Flood Protection Measures for Residential Structures Located in the Flood Plain in Meridian Township, Ingham County, Michigan

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Introduction

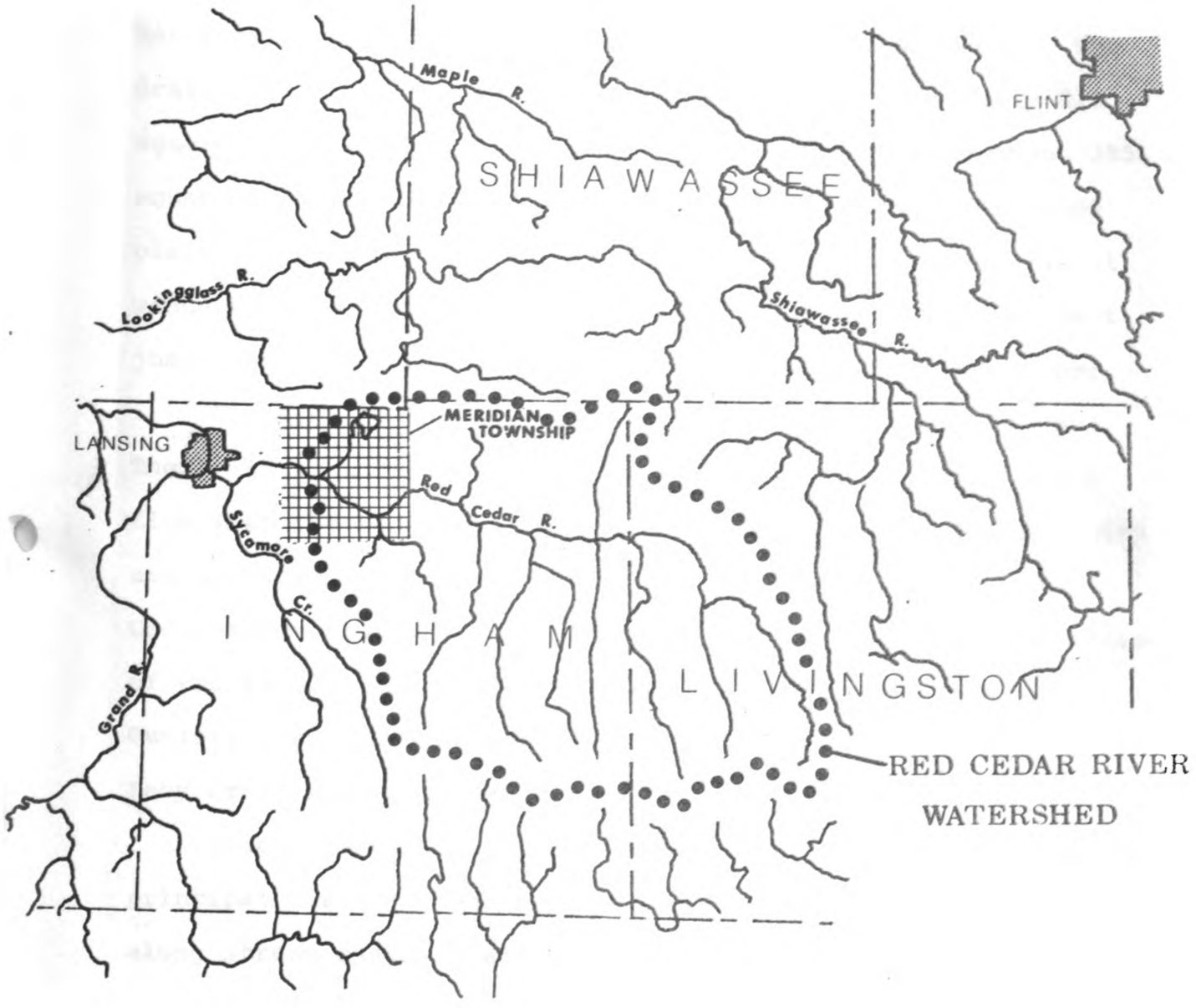
This paper relates to the problem of flooding in Meridian Township and more specifically to the damage done to those single family homes located within the one hundred year flood plain of the Red Cedar River. The approach taken in this document was one of first describing the nature of the Red Cedar River as it flows through Meridian Township and the nature of the community itself including the trends in development over the past few years. Following this information is a summary of the flooding history on the Red Cedar River in Meridian since the turn of the century. Since the second worst flood in history on the Red Cedar occurred in April of this year, an analysis is made of the damage caused by these high waters, especially to the development which has occurred in the flood plain since the 1947 flood. Following an analysis of the existing Township flood protection measures, a number of alternative courses of action are proposed, all of which, if adopted, would have the effect of decreasing the amount of flood damage to homes in the community.

Meridian Township Location and Flooding Problem

Meridian Charter Township is located adjacent to East Lansing and approximately five miles east of Lansing in south central Michigan. Lying at the east edge of the Lansing Urbanized Area, it is both a bedroom community for the region and an expanding commercial center for the east side of the metropolitan area.

Meridian Township's population has increased at a rapid rate since 1920 and most significantly since 1940 when the population was 4,767 persons. U.S. census figures indicate that the 1960 population was 13,884 while the 1970 figure was 23,827. The current population is estimated to be approximately 30,000. Population projections prepared by the Meridian Township Planning Department show the population to increase to 34,000 in 1980 and 53,000 by 1990.

Development has occurred in most areas of Meridian Township, but most intensely in the central portion of the community along the Red Cedar River and its tributaries. The largest area of population concentration is in the Okemos area which houses over 10,000 persons. Portions of several of the subdivisions in the Okemos area are located within flood-prone areas. (For purposes of this report, a flood-prone area is defined as that area that can be expected to be inundated once every 100 years.) The flood plain area east of Okemos is for the most part undeveloped, or agricultural. The flood plain areas of the tributaries are primarily undeveloped with the exception of the Pine Lake Outlet north of Haslett Road and the Okemos Drain west of Okemos Road.

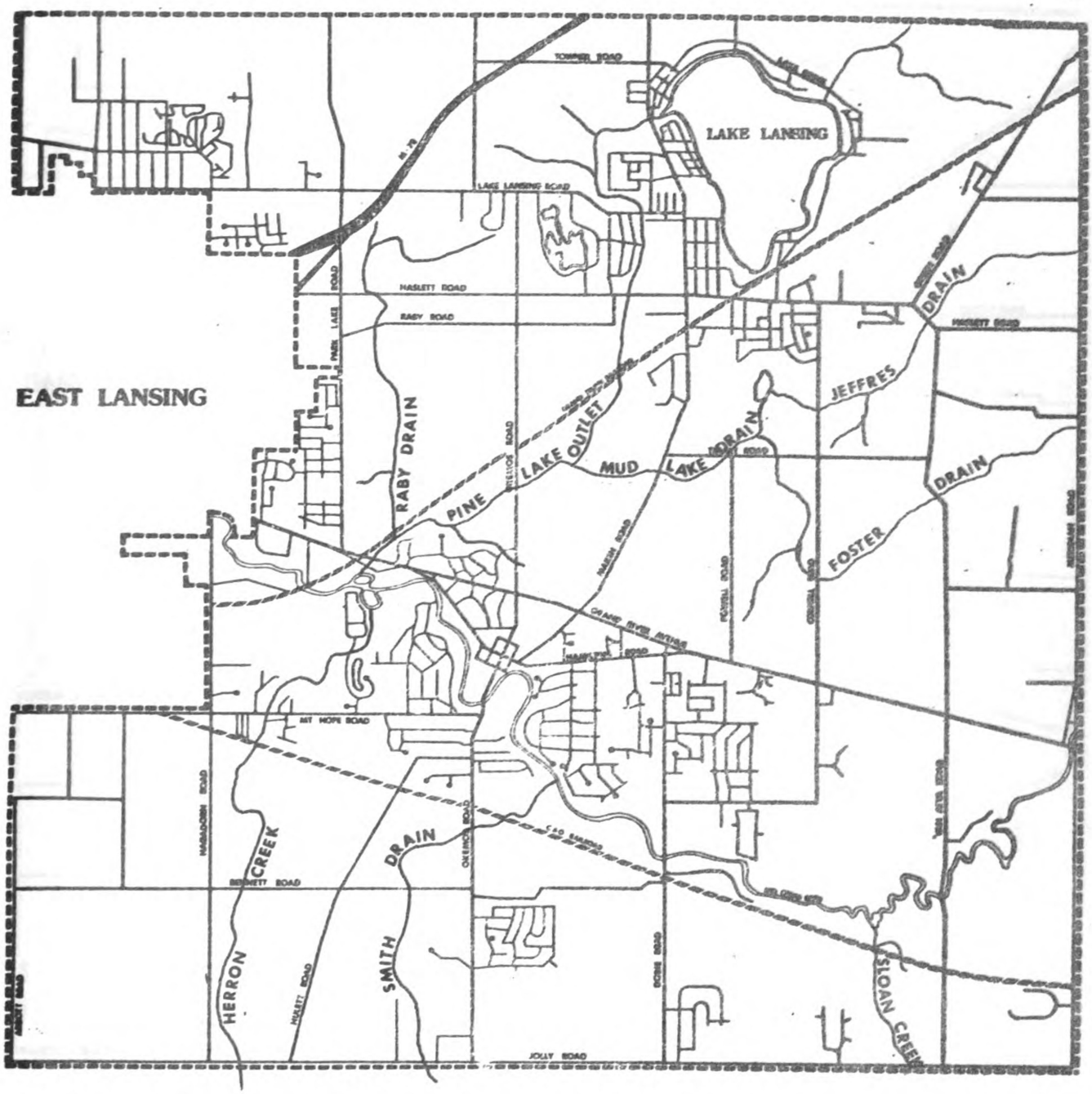


REGIONAL LOCATION

The Red Cedar River flows through the Township from east to west and is the major source of flooding within the community. The Red Cedar River has its source in southwest Livingston County and along its course to the Grand River it has been dredged and alined to accommodate flood runoff. The drainage area of the Red Cedar varies from approximately 315 square miles at the east boundary of the Township to about 355 square miles at Hagadorn Road, the west boundary. The flood plain of the river in Meridian Township varies in width as it winds through the Township and ranges from a few hundred feet just east of Okemos to more than 2,500 feet at Okemos proper.

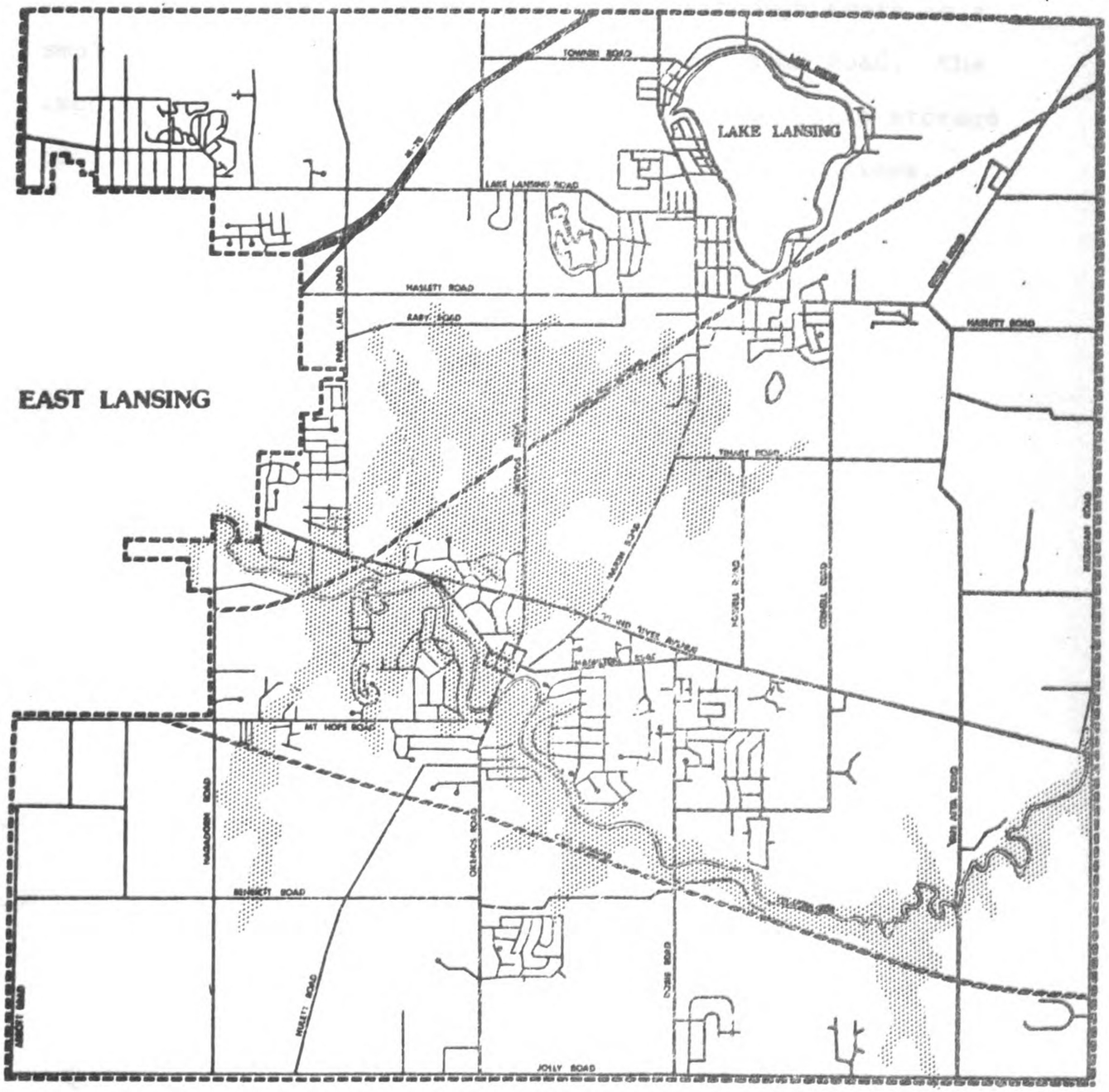
Flooding is not confined to the Red Cedar River alone. There are a number of open-ditch drains or tributaries which flow into the Red Cedar within Meridian Township. These drains are subject to flooding principally when floods on the Red Cedar force flood waters into them for storage during the period of the flood. The drains in question include the Pine Lake Outlet, Herron Creek, Smith Drain, Mud Lake Drain, Foster Drain, Raby Drain and Swan Creek.

Glacial materials, principally of morainal origin, are the principal surface deposits in the basin with outwash occurring along stream channels at some locations. Most of the river basin is relatively flat and drainage is rather poor. The water surface elevation ranges from about 825 feet above sea level at Hagadorn Road to approximately 840 feet at Meridian Road. Most of the basin is rural in nature except in its lower reaches in Okemos and East Lansing where extensive development has occurred. The



CHARTER TOWNSHIP OF MERIDIAN

RED CEDAR RIVER TRIBUTARIES



CHARTER TOWNSHIP OF MERIDIAN

100 YEAR FLOOD PLAIN

river is unregulated for the most part, although there is a small dam about six miles upstream from Meridian Road. The impoundment formed by the Williamston Dam has little storage potential and consequently minimal effect on floodflows.

Red Cedar River Flood History

In the past 70 years eleven floods with magnitudes over 3500 cubic feet per second (cfs) have been recorded on the Red Cedar River. The following table illustrates the worst of these floods and compares them to 10 and 100 year floods.[1]

Table I

Major Floods Recorded on the Red Cedar River

Year	Flow at Farm Lane Gage (cfs)	Gage Height (1975 Conditions) (feet)
1904	8000	14.3
1975	6000	11.9
1947	5920	11.8
1918	5130	10.9
1948	4960	10.7
100 Year Flood	7700	13.9
10 Year Flood	4350	9.7

On April 18, 1975 between 5 p.m. and 12 p.m. Meridian Township experienced an intense rain storm that caused the Red Cedar River to overflow its banks resulting in extensive flooding. Records of the National Weather Service show that most of the Red Cedar River basin received four to five inches of rain during the 7-hour period. Precipitation of that intensity has a frequency of occurrence of about once in 100 years. Nearby communities reported as much as 5.15 inches of precipitation.

[1]Department of Housing and Urban Development, "Charter Township of Meridian, Michigan Flood Insurance Study--Draft Report," (July, 1975), p. 7.

About two weeks prior to the storm a heavy snow covered most of the Red Cedar basin with as much as 13 inches reported in some locations. Subsequent melting resulted in the stream flow on the Red Cedar to be relatively high. In addition, the melting snow saturated the soils and reduced their capacity to absorb water. This condition caused streams in the area to reach higher flood levels than would have normally occurred.

The April 1975 flood was the second worst flood on record for the Red Cedar and caused interruption of transportation routes for several days as well as considerable property damage. Grand River Avenue, the major artery providing access to the commercial core of the township, was closed for several days as was Van Atta Road, Okemos Road, Hamilton Road and numerous subdivision streets.

The April 1975 flood forced many families to evacuate their homes as the floodwaters entered basements and climbed above first floor levels. It has been estimated by Meridian Township officials that property damage within the Township was between $3.5 and $4.0 million. The vast majority of this damage was to single family homes primarily located in Okemos.

Existing Flood Protection Measures

Since adoption of the revised zoning ordinance in 1967, development in the 50 year flood plain has been controlled in Meridian Township. The ordinance was again revised in 1972 and at that time development within the 100 year flood plain was restricted. The 1972 Zoning Ordinance is currently in effect and allows the construction of single family homes within the one hundred year flood plain upon issuance of a Special Use Permit by the Planning Commission. Each structure built within the flood plain must have a first floor level above the one hundred year flood elevation, a reinforced basement and no openings below the one hundred year flood elevation. It should be noted that those homes built within the flood plain in recent years which met the above restrictions did not receive damage in the April 1975 flood.

Those structures which lie within the flood plain today were built on lots in subdivisions platted before the Township adopted a zoning ordinance which prohibits building in the flood plain. No subdivisions approved by the Township in the future will contain lots which are totally located within the 100 year flood plain.

Future Flood Policy Alternatives

The Meridian Township Planning Commission and Township Board are currently reviewing existing Township policies in an attempt to lesson the damage to homes located in the flood plain should future flood conditions become a reality. The April 1975 flood and its disastrous consequences to the community pointed up the need to review existing policy and the urgent need to adopt a future policy regarding flood protection measures. The most difficult problem to resolve is that of the impact of flooding on those homes which have already been built within the flood plain. Future development in the flood plain can be controlled through the current Township subdivision restrictions and zoning ordinance regulations.

Ideally, the best approach is to develop a solution at the river basin level. That is, rather than attempting to develop local solutions to the problem, first consideration should be given to alternative flood control projects on the Red Cedar that lesson the flood damage for large areas in the river basin. A proposal to construct a series of flood control retention ponds in the Red Cedar basin upstream area has been included in the "Grand River Basin Comprehensive Water Resources Study" prepared in 1973 under the supervision of the Grand River Basin Coordinating Committee with chairmanship by the U.S. Army Engineer District, Detroit. This proposal was a part of a plan, referred to as Alternative Plan A which was rejected in the Main Report which contained the committee's recommendations following opposition voiced by citizens at public hearings held in 1970.

Plan A included two multiple-purpose reservoir complexes, each with three pools, on the Red Cedar and Upper Grand River, both upstream from Lansing.[1] The proposed Red Cedar River reservoir complex would include three reservoir pools located on the Red Cedar River upstream of Okemos and on Doan Creek east of Meridian Township.[2] The proposed Red Cedar Complex would be on the main stem of the river; the middle pool, Williamston Reservoir, would be on the main stem of the river upstream of Williamston; and the upper pool, Doan Creek Reservoir, would be on Doan Creek, a tributary of the Red Cedar River just upstream of Williamston.

The lower pool, Okemos Reservoir, would be used to provide for flood control and recreation needs; the maximum pool elevation would be 865 feet above mean sea level. Table II summarizes the important characteristics of this reservoir.[3]

At the present time it does not appear that the plan to construct reservoirs upstream from Okemos will become a reality in the near future since Plan A was rejected by the Grand River Basin Coordinating Committee for several reasons including its cost/benefit ratio. (See Table III) I believe, however, that the plan should be reviewed again for its flood control advantages and its cost/benefit ratio recalculated following the high costs

[1]Grand River Basin Coordinating Committee, "Grand River Basin Comprehensive Water Resources Planning Study--Main Report," (1973) p. 59.

[2]Grand River Basin Coordinating Committee, "Grand River Basin Comprehensive Water Resources Study," Volume XI, Appendix Q -- Alternative Plans (August 1973), p. III-61.

[3]Ibid, Table III - 18, p. III-68.

of the April 1975 flood in Meridian Township alone. Until that is done, the Township must proceed with whatever policy that is feasible to lesson the flood damage to homes which lie within its boundaries. It must be assumed that a basin-wide structural solution will not be developed. The following suggested actions are those which the Township can carry out to address its own flood problem.

Table II

Summary of Data on the Okemos Reservoir Site

GENERAL	
Stream	
River mile	14
Drainage area (square miles)	295
ELEVATION (feet above mean sea level)	
Top of dam	869
Maximum pool	865
Top flood control pool	865
Top water supply and water quality pool	N/A
Top recreation and fish and wildlife pool	N/A
Stream bed	830
STORAGE (acre feet)	11,800
Flood control	10,000
Water supply and water quality	
Recreation and fish and wildlife	1,800
SURFACE AREA (acres)	
Maximum pool	1,760
Top flood control pool	1,760
Top water supply and water quality pool	N/A
Top recreation and fish and wildlife	
PERIMETER	
Perimeter of maximum pool (miles)	13
DESIGN DATA	
Length of dam	2,750
Side slopes (horizontal/vertical)	Upstream 3:1 Downstream 2.5:1
Gates, number and size (feet)	13-7X11 - Tainter
Crest elevation (feet above mean sea level)	857
Apron elevation (feet above mean sea level)	820
Discharge at maximum pool (cubic feet per second)	16,310

Source of Data: Grand River Basin Coordinating Committee, "Grand River Basin Comprehensive Water Resources Study," Volume XI, Appendix Q-Alternative Plans (August 1973), p. III-68.

Table III

SUMMARY OF ECONOMIC DATA ON THE
UPPER GRAND RIVER RESERVOIR SYSTEM

ECONOMIC DATA

Average annual benefits:

Recreation	$2,289,000
Water quality	774,000
Water supply	412,000
Flood control	300,000
Fish and wildlife	192,000
Total	3,967,000
Average annual cost	3,308,000
Benefit/cost ratio	1.20

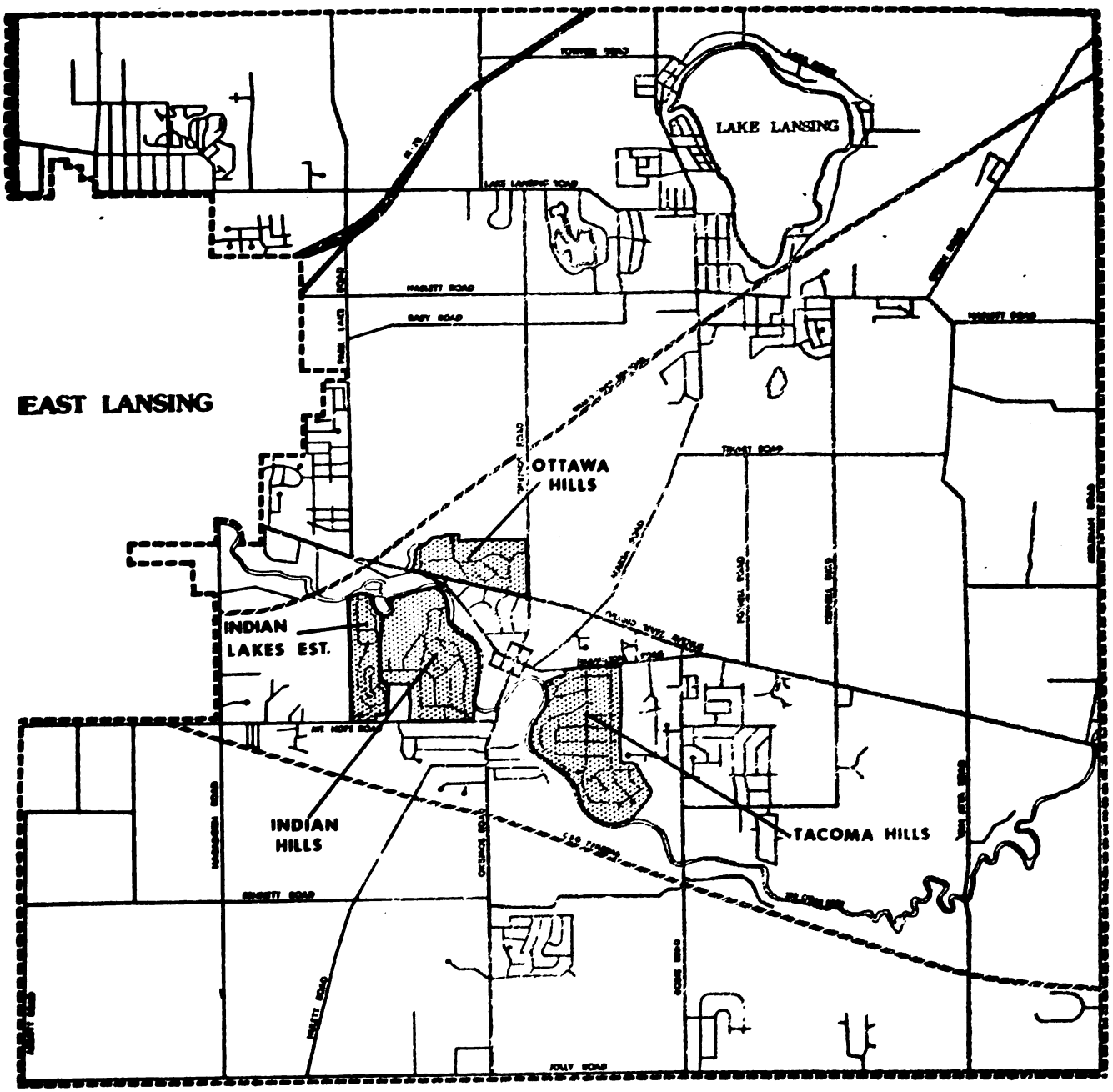
Source of Data: Grand River Basin Coordinating Committee, "Grand River Basin Comprehensive Water Resources Study," Volume XI, Appendix Q-Alternative Plans (August 1973) p. III-69.

It appears that the most appropriate approach to the problem is one which seeks to address the particular situation unique to each flood-prone neighborhood. Each of these residential areas has unique characteristics which effect its flood damage potential, such as the relative value of the homes, source of flooding from the Red Cedar or one of its tributaries, elevations of the first floor of the flood prone homes, potential for alternative land uses, likelihood of sanitary sewer backup into basements lying within the flood plain, etc. It is essential that a study be conducted of each neighborhood before any concrete course of action is embarked upon. Currently such a study is being conducted by Capital Consultants of the Ottawa Hills Subdivision area which lies along the Okemos Drain. The cost of each study could be paid for by a number of ways, among them the following:

A. Property owners in the drainage district in which the neighborhood lies can petition the Township under Chapter 8 of the Drain Code for study to be conducted with the cost of the study to be borne by the Township out of the operating millage.
B. The Township can petition the County Drain Commission to conduct a study of the drainage district if funds are presently available in the account of that particular drainage district.
C. The Township can allocate funds from the general fund to conduct a study of a particular drainage district.

D. The Township can hold a special millage election to raise funds for conducting studies of drainage districts containing homes in the flood plain.

E. The Township can petition the County Drain Commission under Chapter 20 of the Drain Code to conduct a neighborhood study and all or a portion of the study and assess all or a portion of the study costs back to the property owners in the drainage district. The Township may assess all or a portion of the study cost to the Township at large.



CHARTER TOWNSHIP OF MERIDIAN

MAJOR FLOOD-PRONE SUBDIVISIONS

Moving House Out of Flood Plain

One possible course of action is to move the residential structure from the flood site to another parcel which is located above the flood plain. This is a plausible solution for those homes located on lots which have value for neighborhood parks or other such public use. If the Township does not conclude that such public use potential exists on the lot to justify the expenditure of public monies, then the value of this course of action is minimized. The cost of this action is critical both in terms of amount of money that must be expended to purchase the flood plain lot and in terms of the source of funding. Funding for the purchase of the lot could come from a number of sources, including those mentioned earlier for paying for conducting studies.

Raise the Foundations of Homes

In instances where the first floor elevation of the home in the flood plain is less than a few feet below the one hundred year flood elevation, it may be feasible to raise the foundation of the house. Since the greatest amount of flood damage occurs when the flood waters go over the first floor of the home, any amount that the first floor can be raised is beneficial. This course of action has the advantage of being cheaper than moving a home to higher ground and not requiring allocation of public funds. It is estimated that a small home can be raised several feet for approximately three thousand dollars, exclusive of grading costs. This action is also most attractive in cases

where there is not a recurring problem of basement flooding from sanitary sewer backup or other sources, such as in portions of Ottawa Hills and Tacoma Hills.

Build Dikes or Levees

One possible solution for eliminating the danger of flooding from certain properties is to construct dikes or levees. In the case of Meridian Township this solution should be used in only one neighborhood, Indian Lakes Estates. During the 1975 flood, the dike separating the flooded Herron Creek from Indian Lakes Estates to the south became saturated with water and collapsed from the pressure of the flood waters to the north. As a result, a number of homes were damaged. It is recommended that this dike be rebuilt so that it can withstand the pressure of flood waters and protect the vulnerable homes to the south.

Eliminate Storm Water Backup through Sanitary Sewer Leads

Much of the damage in the recent flood resulted from sanitary sewer backups into the basements of homes. Ideally, the sanitary sewer and storm sewer systems are separate, but this is not entirely the case in Meridian Township. The sanitary sewer system becomes charged with storm water (and flood water) due to several reasons:

a. Illegal footing drain connections.

b. Manhole tops are located beside streams and become submerged when the stream level rises.

c. Manhole tops located in roadside ditches become submerged during heavy rains.

Footing drain connections to the sanitary sewer system are currently prohibited by Section 111-5, Title XI of the Township Code of Ordinances. There is reason to believe that many existing homes have illegal footing drain connections which should be disconnected. This will involve a house-to-house inspection plus follow-up visits to ensure enforcement.

There are many instances where sanitary sewer manhole tops are located so low that they receive storm water during periods of heavy rains or floods. Manhole tops located alongside streams could be raised above flood elevations, but the cost of such a program would be several thousands of dollars. In some cases, it is estimated that manhole tops would have to be raised as much as ten (10) feet.

Conclusions

It is apparent to me that the damage to single family homes from flood waters can be severe, thus pointing up the need for Meridian Township to offer some concrete solutions to the problem. It was pointed out in this paper that there is no one solution to the problem; but a series of actions are necessary to treat specific flooding problems. Each solution must be applied to those situations which exhibit a unique set of conditions. It does not appear to me that flood control devices built on the Red Cedar upstream from Meridian Township will be built in the near future, if at all. In the meantime I suggest that Meridian study each flood-prone neighborhood within its jurisdiction and seek to minimize the damage to these homes. The Township should give highest priority to projects which minimize the use of flood control structures (i.e. levees, dikes, dams, etc.). Wherever possible, the Township should encourage the moving of structures out of the flood plain so that the flood plain can be used as nature intended, to store flood water. Highest priority should be given to raising the foundations of homes which lie only a few feet below the flood elevation. This solution is least costly and does not require relocation.

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