PRELIMINARY ENGINEER'S REPORT
FOR THE IMPROVEMENTMENT
OF
POLK COUNTY DITCH NO. 39

Red Lake Watershed Ditch No. 17
(Red Lake Watershed Project No. 179)

January 18, 2019

Prepared for the:
Red Lake Watershed District
1000 Pennington Avenue South
Thief River Falls, MN 56701

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Registered Engineer under the laws of the State of Minnesota.

[Signature]
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1) **Introduction**

The proposed project consists of the improvement of an existing Polk County drain. The drain is presently designated as Polk County Ditch No. 39 and was originally established in 1903. Sometime after 1903 the ditch was relocated approximately 50 feet farther south when Polk County Roadway No. 65 was constructed adjacent to and northerly of the drain. Subsequently the southerly ditch of Polk County Road No. 65 has been continually operated and maintained as Polk County Ditch No. 39. The original right-of-way to construct Polk County Ditch No. 39 appears to be the northerly 49.5 feet of the sections of land that it was constructed through. The original right-of-way map for Polk County Ditch No. 39 is included in the appendix of this report as Exhibit C.

2) **Geometry of Existing Drain**

The attached preliminary plans show cross sections of the existing drainage channel. The cross sections were field surveyed at 200 foot intervals along the entire alignment. These cross sections best describes the geometry of the existing drain. The cross sections show the bottom of the ditch to be at, or slightly below, the existing plan grade. The in-slope of the ditch (road side of the ditch) is at a 5:1 slope from the grass shoulder of the roadway. This 5:1 slope is maintained until the elevation of the in-slope is approximately 6 feet below the top of the edge road. From this point the slope increases to approximately 3:1 to the bottom of the ditch. The ditch bottom width varies between 8 to 12 feet. The back-slope of the ditch (field side of the ditch) has approximately a 3:1 slope to the cultivated field line. There is no well-defined grass buffer strip along the top of the back-slope.

3) **Condition of Existing Drain**

The drain is seeded to grass and has been generally mowed annually. The mowing has largely controlled weeds with the exception of cattails in the bottom of the lower sections of the ditch. A Manning’s n value for the drain is conservatively estimated to be 0.04 which is typical for older established ditches in the area. The ditch has been maintained adequately to its reconstructed line and grade. It was last surveyed in the fall of 2016 by the Polk County ditch inspector. At this time it was determined that the ditch bottom grade was at or below the legal ditch bottom grade and no work could be done without initiating an improvement project.

4) **Performance of Existing Drain**

Over the last 20 years, or more, landowners in the drainage area of Polk County Ditch No. 39 have complained that it does not provide adequate agricultural drainage. In particular, the bottom 4.3 miles of the drain is not allowing the surface water to pass through system without causing frequent significant crop damage throughout the drainage system.
In an effort to improve performance of the drain, Polk County did upsize the mainline culverts along the bottom 4.3 miles. These new culverts were installed approximately 0.5 foot below the channel plan grade. The ditch was last cleaned in February 1995. The results of this maintenance work and the installation of larger culverts produced negligible improved performance of the drain. The cross section and bottom grade of the channel limits the drains flow capacity.

Again in 1998, the Polk County Ditch Engineer investigated these complaints and found that even in a clean condition the drain was inadequately sized to handle a 5 year rainfall event. The drain, in its present condition, has for a long time been performing far below acceptable standards for an agricultural ditch system in the watershed area. The acceptable standard design for new agricultural drains in the Red River Valley and the Red Lake Watershed District is for the drain to provide uniform access to adequate drainage up to a 10 year rainfall event.

5) Petition for Improvement Project

The 2016 growing season was a very wet one that caused a large amount of crop damage along the drain. As stated, a field survey was conducted in the fall of 2016 by the Polk County ditch inspector. It was determined after the survey that an improvement project was required to increase the capacity of the drain. Downstream landowners did meet with Richard Sanders, the Polk County engineer, in Crookston, Minnesota to discuss what could be done with the drain to improve its performance. Also discussed was, if there were to be an improvement project, going forward which ditch authority would be the best for all concerned. The consensus of those in attendance at this meeting was that the entire length of Polk County Ditch No. 39 needed to be improved and it would be best if the drain was turned over to the jurisdiction of the Red Lake Watershed District.

After this meeting, a larger group of land owners and farm operators along the drain did meet in Curtis Amundson’s farmstead shop to discuss what their options were to improve drainage. The landowners were consulted if there were any alternatives to an improvement project such and changing farming and land use practices. The unanimous consensus was that the only alternative to an improvement project was to do nothing and continue with the persistent and costly crop losses that they have been facing. All farm operators who expressed an opinion agreed that it was not practical or cost effective to do nothing and the existing ditch needed to be improved. The scope of a contemplated improvement project was discussed and it was debated if the drain should be turned over to the Red Lake Watershed District. Discussed at this meeting was the location of existing utilities that would have to be relocated if the existing channel were altered. The requirement of a grass buffer strip to be planted along the existing drain was brought up. The land owners were also informed that grant funds could be applied for from the West Polk County Soil and Water District to install field inlet culverts to control soil erosion from field runoff.
The outcome of these farm operator and land owner meetings was a petition for the Red Lake Watershed to construct an improvement project. The petition was prepared by legal counsel and filed with the Board of Managers of the Red Lake Watershed District in accordance with Minnesota Statutes 103E.215. A copy of the signed petition is included in this report as Exhibit A.

The Red Lake Watershed District did accept the petition as presented and appointed Pribula Engineering, PLLC, in accordance with Minnesota Statutes 103E.241, Subd. 1, to prepare a preliminary engineer’s report for an improvement project. The drain was designated as Red Lake Watershed Ditch No. 17 and was assigned a Red Lake Watershed Project No. 179.

The petition requested that the engineer design a 9.3 mile long drain that has an operational 10 year design. It also requested that the engineer consider ditch bottom grades along the alignment as listed in the petition. The preliminary plans contained herein comply substantially with these requests with the exception of the ditch bottom grade though Section 14 of Sullivan Township was changed from 0.055% grade to a 0.073% grade. This was determined to be necessary after the field survey showed that the existing ditch bottom grade at the west (downstream) end of the existing ditch could remain at its existing elevation if a 0.073% grade was maintained from the east. This was determined to be mandatory as other established township roadway ditches enter the drain at the existing mainline culvert elevation.

6) **Intent of this Preliminary Report**

It is the intent of this preliminary engineer’s report to be as complete as possible and to comply with the recommendations and requirements found in the Minnesota Board of Water & Soil Resources “Minnesota Public Drainage Manual” when constructing a drain in accordance with Minnesota State Statute 103E. In particular this report will address that portion of the manual that deals with suggested contents of a preliminary survey and preliminary engineer’s report. If necessary, this report will be revised if a DNR preliminary advisory report should request additional information as to the effects that this project may have on public waters, the environment, land uses, and multipurpose water management criteria as stated in section Minn. Stat. 103E.015.

7) **General Considerations**

The petitioners requested a fairly specific design. It appeared obvious to them that improving the existing drain was the only acceptable way to solve the persistent flooding problems along the drain. I do agree, and with that in mind, it was determined that the preliminary survey should be very complete. Enough accurate field survey data was collected in 2018 so that complete bid document plans could be prepared in the event the project should go forward in 2019. All government section and quarter sections corners were located or set during the cross section survey. The location of these will be required if the channel alignment and right-of-way lines are to be parallel
with the adjacent section lines. Survey datum was collected in Polk County horizontal coordinates and 1988 vertical datum which is the same datum of the most recent LIDAR data. This LIDAR data was utilized in the design process to determine ground elevation throughout the projects drainage basin. At all locations along the drain it is intended that the design water surface profile in the drain will be below the adjacent field elevation. Mainline culverts along the drain are sized in accordance with recommendations of the Technical and Scientific Advisory Committee of the Red River Basin Flood Damage Reduction Work Group. These mainline culverts are typically section line and field approach culverts. The culverts are sized to meter water through the system and to hold back water at flows beyond the design flow. The intent is to create, as best possible, equal access to drainage with uniform retention along drain. Due to existing field topography and the required depth of the channel, downstream lands may have greater access to drainage than others along the drain.

The soils throughout the projects drainage basin are essentially uniform. They are dense, uniform, impermeable glacial lake clay with some small areas of thin fairly permeable glacial lake silt. Due to the consistency of the soils no soil survey was thought necessary.

The outlet for the improved drain is the same as the existing outlet. It is the Grand Marais Creek which has been determined to be an impaired waterway due to a high sediment load. The outlet will require special design considerations that will be listed in Section 17 of this report.

8) Project Type and Objectives

The proposed project is public waterway that is an open channel surface water conveyance drain.

The requested design criteria as stated in the petition, does make the petitioners goals and objectives fairly clear and concise. The objective of the proposed project is to improve the existing Polk County Ditch No. 39 channel to handle a 10 year rainfall event. This is an accepted design standard for all new agricultural drains in the Red Lake Watershed District. The improvement project is necessary as even in a clean condition the existing drain is inadequately sized to handle a 5 year rainfall event. The operation and maintenance of the entire existing Polk County Ditch No. 39 drainage system will be turned over to the Red Lake Watershed District. Both Polk County and the Red Lake Watershed District officials have agreed in principal to transfer the operation and maintenance of an improved drain to the Red Lake Watershed District.

9) Conformance with Existing Water Management Plans

The proposed improvement project conforms to and is consistent with the overall plan of the Red Lake Watershed District, the Red River Agreement, TSAC Technical Papers and State Flood Plain Regulations. The project as presented does incorporate Watershed Restoration and Protection Strategies (WRAPS). It also attempts to conform to the goals of the One Watershed One Plan (1W1P). The proposed surface drain that is
presented and described in this report will provide acceptable agricultural drainage throughout its drainage basin with no negative impact to the environment.

The project incorporates measures as described in TSAC Technical Paper No. 11 to help reduce the peak flow on the Red River during a 100 year flood. It also provides a substantial reduction to local flood damage in the project area. Per Technical Paper No. 11, the timing of the sub-watersheds relative to the main stem peak is very important. All the flow from this sub-basin is classified as early water that tends to arrive ahead of the main stem peak flow on the Red River. Activities that reduce the local peak flows can at times also provide valuable storage during very large flood events. Improvement projects that increases early water conveyance will move more water through the system prior to the peak main stem flow and thereby reduce the peak flood elevation on the main stem. Accelerating early water will reduce downstream flood peaks during larger events. Historically increasing early water conveyance has been a predominant flood damage reduction measure in the Red River Basin.

The Managers of the Red Lake Watershed District are also aware of other requirements of state law applicable to the proposed project, including Minnesota Statutes 103E.015 – Consideration before Drainage Work is Done; 103E.501 to 103E.555 – Construction of Drainage Project; and 103E.601 to 103E.661 – Funding, Collection and Payment of Drainage System Costs.

10) Project Limitations

This project is hydraulically limited to handling a 10 year rainfall event that falls within the drainage basin that it is intended to serve.

This project will not solve the overflow problems of Polk County Ditch No. 66 which should be considered and addressed separately.

11) Physical Characteristics of the Watershed

During prolonged wet periods there has been repetitive flooding of the agricultural lands adjacent to the lower 4.3 miles of Polk County Ditch No. 39. The flooding is due to the natural flat topography of the land that is close to the drains outlet. In the Red River Valley, practically all the agricultural ditches that were constructed in the early 1900’s have the same exact problem as Polk County Ditch No. 39. These ditches were constructed the best that they could be build with equipment that was available at the time. The limited capability of the equipment being used caused the ditch bottom grades to closely conform following the lay of the land. For this reason, the bottom ends of these ditches were constructed with much less grade than the upper ends. There typical was no increase in bottom width to compensate for the flattening of the grade which caused decreased flow capacity. Decreasing flow capacity in the location where capacity should be greater caused flooding in the area. Increased field drainage over the years has also amplified the problem. Polk County Ditches No. 37, 38 and 40 are all east-west county ditches adjacent to and parallel with Polk County Ditch
No. 39. County Ditches 37 and 38 are south of 39 and Polk County Ditch No. 40 is north of 39. All three of these ditches have had the same exact problem as the drain that is the subject of this report. In the past 15 years all Polk County Ditches 37, 38 and 40 have all had improvement projects to increase capacity along the bottom 5 miles of each drain.

12) Hydrologic and Hydraulic Considerations
The land throughout the entire watershed of this project is use for intensive agricultural purposes. The land is used annually to produce high value grain and row crops. If well drain, it is some of the best agricultural land in the world. For this reason, farm operators do the best they can to construct and maintain working field drains that encourages quick runoff. The average annual precipitation is close to 16 inches but can fluctuate widely. The runoff rate depends allot on rainfall patterns and how saturated the soil is during a rainfall event. There is much subsurface drain tile begin installed in the watershed area and that too will influence how much of the rainfall moisture will runoff or be absorbed in the soil.

Initially, USGS - STREAMSTATS was utilized to help determine runoff drainage area. Topography maps with superimposed LiDAR contours and field survey data were used to check the accuracy of the STREAMSTATS runoff area.

There are many methods of estimating flows for a particular runoff event. Three different techniques were used to predicting the flow for a 10 year event in the subject watershed. The methods used were:

- NRCS M-Curve for small watersheds
- Regression Formula, for Red River Valley – Q =27A to 5/6 power (USED)

The results of each method were compared at uniform intervals along the new channel alignment. The methods each produce similar results. The one that produced the largest, most conservative result, was Q=27A to 5/6 power, was utilized to design the improved ditch channel. This formula has been used by many watershed engineers to design agricultural drains in the Red River Valley. The performance of these drains indicates that it predicts very well the runoff flow rate for a 10 year events. If used consistently all drains in the vicinity should perform to the same degree of service. Same degree of service is synonymous to fair and equable which is the goal of most existing water management plans. Manning’s open channel flow equation was used (N = 0.04) to calculate the depth of steady uniform flow in between mainline culverts throughout the alignment. The plan and profile sheets of these preliminary plans show the hydraulic design along the length of the new channel.

A much larger concern is the amount of water that passes from the watershed of Polk County Ditch No. 66 into the system. This unintended flow must be account for and the channel must be designed to handle this water even though it may come erratically. There are three (3) existing 36” RCP centerline culverts through Polk County Road No. 20 between Sections 14 and 15 on Keystone Township that allows water to enter the system when Polk County Ditch No. 66 overflows. The combined flow of these three (3) culverts is 99 CFS when they are simultaneously flowing full with no
head pressure. Using the Red River Valley regression formula, 3 ¼ square miles of drainage area produces a flow rate of 99 CFS. No hydraulic analysis of the Polk County Ditch No. 66 system was done or is necessary because the 3-36" culverts will remain in place and no other culverts will be allowed to be added. Therefore, it is reasonable to plan for only the maximum combined flowing full capacity of these existing culverts. The design flow at the beginning of the drain on the west side of Polk County Road No. 20 is 99 CFS. The capacity of the channel and mainline culverts are incrementally increase as it progresses westerly to the outfall. Based on USGS (2009) Minnesota, Region A, the outlet flows of the drainage basin are listed as follows: Q₂ = 104 cfs, Q₅ = 198 cfs, Q₁₀ = 268 cfs, Q₂₅ = 360 cfs, Q₅₀ = 430 cfs and Q₁₀₀ = 503 cfs. The sizing of the mainline culverts will cause ponding upstream at each section line roadway crossing. Flow from the drainage basin will be restricted to a 10 year event flow by the mainline culverts until such time the roads are topped. The mainline culverts will allow water to backup into the proposed channel during high water events on the Grand Marais Creek and the Red River. The project will not reduce storage during a flooding event and it will not change the FEMA 100 year floodplain elevation in the vicinity of the project.

13) Project Watershed Area

The proposed drain has a design watershed area of 16.5 Square miles. A map that delineates the watershed area is attached to this report as (Exhibit B) in the appendix.

Also attached are maps for the 1903 original benefited area for Polk County Ditch No. 39 (EXHIBIT D) in the appendix, and the 1907 original benefited area for Polk County Ditch No. 66 (EXHIBIT E) in the appendix.

A United States Geological Survey (USGS) website called STREAMSTATS that utilizes LIDAR technology was utilized to determine the contributing drainage area at any location along the proposed new channel. Recent aerial maps that included LIDAR contours were also used to determine drainage area. And finally a field observations and surveys were conducted to check and verify the area that was determined by STREAMSTATS and LIDAR data. The area essentially is bounded by the township roadway one mile to the south, the ¼ section lines one half mile to the north, a natural ridge running northwesterly through Sections 11, 12 and 13, Keystone Township on the east and a natural ridge running northwesterly through Sections 8 and 17, Sullivan Township.

It should be noted that due to possible protection benefits and benefits that may be assigned to lands within the Polk County No. 66 drainage area, the area benefited by constructing the drain is larger than the project watershed area.

14) Polk County Ditch No. 66 – Watershed Concerns

Polk County Ditch No. 66 was constructed in 1907, 4 years after Polk County Ditch No. 39 was constructed. It is anticipated that it was constructed to cut off water coming from the east that was entering Ditch No. 39. It intended to send the intercepted water northerly into another east-west drain, Judicial Ditch No. 2. Some of the land owners within the proposed projects drainage area are concerned that water overflows from
County Ditch No. 66 and is allowed to flow westerly within Polk County Ditch No. 39. They are concerned that water will continue to do so and inadvertently enter the new drain. Their concerns are based on their observations of Polk County Ditch No. 66 overflowing in Sections 11, 12 and 13 of Keystone Township. I do believe that Polk County Ditch No. 66 does regularly overflow and their concerns are valid. This overflow can be sporadic but when it does happen, 3-36" centerline culverts through Polk County Road No. 20 between Sections 14 and 15, Keystone Township will allow water to pass into the drainage basin of the proposed drain. In places the overflows have caused the berms to be eroded away. Some of these washouts have not been repaired which allows more frequent overflowing of County Ditch 66. These washouts should be repaired to a proper elevation so County Ditch No. 66 can handle its intended design flows.

It should also be noted that all existing Polk County Ditches and Red Lake Watershed Drains were originally constructed to a design standard that was acceptable at the time of construction. Engineering methods and acceptable design standards have changed throughout the years. No ditch, including Polk County Ditch No. 66 was originally designed to intentionally overflow. The condition and capacity of a drain like Polk County Ditch No. 66 that was constructed in 1907 may not be acceptable according to today's design standards and probably should be improved. The topography of the land lying westerly Polk County Ditch No. 66 forms a natural ridge that should cut off overland flow water coming from the east. When the capacity of Polk County Ditch No. 66 is surpassed, water will overflow this ridge and allow water to flow into the design watershed area of this proposed drain.

The project as proposed will only handle a 10 year rainfall event that occurs within a watershed area that it is designed for. All water entering the system from the lands east of Polk County Highway No. 20 must pass through three (3) 36" round RCP culverts. The maximum combined full flow rate of these culverts is 99 CFS. When designing the new drainage channel this 99 CFS must be accounted for. It does not matter if it is runoff from land or if it is overflow from Polk County Ditch No. 66.

At some point all drains overflow when they receive water beyond design capacity. The exact capacity of Ditch No. 66 has not been determined and it is not within the scope of this report to do so. Performance would suggest that its existing capacity is below a 5 year design. Regardless, the problems with Ditch No. 66 will continue to exist even if the proposed improvement project is not build.

15) Proposed Channel Alignment

As requested and stated in the petition filed with the Red Lake Watershed District, the drain will begin at a point 65 feet easterly of the northeast corner of Section 15, Township 152 North, Range 48 West (Keystone Township, Polk County) and proceed westerly, approximately 9.3 miles, along the north lines of Sections 15, 16, 17 and 18, Keystone Township and along the north lines of Sections 13, 14, 15, 16, 17 and 18, Township 152 North, range 49West (Sullivan Township, Polk County) to the easterly bank of the Grand Marais Creek that flows northerly through the Northeast Quarter of Section 18, Sullivan Township.
16) Size and Character of proposed Drain

   The preliminary plans for the proposed drain are included with this report and they show the geometry of the proposed channel. As required by the Polk County Highway Department, the in-slope of the new drainage channel will have a 5:1 slope. The width of the channel is also shown on the plans and is dictated by the required hydraulic carrying capacity at any point along the drains alignment. The width of the channel varies in different locations in order to keep the water surface profile in the drain a minimum of 1 foot below the adjacent field when it is flowing at its 10 year design. The plan intends to provide equal access to drainage for all lands along the drain. The back-slope of the new drain will have a 3:1 to 4:1 slope which is needed to be mowable. Beyond the top of the back-slope will be a maintained 16.5 foot wide grass berm as required Minn. Stat. 103E.021 and Minn. Stat. 103F.48.

   The drain will be constructed for the benefit of agricultural lands in its drainage area. The drain’s channel and adjacent berm will be constructed so they can be maintained properly. This drain will also provide an adequate outlet for any existing or future subsurface tile projects that may be adjacent to the drain.

17) Outlet – Grand Marais Creek a Public Waterway

   The receiving watercourse is the Grand Marais Creek. The bottom of the proposed channel will day light out into the south ditch of Polk County Road No. 65 at a point 400 feet easterly of the right bank of the Grand Marais Creek that flows northerly through the Northeast Quarter of Section 18, Township 152 North, Range 29 West (Sullivan Township, Polk County). At this location, the existing Polk County Ditch No. 39 is at a low enough elevation to allow the flow to pass into the Grand Marais Creek. Temporary and permanent vegetative and rock erosion control devices will be utilized to prevent sedimentation from entering the Grand Marais Creek. It is very important that this project will not allow sediment to enter the Grand Marais Creek. Adequate erosion control measures will be incorporated into the construction plans. There is an existing homestead driveway approach directly east of were the ditch bottom will day light out. There is an existing 7’x4’ concrete box culvert and an existing 42” round CMP culvert through this driveway. Preliminarily the intent is to leave these existing culverts in place and add an additional 73”x55” CMP culvert to reduce the velocity of flow as the water enters the Grand Marais Channel.

   Hydraulically, the Grand Marais Creek is an adequate outlet for the project as proposed. Within the last 10 years the Red Lake Watershed District has constructed an extensive improvement project to the Grand Marais Creek where it enters the Red River of the North. The project increased the capacity of the creek by reestablishing its natural meandering outlet into the Red River of the North thereby providing a dual outlet at the bottom end. The proposed new drain has the same effective drainage area as the existing Polk County Ditch No. 39. The total volume entering the Grand Marais Creek will be the same. The project will cause the runoff to reach the creek sooner. Technical Paper No. 11 identifies the drainage area of this project to be in area that contributes early water entering the Red River of the North. The outcome of the
project being constructed may lower the peak flow on the Red River during larger flood events. During smaller events the impact is extremely negligible. There are no structures downstream that will be impacted by the project.

Aggressive erosion control measures will be applied to the existing outlet channel to help minimize the sediment load in the Grand Marais Creek.

18) **Field Inlets – Erosion Control**

The West Polk County Soil and Water Conservation District has approved a grant to install rip-rapped field inlet pipes at all locations where private field drains outlet water into the new ditch channel. 18” CMP culverts will be installed through the grass buffer strip in the spoil area along the drain. The outlet end of the pipes will be rip-rapped according the NRCS recommendations (see detail on attached plans) and flap gates will be installed which will decrease the velocity of the water entering the drain. Inlet aprons will also be installed on all field inlet pipes. The location of inlet pipes will be coordinated with landowners in the field during construction.

19) **Grass Buffer Strip – Erosion Control**

Sufficient permanent right-of-way will be acquired for this project so a 16.5 ft. (1 rod) minimum width of grass buffer strip will be established as part of the project along the entire length of proposed drain. This will be done in accordance with Minnesota Statutes 103E.021.

20) **Storm Water Pollution Prevention Plan (SWPPP)**

A SWPPP specific to the project will be developed. The SWPPP will be a cooperative effort between engineer and the contractor. The SWPPP will incorporate bid item materials along with the means and methods to be provided by the contractor to protect the environment. Erosion and sediment Best Management Practices (BMPs) will be implemented according to the plans and the SWPPP. Temporary and permanent erosion and sediment BMPs will be used to prevent contamination of the Grand Marais Creek.

21) **Required Permits**

All required permits will be applied for as soon as the Red Lake Watershed District Board of Managers determines that the project will go forward. If constructed, permits will be required from:

*Local*

Local requirements for permits include a review and approval of the proposed plans by Polk County Highway Department and possibly the Minnesota Department of Transportation. Additionally, the project will require a permit from the Red Lake Watershed District.
State

A permit may be required from the Minnesota Department of Natural Resources, if the proposed project does involve working in Public Waters. The Department of Natural Resources and Minnesota Board of Water and Soil Resources have the responsibility to review this Preliminary Engineer’s Report and provide an Advisory Report to the Watershed District.

A Storm Water Pollution Prevention Plan (SWPPP) will be developed and a permit will be required from the Minnesota Pollution Control Agency, since construction activities will disturb more than one acre of land.

The petitioned project outlets to wetland identified on the National Westland Inventory (NWI) database (see exhibit B). Current NRCS wetland mitigation rules will be followed if it is determined that wetlands will be impacted by the project. There is no intention to place any fill material within the Grand Marais Creek or any designated wetlands. If this is the case the project will not require permitting or replacement plan per the Wetland Conservation Act.

Federal Requirements

A Corps of Engineers Section 404 permit will be needed if it is determined that fill will be inadvertently placed in a found designated wetland area. No other federal permits are envisioned.

22) Wetlands and Public Lands Affected

There are no known lake basin, wetland, calcareous fen, public water body of public lands that will be affected by the project. The West Polk County Soil and Water District has been contacted to inform them of a possible drainage project. The national wetland inventory map was checked and there were no wetland delineated on it. Also, being the alignment is in the same location of an existing ditch, there are no impacted wetlands that have not already been prior converted.

23) Conservation Easements

There are no known permanent conservation easements on any land within the drainage area of the proposed project. During the field survey, there appeared to be no land enrolled in the CRP that would be disturbed if the project were to be built.
24) Evaluation of Social, Economic and Environmental Impacts

A. Economic Analysis of Private and Public Benefits and Costs of the Project

1. Private Benefits

The private benefits to be expected from project are mainly to adjacent agricultural lands productivity. These private benefits would be experienced through reduced overland flooding and reduced field erosion which will certainly result in greater crop yields.

2. Public Benefits

Public road systems that will be benefited by proposed project include Polk County Highway No. 66, Polk County Highway No. 20 and Polk, Polk County Road No. 65. The proposed project will provide positive drainage away from the roadways. The subgrade of the roads will be strengthened by removal of excess water. An improved subgrade will increase the useful life of the roadway.

3. Project Costs

The estimated total project costs for the proposed drain construction described in this report can be found in the detailed breakdown of the project costs is included in Section 29 at the end of this report.

In addition to economic costs, there are other non-quantifiable factors to be considered. These include impacts on the environment, social costs, and cultural costs. As part of this project some centerline culverts will be installed across Polk County Road No. 65. These culverts will be installed by open cut. This will require traffic to be rerouted for a short period of time. It is expected that each culvert installation will close the road for approximately 8 hours. During construction the project will cause temporary inconveniences such as limiting access to properties. Some lands will be removed permanently from agricultural production, and other land will be not farmed for a period time during construction. The permanent right-of-way for construction of the proposed drain will remove approximately ____ acres of land from agricultural production. An additional ____ acres of existing agricultural land will be required for spoil bank right-of-way along proposed drain. This spoil bank right-of-way is required for the placement and leveling of topsoil and spoil and other construction activities. The land required for spoil bank right-of-way will be lost for agriculturally for one or two production seasons. After completion of the project construction, the spoil bank right-of-way can be used for agricultural purposes again.

There are no known cultural or archeological sites along the alignment of proposed drain. All of the land area along the alignment has been previously disturbed by roadway and drainage ditch construction. The adjacent fields have been farmed continuously for the last 150 years. Therefore, there are no anticipated impacts on cultural or archaeological resources.
B. Alternative Measures

Minnesota Statutes 103E.015 Subdivision 1. (2) requires the consideration of alternative measures to address the drainage problem being addressed by the project. Alternative measures identified in state and locally adopted water management plans would include changing land use by creating wetlands, enrolling the effected land in a permanent easement program through the state of Minnesota (Reinvest in Minnesota), or the federal government (i.e. Conservation Reserve Program, Wetland Reserve Easement, etc.), or flood storage easement through the watershed. All of these alternative measures involve landowner participation on a voluntary basis and would be pursued in a voluntary basis and would meet the goals of Subd. 1. (2)(i-v). All these alternatives were suggested to landowners/farm operators at pre-petition meetings. None of the concerned believed that any of these alternatives to the improvement project were viable. It is unlikely that these alternative measures would be pursued on a voluntary basis. All lands within the project drainage area are classified as intensively farmed land valuable prime land. All land is presently being utilized for high value agricultural crop production. All land owners along the drain will capitulate to the project acquiring land for and the seeding of a required grass buffer strip. This grass berm will limit field drainage to side inlets that will control erosion.

C. Present and Anticipated Land Use within the Project Area

The vast majority of the present land use within the project area is agricultural. In general, land use will remain agricultural for the foreseeable future. The project is compatible with local land use plans. The land drained by the proposed ditch is located in an area zoned “Agricultural” according to Polk County GIS records.

D. Current and Potential Flooding Characteristics of the Property in the Drainage Project and Downstreams and the adequacy of the outlet for the Drainage Project

Sections 9, 10, 12 and 17 all address the projects hydrology and the adequacy of the Grand Marais Creek as the outlet. The flooding characteristics of the project area are discussed in Sections 9 and 11 of this report. These specific flooding, drainage, and erosion problems are all surface water related and have lead landowners to petition for this improvement project. Due to very flat slopes, surface runoff pools on farmland throughout the drainage area of the proposed drain. Essentially all of the agricultural land within the project drainage area is directly impacted by drainage and flooding problems. Annual spring flooding impacts agriculture adversely by delaying the start of spring planting and shortening of the growing season. This results in reduced crop yields. More damaging are heavy summer rainfall events that can cause substantial financial losses to crop producers. The rate of flood water development and magnitude can be much greater than that which occurs in the springtime. These damages are greater because the excess rainfall comes usually early on in the growing season when the crops are most vulnerable to standing in sustained water. Replanting can take place but the potential of the crop is greatly reduced due the soil compaction and shortened growing season. Presently the existing ditch channel is inadequate at discharges that are less than a 5-year event. The proposed improvement will
substantially decrease crop flood damage due to the duration of standing water in depressed areas. Technical briefing papers no. 3 and no. 15 prepared by the International Water Institute (IWI) and RRBFDGR Work Group Technical and Scientific Advisory Committee (TSAC) were utilized as guidance in the design of this drain. The proposed channel is designed for a 10-year discharge capacity. Drainage system design flows and average velocities are indicated on attached preliminary construction plans. For events that are equal to a 10-year recurrence flooding will be equally distributed throughout the drainage system and would last approximately 24 hours. For events greater than a 10-year return frequency some crop damage that is equally distributed throughout the watershed should be expected for a period of approximately 24 hours. When the propose drain is flowing at design capacity there will be limited or no outflow from adjacent fields and mainline culverts will hold water back behind township and county roadways. The highest flood levels (10, 25 and 50-year events and higher) in the project area are driven by breakout and backflow water from the Grand Marais Creek. During these higher events the project channel will provide some detention.

E. Effects of the Proposed Drainage Project on Wetlands

There are no wetlands that would be affected by the proposed project. A review of the National Wetland Inventory (NWI) indicates no wetlands within the project construction area. The petitioned project outlets to and existing county roadway ditch prior to entering the Grand Marais Creek. This ditch is not identified on the National Wetland Inventory (NWI) database, the project will not result in impacts to wetland, since no fill is being placed in any wetland. Proposed ditch will utilize and existing ditch that presently outlets into the Grand Marais Creek. A Storm Water Pollution Prevention Plan (SWPPP) will be prepared for the project. Erosion control techniques such as silt fence, bio-rolls, rip-rap, seeding, Field inlet pipes and limiting unseeded sections as ditch construction proceeds may be utilized. When the project is complete and well vegetated, the sediment load from the project will be lower than before construction. The improved channel area is designed for reduction of erosion and sediment production. Techniques have been incorporated into the project design including piped inlets and grass buffer strips which do not currently exist. The channel will have insignificant effect on the quantity of other water pollutants entering downstream watercourses.

F. Effects of the Proposed Drainage Project on Water Quality

With the implementation of a sound SWPPP of an extreme runoff condition during project construction could minimize any increased sediment load into the downstream channel system. A Storm Water Pollution Prevention Plan (SWPPP) will be prepared for the project. When the project is complete and well vegetated, the sediment load from the project will be lower than before construction. The improved channel area is designed for reduction of erosion and sediment production. Techniques have been incorporated into the project design including piped field inlets as detailed by NRCS, berms to control and reduce field inlet locations and grass buffer strips which do not currently exist. The channel will have insignificant effect on the quantity of other water pollutants entering downstream watercourses.
G. Effects on the Proposed Drainage Project on Fish and Wildlife Resources

The proposed ditch project does not contemplate any major excavation in any existing natural watercourse or lake, and as a result will have insignificant effects on fish resources. Water flows in the ditch channel are intermittent and occur only after heavy rains or spring snow melt. All disturbed areas up outside edge of 16.5 foot grassed buffer are to be seeded to grass as part of the project. This grass will provide a small amount of cover to wildlife native to the area and will have a positive effect on wildlife resources. There is no destruction of prairie wildlife as part of this project.

H. Effects of the Proposed Drainage Project Upon Shallow Ground Water Availability, Distribution, and Use

The proposed drain project should have little or no impact on existing shallow ground water resources within the project drainage area.

I. Overall Environmental Impact

The project engineer foresees that the overall impact of the project will contain no long-term adverse effects on the environment. While construction operations may have some inherent adverse effects on the environment, these effects are temporary in comparison to the long-term benefits anticipated from the project operation.

J. Investigating Potential Use of External Sources of Funding and Technical Assistance

In accordance with Minnesota Statutes 103E.015, Subd. 1a., the Engineer on behalf of the Red Lake Watershed District investigated the potential use of external sources of funding to facilitate the purposes of Minnesota Statutes 103E.001, subd. 5. This included early coordination with the West Polk Soil and Water Conservation District (WPCSWD). A meeting to discuss potential funding for field inlet erosion control structures was held on February 22, 2018 with officials of the WPCSWCD, the NRCS, the Red Lake Watershed District administrator and the engineer. The consensus resulting from this meeting was that the Clean Water Fund grant program administered by the Minnesota Board of Water and Soil Resources would be one potential funding source for the permanent erosion and sediment control features on this project.

25) Evaluation of Public Utility, Benefit or Welfare of the Project - Section 103E.015, Subd. 2

With consideration given to the conservation of soil, water, forest, wild animals, and related natural resources, and to other public interests affected, together with other matters as provided by law in determining whether the project will be of public utility, benefit, or welfare, the project engineers, in consultation with the Board of Managers of the Red Lake Watershed District, provide the following observations.

1. Presently, the storm water and spring runoff from the area proposed to be drained by project is not utilized for municipal, industrial, or irrigation purposes within the project area. It is not anticipated that these uses will materialize in the foreseeable future with or without the proposed project.
2. Ditch grades that are proposed for the establishment of project have been established to maintain non-erosive velocities.

3. Seeded side slopes and the required one rod grassed buffer strips on proposed drain will serve to retain and entrap nutrients, silt, and other materials which impair quality of downstream natural aquatic resources.

4. Recreational activities are currently limited within the project area. There is no anticipated adverse effect on recreation in this area.

5. Since the drainage system consists entirely of manmade ditch, there is no anticipated public navigation potential.

6. The project elements as proposed in this report include no drainage opportunities of existing lakes, wetlands, or other protected environments. Therefore, the proposed project will have little or no effect on fish resources. The ditch side slopes and a part of the berm will be seeded to grass as part of this project. This grass will provide a small amount of cover to wildlife native to the area and will have a positive effect on wildlife resources.

7. There are no known project areas currently designated as scientific natural areas. In addition, there are no known cultural or archaeological resources which would be endangered or adversely affected by project construction or the project components.

26) **Public and Private Utilities Affected**

The known Public utilities that would be affected by the project are:

- PKM Electric Power Company - Warren, MN
- Wickstrom Telephone Company - Karlstad, MN
- Century Link Telephone Company - Grand Forks, ND
- Marshall and Polk Rural Water System - Warren, MN

All have been notified about a probable ditch project. All have responded accept Century Link which is believed to have unused land lines in the vicinity of the project. The preliminary estimate to relocate all public utilities is $90,000 and is estimated as follows:

- PKM 2.25 miles Overhead Power @ $20,000/Mile = $50,000
- Wickstrom Tele. 3.0 miles Fiber Optic @ $10,000/ Mile = $30,000
- Marshall & Polk, miscellaneous line crossings = $6,000
- Century Link, miscellaneous land line crossings = $4,000

Private subsurface drain tile lines and pump stations may be impacted by the project. The exact locations of these are unknown and would be dealt with on an individual basis. Most on the known tile systems are on lands owned by proponents of the project.
27) Public Roadways Affected

There are eight (8) township roadway intersections and three (3) Polk County roads affected by the project. All township roadways are gravel roads that intersect the new drain perpendicularly. The will all be open cut to install new or relocated mainline culverts and north/south culverts will be installed in township roadways ditches that intersect the proposed new drain. Centerline culverts will have traps installed so water cannot back out of the proposed drain into other township and county roadway ditches.

Two county roads are bituminous paved, have existing mainline culverts that remain in place as they are the proper size and elevation. The other county road is Polk County Road No. 65 that runs parallel with and north of the proposed drain. With the approval of the Polk County Highway Department, the new channel will be partially built within the existing roadway. Additional ditch right-of-way will be required from land owners south of the county road to construct the drain and the required grass berm. There will also be new centerline culverts that cross Polk County Road No. 65 so that the land north of the county road can access the proposed drain.

28) Benefits and Damages to Private Lands

There is attached in the appendix of this report a proposed assessment map for the proposed project (EXHIBIT G). The petition, that is also attached, lists the landowners directly adjacent to the drain. These landowners may receive drainage benefits and/or damages if the drain requires construction right-of-way and slope easements to the construct the drain. Viewers will determine benefits and damages if the project goes forward.

The benefits could be viewed as direct drainage benefits or protection from flooding benefits. Viewers will determine the exact assessment area if the project goes forward.

No lands downstream from the drains outlet on the Grand Marais Creek will benefit of be damaged by the construction of this drain.

29) Preliminary Cost Estimate

The preliminary cost estimate is included herein is based on a detailed field survey. The total estimated contractor’s cost is based on the drain being built according to the preliminary plans. The cost of individual bid items are based on ditch projects that have been recently bid in the project area. There is also a total estimated cost construction that includes the contractor, utility relocation, engineering, legal, viewing, bonding, right-of-way, easement, contingences costs.

Based on a final cost of $1,589,552.25 to be assessed to all lands within an 11,520 acre assessment area, the average assessment would be approximately $140/acre. Lands closest to a drain typically have a higher assessment than other lands that are farther away from the drain. If the project should proceed beyond the preliminary landowner
hearing, viewers will review this report and determine the final assessment area and assessment rates.

30) **Project Practicality and Feasibility**

It is the opinion of the Project Engineer, that the proposed project outlined herein is necessary, feasible, and practical. It is recommended that the Managers take the necessary legal and administrative steps to proceed with proposed project.

31) **Appendix**

<table>
<thead>
<tr>
<th>Exhibit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Petition for Drainage Improvement Project</td>
</tr>
<tr>
<td>B</td>
<td>Project Watershed Area</td>
</tr>
<tr>
<td>C</td>
<td>Polk County Ditch No. 39 Original Right-of-Way Map</td>
</tr>
<tr>
<td>D</td>
<td>Original Benefited Map - Polk County Ditch No. 39</td>
</tr>
<tr>
<td>E</td>
<td>Benefit Map - Polk County Ditch No. 66</td>
</tr>
<tr>
<td>F</td>
<td>Polk County Ditch No. 66 – Elevation Map</td>
</tr>
<tr>
<td>G</td>
<td>Proposed Assessment Map</td>
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</tbody>
</table>

32) **Preliminary Plans**

These plans are preliminary and are believed to be sufficient for the engineer to give an opinion of the probable cost to construct the project as proposed. It is based on an accurate field survey and shows the location of the proposed improvements; location of the respective outlet; the location of the existing highways, bridges, and culverts; and all principal project features.
<table>
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<tr>
<th>Item No.</th>
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<th>Unit</th>
<th>Bid Quantity</th>
<th>Unit-Price ($)</th>
<th>Amount</th>
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<td>Excavation (Includes Topsoil Conservation, SWPPP Preparation and</td>
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<td></td>
<td>Erosion Control are all Incidental to this Bid Item)</td>
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<td>9</td>
<td>Roadway Surface Aggregate (MnDOT Class S)</td>
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<td>24” Extreior Flap Gate</td>
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<td>36</td>
<td>$700.00</td>
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Total Estimated Contractor Cost/Bid $1,099,521.25

Estimated Cost to Relocate Utilise $90,000.00
Engineering - Plans / Staking / Inspection (15%) $164,930.00
Contingency (10%) $110,000.00
Legal / Bonding (5%) $55,000.00

Permanent Right-of-Way Acre 53.18 $4,000.00 $212,720.00
Temporary Right-of-Way (2-years @ $250/yr) Acre 100.17 $300.00 $30,051.00

TOTAL PROJECT COST - BEFORE ONE WATERSHED ONE PLAN FUNDING $1,762,222.25

Estimated NRCS Funding - 90% of field inlet engineering/install $172,670.00

ESTIMATED COST TO BE ASSESSED IF SWI GRANT IS RECEIVED $1,589,552.25
APPENDIX INDEX

Exhibit A  Petition for Drainage Improvement Project
Exhibit B  Project Watershed Area
Exhibit C  Polk County Ditch No. 39 Original Right-of-Way Map
Exhibit D  Original Benefited Map - Polk County Ditch No. 39
Exhibit E  Benefit Map - Polk County Ditch No. 66
Exhibit F  Polk County Ditch No. 66 – Elevation Map
Exhibit G  Proposed Assessment Map
EXHIBIT A

PETITION
BEFORE THE RED LAKE WATERSHED DISTRICT,  
ACTING AS DRAINAGE AUTHORITY FOR  
IMPROVEMENT TO POLK COUNTY DITCH #39

Petition for Improvement of Polk County Ditch  
#39, Pursuant to Minnesota Statutes 103E.215

WHEREAS, Petitioners are owners of property within the Polk County Ditch #39 system;

WHEREAS, the Petitioners are requesting that Polk County Ditch #39 be improved, pursuant to Minnesota Statutes 103E.215; and

WHEREAS, Polk County Ditch #39 has insufficient capacity or needs enlarging or extending to furnish sufficient capacity or a better outlet; and

WHEREAS, Petitioners would request that upon completion of this Improvement, the operation and maintenance of the entire existing Polk County Ditch #39 system be turned over to the Red Lake Watershed District as the Drainage Authority; and

WHEREAS, Petitioners request that Pribula Engineering, PLLC, be appointed the engineer, pursuant to Minnesota Statutes 103E.241 to prepare a Preliminary Engineer’s Report; and

WHEREAS, Petitioners generally request the design criteria as outlined on the attached Exhibit A; and

WHEREAS, the starting point, general course and ending point is described as follows:

Beginning at a point 65 feet easterly of the northeast corner of Section 15, Township 152 North, Range 48 West (Keystone Township, Polk County) and proceeding westerly approximately 9.3 miles along the north lines of Sections 15, 16, 17 and 18, Keystone Township and along the north line of Sections 13, 14, 15, 16, 17 and 18, Township 152 North, Range 49 West (Sullivan Township, Polk County), to the easterly bank of the Grand Marais Creek that flows northerly through the Northeast Quarter of Section 18, Sullivan Township;

and

[13333-0011/2743229/1]
WHEREAS, the names and addresses of the owners of the 40 acre tracts or government lots that the Improvement passes over is as follows:

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<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>Legal</th>
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</thead>
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<tr>
<td>Curtis R. and Betty J. Amundson</td>
<td>43507 120th Street SW</td>
<td>W1/2 NE1/4, 18-152-49</td>
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<tr>
<td></td>
<td>East Grand Forks, MN 56721</td>
<td>ALL, 13-152-49</td>
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<tr>
<td>Gerald Enright W., et al.</td>
<td>P.O. Box 284</td>
<td>E1/2 NE1/4, 18-152-49</td>
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<td>East Grand Forks, MN 56721</td>
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<tr>
<td>Mary Ann Cicklinski</td>
<td>3720 Cherry Street, Apt. A4</td>
<td>NW1/4, 17-152-49</td>
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<tr>
<td></td>
<td>Grand Forks, ND 58201</td>
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<tr>
<td>Ellen Wurden</td>
<td>40916 245th St. SW</td>
<td>NE1/4, 17-152-49</td>
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<td></td>
<td>Fisher, MN 56723-9321</td>
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<tr>
<td>Paul Novacek</td>
<td>42764 120th Street SW</td>
<td>N1/2 NW1/4, 16-152-49</td>
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<tr>
<td>TNT Revocable Trust &amp;</td>
<td>5 Middlebury Rd.</td>
<td>NE1/4, 16-152-49</td>
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<tr>
<td>o/o Timothy Meyer</td>
<td>Barrington, IL 60010</td>
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<tr>
<td>Douglas A. Peterson</td>
<td>44194 140th Street SW</td>
<td>N1/2 NW1/4, 15-152-49</td>
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<tr>
<td>Glenn H. Hanson</td>
<td>45232 110th Street NW</td>
<td>NE1/4, 15-152-49</td>
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<td>Ronald D. and Patricia A. Novacek</td>
<td>39226 120th Street SW</td>
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<td>PT NE1/4, 14-152-49</td>
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<td>Kyle J. and Rebecca K. Novacek</td>
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<td>PT NE1/4, 14-152-49</td>
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<td>Folson Farm Corporation</td>
<td>306 7th Avenue NE</td>
<td>ALL, 18-152-48</td>
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<tr>
<td>Marvin L. and Coral E. Zak,</td>
<td>37604 Center Street West</td>
<td>NW1/4, 17-152-48</td>
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<tr>
<td>Trustees</td>
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<tr>
<td>Daniel G. and Donna R. Driscoll</td>
<td>13256 380th Avenue SW</td>
<td>W1/2 NE1/4, 17-152-48</td>
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<td></td>
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<tr>
<td>Robert E. and Dorothy J. Jerik</td>
<td>215 Central Avenue NW</td>
<td>E1/2 NE1/4, 17-152-48</td>
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<tr>
<td>Bradley Owens</td>
<td>12592 260th Avenue NW</td>
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<tr>
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<td>Euclid, MN 56722</td>
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<tr>
<td>Lamonte V. Peterson</td>
<td>31760 Co. Rd. 11, P.O. Box 97</td>
<td>NE1/4, 16-52-48</td>
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<tr>
<td>Owen K. Peterson</td>
<td>Wendell, MN 56590</td>
<td>NE1/4, 16-152-48</td>
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<tr>
<td>Marie E. Hagen</td>
<td>13962 State Hwy. 220 SW</td>
<td>NW1/4, 15-152-48</td>
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<td>East Grand Forks, MN 56721</td>
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<tr>
<td>Ellen and Eileen Vawrma Trustees</td>
<td>5569 Hyland Courts Drive</td>
<td>NE1/4, 15-52-48</td>
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<td>Bloomington, MN 55437</td>
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<tr>
<td>John L. Giese</td>
<td>P.O. Box 438</td>
<td>NW1/4, 14-152-48</td>
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</table>

and

WHEREAS, the proposed Improvement will be of public utility and promote the public health; and
WHEREAS, Petitioners are:

1. at least 26% of the owners of the property affected by the proposed Improvement;

2. are at least 26% of the owners of property that the proposed Improvement passes over;

3. the owners of at least 26% of the property area affected by the proposed Improvement;

4. the owners of at least 26% of the property area that the proposed Improvement passes over;

and

WHEREAS, Petitioners agree that they will pay all costs and expenses that may be incurred if the Improvement proceedings are dismissed.

<table>
<thead>
<tr>
<th>Name</th>
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<th>Date</th>
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<tbody>
<tr>
<td>Curtis Amundson</td>
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<td>Eileen Vavrina, Trustee</td>
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Operation and Maintenance Authority:

The petitioners request that the operation and maintenance of the entire existing Polk County Ditch No. 39 drainage system be turned over the Red Lake Watershed District. The petitioners also request that the benefits for the drain be re-determined after the improvement project has been completed. If for any reason the proposed improvement project is not constructed the petitioners request that the operation and maintenance remain with Polk County.

Design Criteria:

Design Flow Capacity:

The new channel shall be constructed to have an operational 10 year design.

Channel Alignment:

The petitioners request that an improved drainage system be constructed southerly of the existing township and county roadways. The channel to beginning at a point 65 feet easterly of the northeast corner of Section 15, Twp. 152 N., R.48 W. (Keystone Township, Polk County) and proceeding westerly approximately 9.3 miles), along the north line of Sections 15, 16, 17 and 18 Keystone Township and along the north line of Sections 13, 14, 15, 16 17 and 18, Twp. 152 N., R. 49 W. (Sullivan Township, Polk County) to the easterly bank of the Grand Marais Creek that flows northerly through the Northeast Quarter of Section 18, Sullivan Township.

The proposed new channel grade as it passes through each section shall be as follows:

<table>
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<tr>
<th>Section</th>
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<td>18 Sullivan</td>
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<tr>
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<td>15 Sullivan</td>
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<tr>
<td>14 Sullivan</td>
<td>0.055%</td>
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<td>13 Sullivan</td>
<td>0.073%</td>
</tr>
<tr>
<td>18 Keystone</td>
<td>0.073%</td>
</tr>
<tr>
<td>17 Keystone</td>
<td>0.073%</td>
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<tr>
<td>16 Keystone</td>
<td>0.073%</td>
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<tr>
<td>15 Keystone</td>
<td>0.117%</td>
</tr>
</tbody>
</table>

Channel Side Slope Grades:

Throughout the entire alignment, the new channel in-slope shall be a minimum of 5:1 or that to meet Polk County Highway Department requirements. Throughout the entire alignment, the new channel back-slope shall be a minimum of 4:1.

EXHIBIT A
Channel bottom Width:

The project engineer shall determine the proper ditch bottom width so that the new drain will provide all benefitted properties approximately the same degree of service. As best possible, the drain should provide equal opportunity to drain water into the drain and equal protection from flooding.

Channel Mainline Culverts:

The existing 10 foot x 4 foot concrete box culvert under Polk County Road No. 66 between Sections 13 and 14, Sullivan Township shall remain in place at its present alignment and grade. All other mainline culvert shall be shall be sized correctly for the design flow rate. Where feasible, existing culverts that are of the proper size and in good condition should be salvaged and reinstall.

Township and County Roadway Culverts:

In all locations where the new channel crosses through township and county roadways new field approaches shall be installed south of the new drain. These approaches shall have culverts of the appropriate size with flap gates installed. Access to the drain shall be provided to properties north of the drain by existing and/or new centerline culverts that cross the roadways to the north of the drain. These centerline culverts shall be trapped.

Field Side Inlet Culverts:

Trapped field side inlet culverts shall be installed to allow properties south of the drain access to drainage. Where practical, these field inlet culverts should be limited to 5 per mile along the channel. These types of culverts may be eligible for cost share assistance from the Polk County Soil and Water Conservation District. Individual land owners along the project alignment need to apply for this EQIP cost sharing to be eligible for it.

Excavation and Embankment

All spoil from channel excavation shall be deposited adjacent to the improved channel. The spoil shall be placed such that it provides a berm at an elevation of no less than 0.5 feet below the adjacent township roadway (0.5 feet is allowed for settlement). In locations where there is excessive clay spoil, the spoil can be piled higher than the roadway if spillways that are lower than the roadway are provided at ¼ mile intervals. This may be the case in Sections 16 and 17 Sullivan Township. Black topsoil shall be salvaged and replaced on the slope easement and new channel. The channel and buffer strip shall be seeded to grass.

Grass Filter Strip:

A 16.5 foot wide vegetated buffer strip shall be constructed and maintained adjacent to all improved channel.
Exhibit C - Polk County Ditch No. 39 Original Right-of-Way Map