bridge. The change in water surface elevation at this structure is approximately four feet. The second structure on Park Creek is at Fourth Street SE near the water treatment plant. The change in water surface elevation at this structure is approximately three feet. Another structure is the Washington Street box culvert on Silver Creek. The change in water surface elevation at this structure is also approximately four feet. The fourth structure that has the greatest affect on the water surface elevation is the box culvert in the gravel road just east of the Lake Herman dredged sludge holding ponds on Silver Creek. The change in water surface elevation at this structure is approximately five feet. This road and box culvert controls the Lake Herman water surface elevation during the 100-year flood event. Other bridges and box culverts have an affect on the water surface elevation but not as pronounced as the four described above.

VI. EVALUATION OF PROPOSED ALTERNATIVES

A. General: This section describes the development of alternative plans for stormwater management in Lake County.

The following flood control alternatives were evaluated:

- Channel Improvements - cleaning/widening
- Realignment of Channels
- Diverting all or part of the peak flows
- Replacing structures at specific problem areas
- Constructing detention dams
- Wetland Restoration
- Establish Floodway
- Site specific alternatives including flood walls, berms, or floodproofing structures.
- Bank Stabilization and Erosion Control
- Lake Outlet Evaluation

B. Channel and Structure Cleaning: Cleaning and maintaining the channels and drainage structures is a cost effective flood prevention measure. Items stored, within the floodway float downstream when flood water inundates the floodway. Trees, brush and weeds can catch debris during these events. The debris partially plug culverts and bridges which cause flood waters to come out of stream banks even though the channel has the capacity to carry the water. Similarly, silt deposits in a drainage structure restrict the waterway area which results in water backing upstream of the structure. Cleaning should become an integral part of any Master Plan and a routine maintenance schedule established.

C. Channel Widening:

1. General: The City of Madison has approximately 4 miles of stream channel within the City limits including Park Creek, Park Creek Tributary, and Silver Creek. The stream channel banks have

been developed with housing and businesses. Each Creek was evaluated to determine the affects of widening the channel.

2. Park Creek: The Park Creek channel has approximately 1 mile of rock and mortar wall. If an attempt was made to contain the 100-year flood within the channel, the channel would have to be approximately 100′ wide. Widening the channel to this degree is impractical, because of the impact on environment, businesses, housing, culverts, bridges and underground utilities. Each city street crossing the stream would require a drainage structure spanning the 100′ wide channel. The City of Madison has 15 structures on Park Creek from Fourth Street SE to Ninth Street. The cost to widen these structures would be in excess of $ 5,000,000 not including utility relocation which include natural gas pipe lines, water lines, sewer lines, telephone trunk lines, telephone service lines, cable tv and underground electrical lines.

Channel widening at site specific areas where the existing channel capacity is less than the adjacent reaches downstream may be a viable alternative. This usually occurs at or near structures that have restricted the floodplain and structure replacement would be an integral part of the channel widening. Channel widening then becomes a part of the structure replacement projects.

3. Park Creek Tributary: The Park Creek Tributary channel has a natural bottom and banks. If an attempt was made to contain the 100-year flood within the channel, the channel would have to be approximately 20 feet wide by 5 feet deep near Highway 81 and approximately 30 feet wide by 5 feet deep near the confluence with Park Creek. The reach on the west side of town has low banks and the water spreads out very wide. The construction of a channel that is 5 feet deep and 20 feet wide would require fill. The City has developed a park within some of the areas; therefore, channel widening may not be necessary in those areas. Channel modifications

could occur in areas where the channel is more defined but is narrower than 30 feet.

4. Silver Creek: Silver Creek was analyzed with a channel modification for the 100-year storm and the 25-year storm. Each storm (25 and 100 year) was analyzed with a channel modification from the confluence with Park Creek to Lake Herman. Bottom widths of 25 feet, 50 feet, 75 feet and 100 feet were evaluated. Widening the channel without widening the box culverts and constructing berms or dikes did not substantially alter the floodway because the existing channel is very shallow and the water surface elevation is controlled by the structures. The channel would have to be 4.5 feet deep by 151 feet wide to pass the 100-year storm or 4.5 feet deep by 113 feet wide to pass the 25-year storm. The channel could be reconstructed by moving earth to create a channel that is 4.5 feet deep by 151 feet wide.

The development along Silver Creek would allow the construction of a channel 151 feet wide. Each street crossing would have to be modified to accommodate a channel that is 151 feet wide. The section of Silver Creek that would benefit most from a wide channel is between Highland Avenue and Washington Avenue. This section has three street crossings that would have to be widened to 151 feet. The estimated cost for this project is in excess of $4,000,000.

Constructing earth dikes/floodwalls in the area of the housing and industrial developments to protect existing buildings may be an alternative to widening the stream channel. The removal of flood waters behind the earth dikes/floodwalls must be incorporated into any proposed construction.

An area north of Silver Creek between Union Avenue and Highland Avenue has ground elevations that are nearly the same as the channel bottom. Several homes exist in the area. Constructing an earth dike along the creek would provide a barrier from flood waters from the creek, however the natural drainage into the low area would

still flood the low area. The homes adjacent to the low area will be prone to flooding and should be floodproofed or considered for the buyout/relocation program.

D. Realignment of Channels: The existing channels meander through the City of Madison. The capacity of the existing Park Creek channel is approximately 1400 cfs which is less than the 5-year storm flow. When a storm event occurs that is greater than the capacity of the channel the water is going to go over the stream banks and follow the floodplain or overbank region. Therefore, the alignment of the low flow channel will have little affect on the flood waters once the banks have been overtopped. Since the existing channel can only accomodate a 5 year storm flow, channel realignment is not a viable option.

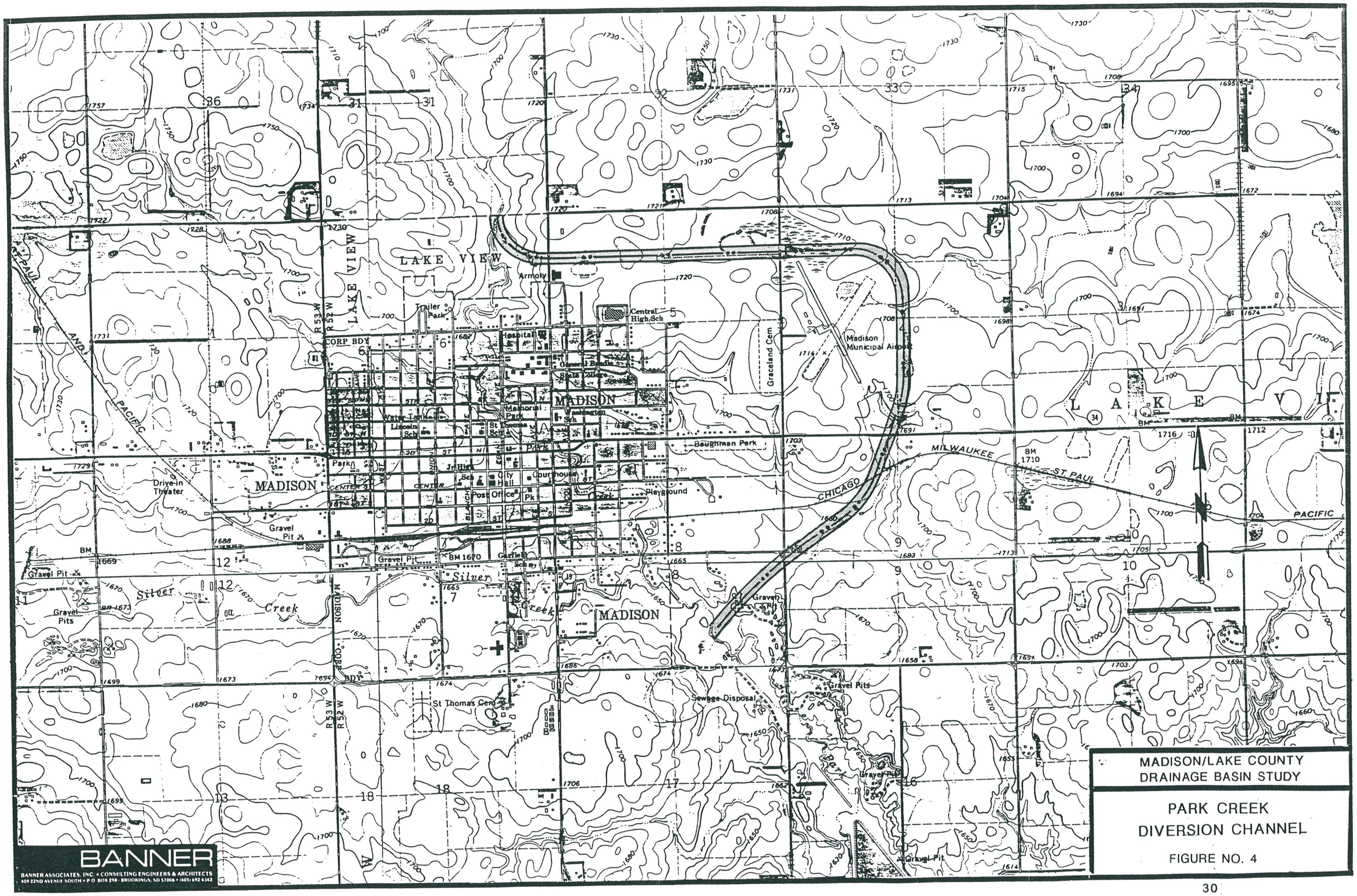
Channel realignment should be considered on structure replacement projects, if the natural channel either does not provide an efficient channel or has an abrupt change in direction just upstream or downstream of the proposed structure. One location where this occurs is at Garfield Avenue and Park Creek. All structures must be designed to accommodate the low flows as well as the design flows. Channel realignment at this location can become a part of the structure replacement project.

E. Diverting All or Part of the Peak Flows: The 1993 flood in the City of Madison is evidence that the existing stream channels do not have the capacity to carry the flood waters associated with a major event without overtopping and causing flood damage. Diverting all or part of the peak flood flow would relieve the existing channels. However, water would arrive at the downstream lakes faster, but the effect on the lake water surface elevation would not be measurable. Water surface elevations at lakes is determined by the associated volume of the lake. The peak flow going through Madison will occur in a matter of hours; whereas the flow through a lake will take days. Therefore, diverting water to the Lake will make a portion of

the water arrive a little sooner, but the over-all volume of water generated by the rainstorm event would be the same.

Diverting water from Park Creek could occur north of the City where the water would be diverted to the east as shown in Figure 4. This diversion channel would take water from the Park Creek Drainage Basin and convey water around the airport and back to Lower Park Creek. If the diversion channel is constructed with a bottom slope of 0.002 ft/ft the channel would have to be constructed to Lower Park Creek in order to obtain an elevation that is low enough to discharge the water. The depth of the diversion Channel would be over 45 feet in some areas and require the installation of five new bridges at intersecting roads and the railroad. The construction cost for the Park Creek diversion channel would exceed $20,000,000. This diversion channel would not be feasible due to the high construction cost and safety hazards associated with the deep channel and structures.

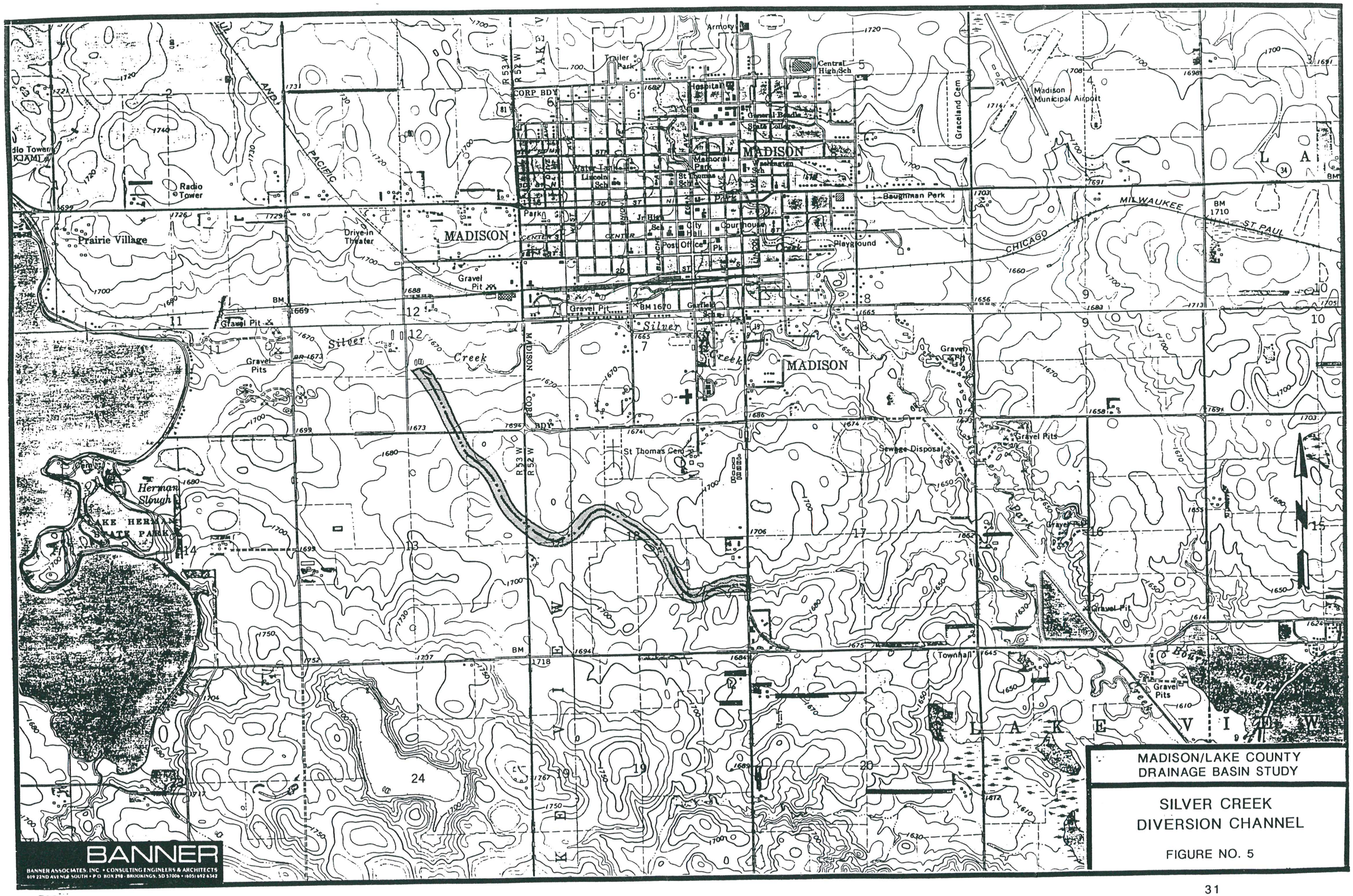
Diverting water from Silver Creek could be accomplished by routing water south to a natural drainage channel that feeds Lake Madison as shown in Figure 5. The basin hydrology indicates the peak flow that occurs in Silver Creek is generated by the watershed between Lake Herman and its confluence with Park Creek. Due to the location, this diversion would not reduce the peak flow generated between Lake Herman and the confluence of Park Creek. In addition, due to the high cost (over $4 million) associated with excavation and construction of drainage structures at intersecting roads, this diversion channel would not be feasible.



MADISON/LAKE COUNTY
DRAINAGE BASIN STUDY

PARK CREEK
DIVERSION CHANNEL

FIGURE NO. 4



MADISON/LAKE COUNTY
DRAINAGE BASIN STUDY

SILVER CREEK
DIVERSION CHANNEL

FIGURE NO. 5

7657

F. Replacing Structures at Specific Problem Areas: The 25-year and 100-year baseline floodway map was generated and evaluated to determine where problem areas exist. Several structures were identified that restrict the flow of water causing the floodway to widen out. The structures evaluated are as follows:

Park Creek

- Fourth Street SE box culvert
- Railroad Bridge
- Garfield Avenue Bridge
- Grant Avenue Bridge

Park Creek Tributary

- Josephine Avenue

Silver Creek

- Private Drive downstream of Washington Avenue
- Washington Avenue box culvert
- Gravel road and box culverts just east of the dredged sludge holding ponds

The computer modeling/evaluation consisted of replacing the existing structures, as referenced above, with a larger structure. The base line flood map, as shown by Figure 3, indicates that water ponds between the railroad tracks and Lincoln Avenue. The structures at Fourth Street SE and the Railroad bridge cause the water to back-up on Lower Park Creek. The restricted box culvert at Fourth Street SE results in backing water up to the railroad. This backup results in reducing the capacity of the railroad bridge causing the water surface to rise and forcing water over the railroad bridge.

Lowering the gravel road (roller rink road) and box culverts just east of the Lake Herman dredged sludge holding ponds will lower the floodwaters on the downstream side of the Lake Herman outlet which will help the residences along the east side of Territorial Road. This change will not affect the flood elevations in town because it will not change the flood flow going into town.

The recommendation on upsizing all of the structures will be dependent on other flood control measures that may be implemented in the selected plan.

G. Constructing Detention Dams: Containing the storm water behind a detention dam and controlling the outflow will reduce the peak flow. The percent of reduction in the peak flow will be dependent on the size of the detention dam constructed. Detention Dams were evaluated at the following locations:

- Above Lake Herman, consisting of 5 different locations
- North of Madison, consisting of 3 different locations

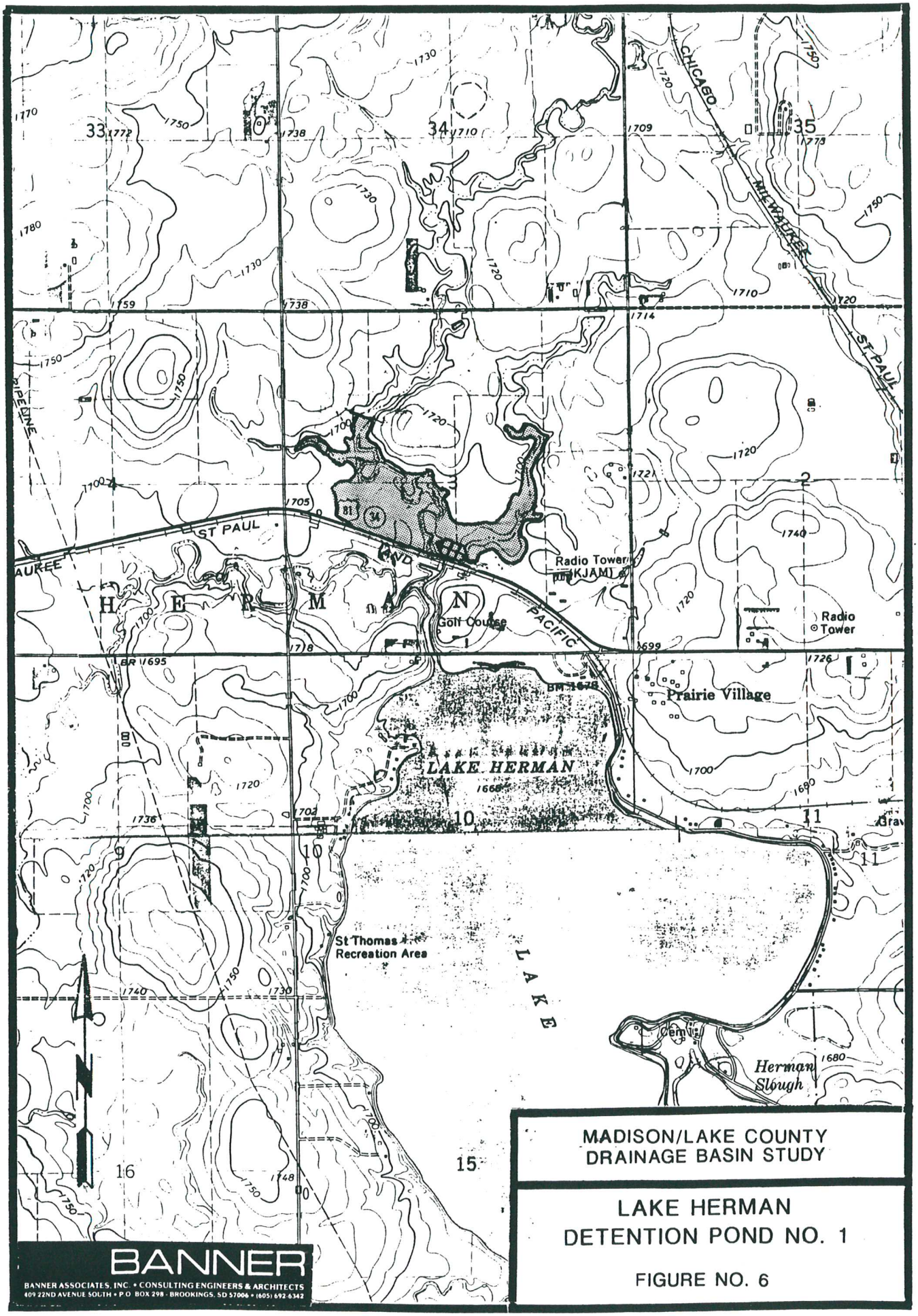
1. Above Lake Herman

a. General: Lake Herman watershed has three existing sediment control structures that were constructed by the Soil Conservation Service. The existing structures were built for sediment control; however, they also function as detention ponds. Reynolds Slough, a large natural slough up-stream of Lake Herman, also acts as a detention pond. These structures and Reynolds Slough are located in the tributaries that feed Lake Herman from the west and south and were modeled in the HEC-1 basin hydrology computer model. The three existing detention ponds were effective in reducing the peak flow reaching Lake Herman from their respective tributaries. Reynolds Slough area was considered noncontributing under normal conditions.

The proposed detention dams are not intended to have a permanent pool of water. Each proposed detention dam will be constructed with a low flow pipe. The low flow pipe will be designed according to the drainage area and the effective detention time desired. The detention dam sites will have an area that will be inundated with water during each major storm event. The City must work out an agreement with the property owner(s) for permanent purchase of the land or a perpetual

easement of the inundated land or combination of permanent purchase and easement of the property.

b. Detention Pond No. 1: Proposed Detention Pond No. 1 is located in Section 3, Herman Township, on the north tributary to Lake Herman as shown in Figure 6. Existing S.D. Highway 34 has created a detention dam for the 100-year storm. The model of the 100-year storm indicates the water will be approximately 2 feet above the road. Previous data collected from the July 3, 1993 flood indicated Highway 34 was overtopped during the 1993 flood. This detention dam can be modified by raising the grade of Highway 34 approximately four to five feet. However, the height can vary if a detention dam is constructed upstream of this site. The location of proposed Detention Pond No. 1, and the area that would be inundated with water, is shown in Figure 6.



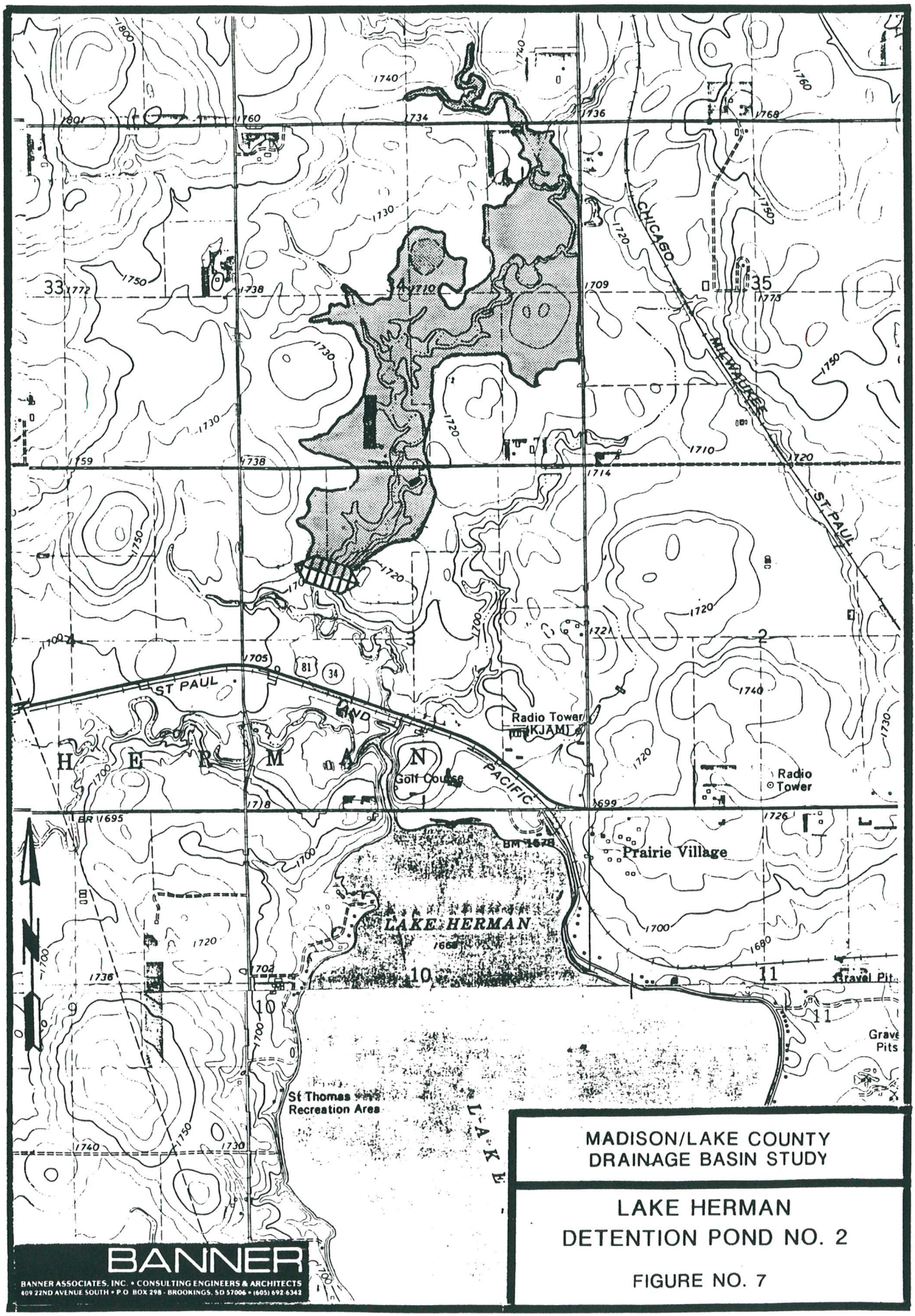
MADISON/LAKE COUNTY
DRAINAGE BASIN STUDY

LAKE HERMAN
DETENTION POND NO. 1

FIGURE NO. 6

c. Detention Pond No. 2: Detention Pond No. 2 is located in Section 3, Herman Township, immediately north of Detention Pond No. 1 on the north tributary to Lake Herman as shown by Figure 7. Detention Pond No. 2 could be an earthen dam similar to the Soil Conservation Service Sediment Control Structures. The top of the dam would be at elevation 1710 with a grass spillway at elevation 1705. The maximum water surface elevation during the 100-year storm event would be 1705.8. This detention pond would store approximately 942 acre-feet of water. The construction of the dam would lower the expected water surface at Highway 34 from 1686.97 to 1677.53. Therefore, if Detention Pond No. 2 is constructed, the embankment on Highway 34 would not have to be raised. The box culvert inlet on highway 34 could be modified to control the flow into Lake Herman.

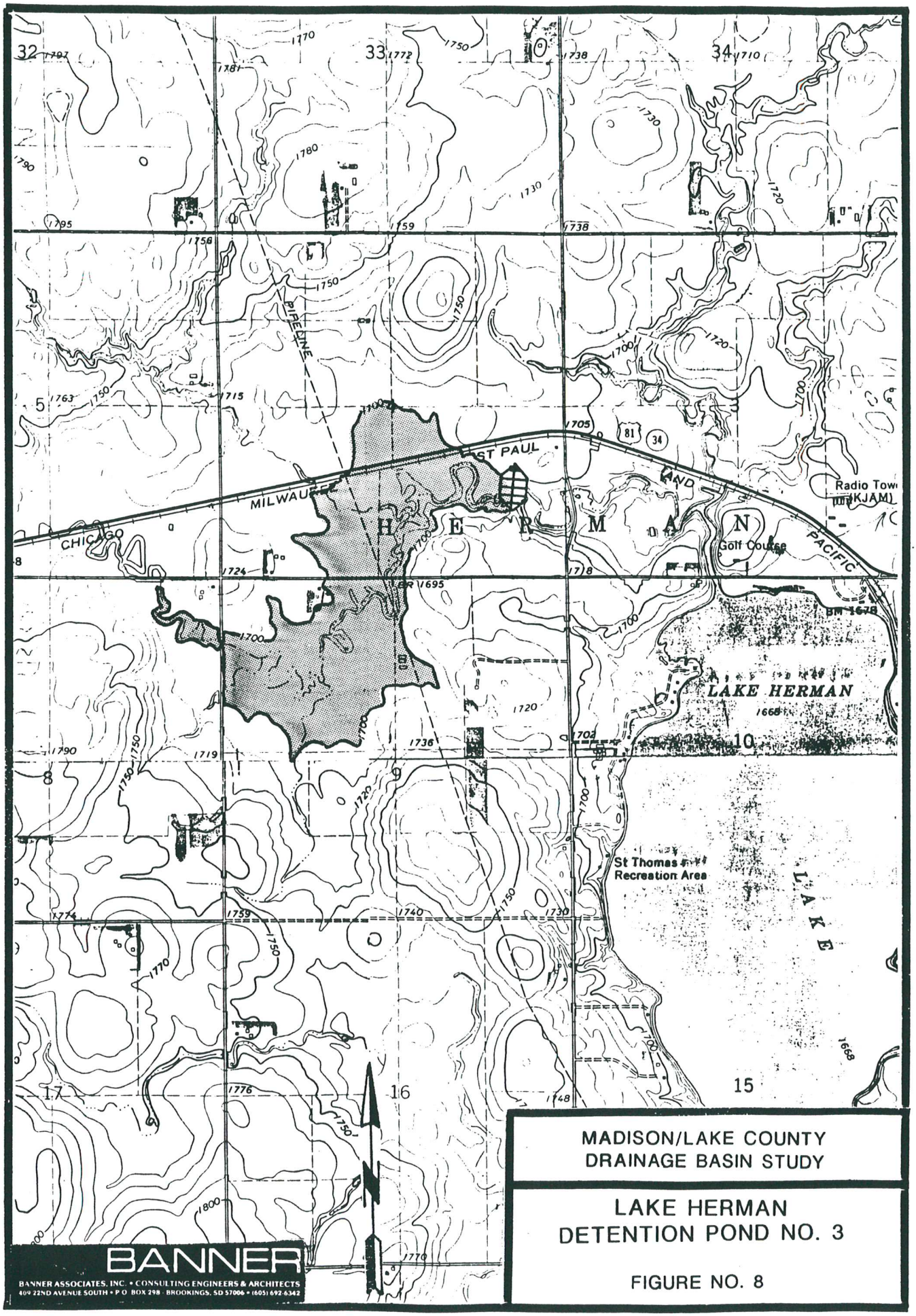
d. Detention Pond No. 3: Detention Pond No. 3 is located in Section 4, Herman Township, immediately west of the golf course, on the west tributary to Lake Herman as shown in Figure 8. Detention Pond No. 3 could also be an earthen dam. The top of the dam would be at elevation 1700 with a grass spillway at elevation 1695. The maximum water surface elevation during the 100-year storm event would be 1699.2. This detention dam would store approximately 1128 acre-feet of water.



MADISON/LAKE COUNTY
DRAINAGE BASIN STUDY

LAKE HERMAN
DETENTION POND NO. 2

FIGURE NO. 7



MADISON/LAKE COUNTY
DRAINAGE BASIN STUDY

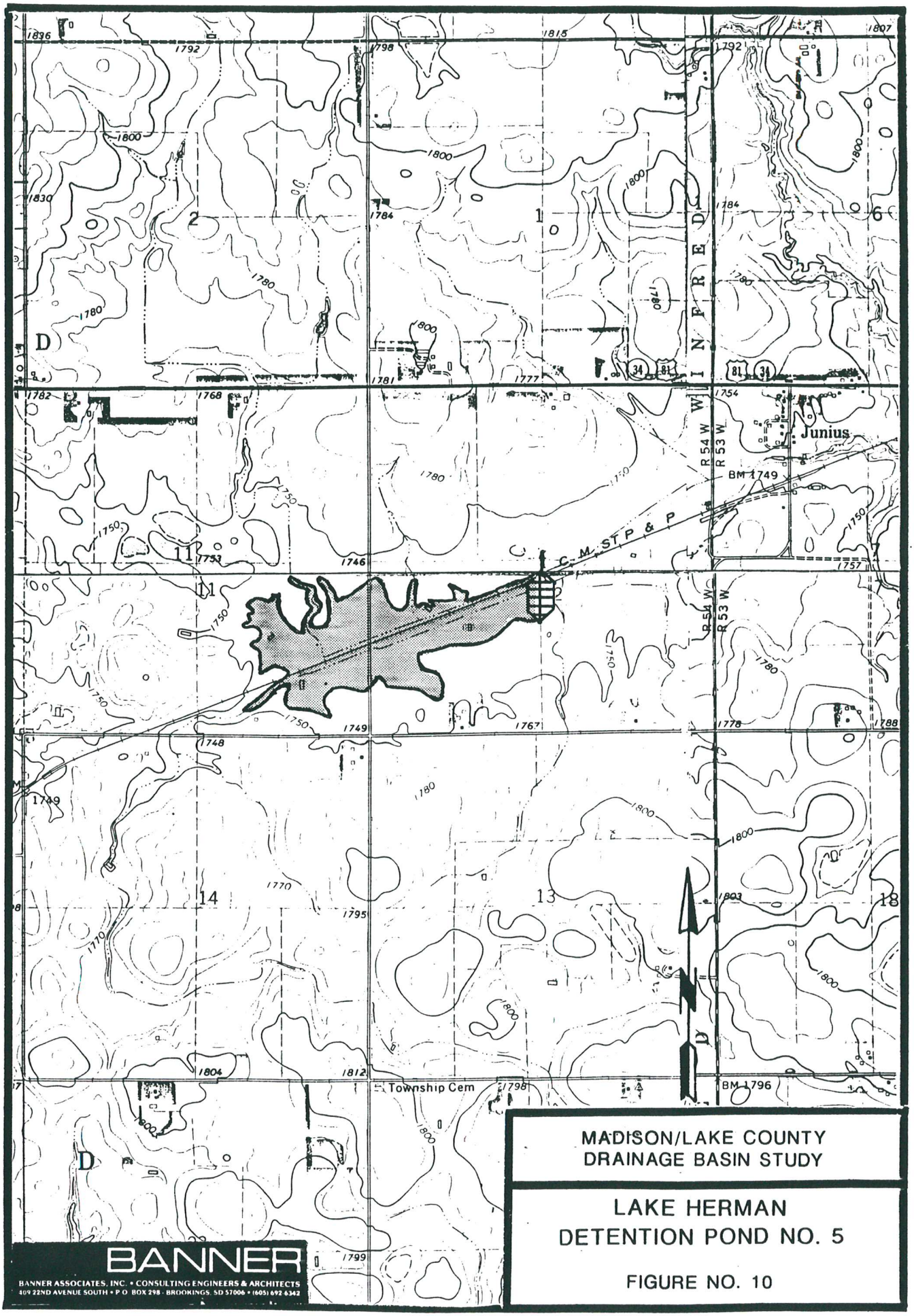
LAKE HERMAN
DETENTION POND NO. 3

FIGURE NO. 8

e. Detention Pond No. 4: Detention Pond No. 4 is located in Section 29, Farmington Township, one mile west and 3 miles north of the golf course on the west tributary to Lake Herman as shown in Figure 9. Detention Pond No. 4 could also be an earthen dam. The top of the dam would be at elevation 1760 with a grass spillway at elevation 1755. The maximum water surface elevation during the 100-year storm event would be 1755.9. This detention dam would store approximately 1033 acre-feet of water.

f. Detention Pond No. 5: Detention Pond No. 5 is located in Section 12, Winfred Township, immediately west of Junius, on the west tributary to Lake Herman as shown in Figure 10. This detention pond could also be an earthen dam. The top of the dam would be at elevation 1740 with a grass spillway at elevation 1735. The maximum water surface elevation during the 100-year storm event would be 1734.5. Detention Pond No. 5 would store approximately 80 acre-feet of water.

g. Summary of Detention Ponds Above Lake Herman: The above described detention ponds will have little affect on flood control for Lake Herman because they are very small compared to the volume of Lake Herman. Constructing all of the detention ponds discussed above will only lower the 100-year modeled water surface elevation in Lake Herman by approximately 1 inch. Constructin of Detention Pond No. 2, north of Highway 34, could eliminate overtopping the Highway during the 100-year storm event. The construction of detention ponds located above Lake Herman could act as sediment control structures which is a necessary part of floodplain management and water quality control.


Junius
BM 1749
C. M. ST P & P
R 54 W
R 53 W
Township Cem
BM 1796
MADISON/LAKE COUNTY
DRAINAGE BASIN STUDY
LAKE HERMAN
DETENTION POND NO. 5
FIGURE NO. 10
BANNER
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