REMEDIAL ACTION CONSTRUCTION COMPLETION REPORT

VOLUME II
AS-BUILT DRAWINGS & DESIGN CHANGE FORMS

Pine Street Canal Superfund Site
Burlington, Vermont

Prepared for
Performing Defendants

Submitted to
U.S. Environmental Protection Agency
Region I
The State of Vermont

Conditionally Approved December 30, 2004

PREPARED BY:

The Johnson Company, Inc.
100 State Street, Suite 600
Montpelier, Vermont 05602

Revision 1
Reprinted November 2006

Disclaimer

This document is a DRAFT document prepared by the Performing Defendants under a government Consent Decree. This document has not undergone formal review by the EPA and VT DEC. The opinions, findings, and conclusions, expressed are those of the author and not those of the U.S. Environmental Protection Agency and VT DEC.

AS-BUILT DRAWINGS

Sheet Index

Area 7 As-built Site Plan

Area 7 Profiles & Details

Area 7 Cross Sections & Details

Area 7 As-built Landscaping Plan

Area 3/2 and B.E.D. Storm Sewer Outlet As-built Site Plan

Area 3/2 Cross Sections & Details

Area 3/2 As-built Landscaping Plan

Canal and Turning Basin As-built Site Plan

Canal and Turning Basin Cross Sections & Profiles

Canal and Turning Basin Cap Thickness Isopachs

REMEDIAL ACTION CONSTRUCTION
PINE STREET CANAL SITE
BURLINGTON, VERMONT
AS-BUILT PLANS - DECEMBER 2004

SHEET INDEX

1 AREA 7 AS-BUILT SITE PLAN

2 AREA 7 PROFILES & DETAILS

3 AREA 7 CROSS SECTIONS & DETAILS

4 AREA 7 AS-BUILT LANDSCAPING PLAN

5 AREA 3/2 & B.E.D. STORM SEWER OUTLET AS-BUILT SITE PLAN

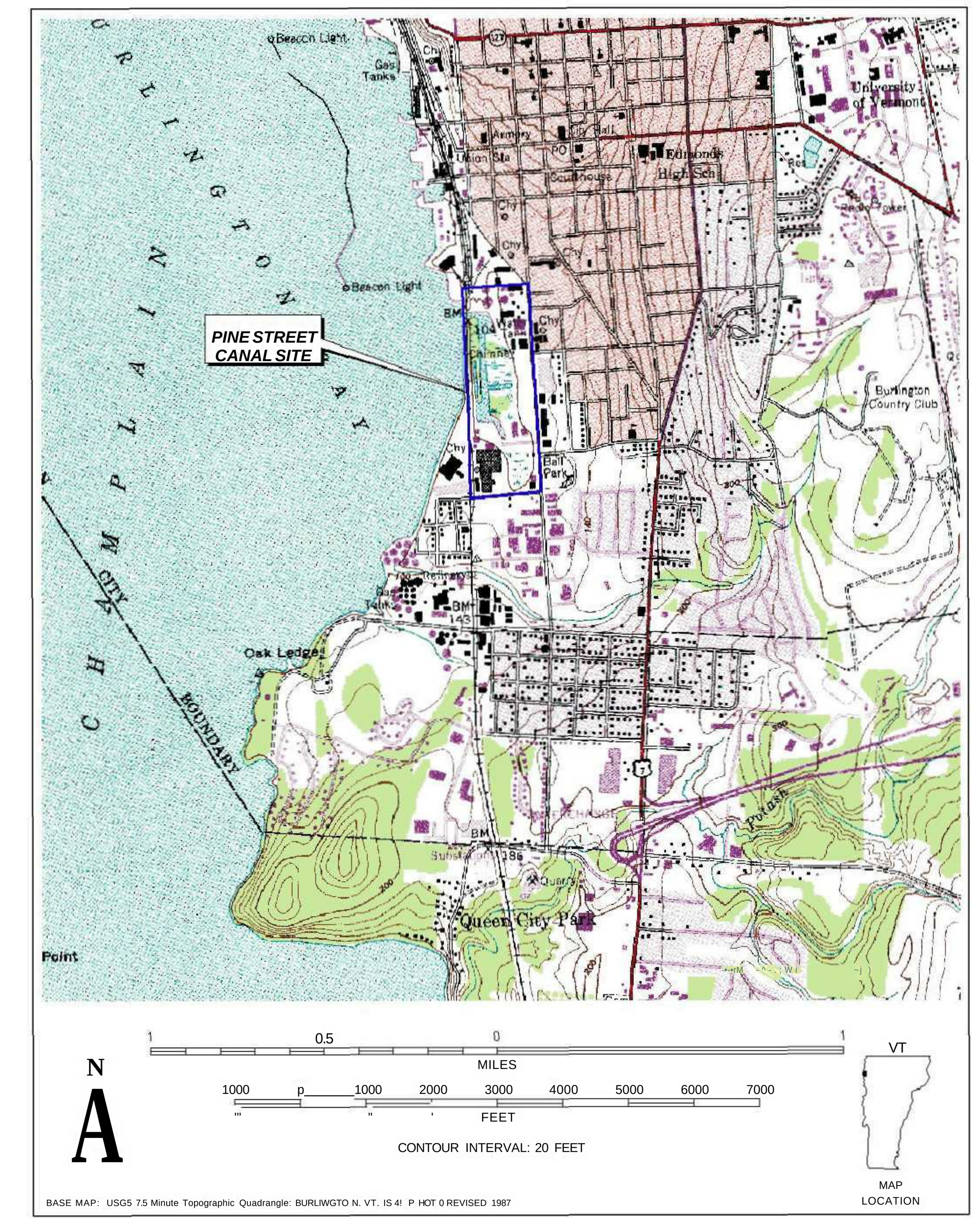
6 AREA 3/2 CROSS SECTIONS & DETAILS

7 AREA 3/2 AS-BUILT LANDSCAPING PLAN

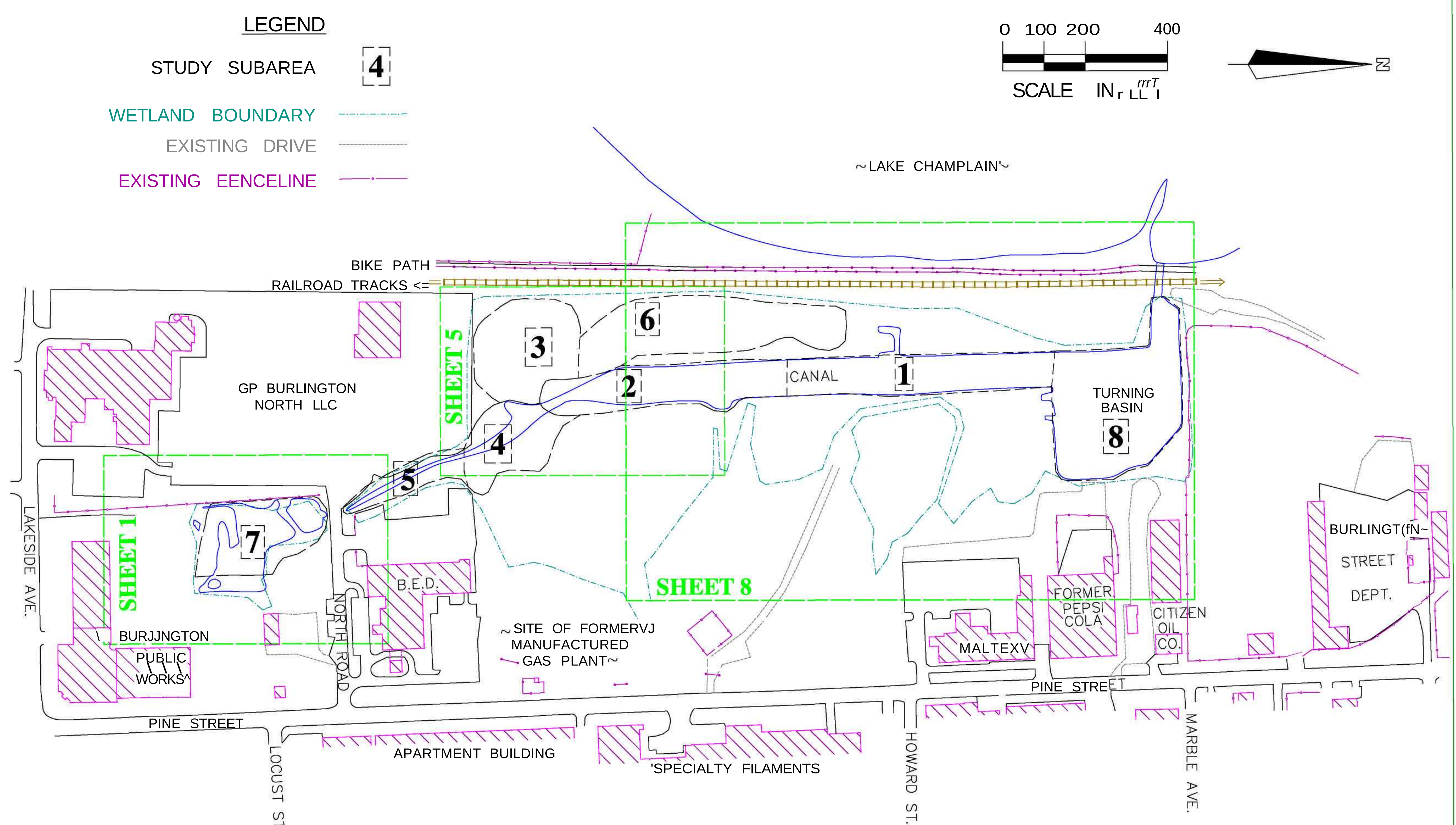
8 CANAL & TURNING BASIN AS-BUILT SITE PLAN

9 CANAL & TURNING BASIN CROSS SECTIONS & PROFILE

10 CANAL & TURNING BASIN CAP THICKNESS ISOPACHS



SITE LOCATION MAP



PLAN SHEETS LOCATION MAP

THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 STATE STREET SUITE 600 MONTPELIER, VT 05602

K:\1-0870-1\CAD\December 2004 CCRCover.dwg

NOTE: VERTICAL & HORIZONTAL CONTROL BY LITTLE RIVER SURVEY COMPANY OF STOWE, VERMONT - AUTUMN, 1992
ADDITIONAL SURVEY DATA - AUTUMN, 1994
ADDITIONAL SURVEY DATA - NOVEMBER, 2000
ADDITIONAL SURVEY DATA - MARCH, 2003
VERTICAL DATUM = NAVD 1988
HORIZONTAL DATUM = NAD 1983

ADDITIONAL JCO SURVEY DATA - SEPTEMBER, 2003

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

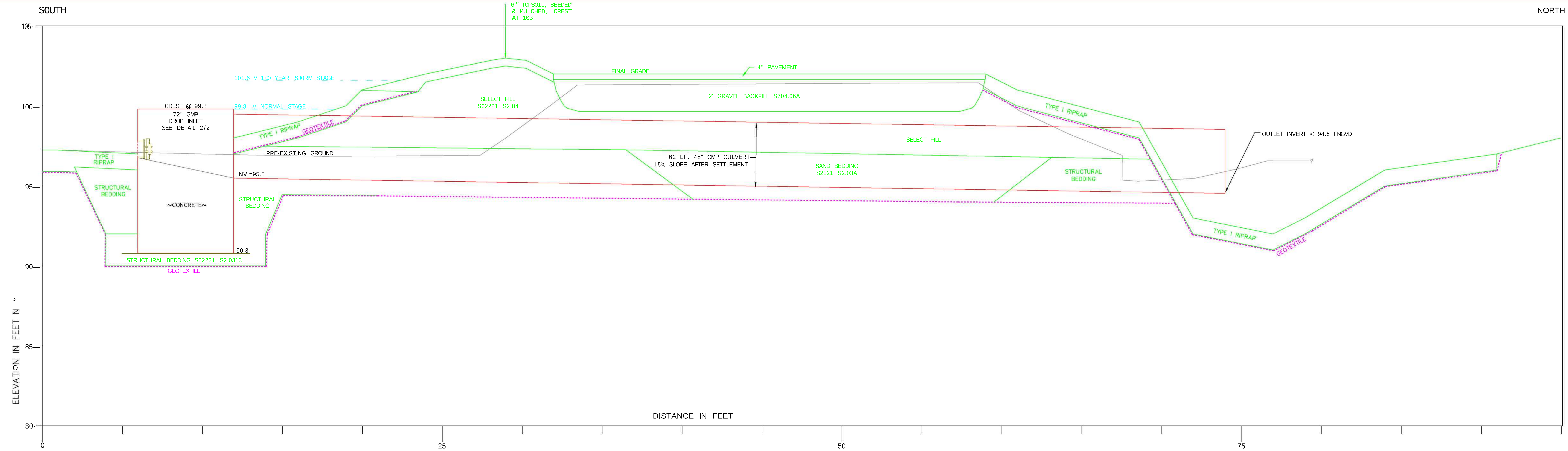
Rev. No.	Date	Description	Made by	Chk'd by	App'd by

AREA 7
AS-BUILT SITE PLAN
PINE STREET CANAL SITE
BURLINGTON, VERMONT

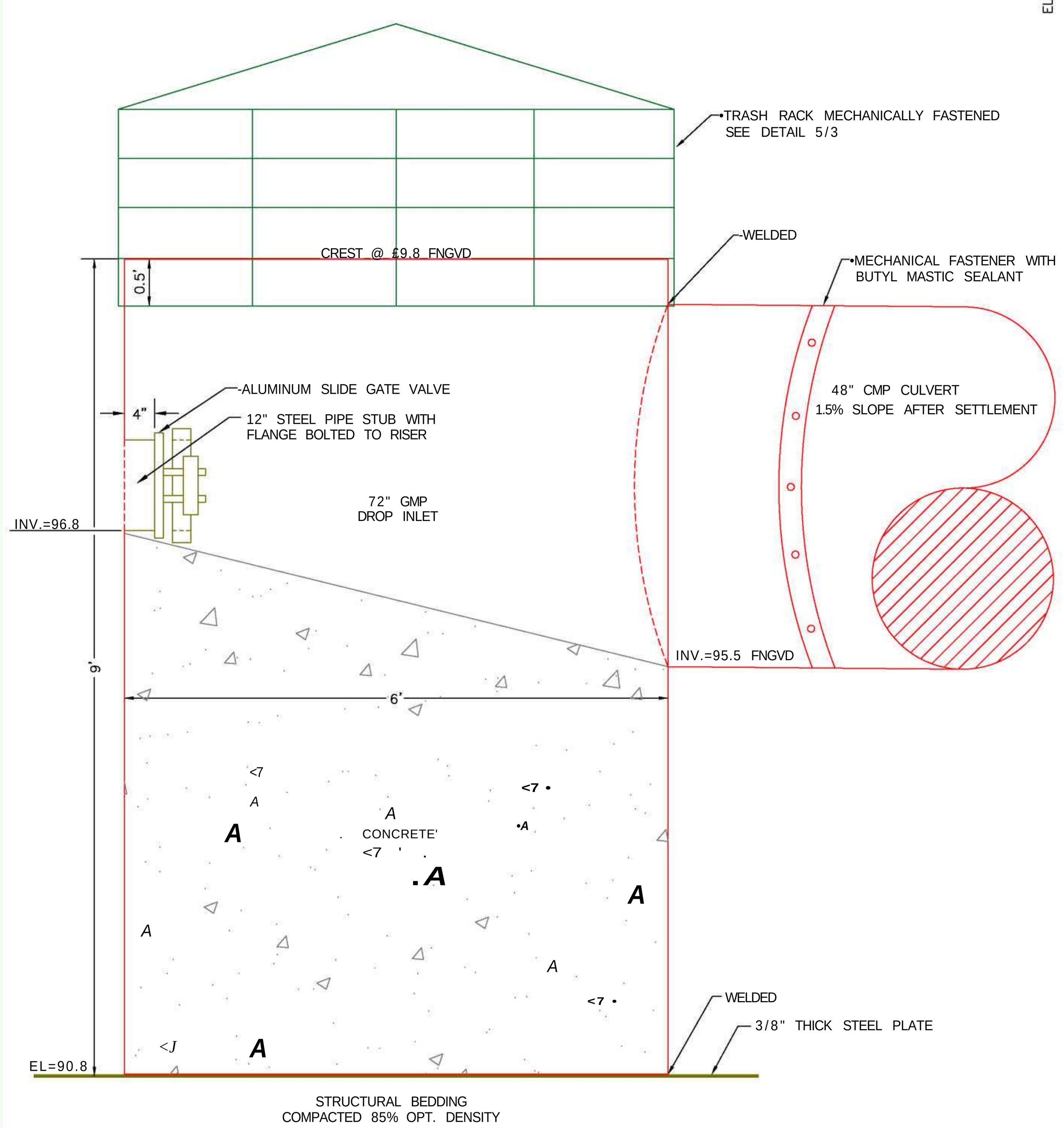
THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VERMONT 05602

Sheet 1 of 10
Scale: 1"=20'
Drawn by: TJK
Chk'd by: J-B
Date: 12/16/04
Job: 1-0870-1

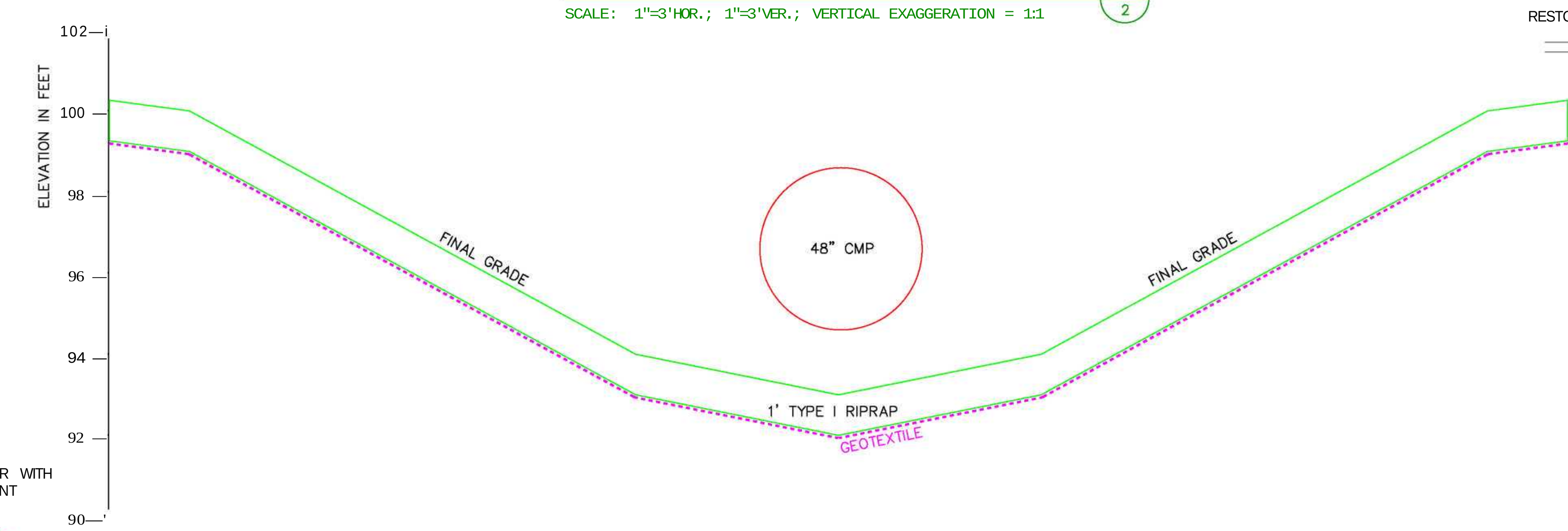
CAD\DECEMBER 2004 CCR\ASBUILT7.dwg



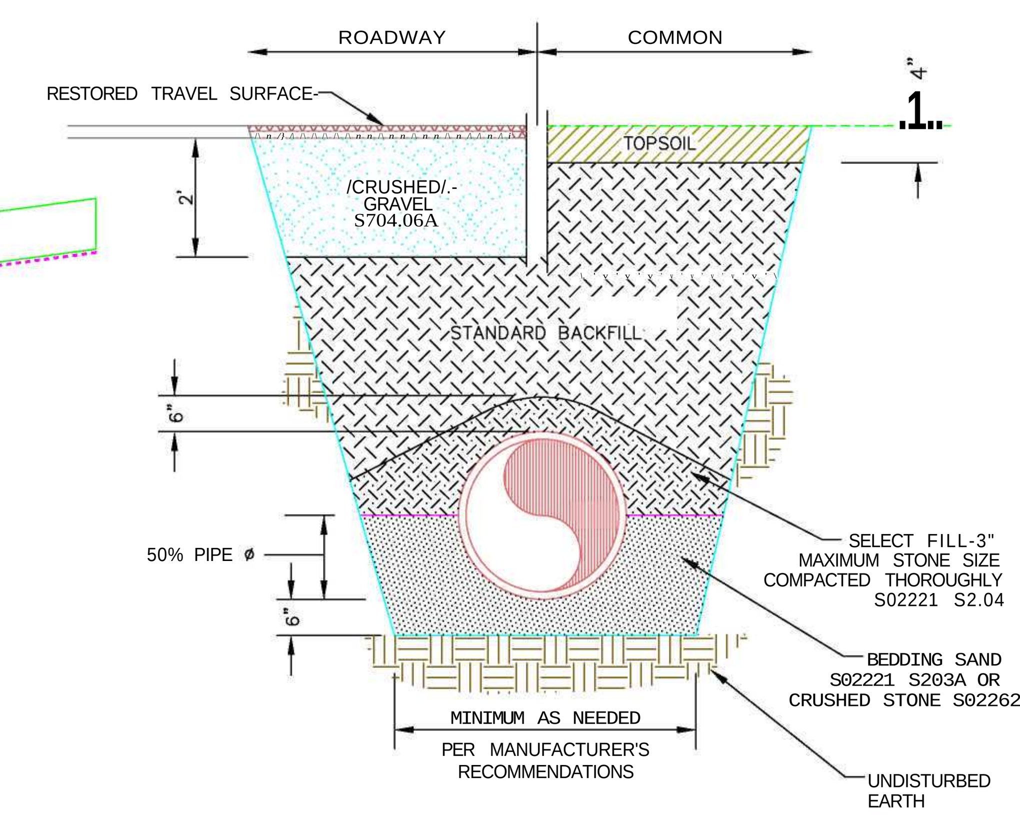
PROFILE NORTH ROAD CULVERT 1/2
SCALE: 1"=3'HOR.; 1"=3'VER.; VERTICAL EXAGGERATION = 1:1



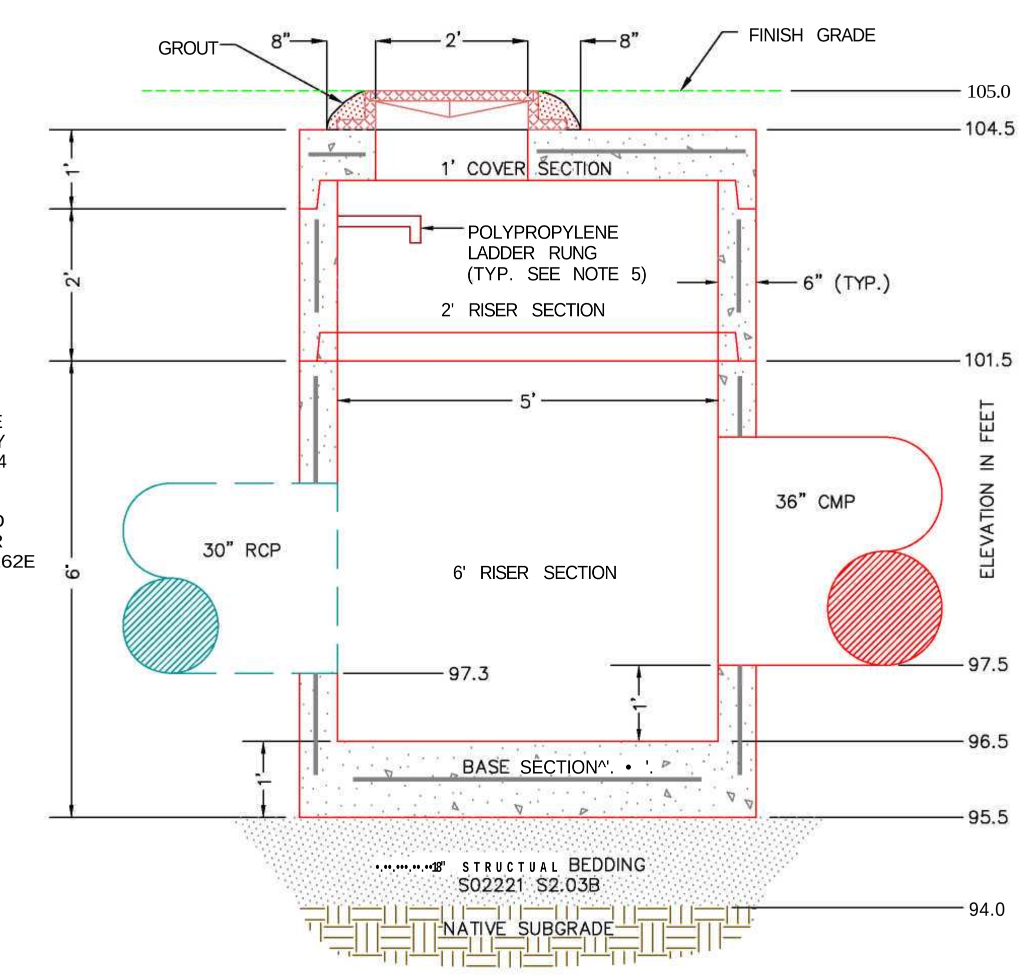
SECTION NORTH ROAD CULVERT DROP INLET 2/2
SCALE: NONE



DETAIL NORTH ROAD CULVERT OUTFALL PLUNGE POOL 6/2
SCALE: 1"=3'

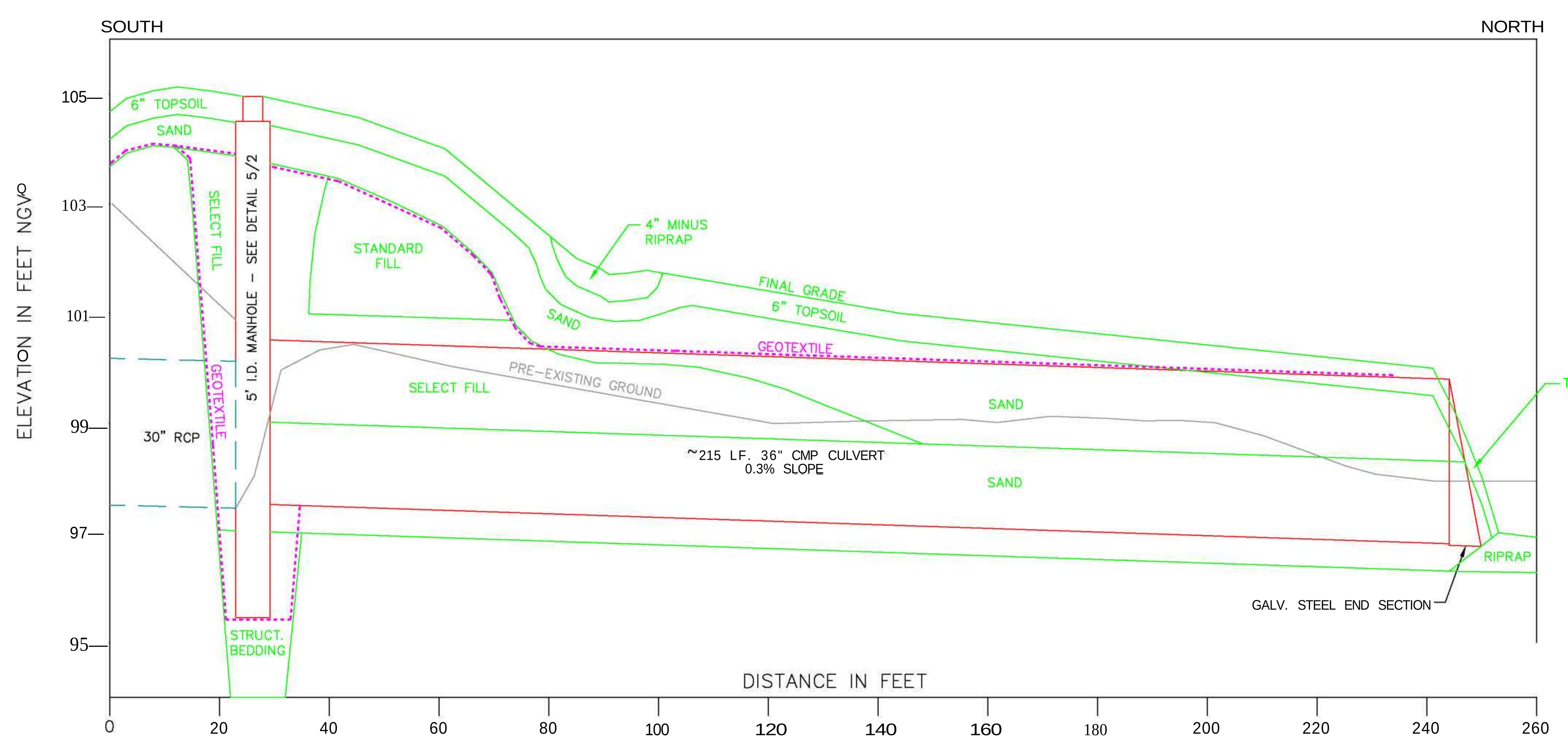


SECTION TYPICAL STORM SEWER TRENCH 3/2
SCALE: NONE



NOTES
1. Precast Manhole Sections built to ASTM Spec. C478-88.
2. 4000 psi Concrete Strength.
3. Steel Reinforced to ASTM Specs. .15 sq.in. per Vertical Foot.
4. Cutouts fo Pipe Entries as Required.
5. Ladder Rungs 12" C.C. to Floor. 2' Maximum to 1st Step.
6. Monolithic Base.
7. Steel Reinforcing for Top Slab — #5's at 6" Each Way. Additional Diagonal Steel Placed Around Opening.
8. Steel Reinforcing for Base Slab — #4 Bars at 12" Each Way.
9. Joints Sealed with Butyl Rope.

SECTION GILBANE CULVERT EXTENSION MANHOLE 5/2
SCALE: NONE



PROFILE GILBANE CULVERT EXTENSION 4/2
SCALE: 1"=20'HOR.; 1"=2'VER.; VERTICAL EXAGGERATION = 10:1

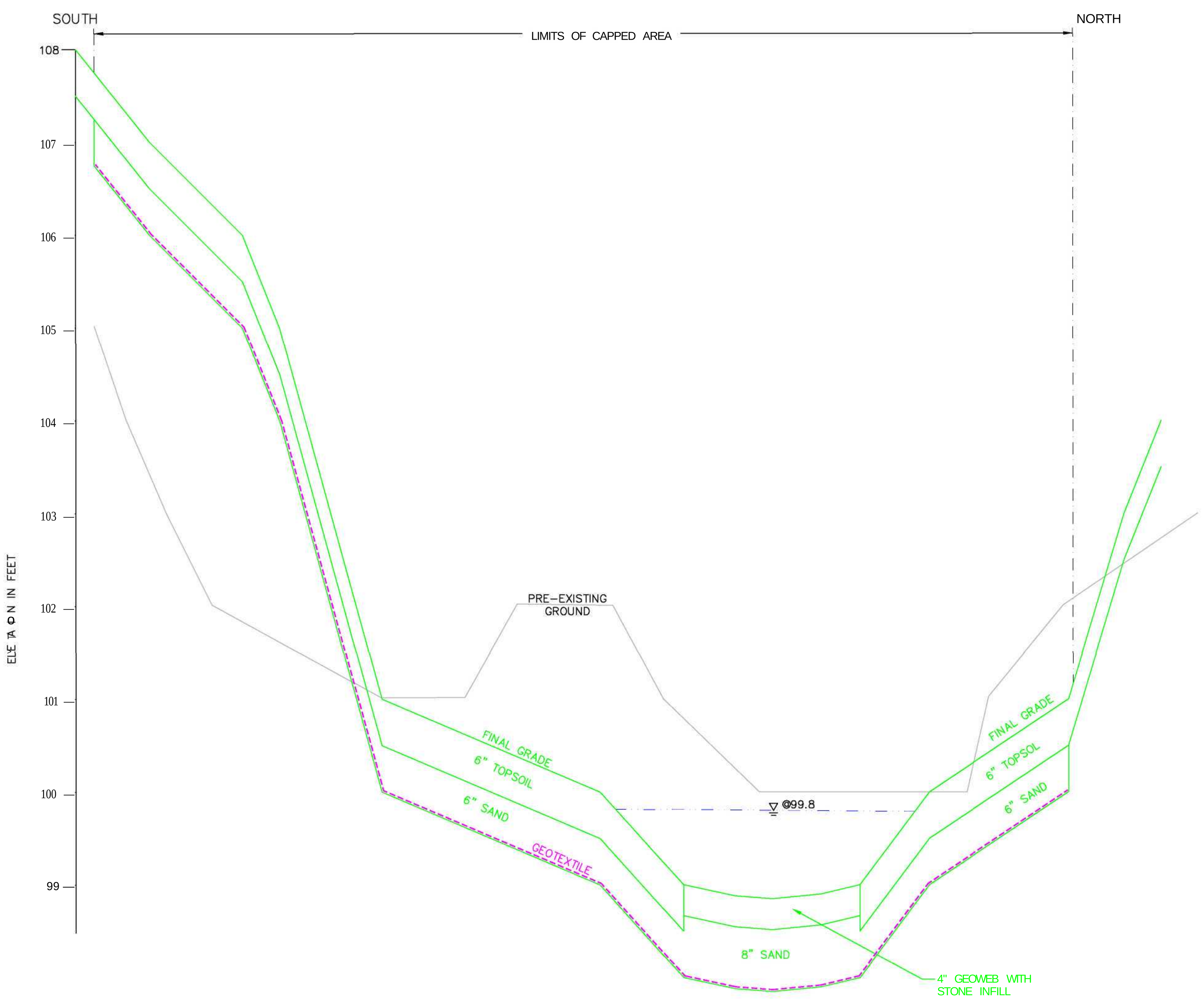
CAD\DECEMBER 2004 CCR\NRCULV.dwg

Rev. No.	Date	Description	Made by	Chk'd by	App'd by

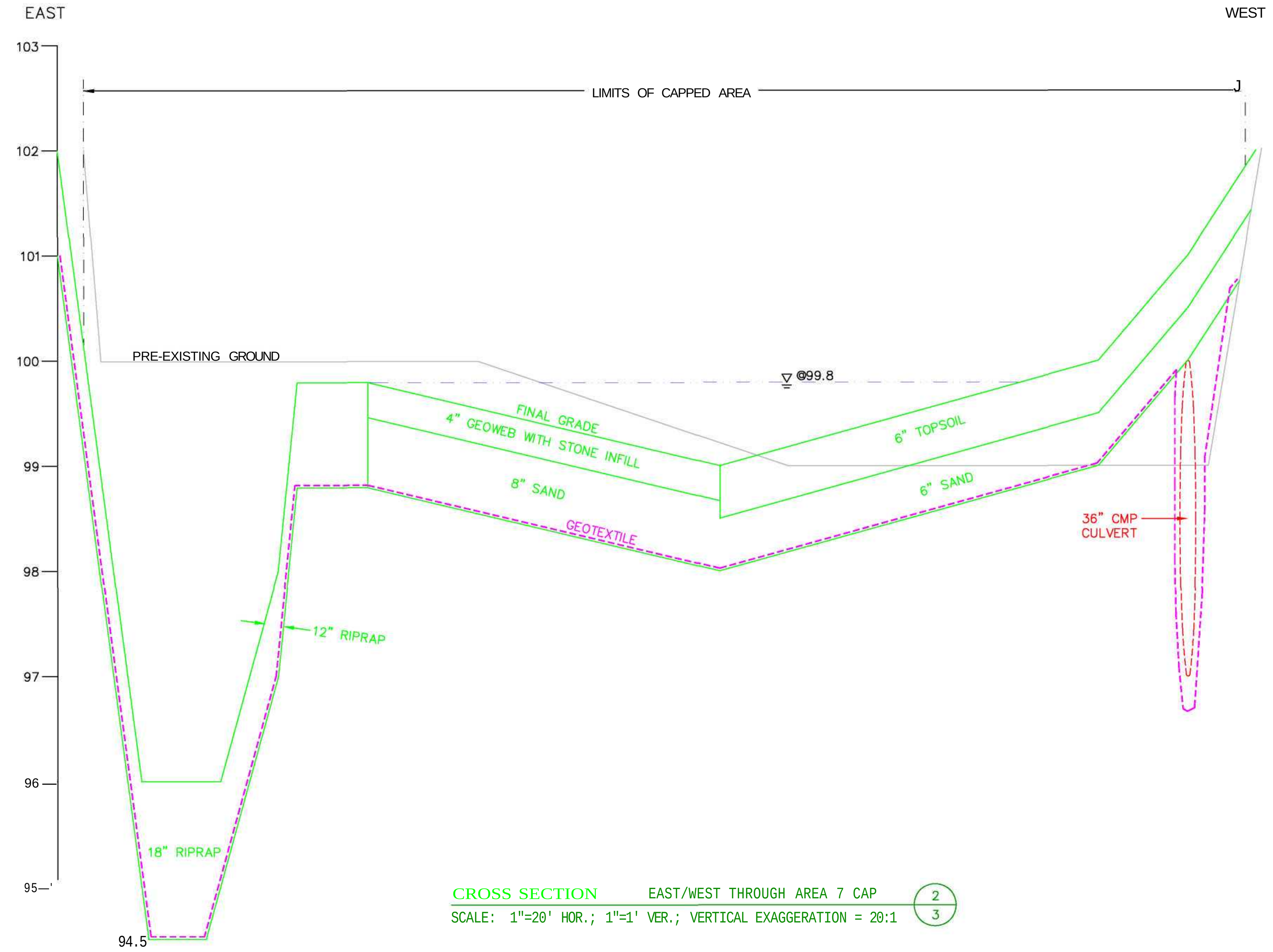
AREA 7
PROFILES & DETAILS
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VERMONT 05602

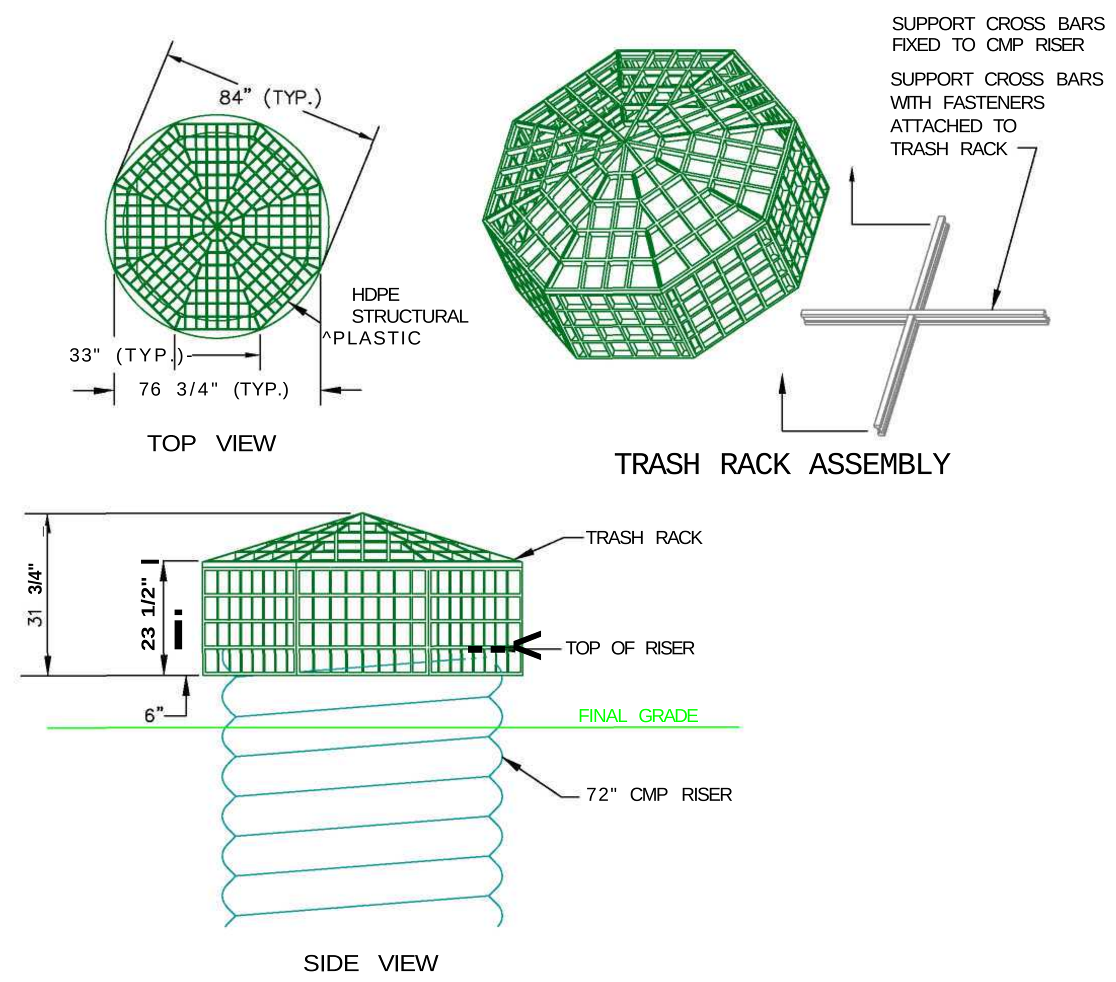
Sheet 2 of 10
Scale: as shown
Drawn by: TJK
Chk'd by: DMM
Date: 12/16/04
Job: 1-0870-1



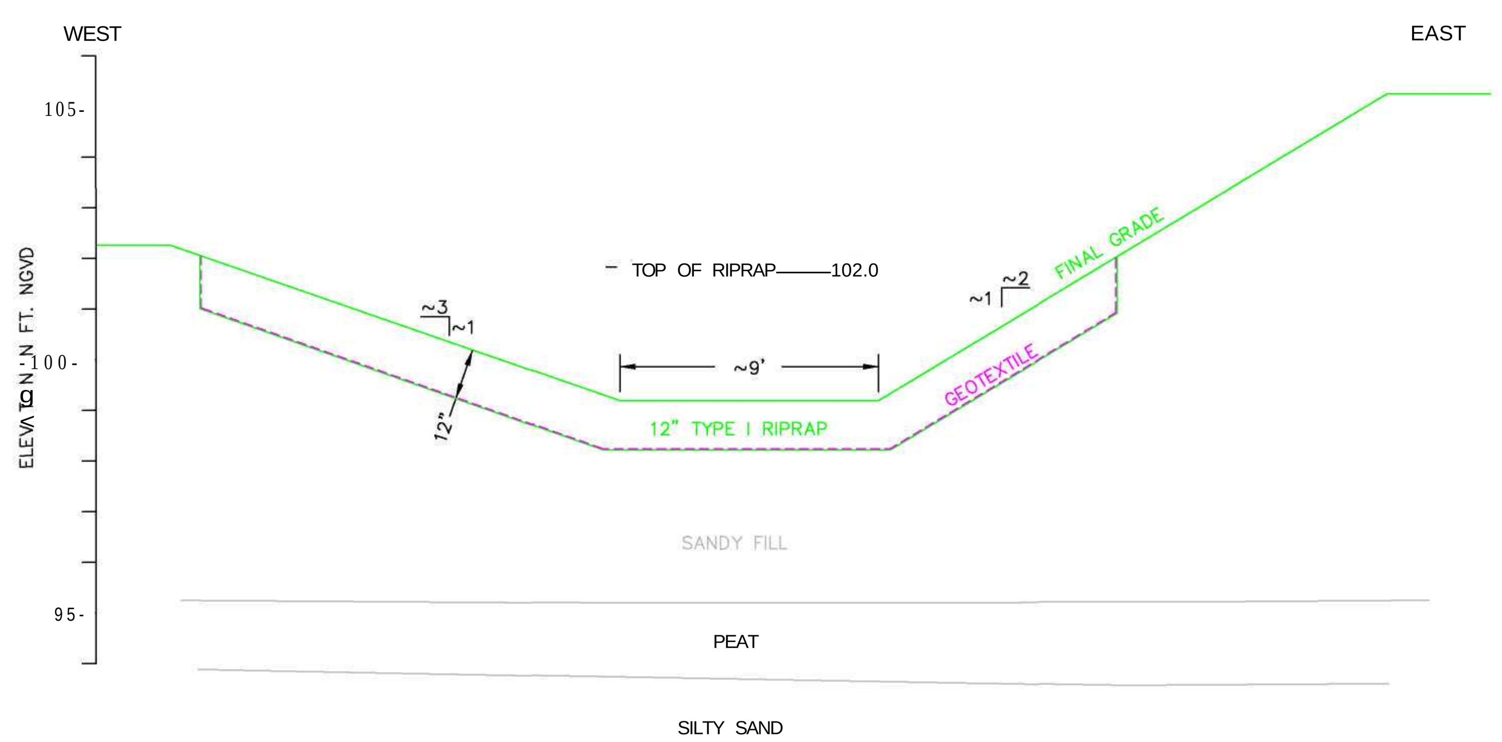
CROSS SECTION SOUTH/NORTH THROUGH AREA 7 CAP (1/3)
SCALE: 1"=20' HOR.; 1"=1' VER.; VERTICAL EXAGGERATION = 20:1



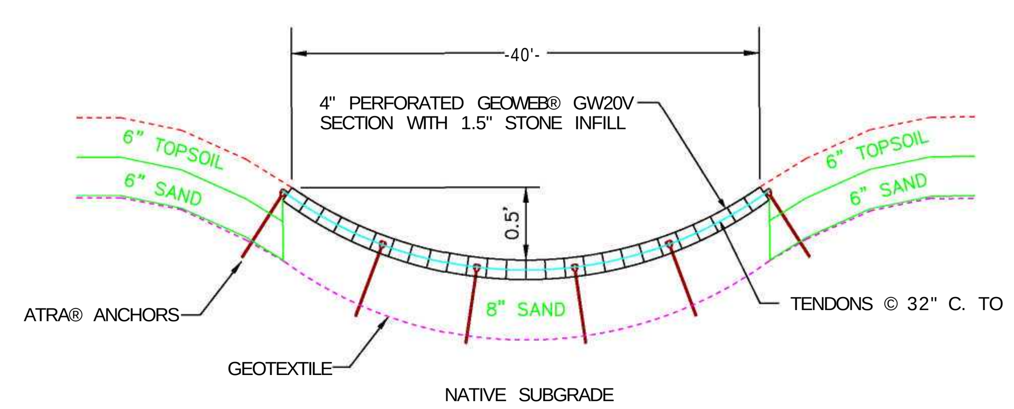
CROSS SECTION EAST/WEST THROUGH AREA 7 CAP (2/3)
SCALE: 1"=20' HOR.; 1"=1' VER.; VERTICAL EXAGGERATION = 20:1



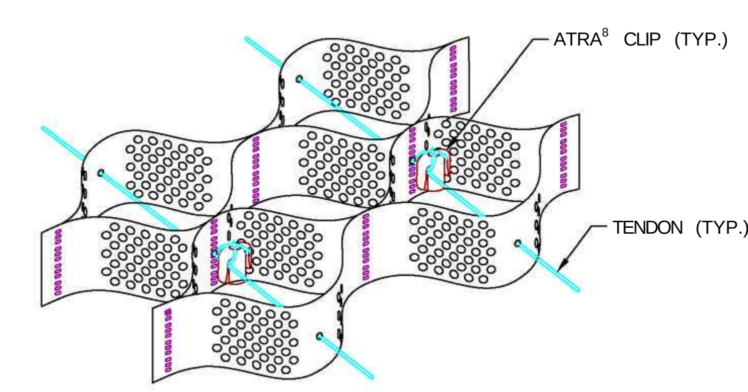
DETAIL TRASH GUARD (5/3)
SCALE: NONE



CROSS SECTION WATERWAY FROM D.P.W. TO FOREBAY (3/3)
SCALE: NONE



FLOW CHANNEL PROTECTION SYSTEM



TYPICAL GEOWEB®

STONE INFILL:
PEAK FLOW VELOCITY LESS THAN 2.0 m/s (6.6 fps) - 38 mm (1 1/2") MEDIAN STONE SIZE

DETAILS GEOWEB® CHANNEL PROTECTION SYSTEM (6/3)
SCALE: NONE

AREA 7 TYPICAL

AREA 7 FOREBAY/SPREADER

SECTIONS CAP DETAILS (4/3)
SCALE: NONE

Rev. No.	Date	Description	Made by	Chk'd by	App'd by

AREA 7
CROSS SECTIONS & DETAILS
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VERMONT 05602

Sheet 3 of 10
Scale: As Shown
Drawn by: TJK
Chk'd by: J-B
Date: 12/16/04
Job: 1-0870-1

CAD\December 2004 CCR\DETAILS7.dwg

LEGEND

MONITORING WELL LOCATION	MW105 (9)
UTILITY POLE	
LIGHT POLE	
CATCH BASIN	D
DRAINAGE MANHOLE	(D)
TREE LOCATION	
SHRUB LOCATION	
SHRUB / HERBACEOUS PLANTING BED	12
WETLAND DIVERSITY MIX OR EQUIVALENT	
WETLAND GRASS SEED MIX	
VERMONT CONSERVATION MIX	

	DRAINAGE DITCH
	1' SURFACE CONTOUR
105	5' SURFACE CONTOUR
	1' BATHYMETRIC CONTOUR
	GRAVEL DRIVE
	EXISTING CULVERT
	STONE
	GEOWEB W/STONE INFILL
	EDGE OF WOODS
	APPROX. EXTENT OF CAPPED AREA

	KEY	Scientific Name	Common Name	Spacing
TREES	AN	Acer negundo	Box Elder	(as shown)
	FP	Fraxinus pennsylvanica	Green Ash	
	PD	Populus deltoides	Cottonwood	
	PT	Populus tremuloides	Quaking Aspen	
	CR	Acer rubrum	Red Maple	
	SN	Salix nigra	Black Willow	
SHRUBS	AR	Alnus rugosa	Speckled Alder	4' O.C.
	CA	Cornus amom	Silky Dogwood	4' O.C.
	CO	Cephalanthus occidentalis	Buttonbush	4' O.C.
	CS	Cornus sericea	Red-osier Dogwood	4' O.C.
	SD	Salix discolor	Pussy Willow	4' O.C.
	VT	Viburnum trilobum	Highbush Cranberry	10' O.C.
HERB.	IV	Iris versicolor	Blue Flag Iris	1.5' O.C.
	LO	Leersia oryzoides	Rice Cut-grass	1' O.C.
	SE	Sparganium eurycarpum	Giant Bur-reed	2' O.C.
	SL	Sagittaria latifolia	Bigleaf Arrowhead	2' O.C.
	TL	Typha latifolia	Cattail	2' O.C.

NOTE: VERTICAL & HORIZONTAL CONTROL
BY LITTLE RIVER SURVEY COMPANY
OF STOWE, VERMONT - AUTUMN, 1992
ADDITIONAL SURVEY DATA - AUTUMN, 1994
ADDITIONAL SURVEY DATA - NOVEMBER, 2000
ADDITIONAL SURVEY DATA - MARCH, 2003
VERTICAL DATUM = NAVD 1988
HORIZONTAL DATUM = NAD 1983

ADDITIONAL JCO SURVEY DATA - SEPTEMBER, 2003

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 40 ft.

Rev. No.	Date	Description	Made by	Chk'd by	App'd by

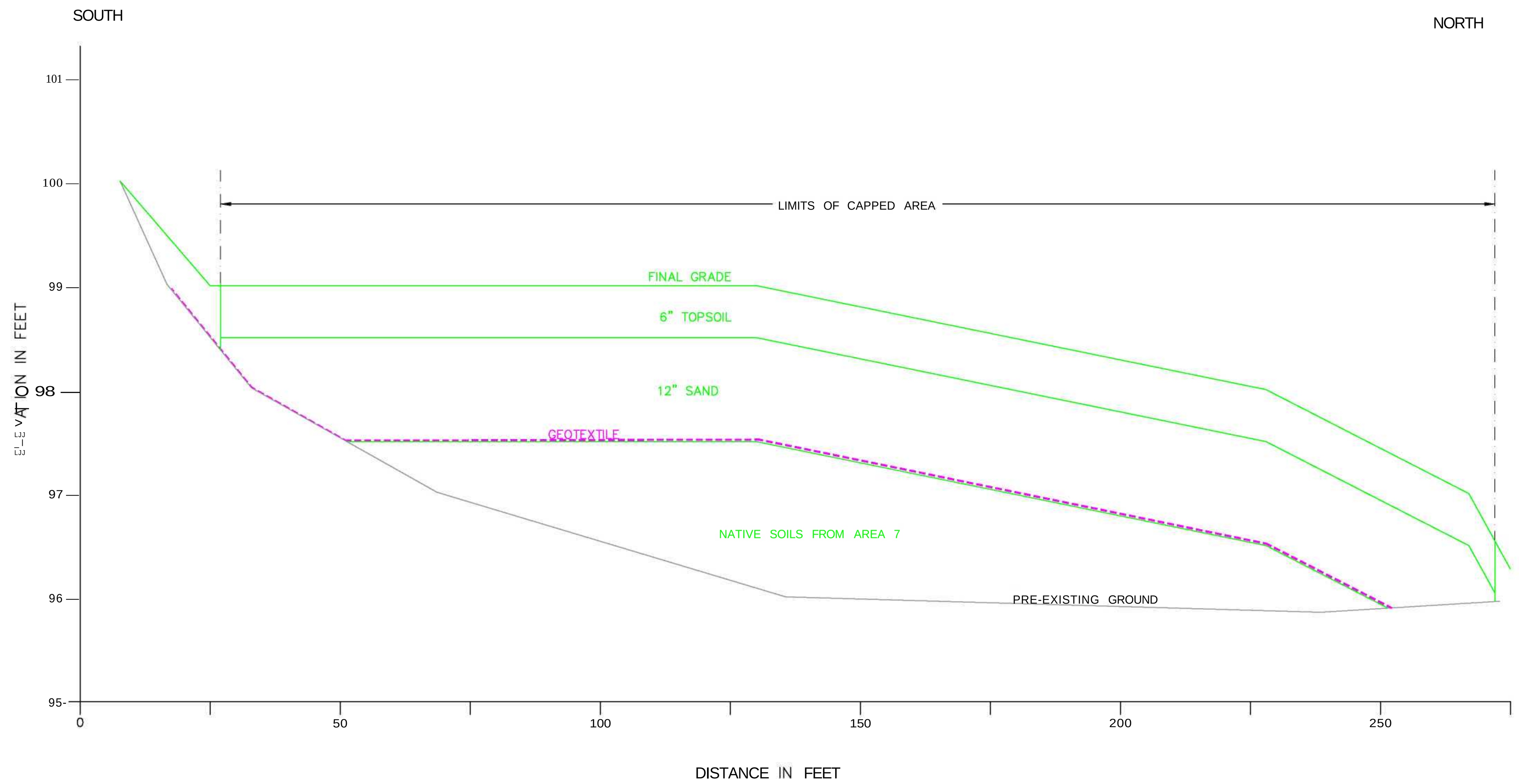
AREA 7
AS-BUILT LANDSCAPING PLAN
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VERMONT 05602

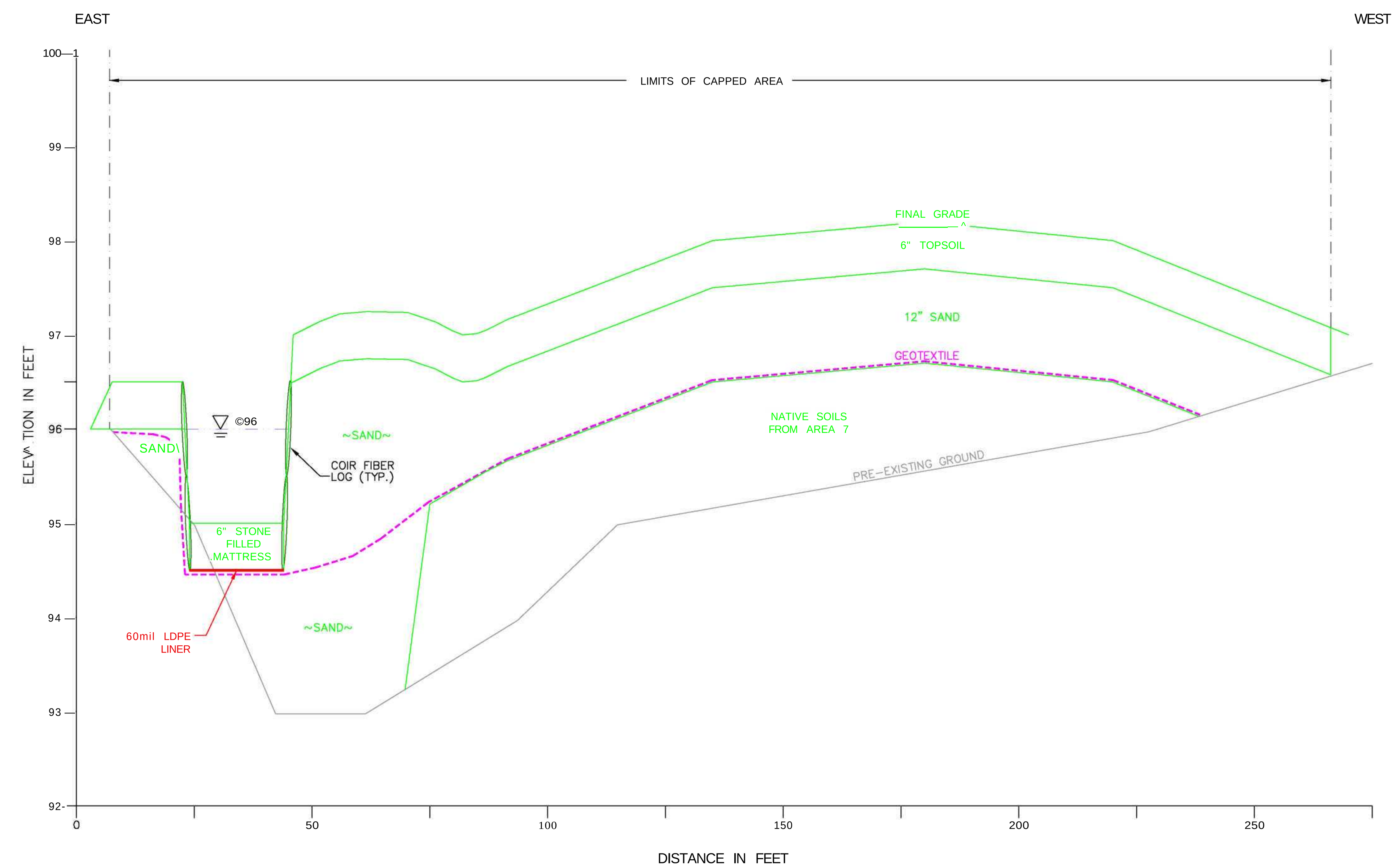
Sheet 4 of 10
Scale: 1"=20'
Drawn by: TJK
Chk'd by: SAS
Date: 12/16/04
Job: 1-0870-1

CAD\December 2004 CCR\Abwet7.dwg

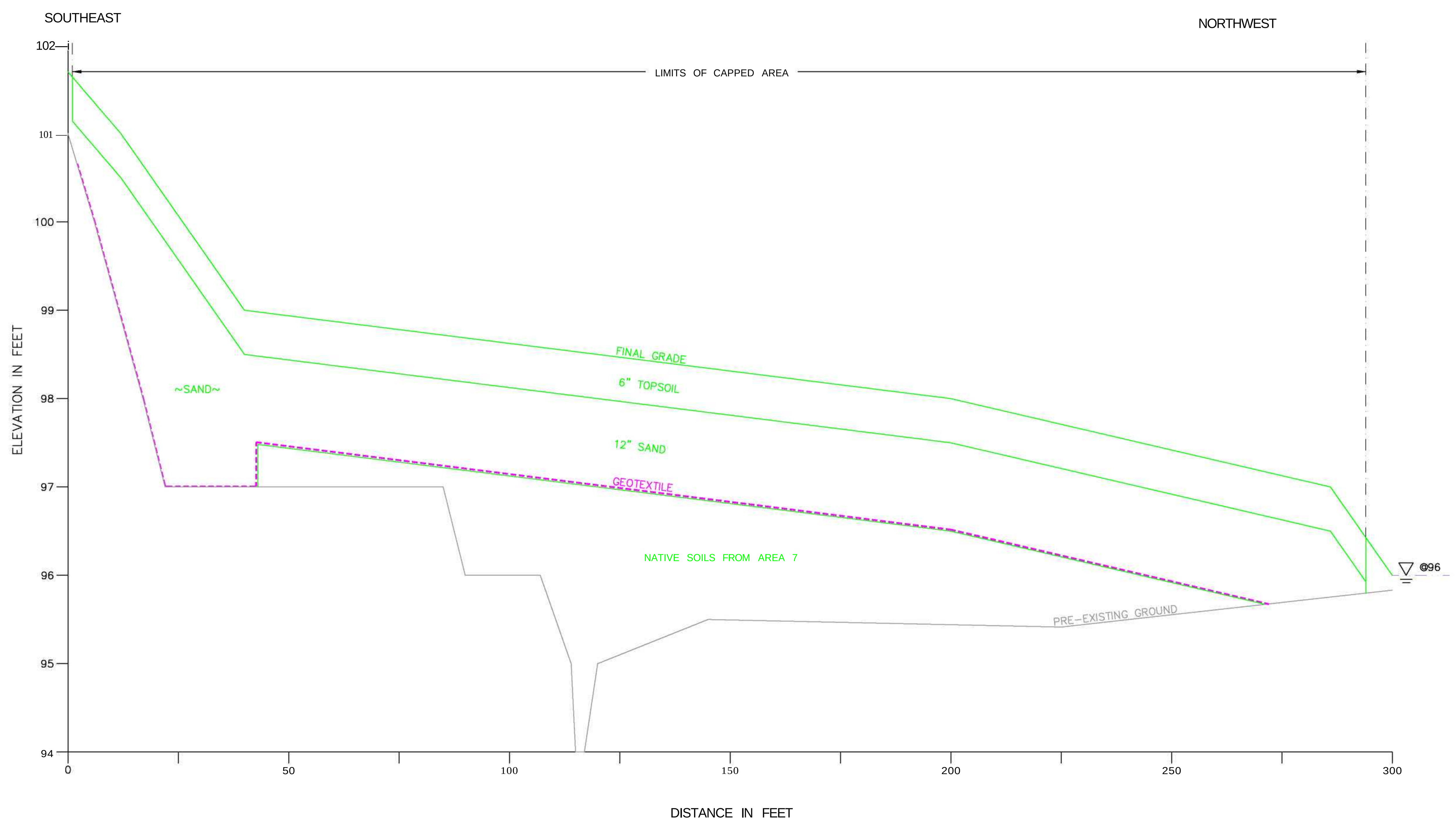

SOUTHWEST
NORTHEAST
ELEVATION IN FEET
FINAL GRADE
PRE-EXISTING GROUND
12" TYPE I RIPRAP
GEOTEXTILE
DISTANCE IN FEET
CROSS SECTION
B.E.D. STORMWATER OUTLET
SCALE: 1"=20' HOR.; 1"=2' VER.; VERTICAL EXAGGERATION = 10:1
FINAL GRADE
12" TYPE I RIPRAP
GEOTEXTILE
NATIVE SUBGRADE
TYPICAL SECTION
NOT TO SCALE
SOUTHEAST
NORTHWEST
42" CMP CULVERT
PRE-EXISTING GROUND
FINAL GRADE
12" TYPE I RIPRAP
GEOTEXTILE
DISTANCE IN FEET
PROFILE
B.E.D. STORMWATER OUTLET
SCALE: 1"=20' HOR.; 1"=2' VER.; VERTICAL EXAGGERATION = 10:1
LEGEND
FENCELINE
GROUND SURFACE CONTOUR
5' GROUND SURFACE CONTOUR
MARBLE MONUMENT
MONITORING WELL LOCATION
CULVERT
APPROX. AREA OF PLACEMENT AND CAPPING OF NAPL CONTAINING SOILS FROM WATERWAY EXCAVATION
STONE/ RIPRAP
6" HIGH STONE FILLED MATTRESS
CRIBBING
EXTENT OF AREA 3/2 CAP
EXTENT OF WEST BANK CAP
TOPSOIL THICKNESS MEASURED MARCH 6-25, 2003
CAP SAND THICKNESS MEASURED DECEMBER 5-17, 2002
CORING LOCATION
TOPSOIL (UPPER) AND CAP SAND (LOWER) THICKNESS MEASURED DURING CORING MAY 22, 2003
OBSERVATION WELL LOCATION
TOPSOIL (UPPER) AND CAP SAND (LOWER) THICKNESS MEASURED DURING OBSERVATION WELL INSTALLATION APRIL 21, 2003
P-12S
GP BURLINGTON NORTH LLC
WE89-5S
WE89-5D
WE89-7S
J_OW-1
J_OW-2
J_OW-3
J_OW-4
DECEMBER 5, 2002 VISUAL INSPECTIONS AND NUMEROUS MEASUREMENTS, WEST HALF OF CAP, AVERAGE SAND THICKNESS = 12"
DECEMBER 16, 2002 6 LOCATIONS, SAND THICKNESS = 12-16"
MARCH 18, 2003 VISUAL INSPECTIONS AND NUMEROUS MEASUREMENTS ALONG FORMER ACCESS ROAD, SAND THICKNESS = 20-24"
AREA 2 WATERWAY
6" HIGH STONE FILLED MATTRESSES
COIR LOGS ON BOTH SIDES OF WATERWAY
ELEV.=99.58
CANAL
STATE GRID
T18
T17
T16
T15
T14
T13
GRAPHIC SCALE
(IN FEET)
1 inch = 20 ft.
MW104A
MW104BM
P104
B.E.D. DISCHARGE APRON
B.E.D. OUTLET POOL
B.E.D. STORM SEWER
(INVERT ELEVATION = ~94.0 FNGVD)
BURLINGTON ELECTRIC DEPARTMENT TRANSFORMER STORAGE YARD
42" CMP
NOTE: VERTICAL & HORIZONTAL CONTROL BY LITTLE RIVER SURVEY COMPANY OF STOWE, VERMONT - AUTUMN, 1992
ADDITIONAL SURVEY DATA - AUTUMN, 1994
ADDITIONAL SURVEY DATA - NOVEMBER, 2000
ADDITIONAL JCO SURVEY DATA - AUGUST, 2002
ADDITIONAL SURVEY DATA - MARCH, 2003
VERTICAL DATUM = NAVD 1988
HORIZONTAL DATUM = NAD 1983
CAD\December 2004 CCR\ASBUILT3.dwg
Rev. No.
Date
Description
Made by
Chk'd by
App'd by
AREA 3/2 & B.E.D. STORM SEWER OUTLET - AS-BUILT SITE PLAN
PINE STREET CANAL SITE
BURLINGTON, VERMONT
THE JOHNSON COMPANY, INC
Environmental Sciences and Engineering
100 STATE STREET
MONTPELIER, VERMONT 05602
Sheet 5 of 10
Scale: 1"=20'
Drawn by: TJK
Chk'd by: J-B
Date: 12/16/04
Job: 1-0870-1



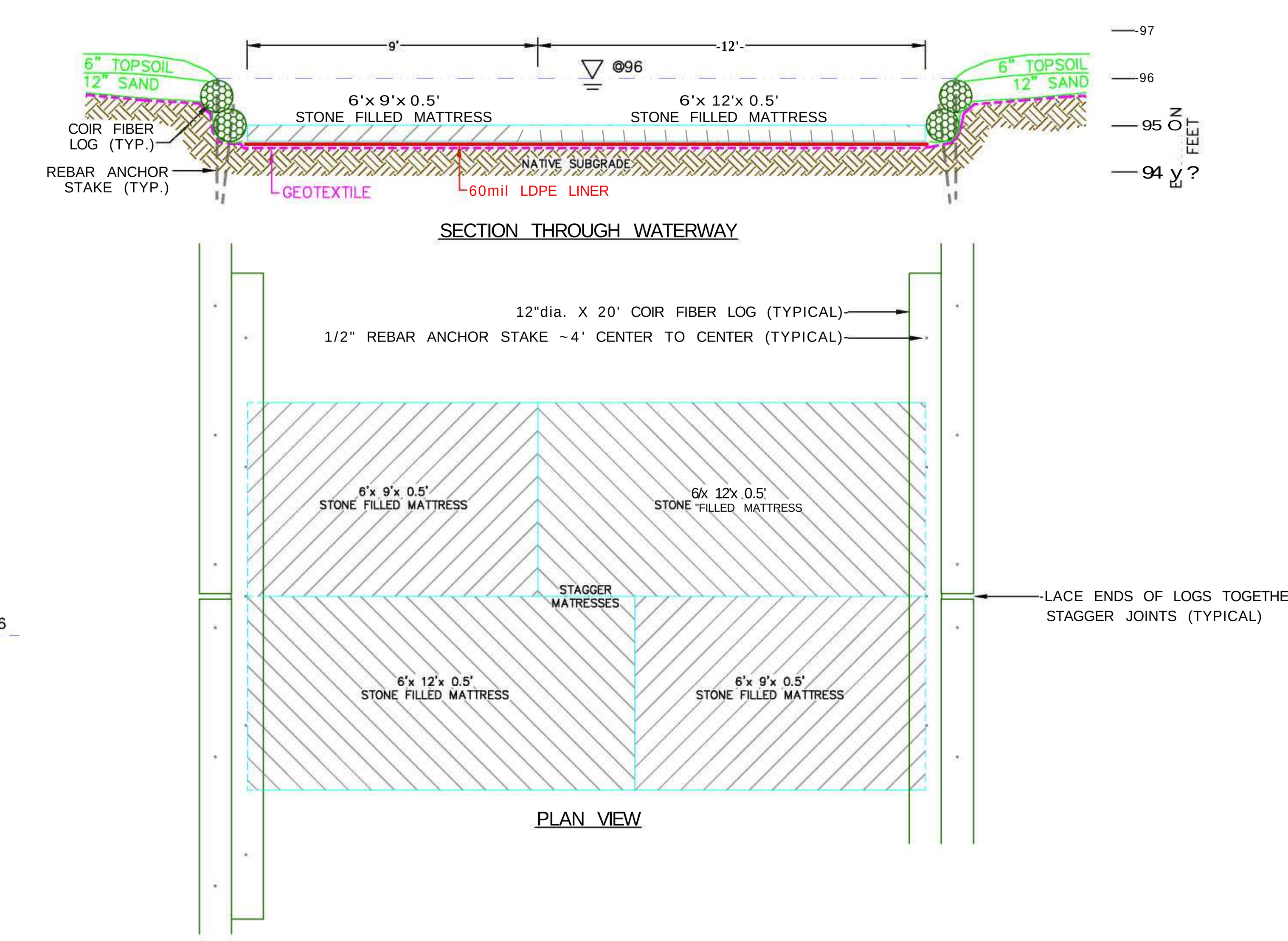
CROSS SECTION SOUTH / NORTH THROUGH AREA 3 CAP 1/6
SCALE: 1"=20' HOR.; 1"=1' VER.; VERTICAL EXAGGERATION = 20:1



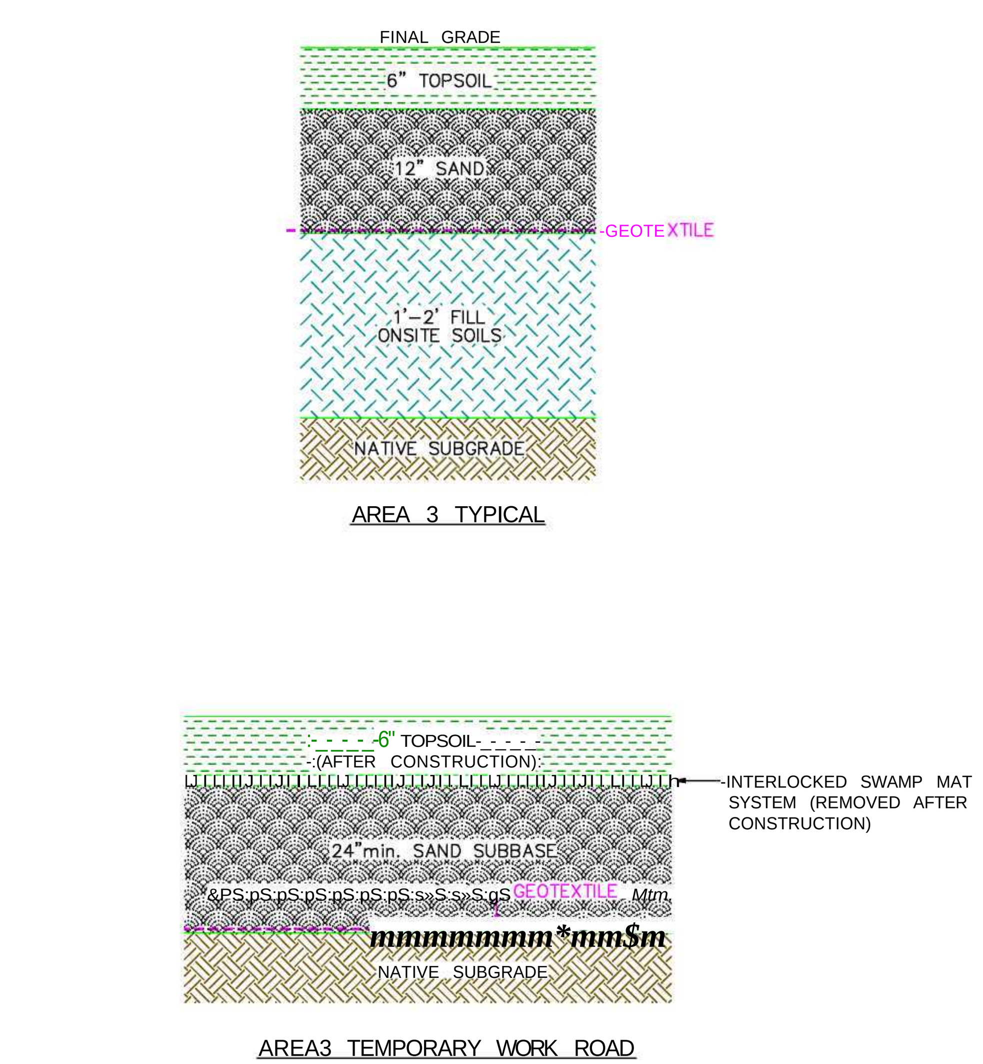
CROSS SECTION EAST / WEST THROUGH AREA 3 CAP 2/6
SCALE: 1"=20" HOR.; 1"=1' VER.; VERTICAL EXAGGERATION = 20:1



CROSS SECTION SOUTHEAST / NORTHWEST THROUGH AREA 3 3/6
SCALE: 1"=20' HOR.; 1"=1' VER.; VERTICAL EXAGGERATION = 20:1



DETAIL AREA 2 WATERWAY 3/6
SCALE: NONE



SECTIONS CAP DETAILS 4/6
SCALE: NONE

CAD\December 2004 CCR\DETAILS3.dwg

Rev. No.	Date	Description	Made by	Chk'd by	App'd by

AREA 3/2
CROSS SECTIONS & DETAILS
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VERMONT 05602

Sheet 6 of 10
Scale: SHOWN
Drawn by: TJK
Chk'd by: DMM
Date: 12/16/04
Job: 1-0870-1

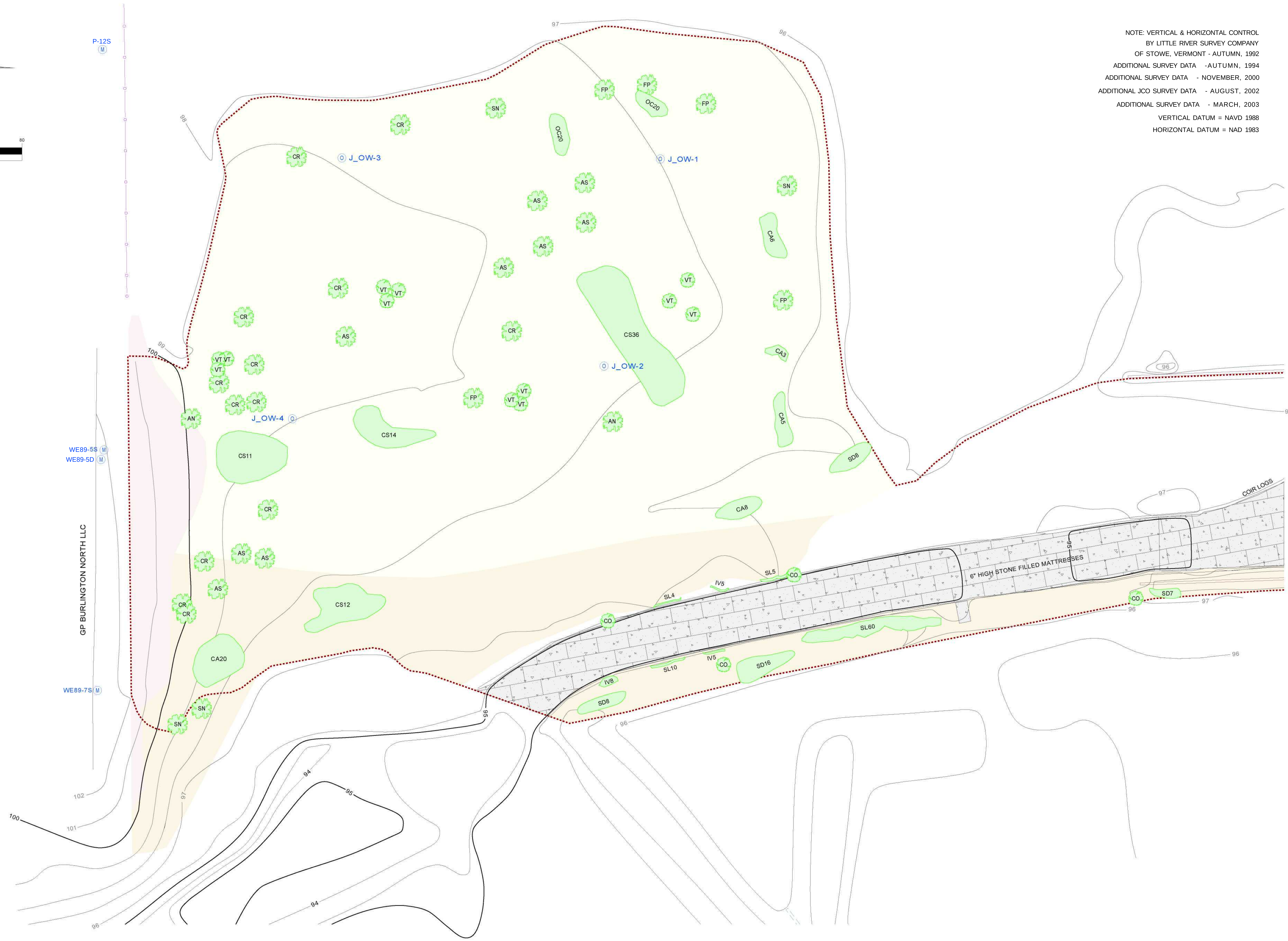
STATE GRID

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 40 ft.

	KEY	Scientific Name	Common Name	Spacing
TREES	AN	Acer negundo	Box Elder	(as shown)
	FP	Fraxinus pennsylvanica	Green Ash	
	PD	Populus deltoides	Cottonwood	
	CR	Acer rubrum	Red Maple	
	AS	Acer saccharinum	Silver Maple	
	SN	Salix nigra	Black Willow	
SHRUBS	AR	Alnus rugosa	Speckled Alder	4' O.C.
	CA	Cornus amom	Silky Dogwood	4' O.C.
	CO	Cephalanthus occidentalis	Buttonbush	4' O.C.
	CS	Cornus sericea	Red-osier Dogwood	4' O.C.
	SD	Salix discolor	Pussy Willow	2' O.C.
	VT	Viburnum trilobum	Highbush Cranberry	10' O.C.
HERBACEOUS	IV	Iris versicolor	Blue Flag Iris	1.5' O.C.
	OC	Osmunda cinnamomea	Cinnamon Fern	0.5' O.C.
	OS	Onoclea sensibilis	Sensitive Fern	V O.C.
	SE	Sparganium eurycarpum	Giant Bur-reed	2' O.C.
	SL	Sagittaria latifolia	Bigleaf Arrowhead	2' O.C.
	TL	Typha latifolia	Cattail	2' O.C.



NOTE: VERTICAL & HORIZONTAL CONTROL
BY LITTLE RIVER SURVEY COMPANY
OF STOWE, VERMONT - AUTUMN, 1992
ADDITIONAL SURVEY DATA -AUTUMN, 1994
ADDITIONAL SURVEY DATA - NOVEMBER, 2000
ADDITIONAL JCO SURVEY DATA - AUGUST, 2002
ADDITIONAL SURVEY DATA - MARCH, 2003
VERTICAL DATUM = NAVD 1988
HORIZONTAL DATUM = NAD 1983

LEGEND

- FENCELINE
- V GROUND SURFACE CONTOUR
- 5' GROUND SURFACE CONTOUR
- MONITORING WELL LOCATION
- OBSERVATION WELL LOCATION
- CULVERT
- STONE/ RIPRAP
- 6" HIGH STONE FILLED MATRESSES
- CRIBBING
- APPROXIMATE EXTENT OF CAPPED AREA
- TREE LOCATION
- SHRUB LOCATION
- 12 SHRUB / HERBACEOUS PLANTING BED
- WETLAND DIVERSITY MIX OR EQUIVALENT
- WETLAND GRASS SEED MIX
- VERMONT CONSERVATION MIX

Rev. No.	Date	Description	Made by	Chk'd by	App'd by

AREA 3/2
AS-BUILT LANDSCAPING PLAN
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VERMONT 05602

Sheet 7 of 10
Scale: 1"=20'
Drawn by: TJK
Chk'd by: SAS
Date: 12/16/04
Job: 1-0870-1

CAD\December 2004 CCR\Abwet3.dwg

LEGEND

LEGEND

- IRON PIN/ROD
- MARBLE MONUMENT
- RAILROAD SWITCH
- UTILITY POLE
- NAPL OBSERVATION WELL
- RAILROAD TRACKS
- FENCELINE
- GRAVEL DRIVE
- WOODEN CRIBBING
- 1' SURFACE CONTOUR
- 5' SURFACE CONTOUR
- 1' BATHYMETRIC CONTOUR
- 5' BATHYMETRIC CONTOUR
- EXTENT OF CAPPED AREA IN CANAL, TURNING BASIN, AND 100Y100' AREA
- EXTENT OF WEST BANK CAP

NOTES

BATHYMETRIC SURVEY DATA BY THE JOHNSON COMPANY, INC. - OCTOBER-NOVEMBER, 2003

VERTICAL & HORIZONTAL CONTROL AND TOPOGRAPHIC SURVEY BY LITTLE RIVER SURVEY COMPANY OF STOWE, VERMONT - 1992, 1994, 2000, 2003.

ADDITIONAL SURVEY DATA BY THE JOHNSON COMPANY, INC. - MARCH, 2003 & SUMMER, 2004.

ADDITIONAL GPS SURVEY DATA BY THE JOHNSON COMPANY, INC. - SEPTEMBER 3, 2003.

ADDITIONAL SOURCES: 3/92 S.R.I., 8/96 A.R.I., 5/98 A.F.S., A.R.I. Fieldbooks and 2002-2003 PSCS RA Fieldbooks 1 through 8. (Documents #337 & #408)

Rev. No.	Date	Description	Made by	Chk'd by	App'd by

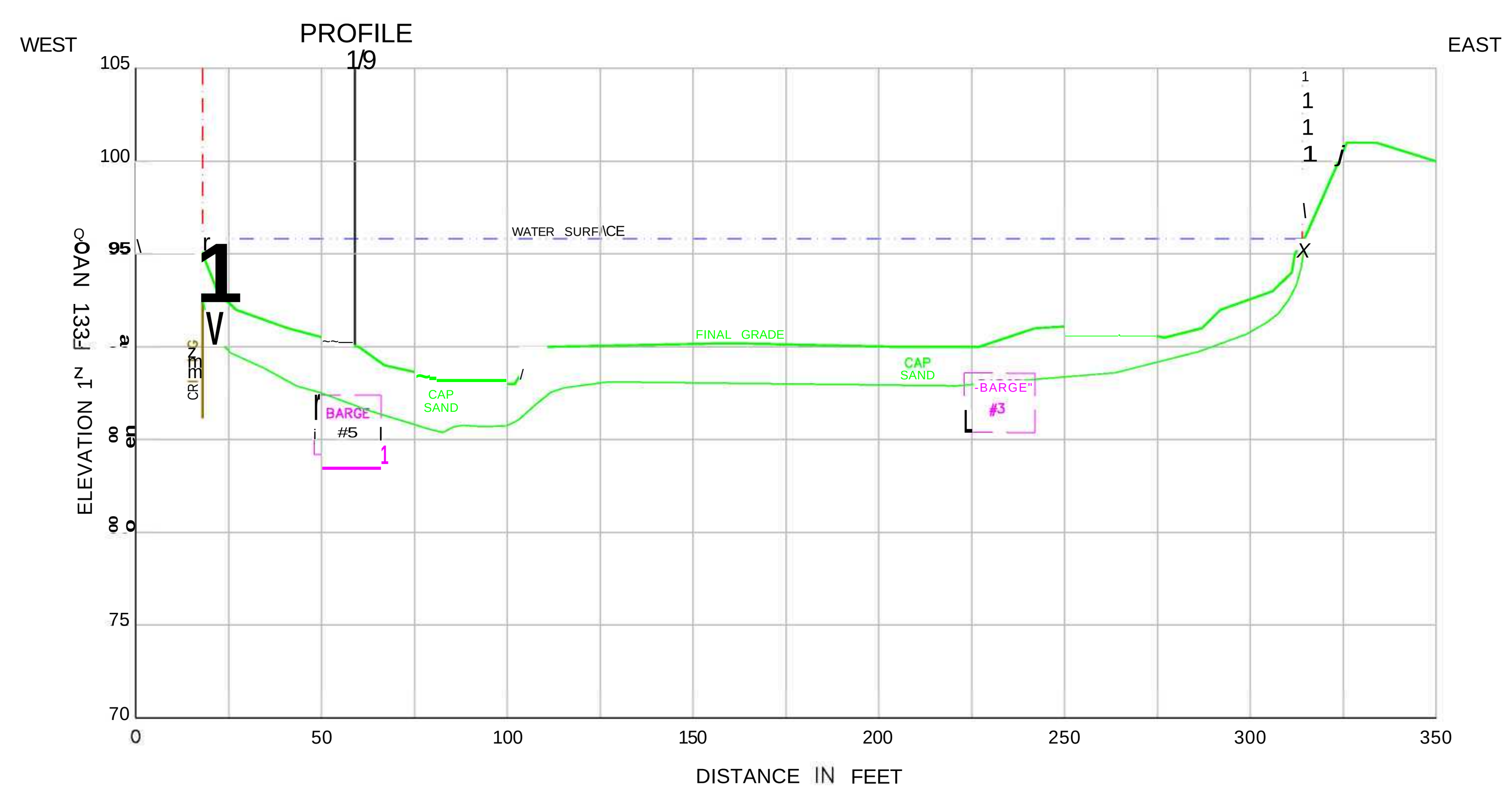
CANAL & TURNING BASIN AS-BUILT SITE PLAN PINE STREET CANAL SITE BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VERMONT 05602

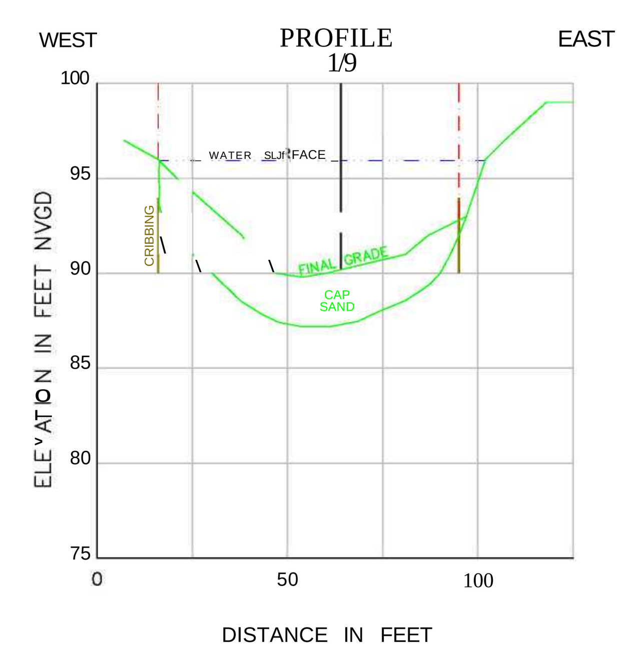
Sheet 8 of 10
Scale: 1"=40'
Drawn by: TJK
Chk'd by: J-B
Date: 12/16/04
Job: 1-0870-1

LEGEND

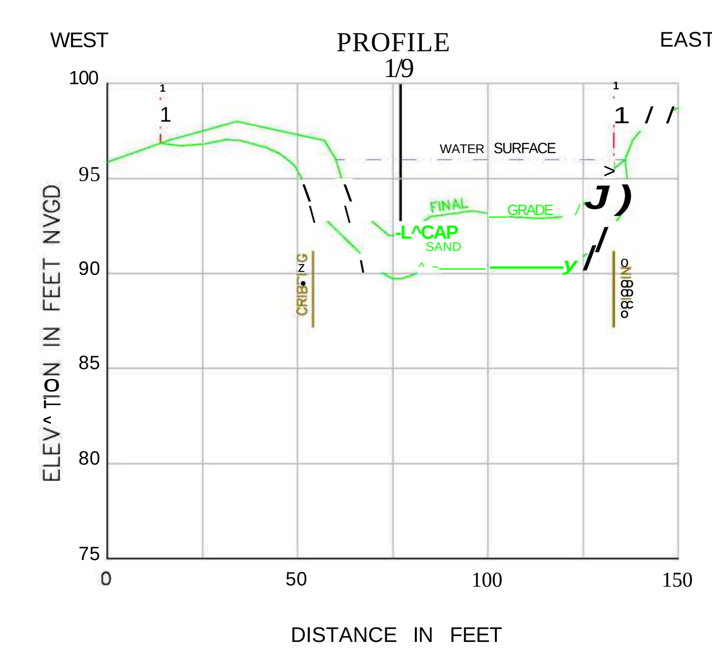
LIMITS OF CAPPED AREA
WATER SURFACE
HISTORIC BARGE (APPROX. LOCATION)



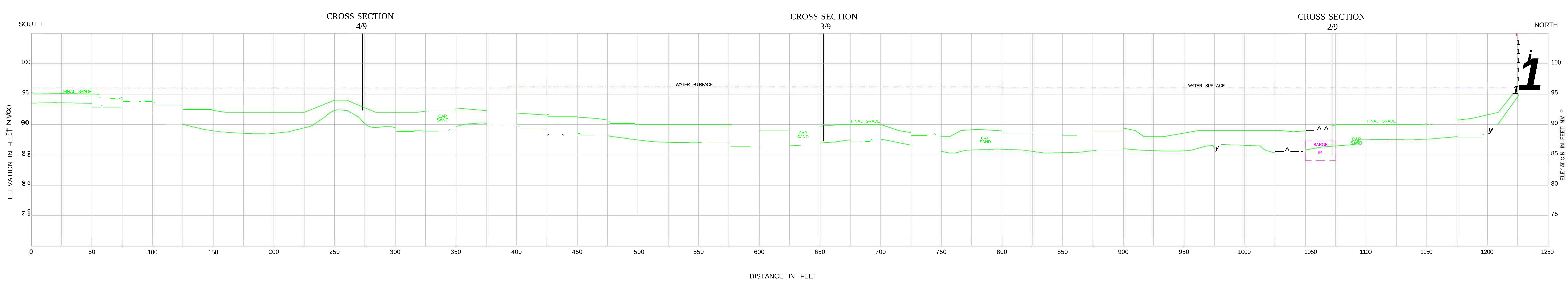
CROSS SECTION T2+30 2/9
SCALE: 1"=40'HOR., 1"=8'VER.; V.E. = 5:1



CROSS SECTION T6+50 3/9
SCALE: 1"=40'HOR., 1"=8'VER.; V.E. = 5:1



CROSS SECTION T10+35 4/9
SCALE: 1"=40'HOR., 1"=8'VER.; V.E. = 5:1



PROFILE CANAL & TURNING BASIN 1/9
SCALE: 1"=40'HOR., 1"=8'VER.; V.E. = 5:1

CAD\December 2004 CCR\CTBXSEC.dwg

Rev. No.	Date	Description	Made by	Chk'd by	App'd by

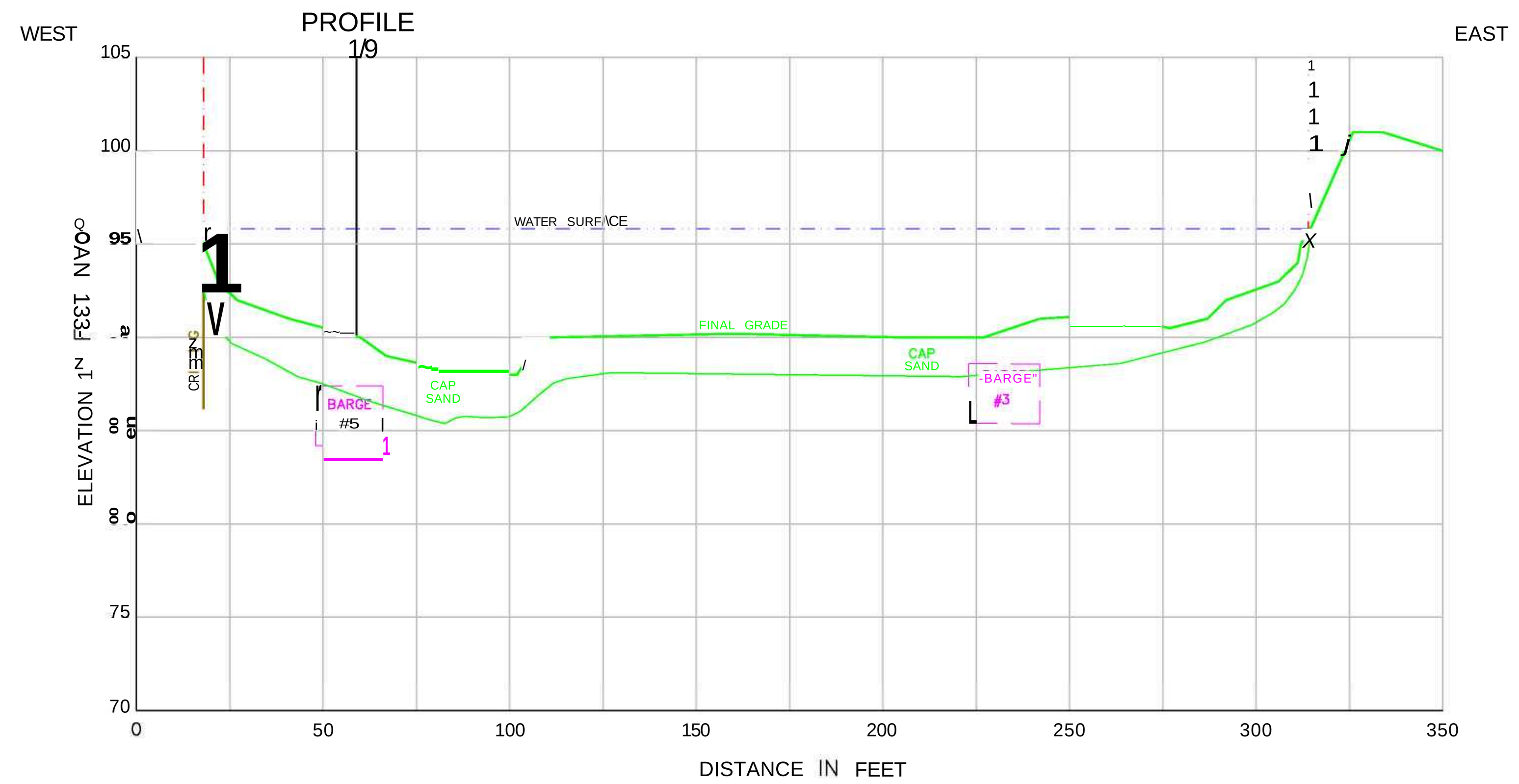
CANAL & TURNING BASIN
CROSS SECTIONS & PROFILE
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VERMONT 05602

Sheet 9 of 10
Scale: as shown
Drawn by: TJK
Chk'd by: DMM
Date: 12/16/04
Job: 1-0870-1

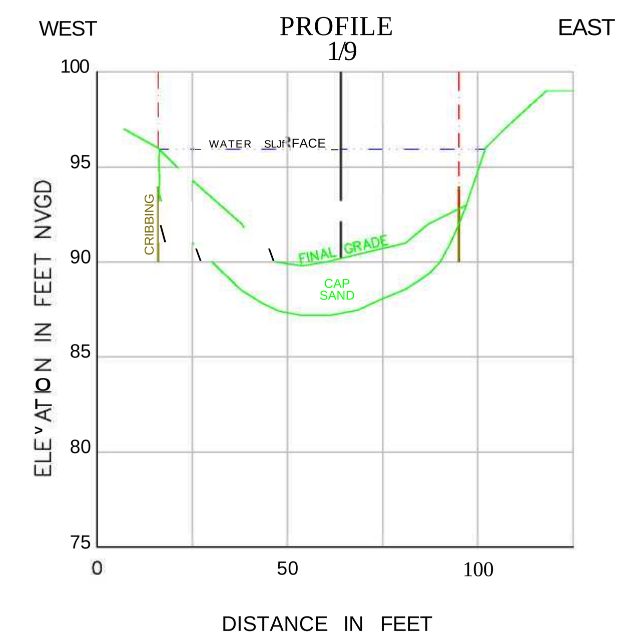
LEGEND

LIMITS OF CAPPED AREA
WATER SURFACE
HISTORIC BARGE (APPROX. LOCATION)



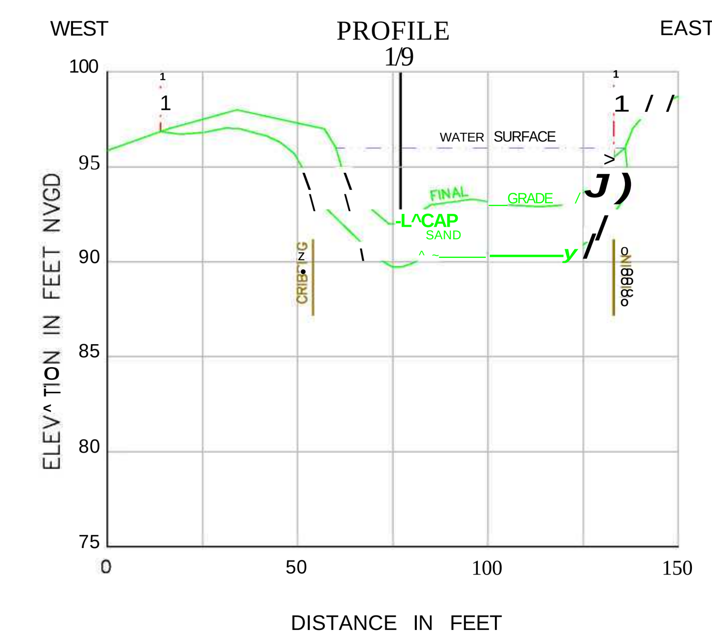
CROSS SECTION T2+30 (2/9)

SCALE: 1"=40'HOR., 1"=8'VER.; V.E. = 5:1



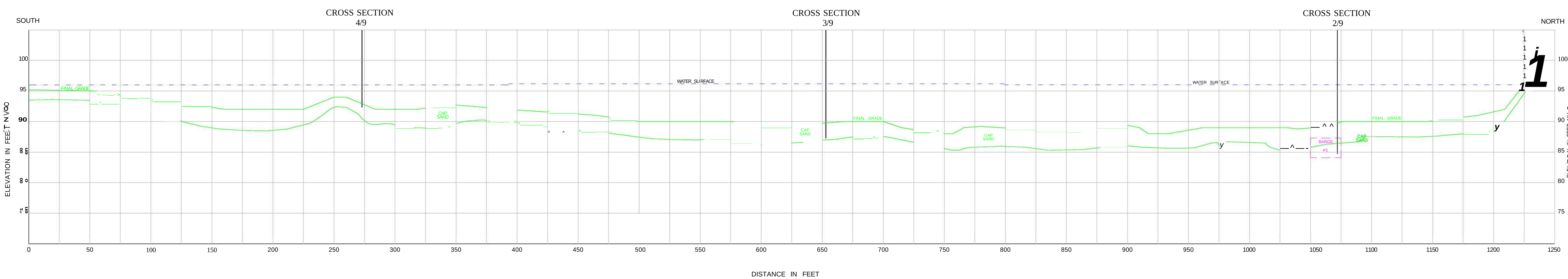
CROSS SECTION T6+50 (3/9)

SCALE: 1"=40'HOR., 1"=8'VER.; V.E. = 5:1



CROSS SECTION T10+35 (4/9)

SCALE: 1"=40'HOR., 1"=8'VER.; V.E. = 5:1



PROFILE CANAL & TURNING BASIN (1/9)

SCALE: 1"=40'HOR., 1"=8'VER.; V.E. = 5:1

CAD\December 2004 CCR\CTBXSEC.dwg

Rev. No.	Date	Description	Made by	Chk'd by	App'd by

CANAL & TURNING BASIN
CROSS SECTIONS & PROFILE
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VERMONT 05602

Sheet 9 of 10
Scale: as shown
Drawn by: TJK
Chk'd by: DMM
Date: 12/16/04
Job: 1-0870-1

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

LEGEND

- RAILROAD TRACKS
- FENCELINE
- GRAVEL DRIVE
- IRON PIN/ROD
- CAP THICKNESS MEASUREMENT LOCATION
- 1.5' - 2' CAP THICKNESS
- 2' - 3' CAP THICKNESS
- 3' - 4' CAP THICKNESS
- 4' - 5' CAP THICKNESS
- > 5' CAP THICKNESS

Rev. No.	Date	Description	Made by	Chk'd by	App'd by

CANAL & TURNING BASIN
CAP THICKNESS ISOPACHS
PINE STREET CANAL SITE
BURLINGTON, VERMONT

TiniJc JOKNESSN COMPANY, INC
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VERMONT 05602

Sheet 10 of 10
Scale: 1"=40'
Drawn by: TJK
Chk'd by: J-B
Date: 12/16/04
Job: 1-0870-1

CAD\December2004 CCR\ISOCAP.dwg

DESIGN CHANGE FORMS

Design Change Request No. 5

Design Change Request No. 6A

Design Change Request No. 6B

Design Change Request No. 7

Design Change Request No. 8

Design Change Request No. 9

Design Change Request No. 10

Design Change Request No. 11

Wetland Restoration Plan Addendum

Design Change Request No. 13

West Bank Cap Const. Design Change Request No. 1

Design Change Request No. 5

CMK
DMM

X7

de maximis, inc.

135 Beaver Street
Fourth Floor
Waltham, MA 02452
(781)642-8775
Fax (781) 642-1078

RECEIVED
SEP 16 2002
1-0870-1
JOHNSON CO. INC.
MONTPELIER, VT

September 13,2002

Ms. Karen Lumino
United States Environmental Protection Agency
Mail Code: HBT
1 Congress Street
Boston, MA 02114

VIA FEDEX

RE: Design Change Request No. 5
Pine Street Canal Superfund Site - Phase IB, Burlington, Vermont

Dear Ms. Lumino:

Attached is minor Design Change Requests No. 5. This design change request is for additional rip-rap along the discharge apron of the BED outfall. The need for that additional rip-rap was triggered by field.

Additional information is contained in the Design Change Request submittal, attached. The Figures accompanying the submittal provide the extent of the rip-rap as-built, as well as an overlay of the as-built versus as-designed.

We would appreciate approval of this minor design change requests.

Please do not hesitate to call me at (781)642-8775 should you have any questions.

Sincerely,

Thor Helgason
Project Coordinator

cc: Mike Smith - VTDEC
Martha Zirbel - M & E
Chris Crandell - The Johnson Co.
Roy Wagner - *de maximis, inc.*

PAPER

SEP 23 2002

PINE STREET BARGE CANAL REMEDIAL ACTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: 005
Major____________
Minor_____X_____
Date of Request: September 10, 2002

RECOMMENDED BY:
EPA
VTDEC
Engineer
Project Manager
Contractor

CHANGE DESCRIPTION:
Notification of a Field Change in the geometry of the BED outfall plunge pool apron was provided to de maximus in a single page summary dated August 21,2002. The rip-rap apron geometry needed to be changed due to changes in the existing ground surface topography since 1994, when the area was last surveyed.

Specifically, additional sand and sediments had been naturally deposited at the proposed end of the aptorx, raising the ground surface elevation by more than a foot since 1994. In order to provide a smooth transition between the rip-rap apron and the existing ground surface it was necessary to extend the apron by six feet in a down-gradient direction, and to reduce the slope of the apron surface. It was also necessary to slightly increase the width of the apron in order to maintain the bottom width and side slopes at designed.

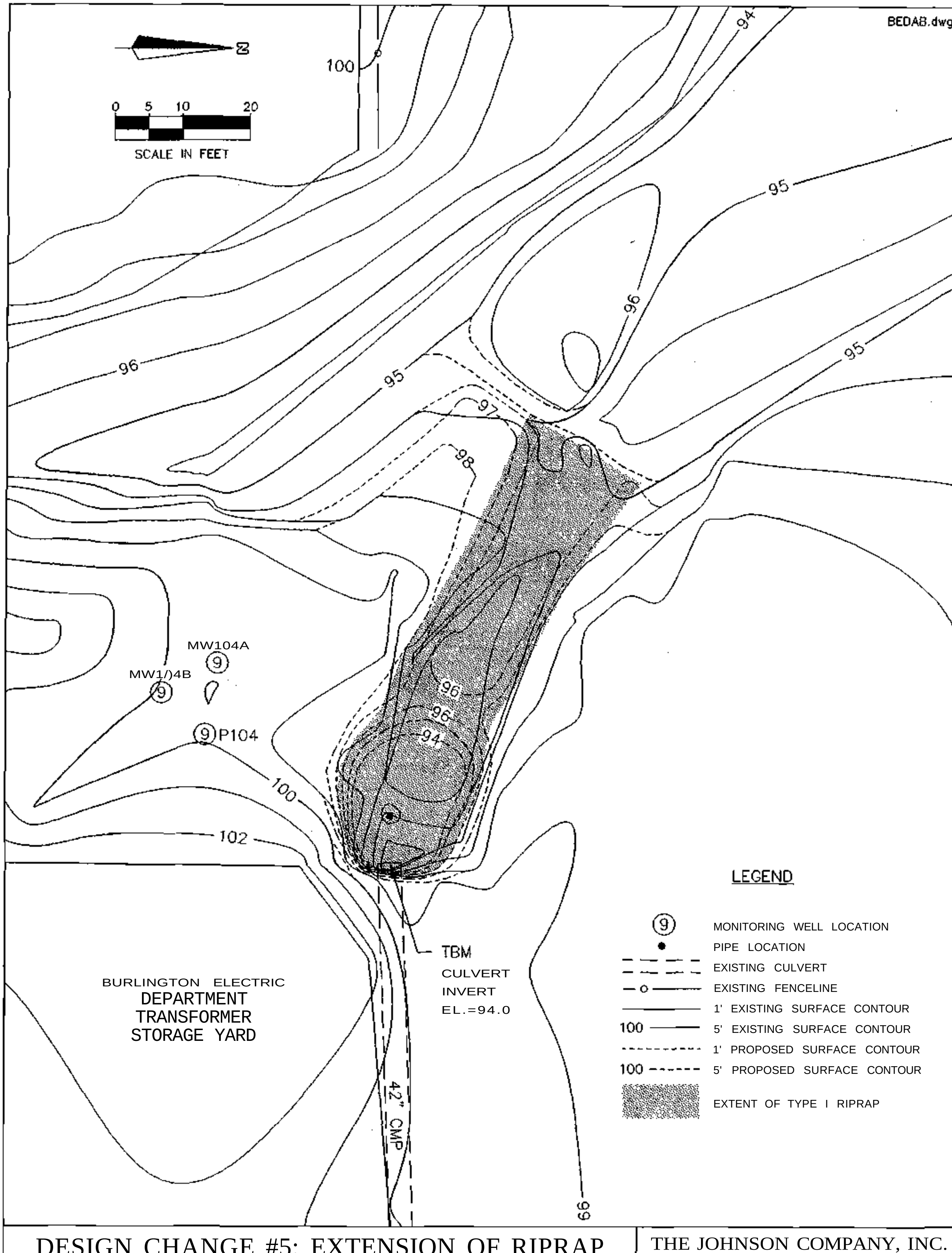
These changes will not decrease the sediment removal efficiency of the apron and plunge pool from that in the approved design (see Sheet 8 of 8 - Grading Plans and Details, B.E-D. Stormwater Outlet). Actually, the sediment removal efficiency is likely to be increased by the decreased slope and increased length of the rip-rap apron.

These changes will not reduce the storm-water carrying capacity of the BED culvert from that in the approved design. During design, the BED pipe capacity was calculated for a cross-section across the plunge pool outlet sill (at 96 ft NGVD). This sill is not affected by the proposed design change, and is the primary control for stormwater flow from the BED culvert.

The proposed changes will not significantly affect the wetlands area at the *Site*. Approximately 0.003 additional acres of rip-rap will be added by the proposed design change.

ATTACHMENTS: (list supporting documentation, if applicable)
Plan view contour map of proposed changes and plan comparing approved design and proposed changes.

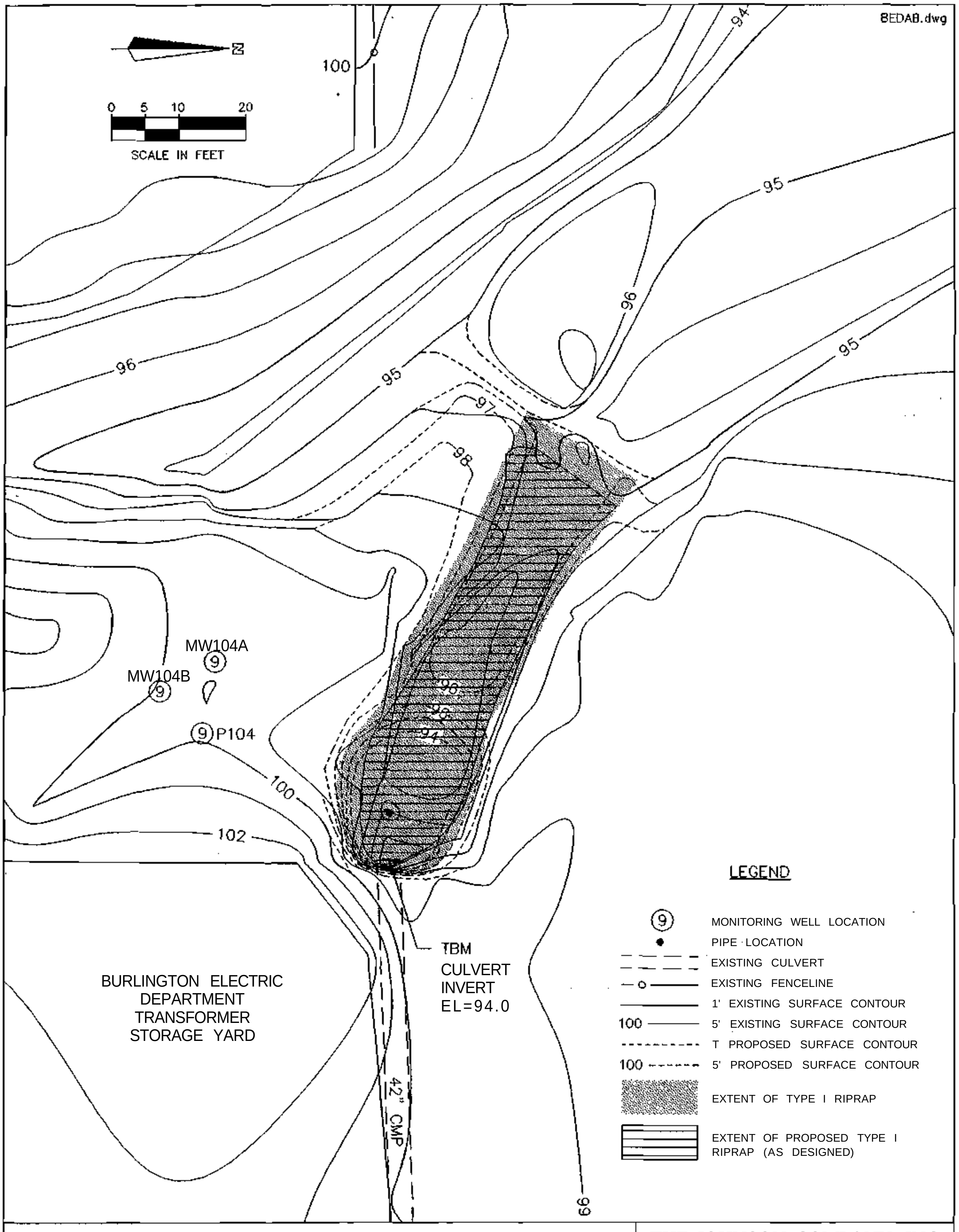
APPROVAL SIGNATURES:
Environmental Protection Agency Karen M Lumino Date: 9/18/02
Vermont Department of Conservation__________ Date: 9/24/02
Engineer__________ Date: 9-11-02
Project Manager__________ Date: 9/13/02



DESIGN CHANGE #5: EXTENSION OF RIPRAP
APRON AT B.E.D. STORMWATER OUTLET
PINE STREET CANAL SITE, BURLINGTON, VT.

THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VT 05602

DATE: 9/11/02
DRAWN BY: TJK
PROJECT: 1-0870-1
SCALE: 1"=20'



DESIGN CHANGE #5: EXTENSION OF RIPRAP APRON AT B.E.D. STORMWATER OUTLET
PINE STREET CANAL SITE, BURLINGTON, VT.

THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VT 05602

DATE: 9/11/02 PROJECT: 1-0870-1
DRAWN BY: TJK SCALE: 1"=20'

Design Change Request No. 6

PINE STREET BARGE CANAL REMEDIAL ACTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: 006
Major_____________
Minor _____X______
Date of Request: September 30,2002
Revised October 2,2002

RECOMMENDED BY:

EPA
VTDEC
Engineer
Project Manager
Contractor

CHANGE DESCRIPTION:

A minor design change for the Area 2 waterway is necessary to accommodate existing field conditions. The design change includes three parts: 1) revise the centerline of the waterway; 2) revise the finished grade of the waterway; and 3) place of a limited quantity (est. 30-50 cubic yards) of non-aqueous phase liquid (NAPL) containing soils within Area 2. The rationale for, details of, and expected consequences of, these changes are provided below.

For background, the approved design includes a waterway finished grade of 94.0 ft NGVD, which requires a subgrade elevation of 93 to complete the waterway per the design. The originally approved waterway location is shown on Sheet 5 of 8 of the approved Design Drawings and the typical cross-section detail for construction is shown as Detail 3 on Sheet 6 of 8.

Waterway Centerline Revision

During layout of the waterway for construction, it was determined that the base of the waterway would intersect the cribbing at the south end of the canal. The cribbing had not been previously located in this area because it had been submerged below the normal water level in the canal.

The proposed design change is to shift the centerline westward approximately 10 feet at Station 2+15 and re-align the waterway to match the cribbing alignment (see attached *Waterway Design Change #6, Area 3/2 Grading Plan).* The coir logs used to define the edges of the waterway will extend up to and alongside the cribbing. This is a simple re-alignment of the waterway to meet the field conditions (keep the waterway between the cribbing).

The width of the waterway will be unchanged. The location of the temporary work road will have to be shifted slightly west to accommodate the waterway, which will casue the capped portion of Area 2 west of the work road to be slightly reduced in area. There are no expected adverse consequences to this proposed change.

Revising the Waterway Final Grade

During the layout of the waterway, it was determined that the existing grades at the south end of the waterway had increased about a foot since last surveyed. At the south end of the waterway, the current grades range from elevation 94.9 to 96.3 ft NGVD, as compared with elevations between approximately 93 and 95.3 ft NGVD shown on Sheet 5 of 8 of the approved Design Drawings.

The proposed change is to raise the waterway finished grade before settlement to 95 ft NGVD in order to approximately meet the average existing grade south of the waterway. The north end of the waterway is proposed to be placed on the existing grade with a finished grade at approximately 95.5 (before settlement). This finished grade at the north end will later transition into the Phase 2 cap which will also be placed at the existing grade (elevation 94.5) at the south end of the Phase 2 work. The existing and proposed grades for the waterway are shown on the attached *Design Change #6, Area 3/2 Waterway Profile.*

As shown on the attached Grading Plan and Profile, Station 2+50 marks the approximate southern extent of where the Canal was formerly dredged. The proposed design change limits the excavation for the waterway to a subgrade cut to 94 ft NGVD between Stations 0+00 and 2+50 (plus or minus 25 feet north/south) and eliminates excavation north of Station 2+50 (plus or minus 25 feet north/south).

This proposed design change will improve the hydraulic transition between the waterway and existing up-stream conditions, and between the waterway and the downstream Phase 2 subaqueous cap. This will reduce the potential for erosion beyond the ends of the waterway. This change will also reduce the quantity of NAPL containing soils which may need to be excavated (see discussion below). The increase in the waterway final grade will not significantly affect the hydraulic capacity of the upstream stormwater control features (i.e. the BED stormwater pipe outfall and the North Road culvert), because the quantity of water passed during the design storm in a one-foot height of channel is only approximately 3.6 % of the design storm (0.43 fps x 20 feet x 1 foot = 8.6 cfs, which is 3.6 % of the 242 cfs design flow: see reference to Remedial Design Appendix C below). There will be no change in the wetlands areal extent due to this change. There are no expected adverse consequences to this proposed change.

Placement of NAPL-Containing Soils beneath the Area 2 Cap

During initial excavation for the waterway, a hole was dug to 93.6 ft NGVD at Station 0+50. Small blobs of non-aqueous phase liquid (NAPL) were observed in the excavation. NAPL was also observed in the shallow soils at other locations along the waterway. Based upon field observations, NAPL-containing soils are likely present below 94 ft NGVD in the waterway area, and approximately 30-50 cubic yards or less of NAPL-containing soils will need to be excavated if the base of the waterway subgrade is limited as described above.

It is proposed that soils with visual evidence of NAPL (e.g. with flowable or blobs of product) will be placed and capped on the west side of the temporary access road in Area 2 (please refer to the stippled area on the attached *Waterway Design Change #6, Area 3/2 Grading Plan* for the specific proposed location). The proposal is to move them from one side of the road to a controlled area on the other side. Since the entire area will be capped and the contamination appears to be present at similar depths in Area 2, the inclusion of these minor quantities of NAPL containing soils will not effect the overall performance of the cap.

The stippled area on the attached grading plan will accommodate the expected volume of materials with no expected change to the approved grading plan contours if they are placed at a thickness of approximately 0.3 feet and covered with the approved 1.5 foot cap design. The current ground surface elevation in this area is approximately 94.5 ft NGVD, the approved final grade is between 96 and 97 ft NGVD.

This change will avoid off-site transport and disposal of NAPL-contaminated soils, which would cause significant delays to the Phase IB Remedial Action schedule. The NAPL-containing soils will be placed in an area where **NAPL** currently exists in any case, so this change will not expand the area of contamination. The soils will be placed and capped with geotextile, sand, and topsoil as specified in the approved design, and no changes to the grading plan contours or approved wetlands balance are necessary.

Prior to placement of the NAPL-containing soils, non-NAPL soils from the waterway excavation will be used to construct a berm along the western side of the area. This berm will be tied into the work road at the northern and southern ends of the stippled area (see attached *Waterway Design Change #6, Area 3/2 Grading Plan),* and will be expanded as necessary to maintain its top above the elevation of the top of the NAPL-containing soils. The berm will ultimately be capped and incorporated into the final grade.

The waterway excavation will be initially limited in depth so that NAPL-containing soils are not excavated and the berm can be constructed. Then during final excavation, the NAPL-containing soils will be moved by excavator from south to north progressively in the waterway excavation until the accumulated NAPL-containing soils are located at approximately Station 2+00 to 2+50 (the approximate northern end of the excavation). The soils will then transferred to the west side of the work road by the excavator and placed directly on top of the existing ground surface. At that location, polyethylene sheeting or geotextile will be used to catch incidental spills during movement of the soils across the work road. After placement (which is expected to take less than one day), the soils will be immediately covered with polyethelene sheeting staked down at it edges to prevent erosion or migration prior to completion of the cap. The existing geotextile below the work road will be overlapped with the geotextile to be placed over the NAPL-containing soils as part of the cap as shown in the attached *Conceptual Cross Section, Station 2+75.* There are no expected adverse consequences to this proposed change.

ATTACHMENTS: (list supporting documentation, if applicable)

Conceptual Cross Section, Station 2+75
Map comparing approved design and proposed changes: *Waterway Design Change #6, Area 3/2 Grading Plan*
Profiles of limits of excavation and expected consolidation: *Design Change #6, Area 3/2 Waterway Profile*

Supporting Documentation References (not attached)
Approved Design Drawings: Sheet 5 of 8, and Detail 3 on Sheet 6 of 8.
Approved Phase IB Remedial Design: Appendix C - Area 2,7 and BED Waterway Hydraulic Design and Erosion Calculations; Attachment 7 - Area 2 Waterway (Final page; MACRA model results for 100 year storm x 1.5, Stretch #4 average velocity (vt = 0.42 fps))
Figure CDR 7-1 (Map 5) Extent of Cap T13-T16.5 and Figure CDR 7-2 Geologic Profile T13-T16

APPROVAL SIGNATURES:

Environmental Protection Agency________________________ Date:__________

Vermont Department of Conservation____________________ Date:__________

Engineer ________________________ Date: 10/3/02

Project Manager________________________ Date:__________

K:\l-O8rO-1\pfiase IBtfJesign Chans? 006 revfeedl0-2-02.wpd

ATTACHMENTS: (list supporting documentation, if applicable)

Conceptual Cross Section, Station 2+7S
Map comparing approved design and proposed changes: *Waterway Design Change #<?, Area 3/2 Grading Phi*
Profiles of limits of excavation and expected consolidation: *Design Change #6, Area 3/2 Waterway Profile*

Supporting Documentation References (not attached)
Approved Design Drawings. Sheet 5 of 8, and Detail 3 on Sheet 6 of 8,
Approved Phase IB Remedial Design: Appendix C - Area 2,7 and BED Waterway Hydraulic Design a$.d ire Calculations; Attachment 7 - Area 2 Waterway (Final page; MACRA model resulls for 100 year storx.; \. *• Stretch #4 average velocity (vt = 0.42 fps))
Figure CDR 74 (Map 5) Extent of Cap T13-T16.5 and Figure CDR 7-2 Geologic Profile T13-T16

APPROVAL SIGNATURES:

Environmental Protection Agency, Karen Lumino Date: 10/11/02

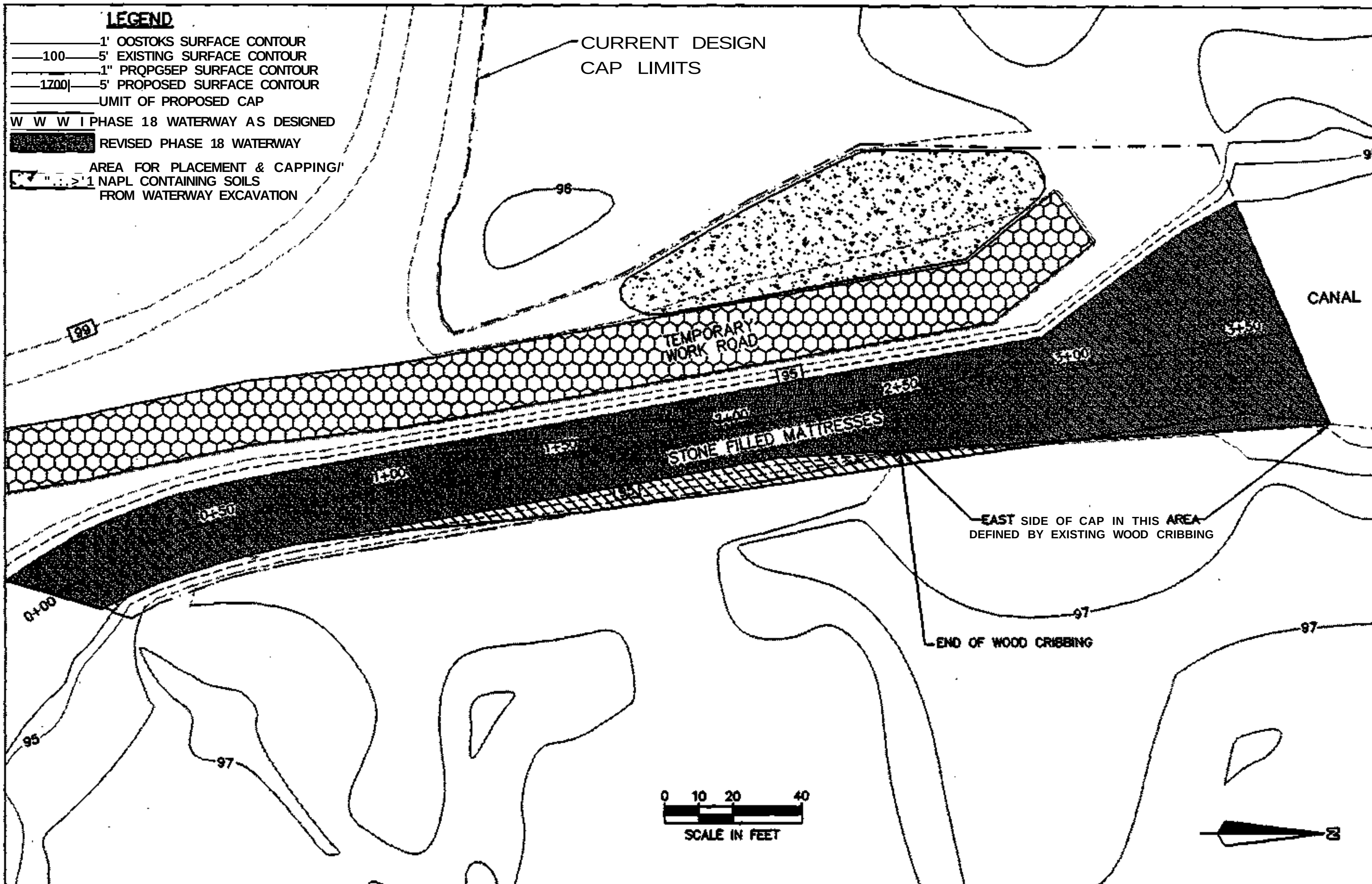
Vermont Department of Conservation Date: 10/15/02

Engineer Date: 10/3/02

Project Manager. Date:

KM-0070-I\Phase IB\Design Change 006 revised 10-2-02 wpd

»L:ON SO/SO: £1 22:£L 20/U/OL

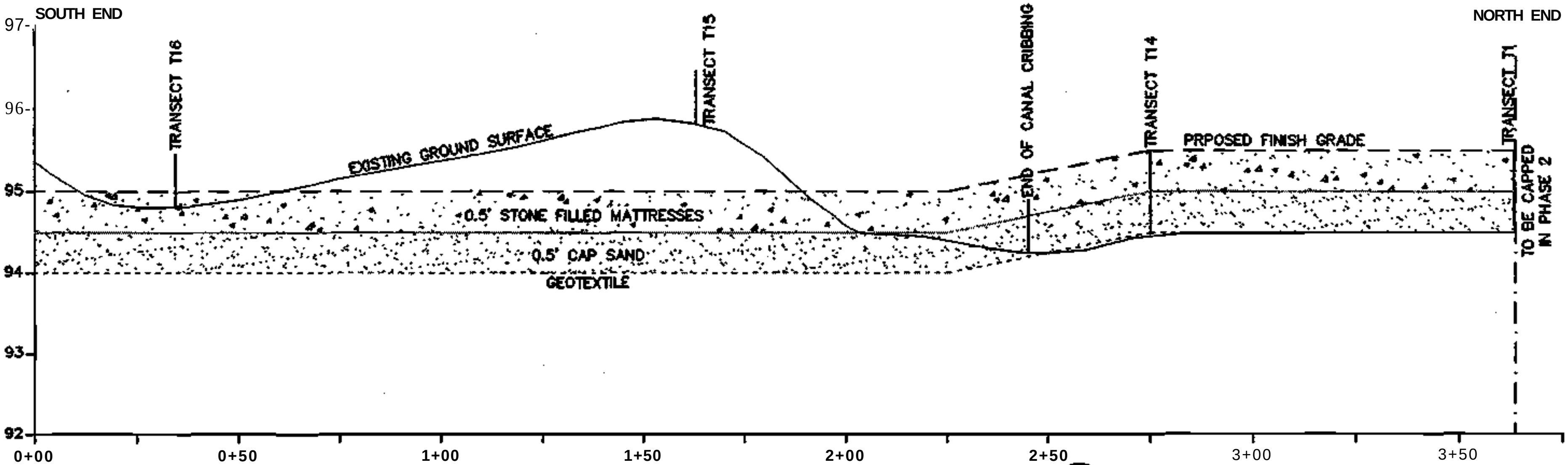


WATERWAY.dwg

WATERWAY DESIGN CHANGE #6
AREA 3/2 GRADING PLAN
PINE STREET CANAL SITE, BURLINTON, VT

THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 STATE STREET MONTPOJER, VT 05802

DATE: 9/25/02 PROJECT: t-O87Q-1
DRAW BY: T,K SCALE; T-40'



PROFILE PROPOSED CUT AND FILL *BEFORE* CONSOUDATION 1/1

SCALE: 1*»4ff HOR.; 1"-2' NCR.; VERDCAL EXAGGERATION - 20:1

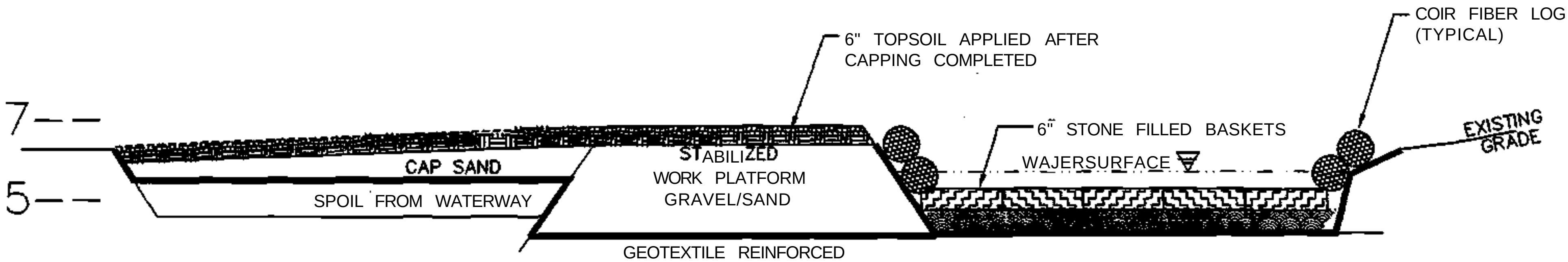
WWAYPROF.dwg

DESIGN CHANGE #6
AREA 3/2 WATERWAY PROFILES
PINE STREET CANAL SITE, BURLINGTON, VT

THE JOHNSON COMPANY, INC.
Snvirarxmen&ai Sciences and Engineering
100 STATE STREET MONTPEUER, VT 0S602

DATE: 9/24/02
DRAWN BY: TJK
PROJECT: 1-0870-1
SCALE: AS SHOWN

CAP DETAIL



DESIGN CHANGE NO.6 - AREA 2 WATERWAY
CONCEPTUAL CROSS-SECTION - STATION 2+75

1-0870-1\cad\asxsec-dc6.dwg 10/2/02 The Johnson Co. Inc.

Design Change Request No. 6A

PINE STREET BARGE CANAL REMEDIAL ACTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: 006A
Major____________
Minor ____X______
Date of Request: October 17, 2002

RECOMMENDED BY: Engineer

CHANGE DESCRIPTION:

A minor design, change for the Area 2 waterway is suggested for two purposes:
1. to further reduce excavation of non-aqueous phase liquid (NAPL) containing soils, and
2. to provide a barrier to reduce possible upwards migration of NAPL following construction.

For background, the approved design as modified in Design Change Number 6 (revised October 2, 2002) includes a geotextile covered by a six-inch thick sand bed and 6-inch stone-filled mattresses. Excavation is required for this structure between Stations 0+00 and 2+25 to a subgrade elevation of 94 ft NGVD (see attached *Waterway Design Change #6, Area 3/2 Grading Plan* for Station locations). Based upon field observations, it is known that NAPL containing soils will need to be excavated for this work.

It is proposed that the six-inch thick sand bed below the stone-filled mattresses be eliminated between approximately Stations 0+00 and 2+50, and replaced with a 40 ml (minimum thickness) low density polyethylene liner. The newly proposed subgrade elevation will be at 94.5 ft NGVD. Any existing low areas (below 94.5 ft NGVD) will be filled with cap sand. The liner will be placed on the subgrade, covered with geotextile, and the mattresses placed on top. Please refer to the attached *Design Change #6A, Area 3/2 Waterway Profile* and *Design Change #6A, Area 3/2 Waterway Cross Section at Station 2+50* for details.

This change will reduce the volume of NAPL contaminated soils which must be excavated. The proposed change will not change the design final grade (before consolidation) of the waterway, and so will not affect its hydraulic capacity. The safety factor against erosion of the waterway will also be unchanged.

As shown on the attached Grading Plan and Profile, Station 2+50 marks the approximate southern extent of where the Canal was formerly dredged. The proposed design change includes the use of the plastic liner between Stations 0+00 to approximately 2+50 (plus or minus 25 feet). However, the proposed change also allows extensions of the area where the plastic liner replaces the sand bedding as necessary based upon field conditions to promote an even transition to the remaining portion of the waterway and to cover locations with visually observed NAPL seeps.

It is anticipated that a 250-foot long and 22-foot wide roll of LDPE will be available and sufficient to perform the proposed change. In this case, no seams or breaks in the LDPE liner will be necessary. If, due to field conditions, it is necessary to connect two pieces of liner, the following method will be used:
- The two pieces of liner will be overlapped a minimum of two feet, with the direction of overlap arranged to minimize the potential for separation (e.g. the upper segment of the over lap will be up-gradient or up-hill from the lower).
- Bentonite powder will be placed dry in a minimum 1-inch thick layer along the inner foot of the overlapped segment.

ATTACHMENTS: (list supporting documentation, if applicable)
Design Change #6A, Area 3/2 Waterway Profile
Design Change #6A, Area 3/2 Waterway Cross Section at Station 2+50
Waterway Design Change #6, Area 3/2 Grading Plan from *Design Change 6* dated September 30, 2002 and Revised October 2

APPROVAL SIGNATURES:

Environmental Protection Agency______________________Date:____________

Vermont Department of Conservation______________________ Date:____________

Engineer [signature]______________________ Date: 10/17/02

Project Manager______________________ Date:____________

KAI -0870-INPhase IB\Design Change 006A revised 10-17-02.wpd

PINE STREET **BARGE CANAL** REMEDIAL **ACTION**
DESIGN CHANGE NOTIFICATION/REQUEST **FORM**

Design Change Number: 006A
Major ______
Minor ___X___ V
Date of Request: October 17,2002

RECOMMENDED BY: £ngiH#r.

CHANGE DESCRIPTION:

A minor design change for the Area *2* waterway is suggested for two purposes;
1, to further reduce excavation of noti-aqueou3 phase liquid (NAJPL) containing soils, and
2. to provide a barrier to reduce possible upwards migration of NAPL following construction.

For background, the approved design as modified iri Design Change Number 6 (revised October 2,2002) include;. a geotexttle covered by a six-inch thick *sand* bed and 6-inch stone-filled roattresscB. Excavation is required for th: structure between Stations 0+00 and 2+25 to a subgradc elevation of 94 ft NGVD (see attached *Waterway Desig-Change #6, Area 3/2 Grading Plan* for Station locations). Based upon field observations, it is known that NAPi containing Boils will need to DC excavated for this wo'A.

It is proposed that the aix-inch thick sand bed below the stone-filled mattresses be eliminated between approximately Stations 0+00 and 2+50, and replaced with a 40 ml (minimum thickness) low density polycthylerk; lnier. The newly proposed subgradc elevation will be at 94.5 ft NGVD. Any existing low »rtas (below 94.5 ft 'NGVD) will be filled with cap sand. The liner will be placed on the subgrade, covered with geotextile, and the mattresses placed on top. Please refer to the attached *Design Change mA, Area V2 Waterway Profile* and I;-. *Change tf6A, Area irt Waterway Cross Section at Station 2+i0* for details.

Thi$ change will reduce the volume of NAPL contaminated soils which must be excavated. The propose; r will not change the de»ign final grade (before consolidation) of the waterway, and so will not affect its hy_.. capacity. The safety factor against erosion of the -waterway *will* also be unchanged.

As shown on the attached GradingPlan and Profile, Station 2+50 marks the approximate southern extent of wh,-: - the Canal was formerly dredged. The proposed design change includes-the Use of the plastic liner betweca Statical 0+00 to approximately 2+50 (plus or minus 25 feet). However, the proposed change also allows extensions of tb: area where the plastic liner replaces the sand bedding as necessary based upon fiela conditions to promote an *tvta* transition to the remaining portion of the waterway and to cover locations with visually observed NAPL seeps*

It is anticipated that a 250-foot long and 22-foot wide roll of LDPE will be available and sufficient to perform th: proposed change. In this case, no seams or breaks in the LDPE liner will be necessary. If, due to field conditi: it is necessary to connect two pieces of liner, the following method will be used:

- The two pieces of liner will be overlapped a minimum of two feet, with the direction of overlap x to minimize the potential for separation (e.g. the uppeT segment of the over lap will be up*grad>eftt or «. JhilJ from die lower).
- Bentonite powder will be placed dry in a minimum 1 -inch thick layer along the inner foot of the overlapped segment.

ATTACHMENTS: (list supporting documentation, if applicable)
Design Change MA, Area i/2 Waterway Profile
*Design Change #&4, Area 3'2 Waterway Cross Section at Swlion 2*50*
*Waterway Design Change *Wf, Area 3/2 Grading Plan from Design Change 6* dated September 30, 2002 &,*£ Revised October 2

APPROVAL SIGNATURES:

Environmental Protection Agency Karen M Lumino Date: 10/21/02

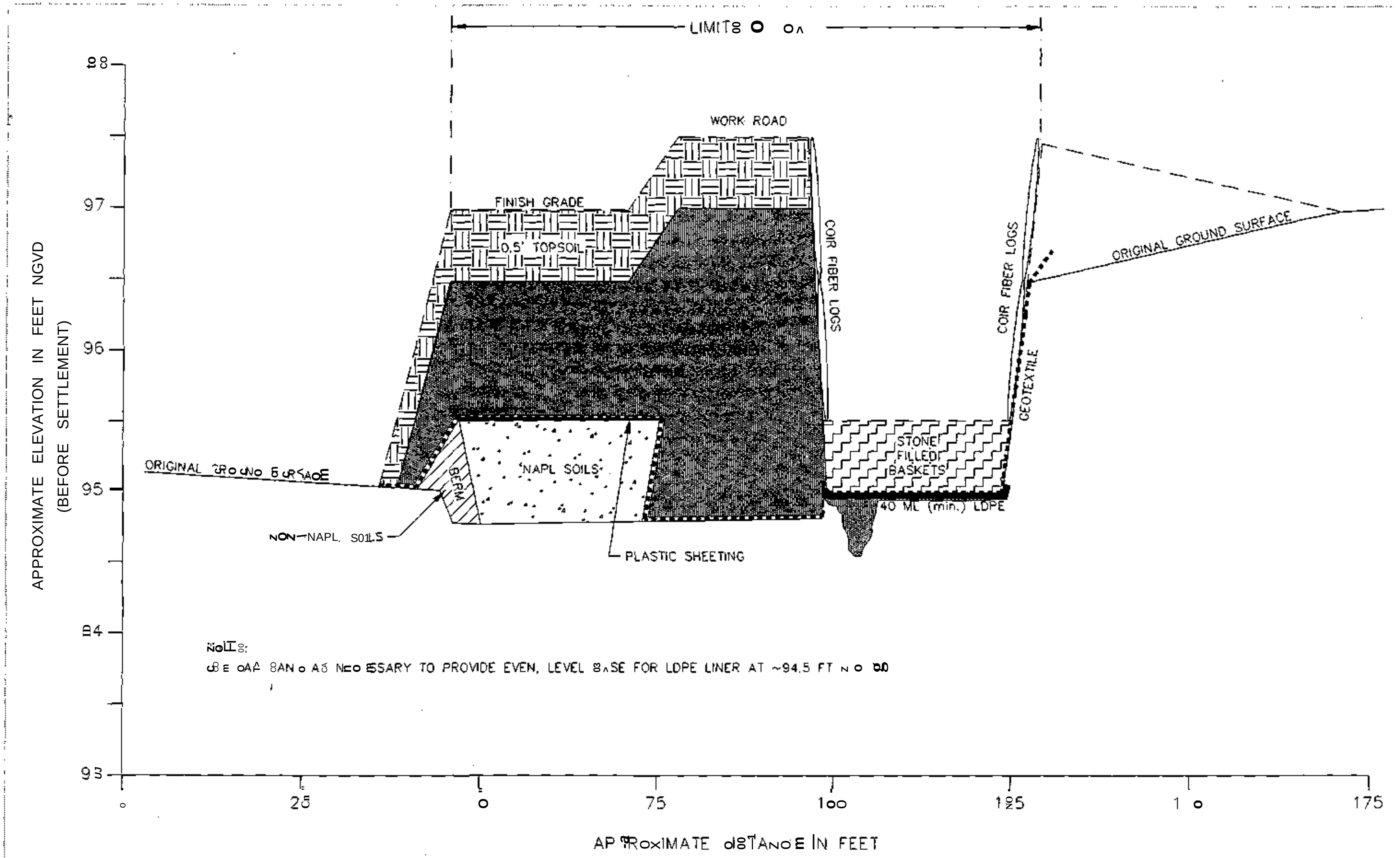
Vennonf Department of Conservation ________ Date: 10/21/02

Engineer ________ Date: 10/17/02

ProjS&1 'Manager________ Date:________

K-AI-OF . ... ign Change 006A revised 10-17-02.wpd

10/21/02 09:13 :02/02 NO:247

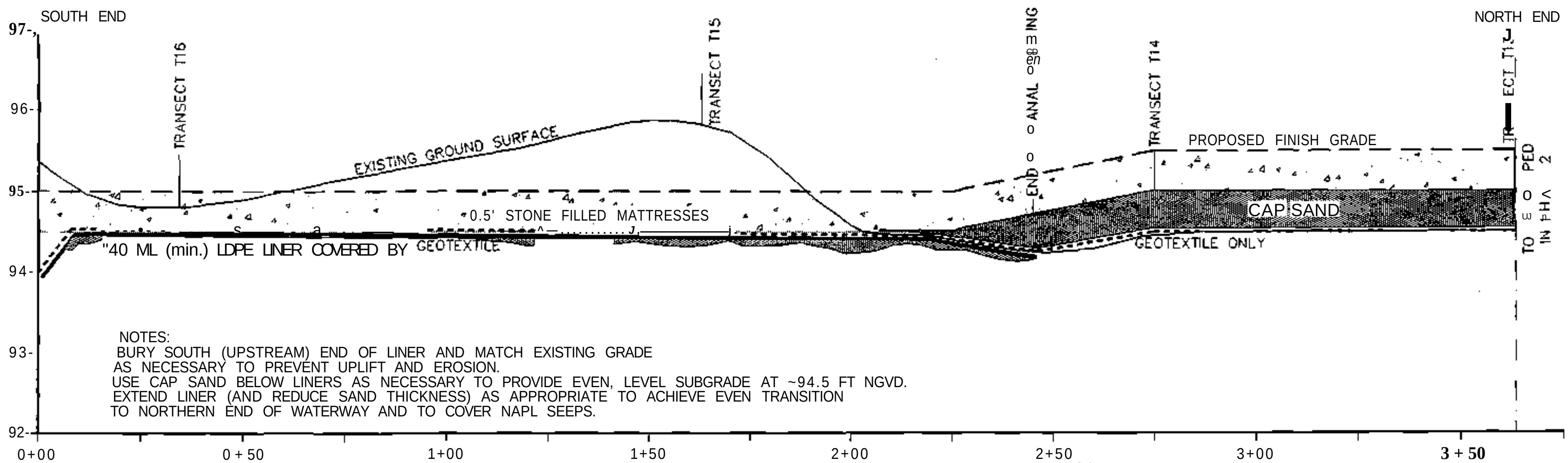


VERTICAL EXAGGERATION = 20:1

WWAYXSEC-REV1.dwg 10/17/02

DESIGN CHANGE #6A: AREA 3/2 WATERWAY
CROSS SECTION AT STATION 2+
PINE STREET CANAL SITE, BURLINGTON, VT

JOHNSON COMPANY, P.C.
Environmental Sciences and Engineering
STATE STREET, MONTPELIER, VT
DATE 10/14/02
PROJECT 1-0870-1
DRAWN BY TJK
SCALE AS SHOWN



NOTES:
BURY SOUTH (UPSTREAM) END OF LINER AND MATCH EXISTING GRADE AS NECESSARY TO PREVENT UPLIFT AND EROSION.
USE CAP SAND BELOW LINERS AS NECESSARY TO PROVIDE EVEN, LEVEL SUBGRADE AT ~94.5 FT NGVD.
EXTEND LINER (AND REDUCE SAND THICKNESS) AS APPROPRIATE TO ACHIEVE EVEN TRANSITION TO NORTHERN END OF WATERWAY AND TO COVER NAPL SEEPS.

PROFILE PROPOSED CUT AND FILL BEFORE CONSOLIDATION

SCALE: 1"=40' HOR.; 1"=2" VER.; VERTICAL EXAGGERATION = 20:1

DESIGN CHANGE #6A
AREA 3/2 WATERWAY PROFILES
PINE STREET CANAL SITE, BURLINGTON, VT

WWAYPROF-revi.dwg 10/17/02 1

COMPANY, INC.
Environmental Science and Engineering
MONTPELIER, VT

DATE: 9/24/02
PROJECT: 1-0870-1
SCALE: AS SHOWN

Design Change Request No. 6B

1-0870-1

de maximis, inc.

135 Beaver Street
Fourth Floor
Waltham, MA 02452
(781) 642-8775
Fax (781) 642-1078

February 17, 2003

Ms. Karen Lumino
United States Environmental Protection Agency
Mail Code: HBT
1 Congress Street
Boston, MA 02114

VIA FAX AND US MAIL

RE: Design Change Request No. 006B
Pine Street Canal Superfund Site, Burlington, Vermont

Dear Ms.Lumino:

Attached is Design Change Request No. 006B for the location of the gabion baskets, and the cribbing berm at the Area 2 Waterway. This Design Change Request incorporates discussion with Jean Choi during his recent visit.

We are requesting EPA approval of this Design Change Request. Please do not hesitate to call me at (781)642-8775 should you have any questions.

Sincerely,
de maximis, inc.

S. McCarthy for:

Thor Helgason
Project Coordinator

cc: Mike Smith - VTDEC
Martha Zirbel - M & E
Deb Roberts
Performing Defendants

Reviewed By:
J:\PROJECTS\l-0870-l\Phase IBVDesign Change No. 6B cover letter.wpd February 17, 2003

PINE STREET BARGE CANAL REMEDIAL ACTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: 006B
Major_____________
Minor______X______
Date of Request: February 14, 2003

RECOMMENDED BY:
EPA
VTDEC
Engineer
Project Manager
Contractor

BACKGROUND
The originally approved Area 2 waterway design was modified in Design Changes 6 and 6A due to the presence of non-aqueous phase liquids in the base soils and the discovery of the eastern cribbing wall as far south as the waterway.

To date, the LDPE 60 mil liner specified in Design Change 6A has been installed, but the rock-filled baskets, coir logs, and other portions of the Area 2 waterway have not been completed north of Station 2+25.

During cap construction in the Canal, it was noted that the southern portions of both the east and west Canal cribbing, composed of driven piles overlaid by a cross beam header, allowed sediments to migrate upwards between the piles during cap placement. To alleviate this problem, a solution was provided for previously capped areas which included removal of the header beam, and placement of bentonite and sand between and on top of the exposed piles (Design Change #013). However, in areas south of Transect 13 + 20 along the west cribbing, and south of approximately Transect 11 + 50 along the east cribbing, the header beam is located at or beneath the existing sediment surface, and removal of it would involve excavation below groundwater, sediment, and NAPL. This was experienced during removal of the cribbing header on the eastern side of the Canal near the south slip (Station T12 +30).

In addition, the currently design of the Area 2 waterway has the rock-filled baskets (which compose the base of the waterway) lying directly adjacent to, and near the same elevation as, the east cribbing piles. This situation of relatively permeable materials (rock baskets) next to a potential pathway (cribbing) is a concern.

CHANGE DESCRIPTION:
To address the concern of the rock baskets near the cribbing pathway, this design change proposes to re-locate the Area 2 waterway five feet westwards from its current design location (without changing its overall width). The change will affect the Area 2 waterway from approximately centerline Stations 2+25 to 3+60 (see attached plan on Figure 1). In addition, this design change proposes placement of an additional 60 mil LDPE liner over to the east cribbing.

To address the concern of removing the buried cribbing header, a revised treatment of the top of the east and west cribbing where the header beam is at or beneath the sediment surface is proposed. This revised treatment involves placement of sufficient cap sand (approximately five feet) over the cribbing to prevent any upward migration of sediment via the cribbing walls, without removing the header beam (see attached cross-sections on Figure 3 and 4). This sand berm would extend five feet past both sides of the cribbing (and in places on the east cribbing, extends onto the LDPE liner - see attached plan) in order to provide sufficient cap thickness in all directions from the cribbing (at least 1.5 feet).

Consolidation
The five foot height of the berm was determined by estimating the probable consolidation of the sediments, while still providing the minimum 1.5 foot isolation thickness (post-consolidation). The estimated consolidation beneath the five feet of proposed cap sand next to the cribbing is approximately two feet. Original estimates for these sediments without any other considerations would suggest greater than two feet of consolidation. However, the

RECEIVED

JOHNSON CO. INC.
MONTPELIER VT

following considerations were taken into account and yielded a lower estimated consolidation: 1) pre-loading by previously placed materials; 2) desiccation and resulting consolidation during the autumn, 2002; 3) observations of approximately 0.5 feet consolidation in the first few days following capping the cribbing further north under cap loads of approximately two to three feet; and 4) measurements of the settlement plates installed at Transect T12+50 in December, 2002 which have been subjected to vehicle loading and temporary stockpiles, as well as two feet of cap sand, have shown consolidation of only about one foot. Substantially less consolidation is expected beneath the Area 2 waterway itself (due to the reduced loading from only the rock baskets), estimated at approximately 0.5 feet (see attached cross sections).

Erosion
Potential erosion of the waterway and berm was considered for this Design Change. The proposed edges of the waterway have generally smoothly curved sides, and are unlikely to erode given the presence of the coir logs and vegetation plantings included in the design. The previous design widths will be maintained, with the exception of the width of the fan at the northern end, which will decrease by five feet. This decrease will not affect the erosion resistance of the waterway, as the purpose of the fan is to disperse the water evenly onto the sand cap, and its width is much larger than the channel portion of the waterway.

As mentioned in the Phase IB Design Report, the design storm results in a maximum water elevation of 96.6 ft NGVD. As shown in the attached cross sections, after expected consolidation occurs, the design storm water stage will be below the top of the coir logs, and erosion of the sand berm will not occur. On the other hand, if consolidation is greater than expected, then the water at flood stage will extend over the adjacent emergent wetlands on the west portion of the Canal, and the full Canal width will be available for passage of the water. Therefore, in the maximum consolidation case, there will be sufficient width to prevent the formation of velocities which would erode the berm.

Wetlands and Planting Plan
The previous designs included the portion of the Canal west of the waterway as emergent wetlands. A five-foot wide strip of this area will be changed to open water as the waterway is moved west. This five-foot strip will be replaced by a five-foot strip on the eastern side of the waterway in the area covered by the sand berm. The design maximum elevation during construction of the sand berm is 99 feet NGVD. Approximately two feet of consolidation is expected, leaving a berm crest at approximately 97 feet NGVD (one foot above the design water level). The estimated final elevation (97 NVGD) is expected to support the establishment of emergent wetlands species, therefore there will be no net loss of emergent wetland area.

No changes are necessary to the planting plan resulting form the re-alignment of the waterway. The planting plan will shift with the alignment. The berms will be covered with 6 inches of topsoil and seeded with wetland grass / seed mix when climatic conditions allow.

ATTACHMENTS: (list supporting documentation, if applicable)

- *Cross Sections of Area 2 Waterway at Transect T14+00 (Station2+65), Design Change 6B*
- *Area 2 Waterway Site Plan, North End, Design Change 6B*

Supporting Documentation References (not attached)

Design Change #6, 6A, and 13 dated 9/30/02, 10/17/02 and 01/16/03, respectively.
Appendix F (Tab 6), Area 2 Geotechnical Evaluation, Phase IB, Volume 2, Remedial Action Design Report

DESIGN CHANGE 6B - APPROVAL SIGNATURES:

Environmental Protection Agency [signature] Date: 2/19/03

Vermont Department of Conservation ______________ Date: ______

Engineer ______________ Date: ______

Project Manager ______________ Date: ______

following considerations were taken into account and yielded a lower estimated consolidation: 1) pre-loading by previously placed sand cap materials; 2) dessication and resulting consolidation during the autumn, 2002; 3) observations of approximately 0.5 feet consolidation in the first few days following capping the cribbing further north under cap loads of approximately two to three feet; and 4) measurements of the settlement plates installed at Transect T12+50 in December, 2002 which have been subjected to vehicle loading and temporary stockpiles, as well as two feet of cap sand, have shown consolidation of only about one foot. Substantially less consolidation is expected beneath the Area 2 waterway itself (due to the reduced loading from only the rock baskets), estimated at approximately 0.5 feet (see attached cross sections).

Erosion

Potential erosion of the waterway and berm was considered for this Design Change. The proposed edges of the waterway have generally smoothly curved sides, and are unlikely to erode given the presence of the coir logs and vegetation plantings included in the design. The previous design widths will be maintained, with the exception of the width of the fan at the northern end, which will decrease by five feet. This decrease will not affect the erosion resistance of the waterway, as the purpose of the fan is to disperse the water evenly onto the sand cap, and its width is much larger than the channel portion of the waterway.

As mentioned in the Phase IB Design Report, the design storm results in a maximum water elevation of 96.6 ft NGVD. As shown in the attached cross sections, after expected consolidation occurs, the design storm water stage will be below the top of the coir logs, and erosion of the sand berm will not occur. On the other hand, if consolidation is greater than expected, then the water at flood stage will extend over the adjacent emergent wetlands on the west portion of the Canal, and the full Canal width will be available for passage of the water. Therefore, in the maximum consolidation case, there will be sufficient width to prevent the formation of velocities which would erode the berm.

Wetlands and Planting Plan

The previous designs included the portion of the Canal west of the waterway as emergent wetlands. A five-foot wide strip of this area will be changed to open water as the waterway is moved west. This five-foot strip will be replaced by a five-foot strip on the eastern side of the waterway in the area covered by the sand berm. The design maximum elevation during construction of the sand berm is 99 feet NGVD. Approximately two feet of consolidation is expected, leaving a berm crest at approximately 97 feet NGVD (one foot above the design water level). The estimated final elevation (97 NVGD) is expected to support the establishment of emergent wetlands species, therefore there will be no net loss of emergent wetland area.

No changes are necessary to the planting plan resulting form the re-alignment of the waterway. The planting plan will shift with the alignment. The berms will be covered with 6 inches of topsoil and seeded with wetland grass seed mix when climatic conditions allow.

ATTACHMENTS: (list supporting documentation, if applicable)

Cross Sections of Area 2 Waterway at Transect T14+00 (Station2+65), Design Change 6B
Area 2 Waterway Site Plan, North End, Design Change 6B

Supporting Documentation References (not attached)

Design Change #6, 6A, and 13 dated 9/30/02, 10/17/02 and 01/16/03, respectively.
Appendix F (Tab 6), Area 2 Geotechnical Evaluation, Phase IB, Volume 2, Remedial Action Design Report

DESIGN CHANGE 6B - APPROVAL SIGNATURES:

Environmental Protection Agency________________________________Date:_______________

Vermont Department of Conservation_____________________________Date:_______________

Engineer__[illegible]__Date:__[illegible]__

ProjecTManager____Date:_______________

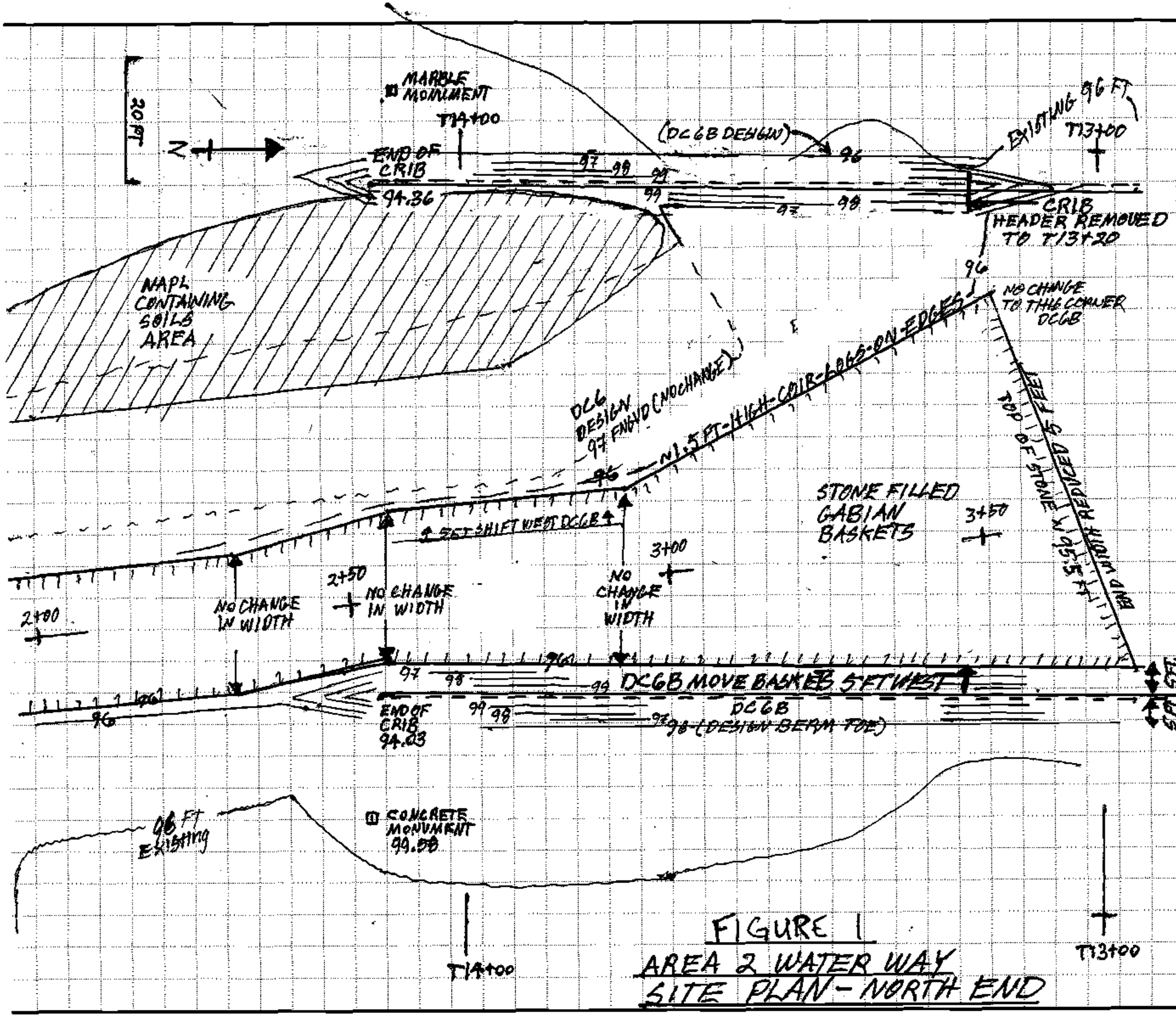


FIGURE 1

AREA 2 WATER WAY SITE PLAN - NORTH END

DESIGN CHANGE 006B

JOB PINE STREET CANAL SUPERFUND SITE BURLINGTON, VERMONT

SHEET NO. ____ OF ____

CALCULATED BY D. MAYNARD, P.E. DATE 2/10/03

CHECKED BY ____ DATE ____

SCALE 1"=20 FT

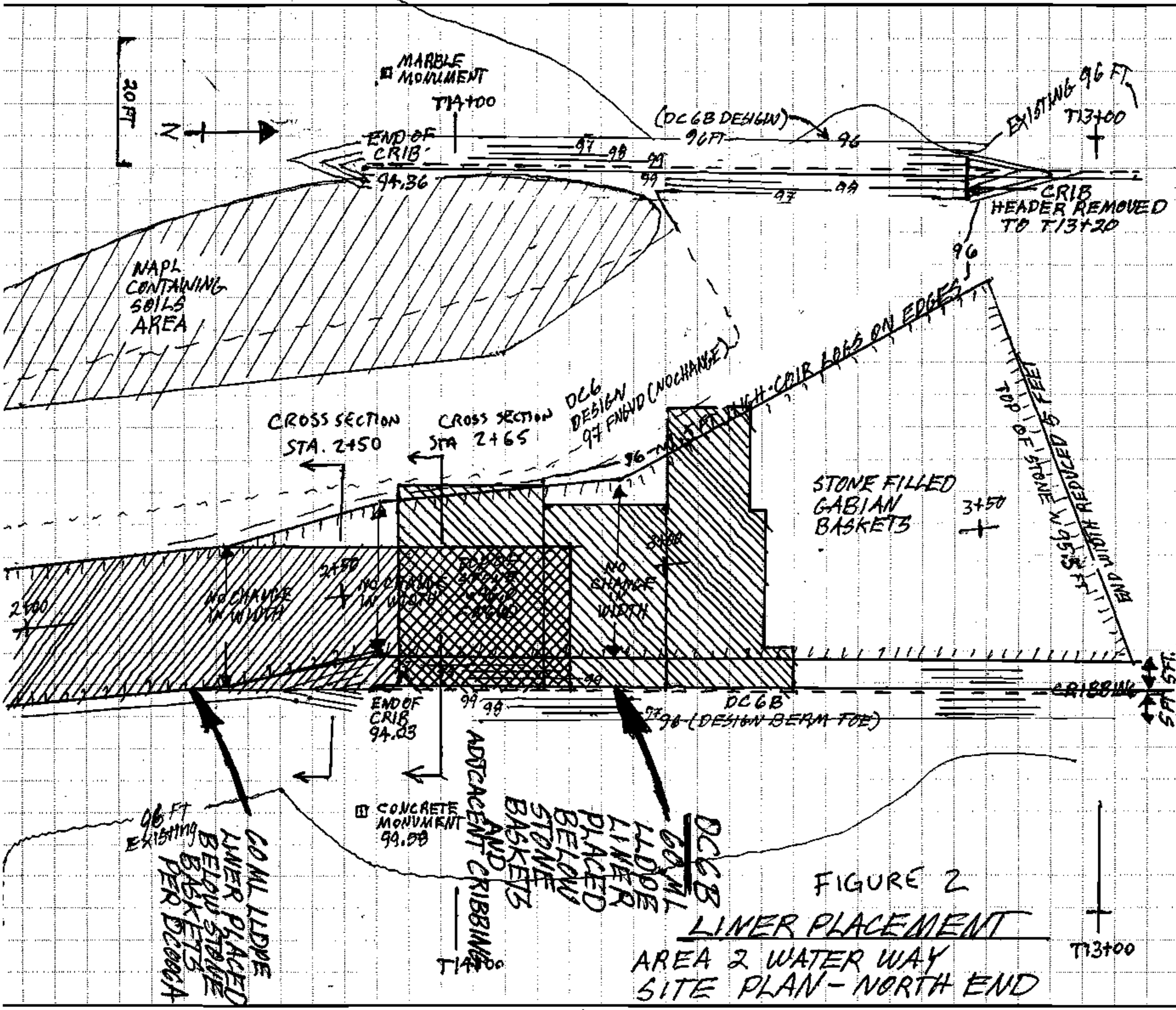


FIGURE 2

LINER PLACEMENT

AREA 2 WATER WAY SITE PLAN - NORTH END

JOB ______ VERMONT

SHEET ______

CALCULATED BY D. ______ PE

CHECKED BY ______ DATE ______

SCALE 1" = 20 FT

THE JOHNSON CO., INC.
100 State Street, Suite 600
MONTPELIER, VERMONT 05602
(802) 229-4600

JOB PINE 3Tj?££rr £A,VArl AtSPJ&?tt//MPJ/&r

SHEET NO. ______ OF ______

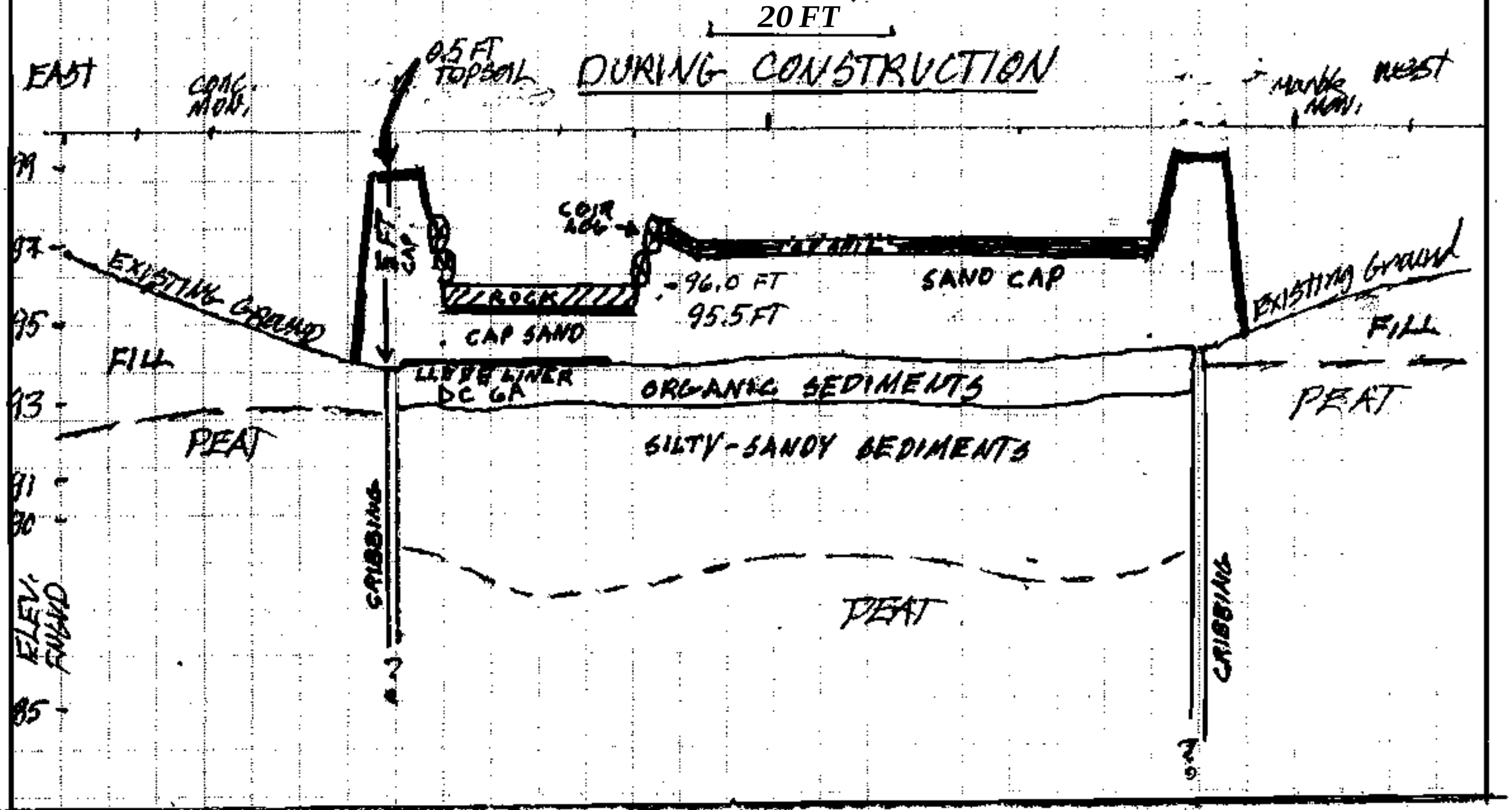
CALCULATED BY P, Mu*?M^. DATE ^ - ^ T ©

CHECKED BY ______ DATE ______

SCALE 1" = 20' horizontal, 1" = 5' vertical

FIGURE S

Remedial Action PHASE 1B DESIGN CHANGE 6B
CROSS SECTION OF PROPOSED REALIGNED WATERWAY
AT SOUTH END OF CANAL, STATION 2+50, TRANSECT T14+15



JOB PINE STREET CANAL SUPERFUND SITE

SHEET NO. ______ OF ______

CALCULATED BY D. Maynard DATE 2/10/03

CHECKED BY ______ DATE ______

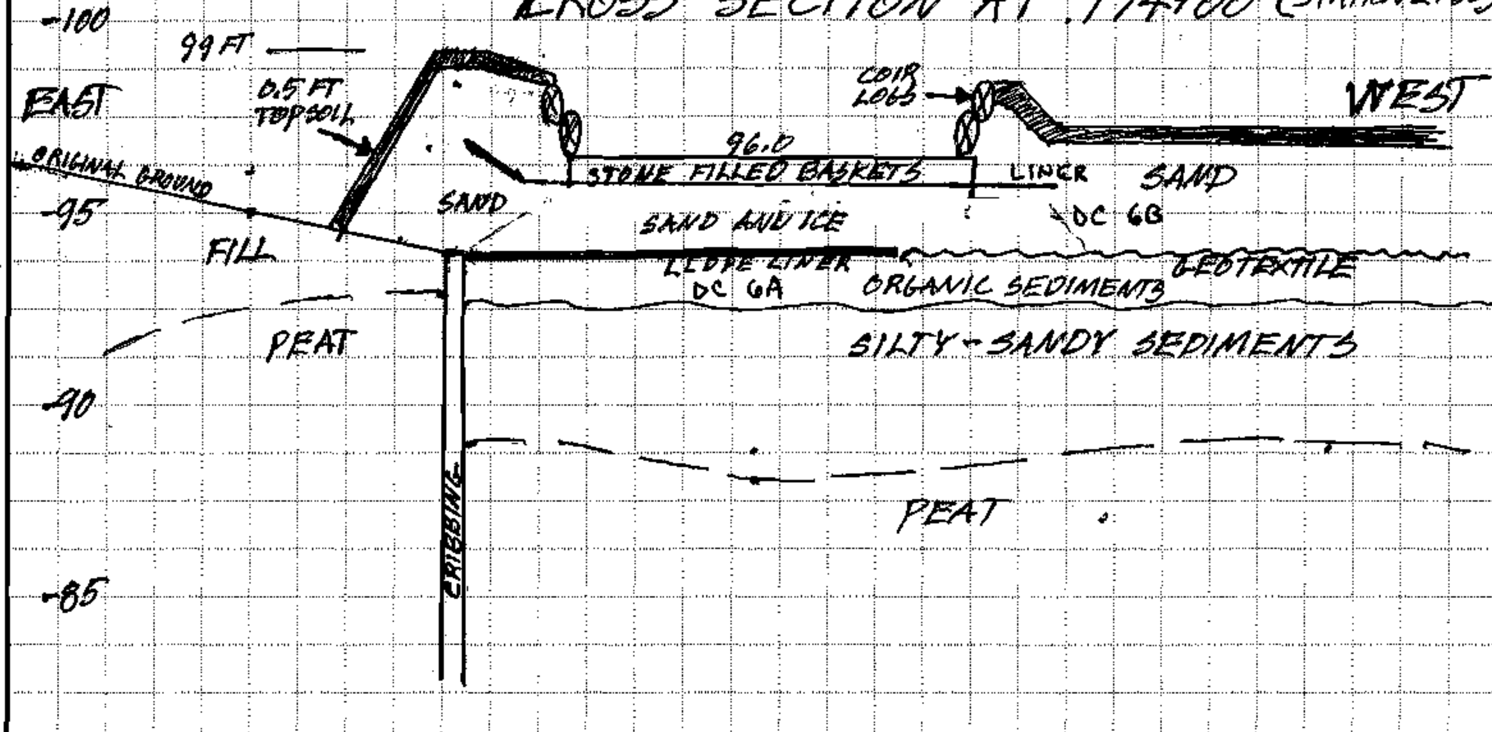
SCALE 1" = 10 FT HORIZONTAL, 1" = 5 FT VERTICAL

FIGURE 4

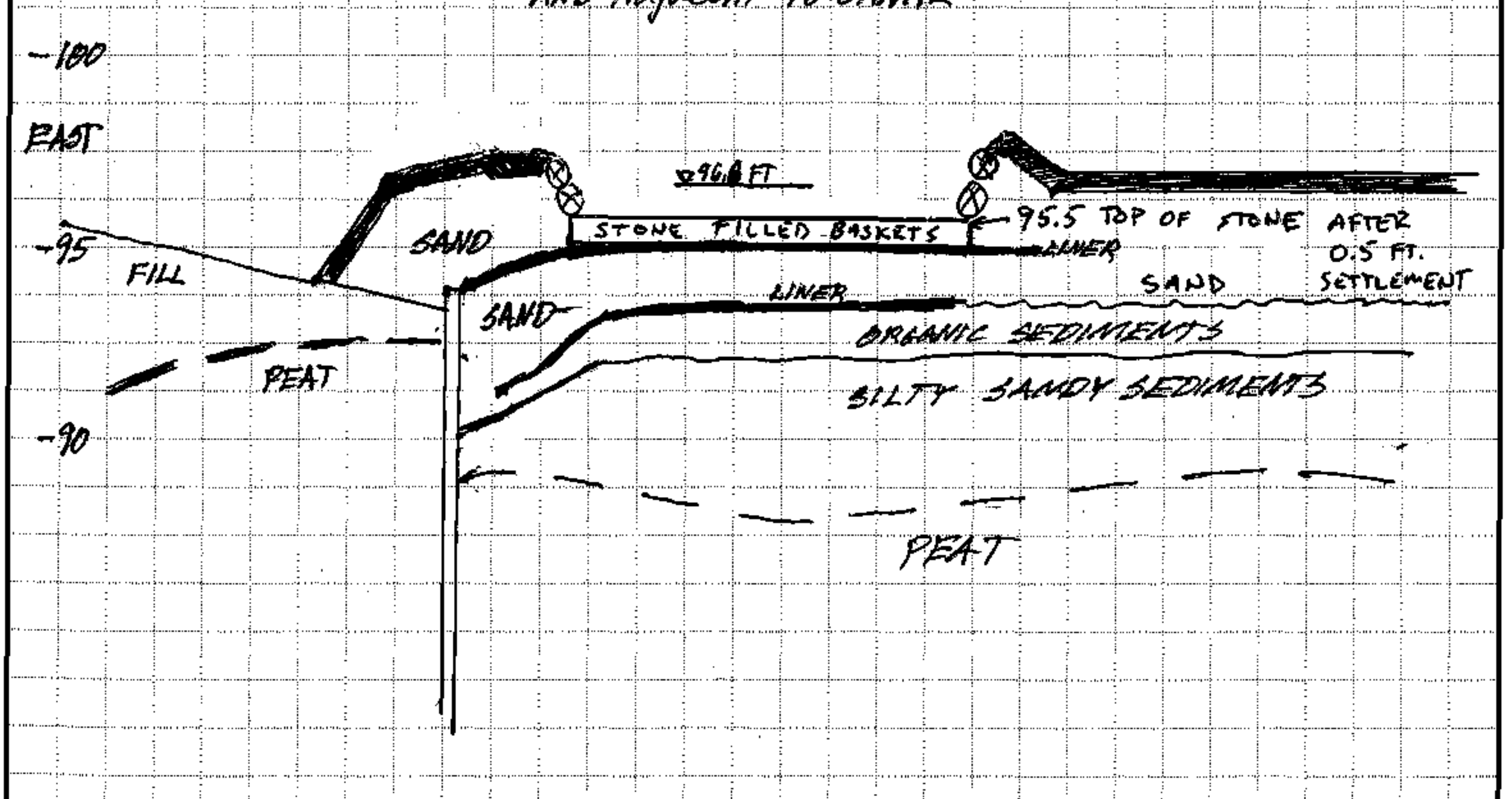
DESIGN CHANGE 6B

AREA 2 WATER WAY DURING CONSTRUCTION

CROSS SECTION AT T/4+00 (STATION 2+65)



AFTER CONSOLIDATION
(ESTIMATED TWO FEET BELOW BERM
AND 0.5 FEET BELOW WATERWAY)
AND Adjacent TO CANAL



THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 State Street, Montpelier, Vermont 05602
Phone: (802)229-4600
FAX: (802)229-5876

FACSIMILE COVER PAGE
February 17, 2003

TO: Karen Lumino - 617-918-1291
Mike Smith - 241-3296

c: Martha Zirbel - 781 -224-6548
Deb Roberts - 518-743-9315
Thor Helgason - 781-642-1078
Roy Wagner/Don Maynard - 802-651-4096

FROM: Chris Crandell

JCO#: 1-0870-1 PHONE CODE: 871

NUMBER OF PAGES, INCLUDING COVER PAGE: 8

Please call if there are any problems with this transmission.

Message

J:\PROJECTS\l-0870-l\Phase IB\DC 6B fax cover.wpd February 14, 2003

Design Change Request No. 7

PINE STREET BARGE CANAL REMEDIAL ACTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: 007
Major ____________
Minor _____X_____
Date of Request: October 1, 2002

RECOMMENDED BY:

EPA
VTDEC
Engineer
Project Manager
Contractor

CHANGE DESCRIPTION:

A minor design change for the North Road drop inlet is necessary to allow germination of the seeds in Area 7 in the event of a significant precipitation event. The six-foot diameter drop inlet, as designed and installed, includes a level crest at 100.0 ft NGVD and a 12-inch diameter drain set with an invert of 97 ft NGVD (please refer to Detail 2 on Sheet 2 of 8 in the approved Design Drawings). Recent precipitation events (such as the 2.2 inches of rain on September 27) resulted in Area 7 water levels temporarily rising to elevations of 100.5 ft NGVD or above. If such an event occurred after the Area 7 wetlands had been seeded, but before germination, the seeds would likely float away.

The proposed change is to cut a window in the drop inlet to allow storm water to by-pass Area 7 while minimizing the increase in water level. The window will be one foot high, and three feet wide, and will be cut on the south (up-stream) side of the drop inlet (please refer to the attached *Design Change #7, Drop Inlet Detail).* The window invert will be at 98.5 ft NGVD. This will provide a minimum of six inches of galvanized metal pipe above and below the window to maintain the structural integrity of the drop inlet.

After the seed has germinated (possibly in late November, 2002 or in summer 2003), the window will be permanently sealed. The seal will consist of a galvanized metal pipe (GMP) patch cut from a six-foot diameter pipe that is two feet high and four feet long. This patch will extend past the window for six inches on all sides, and will have similar corrugations to the existing drop inlet pipe.. Mastic (minimum one-inch thick) will be placed between the inlet pipe and the seal, and mechanical fasteners (ten 3/8-inch diameter bolts) will be used to secure the patch to the pipe. The patch will be placed on the outside of the inlet pipe to provide the most resistence to hydrostatic pressures when the Area 7 water level is at its normal level of 100 ft NGVD.

ATTACHMENTS: (list supporting documentation, if applicable)

Design Change #7, Drop Inlet Detail

Supporting Documentation References (not attached)
Approved Design Drawings: Sheet 2 of 8, Detail 2

APPROVAL SIGNATURES:

Environmental Protection Agency________________________________Date:_______________

Vermont Department of Conservation______________________________Date:_______________

10-2-02

Project Manager____________/________________________________Date:_______________

PINE STREET BARGE CANAL **REMEDIAL ACTION**
DESIGN CHANGE NOTIFICATION/REQUEST **FORM**

Design Change Number 007
Major______________
Minor______X______
Date of Request: October 1, 2002

RECOMMENDED BV:

EPA
VTDEC
Engineer
Project Manager
Contractor

CHANGE DESCRIPTION:

A minor design change fnr the North Road drop inlet is necessary to allow germination of the seeds in Aree, ?.: the event of a significant precipitation event. The six-foot diameter drop inlet, as designed and installed, inc ....:.•; level crest at 100.0 ft NGVD and a 12-inch diameter drain set with an invert of 97 ft NCiVD (please refer to ". .. 2 on Sheet 2 of 8 in the approved Design Drawings). Recent precipitation events (such as the 2.2 inches of r;:.i: ·^ .. September 27) resulted in Area 7 water levels temporarily rising to elevations of 100,5 ft NGVD or above, if auv';; an event occurred after the Area 7 wetlands had been seeded, but before germination, the seeds would likely f!:oftt away.

The proposed change is to cut a window in the drop inlet to allow storm water to by-pass Area 7 while *tmrnt;uix:.* the increase in water level. The window will be one foot high, and throe fed wide, and will be cut on the soiiv.,1 (up-stream) side of the drop inlet (please refer to the attached *Design Change #7, Drop Inlet Detail).* The wr. 2;w invert will be at 98.5 ft NGVP, This will provide a minimum of six inches of galvanized metal pipe abo-vs •'. bislow the window (o maintain the structural integrity of the drop inlet.

After the seed has germinated (possibly in late November, 2002 or in summer 2003), the window wili be permanently sealed. The seal will consist of a galvanized metal pipe (GMP) patch cut from a six-foot *aiaxx* . pipe that is two feet high and four feet long. This patch will extend past the window for six inches on si-. :J:;; will have similar corrugglions to the existing drop inlet pipe.. Mastic (minimum one-inch thick) will be plac : between the inlet pipe and the seal, and mechanical fasteners (ten 3/8-inch diameter bolts) will be used to St.- the patch lo ihe pipe. The parch will be placed *on* I hi: ouwuk of ibe inlet pipe to provide the most resistenc hydrostatic pressure? when the Area 7 water level is at its normal level of 100 ft NGVD,

ATTACHMENTS; (list supporting documentation, if applicable)

Design Change #7, prop Inlet Detail

Supporting Documentation References (not attached)
Approved Design Drawings: Sheet 2 of 8, Detail 2

APPROVAL SIGNATURES;

Environmental Protection Agency Karen Lumino Date: 10/4/02

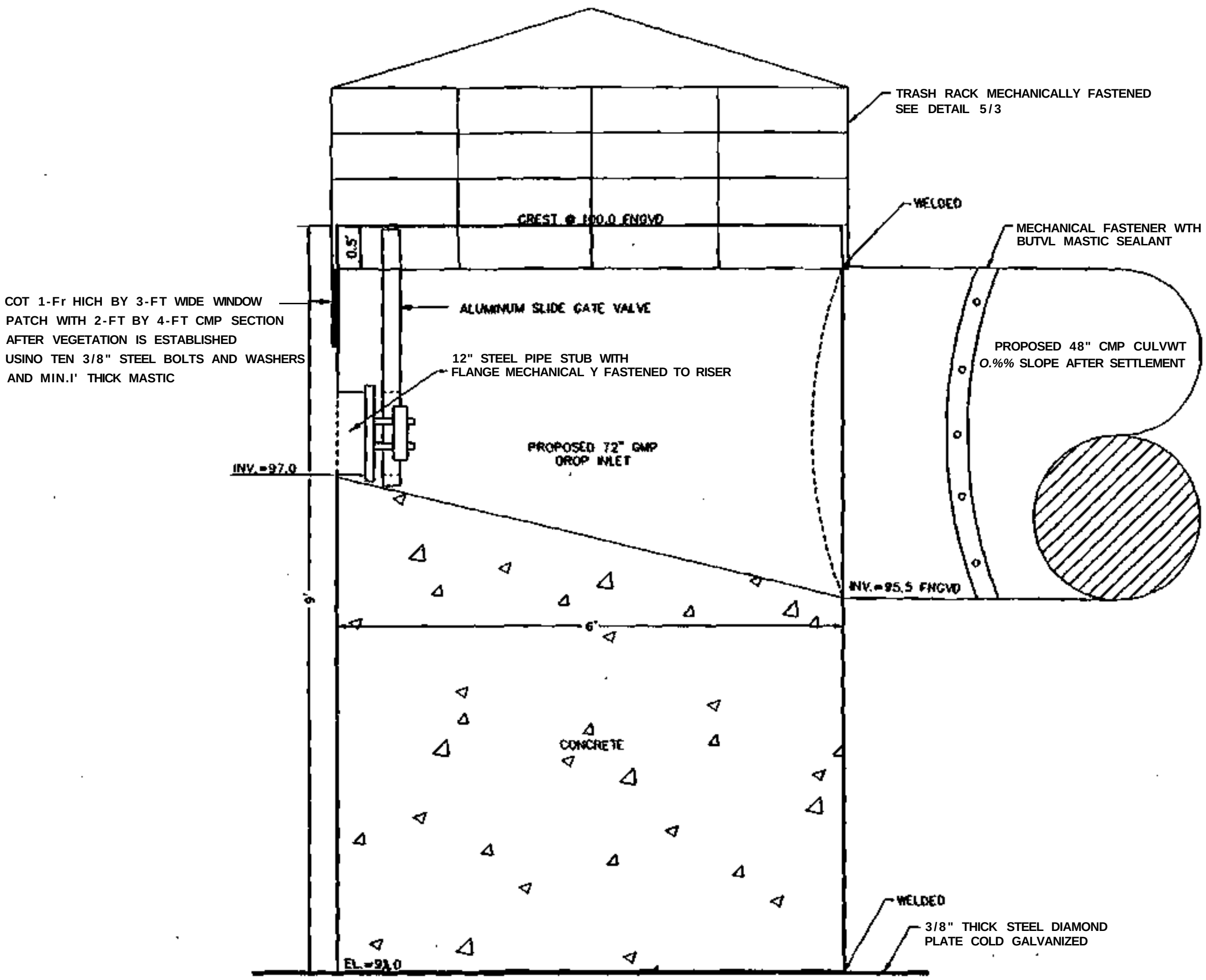
V(SitriOjrt £)cpiiu'trnent of Conservation. ____ Date: /3 dCT 02

Engineer ____ Date: 10-2-02

• Project Matiagcr____ Date:____

V 'Jincnnalgn Ovtimt 0W. Vptl

DESIGN CHANGE No. 7 - Drop Inlet Detail - October 1,2002



STRUCTURAL BEDDING
COMPACTEO 85X OPT. OENSITY
SEE SPECIFICATIONS SECTION 02221

SECTION NORTH ROAD CULVERT OROP INLET
:V-V.I: NONE 10/01/02 Design Choree #7 V.2.

Design Change Request No. 8

PINE STREET BARGE CANAL REMEDIAL ACTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: 008
Major____________
Minor _____X______
Date of Request: October 2,2002

RECOMMENDED BY:
EPA___________________
VT DEC
Engineer __)(___________
Project Manager___________
Contractor

CHANGE DESCRIPTION:

A minor design change for the Area 7 grading plan is necessary to accommodate existing field conditions and to improve erosion resistence. The design change includes three parts: 1) revise the slope of the native soil outside the capped area on the northeast side and remove relict grading contours; 2) revise the slope of the capped uplands area on the southwest side; and 3) provide erosion resistant materials in areas receiving local concentrated storm water runoff from off-site (portions of the DPW yard and Gilbane parking). The rationale for, details of, and expected consequences of, these changes are provided below. The approved design is shown on Sheet 1 of 8 of the approved Design Drawings.

Part 1: Revise the slope of the native soil on the northeast side outside the capped area and remove relict grading contours

The grading for the northeast side of Area 7 requires a cut of up to two feet of uncontaminated materials outside the cap in order to provide a smooth transition between the uncapped to the capped surfaces (please refer to the attached *Design Change #8, Area 7 Grading Plan - Northeast side).* The approved grading plan specifies a slope of approximately 20% (1:5). The proposed change is to increase the slope to a maximum of approximately 33% (1:3). This change will reduce the volume of "clean" un-capped soils which will need to be excavated. This change in grading only affects elevations of 101 ft NGVD and above, so the wetlands balance, and areal extent of cap remain unchanged.

The other change included in this part is to remove relict mounds which were present at the downstream end of the Area 7 waterway. The grading change is indicated by two bold 99 and 100 ft NGVD contour segments, as shown on the attached *Design Change #8, Area 7 Grading Plan - Northwest side.* The two mounds which are being cut down (at elevation 100 ft NGVD) are relicts of a historical road which extended northeast/southwest across Area 7, and which was removed for the construction of the waterway. Removal of the mounds will improve the hydraulic capacity of the waterway and better flow distribution through the wetlands. There are no expected adverse consequences to this proposed change.

Part 2: Revise the slope of the capped uplands area on the south side of Area 7

The southwest side of Area 7 was designated as the receiving area for phragmites root mass, chipped wood, and sediments which were excavated from other portions of Area 7 in order to meet the design grades. This mound of materials will be capped in the same manner as the rest of Area 7. The approved design includes a 10% (1:10) slope for the northern side of the mound. The proposed change is to increase the slope above elevation 102 ft NGVD to as much as 20% (1:5). This change may be necessary in order to accommodate the volume of material which has been excavated. This change does not include any increase in the maximum elevation of the mound. The attached *Design Change #8, Area 7 Grading Plan - Southwest side,* shows the elevation contours representing the maximum slope which would be constructed if this change is approved. The actual as-built slope is likely to be somewhere between 10% and 20%, depending upon the final volume of materials excavated in other portions of Area 7.

The proposed change in grading is all above 102 ft NGVD, so the areal extent and balance of wetlands will not be impacted. The proposed maximum 20% grade will not cause undue erosion of the cap because only limited precipitation falling directly on the slope will run off, and seeding will be mulched prior to germination . The proposed change will insure that all phragmites roots are retained in Area 7 (instead of being sent to Area 3). There are no expected adverse consequences to this proposed change.

Part 3: Provide erosion resistant materials in areas receiving local concentrated storm water runoff

Existing off-site grades on the Department of Public Works and Gilbane properties concentrates stormwater runoff from local areas so that it flows towards the new Gilbane manhole (please refer to the attached *Design Change* #5, *Area 7 Grading Plan - South side).* This runoff may cause local erosion of the cap prior to establishment of vegetation if it is constructed of sand and topsoil as currently specified. The proposed change is to provide a stone-lined swale, approximately five feet wide (or less) and 0.5 feet deep in place of the 0.5 foot thick topsoil specified in the approved plans. This swale will collect the concentrated runoff, and guide it northwards approximately 60 feet along the western edge of Area 7 until it can be dispersed across a wide flat area of the cap. This change includes the option for the on-site Engineer to make minor adjustments to the length and location of the swale to best match existing and proposed conditions. The proposed change in grading is all above 102 ft NGVD, so the areal extent and balance of wetlands will not be impacted. There are no expected adverse consequences to this proposed change.

Also included in this part is the addition of erosion resistant materials (stone) around the downstream (northern) end of the newly installed 36-inch Gilbane culvert (please refer to the attached *Design Change* #5, *Area 7 Grading Plan - Northwest side* for the proposed location of stone placement). The placement of erosion resistant materials at this location will reduce the potential for undermining of the culvert. This work was suggested by Jean Choi of EPA. There are no expected adverse consequences to this proposed change.

ATTACHMENTS: (list supporting documentation, if applicable)

Maps comparing approved design and proposed changes:
Design Change #5, *Area 7 Grading Plan - Northeast side*
Design Change #8, Area 7 Grading Plan - Southwest side
Design Change #8, Area 7 Grading Plan- Northwest side

Supporting Documentation References (not attached)
Approved Design Drawings: Sheet 1 of 8, Grading Plan, Area 7 Cap

APPROVAL SIGNATURES:

Environmental Protection Agency________________________________Date:_______________

Vermont: Department of Conservation____________________________Date:_______________

Engirieirl Mo. 6070 \ti% \M/K T2W*^ W____________Date: 10/3 /02

Project idMfflftfty $ / "____Date:_______________

Part 3: Provide erosion resistant materials in areas receiving 1rtt:itl f.°Pcentl fttted stoml Wftter runoff
Existing off-site grades on the Department of Public Works and Gilbane properties concentrates Btonnwater r.;viof from local areas so that it flows towards the new Gilbane manhole (please refer 10 the attached *Design Chang! ?*, *Area 7 Grading Plan - South side).* This runoff may cause local erosion of the cap prior to establishment cf vegetation if it is constructed of sand and topsoil as currently specified. The proposed change is to provide ;.:. lined swale, approximately five feel wide (or legs) and 0.5 feet deep in place of the 0.5 foot thick topsoil s in the approved plans. This swale will collect the concentrated runoff, and guide it northwards approximate feet along the western edge of Area 7 until it can be dispersed across a wide flat area of the cap. This changt includes the option for the on~site Engineer to make minor adjustments to the length and location of the gwak, best match existing and proposed conditions. The proposed change in grading is all above 102 ft NGYD, so ths areal extent and balance of wetlands will not be impacted. There are no expected adverse consequences tj proposed change.

Also included in this part is the addition of erosion resistant materials (stone) arouttd the downstream (norther) end of the newly installed 36-inch Gilbane culvert (please refer to the attached *Design Change #8, Area* 7 G^i;", *Plan - Northwest side* for the proposed location of stone placement). The placement of erosion resistant raati at this location will reduce Ihe potential for undermining of the culvert, This work was suggested by Jean C EPA. There arc ho expected adverse consequences to this proposed change.

ATTACHMENTS: (H$t supporting documentation, if applicable)

Maps comparing approved design and proposed changes:
Design Change ffl, Area 7 Grading Plan - Northeast side
Design Change #5, Area 7 Grading Plan - South-west side
Design Change #8, Area 7 Grading Plan - Northwest side

Supporting Documentation References (not attached)
Approved Design Drawings.[1] Sheet 1 of 8, Grading Plan, Area 7 Cap

APPROVAL SIGNATURES:

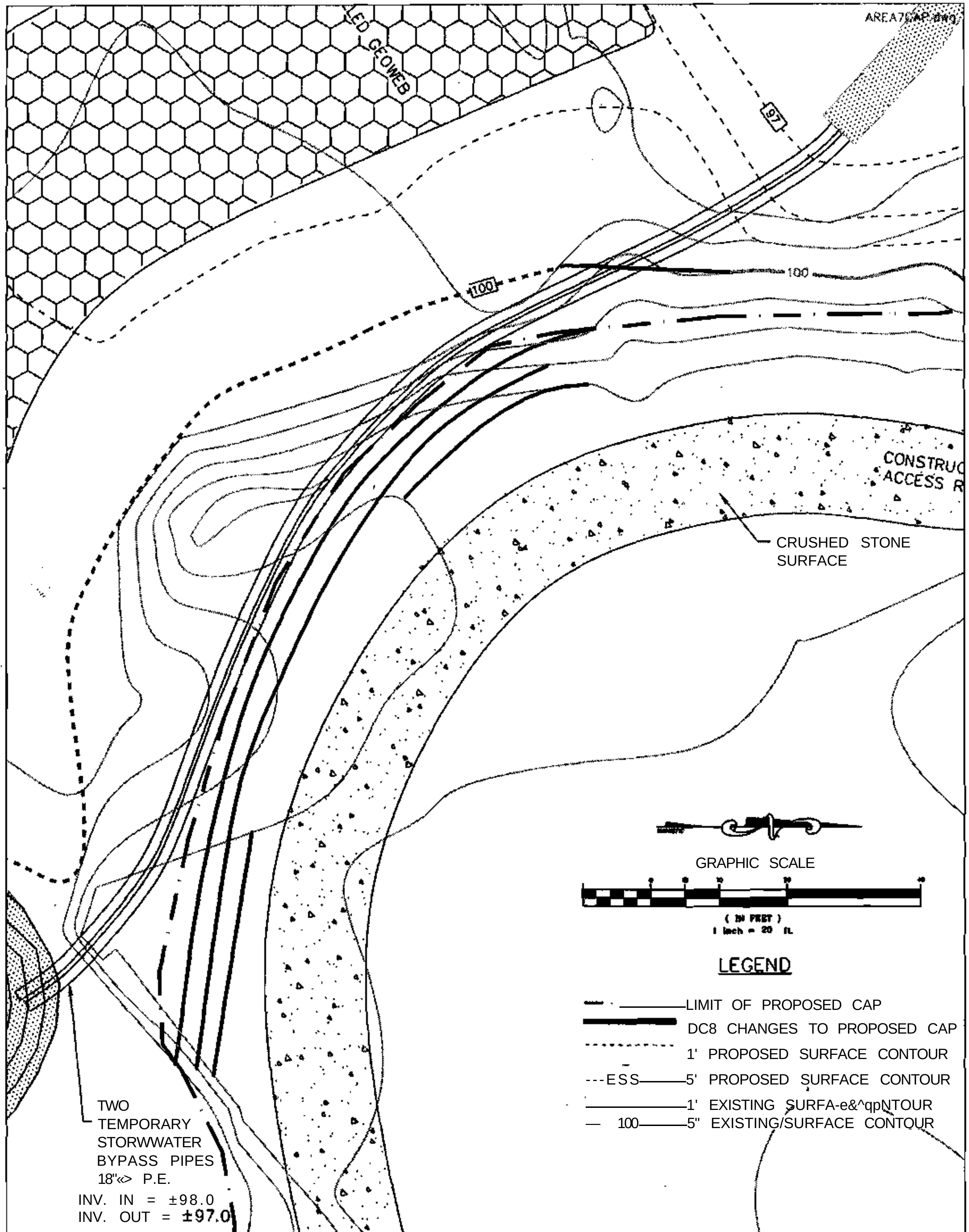
Environmental Protection Agency Date: 10/10/02

Vermont Department of Conservation **Date:** 10/15/02

Engineer **Date:** 10/3/02

Project Manager **Date:**

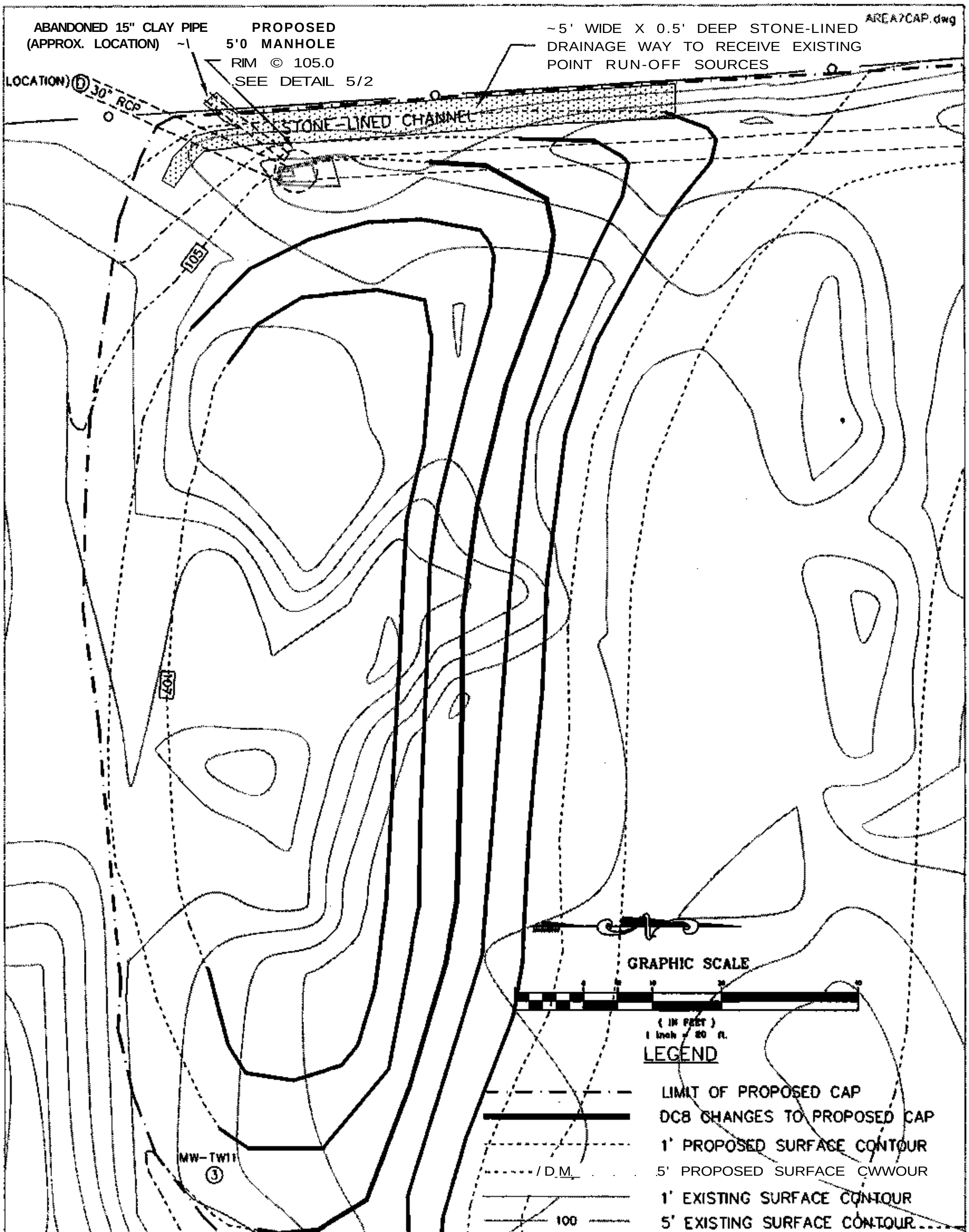
I;vtROjeCTS\I-0I7(LHFM«, unfealp, O m M ODt.vnd



DESIGN CHANGE #8
AREA 7 GRADING PLAN • NORTHEAST SIDE
PINE STREET CANAL, BURLINGTON, VERMONT

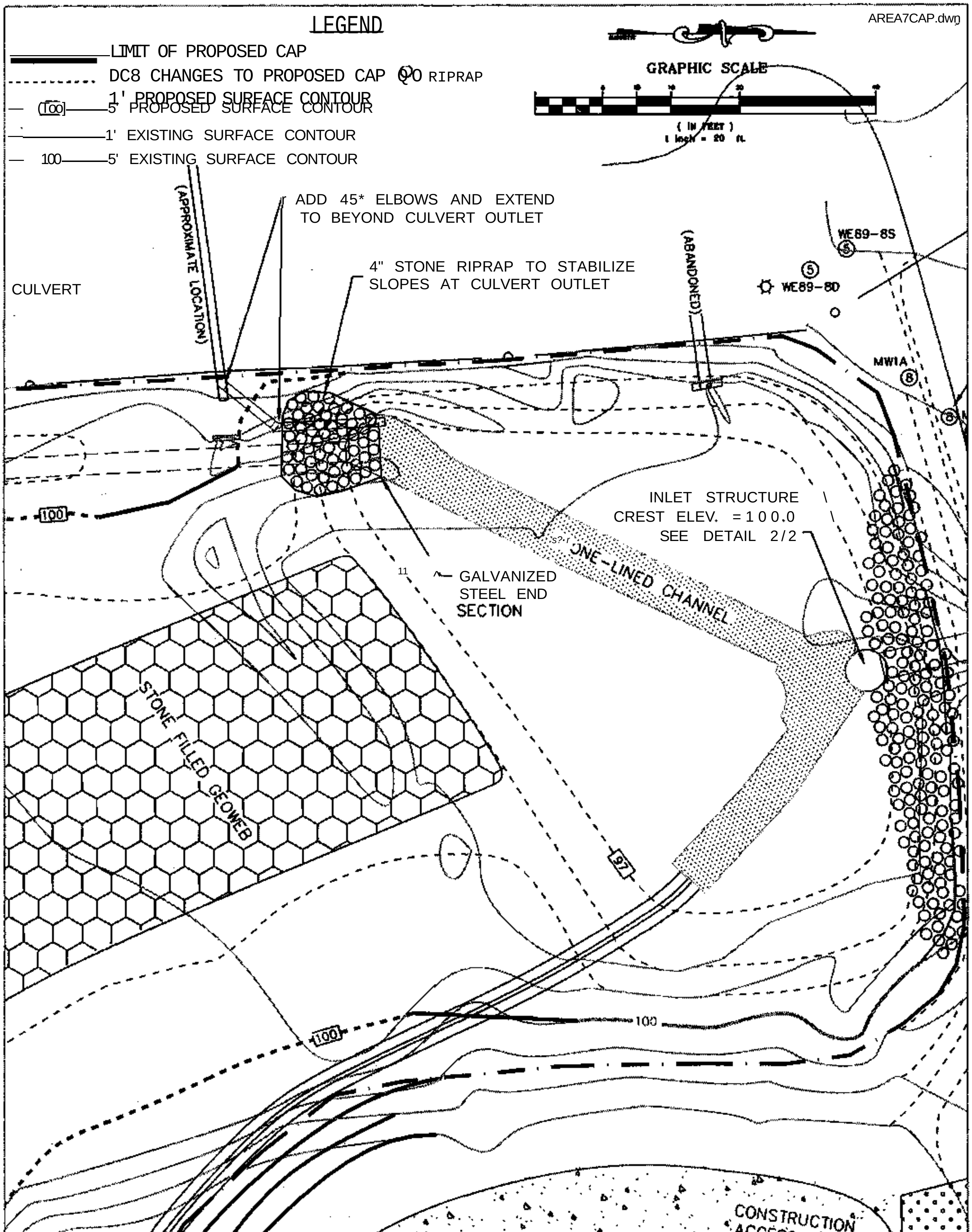
THE JOHNSON COMPANY, INC.
Environmental Scitrnxes and Engineering
100 STATE STRKT MONTPEUER, VT 05503

DATE; Rev. 9/30/02 PROJECT. i~087G-i
DRAWN BY: R«v RTK SCALE: 1:20



DESIGN CHANGE #8
AREA 7 GRADING PLAN - SOUTHWEST SIDE
PINE STREET CANAL, BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC.
Environmental Sciences and SngirmeHng
100 STATE STREET MONTPSUER. VT 05602
DATE- Re*. 9/30/02 PROJECT; 1-0870-1
DRAWN SY; R«v. RTK SCALE: 1:20



DESIGN CHANGE #8
AREA 7 GRADING PLAN - NORTHWEST SIDE
PINE STREET CANAL, BURLINGTON, VERMONT

THE JOHNSON COMPANY INC.
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VT 05602

DATE: Rev. 9/30/02 PROJECT: 1-0870-1
DRAWN BY: Rev, RTK SCALE: 1:20

Design Change Request No. 9

X7

de maximis, inc.

135 Beaver Street
Fourth Floor
Waltham, MA 02452
(781) 642-8775
Fax (781) 642-1078

October 25, 2002

Ms. Karen Lumino *VIA FEDEX*
United States Environmental Protection Agency
Mail Code: HBT
1 Congress Street
Boston, MA 02114

RE: Design Change Request No. 9
Pine Street Canal Superfund Site, Burlington, Vermont

Dear Ms. Lumino:

Attached is Design Change Request No. 9. This Design Change Request addresses expanding the stone area at the Area 7 polishing pond (part 1), and filling the temporary drain pipes (part 2). Details are attached.

Please do not hesitate to call me at (781)642-8775 should you have any questions.

Sincerely,
de maximis, inc.

5 rt/id^Mh (en:

Thor Helgason ^
Project Coordinator

cc: Mike Smith -VTDEC
Chris Crandell - The Johnson Co. (w/o attachment)
Roy Wagner - *de maximis, inc.*

J:VPROJBCTS\l-0870-l\Phase 2\design change 9 cover letter.wpd October 25, 2002

PINE STREET BARGE CANAL REMEDIAL ACTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: 009
Minor ____X_____
Date of Request: October 25, 2002

RECOMMENDED BY:

Engineer ____X________

CHANGE DESCRIPTION:

Part 1: This proposed design change consists of expanding the area of the stone surface at the Area polishing pond to that within the El. 97.0 contour, and the small section of sideslope between the El. 97.0 contour and the end of the stone geoweb. Implementation of this proposed change will improve erosion resistance at the end of the stone geoweb, and improve the effectiveness of the long-term operation and maintenance at the polishing pond. The attached Figure shows the proposed expanded area for the stone placement. The expanded stone area will have eight inches of cap sand, and six inches of stone.

Part 2: The work plan states that the two 18 inch diameter HDPE temporary storm water pipes will be removed when they are no longer needed. Due to construction logistic and efficiency it is preferred to abandon the pipes in place. The pipes would be filled with a low strength cement and sand grout to assure that the pipes will not "float " due to hydrostatic pressure and to limit the effect of frost. A concrete pump will be used to fill the pipes with the grout. The volume of the pipes will be calculated based on field measurements and grout will be placed to occupy at least 90 per cent of the void volume.

ATTACHMENTS: (list supporting documentation, if applicable)

Map showing proposed changes: *Design Change #9, Area 7 Landscaping Plan - North side*

Supporting Documentation References (not attached)
Approved Design Drawings: Sheet 1 of 8, Grading Plan, Area 7 Cap; Sheet 4 of 8 Area 7 Landscaping Plan
Approved Remedial Action Workplan: Revision 1, June 17,2002, Page 13 of 28

APPROVAL SIGNATURES:

Environmental Protection Agency.______________________ **Date:**__________

Vermont Department of Conservation______________________ **Date:**__________

STATE OF VERMONT
JOEL BEHRSING
No. 6070
REGISTERED
PROFESSIONAL ENGINEER

Engineer. Joel Behrsing______________________ **Date:** 10/25/02

Project Manager Thor Helgeson by Joel Behrsing______________________ **Date:** 10/25/02

K:\l-O87O-l\Phase IB\Design Change 009revlO-25-02.wpd

PINE STREET BARGE CANAL REMEDIAL ACTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: *009*
Minor_____X_____
Date of Request: October 25, 2002

RECOMMENDED BY:

Enjtineer ____X_______

CHANGE DESCRIPTION:

Part I: This proposed design change consists of expanding the area of the stone surface at the Area polishing pond to that within the El. 97.0 contour, and the small section of sideslope between the *El.* 97.0 contour and the end of the stone gcoweb. Implementation of this proposed change will improve erosion resistance at the end of the stoae geoweb, and improve the effectiveness of the long-tenn operation and maintenance at the polishing pond. The attached Figure shows the proposed expande<l area for the stone placement. The expanded stone area will have eight inches of cap sand, and six inches of stone.

Part *1:* The work plan slates that the two 18 inch diameter ITDPE temporary storm water pipes will be removed when they are no longer needed. Due io construction logistic and efficiency it is preferred to abandon the pipes in place. The pipes would be filled with a low strength cement and sand grout to assure thai the pipes will not "float " due to hydrostatic pressure and to limit the effect of frost. A concrete pump will be used to fill the pipes with the grout. The volume of the pipes will be calculated based on field measurements and grout will be pieced to occupy at least 90 per cent of the void volume.

ATTACHMENTS: (list supporting documentation, if applicable)

Map showing proposed changes; *Design Change* #9, *Area 7 Landscaping Plan - North side*

Supporting Documentation References (not attached)
Approved Design Drawings: Sheet I of 8, Grading Plan, Area 7 Cap; Sheet 4 of 8 Area 7 Landscaping Plan
Approved Remedial Action Workplan: Revision I, June 17,2002, Page 13 of 28

APPROVAL SIGNATURES:

Environmental Protection Agency Karen Lumino Date: 12/2/02

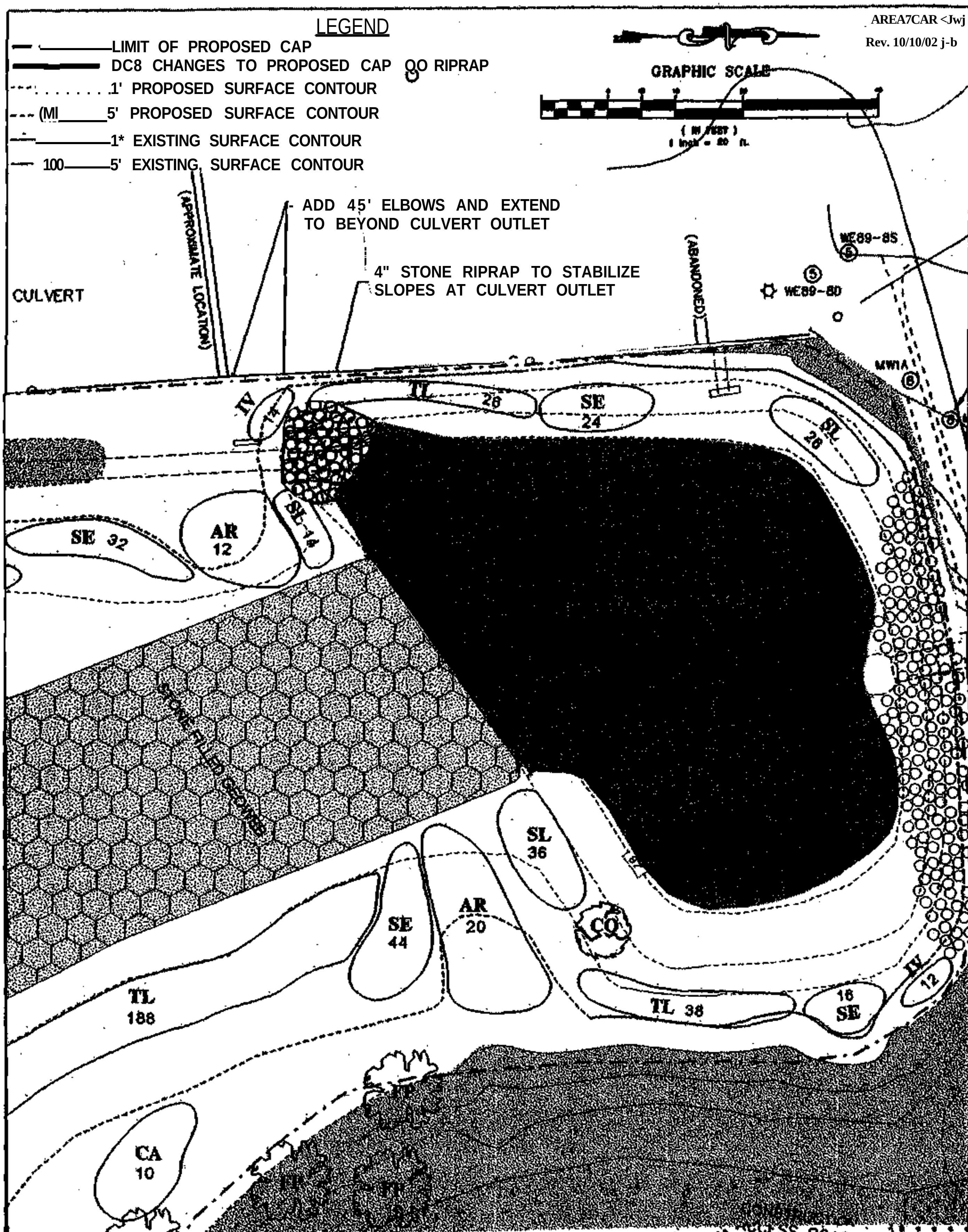
Vermont Department of Conservation Date: 3 DEC 02

STATE OF VERMONT JOEL BEHRSING No. 6070 REGISTERED PROFESSIONAL ENGINEER

Engineer Date: 10/25/02

Project Manager Thor Helgeson by Joel Behrsing Date: 10/25/02

K:\1-0870-1\Phase 1B\Design Change 009\rev10-25-02.wpd



DESIGN CHANGE #9
AREA 7 LANDSCAPING PLAN
PINE STREET CANAL, BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC
Environmental Sc«»vc«* «nrf ffnjinwring
1<» STATE STO£€T MONIPEUER. VT 0S602

DATE: Rev, 9/30/02 PROJECT: 1-0870-1
DRAWN 6* ft«v- RTK SCAtE: V.20

Design Change Request No. 10

PINE STREET BARGE CANAL REMEDIAL ACTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: 010, Rev. 1
Major ____X______
Minor____________
Date of Request: November 1,2002, revised November 15, 2002

RECOMMENDED BY: Contractor

DESIGN CHANGE DESCRIPTION:
The experience and information gathered during the construction of the Area 2 Waterway, including installation of the temporary work road for access, indicates that it may be feasible and advantageous to apply the sand cap over the canal sediment in the dry (i.e., after pumping the water out of the Canal) using low ground pressure tracked skid-steer loaders (Bobcat T190 or T200), conveyor delivery systems, cranes and buckets and/or manual techniques. Therefore, this design change includes dewatering the Canal and using land-based equipment and manual labor to cap the full length of the historically dredged Canal from the end of the Area 2 waterway at approximately Transect T13 to Transect T4+50 at the north end of the Canal where the Canal meets the Turning Basin (as shown on the figure *Plan and Profile, Design Change 010* provided in Attachment 1). Capping of the Canal sediments was previously proposed to be constructed under water (subaqueously) during Phase 2 of the Remedial Action. This dry-application approach may also be extended into the Turning Basin. However, if this is the case, a separate design change request will be submitted just for the Turning Basin.

The first 150 feet of the Canal, from approximately Transect T13 to Tl 1+50, will be accomplished first on a trial-and-error basis as a test case of the feasibility of the various techniques proposed in this Design Change request. The actual distance along the Canal that the cap will be installed in a dry setting as described herein will depend upon the field conditions and the level of success of the techniques used in the 150-foot test section.

Potential advantages of the proposed dry application over subaqueous capping include:

- faster and less expensive application of the cap materials;
- ability to use cap materials with greater silt content (which will improve core recovery during future cap monitoring and reduce contaminant migration);
- ability to visually observe the cap placement, and cap thickness, and therefore to respond to unexpected conditions and local sediment failures which may not have been identified under water;
- ability to use a geotextile below the cap without the problems inherent in installing a geotextile subaqueously; and

• an opportunity to evaluate potential methods and materials for construction of a cap "in the dry" in the Turning Basin.

Cross sections for the Canal at Transects T5, T6+50, T9, T10+35, T12 and T13 are provided in Attachment 1 (Note: cross sections at Transects T6+50 and T10+35 were previously provided as Figure CDR 5-12 in the *Conceptual Design Report*, dated March 1, 2001).

This design change request is organized by the following topical headings:

1. Site Preparation, Construction Access, and Staging Areas
2. Environmental Controls and Surface Water and Groundwater Management
3. Cap Sand Materials
4. Geotextile and Geogrid
5. Cap Thickness and Placement
6. Construction Quality Control
7. Wetlands Restoration and Completion Activities
8. Cap Stability (settlement, erosion, earthquake, static cap loading, and active construction loading)
9. Contaminant Transport in the Cap
10. Construction Schedule

The topics listed above are described sequentially in the following sections of this document and are supported by detailed information provided in the following Attachments:

Attachment 1: Plan and Profile - Design Change 010, and Cross Sections
Attachment 2: Canal Cap and Canal Draw Down Construction Checklists and Table C-QAPP-2 Required Tests and Inspections during Canal Capping
Attachment 3: Cap Construction Conceptual Schematic
Attachment 4: Specifications
Attachment 5: Design Calculations
Attachment 6: NAPL Sampling Protocols and Laboratory Results and Contaminant Transport Modeling Calculations
Attachment 7: Construction Schedule

1. Site Preparation. Construction Access, and Staging Areas

Site preparation will include cutting trees and brush along existing uplands access routes to the Canal from Pine Street and staging/stockpile areas at Transects Tl 1+20 (South Slip), T9 (rowboat launch), T6+20 (Maltex Pond), and at the 100 x 100 foot Area near T4 (please refer to *Plan and Profile, Design Change 010* provided in Attachment 1). These access routes and staging/stockpile areas will be on the Maltex Partnership; the 453 Pine, LLC; and the City of Burlington (formerly Vermont Agency of Transportation) properties. The cut logs and brush will be placed on the sides of the access routes. It is anticipated that few large (greater than six-inch diameter) trees will need to be cut, as the proposed access routes were initially developed for drill rig or construction equipment access in the 1980's. Fill and/or mats will be placed in uplands as necessary to allow access by heavy equipment and trucks. Access across wetlands areas will be minimized to the greatest extent possible. Where it is necessary to cross wetlands, temporary rubber "swamp mats", geotextile, or wooden corduroy will be used to minimize impacts. It may also be necessary to prepare the area west of the fenced former drum storage area (Maltex Associates property) for possible equipment staging and stockpiling of cap materials. Staging and stockpile areas will be limited to upland areas and the 100 feet by 100 feet area only. Silt fencing will be installed around all staging/stockpile areas. In addition, temporary construction fencing will be installed around the historic resources area just south of the Turning Basin to prevent construction impacts to this area. Also, a four-foot high construction fence has been installed along the east side of the Canal and Turning Basin to deter unauthorized access to the dewatered areas of the Canal and Turning Basin. Site preparation also includes installation of controls to prevent unauthorized vehicle access into the Maltex property parking lot access point and other locations as necessary.

Debris present on the sediment surface, including limbs and logs, will be removed. No attempt will be made to remove materials embedded in the sediment, as this would weaken the sediment and make capping more difficult, instead the debris will be cut off at or near the sediment surface. The cut-off debris will be placed along the edges of the Canal.

Access to the Design Change 010 cap area will be from the east along temporary work roads constructed on existing uplands spurs as described above, and from the south along the existing Area 2/3 work road for the 150 foot test area to be installed first between Transects Tl 1+50 and T13 (please refer to *Plan and Profile, Design Change 010* provided in Attachment 1).

For the 150 foot test area, the existing Area 2/3 work road will be extended by approximately 75 feet (to Transect 13) and used to deliver the cap sand and other materials to the area. The work road extension will be constructed in a manner similar to the existing road (geotextile covered by approximately two feet of sand and interlocking plastic mats).

A trailer mounted pump which is pumping water from the Turning Basin to Lake Champlain is currently staged on the west side of the Turning Basin (on the Vermont Railway property) and continued access to it throughout construction will be needed. Access to the this area will be through the east side of the Vermont Railway property across the heavy equipment bridge accessed from South Champlain Street.

2. Environmental Controls and Surface Water and Groundwater Management

Surface Water and Groundwater Management

By-pass pumping of the Canal water to Lake Champlain will continue at its current location in the Turning Basin. Environmental controls upstream of, and around the pump suction (silt curtains and sorbent booms) will be maintained as described in the Phase IB Remedial Design.

If possible, the Canal water level will be drawn down to approximately 85 ft NGVD. The current maximum turbidity limit of 50 NTU will be maintained for discharge of water to Lake Champlain during implementation of the Canal capping.

As necessary, sumps will be created (without excavation) in the Design Change 010 cap area using geotextile, sandbags, plastic or other techniques to pump and control accumulated groundwater and/or surface water in the work area. Surface water may be retained and bypass pumped from Area 7 and/or the BED outlet pool as well. Pump discharges would be to points downstream of the work areas. Alternatively, it may be feasible to allow all base flow and storm water flow to pass through the work areas and down the Canal over the placed geotextile, or over completed portions of the cap in a polyethylene- or biodegradable netting (such as jute)- lined flow channel. If feasible, base flow from the existing Area 7 storm water outfalls may be pumped directly to Lake Champlain or to storm drains which flow by gravity to Lake Champlain.

NAPL Management

Pools or seeps of non-aqueous phase liquid (NAPL) in the Design Change 010 cap area and down stream as accessible will be controlled and collected using sorbent "pom poms", pads, sweeps or similar materials. Most spent sorbents will be collected and disposed of off-site in accordance with the previously approved Site Management Plan for Phase IB construction. Some sorbent pads or materials may be left in place and covered with the sand cap in order to collect and immobilize potential NAPL seepage following cap placement. This approach will be discussed with EPA and VT DEC prior to implementation.

Monitoring

Environmental and site controls (silt curtains, sorbents, construction fences, etc.), as well as turbidity levels (measured manually), and Canal and Lake water levels will be monitored daily during active construction and reported on the *Canal Draw Down Checklist* form included in Attachment 2. Water quality monitoring through sampling and analysis for polycyclic aromatic hydrocarbons (P AHs) and metals will continue on a monthly basis in accordance with the Compliance Monitoring Workplan. However, it will be necessary to reduce the surface water sampling locations to one located at the by-pass pump outfall at Lake Champlain rather than the two locations in the Canal and Turning Basin as currently specified in the Compliance Monitoring Workplan. This is due to the increasingly reduced area of innundation in the Canal and Turning Basin as water levels are drawn down resulting in a lack of safe access for sampling.

As the Canal water level is drawn down, the automated Hydrolabs used to monitor water quality parameters pH, dissolved oxygen, specific conductance, and turbidity will become ineffective due to the lack of water and due to ice formation. Further, these parameters will become increasingly irrelevant since the relatively small volume of water maintained in the Turning Basin will not be an aquatic habitat as much as a sump for stormwater bypass. Therefore, we propose terminating monitoring for these parameters (except for manual daily turbidity measurements at the outfall when pumping) for the duration of the dry capping construction.

3. Cap Sand Materials

The silty sand currently being used to cap Areas 3 and 7 will be used for the Canal cap. The source of this cap material is anticipated to be from the Fontaine Pit in Williston, Vermont which was characterized and approved during Phase IB design review. Alternative sources may be evaluated and used if they meet the Phase IB specifications.

4. Geotextile and Geogrid

A non-woven geotextile will be used under the sand cap for the entire Canal cap area to provide additional support for equipment, workers, and the sand cap. A polypropylene grid (geogrid) may also be used as necessary to provide additional support. The geotextile and geogrid materials and installation methods are described as follows.

Geotextile

The geotextile will be the same as that used for the Area 3 and 7 caps *(Specifications for Phase IB Remedial Action, Revision 1, Section 13550 Geotextile).* The apparent opening size (AOS) of the geotextile is 0.15 mm, which is approximately equivalent to the expected cap material D50 of 0.12 mm (D50 is the median particle size, i.e. 50% of the particles are larger than the D50 and 50% are smaller). AOS values up to 0.22 mm may be used (after AASHTO M288-96) for materials containing greater than 50% passing the #200 sieve, such as the Canal sediment. Therefore, the geotextile will serve to retard and reduce mixing of the cap materials with the sediment. The tensile strength of the geotextile (241 pounds) will reduce the potential for punching failure.

Following debris removal, the geotextile will be manually placed directly onto the existing sediment in the Canal, running lengthwise down the Canal from Transect T13 to approximately T4+50. The geotextile may be placed in two or more events, depending upon the water elevation in the Canal. The geotextile will be draped over the cribbing wall onto the bank and secured as necessary with stakes and sand bags. Two, three-foot pleats in the geotextile will be left at each side of the Canal to account for settlement of sediments during cap placement (see Attachment 3: *Cap Construction Conceptual Schematic*, for a diagram of the geotextile placement). Field connections between geotextile panels will be of two types; mechanical or sewn. In the 150 foot test area, the field connections will be either sewn, or fastened mechanically with a minimum one foot overlap and connected with mechanical ring connections every three feet at a minimum (spacing will be reduced if field conditions warrant it, for example if sediment is observed working its way through the joint). For the remainder of the Canal the connections will be field sewn. The geotextile (and geogrid where used) will be weighted with sand bags as dictated by field conditions to prevent slipping and/or floating prior to sand placement.

Geogrid

A geogrid will likely be used in areas of particularly weak sediments to help spread the weight of the equipment over a larger area of sediment. This will reduce the differential force on the weak sediment and help avoid resulting shear failures during cap placement. The primary proposed geogrid is Tensar Geogrid BX4200 (a specification for this product is provided in Attachment 4). This geogrid, which is available in 13-foot wide rolls, was chosen because of its high rigidity. Adjacent geogrid edges will be attached using Zipties® or metal rings with a minimum of one foot overlap. The required overlap may be increased by the on-site Engineer to provide additional support for equipment in the field based upon observed conditions during cap placement. Overlaps perpendicular to the direction of cap placement (such as between the ends of rolls) will be "shingled" in the direction of placement (e.g. in the 150 foot test area, where placement is from the south to the north, the northern end of a geogrid roll will overlap the southern end of the next roll, instead of being beneath it).

Alternative geogrids, including Tensar Geogrid BX1500 and Tensar Geogrid BX4100, may also be used in selected areas with extremely weak sediments. The specifications for these two products are also included in Attachment 4. The BX1500 is much more rigid than the BX4200, which may allow its placement in areas where manual placement of the BX4200 is impossible due to weak sediment strength. The BX4100 is less rigid, and would only be used in a double layer configuration, with the two layers cross-laid with each other. This double layer of BX4100 would actually provide stability in excess of that provided by the BX1500. When covering these weak areas, the geogrid will be placed as a "patch" extending a minimum of five feet past the edge of the weakened sediments (as best determined in the field and per the recommendation of Tensar).

In most areas where it will be used, it is anticipated that the geogrid will be placed over the geotextile (as recommended by the Tensar representative, Terry Sheridan, personal communication 11-15-02; phone (732) 449-1799). However, in some isolated areas where the sediments are known to be very weak, the geogrid will likely be placed directly over those sediments prior to geotextile placement and/or placed in more than one layer as described above. Based on existing geotechnical data from the pre-design investigations, and from the ARI/AFS, these areas are between T9+50 and Tl 1+50. If it is found in the field that freezing conditions or dewatering has sufficiently increased the sediment strength in these areas, then placement of geogrid directly over the sediment may not be necessary. Generally, the geogrid strip will be placed parallel to the Canal cribbing (north-to-south). This will allow placement of the cap in "fingers" over each field connection between rolls, which results in optimal use of the increased strength of the overlap at the connection (per the recommendation of Mr. Sheridan of Tensar). In cases where the geogrid is placed below the geotextile, the geogrid may be placed across the Canal in an east-west orientation. Placement in this orientation will allow cross-placement of a second geogrid layer parallel to the Canal cribbing which would increase the support provided by the geogrid system.

Unlike the geotextile, it is not expected that the geogrid will extend beyond the Canal cribbing. It is not necessary or desirable to extend the geogrid over the cribbing because the geogrid will not be able to expand to accommodate sediment settlement after capping like the pleated geotextile, and because the primary purpose of the geogrid is to provide stiffness which spreads the applied load in a local manner, rather than as a tensile support to fixed points.

The decision to use geogrid, whether it will be placed over or under the geotextile, and whether or not in more than one layer, will be made in the field by the Engineer and Contractor as dictated by field conditions and as anticipated based upon available geotechnical data and the active construction stability analysis presented in Section 8.

5. Cap Thickness and Placement

Cap Thickness

The cap will have a minimum thickness of 1.5 feet but will range from 1.5 feet to 3 feet thick depending on the location and conditions. Experience constructing the Area 2/3 work road has shown that 1.5 to two feet of sand is generally necessary to support equipment and provide a dry working surface. The proposed cap thicknesses are also supported by the geotechnical calculations for construction and long term stability summarized in Section 8.

The cap thickness is expected to be thinnest (1.5 feet) at the southern end of the Canal in order to provide a smooth transition between the Waterway stone-filled baskets and the cap and along all of the Canal banks. North of the Waterway transition area, and away from the Canal edges, the cap is expected to be generally two-feet thick between Transects T10 and T13. In the northern portions of the Canal (between Transects T4 and T10) the cap will be approximately 1.5 feet thick at the edges, and will gradually thicken to approximately three-feet thick at the center (in order to provide stable cap and sediment slopes as discussed in Section 8).

The cap thickness may be increased in local areas to provide stability for equipment access and localized on-sediment stockpiling, and to cover protruding debris (after partial settlement).

Placement Methods

Methods used to place the cap sand may include a loader, manual labor to spread materials, low-ground-pressure tracked skid-steer loaders (Bobcats), a Putzmeister Telebelt conveyor truck, and/or a crane and bucket. A description of the anticipated sequence and methods for cap placement in different portions of the Canal are provided below. The proposed methods of completing the work are based upon existing information and may need to be changed due to field conditions which arise during construction.

The cap construction will be performed in four steps, in the order listed below (and as shown on *Plan and Profile - Design Change 010* in Attachment 1). This segmentation and the specific order of capping is proposed to help prevent catastrophic failures and "mud waves" as the sediments are differentially loaded.

Step 1 - 150 foot Test Area

For the 150-foot Test Area, the cap material will be transported from stockpiles by loader to the ends of the Area 2/3 temporary access road. A small working stockpile will be maintained in the Canal on linked plastic mats at the end of the access road. Tracked "Bobcat" skid-steer loaders will scoop up the silty-sand cap material from the working stockpile, and carry it to the leading edge of the Canal cap. They will dump the bucket just short of the actual end-of-cap and push it into place. Cap sand will be placed in this manner, in 6 to 8 foot wide strips along the Canal edges first, and then the middle portions of the Canal will be sequentially completed. The northern leading edge of the completed cap along the Canal edges will be maintained approximately 10 to 25 feet further north than the cap in the center of the Canal (as shown in Attachment 3: *Cap Construction Conceptual Schematic).* This method will load the edges first and provide some tensional support via friction on the geotextile. This method will also provide some control over any "mud wave" behavior that may take place. The center portion of the cap will be completed with north-south fingers starting in the middle of the Canal, followed by capping between the fingers. This will further control and stabilize the soft sediment during capping.

Once the cap has been installed northward to approximately Transect T12, the Area 2/3 access road will no longer be needed, and the plastic mats will be removed, excess sand removed to achieve the design subgrade for the Area 2 Waterway, and the rock-filled baskets for the Area 2 Waterway that had not been installed previously will be placed.

Step 2 - Transects T6+50 to TIP

The segment of the Canal between Transects T6+50 and T10 will be capped next after completion of the 150-foot Test Area to stabilize the sloped portion of the Canal bottom (approximately T9 to T10, see Plan and Profile in Attachment 1) before capping takes place over the 7 to 9 foot thick sediments upstream of the sloped area (which will be done as Step 3). This will help minimize the risk of a mud wave and/or slope failure in these segments. Equipment for Step 2 will be mobilized to the Canal access point at Transect T9. An access pad/working stockpile area will be created along the eastern side of the Canal at T9 using the silty sand cap material and the interlinked Dura-Base Mat system (or similar). The silty-sand cap soils will be brought to the Canal's edge via the Transect T9 access route and loaded onto the access pad. The sand will be moved from there to cap the Canal using the tracked Bobcats. The cap will be placed from Transect T9 southwards to approximately T10 (the southern pilot test location) and northwards from Transect T9 to approximately T6+50 (the northern pilot test location). Cap materials will be placed along the Canal edges first, followed by completion of north-south fingers in the center of the canal, and subsequent capping in between.

Step 3 - Transects TIP to T12
For the segment of the Canal between Transects T10 and T12, equipment will be mobilized to the Canal access point at Transect Tl 1+20 (South Slip). The operation will be staged and the cap placed as described above. The placement will progress from Transect Til southwards to approximately T12 and northwards to approximately T10 (the southern pilot test location). The cap will be merged seamlessly with the previously capped areas.

Step 4 - Transects T4 to T6+50
For the segment of the Canal between Transects T4 and T6+50, equipment will be mobilized to the Canal access point at Transect T6+20 (Maltex Pond) and/or the 100 foot x 100 foot Area. The operation will be staged and the cap placed as described above. The placement will progress northwards to T4+50 and southwards to the previously capped area at approximately T6+50.

Contingencies
The cap application method described above (placement using Bobcats) will be the preferred method of application. However, as described in Section 8, there are areas that may not support the active load of a Bobcat. Several contingencies will be available for implementation in those areas. These contingencies are listed below:

- incorporate the use of a geogrid and/or additional geotextile or geogrid layers to bridge particularly weak areas;
- use manual labor to spread the cap sand in localized weak areas;
- use wooden timbers or planks to temporarily bridge weak areas;
- use the dessication of the sediment due to de-watering (and resulting increase in strength), and the potential freezing of the near surface sediments, to provide additional support for the cap and equipment;
- temporarily stop construction in problematic areas and allow additional consolidation and dewatering of the sediments under partial cap loads to strengthen the sediments;

and
- use cranes with concrete buckets or conveyors to place the cap, or to place fingers of cap sand ahead of the Bobcats (or workers, if spreading the cap sand manually) to anchor the geotextile and provide additional strength through tensile support.

If buried obstructions in the sediment form "tents" in the geotextile as the underlying sediment consolidates under the weight of the cap and settlement progresses, an attempt will be made to push the obstructions further into the sediment with equipment to eliminate the tents. If this is not possible or unsuccessful, additional cap materials will be added over the tented areas to maintain a cap thickness within 0.5 feet of that in the adjacent areas. This addition of material may prevent the formation of "bubbles" of sediment pushing into the tented zone due to differential loading. The initial cap will be placed, and additional cap sand added if necessary, so that the post-consolidation cap surface does not have a slope greater than approximately 1:6 (limited by earthquake stability; see Section 8 and Attachment 5).

It is likely that snow and/or ice will be present at times during the Phase IB, Design Change 010 construction. If the snow and ice cover is relatively thin, and does not obscure observation of the cap placement or obstruct the operation of machinery, then the cap will be placed directly over the snow and/or ice. If the snow and/or ice layer is thick, extremely heavy, or has other characteristics which preclude the safe and controlled placement of the cap, then construction will cease until conditions return that favor safe and controllable construction, or contingency measures will be employed. These measures may include the use of shovels or snow blowers to remove the snow. They may also include removal of snow from previously capped areas (but not from un-capped areas) by the bobcats. Another method could be compaction of snow using equipment on the previously capped (but not uncapped) areas, or melting of snow using water. Improved traction on ice may be accomplished by placement of a thin sand layer over it. Road salt, or a road salt/sand mix may be used in local areas (such as on the mats near the stock piles and on the access roads) to provide a safe working surface. The access roads will likely be plowed or the snow compacted with equipment or rollers.

Due to expected temperatures below freezing at times, it is likely that moisture in the stockpiled cap sand will partially freeze. In order to reduce the impact of freezing, large, long-term stockpiles and working faces will be covered when precipitation is expected, or is occurring. The objective is to minimize freezing of the sand. It is inevitable that some freezing will occur. However, the large construction equipment on site will be able to break-up most of the frozen sand. The maximum size lump of frozen material which will be allowed for use in the cap is 12 inches (measured in the smallest dimension). Lumps of this size will only be placed if enough sand can be placed around them to fill any voids. This restriction will ensure that a 1.5 foot cap can be evenly placed, even with frozen materials.

6. Construction Quality Control

An Engineer will be present on-site during all capping of the Design Change 010 area. Measurements will be collected daily during active cap construction, and summarized on the *Canal Cap Construction Checklist* provided in Attachment 2.

Cap Thickness

Measurements will include a determination of the cap thickness at a minimum of twelve locations per 300 linear feet (north-south) of cap. These cap thickness measurements will be performed using a Proving Ring Penetrometer (see Attachment 4), a hand auger, simple graduated penetration rod (e.g., re-bar), or by observing the thickness of sand placed against pre-installed vertical graduated tubes or grade stakes. The locations of the cap thickness measurements will be determined by direct survey, triangulation from surveyed locations, or use of a Global Positioning System.

If the penetrometer is used, it will be inserted into the cap. The dial gauge will be monitored during insertion, and the maximum force and the depth at which it occurs (which will be when the penetrometer point encounters the geotextile) will be recorded. It is anticipated that the penetrometer will not push through the geotextile (i.e., the operator will recognize "refusal" at the geotextile, record the force and depth for that measurement, and withdraw the unit without the point penetrating the geotextile. If the geotextile is inadvertently penetrated, then the dial gauge reading will suddenly drop off (as the penetrometer point enters the weak sediments), and the cap thickness can still be determined and recorded. The penetrometer has the capability of being extended, so it may be feasible to use this technique for long term cap thickness monitoring in subaqueous conditions. Validation of the penetrometer results will be performed using the alternative methods (hand auger, penetration bar, or pre-set grade markers) to confirm its ability to accurately measure cap thickness.

If the graduated tubes or grade stakes are used, they will be placed vertically on the geotextile prior to placement of the silty-sand cap and supported with a localized pile of sand. The cap will then be placed around them until its thickness matches the design thickness marked on the tubes. The tubes/stakes will then be removed.

Settlement

Settlement beneath the load of the cap and the application equipment will also be monitored. Nine settlement plates will be installed on top of the geotextile prior to cap placement at the approximate locations shown on *Plan and Profile - Design Change 010 in* Attachment 1. These plates, which will be located in sets of three running across the Canal, will allow post-capping evaluation of the settlement, or consolidation, of the underlying sediment. This will provide data which can be used to "calibrate" predictive settlement calculations for the remainder of the Canal cap. The settlement plates will be constructed with a ^-inch thick, plastic base approximately three feet square. A 1.5-inch PVC friction cap will be mechanically fastened to the base. PVC pipe, which will have graduated markings placed on the pipe to document cap thickness at the settlement plate locations, will then be inserted into the friction cap prior to cap sand placement. The top of the pipe elevation will be surveyed with an autolevel relative to a temporary benchmark prior to cap placement, daily during active construction, if possible for 7 days after cap placement, and weekly for at least 30 days after cap placement. Attachment 2 contains the Canal Cap Construction form on which this data will be recorded. After completion of settlement measurements, the PVC pipes will be pulled from the friction caps, allowing the holes to naturally fill in with the surrounding cap sand. The plastic base will be left under the cap. If it will not impact the cap integrity (in the opinion of the on-site engineer), one or more of the settlement plates will be left in place to allow continued monitoring by EPA or other interested parties during the remainder of 2003 (but will be removed prior to freeze-up the following winter).

Additional inspections and measurements are provided in the *Table C-QAPP-2 Required Tests and Inspections during Canal Capping* provided in Attachment 2. In the event of a discrepancy between the various documents describing the work and specifying the number, type, or frequency of tests and inspections, the order of precedence is as follows (from highest to lowest):

1. This document (including Table C-QAPP-2)
2. Notes included on Details and Design Plans for Construction
3. Individual Specifications in the Remedial Action Workplan or elsewhere as referenced by this document
4. Site Management Plan
5. Other and previous Remedial Design documents

Prior to re-inundation of the Canal (circa March 15,2002), if timing permits, cap core samples will be collected from the Canal cap for chemical analysis. These cores will be collected and analyzed in accordance with the requirements of the Compliance Monitoring Workplan (CMP). In addition, the sediment traps and seepage meters will be installed in accordance with the CMP.

7. Wetlands Restoration and Construction Completion Activities

Once the cap is completed, the surface water bypass pumping system will be shut down and removed and water will be allowed to accumulate in the Turning Basin and Canal. The water will eventually reach the ultimate weir overflow elevation of 96 feet when it will flow by gravity into Lake Champlain. If by about mid-March, 2003, the accumulated water in the Turning Basin has not reached an elevation of approximately 96 feet from baseflow and stormwater flow into the Canal, then the Canal will be re-inundated with water to a minimum water level of 96 ft. to prevent erosion of the constructed portions of the cap during the spring thaw. This may require pumping water from beneath the ice of Lake Champlain into the Canal.

Because access to the Canal from Pine St. will be along routes previously established for prior work at the Site, clearing to create access is expected to be minimal. Trees or brush that are cut will be left adjacent to the cleared areas. Brush piles provide habitat for wildlife and eventually decompose. Temporary staging areas and other areas disturbed during construction and not needed for construction or maintenance of the Canal cap, the Turning Basin cap or the 100 foot by 100 foot area cap, will be restored. A plan was previously prepared for restoration of wetland areas impacted by the Remedial Action construction and it is presented in Appendix J of the *Phase IB Remedial Design Report.* Once remedial construction is completed, equipment will be demobilized and the areas cleaned-up. In the access areas that are being abandoned, any temporary fills in wetland areas will be removed as described in Appendix J of the Phase IB Remedial Design Report. The disturbed areas will be seeded with Vermont Conservation Mix (as specified in the Phase IB specifications 02821 and 02831) in Spring 2003 when water levels permit (see *Plan and Profile - Design Change 010* in Attachment 1 for areas to be seeded). A field judgement will be made at that time as to whether additional topsoil is needed in any of the construction impacted areas.

Following completion of cap placement in the Canal, the geotextile along the banks of the Canal will be cut, folded and/or fastened to the Canal cribbing, or otherwise managed, so that none is exposed above an elevation of 96 ft NGVD (the design minimum Canal stage). No loose geotextile will be allowed to remain which would float or be visible above the water surface at 96 ft NGVD. The banks of the Canal will therefore retain their current appearance above the water surface.

8. Cap Stability (erosion potential, long term sediment bearing capacity, active construction loading, earthquake stability, and consolidation^

Analysis of erosion potential, stability for long term static cap loading and short term active construction loading, earthquake stability, and consolidation has been performed. The basis of these calculations included the use of conservative values for Canal and Lake water levels (i.e., worst case scenario), subsurface sediment and soil strengths, design storms and earthquakes, and similar variables. The design values for these variables were selected from available site and regional data and good engineering practice. Details of the selected design values and the selection rationale, and final design calculations are provided in Attachment 5.

Erosion Potential

Erosion potential was calculated using a design flow of 150% of the 100 year storm event. Based on this design flow, the cap sand gradation data, the calculated post-settlement canal bottom elevation, and a pre-storm Canal water elevation of 96 feet NGVD, the cap will be stable against erosion from flood flows.

Bearing Strength

The design calculations for long term bearing strength indicate that the average Canal sediments and overlying cap will be stable with a maximum differential cap thickness of approximately 2/3 feet over a short distance (calculations indicate a safety factor of three). The cap design involves a maximum change in cap thickness of 1.5 feet (1.5 feet thick on the canal edges to 3.0 feet thick in the center of the northern canal) but this change in cap thickness will be gradual over a substantial distance. Therefore, the cap will be stable in the long term against differential loading.

Stability During Construction

A minimum acceptable safety factor of 1.1 was used for active construction stability analysis. The analyses used conservative assumptions. The required sediment strength is indirectly proportional to the sediment thickness (i.e., stronger sediments are needed to support the equipment if the sediments are thicker). The analyses indicate that the minimum sediment strength required to support a Bobcat is 31 psf if the sediments are five feet thick (e.g., north of

Transect T9) and 57 psf if the sediments are ten feet thick (e.g., south of Transect 10). The available in-situ vane shear data indicate that 30% of the sediments have a shear strength of 57 psf or greater, and 70% have a shear strength of 31 psf or greater. Therefore, much of the sediments will be stable for Bobcats during construction, while other areas will require manual labor or the use of other contingency measures as described in Section 5.

Consolidation (Settlement)

Based on the anticipated minimum consolidation of sediments, the maximum post-capping Canal bottom elevation is calculated to be approximately 94 feet NGVD (i.e., equal to or lower than the existing maximum bottom elevation). The maximum expected total consolidation, including an estimated secondary consolidation of approximately 20%, is approximately 4 feet in the segments of the Canal with the greatest thickness of soft sediment.

Earthquake Stability

The design calculations for earthquake stability indicate that the average Canal sediments and overlying cap will be stable with a cap slope of 1:6 (with a safety factor greater than 1.1) during a 100 year re-occurrence earthquake.

9. **Contaminant Transport in the Cap**

The March 2001 Conceptual Design Report included an evaluation of the short term and long term transport of contaminants into the cap from the underlying sediment in the Canal. That evaluation was performed by Dr. Danny Reible, Louisiana State University, and relied on a transport model developed by Dr. Reible for the Environmental Protection Agency specifically for evaluation of contaminant transport into subaqueous caps. The concentrations of PAHs in the sediment immediately underlying the cap were assumed to be worst case (highest historical concentrations) based on available data for the purposes of this evaluation. The modeling first evaluated advective transport of dissolved Polycyclic Aromatic Hydrocarbons (PAHs) in sediment porewater when it is expressed into the cap during sediment consolidation. Then, starting with the predicted post-consolidated contaminant conditions in the cap from the advective model, long term diffusive transport (driven by concentration gradients) was evaluated for ultimate equilibrium conditions to assess the resulting PAH concentrations at a compliance point beneath the bioturbation zone in the cap. The resulting concentrations of 13 PAHs at the compliance point were compared to ER-Ms, the performance standards in the SOW, and were found to be significantly below the ER-M levels. A full description of the model was presented in Section 11.2 of the Conceptual Design Report, Draft Revision 0, dated March 1,2001.

As a result of sediment consolidation during dewatering of the Canal (for the Area 2 Waterway construction), non-aqueous phase liquids (NAPL) have been observed on the sediment surface in localized areas. This is likely to continue in some areas during implementation of Design Change 10. Therefore, Dr. Reible revisited the previous modeling exercise. This time, he used analytical results for PAHs from a laboratory analysis of a NAPL sample collected from the sediment surface at Transect T12 + 50 (opposite the South Slip) on October 10,2002, as the starting "sediment" concentrations at the bottom of the cap (see Table 1 for a summary of the NAPL analysis, and Attachment 6 for a description of the sampling protocols and laboratory report). Current design conditions of a two-foot thick cap and 2.5 feet of predicted consolidation were also used in the revised model. Raoult's law was applied to the NAPL analytical results to estimate the initial porewater concentrations. Raoult's Law predicts effective solubility for a contaminant based upon the mole fraction of the contaminant in the mixture. Since the molecular weight of the mixture (necessary for determining the mole fraction) is unknown, Dr. Reible used the mass fraction in the NAPL as a surrogate for molecular weight.

Table 1
Summary of Reported Concentrations in NAPL
collected on 10/1Q/02 [illegible] a pool on the [illegible]

Analytical Method and Compound	[illegible]	[illegible]
SW-846 Method 8260B for volatile organic compounds		
Ethylbenzene	53	B
Isopropylbenzene	540	
1,3,5 - Trimethylbenzene	100	B
P-Isopropyltoluene	97	B
N-Butylbenzene	27	B
1,2,4 - Trimethylbenzene	390	B
Xylene (m,p)	54	B
Xylene (o)	48	
Naphthalene	18,000	B
SW-846 Method 8270C for polycyclic aromatic hydrocarbons		
Naphthalene	44,000	
2-Methylnaphthalene	33,000	
Acenaphthylene	3,000	
Acenaphthene	14,000	
Fluorene	8,100	
Phenanthrene	24,000	E
Anthracene	6,900	
Fluoranthene	6,100	
Pyrene	8,800	
Benzo (a) anthracene	3,100	

Summary of Reported Concentrations in [illegible] collected on 10/10/02 from a [illegible] on the sediment surface at T12+50E10		
Analytical Method and Compound	Results	
	mg/Kg	Laboratory Qualifier
Chrysene	2,800	
Benzo (b) fluoranthene	1,800	
Benzo (a) pyrene	2,400	
Benzo (g,h,i) perylene	1,100	

Note: Only compoxmds with reported detections are included, and concentrations are based upon the most reliable of several analyses at different dilutions

B = Compound was detected in the Method blank

E = Estimated, exceeded the instrument calibration range

This molecular weight evaluation using Raoult's law effectively assumes that the molecular weight of the mixture is the same as the solute (for the lighter PAHs this may cause a slightly low bias and for the heaviest PAHs a slightly high bias). The results of the revised model are summarized in Table 2, and the calculations provided in Attachment 6.

The results indicate that the concentrations resulting from consolidation-induced advection and chemical diffusion will in most cases be several orders of magnitude below the cap performance criteria ER-Ms despite high underlying sediment and NAPL concentrations and significant consolidation of the sediments.

These results are consistent with the modeling performed by Remediation Technologies, Inc. in the Additional Feasibility Study which also predicted long term cap concentrations well below the ER-Ms.

10. Construction Schedule

An estimated construction schedule, based upon "best case" weather conditions, and assuming no unexpected delays is provided as Attachment 7.

Table 2
November 2002 Transport Model and Comparison with Conceptual Design Report Model Results
Pine Street Canal Site

Compound	March 1, 2001 Conceptual Design Report Model Results Predicted Concentrations 1 foot into 3-foot Cap (ug/kg)		November 2002 Model Results Predicted Concentrations 1 foot into two-foot cap (ug/kg) Sediment Porewater Concentrations based on Effective Solubility in NAPL	Performance Standards VR-M
	Using Laboratory Measured Sediment Porewater Concentrations	Using Sediment Porewater Concentrations Calculated based upon Theoretical Partition Coefficients		
Naphthalene	0.5	6.4	261.3	2100
2-methyl naphthalene	<0.1	0.3	237.9	670
Acenaphthylene	0.3	3.7	6.82	640
Acenaphthene	<0.1	1.1	17.2	500
Fluorene	<0.1	0.3	11.3	540
Phenanthrene	6.2	**10.9**	9.13	1500
Anthracene	<0.1	5.5	2.56	1100
Fluoranthene	3.0	**17.2**	0.86	5100
Pyrene	0.5	14.7	1.21	2600
Benzo(a)anthracene	0.6	5.7	0.28	1600
Chrysene	1.8	5.4	0	2800
Benzo(a)pyrene	**24.2**	8.5	0.08	1600
Dibenzo(a,h)anthracene	6.2	0.3	0	260
TOTAL	**43.3**	80.0	548.6	21,010'

[1] Sum of PAHs Benchmark (cap performance criteria) from SOW = 21ppm (21,000 ug/kg)

APPROVAL SIGNATURES:

Environmental Protection Agency ____________________ Date: 12/3/2002
See "AW" below.

Vermont Department of Conservation ____________________ Date: 4 Dec 02

Engineer ____________________ Date: 11/22/02

Pvoject Manager ____________________ **Date:** 11/22/02

Note: DCR #10, dated November 15,2002, is approved with the understanding that the lessons learned diving application of the cap in what has come to be known as the " 150-foot stretch" may compel modifications to the design and/or enhancements to the environmental controls. The water quality monitoring that is proposed in this) DCR is adequate, pending review of the results of the November 2002 sampling event.

Reviewed By: CNC/TR

APPROVAL SIGNATURES:

Environmental Protection Agency____________________________Date:____________

Vermont Department of Conservation_________________________Date:____________

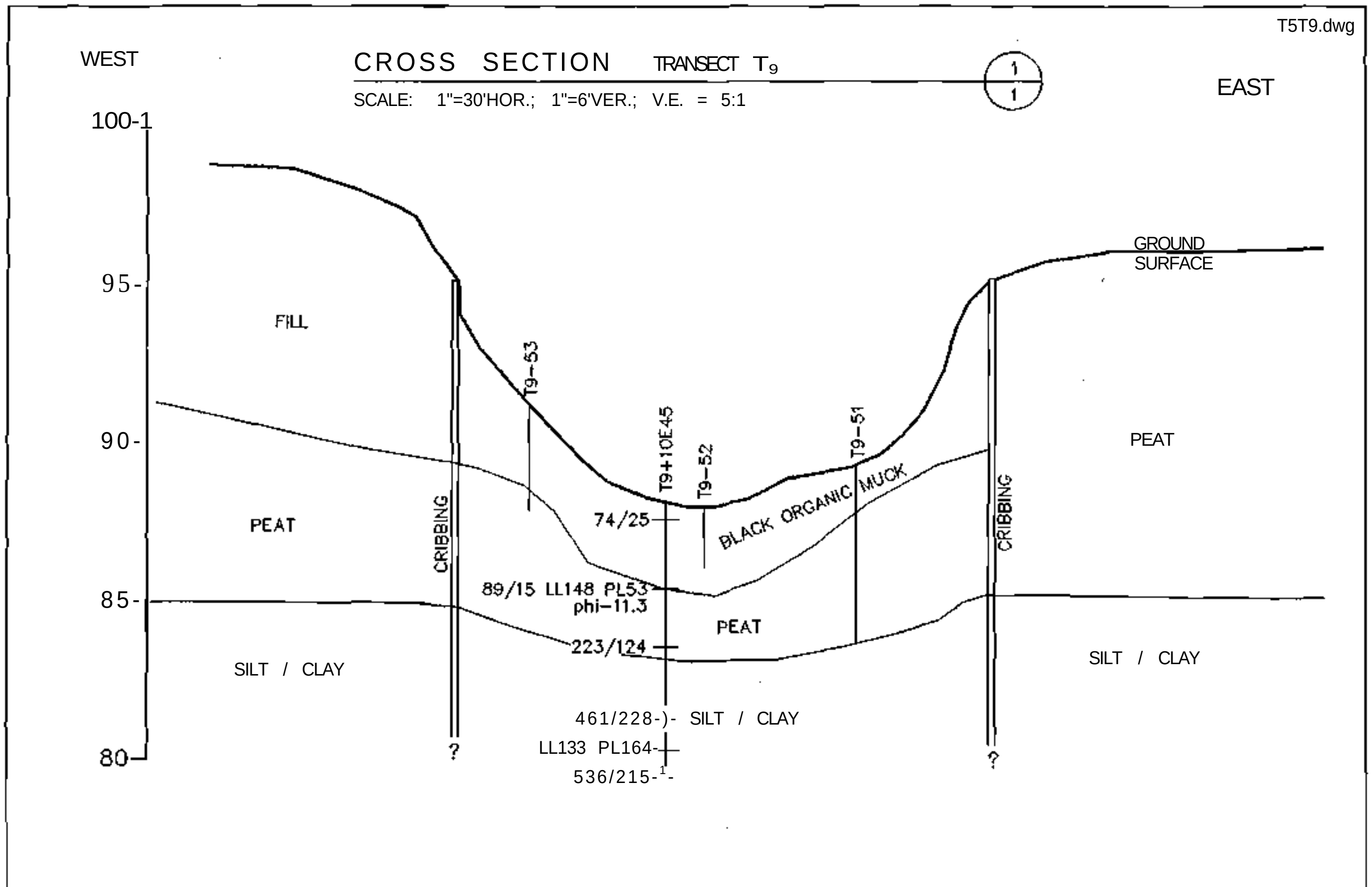
Engineer____Date: 11/22/02

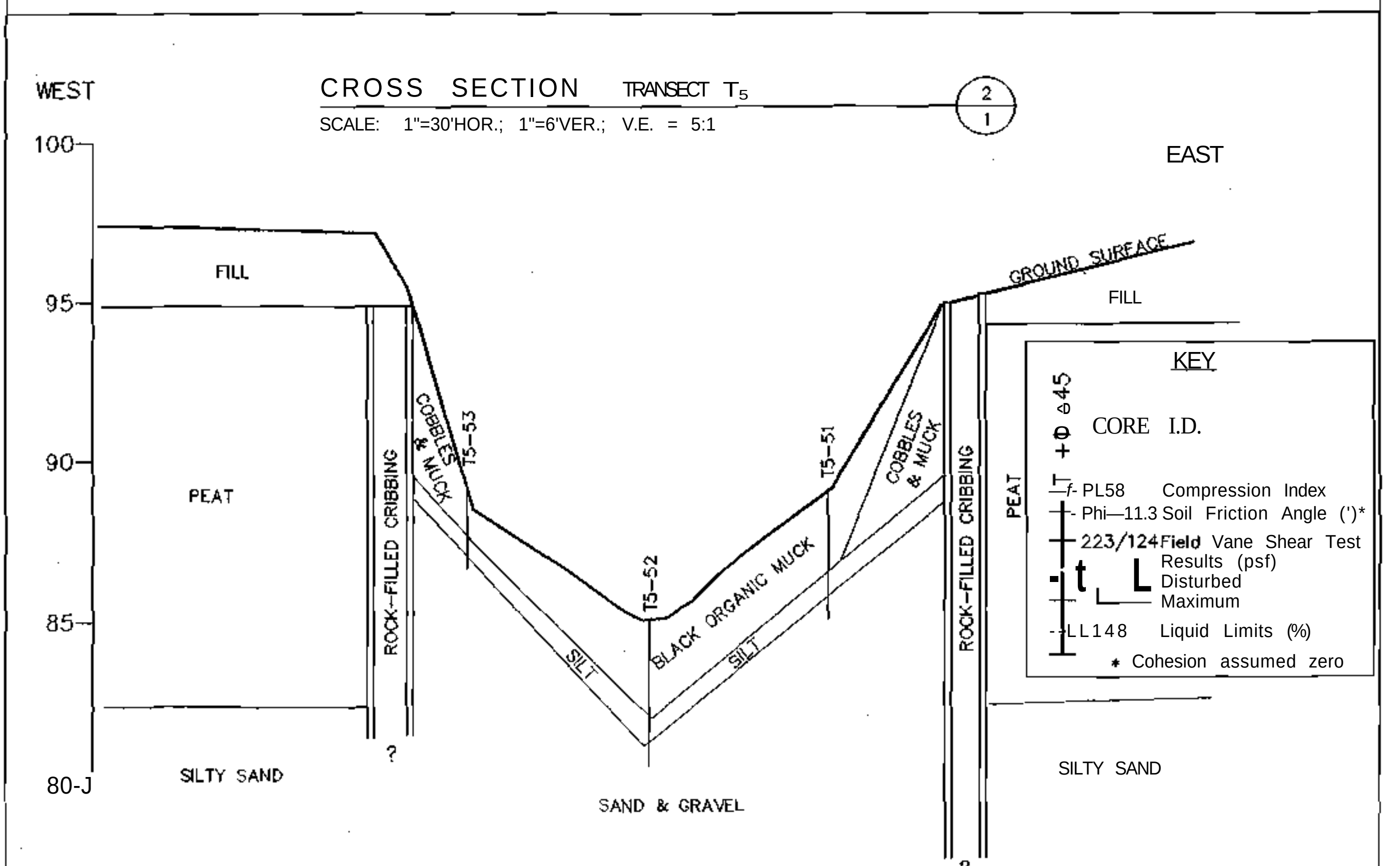
Project Manager____Date:____________

Reviewed By: CMC/TH
J:\PROJECTS\l-0870-l\Phase IB\Design ChangeWesign change 010 rev 1 l-22.wpd November 4, 2002

Attachment 1

Plan and Profile, Design Change 010 and Cross Sections

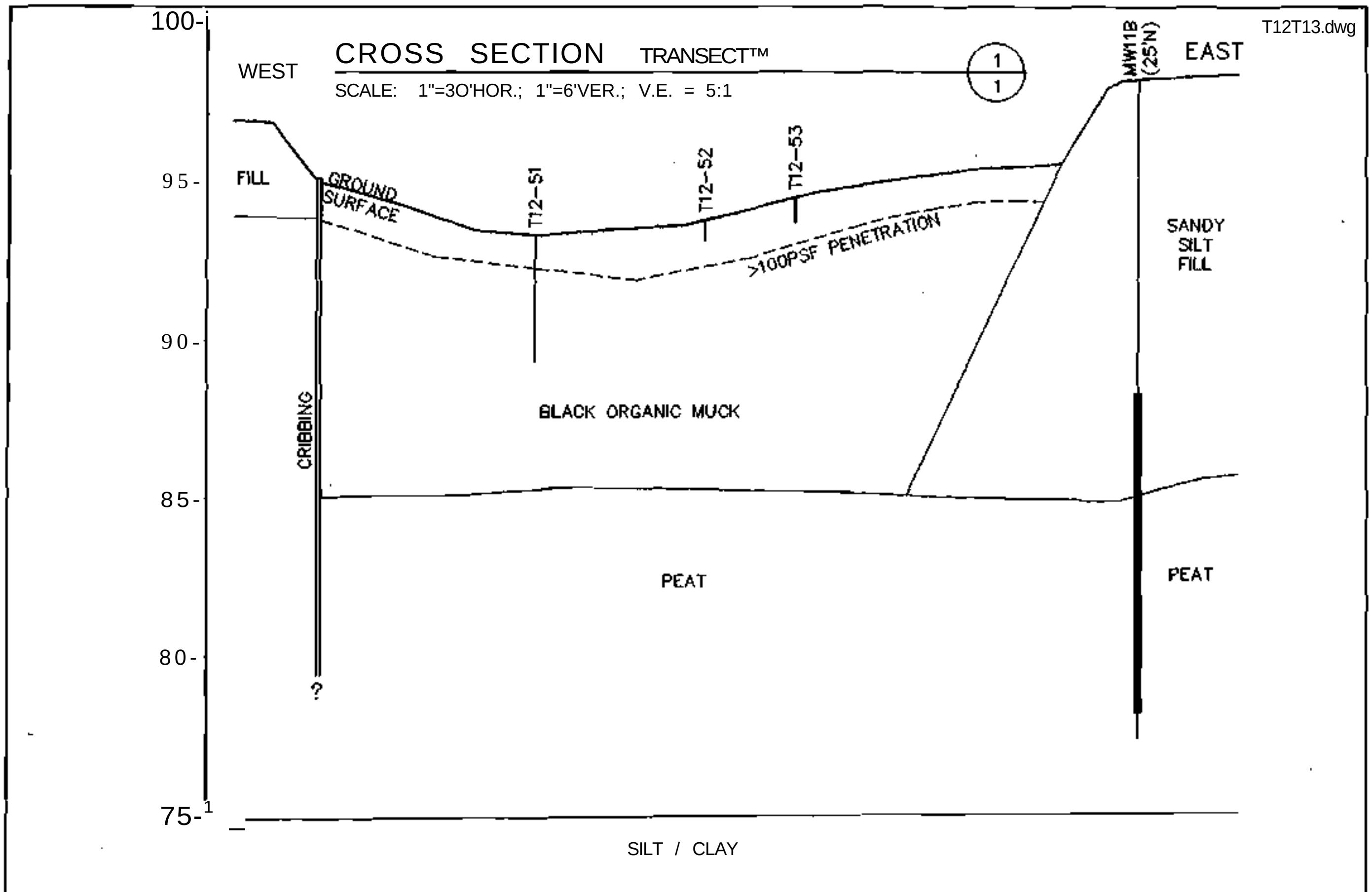


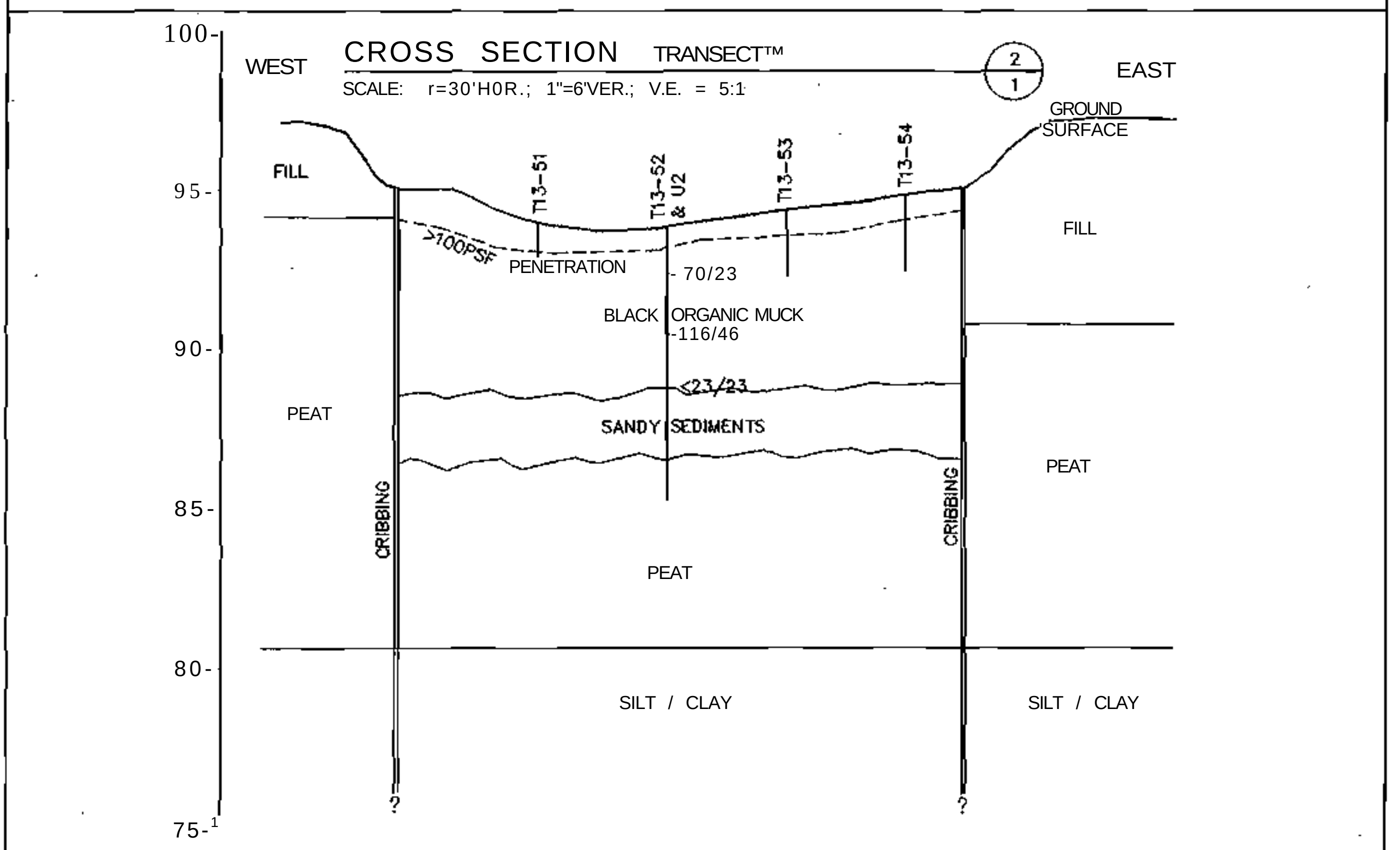


CANAL CROSS SECTIONS T5 & T9
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC.
Environmental Sciences *and Engineering*
100 STATE STREET MONTPELIER, VT 05602

DATE: 10/23/02 PROJECT: 1-0870-1
DRAWN BY: TJK SCALE: AS SHOWN

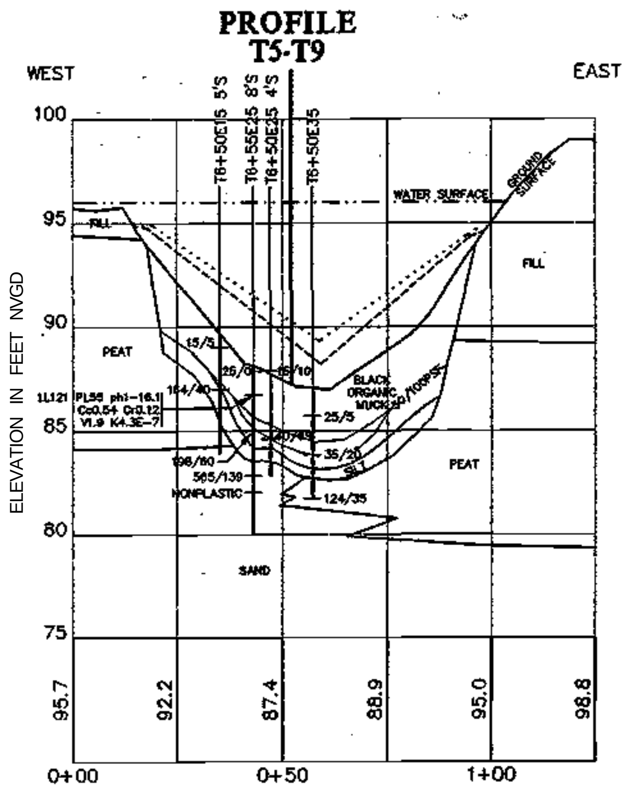




CANAL CROSS SECTIONS T12 & T13
PINE STREET CANAL SITE
BURLINGTON, VERMONT

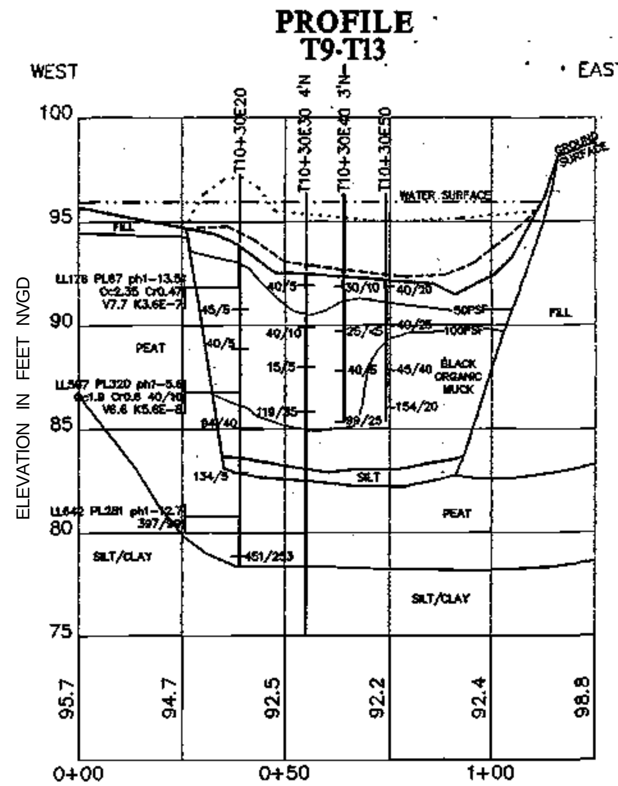
THE JOHNSON COMPANY, INC
EnviTornnental Sciences and EngiTieering
100 STATE STREET MONTPELIER, VT 05602

DATE: 10/21/02
DRAWN BY: TJK
PROJECT: 1-0870-1
SCALE: AS SHOWN



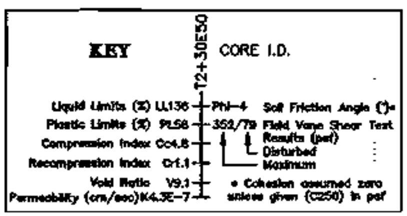
PROFILE T6+50 (1/1)

SCALE: 1"=30'HOR., 1"=6'VER.; V.E. = 5:1



PROFILE T10+35 (2/1)

SCALE: 1"=30'HOR., 1"=6'VER.; V.E. = 5:1



LEGEND

- ·········· PRESETTLEMENT CAP ELEVATION
- ------ FINAL CAP
- —100PSF— 100 PSF PENETRATION
- GEOLOGIC CONTACT

Additional Sources: 3/92 S.R.L., 8/96 A.R.I., 5/98 A.R.I., A.R.I. Fieldbooks (Documents #337 & #408)

FIGURE CDR 5-12
GEOLOGIC PROFILES T6+50 & T10+35
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VT 05602

GEOS17.dwg

DATE: 2/25/01 DRAWN BY: TJK PROJECT: 1-0870-1 SCALE: SHOWN

Attachment 2
Canal Cap and Canal Draw Down Construction Checklists
and
Table C-QAPP-2 Required Tests and Inspections during Canal Capping

PINE STREET CANAL SITE - CANAL DRAW-DOWN
DAILY INSPECTION CHECKLIST

DATE:____________________ INSPECTOR:______________________________

WEATHER:________________ PRECIPITATION IN PREVIOUS 24 HOURS:_______

WIND DIRECTION/SPEED:_________________ TEMPERATURE (degrees F):___________

PUMP ON-TIME[1]:___:___ PUMP OFF-TIME[1]:___:___ PUMPING DURATION;______hrs

1) Air quality:
Time:___:___; Location: ________________; PID reading:____ppmV; Background:____ppmV
Time:___:___; Location: ________________; PID reading:____ppmV; Background:____ppmV

2) Environmental Controls:
Sediment Curtain Transect T-4: Time:___:___; In-place ______; Performing properly________
Sorbent Boom at Transect T-4: Time:___:___; In-place ______; Performing properly________
Sediment Curtain at Canal Outlet: Time:___:___; In-place_____; Performing properly________
Sorbent Boom at Canal Outlet: Time:___:___; In-place _______; Performing properly________
Sediment Curtain at pump intake: Time:___:___; In-place ____; Performing properly________
Sorbent Sweep at pump intake: Time:___:___; In-place ______; Performing properly________

3) Assessment of Water Quality:
At pump intake: Time:___:___; sheens;________________ turbidity: ______________NTU
Morning
At pump discharge: Time:___:___; sheens;________________ turbidity, ______________NTU
Afternoon
At pump discharge: Time:___:___; sheens;________________ turbidity: ______________NTU

4) Pumping Systems:
By-Pass pump; Time:___:___; Suction secure;______; Water Depth at Suction:___________ft
Canal Water Elevation_________feet on staff guage #_____;__________feet NGVD
Discharge secure;_____Discharge hose; leakage__; signs of wear;______couplings;____

5) Seeps, Sheens and NAPL in canal and turning basin. Record time, observation location (transect and offset from west bank), approximate elevation, description (rate, volume, area), and action taken (if any).

____
____
____
____
____
____

[1] since last inspection

PINE STREET CANAL SITE -PHASE IB EXTENSION CONSTRUCTION
CANAL CAP CONSTRUCTION INSPECTION CHECKLIST

DATE:____________________ INSPECTOR:________________________

FIELD BOOK________________________PAGE #s___________________________

1) Sub-grade preparation

Verify removal of debris and obstructions;______________________________________

2) Geotextile/Geogrid placement

Verify location, material, overlap, pleats, connections;______________________________

3) Sand cap material placement

Visual inspection of material upon delivery;____________________________________

Visual inspection of placement;____

In-place thickness penetrometer if used (verify minimum 18" at a minimum of 12 total locations):
Transcript:__________ Offset from East Shore:____ Maximum Reading:_____ Depth:______
Transect:__________ Offset from East Shore:____ Maximum Reading:_____ Depth:______
Transect:__________ Offset from East Shore:____ Maximum Reading:_____ Depth:______

Daily verify cap northern extent location and elevation;______________________________
____

Verify elevation and cap thickness at six settlement plates;
Transect:________Offset from East Shore:____ Plate Elevation:_____ Cap thickness:______
Transect:________Offset from East Shore:____ Plate Elevation:_____ Cap thickness:______
Transect:________Offset from East Shore:____ Plate Elevation:_____ Cap thickness:______
Transect:________Offset from East Shore:____ Plate Elevation:_____ Cap thickness:______
Transect:________Offset from East Shore:____ Plate Elevation:_____ Cap thickness:______
Transect:________Offset from East Shore:____ Plate Elevation:_____ Cap thickness:______

Construction Notes:
____
____
____
____
____

Reviewed By:
J:\PROJECTS\l-0870-l\Phase 2\Canakap conslraction checklistwpd Oct.18,2002

Table C-QAIT-2
Required Tests and Inspections during Canal Capping

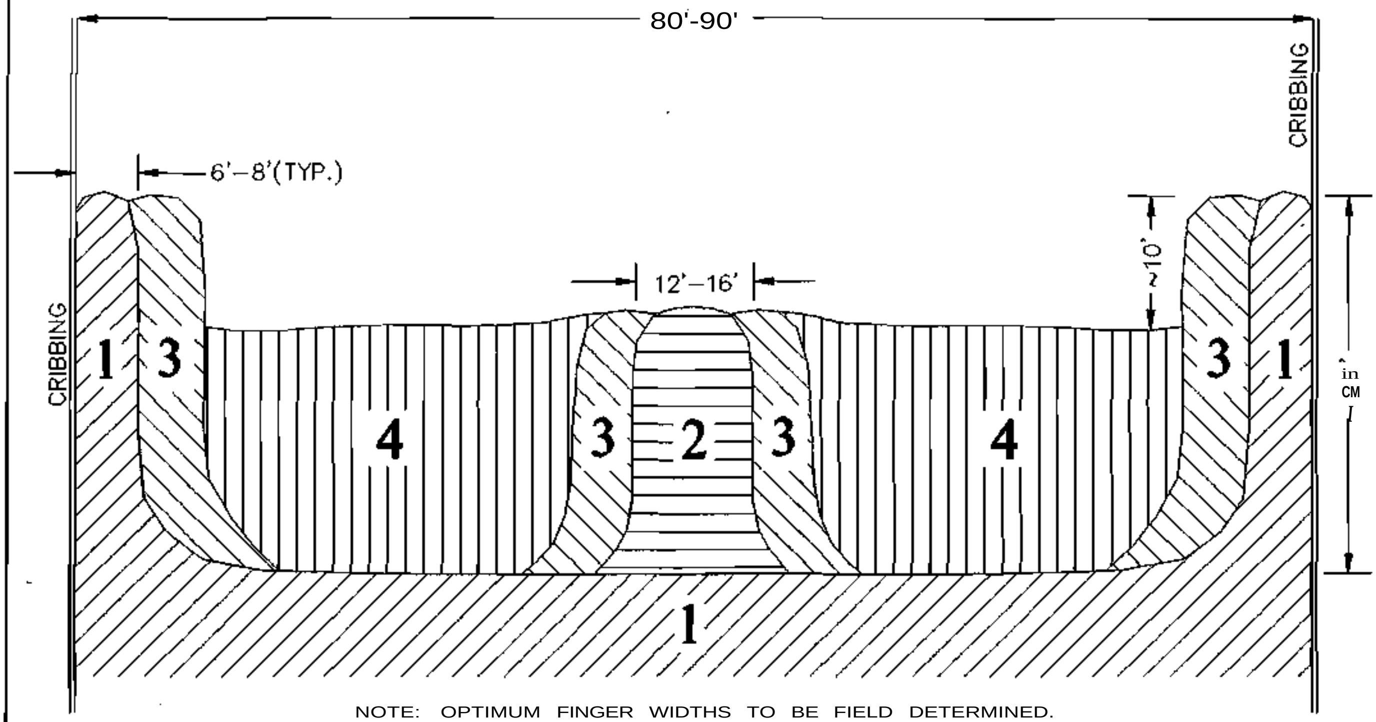
Construction [illegible]	Test or Inspection Method	Description	Timing and Frequency
Access control and support features	Visual	Inspect fences, temporary power lines, equipment and similar features to ensure they are intact and in compliance with the Canal Cap Design.	Immediately after installation, and daily during active construction.
Public health and safety	Visual	Inspect heavy equipment crossing areas on public roads to ensure that public safety will not be threatened. Respond with corrective measures and warning signs if necessary. Conduct air monitoring in the immediate work area and at the perimeter.	Daily during active construction and when conditions change that warrant additional air monitoring.
Silt curtains/silt fences/ and hay bales	Visual	Inspect silt curtains to ensure they are appropriately placed and the base is appropriately bedded and/or weighted. Inspect silt fences to ensure they are functioning. Inspect silt fences and hay bales to insure they are preventing inadvertent release of fill materials to wetland areas not to be disturbed.	Immediately after installation, daily during active construction, and after any significant precipitation event.
Sorbent booms	Visual	Inspect sorbent boom placement to ensure they are appropriately placed, have sufficient slack to allow them to remain floating and not suspended, and still have sorbative capacity. Replace when absorbent capacity has been reached.	Immediately after installation, daily during active construction, and after any significant precipitation event.
By-pass and dewatering pumps	Visual and turbidity monitoring.	Inspect supply lines, discharge lines, intakes and outfalls for wear, clogging and position. Monitor turbidity at bypass pump location and upstream of silt curtain.	Immediately after installation and daily (upon start-up and shutdown) during active construction. Check turbidity monitor calibration monthly.
Placement of geotextiles and geogrids	Visual	Inspect geotextile for damage; inspect placement to be free of excessive slack or folds except as specified (two three-foot pleats on each edge of Canal); inspect connections between sheets and at Canal edges.	During placement of geotextile
Placement of caps	Visual and survey	Perform inspection of delivered sand for detritus, organic material, fines, and other deviations from the specifications. Check final grades and horizontal extent of cap placement; verify sand thickness	During placement of cap materials. Verify thickness and slope (equal to or less than 1:6 (16.7%)at a minimum of 12 locations per acre.
Restoration	Visual	Inspect all areas disturbed and restored.	During and after restoration
Clean-up	Visual	Inspect for the removal of trash and construction debris	During construction and upon work completion.

Table C-QAPP-2
Required Tests and Inspections during Canal Capping

Construction Task	Test or Inspection Method	Description	Timing and [illegible]
Surface water **chemical** monitoring	Unfiltered SVOCs (16 PAHs) by EPA 8270 Filtered SVOCs (16 PAHs) by EPA 8270 Unfiltered Metals (RCRA 8,Cu, Zn by EPA 6010b) Filtered Metals (RCRA8,Cu, Znby EPA 6010b) Total Suspended Solids (EPA Method 160.2)	Grab samples - 2 per sampling event	Monthly during active construction

Attachment 3
Cap Construction Conceptual Schematic

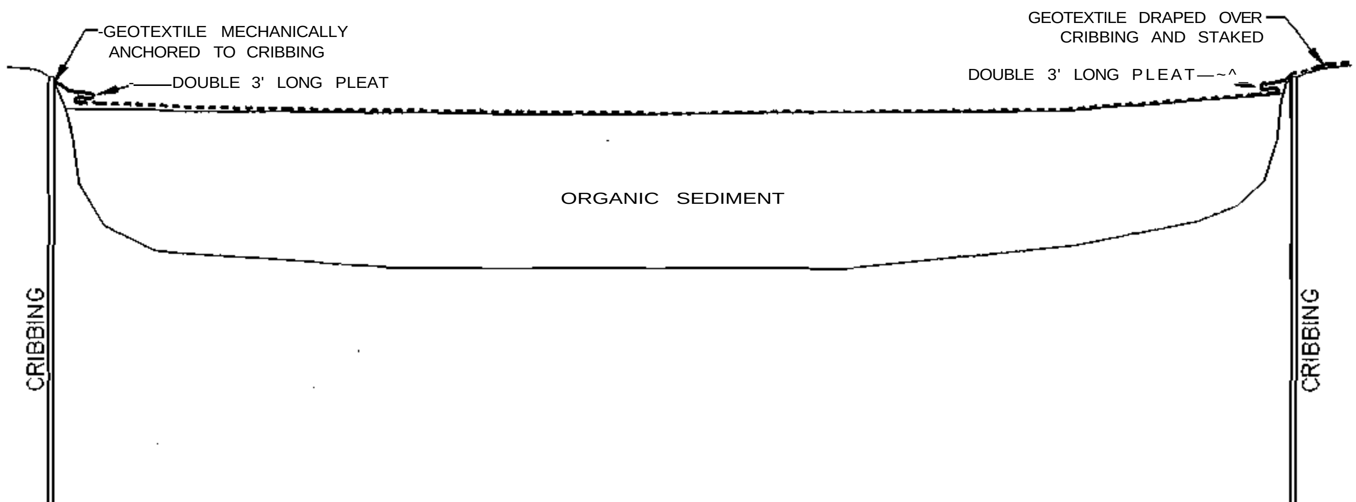
CHANGEIO.dwg



NOTE: OPTIMUM FINGER WIDTHS TO BE FIELD DETERMINED.

PLAN VIEW CAP PLACEMENT SEQUENCE (1/1)

SCALE: NONE



CROSS SECTION GEOTEXTILE PLACEMENT (2/1)

SCALE: NONE

DESIGN CHANGE #10 • CAP CONSTRUCTION CONCEPTUAL SCHEMATIC PINE STREET CANAL SITE, BURLINGTON, VT	THE JOHNSON COMPANY, INC. *Environmental Sciences and. Engineering* 100 STATE STREET MONTPEUER, VT 05602 DATE: 10/22/02 PROJECT: 1-0870-1 DRAWN BY: TJK SCALE: NONE

Attachment 4

Specifications

Bobcat® T190 and T200 G-Series Compact Ttack Loader

SPECIFICATIONS

Performance	T190	T200
Rated Operating Capacity[1] txiO	19001b. (862 kg)	2000 lb. (907 kg)
Tipping Load T*	54301b. (2463 kg)	57151b. (2592 kg)
Hydraulic Pump Capacity	16.7GPM(63L/mln.)	20.6GPM(78L/min.)
High Flow Option	27GPM(102L/mln.)	32 GPM (121,1 L/mln.)
Ground Pressure 12.6 in. tracks	5.0 psi	5.2 psi
Ground Pressure 17.7 In. tracks	•	3.8 psi
Travel Speed	7.1 MPH (11,4 km/hr.)	6.7 MPH (10,8 km/hr.)
Operating Weight	7244 lb. (3286 kg)	8080 lb. (3665 kg)

Dimensions	T190	T200
Length (with bucket)	130.3 in. (3309 mm)	135.4 in. (3439 mm)
Width (with bucket)	68.0 In. (1727 mm)	74.0 In. (1880 mm)
Height	76.3 in. (1938 mm)	82.3 In. (2090 mm)
Height to Bucket Pin	118.2 in. (3002 mm)	121.0 in. (3073 mm)

Engine	T190	T200
Make/Model	Kubota/V2003T-EB	Deutz/BF4M1011F Turbo-charged
Fuel/Cooling	Diesel/ Liquid	Diesel/Oil
Cylinders	4	4
SAE NET HP/Displacement	56.0/122 in.^{3} (2,0 L)	73.0/178 in.^{3} (2,92 L)
Fuel Tank Capacity	26.8 gal. (101,5 L)	25 gal. (94,6 L)

Operation

Steering and Drive	Forward, reverse, travel speed and steering controlled by two hand levers.
Hydraulics	Raise/lower lift arms and dump/rollback bucket controlled by two foot pedals or optional hand controls.
Transmission	Hydrostatic

Standard Features

12.6" Wide Rubber Tracks	Deluxe Cab	Gauges/Warning Lights
Adjustable Suspension Seat (vinyl cowr)	Dual Path Cooling System	Parking Brake
Automatically Activated Glow Plugs	Engine/Hydraulic Shutdown	Seat Bar (available for all Bobcat loaders)
Bobcat Interlock Control System (BICS)	Front & Rear Lights	Seat Belt
Bob-Tach	Front Auxiliary Hydraulics	Top & Rear Windows
	Lift Arm Support	Turbo-Charger (iwMssnimiisty

Options/Accessories

17.7" Wide Rubber Tracks* (•T200 only)	Cab Heater	Power Bob-Tach
Advanced Control System	Deluxe Instrumentation	Rear Auxiliary Hydraulics
Advanced Hand Controls	Flasher/Strobe/Rotating Beacon Lights	Service Safety Training Kit
Air Conditioning	High Flow Auxiliary Hydraulics Package	Side Windows
Attachment Control Kit	Horn	Skid-Steer Loader Operator Training Kit
Backup Alarm	Hydraulic Bucket Position[2]	Sound Cab
Catalytic Purifier	Keyless Start System	Special Applications Kit[3]
Cab Enclosure		Water Kit

Bobcat Attachments

Angle Broom*	Dumping Hopper	Sod Layer*
Auger	Grader	Soil Conditioner
Backhoe	Hydraulic Breaker[4]	Stump Grinder*
Brushcat Rotary Cutter	Hydraulic Pallet Fork	Super Scraper
Buckets	Industrial Grapple	Sweeper
Chipper*	Landplane	Three-Point Hitch
Combination Bucket	Landscape Rake	Tiller
Concrete Mixer*	Pallet Fork	Tree Spade
Concrete Pump*	Planer*	Trench Compactor
Cutter Crusher	Rear Stabilizer	Trencher
Digger (T190 only)	Scarifier	Vibratory Roller
Dozer Blade*	Snowblower*	Wolf Disk

•Attachment Control Kit Required.

Extend your working season with either of these powerful, versatile compact track loaders! Rugged rubber tracks deliver extra traction, greatly reduced ground pressure and low ground disturbance. Superior flotation, too, for working on soft, wet, even muddy ground where other machines stop dead!

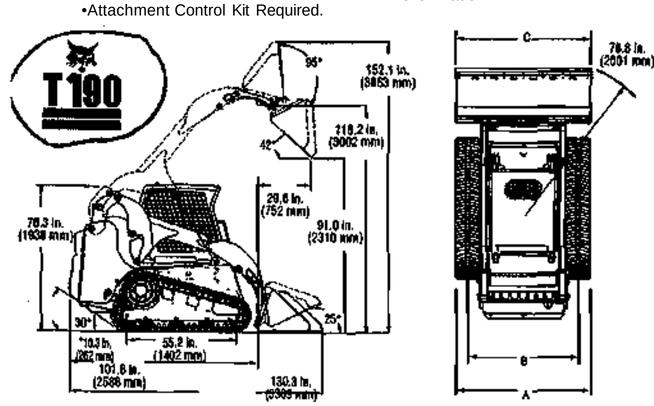
[1] *Operating capacity rated with standard digging bucket according to SAE standard J818- OPERATING CAPACITY TO EQUAL NO MORE THAN 35% OF TIP LOAD.*

[2] *Bucket positioning helps operator keep the same tilt of the load during lifting.*

[3] *Includes lexan front door, top and rear windows.*

[4] *Special application kit (see *3) must be used.*

NOTE—Where applicable, dimensions are in accordance with Society ot Automotive Engineers (SAE) and ISO standards. Specifications and design are subject to change without notice. Pictures of Bobcat loaders may show other than standard equipment. All dimensions are given lor loader equipped with standard tracks. All dimensions are shown In inches. Respective metric dimensions are enclosed by parentheses. Bobcat Company complies with the requirements of ISO 9001 as registered with BSI.

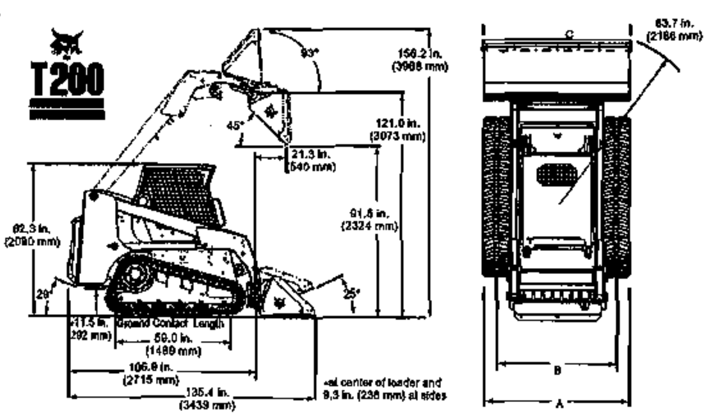


•at center of loader and 8.1 in. (205 mm) at sides

A -12.6 in. Tracks - 66.0 in. (1676 mm)

8 -12.6 In. Tracks - 53.4 in. (1356 mm)

C - 68 In. Bucket Width • 68.0 in. (1727 mm)



A-12.6ln.Tracks-72.8 in. (1849 mm)
17.7 in. Tracks-77.1 in. (1958 mm)

B- 60 in. (1524 mm) Track - Centerllne is used for both 12.6 In. and 17.7 in. wide tracks.

C.-74 In. Bucket Width • 74.0 in. (1880 mm)
80 in. Bucket Width - 80 in. (2032 mm)

Bobcat Company • P.O. Box 6000 • West Fargo, ND 58078 • www.bobcat.com

(IS) Bobcat.®

Kn-5OM-7O1-#64O27O-F

Proving Ring Penetrometer

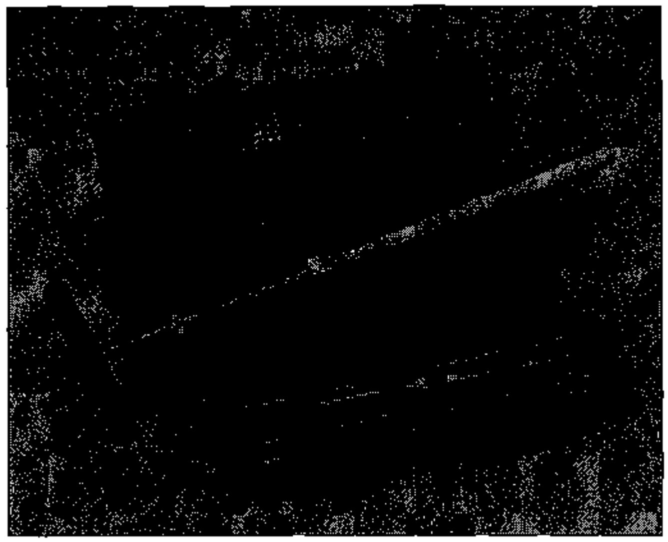
- ***Brake type dial indicator holds final reading until manually released.***
- ***250 lb. (1.1 kN) capacity proving ring.***
- ***Lightweight and compact for easy transport to the field.***

The Proving Ring Penetrometer is a 30 degree cone penetrometer used to determine the bearing capacity of subgrades or to measure soil compaction. The penetrometer also serves as a rapid means of determining the penetration resistance of soil in shallow exploration work.

Specifications

Proving Ring.	*2501b. (1.1 kN) capacity.*
Dial Indicator.	Brake type.
Shaft.	*3/4" (19 mm) diam. x18"l.* (457 *mm); graduated at 6" (152 mm) Intervals.*
Extension Rod.	*314" (19* mm) d/am. x 36" *l. (914 mm);graduated* at 6" *(7 52 mm) intervals.*
Cone.	*30 degree; 1 so? in.', replaceable.*
Handle.	*Cast aluminum.*
Weight.	*Net 12 lbs. (5.4* kg).

Ordering Information
E129-3739.



Proctor Penetrometer Set
ASTM D-1558.

- **100 lb. capacity with 1 lb. subdivisions.**
- ***Includes 9 interchangeable needles as specified in ASTM testing standards.***
- ***Plated for rust resistance and long life.***
- **Convenient *carrying case with individual compartments.***

The Proctor Penetrometer is used for determining the penetration resistance of fine-grained soils. The unit consists of a special calibrated spring dynamometer with a pressure-Indicating scale on the stem of the handle.The pressure scale is calibrated to 100 lbs. by 1 lb. subdivisions.There is a major division located at each 10 lb. interval. A sliding ring on the stem indicates the maximum load obtained during the test

Specifications

Penetrometer.	*Calibrated spring* dynamometer.
Pressure Scale.	*100lbs.x lOlbs.and 11b.subdivisions.*
Test Reading.	*Indicated* by *sliding* ring.
Needles.	*Indudes:1.3/4,1/2,1/3,1/5,1/10 1/20,1/30 and 1/40 sq. In.* end *area needles.*
Carrying Case.	*Plastic with shelt, 18" w.x6'd.x 4-3/4" h. (457 x 152 x 121* mm).
Weight.	Net 7 *lbs. (3.2* kg).

Ordering Information
EI29-3935. Includes penetrometer, nine needles and carrying case.

Replacement Parts
EI29-3935/10. Penetration Needle. 1/20 sq. in.
EI29-3935/11. Penetration Needle. 1/10 sq.in.
EI29-3935/12. Penetration Needle. 1/2 sq. in.
EI29-3935/13. Penetration Needle. 1 sq. in.
EI29-3935/14. Penetration Needle. 1/3 sq. in.
EI29-3935/15. Penetration Needle, 1/5 sq. in.
EI29-3935/16. Penetration Needle. 3/4 sq. in.
EI29-3935/17. Penetration Needle. 1/40 sq.in.
EI29-3935/18. Penetration Needle. 1/30 sq. in.

C.O.E. Cone Penetrometer

- ***Factory calibrated dial indicator reads directly in pounds per square inch (psi).***
- ***Manufactured in accordance with Corps of Engineers specifications.***

The C.O.E. Cone Penetrometer is the principal instrument used in evaluating soil trafficability It consists of a 30 degree cone with a 1/2 sq. in. base area, proving ring, dial indicator, extension rod and a handle.

Specifications

Proving Ring.	*150 lb. capacity; dial indicator calibrated direct in psi,* 0 to 300 psi by 5 psi subdivisions.
Shaft.	5/8" *(15.8 mm)* d/am. *x 19" 1. (483 mm).*
Cone.	*30 degree; 1/2 sq. in. base area.*
Weight.	Net *2 lbs. (0.9* kg).

Ordering Information
EI29-3741.

SECTION 13551
GEOTEXTILE IN CANAL CAP

PART 1.00 GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish all labor, materials, equipment and incidentals required for the installation of the filter fabric specified herein or shown on the Drawings.

PART 2.00 PRODUCTS

2.01 MATERIALS

A. Separator geotextile

1. The fabric shall be non-woven and must be ultraviolet treated and inert to biological degradation and degradation or damage from naturally encountered chemicals, alkalines and acids.

2. Typical minimum property values for the fabric must be as follows:

Property	Minimum Average Value	Test Method
Grab Tensile Strength	900 N	ASTM D-4632-86
Grab Tensile Elongation	20% min.	ASTM D-4632-86
Mullin Burst Strength	2750 kPa	ASTM D-3786
Trapezoid Tear Strength	335 N	ASTMD-4533-86
Puncture Strength	445 N	ASTM D-3787
Apparent Opening Size	0.15 mm	ASTMD-4751
Weight	12oz./squareyard	----------

PART 3.00 EXECUTION

3.01 INSTALLATION

1. The geotextile shall be installed after all debris has been removed or cut off at or near the sediment surface.

2. The application area must be shaped as shown as "Proposed Limits of Cap" on the Plan and Profile, Design Change 010.

3. The fabric shall be installed in strips from south to north. The geotextile will be draped over the cribbing wall onto the bank and secured as necessary with stakes and sand bags. Two, three-foot pleats in the geotextile will be left at each side of the Canal to account for settlement of sediments during cap placement (see Phase IB Remedial Action Design Change 10, Attachment 3: *Cap Construction Conceptual Schematic*, for a diagram of the geotextile placement). The geotextile will be weighted with sand bags as dictated by field conditions to prevent slipping and/or floating prior to sand placement.

4. The fabric shall be furnished in rolls of a width and length which will minimize the number of overlaps. Where overlaps cannot be avoided, field connections between geotextile panels will be of two types, mechanical and sewn. In the 150 foot test area (see *Plan and Profile, Design Change 010)*, the field connections will be either mechanical with a minimum one foot overlap and connected with mechanical ring connections every three feet, or will be field sewn. For the remainder of the Canal the field connections will be sewn.

5. The sewn field connections shall be completed as follows. The seam type may be a flat, prayer, "J" or butterfly seam with a single stitch line. It is acceptable to use hand-held machines, utilizing either a lockstitch (two-thread stitch) or chainstitch (single-thread stitch). A minimum of 3 "stitch counts", or three (3) stitches per inch, is required. Threads may be composed of nylon, polypropylene or polyester.

6. The specified backfill material must be placed so as not to disturb the fabric.

7. The fill shall be placed with a 3 foot maximum height of drop onto the geotextile.

END OF SECTION

J:\PROJECTS\l-0870-l\Phase IBWesign Change\13551 revNov22.*pd

SECTION 13554
GEOGRID

PART 1.00 GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish all labor, materials, equipment and incidentals required for the installation of the structural geogrid in the Canal cap specified herein or shown on the Drawings.

PART 2.00 PRODUCTS

2.01 MATERIALS

A. Structural Geogrid

1. For single (or optionally dual) layer use, the material shall be equivalent to or exceed Tensar BX4200 (see attached Product Specification).

2. For dual-layer use only, the material shall be equivalent to or exceed Tensar BX4100 (see attached Product Specification).

3. For any location, an alternative acceptable material shall be equivalent to Tensar BX1500 (see attached Product Specification).

PART 3.00 EXECUTION

3.01 INSTALLATION

1. The geogrid shall be installed after all debris has been removed or cut off at or near the sediment surface.

2. The preferred location for the geogrid is above the associated geotextile, and the preferred orientation is parallel to the direction of cap placement and the Canal (north-south). However, in areas with known or suspected inadequate sediment shear strengths, it is permissible to place the geogrid directly upon the sediments, prior to geotextile placement. In this event, the preferred orientation of the Geogrid is transverse to the Canal (east-west). If dual layers of geogrid are used, it is preferable to orient the layers at right angles to each other.

3. The locations where the geogrid will be used, whether it will be placed over or under the geotextile, and whether or not in more than one layer, will be made in the field by the Engineer and Contractor as dictated by field conditions and as anticipated based upon available geotechnical data and the active construction stability analysis. Unlike the geotextile, it is not expected that the geogrid will extend beyond the Canal cribbing. When the geogrid is placed as a "patch" over local weak areas, it shall be extended a minimum of five feet past the edge of the weakened sediments (as best determined in the

field). The geogrid shall be weighted with sand bags as dictated by field conditions to prevent slipping and/or floating prior to sand placement.

4. The geogrid shall be furnished in rolls of a width and length which will minimize the number of overlaps. Where overlaps cannot be avoided, field connections between geogrid panels will be mechanical. Adjacent geogrid edges will be attached using Zipties® or metal rings with a minimum of one foot overlap and five feet between ties. The required overlap may be increased by the on-site Engineer to provide additional support for equipment in the field based upon observed conditions during cap placement. Overlaps perpendicular to the direction of cap placement (such as between the ends of rolls) will be "shingled" in the direction of placement (e.g. in the 150 foot test area, where placement is from the south to the north, the northern end of a geogrid roll will overlap the southern end of the next roll, instead of being beneath it).

5. The geogrid may be cut to lie flat around debris or protrusions.

6. The shoving action of cap placement over the geogrid may push up a "wave" in the sheet of geogrid ahead of the advancing cap. "Waving" should be mitigated by pulling the geogrid taut, and removing or replacing sand bag weights to allow the waves to dissipate at the end and edges of the roll.

7. **Do not drive tracked equipment directly upon the geogrid.** Ensure that at least 1.5 feet of cap sand is between the BX geogrid and tracked equipment.

8. If rutting occurs, do not grade out the ruts. Grading will only reduce the cap thickness between the ruts. Instead, fill in the ruts with additional cap sand.

END OF SECTION

J:\PROJECTS\l-0870-l\Phase IB\Design ChangeV13554.wpd

Product Specification - Structural Geogrid BX4200

The structural geogrid shall be an integrally formed grid structure manufactured of a stress resistant polypropylene material with molecular weight and molecular characteristics which impart: (a) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to mechanical stress in installation; (b) high resistance to deformation when the geogrid is subjected to applied force in use; and (c) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to long-term environmental stress.

The structural geogrid shall accept applied force in use by positive mechanical interlock (i.e. by direct mechanical keying) with: (a) compacted soil or construction fill materials; (b) contiguous sections of itself when overlapped and embedded in compacted soil or construction fill materials; and (c) rigid mechanical connectors such as bodkins, pins or hooks. The structural geogrid shall possess sufficient cross sectional profile to present a substantial abutment interface to compacted soil or particulate construction fill materials and to resist movement relative to such materials when subject to applied force. The structural geogrid shall possess sufficient true initial modulus to cause applied force to be transferred to the geogrid at low strain levels without material deformation of the reinforced structure. The structural geogrid shall possess complete continuity of all properties throughout its structure and shall be suitable for reinforcement of compacted soil or particulate construction fill materials to improve their long term stability, in structural load bearing applications such as earth retention systems. The structural geogrid shall otherwise have the following characteristics:

Product Type: **Integrally Formed Structural Geogrid**
Load Transfer Mechanism: **Positive Mechanical Interlock**

Product Properties

Index Properties	**Units**	**MD Values[1]**	**XMD Values[1]**
• Aperture Dimensions[2]	mm (in)	33(1.3)	33(1.3)
• Minimum Rib Thickness[2]	mm (in)	0.76 (0.05)	0.76 (0.05)
Load Capacity			
• True Initial Modulus in Use[3]	kN/m(lb/ft)	280(19,190)	420 (28,790)
• True Tensile Strength @2% Strain[3]	kN/m(lb/ft)	5.5 (380)	2.4(510)
• True Tensile Strength @5% Strain[3]	kN/m(lb/ft)	10.5(720)	14.6(1,000)
Structural Integrity			
• Junction Efficiency[4]	%	93	
• Flexural Stiffness[5]	mg-cm	750,000	
• Aperture Stability[6]	kg-cm/deg	4.8	
Durability			
▪ Resistance to Installation Damage[7]	%SC/%SW/%GP	90 / 83 / 75	
▪ Resistance to Long Term Degradation[8]	%	100	

Dimensions and Delivery

The structural geogrid shall be delivered to the jobsite in roll form with each roll individually identified and nominally measuring 3.0 meters (9.8 feet) or 4.0 meters (13.1 feet) in width and 50.0 meters (164 feet) in length. A typical truckload quantity is 260 rolls. On special request, the structural geogrid may also be custom cut to specific lengths or widths to suit site specific engineering designs.

Notes

1. Unless indicated otherwise, values shown are minimum average roll values determined in accordance with ASTM D-4759. Brief descriptions of test procedures are given in the following notes. Complete descriptions of test procedures are available on request from Tensar Earth Technologies, Inc.
2. Nominal Dimensions.
3. True resistance to elongation when initially subjected to a load measured via ASTM D6637 without deforming test materials under load before measuring such resistance or employing "secant" or "offset" tangent methods of measurement so as to overstate tensile properties.
4. Load transfer capability measured via GRI-GG2-87. Expressed as a percentage of ultimate tensile strength.
5. Resistance to bending force measured via ASTM D-5732-95, using specimens of width two ribs wide, with transverse ribs cut flush with exterior edges of longitudinal ribs (as a "ladder"), and of length sufficiently long to enable measurement of the overhang dimension. The overall Flexural Stiffness is calculated as the square root of the product of machine-and cross-machine-direction Flexural Stiffness values.
6. Resistance to in-plane rotational movement measured by applying a 20 kg-cm moment to the central junction of a 9 inch x 9 inch specimen restrained at its perimeter (U.S. Army Corps of Engineers Methodology for measurement of Torsional Rigidity).
7. Resistance to loss of load capacity or structural integrity when subjected to mechanical installation stress in clayey sand (SC), well graded sand (SW), and crushed stone classified as poorly graded gravel (GP). The geogrid shall be sampled in accordance with ASTM D5818 and load capacity shall be measured in accordance with ASTM D6637.
8. Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments measured via EPA 9090 immersion testing.

Tensar Earth Technologies, Inc.
5883 Glenridge Drive, Suite 200
Atlanta, Georgia 30328-5363
(800) 836-7271

March 15, 2002
This product specification supersedes all prior specifications for the product described above and is not applicable to any products shipped to jobsite prior to March 15, 2002.

Product Specification - Structural Geogrid BX4100

Tensar Earth Technologies, Inc. reserves the right to change its product specifications at any time. It is the responsibility of the specifier and purchaser to ensure that product specifications used for design and procurement purposes are current and consistent with the products used in each instance. Please contact Tensar Earth Technologies, Inc. at 800-836-7271 for assistance

The structural geogrid shall be an integrally formed grid structure manufactured of a stress resistant polypropylene material with molecular weight and molecular characteristics which impart: (a) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to mechanical stress in installation; (b) high resistance to deformation when the geogrid is subjected to applied force in use; and (c) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to long-term environmental stress.

The structural geogrid shall accept applied force in use by positive mechanical interlock (i.e. by direct mechanical keying) with: (a) compacted soil or construction fill materials; (b) contiguous sections of itself when overlapped and embedded in compacted soil or construction fill materials; and (c) rigid mechanical connectors such as bodkins, pins or hooks. The structural geogrid shall possess sufficient cross sectional profile to present a substantial abutment interface to compacted soil or particulate construction fill materials and to resist movement relative to such materials when subject to applied force. The structural geogrid shall possess sufficient true initial modulus to cause applied force to be transferred to the geogrid at low strain levels without material deformation of the reinforced structure. The structural geogrid shall possess complete continuity of all properties throughout its structure and shall be suitable for reinforcement of compacted soil or particulate construction fill materials to improve their long term stability in structural load bearing applications such as earth retention systems. The structural geogrid shall otherwise have the following characteristics:

Product Type: **Integrally Formed Structural Geogrid**
Load Transfer Mechanism: **Positive Mechanical Interlock**

Product Properties

Index Properties	**Units**	**MD Values[1]**	**XMD Values[1]**
• Aperture Dimensions[2]	mm (in)	33(1.3)	33(1.3)
• Minimum Rib Thickness[2]	mm (in)	0.76 (0:03)	0.76 (0.03)
Load Capacity			
• True Initial Modulus in Use[3]	kN/m(lb/ft)	220 (15,080)	300 (20,560)
• True Tensile Strength @2% Strain[3]	kN/m(lb/ft)	4.0 (270)	5.5 (380)
• True Tensile Strength @5% Strain[3]	kN/m(lb/ft)	8.0 (550)	10.5 (720)
Structural Integrity			
• Junction Efficiency[4]	%	93	
• Flexural Stiffness[5]	mg-cm	250,000	
• Aperture Stability[6]	kg-cm/deg	2.8	
Durability			
• Resistance to Installation Damage[7]	%SC/%SW/%GP	90 / 83 / 70	
• Resistance to Long Term Degradation[8]	%	100	

Dimensions and Delivery

The structural geogrid shall be delivered to the jobsite in roll form with each roll individually identified and nominally measuring 3.0 meters (9.8 feet) or 4.0 meters (13.1 feet) in width and 50.0 meters (164 feet) or 75.0 meters (246 feet) in length. A typical truckload quantity is 285 to 380 rolls. On special request, the structural geogrid may also be custom cut to specific lengths or widths to suit site specific engineering designs.

Notes

1. Unless indicated otherwise, values shown are minimum average roll values determined in accordance with ASTM D-4759. Brief descriptions of test procedures are given in the following notes. Complete descriptions of test procedures are available on request from Tensar Earth Technologies, Inc.
2. Nominal Dimensions.
3. True resistance to elongation when initially subjected to a load measured via ASTM D6637 without deforming test materials under load before measuring such resistance or employing "secant" or "offset" tangent methods of measurement so as to overstate tensile properties.
4. Load transfer capability measured via GRI-GG2-87. Expressed as a percentage of ultimate tensile strength.
5. Resistance to bending force measured via ASTM D-5732-95, using specimens of width two ribs wide, with transverse ribs cut flush with exterior edges of longitudinal ribs (as a "ladder"), and of length sufficiently long to enable measurement of the overhang dimension. The overall Flexural Stiffness is calculated as the square root of the product of machine-and cross-machine-direction Flexural Stiffness values.
6. Resistance to in-plane rotational movement measured by applying a 20 kg-cm moment to the central junction of a 9 inch x 9 inch specimen restrained at its perimeter (U.S. Army Corps of Engineers Methodology for measurement of Torsional Rigidity).
7. Resistance to loss of load capacity or structural integrity when subjected to mechanical installation stress in clayey sand (SC), well graded sand (SW), and crushed stone classified as poorly graded gravel (GP). The geogrid shall be sampled in accordance with ASTM D5818 and load capacity shall be measured in accordance with ASTM D6637.
8. Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments measured via EPA 9090 immersion testing.

Tensar Earth Technologies, Inc.
5883 Glenridge Drive, Suite 200
Atlanta, Georgia 30328-5363
(800) 836-7271

March 15,2002
This product specification supersedes all prior specifications for the product described above and is not applicable to any products shipped to jobsite prior to March 15, 2002.

Product Specification - Structural Geogrid BX1500

Tensar Earth Technologies, Inc. reserves the right to change its product specifications at any time. It is the responsibility of the specifier and purchaser to ensure that product specifications used for design and procurement purposes are current and consistent with the products used in each instance. Please contact Tensar Earth Technologies, Inc. at 800-836-7271 for assistance

The structural geogrid shall be an integrally formed grid structure manufactured of a stress resistant polypropylene material with molecular weight and molecular characteristics which impart: (a) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to mechanical stress in installation; (b) high resistance to deformation when the geogrid is subjected to applied force in use; and (c) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to long-term environmental stress.

The structural geogrid shall accept applied force in use by positive mechanical interlock (i.e. by direct mechanical keying) with: (a) compacted soil or construction fill materials; (b) contiguous sections of itself when overlapped and embedded in compacted soil or construction fill materials; and (c) rigid mechanical connectors such as bodkins, pins or hooks. The structural geogrid shall possess sufficient cross sectional profile to present a substantial abutment interface to compacted soil or participate construction fill materials and to resist movement relative to such materials when subject to applied force. The structural geogrid shall possess sufficient true initial modulus to cause applied force to be transferred to the geogrid at low strain levels without material deformation of the reinforced structure. The structural geogrid shall possess complete continuity of all properties throughout its structure and shall be suitable for reinforcement of compacted soil or particulate construction fill materials to improve their long term stability in structural load bearing applications such as earth retention systems. The structural geogrid shall otherwise have the following characteristics:

Product Type: **Integrally Formed Structural Geogrid**
Load Transfer Mechanism: **Positive Mechanical Interlock**

Product Properties

Index Properties	**Units**	**MD Values[1]**	**XMD Values[1]**
• Aperture Dimensions[2]	mm (in)	25(1.0)	30.5(1.2)
• Minimum Rib Thickness[2]	mm (in)	1.78(0.07)	1.78(0.07)
Load Capacity			
• True Initial Modulus in Use[3]	kN/m(lb/ft)	500 (34,270)	625 (42,840)
• True Tensile Strength @2% Strain[3]	kN/m(lb/ft)	8.5 (580)	10.0 (690)
• True Tensile Strength @5% Strain[3]	kN/m(lb/ft)	17.5(1,200)	20.0(1,370)
Structural Integrity			
• Junction Efficiency[4]	%	93	
• Flexural Stiffness[5]	mg-cm	2,000,000	
• Aperture Stability[6]	kg-cm/deg	7.5	
Durability			
▪ Resistance to Installation Damage[7]	%SC / %SW / %GP	91/91/85	
▪ Resistance to Long Term Degradation[8]	%	100	
▪ Carbon Black Content	%	2.0	

Dimensions and Delivery

The structural geogrid shall be delivered to the jobsite in roll form with each roll individually identified and nominally measuring 4.0 meters (13.1 feet) in width and 50.0 meters (164 feet) in length. A typical truckload quantity is 150 rolls. On special request, the structural geogrid may also be custom cut to specific lengths or widths to suit site specific engineering designs.

Notes

1. Unless indicated otherwise, values shown are minimum average roll values determined in accordance with ASTM D-4759. Brief descriptions of test procedures are given in the following notes. Complete descriptions of test procedures are available on request from Tensar Earth Technologies, Inc.
2. Nominal Dimensions.
3. True resistance to elongation when initially subjected to a load measured via ASTM D6637 without deforming test materials under load before measuring such resistance or employing "secant" or "offset" tangent methods of measurement so as to overstate tensile properties.
4. Load transfer capability measured via GRI-GG2-87. Expressed as a percentage of ultimate tensile strength.
5. Resistance to bending force measured via ASTM D-5732-95, using specimens of width two ribs wide, with transverse ribs cut flush with exterior edges of longitudinal ribs (as a "ladder"), and of length sufficiently long to enable measurement of the overhang dimension. The overall Flexural Stiffness is calculated as the square root of the product of machine-and cross-machine-direction Flexural Stiffness values.
6. Resistance to in-plane rotational movement measured by applying a 20 kg-cm moment to the central Junction of a 9 inch x 9 inch specimen restrained at its perimeter (U.S. Army Corps of Engineers Methodology for measurement of Torsional Rigidity).
7. Resistance to loss of load capacity or structural integrity when subjected to mechanical installation stress in clayey sand (SC), well graded sand (SW), and crushed stone classified as poorly graded gravel (GP). The geogrid shall be sampled in accordance with ASTM D5818 and load capacity shall be measured in accordance with ASTM D6637.
8. Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments measured via EPA 9090 immersion testing.

Tensar Earth Technologies, Inc.
5883 Glenridge Drive, Suite 200
Atlanta, Georgia 30328-5363
(800) 836-7271

March 15,2002
This product specification supersedes all prior specifications for the product described above and is not applicable to any products shipped to jobsite prior to March 15, 2002.

Attachment 5

Design Basis/Calculations for

Design Change No. 10

PINE STREET BARGE CANAL SITE
DESIGN CHANGE No. 10
DESIGN BASIS/CALCULATIONS

TABLE OF CONTENTS
DESIGN BASIS/CALCULATIONS
DESIGN CHANGE NO. 10

PINE STREET BARGE CANAL SITE
DESIGN CHANGE No. 10
DESIGN BASIS/CALCULATIONS

I. INTRODUCTION

The basis of design for Design Change No. 10 (capping of the Canal in the "dry") includes the use of conservative values for canal and lake water levels, subsurface sediment and soil strengths, design storms and earthquakes, and similar variables. The design values for these variables were selected from available site and regional data and good engineering practice. Cross sections of the Canal at Transects T5, T6 + 50, T9, T10 + 50, T12 and T13 are provided in Attachment 1 of Design Change 010. A map of the depth to > 100 psf shear strength sediments (based upon penetration tests) and summary tables of the available in-situ vane shear test data are attached to this design document.

II. CAP EROSION POTENTIAL

A. Site Hydrology

A storm water modeling program (HydroCAD Storm Water Modeling System Version 6.00, Applied Microcomputer Systems, Chocorua, NH, 2001) was used to model the hydrologic response of the Site to 24-hour rainfalls of 10-, 25- and 100-year frequencies and Type II distributions (approximately 3.5, 4.1 and 4.8 inches, respectively, for Burlington, Vermont). The modeling software was used to predict peak flow conditions for each design storm and the results were provided in the Phase IB 95/100% Remedial Design. The initial water level was conservatively (from an erosion standpoint) assumed to be at its minimum possible pre-storm elevation of 96 ft. NGVD as presented in the *Phase IB Remedial Action Design Report.* The peak flow rate in the southern Canal from the 100-year storm is 161 cfs and the design flow rate is 242 cfs (150% of the 100-year storm). The Canal stage at this flow is 96.6 ft NGVD.

B. Flow Capacity of Capped Canal

The hydraulic flow capacity evaluation is based upon uniform flow and the Manning-Strickler equation:

$$Q = A^{5/3} x B^{-2/3} x i_f^{1/2}/n$$

Where: Q is flow in cfs

A is the wetted cross sectional area (85 ft wide x 1.6 ft deep =136 square feet)

B is the wetted perimeter (85 ft bottom + 2 x 1.6 ft banks = 88.2 feet)

i_f is the bed slope (0.0005 ft/ft)

n is the Manning's roughness coefficient (0.017)

$$Q = 239 \text{ cfs } (= (136)^{5/3} \text{ x } (88.2)^{-2/3} \text{ x } (0.0005)^{1/2} / 0.017)$$

A description of the rationale for the use of the values for the parameters in this equation is presented below.

The current design includes a silty-sand cap in the southern Canal. The silty-sand (from the Fontaine pit) has a D50 grain size of 0.12 mm, and a D75 of 0.20 mm. A Mannings roughness coefficient, n, of 0.017 was selected based upon the values presented on Page *1-22 of Handbook of Hydraulics* (Brater and King, 6th Edition, 1976) for a good to best, straight uniform earth channel (0.017 to 0.020). The low end of the range was selected to be conservative.

A cross section across Transect T13 was used as the most critical location of the Canal from an erosion potential standpoint because it is the shallowest portion of the Canal. The cap elevation after settlement was assumed to be 95 feet with a water depth during a storm of 1.6 feet. The consolidation calculations presented in Section IV indicate a probable minimum settlement for a 2-foot cap of about 2 feet, which would result in a final cap elevation of 94 feet. However, to account for potential local variability in sediment consolidation response and cap thickness, a final elevation of 95 feet was conservatively selected for erosion potential calculations. The width of the Canal is approximately 80-90 feet wide (85 feet was used for calculations, giving a cross sectional area of 136 square feet and a wetted perimeter of 88.2 feet). The slope of the Canal bottom between Transects T13 and T12 is about 0.05% (0.0005 ft/ft).

In summary, since the Manning-Strickler calculated flow (239 cfs) is nearly identical to the design flow through the southern portion of the Canal (242 cfs), the Canal geometry at the critical Transect T13 location does not restrict the design flow and the design flow is therefore appropriate to use in the erosion stability equations presented below. In addition, these results indicate that the Canal cap, as designed, will not adversely affect the hydraulic capacity of upstream structures (such as the BED storm water outfall).

C. Shear Stress Erosion Analysis

The maximum shear stress (tau) at the cap-water interface (at T13) is calculated as follows:

$$\text{tau} = \text{rho}_w \times R \times i_f$$

Where: rho_w is the density of water (62.4 pcf)
i_f is the bed slope (0.0005 ft/ft)
R is the hydraulic radius in feet (= A/B = 1.54 ft)
and A is the wetted cross sectional area (136 square feet)
B is the wetted perimeter (88.2 feet)

tau = 0.048 psf (= 62.4 pcf x 1.54 ft x 0.0005)

From Ven Te Chow, Open Channel Hydraulics, Figure 7-10 (attached), the permissible average particle diameter is approximately 0.1 mm for tractive forces less than 0.05 psf (depending upon the sediment load). The Fontaine pit silty sand, with a D50 of 0.12 mm, is therefore stable from a tractive force perspective.

D. Velocity Based Erosion Analysis

The mean water velocity at Transect T13 can be calculated by dividing the total design flow by the wetted cross sectional area. The mean velocity at Transect T13 in the Canal at design flows is 1.78 fps (242 cfs /136 sf). A permissible velocity for fine sand of 1.5 to 2.5 fps is suggested on page 7-24 of *Handbook of Hydraulics,* Brater and King, 6th Edition, 1976. This evaluation therefore indicates that the cap materials are acceptable when considering the potential for erosion from a velocity based perspective.

IH. GEOTECHNICAL STABILITY

The geotechnical stability of the cap and the underlying sediments includes an evaluation of bearing strength and shear failure analyses. It is notable that the design includes the presence of a geotextile beneath the entire Canal cap. However, some of the analyses presented below were performed conservatively by ignoring the presence of the geotextile. This was done because the geotextile will not be held taut in this installation (and therefore not in full tension), and therefore may not provide the maximum possible support to the sediment that modeling and calculations may assume.

A. Long-Term Sediment Bearing Capacity

Long-term bearing strength was analyzed for two failure scenarios: 1) general shear failure, and 2) local shear failure. The bearing capacity considering general shear failure of the sediments was calculated using the Terzaghi Solution, as described in Lambe and Whitman, 1969; Soil Mechanics. Local shear failure (i.e., punching mode of failure) analysis was performed using the methods presented in *Guidance for In-situ Subaqueous Capping of Sediments,* Appendix C.

The analyses were conservatively performed assuming that failure of undisturbed sediments would occur in an undrained state and that the internal angle of friction would be zero. The presence of a geotextile or Geogrid was ignored due to it not being fully held in tension as described above. Potential increases in sediment strength following consolidation were conservatively ignored. Embedment of the cap was conservatively assumed to be at zero.

1. General Shear Failure

General shear failure can be modeled using the Terzaghi Equation to calculate the threshold bearing capacity for general shear failure. For the application, the cap was modeled as a continuous strip footing. The failure mechanism for this scenario would be a shear failure resulting from one area of sediment being loaded more than an immediately adjacent area resulting in a differential load. For this design, this scenario results from an abrupt change in cap thickness or a sudden termination of the cap. An allowable differential loading is calculated as follows (including incorporation of an appropriate safety factor) and translated to an allowable differential cap thickness for this project.

The general shear failure bearing capacity for undrained loading, q^, can be estimated by the following equation (the Terzaghi Solution):

q_{ult} - (C x Nc) + (Yb x d) (Lamb & Whitman, Eq. 32.1)

Where: C = Sediment shear strength (31 psf = mean of 15 field vane shear tests in upper two feet of undisturbed sediments)
Nc = bearing factor (5.14 for a continuous strip footing (from *Soil Mechanics,* Lamb & Whitman, page 486).
Yb = mean bulk density for sediments (66 pcf from laboratory data)
d = embedment (modeled at 0 feet)
q_{uW} =159 psf if embedment does not occur (d = 0)

A 3:1 factor of safety (FS) is generally considered acceptable for this type of evaluation: Therefore;

Qaiow = 1/3 x q^ = 53 psf (with no embedment)

The measured saturated bulk density of the sand cap applied at the pilot test was 115 pcf, which gives a buoyant (in place and submerged) cap density (Y') of 52.6 pcf (or 52.6 psf for a 1-foot cap thickness). Therefore, a differential cap thickness in the Canal of one foot or less will be safe from long term generalized shear failure.

In order to evaluate the worst-case scenario with respect to sediment strength, the minimum observed undisturbed field vane shear strength of 15 psf was used in the equations above. The resulting q_{allow} is approximately 26 psf, and the safe differential subaqueous cap thickness is approximately 0.5 feet (again assuming no embedment and neglecting the presence of a geotextile).

2. Local Shear Failure

The allowable differential cap thickness, \xJOW based upon a local shear failure analysis, was calculated using the following equation (from Appendix C of Guidance for In-Situ Subaqueous Capping of Sediments, EPA 1998) which incorporates a safety factor of 3:

h_{all0W}=1.14xC/Y'

Inserting the values presented above, h_{aUow} =1.14x31 psf/ 52.6 pcf
h_{allow} = 0.67 feet

Therefore, the local shear failure analysis (resulting in a maximum differential cap thickness of 0.67 feet) governs over the general shear failure scenario modeled above (which resulted in a maximum differential cap thickness of 1 foot).

3. Summary

In summary, differential cap thicknesses (without a geotextile) of up to about 2/3 feet are stable in the long term against local and generalized shear failure over most of the Canal. In localized weak areas (e.g., shear strength =15 psf), the maximum allowable differential cap thickness would be about 0.5 feet or less. The presence of the geotextile and increases in sediment strength that may occur during consolidation will increase the allowable differential cap thickness. The maximum proposed differential cap thickness is between the 1.5-foot cap at the canal edges and the three-foot cap proposed in the center of the northern portion of the Canal. This 1.5 foot change in cap thickness is designed to occur over a distance of 20 to 30 feet, which is gradual enough to prevent local shear failure, particularly with the added stability afforded by the presence of the geotextile.

B. Active Construction Loading Stability

During construction, it is likely that Bobcat 190 skid-steer loaders will be used to construct the cap. These loaders weigh approximately 7,330 pounds fully loaded. Their ground pressure is approximately 5 psi (see specifications in Design Change 010, Attachment 4), their track width is about 1-foot, and their track length at the ground is about 5-feet. They will operate on top of the two-foot thick sand cap after it is placed. Punching failure was not evaluated due to the presence of the geotextile and two-foot sand cap beneath the Bobcats which renders this type of failure extremely unlikely.

1. General Shear Failure

Using the Rankine wedge solution, the force applied by the Bobcat tracks onto the sediment will be spread out by the presence of the sand at an angle of 31 degrees (45 degrees minus (phi +-2), where phi is the internal angle of friction which is estimated to be 28 degrees for the silty sand cap material). The additional bearing surface at the sediment will therefore be increased by 1.2 feet (tangent 31° x 2 ft) on each side and at the ends of the track. The total bearing area for a Bobcat at the sediment surface will therefore be approximately 50 square feet (2 x [(5 ft + 2 x 1.2 ft) x (1 ft + 2 x 1.2 ft)]. The pressure, Pa, at the sediment surface from a Bobcat over two feet of sand is 147 psf (= 7,330 lbs / 50 sf). A 1.1 dynamic loading factor was used, giving a design Bobcat pressure of 162 psf.

Using the Terzaghi Solution for general shear failure (as described above for the long term static loading analysis), the general shear failure bearing capacity, q_{ult}, for loading from a Bobcat is 183 psf (31 psf (the mean shear strength of the upper two feet of sediment) x Nc> where Nc = 5.9 for a rectangular footing, the modeled geometry for a Bobcat). The safety factor is the ratio P_a / q_{uU} and is approximately 1.1 (183 psf/162 psf)

A safety factor of 1.1 is considered acceptable for active construction calculations due to the limited risk to human health and the environment in the event of a failure. If the minimum observed shear strength of 15 psf is used, the safety factor is less than one (again indicating the need for geotextile, geogrid, hand cap application, etc).

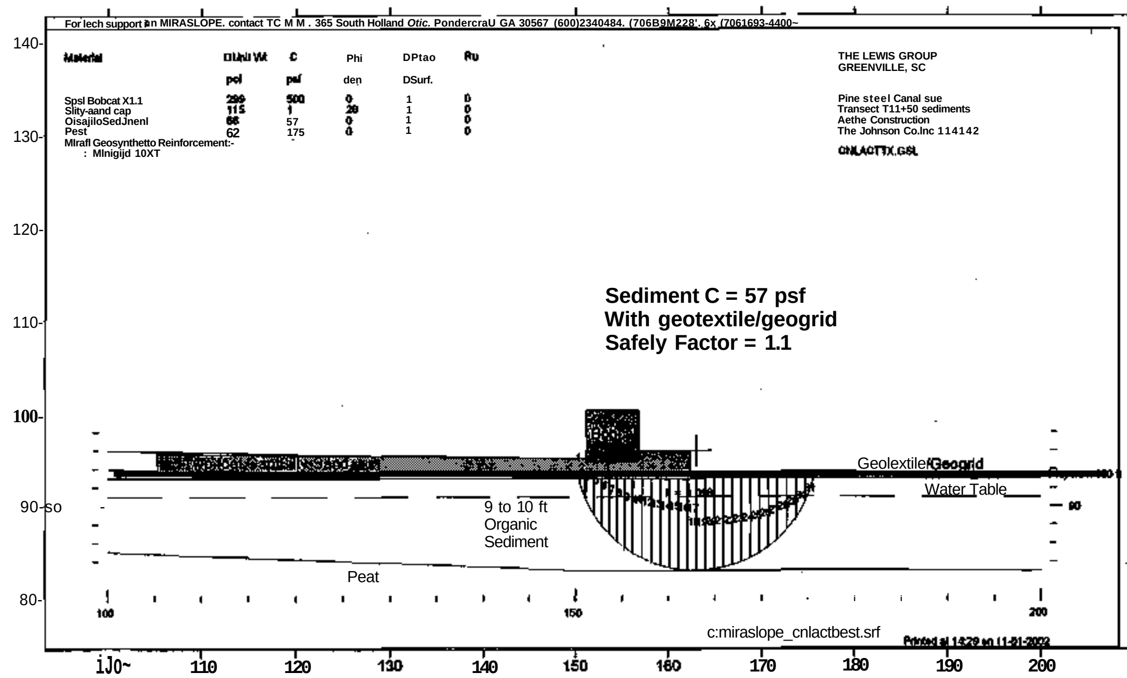
2. Bishop Slip Circle Analysis

The stability of the cap sand and underlying sediments under an active construction loading scenario were also evaluated using the Bishop Slip Circle Method calculated by the computer program "Miraslope". A sediment cohesion of 46 psf (the mean of 43 in-situ vane shear tests performed at all sediment depths) was used in the analyses when the modeled failure surface penetrated deeply into the sediments, and a cohesion of 31 psf (the mean of 15 vane shear tests in the upper two feet of sediments) was used for shallow failure surfaces. An internal angle of friction of 28 degrees was assumed for the silty sand cap materials.

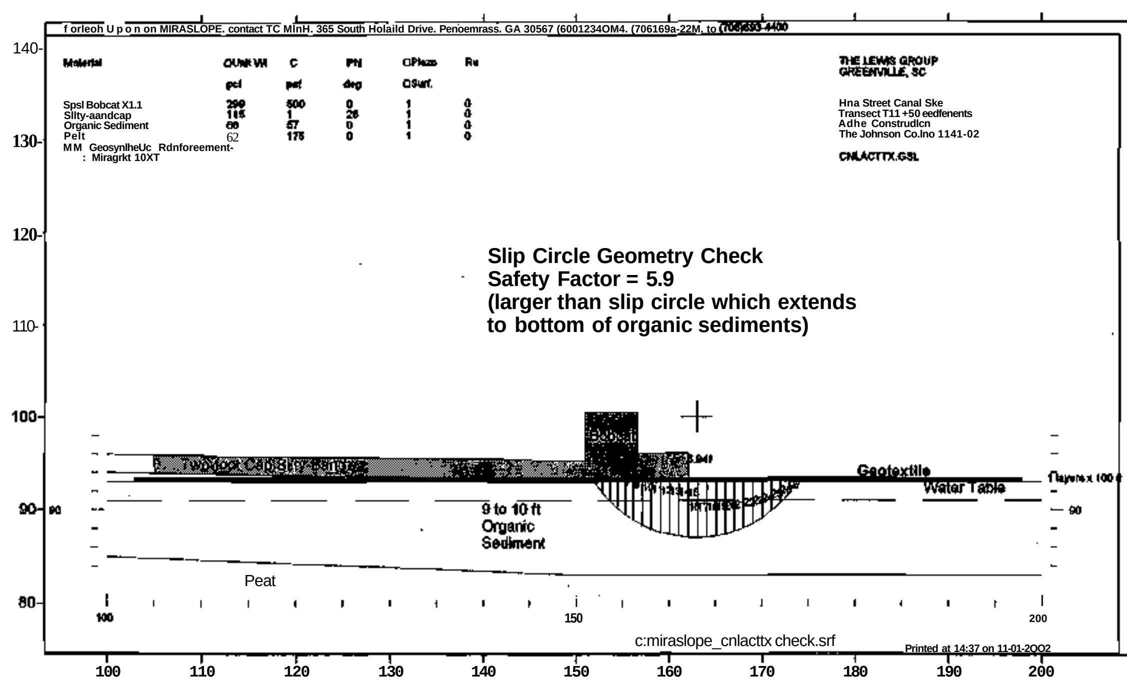
The locations selected for the analysis were in the vicinity of Transects Til and T12, which are considered "worst case" due to the presence of the thickest on-site soft sediments. The sediment thickness was set at ten feet. A two-foot thick silty-sand cap was assumed.

The program assumed that a Bobcat 190 tracked skid-steer loader would be used to place the sand cap, and that the loader would dump a foot-thick pile of sand on an existing 2-foot cap at the edge of the cap, and then push it forward for final placement. The Bobcat weighs 7330 pounds (loaded). The full ground contact footprint between and including the two sets of tracks is 27 square feet (5-feet long by 5.5-feet wide). The Bobcat loading was simulated in the program by a one-foot thick soil unit with cohesion of 500 psf (to mimic the rigidity of the equipment), a length of 5 feet, and a unit weight of 299 pcf (7330 lbs / 27 sf, multiplied by 1.1 to account for active loading).

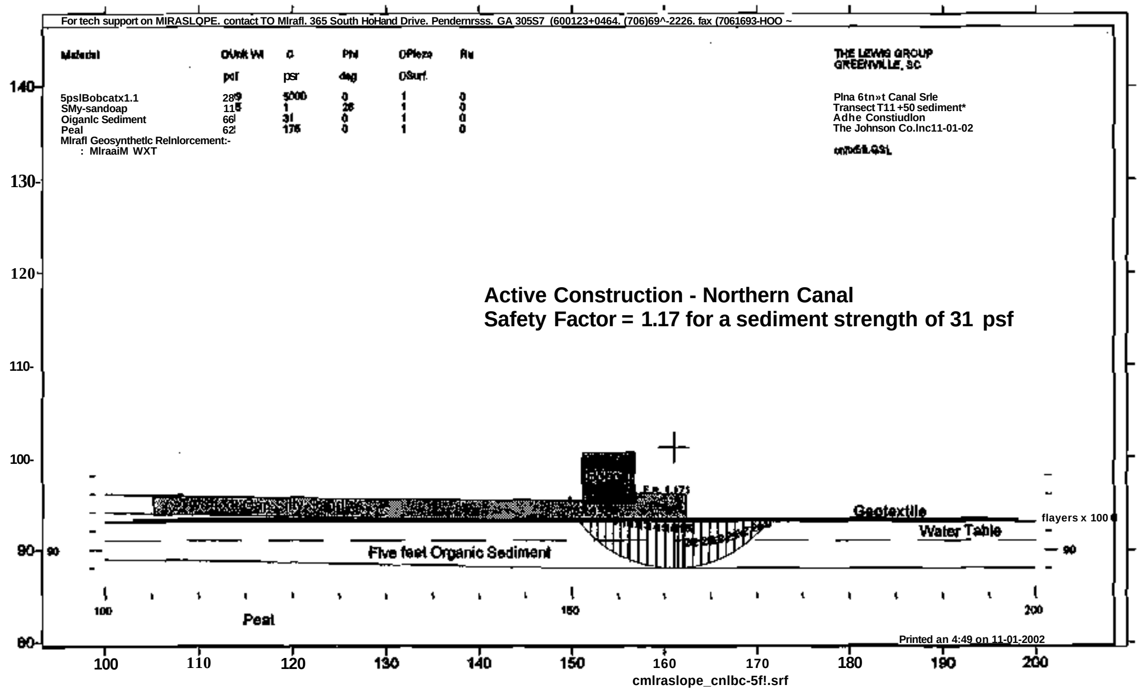
The program was run using a geotextile with a SF of 1 against pull-out (see plot below). The required sediment strength to provide a 1.1 safety factor is 57 psf. Approximately 30% of the in-situ vane shear tests in the Canal indicate sediment strengths greater than 57 psf.



An additional run was performed by forcing a shallow slip circle failure surface to confirm that the deep failure surface selected by the program is, in fact, the worst case scenario. The resulting safety factor of 5.9 confirms that the minimum safety factor under these conditions is calculated for a deep slip circle surface (compare the plot below to the plot above). This check confirms that the "worst case scenario " for this analysis is a failure surface which completely penetrates the thickest soft sediments.



The program was also run for the northern portion of the Canal (north of Transect T9), where the sediment thicknesses are less than five feet. A minimum sediment shear strength of 31 psf is necessary under those conditions to provide a safety factor of greater than 1.1 (see plot below). 70% of the vane shear tests performed in the Canal sediments had shear strengths greater than 31 psf.



These calculations indicate that the use of Bobcats to place the cap, combined with the presence of a geotextile and possibly a geogrid, will be feasible over approximately 30% of the thickest Canal sediments, and approximately 70% of the northern Canal thinner sediments, but that other methods (such as hand placement) are likely to be necessary over weaker areas.

3. <u>Summary</u>

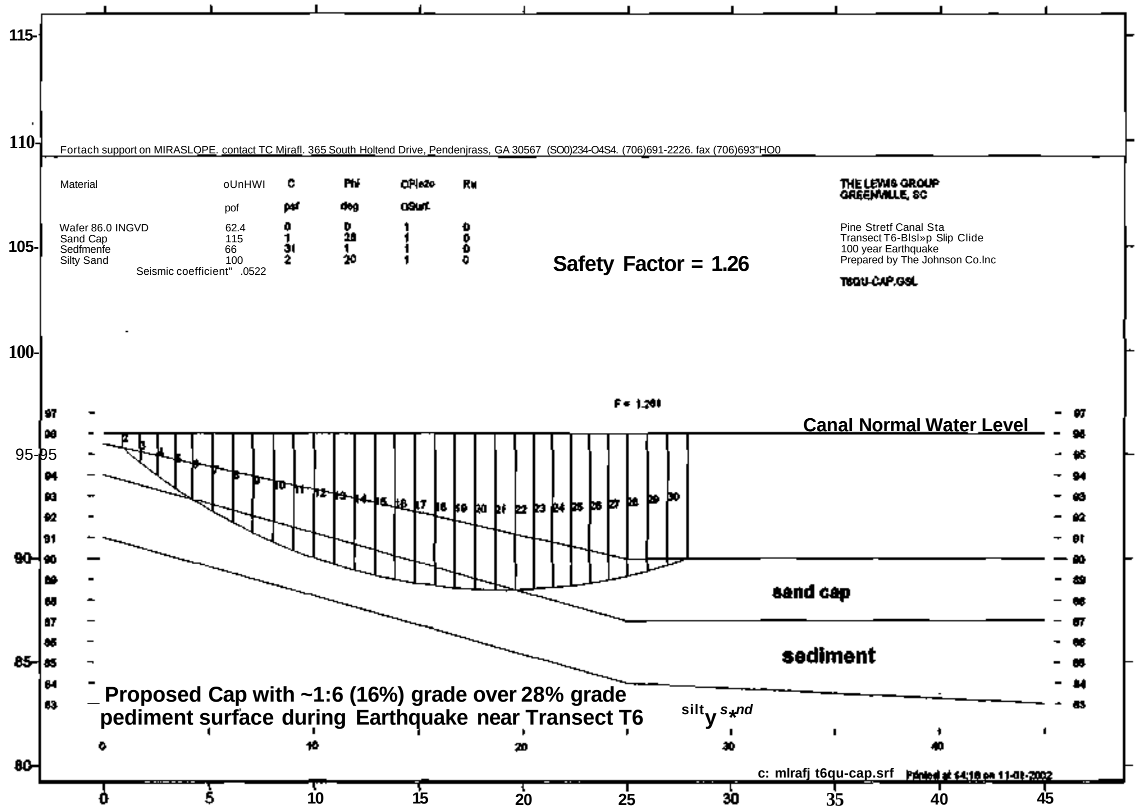
Multiple analyses were performed to assess the sediment stability under active construction loading during cap placement. The analyses indicate that the sediment bearing capacity is generally sufficient for construction using Bobcats on top of the cap sand in most areas of the Canal, particularly where the soft sediments are thinner. However, due to the variability of the sediment strength and potential losses in strength when the sediment is disturbed, and poor stability in areas of thickest sediment (South of T10), contingency plans such as the use of a Geogrid, and manual cap application will be needed in some areas and are included in the design.

C. Earthquake Stability Analysis

The Miraslope Slip Circle computer program was used to evaluate the stability of the cap sand and underlying sediments under an earthquake loading scenario. The model was initially validated by hand calculation of the sand cap stability in subaqueous conditions for a hypothetical scenario of a uniform two-foot thick cap on a 10% slope during a 100 year re-occurrence earthquake. A probabilistic ground acceleration (PGA) of 1.052 g was used for the design. This PGA was calculated by graphing the USGS data for the Site latitude and longitude, and incorporating an amplification factor of two for the presence of thick clay soils (from HAZUS99 methods as presented in *Appendix 1, Phase 1A 95%/100% Design Submittal* dated September 4,2001). The hand calculated safety factor for cap sand was 1.57, compared with a Miraslope computer program generated Safety Factor of 0.93.

This validation indicates that the Miraslope computer program provides conservative safety factors, and is therefore acceptable for use in design.

The Miraslope program was then used to evaluate the sediment and sand cap stability for the actual proposed cap design during a 100-year earthquake (see plot below). A steep portion of the sediments (28% on the west side of the Canal at Transect T6) was chosen as the critical area for evaluation. A sediment cohesive strength of 31 psf was used in the computer simulation which is considered conservative since it is approximately equal to the lowest value of six UU triaxial tests. The safety factor calculated by the Miraslope program was 1.26, indicating that the capped sediments will withstand a 100-year earthquake. Another model run was performed forcing the failure surface through just the sand cap layer (to evaluate the sand stability itself (without sediment failure). The resulting safety factor was 1.5 confirming that sediment stability governs. This safety factor of 1.5 exceeds the hypothetical calibration model run described above because of the thickening cap from 1.5 feet on the Canal edges to 3.0 feet in the center of Canal. Lastly, a "worst case" analysis using the minimum observed undisturbed vane shear strength of 15 psf results in a safety factor of 0.91.



In summary, using the average shear strength for the upper two feet of sediments, both the silty sand cap and the sediments will be stable during a 100-year earthquake event if the cap slope is 1:6 (16%) or less. The presence of a geotextile was ignored for these analyses, so the design is conservative.

IV. CONSOLIDATION

Calculations of sediment consolidation upon loading with a cap have been performed. The following equations were used to predict immediate and primary consolidation of the sediment after placement of the cap.

1. *Calculate the effective stress,* oe, at the center of an initial sediment thickness, H_o:

$$o_e = (\text{sediment bulk density}) \times \text{^}(H,,, \text{ sediment thickness})$$

Note: the equations used did not account for buoyancy since the cap will be applied in the "dry" and the Canal won't be inundated with water until after Immediate and Primary Consolidation is completed.

2. *Calculate the additional stress,* o_v, due to a cap of thickness t, and bulk density, p_b, of the cap sand:

$$o_v = t\,x\,p_b$$

3. *Approximate the settlement,* S, for a compression index C_c, and void ratio e_0 (from Lamb and Whitman Eq. 25.1 la):

$$S = C_c \text{ x } (H_0/(l+e_0)) \text{ x } lo_{g10}((o_e + o_v)/o_e)$$

Using the the range of values for the Compression Index and Void Ratios measured in sediment samples collected near Transect T10, the estimated total immediate and primary consolidation (settlement) for various cap thicknesses are provided in the table below.

Calculated Immediate and Primary Consolidation for Organic Sediments		
Assumed Values of Various Parameters	Cap Thickness	Calculated Immediate and Primary (feet)
sediment layer thickness (H_o) = 7.5 feet sediment bulk density = 66 pcf silty sand cap bulk density = 71 pcf w/5% moisture sediment compression index = 1.9-2.35 initial sediment void ratio = 6.6-7.7	0.5	1.1-1.5
	1.0	1.5-2.1
	1.5	1.8-2.5
	2	2.0 - 2.8
	3	2.2 - 3.2
	4	2.4 - 3.4
[1] Note: calculations performed without buoyancy since the cap will be applied in the dry.		

Approximately two to 2.8 feet of immediate and primary settlement is predicted for the proposed two-foot thick cap over most of the Design Change 10 cap area based upon an assumed 7.5 feet of soft organic sediments (the thickness measured at the T10 pilot test). Increases in settlement of an additional 0.5 feet may occur where the initial sediment thickness is approximately nine feet in the vicinity of Tl 1 and T12. An additional 20% of settlement (of the total immediate and primary settlement) may occur due to secondary consolidation.

Secondary compression and consolidation were not evaluated as these factors generally result in less than 20% of the total consolidation. Since the proposed cap is flexible and not a rigid structure, minor differential settlement and on-going long-term secondary consolidation will not adversely affect its integrity. Furthermore, the cap design (in terms of grain size and anticipated water depth and potential for erosion) is controlled by the minimum expected total consolidation. Therefore underestimation of the total consolidation during the design provides an additional safety factor (i.e., it is conservative).

Reviewed By: J_B CMC
J:\PROJECTS\l-0870-l\Phase 2\11-5-02 DC10 PhaselB geotech calcs.wpd DMM

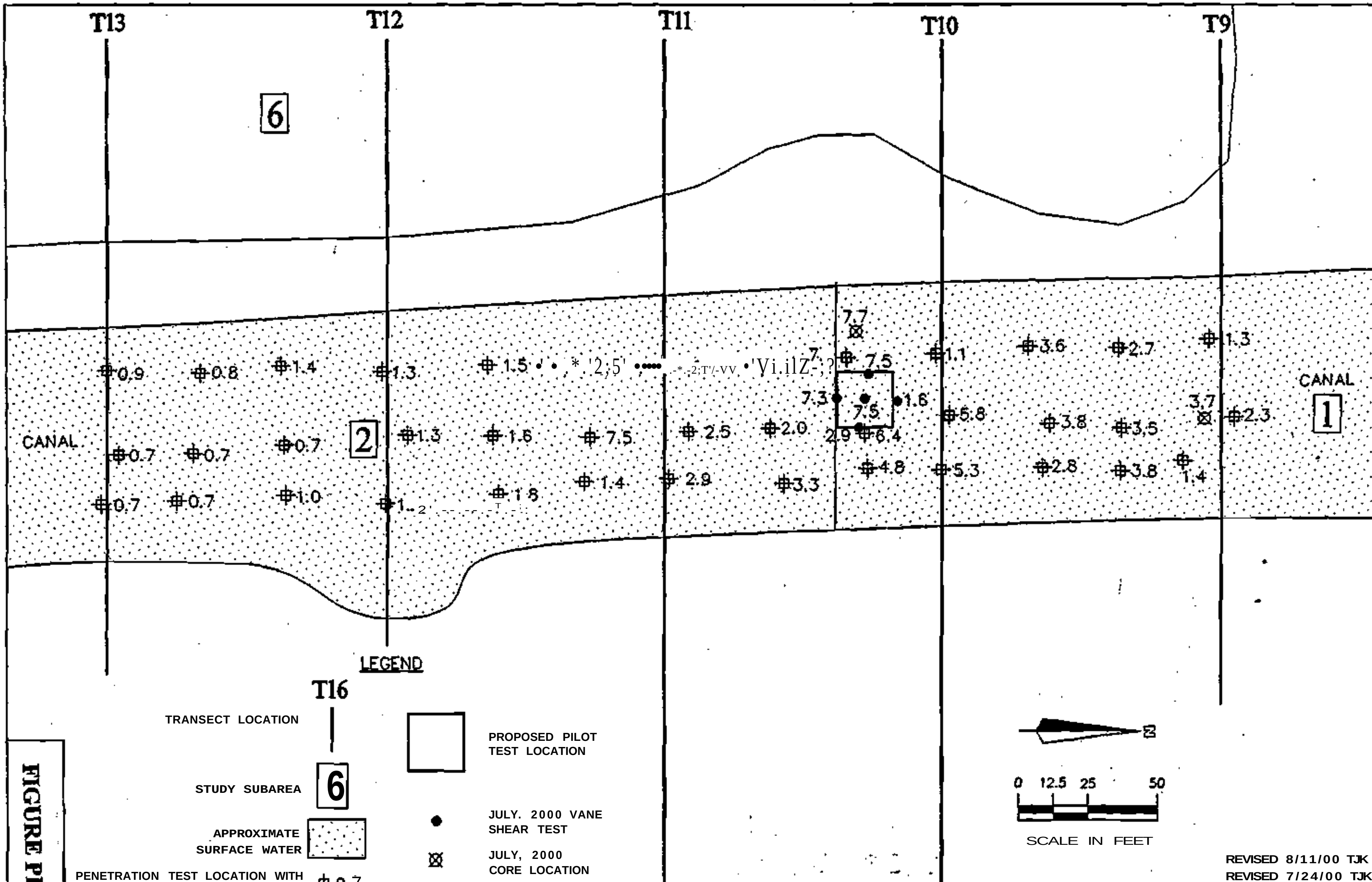


FIGURE PDFIR 2-6

SHEAR100,dwg

SEDIMENT THICKNESS < 100PSF SHEAR STRENGTH
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC.
Environmental Sciences and Engineering
100 STATE STREET MONTPELIER, VT 05602

DATE: 7/26/00
DRAWN BY: TJK
PROJECT: 1-0870-1
SCALE: 1"=50'

Table of In-Situ Vane Test Results					
				Shear Strength (psf)	
}|_ID	Tafit Datfi	Material	Tfist Fifiv. m Nfivm	Pfiak	Rfimoldfid
J_T1+05E80	06/28/00	Organic Muck	89.6	45	20
J_T1+05E80	06/28/00	Organic Muck	87.6	109	45
J_T1+05E80	06/28/00	Organic Muck	85.6	69	20
J_T2+30E150	06/29/00	Organic Muck	86.7	25	< 5
J_T6+40E25	07/20/00	Organic Muck	88.2	35	10
J_T6+40E25	07/20/00	Organic Muck	86.2	174	50
J_T6+50E15	07/20/00	Organic Muck	88.9	15	5
J_T6+50E25	07/20/00	Organic Muck	87.8	15	10
J_T6+50E35	07/20/00	Organic Muck	85.9	25	5
J_T6+50E35	07/20/00	Organic Muck	83.9	35	20
J_T6+55E25	06/27/00	Organic Muck	87.0	25	< 5
J_T6+55E25	06/27/00	Organic Muck	85.0	198	60
J_T6+60E25	07/20/00	Organic Muck	87.8	35	10
J_T6+60E25	07/20/00	Organic Muck	85.8	233	50
J_U4		Organic Muck	-84.0	< 23	< 23
J_T9+10E45	06/26/00	Organic Muck	87.8	74	25
J_T9+10E45	06/26/00	Organic Muck	85.8	89	15
J_T10+20E40	07/20/00	Organic Muck	91.5	50	10
J_T10+20E40	07/20/00	Organic Muck	89.5	40	30
J_T10+20E40	07/20/00	Organic Muck	87.5	69	30
J_T10+30E20	06/30/00	Organic Muck	90.9	45	5
J_T10+30E20	06/30/00	Organic Muck	88.9	40	5
J_T10+30E20	06/30/00	Organic Muck	86.9	40	10
J_T10+30E20	06/30/00	Organic Muck	84.9	94	40
J_T10+30E30	07/20/00	Organic Muck	91.7	40	5
J_T10+30E30	07/20/00	Organic Muck	89.7	40	10
J_T10+30E30	07/20/00	Organic Muck	87.7	15	5
J_T10+30E30	07/20/00	Organic Muck	85.7	119	35
J_T10+30E40	07/19/00	Organic Muck	91.8	30	10
J_T10+30E40	07/19/00	Organic Muck	89.8	25	< 5
J_T10+30E40	07/19/00	Organic Muck	87.8	40	5
J_T10+30E40	07/19/00	Organic Muck	85.8	99	25
J_T10+30E50	07/20/00	Organic Muck	91.8	40	20
J_T10+30E50	07/20/00	Organic Muck	89.8	40	25
J_T10+30E50	07/20/00	Organic Muck	87.8	45	40
J_T10+30E50	07/20/00	Organic Muck	85.8	154	20
J_T10+40E40	07/19/00	Organic Muck	91.5	40	30
J_T10+40E40	07/19/00	Organic Muck	89.5	30	20
J_T10+40E40	07/19/00	Organic Muck	87.5	30	15
J_T10+40E40	07/19/00	Organic Muck	85.5	149	50
J_U3		Organic Muck	-90.5	< 23	< 23
J_U3		Organic Muck	-88.5	23	< 23
J_U3		Organic Muck	-86.5	< 23	< 23
Organic Muck			Number of Tests	43	43
Organic Muck			Minimum	14.9	5.0
Organic Muck			Maximum	233.1	59.5
Oraanic Muck			Geometric Mean	45.9	15.7

Table of In-Situ Vane Test Results					
				Shear Strength (psf)	
^i in	Test Date	Material	TeatFlev tftNfiVm	Peak	Remolded
Organic Muck in upper two feet of sediments					
J_T1+05E80	06/28/00	Organic Muck	89.6	45	20
J_T2+30E150	06/29/00	Organic Muck	86.7	25	< 5
J_T6+40E25	07/20/00	Organic Muck	88.2	35	10
J_T6+50E15	07/20/00	Organic Muck	88.9	15	5
J_T6+50E25	07/20/00	Organic Muck	87.8	15	10
J_T6+50E35	07/20/00	Organic Muck	85.9	25	5
J_T6+55E25	06/27/00	Organic Muck	87.0	25	< 5
J_T6+60E25	07/20/00	Organic Muck	87.8	35	10
J_T9+10E45	06/26/00	Organic Muck	87.8	74	25
J_T10+20E40	07/20/00	Organic Muck	91.5	50	10
J_T10+30E30	07/20/00	Organic Muck	91.7	40	5
J_T10+30E40	07/19/00	Organic Muck	91.8	30	10
J_T10+30E50	07/20/00	Organic Muck	91.8	40	20
J_T10+40E40	07/19/00	Organic Muck	91.5	40	30
J_U3		Organic Muck	-90.5	< 23.0	< 23
Upper Two feet of Organic Muck			Number of Tests	15	15
Upper Two feet of Organic Muck			Minimum	14.9	5.0
Upper Two feet of Organic Muck			Maximum	74.4	29.8
Umiej^^wc feet of Oraalie Muck			Geometric Mean	31.4	10.4
J_T2+30E150	06/29/00	Silt	84.7	352	**79**
J_T6+50E15	07/20/00	Silt	86.9	164	40
J_T6+50E25	07/20/00	Silt	83.8	40	**69**
J_T10+30E20	06/30/00	Silt	82.9	134	5
Silt			Number of Tests	4	4
Silt			Minimum	39.7	5.0
Silt			Maximum	352.2	79.4
Silt			Geometric Mean	**13?.3**	32.3
J_T1+05E80	06/28/00	Silty Sand	83.6	114	15
J_T2+30E150	06/29/00	Silty Sand	83.1	853	169
J_U5		Silty Sand	-83.5	255	46
J_U5		Silty Sand	-81.5	464	23
J_T6+55E25	06/27/00	Silty Sand	83.0	565	139
Silty Sand			Number of Tests	5	5
Silty Sand			Minimum	114.1	14.9
Silty Sand			Maximum	853.1	168.6
Silty Sand			Geometric Mean	365.4	51.7

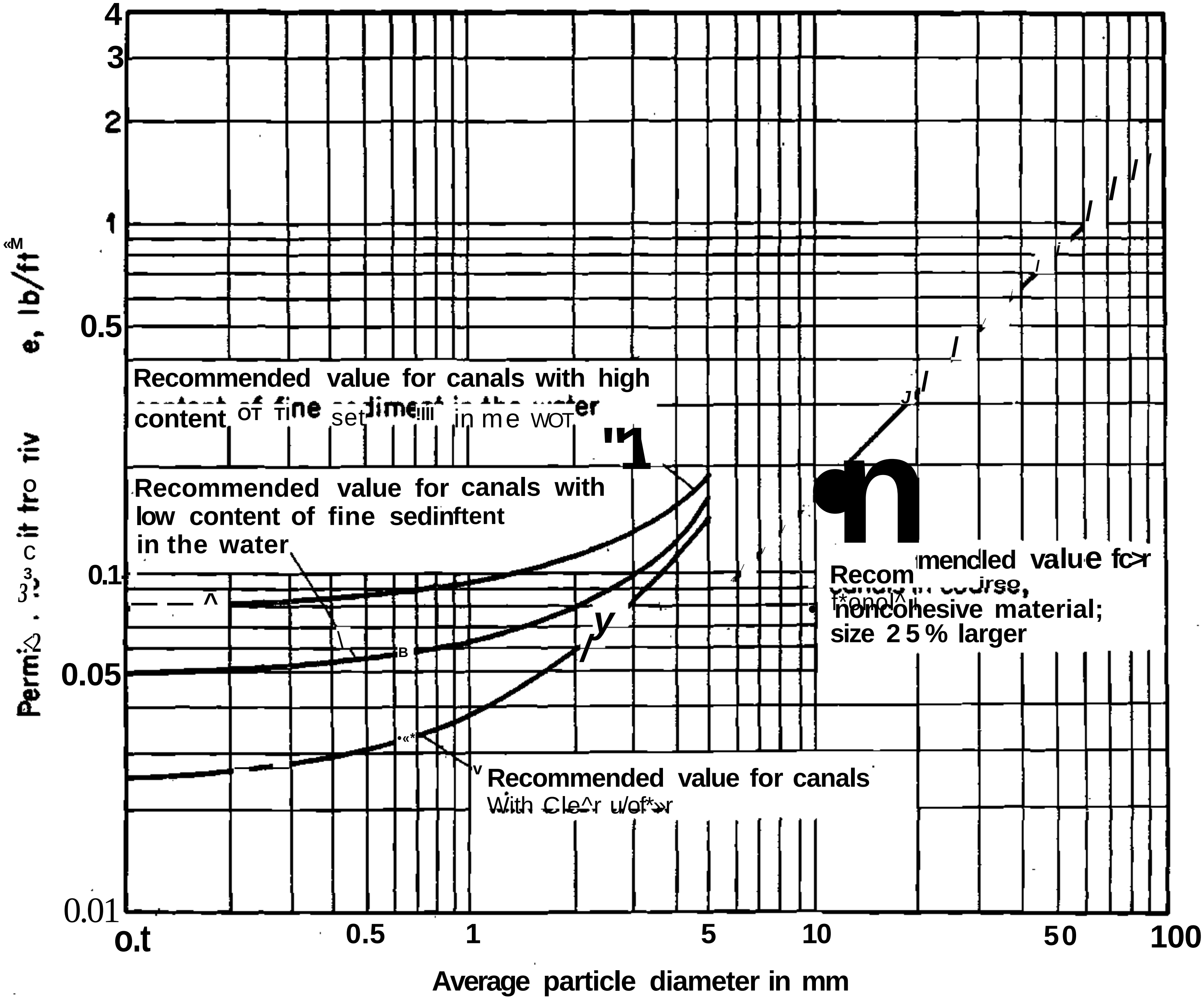


FIG. 7-10. Recommended permissible unit tractive forces for canals in noncohesive material. *(U.S. Bureau of Reclamation.)*

From CHOW - OPEN CHANNEL HYDRAULICS

canals [37]

Attachment 6

NAPL Sampling Protocols and Laboratory Results
and
Contaminant Transport Modeling Calculations

Pine Street Canal Superfund Site, Burlington, Vermont
NAPL Sampling and Laboratory Analytical Protocols and Results

A non-aqueous phase liquid (NAPL) sample was collected from a pool on the sediment surface in the Canal at approximately Transect T12+50 (opposite the South Slip). The sampling and analysis was performed in order to help characterize the NAPL for off-site disposal purposes, to help evaluate potential inhalation risks for workers, and for use in evaluating contaminant migration through the proposed subaqueous cap.

The sample was collected approximately ten feet east of the western cribbing at an elevation of approximately 94 ft NGVD. The water level in the Canal had been drawn down below the sediment surface for approximately one week prior to sampling. The NAPL was black in color en-mass, but brown when observed as a thin film, had a strong odor resembling roofing tar. The sample was collected by immersing a clean glass Mason jar into the sediment until the NAPL flowed over the rim. The NAPL was subsequently poured into unpreserved 40 mL glass VOA vials, stored on ice in a cooler, and shipped under chain-of-custody procedures to Katahdin Analytical Services for analysis by SW-846 Method 8260B (for volatile organic compounds) and SW-846 method 8270C (for polycyclic aromatic hydrocarbons).

It was necessary for Katahdin to dilute the sample several times in order to obtain reliable concentrations for the various compounds detected. The laboratory analytical report is attached.

Reviewed By:SAS
J:\PROJECTS\1 -0870- lVcorrespondanceVNAPL analysis 1] -22-02.wpd DMM

Table 1
Summiry of Uporti-d (rmi-cn trillions in W l'l.
rolli-ctcd on 1(1/10 02 from si pool on tin sediment surface at ri2*5«ll-'10

Analytical Method and Compound	Results HIR/KK
SW-846 Method 8260B for volatile organic compounds	
Ethylbenzene	53
Isopropylbenzene	540
1,3,5 - Trimethylbenzene	100
P-Isopropyltoluene	97
N-Butylbenzene	27
1,2,4 - Trimethylbenzene	390
Xylene (m,p)	54
Xylene (o)	48
Naphthalene	18,000
SW-846 Method 8270C for polycyclic aromatic hydrocarbons	
Naphthalene	44,000
2-Methylnaphthalene	33,000
Acenaphthylene	3,000
Acenaphthene	14,000
Fluorene	8,100
Phenanthrene	24,000
Anthracene	6,900
Fluoranthene	6,100
Pyrene	8,800
Benzo (a) anthracene	3,100
Chrysene	2,800
Benzo (b) fluoranthene	1,800
Benzo (a) pyrene	2,400
Benzo (g,h,i) perylene	1,100

Note: Only compounds with reported detections are included, and concentrations are based upon the most reliable of several analyses at different dilutions

KATAHDIN ANALYTICAL SERVICES
Report of Analytical Results

Client: The Johnson Company
Projects PINE STREET CANAL SITE
PO WO! 1-0870-1(505) PINE ST. CANAL SITE
Sample Date: 10/10/02
Received Date; 10/11/02
Extraction Date: 3,0/16/02
Analysis Date: 10/16/92
Report Cat©: lp/17/2002
Matrix: FP
* Solids; tfh

Lab ID: WS3943-2
Client ID: J-T12f50E10-DIi
$DGi WS3948
Extracted by: JEY
Extraction. Method.: swste 5030
Analyse: JE¥
Analysis Method: SW84$ 82SDB
Lab Prep Batch.: WG357
Units: ug/Kg

compound	Flags	Result*	DP	PQX.	Adj .PQL
Dichlorodifluororaethane	XI	50000	100	10	50000
Chloromethane	TJ	50000	100	10	SOOOO
Viflyi chloride	TT	50000	100	10	50000
Bromoraethane	TT	50000	100	10	50000
Chloroechane	TT	50000	100	10	50000
TrichXorofluoromethane	TJ	50000	loo	10	50000
l,l-fiichloxoechene	TJ	25000	aoo	5	25000
Hfethylene Chloride	TJ	25000	100	5	25000
teans-x,2-DicW.oroethene	TJ	25000	100	5	25000
l,l-Dichloroethane	TJ	25000	100	5	25000
cia-l,2-Dichloroethene	TJ	25000	100	5	25000
2,2-Dichloropropane	U	25000	100	5	25000
Chloroform	U	25000	100	5	25000
Bromochlorome6ha.ne	tr	25000	100	S	25000
1,1,1-Triohloroethane	TJ	25000	100	5	25000
l,2-Dichloroethaae	O	25000	100	5	25000
1,X-Dichloropropene	TJ	25000	100	S	25000
Carbon TetraoJiloridfe	U	25000	100	5	25000
Benzene	CT	25000	100	S	25000
l,2-Dichloropropane	V	25000	100	5	25000
Trichloroethene	t»	25000	100	5	25000
Dibromomethane	IT	25000	100	5	33000
Bxomodichleroitietharie	IT	25000	100	5	25000
cis-l,3-dichloropxopane	TT	25000	100	5	25000
Toluene	TT	25000	10(t	S	25000
trans-1,3-Dichldropropene	TT	25000	100	S	25000
1,1.2-TrichXoroethane	TT	25000	100	5	25000
1,3-Diahloropropane	TT	25000	100	5	25000
Bibromochloromethane	tr	25000	100	5	25000
Tetrachloroethene	TT	25000	100	5	25000
1,2-Dibromoethane	U	25000	100	5	25000
Chlorobenzene	TJ	25000	100	5	25000
l.i,i,2-Tetrachloroechan.e	II	25000	100	5	25000
Ethylbanaeue	B	53000	100	5	25000
Bromoform	TJ	25000	100	5	25000
Styrene	O	25000	100	5	25000
1,1,2,2-Tecraohloroethane	TJ	25000	loo	5	25000
1/2,3-Trichloropiropana	XT	25000	100	5	25000
»tsopropylbenzene		340,000	100	5	25000
BfODobeHzene	U	35000	100	5	25000
2-chlorotoluen^	TI	25000	100	5	25000
IT-Fropylbenzene	U	25000	100	5	25000
4-Chlorotoluene	TJ	25000	100	5	25000

KATAHDIN ANALYTICAL SERVICES
Reporc of Analytical Results

clients The Johnson company
Projeat: BINE STREET CANAL SITE
PO No: 1-0870-1(505) PINE ST. CANAL SITE
Sample Dace: 10/10/02
Received Dace? aO/il/02
Extraction Dace: 10/16/02
Analysis Dace; xo/16/02
Report Dates 10/17/2002
Matrixt FP
% solids: KR

Lab IDs WS394B-2
Client H»: J-T12+50E10-D1E.
SDS; HS3949
Extracted by. JBY
Extraction Methods SW84S 503D
Analyst: JBY
Analysis Methods SW84G 8260B
Lab Prep Batch: HGB57
Units: ug/Kg

Compound	Flags	Results	py	PQI.	Adj.veil
1,3,S-TriinethylbeJiaene	B	100/100	100	5	25000
tert-Sutylbenzene	U	25000	100	5	25000
1,2,4-Trichlorobenzene	U	25000	100	5	25000
3ec-Butylbenzena	XJ	25000	100	5	259Q0
1>3-Dichlorobezusene	XJ	25000	100	5	25000
P-Isopropylcolueme	B	9700D	10a	5	25000
l,4t-Dlehloroben2ene	U	25000	100	5	25000
l,2-Diohlorobenzene	0	25000	100	5	25000
N-Sutylbenzene	B	27/100	100	5	26000
1,2-Dibromo-3-chloropropane	TJ	25000	100	5	25000
1,2,4-Tritttfeth.ylbenzene	B	990,000	100	5	25000
Naphthalene	RB	£$00000	100	5	25000 — see 1⁰\&*X Dilution results
Hexachlorobutadiene	D	25000	100	5	25000
1.2,3-Trichlorabenzene	U	25000	100	5	25000
Methyl text-butyl ether	TJ	25000	100	5	25000
Acetone	TJ	100000	100	20	100000
2-Butanone	XJ	100000	100	20	100000
4"Ujethyl«2•pecftauone	TJ	100000	100	20	100000
2-Hexanone	XJ	100000	100	20	100000
ta+p-Xylenea	B	54,000	100	10	50000
o-Xylena		4^000	100	5	25000
1,3,5-TxicLh.lorabepzene	XT	25000	100	5	25000
Vinyl Acetate	TJ	25000	100	5	25000
Carbon Digulfide	TJ	25000	100	5	25000
Dietbyl Ether	TJ	25000	100	5	25000
Tetrabydxofuran	XT	250000	100	50	250000
Dibzomofluozomethane		97%			
i,a-Dichloroethane-04		102%			
Toluene-D8		90%			
P-Brcmofluorobenzene		92%			

KATAHDIN ANALYTICAL SERVICES
Report of Analytical Results

Clients The Johnson Company
Brojeec- PIKE STREET CANM. SITE
PO NO) 1-0870-1(505) PINE ST. CANAL SITE
Sample Dace: 10/16/02
Received Dates 10/11/02
Extraction pace: io/ie/02
Analysis Dare: 10/16/02
Report Date: lo/ie/2002
Matrix: FP
% solids: NA

Lab ID: N53949-2
Client ID: J-TI2+SOEIO-DIJ
SDG; W53948
Extracted byr OEY
Extraction Metiwpd: SW84S 503 0
Analyst
Analysis Method: SW84G 82G0B
Lab Prep Batch: HGB57
Dnicsi ug/Kg

COOQOUftd	Flags	RMUlCS	DP	PQt>	Adj.tQL
Diohlorodifiluoromethane	U	5000000	10000	10	5000000
Chloromettiane	XS	5000000	10000	10	5000000
Vinyl chloride	0	5000000	10600*	10	5000000
Bromcmethane	0	5000000	10000	10	5000000
chloroechana	0	5000000	10000	10	5000000
Tx'ichloxQfXuoroittebhane	0	5000000	lOOOO	10	5000000
1,l-DichloroetheiKS	0	2500000	10000	[illegible]	2500000
Methylisne Chloride	U	2500000	10000	5	2500000
trans"1,2-Dichloroethene	0	2500000	10000	5	2500000
l, l-Dichloroetiiane	U	2500000	10000	5	2500000
cia-1,2-Dichloroethene.	tr	2500000	io OOO	5	2500000
2,2-Dicbloxropxopane	0	2500000	10000	5	2500000
Chloroform	0	2500000	XOOOO	5	2500000
Brontoehloronietbane	U	2500000	10000	5	2500000
1,1,l-Tricbloroethans	0	2500000	10000	5	2500000
1,2-Dichloroechane	U	2500000	lOOOO	5	2500000
1,1-Dicta©xopropene	0	2500000	lOOOO	5	2500000
Carbon Tetrachloride	0	2500000	lOOOa	5	2500000
Benzene	0	2500009	IOOOO	5	2500000
1,2-Dicfalonopropane	0	2500000	10000.	5	2500000
tcicaaoroechene	0	2500000	IOOOO' ,	5	2500000
Dibromomethaae	0	2500000	iOOOO	5	2500000
BromodichlorompMirme	0	2500000	10000	5'	2500000
cia-1,3-dichloropropene	0	2500000	10000	S	25000OO
Toluene	0	2500000	10000	S	2500000
txana-1,3-Diohlorpprppene	0	2500000	10000	5	2500000
1,1,2-Triabloroethane	0	2500000	10000	5	2500000
l,3-Dichloropropan9	0	2500000	10000	5	2500000
Dibrotnochloromethane	0	2500000	10000	5	2500000
Tetrachloroetbene	0	2600000	10000	5	2500000
l,2-Dibxotaoethane	TJ	2500000	10000	5	2500000
Chloroben2ene	0	2500000	10000	5	2500000
1,1,1,2-Tetrachloroethaue	0	2500000	10000	S	2500000
Ethylbenaene	0	2500000	10000	5	2500000
Bromofozm	0	2500000	10000	5	2500000
styrene	0	2500000	10000	5	2500000
1,1,2,2-Tetraciiioroethanei	U	2500000	10000	5	2500090
1,2,3-Tricfaloropropane	0	2500000	iOOOO	5	2500000
Isopropy-rbenzene	0	2500000	10000	5	2500000
Browobenzene	0	2500000	10000	5	2500000
2-ChloxoColuene	ir	2500000	10000	5	2500000
CT-Propylbenzene	0	2500000	10000	5	2500000
4-ChlorocoXuene	U	2500000	10000	5	2500000

KATAHDIN ANALYTICAL SERVICES
Report of Analytical Results

Client> The Johnson company
Project; PINE STRBET CANAL SITE
PO Mo? 1-0970-1(505) PINE ST. CRMfti SITE
Sample Daca; 10/10/02
Received Date; 10/11/02
Extraction Dace: io/ie/02
Analysis Date: 10/16/02
Report Dace: 10/16/2002
Matrix: P&
% Solids: HA

Lab ID: WS3949-2
Client IDs CT-T12+50E10-DL
SDGi HS3948
Extracted by: JBy
Extraction Method: SWB4G 5030
Analyst: JEY
Analysis Method: SW84S S260B
Lab Prep Batch: WG8S7
Oaitsi ug/Kg

Compound	Flag*	Kesules	DP	PQti	Adj.raii
1,3,5-Trimethylbenzene	n	2S00000	10000	5	2500000
cerc-Butylbeazene	a	2500000	10000	5	2500000
1,2,4-TrichloroberLSene	u	2500000	10000	5	2500000
sea-Butylbenzene	u	2500000	10000	5	2500000
1.3-Dichlorobenzena	XT	2500000	10000	5	2500000
P-Isopropyltoluene	tr	2560000	10000	5	2500000
1,4 -Dichlorobenzesne	13	2500000	1000a	5	2500000
i., 2-pichloxob«nzene	n	2500000	10000	5	2500000
H-Butylfcenzene	U	2500000	10000	5	2500000
1,2-Pibroni£>-3-Chloropropane	tr	2500000	10000	5	2500000
1,3,4-TriuethyXbenzene	D	2500000	10000	5	2500000
Saphcbalene	B	18,000,000	10000	5	250000a
Hexachlorobutadiene	a	2500000	10000	5	2500000
1,2,3-Trdehlorobenzene	a	2500000	IOOOO	S	2500000
Meehyl fce^t-bucyl etHar	XJ	2500000	10000	5	2500000
AoeCene	TJ	10000000	10000	20	10000000
2-BU.fcanone	XT	10000000	10000	20	10000000
4-metliyl-2-pencanone	V	10000000	10000	20	idaOOOOO
2-Bexanone	XJ	10000000	10000	20	10000000
m+p-Xylenes	XT	5000000	10000	XO	5000000
o-Zylene	V	2S000Q0	10000 H	S	2500000
1,3,5-Trichlorobenzene	V	2SO0000	10000	S	2500000
Vinyl Acetate	TJ	2600000	10000	5'	2500000
Carbon Disul£ide	u	2500000	10000	5	2500000
Diethyl Ether	TJ	2500000	10000	5	2500000
Tetfahydrofuraa	U	25000000	10000	50	25000000
Dibromofluoromethane		31*			
1,2-Dioaloxoetbane-D4		aa*			
Toluane-D9		87%			
P-Bromofluorobenzene		B8%			

KATAHDIN ANALYTICAL SERVICES
Report of Analytical Results

client! The Johnson Company
Projectr BUDS STREET CANAL SITS
PO NO; 1-0870-1(505) Pine St. Canal Site
Sample Datei 10/10/02
Received Date: 3.0/11/02
Extraction Date; 10/11/02
Analysis Date: ao/15/03
Report Date: lo/lS/2002
Matrix: FP
% Solidsi HA

Lab ID: WS3948-2
Client tD-. J-T12+50E10
$SG: WS3948
Extracted by: JCG
Extraction Method] 5WB46 3590
Analyst: J J C
Analysis Method: SW846 8270C
Lab Prep Batch; wseis
Units: ug/Kg

Compound	E-lagfl	Hepulta	DF	1PQL	Adj.PQL
Naphthalene	E	35^)00^000	10	330	990000
2-Methylnaphthalene	S	25000,000	10	330	990000
Acenaphthyl ene	-	3,000^,000	10	330	990000
Acenaphthene		14000,000	10	330	990000
Fluorene		8,100,000	10	330	990000
Phenanthrene	B	20/100,000	10	330	990000
Andnracene		^900,000	10	330	990000
Fluotanfthene		6p.00,000	10	330	990000
Pyrene		BSOOjOOO	10	330	990000
Benzo(a)anthracene		3,100000	10	330	990000
Chry&enc		2,600,000	10	330	990000
Benzo(b)f luoranthene.		1BOOP00	10	330	990000
Benzo(k)fluoranfchene	V	990,000	10	330	990000
Benzo (a) pyrene		2,400,000	10	330	990000
Zndeno (1,2,3-cd) pyrene	U	990,000	10	330	990000
Dibenzo (a,h.) anthracene	U	990,000	10	330	990000
Benzo (g,h,i)perylei>e		1^.00,000	10	390	990000
Nitrobensene-DS		72*			
2-Fluorobiphenyl		109%			
Texpbenyl -D14		111*			

]~see 50X DILution

~see 50X DILution

KATASDIN JUWLZTXCKL SERVICES
Report of Analytical Results

Clients The Johnson Company
ProjtCC: PINE STREET CANAL SITE
SO No; 1-0870-1(505) Pine St. Canal Site
Sample Date: 10/7.0/02
Received Dates 10/11/02
Extraction Dates 10/11/02
Analysis Date: 10/15/02
Report Date: 10/1S/2002
Matrix! FF
* Solids! MA

Lab XD: WS394B-2
Client ID: J-T12+50E10-DL
SDG; WS3948
Extracted, by: JCG
Extraction Method: SWS46 3580
Analysts tftfc
Analysis Method: SWB46 S270C
Lab Prep Batch: HGBie
Unitsi ug/Kef

Compound	Flagfl	Results	PF	PQL	Adj.VQb
Naphthalene		44000/300	SO	330	5000000
2-Metbylnaphthalene		33J000,000	SO	330	5000000
Acenaphthylene	//	5000000	50	330	5000000
Acenaphehene		lff000000	50	330	5000000
Fl^orene		aa00000	50	330	5000000
Phenanthrene		24000/100	50	330	SOD0000
Anthracene		7800000	50	330	5000000
Fluorantbene		7400000	50	330	5000000
Pyrene		11000000	SO	330	5000000
Benzo(a)anthracene	Ta	5000000	30	330	5000000
Chrysene	ll	5000000	50	330	5000000
Benzo(b)fluoranthene	XJ	5000000	50	330	5000000
Benzo <k)fluoranthene	O	5000000	50	330	5000000
Benzo(a)pyrene	XJ	5000000	50	330	5000000
Indemi (1, 2, 3-cd> pyrene	XJ	5000000	50	330	5000000
Dibenzo (a, h) anthracene	U	5000000	50	330	5000000
Benzo(g,h,i)pezylene	U	5000000	50	330	5000000
Nitrobenzene-D5		D			
2-Fluorobiphenyl		D			
Terpbenyl-Ol4		D			

KATAHDIN ANALYTICAL SERVICES
Report of Analytical Results

Client:
Project: PINE STREET CflWAL SITE
jpo BOJ l-oa7o-i(5O5) Pine 5c. canal site
saaple Date.- xo/ix/j^^
Received Data: iP/xi/03
Extraction Dates 10/11/02
Analysis Date: 1Q/1S/02
Report Date: 10/16/2002
Matrixs FP
% Solids: NA

Lab ID: WG818-1
Client ID: WGBie-Blank
SDO: 021497
Extracted by= JCG
extraction Method: SM846 3580
Analyst: JJC
Analysis Method: SW84S S270C
LSib Prep Batch: WG81B
units; ug/Kg

Ccmpound	Flags	Raaulcs	DP	pgc	Adj.PQl.
Naphthalene	ar	93000	1.0	330	99000
2-Methylnaphthalene	V	99000	1.0	330	99000
Acenaphthylene	ar	99000	1.0	330	99000
Acfenaphchene	U	99000	1.0	330	99000
Fluoieae	TJ	99000	1.0	330	99060
Phenanfchrene	TI	99000	1.0	330	99000
Anthiacene	TJ	99000	1.0	330	93000
Fluoraathene	TI	99000	1-0	330	99000
Pyxeaa	TI	99000	1.0	330	99000
Benzo(a)anchzaaen^	U	99000	1.0	330	99000
Cbrysen«	U	99000	1.0	330	99000
Benzo(b)fluoranthene	tr	99000	1.0	330	99000
BenzoIk.)fluoianthene	TI	99000	1.0	330	99000
Benzo(a)pyrene	TI	99000	1.0	330	99000
Indeno (1,2,3-cd)pyreiie	IT	99000	1.0	330	99000
Dlbenzo(a,b.)an.t-bra.cene	XT	99000	1.0	330	99000
Benzo(g(±L, Dperylene	U	99000	1.0	330	99000
Nltrbbexkzeae-D5		77*			
a-Fluorobiphenyl		ea*			
Terpheuyl-D14		87%			

Model for Chemical Containment by a Cap
Appendix B - Guidance for In-Situ Subaqueous Capping of Contaminated Sediments
Palermo, Maynord, Miller and Reible

Application to Pine Street Canal, Burlington, VT

Estimation of fluxes and cap contamination - all PAHs
Cap and sediment properties represent measured quantities or estimated "probable" case quantities

Estimation of effective cap thickness

LQ := 2ft — Initial thickness of cap

Lfcio := 10cm — Depth of bioturbation

Lassess := 1-ft — Depth of cap contaminant penetration assessment

ALtop := i^sess > 4io,Wss>4io!PePtn of effective top of cap

ΔL_{cap} := o-cm — Consolidation distance within the cap- Assumed

ΔL_{sed} := 2.5ft — Consolidation distance of underlying sediment- Assumed

$z := \frac{1.6}{2.6}$ OK := (l - E)-2 7-^2- $\frac{}{cm^3}$ Void fraction/bulk density in cap

$\varepsilon_{sed} := \frac{7}{8}$ Pbsed := (l - esed)2-7'^^1 $\frac{}{cm^3}$ fraction/bulk density in sed

$\Delta L_{sed.pw} := \frac{\Delta L_{sed}}{}$ Porewater Penetration distance in cap — ΔL_{sedpw} = 1.238m

L:=1000cm^3

μg := 10^{-6}·gm

$\rho_{oc} := 0 \cdot \frac{mg}{L}$

Dissolved organic carbon concentration in porewater-Assumed - use 0 if employing measured porewater concentrations

$f_{oc\,sed}$:= o.O83 — Fraction organic carbon in sediment

$k_{sed} := 1 \frac{cm}{yr}$ — Effective mass transfer coefficient at sediment-water interface

Estimated (order of magnitude)

11/02

Estimation of sorption characteristics in cap and retardation factor

K_{oc} Organic carbon based partition coefficient

S Solubility in water

K_s Measured partition coefficient in sediment

W_{sed} Measured sediment loading

C_{pw} Estimated porewater concentration using Wsed X S (Raoult's Law concentration w/W~mole fraction)

$$K_{oc} := \begin{pmatrix} 10^{3.25} \\ 10^{3.46} \\ 10^{3.77} \\ 10^{1.77} \\ 10^{4.04} \\ 10^{4.3} \\ 10^{4.29} \\ 10^{4.83} \\ 10^{4.82} \\ 10^{5.35} \\ 10^{5.39} \\ 10^{5.88} \\ 10^{6.4} \end{pmatrix} \cdot \frac{L}{kg} \qquad S := \begin{pmatrix} 33400 \\ 25000 \\ 3860 \\ 2090 \\ 1270 \\ 770 \\ 110 \\ 84 \\ 84 \\ 16 \\ 1.5 \\ 1.7 \\ 0.33 \end{pmatrix} \cdot f \qquad W_{sed} := \begin{pmatrix} 44000 \\ 33000 \\ 3000 \\ 14000 \\ 8100 \\ 24000 \\ 6900 \\ 6100 \\ 8800 \\ 3100 \\ 0 \\ 2400 \\ 0 \end{pmatrix} \cdot \frac{mg}{kg}$$

Compound order

1 - naphthalene
2 - 2-methyl naphthalene
3 - acenaphthalene
4 - acenaphthene
5 - fluorene
6 - phenanthrene
7 - anthracene
8 -fluoranthene
9 - pyrene
10 - benzo(a)anthracene
11 - chrysene
12 - benzo(a)pyrene
13 - dibenzo(a,h)anthracene

$i := 1..13$

$Cpw_i := W_{sed_i} \cdot S_i$

$Cpw =$ (in $\frac{Mg}{L}$)

	3
1	1469.6
2	825
3	11.58
4	29.26
5	10.287
6	18.48
7	5.313
8	0.512
9	0.739
10	0.05
11	0
12	0.004
13	0

$\omega_{crit} := K_{oc} \cdot f_{oc.sed} \cdot S$ Critical sediment loading $\omega_{crit} = 1.893 \times 10^{4} \frac{mg}{kg}$

$f_{oc} := 0.0001$ Cap organic carbon fraction- layer of sediment

$Kd_i := \frac{K_{oc_i} \cdot f_{oc}}{1 + \rho_{oc} \cdot K_{oc_i}}$ $Rf := \varepsilon + \rho_b \cdot K_d$ Estimated partition coefficient/retardation factor in cap

$K_d =$ ($\frac{L}{kg}$)

	1
1	0,178
2	0.288
3	0.589
4	0.589
5	1.096
6	1.995
7	1.95
8	6.761
9	6.607
10	22.387
11	24.547
12	75.858
13	251.189

$R_f =$

	1
1	0,8
2	0.915
3	1.227
4	1.227
5	1.754
6	2.687
7	2.64
8	7.636
9	7.476
10	23.864
11	26.107
12	79.391
13	261.465

$\Delta L_{sed.A} := \frac{\Delta L_{sed}}{Rf}$ Penetration distance of chemical into cap due to consolidation of sediment

$Ltemp := Lo - \Delta L_{top} - \Delta L_{cap} - \Delta L_{sed.A}$ Effective cap thickness

$$L_{eff_i} := \begin{cases} Ltemp_i & \text{if } Ltemp_i > 0\,cm \\ (0.0 \cdot cm) & \text{if } Ltemp_i < 0\,cm \end{cases}$$

$C_o := C_{pw}$ Chemical concentration level

$W_{0_i} := K_{d_i} \cdot C_{pw_i}$

	$\Delta L_{sed.A}$ =	L_{eff} = (ft)	C_0 =	W_0 = ($\frac{MS}{kg}$)
1	3.125	0	1469.6	261.336
2	2.733	0	825	237.933
3	2.038	0	11.58	6.819
4	2.038	0	29.26	17.23
5	1.425	0	10.287	11.279
6	0.93	0.07	18.48	36.872
7	0.947	0.053	5.313	10.36
8	0.327	0.673	0.512	3.464
9	0.334	0.666	0.739	4.884
10	0.105	0.895	0.05	1.11
11	0.096	0.904	0	0
12	0.031	0.969	0.004	0.309
13	0.01	0.99	0	0

Estimation of long-term losses

a. Determination of Peciet number defining the relative importance of advection to diffusion

$U := 0\frac{cm}{yr}$ Average seepage velocity in sediment- assumed

$D_w := 5 \cdot 10^{-6} \cdot \frac{cm^2}{sec}$ Molecular diffusion coefficient in water

$D_{eff} := D_w \cdot \varepsilon^{\frac{4}{3}}$ Miiiington and Quirk model for effective diffusivity

$D_{eff} = 2.617 \times 10^{-6} \frac{cm^2}{sec}$

$Pe := \frac{U \cdot L_{eff}}{Deff}$ $Pe_1 = 0$ Peciet number If ~>1 advection/diffusion both important

Advective flux

$F_{adv} := U \cdot C_0$ Advective flux - since a deep layer of contaminated sediment is assumed, the flux at long time is given by this for a seepage outflow

$F_{adv_1} = 0 kg m^{-2} sec^{-1}$

Dffusive flux- hypothetical unless Pe «1 and depletion of material in sediment can be neglected

$$F_{diff_i} := \frac{D_{eff_i}}{L_{eff_i}} \cdot (C_{r_i} - 0)$$

Steady state diffusive flux (assuming no advection and no depletion of contaminants by diffusion through cap)

Transient behavior- assuming diffusion only

$$\tau_{b_i} := \frac{0.54 \cdot \left(L_{eff_i}\right)^2 \cdot R_{f_i}}{D_{eff_i}}$$

Breakthrough time assuming no depletion of contaminant in sediment

$$\tau_{ss_i} := \frac{3.69 \cdot \left(L_{eff_i}\right)^2 \cdot R_{f_i}}{D_{eff_i}}$$

Time required to reach hypothetical steady state flux (F_{diff}) assuming no depletion of contaminants in sediment

$F_{diff} = \bullet \ \frac{jmg}{m^2\text{-yr}}$

$\tau_b =$

1	0
[illegible]	0
[illegible]	o
[illegible]	o
[illegible]	o
6	0.008
7	0.005
[illegible]	[illegible]
[illegible]	2.039
[illegible]	11.771
[illegible]	13.138
[illegible]	45.833
[illegible]	157.858

yr

$\tau_{ss} =$

1	0
2	0
3	0
4	0
5	0
6	0.055
7	0.031
8	14.529
9	13.931
10	80.435
11	89.773
12	313.19
13	1078.695

yr

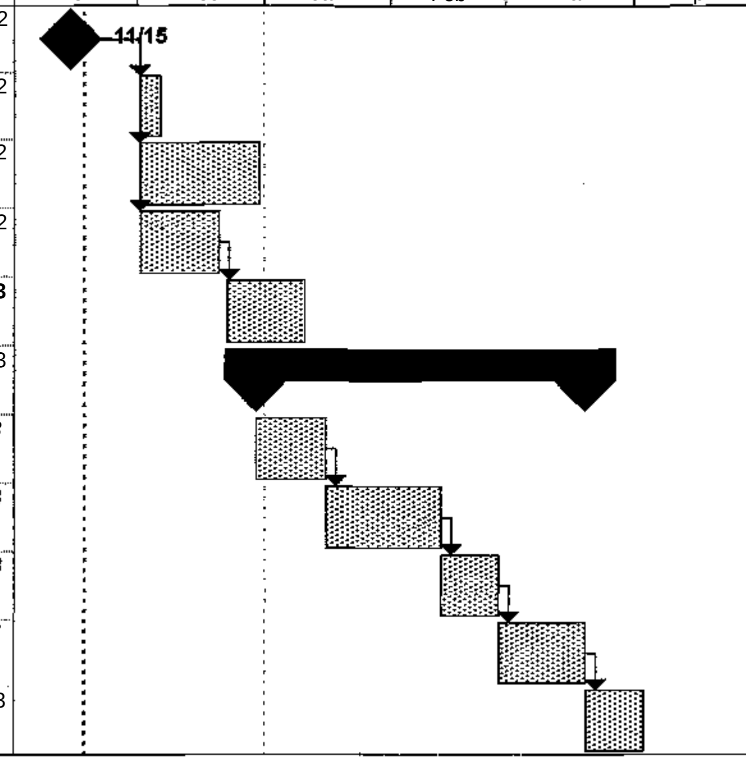
Attachment 7
Construction Schedule

Design Change 010 "Best Case Timeline" November 12, 2002

ID	Task Name	Duration	Start	Finish
1	**EPA Approves Design Change 010**	1 day	Fri 11/15/02	Fri 11/15/02
2	**Site Preparation - Access, Clearing, Debris Removal**	5 days	Mon 12/2/02	Fri 12/6/02
3	**Acquire and Stockpile Cap Material**	21 days	Mon 12/2/02	Mon 12/30/02
4	**Purchase and Deliver Geotextile**	15 days	Mon 12/2/02	Fri 12/20/02
5	**Place Geotextile**	15 days	Mon 12/23/02	**Fri 1/10/03**
6	**Cap Application**	58 days	Mon 12/30/02	Wed 3/19/03
7	Step 1 -150 ft Test Area	*13 days*	Mon *12/30/02*	*Wed 1/15/03*
8	Step 2 - T6+50 to T10	*20 days*	***Thu 1/16/03***	***Wed 2/12/03***
9	**Step 3 - T10 to T11+50**	***10 days***	***Thu 2/13/03***	***Wed 2/26/03***
10	Step 4 - T6+50 to end	*15 days*	[illegible]	*Wed 3/19/03*
11	**Construction Completion**	10 days	Thu 3/20/03	Wed 4/2/03

2003

Nov | Dec | Jan | Feb | Mar | Apr



"Best Case" Timeline
Phase 1B Design Change 010
PSCS REMEDIAL ACTION

Task

Split

Progress

Milestone

Summary

Project Summary

External Tasks

External Milestone

Deadline


NOTE: VERTICAL & HORIZONTAL CONTROL BY LITTLE RIVER SURVEY COMPANY OF STOWE, VERMONT - AUTUMN, 1992
ADDITIONAL SURVEY DATA - AUTUMN, 1994.
ADDITIONAL SURVEY DATA - NOVEMBER, 2000.
VERTICAL DATUM = NAVD 1988
HORIZONTAL DATUM = NAD 1983
BATHYMETRY BY U.S. GEOLOGICAL SURVEY - MAY, 1994.
STEP 1
150 FOOT TEST AREA
STEP 3
STEP 2
STEP 4
ACCESS FROM AREA 3
AREA 2 WATERWAY
T9-T13
T5-T9
T1-T5
CANAL
ACCESS ROUTE FROM PINE STREET
POSSIBLE STOCKPILE AREA
ACCESS ROUTE FROM BUILDING PARKING LOT MALTEX
ARCHEOLOGICALLY SENSITIVE AREA
TURNING BASIN
GRAVEL ACCESS ROAD
T13
T12
T11
T10
T8
T7
T6
T5
T4
GRAPHIC SCALE
(IN FEET)
1 inch = 30 ft.
STATE GRID
KEY
DIRECTION OF CAP APPLICATION
PROPOSED ACCESS ROUTE
LIMITS OF ACCESS AND STAGING/STOCKPILE AREAS
PROP. CONSTRUCTION FENCING
VERMONT CONSERVATION MIX
LEGEND
WETLAND BOUNDARY
SURFACE WATER / DRAINAGE
PROPOSED LIMITS OF CAP
1' BATHYMETRIC CONTOUR
5' BATHYMETRIC CONTOUR
1' GROUND SURFACE CONTOUR
5' GROUND SURFACE CONTOUR
PROP. SETTLEMENT PLATE LOCATION
MONITORING WELL / SOIL BORING LOCATIONS
1994-1995 ARI CORING LOCATION
2000 CORING LOCATION
2000 VANE SHEAR TEST LOCATION
PLAN
PHASE 1B EXTENSION
SCALE: 1"=30'
AREA 2 WATERWAY
STEP1 150 FOOT TEST AREA
SOUTH
NORTH
ELEVATION IN FEET NVGD
WATER SURFACE
CANAL BOTTOM
BLACK ORGANIC MUCK
PEAT
SILT
CLAY
SILT/CLAY
SAND
PROFILE T9 - T13
SCALE: 1" = 30'HOR., 1"=6'VER.; V.E. = 5:1
PROFILE T5 - T9
SCALE: 1" = 30'HOR., 1" = 6'VER.; V.E. = 5:1
PROFILE T1 - T5
SCALE: 1" = 30'HOR., 1"=6'VER.; V.E. = 5:1
LEGEND
PRESETTLEMENT CAP ELEVATION
100 PSF PENETRATION
GEOLOGIC CONTACT
KEY
CORE I.D.
Liquid Limits (%)
Plastic Limits (%)
Compression Index
Recompression Index
Void Ratio
Permeability (cm/sec)
Soil Friction Angle
Field Vane Shear Test Results (psf)
Disturbed
Maximum
* Cohesion assumed zero unless given (C250) in psf
Additional Sources: 3/92 S.R.I., 8/96 A.R.I., 5/98 A.F.S., A.R.I. Fieldbooks (Documents #337 & #408)
Rev. No. | Date | Description | Made by | Chk'd by | App'd by
PLAN & PROFILE
DESIGN CHANGE 010
PINE STREET CANAL SITE
BURLINGTON, VERMONT
THE JOHNSON COMPANY, INC
Environmental Sciences and Engineering
100 STATE STREET
MONTPELIER, VERMONT 05602
EXT1B.dwg
Sheet 1 of 1
Scale: as shown
Drawn by: TJK
Chk'd by: DMM
Date: 11/15/02
Job: 1-0870-1

Design Change Request No. 11

January 24, 2003

Thor Helgason
de maximis, inc.
135 Beaver Street
Waltham, MA 02452

RE: Pine Street Barge Canal Superfund Site
Conditional Approval of Design Change Request #11 and Wetlands Restoration Plan Addendum

Turning Basin

Dear Mr. Helgason:

EPA has reviewed Design Change Request #11 dated January 21, 2003, as amended by your email dated today. The amended design change is approved, with the following conditions:

1. The amending language be incorporated into the design change request and replacement pages be provided to EPA, VT DEC and EPA's contractor.

2. Surface water collected from Areas 2, 7 and/or the BED outlet pool continue to be pumped to the turning basin until VT DEC has had the opportunity to comment on the proposal to discharge it to storm water manholes along Lakeside Avenue or directly to Lake Champlain without monitoring the turbidity.

3. The housekeeping issues related to clearing the access road, and removal of debris from the turning basin, as discussed during our conference call on January 22, be addressed. Debris removed from the turning basin should not be left on the banks of the turning basin. Large piles of brush and trees resulting from the clearing of the access road should not be left on the side of the access road; rather, it should be spread around to resemble the existing conditions. Wood chips must be disposed of in a way so as not to inhibit growth of the understory.

EPA has reviewed the Wetlands Restoration Plan Addendum, dated January 16, 2003. It is approved, with the following conditions:

1. Figure 1 be revised to show that the silt fence does not extend along the north side of the current stockpile area.

2. The following sentence be added to the end of the first paragraph on page one:

"It is acknowledged that the stockpile was ultimately placed in an area that was not contemplated during the site walk-over with EPA."

If you have any questions regarding this letter, please contact me at 617/918-1348.

Sincerely,

Karen M. Lumino, RPM
CT, ME & VT Superfund Section

cc: Michael Smith

X7

de maximis, inc.

135 Beaver Street
Fourth Floor
Waltham, MA 02452
(781)642-8775
Fax (781) 642-1078

January 22, 2003

Ms. Karen Lumino
Unites States Environmental Protection Agency
Mail Code: HBT
1 Congress Street
Boston, MA 02116

RE: Design Change Request No. 11 - Capping of Turning Basin
Pine Street Canal Superfund Site

Dear Ms. Lumino:

Attached is Design Change Request No. 11, addressing the design and installation of the cap in the Turning Basin. This document incorporates the experience to date capping the Canal, and reflects discussion with EPA and M & E regarding the approach presented. Note that the drawings referenced in Attachment 1 (Plan of Turning Basin: 24" x 36" sheet; and four cross sections: 11" x 17" sheets) were shipped to you on Monday, January 20 and are not included again in the attached document. If you need additional copies of the Attachment 1 drawings, please contact Chris Crandell or Joel Behrsing of The Johnson Company directly.

We request approval of this Design Change Request. Please do not hesitate to call me at (781)642-8775 should you have any questions.

Sincerely,
***de** maximis, inc.*

Carol LeCam for:

Thor Helgason
Project Coordinator

cc: Jean Choi - USEPA
Mike Smith - VTDEC
Hasan Abedi - M & E
Martha Zirbel - M & E
Deb Roberts - M & E
Chris Crandell - The Johnson Co.
Roy Wagner - *de maximis, inc.*
Performing Defendants

J:\PROJECTS\l-0870-l\Phase 2\Design Change 011 Cover llr.pd.wpd January 22, 2003

PINE STREET BARGE CANAL REMEDIAL ACTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: 11
Major _____X______
Date of Request: January 21,2003

RECOMMENDED BY: Contractor

DESIGN CHANGE DESCRIPTION:
The experience and information gathered during the construction of the Area 2 Waterway and access road, and the capping of the southern portion of the Canal (as described in Design Change 010), indicates that it is likely feasible and advantageous to apply the sand cap over much or all of the Turning Basin sediment in the dry (i.e., after pumping the water out) using cranes and buckets, bobcat spreaders, and/or manual techniques. The major advantages to capping in the dry are: 1) simple and proven construction techniques may be used; 2) the cap placement can be visually observed and the thickness directly measured; 3) environmental releases can be detected and managed immediately; and 4) the overall remedial action may be completed six to nine months earlier than subaqueous capping.

This design change includes dewatering the Turning Basin and using land-based equipment and manual labor to cap it. The cap of the Turning Basin sediments was previously proposed to be constructed under water (subaqueously) during Phase 2 of the Remedial Action. This dry-application approach was previously proposed and approved for the Canal in the Remedial Action Phase IB, Design Change 010. Note that it is likely that the Turning Basin cannot be completely dewatered. The practical limit of dewatering will not be known until attempts are made. Therefore, provisions for constructing the cap subaqueously in the central, low portions of the Turning Basin are included in this document.

This design change also includes provisions for capping the 100 ft by 100 ft area just south of the Turning Basin.

Attachment 1 includes the figure: *Plan of Turning Basin, Design Change Oil.* Cross sections for the Turning Basin are also provided in Attachment 1 (Note: these cross sections were previously provided as Figures CDR 5-7 through CDR 5-10 in the *Conceptual Design Report,* dated March 1,2001).

This design change request is organized by the following topical headings:
1. Site Preparation, Construction Access, and Staging Areas
2. Environmental Controls and Surface Water and Groundwater Management
3. Cap Sand Materials
4. Geotextile and Geogrid

5. Cap Thickness and Placement
6. Construction Quality Control
7. Restoration and Completion Activities
8. Cap Stability (settlement, erosion, earthquake, static cap loading, and active construction loading)
9. Contaminant Transport in the Cap

A revised project schedule including the completion of the cap in the Canal (Design Change #010), and the Turning Basin and 100 x 100 foot area (Design Change #011) is currently being prepared and will be provided under separate cover.

<u>1. Site Preparation, Construction Access, and Staging Areas</u>

Site Preparation
Site preparation will include cutting some trees and brush along the uplands access areas north and west of the Turning Basin (please refer to Sheet 1 - *Plan of Turning Basin, Design Change 011,* provided in Attachment 1). Logs and brush will be placed on the sides of the access routes.

Debris present on the sediment surface of the Turning Basin will be removed as accessible. No attempt will be made to remove materials embedded in the sediment, including logs, branches, shopping carts, the barges, the former dry-dock railway, or the abandoned automobile. Logs and branches will be cut off at or near the sediment surface. The cut-off debris will be placed along the banks of the Turning Basin above 96 feet NGVD.

The vegetation (including small trees) from the 100 x 100 foot area, will be chipped, and the chips blown (or otherwise broadcast) into a thin layer in the adjacent wooded areas and left to decompose.

Construction Access
Access to the Turning Basin will be from Pine Street on the east via the Jarrett property, from the north via the Havey property and its entrance on South Champlain Street, and from the west via South Champlain Street and the Vermont Railway property. Existing fences along the northern edge of the Turning Basin will be removed as necessary to provide access. These will be replaced following completion of the work. Installation of temporary earthen ramps from the uplands banks on each side of the Turning Basin may be necessary to provide access for equipment. These temporary ramps will be removed above an elevation of 94 ft NVGD (except where elevation is dictated by minimum cap thickness), and the banks restored, following completion of the work. No access across wetlands areas will be necessary for work in the Turning Basin. Access to the 100 x 100 foot area will be along the gated access road off Pine Street (near the former drum storage area), which will include construction of a temporary spur to the north, connecting to the southeast corner of the Maltex Building parking lot. From the parking lot corner, access will continue along the existing construction road north of Maltex

Pond. This access route will impact a small area of wetlands. These wetlands will be restored to their original grades and seeded in accordance with Section 7 of this Design Change Oil.

Staging Areas
A trailer-mounted pump, which is pumping water from the Turning Basin to Lake Champlain, is currently staged on the west side of the Turning Basin (on the Vermont Railway property) and continued access to it throughout construction of the Turning Basin cap will be needed. Access to this area will be through the east side of the Vermont Railway property across the heavy equipment bridge accessed from South Champlain Street.

Staging areas for capping materials will be located on a portion of the 100 x 100 foot area, the Havey Property, and the Vermont Railway property. These areas will be restored to their original grade, with the exception of the 100 x 100 foot areas, which will be restored to final sand cap grade elevation.

2. Environmental Controls and Surface Water and Groundwater Management

Surface Water and Groundwater Management
By-pass pumping of the Canal water to Lake Champlain will continue at its current location in the Turning Basin. Environmental controls around the pump suction (sorbent booms and a stone-filled sump) will be maintained. If possible, the Canal water level will be drawn down to approximately 85 ft NGVD. Samples of the discharge water will be collected and measured for turbidity. If the turbidity exceeds 50 NTU, then the sample will be acidified and re-measured for turbidity. If the turbidity of the acidified sample still exceeds 50 NTU, the discharge pump will be turned off until turbidity levels decrease.

Surface water may be retained and bypass pumped from an existing temporary earth bermed storage area south of Area 2, from Area 7 and/or the BED outlet pool to storm water manholes along Lakeside Avenue or directly to Lake Champlain. These pump discharges would not be monitored for turbidity, as the water being pumped from these locations would not have come in contact with any contaminated materials on-site. Alternatively, it may be feasible to allow all base flow and storm water to flow down a plastic-lined channel to the Turning Basin by-pass pump intake.

NAPL Management
Any pools or seeps of non-aqueous phase liquid (NAPL) as accessible will be controlled and collected using sorbent "pom poms", pads, sweeps or similar materials. Most spent sorbents will be collected and disposed of off-site in accordance with the previously approved Site Management Plan for Phase IB construction. Some sorbent pads or materials may be left in place and covered with the sand cap in order to collect and immobilize potential NAPL seepage following cap placement.

Monitoring

Environmental and site controls (silt curtains, sorbents, construction fences, etc.), as well as turbidity levels (measured manually), and Canal and Lake water levels, will be monitored daily during active construction and reported on the *Canal Draw Down Checklist* form included in Design Change 010, Attachment 2. Water quality monitoring through sampling and analysis for polycyclic aromatic hydrocarbons (PAHs) and metals will continue on a monthly basis in accordance with the Compliance Monitoring Workplan.

3. Cap Sand Materials

The silty sand to be used for the Turning Basin cap and 100 x 100 foot area will meet the Phase IB cap material specifications.

4. Geotextile and Geogrid

Geotextile and/or geogrid will be deployed where deemed useful and conditions allow to facilitate construction of the Turning Basin cap. Some of the proposed cap placement techniques (discussed in Section 5) do not necessarily require equipment directly on the sediments. The use of geotextile/geogrid may facilitate construction, provide protection from erosion of the sediments, allow separation of cap sand from the underlying sediments and allow placement of the cap sand without causing mixing with the sediments. If the sediments are well frozen, it may be possible to construct the Turning Basin cap using Bobcats without geotextile/geogrid. The decision to use geotextile, or geogrid, and whether or not in more than one layer, will be made in the field by the Engineer and Contractor as dictated by field conditions. Geotextile seams will be overlapped a minimum of two feet. Geotextile and/or geogrid, if used, will not be able to practically cover the entire area due to the numerous obstructions in the Turning Basin, including the barges and marine railroad. The As-built drawings will indicate where geotextile and/or geogrid were used. Where the geotextile is utilized adjacent to any cribbing it will be folding back at the cribbing, rather than extending vertically up and over it.

If a geotextile and/or geogrid is used, it will be the same material used and approved for the Canal caps *(Specifications for Phase IB Remedial Action, Revision 1, Section 13550 Geotextile, Revision 1, November 18, 2002, and Specifications for Phase IB Remedial Action, Revision 1, Section 13554 Geogrid, November 18, 2002).*

5. Cap Thickness and Placement

Cap Thickness

The cap will have a minimum thickness of 1.5 feet but will range up to 3 feet thick or more depending on the location and conditions. The cap thickness is expected to be thinnest (1.5 feet) at the edges, and will gradually thicken to approximately three-feet thick at the center (in order to provide stable cap and sediment slopes as discussed in Section 8).

The cap thickness may be increased in local areas to provide stability for manpower or equipment access, or to cover protruding debris after partial settlement.

The initial cap will be placed, and additional cap sand added if necessary, so that the post-consolidation cap surface does not have a slope greater than 1:6 (limited by earthquake stability; see Section 8).

Placement Methods

Turning Basin

Methods used to place the cap sand may include tracked Bobcats, a loader, manual labor to spread materials, and a crane and bucket. In the event of snow or ice, the cap will be placed consistent with the procedures identified in the *"Contingencies for Cap Placemenf* subsection below. A description of the anticipated sequence and methods for cap placement are provided below. The proposed methods may need to be changed due to field conditions encountered during construction.

The crane will be stationed sequentially on the east, north, and west sides of the Turning Basin. The crane's size will allow it to reach the stockpiled sand cap materials on the north side of the Turning Basin (Havey property) for loading, and to place the sand in all areas of the Turning Basin from the three set-up locations. The crane's bucket will be lowered as close as possible to the sediment during sand placement. The sand will be manually raked, or smoothed by Bobcats if conditions allow, as necessary to provide an even thickness. Cap placement will proceed from the edges of the Basin, towards the Center. The area with the pump intake will be capped last. The cap would likely be placed in one lift near the edges (where it is thin) and two or more lifts in the center of the Turning Basin.

Tracked Bobcats or similar equipment will be used to cap portions of the Turning Basin. In this event, geotextile may be placed in any areas where the equipment will travel. The access location for the bobcats will be a ramp constructed on the north side of the Turning Basin from the Havey Property. The ramp would be constructed of gravel, sand, geotextile, and geogrids similar to the Canal access points discussed in Design Change 010. The portion of the ramp below 94 ft NGVD would be left in place following completion of the cap.

There will likely be some amount of open water left despite attempts to completely de-water the Turning Basin, particularly in the lowest depression, where the pump suction is located. Once the final cap is installed in every area that is able to be dewatered, the pump suction will be removed and immediately thereafter sand will be placed through the water via the crane and bucket technique until it is demonstrated that a minimum of 1.5 feet of cap sand has been placed. Access for measuring sand thickness placed through the open water will depend on the extent of open water prior to capping, but may involve planking, or a small, flat bottomed sampling boat.

100x100 foot Area

The cap within the 100 x 100 foot area will be made up of a sand layer covered by a topsoil layer to promote vegetative growth. The sand will meet the gradations specified for the Cap in Areas 3 and 7, and the Canal. The top soil placed over the sand will meet the specifications previously provided in the Phase IB design for Areas 3 and 7.

The existing two feet or more of fill over the peat in the 100 x 100 foot area, and equipment use in nearby areas of similar geology, indicates that low ground pressure equipment can work in the area without hazard. Following use of the area as a sand stockpile location, the residual sand will be supplemented with additional similar sand for a total thickness of approximately one-foot, followed by 0.5 feet of topsoil. The estimated final cap elevation in the 100 x 100-foot area is between 98 and 99 fNGVD.

Historic relics associated with the marine railway structures in the south end of the Turning Basin are present within the 100 x 100 foot cap area. These relics have been located in the field using global positioning system (GPS) equipment and are shown in Figure 2 in Attachment 2. The relics will be flagged in the field prior to clearing and cap construction to ensure that they are not damaged by the construction activities. In addition, a meeting between *de maximis,* The Johnson Company, and Fleet Environmental will be held prior to any work in the area to go over the location of the relics, and the measures to be taken to avoid damaging these historic features.

Contingencies for Cap Placement

The cap application methods described above will be the preferred methods of application. However, several contingencies will be available for implementation as well. These contingencies are listed below:

- incorporate the use of a geogrid and/or geotextile to isolate and/or bridge particularly weak areas;
- Conveyors may be used in place of the crane and bucket if access is restricted (e.g., if the crane cannot cross the heavy equipment bridge on the railway property), or to improve efficiency;
- use wooden timbers or planks to temporarily bridge weak areas;
- use the dessication of the sediment due to de-watering (and resulting increase in strength), and the potential freezing of the near surface sediments, to provide additional support for the cap, manpower and equipment; and
- temporarily stop construction in problematic areas and allow additional consolidation and dewatering of the sediments under partial cap loads to strengthen the sediments.

It is likely that snow and/or ice will be present at times during the Turning Basin cap construction. If the snow and ice cover is relatively thin, and does not obscure observation of the cap placement or obstruct the operation of machinery, then the cap will be placed directly over the snow and/or ice. A discussion of cap stability issues related to ice and subsequent melting is presented in Section 8. If the snow and/or ice layer is thick, extremely heavy, or has other characteristics which preclude the safe and controlled placement of the cap, then construction will cease until conditions return that favor safe and controllable construction. Alternatively, snow may be removed using shovels or snow blowers. Another method could be melting of snow by locally flooding the area by cessation of pumping to Lake Champlain. Limited use of road salt, or a road salt/sand mix, may be necessary in local areas outside of the cap (such as on the Havey Property) to provide a safe working area. The access roads will likely be plowed or the snow compacted with equipment.

Due to expected temperatures well below freezing at times, it is likely that moisture in the stockpiled cap sand will partially freeze. The large construction equipment on site will be able to break-up the frozen sand. The maximum size lump of frozen material which will be allowed for use in the cap is 12 inches (measured in the smallest dimension). This restriction will ensure that a 1.5 foot cap can be evenly placed, even with frozen materials.

6. Construction Quality Control

An Engineer will be present on-site during all times while capping of the Turning Basin is taking place.

Measurements of cap thickness will be collected daily during active cap construction, and summarized on the *Canal Cap Construction Checklist* provided in *Design Change 010, Attachment 2.* Measurements will include a determination of the cap thickness at a minimum of twenty-four locations in a grid pattern with a maximum of 50 ft spacing in the Turning Basin. These cap thickness measurements will be performed using a hand auger, simple graduated penetration rod (e.g., re-bar), or by observing the thickness of sand placed against pre-installed vertical graduated tubes or grade stakes. The locations of the cap thickness measurements will be determined by direct survey, triangulation from surveyed locations, or use of a Global Positioning System. Specific details of the various cap thickness measurement methods are provided in *Design Change 010, Section 6.*

Additional inspections and measurements that will be performed during Turning Basin capping are provided in the *Table C-QAPP-2 Required Tests and Inspections during Canal Capping* provided in *Design Change 010, Attachment 2.* In the event of a discrepancy between the various documents describing the work and specifying the number, type, or frequency of tests and inspections, the order of precedence is as follows (from highest to lowest):

1. This document (including Table C-QAPP-2)
2. Notes included on Details and Design Plans for Construction

3. Individual Specifications in the Remedial Action Workplan, Design Change 010, or elsewhere as referenced by this document
4. Site Management Plan
5. Other and previous Remedial Design documents

If possible, prior to re-inundation of the Turning Basin (circa March 15, 2003) cap core samples will be collected from the Turning Basin cap for chemical analysis. These cores will be collected and analyzed in accordance with the requirements of the Compliance Monitoring Workplan (CMP).

7. Restoration and Construction Completion Activities

Once the cap is completed, the surface water bypass pumping system will be shut down and removed and water will be allowed to accumulate, in the Turning Basin and Canal from groundwater inflow and stormwater. The water will eventually reach the ultimate weir overflow elevation of 96 feet when it will flow by gravity into Lake Champlain. If by about mid-March, 2003, the accumulated water in the Turning Basin has not reached an elevation of approximately 96 feet from baseflow and stormwater flow into the Canal, then the Canal will be re-inundated with water from Lake Champlain to a minimum water level of 96 ft. to prevent erosion of the constructed portions of the cap during the spring thaw. This may require pumping water from beneath the ice of Lake Champlain into the Canal and Turning Basin. The pump discharge from the Lake will be onto the existing rocky bed of the Turning Basin outlet under the railroad bridge where it can flow at a low velocity into the Turning Basin.

If the lowest portion of the Turning Basin can not be dewatered prior to cap placement, then the cap for this area may be performed in the wet (see Section 5). Pumping to Lake Champlain will likely have to cease during this final phase of Turning Basin capping. As a result, any suspended fines in the remaining water after this final phase of capping will have time to settle out (and otherwise be controlled by the existing silt curtains between the Turning Basin and the Lake) prior to re-inundation and resumed hydraulic connectivity to Lake Champlain. In addition, sand with minimum fines is available from the current sand source from a slightly different area of the pit, and that sand will be used to the extent possible to cap areas "in the wet" (to minimize resulting turbidity).

Clearing to create access is expected to be minimal given that most of the work areas and access points are already clear of shrubs and trees. Trees or brush that are cut will be left adjacent to the cleared areas (except for the 100 x 100 foot area, where the brush will be chipped and broadcast into the adjacent wooded areas and left to decompose). Temporary staging areas and other areas disturbed during construction and not needed for construction or maintenance of the Canal cap, the Turning Basin cap or the 100 foot by 100 foot area cap, will be restored. Once remedial construction is completed, equipment will be demobilized and the areas cleaned-up. All disturbed vegetated areas will be seeded with Vermont Conservation Mix (as specified in the Phase IB specifications 02821 and 02831) in Spring 2003 when water levels permit. A field judgement will be made at that time as to whether additional topsoil is needed in any of the construction-impacted areas.

The banks of the Turning Basin will be restored to their pre-construction conditions.

The 100 x 100 foot capped area will be covered with 6 inches of topsoil and planted with wetland grass seed mix. Wetland grass seed mix will be used in this area because its expected final surface elevation will be between the ordinary high water mark (approximate elevation 100 feet) and the low water elevation of 96 feet (as controlled by the outlet weir). The planting will be performed according to construction specifications Section 02821: Establishment of Growth; and Section 02831: Broadcast Seeding. Temporary wetland impacts associated with the construction of the access road south of the 100 ft. by 100 ft. capped area may occur. Every effort will be made to preserve the large silver maple trees in the area between the capped area and the access road that follows the northern margin of Maltex Pond.

8. Cap Stability (erosion potential, long term sediment bearing capacity, active construction loading, earthquake stability, and consolidation)

Analysis of erosion potential, stability for long term static cap loading and short term active construction loading, earthquake stability, and consolidation was performed for the capping of the Canal in *Phase IB, Design Change 010, Section 8.* The basis of these calculations included the use of conservative values for Canal and Lake water levels (i.e., worst case scenario), subsurface sediment and soil strengths, design storms and earthquakes, and similar variables, and the results indicated acceptable factors of safety for all the design events. The design values for these variables were selected from available site and regional data and good engineering practice. Details of the selected design values and the selection rationale, and final design calculations are provided in *Phase IB, Design Change 010, Attachment 5.* The satisfactory results of all the long term analyses also apply to the Turning Basin as the sediments are of similar strength and thickness (or thinner).

Erosion Potential

The outlet channel from the northwest corner of the Turning Basin is the only portion of the Turning Basin that can conceivably be vulnerable to cap erosion. However, the depth of water (~6 ft) and area of flow (360 square feet) in this area are both greater than in the southern portion of the Canal. Erosion potential was calculated for the southern portion of the Canal using a design flow of 150% of the 100 year storm event (provided in Design Change 010 Attachment 5) and the cap there was found to be stable based on this design flow, the cap sand gradation data, the calculated post-settlement cap elevation, and a pre-storm water elevation of 96 feet NGVD. Therefore, the cap in the Turning Basin will also be stable against erosion from flood flows.

Bearing Strength

The design calculations for long term bearing strength (provided in Design change #010 Attachment 5) indicate that the average sediments and overlying cap will be stable with a maximum differential cap thickness of approximately 0.67 feet over a short distance (calculations indicate a safety factor of three). The cap design involves a change in cap thickness of 1.5 feet (1.5 feet thick on the edges to 3.0 feet thick in the center) but this change in cap thickness will be gradual over a substantial distance. The sediment strength in the Turning Basin is similar to that found in the Canal. Therefore, the cap in the Turning Basin will be stable in the long term against differential loading.

Stability During Construction

A minimum acceptable safety factor of 1.1 (using a geotextile and geogrid and placement with a bobcat as in Design Change #10) was used for active construction stability analysis. The bearing strength analyses described above used conservative assumptions and indicates that the cap may be applied in lift thickness up to 1.8 feet without causing sediment failure due to differential loading.

Stability During Ice Melting and Re-inundation

The lowest portions of the sand cap are in the central area of the Turning Basin (and Canal) and therefore the weight of the sand there will be at the toe of the peripheral slopes. This will prevent sand from sliding along the melting ice to the deeper areas (which might otherwise result in exposure of sediments or thinning of the cap near the edges). Previous analyses (in Design Change 010) have shown that the cap is stable at a 1:6 slope (the maximum design slope) during an earthquake, so failure within the cap will also not occur.

The ice in the Turning Basin may not have a uniform thickness and partial melting of ice could potentially result in soft sediment bearing failure and non uniform settlement of the cap. However, the presence of the geotextile (and the geogrid, if used) will provide support to local areas where ice has melted and will retard or prevent significant differential settlement. Further, the geotextile, and geogrid if used, will be fully embedded under the sand cap beyond the potentially weak areas, and will therefore provide its maximum tensile support. In the event that a 1.5 foot minimum thickness cap is not maintained following re-inundation and melting of ice below the cap, the contingency plan is to cap "problem" areas during the early summer of 2002 using subaqueous methods (as described in the Conceptual Design Report dated March 1,2001).

Consolidation (Settlement)

The maximum expected total consolidation, including an estimated secondary consolidation of approximately 20%, is approximately 2.3 feet for the five-foot thick layer of sediment in the center of the Turning Basin and a three-foot thick overlying cap.

Earthquake Stability
The design calculations for earthquake stability (provided in Design Change 010 Attachment 5) indicate that the average sediments and overlying cap will be stable with a cap slope of 1:6 (with a safety factor greater than 1.1) during a 100 year re-occurrence earthquake.

9. Contaminant Transport in the Cap

An evaluation of the short term and long term transport of contaminants into the cap from the underlying sediment in the Canal was performed by Dr. Danny Reible, Louisiana State University. The results indicate that the concentrations resulting from consolidation-induced advection and chemical diffusion will be several orders of magnitude below the cap performance criteria ER-Ms despite potentially high underlying sediment and NAPL concentrations and significant consolidation of the sediments (please refer to *Phase IB, Design Change 010, Section 6* for details).

APPROVAL SIGNATURES:

Environmental Protection Agency____________________________ Date:______________

Vermont Department of Conservation_________________________ Date:______________

Engineer [illegible signature]____________________ Date: 1/22/03

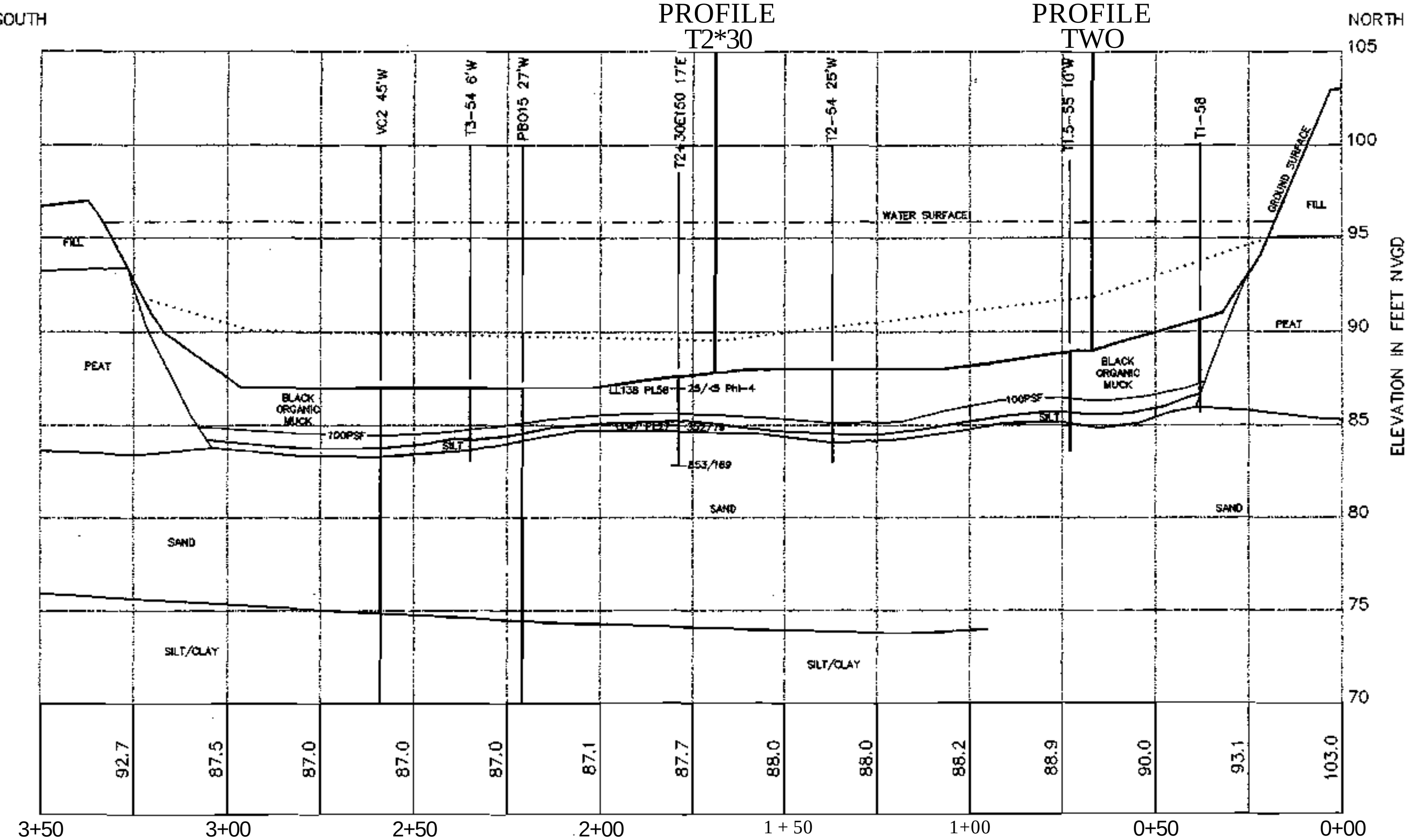
Project Manager____ Date:______________

Reviewed By: CMC/J-B
J:\PROJECTS\l-0870-l\Phase 2\Design change 011 Turning Basin 1-21-O3.wpd January 14, 2003

Attachment 1

Plan of Turning Basin, Design Change Oil and Cross Sections

REVISED 12/11/02 TJK



PROFILE TURNING BASIN

SCALE: 1°=30'H0R.. 1"=6'VER.; V.E. = 5:1

KEY

T2+30E50 CORE I.D.

UquM Limits (X) LL136-j-Phi-4 Soil Friction Angle (>
Plaetfc Limits (X) PL58-I-352/79 Field Vane Sneor Tost
Results (pst)
• Cohesion assumed zero Dbturbe<l
unless given (C250) In psf Moximum

LEGEND

- • • • • • • • • - PRESETTLEMENT CAP ELEVATION
- ——100PSF—— 100 PSF PENETRATION
- GEOLOGIC CONTACT

Additional Sources: 3/92 S.R.I., 8/96 A.R.I., 5/98 A.F.S., A.R.I. Fieldbooks (Documents #337 & #408)

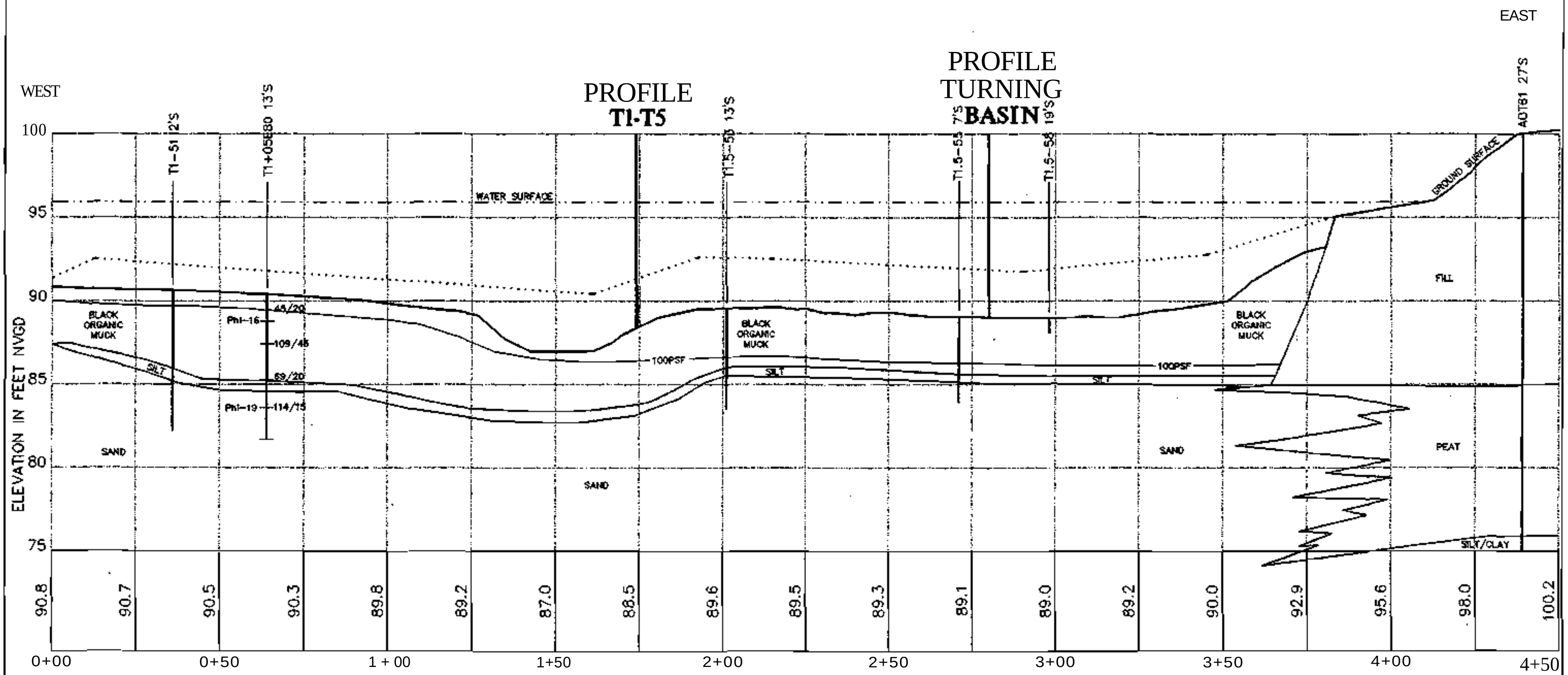
CE0517.OVQ

NORTH • SOUTH OEOLOOIC PROFILE
TURNING BASIN: EASTERN PORTION
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC
Environmental Sciences and *Engineering*
100 STATE STREET MONTPEUER, VT 05602

DATE: 2/26/01 DRAVW BY: TJK PROJECT: 1-0870-1 SCALE; SH0V1N

REVISED 12/11/02 TJK



PROFILE T1+30

SCALE: 1"=30'H0R., 1"=6'VER.; V.E. = 5:1

1
1

KEY

T2+30E50 CORE I.D.

Liquid Limits (%) LL1M-J-PM-4 SoJ Friction Angle (>

Pkwtlo Limits (%) PL68-L352/79 Field Vane Shear Test Results '(psf)

.* Cohesion assumed zero unleos given (C250) in psff Disturbed Maximum

LEGEND

PRESETTLEMENT CAP ELEVATION

100PSF 100 PSF PENETRATION

GEOLOGIC CONTACT

Additional Sources: 3/92 S.R.I., 8/96 A.R.I., 5/98 A.F.S., A.R.I. Fieldbooks (Documents #337 & #408)

EAST - WEST GEOLOGIC PROFILE
TURNING BASIN: TM0
PINE STREET CANAL SITE
BURLINGTON, VERMONT

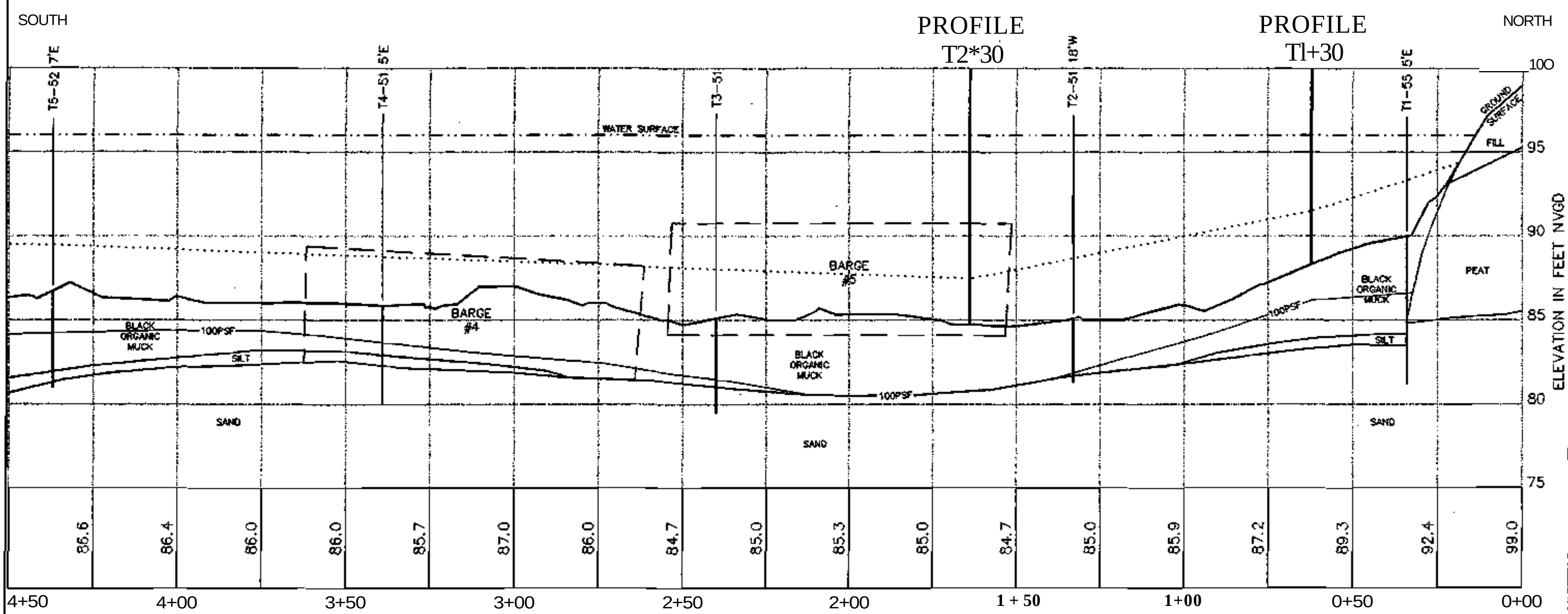
THE JOHNSON COMPANY, INC

JnviTsn-menfal Sciences and *Engineering*

100 STATC STOFFT MONTPELIER VT 05602

CE0S17.dwg | DATE: 2/26/01 DRAWN BY: TJK PROJECT: 1-0870-1 SCALE: SHOWN

REVISED 12/11/02 TJK



PROFILE T1 - T5 1/1

SCALE: 1"=3O"HOR., 1"=6'VER.; V.E. = 5:1

KEY CORE I.D.

Liquid UmitS (X) U-138-|-Phl-4 Soil Friction Angle (>
Plastic UmTts (X) PL5S-1-352/79 Held Vane Shear Test
• Cohesion assumed zero unless given (C250) in psf
Results (psf)
Disturbed
Maximuin

LEGEND
. . . . PRESETUEMENT CAP ELEVATION
—100PSF— 100 PSF PENETRATION
GEOLOGIC CONTACT

Additional Sources: 3/92 S.R.I., 8/96 A.R.I., 5/98 A.F.S., A.R.I. Fieldbooks (Documents #337 & #408)

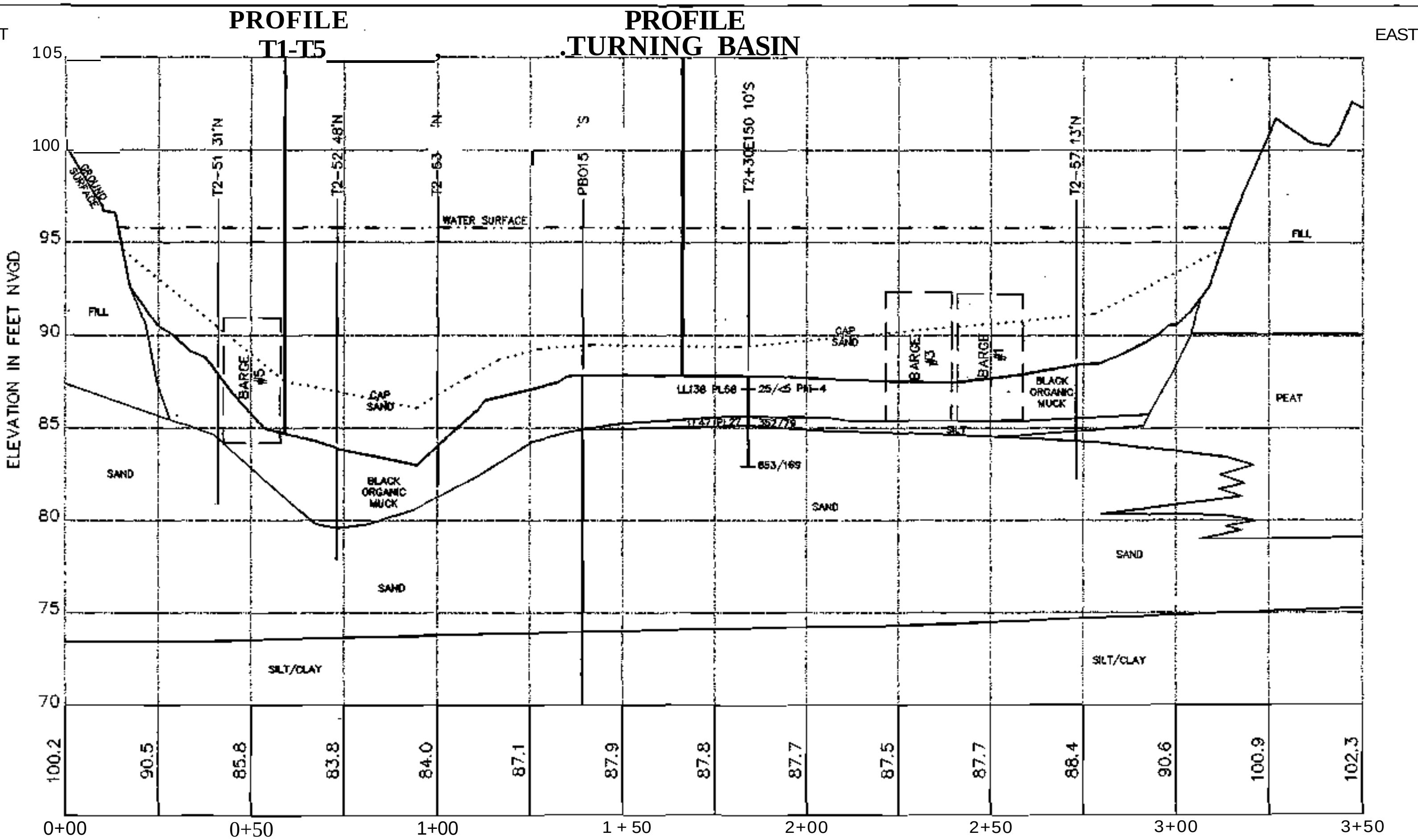
GEOS17.dwg

NORTH - SOUTH GEOLOGIC PROFILE
TURNING BASIN: WESTERN PORTION
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC
Snvimnmental Sciences and Enffimaring
100 STATE STREET MONTPEUER, VT 05602

DATE: 2/26/01 DRAWN DY:TJK PROJECT: 1-0670-1 SCALEiSHOW

REVISED 12/11/02 TJK



PROFILE T2+30

SCALE-. 1"=30'HOR., 1"=6'VER.; V.E. = 5:1

1/1

KEY

T2+30E50 CORE I.D.

UquM Umlts (K) UIM+Phi-4 Sox Friction Angle (>
Plostle Limits (JO PL58 4-352/79 Hold Vane Shear Test
i i Results (oaf)
? J_ Disturbed
Maximum
Cohesion amumed zero unless given (C250) in psf

LEGEND
PRESETTLEMENT CAP ELEVATION
100PSF 100 PSF PENETRATION
GEOLOGIC CONTACT

Additional Sources: 3/92 S.R.I., 8/96 A.R.I., 5/98 A.F.S., A.R.I. Fleldbooks (Documents #337 & #408)

EAST - WEST OEOLOOIC PROFILE
TURNING BASIN: T2.30
PINE STREET CANAL SITE
BURLINGTON, VERMONT

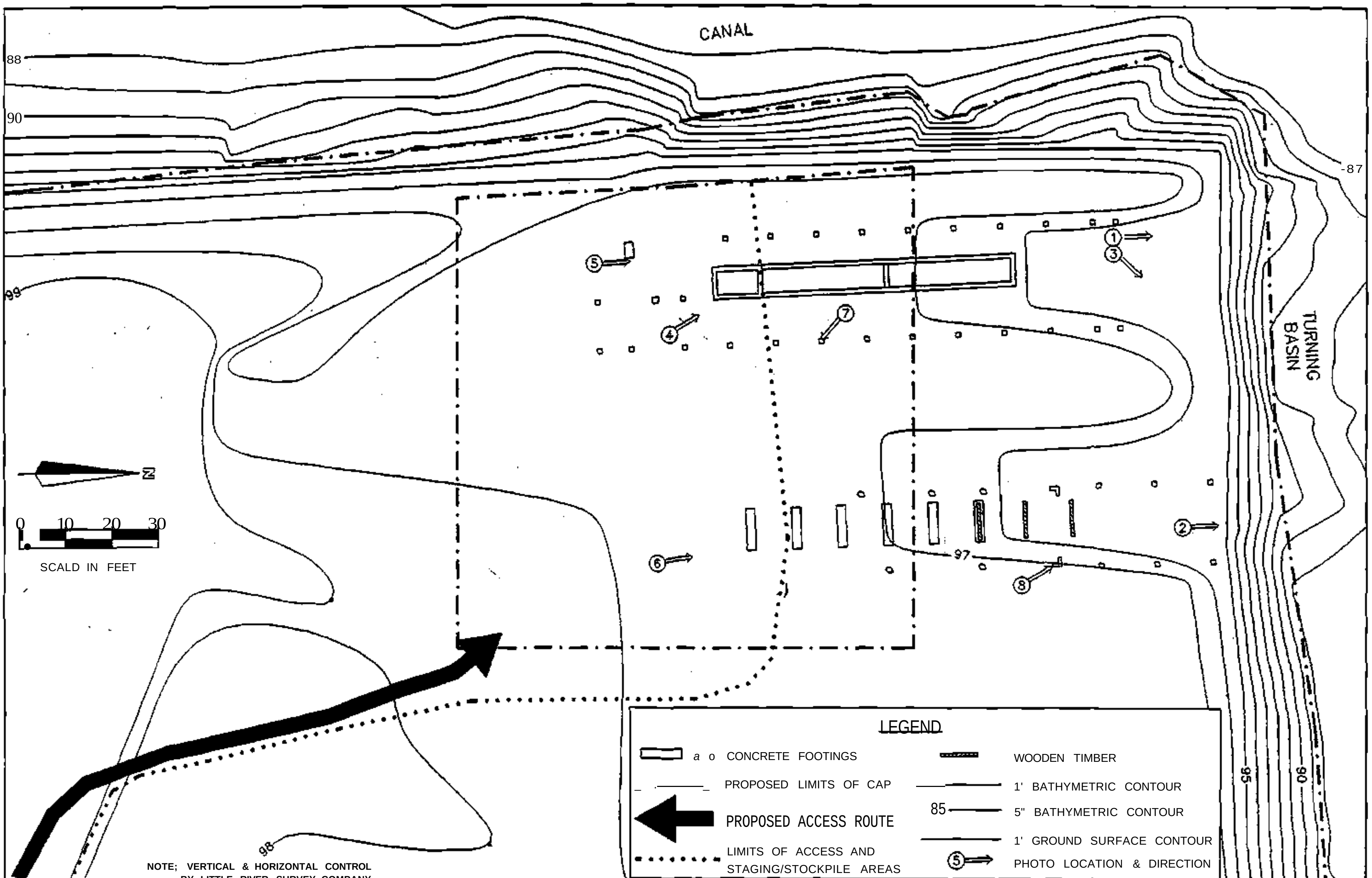
THE JOHNSON COMPANY, INC.
Environmental Soientxa **and** *JSftgine&ring*
100 STATE STREET MONTPELIER, VT 05602

GEOS17.dwg

DATE: 2/26/01 DRAWN BY: TJK PROJECT: 1-OB7Q-1 SCALE: SHOWN

Attachment 2

Figure 2: Historic Relics South of Turning Basin



NOTE; VERTICAL & HORIZONTAL CONTROL
BY LITTLE RIVER SURVEY, COMPANY
OF STOWE, VERMONT - AUTUMN, 1992
ADDITIONAL SURVEY DATA - AUTUMN, 1994.
ADDITIONAL SURVEY DATA - NOVEMBER, 2000.
VERTICAL DATUM - NAVD 1988
HORIZONTAL DATUM » NAD 198J

BATHYMETRY BY U.S. GEOLOGICAL SURVEY - MAY, 1994.
100X100.dwg

FIGURE 2 : HISTORIC RESOURCES IDENTIFIED SOUTH OF TURNING BASIN PINE STREET CANAL SITE, BURLINGTON, VT

THE JOHNSON COMPANY, INC.
Environmental Sciences and. Engineering
100 STATE STREET MONTPEUER, VT Q5602

DATE: 12/24-/02
DRAWN BY: TJK
PROJECT: 1-0870-1
SCALE: 1"=30'


-LAKE CHAMPLAIN-
STATE GRID
GRAPHIC SCALE
(IN FEET)
1 inch = 30 ft.
DISCHARGE
OUTLET WEIR
BENCHMARK RV124
EL=103.64
RIVET ON CONC. WALL
EXIST. VERMONT BRIDGE
ACCESS FROM SOUTH CHAMPLAIN STREET (VIA THE VERMONT RAILWAY PROPERTY)
POSSIBLE STOCKPILE AREA
BYPASS PUMP
INTAKE
T1+30 (TURNING BASIN PROFILE)
T2+30 (TURNING BASIN PROFILE)
WESTERN PORTION (TURNING BASIN PROFILE)
EASTERN PORTION (TURNING BASIN PROFILE)
ACCESS FROM SOUTH CHAMPLAIN STREET (VIA THE HAVEY PROPERTY)
POSSIBLE STOCKPILE AREA
POSSIBLE CRANE / CONVEYOR LOCATION (TYPICAL OF 3)
APPROXIMATE ACCESS RAMP LOCATION FOR BOBCATS
POSSIBLE STOCKPILE AREA
TURNING BASIN
CANAL
100'x100' CAP AREA
BARGE #1
BARGE #2
BARGE #3
BARGE #4
BARGE #5
T1
T2
T3
T4
T5
T6
T7
T8
ACCESS FROM PINE STREET (EXISTING GATE NEAR THE FORMER DRUM STORAGE AREA)
ACCESS FROM PINE STREET (THROUGH THE EXISTING PARKING AREA FOR A COMMERCIAL / INDUSTRIAL COMPLEX)
LEGEND
RAILROAD TRACKS
FENCELINE
GRAVEL DRIVE
1' BATHYMETRIC CONTOUR
5' BATHYMETRIC CONTOUR
1' GROUND SURFACE CONTOUR
5' GROUND SURFACE CONTOUR
CULVERT
2000 VANE SHEAR TEST LOCATION
1994-1995 ARI CORING LOCATION
MONITORING WELL / SOIL BORING LOCATIONS
RAILROAD SWITCH
UTILITY POLE
PROPOSED LIMITS OF CAP
PROPOSED ACCESS ROUTE
LIMITS OF ACCESS AND STAGING/STOCKPILE AREAS
SILT FENCE
TEMPORARY WETLAND IMPACT
VERMONT CONSERVATION MIX
WETLAND GRASS SEED MIX
NOTE: VERTICAL & HORIZONTAL CONTROL BY LITTLE RIVER SURVEY COMPANY OF STOWE, VERMONT - AUTUMN, 1992
ADDITIONAL SURVEY DATA - AUTUMN, 1994.
ADDITIONAL SURVEY DATA - NOVEMBER, 2000.
VERTICAL DATUM = NAVD 1988
HORIZONTAL DATUM = NAD 1983
BATHYMETRY BY U.S. GEOLOGICAL SURVEY - MAY, 1994.
Rev. No.
Date
Description
Made by
Chk'd by
App'd by
PLAN OF THE TURNING BASIN
DESIGN CHANGE 011
PINE STREET CANAL SITE
BURLINGTON, VERMONT
THE JOHNSON COMPANY, INC
Environmental Sciences and Engineering
100 STATE STREET
MONTPELIER, VERMONT 05602
Sheet 1 of 1
Scale: 1"=30'
Drawn by: TJK
Chk'd by: DMM
Date: 1/13/03
Job: 1-0870-1
DC011.dwg

Wetland Restoration Plan Addendum

SL.

de maximis, inc.

135 Beaver Street
Fourth Floor
Waltham, MA 02452
(781)642-8775
^ (78'1} 642.io78

T i/c onn-3

January 16, 2003

Ms. Karen Lumino
Unites States Environmental Protection Agency
Mail Code: HBT
1 Congress Street
Boston, MA 02116

RE: Wetlands Restoration Plan Addendum
Pine Street Canal Superfund Site

Dear Ms. Lumino:

Attached is the Wetlands Restoration Plan Addendum. This Addendum reflects discussions during a site vist held on December 18, 2002 between *de* ***maximis, inc.,*** The Johnson Co., EPA andM&E.

We request approval of this Addendum. Please do not hesitate to call me at (781)642-8775 should you have any questions.

Sincerely,
de maximis, inc.

Carl LaCom for.

Thor Helgason
Project Coordinator

cc: Mike Smith - VTDEC
Martha Zirbel -M & E
Deb Roberts - M & E
Chris Crandell - The Johnson Co.
Roy Wagner - ***de maximis, inc.***
Performing Defendants

Reviewed By:
J:\PROJECTS\l-0870-l\Wetland restoration plan addendum cover letter.wpd January 16, 2003

WETLAND RESTORATION PLAN ADDENDUM

This document is an addendum to Appendix J of the Design Report: Wetland Restoration Plan. The purpose of this document is to present additional details for wetland protection and restoration during construction of the cap in the Canal, and at the 100 x 100 foot area. The information presented in this document reflects the results of a site walk-over on December 18th, 2002, with personnel from EPA, *de maximis,* and The Johnson Company, Inc., when the proposed access routes were walked, and construction impact controls and wetland restoration methods were discussed. As a result of that site meeting, specific access routes and stockpile areas (limits of construction) were flagged, including particularly sensitive areas, and the flagged locations were subsequently located in the field using The Johnson Company's GPS equipment and the location information transferred to the attached CADD drawing (Figure 1).

This addendum is meant to supplement the overall wetland restoration requirements included in the original Restoration Plan. Therefore, all requirements described in the Restoration Plan still apply except, and unless specifically modified herein.

Construction and restoration of access roads

Construction access to the Canal from Pine Street is limited to two routes, both originating at the existing gravel road that starts at the existing gate at Pine Street. To minimize disturbance to the site, clearing along these routes will be limited to the minimum required to provide access. The limits of construction activities are shown on Figure 1 and have been flagged in the field. In areas where access roads must be constructed through wetland, geotextile will be placed on the soil surface before any fill is placed to facilitate removal of the temporary fill after construction is complete. The areas where fill may be required are labeled as areas of "temporary wetland impact" on the attached Figure 1. Hay bales or silt fence will be placed along the edges of the temporary road where fill is placed (see construction specification Section 02805 Erosion Control).

When access along these roads is no longer necessary, the temporary fill and geotextile will be removed, compacted soils tilled, and the areas seeded and mulched (see Phase IB construction specifications Section 02989: Miscellaneous Work and Clean-up; Section 02821: Establishment of Growth; and Section 02831: Broadcast Seeding). In areas where the access road is below ordinary high water (approximately 100 foot elevation), it will be reseeded with wetland grass seed mix. Other impacted wetland and upland areas will be reseeded with Vermont Conservation Mix. Permanent access to the canal will be maintained at the southern access road just south of the Maltex Pond area shown on the attached figure to provide canal access for post construction and long-term monitoring (no wetland impact areas are present along that access route). Temporary construction impacts to the north and south of that access route will be restored.

Restoration of stock pile areas and other areas impacted by construction activities

All areas impacted by construction activities will be restored as described in Phase IB construction specification Section 02989: Miscellaneous Work and Clean-up. Due to the winter conditions at the time, it was not possible during the site visit on December 18th to determine if the proposed stockpile areas south of Maltex Pond would involve wetland impacts. Rather than attempt to conduct another wetland delineation during winter conditions to determine if the stockpile areas would result in temporary wetland impacts, EPA and the PDs concurred that removal of excess sand and restoration of these areas to the original grade, and tilling and re-seeding, would be satisfactory restoration.

Note that the area that was originally delineated for the stockpile area during the site visit on December 18th (north of the access road) was subsequently determined to be too small for the stockpile, so the stockpile was actually placed on the south side of the road instead. Also, use of the original location may have cut off the proposed access road to the 100 x 100 foot area and also would have resulted in taking down a large tree that was identified in the field (on December 18th) as being desirable to save.

Silt fence has been installed around all but the north side (the active face) of the current stockpile to contain the material. The active face of the stockpile is along the access road, so it has not been enclosed with silt fence. There is the potential that the area north of the road will be used as a 2nd stockpile area. If that area is used, silt fence will be similarly installed around the northern perimeter of that area. When construction is completed, any residual sand will be removed and the area will be tilled and seeded. The temporary construction impact areas along the side of the Canal will be planted with wetland grass seed mix. Other areas of construction disturbance will be planted with Vermont Conservation Mix.

Planting Plan for 100 x 100-foot Area

The 100 x 100 foot capped area will be covered with 6 inches of topsoil and planted with wetland grass seed mix. Wetland grass seed mix will be used in this area because its expected final surface elevation will be between the ordinary high water mark (approximate elevation 100 feet) and the low water elevation of 96 feet (as controlled by the outlet weir). The planting will be performed according to construction specifications Section 02821: Establishment of Growth; and Section 02831: Broadcast Seeding. The plan to place chipped branches and logs from the Canal under the 100 ft. by 100 ft. cap has been abandoned. The area will be cleared and the sand cap will be placed directly on the ground surface. The sand cap will be placed over and around the historic resources within the area to be capped in a manner that prevents their disturbance (described in more detail in Design Change #011). Temporary wetland impacts associated with the construction of the access road south of the 100 ft. by 100 ft. capped area may occur. Every effort will be made to preserve the large silver maple trees in the area between the capped area and the access road that follows the northern margin of Maltex Pond.

Reviewed by: j-b
Filename: J:\projects\l-0870-l\Phase lBNDesign ChangeYWetland Restoration PlanAddendum.doc

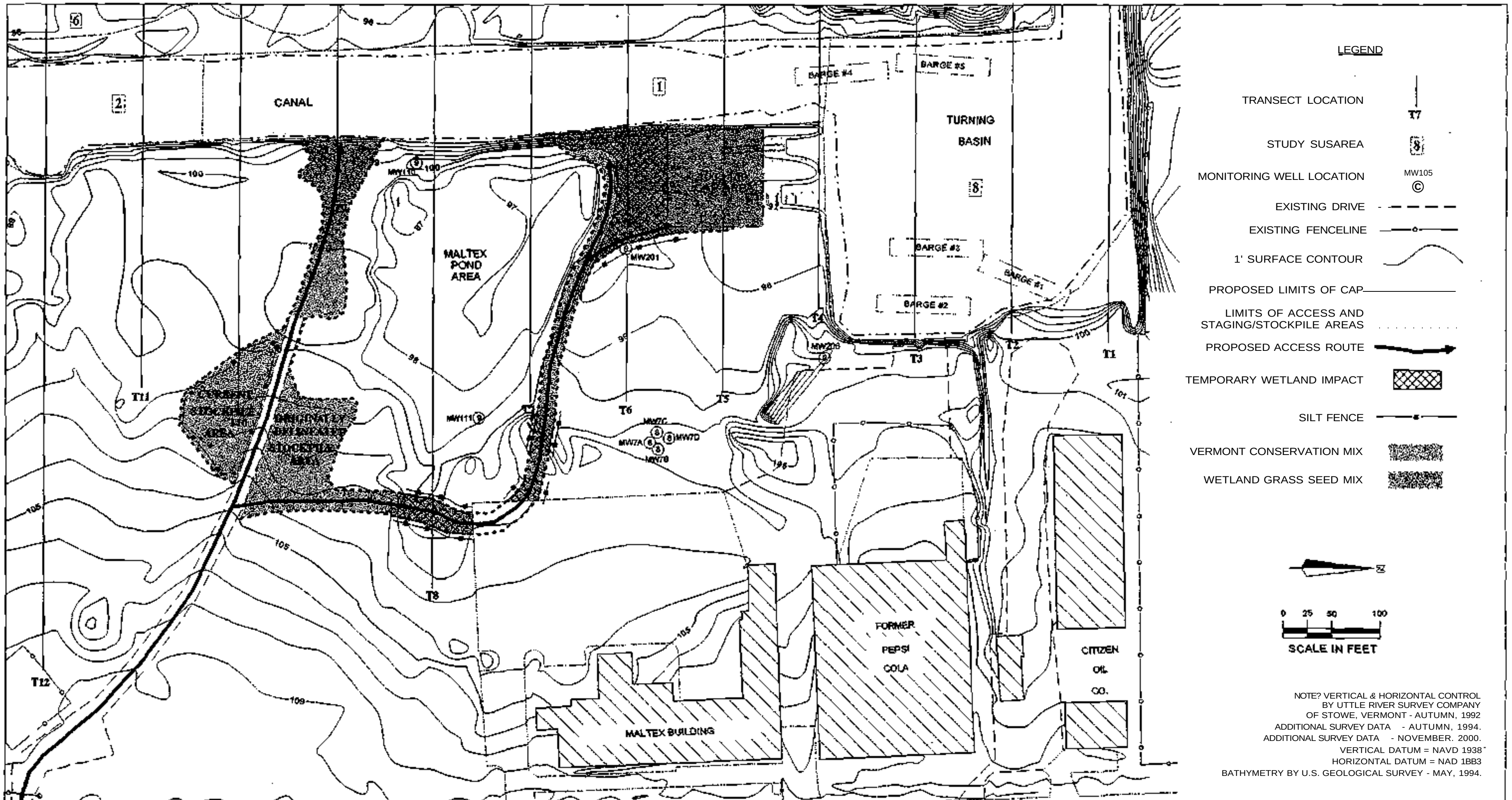


FIGURE 1: RESTORATION PLAN AND ACCESS/STAGING DETAILS FOR DESIGN CHANGES 010 & Oil
PINE STREET CANAL SITE, BURLINGTON, VT

THE JOHNSON COMPANT, INC
Environmental Sciences and Engineering
10Q STATE STREET MONTPEUER. VT 0S602

DATE 1/13/03 DRAWN BY: TJK PROJECT: 1-0670-1 SCALE: 1"=100'

Design Change Request No. 13

de maximis, inc.
135 Beaver Street
Fourth Floor
Waltham, MA 02452
(781) 642-8775
Fax (781) 642-1078

January 16, 2003

Ms. Karen Lumino
Unites States Environmental Protection Agency
Mail Code: HBT
1 Congress Street
Boston, MA 02116

Re: Design Change Request No. 13 - Cribbing Sediment
Pine Street Canal Superfund Site

Dear Ms. Lumino:

Attached is Design Change Request No. 13, addressing the sediment within the cribbing structure. That condition was first noted last week, and in the interim, much discussion has taken place between the Performing Defendants, The Johnson Company, and EPA, both via conference calls and through meetings at the jobsite, regarding plans to address those sediments. The approach presented in this Design Change Request reflects that discussion.

We request approval to implement the measures described herein. Please do not hesitate to call me at (781)642-8775 should you have any questions.

Sincerely,
de maximis, inc.

Carol LaCount for:

Thor Helgason
Project Coordinator

cc: Jean Choi - USEPA
Mike Smith - VTDEC
Hasan Abedi - M & E
Chris Crandell - The Johnson Co.
Roy Wagner - *de maximis, inc.*
Performing Defendants

Reviewed By:
J:\PROJECTS\l-0870-I\Design Change No. 13 cover letter.wpd January 15, 2003

01 PAPER

PINE STREET BARGE CANAL REMEDIAL ACTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: 13
Minor_____X______
Date of Request: January 16,2003

RECOMMENDED BY:
Engineer X

CHANGE DESCRIPTION:

The east and west horizontal limit of the cap in the southern portion of the Canal is a cribbing wall constructed of vertical timber piles. The piles are 10 to 12 inches in diameter and are placed such that there is about 4 to 6 inches between them. There are irregularly spaced vertical planks behind the piles. As part of capping the Canal (see Design Change #010), geotextile has been placed on the sediment surfaee-andrup the vertical^ plane along^me piles prior to cap "5aiidTrtaceaBMr""Tlac«nenl^Fcap"sand'anar" subsequent consolidation of the sediment has caused the sediment between the piles along portions of the western cribbing wall to be forced upward so that sediment surface between the piles is at or near the same elevation as the top of the completed sand cap adjacent to it (see attached sketch, sheet 1 of 3, Revision 1). Two design modifications are proposed (described below) to eliminate the potential for contamination of the completed cap from the elevated sediment in the voids between the piles. Two separate design modifications are necessary due to the increasing exposed height of the piles (above the sediment surface) towards the north, which ultimately restricts access to the top of the piles by construction equipment in the Canal (described below), and two different approaches are needed (one where the piles are not very high above the sediment surface, and another where the piles are relatively high above the sediment surface). At approximately Transect 7+50 and northward, the cribbing wall construction changes to horizontally placed squared timbers that do not have the voids associated with the vertical timber piles. Therefore, this Design Change only applies up to approximately Transect 7+50 from the south. Note also that although this problem has only been experienced along the western cribbing wall thus far (due to the lack of freezing of the sediments near the western cribbing wall), it is possible that the same problem will occur on the eastern cribbing wall when the frozen sediments there thaw in the spring. Therefore, this Design Change is intended to also apply to the eastern cribbing wall.

The first design modification applies to those portions of the canal already capped and north to approximately Transect 10. The modification in this area involves the following steps: 1) folding the geotextile back from the piles on top of the sand cap; 2) removing the horizontal beam (or portions thereof) from the top of the piles; 3) placing approximately two inches of granulated bentonite on the sediment surface between the piles; and 4) placing sand between and on top of the piles with bobcats followed by tamping the sand between the piles by hand to assure the voids are filled (see attached sketch, sheet 2 of 3, Revision 1).

The second design modification applies to those portions of the canal (from approximately Transect 10 north to approximately Transect 7+50) where the top of the piles are too high (relative to the settled cap surface) to allow a stable slope from the top of the cribbing to the settled cap surface (see attached sketch dated January 16,2003). This modification involves the following: 1) folding the geotextile back from the piles on the top of the sand cap; 2) placing (to the extent possible) approximately two inches of granulated bentonite on the sediment surface between the piles; 3) placing a 60 mil LLDPE liner vertically against the piles and into the sediment approximately 1 foot (where possible), minimizing the number of vertical seams; 4) attaching the liner to each pile using 1.5 inch galvanized nails with 1 inch diameter plastic washers on approximate 2 foot centers with the lowest nail approximately 6 inches above the sediment surface leaving the top foot of the liner temporarily unattached; 5) where seams are necessary there will be a minimum overlap of three piles and an asphaltic mastic or other adhesive material placed between the liner sheets along the last pile used in the overlap and sufficient nailing to the pile to compress the mastic the full length of the seam; 6) during or prior to placement of cap, approximately 1.5

feet of sand (or to the top of the cribbing) will be placed between the piles, either from the side or above, depending on whether the horizontal beam atop the piles is present; 7) completing the nailing of the top of the liner to the piles.

ATTACHMENTS: (list supporting documentation, if applicable)

Sheets 1 and 2 (revision 1) of 3 dated January 9,2003 and Sheet 1 of 1 dated January 16,2003 (hand drawn sketches showing the proposed changes).

APPROVAL SIGNATURES:

Environmental Protection Agency____________________________Date:______________

Vermont Department of Conservation________________________Date:______________

Engineer Jel Blemis for Dan Maynard Date: 1/16/03

Project Manager____Date:______________

K:\l-O870-I\Phasc IBMJesign Chang«\draftDC#13rev#l.wpd feet of sand (or to the top of the cribbing) will be plac between the pile*, either firom the side or above, depending on whether the horizontal beam atop the p *it* is present; 7) completing the nailing of the top of the liner to the piles.

ATTACHMENTS: (list supporting documentation, if applicable)

Sheets 1 and 2 (revision 1) of 3 dated January 9,2003 and Sheet 1 of 1 dated January 16,2003 (hand drawn sketches showing the proposed changes)

APPROVAL SIGNATURES:

Environmental Protection Agency Karen M Lumino **Date:** 1/21/2003

Vermont Department of Conservation____________ **Date:**________

Engineer Jed Behrmg for Don Maynard **Date:** 1/16/03

Project Manager____________ **Date:**________

From: <Lumino.Karen@epamail.epa.gov>
To: <thelgas@demaximis.com>
Date: 1/21/03 3:39PM
Subject: DCR #13

thor - i've signed DCR #13 and am about to fax it to your office, michael smith is away this week, but in a voicemail message from him last week, he indicated that he was okay with it as well and had plans to sign it and send it along to you.

karen

CC: <DMM@jcomail.com>, <rwagner@demaximis.com>, <mikes@dec.anr.state.vt.us>

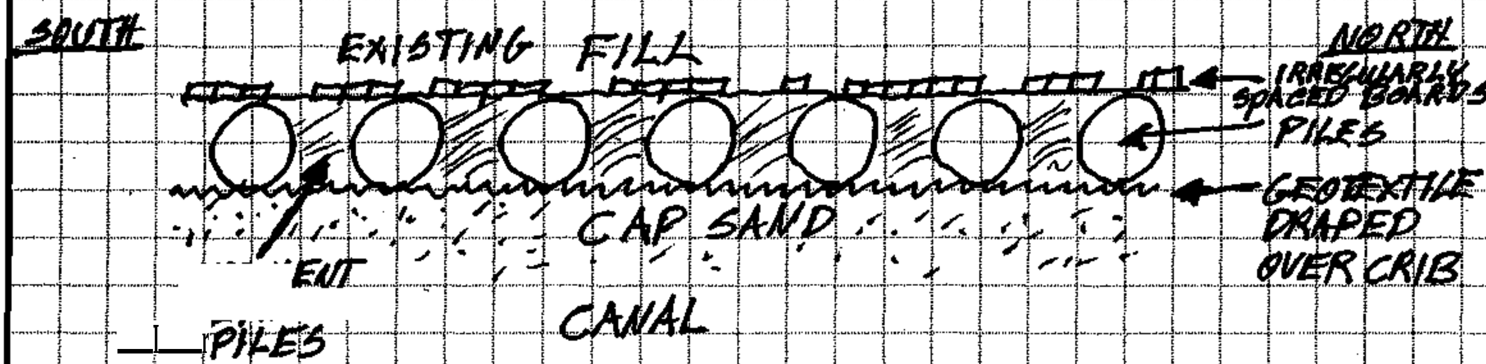
THE JOHNSON CO., INC.
100 State Street, Suite 600
MONTPELIER, VERMONT 05602
(802)229-4600^^/

JOB: PINE STREET CANAL SITE
SHEET NO. 1 OF 3
CALCULATED BY p.MtyA/Ajtf) DATE 1-9-03
CHECKED BY ____ DATE ____
SCALE NOT TO SCALE ~ 1" = 2 Feet

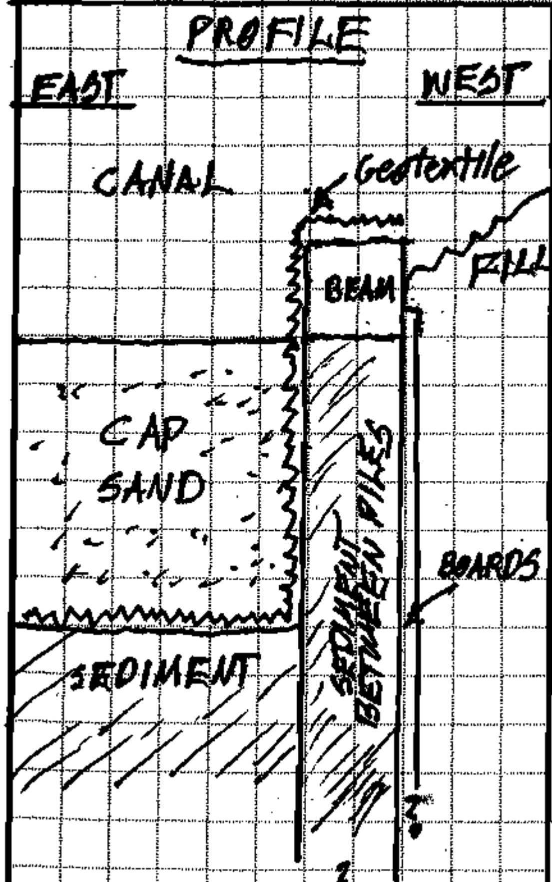
THE PROBLEM:

[illegible] THE CRIBBING IN THE CANAL FROM APPROXIMATELY STATION T7+50 AND SOUTH IS CONSTRUCTED OF DRIVEN PILES APPROXIMATELY 10-12" DIAMETER AND APPROXIMATELY 4-6 INCHES APART. THE PILINGS ARE CAPPED WITH ONE OR TWO BEAMS APPROXIMATEY 10 inches square

MAP VIEW



PROFILE



PLACEMENT OF SAND DID NOT OCCUR BETWEEN THE PILES, THE SEDIMENT WAS FORCED UP DUE TO THE CAP WEIGHT. AT ONE LOCATION NEAR STATION TII+00, west side, The Fabric was FOLDED DOWN AND ADDITIONAL SAND PLACED SIDEWAYS FROM THE EAST AGAINST THE CRIBBING. EVEN USING SHOVELS IT WAS NOT POSSIBLE TO FILL THE VOIDS BETWEEN THE PILES, AND SEDIMENT SQUEEZED UP TO THE LEVEL OF THE SAND CAP.

THE JOHNSON CO., INC.
100 State Street, Suite 600
MONTPELIER, VERMONT 05602
(802) 229-4600

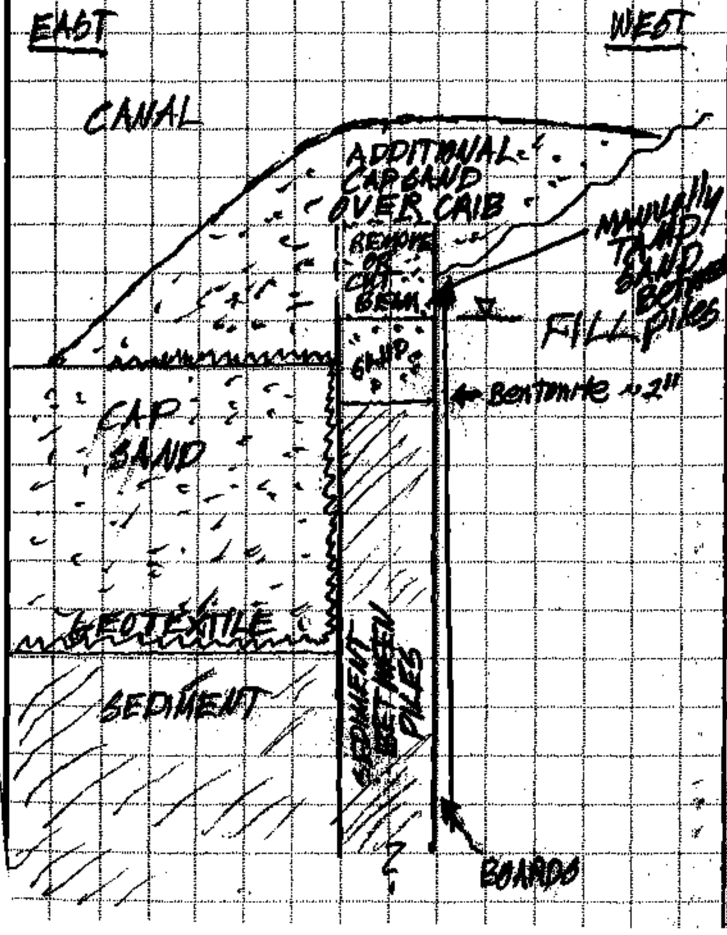
Revision 1

JOB PINE STREET CANAL SITE
SHEET NO. 2 OF 3
CALCULATED BY D. MAj/A/AAD DATE 1-9-03
CHECKED BY ______ DATE ______
SCALE A/ST TO SCALE - Approx 1" = 2 FT

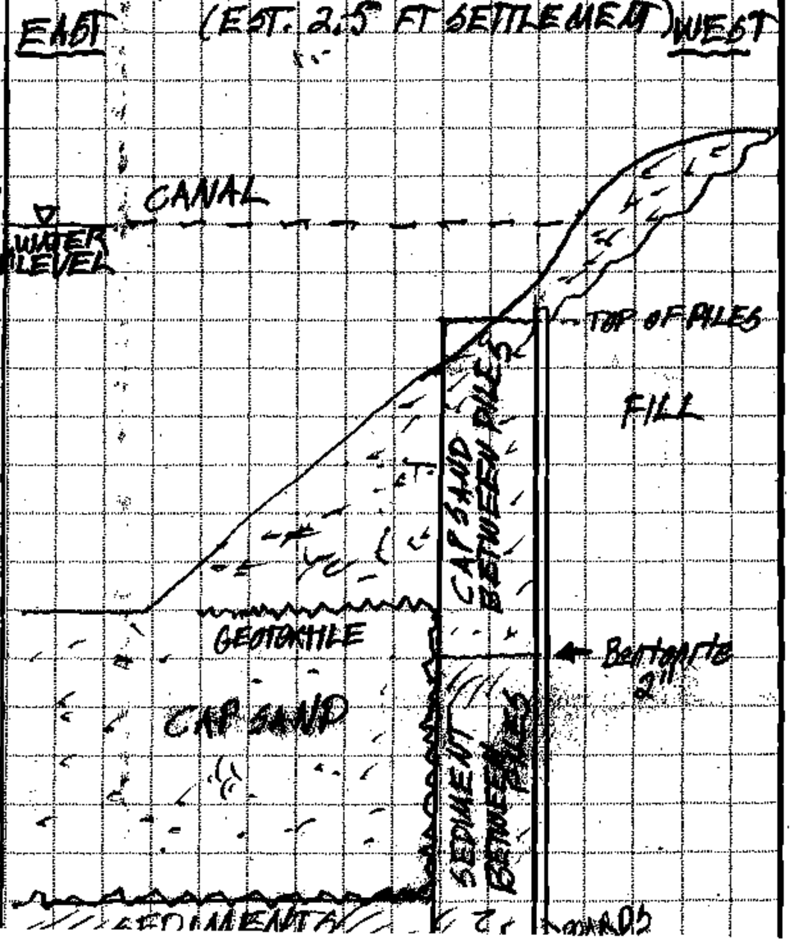
ONE SOLUTION
FOR PREVIOUSLY CAPPED AREAS
AND CAP TO TRANSECT T10+00

1. CUT OR REMOVE BEAMS FROM TOP OF PILES
2. FOLD BACK EXTRA GEOTEXTILE ONTO EXISTING CAP. Place 2 inches Powdered Bentonite ON EXPOSED SEDIMENT
3. DURING OR AFTER PLACEMENT OF SAND CAP, PLACE SAND FROM CANAL WITH BOBCAT ON TOP OF AND BETWEEN PILES. PLACE SUFFICENT SAND ON TOP OF PILES TO COUNTER ACT WEIGHT OF CAP IN CANAL AND PROVIDE 1.5 FEET SAND OVER SEDIMENT. (ESTIMATED MINIMUM 3FT SAND)

PROFILE
DURING CONSTRUCTION



PROFILE AFTER SETTLEMENT
AND RE-INNUNDATION
(EST. 2.5 FT SETTLEMENT)



THE JOHNSON CO., INC.
100 State Street, Suite 600
MONTPELIER. VERMONT 05602
(802) 229-4600

JOB PINE STREET CANAL SITE

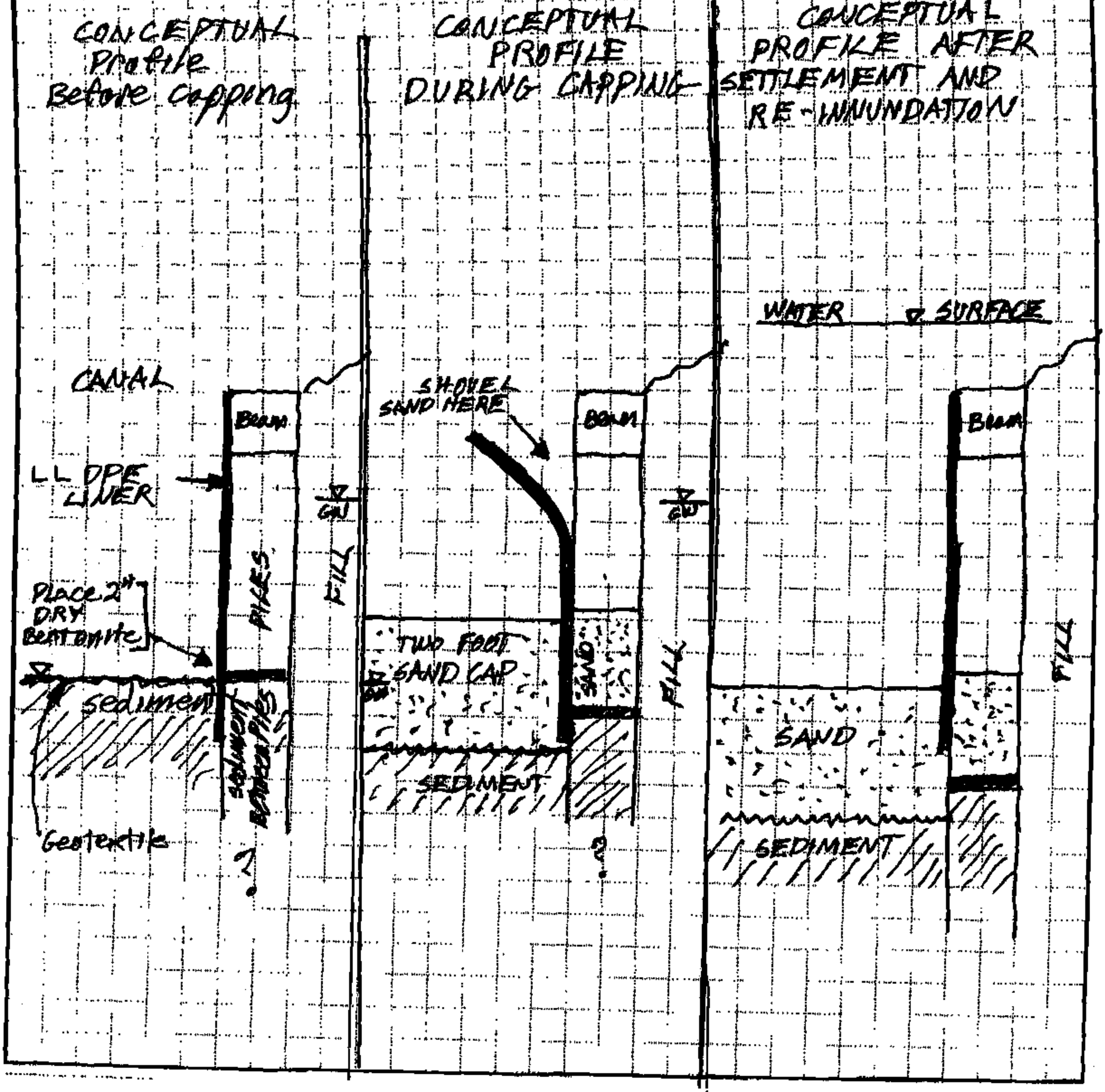
SH6CTNP 1 OF 1

CAUWUTEOBV D. Maynard DATE 1-16-03

CHECKED BY ____ DATE ____

SCALE ~1" = 2'

Canal capping, edge treatment schematic
Transects T7+50 TO Approx. T10+00



From: "Thor Helgason" <thelgas@demaximis.com>
To: <mikes@dec.anr.state.vt.us>, <lumino.karen@epa.gov>, <Choi.Jean@epamail.epa.gov>
Date: 1/30/03 9:31AM
Subject: Pine St. Western Edge

Attached is the plan for addressing the two isolated areas along the western edge oft he Canal where ponded water and NAPL has been observed. The plan incorporates discussion held between EPA, Johnson Co.and de maximis, inc. at the site. The plan also incorporates the input of Dr. Danny Reible, who visited the site recently. I have also faxed a copy.

Please do not hesitate to call me if you have any questions.

CC: "Roy Wagner" <rwagner@demaximis.com>, <Ccrandell@jcomail.com>, <DMM@jcomail.com>, <Jbehrsing@jcomail.com>

Proposed Management of Non-Aqueous Phase Liquid (NAPL)
on Previously Capped Areas along Western Edge

Background: Two low areas of cap along the western edge of the Canal between T10+70 and Tl 1+70 have received groundwater and associated NAPL from seeps through the west cribbing which have locally ponded on top of the previously installed cap (see attached sketch). These areas of ponded water and NAPL have been isolated from the rest of the installed cap with constructed sand berms and sorbent pads have been placed in areas where NAPL was present. The ponded areas have since frozen due to sub-zero temperatures. The proposed final treatment of these areas is as follows:

1) Remove the top beam from the driven piles;

2) Pump the water from under the ice in the ponded areas and discharge the water to a hole in the ice upstream (south) of the silt curtain across the Canal at approximately T-4 (thereby maintaining separation from the pumping area in the Turning Basin).

3) Break up and remove 3 to 5 feet of ice from along the western cribbing and place that ice in the uncapped area of the Canal or Turning Basin.

4) Remove NAPL sediments from within the piles and from the top of the existing sand cap as feasible and drum or place in the uncapped area of the Canal.

5) Consistent with the previously approved remedy along the cribbing, place a minimum of 2 inches of bentonite between the piles, and in addition on the top of the sand cap immediately in front of the piles (approximately 6 inches wide).

6) Place geotextile over the remaining ice from the ponded areas and onto the previously installed sand cap where the ice has been broken away from the cribbing. Use sewn connections between geotextile strips necessary to fully cover the ponded areas to be capped.

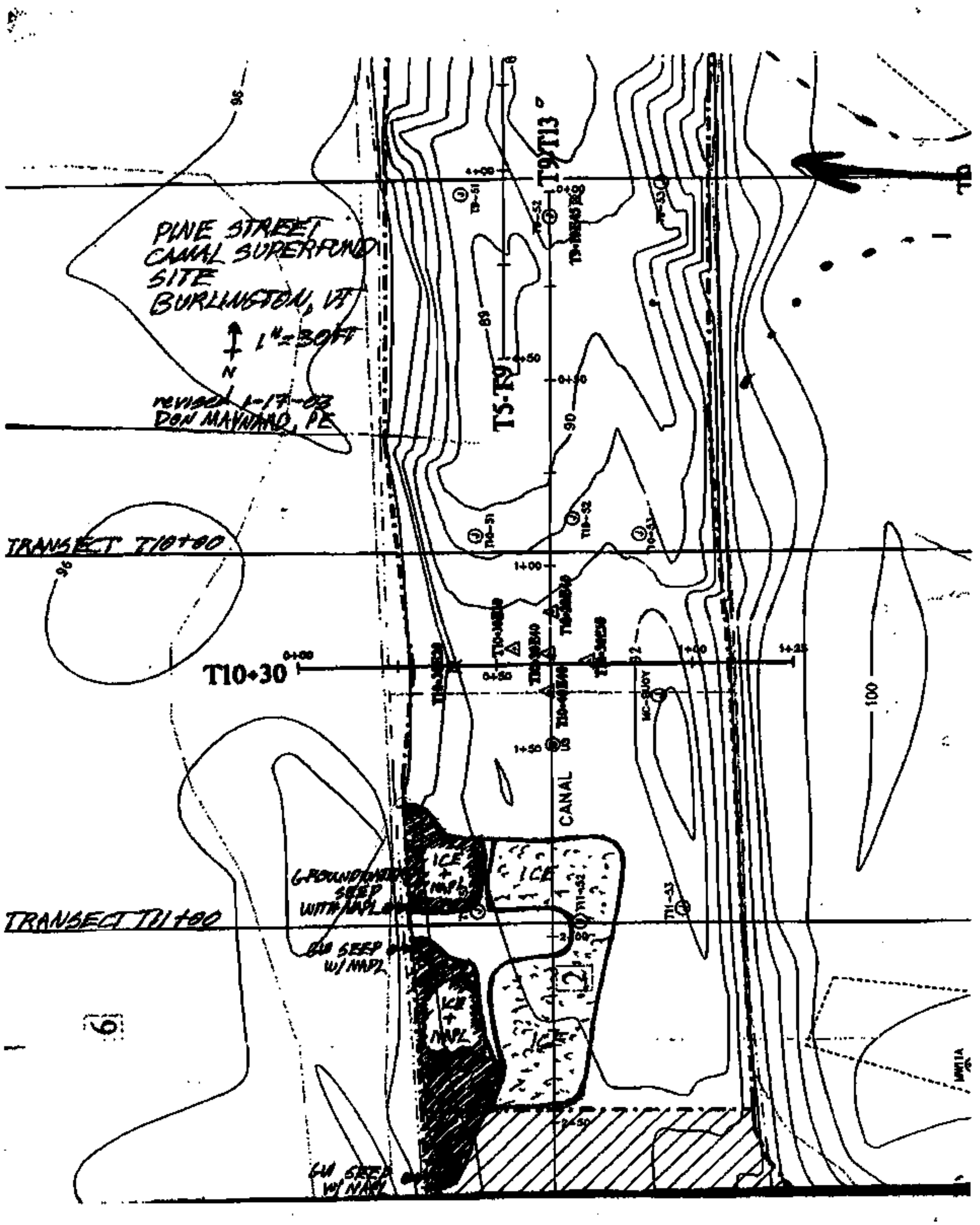
7) Cover the geotextile with a minimum of 1.5 foot thick layer of cap sand on the ice areas and in accordance with the previously approved remedial plan along the cribbing. Hand place sand between and over the piles and tamp into place. Grade the sand out a minimum often feet beyond the edges of the geotextile to meet the existing cap grade. See the attached sketches for the limits of ice/NAPL to be treated as described above and a cross-sectional view of the proposed treatment.

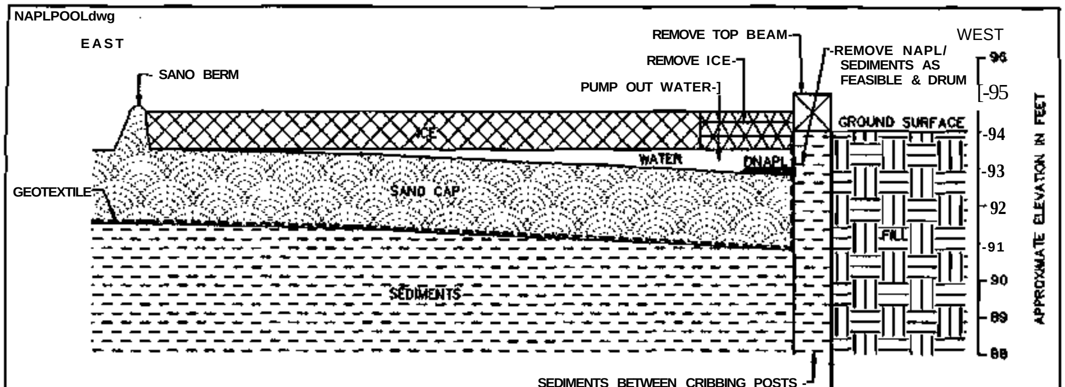
The proposed cap in these areas will achieve the performance standards set forth in the Statement of Work. "Cap materials in Subareas 1,2 and 8 shall be selected and applied so as to iisolate ecological receptors from the contaminated spoils and sediments that will remain in below the cap. Cap thickness, after settling and compaction, shall be sufficient to prevent exposure of benthic organisms that recolonize the cap to underlying contaminants. Increases in the elevation in the bottom of the canal and turning basin shall be minimized to the extent possible. The water column above the subaqueous cap shall be maintained at sufficient depth to minimize the potential for cap erosion."

Dr. Reible revisited the modeling performed pursuant to the conceptual design as part of Design Change #10. In performing the modeling to support design change #10 he used analytical results for PAHs from a laboratory analysis of a NAPL sample collected from the sediment surface at Transect T12 + 50 (opposite the South Slip) on October 10,2002. The resulting concentrations of 13 PAHs at the compliance point (1 foot into the sand cap) were compared to ER-Ms, the performance standards in the SOW, and were found to be significantly below the ER-M levels. The proposed minimum thickness of 1.5 feet will adequately prevent exposure to the contaminants.

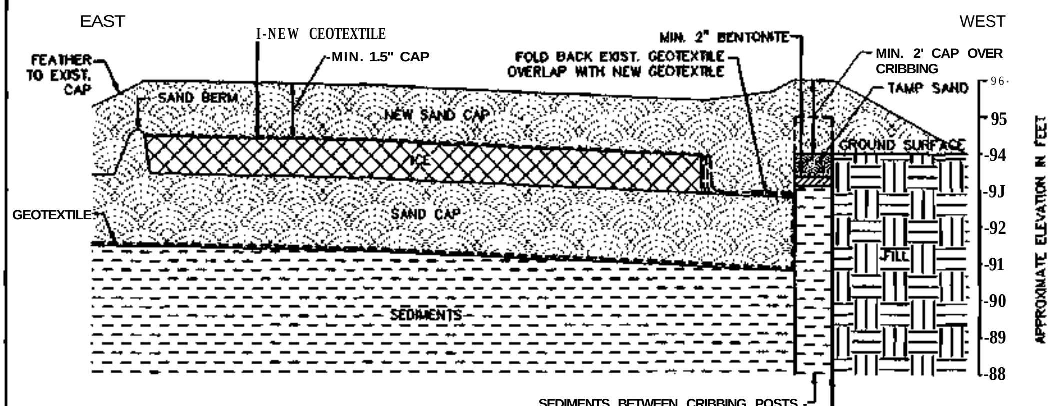
The existing cap surface in the areas of the NAPL and ice is approximately 93.5 feet. The placement of 1.5 feet of additional cap sand will result (prior to consolidation) with the cap surface elevation at 95.0 feet. The analysis performed as part of Design Change #10 (Attachment 5) has indicated that the sand cap is stable from erosion at elevations of 95 feet and below (with a surface water elevation of 96 as to be controlled by the outlet weir).

Reviewed By:
K:\l-O87O-l\Phase 2\ponded area treatment rev012703.wpd January 27,2003 j-b

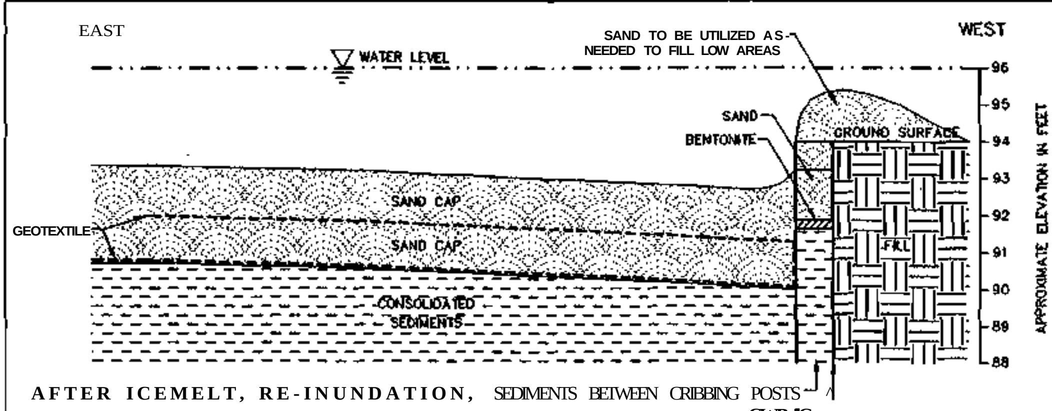

PINE STREET CANAL SUPERFUND SITE BURLINGTON, VT
1" = 30 FT
N
revised 1-17-03
DON MAYNARD, PE
TRANSECT T10+00
TRANSECT T11+00
T10+30
T5-T9
T9/T13
CANAL
GROUNDWATER SEEP WITH NAPL
GW SEEP w/ NAPL
ICE + NAPL
ICE
100
96
9



CURRENT CONDITIONS



DURING REPAIR



AFTER ICEMELT, RE-INUNDATION, & ASSUMED T CONSOLIDATION

REVISED 1/29/03 TJK

NAPL CONTAINING POOL AREAS
PINE STREET CANAL SITE
BURLINGTON, VERMONT

THE JOHNSON COMPANY, INC.
EnviTon-mBnial Sciences ajld Engituiering
100 STATE STREET MONTPELIER. VT 05602

DATE: 1/28/03 PROJECT: 1-0870-1
DRAWN BY: TJK SCALE: 1"-~V

From: <Lumino.Karen@epamail.epa.gov>
To: Thor Helgason <thelgas@demaximis.com>
Date: 1/30/03 1:39PM
Subject: Re: Pine St. Western Edge

thor - it is my understanding from speaking with jean choi early this morning that this plan incorporates his comments, that being the case, it is fine with me.

karen

CC: <Ccrandell@jcomail.com>, <DMM@jcomail.com>, <Jbehrsing@jcomail.com>, <Choi.Jean@epamail.epa.gov>, <mikes@dec.anr.state.vt.us>, Roy Wagner <rwagner@demaximis.com>

West Bank Cap Construction
Design Change Request No. 1

1-0870-1

RECEIVED
JUL - 9 2004
JOHNSON CO. INC
MONTPELIER, VT

PINE STREET BARGE CANAL REMEDIAL ACTION
WEST BANK CAP CONSTRUCTION
DESIGN CHANGE NOTIFICATION/REQUEST EJ6RM

Design Change Number: 001, Rev:
Major_____X_____
Minor___________

Date of Request: June 24? 2004

RECOMMENDED BY: EPA (Jean Choi) and The Johnson Company

DESIGN CHANGE DESCRIPTION:

The experience gathered during the initial construction of the West Bank Cap, including placement of sand up to and over the west cribbing, indicates that it ise feasible and advantageous to extend the sand cap at its maximum elevation of 98.5 Ft NGVD one to two feet east of the eastern edge of the cribbing (versus the current design which shows the cap surface sloping into the Canal from the cribbing edge).

This change would result in a thicker cap over the canal sediment in the critical area adjacent to the cribbing. This area is currently considered the most vulnerable to potential future NAPL releases due the loading of the West Bank Cap. The thicker cap would provide a larger buffer for anticipated settlement and sloughing of the sand over time. Using the consolidation calculations provided in the conceptual Design Report Table CDR 6-1, the primary settlement in the sediments due to this additional loading over the existing Canal cap of approximately two feet of sand is anticipated to be less than 0.3 feet.

This change is proposed for the section of the cap from the former south slip, circa Transect T12+00, to the north end of the West Bank Cap at Transect T9+50. It is limited to this area, because there has been no evidence of releases to the Canal south of T12+00, and because the water depth (2.5 to four feet at normal water level) is sufficient to accommodate the design storm flow without creating velocities sufficient to cause erosion north of T12+00.

It is anticipated that placement of the additional 300 cubic yards of sand will take three days. Since the construction is currently ahead of schedule, this proposed Design Change will not adversely affect the completion of the work on time. If this Design Change is approved in a timely fashion, it can be implemented on Monday June 28.

APPROVAL SIGNATURES:

Environmental Protection Agency Karen M Lumino Date: 6/28/04

Vermont Department of Conservation____________________ Date:__________

Engineer____________________________________ Date:__________

Project Mana[ger]____________________ Date:__________

F:\USER\KLUMINO\PINE\west bank breakthrough\DESIGNChg.of 062404.DOC

1-0870

RECEIVED
JUL - 9 2004
JOHNSON CO. INC.
MONTPELIER, VT

PINE STREET BARGE CANAL REMEDIAL ACTION
WEST BANK CAP CONSTRUCTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: 001, Rev. 0
Major______X______
Minor ____________

Date of Request: June 24, 2004

RECOMMENDED BY: EPA (Jean Choi) and The Johnson Company

DESIGN CHANGE DESCRIPTION:

The experience gathered during the initial construction of the West Bank Cap, including placement of sand up to and over the west cribbing, indicates that it ise feasible and advantageous to extend the sand cap at its maximum elevation of 98.5 Ft NGVD one to two feet east of the eastern edge of the cribbing (versus the current design which shows the cap surface sloping into the Canal from the cribbing edge).

This change would result in a thicker cap over the canal sediment in the critical area adjacent to the cribbing. This area is currently considered the most vulnerable to potential future NAPL releases due the loading of the West Bank Cap. The thicker cap would provide a larger buffer for anticipated settlement and sloughing of the sand over time. Using the consolidation calculations provided in the conceptual Design Report Table CDR 6-1, the primary settlement in the sediments due to this additional loading over the existing Canal cap of approximately two feet of sand is anticipated to be less than 0.3 feet.

This change is proposed for the section of the cap from the former south slip, circa Transect T12+00, to the north end of the West Bank Cap at Transect T9+50. It is limited to this area, because there has been no evidence of releases to the Canal south of T12+00, and because the water depth (2.5 to four feet at normal water level) is sufficient to accommodate the design storm flow without creating velocities sufficient to cause erosion north of T12+00.

It is anticipated that placement of the additional 300 cubic yards of sand will take three days. Since the construction is currently ahead of schedule, this proposed Design Change will not adversely affect the completion of the work on time. If this Design Change is approved in a timely fashion, it can be implemented on Monday June 28.

APPROVAL SIGNATURES:

Environmental Protection Agency____________________________Date:______________

Vermont Department of Conservation__[signature]____________Date: 2-f~ (JC**AS Q y

Engineer____Date:______________

Project Manager____Date:______________

:\I-087O-t\Wejt Bank Cap Remedial A«ion\Deslgn change 001 rev O.doc

PINE STREET BARGE CANAL REMEDIAL ACTION
WEST BANK CAP CONSTRUCTION
DESIGN CHANGE NOTIFICATION/REQUEST FORM

Design Change Number: 001, Rev. 0
Major ____X______
Minor____________
Date of Request: June 24, 2004

RECOMMENDED BY: EPA (Jean Choi) and The Johnson Company

DESIGN CHANGE DESCRIPTION:
The experience gathered during the initial construction of the West Bank Cap, including placement of sand up to and over the west cribbing, indicates that it ise feasible and advantageous to extend the sand cap at its maximum elevation of 98.5 Ft NGVD one to two feet east of the eastern edge of the cribbing (versus the current design which shows the cap surface sloping into the Canal from the cribbing edge).

This change would result in a thicker cap over the canal sediment in the critical area adjacent to the cribbing. This area is currently considered the most vulnerable to potential future NAPL releases due the loading of the West Bank Cap. The thicker cap would provide a larger buffer for anticipated settlement and sloughing of the sand over time. Using the consolidation calculations provided in the conceptual Design Report Table CDR 6-1, the primary settlement in the sediments due to this additional loading over the existing Canal cap of approximately two feet of sand is anticipated to be less than 0.3 feet.

This change is proposed for the section of the capirom the former south slip, circa Transect T12+00, to the north end of the West Bank Cap at Transect T9+50. It is limited to this area, because there has been no evidence of releases to the Canal south of T12+00, and because the water depth (2.5 to four feet at normal water level) is sufficient to accommodate the design storm flow without creating velocities sufficient to cause erosion north of T12+00.

It is anticipated that placement of the additional 300 cubic yards of sand will take three days. Since the construction is currently ahead of schedule, this proposed Design Change will not adversely affect the completion of the work on time. If this Design Change is approved in a timely fashion, it can be implemented on Monday June 28.

APPROVAL SIGNATURES:

Environmental Protection Agency__________________________Date:____________

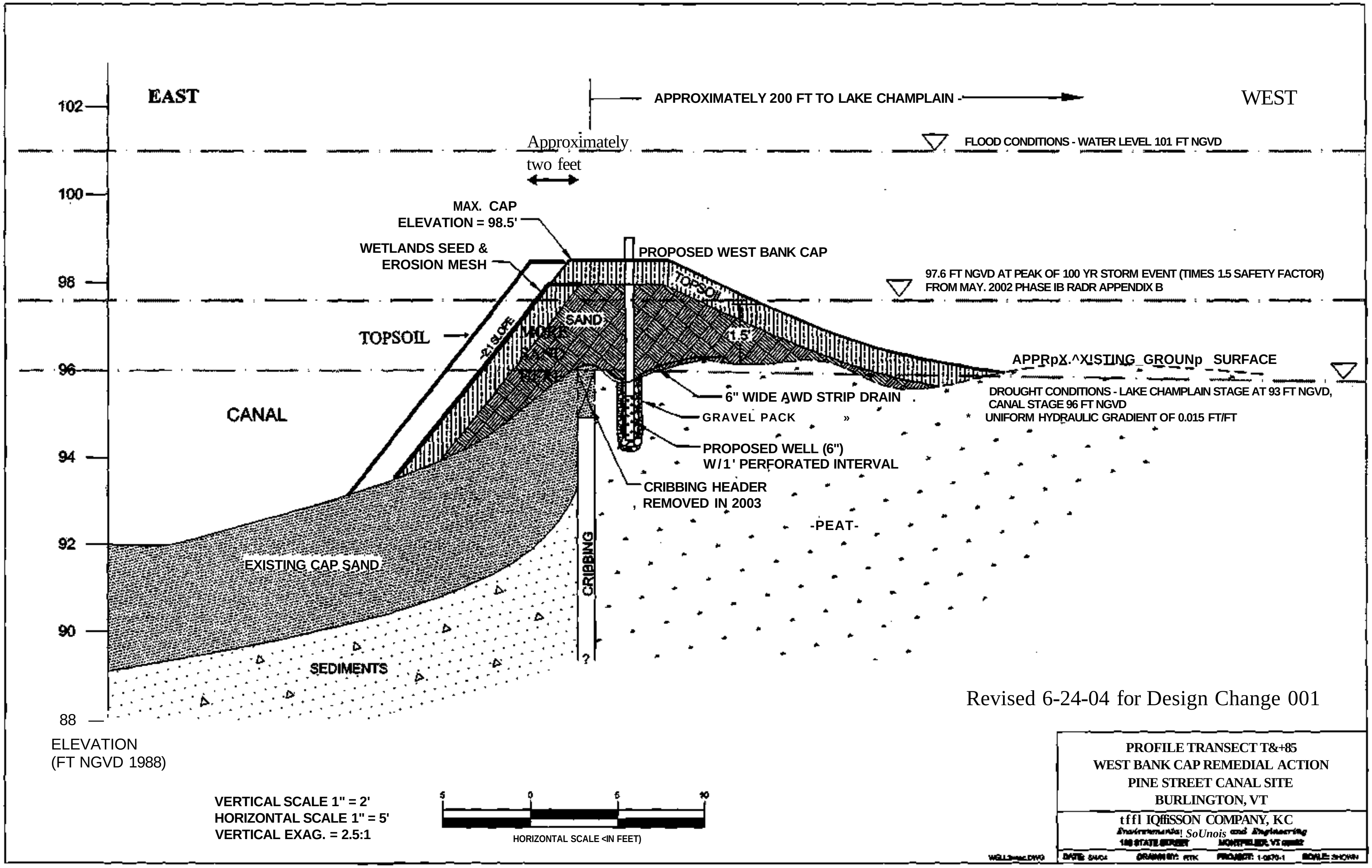
Vermont Department of Con^erjation_______________________Date:____________

Engineer __________________________ Date: 6-24-04

Project Manager__________//___________________________Date:____________

K:\I-0870-I\West Bank Cap Remedial Action\Design change 001 rev O.doc

Attachment 1
Design Change 001 Cross Section


EAST
APPROXIMATELY 200 FT TO LAKE CHAMPLAIN
WEST
102
100
98
96
94
92
90
88
ELEVATION
(FT NGVD 1988)
Approximately
two feet
FLOOD CONDITIONS - WATER LEVEL 101 FT NGVD
MAX. CAP
ELEVATION = 98.5'
WETLANDS SEED &
EROSION MESH
PROPOSED WEST BANK CAP
97.6 FT NGVD AT PEAK OF 100 YR STORM EVENT (TIMES 1.5 SAFETY FACTOR)
FROM MAY. 2002 PHASE IB RADR APPENDIX B
TOPSOIL
SAND
TOPSOIL
1.5'
APPROX. EXISTING GROUND SURFACE
CANAL
6" WIDE AWD STRIP DRAIN
GRAVEL PACK
DROUGHT CONDITIONS - LAKE CHAMPLAIN STAGE AT 93 FT NGVD,
CANAL STAGE 96 FT NGVD
UNIFORM HYDRAULIC GRADIENT OF 0.015 FT/FT
PROPOSED WELL (6")
W/1' PERFORATED INTERVAL
CRIBBING HEADER
REMOVED IN 2003
-PEAT-
CRIBBING
EXISTING CAP SAND
SEDIMENTS
Revised 6-24-04 for Design Change 001
VERTICAL SCALE 1" = 2'
HORIZONTAL SCALE 1" = 5'
VERTICAL EXAG. = 2.5:1
5
0
5
10
HORIZONTAL SCALE (IN FEET)
PROFILE TRANSECT T&+85
WEST BANK CAP REMEDIAL ACTION
PINE STREET CANAL SITE
BURLINGTON, VT
tffl IQffiSSON COMPANY, KC
SoUnois
SCALE: SHOWN