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FINAL CLOSURE
AND
PHASE 1 CORRECTIVE ACTIONS PLAN
FOR THE
CASPAR SOLID WASTE DISPOSAL SITE

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EXECUTIVE SUMMARY

The Caspar Solid Waste Disposal Site (Site) is jointly owned by the City of Fort Bragg and Mendocino County (County). The waste management unit (WMU) received approximately 20,000 tons per year of municipal solid waste from 1967 until it was closed, in October 1992. During an investigation conducted for the preparation of the Report of Waste Discharge (SHN, 1991), it was determined that waste constituents (leachate) had been released into the groundwater. Additional investigations were begun to define the extent of contamination, determine measures to reduce leachate production, and determine feasible corrective actions. Reports submitted to the California Regional Water Quality Control Board, North Coast Region (RWQCB) during the course of these investigation are listed in the "References" section.

A Corrective Actions Feasibility Report was prepared (SHN, June 1992). A corrective actions plan was discussed at a meeting with the County, RWQCB, SHN, and the California Integrated Waste Management Board (CIWMB), in July 1992. It was agreed that corrective actions would be implemented in two phases.

Phase 1

- Final closure of the WMU
- Installation of additional groundwater monitoring wells and spring sampling points
- Determination of the extent of groundwater contamination
- Design and installation of the final cover and associated systems
- Design, installation, and testing of a leachate extraction and treatment/disposal system

- Development of an acceptable leachate disposal method
- Design, installation, and testing of a landfill gas venting system
- Design, installation, and testing of a landfill gas, subsurface migration monitoring system
- Testing of the ambient air within on-site structures and at the property boundaries to determine methane concentrations
- Submittal of a Final Closure and Phase 1 Corrective Actions Plan (Plan) (As final closure was the key element in the proposed corrective action plan, it was decided that these documents could be combined.)
- Submittal of the Phase 1 Corrective Actions Postclosure Maintenance Plan
- Continued sampling and analysis of groundwater, and submittal of quarterly monitoring reports
- The development of a revised (Article 5) groundwater monitoring program
- Monitoring of the effectiveness of Phase 1 corrective action measures through one complete hydrologic cycle (One complete hydrologic cycle was agreed to mean a 12 month period during which the site received the normal average rainfall as measured by the Russian Gulch State Park rain gauge.)
- Submittal of a report that evaluates the effectiveness of the Phase 1 corrective actions and proposes Phase 2 corrective actions (if necessary)

Phase 2

Corrective actions that may be included in Phase 2 include:

- Isolating the WMU from the groundwater by surrounding it with a slurry wall
- Capturing the contaminated groundwater with subsurface drains or an extraction well network
- Dumping and treating the contaminated groundwater

Most of the tasks leading up to the final closure of the WMU have been completed and are documented by this report.

A preliminary slope stability analysis indicated that a very expensive tensile member would have to be added to the conceptual final cover profile. The County requested that additional research and testing be completed so that the final cover's performance is ensured and that construction costs are kept to a minimum. That research, testing, and design work has been completed and is included in the Appendices. Two final cover profiles are presented in this Plan. One profile utilizes low permeability soil as a barrier layer, and the other utilizes high density polyethylene geomembrane. The tensile member is not required for either design.

This Plan also includes the design for a leachate extraction and removal system (LCRS). The LCRS consists of a series of trenches located around the toe of the WMU. The leachate will flow by gravity to storage tanks, then be hauled to the Fort Bragg Wastewater Treatment Plant for disposal.

A Construction Quality Assurances Program has been developed for both of the final cover profiles. A revised cost estimate for final closure and postclosure maintenance has also been completed.

The CEQA process for closure of the Site has not yet been completed. The closure of the Site also involves opening a transfer station. The CEQA process is underway at this time. A Notice of Determination (NOD) will be submitted as an addendum to this Plan when it has been filed.

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INTRODUCTION

This Final Closure and Phase 1 Corrective Actions Plan (Plan) has been prepared by SHN Consulting Engineers & Geologists (SHN) on behalf of Mendocino County Administrative Offices, Solid Waste Division (County) for the Caspar Solid Waste Disposal Site (Site) located near Caspar, California. This document supersedes and replaces the previously submitted Final Closure and Phase 1 Corrective Actions Plan (SHN, March 1993). Inquiries regarding this Plan should be directed to:

Mr. Randall S. Forbes
Solid Waste Division, Mendocino County
559 Low Gap Road
Ukiah, CA 95482
(707) 463-4078

The waste management unit (WMU) was approaching its permitted capacity when waste constituents attributable to the landfill were detected and confirmed in the aquifer downgradient of the Site. Instead of pursuing expansion of the WMU, the County decided to close the WMU as a key element of a corrective actions plan.

A corrective actions feasibility study was prepared (SHN, June 1992), and submitted for review, to the California Regional Water Quality Control Board, North Coast Region (RWQCB); California Integrated Waste Management Board (CIWMB); the Mendocino County Department of Environmental Health (the Lead Enforcement Agency [LEA] for the CIWMB); the State Department of Parks and Recreation; and the County. At a meeting attended by these agencies, on July 16, 1992, the conclusions and recommendations of the study were discussed. The decisions made at that time are discussed in detail throughout this report.

This Plan has been prepared by a civil engineer, registered in the State of California, in accordance with the requirements of Title 14, California Code of Regulations (CCR), Chapter 5, Article 3.4, Section 18262, (Title 14) and meets the requirements of Title 23, CCR, Division 3, Chapter 15. To simplify the review process by the CIWMB, the LEA, the County, and the RWQCB, the information in this document is presented in the same format as the Closure/Postclosure Regulations (CIWMB, June 1990).

Additionally, the requirements of Title 14 are printed in **bold faced** type, and the descriptions of the closure operations are in plain face type. This Plan is a "stand alone" document that contains all of the information necessary for its evaluation.

Letters submitted to the County from the agencies that reviewed the March 1993 closure plan are included in Appendix A.

BACKGROUND INFORMATION

The Site is located approximately 7 miles southeast of the City of Fort Bragg, in the northwest 1/4 of Section 17, Township 17 north, Range 17 west, Mount Diablo Base and Meridian (Figure 1).

Access to the Site from Highway 1 is provided by County Road 409, and by Prairie Way (County Road 561A). The Site consists of two parcels, totaling 65 acres.

The Site began operations in July of 1967, under County Use Permit and Division of Forestry Rubbish Dump Permit No. 1-1049/d. The Site is owned jointly by the City of Fort Bragg and Mendocino County, and is operated by the County under a joint powers agreement. The Site is permitted by RWQCB as a Class II-2 Solid Waste Disposal Site. Although the Site is currently permitted as a Class II-2 disposal site, under the existing Chapter 15 regulations it would be classified as a Class III solid waste disposal site. It is operated under Waste Discharge Requirements (WDR) Order No. 78-125, the Cleanup and Abatement Order (CAO) No. 91-110, and the Cease and Desist Order No. 91-125. The Site is also permitted by the CIWMB and operated under Solid Waste Facilities Permit (SWFP) No. 23-AA-0003. Copies of these documents are included in Appendix A.

The WMU addressed by this Plan covers approximately 16 acres, is located at the east boundary of the Site, and is shown on Sheet 1. Most of the waste is above grade, but the original operation included trenches (shown on Sheet 2) where the waste was piled and burned, then covered with the excavated soils. Since 1977, the operation has been an area fill, with no new excavations occurring below native grades (due to high groundwater conditions). The WMU contains approximately 800,000 cubic yards of waste (above grade) and is in the shape of an elongated pyramid with a nearly flat top (Sheet 3). There are approximately 8 acres of top deck and 8 acres of sideslopes (plan view). Even though the WMU has not yet reached its permitted capacity, disposal operations have ceased (in October 1992), and approximately 2 feet of intermediate cover soil has been applied. One cell (the western access road to the top deck) was left

unfilled and will only be used if an emergency (such as the transfer station becoming inoperable) occurs between now and the application of the final cover. The grades within this last cell are currently 3:1 (ratio of horizontal to vertical distances) or less. These grades will be maintained when and if emergency disposal takes place.

Woodwaste was historically placed in an area along the northern border of the Site. Disposal of woodwaste was discontinued sometime in 1977, and the area was closed in accordance with the regulations in existence at that time. Approximately 2 feet of native soils were placed over the woodwaste as final cover. As agreed upon at the July 16 meeting, water samples from the downgradient monitoring wells were tested for tannins and lignins, pentachlorophenol, and tetrachlorophenol. None of these constituents were detected. Testing of the downgradient monitoring wells will continue during the postclosure maintenance period. This area is considered to have undergone final closure.

The monitoring system for the Site currently includes 18 groundwater monitoring wells, 5 groundwater piezometers, 3 spring monitoring stations, 2 surface water monitoring points, 5 subsurface gas monitoring probes, and 2 leachate extraction wells. The locations of these monitoring points are shown on Sheet 1. Borehole logs and construction diagrams for the groundwater monitoring wells, the piezometers, and the leachate extraction wells are included in Appendix B. Typical construction details for spring monitoring stations and subsurface gas migration monitoring probes are included as Figures 2 and 3, respectively. Various nearby domestic water wells are also monitored by the County. They include Fontaine #1, and #2, Saarinen #1, Lette #1, and #2, and Bernhardy #1.

The existing coastal waste stream has been diverted to other Class 3 solid waste disposal sites, including Willits and the Central landfill, in Sonoma County. The County has finalized an agreement with the City of Willits to accept all of the waste that had previously been disposed at Caspar.

A portion of the Site (west of the WMU, see Sheet 1) is currently being used as a transfer station for "self-hauled" public waste. The County is pursuing a revision of its Solid Waste Facilities Permit (SWFP) to allow the continued use of the Site as a transfer station. A Report of Station Information (RSI) for this operation is included in Appendix C. A CEQA document for establishing the transfer station has been circulated by the County, which is responding to comments. The transfer station will be closed and removed when and if the County or a private operator sites and permits a new transfer station for the coastal wastestream.

EXTENT OF CONTAMINATION

In mid 1991, an investigation to define the extent of contamination associated with the landfill was begun. The report of that investigation, Extent of Contamination at the Caspar Solid Waste Disposal Site (SHN, April 1992), was submitted by the County, to various regulatory agencies. Two addenda to that report were submitted (SHN, July 1992, and SHN, December 1992).

A plume of volatile organic compounds (VOCs), directly attributable to the WMU, has been identified (Figure 4). The plume consists of various VOCs, at concentrations in the part per billion (ppb) range, that have been detected and confirmed in monitoring wells, in an area including approximately 60 acres. The VOC plume definition has been changed (shrunk) since Addendum No. 2 was completed. The change was based on 2 additional quarters of groundwater test results that did not confirm the contamination in monitoring well 91-7.

A metals plume has also been tentatively identified (Figure 5). A list of metals and a range of concentrations at which they are expected to occur (at a 95% confidence level) were developed from a statistical evaluation of data from the upgradient monitoring well 91-3. The metals plume is much smaller in area.

CORRECTIVE ACTIONS

As mentioned earlier, the Corrective Actions Feasibility Study (SHN, June 1992) was submitted to the various regulatory agencies involved with this project. At a meeting held on July 16, 1992, it was agreed that various corrective actions would be implemented, in two phases.

Phase 1 corrective actions include:

- Initiate final closure of the WMU and apply intermediate cover. Institute erosion control measures (completed).
- Determine the extent of groundwater contamination (completed).
- Design and install of the final cover and associated drainage systems (completed).
- Design, install, and test a leachate extraction system. (Two vertical wells have been installed. A toe drain consisting of a series of trenches will be installed under this plan.)

- Develop an acceptable leachate disposal method. (The City of Fort Bragg has agreed to accept the leachate for disposal in their wastewater treatment plant.)

- Design (completed), installation, and testing of a landfill gas venting system (to be installed under final cover.)

- Design, installation, and testing of a landfill gas, subsurface migration monitoring system (completed)

- Testing of the ambient air at the property boundaries to determine methane concentrations (completed)

- Submittal of the Final Closure and Phase 1 Corrective Actions Plan

- Submittal of the Phase 1 Corrective Actions Monitoring and Postclosure Maintenance Plan

- Continued sampling and analysis of groundwater, and submittal of quarterly monitoring reports (ongoing)

- The development of a revised (Article 5) groundwater monitoring program (in progress)

- Monitoring of the effectiveness of the Phase 1 corrective actions through one complete hydrologic cycle

- Submittal of a report that evaluates the effectiveness of the Phase 1 corrective actions and proposes Phase 2 corrective actions (if necessary)

Potential Phase 2 corrective actions include installation of slurry walls and subsurface drains, expansion of the leachate extraction system, retrofitting an active collection and treatment system on the passive gas venting system, and development of landfill gas migration control system. Final closure of the WMU (installation of the final cover and drainage systems) will not preclude implementation of any of the Phase 2 corrective actions that already have been identified as feasible.

The leachate that is collected by the extraction system will be disposed of at the Fort Bragg Wastewater Treatment Plant. A feasibility study (SHN, October 1992) concluded that the treatment plant was capable of safely treating the leachate as long as certain organic and inorganic parameters were not exceeded. The City of Fort Bragg agreed to accept the leachate. An agreement between the County and the City has been reached and is included in Appendix A.

FINAL CLOSURE PLAN

TITLE 14, CCR, CHAPTER 5, ARTICLE 3.4

Section 18262. Final Closure Plan

(a) The purpose of the final closure plan is to:

(1) provide a basis for the operator to establish an accurate cost estimate for closure;

(2) provide a detailed plan and schedule for the operator to implement upon closure of the landfill; and

(3) allow the Board and local enforcement agency (LEA) to easily monitor closure activities to determine that all requirements of landfill closure have been implemented in accordance with the approved plan.

(b) Final closure plans shall be written for the entire landfill and/or for each discrete unit to be closed, in accordance with the requirements of partial closure, Title 14, CCR, Chapter 3, Article 7.8, Section 17764, depending on how the operator intends to implement closure. Plans submitted for partial closure must be compatible with closure of the entire landfill.

* * * * * * * * * *

Section 18262.3 Contents of the Final Closure Plan

(a) At a minimum, the final closure plan shall include, but is not limited to, the following items:

(1) A map of the solid waste landfill in accordance with Section 18261.3(a)(1) of this Article.

Figure 1 shows the general location of the landfill in relation to the town of Caspar and to the Pacific Ocean.

In accordance with Section 18261.3(a)(1), the required Disposal Site Location Map is included as Sheet 1. It shows (at a scale of 1"=200')

- the property boundaries
- the access road
- both on-site structures and structures within 1,000 feet of the property boundary
- the footprint of existing waste
- the locations of the monitoring points

- leachate extraction wells
- the sedimentation basin

(2) Topographic maps in accordance with Section 18261.3(a)(2) of this Article.

The approximate prelandfill and postexcavation topography are shown on Sheet 2. The proposed final grades of the WMU are shown on Sheet 3 at a scale of 1"=50'. The contour interval is 2 feet. As-built plans will be submitted after construction is complete. Reproducible mylars will then be submitted to the CIWMB, the RWQB, and the LEA.

(3) A current description of all monitoring and control systems at the landfill.

The following subsections describe the monitoring and control systems that are in operation at the Site. They include groundwater and surface water monitoring networks, surface water control structures, a leachate extraction system, a landfill gas subsurface migration monitoring system, and differential settlement monitoring control points. During final closure, a gas control system (passive venting) will be installed under the final cover. A toe drain (subsurface collection trench) will be installed during the summer of 1993. The gas control system and the toe drain will be described in the landfill gas monitoring and leachate monitoring section below.

Groundwater Monitoring

The groundwater monitoring system currently includes:

18 groundwater monitoring wells (12 on site and 6 off site)

5 piezometers (4 on site and 1 off site)

6 off-site domestic wells (Lette #1, Lette #2, Fontaine #1, Fontaine #2, Saarinen and, Bernhardy)

3 springs that were developed for sampling, in the Russian Gulch State Park

Groundwater monitoring wells 78-1, 78-2, and 78-3 were installed in 1978 to monitor groundwater immediately downgradient of the WMU. Monitoring wells 87-1, 87-2, 87-3, and 87-4 were installed in 1987 as part of the Solid Waste

Assessment Test (SWAT). As a follow up measure to the SWAT, monitoring wells 88-1, 88-2, and 88-3 were installed. The NE well was a water supply well and is not regularly sampled. Monitoring wells 91-1F, 91-2, and 91-3 and piezometers P-1, P-2, P-3, P-4, and P-5 were installed in 1991 as part of the Verification Monitoring Program required by the RWQCB. Monitoring well 87-1 was originally used as the upgradient well; however, contamination was detected in it, so 91-3 was installed and is now monitored as the upgradient well. Additionally, monitoring wells 91-4, 91-5, 91-6, 91-7, 92-1, and 92-2, and the spring sampling points Russian #1, #2, and #3 were installed as part of the investigation to define the extent of contamination (verification monitoring program) required by RWQCB Cleanup and Abatement Order Number 91-110, issued June 24, 1991 (Appendix A). Locations of all the monitoring points are shown on Sheet 1. Well logs and construction details are included in Appendix B.

All of the groundwater monitoring wells (with the exception of 91-1F) were completed in the marine terrace aquifer and are generally screened between 10 and 25 feet below the ground surface (BGS). Monitoring well 91-1F monitors water from the deeper Franciscan aquifer (screened between 47 and 57 feet BGS). The approximate extent of VOCs and metals contamination in the marine terrace aquifer is illustrated on Figures 4 and 5, respectively. A groundwater contour map is presented as Figure 6. It is based upon groundwater elevations measured in January 1992. Only monitoring wells 91-2, 91-3, 91-4, 91-5, 91-6, 91-7, 92-1, 92-2, 87-1, 87-2, 87-3, 88-2, and 88-3 are recommended for inclusion in the Phase 1 corrective actions monitoring program. The groundwater samples will be collected and analyzed, and the resulting data will be evaluated in accordance with the methodologies presented in the Article 5 Monitoring Program (by others, Appendix D), and stipulated by the revised Waste Discharge Requirement.

The on-site and off-site monitoring wells include:

78-1	87-1	88-2	91-1F	92-1
78-2	87-2	88-3	91-2	92-2
78-3	87-3		91-3	
	87-4		91-4	
			91-5	
			91-6	
			91-7	

Their locations are shown on Sheet 1. A summary of completion details is presented in Table 1.

TABLE 1. SUMMARY OF COMPLETION DETAILS FOR SUBSURFACE MONITORING POINTS

Well Information	78-1	78-2	78-3	87-1	87-2	87-3
Top of Casing Elevation (feet)	393.68'	392.73'	393.26'	416.29'	397.67'	371.80'
Total depth of well borehole	29'	25'	25'	26.5'	20'	15'
Diameter of well casing	6" PVC	6" PVC	6" PVC	4" PVC	4" PVC	4" PVC
Total depth of well casing (BGS)	29'	25'	25'	25'	20'	14.5'
Type of well construction (drilling method)	24" Bucket auger	24" Bucket auger	24" Bucket auger	12" HSA	12" HSA	12" HSA
Perforated interval (BGS) ---- Type of perforations	10' to 29' ---- saw slots	10' to 25' ---- saw slots	10' to 25' ---- saw slots	15' to 25' ---- 0.02" slots	10' to 20' ---- 0.02" slots	9.5' - 14.5' ---- 0.02" slots
Well driller	Kelly Pump & Drilling	Kelly Pump & Drilling	Kelly Pump & Drilling	Herzog & Assoc.	Herzog & Assoc.	Herzog & Assoc.
Year of well construction	1978	1978	1978	1987	1987	1987
Use of well	Monitoring	Monitoring	Monitoring	Monitor	Monitoring	Monitoring
Depth (BGS) and type of seals	0' to 10' concrete	0' to 10' concrete	0' to 10' concrete	0' to 10.5' C5B; 10.5' to 12' BP	0' to 6.5' C5B; 6.5' to 8' BP	0' to 5.5' C5B; 5.5' to 7' BP
Type(s) of well logs	DWR	DWR	DWR	SEL	SEL	SEL
Depth to first encountered groundwater (BGS)	10'	10'	10'	21'	13'	9.5'
Stabilized depth to groundwater from TOC and date of measurement	14.2' (6/92)	11.1' (6/92)	11.5' (6/92)	20.6' (6/92)	13.3' (6/92)	6.8' (6/92)
Aquifer Tests, type and date	2/78; 20 gpm discharge	2/78; 30 gpm discharge	2/78; 25 gpm discharge	None	None	None
Water Quality sampling	from 3/87 to current	from 3/87 to current	from 3/87 to current	from 10/87 to current	from 10/87 to current	from 10/87 to current

TABLE 1. CONTINUED

Well Information	87-4	88-2	88-3	91-1F	91-2	91-3
Top of Casing Elevation	387.24'	392.61'	382.37'	388.73'	381.62'	416.19'
Total depth of well borehole (BGS)	20'	25'	25'	60'	13'	15.8'
Diameter of well casing	4" PVC	4" PVC	4" PVC	4" PVC	4" PVC	4" PVC
Total depth of well casing (BGS)	19.5'	25'	25'	57'	12'	15.09'
Type of well construction (drilling method)	12" PVC	10" Air Rotary	10" Air Rotary	18"/8" HSA, CME-95	12" HSA, CME-95	12" HSA, CME-750
Perforated interval (BGS) ---- Type of perforations	9.5' - 19.5' ---- 0.02" slots	15' to 25' ---- 0.02" slots	15' to 25' ---- 0.02" slots	47' to 57' ---- 0.02" slots	2' to 12' ---- 0.02" slots	4.25' to 13.95' ---- 0.02" slots
Well driller	Herzog & Assoc.	Kelly Pump & Drilling	Kelly Pump & Drilling	All Terrain	All Terrain	All Terrain
Year of well construction	1987	1988	1988	1991	1991	1991
Use of well	Monitoring	Monitoring	Monitoring	Monitoring	Monitoring	Monitoring
Depth (BGS) and type of seals	0' - 5' C5B; 5' - 6.5' BP	0' to 15' concrete	0' to 15' concrete	0' to 32.5' C5B; 32.5' to 36.5' BP	0' to 0.5' C5B; 0.5' to 1.0' BP	0' to 0.33' concrete; 0.33' - 2.0' neat cement; 2.0' to 3.3' BP
Type(s) of well logs	SEL	DWR	DWR	SEL	SEL	SEL/CD
Depth to first encountered groundwater (BGS)	7'	11'	10'	35' (Franciscan water)	5'	5'
Stabilized depth to groundwater (from TOC) and date of measurement	4.4' (6/92)	9.6' (6/92)	2.8' (6/92)	5.6' (6/92)	2.4' (6/92)	4.1' (6/92)
Aquifer Tests, type and date	None	None	None	None	Drawdown (3/91)	Drawdown (3/92)
Water Quality sampling	from 10/87 to current	from 11/88 to current	from 11/88 to current	from 3/91 to current	from 3/91 to current	from 12/91 to current

TABLE 1. CONTINUED

Well Information	91-4	91-5	91-6	91-7	92-1	92-2
Top of Casing Elevation (feet)	371.06'	365.57'	362.84'	374.05'	Not yet surveyed	Not yet surveyed
Total depth of well borehole (BGS)	20.5'	20'	20'	20'	13'	11'
Diameter of well casing	4" PVC	2" PVC	2" PVC	2" PVC	4" PVC	4" PVC
Total depth of well casing (BGS)	18.44'	18.96'	19.91'	18.29'	12'	9'
Type of well construction (drilling method)	12" HSA, CME-750	8" HSA, CME-750	8" HSA, CME-750	8" HSA, CME-750	12" HSA, CME-95	12" HSA, CME-95
Perforated interval (BGS) ---- Type of perforations	9.25' to 18.75' ---- 0.02" slots	9.25' to 18.75' ---- 0.02" slots	9.25' to 18.75' ---- 0.02" slots	9.25' to 18.75' ---- 0.02" slots	6' - 11.75' ---- 0.02" slots	2' to 8.75' ---- 0.02" slots
Well driller	All Terrain	All Terrain	All Terrain	All Terrain	All Terrain	All Terrain
Year of well construction	1991	1991	1991	1991	1992	1992
Use of well	Monitoring	Monitoring	Monitoring	Monitoring	Monitoring	Monitoring
Depth (BGS) and type of seals	0' to 0.33' concrete; 0.33' - 3.5' neat cement; 3.5' to 5.0' BP	0' to 0.5' concrete; 0.5' to 3.5' neat cement; 3.5' to 4.5' BP	0' to 1.0' concrete; 1.0' to 2.5' neat cement; 2.5' to 3.5' BP	0' to 1.0' concrete; 1.0' to 2.5' neat cement; 2.5' to 3.5' BP	0' to 0.5' concrete; 0.5' - 4.0' neatcement; 4.0' - 5.0' BP	0' to 0.5' concrete; 0.5' to 1.0' neat cement; 1.0' to 2.0' BP
Type(s) of well logs	SEL/CD	CD	CD	CD	SEL	SEL
Depth to first encountered groundwater (BGS)	11'	Not measured	Not measured	Not measured	8.6'	4.1'
Stabilized depth to groundwater (from TOC) and date of measurement	7.4' (6/92)	5.68' (1/92)	3.45' (1/92)	10.50' (1/92)	10.8' (8/92)	5.5' (8/92)
Aquifer Tests, type and date	Slug (3/92)	Slug (3/92)	Slug (3/92)	Slug (3/92)	None	None
Water Quality sampling	from 12/91 to current	from 2/92 to current	from 2/92 to current	from 2/92 to current	from 8/92 to current	from 8/92 to current

TABLE 1. CONTINUED

Well Information	P-1	P-2	P-3	P-4	P-5	L-1-P
Top of Casing Elevation	380.12'	396.53'	368.58'	400.96'	376.33'	445'[d]
Total depth of well borehole (BGS)	25'	28'	20'	20'	20'	43.2'
Diameter of well casing	1.5" PVC	1.5" PVC	2" PVC	2" PVC	2" PVC	2" steel, Sch. 80
Total depth of well casing (BGS)	22.5'	27'	18.42'	19.84'	18.97'	43.2'
Type of well construction (drilling method)	8" HSA, CME-750	8" HSA, CME-750	8" HSA, CME-750	8" HSA, CME-750	8" HSA, CME-750	Pushed casing with CME-750 drill rig
Perforated interval (BGS) ---- Type of perforations	16.5' to 22.5' ---- saw slots	21.5' to 27.5' ---- saw slots	9.25' to 18.75' ---- 0.02" slots	9.25' to 18.75' ---- 0.02" slots	9.25' to 18.75' ---- 0.02" slots	28.2' to 43.2' ---- 3/8" drill holes
Well driller	All Terrain	All Terrain	All Terrain	All Terrain	All Terrain	All Terrain
Year of well construction	1991	1991	1991	1991	1991	1992
Use of well	Piezometer	Piezometer	Piezometer	Piezometer	Piezometer	Leachate piezometer
Depth (BGS) and type of seals	0' to 3.5' C5B; 3.5' to 5' BP	0' to 3.5' C5B; 3.5' to 5' BP	0' to 1.0' concrete; 1.0' to 2.7' neat cement; 2.7' to 3.7' BP	0' to 1.2' concrete; 1.2' to 2.5' neat cement; 2.5' to 3.5' BP	0' to 1.0' concrete; 1' to 3' neat cement; 3' to 4' BP	None
Type(s) of well logs	SEL	SEL	CD	CD	CD	CD
Depth to first encountered groundwater (BGS)	10'	21'	Not measured	Not measured	Not measured	41.8' to leachate
Stabilized depth to groundwater (feet TOC) and date of measurement	11.7' (6/92)	17.8' (6/92)	4.53' (1/92)	7.86' (1/92)	13.34' (1/92)	Unable to measure because of casing blockage
Aquifer Tests, type and date	None	None	None	None	None	None
Water Quality sampling	--[c]	--[c]	--[c]	--[c]	--[c]	None

TABLE 1. CONTINUED

Well Information	L-2-P	L-3-P	L-4-P	L-5-P	L-7-E	L-8-E
Top of Casing Elevation	440'[d]	433'[d]	434'[d]	450'[d]	438'[d] (at 8/92 Grade)	447.5'[d] (at 8/92 Grade)
Total depth of well borehole (BGS)	36.0'	32.6'	40.7'	38.1'	41'	51'
Diameter of well casing	2" steel, Sch. 80	2" steel, Sch. 80	2" steel, Sch. 80	2" steel, Sch. 80	8" mild steel	8" mild steel
Total depth of well casing (BGS)	36.0'	32.6'	40.7'	38.1'	40'	50'
Type of well construction (drilling method)	Pushed casing with CME-750 drill rig	Pushed casing with CME-750 drill rig	Pushed casing with CME-750 drill rig	Pushed casing with CME-750 drill rig	18" HSA, CME-95	18" HSA, CME-95
Perforated interval (BGS) ---- Type of perforations	21' to 36' ---- 3/8" drill holes	12.4' to 32.4' ---- 3/8" drill holes	25.7' to 41.2' ---- 3/8" drill holes	23.1' to 38.6' ---- 3/8" drill holes	10' to 40' ---- 0.05" wire-wrapped	10' to 50' ---- 0.05" wire-wrapped
Well driller	All Terrain	All Terrain	All Terrain	All Terrain	All Terrain	All Terrain
Year of well construction	1992	1992	1992	1992	1992	1992
Use of well	Leachate piezometer	Leachate piezometer	Leachate piezometer	Leachate piezometer	Leachate/ Gas extraction well	Leachate/ Gas extraction well
Depth (BGS) and type of seals	None	None	None	None	0' to 3' BP	0' to 3' BP
Type(s) of well logs	CD	CD	CD	CD	SEL	SEL
Depth to first encountered groundwater (BGS)	31.6' to leachate	dry	24.5' to leachate	37.6' to leachate	33.3' to leachate	dry
Stabilized depth to groundwater (from TOC), and date of measurement	Unable to measure because of casing blockage	Unable to measure because of casing blockage	Unable to measure because of casing blockage	Unable to measure because of casing blockage	40' to leachate	dry
Aquifer Tests, type and date	None	None	None	None	Pretest conducted by County personnel	None
Water Quality sampling	None	None	None	None	from 8/92 to current	Not sampled (dry)

FOOTNOTES TO TABLE 1:

BGS = Below the Ground Surface
HSA = Hollow Stem Auger
SEL = Subsurface Exploration Log
C5B = Cement with 5 percent Bentonite
BP = Bentonite Pellets
DWR = Department of Water Resources
TOC = Top of Casing
CD = Construction Diagram

Notes:

- Construction details for site water supply well 88-1 are not included in this table, because this well is not utilized for water quality sampling purposes. The DWR Water Well Drillers' Report for well 88-1 is included in Appendix B. Construction details for leachate piezometer L-6-P are not included in this table, because this piezometer was abandoned due to auger refusal at 10 feet. No leachate was encountered in this piezometer.

- Groundwater elevations are measured monthly and reported in the County's quarterly monitoring report to the RWQCB.

- Monitored for water levels only (not sampled for water quality).

- Elevations are estimated based on topographic survey map.

Spring Monitoring Stations

The installation of groundwater monitoring wells in the Russian Gulch State Park was not allowed by the State Department of Parks and Recreation. Field investigations revealed several springs draining groundwater from the marine terrace aquifer, along the edge of Russian Gulch. These stations represent the southern edge of the marine terrace aquifer in Russian Gulch. During the week of August 3, 1992, three surface spring monitoring stations (Russian #1, Russian #2, and Russian #3) were installed by Mendocino County personnel, south-southwest of the WMU, in the Russian Gulch State Park. The locations of the Russian #1, and Russian #2, and Russian #3 springs are shown on Sheet 1. Each spring monitoring station consists of an approximately 8 inch diameter by 3 feet deep, hand dug hole, lined with filter fabric. Approximately 4 feet of 4 inch diameter PVC well screen (0.020 inch slotted) was placed in each hole. The bottom 2 feet of each hole was backfilled with #3 sand. A 0.5 foot thick, bentonite pellet seal was placed on top of each sand filter pack. The remainder of each hole was backfilled with concrete mix. The construction detail for these installations is illustrated on Figure 2.

The analytical data developed through the spring water testing may not accurately characterize the groundwater flowing into the Park, but is the best data obtainable given the constraints. The spring water has been exposed to atmospheric conditions, which change the physical characteristics of the groundwater and allow some of the volatile organic compounds to escape. These spring monitoring stations were installed to determine if VOCs were present in the spring water flowing onto State property.

Piezometers

Piezometers were installed to obtain additional information regarding groundwater gradient and flow direction. Construction details and borehole logs for piezometers P-1, P-2, P-3, P-4, and P-5 are included in Appendix B. Their locations are shown on Sheet 1. Additional installation information is presented in Table 1. All of the piezometers were completed in the marine terrace aquifer.

Surface Water Monitoring and Control

Surface Water Monitoring

The locations of the surface water monitoring points (S-1 and S-2) are shown on Sheet 1. Surface water runoff flow patterns are shown on Sheet 4. The intent of monitoring these points is to determine if activities at the Site are impacting surface waters as they flow past the Site.

S-1: This surface water monitoring point is located in a drainage swale near monitoring well 87-1, southeast of the WMU. It serves as the background monitoring point, representing the quality of surface water that has not been affected by activities at the Site. Surface water runs in this drainage swale only during and for a short time after rainfall events.

S-2: This surface water monitoring point is located approximately 300 feet west of the northwest corner of the Site in a drainage swale on the Fontaine property. Most of the runoff from the Site passes through this monitoring point.

Surface Water Control

The locations and alignments of surface water drainage control structures are shown on Sheets 3 and 4. The construction details are illustrated on Sheet 5. Drainage control systems include overside drain flumes, culverts, berms, earthen ditches, and a sedimentation basin. Calculations supporting drainage system sizing are presented in Appendix E. The dimensions of the various culverts around the Site are specified on Sheets 3 and 4.

The small amount of upgradient surface water that runs onto the Site is captured by the earthen ditch located on the east side of the WMU's perimeter access road. The runon water is then conveyed around the WMU, along the northern border of the Site, eventually into Doyle Creek.

Runoff from the top deck is captured by earthen berms at the perimeter of the top deck and conveyed down the sideslopes, through overside drain flumes (See Sheet 5). The flumes discharge over energy dissipators and into the perimeter ditch at the toe of the WMU. These flumes will be removed and then replaced after placement of the final cover. Perimeter ditches will be modified during construction of the final cover. The dimensions of the ditches are specified on Sheet 5.

The rainwater falling on the sideslopes of the WMU travels, by sheet flow, into the perimeter ditches at the toe of the WMU.

Water captured in the perimeter ditches flows into the sedimentation basin. Water from the sedimentation basin flows off the northwest corner of the Site, into another ditch, and eventually to Doyle Creek.

During recent storm events the capacity of the drainage ditch that carries runoff from the northwest corner of the Site to surface water monitoring point S-2 was exceeded. This resulted in flooding of the access road leading to the Fontaine property and sheet flow across the Saarinen property. This problem is reported to have been corrected by placement of additional road base, resulting in a larger ditch along the north boundary of the Site. The culverts that convey runoff under the access road are undersized for the design storm (100 yr 30 min event). This may result in inundation and erosion of the road. The grades of the surrounding land do not allow an effective engineering solution to this problem. The road will continue to be periodically flooded by the design storm and repaired as necessary.

The ditches and the sedimentation basin are maintained on an as needed basis. The debris and sediments removed from these structures is transported to the top deck of the WMU, spread out, and seeded.

Additional sediment traps and mid-slope drainage ditches will be installed during final closure and are described in Section (5).A.(G), below. The sedimentation basin will also be modified to dewater between storm events.

Erosion Control

Surface water from the top deck is conveyed down the 3:1 sideslopes in over-side drain flumes and into a perimeter ditch at the toe of the WMU. Energy dissipators will be installed at the end of the flumes to control erosion of the perimeter ditch. The WMU side of the perimeter ditches will also be armored with gravel (See Sheet 5) to control erosion of the final cover. This gravel layer also allows subsurface water captured by the drain net to be released into the perimeter ditch.

Rainwater falling on the sideslopes of the WMU travels, by sheet flow into perimeter ditch at the toe of the WMU (See Sheet 3). In the past, straw mulch and a vegetative cover of annual ryegrass has helped to limit the amount of soil erosion that occurred. The sideslopes will be mulched and vegetated after the

final cover is installed. Mid-slope ditches will also be installed during final closure. They will intercept the sheet flow and convey it into the over-side drain flumes.

Most of the surface water from the WMU flows through the sedimentation basin before leaving the Site. The sedimentation basin is adequate for the capture of sand to silt sized particles (See Appendix E). The sedimentation basin is equipped with an overflow pipe, but was not constructed to dewater between storm events. The basin will be modified to allow it to dewater between storm events. A schematic diagram of the dewatering facility is included on Sheet 5.

Approximately 3 acres of sideslopes are not hydraulically connected to the sedimentation basin. Sediment traps (straw bales and/or filter fabric check dams) will be installed in the swales conveying this water. These sediment traps are also described in a later section of this document. Their locations are shown on Sheet 4.

Leachate Monitoring and Control

The leachate monitoring system includes quarterly sampling of leachate from the vertical leachate extraction wells (L-7-E and L-8-E). The existing leachate control system consists of a number of leachate seep capture systems. These will be replaced by a toe drain system during final closure.

Leachate Seeps

The County has installed leachate seep capture basins at various locations around the WMU. They consist of shallow collection basins, 1 inch diameter PVC drain pipes, and 55 gallon drums for intermediate storage. A cross section of a typical seep collection basin is shown on Sheet 6. The system was designed for use on measurable and persistent seeps. A number of seeps have been captured by this method. The seep capture system will be replaced by a toe drain system during final closure. Seepage of leachate is not expected to occur after the toe drain and final cover are installed.

Leachate Piezometers

On April 30, 1992, 5 leachate piezometers were installed for the purpose of determining leachate levels within the WMU. Their locations are shown on Sheet 7. The leachate piezometers were constructed of 5 foot sections of 2 inch inside diameter, machine-threaded, Schedule 80, steel pipe.

Sections were joined using threaded, steel couplings. The bottom 15 to 20 feet of the casings were perforated with 3/8th inch diameter drilled holes. A cone-pointed steel tip was inserted in the end of the first casing. The casings were pushed vertically down through the top of the WMU by a CME-750 drill rig to depths ranging from 30 to 45 feet. The casings were advanced until refusal occurred. Construction details of leachate piezometers are included in Appendix B. Liquid levels in each of the piezometers were measured soon after the installation was completed and again 12 hours later. The elevations did not change over that 12 hour period. Pertinent data is summarized in Tables 1 and 2.

Table 2. Leachate Piezometer Information

Leachate Piezometer	Total Depth (Feet)	Top of Casing Elevation[a] (Feet)	Ground Surface Elevation[a] (Feet)	Leachate Elevation (Feet)	Approximate Elevation[a] of Native Grade (Feet)	Height of Leachate Column Above Native Grade (Feet)
L-1-P	43.2	445	443	401.2	403	(1.8)[d]
L-2-P[b]	36.0	440	440	408.4	400	8.4
L-3-P	32.6	433	431	Dry	403	--
L-4-P[b]	40.7	434	431.5	407.0	398	9.0
L-5-P	38.1	450	447.5	409.9	400	9.9
L-6-P[c]	10	--	--	--	--	--

a Based on topographic map of the WMU.
b Advanced below estimated native grade, possibly into historic trenches.
c Abandoned due to refusal at 10 feet.
d Depth of leachate below native grade.
e Dry hole. Elevation of the bottom of the hole is 400.4 feet.

Up to 10 feet of leachate was measured in the piezometers. Cross sections of the WMU were drawn through the leachate piezometers (see Sheet 8). The phreatic surface of the leachate was projected out to the elevations of the seeps that occur around the toe of the WMU. The "method of sections" was used to calculate the volume of saturated waste. A porosity of 0.52 was assumed to calculate the volume of leachate present (based on the HELP 2 computer model default parameter). It was estimated that approximately 6 million gallons of leachate was present in the waste above the pre-landfill ground surface grades. This initial estimate is now believed to be too high for the following reasons:

- The porosity of the waste at the bottom of the WMU is probably lower than 0.52. This number is a default value used by the HELP 2 computer model in calculating the flow of rainfall through a landfill and represents an <u>average</u> porosity of all the in-place waste. If measurements were taken at discrete intervals through the waste profile, the density would increase with depth and the porosity would decrease.

- The leachate may exist as perched layers, semi-confined within each lift of waste. The piezometers may have been filled by leachate cascading from higher levels and the lower porosity and higher pressures in the deeper lifts may not have allowed the leachate to leave the casing.

A new volume has not been estimated as no new definitive information has become available. Subsequent monitoring of liquid levels in the piezometers has not been possible. When the County attempted to sample leachate from the piezometers, disposable bailers became lodged in two of them. Measuring tape will not go deeper than 10 feet into the other three. Neither SHN nor the County have been able to determine what has obstructed these piezometers.

Because they can no longer be utilized for monitoring purposes, the leachate piezometers will be destroyed before placement of the final cover. They will be twisted off at least 5 feet below grade. Intermediate cover (foundation material) may have to be excavated to ensure that sufficient length of pipe has been removed. The party completing this work is advised to proceed with caution and consider exposure to hydrogen sulfide, methane, and other organic vapors when developing their safety plans.

Vertical Leachate Extraction Wells

During the week of August 10, 1992, two vertical leachate extraction wells (L-7-E and L-8-E) were installed in the top deck of the WMU. Their approximate locations are shown on Sheet 3, and the borehole logs are included in Appendix B. The wells were installed for the purposes of characterizing and potentially extracting leachate from the WMU.

Leachate extraction well boreholes were drilled through the refuse using a hollow stem auger drill rig. L-7-E was advanced to a depth of 41 feet below the August 1992 surface of the WMU cover. Well L-7-E terminated in refuse at the approximate elevation of the prelandfill ground surface. Well L-8-E was advanced to a depth of 51 feet below the August 1992 surface of the WMU. The bottom of the borehole was approximately 2 feet below the contact between the refuse and the marine terrace deposits.

During drilling, leachate was encountered in well L-7-E at 35.4 feet below the then current surface of the WMU cover. Well L-8-E has been dry since its installation. The County has sampled well L-7-E a number of times since its installation. The results of the analysis are presented and

evaluated in Addendum No. 2 to the Report of the Extent of Contamination (SHN, December 1992). The constituents and concentrations are fairly typical of municipal solid waste leachate.

Well yields were estimated three times using two methods. In December 1992, County personnel performed slug tests to estimate an approximate well yield. By measuring the volume of leachate purged and the time for partial recovery, the County estimated a well yield of 3 gallons per hour for well L-7-E. The initial volume of leachate removed from the well casing was included in the volume calculation, so this estimate is considered high. During April 1993, SHN personnel also performed slug tests and estimated a maximum well yield of 1.2 gallons per hour (25.5 gallons in 22 hours). The third well yield estimate is based on continuously monitoring the leachate level over a number of pumping and recovery cycles. Graphs of the recovery cycles for L-7-E and L-8-E are included as Figures 7 and 8, respectively. The volume of leachate that entered the borehole was divided by the recovery time. The highest flow rate was measured during the first 6 hours of recovery in L-7-E. It was 2.3 gal/hr.

Given an estimate of well yield, and assuming that 7,000 gallons per day (GPD) of leachate can be disposed at the Fort Bragg Wastewater Treatment Plant, the number of wells required to recover 7,000 GPD was estimated. Assuming a maximum well yield of 2.3 gallons per hour, approximately 120 wells would be required to extract 7,000 GPD; and similarly, a well yield of 1.2 gallons per hour would require approximately 250 wells.

Because of the large number of extraction wells required, vertical extraction wells are not considered cost effective at this Site. An alternate leachate extraction system (toe drain) is discussed in Section 5(A)I below.

Leachate Monitoring

Leachate will be monitored in accordance with the revised WDRs and any other additional requirements imposed by the City of Fort Bragg's Wastewater Treatment Plant. Liquid levels in the vertical extraction wells will be measured on a monthly basis. Leachate flow rates from the toe drain system will be measured and recorded on a monthly basis. At least quarterly, samples will be collected from the leachate storage facility (4 tank clusters) and analyzed for the list of constituents presented in Table 3.

Table 3. Analytical Parameters Used to Characterize Leachate

Parameter	EPA Method	Parameter	EPA Method
Volatile Organics	8010&8020	Barium	208.1
Carbonate Alkalinity	403	Chromium	218.1
Bicarbonate Alkalinity	403	Magnesium	242.1
Hydroxide Alkalinity	310.1	Copper	210.1
Chloride	325.3	Iron	236.1
Fluoride	340.2	Molybdenum	246.1
Nitrate	353.2	Nickel	249.1
Sulfate	375.4	Potassium	258.1
pH	150	Lead	239.1
Specific Conductance	120.1	Manganese	243.1
Total Dissolved Solids	160.1	Sodium	273.1
Chemical Oxygen Demand	410.1	Mercury	245.1
Hardness, Calculation	130.2	Thallium	279.1
Antimony	204.1	Tin	7870
Aluminum	202.1	Titanium	200.7
Beryllium	210.1	Vanadium	286.1
Cadmium	213.1	Selenium	270.3
Calcium	215.1	Boron	404B
Arsenic	206.3	Silver	272.2
Cobalt	219.1	Zinc	289.1
Acetone	8020		

Leachate Disposal

The County and the City of Fort Bragg have negotiated an agreement for disposal of leachate from the Caspar Site at the Fort Bragg Wastewater Treatment Plant. A copy of the agreement is included in Appendix A.

Landfill Gas Monitoring and Control

A landfill gas, subsurface migration monitoring system has been installed and sampled by the County and the California Air Resources Control Board. A passive venting gas control system will be installed as an integral part of the final cover.

Landfill Gas Migration Monitoring

Temporary gas monitoring probes were installed as part of an Air Quality Solid Waste Assessment Test (Air SWAT), in March of 1988 (See Appendix F). The Air SWAT concluded that, even though vinyl chloride was detected, hazardous concentrations of gases were not migrating from the Site, and that a significant gas problem did not exist at the Site. The probes were removed after the testing was completed.

The California Air Resources Control Board, in cooperation with the Mendocino County Department of Environmental Health, set up several ambient air sampling units in February of 1992. The test results are included in Appendix F.

In August of 1992, 5 subsurface gas migration probes (G-1, G-2, G-3, G-4, and G-5) were installed along the perimeter of the Site. Their locations are shown on Sheet 1 and a typical construction detail is presented as Figure 3.

Boreholes for the gas probes were advanced 5 feet into the ground using either a hollow stem auger drill rig or a hand auger. Gas probes were completed with 0.5 inch diameter PVC, with 4 feet of saw-cut slots on the bottom. A filter pack of #3 sand was placed to approximately 1 foot below ground surface. A 0.5 foot thick bentonite seal was placed on top of the filter pack. A 0.5 foot thick, concrete surface seal was placed around each gas probe, and sloped away from the PVC to promote drainage. Each gas probe was completed above grade with a lockable, steel, monument cover.

The County sampled all five of the gas migration probes, in December 1992, using Dräger tubes designed for the detection of methane (up to 5% by volume), vinyl chloride (0.5 to 3.0 ppm), and benzene (0.5 to 10 ppm). None of these gasses were detected in any of the probes.

In June 1993, the California Air Resources Control Board attempted to collect air samples into Tedlar bags from the 5 subsurface migration monitoring probes. This sampling methodology requires the removal of several cubic feet of air from each monitoring point. Sufficient quantities of air could not be recovered from 4 of the probes. It appears that the permeability of the near surface soils is low enough to restrict or prevent the flow of air or gas through the near surface soil horizon. As documented in the ROWD (SHN, August 1991), in situ permeabilites (to water) in the top 6 feet of a borehole that was drilled for an on-site monitoring well varied between 1×10^{-6} and 1×10^{-7} cm/sec. Another factor that could restrict the migration of gas is the high groundwater conditions at the Site.

Due to the high groundwater conditions at the Site and the low permeability of the near surface soils, subsurface landfill gas migration is not expected to be a problem at this Site. In addition, a gas venting system will be installed as part of the final cover. This will further reduce the likelihood of subsurface gas migration. The installation of additional permanent gas probes is not anticipated at this time.

The County will field test air samples to ensure that methane concentrations within on-site structures is less than 1.25% by volume and that methane concentrations at the property boundary do not exceed 5% by volume. If landfill gas is not detected or remains below specific concentrations in on-site structures at the end of Phase 1, the County will request that the LEA release them from this monitoring obligation. If gas migration is documented to be a problem, a subsurface control system will be proposed for Phase 2 corrective actions.

Landfill Gas Control

A passive, gas venting system will be installed during construction of the final cover to allow landfill gasses to escape from under the final cover (Sheet 6). Additional details are presented in Section (5)(A)K, below.

Differential Settlement Monitoring

Differential settlement will be monitored by the comparison of topographic maps developed through aerial and land survey techniques. Currently, there are 6 permanent survey monuments (aerial targets) at the Site. One additional target will be installed at the highest point on the WMU during closure (Sheet

1). The scale of the aerial topographic maps will be 1"=40', and they will have 2 foot contour intervals. Land survey techniques will be employed to monitor the development of "birdbaths" on the top deck. Additional details are supplied in the Postclosure Maintenance Plan.

(4) A description of the sequence of closure stages, giving tentative implementation schedules relative to the starting date.

Waste is no longer disposed in the WMU. Approximately 2 feet of intermediate cover soil has been applied and will be utilized as a foundation for the barrier layer. Installation of the final cover is tentatively scheduled to begin in July 1994. The closure will be completed in accordance with the Construction Quality Assurances (CQA) program (Appendix G) by the end of October 1994.

(5) A description of the level of detail required in Section 18262(a), of this Article, of the following items:

(A) Section 18261.3(a)(7), items A through K of this Article:

A. removal of solid waste landfill structures pursuant to Section 17771 of Article 7.8

Small structures that were located along the access road on the northeast portion of the Site have been removed. Structures near the southwest toe of the landfill, will be retained and used to store maintenance equipment and materials. Portable toilets that are located on the Site will also be retained for use by maintenance personnel.

The postclosure land use includes the operation of a transfer station. Various structures and facilities associated with the transfer station will remain in active use.

B. decommissioning of environmental controls pursuant to Section 17772 of Article 7.8

There are no environmental control systems currently in operation that will be decommissioned.

The leachate piezometers that were used to determine leachate levels in the WMU will be twisted off at least 5 feet below grade, prior to the installation of the final cover. These pipes will be disposed in the WMU. Refer to Section (a)(3), above for details on their removal.

The drainage structures (to be constructed), the toe drain leachate extraction system (to be constructed), the gas venting system (to be constructed), and the groundwater monitoring network will remain intact and will be used during the 30 year postclosure maintenance period.

C. providing site security (e.g., fencing, signs) pursuant to Section 17767, of Article 7.8

The WMU is currently closed, but the transfer station at the Site is open to the self-haul public (not to commercial haulers). The existing perimeter fence is intact and repaired, as needed. Although the western boundary of the Site is unfenced, security is maintained because dense vegetation makes vehicular traffic impossible.

The County published legal notice and posted signs as required by Section 17767.

D. placement of final cover pursuant to Section 17773, including identification of potential sources of suitable materials

Two final cover profiles have been designed for use at the Caspar site. Cross sections of the two profiles are shown on Sheet 6. Alternative #1 utilizes high density polyethylene (HDPE Geomembrane) as the barrier layer while Alternative #2 utilizes low permeability soil (clay). The geomembrane alternative will be used on the top deck of the WMU. The clay alternative may be used on the sideslopes if it is significantly less costly when construction bids are received. Either alternative will satisfy the regulatory requirements for final cover. A CQA Program that includes both of the alternatives has been developed (Appendix G). Placement of the final cover alternatives is described below.

Alternative #1 (Geomembrane)

The following list describes each layer of this cover profile from top to bottom:

- An 18 inch thick vegetative cover soil layer. This layer may include soils previously imported to the Site, newly imported soils (from roadwork occurring near Westport), and wood fiber from yard waste that is being chipped at the Site. Alternative vegetative cover materials are being researched by the County.

- A geosynthetic composite drainage net. This layer will remove water that infiltrates through the vegetative cover layer. It will consist of an HDPE drainage net with filter fabric heat bonded to both sides.

- A 40 mil high density polyethylene geomembrane. This plastic sheet will be textured on both sides. Twenty-two foot wide strips will be welded together to form one continuous sheet of plastic.

- A 6 inch layer of sand to cushion the HDPE from sharp objects potentially protruding up from the foundation layer and to allow the flow of gas and leachate out from under the geomembrane. This layer will consist of locally available (Baxman Sand and Gravel, Fort Bragg) dune sand. The gas venting pipe network and the leachate collection system as they relate to this layer are shown on Sheet 6.

- A 24 inch thick foundation layer. This layer will consist mainly of the soils that were previously imported from a road cut near Westport and placed as intermediate cover in October 1992. As allowed by Title 23, CCR, Chapter 15, a portion of the foundation may consist of waste materials.

Alternative #2 (Clay)

The following list describes each layer of this cover profile from top to bottom:

- An 18 inch thick vegetative cover soil layer. This layer may include soils previously imported to the Site, newly imported soils (from roadwork occurring near Westport), and wood fiber from yard waste that is being chipped at the Site. Alternative vegetative cover materials are being researched by the County.

- A geosynthetic drainage net. This layer will remove water that infiltrates through the vegetative cover layer. It will consist of an HDPE drainage net with filter fabric heat bonded to both sides.

- A 12 inch thick layer of compacted soil with an in situ permeability of 1 x 10^{-6} cm/sec, or less. The permeability of the existing foundation layer appears (from testing, Appendix H) to be fairly low (1 x 10^{-6} to 1 x 10^{-8} cm/sec). The County requests that the agencies consider allowing the top 12 inches of the foundation to serve as the clay barrier layer. It would be subject to the testing requirements specified in the CQA program. If this request is denied, the County will have to locate and import additional clayey soils to supplement the soils previously imported from the road cut near Westport.

- A 24 inch thick foundation layer. This layer will consist mainly of the soils that were previously imported from a road cut near Westport and placed as intermediate cover in October 1992. As allowed by Title 23, CCR, Chapter 15, a portion of the foundation may consist of waste materials.

E. final grading in accordance with Section 17776.

The proposed final grades are shown on Sheet 3. The final grades were designed to accommodate minor amounts of subsidence and differential settlement. The sideslopes of the WMU were constructed at 3:1 (H:V). The grades on the top deck are between 3% and 10%. The slopes of most surface water drainage ditches are less than 3%.

Subsidence and differential settlement of the final cover will be monitored through the postclosure maintenance period. An as-built topographic map of the WMU will be prepared after construction of the final cover is complete. An updated topographic map will be prepared every 5 years. The topographic maps will be generated by aerial survey techniques. The scale of the maps will be 1"=40', and the contour interval will be 2 feet.

The final grades will also be field inspected at least twice each year. The inspections will take place during or immediately after rainfall events in October and March. The inspector will identify significant "birdbaths" (puddles of standing water at least 20 feet in diameter) and will mark their location on a map and on the ground. The topography of the HDPE barrier layer will be established through land

survey techniques and monitored on a yearly basis, as described in the Phase 1 Corrective Actions and Postclosure Maintenance Plan (Maintenance Plan).

Significant settlement is not anticipated. Waste was placed and compacted in lifts, and most of it has had many years to consolidate and settle. The maximum height of waste above the ground surface is approximately 55 feet.

If significant differential settlement (> 1' in 10') occurs, it will be corrected in accordance with the Maintenance Plan.

F. final site face in accordance with Section 17777. A slope stability report, when required, shall be submitted with the final closure plan

The stability of the entire WMU was evaluated in the ROWD (SHN August, 1991). The analysis indicated that under both steady-state and dynamic (seismic) conditions, the 3:1 sideslopes were stable with a factor of safety exceeding 1.5.

A geomembrane (HDPE barrier layer, Alternative #1) may be incorporated into the final cover; therefore, a slope stability report, focusing on the veneer stability of the final cover profile is included with this Plan as Appendix H. Both Alternatives # 1 and #2 are stable as designed.

G. installation of drainage controls in accordance with Section 17778

The various elements of the surface water drainage control system including, ditches, flumes, culverts, and the sedimentation basin were analyzed. Calculations are included in Appendix E. Locations and specifications are shown on Sheets 3, 4, and 5.

The existing sedimentation basin that serves the majority of the WMU was also analyzed and appears to be functioning properly. A basin's outlet will be modified to allow the basin to empty between storm events (See Sheet 5).

Approximately 3 acres of the sideslopes on the southern flank of the WMU are not hydraulically connected to the existing sedimentation basin due to topographical constraints. Runoff leaving this area is captured in the perimeter ditch at the toe of the WMU and conveyed down the southern and then the western boundary of the Site. It will

flow through a series of sediment traps (hay bale and/or filter fabric check dams) then will leave the northwest corner of the Site, enter a roadside ditch, and eventually flow into Doyle Creek.

The majority of surface water runoff from the Site exists at the northwest corner and enters the roadside ditch. It was reported by the County that the capacity of this roadside ditch has recently been increased by raising the roads bed through placement of additional road rock. The ditch flows through a culvert under the road on the Fontaine property and then across the Saarinen property to Doyle Creek. As previously described, the culverts running under the access road are undersized for the design storm (100 yr, 30 min event). Periodic flooding cannot be avoided due to topographic constraints.

H. slope protection and erosion control pursuant to Section 17779

The slope protection and erosion control measures were designed to protect the integrity of the final cover, minimize the amount of soil erosion that will occur, and capture as much of the eroding soil as feasible. Erosion caused by wind and water will be visually monitored quarterly during regular sampling events and corrected as necessary in accordance with the Phase 1 Corrective Actions Monitoring and Postclosure Maintenance Plan.

Surface and subsurface water occurring on the top deck will be captured through berms and subsurface drains and be conveyed down the sideslopes of the WMU in overside drain flumes.

Sheet flow running down the 3:1 sideslopes will be captured and conveyed by mid slope earthen ditches to the overside drain flumes as shown on Sheets 3 and 5.

Placing straw mulch over the vegetative cover layer will reduce raindrop impact erosion of the soil and will retain soil moisture critical to the establishment of vegetation.

Due to its hardiness, rapid germination, ease of maintenance, and rooting depth (<6 inches), a mix of annual and perennial ryegrass has been selected for use in the vegetative cover. Additional seed and fertilizer will be applied as necessary during the postclosure maintenance period to maintain a dense vegetative cover.

The surface soil from approximately 20 acres of the Site, west of the WMU was stripped, and used for daily cover during early operations at the Site. The exposed soils are sandy-silt with some clay. The surface grade is approximately 3%. Rainwater falling on this area travels by sheet flow into natural drainage swales. Sand and silts eroded from this area and from the stockpiles of imported soils tend to settle out of the surface water runoff as the grades are fairly shallow and water velocities are low. Additional sedimentation traps (hay bales and/or filter fabric check dams) will be installed in the drainage swales along the south and west boundaries of the 40 acre parcel (See Sheet 4).

The County may also attempt to revegetate this area through the application of wood compost and grass seed. Copious amounts of wood compost may become available in the Fort Bragg area if the Louisiana-Pacific and Georgia-Pacific Corporations decide to clean-close their nearby woodwaste disposal sites. If the wood compost does not become available, bare soil areas will be allowed to naturally revegetate.

I. implementation of leachate control measures pursuant to Section 17781

Seepage Control

The WMU will be inspected for leachate seeps prior to installation of the final cover. If a leachate seep is measurable and persistent, it will be captured as described in Section (3) above, and shown on Sheet 6. The system includes excavation into the seepage area and construction of a collection basin (shallow rock filled basin). The final cover will be constructed over the seep collection basins. Leachate collected in the basins will be gravity drained into the nearest leachate storage facility and then transferred to a tanker truck for disposal at the Fort Bragg Wastewater Treatment Plant. It is unlikely that new leachate seeps will occur after installation of the final cover and the leachate collection toe drain system.

Monitoring

Leachate will be monitored in accordance with the revised WDRs and any other additional requirements imposed by the City of Fort Bragg's Wastewater Treatment Plant. Liquid levels in the leachate extraction wells will be measured and recorded on a

monthly basis so that liquid levels in the WMU can be tracked. Leachate flow rates into the leachate storage facilities will also be measured and recorded on a monthly basis. At least quarterly, samples will be collected from the storage tanks and analyzed for the list of constituents presented in Table 3 (Page 16).

Vadose Zone Monitoring

Monitoring of the vadose zone is not feasible because of the high groundwater conditions at the Site.

Collection of Leachate

Extraction of leachate that is available from within the WMU is a key element of the Phase 1 corrective actions plan. The County is committed to recovering as much leachate as is feasible from the WMU. A flow rate of 7,000 GPD (5 gallons/min) is used for design purposes because that was the figure recommended to Fort Bragg for trickling leachate into their wastewater treatment plant. Fort Bragg may be able to treat higher flow rates but the County may not be able to produce this quantity.

Alternatives that have been evaluated include increasing the number of vertical extraction wells installing several horizontal extraction wells, and installing subsurface toe drains. These alternatives are discussed below.

(1) Vertical Wells

The two leachate extraction wells, L-7-E and L-8-E, described in a previous section on the current leachate monitoring and control system will continue to be monitored. Results of pump tests indicate that the maximum flow rate obtainable per well is too low to consider expansion of the vertical extraction well system for removing leachate from the WMU. No additional extraction wells will be installed.

(2) Horizontal Drains

The County, the RWQCB, and SHN discussed installing horizontal drains. However, because of drilling difficulties, gas locking, clogging, and lowered transmissivity by interstitial pore space collapse, horizontal drains are not considered to be a feasible alternative for removing leachate from the WMU.

(3) Toe Drains

Toe drains are considered to be the best available technology for extracting leachate at Caspar. They consist of gravel filled trenches that provide a conduit for leachate to flow, by gravity, out of the WMU. Perforated and solid pipe is used to capture the leachate and convey it to storage facilities.

Tentatively, eleven toe drains are planned to be installed on three sides of the WMU at the approximate locations indicated in Sheet 9. The number and location may change depending on the experience gained during installation of the first few trenches. The dimensions and number of the trenches are based on a calculated per square foot flow rate of leachate from the extraction wells, the disposal capacity (7,000 gallons per day), and the physical limitations of the operation (side wall stability, and excavation equipment). The supporting calculations are presented at the end of Appendix E.

The trenches are positioned around the north, south, and west perimeter of the WMU. Their positions were chosen based on existing leachate seeps, proximity to extraction wells, and topographic constraints.

The trenches will be perpendicular to the sideslopes of the landfill and will be excavated into the WMU along the native grades. The bottom of the trenches will be graded to drain toward the toe of the WMU. The trenches will be approximately 60 feet long and 20 feet deep (See Sheet 6). Approximately 20 feet of 4 inch inside diameter, perforated, Schedule 80, PVC drain pipe will be placed in the bottom of the upper end of the trench. The perforated pipe will be extended with solid pipe to the toe of the WMU. Portions of the trenches, containing perforated pipe, will be backfilled with drain rock up to the level of saturated refuse. The lower ends of the trenches will be backfilled with compacted low permeability soil to prevent leachate from seeping out of the trenches. The solid 4 inch PVC pipe will transition into 2 inch polyethylene conveyance pipe. The conveyance pipe will drain the leachate, by gravity, to the leachate storage facilities. The perforated end of the PVC pipe will be vented to atmosphere via a 4 inch Schedule 40 PVC pipe. It will penetrate the final cover as shown on Sheet 6 and will also serve as a cleanout.

Storage

Leachate that has been collected by the toe drain trenches will be stored in leachate storage facilities (4 grouping of 2-2,500 gallon polyethylene tanks). Their approximate locations are shown on Sheet 9. Construction details are shown on Sheet 6. The storage tanks will be set above ground on a secondary containment structure consisting of a sand (dredge spoils) bermed area covered with a sheet of 20 mil HDPE.

The conveyance piping will be laid in trenches (at road crossings) and on the ground surface between the trenches and the storage facilities. Ball valves, check valves, and float valves will be used to control the flow of leachate into the tanks. Settleable solids can occasionally be flushed from the conveyance lines by opening the cleanout caps at the end of the pipe and allowing it to empty into the secondary containment.

Treatment

The leachate will be treated at the Fort Bragg Wastewater Treatment Plant. It will be hauled to the plant in tanker trucks. It may be necessary to aerate the leachate to reduce the concentrations of volatile organic compounds, and the biological/chemical oxygen demand of the leachate. The aeration requirements will be determined based on testing of the leachate for the acceptable levels of those constituents named in the Leachate Treatability Report (SHN October, 1992), and on the monitoring of a test run of the leachate through the Fort Bragg Wastewater Treatment Plant. If aeration is required, it will occur in the leachate storage facilities.

Disposal

The City of Fort Bragg has agreed to treat the leachate in their wastewater treatment plant. A treatability study (SHN, October 1992) concluded that the wastewater treatment plant was capable of handling the leachate at specified concentrations. The leachate will be tested regularly under an agreement that was negotiated between the County and the City of Fort Bragg. A copy of the agreement is included at the end of Appendix A.

Reporting

Results of quarterly leachate monitoring will be submitted within 90 days of sampling to the LEA, the CIWMB, and the RWQCB. The report will also contain an estimate of the amount of leachate generated as well as summaries of the records of leachate recovered and disposed.

Quality Assurance/Quality Control Plan for Leachate

(1) Analysis of leachate samples will be done only by laboratories holding a valid certification issued by the Toxic Substances Control Division of the California Environmental Protection Agency for the chemical constituents analyzed.

(2) To ensure accurate and repeatable chemical analyses, the same sample collection, preservation and shipment, and chain-of-custody procedures presented in the proposed Chapter 15, Article 5, monitoring and reporting program (Appendix D) will be followed for the leachate.

J. installation of a groundwater monitoring system pursuant to Section 17782

Eighteen groundwater monitoring wells and 5 piezometers have already been installed on and around the Site. Well logs and construction details are included in Appendix B. Their locations are shown on Sheet 1. Currently, the County does not plan to install any additional groundwater monitoring wells.

K. installation of gas monitoring and control system pursuant to Section 17783

Five landfill gas migration monitoring probes have been installed along the perimeter of the Site. Their installation and testing were described in Section 3 above. Their locations are shown on Sheet 1. A construction detail is presented as Figure 3. The County does not plan to install any additional probes at this time.

Landfill gas control systems are an important feature of closed and capped landfills. Based on the volume and age of the waste, the low permeability of the surface soils the high groundwater conditions at the Site, and monitoring data, it not does not appear that subsurface gas migration is a problem.

The gas generation rate for this WMU is expected to be low due to the age of the waste (up to 20 years old) and the small size of the waste stream (15,000 to 20,000 cubic yards per year). The volume of gasses that will be generated by the WMU during the postclosure period were computer modeled. The results of the modeling are presented in Appendix F and graphed on Figure 9.

The generation rate for the entire WMU is approximately 250 cubic feet per minute. The passive gas venting system will allow this gas to escape from under the barrier layer of the final cover. It is an integral part of both the final cover alternatives. The alignment of the gas venting manifolds are shown on Sheet 3. The venting system for final cover Alternative #1 utilizes a layer of sand under the geomembrane. Perforated PVC pipes, laid in the sand will convey the gasses, and help support risers that will penetrate and be secured into the geomembrane with a special HDPE boot (See Sheet 6). The risers will be approximately 4 feet tall and have 180 degree bends on their tops to prevent rain from entering. The venting system for final cover Alternative #2 relies on gravel filled trenches to collect gas from under the foundation layer. The risers will be similar to the geomembrane system.

There will also be passive gas vents on the leachate extraction toe trenches. The barrier layer penetration will be the same.

Through the Phase 1 monitoring period, all of the risers will be monitored for percent methane (as field measured by a lower explosive limit meter) on a quarterly basis. Samples of gas will then be collected for laboratory analysis, from the three (3) risers that have the highest concentration of methane. When the gas sample is collected, the flow rates of gas out of the risers will also be determined by the use of a propeller type anemometer. Barometric pressure, wind speed, and ambient air temperature will also be measured and recorded. Samples of the gas will be collected in Tedlar bags. The samples will be shipped, in a non-crushable box (no ice), to a State certified laboratory. The sample will be analyzed for volatile organic compounds by a gas chromatograph/mass spectrometer (GC/MS). The target compounds are listed in the EPA 8240 scan. Any unidentified peaks in the chromatograph will identified through a scan of the laboratory's MS library.

The results of laboratory analysis and flow rate measurements will be used, in a risk assessment, to determine if the gas should be collected and filtered. If a risk assessment or the results of subsurface monitoring (to be presented in the Phase 1 monitoring report) indicate that passive venting of the gas is not appropriate, an active gas collection and purification system can be retrofitted into the passive system. An active gas collection system would include manifolding the passive risers, a vacuum pump, and a filter system.

(B) The construction quality assurance proposal pursuant to Title 14, CCR, Chapter 3, Article 7.8, Section 17774.

The Construction Quality Assurance Program is presented as Appendix G.

(C) The slope stability report required pursuant to Title 14, CCR, Chapter 3, Article 7.8, Section 17777.

A slope stability report is attached as Appendix H.

(6) A closure cost estimate pursuant to Section 18263 of this Article.

The closure cost estimate is attached as Appendix I.

(7) A detailed schedule for disbursement of funds for closure from a trust fund, enterprise fund or government securities, if applicable, for either:

(A) advance payment for activities to be performed in accordance with the plan, or

(B) reimbursement of costs paid for activities performed in accordance with the plan.

The Financial Assurances mechanism and the fund disbursement schedule will be established by the County and presented at a later date.

(8) Where one of the above requirements identifies a standard of performance for solid waste landfills, the final closure plan shall describe how a proposed design, monitoring or control method supports the performance standard.

Any standard of performance not adequately addressed in the above section shall be addressed upon a request from LEA and CIWMB.