Sanborn, Head & Associates

Consulting Engineers & Scientists

FEASIBILITY STUDY REPORT

Beede Waste Oil / Cash Energy Site
Plaistow, New Hampshire
Volume I - Text

Prepared for
New Hampshire Department of Environmental Services

Prepared by
Sanborn, Head & Associates, Inc.

File 1371
January 2002

Paul M. Sanborn ■ Charles L. Head ■ R. Scott Shillaber ■ Charles A. Crocetti
Mathew A. DiPilato ■ Daniel B. Carr ■ Duncan W. Wood ■ Joseph G. Engels

Sanborn, Head & Associates, Inc.
6 Garvins Falls Road ■ Concord, New Hampshire 03301
e-mail: concord@sanborn-head.com ■ **www.sanborn-head.com**
Fax (603) 229-1919 ■ **Phone (603) 229-1900**

INSTRUCTIONS FOR USE OF LINKS THROUGHOUT THIS REPORT:

Each section of this document can be accessed by clicking directly on the Table of Contents.

Some of the Appendix sections contain sub-sections which can be accessed by clicking Bookmark headings.

In each section and sub-section page 1 contains a link which takes the user back to the Table of Contents or the page which contains the section's Bookmarked links.

Click on a row to go to the corresponding section

TABLE OF CONTENTS

VOLUME I

EXECUTIVE SUMMARY i

List of Abbreviations, Acronyms, and Symbols I

1.0 INTRODUCTION 1

1.1 Purpose of the FS and Organization of the FS Report 1

1.2 Site Background 2
1.2.1 Site Description 2
1.2.2 Site History 5
1.2.3 Previous Site Investigations and Remedial Activities 9

1.3 Site Hydrogeology 16
1.3.1 Site Climate 16
1.3.2 Site Geology 16
1.3.3 Surface Water Hydrology 16
1.3.4 Groundwater Hydrology 17

1.4 Nature and Extent of Contamination 18
1.4.1 Contaminant Source Areas 19
1.4.2 Distribution of Contaminants in Soil 20
1.4.3 Distribution of Contaminants in Free Product 21
1.4.4 Distribution of Contaminants in Groundwater 21
1.4.5 Distribution of Contaminants in Surface Water and Sediment 22

1.5 Contaminant Transport and Fate 23

1.6 Baseline Human Health and Ecological RAs 25
1.6.1 Human Health RA 25
1.6.2 Ecological RA 26

2.0 IDENTIFICATION/DEVELOPMENT OF ARARs AND TBCs, RAOs, GENERAL RESPONSE ACTIONS AND VOLUMES OF CONTAMINATED MEDIA 28

2.1 Identification and Compilation of ARARs and TBCs 28
2.1.1 Chemical-Specific ARARs and TBCs 29
2.1.2 Location-Specific ARARs and TBCs 29
2.1.3 Action-Specific ARARs and TBCs 29
2.1.4 Policy Considerations 30

Click on a row to go to the corresponding section

2.2 Development of RAOs 30
2.2.1 Development of Soil RAOs 31
2.2.1.1 Soil COCs 31
2.2.1.2 Soil PRGs 34
2.2.1.3 Soil RAOs 35
2.2.2 Development of Groundwater RAOs 36
2.2.2.1 Groundwater COCs 36
2.2.2.2 Groundwater PRGs 36
2.2.2.3 Groundwater RAOs 37
2.2.3 Development of Sediment (and Surface Water) RAOs 38
2.2.3.1 Sediment COCs 38
2.2.3.2 Sediment RAOs 38

2.3 Development of General Response Actions 39
2.3.1 Soil General Response Actions 39
2.3.2 Groundwater General Response Actions 39
2.3.3 Sediment General Response Actions 39

2.4 Areas and Volumes of Contaminated Media 39
2.4.1 Areas and Volumes of Contaminated Soil 40
2.4.2 Areas and Volumes of Landfill and Associated Contaminated Soil . . . 42
2.4.3 Areas and Volumes of Contaminated Groundwater 42
2.4.4 Area and Volume of Contaminant Sediment 43

3.0 SCREENING AND EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS 44

3.1 Identification and Screening of Technologies and Process Options 44
3.1.1 Soil and Sediment 44
3.1.2 Groundwater 45

3.2 Evaluation and Selection of Technologies and Process Options 47
3.2.1 Evaluation and Selection of Technologies and Process Options for Soil 48
3.2.1.1 No Action 48
3.2.1.2 Limited Action 49
3.2.1.3 Containment 52
3.2.1.4 Disposal 56
3.2.1.5 Ex-Situ Treatment 59
3.2.1.6 In-Situ Treatment 68
3.2.1.7 Summary of Selected Technologies and Process Options for Soil 75
3.2.2 Evaluation and Selection of Technologies and Process Options for Groundwater 76
3.2.2.1 No Action 76
3.2.2.2 Limited Action 77
3.2.2.3 Containment 79

Click on a row to go to the corresponding section

3.2.2.4 Collection 83
3.2.2.5 Ex-Situ Treatment 84
3.2.2.6 Discharge 97
3.2.2.7 In-Situ Treatment 101
3.2.2.8 Summary of Selected Technologies and Process Options for Groundwater 103

4.0 DEVELOPMENT OF REMEDIAL ACTION ALTERNATIVES 105

4.1 Rationale for Development of Remedial Action Alternatives 106
4.1.1 Statutory and Policy Guidance 107
4.1.2 Protection of Human Health 107
4.1.3 Protection of Groundwater 107
4.1.4 Protection of Ecological Receptors 108
4.1.5 Floodplain/Wetland Considerations 109
4.1.6 Future Reuse of the Property 110

4.2 Common Actions 110

4.3 SC Alternatives Descriptions 115
4.3.1 Alternative SC-1: No Action 115
4.3.2 Alternative SC-2: Limited Action 116
4.3.3 Alternative SC-3: Hot Spot Removal, Capping, and In-Situ Treatment 117
4.3.3.1 Key Considerations 118
4.3.3.2 Surface/Shallow Soil “Hot Spot” Removal 120
4.3.3.3 Permeable Soil Cover 122
4.3.3.4 Capping of On-Site Landfill 123
4.3.3.5 Sediment Excavation and Disposal 126
4.3.3.6 Wetlands Restoration/Compensatory Wetlands Construction 129
4.3.3.7 In-Situ Treatment of Deep Soil 130
4.3.4 Alternative SC-4: Off-Site Treatment/Disposal 138
4.3.4.1 Key Considerations 139
4.3.4.2 Soil Pile Removal and Disposal 140
4.3.4.3 Surface/Shallow and Subsurface Soil Excavation and Disposal 141
4.3.4.4 Deep Soil Excavation and Disposal 146
4.3.4.5 Landfill Excavation and Disposal 150
4.3.4.6 Sediment Excavation and Disposal 153
4.3.4.7 Wetlands Restoration 153
4.3.4.8 Post-Excavation Activities 155
4.3.5 Alternative SC-5: Off-Site Treatment/Disposal (0 - 10 feet bgs Soil) and In-Situ Treatment (>10 feet bgs Soil) 155
4.3.5.1 Soil Pile Removal and Disposal 157
4.3.5.2 Surface/Shallow and Subsurface Soil Excavation and Disposal 157
4.3.5.3 Landfill Excavation and Disposal 157

Click on a row to go to the corresponding section

4.3.5.4 Sediment Excavation and Disposal 157
4.3.5.5 Wetlands Restoration 158
4.3.5.6 Post-Excavation Activities 158
4.3.5.7 In-Situ Treatment of Deep Soil 159
4.3.6 Alternative SC-6A: On-Site Ex-Situ Thermal Treatment 160
4.3.6.1 Ex-Situ Indirect-Heated Thermal Desorption Treatment 162
4.3.6.2 Soil Pile Treatment and Disposal 165
4.3.6.3 Surface/Shallow and Subsurface Soil Excavation, Treatment, and Disposal 167
4.3.6.4 Deep Soil Excavation, Treatment, and Disposal 171
4.3.6.5 Landfill Excavation and Treatment/Disposal 173
4.3.6.6 Sediment Excavation and Treatment/Disposal 174
4.3.6.7 Wetlands Restoration 174
4.3.6.8 Post-Excavation Activities 175
4.3.7 Alternative SC-6B: On-Site Ex-Situ Thermal Treatment (0 - 10 feet bgs Soil) and In-Situ Treatment (>10 feet bgs Soil) 175
4.3.7.1 Ex-Situ Indirect-Heated Thermal Desorption Treatment 177
4.3.7.2 Soil Pile Treatment and Disposal 177
4.3.7.3 Surface/Shallow and Subsurface Soil Excavation, Treatment, and Disposal 177
4.3.7.4 Landfill Excavation and Treatment/Disposal 178
4.3.7.5 Sediment Excavation and Treatment/Disposal 178
4.3.7.6 Wetlands Restoration 178
4.3.7.7 Post-Excavation Activities 179
4.3.7.8 In-Situ Treatment of Deep Soil 179

4.4 MOM Alternatives Descriptions 181
4.4.1 Alternative MOM-1: No Action 181
4.4.2 Alternative MOM-2: Limited Action 182
4.4.3 Alternative MOM-3: Groundwater Collection and Treatment (Higher Pumping Rate) 183
4.4.3.1 Pre-Design Investigations 183
4.4.3.2 Conceptual Design of Groundwater Collection and Treatment System (High Pumping Rate) 184
4.4.3.3 Clean-up Time Frame 190
4.4.3.4 Natural Attenuation of Selected Source Areas/ Contaminated Groundwater Plumes 190
4.4.3.5 Demobilization/Decommission 192
4.4.4 Alternative MOM-4: Groundwater Collection and Treatment (Lower Pumping Rate) 193
4.4.4.1 Pre-Design Investigations 194
4.4.4.2 Conceptual Design of Groundwater Collection and Treatment System (Low Pumping Rate) 194
4.4.4.3 Clean-up Time Frame 196
4.4.4.4 Natural Attenuation of Selected Source Areas/ Contaminated Groundwater Plumes 196
4.4.4.5 Demobilization/Decommissioning 196
4.4.5 MOM Alternative Not Carried Forward 197

Click on a row to go to the corresponding section

5.0 DETAILED ANALYSIS OF ALTERNATIVES 198

5.1 Criteria for Evaluation of Alternatives 198

5.2 Individual Analysis of SC Alternatives 202
5.2.1 Alternative SC-1: No Action 202
5.2.2 Alternative SC-2: Limited Action 204
5.2.3 Alternative SC-3: Hot Spot Removal, Capping and In-Situ Treatment 207
5.2.4 Alternative SC-4: Off-Site Treatment/Disposal 212
5.2.5 Alternative SC-5: Off-Site Treatment/Disposal (0 - 10 feet bgs Soil) and In-Situ Treatment ((> 10 feet bgs Soil) 216
5.2.6 Alternative SC-6: On-Site Treatment 221

5.3 Comparative Analysis of SC Alternatives 226
5.3.1 Overall Protection of Human Health and the Environment 226
5.3.2 Compliance with ARARs 227
5.3.3 Long-Term Effectiveness and Permanence 227
5.3.4 Reduction of Toxicity, Mobility and/or Volume Through Treatment 228
5.3.5 Short-Term Effectiveness 229
5.3.6 Implementability 231
5.3.7 Cost 233

5.4 Individual Analysis of MOM Alternatives 234
5.4.1 Alternative MOM-1: No Action 234
5.4.2 Alternative MOM-2: Limited Action 236
5.4.3 Alternative MOM-3: Groundwater Collection and Treatment (High Pumping Rate) 239
5.4.4 Alternative MOM-4: Groundwater Collection and Treatment (Low Pumping Rate) 244

5.5 Comparative Analysis of MOM Alternatives 249
5.5.1 Overall Protection of Human Health and the Environment 249
5.5.2 Compliance with ARARs 250
5.5.3 Long-Term Effectiveness and Permanence 250
5.5.4 Reduction of Toxicity, Mobility and/or Volume Through Treatment 251
5.5.5 Short-Term Effectiveness 251
5.5.6 Implementability 252
5.5.7 Cost 253

6.0 REFERENCES 254

Click on a row to go to the corresponding section

VOLUME II

TABLES

Table 2-1 Contaminants of Concern for Soils
Table 2-2 Preliminary Remediation Goals for Soil
Table 2-3 Summary of Soil PRGs for VOCs Based on Soil Leaching to Groundwater
Table 2-4 Recommended Soil Preliminary Remediation Goals
Table 2-5 Contaminants of Concern for Groundwater
Table 2-6 Preliminary Remediation Goals for Groundwater
Table 2-7 Recommended Groundwater Preliminary Remediation Goals
Table 2-8 Contaminants of Concern for Sediment
Table 2-9 Remedial Action Objectives, General Response Actions, Technology Types and Process Options
Table 2-10 Summary of Contaminated Soil Volumes
Table 2-11 Summary of Landfill Volumes

Table 3-1 Initial Screening of Technologies and Process Options for Soil and Sediment (Including Soil Piles, Surface/Shallow Soil, Subsurface Soil and Deeper Soil)
Table 3-2 Initial Screening of Technologies and Process Options for Groundwater
Table 3-3 Evaluation of Process Options for Soil and Sediments (Including Soil Piles, Surface/Shallow Soil, Subsurface Soil and Deeper Soil)
Table 3-4 Evaluation of Process Options for Groundwater

Table 4-1 Assumed Groundwater Treatment System Influent Concentrations

Table 5-1 ARAR Summary for Alternative SC-1, No Action
Table 5-2 ARAR Summary for Alternative SC-2, Limited Action
Table 5-3 ARAR Summary for Alternative SC-3, Hot Spot Removal, Capping and In-Situ Treatment
Table 5-4 ARAR Summary for Alternative SC-4, Off-Site Treatment/Disposal
Table 5-5 ARAR Summary for Alternative SC-5, Off-Site Treatment/Disposal (0 - 10 feet bgs Soil) and In-Situ Treatment (> 10 feet bgs Soil)
Table 5-6 ARAR Summary for Alternative SC-6, On-Site Treatment (SC-6A - On-Site Ex-Situ Thermal Treatment) (SC-6B - On-Site Ex-Situ Thermal Treatment [0 - 10 feet bgs Soil] and In-Situ Treatment [> 10 feet bgs Soil])
Table 5-7 Comparative Analysis of Source Control (SC) Alternatives
Table 5-8 ARAR Summary for Alternative MOM-1, No Action
Table 5-9 ARAR Summary for Alternative MOM-2, Limited Action
Table 5-10 ARAR Summary for Alternative MOM-3, Groundwater Collection and Treatment (High Pumping Rate)
Table 5-11 ARAR Summary for Alternative MOM-4, Groundwater Collection and Treatment (Low Pumping Rate)
Table 5-12 Comparative Analysis of Management of Migration (MOM) Alternatives

Click on a row to go to the corresponding section

FIGURES

Figure 1.1 Locus Plan
Figure 1.2 Site Vicinity Plan
Figure 1.3 General Site Features Plan
Figure 1.4 General Site Features Plan, Parcel 1 Detail
Figure 1.5 Groundwater Elevation Contour Plan - Shallow Groundwater, September 1998
Figure 1.6 Distribution of PCB Surface Soil Contamination
Figure 1.7 Distribution of PCB Surface Soil Contamination - Parcel 1 Detail
Figure 1.8 Distribution of Lead Surface Soil Contamination
Figure 1.9 Distribution of Lead Surface Soil Contamination - Parcel 1 Detail
Figure 1.10 Distribution of Deeper Soil Contamination and Other Source Areas
Figure 1.11 Distribution of VOCs in Subsurface/Deeper Soils
Figure 1.12 Distribution of Total AVOC Concentrations in Groundwater: AGQS Exceedances Noted
Figure 1.13 Distribution of Total CVOC Concentrations in Groundwater: AGQS Exceedances Noted
Figure 1.14 Summary of Contaminant Groundwater Plumes
Figure 1.15 Summary of Wetland Sampling Locations and Proposed Area of Sediment Excavation

Figure 4.1 Delineation of Proposed Groundwater Management Zone (GMZ)
Figure 4.2 Alternative SC-3: 'Hot Spot' Excavation and Site Soil Cover
Figure 4.3 Alternative SC-3: Composite (RCRA) Landfill Cap, Sediment Excavation and Compensatory/Restored Wetlands
Figure 4.4 Alternatives SC-3, SC-5, and SC-6B Steam Injection/SVE System Wells and Piping Conceptual Layout
Figure 4.5 Alternatives SC-3, SC-5, and SC-6B Steam Injection/SVE System Conceptual Process Flow Schematic
Figure 4.6 Alternatives SC-4, SC-5, SC-6A and SC-6B: Soil Proposed for Excavation-Surface/Shallow and Subsurface (0-10' bgs)
Figure 4.7 Alternatives SC-4 and SC-6A: Soil Proposed for Excavation - Deep (>10' bgs)
Figure 4.8 Alternatives SC-6A and SC-6B on-Site Indirect-Heated Thermal Desorption System
Figure 4.9 Alternatives MOM-3 & MOM-4 Groundwater Extraction/Treatment System Well/Piping Layout
Figure 4.10 Alternatives MOM-3 & MOM-4 Groundwater Treatment System Conceptual Process Flow Diagram

Click on a row to go to the corresponding section

VOLUME III

APPENDICES

Appendix A Limitations
Appendix B Potential Applicable or Relevant and Appropriate Requirements (ARARs) and To-Be-Considered Guidelines (TBCs)
Appendix C Numerical and Analytical Groundwater Flow and Contaminant Transport Modeling
C.1 Numerical Groundwater Flow Model Development and Modeling Results
C.2 Effects of Potential Rate-Limiting Processes on Dissolved Phase Contaminant Recovery
C.3 Impact of Contaminated Groundwater Plume Discharge on Kelly Brook Water Quality
C.4 Estimation of Source Area Persistence Under Pumping Conditions and No Source Control Measures
C.5 Development of Leaching to Groundwater-Based PRGs for Soil
Appendix D Media Volume Estimate Calculations
D.1 November 11, 1999 Memorandum - Sampling and Analysis Program to Evaluate Soil Potentially Hazardous for Lead and Other Characteristics
D.2 Soil Volume Calculations
D.3 Landfill Volume Calculations
D.4 Groundwater Volume Calculations
Appendix E Source Control (SC) Alternatives - Cost Estimates and Supporting Information
E.1 SC-1: No Action Alternative
E.2 SC-2: Limited Action Alternative
E.3 SC-3: Hot Spot Removal, Capping, and In-Situ Treatment of Deep Soil
E.4 SC-4: Off-Site Treatment/Disposal
E.5 SC-5: Off-Site Treatment/Disposal (0-10 feet bgs Soil) and In-Situ Treatment (>10 feet bgs Soil)
E.6 SC-6A: On-Site Ex-Situ Thermal Treatment
E.7 SC-6B: On-Site Ex-Situ Thermal Treatment (0-10 feet bgs Soil) and In-Situ Treatment (>10 feet bgs Soil)
Appendix F Management of Migration (MOM) Alternatives - Cost Estimates and Supporting Information
F.1 MOM-1: No Action Alternative
F.2 MOM-2: Limited Action Alternative
F.3 MOM-3: Groundwater Collection and Treatment (High Pumping Rate)
F.4 MOM-4: Groundwater Collection and Treatment (Low Pumping Rate)
F.4.1 MOM-4: 80 gpm Groundwater Collection and Treatment System (Alternative Carried Forward)
F.4.2 MOM-4: 30 to 40 gpm Groundwater Collection and Treatment System with Slurry Wall and Cap (Alternative not Carried Forward)
Appendix G Post-RI Water Quality Results
G.1 Groundwater Quality Data - Volatile Organic Compounds (including July 1999 and September 2000 monitoring rounds by NHDES)
G.2 Groundwater Quality Data - Natural Attenuation/Water Quality Parameters (including July 1999 and September 2000 monitoring rounds by NHDES)
G.3 NHDES Residential Well Data Through October 2000

Click on a row to go to the corresponding section

G.4 Analytical Results for 'Background' Surface Water Samples Collected November and December 1999
Appendix H PRG Memorandum Dated November 10, 2000 from Menzie-Cura & Associates, Inc.
Appendix I Revisions to NHDES RCMP Dated October 2000

S:\DATA\1300s\1371\FS Report\2002 Final Report\0102 Text\FS TOC.wpd