O	O	O
Agricultural land	X	X	X	X	X	O	O
Landfill	O	X	X	O	O	O	X
Incineration	O	O	O	O	O	X	O
Pyrolysis	O	O	O	O	O	X	O

X - Suitable combination.

O - Unsuitable combination.

SOURCE: Brown and Caldwell 1980.

Table B-5. Summary of Alternative Evaluation

Evaluation category	Alternative		
	IIa	IIe	III
Cost	1	2	3
Environmental impacts	2	1	3
Reliability	1	2	3
Flexibility	1	2	3
Program Implementation	1	1	2
Overall rating	1	2	3

Note: 1=Lowest or best condition.
3=Highest or worst condition.

SOURCE: Brown and Caldwell 1980.

Appendix C

Public Health Background Data

Table C-1. Human Enteric Pathogens Occurring in Wastewater and Sludge and the Diseases Associated With the Pathogens
From: Love et al. 1975

PATHOGENS	DISEASES
Bacteria	
Vibrio cholerae	Cholera
Salmonella typhi	Typhoid and other enteric fevers
Shigella species	Bacterial dysentery
Proteus species	Diarrhea
Coliform species	Diarrhea
Clostridium species	Botulism
Pseudomonas species	Local infection
Viruses	
Infectious hepatitis virus	Hepatitis
Echoviruses	Enteric and other diseases
Coxsackie virus	Enteric and other diseases
Poliovirus	Poliomyelitus
Epidemic gastroenteritis virus	Gastroenteritis
Parasites	
Entamoeba histolytical	Amoebic dysentery
Balantidium coli	Balantidial dysentery
Iospora hominis & others	Coccidiosis
Giardia lamblia	Diarrhea
Pinworms (eggs)	Ascariasis
Tapeworms	Tapeworm infestation
Liver & intestinal flukes	Liver or intestinal infestation

Appendix D

Biological Resources Analysis Background Data

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Endangered Species
2625 Parkmont Lane S.W., B-2
Olympia, WA 98502

February 24, 1983

Ms. Minty Green
Jones & Stokes Associates, Inc.
2321 P Street
Sacramento, California 98516

Refer to: 1-3-83-SP-153

Dear Ms. Green:

This is in response to your letter, dated January 28, 1983, for information on listed and proposed endangered and threatened species which may be present within the area of the proposed wastewater treatment sites near Eugene in Lane County, Oregon. Your request and this response are made pursuant to Section 7(c) of the Endangered Species Act of 1973, 16 U.S.C. 1531, et seq.

To the best of our present knowledge there are no listed or proposed species occurring within the area of the subject project. (See attachments) Should a species become officially listed or proposed before completion of your project, you will be required to reevaluate your agency's responsibilities under the Act. We appreciate your concern for endangered species and look forward to continued coordination with your company.

Sincerely,

Jim A. Bottorff
Endangered Species Team Leader

Attachments

cc: RO (AFA-SE)
ES, Olympia
ODFW - Non-Game Program

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR WITHIN THE AREA OF THE PROPOSED WASTEWATER TREATMENT SITES NEAR EUGENE, LANE COUNTY, OREGON
1-3-83-SP-153

LISTED:

None

PROPOSED:

None

CANDIDATE:

None

Attachment A

ORDER

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

5200. 5

10/16/74

SUBJ: FAA GUIDANCE CONCERNING SANITARY LANDFILLS ON OR NEAR AIRPORTS

1. PURPOSE. This order provides guidance concerning the elimination or monitoring of open dumps, waste disposal sites, and sanitary landfills on or in the vicinity of airports.

2. DISTRIBUTION. This order is distributed to Washington headquarters and Regional Airports, Flight Standards and Air Traffic offices to division level; all Airports District Offices; and Flight Standards and Air Traffic field facilities.

3. BACKGROUND. Garbage dumps, sanitary landfills or whatever title is used for this type of operation attract rodents and birds, erodes the airport environment, and where the dump is ignited, creates smoke - all which are undesirable and are potential hazards to aviation.

While the chance of an unforeseeable, random bird strike in flight will always exist, it is nevertheless possible to define the high-risk conditions within fairly narrow limits. Those high-risk conditions exist in the take-off, climb-out, approach and landing areas on and in the vicinity of airports. The increasing number of bird strikes reported on aircraft has become a matter of concern to the FAA and to airport management. Various studies and observations have resulted in the conclusion that sanitary landfills are artificial attractants to birds. Accordingly, landfills located in the vicinity of an airport may be incompatible with safe flight operations. Those conditions that are not compatible must be eliminated, to the extent practicable. Airport owners need guidance in making this decision, and the FAA must be in a position to assist. Some airports are not under the jurisdiction of the community or local governing body having control of land usage in the vicinity of the airport. In these cases, the airport owner should use its influence and best efforts to close or control landfill operations within the general vicinity of the airport.

4. ACTION.

a. Sanitary landfills located within the areas established for an airport by these guidelines as set forth in paragraph 5 of this order should be closed. If a sanitary landfill is determined as

Distribution: WRAS/AT/FS-2; FFS-0, FAT-0, FAS-1 (Normal)

Initiated By: AAS-680

incompatible land use under guidelines of paragraph 5 and cannot be closed within a reasonable time, it should be designed and operated in accordance with the criteria and instructions issued by the Environmental Protection Agency, the Department of Health, Education and Welfare, and other such regulatory bodies that may have applicable requirements. FAA should advise airport owners against locating, permitting or concurring in the location of a landfill on or in the vicinity of airports.

b. The operation of a sanitary landfill located beyond the areas described in paragraph 5 and designed in accordance with the guidelines identified in the foregoing paragraph must be properly supervised to insure compatibility with the airport. If at any time the landfill, by virtue of its operation, presents a potential hazard to aircraft operations, the owner shall take action to correct the situation or terminate operation of the landfill. Failure to take corrective action could place the airport owner in noncompliance with the commitments under a grant agreement.

c. An inspection of current operations at existing landfill sites which have a reported potential bird hazard problem will periodically be made and evaluated. A Bird Hazard Group formed under Order 5200.4 dated 11/20/73 could appropriately be available for consultation regarding this activity. Should it be found that birds attracted to the landfill site do in fact constitute a potential hazard to aircraft, the condition will be reported to AAT-430, National Flight Data Center (NFDC), for possible inclusion in the Airman's Information Manual. The appropriate FAA office should immediately evaluate the situation to determine compliance with the grant agreement and take such action as may be warranted under the guidelines as prescribed in Order 5190.6, Airports Compliance Requirements.

d. This order does not apply to landfills used exclusively for the disposal of rock and earth.

e. This order is not intended to resolve all related problems, but is specifically directed toward eliminating sanitary landfills in the proximity of airports, thus providing a safer environment for aircraft operations.

f. The airport operations manual should require landfill site inspections at least semimonthly for those landfill operations that cannot be closed to assure that bird population is not increasing.

g. Additional information on solid waste disposal, bird hazard and related problems may be obtained from the following agencies:

Bureau of Sport Fisheries and Wildlife
U.S. Department of the Interior
18th and C Streets, N.W.
Washington, D.C. 20240

Office of Solid Waste Management
Programs (HM-562)
U.S. Environmental Protection Agency
1835 K Street, N.W.
Washington, D.C. 20406

U.S. Department of Health, Education & Welfare
330 Independence Avenue, S.W.
Washington, D.C. 20201

5. CRITERIA. Sanitary landfills will be considered as an incompatible use if located within areas established for the airport through the application of the following criteria:

a. Landfills located within 10,000 feet of any runway used or planned to be used by turbojet aircraft.

b. Landfills located within 5,000 feet of any runway used only by piston type aircraft.

c. Landfills outside of the above perimeters but within the conical surfaces described by FAR Part 77 and applied to an airport will be reviewed on a case-by-case basis.

d. Any landfill located such that it places the runways and/or approach and departure patterns of an airport between bird feeding, water, or roosting areas.

William V. Vitale

WILLIAM V. VITALE, Acting Director
Airports Service, AAS-1

consumption, and animal feed for animals whose products are consumed by humans.

(5) "Incorporated into the soil" means the injection of solid waste beneath the surface of the soil or the mixing of solid waste with the surface soil.

(6) "Pasture crops" means crops such as legumes, grasses, grain stubble and stover which are consumed by animals while grazing.

(7) "pH" means the logarithm of the reciprocal of hydrogen ion concentration.

(8) "Root crops" means plants whose edible parts are grown below the surface of the soil.

(9) "Soil pH" is the value obtained by sampling the soil to the depth of cultivation or solid waste placement, whichever is greater, and analyzing by the electrometric method. ("Methods of Soil Analysis, Agronomy Monograph No. 9," C.A. Black, ed., American Society of Agronomy, Madison, Wisconsin, pp. 914–926, 1965.)

§ 257.3–6 Disease.

(a) *Disease Vectors.* The facility or practice shall not exist or occur unless the on-site population of disease vectors is minimized through the periodic application of cover material or other techniques as appropriate so as to protect public health.

(b) *Sewage sludge and septic tank pumpings (Interim Final).* A facility or practice involving disposal of sewage sludge or septic tank pumpings shall not exist or occur unless in compliance with paragraphs (b) (1), (2) or (3) of this section.

(1) Sewage sludge that is applied to the land surface or is incorporated into the soil is treated by a Process to Significantly Reduce Pathogens prior to application or incorporation. Public access to the facility is controlled for at least 12 months, and grazing by animals whose products are consumed by humans is prevented for at least one month. Processes to Significantly Reduce Pathogens are listed in Appendix II, Section A. (These provisions do not apply to sewage sludge disposed of by a trenching or burial operation.)

(2) Septic tank pumpings that are applied to the land surface or incorporated into the soil are treated by a Process to Significantly Reduce Pathogens (as listed in Appendix II, Section A), prior to application or incorporation, unless public access to the facility is controlled for at least 12 months and unless grazing by animals whose products are consumed by humans is prevented for at least one month. (These provisions do not apply to septic tank pumpings disposed of by a trenching or burial operation.)

(3) Sewage sludge or septic tank pumpings that are applied to the land surface or are incorporated into the soil are treated by a Process to Further Reduce Pathogens, prior to application or incorporation, if crops for direct human consumption are grown within 18 months subsequent to application or incorporation. Such treatment is not required if there is no contact between the solid waste and the edible portion of the crop; however, in this case the solid waste is treated by a Process to Significantly Reduce Pathogens, prior to application; public access to the facility is controlled for at least 12 months; and grazing by animals whose products are consumed by humans is prevented for at least one month. If crops for direct human consumption are not grown within 18 months of application or incorporation, the requirements of paragraphs (b) (1) and (2) of this section apply. Processes to Further Reduce Pathogens are listed in Appendix II, Section B.

(c) As used in this section:

(1) "Crops for direct human consumption" means crops that are consumed by humans without processing to minimize pathogens prior to distribution to the consumer.

(2) "Disease vector" means rodents, flies, and mosquitoes capable of transmitting disease to humans.

(3) "Incorporated into the soil" means the injection of solid waste beneath the surface of the soil or the mixing of solid waste with the surface soil.

(4) "Periodic application of cover material" means the application and compaction of soil or other suitable material over disposed solid waste at the end of each operating day or at such frequencies and in such a manner as to reduce the risk of fire and to impede vectors' access to the waste.

(5) "Trenching or burial operation" means the placement of sewage sludge or septic tank pumpings in a trench or other natural or man-made depression and the covering with soil or other suitable material at the end of each operating day such that the wastes do not migrate to the surface.

§ 257.3–7 Air.

(a) The facility or practice shall not engage in open burning of residential, commercial, institutional or industrial solid waste. This requirement does not apply to infrequent burning of agricultural wastes in the field, silvicultural wastes for forest management purposes, land-clearing debris, diseased trees, debris from emergency clean-up operations, and ordnance.

(b) The facility or practice shall not violate applicable requirements developed under a State implementation plan approved or promulgated by the Administrator pursuant to Section 110 of the Clean Air Act.

(c) As used in this section "open burning" means the combustion of solid waste without (1) control of combustion air to maintain adequate temperature for efficient combustion, (2) containment of the combustion reaction in an enclosed device to provide sufficient residence time and mixing for complete combustion, and (3) control of the emission of the combustion products.

§ 257.3–8 Safety.

(a) *Explosive gases.* The concentration of explosive gases generated by the facility or practice shall not exceed:

(1) Twenty-five percent (25%) of the lower explosive limit for the gases in facility structures (excluding gas control or recovery system components); and

(2) The lower explosive limit for the gases at the property boundary.

(b) *Fires.* A facility or practice shall not pose a hazard to the safety of persons or property from fires. This may be accomplished through compliance with § 257.3–7 and through the periodic application of cover material or other techniques as appropriate.

(c) *Bird hazards to aircraft.* A facility or practice disposing of putrescible wastes that may attract birds and which occurs within 10,000 feet (3,048 meters) of any airport runway used by turbojet aircraft or within 5,000 feet (1,524 meters) of any airport runway used by only piston-type aircraft shall not pose a bird hazard to aircraft.

(d) *Access.* A facility or practice shall not allow uncontrolled public access so as to expose the public to potential health and safety hazards at the disposal site.

(e) As used in this section:

(1) "Airport" means public-use airport open to the public without prior permission and without restrictions within the physical capacities of available facilities.

(2) "Bird hazard" means an increase in the likelihood of bird/aircraft collisions that may cause damage to the aircraft or injury to its occupants.

(3) "Explosive gas" means methane (CH_4).

(4) "Facility structures" means any buildings and sheds or utility or drainage lines on the facility.

(5) "Lower explosive limit" means the lowest percent by volume of a mixture of explosive gases which will propagate

Appendix E

Land Use Analysis Background Data and Regulations

Land Use Planning Framework

Land use planning for the alternative sites is guided by statewide planning goals and guidelines set forth by the Oregon Land Conservation and Development Commission (LCDC), as well as by numerous local plans and policies.

STATE LAND USE PLANNING PROCESS

The LCDC is the statewide planning agency whose purpose is to promote coordinated land conservation and development throughout the State of Oregon. LCDC accomplishes its purpose by prescribing planning goals and objectives which state agencies, cities, counties, and special districts throughout Oregon must apply in developing comprehensive plans for their respective jurisdictions. The Commission consists of seven members appointed by the Governor and subject to confirmation by the State Senate (Oregon Revised Statutes, Chapter 197).

Statewide land use goals are set forth in LCDC's Statewide Planning Goals and Guidelines (Oregon LCDC 1980). This tabloid contains 19 goals which must be adhered to in all local government comprehensive plans. This tabloid also contains guidelines for implementing each of the 19 goals. Unlike the goals, however, these guidelines do not have the force of law. They are simply suggested directions for action which local governments can consider in developing comprehensive plans.

Compliance with state land use goals is ensured by LCDC review of local government comprehensive plans. Once a plan is certified by LCDC to be in conformance with state goals, the plan is said to be "acknowledged". If a plan is not acknowledged, LCDC issues an order requiring the local government to bring its plan into conformity with state goals. In the interim, LCDC may prohibit the nonconforming local government from approving subdivisions or building permits if such activities would aggravate the goal violation (Oregon Revised Statutes Chapter 197). Once a local comprehensive plan is acknowledged, that plan is considered the controlling factor in land use decisions.

The goals which are most relevant to the potential land use impacts of the proposed project are Goal 2 (Land Use Planning), Goal 3 (Agriculture), and Goal 6 (Air, Water, and Land Resources Quality). Other goals have less relevance, but, should also be considered. These include Goal 1 (Citizen Involvement), Goal 7 (Areas Subject to Natural Disasters and Hazards), Goal 11 (Public Facilities and Services), and Goal 14 (Urbanization).

Several of the LCDC goals call for the protection of state resource lands, such as agricultural or forestlands. In adopting these goals, LCDC recognized that it would not be possible for local jurisdictions to apply these goals in all cases. Therefore, LCDC's Goal 2 incorporates an exception process, which allows a city or county to conclude, after careful study, that it is not possible to apply a particular goal to certain situations or properties. This conclusion must be supported by compelling reasons and facts, including (Oregon Administrative Rule 660-04-020):

1. Why these other uses should be provided for;
2. What alternative locations within the area could be used for the proposed uses;
3. What are the long-term environmental, economic, social, and energy consequences to the locality, the region or the state from not applying the goal or permitting the alternative use; and
4. A finding that the proposed uses will be compatible with other adjacent uses.

An exception may also be supported by compelling reasons and facts that land has been physically developed or irrevocably committed to uses not allowed by the applicable goal. In such a case, adjacent uses, public facilities and services, parcel size and ownership patterns, neighborhood and regional characteristics, natural boundaries, and other relevant factors must be considered (Oregon Administrative Rule 660-04-025).

An exception takes effect upon adoption of the associated comprehensive plan. LCDC then reviews and approves the exception as a part of their plan review for compliance with state land use goals. Prior to acknowledgement of a comprehensive plan by LCDC, an exception may be appealed to Oregon's Land Use Board of Appeals (LUBA) (Oregon Administrative Rule 664-04-030 and 035). LUBA is an appellate body created by the Oregon State Legislature. Since LUBA operates under LCDC, it must present all of its findings to LCDC for adoption (Delk pers. comm.a).

Goal 3 calls for the preservation and maintenance of agricultural lands. Agricultural land has been defined to include: 1) lands classified by the U. S. Soil Conservation Service (SCS) as predominately Class I-IV soils in western Oregon and I-VI soils in eastern Oregon; b) other lands in different soil classes which are suitable for farm use as defined by ORS 215.203(2)(a), taking into consideration soil fertility; suitability for grazing; climatic conditions; existing and future availability of water for farm irrigation purposes; existing land use patterns; technological and energy inputs required; and accepted farming practices; and c) land which is necessary to permit farm practices to be undertaken on adjacent or nearby agricultural lands (Oregon Administrative Rule 660-05-005).

Goal 3 requires that all agricultural lands be inventoried and preserved by the adoption of exclusive farm use (EFU) zones, pursuant to the Oregon Revised Statutes (ORS) Chapter 215. ORS 215.203 defines permitted farm uses in EFU zones. ORS 215.213 defines permitted nonfarm uses in such zones.

Goal 6 provides for the maintenance and improvement of the quality of the air, water, and land resources of the state. The goal states that with respect to the air, water, and land resources included in state statutes, rules, standards, and implementation plans, such discharges shall not exceed the carrying capacity of such resources considering long-range needs, degrade such resources, or threaten the availability of such resources.

LOCAL LAND USE PLANNING PROCESS

A number of local plans and policies affect the future land use of the alternative sites and their vicinities. The comprehensive plan for Lane County consists of several main components including the Metro Area General Plan, the Lane County General Plan, and numerous countywide elements.

The Metro Area Plan, with amendments adopted by the Cities of Eugene and Springfield and Lane County in February-March 1982, contains policies and land use designations which apply to metropolitan Lane County and the Cities of Eugene and Springfield. The plan was acknowledged by LCDC in August 1982. As required by LCDC Goal 14, the Metro Area Plan designates the Urban Growth Boundary (UGB). The UGB separates the projected urban service area designated to accommodate planned urban development through the year 2000 from urban reserve, agricultural, and rural designations in the outlying areas. A major objective of the plan is to effectively control the potential for urban sprawl and scattered urbanization by requiring compact development within the projected urban service area. This means filling in vacant and underutilized lands, as well as redevelopment, within the limits of the urban growth boundary (Lane Council of Governments 1980b).

The Lane County General Plan covers the unincorporated portions of Lane County beyond the UGB of incorporated cities and the Metro Area General Plan. These lands are primarily rural. The Lane County General Plan consists of two major components: a goals and policies document and 14 subarea plans which evaluate in detail land use issues pertinent to specific geographic subareas. The goals and policies of this plan promote the coordinated growth concept. This concept encourages growth to be concentrated in and around existing communities where urban services can be economically provided. Within the rural areas, this concept envisions some fill-in of existing development, but a reduction of the pressure for new development. Rural development would be excluded from agriculture, open space, forest, and hazardous areas. Where rural development does occur, it must be compatible with maintaining rural environmental values (Lane County 1980a).

The alternative sludge handling sites are located within the Willamette-Long Tom Subarea Plan adopted in July 1976. This subarea plan was developed with the knowledge that there were strong suburbanizing trends in the Eugene/Springfield metropolitan area. The plan states, however, that growth should be guided in an orderly manner in order to retain the rural atmosphere of the subarea, to protect agricultural land, and to prevent urban sprawl (Lane County Department of Environmental Management 1976).

One of the General Plan policies calls for prime and locally important lands to be differentiated from other agricultural lands (Lane County 1980a). As noted earlier, LCDC's Goal 3 also requires local governments to inventory agricultural lands based on the SCS's classification system. The SCS's Land Capability System and the Storie Index are two soil classification systems which have been widely used in United States soil surveys. Both systems express a soil's suitability for agricultural use by assigning a "grade" or "class" ranking based on a combination of factors such as soil depth, texture, drainage, permeability, slope, pH, and the presence or absence of salinity or alkalinity. Based on these systems, prime farmlands (i.e., lands best suited to producing food, feed, forage fiber, and oil seed crops) are usually considered to be soils within Classes I or II or with a Storie Index rating of 60 or higher. The SCS has also developed criteria for defining prime farmland in a policy statement known as the "Land Inventory and Monitoring Memorandum (LIM)". Unlike the Land Capability System or the Storie Index, LIM's criteria for prime lands include considerations of water availability and climatic factors. LIM also provides more generalized definitions of unique farmlands and additional farmlands of statewide or local importance. Unique farmland is land which does not meet all of the criteria for prime farmland, but which economically produces high quality and/or high yields of specific high-value food or fiber crops. The specific definition and the identification of additional farmlands of statewide or local importance is referred to the appropriate state or local agencies. These lands fail to qualify as prime, but nevertheless either produce yields comparable to prime lands or produce certain crops of special importance to the region in which they are located. Soils classified as prime by the Storie Index or Land Capability System generally fall within the prime category as defined by LIM.

Completion of Lane County's SCS soil survey is not expected for several years. However, the Lane County Planning Division, in close coordination with the local SCS office, has produced preliminary soil maps at a scale of 1 inch = 3,000 feet. These maps identify three categories of farmlands: prime farmlands, unique farmlands, and other farmlands (Hudzikiewicz pers.

comm.). According to an unpublished SCS report, about 160,000 acres, or less than 6 percent of Lane County, meets the soil requirements for prime farmland. These lands are located mostly in and adjacent to the Willamette Valley in the central portion of the County. Crops grown on this land (mainly corn, snap-beans, wheat, peppermint, and filberts) accounted for an estimated 50 percent of Lane County's total agricultural income for 1980 (Lane County Department of Environmental Management 1981a).

Lane County's Comprehensive Plan also incorporates several countywide elements, including a Solid Waste Management Plan. This plan contains information regarding solid waste activities in Lane County, addresses problems related to solid waste operations, and suggests ways to minimize adverse environmental impacts and maximize resource recovery (Lane County 1980b).

In February 1981, the Lane County Comprehensive Plan was reviewed by LCDC. The plan was not acknowledged due to the Commission's finding that the plan and its implementing measures did not comply with statewide Goals 2-7, 9, 11-13, and 15-18. A list of tasks has been forwarded to Lane County which must be completed in order to gain acknowledgement. However, LCDC has not restricted or prohibited County review of development applications in the interim with the understanding that the County make a good faith effort at correcting all noncomplying plan provisions (Lane County Department of Environmental Management 1981b).

LCDC's acknowledgement denial was based on many findings, which are summarized in LCDC's Acknowledgement of Compliance (Oregon LCDC 1981c). The findings which are most relevant to this evaluation include:

- Lane County has not defined the word "policy" to reflect the County's "ultimate policy choices". Most policy statements include nonmandatory "should" language and are not binding on the County.

- The County has not developed an inventory or map of agricultural lands as defined by Goal 3.

- None of the County's farm zones is qualified as exclusive farm use zones pursuant to ORS Chapter 215. The County's Exclusive Farm Use (EFU-20), Farm-Forestry (LFF-20), Agricultural Lands (A-1), and Agricultural, Grazing, and Timber Raising (AG-7) zones permit uses not authorized by ORS Chapter 215, and some conditional uses have been permitted as outright uses.

In response to LCDC's acknowledgement denial, Lane County has decided to develop a new, completely revised Comprehensive Plan which will address LCDC's directives. The revised Comprehensive Plan will include two major components: the County's "General Plan policies" and the plan diagrams, one each for the coastal region and the inland region. The subarea plans will no longer be a part of the Comprehensive Plan (Lane County Department of Environmental Management 1982a). Amendments to Lane County's zoning code will also be made a part of the Comprehensive Plan Revision (CPR). These amendments will consist of either changes to existing zones or will permit creation of new zones. Eighteen zones are being proposed, five of which are existing zones (Lane County Department of Planning and Community Development pers. comm.).

The "General Plan policies" document was adopted in November 1982. For each LCDC goal, this document contains one or more policies to be applied by the County toward various land use issues. These policies are classified as: advisory policies which describe the County's position on a particular type; commitment policies which describe a future action which the County plans to undertake; or a plan conformity policy which is intended to guide land use designations on both plan diagrams and zoning maps (Lane County Department of Environmental Management 1982c).

AGRICULTURAL LAND USE

215.203 Adoption of zoning ordinances establishing farm use zones; definitions for ordinances. (1) Zoning ordinances may be adopted to zone designated areas of land within the county as exclusive farm use zones. Land within such zones shall be used exclusively for farm use except as otherwise provided in ORS 215.213. Farm use zones shall be established only when such zoning is consistent with the comprehensive plan.

(2)(a) As used in this section, "farm use" means the current employment of land for the primary purpose of obtaining a profit in money by raising, harvesting and selling crops or by the feeding, breeding, management and sale of, or the produce of, livestock, poultry, fur-bearing animals or honeybees or for dairying and the sale of dairy products or any other agricultural or horticultural use or animal husbandry or any combination thereof. "Farm use" includes the preparation and storage of the products raised on such land for human use and animal use and disposal by marketing or otherwise. It does not include the use of land subject to the provisions of ORS chapter 321, except land used exclusively for growing cultured Christmas trees as defined in subsection (3) of this section.

(b) "Current employment" of land for farm use includes (A) land subject to the soil-bank provisions of the Federal Agricultural Act of 1956, as amended (P. L. 84-540, 70 Stat. 188); (B) land lying fallow for one year as a normal and regular requirement of good agricultural husbandry; (C) land planted in orchards or other perennials prior to maturity; (D) any land constituting a woodlot of less than 20 acres contiguous to and owned by the owner of land specially valued at true cash value for farm use even if the land constituting the woodlot is not utilized in conjunction with farm use; (E) wasteland, in an exclusive farm use zone, dry or covered with water, lying in or adjacent to and in common ownership with a farm use land and which is not currently being used for any economic farm use; (F) land under dwellings customarily provided in conjunction with the farm use in an exclusive farm use zone; and (G) land under buildings supporting accepted farm practices.

(c) As used in this subsection, "accepted farming practice" means a mode of operation that is common to farms of a similar nature, necessary for the operation of such farms to obtain a profit in money, and customarily utilized in conjunction with farm use.

(3) "Cultured Christmas trees" means trees:

(a) Grown on lands used exclusively for that purpose, capable of preparation by intensive cultivation methods such as plowing or turning over the soil;

(b) Of a species for which the Department of Revenue requires a "Report of Christmas Trees Harvested" for purposes of ad valorem taxation;

(c) Managed to produce trees meeting U.S. No. 2 or better standards for Christmas trees as specified by the Agriculture Marketing Services of the United States Department of Agriculture; and

(d) Evidencing periodic maintenance practices of shearing for Douglas fir and pine species, weed and brush control and one or more of the following practices: Basal pruning, fertilizing, insect and disease control, stump culture, soil cultivation, irrigation.
[1963 c.577 §2; 1963 c.619 §1(2), (3); 1967 c.386 §1; 1973 c.503 §3; 1975 c.210 §1; 1977 c.766 §7; 1977 c.893 §17a; 1979 c.480 §1; 1981 c.804 §73]

215.205 [1957 s.s. c.11 §2; renumbered 215.295]

215.210 [Amended by 1955 c.652 §6; renumbered 215.305]

215.213 Nonfarm uses permitted within farm use zones. (1) The following uses may be established in any area zoned for exclusive farm use:

(a) Public or private schools.

(b) Churches.

(c) The propagation or harvesting of a forest product.

(d) Utility facilities necessary for public service, except commercial facilities for the purpose of generating power for public use by sale.

(e) A dwelling on real property used for farm use if the dwelling is:

(A) Located on the same lot or parcel, as those terms are defined in ORS 92.010, as the dwelling of the farm operator; and

(B) Occupied by a relative, which means grandparent, grandchild, parent, child, brother or sister of the farm operator or the farm operator's spouse, whose assistance in the management of the farm use is or will be required by the farm operator.

(f) The dwellings and other buildings customarily provided in conjunction with farm use.

(g) Operations for the exploration of geothermal resources as defined by ORS 522.005.

(h) A site for the disposal of solid waste that has been ordered to be established by the Environmental Quality Commission under ORS 459.049, together with equipment, facilities or buildings necessary for its operation.

(2) The following nonfarm uses may be established, subject to the approval of the governing body or its designate in any area zoned for exclusive farm use:

(a) Commercial activities that are in conjunction with farm use.

(b) Operations conducted for the mining and processing of geothermal resources as defined by ORS 522.005 or exploration, mining and processing of aggregate and other mineral resources or other subsurface resources.

(c) Private parks, playgrounds, hunting and fishing preserves and campgrounds.

(d) Parks, playgrounds or community centers owned and operated by a governmental agency or a nonprofit community organization.

(e) Golf courses.

(f) Commercial utility facilities for the purpose of generating power for public use by sale.

(g) Personal-use airports for airplanes and helicopter pads, including associated hangar, maintenance and service facilities. A personal-use airport as used in this section means an airstrip restricted, except for aircraft emergencies, to use by the owner, and, on an infrequent and occasional basis, by invited guests, and by commercial aviation activities in connection with agricultural operations. No aircraft may be based on a personal-use airport other than those owned or controlled by the owner of the airstrip. Exceptions to the activities permitted under this definition may be granted through waiver action by the Aeronautics Division in specific instances. A personal-use airport lawfully existing as of September 13, 1975, shall continue to be permitted subject to any applicable regulations of the Aeronautics Division.

(h) Home occupations carried on by the resident as an accessory use within dwellings or other buildings referred to in ORS 215.203 (2)(b)(F) or (G).

(i) A facility for the primary processing of forest products, provided that such facility is found to not seriously interfere with accepted farming practices and is compatible with farm uses described in ORS 215.203 (2). Such a facility may be approved for a one-year period which is renewable. These facilities are intended to be only portable or temporary in nature. The primary processing of a forest product, as used in this section, means the use of a portable chipper or stud mill or other similar methods of initial treatment of a forest product in order to enable its shipment to market. Forest products, as used in this section, means timber grown upon a parcel of land or contiguous land where the primary processing facility is located.

(j) The boarding of horses for profit.

(k) A site for the disposal of solid waste approved by the governing body of a city or county or both and for which a permit has been granted under ORS 459.245 by the Department of Environmental Quality together with equipment, facilities or buildings necessary for its operation.

(3) Single-family residential dwellings, not provided in conjunction with farm use, may be established, subject to approval of the governing body or its designate in any area zoned for exclusive farm use upon a finding that each such proposed dwelling:

(a) Is compatible with farm uses described in ORS 215.203 (2) and is consistent with the intent and purposes set forth in ORS 215.243;

(b) Does not interfere seriously with accepted farming practices, as defined in ORS 215.203 (2)(c), on adjacent lands devoted to farm use;

(c) Does not materially alter the stability of the overall land use pattern of the area;

(d) Is situated upon generally unsuitable land for the production of farm crops and livestock, considering the terrain, adverse soil or land conditions, drainage and flooding, vegetation, location and size of the tract; and

(e) Complies with such other conditions as the governing body or its designate considers necessary. [1963 c.577 §3; 1963 c.619 §1a; 1969 c.258 §1; 1973 c.503 §4; 1975 c. 551 §1; 1975 c.552 §32; 1977 c.766 §8; 1977 c.788 §2; 1979 c.480 §6; 1979 c.773 §10; 1981 c.748 §44]

215.214 Effect of solid waste disposal site classification on compliance with agricultural land goals. The Land Conservation and Development Commission shall not consider the provisions of ORS 215.213 (2)(k) as being consistent with any state-wide planning goal relating to the preservation of agricultural lands for the purpose of exempting a unit of local government from applying that goal to agricultural lands. [1979 c.773 §11]

215.215 Reestablishment of nonfarm use. (1) Notwithstanding ORS 215.130 (4), if a nonfarm use exists in an exclusive farm use zone and is unintentionally destroyed by fire, other casualty or natural disaster, the county may allow by its zoning regulations such use to be reestablished to its previous nature and extent, but the reestablishment shall meet all other building, plumbing, sanitation and other codes, ordinances and permit requirements.

(2) Consistent with ORS 215.243, the county governing body may zone for the appropriate nonfarm use one or more lots or parcels in the interior of an exclusive farm use zone if the lots or parcels were physically developed for the nonfarm use prior to the establishment of the exclusive farm use zone. [1977 c.664 §41]

215.220 [Repealed by 1963 c.619 §16]

215.223 Procedure for adopting zoning ordinances; notice. (1) No zoning ordinance enacted by the county governing body may have legal effect unless prior to its enactment the governing body or the planning commission conducts one or more public hearings on the ordinance and unless 10 days' advance public notice of each hearing is published in a newspaper of general circulation in the county or, in case the ordinance applies to only a part of the county, is so published in that part of the county.

(2) The notice provisions of this section shall not restrict the giving of notice by other means, including mail, radio and television.

(3) In effecting a zone change the proceedings for which are commenced at the request

of a property owner, the governing body shall in addition to other notice give individual notice of the request by mail to the record owners of property within 250 feet of the property for which a zone change has been requested. The failure of the property owner to receive the notice described shall not invalidate any zone change. [1963 c.619 §8; 1967 c.589 §3]

215.230 [Repealed by 1963 c.619 §16]

215.233 Validity of ordinances and development patterns adopted before September 2, 1963. Nothing in ORS 215.010, 215.030, 215.050, 215.060 and 215.110 to 215.213, 215.223 and this section shall impair the validity of ordinances enacted prior to September 2, 1963. All development patterns made and adopted prior to that time shall be deemed to meet the requirements of ORS 215.010, 215.030, 215.050, 215.060 and 215.110 to 215.213, 215.223 and this section concerning comprehensive plans. [1963 c.619 §14; 1971 c.13 §3]

215.236 Establishment of dwelling not provided for farm use; disqualification of lot or parcel for farm use valuation; issuance of building permit; conditions. (1) As used in this section:

(a) "Dwelling" means a single-family residential dwelling not provided in conjunction with farm use.

(b) "Lot" and "parcel" have the meaning given those terms in ORS 92.010.

(2) The governing body or its designate shall not grant final approval of an application made under ORS 215.213 (3) for the establishment of a dwelling on land in an exclusive farm use zone that is valued at true cash value for farm use under ORS 308.370 without evidence that the lot or parcel upon which the dwelling is proposed has been disqualified for valuation at true cash value for farm use under ORS 308.370.

(3) The governing body or its designate may grant tentative approval of an application made under ORS 215.213 (3) for the establishment of a dwelling on land in an exclusive farm use zone that is valued at true cash value for farm use under ORS 308.370 upon making the findings required by ORS 215.213 (3). An application for the establishment of a dwelling that has been tentatively approved shall be given final approval by the governing body or its designate upon receipt of evidence that the lot or parcel upon which establishment of the dwelling is proposed has been disqualified for valuation at true cash value for farm use under ORS 308.370.

(4) The owner of a lot or parcel upon which the establishment of a dwelling has been tentatively approved as provided by subsection (3) of this section shall within 60 days after the date tentative approval was granted, simultaneously:

(a) Notify the county assessor that the lot or parcel is no longer being used as farmland; and

(b) Request that the county assessor disqualify the lot or parcel for valuation at true cash value for farm use under ORS 308.370.

(5) When the owner of a lot or parcel upon which the establishment of a dwelling has been tentatively approved notifies the county assessor that the lot or parcel is no longer being used as farmland and requests disqualification of the land for valuation at true cash value for farm use, the county assessor shall:

(a) Disqualify the lot or parcel for valuation at true cash value for farm use under ORS 308.370 by removing the special assessment for farm use as provided by ORS 308.397 (1) or 308.390 (1)(a), whichever is applicable;

(b) Provide the owner of the lot or parcel with written notice of the disqualification for valuation at true cash value for farm use under ORS 308.370; and

(c) Impose the additional tax or penalty, if any, provided by ORS 308.395, 308.399 or 321.960, whichever is applicable.

(6) The Department of Commerce, a building official, as defined in ORS 456.805 (1), or any other agency or official responsible for the administration and enforcement of the state building code, as defined in ORS 456.750, shall not issue a building permit for the construction of a dwelling on land in an exclusive farm use zone without evidence that the owner of the lot or parcel upon which the dwelling is proposed to be constructed has paid the additional tax or penalty, if any, imposed by the county assessor under paragraph (c) of subsection (5) of this section.

(7)(a) A lot or parcel described in subsection (2) of this section that has been disqualified for valuation at true cash value for farm use under ORS 308.370 is not eligible on or after the date of disqualification for valuation at true cash value for farm use under ORS 308.370 (1) or (2) except as provided in paragraph (b) of this subsection.

(b) Land described in paragraph (a) of this subsection may become eligible for valuation at true cash value for farm use under ORS 308.370 if the land becomes part of a larger unit of land, in single ownership, the remainder of which is valued at true cash value for farm use. [1981 c.748 §46]

215.240 [Repealed by 1963 c.619 §16]

215.243 Agricultural land use policy. The Legislative Assembly finds and declares that:

(1) Open land used for agricultural use is an efficient means of conserving natural resources that constitute an important physical, social, aesthetic and economic asset to all of the people of this state, whether living in rural, urban or metropolitan areas of the state.

(2) The preservation of a maximum amount of the limited supply of agricultural land is necessary to the conservation of the state's economic resources and the preservation of such land in large blocks is necessary in maintaining the agricultural economy of the state and for the assurance of adequate, healthful and nutritious food for the people of this state and nation.

(3) Expansion of urban development into rural areas is a matter of public concern because of the unnecessary increases in costs of community services, conflicts between farm and urban activities and the loss of open space and natural beauty around urban centers occurring as the result of such expansion.

(4) Exclusive farm use zoning as provided by law, substantially limits alternatives to the use of rural land and, with the importance of rural lands to the public, justifies incentives and privileges offered to encourage owners of rural lands to hold such lands in exclusive farm use zones. [1973 c.503 §1]

215.250 [Repealed by 1973 c.619 §16]

215.253 Prohibition against restrictive local ordinances affecting farm use zones; exemption for exercise of governmental power to protect public health, safety and welfare. (1) No state agency, city, county or political subdivision of this state may exercise any of its powers to enact local laws or ordinances or impose restrictions or regulations affecting any farm use land situated within an exclusive farm use zone established under ORS 215.203 in a manner that would unreasonably restrict or regulate farm structures or that would unreasonably restrict or regulate accepted farming practices because of noise, dust, odor or other materials carried in the air or other conditions arising therefrom if such conditions do not extend beyond the boundaries of the exclusive farm use zone within which they are created in such manner as to interfere with the use of adjacent lands. "Accepted farming practice" as used in this subsection shall have the meaning set out in ORS 215.203.

(2) Nothing in this section is intended to limit or restrict the lawful exercise by any state agency, city, county or political subdivision of its power to protect the health, safety and welfare of the citizens of this state. [1973 c.503 §8]

215.260 [Amended by 1955 c.652 §3; repealed by 1957 s.s. c.11 §4 (215.261 enacted in lieu of 215.260)]

215.261 [1957 s.s. c.11 §5 (enacted in lieu of 215.260); repealed by 1963 c.619 §16]

215.263 Review of land divisions in exclusive farm use zones; criteria for approval; exemptions. (1) Any proposed division of land included within an exclusive farm use zone resulting in the creation of one or more parcels of land shall be reviewed and approved or disapproved by the governing body of the county in which such land is situated. The governing body of a county by ordinance shall require such prior review and approval for such divisions of land within exclusive farm use zones established within the county.

(2) If the governing body of a county initiates a review as provided in subsection (1) of this section, it shall not approve any proposed division of land unless it finds that the proposed division of land is in conformity with the legislative intent set forth in ORS 215.243.

(3) This section shall not apply to the creation or sale of cemetery lots, if a cemetery is within the boundaries designated for a farm use zone at the time the zone is established.

(4) This section shall not apply to divisions of land resulting from lien foreclosures or divisions of land resulting from foreclosure of recorded contracts for the sale of real property.

(5) The governing body of a county shall not approve any proposed subdivision or partition of a lot or parcel described in ORS 215.213 (1)(e). [1973 c.503 §9; 1977 c.766 §9; 1979 c.46 §2; 1981 c.748 §48]

215.270 [Repealed by 1963 c.619 §16]

215.273 Applicability to nuclear and thermal energy council power plant siting determinations. Nothing in ORS 118.155, 215.130, 215.203, 215.213, 215.243 to 215.273, 308.395 to 308.401 and 316.081 is intended to affect the authority of the Nuclear and Thermal Energy Council in determining suitable sites for the issuance of site certificates for thermal power plants, as authorized under ORS 469.300 to 469.570. [1973 c.503 §16]

215.280 [Repealed by 1963 c.619 §16]

215.285 [Formerly 215.200; repealed by 1971 c.13 §1]

215.290 [Repealed by 1963 c.619 §16]

215.295 [Formerly 215.205; repealed by 1971 c.13 §1]

215.300 [Repealed by 1963 c.619 §16]

215.305 [Formerly 215.210; repealed by 1971 c.13 §1]

215.310 [Repealed by 1971 c.13 §1]

215.320 [Repealed by 1971 c.13 §1]

215.325 [1953 c.662 §6; 1963 c.9 §4; repealed by 1971 c.13 §1]

215.330 [Repealed by 1971 c.13 §1]

215.340 [Repealed by 1971 c.13 §1]

215.350 [Amended by 1953 c.662 §7; repealed by 1971 c.13 §1]

215.360 [Amended by 1953 c.662 §7; subsection (2) enacted as 1953 c.662 §1; repealed by 1971 c.13 §1]

215.370 [Repealed by 1971 c.13 §1]

215.380 [Amended by 1955 c.652 §4; repealed by 1971 c.13 §1]

215.390 [Repealed by 1971 c.13 §1]

215.395 [1953 c.662 §3; 1955 c.652 §5; repealed by 1971 c.13 §1]

215.398 [1955 c.652 §2; repealed by 1971 c.13 §1]

215.400 [Repealed by 1971 c.13 §1]

Appendix F

State of Oregon Sludge Management Guidelines

OREGON STATE DEPARTMENT OF ENVIRONMENTAL QUALITY

GUIDELINES FOR LAND APPLICATION OF WASTEWATER AND SLUDGE

May 18, 1981

A. Purpose

The following guidelines are recommendations for the handling, disposal and beneficial use of wastewater and sludge on land. They are meant to provide assistance in the development of environmentally acceptable long range programs for sludge and wastewater use. The use of new technology, public acceptance and the conservation of energy through recycling should be assessed for each proposed program. If proposals deviate from these guidelines they should be justified.

B. Definitions

"Accumulator" crops means swiss chard, lettuce, spinach carrots and other crops that have been shown to readily accumulate cadmium.

"Agronomic Application Rate" means a rate of sludge, septage, or wastewater application which matches nutrient requirements for a specific crop on an annual basis.

"Beneficial Use Site" means any approved site for application of a regulated amount of sludge, septage, or wastewater used for crop or livestock production, sand dune stabilization, or soil improvement.

"Cation Exchange Capacity" (CEC) means the sum total of exchangeable cations that a soil can absorb. Expressed in milli-equivalents per 100 grams of soil.

"Chemical Treatment" means the process of mixing lime or other chemicals with municipal sludge to reduce the number of bacterial pathogens and putrescible matter.

"Composting" means a process by which sludge or septage is aerated and mixed with carbonaceous material to promote rapid decomposition and ultimate stabilization as well as pathogen reduction. Complete composting is carried out at temperatures above 55 degrees C and followed by curing in a stockpile for at least 30 days.

"Controlled Access" means that public entry or traffic is unlikely; for example rural agricultural land that is privately owned. Parks or other public land may require fencing to insure controlled access.

"Dewatered Sludge" means that sludge with solids concentration of ten (10) to twenty (20) percent.

"Digested Sludge" means sludge resulting from a process which significantly reduces volatile solids and pathogens. Suggested criteria for complete digestion are as follows:

Anaerobic digestion: The process is conducted in the absence of air at residence times ranging from 60 days at 20° C to 15 days at 35° to 55° C, with a volatile solids reduction of at least 38 percent.

Aerobic digestion: The process is conducted by agitating sludge with air or oxygen to maintain aerobic conditions at residence times ranging from 60 days at 15° C to 40 days at 20° with a volatile solids reduction of at least 38 percent.

"Disposal Site" means an approved site used for disposal of sludge, septage or wastewater in excess of agronomic loading rates, so long as surface and/or groundwater are not contaminated and nuisance conditions are avoided.

"Dried Sludge" means that sludge with a solids concentration of greater than twenty (20) percent.

"Effluent" means wastewater which has been treated to remove or neutralize undesirable constituents including solids, organic material (sludge) fecal organisms, metals, and pH.

"Heat Drying" means a process of applying heat as a means of removing excess water from sludge as well as destroying pathogens in municipal sewage sludge.

"Heat Treated" means a process of subjecting sludge to high pressure and/or temperature such that all organisms are destroyed.

"Liquid Sludge" means that sludge with a solids concentration of less than ten (10) percent.

"Non-digested Sludge" means the sludge that has accumulated in a digester not operating efficiently or a septic tank process whose function is confinement and/or separation of liquids and solids.

"NPDES Permit" means a waste dischargae permit issued in accordance with requirements and procedures of the National Pollutant Discharge Elimination System authorized by the Federal Act and of OAR 340-45-005 through 065.

"Person" means the United States and agencies thereof, and state, any individual, public or private corporation, political subdivision, governmental agency, municipality, co-partnership, association, firm, trust, estate or any other legal entity whatever.

"Raw Sewage Sludge" means non-decomposed or nonoxidized sewage sludge.

"Septage" means septic tank pumpings, cesspool pumpings or other non-digested domestic sewage wastes.

"Sewage" or "Domestic Waste Water" means the water-carried human or animal wastes from residences, buildings, industrial establishments or other places, together with such groundwater infiltration and surface water as many be present that flow to wastewater treatment plants.

"Sewage Sludge" or "Sludge" means the accumulated suspended and settleable solids of sewage or wastewater, respectively, deposited in tanks or basins mixed with water to form a semi-liquid mass.

"Treatment" or "Waste Treatment" means the alteration of the quality of waste waters by physical, chemical or biological means or a combination thereof such that the tendency of said wastes to cause any degradation in water quality or other environmental conditions is reduced.

"Wastewater" means untreated liquid waste collected from municipal sewers and industrial or commercial facilities.

"WPCF Permit" means a water pollution control facility permit issued by the Department in accordance with the procedures of OAR 340-14-005 and which is not an NPDES permit.

C. Permits

Any person owning or operating sewage treatment works where sludge is produced and subsequently disposed of, must have in their possession either a valid NPDES or WPCF permit obtained for the purpose set forth in OAR 340-45-005 through 065, or a solid waste disposal permit obtained for a specific site as provided by ORS 459.205.

D. Responsibility

It is the responsibility of the sewage treatment works permittee to insure the proper handling and disposal of all sludge generated at the plant. Transportation of the sludge from the treatment plant to the disposal or application site will be made in such a manner as to prevent leaking or spilling the sludge onto highways, streets, roads, or waterways.

E. Limitations & Restricted Uses

1. Raw and/or non-digested sludge or septage should not be disposed of on land surfaces without specific authorization. Prior to burial, containment or direct incorporation into the soil, authorization must first be obtained from DEQ. Surface

application of septage or non-digested sludge will be permitted only on remote sites where there is little likelihood of creating a public nuisance.

2. Controlled access to municipal sludge or sewage effluent application sites for 12 months following a surface application is required. Access control is assumed on rural private land.

3. Sludge should not be given or sold to the public without their knowledge as to its origin. Sludge analysis should be available on request from the treatment plant.

4. Sludge and wastewater application to agricultural or forest land should not exceed the nitrogen loading required for maximum crop yield. Nitrogen requirements for particular crops can be obtained from the Oregon Cooperative Extension Service. Surface applications may be doubled on some perennial crops since NH_3 volatilization may account for up to a 50% loss of available N.

5. As a general guideline, crops grown for direct human consumption (fresh market fruits and vegetables) should not be planted until 18 months after municipal sludge application. If the edible parts will not be in contact with the sludge amended soil, or if the crop is to be treated or processed prior to marketing such that pathogen contamination is not a concern, this requirement may be waived.

6. Grazing animals should not come in contact with digested municipal sludge or effluent treated pasture or forage until thirty (30) days after application. Chlorinated municipal

effluent irrigation is exempt from this requirement. Grazing restrictions may be extended to 6 months where non-digested municipal sludges are applied.

F. Site Selection and Approval

1. Prior approval must be obtained in writing from the Department of Environmental Quality for the application of sludge, septage, wastewater, and effluent on beneficial use sites or disposal sites.

2. New sites for sludge application or wastewater and effluent irrigation and the expansion of existing sites must be proposed to the Department of Environmental Quality and written approval received prior to use of such sites.

3. Plans for sludge impoundment ponds or reservoirs proposed for temporary storage to facilitate the application of sludge must be proposed to the Department of Environmental Quality and written approval received prior to the use of such ponds or reservoirs.

4. Where appropriate, a management plan should be submitted with the application for site approval.

5. Site approval or denial must be consistent with local land use plans. If a proposed site is not approved, the reasons for denial must accompany the response.

6. The following criteria should be considered in making site selections:

a. Sites should be on a stable geologic formation not subject flooding or runoff from adjacent land. If periodic flooding cannot be avoided, the period of application should be restricted and soil incorporation is recommended.

b. At the time of application the minimum depth to permanent groundwater should be four (4) feet. Sites approved for year-round application should be evaluated carefully to insure that groundwater separation distances conform with this requirement.

c. Topography of the site should be suitable to allow normal agricultural operations and where needed, the construction of runoff and erosion control measures. In general, liquid sludge should not be surface applied on bare soils where the ground slope exceeds 12 percent. Slopes up to 20 percent may be used for dewatered or dried sludge, for direct incorporation of liquid sludge into the soil, or for liquid sludge application with appropriate management to eliminate runoff. Where soil incorporation on sloping ground is not feasible, sludge applications should be restricted to the dry seasons in Western Oregon.

d. Soil should have a minimum rooting depth of 24 inches. The underlying substratum should not be rapidly draining so that leachate will not be short circuited into groundwater.

e. Where heavy metal "accumulator" crops are grown, the soil should have a pH of 6.5 to 8.2. If the pH is below 6.5 at sites where sludge is applied above agronomic rates on an annual basis, or where sludges contain unusually high concentrations of heavy metals, the soil should be limed to raise and maintain the pH at this level. Saline and/or alkali soils should be avoided.

f. Discretion should be used in approving application of sludge or wastewater on land that is in close proximity to residential areas. A buffer strip large enough to prevent nuisance odors or wind drift problems is needed. Size of the buffer strip will depend upon the method of application used, for example:

1. direct injection: no limit required
2. truck spreading: 50 feet or more
3. spray irrigation: 300 to 500 feet

g. Buffer strips should be provided along well traveled highways. The size of the buffer strip will vary with local conditions and should be left to the discretion of the DEQ field representative. No sludge or wastewater should be spread at the site closer than fifty (50) feet to any ditch, channel, pond or waterway or within two-hundred (200) feet of a domestic water source or well.

and returned to the DEQ. In service areas where industrial processes are likely to create heavy metal concentrations higher than those found in domestic sludge, pre-treatment should be required by the permittee to reduce the concentration of heavy metals and extend the useful life of the application site.

H. Application of Municipal Sludge and Septage

The application of sludge on agricultural land should be managed to utilize the fertilizer value to the maximum extent possible. The recommended rate of sludge application is based on the nitrogen requirement of the crop grown and will vary depending on the nitrogen content of the sludge. Calculations to determine the amount of heavy metals being applied to land in sludge are also necessary to insure long term conformance with loading limits specified by EPA regulations.

Sludge analyses offer a guide to determine the rate of application for a particular crop. Crop nitrogen requirements are used routinely to determine application rates for commercial fertilizer and these figures are readily available from state or county Extension Service offices. Applying sludge within these limits insures that sludge nitrogen will be utilized for plant growth and that excess nitrogen which could leach into groundwater will not be of concern. Exceeding crop nitrogen requirements may occasionally be justified in order to achieve rapid soil improvement or to prolong beneficial effects. See appendix A for a sample calculation to determine nitrogen loading.

Municipal sludge contains trace amounts of potentially toxic substances including: zinc (Zn), copper (Cu), nickel (Ni) and cadmium (Cd). Many agricultural chemicals including commercial fertilizers and pesticides are also potentially toxic; however, with safe and appropriate management, these products are used with proven success and cause little if any environmental degradation.

Zn, Cu, and Ni can be toxic to plants when present in soils in excessive amounts. These metals, however, constitute little hazard to the food chain through plant accumulation. The total amount of these metals which may be applied to soil can be limited to prevent toxicity problems (Table 2). The concentration of metals in Oregon sludges is generally low so that sludge may be applied annually to a given site for many years before loading limits would be reached (see appendix B). EPA regulations currently address only Cd in terms of cumulative loading. Where background soil pH is less than 6.5, cumulative Cd applications are not to exceed 5 kg/ha (4.5 lb/acre). Cumulative loading rates of other metals should be considered where concentrations exceed those listed in Table 1, or where metal containing industrial sludges are land applied.

Cd may accumulate in plant tissue and enter the food chain. EPA regulations specify maximum <u>annual</u> Cd application rates as follows:[4]

Time Period	Annual Cd Application Rate (kg/ha)
Present to June 30, 1984	2.0
July 1, 1984 to December 31, 1986	1.25
Beginning January 1, 1987	0.5

Oregon municipal sludges will present no problem in complying with this regulation. For example, a sludge with 25 mg Cd/kg could be applied at up to 8.9 dry tons/acre and still meet the projected 1987 loading limit. This is approximately three times the agronomic rate of application for a sludge with an average total nitrogen content of 4.5 percent.

Long term Cd loading is also addressed in EPA regulations (Table 3). For soils with a background pH less than 6.5 (western Oregon), maximum applications of Cd may not exceed 5.0 kg/ha. Using the example above, sludge can be applied for 300 years before this limit would be reached. In eastern Oregon where background soil pH is greater than or equal to 6.5, applications may be greater depending on soil cation exchange capacity.

Soil pH has been shown to affect Cd uptake for leafy green vegetables and some root crops. Lime should be applied to raise soil pH to 6.5 or greater where these metal "accumulator" crops are grown to minimize Cd uptake. Soil pH adjustment may be warranted on other fruit or vegetable crops grown for processing to satisfy liability concerns.

For most crops grown in Oregon (grasses, forage crops, grains, and fruits) field studies indicate that there is no correlation between soil pH and Cd uptake.

Sewage sludge and septic tank pumpings contain microorganisms which may be pathogenic to man. Treatment plant digestion processes and septic tank residence times greatly reduce the number of disease causing organisms which will be found in the final product. Those which survive the treatment process die off rapidly when subjected to sunlight, soil incorporation, and competition with other micro-organisms.

Crops grown for direct human consumption (fresh market) have the potential of contamination by low numbers of intestinal worm eggs and pathogenic organisms. Root crops and leafy vegetables which are grown in direct contact with sludge amended soil require an 18 month waiting period between sludge application and planting to insure sanitation. When concern exists regarding possible indirect contamination of fresh marketed crops such as green beans, cole crops, sweet corn, fruit and nuts, the same waiting period restriction applies. Management practices such as soil incorporation or injection in advance of planting or fruit set greatly alleviates concern in this area. There is no restriction on planting time for crops not grown for direct human consumption.

Application of digested municipal sludge is also of little concern with pasture and forage crops. However, EPA regulations require that "animals whose products are consumed by humans" be prevented from grazing for at least one month following sludge application. This is particularly true for dairies, where animal contact or direct ingestion of sludge could result in milk contamination. Where non-digested municipal sludges are applied to pasture, restrictions on grazing should be extended to 6 months.

I. Wastewater Irrigation

Sewage effluents as well as various industrial and food processing wastewaters can be utilized beneficially to promote crop growth. Concentrations of constituents such as nutrients, BOD, and metals in treated effluents are normally so dilute that hydraulic loading of soils is the primary limiting factor. However, some wastewaters such as those generated in the food processing industry may be high in nutrients and BOD. If loading rates for nitrogen will exceed crop requirements, such a proposal should be justified from the standpoint of groundwater protection. Site selection criteria listed in Section F should be used when evaluating all proposed irrigation sites for suitability.

To prevent runoff, ponding, or rapid percolation and possible contamination of groundwater, wastewater should be managed according to conventional irrigation practices. This requires matching the wastewater application rate to the infiltration rate and storage capacity of a particular soil. The Oregon Irrigation Guide[6] provides the necessary information for developing appropriate wastewater irrigation application rates and scheduling. Net liquid loading may be doubled in some cases as long as application can be managed to prevent runoff and ponding.

Considerations for developing an irrigation program must be developed according to the specific character of an individual wastewater. An analyses of the wastewater will provide a basis to determine special management requirements. For example, municipal effluents are relatively low in nitrogen. Yet if application rates are high enough, nitrogen loading may approach or exceed the crop requirement. The equation: lb/acre/year = mg/l x ft/year x 2.7 may be used to determine whether nitrogen and other components applied as effluent or wastewater will approximate crop needs or how much supplemental N, P, or K fertilizer must be applied to meet a fertilizer recommendation specified by the Cooperative Extension Service.

Other wastewaters such as those produced by the food processing industry may be high in BOD, nitrogen, or salts. In eastern Oregon where salts may not leach out of soil with natural rainfall, high concentrations of boron, sodium, chloride and total dissolved solids may damage plants (Table 4). High levels of sodium can disperse soil aggregates and reduce soil permeability. Wastewater analyses for dissolved solids, electrical conductivity and sodium absorption ratio should be carefully considered in these situations. Special management practices such as gypsum amendments may be needed to correct soil infiltration problems.

BOD applications should never exceed 35 tons/acre/year. Where high BOD loading rates are anticipated it is a good idea to include annual tillage in the management plan to avoid surface buildup of organic material.

All of the above limitations should be considered when evaluating wastewater or effluent irrigation proposals. In addition, use of municipal effluent should reflect treatment levels or effluent quality to alleviate public health concerns. Suggested uses of municipal effluents are listed in Appendix D. Setbacks from adjacent public or private land should be sufficient to prevent aerosol drift.

Table 1

Metal Content of a Sludge Appropriate for General Application to Agricultural Land [1]

Element	Concentration (mg/kg)
Zn	2000
Pb	1000
Cu	800
Ni	100
Cd[2]	25

Table 2

Maximum Recommended Sludge Metal Applications For Privately Owned Farmland [3]

	Maximum Metal Addition (kg/ha) with a Soil Cation Exchange Capacity (meq/100g)		
Metal	Less than 5	5-15	Greater than 15
Pb	500	1,000	2,000
Zn	250	500	1,000
Cu	125	250	500
Ni	50	100	200
Cd	5	10	20

Table 3

Maximum Cd applications allowed by current EPA regulations [4]

Soil cation exchange capacity (meq/100g)	Maximum cumulative application (kg/ha) Background soil pH <6.5	Background soil pH ≥6.5
<5	5	5
5-15......	5	10
>15.......	5	20

Table 4

Classification of Irrigation Waters as to Salinity Hazard [3]

	Total Dissolved Solids (mg/l)	Electrical Conductivity (mmhos/cm)
Water for which no detrimental effects will usually be noticed	500	0.75
Water that can detrimentally affect sensitive crops	500-1,000	0.75-1.50
Water that may adversely affect many crops and requires careful management practices	1,000-2,000	1.50-3.00
Water that can be used for tolerant plants on permeable soils with careful management practices	2,000-5,000	3.00-7.50

References:

[1] Chaney, R. L. 1973. Crop and food chain effects of toxic elements in sludges and effluents. p 129-141. In Proc. Joint Conf. on Recycling Municipal Sludges and Effluents on Land, USEPA, USDA, University Workshops, Champaign, Ill., 9-13 July 1973. Library of Congress Cat. No. 73-88570.

[2] USEPA, USFDA, USDA. 1981. Land application of municipal sewage sludge for the production of fruits and vegetables; a Statement of Federal Policy and Guidance.

[3] Dowdy, R.H.,R.E. Larsen, and E.Epstein. 1976. Sewage sludge and effluent use in agriculture. p.138-153. In Land Application of Waste Materials. Soil Conservation Society of America. Ankeny, Iowa. Libr. Congr. Cat. No. 76-45727

[4] USEPA. 1979. 40CFR Part 257, Criteria for Classification of Solid Waste Disposal Facilities and Practices; Final, Interim Final, and Proposed Regulations. Federal Register vol. 44 No. 179

[5] Gardner, E. H., D. D. Hemphill, Jr., V. V. Volk, J. A. Moore, T. L. Jackson, and S. A. Wilson. 1981. Fertilizing with Sewage Sludge. Oregon State University Extension Service Fertilizer Guide 64.

[6] SCS Staff. 1973. Oregon Irrigation Guide. USDA Soil Conservation Service. Portland, OR.

Appendix A: Sludge Nitrogen loading* [5]

<u>Example</u>

- Sludge contains 4% solids, 2% mineral N (NH_4-N plus NO_3-N), 5% total N

- Crop N requirement = 150 lbs available N/acre

where:

G = gallons of liquid sludge/acre
N = amount of N required by crop = 150 lbs/acre
S = % solids in wet sludge = 4%
M = % mineral N in dry sludge (NH_4-N plus NO_3-N) = 2%
T = % total N in dry sludge = 5%

$$G = \frac{120{,}000\ N}{S(85M + 15T)}$$

$$= \frac{(120{,}000)(150)}{4[(85)(2) + (15)(5)]}$$

$$= \frac{18{,}000{,}000}{(4)(245)}$$

= 18,400 gallons sludge/acre

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* for complete information on sludge fertilizer value see "Fertilizing with Sewage Sludge." OSU Extension Service Fertilizer Guide #64. May, 1981.

Appendix B: Maximum recommended cumulative sludge applications based heavy metal content.

Example: Sludge metal concentration (dry wt. mg/kg basis)

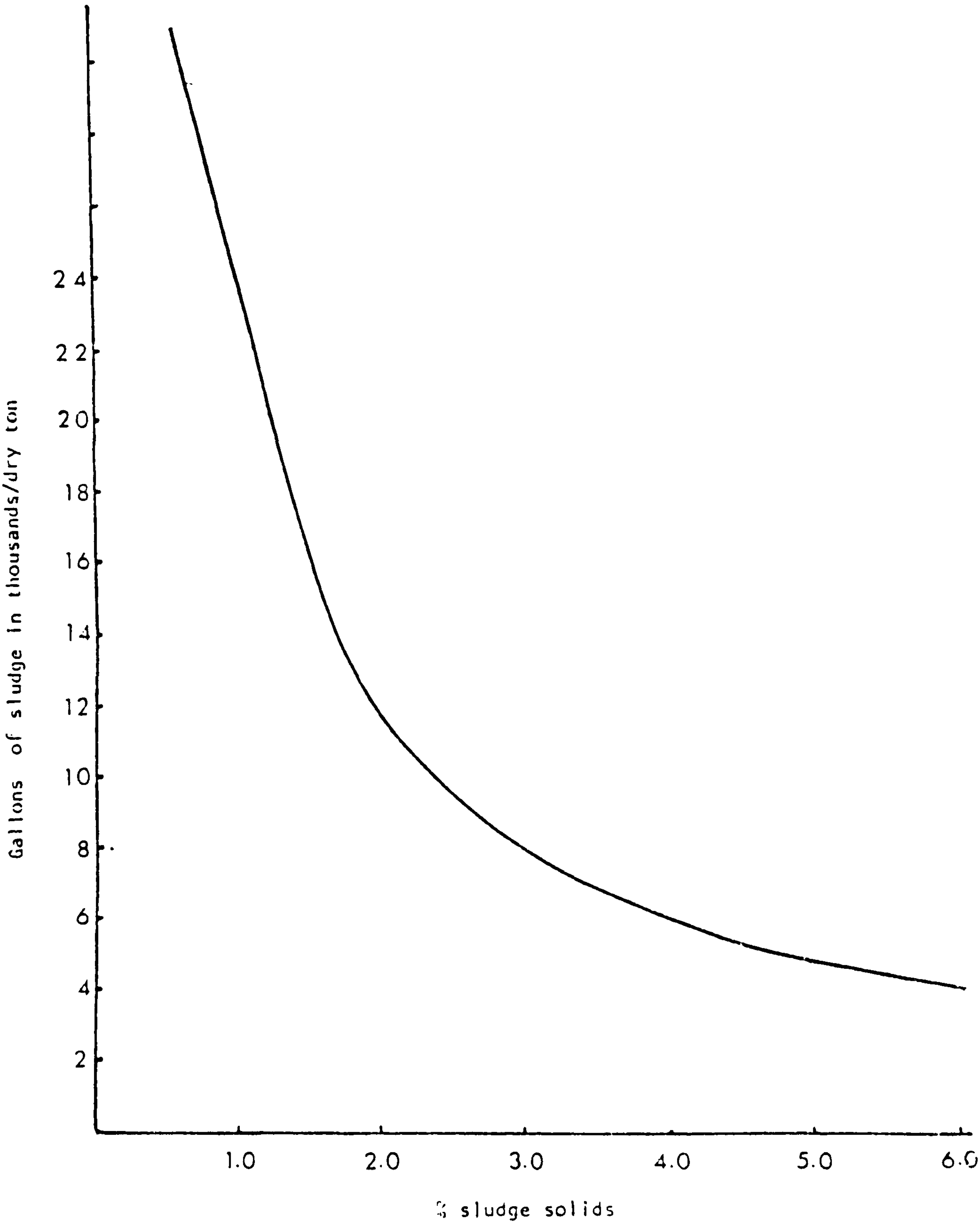
	Metal	Maximum Amount lb/acre	Conc. in Sludge ppm	Tons of Sludge/Acre		Calculation
1.	Pb	2,000	5,000	200	=	$\frac{2000 \text{ lb. Pb/acre}}{5000 \text{ ppm Pb} \times .002}$
2.	Zn	1,000	10,000	<u>50</u>	=	$\frac{1000 \text{ lb. Zn/acre}}{10000 \text{ ppm Zn} \times .002}$
3.	Cu	500	1,000	250	=	$\frac{500 \text{ lb. Cu/acre}}{1000 \text{ ppm Cu} \times .002}$
4.	Ni	200	50	2,000	=	$\frac{200 \text{ lb. Ni/acre}}{50 \text{ ppm Ni} \times .002}$
5.	Cd*	20	10	1,000	=	$\frac{20 \text{ lb. Cd/acre}}{10 \text{ ppm Cd} \times .002}$

The lowest amount is from equation 2. Thus, sludge application is limited by Zn at <u>50 tons/acre.</u>

Note: at 50 tons/acre, sludge could be applied for 16 years at a 3 ton/acre/year agronomic rate.

* maximum cumulative Cd loading rate for soils of CEC greater than 15 and background soil pH less than 6.5 should not exceed 5 kg/ha (4.5 lbs/acre).

Appendix C: Gallons of sludge/dry ton



Appendix D: Acceptable Uses for Municipal Effluent

	Treatment Level		
	Less than Secondary or Secondary without Disinfection	Secondary plus Disinfection	Advanced Wastewater Treatment Plus Disinfection
Bacteriological Quality (# org/100 ml)	---	Total coliform < 1000 Fecal coliform < 200	Total coliform < 100 Fecal coliform < 10
Uses	Forest, range, unimproved land	Pasture, hay, food crops with no contact (i.e., off season)	Golf courses, parks, food crops except fresh market
Public Access	"prevented" (fences, gates, locks)	"controlled" (signs, rural or non-public lands)	No direct public contact during irrigation cycle

Appendix G

Analysis of the Economics of Sludge Reuse

Introduction

The important economic parameters to sludge reuse are examined in this study. The study is organized into two parts. The first part discusses key reuse factors including the identification of potential uses, product characteristics important to those uses, and the regulations affecting the reuse of sludge products. The second part examines four potential markets for sludge reuse.

Reuse Factors

IDENTIFICATION OF POTENTIAL USES

Sludge provides a source of nutrients and organic matter important to plant growth. Nutrients in sludge include nitrogen, phosphorus, potassium and certain trace elements, such as copper, zinc, and molybdenum. Although all of these nutrients are important to plant growth, nitrogen is the key nutrient.

For nutrient-deficient soils, fertilizers are used to provide one or more of the needed nutrients. Fertilizers are used in a wide variety of activities including crop growing, tree growing, reclamation of mined areas, and other plant propagation uses. For each use, nutrient requirements vary.

Sludge also is a source of organic matter that is used to improve soil conditions. The organic matter in sludge can be used as a mulch and topdressing material or as an organic ingredient in soil builders, soil mixes, and a variety of soil conditioning products. One important use of organic material is to break up tightly-bound soil particles in clay soils and to provide aeration so that the soils do not repack. In addition, organic matter improves the moisture holding and nutrient capacity of soils.

PRODUCT CHARACTERISTICS

Based on levels of treatment, sludge products can be classified generally as liquid sludge, dewatered sludge, and dried sludge. As sludge undergoes additional treatment, the chemical and physical characteristics of the sludge change, thereby influencing its suitability for particular uses. In the following section, important characteristics of sludge products are examined.

Liquid Sludge

Liquid sludge is the sludge product removed from either aerobic or anaerobic digesters. The solids content of liquid sludge is typically between 1 and 6 percent, resulting in large volumes of sludge in need of handling. Because of minimal treatment, liquid sludge is characterized by a relatively high occurrence of pathogens and odor.

The nutrients in liquid sludge have important fertilizer value. Because of the higher moisture content, however, utilization of the nutrient content in liquid sludge requires application of large volumes of product to a given area to achieve the desired fertilizing effect. Because of volatilization of nutrients, the type of application technique used is important in determining the amount of nutrients made available for plant growth. Land application methods include spreading, sprinkling, and injection.

Dewatered Sludge

Dewatered sludge has a solids concentration in the range of 20-40 percent and is produced either by air-drying or by mechanical dewatering. Air-drying, which produces a dewatered sludge with a 30-40 percent solids content, requires considerable land, not only for air-drying beds but also for storage of digested sludge.

Mechanical dewatering of sludge can be achieved by several methods, including centrifuges and filter processes. Centrifuges and inexpensive belt filters produce a sludge product with a lower solids content (approximately 20 percent), whereas filter presses produce a sludge product with a solids content of approximately 30 percent. Important advantages to dewatering sludge with mechanical facilities as compared with air-drying include fewer land requirements and year-round dewatering capacity.

Once sludge has been dewatered, it can be further treated by composting, which results in a more stable product (i.e., less subsequent decomposition). Techniques for composting include unconfined processes such as static pile, windrowing, and confined processes. To date, only unconfined processes have been used in the United States to treat sludge. The City of Portland's recent decision to construct an in-vessel composting system, however, has stirred considerable interest in confined systems.

In general, composted sludge products have a solids content of approximately 40 percent. Composted sludge has some distinct advantages and disadvantages compared to air-dried or mechanically dewatered sludge. An important advantage is that composting is an effective method to further reduce pathogens under certain operating conditions. Potential disadvantages of composting include the reduction in concentration of volatile sludge components, such as nitrogen, and the increase in concentration of nonvolatile components, such as heavy metals (Brown and Caldwell 1980).

Because of the reduced moisture content, dewatered sludge products have relatively high concentrations of organic matter. This organic content provides reuse opportunities as a soil amendment.

Thermally Dried Sludge

Dried sludge products generally have a solids content of between 95 percent and 100 percent. The method typically used to produce dried sludge products is thermal evaporation (e.g., rotary kilns and "pulse jet" engines). The additional drying required to produce a dried sludge product not only reduces the moisture content but also reduces pathogens and nutrients in the sludge. Because of the relatively low nutrient content, dried sludge products are valued primarily for the organic content.

REGULATORY CONSTRAINTS

Because of public health and environmental concerns, the reuse of sludge is regulated at the state and federal level. Regulatory constraints can be classified generally as: regulations and guidelines on sludge land application programs and regulations on the commercial distribution of sludge products. For regulation of land application programs, the Oregon DEQ administers a permit program which approves sites for application of sludge from wastewater treatment facilities. Criteria used to determine acceptibility of a site include slope, soil type, groundwater conditions, and crop types.

Once a site has been approved for sludge application, appropriate sludge application rates are determined. Two basic criteria used to determine application rates are: 1) maximum loading rate considered safe for elements which accumulate in the soil (e.g., heavy metals); and 2) assimilative capacity of soil crop combinations for a particular element of concern, generally nitrogen. Because of the relatively small quantities of heavy metals in Oregon sludges in general and Eugene's sludge in particular, heavy metal accumulation is not generally considered a major limiting factor for application of sludge on most crops.

Regulation of the commercial distribution of sludge products is the other major area of regulatory activity. The Oregon State Department of Agriculture administers a registration program for all commercial fertilizers, agricultural minerals, limes, and agricultural amendments. As embodied in the so-called "labeling law" (ORS 633.310-633.500), "each brand and grade of fertilizer, agricultural minerals, lime or agricultural amendments, whether in package or in bulk, shall be registered with the department (Department of Agriculture) by the manufacturer of such product or his agent. No person shall sell, offer or expose for sale or deliver to a user fertilizer, agricultural minerals, lime or agricultural amendments except under a registered brand and grade."

The main thrust of the labeling law is to require that manufacturers of commercial sludge products provide a "guaranteed analysis" of the name and percent, by weight, of each active ingredient in the product. For fertilizer products (5 percent or more of available nitrogen, phosphoric acid, or potash singly, collectively or in combination), only the minimum percentages of these ingredients need to be stated.

At present, the distribution and marketing of sludge products is unregulated at the federal level. Draft regulations were developed by EPA and circulated for public comment in 1980. Because of considerable response, the proposed regulations are currently being revised. It is expected that EPA will issue new guidelines by fall 1983 for states to follow in regulating the commercial distribution of sludge products (Spooner pers. comm.). The focus of these new guidelines likely will be on allowable concentrations of heavy metals.

It should be noted that in addition to the regulatory conditions described above, some specific uses of sludge also are regulated. For example, sludge used for public park maintenance is required to be sterilized. Also, conditions of sludge give-away programs require that all recipients of the sludge product be registered and that they be informed as to the origin of the sludge.

Sludge Reuse Markets

Markets for sludge reuse include the agricultural market, the forestry market, the home and garden market, and the specialty market. Within each market, both soil amendments and fertilizer products are used. Some markets, however, are relatively homogeneous. The agricultural market, for example, uses primarily fertilizers. The specialty markets, in contrast, are more mixed markets, using a wide variety of soil amendments and fertilizers.

In the following section, important characteristics of products currently used in each of the markets are examined. The potential for sludge use is evaluated by assessing the substitution value of sludge products to potential users.

THE AGRICULTURAL MARKET

Agricultural Lands and Nutrient Demands

Agriculture is practiced extensively through the three-county area in proximity to the Eugene/Springfield RWTP. A diversity in crop types typifies agricultural activity in Lane County, Benton County, and Linn County. Although acreage figures by crop vary from year to year because of crop rotation practices, grass seed, pasture, and hay crops generally predominate. Grain and field crops also are important throughout the three-county area.

Agriculture consumes large volumes of fertilizers as nutrients for plant growth. Although nutrients, such as phosphorus, potassium, and certain trace elements are important to plant growth, nitrogen is the key nutrient. Nitrogen requirements of major crop types are presented in Table G-1. As shown, nitrogen requirements vary considerably.

Opportunities for Sludge Use

SUITABILITY OF AVAILABLE LAND. Because of the extent of agriculture and the need for fertilizer in Lane, Benton, and Linn Counties, considerable opportunity exists for agricultural use of sludge. Based on a survey of agricultural lands within a reasonable transport distance (approximately 25 miles) of the Eugene/Springfield treatment plant, it has been estimated that about 77,000 acres have no or only minor limitations for sludge application. Of this total, 50,000 acres are located within Lane County. Limitations include flooding potential, seasonal high water tables, shallow depth to bedrock, and undesirable soil characteristics such as high erosion hazard, high runoff, excessive slope, and coarse texture. Even agricultural lands with identifiable limitations are not necessarily unsuitable for sludge application but may require special management practices.

Based on average applications to supply 100 pounds of available nitrogen per acre per year, the acreage requirements to apply all future sludge produced is presented in Table G-2. As shown, acreage requirements for surface applied liquid sludge and mechanically dewatered sludge exceed acreage requirements for air-dried sludge. The volatilization of nitrogen during air-drying results in the need for higher application rates of air-dried sludge. The increase in acreage requirements over time is needed for all sludge products due to higher initial application rates and lower sludge production.

BENEFITS AND COSTS TO GROWERS. Substituting sludge for other fertilizers can provide considerable benefits to growers. The most important benefit is the potential reduction in fertilizer costs. One recent study estimated that annual expenditures for chemical fertilizers ranged from about $10 per acre for leguminous pasture to $100 or more per acre for intensively-managed cash crops such as peppermint (Brown and Caldwell 1980). In addition, the cost of applying the fertilizer may add between $1 and $5 per acre, depending upon whether the fertilizer is spread, sprinkled, or injected.

Table G-1. Nitrogen Requirements of Selected Crops

CROP	ANNUAL NITROGEN REGUIREMENTS (LB/ACRE)[1]
Grass seed	70-160
Grains	40-150
Pasture grasses	60-100
Processing vegetables	100-150
Orchards	40-75
Peppermint	150-200

[1] Often split into two or more applications during season.

SOURCE: Brown and Caldwell 1980.

Table G-2. Acreage Requirements for Agricultural Reuse of Sludge

	SLUDGE PRODUCTION (TONS/YEAR)		SURFACE-APPLIED LIQUID OR MECHANICALLY-DEWATERED SLUDGE		AIR-DRIED SLUDGE	
YEAR	DIGESTED	FSL HARVESTED	AVERAGE APPLICATION RATE (TONS/ACRE/YEAR)[1]	ACRES REQUIRED	AVERAGE APPLICATION RATE (TONS/ACRE/YEAR)[1]	ACRES REQUIRED
1982	6,771	5,164	2.8	1,850	6.0	850
1990	7,983	6,088	2.2	2,750	3.9	1,550
2000	9,380	7,155	1.9	3,750	3.5	2,050

[1] Based on average applications calculated to supply 100 lbs of available nitrogen/acre/year.

NOTES: Estimates based on assumed start-up date of 1982 for regional plan.
SOURCE: Brown and Caldwell 1980.

To a grower, application of sludge can result in significant dollar savings. Assuming all nutrient requirements are met through free delivery and application of sludge, a farmer could save up to $100 per acre in fertilizer costs. In addition to savings in fertilizer costs, the organic matter in sludge may benefit many soils by improving texture and increasing moisture retention capability. Because of the slow-release nature of nutrients in sludge, a relatively consistent supply of nutrients is provided over 3 or 4 years. This slow-release quality can benefit some crops which efficiently utilize nutrients released at a slow rate.

Certain disadvantages associated with application of sludge on agricultural lands also are noteworthy. New or additional management practices required with sludge application can increase production costs. These costs are most likely to occur where liquid sludge is applied. Changes in management practices include additional tillage to eliminate runoff, additional lime required to maintain soil pH at 6.5, and additional field work in the spring because of accelerated weed growth (Oregon State University 1977).

Other drawbacks to sludge application include potential restrictions on crop selection. For example, crops grown for direct human consumption usually require a waiting period of 18 months between sludge application and planting. Although the waiting period may be waived if the sludge has been heat-treated or subjected to other pathogen-destruction processes (e.g., composting), the costs associated with additional treatment make this option unlikely.

The net value of sludge to growers is the savings in fertilizer costs (plus any incidental benefits) less any increases in production costs. One study (Oregon State University 1977) of sludge utilization economic impact in the Tualatin Basin of Oregon estimated a return ranging from $-6 to $+15 per acre at liquid sludge application rates averaging 1.8 tons per acre. This is equivalent to about $-3.30 to $+8.30 per ton of sludge. In that study, it was assumed that the liquid sludge would be delivered and applied free of charge. Benefits occur from fertilizer savings after subtracting costs for new production practices; negative savings (losses) occur where production costs exceed savings in fertilizer costs. The greatest benefits occurred on the less productive soils.

<u>CONCLUSIONS</u>. Although the potential benefits to farmers from sludge utilization can only be estimated on a case-by-case basis, it appears that many farmers could benefit from use of sludge as a fertilizer source. Potential increases in production costs, however, need to be weighed against savings in fertilizer costs.

Both liquid sludge and dewatered sludge could be applied as a source of fertilizer on agricultural land. Although neither product currently has any commercial or purchase value, dewatered sludge provides some potential to reduce delivery and application costs if made available for free pick-up. This assumes, however, that the value of the product to farmers can be demonstrated clearly.

According to one survey of land application programs conducted by EPA in 1977, liquid sludge delivered and applied by the sewerage district was found generally to be more acceptable to farmers than dewatered sludge, which was stockpiled for pick-up and application by the farmer (Anderson 1977). Because of farmers' sensitivity to price, this preference may be overcome if application of dewatered sludge results in greater net benefits (i.e., less production costs).

THE FORESTRY MARKET

Resource Conditions

Approximately 85 percent of Lane County is under timber production. Privately-owned forest lands in Lane County cover 785,000 acres, 75 percent of which is within 30 miles of Eugene. Private owners of forestlands include small woodland owners, Christmas tree farmers, and large timber companies such as Weyerhaeuser. Significant acreages of publicly-owned forestlands in Lane County are managed by the U. S. Forest Service.

Many of the forest areas in western Oregon are nutrient deficient (Cole 1981). In addition, poor soil texture in these forestlands limits tree growth. To increase biomass production, application of nutrients and organics to soils in the Pacific Northwest is needed.

Opportunities for Sludge Use

SUITABILITY OF AVAILABLE LAND. The abundance of nutrient-deficient, poor-textured soils on forestlands throughout western Oregon provide considerable opportunities for reuse of sludge. Although the exact amount of forestlands without environmental or economic constraints is not known, MWMC estimates that between 10,000 and 20,000 acres of suitable forestland could be available for sludge application upon completion of a successful forestry demonstration project (Cooper pers. comm.). At an estimated application rate of 200-250 pounds of nitrogen per acre per year for established plantations, approximately 1,500-2,000 acres would be required for application of all sludge produced in the year 2000. Suitable forestland and Christmas tree sites have been identified near Marcola, Pleasant Hill, Jasper, Dexter, Bellfountain, Junction City, Crow, Cheshire, Noti, and Veneta.

BENEFITS AND COSTS TO HARVESTERS. In recent years, considerable research on the effects of sludge on tree growth has been conducted by the College of Forest Resources at the University of Washington. Most experiments have occurred at the Pack Forest site in southern Washington. The growth response from sludge use on recently cleared forest areas, newly established tree plantations, and existing forests have all been studied. Most efforts, however, have focused on the latter two forest environments.

Although growth response in the Pack Forest varied considerably by species, age, and density of the stand, sludge application increased tree growth almost without exception. The 2-year response of sludge-amended seedlings showed a height change of between -2 and 64 percent and a diameter increase of between 21 and 101 percent. The negative growth response occurred in the height of western red cedar. Seedlings of western hemlock and western red cedar also showed high rates of mortality. For 25 to 50-year-old Douglas-fir forests, the 2-year percentage increase in basal area ranged from 11-60 percent, with higher growth responses corresponding to lower site classifications. Although the longevity of increases in growth rate is not known, Harvey and Cole (1982) have found the response to last at least 4 years.

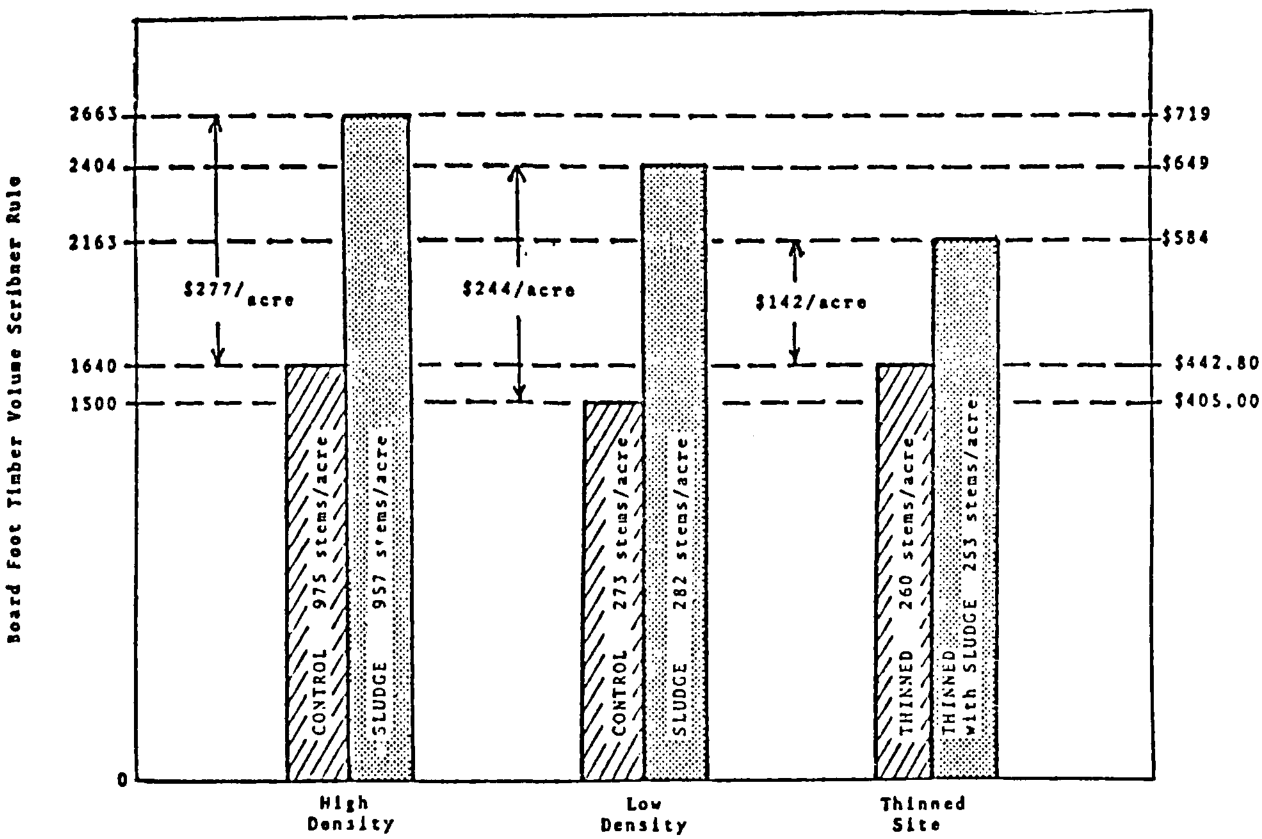
The economic benefit of increased tree growth results from trees reaching their harvest size sooner. Based on observed growth rates for 50-year-old Douglas-firs in the Pack Forest, and on assumptions regarding the longevity of these growth rates, the dollar value of the increased growth can be estimated.

As shown in Figure G-1, the value increase from applying sludge to a 50-year-old Douglas-fir forest for 2 years ranges from $142 per acre for a thinned site to $277 per acre for a high density site. Although the longevity of these growth rates is uncertain, a 10-year period would provide between $710 per acre and $1,385 per acre in increased timber value.

Even though application of sludge on forestlands is likely to increase tree growth, resulting in earlier tree harvest, sludge use also can result in additional management costs. Estimates of these costs vary according to the forest environment. In newly-established plantations, management costs are typically high because of problems with weed control. The weeds also provide an excellent habitat for field mice, which can decimate an entire plantation by girdling the seedlings (Brown and Caldwell 1980). An additional problem with sludge-treated plantations has been the extensive and selective browsing by deer; the higher protein value of sludge-amended seedlings attracts the deer. Fencing is the only reliable method to control deer browsing.

As shown on Table G-3, management costs necessary for increased seedling productivity can be significant. In general, costs experienced by the University of Washington to establish a

Figure G-1. Two-Year Value Increase from Sludge Application to a 50-Year-Old Douglas-Fir Forest[1]



NOTE: [1]Assumed standing timber value of $270/1,000 board feet.

SOURCE: Cole 1982a.

Table G-3. Procedures and Costs for Sludge-Treated Seedling Plantations at the Pack Forest in Washington

ACTIVITY	TIMING	COST
Establishing Plantations:		
Site preparation	Summer (Year 1)	$800 per acre
Sludge application	Spring/summer (Year 2)	-
Grain sowing	Fall (Year 2)	$25 per acre
Sludge/grain incorporation	Spring (Year 4)	$80 per acre
Fencing	Before planting	$1.40 per linear foot
Seedling purchase and planting	Spring (Year 4)	$165 per acre
Maintain Plantations:		
Interplanting	February/March	$0.55 per tree (annual)
Aisle discing	April, June, July, October	$150 per acre (annual)
Spot herbicide spraying	April/May, September/October	$50 per acre (annual)

SOURCE: Cole 1982b.

forest plantation treated with sludge at the Pack Forest site approximated $1,200 per acre, exclusive of the cost of applying sludge (Cole 1981). Additional costs of $200 per acre have been experienced for weed and browse control for at least three additional years following plantation establishment.

It should be noted that the management costs experienced at the Pack Forest are unlikely to reflect costs for a commercial forestry operation utilizing sludge. Furthermore, sludge utilization in existing forests would minimize management requirements. In one recent study (U. S. EPA 1983b) of proposed sludge application to a Douglas-fir forest in western Washington, no change in management practices from sludge application was expected. MWMC indicates that sludge application is its biggest concern in Oregon. Equipment capable of effectively spreading sludge in older forests is not readily available and is expensive to operate.

CONCLUSION. Application of sludge can provide an important source of nutrient and organic matter to forest environments, resulting in increased tree growth. Because sludge application requires changes in management practices in some environments, in particular newly-established seedling plantations, the value of increased growth rates should be evaluated carefully against additional management costs. Since application of sludge to older stands minimizes most of the problems associated with younger stands, except ease of application, it appears that the best use of sludge in forest environments (based on existing knowledge) would be in older stands (between 10 and 50 years) on lower site classifications (Site IV).

THE HOME AND GARDEN MARKET

The home and garden market consists of all indoor and outdoor residential uses. Products used in this market include soil amendments, organically-based fertilizers, and potting soils. Characteristics of these product markets and opportunities for sludge use in these markets are described below.

Product Market

SOIL AMENDMENTS. Materials most commonly used as soil amendments in the home and garden market are bark and sawdust. In a recent study of soil amendments in the Portland area (Gruen Gruen + Associates 1978), bark was the most commonly used soil amendment. Although bark is used primarily for decorative purposes (i.e., ground cover), the vast quantities and low price of bark also make it the most commonly used soil amendment.

In recent years, bark has been substituted for fuel oil to generate steam in lumber and paper mills. Although shortages of bark have not occurred to date, continuation of this trend could increase the demand for other products in the home and garden market. Bark for soil amendment use is currently selling at $12.00-$13.50 per cubic yard in bulk. Bagged bark is currently selling at $1.75 for a 2-cubic-foot bag or about $0.90 per cubic foot vs. approximately $0.45 per cubic foot in bulk (Rexius Forest By-Products pers. comm.).

ORGANIC FERTILIZERS. Organic fertilizers manufactured in the Northwest use an organic compound (e.g., cottonseed meal, blood meal, leather tankage) as a base material which is fortified to achieve a desired nutrient content. Organically-based fertilizers are used on lawns and as a general plant food.

Certain qualities limit the widespread use of organically-based fertilizers in the home and garden market. Organic fertilizers typically contain less nutrient content than chemical fertilizers, thereby requiring that larger volumes be applied to achieve the same nutrient effect. Organic fertilizers are typically more expensive per unit of nutrients than chemical fertilizers. Also, the slow-release quality of organic fertilizers seldom produces the dramatic results of chemical fertilizers (Gruen Gruen + Associates 1978).

An advantage of organic fertilizers over the more popular chemical fertilizers is that organic fertilizers leach less during heavy rainfall. This occurs because organic fertilizers are typically water insoluble as opposed to mostly water soluble chemical products. An additional benefit associated with organic fertilizers is the mulching capacity of the organic matter.

POTTING SOILS. The resurgence of house plants in recent years has increased considerably the demand for potting soils. Potting soil is found in almost every drug, grocery, and variety store. Most potting soil products are a combination of sand or soil and one or more types of organic materials (such as bark-dust, peat moss, or composted steer manure). Some brands of potting soils include pumice or vermiculite to achieve a loamy texture.

The market for locally-produced potting soils appears to include at least the three northwest states of Oregon, Washington, and Idaho (Gruen Gruen + Associates 1978). Although traditionally this market has been supplied primarily by a potting soil produced in southern California (Black Magic), locally-produced products have captured a sizeable share of the market in recent years. This market was estimated at 40,000 cubic yards of bagged potting soil in 1978 (Gruen Gruen + Associates 1978).

Opportunities for Sludge Use

The potential for sludge use in the home and garden market includes opportunities for commercial distribution and the potential for free distribution of sludge products.

COMMERCIAL DISTRIBUTION. For sludge to compete commercially in the home and garden market, sludge products must be pathogen-free and price-competitive. In addition, recent marketing studies (Gruen Gruen + Associates 1977, 1978), indicate that other key factors which influence the purchase of products in the home and garden market include packaging and labeling, texture, degree of odor, and visual effects. Minimal water content (less than 25-30 percent) also is important.

Because of pathogen occurrence, liquid sludge and most dewatered sludge products could not substitute for established products in this market. Composted sludge and dried sludge products are not pathogenic and do have potential for commercial distribution in the home and garden market.

The existing home and garden market for soil amendments would appear to be primarily a bulk market for bark. The significant price advantage to bulk purchases (approximately 50 percent less) is considered a primary reason for this type of distribution potential. Although data on the volume of soils in this market are not known, bulk markets are typically local because of the significance of transport costs. Consequently, the market for sludge products as a soil amendment in the home and garden market is limited most likely to the Eugene area. Although some portion (perhaps 50 percent) of the market could be captured with a product competitive with bark in terms of both price and quality, reuse of a significant share of future sludge production is unlikely.

Opportunities for sludge use as an organic fertilizer in the home and garden market are limited, primarily because the existing market is small. Although organically-based fertilizers (including a sludge-based product) do offer some qualities (i.e., slow-release of nutrients and organic content) which are desirable for certain users, the lower nutrient content per unit of cost considerably limits the potential market.

The potential for sludge use as a potting soil is as a substitute for organic materials, such as barkdust and peat moss. Recent estimates (40,000 cubic yards annually) of the regional market for bagged potting soil suggest significant opportunities for sludge products if the product does not contain objectionable odors and unacceptable levels of heavy metals. The City of Portland's recent decision to dewater and compost its sludge is likely to stiffen competition considerably for a share of the potting soil market.

FREE DISTRIBUTION. Free distribution of sludge products from a central point to the home and garden market has several advantages over commercial distribution. Existing regulatory controls on a free distribution program only require that the recipient have knowledge as to the origin of the sludge and that a log be kept on those receiving sludge. Because regulations are less restrictive, treatment requirements and costs are reduced. For a giveaway program, additional treatment, such as composting or thermal evaporation to further reduce pathogens would not be required, resulting in substantial reductions in treatment costs. Whether this reduction in treatment costs, however, would offset potential revenues from commercial distribution of additionally-treated sludge products cannot be estimated without a detailed market study.

Some insight into the potential for free distribution of sludge can be developed by examining recent giveaway programs at the Eugene and Springfield treatment plants. Approximately 1,250 cubic yards and 200 cubic yards of air-dried sludge (approximately 30 percent solids) were removed from the Eugene and Springfield treatment plants, respectively, in 1977 (Brown and Caldwell 1980). These quantities represent all sludge produced at the Springfield plant in 1977 and approximately 25 percent of sludge produced at the Eugene plant.

Of these total quantities of sludge, approximately 35 percent, or 70 cubic yards, removed from the Springfield plant and approximately 70 percent, or about 875 cubic yards, removed from the Eugene plant were used for home and garden use (e.g., lawns flower gardens, and shrubbery). Because sludge production is expected to increase approximately threefold as a result of treatment at the new plant, it has been estimated (Brown and Caldwell 1980) that between 10 and 15 percent of future sludge production could be disposed of through free distribution.

THE SPECIALTY MARKETS

Specialty markets are characterized by a diversity of users and product requirements. In this market, soil amendments and fertilizers are used by professionals for a variety of landscaping and plant propagation purposes. The market is comprised of commercial and institutional users, both public and private. Although functional similarities exist between the specialty markets and the home and garden market, the specialty markets typically require a higher degree of product specialization.

Landscapers

Landscaping services include landscaping for new construction and landscape maintenance. For new construction, landscapers use significant quantities of soil amendments. A wide range of organic products are used by landscapers as soil amendments. A recent study (Gruen Gruen + Associates 1978) of products used by landscape contractors in the Portland area indicated that bark, used primarily as a topdressing, comprised over 50 percent of the market. Other products used in significant volumes were sawdust, manure, and mushroom compost.

Because of the decline in new home construction in recent years, demand for organic amendments in new landscaping has been reduced sharply (Rexius Forest By-Products pers. comm.). Product use for landscape maintenance services, however, has remained strong. Fertilizers are the primary product used for landscape maintenance. Because of lower costs per unit of nutrient and fewer labor requirements for application, chemical fertilizers have been adopted almost universally for landscape maintenance purposes (Gruen Gruen + Associates 1978).

Landscape maintenance markets include both private and public uses. In the Portland area, the only significant private use is for golf courses. Golf course maintenance typically requires high nutrient-content fertilizers to achieve the desired color and grass conditions. Minor use of organic products occurs to improve green conditions.

Public landscape maintenance services include school districts, highway departments, and parks and public works departments. Of these, parks and public works departments likely comprise the most significant market. In attempts to minimize labor costs, however, most public maintenance departments use high nutrient-content fertilizers (e.g., nitrogen-phosphorus-potash ratio of 30-3-10).

Nurseries

Wholesale nurseries in Oregon consist of container nurseries and field nurseries. Container nurseries, which are a large industry in Oregon, cultivate flowers, foliage plants, shrubs, and some trees in greenhouses; field nurseries, which plant in open land, cultivate primarily shade, fruit, and flowering trees.

For container nurseries, there is considerable variety in the types and ratios of materials used by nurserypersons in blending potting mix (Gruen Gruen + Associates 1978). Although exact formulas are considered trade secrets, soils are typically some combination of organic materials and sand. Common organic ingredients include shredded Douglas-fir bark, composted sawdust, and steer manure. Other important ingredients include lime or gypsum, trace elements, and both fast and slow release chemical fertilizers. Fortification with chemical fertilizer is needed to increase the nitrogen consumed by decomposing organic matter.

In a recent survey (Gruen Gruen + Associates 1978) of field nurseries in Oregon, it was shown that approximately 4,000 acres were devoted to production, most of which is in the Portland region. The primary products of this industry are trees and rhododendrons, both of which require heavy nitrogen application (200-400 pounds per acre).

Opportunities for Sludge Use

COMMERCIAL DISTRIBUTION. Similar to the home and garden market, sludge products must be pathogen-free and price-competitive to compete in the specialty markets. Other important qualities influencing product selection in the specialty market include uniform particle size, sterility, salt content, heavy metal content, texture, quality, consistency, and ready availability at a project site (Gruen Gruen + Associates 1977).

Of the potential sludge products, only dried sludge and composted sludge could meet the product specifications in the specialty markets. The limited nutrient content of these products, however, makes them less desirable for most landscape maintenance uses unless they are fortified with chemical nutrients. Even though the organic matter or organically-based fertilizers would be desirable for some uses (e.g., landscape maintenance associated with clay soils), the market is small. High labor costs associated with the use of low nutrient fertilizers also discourages their use.

Some potential exists for marketing sludge products as a soil amendment. Landscaping services for new construction use significant amounts of organic materials as soil amendment and as topdressing. Although sludge products are generally considered inappropriate as a topdressing (because there is no need for nutrients), opportunities exist for substituting a sludge product for organic materials (e.g., sawdust, bark, manure, and mushroom compost) currently used as soil amendments. Sludge use in this market, however, is dependent upon two important conditions: 1) the resurgence of new home building; and 2) the continued diversion of bark supplies as a source of fuel. Recent declines in fuel oil prices are likely to slow the reallocation of bark as a fuel source.

The relative importance of the wholesale nursery industry in Oregon provides significant market opportunities for sludge use. The specificity of product ingredients, however, is an important constraint on sludge use. In general, product specifications of container nurseries are more stringent than those of landscapers since potting soils are especially sensitive to salt and heavy metal content. The availability of composted sludge from the approved composting plant of the City of Portland will likely increase competition significantly for a share of the wholesale potting soil market.

FREE DISTRIBUTION. The same quality specifications that limit the potential for commercial distribution of sludge products in the specialty markets also limit the potential for free distribution. Although some minor substitution of products may occur if only slight deviations in quality existed, the treatment costs necessary to achieve even this minimum quality standard likely would be prohibitive without some revenue generation.

The potential for free distribution of a sludge product as a fertilizer also is severely limited. The high labor cost associated with the use of a low nutrient-content fertilizer such as sludge-based fertilizer is likely to exceed the savings in product costs.

Appendix H

Oregon State University Archeological Survey Reports and Correspondence with the Oregon State Historic Preservation Office

Department of Anthropology
Oregon State University
Corvallis, Oregon 97331 (503) 754-4515

March 22, 1983

Dr. Le Gilsen
State Historic Preservation Office
525 Trade Street
Salem, OR 97301

Dear Le,

Enclosed is a copy of a cultural resource survey conducted near Eugene, Oregon. The study was prepared as part of an E.I.S. for Jones and Stokes Associates, Sacramento, California.

Mr. Michael Rushton of Jones and Stokes needs a letter of acceptance from your office to be enclosed in the final E.I.S. If the report meets the standards of your office, please advise him as soon as possible. Thank you.

Sincerely,

William D. Honey
Research Associate

Encl.

cc: Michael Rushton
Jones and Stokes Associates
2321 P Street
Sacramento, CA 95816

VICTOR ATIYEH
GOVERNOR

Department of Transportation
STATE HISTORIC PRESERVATION OFFICE
Parks and Recreation Division
525 TRADE STREET S.E., SALEM, OREGON 97310

September 19, 1983

Mike Rushton
Jones and Stokes Associates
2321 "P" Street
Sacramento, CA 95816

Dear Mr. Rushton:

Re: Cultural Resource Survey Report-Sewer Line Route
Coburg/Junction City
Lane County

Our office has reviewed the additional materials supplied to our office for the archaeological survey performed by Oregon State University. Our office concurs that before construction the specific route of the pipeline should be established and flagged and then the impact of the proposed sites on the archaeological sites be determined. Our check of our record indicates site 35LA354 also lies along the pipeline at the McKenzie River. This site is eligible.

The compliance process first requires that a site be determined eligible. If it is not eligible, then the agency and the SHPO keep the documentation and the project can proceed. If the site is eligible, then the next step is to determine whether or not there is going to be an impact. If there is no impact, the agency and the SHPO keep the documentation and the project can proceed. If there is an impact, then we have to determine whether or not it is of "no adverse" or an "adverse" impact. This generally involves some kind of a mitigation plan.

Such mitigation plans are described in the Advisory Council's Handbook, called "The Treatment of Archaeological Properties." The size and scope of mitigation should take into consideration the relative impacts of the proposed project and the importance of the project in terms of the property's research potential. Any environmental reports should take into consideration these comments.

If you have any questions, you can contact Dr. Leland Gilsen at 378-5023.

Sincerely,

D. W. Powers, III
Deputy SHPO

DWP:LG:tla

ARCHAEOLOGICAL SURVEY
IN THE COBURG AND JUNCTION CITY VICINITY
LANE COUNTY, OREGON

REPORT TO JONES AND STOKES, SACRAMENTO

18 MARCH 1983

DEPARTMENT OF ANTHROPOLOGY
OREGON STATE UNIVERSITY
CORVALLIS, OREGON 97331

C. BENSON, ARCHAEOLOGY
W. HONEY, ETHNOHISTORY
D. GRIFFIN, FIELD ASSISTANT

SUMMARY

In March of 1983 a sewer line route and alternate treatment areas were surveyed for cultural resources.

Archaeological material was located in one area of the line route, and in one of the fields surveyed. No cultural material was found in the Coburg Hills site, and two landowners denied the survey crew access to their property.

We recommend further investigation of the first site to determine its extent and depth, so that more specific recommendations for avoiding adverse impacts may be made.

The lithic scatter in area C reflects the native use of the valley floor, but appears to be so diffuse that further investigations are not recommended. It is designated a sensitive area, and project people should be alerted to the potential for encountering cultural material if ground disturbing work is done.

Its sensitivity relative to other locations may affect selection of alternates.

PURPOSE

The preliminary survey was sponsored by Jones and Stokes, as part of their evaluation of sewerage project areas in compliance with federal regulations concerning cultural resources.

PROJECT LOCATION

Alternative areas for project location were chosen by Jones and Stokes Associates, Inc. and its consultant, Brown and Caldwell of Eugene. The areas' sites vary around 200 acres. Project areas are located near Coburg and Junction City (see attached maps).

Current use of the proposed project areas is agricultural; the fields were in pasture land at the time of the survey. The areas lie at an elevation of about 350 feet, and have little relief. The areas have been changed since the time of Native American use by natural floodplain activity and by agricultural use. The sewer line corridors follow the road and rail lines, and cross areas of industrial use.

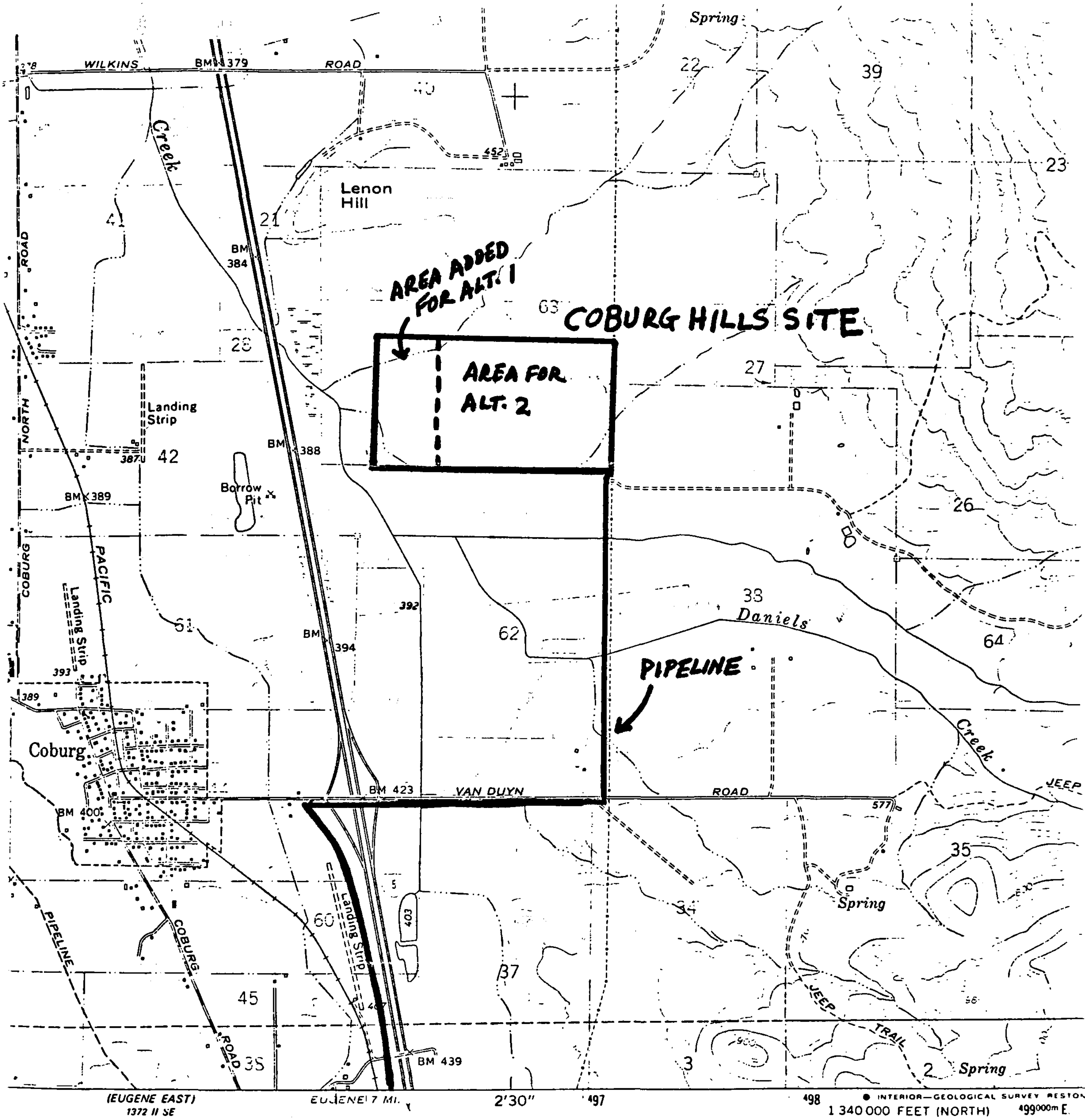
PREVIOUS ARCHAEOLOGICAL WORK

J.A. Follansbee conducted a preliminary survey for this project in 1978 for the Metropolitan Wastewater Management Commission of Eugene. Project design has since been changed, requiring examination of new areas.

In 1969 and 1970 the Hurd site near Coburg was excavated (White 1970), and more recent survey and testing has been done by University of Oregon archaeologists in the project vicinity (though not in the study areas).

CULTURAL BACKGROUND

The survey area had been inhabited at the time of European settlement by the Willamette Valley natives called Kalapuya. Kalapuya populations were decimated by epidemic diseases resulting from initial European contact, and



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OREGON
QUADRANGLE LOCATION

COBURG QUAD

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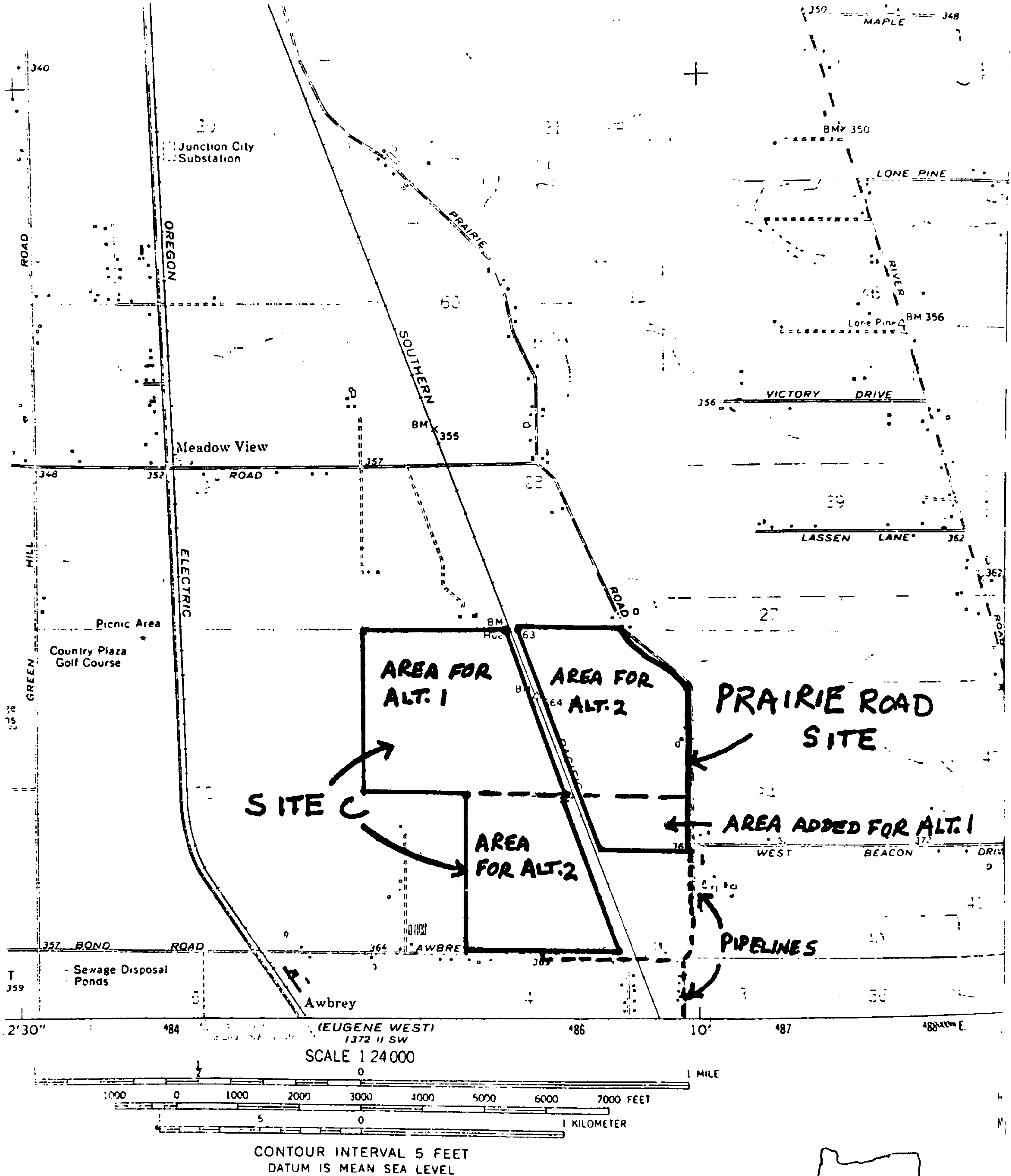
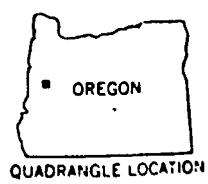
--MAP 1--





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A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

--MAP 2--

their aboriginal lifeways were undocumented. Their culture history can only be written through archaeological means.

HISTORICAL BACKGROUND

The historical background presents broad and general statements concerning the project area and adjacent areas. The purpose of this approach is to not only establish a chronology framework, but to also identify any significant trends operating through time. Included, therefore, is information on the settlement and development of the Willamette Valley and some nearby small communities such as Coburg and Meadow View.

The first systematic effort to colonize the Willamette Valley began with the interior fur traders. In 1811, Robert Stuart of the Pacific Fur Company journeyed upstream on the Willamette River to explore for fur resources and to determine the feasibility of constructing a trading post. A year later, Astorian Donald McKensie explored the upper Willamette Valley in more detail. By the end of the year 1812, a trading post was established near present-day Salem. After the Pacific Fur Company trappers came others associated with the Northwest Company and then the Hudson Bay Company. In 1821, Hudson Bay Company was without competition and began to promote settlement (Clark 1927).

During the 1840s, the Willamette Valley begin receiving a heavy influx of permanent settlers. This settlement preceded the Donation Land Law. Robert Clark (1927:362) notes that the upper Willamette Valley began receiving settlers later than the areas to the north because the "supply of desirable land began decreasing." Eugene Skinner migrated to the upper area in 1846. He filed a claim on which the city of Eugene, Oregon, now stands.

Further stimulation for settlement in the upper Willamette Valley came after 1846 with the opening of the Southern Oregon Immigration Route (Clark 1927), and its subsequent improvement, known as the Applegate Trail. These early routes influenced the distribution of settlement in western Oregon.

As population in the Willamette Valley grew, the need for transportation became clear. Water-based transport, or steamboats, represented early transportation development in the valley. In 1856, the first steamer penetrated the upper Willamette to serve the area around Eugene. Settlers were provided with an expeditious means of transporting crops and other products to market centers such as Portland (Clark 1927).

Roads were also needed, especially to encourage additional immigration. Early legislative bodies chartered many road companies in western Oregon. By the early 1900s an elaborate road system began to emerge in the Willamette Valley.

Clearly, the largest "boom" to the valley came with the railroad. In 1871, the railroad reached Eugene and the upper Willamette Valley. In 1890, plans were begun for a less expensive "narrow gauge" railroad through the valley, with the community of Coburg as terminus (Scott 1919).

The early economy of the upper Willamette Valley was diverse, yet primarily agriculturally based. Cattle, sheep, lumber, and mining were other important activities (Minor and Pecor 1977).

As economics and population diversified, a fuller potential was realized for the Willamette Valley. The Oregon Electric Railroad was one such effort during the early 1900s (Mills 1943). This line eventually ran near Junction City, Meadow View, and Eugene. By the late 1930s the Oregon Electric, or interurban, could not remain economically viable.

The communities of Coburg and Meadow View are adjacent to or within the project area. A brief historical sketch is given of each community. Information on Meadow View is sparse.

<u>Coburg</u>

Initial settlement of the Coburg area began in 1847 through the efforts of Jacob Spores and John Diamond. Spores filed a claim on the north bank of the McKenzie River, while Diamond filed near the now central part of the community. Subsequently, Diamond sold to Issac Van Duyn, whose name is familiar in the early history of the area (Hurd 1966).

In 1851 a post office was established. Early economic activities were grain crops and cattle raising. By 1861 the lumber potential of the area was realized and logs were rafted to a sawmill located near the river.

Through the efforts of Van Duyn, Coburg was platted in 1881. A train depot, grain elevator, and other features were constructed in anticipation of the arrival of the "narrow gauge" railroad. The years 1898-1915 were the period of Coburg's florescence (Hurd 1966). In 1907, attempts were made to establish a glass factory (Nelson 1956); yet the glass products proved to be inferior.

Coburg's decline coincided with the closure of the Booth Kelly Sawmill in 1914. From that time to the present, Coburg served a wide area of farms and small support industries. More currently, it is beginning to feel encroachment from the northern expansion of the city of Eugene.

<u>Meadow View</u>

The community of Meadow View was conceived as a rural farming community, and is less than that today. The sum total of structures is an old warehouse built for the Oregon Electric Railroad. Meadow View was first referred to as Grand Prairie (McArthur 1974), and was first settled in June 1854 by several individuals.

Early promotion was done by J.M. Hanslmair and B.N. Moore. In a promotional pamphlet, Hanslmair and Moore advertised Meadow View as an area of 11 acres in 5-acre parcels and fully described the climate, soil, and general quality of life. The farming potential and variety emphasized truck farming, Irish potatoes, red clover and vetch, dairying, poultry, ducks, bees, and other profitable commodities.

Clearly their effort was not successful. Today Meadow View is an agricultural community more closely associated to Junction City and Eugene.

METHODOLOGY

The field reconnaissance portion of this research conformed to that already described in the archaeological methodology. In addition, literature investigations were conducted at Oregon State University and University of Oregon libraries. The research library at Lane County Museum was also searched for pertinent information. Materials sought were newspaper articles, photographs, diaries, journals, and other historically oriented materials.

Limited interviewing was also conducted with long-time residents of the project area. A title search of property was conducted at the Lane County Courthouse.

FINDINGS

The title search revealed that a major portion of lands within the project area were originally Donation Land Claim properties. Land within the Coburg Hills site were once owned by Issac Van Duyn. There are no remaining features nor are there significant historical events associated with the property.

The Prairie Road Site and Site C have not been owned by persons important in the history of the area as revealed by interviews and literature and title searches.

The field reconnaissance revealed the location of a probable historic site in the northeast corner of Alternative 1, Site C. Research is ongoing to determine the nature of this site.

Contact with the Oregon State Office of Historic Preservation determined that there were no earlier recorded sites or structures within the project boundaries that are listed on the National Register of Historic Places.

SURVEY

1. The proposed pipeline route to the Coburg Hills site (Eugene East Quad) was walked 10 March 1983 by W. Honey and C. Benson. An archaeological site was located north of the McKenzie River and Armitage Park, and west of Spores Point (Map 1). The site, identified by fire-cracked rock and flakes, is bordered on the east by a shallow ditch and the riprapped I-5 bank, and on the west by the abandoned railroad embankment. The site extends for several hundred meters northward and is characterized by higher density of flakes at its northern extent.

Recommendations It may be possible to avoid the site by keeping the pipeline to the east (near the freeway embankment), but this should be determined by coring to establish site limits.

Another site, or higher density area of Site 1, was found farther north on the pipeline route (Eugene East Quad and Coburg Quad). This site is located between the newly constructed Roberts Street to the west and I-5 to the east. It was not determined whether the Roberts Street construction had impacted the site, but keeping pipeline work to the west in this area might avoid impacts. Again, the site's boundaries and extent should be determined by subsurface testing before more specific siting of the line is done.

2. Project area C, north of Irving (Junction City Quad), was surveyed on 10 March 1983 by C. Benson, W. Honey, and D. Griffin. Alternative areas 1 and 2 (west of the Southern Pacific Railroad) were examined. The fields were in fescue primarily, and visibility varied. Current use is sheep grazing. Where bare ground was exposed (along edges of the field and along a small drainage that bisects the field) a light scatter of flakes was found.

Recommendations We recommend that alternative areas 1 and 2 be ranked on a sensitivity scale with the other alternatives when the others have been surveyed. The potential for uncovering cultural materials should be considered in site selection. No further archaeological work is required on these two parcels at present.

Pipeline

The pipeline route between Belt Line Road and Irving (west side of the Northwest Expressway--"Prairie Road") was walked by W. Honey and C. Benson. No cultural material were located, though obsidian appears in the road gravel.

3. On 14 March 1983, W. Honey and D. Griffin surveyed the Coburg Hills area south of Lenon Hill. The survey area was pasture land with deep grass and standing water. It rained during the survey, and visibility was poor. No cultural material was located, though artifacts have been found elsewhere on this landowner's property.

We think the absence of cultural material on Coburg Alternatives 1 and 2 is not due to the poor visibility, but reflects reality since a knowledgeable field foreman has not found any artifacts in this location.

4. The surveyors were denied access to the Prairie Road Site (east of Site C, Junction City Quad) by two landowners. No recommendations can be made for this parcel until it can be examined.

GENERAL RECOMMENDATIONS

1. More specific definition of project routes and boundaries is necessary for specific determinations of avoidance potential and recommendations.

2. The pipeline routes should be flagged, and boundaries of construction areas delineated. Since the project vicinity is culturally sensitive, further specification will help identify and lessen impacts to cultural resources.

3. Permission to survey the Prairie Road locale should be obtained if that area remains an alternative.

More detailed project specifications will help the archaeologists make more efficient recommendations.

REFERENCES

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Department of Anthropology

Oregon State University

Corvallis, Oregon 97331 (503) 754-4515

April 6, 1983

Michael D. Rushton
Jones and Stokes Associates, Inc.
2321 P Street
Sacramento, California 95816

Dear Mike:

Enclosed you will find a copy of the final report prepared by Charlotte Benson and me. As I mentioned earlier, we have addressed only project recommendations for the Metropolitan Wastewater Management Commission.

Attached to the report is an informal budget for core testing the proposed Coburg Hills and Site C areas. You might mention to MWMC that they would be able to save considerable expense if testing procedures were accomplished this spring. Please bear in mind, this informal budget does not obligate the University to perform the work. In addition, the core testing process will not disturb existing crops to any significant degree.

All questions or comments concerning the enclosed material may be directed to Charlotte or me. Thank you.

Sincerely,

Bill

William Honey
Research Associate

Encl.

SUMMARY

1. Cultural significance of the sites usually cannot be determined from surface indications alone. To assess significance (and even defining site size and depth), subsurface testing is required.

From surface observations alone, the Egge site (Coburg Hills pipeline route) appears to have more potential significance than the Area C lithic scatter.

2. It is not clear whether the pipeline can be rerouted to avoid archaeological site #1 because no alternatives were given.

The sensitivity of Area C can be evaluated through subsurface sampling, and the necessity for relocation then addressed.

3. The most expedient and cost effective method for subsurface testing these areas is systematic coring of the pipeline site(s) (Egge and Roberts Road) and sample coring of the lithic scatter in Area C. Coring will provide subsurface information on site size and depth without the time and cost of pit or trench excavation. Site boundaries can be mapped on this basis, and sensitive areas delineated.

4. The coring program can be accomplished effectively by Oregon State University Archaeological Methods students under the direction of project investigators.

If this evaluation is undertaken during Spring Term, it can be done at significantly lower cost and less time than if done later (see attached budget)

RECOMMENDATIONS

A. Coburg Hills

1. Pipeline Route

Before construction, the specific route of the pipeline should be established and flagged. The archaeological site west of Spores Point and north of the McKenzie River at Armitage Park is approximately 100 x 80 meters in size. Core testing of this area will determine the impact of pipeline construction on cultural material and reveal more information regarding site significance. Fire cracked rocks, obsidian, jasper and other chert (cryptocrystalline) flakes were observed in a backhoe trench nearly 0.5 meter in depth (Figure 1). This indicates the likelihood of a considerable period of human occupation. Fire cracked rock suggests seasonal or even permanent encampment, which heightens the potential significance of the sites. No diagnostic artifacts were located.

A few meters to the north of the backhoe trench, an area of the field had been plowed (Figure 2). Cultural materials (flakes and chips) were observed within the disturbed area. Some bone material was located, but fire cracked rock was not observed. Rodent burrows revealed the presence of additional cultural material, primarily flakes. Further north, another archaeological site (or extension of same) was located between Roberts Road and Interstate 5 (Figure 3). The boundaries of this site were not determined; however, lithic material was widely scattered. Again, site parameters and significance can be more accurately established by core testing.

2. Area for Alternatives 1 and 2

These areas are pasture lands in deep grass and standing water (Figure 4). Cultural materials were not located during the survey. The landowner has

Figure 1. Backhoe trench, Coburg Hills pipeline route.

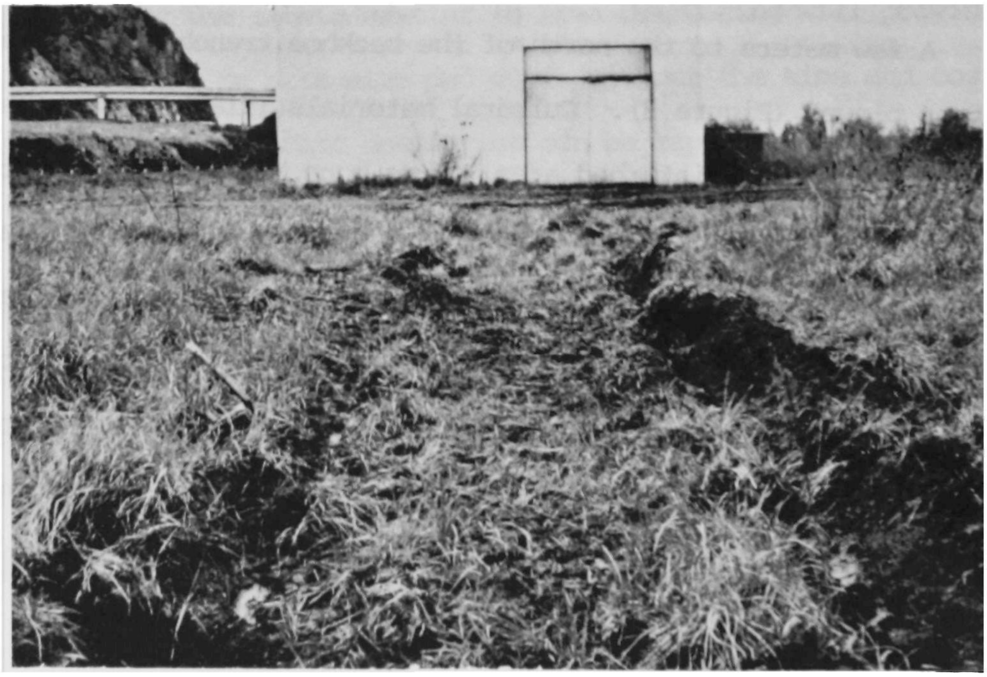

Figure 2. Plowed field, Coburg Hills pipeline route.

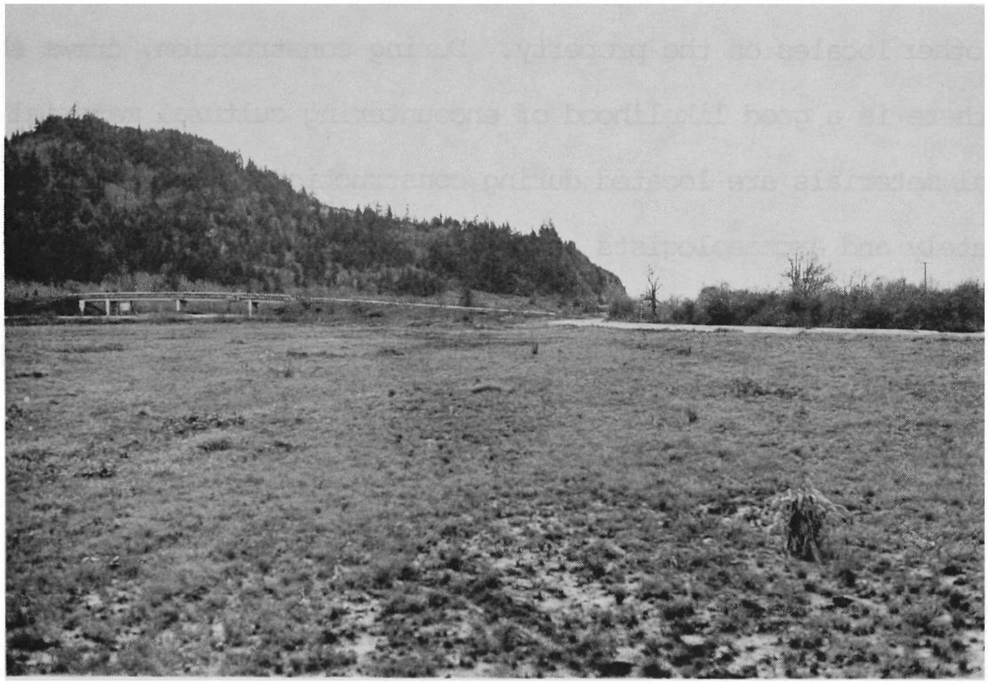

Figure 3. Archaeological site between Roberts Road and Interstate 5, Coburg Hills pipeline route.

Figure 4. Pasture lands, Alternatives 1 and 2, Coburg Hills.

recovered artifacts (mortar and pestles, projectiles) along Daniels Creek and in other locales on the property. During construction, crews should be aware there is a good likelihood of encountering cultural material. If cultural materials are located during construction, work should be halted immediately and archaeologists at Oregon State University or the State Historic Preservation Office should be consulted.

B. Site C

1. Pipeline Route

Cultural materials were not located along this proposed route.

2. Alternatives 1 and 2

The area west of Southern Pacific Railroad revealed nearly 20 flakes. This scatter is composed of obsidian and cryptocrystalline flakes (Figure 5). Several possible cores were also observed. Although these fields were in grass, exposed areas revealed lithic materials. There is an extremely high likelihood that cultural materials will be uncovered during construction. Diagnostic artifacts and fire cracked rocks were not observed.

The historic site located during the survey is still being researched. We recommend core testing at this site.

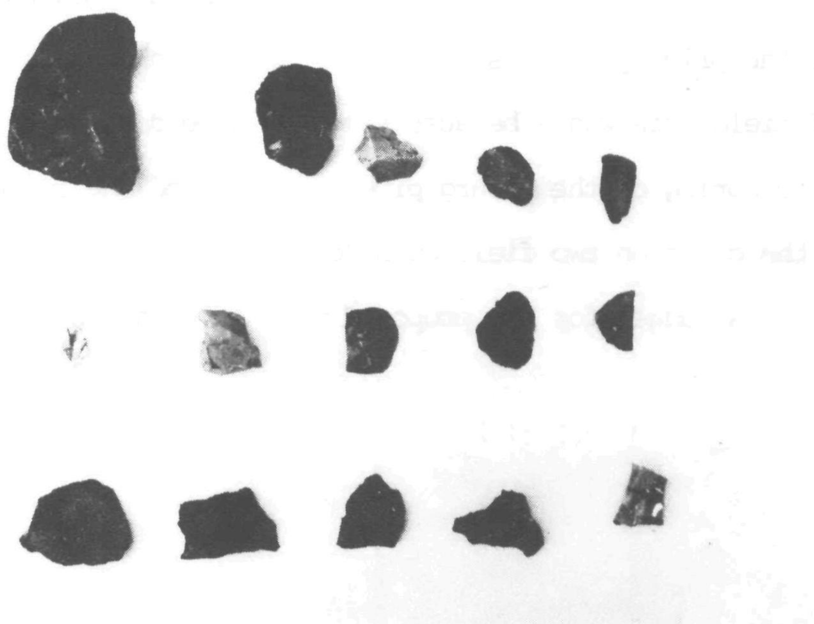

Figure 5. Flakes recovered from Site C, Alternatives 1 and 2.

Charlotte Benson is teaching an upper division class in Archaeological Method and Theory during Spring Term 1983. She is willing to formulate a systematic core testing scheme for MWMC in Eugene. Under her supervision, students can accomplish testing as a class project. Financial costs would be limited to travel, minimal field expenses such as food, equipment, and salary only for the principal investigators. Substantial savings would occur in terms of field crew wages because time would be donated by students.

The coring of the Coburg pipeline site and the field at Area C can be done by the class on two field days (one day for each site) in two separate day trips. A budget for the proposed work is attached.

Appendix I

List of Report Preparers

U. S. Environmental Protection Agency, Region 10

Richard Thiel - Chief, Environmental Evaluation Branch; Seattle, Washington.

Area of EIS Responsibility. Supervises EIS functions; coordinates EPA Region 10 environmental activities.

Daniel I. Steinborn - EIS and Energy Review Team Leader, Environmental Evaluation Branch; Seattle, Washington.

Area of EIS Responsibility. Supervises EIS preparation and review efforts for EPA Region 10.

Norma Young - Project Monitor, Environmental Evaluation Branch; Seattle, Washington.

Area of EIS Responsibility. Principal monitor and reviewer of Eugene/Springfield Sludge Management Program EIS.

Jones & Stokes Associates, Inc.,
Sacramento, California

Charles R. Hazel - B.S., M.S., and PhD., Fisheries Biology. Formerly with California Department of Fish and Game as Director of Water Pollution Control Laboratory. As President of Jones & Stokes Associates, Inc., has managed numerous environmental studies and reports and served as expert consultant in fisheries and water quality ecology.

Area of EIS Responsibility. Program management.

Michael D. Rushton - B.A. and M.A., Physical Geography. As staff Environmental Scientist, responsibilities are project management, coordination of EIS preparation team work efforts, and compilation of EIS. With Jones & Stokes Associates, Inc., for past 10½ years preparing and managing preparation of environmental impact analyses.

Area of EIS Responsibility. Project manager; project and alternatives description, energy consumption, public acceptance, indirect impacts, summary.

Robert D. Sculley - B.S., Zoology; M.S., Ecology. Staff ecologist with special expertise in air quality analysis, including modeling, development of emission inventories, and projection of air quality changes. With Jones & Stokes Associates, Inc., for 11 years, with varying project management, and resource planning and environmental impact analysis experience.

Area of EIS Responsibility. Air quality, odors.

Thomas C. Wegge - B.A., Urban Studies; M.S., Environmental Economics. Environmental economist specializing in socio-economic impacts of land use changes, cost-benefit and risk analysis, and energy impact assessment.

Area of EIS Responsibility. Sludge reuse economics, project costs, alternatives screening process.

Debra Loh - B.A., Geography; M.A., Urban Planning. Urban and environmental planner specializing in land use, transportation, and air quality analysis.

Area of EIS Responsibility. Land resources.

Miriam Green - B.S., Wildlife Biology. Staff biologist with experience in raptor and passerine bird censusing and habitat evaluation; also experience in EIS production.

Area of EIS Responsibility. Biological resources.

Pat Osfeld - Staff librarian responsible for acquisition and organization of reference documents. Conducts literature studies and compiles bibliographies.

Area of EIS Responsibility. Preparation of reference listing, literature research.

Jack Whelehan - Staff technical editor with 7 years experience at Jones & Stokes Associates, Inc.

Area of EIS Responsibility. Technical editing of EIS.

Lorna Russell - Staff technician responsible for operation of word processing equipment.

Area of EIS Responsibility. Compilation and typing of EIS.

Tony Rypich - Staff graphics artist.

Area of EIS Responsibility. Report graphics.

Jones & Stokes Associates, Inc.,
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Robert Denman - B.S., Forest Management; M.S., Forest Hydrology. Environmental hydrologist specializing in forest and stream hydrology, sediment transport, and soil science. Formerly with University of Washington as a research assistant and Weyerhaeuser Company as a forestry aide.

Area of EIS Responsibility. Surface water quality, soil character, and use.

Patricia Gibbon - B.S., Agriculture Economics and Soil Science; M.S., Urban and Regional Planning. Environmental planner specializing in land use and outdoor recreation planning, soil science, and natural resource economics. Formerly with Town of Tiburon, California; Wisconsin Department of Natural Resources; and City of Minneapolis.

Area of EIS Responsibility. Visual aesthetics.

Harding Lawson Associates, Bellevue, Washington

John Newby - B.S. and M.S., Civil Engineering. Civil engineer with 8 years experience in geotechnical engineering and project management.

Area of EIS Responsibility. Management of groundwater quality analysis.

Mark Adams - B.S. and M.S., Geology. Geologist with 5 years of experience in groundwater contamination analysis, hydrology, drainage control, and geologic hazards analysis.

Area of EIS Responsibility. Groundwater quality analysis.

Jeffrey Sherwood - B.S., Natural Resource Studies; M.S., Plant and Soil Science. Soil scientist with 6 years experience in soil and water management and conservation, land disposal of sewage.

Area of EIS Responsibility. Fate of nutrients, heavy metals, and toxics in soil column.

SCS Engineers, Bellevue, Washington

David Roberson - B.S., Bacteriology and Public Health; M.S., Environmental Science. Staff scientist with 5 years experience in the environmental and public health aspects of wastewater and sewage sludge management, and disposal of hazardous wastes.

Area of EIS Responsibility. Public health risks.

SCS Engineers, Long Beach, California

Curtis J. Schmidt - B.S., Sanitary Engineering. Principal with SCS Engineers; Civil and Sanitary Engineer with over 23 years experience in the areas of wastewater and sludge management, process equipment evaluation/selection, and cost estimating.

Area of EIS Responsibility. Management of public health analysis; technical review of MWMC sludge management plans and cost estimates; technical review of EIS alternatives chapter.

Oregon State University Department of Anthropology Corvallis, Oregon

William D. Honey, Jr. - B.S., Anthropology; M.A., Interdisciplinary Studies. Anthropologist with 10 years experience in conducting archeological, historic, and ethnographic research in the Pacific Northwest, with emphasis on the Willamette, Umpqua, and Rogue River Basins.

Area of EIS Responsibility. Management of cultural resources investigation; cultural resources field surveying.

Charlotte L. Benson - B.A., M.A., PhD., Anthropology. Anthropologist with 17 years experience in conducting archeological field surveys and research throughout the Pacific Northwest.

Area of EIS Responsibility. Cultural resources field surveying and literature review.

Dennis Griffin - B.A., Archeology. Graduate student in archeology with over 3 years of experience in conducting archeological field surveys in Oregon.

Area of EIS Responsibility. Cultural resources field surveying.

Appendix J

Draft EIS Distribution List

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STATE AND LOCAL OFFICIALS AND AGENCIES	Governor of Oregon Mayor of Eugene Mayor Springfield Mayor of Coburg Mayor of Junction City Oregon Department of Environmental Quality Oregon Land Conservation and Development Commission Oregon Department of Fish and Wildlife Oregon Department of Water Resources Oregon Health Planning and Development Agency Oregon Department of Transportation Oregon State Historic Preservation Office Oregon State Clearinghouse Lane Council of Governments Lane Regional Air Pollution Authority Lane County Health Department Metropolitan Wastewater Management Commission Eugene and Springfield Planning Departments Eugene and Springfield Public Works Departments Eugene Department of Planning and Community Development
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