THESIS

PROPOSED DRAINAGE OF FAYE LAKE
JACKSON CO. MICHIGAN

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JACKSON CO., MICHIGAN.

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The Faculty Of
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By

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DEDICATION.

To Professor H.K.Vedder, Professor of Civil Engineering at the Michigan Agricultural College, we wish to respectfully dedicate this work.

FOREWORD.

In working out the drainage project outline in this thesis, it has been the purpose of the authors to devote as much time as possible to the practicability of the project. Much of the territory covered by the survey is swampy and covered with brush, making accurate work difficult. The cost of the work has been estimated and is given together with the estimates of the benefits. The legal difficulties to be encountered are also shown. The authors wish at this time to acknowledge the assistance of Professor O.E.Robey of the Farm Mechanics Department, and Mr. F.A.Gould of the Civil Engineering Department, for their kind assistance.

K.L.Baguley.

W.O.Moore.

TABLE OF CONTENTS.

HISTORY.

Faye, Plater, and Cole Lakes, all of which would be effected by the proposed drain, are undoubtably of glacial origin. These Lakes are in Norval Township, all of which is covered by rolling hills interspersed with flat stretches of low land. The lakes are very deep, dropping off rapidly at about one hundred feet from the shore, which would also indicate that the lake was formed by a glacier. Further indications are found in the nature of the soil, which usually varies widely on each farm. At earlier periods when good land was plentiful, it would not be economic to drain the land, but at present with the values of land in the neighborhood ranging up to one hundred dollars per acre, many drainage projects are being carried out.

Insofar as the work on this problem is concerned, there are only two drainage projects which have been carried out, that interest us. These two are the straightening and cleaning out of the outlet to Faye Lake (the outlet dealt with in this problem), and the construction of a drain into the upper end of Faye Lake which is known as the Moore-O'Neill county drain. The outlet was straightened about fifteen years ago. No records were kept of the cost of straightening, and it was evidentially done by interested land owners.

Since being straightened, it has been cleaned twice, and dynamite was used on the portion running through the Arnold farm. The Moore-O'Neill county drain was petitioned and surveyed in the summer and fall of 1915. The work was done at a cost of $1155.20, and was completed in September, 1916. All of the work was done by hand or by teams and scrapers. The drain is beneficial to between 400 and 500 acres. Much of the land that was poor pasture land previous to the construction of the drain has been tile drained and now is valuable land.

Most of the landowners are in favor of the proposed drain which would lower the level of the lake between four and five feet. There are two landowners having land along the lake that might be unfavorable from the view that it would damage the value of the lake as a resort. This is taken up later in the thesis.

ILLUSTRATIONS.

Swamp land stretching from the railroad to the lake.

Typical lowland along outlet.

ILLUSTRATIONS.

Outlet to Faye Lake, showing brush filled streams.

Outlet from Plater Lake into Faye Lake. Note stream, practically no fall.

ILLUSTRATIONS.

Set up over Triangulation Station and
Bench Mark No.1

PROCEDURE.

It is to be remembered at the outset of the this work, that economy of design and construction is one of the necessities for an economic drainage project. With this in view, the authors have endeavored to keep the amount of surveying down near to the amount that would be required for the actual survey of this project.

The first steps taken were to make a general reconissance of the outlet which was to be lowered, noting the amount of fall, and approximately the area that would be affected by such a drain. The amount of fall in the outlet being a prime factor, this was investigated first. A line of levels was run down from an assumed datum plane for a distance down the outlet until the required fall was picked up. As no bench marks were available in the vicinity, an assumed datum of one hundred feet was taken as the elevation of bench mark and triangulation station No. 1. The levels were run back anc checked up again. Starting at triangulation station number one, as system of triangulation was run in and two base lines measured.

A calm morning was selected and stakes were then driven at the existing water level of the lake, so that future measurements taken from these stakes would be from the same level. These stakes were set along the lake near the triangulation stations, in order that approximate levels for elevation of land, water soundings, etc., could later be determined. The instrument (transit) was set up on each triangulation station and after orientation on some other station, shots on breaks in grade of the surrounding land, on the shore line, and soundings for a short distance from the land, were taken. Soundings for a short distance only were taken as the water was in the neighborhood of forty feet deep in the center of the lake and so further soundings were unnecessary. A rough map of Norval Township was obtained from the county drain commissioner of Jackson County, but the scale was too small and the map inaccurate except as to property lines. By the use of the above mentioned map many topographical notes were plotted by noting their position with regard to property lines. Measurements of the depth of the water in the outlet at regular intervals was taken in order to compute the excavation in cubic yards.

The above is a summary of the work done in the

field, and the rest of the work consisted of making maps, determining costs, increased land values, an investigation into the legal status of such a project, etc. Each one of these features is taken up in order.

PRACTICABILITY OF THE PROJECT.

Under this head will be shown how the construction should be done, that the construction of a drain will not reduce the fall below the required, and general construction notes.

Undoubtably the best method of putting in the drain would be by means of a floating dredge. However, as there is no dredge operating at present in Jackson County, this would be uneconomical. Whether or not a floating dredge will be used if the drain is put in will probably depend on the proximity of a dredge at the time. There would be sufficient water from the lake the dredge. There has only been one dredged job in Jackson County up to the present time, and most drains there are not large enough for dredges. One contractor in the vicinity of the job informed us that he has put in much larger drains than this would be by use of a scoop and by hand shoveling. This would probably be the method used. The drain is flowing quite constantly at all seasons, the lakes holding back the freshet water and acting as a reservoir. This would of course, hamper the construction.

The total amount of fall in the outlet for the

estimated necessary length of 8640 feet amounted to 7.34 feet. On the advice of Prof. Robey of the Farm Mechanics Department, who has made a study of drains, an allowance should be made for filling in of the drain, especially in the kind of soil encountered here, i.e., muck and loam containing sand. Thus five feet is taken as the amount necessary to cut to make a permanent cut of four feet, all that is required for the success of this project.

A cut of 5' would leave 2.34' for fall in a distance of 8640 feet, or

$$2.34 \times \frac{5280}{8640} = 1.44' \text{ per mile.}$$

According to Elliot's "Land Drainage" a fall of from 6 to 8 inches per mile is the minimum required. The reasons for taking a greater amount above is to create a sufficient velocity to clear out silt and muck that would tend to segregate due to the nature of the soil, and because a large amount of fall is picked up near the end of the project.

As the outlet has been straightened, no deviations from the present course would be required, and this lessens the amount of excavation. Sheet No. 2 in the envelope in the back cover of this thesis shows the profile of the water level, the new grade line, and the present bottom of the ditch.

ECONOMIC CONSIDERATIONS.

Similar to every economic consideration, it is the desire of the authors to show in this section the actual costs of the job balanced against the benefits derived therefrom. It may be noticed that in the discussion following there is no mention made of damages that might be awarded to injured land holders. This feature is taken care of in the next section entitled legal considerations.

The cost of the job will first be determined. No actual estimate could be obtained on this particular job, and an estimate of the cost is given below based on the depth of the ditch as compared to the cost for a similar ditch, or rather an average of ditches, built during the five year period from 1913 to 1917 in Jackson County. This five year period was a period very similar to the present one, and prices were slightly above those at present, making the estimates on the safe side. Luckily the average depth of ditch for Jackson Co. is nearly the same as the average depth of this ditch.

Average depth Hackson Co. ditches = 4.8'

" " Proposed ditch = 4.24' (See Profile)

Average cost per mile Jackson Co. = $1395.00

Cost of proposed ditch = $\frac{4.24}{4.8}$ x $1395 = $1232.00

(The figures on cost of ditches in Jackson county, and the percentages given below, are taken from Miller and Simons' "Drainage in Michigan."

One figure obtained froma local contractor in the vicinity of the job gives us a price of from $.25 to $.30 per cubic yard for scoop and shovel excavations of this kind. For an average cut of 4.24' and with a 1½ to 1 slope the top width would be (bottom width of 8')

10' plus (4.24 x 1½) = 16.36'

Average width of cut = $\frac{16.36 \text{ plus } 8}{2}$ = 12.18'

Average gross Area of cross section is equal to the average width x average cut, or

12.18 x 4.24 = 51.6 sq. ft.

From this must be taken the average stream cross section. From a series of measurements the width was determined to be 8.5 feet. From Prin No. 2, the average net area, the average stream depth is found to be 2.56' The average cross area of the stream is then,

2.56 x 8.5 = 21.76 sq. ft.

The average net area is then the difference between the gross area and the stream area, or

51.6 - 21.76 = 29.84 sq. ft.

The average cross sectional area x the length of the drain in feet will give the quantity, or

29.84 x 8460 = 258,000 cu. ft. = 9,550 cu. yds.

Taking the highest figure per yard of dirt as given, the total cost of construction will be $2390 The cost as computed from the average costs was determined as $1232.00 per mile, or for a length of 8640 feet, a total of $2040.00. As the above shows, the latter method giving a total cost of $2390 is a maximum and will be used. An estimate of one hundred and fifty ($150.00) per culvert was obtained which would be additional. An itemized list of the cost is given below by the use of the table on page 25, Miller and Simon's "Drainage in Michigan."

Item.	%	Amount.
Surveying.	2.76	$102.00
Printing.	1.32	48.00
Serving notices.	.19	7.00
Probate fees and special commissioners.	.33	12.00
Damages	1.27	47.00
Recording and Abstracts	.86	32.00
Misc.	.66	24.00
Contingency	4.43	164.00
Two culverts.	$150 each	300.00
Construction	(from above)	2390.00
	Total cost	$ 3126.00

The table on the preceding page shows a total cost of $3126.00. As this covers a length of 8640 feet, the cost per mile will be

$$\frac{5280}{8640} \times \$3126.00 = \$1910.00$$

To show that the estimate given above is a conservative one, some of the actual costs for the same five year period as was used will be given. Those counties having a similar average depth will be taken to show the comparison.

County	Average depth of ditch.	Cost per mile.
Barry.	4.3'	$1469.00
Branch	4.4	1315.00
Eaton	4.3	1968.00
Mason	4.3	1271.00
Kalamazoo	4.1	1200.00
Sanilac	4.1	1207.00

The estimated benefits will next be worked out. Although there have been many attempts to make a table showing the increased value of land with increased height above water level, none have been very successful, mostly due to variation in kinds of soil, marketing conditions, scarcity of good soil in that particular vicinity, etc. One that

has been used to some extent is the one put out by the College of Ontario. However, it is not suitable for use in this locality. The value of the land after draining has been arrived at in this problem by consultation with farmers in the vicinity. They gave various figures, but the average is about as follows,

Before Draining	After Draining,	Increase per acre.
Lake bottom	Swamp land.	$ 10.00
Swamp land	Good pasture	15.00
Pasture land	Cultivated land	15.00

It will be noticed by examining the above that the increase is the same for all land effected by the drain except lake bottom exposed by the lowering of the lake level. By "all land effected by the drain" is meant all land in the surrounding area that is at present too low to be drained, and that could be drained by the lowering of the lake. The above estimates of increased values are conservative and do not include the increased value after being tile drained.

By the use of a planimeter it was determined that the area upon Map No. 1 in the rear cover, that was

was effected by the proposed drain, was equal to 493 acres. There is an equal amount of land above Cole Lake that would be benefited, and this is estimated at four hundred acres. In addition to this there is an area of 21.9 acres of Faye Lake uncovered and an area of 3.49 acres of Plater Lake. These areas are shown by the dotted line on the map. The land included in the outside dotted line is the land effected by the project. Below is a table that itemizes the increased values.

Description	Area	Increased value per acre.	Amount.
Faye Lake bottom	21.89	$10	$ 219.80
Plater " "	3.49	$10	34.90
Area of map effected	493.00	16	7995.00
" outside" "	400.00	15	6000.00
		Total Benefit	14,248.80

The value given above balanced against the estimated cost of $ 3126.00 gives a balance of $11,122.80, this amount representing the gain that would be spread among the landowners.

LEGAL CONSIDERATIONS.

At first glance it might seem that the legal difficulties would be encountered only in the usual manner, but in the lowering of a lake level a different problem arises. The problem arising is the case of two laws, both dealing with the same question but the actual force of each law must be found from court decisions. The following is taken from the ordinance of 1787, Article 4, which provides:

"The navigable waters leading into the Mississippi and St. Lawrence, and the carrying places between the same, shall be common highways, and forever free as well as to the inhabitants of the said Territory as to the citizens of the United States, and those of any other states that may be admitted to the Confederacy, without tax, imposts, or duty therefore."

The above will be shown to, on the surface, conflict with Section 3, Chapter I, of the Michigan Drain laws. This reads as follows:

"Drains may be laid or extended into or along or from any lake or other body of water surrounded wholly or in part by a swamp, marsh or other low lands for the general purpose of drainage contemplated by this act but not so as to impair the navigation of any navigable river."

The last act quoted does not make any mention of lakes being navigable, and that they are part of the "navigable waters" mentioned in the Ordinance of 1787. The case given below is one that is often used to settle disputes in Michigan. It will be given as noted in the Michigan Record, 137/419. It not only defines the meaning of navigable but also shows clearly how one law can be used to interpet another in order to bring about justice.

Cole. v Dooley.

1. Navigable waters, Logging.

"A stream and lake which were used for floating logs as long as any were tributary, and since then for skiffs and steamers, are navigable."

2. Drains.-- Navigable Lakes.

"A public drain, the avowed purpose of which is to reclaim land by lowering the level of a navigable lake, is not authorized, under section 4339 of the Compiled Laws, which prohibits the impairing of the navigability of waters by such drains."

Appeal from Barry Co.

From a decree for complintant, defendant appeals. Affirmed.

Description of the Case.

Thornapple Lake is a body of water between two and three miles long, and half a mile in width, in the county of Barry. The testimoney in the case shows that there is deep water in the lake, but that the edges are low and wet, and that shallow water extends some distance into the lake, and that the bottom is soft to a depth of many feet. The shore around the lake is in many places springy, and it appears to be the consensus of opinion that springs exist in the lake which help feed it. Several streams empty into this lake, the largest of which is Thornapple river, about sixty feet wide where it empties into the lake. There is much low land along the river, especially near the lake. The outlet of the lake is also called Thornapple River, and is larger than the inlet of the same name.

Interested parties filed a petition with the county drain commissioner to establish a drain beginning at the outlet of the lake and extending down the stream, the avowed purpose of which was to lower the lake four feet. Near the south bank of this lake there is a high bluff owned by the complinants, which approaches within fifty feet or thereabouts of the waters edge. The complaintants' father owned

this property, consisting of a farm, and he built a dock and filled in along the shore behind it; thereby giving access to the lake, where he kept boats to let and a steamer, which was used to transport pleasure seekers who were attracted to this place. For 3 decades or more he and his children, who now own the place, conducted a successful resort and spent considerable money and improvements. Among other things constructed by them to this end were a dance hall and a larger dwelling, a boathouse, and a depot or waiting room. This was immediately in front of, and within seventy feet or thereabouts of, the house, and also immediately opposite the dock. There is about four feet of water at the dock at the ordinary stage of water.

The drain proposed will lay bare about sixty six acres of the bottom of the lake, and it will make shallows of other lake bottoms now covered by four feet and more of water. It will correspondingly lessen the area that can be traversed by the complaintants's boats, especially their steamboat. The complainants own a mile and a half of the shore of the lake with riparian rights incident thereto, and they oppose the proposed drain, and have filed a bill in this cause to restrain construction. The testimoney shows that the interested landowners, who expect to

have lands reclaimed by this drain have contributed to a fund to conduct the defense; and it is significant that several, if not most, of the large contributors own land near the inlets, and are not owners of the land through which the proposed drain is to be constructed. It seems to be a plain case of tapping and drawing down the surface of the lake, and a barefaced proceeding to improve farms, at complainants expense, under pretense of improving public health, a prostitution of the drain law to private purposes.

The complainants were not made party to the drain proceeding. They were not assessed for benefits, and we do not see how they could be, and, on the other hand, no damages suffered by them were considered.

Section 4339, 2 Comp. Laws, provides: Drains may be laid into or along or from any lake or other body of water surrounded wholly or in part by a swamp marsh, or other low lands, for the general drainage contemplated by this act but not so as to impair the navigation of any navigable water.

The evidence in this case is clear, that Thornapple River has been used for floating logs whenever tnere were logs to float, and occasion to float them. As long as their was timber in the vicinity, it was floated upon the lake; and in the early days timber was brought down the tributaries not only to a boom and mill upon the lake, but also to a mill situated at Quimby, a mile

or so down the river, and it has been navigated since by thousands in steamboats and skiffs owned by complaintants The stream and lake were therefore navigable waters under our decision.

As shown by the last mentioned case, the Ordinance of 1787, Art. 4, which provided:

"The navigable waters leading into the Mississippi and the St. Lawrence, and the carrying places between the same, shall be common highways, and forever free, as well to the inhabitants of the said Territory as to the citiaens of the United States and those of any other states that may be admitted into the Confederacy, without any tax, imposts, or duty therefore."

--- Saved to the public the right to navigate the streams of the state by bateaux or even canoes. Who shall doubt that the Grand River and its tributaries were navigable, under this rule, as well as Thornapple Lake through which the river runs. It may be that the water hurrying from the surface of the land by artificial drains which empty it into the Great Lakes with a celerity that nature abhors, is essential to Public health. Under this statute, it is possible that private lakes and ponds may be obliterated in the interest of public health, upon compensating the owners for the loss, which however, has not been done or proposed in

CONCLUSION.

Practicability: It seems evident that the drain can be put down as suggested, and that it is a sound and not complicated project.

Economy: That the drain would benefit the community is shown that in land improvement along the cost is over four times returned.

Legality: From a legal standpoint, there are evidentially difficulties to be overcome. The consent of the resort owners or an agreement should be had before the project is attempted.

INDEX TO POCKET.

MAP NUMBER ONE ..... Topographical Map

MAP NUMBER TWO ..... Profile Map

MAP NUMBER THREE ..... Map Of Norval Twp.