EIVED
OCT 15 2008

FEMA Levee Accreditation Inventory

Afton, Minnesota

SEH No. AFTON 101403

October 10, 2008

SEH

Multidisciplined. Single Source.
Trusted solutions for more than 75 years.

SEH

October 10, 2008

RE: FEMA Levee Accreditation Inventory
Afton, Minnesota
SEH No. AFTON 101403

Mr. James E. Norman
Interim City Administrator
City of Afton
3033 Saint Croix Trail
PO Box 219
Afton, MN 55001

Dear Mr. Norman:

Attached please find the draft submittal of the FEMA Levee Accreditation Inventory. This inventory report is intended to provide the City of Afton with a summary of the information required to attain FEMA accreditation and also document the available information for the City's levee system in regard to pursuing accreditation.

Please feel free to contact me if you have any questions or require additional information. We will be pleased to meet with you at your convenience to discuss the report.

Sincerely,

Brad T Woznak, PE, CFM
Project Manager

s:\ae\a\afton\101403\reports&specs\levee certification.doc

FEMA Levee Accreditation Inventory
Afton, Minnesota

SEH No. AFTON 101403

October 10, 2008

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Brad T Woznak, PE, CFM

Date: October 10, 2008 Lic. No.: 41674

Reviewed by: October 10, 2008
Date

Short Elliott Hendrickson Inc.
3535 Vadnais Center Drive
St Paul, MN 55110
651.490.2000

Executive Summary

The Afton levee system serves to shelter approximately 25 acres of the City of Afton (City) in Washington County, Minnesota from flooding of the St. Croix River in the Mississippi River Basin. The purpose of this report is to outline the information required to attain accreditation by the Federal Emergency Management Agency (FEMA) and document the available information for the City's levee system. FEMA accreditation means a levee system meets the minimum requirements of the National Flood Insurance Program (NFIP) and thus FEMA recognizes the levee system meeting these requirements as providing protection from the 1-percent annual chance (100-year) flood on Flood Insurance Rate Maps (FIRMs).

The Afton levee system was originally constructed under emergency conditions to protect against flooding from the St. Croix River in 1969. The levee consists of two separate reaches. Reach 1 starts at the intersection of Pike Avenue South and Afton Boulevard South on the north end and extends south to the north bank of No Name Creek (also referred to as Kell's Creek) on the south end. Reach #2 extends from the south bank of No Name Creek on the north end to high ground at the intersection of 37th St. and County Road 21 on the south end. (See attached mapping in Appendix A). The levee system protects approximately 25 acres of residential and commercial property in Afton's "Old Village".

Based on the top of levee survey, approximately 300 lineal feet of the 2000 foot total length of the Reach 1 levee meets the minimum freeboard requirements of 44 CFR 65.10 of the NFIP. Section 65.10 of the NFIP regulations outlines the information FEMA needs to recognize, on NFIP maps, that a levee system provides protection from the flood that has a 1-percent chance of being equaled or exceeded in any given year. This information must be supplied to FEMA by the community seeking recognition of a levee system. FEMA reviews the information for the purpose of establishing the appropriate risk zone determination for NFIP maps and the review does not constitute a determination by FEMA as to how a system will perform in a flood event. Approximately 100 feet of the 550 feet total length of the Reach 2 levee system meets the minimum required freeboard for FEMA accreditation.

Three primary openings in the Afton levee system exist; 32nd Street and the 33rd Street sidewalk on Reach 1 and No Name Creek separating Reaches 1 and 2. During flood fights, all of the openings are closed off with the use of sandbags. Since FEMA does not recognize sandbag closures as providing protection for accreditation, design and construction of structural closure systems would be required for each of these areas if FEMA accreditation is pursued.

While the existing levees appear to have adequate vegetative cover for erosion protection, existing USACE guidelines, which FEMA adheres to, require all vegetation, except grasses, be removed in the area within 15 feet of the levee toe on both the landward and riverward sides. Both levee reaches contain some woody vegetation within this area and additional tree removal would be required as part of the FEMA accreditation process. The City has been working to keep Reach 1 in compliance with USACE requirements for the non-federal levee accreditation program, which in no way reflects a levees adherence to the minimum criteria for obtaining FEMA accreditation.

The existing levee construction compaction data is inadequate for FEMA accreditation because the levee system was built under emergency conditions. Additional geotechnical investigations would be required to evaluate the stability and potential settlement of the levee.

It is likely that existing septic drain fields along both reaches of the levee will require removal as part of the FEMA accreditation process. These drain fields increase the potential for seepage out the landward face of the levee, potentially resulting in seepage conditions that can destabilize the levee during flooding conditions.

Based on the preliminary interior drainage analysis as part of this levee accreditation inventory, both Reach 1 and Reach 2 levees should be provided with collection ditches along the levee and storm water gravity outlets to the St Croix River.

The results of this levee accreditation inventory are summarized below.

Requirements for FEMA Accreditation	***Compliant***	***Non-Compliant***
Freeboard	☐	☑
Closures	☐	☑
Embankment Protection	☐	☑
Embankment and Foundation Stability	☐	☑
Settlement Analyses	☐	☑
Interior Drainage	☐	☑
Operation Plan	☐	☑
Interior Drainage Plan	☐	☑
Maintenance Plan	☐	☑

As illustrated above, the Reach 1 and Reach 2 levees do not meet the minimum requirements for FEMA accreditation as they currently exist and therefore cannot be recognized by FEMA as protecting against the 1-percent flood without additional design and physical modification to the levee system.

Even if the City decides not to pursue FEMA accreditation, it is recommended that the following actions, at a minimum, be pursued.

- Levee easements should be obtained to allow for future maintenance activities by the City and avoid future encroachments into the levee.
- The City's Emergency Operations Plan should be reviewed with City Staff annually and updated as necessary to incorporate current emergency contact information and reflect existing levee system conditions. The plan update should coincide with the annual levee inspections outlined in the existing Emergency Operations Plan.

Table of Contents

Letter of Transmittal
Certification Page
Title Page
Executive Summary
Table of Contents

Page

1.0 Introduction: **1**

2.0 Background: **2**

3.0 Summary: **2**

4.0 Detailed Inventory: **3**

4.1 Checklist for Design Criteria: 3
4.1.1 Freeboard 3
4.1.2 Closures 5
4.1.3 Embankment Protection 6
4.1.4 Embankment and Foundation Stability Analyses 7
4.1.5 Settlement Analyses 9
4.1.6 Interior Drainage 10
4.2 Checklist for Operation Plan: 11
4.2.1 Flood Warning System 11
4.2.2 Plan for Operation of Closures 11
4.2.3 Responsibilities During A Flood Fight 12
4.3 Checklist for Interior Drainage Plan: 12
4.3.1 Procedures for Inspection and Operation of Interior Drainage Facilities 12
4.4 Checklist for Maintenance Plan: 12
4.4.1 Review of Maintenance Activities and Records 12

5.0 Items Necessary for Accreditation **13**

List of Tables

Table 1 Freeboard Requirements 4

List of Figures

Figure 1 – Top of Levee Profile (10+00 to 19+00)
Figure 2 – Top of Levee Profile (18+00 to 27+00)
Figure 3 – Top of Levee Profile (26+00 to 35+00)
Figure 4 – Top of Levee Profile (34+00 to 43+00)
Figure 5 – Levee Sections

SEH is a registered trademark of Short Elliott Hendrickson Inc.

Table of Contents (Continued)

List of Appendices

Appendix A	Site Location Map
Appendix B	Soil Boring Logs
Appendix C	Site Photos
Appendix D	Emergency Operations Plan
Appendix E	FEMA Fact Sheet: Requirements of 44 CFR Section 65.10
Appendix F	FEMA Fact Sheet: Meeting the Criteria for Accrediting Levees on Flood Maps
Appendix G	Code of Federal Regulations Title 44 Section 59.1 Definitions
Appendix H	Code of Federal Regulations Title 44 Section 65.10 Mapping of Areas Protected by Levee Systems

FEMA Levee Accreditation Inventory

Prepared for the City of Afton, Minnesota

1.0 Introduction:

The Afton levee system serves to shelter approximately 25 acres of the City of Afton (City) in Washington County, Minnesota from flooding of the St. Croix River in the Mississippi River Basin. The purpose of this report is to outline the information required to attain accreditation by the Federal Emergency Management Agency (FEMA) and document the available information for the City's levee system. Achieving FEMA accreditation means the levee system meets the minimum requirements of the National Flood Insurance Program (NFIP) and thus FEMA recognizes the levee system as providing protection from the 1-percent annual chance flood on Flood Insurance Rate Maps (FIRMs). The 1-percent annual chance flood, also referred to as the base flood and commonly referred to as the 100-year flood, is a flood having a 1-percent chance of being equaled or exceeded in any given year.

Since 1998, the City has been participating in the US Army Corps of Engineers (USACE) Rehabilitation and Inspection Program (RIP). Communities that have non-federal flood control works in the RIP are eligible to apply for federal assistance to repair storm event damage in excess of $15,000 on a cost shared basis. The RIP is separate from the FEMA NFIP and is not intended to provide for accrediting levees as providing protection on FEMA FIRMs. This report will focus on FEMA levee accreditation and will not address the levees in respect to the USACE RIP.

Based on the Code of Federal Regulations (44 CFR Section 59.1), a levee is defined as a manmade structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. In order for a levee to be FEMA accredited and thus recognized as protecting against the 1-percent annual-chance flood on a FIRM, sufficient data must be presented to document that the levee provides protection from the 1-percent annual chance flood, also known as the base flood. The levee owner, in this case the City, must then continue to meet minimum design, operation, and maintenance standards of the NFIP

regulations. This report will summarize the information required to attain FEMA accreditation and document the available information for the City's levee system in regard to pursuing this accreditation.

2.0 Background:

The Afton levee system was originally constructed under emergency conditions to protect against flooding from the St. Croix River in 1969. The levee consists of two separate reaches. Reach 1 starts at the intersection of Pike Avenue South and Afton Boulevard South on the north end and extends south to the north bank of No Name Creek (commonly referred to as Kell's Creek) on the south end. Reach #2 extends from the south bank of No Name Creek on the north end to high ground at the intersection of 37th St. and County Road 21 on the south end. (See attached mapping in Appendix A). The levee system protects approximately 25 acres of residential and commercial property.

The levee height along Reach 1 varies from 3 to 12 feet and the top width varies from 9 to 12 feet. The riverward slope is roughly 3 horizontal to 1 vertical and the landward slopes varies from approximately 4 to 5 horizontal to 1 vertical. This reach is approximately 2100 feet in length and was constructed in 1969 with modifications in 1997, 1999, and 2002.

The levee along Reach 2 reaches heights up to 8 feet with the top width varying from 9 to 12 feet. The landward slope is approximately 3 horizontal to 1 vertical and the riverward slopes vary from 1 to 2 horizontal to 1 vertical. The reach is approximately 550 feet in length and was constructed in 1969 with modifications in 1997.

3.0 Summary:

A primary task in preparation of this report involved the research and data collection to determine what if any of the existing information available on the levee system could be utilized in the levee accreditation process.

The following data was collected and analyzed:

- NFIP Requirements (44 CFR Sections 59.1 and 65.10; included in Appendices G and H)
- Easement Agreements and Correspondence
- June 1999 Levee Improvements Plan - Howard R. Green Company
- March 2002 Levee Rehabilitation Plans – US Army Corps of Engineers
- April 2005 RIP Continuing Eligibility Inspection Report – Army Corps of Engineers
- National Weather Service High Water Records – Wire weight gage located on the downstream rail of the Highway 212 bridge over the St. Croix at Stillwater, Minnesota
- Site Topography – 2008 SEH, Inc.
- (2) Soil Boring Logs and Reports - American Engineering Testing, Inc.
- Site Photos – April 18, 2008

4.0 Detailed Inventory:

4.1 Checklist for Design Criteria:

4.1.1 Freeboard

FEMA Requirements:

Freeboard is a factor of safety usually expressed in feet above a flood level for purposes of flood plain management. Freeboard tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed.

To be recognized by FEMA, levees must provide a minimum required freeboard of 3 feet above the Base Flood Elevation (BFE) all along the length, and an additional 1 foot within 100 feet of structures (such as bridges) or wherever the flow is constricted. An additional 0.5 foot at the upstream end of the levee must also be provided.

Analysis of Current Conditions:

Based on the results of the SEH top of levee survey the Afton levee system does not meet the minimum freeboard requirements for FEMA accreditation. In the Reach 1 levee system, approximately 300 lineal feet of the 2000 foot total length meets the minimum freeboard requirements of 44 CFR 65.10. Approximately 100 feet of the 550 feet total length of the Reach 2 levee system meets the minimum required freeboard for FEMA accreditation.

The effective BFE in this area is 692.0 feet (NGVD 1929). FEMA is currently in the process of updating the NFIP maps in this area and have released a draft of the new maps. It is anticipated that the Draft maps will become official in 2009, thus superseding previous maps. The Draft BFE ranges from 691.8 to 691.9 feet (NAVD 1988). Since the Draft BFE will become effective in the near future, the minimum required top of levee elevations were compared to that value. Table 1 shows top of levee elevations and freeboard requirements along both levee reaches.

Table 1
Freeboard Requirements

Station	Base Flood Elevation		Minimum Required	Top of Levee
	FEMA 1976 Effective (NGVD 29)	Draft (NAVD 88)	Top of Levee - FEMA Accreditation (NAVD 88)	SEH Survey (NAVD 88)
REACH 2				
10+00	692.00	691.80	694.80	696.40
11+00	692.00	691.80	694.90	696.50
12+00	692.00	691.80	695.00	694.10
13+00	692.00	691.80	695.10	694.82
14+00	692.00	691.80	695.20	693.50
15+00	692.00	691.80	695.30	693.63
16+00	692.00	691.80	695.30	-
REACH 1				
17+00	692.00	691.90	694.90	-
18+00	692.00	691.90	694.90	694.90
19+00	692.00	691.90	694.90	694.61
20+00	692.00	691.90	695.00	694.93
21+00	692.00	691.90	695.00	695.45
22+00	692.00	691.90	695.00	695.51
23+00	692.00	691.90	695.00	695.30
24+00	692.00	691.90	695.10	694.76
25+00	692.00	691.90	695.10	694.39
26+00	692.00	691.90	695.10	694.35
27+00	692.00	691.90	695.10	694.13
28+00	692.00	691.90	695.20	694.36
29+00	692.00	691.90	695.20	694.00
30+00	692.00	691.90	695.20	694.33
31+00	692.00	691.90	695.20	694.81
32+00	692.00	691.90	695.30	692.62
33+00	692.00	691.90	695.30	694.30
34+00	692.00	691.90	695.30	694.65
35+00	692.00	691.90	695.30	694.23
36+00	692.00	691.90	695.40	691.14
37+00	692.00	691.90	695.40	695.00
38+00	692.00	691.90	-	-

Do current conditions meet accreditation requirements?

YES ☐ ***NO*** ☑ ***UNKNOWN*** ☐

4.1.2 Closures

FEMA Requirements:

For the levee system to be accredited by FEMA, all openings in the levee system must be provided with closure devices that are structural parts of the system during operation and have been designed in accordance with sound engineering practice.

Analysis of Current Conditions:

There are three primary openings in the Afton levee system; 32nd Street, and the 33rd Street sidewalk on Reach 1 and No Name Creek separating Reaches 1 and 2. During flood fights, all of the openings are closed off. The city utilizes an earth closure at 32nd Street and the 33rd Street sidewalk. Temporary tie-back levees are placed along the north and south banks of No Name Creek to tie into high ground at the intersection of 36th Street and St. Croix Trail on the north and 37th Street and St. Croix Trail on the south.

There is a 54-inch Corrugated Metal Pipe (CMP) that crosses under the levee near station 27+60. At one time this was used as a gravity outfall for stormwater draining to Reach 1. It has since been blocked with stop logs and rip rap on the riverward side and no longer functions as an outlet.

There are two additional openings in the Reach 1 levee near station 27+60. These openings consist of 10-inch and 12-inch diameter PVC pipes that are utilized during flood fights to pump out water from behind the levee. Based on SEH survey, the 10-inch PVC passes through the levee at elevation 690.0 feet (NAVD88) and the 12-inch PVC passes through at elevation 692.9 feet (NAVD88). Typically, pump discharge lines through the levee freeboard are allowable assuming they are fitted with proper closure mechanisms (such as flap gates) to prevent river water from back flowing through the system. The 12-inch PVC passes through the levee freeboard, but the 10-inch PVC passes through the levee below the BFE. Based on field observation, the 12-inch PVC pipe has been broken on the riverward side of the levee and will require repair to allow proper function during a pumping event.

Do current conditions meet accreditation requirements?

YES ☐ ***NO*** ☑ ***UNKNOWN*** ☐

4.1.3 Embankment Protection

FEMA Requirements:

FEMA accreditation requires that engineering analyses be submitted to demonstrate that no appreciable erosion of the levee embankment can be expected during the base flood, as a result of either currents or waves, and that the anticipated erosion will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and subsequent instability.

Analysis of Current Conditions:

Embankment protection along the Afton levee system appears to be sufficient. The riverward side of the levee is heavily vegetated and reinforced with rip rap in some areas. The attachment entitled "Afton Levee Photos" depicts this. Erosion of the levee embankment as a result of currents or waves is not anticipated. In order to be compliant with FEMA regulations, embankments should be kept clear of brush and debris and they should be mowed. The City should consider clearing the riverward side of Reach 2. Some of the vegetation is overgrown in this area. Existing USACE guidelines, which FEMA adheres to, require all vegetation, except grasses, be removed in the area within 15 feet of the levee toe on both the landward and riverward sides.

Do current conditions meet accreditation requirements?

YES ☐ ***NO*** ☑ ***UNKNOWN*** ☐

4.1.4 Embankment and Foundation Stability Analyses

FEMA Requirements:

In order for the levee system to be accepted by FEMA as protecting against the 1-percent annual chance flood, engineering analyses that evaluate levee embankment stability must be submitted. The analyses must evaluate seepage during the base flood and must also demonstrate that seepage through the levee foundation and embankment will not jeopardize embankment or foundation stability.

Analysis of Current Conditions:

The levees at Afton were originally constructed with sand from local borrow sources. Modifications have been made with sand and gravel from the area. Information from the USACE RIP inspection indicates that the uppermost 1 to 1.5 feet of the levee was constructed using an organic clayey material which was not consistent with the soil testing information obtained for this study.

Two (2) soil borings, and laboratory tests of soil samples collected from the levee, were completed by American Engineering Testing (AET) of St. Paul, Minnesota. Soil borings consisted of two hollow stem auger (HSA) borings with standard penetration test (SPT) sampling to a depth of 25 feet. Borings were completed in general conformance with ASTM D 1586. Laboratory testing consisted of particle size distribution (ASTM D 422) and Atterberg limits (ASTM D 4318). The results of the borings and laboratory testing are shown in Appendix B.

The soil borings are consistent with what is generally known about the levee. Most fill placed as part of levee construction consists of a mixture of clean sand, sand with silt, and silty sand. The levee fill ranges in density from loose to very dense. The locations where SPT blow counts indicate very dense levee fill were likely influenced by the presence of gravel in the sands and the actual soil density could be considerably less than indicated by the blow counts. Under the fill soils, layers of finer alluvial soils consisting of silty clays, clayey sand and sandy silts with sand were encountered. Clayey alluvium soils were firm to stiff, while silty alluvium soils appear to be loose. Deeper deposits below the levee appear to consist of loose to medium dense sands and silty sands.

A full study of the embankment and foundation stability of the levee system is not included within the scope of this inventory. Geotechnical services can be provided in the future if the City chooses to take this investigation to a more detailed level. The following summary of the levee condition is based on the results of the two borings performed as part of this study.

Some level of compaction appears to have been used when levee fill was placed based on the SPT blow counts. However, the degree of compaction relative to the maximum compaction density of the soil cannot be determined from the blow counts alone. It is therefore not possible to determine if an adequate level of compaction was used based on the information that is available. There is considerable variability in the blow counts obtained in the

levee fill. This indicates that the degree of compaction is likely not consistent throughout the levee.

The foundation soils, and the majority of the levee, are relatively pervious sands and silty sands. As a result, seepage could occur both through the levee and through the foundation soils during flood conditions. In addition, seepage occurring under the levee could result in uplift pressures which will reduce levee stability.

Layers of alluvial soils with relatively low SPT blow counts were encountered in both borings drilled along the current levee below the upper sandy fill. Layers of soft alluvial soils can create weak planes that produce slope failures under flood conditions.

There are septic drain fields at several locations along the landward side of both reaches of the levee. Septic drain fields have ability to collect and channel water out the landward face of the levee, potentially resulting in seepage conditions that can destabilize the levee. The widening of the levee in the Reach 1 area in 1999 reduced the potential impacts of the drain fields along that reach, but seepage resulting from their presence is still possible. Drain fields along the Reach 2 portion of the levee are closer to the riverward face of the levee and thus have a high potential to produce seepage out the landward face.

Do current conditions meet accreditation requirements?

YES ☐ ***NO*** ☐ ***UNKNOWN*** ☑

4.1.5 Settlement Analyses

FEMA Requirements:

FEMA requires that engineering analyses must be submitted that assess the potential and magnitude of future losses of freeboard as a result of levee settlement and demonstrate that the minimum freeboard will be maintained. The analysis must address embankment loads, compressibility of embankment soils, compressibility of foundation soils, age of the levee system, and construction compaction methods. Also, a detailed settlement analysis based on the methods outlined in EM 1100-2-1904 must be submitted.

Analysis of Current Conditions:

The soil borings indicate the presence of moderately compressible alluvium soils (silty clays, clayey sands, and sandy silts) at the two locations where borings were performed. Based on a review of the survey information, it appears that the levees have settled slightly between the topographic survey of 1997 and the 2008 survey. An in-depth study to analyze settlement of the levee system is not included within the scope of this inventory. Geotechnical services can be provided in the future if the City chooses to take this investigation to a more detailed level.

Do current conditions meet accreditation requirements?

YES ☐ ***NO*** ☐ ***UNKNOWN*** ☑

4.1.6 Interior Drainage

FEMA Requirements:

FEMA accreditation requires that an interior drainage analysis be submitted that addresses the sources of flooding, the extent of the flooded area, average depth of the flooding, and the water surface elevation of the base flood. The analysis must be based on the joint probability of both interior and exterior flooding and the capacity of interior facilities for evacuating these interior floodwaters.

Analysis of Current Conditions:

Reach 1 of the Afton Levee contains a 70 acre, primarily wooded, watershed with some residential lots and Hydrologic Soil Group B soils. Storm drainage flows overland to the landward base of the levee and flows via an existing culvert to a low area on the landward side of the levee near station 29+30. A 54-inch CMP gravity outfall was once in place for this drainage but has now been blocked with stop logs and riprap. Currently water ponds near station 27+50 and remains there until it is pumped out or eventually infiltrates into the soil.

A hydrologic analysis reveals that the one year 24-hour event produces an expected runoff volume of 0.6 acre-feet with a peak flow rate of 1.7 cubic feet per second (cfs). The two year 24-hour event produces 1.5 acre-feet of runoff with a peak flow rate of 6.2 cfs. The 100-year 24-hour event produces a runoff volume of 10 acre-feet with a peak flow rate of 60 cfs. With the existing gravity outlet blocked and no gravity outlet in place, the interior ponding elevations for the 100-year event will need to be assessed for FEMA accreditation and the area inundated by this event mapped.

Reach 2 of the Afton Levee contains a 74 acre watershed. It is primarily wooded with Hydrologic Soil Group B, moderately well drained loam. Storm drainage flows overland to the landward base of the levee where it ponds until it can eventually infiltrate. The one year 24-hour event produces 0.5 acre-feet of runoff with a peak flow of 1.2 cfs. The two year 24-hour event produces 1.4 acre-feet of runoff with a peak flow of 4.2 cfs. The 100-year 24-hour event produces a runoff volume of 10 acre-feet with a peak flow rate of 41 cfs. Since there is no existing gravity outlet for this area, the interior ponding elevations for the 100-year event will need to be assessed for FEMA accreditation and the area inundated by this event mapped.

If the accreditation process is pursued, a more in-depth investigation into the interior drainage of the Afton levee system would be required to determine the inundation area, average depth of inundation, and rate of seepage through the levee during periods of high water on the St Croix River.

Do current conditions meet accreditation requirements?

YES ☐ ***NO*** ☐ ***UNKNOWN*** ☑

4.2 Checklist for Operation Plan:

4.2.1 Flood Warning System

FEMA accreditation requires documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials that will be used to trigger emergency operation activities; and demonstration that sufficient flood warning time exists to permit activation of mechanized portions of the drainage systems.

Major recent floods have occurred in 1965, 1969, 1993, 1997, and 2001. A copy of the City's Emergency Operations Plan, dated March 2001, was obtained from the City and reviewed as part of this study. A copy of the City's Emergency Operations Plan has been included in Appendix C of this report. The plan, while not current, appears to include the major items requiring documentation for FEMA accreditation. Including items such as flood emergency early warning system, establishing a Control and Command Center, identifying contact information for individuals included in a Disaster Planning and Response Team, a flood fight plan by level of priority, and a plan for annual inspections and evaluation of the flood protection system.

4.2.2 Plan for Operation of Closures

A formal operation of closures plan must be documented and provided to FEMA to attain accreditation of the levee system. This closure operation plan should include documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists for the completed operation of all closure structures, including necessary sealing, before floodwaters reach the base of the closure. The closure plan must include specific actions and assignments of responsibility by individual name or title and must also include provisions for periodic operation, annually, of the closure structures for testing and training purposes.

The City's Emergency Operations Plan includes a closure operation plan by prioritizing the flood fight efforts and closure requirements into three categories (Low, Intermediate, and High) by expected high water elevation.

A Low Level priority event is characterized by a high water event with actual or projected elevation at or below elevation 684. A Low Level event does not require implementing closure of any of the City's openings through the levee system.

An Intermediate Level priority is defined as a high water event that is expected to reach an actual or projected elevation of 685.40. Again this priority level does not actually require construction of any closures within the City, but does call for obtaining and mobilizing the equipment required should construction of closures be necessary.

A High Level priority is characterized by a high water event in which the actual or projected high water elevation on the St Croix River is expected to exceed elevation 685.40. This priority level involves full implementation of the temporary closure structures along the levee system. Along with a 24-hour watch of the water levels and levee system.

4.2.3 Responsibilities During A Flood Fight

The City's Emergency Operations Plan identifies the responsibilities of individuals by title and name during a flood fight. Based on a review of the individuals identified in the plan, it is apparent that the names and contact information should be reviewed and updated. It also appears that it may be necessary to assign new individuals to roles in which the contact person is no longer with the City or Agency identified in the contact list. To ensure that this contact information is current and updated, should use of it be required during flood fight conditions, the contact information for the Disaster Planning and Response Team should at a minimum be updated annually or if individuals identified on the team are no longer available to the City.

4.3 Checklist for Interior Drainage Plan:

4.3.1 Procedures for Inspection and Operation of Interior Drainage Facilities

Interior drainage systems associated with levee systems include all drainage system items on the landward side of the levee and typically include storage areas, gravity outlets, and pumping stations. FEMA will recognize the levee system as providing protection against the base flood if the following minimum criteria are included in the operation plan for the interior drainage system. Similar to the requirements for the operation of closure devices, documentation of the flood warning system that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists to permit activation of the mechanical portions of the interior drainage system.

The City's Emergency Operation Plan also contains information on inspection and operation of the City's interior drainage facilities. Similar to the closure operation plan, the level of priority and required activities is prioritized into three categories, low, intermediate, and high according to actual or expected high water elevations on the St Croix River. The interior drainage plan should be reviewed with City Staff annually and updated as necessary to reflect existing levee system conditions. Along with reviewing and updating the interior drainage plan, annual implementation of the interior drainage plan should be performed to ensure that current staff is well-versed and proficient in implementing the flood fight system when needed during the time of flood fights.

4.4 Checklist for Maintenance Plan:

4.4.1 Review of Maintenance Activities and Records

Maintenance activities such as mowing and clearing of brush are routinely performed by the City although records of these activities are not kept.

5.0 Items Necessary for Accreditation

Several modifications to the levee system are required to meet the minimum requirements of 44 CFR 65.10 and be eligible for FEMA accreditation on the FIRM. To aid the City in making a determination of whether or not to pursue FEMA accreditation of the levee system, feasibility level cost estimates have been provided for each of the required items. These cost estimates are intended for use in the determination of whether or not the City wishes to pursue accreditation. These costs estimates should be revisited with additional planning effort and detail should the city wish to move forward with accreditation and develop a capital planning strategy for implementation.

Freeboard: For each reach, the entire lengths of the levee tying into high ground at each end must maintain the minimum required top of levee elevation outlined in Table 1. If the levee is modified to meet these minimum elevation requirements, periodic maintenance and inspection should be performed to assure that these elevations are maintained. Additional investigation and analysis is required to determine the construction methods required, and in turn estimated cost, to increase the levee heights to the minimum required elevations for FEMA accreditation. If it is determined that the entire levee does not require reconstruction, the cost to raise the Reach 1 and Reach 2 levees to the minimum required elevation is approximately $100,000. If the levees require complete reconstruction to meet the minimum freeboard requirements the estimated cost is likely to approach $800,000 or more.

Closures: In Reach 1, if the 54" CMP is no longer serviceable, it must be open cut and removed, or sealed at each end and filled with a grout material to retain permanent closure and minimize seepage potential. The estimated cost to perform this is approximately $15,000. Structural closure systems at 32nd Street South and the 33rd Street sidewalk must be designed and constructed. The recommended closure type for these openings is a stoplog closure system, which consists of lengths of concrete wall on each side of the opening with a sill plate across the opening and aluminum or steel stop log panels to seal the opening during floods. Closure systems of this size and type typically cost in the range of $250,000 or more. A more economical solution to providing a closure at the 33rd Street sidewalk is to fill the existing opening and allow for the sidewalk to cross over the top of the levee system.

To avoid the requirement for design and construction of a structural closure structure between Reaches 1 and 2, at No Name Creek, permanent tie-back levees must be constructed on each side of the creek extending to high ground near St Croix Trail. Construction of tie-back levees on both the Reach 1 and Reach 2 levees would likely cost in the range of $130,000.

The PVC pumping outlets require raising to pass through the levee freeboard and if not elevated to above the top of levee they require redundant closure systems. If the pumping outlets are modified in the future, it is recommended that the PVC material be replaced with a more resilient, durable material such as ductile iron pipe. The estimated cost to replace the existing outlets with ductile iron pipe and flap gates would likely cost in the range of $30,000.

Embankment Protection: Periodic maintenance and inspection shall be completed to assure that vegetation along the levee embankment remains adequate to protect the levee during a flood. Areas of scour or erosion must be repaired in a timely manner to assure the levee integrity is maintained. Existing USACE guidelines, which FEMA adheres to, require all vegetation, except grasses, be removed in the area within 15 feet of the levee toe on both the landward and riverward sides. Both levee reaches contain woody vegetation within this area and additional tree removal is required as part of the FEMA accreditation process. The additional tree clearing and grubbing required to meet the FEMA accreditation criteria on the Reach 1 and Reach 2 levees is estimated at $15,000.

An existing ponding area has been excavated on the landward side of the levee in Reach 1 in the vicinity of the temporary pumping area. Without more in-depth geotechnical investigation, the impacts of this pond on levee integrity cannot be verified; therefore this ponding area should be filled and eliminated. Filling and eliminating the ponding area is likely to cost in the range of $5,000 to complete.

Embankment and Foundation Stability Analyses/Settlement Analyses: Further geo-technical investigations are required to evaluate the stability of the levee and the potential for settlement. The investigation will need to include additional soil borings, the collection of soil samples for laboratory strength and compression testing, and numerical analyses to evaluate the stability of the levee and the magnitude of any future settlements. In addition, evaluating the compaction level of the soils in the existing levee will require the collection of soil samples to measure the in-situ density which will then need to be compared to the results of laboratory compaction tests performed on the same soils. The estimated cost for the required additional geotechnical investigations for accreditation is approximately $50,000.

It is likely that all residential and commercial septic drain fields along both reaches of the levee will require removal as part of the FEMA accreditation process. These drain fields increase the potential for seepage out the landward face of the levee, potentially resulting in seepage conditions that can destabilize the levee during flooding conditions. The widening of the levee in Reach 1 reduced the potential impacts of the drain fields along that reach, but seepage resulting from their presence is still possible. Estimated costs to remove and relocate the existing septic drain fields is approximately $20,000 for each septic system, which does not include the cost to obtain additional property on which to locate the new drain fields.

Interior Drainage: Detailed documentation of the interior drainage analysis is required to pursue FEMA accreditation. Based on the preliminary findings of this levee accreditation inventory, both Reach 1 and Reach 2 levees should be provided with gravity outlet structures.

In Reach 1, incorporation of a 42" Reinforced Concrete Pipe (RCP) with redundant closure system consisting of a slide gate at the levee and a flap closure riverward of the levee should be installed in this area to transfer the gravity drainage to the riverward side of the levee. At times when the river is high, preventing gravity drainage, a 3,000 gallon per minute (gpm) pump

would accommodate a two year storm event and minimize interior floodwaters. The estimated cost to construct this interior drainage system is $85,000, which assumes no permanent storm water pump station will be constructed and pumps will be rented during times of flooding.

For Reach 2, a 36" RCP with redundant closure system similar to that outlined above for Reach 1 should be incorporated into the levee system. The estimated cost for construction of this system is $70,000. During times when the level of the St Croix River prevents drainage via gravity, a 2,000 gpm pump would be sufficient to accommodate a two year storm event and minimize interior floodwaters. Similar to Reach 1, in this situation, the most economical means handle interior flood waters during high water events is to rent a portable pump, in lieu of constructing a permanent storm water pump station.

Operation and Interior Drainage Plans: The City has addressed these plans as part of the Emergency Operations Plan. This plan should be reviewed with City Staff annually and updated as necessary to incorporate current emergency contact information and reflect existing levee system conditions. It is estimated that $5,000, would be necessary to bring the existing Emergency Operations Plan up to date and an additional $5,000 annually should be dedicated to assuring these plans are maintained and kept up to date to make sure they can be relied upon during flood fights.

Maintenance Plan: A maintenance plan shall be developed and adopted detailing that an agency of Afton assumes ultimate responsibility for levee maintenance. The plan must document that maintenance procedures are to be followed that ensures the size and integrity of the levee system is maintained. The plan must specify maintenance activities and their frequencies as well as the title of the person responsible for them. It is estimated that $5,000 would be sufficient to develop a maintenance plan for the City's levee system.

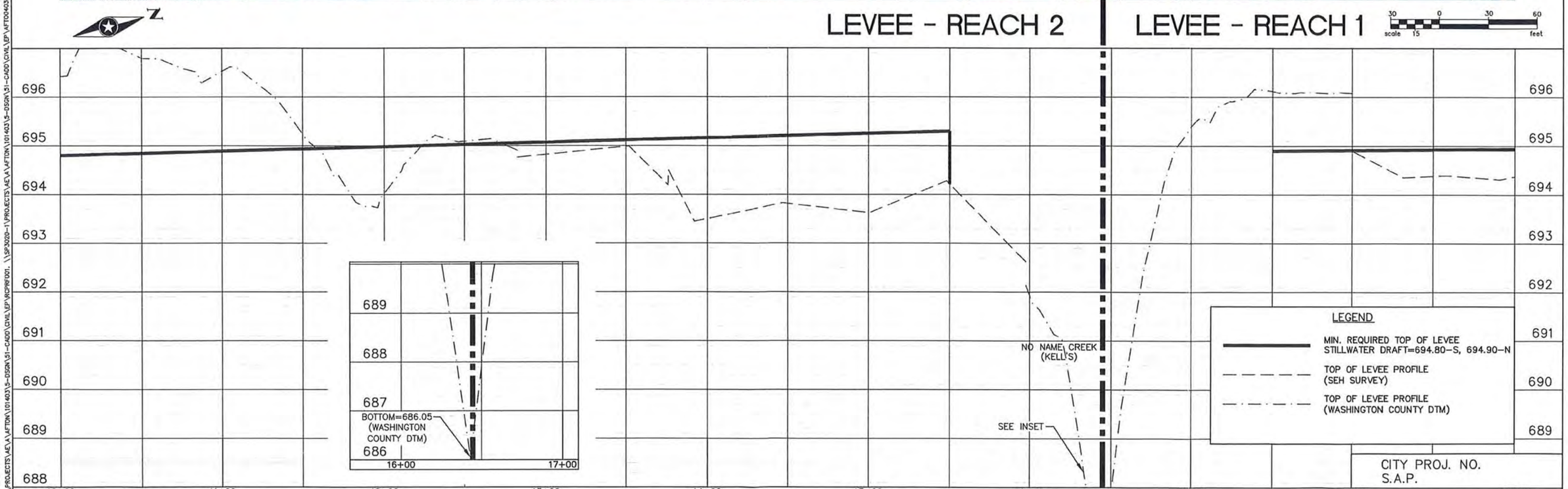
To avoid future encroachments into the levee and allow for adequate future levee maintenance, a permanent easement should be obtained along the levee to a point a minimum of 15-feet horizontal from the levee toe or any other features related to the levee system.

Even if FEMA accreditation is not pursued, it is recommended that levee easements be obtained to allow for future maintenance activities by the City to assure future levee integrity is not compromised.

General: All data submitted must be certified by a Professional Engineer or Federal agency. Certified as-built plans must be included in the submittal.

List of Figures

Figure 1 – Top of Levee Profile (10+00 to 19+00)
Figure 2 – Top of Levee Profile (18+00 to 27+00)
Figure 3 – Top of Levee Profile (26+00 to 35+00)
Figure 4 – Top of Levee Profile (34+00 to 43+00)
Figure 5 – Levee Sections



DRAWN BY: CMR				
DESIGNER: X				
CHECKED BY: X				
DESIGN TEAM	NO.	BY	DATE	REVISIONS

©SHORT ELLIOTT HENDRICKSON 1998. ANY USE OR REUSE OF THIS PLAN/DRAWING AND THE CORRESPONDING COMPUTER AIDED DESIGN/DRAFTING FILES WITHOUT THE EXPRESS WRITTEN CONSENT OF SEH, IS PROHIBITED. SEH SHALL NOT BE RESPONSIBLE FOR ANY UNAUTHORIZED USE OR REUSE OF THESE MATERIALS, OR DAMAGES RESULTING THEREFROM.

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Name , P.E.

Date: XX/XX/XX Lic. No. XXXXX

SEH
PHONE: (651) 490-2000
3535 VADNAIS CENTER DR
ST. PAUL, MN 55110

AFTON, MINNESOTA

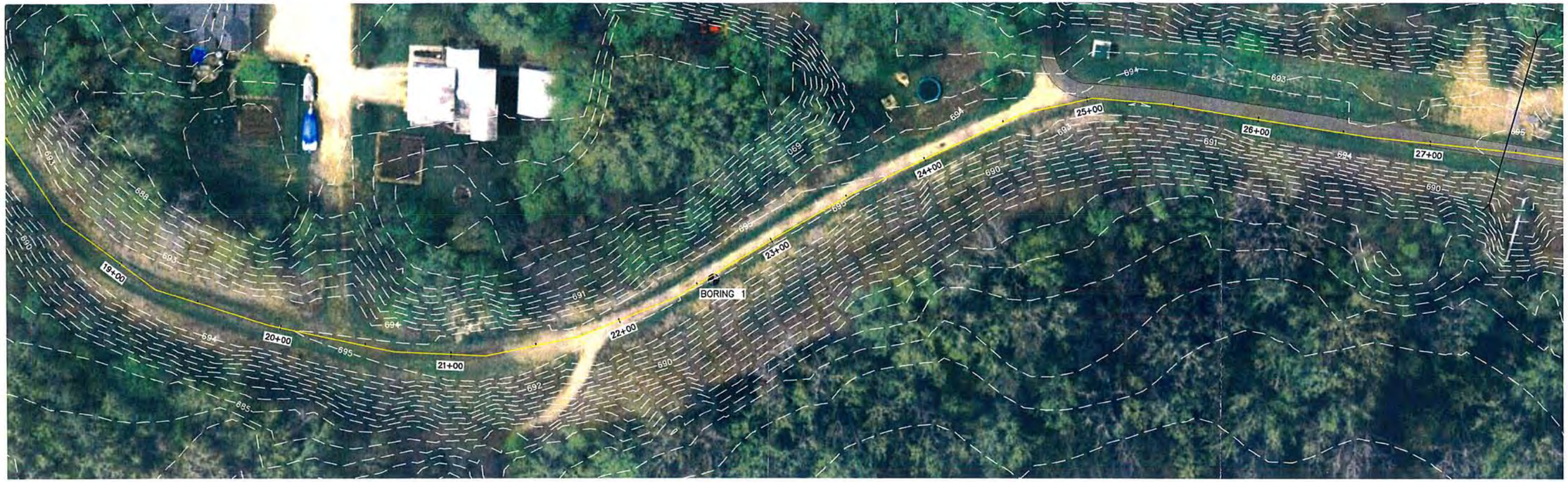
TOP OF LEVEE PROFILE
AFTON LEVEE
FEMA ACCREDITATION INVENTORY

FILE NO. AFTON101403

DATE 5-29-08

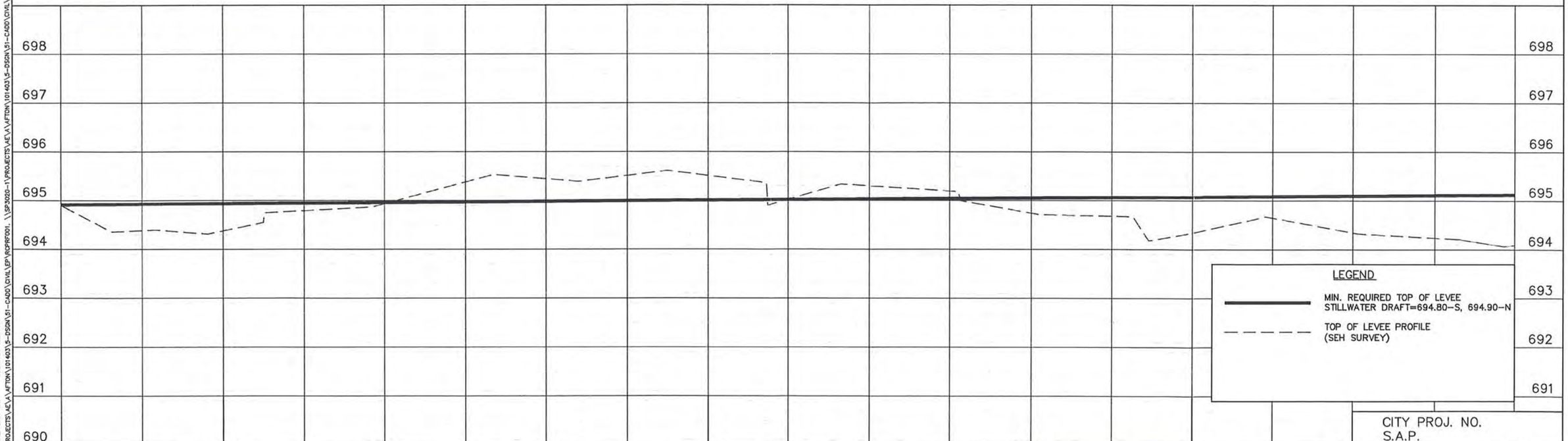
1 / 5

S:\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\RCP01001.DWG
DATE: 07-31-08 TIME: 5:51 am USER: DSPIELMANN
XREFS: \\SP3020-1\PROJECTS\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\RCPRF001, \\SP3020-1\PROJECTS\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\AFTON4038A,
PLOTTED: 10-08-08 @ 11:35 AM



LEVEE - REACH 1

scale 30 0 30 60 feet 15



CITY PROJ. NO.
S.A.P.

DRAWN BY: CMR
DESIGNER: X
CHECKED BY: X
DESIGN TEAM

NO.	BY	DATE	REVISIONS

©SHORT ELLIOTT HENDRICKSON 1998. ANY USE OR REUSE OF THIS PLAN/DRAWING AND THE CORRESPONDING COMPUTER AIDED DESIGN/DRAFTING FILES WITHOUT THE EXPRESS WRITTEN CONSENT OF SEH, IS PROHIBITED. SEH SHALL NOT BE RESPONSIBLE FOR ANY UNAUTHORIZED USE OR REUSE OF THESE MATERIALS, OR DAMAGES RESULTING THEREFROM.

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Name , P.E.
Date: XX/XX/XX Lic. No. XXXXX

SEH
PHONE: (651) 490-2000
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110

AFTON, MINNESOTA

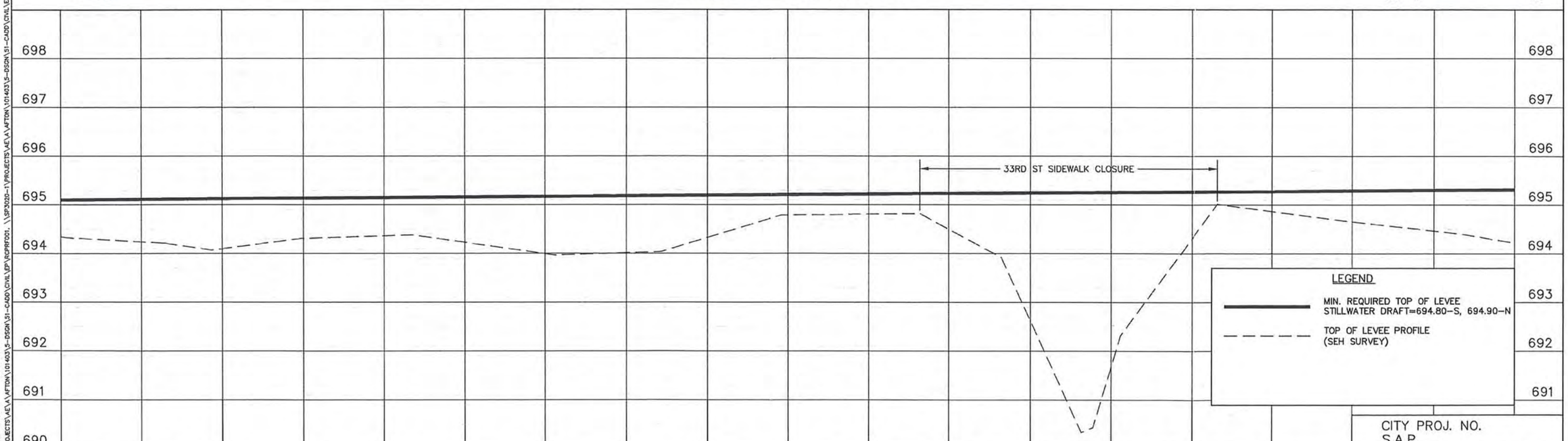
TOP OF LEVEE PROFILE
AFTON LEVEE
FEMA ACCREDITATION INVENTORY

FILE NO. AFTON101403
DATE 05-29-08
2 / 5

PLOTTED: 10-08-08 @ 11:37 AM
S:\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\RCP02001.DWG
DATE: 07-31-08 TIME: 5:51 am USER: DSPIELMANN
XREFS: \\SP3020-1\PROJECTS\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\RCPRF001, \\SP3020-1\PROJECTS\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\AFT004038A,

LEVEE - REACH 1

scale 30 0 30 60 feet (1:15)



CITY PROJ. NO.
S.A.P.

DESIGN TEAM		NO.	BY	DATE	REVISIONS
DRAWN BY:	CMR				
DESIGNER:	X				
CHECKED BY:	X				

©SHORT ELLIOTT HENDRICKSON 1998. ANY USE OR REUSE OF THIS PLAN/DRAWING AND THE CORRESPONDING COMPUTER AIDED DESIGN/DRAFTING FILES WITHOUT THE EXPRESS WRITTEN CONSENT OF SEH, IS PROHIBITED. SEH SHALL NOT BE RESPONSIBLE FOR ANY UNAUTHORIZED USE OR REUSE OF THESE MATERIALS, OR DAMAGES RESULTING THEREFROM.

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Name , P.E.
Date: XX/XX/XX Lic. No. XXXXX

SEH
PHONE: (651) 490-2000
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110

AFTON, MINNESOTA

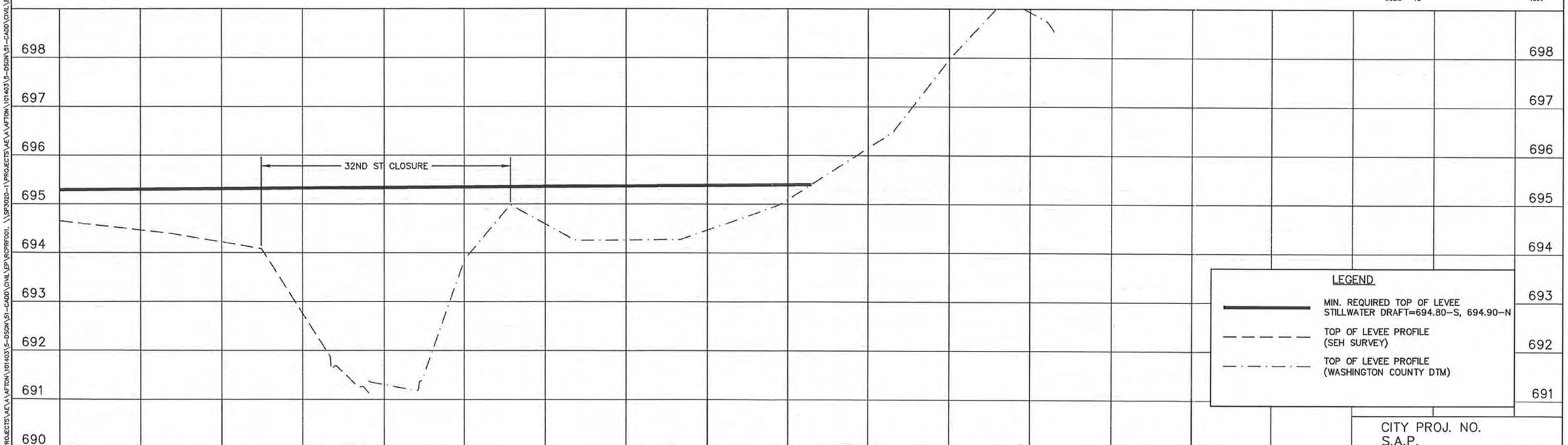
TOP OF LEVEE PROFILE
AFTON LEVEE
FEMA ACCREDITATION INVENTORY

FILE NO. AFTON101403
DATE 5-29-08
3 / 5

S:\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\RCP03001.DWG
DATE: 07-31-08 TIME: 5:52 am USER: DSPIELMANN
XREFS: \\SP3020-1\PROJECTS\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\RCPRF001, \\SP3020-1\PROJECTS\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\AFT0040384,
PLOTTED: 10-08-08 @ 11:38 AM

LEVEE - REACH 1

scale 30 0 30 60 feet (15)



CITY PROJ. NO.
S.A.P.

DRAWN BY: CMR
DESIGNER: X
CHECKED BY: X
DESIGN TEAM

NO.	BY	DATE	REVISIONS

©SHORT ELLIOTT HENDRICKSON 1998. ANY USE OR REUSE OF THIS PLAN/DRAWING AND THE CORRESPONDING COMPUTER AIDED DESIGN/DRAFTING FILES WITHOUT THE EXPRESS WRITTEN CONSENT OF SEH, IS PROHIBITED. SEH SHALL NOT BE RESPONSIBLE FOR ANY UNAUTHORIZED USE OR REUSE OF THESE MATERIALS, OR DAMAGES RESULTING THEREFROM.

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Name , P.E.
Date: XX/XX/XX Lic. No. XXXXX

SEH
PHONE: (651) 490-2000
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110

AFTON, MINNESOTA

TOP OF LEVEE PROFILE
AFTON LEVEE
FEMA ACCREDITATION INVENTORY

FILE NO. AFTON101403
DATE 5-29-08
4 / 5

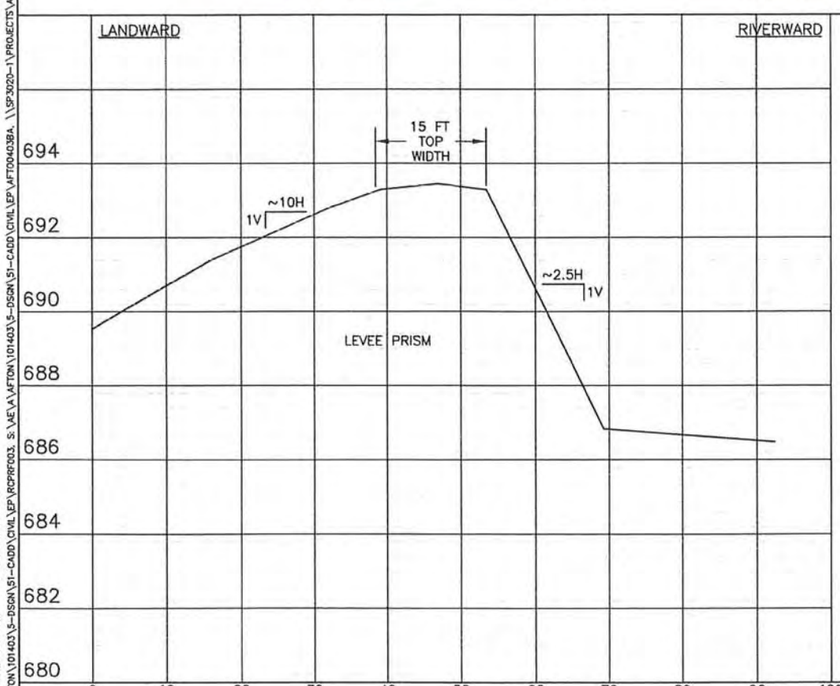
PLOTTED: 10-08-08 @ 11:40 AM
S:\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\RCPR04001.DWG
DATE: 07-31-08 TIME: 5:53 am USER: DSPIELMANN
XREFS: \\SP3020-1\PROJECTS\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\RCPRF001, \\SP3020-1\PROJECTS\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\AFT004038A.

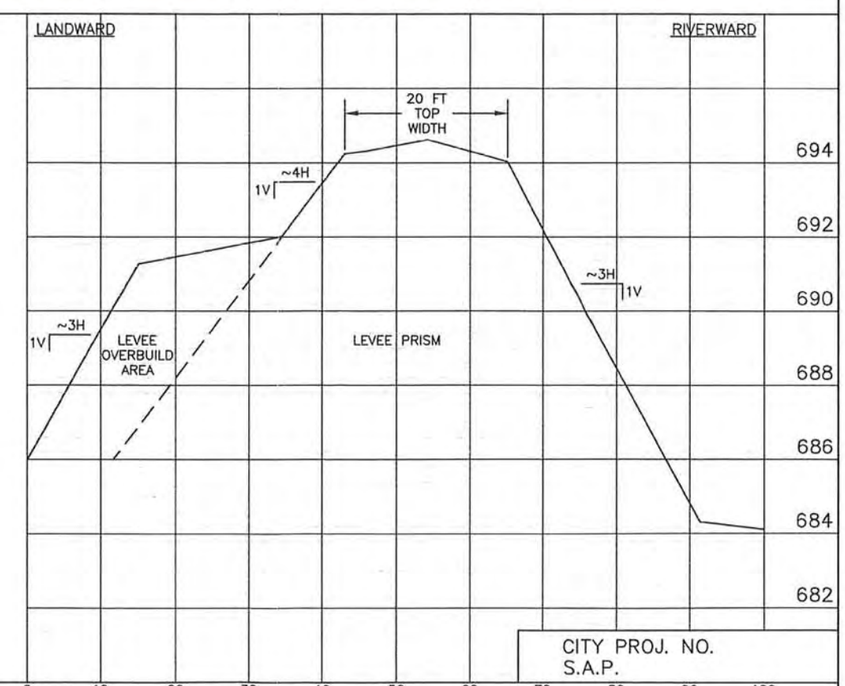
LEVEE - REACH 2

scale 15 — 30 0 30 60 feet

LEVEE - REACH 1

scale 15 — 30 0 30 60 feet





CITY PROJ. NO.
S.A.P.

DRAWN BY: CMR			
DESIGNER: X			
CHECKED BY: X			
DESIGN TEAM	NO.	BY	DATE	REVISIONS

©SHORT ELLIOTT HENDRICKSON 1998. ANY USE OR REUSE OF THIS PLAN/DRAWING AND THE CORRESPONDING COMPUTER AIDED DESIGN/DRAFTING FILES WITHOUT THE EXPRESS WRITTEN CONSENT OF SEH, IS PROHIBITED. SEH SHALL NOT BE RESPONSIBLE FOR ANY UNAUTHORIZED USE OR REUSE OF THESE MATERIALS, OR DAMAGES RESULTING THEREFROM.

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Name , P.E.

Date: XX/XX/XX Lic. No. XXXXX

SEH
PHONE: (651) 490-2000
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110

AFTON, MINNESOTA

LEVEE SECTIONS
AFTON LEVEE
FEMA ACCREDITATION INVENTORY

FILE NO. AFTON101403

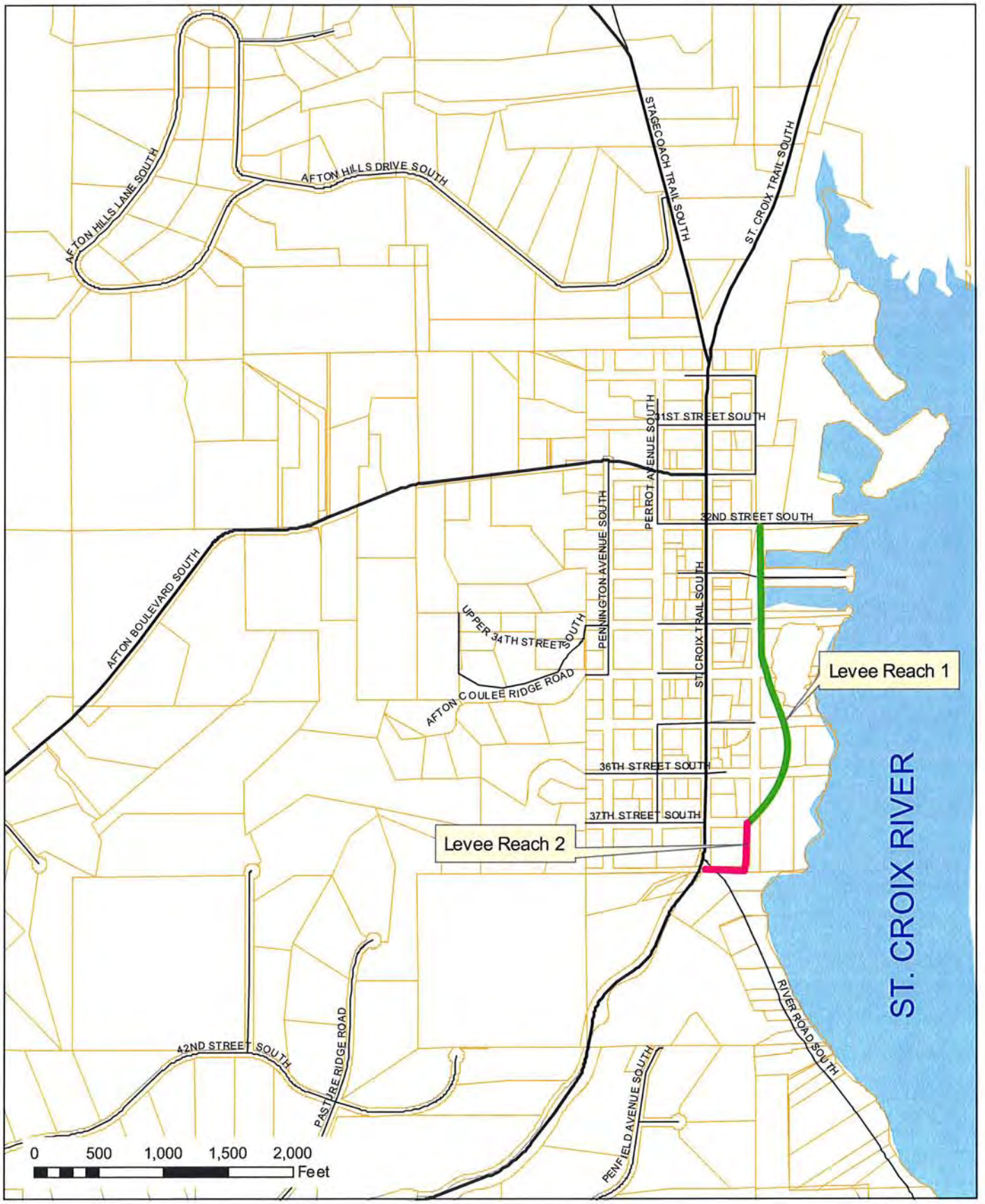
DATE 5-29-08

5 / 5

S:\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\XSECS.DWG
DATE: 07-31-08 TIME: 6:07 am USER: DSPIELMANN
XREFS: S:\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\RCPRF003, S:\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\AFT0040398A, \\SP3020-1\PROJECTS\AE\A\AFTON\101403\5-DSGN\51-CADD\CIVIL\EP\RCPRF002
PLOTTED: 10-08-08 @ 11:41 AM

Appendix A

Site Location Map



SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

FILE NO.
AFTON 101403

DATE:
08/07/2008

PROJECT LOCATION MAP

Afton, Minnesota

Map Document: (S:\AE\A\Afton\Common\Floodplain_management\PLeveeLocation.mxd)
08/07/2008 -- 4:40:55 PM

Appendix B

Soil Boring Logs

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
• ENVIRONMENTAL
• GEOTECHNICAL
• MATERIALS
• FORENSICS

REPORT OF SUBSURFACE BORINGS

PROJECT:
AFTON LEVEE EVALUATION
AFTON, MINNESOTA

REPORTED TO:
SEH
3535 VADNAIS CENTER DRIVE
ST. PAUL, MN 55110

AET JOB NO.: 01-04004

ATTN: BRIAN ALBRECHT

DATE: APRIL 23, 2008

INTRODUCTION

On April 3, 2008, American Engineering Testing drilled 2 test borings for the referenced project. The scope of services (boring, location, depth, etc.) was as requested by SEH.

AUTHORIZED WORK SCOPE

Soil Borings

Procedures

The boring locations were made at the approximate locations staked by SEH.

We have not included a sketch indicating the boring locations or ground surface elevations at the boring locations as it is our understanding this information will be supplied by others.

The boring and sampling was done using the split-spoon and auger methods. Refer to the attached sheets (Field Sampling and Testing Methods) for additional information.

Boreholes were backfilled with bentonite grout.

A field log was maintained for each soil boring. Information on field logs include: contacts between soil layers; geologic identification (driller's opinion) of materials; notes; and other information.

This document shall not be reproduced, except in full, without written approval of American Engineering Testing, Inc.
550 Cleveland Avenue North • St. Paul, MN 55114
Phone 651-659-9001 • Toll Free 800-972-6364 • Fax 651-659-1379 • www.amengtest.com
Offices throughout Florida, Minnesota, South Dakota & Wisconsin
AN AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY EMPLOYER

Soil samples were then examined in the laboratory, and soil classification information was added to the field logs. Soil identifications and descriptions are in accordance (generally) with the ASTM Visual-Manual (D2488) system as shown on the attached sheet. The samples will be discarded or returned to the Client at AET's discretion; unless within 30 days' of the report date, the client provides a written request that AET store or ship the samples, at the client's expense.

Typed logs were then prepared from field logs. The typed logs may not contain all information shown on field logs. (Field logs are available for inspection by our client.)

Results

Typed copies of the field logs are enclosed. Refer to the attached logs for a description of the subsurface conditions encountered in the borings. The logs show: the depths to the contacts between the soil layers; the identification and geology of the soils; water level measurements; standard penetration resistance (N-column); the results of the laboratory tests; and other information. We wish to point out that the split spoon samples were collected using a modified hammer weight calibrated to N_{60} values. For an explanation of this sampling method please refer to the attached Exploration/Classification Method sheet. Please refer to the other attached sheets for descriptions of terminology used on the logs.

Laboratory Tests

Atterberg limits and sieve analysis tests were performed on samples selected by SEH. The results of the tests are presented on the attached logs and gradation curves.

REMARKS

Subsurface soil and ground water conditions can vary from that encountered in the borings at other locations, depths and times. Refer to the attached sheet for more information regarding limitations of subsurface exploration.

As requested by SEH, this is a factual report only.

To protect the addressee, the public, and ourselves, this report (and all supporting information) is provided for the addressee's own use. No representations are made to parties other than the addressee.

American Engineering Testing, Inc. appreciates this opportunity to be of service to you. If you have any questions or need further help, please call me at (651) 659-1356.

Report Prepared By:

American Engineering Testing, Inc.

Pat Francis

Pat Francis
Drilling Manager

Attachments:

- Exploration/Classification Methods
- Subsurface Exploration
- Boring Logs
- Gradation Curves

EXPLORATION/CLASSIFICATION METHODS

SAMPLING METHODS

Split-Spoon Samples (SS) - Calibrated to N_{60} Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM:D1586 with one primary modification. The ASTM test method consists of driving a 2" O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30". The sampler is driven a total of 18" into the soil. After an initial set of 6", the number of hammer blows to drive the sampler the final 12" is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of it's potential energy due to the friction inherent in this system. This converted energy then provides what is known as an N_{60} blow count.

Most of today's drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional N_{60} values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30". The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviation of the N-values using this method are significantly better than the standard ASTM Method.

Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as "DS" or "SU" on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

CLASSIFICATION METHODS

Soil classifications shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM:D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM:D2487 are possible. Otherwise, soil classifications shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USC system, the descriptive terminology, and the symbols used on the boring logs.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

WATER LEVEL MEASUREMENTS

The ground water level measurements are shown at the bottom of the boring logs. The following information appears under "Water Level Measurements" on the logs:

- Date and Time of measurement
- Sampled Depth: lowest depth of soil sampling at the time of measurement
- Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- Cave-in Depth: depth at which measuring tape stops in the borehole
- Water Level: depth in the borehole where free water is encountered
- Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

SUBSURFACE BORING SUPPLEMENT TO TERMS AND CONDITIONS

SECTION 1 - UNDERGROUND UTILITY AND STRUCTURE CLEARANCE

1.1 - It is necessary that borings, excavations and other penetrations be located such that they maintain a minimum safe distance from underground utilities or other man-made objects. Client shall advise AET of all utilities that service or are located on the site, as well as any underground improvements located on the site. AET will contact state notification centers, where available, or individual utility owners where a state notification center is not available prior to drilling.

1.2 - Public utility owners may not provide the locating service on private property. In such situations, the Client is responsible for location of such utilities prior to drilling.

1.3 - The property owner may have private underground improvements which cannot be cleared through the state notification center or public utility owners. The Client is responsible for location of these improvements.

1.4 - AET will not be responsible for any damages to "non-located" or incorrectly located underground utilities or other man-made improvements.

SECTION 2 - SITE RESTORATION

2.1 - Client accepts that in the normal course of field exploration work, certain types of damage to the site may occur which are inherent with this type of work, such as tire indentations to lawns and landscape areas. It is the responsibility of AET to take reasonable precautions to minimize such damage. It is also AET's responsibility to patch boreholes placed through pavement or slab areas after performance of borings. Otherwise, restoration of the site is the responsibility of the client.

SECTION 3 - CONTAMINATION

3.1 - Client acknowledges and accepts that unavoidable contamination risks may be associated with AET's subsurface drilling, sampling and installation of monitoring devices. Risks include, but are not limited to, cross contamination created by linking contaminated zones to uncontaminated zones during the drilling process; containment and proper disposal of known or suspected hazardous materials, drill cuttings and drill fluids; and decontamination of equipment and disposal and replacement of contaminated consumables. Client and AET agree that the discovery of unanticipated actual or suspected hazardous materials may make it necessary for AET to take immediate measures, including regulatory notification, to protect human health and safety, and/or the environment. Client and AET also agree that the discovery of such materials constitutes a changed condition which may result in added costs to the Client, and may require a renegotiation of work scope or termination of services.

3.2 - Pursuant to risks set forth in Section 3.1, which are inherent with AET's work performed on the Client's behalf, Client agrees to hold harmless and indemnify AET from and against liability associated with contamination resulting therefrom.

SECTION 4 - LOST EQUIPMENT

Equipment lost in bore holes may be required to be retrieved or properly abandoned by government agencies. Client agrees to pay AET all costs related to retrieving and/or abandoning such equipment at AET fee schedule rates, unless agreed otherwise.

SECTION 5 - LIMITATIONS OF SUBSURFACE EXPLORATION

Client recognizes that unavoidable risks occur whenever engineering or related disciplines are applied to identify subsurface conditions. Variations in soil conditions usually occur between and beyond sampled/tested locations. Even a comprehensive sampling and testing program performed in accordance with a professional standard of care may fail to detect certain conditions, because the variability of conditions cannot be seen. For similar reasons, actual environmental, geologic and geotechnical conditions that AET characterizes to exist between sampling points may differ significantly from those that actually exist. The passage of time also must be considered, and Client recognizes that, due to natural occurrences or direct or indirect human activities at the site or distant from it, actual conditions discovered may change. Client recognizes that nothing can be done to eliminate the risks associated with these limitations.

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: 01-04004 LOG OF BORING NO. 1 (p. 1 of 1)

PROJECT: Afton Levee Evaluation; Afton, MN

SURFACE ELEVATION: 695.06

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
1	FILL, mixture of clayey sand, lean clay, sand, and crushed limestone, dark brown and brown	FILL	18	M	SS	17	18				
2	FILL, mostly sand, brown						19				
3	FILL, mostly lean clay, trace roots, black		6	M	SS	13					
4	FILL, mixture of sand and lean clay, trace roots, brown, a little dark brown										
5	FILL, mixture of sand with silt and sand, a little to with gravel, brown, a little dark brown, few lenses of silty sand about 13'		30	M	SS	14					
6											
7											
8			25	M	SS	13					6
9											
10			64	M	SS	9					
11											
12											
13			35	M	SS	15					
14											
15			16	M	SS	15					
16	FILL, mostly silty sand, trace roots, dark brown										
17	CLAYEY SAND, dark brown, firm (SC)	MIXED ALLUVIUM									
18			5	M	SS	17	19				
19				▼							
20	SILTY SAND WITH GRAVEL, fine to medium grained, brown, wet, medium dense (SM)	COARSE ALLUVIUM	14	W	SS	3					
21											
22	SAND, a little gravel, fine to medium grained, brown, waterbearing, medium dense (SP)										
23			19	W	SS	2					
24											
25			11	W	SS	16					
26	**END OF BORING**										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-24½' 3.25" HSA	4/3/08	10:07	21.0	19.5	20.0	None	19.1
	4/3/08	10:30	26.0	24.5	22.4	None	20.2
BORING COMPLETED: 4/3/08							
DR: SD LG: SG Rig: 69C							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/04

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: 01-04004 LOG OF BORING NO. 2 (p. 1 of 1)

PROJECT: Afton Levee Evaluation; Afton, MN

SURFACE ELEVATION: 694.82

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
1	FILL, mostly silty sand, a little gravel, dark brown	FILL	11	M	SS	17					
2–3	FILL, mostly sand with silt, a little gravel, brown		15	M	SS	13					
4–5	FILL, mostly silty sand with gravel, brown		20	M	SS	16					18
6–8	FILL, mostly silty sand, a little silt, brown, a little dark brown		9	M	SS	14					31
9–11	SILTY CLAY, trace roots, dark brown and brown, stiff (CL-ML) (possible fill)	FINE ALLUVIUM OR FILL	9	M	SS	15	16		22	16	
12–14	SILT WITH SAND, trace roots, dark brown and brown, moist, loose (ML) (possible fill)		7	M	SS	16	16				
15–16			7	M	SS	13	13		NP	NP	
17–19	SILTY SAND, a little gravel, fine grained, light brown, moist to about 19', then wet, loose, lense of silt about 18' (SM)	COARSE ALLUVIUM	9	M	SS	13					
20–21			10	W	SS	5					
22–23	SILT WITH SAND, brown, wet, very loose (ML)	FINE ALLUVIUM	1	W	SS	18	27				
24–25	SILTY SAND, fine grained, brown, wet, very loose (SM)	COARSE ALLUVIUM	1	W	SS	6					
26	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-24½'	3.25" HSA

BORING COMPLETED: 4/3/08

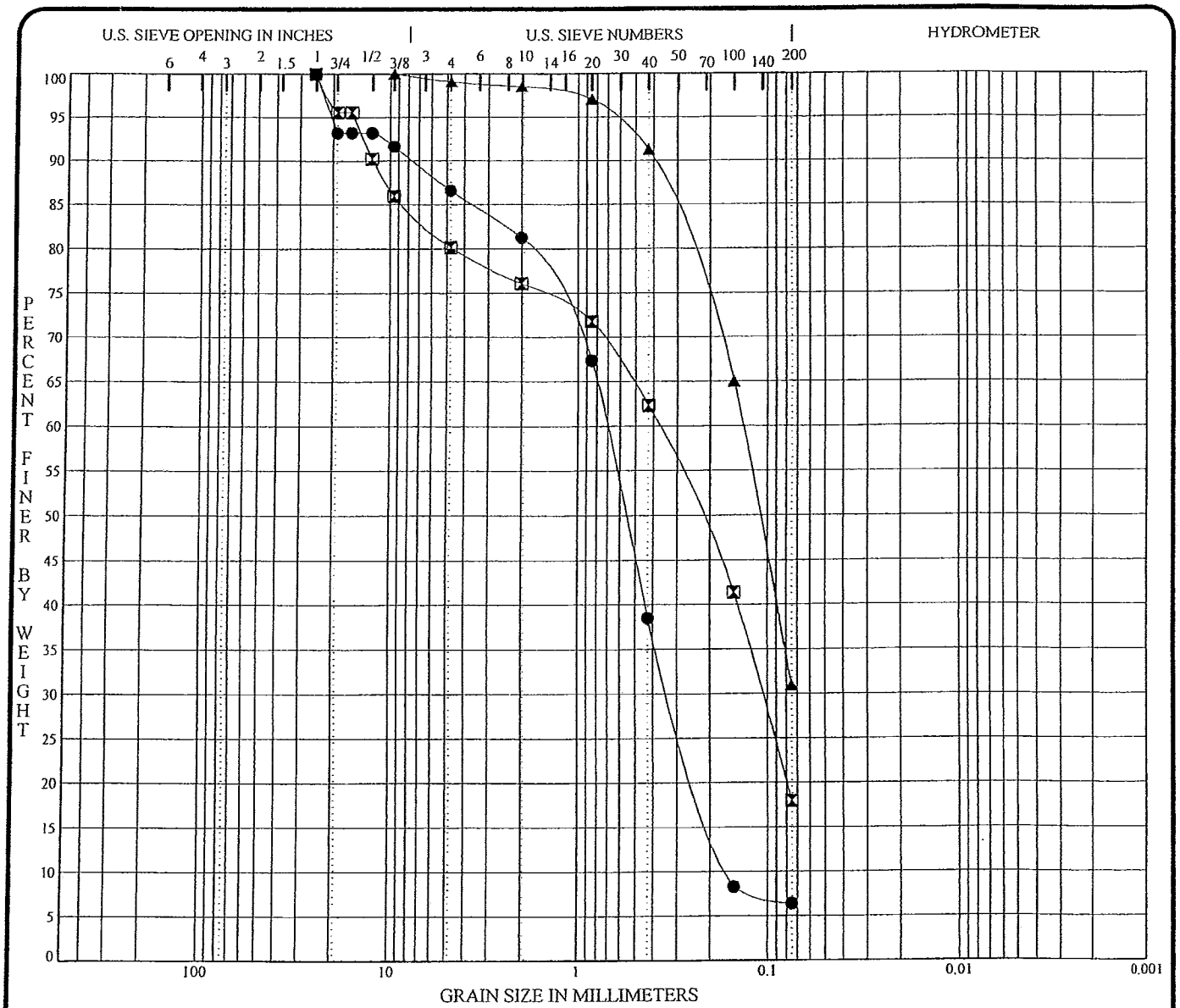
DR: SD LG: SG Rig: 69C

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
4/3/08	11:18	18.5	17.0	18.5	None	Wet
4/3/08	11:23	21.0	19.5	19.9	None	18.9
4/3/08	11:30	26.0	24.5	23.3	None	21.3

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/04



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	1	7.8'						0.89	4.5
⊠	2	5.3'							
▲	2	7.8'							

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	1	7.8'	25.00	0.71	0.317	0.1593	13.4	80.2	6.4	
⊠	2	5.3'	25.00	0.38	0.107		19.8	62.2	17.9	
▲	2	7.8'	9.50	0.14			0.9	68.1	31.0	

PROJECT **Afton Levee; Afton, MN**

AET JOB NO. **01-04004**
DATE **4/3/08**

AMERICAN ENGINEERING TESTING, INC.

GRADATION CURVES

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING SEALING RECORD

Minnesota Statutes, Chapter 103I

Minnesota Well and Boring Sealing No.
Minnesota Unique Well No. or W-series No.
(Leave blank if not known)

H 269208

WELL OR BORING LOCATION

County Name: WASHINGTON

Township Name	Township No.	Range No.	Section No.	Fraction (sm. → lg.)
	28	20	22	SE SE NE

Date Sealed: 4/3/08

Date Well or Boring Constructed: 4/3/08

GPS LOCATION: Latitude_____ degrees_____ minutes_____ seconds
Longitude_____ degrees_____ minutes_____ seconds

Depth Before Sealing: 26 ft.

Original Depth: 26 ft.

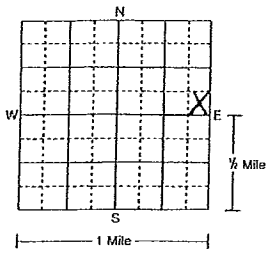
Numerical Street Address or Fire Number and City of Well or Boring Location
EAST OF ST. CROIX TRAIL SO BETWEEN 35TH & UPPER 34TH AFTON, MN

AQUIFER(S): [X] Single Aquifer [ ] Multiaquifer

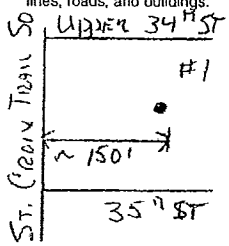
WELL/BORING: [ ] Water-Supply Well [ ] Monit. Well [X] Env. Bore Hole [ ] Other

STATIC WATER LEVEL: [X] Measured [ ] Estimated Date Measured 4/3/08
19.1 ft. [X] below [ ] above land surface

Show exact location of well or boring in section grid with "X."



Sketch map of well or boring location, showing property lines, roads, and buildings.



CASING TYPE(S): TEMPORARY
[ ] Steel [ ] Plastic [ ] Tile [X] Other 3 1/4" HOLLOW STEM AUGER

WELLHEAD COMPLETION N/A

Outside: [ ] Well House [ ] At Grade [ ] Pitless Adapter/Unit [ ] Buried [ ] Well Pit [ ] Other

Inside: [ ] Basement Offset [ ] Well Pit [ ] Buried [ ] Other

PROPERTY OWNER'S NAME/COMPANY NAME
CITY OF AFTON

Property owner's mailing address if different than well location address indicated above
3033 ST. CROIX TRAIL SO
P.O. BOX 219
AFTON, MN. 55001-0219
ATTN: JOHN PAROTTI CITY ENGINEER

CASING(S) TEMPORARY

Diameter	Depth	Set in oversize hole?	Annular space initially grouted
3 1/4 in. from 0	to 26 ft.	[ ] Yes [X] No	[ ] Yes [X] No
____ in. from ____	to ____ ft.	[ ] Yes [ ] No	[ ] Yes [ ] No
____ in. from ____	to ____ ft.	[ ] Yes [ ] No	[ ] Yes [ ] No

WELL OWNER'S NAME/COMPANY NAME
CITY OF AFTON

Well owner's mailing address if different than property owner's address indicated above

SCREEN/OPEN HOLE N/A

Screen from ____ to ____ ft. Open Hole from ____ to ____ ft.

OBSTRUCTIONS
[ ] Rods/Drop Pipe [ ] Check Valve(s) [ ] Debris [ ] Fill [X] No Obstruction

Type of Obstructions (Describe)

Obstructions removed? [ ] Yes [ ] No Describe

GEOLOGICAL MATERIAL	COLOR	HARDNESS OR FORMATION	FROM	TO
If not known, indicate estimated formation log from nearby well or boring.				
FILL CLAYEY SAND	DARK BROWN		0	½
FILL SAND	BROWN		½	1
FILL LEAN CLAY	BLACK		1	2
FILL SAND	~~SAND~~ BROWN		2	4
FILL SAND W/ SILT	BROWN		4	15½
FILL SILTY SAND	DK BROWN		15½	16½
CLAYEY SAND	DK BROWN	FIRM	16½	19
SILTY SAND	BROWN	MED DENSE	19	21½
SAND	BROWN	MED DENSE	21½	26

PUMP
Type
[ ] Removed [X] Not Present [ ] Other

METHOD USED TO SEAL ANNULAR SPACE BETWEEN 2 CASINGS, OR CASING AND BORE HOLE:
[X] No Annular Space Exists [ ] Annular Space Grouted with Tremie Pipe [ ] Casing Perforation/Reme
____ in. from ____ to ____ ft. [ ] Perforated [ ] Re
____ in. from ____ to ____ ft. [ ] Perforated [ ] Re
Type of Perforator
[ ] Other

GROUTING MATERIAL(S) (One bag of cement = 94 lbs., one bag of bentonite = 50 lbs.)
Grouting Material BENTONITE GROUT from 0 to 26 ft. ____ yards 1
____ from ____ to ____ ft. ____ yards
____ from ____ to ____ ft. ____ yards

REMARKS, SOURCE OF DATA, DIFFICULTIES IN SEALING
AET 01-04004

OTHER WELLS AND BORINGS
Other unsealed and unused well or boring on property? [ ] Yes [X] No How many?

LICENSED OR REGISTERED CONTRACTOR CERTIFICATION
This well or boring was sealed in accordance with Minnesota Rules, Chapter 4725. The information contained in this is true to the best of my knowledge.

AET, INC — 1795
Licensee Business Name — *License or Registration*

Kathy J Klecker — 996 — 4/21/08
Certified Representative Signature — *Certified Rep. No.* — *Date*

SEAN DUNLEAVY
Name of Person Sealing Well or Boring

IMPORTANT-FILE WITH PROPERTY PAPERS-WELL OWNER COPY

H 269208

HE-01434-10 IC# 140-0423

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING SEALING RECORD

Minnesota Statutes, Chapter 103I

Minnesota Well and Boring Sealing No.
Minnesota Unique Well No. or W-series No.
(Leave blank if not known)

H 269207

WELL OR BORING LOCATION

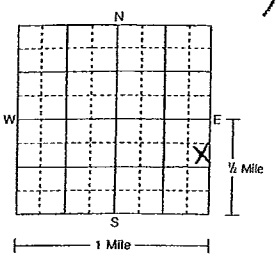
County Name: WASHINGTON

Township Name	Township No.	Range No.	Section No.	Fraction (sm. → lg.)
	28	20	22	SE NE SE

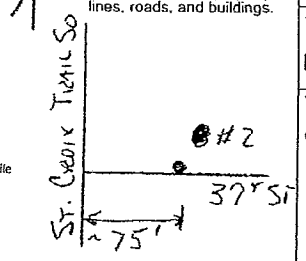
GPS LOCATION: Latitude_____ degrees_____ minutes_____ seconds
Longitude_____ degrees_____ minutes_____ seconds

Numerical Street Address or Fire Number and City of Well or Boring Location
NORTH SIDE OF 37TH EAST OF ST. CROIX TRAIL SO AFTON, MN

Show exact location of well or boring in section grid with "X."



Sketch map of well or boring location, showing property lines, roads, and buildings.



PROPERTY OWNER'S NAME/COMPANY NAME
CITY OF AFTON

Property owner's mailing address if different than well location address indicated above
3033 ST. CROIX TRAIL SO.
P.O. BOX 219
AFTON, MN. 55001-0219
ATTN: JOHN PAROTTI CITY ENGINEER

WELL OWNER'S NAME/COMPANY NAME
CITY OF AFTON

Well owner's mailing address if different than property owner's address indicated above

GEOLOGICAL MATERIAL	COLOR	HARDNESS OR FORMATION	FROM	TO
If not known, indicate estimated formation log from nearby well or boring.				
FILL SILTY SAND	DK BROWN		0	½
FILL SAND W/ SILT	BROWN		½	4
FILL SILTY SAND	DK BROWN		4	9
SAND W/ SILT	BROWN	LOOSE	9	16½
SILTY SAND	BROWN	LOOSE	16½	21½
SILT W/ SAND	BROWN	VERY LOOSE	21½	24
SILTY SAND	BROWN	VERY LOOSE	24	26

REMARKS, SOURCE OF DATA, DIFFICULTIES IN SEALING
AET 01-04004

IMPORTANT-FILE WITH PROPERTY PAPERS-WELL OWNER COPY

H 269207

Date Sealed: 4/3/08
Date Well or Boring Constructed: 4/3/08

Depth Before Sealing: 26 ft.
Original Depth: 26 ft.

AQUIFER(S)
☒ Single Aquifer ☐ Multiaquifer

WELL/BORING
☐ Water-Supply Well ☐ Monit. Well
☒ Env. Bore Hole ☐ Other

STATIC WATER LEVEL
☒ Measured ☐ Estimated Date Measured 4/3/0
18.9 ft. ☒ below ☐ above land surface

CASING TYPE(S) TEMPORARY
☐ Steel ☐ Plastic ☐ Tile ☒ Other 3¼" HOLLOW STEM AUGER

WELLHEAD COMPLETION N/A
Outside: ☐ Well House ☐ At Grade ☐ Pitless Adapter/Unit ☐ Buried ☐ Well Pit ☐ Other
Inside: ☐ Basement Offset ☐ Well Pit ☐ Buried ☐ Other

CASING(S) TEMPORARY

Diameter	Depth	Set in oversize hole?	Annular space initially grouted
3¼ in. from 0	to 24½ ft.	☐ Yes ☒ No	☐ Yes ☒ No
in. from	to ft.	☐ Yes ☐ No	☐ Yes ☐ No
in. from	to ft.	☐ Yes ☐ No	☐ Yes ☐ No

SCREEN/OPEN HOLE N/A
Screen from ___ to ___ ft. Open Hole from ___ to ___ ft.

OBSTRUCTIONS
☐ Rods/Drop Pipe ☐ Check Valve(s) ☐ Debris ☐ Fill ☒ No Obstruction
Type of Obstructions (Describe)
Obstructions removed? ☐ Yes ☐ No Describe

PUMP
Type
☐ Removed ☒ Not Present ☐ Other

METHOD USED TO SEAL ANNULAR SPACE BETWEEN 2 CASINGS, OR CASING AND BORE HOLE:
☒ No Annular Space Exists ☐ Annular Space Grouted with Tremie Pipe ☐ Casing Perforation/Rem
in. from to ft. ☐ Perforated
in. from to ft. ☐ Perforated
Type of Perforator
☐ Other

GROUTING MATERIAL(S) (One bag of cement = 94 lbs., one bag of bentonite = 50 lbs.)
Grouting Material BENTONITE GROUT from 0 to 26 ft. yards 1
from to ft. yards
from to ft. yards

OTHER WELLS AND BORINGS
Other unsealed and unused well or boring on property? ☐ Yes ☒ No How many?

LICENSED OR REGISTERED CONTRACTOR CERTIFICATION
This well or boring was sealed in accordance with Minnesota Rules, Chapter 4725. The information contained in this is true to the best of my knowledge.

AMERICAN ENGINEERING TESTING — 1795
Licensee Business Name — *License or Registration*

Kathy J Kleiter — 996 — 4/21/08
Certified Representative Signature — *Certified Rep. No.* — *Date*

SEAN DUNLEAVY
Name of Person Sealing Well or Boring

HE-01434-10 IC# 140-0423

Appendix C

Site Photos

Photos taken from site visit on 4-18-08

SEH

Taken near station 10+00, looking east along Reach 2.

Taken near station 11+80, looking north along Reach 2.

Taken near station 12+00, looking north along Reach 2.

Taken near station 17+00, looking south to Reach 2.

Taken near station 17+50, looking west up No Name Creek.

Taken near station 22+50, looking southeast, showing location of soil boring

Taken near station 25+50, looking south, showing vegetation on the riverward embankment of Reach 1.

Taken near station 26+00, looking west, showing interior drainage along the landward side of Reach 1.

Taken near station 26+50, looking southwest, showing interior drainage along the landward side of Reach 1.

Taken near station 27+50, showing damaged PVC pumping outlet.

Taken near station 27+50 showing stop logs and heavy rip rap over 54" CMP outfall.

Taken near station 27+50, showing pad and PVC outlet used for pumping.

Taken near station 27+50, showing primary (far) and secondary (near) PVC outlets used for pumping.

Taken near station 27+50, showing corner of pad and PVC outlet used for pumping and top of 54" CMP gravity pipe (outfall is permanently blocked).

Taken near station 27+50, showing the sump area used for pumping.

Taken near station 28+00, looking south, showing septic systems and light pole in levee.

Taken near station 29+00, looking northwest.

Taken near station 29+00, looking south.

Taken near station 30+00, looking southwest.

Taken near station 30+50, looking northwest.

Taken near station 32+30, looking east down the 33rd Street sidewalk.

Taken near station 33+00, looking south, showing 33rd Street sidewalk.

Taken near station 35+50, looking southeast.

Appendix D

Emergency Operations Plan

EMERGENCY OPERATIONS PLAN
CITY OF AFTON
MARCH, 2001

GOAL: To be prepared for natural disasters; to respond quickly, effectively, efficiently and equitably to the needs of our community; and to protect life, property and resources in the City.

I. Early Warning System, Flood Emergency

A. Civil Defense Director or Assistance shall notify City Administrator of flood forecasts from National Weather Service and Army Corps of Engineers after March 15. Coordinate with Windmill and Afton Marinas to determine if flood preparations are necessary.

B. City Administrator confirm that preventative maintenance and preparation of flood control pump, pipe, pad and connections are complete.

C. Civil Defense Director and City Engineer inspect dike, culvert gates, pump pad and accesses to assure they are properly maintained and ready for any event. Notify City Administrator and Corps of Engineers of any deficiencies.

D. City Administrator maintains contact with Washington County Emergency Management.

E. Proceed to Step A, B or C depending on forecasts.

II. Emergency Notification, Other Emergency

A. First Responder (Deputy Sheriff, Fire Department or Washington County Public Works Department) shall notify Civil Defense Director or Assistant and City Administrator of location and nature of emergency.

B. First Responder shall call all other emergency service providers (Police, Fire and/or Public Works) to provide emergency services, traffic or crowd control, fire protection, road clearing, hazard elimination, as needed.

C. City Administrator or staff shall contact Minnegasco, NSP, US West, and other utilities, if they have not been called by first responders, as necessary.

III. Control and Command Center

A. Establish a Command Center at the City Hall. Secure Portable Command Center from Washington County if back-up necessary OR establish a command center at the Fire Hall. If City radios are not available, secure assistance from the Washington County Sheriff for radio communication with police and fire providers. Secure radios from local merchants (Afton Alps, Afton House Inn) for non-emergency communication, if necessary.

B. Direct all public and/or media contacts to Mayor or City Administrator.

C. All other communications about the emergency shall be directed to, through or by the City Administrator or staff.

D. City Administrator or staff shall contact American Red Cross, the Salvation Army and/or the Volunteer Coordinator if emergency food, shelter, transportation, supplies or labor are necessary.

E. City Administrator shall coordinate contacts with the Corps of Engineers, MN/DNR, FEMA, Washington County and other State or Federal Agencies.

F. Civil Defense Director or Assistant shall supervise or direct all activities in the field.

G. City Administrator shall make a determination if and when City funds may be committed or dispersed and when City Council action may be required to authorize or commit to any activity, project or program. The Mayor or any two Councilmembers may call a Special Meeting of the City Council, if necessary.

IV. Disaster Planning and Response Team

A.	**Disaster Control Supervisor**	Home	578-2394		436-8957
	Larry Whittaker, City Administrator		Cell	(612)	669-9334
			Fax		436-1453
B.	**Civil Defense Director**	Home	436-8323		
	Charlie Devine, Mayor				
C.	**Office Director**	Home	436-8129		436-5090
	Twyla Dudley, Deputy City Clerk		Cell	(612)	850-2283
			Fax		436-1453
D.	**Emergency Preparedness Director**				
	Mike Aschittino	Home	436-5593		
E.	**Assistant Civil Defenses Director**				436-8883
	Gordy Jarvis		Cell	(612)	802-2072
			Fax		436-6859
F.	**City Engineer**, John Anderson				644-4389
	Howard R. Green Co.		Fax		644-9446
G.	**Police Services - Washington County Sheriff**				911
	Deputies: John Stoffel, Mike Bonn, Craig Cille	Office			439-9381
H.	**Fire Protection, Lower St. Croix Valley Fire Prot Dist.**				911
	Kris Peterson, Chief	Office			436-7033
I.	**Streets, Public Works** - Washington County				458-0470
	Brad Bodlovick, Supervisor		Cell	(651)	303-1812 Pager 610-1939
			Shop		458-3913
J.	**Volunteer Coordinator** - M. Laine McGee				436-8067
K.	**Army Corp of Engineers** - Flood Forecasts				290-5624 Bob Dempsey
	River Stage Information – Flooding				290-5861 651-290-5443
L.	**W/C Emergency Services**				430-~~6701~~ 6667
	~~Stuart Glaser~~ Michael R. Surface	Pager	651-~~430~~-610-9118		
	14900 61st St. No.; Stillwater, MN 55082	Fax			430-6730
M.	**National Weather Service** - Flood Forecasts				361-6670
N.	**MN/Div. Of Emergency Services** - B5-State Capitol				297-3942
	Howard Strabala				
	Central Region; 75 Constitution Ave; St. Paul, MN 55155				
O.	**American Red Cross**				439-0031
	Jane George or Larry Peterson				
P.	**Salvation Army**			(952)	365-3369
Q.	**Community Volunteer Services**				439-7434
	Bart Anderson				436-7530

V. Flood Emergency Priorities

A. Low Level Priority

1. **Description:** Traditional Spring or storm water event which is not expected to reach an actual or projected elevation of 684.00.
2. **Action:**
   a. Water projections should be monitored to determine the priority rating.
   b. Public Information Campaign begins – MN/DNR and FEMA publications on preventing, controlling, mitigating and cleaning-up flood damage distributed to parties that are likely to be affected. (i.e. water damage to homes and structures, operation of on-site sewer systems, electrical hazards, well water contamination / use, evacuation and emergency numbers). Notice – Stop use of low septic tanks.
   c. Publish general notice and information on flood potential, volunteer needs, emergency phone numbers, etc.
   d. Post flood elevations.
   e. Prepare for evacuations, emergency shelter and storage, if necessary.
   f. Place City pumps on the pad and proceed to Intermediate Level Priority if water elevation exceeds 684.

B. Intermediate Level Priority

1. **Description:** A high water event that is expected to reach an actual or projected elevation of 685.40. This corresponds to an expected maximum high water elevation of 686.5+ at Stillwater.
2. **Action:**
   a. Some control measures will be required during this event
   b. High water projection should be monitored to determine the priority rating.
   c. Materials and equipment should be located and arrangements made to activate the equipment if necessary.
   d. Locate and place stop logs near the 54" culvert.
   e. Locate poly sheeting, sandbags, sand, temporary lights, and other miscellaneous equipment in case water is higher than anticipated.
   f. Organize tentative work force in case conditions change.
   g. Make contact with the US Corps of Engineers, Dave Christianson (612-725-7511), to determine the availability of the 16" Crisafulli pump and 80 LF of 16'' hose if City pumps fail to keep up.
   h. Make contact with a rental supplier for a tractor to drive the pump (75 to 90 HP tractor with PTO) if Crisafulli pump necessary.
   i. Inspect the pump pads for access. Place city diesel pumps and connections on pads.
   j. Verify that the electrical service and streetlight near the culvert is in working order.
   k. Arrange for tank and diesel fuel for pumps.
   l. Notify the affected property owners of the expected high water condition. Advise them of the status of pumping equipment and procedures to be followed should the water crest as projected.
   m. During rising water, the stop logs should be installed in the downstream end of the 54 culvert to maintain a minimum one foot of freeboard from the water surface. A layer of plastic sheeting and sandbags may be required to completely seal the stop log cracks.
   n. Start pumping and proceed to High Level Priority if water elevation exceeds 685.40.
   o. Secure sandbags and supplies, as necessary.

C. **High Level Priority**

1. **Description:** A high water event in which the actual or projected high water elevation is expected to exceed an elevation above 685.40. This corresponds to an elevation of approximately 686.50 at Stillwater.

2. **Action:**

a. Control measures will be required during this event.

b. The measures described for an intermediate priority event should be undertaken in addition to those described below.

c. The 54" CMP should be monitored, with stop logs, poly sheeting and sandbags to be added as necessary to keep the closed elevation one foot above the water level.

d. The Civil Defense Director shall contact the affected property owners and described the expected conditions. Maintenance of the equipment and a pumping schedule should be established. Seepage through the dike, leakage at the culverts, local rains and other factors can affect the rate and other factors can affect the rate and frequency of pumping. A 24-hour watch should be established to monitor water levels. Volunteers should be scheduled.

e. Dike across 32nd Street and close Windmill Marina if water elevation exceeds 690.

f. Secure back-up 16" Crisafulli pump if water elevation exceeds 691.0

g. Access across the dike at 32nd, 33rd and creek should be raised to 695' with sand, poly and sandbags. Advise lower residents of risk.

h. The top of dike elevation is at elevation 695.0. Should the expected high water elevation exceed 693, special action may be required as the stability of the dike, the possibility of overtopping, or water encroaching around the dike, the decisions to evacuate local residents, and other conditions must be considered.

D. **Annual Inspections**

1. The Civil Defense Director and City Engineer at a minimum, shall twice yearly inspect, or cause to be inspected, the dike and surrounding area for potential problems with erosion, excess brush or vegetation, gopher mounds, access, soundness of structures, and other situations which could affect the capability of handling a high water emergency. Inspections should also be done immediately after a flood event.

2. All noted items in need of maintenance, including cleanup, shall be corrected as soon as possible.

3. Local residents should be encouraged to flood proof their properties to minimize the potential for flood possible.

4. New construction should be required to be flood proofed to minimize flood damage potential.

5. Service pumps after use and before storage.

E. **Evaluation**

1. Immediately after a high water event this flood protection policy should be reviewed, along with the actions taken during the event, to determine if these policies were followed, if changes or additions in equipment, methods, monitoring or other aspects, would be beneficial, or if refinements in the policy could further minimize damage or make the policy easier to implement or more complete.

2. After thorough review, this policy should be updated to include those revisions which will provide the best high water protection to the affected property.

V/C TRAILS COMMITTEE

Randy Nelson	105 Stagecoach Trail S	(651) 436-2479
	e-mail:	
City Administrator		(651) 436-8957

EMERGENCY PREPAREDNESS

Randy Nelson (Council Liason	105 Stagecoach Tr. S.	(651) 436-2479
Gordy Jarvis	Afton House Inn – P.O. Box 326	(651) 436-8883
	e-mail: gordy@aftonhouseinn.com	
Paul Robertson	2718 St. Croix Trail – P.O. BOX 5	(651) 436-6892
Joe Riley	6065 32nd Street – P.O. Box 279	(651) 436-7744
	e-mail: joe@windmillmarina.com	
Joe Farrington	15991 Upper 34th St S	(651) 436-5678
	e-mail: ojoes@comcast.net	
Oliver Weir	3633 St Croix Tr	(651) 436-3213
	e-mail: webewir@hotmail.com	
Barbara Leuthe	3364 Pennington Ave S	(651) 436-6182

This is the last updated (most recent) E.P. Committee roster/Goals

Appendix E

FEMA Fact Sheet: Requirements of 44 CFR Section 65.10

FACT SHEET

LEVEES
IDENTIFYING THE RISK

Requirements of 44 CFR Section 65.10:

Mapping of Areas Protected by Levee Systems

As part of a mapping project, it is the levee owner's or community's responsibility to provide data and documentation to show that a levee meets the requirements of Section 65.10 of the National Flood Insurance Program (NFIP) regulations. Links to Section 65.10 and many other documents are available on FEMA's Web site at www.fema.gov/plan/prevent/fhm/lv_fpm.shtm.

The FEMA requirements in Section 65.10 are separated into five categories:

1. General criteria;
2. Design criteria;
3. Operations plans and criteria;
4. Maintenance plans and criteria; and
5. Certification requirements.

The requirements for each of these areas are summarized below.

(A) GENERAL CRITERIA

For purposes of the NFIP, FEMA will only recognize in its flood hazard and risk mapping effort those levee systems that meet, and continue to meet, minimum design, operation, and maintenance standards that are consistent with the level of protection sought through the comprehensive floodplain management criteria established by Section 60.3 of the NFIP regulations. Section 65.10 of the NFIP regulations describes the types of information FEMA needs to recognize, on NFIP maps, that a levee system provides protection from the flood that has a 1-percent chance of being equaled or exceeded in any give year (base flood). This information must be supplied to FEMA by the community or other party seeking recognition of a levee system at the time a study or restudy is conducted, when a map revision under the provisions of Part 65 of the NFIP regulations is sought based on a levee system, and upon request by the Administrator during the review of previously recognized structures. The FEMA review is for the sole purpose of establishing appropriate risk zone determinations for NFIP maps and does not constitute a determination by FEMA as to how a structure or system will perform in a flood event.

(B) DESIGN CRITERIA

For the purposes of the NFIP, FEMA has established levee design criteria for freeboard, closures, embankment protection, embankment and foundation stability, settlement, interior drainage, and other design criteria. These criteria are summarized in subsections below.

(B)(1) FREEBOARD

For riverine levees:

- A minimum freeboard of 3 feet above the water-surface level of the base flood must be provided.
- An additional 1 foot above the minimum is required within 100 feet on either side of structures (e.g., bridges) riverward of the levee or wherever the flow is constricted.

- An additional 0.5 foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required.

Exceptions to the minimum riverine freeboard requirements above may be approved if the following criteria are met:

- Appropriate engineering analyses demonstrating adequate protection with a lesser freeboard must be submitted.
- The material presented must evaluate the uncertainty in the estimated base flood elevation profile and include, but not necessarily be limited to:
    - An assessment of statistical confidence limits of the 1-percent-annual-chance discharge;
    - Changes in stage-discharge relationships; and
    - Sources, potential, and magnitude of debris, sediment, and ice accumulation.
- It must be also shown that the levee will remain structurally stable during the base flood when such additional loading considerations are imposed.

Under no circumstances will freeboard of less than 2 feet be accepted.

For coastal levees, the freeboard must be established at 1 foot above the height of the 1-percent-annual-chance wave or the maximum wave runup (whichever is greater) associated with the 1-percent-annual-chance stillwater surge elevation at the site.

Exceptions to the minimum coastal freeboard requirements above may be approved if the following criteria are met:

- Appropriate engineering analyses demonstrating adequate protection with a lesser freeboard must be submitted.
- The material presented must evaluate the uncertainty in the estimated base flood loading conditions. Particular emphasis must be placed on the effects of wave attack and overtopping on the stability of the levee.

Under no circumstances will a freeboard of less than 2 feet above the 1-percent-annual-chance stillwater surge elevation be accepted.

(B)(2) CLOSURES

The levee closure requirement is that all openings must be provided with closure devices that are structural parts of the system during operation and design according to sound engineering practice.

(B)(3) EMBANKMENT PROTECTION

Engineering analyses must be submitted to demonstrate that no appreciable erosion of the levee embankment can be expected during the base flood, as a result of either currents or waves, and that anticipated erosion will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and subsequent instability.

The factors to be addressed in such analyses include, but are not limited to:

- Expected flow velocities (especially in constricted areas);
- Expected wind and wave action;

- Ice loading;
- Impact of debris;
- Slope protection techniques;
- Duration of flooding at various stages and velocities;
- Embankment and foundation materials;
- Levee alignment, bends, and transitions; and
- Levee side slopes.

(B)(4) EMBANKMENT AND FOUNDATION STABILITY

Engineering analyses that evaluate levee embankment stability must be submitted.

The analyses provided shall evaluate expected seepage during loading conditions associated with the base flood and shall demonstrate that seepage into or through the levee foundation and embankment will not jeopardize embankment or foundation stability.

An alternative analysis demonstrating that the levee is designed and constructed for stability against loading conditions for Case IV as defined in U.S. Army Corps of Engineers (USACE) Engineering Manual 1110-2-1913, Chapter 6, Section II, may be used.

The factors that shall be addressed in the analyses include:

- Depth of flooding;
- Duration of flooding;
- Embankment geometry and length of seepage path at critical locations;
- Embankment and foundation materials;
- Embankment compaction;
- Penetrations;
- Other design factors affecting seepage (e.g., drainage layers); and
- Other design factors affecting embankment and foundation stability (e.g., berms).

(B)(5) SETTLEMENT

Engineering analyses must be submitted that assess the potential and magnitude of future losses of freeboard as a result of levee settlement and demonstrate that freeboard will be maintained within the minimum freeboard standards set forth in B(1).

This analysis must address:

- Embankment loads,
- Compressibility of embankment soils,
- Compressibility of foundation soils,

- Age of the levee system, and
- Construction compaction methods.

A detailed settlement analysis using procedures such as those described in USACE Engineering Manual EM 1100-2-1904 must be submitted.

(B)(6) INTERIOR DRAINAGE

An analysis must be submitted that identifies the source(s) of such flooding; the extent of the flooded area; and, if the average depth is greater than 1 foot, the water-surface elevation(s) of the base flood. This analysis must be based on the joint probability of interior and exterior flooding and the capacity of facilities (such as drainage lines and pumps) for evacuating interior floodwaters. Interior drainage systems usually include storage areas, gravity outlets, pumping stations, or a combination thereof.

For areas of interior drainage that have average depths greater than 1 foot, mapping must be provided depicting the extents of the interior flooding, along with supporting documentation.

(B)(7) OTHER DESIGN CRITERIA

In unique situations, such as those where the levee system has relatively high vulnerability, FEMA may require that other design criteria and analyses be submitted to show that the levees provide adequate protection. In such situations, sound engineering practice will be the standard on which FEMA will base its determinations. FEMA also will provide the rationale for requiring this additional information.

(C) OPERATIONS PLANS AND CRITERIA

For a levee system to be recognized, the operational criteria must be as described below. All closure devices or mechanical systems for internal drainage, whether manual or automatic, must be operated in accordance with an officially adopted operation manual, a copy of which must be provided to FEMA by the operator when levee or drainage system recognition is being sought or when the manual for a previously recognized system is revised in any manner. All operations must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP.

(C)(1) CLOSURES

Operation plans for closures must include the following:

- Documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials, that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists for the completed operation of all closure structures, including necessary sealing, before floodwaters reach the base of the closure;
- A formal plan of operation, including specific actions and assignments of responsibility by individual name or title; and
- Provisions for periodic operation, at not less than 1-year intervals, of the closure structure(s) for testing and training purposes.

(C)(2) INTERIOR DRAINAGE SYSTEMS

Interior drainage systems associated with levee systems usually include storage areas, gravity outlets, pumping stations, or a combination thereof. FEMA will recognize these drainage systems on NFIP maps for flood protection purposes only if the following minimum criteria are included in the operation plan:

- Documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials, that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists to permit activation of mechanized portions of the drainage system;
- A formal plan of operation, including specific actions and assignments of responsibility by individual name or title;
- Provision for manual backup for the activation of automatic systems; and
- Provisions for periodic inspection of interior drainage systems and periodic operation of any mechanized portions for testing and training purposes; no more than 1 year shall elapse between either the inspections or the operations.

(C)(3) OTHER OPERATION PLANS AND CRITERIA

FEMA may require other operating plans and criteria to ensure that adequate protection is provided in specific situations. In such cases, sound emergency management practice will be the standard upon which FEMA determinations will be based.

(D) MAINTENANCE PLANS AND CRITERIA

For levee systems to be recognized as providing protection from the base flood, the following maintenance criteria must be met:

- Levee systems must be maintained in accordance with an officially adopted maintenance plan, and a copy of this plan must be provided to FEMA by the owner of the levee system when recognition is being sought or when the plan for a previously recognized system is revised in any manner.
- All maintenance activities must be under the jurisdiction of a(n):
    - Federal or State agency;
    - Agency created by Federal or State law; or
    - Agency of a community participating in the NFIP that must assume ultimate responsibility for maintenance.
- The maintenance plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and systems are maintained.
- At a minimum, the maintenance plan shall specify:
    - Maintenance activities to be performed;
    - Frequency of their performance; and
    - Person by name or title responsible for their performance.

(E) CERTIFICATION REQUIREMENTS

Data submitted to support that a given levee system complies with the structural requirements set forth in B(1) through B(7) above must be certified by a Registered Professional Engineer. Also, certified as-built plans of the levee must be submitted. Certifications are subject to the definition given in Section 65.2 of the NFIP regulations. In lieu of these structural requirements, a Federal agency with responsibility for levee design may certify that the levee has been adequately designed and constructed to provide protection against the base flood.

Appendix F

FEMA Fact Sheet: Meeting the Criteria for Accrediting Levees on Flood Maps

FACT SHEET

LEVEES
IDENTIFYING THE RISK

Meeting the Criteria for Accrediting Levees on Flood Maps

How-to-Guide for Floodplain Managers and Engineers

A levee is a manmade structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. Levees include floodwalls and other flood-control structures (not including dams).

As part of the countywide flood mapping process, the Department of Homeland Security, Federal Emergency Management Agency (FEMA) and its State and local mapping partners need to review data associated with levees.

It is the levee owner's or community's responsibility to provide data and documentation to demonstrate that a levee meets the requirements of the National Flood Insurance Program (NFIP) as described in Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR Section 65.10) which you may view on FEMA's Web site at www.fema.gov/plan/ prevent/ fhm/lv_fpm.shtm.

To be recognized as providing protection from the 1-percent-annual-chance flood on Flood Insurance Rate Maps (FIRMs), levee systems must meet *and continue to meet* the minimum design, operation, and maintenance standards of 44 CFR Section 65.10 of the NFIP regulations.

To help clarify the responsibilities of community officials, levee owners, or other parties seeking recognition of a levee for providing information on levees identified during a mapping project, FEMA issued Procedure Memorandum No. 34 (PM 34), *Interim Guidance for Studies Including Levees*, on August 22, 2005. PM 34 provided clarification of the existing procedures, which were provided in Appendix H of FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners*.

FEMA issued Revised Procedure Memorandum No. 43, *Guidelines for Identifying Provisionally Accredited Levees*, on March 16, 2007, which will allow mapping contractors and partners to issue preliminary and, in some cases, effective flood maps while communities and levee owners are compiling and submitting the full documentation necessary to show compliance with 44 CFR Section 65.10 requirements.

This document provides information regarding what types of information you'll need to submit during the mapping process for your levee to be recognized as providing protection on FIRMs, including a checklist and an index of further resources you may wish to consult.

COMMUNITIES WITH LEVEES SHOULD KNOW:

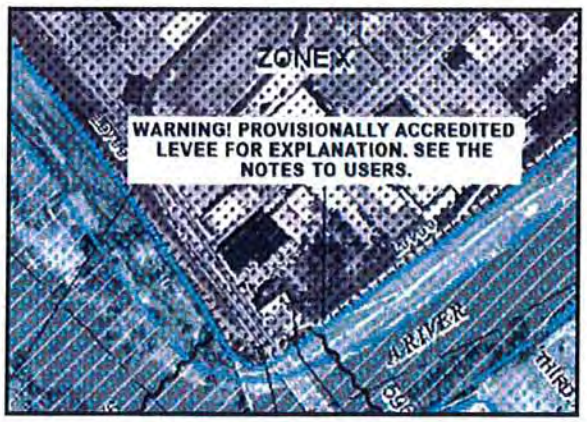
- The participating community and/or other party seeking recognition or continued recognition must provide sufficient data showing that the levee provides protection from the 1-percent-annual-chance flood (also known as the base flood) for FEMA to recognize the levee on a FIRM.
- Communities *must* actively participate in the levee documentation process.
- Levees structures without sufficient documentation will not be credited as providing flood protection.
- Some levees may qualify to be shown as Provisionally Accredited Levees on the FIRM. Guidance regarding Provisionally Accredited Levees is available at www.fema.gov/plan/ prevent/fhm/lv_fpm. shtm.

HOW WILL FEMA MAP LEVEES?

FEMA's mapping requirements are designed to provide the people living and working behind the levee with appropriate risk information so that they may minimize damage and loss of life. It is important to note that FEMA does not evaluate the performance of a levee—this is the responsibility of the levee owner. FEMA is responsible for establishing mapping standards and risk determination zones and reflecting these determinations on flood maps.

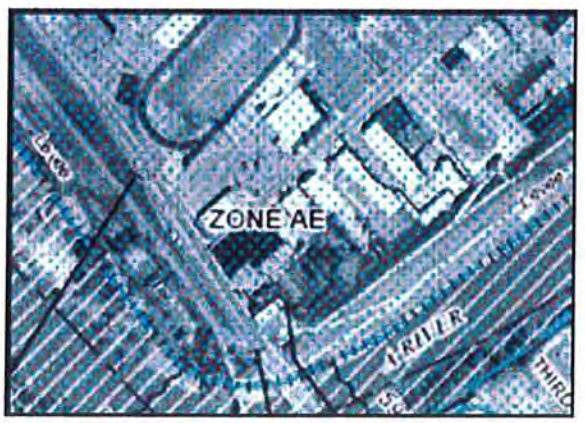
Levee Accredited on FIRM

An accredited levee is a levee that FEMA shows on a FIRM as providing protection from the 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by the NFIP regulations. The area landward of an accredited levee is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which will be shown as Special Flood Hazard Area. Flood insurance is not mandatory in Zone X (shaded); however, it is strongly encouraged for all structures in areas behind levees.



Provisionally Accredited Levee (PAL)

A PAL is a designation for a levee that FEMA has previously accredited with providing 1-percent-annual-chance flood protection on an effective FIRM, and for which FEMA is awaiting data and/or documentation that will show the levee's compliance with NFIP regulations. Before FEMA will designate a levee as a PAL, the community or levee owner will need to sign and return an agreement that indicates that documentation required for compliance with 44 CFR Section 65.10 of the NFIP regulations will be provided within a specified timeframe, depending upon the levee's status. Flood insurance is not mandatory for structures behind a levee with provisional status however, it is strongly encouraged.



Levee Not Accredited or De-accredited on FIRM

If the levee is not shown as providing protection from the 1-percent-annual-chance flood on an effective FIRM, the levee is considered "not accredited" and is mapped as Zone AE or Zone A, depending upon the type of study performed for the area. If the levee was previously shown providing protection from the 1-percent-annual-chance flood on an effective FIRM but does not meet the Provisionally Accredited Levee (PAL) requirements or is no longer eligible for the PAL, FEMA will "de-accredit" the levee and the area landward of the levee will be remapped as Zone AE or Zone A (high-risk flood zones) depending on the type of study performed for the area. Flood insurance will be required for structures with a federally backed mortgage.

Design Criteria*	Section of the NFIP Regulations: 65.10(b)
Description: For levees to be recognized by FEMA, evidence that adequate design and operation and maintenance systems are in place to provide reasonable assurance that protection from the base flood exists must be provided. The following requirements must be met:	
Checklist for Design Criteria:	
■	**Freeboard.** Minimum freeboard required 3 feet above the Base Flood Elevation (BFE) all along length, and an additional 1 foot within 100 feet of structures (such as bridges) or wherever the flow is restricted. Additional 0.5 foot at the upstream end of levee. Coastal levees have special freeboard requirements (see 65.10(b)(1)(iii) and (iv)).
■	**Closures.** All openings must be provided with closure devices that are structural parts of the system during operation and designed according to sound engineering practice.
■	**Embankment Protection**. Engineering analyses must be submitted that demonstrate that no appreciable erosion of the levee embankment can be expected during the base flood, as a result of either currents or waves, and that anticipated erosion will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and subsequent instability.
■	**Embankment and Foundation Stability Analyses.** Engineering analyses that evaluate levee embankment stability must be submitted. The analyses provided shall evaluate expected seepage during loading conditions associated with the base flood and shall demonstrate that seepage into or through the levee foundation and embankment will not jeopardize embankment or foundation stability. An alternative analysis demonstrating that the levee is designed and constructed for stability against loading conditions for Case IV as defined in the U.S. Army Corps of Engineers (USACE) manual, *Design and Construction of Levees*, (EM 1110–2–1913, Chapter 6, Section II), may be used.
■	**Settlement Analyses.** Engineering analyses must be submitted that assess the potential and magnitude of future losses of freeboard as a result of levee settlement and demonstrate that freeboard will be maintained. This analysis must address embankment loads, compressibility of embankment soils, compressibility of foundation soils, age of the levee system, and construction compaction methods. In addition, detailed settlement analysis using procedures such as those described in the USACE manual, *Soil Mechanics Design— Settlement Analysis* (EM 1100–2–1904), must be submitted.
■	**Interior Drainage.** An analysis must be submitted that identifies the source(s) of such flooding, the extent of the flooded area, and, if the average depth is greater than one foot, the water-surface elevation(s) of the base flood. This analysis must be based on the joint probability of interior and exterior flooding and the capacity of facilities (such as drainage lines and pumps) for evacuating interior floodwaters.

Operation Plan*	Section of the NFIP Regulations: 65.10(c)(1)
Description: For a levee system to be recognized, the operational criteria must be as described below. All closure devices or mechanical systems for internal drainage, whether manual or automatic, must be operated in accordance with an officially adopted operation manual, a copy of which must be provided to FEMA by the operator when levee or drainage system recognition is being sought or when the manual for a previously recognized system is revised in any manner. All operations must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP.	
Checklist for Operation Plan:	
■	**Flood Warning System.** Documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials that will be used to trigger emergency operation activities; and demonstration that sufficient flood warning time exists for the completed operation of all closure structures, including necessary sealing, before floodwaters reach the base of the closure.
■	**Plan of Operation**. A formal plan of operation including specific actions and assignments of responsibility by individual name or title.
■	**Periodic Operation of Closures.** Provisions for periodic operation, at not less than one-year intervals, of the closure structure for testing and training purposes.
■	**Interior Drainage Plan**. See below.

Interior Drainage Plan	Section of the NFIP Regulations: 65.10(c)(2)
Description: Interior drainage systems associated with levee systems usually include storage areas, gravity outlets, pumping stations, or a combination thereof. These drainage systems will be recognized by FEMA on NFIP maps for flood protection purposes only if the following minimum criteria are included in the operation plan.	
Checklist for Interior Drainage Plan:	
■	**Flood Warning System.** Documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials that will be used to trigger emergency operation activities; and demonstration that sufficient flood warning time exists to permit activation of mechanized portions of the drainage system.
■	**Plan of Operation.** A formal plan of operation including specific actions and assignments of responsibility by individual name or title.

■	**Manual Backup.** Provision for manual backup for the activation of automatic systems.
■	**Periodic Inspection.** Provisions for periodic inspection of interior drainage systems and periodic operation of any mechanized portions for testing and training purposes. No more than 1 year shall elapse between either the inspections or the operations.
Maintenance Plan	**Section of the NFIP Regulations: 65.10(d)**

Description: For levee systems to be recognized as providing protection from the base flood, the maintenance criteria must be as described herein:

Checklist for Maintenance Plan:	
■	Levee systems must be maintained in accordance with an officially adopted maintenance plan, and a copy of this plan must be provided to FEMA by the owner of the levee system when recognition is being sought or when the plan for a previously recognized system is revised in any manner.
■	All maintenance activities must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP that must assume ultimate responsibility for maintenance.
■	This plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and systems are maintained. At a minimum, the plan shall specify the maintenance activities to be performed, the frequency of their performance, and the person by name or title responsible for their performance.

Certification	**Section of the NFIP Regulations: 65.10(e)**

Description: Data submitted to support that a given levee system complies with the structural requirements set forth in "Design Criteria" (paragraphs (b)(1) through (7) of the regulations) must be certified by a registered PE. Also, certified "as-built" plans of the levee must be submitted. Certifications are subject to the definition given in Section 65.2 of the NFIP regulations. In lieu of these structural requirements, a Federal agency with responsibility for levee design may certify that the levee has been adequately designed and constructed to provide protection against the base flood.

Checklist for Certification Requirement:	
■	All data submitted is certified by Professional Engineer or certified by a Federal agency.
■	Certified as-built levee plans are included in the submittal.

A NOTE ABOUT RISK AND FLOOD INSURANCE

It is important to note that levees are designed to provide a *specific level of protection.* They can be overtopped or fail in a larger flood events.

Levees also decay over time. They require regular maintenance and periodic upgrades to retain their level of protection. When levees do fail, they fail catastrophically. The damage may be more significant than if the levee was not there at all.

For all these reasons, FEMA strongly urges people to understand their flood risk, know their evacuation procedures, and protect their property by purchasing flood insurance.

CHECKLIST INFORMATION

The checklist provided in this publication is meant to assist local officials and levee owners in gathering the documentation that will be required for FEMA to show a levee as providing base flood protection on the community's FIRM. Where possible, text from the actual NFIP regulations (44 CFR Section 65.10) was used.

The checklist is set up according to the appropriate paragraph of 65.10. For example, Design Criteria can be found in Paragraph 65.10(b):

Design Criteria*	Section of the FEMA Regulations: 65.10(b)
Description: For levees to be recognized by FEMA, evidence that adequate design and operation and maintenance systems are in place to provide reasonable assurance that protection from the base flood exists must be provided. The following requirements must be met:	

For a comprehensive description of each item in this checklist, please see Appendix H of the *Guidelines and Specifications for Flood Hazard Mapping Partners*. Locations of this resource, and other useful resources, are provided below.

INDEX OF RESOURCES

This resource, and other levee-related information and materials, can be found at www.fema.gov/plan/prevent/fhm/lv_intro.shtm.

Procedure Memorandum No. 34, *Interim Guidance for Studies Including Levees,* can be found at www.fema.gov/plan/prevent/fhm/lv_fpm.shtm.

Revised Procedure Memorandum No. 43, *Guidelines for Identifying Provisionally Accredited Levees,* can be found at www.fema.gov/plan/prevent/fhm/lv_fpm.shtm.

Appendix H of the *Guidelines and Specifications for Flood Hazard Mapping Partners* can be downloaded at www.fema.gov/plan/prevent/fhm/dl_cgs.shtm.

44 CFR Section 65.10 of the NFIP regulations can be downloaded at www.fema.gov/plan/prevent/fhm/lv_fpm.shtm.

Flood insurance information can be found at www.fema.gov/business/nfip or on the NFIP's consumer site, www.FloodSmart.gov.

Appendix G

Code of Federal Regulations Title 44 Section 59.1 Definitions

Electronic Code of Federal Regulations
e-CFR TM

e-CFR Data is current as of September 17, 2008

Title 44: Emergency Management and Assistance

PART 59—GENERAL PROVISIONS
Subpart A—General

Browse Next

§ 59.1 Definitions.

As used in this subchapter—

Act means the statutes authorizing the National Flood Insurance Program that are incorporated in 42 U.S.C. 4001–4128.

Actuarial rates —see *risk premium rates.*

Administrator means the Federal Insurance Administrator.

Agency means the Federal Emergency Management Agency, Washington DC.

Alluvial fan flooding means flooding occurring on the surface of an alluvial fan or similar landform which originates at the apex and is characterized by high-velocity flows; active processes of erosion, sediment transport, and deposition; and, unpredictable flow paths.

Apex means a point on an alluvial fan or similar landform below which the flow path of the major stream that formed the fan becomes unpredictable and alluvial fan flooding can occur.

Applicant means a community which indicates a desire to participate in the Program.

Appurtenant structure means a structure which is on the same parcel of property as the principal structure to be insured and the use of which is incidental to the use of the principal structure.

Area of future-conditions flood hazard means the land area that would be inundated by the 1-percent-annual-chance (100-year) flood based on future-conditions hydrology.

Area of shallow flooding means a designated AO, AH, AR/AO, AR/AH, or VO zone on a community's Flood Insurance Rate Map (FIRM) with a 1 percent or greater annual chance of flooding to an average depth of 1 to 3 feet where a clearly defined channel does not exist, where the path of flooding is unpredictable, and where velocity flow may be evident. Such flooding is characterized by ponding or sheet flow.

Area of special flood-related erosion hazard is the land within a community which is most likely to be subject to severe flood-related erosion losses. The area may be designated as Zone E on the Flood Hazard Boundary Map (FHBM). After the detailed evaluation of the special flood-related erosion hazard area in preparation for publication of the FIRM, Zone E may be further refined.

Area of special flood hazard is the land in the flood plain within a community subject to a 1 percent or greater chance of flooding in any given year. The area may be designated as Zone A on the FHBM. After detailed ratemaking has been completed in preparation for publication of the flood insurance rate map, Zone A usually is refined into Zones A, AO, AH, A1–30, AE, A99, AR, AR/A1–30, AR/AE, AR/AO, AR/AH, AR/A, VO, or V1–30, VE, or V. For purposes of these regulations, the term "special flood hazard area" is synonymous in meaning with the phrase "area of special flood hazard".

Area of special mudslide (i.e., mudflow) hazard is the land within a community most likely to be subject to severe mudslides (i.e., mudflows). The area may be designated as Zone M on the FHBM. After the detailed evaluation of the special mudslide (i.e., mudflow) hazard area in preparation for publication of the FIRM, Zone M may be further refined.

Base flood means the flood having a one percent chance of being equalled or exceeded in any given year.

Basement" means any area of the building having its floor subgrade (below ground level) on all sides.

Breakaway wall means a wall that is not part of the structural support of the building and is intended through its design and construction to collapse under specific lateral loading forces, without causing damage to the elevated portion of the building or supporting foundation system.

Building —see *structure.*

Chargeable rates mean the rates established by the Administrator pursuant to section 1308 of the Act for first layer limits of flood insurance on existing structures.

Chief Executive Officer of the community (*CEO*) means the official of the community who is charged with the authority to implement and administer laws, ordinances and regulations for that community.

Coastal high hazard area means an area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources.

Community means any State or area or political subdivision thereof, or any Indian tribe or authorized tribal organization, or Alaska Native village or authorized native organization, which has authority to adopt and enforce flood plain management regulations for the areas within its jurisdiction.

Contents coverage is the insurance on personal property within an enclosed structure, including the cost of debris removal, and the reasonable cost of removal of contents to minimize damage. Personal property may be household goods usual or incidental to residential occupancy, or merchandise, furniture, fixtures, machinery, equipment and supplies usual to other than residential occupancies.

Criteria means the comprehensive criteria for land management and use for flood-prone areas developed under 42 U.S.C. 4102 for the purposes set forth in part 60 of this subchapter.

Critical feature means an integral and readily identifiable part of a flood protection system, without which the flood protection provided by the entire system would be compromised.

Curvilinear Line means the border on either a FHBM or FIRM that delineates the special flood, mudslide (i.e., mudflow) and/or flood-related erosion hazard areas and consists of a curved or contour line that follows the topography.

Deductible means the fixed amount or percentage of any loss covered by insurance which is borne by the insured prior to the insurer's liability.

Developed area means an area of a community that is:

(a) A primarily urbanized, built-up area that is a minimum of 20 contiguous acres, has basic urban infrastructure, including roads, utilities, communications, and public facilities, to sustain industrial, residential, and commercial activities, and

(1) Within which 75 percent or more of the parcels, tracts, or lots contain commercial, industrial, or residential structures or uses; or

(2) Is a single parcel, tract, or lot in which 75 percent of the area contains existing commercial or industrial structures or uses; or

(3) Is a subdivision developed at a density of at least two residential structures per acre within which 75 percent or more of the lots contain existing residential structures at the time the designation is adopted.

(b) Undeveloped parcels, tracts, or lots, the combination of which is less than 20 acres and contiguous on at least 3 sides to areas meeting the criteria of paragraph (a) at the time the designation is adopted.

(c) A subdivision that is a minimum of 20 contiguous acres that has obtained all necessary government approvals, provided that the actual "start of construction" of structures has occurred on at least 10 percent of the lots or remaining lots of a subdivision or 10 percent of the maximum building coverage or remaining building coverage allowed for a single lot subdivision at the time the designation is adopted and construction of structures is underway. Residential subdivisions must meet the density criteria in paragraph (a)(3).

Development means any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

Director means the Director of the Federal Emergency Management Agency.

Eligible community or *participating community* means a community for which the Administrator has authorized the sale of flood insurance under the National Flood Insurance Program.

Elevated building means, for insurance purposes, a nonbasement building which has its lowest elevated floor raised above ground level by foundation walls, shear walls, posts, piers, pilings, or columns.

Emergency Flood Insurance Program or *emergency program* means the Program as implemented on an emergency basis in accordance with section 1336 of the Act. It is intended as a program to provide a first layer amount of insurance on all insurable structures before the effective date of the initial FIRM.

Erosion means the process of the gradual wearing away of land masses. This peril is not per se covered under the Program.

Exception means a waiver from the provisions of part 60 of this subchapter directed to a community which relieves it from the requirements of a rule, regulation, order or other determination made or issued pursuant to the Act.

Existing construction, means for the purposes of determining rates, structures for which the "start of construction" commenced before the effective date of the FIRM or before January 1, 1975, for FIRMs effective before that date. "Existing construction" may also be referred to as "existing structures."

Existing manufactured home park or subdivision means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before the effective date of the floodplain management regulations adopted by a community.

Existing structures see *existing construction.*

Expansion to an existing manufactured home park or subdivision means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufacturing homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

Federal agency means any department, agency, corporation, or other entity or instrumentality of the executive branch of the Federal Government, and includes the Federal National Mortgage Association and the Federal Home Loan Mortgage Corporation.

Federal instrumentality responsible for the supervision, approval, regulation, or insuring of banks, savings and loan associations, or similar institutions means the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, the Comptroller of the Currency, the Federal Home Loan Bank Board, the Federal Savings and Loan Insurance Corporation, and the National Credit Union Administration.

Financial assistance means any form of loan, grant, guaranty, insurance, payment, rebate, subsidy, disaster assistance loan or grant, or any other form of direct or indirect Federal assistance, other than general or special revenue sharing or formula grants made to States.

Financial assistance for acquisition or construction purposes means any form of financial assistance which is intended in whole or in part for the acquisition, construction, reconstruction, repair, or improvement of any publicly or privately owned building or mobile home, and for any machinery, equipment, fixtures, and furnishings contained or to be contained therein, and shall include the purchase or subsidization of mortgages or mortgage loans but shall exclude assistance pursuant to the Disaster Relief Act of 1974 other than assistance under such Act in connection with a flood. It includes only financial assistance insurable under the Standard Flood Insurance Policy.

First-layer coverage is the maximum amount of structural and contents insurance coverage available under the Emergency Program.

Flood or *Flooding* means:

(a) A general and temporary condition of partial or complete inundation of normally dry land areas from:

(1) The overflow of inland or tidal waters.

(2) The unusual and rapid accumulation or runoff of surface waters from any source.

(3) Mudslides (i.e., mudflows) which are proximately caused by flooding as defined in paragraph (a)(2) of this definition and are akin to a river of liquid and flowing mud on the surfaces of normally dry land areas, as when earth is carried by a current of water and deposited along the path of the current.

(b) The collapse or subsidence of land along the shore of a lake or other body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels or suddenly caused by an unusually high water level in a natural body of water, accompanied by a severe storm, or by an unanticipated force of nature, such as flash flood or an abnormal tidal surge, or by some similarly unusual and unforeseeable event which results in flooding as defined in paragraph (a)(1) of this definition.

Flood elevation determination means a determination by the Administrator of the water surface elevations of the base flood, that is, the flood level that has a one percent or greater chance of occurrence in any given year.

Flood elevation study means an examination, evaluation and determination of flood hazards and, if appropriate, corresponding water surface elevations, or an examination, evaluation and determination of mudslide (i.e., mudflow) and/or flood-related erosion hazards.

Flood Hazard Boundary Map (FHBM) means an official map of a community, issued by the Administrator, where the boundaries of the flood, mudslide (i.e., mudflow) related erosion areas having special hazards have been designated as Zones A, M, and/or E.

Flood insurance means the insurance coverage provided under the Program.

Flood Insurance Rate Map (FIRM) means an official map of a community, on which the Administrator has delineated both the special hazard areas and the risk premium zones applicable to the community.

Flood Insurance Study see *flood elevation study.*

Flood plain or *flood-prone area* means any land area susceptible to being inundated by water from any source (see definition of "flooding").

Flood plain management means the operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and flood plain management regulations.

Flood plain management regulations means zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as a flood plain ordinance, grading ordinance and erosion control ordinance) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.

Flood protection system means those physical structural works for which funds have been authorized, appropriated, and expended and which have been constructed specifically to modify flooding in order to reduce the extent of the area within a community subject to a "special flood hazard" and the extent of the depths of associated flooding. Such a system typically includes hurricane tidal barriers, dams, reservoirs, levees or dikes. These specialized flood modifying works are those constructed in conformance with sound engineering standards.

Flood proofing means any combination of structural and non-structural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents.

Flood-related erosion means the collapse or subsidence of land along the shore of a lake or other body of water as a result of undermining caused by waves or currents of water exceeding anticipated cyclical

levels or suddenly caused by an unusually high water level in a natural body of water, accompanied by a severe storm, or by an unanticipated force of nature, such as a flash flood or an abnormal tidal surge, or by some similarly unusual and unforeseeable event which results in flooding.

Flood-related erosion area or *flood-related erosion prone area* means a land area adjoining the shore of a lake or other body of water, which due to the composition of the shoreline or bank and high water levels or wind-driven currents, is likely to suffer flood-related erosion damage.

Flood-related erosion area management means the operation of an overall program of corrective and preventive measures for reducing flood-related erosion damage, including but not limited to emergency preparedness plans, flood-related erosion control works, and flood plain management regulations.

Floodway —see *regulatory floodway.*

Floodway encroachment lines mean the lines marking the limits of floodways on Federal, State and local flood plain maps.

Freeboard means a factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed.

Functionally dependent use means a use which cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

Future-conditions flood hazard area, or *future-conditions floodplain* —see *Area of future-conditions flood hazard.*

Future-conditions hydrology means the flood discharges associated with projected land-use conditions based on a community's zoning maps and/or comprehensive land-use plans and without consideration of projected future construction of flood detention structures or projected future hydraulic modifications within a stream or other waterway, such as bridge and culvert construction, fill, and excavation.

General Counsel means the General Counsel of the Federal Emergency Management Agency.

Highest adjacent grade means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

Historic Structure means any structure that is:

(a) Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;

(b) Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;

(c) Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of the Interior; or

(d) Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:

(1) By an approved state program as determined by the Secretary of the Interior or

(2) Directly by the Secretary of the Interior in states without approved programs.

Independent scientific body means a non-Federal technical or scientific organization involved in the study of land use planning, flood plain management, hydrology, geology, geography, or any other related field of study concerned with flooding.

Insurance adjustment organization means any organization or person engaged in the business of

adjusting loss claims arising under the Standard Flood Insurance Policy.

Insurance company or *insurer* means any person or organization authorized to engage in the insurance business under the laws of any State.

Levee means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

Levee System means a flood protection system which consists of a levee, or levees, and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.

Lowest Floor means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage in an area other than a basement area is not considered a building's lowest floor; *Provided,* that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements of §60.3.

Mangrove stand means an assemblage of mangrove trees which are mostly low trees noted for a copious development of interlacing adventitious roots above the ground and which contain one or more of the following species: Black mangrove (Avicennia Nitida); red mangrove (Rhizophora Mangle); white mangrove (Languncularia Racemosa); and buttonwood (Conocarpus Erecta).

Manufactured home means a structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when attached to the required utilities. The term "manufactured home" does not include a "recreational vehicle".

Manufactured home park or subdivision" means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

Map means the Flood Hazard Boundary Map (FHBM) or the Flood Insurance Rate Map (FIRM) for a community issued by the Agency.

Mean sea level means, for purposes of the National Flood Insurance Program, the National Geodetic Vertical Datum (NGVD) of 1929 or other datum, to which base flood elevations shown on a community's Flood Insurance Rate Map are referenced.

Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress, and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs.

Mudslide (i.e., mudflow) area management means the operation of an overall program of corrective and preventive measures for reducing mudslide (i.e., mudflow) damage, including but not limited to emergency preparedness plans, mudslide control works, and flood plain management regulations.

Mudslide (i.e., mudflow) prone area means an area with land surfaces and slopes of unconsolidated material where the history, geology and climate indicate a potential for mudflow.

New construction means, for the purposes of determining insurance rates, structures for which the "start of construction" commenced on or after the effective date of an initial FIRM or after December 31, 1974, whichever is later, and includes any subsequent improvements to such structures. For floodplain management purposes, *new construction* means structures for which the *start of construction* commenced on or after the effective date of a floodplain management regulation adopted by a community and includes any subsequent improvements to such structures.

New manufactured home park or subdivision means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of floodplain management regulations adopted by a community.

100-year flood see *base flood.*

Participating community, also known as an *eligible community,* means a community in which the

Administrator has authorized the sale of flood insurance.

Person includes any individual or group of individuals, corporation, partnership, association, or any other entity, including State and local governments and agencies.

Policy means the Standard Flood Insurance Policy.

Premium means the total premium payable by the insured for the coverage or coverages provided under the policy. The calculation of the premium may be based upon either chargeable rates or risk premium rates, or a combination of both.

Primary frontal dune means a continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

Principally above ground means that at least 51 percent of the actual cash value of the structure, less land value, is above ground.

Program means the National Flood Insurance Program authorized by 42 U.S.C. 4001 through 4128.

Program deficiency means a defect in a community's flood plain management regulations or administrative procedures that impairs effective implementation of those flood plain management regulations or of the standards in §§60.3, 60.4, 60.5, or 60.6.

Project cost means the total financial cost of a flood protection system (including design, land acquisition, construction, fees, overhead, and profits), unless the Federal Insurance Administrator determines a given "cost" not to be a part of such project cost.

Recreational vehicle means a vehicle which is:

(a) Built on a single chassis;

(b) 400 square feet or less when measured at the largest horizontal projection;

(c) Designed to be self-propelled or permanently towable by a light duty truck; and

(d) Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

Reference feature is the receding edge of a bluff or eroding frontal dune, or if such a feature is not present, the normal high-water line or the seaward line of permanent vegetation if a high-water line cannot be identified.

Regular Program means the Program authorized by the Act under which risk premium rates are required for the first half of available coverage (also known as "first layer" coverage) for all new construction and substantial improvements started on or after the effective date of the FIRM, or after December 31, 1974, for FIRM's effective on or before that date. All buildings, the construction of which started before the effective date of the FIRM, or before January 1, 1975, for FIRMs effective before that date, are eligible for first layer coverage at either subsidized rates or risk premium rates, whichever are lower. Regardless of date of construction, risk premium rates are always required for the second layer coverage and such coverage is offered only after the Administrator has completed a risk study for the community.

Regulatory floodway means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

Remedy a violation means to bring the structure or other development into compliance with State or local flood plain management regulations, or, if this is not possible, to reduce the impacts of its noncompliance. Ways that impacts may be reduced include protecting the structure or other affected development from flood damages, implementing the enforcement provisions of the ordinance or otherwise deterring future similar violations, or reducing Federal financial exposure with regard to the structure or other development.

Risk premium rates mean those rates established by the Administrator pursuant to individual community studies and investigations which are undertaken to provide flood insurance in accordance with section

1307 of the Act and the accepted actuarial principles. "Risk premium rates" include provisions for operating costs and allowances.

Riverine means relating to, formed by, or resembling a river (including tributaries), stream, brook, etc.

Sand dunes mean naturally occurring accumulations of sand in ridges or mounds landward of the beach.

Scientifically incorrect. The methodology(ies) and/or assumptions which have been utilized are inappropriate for the physical processes being evaluated or are otherwise erroneous.

Second layer coverage means an additional limit of coverage equal to the amounts made available under the Emergency Program, and made available under the Regular Program.

Servicing company means a corporation, partnership, association, or any other organized entity which contracts with the Federal Insurance Administration to service insurance policies under the National Flood Insurance Program for a particular area.

Sheet flow area —see *area of shallow flooding.*

60-year setback means a distance equal to 60 times the average annual long term recession rate at a site, measured from the reference feature.

Special flood hazard area —see "area of special flood hazard".

Special hazard area means an area having special flood, mudslide (i.e., mudflow), or flood-related erosion hazards, and shown on an FHBM or FIRM as Zone A, AO, A1–30, AE, AR, AR/A1–30, AR/AE, AR/AO, AR/AH, AR/A, A99, AH, VO, V1–30, VE, V, M, or E.

Standard Flood Insurance Policy means the flood insurance policy issued by the Federal Insurance Administrator, or an insurer pursuant to an arrangement with the Administrator pursuant to Federal statutes and regulations.

Start of Construction (for other than new construction or substantial improvements under the Coastal Barrier Resources Act (Pub. L. 97–348)), includes substantial improvement, and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

State means any State of the United States, the District of Columbia, Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

State coordinating agency means the agency of the state government, or other office designated by the Governor of the state or by state statute at the request of the Administrator to assist in the implementation of the National Flood Insurance Program in that state.

Storm cellar means a space below grade used to accommodate occupants of the structure and emergency supplies as a means of temporary shelter against severe tornado or similar wind storm activity.

Structure means, for floodplain management purposes, a walled and roofed building, including a gas or liquid storage tank, that is principally above ground, as well as a manufactured home. *Structure,* for insurance purposes, means:

(1) A building with two or more outside rigid walls and a fully secured roof, that is affixed to a permanent site;

(2) A manufactured home ("a manufactured home," also known as a mobile home, is a structure: built on a permanent chassis, transported to its site in one or more sections, and affixed to a permanent

foundation); or

(3) A travel trailer without wheels, built on a chassis and affixed to a permanent foundation, that is regulated under the community's floodplain management and building ordinances or laws.

For the latter purpose, "structure" does not mean a recreational vehicle or a park trailer or other similar vehicle, except as described in paragraph (3) of this definition, or a gas or liquid storage tank.

Subsidized rates mean the rates established by the Administrator involving in the aggregate a subsidization by the Federal Government.

Substantial damage means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

Substantial improvement means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement. This term includes structures which have incurred "substantial damage", regardless of the actual repair work performed. The term does not, however, include either:

(1) Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions or

(2) Any alteration of a "historic structure", provided that the alteration will not preclude the structure's continued designation as a "historic structure".

30-year setback means a distance equal to 30 times the average annual long term recession rate at a site, measured from the reference feature.

Technically incorrect. The methodology(ies) utilized has been erroneously applied due to mathematical or measurement error, changed physical conditions, or insufficient quantity or quality of input data.

V Zone —see "coastal high hazard area."

Variance means a grant of relief by a community from the terms of a flood plain management regulation.

Violation means the failure of a structure or other development to be fully compliant with the community's flood plain management regulations. A structure or other development without the elevation certificate, other certifications, or other evidence of compliance required in §60.3(b)(5), (c)(4), (c)(10), (d)(3), (e)(2), (e)(4), or (e)(5) is presumed to be in violation until such time as that documentation is provided.

Water surface elevation means the height, in relation to the National Geodetic Vertical Datum (NGVD) of 1929, (or other datum, where specified) of floods of various magnitudes and frequencies in the flood plains of coastal or riverine areas.

Zone of imminent collapse means an area subject to erosion adjacent to the shoreline of an ocean, bay, or lake and within a distance equal to 10 feet plus 5 times the average annual long-term erosion rate for the site, measured from the reference feature.

[41 FR 46968, Oct. 26, 1976]

Editorial Note: ForFederal Registercitations affecting §59.1, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and on GPO access.

Browse Next

For questions or comments regarding e-CFR editorial content, features, or design, email ecfr@nara.gov.

For questions concerning e-CFR programming and delivery issues, email webteam@gpo.gov.

Section 508 / Accessibility

Appendix H

Code of Federal Regulations Title 44 Section 65.10 Mapping of Areas Protected by Levee Systems

Electronic Code of Federal Regulations
e-CFR TM

e-CFR Data is current as of September 17, 2008

Title 44: Emergency Management and Assistance

PART 65—IDENTIFICATION AND MAPPING OF SPECIAL HAZARD AREAS

Browse Previous | Browse Next

§ 65.10 Mapping of areas protected by levee systems.

(a) *General.* For purposes of the NFIP, FEMA will only recognize in its flood hazard and risk mapping effort those levee systems that meet, and continue to meet, minimum design, operation, and maintenance standards that are consistent with the level of protection sought through the comprehensive flood plain management criteria established by §60.3 of this subchapter. Accordingly, this section describes the types of information FEMA needs to recognize, on NFIP maps, that a levee system provides protection from the base flood. This information must be supplied to FEMA by the community or other party seeking recognition of such a levee system at the time a flood risk study or restudy is conducted, when a map revision under the provisions of part 65 of this subchapter is sought based on a levee system, and upon request by the Administrator during the review of previously recognized structures. The FEMA review will be for the sole purpose of establishing appropriate risk zone determinations for NFIP maps and shall not constitute a determination by FEMA as to how a structure or system will perform in a flood event.

(b) *Design criteria.* For levees to be recognized by FEMA, evidence that adequate design and operation and maintenance systems are in place to provide reasonable assurance that protection from the base flood exists must be provided. The following requirements must be met:

(1) *Freeboard.* (i) Riverine levees must provide a minimum freeboard of three feet above the water-surface level of the base flood. An additional one foot above the minimum is required within 100 feet in either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted. An additional one-half foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required.

(ii) Occasionally, exceptions to the minimum riverine freeboard requirement described in paragraph (b)(1)(i) of this section, may be approved. Appropriate engineering analyses demonstrating adequate protection with a lesser freeboard must be submitted to support a request for such an exception. The material presented must evaluate the uncertainty in the estimated base flood elevation profile and include, but not necessarily be limited to an assessment of statistical confidence limits of the 100-year discharge; changes in stage-discharge relationships; and the sources, potential, and magnitude of debris, sediment, and ice accumulation. It must be also shown that the levee will remain structurally stable during the base flood when such additional loading considerations are imposed. Under no circumstances will freeboard of less than two feet be accepted.

(iii) For coastal levees, the freeboard must be established at one foot above the height of the one percent wave or the maximum wave runup (whichever is greater) associated with the 100-year stillwater surge elevation at the site.

(iv) Occasionally, exceptions to the minimum coastal levee freeboard requirement described in paragraph (b)(1)(iii) of this section, may be approved. Appropriate engineering analyses demonstrating adequate protection with a lesser freeboard must be submitted to support a request for such an exception. The material presented must evaluate the uncertainty in the estimated base flood loading conditions. Particular emphasis must be placed on the effects of wave attack and overtopping on the stability of the levee. Under no circumstances, however, will a freeboard of less than two feet above the 100-year stillwater surge elevation be accepted.

(2) *Closures.* All openings must be provided with closure devices that are structural parts of the system during operation and design according to sound engineering practice.

(3) *Embankment protection.* Engineering analyses must be submitted that demonstrate that no appreciable erosion of the levee embankment can be expected during the base flood, as a result of either currents or waves, and that anticipated erosion will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and subsequent instability. The factors to be addressed in such analyses include, but are not limited to: Expected flow velocities (especially in constricted areas); expected wind and wave action; ice loading; impact of debris; slope protection techniques; duration of flooding at various stages and velocities; embankment and foundation materials; levee alignment, bends, and transitions; and levee side slopes.

(4) *Embankment and foundation stability.* Engineering analyses that evaluate levee embankment stability must be submitted. The analyses provided shall evaluate expected seepage during loading conditions associated with the base flood and shall demonstrate that seepage into or through the levee foundation and embankment will not jeopardize embankment or foundation stability. An alternative analysis demonstrating that the levee is designed and constructed for stability against loading conditions for Case IV as defined in the U.S. Army Corps of Engineers (COE) manual, "Design and Construction of Levees" (EM 1110–2–1913, Chapter 6, Section II), may be used. The factors that shall be addressed in the analyses include: Depth of flooding, duration of flooding, embankment geometry and length of seepage path at critical locations, embankment and foundation materials, embankment compaction, penetrations, other design factors affecting seepage (such as drainage layers), and other design factors affecting embankment and foundation stability (such as berms).

(5) *Settlement.* Engineering analyses must be submitted that assess the potential and magnitude of future losses of freeboard as a result of levee settlement and demonstrate that freeboard will be maintained within the minimum standards set forth in paragraph (b)(1) of this section. This analysis must address embankment loads, compressibility of embankment soils, compressibility of foundation soils, age of the levee system, and construction compaction methods. In addition, detailed settlement analysis using procedures such as those described in the COE manual, "Soil Mechanics Design—Settlement Analysis" (EM 1100–2–1904) must be submitted.

(6) *Interior drainage.* An analysis must be submitted that identifies the source(s) of such flooding, the extent of the flooded area, and, if the average depth is greater than one foot, the water-surface elevation (s) of the base flood. This analysis must be based on the joint probability of interior and exterior flooding and the capacity of facilities (such as drainage lines and pumps) for evacuating interior floodwaters.

(7) *Other design criteria.* In unique situations, such as those where the levee system has relatively high vulnerability, FEMA may require that other design criteria and analyses be submitted to show that the levees provide adequate protection. In such situations, sound engineering practice will be the standard on which FEMA will base its determinations. FEMA will also provide the rationale for requiring this additional information.

(c) *Operation plans and criteria.* For a levee system to be recognized, the operational criteria must be as described below. All closure devices or mechanical systems for internal drainage, whether manual or automatic, must be operated in accordance with an officially adopted operation manual, a copy of which must be provided to FEMA by the operator when levee or drainage system recognition is being sought or when the manual for a previously recognized system is revised in any manner. All operations must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP.

(1) *Closures.* Operation plans for closures must include the following:

(i) Documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials, that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists for the completed operation of all closure structures, including necessary sealing, before floodwaters reach the base of the closure.

(ii) A formal plan of operation including specific actions and assignments of responsibility by individual name or title.

(iii) Provisions for periodic operation, at not less than one-year intervals, of the closure structure for testing and training purposes.

(2) *Interior drainage systems.* Interior drainage systems associated with levee systems usually include storage areas, gravity outlets, pumping stations, or a combination thereof. These drainage systems will be recognized by FEMA on NFIP maps for flood protection purposes only if the following minimum criteria are included in the operation plan:

(i) Documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials, that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists to permit activation of mechanized portions of the drainage system.

(ii) A formal plan of operation including specific actions and assignments of responsibility by individual name or title.

(iii) Provision for manual backup for the activation of automatic systems.

(iv) Provisions for periodic inspection of interior drainage systems and periodic operation of any mechanized portions for testing and training purposes. No more than one year shall elapse between either the inspections or the operations.

(3) *Other operation plans and criteria.* Other operating plans and criteria may be required by FEMA to ensure that adequate protection is provided in specific situations. In such cases, sound emergency management practice will be the standard upon which FEMA determinations will be based.

(d) *Maintenance plans and criteria.* For levee systems to be recognized as providing protection from the base flood, the maintenance criteria must be as described herein. Levee systems must be maintained in accordance with an officially adopted maintenance plan, and a copy of this plan must be provided to FEMA by the owner of the levee system when recognition is being sought or when the plan for a previously recognized system is revised in any manner. All maintenance activities must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP that must assume ultimate responsibility for maintenance. This plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and systems are maintained. At a minimum, maintenance plans shall specify the maintenance activities to be performed, the frequency of their performance, and the person by name or title responsible for their performance.

(e) *Certification requirements.* Data submitted to support that a given levee system complies with the structural requirements set forth in paragraphs (b)(1) through (7) of this section must be certified by a registered professional engineer. Also, certified as-built plans of the levee must be submitted. Certifications are subject to the definition given at §65.2 of this subchapter. In lieu of these structural requirements, a Federal agency with responsibility for levee design may certify that the levee has been adequately designed and constructed to provide protection against the base flood.

[51 FR 30316, Aug. 25, 1986]

Browse Previous | Browse Next

For questions or comments regarding e-CFR editorial content, features, or design, email ecfr@nara.gov.

For questions concerning e-CFR programming and delivery issues, email webteam@gpo.gov.

Section 508 / Accessibility