WATER SUPPLY AND SEWERAGE, FOR AKRON, MICHIGAN.

A Thesis Submitted to

The Faculty of

MICHIGAN AGRICULTURAL COLLEGE

By

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Candidates for the Degree of

Bachelor of Science

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Introduction

The village ofAkron has never had any water supply except from private wells and has no sewer system except for storm water. Our object in taking this thesis was to investigate the conditions at Akron and then design water and sewer systems to fit the conditions. Through the help of College instructors and others experienced in this line of work, it has been possible foer us to accomplish this end.

To aid in the determination of the available future supply of good water for Akron, we made a Geological Structure Section map which shows the rock formations as they exist at or near Akron. For the well records used in making this map and for other information on the geology of Tuscola County, we are indebted to Mr. Smith, ofthe United States Geological Survey in Lansing.

First of all it was necessary to go to Akron and make a topographical survey of the village and immediate vicinity. This was done during the winter of 1915 and 1916. Later a complete map was made showing contours at one foot interval. We are indebted to the Civil Engineering Department of M.A.C. for the instruments used on the survey.

Several samples of water from wells in Akron were tested as to their physical, chemical and sanitary fitness and potability for use as a domestic supply. We wish to express our appreciation for the work done by the Bacteriology and Chemestry Departments of M.A.C, in making the tests on these water samples.

The water system was designed to furnish sufficient water for fire consumption. The quantity necessary for domestic consumption was so much less that it did not have to be considered in the design.

On account of the lack of time, we did not attempt to estimate the cost of our proposed systems, but simply designed what would be absolutely if such systems were ever installed in the village of Akron..

The order in which the different subjects are presented in this thesis is as follows:-

Location

The villege of Akron is located in the northeastern part of Tuscola County, Michigan. Part of the villege lies in Fairgrove township and part in Akron township. It is about seven miles from Saginaw Bay and eighteen miles from Bay City, in a large and fertile valley known as the Saginaw valley. A ridge running through Watrousville, Caro and Gagetown forms the southeastern boundry of this valley in Tuscola County.

As is well known to geologists, the rock formations of Michigan are made up like a pile of saucers lying one upon the other with the concave side of the saucers upward. In the sequence of events according to geological history, after these formations were laid down, the surface was smoothed off by erosion, so that it was left comparatively level. The center of these saucer-like formations is very nearly in the central part of the Lower Peninsula. The village of Akron lies about half way between the center and the edge of the saucers. Consequently, all of the rocks at this place dip, toward the southwest.

A geological structure map of a section thru Akron was made, showing the approximate dip, thickness and character of the rock strata and overlying glacial drift. The map is here shown in this thesis. The data used in making this map consists chiefly of well records obtained from the records of the United States Geological Survey in Lansing. Many of these wells were not exactly on the section taken, so that the results which are shown on the map are only approximate. Nevertheless, it serves the purpose of presenting a general view of the rock formations in the vicinity of Akron.

Topography

The topography of Akron and immediate vicinity is pretty well shown on the topographical map which is included in this Thesis (In folder on inside of back cover). The data and notes used in making this map were obtained by the writers in the winter of 1915 and 1916, when they made a complete survey of the village and vicinity. The elevations were obtained by running lines of levels down the center lines of streets and along other lines where a knowledge of the topography was believed to be necessary. An initial elevation of 100' was assumed on the corner of a basement window sill at the Bank of Akron, and all elevations on the map refer to this point as a bench mark. Quite a number of other bench marks or check points were established at other places for the purpose of checking the lines of levels . All elevations were read to the nearest hundreth on the rod, and all lines of levels were checked on bench marks at the end.

The notes taken in this survey are shown on the following pages of this thesis. All of the instruments used in this survey were obtained from the Civil Engineering department of the Michigan Agricultural College.

Profile maps of the street center lines were also made and bound in this volume. These maps also show the positions and grades of the proposed water and sewer mains.

Profile levels running N. on Main St.

Sta.	B.S.	H.I.	F.S.	El.	Remarks.
B.M.	3.96	103.96		100.00	S.E.corner basement window sill Bank of Akron.
1.			4.62	99.34	Cross walk in front of Hotel Bloomfield
T.P.1			6.05	97.91	Cor. Lynn & Main St.
	3.53	101.44			
3			4.76	96.68	Cor. Main & Center.
T.P.2			5.56	95.88	Cor. Main & North.
	3.00	98.88			
100			3.19	95.69	
200			3.80	95.08	
300			3.87	95.01	
T.P. 400			3.11	95.77	
	4.01	99.78			
500			4.30	95.48	
600			4.03	95.75	
700			4.86	94.92	
T.P. 800			5.43	94.35	
	3.83	98.18			
900			3.99	94.19	
1000			4.20	93.98	
1100			4.41	93.77	
			2.12	96.06	Top large stone at N.E. corner Budd French porch

Profile levels running west on W. Beach St.

Sta	B.S.	H.I.	F.S.	El.	Remarks.
B.M.	3.01	103.01		100.00	S.E.corner basement window sill Bank of Akron.
1.			4.95	98.06	N. Main & P.M.R.R.
2			7.01	96.00	Cor. N.Main & Beach St
T.P.1			5.95	97.06	Top of stone at end of N. walk.
	5.62	102.68			
3			4.71	97.97	
4			5.34	97.34	Cor. Beach & Mill St.
T.P.			4.62	98.06	Wood block at W.side of telephone pole.
	1.37	99.43			
5			4.46	94.97	Cor. Beach & W.1st ST.
6			5.93	93.50	Cor. Beach & Creamery St
T.P.			5.97	93.46	S.E. Cor. walk at Landons house.
	3.80	97.28			
7			4.78	92.48	Cor. Beach & W.2nd St.
6 400			5.03	92.23	
5000			5.55	91.71	
T.P.600			6.26	91.00	
	3.52	94.52			
8			4.13	90.39	Top of stone in N. ditch W. of Hickeys.
700			4.19	90.33	
800			4.83	89.69	
900			5.42	89.10	
1000			6.15	88.37	
T.P. 1100			6.51	88.01	
	3.85	91.86			

Profile levels running W. on W.Beach St.

Sta.	B.S.	H.I.	F.S.	El.	Remarks.
6 1200			3.79	88.07	
1300			4.10	87.76	
1400			5.75	86.11	
T.P 1500			7.44	84.42	
	0.92	85.34			
1525			2.01	83.33	
1550			3.33	82.01	
1575			3.77	81.57	
1575			7.52	77 .82	East bank of ditch
			12.41	72.93	E. side Water edge
1600			4.08	81.26	On bridge
1700			4.95	80.39	
1800			2.54	82.80	
			0.95	84.39	Sect. Cor.
			5.35	79.99	N.E.cor. W. abutment of bridge.

Profile levels running So. on So.Main St.

Sta	B.S.	H.I.	F.S.	El.	Remarks.
B.M.	3.51	100.57		97.06	Top of stone at Cor. N.Main & Beach St.
1			3.87	96.70	Cor. So. Main & Beach.
T.P.			4.26	96.31	
	2.18	98.49			
2			5.04	93.45	Cor.So. Main & So. St.
T.P 100			4.65	93.84	
	5.40	99.24			
200			5.56	93.68	
300			5.79	93.45	
400			5.28	93.96	
			5.22	94.02	N.W.Cor. D.B.C.&W culvert
			4.62	94.62	So. Main St crossing D.B.C & W. R.R.
500			4.62	94.62	
600			3.57	95.67	
T.P.700			4.03	95.21	
	2.76	97.97			
800			4.26	93.71	
			4.13	93.84	Horse block at Joe Storms house
900			5.04	92.93	
1000			4.71	93.26	
1100			4.09	93.88	
1200			4.38	93.59	
TP.1300			3.99	93.98	
	3.57	97.55			
1400			3.55	94.00	

Profile levels running So. on So. Main St.

Sta	B.S.	H.I.	F.S.	El.	Remarks.
1500			4.14	93.41	
1600			3.88	93.67	
1700			2.71	94.84	
1800			3.14	94.41	

Profile levels running E. on E. Beach St.

Sta	B.S.	H.I.	F.S.	El.	Remarks.
B.M.	2.23	99.29		97.06	Top of stone at end of walk E. side
1			3.81	95.48	Cor.E.Beach St. & Railroad St.
100			4.85	94.44	
200			5.27	94.02	
T.P.300			5.36	93.93	
	5.86	99.79			
400			5.45	94 34	
500			4.95	94.84	
B.M.			6.22	93.57	Top ofcedar post by mapletree.
600			4.44	95.35	
700			5.00	94.79	
800			5.09	94.70	
1000			4;78	95.01	Pt.24 ft E. of wire fence on N. side of road.

Profile levels running N. on W.1St. St.

Sta	B.S.	H.I.	F.S.	El.	Remarks.
B.M.	0.60	98.66		98.066	Wood block at Cor. Beach & Mill St.
1			5.58	93.08	Cor. Lynn & W.1st.St.
TP			5.29	93.37	Top manhole crock So. edge.
	5,27	98.64			
2			4.80	93.84	Cor Center & W. 1st.
B.M.			4.34	94.30	So. edge of above Cor.
3			6.49	92.15	Cor. N. & W. 1st St.
B.M.			5.47	93.17	Manhole at above Cor.

Establishing B.M's onMain street.

B.M.	4.05	104.05		100.00	B.M. at Bank Bldg.
TP1			6.04	98.01	Walk at S.E.Cor. Tobiass store.
	3.12	101.13			
TP2			4.29	96.84	N.W.Cor. horse block at W.C.Hess.
	4.87	101.71			
B.M.			4.75	96.96	So.W. Cor. lower step at church.

Profile levels on So.St.

B.M.	4.73	102.99		98.06	Wood block at Cor. Beach & Mill St.
1.			5.65	97.14	Cor. Mill & So.St.
TP.			1.35	101.44	Top of iron pipe S.W. C0r Elev. Scales
	0.26	101.70			
B.M.			5.93	95.77	Top of rail on T.B.C.& W.R.R
			6.22	95.48	Cor. So.& Creamery street.

Profile levels running W. on Lynn to West Road.

Sta.	B.S.	H.I.	F.S.	El.	Remarks
B.M.	3.77	97.14		93.37	Top edge of manhole crock.
200			4.70	92.44	
400			6.59	90.55	
483			4.83	92.31	Walk at west sideof school house.
T.P.			7.85	89.29	Walk at S.W. Cor. school house.
	1.58	90.87			
581			0.51	92.36	
600			3.52	97.35	
700			3.68	87.19	
800			3.18	87.69	
1000			4.97	85.90	
1200			5.30	85.57	
T.P.1400			5.52	85.35	
	4.22	89.57			
1500			4.50	85.07	
1600			4.18	85.39	
1700			4.32	85.25	
1748			5.65	83.92	
1764			10.48	79.09	
T.P.1772			12.38	77.19	
	4.79	81.98			
1779			9.26	72.72	Water edge E. Bank
1810			6.45	75.53	
1900			4.71	77.27	
T.P.			2.12	79.86	Top of stone E. of road.
1925			7.90	78.26	
1940			5.86	80.30	
1960			2.70	83.46	℄ of road

Profile levels running W. from Cor.Center & W.1st St.

Sta.	B.S.	H.I.	F.S.	EL.	Remarks
B.M.	0.50	94.80		94.30	Well curb N.E.Cor.
200	2.42			92.38	
300	4.0		4.08	90.72	
400			5.03	89.77	
500			5.80	89.00	
700			8.13	86.67	
T.P.	4		4.73	90.07	
	0.91	90.98			
800			4.42	86.56	
900			4.43	86.55	
1000			5.15	85.83	
1100			5.46	85.52	
1200			5.15	85.83	
1400			6.98	84.00	
T.P.			6.78	84.20	
	3.86	88.06			
1450			6.52	81.54	
1500			4.87	83.19	
1600			3.97	84.09	
1680			5.69	84.37	
1700			8.29	79.77	
1725			12.03	76.03	
T.P.50			12.47	75.59	
	5.08	80.67			
1764			5.49	75.18	E. edge of CO. Drain

Sta.	B.S.	H.I.	F.S.	El.	Remarks.
1772		80.67	9.25	71.42	Elevation of water
1794			7.44	73.23	
1795			5.38	75.29	
1900			5.35	75.32	
T.P.			3.37	77.30	
	7.15	84.45			
1940			1.88	82.57	
1960			0.91	83.54	
check			3.90	80.55	Check on first line
"			5.34	79.11	Check on W. abutment of W. Beach St. Bridge.

Profile levels running E. on a line 1312 ft N. of west Beach street.

Sta.	B. S.	H. I.	F. S.	El.	Remarks
B.M.	1.27	88.22		86.95	Final B.M. of previous line
0.00			0.12	84.17	Stake at side of road bed
100			8.15	76.14	
125			9.86	78.43	
192			7.88	76.41	W. edge of bank
193			9.75	74.54	
200			13.22	71.04	El of water
B.M.	0.16	83.18		83.02	Same as above B.M.
B.M.			4.95	78.23	Top of stump at Intersection of Fence & Co drain.
220			8.16	75.02	
300			7.28	75.90	
335			6.87	76.31	
TP 60			0.88	82.30	
	7.34	89.64			
400			5.63	84.01	
500			6.64	83.00	
600			4.69	84.95	
700			3.42	86.22	
800			4.02	85.62	
check			5.35	84.29	Stone on 2nd line
TP 16			2.89	86.75	Top of large stone
	4.23	90.98			
900			5.28	85.60	
1000			5.64	85.34	
[illegible]			[illegible]	[illegible]	
[illegible]			[illegible]	[illegible]	

Sta	B.S.	H.I.	F.S.	El.	Remarks
1100			4.33	86.65	
TP			1.30	89.68	Top of beach stump
	3.05	92.73			
1200			6.01	86.72	
1300			4.99	87.74	
1400			5.82	86.91	
1500			5.00	87.73	
TP			3.68	89.05	
	6.16	95.21			
1600			5.67	89.54	
1700			4.70	90.51	
1800			4.08	91.13	
TP			3.35	91.86	
	5.88	97.74			
1900			5.36	92.38	
1960			4.57	93.17	Center of W.road
check			3.40	94.34	So. edge of well crock at Cor. Center & W.1st St.

Profile levels on aline from N. Main St. to roa d one half mile west. The line is 300 feet nofth of North St.

Sta	B.S	H.I.	F.S.	El.	Remarks.
B.M.	2.38	99.34		96.96	S.W Cor of lower step ofchurch on Main St.
B.M.2			4.05	95.29	So. edge manhole crock on Main St.
100			4.20	95.14	
200			4.75	94.59	
TP			5.72	93.62	
	3.69	97.31			
300			4.37	92.94	
400			4.09	93.22	
500			4.17	93.14	
600			5.52	91.79	
700			6.34	90.97	
800			6.40	90.91	
TP			6.35	90.96	
	1.94	92.90			
900			2.91	89.99	
1000			4.74	88.16	
1100			5.29	87.61	
1200			5.02	87.88	
1300			6.00	86.90	
TP			5.38	87.52	
	2.26	89.78			
1400			4.56	85.22	
1500			4.14	85.64	
1600			5.28	84.50	

Sta.	B.S.	H.I.	F.S.	El.	Remarks.
1700			4.98	84.89	
1800			5.26	84.52	
1900			5.56	84.22	
TP 2000			6.31	83.47	
	3.35	86.82			
2100			3.82	83.00	
2200			3.03	83.79	
2225			2.46	84.36	
2270			4.80	82.02	
2300			8.80	78.02	
2350			11.76	75.06	
2400			12.75	74.07	
TP			10.09	76.73	Top of stump E. side of ditch.
check			8.54	78.28	Stump at intersection of wire fence and ditch
	4.71	81.44			
2440			7.85	73.59	
2465			5.25	76.19	East bank
2477			10.74	70.70	East Water edge.
2498			8.11	73.33	
2500			6.11	75.33	West Bank
2550			6.90	74.54	
2570			5.28	76.16	
2590			2.18	79.26	
2640			0.82	80.62	Middle of N.&S. Road

Profile levels running E. on Cass St.

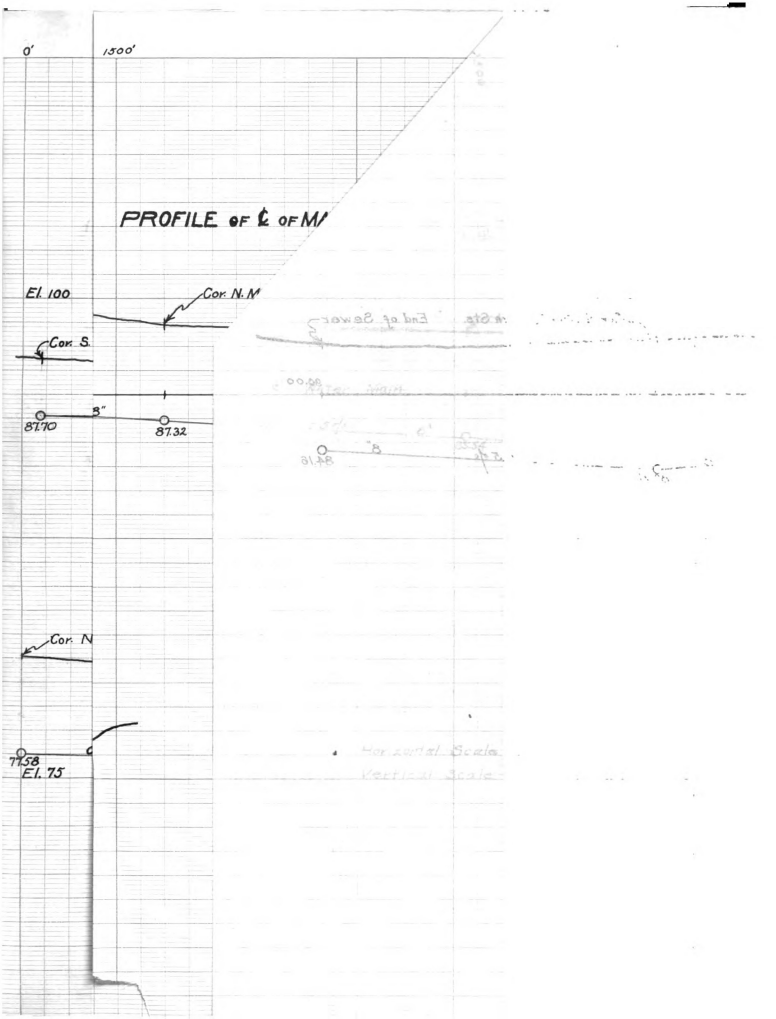
Sta	B.S.	H.I.	F.S.	El.	Remarks
B.M.	1.50	101.50		100.00	B.M. on Bank Bldg.
0.00			4.34	97.16	Intersection Cass St. & P.M.R.R.
TP			4.25	97.25	N. side top of cement walk by telephone pole
	8.61	105.86			
100			8.82	97.04	
165			9.04	96.82	

Profile levels running N. from last station on Cass street.

100			6.31	99.55	
200			3.76	102.15	
300			4.19	101.67	
400			4.13	101.73	
440			3.28	102.58	Highest Pt. Approx. position of stand pipe.

Profile levels along W. side of P.M.R.R. running N.

Sta	B.S.	H. I.	F.S.	El.	Remarks
B.M.	2.09	102.09		100.00	B.M. at Bank Bldg.
120			4.10	97.99	
240			4.02	98.07	
360			3.87	98.22	
TP 480			3.84	98.22	
	4.85	103.10			
600			4.83	98.27	
720			4.91	98.19	
840			5.74	97.36	
TP 960			5.85	97.25	
	5.17	103.42			
1080			5.25	98.17	
1200			6.12	97.30	
1440			6.04	97.38	
TP			4.32	98.10	
	4.24	102.34		98002	
1560			4.32	98.02	
1680			4.48	97.86	
1800			4.55	97.79	
1920			4.53	97.81	


0'
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PROFILE of ℄ of M/
El. 100
Cor. N.M
Cor. S.
8"
87.10
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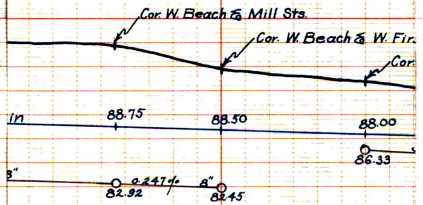
Cor. N
7158
El. 75

1500

H ST. → W


Cor. W. Beach & Mill Sts.
Cor. W. Beach & W. Fir.
Cor.
in
88.75
88.50
88.00
86.33
8"
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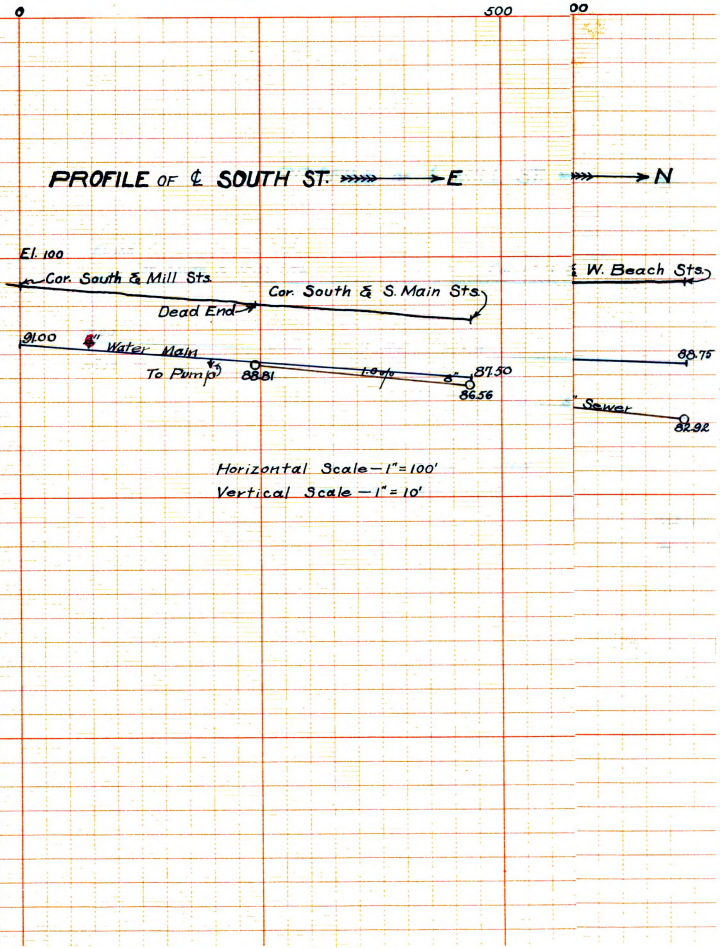
82.92
82.45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PROFILE OF ℄ SOUTH ST. →E
→N
El. 100
Cor. South & Mill Sts.
Cor. South & S. Main Sts.
Dead End
℄ W. Beach Sts.
91.00
4" Water Main
To Pump
88.81
1.0%
8"
87.50
86.56
88.75
" Sewer
82.92
Horizontal Scale — 1" = 100'
Vertical Scale — 1" = 10'

0

200

PROFILE OF ℄ CASS S

El. 100

Dead End

90.00

4" Water Main

Sewer 0.847% 8"

88.94

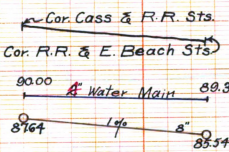
Horizontal S

Vertical S

0 200

PROFILE OF ℄ R.R. ST. ⟶ S

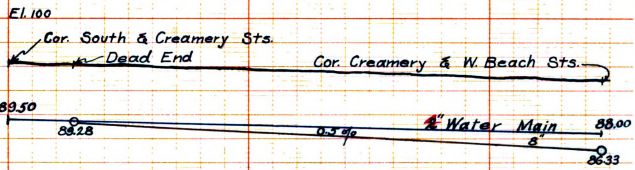
El. 100



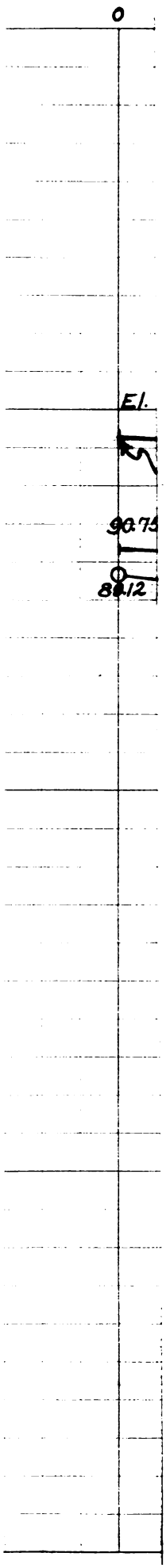
Horizontal Scale — 1" = 100'
Vertical Scale — 1" = 10'

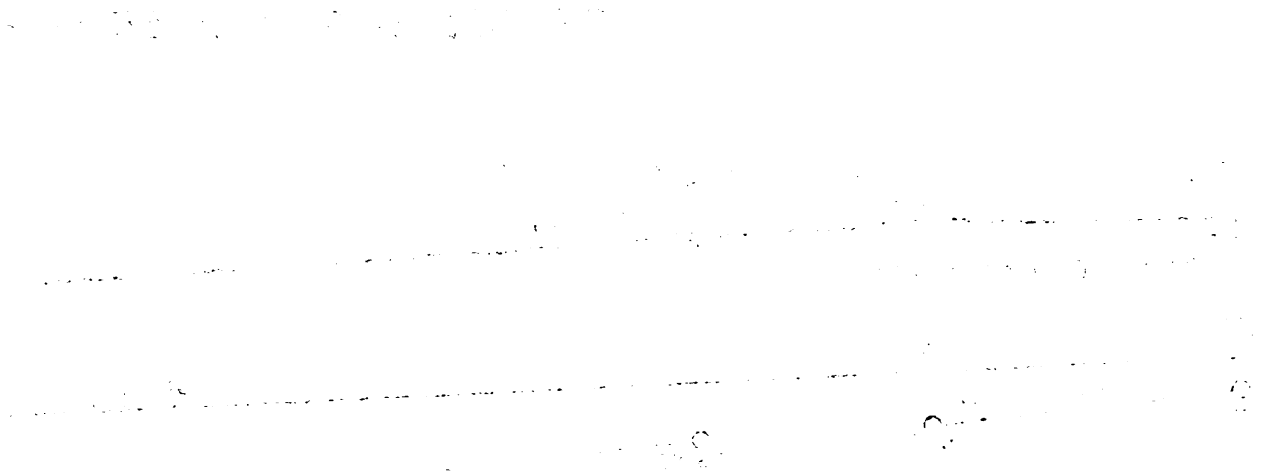
0 500

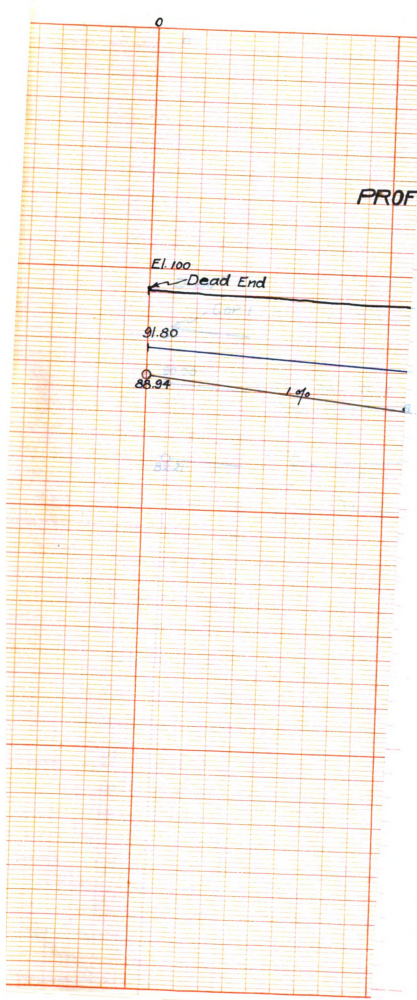
PROFILE OF ℄ CREAMERY ST. »»»»»» → N



Horizontal Scale — 1" = 100'
Vertical Scale — 1" = 10'


0
El.
90.75
88.12




0
PROF
El. 100
Dead End
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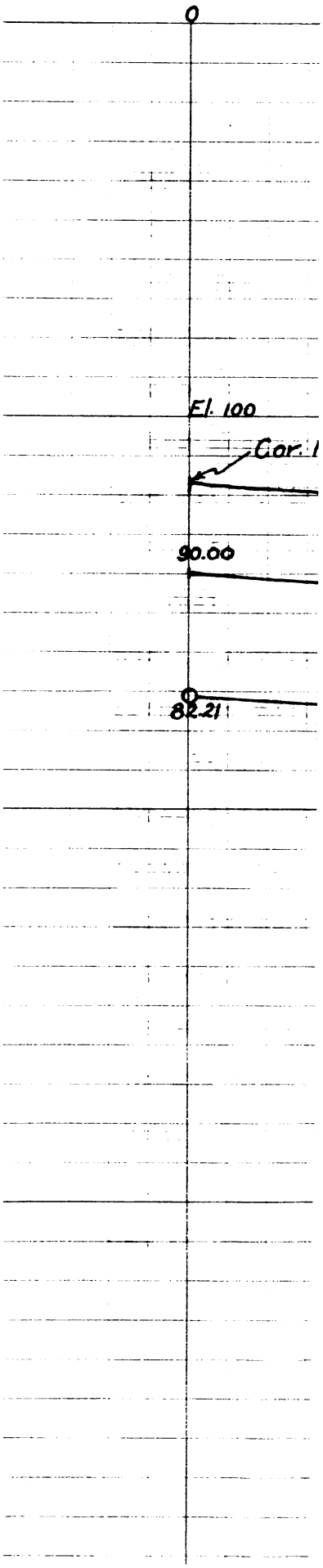
88.94
1 o/o


0
El. 100
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90.00
82.21

Water Supply

The village of Akron has never had a public water supply. All of the water used comes from private wells. Quite a number are shallow drive wells from ten to twenty feet deep, but the majority are drilled wells from 100 to 250 feet deep. It is needless to say that the shallow are a dangerous source of diseases. With privy vaults and other sources of contamination in such close proximity to the wells, it is hardly reasonable to suppose that the water from such shallow wells is sanitary. On this account we must eliminate surface water from our consideration of a public supply. The only other alternative is the water from the deep wells.

In March, 1916, the writers took samples of water from three different deep wells in Akron and tested them both bacteriologically and chemically. The samples for bacterial analysis were taken in sterlized flasks and kept in this condition until they were tested three days later. This analysis was made by R.W.Wyant at the Bacteriology Laboratory of the M.A.C. One pint of water from each well was used for the chemical analysis which was made by the Chemistry Department of the M.A.C. The results of both bacteriological and chemical analyses were as follows:-

Sample No. 4c

Village well at Akron. This is a four-inch well, 147ft deep, and was about one old when the samples were taken. There is no curb at the top of this well. It is located at the corner of Lynn and North Main streets.

Bacterial Analysis:

Three different 48 hour tests showed prasally no bacteria at all. As far as sanitary conditions are concerned, this well is very good.

Chemical Analysis:

HCO_3	40. parts per million
Cl	182.
CaO	350.
Al_2O_3, Fe_2O_3	Trace only
SiO_2	None
SO_3	225
Total Solids (evaporation over water)	1240
Residue heated to constant weight	940

The water from this well could not be used as a source of supply without some sort of treatment which would reduce the total solids. The State Board of Health requires that water for a municipal supply must not contain greater than 500 parts per million of total solids, whereas this water contains 1240. The above analysis shows this water is very high in salt and gypsum.

Sample No.2.

Well belonging to David Somerville:-This well is located on East Beach St. just east of Railroad St. It is a 2inch well, 149 ft-10 inches deep and has no curb. It was about threeyears old when these samples weree taken. The water contains a fine white sediment which givew it a slight cloudy appearence when first pumped outt. It tastes all right and is being used for domestic purposes at the present time.

Bacterial Analysis:

Three 48 hour tests showed no bacteria This shows that the water is perfectly sanitary as far as bacteria are concerned.

Chemical Analysis:

HCO_3	20 parts per million
SO_3	158
CaO	190
Cl	63
$Al_2O_3.Fe_2O_3$	Trace
SiO_2	None
Total Solids (evaporation over water)	619
Residue heated to constant weight	450

This sample also shows too high a percentage of total solids to be used for a municipal supply. It is very high in salts and gypsum, but not as bad as the water from the Village well. The cloudy appearance of this water, before mentioned, is due to the gypsum which is chemically known as calcium sulphate.

Sample No.3.

Well belonging to Rob Albertson:-This well is located on South St., about half way between Main and Mill Sts. It isa 2 inch well, 250 feet deep and is about eigh years old. It has a curb about 6 feet deep to catch waste water. This water looks and tastes the best of any ofthe three samples. Itis clear, quite soft, and sparkling. It would make a pretty nearly ideal water for amunicipal supply. The percentage of total solids is far below the minimum o f 500 parts per million.

Bacterial Analysis:

Three 48 hour tests showed practically no bacteria.

Chemical Analysis:

HCO_3	12 parts per million
SO_3	90
CaO	80
Cl	30
$Al_2O_3.Fe_2O_3$	Trace
SiO_2	1
Total Solids (evaporation over water)	230
Residue heated to constant weigh	175

The analysis shows that this water contains some salt and some gypsum, but not in large enough amounts to seriously affect the quality of the water.

The head at this well is such that the water rises within six feet of the surface.

No attempt was made to make tests on all of the well water in Akron. The samples taken were only typical of the other wells in town, so the three tests made were believed to be sufficient to show the general character of the water throughout the town. It looks as though there might be some difficulty in obtaining a large supply of the right kind of water.

The writers have made an attempt to discover something definite concerning the rock structure beneath Akron, in order to determine where and how deep to drill to get a good supply of water. To carry out this idea, a geological structure section map has been made and included in this thesis. The section taken was from Caro, thru Akron, to Saginaw Bay.

This map shows two good sandstone formations, namely the Parma and the Marshall Sandstones. Both of these are waterbearing rocks, but the water from the Marshall Sandstone at this place is too salty for domestic use. The Marshall The Marshall Sandstone is deeper down than any of the present wells in the village. At first it was thought that the Parma Sandstone might be a good source of supply, but the chemical analysis has dissipated this idea

Two of these wells from which samples were taken do not extend as deep as the Parma Sandstone, but get their supply from the Coal Measures above the Parma. The Coal Measures do not contain any gypsum, but both of these wells are heavy in gypsum which comes only from the formation known as the Grand Rapids Group, below the Parma Sandstone. This shows quite conclusively that the Parma and also the other formations are very irregular and badly broken up by faults and fissures. Evidently, the sulphate waters from the Grand Rapids Group rises and mixes with the waters in the upper formations. This accounts for the sulphates, or gypsum, in the water drawn from the Coal Measures. The fact that the water has a high head at this place, also upholds this argument. The water rises nearly to the surface in all of the wells.

The conclusion is that nothing very definite can be stated as to how deep to drill to get the right kind of a water supply. There is one fact which will help in picking out the proper location for a well. In general, the wells in the south end of town yield better water than those in the north end. It is quite probable that a well about 250 feet deep in the south end of town will yield a plentiful supply of good water.

Water System

The first requisite to a water system is the location of a well, or wells, and a pump house. In this purposed system, the well and pumps were placed on Shuth St. The distributting system was laid out as shown on the large map of Akron(In pocket on inside of back cover). The gridiron system was used throughout. Six-inch and four-inch mains only were used. The sizes are shown on the map. In sizing the mains and placing the hydrants, a hydrant pressure of 75 pounds was assumed. This much pressure is necessary if the system is going to be any good for fire protectio n.

A hydrant pressure of 75 pounds per sq.inch will furnish a 175 gal. stream from a 450 foot hose, or a 250 ga l. stream from a 200 foot hose. This discharge from the hose is in gallons per minute. The above hydrant pressure will give a nozzle pressure of 355 pounds per sq. inch with a one-inch nozzle.

The pumping machinery must be large enough to furnish the required hydrant pressure. A direct pumping system, using a gas engine , is recomended for this place. In fact it is the only practical system to install here. The pumps must be kept running all the time. Of course, this is quite expensive, but it seems to be the only alternative.

Sewer System

Up to the present time, Akron has never had any sewer system except for storm water. One of the chief objects of this thesis is the design of a system to take care of domestic wastes in some convenient manner. The system here advocated is known as the "separate" system with water as the carrier. In this system the sewage does not flow in the same mains with the storm water, but comprises an entirely separate system. At present there is a fairly adequate system for the storm water sewage. This water discharges into an open drain west of the town which in turn empties into Squaw Creek, a county drain nearly a half mile west of the village. This system need not be interrupted in any way by the installation of a system for domestic sewage.

The layout of the proposed sewer system is shown on the large map of Akron in the back of this volume. Both the surface elevation and the outlet elevation at each manhole are shown on the map; also the sizes and grades of the mains. In calculating the sizes and grades of the mains, a minimum size of eight inches was used. The minimum grade to be used for each of the three different sized mains was calculated for the sewer running 0.30 full at a minimum velocity of two feet per second.

The following calculations apply to an 8 inch sewer:-

$V = C\sqrt{r\,s}$, where V velocity in feet per second.

C = friction constant,

r = hydraulic radius

s = slope or drop per foot.

$2 = 120\sqrt{0.1128\,s}$

s = 0.00247 ft.

This gives a 0.247 % grade as a minimum for an 8 inch main running 0.3 full. It was found necessary to use this minimum grade in several places. Inthe same waythe minimum grade to be used for a 10 inch.main was found to be 0.195% and 0.163% for a 12 inch main.

The sewer grades, their sizes, and also the outlet elevation at each manhole are shown on the profile maps in this thesis.

To determine the size of mains to be used it was necessary to know the quanity of sewage flowing. This va value was taken equal to the domestic sewage plus 30 % for leakage of ground water into the mains. The population upon which the domestic sewage was figured was calculated by estimating five people per lot, all vacant lots were included in this. The average daily sewage was assumed at 75 gal. per capita per 24 hr. day. To this value was added 30 % for leakage. The following table gives the estimated population on each street, also the domestic and total sewage per 24 hr. day for the population on each street:

Street	Population	Domestic Sewage gal/24 hr. day	Domestic Sewage 30 % for Gr.water
West 2nd St.	215	16,100	20,950
West 1st St.	115	8,625	11,200
N. Main St	170	12,710	16,550
S. Main St.	90	6,740	8,760
Mill St.	55	4,120	5,350
Creamery St.	40	3,000	3,900
North St.	50	3,750	4,875
Center St.	65	4,875	6,330
Lynn St.	60	4,500	5,850
W.Beach St.	65	4,875	6,330
E.Beach St.	65	4,875	6,330
Cass St.	50	3,750	4,875
South St.	15	1,125	1,460
Total-	1,055	779,045	102,760

The only available stream into which the sewage can be run is the County drain known as Squaw Creek. This is nearly a half mile west of Akron. In order to comply with the requirements of the State Board of Health, it will be necessary to treat the sewage in some very efficent manner. This is compulsory wherever sewage is emptied into a county drain. As a result of pretty thorough investigation in this particular case, it seems that the best method of treating the sewage at Akron will be a combination of a septic tank and sprinkling filters. To do this , the sewage will have to be pumped from the tank to the filter bed, on account of the low elevation of the sewer outlet. The septic tank will have to be built so low that there will be no chance for a filter bed between it and the stream. The tank will have to be made waterproof, as it will be below the high water mark of the stream. The filter bed can be located higher up on the bank. A sprinkling filter will be the best here, because the soil at this place is not suitable for a large filter bed such as is required for a slow sand filter. The filter bed here will have to be entirely made up by hauling in the materials, but it need not be large if sprinkling filters are used. It will be necessary to maintain an engine and pump at this place in order to pump the effulent from the septic tank up onto the filter bed.

This system may be prohibitive on account of the expense, but it appears to be the only method by which the sewage can be properly handled.

Conclusion

It is not at all likely that the village of Akron will be in such a financial condition that they will be able to install water and sewer systems for several years to come. The systems which we have proposed may even be prohibitive for this village on account of the expense. We do not even claim that our proposition is a practical one for Akron, financially. We do hold, however, that we have shown the best and practically the only methods by which this village can have adequate water and sewer systems at all.

In conclusion we will say that it is our sincere wish that, in the event of the installation of such systems, this this may be of some benefit to the people of Akron.

Pocket has: 1 map & 1 suppl.