FEASIBILITY STUDY
for
BUFFALO COLOR AREA "D"

Prepared For

ALLIED-SIGNAL, INC.

and

BUFFALO COLOR CORPORATION

Prepared By

Wehran-New York, Inc.

345 Lang Boulevard, Suite 1

Grand Island, New York 14072

(716) 773-1801

RECEIVED

APR 7 1993

N.Y.S. DEPT. OF
ENVIRONMENTAL CONSERVATION
REGION 9

WE Project No. 00257

December 1990 (Rev. June 1991)

BUFFALO COLOR CORPORATION
AREA "D" FEASIBILITY STUDY

TABLE OF CONTENTS (Page 1)

Page No.

EXECUTIVE SUMMARY

1.0 INTRODUCTION 1-1

1.1 PURPOSE AND ORGANIZATION OF FEASIBILITY STUDY 1-1

1.2 SUMMARY OF THE REMEDIAL INVESTIGATION 1-2

1.2.1 Site Description 1-2
1.2.2 Site History 1-3
1.2.3 Nature and Extent of Contamination 1-4
1.2.4 Contaminant Fate and Transport 1-5
1.2.5 Baseline Risk Assessment 1-5

2.0 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS 2-1

2.1 INTRODUCTION 2-1

2.2 REMEDIAL ACTION OBJECTIVES 2-1

2.2.1 Groundwater 2-1
2.2.2 Soils/Waste 2-3

2.3 GENERAL RESPONSE ACTIONS 2-5

2.3.1 Groundwater 2-5
2.3.2 Soil/Wastes 2-6

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS 3-1

3.1 IDENTIFICATION AND SCREENING OF TECHNOLOGIES 3-1

3.2 CONTAINMENT 3-1

3.2.1 Capping 3-1
3.2.2 Barriers 3-2

3.3 WASTE REMOVAL 3-4

3.4 WASTE TREATMENT 3-5

3.4.1 Contaminant Containment 3-5
3.4.2 In Situ Contaminant Removal 3-5
3.4.3 Contaminant Stripping 3-6
3.4.4 Contaminant Destruction 3-7

BUFFALO COLOR CORPORATION

AREA "D" FEASIBILITY STUDY

TABLE OF CONTENTS (Page 2)

		Page No.
3.5	WASTE DISPOSAL	3-11
3.6	GROUNDWATER COLLECTION	3-12
3.7	GROUNDWATER TREATMENT	3-13
3.7.1	Physical/Chemical Processes	3-13
3.7.2	Biophysical Processes	3-16
3.8	GROUNDWATER DISPOSAL/DISCHARGES	3-17
3.9	ANCILLARY PROCESSES	3-18
3.9.1	Regrading	3-18
3.9.2	Backfilling	3-18
3.9.3	Surface Water Controls	3-18
3.9.4	Air Pollution Controls	3-18
3.9.5	Miscellaneous Materials Handling	3-20
4.0	DEVELOPMENT AND SCREENING OF ALTERNATIVES	4-1
4.1	DEVELOPMENT AND SCREENING	4-1
4.2	ALTERNATIVE 1 - NO ACTION WITH MONITORING	4-1
4.3	ALTERNATIVE 2 - LIMITED ACTION	4-1
4.4	ALTERNATIVE 3 - CAP WITH SHORE STABILIZATION	4-2
4.4.1	Alternative 3a - Cap with Shore Stabilization on East and South Sides	4-3
4.5	ALTERNATIVE 4 - CAP WITH PERIMETER GROUNDWATER COLLECTION, GROUNDWATER PRE-TREATMENT AND DISPOSAL TO BUFFALO SEWER AUTHORITY (BSA), AND SHORE STABILIZATION	4-3
4.5.1	Alternative 4a - Soil Cover and Grading with Perimeter Groundwater Collection, Pre-Treatment and Disposal to BSA and Shore Stabilization and Containment on East and South Sides	4-4
4.6	ALTERNATIVE 5 - CAP, PERIMETER GROUNDWATER COLLECTION, GROUNDWATER PRE-TREATMENT AND DISPOSAL TO BSA, AND SHORE STABILIZATION	4-4
4.7	ALTERNATIVE 6 - CAP, DOWNGRADIENT CUTOFF WALL, PERIMETER GROUNDWATER COLLECTION, GROUNDWATER PRE-TREATMENT AND DISPOSAL TO BSA, AND SHORE STABILIZATION	4-5
4.7.1	Alternative 6a - Cap, Perimeter Groundwater Collection, Treatment and Discharge to Buffalo River, Downgradient Cutoff and Shore Stabilization	4-6

BUFFALO COLOR CORPORATION

AREA "D" FEASIBILITY STUDY

TABLE OF CONTENTS (Page 3)

		Page No.
4.7.2	Alternative 6b – Cap, Perimeter Groundwater Collection and Disposal to TSDF, Downgradient Cutoff and Shore Stabilization	4-6
4.7.3	Alternative 6c - Cap, Perimeter Groundwater Collection and NAPL Collection, Pre-Treatment and Discharge to BSA,Complete Cutoff, Shoreline Fill Excavation and Complete Shore Stabilization	4-7
4.7.4	Alternative 6d – Cap, Complete Cutoff, Shore Stabilization, and Perimeter Groundwater Collection, Treatment and Discharge to Buffalo River	4-8
4.7.5	Alternative 6e – Cap, Perimeter Groundwater Collection and Disposal to TSDF, Complete Cutoff and Shore Stabilization	4-8
4.8	ALTERNATIVE 7 - CAP, PERIMETER GROUNDWATER COLLECTION, PRE-TREATMENT AND DISCHARGE TO BSA, COMPLETE CUTOFF WALL AND SHORE STABILIZATION	4-9
4.9	ALTERNATIVE 8 - TOTAL EXCAVATION AND DISPOSAL WITH SOIL COVER AND GRADING, TOTAL GROUNDWATER COLLECTION, PRE-TREATMENT AND DISCHARGE TO BSA AND SHORE STABILIZATION	4-9
4.10	ALTERNATIVES 9-9e - SOURCE REMOVAL, TREATMENT AND DISPOSAL	4-10
4.10.1	Alternative 9 - Total Groundwater Collection, Pre-Treatment, Discharge to BSA, Total Excavation, Bioremediation, Backfill with Treated Soil, Soil Cover and Grading, and Shore Stabilization ..	4-10
4.10.2	Alternative 9a - Total Groundwater Collection, Pre-Treatment, Discharge to BSA, Total Excavation, Vitrification, Backfill with Treated Soil, Soil Cover and Grading, and Shore Stabilization	4-11
4.10.3	Alternative 9b - Total Groundwater Collection, Pre-Treatment, Discharge to BSA, Total Excavation, Incineration, Backfill with Treated Soil, Soil Cover and Grading, and Shore Stabilization ..	4-12
4.10.4	Alternative 9c - Total Groundwater Collection, Pre-Treatment, Discharge to BSA, Total Excavation, Soil Washing, Backfill with Treated Soil, Soil Cover and Grading, and Shore Stabilization ..	4-12

BUFFALO COLOR CORPORATION

AREA "D" FEASIBILITY STUDY

TABLE OF CONTENTS (Page 4)

		Page No.
4.10.5	Alternative 9d - Total Groundwater Collection, Pre-Treatment, Discharge to BSA, Total Excavation, Stabilization/Solidification, Backfill with Treated Soil, Soil Cover and Grading, and Shore Stabilization	4-13
4.10.6	Alternative 9e - Total Groundwater Collection, Pre-Treatment, Discharge to BSA, Chemical Remediation, Soil Cover and Grading, and Shore Stabilization	4-14
4.11	SUMMARY OF SCREENING ALTERNATIVES	4-14
4.12	ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARs/SCGs	4-15
4.12.1	Action-Specific ARARs/SCGs	4-15
4.12.2	Location-Specific ARARs/SCGs	4-17
5.0	DETAILED ANALYSIS OF ALTERNATIVES	5-1
5.0.1	Groundwater Flow Model	5-2
5.0.2	Groundwater Treatment System	5-3
5.0.3	Groundwater Monitoring Network	5-3
5.1	ALTERNATIVE 1 - NO ACTION WITH MONITORING	5-6
5.1.1	Description	5-6
5.1.2	Evaluation	5-6
5.2	ALTERNATIVE 3 - CAP WITH SHORE STABILIZATION	5-8
5.2.1	Description	5-8
5.2.2	Evaluation	5-8
5.3	ALTERNATIVE 3a - CAP WITH SHORE STABILIZATION	5-10
5.3.1	Description	5-10
5.3.2	Evaluation	5-11
5.4	ALTERNATIVE 4 - CAP WITH PERIMETER GROUNDWATER COLLECTION, PRE-TREATMENT AND DISPOSAL TO BSA, AND SHORE STABILIZATION	5-13
5.4.1	Description	5-13
5.4.2	Evaluation	5-13
5.5	ALTERNATIVE 5 - MULTI-MEDIA CAP, PERIMETER GROUNDWATER COLLECTION, PRE-TREATMENT AND DISPOSAL TO BSA, AND SHORE STABILIZATION	5-15
5.5.1	Description	5-15
5.5.2	Evaluation	5-15

BUFFALO COLOR CORPORATION

AREA "D" FEASIBILITY STUDY

TABLE OF CONTENTS (Page 5)

Page No.

5.6 ALTERNATIVE 6 - CAP, DOWNGRADIENT CUTOFF, PERIMETER GROUNDWATER COLLECTION, PRE-TREATMENT, DISPOSAL TO BSA, AND SHORE STABILIZATION 5-17

5.6.1 Description 5-17
5.6.2 Evaluation 5-17

5.7 ALTERNATIVE 6a - CAP, PERIMETER GROUNDWATER COLLECTION, TREATMENT, DISPOSAL TO BUFFALO RIVER, DOWNGRADIENT CUTOFF, AND SHORE STABILIZATION 5-19

5.7.1 Description 5-19
5.7.2 Evaluation 5-19

5.8 ALTERNATIVE 6b - CAP, PERIMETER GROUNDWATER COLLECTION AND DISPOSAL TO TSDF, DOWNGRADIENT CUTOFF, AND SHORE STABILIZATION 5-21

5.8.1 Description 5-21
5.8.2 Evaluation 5-21

5.9 ALTERNATIVE 6c - CAP, PERIMETER GROUNDWATER COLLECTION AND NAPL COLLECTION, PRE-TREATMENT AND DISPOSAL TO BSA, COMPLETE CUTOFF, SHORELINE FILL EXCAVATION, AND COMPLETE SHORE STABILIZATION 5-22
5.9.1 Description 5-22
5.9.2 Evaluation 5-22

5.10 ALTERNATIVE 6d - CAP, COMPLETE CUTOFF, SHORE STABILIZATION AND PERIMETER GROUNDWATER COLLECTION, TREATMENT AND DISCHARGE TO BUFFALO RIVER 5-24
5.10.1 Description 5-24
5.10.2 Evaluation 5-24

5.11 ALTERNATIVE 6e - CAP, PERIMETER GROUNDWATER COLLECTION AND DISPOSAL TO TSDF, COMPLETE CUTOFF, AND SHORE STABILIZATION 5-25

5.11.1 DESCRIPTION 5-25
5.11.2 EVALUATION 5-26

5.12 ALTERNATIVE 7 - CAP, PERIMETER GROUNDWATER COLLECTION, PRE-TREATMENT AND DISCHARGE TO BSA, COMPLETE CUTOFF WALL, AND SHORE STABILIZATION .. 5-27

5.12.1 Description 5-27
5-12.2 Evaluation 5-27

BUFFALO COLOR CORPORATION

AREA "D" FEASIBILITY STUDY

TABLE OF CONTENTS (Page 6)

		Page No.
5.13	ALTERNATIVE 8 - TOTAL EXCAVATION AND DISPOSAL WITH SOIL COVER AND GRADING, TOTAL GROUNDWATER COLLECTION, PRE-TREATMENT AND DISCHARGE TO BSA, AND SHORE STABILIZATION	5-29
	5.13.1 Description	5-29
	5.13.2 Evaluation	5-29
5.14	COMPARATIVE ANALYSIS OF ALTERNATIVES	5-31
5.15	RECOMMENDATION OF A REMEDIAL ACTION ALTERNATIVE	5-37

BUFFALO COLOR CORPORATION
AREA "D" FEASIBILITY STUDY

TABLE OF CONTENTS (Page 7)

Follows Page No.

LIST OF TABLES

Table 2-1 Potential Groundwater and Surface Water ARARs/SCGs 2-3
Table 3-1 Screening of Process Options and Technology Types 3-1
Table 4-1 Alternative Development and Screening Summary 4-1
Table 4-2 Summary of Potential Alternatives 4-14
Table 4-3 Potential Action-Specific ARARs/SCGs 4-15
Table 5-1 NYSDEC TAGM Detailed Analysis Ranking 5-2
Table 5-2 Summary of Groundwater Modeling Results 5-3
Table 5-3 Summary of Detailed Cost Estimates 5-36

LIST OF FIGURES

Figure 1-1 Vicinity Map 1-2
Figure 1-2 Existing Site Conditions Plan 1-3
Figure 5a Monitoring Locations 5-4
Figure 5b Schematic Cross-Section Showing Vertical Monitoring Well Placement 5-5
Figures 5-1a & b Alternative 1 Schematic and Plan View 5-6
Figures 5-2a & b Alternatives 3 & 3a Schematic and Plan View 5-8
Figures 5-3a & b Alternative 4 Schematic and Plan View 5-13
Figures 5-4a & b Alternative 5 Schematic and Plan View 5-15
Figures 5-5a & b Alternative 6, 6a & 6b, Schematic and Plan View ... 5-17
Figures 5-6a & b Alternative 6c Schematic and Plan View 5-22
Figures 5-7a & b Alternative 6d & 6e Schematic and Plan View 5-24
Figures 5-8a & b Alternative 7 Schematic and Plan View 5-27

BUFFALO COLOR CORPORATION

AREA "D" FEASIBILITY STUDY

TABLE OF CONTENTS (Page 8)

LIST OF APPENDICES

Appendix A	Summary Tables of Contaminants Detected in Subsurface Soils, Waste Residuals, Groundwater, Surface Waters and Sediments
Appendix B	Summary Tables of Carcinogenic Risk and Hazard Index
Appendix C	Letter from BSA to Buffalo Color Corporation dated November 19, 1990
Appendix D	Preliminary Cost Estimates of Alternatives
Appendix E	Response to NYSDEC September 18, 1990 Letter Re: Sheetpiling Placement
Appendix F	NYSDEC TAGM Alternative Screening Scoring Evaluation Sheets (Preliminary and Detailed)
Appendix G	Detailed MODFLOW - Background Information and Results
Appendix H	Groundwater Treatment Evaluation - Description of Treatment System
Appendix I	Detailed Cost Estimates of Alternatives
Appendix J	Letter from Wehran-New York, Inc. to Buffalo Color Corporation Dated April 23, 1990 Re: Response to NYSDEC Comment Letter - 4/6/90 Identification of ARARs 'Area D'
Appendix K	Calculations to Determine Approximate Construction Periods for Alternatives
Appendix L	June 12, 1991 Letter from Allied Signal to NYSDEC - Modified Alternative 6c

EXECUTIVE SUMMARY

This Final Feasibility Study (FS) Report for the Area "D" Site was prepared by Wehran-New York, Inc., Grand Island, New York on behalf of Buffalo Color Corporation (Buffalo Color) and Allied Signal, Inc. (Allied Signal) pursuant to the requirements of an Order of Consent with the New York State Department of Environmental Conservation (NYSDEC). The NYSDEC is considered as the lead agency for this project.

This report presents an analysis of potential alternatives for the remediation of contamination observed at the Area "D" site. The evaluation of remedial alternatives was performed in accordance with the latest NYSDEC and USEPA guidance documents, specifically the "Technical and Administrative Guidance Memorandum for Selection of Remedial Action Technologies", May 1990 and "Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA" October 1988 respectively.

As part of this process, the following activities were performed:

- The findings of the previous remedial investigation performed by Malcolm Pirnie (April 1989) and subsequently revised by Buffalo Color and Allied Signal (August 1989) and the Risk Assessment performed by Wehran-New York, Inc. (October 1990) were analyzed to permit the development of remedial action objectives and general response actions.
- Potential remedial technologies were identified and screened with respect to their technical applicability to each general response action.
- Potentially applicable technologies were combined into remedial alternatives and screened on the basis of effectiveness and implementability.
- Those alternatives remaining were subject to detailed analysis for the following criteria: 1) overall protection of human health and the environment; 2) compliance with applicable or relevant and appropriate requirements (ARARs) or New York State Standards Criteria and Guidelines (SCGs); 3) long-term effectiveness; 4) reduction in toxicity, mobility, and volume through treatment;

5) short-term effectiveness; 6) implementability; 7) cost; 8) State acceptance; and 9) community acceptance.

For the Area "D" site, the remedial action objective for the groundwater is to ensure that the shallow unconfined aquifer throughout the site does not pose a threat to human health and the environment. For the Area "D" soil/waste, the remedial action objective is to contain, isolate, or restore the soils so the potential to pose a risk to human health and the environment through exposure is mitigated.

The general response actions considered for the groundwater included future use restrictions, waste and groundwater containment, collection, treatment and disposal. For the soil/waste, the general response actions included future use and site access restrictions, and containment, removal, treatment or disposal.

Technology screening was performed for several remedial processes, including waste containment, waste removal, waste treatment, waste disposal, groundwater collection, groundwater treatment, and groundwater disposal/discharge. Potentially applicable technologies were combined into 21 alternatives and further evaluated. The following 13 alternatives were analyzed in detail:

Alternative 1 - No Action with Monitoring

No remedial action would take place under this alternative. This alternative was evaluated to provide a baseline from which to evaluate other alternatives.

Alternative 3 - Cap with Shore Stabilization

This alternative would involve the placement of a flexible membrane liner (FML) cap over the entire site. Also, sheetpiling for shore stabilization would be placed along the east and south sides of the site. Access to and future use of the site would be restricted by fencing and deed restrictions. Groundwater monitoring of the existing on-site wells would occur while pumping of the non-aqueous phase liquid (NAPL) from well 8 would continue.

Alternative 3a - Cap with Shore Stabilization

This alternative would involve the placement of a FML cap over the entire site. Also, Fabriform®/Rip-Rap would be placed along the east and

south sides for shore stabilization. Site access would be restricted by deed restrictions and fencing. Groundwater monitoring would be performed on the existing on-site wells and pumping of the NAPL from well 8 would continue.

Alternative 4 – Cap with Perimeter Groundwater Collection, Pre-Treatment and Discharge to Buffalo Sewer Authority (BSA) and Shore Stabilization

This alternative would involve the placement of a FML cap over the entire site. Groundwater would be collected along the perimeter of the site for pre-treatment and discharge to the BSA. Shore stabilization would be provided by Fabriform®/Rip-Rap along the east and south sides. Site access and future use would be restricted by fencing and deed restrictions. The pumping of NAPL from well 8 would discontinue and a groundwater monitoring program would be implemented.

Alternative 5 - Multi-Media Cap, Perimeter Groundwater Collection, Pre-treatment, and Discharge to BSA and Shore Stabilization

This alternative would involve all the same components of Alternative 4, however with the substitution of a multi-media cap for a FML Cap.

Alternative 6 - Cap, Downgradient Cutoff, Perimeter Groundwater Collection, Pre-Treatment, Discharge to BSA and Shore Stabilization

This alternative would involve all the components of Alternative 4 along with the placement of a slurry wall downgradient.

Alternative 6a - Cap, Perimeter Groundwater Collection, Treatment, Discharge to Buffalo River, Downgradient Cutoff, and Shore Stabilization

This alternative would involve all the components of Alternative 6, however with treatment of groundwater for discharge to the Buffalo River.

Alternative 6b - Cap, Perimeter Groundwater Collection and Disposal to Treatment, Storage, and Disposal Facility (TSDF), Downgradient Cutoff and Shore Stabilization

This alternative would involve the same components as Alternative 6 with the exception of disposal of groundwater to a TSDF.

Alternative 6c - Cap, Complete Cutoff, Perimeter Groundwater Collection and NAPL Collection, Pre-Treatment, and Discharge to BSA, Shoreline Fill Excavation, and Complete Shore Stabilization

This alternative would involve the same components as Alternative 6 along with the addition of an upgradient slurry wall for total containment of the site, continuation of the Fabriform®/Rip-Rap along the entire length of shore, extension of the groundwater collection trenches into the areas of known NAPL, and excavation of all fill material outside of the cutoff wall to the point of intersection of the Fabriform®/Rip-Rap prepared slope and a line drawn parallel and two feet into the top of the alluvium layer, as a maximum depth. All material will be placed within the slurry wall containment area beneath the cap.

Alternative 6d - Cap, Complete Cutoff, Perimeter Groundwater Collection, Treatment and Discharge to Buffalo River and Shore Stabilization

This alternative would involve the same components as Alternative 6a along with the addition of an upgradient slurry wall for total containment of the site.

Alternative 6e - Cap, Complete Cutoff, Perimeter Groundwater Collection and Disposal to TSDF, and Shore Stabilization

This alternative would involve the same components as Alternative 6b along with the addition of an upgradient slurry wall for total containment of the site.

Alternative 7 - Cap, Complete Cutoff, Perimeter Groundwater Collection, Pre-Treatment and Discharge to BSA and Shore Stabilization

This alternative would involve the same components as Alternative 6e with the exception of utilizing sheetpiling for shore stabilization in place of Fabriform®/Rip-Rap. Also, groundwater pre-treatment and disposal to the BSA would be used instead of disposal to a TSDF.

Alternative 8 - Total Excavation and Disposal with Soil Cover and Grading, Total Groundwater Collection, Pre-Treatment and Discharge to BSA and Shore Stabilization

This alternative would involve the excavation and disposal of soil/waste and backfilling with new soil/fill material. Total groundwater collection and pre-treatment for discharge to the BSA along with shore stabilization would also occur.

A comparative analysis of these detailed alternatives based upon the nine evaluation criteria noted above, is as follows:

Overall Protection of Human Health and the Environment

The no action alternative (Alternative 1) is clearly not protective of human health and the environment. Under baseline conditions, the total calculated carcinogenic risk of 1×10^{-5} and the hazard index of 200 would not be altered. In addition, potential risks through the inhalation of volatile organics from surface materials would remain. These conditions, which are not adequately protective of human health, may result in unacceptable health risks.

Alternatives 3 and 3a provide a greater level of protection than Alternative 1 through the implementation of a cap. This eliminates any airborne contaminants and contact with the soil/waste. Erosion control through sheetpiling in Alternative 3 and Fabriform®/Rip-Rap in Alternative 3a reduces sediment loading. Sheetpiling in Alternative 3 also affords a reduction in groundwater discharge from the site thereby reducing aquatic toxicity.

Alternative 4 provides increased protection over Alternatives 1, 3, and 3a in that it includes the perimeter collection of groundwater with pretreatment and discharge to BSA. This, in turn, eliminates groundwater discharge from the site to the Buffalo River, thereby eliminating aquatic toxicity.

Alternatives 5, 6 through 6e, 7, and 8, although employing different combinations of technologies than Alternative 4, provide the same general level of protection of human health through the elimination of airborne contaminants, contact and incidental ingestion of soils/waste, and aquatic toxicity.

In summary, Alternatives 4 through 8 provide comparable levels of protection of human health and the environment. Containment of the soil/waste and groundwater through perimeter groundwater collection and/or downgradient and upgradient cut-off via slurry wall afford an equally effective approach of eliminating the exposure pathways, as does complete excavation of the soil/waste.

Compliance with ARARs/SCGs

The no action alternative will not ensure compliance with ARARs/SCGs within a reasonable or predictable time frame. Alternatives 3 and 3a do not meet the chemical-specific ARARs/SCGs for migrating groundwater; however, with the implementation of a cap, they do comply with air standards and guidelines for volatile organic emissions from the site.

Alternatives 4, 5, 6, 6b, 6c, 6e, 7 and 8 provide for groundwater collection which will result in an inward flow of groundwater to the site. Consequently, these alternatives will attain the chemical-specific ARARs/SCGs for migrating groundwater. These alternatives do attain the BSA discharge limitations and air standards and guidelines for emissions from groundwater treatment processes. In the case of Alternatives 6a and 6d, groundwater is collected and discharged to the Buffalo River and therefore the effluent standards for discharges to surface waters will be met.

In addition, Alternatives 3, 4, 5, 6, 6a, 6b, 6c, 6d, 6e, 7 and 8 through shoreline stabilization and Alternative 8 through excavation will meet the site-specific SCGs for soils eroding to the Buffalo River as developed by NYSDEC.

All the containment alternatives can be designed to meet the action-specific ARARs/SCGs with conventional technologies.

Long-Term Effectiveness and Permanence

The no action alternative is neither effective nor permanent in the reduction of the magnitude of residual risk associated with the Area "D" site. This alternative provides for no adequate or reliable controls for the reduction of risk.

Alternatives 3 and 3a provide a greater reduction of residual risk than Alternative 1 in that a cap will eliminate airborne and contact pathways, and provide a reduction in the groundwater flow off-site and reduced soil erosion to the river. Both alternatives require a long-term O&M program; however, Alternative 3a requires greater maintenance of the shore stabilization due to the periodic dredging of the River by the Army Corps of Engineers.

Alternatives 4 and 5 provide a greater reduction of residual risk than Alternatives 3 and 3a due to the elimination of groundwater discharge to the River. These alternatives are not permanent, however, are effective if a maintenance program is employed. The O&M program required will be considerably greater than Alternatives 3 and 3a due to the addition of

pre-treatment facilities. Some minor variations in maintenance of the multi-media cap (Alternative 5) vs. FML cap (Alternative 4) will also be necessary.

Alternatives 6, 6a, and 6b provide the same level of reduction of residual risk as Alternative 4. These alternatives are not permanent; however, they are more effective in that a slurry wall provides a positive cut-off of the groundwater discharge on the downgradient side. (The effectiveness is still somewhat dependent upon the pumping of groundwater.) The O&M program is comparable to Alternative 5, although a slurry wall may require some additional maintenance. For Alternative 6b, off-site disposal would eliminate the O&M for treatment facilities, while not reducing effectiveness.

Alternatives 6c through 6e provide complete containment with an upgradient and downgradient slurry wall which is more effective than Alternatives 1 through 6b even if pumping of the groundwater is down for a period of time. Residual risk is further reduced over the aforementioned alternatives due to complete enclosure of the soil/waste. The O&M program is comparable, although due to the increased length of slurry wall, could be somewhat longer.

Alternative 7 is comparable to Alternatives 4 through 6 with some additional improvement due to sheetpiling providing better erosion control. The O&M program requirements are slightly higher for sheetpiling, however, less than for Fabriform®/Rip-Rap.

Alternative 6c provides an enhanced reduction in residual risk over Alternatives 1 through 7, in that it provides for additional erosion protection and minimization of shoreline soil migration. Under this alternative, the Fabriform®/Rip-Rap is extended to include the west side of the Area "D" site.

Alternative 8 provides the maximum reduction in residual risk due to complete removal of soil/waste and total collection and pre-treatment of contaminated groundwater. This alternative is considered a permanent remedial action as defined by the NYSDEC TAGM (May 1990). The O&M program requirements are less than Alternatives 6 through 6e and 7 due to lack of slurry wall and sheetpiling. However, an O&M program will still be necessary for the pumping and treatment of groundwater and shore stabilization.

Reduction of Toxicity, Mobility, or Volume Through Containment and Treatment

The no action alternative (Alternative 1) involves no containment or treatment, and, consequently, will not contribute to the reduction of contaminant toxicity, mobility or volume at the site.

Alternatives 3 and 3a offer no reduction in the toxicity of the soil/waste and groundwater; however, these alternatives do provide a greater reduction than Alternative 1 in the mobility and volume of groundwater through capping and shore stabilization. Alternative 3a provides more reduction in groundwater flow due to the use of sheetpiling. No reduction in the soil/waste volume is provided by these alternatives.

Alternatives 4 and 5 provide a greater degree of reduction of toxicity and mobility of groundwater than Alternatives 3 and 3a due to collection and treatment of the groundwater; however, no reduction in the soil/waste volume is afforded. Volume of groundwater increases due to the lack of containment or cut-off.

Alternatives 6 through 6e and 7 provide a greater degree of reduction of toxicity, mobility, and volume of groundwater and soils/waste than Alternatives 4 and 5 in that containment of groundwater and soils/waste via a slurry wall or sheetpiling is provided. These alternatives do not provide a reduction of volume of soil/waste.

Alternative 6c provides an enhanced reduction of toxicity, mobility and soils/waste over Alternatives 1 through 7, in that all source contaminants, as well as any non-source fill materials, will be excavated and removed from outside the slurry wall along the entire shoreline, as previously described on Page 4 and place within the slurry wall containment area beneath the cap. This combination of source/fill excavation and containment offers the greatest degree of reduction of volume and toxicity as compared to other alternatives except Alternative 8.

Alternative 8 affords the highest degree of reduction of volume of soil/waste and groundwater through excavation of the soil/waste and total collection and pretreatment of the groundwater. This alternative also provides a greater degree of reduction of mobility and toxicity by eliminating the source.

In summary, Alternative 8 provides the greatest degree of reduction of volume and toxicity. The reduction in mobility is comparable to Alternatives 4, 5, 6, and 7 which rely on containment (although it is significant

to note that since the source is removed in Alternative 8, there is nothing left to be mobilized).

Short-Term Effectiveness

In the short-term, the no action alternative is not effective in protecting human health and the environment. No remediation will be conducted. Improvement of groundwater quality will only occur through natural recovery for a period of time which has not been assessed.

All of the alternatives provide short-term effectiveness for contact and incidental ingestion of the soil/waste. The alternatives which employ groundwater collection and treatment for discharge to the BSA provide short-term effectiveness to aquatic organisms. Alternatives 6a, 6e, and 8 provide for immediate short-term effectiveness to aquatic organisms while also attaining the chemical-specific ARARs/SCGs for groundwater.

Protection against community and worker exposure will be required with all of the containment and treatment options. Additional worker protection measures pursuant to OSHA requirements will be required due to cut-off wall installation requirements under Alternatives 6 through 6e and 7. Likewise, worker protection measures will be necessary for excavation of the waste under Alternatives 6c and 8.

Environmental impacts during construction of the groundwater pumping and treatment components of the containment options are similar and readily mitigatable. Relatively greater potential environmental impacts are envisioned with Alternatives 6 through 6e, 7 and 8 and these impacts will require more formal mitigation measures during the installation of the cut-off wall component and excavation of soil/waste.

Implementability

All of the alternatives are implementable, however, to varying degrees. The no action alternative is considered the least technically feasible action, as it will not contribute toward site remediation.

Alternatives 3 and 3a are more difficult to implement than Alternative 1 due to the institution of a FML cap and sheetpiling (Alternative 3) and Fabriform®/Rip-Rap (Alternative 3a). Fabriform®/Rip-Rap may be easier to install than driving sheetpiling through the fill; however, both are proven technologies and very reliable.

Alternative 4 is more difficult to implement than Alternatives 1, 3 and 3a due to the required installation of wells/trench for the pumping and treatment of the groundwater. The groundwater treatment technologies are reliable and proven; however, treatability studies may be required. More agency coordination is also required.

Alternatives 5 and 6 through 6e are generally similar to Alternative 4 with the following exceptions: Alternative 5 implements a multi-media cap which will be slightly more difficult to construct. Alternatives 6, 6a, and 6b include a downgradient slurry wall which is more difficult to implement than Alternatives 1 through 5. Alternatives 6c through 6e and 7 include an upgradient and downgradient slurry wall and are, therefore, more difficult than Alternatives 1 through 6b. All of the alternatives 5 through 6e utilize proven and reliable technologies with readily available equipment from commercial vendors.

Alternative 7 is slightly more difficult than Alternatives 6 through 6e with the exception of 6c, in that sheetpiling will make implementability more difficult due to potential problems with driving piles into the fill.

Alternative 6c has similar difficulty in implementation compared to Alternative 7 due to the excavation of fill materials along the shoreline of the river, outside of the slurry wall as previously described on Page 4.

Alternative 8 is by far the most difficult to implement due to problems associated with the excavation of the soil/waste. Primarily, problems will be encountered with the dewatering and slope stabilization for excavation, materials handling, disposal, and placement of backfill. The technologies are proven and reliable, however, and equipment is readily available from multiple vendors.

Costs

The no action alternative has the least present value cost of approximately $1,170,000.00. Alternative 3a follows with a cost at $5,195,000.00.

Alternatives 3, 6, 6d, and 6e have costs, ranging from $7,346,000.00 to $8,834,000.00. The next highest cost alternatives are 6a, 6c and 7 with present value costs of $9,432,000.00, $9,556,000.00 and $10,713,000.00, respectively.

Cost for Alternatives 4, 5, and 6b are $13,693,000.00, $16,297,000.00 and $34,927,000.00, respectively. Finally, the highest cost alternative,

- Alternative 8; includes excavation and disposal of on-site contaminated soil and has a present value of $308,689,000.00.

The cost figures indicate that the full slurry wall provides a cost benefit, as it reduces the treatment costs by a greater amount than the cost of the wall.

The cost for pre-treatment of groundwater on-site for disposal to the Buffalo Sewer Authority (BSA) is much less than disposal of the groundwater at a TSDF; although the total treatment costs and pre-treatment costs do not differ greatly, with the pre-treatment costs being less.

State Acceptance

To be completed after NYSDEC review.

Community Acceptance

To be completed after public review of the draft FS Report.

1.0 INTRODUCTION

1.1 PURPOSE AND ORGANIZATION OF FEASIBILITY STUDY

The purpose of the Feasibility Study (FS) is to determine the most appropriate means of remediating the site based upon the findings of the Remedial Investigation (RI) and the requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), New York State Law, and the National Contingency Plan (NCP). These findings were presented in a report entitled "Remedial Investigation Report Buffalo Color Area "D"" prepared by Malcolm Pirnie, dated April 1989, subsequently revised by Allied Signal/Buffalo Color, August 1989 and subsequently reviewed by Wehran-New York, Inc. The purpose of the Feasibility Study Report is to present the analysis used in selecting the recommended site remediation alternatives, and to present a description, conceptual design, and cost of the recommended remediation. The FS is organized into five sections as follows:

Section 1 - Introduction - provides a summary of the RI Findings including history of the site, sources of contamination at the site, contaminant fate and transport, and the baseline risk assessment.

Section 2 - Remedial Action Objectives and General Response Actions - provides a summary of the objectives for the soil/waste and groundwater remediation goals, the associated exposure routes, an identification of the chemical-specific ARARs/SCGs and the general response actions for each affected media at the site.

Section 3 - Identification and Screening of Technology Types and Process Options - presents the identification of technically feasible options for each general response action that can be used to form remedial alternatives. Descriptions of the technology types and actions are discussed throughout.

Section 4 - Development and Screening of Technology Types - presents the remedial alternatives that were developed based on the remedial objectives and general response

actions. The alternatives presented are screened on the basis of effectiveness, implementability, and cost.

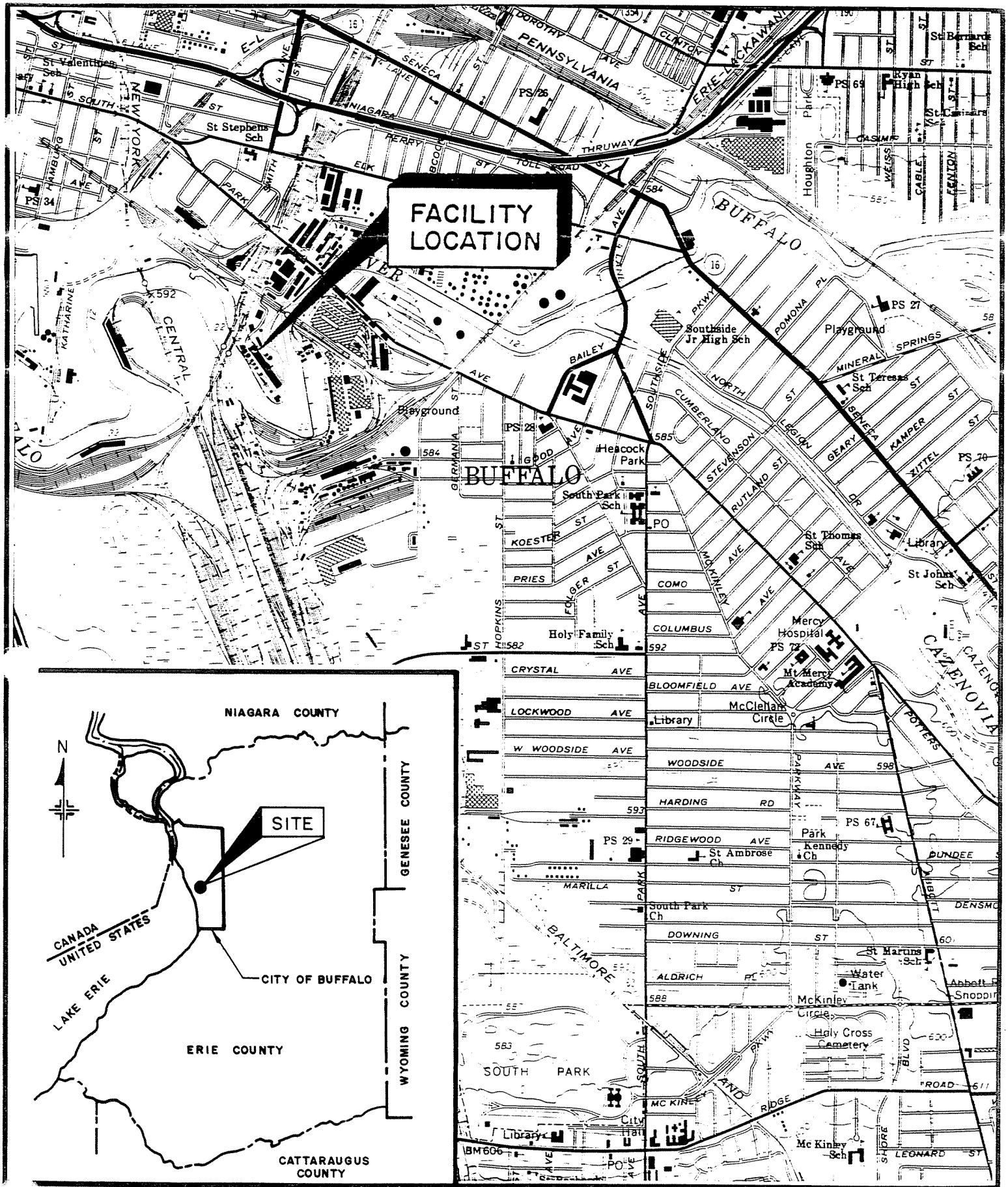
Section 5 - Detailed Analysis of Alternatives - presents those alternatives which passed through the screening process. In this section, these alternatives are defined in greater detail and evaluated in terms of nine evaluation criteria per the United States Environmental Protection Agency (USEPA), CERCLA Guidance Manual (October 1988) and New York State Department of Environmental Conservation (NYSDEC) Remedial Action Technologies Technical and Administrative Guidance Memorandum (TAGM), May 1990. This section also provides a comparative analysis of those alternatives carried through and ultimately the recommendation of a remedial action.

1.2 SUMMARY OF THE REMEDIAL INVESTIGATION

1.2.1 Site Description

Buffalo Color Area "D" is an inactive hazardous waste site situated on a 19-acre peninsula extending into the Buffalo River in the City of Buffalo, Erie County, New York (Figure 1-1). Area "D" was last actively used by Allied Chemical Corporation for the manufacture of a variety of chemicals (principally household detergents and dye intermediates). Buffalo Color purchased the plant and Area "D" from Allied Chemical in 1977, and in 1984 all structures on the site were demolished. Based upon the RI, the portions of Area "D" which were identified are:

1. The "Weathering Area" located at the tip of the peninsula which was utilized for the temporary storage of metal oxide sludges;
2. The "Iron Oxide Sludge Lagoons" which were used for temporary storage of iron oxide sludges generated from the manufacture of dyes and intermediates;
3. Tank farm areas used for the bulk storage of petroleum products and process chemicals; and



WehranEnviroTech

BUFFALO COLOR CORPORATION

BUFFALO ERIE COUNTY NEW YORK

VICINITY MAP

Figure: 1-1

Scale: 1" = 2000'

Date: 12/11/90

Project No: 00257

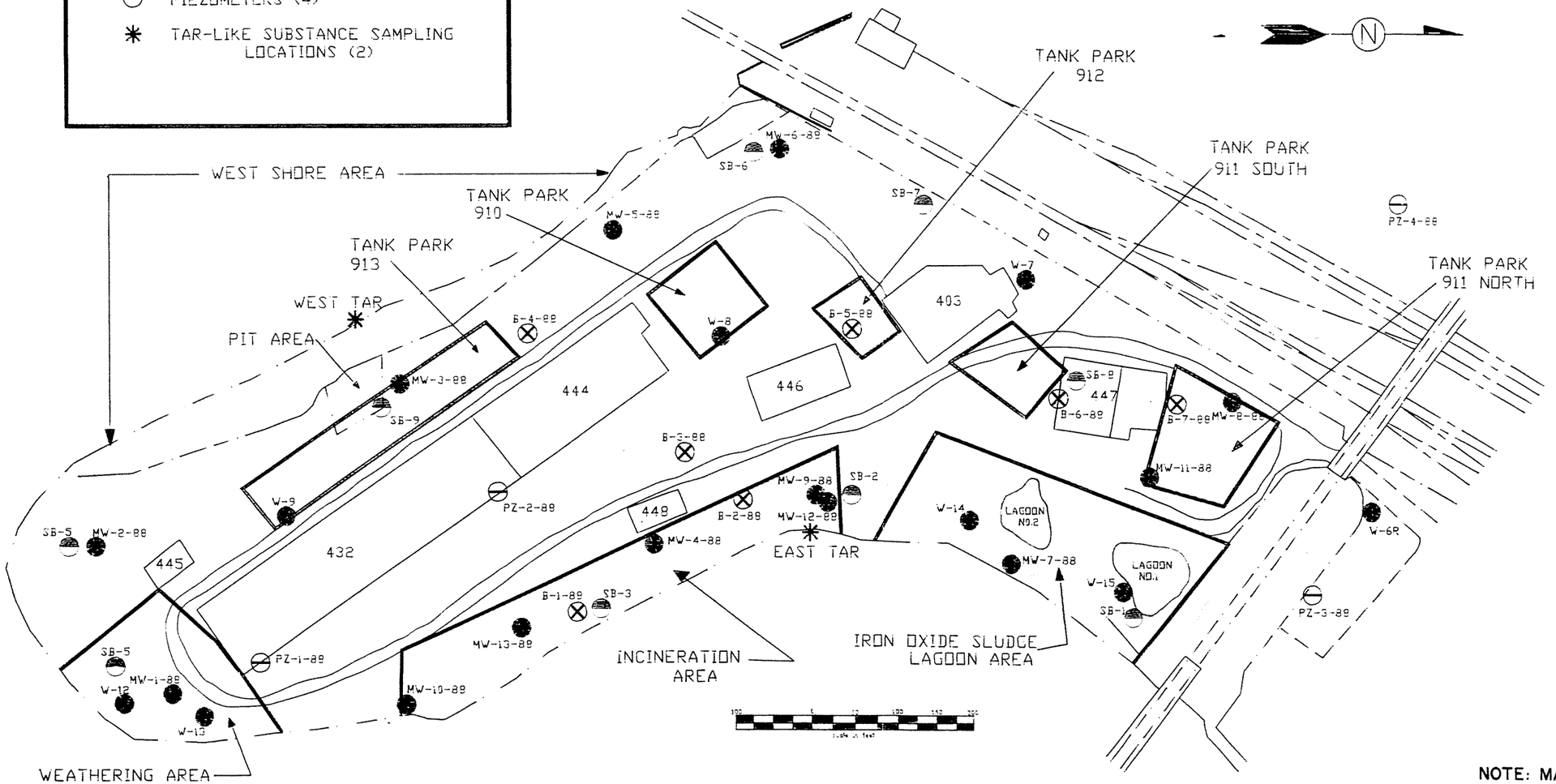
SENECA BLUEPRINT CO., INC.

BUFFALO COLOR CORPORATION

BUFFALO, NEW YORK
AREA D – RI/FS

LEGEND

- 2' SURFICIAL SOIL BORING (9)
- BORINGS (7)
- MONITORING WELLS (20)
- PIEZOMETERS (4)
- TAR-LIKE SUBSTANCE SAMPLING LOCATIONS (2)



NOTE: MAP PREPARED BY AUTOMATED COMPLIANCE SYSTEMS, INC.

WehranEnviroTech	Drawn By : _____ Checked By : _____ Date : _____	Scale AS NOTED		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	EXISTING SITE CONDITIONS PLAN	Figure : 1-2 Project No. 00257

4. The area on the eastern side of the peninsula formerly occupied by open burning pits and later by an incinerator used for burning of organic wastes generated during dye manufacturing processes.

As presented in the RI, the hydrogeology of the Area "D" site consists of three hydrostratigraphic units. These include: the shallow waterbearing zone, overburden aquitard, and bedrock aquifer. The shallow waterbearing zone is located in the fill/alluvium deposits at an average depth of nine to 27.8 feet and yields an average seepage velocity of 1.4×10^{-5} cm/sec. The groundwater flow in this zone is primarily from the north and flows directly to the Buffalo River. The overburden aquitard is a clay-rich confining layer and groundwater flow was determined to be predominantly upward at a rate of 1.2×10^{-9} cm/sec. The bedrock aquifer flow was determined to probably occur under confined conditions.

1.2.2 Site History

The 19 acres known as Area "D" were used for at least 70 years as a chemical manufacturing site. From 1905 to 1917, acids, chemicals, and dye intermediates were produced by Contact Process Company and by National Aniline Chemical Company. Beginning in 1917, phosgene gas was produced at the site through a joint operation with the U.S. Government for use in World War I.

In 1920, Contact Process Company and National Aniline Chemical Company were merged into Allied Chemical and Dye Corporation. Allied Chemical and Dye Corporation manufactured petroleum-based detergents and other chemicals at the Area "D" site until 1974, when chemical manufacturing operations ceased. During this time, three waste management units were operated: the metal sludge weathering area, the iron sludge ponds, and the incinerator area (Figure 1-2). Chemical waste handling at Area "D" ceased in 1976.

In 1977, Area "D" (as well as other portions of the property) was sold to Buffalo Color Corporation which has held the area idle since that time. All structures on the site were demolished to grade by Buffalo Color in 1984.

The "Iron Oxide Sludge Lagoons" and "Weathering Area" are currently listed in the New York State Registry of Inactive Hazardous Waste Disposal Sites, Site Nos. 915012A and 915012B, respectively. Buffalo Color Corporation

and Allied Signal, Inc. entered jointly into an Order of Consent with the NYSDEC to conduct a Remedial Investigation/Feasibility Study (RI/FS) of the entire Area "D" site. A Remedial Investigation (RI) was performed by Malcolm Pirnie and the report was submitted to NYSDEC on April 13, 1989 with revisions on August 31, 1989 and amended revisions on October 30, 1989. This FS follows the general intent of the RI by developing and evaluating several remedial alternatives for the site which meets the objective of ensuring that the site does not pose an unacceptable threat to human health and the environment.

1.2.3 Nature and Extent of Contamination

During the RI, sampling of the surface and subsurface soils, groundwater, surface (River) water, and River sediments was performed in and around the entire Area "D" site. The RI performed by Malcolm Pirnie indicated several conclusions. The fill layer of approximately 24 feet exhibited elevated levels of polynuclear aromatic hydrocarbons (PAHs) and chlorinated benzenes. Virtually all soil borings showed zero or low readings from a HNu photoionization detector, indicating insignificant quantities of volatiles in the soil. Also, variable concentrations of heavy metals and arsenic were found. Comparison of surface water concentration differences between upstream and downstream sampling were inconclusive, but sediments adjacent to the site exhibited elevated levels of PAHs, arsenic, and several heavy metals. Contamination of the groundwater relative to background was found in the surficial glacial/till formations, with the principal contaminants being volatile organics, chlorinated benzenes, iron, and other heavy metals. In addition, an oily sheen was observed in the soils at a number of locations and a six-foot layer of light non-aqueous phase liquid (NAPL) was found floating on the groundwater in the area of former tank park 910.

A summary of the specific chemical substances detected along with the frequency of detection and concentration range is presented in the RI Report and have been included here as Appendix A.

It should also be noted that Buffalo Color is currently implementing interim remedial measures (IRM) associated with the NAPL which was identified in the area of Well W-8. A Work Plan for this program was prepared by Buffalo Color and submitted to the NYSDEC on September 13, 1990. The program was subsequently approved and Buffalo

Color began implementation on September 24, 1990. The NAPL is further addressed in this Feasibility Study. and is dealt with as part of the overall groundwater contamination at the site.

1.2.4 Contaminant Fate and Transport

The Buffalo River receives contamination which migrates off of the Area "D" site. The chemical constituents of the waste enter the groundwater through dissolution, and the groundwater then flows into the Buffalo River. Likewise, the soluble constituents of the NAPL located near tank park 910 are present in the groundwater within the shallow overburden. The waste fill itself is entering the River through mechanical transport of soil waste particles during surficial run-off and erosion of the River banks surrounding the site. Each of these sources was evaluated in the RI to estimate the total contaminant loading to the River.

Based on the data collected during the RI, a daily loading of 1.2 pounds volatile organic compounds (VOCs) and 3.4 pounds semi-volatile organic compounds (SVOCs) is estimated to be migrating from the site to the River via groundwater. The total organic carbon loading to the River from groundwater is estimated to be 44.5 pounds per day. The estimate of 17.4 pounds per day iron and 2.0 pounds per day of other metals which is presented in the RI is conservative, since these estimations are based on total and not filtered metals analysis of groundwater.

The free product found in and around W-8 is assumed to be immobile, based on the fact that it is found in no other well on the site. However, the soluble constituents of the free product are assumed to enter the groundwater and move at the same rate as the groundwater flow. The plume of soluble constituents is, therefore, expected to migrate towards the south-southwest at a rate of approximately 2.5 feet/year.

Mechanical transport due to erosion of the banks and overland run-off is estimated in the RI to contribute approximately 575 cubic yards per year of fill material to the Buffalo River. This is the primary pathway for off-site migration of iron and other metals.

1.2.5 Baseline Risk Assessment

A risk assessment was previously performed for the site. The results of this assessment are presented in a Report entitled "Risk Assessment for

Buffalo Color Area "D"" prepared by Wehran-New York, Inc., and dated February, 1990. Indicator chemicals for the baseline risk assessment were selected based on the concentrations detected in surface soils and groundwater, carcinogenicity, human toxicity, bioconcentration potential, aquatic toxicity, and environmental persistence. The indicator chemicals are:

- Aniline
- Arsenic*
- Benzene
- Benzidine
- Benzo(a)pyrene group (carcinogenic) PAHs
- Cadmium*
- 4-Chloroaniline
- Chromium*
- 1,2-Dichlorobenzene
- 1,4-Dichlorobenzene
- Iron*
- Lead*
- Mercury*
- Methylene chloride
- Napthalene group (noncarcinogenic) PAHs

*** Total Metals**

Four human exposure pathways were judged to be potentially complete: dermal contact with on-site materials, incidental ingestion of on-site materials, inhalation of fugitive dust, and consumption of locally caught fish. The inclusion of the first three pathways is conservative because it assumes that the site is subject to trespassing. In fact, the site is patrolled, fenced along the west side and largely inaccessible, and trespassing has not been documented.

The ambient air concentration of the indicator chemicals found in surface soils was estimated using a United States Environmental Protection Agency (USEPA) wind erosion model for active storage piles. Exposure through the trespassing pathways was estimated based on a scenario which conservatively assumes on-site presence, one hour per visit and six visits per

lifetime. Chemical intakes were calculated using standard published estimates for contact, consumption and ventilation rates.

In order to quantitatively evaluate the fish ingestion and aquatic toxicity pathways, surface water concentrations of indicator chemicals resulting from groundwater loading to the River were estimated by applying the dilution factor of the River to the groundwater concentrations.

Fish tissue concentrations were calculated by modeling uptake from River water using bioconcentration factors (BCFs). Standard factors for fish consumption quantity and gastrointestinal absorption were applied to estimate exposure through this pathway. Fish tissue concentrations resulting from sediment-to-fish bioaccumulation were also calculated. Sediment uptakes were estimated based on studies evaluating sediment and biota concentrations.

Risks were estimated using standard risk assessment protocols. Carcinogenic risk was calculated assuming a lifetime of exposure for fish consumption and six visits per lifetime for on-site pathways. Potency factors were obtained from the USEPA or NYSDOH. Noncarcinogenic hazard indices (HIs) were obtained where possible from the USEPA & NYSDOH; however, where not available, they were derived for indicator chemicals with a significant potential for toxicity.

The final carcinogenic risks and HIs for the Area "D" site are presented in the risk assessment report and have been included here as Appendix B. The incidental ingestion and inhalation pathways do not contribute significantly to overall site risk. For carcinogenic risk, dermal contact, inhalation of off-site fugitive dust and fish consumption pathways are the primary contributors to the multi-pathway of 1×10^{-5} risk which is within the target range of 10^{-4} to 10^{-7}. For noncarcinogenic hazard, the dermal contact to trespassers is the primary contributor to the total HI of 2×10^{2}. Due to the difficulty in separating Area "D" contributions from existing background in the Buffalo River, risks from the sediment-to-fish pathway were not summed as part of the multi-pathway site risk.

Aquatic toxicity was addressed semi-quantitatively by evaluating the toxicity potential of the estimated surface water concentrations resulting from groundwater loading to the River. River water concentrations were compared with New York State Ambient Water Standards or Guidance Values for Class D waters (based on protection of aquatic life) or with USEPA Ambient

Water Quality Criteria (AWQC) for the protection of freshwater life, where available. For chemicals not having standards, guidance values or AWQC, River concentrations were compared to levels associated with aquatic toxicity. For all indicator chemicals, River water concentrations were one to five orders of magnitude below AWQC or toxic levels. This indicated that surface water impacted by Area "D" groundwater does not pose an unacceptable threat to aquatic life.

Elevated concentrations of PAHs, arsenic and several metals were detected in River sediments adjacent to Area "D". Impacts on aquatic life through the presence of contaminated sediments were also evaluated semi-quantitatively by comparison with New York State Fish & Wildlife Sediment Quality Criteria (where available), or Sediment Clean-up Goals generated by USEPA for another site.

Uncertainties in performing the RA for Area "D" were evaluated qualitatively. They occur in three basic categories: measured contaminant concentrations, exposure estimates, and assumptions about exposure, intake and risk. The result is that risk conclusions are highly unlikely to underestimate true risk and may overestimate the actual risk by several orders of magnitude.

2.0 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS

2.1 INTRODUCTION

The first two steps in the development and screening of alternatives for the Feasibility Study are: 1) To establish remedial action objectives and 2) To develop general response actions.

Remedial action objectives and general response actions are both medium-specific. The media of concern identified for Buffalo Color Area "D" are upper unconfined groundwater and surface and subsurface soil/waste. Any off-site receptors will be mitigated by remediation of Area "D" groundwater and soil/waste.

The following sections describe the site specific remedial action objectives and the general response actions developed for the Buffalo Color Area "D" Site.

2.2 REMEDIAL ACTION OBJECTIVES

Remedial action objectives consist of medium-specific goals for protecting human health and the environment. The main purpose of stating remedial action objectives is to establish an acceptable contaminant level or range of levels for each exposure route.

2.2.1 Groundwater

Sources of Contamination

The groundwater component of the RI covered all areas of the site. For the purposes of discussion, the RI divided Area "D" into areas which contained one to three monitoring wells. The areas discussed were the iron oxide sludge lagoons, the incinerator area, the weathering area, the west shore, tank park 911N, tank park 910, tank park 913, and the remainder of the site. Based on data in the RI from groundwater wells, contamination in the underlying aquitard is insignificant and, therefore, not of concern. For purposes of this FS, the groundwater contamination in the shallow aquifer throughout the Area "D" site will be addressed as a whole entity.

Contaminants of Concern

Contamination of groundwater in the shallow unconfined aquifer was noted throughout the Area "D" site. The groundwater in each of the areas

studied in the RI contained significant concentrations of metals such as chromium, iron, and lead. Several areas also contained significant concentrations of arsenic, cadmium, and mercury. All areas except the weathering area and tank park 910 also contained significant concentrations of semi-volatile compounds. In addition to semi-volatiles and metals, four areas also contained significant concentrations of volatile organic compounds. The contaminants which are found in the groundwater beneath the Area "D" site are presented in Appendix A.

Exposure Routes and Receptors

Groundwater beneath the Area "D" site flows directly into the Buffalo River. There is not now, nor has there ever been, any usage of groundwater at Area "D" as a potable or other water supply. There is, therefore, no opportunity for direct exposure to groundwater and no receptors. However, River biota may bioconcentrate groundwater contaminants which are released into the Buffalo River through groundwater to surface water migration. This may result in health risks to humans who consume fish from the River. It may also result in environmental impacts on the River's ecosystem.

Applicable or Relevant and Appropriate Requirements (ARARs)/Standards, Criteria, and Guidelines (SCGs)

The following regulatory requirements have each been identified as being either applicable or relevant and appropriate to the remediation of the groundwater at Area "D":

- 6 NYCRR 703.5(a)(3) Groundwater Standards for Class GA Waters.
- 10 NYCRR Subpart 5-1 Standards for Drinking Water Supplies.
- 10 NYCRR Part 170 – Sources of Water Supply.
- 40 CFR 141.11 Standards for Public Drinking Water Systems.
- 6 NYCRR 701.19 Fresh Surface Water Standards (Class C).
- NYSDEC TOGS 1.1.1.(4-1-87) Ambient Water Quality Standard.
- Clean Water Act 303-304 Water Quality Criteria (Aquatic Life).
- Clean Water Act 303-304 Water Quality Criteria (Fish Consumption).

Where each regulation has a different standard for one of the chemicals of concern, the more stringent will be applied. The chemical-specific ARARs and SCGs applicable to the groundwater contamination at Area "D" are listed in Table 2-1. Surface Water ARARs/SCGs are also presented for purposes of defining those standards which are applicable to the discharge of groundwater to the surface waters of the Buffalo River. It should be noted that the maximum surface water concentrations recorded from one round of sampling during the RI, are comparable to those of a stream surveillance of the Buffalo River which were conducted by NYSDEC and presented in the Buffalo River Remedial Action Plan (Revised RI, August 1989).

Remediation Action Objectives

With some minor exceptions, the contaminants of concern are generally uniform throughout the Area "D" site. Therefore, for the purpose of remediation, mitigation of the entire shallow unconfined aquifer throughout the site will be considered. The remedial action objective is to ensure that the shallow unconfined aquifer throughout the site does not pose a threat to human health and the environment.

The area of attainment for this remediation goal is the affected shallow unconfined aquifer.

2.2.2 Soils/Wastes

Sources of Contamination

The RI divided the site into areas based on the former use of each area for disposal or storage. Site areas identified in the RI are the iron oxide sludge lagoons, the incinerator area, the weathering area, the west shore, tank park 911N, tank park 912, tank park 913, the north rail yard, the east shore, the south shore, the west tar area, and the remainder of the site. While remediation of these areas would contain or remove certain soil contaminants, remediation of only these areas would not contain or remove all contaminants present at the site; therefore, soil/waste throughout the entire Area "D" site will be considered as a whole for remediation.

Based upon a review of the RI data and discussions with Buffalo Color and Allied Signal, the waste characteristics of the Area "D" fill layer is generally that of refractory materials. Concrete or brick fragments occur to depths of three to 16 feet. In addition to this construction and demolition

Ta

BUFFALO COLOR CORPORATION
AREA "D" FEASIBILITY STUDY
Potential Groundwater and Surface Water ARARS/SCGS
(Revised 8/91)

Compound	Maximum Groundwater Concentration (ug/l)	Maximum Surface Water Concentration (ug/l)	Chemical-Specific ARARs/SCGs						
			Groundwater (ug/l in water) (1)	Drinking Water (ug/l in water) (2)	Drinking Water (ug/l in water) (3)	Surface Water (ug/l in water) (4b)	Surface Water (ug/l in water) (5)	Surface Water (ug/l in water) (6a)	Surface Water (ug/l in water) (6b)
Aluminum	67,000	1,140	NA	-	-	100	-	-	-
Antimony	124	ND	NA	-	-	-	-	-	45,000
Arsenic	1,820	ND	25	25	50	190	360	-	0.018
Barium	1,020	76	1,000	1,000	1,000	-	-	-	-
Beryllium	7	ND	NA	-	-	11**	-	5.3	0.12
Cadmium	127	ND	10	10	10	-	5.9*	1.1	-
Chromium	2,140	28	50	50	50	-	2,340*	170,000	3,433,000
Copper	78,700	ND	200	200	-	-	25*	12	-
Iron	405,000	2,170	300	300	-	300	300	-	-
Lead	3,030	13	25	25	50	-	131*	3.2	-
Magnesium	59,700	12,800	-	-	-	-	-	-	-
Manganese	21,300	212	300	300	-	-	-	-	-
Mercury	50	ND	2	2	2	0.2	0.2	0.012	0.15
Nickel	830	ND	NA	-	-	-	2433*	160	100
Selenium	10	ND	10	10	10	1.0	-	35	10
Silver	13	ND	50	50	50	0.1	7.6*	0.12	50
Thallium	94	10	NA	-	-	8	20	40	48
Zinc	9,950	138	300	300	-	30	435*	110	-
Cyanide	56	19	100	100	-	5.2	22	5.2	-
Acenaphthene	26	ND	-	50	-	-	20	500	-
Acetone	15,000	22,000	-	50	-	-	-	-	-
Aniline	660	ND	-	5	-	-	-	-	-
Anthracene	14	ND	-	50	-	-	-	-	-
Benzene	28,000	ND	ND	5	5	-	6	5,300	40
Benzidine	360	ND	-	5	-	0.1	0.1	2,500	0.53

(1) 6NYCRR 703.5 (a) (3) Groundwater Standards for Class GA Waters.
(2) 10 NYCRR Subpart 5-1 Standards for Drinking Water Supplies.
(3) 40 CFR 141.11 Standards for Public Drinking Water Systems.
(4b) 6NYCRR 701.19 Fresh Surface Water Standards (Class C)
(5) NYSDEC TOGS 1.1.1 (9/25/90) Ambient Water Quality Standards and Guidelines.
(6a) Clean Water Act 303-304 Water Quality Criteria (Aquatic Life).
(6b) Clean Water Act 303-304 Water Quality Criteria (Fish Consumption).

NA - Not Analyzed
ND - Not Detected
* - Based on Buffalo River hardness of 144mg/liter.
** - When hardness is less than or equal to 75ppm;
' 1,100 ug/l when hardness is greater than 75ppm

Note: 10 NYCRR Part 170 - Sources of Water Supply Standards are included in the values presented in column #5.

Tat

BUFFALO COLOR CORPORATION
AREA "D" FEASIBILITY STUDY
Potential Groundwater and Surface Water ARARS/SCGS
(Revised 8/91)

Compound	Maximum Groundwater Concentration (ug/l)	Maximum Surface Water Concentration (ug/l)	Chemical-Specific ARARs/SCGs						
			Groundwater (ug/l in water) (1)	Drinking Water (ug/l in water) (2)	Drinking Water (ug/l in water) (3)	Surface Water (ug/l in water) (4b)	Surface Water (ug/l in water) (5)	Surface Water (ug/l in water) (6a)	Surface Water (ug/l in water) (6b)
Benzo(a)anthracene	12	ND	-	50	-	-	-	-	-
Benzo(b)fluoranthene	0.3	ND	-	50	-	-	-	-	-
Benzo(k)fluoranthene	0.6	ND	-	50	-	-	-	-	-
Benzo(a)pyrene	7	ND	ND	50	-	-	0.0012	-	-
Benzoic Acid	18	ND	-	50	-	-	-	-	-
Bis(2-chloroethoxyl)methan	20	ND	-	5	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	52	12	-	50	-	0.6	-	-	-
Bromodichloromethane	7	ND	-	100	100	-	-	-	-
2-Butanone	260	ND	-	50	-	-	-	-	-
Carbon disulfide	43	ND	-	50	-	-	-	-	-
4-Chloroaniline	11,000	ND	-	50	-	-	-	-	-
Chlorobenzene	48,000	ND	-	5	-	5	50	50	-
Chloroform	24	ND	100	50	-	-	-	1,200	18
4-Chloro-3-methylphenol	7	ND	-	50	-	-	-	-	-
2-Chlorophenol	1,800	ND	-	50	-	-	-	2,000	-
Chrysene	11	ND	-	50	-	-	-	-	-
Dibenzofuran	13	ND	-	50	-	-	-	-	-
Di-n-butylphthalate	1	ND	770	50	-	-	-	-	-
1,2-Dichlorobenzene	21,000	ND	4.7	5	-	5	50	760	2.6
1,3-Dichlorobenzene	49	ND	-	5	-	5	50	760	2.6
1,4-Dichlorobenzene	4,900	ND	-	5	75	5	50	760	2.6
1,1-Dichloroethene	8	2	-	5	-	-	-	11,000	-
1,2-Dichloroethene	19	5	-	5	-	-	-	11,000	1.9
Diethylphthalate	4	ND	-	50	-	-	-	-	1,800
2,4-Dimethylphenol	130	ND	-	50	-	-	-	2,100	-

(1) 6NYCRR 703.5 (a) (3) Groundwater Standards for Class GA Waters.
(2) 10 NYCRR Subpart 5-1 Standards for Drinking Water Supplies.
(3) 40 CFR 141.11 Standards for Public Drinking Water Systems.
(4b) 6NYCRR 701.19 Fresh Surface Water Standards (Class C)
(5) NYSDEC TOGS 1.1.1 (9/25/90) Ambient Water Quality Standards and Guidelines.
(6a) Clean Water Act 303-304 Water Quality Criteria (Aquatic Life).
(6b) Clean Water Act 303-304 Water Quality Criteria (Fish Consumption).

NA - Not Analyzed
ND - Not Detected
* - Based on Buffalo River hardness of 144mg/liter.
** - When hardness is less than or equal to 75ppm;
' 1,100 ug/l when hardness is greater than 75ppm

Note: 10 NYCRR Part 170 - Sources of Water Supply Standards are included in the values presented in column #5.

Tal

BUFFALO COLOR CORPORATION
AREA "D" FEASIBILITY STUDY
Potential Groundwater and Surface Water ARARS/SCGS
(Revised 8/91)

Compound	Maximum Groundwater Concentration (ug/l)	Maximum Surface Water Concentration (ug/l)	Chemical-Specific ARARs/SCGs						
			Groundwater (ug/l in water) (1)	Drinking Water (ug/l in water) (2)	Drinking Water (ug/l in water) (3)	Surface Water (ug/l in water) (4b)	Surface Water (ug/l in water) (5)	Surface Water (ug/l in water) (6a)	Surface Water (ug/l in water) (6b)
2,4-Dinitrotoluene	2,000	ND	-	5	-	-	-	-	-
2,6-Dinitrotoluene	1,700	ND	5	5	-	-	-	-	-
Ethylbenzene	43,000	ND	5	5	-	-	-	32,000	3,300
Fluoranthene	54	ND	-	50	-	-	-	3,900	54
Fluorene	24	ND	-	50	-	-	-	-	-
Methylene chloride	15,000	ND	5	5	-	-	-	-	-
2-Methylnaphthalene	16	ND	-	50	-	-	-	-	-
4-Methyl-2-pentanone	24	ND	-	50	-	-	-	-	-
2-Methylphenol	47	ND	-	50	-	-	-	-	-
1-Naphthylamine	42,000	ND	-	50	-	-	-	-	-
Naphthalene	4,900	ND	-	50	-	-	-	-	-
2-Nitroaniline	4	ND	-	50	-	-	-	-	-
Nitrobenzene	15	ND	5	5	-	-	-	27,000	-
N-Nitrosodiphenylamine	15	ND	-	50	-	-	-	-	16
N-Nitrosodipropylamine	24	ND	-	50	-	-	-	-	-
PAH Phenanthrene	63	ND	-	50	-	-	-	-	-
Pentachlorophenol	2	ND	21	50	-	-	1.0	13	-
Phenanthrene	63	ND	-	50	-	-	-	-	-
Phenol,Total chlorinated	77	ND	1.0	50	-	-	1.0	2,500	-
Pyrene	24	ND	-	50	-	-	-	-	-
Toluene	4,700	ND	-	5	-	-	-	17,000	420,000
1,2,4-Trichlorobenzene	1,200	ND	-	5	-	-	50/5	-	-
Trichloroethene	3	ND	5	5	5	-	11	2,100	81
Vinyl chloride	6	ND	2	2	2	-	-	-	530
Xylenes (total)	1,700	6	5	5	5	-	-	-	-

(1) 6NYCRR 703.5 (a) (3) Groundwater Standards for Class GA Waters.
(2) 10 NYCRR Subpart 5-1 Standards for Drinking Water Supplies.
(3) 40 CFR 141.11 Standards for Public Drinking Water Systems.
(4b) 6NYCRR 701.19 Fresh Surface Water Standards (Class C)
(5) NYSDEC TOGS 1.1.1 (9/25/90) Ambient Water Quality Standards and Guidelines.
(6a) Clean Water Act 303-304 Water Quality Criteria (Aquatic Life).
(6b) Clean Water Act 303-304 Water Quality Criteria (Fish Consumption).

NA - Not Analyzed
ND - Not Detected
* - Based on Buffalo River hardness of 144mg/liter.
** - When hardness is less than or equal to 75ppm;
' 1,100 ug/l when hardness is greater than 75ppm

Note: 10 NYCRR Part 170 - Sources of Water Supply Standards are included in the values presented in column #5.

(C&D) debris, the floor pads and foundations of Area "D" buildings demolished in 1984 remain in place. Sewer and utility lines together with footers of former storage tanks, a water tower, and railway spurs also exist within the fill layer.

Contaminants of Concern

Contamination was found in each area discussed above. The principal contaminants were chlorinated benzene compounds and PAHs, and metals such as iron, copper, chromium, lead, and arsenic. A summary of contamination found in the surface and subsurface soils of Area "D" is presented in the RI and is included here in Appendix A.

Exposure Routes and Receptors

Because the site is surrounded on three sides by the Buffalo River and by fenced, patrolled private property (Buffalo Color Corporation and AmTrack) on the fourth side, the potential for trespassing is very low. Reports by Buffalo Color indicate that there is no trespassing problem. However, because the site is theoretically accessible from the Buffalo River, there is potential for exposure to the soils and wastes on the site. The theoretical trespasser's exposure to soils and wastes is possible through the dermal contact, incidental ingestion, and fugitive dust inhalation routes. There is also a potential for off-site residential receptors to be exposed to surface materials via inhalation of fugitive dust. Although, erosion of soils/waste from the banks of Area "D" into the Buffalo River provides a potential source of contaminants to the sediments, the contaminants bind strongly to the sediments under ambient conditions and have low bioavailability. Consequently, significant aquatic impact is unlikely, and thus the exposure to humans through incidental ingestion of fish is low.

Applicable or Relevant and Appropriate Requirements (ARARs) and State Standards, Criteria, and Guidelines (SCGs)

The following guidelines have each been recommended by the NYSDEC in their letter dated April 6, 1990, as being either applicable or relevant and appropriate to the remediation and/or treatment of Area "D" soils eroding to the Buffalo River:

- USEPA Sediment Classification Guidelines (Region V:4/77)

- NYSDEC Guidelines for Area "D" soils

Based on these guidelines, the chemical-specific ARARs and SCGs for the treatment of soil at Area "D" are as follows:

• Arsenic -	7,500 µg/kg
• Cadmium -	1,000 µg/kg
• Chromium -	10,000 µg/kg
• 1,2 - Dichlorobenzene -	425 µg/kg
• 1,4 - Dichlorobenzene -	425 µg/kg
• Iron -	550,000 µg/kg
• Lead -	32,500 µg/kg
• Mercury -	100 µg/kg
• Phenanthrene -	35,000 µg/kg

Remediation Action Objectives

The remedial action objective is to contain, isolate or restore the soils of Area "D" so the potential risk to human health and the environment through exposure is at an acceptable level.

2.3 GENERAL RESPONSE ACTIONS

General response actions describe those actions that could satisfy the remedial action objectives. General response actions may include treatment, containment, excavation, extraction, disposal, institutional actions, or a combination of these. The following subsections describe the general response actions for the two media of interest, groundwater and soil/waste.

2.3.1 Groundwater

Based on the remedial action objectives established for the affected upper unconfined groundwater at the site, the general response actions could be:

- Restrict future groundwater use.
- Contain groundwater contaminant migration using a perimeter cut-off and cap.
- Divert and/or collect run-on and run-off to minimize infiltration.

- Treat the groundwater using biological, thermal, or physical/chemical means.
- Dispose of treated or pretreated groundwater either on-site or off-site.
- Monitor the levels and extent of contamination.

2.3.2 Soil/Wastes

The general response actions for the goal established to prevent contamination of the groundwater and/or human health effects from exposure to soil/waste at the site could be:

- Restrict site access and future land use.
- Contain soil/waste using a perimeter cut-off and cap.
- Remove soil/waste for treatment and disposal.
- Treat soil/waste using biological, thermal, or physical means.
- Dispose of treated or pretreated soil/waste either on-site or off-site.
- Monitor the levels and extent of contamination.

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

3.1 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

The goal of this step in the Feasibility Study process is to identify at least one technically feasible process option for each general response action that can be used to form remedial alternatives. Technologies and process options for each of the general response actions presented in Section 2.3 were previously discussed and reviewed by NYSDEC and comments incorporated. Table 3-1 presents this information. Descriptions of these technology types and actions are discussed in the remainder of this section. Screening comments with respect to technical implementability at the Area "D" site are provided with the descriptions.

3.2 CONTAINMENT

3.2.1 Capping

Capping as a containment option is used to reduce or eliminate the infiltration of precipitation through the site. Capping can also control volatile emissions (airborne contaminants) and prevent human and wildlife contact with the contaminants. Prior to the cap installation, the site would need to be graded to provide positive drainage and prevent ponding. The site is vegetated following cap installation to control erosion.

Synthetic Membrane Cap

The synthetic membrane cap (or flexible membrane liner, FML) is designed to minimize infiltration of precipitation by means of a synthetic barrier between the surface and the waste material. The membrane is installed after the site is regraded by unrolling the membrane and covering exposed surfaces of the site. The membrane would then be covered with soil and vegetated to control erosion and dust. This type of cap would have the proper stability characteristics for the Area "D" site; and is potentially applicable at this site.

Low Permeability Soil Layer Cap

Single layer caps, e.g. two feet of low permeability soil (permeability of 1×10^{-7} cm/sec) cover are not as effective as FML caps in reducing infiltration because they are subject to dessication cracking, freeze/thaw damage and

Table 3-1

BUFFALO COLOR CORPORATION

Area "D" Feasibility Study

Screening of Process Options and Technology Types

General Response Action	Technology Type	Process Option	Retention for Detailed Screening
Containment	Capping	Synthetic membrane	Yes
		Single Layer	No
		Multi-Media	Yes
	Barriers	Slurry Walls	Yes
		Vitrified Wall Barrier	No
		Sheet Piles	Yes
		Grout Curtains	No
		Bottom Sealing (Grouting)	No
		Fabriform	Yes
		Rip Rap	Yes
	Backfilling	N/A	Yes
Removal of Soil/Wastes	Complete Removal	Excavation	Yes
	Partial Removal	Excavation	Yes
Treatment - Soil/Waste	Biological	In situ Bio-remediation	No
	Physical/Chemical	In situ stabilization/solidification	No
		On-site stabilization/solidification	No
		In situ Soil Washing	No
		On-site Soil Washing	Yes
		Soil Vacuum Extraction	No
		On-site Composting	No
		On-site Slurry Bioreactor	Yes
		On-site Leach Bed	Yes
		In situ Vitrification	No
		On-site Vitrification	Yes
		On-site Rotary Kiln	Yes
		On-site Fluidized Bed	No
		In situ Chemical Treatment	No
Disposal - Soil/Waste	Containment	On-site Recra vault	No
		Off-site TSD facility	Yes

* If not a RCRA hazardous waste.

** If RCRA hazardous waste.

Tal 3-1

BUFFALO COLOR CORPORATION

Area "D" Feasibility Study

Screening of Process Options and Technology Types

General Response Action	Technology Type	Process Option	Retention for Detailed Screening
Groundwater Collection	Pumping	Well point dewatering system	No
		Ejector Wells	No
		Pumping Wells	Yes
	Subsurface Drains	Perimeter Drains	Yes
		Horizontal Drains	Yes
Diversion/Collection of Run-on and Run-off	Grading	N/A	Yes
	Surface Water Controls	Dikes and Berms	Yes
		Channels, ditches, trenches	Yes
		Terraces and Benches	No
Treatment - Groundwater	Biological	Suspended growth (activated sludge, SBR)	Yes
		Fixed-film growth (fluidized bed, trickling filter, RBC)	Yes
Treatment - Groundwater	Physical/Chemical	Chemical precipitation (incl.- coagulation, flocculation)	Yes
		Neutralization	Yes
		Chemical Oxidation	No
		Granular Activated Carbon Adsorption	Yes
		Steam Stripping	No
		Air Stripping	Yes
		Filtration (pretreatment or polishing)	Yes
		Chlorination	Yes
	Bio/physical	Powder Activated Carbon Treatment	No
		Fluidized Carbon Bed	No
	Thermal	Incineration	No

* If not a RCRA hazardous waste.

** If RCRA hazardous waste.

Tal 3-1

BUFFALO COLOR CORPORATION

Area "D" Feasibility Study

Screening of Process Options and Technology Types

General Response Action	Technology Type	Process Option	Retention for Detailed Screening
Disposal - Groundwater	Off-site	Local POTW (BSA)	Yes
		Off-site TSDF	Yes
	On-site	Discharge to Buffalo River after treatment	Yes
		Reinjection (recharge of treated groundwater)	No
		Reuse on site (feed water for soil/ sludge treatments)	Yes
Disposal - Soil/Waste	Off-site	Landfill	Yes*
		TSDF after treatment	Yes**
	On-site	RCRA Vault after treatment	Yes**
		Landfill	Yes*

* If not a RCRA hazardous waste.
** If RCRA hazardous waste.

root penetration after construction. In addition, low permeability soil placement methods do not ensure the layer is free from voids, channels or other areas of lower permeability. FML caps, on the other hand, are thoroughly inspected during manufacture and subsequent installation to minimize any potential leaks. Lastly, the permeabilities achieved by FML caps (typically 1×10^{-12} cm/sec) are not achievable with low permeability soil caps. Therefore, a low permeability soil cap will not be considered further for the Area "D" site.

Multi-Media Cap

A multi-media cap combines a number of layers of different materials, such as a compacted clay layer, synthetic membrane, sand drainage layer, barrier protection layer, and topsoil/vegetation to increase the performance of the cap in minimizing infiltration, physical transport of waste by surface run-off, and volatile emissions. Multi-media caps could be designed to meet RCRA guidance and New York State Part 360 closure requirements, and are therefore potentially applicable at this site.

3.2.2. Barriers

Subsurface barriers are used for in situ waste containment, control of groundwater, and erosion control. Barriers would contain the waste and significantly restrict the flow of groundwater into and out of the Area "D" site. This would reduce the migration of contaminants off-site. To completely contain groundwater, subsurface barriers are keyed into an underlying confining layer. The depth to a till and glacial/lacustrine clay confining layer at the Area "D" site is approximately 20 to 30 feet. Subsurface barriers can also be used at shallower depths to control groundwater flow.

Slurry Walls

Slurry walls are constructed by excavating a trench within the transporting aquifer and keying into a geologic unit of low permeability. The trench is kept open during excavation with a slurry of bentonite and water and as excavation proceeds, the trench is backfilled with a soil/bentonite or plastic concrete mixture. A composite slurry wall can be constructed by adding a geomembrane to the sides or the center of the wall to further reduce the wall permeability. Slurry walls are considered reliable containment technology which can be used to provide long-term waste

containment, groundwater containment, and dewatering. Slurry walls are considered potentially applicable to the Area "D" site.

Vitrified Wall Barriers

Vitrified wall barriers are a relatively new technology in long-term in situ waste containment. The barrier is formed by applying an electric current to melt the soil and contaminants into a solid mass of barrier material. This wall would have to be extended into a competent low permeability unit underlying the waste area to effectively contain groundwater. It is uncertain if the overlying fill materials provide the appropriate characteristics for vitrification, and achieving wall continuity would have to be pilot-tested once the wall alignment is selected. Because of these requirements and the heterogeneous nature of the fill material, vitrified wall barriers will not be considered further for the Area "D" site.

Sheet Piles

Sheet pile walls are formed by driving interlocking sheets (e.g., steel) from the surface to an underlying low permeability layer to impede groundwater flow. Sheet piles are a proven technology for short-term waste containment and water diversion, but are considered a low performance option for long-term groundwater containment. Sheet piles do not form a complete low, impermeable barrier to groundwater flow and are not as resistant to attack by chemical contaminants as slurry walls. Therefore, sheet piles are not considered potentially applicable for groundwater containment but will be considered to provide shore stabilization.

Grout Curtains

Grout curtains are subsurface barriers created by injecting grout under pressure into a geologic formation through closely spaced holes in order to form a low permeability barrier. This technology is primarily applicable when the route of concern for possible contaminant transport is fractured bedrock, although it can be used in any unconsolidated material. Grout barriers can be many times more costly than slurry walls and are generally incapable of attaining truly low permeabilities in unconsolidated materials due to problems with non-coalescense of grout in adjacent holes and grout shrinkage. Grout barriers are rarely used when reliable groundwater control in unconsolidated materials is desired.

Bottom Sealing

Bottom sealing involves placing a horizontal barrier beneath an area to prevent vertical migration of contaminants. Most of the techniques used to seal off below the contaminants involve injecting grout under pressure to a desired depth through closely drilled holes. The grout fills ancillary spaces in the formation to form a low permeability floor below the waste. Because of the existing underlying clay layer at the Area "D" site (at a depth of approximately 20 to 30 feet), bottom sealing is not necessary and therefore, will not be considered further.

Fabriform®

Fabriform® is an effective, adaptable and durable erosion control technology which protects against erosive forces with a monolithic concrete armor structure formed by pumping fine aggregate concrete into specially woven synthetic fabric forms. Due to the fact that a large semi-continuous mat of concrete can be installed by this process without heavy equipment, this technology is considered applicable to the Area "D" site for erosion control.

Rip Rap

Rip rap consists of large boulders and rock placed on the shore to reduce the erosion potential of the site. The rock size and thickness of the layer is based upon the velocity of the stream/River and conditions at the shore. Although rip rap does not have the same continuity as afforded by Fabriform®, it can be designed to provide suitable shore stabilization and is considered applicable to the Area "D" site for erosion control.

3.3 WASTE REMOVAL

Excavation

The excavation of the soil and waste material at the Area "D" site may be performed as part of an on-site treatment alternative, or to remove the material for treatment and disposal elsewhere. The use of conventional heavy construction equipment, such as backhoes and loaders, is potentially applicable. Because of the heterogeneous nature of the soil/waste and subsurface structures, materials handling would be extremely difficult. A description of the waste constituents was previously presented in Section 2.2.2. Oversized materials, such as foundation slabs, rail lines and utility lines, would have to be segregated, decontaminated, or crushed for

processing. Excavation, although extremely difficult to implement, may be potentially applicable to the Area "D" site.

3.4 WASTE TREATMENT

3.4.1 Contaminant Containment

The contaminants of concern at the Area "D" site (SVOCs, VOCs, metals) can be immobilized or contained through various treatment processes. Although the soil/waste was not analyzed for VOCs during the RI, because the groundwater exhibited VOC contamination, for purposes of this FS the soil/waste treatment options presented do apply to VOC contamination.

In Situ Stabilization/Solidification

This process is generally considered effective for stabilizing inorganic contaminants and would involve in situ mixing of a stabilizing agent with the soil and waste material in the trench areas to form a structurally sound matrix. For inorganic contaminants or waste material, the reagent is cementitious (similar to Portland cement) or pozzolanic (consisting of silicate materials such as fly ash), and would not be applicable here. For organic contaminants, the same reagents may be used but there is a potential for organics to interfere with the cementitious or pozzolanic bonding. In any case, treatability studies would be required. Because of the heterogeneous nature of the soils/waste and subsurface structures, in situ mixing of reagent and waste with gang augers would be difficult if not impossible. Therefore, in situ stabilization/solidification will not be considered further for the site.

On-Site Stabilization/Solidification

This process is similar to the in situ stabilization/solidification described above, except the soil/waste would be excavated and treated in an on-site plant. Mixing of the reagent with the waste materials would be performed in an on-site plant. Treatability studies would also be required. Because of the need to excavate all the soils/waste prior to on-site pretreatment and potential interference of organics in the process, this process will not be considered further.

3.4.2 In Situ Contaminant Removal

As with contaminant containment, SVOCs, VOCs and heavy metals could be extracted from the soil/waste through various in situ treatment

techniques. On-site techniques, involving excavation, are not considered viable due to the difficulties in excavation. Subsequent handling of the removed contaminants would then be required.

In Situ Soil Washing

This process involves infiltrating a solvent or surfactant solution into the contaminated soil to increase the solubility of the contaminants and accelerate leaching of contaminants out of the waste into the groundwater. Extraction wells or some other collection system would be installed to recover the contaminated groundwater, and a wastewater treatment system would treat the extract. Extraction of contaminants from the solid phase of both the unsaturated and saturated zones can be effected. Treatability studies would have to be done to evaluate this process, e.g., types of extractants. Because of the presence of underground structures, the ability to provide complete soil washing is questionable and, therefore, will not be considered further.

On-Site Soil Washing

This process is the same as described under in situ soil washing except for excavation of the soils/waste and treatment in an on-site plant. Depending on the contaminant of concern, this solution may be water, organic solvents, surfactants, acids, or bases. The washing solution would remove the contaminants from the soil. The treated soil is then dewatered and the washing solution is treated. Treatability studies would be required to evaluate this process. This process is potentially applicable for the Area "D" site.

3.4.3 Contaminant Stripping

In Situ Soil Vacuum Extraction

In situ soil vacuum extraction would involve a series of vertical wells or perforated horizontal pipes installed in the unsaturated zone. An applied vacuum would then remove the volatile organic and some semi-volatile organic compounds from the waste. The air stream would then be treated or vented to the atmosphere. Air injection wells may also be used around the perimeter of the trench area to force airflow through the soil to aid in stripping the volatiles from the soil. Since there is no characterization of VOC contamination, this process will not be considered further.

3.4.4 Contaminant Destruction

SVOCs, VOCs and heavy metals can be destroyed via treatment in a variety of in situ processes. Examples of these processes follow.

Bioremediation

Bioremediation involves the use of introduced microorganisms or stimulation of in situ microorganisms adapted to the waste to biodegrade organic contaminants in the soil. Process variations include in situ or on-site processes after excavation. Several bioremediation processes are discussed below.

On-Site Composting

Composting involves aerobic decomposition of organic matter. Proper aeration, temperature, moisture and nutrient content, and the presence of suitable microorganisms are required for decomposition to occur. The fill material would be excavated and bulky materials separated. In a "static pile" method, waste material would then be mixed with a suitable bulking agent if the waste does not have sufficient void volume for complete aeration. In a "windrow" method, compost piles would require periodic aeration by turning the piles over using special equipment designed for this purpose. In addition, it would be necessary to collect leachate and run-off water from the compost pile for treatment. In-vessel or enclosed composting systems are also available.

Stripping during aeration would probably be the major mechanism of VOC and some SVOC removal rather than biodegradation. Composting is generally applied to wastes containing significant organic matter, e.g., sewage sludge, manure and not to contaminated soils containing toxic materials. Therefore, composting will not be considered further.

In Situ Bioremediation

This process would treat waste in situ by stimulating existing or introduced aerobic or facultative microorganisms to biodegrade the organic fraction of the waste. The conditions for biodegradation in the soils could be enhanced by introducing nutrients and oxygen through injection wells or an infiltration system. A continuous flow system of amended groundwater, infiltrated through the soil/waste mass and collected and recirculated, would be established. Treatability studies would be required. Bioremediation of

both the unsaturated and saturated zones can be effected. Because of the presence of underground structures, it is highly unlikely that complete distribution of the bioremediation fluid can be achieved. Therefore, this process will not be considered further.

On Site Slurry Bioreactor

This process requires the excavation of the contaminated material and the physical separation of bulky materials from the soil/waste matrix. The remaining material is made into a slurry. The slurry is introduced into a bioreactor along with nutrients, oxygen, and acid or alkali for pH control to create optimum conditions for biodegradation. The microorganisms are added at the start of the process to seed the reactor or added continuously to maintain sufficient active biomass concentrations. Upon completion of treatment, the treated slurry is dewatered. The liquid sidestream would then be treated, if necessary. This process is potentially applicable for treatment of organic contaminants.

On-Site Leach Bed

An on-site leach bed system is an open aerobic treatment system consisting of a lined bed overlain by sand to provide protection for the liner and drainage for bioremediation fluid that is infiltrated through excavated waste placed on the bed (after separation of bulky materials). Perforated pipe placed in the sand bed collects the fluid which flows by gravity to a sump and is then pumped to an on-site bioreactor for treatment. Treated leachate can also be reapplied to the waste bed through an overhead irrigation system which is used to add supplemental nutrients and microorganisms needed to keep the system operating properly. The process is potentially applicable.

Vitrification

Vitrification is the transformation of soil and waste material into a durable glass-like material similar in composition and weathering characteristics to obsidian.

In Situ Vitrification

This process involves the in situ melting of the soil/waste at very high temperatures, using heat generated by an electrical current to destroy or contain the contaminants of concern. Electrodes are implanted into the soil in a square pattern, spaced 30 feet apart, and a mixture of graphite and glass

grit is placed on the surface between them to provide a conductive path for the electric current. As the current is passed through the electrodes, resistance causes the temperature to rise to approximately 2,000 degrees C. As a result, the soil begins to melt, becomes more conductive and the molten area grows outward and downward. Organic materials are pyrolyzed and VOCs may be stripped into the off-gas or destroyed. Inorganic materials are melted and encapsulated in the glass. All processing is done under a 40 foot by 40 foot hood at the surface in order to collect the off-gas emissions for treatment before discharge to the atmosphere. Air pollution control systems would be required to treat the air emissions. This process can be used to a maximum depth of 30 feet. The water table would have to be lowered while vitrification was being performed. Treatability studies would also have to be performed. Because of the presence of underground structures, the feasibility of this process is questionable. Therefore, this process will not be considered further.

On-Site Vitrification

This process transforms excavated waste material into a stable glass-like form in an on-site plant. Oversize materials would have to be separated. Temperatures of approximately 1,650 degrees C in the reactor reduce the organic compounds to carbon monoxide, hydrogen, and carbon. The inorganic contaminants are incorporated in the molten glass. Off-gas emissions are then treated before discharge to the atmosphere. The resulting glass material might then be able to be placed back on site or removed for off-site disposal. This process is considered potentially applicable to the Area "D" site.

Incineration

Incineration would involve the thermal destruction of the excavated waste material at high temperatures. Bulky wastes would have to be removed from the excavated soil/waste prior to incineration. Organic constituents of the soil/waste would be oxidized to carbon dioxide and water. Ash, nitrous oxide, sulfur dioxide, and hydrogen chloride gas would be other by-products of combustion. Air pollution control devices would be incorporated into the system to meet air quality requirements. Incineration will produce solid, liquid, and gaseous waste streams. There are several types of incineration

processes that have been used in destroying hazardous wastes and soils such as rotary kilns, fluidized beds and infrared incineration.

On-Site Rotary Kiln

Rotary kiln incinerators consist of a refractory-lined, rotating, cylindrical primary combustion chamber and a secondary combustion chamber. Organic wastes, usually hazardous waste solids or sludges, are oxidized by means of controlled combustion. The system is especially advantageous in handling a wide variety of waste sizes (up to six-inch particle sizes) and heat values because of its durability and thermal mass. The excavated waste is fed into the inclined kiln, and passes through the combustion zone as the kiln rotates. Oversized debris would have to be crushed or shredded prior to being fed into the incinerator. The retention time in the kiln can vary from minutes to an hour or more, depending on the waste being incinerated and the kiln. Residual ash is removed at the lower end of the kiln. The gases are then run through a secondary combustion chamber where auxiliary fuel is introduced to combust any unburned organics. Air pollution control devices would be required to remove particulates, acid gases, products of incomplete combustion, and possibly NO_x and SO_2. This process is considered potentially applicable for the Area "D" site.

On-Site Fluidized Bed

Fluidized bed incinerators consist of a refractory-lined vessel containing an inert fluidizing medium such as sand. The excavated waste material is injected into the sand bed which is fluidized by combustion air forced up through the bed. The large surface area and turbulence in the bed rapidly transfers heat from the bed material to the waste, resulting in combustion. A secondary combustion chamber can be used for the combustion of any unburned organics. Residual gases are then treated before being released into the atmosphere. Because the restrictions on allowable feed size are stricter for this process than those for the rotary kiln, this process will not be considered further for this project.

Chemical Treatment

In Situ Chemical Treatment

The goal of in situ chemical treatment would be to provide oxidation of VOCs and SVOCs in place using chemical oxidizing agents. The treatment

agents (e.g., hydrogen peroxide, oxygen-saturated water) would be delivered to the waste at different depths via wells or infiltration galleries. The resultant treatment fluid would be collected and treated before reuse or disposal. This process would not remove metals. Because of the presence of underground structures, the ability to provide complete distribution of reagents is questionable. Therefore, this process will not be considered further.

3.5 WASTE DISPOSAL

The soil/waste at the site has not been classified as a RCRA hazardous waste to date. There has been no determination whether the soil/waste would be considered a listed waste from a specific industrial process. However, due to the wide variety of processes carried out at the site historically, it is likely that the soil/waste would be considered a mixed soil/debris and determination of it being a RCRA hazardous waste would be on the basis of the Toxicity Characteristic Leachate Procedure (TCLP), corrosivity, ignitability, and reactivity characteristics. Depending on whether the soil/waste is considered a RCRA hazardous waste, various on-site and off-site disposal options could be considered.

Off-Site Landfill

If the soil/waste is not considered a RCRA hazardous waste, it could be disposed off-site at a landfill accepting industrial waste. This option could be applicable.

Off-Site TSDF

If the soil/waste is considered a RCRA hazardous waste it could be disposed at an off-site TSDF after treatment using Best Demonstrated Available Technology (BDAT) to meet allowable constituent levels in the treated soil/waste. This option could be applicable.

On-Site RCRA Vault

If the soil/waste is considered a RCRA hazardous waste, it could possibly be disposed on site in a RCRA vault after treatment to meet allowable constituent levels. This option could be applicable.

On-Site Landfill

If the soil/waste is not considered a RCRA hazardous waste it could possibly be landfilled on site after construction of a solid waste landfill meeting the requirements of 6 NYCRR Part 360. This option could be applicable.

3.6 GROUNDWATER COLLECTION

A groundwater collection system serves two purposes: 1) It provides the first step in most forms of groundwater treatment by pumping the water from the formation so that it can be treated; and 2) By creating zones of influence which extend across the downgradient side of the contaminant source, it serves as an effective barrier to groundwater migration.

Well-Point Dewatering

Well-point collection systems are series of closely spaced wells which are connected to one another and to a pump by a pipe which runs along the surface between the wells. The wells are driven into unconsolidated soils and are pumped by suction lift. The usefulness of this type of system is limited by the height that water can be lifted by suction; 15 feet is usually considered the limit. Since this system is limited by its maximum lift, it will not be considered further for applicability to the Area "D" site.

Pumping Wells

A pumping well is typically a fully penetrating well which can be used to precisely control groundwater levels. This is potentially applicable for groundwater collection at the Area "D" site.

Perimeter Drains (Trench)

Perimeter drains for dewatering are constructed by excavation of a trench into the stratum of concern, by placement of a perforated drainage pipe in the base of the trench, and backfilling the trench with aggregate. These types of drains would be installed at regular intervals across the site depending on the hydraulic performance of the drain system and the desired dewatering time. These are potentially applicable for groundwater collection at the Area"D" site.

Horizontal Drains

Horizontal drains for dewatering are constructed by excavating a drilling pit, drilling horizontal borings through or beneath the strata of

concern and installing perforated drainage pipes. Horizontal drains would be installed radially across the site from drilling pits. The overlapping cones of depression created by pumping would effectively dewater the site. Because of the nature of the fill material and presence of subsurface structures, horizontal drains may be difficult to install. Horizontal drains can be used in conjunction with and connected to perimeter drains and, therefore, are potentially applicable for groundwater collection at the Area "D" site.

3.7 GROUNDWATER TREATMENT

There are two possible groundwater treatment situations that are applicable to the Area "D" site. Specifically, pretreatment for discharge to the Buffalo Sewer Authority (BSA) and treatment for discharge to surface water (the Buffalo River). The pretreatment option would involve treatment of the groundwater to meet effluent standards or to attain BSA discharge limitations. The other treatment option would involve groundwater treatment that would attain the ARARs/SCGs for discharge to the Buffalo River. The treatment options for metals contamination would be designed for treatment of total metals versus filtered metals since the analysis performed on the groundwater during the RI was not for filtered metals, rather total metals. This will provide for more stringent treatment standards.

3.7.1 Physical/Chemical Processes

Chemical Precipitation

Chemical precipitation in wastewater treatment involves the addition of chemicals to alter the physical state of dissolved and suspended solids and facilitate their removal by sedimentation. The process typically consists of chemical addition, coagulation, flocculation, and sedimentation. In the coagulation phase, coagulant agents and/or aids are dissolved in the wastewater through rapid mixing. The subsequent flocculation phase promotes the contact, coalescence and size increase of coagulated particles through gentle mixing. The heavier particles found in the flocculation step are removed from the water by gravity in the sedimentation phase.

The use of various coagulant agents and/or aids has been proven inefficient in the removal of soluble organic matter from contaminated groundwater. Such techniques are quite effective as pretreatment and polishing steps in the overall treatment scheme for removing suspended solids

and metals. Given the nature of groundwater contamination at the Area "D" site, chemical precipitation is potentially applicable for treatment of metals, however not for SVOCs and VOCs.

Neutralization

Neutralization involves adjusting pH levels. It may be utilized for pre-treatment or post-treatment, but not as the main treatment for VOCs, SVOCs or metals removal.

Chemical Oxidation

Chlorinated hydrocarbons in the low part-per-billion (ppb) range can be treated by chemical oxidation. Hydrogen peroxide works well on organic compounds with double and triple bonds. Ozone is the strongest oxidizing agent, and it can eliminate any organic compound in groundwater with sufficient time. Both the cost and handling of these oxidizing agents can be prohibitive. The UV-ozone process uses a smaller amount of ozone in combination with ultra-violet light to catalyze the ozone reaction. Treatability studies would be required to determine the applicability of this process. This process is highly effective for treating chlorinated solvents, but is relatively new and, therefore, will not be considered further.

Granular Activated Carbon

Carbon adsorption is a viable process for the removal of dissolved organics and control of parameters such as COD, TOC and specific organic compounds in the contaminated groundwater. Granular activated carbon (GAC) can be used for pre-treatment, complete treatment or effluent polishing, provided that pre-treatment for the removal of suspended solids and oil and grease is included in the system. It is most effective for non-polar, high molecular weight, slightly soluble organic compounds. The use of GAC is inefficient for treating high strength contaminated groundwater (i.e., leachates) but has been shown to be effective as a polishing step following the biological treatment of leachate, such an anaerobic and/or aerobic processes. This is due to the relatively low sorptive capacity of the low molecular weight organics in contaminated groundwater. This process will be considered further for applicability at the Area "D" site.

Air Stripping

Air striping of volatile organics from the aqueous stream has proven to be a viable treatment for dilute as well as concentrated wastewater. The primary design criterion is the air to water ratio. In order to optimize the mass transfer of volatile organics from the aqueous phase to the vapor phase, the volume of air must be greatly in excess of the liquid being contacted.

In order to be effectively removed from a waste stream by air stripping, a volatile organic compound must, in general, have a Henry's Law Constant greater than 0.04. This constant is the ratio of the vapor to liquid phase concentrations of a substance of equilibrium.

Packed tower air strippers, the most commonly used air stripping process option by virtue of cost, optimize air to liquid contact by dispersing the wastewater into fine droplets, and subjecting the droplets to a counter-current air flow. The air is either injected at the bottom of the column by means of an external blower, or drawn up from the bottom and in through the sides of the column by an overhead fan. Air-to-water ratios can be derived by pilot plant studies, as are column height and packing material. Typically, air to water ratios of 100 to 200 are necessary for achieving 90 + percent removals of volatile organics at normal groundwater temperatures. Depending on the mass of VOCs stripped, vapor phase controls may be required. Because the Henry's Constants of all of the VOCs of concern at the Area "D" site are well above the level considered necessary for economical packed tower air stripping, this option will be evaluated further.

Steam Stripping

Steam stripping of volatile organics is a proven technology which is used extensively in industry for the recovery of solvents from concentrated waste streams. Basically, it is a fractional distillation process designed according to vapor/liquid equilibrium data and by calculation of the required number of distillation trays. The principal index used to estimate steam stripping capacity is the boiling point of the volatile organics is less than 150 degrees C, and its ability to form an azeotrope with water at an organic weight fraction of 0.8 or greater. The estimated steam requirements are on the order of 1.5 to 2.5 pounds of steam per gallon of water treated. Steam stripping could be potentially applicable but because the Henry's Constant for each of the VOCs of concern is sufficiently high, steam stripping presents no

advantage over air stripping. Therefore, steam stripping will not be considered further.

Solids Filtration

Filtration, long applied in treatment of municipal and industrial water supplies, is already a well-established operation for achieving supplemental removal of suspended solids from wastewater effluents of biological and chemical treatment process. Filtration may be used as an ancillary process to polish the effluent generated by other processes used at the Area "D" site.

Chlorination

Micro-organisms can be controlled by treating water with either gaseous chlorine or hypochlorites, chlorine dioxide, or chlorinated lime. Chlorination may be required as an ancillary post-treatment process when biological treatment is utilized.

3.7.2 Biophysical Processes

Biophysical processes provide additional flexibility and enhanced treatment over biological processes. It is applicable to treatment of raw, high-strength contaminated groundwaters.

Powdered Activated Carbon

Powdered activated carbon treatment (PACT) is a method of combining powdered activated carbon and biological treatment in one stage. As a result, bio-oxidation and physical adsorption occur simultaneously. Biodegradable pollutants are biologically assimilated, while adsorbable contaminants that are non-degradable are adsorbed on the activated carbon. Most of the applications involve adding powdered activated carbon to the aeration basin in the activated sludge system.

After aeration, solids are separated in a clarifier and a portion of the underflow solids is recycled to the inlet of the aeration tank. Waste solids are a mixture of activated sludge, carbon, organics, and inert material which typically provides a better settling and dewatering sludge than conventional activated sludge process.

While potentially applicable for VOC removal, PACT is generally applicable only to high-strength waste streams and will not be considered further for the Area "D" site.

Fluidized Carbon Bed

Fluidized carbon beds for high-rate treatment of high-strength leachates and wastewaters can be operated aerobically or anaerobically. The adsorption onto carbon enhances the availability of substrate for biodegradation microorganisms. This process is applicable to high-strength waste streams and will not be considered further for the Area "D" site.

3.8 GROUNDWATER DISPOSAL/DISCHARGES

Local POTW

Disposal of pre-treated groundwater to the Buffalo Sewer Authority (BSA) is a viable option for the Area "D" site. The levels of contaminants allowable into the BSA would have to be developed specifically for the Area "D" effluent and subsequently a permit issued. Discussions have taken place with the BSA regarding the standards for pre-treatment of groundwater. These have been outlined in a letter dated November 19, 1990 and included as Appendix C. Due to the proximity of the Area "D" site to the BSA, this option will be considered further.

Surface Water

Surface water discharge ARARs/SCG for the Buffalo River could be met through treatment of groundwater. The discharge of treated groundwater is considered potentially applicable for the Area "D" site.

Groundwater

Recharge of treated groundwater could be potentially applicable but would most likely be done off-site so that treated groundwater is not recharged, recollected, and retreated. Because of the studies required for this option, and the fact that it has no particular advantage over surface water or POTW disposal, it will not be considered further.

Reuse of treated groundwater on-site could be potentially applicable as feed water for soil/sludge treatment. Therefore this option will be considered further for this site.

Off-Site TSDF

Small amounts of untreated groundwater (thousands of gallons per day) could be transported and disposed of economically at an off-site treatment, storage and disposal facility. Two facilities within the Western New York region exist relatively close to the Area "D" site. Both facilities

could be used efficiently for the disposal of untreated groundwater at cost effective rates. The implementation of a vacuum pump tanker and surge storage tank for the on-site collection of groundwater as a back-up to the tanker would suffice for collection of untreated groundwater. These facilities have been contacted and reviewed for use at Area "D". Because this is a viable and effective option, it will be considered further for this site.

3.9 ANCILLARY PROCESSES

All of the ancillary processes identified below may be used as part of the main remedial alternatives.

3.9.1 Regrading

Regrading would be applicable in conjunction with any construction activities; e.g., excavation, capping. This would be done to promote surface water run-off and reduce erosion potential. All site materials handled, excavated or bored will be used for on-site grading.

3.9.2 Backfilling

Backfilling would be applicable in conjunction with any trenching or excavation operations.

3.9.3 Surface Water Controls

Dikes and Berms

The use of dikes and berms may be incorporated into the remedial design in order to protect the site from surface water runoff and further erosion.

Channels, Ditches and Trenches

The excavation of trenches or ditches to intercept stormwater run-on and run-off may be incorporated with the capping and containment options discussed earlier.

3.9.4 Air Pollution Controls

Air pollution controls may be necessary for some of the soil treatment and groundwater treatment technologies.

Catalytic Incinerator

Catalytic incineration is used to eliminate volatile organics in the emission stream of a VOC stripping process through combustion assisted by a

catalyst. Catalysts used for VOC incineration are usually platinum and paladium. The emission stream passes through the catalyst bed which is usually a metal mesh or ceramic structure designed to maximize the surface area of the catalyst in the combustion chamber. After combustion, the exhaust gases are passed through a heat exchanger and then into the atmosphere. This process can destroy up to 98 percent of the overall volatile compounds present in an emission stream.

Catalytic Oxidizer

A catalytic oxidizer works on the same principal as catalytic incineration except at lower temperatures and without combustion.

Carbon Adsorption

Activated carbon filters can be used to remove organics from the gas generated from the volatile organic stripping processes. The contaminated air is sent through a carbon filter and the organic compounds are adsorbed onto the carbon. When the carbon has reached its adsorbent capacity it is replaced, and the used filter is regenerated by heating it and driving off the contaminants. Large applications include on-site regeneration.

Wet Precipitator

A wet precipitator or scrubber removes particulates or acid fumes emitted from incinerators. The particulates are removed by passing the air stream through a recirculating water or caustic solution. Waste water is a byproduct of this procedure and would be shipped off site for treatment or disposal, or treated in an on site wastewater system. This could be applicable to any incineration process.

Ionized Wet Scrubber

This technology is an efficient means of collecting particulates from incinerator off-gases. An electric charge is used to generate ions which bombard the submicron particles in the emission gas. These particulates are charged by the ions and collected on an electrode. Because this is a wet operation, the electrode is continuously cleaned. The water in the process also puts out any duct fires which may occur. This could be applicable to any incineration process.

Venturi/Packed Tower System

The Venturi packed tower system treats incinerator off-gas in two stages. In the first stage, scrubbing liquid is injected into the high velocity gas stream, atomizing the liquid. The large surface area of the scrubbing liquid during atomization permits the transfer of contaminants in the gaseous form to the liquid via absorption and transfer of contaminant particles to the liquid via impaction and phoretic forces. In the second stage of this process, the cleaned gas is separated from the now-contaminated scrubber water by passing the mixture through a packed tower. This could be applicable to any incineration process.

Spray Dryer/Baghouse System

This system is used if acid gases must be removed from incinerator emissions. A calcium hydroxide slurry is injected into the reaction chamber in a fine spray. Acid gases are absorbed by the slurry and the hot emission gas causes the water in the slurry to evaporate leaving behind a dry reaction product.

The baghouse is located downstream of the spray dryer to collect the reaction products and fly ash. Baghouses use cylindrical fiberglass bags which acts as filters, collecting particulate matter on the outside while clean gas passes up through the center. The cleaned gas is then vented to the atmosphere. This system could be applicable to any incineration process.

Thermal De-NOX (Ammonia Injection)

In some cases, nitrogen oxide incinerator emissions need to be controlled. An aqueous solution of ammonia can be introduced at the inlet to the boiler included to cool the flue gas. After evaporation of the water, ammonia reacts with nitrogen monoxide to form nitrogen and water vapor.

Dust Suppression

Dust suppression may be required for activities such as excavating and stockpiling of soils and waste materials on site. Dust can be minimized by wetting surfaces and covering soil/waste piles. Any ash created by on site incineration would not be allowed to create a dust problem.

3.9.5 Miscellaneous Materials Handling

Various types of material handling equipment may be used depending on the remedial actions chosen for the Area "D" site. These materials

handling processes would apply mainly to handling operations after waste excavation. Conveyor belt systems may be used to move material into an on site remedial processing facility. A shredder or crusher could be used to reduce the size of the waste material to allow it to be incinerated or stabilized on site. The use of screens to separate oversized material from the waste may also be necessary.

4.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

4.1 DEVELOPMENT AND SCREENING

The general types of remedial alternatives employed at hazardous waste sites include no action, limited actions, containment, source removal, treatment, and disposal. Based on the remedial action objectives and general response actions presented in Section 2.0, remedial alternatives were developed for this site (Table 4-1). The costs presented in Table 4-1 are detailed in Appendix D. Each alternative consists of several components in order to meet all of the remedial objectives. At this stage, the alternatives are screened on the basis of effectiveness (meeting ARARs/SCGs and being protective of human health and the environment); implementability (ability to construct and meet permit conditions) and order of magnitude of cost.

4.2 ALTERNATIVE 1 – NO ACTION WITH MONITORING

No remedial action would take place under this alternative. Any improvement in groundwater quality would be solely the result of natural processes. Regular groundwater sampling and analysis of the on-site monitoring wells would be performed for 30 years by Buffalo Color. In addition, the current pumping of NAPL from well 8 would continue. This alternative is clearly implementable. However, it is not effective; the contaminant pathways including groundwater infiltration to the Buffalo River, erosion of soil to the Buffalo River, human exposure to the Area "D" soils and aquatic toxicity from the Area "D" soils remain.

In the absence of source control, there is no assurance that the groundwater ARARs/SCGs will be met within any reasonable and predictable time frame. This alternative will be carried through the detailed screening and analysis of alternatives to provide a baseline from which to evaluate the other alternatives.

4.3 ALTERNATIVE 2 – LIMITED ACTION

This alternative would involve groundwater monitoring with deed restriction and fencing of the entire site. In addition, the current pumping of NAPL from well 8 would continue. The deed for this property would be restricted with respect to future use of the groundwater and property. Fencing would restrict any incidental exposure to surface soil/waste by dermal contact and on-site inhalation of fugitive dust.

Table 4-1
BUFFALO COLOR CORPORATION
Area "D" Feasibility Study
Alternative Development and Screening Summary

ALTERNATIVE	EFFECTIVE	IMPLEMENTABLE	PRELIMINARY PRESENT VALUE COSTS ($000)	CARRY THROUGH DETAILED ANALYSIS
Alternative No. 1 - No Action w/Monitoring - Monitoring Well Program	No	Yes	1,470	Yes
Alternative No. 2 - Limited Action - Monitoring Well Program - Well 8 Pumping (NAPL) - Future Land and GW Use Deed Restrictions - Fencing	Yes for human health, ARARs not met	Yes	1,708	No
Alternative No. 3 - Containment - FML Landfill Cap - Shore Stabilization with Sheetpile - Monitoring Well Program - Well 8 Pumping (NAPL) - Future Land Use and GW Use Deed Restrictions - Fencing	Yes for human health, ARARs potentially met	Yes	6,561	Yes

* The preliminary cost shown is representative of the cost prior to Alternative 6c revisions shown based on NYSDEC comments. The costs presented in Table 5-3 and Appendix I account for these revisions.

ALTERNATIVE	EFFECTIVE	IMPLEMENTABLE	PRELIMINARY PRESENT VALUE COSTS ($000)	CARRY THROUGH DETAILED ANALYSIS
Alternative No. 3a - Containment - FML Landfill Cap - Shore Stabilization with 'Fabriform®'/Rip-Rap - Monitoring Well Program - Well 8 Pumping (NAPL) - Future Land Use and GW Use Deed Restrictions - Fencing	Yes for human health, ARARs potentially met	Yes	4,825	Yes
Alternative No. 4 - Containment w/GW Treatment - FML Landfill Cap - GW Collection, Pre-treatment, and Disosal to BSA - Fabriform®/Rip-Rap for Shore Stabilization - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Yes for Human Health, BSA discharge limitations met; ARARs potentially met	Yes	15,404	Yes

* The preliminary cost shown is representative of the cost prior to Alternative 6c revisions shown based on NYSDEC comments. The costs presented in Table 5-3 and Appendix I account for these revisions.

ALTERNATIVE	EFFECTIVE	IMPLEMENTABLE	PRELIMINARY PRESENT VALUE COSTS ($000)	CARRY THROUGH DETAILED ANALYSIS
Alternative No. 4a - Containment w/GW Treatment - Soil Cover and Grading - GW Collection, Pre-Treatment, and Disposal to BSA - Shore Stabilization with Sheetpile - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Yes for Human Health, BSA discharge limitations met; ARARs potentially met	Yes	17,668	No
Alternative No. 5 - Containment w/GW Treatment - Multi-Media cap - GW Collection, Pre-Treatment, and Disposal to BSA - Shore Stabilization with 'Fabriform®'/Rip-Rap - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Yes for Human Health, BSA discharge limitations met; ARARs potentially met	Yes	17,598	Yes

* The preliminary cost shown is representative of the cost prior to Alternative 6c revisions shown based on NYSDEC comments. The costs presented in Table 5-3 and Appendix I account for these revisions.

ALTERNATIVE	EFFECTIVE	IMPLEMENTABLE	PRELIMINARY PRESENT VALUE COSTS ($000)	CARRY THROUGH DETAILED ANALYSIS
Alternative No. 6 - Containment w/GW Treatment to BSA - FML Landfill Cap - GW Collection, Pre-treatment, and Disosal to BSA - Fabriform®/Rip-Rap for Shore Stabilization - Slurry Wall at Downgradient - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Yes for Human Health, BSA discharge limitations met; ARARs potentially met	Yes	9,781	Yes
Alternative No. 6a - Containment w/GW Treatment for Disposal to Buffalo River - FML Landfill Cap - Fabriform®/Rip-Rap for Shore Stabilization - Slurry Wall at Downgradient - GW Treatment and Disposal to Buffalo River - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Yes for Human Health, ARARs for groundwater met	Yes	9,786	Yes

* The preliminary cost shown is representative of the cost prior to Alternative 6c revisions shown based on NYSDEC comments. The costs presented in Table 5-3 and Appendix I account for these revisions.

ALTERNATIVE	EFFECTIVE	IMPLEMENTABLE	PRELIMINARY PRESENT VALUE COSTS ($000)	CARRY THROUGH DETAILED ANALYSIS
Alternative No. 6b - Containment w/GW Disposal to TSDF - FML Landfill Cap - Shore Stabilization with 'Fabriform®'/Rip-Rap - GW Collection and Disposal to TSDF - Slurry Wall at Downgradient - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Yes for Human Health, ARARs potentially met	Yes	32,186	Yes
Alternative No. 6c - Containment w/GW Treatment for Discharge to BSA - FML Landfill Cap - Fabriform®/Rip-Rap for Shore Stabilization (Entire Shoreline)* - GW Collection, Pre-treatment, and Disposal to BSA - NAPL Collection* - Slurry Wall at Upgradient - Slurry Wall at Downgradient - Fill/waste Excavation Outside Slurry Wall* - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Yes for Human Health, BSA discharge limitations met; ARARs potentially met	Yes	8,692*	Yes

* The preliminary cost shown is representative of the cost prior to Alternative 6c revisions shown based on NYSDEC comments. The costs presented in Table 5-3 and Appendix I account for these revisions.

ALTERNATIVE	EFFECTIVE	IMPLEMENTABLE	PRELIMINARY PRESENT VALUE COSTS ($000)	CARRY THROUGH DETAILED ANALYSIS
Alternative No. 6d - Containment w/GW Treatment for Discharge to Buffalo River - FML Landfill Cap - Fabriform®/Rip-Rap for Shore Stabilization - GW Treatment and Disposal to Buffalo River - Slurry Wall at Upgradient - Slurry Wall at Downgradient - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Yes for Human Health, ARARs potentially met	Yes	9,386	Yes
Alternative No. 6e - Containment w/GW Disposal to TSDF - FML Landfill Cap - Shore Stabilization with 'Fabriform®'/Rip-Rap - GW Collection and Disposal to TSDF - Slurry Wall at Downgradient - Slurry Wall at Upgradient - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Yes for Human Health, ARARs potentially met	Yes	9,946	Yes

* The preliminary cost shown is representative of the cost prior to Alternative 6c revisions shown based on NYSDEC comments. The costs presented in Table 5-3 and Appendix I account for these revisions.

ALTERNATIVE	EFFECTIVE	IMPLEMENTABLE	PRELIMINARY PRESENT VALUE COSTS ($000)	CARRY THROUGH DETAILED ANALYSIS
Alternative No. 7 - Containment w/GW Treatment - FML Landfill Cap - Fabriform®/Rip-Rap for Shore Stabilization - GW Treatment and Disposal to Buffalo River - Slurry Wall at Downgradient - Slurry Wall at Upgradient - Sheetpile at South and East Sides for Shore Stabilization - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Yes for Human Health, ARARs potentially met	Yes	10,358	Yes

* *The preliminary cost shown is representative of the cost prior to Alternative 6c revisions shown based on NYSDEC comments.* The costs presented in Table 5-3 and Appendix I account for these revisions.

ALTERNATIVE	EFFECTIVE	IMPLEMENTABLE	PRELIMINARY PRESENT VALUE COSTS ($000)	CARRY THROUGH DETAILED ANALYSIS
Alternative No. 8 - Containment, GW Treatment, and Soil Excavation - Fencing - Total Excavation of Waste/Fill - Waste/Fill Disposal to TSDF or On-Site - Total Backfill with New Soil - Total GW Collection, Pre-Treatment, and Disposal to BSA - Shore Stabilization with Sheetpiling - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Yes	Difficult due to materials handling problem; heterogeneous nature of fill material at Area "D" site makes for difficult excavation	336,198	Yes
Alternative No. 9 - Containment, GW Treatment, and Soil Treatment - Total Excavation of Waste/Fill - On-site Bioremediation - Total Backfill with Existing Soil - Total GW Collection, Pre-Treatment, and Disposal to BSA - Shore Stabilization with Sheetpiling - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Unknown without Treatability Study	Same as Alternative 8	64,948	No

* The preliminary cost shown is representative of the cost prior to Alternative 6c revisions shown based on NYSDEC comments. The costs presented in Table 5-3 and Appendix I account for these revisions.

ALTERNATIVE	EFFECTIVE	IMPLEMENTABLE	PRELIMINARY PRESENT VALUE COSTS ($000)	CARRY THROUGH DETAILED ANALYSIS
Alternative No. 9a - Containment, GW Treatment, and Soil Treatment - Total Excavation of Waste/Fill - On-Site Vitrification - Total Backfill with Existing Soil - Total GW Collection, Pre-Treatment, and Disposal to BSA - Shore Stabilization with Sheetpiling - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Unknown without Treatability Study	Same as Alternative 8	249,748	No
Alternative No. 9b - Containment, GW Treatment, and Soil Treatment - Total Excavation of Waste/Fill - On-Site Incineration - Total Backfill with Existing Soil - Total GW Collection, Pre-Treatment, and Disposal to BSA - Shore Stabilization with Sheetpiling - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Unknown without Treatability Study	Same as Alternative 8	148,948	No

* The preliminary cost shown is representative of the cost prior to Alternative 6c revisions shown based on NYSDEC comments. The costs presented in Table 5-3 and Appendix I account for these revisions.

ALTERNATIVE	EFFECTIVE	IMPLEMENTABLE	PRELIMINARY PRESENT VALUE COSTS ($000)	CARRY THROUGH DETAILED ANALYSIS
Alternative No. 9c - Containment, GW Treatment, and Soil Treatment - Total Excavation of Waste/Fill - On-Site Soil Washing - Total Backfill with Existing Soil - Total GW Collection, Pre-Treatment, and Disposal to BSA - Shore Stabilization with Sheetpiling - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Unknown without Treatability Study	Same as Alternative 8	61,588	No
Alternative No. 9d - Containment, GW Treatment, and Soil Treatment - Total Excavation of Waste/Fill - On-Site Stabilization/Solidification - Total Backfill with Existing Soil - Total GW Collection, Pre-Treatment, and Disposal to BSA - Shore Stabilization with Sheetpiling - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Unknown without Treatability Study	Same as Alternative 8	101,908	No

* The preliminary cost shown is representative of the cost prior to Alternative 6c revisions shown based on NYSDEC comments. The costs presented in Table 5-3 and Appendix I account for these revisions.

ALTERNATIVE	EFFECTIVE	IMPLEMENTABLE	PRELIMINARY PRESENT VALUE COSTS ($000)	CARRY THROUGH DETAILED ANALYSIS
Alternative No. 9e - Containment, GW Treatment, and Soil Treatment - Total Excavation of Waste/Fill - On-Site Chemical Remediation - Total Backfill with Existing Soil - Total GW Collection, Pre-Treatment, and Disposal to BSA - Shore Stabilization with Sheetpiling - Monitoring Well Program - Future Land Use and GW Use Deed Restrictions - Fencing	Unknown without Treatability Study	Same as Alternative 8	81,748	No

* The preliminary cost shown is representative of the cost prior to Alternative 6c revisions shown based on NYSDEC comments. The costs presented in Table 5-3 and Appendix I account for these revisions.

Human health would be protected under this alternative by minimizing dermal contact and incidental ingestion and inhalation of fugitive dust. In the absence of source control, there is no assurance that chemical-specific ARARs/SCGs would be met within any reasonable and predictable time frame; therefore, this alternative is not effective because the contaminant pathways identified in Alternative 1 remain. Therefore, this alternative will not be carried through the detailed analysis of alternatives. This alternative is implementable.

4.4 ALTERNATIVE 3 – CAP WITH SHORE STABILIZATION

This alternative would involve the placement of a FML cap for closure of the site and installation of sheetpiling on the east and south sides. For purposes of the evaluations required for this Feasibility Study, the FML cap would consist of six inches of compacted subgrade, a 40 mil HDPE or VLDPE membrane, 24-inches of soil cover, and six inches of soil which would support vegetation. The actual design of the cap that will be installed at the site will be finalized in the remedial design (RD) phase.

This alternative would provide protection of human health through the elimination of dermal contact, incidental ingestion of soil and inhalation of fugitive dust, and reduce infiltration of precipitation to groundwater. The FML cap and sheetpiling would not be difficult to construct. Capping alone would reduce infiltration of precipitation into the site, but this would have little effect on the base flow of groundwater through the site which is the major component of groundwater flow to the Buffalo River. The sheetpiling would control bank erosion and reduce the amount of contaminated soil/waste entering the Buffalo River along the east and south sides. In response to the NYSDEC's request of September 13, 1990 the issue of placement of sheetpiling has been addressed and is presented in this FS as Appendix E. The actual remedial design will determine the extent of the sheetpiling.

The chemical-specific ARARs may eventually be met over the long term due to natural recovery of the aquifer, assuming the cap is effective as a source control measure. Under this alternative, the pumping of NAPL from well 8 will continue. This alternative will be carried through to evaluate its ultimate effectiveness for on site containment.

4.4.1 Alternative 3a – Cap with Shore Stabilization on East and South Sides

This alternative offers all the components of Alternative 3 with the substitution of Fabriform®/Rip-Rap on the east and south sides for sheetpiling. Fabriform® is a proven construction system for erosion control. To facilitate the installation of the rip rap or fabric/concrete containment barrier, surface preparation is required. This preparation of the river bank will require removal of material which will be deposited within the slurry wall containment system. This material includes "fill" which has eroded on to the river bank out to the edge of the erosion prevention barrier. It is anticipated that an average depth of two feet will be removed and, in most cases, the removal will extend to the U.S. Army Corps of Engineers dredge limit. This slope preparation will be required for all alternatives utilizing Fabriform®/Rip-Rap. The durability of the woven fabric is immune to attack by mild acids and alkalis, organic solvents, and biological organisms. The installation will not be impaired as evidenced by 20 year service records. Although Fabriform® requires a higher potential for maintenance than sheetpiles, it has lower costs. This alternative will provide for more efficient control of bank erosion thereby reducing the amount of soils/waste entering the Buffalo River, however it will not provide for any greater reduction in groundwater flow from the site.

The protection of human health provided by this alternative includes those identified for Alternative 3. This alternative will be carried through to the detailed analysis.

4.5 ALTERNATIVE 4 – CAP WITH PERIMETER GROUNDWATER COLLECTION, GROUNDWATER PRE-TREATMENT AND DISCHARGE TO BUFFALO SEWER AUTHORITY (BSA), AND SHORE STABILIZATION

This alternative would involve the placement of a FML cap as described for Alternative 3 and the collection, pre-treatment, and disposal of groundwater to the BSA combined with the use of Fabriform®/Rip-Rap for erosion control. This alternative will reduce infiltration of precipitation to groundwater and significantly reduce groundwater flow to the Buffalo River.

This alternative would be effective in providing protection of human health through the elimination of contact with the soil/waste; incidental ingestion and inhalation of soils/dust; and reduced aquatic toxicity which in turn reduces incidental ingestion of contaminated fish. The cap, which is

effective as a source control measure, would prevent infiltration thereby reducing the amount of contaminated groundwater generated at the site. Shore stabilization through the use of Fabriform®/Rip-Rap will reduce the erosion of soils/waste into the Buffalo River. The FML cap and the groundwater collection, pre-treatment, and disposal system would not be difficult to construct. The treatment system would be designed to meet standards established by the BSA. Groundwater would be collected at a rate to maintain an inward gradient towards the site. Groundwater treatment would consist of equalization, settling, air stripping, and post treatment equalization.

This alternative is implementable, therefore it will be carried through the detailed analysis of alternatives.

4.5.1 Alternative 4a – Soil Cover and Grading with Perimeter Groundwater Collection, Pre-treatment and Disposal to BSA and Shore Stabilization and Containment on East and South Sides

This alternative would provide for soil cover and grading over the entire site, groundwater collection and pre-treatment for discharge to the BSA and sheetpiling for shore stabilization. This alternative provides for the protection of human health and aquatic toxicity by reducing contact with the surface soils/waste, pre-treating the groundwater for discharge to the BSA and installing sheetpiling to control bank erosion and reduce the amount of contaminated soils entering the Buffalo River.

This alternative is implementable, however not effective in that the soil cover will not provide thorough protection of human health and also will not reduce infiltration of precipitation to groundwater and ultimately to the Buffalo River. Therefore this alternative will not be carried through the detailed analysis of alternatives.

4.6 ALTERNATIVE 5 – CAP, PERIMETER GROUNDWATER COLLECTION, GROUNDWATER PRE-TREATMENT AND DISCHARGE TO BSA, AND SHORE STABILIZATION

This alternative would involve the placement of a multi-media cap, groundwater collection and pre-treatment for discharge to the BSA, and the use of Fabriform®/Rip-Rap for shore stabilization. For the purpose of evaluations required for this Feasibility Study, the proposed cap would consist of a number of layers of different materials, such as a compacted clay layer,

synthetic membrane, sand drainage layer, barrier protection layer, and topsoil/vegetation to increase the performance of the cap in minimizing infiltration, physical transport of waste by surface run-off, and volatile emissions. The actual design of the cap that would be installed at the site would be finalized as part of the remedial design. The cap design will be at least equivalent to the cap proposed. The same groundwater treatment system as described in Alternative 4 would be utilized.

This alternative would provide protection of human health by reducing the human exposure pathways of contact, inhalation of fugitive dust and incidental ingestion of soils/waste and will reduce aquatic toxicity to the organisms in the Buffalo River by eliminating discharge of contaminated groundwater from the site.

This alternative would be implementable and effective. It will be carried through the detailed analysis of alternatives.

4.7 ALTERNATIVE 6 – CAP, DOWNGRADIENT CUTOFF WALL, PERIMETER GROUNDWATER COLLECTION, GROUNDWATER PRE-TREATMENT AND DISCHARGE TO BSA, AND SHORE STABILIZATION

Alternative 6 and its sub-alternatives 6a, 6b, 6c, 6d and 6e provide variations of the main components of Alternative 6. Specifically, the sub-alternatives (6a-6e) highlight the various approaches to the method of groundwater treatment and placement of the cutoff, or slurry wall.

Alternative 6 would involve the placement of a FML cap over the entire site, a partial cutoff wall downgradient, perimeter groundwater collection and pre-treatment for discharge to the BSA and Fabriform®/Rip-Rap for shore stabilization. A partial cutoff wall downgradient would provide containment during pumping and pre-treatment of contaminated groundwater and reduce inflow to the system.

This alternative would provide protection of human health by reducing the exposure pathway of contact and incidental ingestion and inhalation of fugitive dust/soil. Groundwater flow to the Buffalo River will be further reduced with the implementation of a slurry wall. Shore stabilization and groundwater collection, pre-treatment and disposal would also reduce the aquatic toxicity. The FML cap, slurry wall, groundwater pump and treatment system and Fabriform®/Rip-Rap installation would not be very difficult to construct and utilizes commercially available technologies to implement.

Containment of contaminated groundwater in combination with perimeter groundwater collection and treatment would protect off-site water quality.

This alternative is considered implementable and effective and therefore will be carried through the detailed analysis of alternatives.

4.7.1 Alternative 6a – Cap, Perimeter Groundwater Collection, Treatment and Discharge to Buffalo River, Downgradient Cutoff and Shore Stabilization

This alternative would involve the same components as Alternative 6, however with groundwater treatment for discharge to the Buffalo River. A FML cap would be constructed over the entire site. The same treatment systems would be utilized. The slurry wall would provide containment during the pumping and treatment of groundwater and would reduce groundwater inflow and ultimately reduce groundwater generation. Shore stabilization through the use of Fabriform®/Rip-Rap would reduce the erosion of soil into the Buffalo River.

This alternative would provide protection of human health by reducing the exposure pathway of contact, incidental inhalation and ingestion of fugitive dust/soil, and aquatic toxicity. The components of this alternative are not difficult to construct and utilize commercially available technologies to implement. Containment of contaminated groundwater in combination with a pump and treat system would protect off-site water quality

This alternative is considered implementable and will be carried through the detailed analysis of alternatives.

4.7.2 Alternative 6b –Cap, Perimeter Groundwater Collection and Disposal to TSDF, Downgradient Cutoff, and Shore Stabilization

This alternative provides similar components of Alternative 6 with discharge of contaminated groundwater to an off-site TSDF. The placement of a downgradient slurry wall will provide a reduction of groundwater inflow and thus a reduction in the amount of contaminated groundwater generated on-site. Collection of groundwater for disposal at an off-site TSDF will eliminate the need for on-site treatment facilities. Shore stabilization through the use of Fabriform®/Rip-Rap will reduce the erosion of contaminated soil into the Buffalo River.

This alternative provides protection to human health by reducing exposure of dermal contact, incidental inhalation and ingestion of dust/soils

and aquatic toxicity. The components of this alternative are not very difficult to construct and utilize commercially available technologies to implement. Containment of contaminated groundwater for disposal to a TSDF would assist in the attainment of chemical-specific ARARs for the groundwater outside of the collection system.

This alternative is considered implementable and effective and will be carried through the detailed analysis of alternatives.

4.7.3 Alternative 6c – Cap, Perimeter Groundwater Collection and NAPL Collection, Pre-Treatment and Discharge to BSA, Complete Cutoff, Shoreline Fill Excavation and Complete Shore Stabilization

This alternative would involve the placement of a FML cap as described for Alternative 3, groundwater collection and pre-treatment for discharge to the BSA and a groundwater cutoff wall completely surrounding the Area "D" site. Complete cutoff will provide containment during the pumping and pre-treatment of contaminated groundwater. The cap would decrease the infiltration of water through the site thereby reducing leachate generation. The groundwater will be collected, pre-treated and discharged to the BSA for further treatment. As mentioned in Section 1.2.3, Page 1-5 of this Report, the NAPL will be dealt with as part of the overall groundwater contamination. Additional groundwater collection drains will be installed as needed to facilitate the collection and transport of the NAPL to the perimeter groundwater collection system. These additional drains will be located in the areas of Tank park 910, well W-8 and well MW-4-88. The exact location and extent of these drains will be determined and properly designed at each location during the design phase. Additionally, this alternative, which incorporates on-site pre-treatment, will include an oil/water separator as part of the treatment process. The use of Fabriform®/Rip-Rap for shore stabilization will reduce and control erosion of the banks and the amount of soil entering the Buffalo River. The Fabriform®/Rip-Rap will extend around the entire shoreline on all sides of the site.

Excavation of all fill material outside of the cutoff wall along the shoreline will virtually eliminate the amount of contaminants from the soil entering the river.

This alternative would provide protection of human health through the reduction of exposure to the Area "D" soils by contact, incidental inhalation and ingestion of soils/waste and aquatic toxicity. The cutoff wall, FML cap,

and groundwater collection and pre-treatment system would not be difficult to construct and utilizes commercially available technologies to implement. The BSA discharge standards would be attained for the groundwater being collected and pre-treated and subsequently leaving the Area "D" site.

This alternative is considered implementable and effective and will be carried through the detailed analysis of alternatives.

4.7.4 Alternative 6d – Cap, Complete Cutoff, Shore Stabilization, and Perimeter Groundwater Collection, Treatment and Discharge to Buffalo River

This alternative consists of the same components as Alternative 6a, however with a complete slurry wall around the entire Area "D" site, both upgradient and downgradient of the waste area. A FML cap would be constructed over the entire site. The complete slurry wall would provide for enhanced containment during the pumping and total treatment of groundwater and would reduce groundwater inflow and ultimately leachate generation. With the use of Fabriform®/Rip-Rap for shore stabilization, erosion of the banks and the amount of contaminated soil entering the Buffalo River will be reduced and controlled.

This alternative would provide protection of human health by reducing the exposure pathway of contact, incidental ingestion and inhalation of soils/dust, and aquatic toxicity. The components of this alternative are not very difficult to construct and utilize commercially available technologies to implement. Containment of contaminated groundwater in combination with a pump and treat system would accelerate the attainment of the groundwater ARARs/SCGs.

This alternative is considered implementable and will be carried through the detailed analysis of alternatives.

4.7.5 Alternative 6e – Cap, Perimeter Groundwater Collection and Disposal to TSDF, Complete Cutoff and Shore Stabilization

This alternative would involve the placement of a FML cap as described for Alternative 3, groundwater collection for disposal to a treatment, storage and disposal facility (TSDF), a groundwater cutoff wall completely surrounding the Area "D" site and Fabriform®/Rip-Rap for shore stabilization. A complete cutoff wall will provide enhanced containment during the pumping of contaminated groundwater. A FML cap would be constructed

over the entire site. The cap would decrease the infiltration of precipitation into the site thereby reducing the amount of contaminated groundwater generated at the site. Shore stabilization would reduce the erosion of soil/waste into the Buffalo River.

This alternative would provide protection of human health through the reduction of exposure to the Area "D" soils by contact, incidental inhalation, ingestion, and aquatic toxicity. The cutoff wall, FML cap, and groundwater collection system would not be very difficult to construct and utilizes commercially available technologies to implement.

This alternative is considered implementable and will be carried through the detailed analysis of alternatives.

4.8 ALTERNATIVE 7 – CAP, PERIMETER GROUNDWATER COLLECTION, PRE-TREATMENT AND DISCHARGE TO BSA, COMPLETE CUTOFF WALL AND SHORE STABILIZATION

This alternative would involve the placement of a FML cap as described for Alternative 3, groundwater collection and pre-treatment for discharge to the BSA and a groundwater cutoff wall completely surrounding the Area "D" site. Complete cutoff will provide containment during the pumping and pre-treatment of contaminated groundwater. The cap would decrease the infiltration of water through the site thereby reducing leachate generation. The groundwater will be collected, pre-treated and discharged to the BSA for further treatment. Sheet piling will be provided primarily for erosion control which will also provide enhanced containment of the groundwater.

This alternative would provide protection of human health through the reduction of exposure to the Area "D" soils by contact, incidental inhalation and ingestion of soils/waste and aquatic toxicity. The cutoff wall, FML cap, and groundwater collection and pre-treatment system would not be difficult to construct and utilizes commercially available technologies to implement. The BSA discharge standards would be attained for the groundwater being collected and pre-treated and subsequently leaving the Area "D" site.

This alternative is considered implementable and effective and will be carried through the detailed analysis of alternatives.

4.9 ALTERNATIVE 8 – TOTAL EXCAVATION AND DISPOSAL WITH SOIL COVER AND GRADING, TOTAL GROUNDWATER COLLECTION, PRE-TREATMENT AND DISCHARGE TO BSA AND SHORE STABILIZATION

This alternative would involve the excavation of wastes and off-site or on-site disposal, backfilling with new soil/fill cover and grading, total groundwater collection, pre-treatment and discharge to the BSA, and sheetpiling for shore stabilization. The sheetpiling will also reduce the amount of groundwater inflow to the site, and provide slope stabilization during excavation of the soils/waste. Disposal could be to an on-site or off-site landfill if the waste is not considered a RCRA hazardous waste. The Area "D" site will then be backfilled with new soil/fill cover and graded.

Removal of the source of contamination would accelerate the natural recovery of the aquifer and the attainment of groundwater ARARs/SCGs. Human health would be protected by eliminating exposure to the soil/waste through contact, incidental inhalation and ingestion. In addition, aquatic toxicity would be reduced by removal of the source of contamination. This alternative is considered difficult to implement because of the difficulties with the excavation of the heterogeneous fill materials and materials handling and safety problems, although it would be effective. Consequently, this alternative will be carried through to the detailed analysis.

4.10 ALTERNATIVES 9 - 9e – SOURCE REMOVAL, TREATMENT AND DISPOSAL

Alternative 9 and its sub-alternatives 9a, 9b, 9c, 9d, and 9e provide variations of treatment of the soil/waste. Specifically, the sub-alternatives highlight the various approaches to source removal and either on-site or off-site treatment and disposal.

4.10.1 Alternative 9 - Total Groundwater Collection, Pre-Treatment, Discharge to BSA, Total Excavation, Bioremediation, Backfill with Treated Soil, Soil Cover and Grading, and Shore Stabilization

This alternative would involve the total collection and pre-treatment of groundwater for discharge to the BSA for purposes of dewatering the soil/waste prior to and during excavation. The site would be excavated for treatment of the organics by bioremediation. This treatment process would be used in conjunction with other in situ processes for treatment of the inorganic compounds. The site would then be backfilled with the treated soil

and additional soil cover and grading will be provided. In addition, Fabriform®/Rip-Rap will be used for shore stabilization during excavation of the soils/waste.

Removal of the source of contamination will accelerate the natural recovery of the aquifer and the attainment of groundwater ARARs/SCGs. Human health will be protected by eliminating exposure to the soil/waste through contact, incidental inhalation and ingestion. In addition, aquatic toxicity will be reduced by removal of the source of contamination. Because of the heterogeneous nature of the fill and the existing subsurface building foundations and piping, excavation of the soil/waste will be difficult. Bulky and oversized materials will have to be segregated, possibly decontaminated and disposed of prior to the treatment of the soil waste. Consequently, this alternative is considered difficult to implement.

Many factors including biodegradability of organics, environmental factors which may affect microbial activity, site hydrogeology, and precipitation, can all have diminishing effects upon the performance of bioremediation. The effectiveness of this alternative is unknown without the performance of a treatability study. Because the implementability is questionable and the effectiveness particular to the site is unknown, this alternative will not be carried through to the detailed analysis.

4.10.2 Alternative 9a - Total Groundwater Collection, Pre-Treatment, Discharge to BSA, Total Excavation, Vitrification, Backfill with Treated Soil, Soil Cover and Grading, and Shore Stabilization

This alternative consists of the same components as Alternative 9 with the substitution of vitrification for bioremediation of the soil/waste.

Vitrification involves a thermal treatment process that converts contaminated soil (primarily inorganics) into a chemically inert and stable glass and crystalline product. Metals are either dissolved in the glass or incorporated in the vitreous matrix. Factors which have the largest effect on retention of the metals are burial depth, solubility, and vapor pressure. Organic compounds are destroyed by pyrolysis; the by-products migrate to the surface of the vitrified zone where they combust in the presence of oxygen. Gases are drawn into the off-gas treatment system.

This alternative would provide for natural recovery of the aquifer and attainment of groundwater ARARs/SCGs. The protection of human health and the environment is the same as for Alternative 9. As is the case with

bioremediation, the effectiveness of vitrification is unknown without a treatability study; also, the implementability is difficult if not questionable due to the nature of the fill material. Therefore, this alternative will not be carried through to the detailed analysis.

4.10.3 Alternative 9b- Total Groundwater Collection, Pre-Treatment, Discharge to BSA, Total Excavation, Incineration, Backfill with Treated Soil, Soil Cover and Grading, and Shore Stabilization

This alternative consists of the same components as Alternative 9 except with thermal destruction of the soil/waste.

Incineration of the waste could be done with an on-site rotary kiln or on-site fluidized bed. Both processes destroy organic waste by means of combustion. Allowable feed size is a factor in both technologies, however more with the fluidized bed. Oversized debris would have to be crushed, shredded, or removed altogether prior to being fed into the incinerator. Air pollution control devices are required for residual gases. The rotary kiln incinerator would be the most applicable to Area "D", however, excavation and the size of soil/waste material is questionable and therefore may be difficult to implement. The limitations on the effectiveness of rotary kiln incinerators include: susceptibility to thermal shock, necessity for very careful maintenance, need for additional air due to leakage, high particulate loadings, relatively low thermal efficiency, and high capital cost for installation.

This alternative affords the same degree of protection of human health and the environment as Alternative 9, however with a greater need for protection to the community and workers during implementation. Because this treatment technology is difficult to implement and the effectiveness is unknown without a treatability study, this alternative will not be carried through to the detailed analysis.

4.10.4 Alternative 9c - Total Groundwater Collection, Pre-Treatment, Discharge to BSA, Total Excavation, Soil Washing, Backfill with Treated Soil, Soil Cover and Grading, and Shore Stabilization

This alternative consists of the same components as Alternative 9 except with the use of soil washing.

Soil washing is applicable to inorganic and organic waste and can be performed in situ or at an on-site plant. The process involves the infiltration of a solvent or surfactant solution into the contaminated soil to increase the

solubility of the contaminants and accelerate leaching of contaminants into the groundwater for recovery via extraction wells or a collection system.

Treatment of the soil/waste via soil washing provides for the same degree of protection of human health and the environment as Alternative 9 as well as attainment of groundwater ARARs/SCGs. The implementability of this process is difficult due to the nature of the fill material. Also, the subsurface structures would create difficulties in the in situ mixing of reagent and waste with gang augers. Likewise, an on-site plant would require excavation of the soil/waste which has been previously identified as being difficult to implement. The effectiveness of soil washing is dependent upon the types of extractants used. A treatability study would be necessary to make this determination. Because of the difficulty in implementation and the questionable effectiveness, this alternative will not be carried through to the detailed analysis.

4.10.5 Alternative 9d - Total Groundwater Collection, Pre-Treatment, Discharge to BSA, Total Excavation, Stabilization/Solidification, Backfill with Treated Soil, Soil Cover and Grading, and Shore Stabilization

This alternative consists of the same components as Alternative 9d except with the implementation of stabilization/solidification for treatment of the soil/waste.

Solidification/Stabilization can be performed in situ or at an on-site plant. This process is effective for stabilizing inorganic contaminants and involves in situ mixing of a stabilizing agent with the soil/waste to form a structurally sound matrix. For organic contaminants, there is a potential for interference with the bonding of the reagents and thus the process may be less effective. This alternative would provide for the same protection of human health and the environment as Alternative 9 along with the attainment of groundwater ARARs/SCGs.

On-site stabilization requires excavation of the soil/waste for mixing with the reagent at an on-site plant. For both on-site and in situ stabilization, treatability studies would be required. Because of this and the difficulty associated with the mixing for in situ treatment and the need for excavation for on-site stabilization, this alternative is difficult to implement.

Consequently, this alternative will not be carried through to the detailed analysis.

4.10.6 Alternative 9e - Total Groundwater Collection, Pre-Treatment, Discharge to BSA, Chemical Remediation,Soil Cover and Grading, and Shore Stabilization

This alternative consists of the same components as Alternative 9 except with chemical remediation of the soil/waste. In situ chemical treatment also negates the need for excavation of the soil/waste and backfill of the treated soil.

Through the placement of chemical oxidizing agents, oxidation of volatile organics and semi-volatile organics would occur. This process does not remove inorganics, however, and the effectiveness is reduced by the presence of subsurface structures which limit the complete distribution of reagents.

This alternative provides the same protection of health and the environment as Alternative 9. Because of the question of implementability and effectiveness, this alternative will not be carried through to the detailed analysis.

4.11 SUMMARY OF SCREENING ALTERNATIVES

After the screening process 13 alternatives remain for inclusion in the detailed analysis phase. The no action alternative (Alternative 1) provides a baseline against which the effectiveness of other remedies may be compared. The limited action alternative (Alternative 2) is screened out as being ineffective. Alternatives 3 and 3A involve capping and shore stabilization and will be carried through to detailed analysis. Alternatives 4 through 7 are containment alternatives that will be combined through the detailed analysis. Alternative 8 which involves excavation and off-site disposal combined with groundwater treatment will be carried through the detailed analysis. Alternatives 9 through 9C which involve source excavation and treatment have been screened out as difficult to implement because of material handling difficulties which will be encountered during excavation and/or implementation of the treatment process. A summary of the potential Alternatives is presented in Table 4-2.

The NYSDEC Technical and Administrative Guidance Memorandum (TAGM) for the Selection of Remedial Actions at Inactive Hazardous Waste

TABLE 4-2

BUFFALO COLOR AREA "D"

FEASIBILITY STUDY

SUMMARY OF POTENTIAL ALTERNATIVES

		ALTERNATIVES																			
Unit Description	*Technology*	1	2	3	3a	4	4a	5	6	6a	6b	6c	6d	6e	7	8	9	9a	9b	9c	9d	9e
Monitoring	Groundwater	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Administration	Deed Restriction		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Fencing		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cap	Soil Cover and Grading Only						*									*	*	*	*	*	*	*
	FML Cap			*	*	*			*	*	*	*	*	*	*							
	Multi-Media Cap							*														
GW Collection	Total GW Collection															*	*	*	*	*	*	*
	Perimeter GW Collection					*	*	*	*	*	*	*	*	*	*							
GW Treatment	GW Pre-Treatment					*	*	*	*			*			*	*	*	*	*	*	*	*
	GW Treatment									*			*									
GW Disposal	Disposal Site/TSDF										*			*								
	Buffalo River									*			*									
	Buffalo Sewer Authority					*	*	*	*			*			*	*	*	*	*	*	*	*
Containment	Slurry Wall - SW Side																					
	Slurry Wall - Upgradient											*	*	*	*							
	Slurry Wall - Downgradient								*	*	*	*	*	*	*							
Shore Stabilization	Sheet Piling - E. & S. Sides			*			*								*	*						
	Fabriform/Rip Rap				*	*		*	*	*	*	*	*	*			*	*	*	*	*	*
Excavation	Total Exc.															*	*	*	*	*	*	*
Disposal	Off-Site TSDF															*						
Treatment On-Site	Bioremediation																*					
	Stabilization/Solidification																				*	
	Soil Washing																			*		
	Vitrification																	*				
	Incineration																		*			
	Chemical Remediation																					*
Backfill	Total Backfill - Existing Soil																*	*	*	*	*	*
	Total Backfill - New Soil															*						
Hold Over For Detailed Analysis		X		X	X	X		X	X	X	X	X	X	X	X	X						

Sites, May 1990 was utilized as a guidance for the evaluation and development of remedial alternatives. Specifically, each alternative was evaluated for short/long-term effectiveness and implementability. The NYSDEC TAGM alternative screening scoring evaluations are provided in Appendix F.

4.12 ACTION-SPECIFIC AND LOCATION-SPECIFIC ARARs/SCGs

The remedial alternatives identified under Sections 4.2 through 4.10 which were selected for detailed analysis will be evaluated in Section 5.0. As discussed above, these alternatives are comprised of one or more specific remedial actions. In order to design the final alternative there are both action-specific and location-specific ARARs/SCGs that would have to be considered. As part of the detailed evaluation these remedial actions will be evaluated with respect to their compliance with both the action-specific and location-specific ARARs/SCGs as presented below.

4.12.1 Action-Specific ARARs/SCGs

Action-specific ARARs/SCGs related to these final alternatives are organized under the following five remedial actions:

1. Area "D" Containment (including capping and post-closure monitoring and maintenance)
2. Groundwater Pumping and Treatment
3. Discharge of Treated Leachate and/or Groundwater to Surface Water
4. Discharge of Pre-treated Leachate and/or Groundwater to BSA
5. Collection and disposal of untreated groundwater to a TSDF
6. Discharge to Air Resulting from Leachate and/or Groundwater Treatment

Action-specific ARARs/SCGs are summarized in Table 4-3 and discussed below.

In addition, ARARs/SCGs that protect worker safety and specify site management procedures, as well as requirements for local property acquisition that may pertain to many of the final remedial alternatives, are discussed below.

Table 4-3
BUFFALO COLOR CORPORATION
Area "D" Feasibility Study
Potential Action-Specific ARARS/SCGS

Actions	Requirements	Citation
1. Groundwater pumping and treatment	Must meet applicable local zoning and building regulations for construction of on-site treatment facility.	N/A
2. Discharge of treated leachate and/or groundwater to surface water	***Water Quality Standards*** • Applicable Federally approved State water quality standards must be complied with. These standards may be in addition to or more stringent than other Federal standards under the CWA. • Discharge limitations must be established at more stringent levels than technology-based standards for toxic pollutants	40 CFR 122 6 NYCRR 10 Article 3 6 NYCRR 701
3. Discharge of pre-treated leachate and/or groundwater to BSA	• Must meet BSA regulations for industrial effluent.	N/A
4. Disposal of Untreated Groundwater to TSDF	• Must meet RCRA regulations governing waste transportation and disposal to TSDF; Standards for the operation of TSDF must be met by chosen facility	40 CFR Part 260
5. Discharge to air resulting from leachate and/or groundwater treatment	Emissions must meet the National Emissions for Hazardous Waste Air Pollutants (NESHAPs). Emissions should meet Ambient Guideline Concentrations in NYS Air Guide (permit does not need to be obtained) Prohibits emissions which are injurious to human, plant, or animal life or property. Also limits visible emissions.	40 CFR 61 6 NYCRR 201 6 NYCRR 211

Note: N/A Not Applicable

Groundwater Pumping and Treatment For Discharge to Surface Water

Presently, there is no separate regulatory program for the installation of groundwater collection wells or treatment systems at CERCLA sites on either the State or Federal level. However, local zoning and building requirements may apply to treatment facilities development as part of the remedial activities. The discharge of treated effluent to surface waters are regulated under the National Pollutant Discharge Elimination System (NPDES) (40 CFR Parts 122-125) under the Clean Water Act (Section 402). The NPDES program establishes applicable effluent standards ((i.e., technology based and/or water-quality based) for direct and indirect discharges to surface water and groundwater. In New York, the NYSDEC is authorized to administer the NPDES program which, in New York, is the State Pollution Discharge Elimination System (SPDES) (6 NYCRR Parts 750 through 758).

The SPDES technical requirements of the program would apply to any remedial action that involves the direct discharge of treated groundwater to the surface water or back to groundwater. Administrative permitting requirements would not apply.

Discharge of Pre-Treated Groundwater to the BSA

Discharges to the BSA are regulated by the BSA in accordance with their terms and guidelines for industrial effluent and also the Clean Water Act. The applicable effluent standards are site-specific and therefore would need to be negotiated prior to the commencement of any remedial action.

The BSA discharge limitations would apply to any remedial action that involves the discharge of pre-treated groundwater to the BSA. Administrative permitting requirements would not apply.

Collection and Disposal to a TSDF

The disposal of untreated groundwater from an inactive hazardous waste site is regulated by RCRA for the handling and transportation of the groundwater to a RCRA-permitted TSDF.

Disposal of untreated groundwater from Area "D" would be regulated by RCRA for TSDF's.

Discharge to Air Resulting from Leachate and/or Groundwater Treatment

The Federal Clean Air Act National Emission Standards for Hazardous Waste Air Pollutants (NESHAPs) (40 CFT Part 61) establish emission standards

for vinyl chloride, and benzene (fugitive). However, these standards only apply to specific facilities or processes. The NESHAPs also establish performance standards and repair schedules for general sources of emitting hazardous air pollutants.

New York regulates all air emission sources under the New York Air Pollution Control Regulations (6 NYCRR Part 201) which require all but exempted emissions sources to obtain both construction permits and operation certificates. Though the administrative aspects of this rule do not need to be complied with for a CERCLA remedial action, the permit limitations, which are calculated using New York State Air Guide I, need to be met. New York's General Prohibitions for Air Emissions (6 NYCRR Part 211) provide a generic prohibition of emissions to the air which are injurious to human, plant, or animal life or property. This regulation also limits visible emissions.

Groundwater treatment options which would result in emissions to air would be required to comply with these regulations.

Worker Safety and Site Management

The Occupational Safety and Health Standards for Hazardous Response Contractors (OSHA-29 CFR 1926) establish worker health and safety program goals for CERCLA cleanups. A health and safety program must identify site hazards and procedures for mitigating these hazards; provide training and medical surveillance; provide protective equipment and engineering controls to ensure that maximum permissible exposure limits are not exceeded; inform subcontractors of risks involved; decontaminate employees and equipment; and prevent accidental collapse of site excavations in which employees work.

Remedial actions e.g., excavating for a slurry wall, would need to comply with these requirements, as New York State has no approved worker safety plan.

4.12.2 Location-Specific ARARs/SCGs

There are no location-specific ARARs/SCGS that are likely to pertain to the Area "D" site based on its location; or the location of remedial containment/treatment facilities near the Buffalo River in that no discharge of fill material or dredging of the river will occur as part of the remediation process.

5.0 DETAILED ANALYSIS OF ALTERNATIVES

In this section, each of the alternatives which has passed through the screening process is defined in more detail and evaluated in terms of the following criteria:

- Overall protection of human health and the environment – an assessment of risk reduction afforded by each of the alternatives is provided.
- Compliance with ARARs and SCGs – an assessment of each alternative is made with respect to chemical, action, and location-specific ARARs and SCGs.
- Long-term effectiveness - an assessment of the magnitude of residual risk and adequacy and reliability of controls is made for each alternative.
- Reduction of toxicity, mobility, or volume through treatment - an assessment of the following criteria is made for each alternative:
  - Treatment process used and materials treated;
  - Amount of hazardous materials destroyed or treated;
  - Degree of expected reductions in toxicity, mobility, and volume;
  - Degree to which treatment is irreversible;
  - Type and quantity of residuals remaining after treatment.
- Short-term effectiveness - an assessment of the following criteria is made for each alternative:
  - Protection of community during remedial actions;
  - Protection of workers during remedial actions;
  - Environmental impacts;
  - Time until remedial action objectives are achieved (see Appendix K).
- Implementability – an assessment of the following criteria is made for each alternative:
  - Ability to construct and operate the technology;
  - Reliability of the technology;

- Ease of undertaking additional remedial actions, if necessary
- Ability to monitor effectiveness of remedy;
- Ability to obtain approvals from other agencies;
- Coordination with other agencies;
- Availability of off-site treatment, storage, and disposal services and capacity;
- Availability of necessary equipment and specialists;
- Availability of prospective technologies.

- Cost effectiveness – each alternative is assessed for the following criteria:
  - Capital costs;
  - Operating and maintenance costs;
  - Present worth cost.

- State acceptance – in all cases this to be determined after review of the draft FS Report by NYSDEC.
- Community acceptance – in all cases this is to be determined after review of the draft FS Report by the public.

Table 5-1 presents the scoring of each alternative based upon the NYSDEC TAGM Detailed Analysis Ranking which compares each alternative with the above screening criteria. (The individual scoring sheets are contained in Appendix F).

An important tool that was applied to assess the applicability of the various groundwater treatment alternatives was the groundwater flow simulation model.

5.0.1 Groundwater Flow Model

Estimates of groundwater flow into the Buffalo River and the groundwater collection trench were made for each of the alternatives in the detailed analysis. A groundwater flow simulation model entitled MODFLOW was used for this analysis. Each of the alternatives were evaluated based upon their geometry, material characteristics, boundary conditions and recharge conditions. The model and associated background information is presented in Appendix G. The model was calibrated and appropriate adjustments made prior to its usage. Each of the alternatives were then run through the model

and the estimated flow rates obtained. In addition to the flow rates, the model provided information relative to the cumulative volume and length of time to reach steady state conditions. Table 5-2 has been prepared to illustrate the estimated flows, and is referenced during this evaluation of each alternative.

5.0.2 Groundwater Treatment System

Groundwater treatment was evaluated based upon static groundwater quality data presented in the RI. Two separate treatment options were evaluated, treatment for discharge to the Buffalo River and pre-treatment for discharge to the Buffalo Sewer Authority. Appendix H contains a description of these two treatment options as well as the proposed discharge characteristics. Cost estimates for both systems, at various flow rates, have also been prepared and are included in Appendix I.

5.0.3 Groundwater Monitoring Network

This section describes proposed monitoring networks for the remedial options presented. Groundwater monitoring strategy can be divided according to two major categories of remedial options: containment and non-containment options. Containment options are best represented by Option 6c, in which the site is totally enclosed with a slurry wall keyed into the glaciolacustrine clay and drained with an interior groundwater collection system concentric with the slurry wall. Non-containment options include the no-action and limited action alternatives (Remedial Options 1 and 2).

Conceptual groundwater monitoring networks are presented below in terms of the two major remedial approaches: containment and non-containment.

Containment Options

Monitoring Parameters: Since one of the key objectives of a containment and groundwater collection option is to maintain an inward hydraulic gradient to ensure no release of contaminants, groundwater elevation becomes a major monitoring parameter. With this containment system, all wells outside the slurry wall would be considered hydraulically upgradient of contained contamination, while all inside wells would be considered downgradient of the contamination.

With inward gradient conditions, chemical monitoring becomes secondary to groundwater head monitoring, but is still useful for verification of containment performance. The proposed list of chemical parameters will be established during the design phase of the particular remedial option chosen. The list will be based on chemical data from the Remedial Investigation and may include additional parameter testing depending on potential influences from external sources of contamination (e.g., upgradient and Buffalo River).

Once a containment wall and groundwater collection system is completed, groundwater movement outside the wall will essentially parallel the Buffalo River in a very narrow strip of aquifer between the wall and the river. Monitoring wells outside the wall will initially contain contaminants at some level, but these contaminants should then decline as the strip of aquifer is flushed out. Under Alternative 6c, the waste/fill material will be removed and, therefore, any monitoring wells in this area will be placed in clean fill. If wells are placed in contaminated soil outside the wall, as in alternatives other than 6c, a statistical methodology will have to be employed which will evaluate concentration trends as opposed to simply a statistical comparison with a groundwater protection standard.

Locations of Monitoring Installations: Locations of monitoring wells for containment options should primarily be based upon (1) suitable coverage for confirmation of inward hydraulic gradient conditions and (2) locations adjacent to the areas of worst groundwater degradation.

Based upon the potentiometric maps presented in Malcolm Pirnie's Remedial Investigation Report and geographic considerations, seven groups of wells are recommended as shown in Figure 5a for monitoring groundwater levels. These groups are labeled A through G and each group of wells consists of an inside well and outside well completed in the alluvial/fill aquifer. Inside wells should be located between the wall and the groundwater collection system so that head conditions adjacent to the wall can be monitored. Of the groups of wells shown on Figure 5a, five outside wells located at Groups A, C, D, E, and F are proposed for chemical parameter monitoring. These locations are positioned opposite the containment wall from the following areas: Iron Oxide Sludge Lagoon, Incineration Area, Weathering Area, and the Pit Area. Two existing wells in the till unit underlying the glaciolacustrine clay

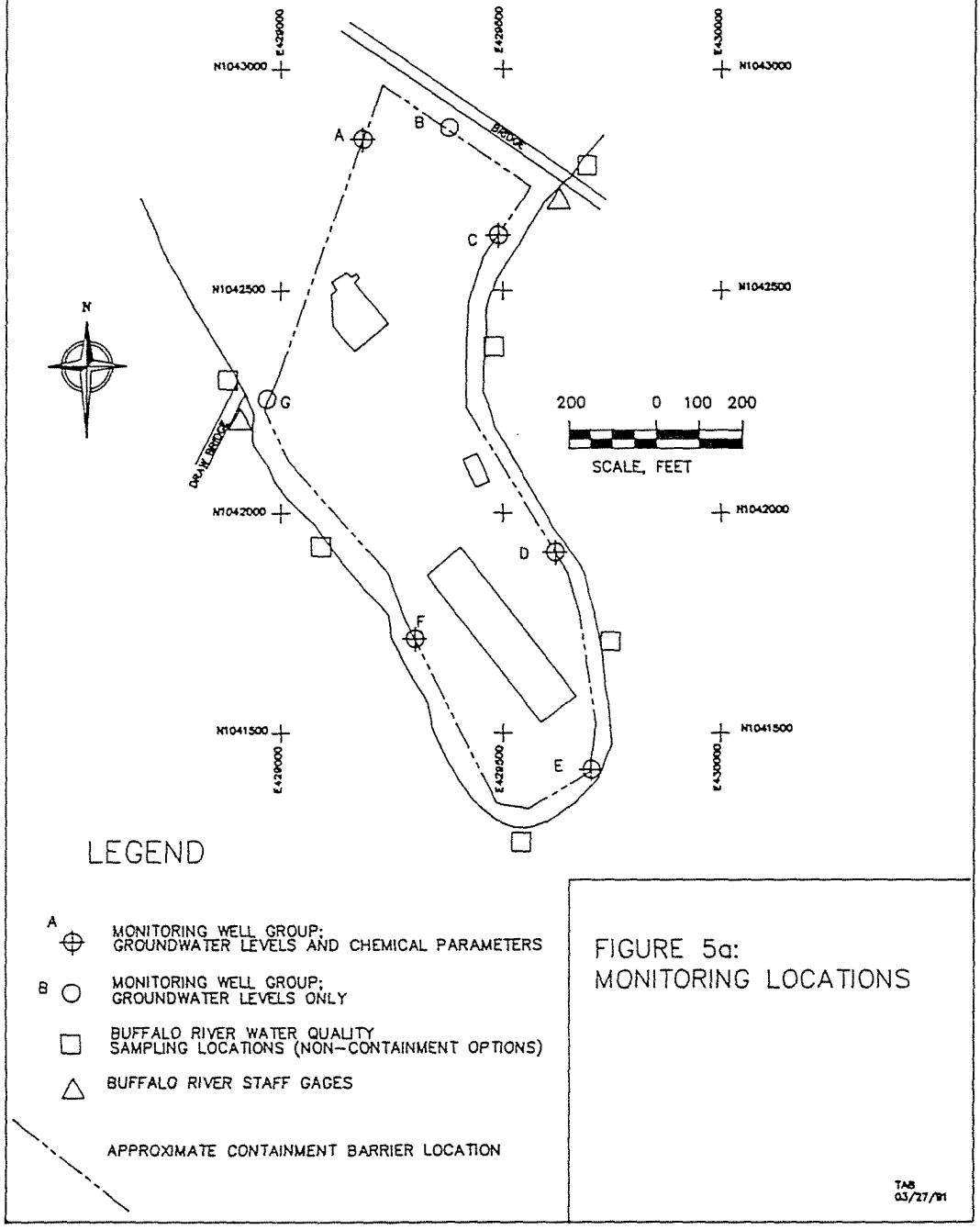


FIGURE 5a:
MONITORING LOCATIONS

TAB
03/27/91

(MW-1-88 and MW-7-88) should also be monitored for groundwater levels to check vertical gradients between the alluvial aquifer and the till unit.

With respect to vertical placement, it is recommended that inside wells be placed at the bottom portion of the aquifer because this unit will be partially dewatered by the groundwater collection system. If wells are placed higher than the aquifer bottom, they could become dry, rendering the monitoring installation useless. Outside wells should be placed approximately in the middle of the saturated portion of the aquifer unit in order to adequately cover the vertical extent of groundwater flow. Five-foot well screens will adequately cover the extent of saturated zone since the average saturated thickness near the river is about ten feet. Five-foot well screens placed in the middle of the saturated interval will leave only 2.5 feet of aquifer above and below the screen that is not immediately adjacent to the screen. During pumping for purging and sampling, groundwater from the ten-foot section will be represented in the sample. Figure 5b shows a schematic of the vertical well placement strategy.

In addition to well locations and stream sampling points, staff gage readings on the river level should be monitored at the upstream and downstream points of the site as shown in Figure 5a.

Sampling Frequency: Frequency of groundwater and river level readings should be monthly until groundwater levels have approached equilibrium from the change in conditions caused by installation of the containment structures. Following equilibration, groundwater and river levels can be obtained quarterly. This schedule provides for evaluation of seasonal influences on groundwater levels inside the containment area.

Changes in groundwater chemistry occur over a much longer period of time than groundwater level changes, so semi-annual groundwater sampling and analysis for chemical parameters should be sufficient to track changes in contaminant migration.

Non-Containment Options

Monitoring Parameters: The parameters identified for monitoring would be the same for non-containment options as they are for containment options as described above. Groundwater and river levels are still important for options with less than total containment in order to evaluate likely paths of contaminant movement.

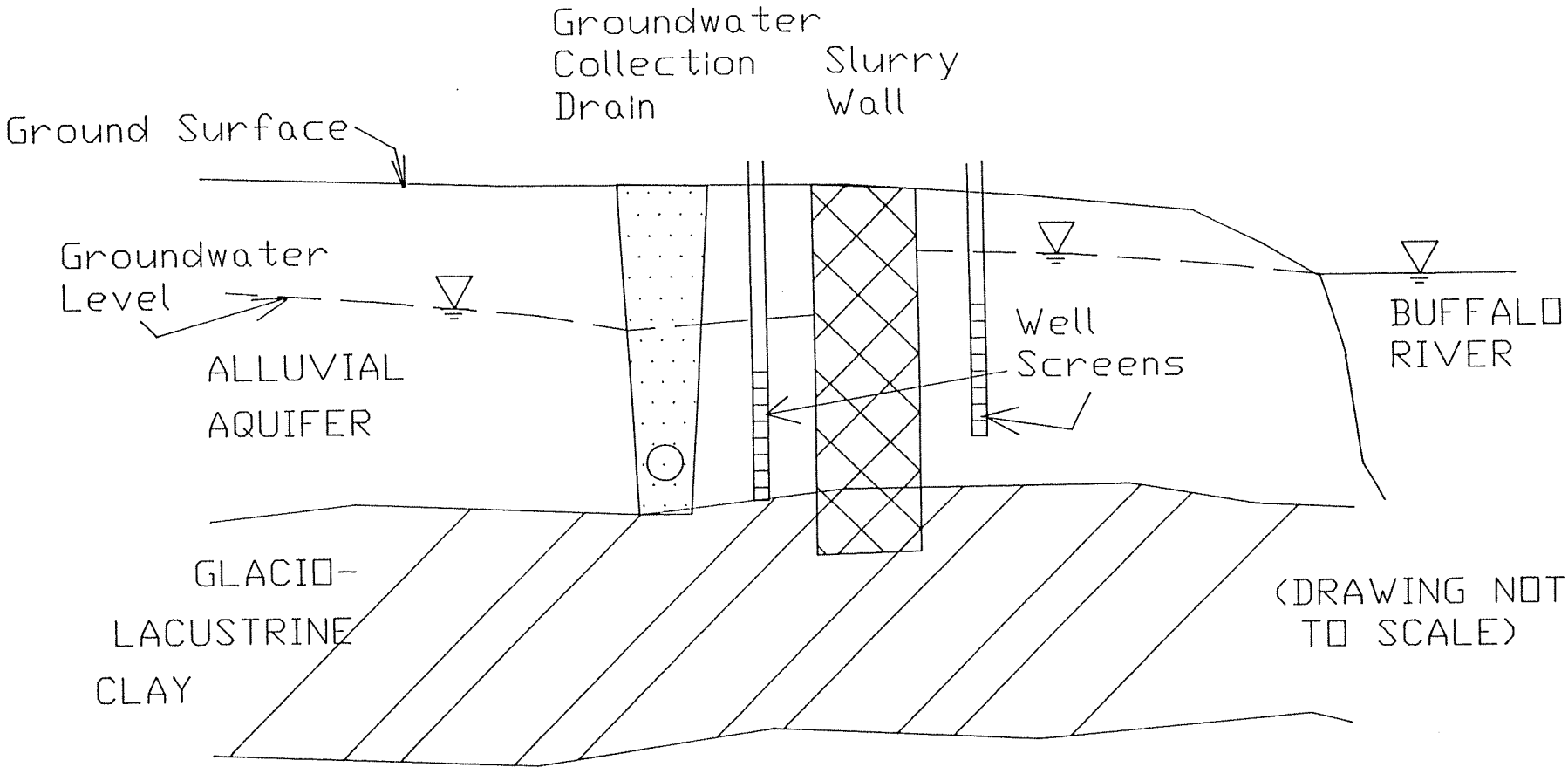


FIGURE 5b

SCHEMATIC CROSS-SECTION SHOWING
VERTICAL MONITORING WELL PLACEMENT

Table 5-1
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY
NYSDEC TAGM DETAILED ANALYSIS RANKING
SUMMARY TABLE

Analysis Factor	1	2	3	3a	4	4a	5	6	6a	6b	6c	6d	6e	7	8
1. Compliance with chemical-specific ARARs/SCGs	0	0	0	0	0	4	4	0	4	4	4	4	4	4	4
2. Compliance with action-specific ARARs/SCGs	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3
3. Compliance with location-specific ARARs/SCGs	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3
COMPLIANCE WITH ARARs AND SCGs	**0**	**0**	**3**	**3**	**6**	**10**	**10**	**6**	**10**	**10**	**10**	**10**	**10**	**10**	**10**
1. Use of the site after remediation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Human health and environmental exposure after remediation	0	0	3	3	7	10	10	10	10	10	10	10	10	10	10
3. Magnitude of residual public health risks after remediation	0	0	2	2	2	2	5	5	5	5	5	5	5	5	5
4. Magnitude of residual environmental risks after remediation	0	0	0	0	3	3	3	5	5	5	5	5	5	5	5
PROTECTION OF HUMAN HEALTH AND ENVIRONMENT	**0**	**0**	**5**	**5**	**12**	**15**	**18**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
1. Protection of community during remedial action	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2. Environmental Impacts	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3
3. Time to implement remedy	1	1	1	1	2	2	2	0	0	0	0	0	0	0	0
SHORT-TERM EFFECTIVENESS	**9**	**9**	**8**	**8**	**9**	**9**	**9**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**7**

Table 5-1
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY
NYSDEC TAGM DETAILED ANALYSIS RANKING
SUMMARY TABLE

Analysis Factor	1	2	3	3a	4	4a	5	6	6a	6b	6c	6d	6e	7	8
1. On-site or off-site treatment or land disposal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2. Permanence of remedial alternative	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
3. Lifetime of remedial actions	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3
4. Quantity and nature of waste or residual remaining	0	0	0	0	2	2	2	2	2	2	2	2	2	2	5
5. Adequacy and reliability of controls	0	0	0	0	2	2	2	2	2	2	2	2	2	2	4
LONG-TERM EFFECTIVENESS	**0**	**0**	**0**	**0**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**16**
1. Volume of hazardous waste reduced	3	3	2	2	4	4	6	4	4	4	4	4	4	4	10
2. Reduction in mobility of hazardous waste	0	0	0	0	2	2	2	2	2	2	2	2	2	2	0
3. Irreversibility	0	0	0	0	5	5	5	5	5	5	5	5	5	5	5
REDUCTION OF TOXICITY, MOBILITY OR VOLUME	**3**	**3**	**2**	**2**	**11**	**11**	**13**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**15**
1. Technical feasibility	6	6	8	8	8	8	7	10	10	10	10	10	10	9	8
2. Administrative feasibility	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1
3. Availability of services and materials	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
IMPLEMENTABILITY	**11**	**11**	**13**	**13**	**13**	**13**	**12**	**14**	**14**	**14**	**14**	**14**	**14**	**13**	**12**
TOTAL	**23**	**23**	**31**	**31**	**58**	**65**	**69**	**65**	**69**	**69**	**69**	**69**	**69**	**68**	**80**

Table 5-2
BUFFALO COLOR CORPORATION
Area "D" Feasibility Study
Summary of Groundwater Modeling Results

Inflow Source*	Steady State Inflow for Alternatives, (ft^3/day)						
	1 & 2	3	3a	4/5	6/6a/6b	6c/6d/6e	7
Rainfall Recharge	2,326	55	55	55	55	55	55
Upgradient Inflow	180	399	407	1,653	2,172	5	5
River	0	56	56	53,969	13	13	13
Upward Leakage through Clay	0	0	0.1	9	12	11	11
Groundwater Flow into Collection System	0	0	0	55,686	2,252	84	84
Groundwater Flow out of Site	2,506	510	518	0	0	0	0

*The model mass balance error is generally 0.1 to 0.2 percent or 2 to 4 ft^3/day; therefore flow rates less than these values are considered negligible.

Locations of Monitoring Installations: For non-containment options, the groundwater quality well locations in Figure 5a are recommended (locations A, C,D,E and F) but the two-well group at these locations would consist of one in the upper alluvial/fill aquifer unit and one in the underlying glacial till unit. In addition, monitoring of water quality in Buffalo River at six locations is recommended along the river as shown in Figure 5a.

Sampling Frequency: For the non-containment options, groundwater levels, river levels, groundwater quality and river quality samples should be taken quarterly to properly take into account seasonal fluctuations and track movement and concentrations of contaminants. Groundwater level maps for the alluvial aquifer and the till unit should be assembled on a quarterly basis for non-containment options as a means of evaluating changes in groundwater flow direction and groundwater quality.

5.1 ALTERNATIVE 1 – NO ACTION WITH MONITORING

5.1.1 Description

The no action alternative would involve regular semi-annual sampling and analysis of the Area "D" monitoring wells by Buffalo Color for a period of 30 years (Figure 5-1a and b). Any improvements in groundwater quality would solely be the result of natural recovery. Eight monitoring wells would be analyzed for SVOCs, VOCs, and metals. The no-action alternative is carried through the screening and detailed evaluation for comparative purposes.

5.1.2 Evaluation

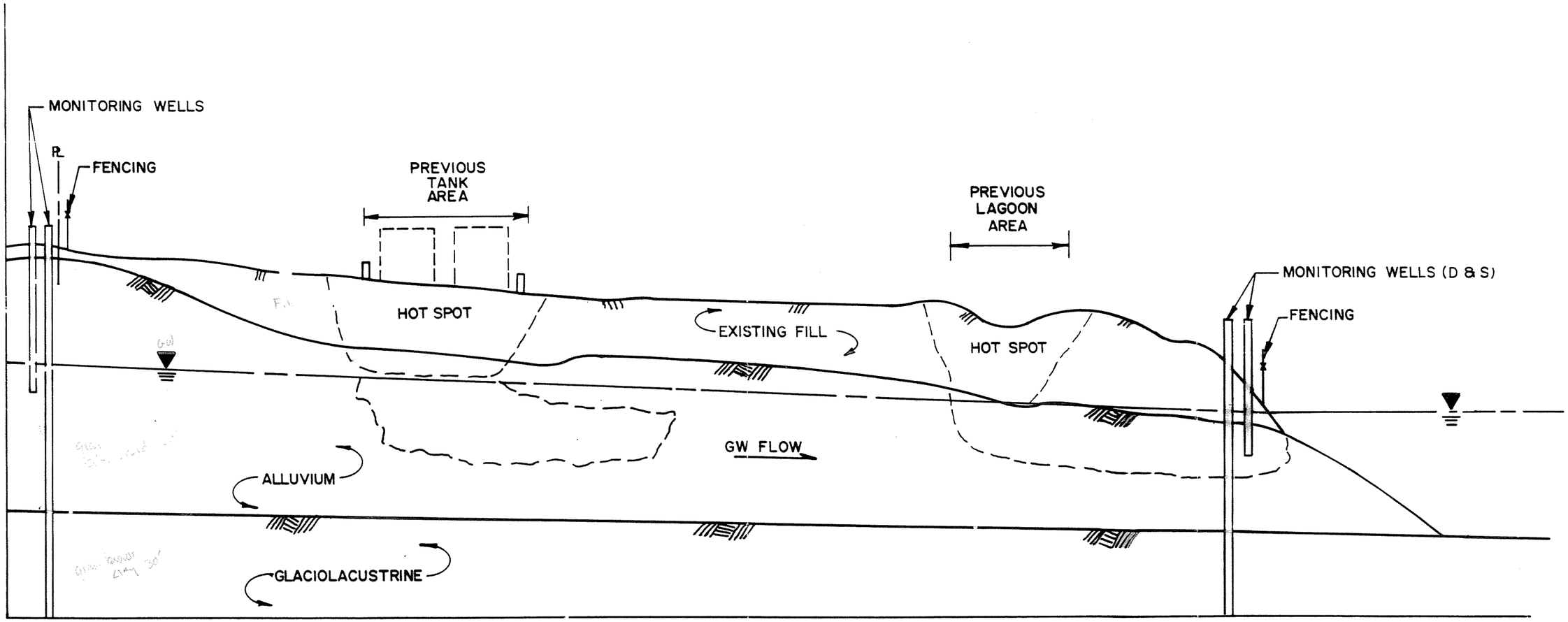
Overall Protection of Human Health and the Environment

In the absence of any remedial action, there would be no reduction in site-related risk or protection of the environment. Thus, the calculated carcinogenic risk of 1×10^{-5} and the hazard index (HI) of 200 would not be altered. In addition, there may be risks through the inhalation of volatile organics which could not be quantified in the risk assessment due to the absence of volatile organic data for surface materials. These risks, of unknown magnitude, would also remain.

There would be no protection of the environment under this alternative.

ALTERNATIVE 1 SCHEMATIC

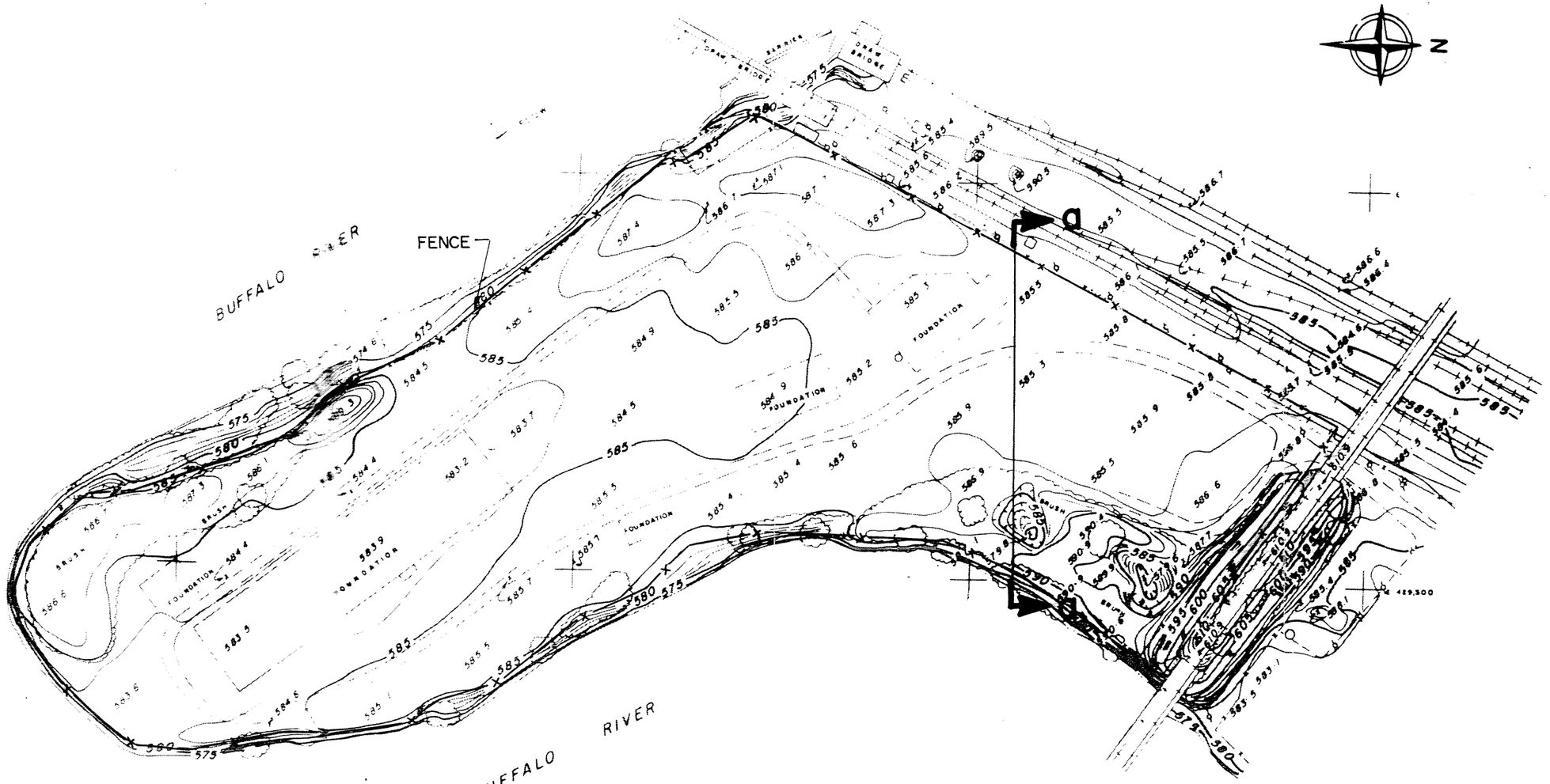
NO ACTION/LIMITED ACTION



GENERALIZED SECTION a-a

APPROX. SCALE
H - 1"=100'
V - 1"=20'

WehranEnviroTech	Drawn By : L.A. Bodzich Checked By : [illegible] Date : 12/12/90	Scale AS NOTED		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY	Figure : 5-1a Project No 00257



OPTIONS

ALTERNATIVE 1

- GW MONITORING – 30 YEARS

WehranEnviroTech	Drawn By: L.F. Kozik Checked By: DBB Date: 12/12/90	Scale 1" = 150'		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY ALTERNATIVE 1	Figure: 5-1b Project No. 00257

Compliance with ARARs

Because no action is being taken, this alternative would not meet the chemical-specific and action-specific ARARs/SCGs for migrating groundwater, eroding soil and fugitive dust emissions.

Long-Term Effectiveness and Permanence

This alternative includes no controls for exposure and no long-term management measures. All current and potential future risks would remain under this alternative. Therefore, residual risk should be similar to the present risk.

Reduction of Toxicity, Mobility, or Volume

The toxicity and volume of contaminated groundwater might decrease gradually over time due to natural processes. However, it is unlikely that there will be any significant attenuation of toxicity or volume in the absence of remedial action. Mobility would be entirely unaffected.

Short-Term Effectiveness

Since no remedial construction would be implemented, protection of the community and workers during remedial action is not an issue. There is no remedial action to achieve the remedial action objectives and therefore, the objectives may never be met.

Implementability

There are no implementability concerns posed by this alternative since no action would be taken and groundwater monitoring is easily implementable.

Cost

The 30-year present worth cost of this alternative is estimated to be $1,170,000 (see Appendix I). This cost consists of implementation of a semi-annual groundwater monitoring program for a period of 30 years.

State Acceptance

To be determined after State review of the draft FS Report.

Community Acceptance

To be determined after public review of the FS Report.

5.2 ALTERNATIVE 3 - CAP WITH SHORE STABILIZATION

5.2.1 Description

The primary components of Alternative 3 (Figure 5-2a and b) are:

- A Flexible Membrane Liner (FML) cap
- Sheetpiling for shore stabilization
- The limited action alternative (groundwater monitoring, fencing, and deed restrictions)

A FML cap is proposed for this alternative. For the purpose of evaluations required for this Feasibility Study, the proposed cap would consist of, from the bottom up, six inches of compacted subgrade, a 40 mil High Density Polyethylene (HDPE) or Very Low Density Polyethylene (VLDPE) membrane, and 24 inches of soil, the upper six inches of which would support vegetation. This type of cap should reduce infiltration through the waste from the current approximately 2,326 cubic feet per day to about 55 cubic feet per day.

The actual design of the cap that will be installed at the site will be finalized as part of the technical design. This cap design will at least be equivalent to the cap described.

Sheetpiling

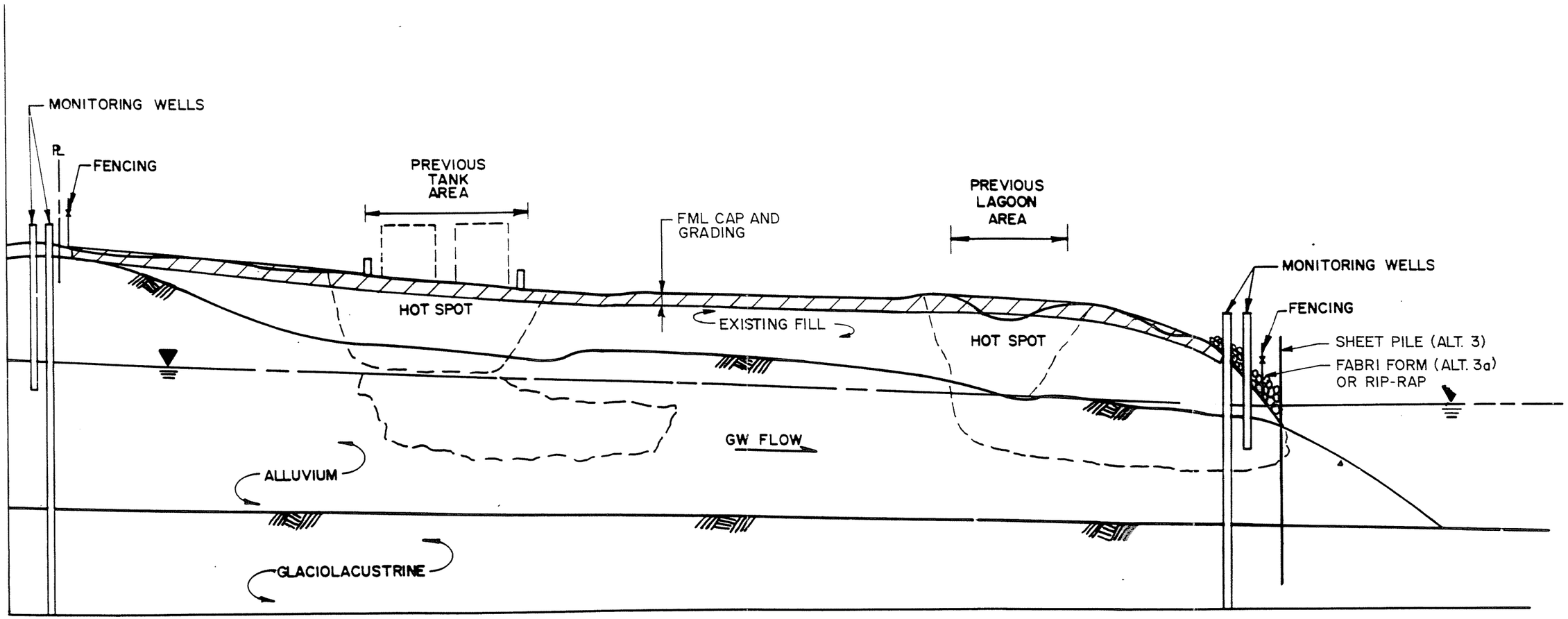
The purpose of the sheetpiling is two fold; stabilization of the shore sediment and reduction of the groundwater flow through the site. The sheetpiling will be located along the shore, on the south and east sides of the site, where there is evidence of erosion. The piling will be driven through the fill and alluvium, into the underlying glaciolacustrine clay providing a partial groundwater cutoff.

5.2.2 Evaluation

Overall Protection of Human Health and the Environment

Capping the site with a FML cap would reduce the on-site risks and the risks due to off-site inhalation of fugitive dust to essentially zero. It would also significantly reduce the loading of contaminants to the River by limiting infiltration of precipitation into the waste. Additional flow reduction would be provided by the sheetpiling to the east and south. At steady-state conditions (one year following remedial action implementation), the

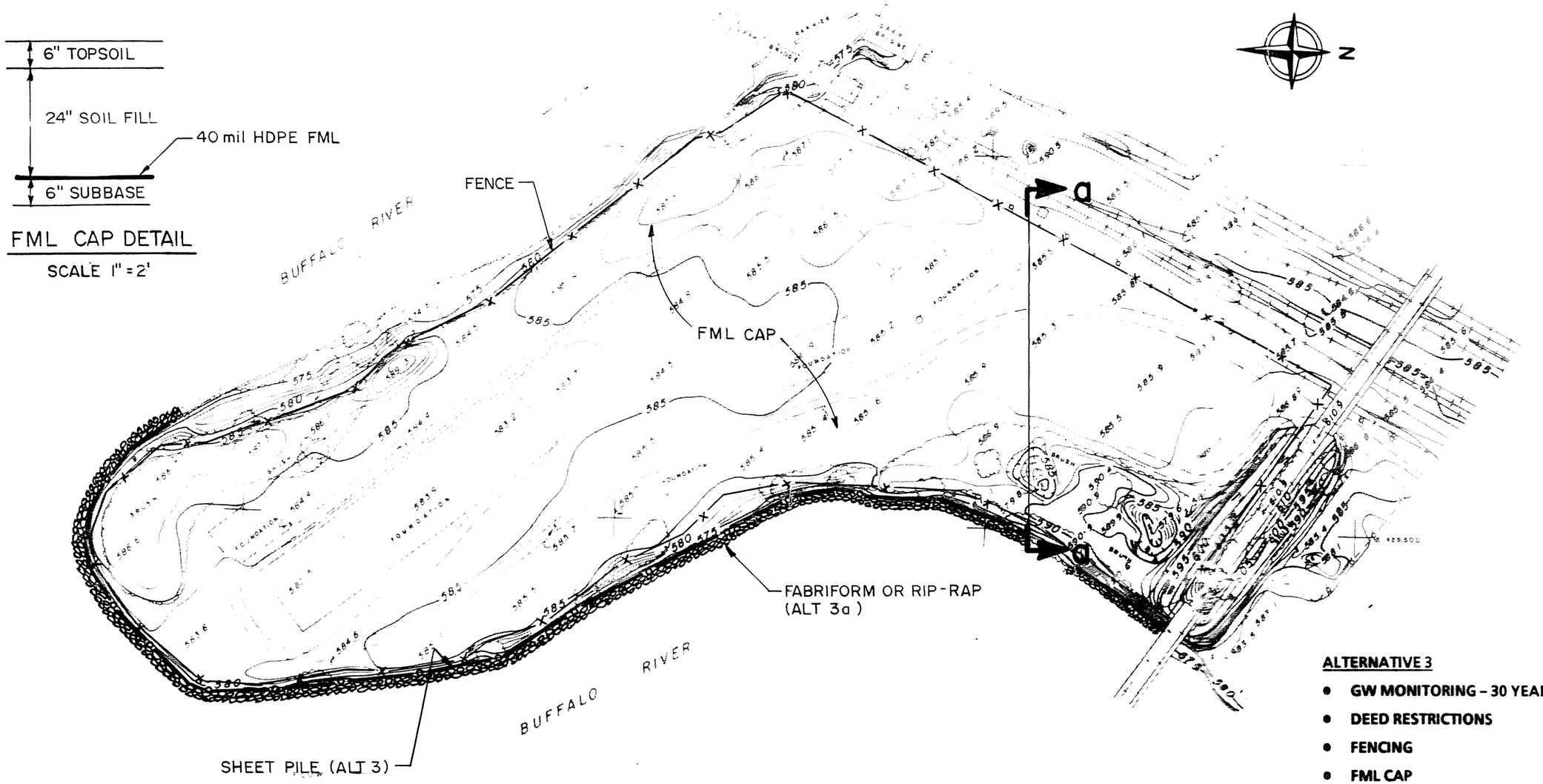
ALTERNATIVE 3 & 3a SCHEMATIC



GENERALIZED SECTION a-a

APPROX. SCALE
H - 1"=100'
V - 1"=20'

WehranEnviroTech	Drawn By: LJ Kobyla Checked By: DAB Date: 12/12/90	Scale AS NOTED		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY	Figure: 5-2a Project No. 00257



ALTERNATIVE 3

- **GW MONITORING – 30 YEARS**
- **DEED RESTRICTIONS**
- **FENCING**
- **FML CAP**
- **SHEET PILE SHORE STABILIZATION**

ALTERNATIVE 3A

- **GW MONITORING – 30 YEARS**
- **DEED RESTRICTIONS**
- **FENCING**
- **FML CAP**
- **'FABRIFORM' OR RIP RAP SHORE STABILIZATION**

WehranEnviroTech	Drawn By: R.F. Gajek Checked By: [illegible] Date: 12/12/90	Scale 1"= 150'		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY ALTERNATIVE 3 & 3a	Figure: 5-2b Project No 00257

groundwater flow from Area "D" into the Buffalo River would be reduced from an estimated 2,506 cubic feet/day (cfd) under baseline conditions to about 510 cfd. This represents approximately an 80 percent decrease. The remaining carcinogenic risk would, therefore, be limited to about 20 percent of the baseline fish ingestion risk (5×10^{-6}) or 1×10^{-6}. The HI would be reduced to 20 percent of the 0.05 attributable to fish ingestion, indicating negligible noncarcinogenic risk (less than 0.01).

Reduction of environmental impacts would occur under this alternative through decreased groundwater loading to the Buffalo River. In addition, sheetpiling to the east and south would reduce contaminant loading to the River via erosion from the banks.

Compliance with ARARs

This alternative will not result in compliance with chemical-specific ARARs/SCGs for migrating groundwater. Regular monitoring would indicate if groundwater quality is improving with time. NYSDEC guidelines for eroding soils are accommodated through shoreline stabilization.

Long-Term Effectiveness and Permanence

This alternative does not provide a permanent remedial action as defined by NYSDEC Hierarchy of Remedial Technology, (TAGM) (May 1990). In order for this alternative to be effective over the long-term, maintenance of the cap and sheetpiling is required. The cap and sheetpiling will require long-term maintenance. Also, without any groundwater collection and treatment, the volume of groundwater leaving the site is reduced with the cap and sheetpiling. The magnitude of the residual risk is less than present due to capping and isolation of sediments with sheetpiling.

Reduction of Toxicity, Mobility, or Volume

Toxicity of the contaminants would not be affected under this alternative. However, capping would reduce both the mobility and volume of contaminated groundwater. Sheetpiling would decrease the mobility of soil-bound contaminants, but would not have any effect on the volume of contaminated soils.

Short-Term Effectiveness

This alternative would pose no short-term risks to the community during the construction of a cap and installation of sheetpiling. Any risks

which may be posed to workers can be mitigated. Likewise, no impacts to the environment will occur during implementation of this alternative. The approximate period of construction for the implementation of this alternative would be one year.

Implementability

This alternative involves the use of proven technologies. A FML cap and sheetpiling are implementable and the required materials and services are available from multiple vendors. No institutional or monitoring problems are foreseen.

Cost

The present worth cost of Alternative 3 is estimated to be $7,346,000 (see Appendix I).

State Acceptance

To be determined after State review of the draft FS report.

Community Acceptance

To be determined after public review of the draft FS report.

5.3 ALTERNATIVE 3a - CAP WITH SHORE STABILIZATION

5.3.1 Description

The primary components of Alternative 3a (Figures 5-2a and b) are:

- A FML cap
- Fabriform®/Rip-Rap for shore stabilization
- The limited action alternative (groundwater monitoring, fencing and deed restrictions)

FML *Cap*

A FML cap is proposed for this alternative and would consist of the same components as identified in Alternative 3. The actual design of the cap that will be installed at the site will be finalized as part of the technical design and be at least equivalent to the cap proposed in Alternative 3.

Fabriform®/Rip-Rap

Fabriform®, which is a monolithic concrete armor structure, or a layer of rip-rap would be installed on the east and south sides of the Area "D" site as a

durable erosion control technology, e.g., to reduce further erosion of the banks and release of contaminated soil from entering the Buffalo River.

To facilitate the installation of the rip rap or fabric/concrete containment barrier, surface preparation is required. This preparation of the river bank will require removal of material which will be deposited within the slurry wall containment system. This material includes "fill" which has eroded on to the river bank out to the edge of the erosion prevention barrier. It is anticipated that an average depth of two feet will be removed and, in most cases, the removal will extend to the U.S. Army Corps of Engineers dredge limit. This slope preparation will be required for all alternatives utilizing Fabriform®/Rip-Rap.

5.3.2 Evaluation

Overall Protection of Human Health and the Environment

This alternative is similar to Alternative 3, however it utilizes Fabriform®/Rip-Rap instead of sheetpiling for erosion control. The Fabriform®/Rip-Rap will provide better containment of the soil/waste to the limit of the fill, but will not provide a reduction in the groundwater flow from the site. At steady-state conditions, flow to the Buffalo River would be reduced to an estimated 518 cfd, or 20 percent of baseline. This would result in total carcinogenic risks, through the fish consumption pathway, of approximately 1.5×10^{-6}. The HI would still indicate negligible noncarcinogenic hazard.

Compliance with ARARs

This alternative will not result in compliance with chemical-specific ARARs/SCGs for migrating groundwater. Regular monitoring would indicate if groundwater quality is improving with time. NYSDEC guidelines for eroding soils are accommodated through shoreline stabilization.

Long-Term Effectiveness and Permanence

This alternative does not provide a permanent remedial action as defined by NYSDEC Remedial Action Technologies TAGM (May 1990). However, in order for this alternative to be effective over the long-term, maintenance of the cap and Fabriform®/Rip-Rap is required. The Corps of Engineers currently dredges the Buffalo River on a regular basis. The dredging of the River will potentially undermine the Fabriform®/Rip-Rap

slope stabilization material. This effect can be reduced with proper anchoring of the Fabriform®/Rip-Rap, as well as timing the placement of the installation shortly after the River has been dredged. The implementation of a FML cap and Fabriform®/Rip-Rap would utilize readily available materials and services. No institutional or monitoring problems are foreseen.

Reduction of Toxicity, Mobility, or Volume

A smaller reduction of environmental impacts associated with groundwater discharge to the River would occur under this alternative than Alternative 3 because of the lower groundwater flow attenuation. However, any impacts due to erosion loading to the River would be reduced.

Short-Term Effectiveness

There is no community risk during the construction phase of this alternative and any worker risk can be mitigated. Likewise, no impact to the environment will occur during construction of this alternative. The approximate construction period for this alternative would be one and one-half years.

Implementability

This alternative involves the use of proven and reliable technologies. A FML cap and Fabriform®/Rip-Rap are easily implementable and require technologies that are readily available from multiple vendors. No significant institutional or monitoring problems are foreseen.

Cost

The present worth cost of Alternative 3a is estimated to be $5,195,000 (see Appendix I).

State Acceptance

To be determined after State review of the draft FS report.

Community Acceptance

To be determined after public review of the draft FS report.

5.4 ALTERNATIVE 4 – CAP WITH PERIMETER GROUNDWATER COLLECTION, PRE-TREATMENT AND DISPOSAL TO BUFFALO SEWER AUTHORITY (BSA), AND SHORE STABILIZATION

5.4.1 Description

Alternative 4 (Figures 5-3a and b) includes the following components:

- A FML cap as described for Alternative 3.
- Fabriform®/Rip-Rap for shore stabilization.
- Pumping of groundwater from perimeter collection drains located along the downgradient sides.
- Pre-Treatment of groundwater for discharge to BSA.
- Limited action alternative (fencing, deed restrictions, monitoring)

5.4.2 Evaluation

Overall Protection of Human Health and the Environment

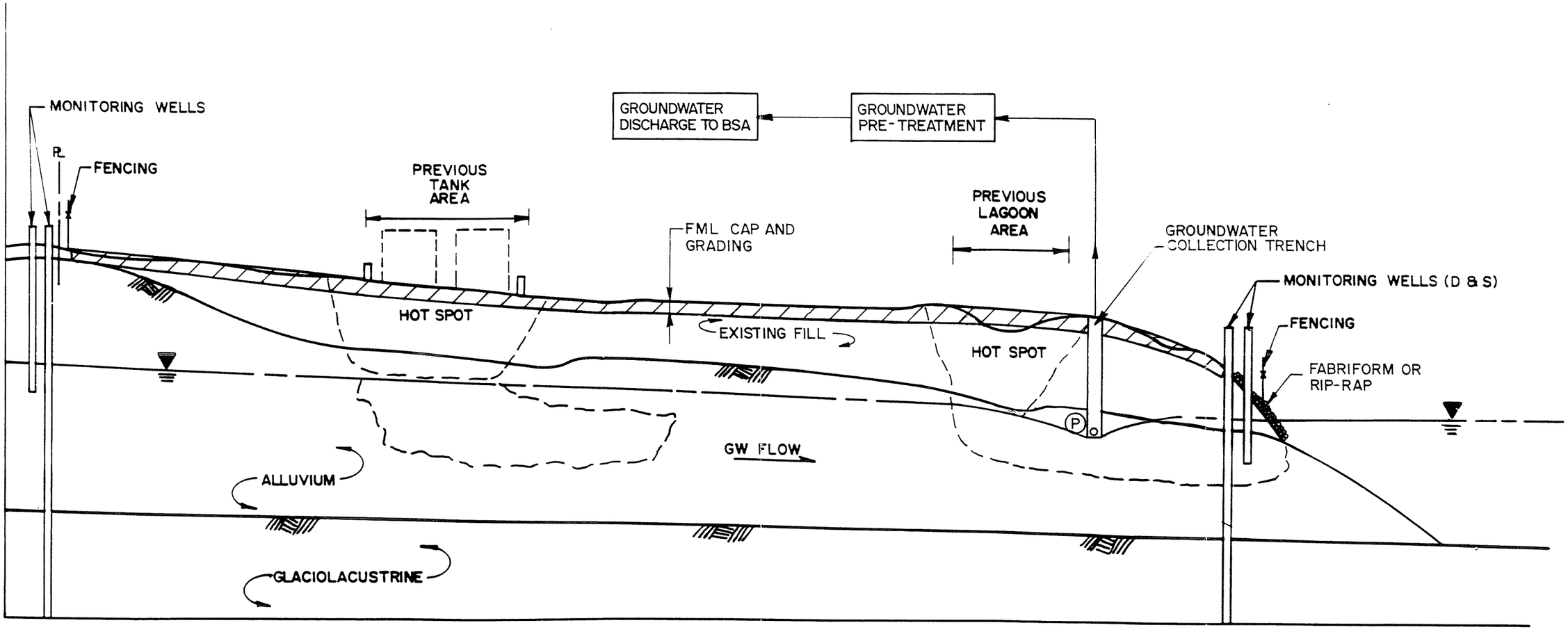
As described for Alternative 3A, the provision of a FML cap and shore stabilization would remove public health risks associated with contact, incidental ingestion and inhalation pathways. The addition of perimeter groundwater collection would also essentially eliminate further migration of contaminated groundwater from Area "D" into the Buffalo River by reversing the flow gradient through associated pumping. This would eventually assist in the reduction of human health risks associated with consumption of contaminated fish from the Buffalo River; the time frame of this reduction is dependent on the turnover of the local game fish population and the ability of fish to metabolize and/or excrete contaminants. Health impacts potentially associated with erosion loading to the River would be mitigated through the use of Fabriform®/Rip-Rap for shore stabilization.

This alternative would provide significant protection of the environment by preventing migration of contaminated groundwater into the Buffalo River and the erosion of soils/waste from Area "D".

Compliance with ARARs/SCGs

In this alternative, groundwater will be moving into the site thereby obviating the applicability of chemical-specific ARARs/SCGs for groundwater. Discharge limitations for pre-treated groundwater to the BSA and discharges to the atmosphere from the treatment process will also be met. NYSDEC

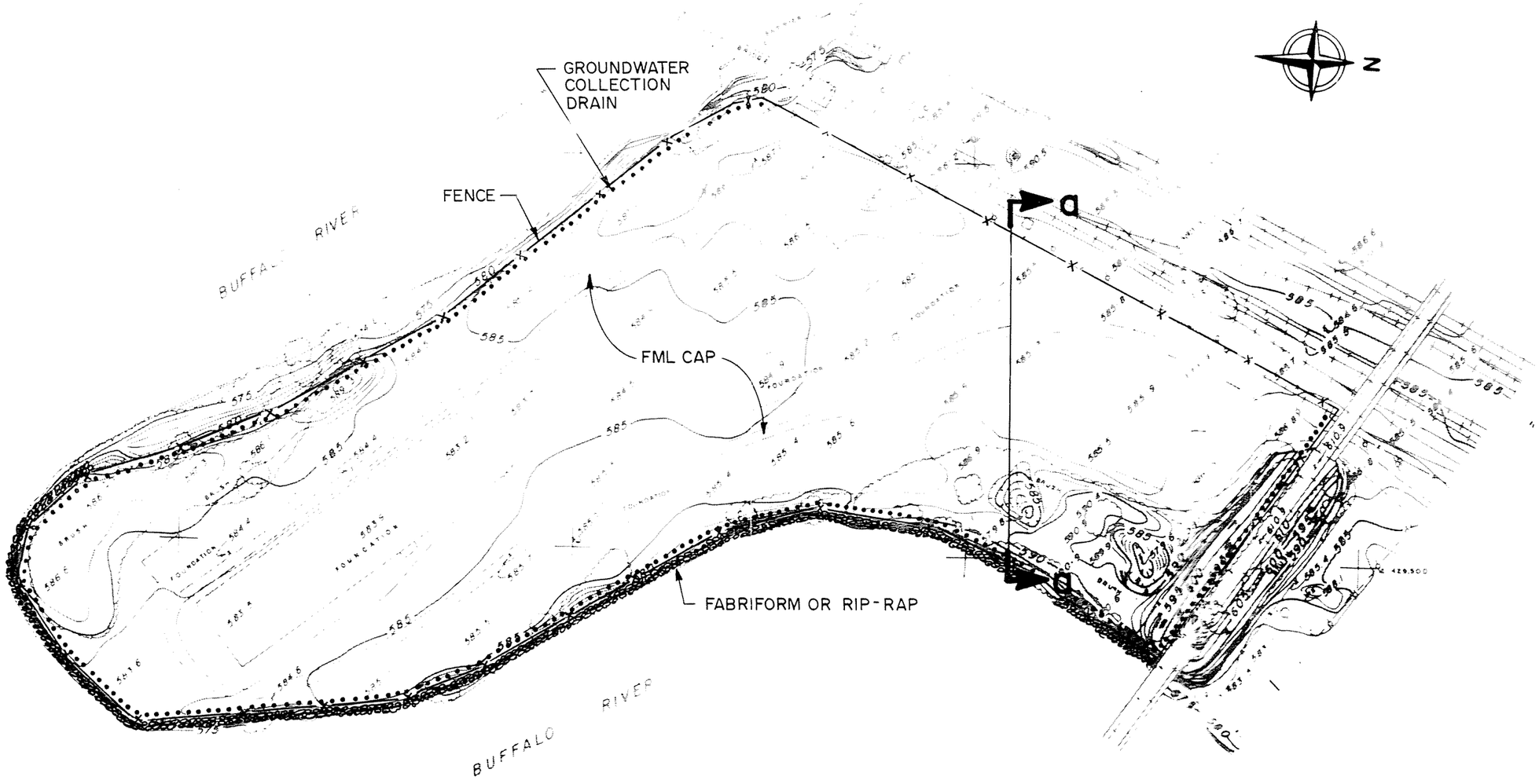
ALTERNATIVE 4 SCHEMATIC



GENERALIZED SECTION a-a

APPROX. SCALE
H - 1"=100'
V - 1"=20'

Weston EnviroTech	Drawn By: K.J. Hodgkins Checked By: [illegible] Date: 12/12/90	Scale AS NOTED		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY	Figure: 5-3a Project No. 00257



ALTERNATIVE 4

- GW MONITORING – 30 YEARS
- DEED RESTRICTIONS
- FENCING
- FML CAP
- PERIMETER GW COLLECTION
- GW PRETREATMENT
- GW DISPOSAL TO BUFFALO SEWER AUTHORITY
- 'FABRIFORM' OR RIP RAP SHORE STABILIZATION

WehranEnviroTech

Drawn By : KY Kodgis
Checked By : DAb
Date : 12/14/90

Scale: 1"= 150'

BUFFALO COLOR CORPORATION
BUFFALO ERIE COUNTY NEW YORK

AREA D FEASIBILITY STUDY
ALTERNATIVE 4

Figure : 5-3b
Project No 00257

guidelines for eroding soils are accommodated through shoreline stabilization.

Long-Term Effectiveness and Permanence

This alternative is not classified as a permanent remedy in accordance with the NYSDEC Remedial Actions Technologies TAGM (May 1990). However, in order for this remedy to provide effectiveness for the expected duration of over 30 years, maintenance of the cap, groundwater pre-treat system and shore stabilization will be necessary.

Reduction of Toxicity, Mobility, or Volume

Under this alternative, an estimated 55,700 cfd of groundwater removed by the perimeter collection system would be treated for disposal to the Buffalo Sewer Authority (BSA). This would provide a significant reduction in toxicity for the groundwater collected at the site. However, the total volume of contaminated groundwater will be increased due to the lack of a cut-off wall. It would also reduce the generation of contaminated groundwater through precipitation infiltration (via the cap). Mobility of groundwater to the River would be entirely eliminated. Toxicity, mobility and volume of soil-bound contaminants and waste materials eroding into the River would be significantly reduced.

Short-Term Effectiveness

This alternative will not impact the community during implementation and worker impacts during construction can be mitigated. There will be no impacts to the environment during construction of the cap and perimeter collection drains. The approximate period for construction of this alternative would be two years.

Implementability

This alternative is implementable in that the materials to construct the components of this alternative are readily available from commercial vendors. In addition, there is minimal intervention from State and local agencies required for permits. No unusual institutional or monitoring problems are foreseen.

Cost

The present value cost of Alternative 4 is estimated to be $13,693,000 (see Appendix I). The O&M costs for pumping and pre-treatment are applicable for a period of 30 years.

State Acceptance

To be determined after State review of the draft FS report.

Community Acceptance

To be determined after public review of the draft FS report.

5.5 ALTERNATIVE 5 – MULTI-MEDIA CAP, PERIMETER GROUNDWATER COLLECTION, PRE-TREATMENT AND DISPOSAL TO BSA, AND SHORE STABILIZATION

5.5.1 Description

The components of Alternative 5 (Figures 5-4a and b) consist of the following:

- Multi-Media Cap.
- Fabriform®/Rip-Rap for shore stabilization.
- Pumping of groundwater from perimeter collection drains along the site.
- Pre-treatment of groundwater for discharge to BSA.
- Limited action alternative (fencing, deed restrictions, monitoring).

5.5.2 Evaluation

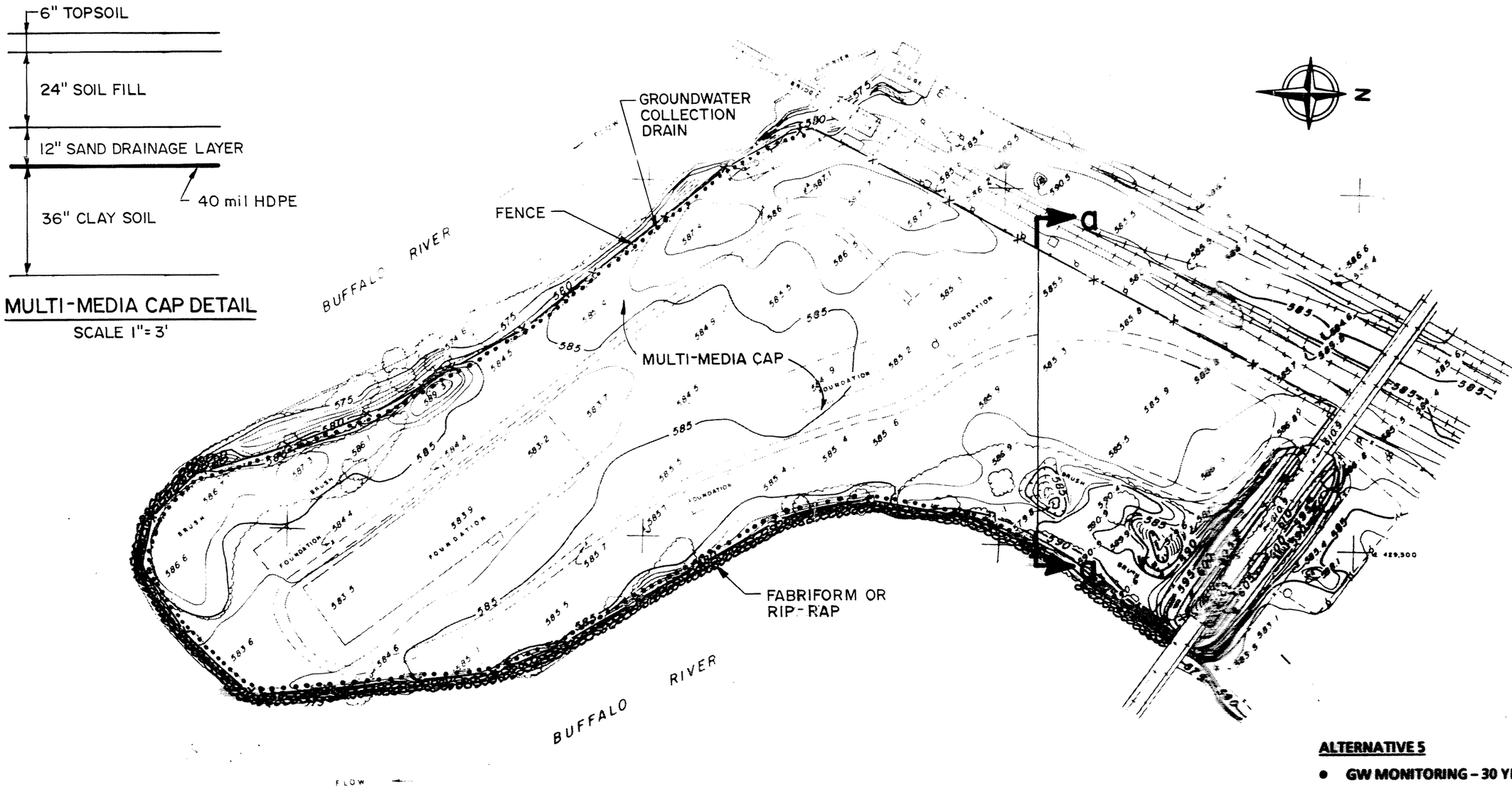
Overall Protection of Human Health and the Environment

This alternative would eliminate the calculated public health risks associated with the site, as described for Alternative 4.

Environmental risks under this alternative would be virtually eliminated due to the prevention of further contaminant loading to the Buffalo River. As discussed under Alternative 4, the reduction in public health and environmental impacts associated with the Buffalo River would decline over time following remedial action implementation.

Compliance with ARARs/SCGs

In this alternative, groundwater will be moving into the site thereby obviating the applicability of chemical-specific ARARs/SCGs for groundwater. Discharge limitations for pre-treated groundwater to the BSA and discharges to the atmosphere from the treatment process will also be met. NYSDEC



MULTI-MEDIA CAP DETAIL

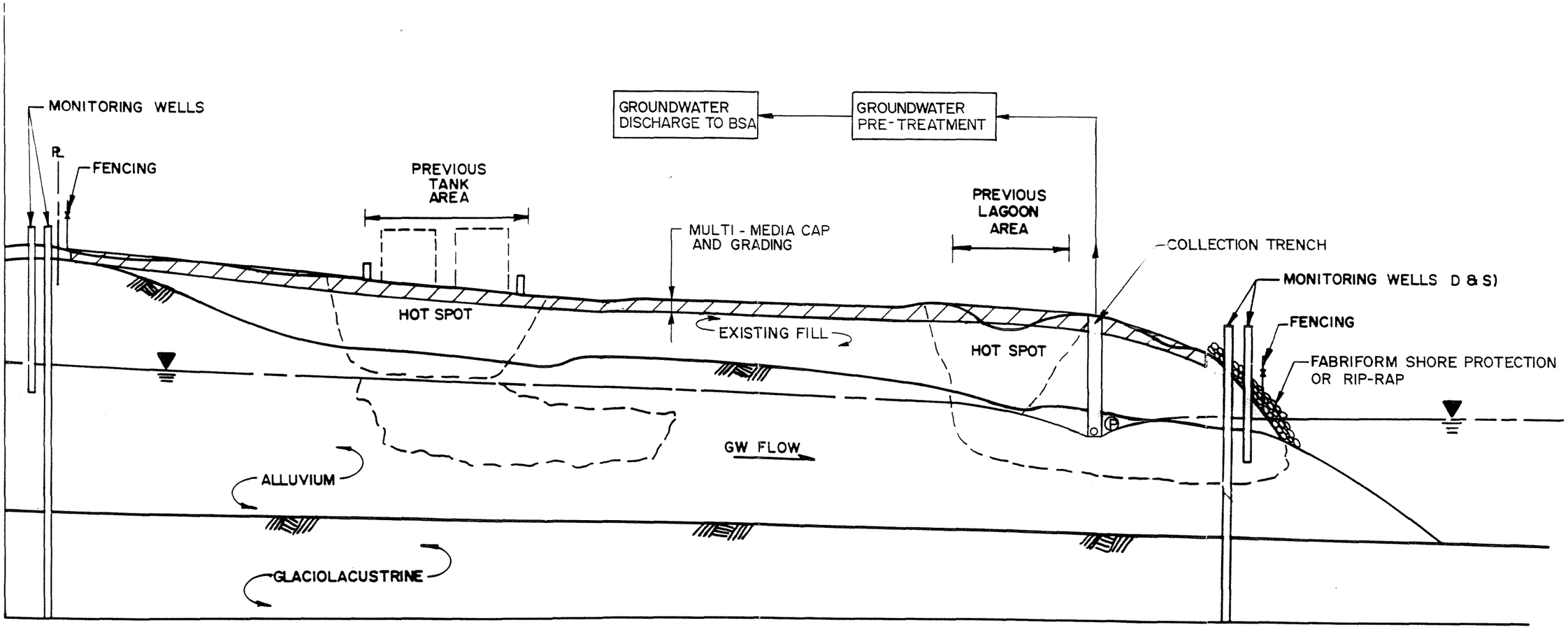
SCALE 1"= 3'

ALTERNATIVE 5

- **GW MONITORING – 30 YEARS**
- **DEED RESTRICTIONS**
- **FENCING**
- **MULTI-MEDIA CAP**
- **PERIMETER GW COLLECTION**
- **GW PRETREATMENT**
- **GW DISPOSAL TO BUFFALO SEWER AUTHORITY**
- **'FABRIFORM' OR RIP RAP SHORE STABILIZATION**

WehranEnviroTech	Drawn By : L. F. Hodgson Checked By : [illegible] Date : 12/12/90	Scale 1" = 150'		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY ALTERNATIVE 5	Figure : 5-4b Project No. 00257

ALTERNATIVE 5 SCHEMATIC



GENERALIZED SECTION a-a

APPROX. SCALE
H - 1"=100'
V - 1"=20'

Wehran EnviroTech	Drawn By: T. F. Gaglio Checked By: JMH Date: 12/12/90	Scale AS NOTED		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY	Figure: 5-4a Project No. 00257

guidelines for eroding soils are accommodated through shoreline stabilization.

Long-Term Effectiveness and Permanence

This alternative does not provide a permanent remedial action as defined by NYSDEC Remedial Action Technologies TAGM, May 1990. However, in order for this remedy to provide effectiveness for the expected duration of 30 years, maintenance of the cap, pump and treat system, and shore stabilization will be necessary for the anticipated duration of clean-up. Although this alternative does not provide a reduction in volume of waste, it does reduce the mobility of waste via a cap, groundwater treatment and shore stabilization. This alternative provides an effective approach to a reduction in the exposure of soil/waste and the toxicity of aquatic organisms in the adjacent Buffalo River.

Reduction of Toxicity, Mobility, or Volume

This alternative would decrease groundwater toxicity via groundwater pretreatment, as discussed under Alternative 4. By restricting erosion using Fabriform®/Rip-Rap, it would also reduce the mobility of waste materials. Through the installation of a cap, the volume of leachate would be reduced by a roughly equivalent amount as in Alternative 4. The substitution of a multi-media cap for an FML cap is not anticipated to reduce the groundwater volume below the 55,700 cfd predicted for Alternative 4.

Short-Term Effectiveness

This alternative provides protection to the community and the environment in that there is no exposure during implementation. Any worker exposure can be mitigated. The approximate period of construction for this alternative would be two and one-half years.

Implementability

This alternative is implementable. The materials to construct a multi-media cap, pump and treat system, and shore stabilization are readily available from commercial vendors. Minimal coordination among State and local agencies is required. No unusual institutional or monitoring problems are foreseen.

Cost

The present value cost of Alternative 5 is estimated to be $16,297,000 (see Appendix I).

State Acceptance

To be determined after State review of the draft FS report.

Community Acceptance

To be determined after public review of the draft FS report.

5.6 ALTERNATIVE 6 – CAP, DOWNGRADIENT CUTOFF, PERIMETER GROUNDWATER COLLECTION, PRE-TREATMENT, DISPOSAL TO BSA, AND SHORE STABILIZATION

5.6.1 Description

Alternative 6 (Figures 5 -5a and b) includes the following components:

- A FML cap as described in Alternative 3.
- Pumping of groundwater from perimeter collection drains located along the downgradient sides.
- Pre-treatment of groundwater for discharge to BSA.
- Slurry wall on the downgradient side of the site.
- Fabriform®/Rip-Rap for shore stabilization.
- Limited action alternative (fencing, deed restrictions, monitoring).

5.6.2 Evaluation

Overall Protection of Human Health and the Environment

This alternative would provide essentially complete protection of human health and the environment, as discussed for Alternative 5.

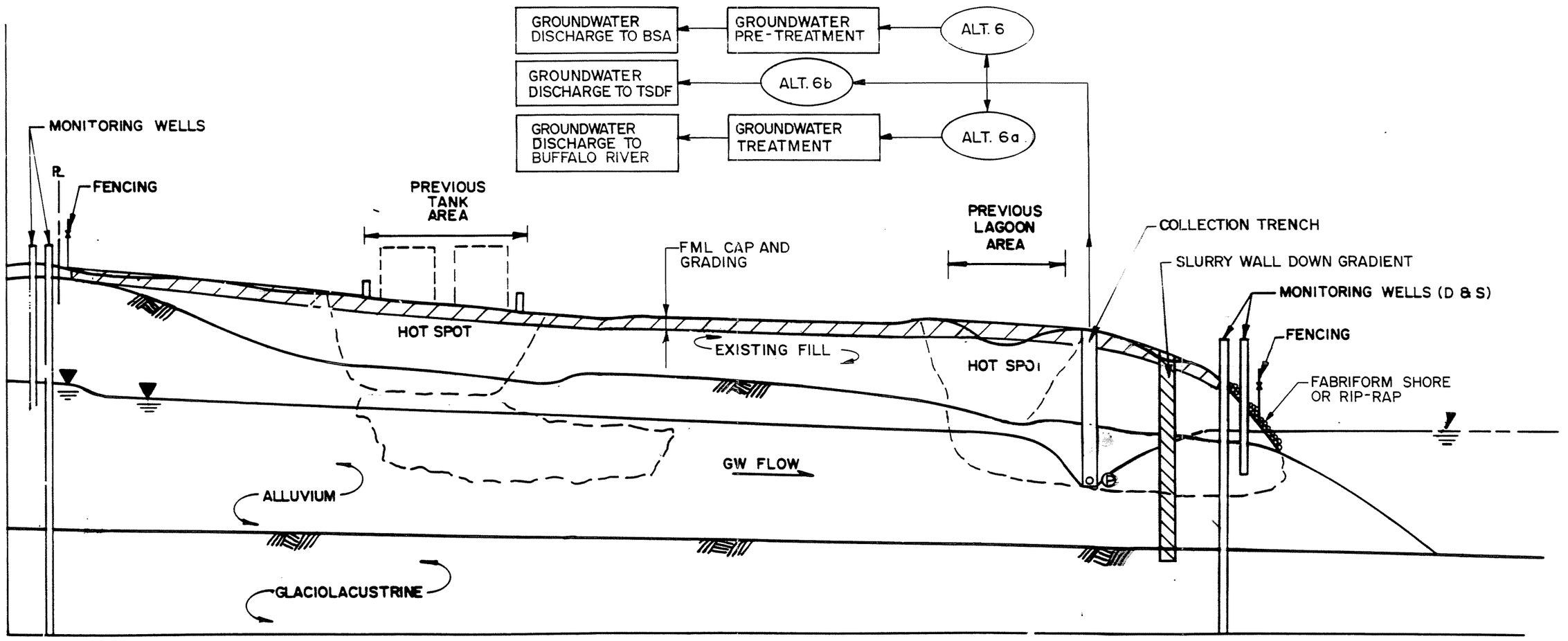
Compliance with ARARs/SCGs

In this alternative, a reduced volume of groundwater will be migrating into the site, thereby obviating the applicability of the chemical-specific migrating groundwater ARARs/SCGs. Discharge limitations for pre-treated groundwater to the BSA and discharges to the atmosphere from the treatment processes will also be met. NYSDEC guidelines for eroding soils are accommodated through shoreline stabilization.

Long-term Effectiveness and Permanence

Although not considered as a permanent remedial action as defined by the NYSDEC TAGM (May 1990), through the implementation of groundwater

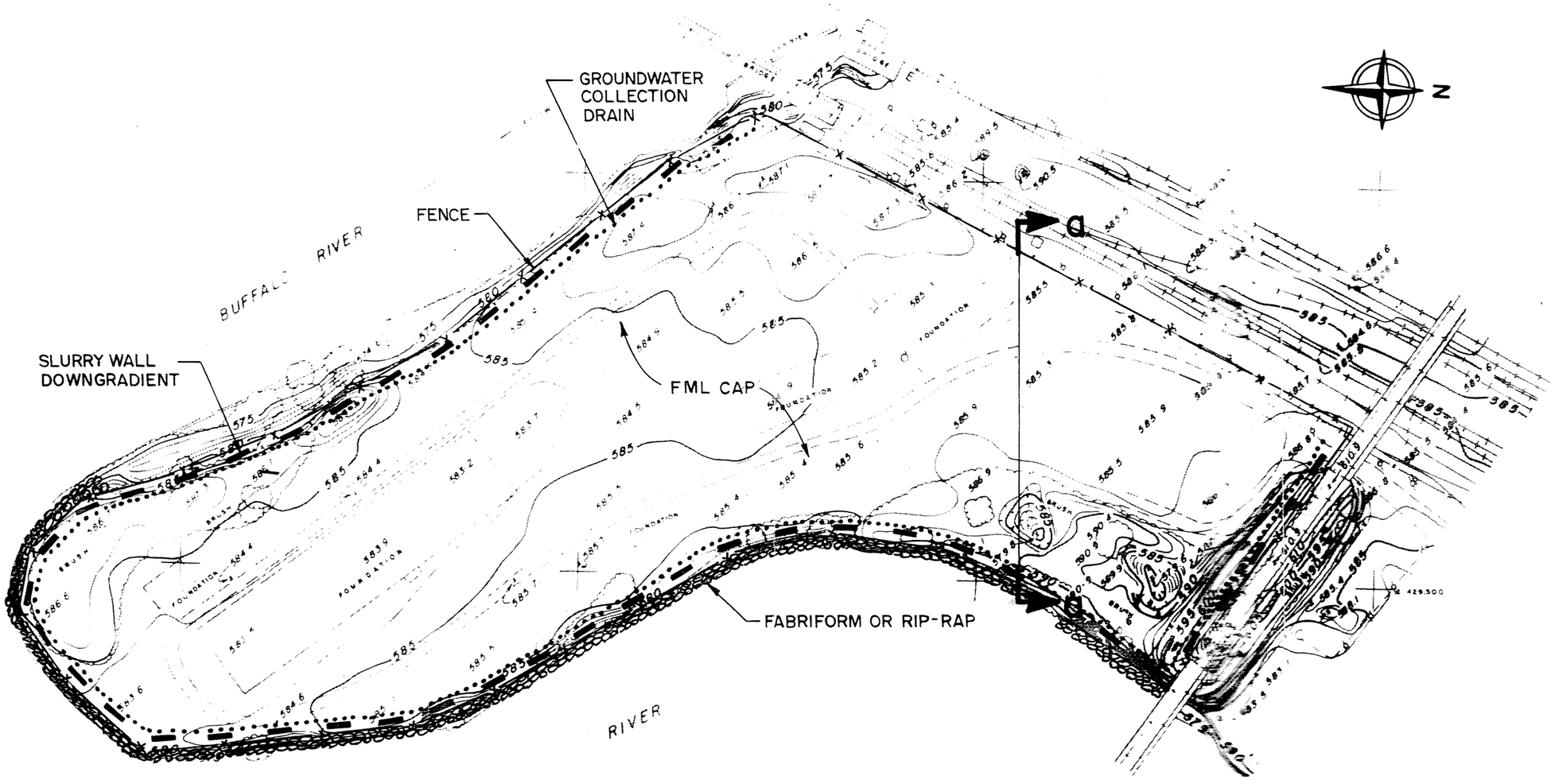
ALTERNATIVE 6, 6a, & 6b SCHEMATIC



GENERALIZED SECTION a-a

APPROX. SCALE
H - 1"=100'
V - 1"=20'

WehranEnviroTech	Drawn By: AF Godzilla Checked By: JJB Date: 12/18/92	Scale AS NOTED		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY	Figure : 5-5a Project No. 00257



ALTERNATIVE 6

- GW MONITORING – 30 YEARS
- DEED RESTRICTIONS
- FENCING
- FML CAP
- PERIMETER GW COLLECTION
- GW PRETREATMENT
- GW DISPOSAL TO BUFFALO SEWER AUTHORITY
- SLURRY WALL – DOWNGRADIENT
- 'FABRIFORM' OR RIP RAP SHORE STABILIZATION

ALTERNATIVE 6A

- GW MONITORING – 30 YEARS
- DEED RESTRICTIONS
- FENCING
- FML CAP
- PERIMETER GW COLLECTION
- GW TREATMENT
- GW DISPOSAL TO BUFFALO RIVER
- SLURRY DOWNGRADIENT
- 'FABRIFORM' OR RIP RAP SHORE STABILIZATION

ALTERNATIVE 6B

- GW MONITORING – 30 YEARS
- DEED RESTRICTIONS
- FENCING
- FML CAP
- PERIMETER GW COLLECTION
- GW DISPOSAL TO TSDF
- SLURRY WALL DOWNGRADIENT
- 'FABRIFORM' OR RIP RAP SHORE STABILIZATION

Weston EnviroTech	Drawn By: L. F. Hogan Checked By: Date: 12/12/90	Scale 1" = 150'		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY ALTERNATIVE 6, 6a & 6b	Figure: 5-5b Project No. 00257

collection and pre-treatment, capping, and downgradient slurry wall, this alternative provides an effective means of reducing the mobility and toxicity of contaminated groundwater and soils from the Area "D" site. This alternative will remain effective provided a long-term O&M program is employed for purposes of cap maintenance and slurry wall upkeep. Likewise, the groundwater pump and treat system will require long-term maintenance. This alternative affords an effective approach to a reduction in the exposure of soil/waste and the toxicity of aquatic organisms in the adjacent Buffalo River.

Reduction of Toxicity, Mobility, or Volume

As discussed, pretreatment of groundwater prior to disposal at the BSA would reduce the toxicity of the groundwater collected. The provision of a cap, groundwater collection, a cutoff wall and shore stabilization (Fabriform®/Rip-Rap) would almost totally eliminate off-site contaminant migration. Volume would be significantly reduced through the installation of a cap and downgradient slurry wall. The estimated groundwater flow through the collection system is 2250 cfd, a 96 percent reduction compared to Alternatives 4 and 5.

Short-Term Effectiveness

This alternative will not impact the community or environment during implementation and any worker exposure can be mitigated. The approximate construction period would be two and one-half years.

Implementability

This alternative is implementable and the remedial technologies are very reliable in meeting the performance goals. Coordination among regulatory agencies and the BSA will be necessary. The technologies for groundwater pump and treat, cap and slurry wall construction are commercially available from multiple vendors. No unusual institutional or monitoring problems are foreseen, however, it is significant to note that the heterogeneous nature of the fill may pose some difficulties in the installation of the slurry wall.

Cost

The present value cost of Alternative 6 is estimated to be $8,620,000 (see Appendix I).

State Acceptance

To be determined after State review of the draft FS report.

Community Acceptance

To be determined after public review of the draft FS report.

5.7 ALTERNATIVE 6a –CAP, PERIMETER GROUNDWATER COLLECTION, TREATMENT, DISPOSAL TO BUFFALO RIVER, DOWNGRADIENT CUTOFF, AND SHORE STABILIZATION

5.7.1 Description

Alternative 6a (Figures 5-5a and b) provides the following components:

- A FML cap as described for Alternative 3.
- Pumping of groundwater from perimeter collection drains located along the downgradient sides.
- Treatment of groundwater for discharge to the Buffalo River.
- Downgradient slurry wall.
- Fabriform®/Rip-Rap for shore stabilization.
- Limited action alternative (fencing, deed restrictions, monitoring).

5.7.2 Evaluation

Overall Protection of Human Health and the Environment

This alternative would provide essentially complete protection of human health and the environment, as discussed for Alternative 6.

Compliance with ARARs/SCGs

In this alternative, a reduced volume of groundwater will be migrating into the site, thereby obviating the applicability the chemical-specific ARARs/SCGs for groundwater. The groundwater treatment system will be designed to meet the permit requirements for discharge to the surface waters of the Buffalo River and the atmosphere. NYSDEC guidelines for eroding soils are accommodated through shoreline stabilization.

Long-Term Effectiveness and Permanence

Although this alternative is not classified in the NYSDEC TAGM (May 1990) as permanent, this alternative will provide an effective means of treatment of the contaminated groundwater while also providing a reduction in exposure to the soils/waste. The cap will provide a reduction in the infiltration of water thus minimizing leachate and/or contaminated groundwater generation.

This alternative will require a long-term O&M program. This alternative affords an effective means of reducing the exposure to soil/waste and the toxicity to aquatic organisms in the adjacent Buffalo River.

Reduction of Toxicity, Mobility or Volume

Reduction in mobility and volume offered by this alternative would be identical to Alternative 6. However, disposal to the Buffalo River (vs. the BSA) would require total groundwater treatment and, therefore, greater reduction in toxicity.

Short-Term Effectiveness

This alternative will not result in any impacts to the community or environment during implementation. Any worker exposure can be mitigated. The approximate construction period would be two and one-half years.

Implementability

This alternative is implementable and utilizes commercially available technologies. The technologies for cap and slurry wall construction along with a pump and treat system are very reliable and will not require additional remedial measures. No significant institutional problems are foreseen, however, it is significant to note that the heterogeneous nature of the fill may pose some difficulties with installation of the slurry wall.

Cost

The present value cost of Alternative 6a is estimated to be $9,432,000 (see Appendix I).

State Acceptance

To be determined after State review of the draft FS report.

Community Acceptance

To be determined after public review of the draft FS report.

5.8 ALTERNATIVE 6b – CAP, PERIMETER GROUNDWATER COLLECTION AND DISPOSAL TO TSDF, DOWNGRADIENT CUTOFF, AND SHORE STABILIZATION

5.8.1 Description

This alternative contains similar components as Alternative 6 with the exception of disposal of collected, untreated groundwater to a RCRA-permitted TSDF (Figures 5-5a and b).

5.8.2 Evaluation

Overall Protection of Human Health and the Environment

This alternative would provide essentially complete protection of human health and the environment, as discussed for Alternatives 6 and 6a.

Compliance with ARARs/SCGs

In this alternative, a reduced volume of groundwater will be migrating into the site, thereby obviating the applicability the chemical-specific ARARs/SCGs for groundwater. The collection of groundwater for disposal to a TSDF will attain the chemical-specific groundwater ARARs/SCGs outside of the collection system and the air discharge standards. NYSDEC guidelines for eroding soils are accommodated through shoreline stabilization.

Long-Term Effectiveness and Permanence

This alternative will provide the same effectiveness and permanence as Alternative 6. An O&M program will be necessary for the anticipated duration of clean-up. This alternative, although not permanent as classified by the NYSDEC TAGM, will provide a reduction in exposure to the soils/waste and control the erosion of contaminated soils into the Buffalo River.

Reduction of Toxicity, Mobility, or Volume

Reduction in toxicity, mobility and volume would be the same under this alternative as under Alternatives 6 and 6a, as the addition of an upgradient wall has no anticipated impact on the volume of groundwater through the collection system.

Short-Term Effectiveness

This alternative affords the same short-term effectiveness as Alternative 6 for purposes of no community and environment exposure and

the ability to mitigate worker exposure. The approximate construction period would be two and one-half years.

Implementability

This alternative is implementable and utilizes commercially available and reliable technologies. Coordination with a RCRA-permitted TSDF will be necessary. No unusual institutional or monitoring problems are foreseen, however, installation of a slurry wall in the heterogeneous fill material may pose some difficulties.

Cost

The present value cost of Alternative 6b is estimated to be $34,927,000 (see Appendix I).

State Acceptance

To be determined after State review of the draft FS report.

Community Acceptance

To be determined after public review of the draft FS report.

5.9 ALTERNATIVE 6c – CAP, PERIMETER GROUNDWATER COLLECTION AND NAPL COLLECTION, PRE-TREATMENT AND DISPOSAL TO BSA, COMPLETE CUTOFF, SHORELINE FILL EXCAVATION, AND COMPLETE SHORE STABILIZATION

5.9.1 Description

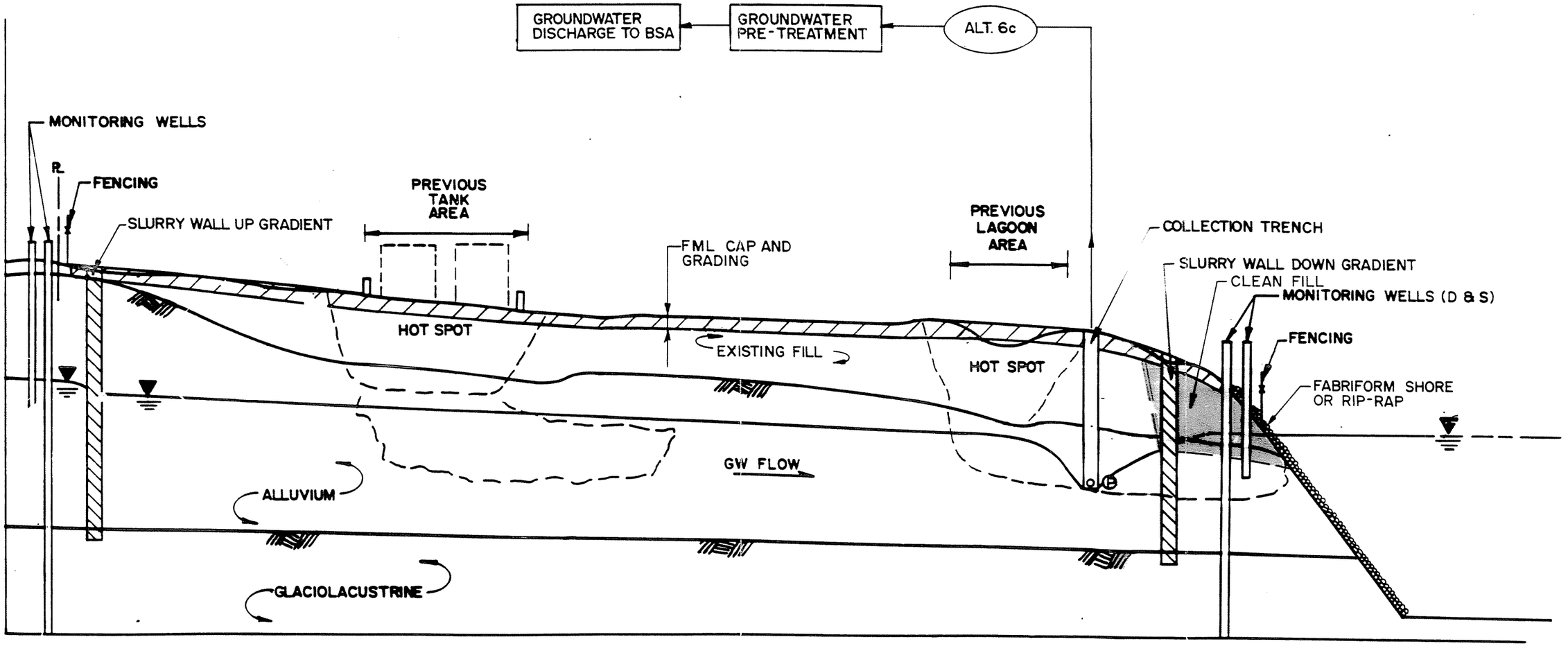
This alternative contains the same components as Alternative 6 with the addition of a complete slurry wall for total containment of the site. Also included in this alternative would be shore stabilization around the entire perimeter, extension of the groundwater collection system into NAPL areas, and excavation of all fill materials outside of the cutoff wall to the point of intersection of the Fabriform®/Rip-Rap prepared slope and a line drawn parallel and two feet into the top of the alluvium layer, as a maximum depth (Figures 5-6a and b).

5.9.2 Evaluation

Overall Protection of Human Health and the Environment

This alternative would provide essentially complete protection of human health and the environment, as discussed for Alternatives 6 through 6b.

ALTERNATIVE 6c SCHEMATIC

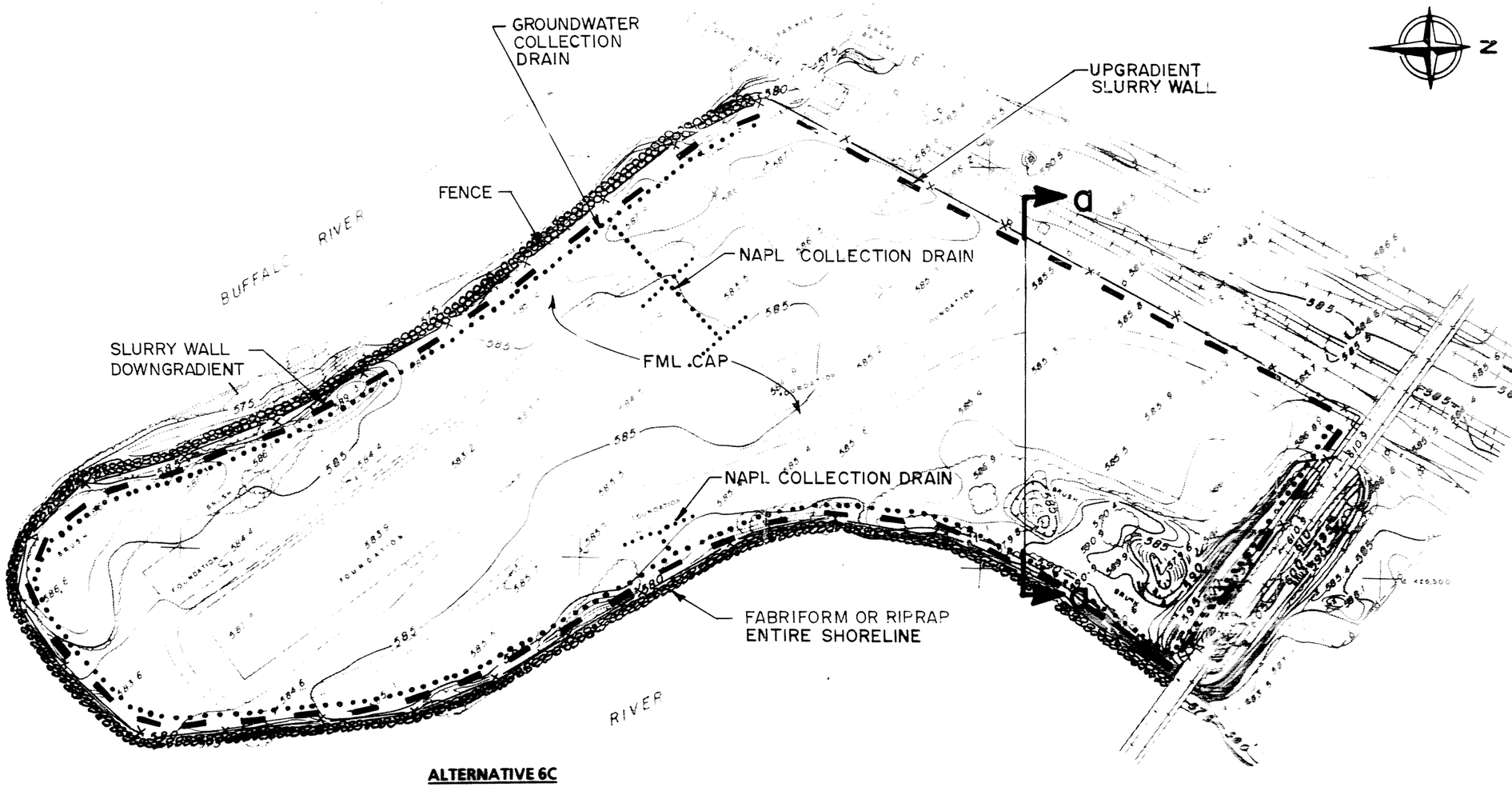


GENERALIZED SECTION a-a

APPROX. SCALE
H - 1"=100'
V - 1"=20'

REVISED 6/25/91

Wehran EnviroTech	Drawn By: LF Sodia Checked By: JAB Date: 12/18/90	Scale AS NOTED		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY	Figure: 5-6a Project No. 00257



ALTERNATIVE 6C

- **GW MONITORING – 30 YEARS**
- **DEED RESTRICTIONS**
- **FENCING**
- **FML CAP**
- **PERIMETER GW COLLECTION**
- **GW PRETREATMENT**
- **GW DISPOSAL TO BUFFALO SEWER AUTHORITY**
- **SLURRY UPGRADIENT**
- **SLURRY DOWNGRADIENT**
- FABRIFORM OR RIPRAP SHORE STABILIZATION AROUND ENTIRE SHORELINE
- SHORELINE EXCAVATION OF FILL OUTSIDE SLURRY WALL
- NAPL COLLECTION

REVISED 6/25/91

WehranEnviroTech	Drawn By : [illegible] Checked By : [illegible] Date : 12/18/90	Scale 1" = 150'		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY ALTERNATIVE 6C	Figure : 5-6b Project No. 00257

Compliance with ARARs/SCGs

In this alternative, a substantially reduced volume of groundwater will be migrating into the site, thereby obviating the applicability the chemical-specific ARARs/SCGs for migrating groundwater. The collection and pre-treatment of groundwater will attain BSA discharge limitations and air standards for treatment discharges to the atmosphere. NYSDEC guidelines for eroding soils are accommodated through shoreline stabilization.

Long-Term Effectiveness and Permanence

This alternative will provide the same effectiveness and permanence as Alternative 6, however with more effective groundwater recovery with the additional upgradient slurry wall. This remedial alternative is not classified as permanent according to the NYSDEC TAGM Hierarchy of Remedial Technologies, however, it does provide separation and treatment of the contaminants present in groundwater and provides a reduction in exposure of the soil/waste while controlling erosion of the soil/waste into the Buffalo River.

Reduction of Toxicity, Mobility, or Volume

This alternative would provide similar reduction in mobility and toxicity as Alternatives 6 through 6b. However, the inclusion of a complete cutoff wall would reduce the volume of contaminated groundwater still further, to an estimated 84 cfd (vs. 2250 cfd in Alternatives 6 through 6b). The total reduction in volume through the collection system compared with no cutoff wall (Alternatives 4 and 5) would still be approximately 0.1 percent.

Additionally, the excavation of all fills outside the cutoff wall, as described above, would immediately reduce the toxicity, mobility and volume of the waste in this area.

Short-Term Effectiveness

This alternative provides the same short-term effectiveness as Alternative 6. The approximate construction period would be three years.

Implementability

This alternative is implementable and utilizes commercially available and reliable technologies. Coordination with the BSA and NYSDEC will be necessary. No significant institutional problems are foreseen, however,

installation of a complete slurry wall into the heterogeneous fill material may pose some difficulties..

Cost

The present value cost of Alternative 6c is estimated to be $9,556,000 (see Appendix I).

State Acceptance

To be determined after State review of the draft FS report.

Community Acceptance

To be determined after public review of the draft FS report.

5.10 ALTERNATIVE 6d – CAP, COMPLETE CUTOFF, SHORE STABILIZATION AND PERIMETER GROUNDWATER COLLECTION, TREATMENT AND DISCHARGE TO BUFFALO RIVER

5.10.1 Description

This alternative has the same components as Alternative 6a with the addition of an upgradient slurry wall for complete groundwater cutoff (Figures 5-7a and b).

5.10.2 Evaluation

Overall Protection of Human Health and the Environment

This alternative would provide essentially complete protection of human health and the environment, as discussed for Alternatives 6 through 6c.

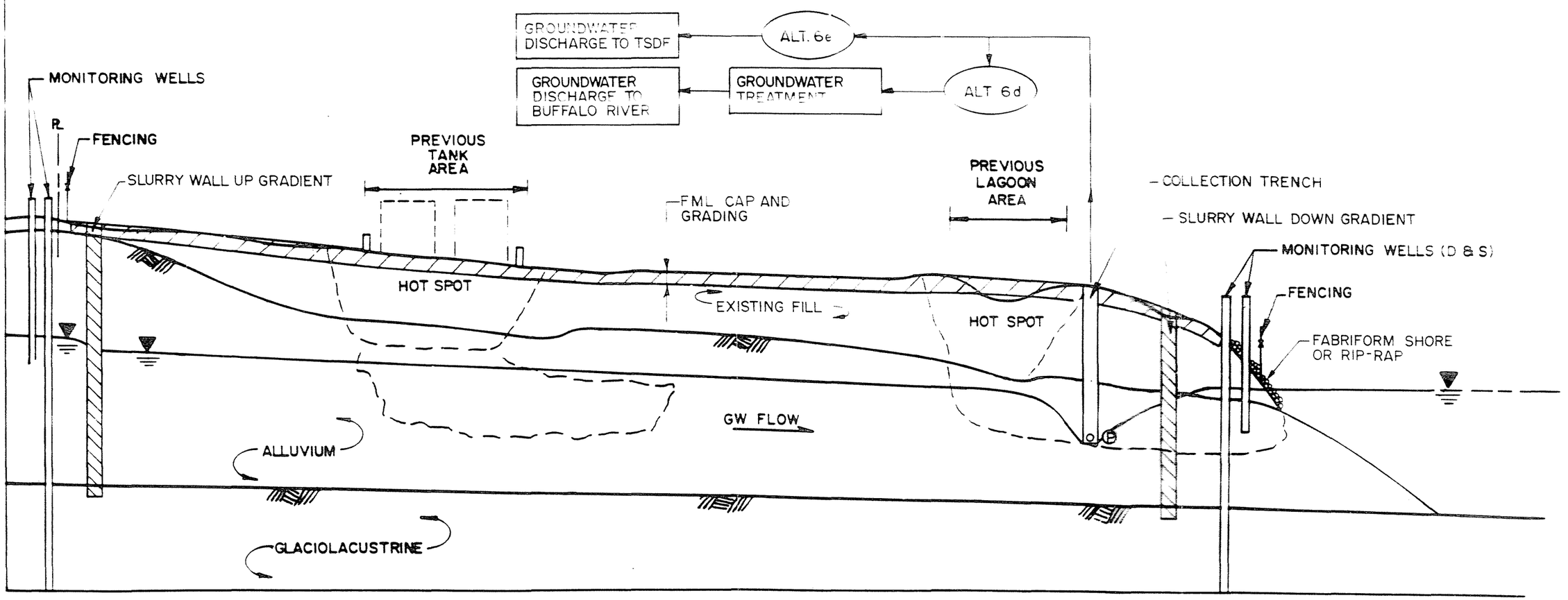
Compliance with ARARs/SCGs

In this alternative, a substantially reduced volume of groundwater will be migrating into the site, thereby obviating the applicability of the chemical-specific ARARs/SCGs for migrating groundwater. The collection and pre-treatment of groundwater will attain BSA discharge limitations and air standards for treatment discharges to the atmosphere. NYSDEC guidelines for eroding soils are accommodated through shoreline stabilization.

Long-Term Effectiveness and Permanence

This alternative is not classified as permanent in accordance with the NYSDEC Remedial Action Technologies TAGM, May 1990; however, it is considered effective in reducing exposure by contact and inhalation and incidental ingestion of dust/soil. Also, with treatment of groundwater, this

ALTERNATIVE 6d & 6e SCHEMATIC

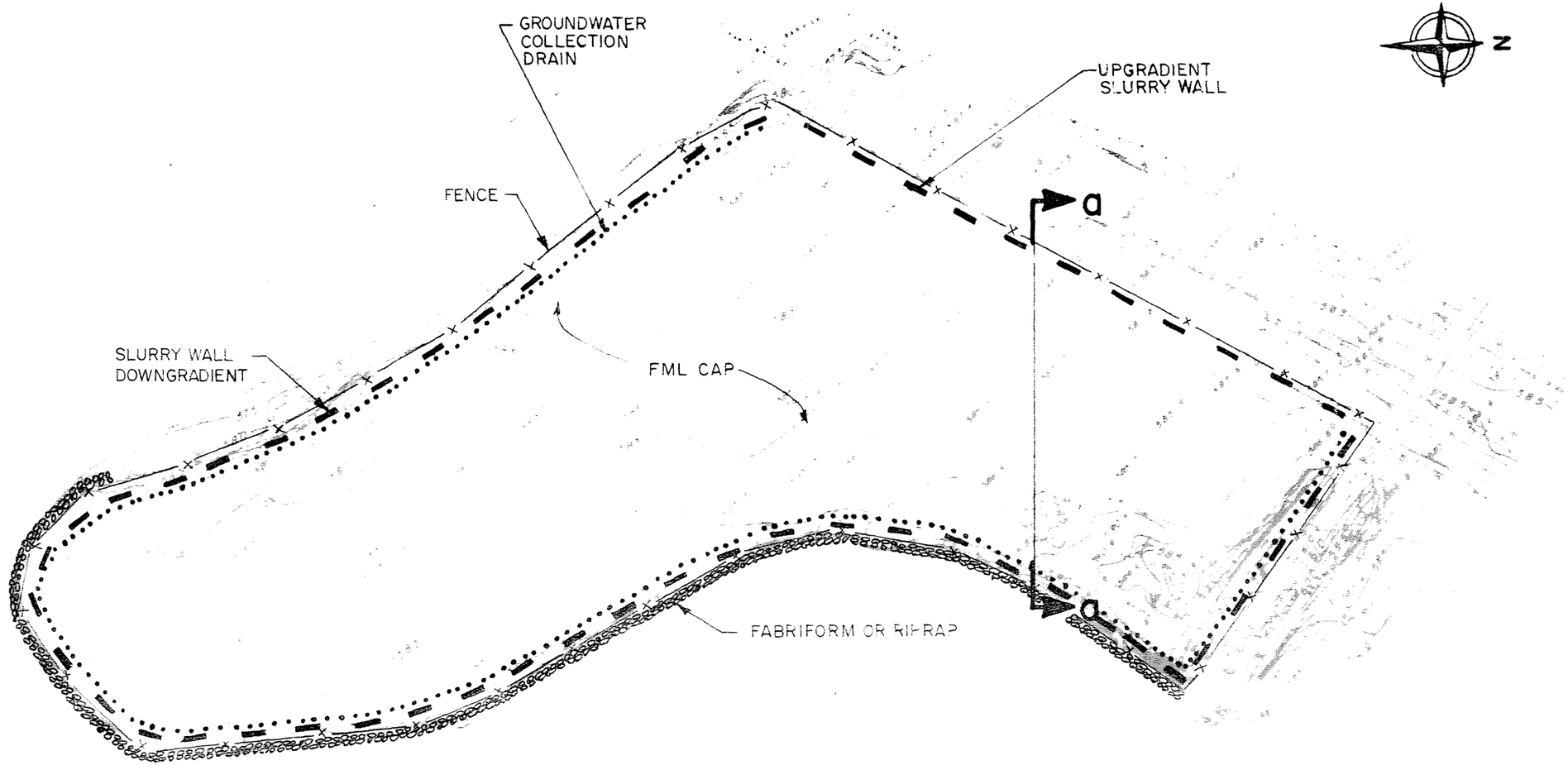


GENERALIZED SECTION a-a

APPROX. SCALE
H - 1"=100'
V - 1"=20'

REVISED 6/25/91

Wehran Envirotech	Drawn By: TC Checked By: AJ Date: 12/18/90	Scale AS NOTED		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY	Figure 5-7a Project No 00257



ALTERNATIVE 6D

- GW MONITORING – 30 YEARS
- DEED RESTRICTIONS
- FENCING
- FML CAP
- PERIMETER GW COLLECTION
- GW TREATMENT
- GW DISPOSAL TO BUFFALO RIVER
- SLURRY WALL UPGRADIENT
- SLURRY WALL DOWNGRADIENT
- 'FABRIFORM' OR RIP RAP SHORE STABILIZATION

ALTERNATIVE 6E

- GW MONITORING – 30 YEARS
- DEED RESTRICTIONS
- FENCING
- FML CAP
- PERIMETER GW COLLECTION
- GW DISPOSAL TO TSDF
- SLURRY WALL UPGRADIENT
- SLURRY WALL DOWNGRADIENT
- 'FABRIFORM' OR RIP RAP SHORE STABILIZATION

REVISED 6/25/91

WehranEnviroTech	Drawn By : EE Hodges Checked By : DAB Date : 12/18/90	Scale 1" = 150'		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY ALTERNATIVE 6d & 6e	Figure : 5-7b Project No. 00257

alternative affords an effective means of reducing contaminated groundwater into the Buffalo River. It is estimated to have a lifetime duration of greater than 30 years and require a long-term O&M program.

Reduction of Toxicity, Mobility, or Volume

This alternative would provide the same decrease in mobility and volume as in Alternative 6c. Due to treatment required for discharge to the Buffalo River, the reduction in toxicity would be greater.

Short-Term Effectiveness

This alternative provides the same short-term effectiveness as Alternative 6a. The approximate construction period would be two and one-half years.

Implementability

This alternative is implementable. The technologies for construction of a cap, slurry wall, pump and treat system, and shore stabilization are readily available from commercial vendors. No institutional problems are foreseen, however, installation of a complete slurry wall into the heterogeneous fill material may pose some difficulties.

Cost

The present value cost of Alternative 6d is estimated to be $8,813,000 (see Appendix I).

State Acceptance

To be determined after State review of the draft FS report.

Community Acceptance

To be determined after public review of the draft FS report.

5.11 ALTERNATIVE 6e – CAP, PERIMETER GROUNDWATER COLLECTION AND DISPOSAL TO TSDF, COMPLETE CUTOFF, AND SHORE STABILIZATION

5.11.1 Description

This alternative has the same components as Alternative 6b with the addition of an upgradient slurry wall for complete groundwater cutoff and more effective groundwater collection (Figures 5-7a and b).

5.11.2 Evaluation

Overall Protection of Human Health and the Environment

This alternative would provide essentially complete protection of human health and the environment, as discussed for Alternatives 6 through 6d.

Compliance with ARARs/SCGs

In this alternative, a substantially reduced volume of groundwater will be migrating into the site, thereby obviating the applicability the chemical-specific ARARs/SCGs for migrating groundwater. The collection and pre-treatment of groundwater will attain BSA discharge limitations and air standards for treatment discharges to the atmosphere. NYSDEC guidelines for eroding soils are accommodated through shoreline stabilization.

Long-Term Effectiveness and Permanence

This alternative will provide the same effectiveness over the long-term as Alternative 6b. It can be considered as being more permanent in that the additional upgradient slurry wall will allow for a more effective collection of contaminated groundwater without the introduction of recharged groundwater.

Reduction of Toxicity, Mobility, or Volume

This alternative would provide the same decrease in mobility and volume as Alternatives 6c and 6d. Since contaminated groundwater would be transported off-site to a RCRA-permitted TSDF, there would be no decrease in toxicity at the site. However, removal of the groundwater for off-site treatment would essentially reduce the toxicity of the groundwater at the site.

Short-Term Effectiveness

This alternative provides the same short-term effectiveness as Alternative 6b. The approximate construction period would be two and one-half years.

Implementability

This alternative is implementable. The technologies for cap and slurry wall construction and groundwater pumping are readily available from commercial vendors and no institutional problems are foreseen. The slurry

wall installation, however, may pose some difficulties due to the heterogeneous nature of the fill material.

Cost

The present value cost of Alternative 6e is estimated to be $8,834,000 (see Appendix I).

State Acceptance

To be determined after State review of the draft FS report.

Community Acceptance

To be determined after public review of the draft FS report.

5.12 ALTERNATIVE 7 – CAP, PERIMETER GROUNDWATER COLLECTION, PRE-TREATMENT AND DISCHARGE TO BSA, COMPLETE CUTOFF WALL, AND SHORE STABILIZATION

5.12.1 Description

This alternative is similar to Alternative 6c, however, with sheetpiling at the east and south sides for shore stabilization and complete containment (Figures 5-8a and b).

5.12.2 Evaluation

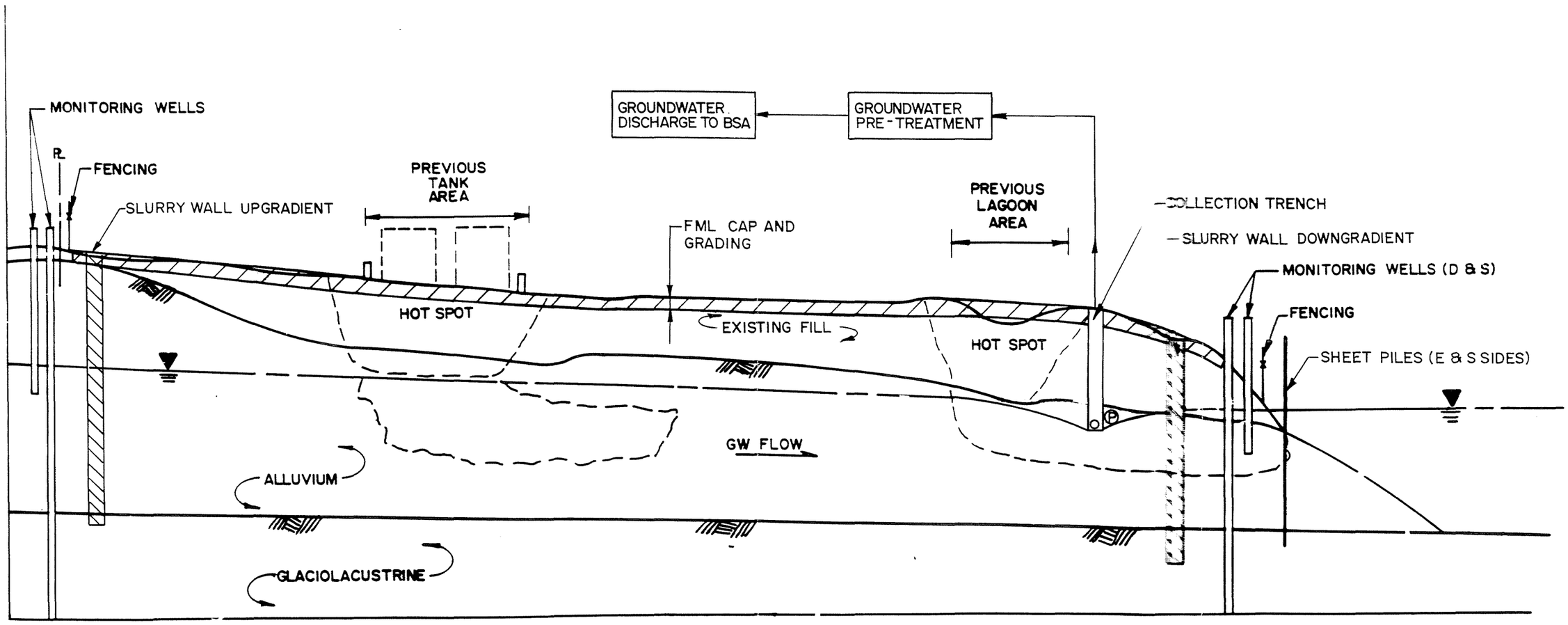
Overall Protection of Human Health and the Environment

This alternative would provide significant protection of human health and the environment, as discussed for Alternatives 6 through 6e. Due to the fact that sheetpiling may be slightly less effective at controlling erosion than Fabriform®/Rip-Rap, there could be some impacts, probably minor, associated with the migration of soil bound contaminants or wastes into the River.

Compliance with ARARs/SCGs

In this alternative, a reduced volume of groundwater will be migrating into the site, thereby obviating the applicability of the chemical-specific migrating groundwater ARARs/SCGs. Discharge limitations for pre-treated groundwater to the BSA and discharges to the atmosphere from the treatment processes will also be met. NYSDEC guidelines for eroding soils are accommodated through shoreline stabilization.

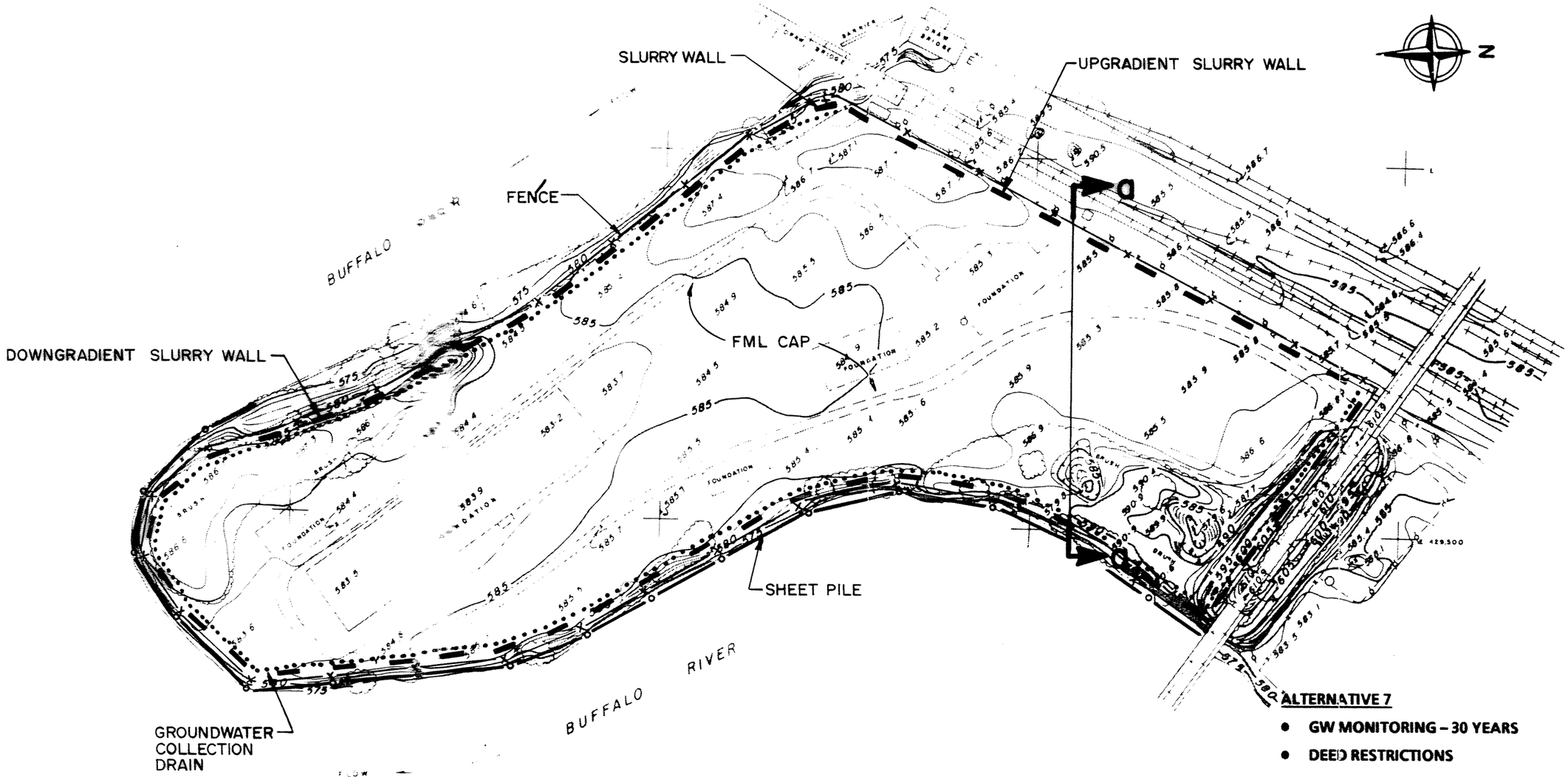
ALTERNATIVE 7 SCHEMATIC



GENERALIZED SECTION a-a

APPROX. SCALE
H - 1"=100'
V - 1"=20'

WehranEnviroTech	Drawn By: [illegible] Checked By: [illegible] Date: 12/12/90	Scale: AS NOTED	BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY	Figure: 5-8a Project No. 00257



ALTERNATIVE 7

- GW MONITORING – 30 YEARS
- DEED RESTRICTIONS
- FENCING
- FML CAP
- PERIMETER GW COLLECTION
- GW PRETREATMENT
- GW DISPOSAL TO BUFFALO SEWER AUTHORITY
- SLURRY WALL UPGRADIENT
- SLURRY WALL DOWNGRADIENT
- SHEET PILE – E&S SIDES AS CONTAINMENT AND AS SHORE STABILIZATION

Weston EnviroTech	Drawn By: L.F. Hadjil Checked By: Date: 11/13/90	Scale 1" = 150'		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	AREA D FEASIBILITY STUDY ALTERNATIVE 7	Figure: 5-8b 00257

Long-Term Effectiveness and Permanence

This alternative would afford the same long-term effectiveness and permanence as Alternative 6c. However, the sheetpiling may provide somewhat better erosion control depending on the placement of the wall.

Reduction of Toxicity, Mobility, or Volume

The reduction in toxicity resulting from pretreatment for discharge to the BSA would be the same as discussed for Alternatives 5, 6, 6b and 6c. Similarly, mobility would be almost entirely eliminated, other than a small erosion contribution due to sheetpiling as opposed to Fabriform®/Rip-Rap. However, the volume of groundwater in the collection system is estimated to be 84 cfd, only about a 62 percent reduction compared to Alternatives 4 and 5 (no containment). This alternative is only about a tenth as effective at reducing volume as Alternatives 6 through 6e.

Short-Term Effectiveness

This alternative provides the same short-term effectiveness as Alternative 6. The approximate construction period would be two years.

Implementability

This alternative is implementable and the technologies are readily available from commercial vendors. No institutional problems are foreseen, however, the installation of a slurry wall into the fill material may pose some difficulties.

Cost

The present value cost of Alternative 7 is estimated to be $10,713,000 (see Appendix I).

State Acceptance

To be determined after State review of the draft FS report.

Community Acceptance

To be determined after public review of the draft FS report.

5.13 ALTERNATIVE 8 – TOTAL EXCAVATION AND DISPOSAL WITH SOIL COVER AND GRADING, TOTAL GROUNDWATER COLLECTION, PRE-TREATMENT AND DISCHARGE TO BSA, AND SHORE STABILIZATION

5.13.1 Description

The components of Alternative 8 includes:

- Excavation of wastes and off-site or on-site disposal (depending on characteristics of waste constituents);
- Backfill with new soil/fill;
- Total groundwater collection, pre-treatment and discharge to BSA;
- Sheetpiling for shore stabilization (and slope stabilization during excavation).

5.13.2 Evaluation

Overall Protection of Human Health and the Environment

This alternative would essentially provide complete protection of human health and the environment.

Compliance with ARARs/SCGs

This alternative will attain the SCGs for the Area "D" soils eroding to the River (as developed by the NYSDEC) through complete excavation and disposal of soils/waste as well as shoreline stabilization. Also, the chemical-specific ARARs/SCGs for the groundwater outside the collection system will be attained and the BSA discharge limitations will be met. Air standards for discharges to the atmosphere from groundwater treatment processes likewise will be attained.

Long-Term Effectiveness and Permanence

This alternative provides an effective means of eliminating volume, mobility and toxicity of contaminated soils from the Area "D" site. Likewise, the groundwater collection and pre-treatment system will assist in reducing the mobility and toxicity of contaminated groundwater from the site. This alternative will remain effective provided a long-term O & M program is employed for purposes of implementing a groundwater pump and treat system. This alternative affords an extremely effective approach to eliminating potential exposure to Area "D" soil/waste through contact, ingestion, and fugitive dust. Shore stabilization through the use of

Fabriform®/Rip-Rap reduces the amount of erosion and the amount of soils/waste entering the Buffalo River.

Reduction of Toxicity, Mobility, or Volume

Excavation of the soil/waste will eliminate contaminant migration both on- and off-site, while eliminating any contact, ingestion, or incidental inhalation of the soil/waste. The volume of contaminated soil/waste will be eliminated which in turn will significantly reduce the toxicity of the groundwater. Total groundwater collection and pretreatment for disposal to the BSA will totally eliminate off-site contaminant migration.

Short-Term Effectiveness

This alternative will not significantly impact the community or environment during implementation. Measures can be taken to minimize exposure to dust during excavation and any worker exposure can be mitigated. The approximate construction period would be three and one-half to five years.

Implementability

This alternative may be difficult to implement due to the heterogeneous nature of the fill. The presence of subsurface structures, piping, C&D debris, sewer lines, and refractory material will make for great difficulties in excavation of the waste/soil and treatment for disposal to a TSDF. Additionally, excavation below the River level will be required, which will necessitate slope stabilization and increased dewatering requirements. The technologies for groundwater pump and treat and shore stabilization are commercially available from multiple vendors. Other than the aforementioned foreseeable problems with excavation of the soil/waste, no unusual institutional or monitoring problems are foreseen.

Cost

The present value cost of Alternative 8 is estimated to be $308,689,000 (see Appendix I).

State Acceptance

To be determined after State review of the draft FS report.

Community Acceptance

To be determined after public review of the draft FS report.

5.14 COMPARATIVE ANALYSIS OF ALTERNATIVES

The following section presents a comparative analysis of the remedial alternatives evaluated for the Area "D" site. This comparative analysis is based upon the nine evaluation criteria presented above.

Overall Protection of Human Health and the Environment

The no action alternative (Alternative 1) is clearly not protective of human health and the environment. Under baseline conditions, the total calculated carcinogenic risk of 1×10^{-5} and the hazard index of 200 would not be altered. In addition, potential risks through the inhalation of volatile organics from surface materials would remain. These conditions, which are not adequately protective of human health, may result in unacceptable health risks.

Alternatives 3 and 3a provide a greater level of protection than Alternative 1 through the implementation of a cap. This eliminates any airborne contaminants and contact with the soil/waste. Erosion control through sheetpiling in Alternative 3 and Fabriform®/Rip-Rap in Alternative 3a reduces sediment loading. Sheetpiling in Alternative 3 also affords a reduction in groundwater discharge from the site thereby reducing aquatic toxicity.

Alternative 4 provides increased protection over Alternatives 1, 3, and 3a in that it includes the perimeter collection of groundwater with pretreatment and discharge to BSA. This, in turn, eliminates groundwater discharge from the site to the Buffalo River, thereby eliminating aquatic toxicity.

Alternatives 5, 6 through 6e, 7, and 8 although employing different combinations of technologies than Alternative 4, provide the same general level of protection of human health through the elimination of airborne contaminants, contact and incidental ingestion of soils/waste, and aquatic toxicity.

In summary, Alternatives 4 through 8 provide comparable levels of protection of human health and the environment. Containment of the soil/waste and groundwater through perimeter groundwater collection and/or downgradient and upgradient cut-off via slurry wall afford an equally

effective approach of eliminating the exposure pathways, as does complete excavation of the soil/waste.

Compliance with ARARs/SCGs

The no action alternative will not ensure compliance with ARARs/SCGs within a reasonable or predictable time frame. Alternatives 3 and 3a do not meet the chemical-specific ARARs/SCGs for groundwater; however, with the implementation of a cap, they do comply with air standards and guidelines for volatile organic emissions from the site.

Alternatives 4, 5, 6, 6b, 6c, 6e, 7 and 8 provide for groundwater collection which will result in an inward flow of groundwater to the site. Consequently, these alternatives will attain the chemical-specific ARARs/SCGs for migrating groundwater. These alternatives do attain the BSA discharge limitations and air standards and guidelines for emissions from groundwater treatment processes. In the case of Alternatives 6a and 6d, groundwater is collected and discharged to the Buffalo River and, therefore, the effluent standards for discharge to the surface waters of the Buffalo River will be met.

In addition, Alternatives 3, 4, 5, 6, 6a, 6b, 6c, 6d, 6e, 7 and 8 through shoreline stabilization and through excavation (Alternative 6c and 8) will meet the site-specific SCGs for soils eroding to the Buffalo River as developed by NYSDEC.

All the containment alternatives can be designed to meet the action-specific ARARs/SCGs with conventional technologies.

Long-Term Effectiveness and Permanence

The no action alternative is neither effective nor permanent in the reduction of the magnitude of residual risk associated with the Area "D" site. This alternative provides for no adequate or reliable controls for the reduction of risk.

Alternatives 3 and 3a provide a greater reduction of residual risk than Alternative 1 in that a cap will eliminate airborne and contact pathways, and provide a reduction in the groundwater flow off-site and reduced soil erosion to the River. Both alternatives require a long-term O&M program; however, Alternative 3a requires greater maintenance of the shore stabilization due to the periodic dredging of the River by the Army Corps of Engineers.

Alternatives 4 and 5 provide a greater reduction of residual risk than Alternatives 3 and 3a due to the elimination of groundwater discharge to the

River. These alternatives are not permanent, however, are effective if a maintenance program is employed. The O&M program required will be considerably greater than Alternatives 3 and 3a due to the addition of pre-treatment facilities. Some minor variations in maintenance of the multi-media cap (Alternative 5) vs. FML cap (Alternative 4) will also be necessary.

Alternatives 6, 6a, and 6b provide the same level of reduction of residual risk as Alternative 4. These alternatives are not permanent; however, they are more effective in that a slurry wall provides a positive cut-off of the groundwater discharge on the downgradient side. (The effectiveness is still somewhat dependent upon the pumping of groundwater.) The O&M program is comparable to Alternative 5, although a slurry wall may require some additional maintenance. For Alternative 6b, off-site disposal would eliminate the O&M for treatment facilities, while not reducing effectiveness.

Alternatives 6c through 6e provide complete containment with an upgradient and downgradient slurry wall which is more effective than Alternatives 1 through 6b even if pumping of the groundwater is down for a period of time. Residual risk is further reduced over the aforementioned alternatives due to complete enclosure of the soil/waste. The O&M program is comparable, although for a slurry wall, it could be somewhat longer.

Alternative 7 is comparable to Alternatives 4 through 6 with some additional improvement due to sheetpiling providing better erosion control. The O&M program requirements are slightly higher for sheetpiling, however, less than for Fabriform®/Rip-Rap.

Alternative 6c provides an enhanced reduction in residual risk over Alternatives 1 through 7 in that it provides for erosion protection and minimization of shoreline soil migration along the entire length of the shoreline. Under this alternative, the Fabriform®/Rip-Rap is extended to include the west side of the Area "D" site.

Alternative 8 provides the maximum reduction in residual risk due to complete removal of soil/waste and total collection and pre-treatment of contaminated groundwater. This alternative is considered a permanent remedial action as defined by the NYSDEC TAGM (May 1990). The O&M program requirements are less than Alternatives 6 through 6e and 7 due to lack of slurry wall and sheetpiling. However, an O&M program will still be

necessary for the pumping and treatment of groundwater and shore stabilization.

Reduction of Toxicity, Mobility, or Volume Through Containment and Treatment

The no action alternative (Alternative 1) involves no containment or treatment, and, consequently, will not contribute to the reduction of contaminant toxicity, mobility or volume at the site.

Alternatives 3 and 3a offer no reduction in the toxicity of the soil/waste and groundwater; however, these alternatives do provide a greater reduction than Alternative 1 in the mobility and volume of groundwater through capping and shore stabilization. Alternative 3a provides more reduction in groundwater flow due to the use of sheetpiling. No reduction in the soil/waste volume is provided by these alternatives.

Alternatives 4 and 5 provide a greater degree of reduction of toxicity and mobility of groundwater than Alternatives 3 and 3a due to collection and treatment of the groundwater; however, no reduction in the soil/waste volume is afforded. Volume of groundwater increases due to the lack of containment or cut-off.

Alternatives 6 through 6e and 7 provide a greater degree of reduction of toxicity, mobility, and volume of groundwater and soils/waste than Alternatives 4 and 5 in that containment of groundwater and soils/waste via a slurry wall or sheetpiling is provided. These alternatives do not provide a reduction of volume of soil/waste.

Alternative 6c provides an enhanced reduction of toxicity, mobility and soils/waste over Alternatives 1 through 7 in that all source contaminants, as well as any non-source fill materials, will be excavated and removed from outside the slurry wall along the entire shoreline and placed within the containment area, as previously described in Section 5.9.1. This combination of source/fill excavation and containment offers the greatest degree of reduction of volume and toxicity as compared to other alternatives, except for Alternative 8.

Alternative 8 affords the highest degree of reduction of volume of soil/waste and groundwater through excavation of the soil/waste and total collection and pretreatment of the groundwater. This alternative also provides a greater degree of reduction of mobility and toxicity by eliminating the source.

In summary, Alternative 8 provides the greatest degree of reduction of volume and toxicity. The reduction in mobility is comparable to Alternatives 4, 5, 6, and 7 which rely on containment (although it is significant to note that since the source is removed in Alternative 8, there is nothing left to be mobilized).

Short-Term Effectiveness

In the short-term, the no action alternative is not effective in protecting human health and the environment. No remediation will be conducted. Improvement of groundwater quality will only occur through natural recovery for a period of time which has not been assessed.

All of the alternatives provide short-term effectiveness for contact and incidental ingestion of the soil/waste. The alternatives which employ groundwater collection and treatment for discharge to the BSA provide short-term effectiveness to aquatic organisms. Alternatives 6a, 6e, and 8 provide for immediate short-term effectiveness to aquatic organisms while also attaining the chemical-specific ARARs/SCGs for groundwater.

Protection against community and worker exposure will be required with all of the containment and treatment options. Additional worker protection measures pursuant to OSHA requirements will be required due to cut-off wall installation requirements under Alternatives 6 through 6e and 7. Likewise, worker protection measures will be necessary for excavation of the waste under Alternatives 6c and 8.

Environmental impacts during construction of the groundwater pumping and treatment components of the containment options are similar and readily mitigatable. Relatively greater potential environmental impacts are envisioned with Alternatives 6 through 6e, 7 and 8 and these impacts will require more formal mitigation measures during the installation of the cut-off wall component and excavation of soil/waste.

Implementability

All of the alternatives are implementable, however, to varying degrees. The no action alternative is considered the least technically feasible action, as it will not contribute toward site remediation.

Alternatives 3 and 3a are more difficult to implement than Alternative 1 due to the institution of a FML cap and sheetpiling (Alternative 3) and Fabriform®/Rip-Rap (Alternative 3a). Fabriform®/Rip-Rap

may be easier to install than driving sheetpiling through the fill; however, both are proven technologies and very reliable.

Alternative 4 is more difficult to implement than Alternatives 1, 3 and 3a due to the required installation of trench drains for the pumping and treatment of the groundwater. Because of the low flow rates determined from the groundwater modeling program, it was realized that point wells may provide an equivalent alternative to the trench drains. This will be further analyzed as part of the remedial design. The groundwater treatment technologies are reliable and proven; however, treatability studies may be required. More agency coordination is also required.

Alternatives 5 and 6 through 6e are generally similar to Alternative 4 with the following exceptions: Alternative 5 implements a multi-media cap which will be slightly more difficult to construct. Alternatives 6, 6a, and 6b include a downgradient slurry wall which is more difficult to implement than Alternatives 1 through 5 due to the nature of the fill. Alternatives 6c through 6e and 7 include an upgradient and downgradient slurry wall and are, therefore, more difficult than Alternatives 1 through 6b for the aforementioned reasons. All of the Alternatives 5 through 6e utilize proven and reliable technologies with readily available equipment from commercial vendors.

Alternative 7 is slightly more difficult than Alternatives 6 through 6e, with the exception of 6c, in that sheetpiling will make implementability more difficult due to potential problems with driving piles into the fill.

Alternative 6c has similar difficulty in implementation compared to Alternative 7 due to the excavation of waste/fill materials along the shoreline.

Alternative 8 is by far the most difficult to implement due to problems associated with the excavation of the soil/waste. Primarily, problems will be encountered with the dewatering and slope stabilization for excavation, materials handling, disposal, and placement of backfill. The technologies are proven and reliable, however, and equipment is readily available from multiple vendors.

Costs

Table 5-3 presents a summary of the present value of each of the detailed alternatives. The no action alternative has the least present value

Table 5-3
BUFFALO COLOR CORPORATION
Area "D" Feasibility Study
Summary Of Detailed Cost Estimates

Alternative	Total Cost
8	$308,689,000
6b	$34,927,000
5	$16,297,000
4	$13,693,000
7	$10,713,000
6c	$9,556,000
6a	$9,432,000
6e	$8,834,000
6d	$8,813,000
6	$8,620,000
3	$7,346,000
3a	$5,195,000
1	$1,170,000

cost of approximately $1,170,000. Alternative 3a follows with a cost at $5,195,000.

Alternatives 3, 6, 6d, and 6e have costs ranging from $7,346,000 to $8,834,000. The next highest cost alternatives are 6a, 6c and 7 with present value costs of $9,432,000, $9,556,000, and $10,713,000, respectively.

Cost for Alternatives 4, 5, and 6b are $13,693,000, $16,297,000, and $34,927,000, respectively. Finally, the highest cost alternative, Alternative 8, includes excavation and disposal of on-site contaminated soil and has a present value of $308,689,000.

The cost figures indicate that the full slurry wall provides a cost benefit, as it reduces the treatment costs by a greater amount than the cost of the wall.

The cost for pre-treatment of groundwater on-site for disposal to the BSA is much less than disposal of the groundwater at a TSDF; although the total treatment costs and pre-treatment costs do not differ greatly, with the pre-treatment costs being less.

State Acceptance

To be completed after NYSDEC review.

Community Acceptance

To be completed after public review of the draft FS Report.

5.15 RECOMMENDATION OF A REMEDIAL ACTION ALTERNATIVE

Based on the foregoing evaluations and comparison of options and costs, the best overall remedial action alternative for the Buffalo Color Area "D" site is Alternative 6c.

Alternative 6c provides the general response actions that satisfy the remedial action objective to contain, isolate or restore the soils of Area "D" so the potential risk to human health and the environment through exposure is at an acceptable level. The components of Alternative 6c, as currently modified, are as follows and are depicted in Figure 1 of the June 12, 1991 letter (Appendix L):

- "Fill" materials near river bank outward of the proposed slurry wall will be excavated and brought into the main site.
- An average amount of two feet of "fill" which has eroded onto the river bank out to the edge of the erosion prevention barrier will be excavated and deposited within the slurry wall containment system.
- The rip rap/fabric concrete containment barrier will be extended to encompass the entire perimeter of Area "D" and will extend past the shoreline to near the USACOE dredge limit.
- Drainage trenches will be installed inside the slurry wall peripherally and through areas of special concern.
- Excavated material will be used to shape the surface of Area "D" for installation of a FML cap; clean fill will replace the excavated material.
- Groundwater pumping will be as such to assure the water table inside Area "D" remains below the water level of the Buffalo River.
- Groundwater pre-treatment will meet BSA specifications.

Although Alternative 8 received the highest score in the NYSDEC TAGM Ranking (Table 5-1) for the selection of the remedy, the recommendation of choosing Alternative 6c over 8 was based on several aspects of Alternative 8, as follows:

- Extremely high cost (32 times greater).
- High difficulty in excavating wastes due to existing building foundations, piping, demolition fill and overall heterogeneous nature of waste material.
- Increased construction complications associated with dewatering of excavated waste and slope stabilization.
- Increased safety concerns during excavation and handling of contaminated materials.
- Increased safety concerns during transportation of wastes across public thoroughfares to disposal at off-site TSDF.
- Increased local truck traffic from and to the site for both waste hauling and subsequent backfill hauling, respectively. Based on the construction duration calculations presented in Appendix K of

this FS Report, Alternative 8 would impose approximately 25 to 100 truck trips per day on the local roads.

- Availability of disposal capacity at local TSDF at the time of remediation operations. May have to hold up project while waiting for space to become available.
- The environmental concerns associated with a large excavation, fill, and clean-up operation and its effects on the workers and local community.
- Longest construction duration of all remedial alternatives.

WehranEnviroTech

APPENDIX A

APPENDIX A

Summary Tables of Contaminants Detected in Subsurface Soils, Waste Residuals, Groundwater, Surface Waters and Sediments

Source – Remedial Investigation Report

Buffalo Color Area "D"

prepared by

Malcolm Pirnie, dated April 1989

Revised by Allied Signal/Buffalo Color August 1989

SITE LOCATION	IRON OXIDE SLUDGE LAGOON			<<<<<<<<<<<<<<<<<<<<INCINERATION AREA>>>>>>>>>>>>>>>>>>>>						
SAMPLE NUMBER	MW-7-88	MW-7-88	MW-7-88	MW-4-88	MW-10-88	MW-10-88	B-1-88	B-1-88	B-2-88	MW-9-88
SAMPLE ZONE	A	B	C	A	B	C	A	B	A	A
DEPTH OF SAMPLE	0-30'	30-32'	36-38'	0-20'	0-2'	6-8'	0-26'	26-28'	6-28'	6-18'
SEMIVOLATILE ORGANICS (mg/kg)										
1,4-DICHLOROBENZENE				11 D			13 DJ			
1,2-DICHLOROBENZENE				27 D			110 D	1.8 DJ		
NITROBENZENE	8.7 DJ						1100 DE	2.0 DJ		0.21 DJ
1,2,4-TRICHLOROBENZENE							150 D	1.2 DJ		
NAPHTHALENE	4.3 DJ				2.7 DJ			2.8 DJ		
2-CHLORONAPHTHALENE							140 D	0.55 DJ		
2-NITROANILINE										
ACENAPHTHYLENE							0.41 DJ			
ACENAPHTHENE										0.40 DJ
2,4-DINITROTOLUENE										
FLUORENE										0.50 DJ
PHENANTHRENE	1.6 BDJ				2.4 BDJ		5.7 DJ			4.6 BDJ
ANTHRACENE							1.3 DJ			1.3 DJ
DI-n-BUTYLPHTHALATE						0.56 BDJ				0.76 BDJ
FLUORANTHENE					1.7 DJ		1.2 DJ			4.8 DJ
PYRENE	0.83 DJ				1.6 DJ		0.93DJ			3.9 DJ
BENZO(a)ANTHRACENE										1.9 DJ
BIS(2-ETHYLHEXYL) PHTHALATE										0.29 BDJ
CHRYSENE										2.1 DJ
DI-N-OCTYL PHTHALATE										
BENZO(b)FLUORANTHENE										3.1 DJ
BENZO(a)PYRENE										1.7 DJ
INDENO(1,2,3-cd)PYRENE										0.76 DJ
DIBENZO(a,h)ANTHRACENE										0.43 DJ
BENZO(g,h,i)PERYLENE										0.78 DJ
EOX (mg/kg)	220	160	<10	14	360	24	<10	<10	<10	53
TOTAL METALS (mg/kg)										
ANTIMONY	4				39		0.91			
ARSENIC	84	13	15	16	276	2860	27	14	16	133
BERYLLIUM		1	1.1					0.99		
CADMIUM				5			1.5		1.6	
CHROMIUM	37	32	39	19	440	42	48	31	22	319
COPPER	4630	32	32	601	936	186	575	34	209	319
IRON	264000	28700	31500	19800	360000	35300	15500	29100	15100	78600
LEAD	187	29	35	9.2	538	38	410	25	51	719
MERCURY	0.24				1.3		0.28			1.8
NICKEL	467	60	64	25	331	31	20	34	48	104
SELENIUM										9.6
SILVER	3			2.2	4.3	0.71				0.82
THALLIUM					1.9	66				9.6
ZINC	473	86	97	500	1160	84	39	82	270	267

Laboratory Qualifiers: B-Detected in lab blank D-Secondary dilution J-Estimated value

SITE LOCATION	<<<<<<<WEATHERING AREA>>>>>>>			<<<<<<<<<<<<<<<<<<<<WEST SHORE>>>>>>>>>>>>>>>>>>>				
SAMPLE NUMBER	MW-1-88	MW-1-88	MW-1-88	MW-2-88	MW-5-88	MW-5-88	MW-6-88	MW-6-88
SAMPLE ZONE	A	B	C	A	A	B	B	C
DEPTH OF SAMPLE	0-6'	6-8'	12-14'	0-16'	12-16'	16-18'	2-4'	8-10'
SEMIVOLATILE ORGANICS (mg/kg)								
1,4-DICHLOROBENZENE								
1,2-DICHLOROBENZENE								
NITROBENZENE				5.9 DJ				
1,2,4-TRICHLOROBENZENE								
NAPHTHALENE				8.2 DJ				
2-CHLORONAPHTHALENE								
2-NITROANILINE								
ACENAPHTHYLENE				1.6 DJ				
ACENAPHTHENE								
2,4-DINITROTOLUENE								
FLUORENE				2.5 DJ				
PHENANTHRENE				9.9 DJ			2.1 DJ	
ANTHRACENE				4.8 DJ				
DI-n-BUTYLPHTHALATE			0.54 DJ		0.60 J	0.36 J		
FLUORANTHENE				14 D			2.5 DJ	
PYRENE				13 D			2.1 DJ	
BENZO(a)ANTHRACENE				6.7 DJ			1.1 DJ	
BIS(2-ETHYLHEXYL) PHTHALATE					0.62	0.23 J		
CHRYSENE				8.2 DJ			1.4 DJ	0.35 DJ
DI-N-OCTYL PHTHALATE								
BENZO(b)FLUORANTHENE				9.7 DJ			1.6 DJ	
BENZO(a)PYRENE				5.5 DJ		0.09 J	0.84 DJ	0.17 DJ
INDENO(1,2,3-cd)PYRENE				2.9 DJ			0.49 JD	
DIBENZO(a,h)ANTHRACENE				0.83 DJ				
BENZO(g,h,i)PERYLENE				2.6 DJ			0.48 DJ	
EOX (mg/kg)	68	<10	20	89	11	17	<10	<10
TOTAL METALS (mg/kg)								
ANTIMONY				7.4	0.71		0.81	0.89
ARSENIC	23	8.1	5	84	38	34	54	61
BERYLLIUM				0.93	0.76	0.7		1
CADMIUM	0.93					4.9		2
CHROMIUM	118	15	14	364	17	16	57	47
COPPER	14500	47	168	341	31	29	121	84
IRON	32700	21600	11700	300000	17900	17300	33000	27400
LEAD	1640	331	21	77	22	24	276	151
MERCURY	6		0.68				1.6	0.89
NICKEL	57	19	20	164	28	41	35	35
SELENIUM				14	21	12	15	20
SILVER				2.1			0.7	
THALLIUM				19	6.3			1.4
ZINC	349	58	59	716	82	106	316	397

Laboratory Qualifiers: B-Detected in lab blank D-Secondary dilution J-Estimated value

SITE LOCATION	<<<<<<<<<<TANK PARK 913>>>>>			TANK PARK 911 NORTH		<<<<<<<<<TANK PARK 912>>>>>>>>>		
SAMPLE NUMBER	MW-3-88	B-4-88	B-4-88	MW-8-88	B-7-88	B-5-88	B-5-88	B-5-88
SAMPLE ZONE	A	A	B	A	A	A	B	C
DEPTH OF SAMPLE	4-18'	6-24'	24-26'	14-18'	4-30'	6-10'	10-12'	16-18'
SEMIVOLATILE ORGANICS (mg/kg)								
1,4-DICHLOROBENZENE								
1,2-DICHLOROBENZENE								
NITROBENZENE								
1,2,4-TRICHLOROBENZENE								
NAPHTHALENE	5.5 DJ					1.9 DJ		
2-CHLORONAPHTHALENE								
2-NITROANILINE								1.1 DJ
ACENAPHTHYLENE						1.7 DJ		
ACENAPHTHENE								
2,4-DINITROTOLUENE	2.6 DJ							3.4 DJ
FLUORENE						1.5 DJ		
PHENANTHRENE	0.72 DJ					11 BD		
ANTHRACENE						3.4 DJ		
DI-n-BUTYLPHTHALATE							0.29 BJ	
FLUORANTHENE						11 D		
PYRENE						8.3 D		
BENZO(a)ANTHRACENE						4.6 DJ		
BIS(2-ETHYLHEXYL) PHTHALATE				1.9 DJ			0.73 B	
CHRYSENE						5.0 DJ		
DI-N-OCTYL PHTHALATE							0.06 J	
BENZO(b)FLUORANTHENE						6.1 DJ		
BENZO(a)PYRENE						3.5 DJ		
INDENO(1,2,3-cd)PYRENE						2.0 DJ		
DIBENZO(a,h)ANTHRACENE						0.69 DJ		
BENZO(g,h,i)PERYLENE						1.8 DJ		
EOX (mg/kg)	<10	160	<10	38	33	170	<10	16
TOTAL METALS (mg/kg)								
ANTIMONY		0.91				119		0.63
ARSENIC	69	7.6	43	22	32	61	43	14
BERYLLIUM			1.3					
CADMIUM			7		5.2	0.7		
CHROMIUM	113	13	27	9.1	64	199	31	9.3
COPPER	86	11	27	135	22	644	60	17
IRON	26500	1750	24400	5080	11900	46400	9620	2180
LEAD	66	36	32	12	28	83200	16	94
MERCURY	0.73	0.48			0.19	14		1.9
NICKEL	68	3.9	35	11	37	39	11	8.7
SELENIUM	11	10	19	4	6.5	1.8		0.99
SILVER	1.3	1.8	5.7		1.1	5.9		
THALLIUM								
ZINC	305	43	88	201	237	229	36	12

Laboratory Qualifiers: B-Detected in lab blank D-Secondary dilution J-Estimated value

SITE LOCATION	TP 911S	<<<<<<<<<<<<<<<<SITE INTERIOR>>>>>>>>>>>>>>>>					NORTH	RAILYARD
SAMPLE NUMBER	B-6-88	B-3-88	B-3-88	B-3-88	PZ-1-88	PZ-2-88	PZ-3-88	PZ-4-88
SAMPLE ZONE	A	A	B	C	B	A	A	B
DEPTH OF SAMPLE	8-26'	20-24'	24-26'	29-31'	2-4'	10-18'	12-18'	0-2'
SEMIVOLATILE ORGANICS (mg/kg)								
1,4-DICHLOROBENZENE						1.7 DJ		
1,2-DICHLOROBENZENE						0.91 DJ		
NITROBENZENE								
1,2,4-TRICHLOROBENZENE								
NAPHTHALENE						0.19 DJ		
2-CHLORONAPHTHALENE								
2-NITROANILINE								
ACENAPHTHYLENE								
ACENAPHTHENE								
2,4-DINITROTOLUENE								
FLUORENE						0.10 DJ		
PHENANTHRENE						0.51 BDJ		
ANTHRACENE								
DI-n-BUTYLPHTHALATE						0.47 BDJ		
FLUORANTHENE						0.19 DJ		
PYRENE						0.14 DJ		
BENZO(a)ANTHRACENE								
BIS(2-ETHYLHEXYL) PHTHALATE						1.1 BDJ		
CHRYSENE								
DI-N-OCTYL PHTHALATE								
BENZO(b)FLUORANTHENE								
BENZO(a)PYRENE						0.43 DJ		
INDENO(1,2,3-cd)PYRENE								
DIBENZO(a,h)ANTHRACENE								
BENZO(g,h,i)PERYLENE								
EOX (mg/kg)	<10	<10	<10	<10	<10	260	<10	99
TOTAL METALS (mg/kg)								
ANTIMONY								
ARSENIC	13	4	16	15	14	11	4.6	16
BERYLLIUM			0.76		0.89			0.99
CADMIUM	2						1.5	0.93
CHROMIUM	7.9	5.7	24	27	20	22	12	43
COPPER	10	6	24	28	22	49	32	101
IRON	7580	8070	23600	27600	18000	9560	8220	28400
LEAD	14	8.4	30	28	14	13	8.9	231
MERCURY								1.1
NICKEL	14	7.1	28	33	23	24	18	19
SELENIUM	5.1							
SILVER	1.1	5.8	2.2	0.93		1	0.89	1.2
THALLIUM								
ZINC	55	44	79	85	154	46	437	359

Laboratory Qualifiers: B-Detected in lab blank D-Secondary dilution J-Estimated value

TABLE 6-6: SUMMARY OF CONTAMINANTS IN SURFACE SOIL (0-2')

SITE LOCATION	IRON OX LAGOONS	EAST SHORE	INCIN AREA	WEATHER AREA	SOUTH SHORE	WEST SHORE	WEST BOUNDARY	TANK PARK 11S	TANK PARK 913
SAMPLE NUMBER	SB - 1	SB - 2	SB - 3	SB - 4	SB - 5	SB - 6	SB - 7	SB - 8	SB - 9
SEMIVOLATILE ORGANICS (mg/kg)									
NITROBENZENE			580						
BENZOIC ACID				2.8 J					
NAPHTHALENE			470						
2-CHLORONAPHTHALENE			66 J						
ACENAPHTHYLENE				16 J					
FLUORENE				25 J					
PHENANTHRENE				270 J					53 J
FLUORANTHENE				330 J					
PYRENE				310 J					
BENZO(a)ANTHRACENE				180 J					
CHRYSENE				180 J					
BENZO(b)FLUORANTHENE				150 J					
BENZO(k)FLUORANTHENE				140 J					
BENZO(a)PYRENE				140 J					
INDENO(1,2,3-cd)PYRENE				77 J					
BENZO(g,h,i)PERYLENE				63 J					
EOX (mg/kg)	87	46	2780	454	66	<10	11	54	27
TOTAL METALS (mg/kg)									
ANTIMONY		25.2	32.2	8					
ARSENIC	20.9	4.5	77.2	16.5	11.1	7.7	9	17.3	25.2
BERYLLIUM		0.9	0.58		1.3	1.2		0.58	1.2
CADMIUM			24.8	3	0.82			1.3	1.9
CHROMIUM	1076	662	1990	804	114	44.2	93.1	153	55.3
COPPER	984	177	3580	1170	118	36.2	44.4	640	134
IRON	537000	71700	80750	38900	53600	25400	98008	43000	15200
LEAD	8.9	224	5520	27300	394	50.4	145	323	221
MERCURY	0.36	4.8	6.2	4.4	3		0.65	1.2	1
NICKEL	351	77.3	363	69.8	33	19.8	14.8	190	17.6
SELENIUM						0.55			
SILVER	4.6	1.3	4.2	1.3	1.1	0.66	1.2	0.93	0.88
ZINC	34.5	159	3320	657	455	203	294	335	639

Sample Date: 11/8/88

Laboratory Qualifiers:

J - Estimated value

SITE AREA SAMPLED	<<<<<<<<<< IRON OXIDE LAGOON AREA>>>>>>>>>>				<<<<<<<<<<WEATHERING AREA>>>>>>>>>>>>>>>>			
SAMPLE NUMBER	WELL 14	WELL 14	WELL 15	WELL 15	WELL 12	WELL 12	WELL 13	WELL 13
SAMPLE DATE	6/24/88	8/18/88	6/24/88	8/18/88	6/23/88	8/17/88	6/23/88	8/17/88
SEMIVOLATILE ORGANICS (ug/l)								
PHENOL								
2-CHLOROPHENOL								
1,3-DICHLOROBENZENE								
1,4-DICHLOROBENZENE								
1,2-DICHLOROBENZENE		3 J						
2-METHYLPHENOL		4 J		18				
N-NITROSO-DI-n-PROPYLAMINE								
NITROBENZENE							10 J	15
2,4-DIMETHYLPHENOL				69				
BENZOIC ACID								
BIS(2-CHLOROETHYL)OXYMETHANE								
1,2,4-TRICHLOROBENZENE			1200	270				
NAPHTHALENE	12 J	15	670	130				
4-CHLOROANILINE								
4-CHLORO-3-METHYLPHENOL								
2-METHYLNAPHTHALENE				10 J				
2-NITROANILINE							4 J	
ACENAPHTHYLENE								
ACENAPHTHENE			26 J	14				
DIBENZOFURAN				13				
2,4-DINITROTOLUENE		NR		NR		NR	2000 E	NR
2,6-DINITROTOLUENE							1500 E	1700 E
DIETHYL PHTHALATE								
FLUORENE			24 J	17				
N-NITROSODIPHENYLAMINE				6 J				
PENTACHLOROPHENOL								
PHENANTHRENE			63 J	59				
ANTHRACENE			14 J	13				
DI-n-BUTYLPHTHALATE								
FLUORANTHENE			18 J	35				
PYRENE			16 J	24				
BENZO(a)ANTHRACENE			8 J	12				
BIS(2-ETHYLHEXYL)PHTHALATE				6 J		52		
CHRYSENE			5 J	11				
BENZO(b)FLUORANTHENE								
BENZO(k)FLUORANTHENE								
BENZO(a)PYRENE				7 J				
BENZIDINE				360				
1-NAPHTHYLAMINE	16000 D	5600	42000 D	9100				
ANILINE	NR		NR	660	NR		NR	

LABORATORY QUALIFIERS:

E-Exceeded calibrated range
J-Estimated value
D-Detected in diluted sample
B-Analyte detected in lab blank
NR-Parameter not inc. in analysis
N-Spike sample recovery outside limits
S-Determined by method of standard addition

SITE AREA SAMPLED	<<<<<<<<<< IRON OXIDE LAGOON AREA >>>>>>>>>>				<<<<<<<<<< WEATHERING AREA >>>>>>>>>>>>>>>>			
SAMPLE NUMBER	WELL 14	WELL 14	WELL 15	WELL 15	WELL 12	WELL 12	WELL 13	WELL 13
SAMPLE DATE	6/24/88	8/18/88	6/24/88	8/18/88	6/23/88	8/17/88	6/23/88	8/17/88
VOLATILE ORGANICS (ug/l)								
VINYL CHLORIDE								
METHYLENE CHLORIDE	650 B	8 B	800 B	91 B	1 BJ	7 B	6 B	7 B
ACETONE		47	510 B	92 B	54 B	110 B	24 B	16 B
CARBON DISULFIDE		NR		NR		NR		NR
1,1-DICHLOROETHENE						1 BJ		1 BJ
1,2-DICHLOROETHENE(TOT)						4 BJ		3 BJ
CHLOROFORM		7						
2-BUTANONE								
BROMODICHLOROMETHANE								
TRICHLOROETHENE								
BENZENE		250 E	1000	510	0.1 BJ		0.4 J	2 J
4-METHYL-2-PENTANONE		NR		NR		NR		NR
TOLUENE			620 B	320	0.09 BJ		1 BJ	2 J
CHLOROBENZENE		2 J	190 J	400			1 J	
ETHYLBENZENE		2 J						
XYLENE (TOTAL)				23 J		7 B		6 B
TOTAL METALS (ug/l)								
ALUMINUM	NR	10200	NR	1200	NR	16800	NR	67000
ANTIMONY	124	58	21			5		7
ARSENIC	1620	1820	35		18	25	460	933
BARIUM	NR	1020	NR	60	NR	112	NR	281
BERYLLIUM							6	7
CADMIUM	127	37	16		6		21	24
CHROMIUM	679	805	24		203	197	62	201
COPPER	27800	3220	49		330	306	28600	78700
IRON	3940	405000	47500	22500	45000	72200	75000	233000
LEAD	2480	3030	22	6.8	2390	1390	312	573
MAGNESIUM	NR	24500	NR	32700	NR	29900	NR	36100
MANGANESE	NR	4440	NR	1230	NR	2770	NR	2170
MERCURY	21	9.6			50	2.8	2.1	5.2
NICKEL	630	760	90		60	60	460	830
SELENIUM								
SILVER			5		9		8	
THALLIUM	57	15	36					
ZINC	3370	4390	72	37	1220	1390	2460	5610
CYANIDE	45	10	13				22	34
HEXAVALENT CHROMIUM (ug/l)		10				130	6	82
TOC (mg/l)	53	110	650	500	27	33	31	39
TOX (ug/l)	27	180	160	5440	29	15	36	21

LABORATORY QUALIFIERS:

E-Exceeded calibrated range
J-Estimated value
D-Detected in diluted sample
B-Analyte detected in lab blank
NR-Parameter not inc. in analysis
N-Spike sample recovery outside limits
S-Determined by method of standard addition

SITE AREA SAMPLED	<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<INCINERATION AREA>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>							
SAMPLE NUMBER	MW-4-88	MW-4-88	MW-9-88	MW-9-88	MW-10-88	MW-10-88	MW-12-88	MW-13-88
SAMPLE DATE	6/23/88	8/18/88	6/23/88	8/17/88	6/23/88	8/17/88	11/21/88	11/21/88
SEMIVOLATILE ORGANICS (ug/l)								
PHENOL								
2-CHLOROPHENOL	1800 D	1200 E						
1,3-DICHLOROBENZENE		49	1 J					
1,4-DICHLOROBENZENE	4900 D	510 E	5 J	6 J				
1,2-DICHLOROBENZENE	21000 D	920 E	5 J					4000
2-METHYLPHENOL		47						
N-NITROSO-DI-n-PROPYLAMINE								
NITROBENZENE								
2,4-DIMETHYLPHENOL	94 DJ	130	4 J					
BENZOIC ACID								
BIS(2-CHLOROETHYL)OXYMETHANE								
1,2,4-TRICHLOROBENZENE	25	8 J						
NAPHTHALENE	33		5 J				0.3 J	4900
4-CHLOROANILINE				8 J			22	11000 E
4-CHLORO-3-METHYLPHENOL								
2-METHYLNAPHTHALENE								
2-NITROANILINE								
ACENAPHTHYLENE								
ACENAPHTHENE								
DIBENZOFURAN								
2,4-DINITROTOLUENE		NR		NR		NR		
2,6-DINITROTOLUENE								
DIETHYL PHTHALATE	4 J							
FLUORENE								
N-NITROSODIPHENYLAMINE	4 J							
PENTACHLOROPHENOL	2 J							
PHENANTHRENE	3 J							
ANTHRACENE	0.9 J							
DI-n-BUTYLPHTHALATE	0.7 J						1 J	
FLUORANTHENE	1 J							
PYRENE	1 J							
BENZO(a)ANTHRACENE	1 J							
BIS(2-ETHYLHEXYL)PHTHALATE	2 J	7 J		7 J		7 J	17 B	
CHRYSENE	0.9 J							
BENZO(b)FLUORANTHENE								
BENZO(k)FLUORANTHENE								
BENZO(a)PYRENE								
BENZIDINE								
1-NAPHTHYLAMINE	2800 D	300	97	16			23	
ANILINE	NR		NR		NR		5	250000

LABORATORY QUALIFIERS:
E-Exceeded calibrated range
J-Estimated value
D-Detected in diluted sample
B-Analyte detected in lab blank
NR-Parameter not inc. in analysis
N-Spike sample recovery outside limits
S-Determined by method of standard addition

| SITE AREA SAMPLED | <<<

| SITE AREA SAMPLED | <<<

| SITE AREA SAMPLED | <<<

SITE AREA SAMPLED	<<<<<<<<<<<<<<<<TANK PARK 913>>>>>>>>>>>>>>>>				<<<<<<TANK PARK 911 NORTH>>>>>>>>>>		
SAMPLE NUMBER	MW-3-88	MW-3-88	WELL 9	WELL 9	MW-8-88	MW-8-88	MW-11-88
SAMPLE DATE	6/22/88	8/16/88	6/24/88	8/16/88	6/23/88	8/17/88	11/21/88
SEMIVOLATILE ORGANICS (ug/l)							
PHENOL	57	77					8 J
2-CHLOROPHENOL	5 J	7 J	0.8 J		5 J	4 J	49
1,3-DICHLOROBENZENE		3 J					
1,4-DICHLOROBENZENE	130	220			1 J	4 J	35
1,2-DICHLOROBENZENE	52	96	2 J				2 J
2-METHYLPHENOL		6 J					
N-NITROSO-DI-n-PROPYLAMINE							
NITROBENZENE							
2,4-DIMETHYLPHENOL	18	13					
BENZOIC ACID		18 J					
BIS(2-CHLOROETHYL)OXYMETHANE							
1,2,4-TRICHLOROBENZENE							
NAPHTHALENE	30	43					
4-CHLOROANILINE							50
4-CHLORO-3-METHYLPHENOL	4 J	7 J					
2-METHYLNAPHTHALENE							16
2-NITROANILINE							
ACENAPHTHYLENE							
ACENAPHTHENE							1 J
DIBENZOFURAN							
2,4-DINITROTOLUENE		NR		NR		NR	
2,6-DINITROTOLUENE							
DIETHYL PHTHALATE							
FLUORENE							2 J
N-NITROSODIPHENYLAMINE							
PENTACHLOROPHENOL							
PHENANTHRENE							6 J
ANTHRACENE							
DI-n-BUTYLPHTHALATE	0.2 J				0.2 J		
FLUORANTHENE							
PYRENE							
BENZO(a)ANTHRACENE							
BIS(2-ETHYLHEXYL)PHTHALATE	8 BJ	5 J				14 J	20 B
CHRYSENE							
BENZO(b)FLUORANTHENE							
BENZO(k)FLUORANTHENE							
BENZO(a)PYRENE							
BENZIDINE							
1-NAPHTHYLAMINE							46
ANILINE	NR		NR		NR		160

LABORATORY QUALIFIERS:
E-Exceeded calibrated range
J-Estimated value
D-Detected in diluted sample
B-Analyte detected in lab blank
NR-Parameter not inc. in analysis
N-Spike sample recovery outside limits
S-Determined by method of standard addition

SITE AREA SAMPLED	<<<<<<<<<<<<<<<<<TANK PARK 913>>>>>>>>>>>>>>>>>				<<<<<<TANK PARK 911 NORTH>>>>>>>>>>		
SAMPLE NUMBER	MW-3-88	MW-3-88	WELL 9	WELL 9	MW-8-88	MW-8-88	MW-11-88
SAMPLE DATE	6/22/88	8/16/88	6/24/88	8/16/88	6/23/88	8/17/88	11/21/88
VOLATILE ORGANICS (ug/l)							
VINYL CHLORIDE						6 J	
METHYLENE CHLORIDE	2000 B	6 B	5 B	9 B	480 B	7 B	
ACETONE		740 BE	190	63 B	15000 BE	39 B	
CARBON DISULFIDE		NR		NR		NR	
1,1-DICHLOROETHENE		2 BJ		1 BJ			
1,2-DICHLOROETHENE(TOT)		4 BJ	1 J	3 BJ		6 B	
CHLOROFORM					0.7 J		
2-BUTANONE							
BROMODICHLOROMETHANE							
TRICHLOROETHENE							
BENZENE	28000 B	1100 E	24	46		3 J	6300 E
4-METHYL-2-PENTANONE		NR		NR		NR	
TOLUENE	160 BJ	20	0.2 BJ	1 J	3 BJ		100
CHLOROBENZENE	3600 B	750 E	130	220 E	1400	1100 E	48000 E
ETHYLBENZENE	1200 BJ	220 E		1 J	5 J		170
XYLENE (TOTAL)	750 BJ	130 B		10 B		7 B	74
TOTAL METALS (ug/l)							
ALUMINUM	NR	1520	NR	2390	NR	35200	NR
ANTIMONY							
ARSENIC	45		52	31	46		5.7
BARIUM	NR	262	NR		NR	259	NR
BERYLLIUM							
CADMIUM	6		11		6	6	
CHROMIUM	27	20		21	80	95	
COPPER	20	16	15	16	168	234	25
IRON	14100	15300	23700	30500	65000	104000	6200
LEAD	28		22		179	117 S	
MAGNESIUM	NR	8900	NR	11800	NR	34300	NR
MANGANESE	NR	1700	NR	743	NR	5630	NR
MERCURY						0.29	
NICKEL					120	140	70
SELENIUM							
SILVER							
THALLIUM			94				
ZINC	237	82	38	23	2040	4080	51
CYANIDE			30	56			NR
HEXAVALENT CHROMIUM (ug/l)		8		7		36	NR
TOC (mg/l)	96	190	44	62	19	101	27
TOX (ug/l)	1310	1610	240	520	200	130	24700

LABORATORY QUALIFIERS:

E-Exceeded calibrated range
J-Estimated value
D-Detected in diluted sample
B-Analyte detected in lab blank
NR-Parameter not inc. in analysis
N-Spike sample recovery outside limits
S-Determined by method of standard addition

SITE AREA SAMPLED	<<<<<<<<<<<<<<TANK PARK 910>>>>>>>>>>>>>>				<<<<<<<<<<REMAINDER OF SITE INTERIOR>>>>>>>>>>			
SAMPLE NUMBER	WELL 8	WELL 8	8 - NAPL	8 - NAPL	WELL 6R	WELL 6R	WELL 7	WELL 7
SAMPLE DATE	6/24/88	8/18/88	6/24/88	8/18/88	6/23/88	8/18/88	6/24/88	8/17/88
SEMIVOLATILE ORGANICS (ug/l)			(ug/kg)	(ug/l)				
PHENOL								
2-CHLOROPHENOL								
1,3-DICHLOROBENZENE					0.7 J			
1,4-DICHLOROBENZENE					5 J	3 J		
1,2-DICHLOROBENZENE					4 J	3 J		
2-METHYLPHENOL								
N-NITROSO-DI-n-PROPYLAMINE								
NITROBENZENE						18		
2,4-DIMETHYLPHENOL								
BENZOIC ACID								
BIS(2-CHLOROETHYL)OXYMETHANE								
1,2,4-TRICHLOROBENZENE								
NAPHTHALENE					16	14		
4-CHLOROANILINE						17		
4-CHLORO-3-METHYLPHENOL								
2-METHYLNAPHTHALENE			22000 J			5 J		
2-NITROANILINE								
ACENAPHTHYLENE					15			
ACENAPHTHENE						18		
DIBENZOFURAN						9 J		
2,4-DINITROTOLUENE		NR		NR		NR		NR
2,6-DINITROTOLUENE								
DIETHYL PHTHALATE								
FLUORENE		4 J			8 J	12		
N-NITROSODIPHENYLAMINE					2 J	3 J		
PENTACHLOROPHENOL								
PHENANTHRENE					15	14		
ANTHRACENE					3 J	3 J		
DI-n-BUTYLPHTHALATE							0.3 J	
FLUORANTHENE	54		190000	37	2 J	2 J		
PYRENE	4 J	7 J	6100	4 J	4 J			
BENZO(a)ANTHRACENE	1 J		2500 J					
BIS(2-ETHYLHEXYL)PHTHALATE	2 J	16 J				16		11
CHRYSENE	1 J		1900 J					
BENZO(b)FLUORANTHENE	0.3 J		1200 J					
BENZO(k)FLUORANTHENE	0.6 J		1100 J					
BENZO(a)PYRENE	0.6 J		1100 J					
BENZIDINE						90		
1-NAPHTHYLAMINE					9 J	6		
ANILINE	NR		NR		NR		NR	

LABORATORY QUALIFIERS:
E-Exceeded calibrated range
J-Estimated value
D-Detected in diluted sample
B-Analyte detected in lab blank
NR-Parameter not inc. in analysis
N-Spike sample recovery outside limits
S-Determined by method of standard addition

SITE AREA SAMPLED	<<<<<<<<<<<<<<<TANK PARK 910>>>>>>>>>>>>>>>				<<<<<<<<<<REMAINDER OF SITE INTERIOR>>>>>>>>>			
SAMPLE NUMBER	WELL 8	WELL 8	8 - NAPL	8 - NAPL	WELL 6R	WELL 6R	WELL 7	WELL 7
SAMPLE DATE	6/24/88	8/18/88	6/24/88	8/18/88	6/23/88	8/18/88	6/24/88	8/17/88
VOLATILE ORGANICS (ug/l)			(ug/kg)	(ug/l)				
VINYL CHLORIDE								
METHYLENE CHLORIDE	140 B	9 B	140 B	6000 B	13 BJ	9 B	1 BJ	7 B
ACETONE	47 J		34 BJ	8900 B	86 B		11	
CARBON DISULFIDE	43	NR	41	NR		NR	7	NR
1,1-DICHLOROETHENE		2 BJ		1100 BJ		1BJ		1 BJ
1,2-DICHLOROETHENE(TOT)		5		3300		5		3 BJ
CHLOROFORM								
2-BUTANONE								
BROMODICHLOROMETHANE		1 BJ		590 BJ		1 BJ		
TRICHLOROETHENE								
BENZENE		5	42	3700	480 B	500 E	16	210 E
4-METHYL-2-PENTANONE		NR		NR		NR		NR
TOLUENE	0.6 BJ	2 BJ	13 BJ	1700 BJ	110 B	88 B		
CHLOROBENZENE	9 J	5 J	110	1200	17 BJ	24		9
ETHYLBENZENE			9 J	920 J			2 J	
XYLENE (TOTAL)	25	11 B	290	37000 B	10 BJ			7 B
TOTAL METALS (ug/l)			(mg/kg)	(mg/kg)				
ALUMINUM	NR	1500	NR	58	NR	2780	NR	2440
ANTIMONY	13						24	
ARSENIC	171	50			41	22	35	
BARIUM	NR	113	NR		NR	84	NR	30
BERYLLIUM				1.6				
CADMIUM	5				5		12	
CHROMIUM	45		1.8	4.9	46	94	40	29
COPPER	25		0.75		78	162	89	61
IRON	9450	6440	16		8140	6890	42400	47600
LEAD	51	5		2.4	82	63	36	17
MAGNESIUM	NR	1780	NR		NR	21800	NR	15600
MANGANESE	NR	1780	NR		NR	214	NR	1640
MERCURY						0.2		
NICKEL					50	70		
SELENIUM					10			
SILVER			0.7		5			
THALLIUM	32		1.9				32	
ZINC	61	27			433	387	114	55
CYANIDE			0.13 mg/kg	38 mg/kg				
HEXAVALENT CHROMIUM (ug/l)	18	6	NR	NR	6			17
TOC (mg/l)	200	1110	NR	NR	51	27	20	25
TOX (ug/l)	77	38	476000 ug/g	404000 ug/g	190	170	62	67

LABORATORY QUALIFIERS:
E-Exceeded calibrated range
J-Estimated value
D-Detected in diluted sample
B-Analyte detected in lab blank
NR-Parameter not inc. in analysis
N-Spike sample recovery outside limits
S-Determined by method of standard addition

SAMPLE NUMBER	MW-1-88	MW-1-88	MW-7-88	MW-7-88
SAMPLE DATE	6/23/88	8/18/88	6/23/88	8/17/88
SEMIVOLATILE ORGANICS (ug/l)				
DIETHYL PHTHALATE				3 J
BIS(2-ETHYLHEXYL)PHTHALATE		17 J		12 J
VOLATILE ORGANICS (ug/l)				
METHYLENE CHLORIDE	1 BJ	8 B	2 BJ	13 B
ACETONE	62 B	27 B	670 BE	20 B
1,2-DICHLOROETHENE(TOT)				3 BJ
2-BUTANONE	14			
BENZENE	6	4	0.3 J	
4-METHYL-2-PENTANONE		NR		NR
TOLUENE	0.6 BJ		0.1 BJ	
CHLOROBENZENE	0.6 BJ		0.5 J	
ETHYLBENZENE			0.5 J	
XYLENE (TOTAL)	1 BJ			6 B
TOTAL METALS (ug/l)				
ALUMINUM	NR	6170	NR	11600
ARSENIC	7.9		7.3	9 N
BARIUM	NR	872	NR	179
CADMIUM				6
CHROMIUM	41	44	30	49
COPPER	124	47	42	64
IRON	14900	6050	12500	15800
LEAD	61	22	54	43
MAGNESIUM	NR	16400	NR	23500
MANGANESE	NR	144	NR	405
MERCURY				0.26
NICKEL	50			30
SILVER			5	26 N
ZINC	350	56	153	2430
HEXAVALENT CHROMIUM (ug/l)		9		17
TOC (mg/l)	30	19	18	55
TOX (ug/l)	26	32	8.1	21

LABORATORY QUALIFIERS:

E-Exceeded calibrated range
J-Estimated value
D-Detected in diluted sample
NR-Parameter not inc. in analysis
N-Sample spike recovery outside limits
S-Determined by method of standard addition
B-Analyte detected in laboratory blank

TABLE 6-11: SUMMARY OF CONTAMINANTS DETECTED IN SURFACE WATER

	DISCRETE DOWNSTREAM SAMPLES				COMPOSITE	DISCRETE UPSTREAM SAMPLES				COMPOSITE
SAMPLE NUMBER	SW-11D	SW-12D	SW-13D	SW-14D	SW-DOWN	SW-21U	SW-22U	SW-23U	SW-24U	SW-UP
SAMPLE DATE	6/27/88	6/27/88	6/27/88	6/27/88	8/19/88	6/27/88	6/27/88	6/27/88	6/27/88	8/19/88
METHYLENE CHLORIDE (ug/l)	1 BJ	1 BJ	1 BJ	1 BJ	6 B	2 BJ	3 BJ	3 BJ	2 BJ	
ACETONE (ug/l)	22000 E	1400 E	320 E	34	35 B	27				5000 BE
1,1-DICHLOROETHENE (ug/l)					1 BJ					2 BJ
1,2-DICHLOROETHENE (TOTAL) (ug/l)					5 J					5 J
XYLENE (TOTAL) (ug/l)					6 B					6 B

SAMPLE NUMBER	SW DOWN	SW DOWN	SW UP	SW UP
SAMPLE DATE	6/27/88	8/19/88	6/27/88	8/19/88
BIS(2-ETHYLHEXYL) PHTHALATE (ug/l)	2 J	9 J		12
TOTAL METALS (ug/l)				
ALUMINUM	NR	530	NR	1140
BARIUM	NR	70	NR	76
CHROMIUM				28
IRON	330	850	170	2170
LEAD		5	13	13
MAGNESIUM	NR	12700	NR	12800
MANGANESE	NR	197	NR	212
THALLIUM	10		15	
ZINC	138	15	131	26
CYANIDE (ug/l)	19	LOST	17	
HEX CHROMIUM (ug/l)	<7	9.5	<7	7
TOC (mg/l)	NR	13	NR	5
TOX (ug/l)	NR	43	NR	53

LABORATORY QUALIFIERS:

NR - Analyte not analyzed for this sample
LOST - Sample lost at lab
E - Analysis exceeded calibrated instrument range
J - Estimated value
D - Detected at secondary dilution
B - Detected in associated lab blank

TABLE 6-12: SUMMARY OF CONTAMINANTS DETECTED IN STREAM SEDIMENTS

SAMPLE NUMBER	SED - 1	SED - 2	SED - 3	SED - 4	SED - 5	SED - 6	SED - 7	SED - 8
SEMIVOLATILE ORGANICS (mg/kg)								
1,2-DICHLOROBENZENE				1.2 DJ				
NITROBENZENE					0.60 DJ			
NAPHTHALENE				0.46 DJ	0.42 DJ			0.88 DJ
ACENAPHTHENE								0.24 DJ
PHENANTHRENE					0.94 DJ	0.79 DJ	0.87 DJ	0.82 DJ
ANTHRACENE								0.61 DJ
FLUORANTHENE					1.2 DJ	0.81 DJ	0.89 DJ	1.7 DJ
PYRENE					0.95 DJ	0.54 DJ	0.58 DJ	1.2 DJ
BENZO(a)ANTHRACENE						0.39 DJ	0.44 DJ	0.74 DJ
CHRYSENE					0.51 DJ	0.26 DJ	0.29 DJ	0.58 DJ
BENZO(b)FLUORANTHENE					0.59 DJ			0.54 DJ
BENZO(a)PYRENE					0.32 DJ			0.31 DJ
INDENO(1,2,3-cd)PYRENE					0.24 DJ			
BENZO(g,h,i)PERYLENE					0.25 DJ			
EOX (mg/kg)	22		24	15	26	63	27	36
TOTAL METALS (mg/kg)								
ANTIMONY				4.8	38	3.4	4.9	4.6
ARSENIC	17	21	21	19	21	138	10	21
BERYLLIUM	0.92			1.1	1.1			
CADMIUM		1.3	1.3	1.5	1.8	5.5	1.5	2.5
CHROMIUM	36	36	36	41	116	63	51	952
COPPER	32	48	48	77	100	5050	87	111
IRON	24200	33100	25800	30900	28200	38900	27200	32400
LEAD	51	64	93	154	222	497	289	310
MERCURY								4.5
NICKEL	31	42	33	40	100	32	30	36
THALLIUM	2.9	3.3	3.1	3.5	3.1	3.6	2.7	2.3
ZINC	119	162	181	226	182	1100	148	319

LABORATORY QUALIFIERS:

D - Present in secondary dilution of samples

J - Estimated concentration

PARAMETER	EAST TAR 11/8/88	WEST TAR 11/8/88
SEMIVOLATILE ORGANICS (mg/kg)		
NITROBENZENE		0.21 DJ
ACENAPHTHENE		0.40 DJ
FLUORENE		0.50 DJ
PHENANTHRENE		4.6 DJ
ANTHRACENE		1.3 DJ
DI-n-BUTYLPHTHALATE		0.76 DJ
FLUORANTHENE		4.8 DJ
PYRENE		3.9 DJ
BENZO(a)ANTHRACENE		1.9 DJ
BIS(2-ETHYLHEXYL) PHTHALATE	1.9 DJ	0.29 DJ
CHRYSENE		2.1 DJ
BENZO(b)FLUORANTHENE		3.1 DJ
BENZO(a)PYRENE		1.7 DJ
INDENO(1,2,3-cd)PYRENE		0.76 DJ
DIBENZO(a,h)ANTHRACENE		0.43 DJ
BENZO(g,h,i)PERYLENE		0.78 DJ
EOX (mg/kg)	5460	300
TOTAL METALS (mg/kg)		
ARSENIC	13.6	25.2
CADMIUM		7.6
CHROMIUM	619	415
COPPER	269	303
IRON	522000	45200
LEAD	74.7	1840
MERCURY	0.07	2.3
NICKEL	405	53.9
SILVER	1.2	1
THALLIUM	0.88	
ZINC	147	593

Laboratory Qualifiers:

J - Estimated concentration

D - Detected in diluted sample

PARAMETER	NUMBER OF DETECTIONS	MINIMUM	MAXIMUM	LOCATION OF MAXIMUM	SITE AREA
SEMIVOLATILE ORGANICS (mg/kg)					
NITROBENZENE	2	0.21	580	SB-3	Incineration Area
BENZOIC ACID	1		2.8	SB-4	Weathering Area
NAPHTHALENE	1		470	SB-3	Incineration Area
2-CHLORONAPHTHALENE	1		66	SB-3	Incineration Area
ACENAPHTHYLENE	1		16	SB-4	Weathering Area
FLUORENE	2	0.50	25	SB-4	Weathering Area
PHENANTHRENE	3	4.6	270	SB-4	Weathering Area
FLUORANTHENE	2	4.8	330	SB-4	Weathering Area
PYRENE	2	3.9	310	SB-4	Weathering Area
BENZO(a)ANTHRACENE	2	1.9	180	SB-4	Weathering Area
CHRYSENE	2	2.1	180	SB-4	Weathering Area
BENZO(b)FLUORANTHENE	2	3.1	150	SB-4	Weathering Area
BENZO(k)FLUORANTHENE	1		140	SB-4	Weathering Area
BENZO(a)PYRENE	2	1.7	140	SB-4	Weathering Area
INDENO(1,2,3-cd)PYRENE	2	0.76	77	SB-4	Weathering Area
BENZO(g,h,i)PERYLENE	2	0.78	63	SB-4	Weathering Area
EOX (mg/kg)	8	11	2780	SB-3	Incineration Area
TOTAL METALS (mg/kg)					
ANTIMONY	3	8	32.2	SB-3	Incineration Area
ARSENIC	9	4.5	77.2	SB-3	Incineration Area
BERYLLIUM	6	0.58	1.3	SB-5	West Shore
CADMIUM	5	0.82	24.8	SB-3	Incineration Area
CHROMIUM	9	44.2	1990	SB-3	Incineration Area
COPPER	9	36.2	3580	SB-3	Incineration Area
IRON	9	15200	537000	SB-1	Iron Oxide Lagoons
LEAD	9	8.9	27300	SB-4	Weathering Area
MERCURY	8	0.07	6.2	SB-3	Incineration Area
NICKEL	9	14.8	363	SB-3	Incineration Area
SELENIUM	1		0.55	SB-6	West Shore
SILVER	9	0.66	4.6	SB-1	Iron Oxide Lagoons
ZINC	9	34.5	3320	SB-3	Incineration Area

	NUMBER OF DETECTIONS	MINIMUM	MAXIMUM	LOCATION OF MAXIMUM	SITE AREA
SEMIVOLATILE ORGANICS (mg/kg)					
1,4-DICHLOROBENZENE	3	1.7	13	B-1-88	Incineration
1,2-DICHLOROBENZENE	4	0.91	110	B-1-88	Incineration
NITROBENZENE	5	0.21	1100	B-1-88	Incineration
1,2,4-TRICHLOROBENZENE	2	1.2	150	B-1-88	Incineration
NAPHTHALENE	7	1.9	8.2	MW-2-88	West Shore
2-CHLORONAPHTHALENE	2	0.55	140	B-1-88	Incineration
2-NITROANILINE	1		1.1	B-5-88	Tank Park 912
ACENAPHTHYLENE	3	0.41	1.7	B-5-88	Tank Park 912
ACENAPHTHENE	1		0.40	MW-9-88	Incineration
2,4-DINITROTOLUENE	2	2.6	3.4	B-5-88	Tank Park 912
FLUORENE	4	0.10	2.5	MW-2-88	West Shore
PHENANTHRENE	9	0.51	11	B-5-88	Tank Park 912
ANTHRACENE	4	1.3	4.8	MW-2-88	West Shore
DI-n-BUTYLPHTHALATE	7	0.29	0.76	MW-9-88	Incineration
FLUORANTHENE	7	0.19	14	MW-2-88	West Shore
PYRENE	8	0.14	13	MW-2-88	West Shore
BENZO(a)ANTHRACENE	4	1.1	6.7	MW-2-88	West Shore
BIS(2-ETHYLHEXYL) PHTHALATE	6	0.23	1.9	MW-8-88	Tank Park 910
CHRYSENE	5	0.35	8.2	MW-2-88	West Shore
DI-N-OCTYL PHTHALATE	1		0.07	B-5-88	Tank Park 912
BENZO(b)FLUORANTHENE	4	1.6	9.7	MW-2-88	West Shore
BENZO(a)PYRENE	7	0.09	5.5	MW-2-88	West Shore
INDENO(1,2,3-cd)PYRENE	4	0.49	2.9	MW-2-88	West Shore
DIBENZO(a,h)ANTHRACENE	3	0.43	0.83	MW-2-88	West Shore
BENZO(g,h,i)PERYLENE	4	0.48	2.6	MW-2-88	West Shore
EOX (mg/kg)	18	11	360	MW-10-88	Incineration
TOTAL METALS (mg/kg)					
ANTIMONY	10	0.63	119	B-5-88	Tank Park 912
ARSENIC	34	4	2860	MW-10-88	Incineration
BERYLLIUM	11	0.7	1.3	B-4-88	West Shore
CADMIUM	12	0.7	7	B-4-88	West Shore
CHROMIUM	34	5.7	440	MW-10-88	Incineration
COPPER	34	6	14500	MW-1-88	Weathering
IRON	34	1750	360000	MW-10-88	Incineration
LEAD	34	8.4	83200	B-5-88	Tank Park 912
MERCURY	14	0.19	14	B-5-88	Tank Park 912
NICKEL	34	3.9	467	MW-7-88	Iron Oxide Lagoons
SELENIUM	14	0.99	21	MW-5-88	West Shore
SILVER	19	0.7	5.9	B-5-88	Tank Park 912
THALLIUM	6	1.4	66	MW-10-88	Incineration
ZINC	34	12	1160	MW-10-88	Incineration

(1) Total Number of Samples: 35	NUMBER OF DETECTIONS	CONCENTRATION MINIMUM	CONCENTRATION MAXIMUM	LOCATION OF MAXIMUM	SITE AREA
SEMIVOLATILE ORGANICS (ug/l)					
PHENOL	3	8	77	MW-3-88	Tank Park 913
2-CHLOROPHENOL	8	0.8	1800	MW-4-88	Incineration
1,3-DICHLOROBENZENE	4	0.7	49	MW-4-88	Incineration
1,4-DICHLOROBENZENE	11	1	4900	MW-4-88	Incineration
1,2-DICHLOROBENZENE	11	2	21000	MW-4-88	Incineration
2-METHYLPHENOL	4	4	47	MW-4-88	Incineration
N-NITROSO-DI-n-PROPYLAMINE	1		24	MW-2-88	West Shore
NITROBENZENE	5	5	15	W-13	Weathering
2,4-DIMETHYLPHENOL	6	4	130	MW-4-88	Incineration
BENZOIC ACID	1		18	MW-3-88	Tank Park 913
BIS(2-CHLOROETHYL)OXYMETHANE	1		20	MW-2-88	West Shore
1,2,4-TRICHLOROBENZENE	4	8	1200	W-15	Iron Oxide Lagoons
NAPHTHALENE	13	0.3	4900	MW-13-88	Incineration
4-CHLOROANILINE	6	8	11000	MW-13-88	Incineration
4-CHLORO-3-METHYLPHENOL	2	4	7	MW-3-88	Tank Park 913
2-METHYLNAPHTHALENE	3	5	16	MW-11-88	Tank Park 911N
2-NITROANILINE	1		4	W-13	Weathering
ACENAPHTHYLENE	1		15	W-6R	Main Plant
ACENAPHTHENE	4	1	26	W-15	Iron Oxide Lagoons
DIBENZOFURAN	2	9	13	W-15	Iron Oxide Lagoons
2,4-DINITROTOLUENE (2)	1		2000	W-13	Weathering
2,6-DINITROTOLUENE	2	1500	1700	W-13	Weathering
DIETHYL PHTHALATE	1		4	MW-4-88	Incineration
FLUORENE	6	2	24	W-15	Iron Oxide Lagoons
N-NITROSODIPHENYLAMINE	5	2	15	MW-2-88	West Shore
PENTACHLOROPHENOL	1		2	MW-4-88	Incineration
PHENANTHRENE	6	3	63	W-15	Iron Oxide Lagoons
ANTHRACENE	5	0.9	14	W-15	Iron Oxide Lagoons
DI-n-BUTYLPHTHALATE	5	0.2	1	MW-12-88	Incineration
FLUORANTHENE	6	1	54	W-8	Tank Park 910
PYRENE	6	4	24	W-15	Iron Oxide Lagoons
BENZO(a)ANTHRACENE	4	1	12	W-15	Iron Oxide Lagoons
BIS(2-ETHYLHEXYL)PHTHALATE	18	2	52	W-12	Weathering
CHRYSENE	4	0.9	11	W-15	Iron Oxide Lagoons
BENZO(b)FLUORANTHENE	1		0.3	W-8	Tank Park 910
BENZO(k)FLUORANTHENE	1		0.6	W-8	Tank Park 910
BENZO(a)PYRENE	2	0.6	7	W-15	Iron Oxide Lagoons
BENZIDINE	2	90	360	W-15	Iron Oxide Lagoons
1-NAPHTHYLAMINE	14	6	42000	W-15	Iron Oxide Lagoons
ANILINE (3)	5	5	660	W-15	Iron Oxide Lagoons

(1) Total Number of Samples: 35	NUMBER OF DETECTIONS	CONCENTRATION MINIMUM	CONCENTRATION MAXIMUM	LOCATION OF MAXIMUM	SITE AREA
VOLATILE ORGANICS (ug/l)					
VINYL CHLORIDE	1		6	MW-8-88	Tank Park 911N
CARBON DISULFIDE (2)	3	1	43	W-8	Tank Park 910
1,1-DICHLOROETHENE	11	1	8	MW-9-88	Incineration
1,2-DICHLOROETHENE(TOT)	16	1	19	MW-9-88	Incineration
CHLOROFORM	3	0.7	24	MW-9-88	Incineration
2-BUTANONE	1		260	MW-13-88	Incineration
BROMODICHLOROMETHANE	4	1	7	MW-9-88	Incineration
TRICHLOROETHENE	2	1	3	MW-13-88	Incineration
BENZENE	28	0.1	28000	MW-3-88	Tank Park 913
4-METHYL-2-PENTANONE (2)	2	3	24	MW-13-88	Incineration
TOLUENE	25	0.09	4700	MW-13-88	Incineration
CHLOROBENZENE	25	0.6	48000	MW-11-88	Tank Park 911N
ETHYLBENZENE	13	0.2	43000	MW-4-88	Incineration
XYLENE (TOTAL)	21	1	1700	MW-4-88	Incineration
TOTAL METALS (ug/l)					
ALUMINUM (3)	16	1200	67000	W-13	Weathering
ANTIMONY	12	5	124	W-14	Iron Oxide Lagoons
ARSENIC	30	5.7	1820	W-14	Iron Oxide Lagoons
BARIUM (3)	14	30	1020	W-14	Iron Oxide Lagoons
BERYLLIUM	2	6	7	W-13	Weathering
CADMIUM	21	5	127	W-14	Iron Oxide Lagoons
CHROMIUM	30	13	2140	MW-2-88	West Shore
COPPER	33	15	78700	W-13	Weathering
IRON	35	3940	405000	W-14	Iron Oxide Lagoons
LEAD	28	5	3030	W-14	Iron Oxide Lagoons
MAGNESIUM (3)	16	8900	59700	MW-9-88	Incineration
MANGANESE (3)	16	214	21300	MW-9-88	Incineration
MERCURY	12	0.29	50	MW-2/W-12	W. Shore/Weathering
NICKEL	23	30	830	W-13	Weathering
SELENIUM	1		10	W-6R	Main Plant
SILVER	9	5	13	MW-13-88	Incineration
THALLIUM	5	15	94	W-9	Tank Park 913
ZINC	35	23	9950	MW-2-88	West Shore
CYANIDE (ug/l)	11	12	56	W-9	Tank Park 913
HEXAVALENT CHROMIUM (ug/l)	20	6	13	W-12	Weathering
TOC (mg/l)	35	19	2350	MW-13-88	Incineration
TOX (ug/l)	35	15	27200	MW-4-88	Incineration

NOTE: (1) The analysis of NAPL-8 and the aquitard wells (MW-1-88 and MW-7-88) are not included in this table.

(2) 2,4-dinitrotoluene, 4-methyl-2-pentanone and carbon disulfide analyzed in first sample round only (19 samples)

(3) Aniline, Al, Ba, Mg and Mn analyzed in second sample round only (16 samples)

TABLE 6-17:FREQUENCY OF DETECTIONS IN STREAM SEDIMENTS

	NUMBER OF DETECTIONS	CONCENTRATION MINIMUM	CONCENTRATION MAXIMUM	LOCATION OF MAXIMUM
SEMIVOLATILE ORGANICS (mg/kg)				
1,2-DICHLOROBENZENE	1		1.2	SED-4
NITROBENZENE	1		0.60	SED-5
NAPHTHALENE	3	0.42	0.88	SED-8
ACENAPHTHENE	1		0.24	SED-8
PHENANTHRENE	4	0.79	0.94	SED-5
ANTHRACENE	1		0.61	SED-8
FLUORANTHENE	4	0.81	1.7	SED-8
PYRENE	4	0.54	1.2	SED-8
BENZO(a)ANTHRACENE	3	0.39	0.74	SED-8
CHRYSENE	4	0.26	0.58	SED-8
BENZO(b)FLUORANTHENE	2	0.54	0.59	SED-5
BENZO(a)PYRENE	2	0.31	0.32	SED-5
INDENO(1,2,3-cd)PYRENE	1		0.24	SED-5
BENZO(g,h,i)PERYLENE	1		0.25	SED-5
EOX (mg/kg)	7	0.02	0.06	SED-6
TOTAL METALS (mg/kg)				
ANTIMONY	5	0.003	0.04	SED-5
ARSENIC	8	0.01	0.14	SED-6
BERYLLIUM	3	0.001	0.001	SED-5
CADMIUM	7	0.001	0.006	SED-6
CHROMIUM	8	0.04	0.95	SED-8
COPPER	8	0.03	5.1	SED-6
IRON	8	24	39	SED-6
LEAD	8	0.05	0.50	SED-6
MERCURY	1		0.005	SED-8
NICKEL	8	0.03	0.1	SED-5
THALLIUM	8	0.002	0.004	SED-6
ZINC	8	0.12	1.1	SED-6



WehranEnviroTech

APPENDIX B

APPENDIX B

Summary Tables of Carcinogenic Risk and Hazard Index

Source – Risk Assessment for Buffalo Color Area "D"

prepared by

Wehran Envirotech dated February 1990

Table 6-18
BUFFALO COLOR AREA D
CALCULATION OF CARGINOGENIC RISK FROM DERMAL CONTACT WITH ON-SITE MATERIALS

Chemical	Risk	Intake (mg/kg/day)	Oral Potency Factor (PF) $(mg/kg/day)^{-1}$	f(c)
Aniline	--	--	5.70×10^{-3}	2.35×10^{-4}
Arsenic	5.24×10^{-9}	1.27×10^{-5}	1.75×10^{0}	--
Benzene	--	--	2.92×10^{-2}	--
Benzidine	--	--	2.30×10^{2}	--
Benzo(a) Pyrene	5.12×10^{-7}	1.89×10^{-4}	1.15×10^{1}	2.35×10^{-4}
Cadmium	--	2.15×10^{-6}	--	--
4-Chloroaniline	--	--	--	--
Chromium (+3)	--	7.16×10^{-4}	--	--
Chromium (+6)	--	1.00×10^{-4}	--	--
1,2-Dichlorobenzene	--	--	--	--
Iron	--	6.50×10^{-2}	--	--
Lead	--	4.61×10^{-4}	--	--
Mercury	--	1.46×10^{-5}	--	--
Methylene chloride	--	--	7.50×10^{-3}	--
Phenanthrene	--	2.27×10^{-3}	--	--
Total	5.17×10^{-7}			

Notes:
f/c = Fraction of 70-year lifetime over which exposure occurs
Risk = Intake × PF × f(c)

Table 6-19
BUFFALO COLOR AREA D
CALCULATION OF HAZARD INDEX FROM DERMAL CONTACT WITH ON-SITE MATERIALS

Chemical	Hazard Index (HI)	Intake (mg/kg/day)	Reference Dose (RfD) (mg/kg/day)
Aniline	--	--	1.4×10^{-2}
Arsenic	1.27×10^{-2}	1.27×10^{-5}	1.0×10^{-3}
Benzene	--	--	7.0×10^{-4}
Benzidine	--	--	3.0×10^{-3}
Benzo(a) Pyrene	1.89×10^{-1}	1.89×10^{-4}	1.0×10^{-3}
Cadmium	2.15×10^{-3}	2.15×10^{-6}	1.0×10^{-3}
4-Chloroaniline	--	--	4.0×10^{-3}
Chromium (+3)	7.16×10^{-4}	7.16×10^{-4}	1.0×10^{0}
Chromium (+6)	2.00×10^{-2}	1.00×10^{-4}	5.0×10^{-3}
1,2-Dichlorobenzene	--	--	9.0×10^{-2}
Iron	--	6.50×10^{-2}	--
Lead	3.29×10^{-1}	4.16×10^{-4}	1.4×10^{-3}
Mercury	4.86×10^{-2}	1.46×10^{-5}	3.0×10^{-4}
Methylene chloride	--	--	5.0×10^{-2}
Phenanthrene	1.51×10^{-2}	2.27×10^{-3}	1.5×10^{-1}
Total	6.18×10^{-1}		

Hazard Index = Intake/RfD

Table 6-20
BUFFALO COLOR AREA D
CALCULATION OF CARCINOGENIC RISK FROM INCIDENTAL INGESTION OF ON-SITE MATERIALS

Chemical	Risk	Intake (mg/kg/day)	Oral Potency Factor (PF) $(mg/kg/day)^{-1}$	f(c)
Aniline	--	--	5.70×10^{-3}	--
Arsenic	7.40×10^{-9}	1.80×10^{-5}	1.75×10^{0}	2.35×10^{-4}
Benzene	--	--	2.92×10^{-2}	--
Benzidine	--	--	2.30×10^{2}	--
Benzo(a) Pyrene	3.61×10^{-8}	1.34×10^{-5}	1.15×10^{1}	2.35×10^{-4}
Cadmium	--	1.82×10^{-7}	--	--
4-Chloroaniline	--	--	--	--
Chromium (+3)	--	1.01×10^{-6}	--	--
Chromium (+6)	--	3.54×10^{-6}	--	--
1,2-Dichlorobenzene	--	--	--	--
Iron	--	1.84×10^{-2}	--	--
Lead	--	2.60×10^{-4}	--	--
Mercury	--	3.09×10^{-7}	--	--
Methylene chloride	--	--	7.50×10^{-3}	--
Phenanthrene	--	1.60×10^{-4}	--	--
Total	4.35×10^{-8}			

Notes:
f/c = Fraction of 70-year lifetime over which exposure occurs
Risk = Intake × PF × f(c)

Table 6-21
BUFFALO COLOR AREA D
CALCULATION OF HAZARD INDEX FROM INCIDENTAL INGESTION OF ON-SITE MATERIALS

Chemical	Hazard Index (HI)	Intake (mg/kg/day)	Reference Dose (RfD) (mg/kg/day)
Aniline	--	--	1.4×10^{-2}
Arsenic	1.80×10^{-2}	1.80×10^{-5}	1.0×10^{-3}
Benzene	--	--	7.0×10^{-4}
Benzidine	--	--	3.0×10^{-3}
Benzo(a) Pyrene	1.34×10^{-2}	1.34×10^{-5}	1.0×10^{-3}
Cadmium	1.82×10^{-4}	1.82×10^{-7}	1.0×10^{-3}
4-Chloroaniline	--	--	4.0×10^{-3}
Chromium (+3)	1.01×10^{-6}	1.01×10^{-6}	1.0×10^{0}
Chromium (+6)	7.07×10^{-4}	3.54×10^{-6}	5.0×10^{-3}
1,2-Dichlorobenzene	--	--	9.0×10^{-2}
Iron	--	1.84×10^{-2}	--
Lead	1.86×10^{-1}	2.60×10^{-4}	1.4×10^{-3}
Mercury	1.03×10^{-3}	3.09×10^{-7}	3.0×10^{-4}
Methylene chloride	--	--	5.0×10^{-2}
Phenanthrene	1.07×10^{-3}	1.60×10^{-4}	1.5×10^{-1}
Total	2.20×10^{-1}		

Notes:
RfD = Reference dose (mg/kg/day)
Hazard Index = Intake/RfD

Table 6-22
BUFFALO COLOR AREA D
CALCULATION OF CARCINOGENIC RISK FROM INHALATION OF FUGITIVE DUST

Chemical	Risk	Intake (mg/kg/day)	Inhalation Potency Factor (PF) $(mg/kg/day)^{-1}$	f(c)
Aniline	--	--	--	--
Arsenic	4.57×10^{-9}	3.89×10^{-7}	5.00×10^{1}	2.35×10^{-4}
Benzene	--	--	2.92×10^{-2}	--
Benzidine	--	--	2.30×10^{2}	--
Benzo(a) Pyrene	4.87×10^{-10}	3.40×10^{-7}	6.10×10^{0}	2.35×10^{-4}
Cadmium	2.76×10^{-11}	1.93×10^{-8}	6.10×10^{0}	2.35×10^{-4}
4-Chloroaniline	--	--	--	--
Chromium (+3)	--	7.71×10^{-7}	--	--
Chromium (+6)	1.56×10^{-9}	1.62×10^{-7}	4.10×10^{1}	2.35×10^{-4}
1,2-Dichlorobenzene	--	--	--	--
Iron	--	1.17×10^{-3}	--	--
Lead	--	4.13×10^{-5}	--	--
Mercury	--	4.18×10^{-8}	--	--
Methylene chloride	--	--	1.43×10^{-2}	--
Phenanthrene	--	4.07×10^{-6}	--	--
Total	6.64×10^{-9}			

Notes:
f/c = Fraction of 70-year lifetime over which exposure occurs
Risk = Intale × PF × f(c)

Table 6-23
BUFFALO COLOR AREA D
CALCULATION OF HAZARD INDEX FROM INHALATION OF FUGITIVE DUST

Chemical	Hazard Index (HI)	Intake (mg/kg/day)	Reference Dose (RfD) (mg/kg/day)
Aniline	--	--	--
Arsenic	1.25×10^{-3}	3.89×10^{-7}	3.1×10^{-4}
Benzene	--	--	7.0×10^{-4}
Benzidine	--	--	3.0×10^{-3}
Benzo(a) Pyrene	3.40×10^{-4}	3.40×10^{-7}	1.0×10^{-3}
Cadmium	1.93×10^{-5}	1.93×10^{-8}	1.0×10^{-3}
4-Chloroaniline	--	--	4.0×10^{-3}
Chromium (+3)	7.71×10^{-7}	7.71×10^{-7}	1.0×10^{0}
Chromium (+6)	3.23×10^{-5}	1.62×10^{-7}	5.0×10^{-3}
1,2-Dichlorobenzene	--	--	9.0×10^{-2}
Iron	--	1.17×10^{-3}	--
Lead	9.62×10^{-2}	4.13×10^{-5}	4.3×10^{-4}
Mercury	8.20×10^{-4}	4.18×10^{-8}	5.1×10^{-5}
Methylene chloride	--	--	5.0×10^{-2}
Phenanthrene	2.71×10^{-5}	4.07×10^{-6}	1.5×10^{-1}
Total	9.87×10^{-2}		

Hazard Index = Intake/RfD

Table 6-24
BUFFALO COLOR AREA D
CALCULATION OF CARCINOGENIC RISK FROM CONSUMPTION OF FISH

Chemical	Risk	Intake (mg/kg/day)	Oral Potency Factor (PF) $(mg/kg/day)^{-1}$	f(c)
Aniline	1.64×10^{-10}	2.89×10^{-8}	5.70×10^{-3}	1.0
Arsenic	5.63×10^{-8}	3.21×10^{-8}	1.75×10^{0}	1.0
Benzene	6.50×10^{-10}	2.23×10^{-8}	2.92×10^{-2}	1.0
Benzidine	4.03×10^{-7}	1.75×10^{-9}	2.30×10^{2}	1.0
Benzo(a) Pyrene	1.40×10^{-7}	1.22×10^{-8}	1.15×10^{1}	1.0
Cadmium	--	2.07×10^{-10}	--	--
4-Chloroaniline	--	3.95×10^{-8}	--	--
Chromium (+3)	--	9.77×10^{-11}	--	--
Chromium (+6)	--	3.41×10^{-10}	--	--
1,2-Dichlorobenzene	--	1.79×10^{-7}	--	--
Iron	--	--	--	--
Lead	--	4.75×10^{-9}	--	--
Mercury	--	7.66×10^{-8}	--	--
Methylene chloride	8.10×10^{-11}	1.08×10^{-8}	7.50×10^{-3}	1.0
Phenanthrene	--	1.19×10^{-5}	--	--
Total	6.00×10^{-7}			

Notes:
f/c = Fraction of 70-year lifetime over which exposure occurs
Risk = Intake × PF × f(c)

Table 6-25
BUFFALO COLOR AREA D
CALCULATION OF HAZARD INDEX FROM CONSUMPTION OF FISH

Chemical	Hazard Index (HI)	Intake (mg/kg/day)	Reference Dose (RfD) (mg/kg/day)
Aniline	2.06×10^{6}	2.89×10^{8}	1.4×10^{2}
Arsenic	3.21×10^{5}	3.21×10^{8}	1.0×10^{3}
Benzene	3.19×10^{5}	2.23×10^{8}	7.0×10^{4}
Benzidine	5.83×10^{7}	1.75×10^{9}	3.0×10^{3}
Benzo(a) Pyrene	1.22×10^{5}	1.22×10^{8}	1.0×10^{3}
Cadmium	2.07×10^{7}	2.07×10^{10}	1.0×10^{3}
4-Chloroaniline	9.87×10^{6}	3.95×10^{8}	4.0×10^{3}
Chromium (+3)	9.77×10^{11}	9.77×10^{11}	1.0×10^{0}
Chromium (+6)	6.83×10^{8}	3.41×10^{10}	5.0×10^{3}
1,2-Dichlorobenzene	1.99×10^{6}	1.79×10^{7}	9.0×10^{2}
Iron	--	--	--
Lead	3.39×10^{6}	4.75×10^{9}	1.4×10^{3}
Mercury	2.55×10^{4}	7.66×10^{8}	3.0×10^{4}
Methylene chloride	2.16×10^{7}	1.08×10^{8}	5.0×10^{2}
Phenanthrene	1.27×10^{4}	1.91×10^{5}	1.5×10^{1}
Total	4.77×10^{4}		

Notes:
RfD = Reference dose (mg/kg/day)
Hazard Index = Intake/RfD



WehranEnviroTech

APPENDIX C

APPENDIX C

Letter from BSA to Buffalo Color Corporation

dated November 19, 1990

BUFFALO SEWER AUTHORITY

1038 CITY HALL
BUFFALO, NEW YORK 14202

855-4664
FAX 856-5810

EDWARD J. PAWLIK
Chairman

BRADLEY J. HURD
Vice Chairman

THEODORE V. MIKOLL
Assistant Vice Chairman

HENRY J. HAHN
Secretary

GILLMAN J. LAEHY, P.E.
General Manager

November 19, 1990

T.J. Wlodarczak
Buffalo Color Corp.
P.O. Box 7027
Buffalo, New York 14240-7027

Re: Inactive Hazardous Waste Site

Dear Mr. Wlodarczak:

Based on the information received by your company and the recent meeting concerning the above subject, the Buffalo Sewer Authority will conditionally accept the leachate from the site, in accordance with the following requirements:

1. Acceptable discharge location.
2. Approved flow metering device.
3. Drawings showing the entire area "D", monitoring wells, collection facilities, pretreatment equipment, if necessary, and discharge location.
4. Documents which will show that the discharge will meet the following daily pollutant limits:

a.	pH	5-12	j.	Zinc	34 lbs
b.	Arsenic	.5 lbs	k.	T. Cyanide	.06 lbs
c.	Cadmium	.8 lbs	l.	Chloroform	.5 lbs
d.	Chromium	2.6 lbs	m.	1,2,4 Trichlorobenzene	.01 lbs
e.	Copper	5.6 lbs	n.	Flouranthene	.06 lbs
f.	Selenium	.1 lbs	o.	Pyrene	1.0 lbs
g.	Silver	.05 lbs	p.	Endosulfan	.002 lbs
h.	Lead	27 lbs	q.	2,3,7,8-TCDD(Dioxin)-	None
i.	Mercury	.01 lbs	r.	Organochlorine Pesticides	0.0002 lbs

s. No other priority pollutant or its derivatives as listed in 40 CFR 403 Appendix B from any of the following EPA test procedures shall exceed 5.3 mg/l:

1.	Purgeable Halocarbons	Method 601
2.	Purgeable Aromatics	Method 602
3.	Phenols	Method 604
4.	Benzidines	Method 605
5.	Phthalate Esters	Method 606
6.	Nitrosamines	Method 607

P.4

NOV 21 '90 11:38 BUFFALO COLOR ENGINEERING

7.	Nitroaromatics & Isophorone	Method 609
8.	Polynucleur Aromatic Hydrocarbons	Method 610
9.	Haloethers	Method 611
10.	Chlorinated Hydrocarbons	Method 612

The present Buffalo Sewer Authority BPDES permit shall be modified to reflect the above requirements once all requirements are met

If there are any questions you may contact Mr. James Caruso or myself for assistance.

Very truly yours,

GILLMAN J. LAEHY, P.E.
GENERAL MANAGER

Donald L. Menno
Industrial Waste Administrator

DLM:bl
IHWS.LTR

NOV 21 '90 11:38 BUFFALO COLOR ENGINEERING

APPENDIX D

APPENDIX D

Preliminary Cost Estimates of Alternatives

ALTERNATIVE 1
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			
	Fencing	LS			
NAPL		LS	$50,000		$50,000
Construction	Mobilization	LS	$100,000		
	Clearing/Grubbing	AC	$3,625		
	Grading/Fill	CY	$10.50		
Cap	FML Cap	AC	$65,000		
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15		
GW Treatment	GW Pre-Treatment	LS			
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4		
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$157,500
Contingency - 25% of Capital Cost					$262,500

TOTAL	$1,470,000

[1] cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 2
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		$50,000
Construction	Mobilization	LS	$100,000		
	Clearing/Grubbing	AC	$3,625		
	Grading/Fill	CY	$10.50		
Cap	FML Cap	AC	$65,000		
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15		
GW Treatment	GW Pre-Treatment	LS			
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4		
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$183,000
Contingency - 25% of Capital Cost					$305,000

TOTAL	$1,708,000

* cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 3
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		$50,000
Construction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000	16.5	$1,072,500
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15		
GW Treatment	GW Pre-Treatment	LS			
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20	84,000	$1,680,000
	Fabriform/Rip Rap	SF	4		
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$703,007
Contingency - 25% of Capital Cost					$1,171,678
			TOTAL		$6,561,398

*I cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 3a
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000	16.5	$1,072,500
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15		
GW Treatment	GW Pre-Treatment	LS			
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$517,007
Contingency - 25% of Capital Cost					$861,678
			TOTAL		$4,825,398

*All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 4
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000	16.5	$1,072,500
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15	50,400	$756,000
GW Treatment	GW Pre-Treatment	LS			$5,200,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$1,600,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$1,650,407
Contingency - 25% of Capital Cost					$2,750,678

TOTAL	$15,403,798

* All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 4a
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000		
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15	50,400	$756,000
GW Treatment	GW Pre-Treatment	LS			$7,500,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$800,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20	84,000	$1,680,000
	Fabriform/Rip Rap	SF	4		
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$1,893,032
Contingency - 25% of Capital Cost					$3,155,053

TOTAL	$17,668,298

* All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 5
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000		
	Multi-Media Cap	AC	$160,000	16.5	$2,640,000
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15	50,400	$756,000
GW Treatment	GW Pre-Treatment	LS			$5,200,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$1,600,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$1,885,532
Contingency - 25% of Capital Cost					$3,142,553

TOTAL	$17,598,298

' cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 6
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000	16.5	$1,072,500
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15	50,400	$756,000
GW Treatment	GW Pre-Treatment	LS			$1,948,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$48,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7	112,500	$787,500
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$1,047,932
Contingency - 25% of Capital Cost					$1,746,553
			TOTAL		$9,780,698

* cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 6a
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

scription of Unit		Unit	Unit Cost	Quantity	*Cost
nitoring	Groundwater	LS			$1,000,000
ninistration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
PL		LS	$50,000		
nstruction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
ɔ	FML Cap	AC	$65,000	16.5	$1,072,500
	Multi-Media Cap	AC	$160,000		
/ Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15	50,400	$756,000
/ Treatment	GW Pre-Treatment	LS			
	GW Treatment	LS			$2,000,000
/ Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			$0
	Buffalo Sewer Authority	LS			
ntainment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7	112,500	$787,500
ɔre Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
cavation	Total Exc.	CY	4		
posal	Off-Site TSDF	TON	310		
atment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
ckfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
gineering - 15% of Capital Cost					$1,048,532
ntingency - 25% of Capital Cost					$1,747,553
			TOTAL		$9,786,298

l sented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 6b
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000	16.5	$1,072,500
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15	50,400	$756,000
GW Treatment	GW Pre-Treatment	LS			
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			$18,000,000
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7	112,500	$787,500
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$3,448,532
Contingency - 25% of Capital Cost					$5,747,553
			TOTAL		$32,186,298

*All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 6c
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000	16.5	$1,072,500
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15	50,400	$756,000
GW Treatment	GW Pre-Treatment	LS			$1,000,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$4,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7	30,600	$214,200
	Slurry Wall - Downgradient	SF	7	112,500	$787,500
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$931,262
Contingency - 25% of Capital Cost					$1,552,103
			TOTAL		$8,691,778

*All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 6d
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000	16.5	$1,072,500
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15	50,400	$756,000
GW Treatment	GW Pre-Treatment	LS			
	GW Treatment	LS			$1,500,000
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			$0
	Buffalo Sewer Authority	LS			
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7	30,600	$214,200
	Slurry Wall - Downgradient	SF	7	112,500	$787,500
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$1,005,662
Contingency - 25% of Capital Cost					$1,676,103

TOTAL	$9,386,178

*All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 6e
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000	16.5	$1,072,500
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15	50,400	$756,000
GW Treatment	GW Pre-Treatment	LS			
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			$1,900,000
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7	30,600	$214,200
	Slurry Wall - Downgradient	SF	7	112,500	$787,500
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$1,065,662
Contingency - 25% of Capital Cost					$1,776,103
			TOTAL		$9,946,178

* All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 7
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000	16.5	$1,072,500
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15		
	Perimeter GW Collection	SF	15	50,400	$756,000
GW Treatment	GW Pre-Treatment	LS			$1,000,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$4,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7	30,600	$214,200
	Slurry Wall - Downgradient	SF	7	112,500	$787,500
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20	84,000	$1,680,000
	Fabriform/Rip Rap	SF	4		
Excavation	Total Exc.	CY	4		
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$1,109,762
Contingency - 25% of Capital Cost					$1,849,603

TOTAL	$10,357,778

All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 8
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000		
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15	100,800	$1,512,000
	Perimeter GW Collection	SF	15		
GW Treatment	GW Pre-Treatment	LS			$2,232,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$33,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20	132,000	$2,640,000
	Fabriform/Rip Rap	SF	4		
Excavation	Total Exc.	CY	4	480,000	$2,880,000
Disposal	Off-Site TSDF	TON	310	720,000	$223,200,000
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4		
	Total Backfill - New Soil	CY	12	480,000	$5,760,000
Engineering - 15% of Capital Cost					$36,021,182
Contingency - 25% of Capital Cost					$60,035,303

TOTAL	$336,197,698

*All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 9
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$500,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000		
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15	100,800	$1,512,000
	Perimeter GW Collection	SF	15		
GW Treatment	GW Pre-Treatment	LS			$2,232,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$33,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4	480,000	$1,920,000
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75	480,000	$36,000,000
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4	480,000	$1,920,000
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$6,958,682
Contingency - 25% of Capital Cost					$11,597,803

TOTAL	$64,947,698

*All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 9a
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$500,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000		
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15	100,800	$1,512,000
	Perimeter GW Collection	SF	15		
GW Treatment	GW Pre-Treatment	LS			$2,232,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$33,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4	480,000	$1,920,000
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350	480,000	$168,000,000
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4	480,000	$1,920,000
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$26,758,682
Contingency - 25% of Capital Cost					$44,597,803

TOTAL	$249,747,698

*All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 9b
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$500,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000		
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15	100,800	$1,512,000
	Perimeter GW Collection	SF	15		
GW Treatment	GW Pre-Treatment	LS			$2,232,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$33,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4	480,000	$1,920,000
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200	480,000	$96,000,000
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4	480,000	$1,920,000
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$15,958,682
Contingency - 25% of Capital Cost					$26,597,803

TOTAL	$148,947,698

*All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 9c
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$500,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000		
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15	100,800	$1,512,000
	Perimeter GW Collection	SF	15		
GW Treatment	GW Pre-Treatment	LS			$2,232,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$33,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4	480,000	$1,920,000
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70	480,000	$33,600,000
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4	480,000	$1,920,000
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$6,598,682
Contingency - 25% of Capital Cost					$10,997,803

TOTAL	$61,587,698

All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 9d
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$500,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000		
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15	100,800	$1,512,000
	Perimeter GW Collection	SF	15		
GW Treatment	GW Pre-Treatment	LS			$2,232,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$33,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4	480,000	$1,920,000
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130	480,000	$62,400,000
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100		
Backfill	Total Backfill - Existing Soil	CY	4	480,000	$1,920,000
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$10,918,682
Contingency - 25% of Capital Cost					$18,197,803

TOTAL	$101,907,698

* All cost presented in present value based upon 10% intrest rate and 6% inflation.

ALTERNATIVE 9e
PRELIMINARY COST ESTIMATE
BUFFALO COLOR AREA "D"
FEASIBILITY STUDY

Description of Unit		Unit	Unit Cost	Quantity	*Cost
Monitoring	Groundwater	LS			$1,000,000
Administration	Deed Restriction	LS			$20,000
	Fencing	LS			$150,000
NAPL		LS	$50,000		
Construction	Mobilization	LS	$100,000		$500,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400
Cap	FML Cap	AC	$65,000		
	Multi-Media Cap	AC	$160,000		
GW Collection	Total GW Collection	SF	15	100,800	$1,512,000
	Perimeter GW Collection	SF	15		
GW Treatment	GW Pre-Treatment	LS			$2,232,000
	GW Treatment	LS			
GW Disposal	Disposal Site/TSDF	LS			
	Buffalo River	LS			
	Buffalo Sewer Authority	LS			$33,000
Containment	Slurry Wall - SW Side	SF	7		
	Slurry Wall - Upgradient	SF	7		
	Slurry Wall - Downgradient	SF	7		
Shore Stabilization	Sheet Piling - E. & S. Sides	SF	20		
	Fabriform/Rip Rap	SF	4	122,500	$490,000
Excavation	Total Exc.	CY	4	480,000	$1,920,000
Disposal	Off-Site TSDF	TON	310		
Treatment On-Site	Bioremediation	CY	75		
	Stabilization/Solidification	CY	130		
	Soil Washing	CY	70		
	Vitrification	CY	350		
	Incineration	CY	200		
	Chemical Remediation	CY	100	480,000	$48,000,000
Backfill	Total Backfill - Existing Soil	CY	4	480,000	$1,920,000
	Total Backfill - New Soil	CY	12		
Engineering - 15% of Capital Cost					$8,758,682
Contingency - 25% of Capital Cost					$14,597,803

TOTAL	$81,747,698

*All cost presented in present value based upon 10% intrest rate and 6% inflation.

WehranEnviroTech

APPENDIX E

APPENDIX E

Response to NYSDEC September 18, 1990 Letter

Re: Sheetpiling Placement

WehranEnviroTech

Wehran-New York, Inc.
345 Lang Boulevard
Suite 1
Grand Island, New York 14072
Tel: 716-773-1601
Fax: 716-773-1828

November 19, 1990

Mr. David Sauer
Buffalo Color Corporation
100 Lee Street
Buffalo, NY 14210

Re: Buffalo Color – Area "D" Feasibility Study
Sediment Removal and Sheetpile Cost
WE Project No. 00257

Dear Mr. Sauer:

Attached please find a summary of the estimated sediment volumes and sheetpiling costs for the above-referenced project. Initially, a representative cross-section was prepared through the east shore using the available topographic mapping and the Army Corps of Engineers dredge maps. The volume of sediment was then calculated based upon locating a sheetpile wall at various increments between the existing shoreline and the edge of the Corps of Engineers dredged channel. The total volume was estimated by multiplying the area of the representative section by the distance along the shore in those areas which have exhibited erosion (i.e., the south and east). An estimate for construction of a sheetpile wall is also included on the attachment. The length of the wall was also estimated based upon coverage of the east and south sides of the site.

In summary, the cost for construction of the sheetpile wall and dredging is:

Sheetpile Wall	–	$2,400,000
Dredging	–	$0 - $280,000 (Depending on Wall Location)

The dredging cost is based upon placement of the excavated sediment within the existing site area.

If you have any comments or require additional information, please feel free to contact me.

Very truly yours
WEHRAN–NEW YORK, INC.

John B. Battaglia
Project Manager

Attachments

cc: C. Yamarino
R. Henschel
R. Predale
W. Manijak

Buffalo Color Sediment Volume
and Sheetpiling Cost Analysis
Wehran PN 00257

Distance From Bank Edge	Sediment Volume Cubic Yards Wall/ Edge	Wall/ Channel	Removal Cost
Edge of Water - 0'	0	32,593	$277,037
10'	13,481	19,111	$162,444
20'	21,704	10,889	$92,556
30'	26,519	6,074	$51,630
Edge of Channel - 85'	32,593	0	$0

Total Bank Length = 2,000 ft
Total Cost of Sheetpiling @ $30/SFT = $2,400,000

Notes:

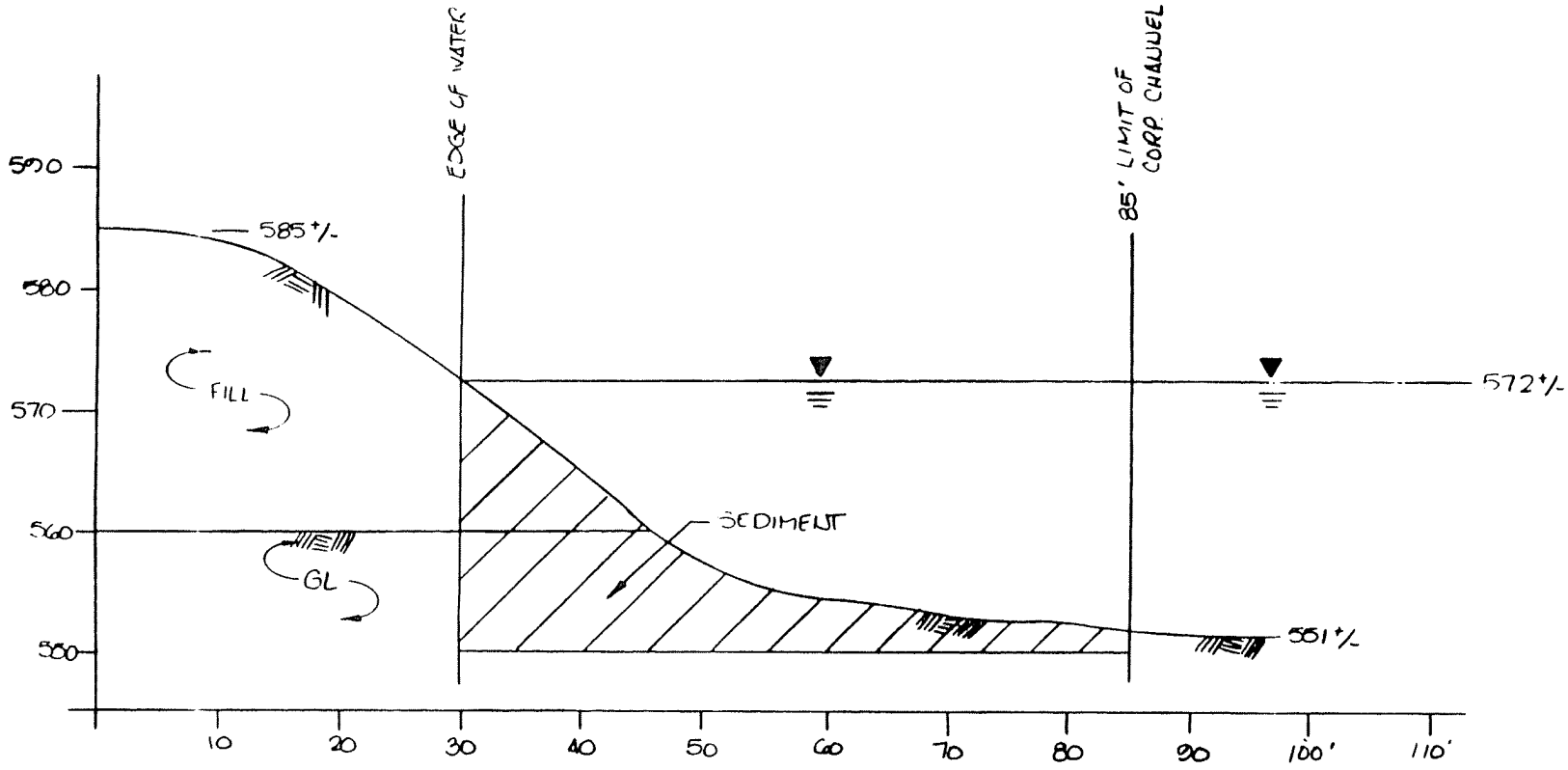
1) Sediment removal cost is based upon MEANS Cost Guide. A unit cost of $8.50 per cubic yard is used.

2) The cost for removal of the sediment between the wall and the Corps. channel along the South and East sides of the site.

3) The sheetpile cost is based upon placement along the South and East shore of Area "D".

SECTION ILLUSTRATING SEDIMENT BETWEEN

EDGE OF WATER AND CORP CHANNEL



WehranEnviroTech	Drawn By : Checked By : Date :	Scale 1" = 10'		"AREA D"	SHORELINE CROSS SECTION	Figure : 1 Project No. 00257



WehranEnviroTech

APPENDIX F

APPENDIX F

NYSDEC TAGM Alternative Screening Scoring Evaluation Sheets (Preliminary and Detailed)

No Action - GW monitoring for 30 years.

Table 4.1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	 ✓	0 4
	° Can the short-term risk be easily controlled?	Yes No	___ ___	1 0
	° Does the mitigative effort to control short-term risk impact the community life-style?	Yes No	___ ___	0 2
Subtotal (maximum = 4)	4			
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	✓ ___	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	___ ✓	3 0
Subtotal (maximum = 4)	0			
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	✓ ___	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	___ ✓	1 0
Subtotal (maximum = 2)	1			
4. On-site or off-site treatment or land disposal	n/a	° On-site treatment* ° Off-site treatment* ° On-site or off-site land disposal		3 1 0
Subtotal (maximum = 3)				
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes				
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 7.)	Yes No	___ ✓	3 0
Subtotal (maximum = 3)	0			

Table 4.1 (cont'd)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. ___ 20-25yr. ___ 15-20yr. ___ < 15yr. ___	3 2 1 0
n/a (?)			
Subtotal (maximum = 3)			
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ___ < 25% ___ 25-50% ___ ≥ 50% 4	3 2 1 0
n/a	ii) Is there treated residual left at the site? (If answer is no, go to Factor 8.)	Yes ___ No ___	0 2
	iii) Is the treated residual toxic?	Yes ___ No ___	0 1
	iv) Is the treated residual mobile?	Yes ___ No ___	0 1
Subtotal (maximum = 5) 0			
8. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___ > 5yr. 4	1 0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes 4 No ___	0 1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ___ Somewhat to not confident 4	1 0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___ Moderate ___ Extensive 4	2 1 0
Subtotal (maximum = 4) 0			
TOTAL (maximum = 25) TOTAL: (5)			

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

No Action - GW monitoring for 30 years.

Table 4.2

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
1. Technical Feasibility			
a. Ability to construct technology. n/a (?)	i) Not difficult to construct. No uncertainties in construction.	4	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		2
	iii) Very difficult to construct and/or significant uncertainties in construction.		1
b. Reliability of technology. n/a (?)	i) Very reliable in meeting the specified process efficiencies or performance goals.		3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		2
c. Schedule of delays due to technical problems.	i) Unlikely	4	2
	ii) Somewhat likely		1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		2
	ii) Some future remedial actions may be necessary.	4	1
Subtotal (maximum = 10)	3		
2. Administrative Feasibility			
a. Coordination with other agencies. 2	i) Minimal coordination is required.	4	2
	ii) Required coordination is normal.		1
	iii) Extensive coordination is required.		0
Subtotal (maximum = 2)	2		
3. Availability of Services and Materials			
a. Availability of prospective technologies. n/a	i) Are technologies under consideration generally commercially available for the site-specific application?	**Yes** / **No**	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	**Yes** / **No**	1 / 0

Table 4.2 (cont'd)

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ___4___ **No** _____	1 0

1

Subtotal (maximum = 3)

TOTAL (maximum = 15) (6)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4.2 (cont'd)

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes**	4	1
		No		0

Subtotal (maximum = 3) 3

TOTAL (maximum = 15) (15)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

LIMITED ACTION (fencing / deed restrictions)

Table 4.1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	 4	0 4
	° Can the short-term risk be easily controlled?	Yes No	 	1 0
	° Does the mitigative effort to control short-term risk impact the community life-style?	Yes No	 	0 2
Subtotal (maximum = 4)	4			
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	4 	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	 4	3 0
Subtotal (maximum = 4)	0			
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	4 	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	4 	1 0
Subtotal (maximum = 2)	2			
4. On-site or off-site treatment or land disposal n/a	° On-site treatment* ° Off-site treatment* ° On-site or off-site land disposal			3 1 0
Subtotal (maximum = 3)				
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes				
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 7.)	Yes No	 4	3 0
Subtotal (maximum = 3)	0			

Table 4.1 (cont'd)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. ___ 20-25yr. ___ 15-20yr. ___ < 15yr. X	3 2 1 0
Subtotal (maximum = 3)		0	
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ___ ≤ 25% ___ 25-50% ___ ≥ 50% X	3 2 1 0
n/a	ii) Is there treated residual left at the site? (If answer is no, go to Factor 8.)	Yes ___ No ___	0 2
	iii) Is the treated residual toxic?	Yes ___ No ___	0 1
	iv) Is the treated residual mobile?	Yes ___ No ___	0 1
Subtotal (maximum = 5)		0	
8. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. X > 5yr. ___	1 0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes X No ___	0 1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ___ Somewhat to not confident X	1 0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___ Moderate ___ Extensive X	2 1 0
Subtotal (maximum = 4)		0	
TOTAL (maximum = 25)		(6)	

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

LIMITED ACTION (fencing/deed restrictions)

Table 4.2

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	4	3
	ii) Somewhat difficult to construct. No uncertainties in construction.	___	2
	iii) Very difficult to construct and/or significant uncertainties in construction.	___	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.	___	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	4	2
c. Schedule of delays due to technical problems.	i) Unlikely	___	2
	ii) Somewhat likely	4	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.	___	2
	ii) Some future remedial actions may be necessary.	4	1
Subtotal (maximum = 10)		7	
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	___	2
	ii) Required coordination is normal.	4	1
	iii) Extensive coordination is required.	___	0
Subtotal (maximum = 2)		1	
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes ___ No ___	1 0
n/a	ii) Will more than one vendor be available to provide a competitive bid?	Yes ___ No ___	1 0

Table 4.2 (cont'd)

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
b. Availability of necessary equipment and specialists. n/a	i) Additional equipment and specialists may be available without significant delay.	**Yes**	___	1
		No	___	0

Subtotal (maximum = 3)

TOTAL (maximum = 15) (8)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Containment w/ treatment of GW & sediment removal

Table 4.1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	 X	0 4
	° Can the short-term risk be easily controlled?	Yes No	 	1 0
	° Does the mitigative effort to control short-term risk impact the community life-style?	Yes No	 	0 2
Subtotal (maximum = 4)	4			
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	X 	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	X 	3 0
Subtotal (maximum = 4)	3			
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	 X	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	 X	1 0
Subtotal (maximum = 2)	0			
4. On-site or off-site treatment or land disposal	° On-site treatment* ° Off-site treatment* ° On-site or off-site land disposal		X X	3 1 0
Subtotal (maximum = 3)	2 (avg. of 2)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes				
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 7.)	Yes No	 X	3 0
Subtotal (maximum = 3)	0			

Table 4.1 (cont'd)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy. (?)	25-30yr. 4	3
		20-25yr. ___	2
		15-20yr. ___	1
		< 15yr. ___	0
Subtotal (maximum = 3) 3			
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ___	3
		< 25% ___	2
		25-50% 4	1
		> 50% ___	0
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 8.)	Yes ___	0
		No 4	2
	iii) Is the treated residual toxic?	Yes ___	0
		No ___	1
	iv) Is the treated residual mobile? 3	Yes ___	0
		No ___	1
Subtotal (maximum = 5)			
8. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. 4	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes 4	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident 4	1
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___	2
		Moderate 4	1
		Extensive ___	0
Subtotal (maximum = 4) 2			
TOTAL (maximum = 25) (17)			

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Containment w/ treatment of GW & sediment removal

Table 4.2

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	___	3
	ii) Somewhat difficult to construct. No uncertainties in construction.	4	2
	iii) Very difficult to construct and/or significant uncertainties in construction.	___	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.	___	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	4	2
c. Schedule of delays due to technical problems.	i) Unlikely	___	2
	ii) Somewhat likely	4	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.	___	2
	ii) Some future remedial actions may be necessary.	4	1
Subtotal (maximum = 10)		6	
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	___	2
	ii) Required coordination is normal.	4	1
	iii) Extensive coordination is required.	___	0
Subtotal (maximum = 2)		1	
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes 4 / No ___	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes 4 / No ___	1 / 0

Table 4.2 (cont'd)

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** 4	1
		No ___	0

Subtotal (maximum = 3) 3

TOTAL (maximum = 15) (10)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Source Removal & On-Site Treatment (Soil, GW)

Table 4.1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	4 —	0 4
	° Can the short-term risk be easily controlled?	Yes No	4 —	1 0
	° Does the mitigative effort to control short-term risk impact the community life-style?	Yes No	— 4	0 2
Subtotal (maximum = 4) 1				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	4 —	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	4 —	3 0
Subtotal (maximum = 4) 3				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	— 4	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	— 4	1 0
Subtotal (maximum = 2) 0				
4. On-site or off-site treatment or land disposal	° On-site treatment* ° Off-site treatment* ° On-site or off-site land disposal		4 4	3 1 0
Subtotal (maximum = 3) 3				
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes				
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 7.)	Yes No	4 —	3 0
Subtotal (maximum = 3) 3				

Table 4.1 (cont'd)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. ✓	3
		20-25yr. ___	2
		15-20yr. ___	1
		< 15yr. ___	0
Subtotal (maximum = 3) 3			
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ✓	3
		≤ 25% ___	2
		25-50% ___	1
		≥ 50% ___	0
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 8.) dependent upon technology employed.	Yes ✓	0
		No ___	2
	iii) Is the treated residual toxic?	Yes ___	0
		No ✓	1
	iv) Is the treated residual mobile?	Yes ___	0
		No ✓	1
5-6			
Subtotal (maximum = 5)			
8. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ✓	1
		> 5yr. ___	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") dependent upon technology-type	Yes ___	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ✓	1
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ✓	2
		Moderate ___	1
		Extensive ___	0
Subtotal (maximum = 4) 4			
TOTAL (maximum = 25) (22)			

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Source Removal & On-Site Treatment (Soil, GW)

Table 4.2

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	4	3
	ii) Somewhat difficult to construct. No uncertainties in construction.	___	2
	iii) Very difficult to construct and/or significant uncertainties in construction.	___	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.	4	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	___	2
c. Schedule of delays due to technical problems.	i) Unlikely	~~4~~	2
	ii) Somewhat likely	4	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.	4	2
	ii) Some future remedial actions may be necessary.	___	1
Subtotal (maximum = 10)		~~10~~ 9	
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	___	2
	ii) Required coordination is normal.	4	1
	iii) Extensive coordination is required.	___	0
Subtotal (maximum = 2)		1	
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes 4 / No ___	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes 4 / No ___	1 / 0

Table 4.2 (cont'd)

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes**	4	1
		No	___	0

3

Subtotal (maximum = 3)

TOTAL (maximum = 15) (13)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

In Situ Treatment

Table 4.1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	___ 4	0 4
	° Can the short-term risk be easily controlled?	Yes No	___ ___	1 0
	° Does the mitigative effort to control short-term risk impact the community life-style?	Yes No	___ ___	0 2
Subtotal (maximum = 4)	4			
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	___ 4	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	___ ___	3 0
Subtotal (maximum = 4)	4			
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	4 ___	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	4 ___	1 0
Subtotal (maximum = 2)	2			
4. On-site or off-site treatment or land disposal	° On-site treatment* ° Off-site treatment* ° On-site or off-site land disposal		4	3 1 0
Subtotal (maximum = 3)	3			
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 7.)	Yes No	4 ___	3 0
Subtotal (maximum = 3)	3			

*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes

Table 4.1 (cont'd)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. 4	3
		20-25yr. ___	2
		15-20yr. ___	1
		< 15yr. ___	0
Subtotal (maximum = 3) 3			
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None 4	3
		< 25% ___	2
		25-50% ___	1
		≥ 50% ___	0
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 8.)	Yes ___	0
		No 4	2
	iii) Is the treated residual toxic?	Yes ___	0
		No ___	1
	iv) Is the treated residual mobile?	Yes ___	0
		No ___	1
Subtotal (maximum = 5) 5			
8. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. 4	1
		> 5yr. ___	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes ___	0
		No 4	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ~~4~~	1
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum 4	2
		Moderate ___	1
		Extensive ___	0
Subtotal (maximum = 4) ~~3~~ 4			
TOTAL (maximum = 25) (28)			

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

In Situ Treatment

Table 4.2

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	4	3
	ii) Somewhat difficult to construct. No uncertainties in construction.	___	2
	iii) Very difficult to construct and/or significant uncertainties in construction.	___	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.	4	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	___	2
c. Schedule of delays due to technical problems.	i) Unlikely	4	2
	ii) Somewhat likely	___	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.	4	2
	ii) Some future remedial actions may be necessary.	___	1
Subtotal (maximum = 10)		10	
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	4	2
	ii) Required coordination is normal.	___	1
	iii) Extensive coordination is required.	___	0
Subtotal (maximum = 2)		2	
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes 4 / No ___	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes 4 / No ___	1 / 0

TOTAL EXCAVATION AND DISPOSAL TO TSDF SITE Table 4.1 ALTERNATIVE 8

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	___ ✓	0 4
	° Can the short-term risk be easily controlled?	Yes No	___ ___	1 0
	° Does the mitigative effort to control short-term risk impact the community life-style?	Yes No	___ ___	0 2
Subtotal (maximum = 4) (4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	✓ ___	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	✓ ___	3 0
Subtotal (maximum = 4) (3)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	___ ✓	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	___ ✓	1 0
Subtotal (maximum = 2) (0)				
4. On-site or off-site treatment or land disposal	° On-site treatment* ° Off-site treatment* ° On-site or off-site land disposal			3 (1) 0
Subtotal (maximum = 3) (1)				
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes				
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 7.)	Yes No	✓ ___	3 0
Subtotal (maximum = 3) (3)				

Table 4.1 (cont'd) ALT. 3

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. ✓ 20-25yr. ___ 15-20yr. ___ < 15yr. ___	3 2 1 0
Subtotal (maximum = 3) (3)			
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ✓ ≤ 25% ___ 25-50% ___ ≥ 50% ___	3 2 1 0
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 8.)	Yes ___ No ✓	0 2
	iii) Is the treated residual toxic?	Yes ___ No ___	0 1
	iv) Is the treated residual mobile?	Yes ___ No ___	0 1
Subtotal (maximum = 5) (5)			
8. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ✓ > 5yr. ___	1 0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes ✓ No ___	0 1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ✓ Somewhat to not confident ___	1 0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ✓ Moderate ___ Extensive ___	2 1 0
Subtotal (maximum = 4) (4)			
TOTAL (maximum = 25) (22)			

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4.2

ALT. 8

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
1. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		___	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		✓	2
	iii) Very difficult to construct and/or significant uncertainties in construction.		___	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		✓	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		___	2
c. Schedule of delays due to technical problems.	i) Unlikely		___	2
	ii) Somewhat likely		✓	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		✓	2
	ii) Some future remedial actions may be necessary.		___	1
Subtotal (maximum = 10)			(3)	
2. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.		___	2
	ii) Required coordination is normal.		✓	1
	iii) Extensive coordination is required.		___	0
Subtotal (maximum = 2)			(1)	
3. Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes	✓	1
		No	___	0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes	✓	1
		No	___	0

Table 4.2 (cont'd)

ALT. 8

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes**	✓	1
		No	___	0

Subtotal (maximum = 3) (3)

TOTAL (maximum = 15) (12)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

ALTERNATIVE NO.1

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	**Yes**	___	4
		No	X	0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	**Yes**	___	3
		No	X	0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	**Yes**	___	3
		No	X	0
TOTAL (Maximum = 10)				0

ALTERNATIVE NO.1

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)		Yes ___ No ✓	20 0
TOTAL (Maximum = 20)				
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?		Yes ___ No ✓	3 0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?		Yes ___ No X	4 0
	iii) Is the exposure to contaminants via sediments/soils acceptable?		Yes ___ No X	3 0
Subtotal (maximum = 10)				
3. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	___	5
	ii) Health risk	≤ 1 in 100,000	___	2
	iii) NO REMEDY		✓	0
Subtotal (maximum = 5)				
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		___	5
	ii) Slightly greater than acceptable		___	3
	iii) Significant risk still exists		✓	0
Subtotal (maximum = 5)				
TOTAL (maximum = 20)				0

ALTERNATIVE No.1

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	___ ✓	0 4
NO REMEDY IMPLEMENTED	° Can the risk be easily controlled?	Yes No	___ ___	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	___ ___	0 2
Subtotal (maximum = 4)				0
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	___ ✓	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	___ ___	3 0
Subtotal (maximum = 4)				4
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	✓ ___	1 0
NO REMEDY IMPLEMENTED	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	___ ___	1 0
Subtotal (maximum = 2)				1
TOTAL (maximum = 10)				(9)

ALTERNATIVE NO 1

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		0 ✓
Subtotal (maximum = 3)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). **(If answer is yes, go to Factor 4.)**	**Yes** ___ **No** ✓	3 0
Subtotal (maximum = 3)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	**25-30yr.** ___ **20-25yr.** ___ **15-20yr.** ___ **< 15yr.** ✓	3 2 1 0
NO REMEDIAL ACTION			
Subtotal (maximum = 3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	**None** ___ **≤ 25%** ___ **25-50%** ___ **≥ 50%** ✓	3 2 1 0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 5.)**	**Yes** ✓ **No** ___	0 2
	iii) Is the treated residual toxic?	**Yes** ✓ **No** ___	0 1
	iv) Is the treated residual mobile?	**Yes** ✓ **No** ___	0 1
Subtotal (maximum = 5)			0

Table 5.5 (cont'd)

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. ___	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes ✓	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ___	1
		Somewhat to not confident ✓	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___	2
		Moderate ___	1
		Extensive ✓	0
Subtotal (maximum = 4)			0
TOTAL (maximum = 15)			

ALTERNATIVE NO. 1

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100% ___ 90-99% ___ 80-90% ___ 60-80% ___ 40-60% ___ 20-40% ___ < 20% ✓	8 7 6 4 2 1 0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes ___ No ✓	0 2
Subtotal (maximum = 10) If subtotal = 10, go to Factor 3			
	iii) After remediation, how is the untreated, residual hazardous waste material disposed? NO REMEDY IMPLEMENTED	Off-site land disposal ___ On-site land disposal ✓ Off-site destruction or treatment ___	0 1 2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100% ___ 60-90% ___ < 60% ✓	2 1 0
	ii) Method of Immobilization - Reduced mobility by containment - Reduced mobility by alternative treatment technologies	___ ___	0 3
Subtotal (maximum = 5)			
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible	___	5
	Irreversible for most of the hazardous waste constituents.	___	3
	Irreversible for only some of the hazardous waste constituents	___	2
	Reversible for most of the hazardous waste constituents.	✓	0
Subtotal (maximum = 5)			
TOTAL (maximum = 15)			3

ALTERNATIVE NO. 1

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		✓	3
	ii) Somewhat difficult to construct. No uncertainties in construction.			2
	iii) Very difficult to construct and/or significant uncertainties in construction.			1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.			3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.			2
	iii) NOT RELIABLE IN MEETING GOALS		✓	0
c. Schedule of delays due to technical problems.	i) Unlikely		✓	2
	ii) Somewhat likely			1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.			2
	ii) Some future remedial actions may be necessary.		✓	1
Subtotal (maximum = 10)				(6)
2. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.		✓	2
	ii) Required coordination is normal.			1
	iii) Extensive coordination is required.			0
Subtotal (maximum = 2)				(2)
3. Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes	✓	1
		No		0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes	✓	1
		No		0

ALTERNATIVE NO. 1

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ✓ **No** ___	1 0
			(3)
Subtotal (maximum = 3)			
TOTAL (maximum = 15)			(11)

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	**Yes**	___	4
		No	✓	0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	**Yes**	✓	3
		No	___	0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	**Yes**	___	3
		No	✓	0

TOTAL (Maximum = 10)

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)		Yes ___ / No ✓	20 / 0
TOTAL (Maximum = 20)				
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?		Yes ___ / No ✓	3 / 0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?		Yes ___ / No ✓	4 / 0
	iii) Is the exposure to contaminants via sediments/soils acceptable?		Yes ___ / No ✓	3 / 0
Subtotal (maximum = 10)				
3. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	___	5
	ii) Health risk	≤ 1 in 100,000	___	2
	iii) NO REMEDY		✓	0
Subtotal (maximum = 5)				
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		___	5
	ii) Slightly greater than acceptable		___	3
	iii) Significant risk still exists		✓	0
Subtotal (maximum = 5)				
TOTAL (maximum = 20)				

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	___ ✓	0 4
	° Can the risk be easily controlled?	Yes No	___ ___	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	___ ___	0 2
Subtotal (maximum = 4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	___ ✓	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	___ ___	3 0
Subtotal (maximum = 4)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	✓ ___	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	___ ___	1 0
Subtotal (maximum = 2)				(9)
TOTAL (maximum = 10)				

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		(0)
Subtotal (maximum = 3)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 4.)	Yes ___	3
		No ✓	0
Subtotal (maximum = 3)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. ___	3
		20-25yr. ___	2
		15-20yr. ___	1
		< 15yr. ✓	0
Subtotal (maximum = 3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ___	3
		< 25% ___	2
		25-50% ___	1
		> 50% ✓	0
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 5.)	Yes ✓	0
		No ___	2
	iii) Is the treated residual toxic?	Yes ✓	0
		No ___	1
	iv) Is the treated residual mobile?	Yes ✓	0
		No ___	1
Subtotal (maximum = 5)			(0)

Table 5.5 (cont'd)

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

alysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. ✓	0
	ii) Are environmental controls required as a part of the remedy to handle po· ntial problems? (If answer is no, go to "iv")	Yes ✓	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ___	1
		Somewhat to not confident ✓	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___	2
		Moderate ___	1
		Extensive ✓	0
Subtotal (maximum = 4)			0
TOTAL (maximum = 15)			0

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100% ___	8
		90-99% ___	7
		80-90% ___	6
		60-80% ___	4
		40-60% ___	2
		20-40% ___	1
		< 20% ✓	0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes ___	0
		No ✓	2
Subtotal (maximum = 10) If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal ___	0
		On-site land disposal ✓	1
		Off-site destruction or treatment ___	2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100% ___	2
		60-90% ___	1
		< 60% ✓	0
NOT APPLICABLE	ii) Method of Immobilization - Reduced mobility by containment	___	0
	- Reduced mobility by alternative treatment technologies	___	3
Subtotal (maximum = 5)			
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible	___	5
	Irreversible for most of the hazardous waste constituents.	___	3
	Irreversible for only some of the hazardous waste constituents	___	2
	Reversible for most of the hazardous waste constituents.	✓	0
Subtotal (maximum = 5)			
TOTAL (maximum = 15)			3

ALTERNATIVE NO. 2

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

	Basis for Evaluation During Detailed Analysis		Score
Feasibility			
to construct ogy.	i) Not difficult to construct. No uncertainties in construction.	✓	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		2
	iii) Very difficult to construct and/or significant uncertainties in construction.		1
lity of ogy.	i) Very reliable in meeting the specified process efficiencies or performance goals.		3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		2
	iii) DOT RELIABLE IN MEETING GOAL	✓	0
e of delays technical s.	i) Unlikely	✓	2
	ii) Somewhat likely		1
caking nal remedial if necessary.	i) No future remedial actions may be anticipated.		2
	ii) Some future remedial actions may be necessary.	✓	1
maximum = 10)			(6)
tive Feasibility			
ation with gencies.	i) Minimal coordination is required.	✓	2
	ii) Required coordination is normal.		1
	iii) Extensive coordination is required.		0
maximum = 2)			(2)
ty of Services als			
ility of tive ogies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes ✓ / No	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes ✓ / No	1 / 0

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ✓ **No**	1 0

(11)

Subtotal (maximum = 3)

TOTAL (maximum = 15)

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Sco
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	**Yes**	___	4
		No	✓	0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	**Yes**	✓	3
		No	___	0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act n/a ?	**Yes**	___	3
		No	✓	0

TOTAL (Maximum = 10) (3)

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes No	___ ✓	20 0
TOTAL (Maximum = 20)	0			
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes No	✓ ___	3 0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes No	___ ✓	4 0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes No	✓ ___	3 0
Subtotal (maximum = 10)	7			
3. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	___	5
	ii) Health risk	≤ 1 in 100,000	✓	2
Subtotal (maximum = 5)	2			
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		___	5
	ii) Slightly greater than acceptable		___	3
	iii) Significant risk still exists		✓	0
Subtotal (maximum = 5)	0			
TOTAL (maximum = 20)	9			

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	 ✓	0 4
	° Can the risk be easily controlled?	Yes No	 	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	 	0 2
Subtotal (maximum = 4)				4
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	✓ 	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	✓ 	3 0
Subtotal (maximum = 4)				3
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	✓ 	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	 ✓	1 0
Subtotal (maximum = 2)				0
TOTAL (maximum = 10)				7

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		(0)
Subtotal (maximum = 3) (0)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 4.)	Yes ___	3
		No ✓	0
Subtotal (maximum = 3) (0)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. ___	3
		20-25yr. ___	2
		15-20yr. ___	1
		< 15yr. ✓	0
Subtotal (maximum = 3) (1)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ___	3
		≤ 25% ___	2
		25-50% ___	1
		≥ 50% ✓	0
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 5.)	Yes ___	0
		No ___	2
	iii) Is the treated residual toxic?	Yes ___	0
		No ___	1
	iv) Is the treated residual mobile?	Yes ___	0
		No ___	1
Subtotal (maximum = 5) (0)			

Table 5.5 (cont'd)

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. ✓	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes ✓	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ___	1
		Somewhat to not confident ✓	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___	2
		Moderate ___	1
		Extensive ✓	0
Subtotal (maximum = 4)			0
TOTAL (maximum = 15)			

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100% ___ 90-99% ___ 80-90% ___ 60-80% ___ 40-60% ___ 20-40% ___ < 20% ✓	8 7 6 4 2 1 0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes ___ No ✓	0 2
Subtotal (maximum = 10) (1) If subtotal = 10, go to Factor 3			
	iii) After remediation, how is the untreated, residual hazardous waste material disposed? (1) (2)	Off-site land disposal ___ On-site land disposal ___ Off-site destruction or treatment ___	0 1 2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100% ___ 60-90% ___ < 60% ___	2 1 0
	ii) Method of Immobilization - Reduced mobility by containment - Reduced mobility by alternative treatment technologies	___ ___	0 3
Subtotal (maximum = 5) (0)			
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible	___	5
	Irreversible for most of the hazardous waste constituents.	___	3
	Irreversible for only some of the hazardous waste constituents	___	2
	Reversible for most of the hazardous waste constituents.	✓ (0)	0
Subtotal (maximum = 5)			
TOTAL (maximum = 15)			(2)

ALTERNATIVE NO. 3

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	✓	(3)
	ii) Somewhat difficult to construct. No uncertainties in construction.		2
	iii) Very difficult to construct and/or significant uncertainties in construction.		1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	✓	(2)
c. Schedule of delays due to technical problems.	i) Unlikely	✓	(2)
	ii) Somewhat likely		1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		2
	ii) Some future remedial actions may be necessary.	✓	(1)
Subtotal (maximum = 10)			(8)
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	✓	(2)
	ii) Required coordination is normal.		1
	iii) Extensive coordination is required.		0
Subtotal (maximum = 2)			(2)
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes ✓ / No	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes ✓ / No	1 / 0

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ✓ **No**	1 0
Subtotal (maximum = 3)			(3)
TOTAL (maximum = 15)			(13)

ALTERNATIVE NO. 3a

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes No	___ ✓	4 0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes No	✓ ___	3 0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes No	___ ✓	3 0

TOTAL (Maximum = 10) (3)

ALTERNATIVE NO. 3a

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes No	___ ✓	20 0
TOTAL (Maximum = 20)	0			
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes No	✓ ___	3 0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes No	___ ✓	4 0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes No	___ ✓	3 0
Subtotal (maximum = 10)	3			
3. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	___	5
	ii) Health risk	≤ 1 in 100,000	✓	2
Subtotal (maximum = 5)	2			
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		___	5
	ii) Slightly greater than acceptable		___	3
	iii) Significant risk still exists		✓	0
Subtotal (maximum = 5)	0			
TOTAL (maximum = 20)	5			

ALTERNATIVE NO. 3a

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	___ ✓	0 4
	° Can the risk be easily controlled?	Yes No	___ ___	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	___ ___	0 2
Subtotal (maximum = 4)	(4)			
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	✓ ___	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	✓ ___	3 0
Subtotal (maximum = 4)	(3)			
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	✓ ___	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	___ ✓	1 0
Subtotal (maximum = 2)	(2)			
TOTAL (maximum = 10)	(9)			

ALTERNATIVE NO. 3a

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		0
Subtotal (maximum = 3)	2		
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 4.)	Yes ___ / No ___	3 / 0
Subtotal (maximum = 3)	2		
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. ___	3
		20-25yr. ___	2
		15-20yr. ___	1
		< 15yr. ___	0
Subtotal (maximum = 3)	1		
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	None ___	3
		< 25% ___	2
		25-50% ___	1
		> 50% ___	0
	ii) Is there treated residual left at the site? (If answer is no, go to Factor 5.)	Yes ___	0
		No ___	2
	iii) Is the treated residual toxic?	Yes ___	0
		No ___	1
	iv) Is the treated residual mobile?	Yes ___	0
		No ___	1
Subtotal (maximum = 5)	3		

Table 5.5 (cont'd) ALTERNATIVE NO. 3c

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. ✓	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes ✓	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ___	1
		Somewhat to not confident ✓	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___	2
		Moderate ___	1
		Extensive ___	0
Subtotal (maximum = 4)			(1)
TOTAL (maximum = 15)			(C)

ALTERNATIVE NO. 3a.

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100%	___	8
		90-99%	___	7
		80-90%	___	6
		60-80%	___	4
		40-60%	___	2
		20-40%	___	1
		< 20%	✓	0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes	___	0
		No	✓	2
Subtotal (maximum = 10) (1)				
If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal	___	0
		On-site land disposal	___	1
		Off-site destruction or treatment	___	2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100%	___	2
		60-90%	___	1
		< 60%	___	0
	ii) Method of Immobilization			
	- Reduced mobility by containment		___	0
	- Reduced mobility by alternative treatment technologies		___	3
Subtotal (maximum = 5) (0)				
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible		___	5
	Irreversible for most of the hazardous waste constituents.		___	3
	Irreversible for only some of the hazardous waste constituents		___	1
	Reversible for most of the hazardous waste constituents.		✓	0
Subtotal (maximum = 5) (0)				
TOTAL (maximum = 15)				

ALTERNATIVE NO. 3a

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	✓	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		2
	iii) Very difficult to construct and/or significant uncertainties in construction.		1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	✓	2
c. Schedule of delays due to technical problems.	i) Unlikely	✓	2
	ii) Somewhat likely		1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		2
	ii) Some future remedial actions may be necessary.	✓	1
Subtotal (maximum = 10)		(8)	
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	✓	2
	ii) Required coordination is normal.		1
	iii) Extensive coordination is required.		0
Subtotal (maximum = 2)		(2)	
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes ✓ / No	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes ✓ / No	1 / 0

ALTERNATIVE NO. 3a.

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes**	✓	1
		No		0

Subtotal (maximum = 3) (3)

TOTAL (maximum = 15) (15)

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis	check	Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes ☒ / No ☑	4 / 0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes ✓ / No ☐	3 / 0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes ✓ / No ☐	3 / 0

TOTAL (Maximum = 10) ~~8~~ 6

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes No	___ ✓	20 (0)
TOTAL (Maximum = 20)				
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes No	✓ ___	3 0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes No	✓ ___	4 0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes No	___ ✓	3 0
Subtotal (maximum = 10) (10)				
3. Magnitude of residual public health risks after the remediation.	i) Health risk ≤ 1 in 1,000,000		___	5
	ii) Health risk ≤ 1 in 100,000		✓	2
Subtotal (maximum = 5) (5)				
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		___	5
	ii) Slightly greater than acceptable		✓	3
	iii) Significant risk still exists		___	0
Subtotal (maximum = 5) (3)				
TOTAL (maximum = 20) (18)				

(2)

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	___ ✓	0 4
	° Can the risk be easily controlled?	Yes No	___ ___	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	___ ___	0 2
Subtotal (maximum = 4) (4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	✓ ___	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	✓ ___	3 0
Subtotal (maximum = 4) (3)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	✓ ___	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	✓ ___	1 0
Subtotal (maximum = 2) (2)				
TOTAL (maximum = 10) (9)				

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		(0)
Subtotal (maximum = 3) (0)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). **(If answer is yes, go to Factor 4.)**	**Yes** ___ **No** ✓	3 (0)
Subtotal (maximum = 3) (0)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	**25-30yr.** ✓	3
		20-25yr. ___	2
		15-20yr. ___	1
		< 15yr. ___	0
Subtotal (maximum = 3) (1)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	**None** ___	3
		< 25% ___	2
		25-50% ___	1
		≥ 50% ✓	0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 5.)**	**Yes** ✓	0
		No ___	2
	iii) Is the treated residual toxic?	**Yes** ___	0
		No ___	1
	iv) Is the treated residual mobile?	**Yes** ___	0
		No ___	1
Subtotal (maximum = 5) (4)			

3

Chief

Table 5.5 (cont'd)

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

nalysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. ✓	(0)
	ii) Are environmental controls required as a part of the remedy to handle po· ntial problems? (If answer is no, go to "iv")	Yes ✓	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ✓	1
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___	2
		Moderate ✓	(1)
		Extensive ___	0
Subtotal (maximum = 4)			(2)
TOTAL (maximum = 15)			(7)

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100% ___ 90-99% ___ 80-90% ___ 60-80% ___ 40-60% ✓ 20-40% ___ < 20% ___	8 7 6 4 2 1 0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes ___ No ___	0 2
Subtotal (maximum = 10) (4) If subtotal = 10, go to Factor 3			
	iii) After remediation, how is the untreated, residual hazardous waste material disposed? (2)/(6)	Off-site land disposal ___ On-site land disposal ___ Off-site destruction or treatment ✓	0 1 2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100% ✓ 60-90% ___ < 60% ___	2 1 0
	ii) Method of Immobilization - Reduced mobility by containment - Reduced mobility by alternative treatment technologies (2)	✓ (0) ___	3
Subtotal (maximum = 5)			
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible	✓	5
	Irreversible for most of the hazardous waste constituents.	___	3
	Irreversible for only some of the hazardous waste constituents	___	2
	Reversible for most of the hazardous waste constituents.	___	0
Subtotal (maximum = 5) (5)			
TOTAL (maximum = 15) (11)			

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	✓	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		2
	iii) Very difficult to construct and/or significant uncertainties in construction.		1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	✓	2
c. Schedule of delays due to technical problems.	i) Unlikely	✓	2
	ii) Somewhat likely		1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		2
	ii) Some future remedial actions may be necessary.	✓	1
Subtotal (maximum = 10)			8
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	✓	2
	ii) Required coordination is normal.		1
	iii) Extensive coordination is required.		0
Subtotal (maximum = 2)			2
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes ✓ / No	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes ✓ / No	1 / 0

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ✓ **No** ___	(1) 0

Subtotal (maximum = 3) (3)

TOTAL (maximum = 15) (13)

ALTERNATIVE NO. 4a

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	**Yes**	✓	4
		No		0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	**Yes**	✓	3
		No		0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	**Yes**	✓	3
		No		0

TOTAL (Maximum = 10)

(10)

ALTERNATIVE NO. 4a

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes No	___ ✓	20 0
TOTAL (Maximum = 20)	(0)			
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes No	✓ ___	3 0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes No	✓ ___	4 0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes No	✓ ___	3 0
Subtotal (maximum = 10)	(7)			
3. Magnitude of residual public health risks after the remediation.	i) Health risk ≤ 1 in 1,000,000		___	5
	ii) Health risk ≤ 1 in 100,000		✓	(2)
Subtotal (maximum = 5)	(2)			
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		___	5
	ii) Slightly greater than acceptable		✓	3
	iii) Significant risk still exists		___	0
Subtotal (maximum = 5)	(3)			
TOTAL (maximum = 20)	(9)			

ALTERNATIVE NO. 4a

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	___ ✓	0 4
	° Can the risk be easily controlled?	Yes No	___ ___	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	___ ___	0 2
Subtotal (maximum = 4)	(4)			
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	✓ ___	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	✓ ___	3 0
Subtotal (maximum = 4)	(3)			
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	✓ ___	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	✓ ___	1 0
Subtotal (maximum = 2)	(2)			
TOTAL (maximum = 10)	(9)			

ALTERNATIVE NO. 4a.

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		(0)
Subtotal (maximum = 3) (0)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). **(If answer is yes, go to Factor 4.)**	**Yes** ___ **No** ✓	3 0
Subtotal (maximum = 3) (0)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	**25-30yr.** ✓ **20-25yr.** ___ **15-20yr.** ___ **< 15yr.** ___	3 2 1 0
Subtotal (maximum = 3) (1)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	**None** ___ **< 25%** ___ **25-50%** ___ **≥ 50%** ✓	3 2 1 0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 5.)**	**Yes** ___ **No** ✓	0 2
	iii) Is the treated residual toxic?	**Yes** ___ **No** ___	0 1
	iv) Is the treated residual mobile?	**Yes** ___ **No** ___	0 1
Subtotal (maximum = 5) (2)			

Table 5.5 (cont'd) ALTERNATIVE NO. 4

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. ✓	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes ✓	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ✓	1
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___	2
		Moderate ✓	1
		Extensive ___	0

Subtotal (maximum = 4) (2)

TOTAL (maximum = 15) (7)

ALTERNATIVE NO. 4a.

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100% ___ 90-99% ___ 80-90% ___ 60-80% ___ 40-60% ✓ 20-40% ___ < 20% ___	8 7 6 4 2 1 0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes ✓ No ___	0 2
Subtotal (maximum = 10) (2) If subtotal = 10, go to Factor 3			
	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal ___ On-site land disposal ___ Off-site destruction or treatment ✓	0 1 2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100% ✓ 60-90% ___ < 60% ___	2 1 0
	ii) Method of Immobilization - Reduced mobility by containment - Reduced mobility by alternative treatment technologies	✓ ___	0 3
Subtotal (maximum = 5) (2)			
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible	✓	5
	Irreversible for most of the hazardous waste constituents.	___	3
	Irreversible for only some of the hazardous waste constituents	___	2
	Reversible for most of the hazardous waste constituents.	___	0
Subtotal (maximum = 5) (5)			
TOTAL (maximum = 15) (11)			

ALTERNATIVE NO. 4a.

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	✓	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		2
	iii) Very difficult to construct and/or significant uncertainties in construction.		1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	✓	2
c. Schedule of delays due to technical problems.	i) Unlikely	✓	2
	ii) Somewhat likely		1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		2
	ii) Some future remedial actions may be necessary.	✓	1
Subtotal (maximum = 10)		(8)	
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	✓	2
	ii) Required coordination is normal.		1
	iii) Extensive coordination is required.		0
Subtotal (maximum = 2)		(2)	
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes ✓ / No	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes ✓ / No	1 / 0

ALTERNATIVE NO. 4a.

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ✓ **No** ___	1 0

Subtotal (maximum = 3) (3)

TOTAL (maximum = 15) (13)

ALTERNATIVE NO. 5

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	**Yes**	✓	4
		No		0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	**Yes**	✓	3
		No		0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	**Yes**	✓	3
		No		0

TOTAL (Maximum = 10) (10)

ALTERNATIVE NO. 5

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes No	___ ✓	20 0
TOTAL (Maximum = 20)				0
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes No	✓ ___	3 0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes No	✓ ___	4 0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes No	✓ ___	3 0
Subtotal (maximum = 10)				10
3. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	✓	5
	ii) Health risk	≤ 1 in 100,000	___	2
Subtotal (maximum = 5)				5
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		___	5
	ii) Slightly greater than acceptable		✓	3
	iii) Significant risk still exists		___	0
Subtotal (maximum = 5)				3
TOTAL (maximum = 20)				18

ALTERNATIVE NO. 5

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	___ ✓	0 4
	° Can the risk be easily controlled?	Yes No	___ ___	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	___ ___	0 2
Subtotal (maximum = 4)	(4)			
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	✓ ___	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	✓ ___	3 0
Subtotal (maximum = 4)	(3)			
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	✓ ___	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	✓ ___	1 0
Subtotal (maximum = 2)	(2)			
TOTAL (maximum = 10)	(9)			

ALTERNATIVE NO. 5

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		0 ✓
Subtotal (maximum = 3) (0)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). **(If answer is yes, go to Factor 4.)**	**Yes** ___ **No** ✓	3 0
Subtotal (maximum = 3) (0)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	**25-30yr.** ✓ **20-25yr.** ___ **15-20yr.** ___ **< 15yr.** ___	3 2 1 0
Subtotal (maximum = 3) (2)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	**None** ___ **≤ 25%** ___ **25-50%** ___ **≥ 50%** ✓	3 2 1 0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 5.)**	**Yes** ___ **No** ✓	0 2
	iii) Is the treated residual toxic?	**Yes** ___ **No** ___	0 1
	iv) Is the treated residual mobile?	**Yes** ___ **No** ___	0 1
Subtotal (maximum = 5) (2)			

Table 5.5 (cont'd) ALTERNATIVE NO. 5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. ✓	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes ✓	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ✓	1
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___	2
		Moderate ✓	1
		Extensive ___	0

Subtotal (maximum = 4) (2)

TOTAL (maximum = 15) 0

7

ALTERNATIVE NO. 5

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100%	___	8
		90-99%	___	7
		80-90%	___	6
		60-80%	✓	4
		40-60%	___	2
		20-40%	___	1
		< 20%	___	0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes	✓	0
		No	___	2
Subtotal (maximum = 10) (4) If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal	___	0
		On-site land disposal	___	1
(2) / (6)		Off-site destruction or treatment	✓	2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100%	✓	2
		60-90%	___	1
		< 60%	___	0
	ii) Method of Immobilization			
	- Reduced mobility by containment		✓	0
	- Reduced mobility by alternative treatment technologies		___	1
Subtotal (maximum = 5) (2)				
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible		✓	5
	Irreversible for most of the hazardous waste constituents.		___	4
	Irreversible for only some of the hazardous waste constituents		___	2
	Reversible for most of the hazardous waste constituents.		___	0
Subtotal (maximum = 5) (5)				
TOTAL (maximum = 15) (13)				

ALTERNATIVE NO. 5

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		✓	3
	ii) Somewhat difficult to construct. No uncertainties in construction.			2
	iii) Very difficult to construct and/or significant uncertainties in construction.			1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.			3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		✓	2
c. Schedule of delays due to technical problems.	i) Unlikely		✓	2
	ii) Somewhat likely			1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.			2
	ii) Some future remedial actions may be necessary.			1
Subtotal (maximum = 10)	(8)			
2. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.		✓	2
	ii) Required coordination is normal.			1
	iii) Extensive coordination is required.			0
Subtotal (maximum = 2)	(1)			
3. Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes	✓	1
		No		0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes	✓	1
		No		0

ALTERNATIVE NO. 5

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ✓ **No** ___	1 0

Subtotal (maximum = 3) (3)

TOTAL (maximum = 15) (12)

ALTERNATIVE NO. 6

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes No	X X	4 0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes No	✓ —	3 0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes No	✓ —	3 0

TOTAL (Maximum = 10) ~~10~~ 6

ALTERNATIVE NO. 6

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)		Yes ___ / No ✓	20 / 0
TOTAL (Maximum = 20) (0)				
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?		Yes ✓ / No ___	3 / 0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?		Yes ✓ / No ___	4 / 0
	iii) Is the exposure to contaminants via sediments/soils acceptable?		Yes ✓ / No ___	3 / 0
Subtotal (maximum = 10) (10)				
3. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	✓	5
	ii) Health risk	≤ 1 in 100,000	___	2
Subtotal (maximum = 5) (5)				
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		✓	5
	ii) Slightly greater than acceptable		___	3
	iii) Significant risk still exists		___	0
Subtotal (maximum = 5) (5)				
TOTAL (maximum = 20) (20)				

ALTERNATIVE NO. 6

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	___ ✓	0 4
	° Can the risk be easily controlled?	Yes No	___ ___	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	___ ___	0 2
Subtotal (maximum = 4) (4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	✓ ___	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	✓ ___	3 0
Subtotal (maximum = 4) (3)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	___ ✓	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	___ ✓	1 0
Subtotal (maximum = 2) (0)				
TOTAL (maximum = 10) (7)				

ALTERNATIVE NO. 6

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		0 ✓
Subtotal (maximum = 3) (0)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). **(If answer is yes, go to Factor 4.)**	**Yes** ___ **No** ✓	3 0
Subtotal (maximum = 3) (0)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	**25-30yr.** ✓ **20-25yr.** ___ **15-20yr.** ___ **< 15yr.** ___	3 2 1 0
Subtotal (maximum = 3) (3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	**None** ___ **< 25%** ___ **25-50%** ___ **≥ 50%** ✓	3 2 1 0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 5.)**	**Yes** ___ **No** ✓	0 2
	iii) Is the treated residual toxic?	**Yes** ___ **No** ___	0 1
	iv) Is the treated residual mobile?	**Yes** ___ **No** ___	0 1
Subtotal (maximum = 5) (4)			

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. ✓	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes ___	0
		No ✓	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ___	1
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___	2
		Moderate ✓	1
		Extensive ___	0
Subtotal (maximum = 4) (2)			
TOTAL (maximum = 15) (9)			

ALTERNATIVE NO. 6

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100%	___	8
		90-99%	___	7
		80-90%	___	6
		60-80%	___	4
		40-60%	✓	2
		20-40%	___	1
		< 20%	___	0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes	✓	0
		No	___	2
Subtotal (maximum = 10) (6)				
If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal	___	0
		On-site land disposal	___	1
		Off-site destruction or treatment	✓	2
(2) (8)				
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100%	✓	2
		60-90%	___	1
		< 60%	___	0
	ii) Method of Immobilization			
	- Reduced mobility by containment		✓	0
	- Reduced mobility by alternative treatment technologies		___	3
Subtotal (maximum = 5) (2)				
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible		✓	5
	Irreversible for most of the hazardous waste constituents.		___	3
	Irreversible for only some of the hazardous waste constituents		___	2
	Reversible for most of the hazardous waste constituents.		___	0
Subtotal (maximum = 5) (5)				
TOTAL (maximum = 15) (11)				

ALTERNATIVE NO. 6

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		✓	3
	ii) Somewhat difficult to construct. No uncertainties in construction.			2
	iii) Very difficult to construct and/or significant uncertainties in construction.			1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		✓	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.			2
c. Schedule of delays due to technical problems.	i) Unlikely		✓	2
	ii) Somewhat likely			1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		✓	2
	ii) Some future remedial actions may be necessary.			1
Subtotal (maximum = 10)			(10)	
2. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.			2
	ii) Required coordination is normal.		✓	1
	iii) Extensive coordination is required.			0
Subtotal (maximum = 2)			(1)	
3. Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes	✓	1
		No		0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes	✓	1
		No		0

ALTERNATIVE NO. 6

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes**	✓	1
		No		0

Subtotal (maximum = 3) (3)

TOTAL (maximum = 15) (14)

ALTERNATIVE NO. 6A

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes No	✓ ___	4 0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes No	✓ ___	3 0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes No	✓ ___	3 0

TOTAL (Maximum = 10) 10

ALTERNATIVE NO. 6a

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes No	___ ✓	20 0
TOTAL (Maximum = 20) (0)				
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes No	✓ ___	3 0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes No	✓ ___	4 0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes No	✓ ___	3 0
Subtotal (maximum = 10) (10)				
3. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	✓	5
	ii) Health risk	≤ 1 in 100,000	___	2
Subtotal (maximum = 5) (5)				
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		✓	5
	ii) Slightly greater than acceptable		___	3
	iii) Significant risk still exists		___	0
Subtotal (maximum = 5) (5)				
TOTAL (maximum = 20) (20)				

ALTERNATIVE NO. 6a

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	 ✓	0 4
	° Can the risk be easily controlled?	Yes No	 	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	 	0 2
Subtotal (maximum = 4) (4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	✓ 	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	✓ 	3 0
Subtotal (maximum = 4) (3)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	 ✓	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	 ✓	1 0
Subtotal (maximum = 2) (0)				
TOTAL (maximum = 10) (7)				

ALTERNATIVE NO. 6a

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		0 ✓
Subtotal (maximum = 3) (0)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). **(If answer is yes, go to Factor 4.)**	**Yes** ___ **No** ✓	3 0
Subtotal (maximum = 3) (0)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	**25-30yr.** ✓ **20-25yr.** ___ **15-20yr.** ___ **< 15yr.** ___	3 2 1 0
Subtotal (maximum = 3) (3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	**None** ___ **≤ 25%** ___ **25-50%** ___ **≥ 50%** ✓	3 2 1 0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 5.)**	**Yes** ✓ **No** ___	0 2
	iii) Is the treated residual toxic?	**Yes** ___ **No** ___	0 1
	iv) Is the treated residual mobile?	**Yes** ___ **No** ___	0 1
Subtotal (maximum = 5) (5)			

Table 5.5 (cont'd) ALTERNATIVE NO. 6a

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr.	___	1
		> 5yr.	✓	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes	✓	0
		No	___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident	✓	1
		Somewhat to not confident	___	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum	___	2
		Moderate	✓	1
		Extensive	___	0
Subtotal (maximum = 4)				(2)
TOTAL (maximum = 15)				(7)

ALTERNATIVE NO. 6a.

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100% ___ 90-99% ___ 80-90% ___ 60-80% ___ 40-60% ✓ 20-40% ___ < 20% ___	8 7 6 4 2 1 0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes ✓ No ___	0 2
Subtotal (maximum = 10) (6) If subtotal = 10, go to Factor 3			
	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal ___ On-site land disposal ___ Off-site destruction or treatment ✓	0 1 2
(2) / (8)			
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100% ✓ 60-90% ___ < 60% ___	2 1 0
	ii) Method of Immobilization - Reduced mobility by containment - Reduced mobility by alternative treatment technologies	✓ ___	0 3
Subtotal (maximum = 5) (2)			
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible	✓	5
	Irreversible for most of the hazardous waste constituents.	___	3
	Irreversible for only some of the hazardous waste constituents	___	2
	Reversible for most of the hazardous waste constituents.	___	0
Subtotal (maximum = 5) (5)			
TOTAL (maximum = 15) (11)			

ALTERNATIVE NO. 6a.

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	✓	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		2
	iii) Very difficult to construct and/or significant uncertainties in construction.		1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.	✓	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		2
c. Schedule of delays due to technical problems.	i) Unlikely	✓	2
	ii) Somewhat likely		1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.	✓	2
	ii) Some future remedial actions may be necessary.		1
Subtotal (maximum = 10)		(10)	
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.		2
	ii) Required coordination is normal.	✓	1
	iii) Extensive coordination is required.		0
Subtotal (maximum = 2)		(1)	
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes ✓ / No	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes ✓ / No	1 / 0

ALTERNATIVE NO. 6a.

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ✓ **No** ___	1 0

Subtotal (maximum = 3) 3

TOTAL (maximum = 15) 14

Table 5.2 ALTERNATIVE NO. 6b

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes No	✓ ___	4 0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes No	✓ ___	3 0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes No	✓ ___	3 0

TOTAL (Maximum = 10) (10)

ALTERNATIVE NO. 66.

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes No	___ ✓	20 0
TOTAL (Maximum = 20) (0)				
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes No	✓ ___	3 0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes No	✓ ___	4 0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes No	✓ ___	3 0
Subtotal (maximum = 10) (10)				
3. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	✓	5
	ii) Health risk	≤ 1 in 100,000	___	2
Subtotal (maximum = 5) (5)				
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		✓	5
	ii) Slightly greater than acceptable		___	3
	iii) Significant risk still exists		___	0
Subtotal (maximum = 5) (5)				
TOTAL (maximum = 20) (20)				

ALTERNATIVE NO. 6b.

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	 ✓	0 4
	° Can the risk be easily controlled?	Yes No	 	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	 	0 2
Subtotal (maximum = 4) (4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	✓ 	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	✓ 	3 0
Subtotal (maximum = 4) (3)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	 ✓	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	 ✓	1 0
Subtotal (maximum = 2) (0)				
TOTAL (maximum = 10) (7)				

ALTERNATIVE NO. 6b.

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		0 ✓
Subtotal (maximum = 3) (0)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). **(If answer is yes, go to Factor 4.)**	**Yes** ___ **No** ✓	3 0
Subtotal (maximum = 3) (0)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	**25-30yr.** ✓ **20-25yr.** ___ **15-20yr.** ___ **< 15yr.** ___	3 2 1 0
Subtotal (maximum = 3) (3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	**None** ___ **≤ 25%** ___ **25-50%** ___ **≥ 50%** ✓	3 2 1 0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 5.)**	**Yes** ___ **No** ✓	0 2
	iii) Is the treated residual toxic?	**Yes** ___ **No** ___	0 1
	iv) Is the treated residual mobile?	**Yes** ___ **No** ___	0 1
Subtotal (maximum = 5) (5)			

Table 5.5 (cont'd) ALTERNATIVE NO. 6

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. ✓	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes ✓	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ✓	1
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___	2
		Moderate ✓	1
		Extensive ___	0
Subtotal (maximum = 4)			(2)
TOTAL (maximum = 15)			(7)

ALTERNATIVE NO. 6b.

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100%	___	8
		90-99%	___	7
		80-90%	___	6
		60-80%	___	4
		40-60%	✓	2
		20-40%	___	1
		< 20%	___	0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes	✓	0
		No	___	2
Subtotal (maximum = 10) (6) If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal	___	0
		On-site land disposal	___	1
		Off-site destruction or treatment	✓	2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100%	✓	2
		60-90%	___	1
		< 60%	___	0
	ii) Method of Immobilization			
	- Reduced mobility by containment		✓	0
	- Reduced mobility by alternative treatment technologies		___	3
Subtotal (maximum = 5) (2)				
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible		✓	5
	Irreversible for most of the hazardous waste constituents.		___	3
	Irreversible for only some of the hazardous waste constituents		___	2
	Reversible for most of the hazardous waste constituents.		___	0
Subtotal (maximum = 5) (5)				
TOTAL (maximum = 15) (11)				

ALTERNATIVE NO. 6b.

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	✓	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		2
	iii) Very difficult to construct and/or significant uncertainties in construction.		1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.	✓	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		2
c. Schedule of delays due to technical problems.	i) Unlikely	✓	2
	ii) Somewhat likely		1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.	✓	2
	ii) Some future remedial actions may be necessary.		1
Subtotal (maximum = 10)			(10)
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.		2
	ii) Required coordination is normal.	✓	1
	iii) Extensive coordination is required.		0
Subtotal (maximum = 2)			(1)
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes ✓ / No	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes ✓ / No	1 / 0

ALTERNATIVE NO. 6b.

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ✓ **No**	1 0

Subtotal (maximum = 3) 3

TOTAL (maximum = 15) 14

ALTERNATIVE NO. 6c, 6d & 6e.

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes No	✓ —	4 0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes No	✓ —	3 0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes No	✓ —	3 0

TOTAL (Maximum = 10) 10

ALTERNATIVE NO. 6c.

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)	Yes No	___ ✓	20 0
TOTAL (Maximum = 20)	(0)			
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	Yes No	✓ ___	3 0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	Yes No	✓ ___	4 0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	Yes No	✓ ___	3 0
Subtotal (maximum = 10)	(10)			
3. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	✓	5
	ii) Health risk	≤ 1 in 100,000	___	2
Subtotal (maximum = 5)	(5)			
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		✓	5
	ii) Slightly greater than acceptable		___	3
	iii) Significant risk still exists		___	0
Subtotal (maximum = 5)	(5)			
TOTAL (maximum = 20)	(20)			

ALTERNATIVE NO. 6C.

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	 ✓	0 4
	° Can the risk be easily controlled?	Yes No	 	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	 	0 2
Subtotal (maximum = 4)	(4)			
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	✓ 	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	✓ 	3 0
Subtotal (maximum = 4)	(3)			
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	 ✓	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	 ✓	1 0
Subtotal (maximum = 2)	(0)			
TOTAL (maximum = 10)	(7)			

ALTERNATIVE NO. 6c.

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		0 ✓
Subtotal (maximum = 3) (3)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). **(If answer is yes, go to Factor 4.)**	**Yes** ✓ **No** ___	3 0
Subtotal (maximum = 3) (3)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	**25-30yr.** ✓ **20-25yr.** ___ **15-20yr.** ___ **< 15yr.** ___	3 2 1 0
Subtotal (maximum = 3) (3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	**None** ___ **< 25%** ___ **25-50%** ___ **≥ 50%** ✓	3 2 1 0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 5.)**	**Yes** ___ **No** ✓	0 2
	iii) Is the treated residual toxic?	**Yes** ___ **No** ___	0 1
	iv) Is the treated residual mobile?	**Yes** ___ **No** ___	0 1
Subtotal (maximum = 5) (5)			

Table 5.5 (cont'd) ALTERNATIVE NO. 6C

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. ✓	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes ✓	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ✓	1
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ___	2
		Moderate ✓	1
		Extensive ___	0
Subtotal (maximum = 4)			(1)
TOTAL (maximum = 15)			(7)

ALTERNATIVE NO. 6e.

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100%	___	8
		90-99%	___	7
		80-90%	___	6
		60-80%	___	4
		40-60%	✓	2
		20-40%	___	1
		< 20%	___	0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes	✓	0
		No	___	2
Subtotal (maximum = 10) (7) If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal	___	0
		On-site land disposal	___	1
		Off-site destruction or treatment	✓	2
(2) (9)				
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100%	✓	2
		60-90%	___	1
		< 60%	___	0
	ii) Method of Immobilization			
	- Reduced mobility by containment		✓	0
	- Reduced mobility by alternative treatment technologies		___	3
Subtotal (maximum = 5) (2)				
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible		✓	5
	Irreversible for most of the hazardous waste constituents.		___	3
	Irreversible for only some of the hazardous waste constituents		___	1
	Reversible for most of the hazardous waste constituents.		___	0
Subtotal (maximum = 5) (5)				
TOTAL (maximum = 15) (11)				

ALTERNATIVE NO. 6c.

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	✓	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		2
	iii) Very difficult to construct and/or significant uncertainties in construction.		1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.	✓	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		2
c. Schedule of delays due to technical problems.	i) Unlikely	✓	2
	ii) Somewhat likely		1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.	✓	2
	ii) Some future remedial actions may be necessary.		1
Subtotal (maximum = 10)		10	
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.		2
	ii) Required coordination is normal.	✓	1
	iii) Extensive coordination is required.		0
Subtotal (maximum = 2)		1	
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes ✓ / No	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes ✓ / No	1 / 0

ALTERNATIVE NO. 6c.

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ✓ **No** ___	1 0

Subtotal (maximum = 3) (3)

TOTAL (maximum = 15) (14)

ALTERNATIVE NO. 7

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes No	✓ —	4 0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes No	✓ —	3 0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes No	✓ —	3 0

TOTAL (Maximum = 10) 10

ALTERNATIVE NO. 7

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.)		Yes ___ / No ✓	20 / 0
TOTAL (Maximum = 20) 0				
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?		Yes ✓ / No ___	3 / 0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?		Yes ✓ / No ___	4 / 0
	iii) Is the exposure to contaminants via sediments/soils acceptable?		Yes ✓ / No ___	3 / 0
Subtotal (maximum = 10) 10				
3. Magnitude of residual public health risks after the remediation.	i) Health risk	≤ 1 in 1,000,000	✓	5
	ii) Health risk	≤ 1 in 100,000	___	2
Subtotal (maximum = 5) 5				
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		✓	5
	ii) Slightly greater than acceptable		___	3
	iii) Significant risk still exists		___	0
Subtotal (maximum = 5) 5				
TOTAL (maximum = 20) 20				

ALTERNATIVE NO. 7

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	Yes No	 ✓	0 4
	° Can the risk be easily controlled?	Yes No	 	1 0
	° Does the mitigative effort to control risk impact the community life-style?	Yes No	 	0 2
Subtotal (maximum = 4) (4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	Yes No	✓ 	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	Yes No	✓ 	3 0
Subtotal (maximum = 4) (3)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	≤ 2yr. > 2yr.	 ✓	1 0
	° Required duration of the mitigative effort to control short-term risk.	≤ 2yr. > 2yr.	 ✓	1 0
Subtotal (maximum = 2) (0)				
TOTAL (maximum = 10) (7)				

ALTERNATIVE NO. 7

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		0 ✓
Subtotal (maximum = 3) (0)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). **(If answer is yes, go to Factor 4.)**	**Yes** ___ **No** ✓	3 0
Subtotal (maximum = 3) (0)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	**25-30yr.** ✓ **20-25yr.** ___ **15-20yr.** ___ **< 15yr.** ___	3 2 1 0
Subtotal (maximum = 3) (3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	**None** ___ **≤ 25%** ___ **25-50%** ___ **≥ 50%** ✓	3 2 1 0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 5.)**	**Yes** ___ **No** ✓	0 2
	iii) Is the treated residual toxic?	**Yes** ___ **No** ___	0 1
	iv) Is the treated residual mobile?	**Yes** ___ **No** ___	0 1
Subtotal (maximum = 5) (2)			

Table 5.5 (cont'd) ALTERNATIVE NO. 7

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. ✓	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv")	Yes ✓	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ✓	1
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required (compare with other remedial alternatives)	Minimum ✓	2
		Moderate ___	1
		Extensive ___	0
Subtotal (maximum = 4)			2
TOTAL (maximum = 15)			7

ALTERNATIVE NO. 2

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100% ___ 90-99% ___ 80-90% ___ 60-80% ___ 40-60% ✓ 20-40% ___ < 20% ___	8 7 6 4 2 1 0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes ✓ No ___	0 2
Subtotal (maximum = 10) If subtotal = 10, go to Factor 3 (9)	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal ___ On-site land disposal ___ Off-site destruction or treatment ✓	0 1 2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100% ✓ 60-90% ___ < 60% ___	2 1 0
	ii) Method of Immobilization - Reduced mobility by containment - Reduced mobility by alternative treatment technologies	✓ ___	0 3
Subtotal (maximum = 5) (2)			
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible	✓	5
	Irreversible for most of the hazardous waste constituents.	___	3
	Irreversible for only some of the hazardous waste constituents	___	2
	Reversible for most of the hazardous waste constituents.	___	0
Subtotal (maximum = 5) (5)			
TOTAL (maximum = 15) (11)			

ALTERNATIVE NO. 2

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Technical Feasibility				
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.		✓	3
	ii) Somewhat difficult to construct. No uncertainties in construction.		—	2
	iii) Very difficult to construct and/or significant uncertainties in construction.		—	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.		—	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.		✓	2
c. Schedule of delays due to technical problems.	i) Unlikely		✓	2
	ii) Somewhat likely		—	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.		✓	2
	ii) Some future remedial actions may be necessary.		—	1
Subtotal (maximum = 10)			7	
2. Administrative Feasibility				
a. Coordination with other agencies.	i) Minimal coordination is required.		—	2
	ii) Required coordination is normal.		✓	1
	iii) Extensive coordination is required.		—	0
Subtotal (maximum = 2)			1	
3. Availability of Services and Materials				
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes	✓	1
		No	—	0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes	✓	1
		No	—	0

ALTERNATIVE NO. 7

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ✓ **No** ___	1 0

Subtotal (maximum = 3) 3

TOTAL (maximum = 15) 13

TOTAL EXCAVATION AND DISPOSAL TO TSDF SITE Table 5.2 ALTERNATIVE NO. 8

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	**Yes**	✓	4
		No		0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	**Yes**	✓	3
		No		0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	**Yes**	✓	3
		No		0

TOTAL (Maximum = 10) (10)

Table 5.3 ALT. 8

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Use of the site after remediation.	Unrestricted use of the land and water. (**If answer is yes, go to the end of the Table.**)	**Yes**	___	20
		No	✓	0
TOTAL (Maximum = 20)			(0)	
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	**Yes**	✓	3
		No	___	0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	**Yes**	✓	4
		No	___	0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	**Yes**	✓	3
		No	___	0
Subtotal (maximum = 10)			(10)	
3. Magnitude of residual public health risks after the remediation.	i) Health risk	**≤ 1 in 1,000,000**	✓	5
	ii) Health risk	**≤ 1 in 100,000**	___	2
Subtotal (maximum = 5)			(5)	
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable		✓	5
	ii) Slightly greater than acceptable		___	3
	iii) Significant risk still exists		___	0
Subtotal (maximum = 5)				
TOTAL (maximum = 20)			(20)	

Table 5.4

ALT 3

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.)	**Yes**	___	0
		No	✓	4
	° Can the risk be easily controlled?	**Yes**	___	1
		No	___	0
	° Does the mitigative effort to control risk impact the community life-style?	**Yes**	___	0
		No	___	2
Subtotal (maximum = 4) (4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.)	**Yes**	✓	0
		No	___	4
	° Are the available mitigative measures reliable to minimize potential impacts?	**Yes**	✓	3
		No	___	0
Subtotal (maximum = 4) (3)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	**≤ 2yr.**	___	1
		> 2yr.	✓	0
	° Required duration of the mitigative effort to control short-term risk.	**≤ 2yr.**	___	1
		> 2yr.	✓	0
Subtotal (maximum = 2) (0)				
TOTAL (maximum = 10)				

Table 5.5

ALT 8

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		(1)
	° On-site or off-site land disposal		0
Subtotal (maximum = 3) (1)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° **Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 4.)**	**Yes** ✓	3
		No ___	0
Subtotal (maximum = 3) (3)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	**25-30yr.** ✓	3
		20-25yr. ___	2
		15-20yr. ___	1
		< 15yr. ___	0
Subtotal (maximum = 3) (3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	**None** ✓	3
		≤ 25% ___	2
		25-50% ___	1
		≥ 50% ___	0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 5.)**	**Yes** ___	0
		No ___	2
	iii) Is the treated residual toxic?	**Yes** ___	0
		No ___	1
	iv) Is the treated residual mobile?	**Yes** ___	0
		No ___	1
Subtotal (maximum = 5) (5)			

Table 5.5 (cont'd)

ALT 3

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ✓	1
		> 5yr. ___	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? **(If answer is no, go to "iv")**	Yes ✓	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	Moderate to very confident ✓	1
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required **(compare with other remedial alternatives)**	Minimum ✓	2
		Moderate ___	1
		Extensive ___	0
Subtotal (maximum = 4)			4
TOTAL (maximum = 15)			22

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

ALT. 3

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Volume of hazardous waste reduced (reduction in volume or toxicity). If Factor 1 is not applicable, go to Factor 2.	i) Quantity of hazardous waste destroyed or treated. Immobilization technologies do not score under Factor 1.	99-100% ✓	8
		90-99%	7
		80-90%	6
		60-80%	4
		40-60%	2
		20-40%	1
		< 20%	0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? If answer is no, go to Factor 2	Yes	0
		No ✓	2
Subtotal (maximum = 10) (10) If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal	0
		On-site land disposal	1
		Off-site destruction or treatment	2
2. Reduction in mobility of hazardous waste. If Factor 2 is not applicable, go to Factor 3	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100%	3
		60-90%	2
		< 60%	0
	ii) Method of Immobilization		
	- Reduced mobility by containment		2
	- Reduced mobility by alternative treatment technologies		1
Subtotal (maximum = 5)			
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible		5
	Irreversible for most of the hazardous waste constituents.		4
	Irreversible for only some of the hazardous waste constituents		2
	Reversible for most of the hazardous waste constituents.		1
Subtotal (maximum = 5) (5)			
TOTAL (maximum = 15) (15)			

Table 5.7

ALT 3

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	___	3
	ii) Somewhat difficult to construct. No uncertainties in construction.	✓	2
	iii) Very difficult to construct and/or significant uncertainties in construction.	___	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.	✓	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	___	2
c. Schedule of delays due to technical problems.	i) Unlikely	___	2
	ii) Somewhat likely	✓	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.	✓	2
	ii) Some future remedial actions may be necessary.	___	1
Subtotal (maximum = 10)		(3)	
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	___	2
	ii) Required coordination is normal.	✓	1
	iii) Extensive coordination is required.	___	0
Subtotal (maximum = 2)		(1)	
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	Yes ✓ / No ___	1 / 0
	ii) Will more than one vendor be available to provide a competitive bid?	Yes ✓ / No ___	1 / 0

Table 5.7 (cont'd)

A = 3

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ✓ **No**	1 0

Subtotal (maximum = 3) 3

TOTAL (maximum = 15) 12



WehranEnviroTech

APPENDIX G

APPENDIX G

Detailed MODFLOW - Background Information and Results

APPENDIX G - GROUNDWATER FLOW SIMULATIONS

Estimates of groundwater flow into the Buffalo River and collection drains under various alternatives presented in Table 5-2 were made by conducting groundwater flow simulations.

Groundwater flow simulations were conducted utilizing MODFLOW, a computer program written by McDonald and Harbaugh of the US Geological Survey. The computer program simulates groundwater flow in three-dimensions using finite-difference approximations of the partial differential equations describing groundwater flow.

In general, inputs to the model include aquifer geometry, aquifer characteristics (e.g., permeability, storage coefficient), aquifer boundary conditions (rivers, cutoff walls, etc.) and known or estimated flow rates (rainfall recharge, lateral groundwater flow into the simulated area). Outputs from the simulation include groundwater elevations in the simulated aquifer(s), and computed flow rates at the boundaries.

AQUIFER GEOMETRY

The lateral boundary of the aquifer underlying Buffalo Color was simulated by overlaying a grid which covers the area of interest as shown in Figure 1A. For most of the simulated area, the boundary is Buffalo River. Inactive grid blocks are outside the aquifer and are not included in the calculations. The alluvial aquifer was simulated under water table conditions; that is, the saturated thickness varies with the groundwater elevation. The bottom of the aquifer was defined by Figure 4-11 from "Remedial Investigation Report, Buffalo Color, Area D", by Malcolm Pirnie. The bottom elevation ranged from 562 down to 554.

The glaciolacustrine clay was simulated by a vertical conductance value between the alluvial aquifer above and the glacial till below. Vertical conductance is equal to the vertical permeability of the lacustrine clay divided by its thickness. An average thickness of 28 feet was utilized for the conductance input.

The underlying glacial till was simulated as a confined layer having a thickness of 12 feet.

MODEL LAYER CHARACTERISTICS

Initial inputs for layer hydraulic conductivities were based on Malcolm Pirnie data and are as follows:

Alluvial Aquifer:	0.00113 cm/sec (3.3 ft/day)
Lacustrine Clay:	3.5 x 10-7 cm/sec (0.001 ft/day)
Glacial Till:	1.0 x 10-5 cm/sec (0.029 ft/day)

During calibration of the model to site conditions, the alluvial aquifer hydraulic conductivity was adjusted to a value of 32.5 feet per day, or ten times greater than the field test result values. This adjustment is described further in the subsection "MODEL CALIBRATION".

Storativity values were unavailable from the Malcolm Pirnie report, so values were obtained from literature. A storativity of 0.20 was utilized for the alluvial aquifer and 0.0001 for the glacial till (Todd, 1980). Storativity varies much less than hydraulic conductivity so estimates based on literature values are adequate for feasibility studies.

MODEL BOUNDARY CONDITIONS AND RECHARGE

Physical boundaries for the alluvial aquifer include the river along the east, south, and west sides of the aquifer and an upgradient inflow boundary on the north side.

The river boundary was simulated by constant head levels which vary along the river from 572.60 upstream down to 572.35 at the downstream point.

The upgradient inflow boundary to the north was simulated during steady state runs as a constant head boundary with a value of 573.6, which is consistent with groundwater levels observed in well PZ-4-88 north of the railroad tracks. For non-steady state runs where drawdown effects occur at the northern extent of the model grid, this boundary was simulated as a constant head value of 575.38 occurring 2000 feet to the north of the model grid. River and upgradient flow boundary conditions are shown in Figure 2A.

Upgradient and downgradient inflow boundaries to the glacial till layer were simulated by constant head values of 573.00 feet and 572.50, respectively. These values are based on readings in wells MW-1-88 and MW-7-88 taken July 7, 1990 by Malcolm Pirnie.

Initially, for simulation of pre-cap conditions, recharge was input at 20 inches per year based on Malcolm Pirnie's water balance calculation. After calibration of the model to site conditions, this recharge value was adjusted as described below under "Model Calibration". For the purposes of comparing different remedial scenarios, rainfall recharge was assumed to be constant throughout the year. For future design work, recharge values can be varied to reflect seasonal fluctuations.

MODEL CALIBRATION

In order to arrive at more reliable estimates of groundwater flows and elevations under future remedial alternatives, the site groundwater flow model was calibrated to actual observed groundwater elevation values. This was done by comparing model computed groundwater elevations to actual groundwater elevations determined in wells on July 7, 1988 by Malcolm Pirnie (see Malcolm Pirnie report, Table 4-3 and Figure 4-15. July 7, 1988 groundwater levels were assumed to represent a reasonable average steady-state condition for the groundwater regime.

Model computed groundwater elevations using initial data input values were on average, over 2 feet higher than observed groundwater elevations. Since groundwater elevations do not vary more than one foot over the site, this comparison was considered unacceptable, and data input values for hydraulic conductivity of the alluvial aquifer and recharge were adjusted to achieve a more reasonable match.

Hydraulic conductivity of the alluvial aquifer was increased ten-fold to 32.6 feet per day. This was considered a reasonable adjustment since typically, actual hydraulic conductivities are ten times greater than hydraulic conductivities determined from in-situ slug tests. In-situ slug tests commonly underestimate hydraulic conductivity because of wellbore damage during drilling.

In addition to raising aquifer hydraulic conductivity, recharge was reduced from the initial estimate of 20 inches per year to 15 inches per year. For recharge estimates this is a minor adjustment. This change, in conjunction with the hydraulic conductivity adjustment, provided a reasonable match between computed groundwater elevations and observed elevations. A summary of the final calibration results are presented in Table 1A. The root mean square error for the comparison (excluding MW-2-88) is 0.20 feet, which represents an acceptable error relative to the groundwater elevation relief at the site. A map of model calibrated groundwater elevations are shown on Figure 5A.

The final calibrated groundwater elevations computed by the model were used as initial conditions for non-steady state simulations of different remedial alternatives which are described below.

SIMULATED REMEDIAL ALTERNATIVES

Five different remedial alternatives that impact groundwater flows were evaluated utilizing the model. A summary of the alternatives are described below (the alternative designations here correspond to the alternative designations given in Table 5-2):

Alternative	Description
3	FML cap, sheet pile on east and south sides, no groundwater collection drain
3a	FML cap, no cutoff walls, no collection drain
4,5	FML cap, no cutoff walls, groundwater collection drain in alluvial aquifer
6,6a,6b	FML cap, slurry wall cutoff on three sides, groundwater collection drain
6c,6d,6e,7	FML cap, slurry wall cutoff all four sides, groundwater collection drain

For all scenarios evaluated, infiltration through the FML cap was assumed to be approximately 20 gallons per day per acre (6 x 10-5 feet/day) For the portion of the model north of the site where no FML cap will be placed, recharge was kept at the calibrated value of 15 inches per year (3.43 x 10-3 feet/day).

Sheet pile conductance was calculated as a leakage factor times the conductance of a 25 feet thick strip of aquifer material between the cutoff and the river. (It was assumed that a sheet pile cutoff would be placed approximately 25 feet from the river). Experience has shown that sheet pile cutoffs typically are 29 percent efficient with respect to inflow reduction and at most, under ideal conditions with supplementary grouting, are 90 percent efficient (Cedergren, 1979, p240, and Design of Small Dams, p233). Therefore, a 60 percent efficiency value was chosen for these simulations and a 0.4 leakage factor applied to the alluvium conductance. The conductance input for the sheet pile cutoff was 313 ft2/day. The location of the sheet pile cutoff is shown in Figure 3A.

The slurry wall cutoff was simulated in the model by inputting a conductance factor, which for each grid cell is equal to the cutoff hydraulic conductivity (2.88 x 10-4 ft/day) times the flow face area (600 ft2) divided by the wall's thickness (three feet) which is 0.0576 ft2/day. The location of the slurry wall cutoff in the model grid is shown in Figure 4A.

The groundwater collection drain was simulated as being set about three feet below river stage. This ensures that intragradient conditions will exist, but of course, induces flow from the river that will be mixed with contaminated groundwater. The presence of a cutoff wall between the river and the drain will reduce this induced river flow into the drain. The drain locations in the model grid are shown on Figure 2A.

SIMULATION RESULTS

Inflows and outflows at steady state conditions for the different scenarios are presented in Table 5-2 in the main body of the report. Not surprisingly, the scenario with a slurry wall upgradient and downgradient provides the most effective cutoff for the site. However, inflow to the site through the glaciolacustrine clay unit due to an upward hydraulic gradient becomes a significant factor for this scenario. Because no site-specific data are currently available on the permeability of the glaciolacustrine clay, two additional simulations of scenario 6c were conducted employing higher assumed values of permeability of the glaciolacustrine clay.

The steady state values of inflow to the site through the clay unit for each permeability value are as follows:

Glaciolacustrine Clay Permeability, cm/sec	Leakage through Clay, ft3/day
3.5 x 10-7	11
3.5 x 10-6	42
3.5 x 10-5	291

As can be seen, if the lacustrine clay permeability is significantly higher than the value obtained from the literature, upward leakage through the clay will increase to the point where it amounts to the bulk of the inflow. Upward leakage through the clay amounts to approximately 13 percent of total inflow for the lowest permeability, 37 percent for the middle range, and 84 percent for the highest clay permeability simulated.

Based on this sensitivity analysis, it is strongly recommended that on-site permeability data be obtained for the glaciolacustrine clay unit.

TABLE 1A

BUFFALO COLOR

STEADY STATE GROUNDWATER CALIBRATION DATA

JUL 7,90

WELL #	GRID ROW,COL	OBSERVED HEAD, FT	MODEL HEAD, FT	OBSERVED-MODEL, FT	DIFF SQRD
MW-2-88	3,3	573.53	572.50	-1.03	1.06
MW-3-88	3,12	572.71	572.60	-0.11	0.01
MW-4-88	10,16	572.95	572.70	-0.25	0.06
MW-5-88	2,19	572.58	572.50	-0.08	0.01
MW-6-88	2,23	572.63	572.50	-0.13	0.02
MW-8-88	13,29	572.97	573.30	0.33	0.11
MW-9-88	10.20	573.21	572.80	-0.41	0.17
MW-10-88	10,9	572.83	572.60	-0.23	0.05
WELL 7	8,27	573.39	573.20	-0.19	0.04
WELL 8*	6,20	573.00	572.90	-0.10	0.01
WELL 9	5,8	572.65	572.70	0.05	0.00
WELL 12	7,2	572.60	572.50	-0.10	0.01
WELL 13	8,5	572.53	572.60	0.07	0.00
WELL 14	13,23	572.67	572.70	0.03	0.00
WELL 15	17,26	572.54	572.90	0.36	0.13
PZ-1-88	8,5	572.66	572.60	-0.06	0.00
PZ-2-88	7,13	572.94	572.80	-0.14	0.02
				RtMnSq:	0.20

* Observed head adjusted for 6 feet of NAPL at SpG=0.85

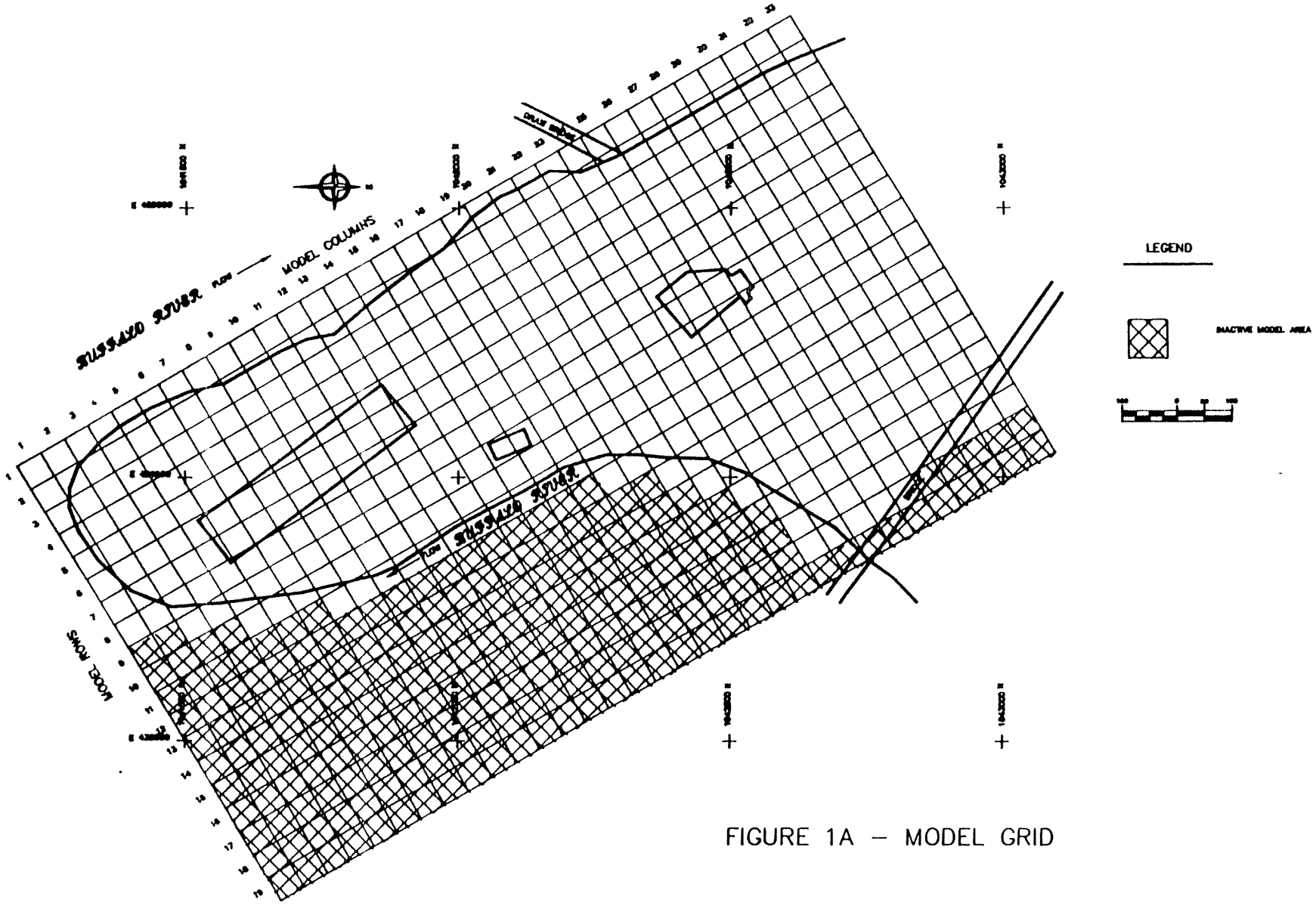


FIGURE 1A – MODEL GRID

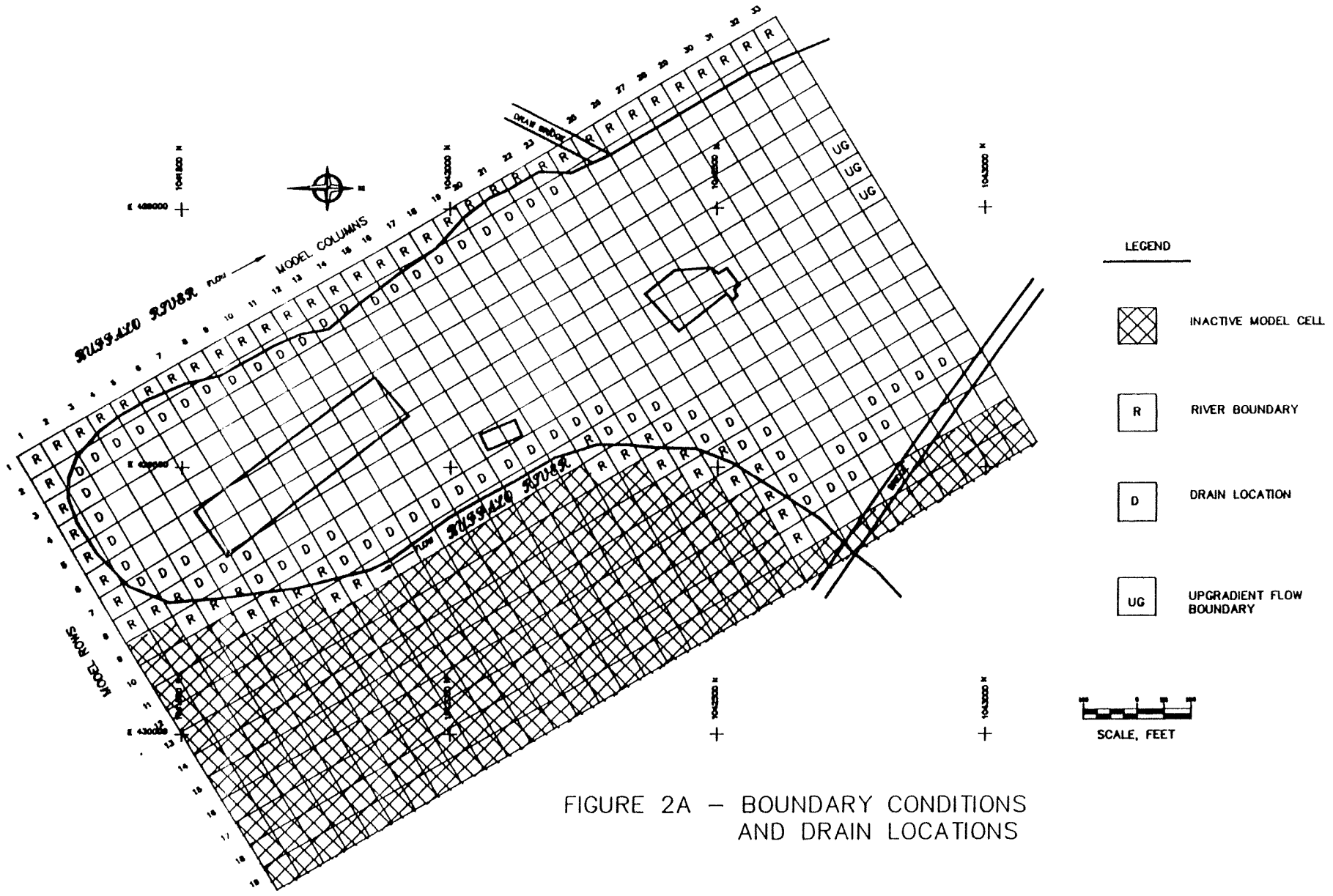


FIGURE 2A – BOUNDARY CONDITIONS AND DRAIN LOCATIONS

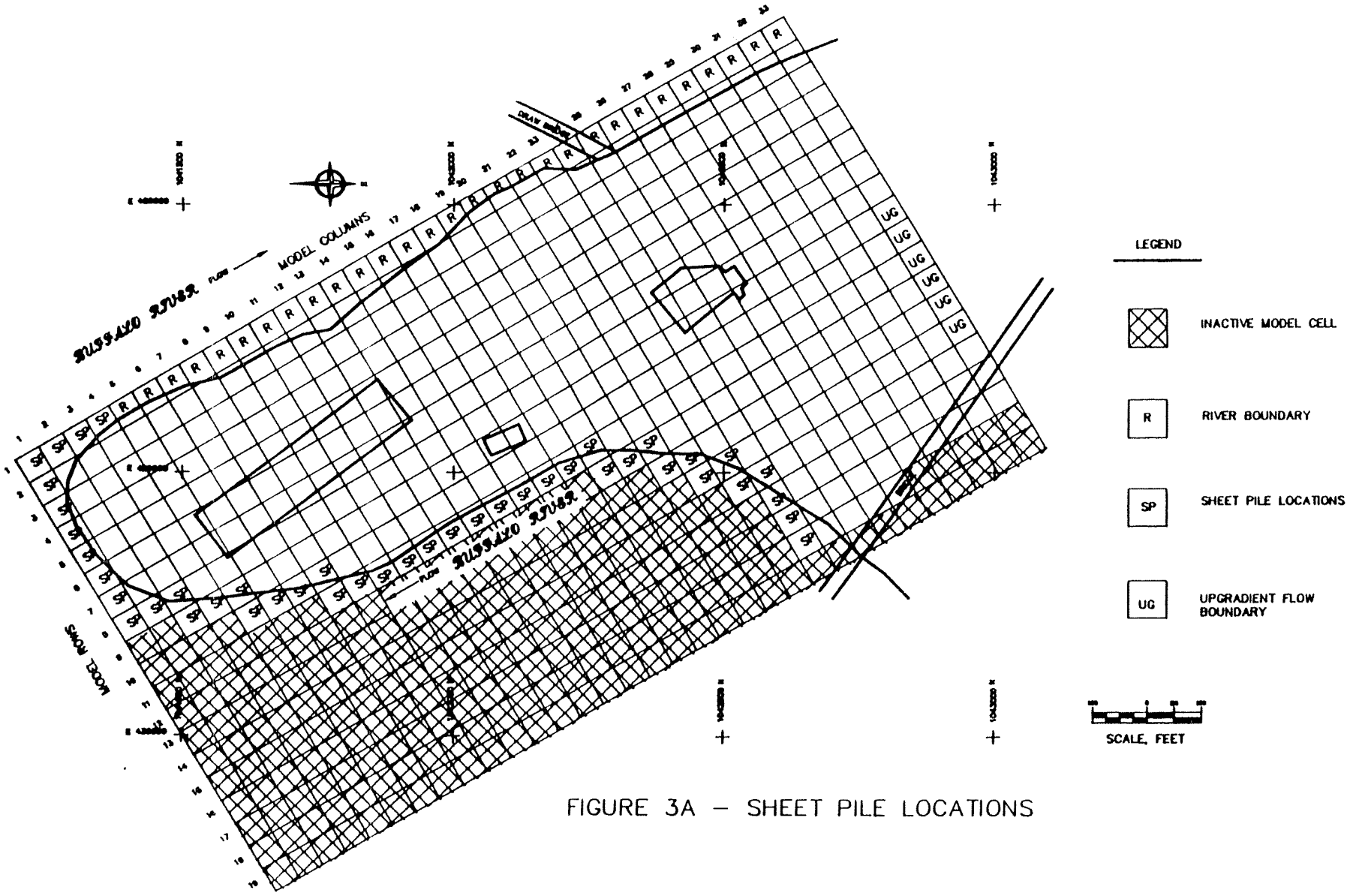


FIGURE 3A – SHEET PILE LOCATIONS

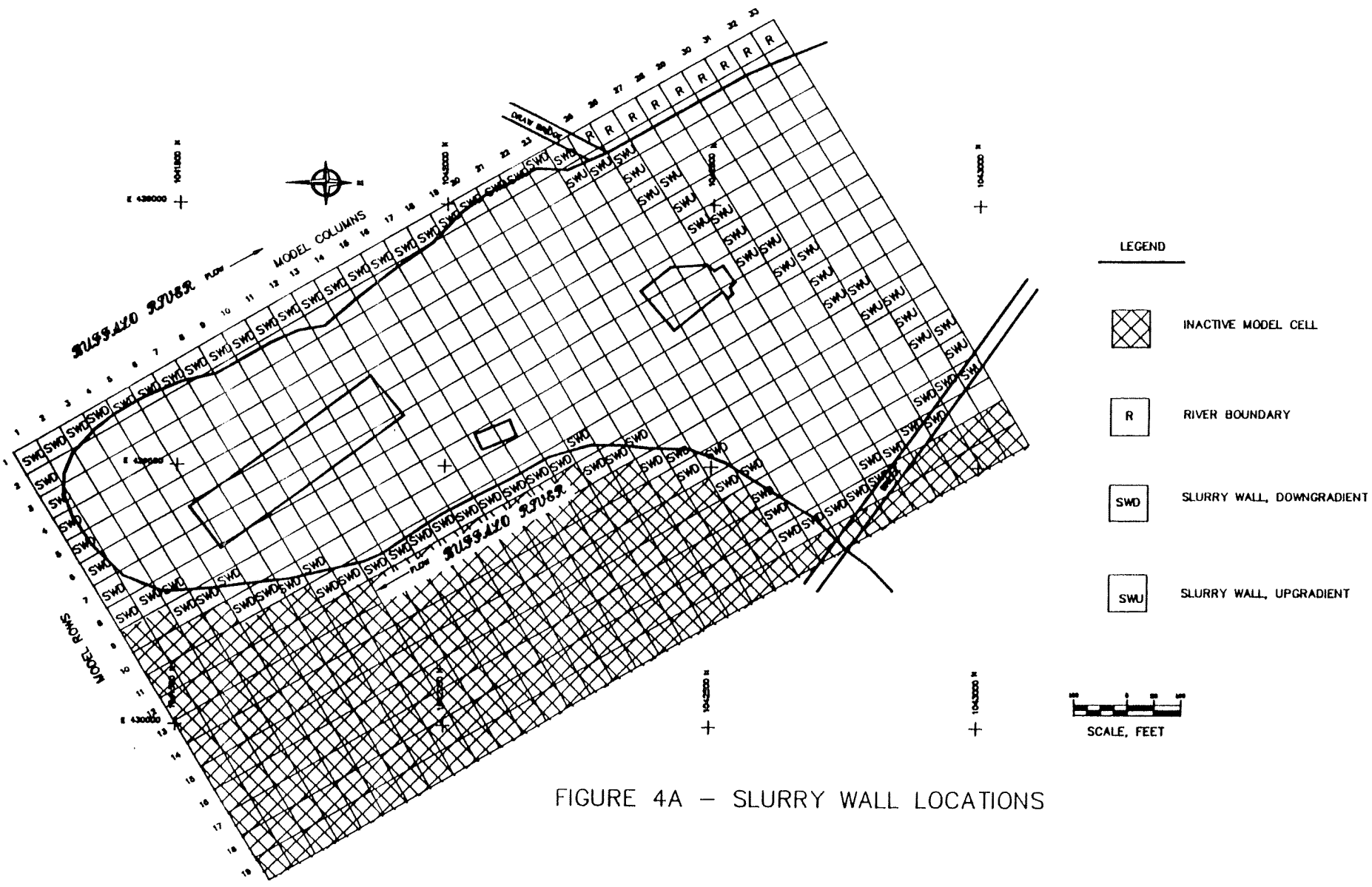


FIGURE 4A – SLURRY WALL LOCATIONS

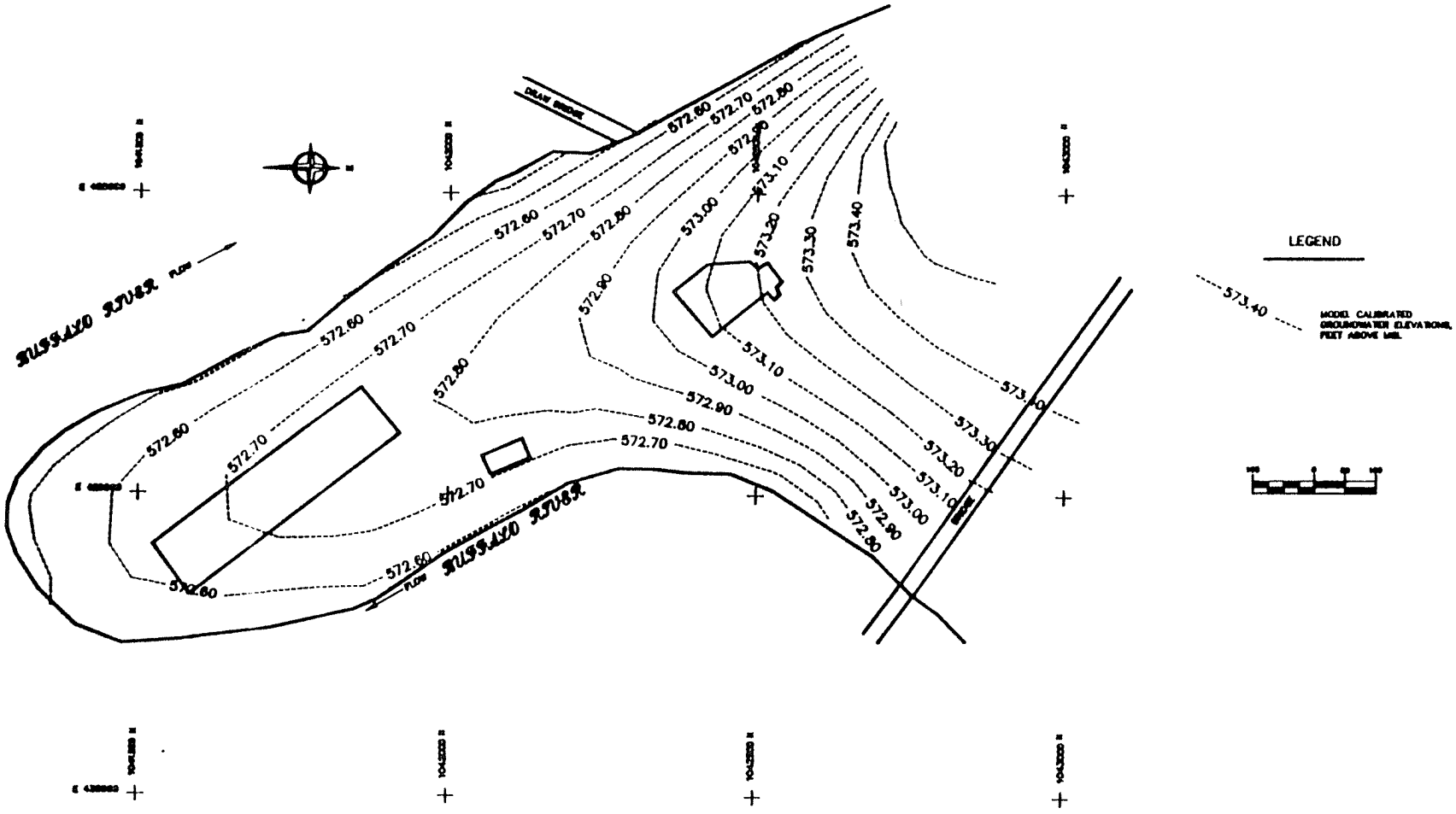


FIGURE 5A – MODEL CALIBRATED GROUNDWATER ELEVATIONS

GROUNDWATER MODEL CALIBRATION

GW model Calibration

```
                U.S. GEOLOGICAL SURVEY MODULAR FINITE-DIFFERENCE GROUND-WATER MODEL
 Conversion from ModelCad to MODFLOW                                        bufcolc
    1 LAYERS        19 ROWS        33 COLUMNS
    1 STRESS PERIOD(S) IN SIMULATION
 MODEL TIME UNIT IS DAYS
 NO UNITS:
  ELEMENT OF IUNIT:  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
         IUNIT:  11  0  0  0  0  0  0 18 19  0  0 30  0  0  0  0  0  0  0  0  0  0  0  0
 BAS1 -- BASIC MODEL PACKAGE, VERSION 1, 12/08/83 INPUT READ FROM UNIT  1
  ARRAYS RHS AND BUFF WILL SHARE MEMORY.
  START HEAD WILL NOT BE SAVED -- DRAWDOWN CANNOT BE CALCULATED
   10719 ELEMENTS IN X ARRAY ARE USED BY BAS
   10719 ELEMENTS OF X ARRAY USED OUT OF  98000
 BCF1 -- BLOCK-CENTERED FLOW PACKAGE, VERSION 1, 12/08/83 INPUT READ FROM UNIT 11
  STEADY-STATE SIMULATION
  CONSTANT HEAD CELL-BY-CELL FLOWS WILL BE PRINTED
      LAYER  AQUIFER TYPE
      ------------------
         1         1
         2         0
    1256 ELEMENTS IN X ARRAY ARE USED BY BCF
   11975 ELEMENTS OF X ARRAY USED OUT OF  98000
 RCH1 -- RECHARGE PACKAGE, VERSION 1, 12/08/83 INPUT READ FROM UNIT 18
  OPTION 1 -- RECHARGE TO TOP LAYER
     627 ELEMENTS OF X ARRAY USED FOR RECHARGE
   12602 ELEMENTS OF X ARRAY USED OUT OF  98000
 SIP1 -- STRONGLY IMPLICIT PROCEDURE SOLUTION PACKAGE, VERSION 1, 12/08/83 INPUT READ FROM UNIT 19
  MAXIMUM OF 100 ITERATIONS ALLOWED FOR CLOSURE
   5 ITERATION PARAMETERS
    5421 ELEMENTS IN X ARRAY ARE USED BY SIP
   18023 ELEMENTS OF X ARRAY USED OUT OF  98000
  Conversion from ModelCad to MODFLOW                                       bufcolc
 1
```

BOUNDARY ARRAY FOR LAYER 1 WILL BE READ ON UNIT 1 USING FORMAT: (25I3)

	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
	21	22	23	24	25	26	27	28	29	30
	31	32	33							
1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1							
2	-1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1							
3	-1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1							
4	-1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1							
5	-1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1							
6	-1	1	1	1	1	1	1	1	1	1

```
                                                
```

```
 18          0          0          0          0          0          0          0          0          0
             0          0          0          0          0          0          0          0          0
             0          0          1          1          1          1          1          0          1
             1          0          1
             1          1          1          0          0          0          0          1          1          1
             1          1          1          0          0          0          0          0          0          0
             0          0          1          0          0          0          0          0          0          0
             1          0          1
```

AQUIFER HEAD WILL BE SET TO -999.99 AT ALL NO-FLOW NODES (IBOUND=0).

INITIAL HEAD FOR LAYER 1 WILL BE READ ON UNIT 1 USING FORMAT: (10E12.4)

	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
	21	22	23	24	25	26	27	28	29	30
	31	32	33							
1	572.5	572.5	572.5	572.5	572.5	572.5	572.5	572.5	572.4	572.4
	572.4	572.4	572.4	572.4	572.4	572.4	572.4	572.4	572.4	572.4
	572.3	572.3	572.3	572.3	572.3	572.3	572.3	572.3	572.3	572.3
	572.3	572.3	572.3							
2	572.5	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6							
3	572.5	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6							
4	572.5	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6							
5	572.5	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	573.4							
6	572.5	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	573.6							
7	572.5	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	573.6							
8	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	573.6							
9	572.6	572.6	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	573.6							
10	572.6	572.6	572.6	572.6	572.5	572.5	572.5	572.5	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	573.6							
11	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.5	572.5	572.5
	572.5	572.5	572.5	572.5	572.5	572.5	572.5	572.5	572.5	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	573.6							
12	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6

	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	573.6							
13	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6							
14	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6							
15	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6							
16	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6							
17	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6							
18	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6							
19	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6							

0

INITIAL HEAD FOR LAYER 2 WILL BE READ ON UNIT 1 USING FORMAT: (10E12.4)

	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
	21	22	23	24	25	26	27	28	29	30
	31	32	33							

1	572.5	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
2	572.5	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
3	572.5	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
4	572.5	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
5	572.5	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
6	572.5	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8

	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
0 8	572.5	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
0 9	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
0 10	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
0 11	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
0 12	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
0 13	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
0 14	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
15	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
0 16	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	573.0							
0 17	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8							
0 18	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8							
0 19	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8	572.8
	572.8	572.8	572.8							

OHEAD PRINT FORMAT IS FORMAT NUMBER 0 DRAWDOWN PRINT FORMAT IS FORMAT NUMBER 0
OHEADS WILL BE SAVED ON UNIT 30 DRAWDOWNS WILL BE SAVED ON UNIT 31
OOUTPUT CONTROL IS SPECIFIED EVERY TIME STEP
0

COLUMN TO ROW ANISOTROPY WILL BE READ ON UNIT 11 USING FORMAT: (20F4.1)

0

DELR WILL BE READ ON UNIT 11 USING FORMAT: (10E12.4)

DELC WILL BE READ ON UNIT 11 USING FORMAT: (10E12.4)

HYD. COND. ALONG ROWS = 32.60000 FOR LAYER 1

BOTTOM FOR LAYER 1 WILL BE READ ON UNIT 11 USING FORMAT: (10E12.4)

VERT HYD COND /THICKNESS = .3320000E-04 FOR LAYER 1

TRANSMIS. ALONG ROWS FOR LAYER 2 WILL BE READ ON UNIT 11 USING FORMAT: (10E12.4)

SOLUTION BY THE STRONGLY IMPLICIT PROCEDURE

MAXIMUM ITERATIONS ALLOWED FOR CLOSURE = 100
ACCELERATION PARAMETER = 1.0000
HEAD CHANGE CRITERION FOR CLOSURE = .10000E-02
SIP HEAD CHANGE PRINTOUT INTERVAL = 1
CALCULATE ITERATION PARAMETERS FROM MODEL CALCULATED WSEED
STRESS PERIOD NO. 1, LENGTH = 1.000000

NUMBER OF TIME STEPS = 1

MULTIPLIER FOR DELT = 1.000

INITIAL TIME STEP SIZE = 1.000000
RECHARGE = .3425000E-02

AVERAGE SEED = .00114671
MINIMUM SEED = .00008450

5 ITERATION PARAMETERS CALCULATED FROM AVERAGE SEED:

.0000000E+00 .8159807E+00 .9661369E+00 .9937685E+00 .9988533E+00

12 ITERATIONS FOR TIME STEP 1 IN STRESS PERIOD 1
MAXIMUM HEAD CHANGE FOR EACH ITERATION:

HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL
-.7751	(1, 12, 33)	.2786	(1, 7, 31)	.3605	(1, 10, 32)	.3103	(1, 17, 31)	.1754	(1, 11, 29
.5131E-01	(1, 17, 31)	-.2320E-01	(1, 8, 25)	.4124E-01	(1, 17, 31)	-.8122E-02	(1, 6, 22)	.5809E-02	(1, 16, 32
-.1798E-02	(2, 16, 32)	.9008E-03	(2, 7, 25)						

HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 0 CELL-BY-CELL FLOW TERM FLAG = 0
OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
1	0	1	0

0	CONSTANT HEAD	PERIOD	1	STEP	1	LAYER	1	ROW	1	COL	1	RATE .0000000
0	CONSTANT HEAD	PERIOD	1	STEP	1	LAYER	1	ROW	1	COL	2	RATE -12.03788
0	CONSTANT HEAD	PERIOD	1	STEP	1	LAYER	1	ROW	1	COL	3	RATE -20.04061
0	CONSTANT HEAD	PERIOD	1	STEP	1	LAYER	1	ROW	1	COL	4	RATE -22.21242
0	CONSTANT HEAD	PERIOD	1	STEP	1	LAYER	1	ROW	1	COL	5	RATE -26.16151
0	CONSTANT HEAD	PERIOD	1	STEP	1	LAYER	1	ROW	1	COL	6	RATE -28.81088

CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 9 RATE -42.45712
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 10 RATE -41.60886
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 11 RATE -41.83618
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 12 RATE -42.40652
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 13 RATE -43.09089
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 14 RATE -43.82322
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 15 RATE -44.59376
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 16 RATE -45.40665
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 17 RATE -46.25063
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 18 RATE -47.05532
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 19 RATE -47.58009
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 20 RATE -47.06872
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 21 RATE -59.78732
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 22 RATE -59.73769
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 23 RATE -61.16968
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 24 RATE -63.29854
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 25 RATE -65.84912
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 26 RATE -68.71867
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 27 RATE -71.87319
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 28 RATE -75.30781
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 29 RATE -79.01345
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 30 RATE -82.92670
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 31 RATE -86.83985
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 32 RATE -90.27897
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 1 COL 33 RATE -92.38212
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 2 COL 1 RATE -12.26667
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 3 COL 1 RATE -20.00380
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 4 COL 1 RATE -25.09679
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 5 COL 1 RATE -28.92270
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 6 COL 1 RATE -13.85210
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 6 COL 33 RATE 163.6203
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 7 COL 1 RATE -10.63636
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 7 COL 33 RATE 37.14306
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 8 COL 1 RATE .0000000
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 8 COL 2 RATE -10.53131
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 8 COL 3 RATE -36.68325
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 8 COL 33 RATE 39.45587
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 9 COL 3 RATE -.3009030E-02
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 9 COL 4 RATE -15.39241
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 9 COL 5 RATE -43.85228
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 10 COL 5 RATE -.4510098E-02
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 10 COL 6 RATE -18.39695
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 10 COL 7 RATE -27.33721
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 10 COL 8 RATE -58.45887
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 11 COL 8 RATE -.6492571E-02
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 11 COL 9 RATE -23.53007
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 11 COL 10 RATE -20.70314
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 11 COL 11 RATE -26.79392
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 11 COL 12 RATE -29.94421
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 11 COL 13 RATE -31.92932
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 11 COL 14 RATE -33.46785
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 11 COL 15 RATE -34.94894
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 11 COL 16 RATE -36.70199
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 11 COL 17 RATE -39.18276
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 11 COL 18 RATE -43.29538
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 11 COL 19 RATE -88.17755
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 12 COL 19 RATE -.1176721E-01
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 12 COL 20 RATE -40.39162
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 12 COL 21 RATE -94.61192
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 13 COL 21 RATE -.1175666E-01
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 13 COL 22 RATE -96.22053
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 14 COL 22 RATE -.1335092E-01
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 14 COL 23 RATE -116.9694
CONSTANT HEAD PERIOD 1 STEP 1 LAYER 1 ROW 15 COL 23 RATE -.1537790E-01

```
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW  17   COL  24   RATE   -99.42117
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW  18   COL  24   RATE   -94.31320
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   1   COL   1   RATE    .3619578E-03
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   1   COL  33   RATE    .3751855E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   2   COL   1   RATE   -.1689933E-02
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   2   COL  33   RATE    .7290785E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   3   COL   1   RATE   -.4042930E-02
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   3   COL  33   RATE    .3290022E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   4   COL   1   RATE   -.6016000E-02
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   4   COL  33   RATE   -.3592085E-02
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   5   COL   1   RATE   -.7321831E-02
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   5   COL  33   RATE   -.4473111E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   6   COL   1   RATE   -.7855879E-02
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   6   COL  33   RATE   -.3295680E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   7   COL   1   RATE   -.7212108E-02
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   7   COL  33   RATE   -.4352514E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   8   COL   1   RATE   -.6003391E-02
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   8   COL  33   RATE   -.4995123E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW   9   COL  33   RATE   -.1001025
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW  10   COL  33   RATE   -.9927908E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW  11   COL  33   RATE   -.9705836E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW  12   COL  33   RATE   -.9388696E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW  13   COL  33   RATE   -.9007047E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW  14   COL  33   RATE   -.8628868E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW  15   COL  33   RATE   -.8306628E-01
 CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  2   ROW  16   COL  33   RATE   -.8133945E-01

                    HEAD IN LAYER  1 AT END OF TIME STEP  1 IN STRESS PERIOD  1
 ---------------------------------------------------------------------

                1           2           3           4           5           6           7           8           9          10
               11          12          13          14          15          16          17          18          19          20
               21          22          23          24          25          26          27          28          29          30
               31          32          33

 ....................................................................................................................................

 0  1    572.5       572.5       572.5       572.5       572.5       572.5       572.5       572.5       572.4       572.4
           572.4       572.4       572.4       572.4       572.4       572.4       572.4       572.4       572.4       572.4
           572.3       572.3       572.3       572.3       572.3       572.3       572.3       572.3       572.3       572.3
           572.3       572.3       572.3
 0  2    572.5       572.5       572.5       572.5       572.5       572.5       572.5       572.5       572.5       572.5
           572.5       572.5       572.5       572.5       572.5       572.5       572.5       572.5       572.5       572.5
           572.5       572.5       572.5       572.5       572.5       572.6       572.6       572.6       572.6       572.6
           572.6       572.6       572.6
 0  3    572.5       572.5       572.5       572.6       572.6       572.6       572.6       572.6       572.6       572.6
           572.6       572.6       572.6       572.6       572.6       572.6       572.6       572.7       572.7       572.7
           572.7       572.7       572.7       572.7       572.7       572.7       572.7       572.8       572.8       572.8
           572.8       572.9       572.9
 0  4    572.5       572.5       572.6       572.6       572.6       572.6       572.7       572.7       572.7       572.7
           572.7       572.7       572.7       572.7       572.7       572.7       572.7       572.7       572.7       572.8
           572.8       572.8       572.8       572.8       572.8       572.9       572.9       572.9       573.0       573.0
           573.0       573.1       573.1
 0  5    572.5       572.5       572.6       572.6       572.6       572.7       572.7       572.7       572.7       572.7
           572.7       572.7       572.8       572.8       572.8       572.8       572.8       572.8       572.8       572.8
           572.8       572.9       572.9       572.9       573.0       573.0       573.0       573.1       573.1       573.1
           573.2       573.3       573.3
 0  6    572.5       572.5       572.6       572.6       572.6       572.7       572.7       572.7       572.7       572.7
           572.8       572.8       572.8       572.8       572.8       572.8       572.8       572.8       572.9       572.9
           572.9       572.9       573.0       573.0       573.0       573.1       573.1       573.2       573.2       573.3
           573.3       573.4       573.6
 0  7    572.5       572.5       572.5       572.6       572.6       572.6       572.7       572.7       572.7       572.7
           572.8       572.8       572.8       572.8       572.8       572.8       572.8       572.8       572.9       572.9
           572.9       573.0       573.0       573.0       573.1       573.1       573.2       573.2       573.3       573.4
           573.4       573.5       573.6
 0  8    572.5       572.5       572.5       572.5       572.6       572.6       572.6       572.7       572.7       572.7
           572.7       572.7       572.8       572.8       572.8       572.8       572.8       572.8       572.8       572.9
```

0 9	1000.	1000.	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.7
	572.7	572.7	572.7	572.7	572.7	572.7	572.7	572.8	572.8	572.8
	572.9	572.9	573.0	573.1	573.1	573.2	573.3	573.3	573.4	573.4
	573.5	573.5	573.6							
0 10	1000.	1000.	1000.	1000.	572.5	572.5	572.5	572.5	572.6	572.6
	572.6	572.6	572.6	572.6	572.7	572.7	572.7	572.7	572.7	572.8
	572.8	572.9	573.0	573.0	573.1	573.2	573.3	573.3	573.4	573.4
	573.5	573.5	573.5							
0 11	1000.	1000.	1000.	1000.	1000.	1000.	1000.	572.5	572.5	572.5
	572.5	572.5	572.5	572.5	572.5	572.5	572.5	572.5	572.5	572.6
	572.7	572.8	572.9	573.0	573.1	573.2	573.2	573.3	573.4	573.4
	573.5	573.5	573.5							
0 12	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	572.5	572.5
	572.6	572.7	572.8	572.9	573.0	573.1	573.2	573.3	573.3	573.4
	573.5	573.5	573.5							
0 13	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	572.6	572.6	572.7	572.8	572.9	573.1	573.2	573.2	573.3	573.4
	573.4	573.5	573.5							
0 14	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	572.6	572.6	572.7	572.9	573.0	573.1	573.2	573.3	573.4
	573.4	573.4	573.5							
0 15	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	572.6	572.6	572.8	573.0	573.1	573.2	573.3	573.3
	573.4	573.4	573.4							
0 16	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	572.6	572.8	572.9	573.0	573.1	573.2	573.3
	573.4	573.4	573.4							
0 17	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	572.6	572.8	572.9	573.0	573.1	573.2	573.3
	573.3	1000.	1000.							
0 18	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	572.6	572.8	572.9	573.0	573.1	1000.	1000.
	1000.	1000.	1000.							
0 19	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.							

1 HEAD IN LAYER 2 AT END OF TIME STEP 1 IN STRESS PERIOD 1

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33							

0 1	572.5	572.5	572.5	572.5	572.5	572.5	572.5	572.5	572.5	572.5
	572.5	572.5	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.7	572.7
	572.7	572.8	573.0							
0 2	572.5	572.5	572.5	572.5	572.5	572.5	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.7	572.7	572.7	572.7	572.7	572.8
	572.8	572.9	573.0							
0 3	572.5	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.6	572.6	572.6	572.7	572.7	572.7
	572.7	572.7	572.7	572.7	572.7	572.8	572.8	572.8	572.8	572.9
	572.9	572.9	573.0							

	572.7	572.8	572.8	572.8	572.8	572.8	572.9	572.9	572.9	573.0
	573.0	573.0	573.0							
0 5	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.6	572.7	572.7
	572.7	572.7	572.7	572.7	572.7	572.7	572.7	572.7	572.8	572.8
	572.8	572.8	572.8	572.9	572.9	572.9	573.0	573.0	573.0	573.0
	573.1	573.0	573.0							
0 6	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.6	572.7	572.7
	572.7	572.7	572.7	572.7	572.7	572.7	572.8	572.8	572.8	572.8
	572.8	572.9	572.9	572.9	573.0	573.0	573.0	573.1	573.1	573.1
	573.1	573.1	573.0							
0 7	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.6	572.7	572.7
	572.7	572.7	572.7	572.7	572.7	572.8	572.8	572.8	572.8	572.8
	572.9	572.9	572.9	573.0	573.0	573.1	573.1	573.1	573.2	573.2
	573.2	573.1	573.0							
0 8	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.6	572.6	572.7
	572.7	572.7	572.7	572.7	572.7	572.7	572.8	572.8	572.8	572.8
	572.9	572.9	572.9	573.0	573.0	573.1	573.1	573.2	573.2	573.2
	573.2	573.1	573.0							
0 9	1000.	1000.	572.5	572.5	572.6	572.6	572.6	572.6	572.6	572.6
	572.7	572.7	572.7	572.7	572.7	572.7	572.7	572.7	572.8	572.8
	572.8	572.9	572.9	573.0	573.1	573.1	573.2	573.2	573.2	573.2
	573.2	573.2	573.0							
0 10	1000.	1000.	1000.	1000.	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.7	572.7	572.7	572.7	572.7	572.7	572.7	572.8
	572.8	572.9	572.9	573.0	573.0	573.1	573.2	573.2	573.2	573.3
	573.2	573.2	573.0							
0 11	1000.	1000.	1000.	1000.	1000.	1000.	1000.	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.7	572.7	572.7	572.7	572.7	572.7
	572.8	572.8	572.9	573.0	573.0	573.1	573.1	573.2	573.2	573.3
	573.2	573.2	573.0							
0 12	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	572.7	572.7
	572.7	572.8	572.9	572.9	573.0	573.1	573.1	573.2	573.2	573.2
	573.2	573.2	573.0							
0 13	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	572.7	572.8	572.8	572.9	573.0	573.0	573.1	573.2	573.2	573.2
	573.2	573.1	573.0							
0 14	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	572.8	572.8	572.8	572.9	573.0	573.1	573.1	573.2	573.2
	573.2	573.1	573.0							
0 15	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	572.8	572.8	572.9	573.0	573.1	573.1	573.2	573.2
	573.2	573.1	573.0							
0 16	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	572.8	572.9	573.0	573.0	573.1	573.2	573.2
	573.2	573.1	573.0							
0 17	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	572.8	572.9	572.9	573.0	573.1	573.1	573.2
	573.2	1000.	1000.							
0 18	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	572.8	572.9	572.9	573.0	573.0	1000.	1000.
	1000.	1000.	1000.							
0 19	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.							

OHEAD WILL BE SAVED ON UNIT 30 AT END OF TIME STEP 1, STRESS PERIOD 1

0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 1 IN STRESS PERIOD 1

CUMULATIVE VOLUMES	L**3		RATES FOR THIS TIME STEP	L**3/T	
IN:			IN:		
STORAGE =	.00000		STORAGE =	.00000	
CONSTANT HEAD =	240.38		CONSTANT HEAD =	240.38	
RECHARGE =	2979.8		RECHARGE =	2979.8	
TOTAL IN =	3220.1		TOTAL IN =	3220.1	
OUT:			OUT:		
STORAGE =	.00000		STORAGE =	.00000	
CONSTANT HEAD =	3216.1		CONSTANT HEAD =	3216.1	
RECHARGE =	.00000		RECHARGE =	.00000	
TOTAL OUT =	3216.1		TOTAL OUT =	3216.1	
IN - OUT =	4.0652		IN - OUT =	4.0652	
PERCENT DISCREPANCY =		.13	PERCENT DISCREPANCY =		.13

TIME SUMMARY AT END OF TIME STEP 1 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	86400.0	1440.00	24.0000	1.00000	.273785E-02
STRESS PERIOD TIME	86400.0	1440.00	24.0000	1.00000	.273785E-02
TOTAL SIMULATION TIME	86400.0	1440.00	24.0000	1.00000	.273785E-02

TYPICAL GROUNDWATER FLOW MODEL OUTPUT

Typical 3D Flow Model Output

```
1                U.S. GEOLOGICAL SURVEY MODULAR FINITE-DIFFERENCE GROUND-WATER MODEL
0 MODFLOW                                                    bufcol6C, FML CAP, SLURRY WALL 4 SIDES, AND
    2 LAYERS        19 ROWS        33 COLUMNS
    1 STRESS PERIOD(S) IN SIMULATION
 MODEL TIME UNIT IS DAYS
0I/O UNITS:
 ELEMENT OF IUNIT:  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
        I/O UNIT: 11  0 12  9  0  0 17 18 19  0  0 20  0  0  0  0  0  0  0  0  0  0  0  0
0BAS1 -- BASIC MODEL PACKAGE. VERSION 1. 12/08/83 INPUT READ FROM UNIT  1
 ARRAYS RHS AND BUFF WILL SHARE MEMORY.
 START HEAD WILL NOT BE SAVED -- DRAWDOWN CANNOT BE CALCULATED
  10719 ELEMENTS IN X ARRAY ARE USED BY BAS
  10719 ELEMENTS OF X ARRAY USED OUT OF  98000
0BCF1 -- BLOCK-CENTERED FLOW PACKAGE. VERSION 1. 12/08/83 INPUT READ FROM UNIT 11
 TRANSIENT SIMULATION
 CONSTANT HEAD CELL-BY-CELL FLOWS WILL BE PRINTED
      LAYER  AQUIFER TYPE
      ------------------
        1        1
        2        0
   2510 ELEMENTS IN X ARRAY ARE USED BY BCF
  13229 ELEMENTS OF X ARRAY USED OUT OF  98000
0DRN1 -- DRAIN PACKAGE. VERSION 1. 12/08/83 INPUT READ FROM UNIT 12
 MAXIMUM OF   69 DRAINS
 CELL-BY-CELL FLOWS WILL BE PRINTED WHEN ICBCFL NOT 0
    345 ELEMENTS IN X ARRAY ARE USED FOR DRAINS
  13574 ELEMENTS OF X ARRAY USED OUT OF  98000
0RCH1 -- RECHARGE PACKAGE. VERSION 1. 12/08/83 INPUT READ FROM UNIT 18
 OPTION 1 -- RECHARGE TO TOP LAYER
    627 ELEMENTS OF X ARRAY USED FOR RECHARGE
  14201 ELEMENTS OF X ARRAY USED OUT OF  98000
0GHB1 -- GHB PACKAGE. VERSION 1. 12/08/83 INPUT READ FROM UNIT 17
 MAXIMUM OF   97 HEAD-DEPENDENT BOUNDARY NODES
 CELL-BY-CELL FLOW WILL BE PRINTED WHEN ICBCFL NOT 0
    485 ELEMENTS IN X ARRAY ARE USED FOR HEAD-DEPENDENT BOUNDARIES
  14686 ELEMENTS OF X ARRAY USED OUT OF  98000
0SIP1 -- STRONGLY IMPLICIT PROCEDURE SOLUTION PACKAGE. VERSION 1. 12/08/83 INPUT READ FROM UNIT 19
 MAXIMUM OF 100 ITERATIONS ALLOWED FOR CLOSURE
  5 ITERATION PARAMETERS
   5421 ELEMENTS IN X ARRAY ARE USED BY SIP
  20107 ELEMENTS OF X ARRAY USED OUT OF  98000
1 MODFLOW                                                    bufcol6C, FML CAP, SLURRY WALL 4 SIDES, ANI
0
```

DRAFT

BOUNDARY ARRAY FOR LAYER 1 WILL BE READ ON UNIT 1 USING FORMAT: (25I3)

```
          1   2   3   4   5   6   7   8   9  10
         11  12  13  14  15  16  17  18  19  20
         21  22  23  24  25  26  27  28  29  30
         31  32  33
 ..........................................................................
0  1      1   1   1   1   1   1   1   1   1
          1   1   1   1   1   1   1   1   1
          1   1   1   1   0   0   0   0   0
          0   0   0
0  2      1   1   1   1   1   1   1   1   1
          1   1   1   1   1   1   1   1   1
          1   1   1   1   1   1   0   0   0
          0   0   0
0  3      1   1   1   1   1   1   1   1   1
          1   1   1   1   1   1   1   1   1
```

0	4	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	0	0
		0	0	0						
0	5	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	0	0
		0	0	0						
0	6	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	0
		0	0	0						
0	7	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	0
		0	0	0						
0	8	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1
		0	0	0						
0	9	0	0	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1
		0	0	0						
0	10	0	0	0	0	1	1	1	1	1
		1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1
		0	0	0						
0	11	0	0	0	0	0	0	0	1	1
		1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1
		1	0	0						
0	12	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	1
		1	1	1	1	1	1	1	1	1
		1	1	0						
0	13	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0
		1	1	1	1	1	1	1	1	1
		1	1	0						
0	14	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0
		0	1	1	1	1	1	1	1	1
		1	1	1						
0	15	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0
		0	0	1	1	1	1	1	1	1
		1	1	1						
0	16	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0
		0	0	0	1	1	1	1	1	1
		1	1	1						
0	17	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0
		0	0	0	1	1	1	1	1	1
		1	0	0						
0	18	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0
		0	0	0	1	1	1	1	1	0
		0	0	0						
0	19	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0
		0	0	0						

BOUNDARY ARRAY FOR LAYER 2 WILL BE READ ON UNIT 1 USING FORMAT: (25I3)

	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
	21	22	23	24	25	26	27	28	29	30
	31	32	33							
0 1	-1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	-1							
0 2	-1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	-1							
0 3	-1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	-1							
0 4	-1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	
	1	1	-1							
0 5	-1	1	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	-1							
0 6	-1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	-1							
0 7	-1	1	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	-1							
0 8	-1	1	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	-1							
0 9	0	0	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	-1							
0 10	0	0	0	0	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	-1							
0 11	0	0	0	0	0	0	0	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	1	1	1	1	1	1	1	
	1	1	-1							
0 12	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	1	
	1	1	1	1	1	1	1	1	1	
	1	1	-1							
0 13	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	
	1	1	1	1	1	1	1	1	1	
	1	1	-1							
0 14	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	
	0	1	1	1	1	1	1	1	1	
	1	1	-1							

```
                0          0          0          0          0          0          0          0          0
                0          0          1          1          1          1          1          1          1
                1          1         -1
 16             0          0          0          0          0          0          0          0          0
                0          0          0          0          0          0          0          0          0
                0          0          0          1          1          1          1          1          1
                1          1         -1
 17             0          0          0          0          0          0          0          0          0
                0          0          0          0          0          0          0          0          0
                0          0          0          1          1          1          1          1          1
                1          0          0
 18             0          0          0          0          0          0          0          0          0
                0          0          0          0          0          0          0          0          0
                0          0          0          1          1          1          1          1          0
                0          0          0
 19             0          0          0          0          0          0          0          0          0
                0          0          0          0          0          0          0          0          0
                0          0          0          0          0          0          0          0          0
                0          0          0
OAQUIFER HEAD WILL BE SET TO  999.99     AT ALL NO-FLOW NODES (IBOUND=0).
0

                                        INITIAL HEAD FOR LAYER  1 WILL BE READ ON UNIT  1 USING FORMAT: (10F12.4)
-------------------------------------------------------------------------------------------------------------------

                1          2          3          4          5          6          7          8          9         10
               11         12         13         14         15         16         17         18         19         20
               21         22         23         24         25         26         27         28         29         30
               31         32         33
.....................................................................................................................
0  1       572.5      572.5      572.5      572.5      572.5      572.5      572.5      572.5      572.4      572.4
           572.4      572.4      572.4      572.4      572.4      572.4      572.4      572.4      572.4      572.4
           572.3      572.3      572.3      572.3      572.3      572.3      572.3      572.3      572.3      572.3
           572.3      572.3      572.3
0  2       572.5      572.5      572.5      572.5      572.5      572.5      572.5      572.5      572.5      572.5
           572.5      572.5      572.5      572.5      572.5      572.5      572.5      572.5      572.5      572.5
           572.5      572.5      572.5      572.5      572.5      572.6      572.6      572.6      572.6      572.6
           572.6      572.6      572.6
0  3       572.5      572.5      572.5      572.6      572.6      572.6      572.6      572.6      572.6      572.6
           572.6      572.6      572.6      572.6      572.6      572.6      572.6      572.7      572.7      572.7
           572.7      572.7      572.7      572.7      572.7      572.7      572.7      572.8      572.8      572.8
           572.8      572.9      572.9
0  4       572.5      572.5      572.6      572.6      572.6      572.6      572.7      572.7      572.7      572.7
           572.7      572.7      572.7      572.7      572.7      572.7      572.7      572.7      572.7      572.8
           572.8      572.8      572.8      572.8      572.8      572.9      572.9      572.9      573.0      573.0
           573.0      573.1      573.1
0  5       572.5      572.5      572.6      572.6      572.6      572.7      572.7      572.7      572.7      572.7
           572.7      572.7      572.8      572.8      572.8      572.8      572.8      572.8      572.8      572.8
           572.8      572.9      572.9      572.9      573.0      573.0      573.0      573.1      573.1      573.1
           573.2      573.3      573.3
0  6       572.5      572.5      572.6      572.6      572.6      572.7      572.7      572.7      572.7      572.7
           572.8      572.8      572.8      572.8      572.8      572.8      572.8      572.8      572.9      572.9
           572.9      572.9      573.0      573.0      573.0      573.1      573.1      573.2      573.2      573.3
           573.3      573.4      573.6
0  7       572.5      572.5      572.5      572.6      572.6      572.6      572.7      572.7      572.7      572.7
           572.8      572.8      572.8      572.8      572.8      572.8      572.8      572.8      572.9      572.9
           572.9      573.0      573.0      573.0      573.1      573.1      573.2      573.2      573.3      573.4
           573.4      573.5      573.6
0  8       572.5      572.5      572.5      572.5      572.6      572.6      572.6      572.7      572.7      572.7
           572.7      572.7      572.8      572.8      572.8      572.8      572.8      572.8      572.8      572.9
           572.9      573.0      573.0      573.1      573.1      573.2      573.2      573.3      573.3      573.4
           573.5      573.5      573.6
0  9      1000.      1000.      572.5      572.5      572.5      572.6      572.6      572.6      572.6      572.7
```

```
      573.5     573.5     573.6
0 10  1000.     1000.     1000.     1000.     572.5     572.5     572.5     572.5     572.6     572.6
      572.6     572.6     572.6     572.6     572.7     572.7     572.7     572.7     572.7     572.8
      572.8     572.9     573.0     573.0     573.1     573.2     573.3     573.3     573.4     573.4
      573.5     573.5     573.5
0 11  1000.     1000.     1000.     1000.     1000.     1000.     1000.     572.5     572.5     572.5
      572.5     572.5     572.5     572.5     572.5     572.5     572.5     572.5     572.5     572.6
      572.7     572.8     572.9     573.0     573.1     573.2     573.2     573.3     573.4     573.4
      573.5     573.5     573.5
0 12  1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     572.5     572.5
      572.6     572.7     572.8     572.9     573.0     573.1     573.2     573.3     573.3     573.4
      573.5     573.5     573.5
0 13  1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      572.6     572.6     572.7     572.8     572.9     573.1     573.2     573.2     573.3     573.4
      573.4     573.5     573.5
0 14  1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     572.6     572.6     572.7     572.9     573.0     573.1     573.2     573.3     573.4
      573.4     573.4     573.5
0 15  1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     572.6     572.6     572.8     573.0     573.1     573.2     573.3     573.3
      573.4     573.4     573.4
0 16  1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.     572.6     572.8     572.9     573.0     573.1     573.2     573.3
      573.4     573.4     573.4
0 17  1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.     572.6     572.8     572.9     573.0     573.1     573.2     573.3
      573.3     1000.     1000.
0 18  1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.     572.6     572.8     572.9     573.0     573.1     1000.     1000.
      1000.     1000.     1000.
0 19  1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.     1000.
      1000.     1000.     1000.
0
```

INITIAL HEAD FOR LAYER 2 WILL BE READ ON UNIT 1 USING FORMAT: (10F12.4)

```
        1         2         3         4         5         6         7         8         9        10
       11        12        13        14        15        16        17        18        19        20
       21        22        23        24        25        26        27        28        29        30
       31        32        33
.....
0  1  572.5     572.5     572.5     572.5     572.5     572.5     572.5     572.5     572.5     572.5
      572.5     572.5     572.5     572.5     572.5     572.6     572.6     572.6     572.6     572.6
      572.6     572.6     572.6     572.6     572.6     572.6     572.6     572.6     572.7     572.7
      572.7     572.8     573.0
0  2  572.5     572.5     572.5     572.5     572.5     572.5     572.6     572.6     572.6     572.6
      572.6     572.6     572.6     572.6     572.6     572.6     572.6     572.6     572.6     572.6
      572.6     572.6     572.6     572.6     572.7     572.7     572.7     572.7     572.7     572.8
      572.8     572.9     573.0
0  3  572.5     572.5     572.5     572.5     572.6     572.6     572.6     572.6     572.6     572.6
      572.6     572.6     572.6     572.6     572.6     572.6     572.6     572.7     572.7     572.7
      572.7     572.7     572.7     572.7     572.8     572.8     572.8     572.8     572.8     572.9
      572.9     572.9     573.0
```

	572.7	572.8	572.8	572.8	572.8	572.8	572.9	572.9	572.9	573.0
	573.0	573.0	573.0							
0 5	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.6	572.7	572.7
	572.7	572.7	572.7	572.7	572.7	572.7	572.7	572.7	572.8	572.8
	572.8	572.8	572.8	572.9	572.9	572.9	573.0	573.0	573.0	573.0
	573.1	573.0	573.0							
0 6	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.7	572.7	572.7
	572.7	572.7	572.7	572.7	572.7	572.7	572.8	572.8	572.8	572.8
	572.8	572.9	572.9	572.9	573.0	573.0	573.0	573.1	573.1	573.1
	573.1	573.1	573.0							
0 7	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.6	572.7	572.7
	572.7	572.7	572.7	572.7	572.7	572.8	572.8	572.8	572.8	572.8
	572.9	572.9	572.9	573.0	573.0	573.1	573.1	573.1	573.2	573.2
	573.2	573.1	573.0							
0 8	572.5	572.5	572.5	572.6	572.6	572.6	572.6	572.6	572.6	572.7
	572.7	572.7	572.7	572.7	572.7	572.7	572.8	572.8	572.8	572.8
	572.9	572.9	572.9	573.0	573.0	573.1	573.1	573.2	573.2	573.2
	573.2	573.1	573.0							
0 9	1000.	1000.	572.5	572.5	572.6	572.6	572.6	572.6	572.6	572.6
	572.7	572.7	572.7	572.7	572.7	572.7	572.7	572.7	572.8	572.8
	572.8	572.9	572.9	573.0	573.1	573.1	573.2	573.2	573.2	573.2
	573.2	573.2	573.0							
0 10	1000.	1000.	1000.	1000.	572.6	572.6	572.6	572.6	572.6	572.6
	572.6	572.6	572.7	572.7	572.7	572.7	572.7	572.7	572.7	572.8
	572.8	572.9	572.9	573.0	573.0	573.1	573.2	573.2	573.2	573.3
	573.2	573.2	573.0							
0 11	1000.	1000.	1000.	1000.	1000.	1000.	1000.	572.6	572.6	572.6
	572.6	572.6	572.6	572.6	572.7	572.7	572.7	572.7	572.7	572.7
	572.8	572.8	572.9	573.0	573.0	573.1	573.1	573.2	573.2	573.3
	573.2	573.2	573.0							
0 12	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	572.7	572.7
	572.7	572.8	572.9	572.9	573.0	573.1	573.1	573.2	573.2	573.2
	573.2	573.2	573.0							
0 13	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	572.7	572.8	572.8	572.9	573.0	573.0	573.1	573.2	573.2	573.2
	573.2	573.1	573.0							
0 14	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	572.8	572.8	572.8	572.9	573.0	573.1	573.1	573.2	573.2
	573.2	573.1	573.0							
0 15	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	572.8	572.8	572.9	573.0	573.1	573.1	573.2	573.2
	573.2	573.1	573.0							
0 16	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	572.8	572.9	573.0	573.0	573.1	573.2	573.2
	573.2	573.1	573.0							
0 17	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	572.8	572.9	572.9	573.0	573.1	573.1	573.2
	573.2	1000.	1000.							
0 18	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	572.8	572.9	572.9	573.0	573.0	1000.	1000.
	1000.	1000.	1000.							
0 19	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.							

OHEAD PRINT FORMAT IS FORMAT NUMBER 0 DRAWDOWN PRINT FORMAT IS FORMAT NUMBER 0

OHEADS WILL BE SAVED ON UNIT 30 DRAWDOWNS WILL BE SAVED ON UNIT 31

OUTPUT CONTROL IS SPECIFIED EVERY TIME STEP

COLUMN TO ROW ANISOTROPY WILL BE READ ON UNIT 11 USING FORMAT: (20F4.1)

DELR WILL BE READ ON UNIT 11 USING FORMAT: (10E12.4)

DELC WILL BE READ ON UNIT 11 USING FORMAT: (10E12.4)

PRIMARY STORAGE COEF = .2000000 FOR LAYER 1
HYD. COND. ALONG ROWS = 32.60000 FOR LAYER 1

BOTTOM FOR LAYER 1 WILL BE READ ON UNIT 11 USING FORMAT: (10E12.4)

VERT HYD COND /THICKNESS = .3320000E-04 FOR LAYER 1
PRIMARY STORAGE COEF = .1000000E-03 FOR LAYER 2

TRANSMIS. ALONG ROWS FOR LAYER 2 WILL BE READ ON UNIT 11 USING FORMAT: (10E12.4)

SOLUTION BY THE STRONGLY IMPLICIT PROCEDURE

MAXIMUM ITERATIONS ALLOWED FOR CLOSURE = 100
ACCELERATION PARAMETER = 1.0000
HEAD CHANGE CRITERION FOR CLOSURE = .10000E-02
SIP HEAD CHANGE PRINTOUT INTERVAL = 1
CALCULATE ITERATION PARAMETERS FROM MODEL CALCULATED WSEED
STRESS PERIOD NO. 1, LENGTH = 730.0000

NUMBER OF TIME STEPS = 10

MULTIPLIER FOR DELT = 1.414

INITIAL TIME STEP SIZE = 9.764241

69 DRAINS

LAYER	ROW	COL	ELEVATION	CONDUCTANCE	DRAIN NO.
1	2	2	569.5	3016.	1
1	2	3	569.5	3016.	2
1	2	4	569.5	3016.	3
1	2	5	569.5	3016.	4
1	2	6	569.5	3016.	5
1	2	7	569.5	3016.	6
1	2	8	569.5	3016.	7
1	2	9	569.5	3016.	8
1	2	10	569.5	3016.	9
1	2	11	569.5	3016.	10
1	2	12	569.5	3016.	11

1	2	14	569.5	3016.	13
1	2	15	569.5	3016.	14
1	2	16	569.5	3016.	15
1	2	17	569.5	3016.	16
1	2	18	569.5	3016.	17
1	2	19	569.5	3016.	18
1	2	20	569.5	3016.	19
1	2	21	569.5	3016.	20
1	2	22	569.5	3016.	21
1	2	23	569.5	3016.	22
1	3	2	569.5	3016.	23
1	4	2	569.5	3016.	24
1	5	2	569.5	3016.	25
1	6	2	569.5	3016.	26
1	7	2	569.5	3016.	27
1	7	3	569.5	3016.	28
1	7	4	569.5	3016.	29
1	8	4	569.5	3016.	30
1	8	5	569.5	3016.	31
1	8	6	569.5	3016.	32
1	9	6	569.5	3016.	33
1	9	7	569.5	3016.	34
1	9	8	569.5	3016.	35
1	9	9	569.5	3016.	36
1	10	9	569.5	3016.	37
1	10	10	569.5	3016.	38
1	10	11	569.5	3016.	39
1	10	12	569.5	3016.	40
1	10	13	569.5	3016.	41
1	10	14	569.5	3016.	42
1	10	15	569.5	3016.	43
1	10	16	569.5	3016.	44
1	10	17	569.5	3016.	45
1	10	18	569.5	3016.	46
1	10	19	569.5	3016.	47
1	10	20	569.5	3016.	48
1	11	20	569.5	3016.	49
1	11	21	569.5	3016.	50
1	11	22	569.5	3016.	51
1	12	22	569.5	3016.	52
1	12	23	569.5	3016.	53
1	13	23	569.5	3016.	54
1	13	24	569.5	3016.	55
1	14	24	569.5	3016.	56
1	14	25	569.5	3016.	57
1	15	25	569.5	3016.	58
1	16	25	569.5	3016.	59
1	17	25	569.5	3016.	60
1	17	26	569.5	3016.	61
1	17	27	569.5	3016.	62
1	15	32	569.5	3016.	63
1	15	30	569.5	3016.	64
1	15	31	569.5	3016.	65
1	15	29	569.5	3016.	66
1	16	29	569.5	3016.	67
1	16	27	569.5	3016.	68
1	16	28	569.5	3016.	69

0

RECHARGE WILL BE READ ON UNIT 18 USING FORMAT: (10E12.4)

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20

	31	32	33							
0 1	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 2	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 3	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 4	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 5	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 6	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 7	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 8	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 9	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 10	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 11	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 12	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 13	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 14	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 15	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05							
0 16	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05
	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05	6.0000E-05

0 17 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05
6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05
6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05
6.0000E-05 6.0000E-05 6.0000E-05

18 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05
6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05
6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05
6.0000E-05 6.0000E-05 6.0000E-05

19 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-0
6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05
6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-05 6.0000E-0
6.0000E-05 6.0000E-05 6.0000E-05

0

97 HEAD-DEPENDENT BOUNDARY NODES

0

LAYER	ROW	COL	ELEVATION	CONDUCTANCE	BOUND NO.
1	15	24	572.6	.5760E-01	1
1	16	24	572.6	.5760E-01	2
1	17	24	572.6	.5760E-01	3
1	18	24	572.6	.5760E-01	4
1	1	4	572.5	.5760E-01	5
1	11	14	572.5	.5760E-01	6
1	9	4	572.5	.5760E-01	7
1	8	3	572.5	.5760E-01	8
1	9	3	572.5	.5760E-01	9
1	8	1	572.5	.5760E-01	10
1	8	2	572.5	.5760E-01	11
1	1	1	572.5	.5760E-01	12
1	2	1	572.5	.5760E-01	13
1	3	1	572.5	.5760E-01	14
1	4	1	572.5	.5760E-01	15
1	5	1	572.5	.5760E-01	16
1	6	1	572.5	.5760E-01	17
1	7	1	572.5	.5760E-01	18
1	1	2	572.5	.5760E-01	19
1	1	3	572.5	.5760E-01	20
1	9	5	572.5	.5760E-01	21
1	10	5	572.5	.5760E-01	22
1	11	8	572.5	.5760E-01	23
1	11	9	572.5	.5760E-01	24
1	11	10	572.5	.5760E-01	25
1	11	11	572.5	.5760E-01	26
1	11	12	572.5	.5760E-01	27
1	11	13	572.5	.5760E-01	28
1	10	6	572.5	.5760E-01	29
1	10	7	572.5	.5760E-01	30
1	11	15	572.6	.5760E-01	31
1	11	16	572.6	.5760E-01	32
1	11	17	572.6	.5760E-01	33
1	11	18	572.6	.5760E-01	34
1	11	19	572.6	.5760E-01	35
1	12	19	572.6	.5760E-01	36
1	12	20	572.6	.5760E-01	37
1	12	21	572.6	.5760E-01	38
1	13	21	572.6	.5760E-01	39
1	13	22	572.6	.5760E-01	40
1	14	22	572.6	.5760E-01	41
1	14	23	572.6	.5760E-01	42
1	15	23	572.6	.5760E-01	43
1	1	23	572.3	.5760E-01	44
1	1	24	572.3	.5760E-01	45
1	1	14	572.4	.5760E-01	46
1	1	15	572.4	.5760E-01	47

1	1	18	572.4	.5760E-01	50
1	1	19	572.4	.5760E-01	51
1	1	20	572.4	.5760E-01	52
1	1	21	572.4	.5760E-01	53
1	1	22	572.4	.5760E-01	54
1	1	5	572.5	.5760E-01	55
1	1	6	572.5	.5760E-01	56
1	1	7	572.5	.5760E-01	57
1	1	8	572.5	.5760E-01	58
1	1	9	572.5	.5760E-01	59
1	1	10	572.5	.5760E-01	60
1	1	11	572.5	.5760E-01	61
1	1	12	572.5	.5760E-01	62
1	1	13	572.5	.5760E-01	63
1	18	25	572.6	.5760E-01	64
1	18	26	572.6	.5760E-01	65
1	18	27	572.6	.5760E-01	66
1	18	28	572.6	.5760E-01	67
1	17	28	572.6	.5760E-01	68
1	17	29	572.6	.5760E-01	69
1	17	30	572.6	.5760E-01	70
1	17	31	572.6	.5760E-01	71
1	16	31	572.6	.5760E-01	72
1	16	32	572.6	.5760E-01	73
1	2	25	572.6	.5760E-01	74
1	2	26	572.7	.5760E-01	75
1	3	26	572.8	.5760E-01	76
1	4	26	572.9	.5760E-01	77
1	4	27	573.0	.5760E-01	78
1	5	27	573.0	.5760E-01	79
1	6	27	573.1	.5760E-01	80
1	6	28	573.1	.5760E-01	81
1	7	28	573.2	.5760E-01	82
1	8	28	573.2	.5760E-01	83
1	8	29	573.3	.5760E-01	84
1	9	29	573.3	.5760E-01	85
1	9	30	573.4	.5760E-01	86
1	10	30	573.4	.5760E-01	87
1	11	30	573.4	.5760E-01	88
1	11	31	573.4	.5760E-01	89
1	12	31	573.4	.5760E-01	90
1	12	32	573.4	.5760E-01	91
1	13	32	573.4	.5760E-01	92
1	14	32	573.4	.5760E-01	93
1	14	33	573.2	.5760E-01	94
1	15	33	573.0	.5760E-01	95
1	16	33	572.8	.5760E-01	96
1	2	24	572.3	.5760E-01	97

0AVERAGE SEED = .00113737
 MINIMUM SEED = .00008108
0

5 ITERATION PARAMETERS CALCULATED FROM AVERAGE SEED:

.0000000E+00 .8163567E+00 .9662751E+00 .9938067E+00 .9988626E+00

0

9 ITERATIONS FOR TIME STEP 1 IN STRESS PERIOD 1

0MAXIMUM HEAD CHANGE FOR EACH ITERATION:

0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER

-3.152 (1, 15, 31) -1.392 (1, 18, 24) -.6748 (2, 13, 27) -.1587 (2, 17, 29) -.7618E-01 (2,
-.1849E-01 (2, 18, 28) -.9237E-02 (2, 11, 25) -.2303E-02 (2, 10, 27) -.5639E-03 (2, 11, 28)

0

0HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 6 CELL-BY-CELL FLOW TERM FLAG = 0

0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD DRAWDOWN HEAD DRAWDOWN

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
0	0	0	0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 1 IN STRESS PERIOD 1

CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
IN:		IN:	
STORAGE =	.36280E+06	STORAGE =	37156.
CONSTANT HEAD =	38.473	CONSTANT HEAD =	5.9885
DRAINS =	.00000	DRAINS =	.00000
RECHARGE =	535.00	RECHARGE =	54.792
HEAD DEP BOUNDS =	113.07	HEAD DEP BOUNDS =	11.580
TOTAL IN =	.36350E+06	TOTAL IN =	37228.
OUT:		OUT:	
STORAGE =	.57909E-01	STORAGE =	.59308E-02
CONSTANT HEAD =	.00000	CONSTANT HEAD =	.00000
DRAINS =	.36348E+06	DRAINS =	37226.
RECHARGE =	.00000	RECHARGE =	.00000
HEAD DEP BOUNDS =	.00000	HEAD DEP BOUNDS =	.00000
TOTAL OUT =	.36348E+06	TOTAL OUT =	37226.
IN - OUT =	24.844	IN - OUT =	2.5430
PERCENT DISCREPANCY =	.00	PERCENT DISCREPANCY =	

TIME SUMMARY AT END OF TIME STEP 1 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	843630.	14060.5	234.342	9.76424	.267330E-01
STRESS PERIOD TIME	843630.	14060.5	234.342	9.76424	.267330E-01
TOTAL SIMULATION TIME	843630.	14060.5	234.342	9.76424	.267330E-01

1
10 ITERATIONS FOR TIME STEP 2 IN STRESS PERIOD 1
0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER

-.6381 (1, 11, 8)	-.4634 (1, 6, 13)	-.4740 (1, 8, 29)	-.1114 (2, 4, 25)	-.4964E-01 (2,
-.8473E-02 (2, 18, 28)	-.5451E-02 (2, 10, 25)	-.2768E-02 (2, 9, 26)	-.1266E-02 (1, 8, 29)	-.1271E-03 (2,

0
0HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 6 CELL-BY-CELL FLOW TERM FLAG = 0
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
0	0	0	0

0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 2 IN STRESS PERIOD 1

CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
IN:		IN:	

DRAINS =	.00000	DRAINS =	.00000
RECHARGE =	1291.5	RECHARGE =	54.792
HEAD DEP BOUNDS =	721.09	HEAD DEP BOUNDS =	15.067
TOTAL IN =	.48494E+06	TOTAL IN =	8795.6
OUT:		OUT:	
STORAGE =	.57909E-01	STORAGE =	.00000
CONSTANT HEAD =	.00000	CONSTANT HEAD =	.00000
DRAINS =	.48497E+06	DRAINS =	8799.3
RECHARGE =	.00000	RECHARGE =	.00000
HEAD DEP BOUNDS =	.00000	HEAD DEP BOUNDS =	.00000
TOTAL OUT =	.48497E+06	TOTAL OUT =	8799.3
IN - OUT =	-26.500	IN - OUT =	-3.7178
PERCENT DISCREPANCY =	-.00	PERCENT DISCREPANCY =	

TIME SUMMARY AT END OF TIME STEP 2 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	.119289E+07	19881.6	331.359	13.8066	.378005E-01
STRESS PERIOD TIME	.203652E+07	33942.1	565.701	23.5709	.645336E-01
TOTAL SIMULATION TIME	.203652E+07	33942.1	565.701	23.5709	.645336E-01

10 ITERATIONS FOR TIME STEP 3 IN STRESS PERIOD 1

MAXIMUM HEAD CHANGE FOR EACH ITERATION:

HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,
-.2708	(1, 9, 30)	-.2799	(1, 6, 24)	-.4085	(1, 8, 29)	-.1020	(2, 5, 25)	-.5848E-01	(2,
-.1107E-01	(2, 1, 25)	.5523E-02	(2, 2, 29)	-.3181E-02	(2, 8, 26)	-.1798E-02	(1, 8, 29)	-.1971E-03	(1,

HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 6 CELL-BY-CELL FLOW TERM FLAG = 0

OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
0	0	0	0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 3 IN STRESS PERIOD 1

CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
IN:		IN:	
STORAGE =	.54386E+06	STORAGE =	3109.4
CONSTANT HEAD =	365.78	CONSTANT HEAD =	9.6917
DRAINS =	.00000	DRAINS =	.00000
RECHARGE =	2361.2	RECHARGE =	54.792
HEAD DEP BOUNDS =	640.95	HEAD DEP BOUNDS =	16.384
TOTAL IN =	.54722E+06	TOTAL IN =	3190.2
OUT:		OUT:	
STORAGE =	.57909E-01	STORAGE =	.00000
CONSTANT HEAD =	.00000	CONSTANT HEAD =	.00000
DRAINS =	.54723E+06	DRAINS =	3189.0
RECHARGE =	.00000	RECHARGE =	.00000
HEAD DEP BOUNDS =	.00000	HEAD DEP BOUNDS =	.00000
TOTAL OUT =	.54723E+06	TOTAL OUT =	3189.0

PERCENT DISCREPANCY = PERCENT DISCREPANCY =

TIME SUMMARY AT END OF TIME STEP 3 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	.168675E+07	28112.5	468.542	19.5226	.534499E-01
STRESS PERIOD TIME	.372328E+07	62054.6	1034.24	43.0935	.117983
TOTAL SIMULATION TIME	.372328E+07	62054.6	1034.24	43.0935	.117983

10 ITERATIONS FOR TIME STEP 4 IN STRESS PERIOD 1

MAXIMUM HEAD CHANGE FOR EACH ITERATION:

HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,
-.1796	(1, 6, 28)	-.1911	(1, 6, 25)	-.2918	(1, 6, 28)	-.7764E-01	(2, 5, 25)	-.5511E-01	(2,
-.1138E-01	(2, 1, 25)	.5186E-02	(2, 2, 29)	-.3104E-02	(2, 8, 25)	-.2060E-02	(1, 8, 29)	-.2630E-03	(2,

HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 6 CELL-BY-CELL FLOW TERM FLAG = 0

OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
0	0	0	0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 4 IN STRESS PERIOD 1

CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
IN:		IN:	
STORAGE =	.57587E+06	STORAGE =	1159.8
CONSTANT HEAD =	649.22	CONSTANT HEAD =	10.268
DRAINS =	.00000	DRAINS =	.00000
RECHARGE =	3873.7	RECHARGE =	54.792
HEAD DEP BOUNDS =	1112.1	HEAD DEP BOUNDS =	17.068
TOTAL IN =	.58151E+06	TOTAL IN =	1242.0
OUT:		OUT:	
STORAGE =	.57909E-01	STORAGE =	.00000
CONSTANT HEAD =	.00000	CONSTANT HEAD =	.00000
DRAINS =	.58138E+06	DRAINS =	1237.0
RECHARGE =	.00000	RECHARGE =	.00000
HEAD DEP BOUNDS =	.00000	HEAD DEP BOUNDS =	.00000
TOTAL OUT =	.58138E+06	TOTAL OUT =	1237.0
IN - OUT =	133.06	IN - OUT =	4.9373
PERCENT DISCREPANCY =	.02	PERCENT DISCREPANCY =	

TIME SUMMARY AT END OF TIME STEP 4 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	.238507E+07	39751.1	662.519	27.6049	.755782E-01
STRESS PERIOD TIME	.610834E+07	101806.	1696.76	70.6984	.193562
TOTAL SIMULATION TIME	.610834E+07	101806.	1696.76	70.6984	.193562

0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,R

-.1048 1, 6, 28) -.1066 1, 6, 25) -.1748 1, 6, 28) -.4847E-01 (2, 6, 25) -.3899E-01 (2,
-.3753E-02 (2, 1, 25) .3334E-02 (2, 2, 29) -.2357E-02 (2, 8, 25) -.1819E-02 (1, 8, 29) -.2601E-03 (2,

0
0HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 0 CELL-BY-CELL FLOW TERM FLAG = 0
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
0	0	0	0

0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 5 IN STRESS PERIOD 1

0 CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
IN:		IN:	
STORAGE =	.59137E+06	STORAGE =	396.96
CONSTANT HEAD =	1061.2	CONSTANT HEAD =	10.555
DRAINS =	.00000	DRAINS =	.00000
RECHARGE =	6012.4	RECHARGE =	54.792
HEAD DEP BOUNDS =	1792.5	HEAD DEP BOUNDS =	17.430
0 TOTAL IN =	.60023E+06	TOTAL IN =	479.73
0 OUT:		OUT:	
STORAGE =	.57909E-01	STORAGE =	.00000
CONSTANT HEAD =	.00000	CONSTANT HEAD =	.00000
DRAINS =	.60003E+06	DRAINS =	477.88
RECHARGE =	.00000	RECHARGE =	.00000
HEAD DEP BOUNDS =	.00000	HEAD DEP BOUNDS =	.00000
0 TOTAL OUT =	.60003E+06	TOTAL OUT =	477.88
0 IN - OUT =	205.56	IN - OUT =	1.8572
0 PERCENT DISCREPANCY =	.03	PERCENT DISCREPANCY =	

0

TIME SUMMARY AT END OF TIME STEP 5 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	.337248E+07	56208.1	936.801	39.0334	.106868
STRESS PERIOD TIME	.948083E+07	158014.	2633.56	109.732	.300429
TOTAL SIMULATION TIME	.948083E+07	158014.	2633.56	109.732	.300429

1
10 ITERATIONS FOR TIME STEP 6 IN STRESS PERIOD 1
0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER

-.4718E-01 (1, 6, 28) -.4724E-01 (1, 6, 25) -.8274E-01 (1, 6, 28) -.2381E-01 (2, 6, 25) -.2072E-01 (2,
-.5016E-02 (2, 1, 25) -.2006E-02 (1, 7, 28) -.1356E-02 (2, 7, 25) -.1179E-02 (1, 8, 29) -.1788E-03 (2,

0
0HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 6 CELL-BY-CELL FLOW TERM FLAG = 0
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
0	0	0	0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 6 IN STRESS PERIOD 1

CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
IN:		IN:	
STORAGE =	.39779E+06	STORAGE =	116.31
CONSTANT HEAD =	1550.7	CONSTANT HEAD =	10.680
DRAINS =	.00000	DRAINS =	.00000
RECHARGE =	9036.6	RECHARGE =	54.792
HEAD DEP BOUNDS =	2763.5	HEAD DEP BOUNDS =	17.593
TOTAL IN =	.61124E+06	TOTAL IN =	199.38
OUT:		OUT:	
STORAGE =	.57909E-01	STORAGE =	.00000
CONSTANT HEAD =	.00000	CONSTANT HEAD =	.00000
DRAINS =	.61084E+06	DRAINS =	195.86
RECHARGE =	.00000	RECHARGE =	.00000
HEAD DEP BOUNDS =	.00000	HEAD DEP BOUNDS =	.00000
TOTAL OUT =	.61084E+06	TOTAL OUT =	195.86
IN - OUT =	399.50	IN - OUT =	3.5138
PERCENT DISCREPANCY =	.07	PERCENT DISCREPANCY =	

TIME SUMMARY AT END OF TIME STEP 6 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	.476869E+07	79478.2	1324.64	55.1932	.151111
STRESS PERIOD TIME	.142495E+08	237492.	3958.20	164.925	.451540
TOTAL SIMULATION TIME	.142495E+08	237492.	3958.20	164.925	.451540

7 ITERATIONS FOR TIME STEP 7 IN STRESS PERIOD 1

MAXIMUM HEAD CHANGE FOR EACH ITERATION:

HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER,ROW,COL	HEAD CHANGE	LAYER
-.1632E-01	(1, 6, 28)	-.1627E-01	(1, 6, 25)	-.3024E-01	(1, 6, 28)	-.8967E-02	(2, 6, 25)	-.8215E-02	(2,
-.2120E-02	(2, 1, 25)	-.8436E-03	(1, 7, 28)						

HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 6 CELL-BY-CELL FLOW TERM FLAG = 0

OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
0	0	0	0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 7 IN STRESS PERIOD 1

CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
IN:		IN:	
STORAGE =	.59993E+06	STORAGE =	27.438
CONSTANT HEAD =	2487.5	CONSTANT HEAD =	10.723
DRAINS =	.00000	DRAINS =	.00000
RECHARGE =	13313.	RECHARGE =	54.792

OUT:		OUT:	
STORAGE =	.57909E-01	STORAGE =	.00000
CONSTANT HEAD =	.00000	CONSTANT HEAD =	.00000
DRAINS =	.61926E+06	DRAINS =	107.87
RECHARGE =	.00000	RECHARGE =	.00000
HEAD DEP BOUNDS =	.00000	HEAD DEP BOUNDS =	.00000
TOTAL OUT =	.61926E+06	TOTAL OUT =	107.87
IN - OUT =	812.69	IN - OUT =	2.7310
PERCENT DISCREPANCY =	.10	PERCENT DISCREPANCY =	

TIME SUMMARY AT END OF TIME STEP 7 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	.674293E+07	112382.	1873.04	78.0432	.213671
STRESS PERIOD TIME	.209925E+08	349874.	5831.24	242.968	.665211
TOTAL SIMULATION TIME	.209925E+08	349874.	5831.24	242.968	.665211

1
6 ITERATIONS FOR TIME STEP 8 IN STRESS PERIOD 1
0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,R

-.4397E-02 (1, 6, 28)	-.4428E-02 (1, 7, 26)	-.8687E-02 (1, 6, 28)	-.2642E-02 (2, 6, 25)	-.2486E-02 (2,
-.6773E-03 (2, 1, 25)				

0
0HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 6 CELL-BY-CELL FLOW TERM FLAG = 0
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
0	0	0	0

0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 8 IN STRESS PERIOD 1

0 CUMULATIVE VOLUMES L**3		RATES FOR THIS TIME STEP L**3/T	
IN:		IN:	
STORAGE =	.60051E+06	STORAGE =	5.2617
CONSTANT HEAD =	3672.2	CONSTANT HEAD =	10.735
DRAINS =	.00000	DRAINS =	.00000
RECHARGE =	19359.	RECHARGE =	54.792
HEAD DEP BOUNDS =	6090.4	HEAD DEP BOUNDS =	17.666
0 TOTAL IN =	.62963E+06	TOTAL IN =	88.455
0 OUT:		OUT:	
STORAGE =	.21050	STORAGE =	.13827E-02
CONSTANT HEAD =	.00000	CONSTANT HEAD =	.00000
DRAINS =	.62874E+06	DRAINS =	85.966
RECHARGE =	.00000	RECHARGE =	.00000
HEAD DEP BOUNDS =	.00000	HEAD DEP BOUNDS =	.00000
0 TOTAL OUT =	.62874E+06	TOTAL OUT =	85.968
0 IN - OUT =	887.19	IN - OUT =	2.4873
0 PERCENT DISCREPANCY =	.14	PERCENT DISCREPANCY =	

TIME SUMMARY AT END OF TIME STEP 8 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	.953451E+07	158908.	2648.47	110.353	.302130
STRESS PERIOD TIME	.305270E+08	508763.	8479.71	353.321	.967341
TOTAL SIMULATION TIME	.305270E+08	508783.	8479.71	353.321	.967341

1

1 ITERATIONS FOR TIME STEP 9 IN STRESS PERIOD 1

0MAXIMUM HEAD CHANGE FOR EACH ITERATION:

0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,

-.9748E-03 (1, 6, 28)

0

0HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 0 CELL-BY-CELL FLOW TERM FLAG = 0

0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
0	0	0	0

0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 9 IN STRESS PERIOD 1

0	CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
	IN:		IN:	
	STORAGE =	.60053E+06	STORAGE =	.13110
	CONSTANT HEAD =	5347.3	CONSTANT HEAD =	10.735
	DRAINS =	.00000	DRAINS =	.00000
	RECHARGE =	27909.	RECHARGE =	54.792
	HEAD DEP BOUNDS =	8847.2	HEAD DEP BOUNDS =	17.634
0	TOTAL IN =	.64263E+06	TOTAL IN =	83.293
0	OUT:		OUT:	
	STORAGE =	.94372	STORAGE =	.46990E-02
	CONSTANT HEAD =	.00000	CONSTANT HEAD =	.00000
	DRAINS =	.64222E+06	DRAINS =	86.334
	RECHARGE =	.00000	RECHARGE =	.00000
	HEAD DEP BOUNDS =	.00000	HEAD DEP BOUNDS =	.00000
0	TOTAL OUT =	.64222E+06	TOTAL OUT =	86.339
0	IN - OUT =	416.81	IN - OUT =	-3.0466
0	PERCENT DISCREPANCY =	.06	PERCENT DISCREPANCY =	

0

TIME SUMMARY AT END OF TIME STEP 9 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	.134818E+08	224697.	3744.94	156.039	.427212
STRESS PERIOD TIME	.440088E+08	733479.	12224.7	509.361	1.39455
TOTAL SIMULATION TIME	.440088E+08	733479.	12224.7	509.361	1.39455

1

1 ITERATIONS FOR TIME STEP 10 IN STRESS PERIOD 1

0MAXIMUM HEAD CHANGE FOR EACH ITERATION:

0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER

```
0HEAD/DRAWDOWN PRINTOUT FLAG = 1     TOTAL BUDGET PRINTOUT FLAG = 6     CELL-BY-CELL FLOW TERM FLAG = 6
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:
   HEAD     DRAWDOWN  HEAD  DRAWDOWN
 PRINTOUT  PRINTOUT  SAVE    SAVE
 ---------------------------------

     1         0       1       0
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   1   COL   1   RATE    .6558657
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   1   COL  33   RATE    .1602822
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   2   COL   1   RATE    .6443998
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   2   COL  33   RATE    .1596705
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   3   COL   1   RATE    .6448894
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   3   COL  33   RATE    .1641472
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   4   COL   1   RATE    .6458374
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   4   COL  33   RATE    .1709480
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   5   COL   1   RATE    .6477431
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   5   COL  33   RATE    .1902882
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   6   COL   1   RATE    .6515369
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   6   COL  33   RATE    .1925890
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   7   COL   1   RATE    .6586617
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   7   COL  33   RATE    .2085256
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   8   COL   1   RATE    .6694170
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   8   COL  33   RATE    .2290902
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW   9   COL  33   RATE    .2551417
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW  10   COL  33   RATE    .2880400
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW  11   COL  33   RATE    .3380076
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW  12   COL  33   RATE    .4190456
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW  13   COL  33   RATE    .4490720
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW  14   COL  33   RATE    .7542084
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW  15   COL  33   RATE    .7669026
0   CONSTANT HEAD   PERIOD  1   STEP 10   LAYER  2   ROW  16   COL  33   RATE    .7808098
0          DRAINS   PERIOD  1   STEP 10   DRAIN   1   LAYER  1   ROW   2   COL   2   RATE  -1.656738
0          DRAINS   PERIOD  1   STEP 10   DRAIN   2   LAYER  1   ROW   2   COL   3   RATE  -1.104492
0          DRAINS   PERIOD  1   STEP 10   DRAIN   3   LAYER  1   ROW   2   COL   4   RATE  -.9204102
0          DRAINS   PERIOD  1   STEP 10   DRAIN   4   LAYER  1   ROW   2   COL   5   RATE  -.9204102
0          DRAINS   PERIOD  1   STEP 10   DRAIN   5   LAYER  1   ROW   2   COL   6   RATE  -.9204102
0          DRAINS   PERIOD  1   STEP 10   DRAIN   6   LAYER  1   ROW   2   COL   7   RATE  -.9204102
0          DRAINS   PERIOD  1   STEP 10   DRAIN   7   LAYER  1   ROW   2   COL   8   RATE  -.9204102
0          DRAINS   PERIOD  1   STEP 10   DRAIN   8   LAYER  1   ROW   2   COL   9   RATE  -.9204102
0          DRAINS   PERIOD  1   STEP 10   DRAIN   9   LAYER  1   ROW   2   COL  10   RATE  -.9204102
0          DRAINS   PERIOD  1   STEP 10   DRAIN  10   LAYER  1   ROW   2   COL  11   RATE  -1.104492
0          DRAINS   PERIOD  1   STEP 10   DRAIN  11   LAYER  1   ROW   2   COL  12   RATE  -.9204102
0          DRAINS   PERIOD  1   STEP 10   DRAIN  12   LAYER  1   ROW   2   COL  13   RATE  -1.104492
0          DRAINS   PERIOD  1   STEP 10   DRAIN  13   LAYER  1   ROW   2   COL  14   RATE  -1.104492
0          DRAINS   PERIOD  1   STEP 10   DRAIN  14   LAYER  1   ROW   2   COL  15   RATE  -1.104492
0          DRAINS   PERIOD  1   STEP 10   DRAIN  15   LAYER  1   ROW   2   COL  16   RATE  -1.104492
0          DRAINS   PERIOD  1   STEP 10   DRAIN  16   LAYER  1   ROW   2   COL  17   RATE  -1.104492
0          DRAINS   PERIOD  1   STEP 10   DRAIN  17   LAYER  1   ROW   2   COL  18   RATE  -1.104492
0          DRAINS   PERIOD  1   STEP 10   DRAIN  18   LAYER  1   ROW   2   COL  19   RATE  -1.472656
0          DRAINS   PERIOD  1   STEP 10   DRAIN  19   LAYER  1   ROW   2   COL  20   RATE  -1.472656
0          DRAINS   PERIOD  1   STEP 10   DRAIN  20   LAYER  1   ROW   2   COL  21   RATE  -1.656738
0          DRAINS   PERIOD  1   STEP 10   DRAIN  21   LAYER  1   ROW   2   COL  22   RATE  -2.024902
0          DRAINS   PERIOD  1   STEP 10   DRAIN  22   LAYER  1   ROW   2   COL  23   RATE  -4.233887
0          DRAINS   PERIOD  1   STEP 10   DRAIN  23   LAYER  1   ROW   3   COL   2   RATE  -1.288574
0          DRAINS   PERIOD  1   STEP 10   DRAIN  24   LAYER  1   ROW   4   COL   2   RATE  -1.288574
0          DRAINS   PERIOD  1   STEP 10   DRAIN  25   LAYER  1   ROW   5   COL   2   RATE  -1.288574
0          DRAINS   PERIOD  1   STEP 10   DRAIN  26   LAYER  1   ROW   6   COL   2   RATE  -1.104492
0          DRAINS   PERIOD  1   STEP 10   DRAIN  27   LAYER  1   ROW   7   COL   2   RATE  -1.472656
0          DRAINS   PERIOD  1   STEP 10   DRAIN  28   LAYER  1   ROW   7   COL   3   RATE  -1.104492
0          DRAINS   PERIOD  1   STEP 10   DRAIN  29   LAYER  1   ROW   7   COL   4   RATE  -.9204102
0          DRAINS   PERIOD  1   STEP 10   DRAIN  30   LAYER  1   ROW   8   COL   4   RATE  -1.104492
0          DRAINS   PERIOD  1   STEP 10   DRAIN  31   LAYER  1   ROW   8   COL   5   RATE  -.9204102
0          DRAINS   PERIOD  1   STEP 10   DRAIN  32   LAYER  1   ROW   8   COL   6   RATE  -.9204102
0          DRAINS   PERIOD  1   STEP 10   DRAIN  33   LAYER  1   ROW   9   COL   6   RATE  -.9204102
0          DRAINS   PERIOD  1   STEP 10   DRAIN  34   LAYER  1   ROW   9   COL   7   RATE  -.9204102
```

```
0          DRAINS  PERIOD  1   STEP 10   DRAIN  37   LAYER  1   ROW  10   COL   9   RATE  -.9204102
0          DRAINS  PERIOD  1   STEP 10   DRAIN  38   LAYER  1   ROW  10   COL  10   RATE  -.9204102
0          DRAINS  PERIOD  1   STEP 10   DRAIN  39   LAYER  1   ROW  10   COL  11   RATE  -.9204102
0          DRAINS  PERIOD  1   STEP 10   DRAIN  40   LAYER  1   ROW  10   COL  12   RATE  -1.104492
0          DRAINS  PERIOD  1   STEP 10   DRAIN  41   LAYER  1   ROW  10   COL  13   RATE  -.9204102
0          DRAINS  PERIOD  1   STEP 10   DRAIN  42   LAYER  1   ROW  10   COL  14   RATE  -1.104492
0          DRAINS  PERIOD  1   STEP 10   DRAIN  43   LAYER  1   ROW  10   COL  15   RATE  -1.104492
0          DRAINS  PERIOD  1   STEP 10   DRAIN  44   LAYER  1   ROW  10   COL  16   RATE  -1.104492
0          DRAINS  PERIOD  1   STEP 10   DRAIN  45   LAYER  1   ROW  10   COL  17   RATE  -1.104492
0          DRAINS  PERIOD  1   STEP 10   DRAIN  46   LAYER  1   ROW  10   COL  18   RATE  -1.288574
0          DRAINS  PERIOD  1   STEP 10   DRAIN  47   LAYER  1   ROW  10   COL  19   RATE  -1.288574
0          DRAINS  PERIOD  1   STEP 10   DRAIN  48   LAYER  1   ROW  10   COL  20   RATE  -1.656738
0          DRAINS  PERIOD  1   STEP 10   DRAIN  49   LAYER  1   ROW  11   COL  20   RATE  -.9204102
0          DRAINS  PERIOD  1   STEP 10   DRAIN  50   LAYER  1   ROW  11   COL  21   RATE  -1.288574
0          DRAINS  PERIOD  1   STEP 10   DRAIN  51   LAYER  1   ROW  11   COL  22   RATE  -2.024902
0          DRAINS  PERIOD  1   STEP 10   DRAIN  52   LAYER  1   ROW  12   COL  22   RATE  -1.104492
0          DRAINS  PERIOD  1   STEP 10   DRAIN  53   LAYER  1   ROW  12   COL  23   RATE  -1.840820
0          DRAINS  PERIOD  1   STEP 10   DRAIN  54   LAYER  1   ROW  13   COL  23   RATE  -1.104492
0          DRAINS  PERIOD  1   STEP 10   DRAIN  55   LAYER  1   ROW  13   COL  24   RATE  -2.024902
0          DRAINS  PERIOD  1   STEP 10   DRAIN  56   LAYER  1   ROW  14   COL  24   RATE  -1.104492
0          DRAINS  PERIOD  1   STEP 10   DRAIN  57   LAYER  1   ROW  14   COL  25   RATE  -1.840820
0          DRAINS  PERIOD  1   STEP 10   DRAIN  58   LAYER  1   ROW  15   COL  25   RATE  -1.104492
0          DRAINS  PERIOD  1   STEP 10   DRAIN  59   LAYER  1   ROW  16   COL  25   RATE  -.9204102
0          DRAINS  PERIOD  1   STEP 10   DRAIN  60   LAYER  1   ROW  17   COL  25   RATE  -1.104492
0          DRAINS  PERIOD  1   STEP 10   DRAIN  61   LAYER  1   ROW  17   COL  26   RATE  -.9204102
0          DRAINS  PERIOD  1   STEP 10   DRAIN  62   LAYER  1   ROW  17   COL  27   RATE  -1.104492
0          DRAINS  PERIOD  1   STEP 10   DRAIN  63   LAYER  1   ROW  15   COL  32   RATE  -3.865723
0          DRAINS  PERIOD  1   STEP 10   DRAIN  64   LAYER  1   ROW  15   COL  30   RATE  -2.393066
0          DRAINS  PERIOD  1   STEP 10   DRAIN  65   LAYER  1   ROW  15   COL  31   RATE  -2.761230
0          DRAINS  PERIOD  1   STEP 10   DRAIN  66   LAYER  1   ROW  15   COL  29   RATE  -2.208984
0          DRAINS  PERIOD  1   STEP 10   DRAIN  67   LAYER  1   ROW  16   COL  29   RATE  -1.288574
0          DRAINS  PERIOD  1   STEP 10   DRAIN  68   LAYER  1   ROW  16   COL  27   RATE  -1.104492
0          DRAINS  PERIOD  1   STEP 10   DRAIN  69   LAYER  1   ROW  16   COL  28   RATE  -1.288574
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY   1   LAYER  1   ROW  15   COL  24   RATE   .1784988
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY   2   LAYER  1   ROW  16   COL  24   RATE   .1784988
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY   3   LAYER  1   ROW  17   COL  24   RATE   .1784883
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY   4   LAYER  1   ROW  18   COL  24   RATE   .1784707
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY   5   LAYER  1   ROW   1   COL   4   RATE   .1726875
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY   6   LAYER  1   ROW  11   COL  14   RATE   .1755809
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY   7   LAYER  1   ROW   9   COL   4   RATE   .1726840
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY   8   LAYER  1   ROW   8   COL   3   RATE   .1726981
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY   9   LAYER  1   ROW   9   COL   3   RATE   .1726559
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  10   LAYER  1   ROW   8   COL   1   RATE   .1725996
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  11   LAYER  1   ROW   8   COL   2   RATE   .1726594
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  12   LAYER  1   ROW   1   COL   1   RATE   .1725926
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  13   LAYER  1   ROW   2   COL   1   RATE   .1726383
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  14   LAYER  1   ROW   3   COL   1   RATE   .1726594
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  15   LAYER  1   ROW   4   COL   1   RATE   .1726664
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  16   LAYER  1   ROW   5   COL   1   RATE   .1726664
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  17   LAYER  1   ROW   6   COL   1   RATE   .1726629
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  18   LAYER  1   ROW   7   COL   1   RATE   .1726418
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  19   LAYER  1   ROW   1   COL   2   RATE   .1726488
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  20   LAYER  1   ROW   1   COL   3   RATE   .1726805
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  21   LAYER  1   ROW   9   COL   5   RATE   .1727086
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  22   LAYER  1   ROW  10   COL   5   RATE   .1726594
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  23   LAYER  1   COL   8   RATE   .1755527
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  24   LAYER  1   ROW  11   COL   9   RATE   .1755738
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  25   LAYER  1   ROW  11   COL  10   RATE   .1755809
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  26   LAYER  1   ROW  11   COL  11   RATE   .1755809
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  27   LAYER  1   ROW  11   COL  12   RATE   .1755809
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  28   LAYER  1   ROW  11   COL  13   RATE   .1755809
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  29   LAYER  1   ROW  10   COL   6   RATE   .1755703
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  30   LAYER  1   ROW  10   COL   7   RATE   .1755879
0 HEAD DEP BOUNDS  PERIOD  1   STEP 10   BOUNDARY  31   LAYER  1   ROW  11   COL  15   RATE   .1784602
```

```
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  34   LAYER  1   ROW  11   COL  18   RATE   .1784637
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  35   LAYER  1   ROW  11   COL  19   RATE   .1784742
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  36   LAYER  1   ROW  12   COL  19   RATE   .1784391
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  37   LAYER  1   ROW  12   COL  20   RATE   .1784672
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  38   LAYER  1   ROW  12   COL  21   RATE   .1784848
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  39   LAYER  1   ROW  13   COL  21   RATE   .1784531
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  40   LAYER  1   ROW  13   COL  22   RATE   .1784813
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  41   LAYER  1   ROW  14   COL  22   RATE   .1784566
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  42   LAYER  1   ROW  14   COL  23   RATE   .1784883
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  43   LAYER  1   ROW  15   COL  23   RATE   .1784672
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  44   LAYER  1   ROW   1   COL  23   RATE   .1639055
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  45   LAYER  1   ROW   1   COL  24   RATE   .1637226
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  46   LAYER  1   ROW   1   COL  14   RATE   .1669430
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  47   LAYER  1   ROW   1   COL  15   RATE   .1669430
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  48   LAYER  1   ROW   1   COL  16   RATE   .1669430
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  49   LAYER  1   ROW   1   COL  17   RATE   .1669430
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  50   LAYER  1   ROW   1   COL  18   RATE   .1669395
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  51   LAYER  1   ROW   1   COL  19   RATE   .1669359
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  52   LAYER  1   ROW   1   COL  20   RATE   .1669289
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  53   LAYER  1   ROW   1   COL  21   RATE   .1669113
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  54   LAYER  1   ROW   1   COL  22   RATE   .1668727
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  55   LAYER  1   ROW   1   COL   5   RATE   .1698152
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  56   LAYER  1   ROW   1   COL   6   RATE   .1698187
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  57   LAYER  1   ROW   1   COL   7   RATE   .1698223
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  58   LAYER  1   ROW   1   COL   8   RATE   .1698223
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  59   LAYER  1   ROW   1   COL   9   RATE   .1698258
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  60   LAYER  1   ROW   1   COL  10   RATE   .1698258
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  61   LAYER  1   ROW   1   COL  11   RATE   .1698258
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  62   LAYER  1   ROW   1   COL  12   RATE   .1698258
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  63   LAYER  1   ROW   1   COL  13   RATE   .1698223
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  64   LAYER  1   ROW  18   COL  25   RATE   .1784883
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  65   LAYER  1   ROW  18   COL  26   RATE   .1784953
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  66   LAYER  1   ROW  18   COL  27   RATE   .1784883
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  67   LAYER  1   ROW  18   COL  28   RATE   .1784742
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  68   LAYER  1   ROW  17   COL  28   RATE   .1784953
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  69   LAYER  1   ROW  17   COL  29   RATE   .1784777
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  70   LAYER  1   ROW  17   COL  30   RATE   .1784391
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  71   LAYER  1   ROW  17   COL  31   RATE   .1784144
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  72   LAYER  1   ROW  16   COL  31   RATE   .1784320
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  73   LAYER  1   ROW  16   COL  32   RATE   .1783933
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  74   LAYER  1   ROW   2   COL  25   RATE   .1777043
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  75   LAYER  1   ROW   2   COL  26   RATE   .1833082
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  76   LAYER  1   ROW   3   COL  26   RATE   .1890105
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  77   LAYER  1   ROW   4   COL  26   RATE   .1946707
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  78   LAYER  1   ROW   4   COL  27   RATE   .2003063
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  79   LAYER  1   ROW   5   COL  27   RATE   .2002887
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  80   LAYER  1   ROW   6   COL  27   RATE   .2060367
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  81   LAYER  1   ROW   6   COL  28   RATE   .2059664
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  82   LAYER  1   ROW   7   COL  28   RATE   .2117742
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  83   LAYER  1   ROW   8   COL  28   RATE   .2118551
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  84   LAYER  1   ROW   8   COL  29   RATE   .2175961
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  85   LAYER  1   ROW   9   COL  29   RATE   .2176945
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  86   LAYER  1   ROW   9   COL  30   RATE   .2234602
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  87   LAYER  1   ROW  10   COL  30   RATE   .2235867
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  88   LAYER  1   ROW  11   COL  30   RATE   .2237730
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  89   LAYER  1   ROW  11   COL  31   RATE   .2238187
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  90   LAYER  1   ROW  12   COL  31   RATE   .2239629
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  91   LAYER  1   ROW  12   COL  32   RATE   .2239980
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  92   LAYER  1   ROW  13   COL  32   RATE   .2241316
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  93   LAYER  1   ROW  14   COL  32   RATE   .2243250
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  94   LAYER  1   ROW  14   COL  33   RATE   .2122973
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  95   LAYER  1   ROW  15   COL  33   RATE   .2013644
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  96   LAYER  1   ROW  16   COL  33   RATE   .1898402
0 HEAD DEP BOUNDS   PERIOD  1   STEP 10   BOUNDARY  97   LAYER  1   ROW   2   COL  24   RATE   .1636207
```

	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
	21	22	23	24	25	26	27	28	29	30
	31	32	33							
0 1	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.							
0 2	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	1000.	1000.	1000.	1000.
	1000.	1000.	1000.							
0 3	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	1000.	1000.	1000.	1000.
	1000.	1000.	1000.							
0 4	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	1000.	1000.	1000.
	1000.	1000.	1000.							
0 5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	1000.	1000.	1000.
	1000.	1000.	1000.							
0 6	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	1000.	1000.
	1000.	1000.	1000.							
0 7	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	1000.	1000.
	1000.	1000.	1000.							
0 8	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	1000.
	1000.	1000.	1000.							
0 9	1000.	1000.	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	1000.	1000.	1000.							
0 10	1000.	1000.	1000.	1000.	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	1000.	1000.	1000.							
0 11	1000.	1000.	1000.	1000.	1000.	1000.	1000.	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	1000.	1000.							
0 12	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	1000.							
0 13	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	1000.							
0 14	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5							
0 15	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.

0 16	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.5							
0 17	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	1000.	1000.							
0 18	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	569.5	569.5	569.5	569.5	569.5	1000.	1000.
	1000.	1000.	1000.							
0 19	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.							

1 HEAD IN LAYER 2 AT END OF TIME STEP 10 IN STRESS PERIOD 1

	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
	21	22	23	24	25	26	27	28	29	30
	31	32	33							

0 1	572.5	571.4	570.6	570.2	569.9	569.8	569.7	569.6	569.6	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.6	569.6	569.7	569.8	569.9	570.2	570.5	570.8	571.2	571.7
	572.1	572.5	573.0							
0 2	572.5	571.4	570.6	570.2	569.9	569.8	569.7	569.6	569.6	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.6	569.6	569.6	569.7	569.9	570.1	570.4	570.8	571.2	571.6
	572.1	572.5	573.0							
0 3	572.5	571.4	570.6	570.2	569.9	569.8	569.7	569.6	569.6	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.6	569.6	569.6	569.7	569.8	570.0	570.4	570.8	571.2	571.6
	572.1	572.5	573.0							
0 4	572.5	571.3	570.6	570.2	569.9	569.8	569.7	569.6	569.6	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.6	569.6	569.7	569.8	570.0	570.2	570.7	571.1	571.5
	572.0	572.5	573.0							
0 5	572.5	571.3	570.6	570.2	569.9	569.8	569.7	569.6	569.6	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.6	569.6	569.7	569.8	569.9	570.2	570.5	571.0	571.5
	572.0	572.5	573.0							
0 6	572.5	571.3	570.6	570.2	569.9	569.7	569.6	569.6	569.6	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.6	569.6	569.6	569.7	569.9	570.1	570.4	570.9	571.4
	571.9	572.4	573.0							
0 7	572.5	571.3	570.6	570.1	569.9	569.7	569.6	569.6	569.6	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.6	569.6	569.6	569.7	569.8	570.0	570.3	570.7	571.2
	571.8	572.4	573.0							
0 8	572.5	571.3	570.4	570.1	569.8	569.7	569.6	569.6	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.6	569.6	569.7	569.8	569.9	570.2	570.5	571.1
	571.7	572.3	573.0							
0 9	1000.	1000.	570.1	569.9	569.8	569.7	569.6	569.6	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.6	569.6	569.7	569.7	569.9	570.1	570.4	570.8
	571.5	572.3	573.0							
0 10	1000.	1000.	1000.	1000.	569.7	569.6	569.6	569.6	569.5	569.5
	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5	569.5
	569.5	569.5	569.6	569.6	569.6	569.7	569.8	570.0	570.3	570.7
	571.4	572.2	573.0							

	569.5	569.5	569.5	569.6	569.6	569.7	569.8	569.9	570.2	570.5
	571.1	572.0	573.0							
0 12	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	569.5	569.5
	569.5	569.5	569.5	569.6	569.6	569.7	569.7	569.9	570.1	570.4
	571.0	571.8	573.0							
0 13	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	569.5	569.5	569.5	569.6	569.6	569.6	569.7	569.8	570.0	570.4
	570.9	571.7	573.0							
0 14	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	569.5	569.5	569.6	569.6	569.6	569.7	569.8	570.0	570.3
	570.8	571.7	573.0							
0 15	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	569.5	569.6	569.6	569.6	569.7	569.8	570.0	570.3
	570.8	571.6	573.0							
0 16	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	569.6	569.6	569.6	569.7	569.7	569.9	570.2
	570.6	571.6	573.0							
0 17	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	569.6	569.6	569.6	569.6	569.7	569.9	570.0
	570.2	1000.	1000.							
0 18	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	569.5	569.6	569.6	569.6	569.6	1000.	1000.
	1000.	1000.	1000.							
0 19	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.	1000.
	1000.	1000.	1000.							

OHEAD WILL BE SAVED ON UNIT 30 AT END OF TIME STEP 10, STRESS PERIOD 1

0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 10 IN STRESS PERIOD 1

0	CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
	IN:		IN:	
	STORAGE =	.60055E+06	STORAGE =	.77908E-01
	CONSTANT HEAD =	7715.9	CONSTANT HEAD =	10.735
	DRAINS =	.00000	DRAINS =	.00000
	RECHARGE =	39998.	RECHARGE =	54.792
	HEAD DEP BOUNDS =	12745.	HEAD DEP BOUNDS =	17.667
0	TOTAL IN =	.66101E+06	TOTAL IN =	83.272
0	OUT:		OUT:	
	STORAGE =	2.8369	STORAGE =	.85804E-02
	CONSTANT HEAD =	.00000	CONSTANT HEAD =	.00000
	DRAINS =	.66220E+06	DRAINS =	90.568
	RECHARGE =	.00000	RECHARGE =	.00000
	HEAD DEP BOUNDS =	.00000	HEAD DEP BOUNDS =	.00000
0	TOTAL OUT =	.66220E+06	TOTAL OUT =	90.577
0	IN - OUT =	-1194.8	IN - OUT =	-7.3047
0	PERCENT DISCREPANCY =	-.18	PERCENT DISCREPANCY =	

TIME SUMMARY AT END OF TIME STEP 10 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	.190633E+08	317721.	5295.35	220.639	.604078
STRESS PERIOD TIME	.630720E+08	.105120E+07	17520.0	730.000	1.99863
TOTAL SIMULATION TIME	.630720E+08	.105120E+07	17520.0	730.000	1.99863

1

WehranEnviroTech

APPENDIX H

APPENDIX H

Groundwater Treatment Evaluation - Description of Treatment System

APPENDIX H

Description of Treatment System

Treatment - Disposal to Buffalo River

In order to assess the treatment scheme required for treatment of the groundwater collected at the site prior to its disposal, the existing static groundwater quality data from the Remedial Investigation (RI) report was utilized. The parameters of concern were identified, and the average concentration for each was determined for the purposes of this report to be the sum of the reported values divided by the number of occurrences.

The summary of Shallow Groundwater Results presented in the Remedial Investigation was used for data evaluation. All values presented were averaged with the exception of the samples identified as Tank Park 910, 8-NAPL. According to the text, these wells contained a six-foot layer of oil above the groundwater. The data listed under 8-NAPL was for that oil layer and, therefore, was not included in our evaluation of the groundwater data. Table H-1 summarizes the results of this evaluation and presents the average expected treatment system influent concentration of each parameter of concern for the flow scenarios considered in this report.

During the Remedial Design Phase, it is recommended that containment transport modeling be performed on the proposed collection system to determine actual influent concentrations. It is also recommended that the groundwater be sampled and analyzed for conventional parameters (BOD, COD, NH3-N, TKN, TSS and TDS) so that these parameters may be evaluated for use in designing the treatment system. High concentrations of these parameters can significantly increase the cost of treatment.

Since this Feasibility Study is based on an evaluation of existing RI data and since the need for additional data has been identified, the treatment scheme proposed herein would have to be re-evaluated against any new data, prior to remedial design.

Discharge limitations were also investigated to determine required treatment efficiencies. The most stringent limitations determined by review of ARAR's are shown in the far right column of Table H-1. For the purpose of this report, it is assumed that limitations similar to those presented would be required for direct discharge to the Buffalo River. A process flow schematic for the treatment of groundwater at this site before discharge to the Buffalo River is shown in Figure H-1.

TABLE H - 1

BUFFALO COLOR FEASIBILITY STUDY

SUMMARY OF RESULTS FOR GROUNDWATER SAMPLING
AVERAGE INFLUENT CONCENTRATIONS and POTENTIAL EFFLUENT CRITERIA
(ALL VALUES SHOWN mg/l)

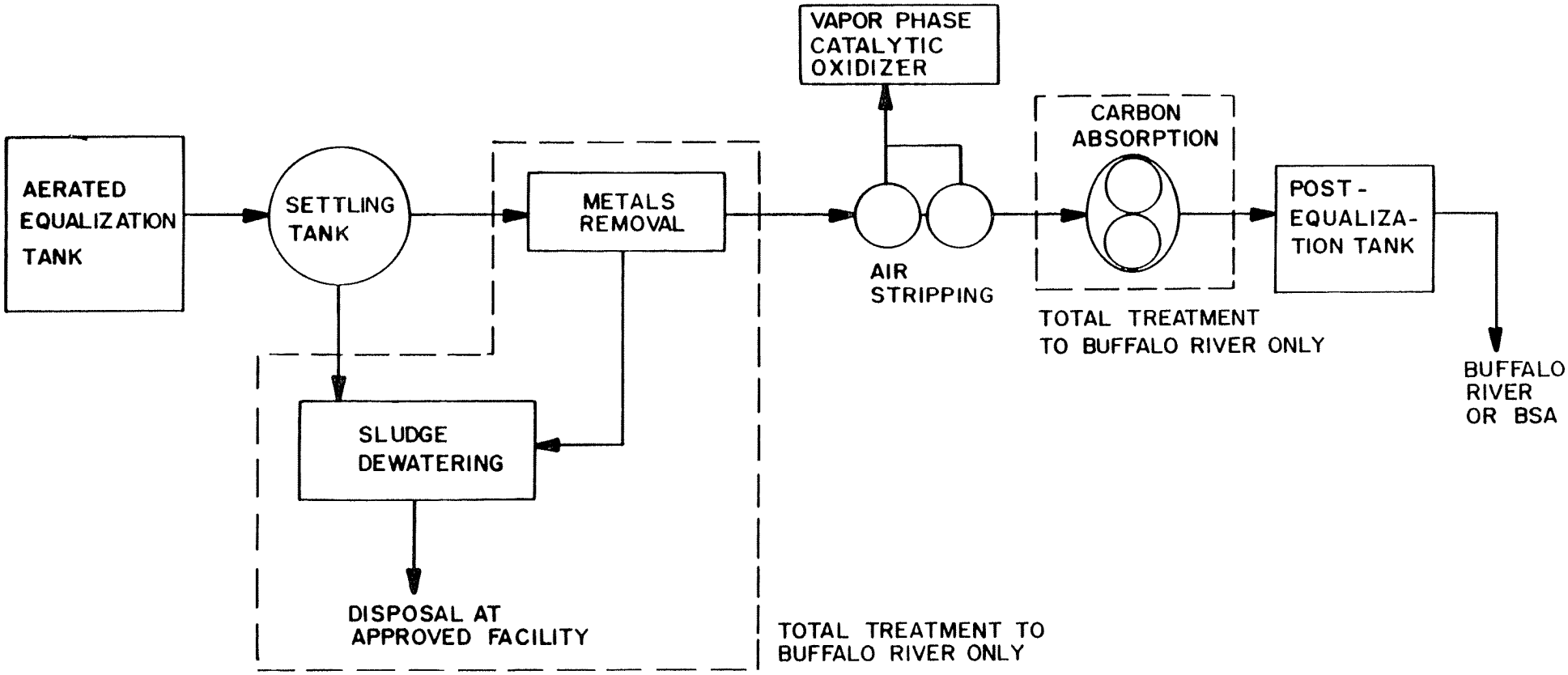
	INFLUENT			EFFLUENT
PARAMETER	AVG. 20 GPM	AVG. 60 GPM	AVG. 120 GPM	BASED ON ARAR's
Acetone	0.659	0.220	0.110	0.2800
Aniline	62.820	20.940	10.470	0.8100
Benzene	1.268	0.423	0.211	0.0010
Benzidine	0.225	0.075	0.038	0.0010
Benzo(a)anthracene	0.006	0.002	0.001	0.0590
Benzo(b)Fluoranthene	0.001	0.000	0.000	0.0550
Benzo(k)Fluoranthene	0.001	0.000	0.000	0.0590
Benzo(a)pyrene	0.004	0.001	0.001	0.0610
Bromodichloromethane	0.003	0.001	0.001	0.3500
2-Butanone	0.137	0.046	0.023	---
Carbon Disulfide	0.017	0.006	0.003	---
4, Chloroaniline	1.854	0.618	0.309	0.0500
Chlorobenzene	3.757	1.252	0.626	0.0500
2, Chlorophenol	0.384	0.128	0.064	0.0440
Chrysene	0.005	0.002	0.001	0.0590
1,2 Dichlorobenzene	2.372	0.791	0.395	0.0500
1,4 Dichlorobenzene	0.529	0.176	0.088	0.0050
1,1 Dichloroethene	0.002	0.001	0.000	0.0050
1,2-Dichloroethene (TOT)	0.005	0.002	0.001	0.0050
2,4-Dinitrotoluene	2.000	0.667	0.333	0.3200
2,6-Dinitrotoluene	1.600	0.533	0.267	0.5500
Ethylbenzene	3.223	1.074	0.537	0.0570
Fluoranthene	0.021	0.007	0.004	0.0680
Methylene Chloride	0.513	0.171	0.086	0.0890
2-Methylnaphthalene	0.011	0.004	0.002	---
Naphthalene	0.452	0.151	0.075	0.0590
1-Naphthylamine	5.653	1.884	0.942	0.0500
Phenol	0.047	0.016	0.008	0.0390
Pyrene	0.009	0.003	0.002	0.0670
1,2,4 Trichlorobenzene	0.376	0.125	0.063	0.0500
Toluene	0.255	0.085	0.043	0.0050
Xylene	0.181	0.060	0.030	0.0050
TOC	175.850	58.617	29.308	---
Al	11.385	3.795	1.898	0.1000
Ag	0.009	0.003	0.002	0.0500

TABLE H – 1

BUFFALO COLOR FEASIBILITY STUDY

SUMMARY OF RESULTS FOR GROUNDWATER SAMPLING
AVERAGE INFLUENT CONCENTRATIONS and POTENTIAL EFFLUENT CRITERIA
(ALL VALUES SHOWN mg/l)

	INFLUENT			EFFLUENT
PARAMETER	AVG. 20 GPM	AVG. 60 GPM	AVG. 120 GPM	BASED ON ARAR's
Ar	0.255	0.085	0.043	0.0500
Be	0.005	0.002	0.001	0.0030
Cd	0.023	0.008	0.004	0.0060
Cr	0.186	0.062	0.031	0.2000
Cu	3.920	1.307	0.653	0.0120
Fe	45.072	15.024	7.512	0.3000
Hg	0.005	0.002	0.001	0.0001
Mg	27.900	9.300	4.650	35.0000
Mn	4.188	1.396	0.698	0.3000
Ni	0.208	0.069	0.035	0.1000
Pb	0.433	0.144	0.072	0.1310
Sb	0.029	0.010	0.005	0.0030
Se	0.010	0.003	0.002	0.0100
Tl	0.038	0.013	0.006	0.0040
Zn	1.396	0.465	0.233	0.4350
CN	0.024	0.008	0.004	0.0010



Wehran envirotech	BUFFALO COLOR CORPORATION	PROCESS FLOW SCHEMATIC GROUNDWATER TREATMENT	FIGURE: H-1 Scale: NA Project No.: 00257

The groundwater treatment system would consist of the following treatment units:

- aerated equalization/storage tank
- settling tank
- metals removal system
- air stripping units with vapor phase catalytic oxidizer
- carbon adsorption treatment units
- post treatment equalization

The equalization/storage tank, which precedes the treatment train would be an aerated, glass-fused-to-steel bolted tank with a one day detention time. The aeration system would maintain a dissolved oxygen concentration of 1 mg/l and would assist in keeping the settleable solids in suspension.

The aerated equalization tank would be followed by a settling tank so that settleable solids will be removed prior to the remaining treatment units.

The metals removal system would consist of pH adjustment in a flash mix tank, followed by flocculation assisted by polymer addition, settling and then neutralization.

The solids removed from the metals removal system would be dewatered by a plate/frame filter press (40 to 50 percent solids) prior to disposal at an approved facility.

Air stripping towers arranged in a series flow configuration would be utilized to remove the constituents which are amenable to this treatment (ie, volatile organics); stripping would also act as a partial treatment for the constituents to be adsorbed.

The air strippers are typically constructed of fiberglass reinforced plastics and generally are equipped with blowers, pumps, piping and appurtenances. The vapor phase released from the air stripper would be further treated by a catalytic oxidizer. The need for vapor phase control from the air stripper will be determined in the remedial design phase after better determination of influent VOC concentrations but is assumed to be necessary at this point. The carbon adsorption system would consist of upflow units packed with granular activated carbon, skid mounted with pre-engineered controls.

The entire treatment system would be followed by an equalization tank. This past-treatment tank would have a one day detention time and no aeration equipment. The purpose of this tank would be to hold treated effluent for treatment plant use and for surge control during operation and maintenance tasks.

Discharge requirements for disposal at the Buffalo Sewer Authority were also investigated. The limitations for this discharge alternative are shown for comparison against the expected average influent concentration in Table H-2.

Pre-Treatment - Disposal to BSA

Based on these less stringent limitations, the on-site pre-treatment system would conceptually consist of the following unit processes:

- aerated equalization/storage tank
- settling tank
- air stripping units with vapor phase catalytic oxidizer
- post treatment equalization

Figure H-1 shows a process flow schematic for this pre-treatment scheme.

Treatment Costs

A capital cost curve was generated for each treatment train in order to estimate costs for alternatives having different groundwater removal rates (see Table H-3).

The treatment trains discussed represent the concept for removal of the contaminants of concern and their estimated concentrations based on the RI data as noted.

TABLE H – 2

BUFFALO COLOR FEASIBILITY STUDY

GROUNDWATER PRE-TREATMENT AND DISCHARGE TO BSA
AVERAGE INFLUENT CONCENTRATIONS VS. BSA DISCHARGE LIMITATIONS

PARAMETER	AVG. INFLUENT CONCENTRATION (lb/day)	EFFLUENT LIMITATION (lb/day)
PH, UNITS	6–8	5–12
ARSENIC	0.06	0.3
CADMIUM	0.006	0.8
CHROMIUM	0.047	2.6
COPPER	0.98	5.6
SELENIUM	0.002	0.1
SILVER	0.002	0.05
LEAD	0.11	27
MERCURY	0.001	0.01
ZINC	0.35	34
CYANIDE, TOTAL	0.006	0.06
CHLOROFORM	–	0.5
1,2,4 TRICHLOROBENZENE	0.09	0.01
FLOURANTHENE	0.005	0.06
PYRENE	0.002	1
ENDOSULFAN	–	0.002
2,3,7,8–TCDD	–	NONE
ORGANOCHLORINE PESTICIDES	–	0.000
PURGEABLE HYDROCARBONS	7.2 mgl	5.3 mgl
PURGEABLE AROMATICS	11.15 mgl	5.3 mgl
PHENOLS	0.49 mgl	5.3 mgl
BENYIDINES	0.23 mgl	5.3 mgl
PHTHALATE ESTERS	0.016 mgl	5.3 mgl
NITROSAMINES	0.006 mgl	5.3 mgl
NITROAROMATICS &ISOPHORONE	3.6 mgl	5.3 mgl
POLYNUCLEAR AROMATIC HYDROCARBONS	0.57 mgl	5.3 mgl
HALOETHERS	–	5.3 mgl
CHLORINATED HYDROCARBONS	3.29 mgl	5.3 mgl

TABLE H – 3

BUFFALO COLOR FEASIBILITY STUDY

GROUNDWATER TREATMENT
CAPITAL, OPERATING, AND MAINTENANCE COSTS

SUMMARY OF PRE-TREATMENT SYSTEM COSTS

FLOW (gpm)	10	20	60	90	120	180	290
CAPITAL incl. 25% cont.	$130,000	$180,000	$400,000	$480,000	$580,000	$720,000	$975,000
O / M (annual) ($/yr)	$64,000	$70,000	$86,000	$101,000	$120,000	$158,000	$238,000

SUMMARY OF TOTAL TREATMENT COSTS

FLOW (gpm)	2 or 0.5	10	20	60	90	120	180	290
CAPITAL COST incl. 25% cont.	$283,750	$340,000	$420,000	$743,000	$881,250	$1,043,750	$1,265,000	$1,712,500
O / M (annual) ($/yr)	$47,780	$95,160	$119,260	$209,540	$275,290	$370,450	$518,620	$893,250



WehranEnviroTech

APPENDIX I

APPENDIX I

Detailed Cost Estimates of Alternatives

ALTERNATIVE 1
DETAILED COST ANALYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YR	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
NAPL	Collection/Disposal	LS			$50,000		$50,000
Engineering - 15% of Capital		LS			$23,000		$23,000
Contingency - 25% of Capital		LS			$18,250		$18,250

TOTAL	$1,170,273

==========

ALTERNATIVE 3
DETAILED COST ANALYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YR	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
Administration	Deed Restriction	LS			$20,000		$20,000
	Fencing	LF	$18	3,975	$71,550		$71,550
Construction	Mobilization	LS			$100,000		$100,000
	Clearing/Grubing	AC	$3,625	16.5	$59,813		$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400		$554,400
FML Cap	Subbase	CY	$13.09	13,310	$174,228		$174,228
	40 Mil HDPE	SF	$0.40	718,740	$287,496		$287,496
	Soil Fill	CY	$12.58	66,550	$837,199		$837,199
	Top Soil	CY	$20.00	13,310	$266,200		$266,200
	Seeding/Fertilizer	AC	$1,533	16.50	$25,295		$25,295
Stabilization	Sheet Piling	SF	$20.00	84,000	$1,680,000		$1,680,000
	Tie Backs	EA	$2,000	175	$350,000		$350,000
NAPL	Collection/Disposal	LS			$50,000		$50,000
Engineering - 15% of Capital		LS			$671,427		$671,427
Contingency - 25% of Capital		LS			$1,119,045		$1,119,045

TOTAL	$7,345,675

NOTES:

1) PRESENT VALUE IS BASED ON 10% INTEREST RATE AND 6% INFLATION RATE.

2) MOBILIZATION COST INCLUDES:
   - LEVEL "C" WORKER PROTECTION
   - ON SITE CONTRACTOR FACILITIES
   - EQUIPMENT TRANSPORT/DECONTAMINATION

ALTERNATIVE 3a
DETAILED COST ANALYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/ UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YR	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
Administration	Deed Restriction	LS			$20,000		$20,000
	Fencing	LF	$18	3,975	$71,550		$71,550
Construction	Mobilization	LS			$100,000		$100,000
	Clearing/Grubing	AC	$3,625	16.5	$59,813		$59,813
	Grading/Fill	CY	$10.50	40,300	$423,150		$423,150
FML Cap	Subbase	CY	$13.09	13,310	$174,228		$174,228
	40 Mil HDPE	SF	$0.40	718,740	$287,496		$287,496
	Soil Fill	CY	$12.58	66,550	$837,199		$837,199
	Top Soil	CY	$20.00	13,310	$266,200		$266,200
	Seeding/Fertilizer	AC	$1,533	16.50	$25,295		$25,295
Shoreline	Slope Preparation	CY	$10.00	12,500	$125,000		$125,000
	Fabriform/Rip Rap	SF	$4.00	122,500	$490,000		$490,000
	Sediment Control Fencing	SF	$1.00	10,000	$10,000		$10,000
NAPL	Collection/Disposal	LS			$50,000		$50,000
Engineering - 15% of Capital		LS			$440,989		$440,989
Contingency - 25% of Capital		LS			$734,982		$734,982

TOTAL	$5,194,925

==========

ALTERNATIVE 4
DETAILED COST ANALYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/ UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YR	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
Administration	Deed Restriction	LS			$20,000		$20,000
	Fencing	LF	$18	3,975	$71,550		$71,550
Construction	Mobilization	LS			$100,000		$100,000
	Clearing/Grubing	AC	$3,625	16.5	$59,813		$59,813
	Grading/Fill	CY	$10.50	40,300	$423,150		$423,150
FML Cap	Subbase	CY	$13.09	13,310	$174,228		$174,228
	40 Mil HDPE	SF	$0.40	718,740	$287,496		$287,496
	Soil Fill	CY	$12.58	66,550	$837,199		$837,199
	Top Soil	CY	$20.00	13,310	$266,200		$266,200
	Seeding/Fertilizer	AC	$1,533.00	16.5	$25,295		$25,295
GW Collection	Perimeter GW Collection	SF	$15.00	50,400	$756,000		$756,000
GW Treatment	GW Pre-Treatment	GPY	$0.0016	1.52E+08	$950,000	$243,315	$5,157,418
GW Disposal	Buffalo Sewer Authority	GPY	$0.00075	1.52E+08		$114,054	$1,972,227
Shoreline	Slope Preparation	CY	$10.00	12,500	$125,000		$125,000
	Fabriform/Rip Rap	SF	$4.00	122,500	$490,000		$490,000
	Sediment Control Fencing	SF	$1.00	10,000	$10,000		$10,000
Engineering - 15% of Capital		LS			$689,389		$689,389
Contingency - 25% of Capital		LS			$1,148,982		$1,148,982

TOTAL	$13,692,971

PRESENT VALUE IS BASED ON 10% INTEREST RATE AND 6% INFLATION RATE.

ALTERNATIVE 5
DETAILED COST ANALYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/ UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YR	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
Administration	Deed Restriction	LS			$20,000		$20,000
	Fencing	LF	$18	3,975	$71,550		$71,550
Construction	Mobilization	LS			$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813		$59,813
	Grading/Fill	CY	$10.50	40,300	$423,150		$423,150
Cap Multi-Media	Soil Fill	CY	$12.58	66,550	$837,199		$837,199
	Clay Soil @ 3'	CY	$18.00	79,860	$1,437,480		$1,437,480
	40 Mil HDPE	SF	$0.40	718,740	$287,496		$287,496
	Drainage Soil	CY	$15.00	39,930	$598,950		$598,950
	Top Soil	CY	$20.00	13,310	$266,200		$266,200
	Seeding/Fertilizer	AC	$1,533	16.50	$25,295		$25,295
GW Collection	Perimeter GW Collection	SF	$15.00	50,400	$756,000		$756,000
GW Treatment	GW Pre-Treatment	GPY	$0.0016	1.52E+08	$950,000	$243,200	$5,155,422
GW Disposal	Buffalo Sewer Authority	GPY	$0.00075	1.52E+08		$114,000	$1,971,292
Shoreline	Slope Preparation	CY	$10.00	12,500	$125,000		$125,000
	Fabriform/Rip Rap	SF	$4.00	122,500	$490,000		$490,000
	Sediment Control Fencing	SF	$1.00	10,000	$10,000		$10,000
Engineering - 15% of Capital		LS			$968,720		$968,720
Contingency - 25% of Capital		LS			$1,614,533		$1,614,533

TOTAL	$16,297,122

PRESENT VALUE IS BASED ON 10% INTEREST RATE AND 6% INFLATION RATE.

ALTERNATIVE 6
DETAILED COST ANALYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/ UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YR	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
Administration	Deed Restriction	LS			$20,000		$20,000
	Fencing	LF	$18	3,975	$71,550		$71,550
Construction	Mobilization	LS			$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813		$59,813
	Grading/Fill	CY	$10.50	40,300	$423,150		$423,150
FML Cap	Subbase	CY	$13.09	13,200	$172,788		$172,788
	40 Mil HDPE	SF	$0.40	718,740	$287,496		$287,496
	Soil Fill	CY	12.58	66,550	$837,199		$837,199
	Top Soil	CY	$20.00	13,310	$266,200		$266,200
	Seeding/Fertilization	AC	$1,533	16.50	$25,295		$25,295
GW Collection	Perimeter GW Collection	SF	$15	50,400	$756,000		$756,000
GW Treatment	GW Pre-Treatment	GPY	$0.011	5,680,000	$130,000	$62,480	$1,210,406
GW Disposal	Buffalo Sewer Authority	GPY	$0.00075	5,680,000		$4,260	$73,664
Containment	Slurry Wall - Downgradient	SF	$7.00	112,500	$787,500		$787,500
Shoreline	Slope Preparation	CY	$10.00	12,500	$125,000		$125,000
	Fabri-Form/Rip Rap	SF	$4.00	122,500	$490,000		$490,000
	Sediment Control Fencing	SF	$1.00	10,000	$10,000		$10,000
Engineering - 15% of Capital		LS			$684,299		$684,299
Contingency - 25% of Capital		LS			$1,140,498		$1,140,498

TOTAL	$8,619,879

PRESENT VALUE IS BASED ON 10% INTEREST RATE AND 6% INFLATION RATE.

ALTERNATIVE 6a
DETAILED COST ANALYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/ UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YRS	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
Administration	Deed Restriction	LS			$20,000		$20,000
	Fencing	LF	$18	3,975	$71,550		$71,550
Construction	Mobilization	LS			$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813		$59,813
	Grading/Fill	CY	$10.50	40,300	$423,150		$423,150
FML Cap	Subbase	CY	$13.09	13,310	$174,228		$174,228
	40 Mil HDPE	SF	$0.40	718,740	$287,496		$287,496
	Soil Fill	CY	$12.58	66,550	$837,199		$837,199
	Top Soil	CY	$20.00	13,310	$266,200		$266,200
	Seeding/Fertilizer	AC	$1,533	17	$25,295		$25,295
GW Collection	Perimeter GW Collection	SF	$15.00	50,400	$756,000		$756,000
GW Treatment	Total GW Treatment	GPY	$0.017	5,680,000	$340,000	$96,560	$2,009,719
GW Disposal	Buffalo River	N.A.					
Containment	Slurry Wall - Downgradient	SF	$7.00	112,500	$787,500		$787,500
Shoreline	Slope Preparation	CY	$10.00	12,500	$125,000		$125,000
	Fabriform/Rip Rap	SF	$4.00	122,500	$490,000		$490,000
	Sediment Control Fencing	SF	$1.00	10,000	$10,000		$10,000
Engineering - 15% of Capital		LS			$716,014		$716,014
Contingency - 25% of Capital		LS			$1,193,357		$1,193,357

TOTAL	$9,431,543

PRESENT VALUE IS BASED ON 10% INTEREST RATE AND 6% INFLATION RATE.

ALTERNATIVE 6b
DETAILED COST ANALYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/ UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YRS	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
Administration	Deed Restriction	LS			$20,000		$20,000
	Fencing	LF	$18	3,975	$71,550		$71,550
Construction	Mobilization	LS			$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813		$59,813
	Grading/Fill	CY	$10.50	40,300	$423,150		$423,150
FML Cap	Subbase	CY	$13.09	13,310	$174,228		$174,228
	40 Mil HDPE	SF	$0.40	718,740	$287,496		$287,496
	Soil Fill	CY	$12.58	66,550	$837,199		$837,199
	Top Soil	CY	$20.00	13,310	$266,200		$266,200
	Seeding/Fertilizer	AC	$1,533	17	$25,295		$25,295
GW Collection	Perimeter GW Collection	SF	$15.00	50,400	$756,000		$756,000
GW Disposal	Disposal Site/TSDF	GPY	$0.28	5,680,000	$100,000	$1,590,400	$27,601,250
Containment	Slurry Wall - Downgradient	SF	$7.00	112,500	$787,500		$787,500
Shoreline	Slope Preparation	CY	$10.00	12,500	$125,000		$125,000
	Fabriform/Rip Rap	SF	$4.00	122,500	$490,000		$490,000
	Sediment Control Fencing	SF	$1.00	10,000	$10,000		$10,000
Engineering - 15% of Capital		LS			$680,014		$680,014
Contingency - 25% of Capital		LS			$1,133,357		$1,133,357

TOTAL	$34,927,074

PRESENT VALUE IS BASED ON 10% INTEREST RATE AND 6% INFLATION RATE.

ALTERNATIVE 6c
DETAILED COST ANAYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YRS	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
Administration	Deed Restriction	LS			$20,000		$20,000
	Fencing	LF	$18	3,975	$71,550		$71,550
Construction	Mobilization	LS			$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813		$59,813
	Grading	CY	$4.00	15,000	$60,000		$60,000
FML Cap	Subbase	CY	$13.09	12,100	$158,389		$158,389
	40 Mil HDPE	SF	$0.40	653,400	$261,360		$261,360
	Soil Fill	CY	$12.58	48,400	$608,872		$608,872
	Top Soil	CY	$20.00	12,100	$242,000		$242,000
	Seeding/Fertilizer	AC	$1,533	15.0	$22,995		$22,995
GW Collection	Perimeter GW Collection	SF	$15.00	49,500	$742,500		$742,500
	NAPL Trenches	SF	$15.00	9,360	$140,400		$140,400
GW Treatment	GW Pre-Treatment	GPY	$0.20	229,000	$135,000	$45,800	$926,975
GW Disposal	Buffalo Sewer Authority	GPY	$0.00075	229,000		$172	$2,970
Containment	Slurry Wall - Upgradient	SF	$7.00	34,100	$238,700		$238,700
	Slurry Wall - Downgradient	SF	$7.00	77,000	$539,000		$539,000
Excavation/Fill	Soil Excavation	CY	$6.00	34,000	$204,000		$204,000
	Fill	CY	$12.58	34,000	$427,720		$427,720
Shoreline	Slope Preparation	CY	$10.00	45,000	$450,000		$450,000
	Fabriform	SF	$4.00	247,500	$990,000		$990,000
	Sediment Control Fencing	SF	$1.00	15,000	$15,000		$15,000
Engineering - 15% of Capital		LS			$823,095		$823,095
Contingency - 25% of Capital		LS			$1,371,825		$1,371,825

TOTAL	$9,556,186

PRESENT VALUE IS BASED ON 10% RETURN ON INVESTMENT AND 6% INFLATION RATE.

ALTERNATIVE 6d
DETAILED COST ANALYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YRS	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
Administration	Deed Restriction	LS			$20,000		$20,000
	Fencing	LF	$18	3,975	$71,550		$71,550
Construction	Mobilization	LS			$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813		$59,813
	Grading/Fill	CY	$10.50	40,300	$423,150		$423,150
FML Cap	Subbase	CY	$13.09	13,310	$174,228		$174,228
	40 Mil HDPE	SF	$0.40	718,740	$287,496		$287,496
	Soil Fill	CY	$12.58	66,550	$837,199		$837,199
	Top Soil	CY	$13.50	13,310	$179,685		$179,685
	Seeding/ Fertilizer	AC	$1,533	17	$25,295		$25,295
GW Collection	Perimeter GW Collection	SF	$15	50,400	$756,000		$756,000
GW Treatment	Total GW Treatment	GPY	$0.24	229,000	$284,000	$54,960	$1,234,370
GW Disposal	Buffalo River	N.A.					
Containment	Slurry Wall - Upgradient	SF	$7.00	30,600	$214,200		$214,200
	Slurry Wall - Downgradient	SF	$7.00	112,500	$787,500		$787,500
Shoreline	Slope Preparation	CY	$10.00	12,500	$125,000		$125,000
	Fabriform/Rip Rap	SF	$4.00	122,500	$490,000		$490,000
	Sediment Control Fencing	SF	$1.00	10,000	$10,000		$10,000
Engineering		LS			$726,767		$726,767
Contingency - @ 25%		LS			$1,211,279		$1,211,279

TOTAL	$8,812,554

PRESENT VALUE IS BASED ON 10% RETURN ON INVESTMENT AND 6% INFLATION RATE.

ALTERNATIVE 6e
DETAILED COST ANALYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/ UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YRS	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
Administration	Deed Restriction	LS			$20,000		$20,000
	Fencing	LF	$18	3,975	$71,550		$71,550
Construction	Mobilization	LS			$100,000		$100,000
	Clearing/Grubbing	AC	$3,625	16.5	$59,813		$59,813
	Grading/Fill	CY	$10.50	40,300	$423,150		$423,150
FML Cap	Subbase	CY	$13.09	13,310	$174,228		$174,228
	40 Mil HDPE	SF	$0.40	718,740	$287,496		$287,496
	Soil Fill	CY	$12.58	66,550	$837,199		$837,199
	Top Soil	CY	$20.00	13,310	$266,200		$266,200
	Seeding/Fertilizer	AC	$1,533	17	$25,295		$25,295
GW Collection	Perimeter GW Collection	SF	$15	50,400	$756,000		$756,000
GW Disposal	Disposal Site/TSDF	GPY	$0.28	229,000	$100,000	$64,120	$1,208,765
Containment	Slurry Wall - Upgradient	SF	$7.00	30,600	$214,200		$214,200
	Slurry Wall - Downgradient	SF	$7.00	112,500	$787,500		$787,500
Shoreline	Slope Preparation	CY	$10.00	12,500	$125,000		$125,000
	Fabri-Form/Rip Rap	SF	$4.00	122,500	$490,000		$490,000
	Sediment Control Fencing	SF	$1.00	10,000	$10,000		$10,000
Engineering - 15% of Capital		LS			$712,144		$712,144
Contingency - 25% of Capital		LS			$1,186,907		$1,186,907

TOTAL	$8,834,470

PRESENT VALUE IS BASED ON 10% INTEREST RATE AND 6% INFLATION RATE.

ALTERNATIVE 7
DETAILED COST ANALYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/ UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YR	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
Administration	Deed Restriction	LS			$20,000		$20,000
	Fencing	LF	$18	3,975	$71,550		$71,550
Construction	Mobilization	LS			$100,000		$100,000
	Clearng/Grubbing	AC	$3,625	16.5	$59,813		$59,813
	Grading/Fill	CY	$10.50	52,800	$554,400		$554,400
FML Cap	Subbase	CY	$13.09	13,310	$174,228		$174,228
	40 Mil HDPE	SF	$0.40	718,740	$287,496		$287,496
	Soil Fill	CY	$12.58	66,550	$837,199		$837,199
	Top Soil	CY	$20.00	13,310	$266,200		$266,200
	Seeding/Fertilizer	AC	$1,533	16.5	$25,295		$25,295
GW Collection	Perimeter GW Collection	SF	$15.00	50,400	$756,000		$756,000
GW Treatment	GW Pre-Treatment	GPY	$0.20	229,000	$130,000	$45,800	$921,975
GW Disposal	Buffalo Sewer Authority	GPY	$0.00075	229,000		$172	$2,970
Containment	Slurry Wall - Upgradient	SF	$7.00	30,600	$214,200		$214,200
	Slurry Wall - Downgradient	SF	$7.00	112,500	$787,500		$787,500
Stabilization	Sheet Pile	SF	$20.00	84,000	$1,680,000		$1,680,000
	Tie Backs	EA	$2,000	175	$350,000		$350,000
Engineering - 15% of Capital		LS			$947,082		$947,082
Contingency - 25% of Capital		LS			$1,578,470		$1,578,470

TOTAL $10,713,400

==========

ALTERNATIVE 8
DETAILED COST ANALYSIS
BUFFALO COLOR AREA "D"

DESCRIPTION		UNITS	COST/ UNIT	QUANTITY	CAPITAL COST	YEARLY O/M COST-30 YR	PRESENT VALUE
Monitoring	Groundwater	EA/YR	$7,800	8		$62,400	$1,079,023
Administration	Deed Restriction	LS			$20,000		$20,000
	Fencing	LF	$18	3,975	$71,550		$71,550
Construction	Mobilization	LS			$100,000		$100,000
	Clearng/Grubbing	AC	$3,625	16.5	$59,813		$59,813
Cap	Grading/Fill	CY	$10.50	52,800	$554,400		$554,400
	Seeding/Fertilizer	AC	$1,533	16.5	$25,295		$25,295
GW Collection	Total GW Collection	SF	$15	100,800	$1,512,000		$1,512,000
GW Treatment	GW Pre-Treatment	LS			$2,232,000		$2,232,000
GW Disposal	Buffalo Sewer Authority	LS			$33,000		$33,000
Shore Stabilization	Sheet Piling	SF	$30	132,000	$3,960,000		$3,960,000
	Tie Backs	EA	$2,000	1,320	$2,640,000		$2,640,000
Excavation	Total Exc.	CY	$4	480,000	$1,920,000		$1,920,000
Disposal	Off-Site TSDF	TON	$310	720,000	$223,200,000		$223,200,000
Backfill	Total Backfill - New Soil	CY	$12	480,000	$5,760,000		$5,760,000
Engineering - Lump Sum		LS			$5,000,000		$5,000,000
Contingency - 25% of Capital		LS			$60,522,014		$60,522,014

TOTAL $308,689,094

PRESENT VALUE IS BASED ON 10% INTERSET RATE AND 6% INFLATION RATE.



WehranEnviroTech

APPENDIX J

APPENDIX J

Letter from Wehran-New York, Inc. to Buffalo Color Corporation

Dated April 23, 1990 Re: Response to NYSDEC Comment Letter - 4/6/90

Identification of ARAR's "Area D"

WehranEnviroTech

Wehran-New York, Inc.
345 Lang Boulevard
Suite 1
Grand Island, New York 14072
Tel: 716-773-1801
Fax: 716-773-1828

April 23, 1990

Mr. Walter Manijak
Project Manager
Buffalo Color Corporation
100 Lee Street
Buffalo, NY 14240

RE: Response to NYSDEC Comment Letter – 4/6/90;
Identification of ARARs "Area D"
Buffalo Color Site
WE Project No. 00257 F4

Dear Mr. Manijak:

This letter serves as a revision to the Identification of ARARs document dated January 16, 1990. This revision identifies three additional action-specific requirements and a new situation at the Area D site, specifically the use of soils for fill below the mean high water level of the Buffalo River. Along with this new situation are the applicable relevant and appropriate regulations and guidelines provided by the NYSDEC in their April 6, 1990 comment letter.

CHEMICAL – SPECIFIC STANDARDS

Eleven situations, which are presented and referenced throughout this section, have been developed to correspond to known routes of egress of potential contaminants from the "Area D" site. Upon a review of all chemical-specific regulatory requirements, at least one standard has been found to be either applicable or relevant and appropriate to each situation. At the same time, the following regulatory requirements have each been identified as being either applicable or relevant and appropriate to at least one of the existing or potential situations at the "Area D" site:

Soil	• USEPA Sediment Classification Guidelines (Region V: 4/77) • NYSDEC Guidelines for Area D soils
Groundwater	• 6 NYCRR 703.5(a)(3) Groundwater Standards for Class GA Waters.

	• 40 CFR 264.94 Groundwater Standards for Owners of Treatment, Storage and Disposal (TSD) Facilities.
Drinking Water	• 10 NYCRR Subpart 5-1 Standards for Drinking Water Supplies. • 40 CFR 141.11 Standards for Public Drinking Water Supplies. • 10 NYCRR 170 Standards for Sources of Water Supply.
Surface Water	• 6 NYCRR 701.19 Fresh Surface Water Standard (Class C) • NYSDEC Technical and Operational Guidance Series 1.1.1 (4-1-87) Ambient Water Quality Standards and Guidance Values. • NYSDEC Technical and Operational Guidance Series 1.1.1 (4-1-87) Ambient Water Quality Guidance Values. • Clean Water Act 303-304 Water Quality Criteria for Aquatic Life and Drinking Water.
Air	• 6 NYCRR 212 Processes and Exhaust and/or Ventilation Systems. • 40 CFR 50 National Ambient Air Quality Standards.
Waste Water	• Buffalo Sewer Authority Regulations under 40 CFR 403. • 40 CFR 261.24 Toxicity Characteristic. • 6 NYCRR 703.6 Standards for Discharges to Groundwater.

The attached three tables have been developed to match requirements with situations and to identify some of the numerical standards associated with each requirement. A summary of each table follows:

- Table 1 identifies the chemical-specific ARARs relative to eleven existing and potential situations in "Area D".
- Table 2 identifies the chemical specific numerical standards from the ARARs that apply to the 15 indicator compounds which are identified in the risk assessment.
- Table 3 is a combination of Tables 1 and 2 and identifies the most stringent ARAR for each contaminant of concern relative to the eleven situations. For each situation, the sources of the standards which

Table 1
DETERMINATION OF CHEMICAL-SPECIFIC STANDARDS
APPLICABLE OR RELEVANT AND APPROPRIATE
TO SITUATIONS IN AREA D

SITUATION	ARAR	Soil		Ground Water		Drinking Water			Surface Water					Air		Waste Water		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9A)	(9B)	(10A)	(10B)	(11)	(12)	(13)	(14)	(15)
1 Soil erosion to the Buffalo River	Applicable	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Relevant	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Appropriate	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2 Soil used for fill below the mean Buff. Riv. high water line	Applicable	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Relevant	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Appropriate	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 Untreated Groundwater to the Buffalo River	Applicable	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO	YES	NO	NO	NO	NO	NO	NO
	Relevant	NO	NO	YES	YES	NO	NO	NO	-	-	YES	NO	YES	NO	NO	NO	NO	NO
	Appropriate	NO	NO	YES	YES	NO	NO	NO	-	-	YES	NO	YES	NO	NO	NO	NO	NO
4 Untreated Groundwater to the Buffalo Sewer Authority	Applicable	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO
	Relevant	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-	NO
	Appropriate	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-	NO
5 Untreated Groundwater to a Drinking Water Supply	Applicable	NO	NO	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Relevant	NO	NO	-	-	-	-	-	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Appropriate	NO	NO	-	-	-	-	-	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6 Untreated Groundwater immobilized in Area D	Applicable	NO	NO	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Relevant	NO	NO	-	-	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Appropriate	NO	NO	-	-	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
7 Precipiation Run-off to the Buffalo River	Applicable	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO	YES	NO	NO	NO	NO	NO	NO
	Relevant	NO	NO	NO	NO	NO	NO	NO	-	-	YES	NO	YES	NO	NO	NO	NO	NO
	Appropriate	NO	NO	NO	NO	NO	NO	NO	-	-	YES	NO	YES	NO	NO	NO	NO	NO
8 Treated Groundwater to the Buffalo River	Applicable	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO	YES	NO	NO	NO	NO	NO	NO
	Relevant	NO	NO	YES	YES	NO	NO	NO	-	-	YES	NO	YES	NO	NO	NO	NO	NO
	Appropriate	NO	NO	YES	YES	NO	NO	NO	-	-	YES	NO	YES	NO	NO	NO	NO	NO
9 Treated Groundwater to the Buffalo Sewer Authority	Applicable	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO
	Relevant	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-	NO
	Appropriate	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-	-	NO
10 Treated Groundwater returned to Area D soils	Applicable	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES
	Relevant	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-
	Appropriate	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-
11 Process Air Emissions to the Surrounding Area	Applicable	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO
	Relevant	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	-	NO	NO	NO
	Appropriate	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	-	NO	NO	NO

Soil (1) USEPA Sediment Classification Guidelines (Region V: 4/77)
Soil (2) NYDEC Guidelines for Area D Soils
Groundwater (3) 6NYCRR 703.5 (a) (3) GW Standards for Class GA waters
Groundwater (4) 40 CFR 264.94 GW Standards for owners of TSD Facilities
Drinking Water (5) 10NYCRR Subpart 5-1 Standards for Drinking Water Supplies
Drinking Water (6) 40 CFR 141.11 Standards for Public Drinking Water Systems
Drinking Water (7) 10NYCRR 170 Standards for Sources of Water Supply
Surface Water (8) 6NYCRR 701.19 Fresh Surface Water Standard (Class C)
Surface Water (9) NYDEC TOGS 1.1.1 (4-1-87) Ambient Water Quality Standards
Surface Water (9A) = Standards (9B) = Guidelines
Surface Water (10) Clean Water Act 303-304 Water Quality Criteria
Surface Water (10A) = Aquatic Life (10B) = Drinking Water
Air (11) 6NYCRR 212 Processes and Exhaust and/or Ventilation Systems
Air (12) 40 CFR 50 National Ambient Air Quality Standards
Waste Water (13) Buffalo Sewer Authority Regulations under 40 CFR 403
Waste Water (14) 40 CFR 261.24 Toxicity Characteristic
Waste Water (15) 6NYCRR 703.6 Standards for Discharges to Groundwater

Table 2
CHEMICAL-SPECIFIC STANDARDS

CONTAMINANTS OF CONCERN	Soil (ug/Kg) (In Soil)		Ground Water (ug/liter) (In water)		Drinking Water (ug/liter) (In water)			Surface Water (ug/liter) (In water)				Air (ug/m3) (In air)		Waste Water (ug/liter) (In water)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) (9A)	(9B)	(10A)	(10B)	(11)	(12)	(13)	(14)	(15)
Arsenic	8000	7500	25	50	50	50	50	190	-	0.018	-	0.67	-	100	5000	50
Cadmium	6000	1000	10	-	10	-	10	1.5*	-	-	1.1	2	-	200	1000	20
Chromium (3)	75000	10000	-	50	50	50	-	273*	-	3433	200	-	-	1000	5000	-
Chromium (6)	-	-	50	50	50	50	50	11	-	-	11	0.167	-	100	-	100
Iron	25000000	550000	300	-	300	-	-	300	-	-	-	-	-	-	-	600
Lead	60000	32500	25	50	50	50	50	4.9*	-	-	3.2	1.5	1.5	100	5000	50
Mercury	1000	100	2	2	2	2	5	-	0.2	0.15	0.012	0.1	-	10	200	4
Aniline	-	-	-	-	50	-	-	-	-	-	-	0.4	-	-	-	-
Benzene	-	-	ND	-	5	-	-	-	6	40	5300	100	-	-	500	ND
Benzidine	-	-	-	-	50	-	-	0.1	-	0.53	2500	ND	-	-	-	-
4-Chloroaniline	-	-	-	-	50	-	-	-	-	-	-	6	-	-	-	-
1,2-Dichlorobenzene	-	425	4.7	-	5	-	-	5	-	-	-	1000	-	-	-	-
Methylene Chloride	-	-	-	-	5	-	-	-	-	-	-	1167	-	-	-	-
Phenanthrene	-	35000	-	-	50	-	-	-	-	-	-	-	-	-	-	-
Polyaromatic Hydrocarbons	-	550	ND	-	-	-	-	-	-	-	-	-	-	-	-	-

* Based on Buffalo River Hardness of 140 mg/liter

CHEMICAL-SPECIFIC STANDARDS APPLICABLE OR RELEVANT AND APPROPRIATE TO SITUATIONS IN AREA D

NTAMINANTS OF CONCERN	(1) Soil erosion to the Buffalo River (ug/Kg) (In Soil)	(2) Soil used for fill below mean high water line (ug/Kg) (In Soil)	(3) Untreated Groundwater to the Buffalo River (ug\liter) (In water)	(4) Untreated Groundwater to the Buffalo Sewer Authority (ug\liter) (In water)	(5) Untreated Groundwater to a drinking water supply (ug\liter) (In water)	(6) Untreated Groundwater immobilized in Area D (ug\liter) (In water)	(7) Precipitation Runoff to the Buffalo River (ug\liter) (In water)	(8) Treated Groundwater to the Buffalo River (ug\liter) (In water)	(9) Treated Groundwater to the Buffalo Sewer Authority (ug\liter) (In water)	(10) Treated Groundwater returned to Area D soils (ug\liter) (In water)	(11) Process Air emissions to the surrounding area (ug/m3) (In air)
rsenic	7500	8000	0.018/25	100*	25/50	25	0.018	0.018/25	100*	50	0.67
admium	1000	6000	1.1/10	200*	10	10	1.1	1.1/10	200*	20	2
hromium (3)	10000	75000	50/200	1000*	50	50	200	50/200	1000*	-	-
hromium (6)	-	-	11/50	100*	50	50	11	11/50	100*	100	0.167
ron	550000	25000000	300	*	300	300	300	300	*	600	-
ead	32500	60000	3.2/25	100*	25/50	25	3.2	3.2/25	100*	50	1.5
ercury	100	1000	0.012/2	10*	2	2	0.012	0.012/2	10*	4	0.33
niline	-	-	1***	*	50/-	-	1**	1**	*	-	0.4**
enzene	-	-	ND/6	*	ND/5	ND	6	ND/6	*	ND	100
enzidine	-	-	0.1/-	*	50/-	-	0.1	0.1/-	*	-	ND
-Chloroaniline	-	-	-	*	50/-	-	-	-	*	-	6
,2-Dichlorobenzene	425	-	4.7/50	*	4.7/5	4.7	50	4.7/50	*	-	1000
ethylene chloride	-	-	-	*	5/-	-	-	-	*	-	1167
henanthrene	35000	-	-	*	50/-	-	-	-	*	-	-
olyaromatic Hydrocarbon	500	-	ND/-	*	ND/-	ND	-	ND/-	*	-	-
ources of Standards	Soil	Soil	Ground W. Surface W.	Waste W. (BSA)	Drinking W. Ground W.	Ground W.	Surface W.	Ground W. Surface W.	Waste W. (BSA)	Waste W. (Gr. W.)	Air

* All loadings to the BSA are also limited by a mass allocation determined from the BSA's net impact on the Niagara River.
** NYDOH Standard under dispute based on methodology guidelines from the U.S. Office of Science and Technology Policy. Reference 50 FR 10371 March 14, 1985.

apply are identified according to the media affected (i.e., soil, surface water, groundwater, etc.).

The tables were developed in conjunction with the identification of the requirements for groundwater, surface water, drinking water, wastewater, and air. Tables 2 & 3, which cover numerical standards for only the 15 indicator contaminants listed in the risk assessment, could be expanded to include any of the other 24 contaminants identified as exceeding an enforceable standard in Table 8-2 of the revised remedial investigation report.

A brief overview of each ARAR is presented below along with reference to the eleven situations. The situations, numbered one to eleven, are described in Tables 1, 2 and 3.

1. **Clean Water Act (CWA) 404 USEPA Sediment Classification Guidelines (Region V: 4/77)**

   These Federal Dredging Standards were developed by the USEPA and are used as guidelines by the Army Corps of Engineers (ACOE) for dredge and fill activities. These guidelines have been substituted for the soil erosion standards (formerly based artificially on water standards) for soil eroding to the Buffalo River. This is reflected on Table 1 as Situation 1. These guidelines may be relevant and appropriate to Situations 1 and 2 (Soil used for fill below the mean Buffalo River high water line).

2. **NYSDEC Guidelines for Area D Soils**

   These State guidelines have been developed specifically for the Area D soils to provide recommended soil cleanup goals and soil cleanup criteria to protect groundwater quality. These guidelines may be relevant for Situation 1.

3. **6 NYCRR Part 703.5 (Groundwater Standards)**

   Best usage of Class GA groundwater is as a source of potable water supply. Quality standards for Class GA waters are the most stringent of: Part 703.5(a)(3), 10NYCRR Subpart 5-1, 40 CFR Part 141, 10 NYCRR Part 170. The three latter standards are for drinking water and are presented as ARARs 3, 4 and 5.

   Part 703.5(a)(3) standards can be determined to be applicable to the groundwater at the Buffalo Color site for both Situation 5 where the

groundwater is used as a drinking water supply, and Situation 6 where it is not. For Situations 3 and 8 this standard may be relevant and appropriate to untreated and treated groundwater moving toward the Buffalo River.

4. **40 CFR 264.94 Groundwater Standards for Owners of TSD Facilities**

The RCRA Maximum Concentration Levels (MCLs) are adopted as part of 40 CFR 264.94 for groundwater monitoring and response requirements for permitted RCRA – regulated units. The purpose of the requirement is to regulate groundwater monitoring and response requirements for RCRA permitted units.

RCRA MCLs may apply to the Buffalo Color site for Situations 5 and 6, as general groundwater and may be relevant and appropriate for Situations 3 and 8 as groundwater moving toward the Buffalo River.

5. **10 NYCRR Subpart 5-1 Standards for Drinking Water Supplies**

10 NYCRR Subpart 5-1 requirements have been promulgated to protect present or future sources of water supply. Provisions apply to all existing and proposed sources of water supply. The 10 NYCRR Subpart 5-1 MCLs may be determined to be applicable for Situation 5. However, in as much as the groundwater and surface water at the Buffalo Color site is not used as a source of drinking water, the MCLs may be determined to be neither applicable nor relevant and appropriate to the other situations.

6. **40 CFR 141.11 Standards for Public Drinking Water Systems (Safe Drinking Water Act [SDWA] MCLs)**

SDWA standards are set for cleaning up groundwater or surface water that is or may be used for drinking. Maximum concentration levels (MCLs) are applicable where the water will be provided directly to 25 or more people or will be supplied to 15 or more service connections. SDWA MCLs can be determined to be applicable to the groundwater and surface water at the Buffalo Color site for Situation 5. But if the water is not used for drinking water, the MCLs may be determined to be neither applicable nor relevant and appropriate.

7. **10 NYCRR 170 Standards for Sources of Water Supply**

Standards for sources of water supply are set to protect existing or future sources of water. Part 170 Standards can likewise be determined to be applicable only to Situation 5 at the Buffalo Color Site.

8. **6NYCRR Part 701.19 Fresh Surface Water Standard (Class C)**

Surface water standards are set for the protection of human health and potable water supplies, protection of aquatic life, fish and fish propagation, and for fish survival and propagation. The Buffalo River in the vicinity of "Area D" is currently classified as "D" which has a designated best usage of fishing. Also, the waters must be suitable for fish survival. Plans are underway to reclassify the Buffalo River as "C". In anticipation of the reclassification, the Class "C" standards have been used in the Tables. Surface water standards may be considered applicable for Situations 1, 3, 7 and 8 at the Buffalo Color site.

9. **NYSDEC TOGS 1.1.1 (4-1-87) Ambient Water Quality Standards**

The NYSDEC Technical and Operational Guidance Series provides both standards and guidelines for surface water. The standards may be determined to be applicable for Situations 1, 3, 7 and 8 at the Buffalo Color site, while the guidelines may be determined to be relevant and appropriate.

10. **Clean Water Act (CWA) 303-304 Water Quality Criteria (WQCs)**

WQC is established as non-enforceable guidance developed under CWA 304 used to establish standards under CWA 303 for the direct discharges to surface waters; indirect discharges to POTWs; and the discharge of dredged or fill material. WQC is developed for human consumption of fish and drinking water, fish consumption only, and for protection of aquatic freshwater organisms. With respect to the Buffalo Color site, the potential for accidental human consumption of fish contaminated by soils eroded from the "Area D" site may exist, and therefore the WQCs for protection of human health for fish consumption and protection of aquatic life may be relevant and appropriate to Situations 1, 3, 7 and 8.

11. **6 NYCRR 212 Processes and Exhaust and/or Ventilation Systems**

This regulation pertains to those remedial technologies which involve process emissions. Part 212 may be relevant and appropriate to Situation 11.

12. **40 CFR 50 National Ambient Air Quality Standards**

Air quality standards define levels of air quality to protect human health. The standards set may be considered applicable to Situation 11 at the Buffalo Color site, where air emissions will affect the surrounding area.

13. **Buffalo Sewer Authority (BSA) Regulations (Under 40 CFR 403)**

The standards set under the BSA regulations are for the direct or indirect discharge of all liquid carried wastes to facilities of the BSA. The BSA standards may be considered applicable to both Situation 4, where untreated groundwater is discharged to the BSA, and Situation 9, where treated groundwater is discharged to the BSA.

14. **40 CFR 261.24 Toxicity Characteristic**

The RCRA EP toxicity characteristic is currently being expanded to include 25 organic chemicals. In light of this new rule, the standards set for the 39 parameters may be applicable to Situations 4 and 9 regarding groundwater.

15. **6 NYCRR 703.6 Standards for Discharges to Groundwater**

The effluent standards have been established to regulate the discharge from a point source or outlet which will or may enter the unsaturated or saturated zones. The standards may be considered applicable to Situation 10 where groundwater might be reinjected into the soil at the "Area D" site.

LOCATION – SPECIFIC REQUIREMENT

Upon a review of all location-specific requirements, it was determined that the following requirement is a potential location - specific ARAR for the Buffalo Color site:

Fish and Wildlife Coordination Act (40 CFR 6.302)

Requires action to protect fish and wildlife from remedial actions modifying streams or rivers or areas affecting streams or rivers. Under this Act, the appropriate State agency will consult with the Fish and Wildlife Service to ascertain the means

and measures necessary to mitigate, prevent, and compensate for project related losses to wildlife and fish resources and to enhance the resources.

ACTION – SPECIFIC REQUIREMENTS

Action – specific requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. Since several alternative actions may come into play for the remediation of the Buffalo Color site, very different requirements can apply. The list of actions to follow have been determined as potential remedial actions for the Buffalo Color site. The actions listed do not determine the remedial action, rather they assist in how a selected alternative(s) must be achieved. This list will continually be modified during the remedial technology selection process of the Feasibility Study (FS) to better reflect the action - specific ARARs for the chosen alternative(s).

Actions:

- Air Stripping
- Capping
- Closure with No Post-Closure Care (e.g. Clean Closure - removal or decontamination of all residuals such that health - based standards are met).
- Closure with Waste in Place (i.e. capping or disposal closure).
- Discharge of Dredge and Fill Material to Waters of the U.S. or Ocean Waters.
- Discharge of Treatment System Effluent
- Discharge to Publicly Owned Treatment Works (POTW)
- Excavation
- Groundwater Diversion
- Placement of Waste in Land Disposal Unit
- Slurry Wall
- Surface Water Control
- Treatment (in a unit)
- Treatment (when Waste will be Land Disposed)

A description of each action and the associated citation(s) follows:

Air Stripping

Citation: Clean Air Act requirements to be provided.

Applicability: Treatment of groundwater.

Capping

Citation: 40 CFR Part 264.310(a) (Landfills)
40 CFR Part 264.258(b) (Waste Piles)

Applicability: RCRA hazardous waste placed at site after effective date of requirement. (Note: May be relevant and appropriate even if RCRA definition of storage, disposal, or hazardous waste are not met, or if the waste at the site is similar to but not identifiable as a RCRA hazardous waste).

Closure with No Post-Closure

Citation: 40 CFR Part 264.111, 178, 197, 288(o)(1) and .258; Part 244.111

Applicability: Land based unit containing hazardous waste; contaminated soil from dredging or soil disturbed in the course of drilling or excavation, and returned to land (see note above).

Closure with Waste in Place

Citation: 40 CFR Part 264.288(a)(2) and .258

Applicability: Land disposal of hazardous waste (not applicable if treated in situ or consolidated within area of contamination) (see note above).

Discharge of Dredge and Fill Material to Waters of the U.S. or Ocean Waters

Citation: 40 CFR Part 230
33 CFR Part 320 - 330

Applicability: Capping; disposal of contaminated soil, waste material or dredged material.

Discharge of Treatment System Effluent

Citation: 40 CFR 122.44(a); State regulations approved under 40 CFR 131 (10 NYCRR 170 – Standards for Sources of Water Supply; 6 NYCRR Part 701.19 Fresh Surface Water Standard; NYSDEC TOGS 1.1.1. – Ambient Water Quality

Standards and Guidance Values); 40 CFR 125.100; 125.104; 122.41(i); 136.1-136.4.

Applicability: Point Source discharge to waters of the United States

Discharge to Publicly Owned Treatment Works (POTW)

Citation: 40 CFR 403.5 and local POTW regulations (Buffalo Sewer Authority)

Applicability: Indirect discharge to a POTW

Citation: 40 CFR 270.60

Applicability: Transport of RCRA hazardous wastes to POTWs by truck, rail, or dedicated pipe (i.e., pipe solely dedicated for hazardous waste [as defined in 40 CFR 264] which discharges from within the boundaries of the CERCLA site to within the boundaries of the POTW).

Excavation

Citation: 40 CFR Part 268 Subpart D

Applicability: Materials containing RCRA hazardous wastes subject to land disposal restrictions are placed in another unit.

Groundwater Diversion

Citation: Same as for capping and closure with waste in place.

Applicability: Materials containing RCRA hazardous waste subject to land disposal restrictions are placed into another unit.

Placement of Waste in Land Disposal Unit

Citation: 40 CFR Part 268 Subpart D

Applicability: Placement of RCRA hazardous waste in a landfill, surface impoundment, waste pile, injection well, or land treatment facility.

Slurry Wall

Citation: None Listed

Applicability: Materials containing RCRA hazardous waste subject to land disposal restrictions are placed in another unit (see Excavation)

Surface Water Control

Citation: 40 CFR Part 264.221(c), 251(c)(d), 273(c)(d) and 301(c)(d).

Applicability: RCRA hazardous waste treated, stored, or disposed after the effective date of the requirements.

Treatment (in a unit)

Citation: 40 CFR Part 264.221 (surface impoundment), 251 (waste pile), 273 (land treatment unit).

Applicability: Treatment of hazardous waste in a unit.

Treatment (when waste will be land disposed)

Citation: 40 CFR Part 268.10, 11, 12, 41, Subpart D, 51 FR 40641, 25760

Applicability: All wastes listed as hazardous in 40 CFR Part 261 as of November 8, 1984, except for spent solvent wastes and dioxins containing wastes, are scheduled for land disposal prohibition and/or treatment standard determinations.

SUMMARY

The aforementioned discussions present our identification of the ARARs for the Buffalo Color site in conjunction with those previously identified in the Malcolm Pirnie Remedial Investigation (RI) and its two subsequent revisions. Attempts have been made to designate which of the listed requirements are applicable and which are relevant and appropriate. Likewise, in identifying both existing and potential conditions at the site, we have developed a framework from which a conclusive list of the ARARs has been determined.

We are confident that this submission will greatly assist the Department in the review of the ARARs for the "Area D" site. We will be available to review this submission and/or answer any questions at your convenience should it be necessary.

We look forward to a timely review of this submission. Should you wish to schedule a review meeting or have questions, please do not hesitate to call.

Very truly yours,

WEHRAN-NEW YORK, INC.

Carol F. Yamanno
Task Manager

Pedro Fierro
Project Manager

CFY/PF/asb
cc: R. Predale, Allied Signal Inc.

WehranEnviroTech

APPENDIX K

APPENDIX K

Calculations to Determine Approximate Construction Periods for Alternatives

By PG Date 6/25/91
Chkd. by _____ Date _____
Subject BUFFALO COLOR - FEASIBILITY STUDY

WehranEnviroTech Job No. 00257.01
Sheet No. 1 of 3

SUMMARY OF CONSTRUCTION DURATION FOR SELECT ALTERNATIVES

ALTERNATIVE	YEARS *
3.0	1.0
3.A	1.5
4.0	2.0
5.0	2.5
6.0, 6.A or 6.B	2.5
6.C	3.0
6.D, 6E	2.5
7.0	2.0
8.0	3.5 - 5.0

* CONSTRUCTION DURATION BASED ON ESTIMATED PRODUCTION RATES FOR MAJOR ACTIVITIES (REFERENCE FILE = BC) AND OVERLAP OF SOME CONSTRUCTION ACTIVITIES.

ESTIMATED CONSTRUCTION DURATIONS :
(REFERENCE FILE BC)

ALTERNATIVE 3.0

SHEET PILES AND FML CONSTRUCTION AT SAME TIME, ONE SEASON REQ'D.

1 YEAR

ALTERNATIVE 3.A

ASSUME TWO CONSTRUCTION SEASONS REQ'D TO PLACE RIPRAP (NO WORK DEC. THRU MARCH)

1.5 YEARS

ALTERNATIVE 4.0

ASSUME GROUNDWATER COLLECTION TRENCH AND PORTION OF RIPRAP INSTALLED DURING ONE CONSTRUCTION SEASON. FML CAP AND REMAINDER OF RIP RAP DURING SECOND

2.0 YEARS

ALTERNATIVE 5.0

ASSUME GW COLLECTION TRENCH AND PORTION OF RIPRAP INSTALLED DURING FIRST SEASON. ASSUME MULTI-MEDIA CAP & REMAINDER OF RIPRAP TO REQUIRE ONE FULL SEASON AND PART OF 3rd.

2.5 YEARS

ALTERNATIVE 6.0, 6.A & 6.B

ASSUME THE TIME REQUIRED FOR CONSTRUCTION OF EACH OF THESE ALTERNATIVES IS EQUAL.

ASSUME GROUNDWATER COLLECTION TRENCH & PORTION OF RIPRAP INSTALLED DURING FIRST CONSTRUCTION SEASON ASSUME SLURRY WALL, FML CAP AND REMAINDER OF RIPRAP INSTALLED DURING SECOND SEASON AND PORTION OF 3rd.

2.5 YEARS

ALTERNATIVE 6.C

ASSUME GROUNDWATER COLLECTION TRENCH, SHORELINE FILL EXCAVATION AND BACKFILL AND PORTION OF FABRIFORM INSTALLED DURING FIRST CONSTRUCTION SEASON. SLURRY WALL, FML CAP AND REMAINDER OF FABRIFORM INSTALLED DURING SECOND AND THIRD YEARS.

3.0 YEARS

ALTERNATIVE 6.D & 6.E

ASSUME THE TIME REQUIRED FOR CONSTRUCTION OF EACH OF THESE ALTERNATIVES IS EQUAL.

ASSUME SAME TIME REQ'D AS ALT. 6.0, 6.A & 6.B (ONLY DIFFERENCE IS QUANTITY OF SLURRY WALL).

2.5 YEARS

ALTERNATIVE 7.0

ASSUME GW COLLECTION TRENCH AND SHEET PILE TO BE INSTALLED DURING INITIAL CONSTRUCTION SEASON. ASSUME SLURRY WALL AND FML CAP TO BE COMPLETED DURING THE SECOND SEASON.

2.0 YEARS

ALTERNATIVE 8.0

BASED ON EXCAVATION OF SOIL, 3.0 YEARS REQ'D TO REMOVE ALL SOIL. ASSUME AN ADDITIONAL 6 MONTH PERIOD TO FILL EXCAVATION AND RECLAIM.

3.5 YEARS

A CONSTRUCTION PERIOD OF 3.5 YEARS WILL REQUIRE CONTINUOUS HAULING AND DISPOSAL OF THE 480,000 CY OF SOIL AT AN OFF-SITE LANDFILL. LOCATING A LANDFILL(S) TO ACCEPT THIS LARGE QUANTITY OF MATERIAL OVER A 3.0 YEAR PERIOD MAY NOT BE POSSIBLE. A MORE REALISTIC TIME PERIOD FOR THE REMEDIATION OF THE SITE DUE TO LIMITED OFF-SITE DISPOSAL FACILITIES WOULD OPTIMISTICALLY BE 5.0 YEARS.

∴ 3.5 - 5.0 YEARS

BUFFALO C.
FEASIBILITY STUDY

FILE: BC
DISK: BC1
BY: PG
DATE: 6/25/91

EVALUATION OF MAJOR CONSTRUCTION ACTIVITY DURATIONS FOR "SCREENED" ALTERNATIVES

ITEM	UNITS	PRODUCTION RATE (UNITS/DAY)	ALTERNATIVE 3.0			ALTERNATIVE 3.A			ALTERNATIVE 4.0			ALTERNATIVE 5.0			ALT. 6.0,6.A & 6.B			ALTERNATIVE 6.C		
			QUANTITY	DAYS	MONTHS	QUANTITY	DAYS	MONTHS	QUANTITY	DAYS	MONTHS	QUANTITY	DAYS	MONTHS	QUANTITY	DAYS	MONTHS	QUANTITY	DAYS	MONTHS
FML CAP	ACRE	0.16	16.5	103	4	16.5	103	4	16.5	103	4	0	0	0	16.5	103	4	16.5	103	4
MULTI MEDIA CAP	ACRE	0.08	0	0	0	0	0	0	0	0	0	16.5	206	8	0	0	0	0	0	0
GW COLLECTION TRENCH	LF	15	0	0	0	0	0	0	3,100	207	8	3,100	207	8	3,100	207	8	3,100	207	8
SLURRY WALL	SF	2,000	0	0	0	0	0	0	0	0	0	0	0	0	112,500	56	2	143,100	72	3
SHEET PILE	SF	500	84,000	168	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RIPRAP	SF	400	0	0	0	122,500	306	12	122,500	306	12	122,500	306	12	122,500	306	12	122,500	306	12
EXCAVATION	CY	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35,000	70	3
SOIL FILL	CY	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35,000	18	1
TOTAL CONSTRUCTION MONTHS (SEE NOTE 2)					10			16			24			28			26			30

ITEM	UNITS	PRODUCTION RATE (UNITS/DAY)	ALT. 6.D & 6.E			ALTERNATIVE 7.0			ALTERNATIVE 8.0		
			QUANTITY	DAYS	MONTHS	QUANTITY	DAYS	MONTHS	QUANTITY	DAYS	MONTHS
FML CAP	ACRE	0.16	16.5	103	4	16.5	103	4	0	0	0
MULTI MEDIA CAP	ACRE	0.08	0	0	0	0	0	0	0	0	0
GW COLLECTION TRENCH	LF	15	3,100	207	8	3,100	207	8	0	0	0
SLURRY WALL	SF	2,000	143,100	72	3	143,000	72	3	0	0	0
SHEET PILE	SF	500	0	0	0	84,000	168	6	132,000	264	10
RIPRAP	SF	400	122,500	306	12	0	0	0	0	0	0
EXCAVATION	CY	500	0	0	0	0	0	0	480,000	960	37
SOIL FILL	CY	2,000	0	0	0	0	0	0	480,000	240	9
TOTAL CONSTRUCTION MONTHS (SEE NOTE 2)					26			21			56

NOTES:

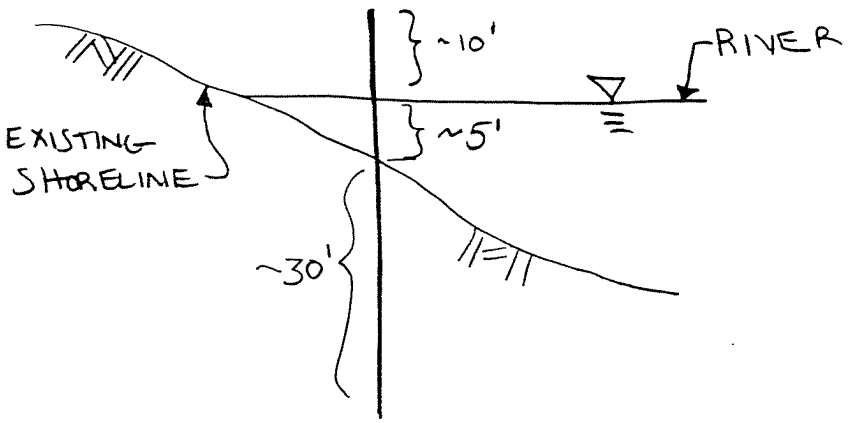
1.) MONTHLY DURATIONS BASED ON SIX DAY WORK WEEKS (26 WORK DAYS PER MONTH).

2.) ACTUAL PROJECT CONSTRUCTION DURATIONS MAY BE LESS THAN TOTAL CONSTRUCTION MONTHS (SUM OF INDIVIDUAL ACTIVITIES) DUE TO THE OVERLAP OF CONSTRUCTION ACTIVITIES.

ESTIMATE OF PRODUCTION RATES FOR MAJOR CONSTRUCTION ACTIVITIES (BUFFALO COLOR FS)

(1) SHEET PILING

- QUANTITY = 84,000 SF TO 132,000 SF
- PURPOSE = EROSION CONTROL ALONG SHORELINE OF RIVER
- TYPICAL SECTION



- PRODUCTION RATE

1991 MEANS SITE WORK COST DATA
PG 26

LEAVE IN PLACE = RANGE FROM 960 TO 1,000 SF/DAY

— DUE TO WORKING ALONG SHORELINE SAY PRODUCTION RATE REDUCED BY 50%

∴ SAY PRODUCTION RATE = 500 SF/DAY

(2) FABRIFORM OR RIPRAP

- QUANTITY = 122,500 SF
- PURPOSE = EROSION CONTROL ALONG SHORELINE (ALTERNATIVE TO USING SHEET PILING)
- SPECIAL REQUIREMENT - TO PREVENT RIPRAP FROM BEING UNDERMINED (RIVER IS PERIODICALLY DREDGED) TOE MUST BE KEYED IN ALONG THE SHORELINE (BELOW THE WATER LEVEL) ~ 1,900 LF
- PRODUCTION RATE

1991 MEANS SITE WORK
PAGE 40

RIPRAP 18" MIN. THICKNESS NOT GROUTED = 53 SY/DAY
OR 477 SY/DAY

- DUE TO WORKING ALONG SHORELINE AND KEY IN REDUCE BY 50%.

∴ SAY PRODUCTION RATE = 225 SF/DAY

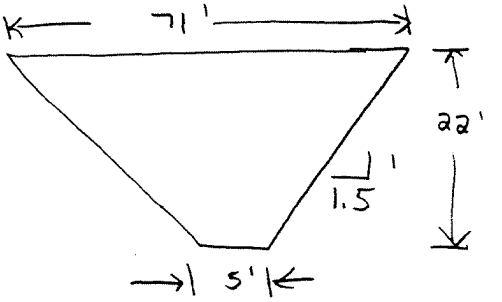
- INCREASED TO ~ 400 SF/DAY - 2 CREWS

(3) GROUNDWATER COLLECTION TRENCH

- QUANTITY 3,100 LF
  22 FT AVE. DEPTH

- COLLECTION DRAIN, 6" PERF. PIPE, ~2'x3' STONE BEDDING, INSTALLED ~5' BELOW WATERTABLE.

- ASSUME PRODUCTION RATE OF TRENCH BASED ON RATE OF EXC.



$A = (5)(22) + (\frac{1}{2})(22)(33)(2) = 836$ SF or 31 CY/LF

- 1991 MEANS - EXCAVATION TRENCHING

  AVE RATE ~ 500 CY/DAY PER BACKHOE

  SAY TWO BACKHOE OPERATING ∴ 1000 CY/DAY

  RATE OF TRENCH PROGRESS = $\frac{1000 \text{ CY/DAY}}{31 \text{ CY/LF}}$

  = 32 LF/DAY

- REDUCE TO 15 LF/DAY - POTENTIAL PROBLEMS ASSOCIATED WITH EXCAVATION OF CONTAMINATED SOILS

(4) SLURRY WALL

- QUANTITY = 3000 LF, 40 FT AVE. DEPTH } => 120,000 SF

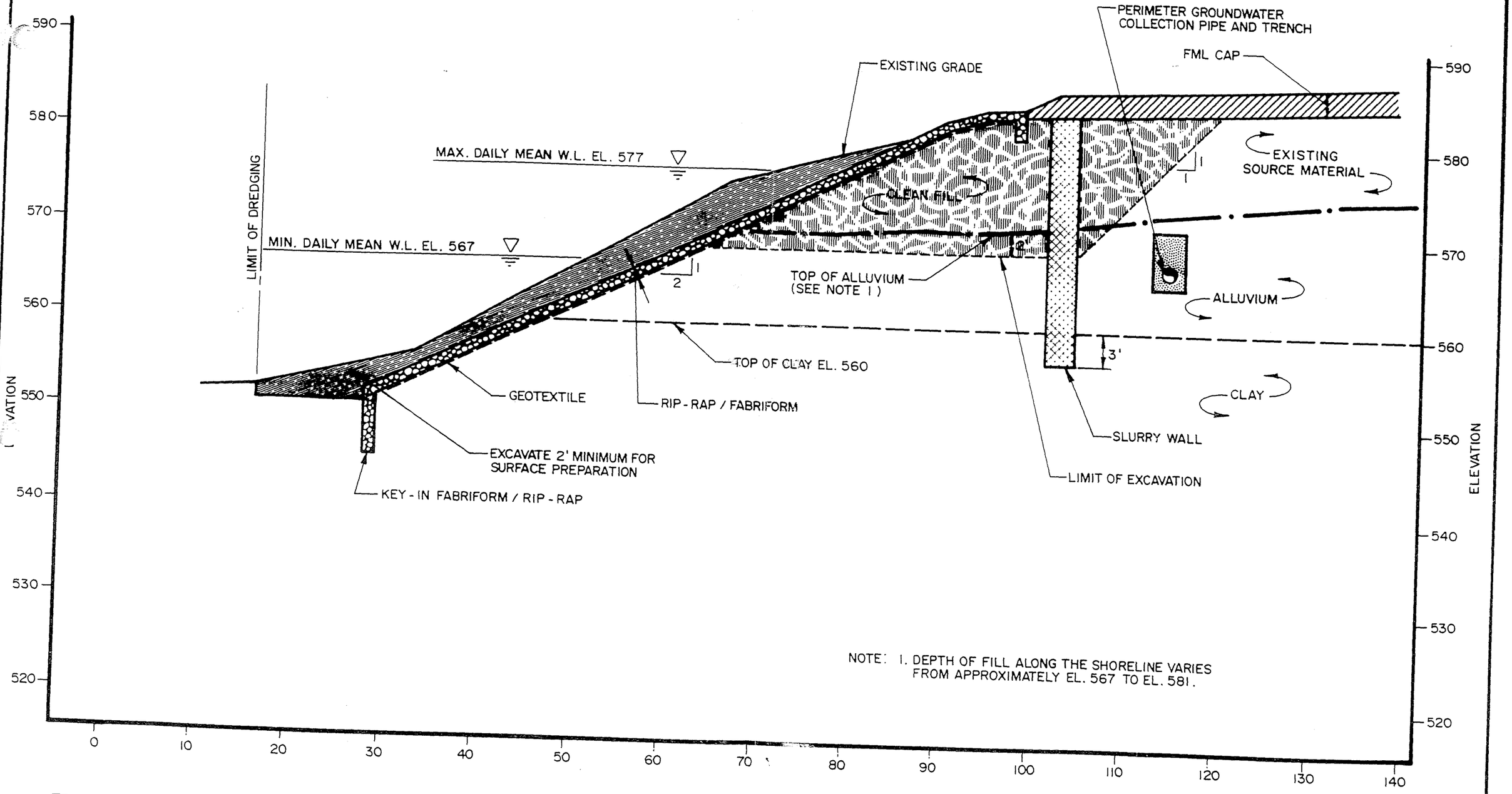
- SOIL BENTONITE / SAND BENTONITE MIX (SLURRY)
- WALL TO EXTEND ~ 25' BELOW WATERTABLE

- PRODUCTION RATE

  1991 MEANS - PAGE 27

  SLURRY TRENCH, WET SOIL MIN = 120 SF/DAY
  MAX = 150 SF/DAY

- BASED ON DISCUSSION WITH NICK CAVALLI OF WEHRAN / MIDDLETOWN OFFICE, ~20 YEAR EXPERIENCE AS A CONTRACTOR SPECILIZING IN SLURRY WALL CONSTRUCTION) USE PRODUCTION RATE OF 2,000 SF/DAY



NOTE: 1. DEPTH OF FILL ALONG THE SHORELINE VARIES FROM APPROXIMATELY EL. 567 TO EL. 581.

Wehran EnviroTech	Drawn By: J. Stolyck Checked By: R. Ulrich Date: 6/11/91	Scale 1"= 10'		BUFFALO COLOR CORPORATION BUFFALO ERIE COUNTY NEW YORK	TYPICAL SECTION	Figure: 1 Project No. 00257

APPENDIX L

June 12, 1991 Letter from Allied Signal to NYSDEC

Modified Alternative 6c

RECEIVED JUN 21 1991

Allied Signal

Allied-Signal Inc.
Engineered Materials Sector
P.O. Box 1139R
Morristown, NJ 07962-1139

June 12, 1991

Mr. Christopher Allen, Section Chief
Remedial Section B
New York State Department of Environmental Conservation
Division of Hazardous Waste Remediation
50 Wolf Road
Albany, NY 12233

Dear Mr. Allen:

The purpose of this letter is to summarize Buffalo Color Corporation's and Allied-Signal Inc.'s understanding of the technical issues agreed to by the NYDEC at our meeting on May 13, 1991. This meeting was a follow-up to Allied-Signal Inc.'s and Buffalo Color Corporation's March 28, 1991 letter to you in which we responded to your February 26, 1991 comments on the Feasibility Study. In our response we requested a meeting to address your comments on "tars" on the east and west areas of Area "D" (comment #16), alternate methods for remedial action to the west shore (comment #17e) and remedial action to contain contaminated fill between the water's edge and the slurry wall (comment #19b).

As a result of a meeting, Allied-Signal Inc. and Buffalo Color Corporation are proposing to modify alternative 6C to include the following:

- The Remedial Investigation found the source of contamination only in the "fill" but not the "alluvial" layers in Area D. Consequently the "fill" materials near the river bank outboard of the proposed slurry wall will be excavated and brought into the main site.

- To facilitate the installation of the rip rap or fabric/concrete containment barrier, surface preparation is required. This preparation of the river bank will require removal of material which will be deposited within the slurry wall containment system. This material includes "fill" which has eroded on to the river bank out to the edge of the erosion prevention barrier. It is anticipated that an average depth of two feet will be removed and, in most cases, the removal will extend to the U.S. Army Corp of Engineer dredge limit.

- The rip rap/fabric concrete containment barrier will be extended to encompass the entire perimeter of Area D. This erosion-prevention barrier will extend from the slurry wall, down past the shore line and out to near the U.S. Army Corps of Engineer dredge limit.

- Drainage trenches will be installed inside the slurry wall peripherally and through areas of special concern. Separation equipment will be installed near sources of non-aqueous phase liquids to collect contaminants and prevent their spreading through the collection system.

- The excavated fill materials will be moved behind the slurry wall and will be used to shape the surface of Area D for the installation of an FML cap which will prevent precipitation from percolating into the interior of Area D and into the drainage system. The excavated material will be replaced by clean fill.

- Groundwater will be pumped out of the drainage system in sufficient volume to assure that the water table inside Area D remains below the water level of the Buffalo River. This will assure that any leakage through the slurry wall is into the peninsula, not out of it.

- Groundwater will be pre-treated as necessary to meet the specifications of the Buffalo Sewer Authority.

A copy of the drawing which was presented at the meeting is attached.

It is our intention to incorporate these changes into Alternative 6C. Please let us know as soon as possible if you have any comments on these proposed changes. It is our intention to incorporate these changes into a final version of Feasibility Study document and to provide you with twelve (12) copies by June 27, 1991.

Sincerely,

Robert A. Predale, Manager
Site Remediation

RAP/ks

cc: G. Bolles
D. Sauer
W. Hague
J. Battaglia

By PG Da 1/91
Chkd. by ____ Da ____
Subject BUFFALO OR

Wehran EnviroTech

Job No. ____
Sheet No. 1 of 1

ESTIMATIF CONSTRUCTION DURATION ACTIVITIES:

ALTERNAT 8.0 - EXCAVATE ALL SOIL

TO EXC & HAUL SOIL TO A LANDFILL (CWM - MODEL CITY)

ASSUME 20 TRUCKS OPERATING EACH DAY
TRUCK CAPACITY = 20 CY / TRUCKLOAD
ROUND TRIP CYCLE TIME = 2 HOURS / TRUCKLOAD
10 HOUR WORK DAYS

∴ OUTPUT =

$$\left(\frac{20\ \text{TI}}{\text{DAY}}\right)\left(\frac{20\ \text{CY}}{\text{TRUCKLOAD}}\right)\left(\frac{1\ \text{TRUCKLOAD}}{2\ \text{HOURS}}\right)\left(\frac{10\ \text{HOURS}}{\text{DAY}}\right) = 2000\ \text{CY/DAY}$$

THIS UCTION RATE ASSUMES CONDITIONS SIMILIAR TO EXCAVATIN SOIL FROM A BORROW AREA.

OF THE UNKNOWNS INVOLVED IN REMOVING THE SOIL (FATIONS, PILES, C & D FILL, ETC.) AND THE ENVIRONM MONITORING REQUIREMENTS, REDUCE THE EXCAVATI RATE TO ~ 500 CY / DAY (ONLY NEED FIVE TYS OPERATORS)

- AN ITIONAL FACTOR WHICH WILL SLOW DOWN THE EXCATION IS THE DEWATERING WHICH WILL BE REQD

TO HAUL CLEAN FILL, ASSUME 20 TRUCKS / DAY

⟹ 2,000 CY / DAY