

FLOOD CONTROL PERMIT NO. FC-36

Name of Applicant: City of Sioux Falls

Address: 224 W 9th St, Sioux Falls SD 57117

Phone: 605 367-8600

Amount of Water Claimed: Total Acres:

Source of Water Supply: Big Sioux River and Skunk Creek

Water to be used for: flood control project

County: Minnehaha

Type of Waste Disposal System:

Location:

PRIORITY

Date Received: 7-23-09

Application/License Fee: \$

Corrected Application Received: _

Period of Annual Use: January 1 – December 31

Remarks:

Diversion Point:

Land to be Irrigated: NA

Depth of Well:

Well Driller:

Remarks:

Type of Map:

Prepared by:

Reviewed and the Number Assigned on: 9-15-09

By: **Karen Schlaak**

Notice of Hearing - date to intervene: _____

FORM 2: Application for flood control permit
(type or print)

Mail to: Water Rights Program Joe Foss Building 523 E. Capitol Pierre, SD 57501-3181 (605) 773-3352	(office use only)	
	No. <u>FC-36</u>	Hydrologic Unit <u>10170203</u>
	Basin <u>Sioux River</u>	
	Newspaper <u>Argus Leader, PO Box 5034</u> <u>605-331-2200</u>	<u>Sioux Falls 57117</u>

RECEIVED
JUL 23 2009
WATER RIGHTS
PROGRAM

Application For Flood Control Permit Within The State Of South Dakota

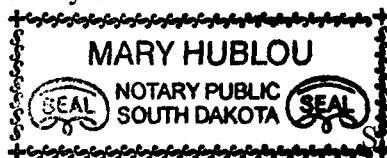
- Name of Applicant City of Sioux Falls
Address 224 W 9th St
(Street, RR or Box)
Sioux Falls SD 57117 Phone No. 367-8600
(City) (State) (Zip Code)
- Name of watercourse Big Sioux River and Skunk Creek
- Location of project (e.g. SW $\frac{1}{4}$ NE $\frac{1}{4}$ section 2-T89N-R58W)
Township 101 N Range 50 W, Township 101 N Range 49 W, and Township 102 N Range 49 W
- County or counties where project is located Minnehaha
- Give a brief description of the proposed project including the type of project (Dam, Dikes, Channel Modifications, etc.) and purpose for the project. When available include any preliminary engineering reports or other information that will help explain the project. (Attach sheet if more space is needed.)

The project continues raising the levee system along the Big Sioux River and Skunk Creek to provide continued protection for the 100-year flood events. Parts of Phase 2 and all of Phase 3 are to be completed with this project. After recalculations were done by the Army Corps of Engineers, it showed that the 100-year flood events were greater than previously thought and that the existing system did not provide for protection from the 100-year events in the channels. In order to meet Federal Emergency Management Administration Requirements to provide for continued protection of properties along the Big Sioux River and Skunk Creek, the City of Sioux Falls and the federal government through the United States Army Corps of Engineers are working together to improve the flood control system.

Attachment: Attach Map (see instructions)

STATE OF SOUTH DAKOTA) SS
County of Minnehaha)

I, DAVE MCKINSON the applicant, certify that I have read this application, have examined the attached map and that the matters are true and that I intend, and am able to complete the necessary construction.



Signed

Dave McKinson

Subscribed and sworn to before me this 8 day of July 2009

Mary Hublou

Notary Public

My Commission Expires

6-24-2014

CITY USE ONLY	
Agreement No. <u>09-3361</u>	Dept. No. and MOU <u>MDC</u>
P.O. No. <u>201279</u>	Attorney <u>JP2</u>
CIP No. <u>126049</u>	Finance <u>JP2</u>
Project <u>BSR Flood Control</u>	City Engineer <u>CSH 6/26/09</u>

SOUTH DAKOTA
FLOOD CONTROL PERMIT NO. FC-36

Date of first receipt of application July 23, 2009.

Date of return to applicant for corrections, amendments or changes July 31, 2009.

Date of receipt of corrected application September 15, 2009.

The Water Management Board approved Flood Control Permit No. FC-36 on December 9, 2009 for the City of Sioux Falls, 224 W 9th St, Sioux Falls SD 57117 authorizing subject to the following limitations, conditions and qualifications:

1. Flood Control Permit No. FC-36 authorizes improvements to the existing flood control system located within the corporate limits of Sioux Falls in Minnehaha County. The system reroutes and contains within levees, the Big Sioux River and Skunk Creek flood flows. The flood control system will be designed to provide protection for the 100-year flood event as defined by the US Corps of Engineers. The legal description of the project area includes sections within T101N, R49W; T101N, R50W and T102N, R49W. The project is divided into three phases. Phase 1, Phase 2A & 2B have been completed under authorization of Flood Control Permit No. FC-30. Phase 2C & Phase 3 will be constructed under Permit No. FC-36 (see public notice and report on FC-36 for a full description of the project).
2. The date from which applicant may claim right is July 23, 2009.
3. All construction is to be completed on or before December 9, 2014.

QUALIFICATIONS

1. The city of Sioux Falls is responsible for operation and maintenance of the flood control works.
2. Flood Control Permit No. FC-36 is subject to securing easement and/or land acquisitions on any areas, other than city property, where construction activities will take place or additional lands are flooded. These documents shall be held by the city of Sioux Falls and be available for review by the Department of Environment and Natural Resources.
3. Prior to construction of Phase 3, final design shall be submitted to the Chief Engineer of the Water Rights Program of DENR for review and approval.
4. Engineer change notices, software calibrations or other calculations that effect water surface elevations or seepage analysis data previously submitted are subject to review and approval by the Chief Engineer.
5. Design of all levees shall include measures to reduce uplift pressures to result in an exit gradient not to exceed 0.8 at the landward levee toe, to satisfy criteria in EM 1110-2-1901, Seepage Analysis and Control for Dams.
6. The Operation and Maintenance (O & M) Manual for the system shall be completed upon completion of construction. The manual shall set forth criteria for operation of the diversion dam in various flood events. The manual shall provide guidelines for the controlled breach of the levee system if a breach is needed to prevent a catastrophic, random failure and operating criteria for the gated dam structure on the Big Sioux River above Skunk Creek's confluence with the river. The operating manual is subject to review and approval by the Chief Engineer.
7. The Water Management Board retains jurisdiction of Flood Control Permit Nos. FC-30 and FC-36 in the event that additional information shows this project causes an increase in the severity of flood damages in areas other than the project area.

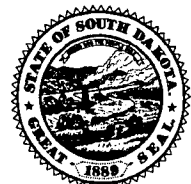
WATER MANAGEMENT BOARD

By: Garland Erbe

Garland Erbe, Chief Engineer
Water Rights Program
Department of Environment and Natural Resources

JAN 14 2010

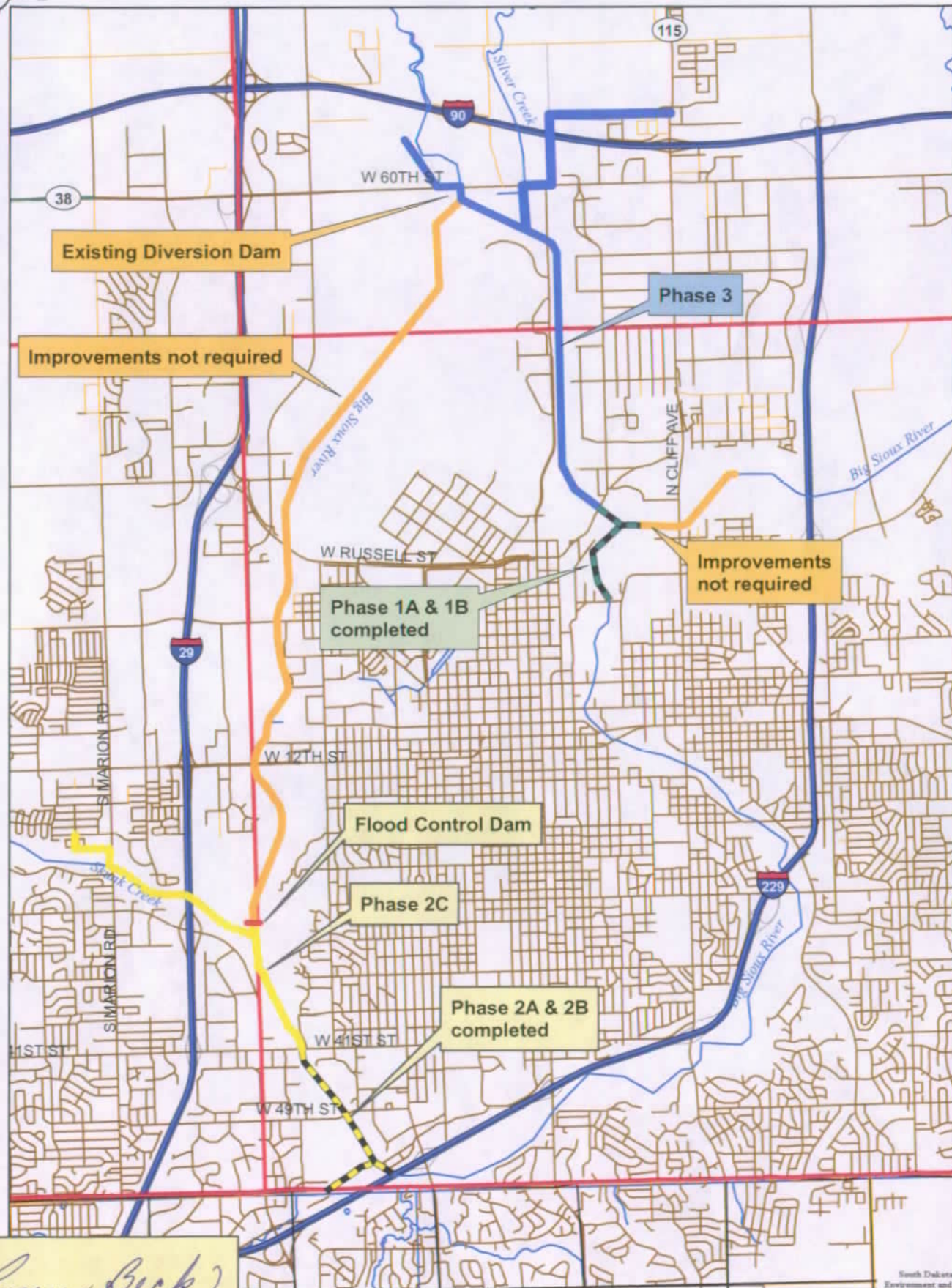
date



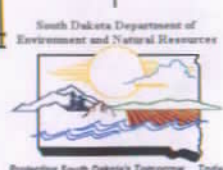


FLOOD CONTROL PERMIT FC-36

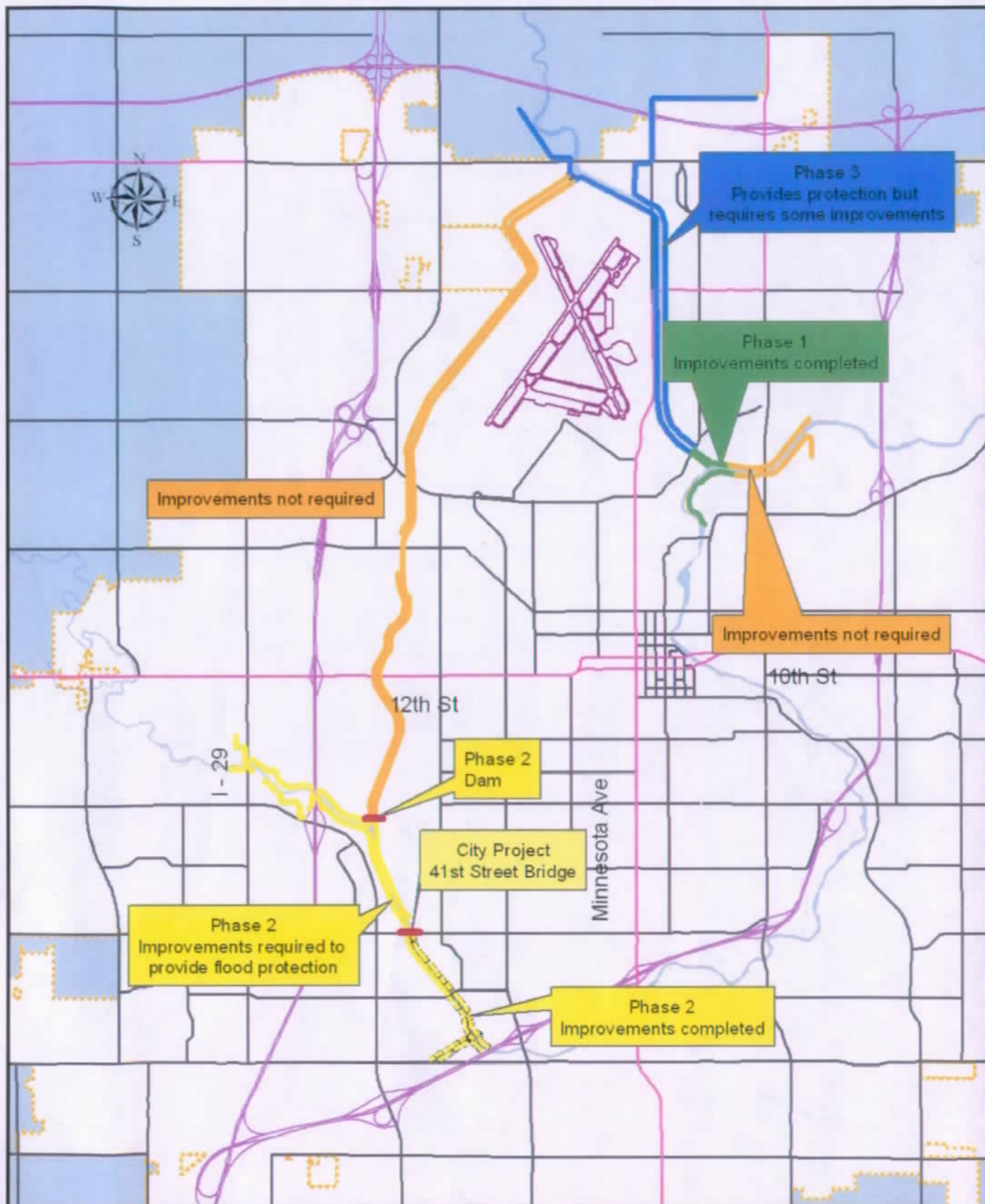
City of Sioux Falls Flood Control System



Lynn Beck
Lynn Beck
DENR - Water Rights Program
October 27, 2009



City of Sioux Falls Flood Control System

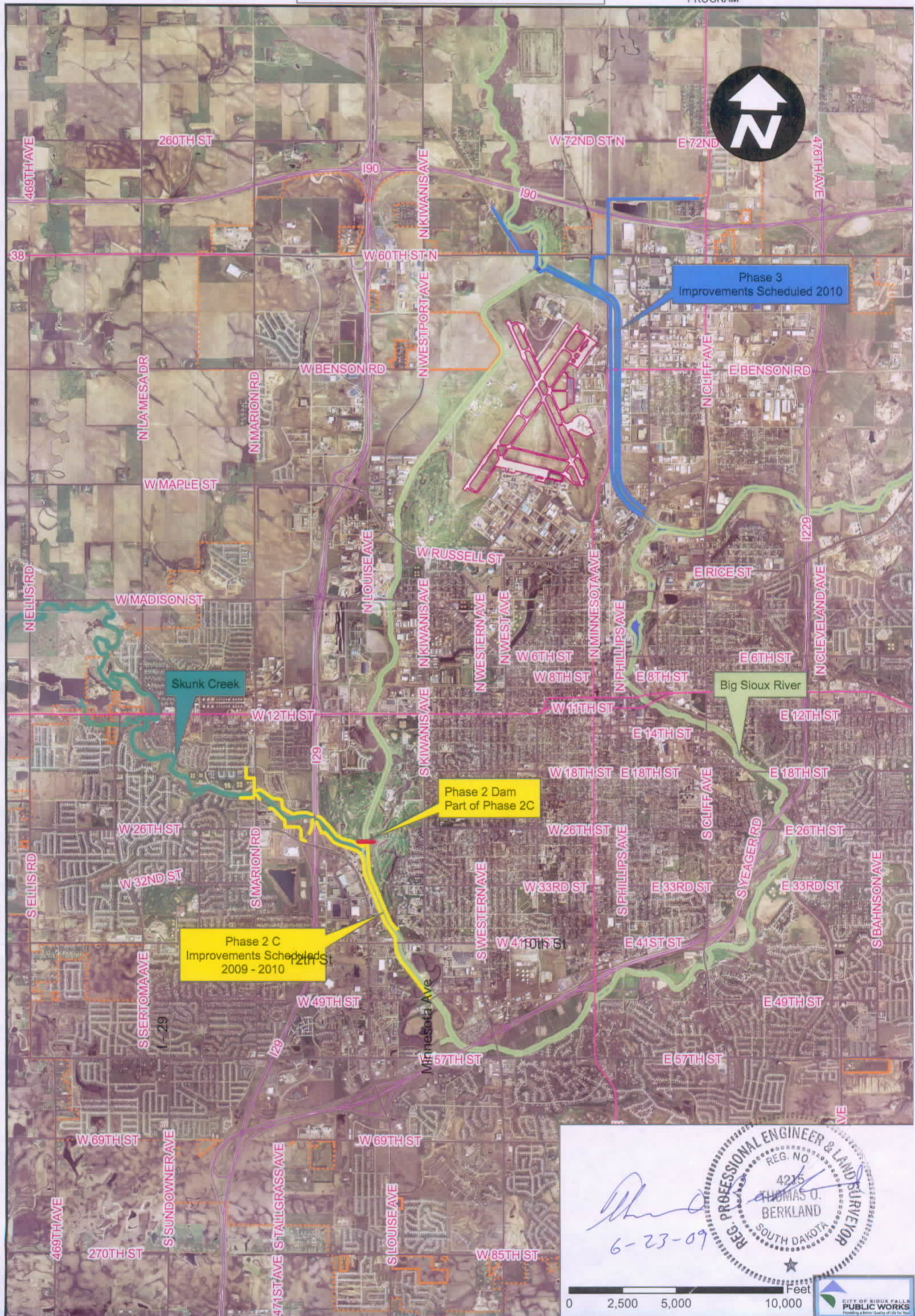


City of Sioux Falls Flood Control System Permit Application

RECEIVED

JUL 23 2009

WATER RIGHTS
PROGRAM



Phase 3
Improvements Scheduled 2010

Phase 2 Dam
Part of Phase 2C

Phase 2 C
Improvements Scheduled
2009 - 2010

6-23-09

PROFESSIONAL ENGINEER & LAND SURVEYOR
REG. NO. 4215
THOMAS O. BERKLAND
SOUTH DAKOTA

0 2,500 5,000 10,000 Feet

CITY OF SIOUX FALLS
PUBLIC WORKS
Providing a Better Quality of Life for You

RECEIPT

WATER RIGHTS PROGRAM

South Dakota Department of Environment and Natural Resources

Date 11/19, 20 09

RECEIVED OF City of Sioux Falls PO Box 7002 Sioux Falls SD 57717

The following amount in fees for services rendered as provided for by law:

Fee for Application for Permit No. <u>FC-36</u> to Appropriate Water, to construct and to put water to beneficial use	300	00
Fee for Application for Permit No. _____ to Appropriate Water for Future use		
Fee to retain Future Use Permit No. _____ after period of seven years.		
Fee for Inspecting Constructed Works, confirming beneficial use and issuing Water License No. <u>FC-36</u>	200	00
Fee for Filing Transfer Form _____		
Fee for _____		
Fee for Issuing New Well Driller's License No. _____ for C.Y. _____		
Fee for Renewal of Well Driller's License No. _____ for C.Y. _____		
Fee for Issuing Well Pump Installer's License No. _____ for C.Y. _____		
Fee for Renewal of Well Pump Installer's License No. _____ for C.Y. _____		
(Any Other Work Provided by Law)	TOTAL	500 00

99

No. 04246

By *Michael Erbe*
Chief Engineer

RECEIPT

WATER RIGHTS PROGRAM

South Dakota Department of Environment and Natural Resources

Date 8/3, 2009

RECEIVED OF City of Sioux Falls PO Box 7042 Sioux Falls SD 57117

The following amount in fees for services rendered as provided for by law:

Fee for Application for Permit No. _____ to Appropriate Water, to construct and to put water to beneficial use	200	00
Fee for Application for Permit No. _____ to Appropriate Water for Future use		
Fee to retain Future Use Permit No. _____ after period of seven years.		
Fee for Inspecting Constructed Works, confirming beneficial use and issuing Water License No. _____		
Fee for Filing Transfer Form _____		
Fee for _____		
Fee for Issuing New Well Driller's License No. _____ for C.Y. _____		
Fee for Renewal of Well Driller's License No. _____ for C.Y. _____		
Fee for Issuing Well Pump Installer's License No. _____ for C.Y. _____		
Fee for Renewal of Well Pump Installer's License No. _____ for C.Y. _____		
(Any Other Work Provided by Law)	TOTAL	200 00

No. 04190

By

Michael Erbe
Chief Engineer

Gronlund, Eric

From: Beck, Lynn
Sent: Monday, August 10, 2009 7:43 AM
To: Gronlund, Eric; Rath, Mark; Schaal, Tim
Subject: RE: Permit Application

I just looked at the project to see where they were since the construction period was up 7-10-2008. It is a multi step project and as a result there were updates that require application in addition to the fact that the construction period had expired. Tom Berkland inherited the project administration since he was the only one left in the office that was around when it started but he was not part of the original staff working on it. The corps' seepage study has been submitted and it is another long document that gives one a headache. I think the dam has been part of the original project but the type has been an issue. When I visited with Tom there was no final decision other than a dam is needed. Tim, weren't you in on some of the discussion when Sioux Falls was looking at a bladder type dam? Anyway, there was no final dam plan so the dam analysis was not done so no dam permit until it is and when the dam analysis comes in I think the dam engineer is the best to do the dam review.

-----Original Message-----

From: Gronlund, Eric
Sent: Friday, August 07, 2009 3:52 PM
To: Rath, Mark; Schaal, Tim; Beck, Lynn
Subject: FW: Permit Application

Did any of you even attempt to look at this?. I did briefly and got dizzy. Barring no comments from anyone on what else is needed my thoughts are:

- 1) for the administrative record we will need a hard copy (whether that's us print out 277 pages or make them submit it I don't much care)
- 2) I see plans for this concrete dam but not the supporting analysis regarding sizing, etc. While the hydrology from the original permit may not change, it seems to me that placing a concrete dam in the middle of the Big Sioux River would change the analysis in some manner and I think that supporting documentation needs to be included.

I'm not sure which of you is taking the lead on this? Lynn did an inspection of FC-30 but this now also includes a dam as part of the review.

-----Original Message-----

From: Berkland, Tom [mailto:tberkland@SIOUXFALLS.org]
Sent: Wednesday, August 05, 2009 9:00 AM
To: Gronlund, Eric
Cc: Berg, Andrew
Subject: Permit Application

Eric,

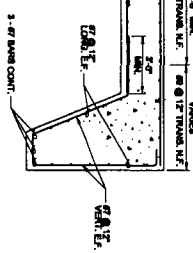
The hydrology has not changed from the original permit, do you need the Corps to resend the information for this permit application? Will you need paper copies of the plans or are the electronic copies acceptable? I have placed the Corps of Engineers construction plans and specs for Phase 2 are on our ftp site. You may access it by going to <http://files.siouxfalls.org>

The login ID is sddenr and the password is cola44

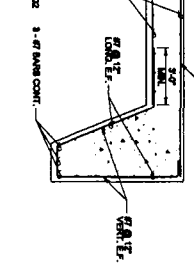
The Corps does not have the plans completed for Phase 3. We will submit them when they are done. I will process a check for the additional \$500.

Tom Berkland, LS-PE
Principal Engineer
City of Sioux Falls Public Works / Engineering

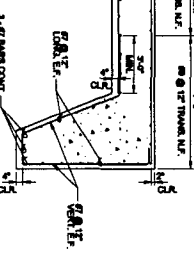
SECTION
SECTION 1
SCALE: 3/8" = 1'-0"



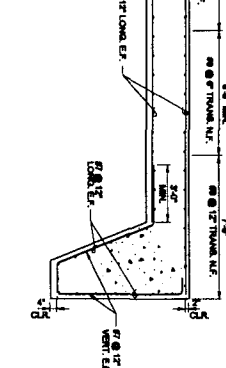
SECTION
SECTION 2
SCALE: 3/8" = 1'-0"



SECTION
SECTION 3
SCALE: 3/8" = 1'-0"



SECTION
SECTION 4
SCALE: 3/8" = 1'-0"



ALL SCALES SHOWN ARE BASED ON A STANDARD DRAWING SIZE OF 36" X 48" OR METRIC DRAWING SIZE OF 1000mm X 750mm. IF ANY OTHER SIZE DRAWINGS ARE FURNISHED OR PLOTTED THE CONTRACTOR SHALL ADJUST THE SCALES ACCORDINGLY. THE CONTRACTOR SHALL ALSO ADVISE SUB-CONTRACTORS OF THE ABOVE.

**MISSOURI RIVER AND BOLCK CREEK
SOUTH DAKOTA
CONCRETE DAM
FLOOD PROTECTION PROJECT - PHASE 2C
CONCRETE DAM - REINFORCEMENT DETAILS**

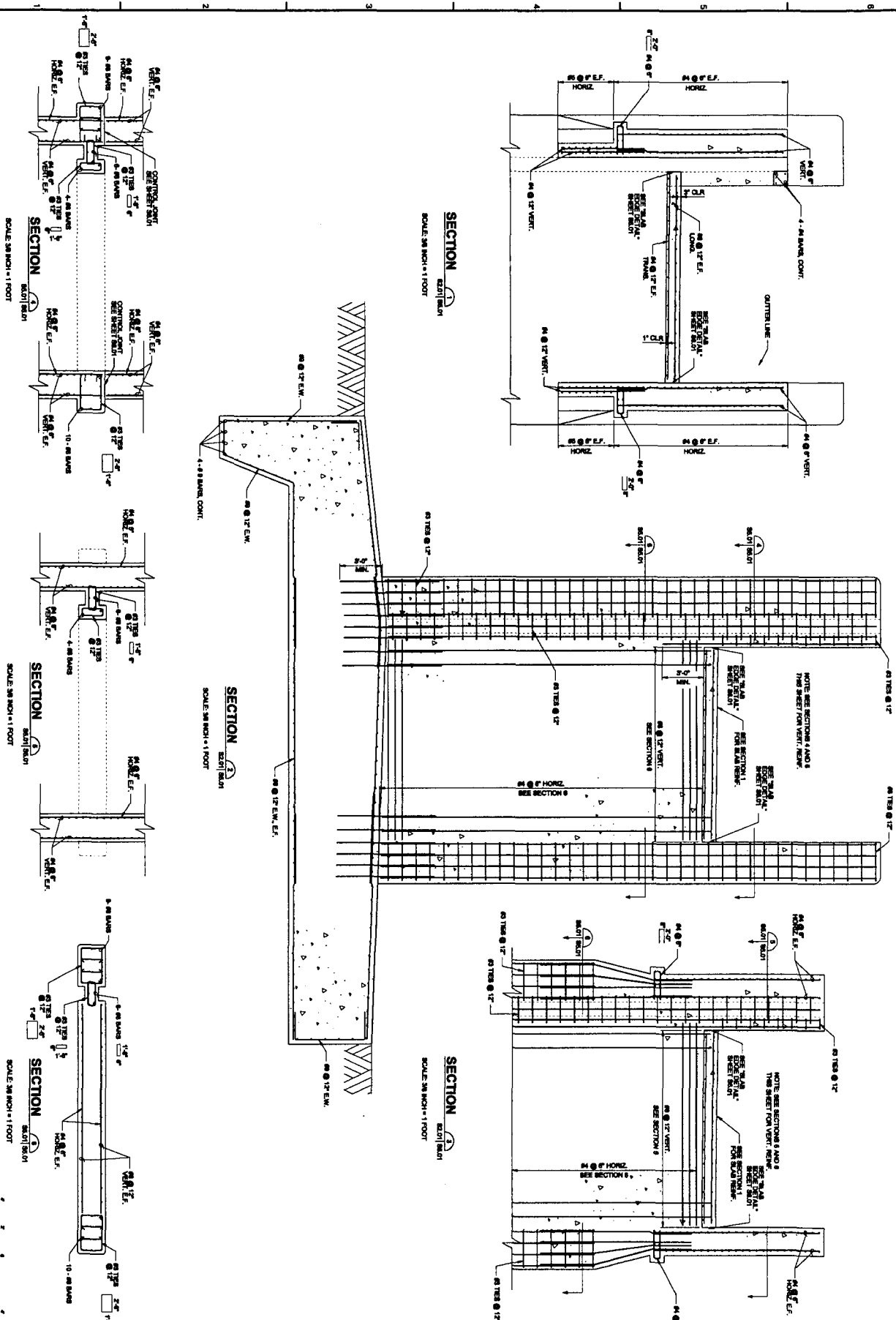
Designed by: N.E. PARSONS
Submitted by: BRUCE H. HARRIS
Date: 10/20/2008
Drawn by: N.E.P.
Checked by: N.E.P.
Date: 10/20/2008

Date: OCTOBER 2008
Design File Name: 022008022.dgn
Plot Scale Ratio: 1:1
Drawing Code: MS23-022

Rev:	
Spec. No.:	
Contract No.:	
Project No.:	
Sheet No.:	
Sheet Title:	



Sheet
Number:
55.02



ALL SCALES SHOWN ARE BASED ON A STANDARD DRAWING SIZE OF 36" X 48" OR METRIC DRAWING SIZE OF 1000mm X 1250mm. IF ANY OTHER SIZE DRAWINGS ARE ALLOWED OR PLOTTED, THE CONTRACTOR SHALL ADJUST THE SCALES ACCORDINGLY. THE CONTRACTOR SHALL ALSO ADVISE SUB-CONTRACTORS OF THE ABOVE.

800 SIOUX RIVER AND SIOUX CREEK
SIOUX FALLS SOUTH DAKOTA
CONCRETE DAM
FLOOD PROTECTION PROJECT - PHASE 2C
CONCRETE DAM - REINFORCEMENT DETAILS

Designed by: N.E.P.
N.E. PARSONS
Submitted by: BRUCE H. HARRIS
Date: 10/20/00
Cust:

Date: OCTOBER 2000
Design File Name: 8P200007.dgn
Plot Scale Ratio: 1:1
Drawing Code: 8583-022

Rev.	Spec. No.	Contract No.
1	W920P-08-3-000X	W920P-08-3-000X



Sheet
Number
S5.01

Gronlund, Eric

From: Berkland, Tom [tberkland@SIOUXFALLS.org]
Sent: Wednesday, August 12, 2009 10:20 AM
To: Gronlund, Eric
Cc: Uptmor, Louis E NWO; Adams, Kevin K NWO; Berg, Andrew
Subject: RE: Permit Application

Eric,

Phase 1 was completed in 2002. The modeling for the project included all improvements (Phase 1, 2 & 3). The Corps did modeling for the concrete dam. I will ask Kevin Adams, with the Corps, to provide a copy of that model.

Tom

From: Eric.Gronlund@state.sd.us [mailto:Eric.Gronlund@state.sd.us]
Sent: Tuesday, August 11, 2009 11:25 AM
To: Berkland, Tom
Subject: RE: Permit Application

Tom:

- 1) A paper copy is required for the administrative record on the application.
- 2) It was my understanding that since the time FC-30 was obtained back in 2003, the height of the levees were in Phase 1 were increased. Is this incorrect? If the height of the levees were increased, I assume the COE updated the computer analysis to assess the impacts. If this has been conducted, a copy should accompany the application.
- 3) Soon after FC-30 was issue there was discussion of this dam on the Big Sioux River upstream of Skunk Creek's confluence with the river. It began as a concept for a rubber/bladder dam with uncertainties on whether it will be actually be part of the project. The submitted plans for Phase 2C include a concrete dam. Did the COE conduct computer modeling analysis for the dam? This is necessary for both the flood control application and review and approval under state dam safety regulations.

Eric Gronlund
Water Rights Program, DENR
605 773-3352
eric.gronlund@state.sd.us

-----Original Message-----

From: Berkland, Tom [mailto:tberkland@SIOUXFALLS.org]
Sent: Wednesday, August 05, 2009 9:00 AM
To: Gronlund, Eric
Cc: Berg, Andrew
Subject: Permit Application

Eric,

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09/11/2009

copies acceptable? I have placed the Corps of Engineers construction plans and specs for Phase 2 are on our ftp site. You may access it by going to <http://files.siouxfalls.org>

The login ID is sddenr and the password is cola44

The Corps does not have the plans completed for Phase 3. We will submit them when they are done.

I will process a check for the additional \$500.

Tom Berkland, LS-PE

Principal Engineer

City of Sioux Falls Public Works / Engineering

(605) 367-8611

tberkland@siouxfalls.org





REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

RECEIVED

SEP 15 2009

WATER RIGHTS
PROGRAM

14 September 2009

Mr. Eric Gronlund, PE
Water Rights Program, DENR
Joe Foss Building
523 East Capitol Avenue
Pierre, SD 57501

Dear Mr. Gronlund,

Thank you for your time and discussion last Friday afternoon on the Big Sioux River and Skunk Creek Flood Protection Project. Per discussion, we are forwarding the following:

- 1) Phase 2A Plans (hard copy)
- 2) Phase 2B Plans (hard copy)
- 3) Phase 2C Plans (hard copy includes the Phase 2C Dam)
- 4) Plans and Specifications in pdf format for Phase 2A, 2B, and 2C (CD)
- 5) Big Sioux River and Skunk Creek RAS Model (DVD)

Please feel free to contact me regarding any questions. I may be contacted at 402-995-2713 or Louis.E.Uptmor@usace.army.mil. I will coordinate any questions with the appropriate internal technical disciplines accordingly.

Thank you,

Louis E. Uptmor, PE, PMP





**US Army Corps
of Engineers**
Omaha District

Project:	Sioux Falls Levee Improvements					Sheet No.	1/3
CENWO-ED-HD							
Subject:	RAS Modeling						
Computed by:	KKA	Date:	Sep 2009	Checked by:	RLK	Date:	9/21/09
Revised by:		Date:					

1. References.

- HEC-RAS User's Manual.
- HEC-RAS Application's Guide.
- HEC-GeoRAS User's Manual.

2. HEC-GeoRAS.

- Version 3.1 HEC-GeoRAS was used to create cross sections and centerlines in ArcView for Phase I, Phase II, the majority of Phase III, and the Section 22 Reach. All of this data is properly georeferenced. Additional data was incorporated during the RAS modeling that is not properly georeferenced, including the area between diversion dam and Russell Street and some of the Silver Creek area. The georeferencing does not impact the actual RAS modeling.
- ArcView has since been replaced by ArcMap for GIS and GeoRAS applications.

3. HEC-RAS Geometry.

- Separate HEC-RAS models were initially set up for the various phases (I, II, and III) of the Sioux Falls Levee Improvement Project and the Sioux Falls Section 22 Study due to scheduling and funding constraints.
- After the Phase III model was set up, it became apparent that it did not adequately address flow leaving the Big Sioux River (BSR), entering Silver Creek, and returning to the Diversion Channel. Therefore, the split flow option was added to connect Silver Creek to the BSR and the Diversion Channel. Cross Sections that had previously been used to model the BSR that extended across Silver Creek were copied and used for both reaches. The blocked obstruction option was used to limit flow to the appropriate river or creek. Additional upstream cross sections were added from the old FIS HEC-2 model that were beyond the TIN surface used to create the geometry. The Silver Creek centerline and the HEC-2 cross sections are not georeferenced.
- The individual models were then combined into a single RAS model to represent the levee and river system in Sioux Falls. The upstream limits of the model are approximately 12th Street on Skunk Creek and north of I-90 on the BSR and Silver Creek. The downstream limit is approximately Cliff Ave downstream from the chute. Supplemental cross sections based on the O&M Manual channel design were added to the historic river reach to connect the area between Phase II (approximately Russell Street) and Phase III (existing diversion dam). Although these area appear correct on the RAS plan view, they are not georeferenced. Cross sections representing the chute were added connecting Phase I and Phase III. The diversion dam structure was also added as an inline gated structure.



**US Army Corps
of Engineers**
Omaha District

Project:	Sioux Falls Levee Improvements					Sheet No.	2/3
CENWO-ED-HD							
Subject:	RAS Modeling						
Computed by:	KKA	Date:	Sep 2009	Checked by:	RLK	Date:	9/21/09
Revised by:		Date:					

- Some stationing was renamed to facilitate a single model with proper reach designations. Further renaming adjustments were made to the stationing to facilitate FDA modeling. Adjustments followed a constant shift such as adding 10000 feet or dividing by 1000 to the original stationing to allow comparison of model values without changing cross section reach lengths.
- Although the combined RAS model was verified against individual RAS model results, water surface profiles and specific cross section cwsel values from the combined RAS model vary up to 0.2' from individual phase models.
- The individual models were set up using different versions of HEC-RAS. All current modeling of the combined reaches uses HEC-RAS version 4.0.
- The model assumes that the 41st bridge is raised and is entered into the RAS model based on the new bridge plans. The City of Sioux Falls will raise this bridge independently from the levee raise projects. This work is currently scheduled for award in late 2009.
- The new backflow dam was added to the model as an inline structure.

4. HEC-RAS Flow.

- FEMA and the COE have adopted different statistical analytical methods for determining frequency discharges. FEMA uses a "without expected" probability to compute frequency discharges that makes no adjustments based on the available years of record data. COE uses a "with expected" probability to compute frequency discharges that makes an adjustment based on the available years of record data. Both frequencies have been referenced in documents associated with this project.
- The flows in the current RAS model use the FEMA frequency discharges that were used in the Conditional Letter of Map Revision (CLOMR) and will be used in the Letter of Map Revision (LOMR) and the levee certification process.
- The RAS model includes two different flood sources; the Big Sioux River and Skunk Creek. A hydrologic analysis determined that the two sources do not produce coincident floods. For modeling purposes, a constant 2-year flood event was used coincident with the variable frequency flood events from the other source.

5. Background.

- The designed raised top of levee elevation was set equal to the water surface profile for the design discharge for Phase II. This method was identified in the 1993 Feasibility Study. The design or equivalent discharge was a discharge greater than the 100-year frequency discharge. The equivalent discharge is determined by comparing rating curves for two different Manning's "n" values--one for design conditions and one for an increased roughness condition to capture all the uncertainties inherent in hydraulic



**US Army Corps
of Engineers**
Omaha District

Project:	Sioux Falls Levee Improvements					Sheet No.	3/3
CENWO-ED-HD							
Subject:	RAS Modeling						
Computed by:	KKA	Date:	Sep 2009	Checked by:	RLK	Date:	9/21/09
Revised by:		Date:					

modeling. The model also incorporated debris on bridges in determining the water surface profile to set the levee height. Additional freeboard was not added to this computed water surface. The freeboard was provided by the increased equivalent discharge. The design discharge for Skunk Creek and the Phase II levee raise was 29,000 cfs; compared to a with expected probability 100-year event discharge of 23,500 cfs and a without expected probability 100-year event discharge of 20,800 cfs.

- The designed raised top of levee elevation was set equal to the water surface profile for the 500-year event for Phase I and Phase III. This method was identified in the 1993 Feasibility Study. However, this included a release through the fuseplug north of the diversion dam into the area behind the levee system northwest of the project. During the Phase III design, it became apparent that with new survey data, the contour of the land would not allow the designed discharge to exit through the fuseplug and flow out of the system. New criteria was developed and agreed to during the Phase III design process to provide a maximum levee capacity system that did not utilize a fuseplug and also met discharge limitations from the recently completed Phase I chute walls renovations. This provides a slightly larger than 200-yr event protection level.
- The Feasibility Study included levee raises from the confluence of the Big Sioux River and Skunk Creek to approximately Russell Street. Because of complications associated with impacts to a railroad bridge in this area, the plan was revised to replace the levee raise with an inflatable dam preventing backflow for Skunk Creek flow in this area. After design was nearly complete, Bridgestone, the sole source provider of an inflatable dam of the required size, quit making the product. The inflatable dam was then replaced with the more conventional concrete and steel gated structure. The new backflow dam is included in the RAS model.

6. Analysis.

- The designed top of levee raise for all phases was compared to the more traditional FEMA 100-year level of protection with 3 feet of freeboard to ensure that the project would meet FEMA requirements.
- The gates for the new Phase II backflow dam were sized and configured to ensure minimal upstream impacts.
- The model includes the no levee area between I-229 and Falls Park Road as well as the no raise of the existing levee area between Skunk Creek and the existing diversion dam.
- Joint operating criteria of dams will be developed in the new Operations & Maintenance Manual.

Flood Control Application No. FC-36
City of Sioux Falls

Top of Levee Elev. - 1424.85' Cat. 3 - Low Hazard Dam

Top of Bridge Elev. - 1423.85'

Max. Water Level DS - 1423.85'

Max. Water Level US - 1420

Gate Bottom/Floor Elev. - 1400'

Ht. = 23.85' ft.

Normal Storage Capacity - 0 Ac-Ft (Flood Control Dam)
Max. Storage Capacity - 660 Ac-Ft

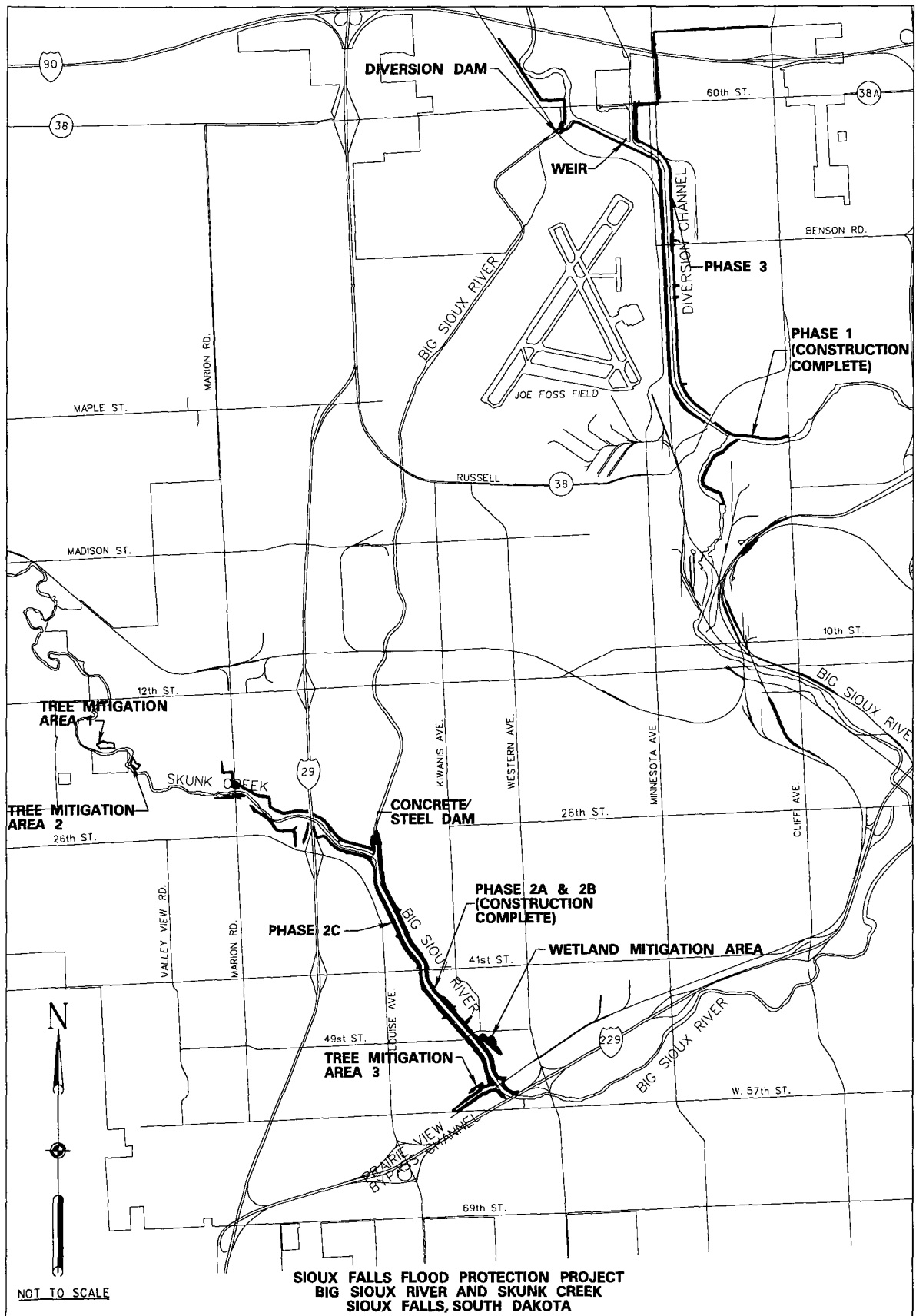
Cat. 3 - Small Size Dam - 50 yr Minimum Spillway Design

The Big Sioux River/Skunk Creek Dam will have 10-8' x 15' steel gates and designed for a $Q_{100} = 7300$ cfs - the same capacity as the upstream Sioux Falls Diversion Dam.

The City of Sioux Falls Diversion Dam (SD 00697) & the Diversion Weir are located upstream on the Big Sioux River and Diversion Channel. They are listed as Cat. 2 - Significant Hazard Dams due to their operation as part of the City's water supply system. The Big Sioux River/Skunk Creek Dam will be operated to prevent Skunk Creek flood flows from backing-up into the Big Sioux River. It will not be part of the water supply system; therefore it will be listed on the National Inventory of Dams (NID) as a Cat. 3 - Low Hazard Dam.

Section 74:02:08:09

1. Topo Map - OK
2. Dam Axis Profile - OK
3. Dam Max. X-Sec. - OIS
4. Area Capacity - OK
5. Inlet Details - OIS
6. Spillway Discharge - OIS
7. Spillway Details - OIS
8. Specs - OK
9. EPP - N/A Cat 3 - OK





Sheet Number	56.02
Project Name	CONCRETE DAM - MISCELLANEOUS DETAILS
Phase	FLOOD PROTECTION PROJECT - PHASE 2C
Drawn By	W.E. PHIBBS
Checked By	BRUCE N. HANSEN
Date	11/1/80
Project No.	MS-83-022
Contract No.	MS-83-022
Drawn By	W.E. PHIBBS
Checked By	BRUCE N. HANSEN
Date	11/1/80
Project No.	MS-83-022
Contract No.	MS-83-022

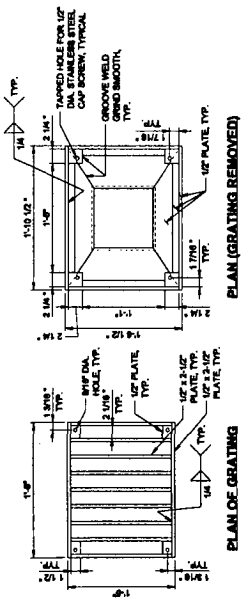
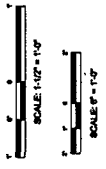
Drawn By	W.E. PHIBBS
Checked By	BRUCE N. HANSEN
Date	11/1/80
Project No.	MS-83-022
Contract No.	MS-83-022

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Date	11/1/80
Project No.	MS-83-022
Contract No.	MS-83-022

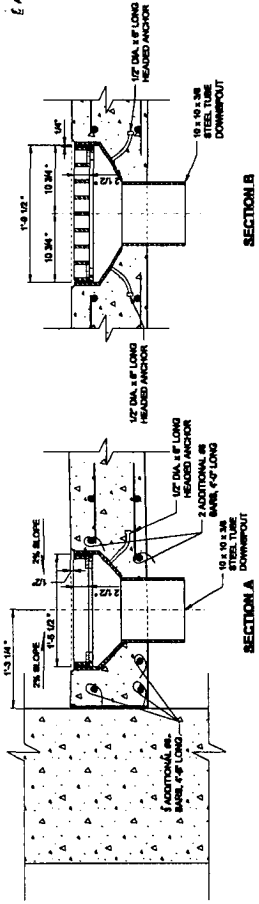
Drawn By	W.E. PHIBBS
Checked By	BRUCE N. HANSEN
Date	11/1/80
Project No.	MS-83-022
Contract No.	MS-83-022

Drawn By	W.E. PHIBBS
Checked By	BRUCE N. HANSEN
Date	11/1/80
Project No.	MS-83-022
Contract No.	MS-83-022

ALL DIMENSIONS SHOWN ARE BASED ON A STANDARD DRAWING SIZE OF 36" X 48" OR LARGER. DIMENSIONS OF 36" X 48" OR LARGER SHALL BE ADJUSTED TO FIT THE DRAWING SIZE. DIMENSIONS OF 36" X 48" OR LARGER SHALL BE ADJUSTED TO FIT THE DRAWING SIZE. DIMENSIONS OF 36" X 48" OR LARGER SHALL BE ADJUSTED TO FIT THE DRAWING SIZE.



PLAN (GRATING REMOVED)



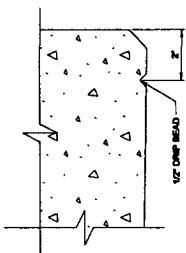
SECTION A

SECTION B

SLAB SCUPPER DETAILS

SCALE 1/8" = 1'-0"

- NOTES:
1. STEEL SHALL CONFORM TO ASTM A572, GRADE 50.
 2. WELDING SHALL CONFORM TO AWS D1.1, E70XX.
 3. ELECTRODES.
 4. REINFORCEMENT SHALL BE 13" MISCELLANEOUS METAL FABRICATIONS.
 5. FIELD-BEND OR CUT REINFORCEMENT TO CLEAR SCUPPER A MINIMUM OF 1 INCH.

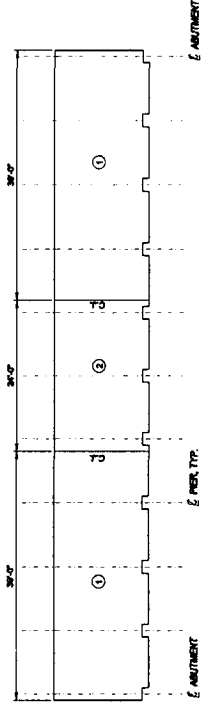


DRIP BEAD DETAIL

SCALE 1/8" = 1'-0"

SLAB POURING SEQUENCE

SCALE: NO SCALE



NOTES:

1. ① INDICATES POUR NUMBER.
2. POURS WITH THE SAME NUMBER MAY BE PLACED SIMULTANEOUSLY DURING THE SAME POURING OPERATION OR SEPARATELY. IF SEPARATELY, THE POURS SHALL BE PLACED WITHIN 15 MINUTES OF EACH OTHER. IF PLACED SEPARATELY, THE POURS SHALL BE PLACED WITHIN 15 MINUTES OF EACH OTHER.
3. A MINIMUM OF 72 HOURS SHALL ELAPSE BETWEEN ADJACENT POURS.
4. THE CONTRACTOR MAY ADJUST AN ALTERNATE POURING SEQUENCE SUBJECT TO THE APPROVAL OF THE ENGINEER.
5. REINFORCEMENT SHALL BE CONTINUOUS THROUGH CONSTRUCTION JOINTS (C.J.).



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

November 6, 2009

Thomas Berkland
Public Works Department
City of Sioux Falls
224 W. 9th Street
Sioux Falls, SD 57117

Dear Mr. Berkland:

We have reviewed the plans and specifications for the City of Sioux Falls Concrete Dam project associated with the Phase 2C Big Sioux River and Skunk Creek Flood Protection Project. The Concrete Dam will be located on the Big Sioux River just upstream of the confluence of Skunk Creek in the NE $\frac{1}{4}$ NE $\frac{1}{4}$ of Sec. 25-T101N-R50W, in Minnehaha County. The plans and specifications for your dam are approved. Approval of the plans and specifications does not authorize construction of the dam. The construction of the dam may not begin until Flood Control Application No. FC-36 is approved.

Our review was to determine compliance with the requirements of the Water Management Board Safety of Dams Rules, Chapter 74:02:08. Approval of these plans and specifications does not release the City of Sioux Falls, as owner of the dam, from the responsibility for operating and maintaining the dam in good repair to ensure the safety of the dam.

The Big Sioux River/Skunk Creek Dam will be classified as a small size Category 3, Low Hazard dam with a dam height of 23.85 feet and a normal storage capacity of 0 acre-feet (flood control dam) and a maximum storage capacity of 660 acre-feet.

If you have any questions, please feel free to contact us.

Sincerely,

Timothy G. Schaal, P.E.
Natural Resources Engineering Specialist
for Garland Erbele, Chief Engineer
Water Rights Program
(605) 773-3352

c: Louis E. Uptmor, US Army Corps of Engineers



**DEPARTMENT of ENVIRONMENT
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www.state.sd.us/denr

October 15, 2009

Thomas Berkland
Public Works Department
City of Sioux Falls
224 W 9th St
Sioux Falls SD 57117

Dear Mr. Berkland:

On July 23, 2009, you submitted *an Application for Flood Control Permit Within the State of South Dakota* on behalf of the City of Sioux Falls.

- A check for \$200.00 accompanied the application. The application/licensing fee for this flood control permit is \$700.00. This letter is a reminder that an additional \$500.00 is required.

If you have any questions, please contact me.

Sincerely,

Karen Schlaak
Water Rights Program
605 773-3352
karen.schlaak@state.sd.us

City of *Sioux Falls*



CITY OF SIOUX FALLS
PUBLIC WORKS

Providing a Better Quality of Life for You!

Administration/GIS

224 West Ninth Street
P.O. Box 7402
Sioux Falls, SD 57117-7402
T: 605-367-8600 F: 367-4605

Engineering/Real Estate

224 West Ninth Street
P.O. Box 7402
Sioux Falls, SD 57117-7402
T: 605-367-8601 F: 367-4310

Environmental

1203 North Western Avenue
Sioux Falls, SD 57104-1201
T: 605-367-8276 F: 367-4886

Fleet Management

1000 East Chambers Street
P.O. Box 7402
Sioux Falls, SD 57117-7402
T: 605-367-7170 F: 367-7421

Household Hazardous Waste Facility

1015 East Chambers Street
Sioux Falls, SD 57104-7200
T: 605-367-8695 F: 367-4993

Landfill

224 West Ninth Street
P.O. Box 7402
Sioux Falls, SD 57117-7402
T: 605-367-8162 F: 526-3371

Light

2000 North Minnesota Avenue
P.O. Box 7402
Sioux Falls, SD 57117-7402
T: 605-367-7006 F: 367-8306

Street

1000 East Chambers Street
P.O. Box 7402
Sioux Falls, SD 57117-7402
T: 605-367-8255 F: 367-7010

Utility Billing

1201 North Western Avenue
P.O. Box 7401
Sioux Falls, SD 57117-7401
T: 605-367-8131 F: 367-7341

Utility Maintenance

668 West Algonquin Street
P.O. Box 7402
Sioux Falls, SD 57117-7402
T: 605-367-7020 F: 367-7883

Water Purification

2100 North Minnesota Avenue
P.O. Box 7402
Sioux Falls, SD 57117-7402
T: 605-367-7025 F: 367-8475

Water Reclamation

4500 North Sycamore Avenue
Sioux Falls, SD 57104-9612
T: 605-367-8188 F: 367-8484

November 18, 2009

Department of Environment
and Natural Resources
PMB 2020

Joe Foss Building
523 East Capitol
Pierre, SD 57501-3182

AGREEMENT:

Application for Flood Control Permit Within
the State of South Dakota
09-3361

AGREEMENT NO.:

Dear Karen:

Enclosed is Check No. 231542 in the amount of \$500 as payment for this permit application. I've also enclosed a copy of your letter and the permit application. This is your notice to proceed.

Please feel free to contact me or the Project Manager if you have any questions. Thank you.

Sincerely,

A handwritten signature in cursive script, appearing to read "Barbara Suckstorf".

Barbara Suckstorf
Contract/Bid Specialist

Enclosures

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NOV 19 2009

WATER RIGHTS
PROGRAM



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

PMB 2020
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www.state.sd.us/denr

July 31, 2009

Thomas Berkland
Public Works Department
City of Sioux Falls
224 W 9th Street
Sioux Falls SD 57117

Dear Mr. Berkland:

The Water Rights Program is in receipt of the city of Sioux Falls' flood control permit application. This application is to continue the levee raise along the Big Sioux River and Skunk Creek for protection for the 100 year flood event as well as proceed with part of Phase 2 and all of Phase 3 of the project. This application is intended to be a continuation of Flood Control Permit No. FC-30 (copy enclosed) which had a date to complete construction of July 10, 2008.

In order to review the application, plans and specifications will need to be filed with the Water Rights Program. This shall include results of hydrologic modeling of downstream effects by the raise in the levee system at the anticipated elevation necessary to provide protection for the 100 year event. In addition, a condition of Flood Control Permit No. FC-30 requires submittal of final design for Phase 2 and 3 for review and approval. To date, the final design for Phase 2 and 3 has not been submitted. This shall include plans and specifications for the proposed dam on the Big Sioux River near Skunk Creek's confluence in order to comply with dam safety regulations.

The application filing fee and licensing fee totals \$700 for a flood control permit application. This is a result of fee increases established by the state legislature that went in to effect July 1st. The city submitted \$200 with this application. Please remit an additional \$500.

If you have any questions, please feel free to contact Lynn Beck or myself at (605) 773-3352.

Sincerely,

Eric Gronlund
Water Rights Program, DENR
605 773-3352



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

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PIERRE, SOUTH DAKOTA 57501-3182
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**RECOMMENDATION OF CHIEF ENGINEER FOR FLOOD CONTROL PERMIT
APPLICATION NO. FC-36, City of Sioux Falls**

Pursuant to SDCL 46-2A-2, the following is the recommendation of the Chief Engineer, Water Rights Program, Department of Environment and Natural Resources concerning Flood Control Permit Application No. FC-36, City of Sioux Falls, c/o Tom Berkland, Public Works Department, City of Sioux Falls, 224 W 9th Street, Sioux Falls SD 57117.

The Chief Engineer is recommending APPROVAL of Application No. FC-36 because 1) the project 1) will not increase the likelihood or the severity of flood damages, 2) will not endanger human life or property, 3) will not impair existing water rights, and 4) necessary land and /or easements will be obtained prior to construction on the phases yet to be completed , and 5) it is in the public interest to provide protection for 100 year flood event within the highly developed areas of Sioux Falls with the following qualifications:

1. The city of Sioux Falls is responsible for operation and maintenance of the flood control works.
2. Flood Control Permit No. FC-36 is subject to securing easement and/or land acquisitions on any areas, other than city property, where construction activities will take place or additional lands are flooded. These documents shall be held by the city of Sioux Falls and be available for review by the Department of Environment and Natural Resources.
3. Prior to construction of Phase 3, final design shall be submitted to the Chief Engineer of the Water Rights Program of DENR for review and approval.
4. Engineer change notices, software calibrations or other calculations that effect water surface elevations or seepage analysis data previously submitted are subject to review and approval by the Chief Engineer.
5. Design of all levees shall include measures to reduce uplift pressures to result in an exit gradient not to exceed 0.8 at the landward levee toe, to satisfy criteria in EM 1110-2-1901, Seepage Analysis and Control for Dams.

6. The Operation and Maintenance (O & M) Manual for the system shall be completed upon completion of construction. The manual shall set forth criteria for operation of the diversion dam in various flood events. The manual shall provide guidelines for the controlled breach of the levee system if a breach is needed to prevent a catastrophic, random failure and operating criteria for the gated dam structure on the Big Sioux River above Skunk Creek's confluence with the river. The operating manual is subject to review and approval by the Chief Engineer.
7. The Water Management Board retains jurisdiction of Flood Control Permit Nos. FC-30 and FC-36 in the even that additional information shows this project causes an increase in the severity of flood damages in areas other than the project area.

See report on application for additional information.

A handwritten signature in black ink, appearing to read "Garland Erbele". The signature is written in a cursive, flowing style.

Garland Erbele, Chief Engineer

November 6, 2009

**BIG SIOUX RIVER and SKUNK CREEK
FLOOD CONTROL PROJECT FC-36
City of Sioux Falls
October 20, 2009**

Flood Control Application FC-36, City of Sioux Falls, SD, proposes to modify and continue the work on the flood control project authorized by FC-30. The flood control project reroutes and contains, within levees, Big Sioux River and Skunk Creek flood level flows. The existing flood control system and flood control works proposed by FC-36 are located within the corporate limits of Sioux Falls, Minnehaha County, SD. This application proposes to raise the existing levee system, construct a concrete and steel gated backflow dam, and construct any necessary seepage control to provide continued protection for the 100-year flood events on the Big Sioux River and Skunk Creek.

The applicable statute regarding this issue is:

SDCL 46-2A-11. Flood control works--When permit may be issued. A permit for flood control works may be issued only if the project will reduce the damage from flooding or erosion in the area proposed to be benefited, the project will not increase the likelihood or the severity of flood damages in areas other than the project area or the area proposed to be benefited, the project will not endanger human life or property and the project will not impair existing water rights, except to the extent that such rights are extinguished or compensated through agreement or exercise of the power of eminent domain.

Existing Flood Control Permit

Permit FC-30 authorizes improvements to an original flood control system that was constructed between 1956 and 1965. The permit was to modify the original flood control system to provide protection for the 100-year flood event as defined by the US Army Corps of Engineers. The project consisted of three phases with construction to be completed by July 10, 2008.

Phase 1 included raising the diversion channel spillway chute walls, stilling basin walls, and approach walls, and providing buttressing to the chute walls. This phase also included setting back the existing stilling basin right bank levee downstream of the spillway chute and raising a portion of the levee in order to provide a smoother transition curve to improve flow.

Phase 2 included both banks of the Big Sioux River from south of the I-229 bridge to Russell Street and both banks of Skunk Creek from Marion Road east to the Big Sioux River. Levees were to be elevated and strengthened and flood walls added plus levee seepage corrective measures. Work was to also include elevating and lengthening the Marion Road bridge and elevating the 41st Street bridge.

Phase 3 included both banks of the diversion channel, the levee on the east side of Silver Creek north of the diversion channel to just west of North Cliff Avenue, and levees on the west bank of the Big Sioux River from the diversion dam to just south of I-90. Work was to also include elevating and strengthening levees, adding flood walls, and levee seepage corrective measures.

To date, Phase 1 and Phase 2A and 2B of the project have been completed. A new application is necessary to authorize construction of Phase 2C and Phase 3. See Attached report *Big Sioux River and Skunk Creek Flood Control Project FC-30* for more detailed description of the flood control project analysis.

Project Description

This project continues to raise the levee system along the Big Sioux River and Skunk Creek to provide protection for the 100-year flood events. Phase 2C and all of Phase 3 are to be completed with this project. In addition, a concrete gated dam has been added to Phase 2C to prevent backflow upstream of the confluence of Skunk Creek and the Big Sioux River. The backflow dam will eliminate the need for levee raises upstream of the dam to Russell Street.

Phase 2C

The gated dam structure is to be located just upstream of the confluence of Skunk Creek and the Big Sioux River in the NE¼ NE¼ Section 25-T101N-R50W. The structure will prevent upstream impacts on the Big Sioux River when Skunk Creek flood waters enter the Big Sioux River. The dam is classified as a small size Category 3, Low Hazard dam with a height of 24 feet and a normal storage of 0 acre-feet (flood control dam) and a maximum storage capacity of 600 acre-feet. The review of the plans and specifications determined compliance with the requirements of the Water Management Board Safety of Dams Rules, Chapter 74:02:08. Phase 2C also includes levee raises along both sides of Skunk Creek from Marion Road to the Big Sioux River. Levee raises continue on the Big Sioux River from the flood control dam to 41st Street. The levee raises are located in the S½ Section 24 and the NE¼ Section 25, T101N, R50W and in the W½ Section 30, T101N, R49W.

The final design of Phase 2C has been reviewed as part of this application and with its completion Phase 2 of the project will be complete.

Phase 3

Phase 3 will raise levees on both banks of the Big Sioux River Diversion Channel from the spillway chute to Silver Creek on the east side and the Big Sioux River on the west side. Work also includes elevating and strengthening levees, adding flood walls, and levee seepage corrective measures. Final design for Phase 3 has not been completed.

Phase 3 will determine the fate of a fuse plug located upstream of the Diversion Dam on the right levee. The overflow plug was originally designed to breach and pass flows exceeding 24,400 cfs. Presently the overflow plug is heavily fortified with riprap so that breaching would not occur during flooding episodes. If during catastrophic flood flows in the Big Sioux River or Skunk Creek, the need arises to divert any flow from the flood control system to protect human life or property, the City of Sioux Falls will, after safety, engineering, and economical risk assessments, perform a controlled breach at the most favorable location in lieu of using an overflow plug.

Phase 3 is located in portions of Sections 28, 29, 32, and 33, T102N, R49W and portions of Sections 4 and 9, T101N, R49W.

Seepage Measures – Information from the *Seepage Analysis Report*, USACE, Omaha District.

A seepage analysis was performed for the Phase 2 and Phase 3 projects in order to assess the potential for seepage to occur in permeable stratum beneath levee embankments. Increasing the levee height to provide 100-year flood protection results in the potential for increased hydrostatic pressure to act against the levee embankment during high-water events. The increase in hydrostatic pressure may result in unacceptable rates of seepage.

One area that is still part of the Phase 2 Project was identified as needing seepage control measures. The area of seepage concern is located 1,500 north of 49th Street to 500 feet north of 49th Street on the Big Sioux River along the left bank. A landside seepage berm was constructed as part of Phase 2B which is complete.

There are four areas of seepage concern in Phase 3. Landward seepage berms are to be used to reduce uplift pressures to acceptable levels. The location, thickness, and material type will be determined during Phase 3 final design which is yet to be done.

Hydrologic & Geotechnical Analyses

The USACE HEC-RAS computer software is being used by the USACE, Omaha District to determine water surface elevations for pre and post conditions of each phase of the project. Models are calibrated using observed levels from previous flooding episodes and analyses are subjected to the USACE Quality Assurance system. The hydrology has not changed from the original permit FC-30.

See Attached report *Big Sioux River and Skunk Creek Flood Control Project FC-30* for more detailed description of the flood control project analysis.

Flood Control System Operation

The City of Sioux Falls will be responsible for the operation and maintenance of the modified flood control system. The Operation and Maintenance (O&M) Manual presently in place will be completely revised, especially to add sections for the operation of the Diversion Dam gates and controlled levee breaching.

The USACE, Omaha District is developing upstream pool elevation-gate opening versus flow curves for the Diversion Dam gates that will be incorporated into the new O&M Manual for safe control of water elevations during periods of increased flows in the Big Sioux River.

The methods and responsibilities for completing the safety, engineering, and economical risk assessments before performing a controlled levee breach during catastrophic flood flows will also be incorporated into the new O&M Manual.

The City of Sioux Falls will initiate interim procedures covering controlled levee breaching and operation of the Diversion Dam gates until complete revision of the O&M Manual is accomplished.

Conclusions

1. Consideration of this Flood Control Permit for modifications to the existing Sioux Falls, SD flood control system is evaluated on criteria pertaining to this proposed project's future impacts on the conditions outlined in SDCL 46-2A-11 and not how the original flood control system impacts these same conditions.
2. The USACE and their contractors used software programs, analyses procedures, and quality assurance procedures recognized and accepted in the public and private sectors to produce geotechnical and hydrologic data for the design of this project.
3. Design data show the project will reduce the damage from flooding or erosion in the area proposed to be benefited, the project will not increase the likelihood or the severity for flood damages in areas other than the project area or the area proposed to be benefited, the project will not endanger human life or property, nor impair existing rights.
4. The final design of Phase 2C has been reviewed as part of this application and with its completion Phase 2 of the project will be complete.
5. When finalized, the design for Phase 3, any design engineering change notices (ECN), water surface elevation or other calculations and software calibration data pertaining to this Phase or ECNs should be reviewed by the Chief Engineer or his representative before the work is implemented.



Lynn Beck
Natural Resources Engineer Specialist
DENR – Water Rights Program

References

South Dakota Department of Environment and Natural Resources, Water Rights Program Records.

Big Sioux River and Skunk Creek Flood Control Project FC-30, City of Sioux Falls, SD, Department of Environment and Natural Resources, Water Rights Program.

Sioux Falls Flood Control Project Design Optimization Study Big Sioux River, Skunk Creek and Diversion Channel, Sioux Falls, SD HDR Engineering Inc. for US Army Corps of Engineers, March 2000.

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PO # 149920

1128

Customer Number:

078011

City Of Sioux Falls

Invoice Number:

1241962

AFFIDAVIT OF PUBLICATION-

Argus Leader
AFFIDAVIT OF PUBLICATION

STATE OF SOUTH DAKOTA

COUNTY OF MINNEHAHA } ss

Linda Schulte being duly sworn, says: That The Argus Leader is, and during all the times hereinafter mentioned was, a daily legal newspaper as defined by SDCL 17-2-21, as amended published at Sioux Falls, Minnehaha County, South Dakota; that affiant is and during all of said times, was an employee of the publisher of such newspaper and has personal knowledge of the facts stated in this affidavit; that the notice, order or advertisement, a printed copy of which is hereto attached, was published in said newspaper upon

Thursday, the 12 day of November 2009,

Thursday, the 19 day of November 2009,

_____, the _____ day of _____ 2009,

_____, the _____ day of _____ 2009,

_____, the _____ day of _____ 2009,

_____, the _____ day of _____ 2009,

_____, the _____ day of _____ 2009,

and that \$240.20 was charged for publishing the same

Linda Schulte

11/27/2009

JUDY WIESE



NOTARY PUBLIC
SOUTH DAKOTA



Judy Wiese
Notary Public, South Dakota

My Commission expires December 22, 2009

Nov 3, 2012

City Business

NOTICE OF FLOOD CONTROL APPLICATION

NO. FC-36, City of Sioux Falls
Notice is given that the City of Sioux Falls, c/o Thomas Berkland, Public Works Department, 224 West 9th Street, Sioux Falls SD 57117 has filed a flood control permit application for improvements to the existing flood control system located within the corporate limits of Sioux Falls in Minnehaha County. The system reroutes and contains within levees the Big Sioux River and Skunk Creek flood flows. The existing system was designed and constructed between 1955 and 1965 to provide protection in excess of the 100 year flood event along the Big Sioux River and Skunk Creek based on the hydrological data available at the time. This modification of the flood control system is designed to provide protection for the 100 year flood event as currently defined by the US Army Corps of Engineers. The flood control system consists of a diversion dam, diversion channel, weir, spillway chute, stilling basin, levee overflow plug, and levee along the Big Sioux River natural channel, Skunk Creek and the diversion channel. The original project was constructed prior to the state of South Dakota having a flood control permitting process.

Sioux Falls obtained Flood Control Permit No. FC-30 for this project in 2003 for improvements to bring the system to the level of protection for the 100 year flood event. Construction began and was completed on portions of the project. However, the time set forth by state law to complete the entire project expired, requiring the city to obtain another flood control permit in order to continue work and complete the project.

The legal description of the project area includes sections within T101N, R49W, T101N, R50W and T102N, R49W.

The project is divided into three phases. Phase 1 and Phase 2A & 2B have been completed under authorization of Flood Control Permit No. FC-30. Phase 2C and Phase 3 are contemplated for construction under Application FC-36.

The phases are:
Phase 1 (completed) raised the diversion channel spillway chute walls, the stilling basin walls, the approach walls and provide buttresses to the chute walls. This phase also included setting back of the existing stilling basin right bank levee downstream of the spillway chute and raising a portion of

the levee in order to provide a smoother transition curve to improve flow. This phase is located in Section 6, T101N, R49W.

Phase 2 involves both banks of the Big Sioux River from the 229 bridge to just about the confluence of Skunk Creek with the Big Sioux River and both banks of Skunk Creek from just upstream of Marion Road east to the Big Sioux River. Work will consist of elevating and strengthening levees and adding flood walls plus levee seepage corrective measures. The work on the Marion Road Bridge has been completed and yet to be completed is elevating and lengthening the 41st Street Bridge on the river. Finally, the plan includes a gated dam structure located upstream of the confluence of Skunk Creek and the Big Sioux River in the NE 1/4 NE 1/4 Section 25, T101N, R50W. The structure will prevent upstream impact on the Big Sioux River when Skunk Creek flood water enters the Big Sioux River. To date the levee improvements south of the 41st Street bridge to the 1-229 bridge are complete.

Phase 3 will raise the levees on both banks of the Big Sioux River diversion channel from the spillway chute to Silver Creek on the east side and the Big Sioux River on the west side. Work includes elevating and strengthening levees, adding flood water and levee seepage corrective measures. This phase is located in portions of Sections 28, 29, 32, 33, T102N, R49W and portions of Sections 4 and 9, T101N, R49W.

Pursuant to SDCL 46-2A-2, the Chief Engineer recommends APPROVAL of Application No. FC-36 because 1) the project does not increase the likelihood or the severity of flood damages downstream, 2) necessary assessments have been obtained, 3) it will not impair existing water rights, and 4) it is in the public interest.

Any person interested in opposing or supporting the application must file a written petition with BOTH the applicant and Chief Engineer. The Chief Engineer's address is "Water Rights Program, P.O. Box 523, 523 E Capitol, Pierre SD 57501 (805 773-3352)" and the applicant's mailing address is given above. A petition filed by either an interested person or the applicant must be filed by November 30, 2009. The petition may be informal, but must include a statement describing the petitioner's interest in the application, the petitioner's reasons for opposing or supporting the application, and the signature and mailing address

of the petitioner or the petitioner's legal counsel, if legal counsel is obtained.

The Water Management Board will consider the application at 2:00 PM on Wednesday, December 9, 2009 at the Matthew Training Center, Joe Foss Building, 523 E. Capitol Ave., Pierre SD. The Chief Engineer's recommendation is not final or binding upon the Board. The Board is authorized to 1) approve, 2) approve with qualifications, 3) defer, or 4) deny the application based on the facts presented at the public hearing. The hearing date will be automatically delayed for at least 30 days upon written request to the Chief Engineer from the applicant or any interested person opposing the application. The request for an automatic delay must be filed by November 30, 2009.

Any hearing will be an adversary proceeding. Any person filing a petition and/or the applicant have the right to be represented by a lawyer and may present evidence or cross-examine witnesses according to SDCL 1-26. These and other due process rights will be forfeited if not exercised. Decisions of the Board may be appealed to the Circuit Court and State Supreme Court as provided by law. Contact: Eric Gronlund by November 30, 2009, at the above Water Rights Program address to request a copy of information pertaining to the application. In addition, please notify the Department of Environment and Natural Resources at least 48 hours before the public hearing if you have a disability for which special arrangements must be made at the hearing.

Since the application does not involve a monetary contribution in excess of \$2,500.00 or termination of a property right in accordance with SDCL 1-26-15.3, the Chief Engineer has determined this contested case may not be referred to the Office of Hearing Examiners. If any party disagrees with this determination, the Chief Engineer shall be notified by November 30, 2009.

The legal authority and jurisdiction under which the hearing is held is SDCL 46-1-14, 46-1-15, 46-1-16, 46-2-3.1, 46-2-5, 46-2-9, 46-2-11, SDCL 46-2A-1 thru 46-2A-11, 46-2A-12 and SDCL 46-5-30.4 and 46-5-47.

The particular sections of the statutes and rules involved are SDCL 46-1-1 thru 46-1-8, 46-1-14 thru 46-1-16, 46-2-3.1, 46-2-5, 46-2-11, 46-2-12, 46-2-17, 46-2A-1 thru 46-2A-9, 46-2A-12, 46-2A-14, 46-2A-15, 46-5-11, 46-5-10, 46-5-11, 46-5-13 thru 46-5-15, 46-5-24, 46-5-25,

46-5-30.2, 46-5-30.4, 46-5-31, 46-5-47, and SDCL 34A-2-209, (6) and (12), 34A-2-10 through 34A-2-11.1 and SDCL 34A-2-21, and Board Rules ARSD 74:02:01:01 thru 74:02:01:15 and ARSD 74:51:02:31, 74:51:02:03, 74:51:02:02, and ARSD 74:51:02:01. Steven M. Pinner, Secretary, Department of Environment and Natural Resources.

Published twice at the total approximate cost of \$240.15.
12/19/02 Nov. 12 & 19, 2009



DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

November 6, 2009

Argus Leader
PO Box 5034
Sioux Falls SD 57117

ATTENTION: Legal Public Notice

Enclosed is a Notice on Application No. FC-36 to Appropriate Water to be published twice. Please publish the first notice on November 12, 2009 with the second publication 7 days later. The text of the notice can be e-mailed to your paper by contacting Karen Schlaak at (605) 773-3352.

The applicant must verify to you that the notice is to be published, before you make the first publication. **Please BILL the APPLICANT for the cost of publication.** The APPLICANT is City of Sioux Falls, c/o Thomas Berkland, Public Works Dept., 224 W 9th St., Sioux Falls SD 57117 (Ph # 605-367-8600).

Please send the Water Rights Program the first publication immediately. The publication is checked for accuracy so any corrections can be made in the second publication. You may use the form below or fax a copy of the first publication. Any fax should be sent to the attention of Karen Schlaak at (605) 773-4068. Publication errors can invalidate the public notice.

After the second publication, **please send us an affidavit or use the enclosed Proof of Publication form.** The applicant pays the cost of publication, but the Water Rights Program records require an affidavit or Proof of Publication. Delays in receiving the affidavit can be costly to the applicant.

Sincerely,

Eric Gronlund
Natural Resources Engineer
605 773-3352

enclosures

-----CUT HERE-----

No. FC-36

TO: Eric Gronlund
Water Rights Program
Joe Foss Building
Pierre SD 57501-3181

Date _____

We are in receipt of your letter of November 6, 2009 enclosing Notice to Appropriate Water by Application No. FC-36 which was first published in our issue of _____. ENCLOSED IS A COPY OF THIS FIRST PUBLICATION.

Name

Newspaper



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

NOTE: TO BE SURE OF PUBLICATION ON
THE CORRECT DATES, CONTACT
THE NEWSPAPER RIGHT AWAY.

November 6, 2009

City of Sioux Falls
c/o Thomas Berkland
Public Works Dept.
224 W 9th St
Sioux Falls SD 57117

Dear Mr. Berkland:

Flood Control Application No. FC-36 has been examined and found to comply with the South Dakota Water Laws and applicable rules. A notice has been sent to the Publisher of the Argus Leader printed at Sioux Falls SD (Ph # 605-331-2200). You will need to contact the newspaper and authorize publication of this notice. For your information, a copy of the notice, the recommendations of the Chief Engineer and reports on the applications are enclosed. Please review the notice prior to publication and notify this office, if you have any corrections or questions.

Be sure to contact the above newspaper to authorize publication of your Notice and to arrange for payment. Early contact with the paper can eliminate delays. Upon receiving authorization, the publisher has been instructed to publish your notice once each week for two consecutive weeks. The newspaper has also been instructed to send us the Proof of Publication. We must receive Proof of Publication before action can be taken on the applications.

Sincerely,

Eric Gronlund
Natural Resources Engineer
(605) 773-3352
eric.gronlund@state.sd.us

enclosures

NOTE: If you plan to contest any part of the Chief Engineer's recommendation, you must file a petition pursuant to the procedures outlined in the attached notice of hearing. The Water Management Board will then consider your concerns during a hearing on the application.

Instruction to Newspaper - Publish first Notice on November 12, 2009 with the second publication 7 days later. The applicant is responsible for payment. The text of the notice can be e-mailed to your paper by contacting Karen Schlaak at (605) 773-3352 or email: karen.schlaak@state.sd.us.

NOTICE OF FLOOD CONTROL APPLICATION NO. FC-36, City of Sioux Falls

Notice is given that the City of Sioux Falls, c/o Thomas Berkland, Public Works Department, 224 West 9th Street, Sioux Falls SD 57117 has filed a flood control permit application for improvements to the existing flood control system located within the corporate limits of Sioux Falls in Minnehaha County. The system reroutes and contains within levees the Big Sioux River and Skunk Creek flood flows. The existing system was designed and constructed between 1956 and 1965 to provide protection in excess of the 100 year flood event along the Big Sioux River and Skunk Creek based on the hydrological data available at the time. This modification of the flood control system is designed to provide protection for the 100 year flood event as currently defined by the US Army Corps of Engineers. The flood control system consists of a diversion dam, diversion channel, weir, spillway chute, stilling basin, levee overflow plug, and levees along the Big Sioux River natural channel, Skunk Creek and the diversion channel. The original project was constructed prior to the state of South Dakota having a flood control permitting process.

Sioux Falls obtained Flood Control Permit No. FC-30 for this project in 2003 for improvements to bring the system to the level of protection for the 100 year flood event. Construction began and was completed on portions of the project. However, the time set forth by state law to complete the entire project expired, requiring the city to obtain another flood control permit in order to continue work and complete the project.

The legal description of the project area includes sections within T101N, R49W; T101N, R50W and T102N, R49W

The project is divided into three phases. Phase 1 and Phase 2A & 2B have been completed under authorization of Flood Control Permit No. FC-30. Phase 2C and Phase 3 are contemplated for construction under Application FC-36. The phases are:

Phase 1 (completed) raised the diversion channel spillway chute walls, the stilling basin walls, the approach walls and provide buttress to the chute walls. This phase also included setting back of the existing stilling basin right bank levee downstream of the spillway chute and raising a portion of the levee in order to provide a smoother transition curve to improve flow. This phase is located in Section 9, T101N, R49W.

Phase 2 involves both banks of the Big Sioux River from I-229 bridge to just about the confluence of Skunk Creek with the Big Sioux River and both banks of Skunk Creek from just upstream of Marion Road east to the Big Sioux River. Work will consist of elevating and strengthening levees and adding flood walls plus levee seepage corrective measures. The work on the Marion Road Bridge has been completed and yet to be completed is elevating and lengthening the 41st Street Bridge on the river. Finally, the plan includes a gated dam structure located upstream of the confluence of Skunk Creek and the Big Sioux River in the NE ¼ NE ¼ Section 25, T101N, R50W. The structure will prevent upstream impact on the Big Sioux River when Skunk Creek flood water enter the Big Sioux River. To date the levee improvements south of the 41st Street bridge to the I-229 bridge are complete.

Phase 3 will raise the levees on both banks of the Big Sioux River diversion channel from the spillway chute to Silver Creek on the east side and the Big Sioux River on the west side. Work includes elevating and strengthening levees, adding flood water and levee seepage corrective measures. This phase is located in portions of Sections 28, 29, 32, 33, T102N, R49W and portions of Sections 4 and 9, T101N, R49W.

Pursuant to SDCL 46-2A-2, the Chief Engineer recommends APPROVAL of Application No. FC-36 because 1) the project does not increase the likelihood or the severity of flood damages downstream, 2) necessary easements have been obtained, 3) it will not impair existing water rights, and 4) it is in the public interest.

Any person interested in opposing or supporting the application must file a written petition with BOTH the applicant and Chief Engineer. The Chief Engineer's address is "Water Rights Program, Foss Building, 523 E Capitol, Pierre SD 57501 (605 773-3352)" and the applicant's mailing address is given above. A petition filed by either an interested person or the applicant must be filed by November 30, 2009. The petition may be informal, but must include a statement describing the petitioner's interest in the application, the petitioner's reasons for opposing or supporting the application, and the signature and mailing address of the petitioner or the petitioner's legal counsel, if legal counsel is obtained.

The Water Management Board will consider the application at 2:00 PM on Wednesday, December 9, 2009 at the Matthew Training Center, Joe Foss Building, 523 E. Capitol Ave., Pierre SD. The Chief Engineer's recommendation is not final or binding upon the Board. The Board is authorized to 1) approve, 2) approve with qualifications, 3) defer, or 4) deny the application based on the facts presented at the public hearing. The hearing date will be automatically delayed for at least 20 days upon written request to the Chief Engineer from the applicant or any interested person opposing the application. The request for an automatic delay must be filed by November 30, 2009.

Any hearing will be an adversary proceeding. Any person filing a petition and/or the applicant have the right to be represented by a lawyer and may present evidence or cross-examine witnesses according to SDCL 1-26. These and other due process rights will be forfeited if not exercised. Decisions of the Board may be appealed to the Circuit Court and State Supreme Court as provided by law. Contact Eric Gronlund by November 30, 2009, at the above Water Rights Program address to request a copy of information pertaining to the application. In addition, please notify the Department of Environment and Natural Resources at least 48 hours before the public hearing if you have a disability for which special arrangements must be made at the hearing.

Since the application does not involve a monetary controversy in excess of \$2,500.00 or termination of a property right in accordance with SDCL 1-26-18.3, the Chief Engineer has determined this contested case may not be referred to the Office of Hearing Examiners. If any party disagrees with this determination, the Chief Engineer shall be notified by November 30, 2009.

The legal authority and jurisdiction under which the hearing is held is SDCL 46-1-14, 46-1-15, 46-1-16, 46-2-3.1, 46-2-5, 46-2-9, 46-2-11, SDCL 46-2A-1 thru 46-2A-11, 46-2A-12, and SDCL 46-5-30.4 and 46-5-47.

The particular sections of the statutes and rules involved are SDCL 46-1-1 thru 46-1-9, 46-1-14 thru 46-1-16; 46-2-3.1, 46-2-9, 46-2-11, 46-2-13, 46-2-17; 46-2A-1 thru 46-2A-9, 46-2A-12, 46-2A-14, 46-2A-15, 46-5-1 thru 46-5-1.1, 46-5-5, 46-5-6.11, 46-5-10, 46-5-11, 46-5-13 thru 46-5-15, 46-5-24, 46-5-25, 46-5-30.2, 46-5-30.4, 46-5-31; 46-5-47, and SDCL 34A-2-2(5), (6), and (12), 34A-2-10 through 34A-2-11.1 and SDCL 34A-2-21, and Board Rules ARSD 74:02:01:01 thru 74:02:01:15 and ARSD 74:51:02:31; 74:51:02:03, 74:51:02:02, and ARSD 74:51:02:01. Steven M. Pirner, Secretary, Department of Environment and Natural Resources. Published twice at the total approximate cost of _____.



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
denr.sd.gov

January 14, 2010

Thomas Berkland, Principal Engineer
Sioux Falls Public Works
PO Box 7402
Sioux Falls SD 57117

Dear Mr. Berkland:

Enclosed is Flood Control Permit No. FC-36 as approved by the Water Management Board on December 6, 2009. Also, enclosed are the receipts for payment of the application and license fees.

If you have any questions pertaining to the permit, please contact this office.

Sincerely,

A handwritten signature in black ink, appearing to read "Garland Erbele".

Garland Erbele, Chief Engineer
Water Rights Program
(605) 773-3352

enclosures

FC30-3

REPORT ON INSPECTION OF FLOOD CONTROL PERMIT NOS. FC-30 & FC-36

Big Sioux - Water District Report Of Examination of Works

TO: Chief Engineer, Water Rights Program, DENR, Foss Bldg., Pierre, SD 57501

On, April 24, 2025, staff engineers Whitney Kilts, Brittan Hullinger and I made a thorough examination of the flood control project constructed by the City of Sioux Falls of 231 North Dakota Ave, Sioux Falls SD 57104 holder of Flood Control Permit No. FC-30, bearing the priority of May 8, 2003 and Flood Control Permit No. FC-36, bearing the priority of July 23, 2009 authorizing the construction and operation of the flood control project, in Minnehaha County.

Contact Person & Address: Aaron Fagerness, Principal Engineer - City of Sioux Falls
231 North Dakota Ave, Sioux Falls SD 57104

Project Legal Description: Sections located within T101N-R49W; T101N-R50W and T102N-R49W

Description of flood control works: The City of Sioux Falls constructed the Big Sioux flood control project between 1956 and 1961, this work pre-dated the requirement to obtain a flood control permit. The flood control works includes a system of levee protection and floodwall along the historic Big Sioux channel and Skunk Creek above the confluence with the Big Sioux, a diversion dam, diversion channel, and spillway.

In 2003, the City applied for and was issued flood control permit, FC-30. FC-30 authorized construction of a gated control dam upstream of the Skunk Creek confluence to prevent backflow upstream of the Skunk Creek confluence with the Big Sioux River. The permit also authorized the raising and extending the levees upstream of the confluence along Skunk Creek and downstream along the Big Sioux River to the Minnehaha-Lincoln County line.

In 2009, the City applied for and was issued flood control permit, FC-36. FC-36 authorized the raising of the levees west of the Big Sioux River and east of Silver Creek on the Big Sioux flood plain upstream of the diversion dam. It also authorized the raising and strengthening levees, adding flood walls and levee seepage corrective measures along the diversion channel above the spillway.

Water Rights staff members made a visual inspection of the entire Sioux Falls flood control project to verify the project upgrades were completed as permitted.



Big Sioux River Diversion Dam located in the NE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec 32 T102N-R49W.



Diversion channel spillway located in the SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec 9 T101N-R49W.



Big Sioux River a gated control dam upstream of the Skunk Creek confluence located in the NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec 25 T101N-R50W.



Big Sioux River channel levee raise located in the NE $\frac{1}{4}$ Sec 25 T101N-R50W at the confluence of the Skunk Creek with the Big Sioux River.

The system is in the following condition **good**.

Applicable permit qualifications have been complied with: **yes**.

Comments:

The City of Sioux Falls provided Water Rights staff with a copy of a portion of the Operation & Maintenance Manual for the Sioux Falls flood Risk Reduction Project dated August 2015 to address most of the qualifications listed on FC-30 and FC-36.

Exceptions to compliance are: **None**



Mark D. Rath
Water Right Inspector
DANR, Water Rights Program

5-6-2025

Date

OPERATION & MAINTENANCE MANUAL

SIOUX FALLS FLOOD RISK REDUCTION PROJECT

BIG SIOUX RIVER AND SKUNK CREEK SIOUX FALLS, SOUTH DAKOTA



**US Army Corps
of Engineers®**
Omaha District

August 2015

**SIOUX FALLS FLOOD DAMAGE REDUCTION PROJECT
SIOUX FALLS, SOUTH DAKOTA
OPERATION AND MAINTENANCE MANUAL**

PREFACE

Enclosed is the revised Operation and Maintenance (O&M) Manual for the Sioux Falls Flood Risk Reduction Project, Sioux Falls, South Dakota. The original O&M Manual was published in May 1964 and subsequently revised in April 1981. This O&M Manual supersedes previously published manuals for the Sioux Falls Flood Risk Reduction Project.

This revised O&M Manual incorporates current inspection requirements, flood fighting procedures, new aerial mapping, and documentation of design and construction activities performed on the Project.

The Non-Federal Project Sponsor for the Sioux Falls Flood Risk Reduction Project, Sioux Falls, South Dakota, entered into an agreement with the Federal Government through the U.S. Army Corps of Engineers that requires specific actions and measures be performed by the Project Sponsor for operation and maintenance of the Project.

The Project Sponsor is responsible for the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of this Project. Rehabilitation assistance for repair of flood damage to the Project may be provided through Public Law 84-99 Rehabilitation and Inspection Program, which is administered by the U.S. Army Corps of Engineers.

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03 11 13.00 10	Structural Concrete Formwork
03 15 14	Expansion, Contraction and Construction Joints in Concrete for Civil Works
03 20 01.00 10	Concrete Reinforcement
03 30 04	Lean Concrete
03 31 01	Cast-in-Place Structural Concrete for Civil Works
04 72 00	Architectural Cast Stone
05 72 00	Decorative Metal Fence and Gate Specialties
07 14 00	Fluid-Applied Waterproofing
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SECTION 1 - INTRODUCTION

1.1 PROJECT SPONSOR

The City of Sioux Falls, South Dakota, assumed the duties as Project Sponsor of the Sioux Falls Flood Protection Project in January 1961, and is responsible for all operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of this project. Project Sponsor responsibilities also include performing inspections, preparing for emergencies, and reporting, as outlined in this manual.

1.2 OVERVIEW

The Sioux Falls Flood Risk Reduction Project is a federally constructed and locally owned and operated levee improvement project located along the Big Sioux River and Skunk Creek in the City of Sioux Falls, South Dakota. Although the project provides a high degree of protection, it does not completely remove the threat of flooding to the protected areas. The fulfillment of the project's design capabilities requires surveillance of the levees, channel banks, dams, drainage structures, pump structures, closure structures, and other pertinent project features; the collection and analysis of flood forecast information; and the timely repair to any defective portion of the project's facilities.

All flood damage reduction projects must be properly operated and maintained to provide the level of protection for which they were designed. This Operation and Maintenance (O&M) Manual covers all pertinent operation and maintenance procedures, including those to be employed during high water periods. The flood damage reduction project must be properly operated and maintained to provide the design level of protection. For a pending flood event there will be little, if any time, to make repairs to the project, should the project be in disrepair.

1.3 PURPOSE

The purpose of this manual is to provide detailed information specifically for the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of the Sioux Falls Flood Risk Reduction Project. It is intended to serve as a practical outline for persons having inspection, maintenance, and operation responsibilities under both normal and flood conditions. Adherence to the inspection procedures and compliance with the descriptive materials contained in this manual will ensure conformance with the federal regulation requirements.

Refer to [Appendix E](#), Code of Federal Regulations, Title 33 – Navigation and Navigable Waters, Part 208 – Flood Control Regulations, Maintenance and Operation of Flood Control Works as approved by the Acting Secretary of War on 9 August 1944.

1.4 LEVEE SYSTEM AND SEGMENT DESCRIPTION

For purposes of the USACE Levee Safety Program, flood damage reduction systems, such as levees, are delineated into projects, systems, and segments as defined below.

- Project: A project is made up of one or more flood damage reduction systems that were constructed under the same authorization.

- **System:** A levee system comprises one or more levee segments and associated features which collectively provide flood, storm, or hurricane damage reduction to a defined area (Figure 1-1). Failure of one feature or segment within a levee system constitutes failure of the entire system. The levee system is inclusive of all features that are interconnected and necessary to ensure protection of the associated separable floodplain. These levee features may consist of embankment sections, floodwall sections, closure structures, pumping stations, interior drainage works, and flood damage reduction channels.

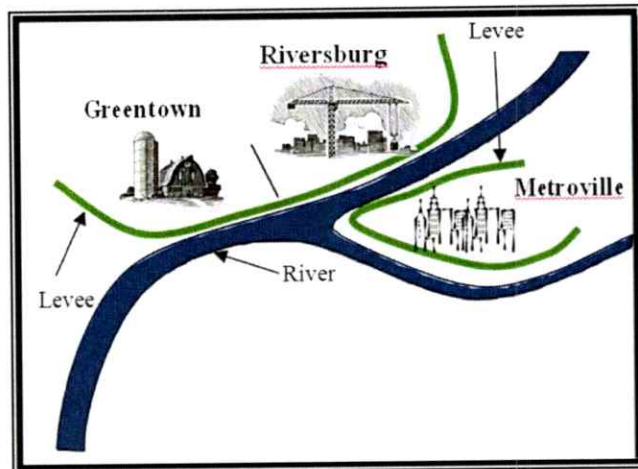


Figure 1-1. Levee System Example

This diagram shows two levee “systems” wherein each protects a separable floodplain. Ownership boundaries and construction sequence and authorization limits are not relevant to “system” determinations.

- **Segment:** A segment is defined as a discrete portion of a flood damage reduction system that is operated and maintained by a single entity. A segment can be made up of one or more components (for example, levees, channels, floodwalls, and pump stations).
- **National Levee Database (NLD):** Authoritative USACE proprietary database that describes the location and condition of the Nation’s levees, and the potential consequence behind those levees. The NLD Public View web address is <http://nld.usace.army.mil>.

Under the system/segment approach for evaluating the functionality and performance of federal constructed levee systems, implemented in 2008, this levee system was re-designated as outlined in the following table. Table 1-1 below shows how the project is digitally stored in the NLD.

1.5 SPONSOR RESPONSIBILITIES

The City of Sioux Falls is responsible for the OMRR&R of the federally constructed levee system. These responsibilities include training levee inspectors and maintenance personnel, conducting inspections, performing maintenance activities and repairs, preparing for emergencies, surveillance activities during emergencies, reporting, and community outreach and education. The Project Sponsor is the owner and operator of the Sioux Falls Flood Damage Reduction Project levee system.

Maps of each system/segment are provided in [Appendix C](#).

Table 1-1: Levee Project, Sponsor, Systems, and Segments

Federally Authorized Project Name: Big Sioux River Flood Risk Reduction Project Sioux Falls, South Dakota	
Sponsor: City of Sioux Falls, South Dakota	
System Name	Segment Name
Sioux Falls – Big Sioux LB & Diversion Channel RB	Sioux Falls – Big Sioux LB & Diversion Channel RB
Sioux Falls – Big Sioux RB	Sioux Falls – Big Sioux RB
Sioux Falls – Big Sioux RB & Skunk Creek LB	Sioux Falls – Big Sioux RB & Skunk Creek LB
Sioux Falls – Big Sioux RB & Skunk Creek RB	Sioux Falls – Big Sioux RB & Skunk Creek RB
Sioux Falls – Diversion Channel LB - North	Sioux Falls – Diversion Channel LB - North
Sioux Falls – Diversion Channel LB - South	Sioux Falls – Diversion Channel LB - South
Sioux Falls – Big Sioux LB - Downtown	Sioux Falls – Big Sioux LB - Downtown

1.6 POINTS OF CONTACT AND PLAN HOLDERS LIST

A listing of points of contact for the Project Sponsor, U.S. Army Corps of Engineers, and other agencies are provided in [Appendix A](#). The Project Sponsor must update the organizational structure and points of contact on an annual basis. The Project Sponsor should ensure that there are a sufficient number of primary and alternate routine and emergency response team members available. A list of holders of the O&M Manual is also provided in [Appendix A](#). All plan holders need to receive any addendums, revisions, or updates to the O&M Manual.

1.7 CRITICAL AREA

The Project Sponsor is responsible for controlling activities within the project right-of way. In addition, the Project Sponsor should coordinate with adjacent landowners in controlling construction activities within an area that extends riverward and landward of the levee that is termed the “critical area” in an effort to prevent any adverse impact to the levee system. The critical area is generally considered to extend 500 feet landward and 300 feet riverward of the levee centerline. In some instances, the critical area may extend beyond 500 feet, if any impact on the levees can be identified.

1.8 MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION

Maintenance refers to periodic routine activities required to be performed by the Project Sponsor, such as mowing, tree and weed control, resurfacing levee crest and trails, exercising drainage structure gates, removing debris and silt from flap gates, servicing pump station motors, cleaning and pump testing relief wells, etc. Repair is considered to entail those activities of a routine nature where corrective actions are required to maintain the project in a well-kept condition. Replacement covers those activities taken when a worn-out element or portion thereof is replaced. Rehabilitation refers to a set of activities as necessary to bring a deteriorated project back to original condition. Repair, replacement, and rehabilitation actions are to conform to the

as-built plans and specifications unless other arrangements are made with the U.S. Army Corps of Engineers. These activities are the responsibility of the Project Sponsor.

1.9 IMPROVEMENTS OR ALTERATIONS

Any proposed excavations or alterations within the critical area of the levee system or to levee system components, or changes to the operation of the levee system will need to be reviewed and must be approved prior to implementation, as outlined below. This includes any/all proposed utility line installations/relocations within, under, or over features of the levee system. The Project Sponsor is responsible for submitting detailed design documents to USACE for review and approval prior to the start of construction activities. The design documents shall include, but shall not be limited to, a design document including all design criteria and calculations, and detailed construction plans and specifications. The plans shall include a general location plan, site plans, plan views, cross sections, and other detail sheets as necessary. The Project Sponsor is responsible for construction oversight for any approved modification within the critical area to ensure that it is constructed/implemented in accordance with the USACE reviewed and approved plans and specifications. The Project Sponsor is also responsible for ensuring that the O&M Manual is revised to reflect any modifications, alterations, or other changes to or under the levee system.

Any proposed alteration cannot be injurious to the public interest or impair the usefulness of the project. Public safety is the number one priority and cannot be compromised. The conditions for allowing improvements or alterations are outlined in the Flood Control Regulations ([Appendix E](#)). The City of Sioux Falls, South Dakota, as the Project Sponsor, needs to fully consider, review and endorse any proposed modification to the Sioux Falls Flood Damage Reduction Project and, if acceptable to the Project Sponsor, submit detailed information for the proposed modification to the U.S. Army Corps of Engineers for review and consideration.

No improvement or alteration will be allowed to the Sioux Falls Flood Damage Reduction Project without the written approval of the U.S. Army Corps of Engineers, Omaha District Commander or his/her authorized representative.

As required in [Appendix F](#), the aforementioned submittal to the U.S. Army Corps of Engineers must include engineering drawings (plans, profiles, cross sections, and details) that fully illustrate the proposed improvement or alteration and its relationship to the existing flood protection project. The drawings will be accompanied by a technical write-up, specifications, analysis and other data that describes the proposed improvement or alteration and its impact to the flood protection project and any required mitigation measures. The submittal **must** include a signed statement from the design engineer (engineer-of-record) for the proposed modification that there will be no adverse impact to the federally constructed project from the proposed modification.

The party that is proposing any modification or alteration of the levee system needs to consult U.S. Army Corps of Engineers' technical guidance, policy, and governing regulations prior to requesting review of the proposal. This information is typically available on U.S. Army Corps of Engineers' website. The Project Sponsor's and/or U.S. Army Corps of Engineers' review may result in a determination that the proposed alterations or modifications will not be allowed.

1.10 AS-BUILT DRAWINGS, CONSTRUCTION SPECIFICATIONS, AND MANUFACTURER'S DATA

As-built drawings and technical specifications are provided in [Appendices H and I](#). This information should be consulted prior to any maintenance, repair, replacement, rehabilitation, or alteration to the levee systems.

1.11 O&M MANUAL UPDATES, ADDENDUMS, AND REVISIONS

The Project Sponsor is responsible for all addendums, updates, and revisions to this O&M Manual, contingent upon USACE review and approval, and for providing all O&M Manual holders with the revised sections or documents. With respect to updates, the Project Sponsor shall complete, review, and update the emergency supplies, equipment, and contractor sheet in [Appendix A](#) on an annual basis. Any time there is a modification to the levee; a utility line is constructed through, under, or over the levee; there is a change in operation; or any other change in the levee system; an addendum to the O&M Manual needs to be prepared for documentation and record purposes. Periodically, the entire O&M Manual will need to be revised to consolidate all updates, addendums, and other changes to the manual. These complete O&M Manual revisions will be performed by the Project Sponsor on an as-needed basis.

The U.S. Army Corps of Engineers must review and approve any changes, addendums, or revisions to this O&M Manual to ensure the changes do not adversely impact operation or integrity of the federally constructed levee system. This authority is provided through agreements the City of Sioux Falls, South Dakota, entered into with the U.S. Army Corps of Engineers at inception of the project. Refer to [Appendix F](#) for guidance on developing an O&M Manual addendum.

The U.S. Army Corps of Engineers may revise this O&M Manual to reflect changes in site conditions, changes in guidance, or as otherwise warranted.

A list of holders of the O&M Manual is provided in [Appendix A](#). All plan holders need to receive any addendums, revisions or updates to the O&M Manual.

1.12 MAINTENANCE OF RECORDS

The Project Sponsor is required to maintain and update this O&M Manual as outlined above. In addition, the Project Sponsor will retain any/all design documents, records of modifications, maintenance activities and repair or rehabilitation efforts (i.e., cost, type, location, dates, etc.), inspection reports, flood fight records, problem areas, O&M Manual addendums, etc. All such documents need to be maintained in a central location, such as the Project Sponsor's office; be organized; and readily accessible.

1.13 REHABILITATION ASSISTANCE

The U.S. Army Corps of Engineers, under authority of Public Law (PL) 84-99, administers the Rehabilitation and Inspection Program (RIP) for flood damage reduction projects. This program allows the U.S. Army Corps of Engineers to provide assistance in the repair of eligible federal and locally constructed projects that are damaged by flood events. Any such assistance has to be

economically justified (i.e., benefit-cost ratio greater than 1.0) and meet other program requirements. Rehabilitation assistance is only available to projects that are in an active status at the time flood damage is incurred. The assistance is limited to the repair or restoration of a project to its pre-disaster condition and level of protection. In order to be active in the RIP, the project must meet initial eligibility requirements, be admitted into the program, and be maintained in a satisfactory condition as determined by the U.S. Army Corps of Engineers. Federally constructed projects are automatically entered into the program upon completion of construction.

1.14 FEDERAL GOVERNMENT ACCESS

The U.S. Army Corps of Engineers, or designated representatives, will have unrestricted access to the Sioux Falls Flood Damage Reduction Project in accordance with Part 208 of Title 33 of the Code of Federal Regulation. Appropriate notification will be provided to the Project Sponsor should access be needed.

1.15 COMMUNITY OUTREACH AND EDUCATION

Although levee improvements provide a high degree of protection, they do not completely remove the threat of flooding to the affected areas. Consequently, the community shall be periodically informed of the risks and properly prepared in the event flood discharges on the Big Sioux River and Skunk Creek exceed the design capacity of the levee system. The Project Sponsor shall coordinate with state and local emergency management agencies to develop notification and evacuation plans in the event of imminent flooding of the protected areas behind the levee. Project Sponsor shall develop a program for periodically educating the residents and stakeholders located behind the levee of the function and associated risks of the levee system. Frequency of community outreach and education programs shall take into consideration the expected turnover in general population in the affected areas. Areas of higher turnover, including but not limited to, higher education institutions, may require additional community outreach and education efforts.

1.16 APPLICABLE ENGINEERING REGULATIONS (ER) AND OTHER REFERENCES

Federal Flood Control Regulations, Title 33 – Chapter II, Corps of Engineers, Dept. of the Army, Part 208-Flood Control Regulations, Section 208.10 Local Flood Protection Works; Maintenance and Operation of Structures and Facilities.

ER 500-1-1, "Emergency Employment of Army and Other Resources - Civil Emergency Management Program", 30 September 2001.

ER 1110-2-100, "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures", 15 February 1995.

ER 1110-2-101, "Reporting of Evidence of Distress of Civil Works Structures", 15 March 1996.

SECTION 8 – DIVERSION DAM

8.1 OVERVIEW

This section of the manual is intended to cover the O&M requirements for the Diversion Dam. The other sections of the manual will cover other separable components of the levee system.

The diversion dam is a monolithic reinforced concrete structure consisting of a base slab, a gated superstructure, abutment walls, and wingwalls, as described below. See Plates E-12 through E-15 and Exhibit 9K (all exhibits are included at the end of this section).

8.1.1 Modifications to Structure

During Phase 3 construction, grouted soil anchors were added to the diversion dam foundation to increase sliding stability so that the dam could withstand the additional hydrostatic load generated from increasing the capacity of the diversion channel. New 3 feet wide by 2 feet-7 inches high concrete block was added to the upstream face of the dam to increase the height of the dam by 2 feet-7 inches. I-type wing floodwalls were added on either side of the dam that tie back into the levee, providing additional 2 feet-7 inches height of protection. The diameter of the gate stems was increased from 2.5 inches to 3 inches to handle the increased operating forces and new gate hoists provided. New steel gates similar to the existing were fabricated after extensive corrosion was discovered on the bottom of the existing gates and the new gates were coated using vinyl paint system 5-E-Z. Concrete and joint repairs were also performed to the stilling basin floor and on the baffle blocks.

8.2 DESCRIPTION

8.2.1 Location

The diversion dam is located in the Big Sioux River Channel, north of the Sioux Falls Municipal Airport (Joe Foss Field) and between the Big Sioux River diversion channel junction upstream and the Burlington Northern railroad bridge downstream. The gated structure was constructed to divert high water around the City of Sioux Falls. The relative location of the diversion dam is shown on Plate B-1.

8.2.2 Base Slab

The base slab measures approximately 82 feet in the direction of flow and 90 feet back to back of abutments. The slab thickness varies from 5.5 feet in the upstream approach area to 3.0 feet in the downstream stilling basin area. Beginning at the upstream end and for 30 feet downstream the top surface of the slab is constructed at river channel El. 1414.5 feet (vertical datum), thence, along the path of a parabolic curve for 21 feet to El. 1408.0 feet. The top surface continues at El. 1408.0 for 31 feet to the downstream end of the slab. A concrete key extends down 6.5 feet from the bottom of the base slab at the upstream end. Reinforced concrete baffle blocks and a reinforced concrete end sill are constructed on the downstream surface of the base slab to dissipate water energy. The slab is constructed in three monoliths separated from each other by longitudinal expansion joints of premolded filler and a vinyl waterstop.

8.2.3 Gated Superstructure

The superstructure above the base commences 14 feet downstream from the upstream end of the base slab and consists of 10 gated sluices with a gate hoist platform and roadway above. The sluices are 7.25 feet wide by 7.67 feet high by 16 feet long, with the invert at the top of base slab El. 1415.5 feet. The sluices are gated on the upstream end. Vertical walls and horizontal slabs are 1.0 foot thick from the sides and top of the sluices. The vertical sidewalls continue up to support the roadway and gate hoist platform slabs above. On the upstream face of the superstructure, a 1.0 foot thick headwall extends from the top of the sluice openings to the bottom of the gate hoist platform slabs. The roadway slab is 1.0 foot thick and ten feet wide with the top surface at El. 1434.5 feet. The gate hoist platform slab is 1.5 feet thick by 7.0 feet wide and is located on the upstream side of the roadway. An 8-inch wide by 6-inch high concrete curb is constructed on top of the downstream side of the roadway. The gated superstructure, like the base slab below, is constructed in three monoliths separated by premolded filler material. A vertical vinyl waterstop is located on the upstream face between monoliths.

8.2.4 Abutment Walls

The abutment walls adjacent to the gated sluices extend from the top of the base slab to the bottom of the roadway slab above and are cast monolithically with the base slab. The top of the abutment walls support the roadway and gate hoist platform gated sluices. The abutment walls cantilever from the top of the base slab. The channel face of the abutment walls is vertical throughout. The backfill face is vertical above El. 1428.0 feet and battered below that elevation.

8.2.5 Wingwalls

From the upstream end of the abutment walls, wingwalls extend landward to the adjacent levees. The wingwalls are of the cantilever type. The top is 1.0 foot wide and slopes uniformly from EL. 1428.0 feet at the abutments to El. 1421.25 feet, where the wingwalls meet the levee slopes and are terminated. The channel face of the stem is vertical, and the backfill face is vertical from El. 1428.0 to El. 1421.25 feet. Below El. 1421.25 feet the backfill face is battered. Vertical expansion joints with premolded filler material and a vinyl waterstop separate the wingwalls from the abutment walls.

8.2.6 Appurtenant Structures

8.2.6.1 Slide Gates, Guides, and Gate Hoists

Water through each of the ten sluices may be regulated by a steel slide gate at each upstream opening. See Plates E-16 and E-17. The slide gates are 7.67 feet wide by 7.92 feet high, fabricated from steel angles and plates. Each gate has removable galvanized steel guides bolted to embedded galvanized steel sections on each side of the opening. A 3 inch diameter corrosion resistant stem is bolted to each slide gate and is engaged to a double enclosed gear gate hoist anchor bolted to the top surface of the gate hoist platform slab. Adjustable stem guides are mounted on the face of the concrete headwall. A stem cover is mounted on top of each gate to protect the stem threads.

Electric multi-turn actuators were installed to operate electric motors that lift and lower the gates. Actuators have manual overrides to operate the gates in an emergency or during power loss. Separate Operation & Maintenance Manuals are provided and titled as follows:

Vertical Lift Gates and Stop Logs, August 2011

Confluence Dam Structure Gate Actuators and Gear Boxes, April 2013

These and other similar manuals are kept on file by the City of Sioux Falls. The front sheet of each such manual is also referenced in Appendix J – Product Manufacturer's Data. See Appendices J-3 and J-4.

8.2.6.2 Pressure Relief Wells

To relieve uplift forces beneath the base slab, resulting from hydrostatic pressure in the substratum, four Type "A" pressure relief wells have been constructed, two in the backfill side of each downstream abutment wall. Nine Type "B" pressure relief wells are located in the slab on the downstream side of the sluice wall. See Plates E-13, and E-19 through E-23. For the Type "A" wells, concrete projections were constructed on the backfill side of the abutment walls and a 24-inch diameter vertical liner pipe was installed to form a well pit from the bottom to the top of the walls. Each Type "A" relief well consists of an 8-inch inside diameter, wire wrapped, wood stave, slotted well screen that extends 29 feet into a gravel pack below the bottom of the base slab, and an 8-inch inside diameter, wire wrapped, wood stave riser pipe inside the well pit to El. 1416.75 feet. These wells overflow by artesian flow. Water outflows from the well pit through an 8-inch cast iron pipe embedded in the abutment with the outlet end flush with the channel face of the wall. The outlet invert is at El. 1416.0 feet. Each outlet has a removable bird or rodent screen. The walls have a removable cast iron cover flush with the top of the abutment wall. Each Type "B" relief well consists of a 4-inch diameter galvanized, steel riser pipe embedded in the base slab and a metal slotted well screen in a gravel pack for 6.0 feet below the bottom of the slab. A removable 4-inch diameter galvanized steel pipe return bend is bolted to the top of the riser pipe with the outlet end at El. 1416.0 feet. The outlet has a removable bird screen.

8.2.6.3 Air Vents

A 4-inch diameter cast iron wall pipe air vent is embedded in the top slab of the upstream end of each sluice to eliminate possible reactions on the sluice from negative pressures during high flows prior to submergence. A 4-inch diameter cast iron pipe is bolted to the top of each wall pipe and extends up approximately 5 feet to a 4-inch diameter cast iron return bend. The return bend opening has a removable bird screen. See Plate E-18.

8.2.6.4 Guardrail

Guardrail protection is provided from abutment to abutment on the upstream side of the gate hoist platform slab and on the curb adjacent to the downstream side of the roadway slab. See Plate E-18. The guardrails are 3 feet high with 1.5-inch galvanized steel pipe top rails, intermediate rails and posts. The posts are spaced at approximately 8.25-foot centers. Steel base plates are welded to the bottom of the posts and punched for cap screws which fasten the railing to embedded galvanized steel plates.

8.2.6.5 Riprap and Derrick Stone

Riprap was placed to El. 1430.5 feet on the levee slopes upstream from the diversion dam and to El. 1428.0 feet on the downstream slopes to protect the right and left levee slopes against scour and erosion from turbulence during periods of high water. Channel and slope protection was provided for 17 feet upstream and 35 feet downstream from the diversion dam. All of the channel slope protection upstream and 25 feet of the protection downstream was a 36-inch layer

of 30-inch median size derrick stone over a 9-inch layer of spalls and a 9-inch layer of sand and gravel filter. The last 10 feet of protection downstream was a 4 feet-6 inch layer of quarry run riprap with a 15-inch median size rock. For production of derrick stone and riprap Sioux quartzite was used from commercial quarries in the Sioux Falls area (Concrete Materials Co. of Sioux Falls; L.G. Everist, Inc., and Dell Rapids Quarry Co., both of Dell Rapids). See Appendix I – Technical Specifications, for gradations of derrick stone, riprap, spalls, and bedding material.

8.3 MAINTENANCE

8.3.1 General

Periodic inspections shall be made, using a check list similar to Exhibit 8-1, to be certain that:

- a) The diversion dam has not undergone cracking, chipping, breaking, or settling to an extent which might affect the operation, stability, and watertightness of the structure.
- b) The slide gates and guides are not bent, broken, or otherwise damaged to an extent which might affect their operation. The slide gates are well protected with paint.
- c) The stems are not bent or broken, are lubricated where they pass through the stem guides, and are lubricated at their threaded ends.
- d) The gate hoists are in good operating condition and well lubricated.
- e) The pressure relief well system is in good operating condition with the outlet openings free of silt and debris.
- f) The expansion joints are watertight.
- g) The air vents are not damaged and are free of silt and debris.
- h) The guardrails are not damaged and are securely fastened to the structure. All rusted areas are be properly painted.
- i) The gated sluices are free of silt and debris.
- j) All riprap and derrick stone are in-place and in good condition.
- k) The portable gasoline-engine-driven motor-generator and two power wrenches are in good operating condition.

8.3.2 Relief Wells

8.3.2.1 Type "A" Wells

The inspection and sounding, cleaning, and pumping procedures, and the data required for the Type "A" wells are the same as for the Type "A" wells in the diversion chute walls as described in paragraph 10.3.2. Table 8-1 provides depths and reference elevations as follows:

Table 8-1. Type "A" Relief Well Depth and Reference Elevations

Station	Top Elev.	Depth to Bottom of Floor Slab	Depth to Outlet Pipe	Depth to Gravel Pack	Depth to Bottom of Well
62+14.67R	1431.6	24.6	15.6	17.6	53.6
62+14.67L	1431.6	24.6	15.6	17.6	53.6
62+36.67R	1428.0	23.0	12.0	14.0	52.0
62+36.67L	1428.0	23.0	12.0	14.0	52.0

Note: All elevation and depth measurements in Table 8-1 are in feet.

All inspection and maintenance data for these wells shall be recorded on a form similar to Exhibit 10-2. Use as many copies of the form as are necessary for a complete inspection.

8.3.2.2 Type "B" Wells

The Type "B" wells shall be inspected annually for damage and deterioration. The outlet screen should be free of obstructions. In the first several annual inspections, the return bend shall be removed and each well sounded. If more than two feet of material has accumulated in the bottom, the material shall be removed. This can be done by inserting a suction hose into the well and slowly pumping the sand and silt to the surface. If the rate of accumulation is found to be such that it will take five years to accumulate to this 2-foot depth, then sounding shall be necessary only every five years. However, the sounding interval shall never be longer than five years, no matter how low the rate of accumulation of material may be. A table of depths and reference elevations, with the return bend removed, for these nine wells is given as follows:

Table 8-2. Type "B" Relief Well Depth and Reference Elevations

Station	Top Elev.	Outlet Elev.	Depth to Bottom of Well
62+06.17	1416.0	1416.0	12.5
62+06.17	1416.0	1416.0	12.5
62+06.17	1416.0	1416.0	12.5
62+06.17	1416.0	1416.0	12.5
62+06.17	1416.0	1416.0	12.5
62+06.17	1416.0	1416.0	12.5
62+06.17	1416.0	1416.0	12.5
62+06.17	1416.0	1416.0	12.5
62+06.17	1416.0	1416.0	12.5

Note: All elevation and depth measurements in Table 8-2 are in feet.

All inspection and maintenance data for these wells shall be recorded on a form similar to Exhibit 8-2. Use as many copies of the form as are necessary for a complete inspection.

8.3.3 Stilling Basin

Diversion dam stilling basin shall be dewatered and inspected every 5 years, to coincide with periodic inspection frequency. Any damage found shall be repaired as part of routine maintenance.

8.4 OPERATION

The primary function of the diversion dam is to divert high water into the diversion channel in order to limit downstream discharges to the safe capacity of the channel and levee system constructed around the City of Sioux Falls. Recommended operational procedures for the diversion dam sluice gates are designed to achieve this primary project function and still keep maintenance problems at a minimum level. These procedures are outlined in the following paragraphs for the three conditions which are believed to be most pertinent for successful operation of the project, namely:

- 1) Big Sioux River flooding,
- 2) Skunk Creek flooding, and
- 3) Coincident flooding.

Rating curves on which the operating criteria are based are presented in [Exhibits 9C through 9I](#). The water stage recorder originally at U.S. Highway 16 was relocated in April 1972 to the current Marion Road Bridge. The USGS website should be consulted for the most recent gage datum and other pertinent information.

8.4.1 Big Sioux River Flooding

During normal operation, all of the diversion dam gates should be closed except for one or two which may be left sufficiently open to allow passage of the lower river flow. The gate opening during this period may be adjusted to create a nominal backwater condition upstream of the diversion headworks structure. This will help to recharge the aquifer which feeds the City of Sioux Falls water supply wells.

Operation of the diversion dam gates will be necessary when the Big Sioux River flow reaches 12,700 cfs. The gates should be operated to maintain a nearly constant 12,700 cfs flow through the diversion channel when Big Sioux River flows are between 12,700 cfs and 19,800 cfs by passing 0 cfs to 7,100 cfs through the diversion dam. The diversion dam gates should be operated to pass 7,300 cfs when Big Sioux River flows are between 19,800 cfs and 37,300 cfs. However, there may be increased upstream water surface elevations under these conditions, especially at the higher flows. If Big Sioux River flow exceeds 37,300 cfs, the diversion dam gates should be opened to pass 8,500 cfs, with all remaining flows diverted into the diversion channel. The system downstream from the diversion dam will overtop if flow exceeds 8,500 cfs. The levee system is expected to overtop if flows downstream of the diversion dam exceed 8,500 cfs or diversion channel flows exceed 37,300 cfs. Constant surveillance and monitoring is required as flows approach these values.

All gates should be opened and closed concurrently. The variation in gate openings at any given time shall be no more than one foot.

8.4.2 Skunk Creek Flooding

Skunk Creek flow less than 12,400 cfs will have no impact on the operation of the diversion dam. Diversion dam operations will be impacted when Skunk Creek discharge reaches 12,400 cfs, corresponding to a gage elevation reading of 1416.0 feet (NAVD88) at the confluence dam. When this gage reading is met or exceeded, the diversion dam gates should be immediately closed. See Section 11 for additional confluence dam information.

8.4.3 Coincident Flooding

Coincident flooding between Skunk Creek and the Big Sioux River is not expected due to thunderstorm fueled flash floods expected on Skunk Creek and spring snow melt floods on the Big Sioux River. However, under very rare events, it may become necessary to operate the diversion dam and confluence dam when both Big Sioux River and Skunk Creek flooding are occurring simultaneously. Joint operation of the two dams should be determined by qualified personnel on site during flood fighting operations under this scenario.

Figure 8-1 below summarizes the operation of the dams for the two flood sources, and provides guidance to minimize adverse impacts from diversion dam gate operations:

Figure 8-1. Summary of Operation of Dams for Different Flooding Sources

The BSR flows are based on the I-90 gage per Colleen Horihan 3/28/19

		BIG SIOUX RIVER FLOWS, cfs						
		0	10-year 12700	approximate 20-year 19800	50-yr 27100	100-year 35000	max chan cap 37300	max sys cap 45800
SKUNK CREEK FLOWS, cfs	0	No Restrictions No Upstream Impacts	Operate Diversion Dam to pass variable discharge from 0 - 7100 cfs to maintain 12700 cfs in diversion channel to provide no upstream impacts		Operate Diversion Dam to pass 7300 cfs with remaining flows in diversion channel Expect increased water surfaces upstream from project		Operate Diversion Dam to pass maximum capacity of 8500 cfs Closely monitor levees between Diversion Dam and Confluence Dam	
	12400	Diversion Dam Gates Close Confluence Dam Gates Close (trip water surface elevation at 1416) no upstream impacts		Concurrent Operation of Diversion Dam and Confluence Dam to be determined by qualified personnel on site. Adverse impacts are likely		Operate Diversion Dam to pass maximum capacity of 8500 cfs Overtopping of Confluence Dam and levee system likely		
	29000							

Diversion Dam operation procedures are described in Appendix H-2, Operation of Big Sioux River Dams – April 2014.

8.4.4 General Operating Criteria

The operating procedures recommended in the above discussion were developed to maximize flood damage reduction and minimize adverse impacts. Recommended operating procedures are to be followed closely. Specific procedures are discussed below:

- 1) The diversion dam gates are to be completely closed when the confluence dam gage reaches 1416.0 feet (NAVD88) to ensure the levees are not overtopped between the diversion dam and the confluence dam.
- 2) Sluice gates are to be periodically exercised to help limit amount of upstream sediment deposition.
- 3) Appropriate measures should be taken to prevent the formation of jams of ice or debris around the diversion dam. Objects which become lodged in the sluice openings must be removed as soon as practicable. Inspection of the dam and openings shall be made immediately following each major high water period to determine if the sluices are open and the gates in operable condition.
- 4) In opening and closing the gates in the diversion headworks it is important that it be done systematically. Open or close the gates so that the open gates form as near as practical a symmetrical pattern above the centerline of the structure as shown in Exhibit 9K.. This will tend to minimize undesirable flow patterns downstream of the structure.
- 5) Electric multi-turn actuators were installed to operate electric motors that lift and lower sluice gates. Actuators have manual overrides to operate sluice gates in an emergency or during power loss. Separate Operation & Maintenance Manuals are provided and titled as follows:

Vertical Lift Gates and Stop Logs, August 2011

Confluence Dam Structure Gate Actuators and Gear Boxes, April 2013

These and other similar manuals are kept on file by the City of Sioux Falls. The front sheet of each such manual is also referenced in Appendix J – Product Manufacturer's Data. See Appendices J-3 and J-4.

8.5 REPORTING RESULTS OF INSPECTIONS

A form suggested as a check list for reporting inspections of the diversion dam is included as Exhibit 8-1. Use as many copies of the form as are necessary for a complete inspection.

A form suggested as a check list for reporting inspections of the Type "A" relief wells is included as Exhibit 8-2 and of the Type "B" relief wells as Exhibit 8-3. One complete form shall be used for each relief well. Use as many copies of the form as are necessary for a complete inspection.

**BIG SIOUX RIVER FLOOD RISK REDUCTION PROJECT
SIOUX FALLS, SOUTH DAKOTA**

EXHIBIT 8-1

CHECK LIST – DIVERSION DAM

Date: _____

Item	Description	Action
Conditions of gates.		
Condition of paint.		
Trial operated. Date:		
Condition of gate hoists: oiled, greased, and trial operated. Date:		
Condition of stems, stem covers, and stem guides.		
Condition of concrete walls and slabs.		
Condition of expansion joints.		
Condition of relief wells and outlets.		
Condition of guardrail.		
Condition of cast iron air vents.		
Signs of vertical and horizontal movement of structure.		
Gated openings free of silt and debris.		
Riprap.		
Condition of portable motor generator and two power wrenches.		
Miscellaneous.		

Note: Use additional sheets as needed.

Inspected by: Name _____

Title _____

Signed _____

**BIG SIOUX RIVER FLOOD RISK REDUCTION PROJECT
SIOUX FALLS, SOUTH DAKOTA**

EXHIBIT 8-2

CHECK LIST – RELIEF WELLS – TYPE “A”

Date: _____

Structure: _____

Station	Top Elev.	Depth To Sand in Screen	Depth to Gravel Pack	Depth to Bottom Floor Slab	Depth to Water Level	Depth to Draw Down	Time Pumping Began	Time Draw Down Stabilized	Time Pumping Ended
62+14.67R	1431.6	_____	_____	_____	_____	_____	_____	_____	_____
62+14.67L	1431.6	_____	_____	_____	_____	_____	_____	_____	_____
62+36.67R	1428.0	_____	_____	_____	_____	_____	_____	_____	_____
62+36.67L	1428.0	_____	_____	_____	_____	_____	_____	_____	_____

Pumping Record

Time (hours)	Initial	1	2	3	4	5	6
Drawdown (feet)	_____	_____	_____	_____	_____	_____	_____
Discharge (g.p.m.)	_____	_____	_____	_____	_____	_____	_____

Remarks:

Note: All elevation measurements in Exhibit 8-2 are in feet.
Use separate sheet for each relief well tested.

Inspected by: Name _____

Title _____

Signed _____

**BIG SIOUX RIVER FLOOD RISK REDUCTION PROJECT
SIOUX FALLS, SOUTH DAKOTA**

EXHIBIT 8-3

CHECK LIST – RELIEF WELLS – TYPE “B”

Date: _____

Well No.	Station	Top Elev.	Outlet Elev.	Depth to Bottom of Well	Depth to Material in Well	Was Material Removed?
-------------	---------	--------------	-----------------	-------------------------------	---------------------------------	-----------------------------

Diversion Dam

1	62+06.17	1416.0	1416.0	12.5		
2	62+06.17	1416.0	1416.0	12.5		
3	62+06.17	1416.0	1416.0	12.5		
4	62+06.17	1416.0	1416.0	12.5		
5	62+06.17	1416.0	1416.0	12.5		
6	62+06.17	1416.0	1416.0	12.5		
7	62+06.17	1416.0	1416.0	12.5		
8	62+06.17	1416.0	1416.0	12.5		
9	62+06.17	1416.0	1416.0	12.5		

Diversion Weir

1	131+00	1421.0	1411.0	21.4		
2	131+00	1421.0	1411.0	21.4		
3	131+00	1421.0	1411.0	21.4		
4	131+00	1421.0	1411.0	21.4		
5	131+00	1421.0	1411.0	21.4		
6	131+00	1421.0	1411.0	21.4		
7	131+00	1421.0	1411.0	21.4		

Note: All elevation and depth measurements in Exhibit 8-3 are in feet.

Inspected by: Name _____

Title _____

Signed _____

SECTION 11 – CONFLUENCE DAM

11.1 OVERVIEW

This section of the manual is intended to cover the O&M requirements for the Confluence Dam. The other sections of the manual will cover other separable components of the levee system.

11.2 DESCRIPTION

The Confluence Dam is intended to prevent floodwater from Skunk Creek backing up along the Big Sioux River historic channel and overtopping the levees between the confluence and the diversions dams.

11.2.1 Location

The Confluence Dam is a gated structure in the historic channel of the Big Sioux River (BSR) located just north (upstream) of the confluence with Skunk Creek. The new dam is located on the Big Sioux River 5.75 miles downstream from the Diversion Dam.

11.2.2 Features

The Confluence Dam is approximately 100 feet long with a roadway 14 feet wide and has ten self-contained stainless steel vertical lift gates with non-rising stems. The gates were manufactured by Fontaine and are 8 feet wide by 15 feet high. The gates are normally stored in the open position and hidden from view behind a decorative concrete screen wall. The screen wall extends to elevation 1435.0 feet above the top of the levee in order to completely screen the gates from view. The top of the levee is at elevation 1424.85 feet. The top of the wing walls are at elevation 1423.85 feet where they intersect the dam such that water will overtop the wing walls by the dam before overtopping the levees. The foundation of the dam is 45 feet wide and varies in thickness from 5.5 feet to 7 feet with a 6 foot deep key to resist sliding. The top of the dam foundation slab slopes away from the gate sill on both sides to provide drainage.

Electric multi-turn actuators were installed to operate electric motors that lift and lower the gates. Actuators have manual overrides to operate the gates in an emergency or during power loss. Separate Operation & Maintenance Manuals are provided and titled as follows:

Vertical Lift Gates and Stop Logs, August 2011

Confluence Dam Structure Gate Actuators and Gear Boxes, April 2013

These and other similar manuals are kept on file by the City of Sioux Falls. The front sheet of each such manual is also referenced in Appendix J – Product Manufacturer's Data. See [Appendices J-3 and J-4](#).

The Confluence Dam wing walls are T-wall type reinforced concrete retaining walls with foundation keys. The centerline of the wing walls forms a 25° angle with the edge of the channel. The top of each wing wall slopes down from a maximum elevation of 1423.85 feet to intersect the levee slope. The footing for the wing walls steps up twice as the height of the wall decreases away from the dam. The wing walls have a layer of granular drainage material immediately behind the walls and PVC drains with flap gates.

11.3 MAINTENANCE

Periodic inspections and maintenance shall be performed, using a check list similar to Exhibit 11-1, to be certain that:

- a) The confluence dam has not undergone cracking, chipping, spalling, or settling to an extent which might affect the operation, stability, and watertightness of the structure.
- b) The lift gates and guides are not bent, broken, or otherwise damaged to an extent which might affect their operation.
- c) The stems are not bent or broken, are lubricated where they pass through the stem guides, and are lubricated at their threaded ends.
- d) The gate hoists are in good operating condition and well lubricated.
- e) The expansion joints are watertight.
- f) The guardrails are not damaged and are securely fastened to the structure. All rusted areas should be cleaned and properly painted.
- g) The gated sluices are free of silt and debris.
- h) All riprap stone is in-place and has not deteriorated.
- i) The portable gasoline-engine-driven motor-generator and two power wrenches are in good operating condition.

11.4 OPERATION

11.4.1 Big Sioux River Flooding

The confluence dam gates were sized to safely pass any flow the diversion dam gates pass. Under normal operating conditions, the confluence dam gates will be completely open and remain open during Big Sioux River flooding. Operation of the confluence dam is not needed to control Big Sioux River flooding. No changes to the operation of the diversion dam are required with the levee improvements for Big Sioux River flooding.

11.4.2 Skunk Creek Flooding

The confluence dam was constructed to keep Skunk Creek flood flows from backing up into the historic BSR channel between the diversion dam and the Skunk Creek confluence. Under normal operating conditions, the existing diversion dam only allows minimal flow into the historic channel and the confluence dam gates would be fully open. All confluence dam gates must be closed before overtopping of the un-raised portion of the levee downstream from the diversion dam occurs from back water. It is imperative that the diversion dam gates be closed prior to the confluence dam gates being closed to prevent overtopping of the levee system between the two dams.

The sponsor had indicated a preference for limiting the closure of the gates to less frequent floods. The diversion dam gates are to be closed completely when Skunk Creek flooding reaches elevation 1416.0 feet (NAVD88) at the confluence dam gage. The confluence dam gates are to be closed immediately after the diversion dam gates are closed. Both sets of gates are to remain closed until Skunk Creek flooding has receded below elevation 1416.0 feet (NAVD 88) at the confluence dam gage. The 1416.0 feet (NAVD 88) gage reading corresponds to an approximate Skunk Creek discharge of 12,400 cfs.

11.4.3 Coincident Flooding

Coincident flooding between Skunk Creek and the Big Sioux River is not expected due to thunderstorm fueled flash floods expected on Skunk Creek and spring snow melt floods on the Big Sioux River. However, under very rare events, it may become necessary to operate the diversion dam and confluence dam when both Big Sioux River and Skunk Creek flooding are occurring simultaneously. Joint operation of the two dams should be determined by qualified personnel on site during flood fighting operations under this scenario.

Figure 11-1 below summarizes the operation of the dams for the two flood sources, and provides guidance to minimize adverse impacts from diversion dam gate operations:

Figure 11-1. Summary of Operation of Dams for Different Flooding Sources

BIG SIOUX RIVER FLOWS, cfs						
	0	10-year 12700	approximate 20-year 19800	50-yr 27100	100-year 35000	max chan cap 37300 max sys cap 45800
SKUNK CREEK FLOWS, cfs	0	No Restrictions No Upstream Impacts	Operate Divers on Dam to pass variable discharge from 0 - 7100 cfs to maintain 12700 cfs in diversion channel to provide no upstream Impacts	Operate Diversion Dam to pass 7300 cfs with remaining flows in diversion channel Expect increased water surfaces upstream from project		Operate Diversion Dam to pass maximum capacity of 8500 cfs
	12400 29000	Diversion Dam Gates Close Confluence Dam Gates Close (trip water surface elevation at 1416)				Operate Diversion Dam to pass maximum capacity of 8500 cfs Overtopping of Confluence Dam and levee system likely

Confluence Dam operation procedures are described in [Appendix G-2](#), Operation of Big Sioux River Dams – April 2014.

11.5 REPORTING RESULTS OF INSPECTIONS

A form suggested as a check list for reporting inspections of the diversion dam is included as Exhibit 11-1. Use as many copies of the form as are necessary for a complete inspection.

**BIG SIOUX RIVER FLOOD RISK REDUCTION PROJECT
SIOUX FALLS, SOUTH DAKOTA**

EXHIBIT 11-1

CHECK LIST – CONFLUENCE DAM

Date: _____

Item	Description	Action
Condition of gates.		
Condition of paint.		
Condition of gate hoists.		
Condition of stems, stem covers, and stem guides.		
Oiled, greased, and trial operated. Date:		
Condition of concrete walls and slabs.		
Condition of expansion joints.		
Condition of guardrail.		
Signs of vertical and horizontal movement of structure.		
Gated openings free of silt and debris.		
Condition of riprap.		
Condition of portable motor generator and two power wrenches.		
Miscellaneous.		

Note: Use additional sheets as needed.

Inspected by: Name _____

Title _____

Signed _____

SECTION 19 - HIGH WATER EVENTS AND EMERGENCY OPERATIONS

19.1 OVERVIEW

The Sioux Falls Flood Risk Reduction Project was designed and constructed to protect against flooding from both the Big Sioux River and Skunk Creek with minimum damage and inconvenience to the leveed areas. The project reduces but does not eliminate the threat of flooding to leveed areas. In order for the project to fulfill all design capabilities, surveillance of the levee and its components; collection and analysis of flood forecast information; and timely repair to any defective portion of the project are necessary. When flood stages occur or are predicted, the Project Sponsor should initiate all necessary actions to initiate emergency operations. The Project Sponsor shall monitor for potential flooding conditions as outlined below.

19.1.1 Project Sponsor and Emergency Response Team

The Sponsor is responsible for the overall operation of the flood damage reduction system during flood events to include surveillance, monitoring, and flood fighting, if necessary. The Emergency Response Team shall consist of flood damage reduction system personnel and other individuals that are trained in the inspection and operation of the levee system, including flood fighting techniques and procedures. Points of contact for the Project Sponsor and Emergency Response Team members are provided in [Appendix A](#). The Project Sponsor should keep a current list of contacts readily available in case of emergencies. The organizational structure, rosters, and points of contact shall be updated on an annual basis. The Project Sponsor should also consider utilization of other resources for flood fighting and surveillance activities.

19.1.2 Emergency Materials, Equipment, and Contractors

A list of the locations and points of contact for emergency materials (e.g., sand bags; soil, sand, and rock stockpiles, etc.), equipment (e.g., earth moving equipment, pumps, etc.), and contractors, that may be needed to respond to a high water event, is provided in [Appendix A](#). This list shall be updated annually by the Project Sponsor.

In addition, the Project Sponsor shall maintain adequate supplies for the Emergency Response Team to allow them to carry out their responsibilities day or night. Supplies needed include flashlights, spotlights, two-way radios, cameras, vehicles, flagging, wood stakes, markers, rope, etc. The Project Sponsor shall ensure that these supplies are available and located in a central location that can be readily accessed by the Emergency Response Team.

19.1.3 Assistance During Flooding

The U.S. Army Corps of Engineers can provide consultation and assistance during a flood event. Refer to the PL84-99 Fact Sheet attached at the end of this section and in [Appendix G](#) regarding assistance that can be provided by the U.S. Army Corps of Engineers and the correct process required to receive assistance. The U.S. Army Corps of Engineers' emergency flood fight assistance under PL84-99 is subject to the following:

- The U.S. Army Corps of Engineers emergency assistance under PL 84-99 during flood events will be of a temporary nature to meet immediate threat and will be undertaken only to supplement State and Local efforts.

- During flood emergencies, State and Local authorities are expected to take the initiative in flood fighting activities and must commit all resources in order to attain U.S. Army Corps of Engineers assistance.
- The U.S. Army Corps of Engineers assistance is provided strictly for the protection of critical public infrastructure.
- Requests for assistance to the U.S. Army Corps of Engineers shall be received from the State of South Dakota via State Emergency Management Agency.
- Refer to Appendix A - Points-of-Contact for U.S. Army Corps of Engineer emergency operations contact information.

19.1.4 Evacuation Plan

The development, updating, and implementation of an Evacuation Plan for areas located behind the flood damage reduction system in the event that a flood greater than the design event occurs, or if the flood damage reduction system is otherwise compromised, is the responsibility of the City of Sioux Falls. Evacuation Plan should include evacuation routes and procedures.

19.2 FLOOD CHARACTERISTICS, FORECASTS, AND INFORMATION

Critical stages in the Big Sioux River and Skunk Creek may be reached at unexpected periods of the day and night. Precautionary steps should be enacted as far in advance as possible to ensure preparedness for a significant flood event.

Listed below is the contact information of governmental agencies which can be contacted for information concerning pertinent streamflows and precipitation amounts:

National Oceanic and Atmospheric Administration (NOAA) National Weather Service. The Weather Service is the primary source of flood forecast data. This agency is officially responsible for the operation of a river flood forecasting service. The Big Sioux River basin is located in the Sioux Falls River District which may be contacted as follows:

Address:	Sioux Falls, SD Weather Forecast Office 26 Weather Lane Sioux Falls, SD 57104-0198
Phone:	605-330-4247
Email:	w-fsd.webmaster@noaa.gov
Website:	http://www.crh.noaa.gov/fsd/

U. S. Geological Survey. The Geological Survey has the responsibility for collecting, analyzing and interpreting streamflow data. This agency frequently has information available on current river conditions. The following office should be contacted for information:

Address: U.S. Geological Survey
Earth Resources Observation and Science (EROS) Center
47914 252nd Street
Sioux Falls, SD 57198-0001
Phones: 605-594-6151 or 800-252-4547
Email: custserv@usgs.gov
Website: <http://eros.usgs.gov/>

U. S. Army Corps of Engineers, Omaha District. The Water Control & Water Quality Section of the U.S. Army Corps of Engineers, Omaha District, receives weather, precipitation, and stream gage information from the National Weather Service. This office is open 5 days a week, 8 hours daily, Monday through Friday.

Address: U.S. Army Corps of Engineers, Omaha District
Water Control & Water Quality Section
1616 Capitol Avenue, Ste. 9000
Omaha, NE 68102-4901
Phone: (402) 995-2308
Fax: (402) 995-2307
Email: dll-cenwo-ed-ha@usace.army.mil
Website: <http://www.nwo.usace.army.mil/>

Contact information is also provided in [Appendix A](#).

19.3 FLOOD WARNING SYSTEM

19.3.1 General

There is no automatic flood warning system for the Sioux Falls Flood Damage Reduction Project.

Floods along the Big Sioux River and/or Skunk Creek at Sioux Falls can be caused by rapid runoff from snowmelt augmented by ice jam conditions and early spring rainfall. It is of the utmost importance the Sponsor monitor this type of flood condition each year. Also, flood producing runoff along the Big Sioux River and Skunk Creek may result from late spring and summer rainfalls and/or heavy local thunderstorms. It is difficult to establish a firm relationship between point rainfall values and resultant runoff. However, general rains of 3 to 4 inches over the basin could produce runoff that requires attention to the project operation. Storms that produce rainfall amounts that exceed 4 to 5 inches require close attention be given to all project operations.

Precipitation gages are operated, maintained, and their readings provided by the NOAA, National Weather Service. The locations of four recording precipitation gages in or near the Big Sioux River basin are listed below:

Sioux Falls, SD 57104

Location ID: ZIP:57104
Period of Record, since: 1948-08-01

Sioux Falls EROS CTR, SD US

Station ID: COOP:397662
Location: South Dakota, US
Period of Record, since: 1974-02-01

Sioux Falls Foss Field, SD US

Station ID: COOP:397667
Location: South Dakota, US
Period of Record, since: 1948-08-01

Sioux Falls Weather Forecast Office Airport, SD US

Station ID: COOP:397666
Location: South Dakota, US
Period of Record, since: 2003-08-01

More information may be found at the following website:

<http://www.ncdc.noaa.gov/cdo-web/search#t=secondTabLink>

Automated river stage gages should be monitored for pending flooding risks. There are four stream gage stations, as listed below:

USGS 06481000 Big Sioux River near Dell Rapids, South Dakota:

A water stage recorder operated by the USGS and located on left bank at downstream side of highway bridge, 0.2 miles downstream from confluence of divided channels, and 3.0 miles southwest of Dell Rapids. The National Weather Service flood stage is 12.0 feet.

USGS 06481500 Skunk Creek at Sioux Falls, South Dakota:

Water stage recorder and crest stage gage operated by the USGS and located on downstream left bank 180 feet from bridge on Marion Road, 1.3 miles upstream from mouth, 1.8 miles downstream from small right-bank tributary, and 0.5 miles west of I-29 in Sioux Falls. The gage datum is 1400.1 feet (NGVD 1929). The National Weather Service flood stage is 11.5 feet.

Water stage recorder on Skunk Creek Confluence Dam:

This staff gage is operated by the City of Sioux Falls and has set trigger points for the operation of the Skunk Creek Confluence Dam and upstream Big Sioux River Diversion Dam. During a Skunk Creek flood event, at elevation 1416.0 feet (NAVD88), the diversion dam is closed completely and immediately followed by closure of the confluence dam gates.

USGS 06481493 Skunk Creek near Hartford, South Dakota:

This is a seasonal water-stage recorder, crest-stage gage. Datum of gage is 1,470.89 feet (NGVD 1929). On left downstream end of Skunk Creek Avenue Bridge between 465 and 466 Avenues, 2.3 miles northeast of Hartford, and about 3 miles downstream from confluence of West Branch Skunk Creek, and approximately 17 river miles upstream from USGS 06481500, Skunk Creek at Sioux Falls. National Weather Service flood stage is 10.0 feet.

More information may be found at the following website:

<http://waterdata.usgs.gov/sd/nwis/current/?type=flow>

19.3.2 Procedures for Initiating Emergency Response

When risk of flooding is high or unusually high river stages are imminent, the Sponsor shall:

- Verify emergency personnel are alerted via phone. See [Appendix A](#) for points of contact.
- Contact and assemble the Emergency Response Teams to prepare for further necessary actions.

19.4 PROJECT SURVEILLANCE DURING FLOODS

19.4.1 General

When flood conditions develop and water is or may be against the levee, or other parts of the flood damage reduction system, the Project Sponsor must initiate monitoring and surveillance of the whole system and provide any operations or emergency actions necessary.

The need for, and level of surveillance required will be determined by the Project Sponsor. Team members should be provided the appropriate equipment (e.g., two-way radios, cameras, spotlights, etc.) to initiate surveillance of the flood damage reduction system. Team members should make detailed inspections of the flood damage reduction system giving special attention to the following:

- Check communications with the Sponsor and team members (e.g., radio-checks).
- Condition of the project features including levees, channels, floodwalls, flood control structures (Diversion Chute, Diversion Dam, and Confluence Dam), relief wells, and any recent repair areas.
- Condition of drainage structures with special attention given to the flapgates, if accessible (is it blocked in open position allowing water into the protected areas?).
- Closure structures (readiness for assembly, logistics of set up, etc.)
- River stages.
- Erosion occurring from high water.

- Accumulations of debris, trash, ice, etc.
- Vehicular roads and access including levee crest roads, levee access ramps, and other applicable facilities.

After the initial inspection, the Emergency Response Team will perform the following work as required:

- Review the list of emergency materials, equipment, and contractors.
- Locate necessary tools and materials, and distribute and store them at points where active maintenance is anticipated.
- Ascertain that necessary access roads along the project are usable.
- Fill holes, gullies, and washes in the levee crown and slopes.
- Examine all drainage ditches or swales on the landside of the levee and remove any obstructions.

The Sponsor will determine when surveillance of the levee systems is no longer necessary and when the Emergency Response Team can be released.

19.4.2 Levees

An earthen levee is in potential danger whenever there is water against it. The danger increases with the height of water, the duration of the flood stage, and the intensity of either the current or wave action against the levee face. Consequently, constant surveillance is necessary during floods to detect erosion, sloughing, slides, sand boils, or other signs of potential threat to the integrity of the levee. Failures due these types or problems can be minimized if prompt action is taken and proper methods of treatment are employed.

Careful observation should be made of the riverside of the levee for its entire length during high water periods. Scour occurs when the current velocity against the levee is adequate to remove levee embankment materials. Once scouring begins to occur, the protective sod cover is damaged or destroyed and additional scour may develop very quickly. Scouring will most likely develop at road ramp crossings, where structures penetrate the levee, or any other location where there is an obstruction to the smooth flow along or near the levee face. If any scour is observed, soundings should be taken to determine the extent of damage and amount of treatment required.

Sloughing may occur if the levee embankment becomes saturated as a result of prolonged high river or channel stages. Sloughs can also develop when seepage water under the levee creates one or more large sand boil at or near the landside levee toe. In either case, sloughing may develop into a larger and more damaging slide if corrective action is not taken. For a slope failure condition resulting from a slide, a substantial section of the levee embankment breaks away along a clearly defined crack and moves downward and landward. The displacement of soil on the slope will result in a reduction of the embankment section and poses a major threat to the integrity of the levee.

During flood periods, surveillance of the levee should be initiated as soon as water is on the levee embankment. Surveillance frequency should be increased as water levels increase and should continue until flood stages have receded.

To remain in a state of operational readiness, levees shall be maintained according to procedures discussed in [Section 5](#) of this manual.

19.4.3 Channels

During floods, the project channels should be patrolled and protective measures instigated to prevent erosion of the banks and formation of ice and debris jams. Large objects should be removed which become lodged against banks or bridges. See 19.5 for more details on protective measures.

To remain in a state of operational readiness, channels shall be maintained according to procedures discussed in [Section 6](#) of this manual.

19.4.4 Floodwalls

The project has about 1800 feet of concrete floodwall located on the left bank of the Big Sioux River in the downtown business district of Sioux Falls between the 10th Street bridge at the upstream end and the pedestrian bridge on the downstream end, and a floodwall next to the Minnehaha Country Club golf course along the Big Sioux River left bank downstream from the Skunk Creek confluence. The floodwalls will perform their function if properly maintained in low water periods between flood events. Damage or deterioration of floodwalls shall be corrected as soon as river conditions permit.

To remain in a state of operational readiness, floodwalls shall be maintained according to procedures discussed in [Section 7](#) of this manual.

19.4.5 Drainage Structures

This project contains numerous drainage structures that are used to discharge interior storm water from within the leveed area into the river. All flapgates should be inspected prior to the time when flood waters rise to the outlet invert elevation of any drainage structure. Because of their location, drainage structures are generally subject to inundation at lower stages than most other project features. Any trash, debris, or other potential obstruction present should be removed from the structure. If, for any reason, a flapgate fails to close and cannot be repaired because of high water, immediate consideration should be given to blocking the structure opening by other means. Blocking of the outlet end of the structure should be given first consideration if river or channel stages permit. Timber, metal plates, or a tarp covering held in place by sandbags are suggested methods of providing an effective temporary closure. If the efforts to plug the outlet end of the structure fail, immediate action should be taken to build a sandbag or earth ring around the inlet end of the structure. While it is of utmost importance that the structures are blocked to prevent high stages of the river from flowing into the protected area, such emergency closures should be such that they can be readily removed after high river stages recede. Sealing off leakage around the sluice gate within the gatewell structure should also be given consideration. This can be performed by placing plastic in front of the sluice gate and holding the plastic in place with sandbags. It is the Sponsor's responsibility to remove these flood-fighting materials once the flood threat has passed.

Given below are the basic operational procedures to be followed during a flood emergency:

- 1) Automatic flap gates will be closely observed until it is certain that their operation is unobstructed. In case a flap gate fails to close and cannot be repaired because of highwater, the manual slide gate should be closed or a sandbag closure made to prevent flow into the protected area.
- 2) Manual slide gates shall be closed according to the guidelines set forth in Section 13.
- 3) Pump Stations shall be ready for operation according to the guidelines set forth in Section 14.
- 4) Zoo Inlet Structure (Station 313+00L). No special operating requirements are needed during Skunk Creek flooding. The sluice gate of this structure should be closed whenever the diversion dam gates are opened above normal operating levels.
- 5) All outlet structures should be inspected frequently during flood periods to ascertain whether seepage is taking place along the lines of contact with the embankment. If seepage exists, immediate action should be taken to correct adverse conditions.

The operation and maintenance of outlet structures and their reverse flow protective outlet gates are more fully discussed in Section 13 and pertinent structure information is contained in tables shown on Plates C-1, C-14, and C-33 of this manual.

To remain in a state of operational readiness, drainage structures shall be maintained according to procedures discussed in [Section 13](#) of this manual.

19.4.6 Diversion Chute

The concrete diversion chute is located at the downstream end of the diversion channel in the northeast part of Sioux Falls just east of the State Penitentiary. The function of this chute is to convey floodwaters from the diversion channel back to the Big Sioux River channel located below. The diversion chute requires no operation; however, during periods of high water, personnel should observe the structure in conjunction with operation of the diversion dam to determine its hydraulic adequacy and monitor possible seepage below the surface of the chute.

To remain in a state of operational readiness, the diversion chute shall be maintained according to procedures discussed in [Section 10](#) of this manual.

19.4.7 Diversion Dam

The diversion dam is located in the Big Sioux River channel, north of the Sioux Falls Municipal Airport (Joe Foss Field) and between the Big Sioux River diversion channel junction on the upstream side and the Burlington Northern railroad bridge on the downstream side. The primary function of this gated structure is to divert flood discharges into the diversion channel in order to limit flows along the historic Big Sioux River channel through Sioux Falls to the capacity of the

improved channel and flood damage reduction system. The operating procedure for this structure during normal flow and flood conditions is contained in Section 8 of this manual.

To remain in a state of operational readiness, the diversion dam shall be maintained according to procedures discussed in [Section 8](#) of this manual.

19.4.8 Confluence Dam

The confluence dam is located in the historic Big Sioux River channel, immediately north of the confluence with Skunk Creek. The primary function of this gated structure is to prevent Skunk Creek floods from backing up into the historic Big Sioux River channel and overtopping the levees between the confluence dam and the diversion dam. The operating procedure for this structure during normal flow and flood conditions is contained in Section 11 of this manual.

To remain in a state of operational readiness, the diversion dam shall be maintained according to procedures discussed in [Section 11](#) of this manual.

19.4.9 Relief Wells

Relief wells are an integral part of the flood damage reduction project and are of vital importance during the flood because they relieve underseepage pressures under project levees and structures. Monitoring relief well performance during high water events should be included into daily monitoring program routines. Make sure relief well outlets are free of debris, so water can flow out freely. If relief well is not releasing water during flood conditions, especially if other relief wells nearby do, that is the sign that this particular relief well is not working properly, increasing the risk of underseepage in that area with boils being the first sign of such condition. Special attention should be given to these areas during the flood. Inspect for boils not only in the vicinity of the malfunctioning relief well but also further afield. After the flood, problem relief wells should be repaired or replaced.

19.4.10 Closure Structures

Currently, the flood damage reduction project at Sioux Falls contains six closure structures including three road closure structures and three railroad closure structures. The closure structures are vital to the flood damage reduction system. Without them the system would not provide the authorized level of protection; therefore, it is critical that the structures be in place before flood waters reach the sill elevation of each structure.

Closure structures will be operated based on a three-step “trigger” process – notification, mobilization, and closure. Notification places city and other appropriate personnel on alert and signals the need to make arrangements and plans for an eventual closure. Mobilization signifies the point in time that personnel are to actively move the stop logs from storage to the closure site and appropriate labor and equipment are assembled at the site in preparation for closure. In some instances, there is a limited amount of time between mobilization and closure. Closure identifies the point in time that the stop logs are actually placed in position. Leading and receding times are based on the balanced hydrographs used during design of the flood damage reduction project. The difference between “Leading time (hrs)” in the tables in [Section 12](#) provides the approximate amount of time between trigger points.

All suggested notification, mobilization, and closure points are guidelines. Floods are dynamic and actual conditions may vary. Appropriate personnel should be available to make necessary adjustments and decisions as to when structures are actually closed.

After mobilization, assembly time per closure structure can be estimated assuming one man hour per 100-200 square feet of closure. Accordingly, each closure should not take more than 2 hours assuming a four-person crew.

The closure structures must be continuously monitored during flood events, particularly when floodwaters reach the upper stoplogs. The closure structures will not be watertight, therefore pumps and sandbags should be on hand to control water leakage. Excessive leakage may indicate improper installation, overstress of the closure components or impending failure due to damage, and therefore must be investigated. If the water is not too high, it may be possible to correct improper installation by use of pry bars and hammers, but caution must be used to avoid damage. Stuffing gaps with rags, applying clamps, or placing plastic sheeting over riverside of the affected areas may reduce leakage. Failure may occur if the structure is not installed properly, if the components are damaged or defective, or if large floating debris impacts the structure. For safety reasons the area on the dry side of the closures should be kept clear of people and equipment during floods, and people should not be allowed on the structure itself. If the structure appears to be deflecting excessively or shows signs of structural distress, non-essential personnel should be evacuated from the immediate area and, if the structure appears stable, efforts should be initiated to shore up the affected members. Shoring in the form of wood struts placed at approximately 45 degrees and as high as possible on the upper stoplogs would be the most effective means of relieving loads on the posts. The lower end of the strut should be staked or blocked. If bracing does not appear feasible, the affected sections should be backed up with sandbags stacked to the same height as the water level with a minimum slope of 1 vertical on 1 horizontal. The number of persons involved in the shoring operation and the amount of time spent behind the structure should be kept to a minimum. While the shoring or sandbags are being installed extra observers should be stationed to watch the structure closely so the crew can be alerted or evacuated if further structural distress becomes evident.

The operation and maintenance of the closure structures are more fully discussed in [Section 12](#).

To remain in a state of operational readiness, the drainage structures shall be maintained according to procedures discussed in [Section 12](#) of this manual.

19.5 FLOOD FIGHTING AND EMERGENCY RESPONSE ACTIONS

For a full list and description of flood fighting techniques refer to *U.S. Army Corps of Engineers Emergency Flood Fight Training Manual, September 2002* (see [Appendix G](#)).

All exhibits mentioned in this section are included in [Appendix G](#).

19.5.1 Raising Low Reaches of Levee Crest

If an official weather forecast indicates the probability that river stages will approach or exceed the height of the existing levees, or any other part of the flood damage reduction system,

immediate attention should be given to raising low reaches of the levee crown. Low areas may already have been identified by historical observations, profile surveys along the levee crest, or through freeboard observation as the river rises against the levee. Raising the height of the levee at a low area may prevent failure of the levee system by not allowing high velocity erosive flows from overtopping the levee at that location. Several methods have been used successfully to accomplish levee crown raises (see [Exhibit b](#) thru [Exhibit d](#)). The most common of these are earth topping fill and sandbag topping.

19.5.1.1 Earth Fill

This method should receive first consideration in raising low reaches of levee provided the work can be accomplished in advance of the high water stages. Heavy hauling equipment should not be allowed on the levee when the water is high on the levee since weight and vibration might result in embankment failure. This is especially true of levees constructed with predominately sandy materials. Borrow areas should be located well back from the levee (500 feet landward minimum). If available, borrow should come from areas comparable in elevation to the top of the levee. A moist impervious material is preferable to sand for accomplishing the raise. Existing or newly constructed ramps of adequate grade and section should be used for access to the levee top. Travel up and down the levee side slopes should be avoided. Elevation control should be established prior to beginning the filling operation and a continuous check made to insure settlement caused by the added weight and hauling activities is not reducing effectiveness of the desired crown raise. If it is determined that significant settlement is occurring, the earth fill operation should be abandoned in favor of a method that would cause less weight to be applied to the levee structure. The following sections provide some examples of those methods.

19.5.1.2 Sandbags

A sandbag topping constructed of partially filled sandbags is a quick and effective method of raising low reaches (see [Exhibit h](#)). This is particularly true where the reach or reaches are relatively short and the required raise is three feet or less. Sandbags should be lapped at least one third either way and should be well tamped and packed into place (see [Exhibit h](#)). Even a properly constructed sandbag section will allow a considerable amount of seepage through the sandbags if river or channel stages rise above the top of the levee. To prevent through seepage, plastic sheeting placed and secured over the riverward sandbags has been used to reduce this type of seepage to an acceptable amount. The easiest method to secure the plastic is to place the plastic on the levee crest, near the riverside shoulder, and start the sandbag placement on top of the plastic. After the sandbag section is completed, the plastic should be wrapped up and over the sandbag section and held in place with additional sandbags. Adjacent plastic sheets should be placed so that they are “shingled” in a downstream direction to prevent river flows from entering behind the plastic. Additional sandbags should also be placed along the joints of the overlapped joints of the plastic. Through seepage should not be allowed to pond and soak into the levee crown because of the weakening effect saturation has on embankment strength. Small ditches or drainage ways should be provided at exit points using hand shovels to provide a discharge channel for the water. The ditches or drainage ways must be constructed in a manner that minimizes scour of the levee side slope. The ditches will require monitoring to determine if excessive scouring is occurring and should be repaired as needed. Sandbag topping is generally used when it is expected the topping would be required to hold back water depths of 18 inches or less.

19.5.1.3 Other

Various products are available on the market that can be used as temporary flood barriers. These products can be used to raise limited low areas of a levee or to raise entire reaches. Since these are manufactured products, they would need to be ordered by the Sponsor well in advance of need and appropriately stored for potential future use. The U.S. Army Corps of Engineers does maintain a limited supply of such products that may be provided to local communities during severe flooding. For more information, contact the U.S. Army Corps of Engineers ([Appendix A](#)).

19.5.2 Sand Boils

19.5.2.1 Description

A sand boil develops when underseepage pressures are great enough on the landward side of an earthen levee to move soil particles. This condition is illustrated in [Exhibit a](#). Usually, but not always, a sand boil emerges near the landward toe of the levee. Boils result from a combination of factors and present a significant threat to the integrity of the levee. When river or channel side water heights are such that the levee is holding back water from the protected areas, water pressure exerted by the higher river or channel side stages will tend to move water landward through the foundation soils. The movement of water will be through the zone(s) of least resistance, which are typically sands and gravels. If the pressure is great enough, the water will erupt or “boil” from the ground surface on the landward side of the levee as it tries to reach an equilibrium point. This is commonly referred to as a “quick” or “quick sand” condition. After a boil location forms, it may discharge relatively clear water that indicates the velocity of the underseepage water is not great enough to continue movement of soil particles. A much more serious condition exists when the water discharging from a boil is dirty (i.e., contains quantities of soil particles). This indicates that seepage waters are removing soil from underneath the levee. Boils may grow from small to large very quickly, and boils that begin by discharging clear water may suddenly develop into a condition where soil particles are being carried with the seepage flows.

Unless corrective actions are taken, a solution channel or pipe may develop and enlarge to the point where the levee could fail. Early preventive action when sand boils are found to be transporting soil materials is the best insurance against having a piping condition develop.

19.5.2.2 Sandbag Ring Levees

The most common and accepted method of treating sand boils that are displacing soil particles is to construct a ring of sandbags around the boils as illustrated in [Exhibit b](#). The purpose of the sandbag ring is to contain the underseepage flows until a sufficient head of water is built up to counterbalance the upward pressure and prevent further movement of soil particles. Treated areas should be kept under constant surveillance until the high water recedes. The condition at each sand boil or area of sand boils will dictate the dimensions and shape of the sandbag ring. The proper procedures for constructing a sandbag ring around a boil(s) are outlined below.

- Where several sand boils develop in a localized area, a ring levee of sandbags should be constructed around the entire area.

- "Weak" or "quick" ground near a boil should be included within the sack ring to prevent these areas from developing into active boils when the active boil is treated.
- When a sand boil is located very near the levee toe, the sandbag ring may be tied into the landside slope of the levee.
- The base or foundation for the sandbag ring should be cleared of debris and scarified to provide a reasonable watertight bond between the ground surface and the sandbags.
- The ring is constructed with sandbags filled approximately two-thirds (2/3) full of sand or silt, which are then positioned and tamped firmly into place. Tying the ends of sandbags is neither necessary nor desirable. The width of the sandbag ring section should not be less than the contemplated final height. Subsequent layers are built on the top of the previous layer with the joints staggered for stability and water tightness. The untied ends of sandbags should be laid towards the inside of the ring and placed so the loose end falls down over the next sandbag below.
- If plastic sheeting is available, it is desirable to line the inside of the sandbag ring with plastic to prevent seepage water from the boil from exiting through the sandbag section. The plastic is most effective if it is placed on the ground surface, underneath of the bottom sandbag layer, as the ring levee is being constructed. The plastic should then be wrapped up over the top of the completed ring and held in place with additional sandbags.
- The height of the sandbag ring needs to be only high enough to stop the movement of soil particles from the boil, and thus resulting in only clean water flowing out of the boil. Never attempt to completely stop the flow from a boil as this may result in the development of other boils nearby.
- A spillway or exit channel should be provided at the top of the sandbag ring to carry off the overflow water to a location well away from the boil. Sandbags are normally used to construct the spillway.

19.5.2.3 Seepage Berms

Along levee stretches where numerous boils are present and the size of the area and number of the boils make it impractical to construct ring levees, construction of emergency berms have proven to be effective. A fine to medium sand is the most effective material for the construction of berms. Sand is fine enough that it will limit the migration and loss of foundation material due to boil activity, yet pervious enough that it will allow for pressure relief within the berm area. A geotextile filter could also be used for this purpose by placing the geotextile on the ground surface over the top of boil areas, and then placing berm material over the top of the geotextile. Placement of the berm should start at the toe of the levee and against the landside slope of the levee and extend landward of boil field area. The footprint of the berm should extend approximately 25-feet beyond the boil activity, landward and parallel to the levee alignment. The thickness of the berm would typically be 3-5 feet.

19.5.3 Through Seepage

During periods of high water, seepage conditions through the levee may develop which can lead to instability and failure of the landward slope. Normally, early treatment of saturated areas as discussed below can prevent serious sloughing or sliding conditions or the piping of levee materials from developing. If the landward slope of the levee becomes saturated and sand boils are not in evidence, the seepage water should be drained away from the area to the nearest drainage ditch or sump located well away from the levee, if possible.

There are two methods that have proven to be successful in controlling the effects of excessive through seepage. An emergency sand berm can be constructed along the landside slope of the levee. Although a sandy material is preferable for this application during a high water event, cohesive (clay) materials or other soil types can be used if more readily available during an emergency situation. For this application, the berm would be 5-10 feet wide, extend up the slope to a point above the line of through seepage, and extend upstream and downstream of the affected area.

The second method would consist of constructing a small berm out of sand bags. Sandbags should be placed starting at the toe of the levee and working up slope. Generally, three or more layers of sandbags are used to form a short landside berm along the lower portion of the levee, with the sandbag layer thickness decreasing as it proceeds up slope. Sandbagging should extend up the slope to above the line of through seepage. Walking and working on the levee slope during high water conditions should be kept to a minimum because these loads on a soft slope may induce and/or aggravate sloughing or sliding.

19.5.4 Wash and Scour

The potential for wave wash should be considered in advance of a flood event. The Sponsor should assemble a reserve supply of materials close to locations most likely to experience such damage. Materials such as plastic sheeting, stakes, sandbags, and rock (riprap) should be located and delivered to the project if the necessity arises. During periods of high water, especially when combined with high wind and/or ice, the potential for rapidly developing damage will be present. When such conditions are present, an ample labor force should be assembled to patrol and identify potential scouring of the levee.

During a flood event, an effective method used to limit scour or wave erosion from progressing is to place plastic down the riverside face of the levee and anchoring the plastic with stakes, in a trench on the levee crest, or sandbags on the levee crest and anchoring the toe of the plastic with rock or sandbags. Plastic should be placed with adjacent sheets "shingled" in the downstream direction. In addition to waves and flow velocities causing damage to the riverside slope, proper anchoring of the plastic sheets against high winds is also critical. High winds can get underneath the plastic and rip the plastic out from the anchoring and cause continued erosion and scour of the levee. Plastic should be anchored at the shoulder of the levee crest as discussed above, anchored with sandbags or rock along the levee toe. Sandbags should also be placed along the overlap of the adjacent plastic sheets on the levee slope and also at other lines along the slope as required. Sandbags placed on the levee slope should be continuously placed starting at the levee toe and working up slope, or these sandbags can be held in place by placing a stake in the levee crest and tying a rope or twine to the stake and to the tops of sandbags going down the slope. Either method will prevent sandbags from sliding. If large scour areas have developed on the

riverside slope or toe area, the placement of riprap within the scour area may be required to stop or slow down the scouring process.

19.5.5 Animal Burrows

During a flood event, any areas along either side of the levee with animal burrows present pose a significant risk to the performance of the levee. On the riverside slope of the levee, animal burrows create a location where seepage through the levee can initiate. On many of the Missouri River levee systems, the primary zone of the levee section containing low permeability material is on the riverside face. On the landside slope of the levee, an animal burrow may provide an exit point where through seepage will concentrate and start moving levee material, thus leading to failure of the levee system. It should also be noted that even if excellent rodent control and levee repair practices are in place, the levee may be subject to increased rodent activity during a flood event because animals have been forced out of the flood plain areas to higher ground.

If animal burrows are encountered, the quickest and most effective method of eliminating the seepage and piping conditions created by the burrows has been to pack the rodent holes with bentonite. The bentonite can be in either pellet or powder form. As water reaches the bentonite, the bentonite will swell and seal the hole.



**DEPARTMENT of AGRICULTURE
and NATURAL RESOURCES**
JOE FOSS BUILDING
523 E. CAPITOL AVE
PIERRE SD 57501-3182
danr.sd.gov

JUN 02 2025

(FC36-3)
FC-36

City of Sioux Falls
c/o Thomas Berkland
224 W 9th St
Sioux Falls, SD 57104

Dear Mr. Berkland:

Enclosed is Flood Control License No. FC-36. This is the final water right document completing your process of obtaining a Water Right. Included with your license is a map prepared by the staff engineer who conducted the field investigation.

As long as qualifications continue to be met as stated in the Water License, State Water Laws provide that you have a continuing right to use the water. If you have any questions, please contact our office.

Sincerely,

Mark Mayer, PE
Director of Office of Water
(605) 773-3352

enclosures

STATE OF SOUTH DAKOTA
FLOOD CONTROL LICENSE NO. FC-36 (FC36-3)

(1) On May 8, 2003, City of Sioux Falls, 224 W 9th St, Sioux Falls, SD 57102 made Application No. FC-30 (FC30-3), for a flood control permit to authorize improvements to the existing flood control system located within the corporate limits of Sioux Falls in Minnehaha County, South Dakota. Permit No. FC-30 (FC30-3) was approved by the Water Management Board July 10, 2003, for the purpose of a flood control system designed to provide protection for the 100-year flood event along the Big Sioux River and Skunk Creek. Phase 1, Phase 2A & 2B are to be completed under authorization of flood control Permit No. FC-30 (FC30-3). The applicable portions of flood control Permit No. FC-30 (FC30-3) are incorporated into this license.

City of Sioux Falls made Application No. FC-36 (FC36-3), July 23, 2009, for a flood control permit to authorize improvements to the existing flood control system located within the corporate limits of Sioux Falls in Minnehaha County, South Dakota. Permit No. FC-36 (FC36-3) was approved by the Water Management Board December 9, 2009. The flood control works include a system of levee protection and flood well along the Big Sioux channel and Skunk Creek.

The flood control system was built in 3 phases. FC-30 (FC30-3) authorized Phase 1, Phase 2A, and 2B. FC-36 (FC36-3) authorized Phase 2C and Phase 3.

(2) It is certified that the permit holder has complied with the provisions of South Dakota State Law relating to completion of the flood control project. The location of the structure is:

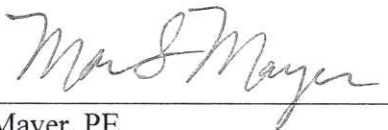
- Big Sioux River Diversion Dam located in the NE $\frac{1}{4}$ NW $\frac{1}{4}$, Section 32, T102N, R49W
- Diversion channel spillway located in the SE $\frac{1}{4}$ NW $\frac{1}{4}$, Section 9, T101N, R49W
- Big Sioux River gated control dam upstream of the Skunk Creek confluence located in the NE $\frac{1}{4}$ NE $\frac{1}{4}$, Section 25, T101N, R50W
- Big Sioux River channel levee raise located in the NE $\frac{1}{4}$, Section 25, T101N, R50W at the confluence of the Skunk Creek with the Big Sioux River

(3) Pursuant to South Dakota Water Law 46-5-30.1 City of Sioux Falls, the holder and/or owner of Water Right No. FC-36 (FC36-3) is issued a license for flood control purposes. FC-36 (FC36-3) carries priority dates of May 8, 2003 and July 23, 2009.

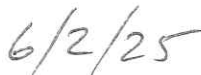
This license is subject to South Dakota Water Law, any limitations or conditions listed in Water Right No. FC-36 (FC36-3) and subject to the following qualifications:

1. The city of Sioux Falls is responsible for operation and maintenance of the flood control works.
2. Flood Control Permit No. FC-36 (FC36-3) is subject to securing easement and/or land acquisitions on any areas, other than city property, where construction activities will take place or additional lands are flooded. These documents shall be held by the city of Sioux Falls and be available for review by the Department of Environment and Natural Resources (*DANR*).

3. Prior to construction of Phase 3, final design shall be submitted to the Chief Engineer of the Water Rights Program of DENR (*DANR*) for review and approval.
4. Engineer change notices, software calibrations or other calculations that effect water surface elevations or seepage analysis data previously submitted are subject to review and approval by the Chief Engineer.
5. Design of all levees shall include measures to reduce uplift pressures to result in an exit gradient not to exceed 0.8 at the landward levee toe, to satisfy criteria in EM 1110-2-1901, Seepage Analysis and Control for Dams.
6. The Operation and Maintenance (O & M) Manual for the system shall be completed upon completion of construction. The manual shall set forth criteria for operation of the diversion dam in various flood events. The manual shall provide guidelines for the controlled breach of the levee system if a breach is needed to prevent a catastrophic, random failure and operating criteria for the gated dam structure on the Big Sioux River above Skunk Creek's confluence with the river. The operating manual is subject to review and approval by the Chief Engineer.
7. The Water Management Board retains jurisdiction of Flood Control Permit Nos. FC-30 (*FC30-3*) and FC-36 (*FC36-3*) in the event that additional information shows this project causes an increase in the severity of flood damages in areas other than the project area.



Mark Mayer, PE
Director of Office of Water


date

