Environmental Consulting & Technology, Inc.
2200 Commonwealth Blvd., Suite 300, Ann Arbor, Michigan 48105

FINAL REPORT

GRAND TRAVERSE COUNTY PHYTOREMEDIATION PROJECT

Grant No. 15-DG-11420004-250

Grand Traverse County, Michigan

December 20, 2018

ECT No. 160585

Document Review

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This document has been authored and reviewed by the following employees:

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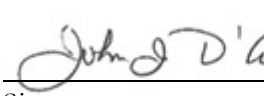	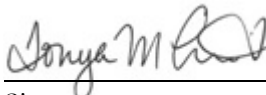
Signature	Signature
12-20-18	12-20-18
Date	Date

Table of Contents

Grant Information

Grant Project Period: October 1, 2015 – September 30, 2018

Grant Recipient: Grand Traverse County, Michigan

Grant Number: 15-DG-11420004-250

DUNS Number: 080341472

EIN: 38-600-48-52

Recipient Contact Person:

Heidi Scheppe, County Treasurer, Grand Traverse County, 231-922-4740

Principal Contractor:

John J. D'Addona, Environmental Consulting & Technology, Inc. 734-769-3004

1.0 Introduction

Grand Traverse County, Michigan successfully completed a three-year phytoremediation project in downtown Traverse City. Trees and shrubs were planted in two areas of known contamination to reduce toxic substances at, and around, the brownfield sites and nearby water bodies within the Lake Michigan watershed. The planting areas are known as the West Bay Site and the Boardman Lake Site (see **Figure 1**). Both areas have a history of contamination from industrial uses and were found to be adversely impacted by contaminants in the soil and groundwater.

Initially, the primary objective of the project was to reduce the gallons of contaminated groundwater (and pounds of cyanide) that would vent to West Grand Traverse Bay (West Bay), a bay of Lake Michigan. As the project proceeded, site conditions at the West Bay Site required the diversification of planting sites resulting in the addition of the Boardman Lake Site to the project. The objective of the Boardman Lake plantings was to reduce contaminated groundwater (volatile organic compounds, semi-volatile organic compounds and metals) from discharging to Boardman Lake and the Boardman River, a tributary to West Bay. The reduction of contaminated groundwater from reaching the surface waters using phytoremediation would be accomplished by:

- Reducing surface runoff by establishing a vegetated riparian buffer along the low-lying water's edge;
- Improving the quality of soil and groundwater by using phytoremediation to sequester, degrade, or stabilize contaminants; and
- Reducing the quantity of cyanide contaminated groundwater venting to West Bay as part of a treatment train approach and volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and metals to Boardman Lake.

Verification of the effectiveness of phytoremediation plantings in the West Bay Site would be evaluated to determine if phytoremediation at similar future brownfield redevelopment sites throughout Grand Traverse County could be utilized.

This final report details the planting and associated activities completed during the project with special emphasis on the last reporting period of the grant.

2.0 Background

The West Bay Site has been contaminated with cyanide for decades from a manufactured gas plant (MGP) site located just upgradient of the planting area while the Boardman Lake Area has been contaminated with VOCs, SVOCs and metals emanating from the Cone Drive Textron manufacturing site and the former Michigan Department of Transportation (MDOT) railyard site, both of which are located just upgradient of the Boardman Lake Site. Both planting areas serve as a buffer to stormwater and contaminated groundwater discharging to West Bay and Boardman Lake, respectively.

Studies suggest that plant processes are involved with organic and inorganic contaminant transformations and removal using phytotechnology mechanisms. There are seven phytotechnology mechanisms:

- Phytodegradation (organics only): Plant destroys it.
- Rhizodegradation (inorganics only): Microbes in soil destroy it.
- Phytovolatilization: Plant releases it as a gas.
- Phytometabolism: Plant uses it in growth, incorporates it into biomass.
- Phytoextraction: Plant extracts it, and for inorganics it is stored and must be harvested for removal.
- Phytohydraulics: Plant pulls up water, and the contaminants may come with it.
- Phytostabilization: Plant holds it in place.

Cyanide is an inorganic compound and is likely taken up by plants, broken down and used in the plant growth process as nutrient building blocks for photosynthesis and biomass creation (phytometabolism). VOCs on the other hand are transformed in a number of ways, including phytodegradation, rhizodegradation, phytovolatilization, phytohydraulics and phytostabilization. Due to the short length of the grant in terms of tree and plant growth, identification of the removal effectiveness of phytotechnologies and which mechanisms are prominent at the two planting areas was not possible.

3.0 Scope of Work

Project elements included the following:

1. Design – Conceptual and detailed design plans and specifications were developed for both planting areas. Plant materials were required to meet the American Standard for Nursery Stock (ANSI Z60.1). Tree planting followed "Principles and Practices for Planting Trees and Shrubs," International Society of Arborculture.
2. Planting – Approximately 108 trees and 1920 shrubs and grasses were planted at the two phytoremediation sites.
3. Operation & Maintenance (O&M) – The plantings were maintained through the 2018 growing season.

Each work element is briefly summarized in the following subsections.

3.1 Design

Design work was completed in 2017 for the Boardman Lake Site and in 2018 for the West Bay Site. At the initiation of the Grant, it was anticipated that all or a majority of the plantings would be adjacent to West Bay and that the plantings there would be part of a treatment train in which the majority of the cyanide contamination in groundwater would be eliminated using treatment alternatives funded by matching funds from an EPA Brownfield Revolving Loan Fund (RLF) and the Michigan State Land Bank to Grand Traverse County followed by phytoremediation to remove remaining low concentrations of cyanide and funded by the USFS Grant. However, project delays with the RLF funding and delineation of the cyanide contaminant plume resulted in a request by Grand Traverse County to install a second planting area adjacent to Boardman Lake. This planting area was approved by USFS staff and design of the Boardman Lake Site was completed. Both the West Bay and Boardman Lake phytoremediation areas are shown in **Figure 1**. Planting areas at the Boardman Lake and West Bay Sites are shown in **Figures 2A-D and 3**, respectively.

Eventually, as part of the RLF funding, it was determined that the extent of cyanide contamination venting to West Bay was significantly less than anticipated. Therefore, the treatment train approach was scaled down to simply add trees and shrubs as part of the USFS Grant, in a small condensed area very close to West Bay.

3.2 Planting

Boardman Lake Site

The Boardman Lake Site consisted of 5 planting zones (see **Figures 2A through E**). Plantings were completed in Zones 1-4 in 2017 while the Zone 5 plantings were completed by the contractor in collaboration with the railway property owner and MDOT in June 2018. As shown in **Figures 2A through C,** Zone 5 plantings were integrated with previous plantings along the north side of the property and adjacent to the existing railroad and recreational trail. A total of 1,310 plantings (see **Figure 2E**) were completed on the Boardman Lake Site. **Figure 2E** also identifies names and quantities of trees and shrubs in Zones 1-4, all of which are native to Michigan. See below for a summary of all Boardman Lake plantings.

Through the 2018 growing season the survival rate for plantings was approximately 98%. The Zone 5 plantings that do not survive due to dry summer and fall conditions are scheduled to be replaced under the 1-year maintenance guarantee through September 2019.

A photograph log included in **Appendix A** shows the site preparation and plantings completed as part of the phytoremediation project at the Boardman Lake Site.

Table 1 -Summary of Boardman Lake Plantings

Quantity	Scientific Name	Common Name
30	*Aronia melanocarpa*	Black Chokeberrry
40	*Cornus amomum*	Silky Dogwood
20	*Cornus sericea*	Red Osier Dogwood
321	*Ceanothus americanus*	New Jersey Tea
247	*Diervilla lonicera*	Bush Honeysuckle
30	*Ilex verticillata*	Winterberry
65	*Physocarpus opulifolius*	Ninebark
306	*Potentilla fruticosa*	Shrubby cinquefoil
30	*Rosa palustris*	Swamp Rose
40	*Salix interior*	Sandbar Willow
20	*Sambucus canadensis*	American Elderberry
33	*Viburnum dentatum*	Arrowwood
48	*Viburnum lentago*	Nannyberry
30	*Viburnum trilobum*	Highbush Cranberry
3	*Acer rubrum*	Red Maple
4	*Acer saccharum*	Sugar Maple
2	*Betula alleghaniensis*	Yellow Birch
10	*Celtis occidentalis*	Northern Hackberry
8	*Liriodendron tulipifera*	Tulip Poplar
5	*Populus tremuloides*	Quaking Aspen
5	*Quercus bicolor*	Swamp White Oak
10	*Quercus macrocarpa*	Bur Oak
3	*Quercus rubra*	Red Oak

West Bay Site

The planting of 58 trees and shrubs along with 660 grasses, all of which are native to Michigan, was completed in September 2018 at the West Bay Site. The plantings were completed around existing vegetation and infrastructure as shown in **Figure 3.** See below for a summary of all West Bay plantings.

The plantings that do not survive due to dry summer and fall conditions are scheduled to be replaced under the 1-year maintenance guarantee through September 2019.

A photograph log included in **Appendix B** shows the site preparation and plantings completed as part of the phytoremediation project at the West Bay Site.

Table 2 -Summary of West Bay Plantings

Quantity	Scientific Name	Common Name
300	*Ammophila breviligulata*	Beach Grass
114	*Carex vulpinoidea*	Brown Fox Sedge
18	*Carex pensylvanica*	Pennsylvania Sedge
114	*Panicum virgatum*	Switchgrass
114	*Schizachyrium scoparium*	Little Bluestem
20	*Ceanothus americanus*	New Jersey Tea
6	*Acer rubrum*	Red Maple
2	*Liriodendron tulipifera*	Tulip Poplar
30	*Populus tremuloides*	Quaking Aspen

3.1 Operation, Maintenance and Monitoring

Operation, Maintenance & Monitoring (OM&M) of planted trees in 2018 primarily consisted of irrigation during the dry summer months and weeding the shrub mulch circles for invasive plant control. Some watering is likely to continue in 2019 to ensure shrubs and trees can survive well into the future.

3.1.1 Groundwater Monitoring

Groundwater monitoring was included in the original scope of work for West Bay plantings. Groundwater monitoring wells were completed as part of the Michigan State Land Bank Loan/Grant to design and treat groundwater for cyanide removal. These wells were sampled for amenable cyanide prior to the tree and shrub plantings. Low levels of amenable cyanide exist in the West Bay phytoremediation area.

4.0 Future Activities

As the trees and shrubs grow in this area, it is planned that 1 or 2 key monitoring wells will be periodically sampled to observe whether the plantings have been successful in reducing or eliminating the remaining cyanide before it reaches West Bay.

Figures

Figure 1 - Site Location Map

1 Site Planting Plan
1 Scale: 1" = 50'

Notes:

1. Maintain 50' setback from railroad and utility poles.
2. Proposed work on MDOT/CSX property to be confirmed prior to installation.
3. All proposed plantings shall be field adjusted as necessary based on existing vegetation and infrastructure.

Figure 2A
Boardman Lake Planting Areas

3 WORKING DAYS
BEFORE YOU DIG
CALL MISS DIG
1-800-482-7171

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2200 Commonwealth Blvd, Suite 300
Ann Arbor, Michigan 48105
734.769.3004
734.769.3164 fax
www.ectinc.com

GRAND TRAVERSE COUNTY PHYTO-REMEDIATION PROJECT

CITY OF TRAVERSE CITY
TRAVERSE CITY, MICHIGAN

FINAL	10-16-17
PRELIMINARY	09-19-17

160585-0100
ECT PROJECT NUMBER

EL/MP	TONYA HUNTER
DESIGNED BY	CHECKED BY
EL/MP	TML
DRAWN BY	APPROVED BY

SHEET TITLE

COVER SHEET

SCALE: 1" = 50' @ 22" x 34"

0 50' 100'

NORTH

SHEET NUMBER

2A

1/2 Zone 5 - Part 1 Planting Plan

1/3 Zone 5 - Part 2 Planting Plan

Zone 5 - Planting Plan Overview
Scale: 1" = 50'

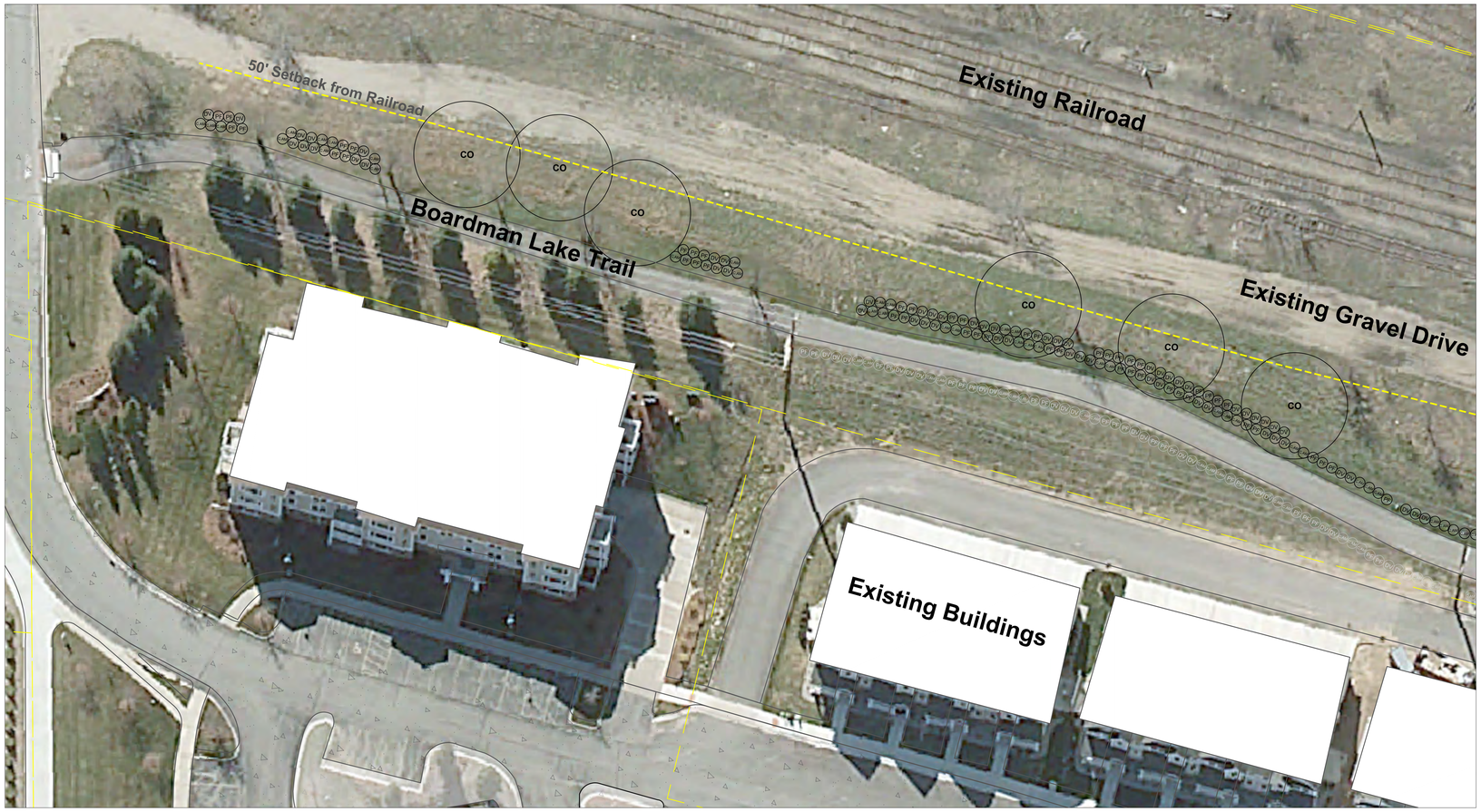
0 50' 100'

Zone 5 Plant Schedule

15

Notes:

1. Maintain 50' setback from railroad and utility poles.
2. Proposed work on MDOT/CSX property to be confirmed prior to installation.
3. All proposed plantings shall be field adjusted as necessary based on existing vegetation and infrastructure.



1/2 **Zone 5 - Part 1 Planting Plan**
Scale: 1" = 20'

0 20' 40'

Figure 2B
Boardman Lake Planting Areas

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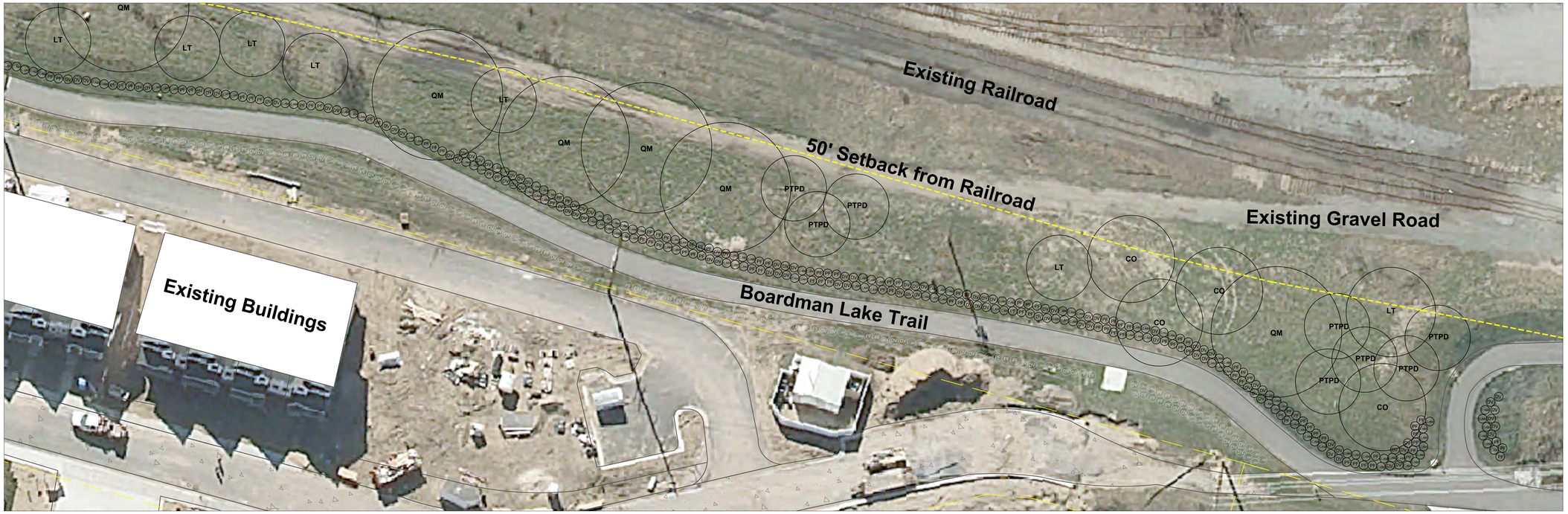
SHEET TITLE

ZONE 5 PLANTING PLAN DETAIL

NORTH

SHEET NUMBER
2B



1/3 **Zone 5 - Part 2 Planting Plan**
Scale: 1" = 20'

0 20 40

Zone 5 Plant Schedule

Notes:

1. Maintain 50' setback from railroad and utility poles.
2. Proposed work on MDOT/CSX property to be confirmed prior to installation.
3. All proposed plantings shall be field adjusted as necessary based on existing vegetation and infrastructure.

Figure 2C
Boardman Lake Planting Areas

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160585-0100
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DESIGNED BY	CHECKED BY
EL/MP	TML
DRAWN BY	APPROVED BY

SHEET TITLE

ZONE 5- PART 2 PLANTING PLAN DETAIL

NORTH

SHEET NUMBER
2C

1/4 **Zone 1 - Planting Plan**

Scale: 1" = 10'

0 10' 20'

Zone 1 Plant Schedule

Zone	Symbol	Quantity	Scientific Name	Common Name	Spacing	Type	Height
1		10	*Cornus amomum*	Silky Dogwood	6' OC	Shrub	6'-12'
		20	*Cornus sericea*	Red Osier Dogwood	6' OC	Shrub	6'-9'
		96	*Ceanothus americanus*	New Jersey Tea	4' OC	Shrub	3'
		42	*Diervilla lonicera*	Bush Honeysuckle	4' OC	Shrub	4'
		78	*Potentilla fruticosa*	Shrubby cinquefoil	4' OC	Shrub	3'
		35	*Physocarpus opulifolius*	Ninebark	6' OC	Shrub	5'-8'
		3	*Viburnum dentatum*	Arrowwood	6' OC	Shrub	6'-10'
		18	*Viburnum lentago*	Nannyberry	6' OC	Shrub	14'-16'
		3	*Acer rubrum*	Red Maple	35' OC	Tree	40'-70'
		4	*Celtis occidentalis*	Northern Hackberry	35' OC	Tree	40'-60'
		1	*Liriodendron tulipifera*	Tulip Poplar	35' OC	Tree	60'-90'
		1	*Quercus macrocarpa*	Bur Oak	35' OC	Tree	60'-80'
	Total	302					
2		30	*Cornus amomum*	Silky Dogwood	6' OC	Shrub	6'-12'

Notes:

1. Maintain 50' setback from railroad and utility poles.
2. Proposed work on MDOT/CSX property to be confirmed prior to installation.
3. All proposed plantings shall be field adjusted as necessary based on existing vegetation and infrastructure.

Figure 2D
Boardman Lake Planting Areas

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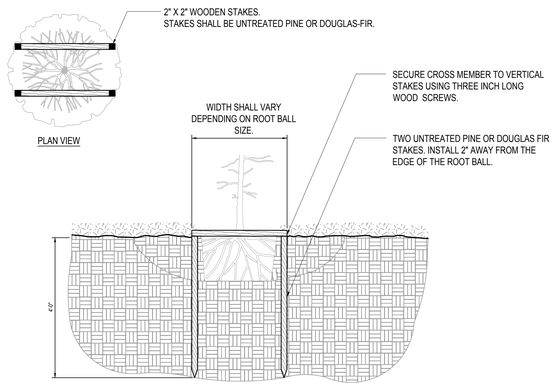
DESIGNED BY	CHECKED BY
EL/MP	TML
DRAWN BY	APPROVED BY

SHEET TITLE

ZONE 1 PLANTING PLAN DETAIL

NORTH

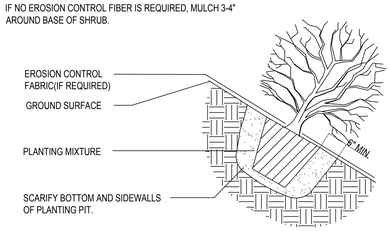
SHEET NUMBER
2D



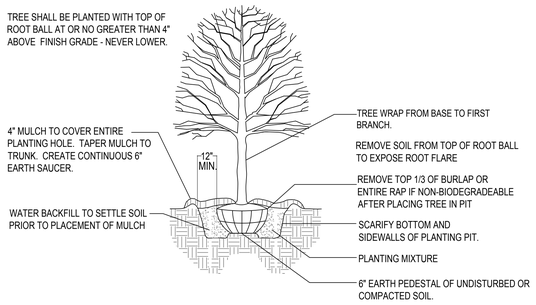
Shoreline Tree Planting Detail (TYP)
Not-to-Scale

NOTES:

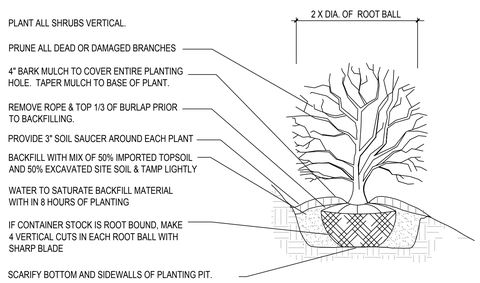
1. SHRUB SHALL BEAR SAME OR SLIGHTLY HIGHER RELATION TO FINISH GRADE AS TO PRIOR GRADE - NEVER LOWER.
2. PLANT SHRUBS WITH MAIN LEADER PERPENDICULAR TO THE GROUND SURFACE.
3. IF NO EROSION CONTROL FIBER IS REQUIRED, MULCH 3-4" AROUND BASE OF SHRUB.



Shoreline Shrub Planting Detail (TYP)
Not-to-Scale



Upland Tree Planting Detail (TYP)
Not-to-Scale



Upland Shrub Planting Detail (TYP)
Not-to-Scale

Notes:

1. All materials shall conform to the details and specifications in the drawings, or equal, as approved by project engineer.
2. Maintain 50' setback from railroad and utility poles.
3. All proposed plantings shall be field adjusted as necessary based on existing vegetation and infrastructure.
4. All plant spacing must be adhered to for plant species as shown.

Site Restoration and Cleanup:

1. Immediately clean up construction materials, excess soil, mulch, or other debris and properly dispose of deleterious materials legally off-site in a manner consistent with local laws. Site generated materials shall remain on site and stockpiled in the designated stockpile area.
2. Promptly remove equipment and unused materials at completion of activities.
3. Return staging areas to their original grade and restore ground surfaces after stored material has been removed, stockpiles shall be seeded and stabilized after grading activities have been completed.
4. Contractor shall repair damaged vegetation and aerate soil over root zone of negatively impacted vegetation, re-seed all disturbed areas to pre-existing conditions.

Maintenance and Guarantee Period:

1. Trees and seedlings installed under this contract will be healthy and in flourishing condition of active growth for one (1) full growing season (April through October) from date of final acceptance.The contractor shall respond within two (2) weeks of written requests by the owner for replacement or repair. If the contractor fails to respond within this time, the owner may proceed with replacement work and bill the contractor.
2. All delays in completion of planting operations which extend the planting into more than one planting season shall extend the guarantee period accordingly.
3. Replacements: As soon as weather conditions permit, replace, without cost to owner, all dead plants and all plants not in a vigorous, thriving condition, as determined by the consultant during and at the end of the guarantee period.
4. Contractor is responsible for periodic maintenance and weeding for a period of two years following installation of all vegetation.
5. All plant stock shall be watered by the contractor to ensure the health and vigor of the planted materials, the contractor shall water as needed based on natural rainfall during the installation period. Watering shall continue so plant materials do not dry out once watering has begun. The watering shall be done from surface methods at a pressure not to exceed the infiltration rate of the soil, limiting runoff during the watering period. Each area will be watered with sufficient water to completely saturate the root zone.
6. Erosion shall be repaired by the contractor.
7. Notify the owner prior to and following any maintenance activity.
8. Final acceptance of work will be subject to acceptance by project manager at the end of installation.

Utilities:

1. Underground utilities: For protection of underground utilities and in conformance with Public Act 53, 1974, the contractor shall dial 1-800-482-7171 a minimum of three full working days, excluding Saturdays, Sundays and holidays prior to beginning each excavation in areas where public utilities have not been previously located, members will thus be routinely notified. This does not relieve the contractor of the responsibility of notifying owners who may not be a part of the "Miss Dig" alert system.
2. All utilities, benchmarks, and existing items to remain shall be preserved during construction activities unless otherwise shown on the drawings, contractor to replace or repair damaged items at own expense.
3. Transportation of equipment and materials to/from the site on state highways and trunk lines shall conform to all local and state traffic laws, contractor shall obtain all necessary permits pertaining to delivery of equipment and materials to/from site. Costs of obtaining necessary permits is incidental to the work.
4. All work shall be completed between the hours of 7:00am and 7:00pm. All work shall be completed Monday through Saturday.
5. Contractor shall adhere to setbacks as shown from existing utilities.

Submittals:

1. Submittals for approval by engineer are required for all materials prior to mobilization. All expenses incurred by contractor prior to engineer's approval shall not be paid by owner.

Plant Schedule

Complete

Zone	Symbol	Quantity	Scientific Name	Common Name	Spacing	Type	Height
1		10	*Cornus amomum*	Silky Dogwood	6' OC	Shrub	6'-12'
		20	*Cornus sericea*	Red Osier Dogwood	6' OC	Shrub	6'-9'
		96	*Ceanothus americanus*	New Jersey Tea	4' OC	Shrub	3'
		42	*Diervilla lonicera*	Bush Honeysuckle	4' OC	Shrub	4'
		78	*Potentilla fruticosa*	Shrubby cinquefoil	4' OC	Shrub	3'
		35	*Physocarpus opulifolius*	Ninebark	6' OC	Shrub	5'-8'
		3	*Viburnum dentatum*	Arrowwood	6' OC	Shrub	6'-10'
		18	*Viburnum lentago*	Nannyberry	6' OC	Shrub	14'-16'
		3	*Acer rubrum*	Red Maple	35' OC	Tree	40'-70'
		4	*Celtis occidentalis*	Northern Hackberry	35' OC	Tree	40'-60'
		1	*Liriodendron tulipifera*	Tulip Poplar	35' OC	Tree	60'-90'
		1	*Quercus macrocarpa*	Bur Oak	35' OC	Tree	60'-80'
	Total	302					
2		30	*Cornus amomum*	Silky Dogwood	6' OC	Shrub	6'-12'
		30	*Ilex verticillata*	Winterberry	5' OC	Shrub	3'-12'
		30	*Rosa palustris*	Swamp Rose	4' OC	Shrub	3'-6'
		20	*Salix interior*	Sandbar Willow	10.5' OC	Shrub	30'-60'
		20	*Sambucus canadensis*	American Elderberry	5' OC	Shrub	5'-12'
		30	*Viburnum dentatum*	Arrowwood	6.5' OC	Shrub	6'-10'
		30	*Viburnum trilobum*	Highbush Cranberry	6' OC	Shrub	14'-16'
	Total	190					
3		5	*Populus tremuloides*	Quaking Aspen	10' OC	Tree	20'
		5	*Quercus bicolor*	Swamp White Oak	30' OC	Tree	50'-60'
		30	*Aronia melanocarpa*	Black Chokeberrry	3' OC	Shrub	3'-8'
		30	*Physocarpus opulifolius*	Ninebark	6' OC	Shrub	5'-8'
		20	*Salix interior*	Sandbar Willow	10.5' OC	Shrub	30'-60'
		30	*Viburnum lentago*	Nannyberry	6.5' OC	Shrub	14'-16'
	Total	120					
4		75	*Ceanothus americanus*	New Jersey Tea	4' OC	Shrub	3'
		75	*Diervilla lonicera*	Bush Honeysuckle	4' OC	Shrub	4'
		75	*Potentilla fruticosa*	Shrubby cinquefoil	4' OC	Shrub	3'
	Total	225					
5		150	*Ceanothus americanus*	New Jersey Tea	4' OC	Shrub	3'
		130	*Diervilla lonicera*	Bush Honeysuckle	4' OC	Shrub	4'
		150	*Potentilla fruticosa*	Shrubby cinquefoil	4' OC	Shrub	3'
		6	*Celtis occidentalis*	Northern Hackberry	35' OC	Tree	40'-60'
		7	*Liriodendron tulipifera*	Tulip Poplar	35' OC	Tree	60'-90'
		2	*Betula alleghaniensis*	Yellow Birch	35' OC	Tree	40'-60'
		3	*Quercus rubra*	Red Oak	35' OC	Tree	60'-80'
		9	*Quercus macrocarpa*	Bur Oak	35' OC	Tree	60'-80'
		4	*Acer saccharum*	Sugar Maple	25' OC	Tree	20'-40'

Figure 2E
Boardman Lake Planting Areas

3 WORKING DAYS
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160585-0100
ECT PROJECT NUMBER

EL/MP DESIGNED BY | TONYA HUNTER CHECKED BY
EL/MP DRAWN BY | TML APPROVED BY

SHEET TITLE

PLANTING NOTES & DETAILS

NORTH

SHEET NUMBER
2E

Typical Section View of Aspen and New Jersey Tea

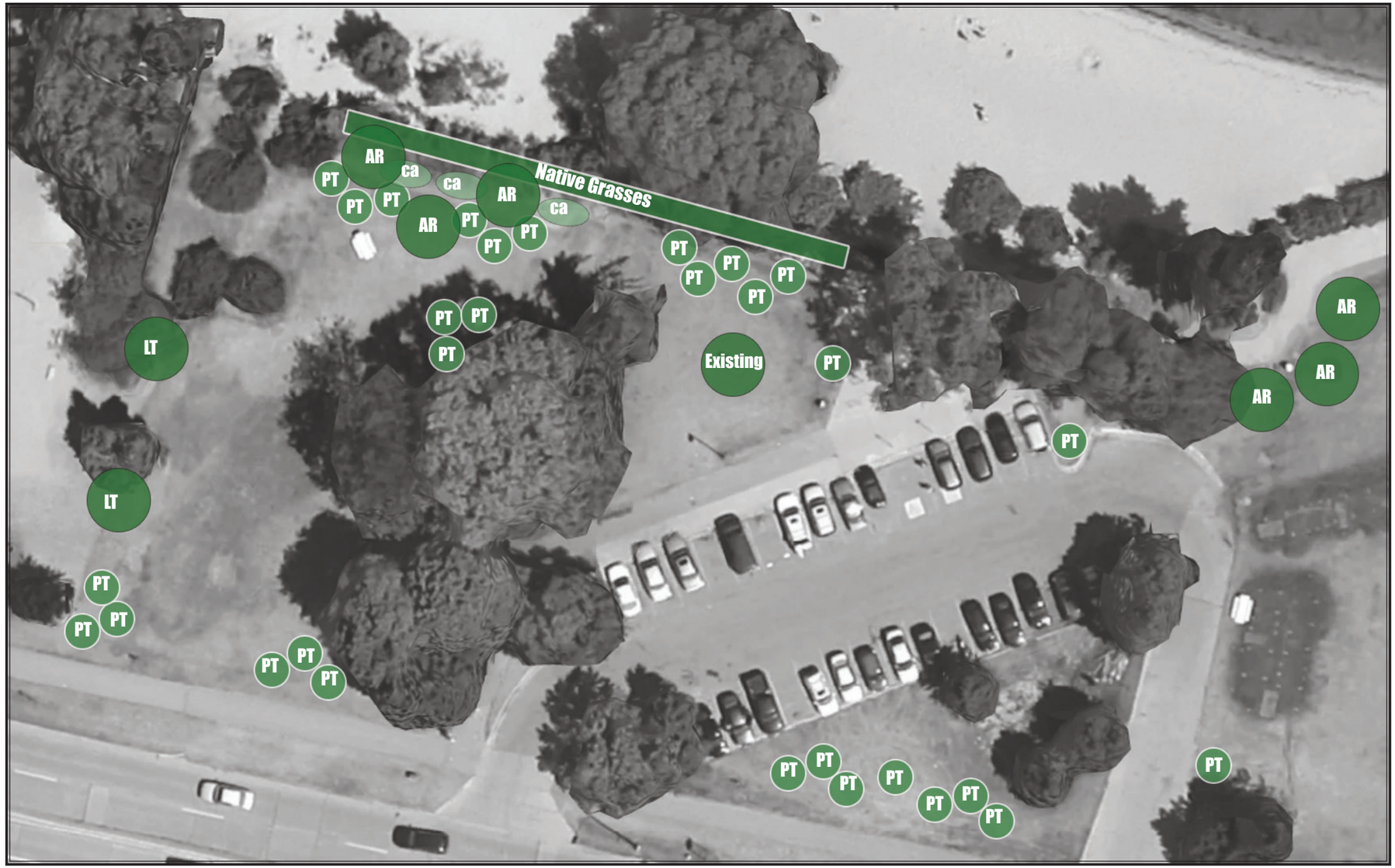
Notes:

1 All proposed tree locations are approximate. All proposed plantings shall be field adjusted as necessary based on existing vegetation and infrastructure. Existing upland trees to remain.

2 All proposed trees will maintain a 6' minimum setback from the existing sidewalk/impervious surfaces.

3 Invasive species along wall/shore to be cleared (by others) and planted with native grasses mix.

4 Native grass mix, and quantities to be determined upon completion of invasive species removal along wall/shore.



Plant List:

Symbol	Quantity	Scientific Name	Common Name	Spacing	Type	Height
	114	*Schizachyrium scoparium*	Little Bluestem	18" OC	Grass	2'-4'
	300	*Ammophila breviligulata*	Beach Grass	18" OC	Grass	2'-4'
	114	*Panicum virgatum*	Switchgrass	18" OC	Grass	3'-5'
	114	*Carex vulpinoidea*	Brown Fox Sedge	18" OC	sedge	1'-2'
	18	*Carex pensylvanica*	Pennsylvania Sedge	18" OC	sedge	.5'-1'
ca	20	*Ceanothus americanus*	New Jersey Tea	3' OC	Shrub	3'
AR	6	*Acer rubrum*	Red Maple	25' OC	Tree	40'-70'
LT	2	*Liriodendron tulipifera*	Tulip Poplar	25' OC	Tree	40'-60'
PT	30	*Populus tremuloides*	Quaking Aspen	15' OC	Tree	40'-50'

Figure 3
West Bay Planting Area

ECT Environmental Consulting & Technology, Inc.

Appendix A

Phytoremediation Project Photolog
Boardman Lake Area

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	Boardman Lake	160585

Photo No.	Date:
1	June 2018

Direction Photo Taken:

South

Description:

Zones 4 and 5 Plantings

Photo No.	Date:
2	June 2018

Direction Photo Taken:

South

Description:

Zone 4 Plantings

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	Boardman Lake	160585

Photo No.	Date:
3	June 2018

Direction Photo Taken:

South

Description:

Zone 4 Plantings

Photo No.	Date:
4	Sept. 2018

Direction Photo Taken:

North

Description:

Zones 4 and 5 Plantings

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	Boardman Lake	160585

Photo No.	Date:
5	Sept. 2018

Direction Photo Taken:

South

Description:

Zone 1 Plantings

Photo No.	Date:
6	June 2018

Direction Photo Taken:

South

Description:

Zones 4 and 5 Plantings

ECT Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	Boardman Lake	160585

Photo No.	Date:
7	June 2018

Direction Photo Taken:

North

Description:

Zones 4 and 5 Plantings

Photo No.	Date:
8	June 2018

Direction Photo Taken:

South

Description:

Zone 5 Plantings

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	Boardman Lake	160585

Photo No.	Date:
9	June 2018

Direction Photo Taken:

Northwest

Description:

Zones 4 and 5 Plantings

Photo No.	Date:
10	Sept. 2018

Direction Photo Taken:

North

Description:

Zone 1 Plantings

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	Boardman Lake	160585

Photo No.	Date:
11	Sept. 2018

Direction Photo Taken:

South

Description:

Zone 1 Plantings

Photo No.	Date:
12	Sept. 2018

Direction Photo Taken:

Southwest

Description:

Zone 5 Plantings

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	Boardman Lake	160585

Photo No.	Date:
13	Sept. 2018

Direction Photo Taken:

South

Description:

Zone 5 Plantings

Photo No.	Date:
14	June 2018

Direction Photo Taken:

North

Description:

Zones 4 and 5 Plantings

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	Boardman Lake	160585

Photo No.	Date:
15	Sept. 2018

Direction Photo Taken:

Southeast

Description:

Zones 1 and 2 Plantings

Photo No.	Date:
16	Sept. 2018

Direction Photo Taken:

East

Description:

Zone 3 Plantings

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	Boardman Lake	160585

Photo No.	Date:
17	Sept. 2018

Direction Photo Taken:

Southeast

Description:

Zone 3 Plantings

Photo No.	Date:
18	Sept. 2018

Direction Photo Taken:

Southwest

Description:

Zone 4 and 5 Plantings

Cone Drive Textron in Background

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	Boardman Lake	160585

Photo No.	Date:
19	Sept. 2018

Direction Photo Taken:

South

Description:

Zones 4 and 5 Plantings

Photo No.	Date:
20	Sept. 2018

Direction Photo Taken:

South

Description:

Zones 4 and 5 Plantings

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	Boardman Lake	160585

Photo No.	Date:
21	June 2018

Direction Photo Taken:

North

Description:

Zone 5 Plantings

Photo No.	Date:
22	June 2018

Direction Photo Taken:

Northwest

Description:

Zone 5 Plantings

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	Boardman Lake	160585

Photo No.	Date:
23	June 2018

Direction Photo Taken:

Northwest

Description:

Zones 4 and 5 Plantings

Photo No.	Date:

Direction Photo Taken:

Description:

Appendix B

Phytoremediation Project Photolog
West Bay Area

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
1	Sept. 2018

Direction Photo Taken:

East

Description:

Planting Beach Grasses and Trees

Photo No.	Date:
2	Sept. 2018

Direction Photo Taken:

West

Description:

Planted Beach Grasses

ECT Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
3	Sept. 2018

Direction Photo Taken:

East

Description:

Planted Beach Grasses

Photo No.	Date:
4	Sept. 2018

Direction Photo Taken:

West

Description:

Planted Beach Grasses

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
5	Sept. 2018

Direction Photo Taken:

North

Description:

Planted Beach Grasses

Photo No.	Date:
6	Sept. 2018

Direction Photo Taken:

West

Description:

Planted Beach Grasses

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
7	Sept. 2018

Direction Photo Taken:

South

Description:

Planted Beach Grasses

Photo No.	Date:
8	Sept. 2018

Direction Photo Taken:

East

Description:

Quaking Aspen Ready for Planting

ECT Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
9	Sept. 2018

Direction Photo Taken:

West

Description:

Beach Grasses and Maple Tree

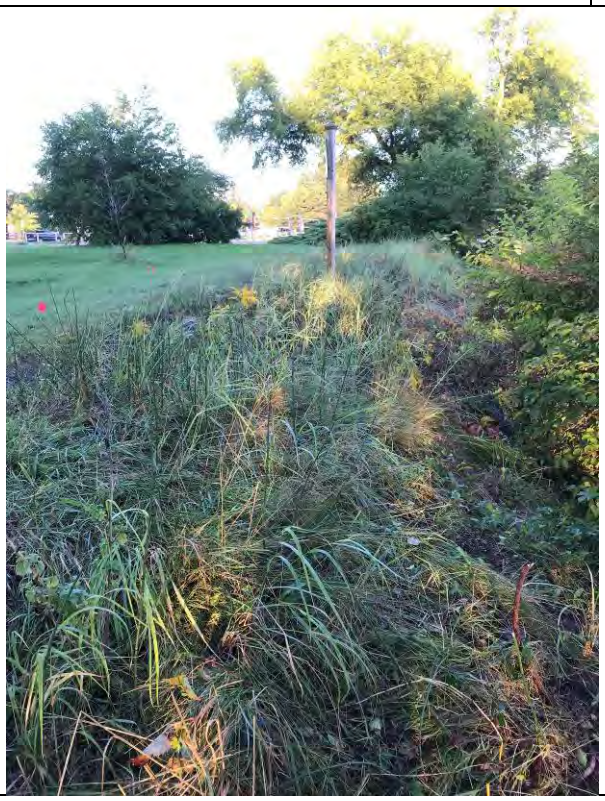


Photo No.	Date:
10	Sept. 2018

Direction Photo Taken:

West

Description:

Planted Maple and New Jersey Tea

ECT Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
11	Sept. 2018

Direction Photo Taken:

West

Description:

Newly Planted Trees

Photo No.	Date:
12	Sept. 2018

Direction Photo Taken:

East

Description:

Watering Trees

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
13	Sept. 2018

Direction Photo Taken:

Southwest

Description:

Tulip Poplars

Photo No.	Date:
14	Sept. 2018

Direction Photo Taken:

Northwest Towards West Bay

Description:

Maples, Aspen and New Jersey Tea

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
15	Sept. 2018

Direction Photo Taken:

East

Description:

Maples Planted Beyond Existing Trees

Photo No.	Date:
16	Sept. 2018

Direction Photo Taken:

West

Description:

Quaking Aspen

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
17	Sept. 2018

Direction Photo Taken:

West

Description:

Quaking Aspen

Photo No.	Date:
18	Sept. 2018

Direction Photo Taken:

Southwest

Description:

Grasses and Trees Blended with Existing Trees and Shrubs

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
19	Sept. 2018

Direction Photo Taken:

East

Description:

Maples

Photo No.	Date:
20	Sept. 2018

Direction Photo Taken:

South

Description:

Quaking Aspen

ECT Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
21	Sept. 2018

Direction Photo Taken:

East

Description:

Blending with Existing Trees

Photo No.	Date:
22	Sept. 2018

Direction Photo Taken:

Southeast

Description:

Quaking Aspen

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
23	Sept. 2018

Direction Photo Taken:

Northeast

Description:

Quaking Aspen

Photo No.	Date:
24	Sept. 2018

Direction Photo Taken:

North Towards West Bay

Description:

Quaking Aspen in Foreground, Maples in Distance.

Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Grand Traverse County	West Bay	160585

Photo No.	Date:
25	Sept. 2018

Direction Photo Taken:

West

Description:

Blending with Existing Trees

Photo No.	Date:
26	Sept. 2018

Direction Photo Taken:

West

Description:

Blending with Existing Trees