

Robinson Intercounty Drain

Engineering Report



Prepared for:

Robinson Intercounty Drain Drainage Board

September 7, 2016

LAND & RESOURCE
ENGINEERING INC.

Common Sense • Lasting Solutions

3800 West River Drive Suite A, Comstock Park, MI 49321

Phone: 616.301.7888

LAND & RESOURCE
ENGINEERING INC.
Common Sense • Lasting Solutions

TABLE OF CONTENTS

Description:	Page(s)
Introduction	2
Field Reconnaissance	4
Evaluation of Alternatives	6
Recommendations and Implementation	8

List of Figures

Exhibit B-1 – Lands Added / Removed Map
Exhibit B-2 – Drainage District Map
Sheet C1 – Plan & Profile Alternatives

Appendix

Appendix – Preliminary Cost Estimates

INTRODUCTION

Drainage District Overview

The Robinson Intercounty Drain Drainage District (District) encompasses 826 acres of land within Greenwood (Oceana County), Dayton and Sheridan (Newaygo County), and Holton (Muskegon County) Townships as shown in [Exhibit B-2 - Drainage District Map](#). The District is located within the White River watershed.

The topography of the District is characterized by rolling terrain, with steeper hills in the southern and eastern portions of the District and flatter terrain in the northern and western regions of the District. The land use is predominately agricultural, with some commercial areas near the intersection of M-120 (Maple Island Road) and Skeels Road. Soils within the District are primarily composed of clay loams with slow infiltration rates and “C/D” hydrologic soil group classifications.



*Drain along M-120
Looking North (Stagnant Water)*

The historic District as described in the 1953 Final Order of Determination included an area of 793.5 acres as shown in the enclosed [Exhibit B-1](#). Land and Resource Engineering, Inc. delineated the District boundary based on available topographic contours, record drawings and field verification. Micro-topography and depression storage areas that may provide for some infiltration within the larger boundary were included in the District. The revised District encompasses 826 acres (485 acres Newaygo, 334 acres Muskegon, 7 acres Oceana) as shown in the enclosed [Exhibits B-1 and B-2](#).

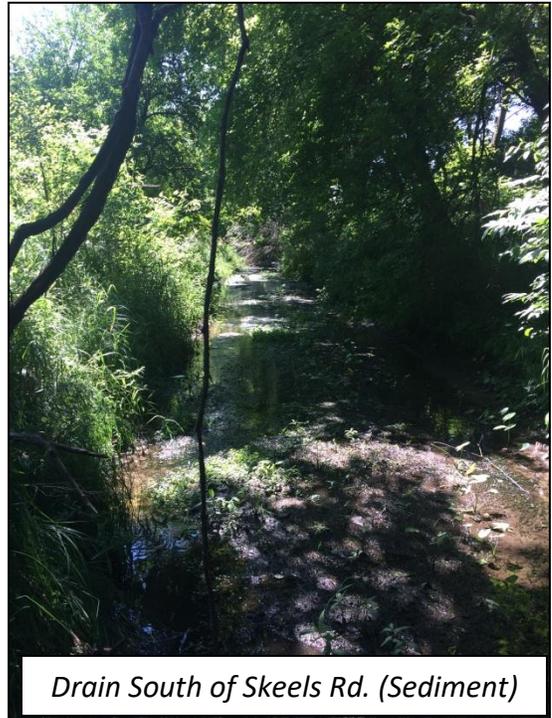
Route and Course

The Robinson Intercounty Drain (Drain) is a tributary to Cushman Creek and was legally established in 1906. The upstream terminus of the Drain is located in the northeast quarter of Section 12, Holton Township, Muskegon County. The total length of the Drain is approximately 1.5 miles and flows from south to north through Section 1, Holton Township, Muskegon County. The historic Drain alignment meandered into the west half of Section 6, Sheridan Township, Newaygo County, then back into the east half of Section 1, Holton Township, Muskegon County. The Drain continues into the southeast quarter of Section 36, Greenwood Township, Oceana County to the downstream terminus of the Drain in Cushman Creek.

Improvements to the Robinson Drain were constructed in 1936, including channel dredging and replacement of a 40-inch “boiler tube” with a 42-inch corrugated iron pipe. The Drain was relocated in 1953 to follow the west line of M-120 (Maple Island Road) in the east half of Section 1, Holton Township. There is no evidence to suggest the portion of the Drain in Newaygo County was ever abandoned. The width of drainage easement along the Drain is 30-feet (15-feet on each side of the centerline).

Drain Maintenance

In general, maintenance of the Robinson Intercounty Drain has been conducted by the property owners adjacent to the Drain. The last maintenance project was performed by a group of Amish farmers at the upstream portion of the Drain in Muskegon County sometime around 2010. Prior to this, the last recorded maintenance activity was carried out by the Intercounty Drainage Board in 1953. In addition, conflicting statements by residents indicate that maintenance dredging (conducted by a property owner) has occurred along M-120 within the past 10 years. Although this claim could not be substantiated, it does appear that the channel along M-120 has been excavated numerous times since the last recorded maintenance project.



Drain South of Skeels Rd. (Sediment)

Purpose of Study

Drainage complaints and a growing concern over the amount of sediment in the Drain led the Robinson Intercounty Drain Drainage Board (Board) to solicit a proposal to complete an engineering study of the Drain. The primary purpose of the study is to determine whether or not additional improvements to the Drain are necessary beyond the provisions allowed under maintenance by the Michigan Drain Code (Act 40 of 1956).

LRE was retained by the Board on July 6, 2016 to conduct an engineering study of the Robinson Intercounty Drain. The engineering study included a preliminary topographic survey of the Drain to identify any impairment including potential hydraulic restrictions, channel instability, bank erosion, and sediment buildup. The results and recommendations of our engineering study are presented in this report.

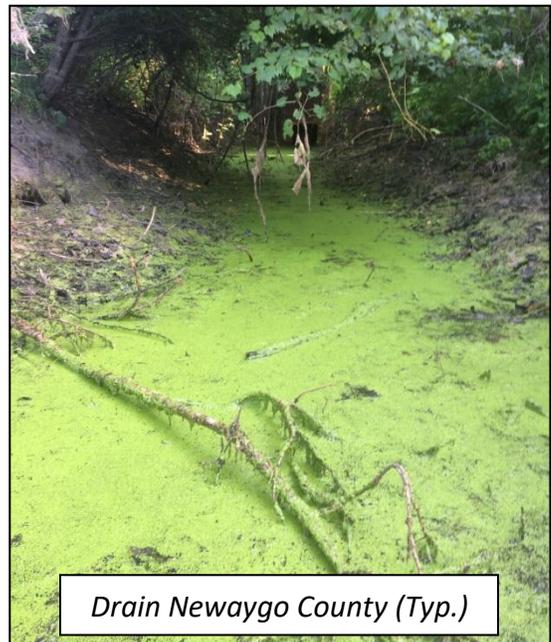
FIELD RECONNISANCE

Field Investigation / Topographic Survey

Field investigations of the Drain and associated District were conducted by LRE staff on July 14, 2016. In addition, LRE staff spoke with representatives from the Wagonmaker family regarding flooding issues within the District. LRE conducted a topographic survey of the Drain on July 22, August 30 and September 1, 2016. Existing channel alignments and profiles of the Drain are shown in the enclosed [Sheet C1](#).

Robinson Intercounty Drain – Current Alignment: The current alignment of the Drain is highly channelized with a trapezoidal cross section, flat gradient and linear alignment. Historically (per 1953 notice of letting), the channel bottom width was fairly consistent throughout the Drain at 3 to 4 feet with an average depth of 6.7 feet, bank slopes were graded 1:1 (H:V), and gradient was constant at 0.05% slope.

In general, channel banks are relatively stable with only a few areas of minor bank erosion / scour along the toe of slope primarily near culvert outlets. Aside from one large obstruction, some minor deadfall, and thick non-woody vegetation, the channel is relatively open and free of debris. The current channel geometry is similar to historic documentation in the upstream and downstream stretches of the Drain, however, it is evident the stretch of Drain running along M-120 has been altered significantly from the historic geometry. In this area, which borders Wagonmaker Farms, the bottom width measured in excess of 15 feet and held a large amount of stagnant water. The bottom of the Drain along M-120 was extremely mucky with up to 3-feet of sediment accumulation. Other areas of the Drain have between 1 and 1.5 feet of sediment build-up.

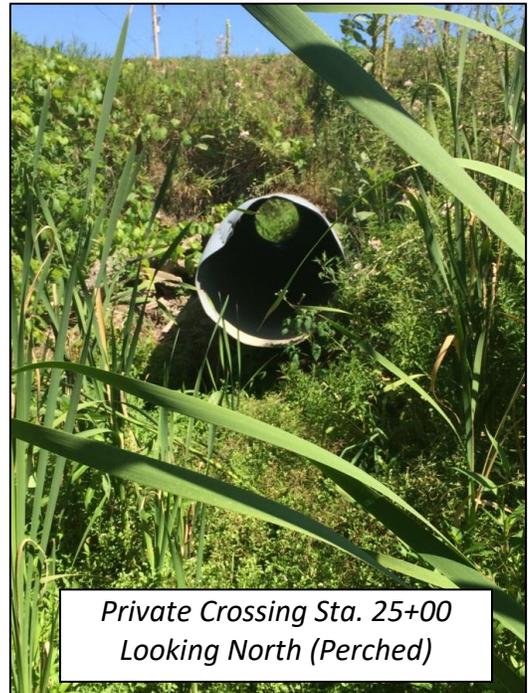


Drain Newaygo County (Typ.)

LRE spoke with Mr. Wagonmaker, who took responsibility for some of the sediment that had accumulated in the Drain, admitting that it had been pumped by his dewatering pumps unintentionally into the channel. Mr. Wagonmaker was very concerned about the lack of flow through the channel, stating that there have been several instances where the water in the channel has overtopped the berm protecting his celery field, the most recent occurrence was approximately 2 years ago. Mr. Wagonmaker stated that water levels in the Drain nearly reach the top of berm at least four times a year.

LRE conducted a thorough inspection of each culvert along the current Drain alignment. Aside from the culvert under Skeels Road and a private crossing in the upstream portion of the Drain, the culverts are in poor condition. The 36-inch CMP culvert just upstream of the convergence of the current alignment and the Newaygo County portion of the Drain (Sta. 25+00) is perched more than 3-feet above the channel centerline.

Robinson Intercounty Drain – Newaygo County: The Newaygo County portion of the Drain is highly channelized with trapezoidal cross section, flat gradient and linear alignment. Historically (per 1906 notice of letting), the channel bottom width was fairly consistent throughout the Drain at 3 to 4 feet with a depth ranging from 2 to 5 feet, bank slopes were graded 1:1 (H:V), and the gradient ranged from 0.02% to 0.05%.



*Private Crossing Sta. 25+00
Looking North (Perched)*

In general, the channel banks are stable with only a few areas of minor bank erosion. The channel bottom was mostly dry with only a few areas upstream holding stagnant water. At some point it appears that the channel was dammed up in an attempt to construct an irrigation pond for areas adjacent to the Drain that historically had been farmed. The earthen dam is still in place along with a large pump system, which essentially cuts off upstream flow. A significant amount of sediment build-up has occurred upstream of the dam structure to the terminus of the Newaygo County portion of the Drain. Aside from some minor deadfall and thick non-woody vegetation, the channel is relatively open and free of debris. The private crossing located upstream of M-120 is in poor condition. The clear span bridge at the downstream terminus is showing signs of spalling on the bottom of the bridge deck. The historic culvert at the upstream terminus of the Newaygo Portion of the Drain was not located.



*M-120 Clear Span Bridge Looking East
(Spalling Concrete / Wood Obstructions)*

EVALUATION OF ALTERNATIVES

Several alternatives were considered to improve drainage and reduce the potential for flooding along the Drain, including: Routine Maintenance, Minimal Conveyance Improvements, and Full Scope Conveyance Improvements.

Alternative 1 – Routine Maintenance

Routine Maintenance would potentially improve storm water conveyance in the downstream portions of the Drain by removing the obstructions noted from Skeels Road to the convergence with the Newaygo County portion of the Drain. However, this alternative will have a minimal effect on the conveyance upstream of the convergence (including the Wagonmaker property) due to the private crossing near Sta. 25+00, which is perched approximately 2 to 3 feet above the Drain bottom.

Construction Cost Estimate: The preliminary estimate of probable construction cost to implement Alternative 1 is approximately \$20,000. A detailed project cost breakdown is provided in the [Appendix](#).

Alternative 2 – Conveyance Improvements (Minimum Scope)

This alternative includes a combination of woody debris management, open channel excavation, and replacement of the perched private crossings near Sta. 25+00 and Sta. 39+00 to provide an adequate outlet for the upstream portion of the Drain.

Woody Debris Management: The portion of the Drain between Skeels Road to the convergence of the Newaygo County portion of the Drain is littered with several obstructions. Approximately 2,000 linear feet of Woody Debris Management is proposed along the current alignment of the Drain to remove obstructions that are impeding flow.

Culvert Replacement: As noted in the Field Reconnaissance section, most of the culverts along the Drain are in poor condition. This alternative includes the replacement of two private crossings upstream of the convergence with the Newaygo County portion of the Drain (Sta. 25+00 and Sta. 39+00), ensuring that the crossings meet a minimum 10-year level of flood protection, and installing the culverts at the proper grade.



*Sta. 15+00 – Looking Downstream
(Woody Obstruction)*

Open Channel Excavation: Approximately 4,000 linear feet of Open Channel Excavation is proposed to remove sediment build-up and restore a positive channel gradient along portions of the Drain that are adversely impacted by culverts that are currently perched. A profile of the proposed channel bottom is shown in the enclosed [Sheet C1](#).

Newaygo County Portion: No improvements along the Newaygo County portion of the Drain are included in this alternative.

Construction Cost Estimate: The preliminary estimate of probable construction cost to implement Alternative 2 is approximately \$87,000. A detailed project cost breakdown is provided in the [Appendix](#).

Alternative 3 – Conveyance Improvements (Full Scope)

This alternative includes the most extensive scope of construction but will provide the Drain with the ability for the most improved storm water conveyance capacity. Included in this alternative is a combination of woody debris management, open channel excavation, and culvert replacement.

Woody Debris Management: The portion of the Drain between Skeels Road to the convergence of the Newaygo County portion of the Drain is littered with several obstructions. Approximately 2,000 linear feet of Woody Debris Management is proposed along the current alignment of the Drain to remove obstructions that are impeding flow.

Open Channel Excavation: Approximately 6,350 linear feet of Open Channel Excavation is proposed from Skeels to Meinert Road. This includes removing up to 3 feet of sediment from the Drain. A profile of the proposed channel bottom is shown in the enclosed [Sheet C1](#).

Culvert Replacement: The replacement of deteriorated, perched and/or undersized crossings with appropriately sized crossings at the proper invert elevation is proposed along the Drain, ensuring that each crossing meets a minimum 10-year level of flood protection.

Newaygo County Portion: Major items included in the scope of improvements to the Newaygo County portion of the Drain consist of approximately 1,200 linear feet of Woody Debris Management, 1,400 linear feet of Open Channel Excavation, Private Crossing Replacement, replacement of the clear span bridge under M-120 (Maple Island Road) with an appropriately sized concrete box culvert, and removal of an impoundment structure located in the Drain.

Construction Cost Estimate: The preliminary estimate of probable construction cost to implement Alternative 3 is approximately \$333,000. A detailed project cost breakdown is provided in the [Appendix](#).

RECOMMENDATIONS & IMPLEMENTATION

Recommendations

LRE will work with Robinson Intercounty Drainage Board to establish the final scope of work and recommendations after receiving input from the progress meeting scheduled for September 7, 2016.

Implementation

Implementation of the recommended scope of work presented in this report requires consideration of the following:

Funding: Conveyance improvements to the Drain will likely exceed annual maintenance provisions as specified under the Michigan Drain Code (Act 40 of 1956), therefore, a petition may be necessary to implement the recommended scope of work.

Easement Acquisition: The existing 30-foot wide drainage easement may not be sufficient for construction purposes. In addition, the historic route and course of the Drain alignment within Newaygo County does not entirely match the current location of the water course. Therefore, additional easement acquisition may be required.

Permitting: The proposed Drain maintenance and conveyance improvements should be exempt from MDEQ permitting related to Part 301, Inland Lakes and Streams, and Part 303, wetlands protection, of the of the Natural Resources and Environmental Protection Act, PA 451 of 1994 (NREPA).

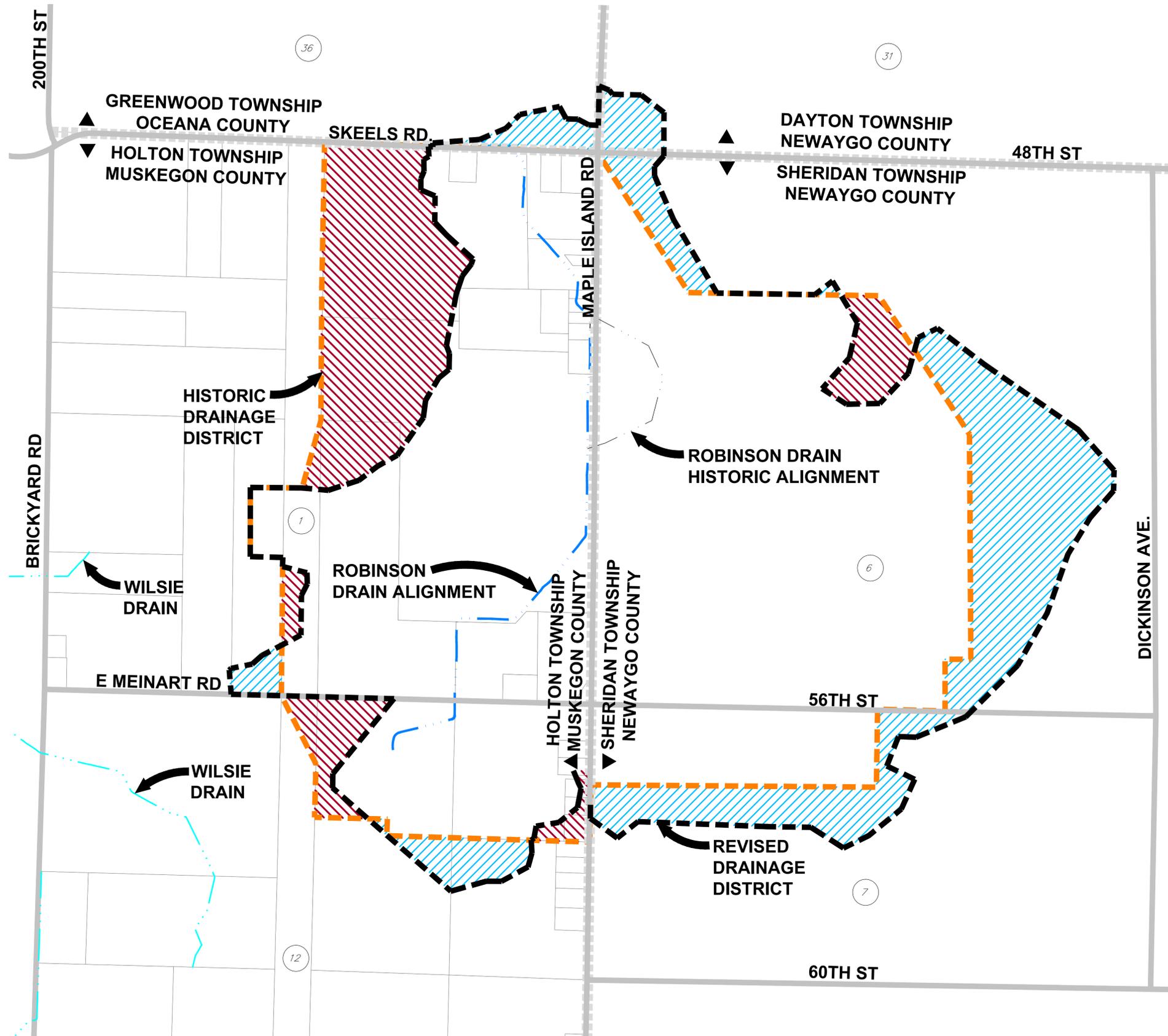
Final Design and Construction: Establish a project schedule, complete the final design and prepare contract documents for bidding and construction.

ROBINSON INTERCOUNTY DRAIN DRAINAGE DISTRICT

SECTION 36 OF GREENWOOD TOWNSHIP,
OCEANA COUNTY, MICHIGAN

SECTIONS 1 & 12 OF HOLTON TOWNSHIP,
MUSKEGON COUNTY, MICHIGAN

SECTIONS 6 & 7 OF SHERIDAN TOWNSHIP,
SECTION 31 OF DAYTON TOWNSHIP,
NEWAYGO COUNTY, MICHIGAN

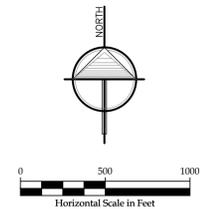


DRAIN INFORMATION:

HISTORIC DISTRICT:	794 ACRES
REVISED DISTRICT:	826 ACRES
LANDS ADDED:	146 ACRES
LANDS REMOVED:	114 ACRES

LEGEND

- DRAIN ALIGNMENT
- HISTORIC DRAINAGE DISTRICT BOUNDARY
- REVISED DRAINAGE DISTRICT BOUNDARY
- ROAD CENTERLINE
- PARCEL LINE
- SECTION NUMBERS
- SECTION LINE
- TOWNSHIP LINE
- LANDS REMOVED
- LANDS ADDED



LANDS ADDED/REMOVED MAP
EXHIBIT B-1

LAND & RESOURCE
ENGINEERING INC.

Common Sense • Lasting Solutions
3820 West River Drive, Ste. A, Comstock Park, MI 49317 Ph:616.321.7888

ROBINSON INTERCOUNTY DRAIN DRAINAGE DISTRICT

SECTION 36 OF GREENWOOD TOWNSHIP,
OCEANA COUNTY, MICHIGAN

SECTIONS 1 & 12 OF HOLTON TOWNSHIP,
MUSKEGON COUNTY, MICHIGAN

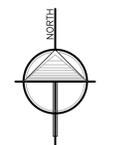
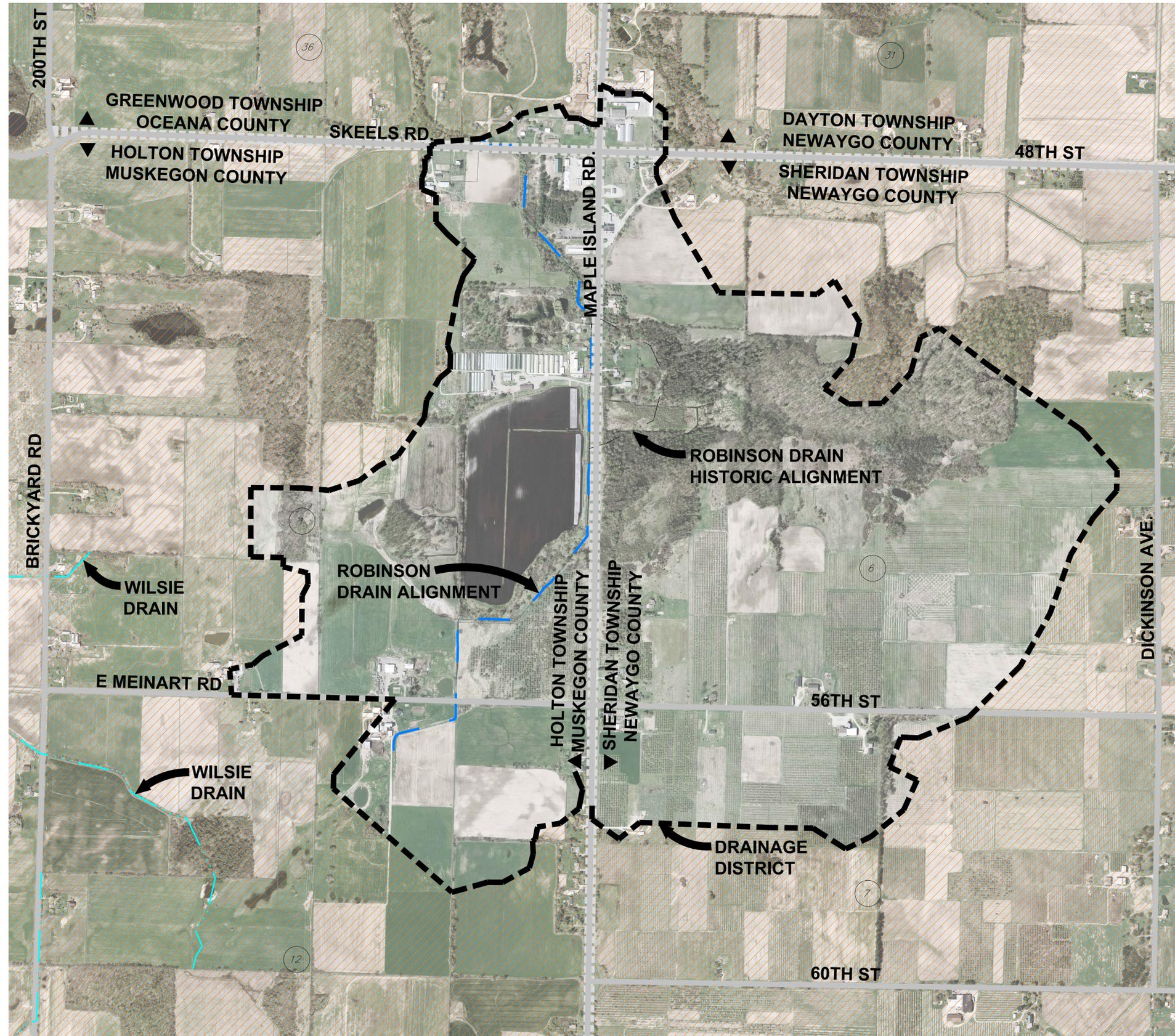
SECTIONS 6 & 7 OF SHERIDAN TOWNSHIP,
SECTION 31 OF DAYTON TOWNSHIP,
NEWAYGO COUNTY, MICHIGAN

DRAIN INFORMATION:

DRAINAGE DISTRICT AREA: 826 ACRES

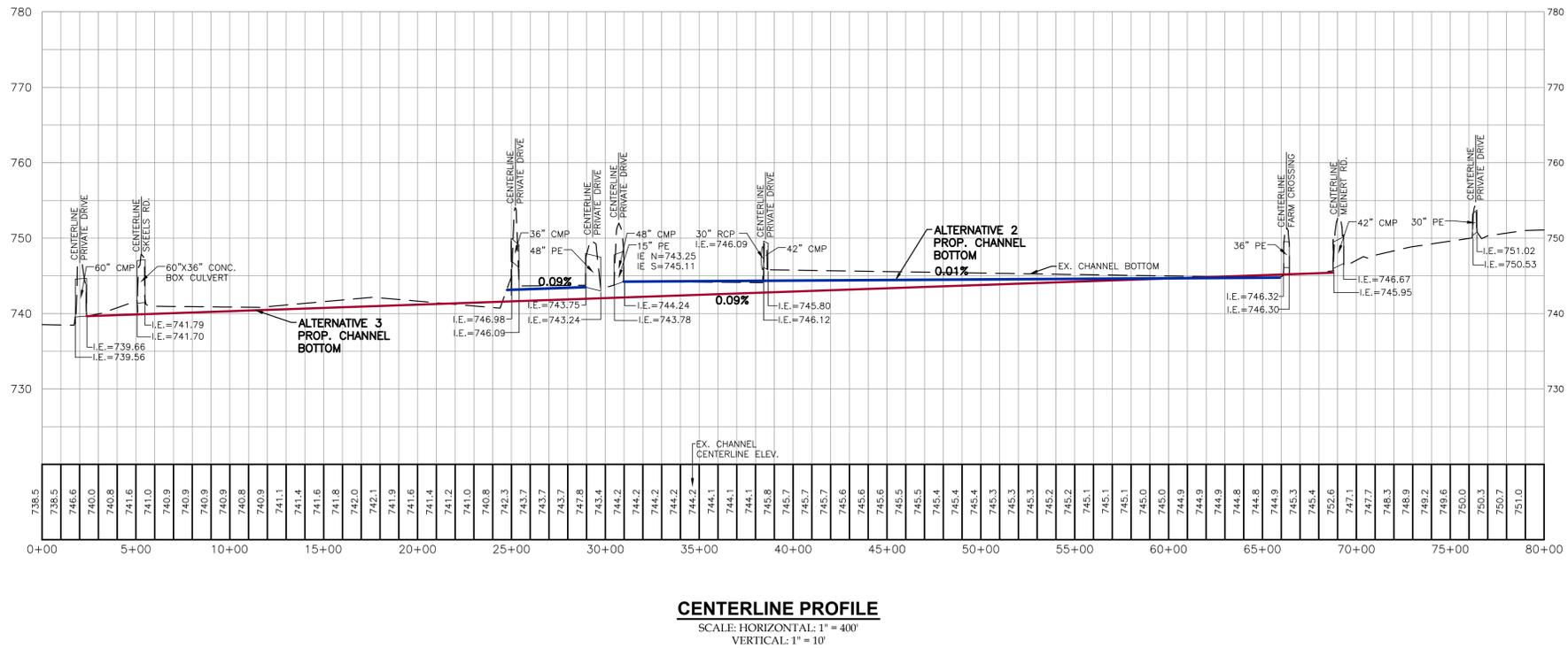
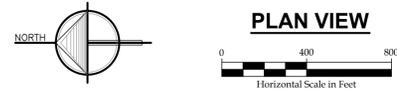
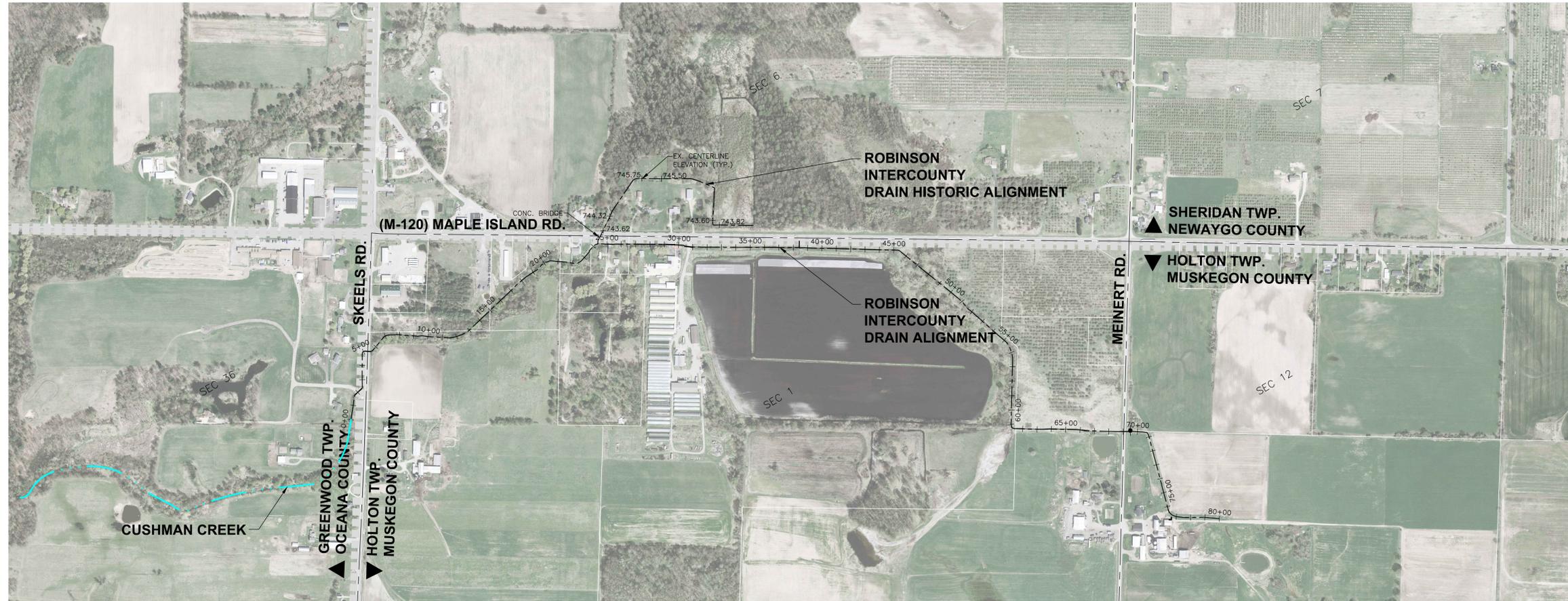
LEGEND

-  DRAIN ALIGNMENT
-  DRAINAGE DISTRICT BOUNDARY
-  ROAD CENTERLINE
-  PARCEL LINE
-  SECTION NUMBERS
-  SECTION LINE
-  TOWNSHIP LINE



**DRAINAGE DISTRICT MAP
EXHIBIT B-2**

LAND & RESOURCE
ENGINEERING INC.
Common Sense • Lasting Solutions
3820 West River Drive, Ste. A, Comstock Park, MI 49317 Ph: 616.321.7888



CENTERLINE PROFILE
 SCALE: HORIZONTAL: 1" = 400'
 VERTICAL: 1" = 10'

LAND & RESOURCE ENGINEERING INC.
 Common Sense • Lasting Solutions
 880 West River Drive, Ste. A, Comstock, MI, 49317 Phone: 616.288.1111

REVISIONS:	DATE
NO.	ISSUED FOR

ROBINSON INTERCOUNTY DRAIN DRAINAGE BOARD
 PROJECT: **ROBINSON INTERCOUNTY DRAIN**
 MUSKEGON, OCEANA, AND NEWAYGO COUNTIES

PROJECT NUMBER: 16-073	DATE: 9/2016
SURVEYED BY: RIB, CVF	9/2016
DESIGNED BY: DJF	9/2016
DRAFTED BY: LCG	9/2016
QA/QC:	9/2016

PLAN & PROFILE ALTERNATIVES
 STA. 0+00 - 80+00

C1

**ROBINSON INTERCOUNTY DRAIN
 ALTERNATIVE 1 - ROUTINE MAINTENANCE
 PRELIMINARY PROJECT COST ESTIMATE**

Prepared By: Land & Resource Engineering, Inc., 9/7/2016

Robinson Intercounty Drain

No.	Item Description	Quantity		Unit Cost	Total Cost
1	Woody Debris Management	2000	LF	\$ 2.00	\$ 4,000.00
2	Miscellaneous Maintenance Items	1	LS	\$ 2,000.00	\$ 2,000.00
3	Restoration	1	LS	\$ 2,000.00	\$ 2,000.00

Construction Sub-Total \$ 8,000.00

PRELIMINARY ESTIMATE OF PROJECT COST

Estimated Total Construction Cost	\$	8,000.00
Engineering Study	\$	8,700.00
Estimated Engineering (Design and Construction)	\$	1,000.00
~15% Contingency	\$	2,300.00
* Preliminary Estimate of Total Project Cost	\$	20,000.00

* Does not include Legal, Administrative, Permitting, Easement Acquisition or Financing Costs.

**ROBINSON INTERCOUNTY DRAIN
ALTERNATIVE 2 - CONVEYANCE IMPROVMENTS (MIN. SCOPE)
PRELIMINARY PROJECT COST ESTIMATE**

Prepared By: Land & Resource Engineering, Inc., 9/7/2016

Robinson Intercounty Drain

No.	Item Description	Quantity		Unit Cost	Total Cost
1	Woody Debris Management	2000	LF	\$ 2.00	\$ 4,000.00
2	Open Channel Excavation	4000	LF	\$ 5.00	\$ 20,000.00
3	Private Crossing Replacement	100	LF	\$ 175.00	\$ 17,500.00
4	Rock Riprap (End Treatment, etc.)	100	SY	\$ 65.00	\$ 6,500.00
5	Open Channel Restoration	4000	LF	\$ 1.00	\$ 4,000.00
6	Roadway / Driveway Restoration (Gravel)	2	EA	\$ 1,500.00	\$ 3,000.00

Construction Sub-Total \$ 55,000.00

PRELIMINARY ESTIMATE OF PROJECT COST

Estimated Total Construction Cost	\$	55,000.00
Engineering Study	\$	8,700.00
Estimated Engineering (Design and Construction)	\$	12,300.00
~15% Contingency	\$	11,000.00
* Preliminary Estimate of Total Project Cost	\$	87,000.00

* Does not include Legal, Administrative, Permitting, Easement Acquisition or Financing Costs.

**ROBINSON INTERCOUNTY DRAIN
ALTERNATIVE 3 - CONVEYANCE IMPROVMENTS (FULL SCOPE)
PRELIMINARY PROJECT COST ESTIMATE**

Prepared By: Land & Resource Engineering, Inc., 9/7/2016

Robinson Intercounty Drain - Current Alignment

No.	Item Description	Quantity		Unit Cost	Total Cost
1	Woody Debris Management	2000	LF	\$ 2.00	\$ 4,000.00
2	Open Channel Excavation	6350	LF	\$ 5.00	\$ 31,750.00
3	Skeels Road Crossing Replacement	50	LF	\$ 600.00	\$ 30,000.00
4	Private Crossing Replacement (4)	200	LF	\$ 175.00	\$ 35,000.00
5	Mienart Road Crossing Replacement	60	LF	\$ 200.00	\$ 12,000.00
6	Rock Riprap (End Treatment, etc.)	300	SY	\$ 65.00	\$ 19,500.00
7	Rock Chute Side Inlet (Miscellaneous Item)	3	EA	\$ 1,500.00	\$ 4,500.00
8	Open Channel Seeding	6350	LF	\$ 1.00	\$ 6,350.00
9	Roadway Restoration (Pavement)	2	EA	\$ 4,000.00	\$ 8,000.00
10	Roadway / Driveway Restoration (Gravel)	4	EA	\$ 1,500.00	\$ 6,000.00

Construction Sub-Total \$ 157,100.00

Robinson Intercounty Drain - Newaygo County Portion

No.	Item Description	Quantity		Unit Cost	Total Cost
1	Woody Debris Management	1200	LF	\$ 2.00	\$ 2,400.00
2	Open Channel Excavation	1400	LF	\$ 3.50	\$ 4,900.00
3	Maple Island Road (M-120) Crossing Replacement	100	LF	\$ 600.00	\$ 60,000.00
4	Private Crossing Replacement	30	LF	\$ 175.00	\$ 5,250.00
5	Remove Impoundment Structure	1	LS	\$ 1,500.00	\$ 1,500.00
6	Rock Riprap (End Treatment, etc.)	100	SY	\$ 65.00	\$ 6,500.00
7	Rock Chute Side Inlet (Miscellaneous Item)	2	EA	\$ 1,500.00	\$ 3,000.00
8	Open Channel Seeding	1400	LF	\$ 1.00	\$ 1,400.00
9	Roadway (m-120) Restoration (Pavement)	1	EA	\$ 6,000.00	\$ 6,000.00
10	Roadway / Driveway Restoration (Gravel)	1	EA	\$ 1,500.00	\$ 1,500.00

Construction Sub-Total \$ 92,450.00

PRELIMINARY ESTIMATE OF PROJECT COST

Estimated Total Construction Cost	\$ 249,550.00
Engineering Study	\$ 8,700.00
Estimated Engineering (Design and Construction)	\$ 31,300.00
~15% Contingency	\$ 43,450.00
* Preliminary Estimate of Total Project Cost	\$ 333,000.00

* Does not include Legal, Administrative, Permitting, Easement Acquisition or Financing Costs.