# GARVIN BROOK WATERSHED
## WINONA COUNTY, MINNESOTA

# ASSESSMENT REPORT

May 2008

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## Scope of Assessment Report

Based on the FEMA floodway maps, public input, and other existing data, this report focuses on analyzing flood protection alternatives for the City of Stockton and to a lesser extent the Gunderson Addition which is located just upstream of Minnesota City. This report does not address any flood concerns relating to Rollingstone. The FEMA floodway map for Rollingstone shows minimal flooding. There was also much less public concern and input regarding Rollingstone.

## Setting

The Garvin Brook Watershed is located within Winona County, Minnesota approximately 100 miles southeast of Minneapolis/St. Paul. The watershed is approximately 63,220 acres in size and drains directly into the Mississippi River at Minnesota City. The three largest cities in the watershed are Stockton, Rollingstone and Minnesota City. Based on census population estimates there are over 800 people living in Stockton, 640 in Rollingstone, and 215 in Minnesota City.[1] See Appendix A for Watershed Map.

Garvin Brook, which runs through of Stockton, and Rollingstone Creek are both designated trout streams. Although brown trout are most common in these streams, Garvin Brook is also managed for brook trout, especially in the upper reaches of the streams. Both the brook and brown trout populations in Garvin Brook are self sustaining and have been so for over 20 years. This has made it a highly valued recreational trout fishery for Southeast Minnesota (Appendix E – Environmental Evaluations).

Based upon the information gathered from Minnesota Climatology Office climatic averages for this area are as follows: 34 inches of total precipitation, 28 inches of snowfall and annual temperatures range from -22 to 90 degrees F.

A Federal Emergency Management Agency (FEMA) - Flood Insurance Study, dated February 2, 1982, was conducted for the City of Stockton. Table 1 below summarizes the estimated channel flows during a 10, 50, 100, and 500-year events from the FEMA report. Figure 1 displays a map of Stockton to identify the locations. FEMA floodway maps for each city in the watershed can be viewed in Appendix F.

**Table 1 - Summary of Garvin Brook Discharges**

| Location | Drainage Area (sq mi) | Peak Discharge (cfs) | | | |
|---|---|---|---|---|---|
| | | 10-year | 50-year | 100-year | 500-year |
| At Broadway Street | 38.3 | 4,625 | 8,484 | 10,118 | 15,203 |
| At the confluence of East Tributary | 36.0 | 4,608 | 8,438 | 10,160 | 15,237 |
| At City Road | 35.9 | 4,966 | 8,683 | 10,574 | 15,434 |
| At F Street | 15.5 | 2,437 | 4,149 | 5,263 | 7,369 |

[1] www.census.gov Estimates are from the year 2006 and are projections based on data from the 2000 census.

A HEC-HMS hydrology model was developed and calibrated to regional gages to assist in evaluation of flood reduction alternatives. For modeling purposes, the Garvin Brook watershed was divided into 31 subareas so that flow/frequency information could be developed at various points/junctions. The HEC-HMS values for the Stockton area were within 10% of the FEMA values shown in Table 1. See Appendix C for the sub-area map of the watershed and the tabular summary of the HEC-HMS flow/frequency values.

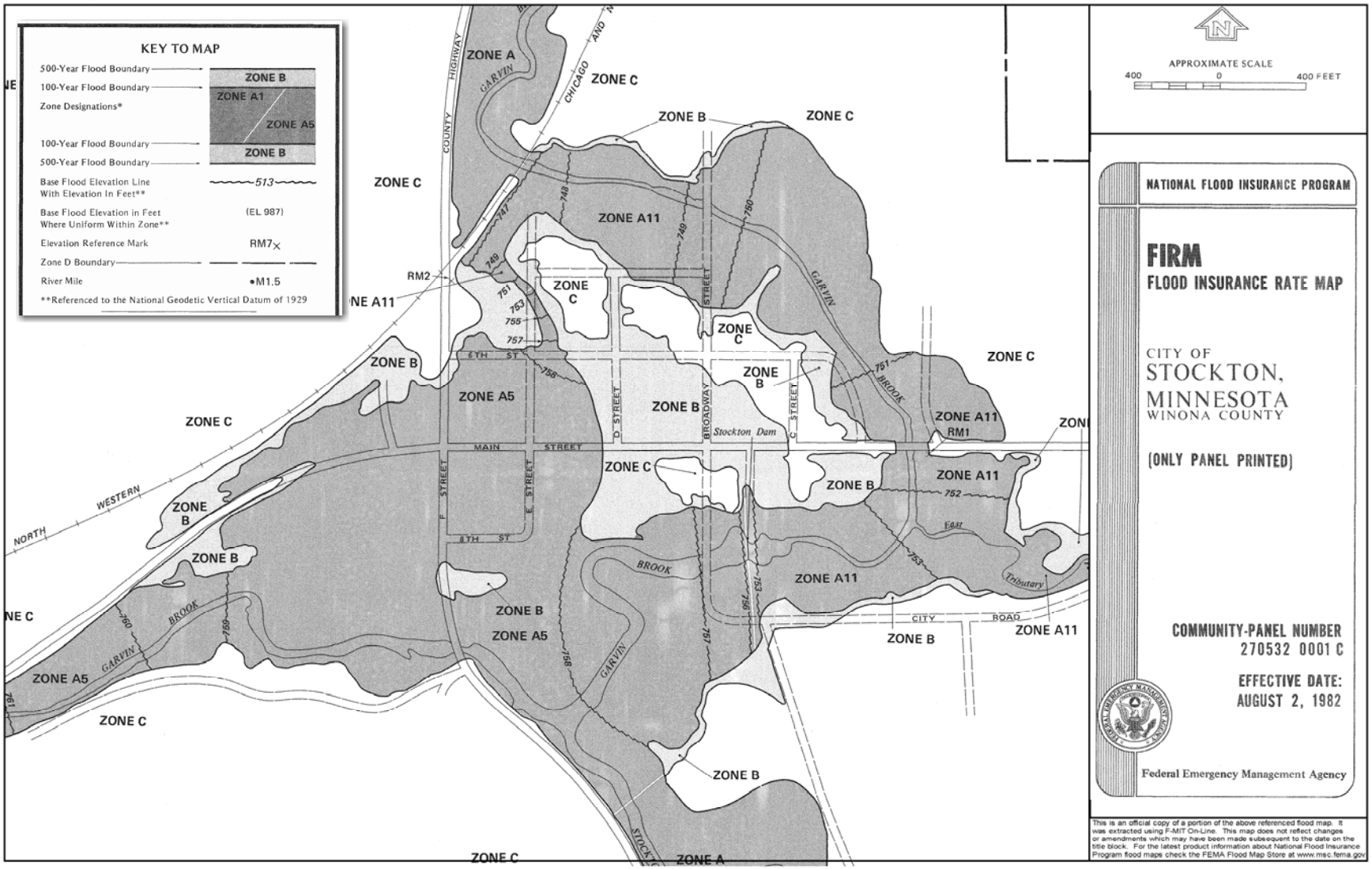
## Land Cover

Garvin Brook watershed is located in the driftless (unglaciated) region of Minnesota. Being such, the watershed is comprised of rolling upland areas and rugged valleys with many deep ravines. The watershed is dominated by two major land use types, agriculture (46%) and forest (36%) (Table 2). The uplands in the watershed are heavily farmed, while the steep ravines remain in deciduous forest cover. The agricultural lands are comprised primarily of soybean, corn and hay/alfalfa production. Much of the river bottoms are used for pasturing.

**Table 2 - Garvin Brook Watershed Land Cover**

| Land Cover | Acres | Percent |
|---|---|---|
| Cultivated Land | 29,300 | 46% |
| Deciduous Forest | 22,700 | 36% |
| Grassland | 7,650 | 12% |
| Farmsteads and Rural Residences | 1,050 | 2% |
| Roads | 960 | 2% |
| Wetlands | 750 | 1% |
| Urban and Industrial | 530 | 1% |
| Other Rural Developments | 90 | 0% |
| Grassland-Shrub-Tree | 70 | 0% |
| Rural Residential Development | 60 | 0% |
| Other | 60 | 0% |
| Water | 50 | 0% |
| **Total** | **63,270** | **100%** |

**Figure 1 – FIRM Map of Stockton**



## Historic Flood Problems

Floodwater damage in the watershed is a major problem. Floods within the watershed have occurred in 1919, 1932, 1936, 1941, 1946, 1951, 1991, and 2007. The 2007 flood, which led to this assessment, was the result of over 14 inches of rainfall upstream of Stockton over a 36 hour period. This flood was responsible for 6 fatalities. It was estimated by Gov. Tim Pawlenty's Office that the 2007 storm event resulted in $67 million in damages to homes, businesses and public infrastructure (Office of the Governor 2007). This event is estimated to have a return period that is greater than 500-year.

The 1991 storm event consisted of 12 inches of rain in the Garvin Brook Watershed. It was also estimated that between 6 and 8 inches of rain fell in 2.5 to 3 hours. Nearly 90% of the homes in Stockton sustained some level of damage from the flood. The damages from the 1991 flood were estimated at $2.8 million. High water marks measured from this event exceeded the current FEMA 500-year profile information.

## Planning History and Prior Reports

The Garvin Brook Watershed Association was formed in April 1956. In August of the same year, a Public Law 83-566 (PL-566) application for aid in flood damage reduction was submitted to State Soil Conservation Committee. A copy of the request was forwarded to SCS (Soil Conservation Service, now known as NRCS). The project sponsors listed on the initial application were Winona County, Rollingstone, Stockton, Winona, Gilmore SCD, Villages of Stockton and Minnesota City, and Warren Township.

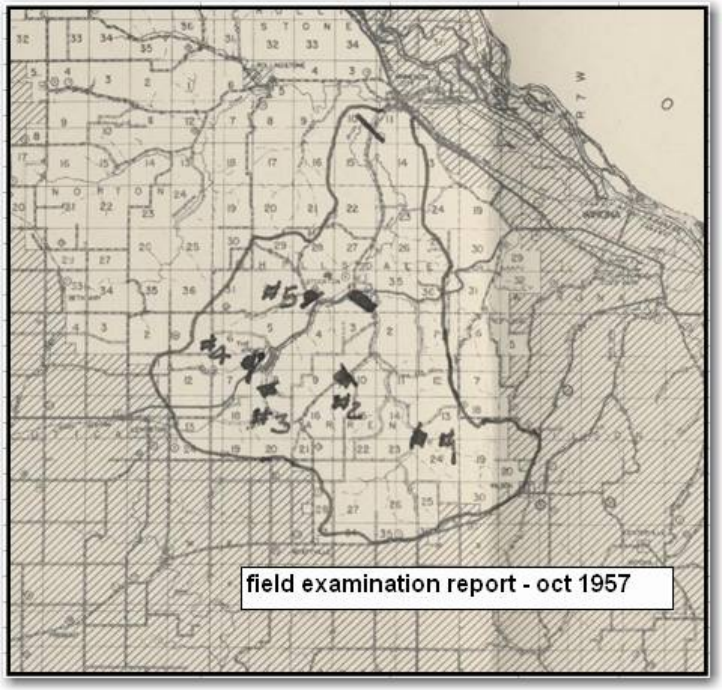
The PL-566 application was accepted by SCS and in October 1957 a field review of the watershed was conducted by SCS to determine potential flood damage reduction alternatives. From this review, it was determined that two channel stabilization structures, five retention structures, and grade control would be required above Minnesota City Railroad and below the Stockton Mill Pond (Figure 2). It was estimated that the proposed project would provide (1957 dollars):

- $5,000 Average Annual cropland flood reduction benefits
- $1,270 Average Annual City of Stockton Urban benefits
- $30,000 Average Annual Land Enhancement benefits

The proposed project was estimated to have a benefit to cost (B:C) ratio of 3:1. Although there was potential for the project to be feasible in terms of economics and hydraulics, no action was taken.

In June 1958, the Minnesota SCS staff conducted a second field review. The staff reduced the proposed project to two floodwater retention structures (#1 and #5 in Figure 2) and two grade control structures. The Stockton-Rollingstone-Minnesota City Watershed District formed December 1958. In April 1959, Minnesota SCS was authorized to develop a work plan in order to proceed with detailed planning.

**Figure 2 - October 1957 Field Review - Watershed Map with Structure Sites Identified**




An internal audit of the proposed project was completed by the SCS Milwaukee E&WP Unit staff in December 1959. This audit resulted in the land enhancement benefits claimed by the project being removed in addition to finding no crop or urban damages in the Rollingstone Creek Watershed. The removal of the land enhancement benefits reduced the B:C ratio to 0.2:1.0. With the proposed project now economically infeasible, the E&WP Unit suggested and evaluated two alternatives:

- Alternative 1 - construction of one retention structure upstream of Stockton. It was estimated the structure would reduce the discharges by 3,000 cfs in Stockton. This alternative resulted in a B:C ratio of 0.44:1.0.

- Alternative 2 – construction of one grade stabilization structure below Mill Pond and build levees south and west of Stockton. It was felt that the levee costs would be justified on the urban benefits alone.

The results of the SCS internal audit were shared with the Sponsors and in July of 1960, the Sponsors verbally expressed the desire to proceed with preparing a work plan to include one grade stabilization structure and levees around Stockton. However, a formal letter verifying the request was never mailed to Minnesota SCS.

In September of 1960 the Stockton-Rollingstone-Minnesota City watershed District sent a letter to the Minnesota Water Resources Board requesting PL-566 assistance to install the stabilization structure and diversion levees. At the time, Minnesota SCS was unable to proceed with the request as they were waiting for an official request from the original

sponsors (Winona County and Rollingstone, Stockton, Winona, Gilmore SCD, Villages of Stockton and Minnesota City, and Warren Township).

In April 1961 the Sponsors held a meeting to discuss their options. A referendum was held resulting in a 19 to 6 vote to proceeding with PL -566 planning. Again, a formal letter verifying this request was never mailed to Minnesota SCS.

The Sponsors were not able to generate sufficient local support for the levee and stabilization structure alternative, and in March of 1962 Minnesota SCS suspended preparation of the work plan.

In February 1964, the Sponsors gained a renewed interest for a flood damage reduction project due to changes in PL-566 procedures, which now allowed for the inclusion of recreational benefits. The Sponsors were now interested in two dams (#2 in Figure 3 and #7 in Figure 4). However, in June 1967, Minnesota SCS terminated all planning efforts.

**Figure 3 - Structure Sites (Feb 1958)**

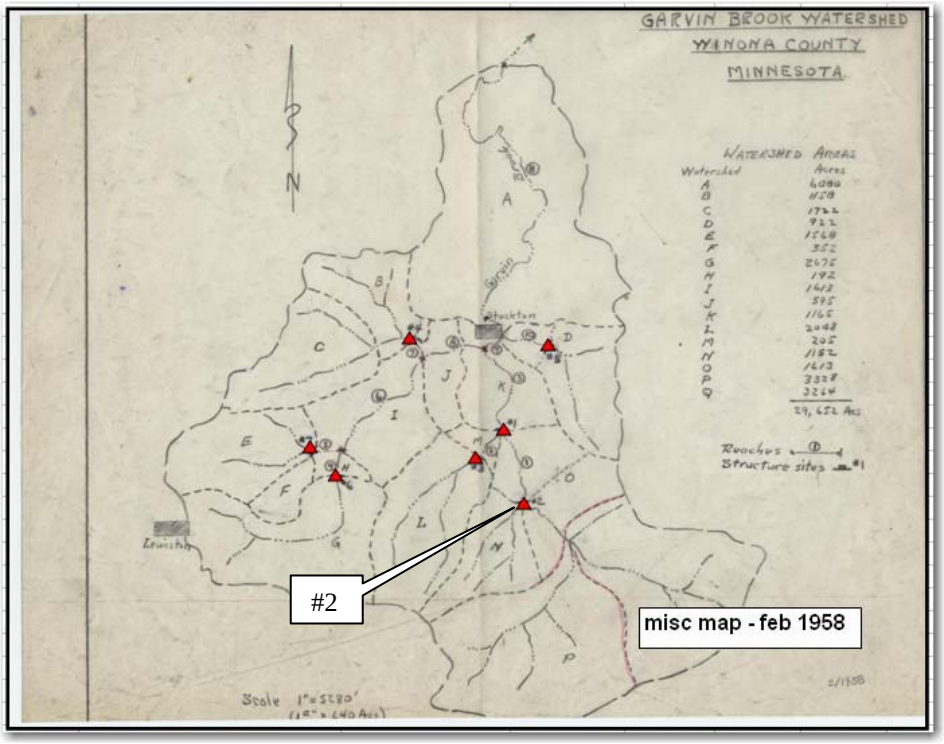
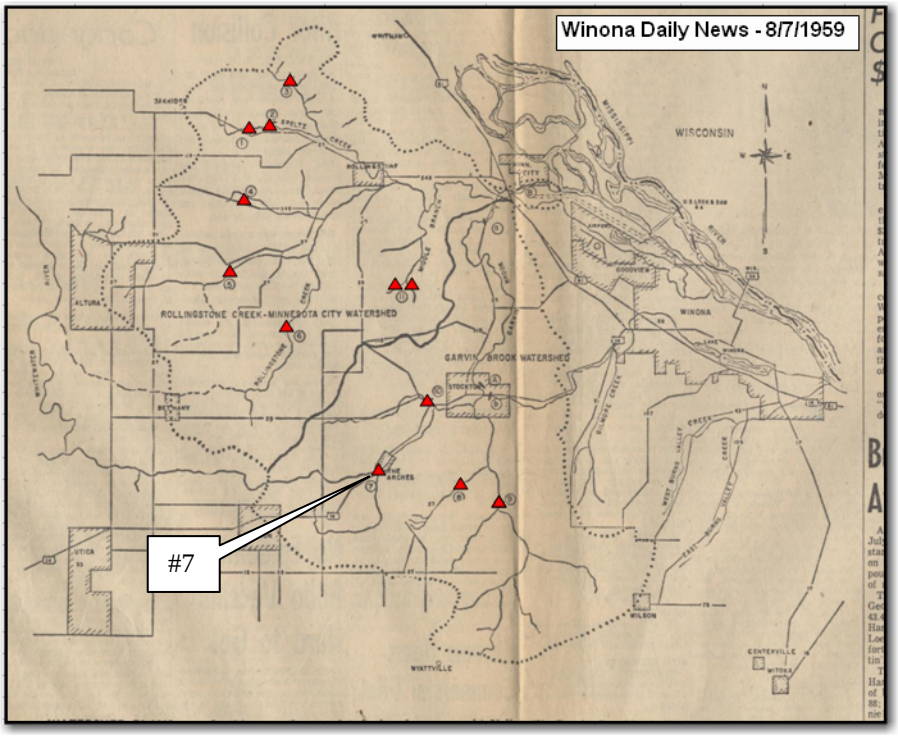


**Figure 4 - Structures Identified in Winona Daily News Article (8/7/1959)**




In response to the severe flooding experienced by the residents of Stockton in 1991, the US Army Corps of Engineers (USACE) completed a report that investigated potential flood control measures (USACE 1994). Table 3 below summarizes the USACE's estimate of damages by return period for Stockton (2008 dollars).

**Table 3 - Estimated Flood Damages in Stockton (2008 $)**

| 2-year | 5-year | 10-year | 25-year | 50-year | 100-year | 500-year | Average Annual |
|---|---|---|---|---|---|---|---|
| $247,420 | $358,460 | $465,370 | $629,990 | $709,870 | $865,830 | $1,149,200 | $197,530 |

The USACE report investigated several flood control alternatives, though the report issued in 1994 provides detail only on the most feasible alternative. The alternative described in the report involves a combination of dike and floodplain modifications of Garvin Brook in and around the City of Stockton. A detailed description of the flood damage reduction plan proposed by the USACE can be found below in the description of alternatives.

The final conclusion of the USACE report is that the project was not economically feasible. The proposed project would have provided flood damage reduction to the 100-year flood level. It was estimated that this would result in $196,630 in average annual benefits.[2] Average annual project cost was estimated by the USACE to be $248,910

[2] Based on the USACE report, even with the flood damage reduction plan in place, the city of Stockton would experience flood damages during 50-year events and greater. These damages amounted to $900 average annual.

resulting in an overall project benefit to cost ratio of 0.8:1.0. Because the estimated costs exceeded benefits, no further analysis or project work was completed by the USACE.

The purpose of this report is to re-evaluate the USACE project. In addition, several other alternatives are presented and evaluated. This re-evaluation and additional analysis was conducted in response to the 2007 flood event.

## Alternatives

Plan formulation for works of improvement administrated by NRCS must be in accordance with the U.S. Water Resources Council's "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (P&G). P&G specifies that the federal objective of water and land resources planning is to develop projects which contribute to national economic development (NED) consistent with protecting the nation's environment while still being responsive to state and local concerns.

All reasonable methods for solving the identified water and related land resource problems of the watershed are considered. Alternative plans are formulated in consideration of four criteria: (1) Completeness, (2) Effectiveness, (3) Efficiency, and (4) Acceptability. The alternative plans are then evaluated for effects and compared with one another. A recommended plan is then selected. Alternative plans evaluated include:

1. No Action

2. Land Treatment Measures

3. Nonstructural Measures
    - Stockton – City Buyout

4. Structural Measures
    - Stockton - Dike and channel excavation (USACE 1994 plan)
    - Stockton - Diversion
    - Stockton – Large floodwater retention structures
    - Stockton – Upland ponds with 100-yr level runoff storage capacity
    - Gunderson Addition – Dike
    - Gunderson Addition – Floodwater retention structures

NO ACTION

A no action plan or maintaining the status quo would not reduce the flood damages in the future as existing problems would remain.

LAND TREATMENT MEASURES

No land treatment measures were researched.[3] The amount of protection required for the City of Stockton or Minnesota City would not be achieved by land treatment measures.

NON STRUCTURAL MEASURES

**Stockton – City Buyout**
The only nonstructural flood damage reduction alternative considered for the City of Stockton was a buyout of all residential and commercial properties. Although this alternative is not in line with the sponsors goals, it was evaluated for completeness.

In order to evaluate the alternatives presented in this report, the flood damage reduction alternatives evaluated by the USACE in 1994 for the City of Stockton were re-evaluated. Using updated damage frequency curves from the report, NRCS was able to estimate the benefits of all alternatives. Detailed information on the economic data and the updated (USACE) damage frequencies curves can be found in the economics section below and Appendix B.

To estimate the cost of a buying out the entire City of Stockton, the inventory of parcels presented in the USACE report was used. This inventory consisted of 77 residential and 15 commercial properties. Using cost information from pending FEMA buyouts following the 2007 event, it was estimated that a buyout of the city would cost $11.04 million, or an average annual value of $517,000.[4] This alternative would provide complete flood protection for all storm events, in perpetuity. A complete buyout of the City of Stockton would yield an average annual benefit of $197,530. Given this protection, the alternative is still economically infeasible (B:C ratio 0.38:1.0). However, if homes were to be elevated or some other form of flood reduction measures were to be installed, a mix of buyouts and flood reduction measures may lower the cost making this alternative feasible. Evaluation of such an alternative would require more detailed information. Additionally, it is likely that the estimated benefits will change given pending buyouts, current and future residential and commercial inventory.

STRUCTURAL MEASURES

**Stockton - Dike and floodplain excavation (USACE 1994 plan)**
The COE proposal included the following elements (Continued on next page):

- 2,450 feet of floodplain enhancement/excavation on Garvin Brook from U.S. Highway 14 bridge downstream of the Chicago and North Western Railroad Bridge. Some sections of channel would be riprapped to provide bank protection where needed.

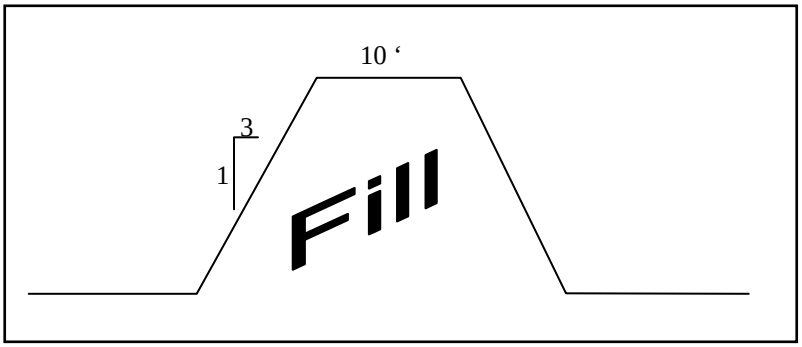
[3] For the purpose of this report, the NRCS definition of land treatment measures encompasses features such as grassed waterways, tillage practices, riparian buffers, etc. These land treatment features deal almost entirely with agricultural lands.
[4] Cost based on 16 homes with a total buyout cost of $1.98 million, average home value $120,000 (FEMA 2007)

The COE proposal included the following elements (Continued):

- 3,800 feet of dike along the left bank (looking downstream) of Garvin Brook, upstream from the Highway 14 bridge.
- Removal of the Broadway Street North and Broadway Street South bridges.
- Riprapping the channel under the railroad crossing.
- Riprapping the channel under U.S. Highway bridges.
- Construction of a new road along the east side of Stockton.
- Installation of culverts under residential roads north of U.S. Highway 14 to divert interior runoff eastward away from the dike into the channel downstream of the U.S. Highway 14 bridge.
- Relocation of one sanitary line passing under the proposed dike alignment.
- Relocation of power and telephone lines crossing the channel at two locations downstream of the U.S. Highway 14 bridge.

The proposed dike would have a standard cross-section including a 10-foot top width, 3:1 side slopes, and a 3 foot freeboard[5] above the 100-year flood level. The base width ranges from 32 to 61 feet with an average width of 48 feet. The dike height ranges from 3.7 to 8.4 feet with an average height of 6.3 feet. The dike would be topsoiled and seeded. To provide a continuous line of protection, County Road 23 would be ramped to the top of the dike. Flood flows would pass over the road on the channel side of the dike.

**Figure 5 – Typical Dike Cross Section**




Between the U.S. Highway 14 and the Chicago and North Western Railroad bridges (station 0+00 to 24+50) there would be no dike. Flood stages in this reach would be reduced by widening the right (looking downstream) floodplain to a 75 foot base width. The existing channel below a 2-year flow would be left undisturbed limiting impacts to the trout fishery. The widened overbank would act as a floodway to convey flood flows, whereas the existing channel would convey low flows. The excavated channel would be topsoiled, seeded, and riprapped to protect from erosive velocities.

In June 1994, the USACE estimated a total construction cost of $1,989,000. Indexing the USACE costs up to 2008 values[6] with a few other minor adjustments, the estimated total construction cost is now $3,050,000.

[5] Freeboard requirements as stated in the National Flood Insurance Program (NFIP) regulations. (44 CFR Section 65.10: Mapping of Areas Protected by Levee Systems)
[6] Using the Construction Cost Index

**Figure 6 - Typical Floodplain Modification Cross-Section**

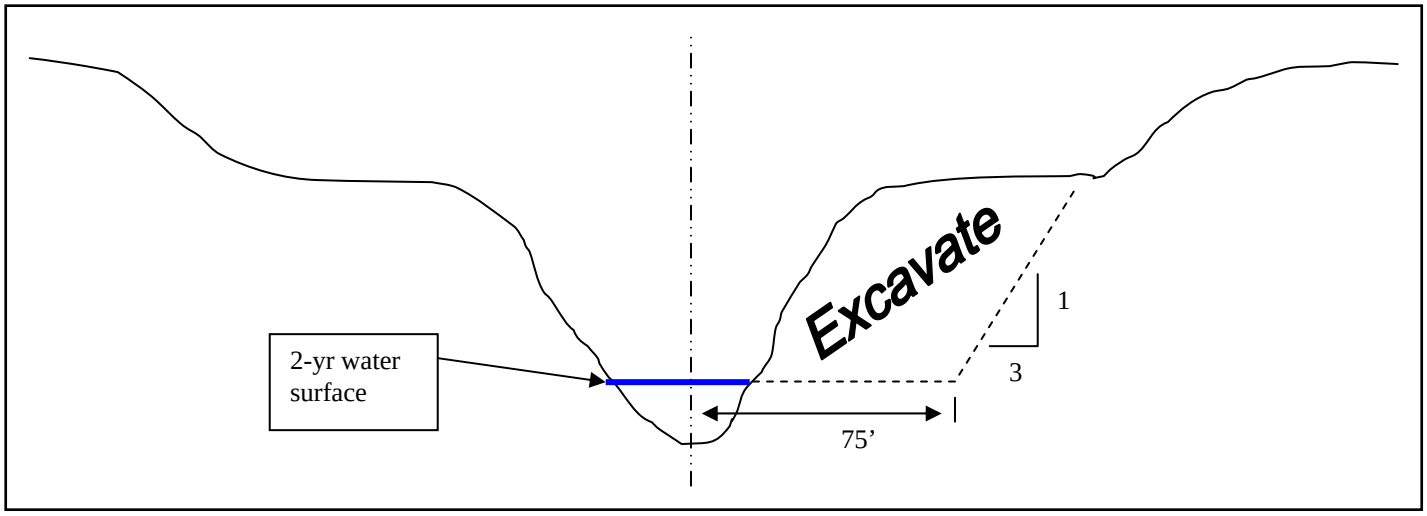
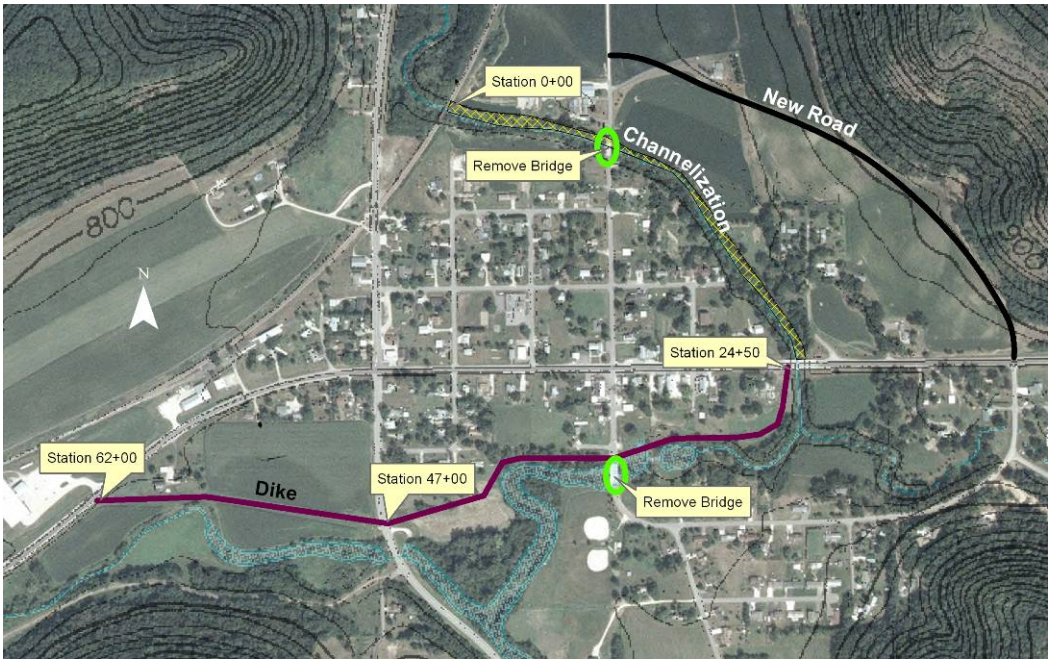



**Figure 7 - USACE 1994 Plan**




*Economic Analysis*

Again, to determine the economic feasibility of this alternative, the updated damage frequency curves developed by the USACE were used. Assuming the same level of flood protection as the USACE, it was estimated that the average annual flood protection benefits provided by this alternative were $196,630. These benefits are a combination of commercial and residential flood protection and are presented in Table 4.

**Table 4 - USACE 1994 Plan Updated Flood Protection Benefits**

| AA Benefits | |
|---|---|
| Commercial | $7,290 |
| Indirect residential | $74,010 |
| Direct Residential | $115,330 |
| Total Residential | $189,340 |
| Total All | $196,630 |

The estimated installation cost of the plan was $3.03 million, or an average annual cost of $142,010. Including an O&M cost equal to 0.3% of the total installation cost, the average annual cost of this alternative is $149,940. Based on a 100 year lifetime and an interest rate of 4.875%, the benefit to cost ratio of this alternative is 1.31:1.0.

**Stockton - Diversion**

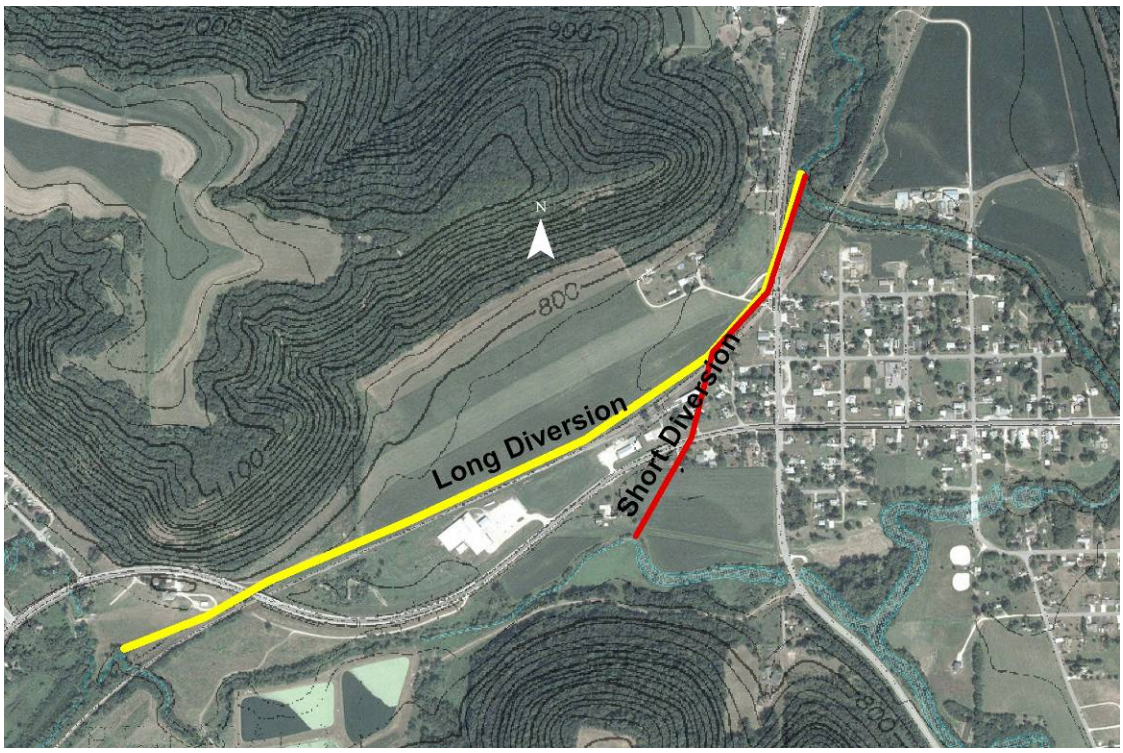
This alternative proposes a floodwater diversion structure around the City of Stockton. Stockton Valley Creek enters Garvin Brook downstream of F Street. At that junction, Garvin Brook and Stockton Valley Creek have approximately the same contributing drainage area. During a 100-year event, it is estimated that flows are at this confluence are 10,160 cfs. To reduce the damages in Stockton, almost all flows in Garvin Brook would need to be diverted during storms up to a 100-year event. Two different locations for the diversion were compared – a short diversion and a long diversion (Figure 8). A lateral weir would be built that would allow water to enter the diversion channel at approximately a 2.5-year event.

Whether the long or short diversion is installed, a reduced version of the USACE 1994 Plan would still need to be constructed to provide Stockton the level of protection desired. With either diversion installed, the dike heights proposed in the USACE Plan could be lowered by approximately 3 feet, while reducing the amount of floodplain excavation required.

For both short and long diversion options, approximately 6,300 cfs needs to be rerouted during a 100-year event. A side inlet weir would be built to allow water into the diversion channel. The channel would have a base width of 100 feet, side slopes of 3:1, and a depth of 8.5 feet. The estimated velocity in the channel would be 6 ft/s. For the cost estimates below, they do not include additional environmental and O&M&R costs that are associated with installation.

> Short Diversion: The length of the short diversion option would be approximately 2,500 feet. Construction would include two road crossings (bridges), one railroad crossing, three property relocations, a diversion channel, a lateral weir, two drop structures, land, seeding and permit fees. The estimated installation cost for the diversion is $5,130,000 plus the cost of a reduced USACE 1994 plan.

**Figure 8 - Location of the Short and Long Diversion Channel Locations**




Long Diversion: The length of the long diversion option is approximately 5,350 feet. Construction would include two road crossings (bridges), one property relocated, a diversion channel, a lateral weir, two drop structures, land, seeding, and permits. The estimated installation cost for the diversion is $14,880,000 plus the cost of a reduced USACE 1994 plan.

**Table 5 - Summary of Diversion Costs**

| Alternative | Diversion Installation Estimated Cost ($) | Reduced USACE 1994 Plan Cost Estimate ($) | Total Estimated Installation Cost ($) |
|---|---|---|---|
| Short Diversion | 5,130,000 | 2,987,000 | 8,117,000 |
| Long Diversion | 14,880,000 | 2,987,000 | 17,867,000 |

*Economic Analysis*

Based on the hydrologic analysis of the two diversions around the City of Stockton, an economic feasibility analysis was completed. It was assumed that either diversion, the short or long configuration, would provide the same level of flood protection as the 1994 USACE report. Using the updated damage frequency curves estimated in the 1994 report, the flood protection benefits of the diversions would not exceed the costs. The average annual installation costs were estimated to be $380,380 for the short diversion, and $837,370 for the long diversion. Average annual values are estimated over 100 years

and a 4.875% discount rate[7]. The projected average annual flood protection benefits were $196,630 (Table 4). Thus the diversion alternatives were determined to be economically infeasible (B:C ratio of 0.5:1.0 for the short diversion, and 0.23:1.0 for the long diversion).

**Stockton – Large Floodwater Retention Structures**

An HEC-HMS hydrology model was developed to estimate the effects of potential floodwater retention structures upstream of Stockton. Figure 9 shows the locations of the structures considered. Table 6 summarizes the peak discharge reductions for these structures. Details of the hydrologic modeling for these structures can be found in Appendix C.

**Table 6 - Modeled Peak Discharge Reductions from Upland Retention Structures**

| Structure Number | Upstream Drainage Area (square miles) | Average Peak Discharge Reduction in Stockton |
|---|---|---|
| 1 | 13.59 | -31% |
| 2 | 3.62 | -12% |
| 3 | 18.50 | -48% |
| 6 | 7.41 | -25% |
| 4 +5 north + 5 south | Similar to Str 6 alone | Similar to Str 6 alone |
| 7 | 4.43 | -13% |
| 8 | 1.73 | -3% |

It was determined that building the retention structures alone would not provide protection to the 100-year flood level; therefore, additional flood damage reduction measures would need to be constructed around the city. For this analysis, the additional measures were assumed to be the same components as the 1994 USACE plan (dikes + floodplain modification) however their size would be reduced due to the reduced discharges provided by the retention structures.

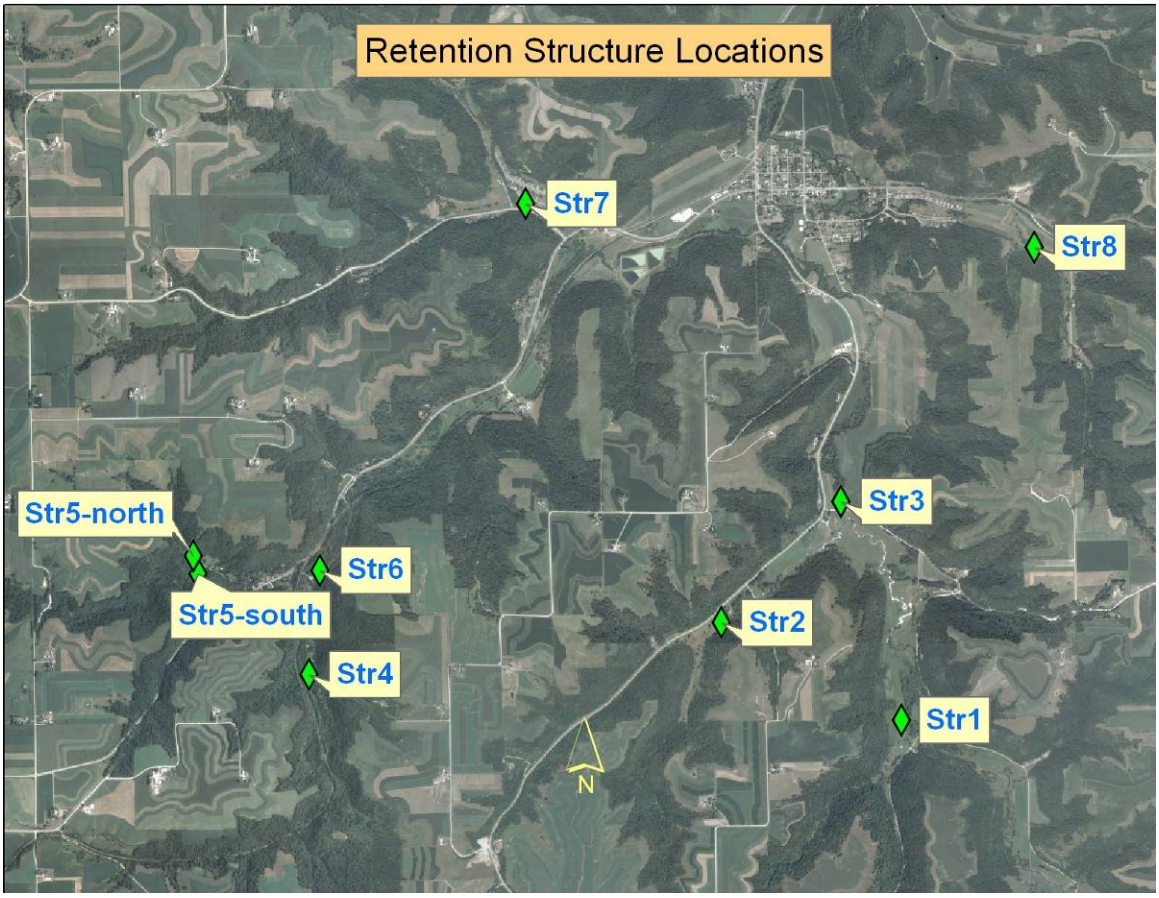
*Structure 1*

This structure could offer the City of Stockton some flood protection, but additional flood damage reduction measures around the city would be needed. The estimated structure cost is $5.00 million.

The additional flood damage reduction measures include building all the components of the USACE Plan. As a result of the structure, it was estimated that the height of the dikes along the south side of the city could be reduced by 1 foot. However, the remaining components would not change. The estimated cost for the additional flood damage reduction measures is $3.01 million

[7] Based on the high installation costs, O&M&R costs were not included as they would only render the alternatives even more economically infeasible

**Figure 9 - Map of Potential Flood Retention Structures**




*Str2*
This structure could offer the City of Stockton some protection, though additional flood damage reduction measures would need to be installed. To achieve the flood storage needed to achieve the discharge reductions required in Stockton, 2,300 feet of US Hwy would need to be replaced. The estimated structure and relocation costs are $2.80 million. Appendix G contains the estimated inundation map for this structure.

The additional flood damage reduction measures include building all the components of the USACE Plan. As a result of the structure, it was estimated that the height of the dikes along the south side of the city could be reduced by 1 foot. However, the remaining components would not change. The estimated cost for the additional flood damage reduction measures is $3.01 million. To provide 100-year flood protection for the City of Stockton with Str2 installed would cost an estimated $5.8 million. Because of the cost, this structure option was dropped from further investigation.

*Str3*
This structure could offer the City of Stockton some protection, though additional flood damage reduction measures would need to be installed. The estimated installation cost of the structure cost is $5.94 million. Because the structure cost alone was so high, this structure was dropped from further investigation.

*Str6*
This structure could offer the City of Stockton some protection, though additional flood damage reduction measures would need to be installed. To achieve the flood storage needed to achieve the discharge reductions required in Stockton, an estimated 20 houses would need to be relocated, 1,900 feet of US Hwy and 3,300 feet of county roads replaced, and 600 feet of railroad track upgraded. The estimated structure cost is $6.98 million. Because of the structure cost alone, this structure location was removed from further consideration. Appendix G contains the estimated inundation map for this structure.

*Str4, Str5 North and Str5 South*
Because of the high relocation and replacement costs for Str6, three structure locations upstream of Str6 were identified - Str 5-north, Str 5-south, and Str 4. All three structures would need to be installed to replace Str6. The three structures would control approximately 86% of the drainage area to Str6. To achieve the flood storage needed to achieve the discharge reductions required in Stockton, 1,860 feet of railroad track and one bridge would need to be upgraded. The estimated structure costs for all three structures would total $5.58 million. Because of the structure costs alone, these structure locations were removed from further consideration. Appendix G contains the estimated inundation map for these structures.

**Table 7 - Estimated Costs for Structure, Relocation and Flood Damage Reduction**

| Structure ID | Estimated Structure Cost | Estimated Relocation Cost | Estimated Flood Prevention Cost | Total Installation Cost |
|---|---|---|---|---|
| Str1 | $5.00 M | * | * | > $5.00M |
| Str2 | $2.55 M | $0.25 M | $3.01 M | $5.81 M |
| Str3 | $5.94 M | * | * | > $5.94 M |
| Str6 | $3.71 M | $3.27 M | * | >$6.98 M |
| Str4, Str5-north, & Str5-south | $5.24 M | $0.34 M | * | >$5.58 M |
| Str7 | $2.80 M | $6.88 M | * | >$9.68 M |
| Str8 | $1.57 M | * | * | > $1.57 M |

* This part of the analysis was not completed because the estimated cost of the components already completed was already too expensive.

*Str7*
This structure could offer the City of Stockton some protection, though additional flood damage reduction measures would need to be installed. To achieve the flood storage needed to achieve the discharge reductions required in Stockton, it was estimated that 50 houses or more houses or mobile homes would need to be relocated, 1,800 feet of US Hwy and 1,850 feet of county road replaced. The estimated structure installation cost is $9.68 million. Because of the structure cost alone, this structure location was removed from further consideration. Appendix G contains the estimated inundation map for this structure.

*Str8*
This structure could offer the City of Stockton very little flood protection and additional flood damage reduction measures would be required around the city. The estimated structure cost is $1.57 million, but because of the structure's ineffectiveness, it was removed from further consideration.

*Economic Analysis*
All floodwater storage alternatives considered were removed from detailed study due to their economic feasibility. This section provides details on the limited economic analysis conducted. Table 8 presents the damage reduction benefits provided by the structures. The benefits are presented for 6 storm frequencies in addition to an average annual value. The hydrological analysis estimated the reduction in flows that would be realized in Stockton. Using this reduction in discharge, flood protection benefits were estimated based on the damage frequency curve estimate in the 1994 USACE analysis.

The results presented in Table 8 reveal that although the structures do provide flood protection benefits (with the exception of structure 8), the structures are not economically feasible. The structure with the best benefit to cost ratio is Structure 3. With average annual benefits estimated at $90,090 and average annual costs over $278,000, the B:C ratio for the structure is 0.32:1.0.

**Table 8 – Economics of Flood Storage Structures**

| | Damage Reduction @ Stockton | | | | | | Economic Evaluation | | |
|---|---|---|---|---|---|---|---|---|---|
| Structure | 2-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr | AA Benefit | Installation Cost | AA Cost |
| 1 | 75,230 | 110,760 | 145,360 | 198,410 | 224,960 | 276,000 | 59,150 | $5 M | 234,330 |
| 2 | 27,920 | 41,640 | 54,650 | 74,570 | 84,490 | 103,570 | 22,180 | $5.1 M | 239,020 |
| 3 | 114,760 | 169,060 | 221,080 | 301,370 | 341,240 | 418,100 | 90,090 | $5.9 M | 278,390 |
| 4, 5N, 5S | 55,700 | 78,170 | 100,130 | 133,910 | 149,610 | 181,010 | 41,440 | $5.6 M | 261,520 |
| 6 | 64,770 | 90,890 | 116,430 | 155,700 | 173,960 | 210,480 | 48,190 | $7M | 327,130 |
| 7 | 33,090 | 47,820 | 62,140 | 83,950 | 94,480 | 115,100 | 25,440 | $9.7M | 453,670 |
| 8 | - | - | - | - | - | - | - | $1.6M | 74,990 |
| 3,6,7,8 | 216,600 | 312,590 | 405,180 | 548,050 | 616,960 | 751,800 | 166,190 | $24.2M | 1.13M |

**Stockton – Upland ponds with 100-yr level runoff storage capacity**
This alternative investigated the feasibility of installing several small "pond-sized" floodwater retention structures upstream of Stockton. These structures would generally be located in existing draws where the drainage from upland cropped areas enters the main valleys. The size of these ponds would be based on local drainage area and would include floodwater storage volume for a 100-year event. The design would also include sufficient volume for 100 years of sediment accumulation. The type of outlet structure (hooded inlet, trickle tube, pipe and riser, etc.) would need to be determined on a site-by-site basis. In addition to the upland ponds, dikes around Stockton would be needed to provide the desired level of flood damage reduction.

For this analysis the number and size of ponds for a small subwatershed upstream of Stockton were identified. This estimate was then extrapolated to the remaining drainage

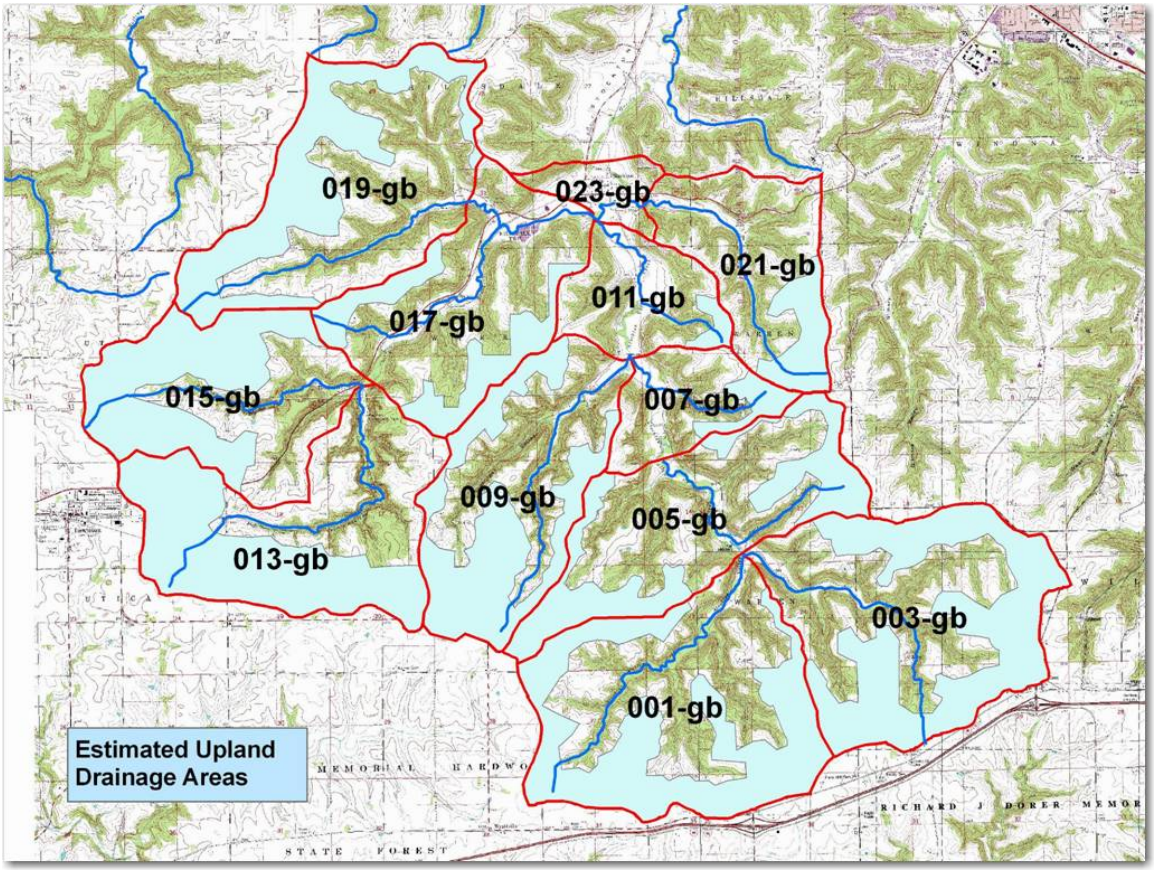
area. It was estimated that a total of 145 pond structures would be needed upstream of Stockton to reduce the peak discharge by approximately 50%. Each structure would have an average drainage area of 64 acres, an average fill height of 23 feet, and average flood storage of 18.1 acre-feet. See Appendix C for more details about the installation of pond structures.

**Table 9 - Impacts of Ponds on Garvin Brook Flows at Highway 14 in Stockton (100-year Event)**

| Total Upstream Drainage Area (square miles) | Estimated Total # of Upstream Pond Sites | Upstream Drainage Area Controlled by Ponds (square miles) | Uncontrolled Upstream Drainage Area (square miles) | Total Pond Flood Storage During 100-year Event (Ac Ft) | Present Condition 100-year Peak Discharge (cfs) | With Ponds 100-year Peak Discharge (cfs) | % Reduction in Peak Flow |
|---|---|---|---|---|---|---|---|
| 35.3 | 145 | 14.1 | 21.2 | 2,620 | 11,650 | 5,790 | -50.3% |

summarizes the impacts on the 100-year peak discharge in Stockton from installing 145 ponds upstream. It should be emphasized that the analysis was based on information gathered from USGS quad maps without any field review, foundation/geologic analysis, or topographic survey. It should also be noted that the effectiveness of such ponds during flood events with the magnitude of the July 1991 and August 2007 events would be limited. In such events emergency spillways on the upland ponds would likely be flowing at capacity, limiting the overall impact on peak flows.

**Figure 10 - Estimated Upland Drainage Areas for Pond Analysis**



*Economic Analysis*
The upland floodwater storage pond alternative considered revealed that it could in fact reduce peak flows in Stockton during events up to the 100-year event. However, after completing a limited economic analysis, this alternative was removed from further consideration. Based on average cost estimates for the types of structures needed for this alternative, it was estimated that the 145 structures required would cost $7.25 million. The dikes required around the City of Stockton would cost an additional $1.29 million, for a total installation cost of $8.54 million. Assuming a 100 year project lifetime, this amounts to over $400,000 in average annual costs. This cost estimate does not account for any O&M&R, permits, environmental or wetland mitigation, contingency, or administration services.

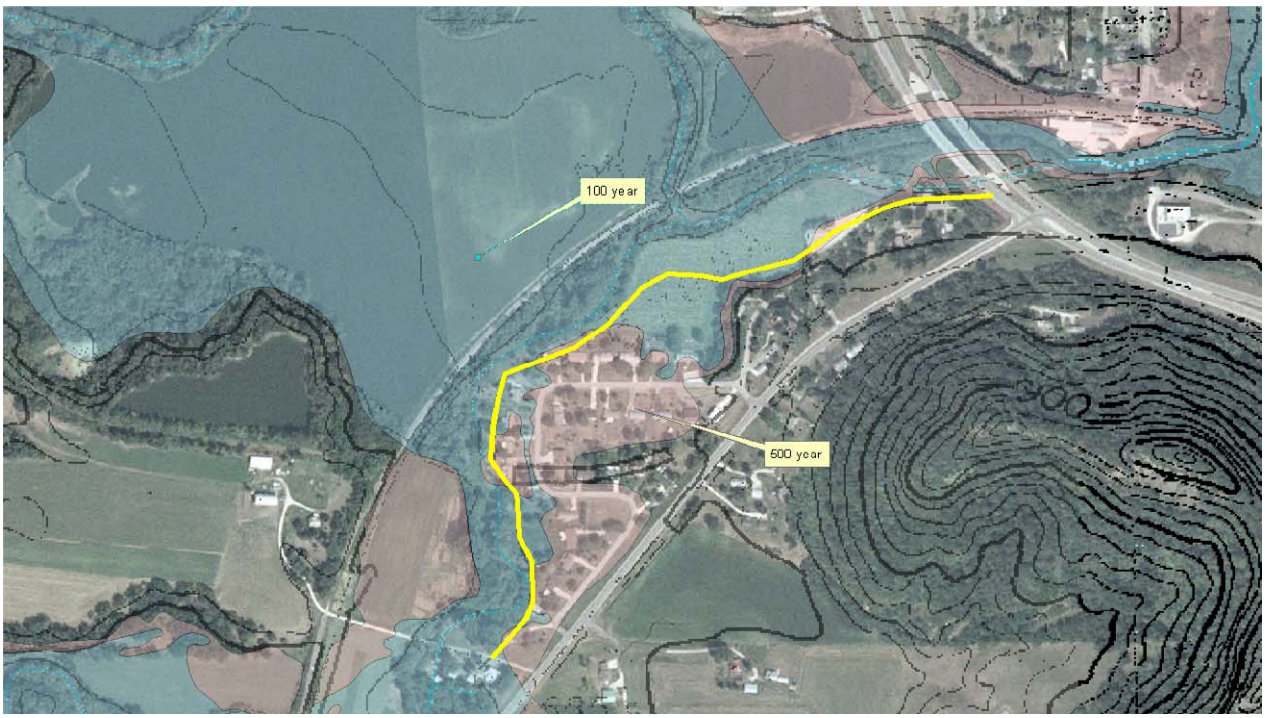
The hydraulic analysis indicated that the structures would provide some degree of flood damage reduction. However, the upland ponds would not provide the same level of protection as the USACE plan. It was estimated that ponds would only reduce the peak flows in Stockton by roughly 50%, resulting in the additional dikes needed. Assuming the full flood damage reduction benefits of the USACE report and the average annual costs of the upland ponds and dikes, the B:C ratio for this alternative is 0.5:1.0. This alternative was dropped from further consideration.

**Gunderson Addition – Dike**
To protect the Gunderson Addition, one alternative considered was a dike along the west/north border. In Figure 11, a proposed dike alignment (yellow line) is shown. The line is drawn along the 680' contour. The dike would have a top width of 10 feet and a side slope of 3:1. Ground elevations and dikes heights were estimated using information obtained from the FEMA Flood Insurance Study and the USGS topographic maps.

This alternative assumes that there is enough available land to build a dike between the existing houses and Garvin Brook. Dike construction, seeding, land, installing side water inlets, and upgrading 200 feet of road have an estimated cost of $370,000. This does not account for any O&M&R, permits, environmental or wetland mitigation, contingency, or administration services.

Earthen fill quantities for the dike were increased by 10% to account for settlement. No testing was done to verify this assumption. Actual settlement quantities may change. The estimated cost is subject to change once additional information (soil borings, survey data, and alignment determined) is obtained.

**Figure 11 - Gunderson Addition**




*Economic Analysis*

Using the estimated cost of $370,000, the average annual cost of the dike is $17,340. This assumes a 100 year life span. For this analysis data on the flood damages reported by the Winona County Planning Department after the 2007 storm event was obtained. It was estimated that the Gunderson Addition sustained $3.6 million in damages (28 parcels), or an average annual value of approximately $18,000. This value is based on the assumption that the 2007 flood was a 500-year event. Looking closely at the flood insurance maps (Appendix F), it appears that little to no damages would result from storm events at or below the 100-year levels. Therefore, no additional flood damage reduction benefits could be attributed to the dike. Using this limited detail, the benefit to cost ratio of the Gunderson Addition Dike is 1.03:1.0. Based on this initial assessment and assumptions, it appears that a dike around the Gunderson Addition may be economically feasible.

It should be noted that if damages from flood events between a 100 and 500-year event do occur and could be measured in a more detailed investigation, they would result in average annual benefits greater than $18,000. This would further improve the alternatives B:C ratio.

**Gunderson Addition – Floodwater retention structures**

If the large floodwater retention structures were built upstream of Stockton, they would also provide flow reductions for the Gunderson Addition. Table 10, displays the estimated percentage reduction in peak discharge at the confluence of Garvin Brook and Rollingstone provided by each of the retention structures. However, as discussed in the

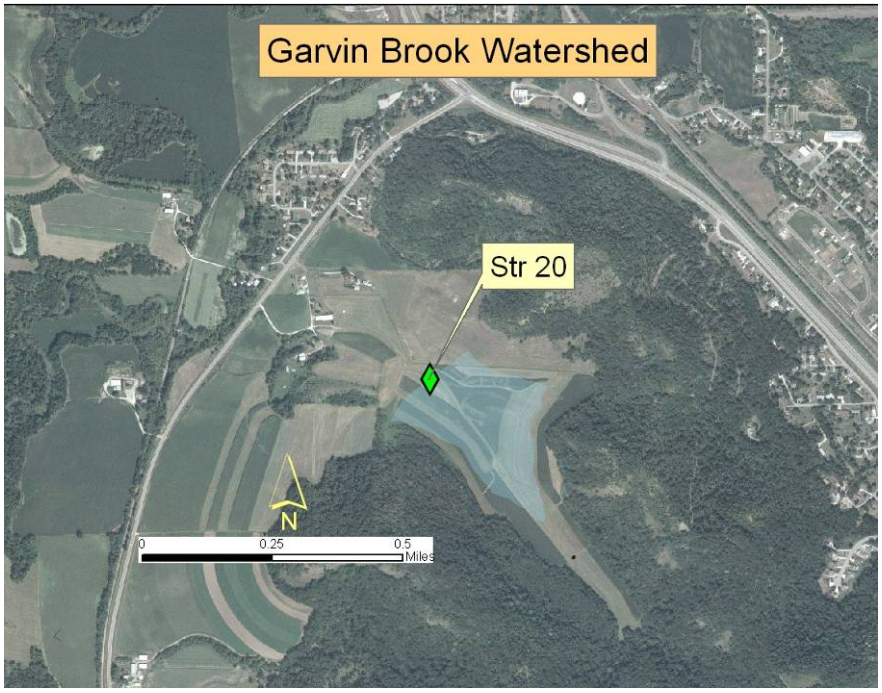
*Stockton - Floodwater Retention Structures* section above, the structures were not economically feasible and were removed from further consideration.

**Table 10 – Estimated Peak Discharge Reduction at the Confluence of Garvin Brook and Rollingstone Based Upon Installation of Retention Structure Upstream of City of Stockton**

| Structure ID | Estimated Peak Discharge Reduction (%) |
|---|---|
| Str1 | 7 |
| Str2 | 5 |
| Str6 | 7 |
| Str7 | 7 |
| Str8 | 3 |
| Str1, 2, 6, 7 | 20 |
| Str1, 6 | 12 |

A final structure was considered for the Gunderson Addition. Upstream of the Gunderson Addition is a small tributary entering Garvin Brook (Figure 12). If a structure (Str20) was built here it would control approximately 300 acres. This structure would only reduce peak flows to the Gunderson Addition by 1%. This small reduction would not justify the construction costs of the structure. Therefore, this alternative was dropped from further investigation.

**Figure 12 - Possible Retention Structure Site Upstream of Gunderson Addition**



*Economic Analysis*
Data obtained from the Winona County Planning Department indicated that the damages reported from the 2007 event were approximately $3.6 million. Assuming that this flood was equivalent to a 500 year event, average annual damages totaled approximately $18,000. Based on the reduction in peak discharges for a 100 year event presented earlier, the largest reduction provided by a structure was 18%. Based on the design of this structure, a similar reduction in peak discharges for a 500 year 24 hour storm could be expected. This reduction in discharge would provide approximately $3,240 in average annual benefits. When the flood protection benefits accruing as a result of protection to the Gunderson Addition are added to the flood protection benefits for the City of Stockton, the benefit to cost ratio is still far below 1.0:1.0.

**Economics**
The potential benefits of the flood protection features presented above are based primarily on the damage frequency curves developed by the USACE in their 1994 report. The estimated damages and flood control benefits were based on residential and commercial properties. Damages estimated by the USACE were based on structural and content value, clean up costs and damages to commercial merchandise. The flooding was assumed to be the result of overland flooding, sewer backups and basement flooding. Site surveys of the impacted are were conducted by the USACE staff. First floor elevations and the presence of basements were noted in order to relate flood damages to depth and duration of flood events. The damage frequency curves produced by the USACE are included in Appendix B. The estimated damages have been updated to 2008 dollars using appropriate price indices.

Mentioned earlier in the review of the USACE report, the focus of this report was the City of Stockton. Therefore, the damages presented in the report and the damage frequency curves are exclusive to damages in Stockton, unless otherwise noted. In order to estimate the potential economic effectiveness of flood protection measures beyond the City of Stockton, flood damages reported after the 2007 event were collected from the Winona County Planning Department. This data provided total damages reported to residential and commercial structures in Stockton and the Gunderson Addition.

It should be noted here that there are limitations to the accuracy of the damages reported by the USACE report, and the potential benefits of the flood alternatives evaluated. The site surveys conducted by the USACE were completed in 1991. There is the potential for new construction of residential and commercial properties in the City of Stockton since the report was issued. However, after speaking with the Winona County Planning Department, it was determined that little to no new construction had occurred. It was also noted by the Planning Department that if there had been new construction, it would have happened in areas that were not prone to flooding from Garvin Brook.

A second limitation to the benefits estimated in this assessment is the potential impacts of FEMA buyouts. Several properties may be purchased by FEMA (Office of the MN Governor 2007). If these or similar buyouts or re-locations transpire, the benefits of the alternatives evaluated would be reduced. If any of the alternatives assessed in this report move to a detailed planning effort, these data limitations would need to be addressed.

## Environmental Concerns

Two federally endangered species, the Higgens Eye Pearly Mussel and the Karner Blue Butterfly, and two federally listed candidate species, the Eastern Massassauga Rattlesnake and the Sheepnose Mussel are listed as occurring within Winona County (U.S. Fish and Wildlife Service (FWS)). In addition, eighteen plant and animal species are listed as occurring within Winona County by the Minnesota Department of Natural Resources (MN DNR) as either endangered, threatened, of or special concern (Table 18E). A consultation would have to be initiated with the FWS and the MN DNR to protect these species if they are determined to occur within the proposed project area.

For over 20 years, Garvin Brook has maintained a self-sustaining, naturally reproducing trout fishery. Brook trout inhabit the headwaters and upper reaches of Garvin Brook (above Farmers Park located southeast of the City of Lewiston). A self sustaining, naturally reproducing brown trout fishery exists in the remaining downstream reaches of Garvin Brook (downstream of Farmers Park and through the City of Stockton into Lower Stockton Valley Creek).[8]

Minnesota DNR has not, as yet, been able to assess the total impacts of the 2007 flood to this high value trout fishery. MN DNR did determine that 15 trout lunker habitat structures had been completely washed out of the Garvin Brook and channel banks had been undercut, reducing these prime habitat structures. It would be desirable to reconstruct these habitat structures, helping to restore the high value and recreationally valuable trout fishery. MN DNR Fisheries surveys from last Spring and this Fall show the 2007 flood did little to diminish the trout populations. Populations were estimated to be between 1,200 to 1,300 trout per mile in Garvin Brook, Rush Creek, and the South and Middle Branches of the Whitewater River.[9] Any proposed channel modifications impacting stream flows and modified water regimes and velocities (cfs) will have to be coordinated with MN DNR.

The National Wetland Inventory estimates 748.6 acres of wetlands within the Garvin Brook Watershed. (Figure 28E). Any wetlands potentially impacted by project activities would require field determinations. As part of any required wetland mitigation, these determinations will guide the restoration to their required function and value. The required total acreage restoration ratio is mandated by the Minnesota Wetland Conservation Act (Table 19).

All installation costs and economic analyses of the alternatives do not account for any potential mitigation costs. As highlighted here, if any of the alternatives would move into detailed planning, the potential environmental impacts would need to be assessed. In the event that an alternative would result in negative environmental impacts, all mitigation required by the governing agency would be implemented.

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[8] Personal Communication, John Huber, Fish Hatchery Manager, MN Crystal Springs Fish Hatchery, Whitewater State Park, MN, 04/04/08.

[9] Steve Klotz, MN DNR Area Fisheries Supervisor, Lanesboro, MN, "After the Flood", St. Paul Pioneeer Press, Outdoors Section, Chris Niskanen, 04/06/08.

## Conclusion

Based upon the results of this assessment, an updated version of the USACE 1994 plan (Stockton - Dike and floodplain excavation) has the potential to be a feasible alternative to reduce the risk of flooding in City of Stockton. Additionally, the construction of a dike around the Gunderson Addition has the potential to provide economically feasible flood damage reduction. Based on this assessment, additional data would need to be collected to verify the feasibility, address environmental concerns, and obtain public input for the plans recommended for detailed study. Changes to any of these issues may affect the alternatives overall ratings.

**References**

Federal Emergency Management Agency. January 19, 1982. Flood Insurance Study – City of Minnesota City, MN, Winona County.

Federal Emergency Management Agency. February 2, 1982. Flood Insurance Study – City of Stockton, MN, Winona County.

Office of the MN Governor, Tim Pawlenty. 2007. Cities and counties within disaster declaration will receive payments in September. http://www.governor.state.mn.us/mediacenter/pressreleases/printerfriendly/PROD008291.html?BV_SessionID=@@@@1175886643.1205435336@@@@&BV_EngineID=cccfadediddimgjcfjkcenndfifdgon.0

United States Army Corps of Engineers. 1994. Section 205 Reconnaissance Report for Flood Control. Garvin Brook, Stockton, MN

United States Department of Agricultural - Soil Conservation Service. April 1978. Watershed Plan and Environmental Impact Statement, South Zumbro Watershed, Dodge and Olmsted Counties, MN. [Report].

## APPENDICES

A. WATERSHED MAP

B. ECONOMIC DATA

C. HYDROLOGIC DATA
- Hydrology
- Hydraulics

D. ENGINNERING DATA

E. ENVIRONMENTAL EVALUATIONS
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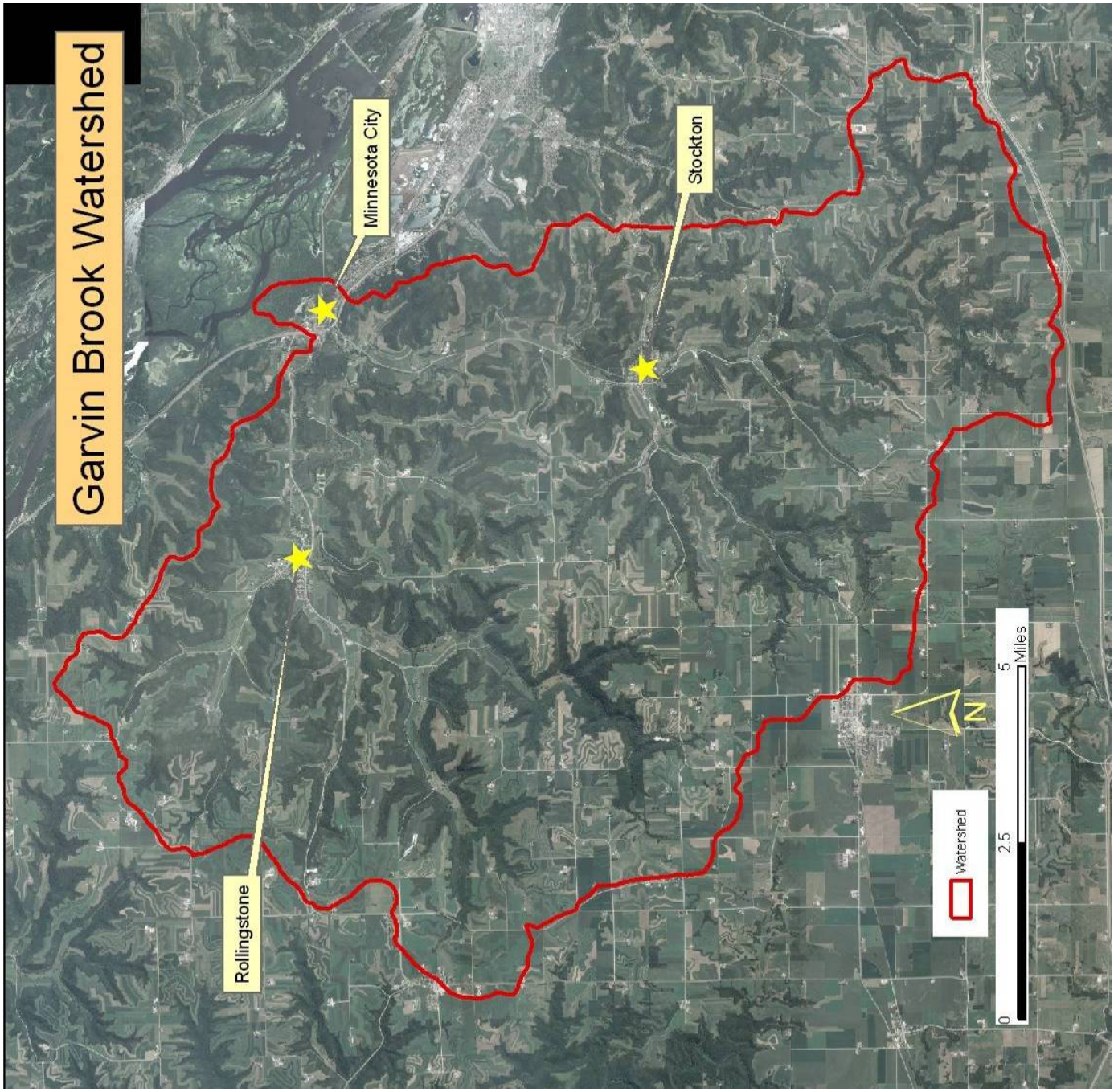
- Trout Fishery
- Wetlands

F. FEMA FLOODWAY MAPS

G. STRUCTURE INUNDATION MAPS

APPENDIX A - WATERSHED MAP

**Figure 13A - Garvin Brook Watershed Map**



# APPENDIX B - ECONOMIC DATA

The potential benefits of the flood protection features presented above are based primarily on the damage frequency curves developed by the USACOE in their 1994 report. The estimated damages and flood control benefits were based on residential and commercial properties. Damages estimated by the COE were based on structural and content value, clean up costs and damages to commercial merchandise. The flooding was assumed to be the result of overland flooding and sewer backups and basement flooding. Site survey of the impacted are were conducted by the COE staff. First floor elevations and the presence of basements were noted in order to relate flood damages based on depth and duration of flood events.

Using the data collected from the site surveys, the USACE was able to model the residential and commercial damages that would occur under various simulated flood events. The model then estimated a damage frequency curve. The curve allows damages to be estimated at any level of flooding by relating the depth of flooding to the structural elevations, percent damage to structure and contents and market values. The damage frequency curves produced by the USACE are included here. The estimated damages have been updated to 2008 dollars using appropriate price indices. Mentioned earlier in the review of the USACE report, the focus of the report was the City of Stockton. Therefore, the damages presented in the report and the damage frequency curves are exclusive to damages in Stockton, unless otherwise noted.

In order to estimate the potential economic effectiveness of flood protection measures beyond the city of Stockton, flood damages reported after the 2007 event were collected from the Winona County Planning Department. This data provided total damages reported to residential and commercial structures in Stockton and the Gunderson Addition. To estimate damages to the Gunderson addition in the economic analysis presented in the report, the data was parsed to the Gunderson addition. It was assumed that the 2007 flooding was the result of a 500-year event. The total damages were then converted to an average annual value. The Gunderson Addition reported 28 homes sustaining an estimated $3.59 million in total damages.

It should be noted here that there may be some limitation to the accuracy of the damages reported by the USACE report, and the potential benefits of the flood damage reduction alternatives evaluated here. The site survey conducted by the USACE was completed in 1991. There is the potential for new construction of residential and commercial properties in the City of Stockton. However, after speaking with the Winona County Planning Department it was determined that little to no new construction had occurred since the COE evaluation. Additionally, if there had been new construction, it would have happened in areas of the city that are not prone to flooding from Garvin Brook. A second limitation to the benefits estimated in this assessment is the potential impacts of FEMA buyouts. Several properties may be purchased and eliminated by FEMA (Office of the MN Governor 2007). If these or similar buyouts or re-locations transpire, the benefits of flood protection would decline. If any of the flood protection alternatives assessed in this report move into a more detailed planning effort, these data limitations would need to be addressed.

**Table 11B – Updated USACE Damage Frequency Curve (Baseline Conditions)**

| Baseline Conditions - 2008 COE Indexed Values | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 yr | 2 yr | 5 yr | 10 yr | 25 yr | 50 yr | 100 yr | 500 yr | PMP | AA Damages |
| Commercial | - | - | 11,390 | 22,790 | 35,610 | 45,580 | 59,820 | 96,850 | 96,850 | 7,330 |
| Indirect residential | - | 229,830 | 147,630 | 65,930 | 56,630 | 21,550 | 74,660 | 146,010 | 149,550 | 74,290 |
| Direct Residential | - | 17,590 | 199,440 | 376,640 | 537,740 | 642,740 | 731,350 | 906,330 | 925,790 | 115,910 |
| Total Residential | - | 247,420 | 347,060 | 442,580 | 594,380 | 664,290 | 806,010 | 1,052,340 | 1,075,340 | 190,200 |
| Total All | - | 247,420 | 358,460 | 465,370 | 629,980 | 709,870 | 865,830 | 1,149,200 | 1,172,190 | 197,530 |

**Table 12B - Updated USACE Damage Frequency Curve (Project Conditions)**

| With Project Conditions - 2008 COE Indexed Values | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 yr | 2 yr | 5 yr | 10 yr | 25 yr | 50 yr | 100 yr | 500 yr | PMP | AA Damages |
| Commercial | - | - | - | - | - | - | - | 7,120 | 7,830 | 40 |
| Indirect residential | - | - | - | - | - | 7,690 | 8,330 | 14,510 | 15,670 | 280 |
| Direct Residential | - | - | - | - | - | - | 15,140 | 73,350 | 78,340 | 580 |
| Total Residential | - | - | - | - | - | 7,690 | 23,470 | 87,860 | 94,000 | 860 |
| Total All | - | - | - | - | - | 7,690 | 23,470 | 94,990 | 101,840 | 900 |

APPENDIX C - Hydrology and Hydraulic Data

The hydrology for the project was developed using a calibrated HEC-HMS model. The original TR20, developed by TKDA and Associates for the 1982 FIS Study, was obtained from the Minnesota Department of Natural Resources. Sub watersheds from this analysis were transferred to an ARC-GIS coverage. A few additional sub watersheds were added to accommodate structural alternative analysis. See Figure 15.

The same runoff curve numbers from the original FIS study were used in this analysis. Because several of the original sub watersheds were subdivided, updated times of concentrations (Tc) were calculated. The model was set up and run using a 24-hour, Type II rainfall distribution. Calibration was accomplished by assuming target[10] flow/frequency values at various points in the watershed and then developing an HMS discharge/target discharge by drainage area relationship. See Table 13 for calibration target locations.

**Table 13C - Calibration Locations for Garvin Brook HMS Hydrology Model**

| Location | Drainage Area (mi2) | Target Source |
|---|---|---|
| Straight Valley Ck near Rollingstone | 4.99 | USGS Stream Gage 05378300 Flow/Freq Relationship |
| Garvin Brook Upstream of Stockton | 15.3 | Gage Transfer (using Mill Creek nr Chatfield USGS Gage 05383720) |
| Stockton Valley Creek Upstream of Stockton | 19.98 | Gage Transfer (using Mill Creek nr Chatfield USGS Gage 05383720) |
| Junction Garvin Brook + Stockton Valley Creek | 35.29 | 1982 FIS Flow/Freq Values |
| Junction Garvin Brook + East Tributary | 37.63 | 1982 FIS Flow/Freq Values |
| Garvin Brook Upstream of Junction w/ Rollingstone Creek | 43.01 | Gage Transfer (using Mill Creek nr Chatfield USGS Gage 05383720) |

[10] "Target" refers to a value that the model is calibrated to. These are usually locations within a watershed where flow/frequency values have already been established. This could be a gage site where a statistical flow/frequency value based on a period of record has been determined or transfer of gage information from another watershed with similar characteristics (size, slope, etc).

Figure 14 below shows the ratio of raw HMS peak discharges (100-year) to the target 100-year values by drainage. The best fit line through this data is used to adjust all HMS discharges. The adjustment factor, as shown, is a function of drainage area: the larger the drainage area, the bigger the adjustment. The average adjustment factor is approximately 0.75.

**Figure 14C - HMS Adjustment Factor**

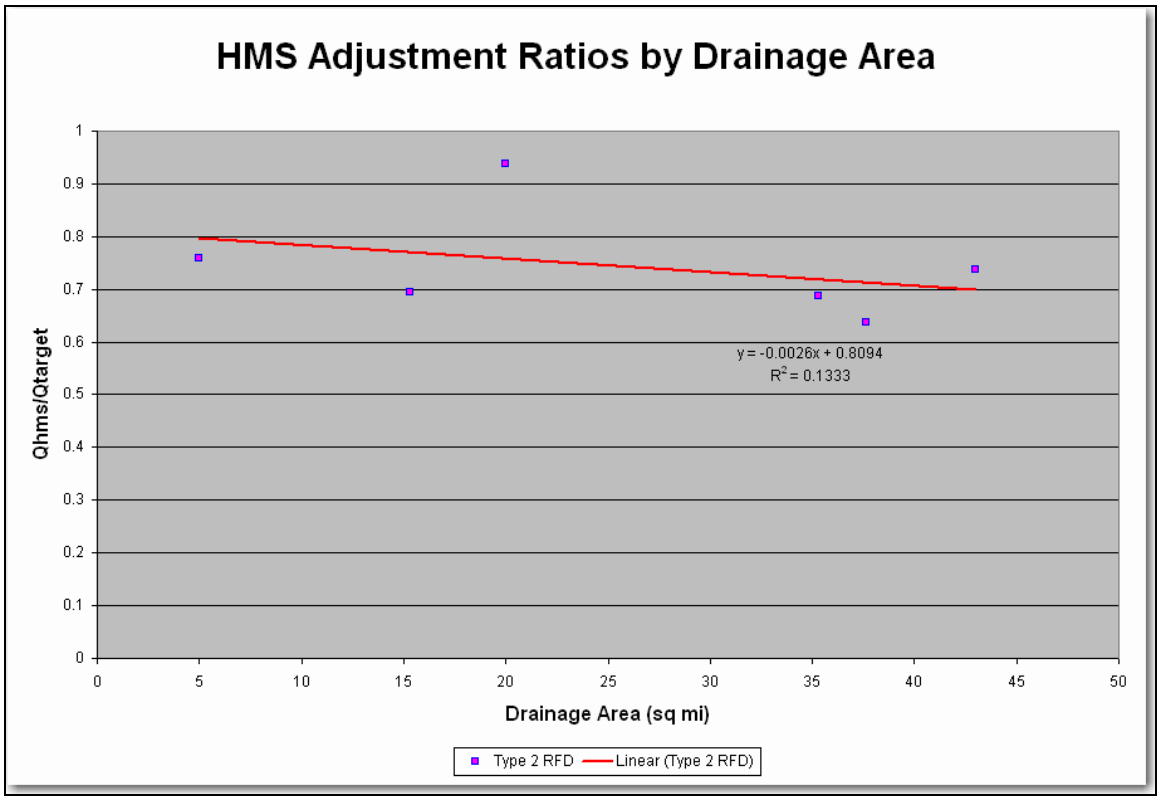
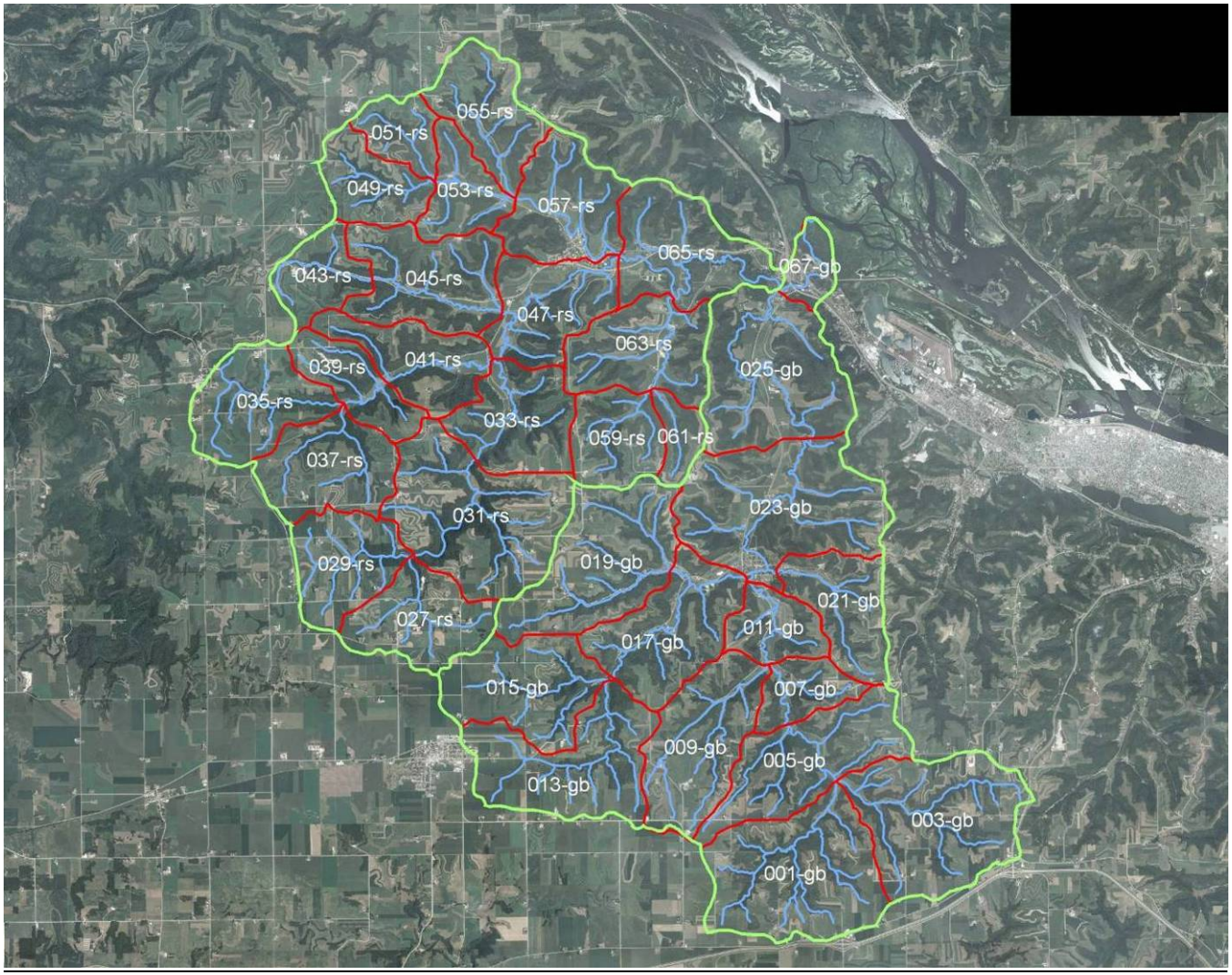


**Figure 15C - HEC-HMS Hydrology Model Sub Watersheds**



Hydraulic Analysis

The existing COE-HEC2 hydraulic models that were used for the 1982 FEMA Flood Insurance Study were obtained from the Minnesota Department of Natural Resources. These models had been updated by various agencies/consulting firms over the years to account for new bridges installed between 1982 and now (Co Rd 23, Hwy 14, New Broadway South Bridge) and for removal of the mill dam. For this assessment, these HEC2 models were then updated by NRCS for use in the current version of the COE water surface profile model HEC-RAS. Changes to the HEC2 data sets include:

- Geo-referencing of cross section locations and river alignment for display purposes
- Revise CNW railroad crossing geometry to better reflect current conditions
- Revise North Broadway Street low water crossing geometry based on photo interpretation
- Adjust bank stations to better reflect channel and floodplain flow components
- Adjust ineffective flow locations

below is a plan showing the HEC-RAS cross section layout. With this model, water surface profiles through the city were estimated for all return periods. Both current conditions and with 1991 Corp of Engineers proposed flood damage reduction plan (levee upstream of Highway 14 and floodplain excavation downstream of Highway 14) were evaluated.

Figure 17 below shows the 100-year and 500-year water surface profiles through the city along with high water marks (HWM's) from the July 1991 event. (green pts = FIS 100-yr, orange pts = FIS 500-yr, pink pts = July 1991 event HWM's). These profiles reflect unobstructed bridge openings and updated hydrology discharges (within 10% of FIS discharges). 100-year elevations from the updated are within approximately 0.5' of the original FIS values however the 500-yr updated points are approximately 2.0' lower than the FIS values. This is likely due to the changes estimated at the CNW railroad bridge. If the project goes forward, a re-survey of all bridges and cross sections would have to be undertaken to verify/improve water surface profile estimates. Another thing to note is that the July 1991 is above the 500-year FIS profile.

**Figure 16C - HEC-RAS Hydraulic Model Plan View**

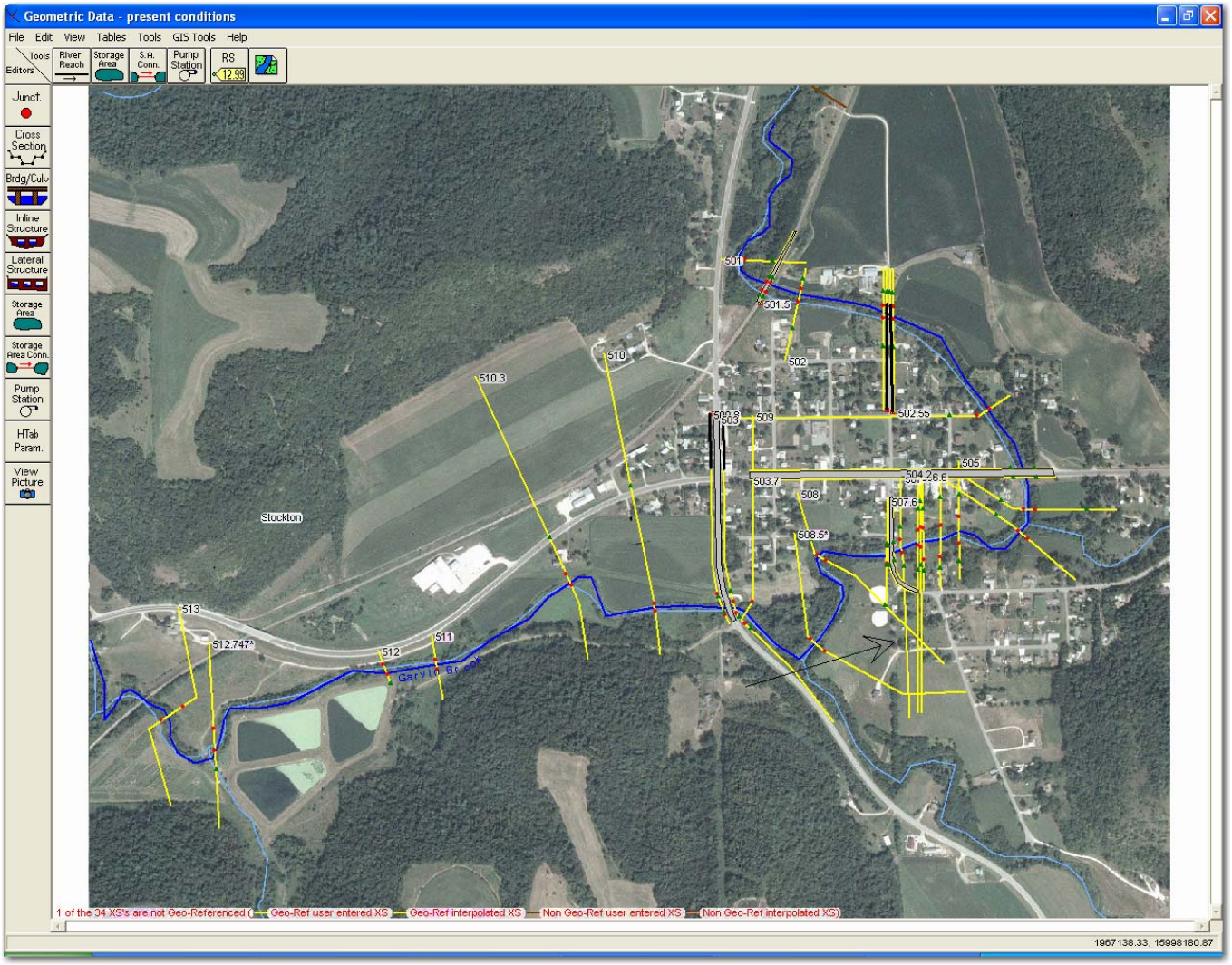
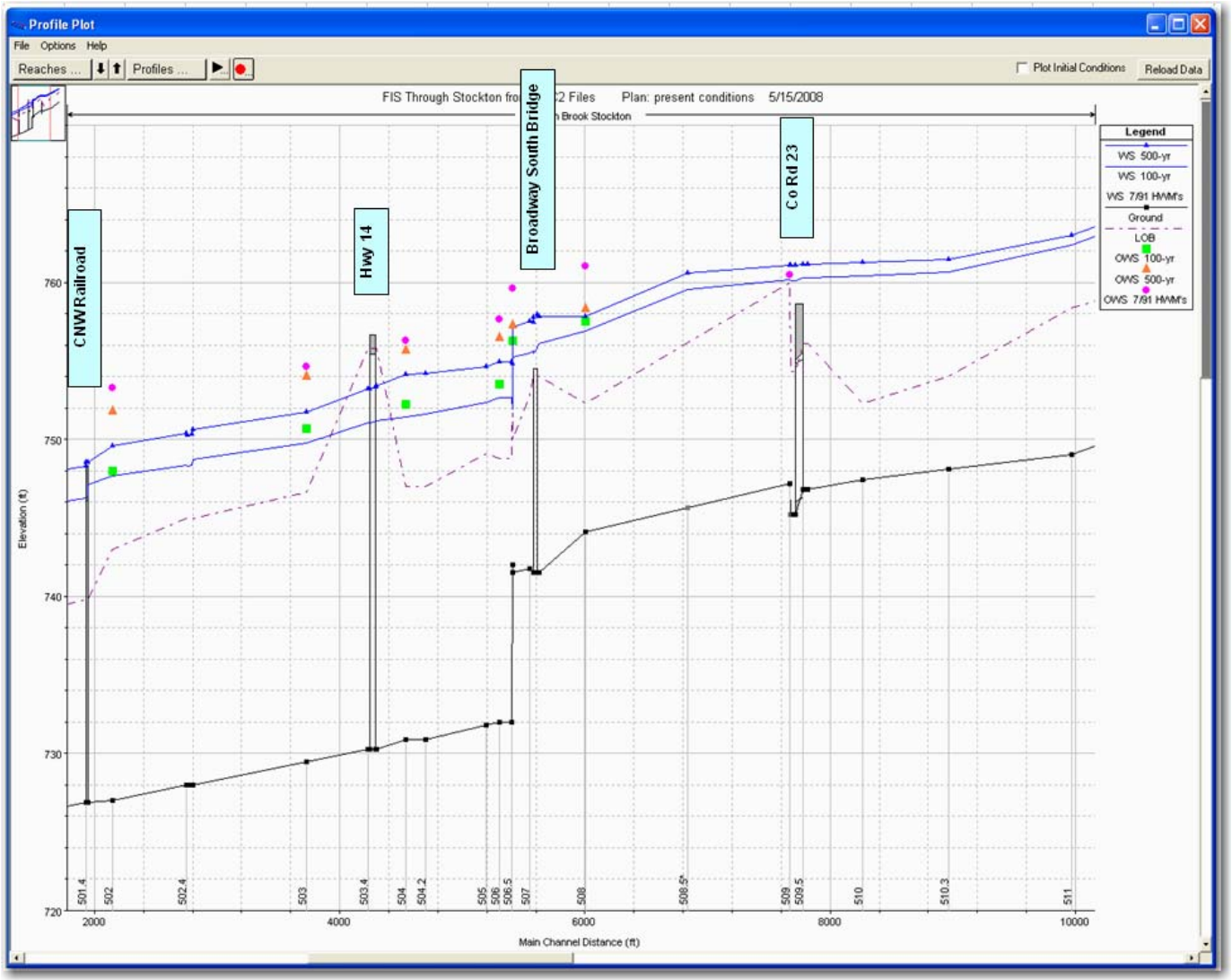


**Figure 17C - HEC-RAS Water Surface Profiles (100-yr, 500-yr) July 1991 High Water Marks Shown**



Pond Analysis

The potential flood reduction benefit from installing several small ponds in the upland watershed was evaluated. The size of these ponds would be based on local drainage area and would include floodwater storage volume for a 100-year magnitude event. The ponds would also include volume for 100 years worth of sediment accumulation[11]. See Figure 18 for a typical pond cross section. Actual outlet structure type (hooded inlet, trickle tube, pipe and riser, etc.) would need to be determined on a site-by-site basis.

The general process for analyzing this alternative includes the following steps:

1. Estimate a rough drainage area of "controllable upland cropland" (area that would drain through a small storage structure) for each of the sub watersheds upstream of Stockton. See Figure 19.

2. Within one of these sub watersheds upstream (003-gb) of Stockton, use USGS topographic maps along with aerial photos to select potential structure locations and detailed drainage area for each. See Figure 20. For this particular sub watershed, 23 potential sites were identified with individual drainage areas ranging from 13 to 157 acres (average of 64 acres). Rough estimates of fill heights (based on USGS quad map contours) range from 11 to 36 feet high (includes sediment storage + 100-year runoff volume + 3 feet emergency spillway depth). Average flood storage per structure is 18.1 acre feet.

3. Determine the percentage of "detailed" drainage area (2. above) to "rough" drainage area (1. above) and apply that ratio to all the sub watersheds to get a pond upland drainage area by sub watershed.

4. Use GIS to determine runoff curve numbers for the controlled upland and uncontrolled valley areas for each sub watershed.

5. Hydrologic impacts were estimated by using the HEC-HMS hydrologic model with a 100-year event (6.1" inches in 24 hrs). The **Present Condition** situation assumes the entire area of each sub watershed contributes runoff (runoff volume based on a composite valley/upland runoff curve number). The **With Ponds** option assumes a constant 20 csm (cubic feet per second per square mile drainage area) release rate from the ponds while the remaining uncontrolled area contributes hydrographs based only on the uncontrolled valley drainage area and valley runoff curve number. Time of concentration was assumed to be the same for each scenario (this assumes that there is at least on tributary flow path to the watershed divide that does not flow through a pond – see dashed blue line on Figure 20).

[11] Sediment volume based on June 2000 Hadley Valley Sediment Budget (3.96 ton/ac gross erosion), 25% sediment delivery ratio, 90% trapping efficiency in the ponds, and submerged sediment density of 50#/cu ft.

**Figure 18C - Typical Pond Components**

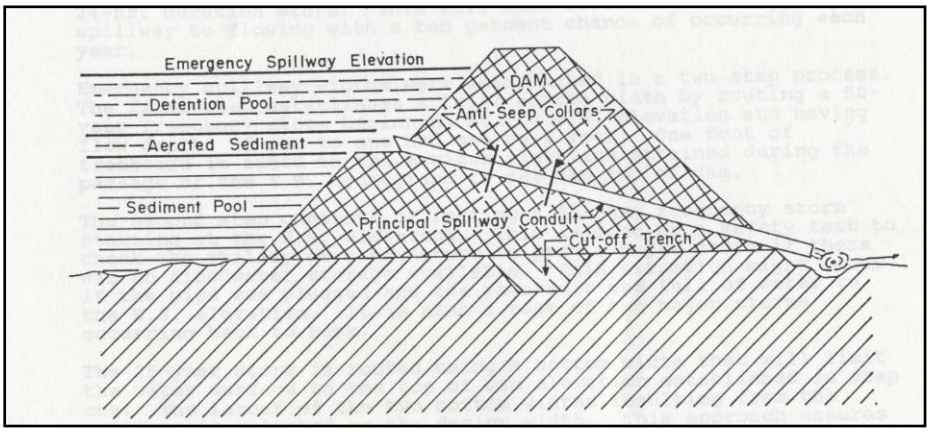



Table 14C summarizes the impacts of installing all 145 ponds upstream of Stockton on the 100-year peak discharge. In general, peak discharges within Stockton would be reduced by approximately 50% if all ponds were installed. It should be emphasized that the analysis is based on information gathered from USGS quad maps only without any field review, foundation/geologic analysis, or topographic survey. Also, diversions may be required at some sites to maximize the amount of cropland runoff that would flow through these structures. It should also be noted that the effectiveness of such ponds during July 1991 and August 2007 events would be limited. For events of that magnitude, emergency spillways would likely be flowing full thus having limiting impact on peak flows.

**Figure 19C - General Upland Pond Drainage Areas Upstream of Stockton**

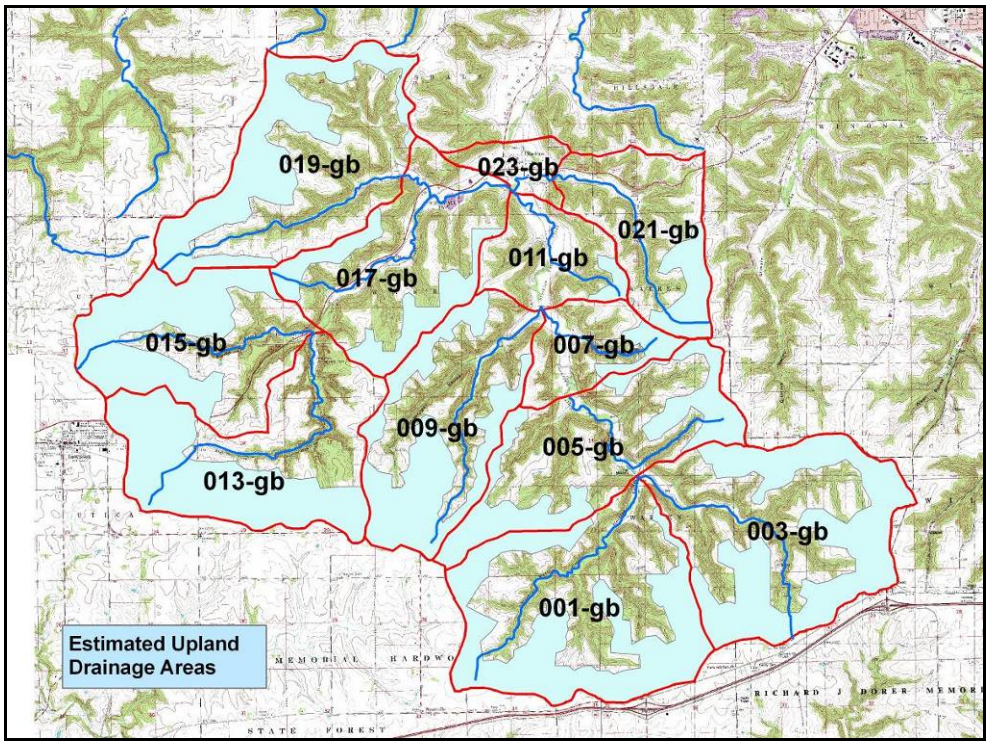



**Figure 20C - Detailed Upland Pond Drainage Area for Sub Watershed 003-gb**

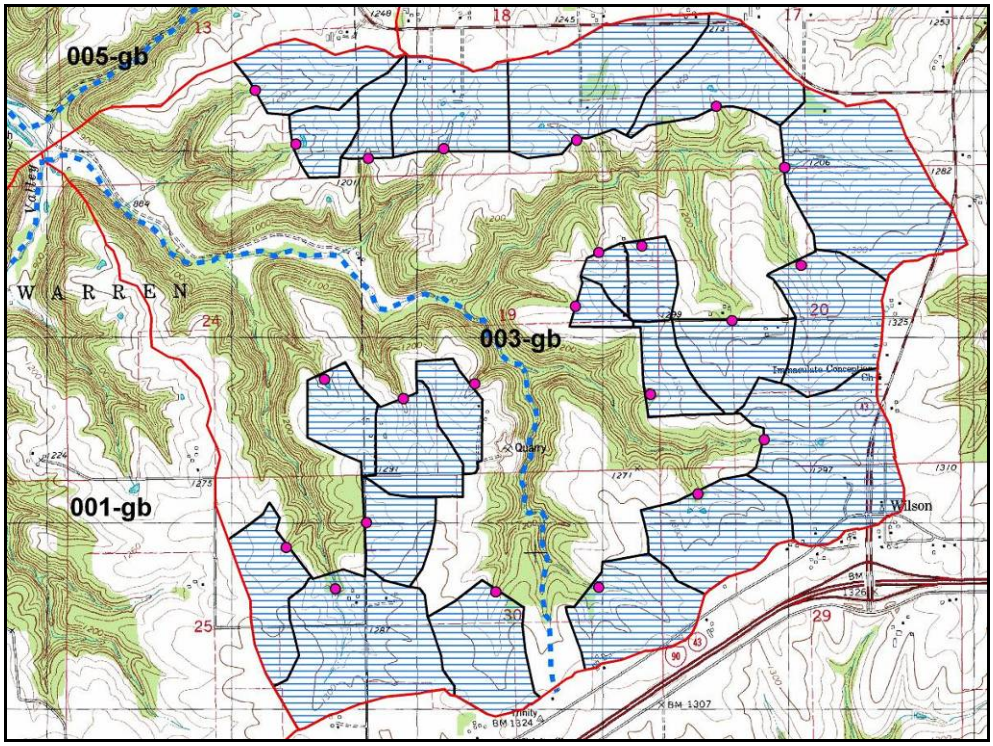


**Table 14C - Impacts of Ponds on Garvin Brook Flows at Highway 14 in Stockton (100-year Event)**

| Total Upstream Drainage Area (square miles) | Estimated Total # of Upstream Pond Sites | Upstream Drainage Area Controlled by Ponds (square miles) | Uncontrolled Upstream Drainage Area (square miles) | Total Pond Flood Storage During 100-year Event (Ac Ft) | Present Condition 100-year Peak Discharge (cfs) | With Ponds 100-year Peak Discharge (cfs) | % Reduction in Peak Flow |
|---|---|---|---|---|---|---|---|
| 35.3 | 145 | 14.1 | 21.2 | 2,620 | 11,650 | 5,790 | -50.3% |

Large Floodwater Retarding Structures Analysis

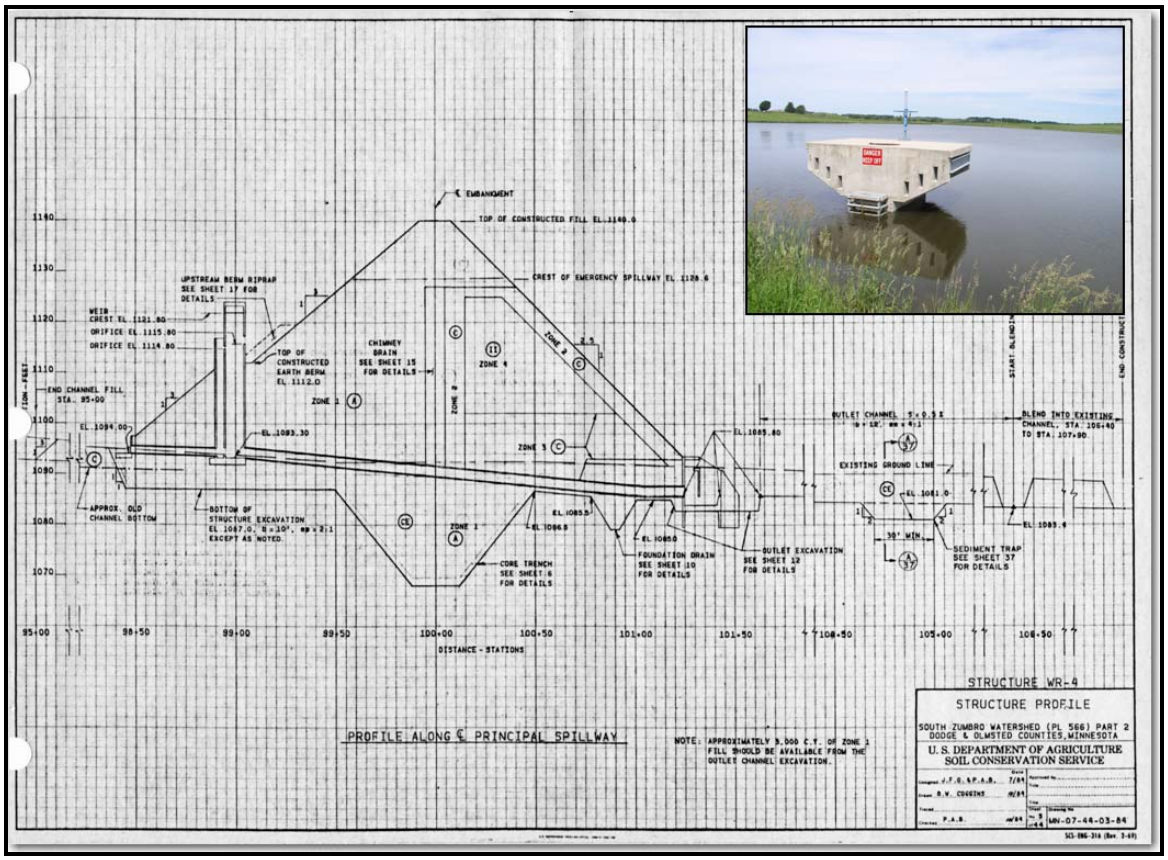
Past PL566 documents were reviewed to identify large floodwater storage sites that were considered in the 1950's and 1960's planning efforts. These structure sites were then incorporated into the HEC-HMS hydrology model to simulate the effects on peak flows. This was done for the entire Garvin Brook and Rollingstone Creek watershed although the emphasis of discussion in the main report is on the impacts just within Stockton. See Figure 22 for a map showing structure locations. Table 15 below shows the drainage areas and watersheds associated with each of the structures evaluated.

**Table 15C - Drainage Areas of Potential Floodwater Retarding Structures Sites**

| Structure ID | Drainage Area (acres) | Watershed |
|---|---|---|
| Str01-svc | 8695 | Stockton Valley Creek |
| Str02-svc | 1930 | Stockton Valley Creek |
| Str03-svc | 2315 | Stockton Valley Creek |
| Str04-gb | 2606 | Garvin Brook |
| Str05-gb | 2135 | Garvin Brook |
| Str06-gb | 4741 | Garvin Brook |
| Str07-gb | 2832 | Garvin Brook |
| Str08-gb | 1105 | Garvin Brook |
| Str09-rs | 4786 | Garvin Brook |
| Str10-rs | 6692 | Rollingstone Creek |
| Str11-rs | 1000 | Rollingstone Creek |
| Str12-rs | 1168 | Rollingstone Creek |
| Str13-rs | 770 | Rollingstone Creek |
| Str14-rs | 265 | Rollingstone Creek |
| Str15-rs | 1289 | Rollingstone Creek |
| Str16-rs | 507 | Rollingstone Creek |

The stage-discharge-storage relationships for these structures were developed by transferring stage/discharge/storage relationships from the NRCS PL566 South Zumbro Watershed Structures. An average storage (watershed inches)/discharge (cubic feet per second per square mile) relationship was used. See Figure 23 for plot of this relationship. These structures assume a two-stage pipe/riser type design with 100-years worth of sediment deposition capacity. See Figure 21 for a typical profile view of this type of structure. A low stage orifice would set at the sediment pool level while a second stage would provide for weir overflow, increasing discharges during the 10- to 25-year level events. An emergency spillway would be installed to bypass large runoff volumes around the structure during events with greater than 100-year return periods.

**Figure 21C - Typical Two Stage Pipe/Riser Profile View**




Various combinations of structures were placed within the hydrology model to estimate the impact on peak flows within Stockton. See Table 16 for summary of peak discharge reduction impacts of these structures. In general, the percent reduction in flows closely follows the percent of the drainage area controlled. See
Figure 24 for a hydrograph showing flow into and out of Str01-svc.
Figure 25 compares the present condition 100-year hydrograph in Stockton to the hydrograph if only Str01-svc were installed.

**Table 16C - Impacts of Large Floodwater Retarding Structures – 100-year Event**

| Structure(s) | Percent Reduction in Peak Discharge Immediately Downstream of Structure | Percent Reduction in Peak Discharge Within Stockton | Percent Drainage Area Controlled |
|---|---|---|---|
| Str01-svc | -95% | -27% | 38.5% |
| Str02-svc | -97% | -12% | 8.6% |
| Str03-svc | -92% | -45% | 43.9% |
| Str06-gb | -96% | -27% | 21.0% |
| Str07-gb | -96% | -13% | 12.6% |
| Str08-gb | -97% | -3% | 4.9% |
| Str03-gb + Str06-gb + Str07-gb + Str08-gb | N/A | -86% | 92.3% |

**Figure 22C - Potential Large Floodwater Storage Sites**

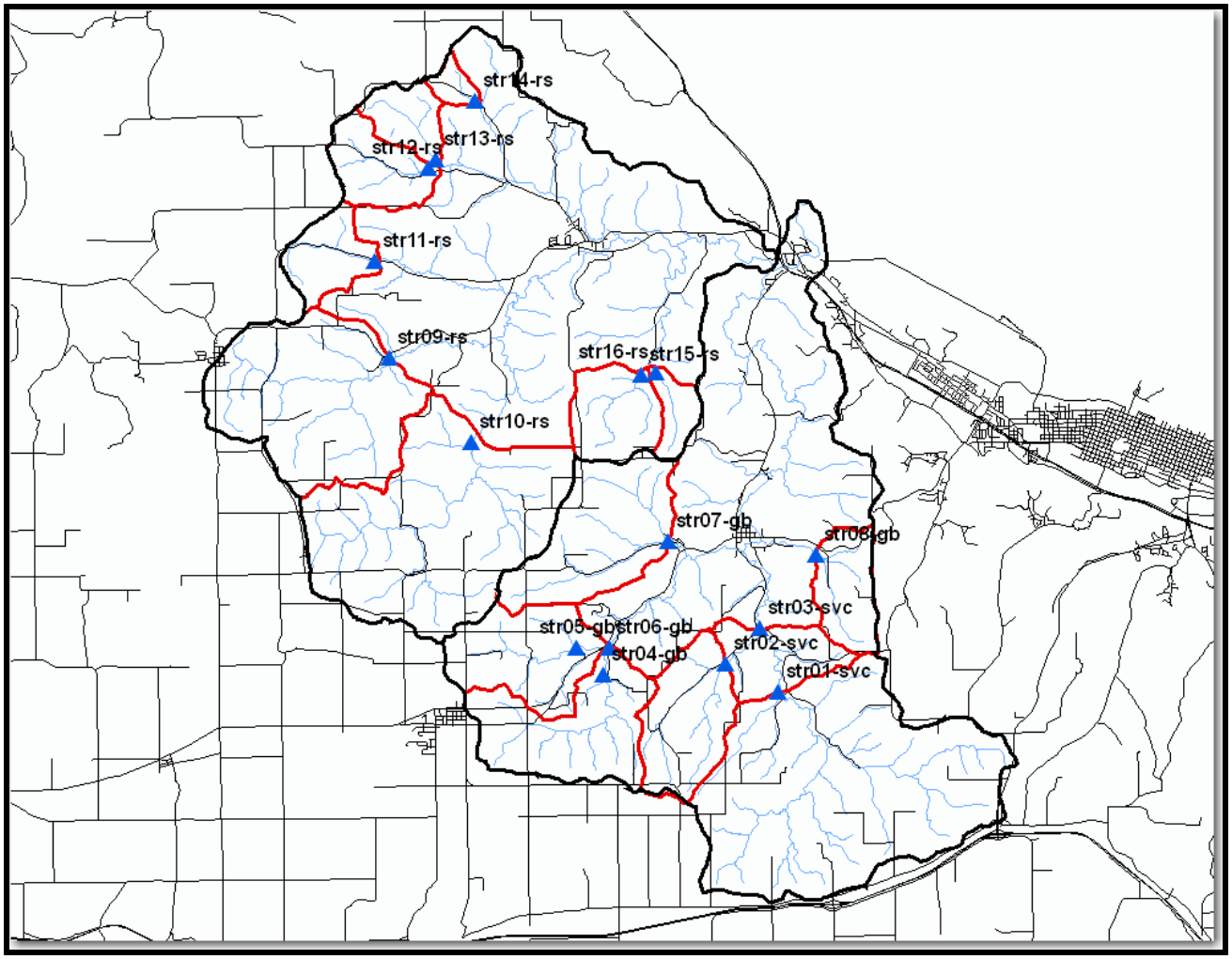


**Figure 23C - Assumed Storage/Discharge Relationship (South Zumbro Structures used as reference)**

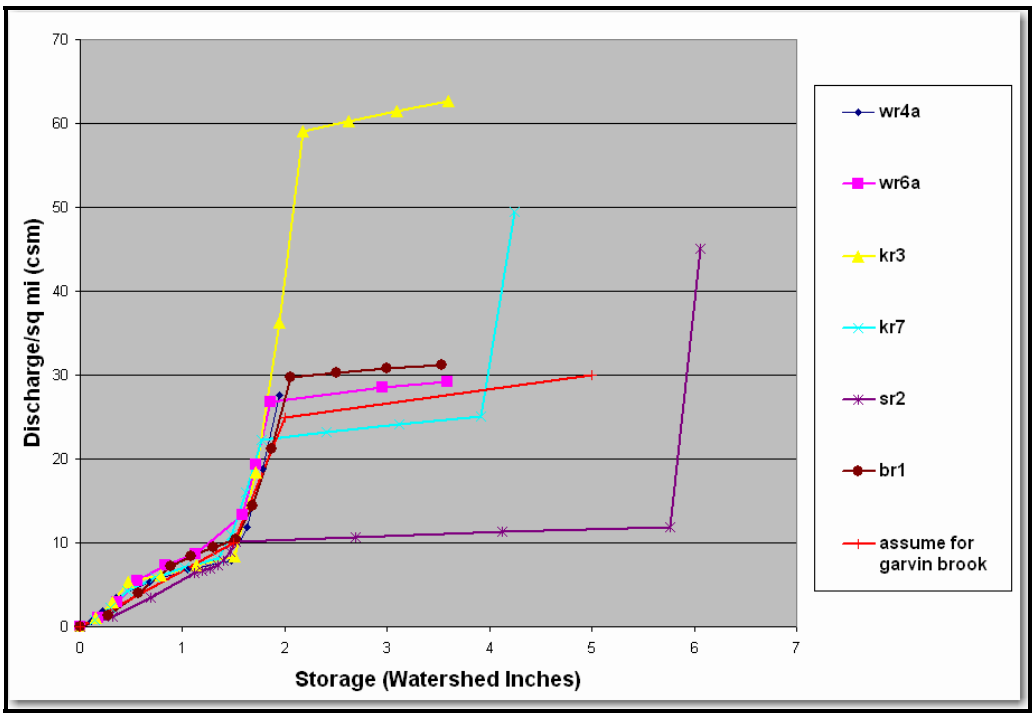



**Figure 24C - Flows Through Str01-SVC Upstream of Stockton**

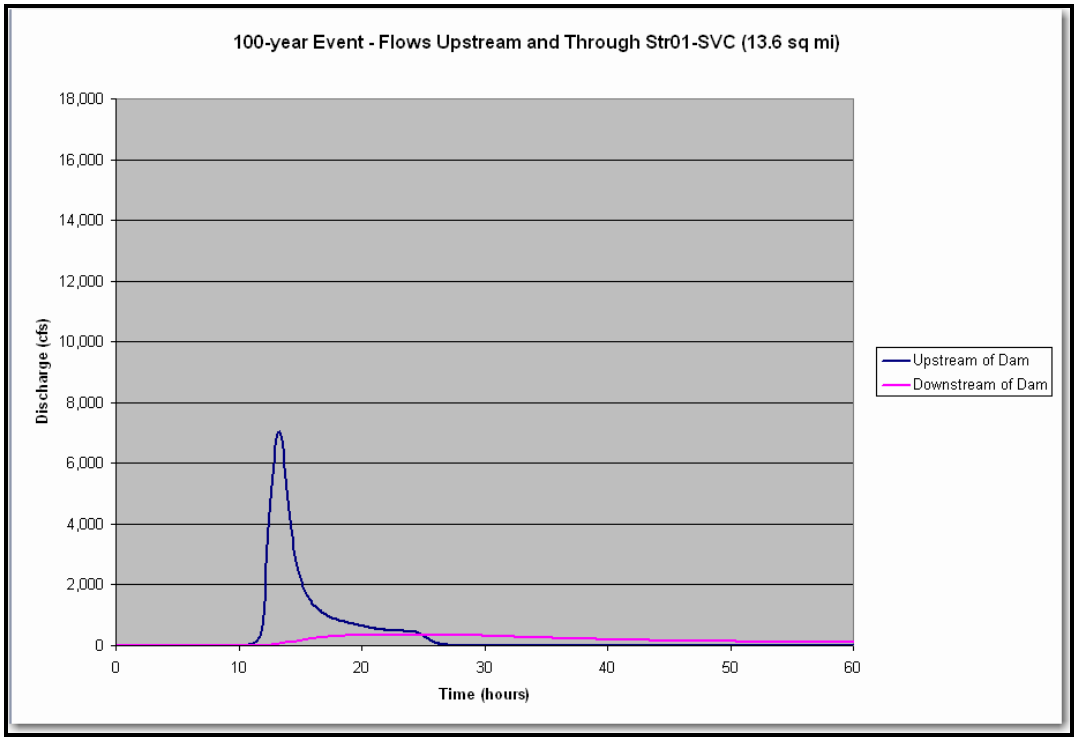
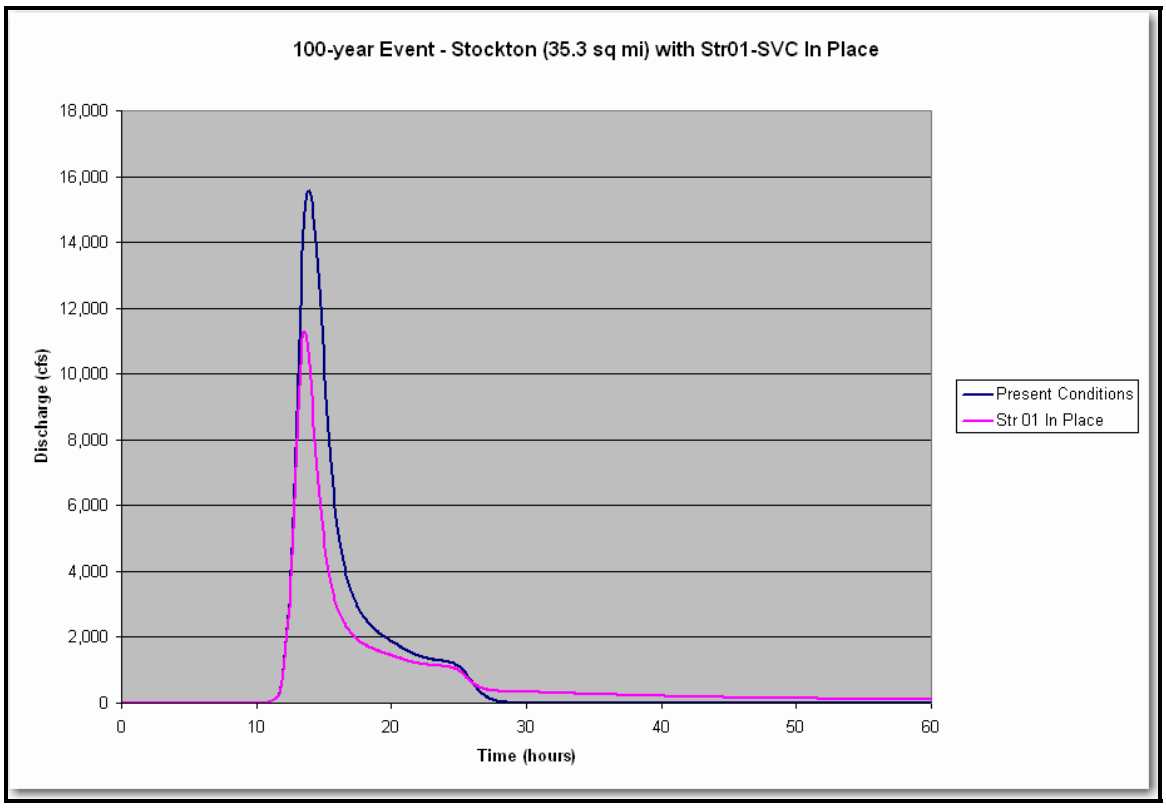


**Figure 25C - Effects of Structure STR01-SVC on Flows Through Stockton**

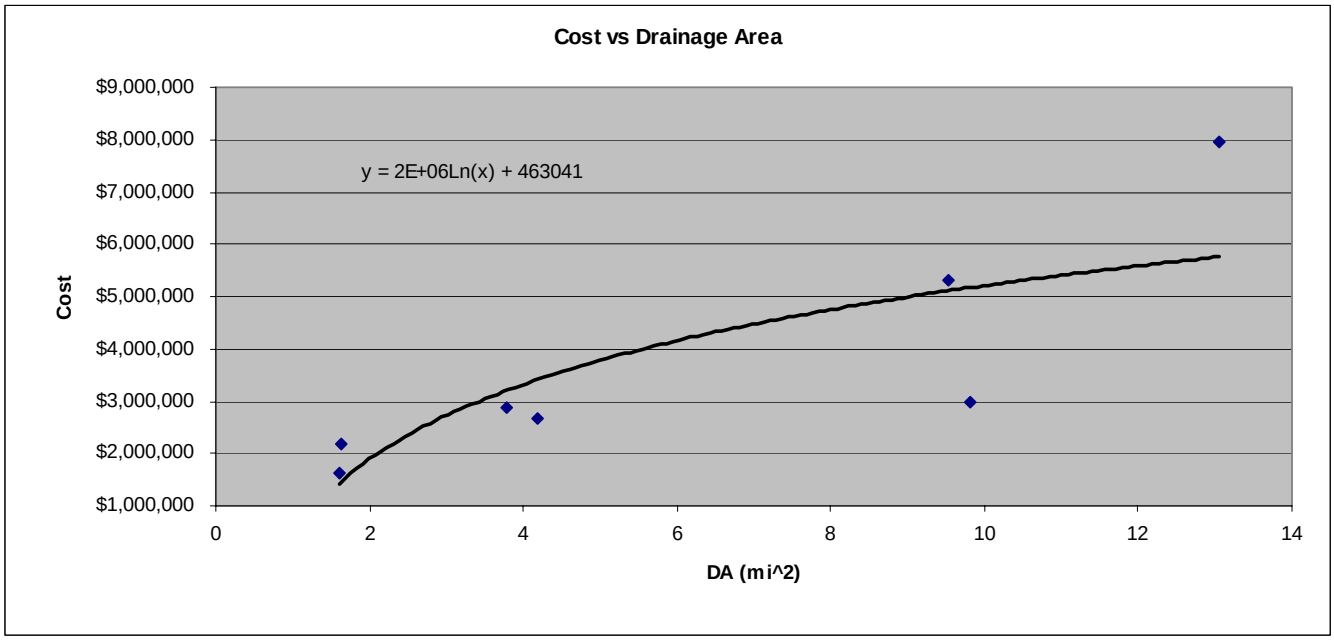


APPENDIX D - ENGINEERING DATA

NRCS completed a flood prevention project (South Zumbro) for the City of Rochester. Cost estimates for each structure were estimated for the City of Stockton using the updated costs[12] and structure variables from the South Zumbro project.

The estimated costs for the structures were based upon two different graphs. The first graph was drainage area to the structure versus cost, Figure 26D. The second graph used was flood storage required for each structure versus cost, Figure 27D. The estimated structure cost is an average of the two. Table 17D displays the estimated costs for the proposed structures.

**Figure 26D - South Zumbro Data – Drainage Area**




[12] Construction Cost Index was used. For the South Zumbro project, the value used for 1976 was 2401 and compared to the value for 2007 (8089).

**Figure 27D - South Zumbro Data - Flood Storage**

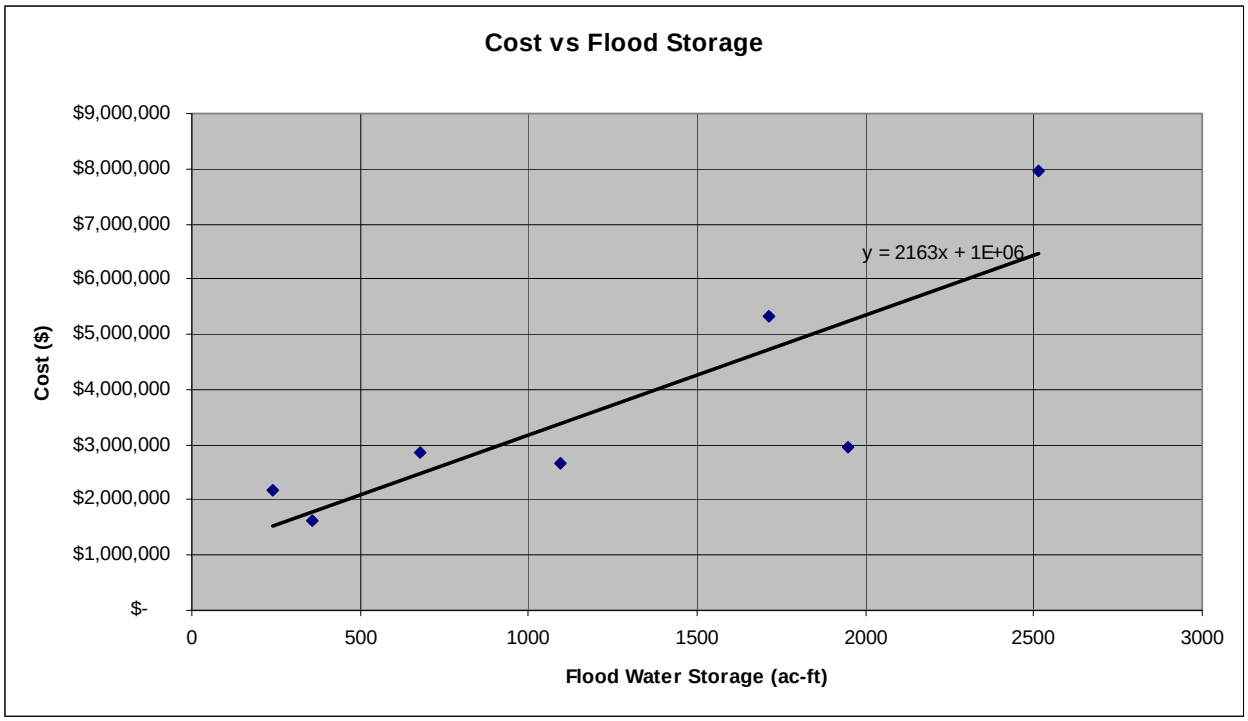



**Table 17D - Estimated Structure Installation Costs**

| Structure ID | Drainage Area (sq mi) | 100-year Flood Storage (ac-ft) | Estimated Cost Based on Drainage Area | Estimated Cost Based on Flood Storage | Estimated Structure Cost |
|---|---|---|---|---|---|
| Str1 | 13.59 | 1534 | $5.68 M | $4.32 M | $5.00 M |
| Str2 | 3.62 | 426 | $3.04 M | $1.92 M | $2.55 M |
| Str3 | 18.50 | 2114 | $6.30 M | $5.57 M | $5.94 M |
| Str6 | 7.41 | 907 | $4.47 M | $2.96 M | $3.71 M |
| Str7 | 4.43 | 531 | $3.44 M | $2.01 M | $2.80 M |
| Str8 | 1.73 | 267 | $1.55 M | $1.58 M | $1.57 M |

To provide the City of Stockton with flood protection to the 100-year level, three components are needed to be built. The three components are:

- Building a retention structure
- Relocating affected structures within the retention structure inundated area
- Additional flood prevention measures

**Trout Fishery**: Prior to the recent flooding, DNR reported a naturally reproducing, and sustainable Brook Trout, *Salvelinus fontinalis* fishery in the Garvin Brook headwater reach north of State Highway 14, southeast of Lewiston, and upstream of Farmer's Park. Downstream of Farmer's Park, a sustainable, naturally reproducing Brown Trout, *Salmo trutta*, fishery existed all the rest of the way downstream to the outlet of Garvin Brook into the Mississippi River Bottoms. To date, MN DNR Fisheries has not conducted any stream surveys to determine the current population of either the Brook or Brown Trout species.

MN DNR reports considerable damage to the channel itself with some complete channel displacement into its floodplain with considerable abrading and head cutting. So far, MN DNR has determined that 15 trout lunker structures just below Farmer's Park, installed by Trout Unlimited over the years, have been completely destroyed by the flooding. MN DNR is working with FEMA; the Drifless Area Trout Unlimited Initiative; and the FWS National Fish Habitat Program to secure funding assistance to replace these lost lunker structures. MN DNR is still inventorying debris removal needs in the channel, and has concentrated so far, on road approaches to the channel, County and State road bridge replacement, and the replacement of RR Crossing bridges over the Garvin Brook Channel. MN DNR is permitting debris removal, but not channel substrate removal unless a public safety hazard exists ponding water up onto road approaches and bridge abutments over the channel.

MN DNR has created a Special Task Force Team to be led by MN DNR Fishery Research Biologist, Ian Chisholm, to help determine trout stream channel habitat restoration needs throughout Southeast MN as a result of the flooding. At this point in time, MN DNR intends to just let nature take its course with the Spring runoff through existing, and the flood altered channel morphology.[13]
Table 18E below lists all of the State of Minnesota Threatened, endangered, and species of special concern identified as occurring within the Garvin Brook Watershed. A confidential map showing the known location of these specific categories of State protected species is available for NRCS use. This map can be consulted as specific project structural work is planned to determine if we will need to consult with MN DNR to avoid these species and their respective habitats where they may occur. The MN State Endangered Species Act protects state listed species. NRCS projects must address any potential impacts to state listed species.

A formal federal consultation will need to begin with the U. S. Section 7 of the Endangered Species Act (ESA) of 1973 requires all federal agencies to carry out programs for the conservation of threatened and endangered species. It will also require NRCS to do consultation with the FWS for any project that might impact a federally listed species or its designated critical habitat.

[13] Personal Communications with Steve Klotz, MN DNR Area Fisheries Supervisor, Lanesboro, MN, 01/29/08.

Section 2 of the Fish and Wildlife Coordination Act (FWCA) of 1958 (as amended) requires consultation with the FWS and the state fish and wildlife agency if a project is going to control or modify a stream or any other body of water. This consultation is to prevent loss of and damage to wildlife resources. This may very well occur if any channel work is implemented in the Garvin Brook stream channel.

It is not anticipated that any work will occur within the Mississippi River channel, so no impacts would be expected to occur to the Federal Endangered Higgins Eye, nor the federal Candidate Sheepnose mussel species since their habitat is exclusively in the Mississippi Channel.

However, consultation will be required with the federal Endangered Candidate Massasauga Rattlesnake species because its habitat occurs in floodplain wetlands and nearby upland areas along the Mississippi River and Tributaries where project work is tentatively being planned. This will also apply to the federal Endangered Karner Blue Butterfly whose habitat occurs in pine barens and oak savannas on sandy soils and containing wild lupines (*Lupinus perennis)*, the only know food plant of the larvae of this protected butterfly species.

**Table 18E - Federal and State Threatened, Endangered, and Special Concern (SPC) animal and plant species in the Garvin Brook Watershed, Winona County, MN**

| SPECIES | COMMON NAME | SPECIES STATUS |
|---|---|---|
| *Sistrurus catenatus catenatus* | Eastern Massasauga Rattlesnake | Federal Candidate |
| *Plethobasus cyphyus* | Sheepnose Mussel | Federal Candidate |
| *Lampsilis higginsi* | Higgens Eye Pearly Mussel | Federal Endangered |
| *Lycaeides melissa samuelis* | Karner Blue Butterfly | Federal Endangered |
| *Crotalus horridus* | Timber Rattlesnake | MN State Threatened |
| *Haliaeetus leucocephalus* | Bald Eagle | MN State Species of Special Concern (SPC) |
| *Dendroica cerulea* | Cerulean Warbler | MN SPC |
| *Empidomax virescens* | Acadian Flycatcher | MN SPC |
| *Pipistrellus subflavus* | Eastern Pipistrelle Bat | MN SPC |
| *Seiurus motacilla* | Louisiana Waterthrush | MN SPC |
| Adoxa moschartellina | Moschatel Plant | MN SPC |
| Baptisia bracteata | Plains Wild Indigo | MN SPC |
| Carex plantaginea | Plantain–leaved Sedge | MN Endangered |
| Carex woodii | Wood’s Sedge | MN SPC |
| Cheilanthes lanosa | Hairy Lipfern | MN Endangered |
| Diplazium pycnocarpon | Narrow-leafed Spleenwort | MN Threatened |
| Dryopteris goldiana | Goldie’s Fern | MN SPC |
| Hamamelis virginiana | Witch Hazel | MN SPC |
| Panax quinquefolius | American Ginseng | MN SPC |
| Silene nivea | Snowy Champion | MN Threatened |
| Solidago sciaphila | Cliff Golden Rod | MN SPC |
| Trillium nivale | Snow Trillium | MN SPC |

**Figure 28E - NWI Map for Garvin Brook Watershed**

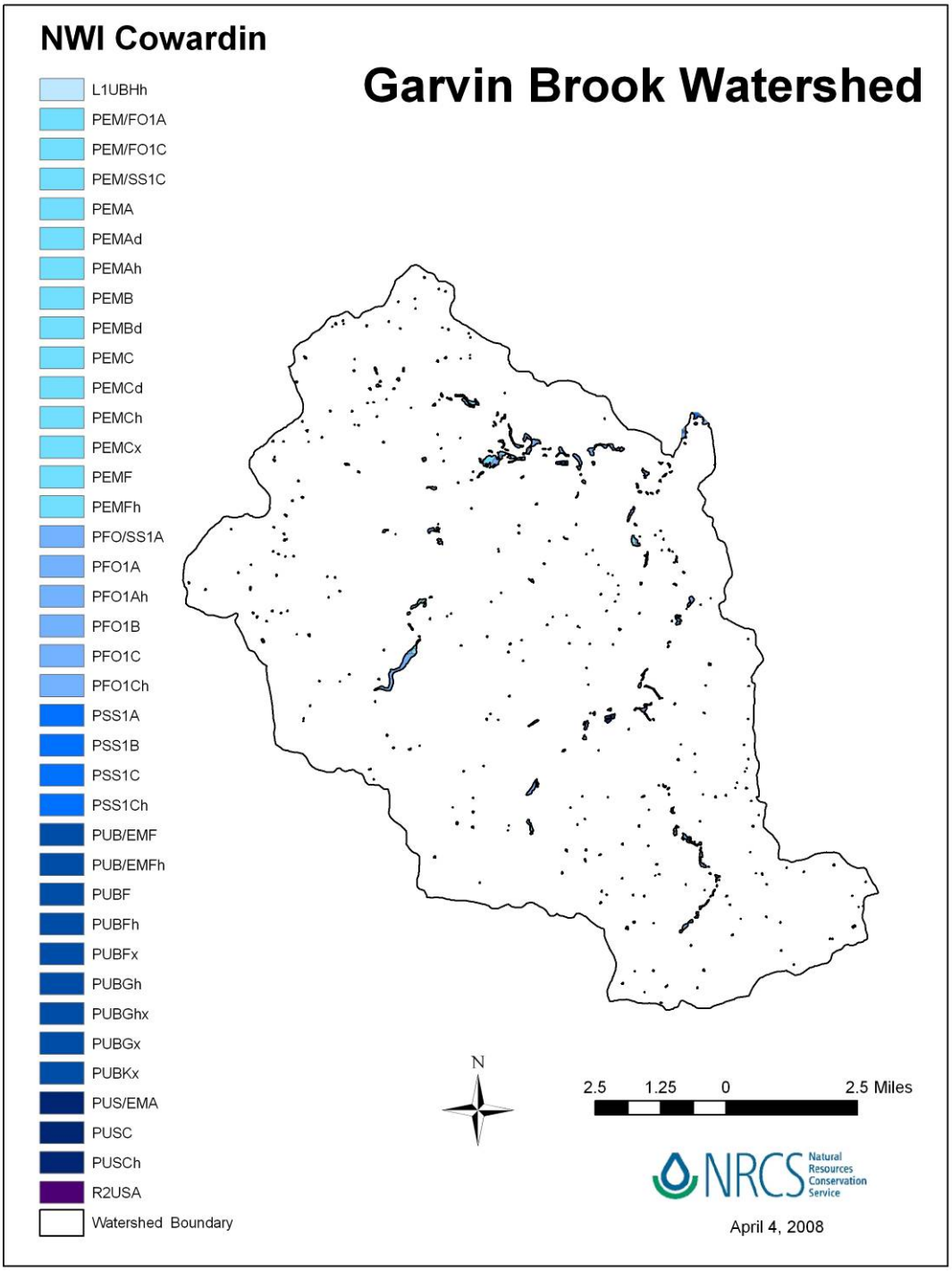


**Table 19E – Total Number and Acres of Cowardin Type Wetlands Mapped Within Garvin Brook Watershed**

| NWI Cowardin | Total # of Cowardin Type Wetlands | Total Acres |
|---|---|---|
| L1UBHh | 1 | 8.8 |
| PEM/FO1A | 3 | 8.9 |
| PEM/FO1C | 2 | 7.0 |
| PEM/SS1C | 1 | 1.1 |
| PEMA | 16 | 19.8 |
| PEMAd | 1 | 0.3 |
| PEMAh | 1 | 0.6 |
| PEMB | 13 | 58.4 |
| PEMBd | 2 | 8.7 |
| PEMC | 35 | 51.8 |
| PEMCd | 1 | 1.5 |
| PEMCh | 15 | 4.1 |
| PEMCx | 3 | 1.0 |
| PEMF | 1 | 0.6 |
| PEMFh | 4 | 0.8 |
| PFO/SS1A | 2 | 7.3 |
| PFO1A | 50 | 251.7 |
| PFO1Ah | 4 | 143.1 |
| PFO1B | 1 | 2.9 |
| PFO1C | 12 | 6.7 |
| PFO1Ch | 5 | 31.9 |
| PSS1A | 2 | 2.3 |
| PSS1B | 1 | 0.4 |
| PSS1C | 1 | 0.6 |
| PSS1Ch | 10 | 14.6 |
| PUB/EMF | 1 | 0.3 |
| PUB/EMFh | 2 | 1.8 |
| PUBF | 4 | 1.1 |
| PUBFh | 40 | 7.0 |
| PUBFx | 2 | 0.9 |
| PUBGh | 173 | 65.8 |
| PUBGhx | 1 | 0.2 |
| PUBGx | 15 | 4.6 |
| PUBKx | 7 | 18.0 |
| PUS/EMA | 1 | 0.3 |
| PUSC | 1 | 0.1 |
| PUSCh | 12 | 4.8 |
| R2USA | 17 | 8.4 |
| | **Total Wetland Acres** | 748.6 |

APPENDIX F - FEMA FLOODWAY MAPS

**Figure 29F - FEMA Floodway Map of City of Stockton**

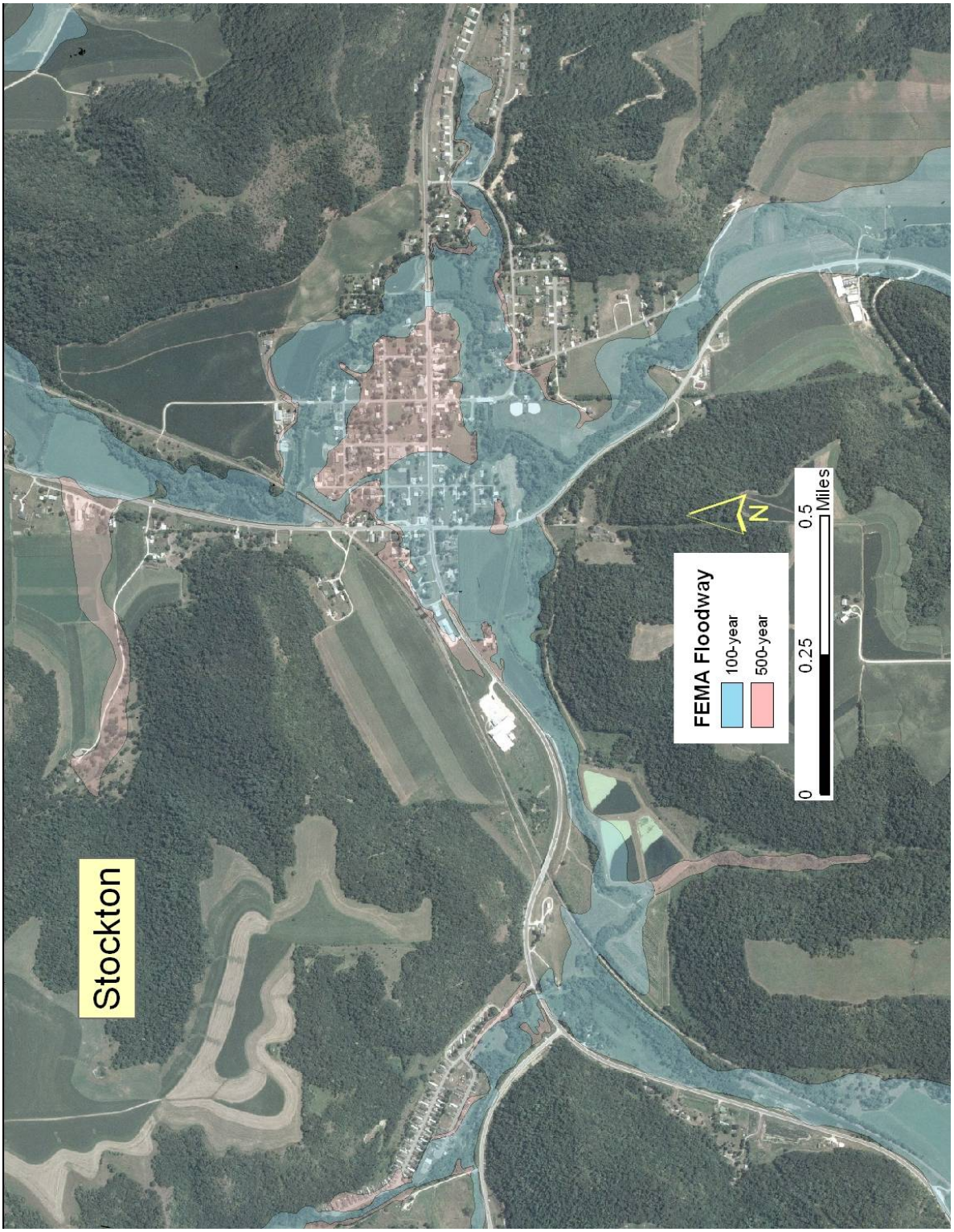


**Figure 30F - FEMA Floodway Map of Rollingston**

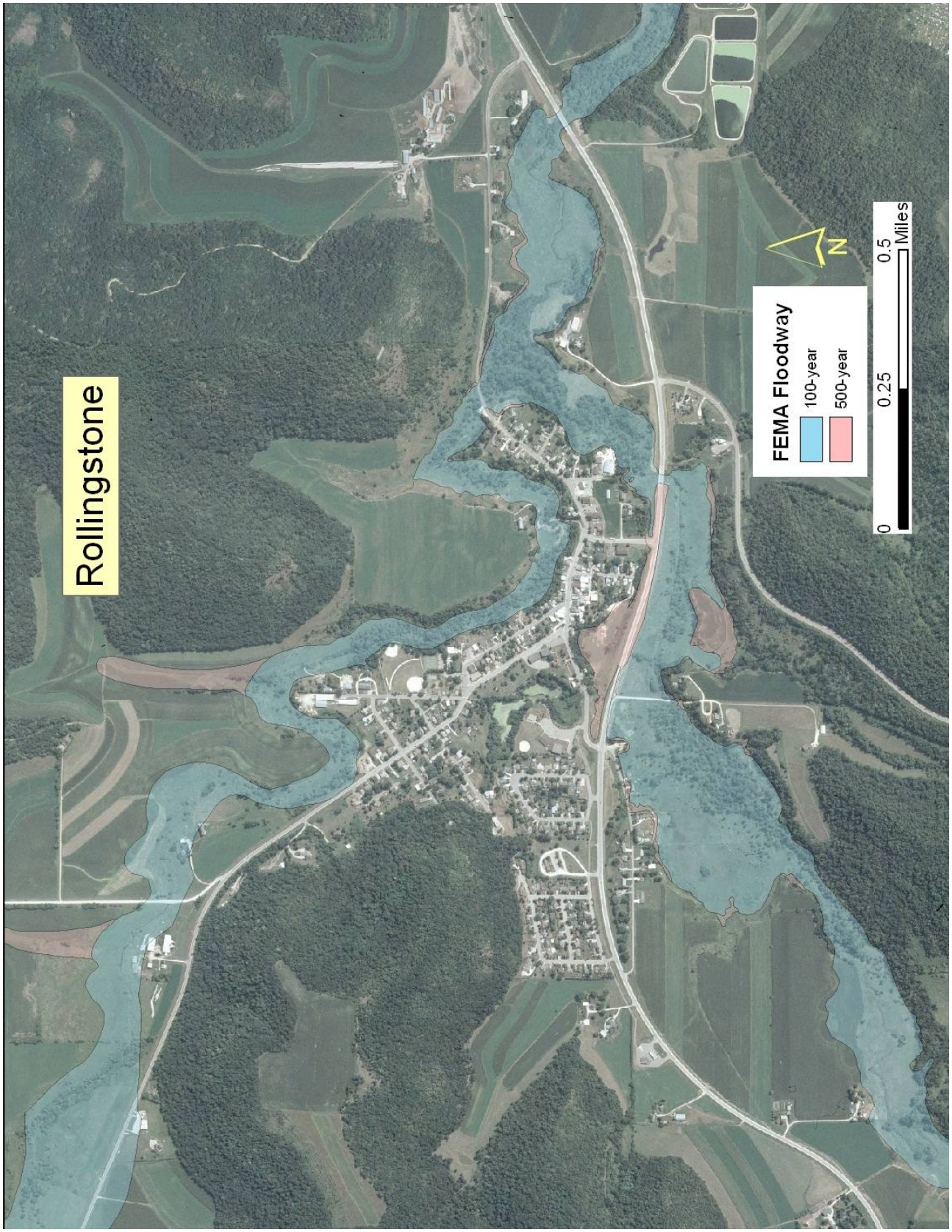
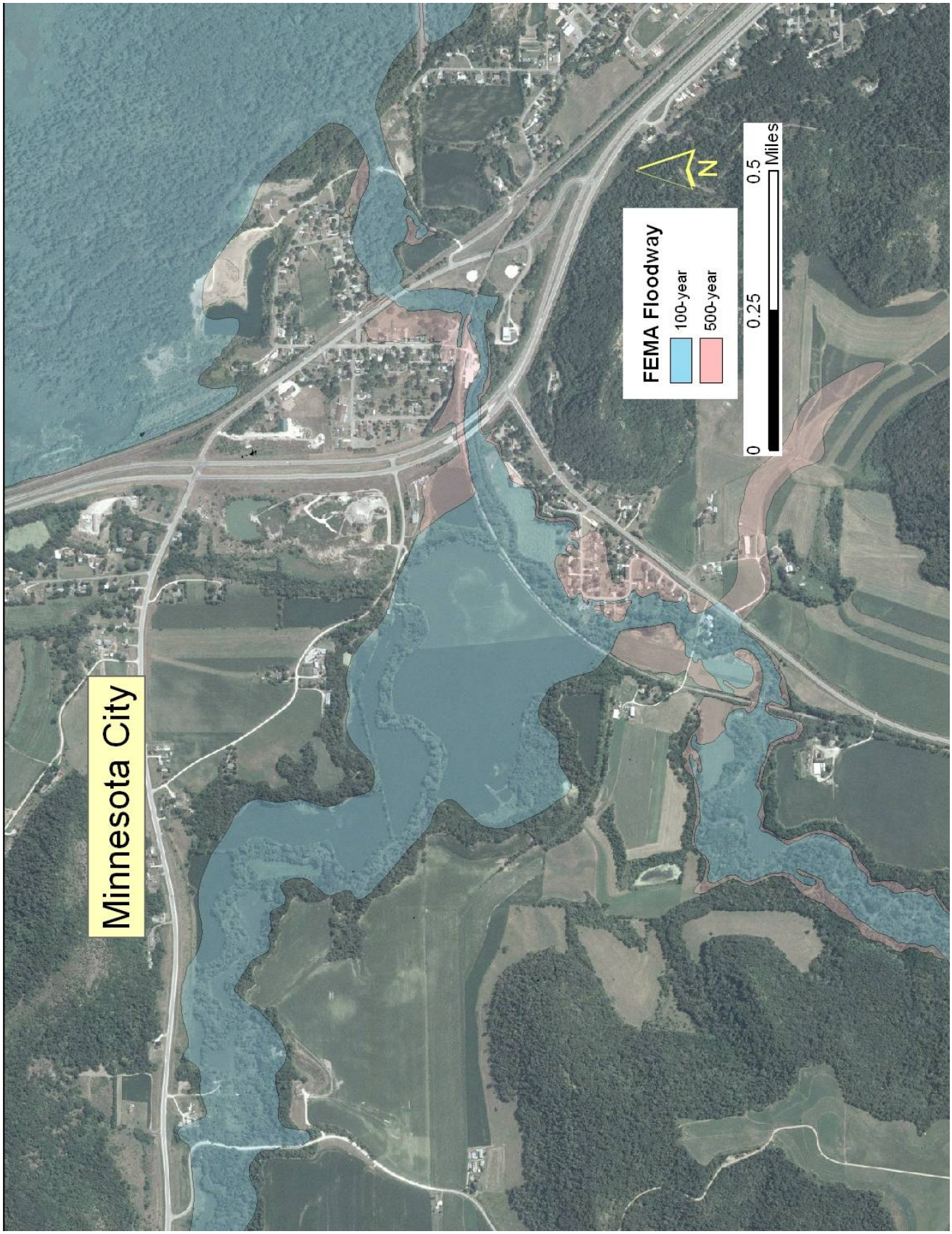


**Figure 31F - FEMA Floodway Map of Minnesota City**



APPENDIX G - LARGE STRUCTURE INUNDATION MAPS

**Figure 32G - Structure 2, Inundation Map**

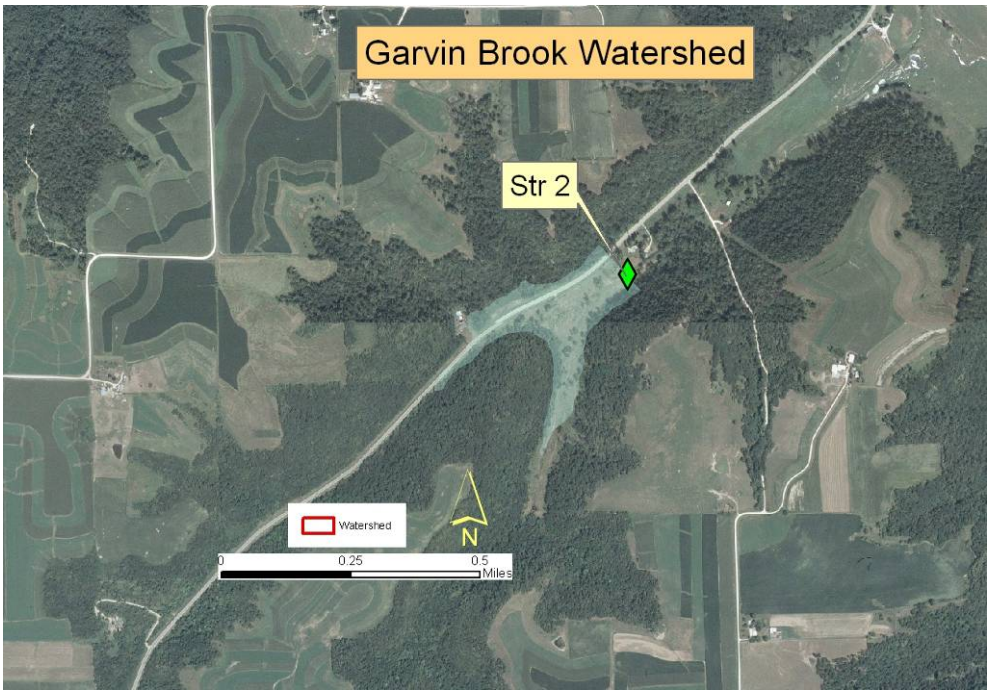



**Figure 33G - Structure 6, Inundation Map**

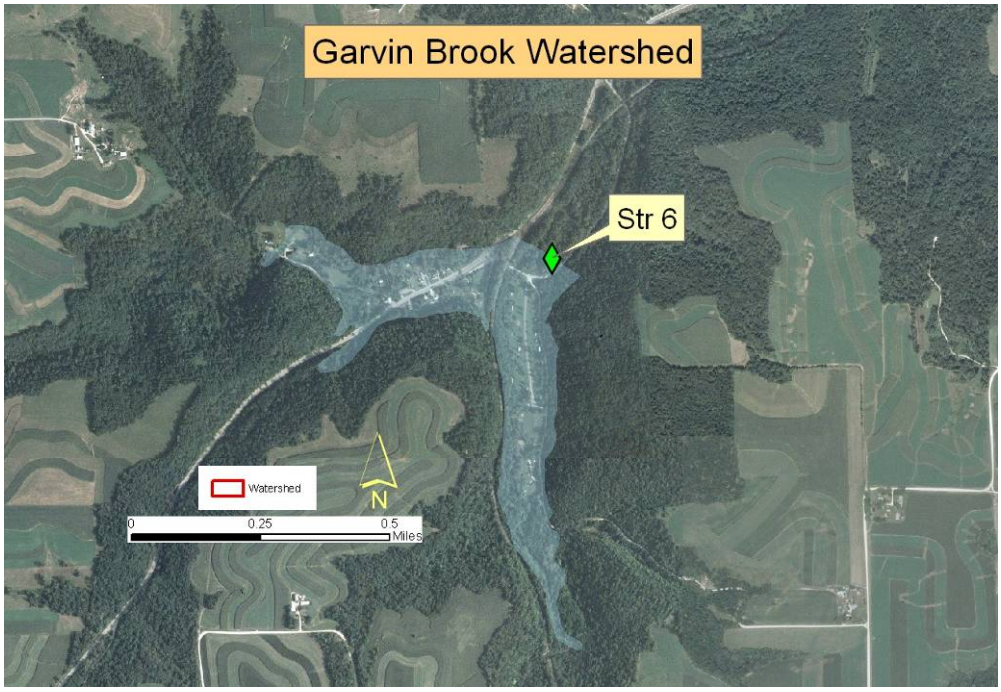


**Figure 34G - Structure 5-north, 5-south, & 4, Inundation Map**

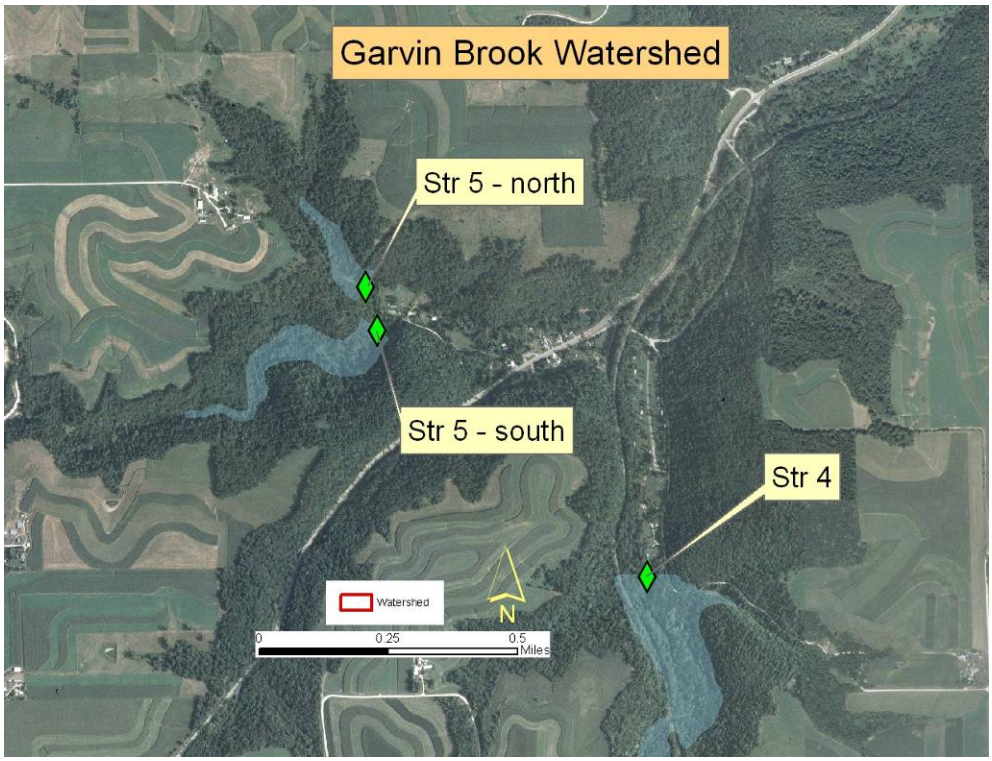
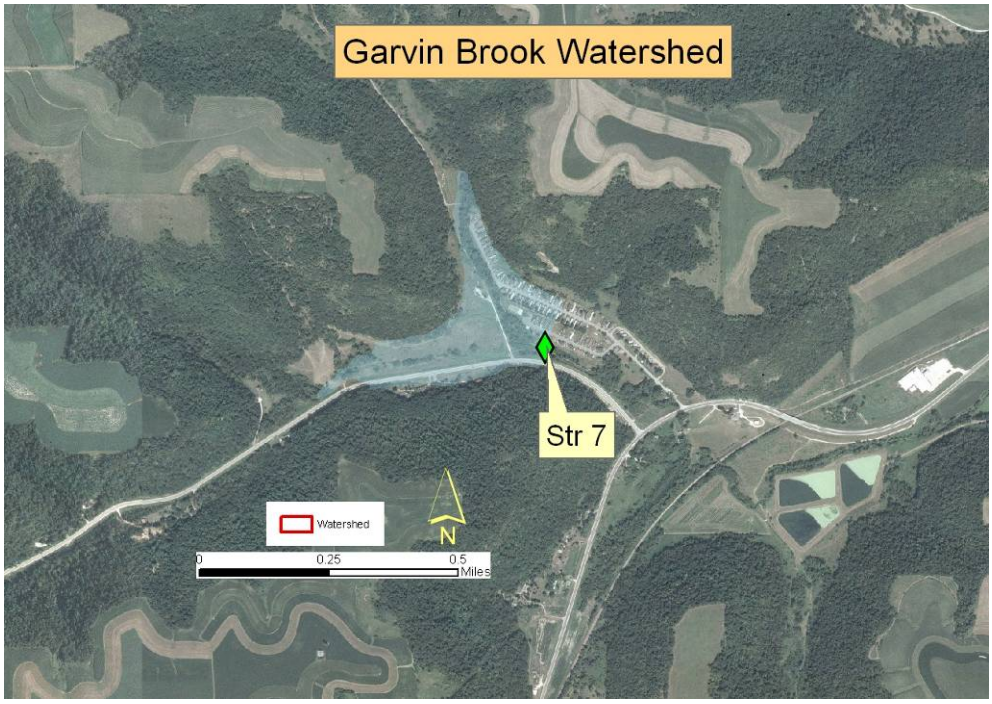



**Figure 35G - Structure 7, Inundation Map**



# APPENDIX H - USACE and NRCS MEETING NOTES

**United States Department of Agriculture**

NRCS
Natural Resources Conservation Service
375 Jackson Street, Suite 600
St. Paul, MN 55101-1854

Phone: (651) 602-7900
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May 9, 2008

**To**: U.S. Army Corp of Engineers (USACE) and the NRCS – Water Resources Staff

**From:** Allan Sommer, WRS Economist, Garvin Brook Project Coordinator

**RE**: Memo to the Record – Garvin Brook Project Meeting with the U.S. Army Corp of Engineers (USACE), May 2nd, 2008 St. Paul, MN,

The following is a brief summary of the meeting held on Friday May 2nd, 2008, regarding the Natural Resource Conservation Service (NRCS) Draft Assessment Report for the Garvin Brook Watershed located in Winona County, MN. Members from the U.S. Army Corp of Engineers (USACE) and the NRCS – Water Resources Staff were present. The purpose of the meeting was to review the re-analysis of the USACE 1994 report recently conducted by the NRCS. The NRCS findings were contrary to the original findings by the USACE, and this meeting allowed the differences between the two conclusions to be addressed. The meetings agenda was as such:

| | | |
|---|---|---|
| 9:00 – 9:05 | Welcome/Introductions/Overview | Allan Sommer |
| 9:05 – 9:15 | Overview of USACE 1994 Plan | Brett Coleman |
| 9:15 – 9:25 | Hydraulics | Pete Cooper |
| 9:25 – 9:35 | Cost and Benefits of USACE Plan | Allan Sommer |
| 9:35 – 9:45 | Environmental Concerns | Bill Lorenzen |
| 9:45 – 10:00 | Discussion/Next Steps | All Attendees |

*Meeting Attendees:*
Allan Sommer, NRCS
Brett Coleman, NRCS
Pete Cooper, NRCS
Bill Lorenzen, NRCS
John Beckwith, NRCS
Terry Zien, USACE
Rick Carlson, USACE

***Items of Discussion***
Terry Zien indicated that in order to have FEMA certification the dikes must have 3' of freeboard. NRCS will revise the draft plan and associated costs to account for this. The draft plan called for 2' of freeboard in accordance with NRCS standards and specs.

Terry also mentioned that this requirement will be prominent in the minds of all city planners as all current levees and dikes must re-certify that they are adequate as part of MapMod, an update of FIRM

Terry also informed NRCS that as part of a FEMA buyout, nothing can be built on the parcel after purchase, unless you are granted an exemption. An exemption is extremely rare. Based on this stipulation, in a flood protection project you may want to orchestrate the city/sponsor dollars to be used towards buyouts to allow for construction of dikes/levees/etc possible in the future.

Rick Carlson discussed the application of the HEC-FDA model used in flood risk management analyses preformed by the Corps. This model allows the agency to claim benefits up to the top of the levee. The concept of freeboard is no longer used. To be certified for 100- year level of protection the structure must contain 90% of the 1% chance event. There was also some discussion here regarding risk and uncertainty of flood damage reduction projects and how this is accounted for in the determination of benefits.

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Pete Cooper led a discussion on the peak discharges and updated hydrology of Garvin Brook that was used for the NRCS analysis. The updated hydrology used was very close to the 1982 FIS. Terry noted that this may be much different when the 2007 event is included in an updated flow/frequency relationship. The USACE's recent re-evaluation of flow/frequency in Rushford saw significant changes. If the plan moves into detailed planning, this will need to be investigated more closely.

Allan Sommer discussed the estimated benefits of the project. One caveat of the benefits estimated is that based on pending FEMA buyouts, the benefits resulting from the proposed project would likely change. This would also need to be investigated in more detail. An alternative will be added to the draft plan discussed during the meeting that will estimate the cost of re-locating or buying out the town of Stockton.

A discussion regarding potential sources of federal funding for detailed study included the USACE 205 program. Terry indicated that $100K is available for federal reconnaissance, which may be similar to the evaluation conducted by the NRCS. If the project is approved under the 205 program, there would be a $13 million cap, with a maximum of $7 million in federal funds. Terry made no commitment that this project would qualify for these funds.

***General Editorial Comments***
Change from "flood protection" to "flood risk management" or "flood damage reduction". You can never fully protect from flooding.

Review of Draft Plan received from Terry Zien. NRCS will incorporate comments/edits.

***Conclusion-***
It appears that the original plan presented by the USACE in 1994 may in fact be economically feasible. The Corps plan was evaluated assuming a project life of 50 years and a discount rate of 8.17%. The re-evaluation completed by NRCS, assumes a 100 year project life and a discount rate of 4.875%, resulting in a project B:C ratio of 1.31:1.0. It is recommended by NRCS that if the projects' sponsors agree to the project design, that they begin to seek federal assistance for project planning. The USACE agreed with the conclusion reached by the NRCS re-evaluation, contingent on their comments and edits being addressed in the final report.