

CITY OF ELLENSBURG
AGENDA
Council Conference
Thursday, November 18, 2021
3:30 PM - Utility Advisory Committee

1. CALL TO ORDER

2. ROLL CALL

3. APPROVAL OF MINUTES

- 3.A Approve minutes - October 21st, 2021 regular meeting minutes
[UAC Minutes 10-21-21.docx](#)

4. APPROVAL OF CONSENT AGENDA Consent items have been distributed to committee members in advance for study and will be enacted by one motion. If separate discussion is desired on an item, that item may be removed from the Consent Agenda and placed on the Regular Agenda at the request of a committee member or at the request of a member of the public with concurrence of a committee member.

5. CORRESPONDENCE AND CITIZEN COMMENTS ON NON-AGENDA ITEMS Time is set aside each meeting to allow citizens to address the Utility Advisory Committee on city utility issues that are not on the agenda. Please limit remarks to three minutes. The Committee will not take action when the issue is first raised, but may place the issue on a future agenda. Citizen comment on items on the agenda is also welcome. Please let the chair know you wish to speak and then wait to be recognized.

6. TELECOMMUNICATIONS UTILITY DISCUSSION ITEMS

7. ELECTRIC, NATURAL GAS, WATER, WASTEWATER, STORMWATER UTILITY DISCUSSION ITEMS

- 7.A [EPA Natural Gas STAR Program and Methane Challenge Enrollment](#)
[NG STAR Program Partnership Agreement BLANK.pdf](#)
[NG STAR Distribution Implementation Plan.pdf](#)
[Methane Challenge Partnership Agreement BLANK.pdf](#)
[Methane Challenge Distribution Implementation Plan.pdf](#)

- 7.B [Clean Energy Transformation Act \(CETA\) - Clean Energy Implementation Plan \(CEIP\)](#)
[CEIP-COE-Draft-Template-08-25-21-Nov-UAC-Rev 1.pdf](#)
[Exhibit A - Ellensburg_Conservation Potential Assesment.pdf](#)
[Exhibit B - Ellensburg_Demand Response Potential Assesment.pdf](#)

- 7.C [Natural Gas Rate Stabilization Fund Discussion](#)

8. INFORMATIONAL ITEMS

- 8.A [Reecer Creek Levee System O&M Plan.](#)

[Reecer Cr Levee System O&M Plan 21_Oct.pdf](#)

8.B [Past Due Utility Accounts
Late Payment Charts - Combined.pdf](#)

8.C [Public Works & Utilities Issues and Updates
UAC November 2021 Public Works & Utilities Issues Update.docx](#)

9. NEXT MEETING

9.A December 16th, 2021 at 3:30 pm

10. ADJOURNMENT



CITY OF ELLENSBURG

Utility Advisory Committee

Date of Meeting

October 21, 2021

Time of Meeting

3:30 PM

Place of Meeting

Council Conference & remotely via Zoom

Nancy Lillquist, Chairperson, term expires May 31, 2022

Ed Barry, Vice Chairperson, term expires May 31, 2023

Nancy Goodloe, City Council, term expires May 31, 2024

Gary Gleason, CWU, term expires May 31, 2022

Bryan Clark, KITTCOM, term expires May 31, 2023

Jim Goeben, Telecommunications Utility customer, term expires May 31, 2023

Nate Sitton, City Utility Customer, term expires May 31, 2023

1. CALL TO ORDER

Chair Lillquist called the meeting to order at 3:30 pm.

2. ROLL CALL

Members present: Nancy Lillquist, Chair; Ed Barry, Vice Chair; Nancy Goodloe, City Council; Gary Gleason, CWU; Nate Sitton, City Utility Customer; Bryan Clark, KITTCOM.

Also present: Ryan Lyyski, Public Works & Utilities Director; Darren Larsen, Assistant Utilities Director; Darin Yusi, Gas Engineer; Kim Bowie, Operations Analyst; Buddy Stanavich, Power & Gas Manager; Nicole Klauss, Public Information Officer; Heidi Behrends Cerniwey, City Manager; Jon Morrow, Stormwater Manager; Drew Houck, IT; Meghan Anderson; Sylvia Shriner; Barry Brunson; Susan Kaspari; approximately 5 other virtual attendees. David Dunbar; Meg Ludlum; approximately 2 other attendees.

3. APPROVAL OF MINUTES

3.A. Approve minutes - September 16th, 2021 regular meeting minutes

Ed Barry moved to approve the minutes. Goodloe seconded. All in favor; **motion approved.**

4. APPROVAL OF CONSENT AGENDA

None

5. CORRESPONDENCE AND CITIZEN COMMENTS ON NON-AGENDA ITEMS

Nancy Lillquist shared email correspondence from Meghan Anderson regarding SB5126 – legislation supporting the Climate Commitment Act. Nancy Lillquist also shared that she would like to discuss the natural gas rate stabilization fund, past due utility accounts and, if time allows, a "Climate Commitment Act 101" at the next meeting.

6. TELECOMMUNICATIONS UTILITY DISCUSSION ITEMS

None

7. ELECTRIC, NATURAL GAS, WATER, WASTEWATER, STORMWATER UTILITY DISCUSSION ITEMS

7.A. Natural Gas Rebates Review and 2022 Rebate Plan

Meghan Anderson, Susan Kaspari, Barry Brunson, Meg Ludlum, Sylvia Shriner, Dave Dunbar, and Nancy Lillquist spoke against natural gas rebates.

Nate Sitton reminded the committee if the natural gas system were to be removed, people might turn to propane which is a bigger threat to the environment.

Nancy Goodloe moved the committee to discontinue all natural gas rebates except the qualifying smart thermostat rebate for 2022. Nancy Lillquist seconded for discussion.

Nate Sitton move to amend the original motion to include the appliance upgrade rebate, still eliminating fuel switching & new construction gas rebates. Barry/Sitton/Goodloe in favor, Lillquist/Gleason opposed; **motion approved.**

Gary Gleason move to amend all motions and leave gas rebates as-is for 2022. Ed Barry seconded. Gleason in favor, Barry/Lillquist/Goodloe/Sitton opposed; **motion failed.**

Nancy Lillquist made a final motion to move the committee discontinue fuel switching & new construction rebates in 2022, but continue natural gas rebates for smart thermostats & appliance upgrades. Barry/Lillquist/Goodloe/Sitton in favor, Gleason opposed; **motion approved.**

7.B. APGA Research Foundation Renewal

Nancy Goodloe move the committee to move forward with the 2022 budget inclusion of \$4,885.00 for contribution and to maintain the current membership of the APGA Research Foundation. Barry seconded. All in favor; **motion approved.**

7.C. Clean Energy Transformation Act (CETA) - Draft Clean Energy Implementation Plan (CEIP)

Buddy Stanavich presented updates and a PowerPoint on CETA & CEIP. The committee discussed the draft plan. Public comment is open until October 29th and will be shared at the next UAC meeting. The UAC will need to provide recommendation to City Council at the November meeting, as the CEIP is required to be adopted by Council by end of year.

Nancy Goodloe move the committee recommend moving forward with the draft CEIP form for public comment. Barry seconded. All in favor; **motion approved.**

8. INFORMATIONAL ITEMS

8.A. Design and Permitting agreement with Aspect Engineering for Gateway II

Jon Morrow welcomed any questions or comments regarding the Gateway II project.

8.B. Public Works & Utilities Issues and Updates

Staff gave updates for water, sewer, gas, electric and storm water. Sunday, October 17th sewer maintenance was performed at the treatment plant. A secondary digester was emptied for maintenance. Staff will bring forward a contract and update on the aquifer storage and recovery project for the November meeting. A link will be shared inviting everyone to a virtual celebration for the Schaaake habitat improvement project.

9. NEXT MEETING

9.A. November 18th, 2021 at 3:30 pm

10. ADJOURNMENT

With no further discussion, the meeting adjourned at 5:30 pm.

Kim Bowie
Recording Secretary
Drafted: 10/22/2021
Approved:



AGENDA REPORT

Meeting Date:	November 18, 2021
Agenda Subject:	EPA Natural Gas STAR Program and Methane Challenge Enrollment
Submitted by:	Darin Yusi Public Works & Utilities
Recommended Action or Motion:	Staff seeks a recommendation from the Utility Advisory Committee to allow the City's Natural Gas Division to enroll in a partnership with the Environmental Protection Agency (EPA) through their Natural Gas STAR Program.
Background/Summary:	Staff began looking into the EPA Natural Gas STAR program earlier this year and has determined it would be a valuable commitment from the City Gas Division. The Natural Gas STAR Program is a flexible, voluntary partnership between the EPA and the oil and natural gas industry aimed at demonstrating the cost-effectiveness and environmental benefits of methane emission reduction opportunities. By joining the Program, Partner companies commit to evaluate and implement cost-effective methane emission reduction opportunities and communicate and share that information across their corporation and with the Natural Gas STAR Program. The Methane Challenge Program partners transparently report systematic and comprehensive actions to reduce methane emissions and are publicly recognized as leaders in reducing methane emissions in the U.S. Reducing methane emissions reduces operational risk, increases efficiency, and demonstrates company concern for the environment, with benefits spanning from climate change to air quality improvements to conservation of a non-renewable energy resource.
Previous Council Action:	None
Analysis:	The Natural Gas STAR Program Implementation Plan is

attached to this agenda report and includes a commitment to BMP 1 - Directed Inspection and Maintenance (DI&M) at Gate Stations and Surface Facilities, DI&M: Survey and Repair Leaks, and Installation of Excess Flow Valves.

The Methane Challenge Implementation Plan is also attached to this agenda report and includes a commitment to reducing Excavation Damages.

These voluntary Programs allow the City Gas Division to collaborate with the EPA to promote and track ambitious, transparent commitments to voluntarily reduce methane emissions beyond regulatory requirements and to recognize EPA partners for their progress.

Financial Impact: No financial costs or obligations for this voluntary program.

Attachments:

[NG STAR Program Partnership Agreement BLANK.pdf](#)

[NG STAR Distribution Implementation Plan.pdf](#)

[Methane Challenge Partnership Agreement BLANK.pdf](#)

[Methane Challenge Distribution Implementation Plan.pdf](#)



OMB Control No. 2060-0328
Expires 4/30/2022

NATURAL GAS STAR PROGRAM PARTNERSHIP AGREEMENT

The **Natural Gas STAR Program** is a flexible, voluntary partnership between EPA and the oil and natural gas industry aimed at demonstrating the cost-effectiveness and environmental benefits of methane emission reduction opportunities.

This is a voluntary agreement between _____ (*company name*) and the U.S. Environmental Protection Agency (EPA) for the purpose of reducing methane releases to the atmosphere by implementing cost-effective emission reduction technologies and practices. Responsibilities for both parties and General Terms are outlined on the following page.

Please select which sector segment(s) this partnership will cover (*check all that apply*):

☐ Production ☐ Gathering and Processing ☐ Transmission ☐ Distribution

Authorized Partner Company Representative: (*name and title*)

Name, Title

Signature: _____ *Date:* _____

EPA Representative:

Paul M. Gunning: Director, Climate Change Division, U.S. Environmental Protection Agency

Signature: _____ *Date:* _____

Partner Designated Natural Gas STAR Implementation Manager:

Name:

Address:

Title:

City/State/Zip:

E-mail:

Telephone:

This collection of information is approved by OMB under the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. (OMB Control No. 2060-0328). Responses to this collection of information are voluntary 42 USC 7403(g). An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The public reporting and recordkeeping burden for this collection of information is estimated to 57 hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates and any suggested methods for minimizing respondent burden to the Regulatory Support Division Director, U.S. Environmental Protection Agency (2821T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

EPA's Responsibilities

1. Provide contact information for an EPA Program Manager to assist the Partner in Program implementation.
 2. Assist Partners with Program implementation with the following, as appropriate:
 - a. Analyzing and developing information on emerging technologies and practices;
 - b. Developing workshops and training courses; and
 - c. Providing technical assistance to Partners in implementing the Program Best Management Practices (BMPs) found at www.epa.gov/natural-gas-star-program
 3. Provide public recognition for Partner company commitments to the Program through acknowledgement on EPA's web site.
 4. EPA will only release information obtained from the Partner company without prior authorization from that company if required to do so under the Freedom of Information Act, the Agency's regulations at 40 CFR part 2, subpart B, or other applicable law.
-

Natural Gas STAR Partner's Responsibilities

1. Appoint a company representative as the Natural Gas STAR Program Implementation Manager responsible for implementing this voluntary agreement.
 2. Develop a company-specific approach for active participation in the Program, including identifying expected activities and scope of implementation. This may include development of an Implementation Plan to be shared with EPA.
 3. Annually evaluate cost-effective methane emission reduction opportunities and voluntarily implement BMPs to the extent feasible across operations within the United States.
 4. Engage and share information with the Program on voluntary emission reduction activities annually, including one or more of the following activities:
 - a. Providing EPA with annual reports describing the BMPs implemented;
 - b. Presenting at a Natural Gas STAR workshop or other Program event; or
 - c. Developing technical documents that can be shared with Partners, such as through the Natural Gas STAR website.
 5. Communicate participation to employees and cooperate with EPA efforts to publicize the Program.
-

General Terms

1. This agreement can be terminated by either party at any time, with no penalties and no further obligation. EPA requests that Partners notify EPA immediately if they plan to withdraw from the Partnership. EPA agrees not to publicize a Partner's withdrawal from the Program.
 2. The Partner agrees that the activities it undertakes connected with this agreement are not intended to provide services to the federal government and that the Partner will not seek compensation from a federal agency.
 3. The Partner agrees that it will not claim or imply that its participation in the Program constitutes EPA approval or endorsement of anything other than the commitment to the Program.
 4. The Partner agrees to only share non-Confidential Business Information (CBI) to fulfill Gas STAR Program requirements, and understands that information submitted to the Program is subject to the Freedom of Information Act.
-

Please sign this form and send to:

EPA Natural Gas STAR Program
USEPA Headquarters
1200 Pennsylvania Avenue, NW
Mail Code: 6207A
Washington, DC 20460
GasSTAR@epa.gov

If overnight, send to:

1201 Constitution Ave NW
Room Number 4353PP
Washington, DC 20004

Implementation Plan  Distribution Sector	<table border="1"> <thead> <tr> <th colspan="2">Company Information</th> </tr> </thead> <tbody> <tr> <td>Company Name:</td> <td>City of Ellensburg Gas Division</td> </tr> <tr> <td>Gas Star Contact:</td> <td>Darin Yusi</td> </tr> <tr> <td>Position:</td> <td>Gas Engineer</td> </tr> <tr> <td>Address:</td> <td>501 N Anderson St</td> </tr> <tr> <td>City, State, Zip Code:</td> <td>Ellensburg, WA 98926</td> </tr> <tr> <td>Telephone:</td> <td>(509) 962-7229</td> </tr> <tr> <td>Fax:</td> <td>(509) 925-8662</td> </tr> <tr> <td>Email:</td> <td>yusid@ci.ellensburg.wa.us</td> </tr> </tbody> </table>	Company Information		Company Name:	City of Ellensburg Gas Division	Gas Star Contact:	Darin Yusi	Position:	Gas Engineer	Address:	501 N Anderson St	City, State, Zip Code:	Ellensburg, WA 98926	Telephone:	(509) 962-7229	Fax:	(509) 925-8662	Email:	yusid@ci.ellensburg.wa.us
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Implementation Plan Elements																			
ELEMENT 1 Best Management Practices (BMPs) The following BMPs have been identified as significant opportunities to cost effectively reduce methane emissions from the distribution sector. They were selected based on their applicability to the industry, economic feasibility, and cost-effectiveness. There are two core BMPs for the distribution sector: BMP 1 Directed inspection and maintenance at gate stations and surface facilities BMP 2 Identify and rehabilitate leaky distribution pipe For detailed information on these BMPs, please refer to the <i>Lessons Learned</i> publications on the Natural Gas STAR website: https://www.epa.gov/natural-gas-star-program/recommended-technologies-reduce-methane-emissions.																			
ELEMENT 2 Additional Activities Current partners have reported many processes and technologies that are considered additional Best Management Practices by the program. New partners are encouraged to evaluate and report current and new practices or technologies that cost effectively reduce methane emissions.																			
ELEMENT 3 Inventory Past Reductions Partners are encouraged to report past methane emission reductions back to 1990. Accounting for these historical reductions will create a permanent record of your company's methane emission reduction efforts. In addition, reviewing past activities will help guide companies' participation in Natural Gas STAR by creating a base of understanding of current activities to facilitate planning of future activities.																			

The Implementation Plan is designed to be a dynamic tool for Natural Gas STAR Partners to plan their program activities. As company priorities and plans shift over time, the Implementation Plan may be revised or updated by submitting a new form to the program. The Partner should only share non-Confidential Business Information (CBI) to fulfill Gas STAR Program requirements.

ELEMENT 1 Best Management Practices

BMP 1 Directed Inspection and Maintenance (DI&M) at Gate Stations and Surface Facilities									
A DI&M program is a system for performing routine leak detection and repair where leak measurement data from previous inspections are used to guide subsequent inspections and direct maintenance to those leaks that are cost effective to repair.	Estimated Reduction Potential 1,190 Mcf per station								
Will you be implementing this BMP? ☒ Yes ☐ No If no, why? ☐ Not cost effective ☐ May consider at a later date ☐ Other _____ please describe: If yes, at what scale will you be implementing this BMP? ☒ Company Wide ☐ Pilot Project ☐ Other _____ Please describe: Kittitas Tap Station and Seattle Regulator Station Facilities									
Activity Summary									
Number of gate stations and surface facilities? <u>2</u> Number of gate stations and surface facilities at which DI&M will take place? <u>2</u>									
Inspection Schedule									
Facilities will be inspected: ☐ quarterly ☒ annually ☐ biannually ☐ other _____ Please list the number of gate stations and surface facilities that will implement BMP 1 in upcoming years. <table style="width: 100%;"> <tr> <td style="width: 20%;">Year <u>2022</u></td> <td>Number of gate stations and surface facilities <u>All 2</u></td> </tr> <tr> <td>Year _____</td> <td>Number of gate stations and surface facilities _____</td> </tr> <tr> <td>Year _____</td> <td>Number of gate stations and surface facilities _____</td> </tr> <tr> <td>Year _____</td> <td>Number of gate stations and surface facilities _____</td> </tr> </table>		Year <u>2022</u>	Number of gate stations and surface facilities <u>All 2</u>	Year _____	Number of gate stations and surface facilities _____	Year _____	Number of gate stations and surface facilities _____	Year _____	Number of gate stations and surface facilities _____
Year <u>2022</u>	Number of gate stations and surface facilities <u>All 2</u>								
Year _____	Number of gate stations and surface facilities _____								
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Year _____	Number of gate stations and surface facilities _____								
Additional Information on Anticipated Plans and Projects									

If additional space is needed, please continue on the back.

BMP 2 Identify and Rehabilitate Leaky Distribution Pipe	
To reduce methane emissions, companies can use data from leak surveys and patrols, leak repair histories, corrosion monitoring records and other sources to identify and repair or replace the leakiest pipeline segments.	Estimated Reduction Potential 29 Mcf/mile/year - Average Mains 0.3 Mcf/service/year - Average Services
Will you be implementing this BMP? ☐ Yes ☒ No If no, why? ☐ Not cost effective ☐ May consider at a later date ☒ Other _____ please describe: No known leaking distribution or service pipe. All pipe is HDPE and Coated/Wrapped Steel. BMP 2 is already complete and thus not applicable to the City of Ellensburg Gas Division's system. If yes, at what scale will you be implementing this BMP? ☐ Company Wide ☐ Pilot Project ☐ Other _____ Please describe: 	
Activity Summary	
Total distribution pipeline mileage? <u>135</u> Total distribution pipeline mileage selected for this BMP? <u>0</u>	
Replacement Schedule	
Total distribution pipeline mileage to be rehabilitated by the end of: Year 1: <u>0</u> Year 2: <u>0</u> Year 3: <u>0</u> Year 4: <u>0</u>	
Additional Information on Anticipated Plans and Projects	

If additional space is needed, please continue on the back.

ELEMENT 2 Additional Activities

Additional Activities	
Your company may take advantage of additional technologies or practices to reduce methane emissions. The following is a list of some of the additional activities that have been reported by other Natural Gas STAR partners, which may be applicable to your operations (for more information on these activities, please view: https://www.epa.gov/natural-gas-star-program/recommended-technologies-reduce-methane-emissions): ☐ Reduce/downgrade system pressure ☐ Inject blowdown gas into low pressure system ☒ DI&M: survey and repair leaks ☐ Use hot taps for in-service pipeline connections	
Additional activities you will be implementing	Please describe
Activity <u>DI&M: Survey and Repair Leaks</u> At what scale will this activity be implemented? ☐ Company Wide ☐ Pilot Project ☐ Other _____	Perform annual leak surveys. Each year a quarter of the system will be surveyed with the entire system being surveyed over 4 years. This is an increase from the regulations that require the system be surveyed every 5 years.
Activity <u>Install Excess Flow Valves</u> At what scale will this activity be implemented? ☐ Company Wide ☐ Pilot Project ☐ Other _____	Offer, advertise and install EFV's as requested. Install EFV's with every new service. Install EFV's on existing services whenever an opportunity becomes available.
Activity _____ At what scale will this activity be implemented? ☐ Company Wide ☐ Pilot Project ☐ Other _____	
Activity _____ At what scale will this activity be implemented? ☐ Company Wide ☐ Pilot Project ☐ Other _____	
Activity _____ At what scale will this activity be implemented? ☐ Company Wide ☐ Pilot Project ☐ Other _____	

ELEMENT 3

Inventory Past Reductions

An inventory of past reductions will help to create a permanent record of your past efforts.

As a first step, many new partners find it useful to inventory and document past methane emission reduction efforts. The inventory process helps companies quantify the success of their past activities and target future methane emission reduction efforts. Historical methane emission reductions identified as part of the inventory process can be reported to the Natural Gas STAR Program.

Will you inventory past activities to include in your annual report? ☐ Yes ☒ No

If yes, please describe your company's plans for reviewing past methane emission reduction activities.

The Natural Gas STAR Program thanks you for your time.

Please send completed forms to:

Regular Mail

Natural Gas STAR Program
U.S. EPA (6207A)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Express/Overnight Mail

Natural Gas STAR Program
1201 Constitution Ave NW
Room Number 4353PP
Washington, DC 20004

Questions? Please call Jerome Blackman at (202) 343-9630, or send an email to GasSTAR@epa.gov.

The public reporting and recordkeeping burden for this collection of information is estimated to average 25 hours for each new response and 12 hours for subsequent responses. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.





Natural Gas STAR Methane Challenge Program Partnership Agreement for Best Management Practice (BMP) Commitment

The Natural Gas STAR Methane Challenge Program is a flexible, voluntary partnership between the U.S. Environmental Protection Agency (EPA) and oil and natural gas companies. This voluntary Program allows the EPA to collaborate with Partners to promote and track ambitious, transparent commitments to voluntarily reduce methane emissions beyond regulatory requirements and to recognize Partners for their progress. By signing this agreement, _____ (*company name*) agrees to join the U.S. EPA to reduce methane emissions through a Best Management Practice (BMP) Commitment. The BMP Commitment entails a Partner commitment to company-wide implementation of BMPs to reduce methane emissions from key sources by a future target date. Partners commit to at least one emission source and specify a target year of completion (maximum of five [5] years from commitment start date).

Partner's Best Management Practice Commitment: Please specify participating sources, start date, and target achievement year in the table below; check all that apply. For companies joining at the corporate level that wish to make separate commitments for each of their subsidiaries/LDCs, please use "Appendix A: Commitment Table" found on the Methane Challenge Program website and submit in conjunction with this Partnership Agreement.

Source	Start Date	Achievement Year
Onshore Production		
☐ Pneumatic Controllers		
☐ Equipment Leaks/Fugitive Emissions (<i>commitment not finalized</i>)		
☐ Liquids Unloading (<i>commitment not finalized</i>)		
☐ Pneumatic Pumps (<i>commitment not finalized</i>)		
☐ Fixed Roof, Atmospheric Pressure Hydrocarbon Liquid Storage Tanks		
Gathering and Boosting		
☐ Pneumatic Controllers		
☐ Equipment Leaks/Fugitive Emissions (<i>commitment not finalized</i>)		
☐ Pneumatic Pumps (<i>commitment not finalized</i>)		
☐ Fixed Roof, Atmospheric Pressure Hydrocarbon Liquid Storage Tanks		
☐ Reciprocating Compressors - Rod Packing Vent		
☐ Centrifugal Compressors - Venting		
Natural Gas (NG) Processing		
☐ Reciprocating Compressors - Rod Packing Vent		
☐ Centrifugal Compressors - Venting		
NG Transmission & Underground Storage		
☐ Reciprocating Compressors - Rod Packing Vent		
☐ Centrifugal Compressors - Venting		
☐ Equipment Leaks/Fugitive Emissions		
☐ Transmission Pipeline Blowdowns between Compressor Stations		
☐ Pneumatic Controllers		
NG Distribution		
☐ M&R Stations/City Gates (<i>commitment not finalized</i>)		
☐ Mains – Cast Iron and Unprotected Steel (<i>Commitment Rate: _____</i>)		
☐ Services – Cast Iron and Unprotected Steel		
☐ Distribution Pipeline Blowdowns (<i>Commitment Rate: _____</i>)		
☒ Excavation Damages		

EPA's Responsibilities

1. Assign a Methane Challenge Program Representative responsible for assisting the Partner in implementing the Program.
2. Provide relevant Program details, which can be found in the Natural Gas STAR Methane Challenge Program: BMP Framework and Methane Challenge BMP Supplemental Technical Information documents.
3. Assist Partners with Program implementation by:
 - (i) providing relevant technical information;
 - (ii) developing a mechanism for reporting supplemental information;
 - (iii) updating Program information as needed, including updating the list of participating sources and mitigation options covered in the Program; and
 - (iv) answering questions about Program participation.
4. Encourage new and innovative methane emission mitigation technologies, as well as methodologies for monitoring and measuring progress, and incorporate them into the Program.
5. Track Partner progress through provision of a user-friendly reporting system through which Partners can report supplementary data relevant to achieving their Methane Challenge commitments. Supplementary data will be used in conjunction with data that are already collected by Subpart W of the Greenhouse Gas Reporting Program (GHGRP) to track Partner progress.
6. Promote the transparency and visibility of the Methane Challenge Program and member commitments and achievements, by publicly releasing non-confidential data that is submitted either through the Methane Challenge Program or through the GHGRP.
7. Acknowledge Program Partners through announcement of commitments, Implementation Plans, progress, and achievement of goals on the EPA's Methane Challenge website.

Natural Gas STAR Methane Challenge Partner's Responsibilities

1. Designate a company representative as the Natural Gas STAR Methane Challenge Program Implementation Manager responsible for serving as the contact point concerning implementation of this voluntary agreement.
2. Submit an Implementation Plan within six (6) months of signing this agreement outlining expected activities and milestones for achieving commitments.
3. Specify commitment start date(s), which will be within six (6) months of joining the Program.
4. Implement BMPs for the selected participating sources across company operations to achieve mitigation commitments by the specified commitment target year, not to exceed five (5) years from the specified commitment start date.
5. Report on an annual basis non-CBI supplementary data relevant to achieving Methane Challenge commitments, as outlined in Program documents. Supplementary data will be used in conjunction with data collected by Subpart W of the GHGRP to demonstrate Partner progress within the Program.
6. Communicate participation to employees.

General Terms

1. This voluntary partnership is intended to promote and recognize voluntary actions taken by oil and gas companies to reduce methane emissions from their operations. It is understood that Partners to this Program may have operations covered by federal, state, and/or other regulatory requirements. It is anticipated that Partners may achieve their Methane Challenge Program commitments through a combination of voluntarily- and regulatorily-driven actions. Participation in this Program does not in any way change legal obligations of Partners to comply with applicable laws regulations.
2. This agreement can be terminated by either party at any time, with no notice or penalties and no further obligation. The EPA agrees not to publicize a Partner's withdrawal from the Program beyond removing the Partner's name from Methane Challenge website. By setting out a target date on this form the Company does not intend to expose itself to regulatory liability if it cannot meet the target date.

3. The Partner agrees that the activities it undertakes connected with this Partnership Agreement are not intended to provide services to the federal government and that the Partner will not seek compensation from a federal agency.
4. The Partner agrees that it will not claim or imply that its participation in the Program constitutes the EPA approval or endorsement of anything other than the commitment to the Program. The Partner cannot use or appropriate the EPA seal or identifier in any way.
5. In order to maintain status as a Partner in the Methane Challenge Program, the Partner agrees to annually report specified supplemental data, per Program reporting specifications.
6. If the Partner is unable to meet a BMP commitment by the target year, and intends to remain in the Program, the Partner company will provide relevant contextual information for the delay and set a new target year. The EPA will note the adjustment to the implementation timeline on the Methane Challenge website.
7. All commitments made by the EPA in this Partnership Agreement are subject to the availability of appropriated funds. Nothing in this Partnership Agreement, in and of itself, obligates the EPA to expend appropriations or to enter into any contract, assistance agreement, interagency agreement, or incur other financial obligations that would be inconsistent with Agency budget priorities. This Partnership Agreement does not exempt the Partner from the EPA policies governing competition for assistance agreements. Any transaction involving reimbursement or contribution of funds between the parties to this Partnership Agreement will be handled in accordance with applicable laws, regulations, and procedures under separate written agreements.
8. Regarding privacy of the information provided, any contact information for company representatives is used to identify the point of contact for implementation of the Natural Gas STAR Methane Challenge Program. Such information will only be used to communicate and coordinate with Partner companies about their participation in the Natural Gas STAR Methane Challenge Program, such as annual reporting, attending upcoming Program workshops, and progress on their Program commitments. However, some information may be made available to public as required by the Freedom of Information Act, 5 U.S.C. § 552.

Signatures and Partner Contact Details

Authorized Company Representative: _____

Signature: _____ Date: _____

Authorized U.S. EPA Representative: *Paul M. Gunning, Director, Climate Change Division*

Signature: _____ Date: _____

Partner's Designated Natural Gas STAR Methane Challenge Implementation Manager:

Name: _____

Title: _____

Address: _____

City/State/Zip: _____

Telephone/Fax: _____ E-mail: _____

Instructions

Please send this form to: Natural Gas STAR Methane Challenge Program

Standard Mail: Mail Code 6207A
 1200 Pennsylvania Ave NW Washington, DC 20460

Overnight Mail: 1201 Constitution Ave NW, Room Number 4353NN
 Washington, DC 20004

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Natural Gas STAR Methane Challenge Program Implementation Plan

Partner Name**Current as of (date)**City of Ellensburg Gas Division

Partner Implementation ManagerName: Darin Yusi

Title: Gas Engineer

Address: 501 N Anderson St

City/State/Zip: Ellensburg, WA 98926

Telephone/Fax: (509) 962-7229 E-mail: yusid@ci.ellensburg.wa.us

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Natural Gas STAR Methane Challenge Program Implementation Plan

Partner Methane Challenge Commitments¹

BMP Commitment Option

Source		Start Date	Achievement Year
Onshore Production			
☐	Pneumatic Controllers		
☐	Fixed Roof, Atmospheric Pressure Hydrocarbon Liquid Storage Tanks		
Gathering and Boosting			
☐	Pneumatic Controllers		
☐	Fixed Roof, Atmospheric Pressure Hydrocarbon Liquid Storage Tanks		
☐	Reciprocating Compressors - Rod Packing Vent		
☐	Centrifugal Compressors - Venting		
Natural Gas (NG) Processing			
☐	Reciprocating Compressors - Rod Packing Vent		
☐	Centrifugal Compressors - Venting		
NG Transmission & Underground Storage			
☐	Reciprocating Compressors - Rod Packing Vent		
☐	Centrifugal Compressors - Venting		
☐	Transmission Pipeline Blowdowns between Compressor Stations		
☐	Pneumatic Controllers		
NG Distribution			
☐	Mains – Cast Iron and Unprotected Steel (<i>Commitment Rate:</i>)		
☐	Services – Cast Iron and Unprotected Steel		
☐	Distribution Pipeline Blowdowns (<i>Commitment Rate:</i>)		
☒	Excavation Damages	Jan 1, 2022	2027

Partner Methane Challenge Commitments

ONE Future Emissions Intensity Commitment Option

Segment:		Intensity Target:		Target Year:	
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¹ Partners may delete unused rows within the table, and may duplicate rows and add relevant details as needed (e.g., a corporate parent partner that has different commitments for each LDC can duplicate relevant rows to list the commitments for each LDC).

Natural Gas STAR Methane Challenge Program Implementation Plan

Milestones/Timeframes for Meeting Commitments

Provide information on steps for achieving commitments such as anticipated rate of progress, key milestones, or other context (e.g., referencing work to be done during the next planned shutdown of a facility).

The City of Ellensburg Gas Division is pleased to partner with the EPA through this program and implementation plan to work toward reducing methane emissions. The City Gas Division has committed to pursue a Best Management Practice (BMP) within the Excavation Damages category for Natural Gas Distribution.

The City of Ellensburg Gas Division's greatest threat to the integrity of its system and methane emissions has been identified as excavation damages. The City has worked hard through its Public Awareness and Damage Prevention Program to educate contractors and excavators and minimize damages. Joining the Methane Challenge will encourage and challenge the City Gas Division to expand our data analysis, regularly evaluate our damage prevention program and efforts, and come up with additional tracking metrics to evaluate our progress toward our 2027 goal.

The City of Ellensburg Gas Division will be implementing the following goals for this BMP:

- Reduce excavation damage frequency (damages per 1000 tickets) to below 2.0.
- Send letters to contractors or excavators for any known improper excavation practices performed.
- Ensure that all new gas lines are traceable.
- Improve maps and records to facilitate better asset location/identification.
- Have no mislocates/mismarks annually.

Natural Gas STAR Methane Challenge Program Implementation Plan

Additional Information/Context (optional)

Use this space, if desired, to provide other information about Program participation, such as plans for expanding Methane Challenge commitments, how historical actions informed Methane Challenge commitments, or other information on how the Program will be implemented.

The City of Ellensburg Gas Division has been minimizing system emissions since it became a utility in 1956. Thanks to a strong City Council and utility team all pipe in Ellensburg's system is coated and cathodically protected steel or high density polyethylene. By not introducing cast iron or other materials now being replaced across the country, the City of Ellensburg Gas Division has shown its dedication to being a leader in reducing methane emissions associated with operations while also providing increased pipeline integrity.

In addition to the City's commitment to reduce excavation damages through this implementation plan, the City Gas Division will continually assess additional measures, both within this program and outside of it, that could offer meaningful emission reductions.



AGENDA REPORT

Meeting Date:	November 18, 2021
Agenda Subject:	Clean Energy Transformation Act (CETA) - Clean Energy Implementation Plan (CEIP)
Submitted by:	Buddy Stanavich Public Works & Utilities
Recommended Action or Motion:	Staff recommends the Utility Advisory Committee review the updated CEIP and forward the recommended plan to Council for consideration and adoption.
Background/Summary:	At the October UAC meeting, an overview and presentation of the City of Ellensburg's <u>draft</u> Clean Energy Implementation Plan (CEIP) was given. Public comment was open from October 21 to 29 and no comments were received. Staff has updated the CEIP (attached) and is seeking a favorable recommendation for City Council adoption. WAC 194-40-050 establishes that each utility must submit by January 1, 2022, and every four years thereafter, a CEIP for resources to be acquired and other actions to be undertaken during the next interim performance period. WAC 194-40-200 establishes that the utility must do the following through a public process: 1. WAC 194-40-200 (4)(b) Identify vulnerable populations 1. Based on the adverse socioeconomic factors 2. Based on sensitivity factors 2. WAC 194-40-200 (4)(c)(i) Include indicators applicable to the utility's service area associated with: 1. Energy benefits 2. Nonenergy benefits 3. Reduction of burdens 4. Public health 5. Environment 6. Reduction in cost 7. Energy security 8. Resiliency 3. Highly Impacted Communities (designated by Department

of Health with a ranking of 9 or 10 on the Environmental Health Disparities map).

“Vulnerable populations” means communities that experience a disproportionate cumulative risk from environmental burdens due to:

- (a) Adverse socioeconomic factors, including unemployment, high housing and transportation costs relative to income, access to food and health care, and linguistic isolation; and
- (b) Sensitivity factors, such as low birth weight and higher rates of hospitalization

There are five (5) census tracts within the City of Ellensburg service area, which also expand into Kittitas County. The following are the communities ranked 9 or 10 in Kittitas County:

1. Lead Risk from Housing
2. Low Birth Weight Combined
3. No High School Diploma
4. Population living in poverty $\leq 185\%$ of FPL
5. Proximity to Risk Management Plan (RMP) Facilities
6. Transportation Expense
7. Unaffordable Housing ($>30\%$ of income)

4. **Forecasted distribution of energy and nonenergy costs and benefits for the utility’s portfolio of specific actions, including impacts resulting from the achievement of the specific targets established in WAC 194-40-200(3) for Energy Efficiency; Demand Response Resources; Renewable Energy**

Categories:

1. Energy Benefits
2. Non-Energy Benefits
3. Reduction of Burdens
4. Public Health
5. Environment
6. Reduction in Cost
7. Energy Security
8. Resiliency

5. WAC 194-40-330 Methodologies for energy efficiency and demand response resources:

1. Energy efficiency potential
 1. Exhibit A – Electric Conservation Potential Assessment
2. Demand response resources
 1. Exhibit B – Demand Response Potential Assessment

Previous Council Action: N/A

Analysis: N/A

Financial Impact: Fiscal impact not known at this time.

Attachments:

[CEIP-COE-Draft-Template-08-25-21-Nov-UAC-Rev 1.pdf](#)

[Exhibit A - Ellensburg_Conservation Potential Assesment.pdf](#)

[Exhibit B - Ellensburg_Demand Response Potential Assesment.pdf](#)

Deadline: January 1, 2022

Submission: Email this workbook and all supporting documentation to CETA@commerce.wa.gov

Questions: Glenn Blackmon, Sarah Vorpahl, Austin Scharff, State Energy Office, CETA@commerce.wa.gov



Enter information in green fields.

Do not modify blue-shaded fields.

RCW 19.405.060

Clean energy implementation plan—Compliance criteria—Incremental cost of compliance.

(2)(a) By January 1, 2022, and every four years thereafter, each consumer-owned utility must develop and submit to the department a four-year clean energy implementation plan for the standards established under RCW 19.405.040(1) and 19.405.050(1) that: (i) Proposes interim targets for meeting the standard under RCW 19.405.040(1) during the years prior to 2030 and between 2030 and 2045, as well as specific targets for energy efficiency, demand response, and renewable energy; (ii) Is informed by the consumer-owned utility's clean energy action plan developed under RCW 19.280.030(1) or other ten-year plan developed under RCW 19.280.030(5); (iii) Is consistent with subsection (4) of this section; and (iv) Identifies specific actions to be taken by the consumer-owned utility over the next four years, consistent with the utility's long-range resource plan and resource adequacy requirements, that demonstrate progress towards meeting the standards under RCW 19.405.040(1) and 19.405.050(1) and the interim targets proposed under (a)(i) of this subsection. The specific actions identified must be informed by the consumer-owned utility's historic performance under median water conditions and resource capability and by the consumer-owned utility's participation in centralized markets. In identifying specific actions in its clean energy implementation plan, the consumer-owned utility may also take into consideration any significant and unplanned loss or addition of load it experiences.

(b) The governing body of the consumer-owned utility must, after a public meeting, adopt the consumer-owned utility's clean energy implementation plan. The clean energy implementation plan must be submitted to the department and made available to the public. The governing body may adopt more stringent targets than those proposed by the consumer-owned utility and periodically adjust or expedite timelines if it can be demonstrated that such targets or timelines can be achieved in a manner consistent with the following: (i) Maintaining and protecting the safety, reliable operation, and balancing of the electric system; (ii) Planning to meet the standards at the lowest reasonable cost, considering risk; (iii) Ensuring that all customers are benefiting from the transition to clean energy: Through the equitable distribution of energy and nonenergy benefits and reduction of burdens to vulnerable populations and highly impacted communities; long-term and short-term public health and environmental benefits and reduction of costs and risks; and energy security and resiliency; and (iv) Ensuring that no customer or class of customers is unreasonably harmed by any resulting increases in the cost of utility-supplied electricity as may be necessary to comply with the standards.

(3)(a) An investor-owned utility must be considered to be in compliance with the standards under RCW 19.405.040(1) and 19.405.050(1) if, over the four-year compliance period, the average annual incremental cost of meeting the standards or the interim targets established under subsection (1) of this section equals a two percent increase of the investor-owned utility's weather-adjusted sales revenue to customers for electric operations above the previous year, as reported by the investor-owned utility in its most recent commission basis report. All costs included in the determination of cost impact must be directly attributable to actions necessary to comply with the requirements of RCW 19.405.040 and 19.405.050.

(b) If an investor-owned utility relies on (a) of this subsection as a basis for compliance with the standard under RCW 19.405.040(1), then it must demonstrate that it has maximized investments in renewable resources and nonemitting electric generation prior to using alternative compliance options allowed under RCW 19.405.040(1)(b).

(4)(a) A consumer-owned utility must be considered to be in compliance with the standards under RCW 19.405.040(1) and 19.405.050(1) if, over the four-year compliance period, the average annual incremental cost of meeting the standards or the interim targets established under subsection (2) of this section meets or exceeds a two percent increase of the consumer-owned utility's retail revenue requirement above the previous year. All costs included in the determination of cost impact must be directly attributable to actions necessary to comply with the requirements of RCW 19.405.040 and 19.405.050.

(b) If a consumer-owned utility relies on (a) of this subsection as a basis for compliance with the standard under RCW 19.405.040(1), and it has not met eighty percent of its annual retail electric load using electricity from renewable resources and nonemitting electric generation, then it must demonstrate that it has maximized investments in renewable resources and nonemitting electric generation prior to using alternative compliance options allowed under RCW 19.405.040(1)(b).

(5) The commission, for investor-owned utilities, and the department, for consumer-owned utilities, must adopt rules establishing the methodology for calculating the incremental cost of compliance under this section, as compared to the cost of an alternative lowest reasonable cost portfolio of investments that are reasonably available.

WAC 194-40-200

Clean energy implementation plan.

(1) **Specific actions.** Each utility must identify in each CEIP the specific actions the utility will take during the next interim performance period or GHG neutral compliance period to demonstrate progress toward meeting the standards under RCW 19.405.040(1) and 19.405.050(1) and the interim targets under subsection (2) of this section and the specific targets under subsection (3) of this section. Specific actions must be consistent with the requirements of RCW 19.405.060 (2)(a)(iv).

(2) **Interim target.** The CEIP must establish an interim target for the percentage of retail load to be served using renewable and nonemitting resources during the period covered by the CEIP. The interim target must demonstrate progress toward meeting the standards under RCW 19.405.040(1) and 19.405.050(1), if the utility is not already meeting the relevant standard.

(3) **Specific targets.** The CEIP must establish specific targets, for the interim performance period or GHG neutral compliance period covered by the CEIP, for each of the following categories of resources:

(a) **Energy efficiency.** (i) The CEIP must establish a target for the amount, expressed in megawatt-hours of first-year savings, of energy efficiency resources expected to be acquired during the period. The energy efficiency target must comply with WAC 194-40-330(1). (ii) A utility may update its CEIP to incorporate a revised energy efficiency target to match a biennial conservation target established by the utility under RCW 19.285.040 (1)(b) and WAC 194-37-070.

(b) **Demand response resources.** The CEIP must specify a target for the amount, expressed in megawatts, of demand response resources to be acquired during the period. The demand response target must comply with WAC 194-40-330(2).

(c) **Renewable energy.** The utility's target for renewable energy must identify the quantity in megawatt-hours of renewable electricity to be used in the period.

(4) **Specific actions to ensure equitable transition.** To meet the requirements of RCW 19.405.040(8), the CEIP must, at a minimum:

(a) Identify each highly impacted community, as defined in RCW 19.405.020(23), and its designation as either: (i) A community designated by the department of health based on cumulative impact analyses; or (ii) A community located in census tracts that are at least partially on Indian country.

(b) Identify vulnerable populations based on the adverse socioeconomic factors and sensitivity factors developed through a public process established by the utility and describe and explain any changes from the utility's previous CEIP, if any;

(c) Report the forecasted distribution of energy and nonenergy costs and benefits for the utility's portfolio of specific actions, including impacts resulting from achievement of the specific targets established under subsection (3) of this section. The report must: (i) Include one or more indicators applicable to the utility's service area and associated with energy benefits, nonenergy benefits, reduction of burdens, public health, environment, reduction in cost, energy security, or resiliency developed through a public process as part of the utility's long-term planning, for the provisions in RCW 19.405.040(8); (ii) Identify the expected effect of specific actions on highly impacted communities and vulnerable populations and the general location, if applicable, timing, and estimated cost of each specific action. If applicable, identify whether any resource will be located in highly impacted communities or will be governed by, serve, or otherwise benefit highly impacted communities or vulnerable populations in part or in whole; and (iii) Describe how the specific actions in the CEIP are consistent with, and informed by, the utility's longer-term strategies based on the analysis in RCW 19.280.030 (1)(k) and clean energy action plan in RCW 19.280.030(1)(l) from its most recent integrated resource plan, if applicable.

(d) Describe how the utility intends to reduce risks to highly impacted communities and vulnerable populations associated with the transition to clean energy.

(5) **Use of alternative compliance options.** The CEIP must identify any planned use during the period of alternative compliance options, as provided for in RCW 19.405.040 (1)(b).

(6) The CEIP must be consistent with the most recent integrated resource plan or resource plan, as applicable, prepared by the utility under RCW 19.280.030.

(7) The CEIP must be consistent with the utility's clean energy action plan developed under RCW 19.280.030(1) or other ten-year plan developed under RCW 19.280.030(5).

(8) The CEIP must identify the resource adequacy standard and measurement metrics adopted by the utility under WAC 194-40-210 and used in establishing the targets in its CEIP. (9) If the utility intends to comply using the two percent incremental cost approach specified in WAC 194-40-230, the CEIP must include the information required in WAC 194-40-230(3) and, if applicable, the demonstration required in WAC 194-40-350(2).

(10) Any utility that is not subject to RCW 19.280.030(1) may meet the requirements of this section through a simplified reporting form provided by commerce.

Utility name:	City of Ellensburg
Report date:	12/31/2021
Contact name/Dept:	Buddy Stanavich
Phone:	509-962-7225
Email:	stanavichm@ci.ellensburg.wa.us
Web address of published CEIP:	https://ci.ellensburg.wa.us/
Small utility:	Yes

A small utility is a utility that is not required by RCW 19.280.030(1) to prepare an integrated resource plan.

City of Ellensburg

Interim target: Percentage of retail load to be served using renewable and nonemitting resources (WAC 194-40-200(2))

Resource	2022	2023	2024	2025	4-year Period
Renewable	83%	83%	83%	83%	83%
Nonemitting	11%	11%	11%	11%	11%
Total	95%	95%	95%	95%	95%

[Small utilities may enter a single value in cell G6 and leave the remaining cells blank.]

Describe how the target demonstrates progress toward meeting the 2030 and 2045 CETA standards (WAC 194-40-200(2)). This section is not required if the value in cell G6 is 80% or greater :

N/A

City of Ellensburg Total Retail Load Forecast Weather Adjusted History 2021-2025					
Fiscal	Year	MWh	aMW	Growth	
	2021	212,843	24.30	0.6%	Hydro/Nuclear 95%
	2022	214,090	24.44	0.6%	Hydro 83%
	2023	214,743	24.51	0.3%	203,385 177,694
	2024	216,063	24.60	0.3%	204,005 178,236
	2025	216,017	24.66	0.3%	205,260 179,333
					205,216 179,294
					4yr CEIP 714,558

Specific targets (WAC 194-40-200(3)):

Resource	Amount	
Energy Efficiency	6,041	MWh to be acquired over the interim performance period (measured in first-year savings)
Renewable energy	714,558	MWh to be used during the interim performance period
Demand response	0	MW to be acquired over the interim performance period

Identify and describe the specific actions the utility will take over the next interim performance period to demonstrate progress toward meeting the utility's interim targets and the 2030 GHG neutral and 2045 clean electricity standard (WAC 194-40-200(1)):

Specific action proposed	Description of how the action demonstrates progress toward meeting interim targets and the standards
BPA's Energy Efficiency Implementation Program	Energy efficiency focuses on reducing the amount of electricity used by increasing the efficiency of energy use. The City of Ellensburg provides incentives to encourage participation in residential and non-residential programs to promote more efficient use of energy.
Receive BPA's Fuel Mix	The City's resource mix from BPA is 83% hydro, 11% Nuclear

Highly impacted communities (WAC 194-40-200(4))

Report each Highly Impacted Community in the table below.

Highly Impacted Community is defined in RCW 19.405.020(23) as:

(23) "Highly impacted community" means a community designated by the department of health based on cumulative impact analyses in RCW 19.405.140 or a community located in census tracts that are fully or partially on "Indian country" as defined in 18 U.S.C. Sec. 1151.

Department of Health has designated Highly Impacted Communities as those ranking 9 or 10 on the Environmental Health Disparities map. Visit the Department of Health website for instructions on how to identify Highly Impacted Communities:

<https://www.doh.wa.gov/DataandStatisticalReports/WashingtonTrackingNetworkWTN/ClimateProjections/CleanEnergyTransformationAct/CETAUtilityInstructions>

Census Tract (enter 11 digit FIPS code)	County Name	Tribal Lands (Yes/No)	Environmental Health Disparities Topic Rank
53037975600	Kittitas	N	Lead Risk from Housing
53037975401	Kittitas	N	Low Birth Weight Combined
53037975500	Kittitas	N	Low Birth Weight Combined
53037975600	Kittitas	N	No High School Diploma
53037975401	Kittitas	N	Population living in poverty <=185% of FPL
53037975500	Kittitas	N	Population living in poverty <=185% of FPL
53037975600	Kittitas	N	Population living in poverty <=185% of FPL
53037975402	Kittitas	N	Proximity to Risk Management Plan (RMP) Facilities
53037975500	Kittitas	N	Proximity to Risk Management Plan (RMP) Facilities
53037975600	Kittitas	N	Proximity to Risk Management Plan (RMP) Facilities
53037975402	Kittitas	N	Transportation Expense
53037975500	Kittitas	N	Transportation Expense
53037975402	Kittitas	N	Unaffordable Housing (>30% of income)
53037975500	Kittitas	N	Unaffordable Housing (>30% of income)
53037975600	Kittitas	N	Unaffordable Housing (>30% of income)

Vulnerable populations (WAC 194-40-200(4))

Please list all socioeconomic factors and sensitivity factors developed through a public process and used to identify Vulnerable Populations based on the definition in RCW 19.405.020(40):

(40) "Vulnerable populations" means communities that experience a disproportionate cumulative risk from environmental burdens due to:

(a) Adverse socioeconomic factors, including unemployment, high housing and transportation costs relative to income, access to food and health care, and linguistic isolation; and

(b) Sensitivity factors, such as low birth weight and higher rates of hospitalization

Factors	Details	Caveats	Source	Date Last Updated	Approximate number of households in service territory (if applicable)
Lead Risk from Housing	Homes built before 1980	Washington Tracking Network values have a 90% margin of error; 2016 data estimated 3263 homes in Kittitas County; 2019 data estimated 3601 homes built before 1980 Data adjusted per State: before 1940 = 0.68; 1940 - 1959 = 0.43; 1960 - 1979 = 0.08	2019 ACS 5-year Housing Data	2021	3601 - Kittitas County 1642 - Ellensburg
Low Birth Weight Combined	Ranking of population with low birth weight, < 2500 g (~5.5 pounds)	Multiple births, abortions and fetal deaths are not included	WA Dept of Health Statistics	2021	21 - Kittitas County annual average number of low birth weight 5.2% - Kittitas County annual average percentage of low birth weight 6.3% - Washington State annual average percentage of low birth weight 2003 - 2019
No High School Diploma	Age 25+ and no high school diploma	Washington Tracking Network values shown have a 90% margin of error	2019 ACS 5-year grouping	2021	2392 - Kittitas County 8.6% - Kittitas County 791 - Ellensburg 8.4% - Ellensburg 8.7% - Washington State
Population living in poverty <=185% of FPL	2019 5-year roll-up of estimated number of people living below 185% of Federal Poverty Level, which varies by household size	Washington Tracking Network values shown have a 90% margin of error	WA Dept of Health Population Living in Poverty	2021	13,600 - Kittitas County 30.7% - Kittitas County 8,370 - Ellensburg 44.8% - Ellensburg 21.9% - Washington State

Factors	Details	Caveats	Source	Date Last Updated	Approximate number of households in service territory (if applicable)
Proximity to Risk Management Plan (RMP) Facilities	Facilities with a Risk Management Plan within 5 km of a census tract;	This indicator was developed using nationwide databases and may not reflect the risk of living within close proximity to all RMP facilities in Washington. The 5km buffer size used in this indicator was found to be appropriate for the national indicator. However, a smaller buffer size may be more appropriate for state-specific applications. This measure displays the proximity of facilities with a Risk Management Plan (RMP) by displaying the count of facilities within 5 km of a tract divided by the distance of the facility. If no facility existed within 5km of the tract, the nearest neighbor was used. The data was downloaded from EJSCREEN in 2017.	EPA EJSCREEN map: https://ejscreen.epa.gov/arcgis/rest/services/EMEF/efpoints/MapServer	2017	EF Points: Superfund - 0 Toxic Releases - 2 Water Dischargers - 28 Air Pollution - 1 Hazardous Waste - 43 Brownfields - 8 Toxic Substances Control Act - 0
Transportation Expense	Transportation costs based on percentage of income for the regional moderate household (80% AMI)	The index is intended for use by researchers, developers, planners and policymakers to enhance their understanding of the cost burden of transportation. Indicators that can change more quickly like car ownership can be less accurate inputs than indicators that tend to change slowly like neighborhood block size.	The Housing + Transportation (H+T®) Affordability Index https://www.cnt.org/tools/housing-and-transportation-affordability-index	2008 - 2012	Census Tracts (last 4 digits) 5300 - 35% 5401 - 26% 5402 - 28% 5500 - 28% 5600 - 25%

Factors	Details	Caveats	Source	Date Last Updated	Approximate number of households in service territory (if applicable)
Unaffordable Housing (>30% of income)	Housing burden indicator displays the modeled percent of income spent on housing for a 4-person household making the median household income based on ACS 5-year estimates There are three categories under "Selected Monthly Costs as Percentage of Household Income": households with mortgages, households without mortgages, and rentals. "Unaffordable housing" is defined as households spending great than 30 percent of their income on housing costs.	Washington Tracking Network values shown have a 90% margin of error	2019 ACS 5-year Housing Data	2012 - 2016	6,530 - Kittitas County 37% - Kittitas County 60% of > 30% - Rentals Kittitas County 3,694 - Ellensburg 49% - Ellensburg 82% of > 30% - Rentals Ellensburg 32% - Washington State

*** Data are based on a sample and are subject to sampling variability. The degree of uncertainty for an estimate arising from sampling variability is represented through the use of a margin of error. The value shown here is the 90 percent margin of error. The margin of error can be interpreted roughly as providing a 90 percent probability that the interval defined by the estimate minus the margin of error and the estimate plus the margin of error (the lower and upper confidence bounds) contains the true value.*

Describe and explain any changes to the factors from the utility's previous CEIP, if any:

N/A, 2022 is first CEIP

Distribution of energy and non-energy costs and benefits (WAC 194-40-200(4))

Please report one or more indicators, developed through a public process, and used to identify the forecasted distribution of energy and non-energy costs and benefits for the utility's portfolio of specific actions, including impacts resulting from achievement of the specific targets established under WAC 194-40-200(3).

Indicators must be associated with one of the following categories: energy benefits, non-energy benefits, reduction of burdens, public health, environment, reduction in cost, energy security, or resiliency.

Category	Indicator	Details	Source	Date Last Updated
Energy	Renewable Energy Product	Offer a Renewable Energy Product to customers that sign up for it	Utility Data	2021
	Efficiency Programs	Energy Efficiency, Weatherization, Net-Metering incentives on Low-Income housing	Energy Efficiency measures	2021
	Resource Adequacy	Planning for future uptake	Utility Data	2021
Non-Energy	Efficiency Programs	Energy Efficiency, Weatherization, Net-Metering incentives on Low-Income housing	Energy Efficiency measures	2021
	Supplier Strength	Strength and Health of BPA	Utility Data	2021
	Communication	Targeted communications, rise in number of outreach and impressions to increase accessibility	Utility Data	2021
Reduction of Burden	Efficiency Programs	Energy Efficiency, Weatherization, Net-Metering incentives on Low-Income housing	Energy Efficiency measures	2021
	Number of households with high energy burden	Identify energy burdened households	Utility Data	2021
	Low income rate class	Subsidized by other rate payers, the low income rate classes reduces costs for the customer in the short-term	Utility data	2021
Public health	Cleaner indoor air	more efficient HVAC units can increase filtering of air inside the home	Energy Efficiency measures	2021
Environmental	Greenhouse Gas Emissions	Ellensburg GHG emissions	Utility Data	2021
	Efficiency Programs	Energy Efficiency, Weatherization, Net-Metering incentives on Low-Income housing	Energy Efficiency measures	2021
Reduction in Cost	Efficiency Programs	Energy Efficiency, Weatherization, Net-Metering incentives on Low-Income housing	Energy Efficiency measures	2021
	Number of households with high energy burden	Identify energy burdened households	Utility Data	2021
	Reduced energy burden	Weatherization improvements can reduce energy costs for the customer in the long-term	Energy Efficiency measures	
Energy Security	Supplier Generation Location	Generation located in Washington or Connected to BPA Transmission	Utility Data	2021

Long-term plans (WAC 194-40-200(4)(c)(iii))

Describe how the specific actions in the CEIP are consistent with, and informed by, the utility's longer-term strategies based on the analysis in RCW 19.280.030 (1)(k) and clean energy action plan in RCW 19.280.030 (1)(l) from its most recent integrated resource plan, if applicable:

This report presents the results of the Twenty Year Distribution Study prepared by Electrical Consultants, Inc. (ECI) for the City of Ellensburg (the City). This study evaluates the City's distribution system providing electric service in Central Washington.

Based upon the planning criteria identified in Section 3.0 and pertinent historical trends and load forecasts identified in Section 4.0, distribution system performance was evaluated in order to identify criteria violations for voltage drop, voltage and current imbalance, line and equipment loading, as well as power factor and losses.

System performance was evaluated by first performing load flows for peak loading conditions. A thorough review of the existing system performance with the present, transition (6 year), long range (20 year), long range extreme (20 year extreme) loading was performed. The peak models are represented by the maps located at the end of the report in the Maps Appendix. These maps include voltage levels across the City's distribution system along with projected loads. Results of the load flow analysis are summarized in Section 5.0 along with recommendations for system improvement.

All recommendations were designed to be in general concurrence with planning criteria and to ensure that no adverse impacts to the integrity of the City's system were imposed. The mechanical condition of the City's plant, along with reliability of service to members, was also factored into the recommendations for system improvement. Single contingency outages were investigated through analysis of load flow and voltage drop studies to address system requirements during such operating conditions.

Connection Statistics and Energy Use

The City serves residential, commercial, and industrial customers. In terms of number of accounts, residential is the most profuse, followed by commercial and industrial, respectively. In recent years, industrial/commercial loads have decreased, however there are several proposed projects that could increase these categories.

Historical Demand and Growth Patterns

The City of Ellensburg provides distribution-level voltage through four (4) substations. These include Helena, East Ellensburg, Dolarway #1 and Dolarway #2. The table also shows loads allocated to each substation for the six-year and twenty-year periods.

Figure 4-6-1 shows the historical and forecasted growth characteristics of the City's entire system for the period 2006 through 2037. This forecast gives a base case and an upper confidence bound, the upper confidence bound is a maximum anticipated value.

Having developed a predictor of future growth, growth could then be assigned. This was accomplished through consultation with the City. All areas

with potential new development were identified and a large customer was then assigned. Refer to the Projected Loads Maps in the Appendix for where growth was assigned. Total system kW projections at six-year and twenty year loads were then compared to the projected growth. As can be seen from the trend lines in Figures 4-6-1 through 4-6-4 system growth is negative for the system, according to the linear regression of data provided by the City and BPA reads. The decrease in loads on the system in recent years is due to industrial/commercial loads leaving the city and increased electrical efficiency. Although the load decrease results in a negative trend, it is not an accurate predictor of future growth. Residential loads in the city are anticipated to continue to grow. Projected load growth areas were discussed with City personnel and loads were added to the system based upon the possibility of new subdivisions, industrial/business parks, territory expansion, and the forecast projections. For this reason, projected loads are higher than the linear regression projections would suggest, however, they are in line with City growth projections.

Consumer statistics were analyzed between 2012 and 2017, there were 9,485 customers and 60 MW of non-coincident peak during the 2012 plan, and there was 9,343 customers and 53 MW of non-coincident peak during the 2017 plan. These numbers infer that in 2012 the average kW per customer was 6.326 kW per customer and in 2017 it was 5.672 kW per customer. This analysis does not take into account Twin City Foods load being taken offline for the 2017 plan. Twin City Foods had approximately 4.5 MW of load in the 2012 plan, removing it from the 60 MW load brings the load to 55.5 MW and this changes the average kW per customer to 5.85 kW which is much closer to the current usage per customer. While these numbers show a decrease in usage per customer it is important to note that based upon past experience this decrease is likely due to increased efficiency in homes and businesses. Increased efficiency will initially look like a decrease in loads, however, this decrease cannot maintain into the future and as the population grows loads will continue to increase. For this reason and discussion with City personnel loads are anticipated to begin to increase in the future as the city expands.

Loads were also compared to the BPA load forecast included in the Appendix. The load forecast from BPA shows no growth anticipated, however, as discussed previously residential growth is anticipated to continue within the City and therefore increased load is expected.

Population growth is assumed at 2% year over year with a total population of 32,540 residents by 2037. Growth projections came from a 2016 study by BERK Consulting and the Kittitas County conference of Governments.

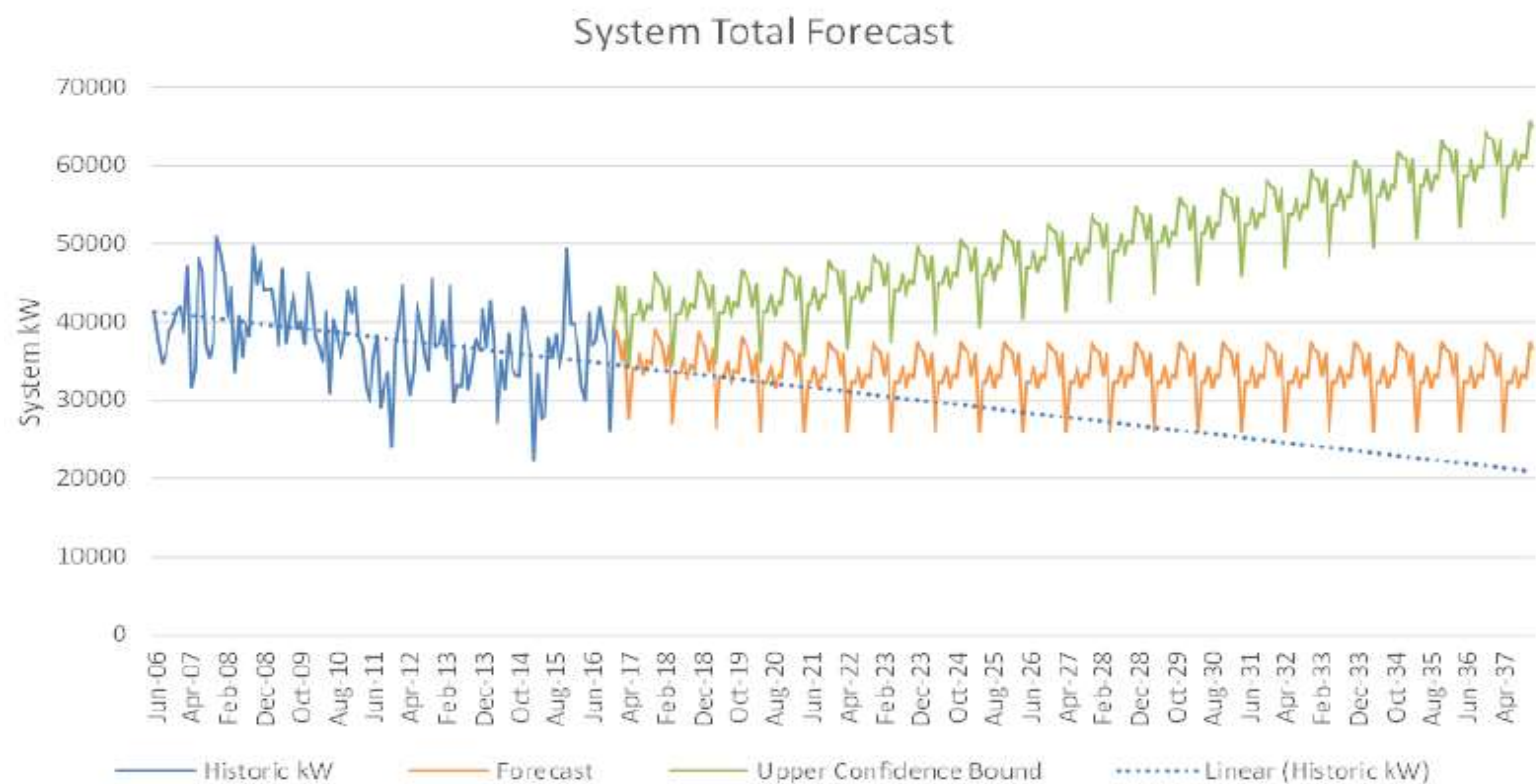


Figure 4-6-1

Integrated resource plan compliance (WAC 194-40-200(6))

This CEIP is consistent with the most recent integrated resource plan or resource plan, as applicable, prepared by the utility under RCW 19.280.030. **Select yes or no.**

Yes

Clean energy action plan compliance (WAC 194-40-200(7))

The CEIP is consistent with the utility's clean energy action plan developed under RCW 19.280.030(1) or other ten-year plan developed under RCW 19.280.030(5). **Select yes or no.**

Yes

Risk (WAC 194-40-200(4)(d))

Describe how the utility intends to reduce risks to highly impacted communities and vulnerable populations associated with the transition to clean energy.

Focus on risk reduction through energy security and resiliency. Reduce energy burden on our customers by continuing to provide weatherization improvement rebates to qualifying low-income customers at no cost to low income customers utilizing a variety of funding sources, to include, but not limited to City conservation funds through the BPA program, Department of Commerce, and others.

Public participation (WAC 194-40-200(4), -220(1))

Provide a summary of the public input process conducted in compliance with WAC 194-40-220. Describe how public comments were reflected in the specific actions under WAC 194-40-200(4), including the development of one or more indicators and other elements of the CEIP and the utility's supporting integrated resource plan or resource plans, as applicable.

- 1.) One open public meeting - No comments provided
- 2.) Open comment period - No comments received

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Clean Energy Transformation Act

Clean Energy Transformation Act (CETA)

On May 7, 2019, Governor Jay Inslee signed into law the [Clean Energy Transformation Act \(CETA\)](#), which commits Washington State to achieve an electricity supply that is 100% greenhouse gas emissions free by 2045. As an electric utility, the City of Ellensburg is required to meet these requirements.



Electricity production is the third-largest source of carbon emissions in the state. **The good news is that the City of Ellensburg's electricity fuel mix is 95% carbon free.** The bill aims to curb that by eliminating coal power, including the importation of electricity produced by coal-fired power plants in neighboring states, by 2025. Washington utilities, including the City of Ellensburg, are required by law to transition to a carbon-neutral electricity supply by 2030, before eliminating fossil fuel electricity production completely by 2045.

Clean electricity will allow Washington residents and businesses to power their buildings and homes, vehicles, and appliances with carbon free resources, such as wind and solar. Reductions in fossil fuel use will improve the health of communities, grow the economy, create family-sustaining jobs, and enable the state to achieve its long-term climate goals.

The law provides safeguards to maintain affordable rates and reliable service. It also requires an equitable distribution of the benefits from the transition to clean energy for all utility customers and adds and expands energy assistance programs for low-income customers.

The legislation requires utilities to engage the public to help determine their clean energy transition. Utilities will be required to account for the costs and impacts of carbon pollution when considering energy sources. As part of this requirement, utilities must develop a Clean Energy Implementation Plan (CEIP) that demonstrates how they will work to meet carbon standards at the lowest reasonable cost in the next four years. The City of Ellensburg is currently developing the CEIP, which will be available for review at a future Utility Advisory Committee meeting and will be posted online when complete.

Key milestones for Washington utilities under this law include:

- 2022 – Prepare and publish a clean energy implementation plan with targets for energy efficiency and renewable energy
- 2025 – Eliminate coal-fired electricity from their state portfolios
- 2030 – Achieve greenhouse gas neutrality, may include provisions for offsets
- 2045 – Supply 100% renewable or non-emitting electricity, with no provision for offsets

For more information on CETA, please visit Washington State Department of Commerce's web site [here](#). For a deeper dive into data and visual illustrations on Washington State greenhouse gas emissions, visit the [Department of Ecology](#) webpage.

Learn more about the Clean Energy Implementation Plan at the Utility Advisory Commission (UAC) meeting on Thursday, October 21, 2021 at 3:30 p.m. Join virtually or attend in person at City Hall.

There will be additional meetings for public participation including future UAC and City Council meetings.

Use of alternative compliance options (WAC 194-40-200(5))

Identify any planned use during the period of alternative compliance options, as provided for in RCW 19.405.040(1)(b):

Alternative compliance payments:		Dollars
Unbundled renewable energy credits:		Credits
Credits from energy transformation projects:		MWh
Electricity from the Spokane municipal solid waste to energy facility:		MWh

City of Ellensburg

Resource adequacy standard (WAC 194-40-200(8))

Identify the resource adequacy standard and measurement metrics adopted by the utility under WAC 194-40-210 and used in establishing the targets in the CEIP.

Resource adequacy standard	5%
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Methods of measurement	5% is the regional threshold established for loss of load probability. The City of Ellensburg is a 100% load-following customer of BPA and short-term Tier 2 needs are also provided by BPA.
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WAC 194-40-210

Resource adequacy standard.

(1) Each utility that is required to prepare an integrated resource plan under RCW 19.280.030(1) must establish by January 1, 2022, a standard for resource adequacy to be used in resource planning, including assessing the need for and contributions of generating resources, storage resources, demand response resources, and conservation resources. The resource adequacy standard must be consistent with prudent utility practices and relevant regulatory requirements and must include reasonable and nondiscriminatory:

- (a) Measures of adequacy, such as peak load standards and loss of load probability or loss of load expectation;
- (b) Methods of measurement, such as probabilistic assessments of resource adequacy; and
- (c) Measures of resource contribution to resource adequacy, such as effective load carrying capability applicable to all resources available to the utility including, but not limited to, renewable, storage, hybrid, and demand response resources.

(2) Each utility not subject to subsection (1) of this section must identify by January 1, 2022, the resource adequacy standard relied on by the utility in preparing its resource plan and CEIP.

(3) In each CEIP submitted after 2022, each utility must identify and explain any changes to its resource adequacy standard.

[Statutory Authority: RCW 19.405.100 and 19.405.060. WSR 21-02-039, § 194-40-210, filed 12/29/20, effective 1/29/21.]

Annual cost threshold (WAC 194-40-200(9))

Enter information in the blue column only. The rest will pre-populate.

Do not complete this section unless the utility intends to comply using the 2% incremental cost approach specified in WAC 194-40-230.

Year	Retail revenue requirement	Annual amount from revenue increase equal to 2% of prior year revenue requirement	Number of years in effect	Threshold amount over four years	Sum of threshold amounts	Annual threshold amounts
2021						
2022		\$	4	\$.00	\$.00	\$.00
2023		\$	3	\$.00		
2024		\$	2	\$.00		
2025		\$	1	\$.00		
Annual threshold ammount as a percentage of average retail revenue requirement						#DIV/0!

EXHIBIT A

Electric Conservation Potential Assessment

This section describes the methodology and results of the City of Ellensburg's (City's) 2016 Electric Conservation Potential Assessment (CPA). This assessment provides estimates of electric energy savings by sector for the period: 2017 to 2036. The assessment considered a wide range of conservation resources that are reliable, available and cost-effective within the 20-year planning period.

Background

The City provides electricity service to nearly 10,000 customers within the City of Ellensburg in central Washington. As noted in the supply-side analysis for the City's 2016 IRP, energy efficiency is the least expensive resource available to the City and is the most attractive resource for serving above-RHWM loads. Therefore, this analysis identifies available conservation potential for the City's service area and applicable programs to assist the utility in strategic conservation program planning. The conservation potential identified in the CPA can be evaluated along with other demand and supply-side resources to inform resource planning for the City's service area over the 20-year planning period. The CPA focuses on available and cost-effective conservation potential for the planning period: 2017 through 2036.

Study Uncertainties

The savings estimates presented in this study are subject to the uncertainties associated with the input data. This study utilized the best available data at the time of its development; however, the results of future studies will change as the planning environment evolves. Specific areas of uncertainty include the following:

- Customer Characteristic Data – Residential and commercial building data and appliance saturations are in many cases based on regional studies and surveys. There are uncertainties related to the extent that the City's service area is similar to that of the region, or that the regional survey data represents the population.
- Measure Data – In particular, savings and cost estimates (when comparing to current market conditions), as prepared by the Northwest Power and Conservation Council (NWPC Council) and Regional Technology Forum (RTF), will vary across the region. In some cases, measure applicability or other attributes have been estimated by the NWPC or the RTF based on professional judgment or limited market research.
- Market Price Forecasts – Market prices (and forecasts) are continually changing. The market price forecasts for electricity and natural gas utilized in this analysis are based on the most recent available information but represent a snapshot in time. Given a different snapshot in time, the results of the analysis would vary. However, risk credits are included in the High scenario for this analysis to mitigate the market price risk over the study period.

- **Utility System Assumptions** – Credits have been included in this analysis to account for the avoided costs of bulk transmission and distribution system expansion and local distribution system expansion. Though potential transmission and distribution system cost savings are dependent on local conditions, the NWPCC considers these credits to be representative estimates of these avoided costs.
- **Discount Rate** –This study reflects the current borrowing market although changes in borrowing rates will likely vary over the study period.
- **Load and Customer Growth Forecasts** – The CPA bases the 20-year potential estimates on forecasts of load and customer growth. Each of these forecasts includes a level of uncertainty.
- **Load Shape Data** – Conservation load shapes are used to value the time value of energy measure savings. Load shapes used in the CPA are taken from the NWPCC and represent estimated regional measure savings shapes. In practice, load shapes will vary by utility based on weather, customer types, and other factors. Finally, peak savings estimates are based on coincident factors and load factors by end-use. In practice, these data will vary by utility since not all utility peaks occur at the same time and not all customer classes contribute to the peak demand in the same way.
- **Frozen Efficiency** – The CPA assumes that the measure baseline efficiency levels and end-using devices do not change over the planning period. In addition, it is assumed that once an energy efficiency measure is installed, it will remain in place over the remainder of the study period.

Due to these uncertainties and the changing environment, it is recommended that utilities update conservation resource assessments regularly.

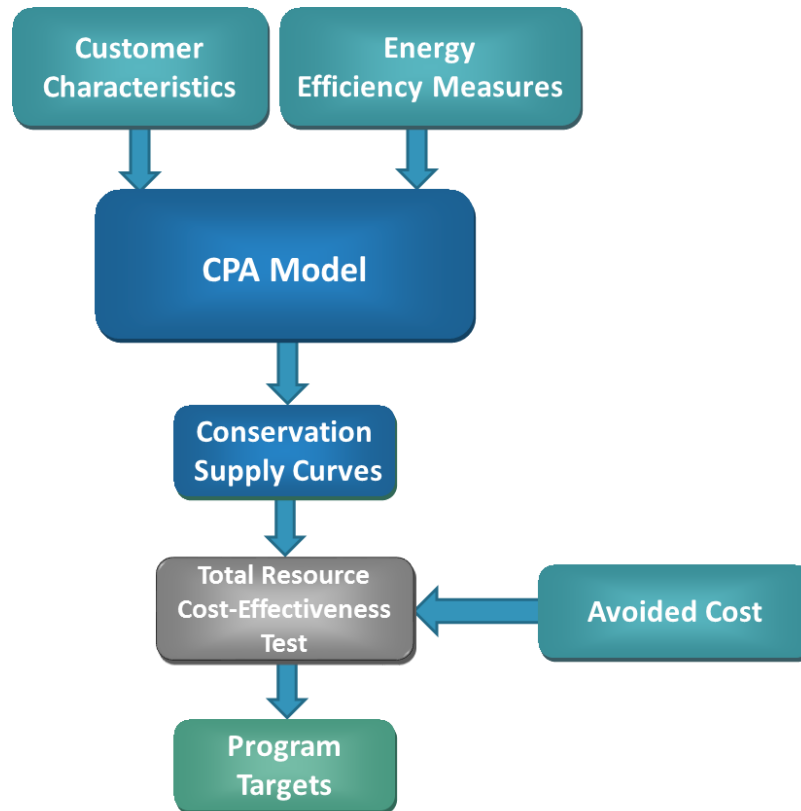
CPA Methodology

This study is a comprehensive assessment of the energy efficiency potential in the City’s service area for the period: 2017 to 2036. This section provides an overview of the methodology used to develop the City’s estimated conservation potential.

Basic Modeling Methodology

The basic methodology used for this assessment is illustrated in Figure 1. A key factor is the kilowatt hours saved annually from the installation of an individual energy efficiency measure. The savings from each measure is multiplied by the total number of measures that could be installed over the life of the program. Savings from each individual measure are then aggregated to produce the total potential.

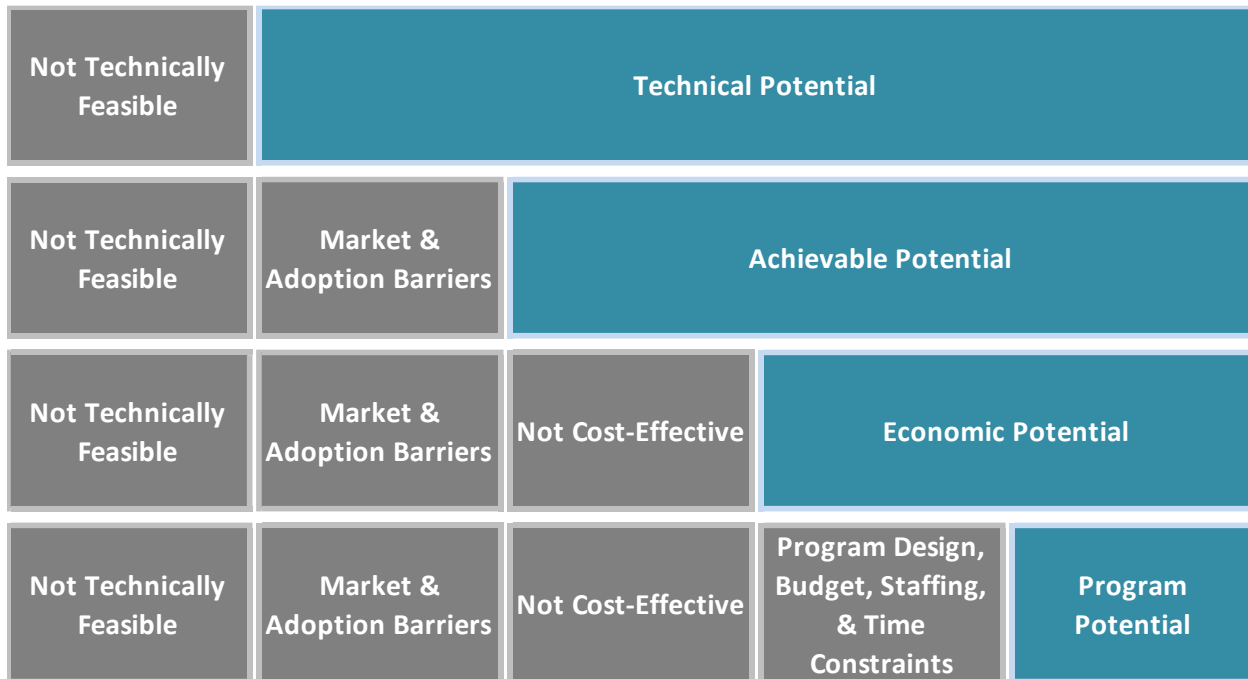
Figure 1
Conservation Potential Assessment Process



Types of Potential

Three types of potential are used in this study: technical, achievable, and economic potential. Technical potential is the theoretical maximum efficiency in the service territory if cost and achievability barriers are excluded. There are physical barriers, market conditions, and other consumer acceptance constraints that reduce the total potential savings of an energy efficient measure. When these factors are applied, the remaining potential is called the achievable potential. Economic potential is a subset of the technical-achievable potential that has been screened for cost effectiveness through a benefit-cost test. Figure 2 illustrates the four types of potential followed by more detailed explanations.

Figure 2
Types of Energy Efficiency Potential¹



Technical – Technical potential is the amount of energy efficiency potential that is available, regardless of cost or other technological or market constraints, such as customer willingness to adopt measures. It represents the theoretical maximum amount of energy efficiency absent these constraints in a utility’s service territory.

Estimating the technical potential begins with determining a value for the energy efficiency measure savings. Then, the number of “applicable units” must be estimated. “Applicable units” refers to the number of units that could technically be installed in a service territory. This includes accounting for units that may already be in place. The “applicability” value is highly dependent on the measure and the housing stock. For example, a heat pump measure may only be applicable to single family homes with electric space heating equipment. A “saturation” factor accounts for measures that have already been completed.

In addition, technical potential considers the interaction and stacking effects of measures. For example, if a home installs insulation and a high-efficiency heat pump, the total savings in the home is less than if each measure were installed individually (interaction). In addition, the measure-by-measure savings depend on which measure is installed first (stacking).

Total technical potential is often significantly more than the amount of economic and achievable potential. The difference between technical potential and economic potential is due to the

¹ Reproduced from U.S. Environmental Protection Agency. *Guide to Resource Planning with Energy Efficiency*. Figure 2-1, November 2007.

number of measures in the technical potential that are not cost-effective and the applicability or total amount of savings of those non-cost effective measures.

Achievable – Achievable potential is the amount of potential that can be achieved with a given set of conditions. Achievable potential takes into account many of the realistic barriers to adopting energy efficiency measures. These barriers include market availability of technology, non-measure costs, and physical limitations of ramping up a program over time. The level of achievable potential can increase or decrease depending on the given incentive level of the measure. The NWPCC uses achievability rates equal to 85 percent for retrofit measures and 65 percent for lost opportunity measures over the 20-year study period. This CPA follows the NWPCC’s methodology, including the achievability rate assumptions. Note that the achievability factors are applied to the technical potential before the economic screening.

Economic – Economic potential is the amount of potential that passes an economic benefit-cost test. This means that the present value of the benefits exceeds the present value of the costs over the lifetime of the measure. This CPA uses a total resource cost test (TRC) is used to determine economic potential. TRC costs include the incremental costs and benefits of the measure regardless of who pays a cost or receives the benefit. Costs and benefits include the following: capital cost, O&M cost over the life of the measure, disposal costs, program administration costs, environmental benefits, distribution and transmission benefits, energy savings benefits, economic effects, and non-energy savings benefits. Non-energy costs and benefits can be difficult to enumerate, yet non-energy costs are quantified where feasible and realistic. Examples of non-quantifiable benefits might include: added comfort and reduced road noise from better insulation, or increased real estate value from new windows. A quantifiable non-energy benefit might include reduced detergent costs or reduced water and sewer charges.

For this potential assessment, the NWPCC’s ProCost models are used to determine cost-effectiveness for each energy efficiency measure. The ProCost model values measure energy savings by time of day using conservation load shapes (by end-use) and time of use energy prices. The version of ProCost used in this CPA evaluates measure savings on a monthly basis and by four time segments. The four segments are defined by the NWPCC and include heavy load hours, shoulder hours, light load hours, and very light load hours (i.e. holidays). These four segments differentiate savings values across these different time periods.

Program – Program potential is the amount of potential that can be achieved through utility administered programs. The program achievable potential excludes savings estimates that are achieved through future code changes and market transformation. The program potential is not the emphasis of this assessment, but understanding the sources of achievement is an important reporting requirement.

Energy Efficiency Measure Data

The characterization of efficiency measures includes measure savings (kWh), demand savings (kW), measure costs (\$), and measure life (years). Other features, such as measure load shape, operation and maintenance costs, and non-energy benefits are also important for measure

definition. The NWPCC's Seventh Power Plan was finalized in early 2016. The primary sources for conservation measure data are the NWPCC's Seventh Plan supply curve workbooks.

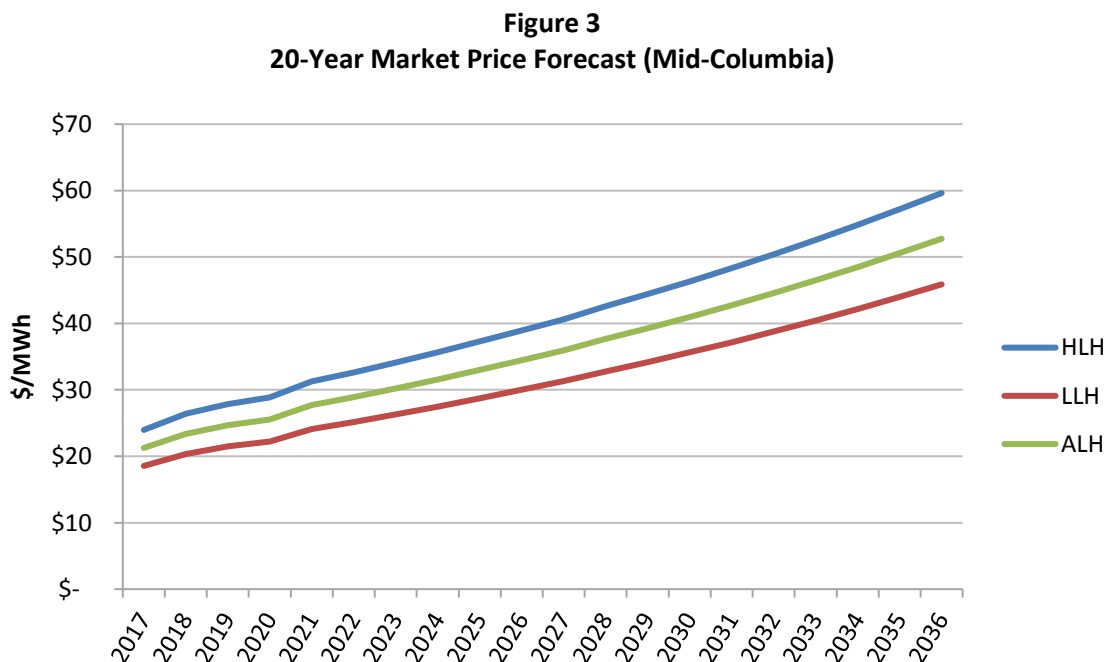
The measure data include adjustments from raw savings data for several factors. The effects of space-heating interaction, for example, are included for all lighting and appliance measures, where appropriate. For example, if an electrically-heated house is retrofitted with efficient lighting, the heat that was originally provided by the inefficient lighting will have to be made up by the electric heating system. These interaction factors are included in measure savings data to produce net energy savings.

Other financial-related data needed for defining measure costs and benefits include: current and forecasted loads, growth rates, discount rate, avoided costs, line losses, and deferred capacity-expansion benefits.

Avoided Cost

The avoided cost of energy is represented as a dollar value per MWh or dollar per kW-year for conservation savings. Avoided costs are used to value energy and demand savings benefits when conducting cost effectiveness tests and are generally included in the numerator in a benefit-cost test. These energy benefits are often based on the cost of a generating resource, a forecast of market prices, or the avoided resource identified in the integrated resource planning process.

Figure 3 shows the price forecast used as the primary avoided cost component for the planning period. The price forecast is shown for heavy load hours (HLH), light load hours (LLH), and average load hours (ALH). The levelized market price for the planning period is \$35.43/MWh.



In order to evaluate uncertainty, high and low conservation scenarios were modeled using a range of market price forecasts and growth assumptions. A low and high market price forecast were used along with various growth assumptions to model a range of scenarios.

Discount Rate

The discount rate used to calculate the net present value of costs and benefits is 4 percent. This discount rate is consistent with the rate used in the City's IRP.

Building Characteristic Data

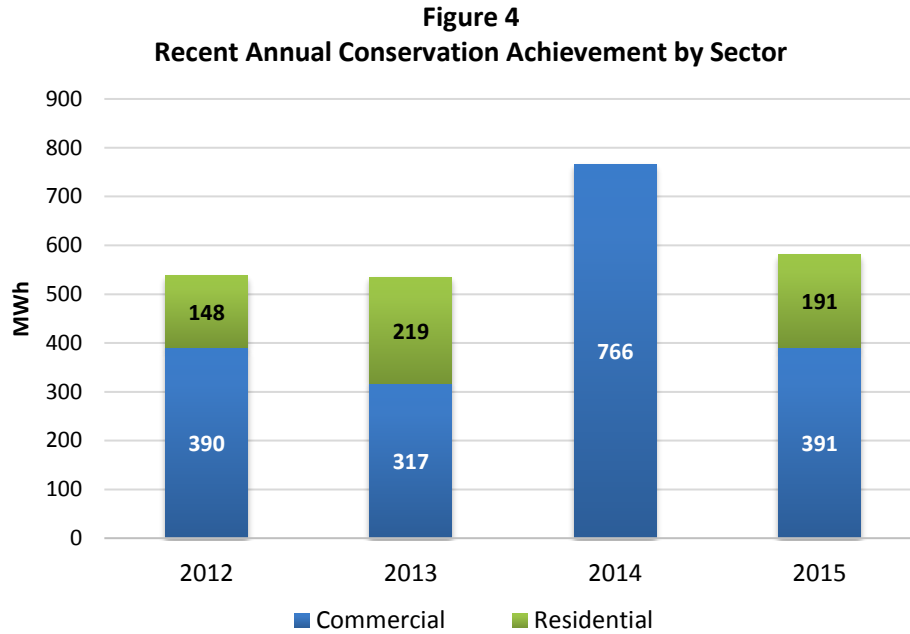
Building characteristics, baseline measure saturation data, and appliance saturation influence the City's total conservation potential. For this analysis, the characterization of the City's baseline was determined using data provided by the utility, County Assessor data and regional data from NEEA's Commercial and Residential Building Stock Assessments. Details of data sources and assumptions are described for each sector later in the report.

This assessment primarily sourced baseline measure saturation data from the NWPCC's Seventh Plan measure workbooks. The NWPCC's data was developed from NEEA's Building Stock Assessments, studies, market research and other sources, and the NWPCC has updated baselines for regional conservation achievement in preparation for the release of the Seventh Power Plan.

Recent Conservation Achievement

The City has pursued energy efficiency and conservation resources for over 30 years and continues to offer a range of conservation programs for residential and non-residential customers. Figure 4 shows recent energy savings achieved through the City's conservation programs.² The City's programs achieved 0.28 aMW (2,421 MWh) of energy savings from 2012 to 2015, with average annual savings of 0.07 aMW (605 MWh). The majority of recent conservation acquisition is due to commercial programs (77 percent), and the remaining achievement is due to residential conservation programs (23 percent). Notably, the City completed nearly 50 commercial energy efficiency projects, which saved customers a total of 0.09 aMW (766 MWh).

² Conservation achievement data provided by the City of Ellensburg.



Current Conservation Programs

The City currently offers incentives for electrically heated residential and commercial customers such as; insulation upgrades and air sealing, commercial energy efficiency projects such as lighting, refrigeration and motor/pump upgrades. The City is offering a limited-time incentive for energy efficiency lighting projects at small commercial facilities, which pays a higher incentive level and is not subject to the standard 70 percent project-cost cap that would normally apply to commercial projects. A summary of the City’s current conservation program offerings is provided below.

- ***Attic Insulation*** – Rebates of up to \$0.80 per square foot are available for residential and commercial attic insulation upgrades for electrically-heated homes and facilities.
- ***Wall Insulation*** – The City currently offers rebates of up to \$0.80 per square foot for wall insulation upgrades (R0 to R11) in electrically-heated residential and commercial buildings.
- ***Floor Insulation*** – The utility offers up to \$0.35 per square foot for floor insulation upgrades in electrically-heated residential and commercial buildings.
- ***Duct Sealing/Insulation*** – Rebates of \$1.25 per linear foot are available for duct sealing and insulation projects for electrically-heated residential and commercial buildings. Incentives may not exceed the lower of: the project cost or \$250.
- ***Commercial Lighting LED Upgrades*** – The City currently offers incentives for energy efficient lighting upgrades at commercial facilities. Customers must contact the utility for program details.
- ***Commercial Custom Projects*** – The City currently offers a range of incentives for custom energy efficiency projects for commercial customers. Eligible projects include upgrades for

compressors, motors, pumps and refrigeration systems. Customers must contact the utility for details on incentives for custom energy efficiency projects.

- **Fuel Switching** – The City is offering a range of incentives to switch from electric appliances to natural gas appliances.

The City does not currently offer incentives for heat pumps as these appliances are a net gain in electric consumption in the climate zone due to cold winter temperatures and the addition of space cooling loads.

Customer Characteristics Data

The City currently serves nearly 10,000 electricity customers located in the City of Ellensburg in Central Washington. A key component of an energy efficiency assessment is to understand the characteristics of these customers, primarily the building and end-use characteristics. Characteristics for each customer class are described below.

Residential

For the residential sector, the key characteristics include house type distribution, space-heating fuel type, and water heating fuel. Tables 1, 2 and 3 show relevant residential data for single-family, multi-family and manufactured homes in the City's service territory. Characteristics for existing homes and new construction are provided separately when applicable. Estimates of the number of residential electric customers served by the City and total population of the City of Ellensburg,³ are provided as well.

Residential sector characteristics are based on data provided by the City, County Assessor data and Washington State data for single-family, multi-family and manufactured homes. Washington State data points are based on the 2011 Residential Building Stock Assessment (RBSA), developed by NEEA. Regional data for all residential housing characteristics are provided for reference. These data provide an estimate of the current residential characteristics in the City of Ellensburg and are utilized as the residential sector baseline in this study. Average annual net residential growth for the CPA planning period is estimated at 0.3 percent, based on recent single-family, new house construction building permits in the City of Ellensburg⁴ and the NWPCC's residential demolition rate assumptions.

³ 2016 projected.

⁴ City-Data. *Single-Family New House Construction Building Permits: Ellensburg, Washington*. April 2016. Retrieved from: <http://www.city-data.com/city/Ellensburg-Washington.html>.

Table 1
Residential Building Characteristics – Single Family

Heating Zone 1	Cooling Zone 3	Solar Zone 3	Residential Households ¹ 8,134	Total Population ² 18,810			
Housing Stock	Existing	New	Regional %	Residential Appliances	Existing	New	Regional %
House Type ³				Foundation Type ⁴			
Single Family	45%	45%	74%	Crawlspace	95%	95%	62%
Multi-Family	51%	51%	17%	Full Basement	2%	2%	28%
Manufactured Homes	4%	4%	8%	Slab on Grade	3%	3%	10%
Housing Vintage ⁵				Water Heating ⁴			
Pre-1980	67%	N/A	67%	Electric	82%	82%	61%
1980 - 1993	14%	N/A	14%	Natural Gas	18%	18%	37%
Post 1993	19%	N/A	19%				
Heat Fuel Type ⁴				Appliance Saturation ⁵			
Natural Gas Homes	86%	50%	30%	Refrigerator	129%	129%	129%
Electric Homes	14%	50%	44%	Freezer	53%	53%	53%
Other Fuel Homes	0%	0%	26%	Clothes Washer	99%	99%	99%
Electric Heat System Type ⁵				Electric Dryer	98%	98%	98%
Forced Air Furnace	7%	7%	7%	Dishwasher	89%	89%	89%
Heat Pump	21%	21%	21%	Electric Oven	75%	75%	75%
Zonal (Baseboard)	71%	71%	71%	Room AC	14%	14%	14%
Electric Other	1%	1%	1%	Central AC	48%	48%	48%

1. Active residential electric services (December 2015) – Source: City of Ellensburg.
2. 2015 population estimate for the City of Ellensburg – Source: WA Office of Financial Management.
3. Source: City-Data.
4. Provided by City of Ellensburg.
5. Based on the 2011 Residential Building Stock Assessment (NEAA) – Single-Family, Washington State.

Table 2
Residential Building Characteristics – Multi-Family

Housing Stock	Existing	New	Regional %	Residential Appliances	Existing	New	Regional %
Housing Vintage ²				Water Heating ¹			
Pre-1980	50%	N/A	50%	Electric	90%	90%	77%
1980 - 1993	26%	N/A	26%	Natural Gas	10%	10%	22%
Post 1993	24%	N/A	24%				
Heat Fuel Type ²				Appliance Saturation ²			
Natural Gas Homes	8%	8%	8%	Refrigerator	103%	103%	103%
Electric Homes	90%	90%	90%	Freezer	4%	4%	4%
Other Fuel Homes	2%	2%	2%	Clothes Washer	47%	47%	47%
Electric Heat System Type ²				Electric Dryer	47%	47%	47%
Forced Air Furnace	2%	2%	2%	Dishwasher	78%	78%	78%
Heat Pump	0%	0%	0%	Electric Oven	97%	97%	97%
Zonal (Baseboard)	97%	97%	97%	Room AC	11%	11%	11%
Electric Other	1%	1%	1%	Central AC	2%	2%	2%

1. Provided by City of Ellensburg.
2. Based on the 2011 Residential Building Stock Assessment (NEAA) – Multi-Family, Washington State.

Table 3 Residential Building Characteristics – Manufactured Homes							
Housing Stock	Existing	New	Regional %	Residential Appliances	Existing	New	Regional %
Housing Vintage ²				Water Heating ¹			
Pre-1980	31%	N/A	31%	Electric	72%	62%	83%
1980 - 1993	42%	N/A	42%	Natural Gas	28%	38%	12%
Post 1993	27%	N/A	27%				
Heat Fuel Type ¹				Appliance Saturation ²			
Natural Gas Homes	0%	0%	6%	Refrigerator	121%	121%	121%
Electric Homes	95%	95%	82%	Freezer	43%	43%	43%
Other Fuel Homes	5%	5%	12%	Clothes Washer	99%	99%	99%
Electric Heat System Type ¹				Electric Dryer	95%	95%	95%
Forced Air Furnace	77%	77%	69%	Dishwasher	77%	77%	77%
Heat Pump	0%	0%	16%	Electric Oven	90%	90%	90%
Zonal (Baseboard)	23%	23%	15%	Room AC	17%	17%	17%
Electric Other	0%	0%	0%	Central AC	26%	26%	26%

1. Provided by City of Ellensburg.

2. Based on the 2011 Residential Building Stock Assessment (NEAA) – Manufactured Homes, Washington State.

Commercial

Building square footage is the key parameter used to determine conservation potential for the commercial sector, as many of the measures are based on savings as a function of building area (kWh per square foot).

For this assessment, the City provided 2015 square footage for all commercial segments (building categories) except University and Hospital. The City sourced commercial building square footage from the Kittitas County Assessor's Office records. The City provided 2015 energy consumption for the University and Hospital segments. These values were converted to square footage based on segment-specific energy use intensity (EUI) estimates.

Regional EUI values by building segment are based on the 2014 Commercial Building Stock Assessment (CBSA), conducted by NEEA. These values are shown in the third column of Table 4. EUI values are often used to derive commercial square footage, if only energy consumption data is available. To determine square footage for the University and Hospital segments, energy consumption for each these segments was divided by the applicable EUI value. Commercial square footage and EUI values by segment are shown in Table 4. Commercial building floor area is estimated at 7.1 million square feet.

Table 4
Commercial Building Square Footage Estimates

Segment	Area (Square Feet)	EUI (kWh/sf)
Large Office	104,985	15.6
Medium Office	66,639	20.2
Small Office	322,273	14.1
Big Box Retail	66,660	13.9
Small Box Retail	878,277	13.0
K-12 Schools ¹	365,585	9.0
University	2,282,708	16.9
Warehouse	848,808	7.3
Supermarket	259,340	53.4
Mini Mart	29,678	80.9
Restaurant	195,567	50.7
Lodging	645,070	14.6
Hospital	132,477	27.4
Other Health Facilities	183,818	14.9
Assembly Hall	70,082	10.5
Other	651,640	12.5
Total	7,103,607	16.8

1. Provided by the school district.

The City's goal is to encourage growth in the commercial sector over the planning period. Net annual energy sales growth for the sector may be minimal due to ongoing conservation efforts however, large new commercial project(s) would have an impact on the growth rate for this sector.

Industrial

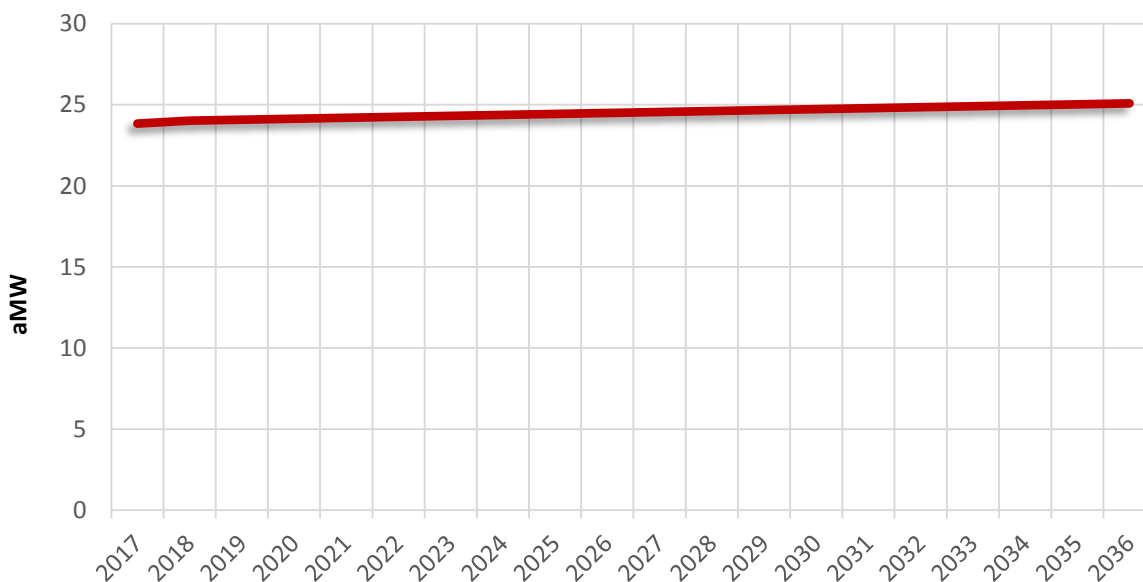
The methodology for estimating industrial potential is different than approaches used for the residential and commercial sectors, primarily because industrial energy efficiency opportunities are based on the distribution of electricity use across processes at industrial facilities. Industrial potential for this assessment was estimated based on the NWPCC's "top-down" methodology that utilizes annual consumption by industrial segment and then disaggregates total electricity usage by process shares to create an end-use profile for each segment. Estimated measure savings are applied to each sector's process shares.

The City provided 2015 energy use for one industrial segment: frozen food annual consumption in 2015 was 6,425 MWh and is expected to grow at a negative 0.5 percent annually. In addition, water and wastewater measures are applied to estimated water and wastewater systems. Municipal wastewater is estimated at 3.95 million gallons of water per day (0.18 MGD per 1,000 population). Water supply measures are applied based on population estimates.

Distribution Efficiency (DEI)

For this analysis, EES developed an estimate of distribution system conservation potential using the NWPCC's Seventh Plan approach. The Seventh Plan estimates distribution potential as a fraction of end system sales (0.12 to 4.4 kWh per MWh depending on measure). Distribution system potential for this assessment is based on BPA's Total Retail Load Forecast (December 2015) for the City of Ellensburg. The Base Case load forecast is graphed in Figure 5 and distribution system conservation potential is discussed in detail in the next section.

Figure 5
20-year End System Load Forecast



Results – Energy Savings and Costs

Technical Achievable Conservation Potential

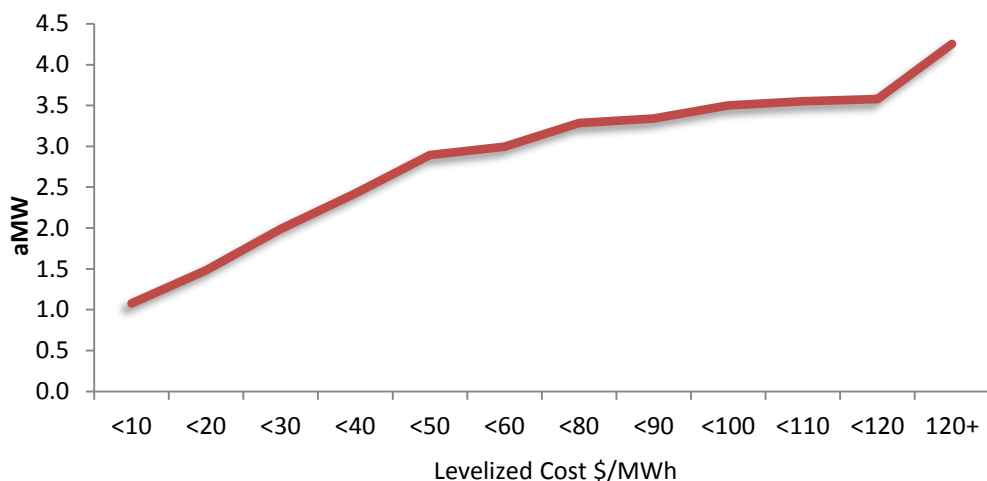
Technical achievable potential is the amount of energy efficiency potential that is available regardless of cost. It represents the theoretical maximum amount of energy efficiency when accounting for achievability. Technical potential has not been screened for cost effectiveness.

Figure 6, below, shows a supply curve of 20-year, technically achievable potential. A supply curve is developed by plotting energy efficiency savings potential at busbar (aMW) against the levelized cost (\$/MWh) of the conservation. Costs are standardized (levelized), allowing for the comparison of measures with different life lengths. The cost per MWh of technical potential

shown in Figure 6 is based on the estimated costs that the City would incur to acquire the conservation, inclusive of administration costs and incentives paid to customers.⁵

The supply curve facilitates comparison of energy efficiency resources to other demand-side resources and supply-side resources. Figure 6 shows that nearly 2.0 aMW of saving potential is available for \$30/MWh or less. Total technical achievable potential is approximately 4.25 aMW over the 20-year study period.

Figure 6
20-Year Technical-Achievable Potential Supply Curve



Economic Achievable Conservation Potential

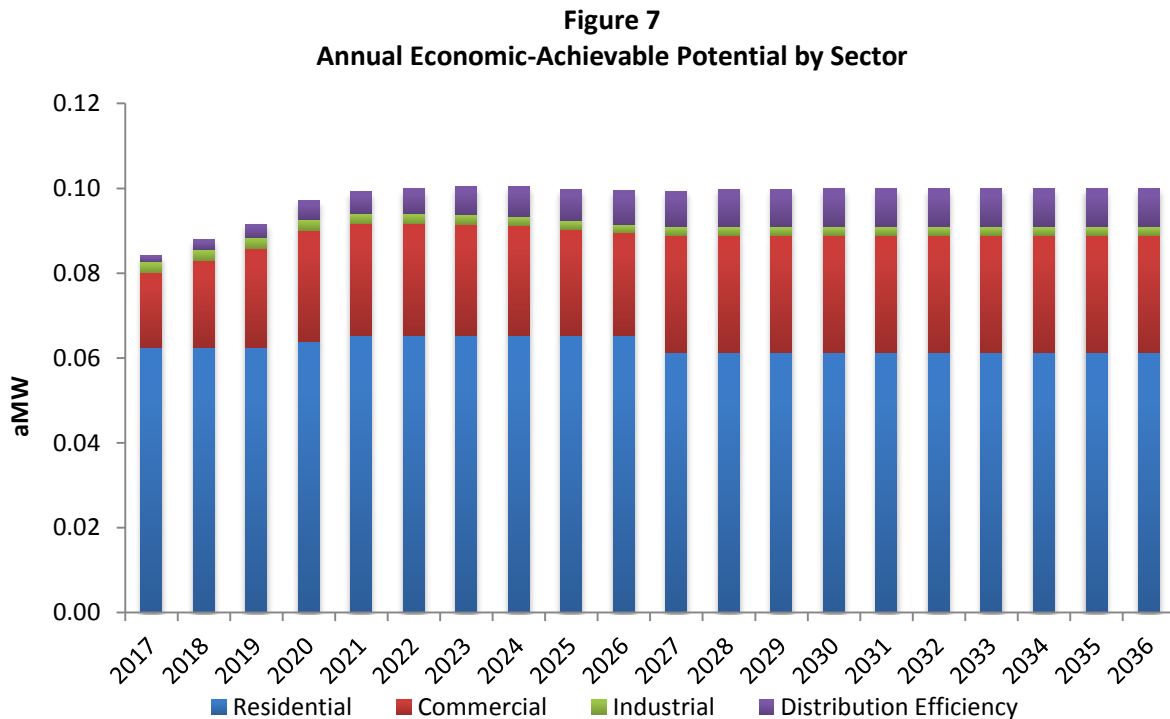
Economic achievable potential is the amount of achievable potential that passes the Total Resource Cost (TRC) test. This means that the present value of the total benefits attributed to the conservation measure exceeds the present value of the total costs over the measure lifetime.

Table 5 shows aMW of economically-achievable (cost-effective) potential by sector in 2, 5, 10 and 20-year increments (savings are measured at busbar). Compared with the technical achievable potential, it shows that 1.96 aMW of the total 4.25 aMW is cost effective for the City.

Table 5 Cost-Effective Achievable Potential (aMW)				
	2 Year	5 Year	10 Year	20 Year
Residential	0.12	0.32	0.64	1.26
Commercial	0.04	0.11	0.24	0.52
Industrial	0.01	0.01	0.02	0.04
Distribution Efficiency	0.00	0.02	0.05	0.14
TOTAL	0.17	0.46	0.96	1.96

Sector Summary

Figure 7 shows economic achievable potential by sector on an annual basis.



Approximately 64 percent of the potential over the 20-year study period is in the residential sector, followed by notable savings potential in the commercial sector. Ramp rates are used to establish reasonable annual conservation achievement levels; which are affected by factors including timing and availability of measure installation (lost opportunity measures), program (technological) maturity, non-programmatic savings, and current utility staffing and funding.

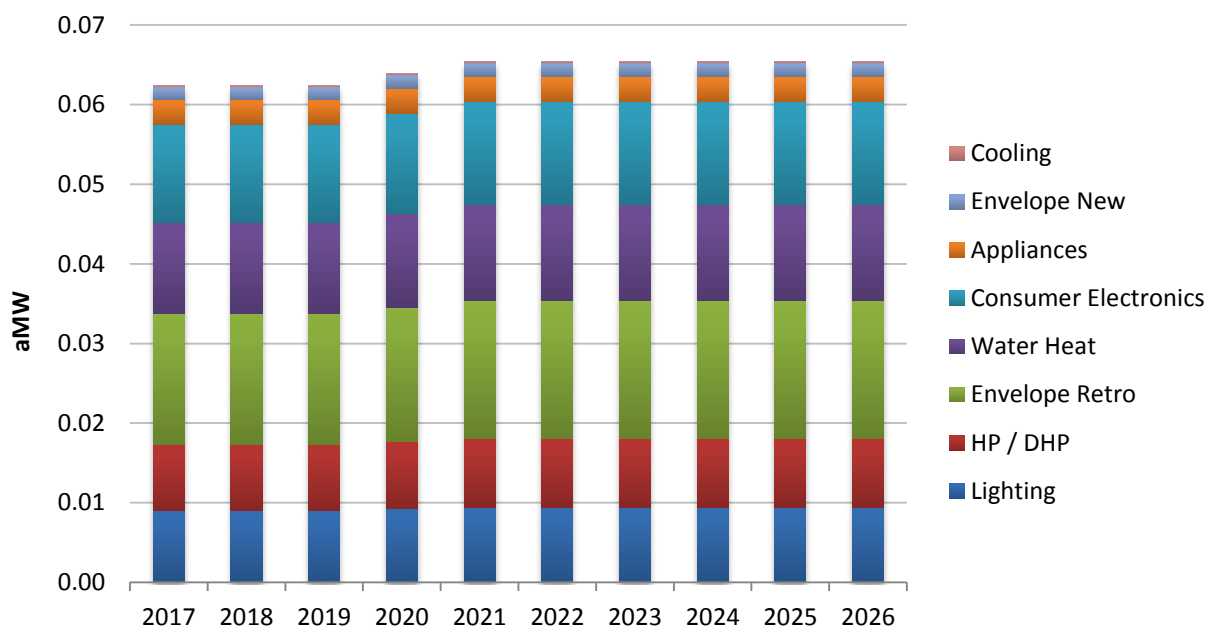
The next sections provide high level overviews of conservation potential by customer sector and measure end-use category. More detailed potential estimates are provided in Appendix III.

Residential

Figure 8 shows the distribution of residential potential savings for the first ten years of the planning period. This assessment also indicates notable potential due to consumer electronics measures, particularly from the installation of new advanced power strips. Weatherization programs for existing buildings have achieved significant savings over program history. Savings potential for envelope measures applied to existing building stock consist primarily of window replacements in multifamily homes.

Sixth Plan residential lighting measures have been replaced due to lighting standards that took effect over the past two years. Whereas previous residential lighting measure sets included CFL measures, the newest measure set is designed solely around LED lighting. Behavioral measures such as turning down water heater temperature, reducing HVAC usage and reducing lighting hours of use were evaluated in this analysis. These measures were not cost-effective.

Figure 8
Annual Residential Potential by End-Use

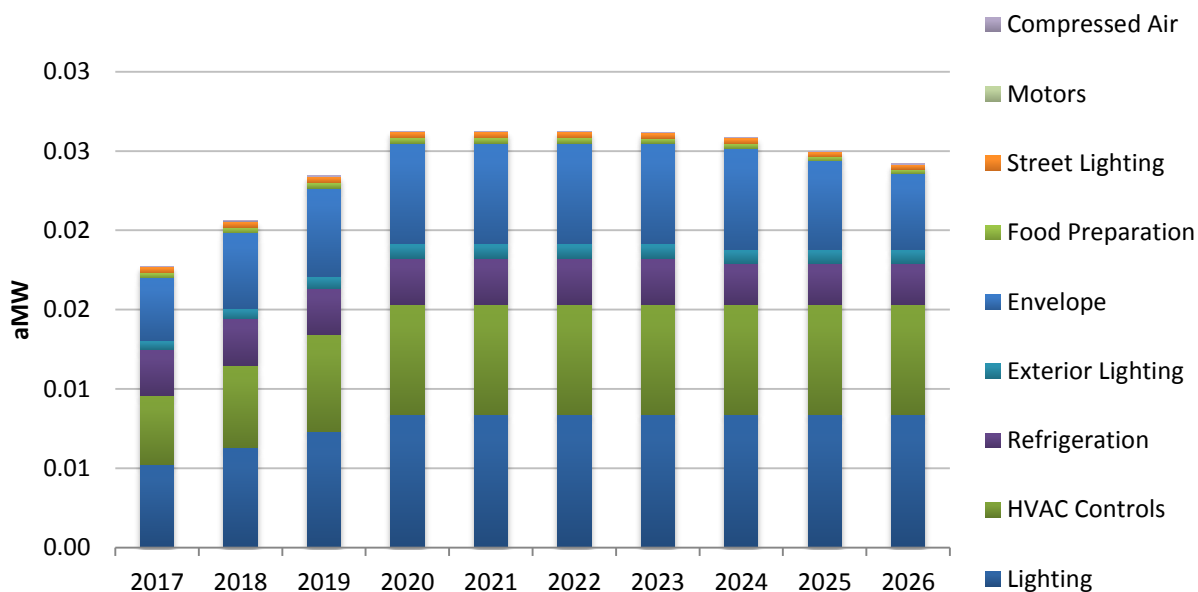


Commercial

Commercial rooftop insulation measures account for the largest single area of potential for this sector. This assessment indicates that commercial lighting potential, particularly lighting power density improvement potential, is also significant. HVAC control measures, including rooftop controller and energy management measures, also account for a substantial part of commercial

conservation potential for this assessment. Annual commercial sector potential by measure end-use is shown in Figure 9.

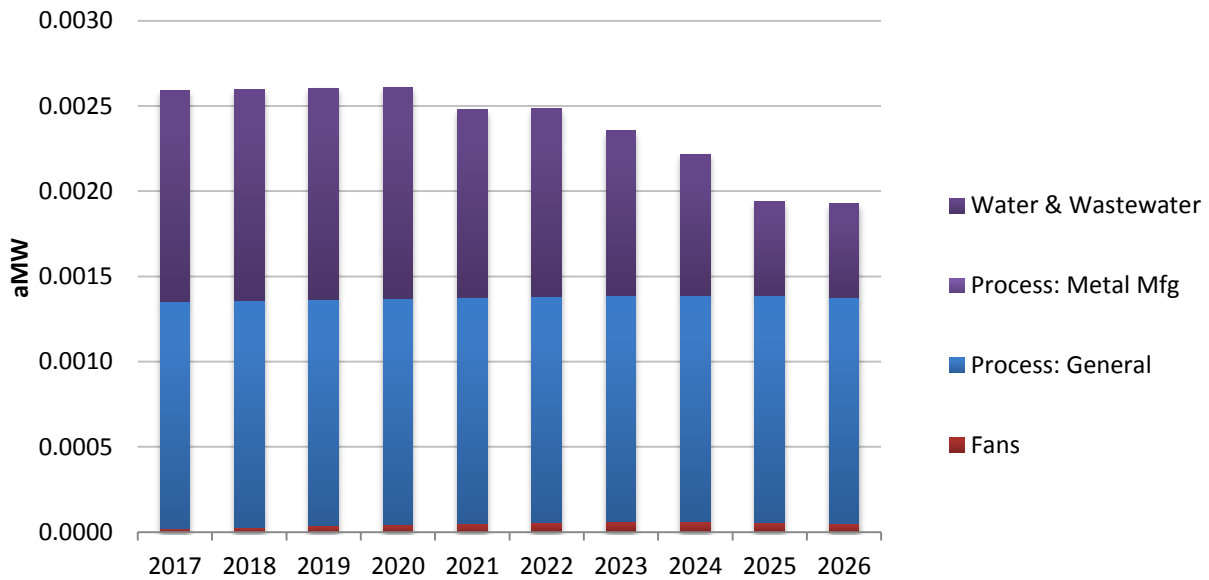
Figure 9
Annual Commercial Potential by End-Use



Industrial

The City's industrial sector includes loads for the frozen food segment only. This customer has moved to limited operations and the City has already pursued several energy efficiency projects at the location. Savings potential is reported below for this industrial customer as well as for water supply and wastewater treatment.

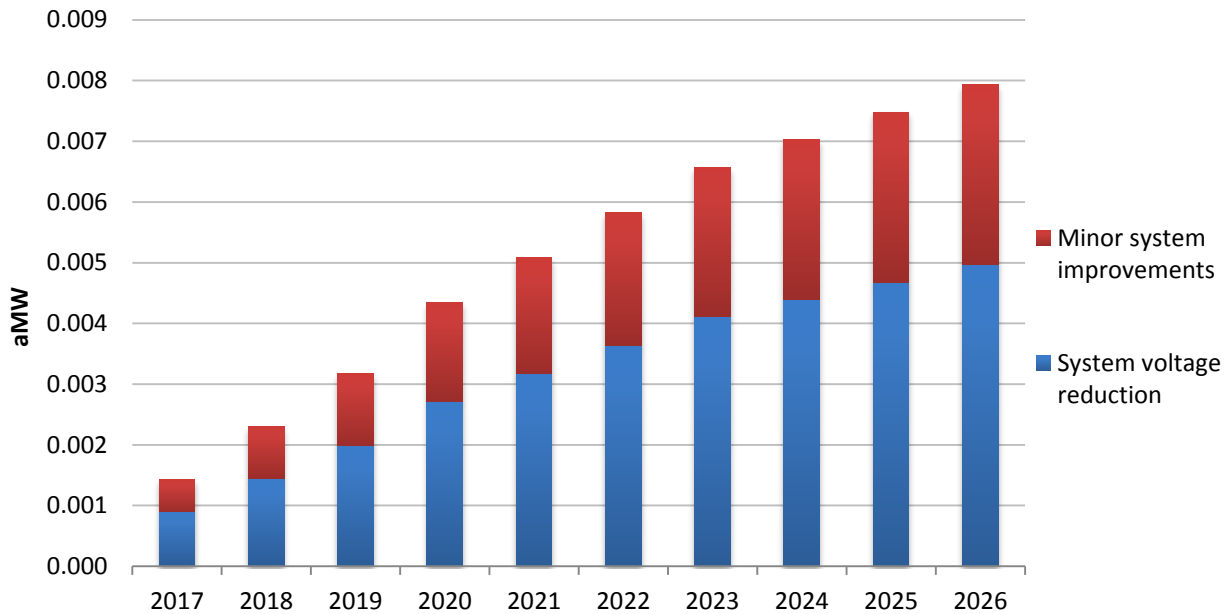
Figure 10
Annual Industrial Potential by End-Use



Distribution Efficiency

Distribution system conservation potential is estimated using the NWPCC's methodology which estimates savings as a fraction of end-system sales (total utility system load less line losses). Minor system improvements include var management, phase load balancing and feeder load balancing. The system voltage reduction potential shown in Figure 11 consists of voltage optimization through line drop compensation (LDC) methods.

Figure 11
Annual Distribution System Efficiency Potential



Cost

Budget costs can be estimated at a high level based on the incremental capital cost of conservation measures. The assumptions in this estimate include: 20 percent of measure capital cost for administrative expenses and 40 percent for incentives. A 20 percent allocation of measure costs to administrative expenses is a standard assumption for utility conservation programs and a 40 percent allocation to measure incentives is commonly used for utility conservation program planning. The incentive includes both funds reimbursed by BPA as well as funds directly from the City.

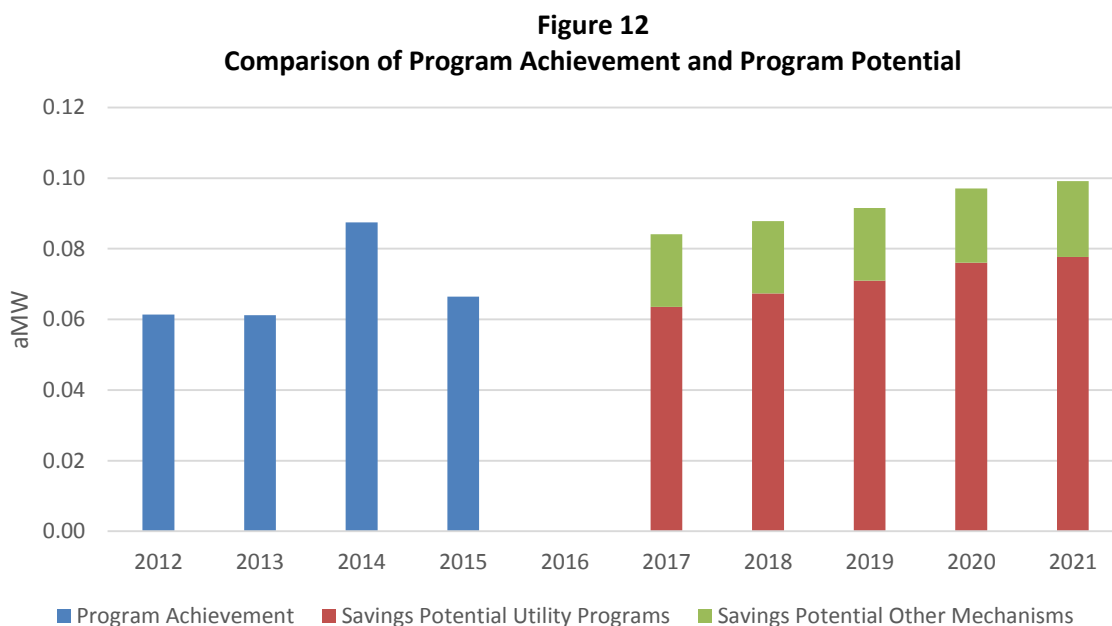
Given these assumptions, electric conservation potential over the next two years may cost the City and BPA \$388,800. The bottom row of Table 6 shows the cost per MWh of first-year savings.

Table 6 Cost for Achievable Conservation Potential (2015\$)				
	2 Year	Utility First Year Cost		
		5 Year	10 Year	20 Year
Residential	\$322,600	\$818,200	\$1,663,800	\$3,767,400
Commercial	\$58,800	\$175,300	\$370,500	\$753,100
Industrial	\$6,100	\$15,000	\$27,600	\$51,200
Distribution Efficiency	\$1,300	\$5,700	\$17,700	\$48,600
TOTAL	\$388,800	\$1,014,200	\$2,079,600	\$4,620,300
Unit Cost (\$/MWh first year)	\$258	\$252	\$247	\$269

Summary

This assessment provides estimates of electricity savings by sector for the period: 2017 to 2036. The assessment considered a wide range of electric conservation resources that are reliable, available, and cost effective within the 20-year planning period. These resources will be achieved through the City's own energy efficiency programs and momentum savings.⁶ Figure 12 compares the cost-effective and achievable energy efficiency potential estimated for the City with recent program achievements. Note that data for 2016 is not yet available.

The potential estimate is broken down into savings that are likely to be achieved through utility programs and savings that are likely to be achieved through other efforts. Future changes to codes and standards and market transformation efforts may shift savings from utility program to the other mechanism category. For this analysis, residential heat pumps and consumer electronics are included in potential that is likely to be achieved outside of utility programs. These two measure groups were selected since the City does not currently offer heat pump programs due to the net gain in consumption issue mentioned previously, and consumer electronics savings are likely to be achieved through market transformation.



Based on the above breakdown, future program savings potential is estimated to be at approximately the same level as recent achievement (0.06 aMW/year). This potential may be

⁶ Momentum savings refers to energy efficiency that occurs outside of utility programs (direct incentives) regardless of how and why. These savings include state code and federal standard changes, market transformation efforts, and spillover.

achieved at a cost that is similar to what has been experienced in recent program history. While these conservation resources are a valuable part of the City's resource strategy, the potential estimated is not great enough to meet the City's resource needs above BPA Tier 1 power supply.

EXHIBIT B

Demand Response Potential Assessment

This section summarizes the methodology and results of the demand response (DR) potential assessment conducted for the City of Ellensburg (City) for the period: 2017 to 2036. The DR analysis utilized measure assumptions and models developed by the NWPC Council and other stakeholders for estimating regional DR potential for the Seventh Plan. This DR assessment included analysis of four types of DR programs for the residential sector. Specifically, the analysis included two dispatch technologies and a range of seasonal profiles.

Overview of NWPC Council's Approach to DR Analysis

The NWPC Council defines demand response (DR) as, “a voluntary and temporary change in consumers’ use of electricity when the power system is stressed.”⁷ DR programs focus on temporarily reducing demand in response to a price signal or other incentive. The benefits of DR include reducing peak load, which helps to defer building new peaking resources and avoid additional market purchases. Peak load reduction also helps to defer transmission system upgrades and expansion and may improve system reliability. DR also provides ancillary services, including contingency reserves, operating reserves, and transmission and distribution system congestion relief.

Though DR potential for balancing reserves was evaluated in preliminary studies for the Seventh Plan, DR programs evaluated for the Seventh Plan regional portfolio are based solely on demand response for peak load reduction. Therefore, DR potential for this assessment focuses on DR as a peaking resource.

Demand Response Potential Assessment Methodology

Since demand response resources have some characteristics of conservation resources (demand-side), and also share characteristics of generation resources (dispatchable), the methodology used to estimate DR potential for this assessment, and for the Seventh Plan, is based on a hybrid of approaches used to develop conservation and generation resource potentials.

For the Seventh Plan, the NWPC Council commissioned Navigant Consulting to conduct an assessment of regional DR programs and develop methodologies for assessing regional DR potential. Cost and availability assumptions used in the Seventh Plan DR analysis are based on the Navigant study, stakeholder comments and additional data sources.

⁷ Northwest Power and Conservation Council. *Seventh Northwest Conservation and Electric Power Plan*. Feb 2016. (pp. 14-2).

Basic Modeling Methodology

Measures are primarily characterized by dispatch technology, load impact (kW/customer), load impact seasonality (% load impact on summer and winter peak demand), enablement costs (\$/customer), and implementation costs (\$/kW-yr). Additional key parameters used to determine DR program potential include assumptions for measure saturation (availability), participation rates, DR acquisition schedules (ramp rates) and measure turnover.

The key modeling parameter used to estimate DR potential is load impact (kW/customer). The load impact estimate for each DR program was applied to forecasts of eligible residential customers to calculate technical achievable DR potential. DR market potential technical achievable potential) was primarily estimated based on assumptions for program saturation (availability) and program participation. Ramp rates were used to establish reasonable forecasts of available DR potential. Finally, seasonal shapes were used to estimate each DR program's impact on winter and summer peak loads.

The following sections provide details of the key DR modeling inputs and assumptions.

Demand Response Measure Data

Load Impacts

DR load impacts are primarily based on estimates of load reductions at the end-use consumption level. Regional data describing end-use energy distribution for the residential sector provided the initial inputs for estimating DR program load impacts. System peak impacts for the sector's end-use categories were determined, based on end-use load profiles. End-use impacts were then aggregated to estimate DR program potential per customer (kW/customer).

Load Impact Seasonality

DR resources have a range of seasonal shapes, based on the nature of the technology and levels of effectiveness during different seasons. Some resources are only available, or are most effective, during the summer, such as space cooling DR programs, or winter, such as space heating DR programs. Other resources, such as water heating DR programs, are effective year-round. Seasonal peak demand impacts of DR resources are modeled based on assumptions for seasonal peak capacity percentage values for summer and winter. Seasonal profiles for DR measures are discussed in more detail in the residential customer sector results sections of the demand response potential assessment.

Dispatch Technologies

Two DR program dispatch options were considered for this analysis. One option utilizes traditional means for curtailing loads and the second option makes use of advanced, or 'smart' technologies. The DR programs included in this assessment were modeled for both traditional and advanced deployment. A brief overview of these technologies, as they apply to this analysis,

is provided below. The results section of the demand response potential assessment provides more detail on dispatch options for specific DR programs.

- **Traditional DR Technologies** – Includes Direct Load Control (DLC) programs that utilize traditional switch technologies for load curtailment and curtailable/interruptible tariffs. DLC programs allow a utility to remotely interrupt or cycle electrical equipment and appliances at a customer site. This study evaluated traditional DLC program potential for residential space heating, space cooling and water heating. DLC has historically relied on one-way communicating switches for space heating and cooling DR programs, but utilities are increasingly utilizing more advanced technologies, such as programmable communicating thermostats (PCTs) for these applications.
- **Advanced DR Technologies** – Includes programmable communicating thermostats (PCTs) and automatic water heater controls. PCTs allow utilities to remotely cycle customers’ heating and cooling systems to reduce loads during peak events. The two-way communication capabilities of PCTs provide numerous benefits to operators, including providing feedback and data that may be used to improve reliability of load shedding during peak events. Automatic water heater controls allow for this same type of load management with water heating.

Table 7 summarizes the DR programs evaluated for this assessment. More detail on these programs is provided in the residential customer sector section.

Table 7 Programs Included in the City’s Demand-Response Potential Assessment			
DR Sector	DR Component	DR Technology	Seasonality
Residential	Space Heating	Direct Load Control (DLC) and Programmable Communicating Thermostats (PCT)	Winter Only
	Water Heating	DLC and Automatic Water Heater Controls	Summer and Winter
	Space Cooling – Central Air Conditioning (CAC)	DLC and PCT	Summer Only
	Space Cooling – Room Air Conditioning (CAC)	DLC and PCT	Summer Only

Source: Seventh Northwest Power and Conservation Plan, Table 14-2

Resource Costs

DR resource costs consist of enablement costs and implementation costs. Enablement costs are costs incurred to purchase and install DR technologies. Implementation costs consist of

administrative costs and customer incentives, inclusive of costs incurred to market DR programs and research new DR opportunities, pay program support staff and fund customer incentives.

Net levelized implementation cost calculations include a bulk transmission system expansion deferral credit of \$26/kw-yr. This value is included to account for upgrades and expansion of the bulk transmission system that can be deferred by reducing peak demand and is consistent with the transmission deferral credit used in the City’s CPA cost-effectiveness analysis. Unlike the CPA analysis, however, a distribution system expansion deferral credit is not included in the DR analysis. The NWPC Council’s analysis of DR potential assumes that utility distribution systems would need to be sized to serve customers’ peak demand when DR resources are not dispatched.

The total resource cost is the sum of the levelized enablement cost and the net levelized implementation cost for each DR resource. A four percent discount rate was used in the levelized cost calculations for DR resources, consistent with the discount rate used throughout this IRP. Levelized costs and program costs are discussed in the ‘Levelized Cost’ section of the demand response potential analysis.

Customer and Load Forecasts

Residential housing forecasts from the City’s Base Case Conservation Potential Assessment were used to estimate eligible populations for DR programs. Table 8 shows residential customer forecasts and average annual growth rates over the 20-year planning period.

Table 8 Residential Customer Forecasts					
	20-yr Average Annual Growth Rate	2021	2026	2031	2036
Residential	0.3%	8,236	8,370	8,509	8,607

Estimates of DR load impact, as a percentage of winter and summer peak loads, are based on assumed seasonal peak demands for the City’s service area over the planning period. EES calculated load factors for summer and winter peak loads from the City’s Customer System Peak and Total Retail Load forecasts from BPA’s 2016 TRM Billing Determinants Model. Monthly Total Retail Load forecasts were also used to estimate monthly wholesale energy consumption, based on the retail load forecast used for the City’s Base Case CPA analysis and the utility-provided line loss assumption of 3.0 percent. The monthly load factors were applied to monthly wholesale energy forecasts for winter (January) and summer (July) peak months to estimate seasonal peak demands over the planning period. The City’s baseline winter peak demand in 2036 was estimated at 45 MW and the baseline summer peak demand was estimated at 40 MW. It should be noted that the City’s DR potential is not affected by these data; they are only used to provide a reference for peak load reduction.

Study Uncertainties

- **Measure Data** – DR program costs, savings, availability, participation, ramp rates and other resource attributes are based on a range of data resources, which inherently carries a level of uncertainty. In some cases, DR resource inputs were estimated based on limited data and/or assumptions based on the professional judgement of Navigant Consulting and other parties. In addition, though the NWPC Council considers the DR resource inputs used in this assessment to be representative of the region and available DR technologies, actual DR program attributes vary depending on service area climate, customer usage patterns, appliance size, etc. Finally, costs and load impacts for each installed DR resource are static over the 20-year planning period and therefore do not account for market availability of new or improved DR technologies.
- **Customer Growth Forecasts** – This analysis bases DR potential on customer growth forecasts, by sector, for the period: 2017 to 2036. Actual customer growth may differ from these assumptions, particularly in the later years of the planning period.

Demand Response Potential

Table 9 summarizes estimates of the City’s technical-achievable DR potential for the 20-year planning period. By 2036, the estimated impact of DR programs is approximately 1.8 MW during the winter and 1.2 MW during the summer. The bottom row of Table 9 shows DR load curtailment as a percentage of estimated summer and winter peak demand for the City’s system.

Table 9 Residential Technical-Achievable Load Impact								
	2021		2026		2031		2036	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
Load Impact (kW)	1,489	1,003	1,781	1,200	1,810	1,220	1,831	1,234
Load Impact (%)	3.5%	2.6%	4.1%	3.1%	4.1%	3.1%	4.1%	3.1%

The above estimates consider applicability and participation factors taken from the NWPC Council’s analysis.

Advanced DR programs account for approximately 2.0 percent of winter load impacts and 1.3 percent of summer load impacts. Standard technology DR programs account for approximately 2.0 percent of winter load impacts and 1.9 percent of summer load impacts.

Figure 13 shows annual technical-achievable DR potential by program category, inclusive of winter and summer demand impacts. DR acquisition schedules, developed by Navigant for DR resource assessment in the Seventh Plan, assume that potential DR acquisition grows steadily over the first five years of the planning period then reaches a constant state of modest growth through the remaining years.

Figure 13
Annual Technical Achievable DR Potential by Program Category

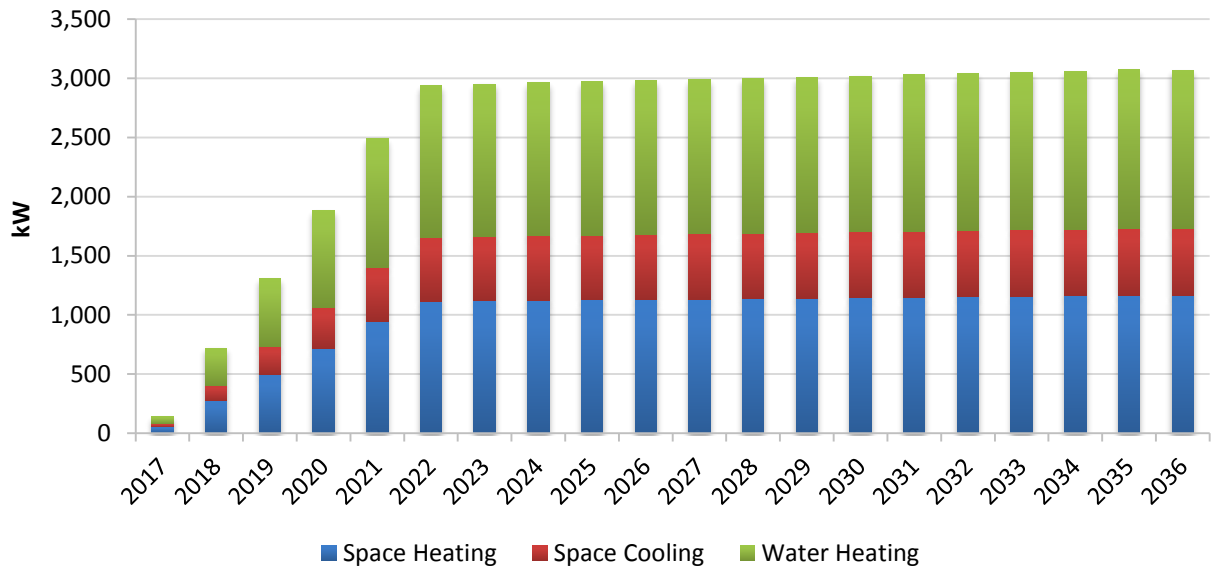


Table 10 shows the residential DR program categories evaluated for this assessment as well as their associated load impacts (kW/customer) and load impact seasonality values (% applicability). As expected, space heating programs impact winter peak loads and space cooling programs impact summer peak loads. Water heating programs are the only residential DR programs evaluated for this assessment that have the potential to reduce loads year-round. As previously noted, space heating DR load impacts per customer are the most significant among the residential DR programs.

Table 10
Residential DR Programs – Load Impact and Seasonality Inputs

DR Component	Load Impact (kW/customer)	Load Impact Seasonality	
		Winter	Summer
Space Heating – DLC	1.74	100%	0%
Space Cooling – CAC DLC	0.60	0%	100%
Space Cooling – RAC DLC	0.27	0%	100%
Water Heating – DLC	0.58	100%	100%

CAC = Central air conditioning; RAC = Room air conditioning

DLC is the most widely deployed type of DR program. Utilities generally use DLC for load shedding during peak events, but may also curtail loads to avoid high on-peak electricity purchases. DLC programs typically limit the number of times or hours that a program participant's appliance, equipment or system can be remotely turned off per year. A fixed monthly incentive is generally offered for participation in DLC programs. Technical-achievable DR program potential for the City's residential sector is shown in Table 11. The DR potential shown in Table 11 includes basic and smart technology deployments.

Table 11 Technical-Achievable Potential – Residential (kW)								
	2021		2026		2031		2036	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
Space Cooling - CAC DLC	0	346	0	413	0	420	0	425
Space Cooling - RAC DLC	0	114	0	136	0	138	0	140
Space Heating - DLC	945	0	1,130	0	1,149	0	1,162	0
Water Heating - DLC	544	544	651	651	661	661	669	669
Total Load Impact	1,489	1,003	1,781	1,200	1,810	1,220	1,831	1,234

The most significant area of load shedding due to residential DR programs is space heating. This study estimates that 1,162 MW of winter load reduction may be achieved through these programs over the 20-year study period. Residential space heating DR accounts for approximately 64 percent of the sector's winter load impact. Residential space cooling DR accounts for nearly 46 percent of the total summer load impact. Water heating DR potential accounts for 37 percent of the sector's winter potential and 54 percent of residential summer potential. Residential water heating DR programs make up approximately 44 percent of the total annual peak load reduction potential.

DLC programs have traditionally relied on one-way remote switches to shut off or cycle customer equipment but, with the recent market availability of more sophisticated load control technologies, residential DLC programs are trending toward offering programmable communicating thermostats (PCTs) for space heating and cooling DR programs and water heater controls for water heating DR programs. Advanced DR technologies utilize two-way communications, which can increase the reliability of load management during peak events by allowing operators to verify that installed DR technologies are functioning properly and get feedback from DR events to improve predictions of load shedding for future events.

Both standard technology (switch) and smart technology (PCT and water heater controls) deployments were evaluated for each of the DR components shown in Table 12. Figures 14 and Figure 15 show annual residential DR potential load impacts for winter and summer, respectively. Winter potential is split nearly evenly between traditional DR technologies (52 percent) and advanced DR technologies (48 percent). Traditional DR accounts for 60 percent of summer load impacts.

Figure 14
Technical-Achievable Residential DR Potential by Program – Winter

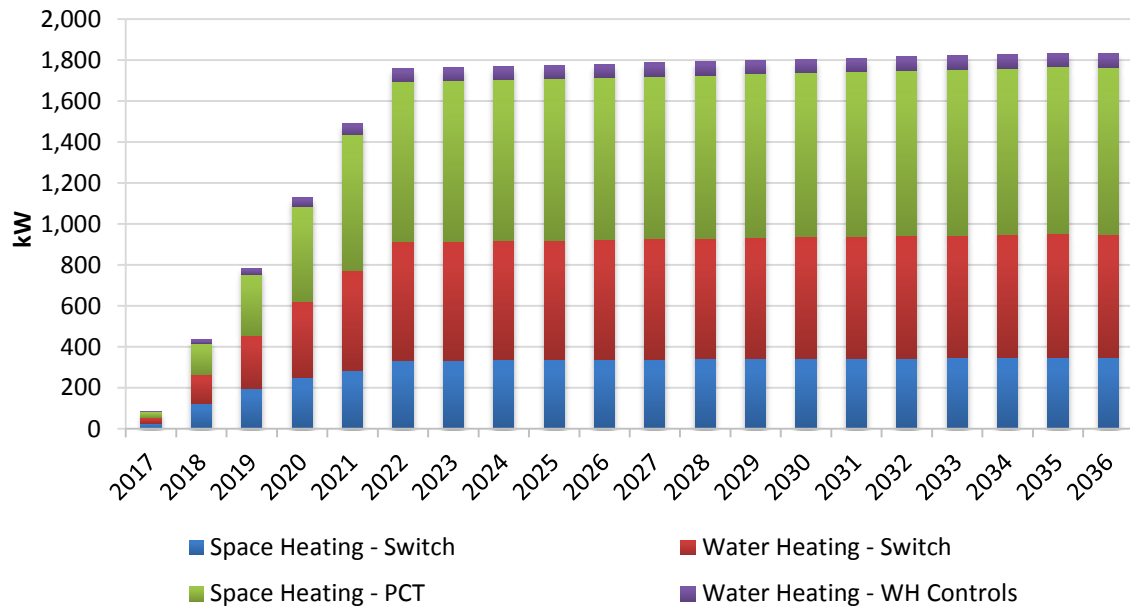
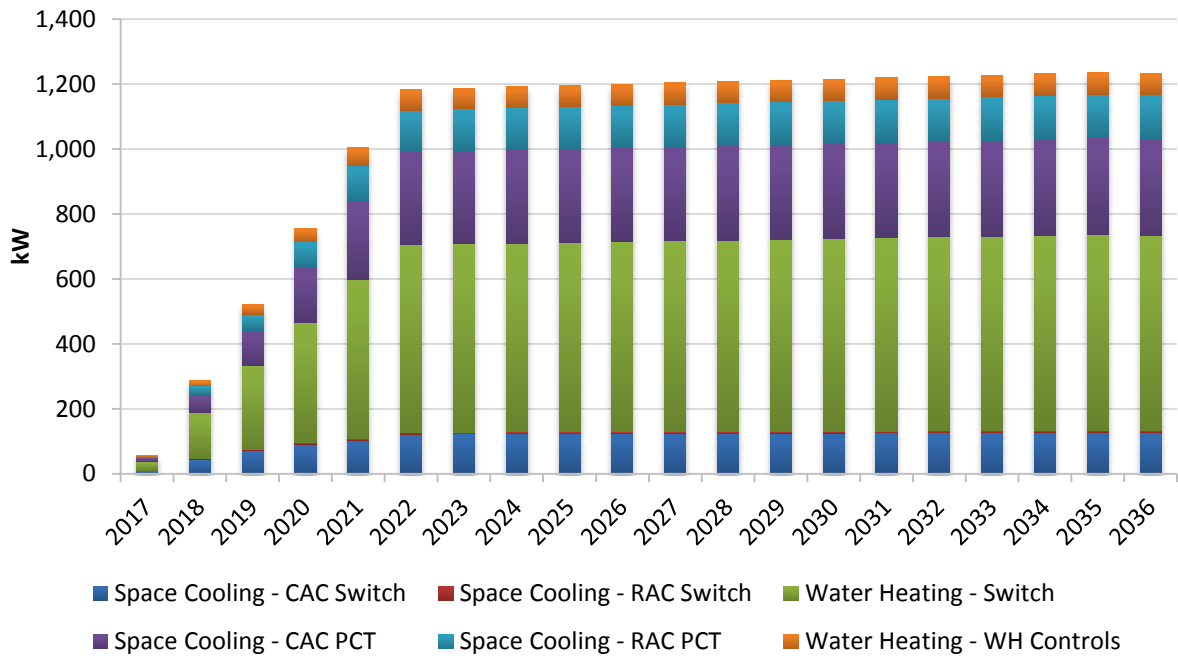
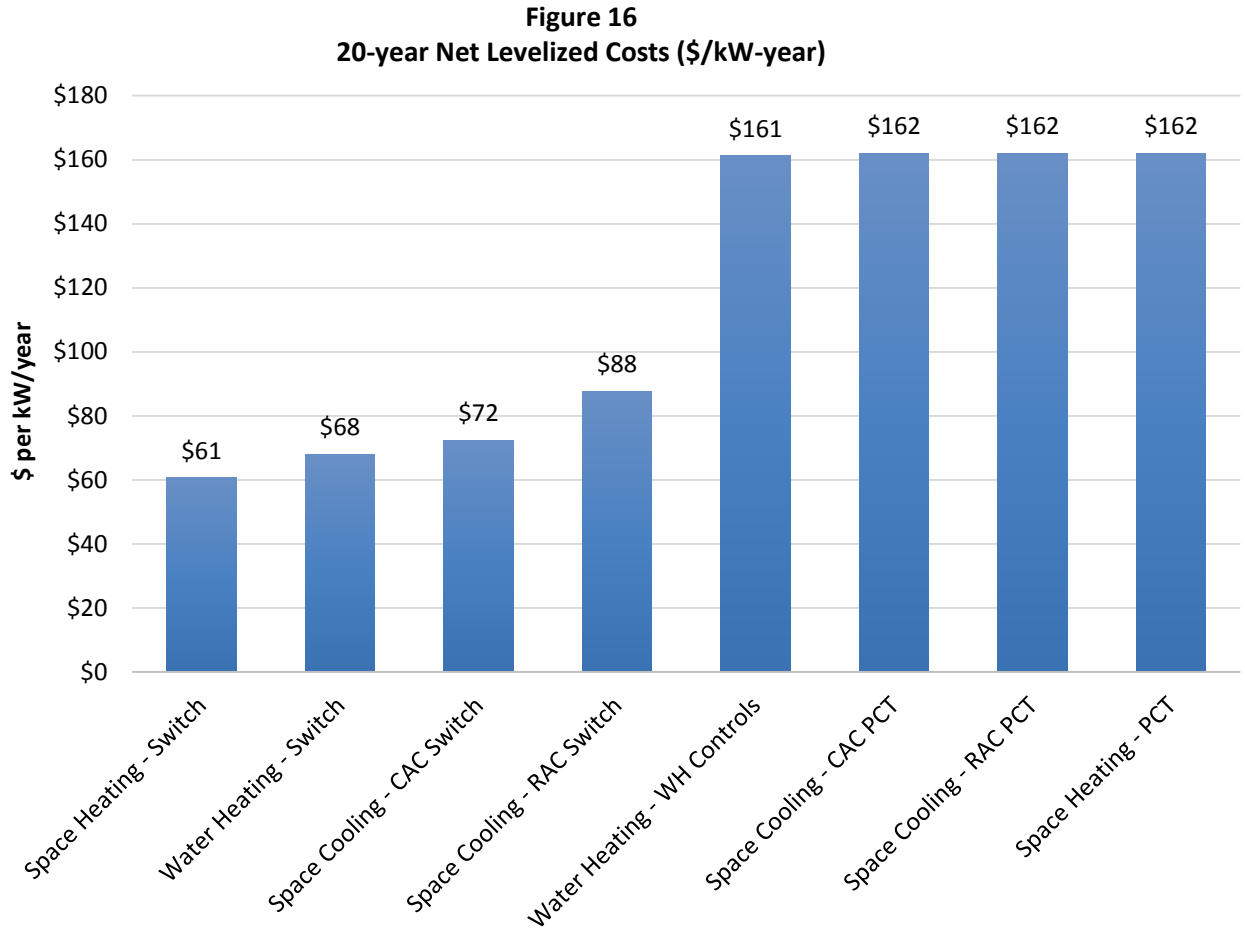


Figure 15
Technical-Achievable Residential DR Potential by Program – Summer



Levelized Costs

Figure 16 shows the 20-year net levelized costs for the DR resources evaluated in this analysis. The costs shown in Figure 16 represent the total resource costs of the DR programs, levelized over the 20-year planning period. The TRC levelized cost includes two primary components: implementation costs and enablement costs. Implementation costs are the costs associated with running a DR program, inclusive of staffing costs, marketing and customer incentives. Enablement costs include the capital costs of DR technologies and installation costs. Implementation costs are applied to all participants and enablement costs apply to new participants only. The net levelized implementation costs include a transmission deferral credit of \$26 per kilowatt year to account for the value of transmission system expansions and upgrades that may be deferred by reducing peak demand through DR programs. As shown in Figure 16, smart DR technologies are more expensive than basic technologies.



The TRC levelized costs range from \$61 to \$162 per kilowatt year. Similar to conservation programs, residential DR programs are generally more expensive than programs in other customer sectors, due to the relatively high recruitment costs and high technology and installation costs, compared with program impact.

Figure 17 shows levelized costs without the transmission deferral credit. Since deferred costs for transmission system expansion and upgrades do not directly benefit the City, the costs shown in Figure 17 represent the City's estimated net program costs for the DR potential results in this assessment.

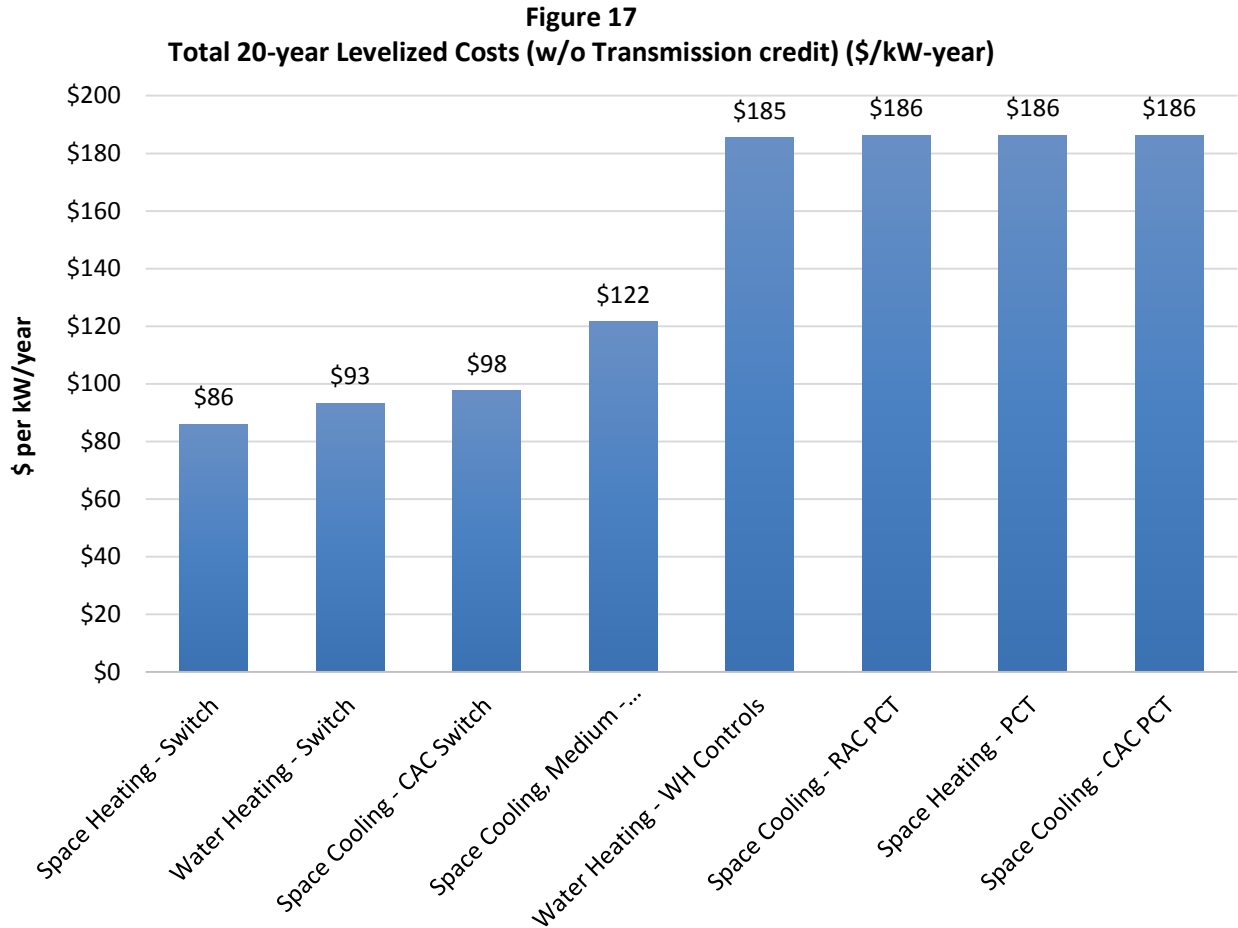


Table 12 shows rounded estimates of program costs by sector for the DR potential estimated in this assessment. The costs in Table 12 do not include the transmission deferral credit. The bottom row of Table 12 shows the total program costs throughout the planning period. The annual average program cost for DR acquisition in this assessment is approximately \$42,600.

Table 12 Demand Response Program Costs (2015\$)				
	2021	2026	2031	2036
Residential				
Enablement Costs	\$ 26,201	\$ 26,640	\$ 27,015	\$ 27,015
Implementation Costs	\$ 27,241	\$ 26,768	\$ 22,367	\$ 18,597
Total Program Cost	\$ 53,442	\$ 53,408	\$ 49,383	\$ 45,612

Power Supply Savings

The DR potential and program costs discussed in this study have not yet considered whether the DR programs are cost-effective for the City. In order to evaluate cost-effectiveness, the City's wholesale power supply costs with and without DR programs are estimated and compared with the cost of the programs. For the wholesale power supply cost estimate, a TRM model was developed using monthly forecast of peak demand and energy for the City. The cost-effectiveness analysis assumes that all residential DR potential is achieved by 2018, a time when rates and resources are well-known. Monthly peak demand for November through February is reduced by 1.8 MW and summer peak demand for July through September is reduced by 1.2 aMW. The resulting wholesale power supply costs are provided in Table 13 below.

Table 13 Demand Response Program Impact on Wholesale Power Supply Costs CY 2018			
	No DR Programs	DR Programs	Difference
<u>Breakdown of Power Supply Costs</u>			
BPA Customer Charges	\$7,596,633	\$7,596,633	\$0
Demand - BPA Contracts	\$598,759	\$487,592	\$111,168
Load Shaping, HLH	(\$332,706)	(\$332,706)	\$0
Load Shaping, LLH	\$8,653	\$8,653	\$0
Tier 2 Purchase (Energy)	\$808,321	\$808,321	\$0
Customer Refund	(\$307,300)	(\$307,300)	\$0
<u>Break-down of Transmission/Ancillary Costs</u>			
Energy	\$153,521	\$153,521	\$0
Demand	\$0	\$0	\$0
Coincident Transmission Peak-Demand	\$845,742	\$822,837	\$22,904
Total Wholesale Power Supply Costs	\$9,371,622	\$9,237,551	\$134,072

It is estimated that DR program potential may reduce the City's demand and transmission bills by approximately \$134,000 per year when full potential is realized (assuming 2018 rates). The analysis above assumed that peak demand would be reduced for 3 summer months and 4 winter months. The 20-year levelized program costs are estimated \$56,000 resulting in benefit/cost ratio of 2.4. If the City is only able to reduce peak demand for one winter month and one summer month, the power bill savings total \$92,000 per year. In this scenario, the benefit/cost ratio for the program is 1.6.

Summary

This assessment evaluated residential demand response program potential for the City of Ellensburg's service area for the period 2017 to 2036. The residential DR programs evaluated for

this analysis are based on DR programs evaluated for the Seventh Power Plan. This assessment estimates that approximately 1,830 kW of winter load shedding and 1,230 kW of summer load shedding may be available from residential DR programs over the 20-year planning period. This potential represents 4.1 percent of the City's estimated winter peak demand and 3.1 percent of summer peak demand and is cost-effective based on the avoided cost of power supply.



AGENDA REPORT

Meeting Date:	November 18, 2021
Agenda Subject:	Natural Gas Rate Stabilization Fund Discussion
Submitted by:	Darren Larsen Public Works & Utilities
Recommended Action or Motion:	For discussion with potential action or motion to determine a gas rate threshold in which the gas rate stabilization fund is utilized to minimize future rate impacts.
Background/Summary:	During the extreme cold event in the middle of February 2021 that occurred through the Midwest south through Texas, the city was able to sell off fixed natural gas contracts and storage reserves in the Rocky Mountain basin and back fill with lower cost gas from the North. This amounted to \$2,533,590 in net proceeds to the gas utility.
Previous Council Action:	The Utility Advisory Committee considered this natural gas sale at their April 15, 2021 meeting. After discussion, the Utility Advisory Committee recommended City Council direct half of the proceeds be placed in Gas Division reserves to reduce future upward rate pressure by financing capital/maintenance projects and establish a rate stabilization account for the other half to be used to minimize future rate impacts from an extreme weather event or other increases in costs to our customers. At the May 3, 2021 City Council Meeting, City Council directed half of the proceeds from the February 2021 natural gas sale be placed in Gas Division reserves for financing capital/maintenance projects and establish a rate stabilization account for the other half, and approve the necessary budget adjustments.
Analysis:	The Utility Advisory Committee considered this natural gas sale at their April 15, 2021 meeting. After discussion, the Utility Advisory Committee recommended City Council direct half of the proceeds be placed in Gas Division reserves to reduce future upward rate pressure by financing capital/maintenance projects and establish a rate stabilization account for the other half to be used to minimize future rate impacts from an extreme weather event or other increases in costs to our customers. Staff will present more detailed cost information such as average gas purchase prices versus the price spikes that both cost Ellensburg ratepayers and that led to the surplus for Ellensburg ratepayers earlier

in 2021.

Financial Impact:

A credit to the gas utility in the amount of \$2,283,981; \$2,533,590 in net proceeds less \$249,609 in combined City and State utility taxes. A budget adjustment was made to increase 2021 expenditure authority for utility taxes.



AGENDA REPORT

Meeting Date:	November 18, 2021
Agenda Subject:	Reecer Creek Levee System O&M Plan.
Submitted by:	Jon Morrow Public Works & Utilities
Recommended Action or Motion:	Information only
Background/Summary:	Council approved the Inter Local Agreement with Kittitas County Flood Control Zone District to receive funds for: • The City's consultant Aspect Engineering wrote a technical floodplain certification memorandum (not attached), which includes the O&M plan (attached) and a geotechnical report (not attached). • This report now goes to the County and their consultant to write a conditional letter of map revision (CLOMR) and then to FEMA for review. • The O&M plan is the only part of the technical memorandum that needs Council approval as this is a FEMA requirement for certification. • If the CLOMR get's approved by FEMA, then next steps are to write a letter of map revision (LOMR) to get the new levee and existing levee certified so businesses and homeowners on the back side are no longer in the floodplain.
Previous Council Action:	Council approved the Inter Local Agreement with Kittitas County Flood Control Zone District to receive funds for the bullet points in background/summary.
Analysis:	Due to timeframe, approval of the plan already went before City Council on the November 15, 2021 Consent Agenda.
Financial Impact:	None
Attachments:	Reecer Cr Levee System O&M Plan 21_Oct.pdf



REECER CREEK LEVEE SYSTEM OPERATION AND MAINTENANCE PLAN

October 2021

IMPORTANT QUICK REFERENCE INFORMATION CONCERNING THIS PROJECT:

1. PROJECT NAME: Reecer Creek Levee System
2. RIVER: Reecer Creek (Tributary to the Yakima River)
3. PROJECT LOCATION
CITY/COUNTY: Ellensburg / Kittitas
TOWNSHIP/SECTION: Township 18 / Section 34
4. PUBLIC SPONSOR: City of Ellensburg
CONTACT RESPONSIBLE FOR O&M: Jon Morrow
TELEPHONE NUMBER: (509) 925-8619
EMAIL: morrowj@ci.ellensburg.wa.us
1. ARMY CORPS OF ENGINEERS DISTRICT OFFICE
LOCATION: Seattle
TELEPHONE NUMBER: (206) 764-3406
2. EMERGENCY POINT OF CONTACT FOR THE ARMY CORPS OF ENGINEERS
NAME: Doug Weber
TELEPHONE NUMBER: (206) 764-3406
EMAIL: douglas.t.weber@usace.army.mil
3. COUNTY EMERGENCY OPERATIONS CENTER: Kittitas Co. FCZD
4. STATE EMERGENCY OPERATIONS CENTER: WA Dept. of Ecology

PREFACE

This Operation and Maintenance Plan (Manual) applies to both the existing levee and, once constructed, will apply to the new levee. The Manual is intended to meet the requirements of CFR 65.10 (c) Operation Plans and CFR 65.10(d) Maintenance Plans in support of levee accreditation by FEMA.

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APPENDIX E: Rehabilitation Request Form

APPENDIX F: Cooperation Agreement for Rehabilitation of Non-Federal Flood Control Works

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APPENDIX H: Cooperation Agreement for Advance Measures Assistance

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1. INTRODUCTION

1.1 Purpose of This Manual

The purpose of this Manual is to provide the City of Ellensburg (public sponsor) with a single reference that describes proper operation and maintenance of the Reecer Creek Levee System and outlines the types of assistance the U.S. Army Corps of Engineers (Corps) can provide before, during, and after a flood. This manual provides information regarding the Corps' Rehabilitation and Inspection Program (RIP) and explains the minimum standards for operation and maintenance that the Corps requires of non-federal flood control projects, in order for them to be eligible for the Corps' rehabilitation assistance after a flood. The procedures described are considered to be the minimum guidelines for proper maintenance of any flood control project.

1.2 Scope of This Manual

This Manual is intended for use by the public sponsor for the Reecer Creek Levee System. Corps inspections may address specific features that aren't specifically covered in this manual. For supplementary information on the operations and maintenance of Corps programs, specific features of this project, or specific situations, please contact the City of Ellensburg or the Corps district's Emergency Management Office.

1.3 Supporting and Related Laws and Regulations

In addition to presenting practical guidance on the operation and maintenance of the Reecer Creek Levee System, this manual gathers together a lot of information from official laws and Corps regulations. Though every effort was made to present this information as accurately as possible, this manual itself is not meant to establish policy or official guidance. For additional details on the policies described and to find the actual wording given in the laws and regulations summarized in this manual, the reader is referred to the following documents:

a. Public Law (PL) 84-99

This is the federal law which gives the Corps the legal authority to supplement local efforts in the repair of flood control projects that are damaged by floods. It can be found on the web at <http://uscode.house.gov>. Click on the link to “Search the US Code.” Search for title “33” and chapter “15”. Look through the search results, and the current form of PL 84-99 will be listed as 33 USC 701n.

b. Title 33, Code of Federal Regulations, Part 203 (33 CFR 203)

This federal regulation establishes the Rehabilitation and Inspection Program (RIP), describes the types of assistance the Corps can provide, and describes the general operation, maintenance, and disaster preparedness that is expected of non-federal flood control works. The current version of the CFR can be accessed through the CFR main page, <http://www.gpoaccess.gov/cfr/index.html> Select “Browse and/or search the CFR,” then scroll down to the current version of Title 33, (Navigation and Navigable Waters). Browse parts 200-399; then open part 203.

c. Title 33, Code of Federal Regulations, Part 208 (33 CFR Part 208):

This federal regulation provides more specific details on the operation and maintenance required of Federally constructed FCWs. This regulation provides a guideline for O&M, but doesn’t provide the level of detail regarding specific requirements that the Levee Owner’s manual does. The current version of the CFR can be accessed through the CFR main page, <http://www.gpoaccess.gov/cfr/index.html> Select “Browse and/or search the CFR,” then scroll down to the current version of Title 33, (Navigation and Navigable Waters). Browse parts 200-399; then open part 208.

d. Engineer Regulation (ER) 500-1-1

This Corps-wide regulation expands on the previously mentioned laws and regulations, provides basic information on the Corps’ implementation of Public Law 84-99. Chapter 5 of ER 500-1-1 details the RIP program. Any discrepancies or conflicts that occur between the Levee Owner's Manual and ER 500-1-1 will be resolved based on the content of ER 500-1-1. This document can be found on the web at <http://www.usace.army.mil/inet/usace-docs/eng-reggs/er500-1-1/toc.htm>

e. Engineer Pamphlet (EP) 500-1-1

This Corps-wide pamphlet provides further detail on how the ER will be applied practically. It establishes the Inspection Guide and other applicable forms that are listed in the appendices to this manual. Any discrepancies or conflicts that occur between the Levee Owner's Manual and any EP or ER will be resolved based on the content of the ER or EP, and any discrepancies or conflicts that occur between the EP and the ER will be resolved based on the content of the ER. EP 500-1-1 can be found on the web at <http://www.usace.army.mil/inet/usace-docs/eng-pamphlets/ep500-1-1/toc.htm>

f. Engineer Manual (EM) 1110-2-1913

This manual provides the Corps of Engineer's guidelines for engineering design and construction of levees. The document can be found at

<http://www.usace.army.mil/inet/usace-docs/eng-manuals/em1110-2-1913/toc.htm>

g. Engineer Manual (EM) 1110-2-301

This manual provides guidelines for landscape planting at Floodwalls, Levees, and Embankment Dams. This document provides additional clarification as to which types of vegetation are acceptable on and around flood control works. This can be found at

<http://www.usace.army.mil/inet/usace-docs/eng-manuals/em1110-2-301/toc.htm>

h. Engineer Manual (EM) 1110-2-2705

This manual provides guidance on the design of closure structures for local flood control projects. It can be found on the web at

<http://www.usace.army.mil/inet/usace-docs/eng-manuals/em1110-2-2705/toc.htm>

i. Engineer Manual (EM) 1110-2-1205

This manual provides information regarding environmental engineering for flood control channels. This EM can be found at

<http://www.usace.army.mil/publications/eng-manuals/em1110-2-1205/toc.htm>

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2. MAINTENANCE OF PROJECT FEATURES

2.1 Introduction

All flood control works (FCWs) must be properly maintained to provide the protection for which they were designed. The City is responsible for ensuring that the FCW is properly maintained and will protect lives and property. Even if there are sub-agreements with local landowners who routinely perform project maintenance, these landowners are not ultimately responsible for the operations and maintenance of the FCW. If landowners fail to perform needed maintenance or correct deficiencies on their property, it's the City's duty to ensure that the maintenance and repairs are completed. Proper maintenance of the FCW must be taken very seriously, and local plans and budgets need to be structured so that the maintenance of each project feature is carried out on a regular and continual basis. In addition to providing for usual operations and maintenance expenses, this budget needs to account for the replacement of more expensive project components such as pumps, motors, gates, and corrugated metal pipes as they age and come to the end of their design life.

This chapter identifies many of the activities that are necessary to maintain flood control works. The following sections provide maintenance recommendations, requirements, and examples of the types of deficiencies that will reduce the project's eligibility status within the Rehabilitation and Inspection Program (RIP), which is described in chapter 6. To avoid confusion between the baseline requirements that the U.S. Army Corps of Engineers has established for inclusion in the RIP and the additional suggestions and recommendations that are provided in this chapter, please refer to the Corps' Inspection Guide, found in Appendix C. The Inspection Guide is used in Corps inspections of all non-Federally constructed FCWs, and lists the specific requirements for inclusion in the RIP. This listing is not all-inclusive and some Corps districts may specify additional requirements based on local conditions. More information on Corps inspections is provided in chapter 7.

Note that many of the pictures in this chapter are labeled with the words "*ACCEPTABLE*", "*MINIMALLY ACCEPTABLE*" and "*UNACCEPTABLE*." The ratings are provided here along with the pictures in order to give you a better understanding of the standards that the Corps uses while inspecting flood control works across the country. The ratings given are the ones that a Corps inspector might assign to the project feature if it was observed during a routine inspection. A definition of these ratings is provided in chapter 7.

2.2 Erosion (Applicable to all FCWs)

a. Types of Erosion

There are several types of erosion that effect FCWs. For example, the slopes of any embankment can become eroded from rain runoff, as shown in Figure 2.1 or by embankment overtopping, as in Figure 2.2. Depending on the extent of the erosion, the level of protection provided by the FCW can be significantly reduced. In cases of embankment overtopping during a flood, there may be a total failure of the structure.

A second type of erosion often seen on embankments is wave wash. Under high water conditions, wave action can form long terraces along the length of the embankment slopes. If additional material or bank protection is not provided, the embankment will continue to cave as the waves work their way farther into the slope. Further discussion on the treatment of wave wash is provided in Appendix D of this manual.

A third type of embankment erosion is caused by the flow of water within a river or channel. These flows can erode a channel bank or levee, or undermine other flood control structures and cause them to cave into the water. Bank caving or stream bank erosion can be a very serious threat to the stability of an FCW. It's critical that the riverward bank be inspected for bank caving or erosion. If the river or stream bank erosion or caving is observed to be moving in the direction of a levee or floodwall, immediate action should be taken to stabilize the banks.

b. Repair of Areas Damaged by Erosion

All erosion gullies like those pictured in 2.1 need to be repaired to prevent further erosion and more significant damage during high water. The ground

should be scarified and backfilled with the same type of material that the levee is made of. The backfill material should generally be placed in 6 inch layers and compacted mechanically or by hand, in order to restore the original shape of the levee. Additionally, since this erosion is typically a reoccurring problem, something should be done to improve the drainage and prevent further erosion in the area. Consideration



Figure 2.1 Erosion of levee slope. (TX)



Figure 2.2 Flood damage. (WA)



Figure 2.3 Slope failure on bank protection project. (WA)

should be given to installing drainage channels or appropriately sized rock, and areas of the levee that remain exposed should be reseeded and mulched. Please refer to section 2.7, below, for details on the placement of riprap. In extreme cases of channel/ bank erosion, a relocation or setback of the levee may be the only economical solution.

2.3 Encroachments (Applicable to all FCWs)

Excavations, structures, or other obstructions present within the project easement area are generally prohibited. Fencing that prohibits access along the crown of the levee is prohibited. Where access control is needed, the public sponsor should install gates that will allow continued access along the crown of the levee for surveillance and flood fight activities. The Corps may make certain exceptions to this rule, provided the encroachment does not impact the operation, maintenance, or structural integrity of the project. Figures 2.5 through 2.14 are examples of common encroachments that should not be permitted.



Figure 2.4 *ACCEPTABLE.* Landowner has not encroached on levee easement area and has stayed back 10 - 15 feet. (MN)



Figure 2.5 *MINIMALLY ACCEPTABLE.* Field encroaches on levee easement. The landowner has tilled the soil right to toe of the levee, and was requested to stay back at least 10 feet. (ND)



Figure 2.6 *UNACCEPTABLE* levee encroachments. This landowner tilled near one third of the way up the landward levee slope. (MN)



Figure 2.7 UNACCEPTABLE levee encroachments. Utility poles in levee embankment. (IN)



Figure 2.8 UNACCEPTABLE encroachment. Piping for lawn irrigation system drilled through levee without approval. (ND)



Figure 2.9 UNACCEPTABLE encroachments on earthen levee. Fallen woody debris requires removal. (KS)



Figure 2.10 UNACCEPTABLE, unapproved encroachment. Material stockpiled against the levee. (OK)



Figure 2.11 UNACCEPTABLE encroachment. Residential and rural fences crossing the levee. (ND)



Figure 2.12 UNACCEPTABLE, unapproved encroachment on levee easement (fencing). (OK)



Figure 2.13 UNACCEPTABLE encroachment. Gardens and compost bins located on levee crest and riverward slope. (ND)



Figure 2.14 UNACCEPTABLE encroachment. Patio construction using railway timbers and fill without approval. (ND)

2.4 Slope Stability (Applicable to all FCWs)

Some earthen materials tend to become saturated with water very easily. When this happens, they lose stability and can't support their own weight. If a stream or river embankment is composed of these materials, the embankment will slump off and move down the slope into the river, causing a bulge at the base of the slope. When river banks break down like this, they are said to have slope stability problems and need to be repaired. Slope failures can lead to serious problems, especially if the failure occurs near a levee or floodwall. Figures 2.15 through 2.17 show examples of slope stability problems.



Figure 2.15 UNACCEPTABLE. Slope failure and erosion caused by inadequate channel bottom and side slope protection. This was a direct result of bottom scouring that undercut the levee slope and erosion caused by turbulent flow at the end of the bank protection. (ND)



Figure 2.16 UNACCEPTABLE. Slope failure and erosion on a channel improvement project. (MN)

Levees, like riverbanks, are subject to the same soil saturation effects during a flood or period of heavy rainfall. Levees are generally less susceptible to slope stability problems because of the materials they are made of and because of their shallow slopes. However, slope failures have occurred during prolonged periods of high water or heavy rainfall. Figure 2.16 shows an earthen embankment that failed as floodwaters receded. While slope failures will generally occur on the riverward slope of a levee, be aware that slope failures on



Figure 2.17 UNACCEPTABLE earthen embankment failure. (MN)

landward slopes are also possible. A levee should be carefully inspected for slope stability problems after these events.



Figure 2.18 *Classic picture of a tree causing slope failure. (WA)*

A related slope failure/ stability problem involves trees growing on or near the channel or levee slopes. It's very important to prevent tree growth near levee or channel embankments, because when the roots of these trees decay they leave voids in the soil, which allow water to quickly saturate the slope and cause a slope failure. Trees can also be uprooted and deflect flood flows into the embankment, accelerating the erosion of the bank.

The classic signs of slope stability problems are listed below, and you should watch for these signs during routine inspections.

- a. Wide deep cracks that parallel the riverbank or levee crest. In the case of levees, these cracks may also extend down the slope of the levee.
- b. Vertical movement of the material along the crack. Remember that this movement may be very obvious like in Figures 2.16 or 2.17, or very subtle if the stability problem is just starting to develop.
- c. If the slope has slumped or is starting to slump, examine the area along the toe of the embankment. In many cases there will be a noticeable bulge in the slope or riverbank.

Please also refer to section 2.9 for further discussion on levee cracking.

Deep seated sliding often requires the removal and replacement of that section of the levee or river slope, and the stabilization of the area with a soil or rock berm. If you identify signs of a developing slope stability problem, it is very important that you contact your local Corps district office for an investigation and to get technical assistance as to the best way to repair the problem.

2.5 Removal of Debris (Applicable to all FCWs)

Any accumulations of drift, grass clippings, and other objectionable materials deposited on the riverward side of any FCW or along the crown and side slopes of a levee must be removed and disposed of at suitable locations outside of the floodway. When debris collects in a flowing



Figure 2.19 UNACCEPTABLE erosion of river channel, caused by a log jam. (ND)

channel, it can deflect the water towards the channel bank, causing significant damage to the FCW. Figure 2.19 shows the result of what started out as a beaver dam that was not removed, which expanded into a log jam. Before this log jam was removed, both the inside river bank and the levee experienced severe bank erosion. Log jams have endangered bridges and railway crossings, and they lead to higher flood crest elevations upstream of the obstruction.

One common problem experienced along urban levees is that the residents pile lawn clippings and yard waste on the riverward side of the levee. This practice should not be allowed because the clippings will kill the grass cover that protects the levee. During a flood, the debris gets washed away, exposing the levee material to erosion.

2.6 Animal Control (Applicable to all FCWs)

Close attention must be given to the presence of burrowing animals, since they may not be readily detected without a thorough inspection. Burrows created by gophers, muskrats, opossums, badgers, and other animals can lead to rapid levee failures during floods. For this reason, an active animal abatement program needs to be implemented to remove these animals. Rodent control techniques involving fumigation, bait stations, bait broadcasting, or

trapping have proven effective in certain situations, but you should always contact your



Figure 2.20 Animal burrow in a levee. (IA)

state's Fish and Game Agency, Department of Natural Resources, or Wildlife Agency to determine which rodent control procedures are allowable and recommended in your area.

Inspections to detect the presence of burrowing animal activity are generally most effective immediately after the levee has been mowed. Animal burrows that are identified should be thoroughly excavated and inspected, backfilled with compacted soil that is similar to material

of the levee, and reseeded. This will avoid the possibility of water piping through unfilled portions of the burrows during a flood.

Beavers pose an additional concern in streams and channel improvement projects. They have been known to cause problems by building dams, blocking culverts, and by burrowing into the stream bank to create a den. When beaver activity is noted, the beaver should be removed and the dam and blockages removed. Failure to correct the problem may result in increased bank erosion and slope stability problems in the area of the beaver den during periods of high water.



Figure 2.21 Beaver dam. Such dams can stop flow within the channel and cause erosion to the channel banks. Sponsors are encouraged to remove beaver dams ASAP. (ND)



Figure 2.22 Beavers attempting to block the culvert passing through a gated embankment. (MN)

2.7 Riprap Revetments and Banks (Applicable to all FCWs)

As shown in Figure 2.23, riprap can be a very effective method for protecting a riverbank or flood control feature from erosion. However, if the riprap protection is not placed correctly, it can cause eddy currents to erode unprotected areas of the bank upstream or downstream of the project, as shown in figure 2.24.



Figure 2.23 Flood damage on a naturally protected bank, as compared to damage on an adjacent bank which was protected with riprap. (Note that even though the riprap clearly protected the area during the flood, if it was observed an inspection it would have probably been rated Minimally Acceptable because the grass would have prevented an inspector from properly examining the riprap.) (WA)



Figure 2.24 Channel erosion located at the upstream end of a flood control levee protected by riprap. Erosion caused by riprap protection and eddy currents. (MN)

For riprap protection to be effective, it's important to ensure that it is properly maintained. During project inspections, look for settled areas that may indicate the riprap is being undermined by the river, ice, or debris. When undermining or rock displacement occurs, additional rock will need to be added to restore the even slope. When the rock protection is uneven the flow turbulence will increase, resulting in additional erosion of the project or of areas upstream or downstream of the project.

The protected area needs to be kept free of unwanted brush, saplings, and trees. Unwanted vegetation should be sprayed with an appropriate herbicide to kill the plant, and the root system should be removed. Failure to control the sapling and tree growth can result in the trees being uprooted during a flood, displacing the riprap and increasing the rate of erosion.



Figure 2.25 *ACCEPTABLE* riprap for erosion control. (MT)



Figure 2.26 *ACCEPTABLE* riprap for erosion control. (NE)



Figure 2.27 *MINIMALLY ACCEPTABLE*. Trees and saplings are becoming established within riprap-protected areas and along the lower portions of the river channel, and must be removed. (ND)



Figure 2.28 *UNACCEPTABLE*. Tree and sapling growth is well established within the riprap protection on an earthen levee. This overgrowth must be removed. (MO)

Any areas of stone riprap that have settled, moved, or been damaged by erosion should be filled in with hard, durable rock of suitable size or with a six-inch filter-blanket layer or a layer of geotextile fabric under the stone riprap, between the soil and the rock. These sublayers allow the water to pass from the soil, yet prevent the fine soil from washing out from under the

stone riprap. It's very important that you contact the Corps for technical assistance when installing geotextile fabrics, as the Corps has significant experience in installing riprap over geotextile fabric, and can help you to avoid complications with the process.

When selecting stone for riprap, choose durable rock that's insoluble in water. Stratified or easily crumbled rocks such as shale, or rocks such as claystones that are likely to decompose in water are not good for riprap. Stone for riprap should be block shaped with a specific gravity of at least 2.5. Smooth rounded stone or flat, thin, elongated and slab stones are not recommended. As a general rule, no more than 25% of the stones distributed throughout the gradation should have a length more than 2.5 times longer than the other dimensions, and none of the stones should be 3 times longer than their width or thickness.

Grouted riprap should be avoided unless it is absolutely necessary. The surface of grouted riprap can look perfectly fine until the bond between the grout and the rock fails. Grouted riprap can fail suddenly if it is undermined, and this can lead to unexpected and catastrophic failure of the slope. Other objections to using grout include the cost of installation, the lasting environmental impact, and the undesirable aesthetics of having a cement-lined stream bank as opposed to a plain rock bank.

It should be noted that work within a river channel which involves placing or adding material (soil or rock) may require a Section 404 permit from the Corps. Please contact your Corps district before placing any material along the banks of a river or stream to determine whether you will need a permit for the work. If the FCW is damaged by a flood or by high-water and is eligible for rehabilitation assistance under PL 84-99 as discussed in later chapters of this manual, the Corps will help you to obtain the necessary permits.

The Corps can provide recommendations or materials on the proper sizing, gradation, thickness, use of geotextile fabrics, and other details related to the placement of riprap.

2.8 Vegetation (Levee Specific)

The Corps' policy for landscaping around levees, floodwalls, and embankment dams, is found in EM 1110-2-301. The requirements are sometimes seen as being excessive and out of touch with contemporary environmental concerns, but as the primary function of a levee is to protect communities from flooding, the Corps' maintenance requirements have been established to reduce the chance of catastrophic failures during high water. If you'd like a variance to the Corps' vegetation requirements (allowing additional vegetation on or around the levee) then you need to contact your local Corps district. A variance would be granted if the proposed vegetation is seen to preserve, protect, or enhance natural resources, or if it protects the rights of Native Americans. Such variances will only be granted if the vegetation retains the safety, structural integrity, and functionality of the levee; retains the accessibility for inspection and flood fighting purposes; and doesn't reduce the level of protection required by the National Flood Insurance Program or the RIP if the levee is a part of these programs. Specific items relating to the maintenance of levee vegetation include the maintenance of the grass or sod cover and the removal of unwanted bushes and trees.

a. Maintaining and Promoting a Good Grass or Sod Cover

Grass or sod cover is one of the most effective and economical means of protecting flood control levees and drainage swales against erosion caused by rain runoff, channel flows, and wave wash. As the public sponsor, the City is required to ensure the grass cover has every opportunity to grow. This will require that you periodically fertilize, water, and mow the grasses as needed. In addition, every effort must be made to prevent unauthorized encroachments, grazing, vehicle traffic, the misuse of chemicals, or burning during inappropriate seasons. Failure to properly maintain the grass cover can result in unnecessary erosion and possible embankment failure.

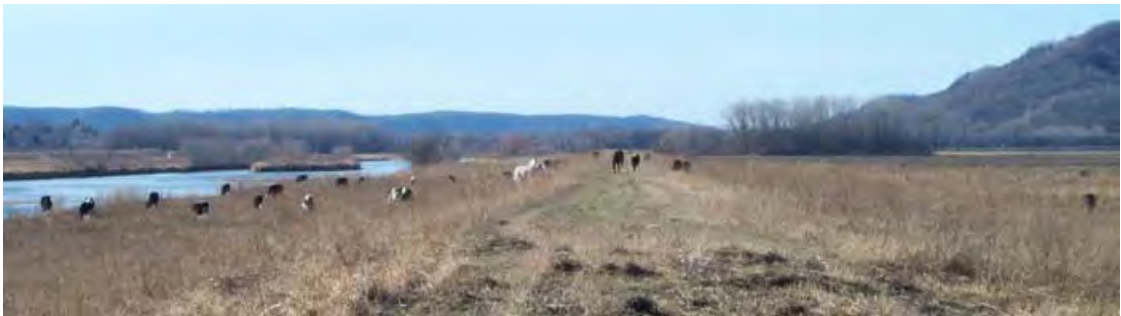


Figure 2.29 MINIMALLY ACCEPTABLE. This photo shows cattle grazing on the levee. Cattle typically don't harm the sod cover to the extent that sheep or other animals do. In this case, the landowner and the public sponsor were informed of the Corps' policy that grazing is not permitted on levees or within the levee easement area.

b. Mowing

Periodic mowing is essential to maintaining a good ground cover. Levees should be mowed regularly in order to control weeds and to prevent the growth of brush and saplings. Long grasses and native prairie grasses are one of the many challenges facing the project inspector. Long grasses (greater than 12 inches in length) can make a visual inspection nearly impossible and can hide serious concerns such as rodent activity, levee slides, and cracking; all of which can lead to the failure of the levee. For these

reasons, the grass should be mowed to a minimum height of 3 inches. The last mowing of the season should be accomplished under conditions that will allow the grass to grow to approximately 8 to 10 inches by the winter season. It's important to ensure that the entire levee profile has been mowed, including zones extending 15 feet beyond the toes of the embankment, which should be free of all woody growth and should be clear of other obstructions so that a truck could drive beside the levee if needed.

c. Control of Trees, Brush, and Weeds

If the public sponsor mows the levee at regular intervals, the growth of saplings, trees, and brush will not become a problem. However, if the levee is not mowed regularly, the resulting growth will make it difficult to properly maintain and inspect the project. Trees and brush can also affect the stability of the structure and interfere with emergency operations during high-water conditions. All trees and brush must be cleared and disposed of away from the flood control project. The disposal of material on the riverward side of the levee or areas where flood waters can carry the material downstream is prohibited. In riprap protected areas, ditches, or in other areas of the project where power mowing is impractical, the unwanted vegetation should be controlled with an approved herbicide spray or should be cut by hand. Herbicides must be used in accordance with state and local laws and regulations. Any trees that reach 2 inches in diameter or greater, and are located on the levee, riprapped areas, drainage channels, or within 15 feet of the toe of the levee must be cut down, the root ball removed, the voids filled with impervious material, and the fill material firmly compacted and reseeded.



Figure 2.30 UNACCEPTABLE levee with knee-high grass, making visual inspection nearly impossible. (MN)



Figure 2.31 UNACCEPTABLE. Levee is mowed but trees and longer grasses within levee easement area. Trees are greater than 2" in diameter. (MN)



Figure 2.32 UNACCEPTABLE long grasses and trees on levee side slopes. (ND)

2.9 Cracking (Levee Specific)

It's important to closely monitor and evaluate all visible areas of cracking on a levee or riverbank, to ensure they don't develop slope stability problems as shown in Figure 2.35 and discussed in section 2.4. Cracks in a levee develop when the levee material is saturated with water and when it is overly dry. Clay, like most impervious materials, will shrink as it dries and re-expand when wet. Clay levee surfaces tend to shrink and expand slightly, and some cracks in the surface of the FCW are to be expected. Shrinkage cracks are generally narrow and shallow, not extending more than a few inches into the levee, but



Figure 2.33 *ACCEPTABLE* cracking in clay levee with shrinkage cracking caused by dry conditions. (MN)

during long periods of drought they may extend as much as two feet into the levee. These cracks can run longitudinally or transverse to the levee, as in Figure 2.33, or may appear as blocks as shown in Figure 2.34. If the cracking becomes excessive, it needs to be corrected even if the levee appears to be stable. It's important that you contact your local Corps district office for guidance on how to repair cracks observed in your levee.



Figure 2.34 *UNACCEPTABLE* cracking with landside pooling, Whitehead Levee Project, (IA)



Figure 2.35 *UNACCEPTABLE* embankment cracking and slope failure. This photo shows what started out as cracking along the crest of the embankment and quickly developed into a slope failure. All cracking located on a levee or riverbank must be closely monitored. (MN)

2.10 Ruts and Depressions (Levee Specific)

Ruts and other depressions often develop along levees or patrol roads as a result of pedestrian or vehicular traffic, settlement, or because of an inadequate crown slope. Sometimes the levee material over a culvert can settle, leaving a trench across the crown of a levee. This process and related maintenance is discussed below in section 2.20. Ruts and depressions are a problem because they allow water to pond on the levee crest or access road. If left uncorrected, the ponded water will seep into the levee's interior or into roadway embankment, saturating the foundation material, and making the levee more susceptible to failure during a flood. The levee or access road should be inspected for ruts, pot holes, and areas of standing water after it rains.

To correct these problems, the topsoil and sod should be removed and the existing levee surface should be roughened. This is ideally done when the ground is not frozen; if there are ice crystals in the ground then the entire frozen layer should be removed. Loose fill material should be added evenly, in approximately 6 inch layers. Add water or dry the backfill materials as necessary to attain optimal moisture content during compaction. Compact in place by hand or mechanical methods in order to bring the levee back to its original shape. The topsoil should be replaced and the area should be reseeded and mulched for erosion control.

Figures 2.36 through 2.39 show common ruts that can hold water on access roads and levees.



Figure 2.36 *MINIMALLY ACCEPTABLE levee rutting caused by pedestrian and bicycle traffic. (ND)*



Figure 2.37 *UNACCEPTABLE ruts in levee crown require fill. (MO)*



Figure 2.38 *MINIMALLY ACCEPTABLE ponded water along a levee crest. (MN)*



Figure 2.39 *UNACCEPTABLE rutting in levee. (OK)*

When the crest of the levee is used for recreation, inspections, surveillance during floods, and flood fighting activities, a surface treatment (e.g., gravel, crushed rock, pavement, etc.) should be provided to reduce the deficiencies listed above. This is not a requirement but it is recommended for active levees.

2.11 Underseepage Control Berms (Levee Specific)

Underseepage control berms, also known as seepage berms, perform two functions in controlling seepage. First, they provide a downward weight to counteract the upward force of the seepage pressure within the foundation material adjacent to the levee, which is where the pressure is highest. Second, seepage berms lengthen the seepage path, which increases the flow resistance and decreases the seepage pressure in the area beyond the berm. The berms should be constructed with material at least as permeable as the existing levee to reduce the chance of increasing dangerous build up of hydrostatic pressures within the levee. They should be thoroughly inspected both before and after each flood along with the rest of the FCW, and any cracks, depressions, settlement, or other problems identified need to be repaired as outlined in previous sections of this chapter.

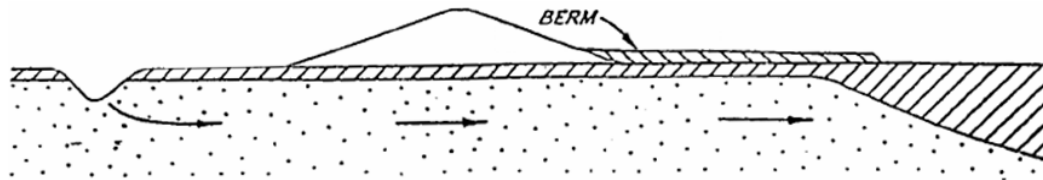


Figure 2.40 Sketch of a seepage berm.

2.12 Excavations (Levee Specific)

The removal of levee blanket materials may endanger the levee by increasing the potential for seepage or stability problems. Any excavation that is proposed within the boundaries of the levee easement or right-of-way should be reviewed by the Corps. This review may result in a recommendation to not allow the excavation, or to recommend restrictions on the excavation in order to maintain the project's eligibility for rehabilitation assistance. The areas the public sponsor should monitor for excavation activities include the levee itself, and those areas within 100 feet, both landward and riverward, of the levee.

2.13 Utilities (Levee Specific)

It's also recommended that you coordinate the construction of any utilities that cross over, under, or through levees or other flood control structures with the Corps prior to the start of construction. During the installation of the utility, care needs to be taken to ensure that pipes do not leak, and that there is adequate compaction around the utility. Failure to provide good compaction will allow for seepage along the pipe during a flood. Once installed, the utility trench will need to be monitored for cracks, depressions, settlement, sink holes, or saturated soils that may indicate a leak or possible seepage along the utility line. These types of problems should be brought to the utility company's attention as soon as they are discovered and repaired expeditiously. Additional guidance on the placement of utilities, excavations, and on other related topics can be found at

http://www.nwk.usace.army.mil/local_protection/guidance.html, as referenced in Appendix I of this manual. Your district office may be able to provide additional information, if needed.

2.14 Underseepage Relief Wells/ Toe Drainage (Levees and Floodwalls)

Relief wells are used to relieve hydrostatic pressures in the foundation of a levee, which is caused by fluctuation in the water table or seepage under a levee or flood control structure during a flood. Typical relief wells consist of a well screen, a filter pack (granular material surrounding the well screen), a riser, and an outlet system. Relief wells, over time, can become less efficient at relieving hydrostatic pressures because of clogging of the filter pack, sedimentation build up in the well screen, and/or bio-fouling. Clogging of the filter pack and sedimentation within the relief well occurs when the foundation material migrates into the filter pack, making it less permeable and reducing the well's effectiveness. Bio-fouling is the build up of bacteria on the well screen itself, reducing the area in the screen through which water can flow.

Maintenance of relief wells requires surging and pump testing of the well, and comparing the results to the test results recorded when the well was initially installed. Well testing and clearing should be accomplished by qualified well drillers. You can request technical assistance from the Corps on the proper procedures and/or a list of qualified well drilling contractors in your area.

2.15 Seepage/ Sandboils (Levees and Floodwalls)

Sandboils and seepage problems are not generally identified during routine inspections because these problems typically only appear under high water conditions. However, if sandboils or continuously saturated soils (not caused by ponded water or poor drainage) are observed on the landward side of the levee or floodwall under low water conditions, regardless of their size, they will likely become serious problems under high water conditions. Sandboils and underseepage is a serious problem that should not be taken lightly. If sandboils are observed during a flood or low water conditions, or if there's evidence that



Figure 2.41 Evidence of sandboils. (IN)

foundation material is being (or has been) removed from the levee foundation, then the Corps should be contacted to evaluate the situation and provide technical advice regarding repairs. Appendix D of this manual provides additional information regarding seepage and sandboils.

2.16 Closure Structures (Levees and Floodwalls)

Closure structures must be in good repair. Placing equipment, stoplogs, sandbags, and other materials must be readily available at all times; stored nearby on the protected side of the levee, or stored on a trailer for quick transportation to the site. It's important that all components are clearly marked and that installation instructions and related procedures are readily available. You should regularly check your inventory of all components of the closure structure to ensure that stoplogs and other components will be there when you need them. Note that when aluminum stoplogs are stored, they should be supported along their entire length so they don't deform during extended periods of storage.



Figure 2.42 *ACCEPTABLE floodgate in a levee. (KS)*

2.17 Concrete Surfaces (Applicable to all concrete structures)

Visible cracking, scaling, or spalling are signs of concrete movement and stresses within the concrete. Cracks in concrete walls that aren't repaired are subject to freeze / thaw damage, which widens the gap and leads to additional spalling of the concrete. When examining any concrete flood control structures, spalling, scaling, or cracking should be very minimal. Figures 2.43 through 2.47, on the following page, show various degrees of cracking, spalling, and scaling.



Figure 2.43 MINIMALLY ACCEPTABLE 1/8th inch crack extends through concrete floodwall and needs to be sealed to prevent further damage. (MN)



Figure 2.44 MINIMALLY ACCEPTABLE Vertical floodwall crack with spalling. The rating for this particular crack is Minimally Acceptable because the crack is still tight but there is some spalling occurring as well. (MN)



Figure 2.45 UNACCEPTABLE exposed rebar. Monolith joint separation with exterior spalling along the joint and interior spalling in the area of the rebar. (MN)



Figure 2.46 Detail of the crack in Figure 2.45, showing the exposed rebar that tied the two monoliths together. (MN)



Figure 2.47 MINIMALLY ACCEPTABLE floodwall. Exposed surface rebar resulting from poor construction practices. The public sponsor has painted over the rebar in an attempt to keep it from rusting. (MN)

Fire and extreme heat can also be very damaging to concrete, and sponsors should discourage fires from being built beside concrete structures. Common grass or incidental fires are not typically a great concern, but repeated hot or large fires such as bon fires, camp fires, or brush fires can cause spalling in the concrete. Even though fire damage is not specifically listed in the Corps' FCW Inspection Guide (Appendix C), the related spalling, cracking, or other damage would be noted during an inspection and is something that should be taken seriously. If this type of damage is identified, efforts must be made immediately to stop fires near the FCW. Depending on the extent of the damage, the integrity of the structure should be investigated and repairs should be made as soon as possible.

Over time, concrete surfaces will weather, leaving the concrete rough to the touch, or will hold moisture on the surface. When this occurs consider applying a protective coating to the concrete to help prevent moisture from entering the structure. By applying a protective coating to the concrete surface and sealing the cracks the chances of freeze / thaw damage will be greatly reduced, increasing the life expectancy of the structure. Prior to the application of a concrete sealer the structure should be cleaned, existing cracks should be sealed with a flexible sealant, and any spalling repaired. Any sealer chosen for the concrete floodwall should be a water or solvent-based acrylic protective coating, which may be either clear or colored, and may be textured. A clear system should contain at least 23% solids by weight, and a colored system should contain at least 67% solids by weight and 46% solids by volume.

More serious damage such as spalling should be repaired as soon as it is identified, especially if steel reinforcing has been exposed. Perform concrete repairs with a polymer-modified Portland cement mortar that will provide a minimum of 2500-psi compressive strength in two hours. For repairs greater than 1 1/2 inches deep, add 3/8-inch clean-washed pea gravel so that aggregates don't result in variations of the physical properties of the mortar. Limestone gravel is not acceptable. All surfaces to be patched need to be structurally sound, clean, and free of loose debris, oils, vegetation, paints, sealants, and other contaminants. Remove all deteriorated concrete to a minimum of 1/4-inch in depth. Cut edges should be square with the concrete surfaces, and not feathered. Surfaces should be sufficiently rough to ensure a good bond. Any existing reinforcing bars should be thoroughly cleaned. If required, existing concrete should be removed to fully expose the reinforcing bar. Sandblasting may be required to clean them thoroughly. All surfaces should be fully saturated and freestanding excess water should be removed before applying the repair material. The material should be placed in the prepared area starting from one side and working to the other side. For vertical areas, trowel the material in an upward motion over the repaired area. Successive applications must be troweled against the previously placed material just prior to hardening. Work the material firmly into the bottom and sides of the repair. Level the material to the desired thickness and close up edges of the repair with a trowel. Finish the material to match the existing concrete finish. Remove any material applied or spilled beyond the desired areas. All exposed surfaces should be thoroughly saturated with water immediately after finishing.

2.18 Tilting, Sliding, and Settlement (Applicable to all Concrete Structures)

If soil conditions were poor prior to construction or if there has been inadequate soil compaction, concrete structures (floodwalls, pump stations, and gate wells) will frequently show signs of settlement. As the structure settles it may begin tilting in the lateral or transverse directions, settle vertically, or may even begin to slide downhill, if constructed on a slope. As the pressure within the concrete builds cracking and large spalls will develop. If the movement is considerable like that shown in Figures 2.48 and 2.49, a licensed engineer should be contacted to determine the best approach to correct the problem, or to closely monitor the structure during high water to avoid a structural failure.

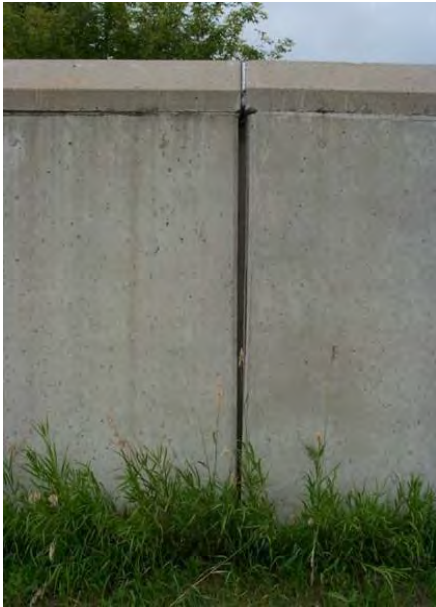


Figure 2.48 MINIMALLY ACCEPTABLE floodwall. Monolith joint separation caused by settlement, no landward or riverward tilting. The opening is about 3 inches wide at the top but the rubber joint sealer is still intact and undamaged. This joint has since been repaired by bolting another joint sealer on the both sides of the wall and filling the void with an expandable joint sealer. (ND)



Figure 2.49 UNACCEPTABLE monolith movement in floodwall. The monolith shown in the photo has tilted about 6 inches riverward as well as vertically. Note the movement when compared to the adjoining monolith and the top cap. As the monolith moved considerable spalling has occurred along the joint. This project is monitored very closely during flood events. (ND)



Figure 2.50 ACCEPTABLE. decorative floodwall is in straight alignment, with no tilting or spalling, and all joints are tight together. (MN)

2.19 Vegetation (Floodwall specific)

Vegetation must be removed from both sides of floodwalls for maintenance, flood fighting activities, and to protect the floodwall from damage from roots. Roots under a floodwall can greatly accelerate seepage rates during high water, increasing the chance of sandboils on the landward side and potentially leading to the failure of the structure. For these reasons, you should maintain a zone extending 2.5 meters (8') beyond both the underground toe and heel of the floodwall, keeping it free of everything but grass or sod, or possibly riprap on the riverward side. Since the floodwall may have been constructed in the shape of an inverted T, the underground toe and heel may extend several feet past the visible base. Additional guidance on landscaping around levees, floodwalls and embankment dams can be found in EM 1110-2-301, as referenced in Chapter 1.



Figure 2.51 UNACCEPTABLE. Trees growing too close to floodwall. (KY)



Figure 2.52 UNACCEPTABLE. Trees growing too close to floodwall. (KY)

2.20 Internal Drainage Systems

During non-flood conditions, rainwater is permitted to drain naturally through culverts in the levee and into the river. However, during highwater, the gates on the drainage culverts are closed, and rainfall and flood seepage become trapped within the protected area of the FCW. If there is insufficient ponding area within the FCW, the water will need to be pumped over the levee or

floodwall and into the river. Even if a levee operates exactly as intended to keep the river back, a community can still be flooded from within if the interior drainage system is not functioning properly.



Figure 2.53 UNACCEPTABLE interior drainage at the toe of an earthen levee. (OK)

Some of the features of an interior drainage system include ponding areas, drainage swales or ditches, inlet and outlet structures including gates and concrete components, culverts, gate wells, and pump stations. Natural or modified streams or ditches within the protected area are generally not considered part of the flood control project unless specifically stated in the project design. However, don't forget that you could still experience significant damage from seepage and rain

runoff if these channels are not maintained.

As the public sponsor, it's the City's responsibility to ensure that all ditches, drainage structures, and other components of the project are kept in an acceptable condition. All drainage structures should be inspected and maintained at least once a year prior to flood season and again after periods of high water. The following paragraphs describe the maintenance of some components of interior drainage in greater detail.

a. Drainage Ditches

Drainage ditches should be maintained to ensure that the capacity of the ditch is not decreased by heavy vegetation growth or sedimentation. As part of a good maintenance program, the drainage ditches should be cleared at scheduled intervals and restored to the original channel design grade and cross section. Material removed from drainage ditches should be removed from the floodway, and not left in area near the banks. Removal of the excavation spoils will improve water quality and help to prevent further flooding and maintenance problems. During an inspection, drainage ditches are rated on flow capacity, sedimentation, vegetative growth, and cross section. Regularly scheduled maintenance will ensure the flood control project performs in a satisfactory manner during high water.



Figure 2.54 *ACCEPTABLE* interior drainage channel. (IA)



Figure 2.55 *MINIMALLY ACCEPTABLE* vegetation (cat tails and bull rushes) in interior drainage ditch. (MN)



Figure 2.56 *UNACCEPTABLE* vegetation and sediment in interior drainage channel. (IA)



Figure 2.57 *ACCEPTABLE* interior ponding area and drainage ditch. (MN)

b. Concrete Culverts/ Pipes

All culverts must be clear of debris and must be structurally sound. Remember that inspections of drainage structures require compliance with confined space entry regulations. Any spalling in concrete culverts should be patched with an appropriate concrete material as described above. Repairs should be made to the bottom of the culvert if they show more than 1 inch of loss due to wear and abrasion. If significant settlement is detected in a culvert or pipe, it should be excavated, the foundation raised, the pipe replaced, the fill material added in four



Figure 2.58 Concrete drainage tunnel. (AK)

inch layers and compacted around the pipe to a density equal to or greater to that of the surrounding undisturbed material, and the area reseeded. Do not use a roller or heavy machinery to compact fill material when repairing the settlement over a culvert.



Figure 2.59 The culvert on the left is Minimally Acceptable with sediment accumulation within the culvert. The culvert on the right is totally unacceptable with 2/3 of its flow capacity reduced by sediment and debris. This project was rated as UNACCEPTABLE because of the reduced flow capacity of the culverts. (MN)



Figure 2.60 MINIMALLY ACCEPTABLE, vegetation blocking the concrete culvert must be removed. (KS)

c. Corrugated Metal Pipes

One significant maintenance item in many levee systems involves the repair and replacement of corrugated metal pipes (CMPs). Many levees all over the country were constructed with corrugated metal pipes to transport interior drainage, because CMP was one of the cheapest and most reliable materials available at the time. When the levees were constructed, the engineers designed them for an established design life (usually no more than 50 years), and since CMP was predicted to last for design life of the project, it was the material of choice for many drainage culverts. However, with many of the levees around the country at or beyond the design life of the CMP, it becomes critical that the pipes are inspected frequently and thoroughly, and replaced as needed. Remember that even if a CMP looks OK on the inside, the outside of the pipe may be very corroded and weak. Interior and exterior rust, reduction in metal thickness, joint separation, holes, and settlement, have all lead to the failure of the culverts. When a CMP fails during a flood, not only does the culvert cease to function as necessary, but material from the levee collapses to fill in the void, leaving a low spot in the crown of the levee. This low spot can quickly lead to a breach in the levee and the flooding of the protected area.

In some cases, a decaying CMP may temporarily be maintained by lining the pipe with an appropriate plastic liner or by patching it in various ways, but these are only temporary solutions and the pipe will eventually need to be replaced as part of the ongoing maintenance of the project. Because of this, you need to budget for the replacement of the pipes as their design life comes to an end. If it is noted during an inspection that a CMP culvert is Minimally Acceptable and the levee becomes damaged during a flood as a direct result of the failure of the CMP, then the Corps will deny post flood rehabilitation assistance for the repair of this damage. The maintenance and replacement of these pipes is considered to be part of the ongoing maintenance of the project and is therefore the responsibility of the public sponsor.



Figure 2.61 UNACCEPTABLE, Failing corrugated metal pipe. DO NOT WALK INTO A FAILING CULVERT LIKE THIS. This section has actually separated, allowing the surrounding soil to enter the pipe and the overburden to collapse. This sponsor was denied rehabilitation assistance due to this maintenance deficiency.



Figure 2.62 Pieces of the same pipe, once removed from the levee. Note that while much of the pipe may have appeared to be in good condition from the inside, the outside was extremely corroded. The public sponsor attempted to patch the pipe the first year, but when it failed again, the entire CMP was replaced.

d. Gated Structures

All flap gates, slide gates, and other gate systems need to be inspected and lubricated at least once a year just before the flood season. If gates aren't seated properly, water will flow back through the drainage structure during high water. During the inspection, all gates should be manually operated, and any debris or obstructions removed. All gate seats should be checked and the

frames readjusted if the gate is not seating properly. Cracked or damaged



Figure 2.63 *ACCEPTABLE culvert gate. (LA)*

gates need to be replaced. The inlet and outlet channels need to be kept free of debris, trees, brush and other vegetation, and sediment. All concrete cracks in the inlet/ outlet structure need to be repaired. Metal grates, hand wheels, and other metalwork should be secure and sound, free from rust, and regularly maintained by cleaning, painting, and greasing. If any pipe or culvert has separated from the inlet/ outlet structure headwall, this needs to be repaired as soon as possible. When high water is predicted, all flap and slide gates should again be inspected and any debris or obstructions should be removed immediately.



Figure 2.64 *ACCEPTABLE flap gates in earthen levee. (KS)*



Figure 2.65 *UNACCEPTABLE vegetation around flap gates in earthen levee. (OK)*



Figure 2.66 *UNACCEPTABLE flap gate in earthen levee. (Broken hinge and vegetation)*

growth.) (MO)

2.21 Pump Stations

Pump Stations should be inspected at least annually by the sponsor, preferably just before the flood season, following the manufacturers' publications and recommendations on maintenance. Preventative maintenance includes adjusting, lubricating, repairing, and replacing worn out or defective parts. A guide for the inspection frequencies and tasks for the various items of equipment is usually found in the manufacturer's recommendations, but may need to be adjusted depending on the frequency of operation of the pumping station. Any change



Figure 2.67 Hole in roof of pumping station. (IL)

to the manufacturer's recommendations should be coordinated with the manufacturer to avoid the possibility of voiding warranties.

Some pump stations are located in remote areas and operated automatically. These stations may be easily overlooked, but need to be inspected, tested, and maintained just like any other pump station.

Megger tests need to be conducted at least every other year to ensure proper insulation of electrical components. While the cost of running the pumps typically prohibits the Corps from conducting a Megger test during continuing eligibility inspections, you need to conduct this test on your own when the pump is in operation. A logbook needs to be maintained at each pump station, which should include the date and type of testing conducted, the maintenance performed, and the number of hours each pump or piece of machinery was operated.



Pump stations are exposed to potential fires, and should have adequate fire protection measures. This would include safety equipment for diesel generators and may include automatic sprinklers.

2.22 Flood Control Rivers and Channels

Flood control channels should be inspected on a regular and continual basis to ensure that erosion is not causing bank instability that could result in a bank failure/ sloughing. When areas of bank instability or erosion are located, measures should be taken to correct the problem. If left unattended, the continued bank erosion will form sediment shoals within the river channel causing a reduction in channel capacity. As the shoals grow in size they begin to support vegetation and divert the channel flow into the river bank, causing additional bank erosion and instability. Trees that have



Figure 2.69 *UNACCEPTABLE* vegetation in channel and sediment shoaling. (OK)

fallen into the river channel or that may soon fall need to be removed to prevent log jams during high water, which can cause significant damage as described in section 2.5 above.

Sedimentation, silt, vegetation, downed trees, and other debris in the channel must be removed to maintain channel capacity. These materials should be disposed of in a manner that does not adversely affect the project or the floodway/floodplain. This improves water quality as well as helping prevent further flooding and maintenance problems. Before removing any sediment, trees, vegetation, or placing rock bank protections, you should contact the Corps' Regulatory Office and your local Department of Natural Resources to determine if any environmental permits are required.



Figure 2.70 *UNACCEPTABLE* channel shoaling below a control structure. The original channel bottom extended all the way to the riprapped banks. There is an estimated 2-3 feet of sediment in the channel, mostly from upstream field erosion and highway construction. (MN)



Figure 2.71 *MINIMALLY ACCEPTABLE* shoaling within a concrete lined channel. (MN)

2.23 Concrete Lined Channels

Concrete lined channels should be kept clear of debris, sediment, and vegetation. The concrete, flap gates, and other structures must be inspected annually and maintained as described in previous sections of this chapter. Sample maintenance and inspection activities may include (but are not limited to) clearing the sediment, vegetation, and debris; replacing joint seals as needed, and repairing damage to the concrete.



Figure 2.72 ACCEPTABLE concrete lined flood control channel. (ID)



Figure 2.73 ACCEPTABLE intake structure upstream of the concrete channel. (ID)



Figure 2.74 ACCEPTABLE concrete lined channel. (AK)



Figure 2.75 UNACCEPTABLE vegetation and extensive sediment in channel. (TX)

2.24 Debris Basins

Debris basins, sometimes called sediment retention basins, are reservoirs that are placed upstream of flood protection or navigation channels in order to collect sand, rocks, logs and other debris, and prevent it from obstructing the channel downstream. They help with flooding and navigation, and make the project easier to maintain, since it's easier to clean out the basin than to remove debris from the entire length of a channel.

As the basin fills up with sediment, the flowing water tends to take on the same width as the natural channel (rather than spreading over the surface of the basin), and the basin loses its ability to hold back as much debris. For this reason, debris basins are designed with the intent that they'll be periodically cleaned out. While some basins may have a 50 or 100-year capacity, others are sized for only one or two major storms.

Remove the sediment from the debris basin whenever it approaches one-half of its capacity by visual inspection, and whenever the deposits direct the flow against the channel or levee slope where they can cause erosion. Remove any large obstructions after every high-water event. The debris basin should kept be free from brush and trees, and sod should be maintained over the area to protect it from erosion.

The bottom of the basin slopes can erode during high water. Any eroded areas should be repaired as described in previous sections of this manual, and riprap or other erosion protection should be placed along the slopes to prevent further damage.

2.25 Floodways

A floodway is a designated piece of land that is purposefully left clear of development, for the purpose of passing floodwaters. When water rises beyond the capacity of the nearby rivers and channels, it then passes over this designated area. (In some areas of the country, the term floodway is used to designate the 100-year floodplain.) Floodways must be maintained so that when water passes over them, it doesn't rise beyond the expected levels. Obstructions such as earth deposits, debris, trash, undesirable vegetation, or unauthorized structures or encroachments reduce the floodway capacity and must be removed and disposed of properly. Vegetative growth that contributes to the preservation of natural resources and wildlife should be left alone unless the growth lessens the degree of protection or threatens the structural integrity of the project.

3. FLOOD PREPAREDNESS



Figure 3.1 Flooding along Skagit River. (WA)

Flood fighting is an art, and can be extremely difficult to execute. There is no absolute method that one can apply to guarantee success. However, failure to react in a timely manner and apply proven flood fighting techniques greatly increases the risk of failure. Although each flood is unique, there are many common elements from one flood to the next, and plans and preparations will improve your response time and success.

Public sponsors of flood control works are responsible for project maintenance and flood fighting activities during high water events. To be ready for these tasks, sponsors are responsible for establishing flood fight plans, conducting training, stockpiling needed materials, and for other

flood preparations. Disaster preparedness and flood fighting training are necessary for project inclusion in the U.S. Army Corps of Engineer's Rehabilitation and Inspection Program (RIP). This chapter outlines some basic preparedness activities that will help insure that your flood responses will be timely and effective.

3.1 Flood Fight Equipment and Supplies

As the local project sponsor, it is your responsibility to stockpile and maintain the necessary supplies and equipment needed to respond to typical high-water events. In a flood, the stockpiled materials will allow you to quickly provide an initial flood response while additional materials and equipment are being delivered. The specific requirement for supplies varies depending on the size of your FCW and on past flood events. The best way to determine the quantities that are needed is to look at the supplies that were needed during previous floods. For example, if you



Figure 3.2 Sandbag storage in a levee pumping station. (OK)

typically use 1,500 sandbags in a flood response, then you should maintain a stockpile of 1,500 sandbags in a secure location within the protected area.

a. Sandbags

As stated above, it's your responsibility to maintain an adequate supply of sandbags to allow you to respond to typical high-water events. Burlap sandbags have a limited shelf life (usually about 8 years if humidity is controlled) and should be inspected annually and replaced when necessary. The stockpile of sandbags should be stored in a dry, secure location that does not expose the sandbags to sunlight. Continued sunlight and weather will rapidly deteriorate the sandbag material.

b. Plastic Sheeting

There are many applications for plastic sheeting during flood fights. If it is one of the things that typically gets used in your community during a flood fight and there is any doubt about its availability during an emergency, it should be stockpiled in preparation of an event. 6 mil polyethylene sheeting is the minimum thickness recommended for flood fighting applications.

c. Shovels/ Sandbag Filling Machines

If you've identified places that you know you're going to need a lot of sandbags, then you need to have a reliable method for filling them, and you may want to consider investing in some equipment that will let you do it more quickly. Some Corps districts own sandbag filling machines and can lend them out during emergencies. If these machines are needed, you should contact your State. Since the availability of these machines changes, your State may need to coordinate and prioritize these requests before passing them to the Corps. See Appendix D for details on sandbagging operations and other tools that have been used.

d. Emergency Lighting

Unfortunately, flood fight operations don't stop at night. It is strongly recommended that you plan ahead to find some emergency lighting which would be readily available for use during flood fights.

e. Communications System

A reliable communication system is extremely important for coordinating flood fighting efforts and for calling for assistance when needed. Cell phones work very well but are limited in their capacity for communicating with multiple people at one time, which can be important during emergencies. You may also experience dead spots or non-availability of service if the phone traffic is very heavy. Because of these problems, two-way radios are preferable because they are extremely reliable for short distances and have the capability to broadcast to several people at once. Without a reliable communication system, any flood fighting effort will be much more difficult and will probably require additional man power.

f. Riprap for Erosion

It is recommended that you develop plans to address erosion that may occur during a flood emergency. It might not always be necessary to stockpile riprap, but you should at least know the location and emergency telephone numbers of local quarries capable of supplying riprap if it's needed. Some levee districts choose to keep a supply of gravel on hand, so they can maintain the levee access routes during an emergency.

g. Floatation Vests.

The safety of workers and volunteers should always be the highest priority during a flood fight. Floatation coats or vests (PFD) are recommended and should be worn at all times when working near the riverward crest of the levee, on the riverward side slope, or near fast moving water. Floodwaters can quickly sweep a person downstream, and hypothermia can set in quickly in cold water conditions.

h. Pumps

Like sandbags, pumps are also a critical part of any flood fighting effort. Pumps are used to control interior drainage and seepage through the levee. Those communities that experience frequent flooding should consider purchasing one or more high capacity pumps. If additional pumps are needed during a flood fight, you should contact your State, because your local Corps district office may have pumps available, but your State may need to coordinate and prioritize these requests before passing them to the Corps.



Figure 3.3 *Portable pumps supplied by the Corps of Engineers during an emergency.*

i. Sources of Borrow Material

Sources of borrow material should be located prior to a flood event. Several borrow areas should be identified in advance, because wet or sloppy weather could unexpectedly limit access to some sites. Carefully consider the access points to your levee when you choose the sites for the borrow material.

3.2 Plans

It is a local sponsor's responsibility to develop and maintain a minimal level of written plans, and to keep those plans up to date. The extent of the plans depends on the specific FCW. Large systems with multiple pumps and drains would require more detailed plans than smaller systems. Documented plans ensure that the information needed to address known problem areas will be available during a flood, even if the main supervisor is unavailable. As a minimum, every sponsor should maintain at least an organizational chart or roster, and lists or maps of important project features. Additional planning is also recommended, and some guidance is presented to help you develop these plans.

As you read through this section, you'll see that there's a large amount of planning that can be done in advance of a flood. While it would clearly take a substantial amount of time to collect and update all of the information described, don't be discouraged and assume that this planning is too big of a chore to ever begin. Instead, try to prioritize the work, remembering that every piece of information you assemble and every decision you can make before an actual flood will potentially make your response that much more effective during a real emergency.

a. Organizational Chart / Roster

You need to keep an updated list of project supervisors, inspectors, and other personnel, including their detailed contact information. The list should clearly indicate which people would be contacted during a flood emergency.

Additionally, it's strongly recommended that you compile a directory including telephone numbers for your Corps district's Emergency Operation Center, local contractors, flood fight supply and equipment vendors, the Red Cross, Salvation Army, hospitals, railroad/ highway departments, the police and fire departments, local and state Emergency Operations Centers, and other critical numbers.

b. List of Important Project Features

As a minimum requirement for planning, you need to develop and maintain either a bullet-point list or annotated map that describes each project feature and areas of concern during a flood event. The list should clearly note things such as:

- Low areas
- Areas subject to boils
- Areas of known seepage
- Areas of recent rodent activity
- Alternate access points to the levee (should one become impassible)
- Locations of drains that should be checked for closure
- Available sources and locations of sandbags, pumps and other supplies

Along with this information, you should develop and maintain a detailed table of all of the locations of project features that may need to be closed, such as

- Floodgates
- Flap gates
- Other closures

In this table, you should indicate the river level or other indicator that would signal that each of these project features needs to be closed. Remember that the highway or railroad departments need to be contacted prior to closing roads or railroad tracks running through levees and floodwalls.

c. Flood Response Plan

It is strongly recommended that you supplement the previously mentioned rosters and lists of project features with a site specific flood response plan. This plan does not have to be long and shouldn't be wordy, but should outline the things that need to be done during a flood fight, and indicate when they need to be done. Ideally, it would also delegate responsibilities for the tasks, and this information would be updated as necessary to account for changes in personnel. Your plan should identify necessary information such as potential assembly or staging areas for flood fights, and the location of earth borrow sites, and should address procedures for maintaining records of equipment, manpower, and supplies used during a flood fight. The records are key items for obtaining assistance for flood and post flood activities. Flood fighting plans should acknowledge that it may not be feasible to protect entire communities, based on economic or time and equipment considerations; therefore, evacuation of certain areas may be a necessary fact of an emergency operation. There should be a plan of evacuation for all areas lying in the flood plain, in case the need develops. See the following chapter of this manual for additional information on flood response plans.

d. Short Term Planning Elements

In addition to your long-term planning, it is your responsibility to have an understanding of the FCW and the ability to address any short term situations that may arise during the life of the project. For example, if a culvert that runs through a levee is being replaced, then you need a plan for what to do in case there's a flood during the construction, when the levee integrity is lacking.

e. Continued Plan Management

Your flood response plan should be reviewed annually and after each event where flood levels reach half of the levee or wall height, or where an unusual or unexpected incident has occurred.

Annual plan updates should include verification that sources of emergency equipment, contact names and telephone numbers are current, review of evacuation routes and emergency shelter locations.

After a flood or flood exercise, closely examine the events and actions taken to determine whether they were effective and efficient. Because floods may occur decades apart, it's important that information be recorded for use in future planning efforts. Debriefing sessions, with all participants represented, provide valuable feedback on the lessons learned. Note which actions worked well, and identify the reason for their success. Note which actions could be improved upon, and solicit suggestions to correct the problems. Collect data on the response effort, such as necessary materials, equipment, man-hour estimates, weather reports, and monitoring reports. Compare the planned responses with the actions taken, and incorporate the information learned into the plan.

Updated information should be forwarded to the Corps and to your local and state Emergency Operations Center.

3.3 Training and Exercises.

As the public sponsor, the City is responsible for training personnel to operate, maintain, and patrol your FCW. The Corps encourages you to hold training or flood control exercises at least once a year. There are many reasons to hold these exercises. First, they show new personnel how to do things like operate the closure structures, respond to sandboils and patrol the FCW during a flood. Second, none of the plans you've developed for a flood response are any good unless they're practiced and communicated to those who need them. Training exercises also let you know how much time and manpower is necessary to complete certain tasks. Important practical considerations and physical limitations that could be easily overlooked in a plan become clearly exposed during an actual exercise.

At a minimum, these exercises should include:

- Physical operation of project features such as sluice gates, pumping stations, and closure structures
- Notification of emergency response personnel
- Testing communications/ backup communications system
- Mobilization of monitoring teams, and monitoring project features
- Basic flood fight techniques, such as how to ring a sandbail
- Coordination and control (between volunteers, patrols, operators, nearby levee districts, the highway department, the state Emergency Operations Center, the Corps, etc.)
- Dissemination of information to the public

The exercises can also be more elaborate, to include other emergencies that may take place during a flood such as car accidents or gas spills occurring when interior streets are flooded or evacuation routes are flooded. The exercises should be tailored to your community. Representatives from agencies or organizations that would actually be called upon, such as medical personnel, public works, and the mayor's office might be involved in planning more complex exercises. You are encouraged to involve the local and state Emergency Operations Center in these events, and your local Corps district can also provide technical assistance for training and exercises as needed.

Documentation of the exercise is important to identify where any shortfalls exist in planning and coordination, training, personnel, equipment, and facilities. Debriefing sessions held with all participants can provide valuable feedback on the effectiveness of policies and procedures, identification of areas of improvement and suggestions to correct deficiencies. Lessons learned during the exercise should be incorporated into the project operations plan and local emergency operations plan.

3.4 Relations with Local and State Partners

There are usually many ways that your county and state can assist you during a flood. For example, states may provide trucks, tractors, radios, helicopters for emergency inspections, support from the National Guard, or financial assistance. If you run out of supplies needed for a flood fight, you should try to find the needed supplies at the local and state level, before requesting this aid from the federal government. The Corps expects counties and states to be involved with the levee districts, and provides support only when state resources are being fully utilized. For these reasons, you are strongly encouraged to maintain relations with the Emergency Managers at your local and state Emergency Operations Center and to contact them at least once annually, well in advance of a flood. You should keep them informed on the condition of your project, and send them ongoing situation reports during a flood response. It's very important that you know what kinds of support the state can provide, and that you know who to call in order to get the support you need.

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4. ACTIONS DURING HIGH WATER EVENTS

This chapter provides sample framework that you could use as a starting point as you develop your community's flood response plan, as described in Chapter 3. The chapter outlines many of the steps that are recommended immediately before, during, and after high water events. Not everything that's included here will be applicable in all situations, and there's a lot of important information you may find necessary to add. Building on the material presented, a flood response plan should be developed that would identify and prioritize the given activities, identify locations along your FCW which would require attention, go into more specific details as to how the tasks should be completed, and specify who within your community would be responsible for them. Additional details on some of the steps listed (for example, how to raise a levee) are presented in Appendix D.

The response activities listed below have been broken up into two phases. Phase I activities include the preliminary response activities that should be completed before the river rises to its bank full stage. By the time the river reaches its bank full stage, everything should be ready, and all necessary personnel should be prepared to respond to the flood. Phase II activities include the things that should take place once the river has risen to some gage-height beyond bank full, which is something should be decided ahead of time. With some rivers, it's possible to specify a river gage level that would indicate when the activities should expand from Phase I to Phase II. Other rivers rise more quickly, and the expansion of response activities depends more on the developing situation than on a predetermined gage height. In developing your flood response plan, consider the characteristics of all adjacent rivers and streams. Flashing streams and rivers require rapid response, while moderately rising streams or rivers allow greater reaction and warning time. It's essential that your flood fighting activities are based on the available time.

4.1 Phase I: Preliminary Response Activities

a. Public Sponsor Duties

Upon receipt of official information forecasting imminent high water, the levee district should immediately alert all project personnel concerned in flood fighting operations, mobilizing a skeleton organization capable of quick expansion. If the public sponsor is responsible for many miles of a levee system, definite sections of the levee should be assigned to individual section leaders/ supervisors. Additionally during Phase I, the sponsor should:

- i. Review emergency plans and past lessons learned; identify problem areas.
- ii. Verify that personnel have access to the gate keys, current rosters, a listing of project features and closings, plans, and other critical items.
- iii. Coordinate efforts with communities upstream and downstream of you.
- iv. There may be isolated gates or valves on private property, and the owners may need to be alerted to take action.

- v. Alert the community to the potential of flooding. This will give them advance warning to take action to minimize potential damage to their business or home.
- vi. Keep local/state Emergency Operations Center informed of the situation.
- vii. Begin documenting the situation; send situation reports to the local or state EOC and to the Army Corps of Engineers as necessary. (It's not necessary to send reports to the Corps every time there's high water; only during unusual situations or when there's the potential for significant damage or overtopping.)

b. Initial Project Inspection

As soon as they've been notified that high water is expected, section leaders/ superiors should immediately make a thorough inspection of their section of the levee, omitting nothing from this inspection based on adequate performance during past high water events. In addition to the items that are typically inspected during patrols (which are listed in part c, below), special attention needs to be given to the following items during this initial inspection. (Note that several of these items can and should be accomplished annually and not wait for a high water prediction.)

- i. Section Limits: Ensure that the dividing line between sections/section leaders are clearly defined and marked, if necessary.
- ii. Condition of any recent repairs to the levee.
- iii. Water conditions and any accumulation of trash, debris, ice, etc.
- iv. Transportation Facilities: roads, rail, and water access.
- v. Material Supply: Identify location, quantity, and conditions of all necessary tools and materials (sacks, sandbags, lumber, lights, etc.) and distribute and store them at points where maintenance is anticipated.
- vi. Communications: Locate and check all two-way radios and telephones.
- vii. Drainage Structures: Most drainage structures are situated to convey interior drainage from low points of the protected area through the levee by gravity flow. Because of the location, drainage structures are generally subject to inundation at lower stages than most other project features, and special attention needs to be given to flap gates and other drainage structures that might not be accessible later. (See section d, below, for maintenance during high water.)

c. Patrols

To minimize damage and to prevent the FCW from failing, any problems must be detected early and treated appropriately. The entire FCW should be patrolled at least once a day during the Phase 1 response and continually during Phase II. Patrols should be conducted by teams, rather than by individuals. Many of the tasks typically accomplished during high water inspections and patrols are listed below. Any significant or unusual conditions identified should be reported to the Army Corps of Engineers. The following section lists some typical responsibilities of patrols.

i. Patrol Responsibilities:

General items

- Record gage readings. (hourly)
- Inspect fences on the riverside of the levee frequently to make sure they are free from debris. If debris does collect along the fence, it must be cleared immediately or the fence must be cut to free the debris and decrease the possibility of damage to the levee.
- Verify that all necessary access roads and ramps along the levee are usable or will be satisfactorily conditioned.
- Take photographs of all significant issues. (Use date/time stamp on your camera when possible)

Levees

- Look for sandboils or unusual wet areas landward of the landside toe.
- Look for slides or soughs in levee side slopes.
- Look for wave wash or scouring of the riverside levee slope.
- Look for low areas in levee crown.
- Monitor relief wells (flowing/non-flowing).
- Check flap/sluiice gates for proper closure.
- Check gap closures (stoplog/ sandbag, etc.).

Floodwalls

- Look for saturated areas or sandboils landward of the floodwall.
- Look for settlement (movement) of the floodwall.
- Look for bank caving which may affect the structural stability of the floodwall.
- Inspect toe drain risers (discharging/non-discharging).
- Inspect the landside of floodwall for any leakage, especially around the monolith joints.
- Inspect for wet areas, soft areas, seeps, and sink holes landward of the toe of the floodwall.
- Check gap closures (stoplog/ sandbag, etc.).

Pump Stations

- Verify proper ventilation (fans on, vents open, etc.) of the pumping plant, to prevent overheating of pump motors.
- Look for sink holes or wet areas around the perimeter of the pumping plant, and/or settlement of the pump house, all of which could potentially be the result of separation in the conduits. If this condition is suspected, the pumps and motors should be shut down until an engineering review can be conducted to analyze the condition.
- Verify that assigned operators are on duty 24 hours daily.

ii. Equipment for Patrols

- Portable radio or cell phone
- Watch
- Log book
- Patrolling instructions
- Plan of action for patrolling
- Plans of flood control project
- Operation and Maintenance Manual for the project
- Weather gear
- Flashlights
- Record Log
- Life Jackets
- Probing rod
- Short wooden stakes
- 40 feet of ½ inch nylon safety line to connect team members
- Camera

iii. Safety/Security Precautions

The members of the patrol team should walk side by side with one person on the water side of the levee near the water surface, one at the top of the levee, and one on the land side toe of the levee. The team should move slowly enough to enable the member closest to the water to probe below the surface with a rod, to discover any erosion that may be taking place. The person closest to the water should be wearing a safety line.

The person walking closest to the water should be especially observant of floating objects. The limbs and roots of a floating tree that has been uprooted can extend above the water surface and strike anyone walking along the water's edge. To increase the chance of seeing floating objects, it's best to walk upstream when patrolling the water side of the levee.

When patrolling floodwalls, the patrol should not attempt to walk the top of the wall, but should concentrate on potential problem areas on the land side (inside) of the wall. Where the wall is more than five feet above the land side ground level, it is recommended that observation points be selected every 100 yards or so, and ladders used to observe the water side of the floodwall.

Each person on the patrol should be thoroughly familiar with the community evacuation plan and signals. If evacuation is necessary, the patrolling organization should move to a predetermined location and keep the team intact.

If evacuated, when returning to the levees and floodwalls, physical conditions may be considerably different from those observed prior to the evacuation, especially if

the levee was overtopped. If overtopping occurs during the darkness, it's recommended that the patrols not be resumed until daylight, though there may be cases where this recommendation can't be followed.

Patrols should also keep an eye out for anyone that seems out of place, or who is doing something that looks doubtful. There are unfortunately some people, terrorists or otherwise, that would try to take advantage the already dangerous situations on levees or floodwalls for their own purposes. Any suspicious activities observed by the patrol should be reported immediately to the local law enforcement agency.

iv. Interaction with the public

The patrol team may see observers on the levees or at floodwalls. If there are many observers, it is recommended that an additional person be assigned to each patrol team. This additional person will act as a safety officer, explaining the dangers that are present. The patrol team is not responsible to order observers off the levees and floodwalls.

It is recommended that each team carry and pass out instruction cards describing the community evacuation plan. It is important to pass out information, so the observers are aware of the danger.

d. Phase 1 General Maintenance Activities

Once the initial inspection has been completed, each section leader should organize his labor force to take care of any pressing maintenance issues, before the river rises further. Emergency maintenance activities are no substitute for normal annual maintenance, and many of the activities listed here should not wait until high water.

- i. Because of their location, drainage structures are generally subject to inundation at lower stages than most other features of the flood control project, and any maintenance problems need to be identified and corrected as quickly as possible before the water rises. Manually check all flap gates that are critical or in questionable repair, and maintain as needed. Sluice gates should be inspected before the outlet end of the structure becomes submerged, and any trash, debris, or other potential obstruction present should be removed. If, for any reason, the gate system on a drainage structure fails to operate and cannot be repaired because of high water, immediate consideration should be given to blocking the structure opening by other means. If stream stages permit, the outlet end of the structure should be blocked using timber, metal plates, tarps, sandbags, or by other means. If the efforts to plug the outlet structure fail, immediate action should be taken to build a sandbag or earth ring around the inlet structure. While the primary concern in blocking the structures is to prevent high stages of the river from

flowing into the protected area, emergency closures should be such that they can be readily removed after the river recedes.

- ii. Immediate attention should be given to the grade line of each levee section or profile by comparison of existing grades with those shown in “As Built” record drawings. Fill any holes, gullies, and washes in the levee crown, embankments, and landside berms with compacted fill material if possible, or otherwise fill them with sandbags. (See Appendix D for details)
- iii. Examine all drainage ditches on the landside of the levee and remove any obstructions. Be prepared to construct seepage drainage ditches, but not until actual seepage appears. Excavation of ditches near the levee or in the long berm area is hazardous and should not be undertaken except under direct supervision of the section leader and with the advice of the Corps of Engineer advisor assigned to that unit.
- iv. Repair all levee settlement or depressions which have been worn down below levee grade. Materials to be used in filling holes and depressions should be obtained from distant sources (not adjacent to a levee system) unless it has been determined that borrowing in areas adjacent to the levee will not adversely affect its stability or the control of underseepage. Avoid taking material for these repairs from the area adjacent to the levee, particularly in the area of the seepage berm, except under direct supervision of the section leader and with the advice of the Corps of Engineer advisor. The fill material should be compacted and protected from wave wash and other erosion as necessary.

e. Other Phase 1 Activities

Once the initial inspection has been completed, each section leader should organize his labor force to perform the maintenance work as described in Appendix D of this manual. Additional activities to complete during Phase I are listed below:

- i. Review assignments for patrols, closings, etc.
- ii. Obtain lists of all construction equipment, motorboats, cars, earthmoving equipment and trucks that can be made available.
- iii. Assess needed support (Vehicles, radios, etc).
- iv. Verify serviceability of flood fighting equipment.
- v. Record gage readings and monitor river stages.
- vi. Close the levee to the public and remove cattle as necessary.
- vii. Install levee or floodwall closures as necessary. (Remember to coordinate all road closings with the Department of Transportation or railroad authorities before limiting road or rail access through the levee!)
- viii. Remove all dynamite and explosives from the vicinity of the levee.

4.2 Phase II: Full Response Activities

a. Continuing Activities

- i. Patrol continuously, 24/7 (as the situation requires).
- ii. Be sure all of the closures and gates are in place, and all maintenance is complete as described in Phase I, above.
- iii. Completely remove padlocks from access gates to facilitate patrols.
- iv. Monitor inventory of flood fighting equipment, materials and supplies as they are used.
- v. Keep the public informed of the current situation through the media, if warranted.
- vi. Repair any erosion and seepage problems identified by patrols as quickly as possible, as described in Appendix D of this manual.
- vii. During flood periods, competent operators should be on duty whenever it appears that operation is imminent, even when station operation has been automated. Operators should thoroughly understand the manner in which the pumping station was designed to operate and be capable of manual operation should automated equipment or sensors fail.
- viii. Portable pumps may be used to pump water over the levee, if water is ponding in undesirable areas or is rising too quickly in ponding areas. Ponding areas should be continually patrolled during high water.
- ix. Monitor debris basins and trashracks for sediment and accumulated debris. As debris and sediment continue to be deposited in the basin, debris loads will substantially block racks, and sediment deposits will block the entrance to the basin, forcing the flow against the sides. Any large accumulation of debris on racks or flow directed on the sides of basins will cause local erosion and scour. Levees and concrete structures that are part of the debris basin facility will need to be closely monitored to ensure performance. Debris should be removed from trashracks at pumping stations periodically when the station is in operation.

b. Volunteer Assistance

If it becomes necessary to recruit volunteers during the flood fight, there are a number of steps that can be taken to organize their support.

- i. Identify primary and alternate assembly areas, with adequate parking.
- ii. Arrange transportation, subsistence, and shelter for the labor force as appropriate.
- iii. Contact media to request that volunteers report to the designated assembly area, bringing flashlight, work gloves, rain gear, shovel, and a snack.
- iv. Maintain sign-in roster at assembly area, to account for volunteers and personnel (name, home phone number, address, work group assignment).

- v. Identify staging areas, away from the work site but as close to the flood fight locations as possible and with good access to clear roads. Separate areas in the staging site should be established for:
 - sandbag filling
 - carrying and loading
 - materials stockpiles
 - rest and breaks
 - first aid
- vi. Establish an emergency operations center to oversee the flood fight operations, and for interagency coordination. This operations center is to be manned 24 hours daily until the emergency is over. Consider equipping the EOC with:
 - Radios and telephones for communication
 - Television and/or radio to monitor weather and river forecasts
 - Emergency generator in case of power outages
 - Flashlights
 - Administrative supplies
 - Levee operations and maintenance manuals
 - All emergency action plans
 - Past flood reports/ after action reports
 - State, county, and local maps; utility, flood plain, and levee maps
 - Telephone books, phone rosters, and a directory listing numbers for the Army Corps of Engineers' Emergency Operation Center, railroad/ highway departments (needed when closing access), local contractors, the Red Cross, Salvation Army, hospitals, the police and fire departments, local and state Emergency Operations Centers, and other critical numbers
- vii. Establish traffic patterns that will be used to move the sandbags from the staging area to the work site. If conditions permit, one-way traffic patterns should be established on the levee system if trucks are going to be used to transport the filled sandbags to the laying party.
- viii. Be certain that the people laying sandbags are well supervised by a trained individual that knows how to properly lay the sandbags.

4.3 Evacuation Plans

You should be ready with a plan to evacuate the area. Consider the following points:

- a.** Immediately coordinate evacuation with police, fire department, and responders.
- b.** Remove sign-in roster and contact information from EOC, if possible.
- c.** Follow the predetermined plan for evacuation.
- d.** Meet in predetermined locations & immediately verify the safety of all personnel.

4.4 After the Event

Once the water has subsided and it isn't predicted to rise again, the area should be returned to the pre-flood condition.

- a.** Reopen any sluice gates that were closed, once the water on the river side has receded to 3 inches below the pond level on the protected side.
- b.** Open all closure structures and properly store all components.
- c.** All temporary protection measures (e.g. sandbags and material placed during temporary levee raises) must be removed and disposed of properly.
- d.** Take an inventory of all remaining flood fight equipment, sandbags, plastic, and other supplies. Repair or replace damaged equipment, and restock supplies such as sandbags or plastic in preparation for the next flood event.
- e.** Salvage any materials and supplies (e.g. wood from flashboards).
- f.** Return all borrowed equipment.
- g.** Identify whether remaining materials can be reused within the community.
- h.** Inspect the entire flood control work, noting locations of damage and the extent of damage at each location.
- i.** Coordinate potential rehabilitation with the Army Corps of Engineers.
- j.** Soon after the event, meet with key personnel, volunteer representatives, and community partners to debrief, share remaining concerns, and discuss lessons that were learned during the event.
- k.** Revise local emergency plans to account for lessons learned and changes to recommended procedures.
- l.** Document the event: keep a map record of the FCW, indicating areas that were in stress at the time of the flooding. This is useful for making repairs or improvements, and for use as a guide to focus attention on these areas during the next flood event.
- m.** For future planning, locate and keep records of the flood's high water marks; keep these records along with any rainfall and river data you may have gathered.
- n.** Make repairs to the FCW as soon as possible, in preparation for the next flood event.
- o.** Initiate actions to provide a permanent means of flood protection, if the existing system relies heavily on temporary solutions during emergencies.

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5. ADDITIONAL SPONSOR RESPONSIBILITIES

As the public sponsor, the City is responsible for ongoing maintenance as discussed in chapter 2, for preparedness activities as discussed in chapter 3, and for flood response activities during high water as outlined in chapter 4. There are several additional requirements that you should be aware of.

5.1 Annual Pre-Flood-Season Inspections

You should have a pre-flood-season inspection program in place for your flood control projects, using information from this manual along with your own experience and resources. The specific maintenance items to look for and some of the corrective actions that should be taken are discussed in detail in chapter 2 of this manual, and the U.S. Army Corps of Engineers' Inspection Guide (Appendix C) can be used as a guide for these inspections. If you'd like more specific advice or information regarding FCW operations, maintenance, or inspections, please contact your Corps district office. When you make these pre-flood-season inspections, you should document the condition of your project in an annual inspection report. Items that would be appropriate to document in this report include:

- The name/ location of the FCW
- The date of the inspection
- The name of the inspector
- What project features were inspected
- The overall condition of the project features
- Maintenance that has been completed
- Maintenance that is being preformed currently
- Maintenance items that need to be accomplished in the future
- Photographs showing flood damages, noted deficiencies, and overall project condition.
- Maintenance costs incurred for the flood control project that year, etc.

5.2 Public Awareness Activities

Many sponsors of flood control projects have trouble finding the funding and support they need to make necessary repairs and improvements. The best examples of well supported levee districts are those that have ensured that local businesses and citizens understand the flood hazard and the importance of the flood control system. While public awareness activities are not required for participation in the RIP, the key to ensuring support from your community lies in promoting a public awareness of the situation. You may be able to promote a greater awareness of key issues through publications and planned public meetings, as described below.

a. Provide Public Materials

Flood protection is interesting! Many people will take the time to read through brochures or leaflets detailing local flood protection if this material is provided to them. You might also release annual newsletters or articles for newspapers on the subject. Information should be presented on the following topics:

- i. The areas protected
- ii. The key elements/ equipment in the local flood control system
- iii. How the system works
- iv. The regular impact on the community and ongoing costs for regular operation and maintenance
- v. The consequences if it fails
- vi. Local flood evacuation plans
- vii. Historical overview of past floods and experiences
- viii. Flood response plans and procedures- how the community can contribute

b. Schedule Public Meetings

Unless there's an actual flood, attendance at public meetings on flood control may be discouraging, especially if the public is poorly informed on flood control to begin with. You may find it useful to combine such meetings with discussions on local industry or other issues, or to raise certain issues during community events. Always try to involve industry and local groups in your decision making process, so they will support what you're doing.

5.3 Awareness of Adjacent Systems

A flood control system is made up of many components, and won't protect you unless they all work together properly. You need to understand how adjacent sections of levee or components on private property impact the larger system. Even though these components might not be situated within your area of responsibility, your community could still be flooded if adjacent systems don't operate properly.

5.4 Permits

Whenever you plan to modify the FCW, be sure to get the appropriate local, state, tribal, or federal permits (or waivers for these permits). The process of getting some of these permits may be cumbersome, expensive, and frustrating, and may be more difficult in some states than in others. However, you must be prepared to get these permits in order to comply with the law. If you make changes to your flood control project without first obtaining the necessary permits, you may be denied rehabilitation assistance after a flood, regardless of whether a Corps inspector noticed the changes and asked to view the permits during a Continuing Eligibility Inspection. Please understand that this requirement wasn't invented so that the Corps can deny post flood assistance. Modifications to your FCW don't only affect your own community but can also affect communities upstream and downstream of you as well, or can have a negative impact environmentally; so it's important that any proposed modifications are reviewed and approved by the appropriate parties before you begin construction.

5.5 Records

As the public sponsor, the City is responsible for keeping accurate records of all repairs done to the flood control project, including photographs, plans and specifications, as-built drawings, and surveys. Make records of all modifications such as the installation of natural gas pipes, fiber optic cables, and any sewage outfall lines added by commercial companies or municipal agencies. It's important to coordinate these types of changes with the Corps and to provide them with copies of the documents for their files.

To assist you in the proper maintenance of the project, it's also recommended that you keep organized, accurate records of all equipment, maintenance, and inspections. An equipment database file should be maintained that indexes equipment by name or title and contains all pertinent data for that equipment, such as manufacturer's instruction books, operating pressure limits, parts catalogues, manufacturer's drawings, reference field tests, special reports on major requirements, and most importantly, changes in operating procedures. A preventative maintenance database file for things like pump stations should contain equipment inspection, maintenance data, hours of operation, number of operations, and other significant operating data.

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6. REHABILITATION AND INSPECTION PROGRAM (RIP)

6.1 Overview of the Rehabilitation and Inspection Program

The U.S. Army Corps of Engineers has authority under Public Law (PL) 84-99 to supplement local efforts to repair flood control projects after they get damaged during a flood. There are many things that must be carefully balanced in carrying out this authority, such as the needs of the local community, sensitivity to the environment, the need to apply sound engineering judgment for the proper functioning of the FCW, and the need to provide proper stewardship of the taxpayers' dollars with which the Corps is entrusted. In light of all these

competing interests, the Corps has developed a program called the Rehabilitation and Inspection



Figure 6.1, *Levee breach in Lynden, WA*

Program (RIP), which specifically defines the types of projects that can be eligible for assistance, and specifies the ongoing for operation and maintenance requirements for the FCWs that qualify.

The principal reason the RIP exists is to ensure that flood control works continue to provide reliable protection, so that people's lives, communities, and improved property are protected from floods. The principal benefit of the RIP for the City is that through this program you can receive federal assistance to help repair your FCW if it becomes damaged in a flood.



Figure 6.2 and 6.3, *Levee breaches along the Wabash River*

6.2 Projects that Qualify

The Rehabilitation and Inspection Program covers certain levees, channels, floodwalls, flood control dams, retention basins, pump stations, and even some extremely large underground tunnels that have been built for flood control. However, there are certain exclusions to the types of projects that may enter the program. Projects that don't meet the basic criteria below are categorically excluded from the Rehabilitation and Inspection Program. For more information regarding the types of projects that are eligible for the RIP, refer to ER / EP 500- 1-1, which can be found through the web-link provided in Chapter 1 of this manual.

a. Protecting People and Property

The principal function of the project must be to protect people or property from floods. If the project was built or is primarily used for any other purpose, such as channel alignment, recreation, fish and wildlife, land reclamation, drainage, or to protect against land erosion or tidal inflows, then it's categorically excluded from admittance in the RIP.

b. Public Sponsor

The project's non-federal public sponsor is the City of Ellensburg. The public sponsor is the public representative for the project, and represents the interests of any private landowners involved. For example, a levee may be constructed by a county, which would be the public sponsor, on private land for which the county has an easement from the property owners. A public sponsor is a legally constituted public body with full authority and capability to perform the terms of its agreement as the non-federal partner of the Corps for a project, able to pay damages, if necessary, in the event of its failure to perform. The public sponsor may be a state, county, city, town, Federally recognized Indian tribe or tribal organization, Alaska Native Corporation, or any political subpart of a state or group of states that has the legal and financial authority and capability to provide the necessary cash contributions, and the lands, easements, rights-of-way, relocations, and borrow and dredged or excavated materials disposal areas (LERRD's) necessary for the project. Finally, the public sponsor must be legally able to "hold and save" the federal government free from damages that could arise during post-flood rehabilitations or other work the federal government would undertake on the FCW. If it ever becomes necessary to rehabilitate the project, the sponsor will need to sign an agreement limiting the federal government's liability before the Corps will begin any work on the project.

c. Reliability

The project must provide reliable flood protection, and it must be technically sound. To provide complete flood protection, the floodwall or levee must either make a complete a ring around the community, or tie into high ground on both the upstream and downstream ends of the project. From an engineering perspective, it has to be geotechnically stable and properly designed, and it must be well maintained.

d. Project Completion Required

The project must be completed. If it's still under construction, it can't enter the RIP.

e. Minimum Level of Protection

To be eligible to enter the RIP, agricultural levees (those protecting predominantly agricultural areas or agribusinesses) must be built to provide at least a 5-year level of protection. Urban levees (those protecting land with residences, public or commercial buildings, industrial facilities, etc.) must provide at least a 10-year level of protection. Drainage channels that were designed and constructed for flood control are required to have capacity for a 10 year flood event and must additionally provide drainage to an area 1.5 square miles or greater and have a drainage capacity greater than 800 cfs.

To clarify some of this terminology, a 5-year flood event means that there's a twenty percent chance of this level of flooding every year, not that the flooding actually happens every five years. This means that if an agricultural levee, for example, has a statistical probability of being overtopped more than once every five years, it is categorically ineligible to be in the RIP.

Drainage structures that were specifically constructed for flood control as components of a larger FCW system (such as ponding areas or channels carrying water from the ponding area up to and through a levee) are considered to be components of the overall FCW system. They would be evaluated for inclusion in the RIP and potential rehabilitation with the remainder of the FCW. However, natural or modified streams within a levee'd area, including drainage swales such as roadside ditches, are not considered to be components of flood control works and would not be included in the RIP.

f. Primary Levee Requirement

In the case of a levee project, the levee must be a primary levee. Secondary levees are not eligible to enter the rehabilitation program. Exceptions to this policy may be granted if the secondary levee was designed to protect human life or the levee is a major component of the primary levee system and is necessary to assure the flood control protection of the total system.

g. Construction Compliance

The project must have been constructed in accordance with all applicable federal, state and local permits, codes, ordinances, and applicable laws. This includes flood plain management ordinances in counties where no flood insurance programs exist.

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7. CORPS INSPECTIONS

The U.S. Army Corps of Engineers has established minimum standards for the construction, operation, maintenance, and preparedness of flood control works that must be met in order for the FCW to be eligible for federal rehabilitation assistance after a flood. This chapter describes the inspections that the Corps conducts in order to monitor the condition of levees, floodwalls, channels, and other FCWs. The information described in this chapter is supplemented in a flowchart in Appendix B, which summarizes the relationships between the Corps' inspections and the status of a project's eligibility for rehabilitation assistance. Additional information on the Corps' inspections can be found in Appendix C, which is the Inspection Guide used during all Corps inspections of non-federal FCWs.



Figure 7.1. *Inspection of pumping station controls. (OK)*

One important note on Corps inspections and project ratings is that individual sponsors are not treated completely independently, but the Corps inspects and rates the entire “hydrologically independent” flood control project as one system. This means that if there are multiple public sponsors with responsibility over sections of a single flood control system, then they’ll all pass or fail their inspections together. This only makes sense, because the entire area will flood if one section fails during high water. It’s the responsibility of the multiple public sponsors, not of the Corps, to coordinate all necessary responsibilities and obligations under the RIP.

7.1 Entering the RIP – The Initial Eligibility Inspection (IEI)

To enter the RIP, you should contact your local Corps Emergency Management Office. Upon receiving a request to join the RIP, the Corps will conduct an Initial Eligibility Inspection (IEI) of your non-federal flood control project, which will include an evaluation of the technical capabilities of your project, as well as a review of project operation, maintenance, and preparedness. The purpose of the IEI is to determine whether the project meets the specific minimum criteria and standards set forth by the Corps for

Active: A status applied to flood control projects concerning their participation in the Rehabilitation and Inspection Program under authority of PL 84-99. An Active project has met the Corps' criteria for entry into the program, and continues to meet ongoing criteria for continuing eligibility. Only Active projects may receive PL 84-99 rehabilitation assistance to repair damage caused by a flood event or coastal storm.

providing reliable flood protection. During the IEI, the Corps will evaluate things such as the standards of construction, physical location of the FCW, the cross-section of levees, and the elevation of levees and floodwalls in relation to the anticipated flood levels. The Corps normally conducts IEIs when FCWs are undamaged during low water or normal water-level

conditions. This allows for more of the FCW to be inspected, so the condition of the project can be determined more accurately.

After the IEI is conducted, you'll receive a letter with the inspection results. If your project is rated "Acceptable," it is immediately placed in an Active status in the RIP. If it's rated Minimally Acceptable, it's placed in an Active status in the RIP and the letter will indicate the deficiencies that would need to be corrected in order for your project to meet the Corps' standards for entering the program, as well as a time frame for making these repairs. If the project is rated Unacceptable, the sponsor will be notified of the inspection results and the project will be placed in an Inactive status in the RIP (or may not be entered into the program at all). In this case, the deficiencies may have come from poor maintenance, or from more fundamental aspects of the FCW such as inadequate elevation or cross section in relation to the anticipated flood levels. Further inspections of a project receiving an IEI rating of Unacceptable will not be made until the Corps has been notified in writing that such corrective action work has been completed. If you don't agree with the results of the Corps' evaluation, you may choose at your own expense to provide a detailed engineering study (certified by a licensed professional engineer) of the FCW and request that the Corps reconsider its evaluation.

7.2 Maintaining Active Status – Continuing Eligibility Inspections (CEIs)

To maintain an Active status in the RIP, you're required to provide ongoing maintenance of the project. The Corps monitors this ongoing maintenance through Continuing Eligibility Inspections (CEIs), which are conducted at least every other year, though many Corps districts have elected to hold them on a more frequent basis in order to ensure compliance with the requirements of the RIP. CEIs typically don't go into the same level of detail that IEIs do, since project features such as elevation or cross section don't need to be reevaluated during continuing inspections. However, the majority of project components are inspected using the same criteria that were used during the Initial Eligibility Inspection.

If, during the CEI, the FCW is found to meet the Corps' standards for the RIP program, it will remain Active in the RIP. If it's found to be "Minimally Acceptable," based on deficiencies in some area of operation or maintenance, you'll be required to correct the noted deficiencies, and will be given a timeframe to make those repairs. If the repairs are completed to the Corps' specifications, the FCW will remain Active in the program. If the repairs are not completed within a timeframe, the FCW will be put into an Inactive status in the RIP. If the FCW is given an "Unacceptable" rating, then the FCW will immediately be put into an Inactive status in the RIP. You will regain your Active status as soon as you send the Corps documentation showing that the repairs are complete.

7.3 Inspection Methodology

Using the Inspection Guide found in Appendix C, each of the individual items or components of the project are rated according to the following table:

INDIVIDUAL ITEM / COMPONENT RATING		
<i>SYMBOL</i>	<i>CONDITION</i>	<i>DEFINITION</i>
A	Acceptable	The rated item is in satisfactory, acceptable condition, and will function as designed and intended during the next flood event.
M	Minimally Acceptable	The rated item has a minor deficiency that needs to be corrected. The minor deficiency will not seriously impair the functioning of the item during the next flood event. The overall reliability of the project will be lowered because of the minor deficiency.
U	Unacceptable	The rated item is unsatisfactory. The deficiency is so serious that the item will not adequately function in the next flood event, compromising the project's ability to provide reliable flood protection.

Once each project feature is rated, the inspector will look through the list of rated items to identify the lowest rating that was given for a project feature. The overall project is rated based on the lowest-rated project feature, and the overall project status is confirmed as either Active or Inactive in the RIP depending on the overall project rating.

DETERMINATION OF OVERALL PROJECT RATING AND PROJECT STATUS		
If the lowest rated project component is:	Then this results in an overall project rating of:	And the project status in the RIP is:
Acceptable	Acceptable	Active
Minimally Acceptable	Minimally Acceptable	Active, though status is contingent upon completion of required work.
Unacceptable	Unacceptable	Inactive

Finally, the overall project ratings are defined as follows:

OVERALL PROJECT RATING		
<i>SYMBOL</i>	<i>CONDITION</i>	<i>DEFINITION</i>
A	Acceptable	No immediate work required, other than routine maintenance. The flood control project will function as designed and intended, with a high degree of reliability, and necessary cyclic maintenance is being adequately performed.
M	Minimally Acceptable	One or more deficient conditions exist in the flood control project that needs to be improved / corrected. However, the project will essentially function as designed and intended, but with a lesser degree of reliability than what the project should provide. Specific items of the project must be improved / corrected.
U	Unacceptable	One or more deficient conditions that can reasonably be foreseen to prevent the project from functioning as designed, intended, or required.

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8. REHABILITATION ASSISTANCE

The purpose of this chapter is to provide information on the rehabilitation assistance that the U.S. Army Corps of Engineers can provide if an FCW is damaged during a flood. It describes the criteria that must be met before this assistance can be given, as well as the process for requesting it and the types of activities to which this assistance can be applied. Although the rehabilitation assistance described in this chapter can only be given to those FCWs with Active status in the RIP, Chapter 9 lists additional types of emergency assistance the Corps can provide regardless of your participation or status in the RIP.

8.1 Requesting Rehabilitation Assistance

In the event of a significant flood, the Army Corps of Engineers District Commander will declare the flood an emergency. Immediately after the declared flood subsides (when the river goes back down to its bank full condition and is not predicted to rise again), the Corps district will issue a “Notice to Public Sponsors,” which lets you, as the public sponsor, know that the Corps is accepting requests for rehabilitation. If your project was damaged during the flood, you’ll typically be given 30 days to respond to this notification and submit a formal, written request for rehabilitation assistance. A sample request form can be found in Appendix E.

8.2 Requirements for Receiving Rehabilitation Assistance

Upon receipt of your request, the Corps will first determine whether the repairs would be eligible for rehabilitation assistance. There are a number of requirements that must be met before the Corps will provide this assistance:

a. The FCW must have an Active status in the RIP.

b. The FCW must have been damaged by a flood or coastal storm

Damages by non-flood events, regardless of whether they are natural or man-made, are generally not eligible for Corps assistance under the RIP.

c. Cost / Benefit Calculation

To determine whether the cost of the repair is economically justified, the Corps will calculate the benefits and the costs of the repair using standard principles and guidelines for water resource projects. The calculated benefits will be based on the benefits to the entire area protected by the complete (hydrologically independent) flood control system, and the calculated repair costs will reflect the flood damages along the complete flood control system. To qualify for rehabilitation assistance, the benefits of the repair must outweigh the cost.

d. Construction Cost Minimum Requirement

The construction cost of the repair must be more than \$15,000. There are several reasons for this policy. First, damages under \$15,000 are considered to be routine maintenance that the public sponsor must undertake at its own expense. Second, before the Corps can undertake any project, specialists from many different disciplines must review the project. These specialists ensure that real estate and rights-of-way are

available, review environmental and endangered species considerations, and verify that the Corps is legally and financially correct in undertaking the repair. This work must be done regardless of how big or small the job is. Because of the considerable cost of undertaking this background work, small repair jobs simply don't justify all of the work needed for Corps involvement.

8.3 Cooperation Agreements

If these qualifications are met, then a cooperation agreement will be prepared. The cooperation agreement is a contract between you, as the public sponsor, and the Corps. It clarifies the details of the rehabilitation, including the specific work to be done, and sponsor requirements of cost sharing and local cooperation. The Corps will prepare this document following the format in Appendix F. The sponsor and the District Engineer must sign the cooperation agreement before the rehabilitation can begin, and there could be additional costs involved if it takes more than 30 days for you to sign the document once it's complete.

The cooperation agreement outlines the cost breakdown for the work. The following sections outline the types of items that will typically be paid for by the US government, the items that are typically cost shared, and the items that you would usually be responsible for at 100 % local cost. Keep in mind that this isn't a complete list, and that certain details have been omitted for brevity. Specific details concerning the cooperation agreement can be found in paragraph 5-10 of ER 500-1-1 and in paragraph 5-13 of EP 500-1-1.

a. Rehabilitation components typically covered at 100% Federal cost

The Corps will fund, at 100% federal cost, costs associated with the preparation and approval of Preliminary Investigation Reports, as well as the engineering and design costs for approved projects.

b. Items typically cost shared at 80% Federal and 20% Local cost

Cost sharable items include construction costs, contingency costs for construction, and supervision and administration (S&A) costs.

There are several details you should know about your 20% local cost share contribution. Most importantly, it may be a combination of cash or work in kind. The value of work in kind is determined by the Corps as the estimated cost that the Corps would have to pay if it was to perform or contract for the same work. (Be aware that the Corps won't reimburse you for work in kind that you contribute beyond your 20% requirements.) Also, cash contributions could potentially include funds from other federal agencies, as long as the other agency confirms in writing that their money can legally be spent on the rehabilitation.

c. Items you are responsible for at 100% local cost

These items do not constitute credit towards your 20% local cost share, but are additional costs for which you will be responsible.

i. LERRDs

All suitable Lands, Easements and Rights-of-way, including borrow and dredge material disposal areas, and relocations (e.g., roadways, utilities, etc.) that are necessary to perform the required repairs and to secure the necessary permits.

ii. Betterments

Any construction effort that increases the protected area, provides features that did not exist prior to the flood event, or increases the degree or level of protection provided by the FCW are considered betterments, and are not eligible for funding under the RIP. Examples of betterments might include increasing the height of a levee, or the placement of riprap where none previously existed. Repairs that incorporate modern materials or technologies commonly incorporated into current designs (for example, the use of geotextile fabric) are not considered betterments and may be cost shared as part of the rehabilitation work.

iii. Deliberate Levee Cuts

Rehabilitation assistance will generally not be provided for the repair of levees that were deliberately breached by the public sponsor. For example, as river levels begin to recede after a flood, a public sponsor may wish to intentionally breach the levee in order to let out ponded water. The repairs for this deliberate levee cut would not be eligible for rehabilitation assistance.

However, there may be cases when the Corps acknowledges a valid need for a deliberate levee cut in order to protect the integrity of the levee (or adjacent levee system) and minimize overall damages from a flood. If you consult with the Corps before making a deliberate levee cut and the Corps specifically approves the cut, then an exception would be made to the above policy and rehabilitation assistance could be provided to repair the breach.

iv. Repairs that wouldn't be the least cost alternative to the Federal Government

If you prefer an alternative method of repair that is not the least cost alternative, you are responsible for paying 100% of the cost difference between the two alternatives. For example, the transportation of borrow material from the closest acceptable borrow source (as determined by the Corps) is a cost sharable item (80/20). However, if you wanted to use borrow material from a further source, then you're responsible for paying for 100% of the transportation costs beyond what would have been incurred, had you opted for the closer source.

v. Maintenance Deficiencies

If maintenance deficiencies are noted during a routine inspection, and your project is rated “Minimally Acceptable,” you will be given a period of time to make the repairs. If the maintenance is still outstanding when there is a flood, you are still responsible for 100% of the cost of this deferred maintenance. The maintenance repairs must be completed either prior to or concurrently with any approved project rehabilitation. It may be possible to have the Corps make the repairs along with the project rehabilitation, but the cost associated with the deferred maintenance is still your responsibility, and will be added to your 20% cost-share for the rehabilitation. To clarify this issue, here are two examples of deferred maintenance that would be the responsibility of the public sponsor:

Deferred Maintenance Example 1: Flap Gate Requires Maintenance

During a CEI, it was found that a flap gate for a culvert was not closing properly and required maintenance. After the CEI and before the public sponsor fixed the problem, there was a flood. Because the flap gate didn’t close properly, the levee around the culvert was eroded, necessitating earthwork and a new culvert. The public sponsor will be responsible for 100% of the cost of repairing the flap gate. Depending on the circumstances and the actions the local sponsor had taken to repair the flap gate and reduce the amount of flood damage, the sponsor may be responsible for replacing the culvert and the damage to the levee as well.

Deferred Maintenance Example 2: Rusted Metal Pipe

A corrugated metal pipe runs through the levee. Over time, it has rusted significantly, and is in danger of failure. It’s noted in a CEI that the pipe needs to be replaced. Even though the repair of the pipe would be a large expense, this type of repair is considered to be part of regular maintenance and is the sponsor’s responsibility. If the pipe collapses and causes the levee to fail at this location during a flood, the sponsor is not only responsible for the cost of a new pipe and installation, but also for the complete cost of repair to the surrounding levee. (If the pipe fails but the levee failure was unrelated to the rusted pipe, then the Corps may assist with the repairs, but the sponsor would still be responsible for replacing and installing a new pipe.)

8.4 Nonstructural Alternatives to Rehabilitation

If your FCW is damaged in a flood and is eligible for rehabilitation assistance, the project could be repaired as previously discussed, or you could request a Nonstructural Alternative Project (NSAP) in lieu of the structural repair. This option essentially allows you to use the federal funding that would have been authorized to rehabilitate your flood control work, and apply it towards the restoration of the flood plains or floodways that were originally in your area. Because of this, you would typically only choose a nonstructural alternative (NSA) once you were absolutely sure that you no longer wanted to rely on your FCW to protect you from floods. Some of the things an NSA might fund include the acquisition of land for the project, the removal of utility connections and other structures, the total or partial removal of levee reaches, and the restoration of natural habitats. If you're thinking of requesting an NSA, remember that the Corps may, in its sole discretion, reject a request for an NSA if it believes that the project would lead to significantly increased flood protection expenses, would negatively impact adjacent or nearby FCWs, or would lead to increased risk to life or property during flood events. Once an NSAP is implemented, the project is no longer eligible for rehabilitation assistance because it will no longer be functioning as a flood control project.

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9. OTHER TYPES OF ARMY CORPS OF ENGINEERS EMERGENCY ASSISTANCE

Whereas the rehabilitation assistance described in the previous chapter is only provided to sponsors of flood control works that have an Active status in the RIP, the purpose of this chapter is to present information on other emergency related assistance the U.S. Army Corps of Engineers can provide you, regardless of your participation or status in the RIP. In fact, the assistance described in this chapter may be provided regardless of whether there is any Flood Control Work protecting your community. The other types of assistance authorized under PL 84-99 include technical assistance with preparedness activities such as planning and training, advance measures assistance, direct assistance during and immediately after a flood, and emergency water assistance which may be provided during droughts or when your primary water source becomes contaminated.

It should be noted that all of the assistance described in this chapter would be of a temporary nature to meet immediate threats, and is not intended to provide permanent solutions to flood or water problems. Remember that the Corps will only provide these types of assistance after local and state authorities have committed all available resources and are still unable to cope with the situation, and in some cases will only do so if the benefits of constructing the project are found to outweigh the cost of the construction. Finally, except in the case of technical or direct assistance, the Corps will only consider requests for these categories of assistance if they come from the governor of a state, or from a Native American tribal leader. If you, as the public sponsor, believe that one of these types of assistance would be appropriate in your situation, first speak with your Corps district office to determine what sorts of details would need to be included in the request, and then coordinate your request so that it comes to the Corps through the proper official channels.

9.1 Technical Assistance

The Corps is authorized to furnish technical assistance to local authorities at their request, advising them in their efforts to maintain the integrity of their FCWs. Technical assistance consists of providing technical review advice, and/or recommendations in support of state and local agency efforts, and helping determine feasible solutions to uncommon situations. The following are examples of technical assistance:

a. Provision of Experienced Personnel

Providing experienced Corps personnel to inspect existing FCWs and/or structurally threatened dams to identify potential problems and recommend corrective measures, to evaluate conditions to determine the requirements for additional flood control protection, and to recommend the most expedient emergency construction methods.

b. Flood fight Techniques

Providing personnel to give guidance on flood fight techniques.

c. Hydraulic, Geotechnical and Topography

Providing hydraulic or hydrologic analysis, geotechnical evaluations, topography and available stream data, maps, and historic flood or storm information.

d. Provision of Information

Providing information, which is readily available at Corps districts, for use in the preparation of local evacuation and/or contingency flood plans.

9.2 Direct Assistance

The Corps is authorized under PL 84-99 to provide direct assistance to local communities in response to flooding or coastal emergencies. Direct assistance may include, but is not limited to, issuing supplies, the loan of flood fight supplies and equipment, assistance with contingency contracting during emergencies, and supplemental support to aid local authorities in rescue operations and in the direction of flood fight operations. This is done in order to protect public facilities, residences, or improved property from flooding, or when there's a potential for loss of life. As a matter of policy, the Corps limits its flood fight activities on agricultural levees to technical assistance. Direct assistance does not need to be requested by the governor of a state, and may initially be granted based on a verbal request, though a written request must follow and a signed cooperation agreement must be signed before it can be provided. Legal responsibility for the actions remains with the requesting state or local official. For more details on direct assistance, please contact your local Corps district.

9.3 Advance Measures Assistance

Advance measures assistance is another type of assistance available under authority of PL 84-99. Advance measures assistance is provided when there is a clear prediction that there is an imminent threat of unusual flooding, which would result in substantial flood damages to an area if no preventative action is taken in advance of the flooding. Advance measures assistance is provided prior to the predicted unusual flooding, and can include technical and/or direct assistance such as supplies, equipment, and/or emergency contracting, through which the Corps may be able to repair, strengthen, or temporarily raise your flood control projects, or remove stream obstructions. However, there are several key qualifications to this type of assistance that significantly restrict the types of situations where it can be provided, and these are listed below. Please contact your local Corps district for the terms of local cooperation, for details on the governor's request, or for other details regarding this assistance.

a. Imminent Threat & Unusual Flooding

The Corps must determine that an "imminent threat" of "unusual flooding" exists in order to approve advance measures projects. The evaluation of the threat must come from an objective, statistically supported source like the National Weather Service. The determination of what qualifies as "unusual flooding" is subjective, but for example, if it has been predicted that the flooding will approach an area's flood of record or will be greater than a 50-year level of flooding, these may be considered unusual flood events. Be aware, however, that some areas of the country get flooded so frequently that sometimes even a 50-year flood isn't always considered a particularly unusual event. Again, this is a subjective determination that's made by the Corps.

b. Project Investigation Report

The Corps will prepare a project investigation report before advance measures assistance is provided. This report is needed to evaluate and justify the construction of an advance measures project, and this particular type of assistance wouldn't be given in cases where there wouldn't be sufficient time to complete this investigation before the flooding is expected.

c. Temporary Protection Only

Advance measures projects will only be constructed to provide temporary protection from flooding, and must be removed or upgraded by the public sponsor to meet federal flood protection standards, after the flood threat has passed. This assistance is not to be used as a means of circumventing the normal authorization process to have the Corps construct more permanent FCWs, and is not to be used as a "quick fix" for local agencies that do not adequately perform regular and routine maintenance.

9.4 Post Flood Assistance

Immediately following a major flood, hurricane, or coastal storm, the governor of your state may request post flood assistance, in writing, from the District Engineer. This request must be made concurrently with or immediately after the governor's request to FEMA for a disaster declaration under the Stafford Act. Post flood assistance may be either technical or direct assistance and is limited to actions to save lives and protect improved property. The Corps may assist in clearing flood-deposited debris in order to reopen critical transportation routes (to provide access to medical facilities, for example), or to clear watercourses, drainage channels, bridge openings, water intakes, sewer outfalls, or other structures, if critical for the restoration of public services, public safety or to prevent further significant damage. This assistance may be provided for a maximum of ten days of receipt of the governor's request. No work will be performed after the 10-day period expired, or initiated subsequent to a presidential disaster declaration or denial.

The assistance won't be provided directly to individual homeowners, businesses, or agricultural property, and won't be provided for efforts to collect post-flood data. Please contact your local Corps district for details on the governor's request, for the terms of local cooperation, or for other details regarding this type of assistance.

9.5 Emergency Water Assistance

If requested by the governor of a state, the Corps may provide temporary emergency water for human consumption to drought distressed areas or to those areas with contaminated water sources in order to meet minimum public health and welfare requirements. Long-term solutions to water supply problems are the responsibility of state and local interests. Typically, the Corps will fund the transportation of water to areas with extreme drought, but will not purchase the actual water. For more details on this type of assistance, please contact your Corps district office.

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APPENDIX A: ACRONYMS AND DEFINITIONS

Section I -Acronyms

AR - Army Regulation
BCR - Benefit Cost Ratio
CEI - Continuing Eligibility Inspection
CFR - Code of Federal Regulations
EM - Engineer Manual, Emergency Manager, Emergency Management
EOC - Emergency Operations Center
EP - Engineer Pamphlet
ER - Engineer Regulation
FCCE - Flood Control and Coastal Emergencies
FCW - Flood Control Work
ICW - Inspection of Completed Works
IEI - Initial Eligibility Inspection
LERRDs - Lands, easements, rights-of-way, relocations, and borrow and dredged or excavated materials disposal areas.
NSAP - Nonstructural Alternatives Project
O&M - Operations and Maintenance
OMRR&R - Operation, Maintenance, Repair, Replacement, and Rehabilitation
PCA - Project Cooperation Agreement.
PIR - Project Information Report
PL - Public Law
RIP - Rehabilitation and Inspection Program
USACE - U.S. Army Corps of Engineers
USC - United States Code
WRDA - Water Resources Development Act

Section II - Definitions

Active. A status applied to FCWs concerning participation in the Rehabilitation and Inspection Program under authority of PL 84-99. An Active project must have met the Army Corps of Engineer's criteria for entry and been entered into the RIP. Only Active projects may receive rehabilitation assistance to repair damages caused by a flood event or coastal storm.

Agricultural Levee. A levee that provides at least a 5-year level of flood protection to predominantly agricultural areas or agribusinesses. May be federal or non-federal.

Betterment. During repair of an FCW, any construction effort that increases the area protected, provides features that did not exist prior to the flood event, or increases the degree or level of protection provided by the FCW. Examples of betterments include increasing the height of a levee, or providing riprap where none previously existed.

Channel. A natural or artificial watercourse with definite bed and banks to confine and conduct flowing water.

Channel Capacity. The maximum flow that can pass through a channel without overflowing the banks.

Cooperation Agreement. An agreement entered into by a District Commander (acting as the agent for the Department of the Army on behalf of the United States Government) and the public sponsor for the purpose of identifying each party's rights and obligations concerning the expenditure of federal funds under authority of PL 84-99.

Deflection Weir. Also known as a bendway weir, this is a structure (earth, rock, or timber) built part way across a river for the purpose of controlling erosion and maintaining the navigation channel.

Deliberate Levee Cut. A deliberate cut made in a levee, with the intention of either protecting the integrity of the structure (or an adjacent structure) from actual or forecasted river stages, or reducing the overall anticipated damages expected to occur to the existing structure by the current flood event. See also Dewatering Levee Cut.

Dike. In some areas of the United States, this term is used synonymously with levee. In other areas, it is used for the kind of structure referred to in this manual as a deflection, or bendway weir. Some people use it exclusively to refer to the salt-water version of a levee, designed to protect an area from sea water. Since this term is used so differently by different people, "dike" isn't used in this manual.

Drainage Structure. Generally, any feature or system (e.g., culverts) constructed for the purpose of discharging surface water run-off. Such structures are components of interior drainage systems.

Eligible Levee. A levee categorized as "Active" in the RIP, for which the Army Corps of Engineers can provide assistance under authority of PL 84-99 to repair damage caused by a flood event.

Emergency. A situation involving a natural or technological disaster that would result in an unacceptable hazard to human life, a significant loss of property, or significant economic hardship.

Emergency Preparedness. All those activities and measures designed or undertaken to prepare for or minimize the effects of a hazard upon the civilian population, to deal with the immediate emergency conditions that would be created by the hazard, and to effectuate emergency repairs to, or the emergency restoration of, vital utilities and facilities destroyed or damaged by the hazard.

Federally Authorized Projects/Federal Projects. An FCW project built by the Army Corps of Engineers that was authorized for construction by Congress or by the Corps' continuing authorities (e.g., Section 205.)

Federal FCW/Federal Levee. A Federally authorized FCW, levee, or levee system project. FCWs constructed by non-federal interests, or other (non-Corps) federal agencies, and incorporated into a federal system by specific Congressional action (i.e., United States law) are also designated as federal FCWs. Construction by, or previous rehabilitation or reconstruction of a non-federal FCW by a federal Agency (to include the Army Corps of Engineers, FEMA, NRCS, and EDA) does not make the levee a federal levee. Levees constructed under the authority of the Works Progress Administration are not federal levees. Section 14 projects constructed under authority of PL 79-526 are not federal FCWs.

Flood. Abnormally high water flow or water level that overtops the natural or artificial confining boundaries of a waterway. A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of river and/or tidal waters and/or the unusual accumulations of waters from any sources.

Flood Control Project. See flood control work.

Flood Control Work(s) (FCW). Structures designed and constructed to have appreciable and dependable effects in preventing damage caused by irregular and unusual rises in water level. FCW may include levees, channels, floodwalls, dams, and Federally authorized and constructed hurricane or shore protective structures. Structures designed and constructed to protect against salt water intrusion or tidal fluctuations, channel alignment, navigation, recreation, fish and wildlife, land reclamation, or to protect against land erosion are not considered to be FCWs. A riprap bank erosion control structure is not considered to be a flood control work.

Flood Fighting. Actions taken immediately before or during a flood to protect human life and to reduce flood damages, such as evacuation, emergency sandbagging, and providing assistance to flood victims.

Flood Plain. Any normally dry land area that is susceptible to being inundated by any natural source, such as a stream, during floods. The Army Corps of Engineers, as a matter of policy, encourages local governments to zone their flood plains against development and thereby avoid property damage and reduce obstruction to passage of floodwaters.

Flood Stage. The water surface elevation of a river, stream, or body of water, above which flooding and damages normally begin to occur, normally measured with respect to a specific reference gage. Flood stage is normally the level at which a river overflows its banks. Flood stage for any particular geographic area is unique to that geographic area.

Floodwall. A type of flood control work usually constructed of stone or reinforced concrete, and which may occasionally have plastic or steel components. Floodwalls are generally constructed in urban areas where insufficient area exists to construct earthen levees.

Floodway. Designated land left essentially clear of development, for the purpose of passing floodwaters. In some areas, floodway is used to designate the 100-year flood plain.

Freeboard. A factor of safety usually expressed in feet above a flood level for purposes of designing flood protection facilities and for floodplain management. Freeboard tends to compensate for the many uncertain factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge obstructions, and the hydrological effect of urbanization of the watershed. Freeboard is being replaced as a technique through risk and uncertainty management.

Haul Road. Any privately owned road used by Corps vehicles or Corps contractor's vehicles to haul rock, earth fill, or other borrow materials to the site of a repair/flood fight/rehabilitation effort, or on which empty vehicles return. This includes haul roads specifically constructed for a repair/rehabilitation effort. Also included are levee crown roads and levee patrol roads that are not public roads, if their principal purpose is for access for maintenance, inspection, and flood fight purposes. All public roads are specifically excluded, to include any public roads that are situated on levees.

Hundred Year Flood. More accurately referred to as a "one percent chance flood," a flood of a magnitude that, according to historical statistics, has one chance in one hundred of occurring in any given year.

Imminent Threat. A subjective, statistically supported evaluation of how quickly a threat scenario can develop, how likely that threat is to develop in a given geographical location, and how likely the threat will produce catastrophic consequences to life and improved property. Implicit in the timing aspect can be considerations of time (e.g., a storm front's predicted path) or season (e.g., a snowpack that will melt in the coming spring runoff) or of known cyclical activities (e.g., rising water levels in the Great Lakes), but occurring inside the normal Corps decision and execution cycle for small project construction.

Inactive. A status applied to FCW concerning participation in the RIP. An Inactive project is, simply, any project that is not Active. It includes formerly Active FCW that left Active status in the RIP, either voluntarily or involuntarily, as well as those FCW that have never been Active in the RIP. See also "Active."

Initial Repair. A hastily effected temporary repair of a breached levee that provides a 10- to 25-year level of protection for a short (less than 12 month) period of time until the permanent repair can be designed and executed.

Interior Drainage. Natural or modified outflow of streams within a levee'd area for the conveyance of run-off. Interior drainage systems are not components of flood control works.

LEERRDs. Lands, easements, rights-of-way, relocations, and borrow and dredged or excavated materials disposal areas.

Levee. A structure, normally of earth or stone, built generally parallel to a river to protect land from flooding. A levee is a complete unit, designed and intended for flood control. A levee (excluding a ring levee) is always tied to high ground at both ends.

Level of Protection. The degree of protection against flooding provided by an FCW, normally expressed in terms of the cyclical flood-level against which protection is provided.

Local Cost Share. That portion of the cost of undertaking assistance authorized under PL 84-99 (e.g., repairing a damaged Active levee) for which the public sponsor is responsible. The local cost share may be paid either in cash or as work-in-kind, or as a combination of the two.

Major Flood. A flood event determined to be a 100-year event or better, or a series of weather events over a short period of time (normally seven days or less), which causes loss of human life and/or property damage exceeding \$1 million.

Non-Federal Levee/Non-Federal Project/Non-Federal FCW. A flood control work not authorized by Congress, or under other federal agency authority. Works Progress Administration (WPA) projects are considered non-federal FCW for the application of PL 84-99 authority.

Nonstructural Alternative Project. A type of project, authorized by an amendment to PL 84-99 contained in WRDA 96, that, in lieu of a structural rehabilitation effort, allows for restoration of floodways, flood plains, and/or the reduction of future flood damages and associated FCW rehabilitation costs.

Political Subdivision. A city, town, borough, township, county, parish, district, association, or other public body created by or pursuant to state law and having jurisdiction over the water supply of such public body.

Project Cooperation Agreement. An agreement entered into by a District Commander (acting as the agent for the Department of the Army on behalf of the United States Government) and the public sponsor for the purpose of identifying each party's rights and obligations concerning the expenditure of federal funds under the Army Corps of Engineers' authority other than that of PL 84-99. See also Cooperation Agreement.

Public Sponsor. A public sponsor is a legally constituted public body with full authority and capability to perform the terms of its agreement as the non-federal partner of the Corps for a project, and able to pay damages, if necessary, in the event of its failure to perform. A public sponsor may be a state, county, city, town, Federally recognized Indian tribe or tribal organization, Alaska Native Corporation, or any political subpart of a state or group of states that has the legal and financial authority and capability to provide the necessary cash contributions and lands, easements, rights-of-way, relocations, and borrow or dredged or excavated material disposal areas (LERRD's) necessary for the project.

Rehabilitation and Inspection Program (RIP). A component of the Civil Emergency Management Program concerned with the inspection and rehabilitation of FCWs.

Rehabilitation Assistance. Repair and restoration under authority of PL 84-99 of an Active FCW damaged in a flood event.

Rehabilitation Project. An action or series of actions focused on the repair of an Active flood control work to return the FCW's level of protection to its pre-flood/pre-storm level.

Repair and Rehabilitation. The terms "repair", "rehabilitation", or "repair and rehabilitation" mean the repair or rebuilding of a flood control structure, after the structure has been damaged by a flood, hurricane, or coastal storm, to the level of protection provided by the structure prior to the flood, hurricane, or coastal storm. The terms do not include improvements (betterments) to the structure, nor does "repair and rehabilitation" include any repair, reconstruction, or rehabilitation activities of a flood control structure which, in the normal course of usage, has become structurally unsound and is no longer fit to provide the level of protection for which it was designed.

Saturation.

(1) Soil Saturation. A condition in soil in which all spaces between the soil particles are filled with water. Such conditions normally occur after prolonged periods of rainfall and/or snowmelt. The result of a saturated condition is that any additional rainfall or snowmelt runs off into streams and rivers instead of soaking into the ground.

(2) Levee saturation. Soil saturation that has occurred in an earthen levee because of floodwaters remaining above flood stage for extremely long periods of time. This condition can lead to catastrophic failure of the levee.

Secondary Levee. A levee that is landward of the main or principal levee. The level of protection of a secondary levee is always less than the level of protection provided by the main levee.

Stream. A body of water flowing in a definite natural or manmade course that has the potential to flood. The term stream refers to rivers, streams, creeks, brooks, etc., and includes intermittent streams that are subject to flooding.

Unusual Flooding. For use with Advance Measures, a subjective determination that considers potential ability to approach an area's Flood of record, a catastrophic level of flooding, or a greater than 50-year level of flooding.

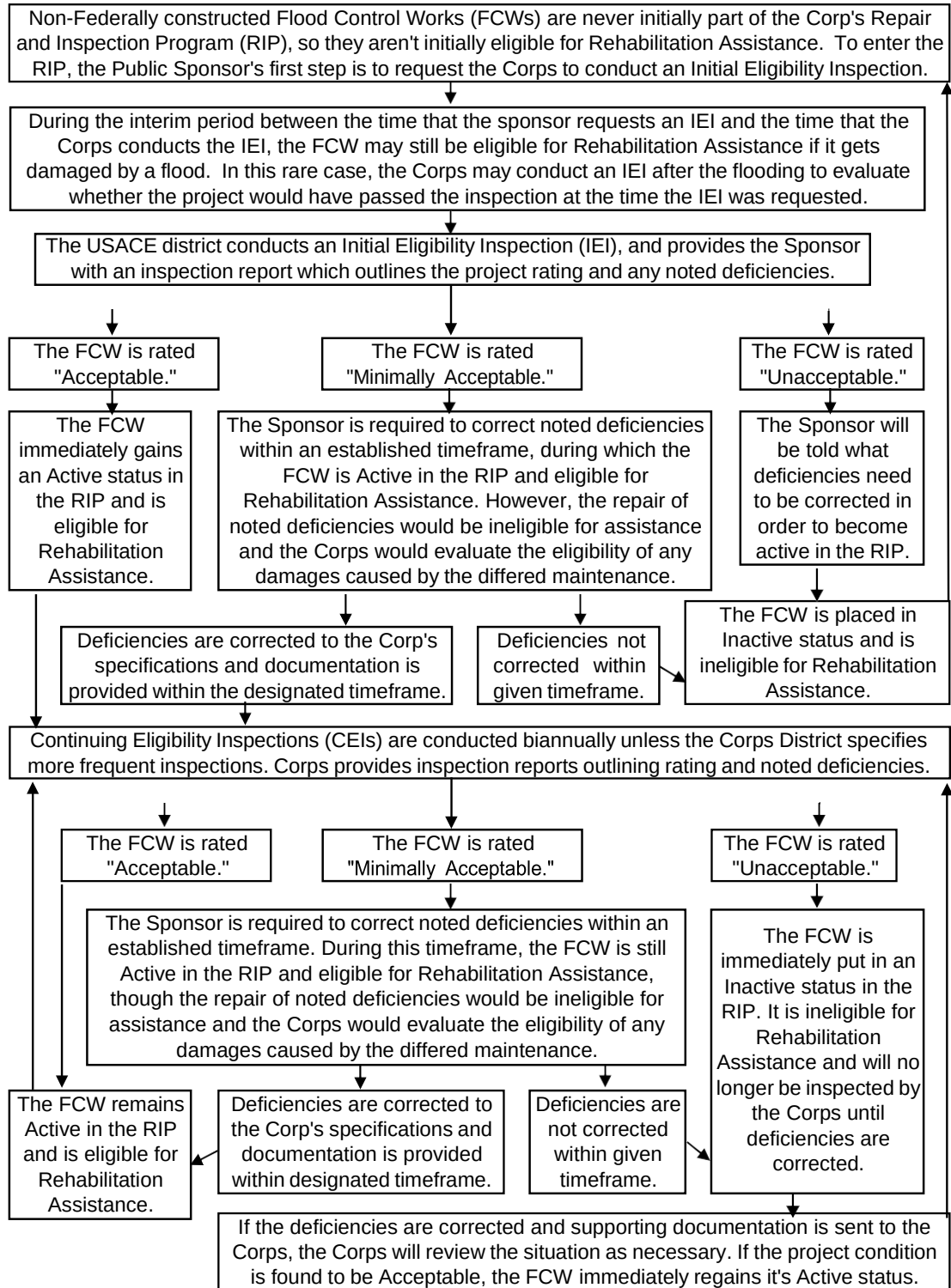
Urban areas. Cities, towns, or other incorporated or unincorporated political subdivisions of States that provide general local government for specific population concentrations, and occupy an essentially continuous area of developed land containing such structures as residences, public and commercial buildings, and industrial sites.

Urban Levee. A levee providing greater than a 10-year level of flood protection to a predominantly urban area.

Work-in-Kind. That portion of a public sponsor's cost share to rehabilitate a non-federal FCW that is a non-cash contribution. The work-in-kind may be in the form of labor, equipment, supplies, and/or services. Labor is defined as blue collar-type of work normally paid on an hourly wage basis, comparable to federal Wage Grade positions.

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APPENDIX B: Flowchart of RIP Eligibility and Inspection Processes for Non-Federal FCW



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APPENDIX C: FCW INSPECTION GUIDE

Public Sponsor Representative: _____

Overall Project Rating (Check One): ☐ **Acceptable**
☐ **Minimally Acceptable (Maintenance is required)**
☐ **Unacceptable**

Note: A plan view drawing of the Flood Control Works, with stationing, should be attached to this report to reference locations of items rated less than acceptable. Photos should be taken of general project condition and any noted deficiencies.

Basic Eligibility

For use only during Initial Eligibility Inspections of Non-Federally Constructed Flood Control Works

Page 1 of 1

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Public Sponsor (A or U only)					A The Public Sponsor is a legally constituted public body with full authority and capability to perform the terms of its agreement as the non-Federal partner of the Corps for a project, able to pay damages, if necessary, in the event of its failure to perform. The public sponsor may be a State, County, City, Town, Federally recognized Indian Tribe or tribal organization, Alaska Native Corporation, or any political subpart of a State or group of states that has the legal and financial authority and capability to provide the necessary cash contributions and the lands, easements, rights-of-way, relocations, and borrow and dredged or excavated materials disposal areas (LERRD's) necessary for the project, and who could legally hold and save the Federal government free from damages that could potentially arise during post-flood rehabilitations or other work on the FCW. U The project does not have a public sponsor as defined above.	
2. Flood Protection (A or U only)					A The principal function of the project is to protect people or property from floods. U The project was built or is primarily used for channel alignment, recreation, fish and wildlife, land reclamation, drainage, to protect against land erosion or tidal inflows, or for some other non-flood related purpose.	
3. Project Completion (A or U only)					A Project construction has been completed. U The project is still under construction.	
4. Construction Compliance (A or U only)					A Appropriate local, State, tribal, and/or Federal permits (right-of-way, easements, regulatory permits, etc.), or waivers thereof, have been obtained for FCW construction and subsequent modifications. The project was constructed in accordance with all applicable Federal, state and local codes, ordinances, and applicable laws. U The appropriate permits (or waivers thereof) have not been obtained for the project, or the project was not constructed in accordance with applicable codes, ordinances, and laws.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

FCW Engineering

Page 1 of 2

For use only during Initial Eligibility Inspections of Non-Federally Constructed Flood Control Works

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Minimum Elevation (A or U only) (See instructions)					A • Urban Levees and Floodwalls- Minimum elevation corresponding to a flood level with 10% probability of occurring in a given year (10-year flood). • Agricultural Levees and Floodwalls- Minimum elevation corresponding to a flood level with 20% probability of occurring in a given year (5-year flood). • Flood Control Channels- Minimum capacity is for a flood with a 10% probability of occurring in a given year (10-year flood). Improved channels must additionally provide drainage for at least 1.5 square miles of land and have a capacity of at least 800 cfs. (NOTE: Interior drainage channels within the protected area of a levee system are not flood control channels.)	
					U The FCW does not meet requirements for minimum elevation, capacity, or drainage area.	
2. Physical Location and Cross Section (A or U only)					A The physical location, cross section, and other design elements of the FCW are sufficient to provide reliable flood protection. The FCW is (or is an element of) a closed system, tied into high ground.	
					U The FCW was not constructed in an appropriate location, does not have an appropriate cross section; is not properly tied into high ground, or has other shortcomings with design elements necessary for providing reliable flood protection.	
3. Embankment Fill					A Embankment material is suitable to prevent slides and seepage problems.	
					U Embankment material is unsuitable and is likely to contribute to the development of slides or seepage problems.	
4. Embankment Material Uniformity/ Compactness					A Fill material is uniform and adequately compacted throughout the entire FCW.	
					M Fill material is uniform and adequately compacted in 75% or more of the FCW.	
					U Fill material is not uniform, or there is no compaction and evidence indicates a need for compaction.	
5. Foundations					A Foundation material will not cause piping, sand boils, seepage, or settlements that will reduce the level of protection.	
					M Foundation material may show signs of excessive seepage, minor sand boils, and localized settlement.	
					U Foundation materials are unsuitable and likely to cause excessive uncontrolled seepage, sand boils, and / or piping.	
					N/A The foundation problems described above do not apply to this type of FCW.	
6. Primary Levee					A In the case of a levee project, the levee is a primary levee or is a secondary levee which is designed to protect human life or was designed as a major component of the primary levee system, necessary to assure the flood control protection of the total system.	
					U The levee is a secondary levee, and was not designed to protect human life or as a major component of the primary levee system.	
					N/A The FCW is not a levee system.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

FCW Engineering - Continued on Next Page

FCW Engineering (continued)

Page 2 of 2

For use only during Initial Eligibility Inspections of Non-Federally Constructed Flood Control Works

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
7. Interior Drainage System (including culverts, gates, pump stations)					A Given the level of protection provided by the FCW, interior drainage structures are appropriately sized, situated, and constructed to move anticipated runoff and seepage out of the protected area. Pump stations will not become inundated during regular operation and their power system is adequately designed and reliable.	
					U Interior drainage structures are undersized, poorly constructed, poorly situated, or unreliably designed.	
					N/A The issue of interior drainage does not apply to this type of FCW.	
8. Structures					A Structures are capable of performing their designed functions and show no signs of failure.	
					M Structures are performing their design functions but show signs of overtopping and bypassing flows.	
					U Structures are not performing their designed functions or show signs of potential structural failure.	
9. Erosion Control					A Erosion protection is capable of handling the designed flow velocity for the level of protection for the entire FCW. The FCW is protected against bank caving and slides in all necessary areas, and has adequate drainage to protect FCW slopes from runoff erosion.	
					M Erosion protection is capable of handling the designed flow velocity for the level of protection for 75% or more of the FCW.	
					U Erosion protection measures protect less than 75% of the FCW. Erosion protection is not present and there is evidence indicating a need for erosion protection.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

General Items for All Flood Control Works

For use during Initial and Continuing Eligibility Inspections of all Flood Control Works

Page 1 of 1

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Project Operations and Maintenance Manual (A or U only)					A Levee Owner's Manual, ICW O&M Manuals, and/or manufacturer's operating instructions are present.	
					U These manuals are lost or missing.	
2. Emergency Supplies and Equipment					A The sponsor maintains a stockpile of sandbags, shovels, and other flood fight supplies which will adequately supply all needs for the initial days of a flood fight.	
					M The sponsor does not maintain an adequate supply of flood fighting materials as part of their preparedness activities.	
3. Flood Preparedness and Training (A or M only)					A Sponsor has a solid understanding of how to operate, maintain, and staff the FCW during a flood, and has written plans that include information such as low spots or sand boils. The sponsor also has plans that cover short term situations. (For instance, if a culvert through the levee is being replaced, then the sponsor knows how to respond to a flood while the levee integrity is lacking due to the construction.)	
					M The sponsor maintains a good working knowledge of flood response activities, but there are insufficient plans to address project specific features or short term situations, or the knowledge of flood response activities is maintained by a very small number of individuals within the community. Additional planning or training is required to ensure the success of the FCW during a flood event.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Levees

Page 1 of 3

For use during all Initial and Continuing Eligibility Inspections of levees

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Sod Cover					A There is good coverage of sod cover over the levee.	
					M Approximately 25% of the sod cover is missing or damaged over a significant portion or over significant portions of the levee embankment. This may be the result of over-grazing or feeding on the levee, unauthorized vehicular traffic, chemical or insect problems, or burning during inappropriate seasons.	
					U Over 50% of the sod cover is missing or damaged over a significant portion or over significant portions of the levee embankment. This may be the result of over-grazing or feeding on the levee, unauthorized vehicular traffic, chemical or insect problems, or burning during inappropriate seasons.	
2. Unwanted Vegetation Growth					A The levee has a good grass cover with little or no unwanted vegetation (trees, bushes, or undesirable weeds) and has been recently mowed. Except in those cases where a vegetation variance has been granted by the Corps, a 5 meter (15') zone, free from all woody vegetation, is maintained adjacent to the landward/ riverside toe of the FCW for maintenance and flood-fighting activities. Additionally, a 1 meter (3') root free zone is maintained to protect the external limits of the levee cross section. Reference EM 1110-2-301 and/or local Corps policy.	
					M Minimal number of trees (5 cm (2") diameter or smaller) and/or brush present on the levee or within the 5 meter (15') zone, that will not threaten the integrity of the project but which need to be removed.	
					U Tree, weed, and brush cover exists in the FCW requiring removal to reestablish or ascertain FCW integrity. (NOTE: If significant growth on levees exists, prohibiting the inspection of animal burrows or other inspection items, then the levee inspection should be ended until this item is corrected.)	
3. Depressions/ Rutting					A There are no ruts, pot holes, or other depressions on the levee, except for minor depressions caused by levee settlement. The levee crown, embankments, and access road crowns are well established and drain properly without any ponded water.	
					M Some minor depressions in the levee crown, embankment, or access roads that will not pond water and do not threaten the integrity of the levee.	
					U There are depressions greater than 15 cm (6 inches) deep that will pond water, endangering the integrity of the levee.	
4. Erosion/ Bank Caving					A No active erosion or bank caving observed on the landward or on the riverward side of the levee.	
					M There are areas where active erosion is occurring or has occurred on or near the levee embankment, but levee integrity is not threatened.	
					U Erosion or caving is occurring or has occurred that threatens the stability and integrity of the levee. The erosion or caving has progressed into the levee section or into the extended footprint of the levee foundation and has compromised the levee foundation stability.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Levees - Continued on Next Page

Levees (continued)

Page 2 of 3

For use during all Initial and Continuing Eligibility Inspections of levees

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
5. Slope Stability					A No slides present.	
					M Minor superficial sliding that with deferred repairs will not pose an immediate threat to FCW integrity.	
					U Evidence of deep seated sliding that threatens FCW integrity. Repairs are required to reestablish FCW integrity.	
6. Cracking					A No cracking observed on the levee greater than 15 cm (6 inches) deep.	
					M Longitudinal and/or transverse cracking greater than 15 cm (6 inches) deep. No evidence of vertical movement along the crack.	
					U Longitudinal and/or transverse cracking present and exhibits signs of vertical movement.	
7. Animal Control					A Continuous animal burrow control program in place that includes the elimination of active burrowing and the filling in of existing burrows.	
					M The existing animal burrow control program needs to be improved. Several animal burrows present which may lead to seepage or slope stability problems, and they require immediate attention.	
					U Animal burrow control program is not effective or is nonexistent. Significant maintenance is required to fill existing burrows, and the levee will not provide reliable flood protection until this maintenance is complete.	
8. Encroachments					A No trash, debris, excavations, structures, or other obstructions present within the project easement area. Encroachments which do not diminish proper functioning of the project have been previously approved by the Corps.	
					M Trash, debris, excavations, structures, or other obstructions present, or inappropriate activities that will not inhibit project operations and maintenance or emergency operations. Encroachments have not been approved by the Corps.	
					U Trash, debris, excavation, structures, or other obstructions present, or inappropriate activities that will inhibit project operations and maintenance or emergency operations.	
9. Riprap Revetments & Banks					A Existing riprap protection is properly maintained and is undamaged. Riprap clearly visible.	
					M No riprap displacement or scouring activity that could undercut banks, erode embankments, or restrict desired flow. Unwanted vegetation must be cleared and sprayed with an appropriate herbicide.	
					U Dense brush, trees, or grasses hide the rock protection, or meandering and/or scour activity is undercutting banks, eroding embankments, or impairing channel flows by causing turbulence or shoaling.	
					N/A There is no riprap protecting the levee.	

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Levees - Continued on Next Page

Levees (continued)

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For use during all Initial and Continuing Eligibility Inspections of levees

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
10. Closure Structures (Stop Log, Earthen Closures, or Gates) (A or U only)					A Closure structure in good repair. Placing equipment, stoplogs, and other materials are readily available at all times. Components of closure clearly marked and installation instructions / procedures readily available.	
					U Closure structure in poor condition. Parts missing or corroded. Placing equipment may not be available within normal warning time.	
					N/A There are no closure structures along the levee.	
11. Underseepage Relief Wells/ Toe Drainage Systems					A Toe drainage systems and pressure relief wells necessary for maintaining FCW stability during flood events functioned properly during the last flood event and no sediment is observed in horizontal system (if applicable). Nothing is observed which would indicate that the system won't function properly during the next flood.	
					M Toe drainage systems or pressure relief wells are damaged and may become clogged if they are not repaired.	
					U Toe drainage systems or pressure relief wells necessary for maintaining FCW stability during flood events have fallen into disrepair or have become clogged.	
					N/A There are no relief wells/ toe drainage systems along the levee.	

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Additional issues noted during the inspection:

Concrete Floodwalls

For use during all Initial and Continuing Eligibility Inspections of concrete floodwalls

Page 1 of 2

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Concrete Surfaces					A Negligible spalling, scaling or cracking. If the concrete surface is weathered, rough to the touch, or holds moisture, it is still satisfactory but should be seal coated to prevent freeze/ thaw damage.	
					M Spalling, scaling, and open cracking present, but the immediate integrity or performance of the structure is not threatened. Reinforcing steel may be exposed. Repairs/ sealing is necessary to prevent additional damage during periods of thawing and freezing.	
					U Surface deterioration or deep, controlled cracks present that result in an unreliable structure.	
2. Tilting, Sliding or Settlement of Concrete and Sheet Pile Structures					A There are no significant areas of tilting, sliding, or settlement that would endanger the integrity of the project.	
					M There are areas of tilting, sliding, or settlement (either active or inactive) that need to be repaired. The integrity of the structure is not in danger.	
					U There are areas of tilting, sliding, or settlement (either active or inactive) that threaten the structure's integrity and performance.	
3. Foundation of Concrete and Sheet Pile Structures					A No scouring / erosion, or undermining near the structure.	
					M Scouring / erosion near the footing of the structure but not close enough to affect structure stability during the next flood.	
					U Scouring or undermining at the foundation that has affected structural integrity.	
4. Monolith Joints					A The monolith joint material is in good condition.	
					M The monolith joint material is deteriorating and needs to be repaired or replaced to prevent spalling and cracking during freeze/ thaw cycles.	
					U The monolith joint material is severely deteriorated and the concrete has spalled and cracked, damaging the waterstop to the point where it will not provide the intended level of protection during a flood.	
					N/A There are no monolith joints in the floodwall.	
5. Erosion/ Bank Caving					A No active erosion or bank caving on the riverward side of the floodwall which might endanger its stability.	
					M There are areas where the ground is eroding towards the base of the floodwall and efforts need to be taken to slow and repair this erosion, but the erosion has not yet progressed to the point that the floodwall will lose stability during a flood event.	
					U Erosion or bank caving is occurring or has occurred riverward of the levee which threatens the stability of the floodwall.	

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Concrete Floodwalls- Continued on the next page

Concrete Floodwalls (continued)

Page 2 of 2

For use during all Initial and Continuing Eligibility Inspections of concrete floodwalls

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
6. Unwanted Vegetation Growth					A A grass-only zone is maintained on both sides the floodwall. All trees, brush, and unwanted vegetation have been removed from this zone for maintenance, flood-fighting activities, and to protect the floodwall. The grass-only zone extends from the concrete wall to a point 2.5 meters (8') beyond the underground toe and heel of the floodwall. Reference EM 1110-2-30 and/or local Corps policy.	
					M There are some areas where unwanted vegetation is growing near the floodwall. This vegetation must be removed, but does not currently threaten the integrity of the project.	
					U There is a significant amount of tree, weed, or brush growth near the floodwall, which may limit access during flood fight operations or the roots of which may offer accelerated seepage paths under the structure.	
7. Encroachments					A No trash, debris, excavations, structures, or other obstructions present within the project easement area. Encroachments which do not diminish proper functioning of the project have been previously approved by the Corps.	
					M Trash, debris, excavations, structures, or other obstructions present, or inappropriate activities that will not inhibit project operations and maintenance or emergency operations. Encroachments have not been approved by the Corps.	
					U Trash, debris, excavation, structures, or other obstructions present, or inappropriate activities that will inhibit project operations and maintenance or emergency operations.	
8. Closure Structures (Stop Log Closures and Gates) (A or U only)					A Closure structure in good repair. Placing equipment, stoplogs, and other materials are readily available at all times. Components of closure clearly marked and installation instructions / procedures readily available.	
					U Closure structure in poor condition. Parts missing or corroded. Placing equipment may not be available within normal warning time.	
					N/A There are no closure structures along the floodwall.	
9. Underseepage Relief Wells/ Toe Drainage Systems					A Toe drainage systems and pressure relief wells necessary for maintaining FCW stability during flood events functioned properly during the last flood event and no sediment is observed in horizontal system (if applicable). Nothing is observed which would indicate that the system won't function properly during the next flood.	
					M Toe drainage systems or pressure relief wells are damaged and may become clogged if they are not repaired.	
					U Toe drainage systems or pressure relief wells necessary for maintaining FCW stability during flood events have fallen into disrepair or have become clogged.	
					N/A There are no relief wells/ toe drainage systems along the floodwall.	

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Additional issues noted during the inspection:

Interior Drainage System

Page 1 of 4

For use during all Initial and Continuing Eligibility Inspections of systems carrying interior drainage through the FCW

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Vegetation and Obstructions					A Minimal, scattered obstructions or vegetation. The flow is not impeded.	
					M Log jams, snags, vegetation growth (such as cat tails, bull rushes, bushes, or saplings), or other obstructions block approximately 25% of the FCW.	
					U Log jams, snags, vegetation growth (such as cat tails, bull rushes, bushes, or saplings), or other obstructions block approximately 50% of the FCW.	
2. Encroachments					A No trash, debris, excavations, structures, or other obstructions present within the project easement area. Encroachments which do not diminish proper functioning of the project have been previously approved by the Corps.	
					M Trash, debris, excavations, structures, or other obstructions present, or inappropriate activities that will not inhibit project operations and maintenance or emergency operations. Encroachments have not been approved by the Corps.	
					U Trash, debris, excavation, structures, or other obstructions present, or inappropriate activities that will inhibit project operations and maintenance or emergency operations.	
3. Riprap Revetments of Inlet/ Discharge Areas					A Existing riprap protection is properly maintained and is undamaged. Riprap clearly visible.	
					M No riprap displacement or scouring activity that could undercut banks, erode embankments, or restrict desired flow. Unwanted vegetation must be cleared and sprayed with an appropriate herbicide.	
					U Dense brush, trees, or grasses hide the rock protection, or meandering and/or scour activity is undercutting banks, eroding embankments, or impairing channel flows by causing turbulence or shoaling.	
					N/A There is no riprap protecting the interior drainage system, or the riprap is discussed in another section.	
4. Erosion of Inlet/ Discharge Areas					A No active erosion or bank caving observed on the landward or on the riverward side of the levee.	
					M There are areas where active erosion is occurring or has occurred on or near the levee embankment, but levee integrity is not threatened.	
					U Erosion or caving is occurring or has occurred that threatens the stability and integrity of the levee. The erosion or caving has progressed into the levee section or into the extended footprint of the levee foundation and has compromised the levee foundation stability.	
					N/A There are no inlet/discharge areas.	

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Interior Drainage - Continued on Next Page

Interior Drainage System (continued)

Page 2 of 4

For use during all Initial and Continuing Eligibility Inspections of systems carrying interior drainage through the FCW

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
5. Blockage of Culverts (Inlets, Sump, and Discharge Areas)					A There is little or no debris, sediment, or vegetation blocking the culverts, inlets, sump, or discharge areas. The channel capacity for designed flow is not affected.	
					M Debris, sediment, or vegetation blocks less than 10 percent of the culvert opening, but must be removed.	
					U Accumulated debris, sediment, or vegetation blocks more than 10 percent of the culvert opening, impairing the culvert's capacity and hydraulic effectiveness.	
					N/A There are no culverts.	
6. Culverts					A There are no breaks, holes, cracks in the culvert that would result in significant water leakage. Corrugated metal pipes, if present, are in good condition or have been relined with appropriate material, which is still in good condition.	
					M There are breaks, holes, cracks in the culvert that would result in water leakage and need to be repaired, but do not threaten the integrity of the project. Corrugated metal pipes, if present, are showing deterioration but the entire length of pipe is still structurally sound and is not in danger of collapsing.	
					U Culvert has deterioration and/or has significant leakage such that it threatens the integrity of the FCW. Corrugated metal pipes are in danger of collapsing or have already begun to collapse.	
					N/A There are no culverts.	
8. Trash Racks (non-mechanical)					A Trash racks are fastened in place and properly maintained.	
					M Trash racks are in place but are unfastened or have bent bars that allow debris to enter into the pipe or pump station. Repair or replacement is required.	
					U Trash rack is missing or damaged to the extent that it is no longer functional and must be replaced.	
					N/A There are no trash racks.	
9. Flap Gates/Flap Valves/ Pinch Valves RODI					A Flap gates open and close easily with minimal leakage. Gates show no corrosion damage and have been maintained.	
					M Gate will not fully open or close because of obstructions that can be easily removed, or has corrosion damage that requires maintenance.	
					U Gate is missing, has been damaged, or has deteriorated and needs repair.	
					N/A There are no flap gates.	

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Interior Drainage - Continued on Next Page

Interior Drainage System (continued)

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For use during all Initial and Continuing Eligibility Inspections of systems carrying interior drainage through the FCW

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
10. Sluice / Slide Gates RODI					A Gates open and close freely with minor leakage. Sill is free of sediment and other obstructions. Gates and lifters have been maintained.	
					M Gates have been damaged or have deteriorated, and open and close with resistance or binding. Leakage quantity is controllable and is not a threat to project performance. Maintenance is required.	
					U Gates do not open or close. Gate, stem, lifter and/or guides may be damaged or corroded.	
					N/A There are no sluice/ slide gates.	
11. Electric Gate Operators for Sluice / Slide Gates RODI					A All electric gate operators are in good working condition and are adequately powered, and are capable of opening and closing the gate properly. Preventative maintenance is being performed and the system is tested periodically.	
					M All electric gate operators are operational with minor deficiencies, but should perform through the next period of usage.	
					U The electric gate operators are not operational, or the power source is not considered reliable to sustain operations during flood conditions.	
					N/A There are no electric gate operators.	
12. Manual Operators (Backups) for Sluice / Slide Gates RODI					A All manual gate operators are in good working condition and are capable of opening and closing the gate properly. Preventative maintenance is being performed and the system is tested periodically.	
					M Manual gate operators are operational with minor deficiencies, but should perform through the next period of usage.	
					U Manual gate operators are not operational.	
					N/A If there are sluice or slide gates, there needs to be means of operating them manually. If there are no sluice/slide gates, this item is N/A.	
13. Concrete Surfaces (Such as gate wells, outfalls, intakes, or culverts)					A Negligible spalling, scaling or cracking. If the concrete surface is weathered, rough to the touch, or holds moisture, it is still satisfactory but should be seal coated to prevent freeze/ thaw damage.	
					M Spalling, scaling, and open cracking present, but the immediate integrity or performance of the structure is not threatened. Reinforcing steel may be exposed. Repairs/ sealing is necessary to prevent additional damage during periods of thawing and freezing.	
					U Surface deterioration or deep, controlled cracks present that result in an unreliable structure.	
					N/A There are no concrete surfaces.	

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Interior Drainage - Continued on Next Page

Interior Drainage System (continued)

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For use during all Initial and Continuing Eligibility Inspections of systems carrying interior drainage through the FCW

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
14. Tilting, Sliding or Settlement of Concrete and Sheet Pile Structures (Such as gate wells, outfalls, intakes, or culverts)					A There are no significant areas of tilting, sliding, or settlement that would endanger the integrity of the project.	
					M There are areas of tilting, sliding, or settlement (either active or inactive) that need to be repaired. The integrity of the structure is not in danger.	
					U There are areas of tilting, sliding, or settlement (either active or inactive) that threaten the structure's integrity and performance.	
					N/A There are no concrete structures.	
15. Foundation of Concrete Structures (Such as gate wells, outfalls, or culverts)					A No scouring / erosion, or undermining near the structure.	
					M Scouring / erosion near the footing of the structure but not close enough to affect structure stability during the next flood.	
					U Scouring or undermining at the foundation that has affected structural integrity.	
					N/A There are no concrete structures.	
16. Safety Fencing RODI					A Safety/ security fencing is in good condition and provides protection against falling or unauthorized access. Gates open and close freely, locks are in place, and there is little corrosion on metal parts.	
					M Safety/ security fencing or gates are damaged or corroded but appear to be maintainable. Locks may be missing or damaged.	
					U Safety/ security fencing and gates are damaged or corroded to the point that replacement is required, or potentially dangerous project features are not secured.	
					N/A There are no features of the internal drainage system that require safety fencing.	
17. Other Metallic Items					A All metal parts are protected from corrosion damage, and show no rust, damage, or deterioration that would cause a safety concern.	
					M Corrosion seen on metallic parts appear to be maintainable.	
					U Metallic parts are severely corroded and require replacement to prevent failure, equipment damage, or safety issues.	
					N/A There are no other significant metallic items associated with the interior drainage system.	

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Additional issues noted during the inspection:

Pump Stations

Page 1 of 4

For use during all Initial and Continuing Eligibility Inspections of pump stations

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Pump Stations Operating Log (A or U only)					A Operation and maintenance log is present at the pump station and is being used and updated, and personnel have been trained in pump station operations. Names and last training date shown in the log book.	
					U No operating log present, or refresher training for personnel has not been conducted.	
2. Pump Station Operations and Maintenance Manual (A or U only)					A Operation and Maintenance Manual and/or posted operating instructions are present and adequately cover all pertinent pump station features.	
					U Operation and Maintenance Manual missing or sponsor is unsure of location.	
3. Plant Building					A The building is in good structural condition, with no major cracks in concrete or brick. The roof is not leaking, exhaust fans are operational, there are no exposed electrical components, and the working environment is safe.	
					M There is significant cracking in the building structure, or the building is damaged in other ways such that it needs repair but does not threaten pumping operations.	
					U The structural integrity or stability of the building is threatened, or there is other damage to the building such that pumping operations can not be performed as intended.	
4. Communications (A or U only)					A A telephone, cellular phone, two-way radio, or similar device is available to pump station operator and maintenance personnel.	
					U A telephone, cellular phone, two-way radio, or similar device is <u>not</u> available to pump station operator and maintenance personnel.	
5. Safety (A or U only)					A Exhaust fans, vents/louvers are working properly. Fuel storage / distribution meets state / local requirements. Fire extinguishers of sufficient quality, quantity, and type are on hand and are properly charged. Safety hardware (hand rails, grates for wet-wells, etc) is installed. Required safety items used (hearing, eyes, etc).	
					U Safety issues exist that could cause injury or loss of life.	
6. Safety Fencing RODI					A Safety/ security fencing is in good condition and provides protection against falling or unauthorized access. Gates open and close freely, locks are in place, and there is little corrosion on metal parts.	
					M Safety/ security fencing or gates are damaged or corroded but appear to be maintainable. Locks may be missing or damaged.	
					U Safety/ security fencing and gates are damaged or corroded to the point that replacement is required, or potentially dangerous project features are not secured.	
					N/A There are no features in or around the pump stations that require safety fencing.	

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Pump Stations - Continued on Next Page

Pump Stations (continued)

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For use during all Initial and Continuing Eligibility Inspections of pump stations

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
7. Cranes RODI					A Crane operational, and have been inspected and load tested in accordance with OSHA requirements.	
					M Crane has not been inspected or operationally tested with the past year, or there are visible signs of corrosion, oil leakage, etc, requiring maintenance.	
					U Crane not operational, or tagged out of service.	
					N/A There are no cranes.	
8. Pumps					A All pumps are properly maintained and lubricated. Systems are periodically tested, and there is no evidence of cavitation, vibrations, or unusual sounds.	
					M Minor deficiencies exist which need to be closely monitored or repaired, such as the presence of minor vibrations or the corrosion of the pump shaft housing. However, the pumps are operational and are expected to perform through the next period of usage.	
					U One or more of the pumps are not operational, or the pump capacity has degraded to the point where project performance is in question.	
9. Power (A or U only)					A The power source is adequate, safe, and reliable. Backup generators are on hand or there is a reliable backup power plan in place. Backup units are properly sized, operational, periodically exercised, and properly maintained.	
					U Power source not considered safe or reliable to sustain operations during flood conditions.	
10. Insulation Megger Testing					A Results of megger tests show that the insulation meets manufacturer's or industry standards. Tested within the last 2 years.	
					M Results of megger test show that insulation resistance is lower than manufacturer's or industry standard, but can be corrected with proper application of heat, or megger testing not conducted with the last 2 years.	
					U Megger tests not conducted within past three years or indicate that insulation resistance is low enough that the equipment will not be able to meet design standards of operation; or evidence of arching or shorting is detected visually.	
11. Motors, Engines, Fans and Gear Reducers					A All items are operational. Preventative maintenance and lubrication is being performed and the system is periodically subjected to performance testing. Instrumentation, alarms, and auto shutdowns are operational.	
					M Systems have minor deficiencies, but are operational and will function adequately through the next flood.	
					U One or more of the primary motors or systems is not operational.	

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Pump Stations - Continued on Next Page

Pump Stations (continued)

Page 3 of 4

For use during all Initial and Continuing Eligibility Inspections of pump stations

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
12. Pump Control Systems					A Operational and maintained free of damage, corrosion, or other debris.	
					M Operational with minor discrepancies. Will function adequately during the next flood event.	
					U Pump controls not operational. May not function adequately during the next flood event.	
13. Sumps / Wet well					A Clear of excessive debris, sediment, or other obstructions. Procedures are in place to remove debris accumulation during operation.	
					M Debris, sediment, or other obstructions are present and must be removed, but the sump/ wet well will function as intended during the next flood. Procedures are in place to remove debris accumulation during operation.	
					U Large debris or excessive silt present which will hinder or damage pumps during operation, or no procedures have been established to remove debris accumulation during operation.	
14. Trash Rakes (Mechanical Operations) RODI					A Drive chain, bearing, gear reducers, and other components are in good operating condition and are being properly maintained.	
					M The trash rake is in need of maintenance, but is still operational.	
					U Trash rake not operational or deficiencies will inhibit operations during the next flood event.	
					N/A There are no mechanical trash rakes.	
15. Trash Racks (non-mechanical)					A Trash racks are fastened in place and properly maintained.	
					M Trash racks are in place but are unfastened or have bent bars that allow debris to enter into the pipe or pump station. Repair or replacement is required.	
					U Trash rack is missing or damaged to the extent that it is no longer functional and must be replaced.	
					N/A There are no non-mechanical trash racks.	
16. Sluice / Slide Gates RODI					A Gates open and close freely with minor leakage. Sill is free of sediment and other obstructions. Gates and lifters have been maintained.	
					M Gates have been damaged or have deteriorated, and open and close with resistance or binding. Leakage quantity is controllable and is not a threat to project performance. Maintenance is required.	
					U Gates do not open or close. Gate, stem, lifter and/or guides may be damaged or corroded.	
					N/A There are no sluice/slide gates.	

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Pump Stations - Continued on Next Page

Pump Stations (continued)

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For use during all Initial and Continuing Eligibility Inspections of pump stations

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
17. Electric Gate Operators for Sluice / Slide Gates (Intake/ Discharge) RODI					A All electric gate operators are in good working condition and are adequately powered, and are capable of opening and closing the gate properly. Preventative maintenance is being performed and the system is tested periodically.	
					M All electric gate operators are operational with minor deficiencies, but should perform through the next period of usage.	
					U The electric gate operators are not operational, or the power source is not considered reliable to sustain operations during flood conditions.	
					N/A There are no electric gate operators.	
18. Manual Operators (Backups) for Sluice / Slide Gates RODI					A All manual gate operators are in good working condition and are capable of opening and closing the gate properly. Preventative maintenance is being performed and the system is tested periodically.	
					M Manual gate operators are operational with minor deficiencies, but should perform through the next period of usage.	
					U Manual gate operators are not operational.	
					N/A If there are sluice or slide gates, there needs to be means of operating them manually. If there are no sluice/slide gates, this item is N/A.	
19. Other Metallic Items (Equipment, Ladders, Platform Anchors, etc)					A All metal parts are protected from corrosion damage, and show no rust, damage, or deterioration that would cause a safety concern.	
					M Corrosion seen on metallic parts appear to be maintainable.	
					U Metallic parts are severely corroded and require replacement to prevent failure, equipment damage, or safety issues.	
					N/A There are no other significant metallic items associated with the pump stations.	

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Additional issues noted during the inspection:

Earthen (Excavated) Flood Control Channels

Page 1 of 2

For use during all Initial and Continuing Eligibility Inspections of excavated flood control channels

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Vegetation and Obstructions					A There are minimal obstructions or vegetation blocking the FCW.	
					M The channel is obstructed by minor log jams, snags, or vegetation. Less than 20% of the channel is obstructed.	
					U Obstructions or vegetation growth have obstructed over 20% of the river or channel.	
2. Shoaling					A No shoaling present.	
					M Non-aquatic grasses present on shoal. No trees or brush is present on shoal, and channel flow is not impeded.	
					U Shoaling is well established, stabilized by trees, brush, or other vegetation. Shoals are diverting flow to channel bank causing bank erosion and undercutting.	
3. Encroachments					A No trash, debris, excavations, structures, or other obstructions present within the project easement area. Encroachments which do not diminish proper functioning of the project have been previously approved by the Corps.	
					M Trash, debris, excavations, structures, or other obstructions present, or inappropriate activities that will not inhibit project operations and maintenance or emergency operations. Encroachments have not been approved by the Corps.	
					U Trash, debris, excavation, structures, or other obstructions present, or inappropriate activities that will inhibit project operations and maintenance or emergency operations.	
4. Riprap Revetments & Banks					A Existing riprap protection is properly maintained and is undamaged. Riprap clearly visible.	
					M No riprap displacement or scouring activity that could undercut banks, erode embankments, or restrict desired flow. Unwanted vegetation must be cleared and sprayed with an appropriate herbicide.	
					U Dense brush, trees, or grasses hide the rock protection, or meandering and/or scour activity is undercutting banks, eroding embankments, or impairing channel flows by causing turbulence or shoaling.	
					N/A There is no riprap protecting the channel.	
5. Erosion					A No head cutting or horizontal deviation observed.	
					M Head cutting and horizontal deviation evident, but is less than 30 cm (1 foot) from the designed grade or cross section.	
					U Apparent head cutting and horizontal deviation of more than 30 cm (1 foot) from the designed grade or cross section. Corrective actions required to stop or slow erosion.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Earthen Flood Control Channels - Continued on Next Page

Earthen (Excavated) Flood Control Channels (continued)

Page 2 of 2

For use during all Initial and Continuing Eligibility Inspections of excavated flood control channels

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
6. Concrete Surfaces					A Negligible spalling, scaling or cracking. If the concrete surface is weathered, rough to the touch, or holds moisture, it is still satisfactory but should be seal coated to prevent freeze/ thaw damage.	
					M Spalling, scaling, and open cracking present, but the immediate integrity or performance of the structure is not threatened. Reinforcing steel may be exposed. Repairs/ sealing is necessary to prevent additional damage during periods of thawing and freezing.	
					U Surface deterioration or deep, controlled cracks present that result in an unreliable structure.	
					N/A There are no concrete structures associated with the flood control channel.	
7. Tilting, Sliding or Settlement of Concrete Structures					A There are no significant areas of tilting, sliding, or settlement that would endanger the integrity of the project.	
					M There are areas of tilting, sliding, or settlement (either active or inactive) that need to be repaired. The integrity of the structure is not in danger.	
					U There are areas of tilting, sliding, or settlement (either active or inactive) that threaten the structure's integrity and performance.	
					N/A There are no concrete structures associated with the flood control channel.	
8. Foundation of Concrete Structures					A No scouring / erosion, or undermining near the structure.	
					M Scouring / erosion near the footing of the structure but not close enough to affect structure stability during the next flood.	
					U Scouring or undermining at the foundation that has affected structural integrity.	
					N/A There are no concrete structures associated with the flood control channel.	
9. Flap Gates/Flap Valves/ Pinch Valves RODI					A Flap gates open and close easily with minimal leakage. Gates show no corrosion damage and have been maintained.	
					M Gate will not fully open or close because of obstructions that can be easily removed, or has corrosion damage that requires maintenance.	
					U Gate is missing, has been damaged, or has deteriorated and needs repair.	
					N/A There are no flap gates.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Additional issues noted during the inspection:

Concrete Lined Flood Control Channels

Page 1 of 2

For use during all Initial and Continuing Eligibility Inspections of concrete lined flood control channels

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Vegetation and Obstructions					A No obstructions, vegetation, debris, or sediment accumulation within the channel. Channel joints and weep holes are also free of grass and weeds.	
					M Sediment and debris present, but not to the degree that it supports vegetation. Obstructions/ debris have not impaired the channel flow capacity. Sediment and debris removal recommended.	
					U Sediment shoals are well established and support vegetation, or there are obstructions or accumulated debris that have impaired the channel flow capacity. Sediment and debris removal required to re-establish flow capacity.	
2. Shoaling					A No shoaling present.	
					M Non-aquatic grasses present on shoal. No trees or brush is present on shoal, and channel flow is not impeded.	
					U Shoaling is well established, stabilized by saplings, brush, or other vegetation. Shoals are diverting flow to channel walls. Channel flow capacity is reduced and maintenance is required.	
3. Concrete Surfaces					A Negligible spalling, scaling or cracking. If the concrete surface is weathered, rough to the touch, or holds moisture, it is still satisfactory but should be seal coated to prevent freeze/ thaw damage.	
					M Spalling, scaling, and open cracking present, but the immediate integrity or performance of the structure is not threatened. Reinforcing steel may be exposed. Repairs/ sealing is necessary to prevent additional damage during periods of thawing and freezing.	
					U Surface deterioration or deep, controlled cracks present that result in an unreliable structure.	
4. Tilting, Sliding or Settlement of Concrete Structures					A There are no significant areas of tilting, sliding, or settlement that would endanger the integrity of the project.	
					M There are areas of tilting, sliding, or settlement (either active or inactive) that need to be repaired. The integrity of the structure is not in danger.	
					U There are areas of tilting, sliding, or settlement (either active or inactive) that threaten the structure's integrity and performance.	
5. Foundation of Concrete Structures					A No scouring / erosion, or undermining near the structure.	
					M Scouring / erosion near the footing of the structure but not close enough to affect structure stability during the next flood.	
					U Scouring or undermining at the foundation that has affected structural integrity.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Concrete Lined Channels - Continued on Next Page

Concrete Lined Flood Control Channels

Page 2 of 2

For use during all Initial and Continuing Eligibility Inspections of concrete lined flood control channels

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
6. Monolith Joints					A The monolith joint material is in good condition.	
					M The monolith joint material is deteriorating and needs to be repaired or replaced to prevent spalling and cracking during freeze/ thaw cycles.	
					U The monolith joint material is severely deteriorated and the concrete has spalled and cracked, damaging the waterstop to the point where it will not provide the intended level of protection during a flood.	
					N/A There are no monolith joints.	
7. Flap Gates/Flap Valves/ Pinch Valves RODI					A Flap gates open and close easily with minimal leakage. Gates show no corrosion damage and have been maintained.	
					M Gate will not fully open or close because of obstructions that can be easily removed, or has corrosion damage that requires maintenance.	
					U Gate is missing, has been damaged, or has deteriorated and needs repair.	
					N/A There are no flap gates.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Additional issues noted during the inspection:

Instructions for the Inspection Guide

GENERAL INSTRUCTIONS.

1. The sections of this report labeled "Basic Eligibility" and "FCW Engineering" only need to be completed during Initial Eligibility Inspections.
2. Determination of Minimum Elevation for Levees and Floodwalls (#1 under FCW Engineering):
Depending on available data and local Corps policy, the minimum elevation required may be calculated using traditional methods, with the addition of 1 foot of freeboard in agricultural areas and 2 feet of freeboard in urban areas, or using annual exceedance probability, which numerically accounts for the natural variation and uncertainty when estimating discharge-probability and stage-discharge functions so that additional requirements for elevation are based on the level of risk in the data.
3. All other sections of this guide that correspond to project features in the Flood Control Work must be fully completed during every Continuing and Initial Eligibility Inspection.
4. RODI stands for "Requires Operation During Inspection". Items marked "RODI" will be rated based on the way they work during the inspection.
5. Additional areas for inspection will be incorporated by the inspector into this guide if the layout or physical characteristics of the project warrant this. Appropriate entries will be made in the REMARKS block.

RATINGS OF INDIVIDUAL ITEMS:

The following terms and definitions are used when determining the rating for each item and/or component in the flood control work.

A - Acceptable: The rated item is in satisfactory condition, with no deficiencies, and will function as designed and intended during the next flood event.

M - Minimally Acceptable: This rated item has minor deficiencies that need to be corrected. The minor deficiencies will not seriously impair the functioning of the item during the next flood event. The overall reliability of the project will be lowered because of the minor deficiency.

U - Unacceptable: The deficiencies are serious enough that the rated item will not adequately function during the next flood event, compromising the project's ability to provide reliable flood protection.

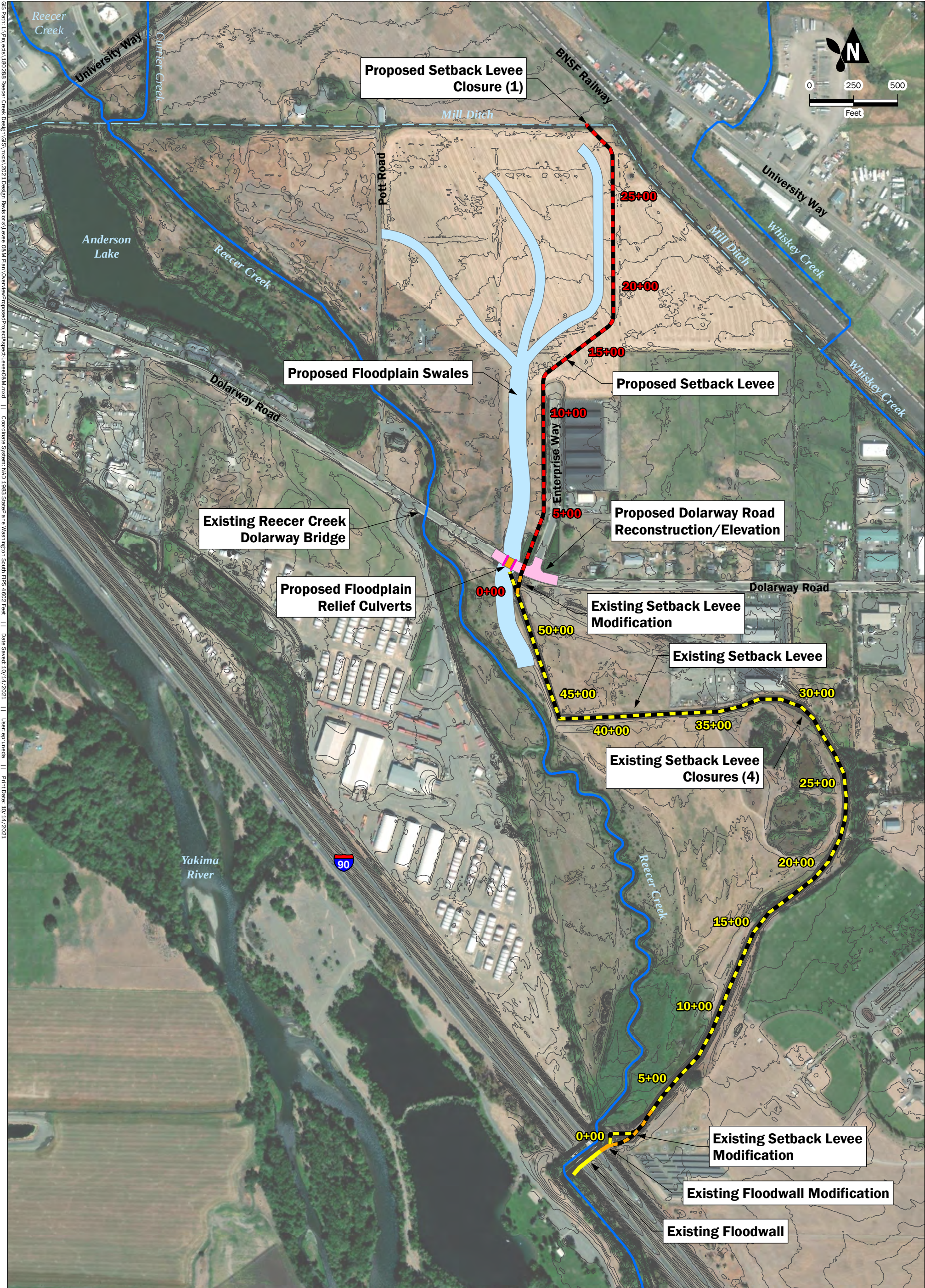
DETERMINATION OF OVERALL PROJECT CONDITION CODE:

The lowest single rating given for a rated item will determine the overall condition of the project:

1. If all items are rated as Acceptable, the overall project condition will be rated as Acceptable.
2. If one or more items are rated as Minimally Acceptable, the overall project condition will be rated Minimally Acceptable.
3. If one or more item is rated as Unacceptable, the overall project condition will be rated as Unacceptable.

PROJECT CONDITION AND ELIGIBILITY FOR PL84-99 ASSISTANCE:

1. Projects rated as Acceptable are considered "**Active**" and eligible for PL84-99 post flood or storm damage rehabilitation assistance from the U.S. Army Corps of Engineers.
2. Projects rated Minimally Acceptable are considered "**Active**" and eligible for PL84-99 rehabilitation assistance during the time that it takes to make needed corrections. This timeframe will be agreed upon between the project sponsor and Corps inspector at the time of the inspection (or shortly thereafter). If the project sponsor does not present the Corps with proof of completion of the repairs/maintenance by the end of this timeframe, then the project will be "**Inactive**" and will be ineligible for PL84-99 rehabilitation assistance.
3. Projects rated as Unacceptable are immediately put in an "**Inactive**" status and are not eligible for PL84-99 post flood or storm damage rehabilitation assistance from the Corps of Engineers. The project will remain in an inactive status until the project sponsor presents the Corps with proof that all of the required repairs/maintenance has been completed. (This includes any repairs/ maintenance required for project features rated minimally Acceptable, as well as those rated Unacceptable.)



GIS Path: L:\Projects\180286 Reecer Creek Design\GIS\mxd\2021 Design Revisions\Levee O&M Plan (Overview)\05052021\RecepLeveeO&M.mxd | Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 feet | Date Saved: 10/14/2021 | User: epuneda | Print Date: 10/14/2021

- | | |
|-------------------------------------|---------------------------------------|
| Existing Waterbody | Proposed Setback Levee |
| Existing Setback Levee | Proposed CMP Arch Culvert |
| Existing Setback Levee Modification | Proposed Floodplain Relief Culvert |
| Existing Floodwall | Proposed Dolarway Road Reconstruction |
| Existing Floodwall Modification | Proposed Floodplain Swale |
| | Existing 1-FT Contours |

Reecer Creek Levee System Overview Map

Reecer Creek Levee System Operation and Maintenance Plan
Ellensburg, Washington



OCT-2021
BY:
EBP

APPENDIX NO.
C

APPENDIX D: Flood Fighting Techniques on Levees

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1. Introduction

If a well-constructed levee of correct cross section is properly maintained and is not overtopped, it should hold throughout any major flood event. However, the levee is still in potential danger whenever there is water against it. The danger increases with the height of water, the duration of the flood stage, the intensity of the current, and the wave action against the levee face. There are three primary factors that lead to levee failures.

1. Overtopping
2. Seepage problems such as sandboils or slides
3. Erosion from the current or waves

Potential levee failures may be prevented if prompt action is taken and proper methods of treatment are employed. This appendix describes some of the general actions that should be taken to raise the crown of a levee or to respond to sandboils, seepage problems, or wave wash if these problems are identified during a patrol. The methods described have been developed from many years of experience in dealing with problems that arise as a result of high water, and should be followed as closely as possible. (The intent of this isn't to destroy personal initiative when dealing with unusual emergencies. On the contrary, if a dangerous situation occurs along a levee line, immediate action is demanded using the materials and labor at hand. However, an emergency is not a time in which to experiment, and these proven methods should be employed wherever possible.) Conditions and problems may arise which are not adequately covered by the suggestions provided or if there's any doubt as to the proper procedure that should be taken, the local U.S. Army Corps of Engineers district Emergency Management Office should immediately be consulted for advice and assistance.

2. Overtopping

A levee is overtopped when water flows over the levee crown. Low reaches in the levee crown must be identified as early as possible and raised to a uniform level. If the stream is predicted to approach or exceed the height of the existing levee, immediate attention should be given to raising the levee crown.

On the other hand, if the stream is likely to crest many feet beyond the elevation of the levee, the best approach may be to simply allow the levee to overtop, so that flood fight efforts can be redirected to other areas. If this is the case, low reaches in the levee crown need to be raised, leveled or otherwise prepared so that it overtops uniformly, to keep the damage to a minimum. Ideally, the levee should be allowed to overtop uniformly along the downstream portion of the system, so the protected area is "backfilled" with flood water. If the levee is breached due to the overtopping along the downstream portion of the FCW, it prevents the full force of the river's current from flowing into the protected area. An upstream breach will allow the river current to bring in much more debris (for example, entire trees), and would possibly cause much more scouring damage to the protected area than a downstream overtopping breach. It's very important that you contact the Corps district office when faced with decisions relating to the overtopping of a levee, as the Corps has a great deal of experience with flood fighting and can provide technical assistance and guidance as needed.

Generally, emergency barriers are constructed 2 feet above the current predicted river crest. For example, if the river is predicted to rise 1 1/2 feet beyond the elevation of the levee, then a 3 1/2 foot capping would be necessary in order to maintain two feet of freeboard as a factor of safety. If the crest prediction increases during construction, additional height must be added.

2.1 Options for Raising a Levee

There are a number of ways that the levee crown can be raised. Provided the work is done well in advance of the high water, in areas where there is sufficient space for construction and with the proper equipment, the most efficient means of raising low stretches of the levee is to scarify the surface, haul in fill material and compact it in place, as discussed in section 2.2, below. However, this is not always possible. No heavy equipment should be used on a levee when water is near the top, as the vibration may cause a failure. In no case should such equipment be allowed on an earthen levee after the levee has commenced to seep. For these reasons, raising the elevation with compacted earthen fill may not be an option. The levee crown may alternately be raised with a sandbag capping or with flashboard structures. Jersey barriers have also successfully been converted into floodwalls during emergency situations.

Additionally, there are a large number of contemporary technologies that may be used to raise an emergency levee; including bladders, structurally supported membranes, and lightweight shells that are filled with sand from a bucket loader. The Corps' Engineer Research and Development Center has recently completed a rigorous and impartial study on several of these flood fight technologies. You are encouraged to visit <http://chl.erd.c.usace.army.mil/ffs> for details on the tests and products, since this site will have the Corps' most current information on the subject, and the website will be updated as additional products are tested.

With so many options available for raising a flood barrier, there are several things you should consider as you decide how to best protect your community:

a. Cost of materials and labor

The materials for sandbag construction are generally much less expensive than the alternatives. Sandbag construction is very labor intensive, but at the same time, volunteer labor is often readily available during high water.

b. Available time

Flashboards or contemporary options are better suited to conditions when there is little time available for the construction, because they typically require less labor and can be put in place much faster than sandbag levees.

c. Allowable seepage

Most construction methods will allow some degree of seepage through the structure. As is the case with sandbags, modifications may be made to the basic designs so that the seepage is reduced, but these modifications usually take additional time to construct.

d. Suitability for construction in the given area

Sandbags are extremely versatile and sandbag structures can be constructed almost anywhere. Sandbags can be used to close small roads or to fill gaps, or can be built into long stretches of levees if there is adequate time and manpower. Flashboards and newer technologies are generally not as versatile, but depending on the technology and the construction, they are typically well suited for raising the elevation over longer stretches.

e. Equipment requirements

Sandbag structures can be built without heavy machinery, which may be required for some other options. There are a number of situations where it's not possible to use even light earthmoving machinery. For example, there might not be enough space for the machinery, or the foundations might be too unstable. Also, individual landowners may object to the use of machinery over their properties.

f. Necessary elevation

Though sandbag levees are best suited for elevations of 3 feet or less, they have successfully been used to raise elevations by 20 feet or more in extreme flooding situations. Flashboards are typically only built to a maximum of 3 feet, and the elevation provided by other technologies varies. In deciding between the various options, it's important to consider how reliably they can forecast the crest height of the river. If the river stage might rise several feet beyond what is currently predicted, a sandbag levee could be raised higher, while it would be much more difficult to raise something like a flashboard or Jersey barrier structure.

g. Disposal

Burlap sandbags are biodegradable and relatively easy to remove and dispose of. Other options typically take much longer to remove and create more waste. Some are reusable.

Situations may arise when one of the more contemporary products may be readily available and appropriate for the given conditions, when there would be insufficient workers available to protect the area with sandbags or when time was extremely limited; and in these situations the cost of using these products may be justified. While it would be prohibitively expensive for the Corps to stockpile enough inventories to adequately address all problems that might be faced across the country, the Corps may purchase such items and make them available for public sponsors if conditions warrant. However, in the majority of situations, sandbags are almost always preferred and recommended during flood fights when construction with earthen fill is not possible. The following sections provide specific guidance on raising levees using earthen fill, sandbags, and flashboards.

2.2 Raising a Levee with Earthen Fill

a. Borrow Area and Haul Road

Borrow material can become a critical item of supply in some areas due to long haul, project isolation, or for other reasons. The two prime requisites for a borrow area are that adequate material be available and that the site be accessible at all times. The quantity estimate plus an additional 50 percent should provide the basis for the area requirement, in order to provide suitable materials for levee construction as covered below. The area must be located so that it will not become isolated from the project by high water. Local contractors and local officials are the best source of information on available borrow areas. In undeveloped areas, the area should be cleared of brush, trees, and debris, with topsoil and humus being stripped. In early spring, it will probably be necessary to rip the area to remove frozen material. An effort should be made to borrow from the area in such a manner that the area will be relatively smooth and free draining when the operation is complete. The haul road may be an existing road or street, or it may have to be constructed. To mitigate damages, it is highly desirable to use unpaved trails and roads, or to construct a road if the haul distance is short. In any case, the road should be maintained to avoid unnecessary traffic delays. The use of flagmen and warning signs is mandatory at major crossings, such as highways, near schools, and at major pedestrian crossings. It may become necessary to stockpile material near anticipated trouble areas.

b. Equipment

One of the important considerations in earthwork construction is the selection of proper equipment to do the work. Under emergency conditions, obtaining normally specified earthwork equipment will be difficult and the work will generally be done with locally available equipment. It may be wise to call for technical assistance in the early contract stage to ensure that proper and efficient equipment use is proposed. If possible, compaction equipment should be used in flood barrier construction. This may

involve sheepsfoot, rubber-tired, or vibratory rollers. Scrapers should be used for hauling when possible because of speed (on short haul) and large capacity. Truck haul, however, has been the most widely used. A ripper is almost essential for opening borrow areas in the early spring. A bulldozer of some size is mandatory on the job to help spread dumped fill and provide some compaction.

c. Foundation preparation

One of the primary differences in the construction of emergency levees and the construction of permanent levees lies in the preparation of the foundation. Prior to any embankment construction, it's very important that the foundation is prepared, particularly if the levee is to be left in place. For emergency construction during spring flooding, the first item of work will probably be snow removal. The snow should be pushed riverward so as to decrease ponding when it melts. Any trees that might be present should be cut and the stumps removed. If at all possible, any obstructions above the ground (brush or similar debris) should be removed. The foundation should then be stripped of topsoil and surface humus. (Clearing and grubbing, structure removal and stripping should be performed only if time permits.) Stripping may be impossible if the ground is frozen, and in this case, the foundation should be ripped or scarified, if possible, to provide a tough surface for the material to bond to. Every effort should be made to remove all ice or soil containing ice lenses. Frost or frozen ground can give a false sense of security in the early stages of a flood fight. It can act as a rigid boundary and support the levee, but when it thaws, the soil strength may be reduced sufficiently for cracking or the development of slides. The ice also forms an impervious barrier to prevent seepage. This may result in a considerable build-up in pressure under the soils landward of the levee and, upon thawing, pressure may be sufficient to cause sudden blowouts. If this condition exists, it must be monitored, and one must be prepared to act quickly if sliding or boiling starts. If stripping is possible, the material should be pushed landward and riverward of the toe of levee and windrowed. After the flood, this material can be spread on the slopes to provide topsoil for vegetation.

d. Materials

Earth fill materials for emergency levees will come from local borrow areas. An attempt should be made to utilize materials which are compatible with the foundation materials as explained below. However, due to time limitation, any local materials may be used if reasonable construction procedures are followed. The materials should not contain large frozen pieces of earth.

i. Clay

Clay is preferred because the section can be made smaller (steeper side slopes). Also, clay is relatively impervious, and has relatively high resistance to erosion when it's compacted. A disadvantage in using clay is that adequate compaction is difficult to obtain without proper equipment. Additionally, the water content in impervious fill can impact the compaction needs. Efforts are typically made at the borrow site to obtain material with the optimal moisture; otherwise, if that is not

possible, more time may be required for compaction. Another disadvantage is that the clay may be wet and sub-freezing temperatures may cause the material to freeze in the borrow pit and in the hauling equipment. Weather could cause delays and should definitely be considered in the overall construction effort.

ii. Sand

If sand is used, the section should comply as closely as possible with recommendations in the paragraph titled Levee Section, below. Flat slopes are important, as steep slopes without poly coverage will cause seepage through the levee to outcrop high on the landward slope, and may cause the slope to slump.

iii. Silt

Material that is primarily silt should be avoided, and if it is used, poly facing must be applied to the river slope. Silt, upon wetting, tends to collapse under its own weight and is very susceptible to erosion.

e. Levee Section

In standard levees, the foundation soils and available construction materials generally dictate the design configuration of the levee. Therefore, even under emergency conditions, an attempt should be made to make the embankment compatible with the foundation. Information on foundation soils may be available from local officials or engineers, and it should be utilized. The three foundation conditions and the levee sections cited below are classical and idealized, and usual field conditions depart from them to various degrees. However, they should be used as a guide so that possible serious flood fight problems might be lessened during high water. In determining the top width of any type of section, consideration should be given as to whether a revised forecast will require additional fill to be placed. A top width adequate for construction equipment will facilitate raising the levee. Finally, actual levee construction will in cases, depend on time, materials, and right-of-way available.

i. Sand Foundation

If the foundation material under the emergency levee is sand or some other pervious material, the following guidance is provided:

- If the levee section is to be made of sand, use a minimum of 1V (Vertical) on 3H (Horizontal) river slopes. A 1V on 4H river slope is preferable, and will be less susceptible to erosion, but a 1V on 3H slope is considered an adequate minimum for emergency purposes. Use 1V on 5H for the landward slope, and 10-foot top width.
- If the levee section is to be made of clay, use 1V on 2 1/2 H for both slopes. 1V on 3H slopes are preferable, but 1V on 1 1/2 H is an acceptable minimum for emergency purposes. The bottom width should comply with creep ratio criteria; i.e., L (across bottom) should be equal to C x H; where C=9 for fine gravel and 15 for fine sand in the foundation, and H is levee height.

This criteria can be met by using berms either landward or riverward of the levee. Berm thickness should be 3 feet or greater. Berms are used mainly to control or to relieve uplift pressures and will not reduce seepage significantly.

ii. Clay Foundation

If the foundation material under the emergency levee is clay, the following guidance is provided:

- If the levee section is to be made of sand, it should be constructed with 1V on 3H for the river slope. Again, a 1V on 4H is preferable, but the steeper slope is considered adequate for emergency purposes. Use 1V on 5H for the landward slope, and a 10-foot top width, as described in the previous section.
- If the levee section is to be made of clay, use 1V on 2 1/2 H for both slopes. 1V on 3H slopes are preferable for clay levees, but 1V on 1 1/2 H is an acceptable minimum for emergency purposes. With a clay foundation, there is no need to construct additional berms.

iii. Clay Layer over a Sand Foundation

If the foundation material is such that there is an impervious clay layer resting over a pervious sand layer, the following guidance is provided:

- If the levee section is to be made of sand, use a minimum of 1V (Vertical) on 3H (Horizontal) river slopes for emergency purposes. A 1V on 4H slope is preferable, if this construction is possible. 1V on 5H landward slope, and 10-foot top width. In addition, a landside berm of sufficient thickness may be necessary to prevent rupture of the clay layer. The berm may be constructed of sand, gravel, or clay, but since berms made of clay generally need to be wider and thicker than those made of pervious materials, it would probably reduce the construction effort to build the berm with sand or gravel, if these materials were available. Standard design of berms requires considerable information and detailed analysis of soil conditions. However, prior technical assistance may reduce berm construction requirements in any emergency situation.
- If the levee section is to be made of clay, use 1 V on 2 1/2 H for both slopes. Again, 1V on 3H slopes are preferable, but 1V on 1 1/2 H is an acceptable minimum for emergency purposes. Additionally, a berm may be necessary to prevent rupture of the impervious top stratum.

f. Placement

Layers should be started out to the full width of the embankment base, and subsequent lifts shall be placed so that the tops are substantially horizontal. In general, the levee

section should be homogeneous. However, when materials of varying permeability are encountered in the borrow area, the more pervious material should be placed on the landside of the embankment.

g. Compaction

As stated above, obtaining proper compaction equipment for a given soil type will be difficult. It is expected in most cases that the only compaction will be from that due to the hauling and spreading equipment, i.e., construction traffic routed over the fill. It is to be realized that even the minimum requirements may not be possible or feasible, and, if situation demands, material should be placed and compacted in any way possible and the levee observed closely for signs of distress. A construction engineer should ideally oversee the design of emergency levees. Use of these guidelines should not be taken as a guarantee that a safe structure will be constructed.

i. Pervious Fill

Material shall be placed in layers not more than 12 inches in thickness prior to compaction. In emergency situations, each layer should be compacted at the very minimum by one pass of the hauling equipment. However, whenever time, cost and availability of equipment will permit, a much safer structure will result if each layer gets compacted by a minimum of 3 complete passes of a crawler-type tractor, or by 2 passes of a vibratory roller.

ii. Impervious Fill

Fill material shall be placed in layers not exceeding 9 inches prior to compaction. In emergency situations, each layer should receive at least one complete coverage of the track or wheel of the placing equipment or equivalent. However, whenever time, cost and availability of equipment will permit, a much safer structure will result if each layer gets compacted by a minimum of 4-6 complete passes of a tamping type roller or 4 complete passes of a rubber-tired roller.

2.3 Raising a Levee with Sandbags

a. Sandbags

Sandbags are available in plastic and in burlap. The preferred bags are untreated, close weave burlap sacks available at feed or hardware stores. Empty bags should be stockpiled for emergency use, and can be stored for approximately 8 years in a rodent-free environment with low humidity. Don't fill the bags ahead of time, because they will deteriorate quickly. Commercial polypropylene sandbags are also effective in a flood fight, but since plastic bags are not readily biodegradable, burlap bags will allow more options for disposal if the bags are not going to be reused. (No sandbags should be left in place after the flood fight, regardless of whether they are burlap or plastic.) Do not use garbage bags, as they are too slick to stack; and don't use feed sacks, as they are too large to handle. Experience shows that bags work well if they are approximately 14 inches wide and 24 inches deep.

b. Fill Material

A sandy soil is most desirable for filling sandbags, as it's easiest to shovel, and the bags can most easily be shaped as needed. Fine sand tends to leak through the weave in the bag, and if it is used it should be double bagged. Silty soils also tend to leak through the bags, and both silty soils and clays are difficult to shape into place. Gravelly or rocky soils are generally poor choices for sandbag structures because of their permeability, though rocks and gravel may be used in sandbags in order to divert water flows, to fill holes, or to hold objects in position. However, any usable material at or near the site has definite advantages. Material should generally not be removed from within 500 feet of the landward toe of a levee, except for in extreme emergency situations.

c. Sandbag Filling

Filling sandbags manually requires two people. One member of the team folds the throat of the bag outward to form a collar, and holds it open so that the other person can shovel in material. The one holding the bag should hold it between or slightly in front of his or her feet, either crouching with his elbows resting on his knees or standing with his knees slightly flexed, while keeping his head and face as far away from the shovel as possible. Both people should be wearing gloves to protect their hands, and safety goggles may also be desirable, especially on dry or windy days.



Figure D.1 This two-person team is positioned properly for sandbag filling.

If they are available during large-scale operations, bag-holding racks and power loading equipment can expedite the operation. Sandbag filling machines can

be very effective if they are functioning correctly. Alternately, some people have reported success with improvised sandbag filling devices during a flood response. Inverted traffic cones or large metal funnels have been placed into holes in a table, and feeding bins with doors in their bases have been used to pour sand into bags.

Regardless of what method you use to fill them, bags should be filled between one-half (1/2) to two-thirds (2/3) of their capacity. This keeps the bag from getting too heavy, but more importantly, sandbag structures do not seal or keep out water as well if the bags are more than 2/3 full. Be very careful not to overfill or under fill the bags.

d. Tied vs. Untied Bags

Although tied sandbags are generally easier to handle and stockpile, untied sandbags are recommended for most situations, because untied bags make a better seal when they're stacked. Since the bags aren't more than 2/3 full, they can be transported almost as easily whether they're tied or untied. Tied sandbags should be used only for

special situations when the bags need to be pre-filled and stockpiled, or for specific purposes such as filling holes or for holding objects in position.

e. Preparing the Ground

Any debris must be removed from the area before the bags are laid in place. Typically, flat headed shovels are used to scrape up (“scarp”) the sod or gravel where they are to be laid, to get down to the solid ground where the bags are to be laid. Do not scarp the ground beyond the area directly under the sandbags, because the sod cover in other areas is needed to protect the ground from erosion.

Before laying the bags along the entire length of an area to raise the levee, it’s important that you first fill in any low areas with sandbags or with tightly packed earth, so that subsequent sandbag layers will be kept level.

f. Sandbag Placement

When laying the sandbags, the open end of the unfilled portion of the bag is folded over to form a triangle. If tied bags are used, flatten or flare the tied end. Place the partially filled bags lengthwise and parallel to the direction of flow, so the bottom of the bag faces downstream and the folded end faces upstream. (This positioning reduces the chance that floating debris will snag on the tucks and open the bags.)

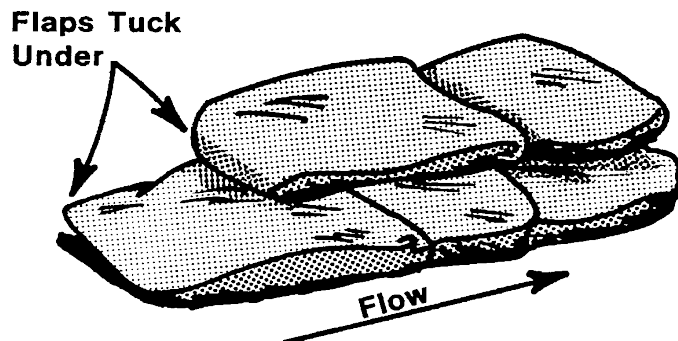


Figure D.2 Sandbag placement – tucking in the flaps.

Tuck the flaps under, keeping the unfilled portion under the weight of the sack. Overlap the next bag slightly over the one before it, so that the top of that sandbag layer can be flattened without leaving any gaps between the bags. Once a bag is placed, it’s very important that you then walk over it, stomp on it, or maul it into place to eliminate voids and form a tight seal.



Place each succeeding bag tightly against and partially overlapping the previous one. Compact and shape each bag by walking on it.

Figure D.3 Sandbag placement – compacting bags together.

When succeeding layers are added, stagger the bags like bricks, so that each one is placed over the gap between the two below it. This ensures that each seam is interlocked between bags and strengthens the structure. (There should never be less than 1/3 the length of a bag overlapping with the ones beneath it.) When placed properly, each bag should raise the elevation of the structure by 4 inches.

g. Sandbag Levees

Sandbags can be used to raise the height of an existing levee or can be used over open ground to protect an area with no levee at all. Any time a sandbag levee will be constructed over one layer high; the bag should be stacked in a pyramid structure to ensure stability. The basic rule of thumb in constructing these structures is that they must be approximately three times as wide as they are high, and the sandbags should be staggered within each layers just as they are staggered from one layer to the next. The directions of the bags (transverse or longitudinal) may be alternated, as long as no loose ends are left exposed. Use this rule of thumb in determining the dimensions of the pyramid:

- 1 bag in length equals about 1 foot
- 3 bags in width equals about 2 ½ feet
- 3 bags in height equals about 1 foot

When building these structures on top of an existing levee, the bags should begin 1 foot from the riverward crown (shoulder) of the levee. Where space is extremely limited on the levee crown, this distance may be reduced but the structure should never be built less than 6 inches from the edge of the levee crown. Stamp each bag in place, overlap sacks, maintain staggered joint placement, and tuck in any loose ends.

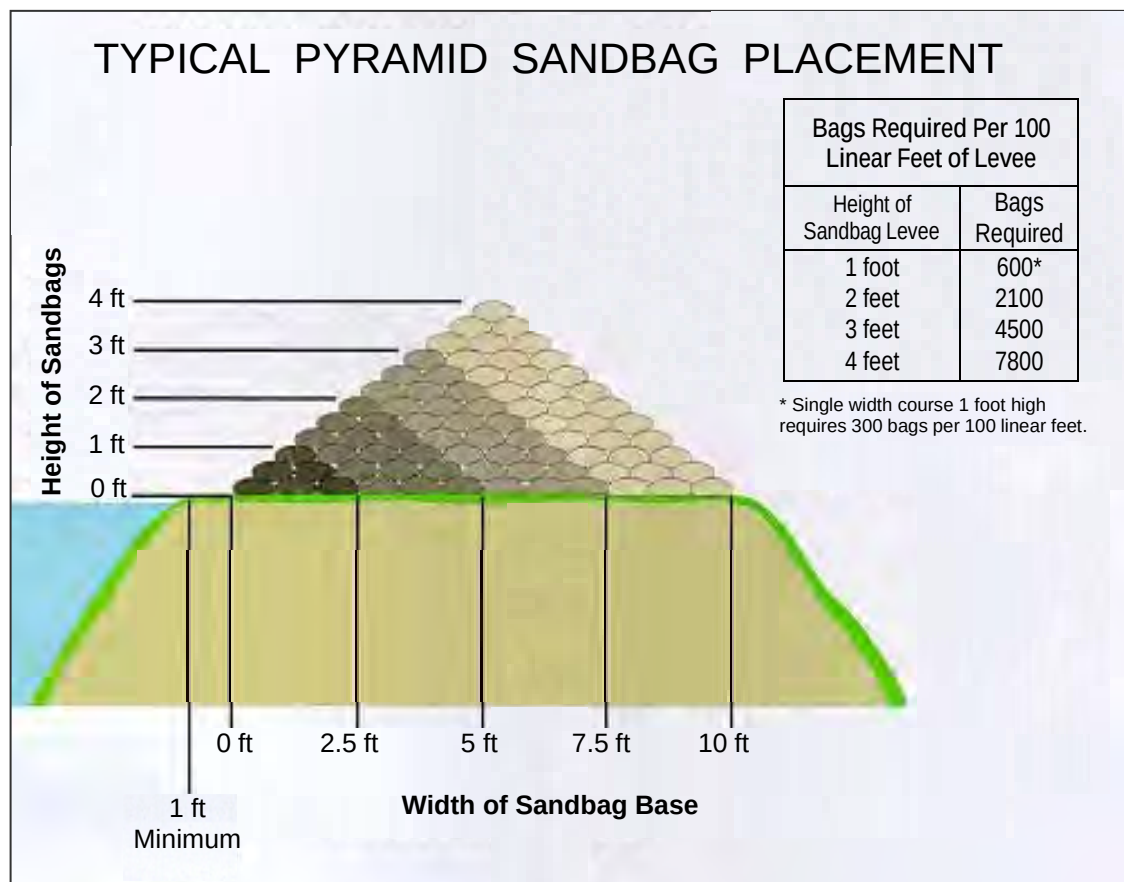


Figure D.4 Pyramid sandbag placement.

h. Material, Tools, and Labor Requirements for Sandbag Levee

Listed below are the materials, tools, and labor required to construct 100 linear feet of sandbag levee, two feet high, with a haul distance of 1 mile round trip.

i. Materials and Tools

- 1,800 Sandbags
- 10 Shovels
- 27 Flash lights
- 10 Tons sand (approx)
- 2 Emergency light sets
- 2 Radios or cell phones (one at filling site; one at laying site)
- 6 Pickup trucks

ii. Labor Requirements:

- 10 Filling sandbags
- 5 Loading
- 6 Hauling
- 5 Laying
- 2 Foremen (1 at sandbag filling site, 1 at work site)
- 28 People required, total**

iii. Time Requirements:

With given resources, the time for completion is estimated at 2 ½ hours, from start to finish.

i. Bonding Trench and Plastic Sheeting

Seepage through a sandbag structure can be kept to a minimum if the structure is built carefully using untied bags. One method that's been successfully used to reduce the seepage through a sandbag levee and to increase the horizontal stability is to construct a bonding trench under the structure before the sandbags are laid in place, as pictured below. An additional precaution is to build the structure over some plastic sheeting, which is pulled up and over the structure once it's complete.

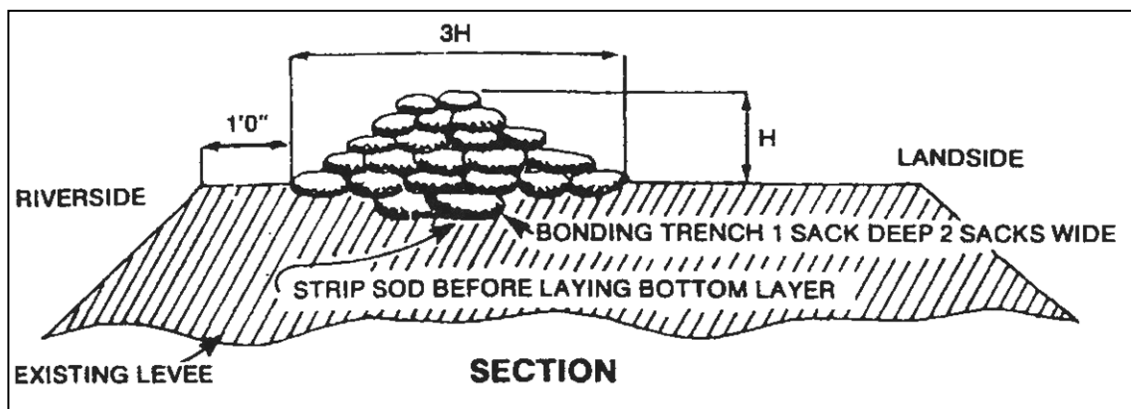


Figure D.5 Sketch of a typical levee raise with bonding trench.

While it's always recommended at least to scarp the ground before the bags are laid, the decision to dig this trench or use the plastic sheeting depends on local conditions, as well as on the expected height of the structure and the time that's available to build it. One of the primary concerns when considering bonding trenches and/or plastic sheeting is the amount of time that's available. If there's sufficient time and adequate material, the seepage can be reduced, but if there is very little time available, the ground should be scarped and a typical sandbag structure constructed with no bonding trench at all. An additional concern is whether the sandbag levee would have to be raised in the future, because any plastic sheeting has to be removed before the structure can be raised.

If plastic sheeting is to be used in conjunction with the sandbag levee, begin by digging a bonding trench 2 sandbags wide and one sandbag deep. The edge of the plastic is placed in the hole and weighed down with sandbags, with most of the plastic laying out in the direction of the river. It's very important that the plastic is never laid across the entire width of the sandbag levee base. Sandbag levees are held together by frictional forces between the bags and with the ground surface; sandbag structures are much less stable when wrapped with plastic, and can slide apart under high water. Construct the sandbag levee over the sheeting, pull the plastic up and overtop of the structure and weigh it down with sandbags on the landward side. Always work from downstream to upstream so that the upstream plastic seams all overlap the ones downstream, in order to prevent debris from snagging the plastic and pulling the sandbag levee apart.

2.4 Raising the levee with Flashboards or Lumber and Sack Cappings

If it appears that the levee raise would have to hold back more than 18 inches of water, consideration should be given to use of a lumber and sack capping or a flashboard capping. A lumber and sack capping is shown in plate 3, which may be used as a guide to estimate the materials required for a levee raise of about 3 feet. A flashboard structure is very similar, but the face of the structure is constructed of plywood instead of boards. These wooden facings provide a more positive control against excessive through seepage than is provided by sandbags alone. Either structure can be supported from behind with either sandbags or with compacted earthen fill, depending on how accessible the crown of the levee is to earthmoving machinery.

Additionally, plastic sheeting may be installed on the riverside face of the plywood or flashboards, to protect the wood and reduce seepage through the flashboards. Flashboards do tend to leak a little, depending on how they are constructed and how the boards expand when they're wet; though these structures are never constructed without a sandbag backing. If plastic sheeting is to be used, it should extend 1' riverward from the riverside bottom of the plywood/flashboard. A row of sandbags should then be stamped into place along the riverside bottom edge of the plywood/flashboards to help prevent seepage under the flashboard system. The plastic is brought up the riverside of the plywood/flashboards and over the top to the landside supports and held in place by sandbags or nails where necessary. Field conditions, the available time, and the availability of materials would dictate the actual requirements.

3. Seepage

As a river or stream rises, the hydrostatic pressure against a levee slope increases significantly and can force water into and under the levee embankment. Even when a levee is properly constructed and of such mass to resist the destructive action of flood water, this seepage tends to push its way through regions of least resistance (such as sandy layers under the levee or animal burrows) out to the surface on the landward side of the structure. If there isn't sufficient pressure on the landward side to hold back the seepage water, it will break through the ground surface on the landward side, in the form of bubbling springs, which erode and carry soil particles from under the levee.

Seepage is almost impossible to eliminate and attempt to do so may create a much more severe condition. Seepage is generally not a problem unless 1) the landward levee slope becomes saturated over a large area, 2) seepage water is carrying material from the levee, or 3) pumping capacity is exceeded. Pumping of seepage should be held to a minimum, and ponding should be allowed during high water to the extent that it doesn't cause damages. Several levees were endangered during past floods by attempts to keep low areas pumped dry, and additional time and effort were expended in controlling sandboils caused by pumping. Therefore, seepage should be permitted if no apparent ill-effects are observed and if adequate pumping capacity is available.

3.1 Effects of Underseepage

Underseepage can produce three distinctly different effects on a levee, depending upon the condition of flow under the levee.

a. Piping Flow

In extreme conditions of excessive underseepage, the movement of seepage water erodes the foundation materials, and a clearly defined pipe or tube develops under the levee. Unless corrective actions are taken, water continues to erode and enlarge this pipe, so that a cavern develops under the levee, and levee material collapses to fill in the void. In an advanced state, piping under the levee can be identified by a slumping of the levee crown, and the levee can quickly fail if it's overtopped through this low spot. To prevent this condition from developing, any boils found to be transporting soil material need to be treated as early as possible.

b. Non-Piping Flow

In this case, seepage water flows under the levee without following a well-defined path, and results in one or more boils outcropping at or near the landside toe. The flow from these boils tends to undercut and ravel the landside toe, resulting in sloughing of the landward slope. Sloughing is the movement of small amounts of soils from the embankment slopes. Sloughing may also occur if the levee embankment becomes saturated as a result of prolonged high creek stages. Evidence of this type of failure is found in undercutting and raveling at the landside toe.

c. Saturating Flow

In this case, numerous small boils, many of which are scarcely noticeable, outcrop at or near the landside toe. While no boil may appear dangerous in itself, a group of boils may cause significant damage. The flowing water may erode away supporting material and/or keep the area saturated and cause flotation ("quickness") of the soil, reducing the shearing strength of the material at the toe (where maximum shearing stress occurs) which could lead to slope failure. In a slope failure condition, a substantial section of the levee embankment breaks away along a clearly defined crack and slides away from the levee. The displacement of the soil will result in a reduction in the cross sectional area of the levee and poses a major threat to the integrity of the structure.

3.2 Sandboils

a. Identification of Sand Boils

Sandboils usually occur within 10 to 300 feet from the landside toe of the levee and, in some instances, have occurred up to 1,000 feet away. Boils will have an obvious exit (such as a rodent hole), but the hole may be very small. When material is carried upward through a boil, it is deposited in a circular pattern around the exit location, and is comparable to an ant hill or volcano. Alternately, sandboils may exit into standing water. In this case, they may be difficult to identify, especially if the hole is small and the water cloudy from siltation. If you see any movement in what appears to be standing water on the landward side of the structure, this may be the exit point for a sandboil. Carefully approach the site, disturbing the water as little as possible, and let the water settle in order to look for the exit point. If there is no distinct hole, the water flow is not a threat. All boils should be conspicuously marked with flagging so that patrols can locate them without difficulty and observe changes in their condition.

You can tell how serious a boil is by the color of the water that is coming out. If the water is relatively clear, it means that there is relatively little material being eroded away through the boil. The site should be monitored regularly for changes, but nothing else should be done to treat the clear boil. If it's dark or muddy, then it's full of material that's been eroded away from under the levee, and must be treated immediately. Boils may quickly grow very large, and boils, which are discharging clear water, may suddenly begin to discharge soil materials along with the seepage flows. For this reason, any boil, whether the flow is clear or muddy, can potentially lead to the failure of the levee and must be monitored closely.

b. Treatment of Sandboils

The most common and accepted method of treating sandboils that are displacing soil is to construct a ring of sandbags around the boil(s) as illustrated in Figure D.7. The purpose of the ring is to raise a head of water over the boil to counterbalance the upward pressure of the seepage flow. The height of the water column is adjusted so that the water exiting the boil runs clear and no longer removes soil from the levee foundation. It's extremely important that the flow of water is never stopped

completely, as this may cause additional boils to break out nearby. Treated areas should be kept under constant surveillance until the water recedes.

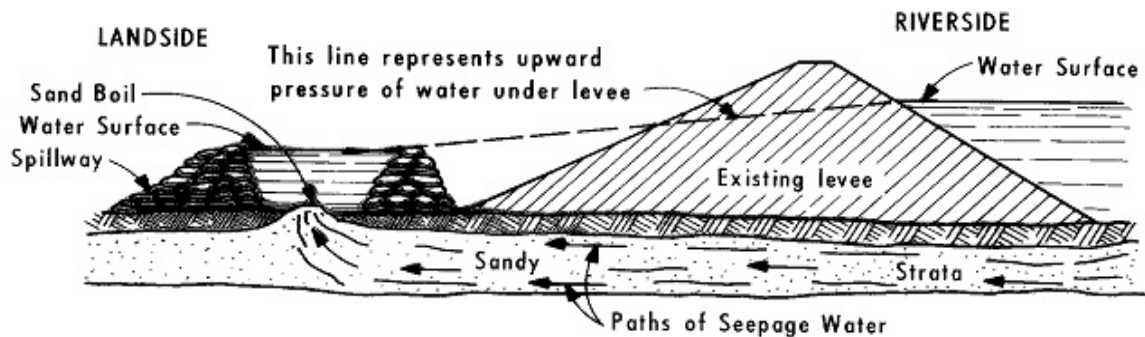


Figure D.6 To treat the sandboil, the pressure of the seepage water is counterbalanced by hydrostatic pressure from the column of water in the ring levee.

The diameter and height of the ring will depend on the actual conditions at each sandboil. The base width should be at least $1\frac{1}{2}$ times the contemplated height, and the inner ring of sandbags should begin between one and three feet from outer edge of the sandboil. "Weak" or "quick" ground near a boil should be included within the sack ring to prevent these areas from developing into new boils when the active boil is treated. Where several sandboils develop in a localized area, a ring levee of sandbags should be constructed around the entire area. The ring should ideally be of sufficient diameter to permit sacking operations to keep ahead of the flow of water. When a sandboil is located near the levee toe, the sandbag ring may be tied into the landside slope of the levee, as shown in Figure D.8.

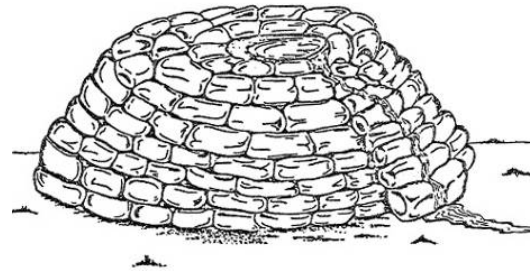


Figure D.7 Sketch of a typical ring levee with spillway.

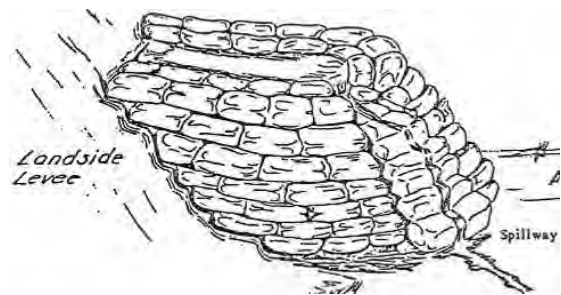


Figure D.8 Sketch of ring levee tied to a levee slope, with spillway. Construction against the levee slope results in a U-shaped sandbag "chimney."

The base or foundation for the sack ring should be cleared of debris and scarified

to provide a reasonably watertight bond between the ground surface and the sandbags. The ring is constructed with sacks filled approximately two-thirds ($\frac{2}{3}$) full of sand, and tamped firmly into place. Do not tie the ends of the sacks. When adding subsequent layers, the joints should be staggered for stability and water tightness. The untied ends of sandbags should be laid towards the inside of the ring and folded under. The height of the sack ring should be only sufficient to slow the flow until the water

exiting the boil runs clean. Never place sandbags directly over the sandboil or attempt to completely stop the flow through the boils, as this may result in other boils developing nearby.

A spillway or exit channel should be constructed on the top of the sack ring so that the level of the water in the ring levee can be adjusted, and the overflow water can be carried a safe distance from the boil, away from the direction of the levee. Because the height of the water is the critical factor in adjusting the rate of flow through the boil, the spillway will require constant monitoring and adjustment once the sandbag ring levee is filled with water. This spillway is normally constructed of sandbags, but alternately, a V-shaped drain can be constructed of two boards; or PVC pipe, plastic sheeting, or other materials may be helpful in building the spillway.

c. Material, Tools, and Labor Requirements for Sandbag Ring Levee:

Materials, tools, and labor required to construct a Sandbag Ring Levee 2½ feet high and 10 feet in diameter with a haul distance of 1 mile round trip.

i. Materials and Tools:

- 1,125 Sandbags
- 5 Shovels, long or short handle
- 9 Tons of sand (approximately)
- 5 Pick up trucks
- 2 Radios or cell phones (one at filling site; one at laying site)
- 2 Emergency light sets
- 15 Flashlights
- 15 Pairs of work gloves

ii. Labor Requirements:

- 4 Filling sandbags
- 3 Loading/ carrying
- 5 Hauling to work site
- 3 Laying (placement)
- 2 Foremen (1 at sandbag filling site 1 at work site)
- 17 People required, total**

iii. Time Requirements:

With given resources, time for construction is estimated to be 1-½ hours from start to finish.

d. Alternate Methods of Treating Sandboils

An alternate method of ringing sandboils is by use of corrugated sheet-steel piling, as shown in Figure D.9. The area is cleared of debris, and the piling is driven about 1-½ feet into the ground around the boil. This method accomplishes the same task faster than sandbagging, but is limited in use by the availability of material, equipment, and the location and foundation condition of boils. Expedient methods can be improvised in other ways, to include using sections of corrugated metal piping. Special care must be taken with the design of these structures to make sure there is a reliable means for adjusting the water level, so the water column doesn't completely stop the flow of water through the boil.

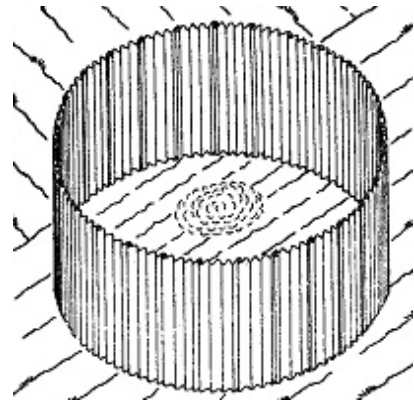


Figure D.9 *A ring of steel-sheet piling can alternately be used to ring the boil, if conditions permit.*

Alternately, it may sometimes be possible to locate the inlet side of a boil under the water on the riverward bank of the levee. A swirl may be observed in the water at this point, or the location of the entry point may have been identified after a previous high water event. Sometimes, because of the current, the swirling vortex appears on the water's surface slightly downstream of the actual opening. If the opening is located, it may be possible to block the seepage flow at its entry point, since blocking the entry point may take much less time than constructing a sandbag ring levee. If the entry point is located, it can be blocked by anchoring a sheet of plastic over the area, using rope and sandbags. It may sometimes be possible to plug a flooded animal burrow by placing a mixture of manure and straw or dry hay into the water at the burrow entrance. If the entry point is blocked, both the blockage and the location of boil need to be closely monitored for any changes.

3.3 Sloughs

If seepage causes saturation and sloughing of the landward slope, the slope should ideally be flattened to 1V (vertical) on 4H (horizontal) or flatter. Material for flattening should be at least as pervious as the embankment material. If any sloughs develop in the levee, all soft areas should be thoroughly drained by excavating shallow ditches in the side slopes, as shown in Plate 4. Contact your Corps district office before undertaking this method.

3.4 Floating Soil Conditions

When seepage exits landward of the levee toe at a pressure that creates a sensation like the soil is fluid, the levee and foundation become susceptible to sliding and/or sloughing which can lead to an embankment failure. A fluid soil condition is an indicator that soil particles or the soil mass is floating, and the soil's ability to support a load such as a vehicle or heavy equipment and/or the levee embankment itself has been reduced. When this condition is observed, the safety, health and welfare of those individuals who are responding to the flood fight and/or those who live within the protected area must come first. Consideration must be given to evacuating the area. If the sod layer appears to pop loose or lift up, evacuate the area immediately. In a past flood, this condition was observed and successfully solved with the placement of clean, free-draining sand fill, classified as SP medium to fine sand, with less than 5 percent fines passing the number 200 sieve. The sand was brought in from another location (away from the levee), and a bulldozer was used to push the sand over the area, creating a blanket some 3 feet in thickness and some 20 feet in width. The thickness and width necessary may vary depending on the observed conditions.

3.5 Other Seepage Related Considerations

Any basement or similar depression near the levee should be closely watched for heaving of floors, caving of walls, and boil activity. It may become necessary to support basement walls or weight down basement floors by intentionally flooding the basement with clean water, to prevent walls from caving in, piping, or excessive seepage.

4. Erosion

4.1 Wave Wash

During high water, continuing wave action against a levee slope can erode wide terraces along the length of the levee. This causes scour or beaching along the riverward slope of the levee and reduces the cross sectional area, which can potentially lead to a failure. This type of damage doesn't typically arise during short (hour-long) storms, especially if the slope has good sod cover. However, during longer periods of high water, especially during windy or icy conditions, the damage can develop very rapidly. The section leader should study the levee beforehand to assess the potential for wave wash. All potential trouble areas should be located well in advance, and section leaders should assemble a reserve supply of materials (filled sandbags, lumber, stakes, plastic sheeting, rock, etc) close to locations most likely to experience such damage. During periods of high wind and high water, when waves attack a levee, ample labor should be assembled and experienced personnel should patrol the areas to identify the beginnings of scour, washouts, or breaching. Because wave wash damage can spread rapidly, it is important that damaged areas are treated as soon as they are identified. There are a number of accepted methods of protecting a levee against wave wash.

a. Sandbags

In emergency situations, the preferred treatment method is to place sandbags in to the cut as shown in Plate 5. The filled sacks should be laid in sections of sufficient length to give protection well above the anticipated rise.

b. Plastic Sheeting and Sandbags

Experience has shown that a combination of plastic sheeting and sandbags is one of the most expedient, effective and economical methods of combating slope attack in a flood situation. Other materials such as snow fence, cotton, or burlap have successfully been used in place of the plastic in the past. Poly and sandbags can be used in a variety of combinations, and time becomes the factor that may determine which combination to use. Ideally, poly and sandbag protection should be placed in the dry. However, many cases of unexpected slope attack will occur during high water, and a method for placement in the wet is covered below. See Plates 6 and 7 for recommended methods of laying poly and sandbags. Plate 8 shows a minimal configuration for emergency use. Since each flood fight project is generally unique (river, personnel available, materials, etc.), specific details of placement and materials handling will not be covered, though some guidelines are provided below. Field personnel must be aware of resources available when using poly and sandbags.

i. Dry Placement

Anchoring the poly along the riverward toe is important for a successful job. It may be done in three different ways: 1) after completion of the levee, a trench excavated along the toe, poly placed in the trench, and the trench backfilled; 2) poly placed flat-out away from the toe, and earth pushed over the flap; 3) poly placed flat-out from the toe and one or more rows of sandbags placed over the flap. The poly should then be unrolled up the slope and over the top enough to allow for

anchoring with sandbags. Poly should be placed from downstream to upstream along the slopes and overlapped at least two feet. The poly is now ready for the "hold-down" sandbags.

It is mandatory that poly placed on levee slopes be held down along the slopes as well. An effective method of anchoring poly is a grid system of sandbags, unless extremely high velocities, heavy debris or a large amount of ice is anticipated. Then, a solid blanket of bags over the poly should be used. A grid system can be constructed faster and requires fewer bags and much less labor than a total covering. Various grid systems include vertical rows of lapped bags, two-by-four lumber held down by attached bags, and rows of bags held by a continuous rope tied to each bag. Poly has been held down by a system using two bags tied with rope and the rope saddled over the levee crown with a bag on each slope.

ii. Placement in the Wet

In many situations during high water, poly and sandbags placed in the wet must provide the emergency protection. Wet placement may also be required to replace or maintain damaged poly or poly displaced by current action. Plate 7 shows a typical section of levee covered in the wet. Sandbag anchors are formed at the bottom edge and ends of the poly by bunching the poly around a fistful of sand or rock, and tying the sandbags to this fist-sized ball. Counterweights consisting of two or more sandbags connected by a length of 1/4-inch rope are used to hold the center portion of the poly down. The number of counterweights will depend on the uniformity of the levee slope and current velocity. Placement of the poly consists of first casting out the poly sheet with the bottom weights and then adding counterweights to slowly sink the poly sheet into place. The poly, in most cases, will continue to move down slope until the bottom edge reaches the toe of the slope. Sufficient counterweights should be added to insure that no air voids exist between the poly and the levee face and to keep the poly from flapping or being carried away in the current. For this reason, it is important to have enough counterweights prepared prior to the placement of the sheet.

iii. Overuse of Plastic Sheeting

In past floods, there has been a tendency to overuse and in some cases misuse poly on slopes. For example, on well-compacted clay embankments, in areas of relatively low velocities, use of poly would be excessive. Plastic should never be used on the landward slopes, as it holds through-seepage against the levee slope. A critical analysis of a situation should be made before poly and sandbags are used, with a view toward less waste and more efficient use of these materials and available manpower. However, if a situation is doubtful, poly should be used rather than risk a failure. Critical areas should have priority.

c. Moveable Panels

Wave wash may also be effectively checked by the use of movable panels constructed of lumber. These panels are anchored in place on the levee slope with stakes and are weighted down with sandbags or stone as shown on Plate 9. A portable bulkhead constructed with lumber and staked into place is another alternate type of wave wash protection.

d. Miscellaneous Measures

Several other methods of slope protection have been used. Straw bales pegged into the slope were successful against wave action, as was straw spread on the slope and overlain with snow fence.

4.2 Scours

Scouring 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. Careful observation should be made along the entire length of the riverside of the levee during high water periods, and especially in locations where the current flow is two feet per second or more. Scouring will most likely develop at road crossing ramps and at locations where pipes, sewers, and other structures penetrate the levee. It may also develop in ditches, excavations or building basements near the levee, around riverside stability berms, or in other locations where there is an obstruction to the smooth flow of water along the levee face. If any scour is observed, soundings should be taken if possible to determine the extent of damage and the amount of treatment required.

a. Deflection Weirs

Deflection weirs (also known as bendway weirs), extending 10 feet or more into the channel have been effective in deflecting current away from the levees. These emergency structures can be constructed using lumber, stakes, brush, sandbags, and stone, and are tied in place as shown on Plates 10 and 11. Snow fence, plain riprap, compacted earth or any other substantial materials available may also be used; even old car bodies have been used in the past. Preferably, the weirs should be placed in the dry at locations where severe scour may be anticipated, because construction during high water will be very difficult. A series of weirs may be needed to protect the area, or a longer weir may be constructed in the water parallel to the levee. Care should be given in the placement of weirs, because haphazard placement may shift the current towards other banks and lead to even worse scouring. Hydraulic technical assistance should be sought if questions arise in the use of emergency weirs.

b. Plastic Sheeting

Plastic sheeting may be useful in protecting the embankment from scouring, as described under the previous section on wave wash.

c. Other Protection

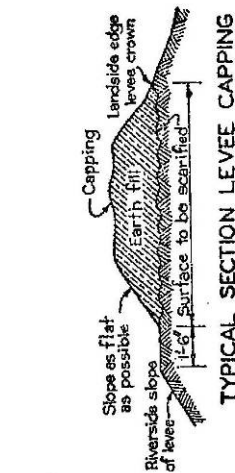
If scour begins to take place after water is up on the levee, a protective berm should be constructed over the entire scour area using stone, slag, or other durable material with sufficient size and weight withstand the erosive velocity of the current. Construction of this berm will generally require equipment capable of operating from the levee crown. Riprap has been used to provide slope protection where erosive forces were too large to be effectively controlled by other means. Objections to using riprap when flood fighting include the cost and the large quantities that are typically necessary to protect a given area. It's usually very difficult to control the placement of the riprap, particularly during times of high water, but careful use of an excavator has been effective even in difficult conditions.



Figure D.10 *Placement of Riprap. Careful use of an excavator may allow for more accurate placement than is shown above.*

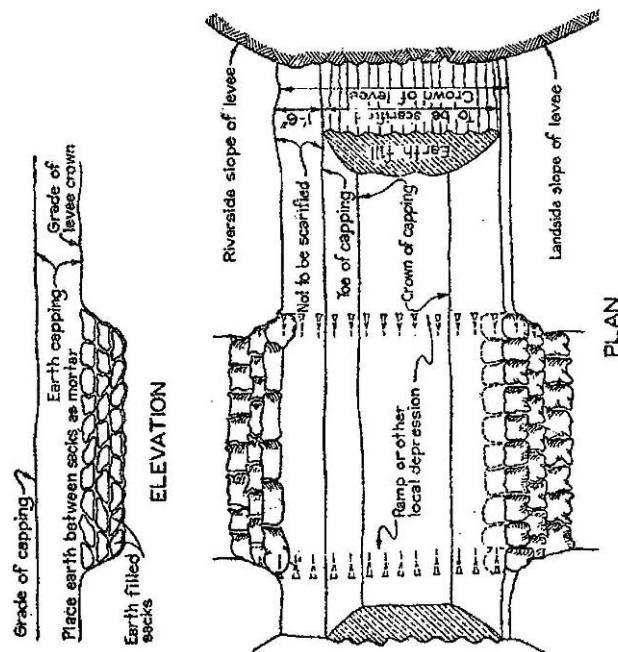
4.3 Ice and Floating Debris

Sometimes ice conditions are such that protection provided by the methods outlined above will not be totally effective. The primary method for protecting a levee slope from debris or ice attack is to construct a floating boom parallel to the levee embankment. Logs, driftwood, or any available timber are cabled together end to end and moored to the ground in such a way that they float out in the current about 15 feet from the water's edge. Depending on the size of the logs, the boom will deflect floating objects. Since a detailed discussion of ice jams lies beyond the scope of this manual, please refer to the references in Appendix I for additional information.

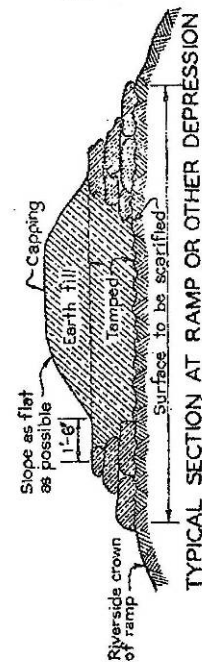


TYPICAL SECTION LEVEE CAPPING

NOTE: This type of capping not to be used on levees with crown less than 10' wide or on levees exposed to wave wash.



EMERGENCY FLOOD FIGHTING
EARTH CAPPING
 FOR RAISING DEPRESSIONS AND LEVEE CAPPING
 (THIS DESIGN IS ADEQUATE FOR HEIGHTS UP TO 1½')
 U.S. ARMY CORPS OF ENGINEERS



TYPICAL SECTION AT RAMP OR OTHER DEPRESSION

Plate 1

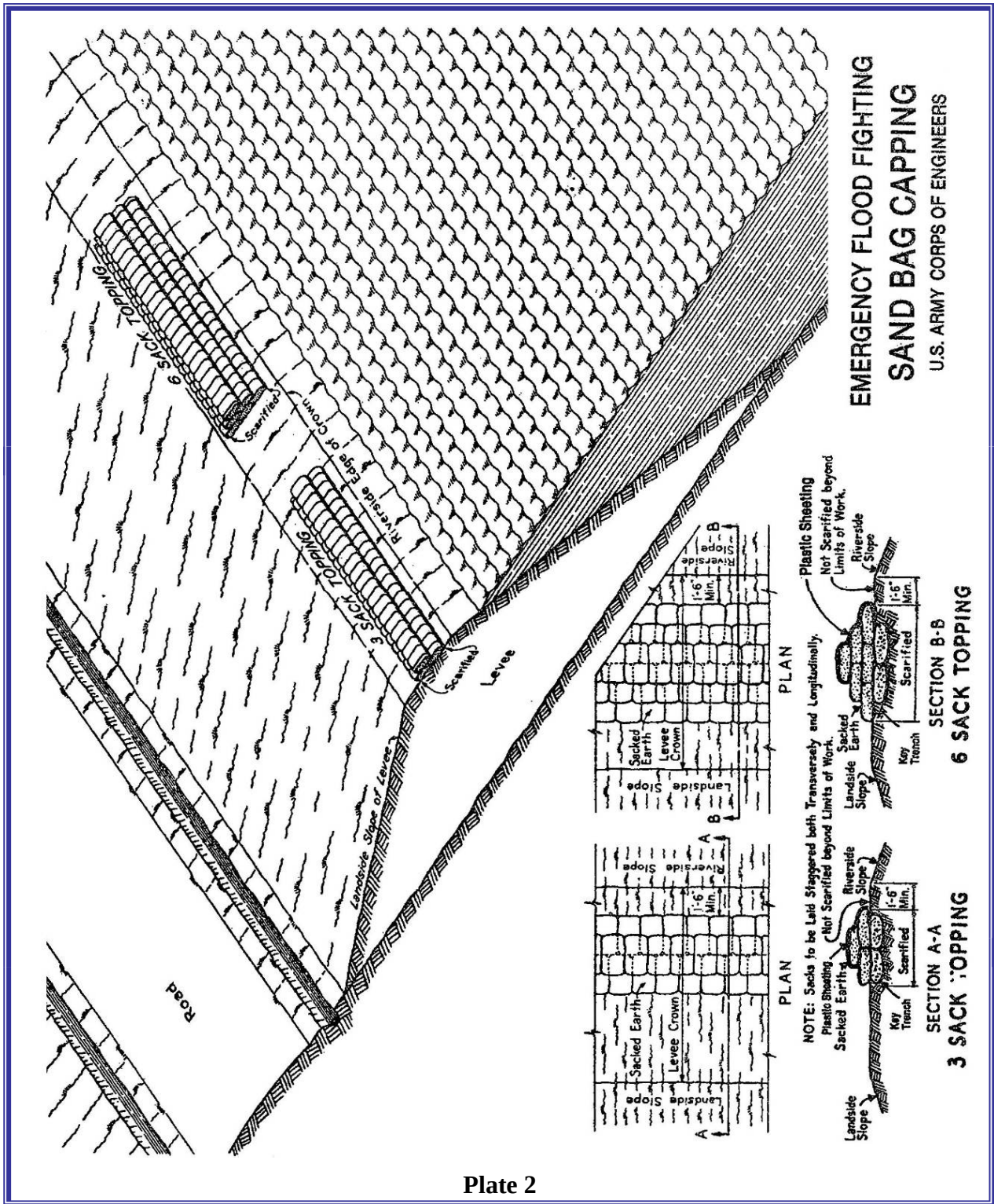
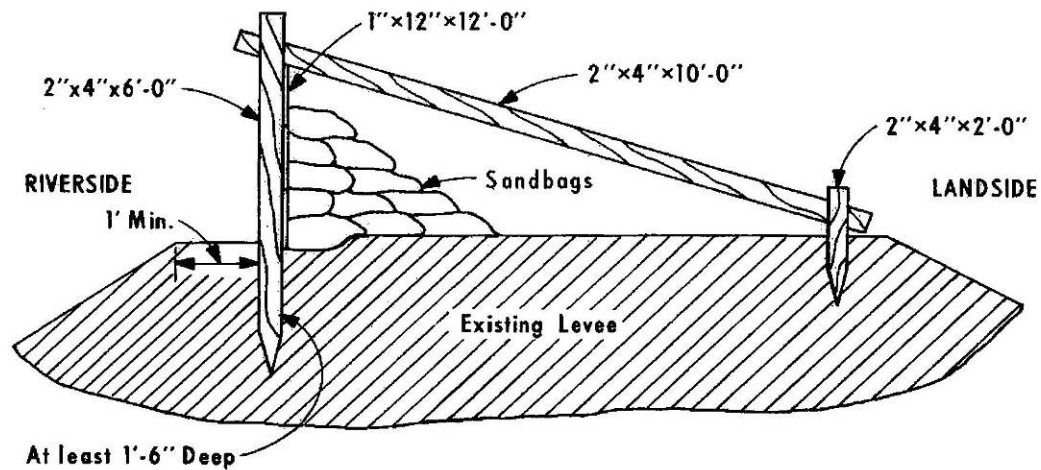
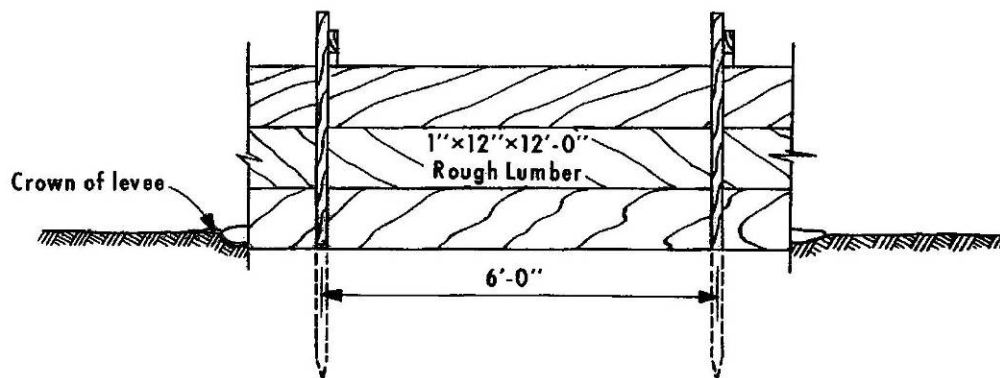


Plate 2



SECTION

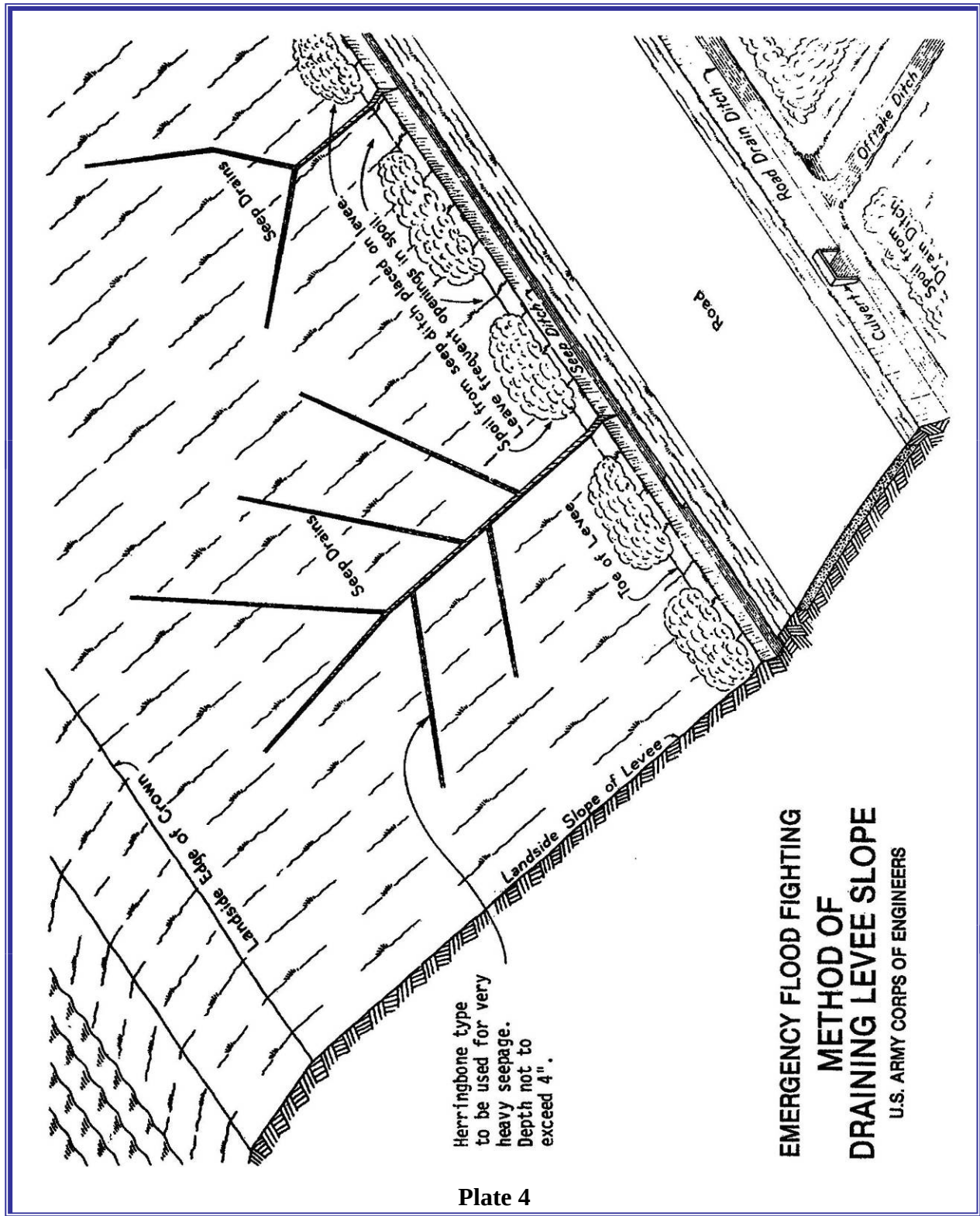


FRONT ELEVATION

BILL OF MATERIAL FOR 100 FT.	
LUMBER	
25 pieces	1" x 12" x 12'-0"
17 pieces	2" x 4" x 10'-0"
17 pieces	2" x 4" x 6'-0"
17 pieces	2" x 4" x 2'-0"
NAILS	
2 lbs	8d Common
2 lbs	16d Common
SANDBAGS	
1100	Filled Bags

CONSTRUCTION METHODS
FOR
HIGH WATER
LUMBER AND SACK TOPPING
U. S. ARMY CORPS OF ENGINEERS

Plate 3



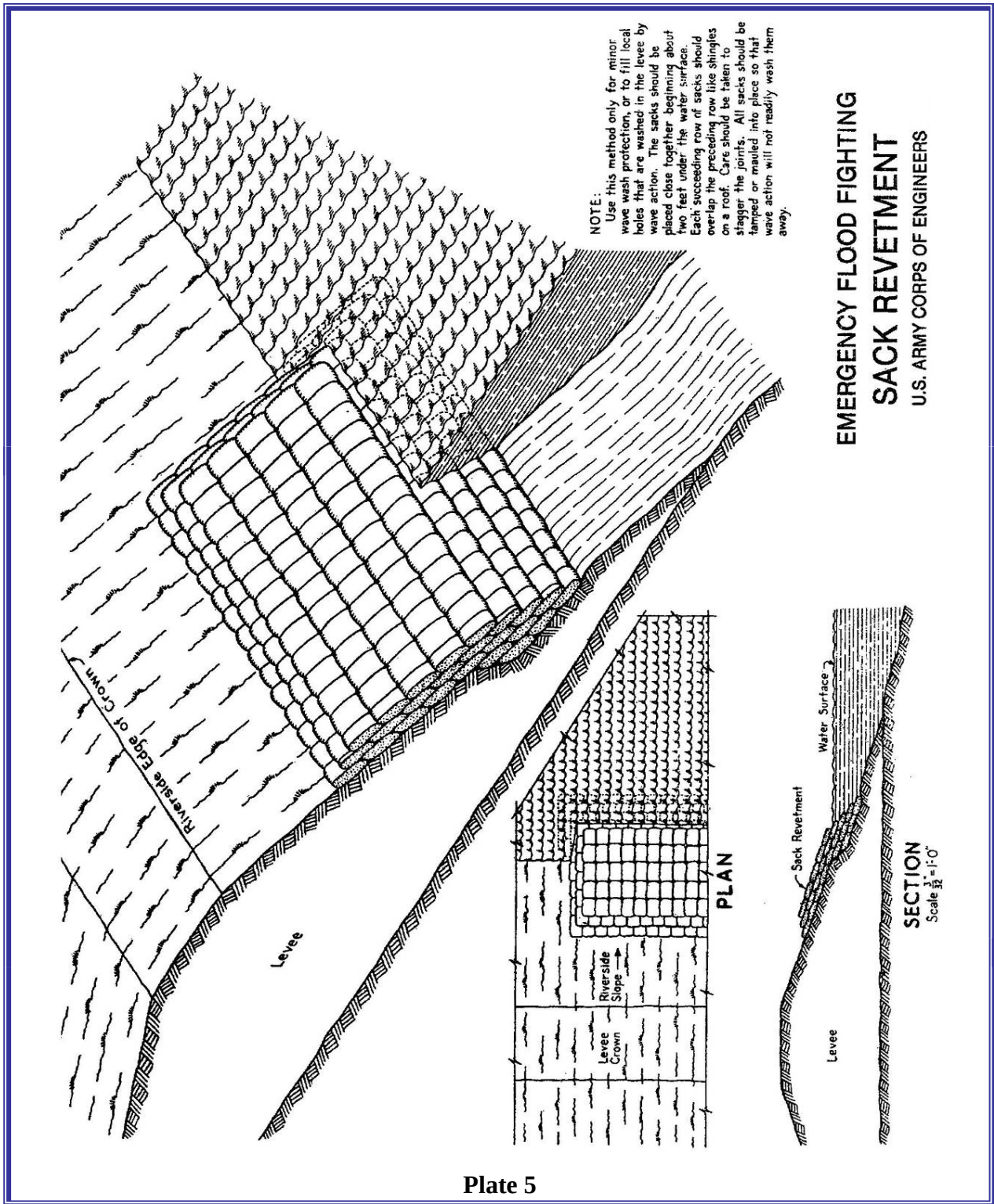
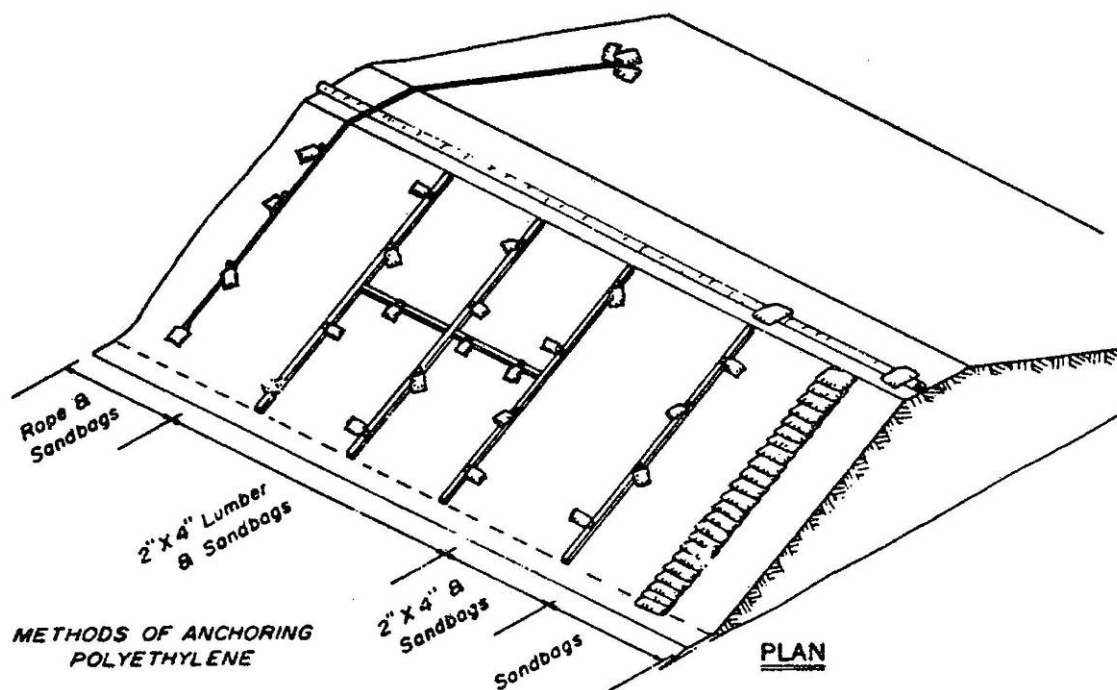
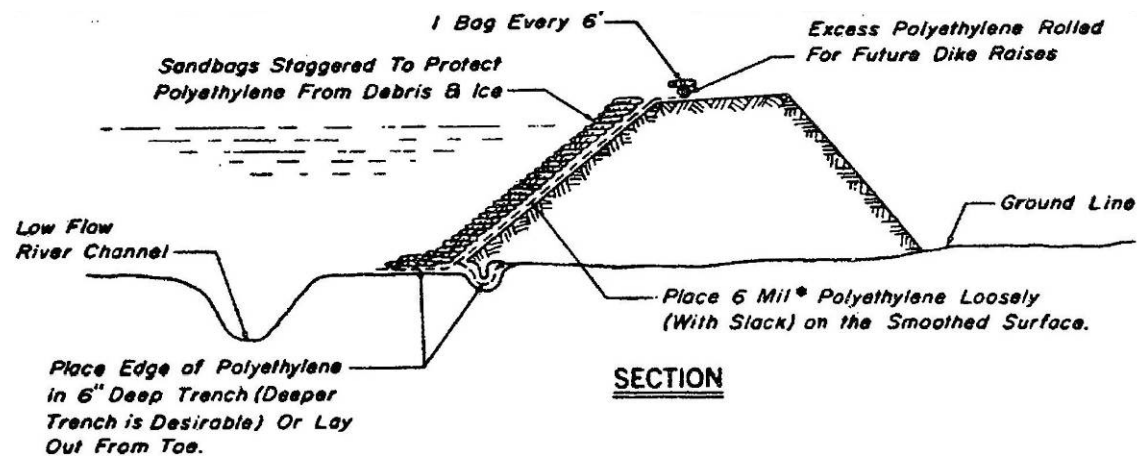


Plate 5

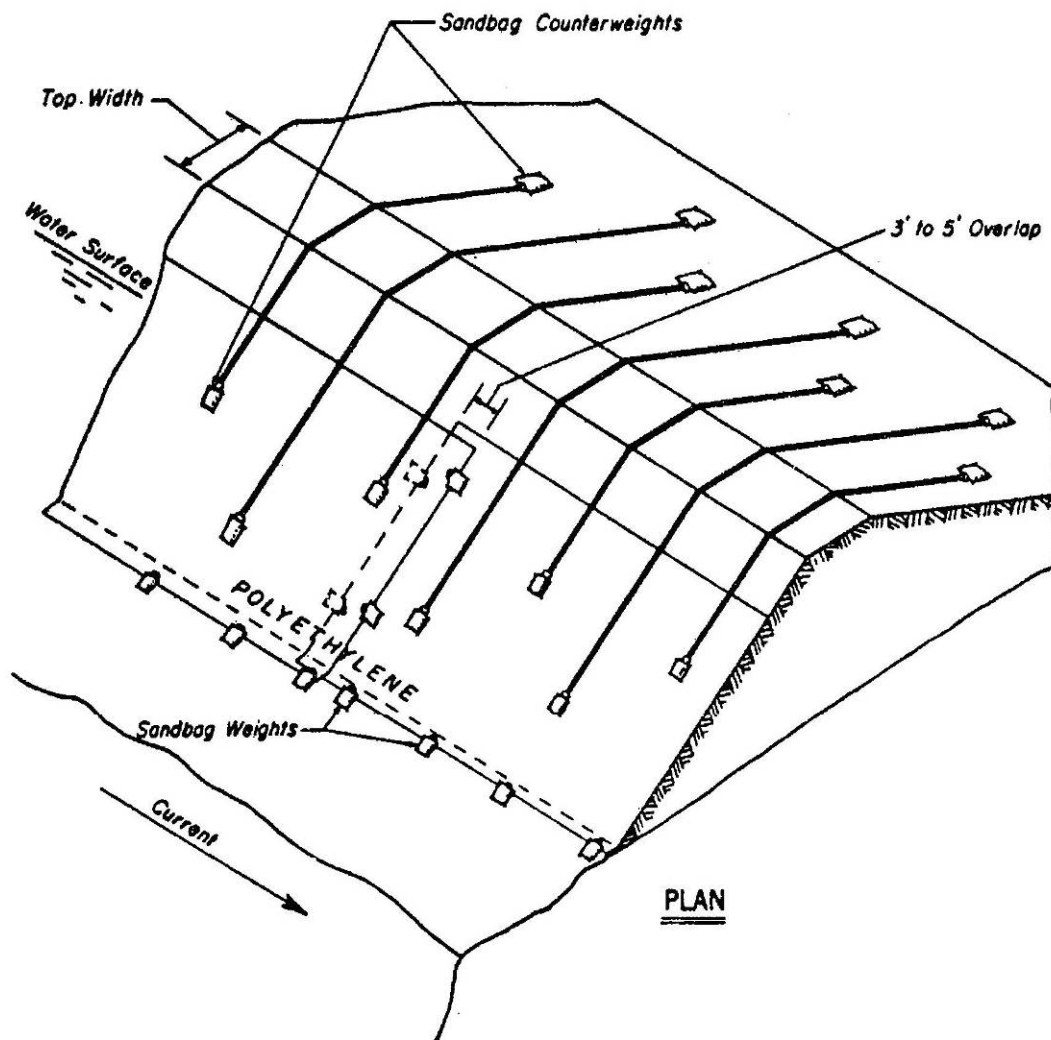


* 6 Mil Black Polyethylene is the most Desirable, 6 Mil Clear Second, 4 Mil Black Third, 4 Mil Clear Fourth & 2 Mil Polyethylene Should Only Be Used As A Last Resort.

EMERGENCY FLOOD FIGHTING POLYETHYLENE LEVEE PROTECTION

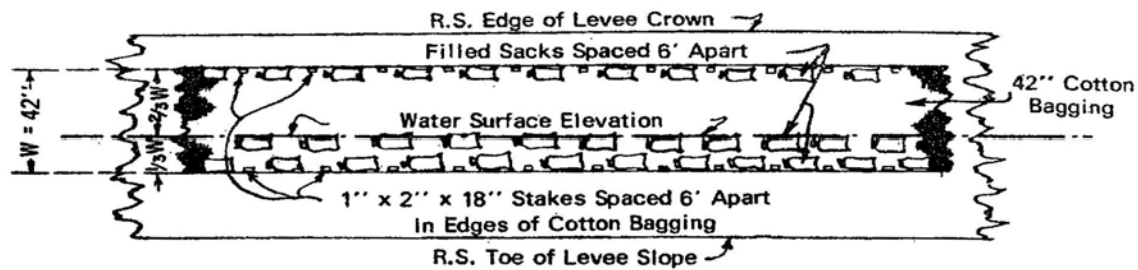
U.S. ARMY CORPS OF ENGINEERS

Plate 6

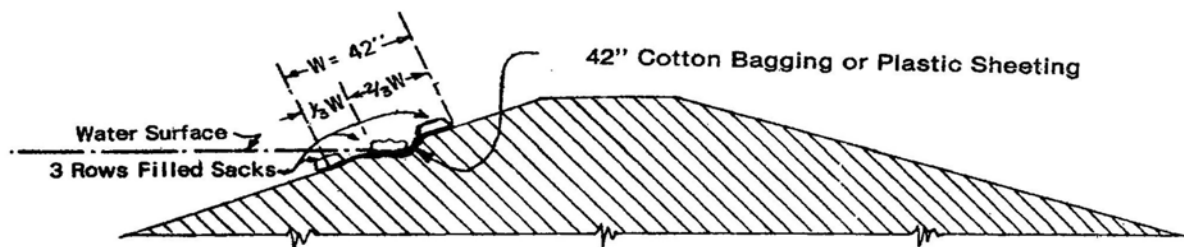


EMERGENCY FLOOD FIGHTING
 PLACEMENT OF
 POLYETHYLENE
 SHEETING IN THE WET
 U.S. ARMY CORPS OF ENGINEERS

Plate 7



PLAN



CROSS SECTION

BILL OF MATERIAL
TO CONSTRUCT 180 FT.

1 Roll Jute Cotton Bagging 42" x 180'
90 Filled Sacks
60 Stakes 1" x 2" x 18" = 15 Bd. Ft.

INSTRUCTIONS

Lay 42" cotton bagging (Jute) longitudinally along riverside slope of levee with approximate 2/3 width above water surface.

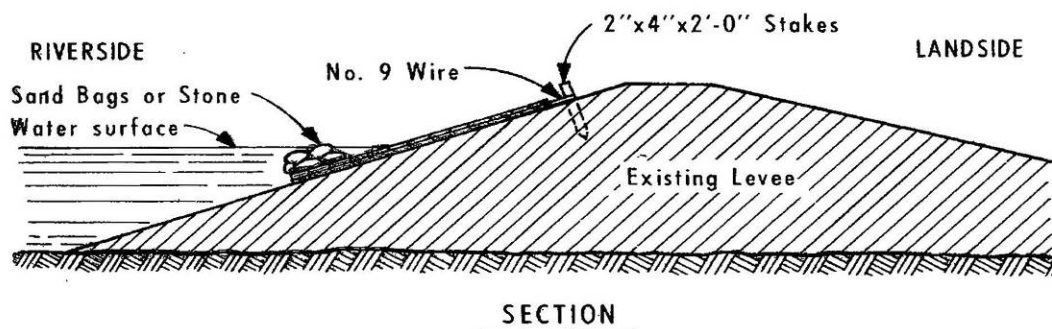
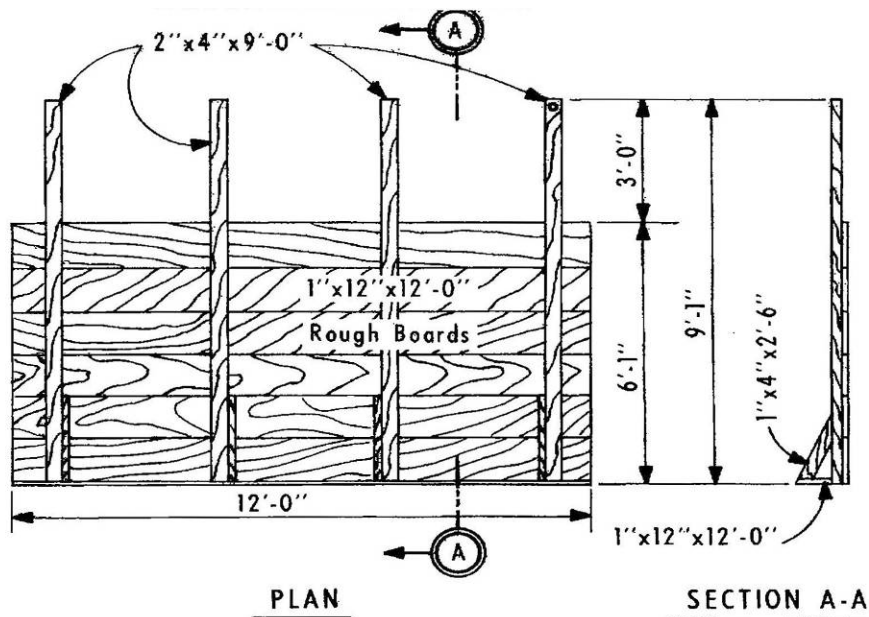
Weight bagging along edges and at water surface with filled sacks spaced approximately 6' apart. Drive stakes alternately between sacks along both edges of bagging.

If additional width is required, lace two or more widths of bagging together and lay as desired.

**EMERGENCY FLOOD FIGHTING
TYPE OF WAVEWASH PROTECTION**

U.S. ARMY CORPS OF ENGINEERS

Plate 8



BILL OF MATERIAL FOR 100 FT.	
LUMBER	
55 Pieces	1"x12"x12'-0"
32 Pieces	1"x4"x2'-6"
32 Pieces	2"x4"x9'-0"
32 Pieces	2"x4"x2'-0"
WIRE	
100 Ft.	No. 9
NAILS	
6lbs.	8d Common

**CONSTRUCTION METHODS
FOR
HIGH WATER
WAVE WASH PROTECTION
MOVABLE**

U. S. ARMY CORPS OF ENGINEERS

Plate 9

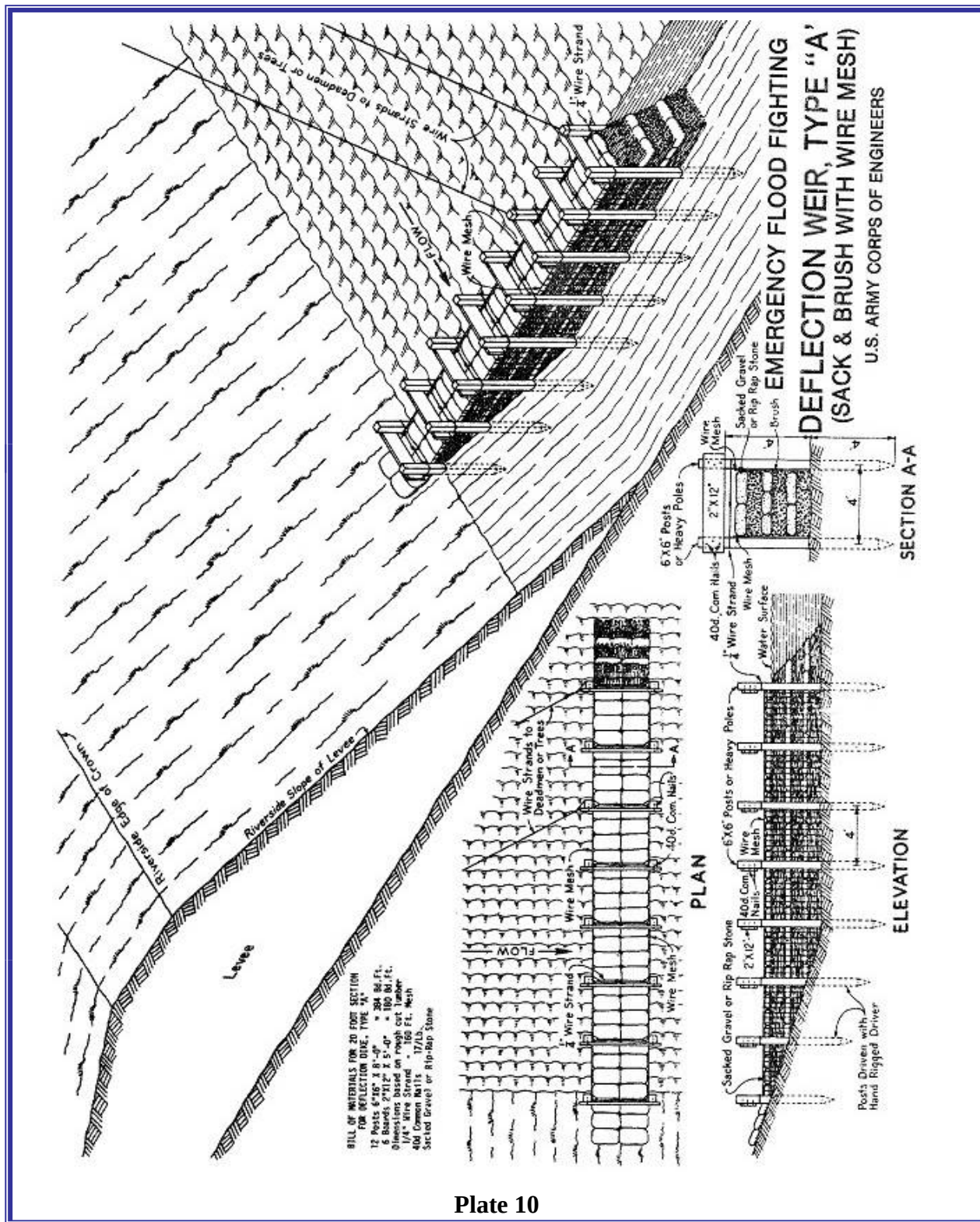


Plate 10

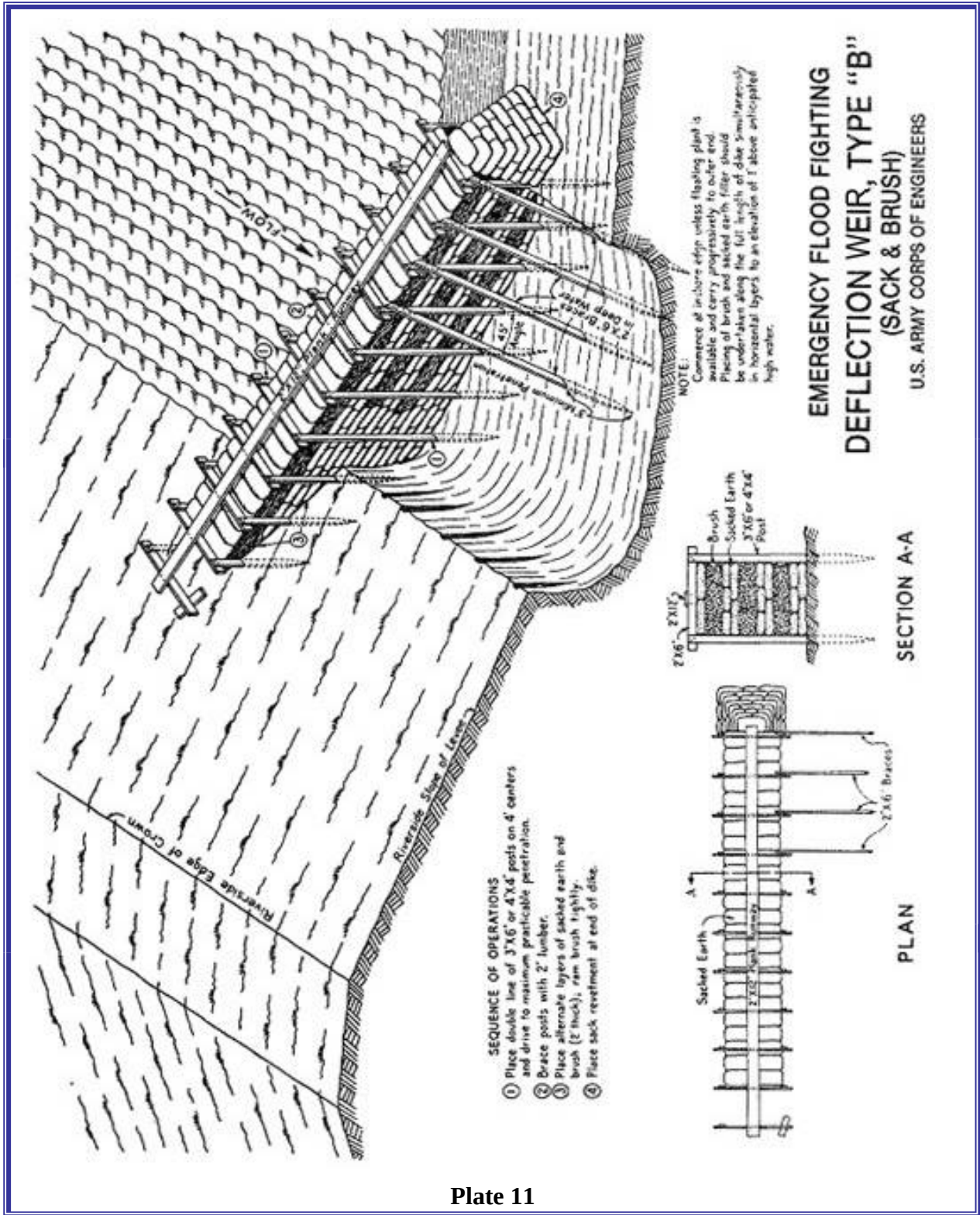


Plate 11

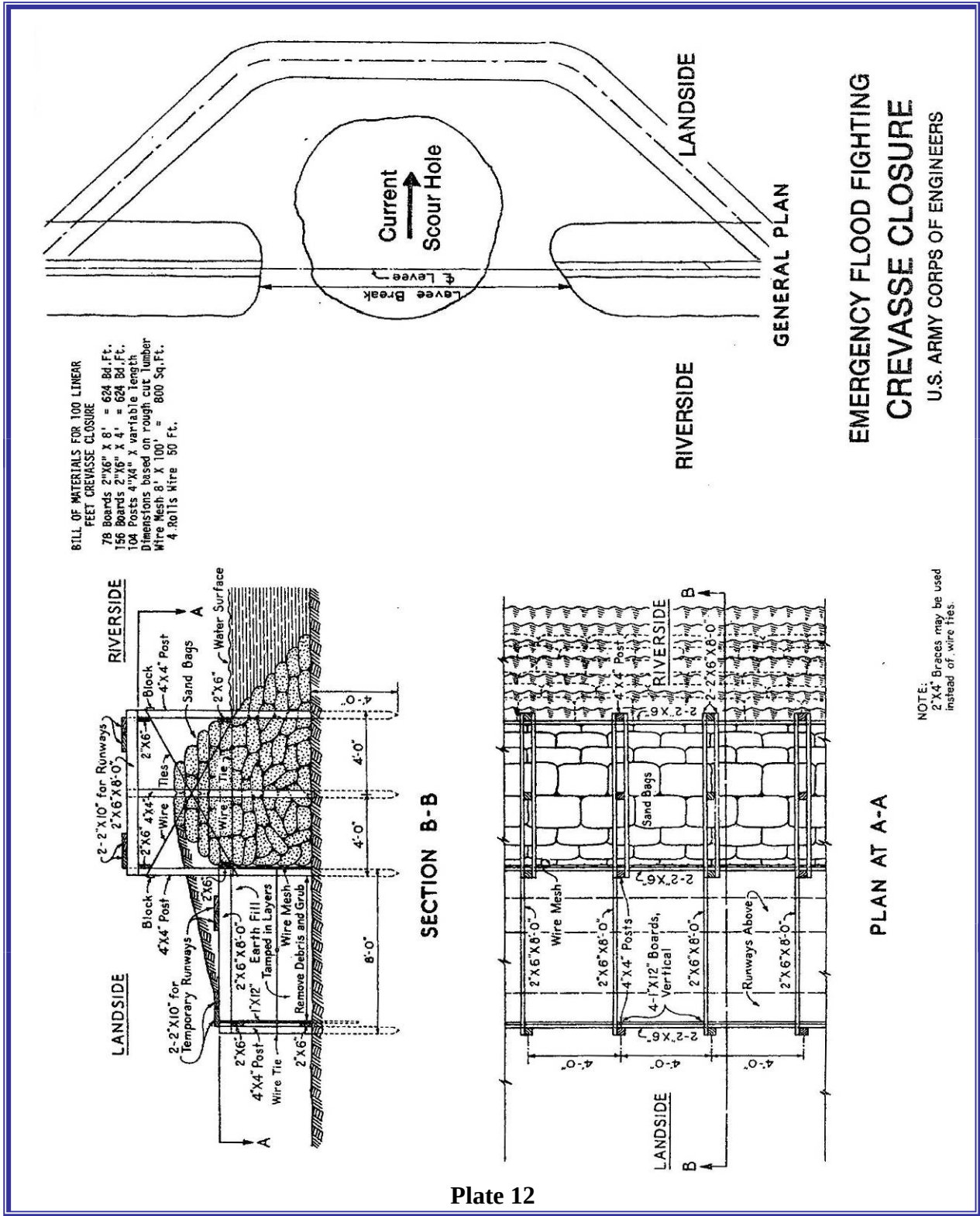
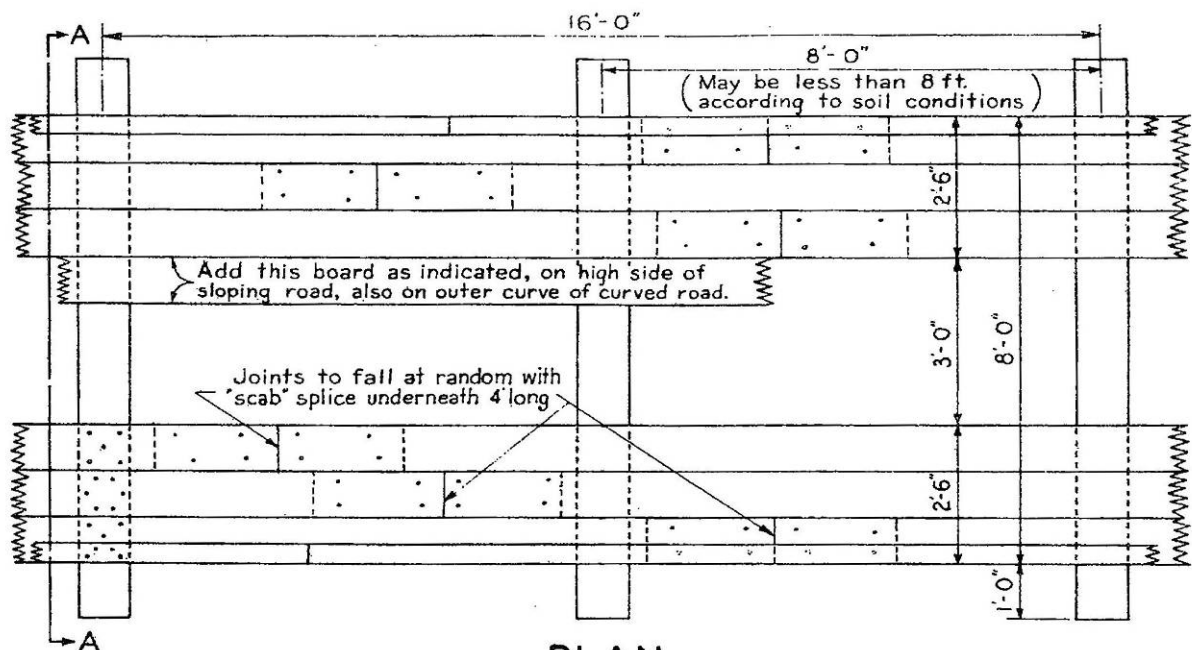
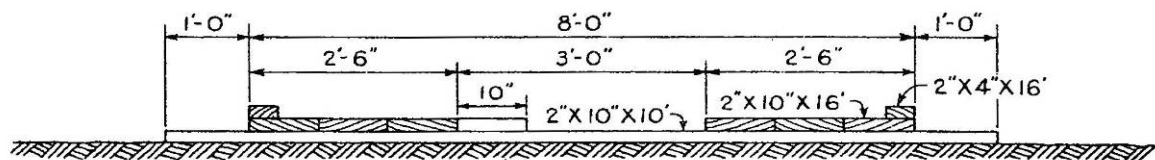


Plate 12



PLAN
Scale $\frac{3}{8}" = 1'-0"$



SECTION A-A
Scale $\frac{1}{2}" = 1'-0"$

**BILL OF MATERIALS FOR
100 LINEAR FEET OF ROADWAY**

Cross Members	13 Pcs. 2"x10"x10' =	217 Bd. Ft.
Road Bed	38 Pcs. 2"x10"x16' =	1014 Bd. Ft.
Guard Rail	13 Pcs. 2"x4"x16' =	139 Bd. Ft.
Total		1370 Bd. Ft.

18 Lbs. 30d. Common Nails
10 Lbs. 60d. Common Nails

Kind of Lumber: Hardwood, Rough.

Actual quantities. No allowance made for waste.

NOTE:

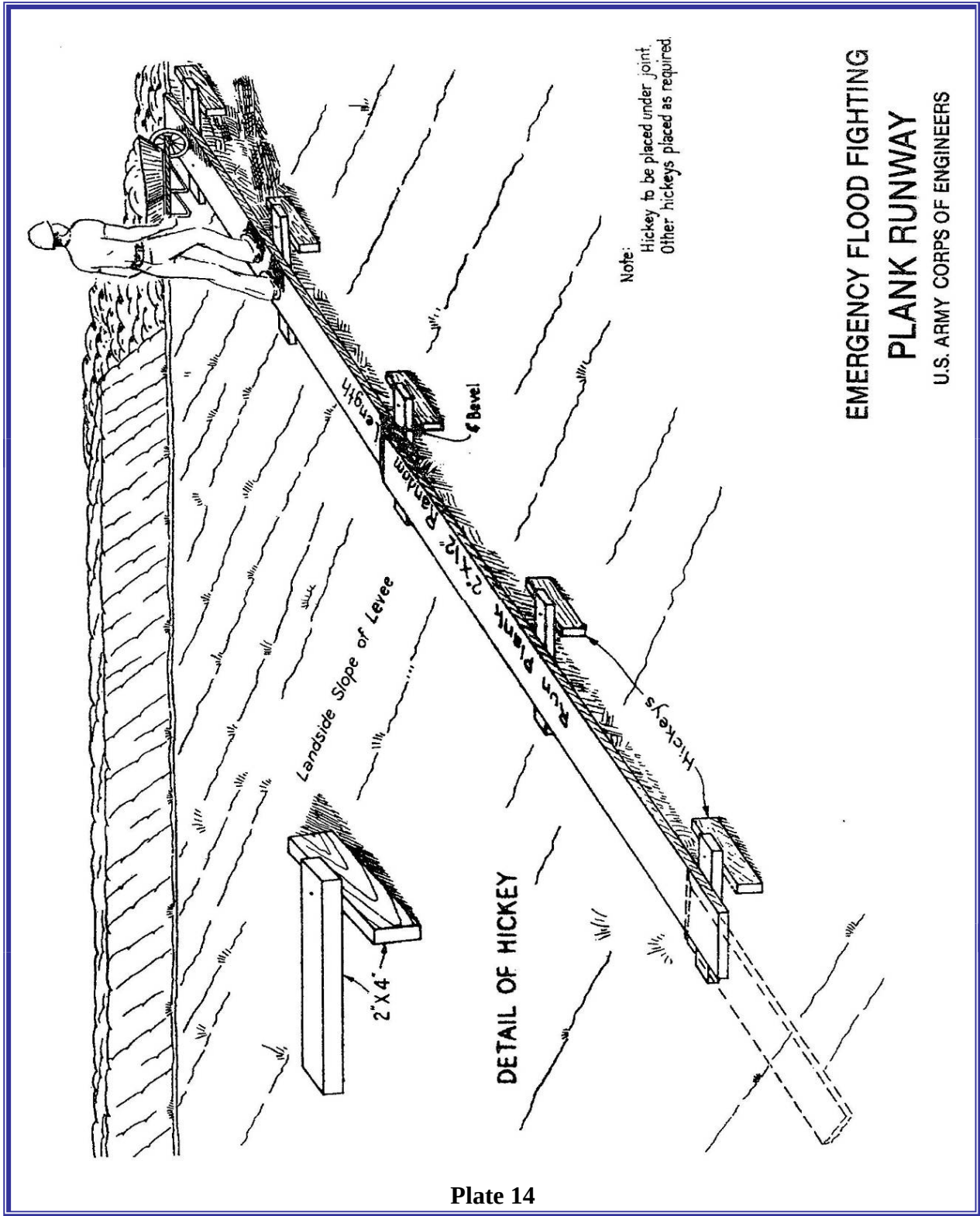
Where foundation is very soft, 12 ft. flooring should be used with cross members at 6 ft. centers. In this case add approximately 33 1/3% or 1/3 to Bill of Materials at left, for 100 ft. of roadway.

* Random not less than 12'

**EMERGENCY FLOOD FIGHTING
PLANK ROAD**

U.S. ARMY CORPS OF ENGINEERS

Plate 13



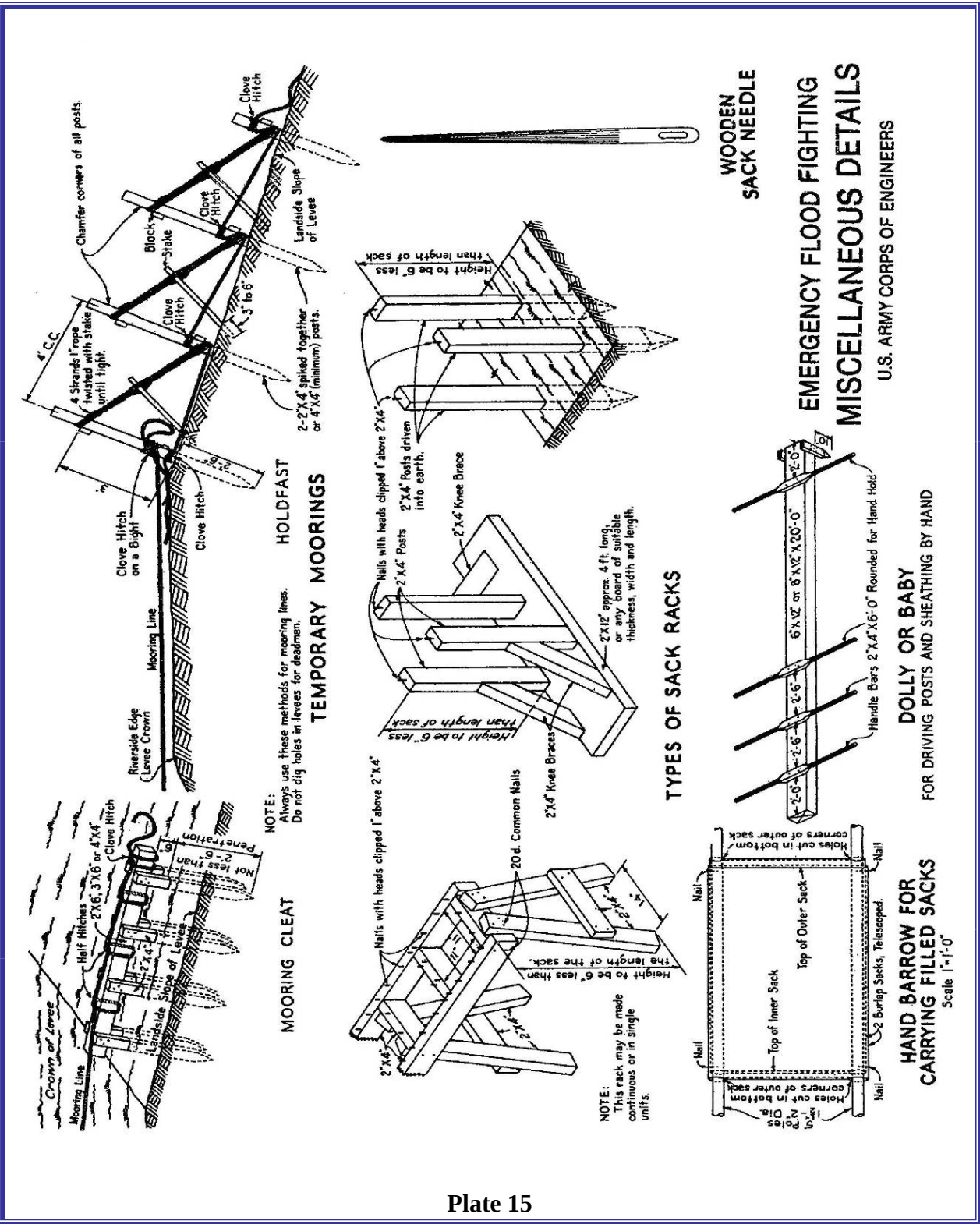


Plate 15

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APPENDIX E: REHABILITATION REQUEST FORM

U.S. Army Corps of Engineers, _____ District	Date of
Request: _____	
ATTN: Emergency Management Branch	
Street Address	
City, State ZIP+4	
Dear Sir:	
The purpose of this letter is to request Rehabilitation Assistance from the Corps of Engineers under Public Law 84-99 for the repair of the _____ levee (or other type of flood control project) that was damaged by (flood)(high waters) during _____ 20____. The project is Active in the Rehabilitation and Inspection Program, and was last inspected by the Corps of Engineers on _____. The location of the levee and a brief description of the damage are as follows:	
Project Identification Number _____ River or Stream _____	
Bank (circle): Left, Right, Both	
Description of Damage _____	

City _____ County _____ State _____	
Section _____ Township _____ Range _____	
Public Sponsor Point of Contact:	
Name _____	
Address _____ City _____ State _____	
Telephone (W) _____ (H) _____	
If this project is eligible for PL 84-99 Rehabilitation Assistance, I further request that the Corps of Engineers take all necessary steps to accomplish the appropriate repairs. It is agreed that the required items of local cooperation will be provided should the levee be eligible for Rehabilitation Assistance under PL 84-99 and the repair work is accomplished by the Corps of Engineers.	
I hereby certify that the right-of-way which is required for any authorized repair work is presently available, and this letter constitutes permission for the Government and its agents to enter and use said right-of-way in undertaking authorized repair work.	
Sincerely,	

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APPENDIX F: Cooperation Agreement for Rehabilitation of Non-Federal Flood Control Works

COOPERATION AGREEMENT BETWEEN THE UNITED STATES OF AMERICA and _____ for REHABILITATION OF A NON-FEDERAL FLOOD CONTROL WORK THIS AGREEMENT, entered into this ____ day of _____, 20____, by and between THE DEPARTMENT OF THE ARMY (hereinafter referred to as the "Government") represented by the District Engineer, _____ District, U.S. Army Corps of Engineers, and the _____ [PUBLIC SPONSOR], (hereinafter referred to as the "Public Sponsor"), represented by _____ [TITLE OF PERSON SIGNING THIS AGREEMENT]. WITNESSETH THAT: WHEREAS, pursuant to 33 U.S.C. 701n, the Government is authorized to assist in the repair or restoration of flood control improvements threatened or destroyed by flood; WHEREAS, via written correspondence, the Public Sponsor has requested the Government to repair or restore a certain flood control work damaged by recent flooding or coastal storms, in accordance with 33 U.S.C. 701n and established policies of the U.S. Army Corps of Engineers; and, WHEREAS, the Public Sponsor hereby represents that it has the authority and legal capability to furnish the non-Federal cooperation hereinafter set forth and is willing to participate in the rehabilitation effort in accordance with the terms of this Agreement; NOW, THEREFORE, the Government and the Public Sponsor agree as follows: ARTICLE I - DEFINITIONS AND GENERAL PROVISIONS For purposes of this agreement: A. The term "Rehabilitation Effort" shall mean [DESCRIBE THE WORK TO BE UNDERTAKEN PURSUANT TO THIS AGREEMENT IN SUFFICIENT DETAIL AS IS NECESSARY TO AVOID ANY CONFUSION OVER WHAT WORK IS OR IS NOT INCLUDED], as generally described in a report entitled _____ [SPECIFY THE REPORT] prepared by the District Engineer, U.S. Army Engineer District _____, dated _____, and approved by the Division Engineer on _____.
--

B. The term "Rehabilitation Effort costs" shall mean all costs incurred by the Public Sponsor and the Government, in accordance with the terms of this Agreement, directly related to implementation of the Rehabilitation Effort. The term shall include, but is not necessarily be limited to, actual construction costs, including supervision and inspection costs; costs of contract dispute settlements or awards; and the cost of investigations to identify the existence of hazardous substances as identified in Article XIA. The term shall not include any costs for operation and maintenance; any costs that correct deferred or deficient maintenance; any increased costs for betterments or Public Sponsor preferred alternatives; or the costs of lands, easements, rights-of-way, relocations, or suitable borrow and dredged or excavated material disposal areas required for the Rehabilitation Effort.

C. The term "betterment" shall mean the design and construction of a Rehabilitation Effort feature accomplished on behalf of, or at the request of, the Public Sponsor, in accordance with standards that exceed the standards that the Government would otherwise apply for accomplishing the Rehabilitation Effort.

ARTICLE II - OBLIGATIONS OF THE GOVERNMENT AND PUBLIC SPONSOR

A. The Government, subject to receiving funds appropriated by the Congress of the United States and using those funds and funds provided by the Public Sponsor, shall expeditiously implement the Rehabilitation Effort, applying those procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations, and policies. The Public Sponsor shall be afforded the opportunity to review and comment solicitations for all contracts, including relevant plans and specifications, prior to the issuance of such solicitations. The Contracting Officer will, in good faith, consider the comments of the Public Sponsor, but award of contracts, modifications or change orders, and performance of all work on the Rehabilitation Effort (whether the work is performed under contract or by Government personnel), shall be exclusively within the control of the Contracting Officer.

B. As further specified in Article III, the Public Sponsor shall provide all lands, easements, and rights-of-way, and suitable borrow and dredged or excavated material disposal areas, and perform all relocations determined by the Government to be necessary for construction, operation, and maintenance of the Rehabilitation Effort and the Project.

C. As further specified in Article IV, the Public Sponsor shall contribute, in cash, in-kind services, or a combination thereof, a contribution toward construction of the Rehabilitation Effort in an amount equal to 20 percent of total Rehabilitation Effort costs.

D. The Public Sponsor shall not use Federal funds to meet its share of total Rehabilitation Effort costs under this Agreement unless the Federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute.

E. The Public Sponsor shall hold and save the Government free from all damages arising from the construction, operation, and maintenance of the Rehabilitation Effort, and any related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

F. The Public Sponsor agrees to participate in and comply with the policies and procedures of the U.S. Army Corps of Engineers Rehabilitation and Inspection Program.

G. The Public Sponsor may request the Government to accomplish betterments. The Public Sponsor shall be solely responsible for any increase in costs resulting from the betterments and all such increased costs will be paid in advance by the Public Sponsor in accordance with Article IV.

ARTICLE III - LANDS, RELOCATIONS, DISPOSAL AREAS, AND PUBLIC LAW 91-646 COMPLIANCE

A. The Government shall provide the Public Sponsor with a description of the anticipated real estate requirements and relocations for the Rehabilitation Effort. Thereafter, the Public Sponsor shall furnish all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform any relocations, as may be determined by the Government in that description, or in any subsequent description, to be necessary for the construction, operation, and maintenance of the Rehabilitation Effort. The necessary lands, easements, and rights-of-way may be provided incrementally for each construction contract. All lands, easements, and rights-of-way determined by the Government to be necessary for work to be performed under a construction contract must be furnished prior to the solicitation of that construction contract.

B. The Public Sponsor shall comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisitions Policy Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights of way, and performing relocations for construction, operation, and maintenance of the Rehabilitation Effort, including those necessary for relocations, borrow materials, and dredged and excavated material disposal, and shall inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

ARTICLE IV - METHOD OF PAYMENT

A. The Public Sponsor shall provide, during the period of construction, cash payments, in-kind services, or a combination thereof, required to meet the Public Sponsor's obligations under Article II of the Agreement. Rehabilitation Effort costs are currently estimated to be \$_____ and the Public Sponsor's share (cash and services in kind) of total Rehabilitation Effort costs is currently estimated to be \$_____. In order to meet the Public Sponsor's cash payment requirements, the Public Sponsor must provide a cash contribution estimated to be \$_____. The dollar amounts set forth in this paragraph are based upon the Government's best estimates that reflect projections of costs, price level changes, and anticipated inflation. Such cost estimates are subject to adjustments based upon costs actually incurred and are not to be construed as the total financial responsibilities of the Government and the Public Sponsor.

B. The required cash contribution shall be provided as follows: At least ten calendar days prior to the award of the first construction contract, the Government shall notify the Public Sponsor of the Public Sponsor's estimated share of the total Rehabilitation Effort costs including the Public Sponsor's estimated share of the costs attributable to the Rehabilitation Effort incurred prior to the initiation of construction.

Within five calendar days thereafter, the Public Sponsor shall provide the Government the full amount of the required contribution by delivering a check payable to "FAO, USAED _____" to the Contracting Officer representing the Government. The Government shall draw on the funds provided by the Public Sponsor such sums as the Government deems necessary to cover contractual and in-house fiscal obligations attributable to the Rehabilitation Effort as they are incurred, as well as Rehabilitation Effort costs incurred by the Government. In the event that Rehabilitation Effort costs are expected to exceed the estimate given at the outset of construction, the Government shall immediately notify the Public Sponsor of the additional contribution the Public Sponsor will be required to make to meet the Public Sponsor's share of the revised estimate. Within ten calendar days thereafter, the Public Sponsor shall provide the Government the full amount of the additional required contribution.

C. During the period of construction, the Government will provide periodic financial reports on the status of the total Rehabilitation Effort costs and status of contributions made by the Public Sponsor. Upon completion of the Rehabilitation Effort and resolution of all relevant contract claims and appeals, the Government shall compute the Rehabilitation Effort costs and tender to the Public Sponsor a final accounting of the Public Sponsor's share of Rehabilitation Effort costs.

1. In the event the total contribution by the Public Sponsor is less than the Public Sponsor's required share of total Rehabilitation Effort costs, the Public Sponsor shall, no later than 90 calendar days after receipt of written notice, make a cash payment to the Government of whatever sum is required to meet the Public Sponsor's required share of Rehabilitation Effort costs.

2. In the event total contribution by the Public Sponsor is more than the Public Sponsor's required share of Rehabilitation Effort costs, the Government shall, no later than 90 calendar days after the final accounting is complete, subject to the availability of funds, return the excess to the Public Sponsor; however, the Public Sponsor shall not be entitled to any refund for in-kind services. In the event the existing funds are not available to repay the Public Sponsor for excess contributions provided, the Government shall seek such appropriations as are necessary to repay the Public Sponsor for excess contributions provided.

ARTICLE V - CREDITING OF IN-KIND SERVICES

The Government has approved a credit for In-Kind Services, compatible with the Rehabilitation Effort, in the estimated amount of \$ _____ for implementation of such services by the Public Sponsor. The affording of such credit shall be subject to an onsite inspection by the Government to verify that the work was accomplished in a satisfactory manner and is suitable for inclusion in the Rehabilitation Effort. The actual amount of such credit shall be subject to an audit conducted to determine reasonableness, allocability, and allowability of costs. The Government shall apply the credit amount toward any additional cash contribution required under this Agreement. The Public Sponsor shall not receive credit for any amount in excess of such additional cash contribution, nor shall the Public Sponsor be entitled to any reimbursement for any excess credit amount.

ARTICLE VI - OPERATION AND MAINTENANCE

A. After the Contracting Officer has determined that construction of the Rehabilitation Effort is complete and provided the Public Sponsor with written notice of such determination, the Public Sponsor

shall operate and maintain the Project, at no cost to the Government, in accordance with specific directions prescribed by the Government in Engineer Regulation 500-1-1 and any subsequent amendments thereto.

B. The Public Sponsor hereby gives the Government a right to enter, at reasonable times and in a reasonable manner, upon land that the Public Sponsor owns or controls for access to the Project for the purposes of inspection, and, if necessary, for the purpose of completing, operating, and maintaining the Project. If an inspection shows the Public Sponsor for any reason is failing to fulfill the Public Sponsor's obligations under this Agreement without receiving prior written approval from the Government, the Government will send a written notice to the Public Sponsor. If, after 30 calendar days from receipt of such notice, the Public Sponsor continues to fail to perform, then the Government shall have the right to enter, at reasonable times and in a reasonable manner, upon lands the Public Sponsor owns or controls for access to the Project for the purposes of completing, operating, and maintaining the Project, or to deny further assistance under Public Law 84-99. No action by the Government shall operate to relieve the Public Sponsor of responsibility to meet the Public Sponsor obligations as set forth in this Agreement, or to preclude the Government from pursuing any other remedy at law or equity to assure faithful performance pursuant to this Agreement.

ARTICLE VII - FEDERAL AND STATE LAWS

In the exercise of the Public Sponsor's rights and obligations hereunder, the Public Sponsor agrees to comply with all applicable Federal and state laws and regulations.

ARTICLE VIII - RELATIONSHIP OF PARTIES

The Government and the Public Sponsor act in an independent capacity in the performance of their respective functions under this Agreement, and neither party is to be considered the officer, agent, nor employee of the other.

ARTICLE IX - OFFICIALS NOT TO BENEFIT

No member of or delegate to the Congress, or resident commissioner, shall be admitted to any share or part of this Agreement, or to any benefit that may arise therefrom.

ARTICLE X - COVENANT AGAINST CONTINGENT FEES

The Public Sponsor warrants that no person or selling agency has been employed or retained to solicit or secure this Agreement upon agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Public Sponsor for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this Agreement without liability, or, in the Government's discretion, to add to the Agreement or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

ARTICLE XI - TERMINATION OR SUSPENSION

If at any time the Public Sponsor fails to carry out its obligations under this Agreement, the District Engineer shall terminate or suspend work on the Rehabilitation Effort, unless the District Engineer determines that continuation of work on the Rehabilitation Effort is in the interest of the United States or is necessary in order to satisfy agreements with any other non-Federal interests in connection with this Rehabilitation Effort and Project. However, deferral of future performance under this agreement shall not affect existing obligations or relieve the parties of liability for any obligation previously incurred. In the event that either party elects to terminate this Agreement pursuant to this Article, both parties shall conclude their activities relating to the Rehabilitation Effort and proceed to a final accounting in accordance with Article IV of this Agreement. In the event that either party elects to defer future performance under this Agreement pursuant to this Article, such deferral shall remain in effect until such time as either the Government or Public Sponsor elects to proceed with further construction or terminates this Agreement.

ARTICLE XII - HAZARDOUS SUBSTANCES

A. After execution of this Agreement and upon direction by the Contracting Officer, the Public Sponsor shall perform, or cause to be performed, such investigations for hazardous substances as are determined necessary by the Government of the Public Sponsor to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 42 U.S.C. Sections, 9601-9675, on lands necessary to Rehabilitation Effort construction, operation, and maintenance. All actual costs incurred by the Public Sponsor that are properly allowable and allocable to performance of any such investigations for hazardous substances shall be included in total Rehabilitation Effort costs and cost shared as a construction cost.

B. In the event it is discovered through an investigation for hazardous substances or other means that any lands, easements, rights-of-way, or disposal areas to be acquired or provided for the Project or the Rehabilitation Effort contain any hazardous substances regulated under CERCLA, the Public Sponsor and the Government shall provide prompt notice to each other, and the Public Sponsor shall not proceed with the acquisition of lands, easements, rights-of-way, or disposal areas until mutually agreed.

C. The Government and the Public Sponsor shall determine whether to initiate construction of the Rehabilitation Effort, or, if already in construction, to continue with construction of the Rehabilitation Effort, or to terminate construction of the Rehabilitation Effort for the convenience of the Government in any case where hazardous substances regulated under CERCLA are found to exist on any lands necessary for the Rehabilitation Effort. Should the Government and the Public Sponsor determine to proceed or continue with the construction after considering any liability that may arise under CERCLA, the Public Sponsor shall be responsible, as between the Government and the Public Sponsor, for any and all necessary clean up and response costs, to include the costs of any studies and investigations necessary to determine an appropriate response to the contamination. Such costs shall not be considered a part of the total Rehabilitation Effort costs as defined in this Agreement.

In the event the Public Sponsor fails to provide any funds necessary to pay for clean up and response costs or to otherwise discharge the Public Sponsor's responsibilities under this paragraph upon direction by the Government, the Government may either terminate or suspend work on the Rehabilitation Effort or proceed with further work as provided in Article X of this Agreement.

D. The Public Sponsor and Government shall consult with each other to assure that responsible parties bear any necessary clean up and response costs as defined in CERCLA. Any decision made pursuant to paragraph C of this Article shall not relieve any party from any liability that may arise under CERCLA.

E. As between the Government and the Public Sponsor, the Public Sponsor shall be considered the operator of the Project (which the Rehabilitation Effort is repairing and restoring) for purposes of CERCLA liability. To the maximum extent practicable, the Public Sponsor shall operate and maintain the Project in a manner that will not cause liability to arise under CERCLA.

ARTICLE XIII - NOTICES

A. All notices, requests, demands, and other communications required or permitted to be given under this Agreement shall be deemed to have been duly given if in writing and delivered personally, given by prepaid telegram, or mailed by first-class (postage prepaid), registered, or certified mail, as follows:

If to the Public Sponsor:

If to the Government:
District Engineer

B. A party may change the address to which such communications are to be directed by giving written notice to the other party in the manner provided in this Article.

C. Any notice, request, demand, or other communication made pursuant to this Article shall be deemed to have been received by the addressee at such time as it is either personally delivered, or, seven calendar days after it is mailed, as the case may be.

IN WITNESS HEREOF, the parties hereto have executed this Agreement, which shall become effective upon the date it is signed by the District Engineer.

THE DEPARTMENT OF THE ARMY

BY: _____

[SIGNATURE]

[TYPED NAME]

[TITLE IN FULL]

DATE: _____

THE [NAME OF PUBLIC SPONSOR]

BY: _____

[SIGNATURE]

[TYPED NAME]

[TITLE IN FULL]

DATE: _____

CERTIFICATION REGARDING LOBBYING

The undersigned certifies, to the best of his or her knowledge and belief that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

DATED this _____ day of _____, 20_____

[SIGNATURE OF CA SIGNATORY]
[TYPED NAME]
[TYPED TITLE]

APPENDIX G: COOPERATION AGREEMENT FOR FLOOD FIGHT

COOPERATION AGREEMENT BETWEEN THE UNITED STATES OF AMERICA and _____ for EMERGENCY ASSISTANCE (FLOOD or COASTAL STORM)	
THIS AGREEMENT, entered into this ____ day of _____, 20__, by and between THE DEPARTMENT OF THE ARMY (hereinafter referred to as the "Government") acting by and through the District Engineer, _____ District, U.S. Army Corps of Engineers, and the _____ [PUBLIC SPONSOR], (hereinafter referred to as the "Public Sponsor"), acting by and through _____ [TITLE OF PERSON SIGNING THIS AGREEMENT].	
WITNESSETH THAT:	
WHEREAS, Public Law 99, 84th Congress, approved 28 June 1955, authorizes the Chief of Engineers to flood fight and perform rescue operations.	
WHEREAS, the Public Sponsor has requested assistance under Public Law 84-99, and the Public Sponsor qualifies for assistance in accordance with the established policies of the U.S. Army Corps of Engineers.	
NOW, THEREFORE, the parties agree as follows:	
1. The Government will perform the work described in its scope of work (attached) that is made part of this agreement.	
2. The Public Sponsor agrees, in consideration of the Government providing assistance, to fulfill the requirement of non-Federal cooperation required by the U.S. Army Corps of Engineers regulations, to wit:	
a. Provide without cost to the Government all lands, easements, rights-of-ways, borrow material, and disposal areas necessary for the authorized work, for the use of borrow areas and/or spoil areas, and for access to and from the site(s) of the structure(s) or work area(s), the borrow sites, and spoil areas.	
b. Hold and save the Government free from damages due to the authorized work, except damages due to the fault or negligence of the Government or its contractors.	
c. Maintain and operate the completed work in a manner satisfactory to the Government.	
3. The Public Sponsor further agrees to remove, at no cost to the U.S. Army Corps of Engineers, all temporary work constructed by the Government; and,	
a. (Add others as applicable)	
4. Additional obligation under the terms of this agreement terminates when the authorized work performed by the Government is completed.	
5. ATTACHMENTS:	
a. Exhibit A - Government Scope of Work.	
b. (Add others as applicable)	
IN WITNESS WHEREOF, the parties hereto have executed this agreement of the day and year first above written.	
THE DEPARTMENT OF THE ARMY	THE [NAME OF PUBLIC SPONSOR]

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APPENDIX H: COOPERATION AGREEMENT FOR ADVANCE MEASURES ASSISTANCE

COOPERATION AGREEMENT BETWEEN THE UNITED STATES OF AMERICA and _____ for ADVANCE MEASURES ASSISTANCE THIS AGREEMENT, entered into this _____ day of _____, 20_____, by and between THE DEPARTMENT OF THE ARMY (hereinafter referred to as the "Government") represented by the District Engineer, _____ District, U.S. Army Corps of Engineers, and the _____ [PUBLIC SPONSOR], (hereinafter referred to as the "Public Sponsor"), represented by _____ [TITLE OF PERSON SIGNING THIS AGREEMENT]. WITNESSETH THAT: WHEREAS, 33 U.S.C. 701n authorizes the Chief of Engineers to provide Advance Measures. WHEREAS, the Public Sponsor has requested, in writing, assistance under 33 U.S.C. 701n and qualifies for such assistance in accordance with the established policies of the U.S. Army Corps of Engineers; and, WHEREAS, the Public Sponsor hereby represents that it has the authority and legal capability to furnish the non-Federal cooperation hereinafter set forth and is willing to participate in accordance with the terms of this agreement. NOW, THEREFORE, the parties agree as follows: 1. The Government will perform the work described in its scope of work, which is made part of this agreement. 2. The Public Sponsor will: a. Provide without cost to the Government all lands, easements, rights-of-ways, relocations, and borrow and dredged or excavated material disposal areas necessary for the work.
--

b. Hold and save the Government free from damages arising from construction, operation, maintenance, repair, replacement, and rehabilitation of the work, except damages due to the fault or negligence of the Government or its contractors.

c. Operate, maintain, repair, replace, and rehabilitate the completed work in a manner satisfactory to the Government; and

d. Remove all temporary work constructed by the Government, with initiation of removal within 30 days of the conclusion of the flood event.

3. The Public Sponsor further agrees to: (Add as applicable)

4. ATTACHMENTS:

a. Exhibit A - Written request for assistance from the Public Sponsor.

b. Exhibit B - Government Scope of Work.

c. Add others as applicable.

IN WITNESS WHEREOF, the parties hereto have executed this agreement of the day and year first above written.

THE DEPARTMENT OF THE ARMY

THE [NAME OF PUBLIC SPONSOR]

BY: _____

BY: _____

[SIGNATURE]

[SIGNATURE]

[TYPED NAME]

[TYPED NAME]

[TITLE IN FULL]

[TITLE IN FULL]

ADDRESS:

ADDRESS:

APPENDIX I: USEFUL LINKS

Organizations:

<http://www.usace.army.mil>

Homepage of the U.S. Army Corps of Engineers. All districts and divisions are linked through this page, and can be accessed through alphabetical listings and through clicking on a map of the United States. Emergency Management Offices are accessible through division and district home pages.

<http://www.fema.gov>

Homepage of the Federal Emergency Management Agency.

<http://www.nws.noaa.gov/>

National Weather Service Website. If you click on the “Rivers” tab, you can view river gage information.

Laws and Regulations:

<http://uscode.house.gov/>

Searchable database of the US Code (Public Laws)

<http://www.gpoaccess.gov/cfr/index.html>

The Code of Federal Regulations Main Page

<http://www.usace.army.mil/inet/usace-docs/>

Publications of the Army Corps of Engineers Headquarters. There are a number of Corps publications that may provide additional guidance in the operation, maintenance or preferable design of flood control works. Some specific references are listed in Chapter 1 of this manual.

Other Useful Information:

http://www.nwk.usace.army.mil/local_protection/guidance.html This site has a lot of information that the Corps' geotechnical engineers have assembled for public use. It gives more detailed guidance on many topics, such as running utilities over and through a levee, power poles, slope protection, gates, and a number of other related topics.

<http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=em&pagename=Floodfi>
This Corps site has presentations and brochures on sandbagging.

<http://chl.ercd.usace.army.mil/ffs> This website, "Laboratory and Field Testing of Temporary Barrier Type Flood Fighting Products," provides information the Corps has gathered on alternative flood fight technologies. There are several innovative flood fight products that the Corps has tested, and the results are publicly available on this site.

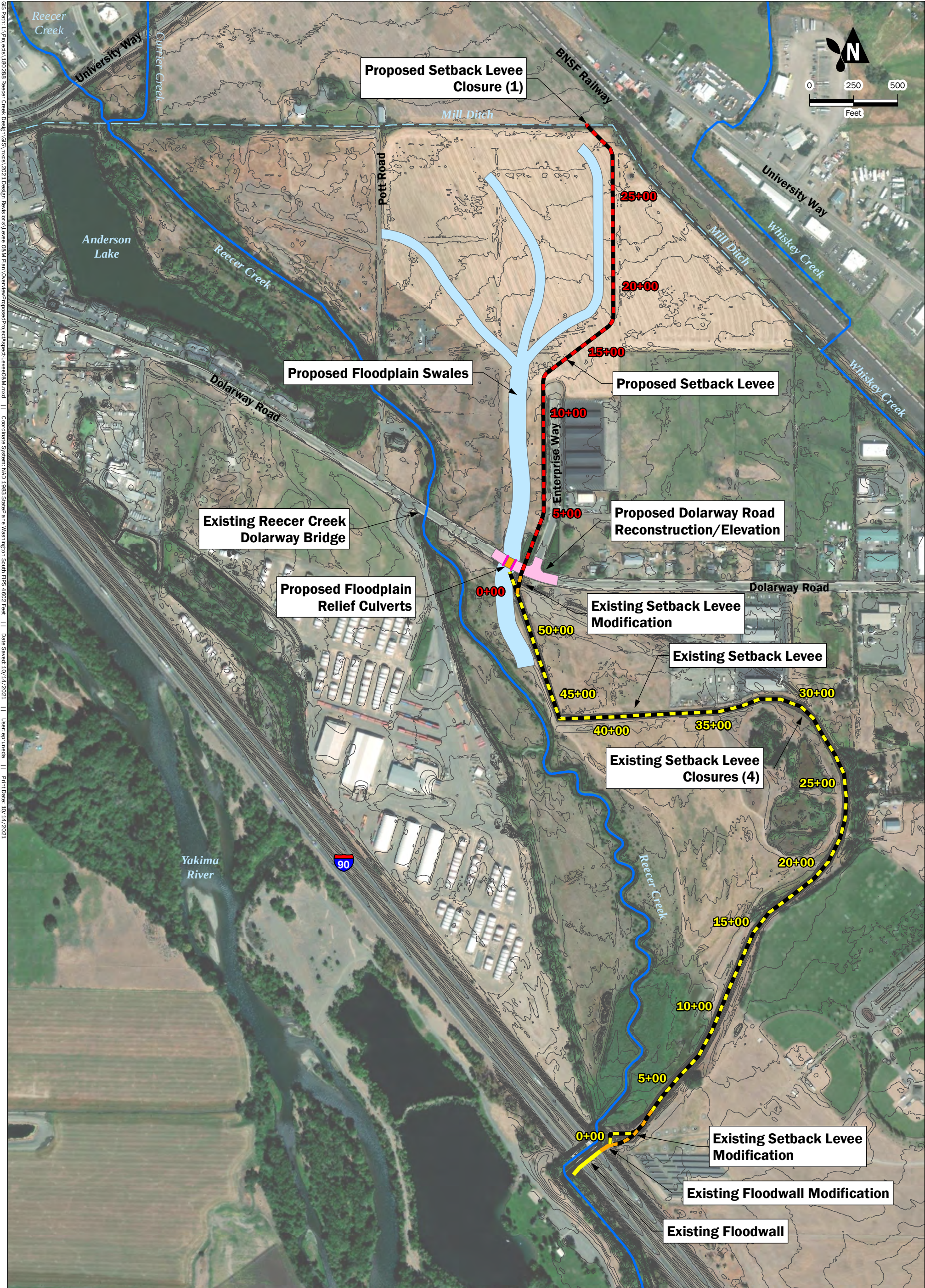
<http://www.crrel.usace.army.mil/icejams/index.htm>
This Corps site provides information on ice jams.

<http://www.gnb.ca/0009/0369/0004/>
While this website is specific to New Brunswick, Canada, it is another very good source of information on ice jams.

http://chl.wes.army.mil/research/hydstruc/bankprotect/scm_guide_screen.pdf
The Kansas River and Stream Corridor Management Guide presents some good general information on channels, erosion control measures, and other topics related to watershed management.

<http://www.fema.gov/fima/>
Of particular note on the FEMA webpage is the Mitigation Division homepage. This page has a lot of useful information on flood insurance and grant programs. It also includes a searchable database of best practices and case studies, http://www.fema.gov/mitigationss/sstory_find_gui.do If you select "Flooding" as a hazard, and "Flood Control" as a category, you can find a number of success stories of flood control works from around the country. This database also includes some good examples of relocations and non-structural alternatives to flooding problems.

APPENDIX J: REECER CREEK LEVEE SYSTEM MAPS



GIS Path: L:\Projects\180286 Reecer Creek Design\GIS\mxd\2021 Design Revisions\Levee O&M Plan (Overview)\05052021\RecepLeveeO&M.mxd | Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 feet | Date Saved: 10/14/2021 | User: epuneda | Print Date: 10/14/2021

- | | |
|-------------------------------------|---------------------------------------|
| Existing Waterbody | Proposed Setback Levee |
| Existing Setback Levee | Proposed CMP Arch Culvert |
| Existing Setback Levee Modification | Proposed Floodplain Relief Culvert |
| Existing Floodwall | Proposed Dolarway Road Reconstruction |
| Existing Floodwall Modification | Proposed Floodplain Swale |
| | Existing 1-FT Contours |

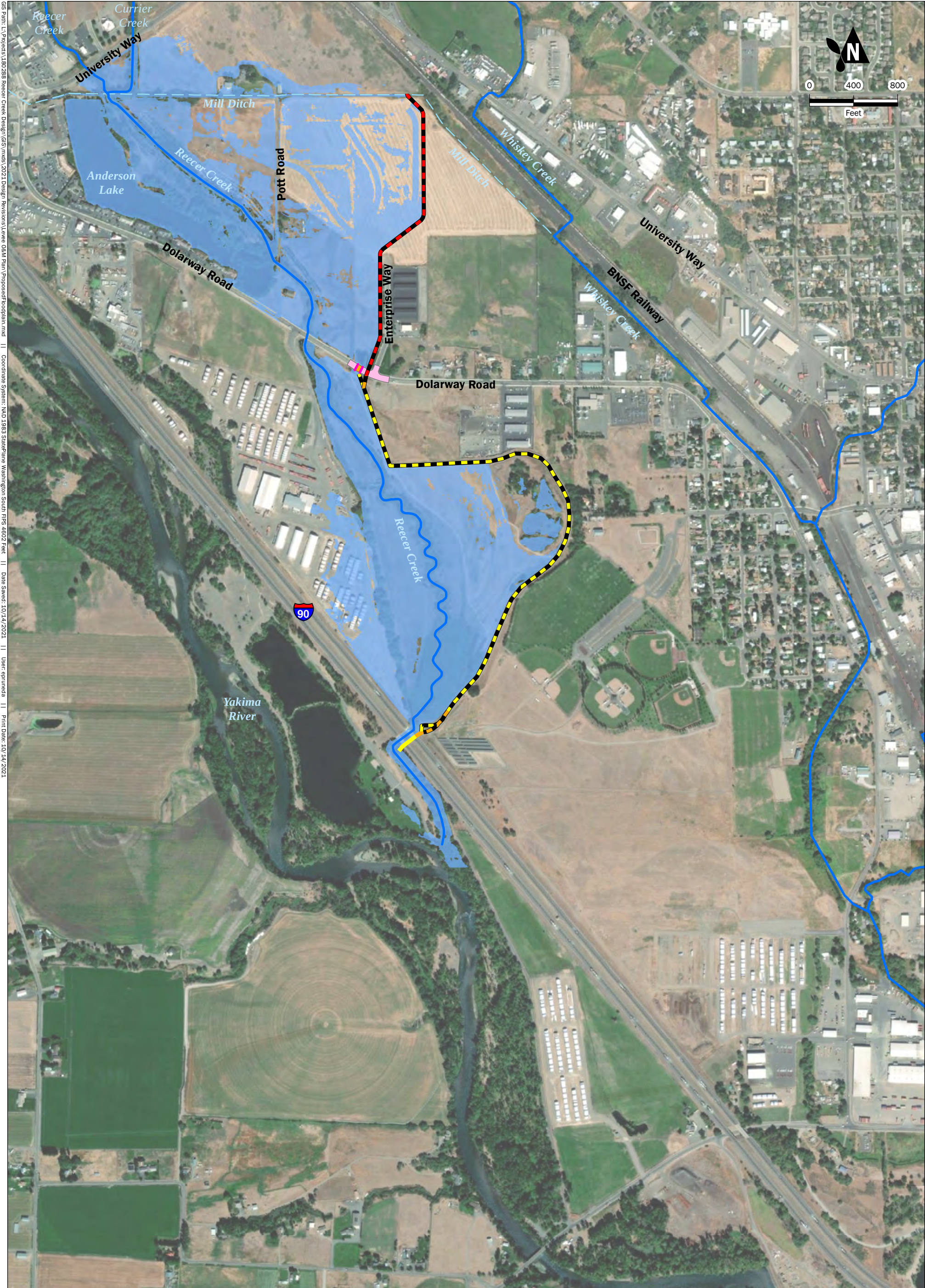
Reecer Creek Levee System Overview Map

Reecer Creek Levee System Operation and Maintenance Plan
Ellensburg, Washington



OCT-2021
BY:
EBP

APPENDIX NO.
J-1



GIS Path: L:\Projects\180288 Reecer Creek Design\GIS\mxds\2021 Design Revisions\Levee O&M Plan\ProposedFloodplain.mxd | Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet | Date Saved: 10/14/2021 | User: efrumada | Print Date: 10/14/2021

- | | |
|-------------------------------------|---|
| Existing Waterbody | Proposed Setback Levee |
| Existing Setback Levee | Proposed CMP Arch Culvert |
| Existing Setback Levee Modification | Proposed Floodplain Relief Culvert |
| Existing Floodwall | Proposed Dolarway Road Reconstruction |
| Existing Floodwall Modification | Preliminary Proposed 100-Year Reecer Creek Floodplain |

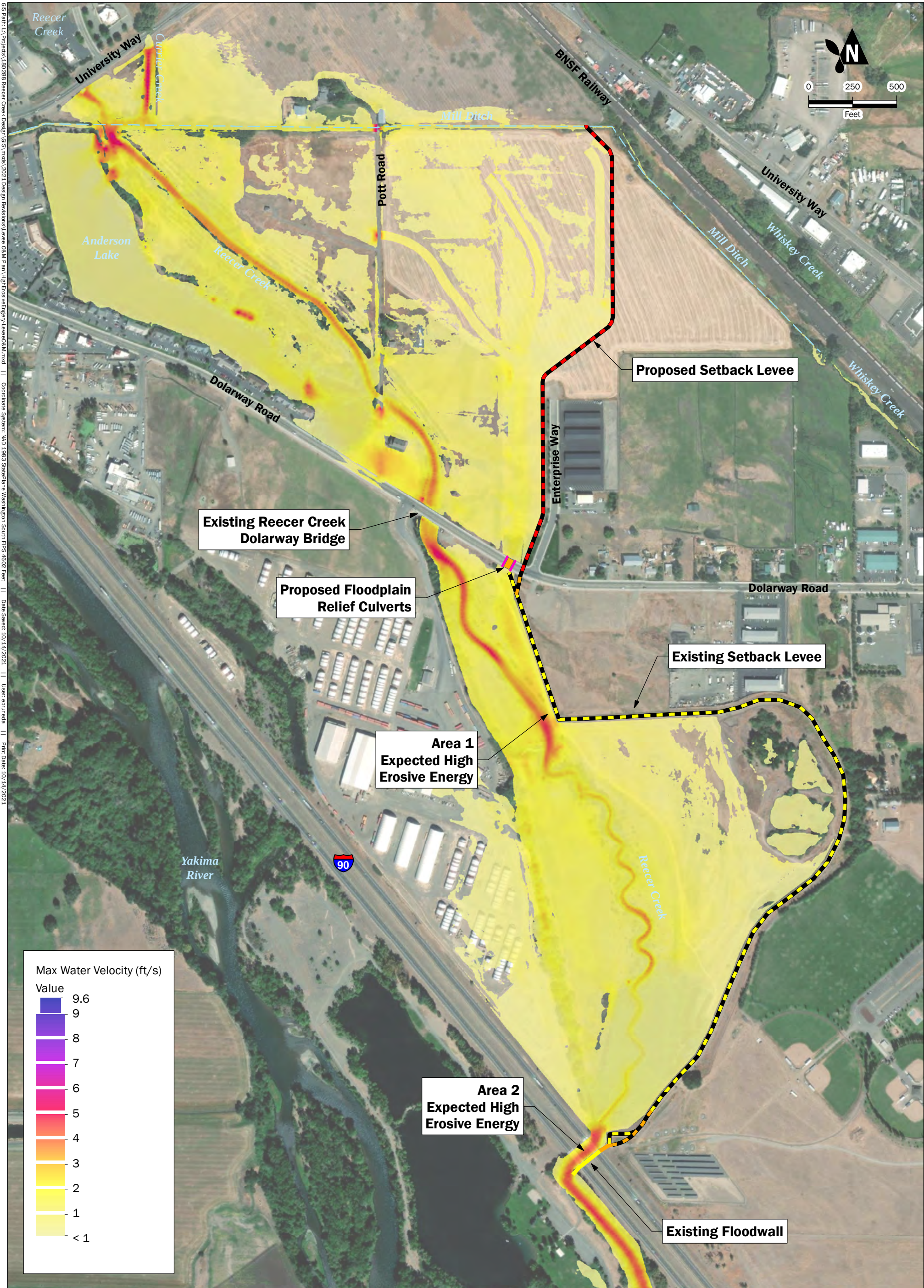
**Reecer Creek Levee System
Proposed Floodplain**

Reecer Creek Levee System Operations and Maintenance Plan
Ellensburg, Washington



OCT-2021
BY:
EBP

APPENDIX NO.
J-2



GIS Path: L:\Projects\180286 Reecer Creek Design\GIS\mxds\2021 Design Revisions\Level OAM Plan\Map\ReecerCreekLeveeOAM.mxd | Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet | Date Saved: 10/14/2021 | User: epruveda | Print Date: 10/14/2021

- | | |
|-------------------------------------|------------------------------------|
| Existing Setback Levee | Proposed Setback Levee |
| Existing Setback Levee Modification | Proposed CMP Arch Culvert |
| Existing Floodwall | Proposed Floodplain Relief Culvert |
| Existing Floodwall Modification | |

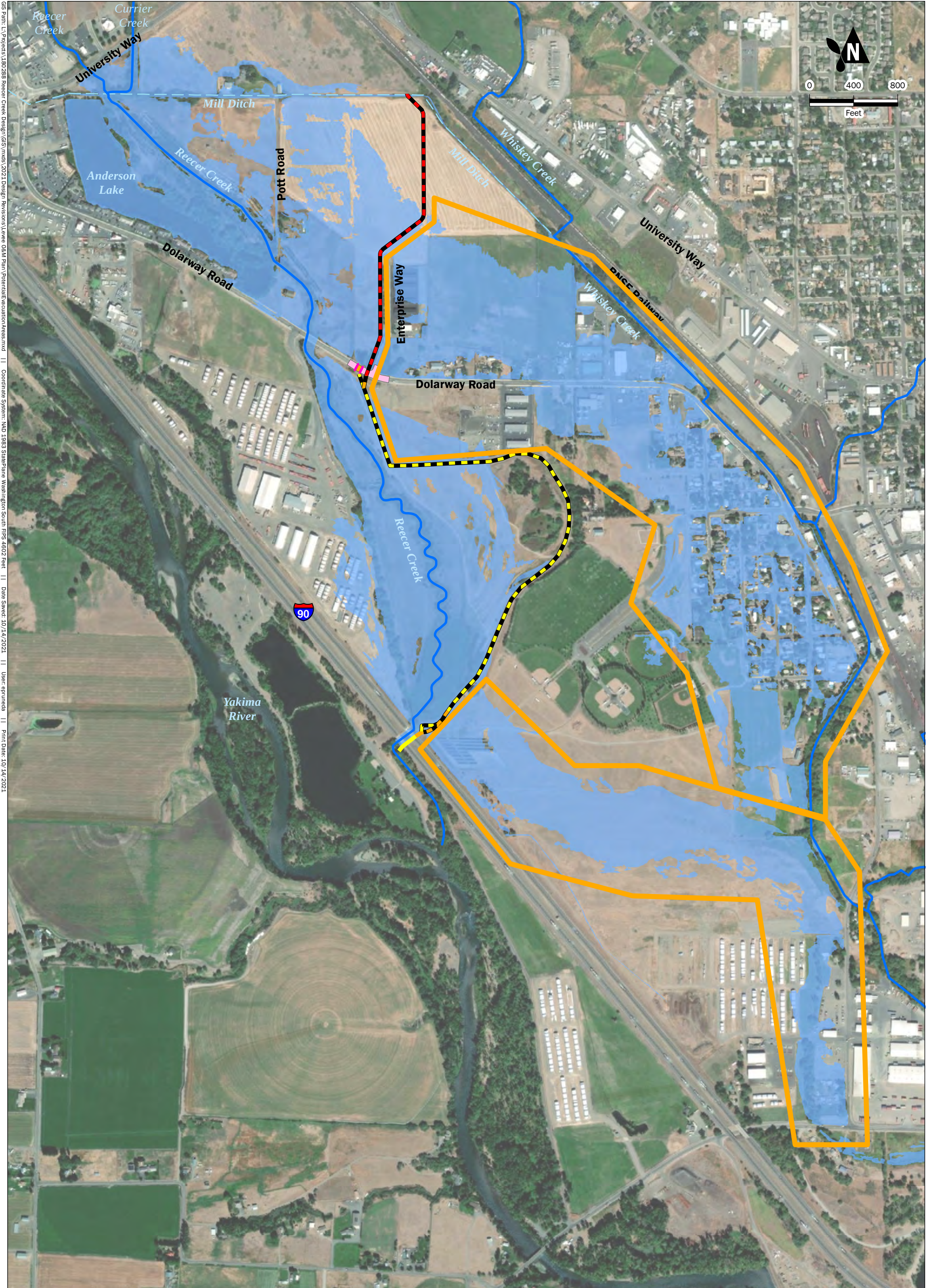
Reecer Creek Levee System Expected Areas with High Erosive Energy

Reecer Creek Levee System Operation and Maintenance Plan
Ellensburg, Washington



OCT-2021
BY:
EBP

APPENDIX NO.
J-3



GIS Path: L:\Projects\180288 Reecer Creek Design\GIS\mxds\2021 Design Revisions\Levee O&M Plan\Potential Evacuation Areas.mxd | Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet | Date Saved: 10/14/2021 | User: epuranda | Print Date: 10/14/2021

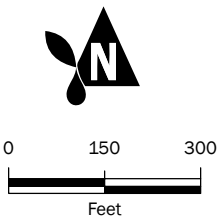
- Existing Waterbody - Existing Setback Levee - Existing Setback Levee Modification - Existing Floodwall - Existing Floodwall Modification	- Proposed Setback Levee - Preliminary Existing 100-Year Reecer Creek Floodplain - Proposed CMP Arch Culvert - Proposed Floodplain Relief Culvert - Proposed Dolarway Road Reconstruction - Potential Evacuation Area	Reecer Creek Levee System Potential Evacuation Areas Reecer Creek Levee System Operations and Maintenance Plan Ellensburg, Washington <table><tr><td rowspan="2"></td><td rowspan="2"></td><td>OCT-2021</td><td rowspan="2">APPENDIX NO. J-4</td></tr><tr><td>BY: EBP</td></tr></table>			OCT-2021	APPENDIX NO. J-4	BY: EBP
		OCT-2021			APPENDIX NO. J-4		
		BY: EBP					



See Proposed Levee Interior Drainage Figure for Area North of Dolarway Road

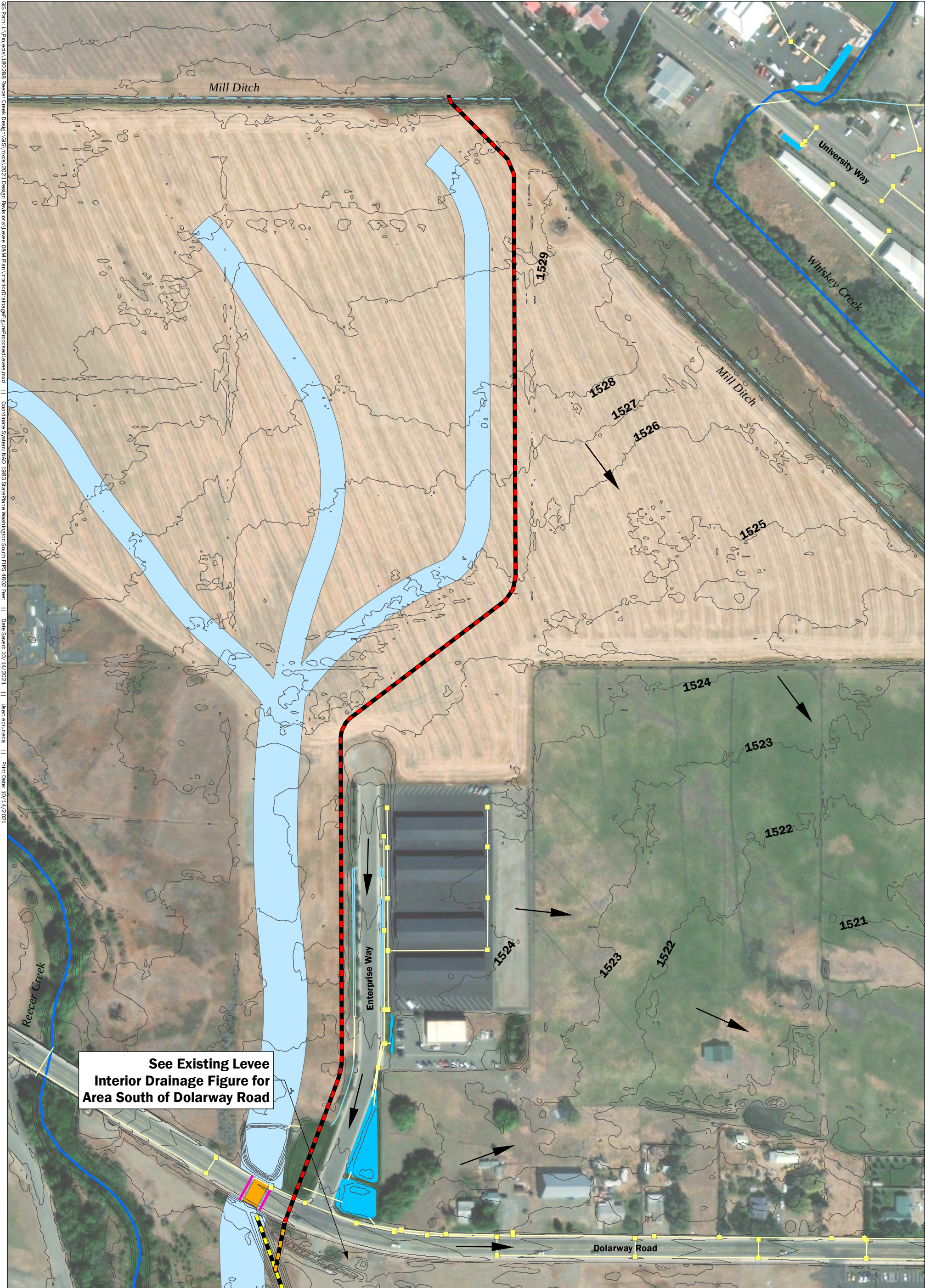
Four stormwater drainage pipes collecting stormwater runoff from Dolarway Road penetrate the existing setback levee at station 28+00 ±. Each drainage pipe is equipped with a slide gate that can be closed during a flood event. Refer to as-buils for additional information.

- | | | |
|-------------------------------------|------------------------------------|----------------------------|
| Existing Storm Catch Basin | Existing Floodwall | Approximate Flow Direction |
| Existing Storm Drain Pipe | Existing Floodwall Modification | |
| Existing Storm Open Channel | Proposed Setback Levee | |
| Existing Storm Infiltration Basin | Proposed CMP Arch Culvert | |
| Existing Waterbody | Proposed Floodplain Relief Culvert | |
| Existing Setback Levee | Proposed Floodplain Swale | |
| Existing Setback Levee Modification | Existing 1-FT Contours | |



Reecer Creek Levee System
Existing Levee Interior Drainage
Reecer Creek Levee System Operation and Maintenance Plan
Ellensburg, Washington

	OCT-2021 BY: EBP	APPENDIX NO. J-5



See Existing Levee Interior Drainage Figure for Area South of Dolarway Road

Existing Storm Catch Basin	Proposed Setback Levee
Existing Storm Drain Pipe	Proposed CMP Arch Culvert
Existing Storm Open Channel	Proposed Floodplain Relief Culvert
Existing Storm Infiltration Basin	Proposed Floodplain Swale
Existing Waterbody	Existing 1-FT Contours
Existing Setback Levee	Approximate Flow Direction
Existing Setback Levee Modification	

0 100 200
Feet

Reecer Creek Levee System

Proposed Levee Interior Drainage

Reecer Creek Levee System Operation and Maintenance Plan
Ellensburg, Washington

OCT-2021

BY:
EBP

APPENDIX NO.
J-6

Basemap Layer Credits || Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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AGENDA REPORT

Meeting Date: November 18, 2021

Agenda Subject: Past Due Utility Accounts

Submitted by: Buddy Stanavich Public Works & Utilities

Recommended Action or Motion: N/A

Background/Summary:

Proclamation 20-23, issued on March 18, “strongly encouraged” utility providers to mitigate the economic impacts of COVID-19 on their customers and imposed mandatory prohibitions on investor-owned utilities regulated by the Utilities and Transportation Commission (UTC). But, beginning with Proclamation 20-23.2, issued April 17, the governor extended the order to apply to all local government public utility service providers of energy, water, and telecommunications and retroactively applied the mandatory prohibitions in the original proclamation to March 23, the day of the initial “Stay Home - Stay Healthy” order. Proclamation 20-23.2, and those issued subsequently, prohibit:

Disconnecting any residential customers from energy, telecommunications, or water service due to nonpayment, except at the request of the customer;

Refusing to reconnect any residential customer who has been disconnected due to nonpayment; and charging fees for late payment or reconnection of services.

The City of Ellensburg issued City Management Emergency Order Number 2020-02 on May 22, 2020. Regarding repayment of accounts, this order provided that account holders shall enter into a repayment plan within 60 days of the rescission of this order. The repayment plan shall be for equal payments of past due utility billings added to new monthly utility cost. The repayment plan will be allowed for a maximum six months.

Following 60 days after rescission of this order, any account holder that has not entered into a repayment agreement as provided above, will be subject to the normal charges and collection processes for overdue accounts as authorized in Chapter 2.12 of the Ellensburg City Code.

Any utility account still in arrears after the repayment plan period has expired will be subject to penalties, charges and collection as provided in Chapter 2.12 of the Ellensburg City Code.

The utility moratorium ended September 30, 2021.

Repayment agreements are being sent out to customers.

The number of accounts owing as well as the amount owing has continued to increase through October 31, 2021

Previous Council Action: N/A

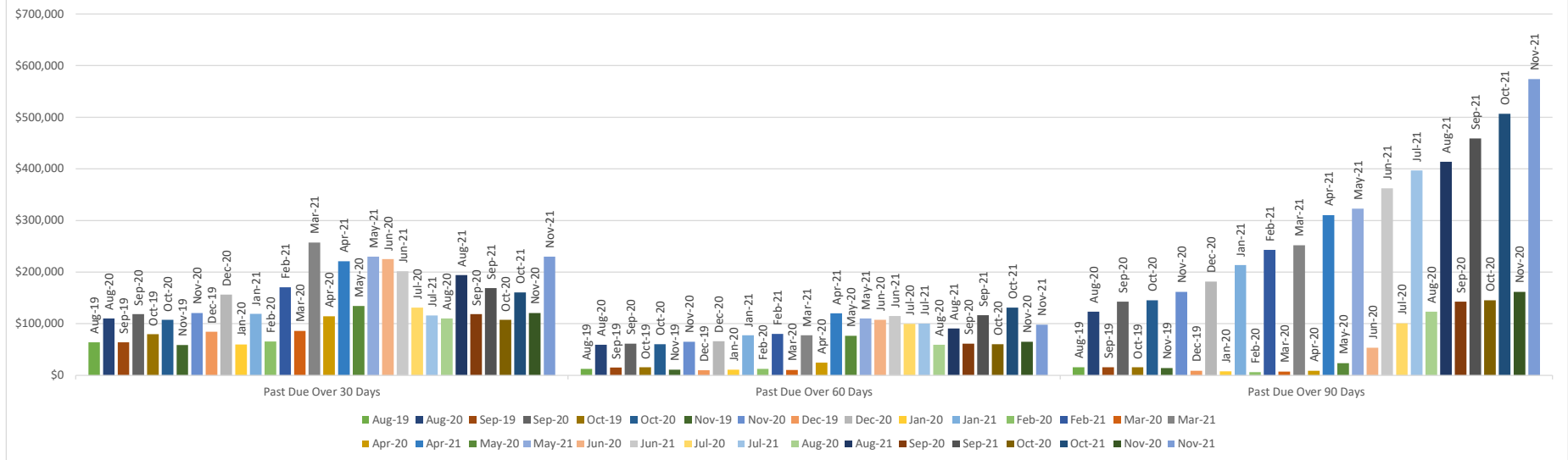
Analysis: N/A

Financial Impact: As of October 31, 2021, \$901,885 was owing across all utilities for 1,803 accounts.

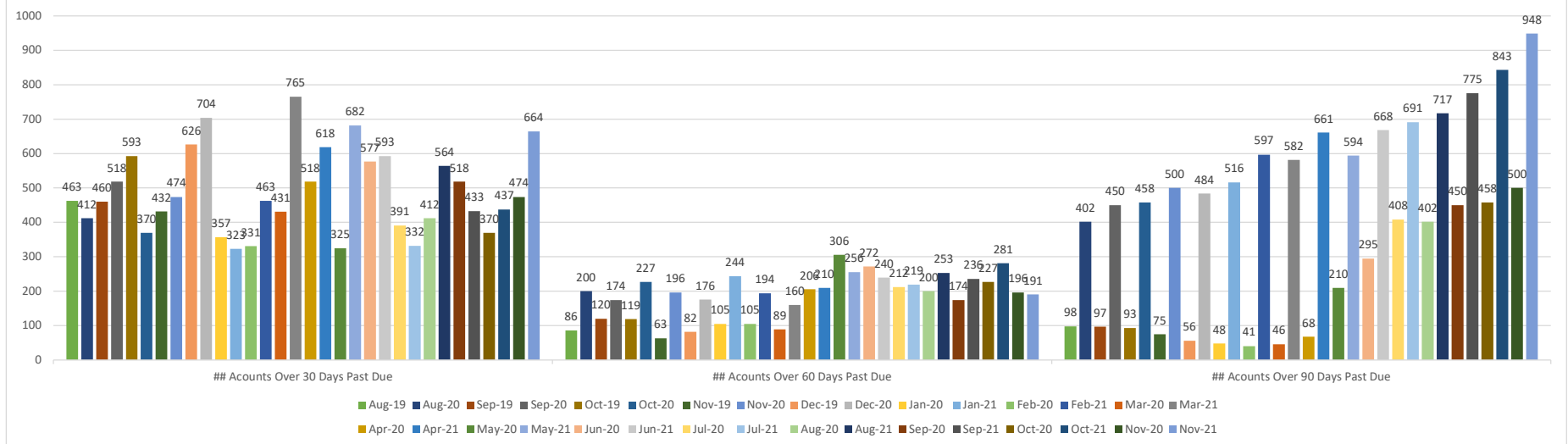
Attachments:

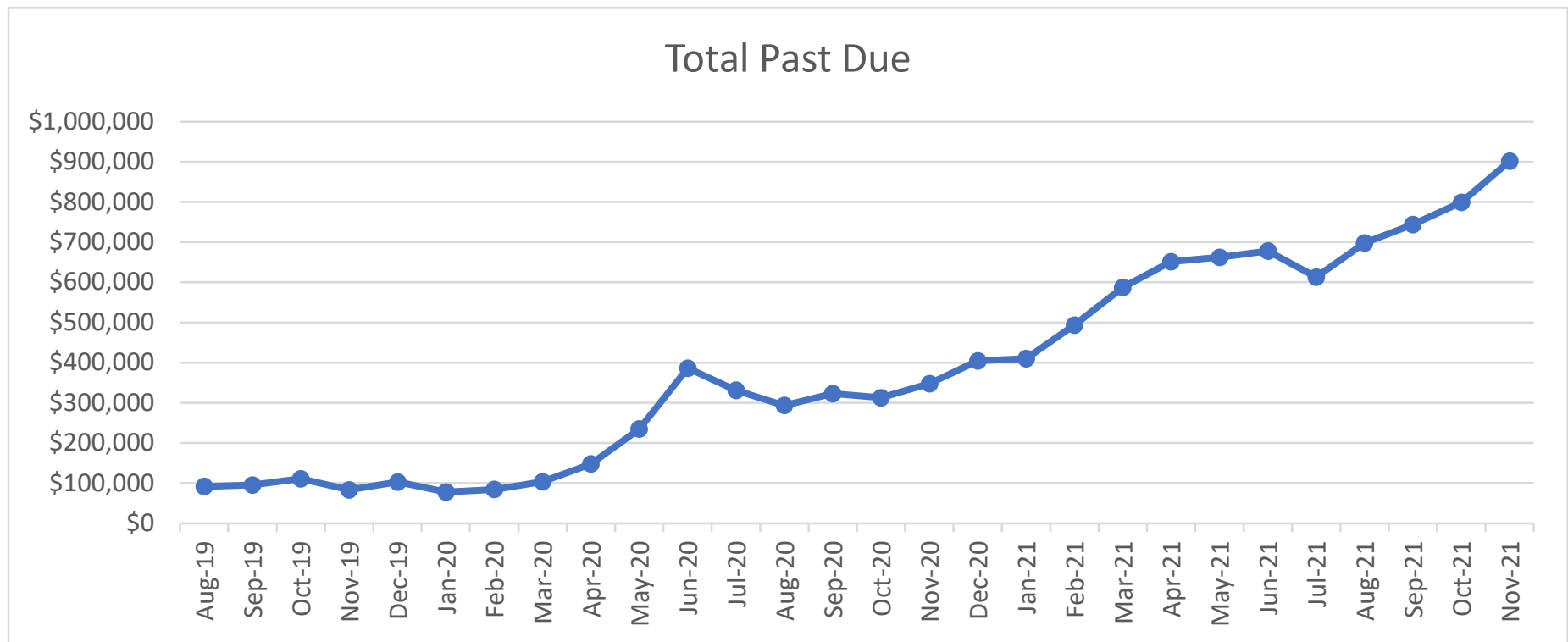
[Late Payment Charts - Combined.pdf](#)

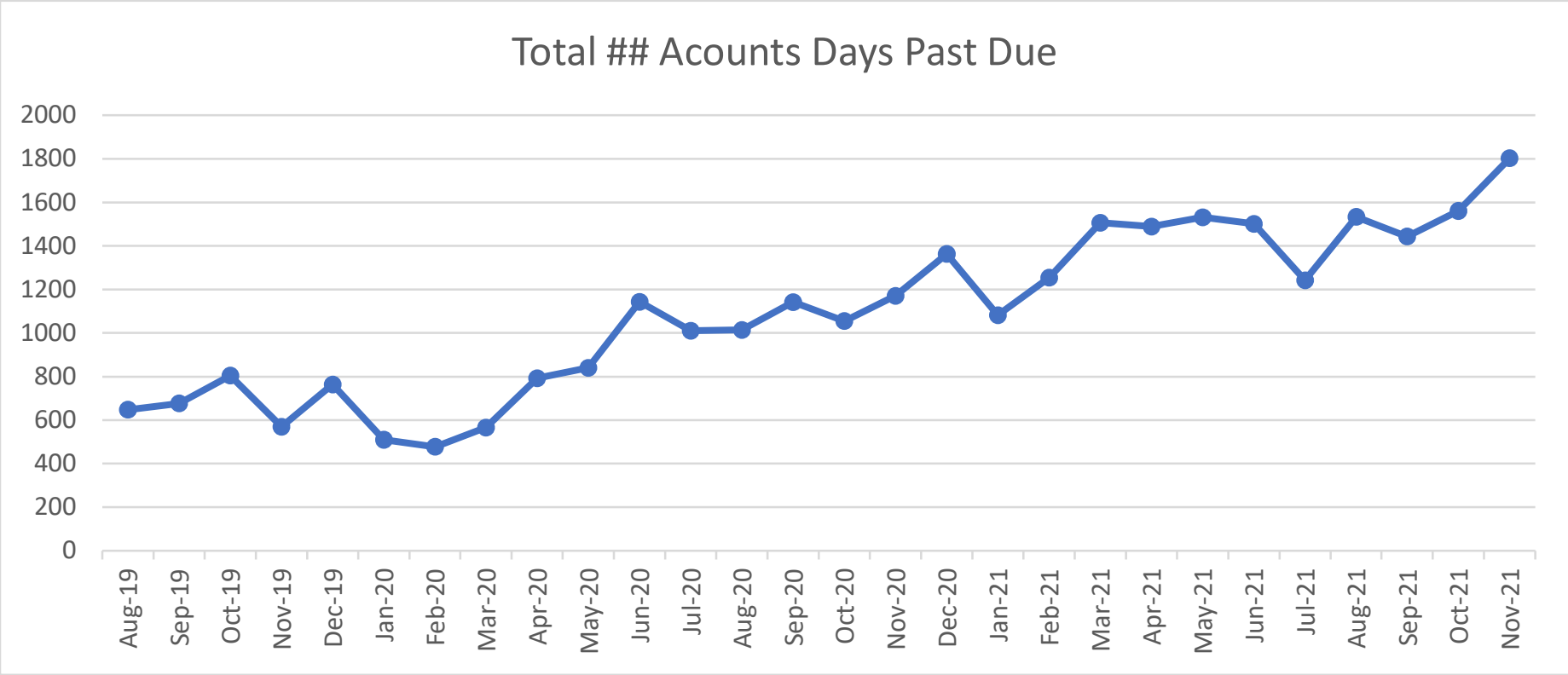
HISTORICAL MONTHLY COMPARISON OF TOTAL PAST DUE ACCOUNTS \$\$



Historical Monthly Comparison of Total Past Due Accounts







Ellensburg Utility Advisory Committee
Public Works & Utilities Issues and Updates
November 18, 2021

Consent Items

Agenda Reports for items approved by the City Council since our last meeting are attached.

All Utilities

- The Bull Road Utilities Project continues to progress nicely. All utilities have been installed in Bull Road and the road fully restored. The contractor has been completed the installation of utilities in the Berry Road portion and will begin restoration of Berry Road, with restoration of Berry Road being completed in late October. The contractor will then focus on the short piece of utilities that need to be installed between Berry Road and I-90. This section is the last section to complete the looping of utilities. Due to the crossing of the irrigation ditch (Bull Ditch) this section, construction has been scheduled around when the canal is off, which will be near mid-Oct. Therefore the completion of the utility portion of the project is anticipated to be complete by mid-November. Complete restoration of this last section will be completed late November or could be pushed to spring, depending on weather.
- COSA Update - Staff is responding to a preliminary data request to allow FCS Group to begin updating the information required for the Comprehensive Multi-Utility Rate Study Update.

Sewer

- The biosolids have been tested and approved for hauling and application. Natural Selection Farms began hauling biosolids for beneficial reuse in early November.
- Collection crews continue to work on the fall jet list, inspections, and system maintenance.
- The Wastewater Treatment Facility Administration Building Roof and HVAC replacement project is underway. The roof replacement is complete, and the HVAC replacement is expected to begin in the middle of November, when the unit arrives from the manufacturer. The roofers will return after the new HVAC unit is installed to finish around the curb of the new unit.
- WWTF staff recognized that sludge from the secondary digester wasn't flowing as well as expected. Staff decided that digester needed to be drained, cleaned, and inspected. This process takes several days. Upon inspection staff noticed a buildup of struvite in the outlet pipes which they were able to remove. Some other improvements to piping were made while the digester was empty. The digester has been refilled and is operating as it should after the cleaning. Staff intends to perform this process and inspection more frequently in the future (Every 3-5 years).
- The Bureau of Reclamation's Schaake Project is nearing completion. As the UAC is aware, the City committed to a land exchange with the Bureau under a Memorandum of Understanding. The land exchange is getting closer; however, the MOU is set to expire in December. The Bureau is in the process of sending a proposed amendment to the City extending the termination date of the MOU. Staff will likely take the MOU amendment straight to Council for approval due to timing. The land exchange is currently anticipated early in 2022.
- Staff have completed interviews for consultants for the General Sewer System plan update and design of a replacement Aeration System at the WWTF. Kennedy Jenks Engineering was deemed the most qualified consultant and staff has now begun negotiating a scope and fee to complete the work. Once an agreement has been completed, staff will return to UAC with the completed agreement for consideration.

Water

- Water pumped for October 2021 was 102,220,548 compared to September 2020 which was 102,325,125.
- Crews are continuing to repair leaks discovered during Phase 2 of the annual leak survey. All of the remaining leaks to be repaired are small in nature.
- Staff discovered that one of the booster pumps that pumps water to the upper pressure zone wasn't operating properly. The pump was removed and sent for evaluation. It has been determined that the pump is in need of replacement, and a quote was received. Lead time on the replacement and installation is six to eight weeks. CWU has been contacted and have agreed to provide water to the upper zone through Brooklane Well if the need arises considering that the City will be relying on the one remaining booster pump in operation.
- Crews are continuing to perform meter maintenance, hydrant maintenance, and rebuilding services in need of upgrade.
- Crews are working on the fall flush list.
- Due to lesser demand for water in the fall and winter months, staff have stopped pumping from the Hayward Well and the Route 10 Well for energy efficiency. This is one of the recommendations in the Strategic Energy Management Report.
- Staff has received verbal notification of receipt of a \$300,000 Dept. of Ecology grant for the design and permitting of a pilot test for Aquifer Storage and Recharge (ASR). The concept of the pilot test would be to pump shallow water from our City Wells site and inject this water into the deeper aquifer that all of our other municipal wells pump from. We are hopeful to have a contract with Ecology and a consultant agreement contract available by the time of the meeting, but we are still awaiting contract language from Ecology at this time.

Storm

- The Stormwater Utility hosted a tree planting event on Saturday October 30, 2021 at 15th and Water with volunteers from CWU. The event planted sixty native tree species ranging from Quaking Aspen to Ponderosa Pine, Black Hawthorn Rocky Mountain Juniper, Western Larch and Vine Maple. The event was a success and over 30 volunteers turned out. The city purchased the trees and provided the tools.
- Gateway 1 is quickly moving forward again. A reimbursement agreement along with a joint utility trench agreement to re-designed around underground communication utility vaults will allow the project to get out to bid late winter.
- Gateway II design and permitting is underway with Aspect Engineering out of Yakima. It's anticipated Gateway II will go out to bid in 2023.
- The city held its kickoff meeting with Osborn Consulting, CWU, Fisheries, Flood District, Mid-Columbia Enhancement Group, Parks and Ecology, to assemble a team who will support and help facilitate a grant to move Wilson Creek off Brooklane. Pre grant applications are due January 2022. If successful, the city and consultant will be asked to do a presentation to the Floodplains by Design (FbD) staff at Ecology. Following the City and consultant will prepare round two of the application process to FbD and awards will be decided in 2022.
- The outreach and effectiveness study with fast food restaurants is going very well. The study is targeting the management of fats, oils and grease (FOG) at several locations in town. It's an educational outreach program with no enforcement. Staff training, posters, fliers and information on how to better manage FOG has been helpful.

- The new Dolarway bridge and levee certification process is about to go from the technical memorandum level to the CLOMR level very soon. The city hired Aspect to write the technical memo and that will now go to the County and their consultant Watershed Sciences to write the CLOMR to FEMA. If FEMA approves the CLOMR, then a LOMR will be drafted to FEMA for certification approval. If approved, then the businesses and residences on the back side could eventually be taken out of the floodplain and not have to pay flood insurance.

Electric

- We are advertising for two vacant Journeyman Lineman position.
- Avery Miller, Journeyperson Lineperson submitted his resignation in November. He has taken a job with Grant County PUD.
- Crews have been working on changing out old power poles and traffic signal maintenance.
- Meter department has been focusing on meter audits
- Basin tree services will be completed with contracted work on Monday 11/15/21.
- Staff has provided approval of the temporary construction occupancy for the new elementary school. Several punch list items remain to be completed prior to final approval.
- Staff, with the aid of D. Hittle & Associates, in the next week will be advertising for bid the substation power transformer for the Dolarway Substation project.
- Aubrey Silvey Enterprises Inc. is scheduled to perform substation maintenance the week of December 6th.
- Staff advertised Bid Call 2021-12 15kV Medium Voltage Underground Distribution Cable and received two bids. Staff has asked City Council to award the bid to Anixter Inc. the lowest responsive bidder at the Nov 15th meeting. Anixter's bid was for \$112,740.30 and is above the Engineers Estimate of \$88,700, by approximately 21%. This increase is expected due to recent market conditions. These materials are essential to the operations of the Electrical Utility and must be purchased. Adequate budget exists to accommodate the additional cost.

Gas

- At the November 15th City Council Meeting, staff notified Council, as required by Chapter 9.80 of the ECC, of two recent natural gas purchase commitments to Shell Energy North America. The first purchase commitment is for 500 MMBtu/day at \$4.61/MMBtu for the months of November 2022 through March 2023. The total value of the contract purchase is \$348,055. The second purchase commitment is for 500 MMBtu/day at \$4.89/MMBtu for the months on November 2022 through March 2023 as well. The total value of the second contract purchase is \$369,195. The total combined value of the two contract purchases is \$717,250.
- Crews performed scheduled monthly pipeline patrol tasks including odorant reads, rectifier and C.P. checks. Crews also installed new PE services at the customer's request and tied in new main on Berry Road.
- Chet Weekes took his Code School Test on November 11th and passed. This is a requirement for completing his Apprenticeship.
- Staff is working on our annual safety newsletter to be included with utility bills and placed on the city's website.
- Staff continues to review material inventory and projected needs in anticipation of supply chain issues.

- Staff was notified by the Washington Utilities and Transportation Commission that we will have two scheduled safety audits in 2022. An annual review as well as an Operations and Maintenance Manual review.
- Staff attended a Northwest Pipeline – Pre-filing Rate Case Settlement Conference.