BOWER ELEMENTARY SCHOOL
LEVEE DESIGN AND CERTIFICATION
DUPAGE COUNTY, IL

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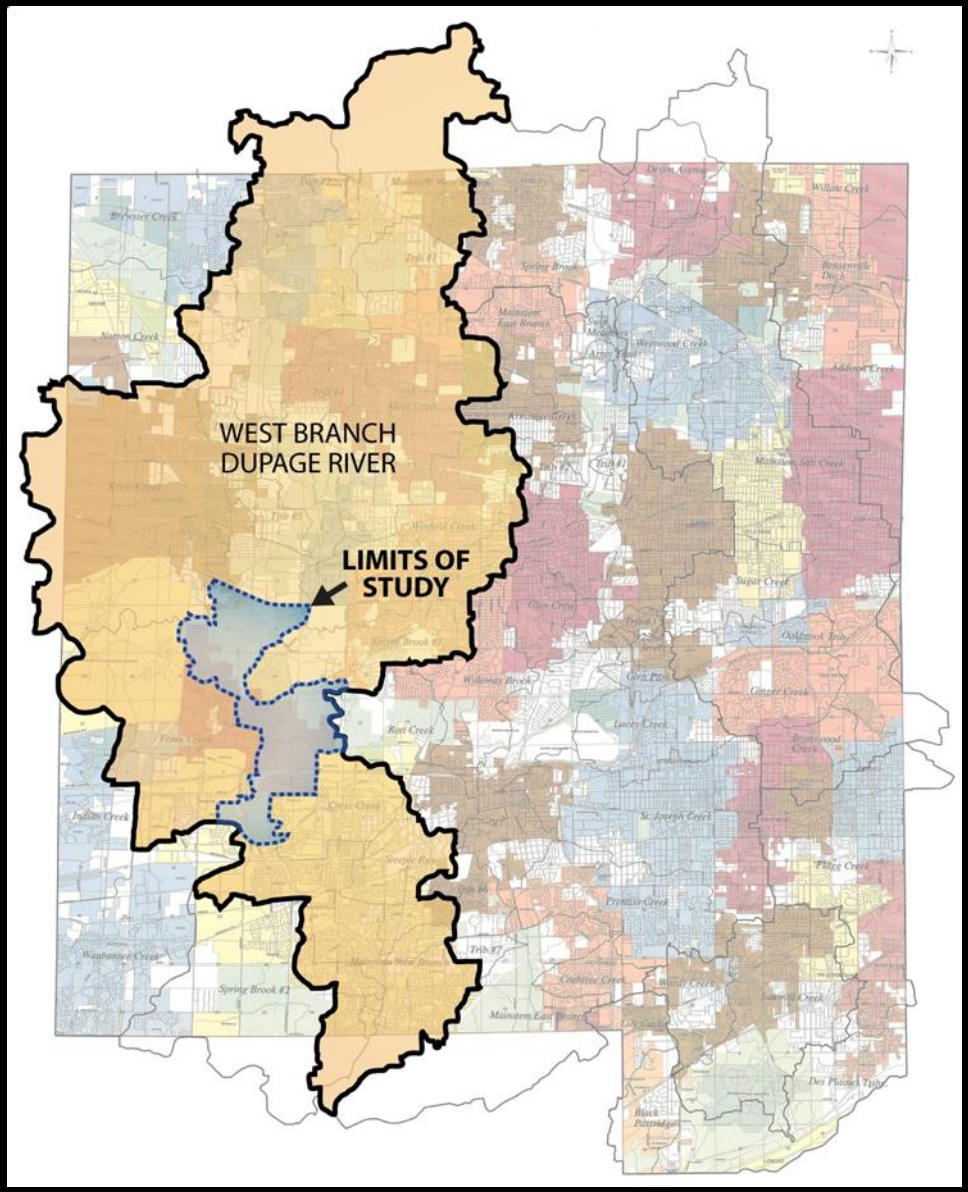
Cell: (630) 417-2212

Special Thanks To Project Partners:

PRESENTATION OUTLINE

- General Overview
- Bower School Levee
- Levee Certification
- River Road Levee
- Questions

Project Location

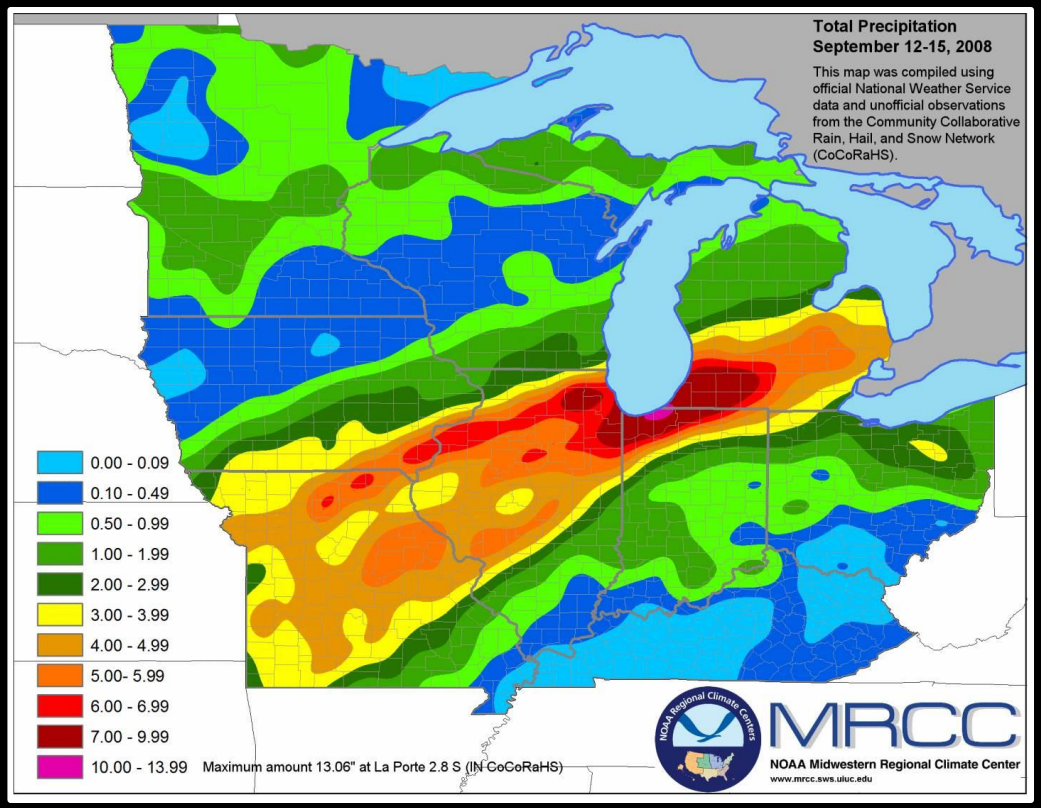


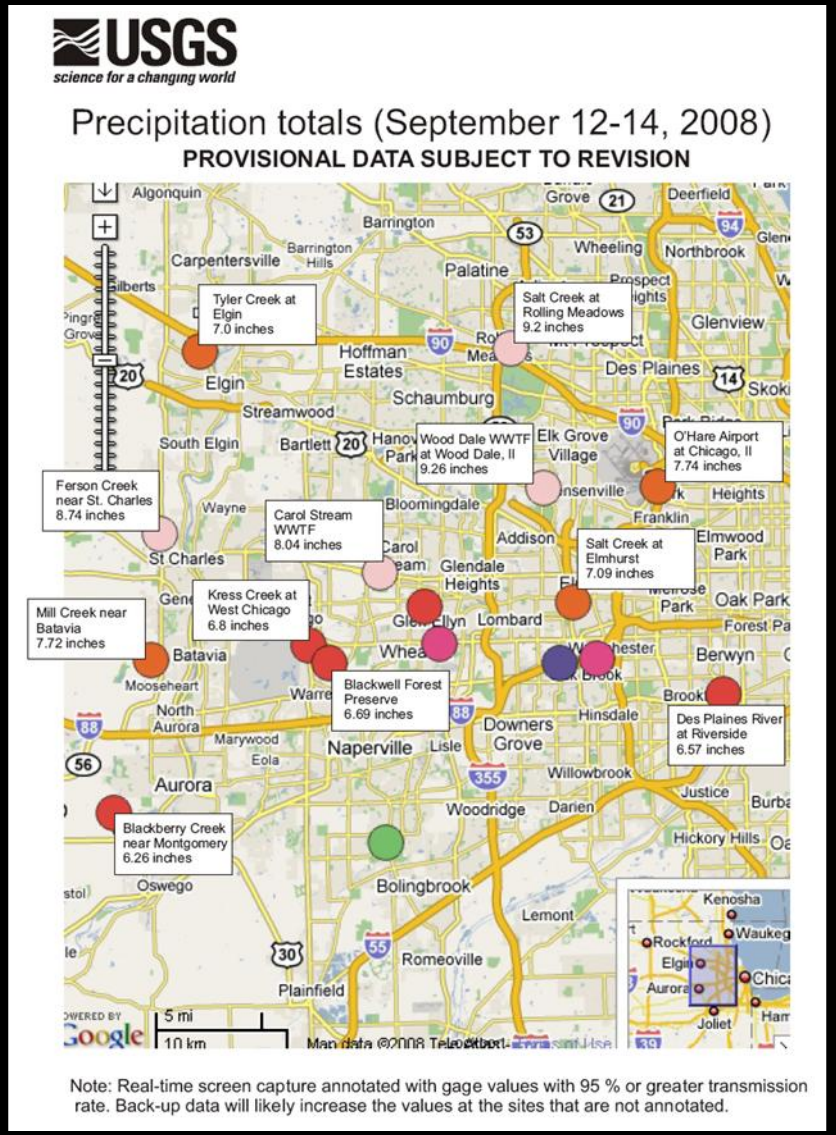
West Branch DuPage River Watershed

- 128 square miles
- 17 Tributaries
- 14 Communities & Unincorporated DuPage

September 2008 Storm

DuPage County experienced six to ten inches of rain





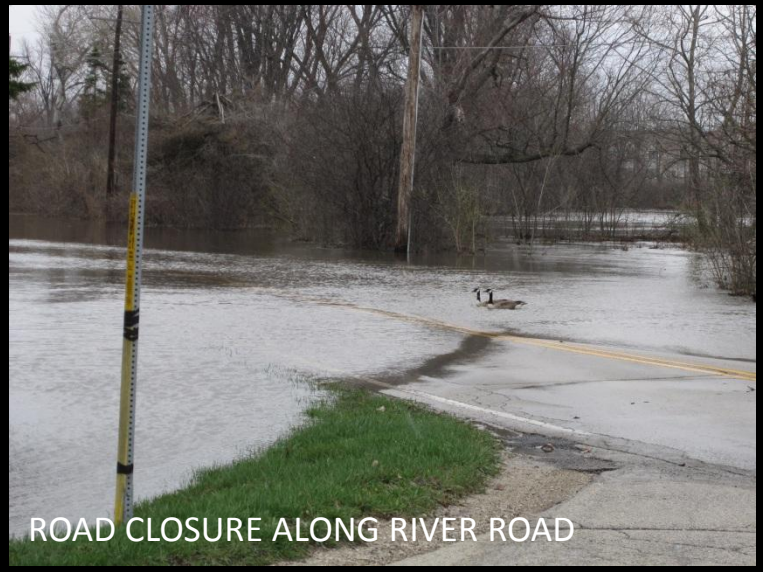
Note: Real-time screen capture annotated with gage values with 95 % or greater transmission rate. Back-up data will likely increase the values at the sites that are not annotated.

2008 Flooding in Warrenville

2008 Flooding in Warrenville

COMMERCIAL FLOODING ALONG RIVER ROAD

RESIDENTIAL FLOODING ALONG RIVER ROAD

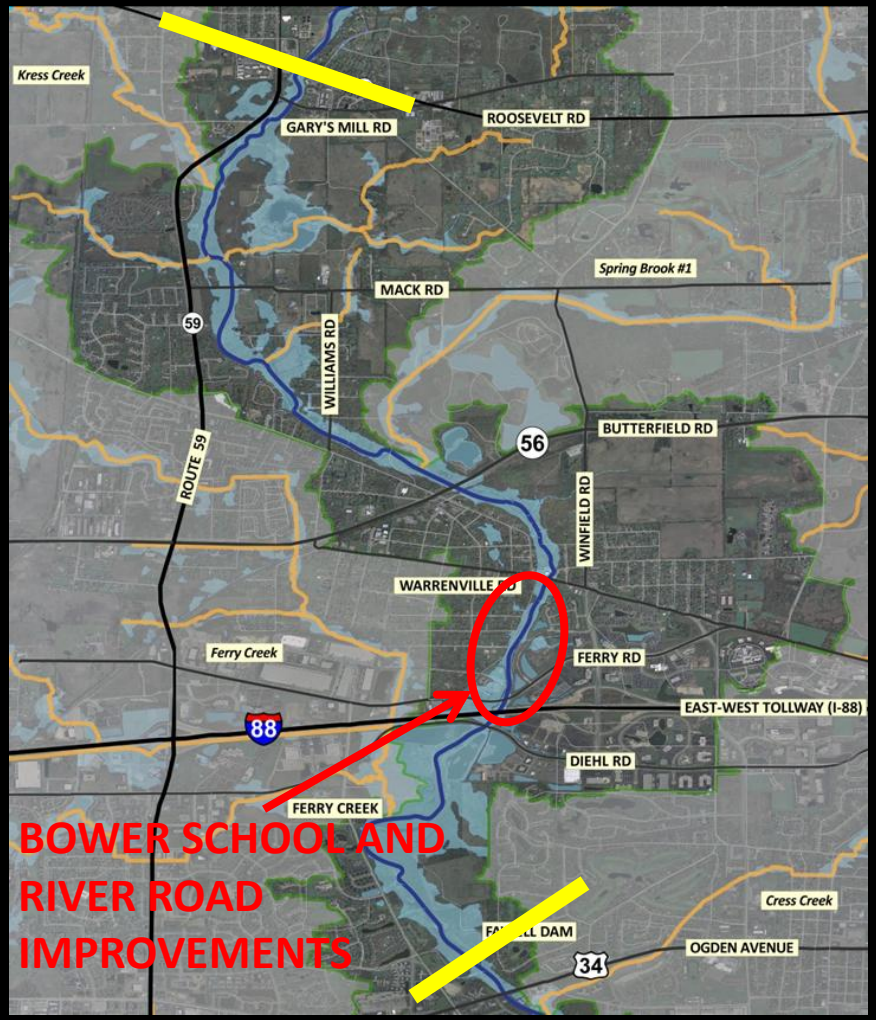


ROAD CLOSURE ALONG RIVER ROAD

WARRENVILLE ROAD BRIDGE

2008 Flooding in Warrenville

West Branch Watershed Plan Addendum



County's Response to September 2008 Storm

Study Limits: Roosevelt Road to Upstream of Fawell Dam

Total Reach Length: 7.0 Miles

Preferred Alternatives Included:

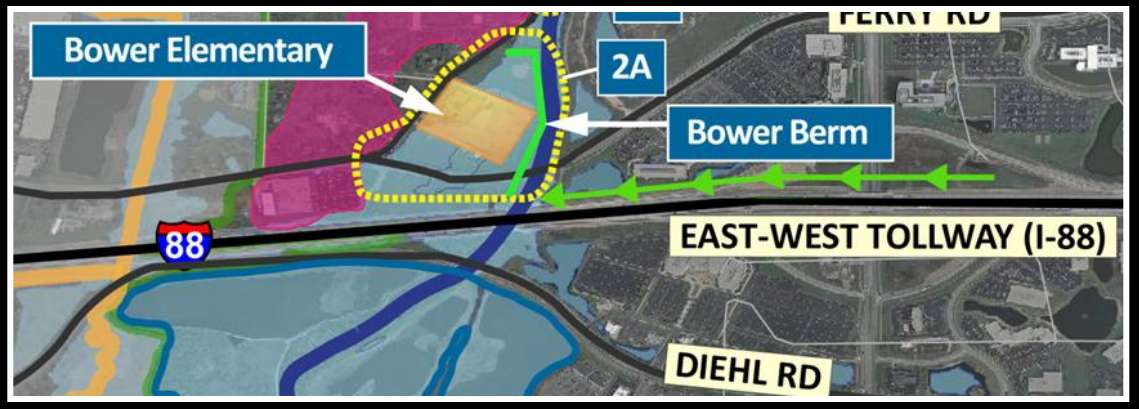
- Bower Berm Berm
- Raising River Road
- 2nd Street Corridor Restoration
- Williams Road Bridge Replacement
- Warrenville Rd Bridge Replacement
- Flood Control Berms N. of Williams Road

Approved by Stormwater Management Committee & DuPage County Board - 2010

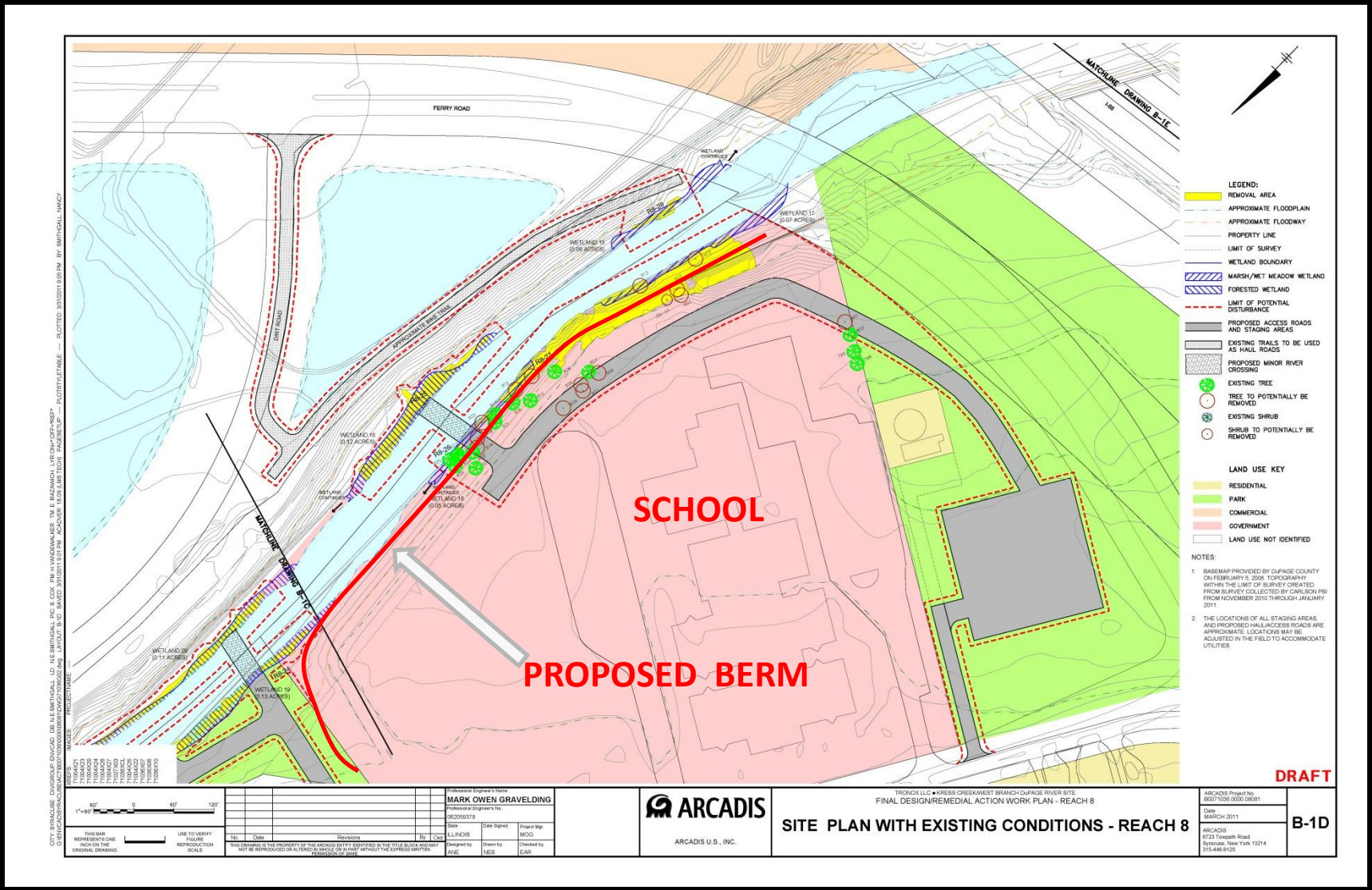
BOWER SCHOOL – EXISTING CONDITIONS

Bower School Berm and Levee Certification

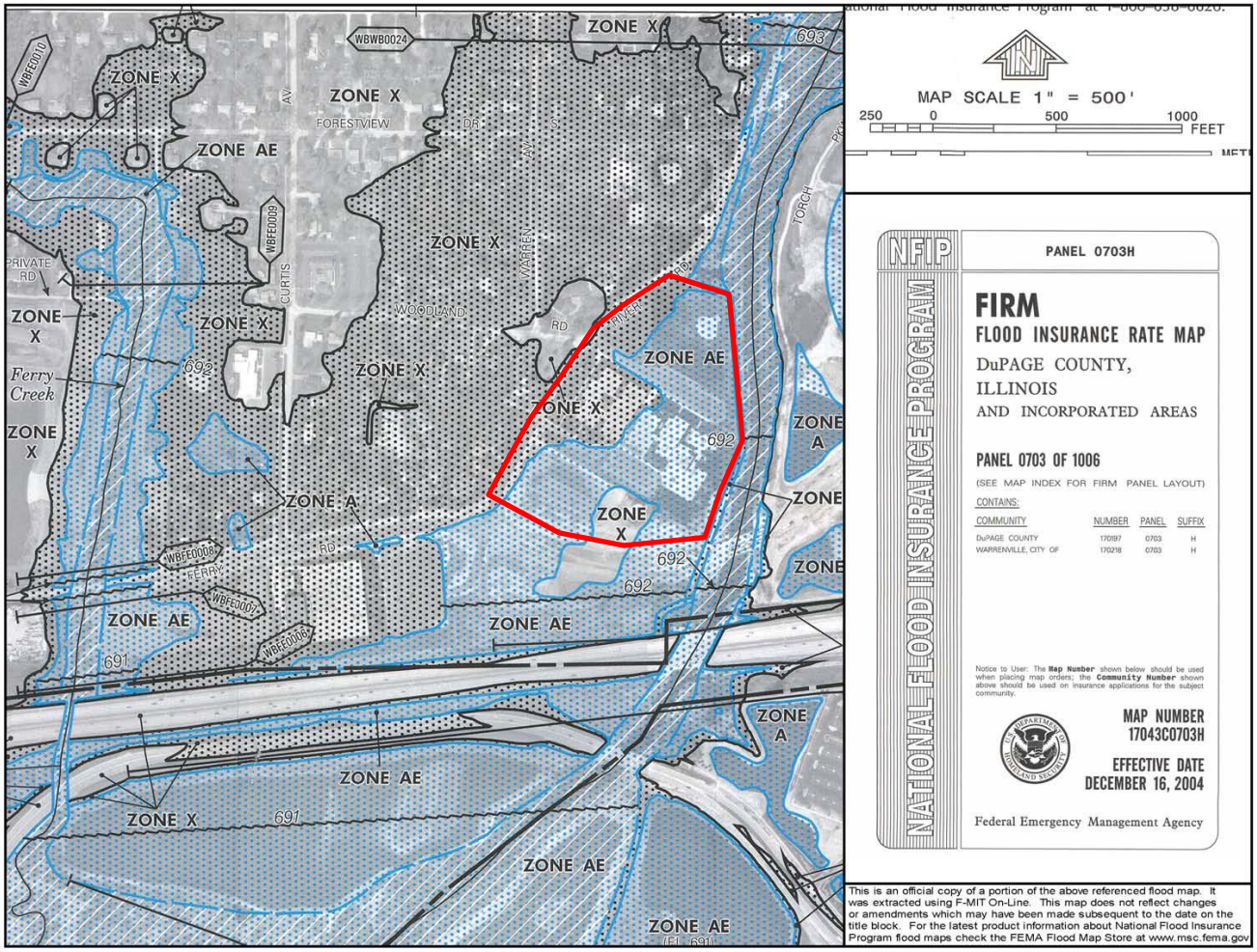
- Stakeholders
  - Bower Elementary School
  - DuPage County
  - City of Warrenville
  - EPA
- Objective: Protect School
- Overlapping Projects
  - Berm and Superfund cleanup
- Coordination
  - Cost Share (County, School, City)
  - FEMA
  - EPA Superfund Cleanup
  - Permits
  - Intergovernmental Agreements



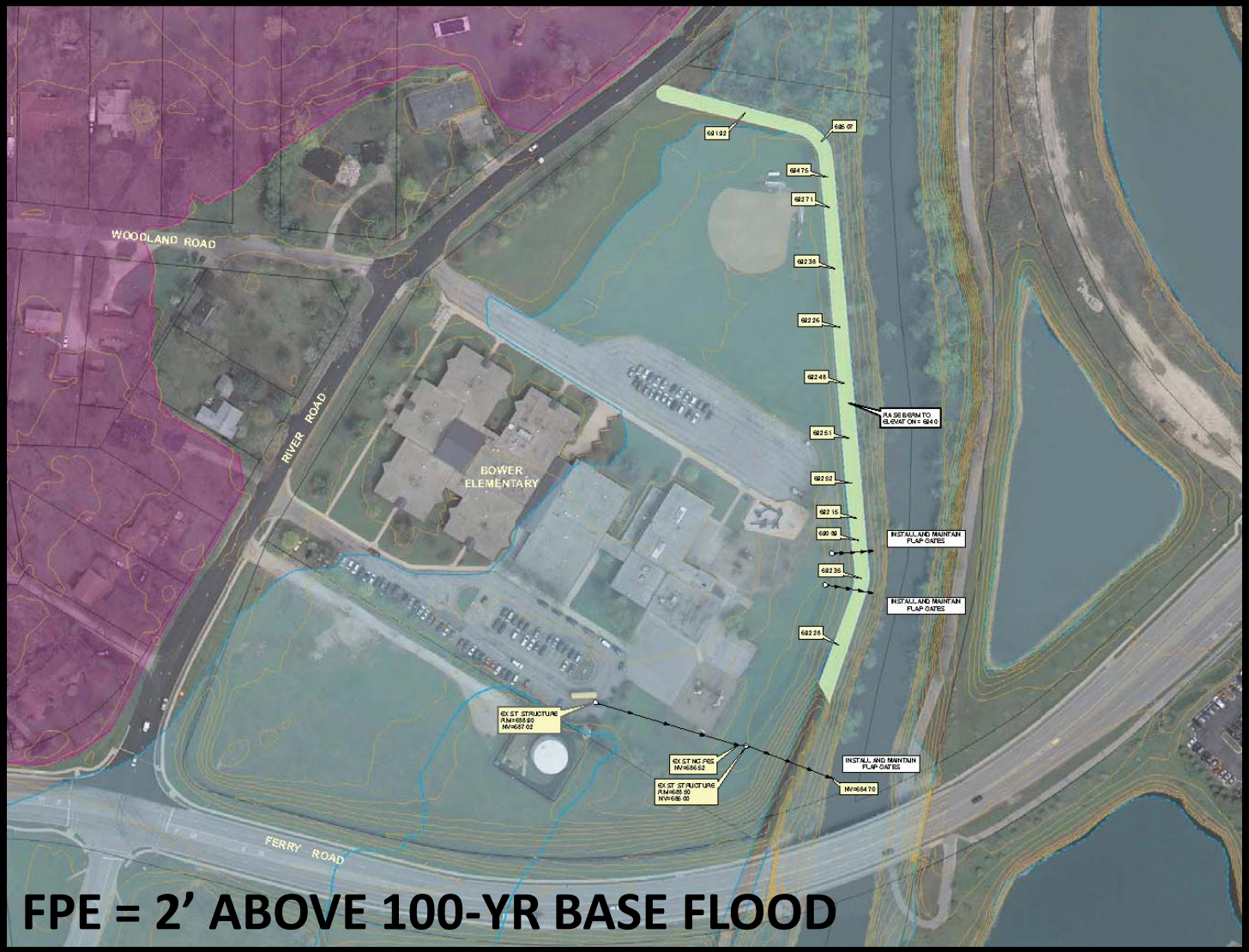
OVERLAPPING PROJECTS – BERM AND SUPERFUND CLEANUP



Current Regulatory Floodplain

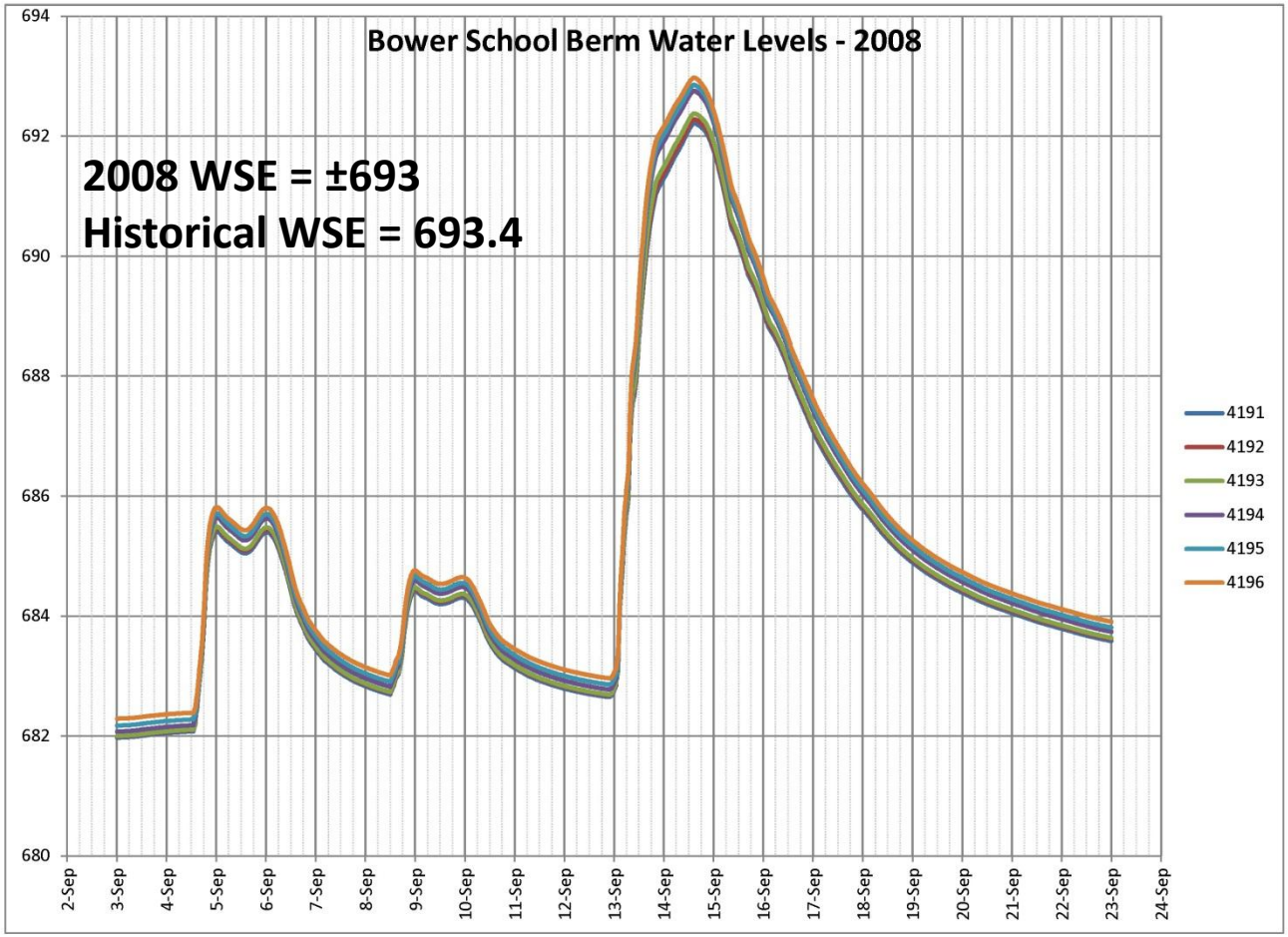


Bower Elementary Flood Control Improvements
West Branch Watershed Plan Addendum



FPE = 2’ ABOVE 100-YR BASE FLOOD

2008 Peak Water Levels at Bower School



What Should be the Flood Protection Elevation?

County's commitment is to protect to 2' above BFE i.e. top of berm at 694'?

Possibility to raise berm to meet FEMA levee certification criteria is discussed

Berm would need to be raised to a minimum of 695' to meet freeboard requirements for levee certification.

Freeboard Requirements for Levee Certification

Min. 3’ above the 100-yr BFE

An additional 1’ above the minimum is required within 100 feet in either side of structures

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

BOWER BERM

School Opts for Certified Levee

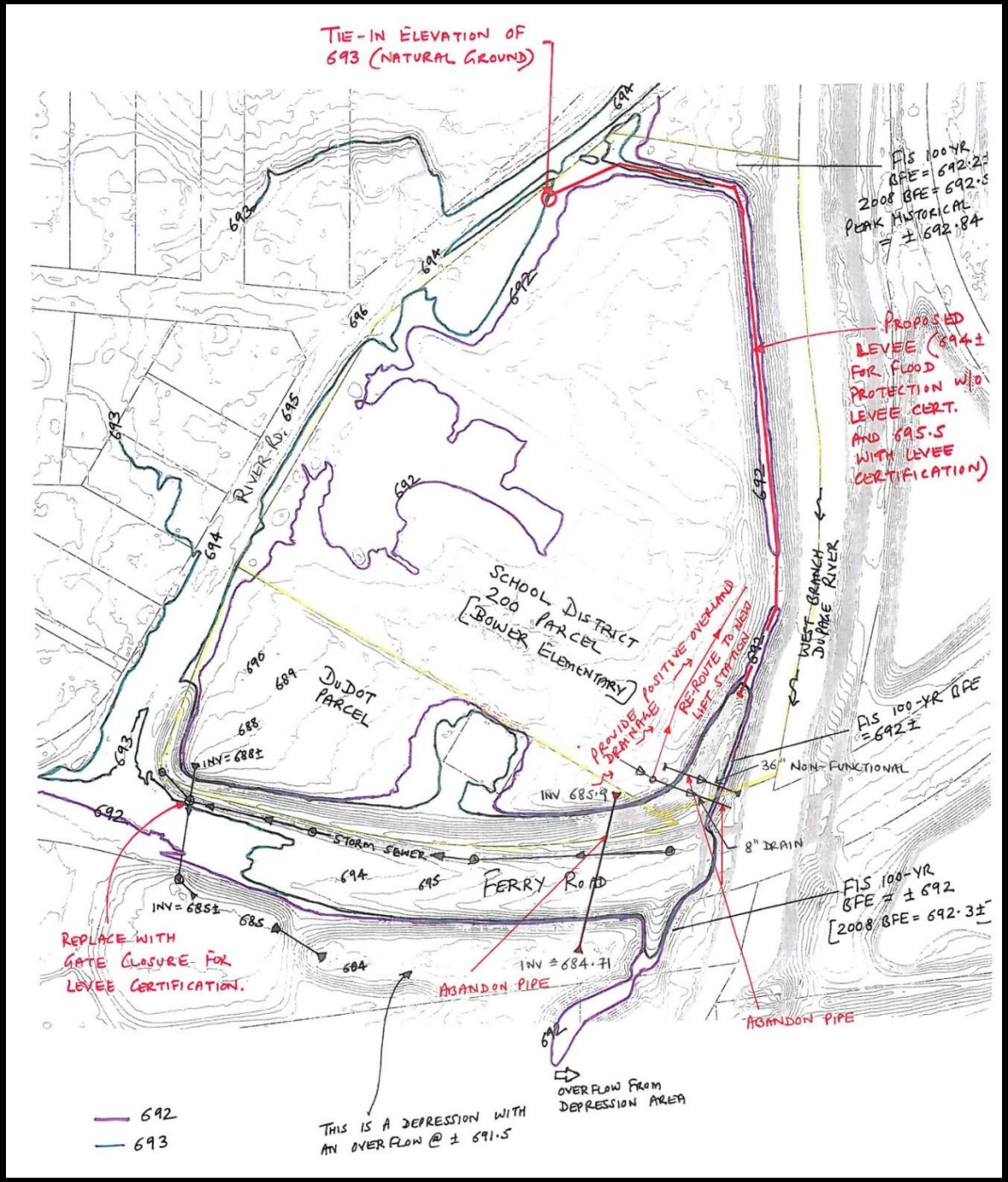
FPE of 695.5 is chosen

County/School Cost Participation. Need an Intergovernmental Agreement

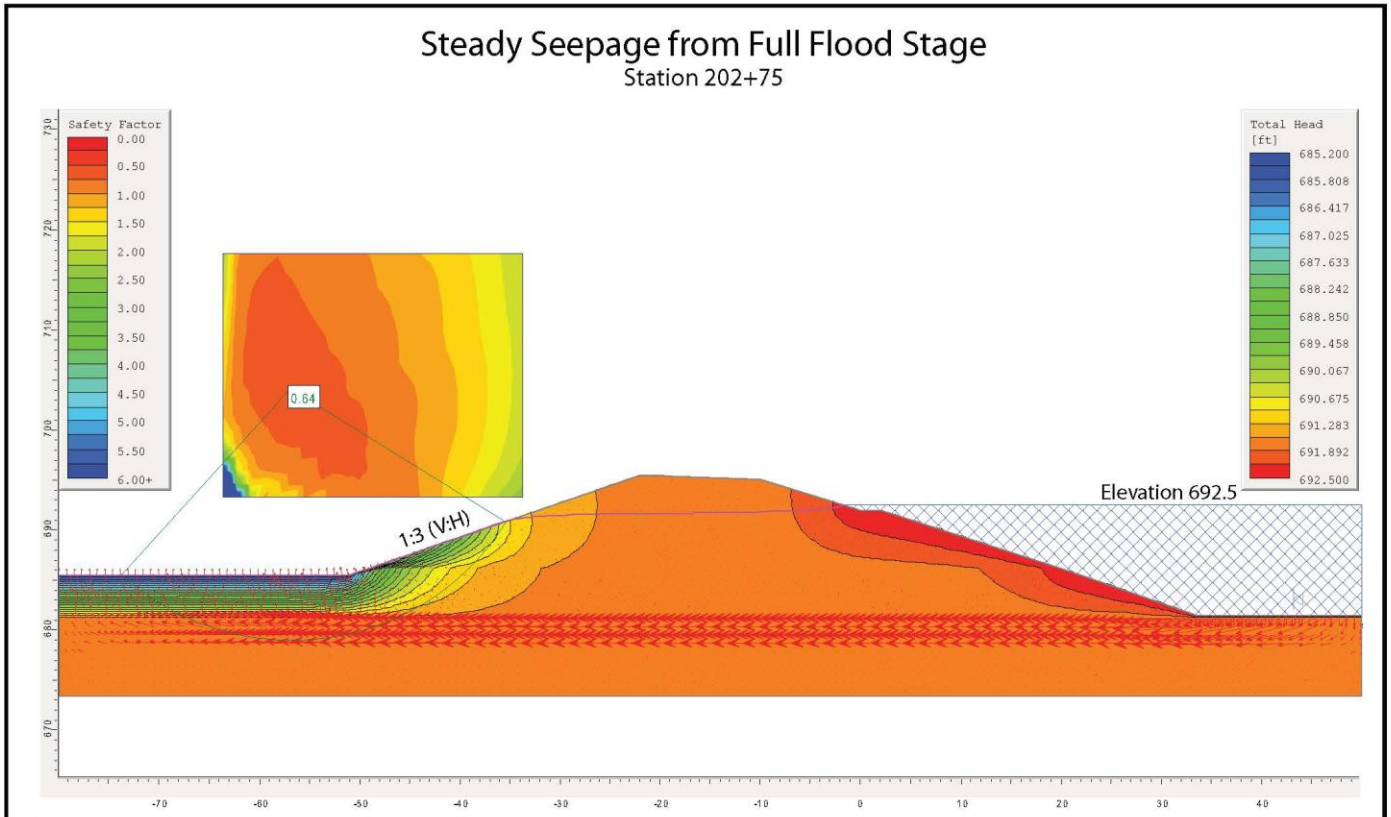
Would the levee need to meet freeboard requirements on all sides?

Can a School Own/Operate a Levee? Apply for Levee Certification?

Early coordination with FEMA completed



Seepage Analysis - Existing Conditions



Soil Parameters

Soil ID	Soil Type	Unit Weight (pcf)	Drained Parameter C' (psf)	Drained Parameter ϕ (deg.)	Coefficient of Permeability, K (ft/sec)		(cm/sec)
Fill	IDOT Cohesive FILL	125	100	29	3.10^{-7}	/	10^{-5}
1	Hard LEAN CLAY FILL	125	100	31	3.10^{-7}	/	10^{-5}
2	Medium Stiff CLAY	120	25	27	3.10^{-6}	/	10^{-4}
3	Medium Dense WELL-GRADED SAND	120	0	32	3.10^{-2}	/	1
4	Hard LEAN CLAY	125	300	32	3.10^{-7}	/	10^{-5}

GLOBAL STABILITY ANALYSIS: BOWER SCHOOL LEEVE
WARRENVILLE, DuPAGE COUNTY IL

SCALE: GRAPHICAL | **EXHIBIT 5-3A** | DRAWN BY: A. Kurnia CHECKED BY: S. Sugiarto

Wang Engineering

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Lombard, IL 60148
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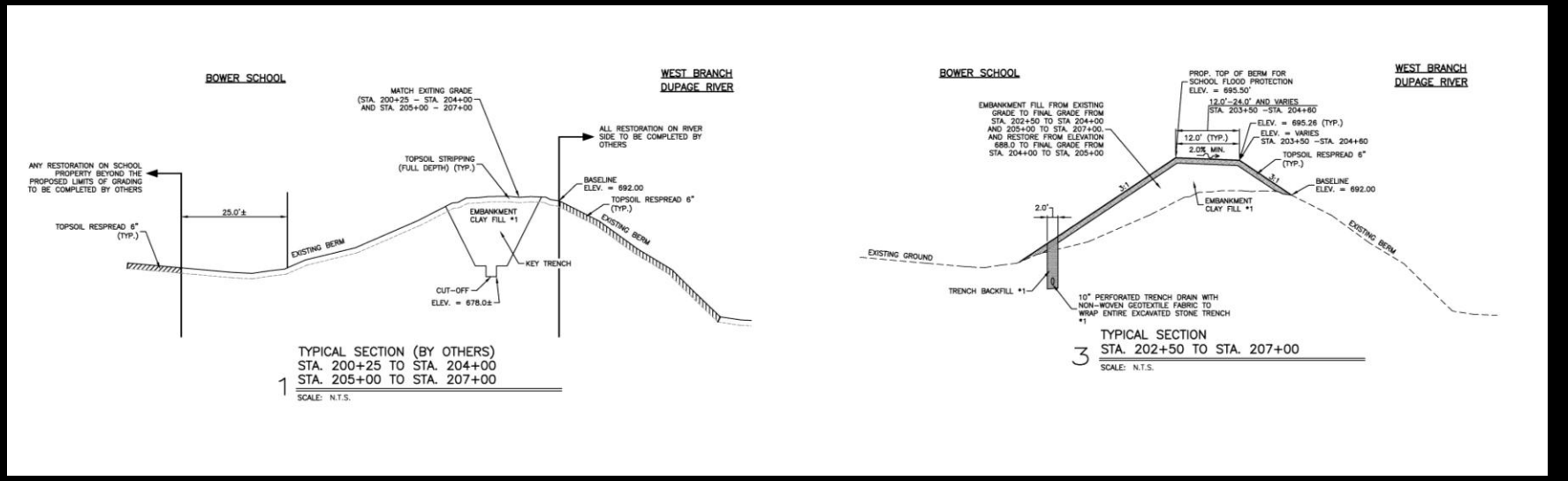
FOR HR GREEN, INC. | **811-01-01**

BOWER LEVEE – TYPICAL SECTIONS



Levee Certification
Example Embankment Specifications

The material shall consist of approved materials that are free of organic matter and debris. The soil shall be of classification CL in accordance with the Unified Soil Classification System obtained from glacial till deposits. The soil shall have a **liquid limit greater than 30 and less than 50, a plasticity index of greater than 15 and less than 30, the fines content (percent passing sieve #200) greater than 30% and a hydraulic conductivity of less than $1x10^{-6}$ cm/sec or less.**

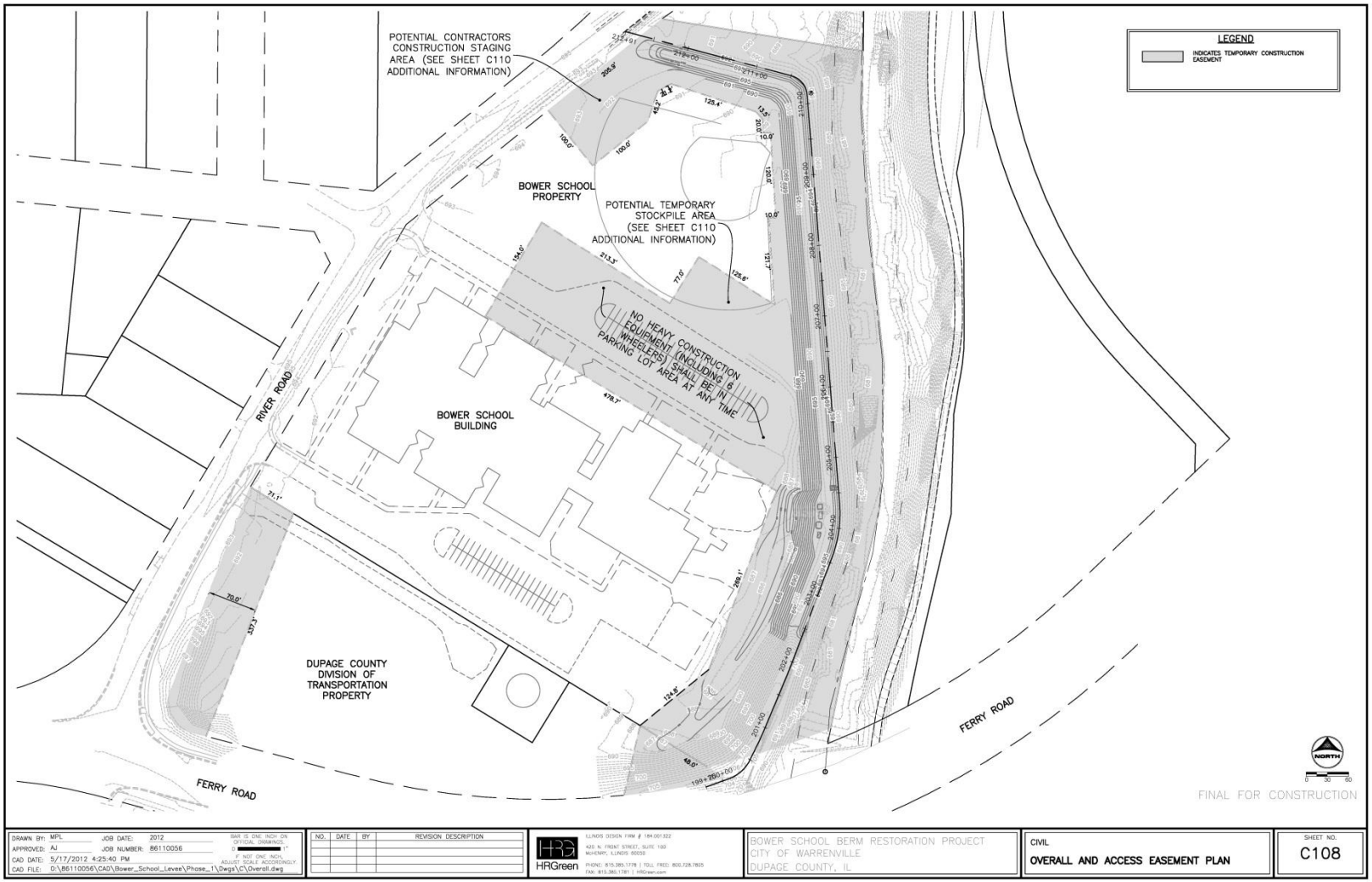
The Owner will employ the professional services of a qualified geotechnical firm at Owner's expense to provide material sampling, material testing, quality assurance and field quality control. Material used for embankment fill including embankment soil compaction shall be per the direction of the Owners geotechnical engineer.

Levee Certification
Example Embankment Specifications

Embankment Soils Compaction: Embankment compaction shall be done in accordance with the applicable portions of Article 205.06 of the Standard Specifications. Density and moisture content shall be as specified below: Field density test frequency shall be at least one test per each 10 cubic yards placed within areas adjacent to structures, a minimum of two tests shall be performed for each structure located within the embankment. Field density test frequency shall be at least one test per 100 cubic yards in open areas of the embankment. A minimum of three tests shall be completed for any lift of fill. Locations of field density tests shall be subject to approval by the Owner's geotechnical engineer. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet (46 m) or less of trench length, but no fewer than 2 tests.

Moisture Content: The clay fill shall be brought to a moisture content between +2% and +4% greater than the optimum moisture content and compacted to a minimum 95% of the maximum dry unit weight according to ASTM D 698 Method A. After compacting each lift, the surface should be scarified for bonding between successive lifts. Contractor must maintain moisture content until acceptance by Owner. If the hydraulic conductivity is not met, Contractor shall re-compact or replace at the Contractor expense

BOWER LEVEE – OVERALL PLAN



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APPROVED: AJ JOB NUMBER: 86110056
CAD DATE: 5/17/2012 4:25:40 PM
CAD FILE: O:\86110056\CAD\Bower_School_Levee\Phase_1\Dwgs\C\Overall.dwg

BAR IS ONE INCH ON ORIGINAL DRAWINGS. IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY

NO.	DATE	BY	REVISION DESCRIPTION

HRGreen

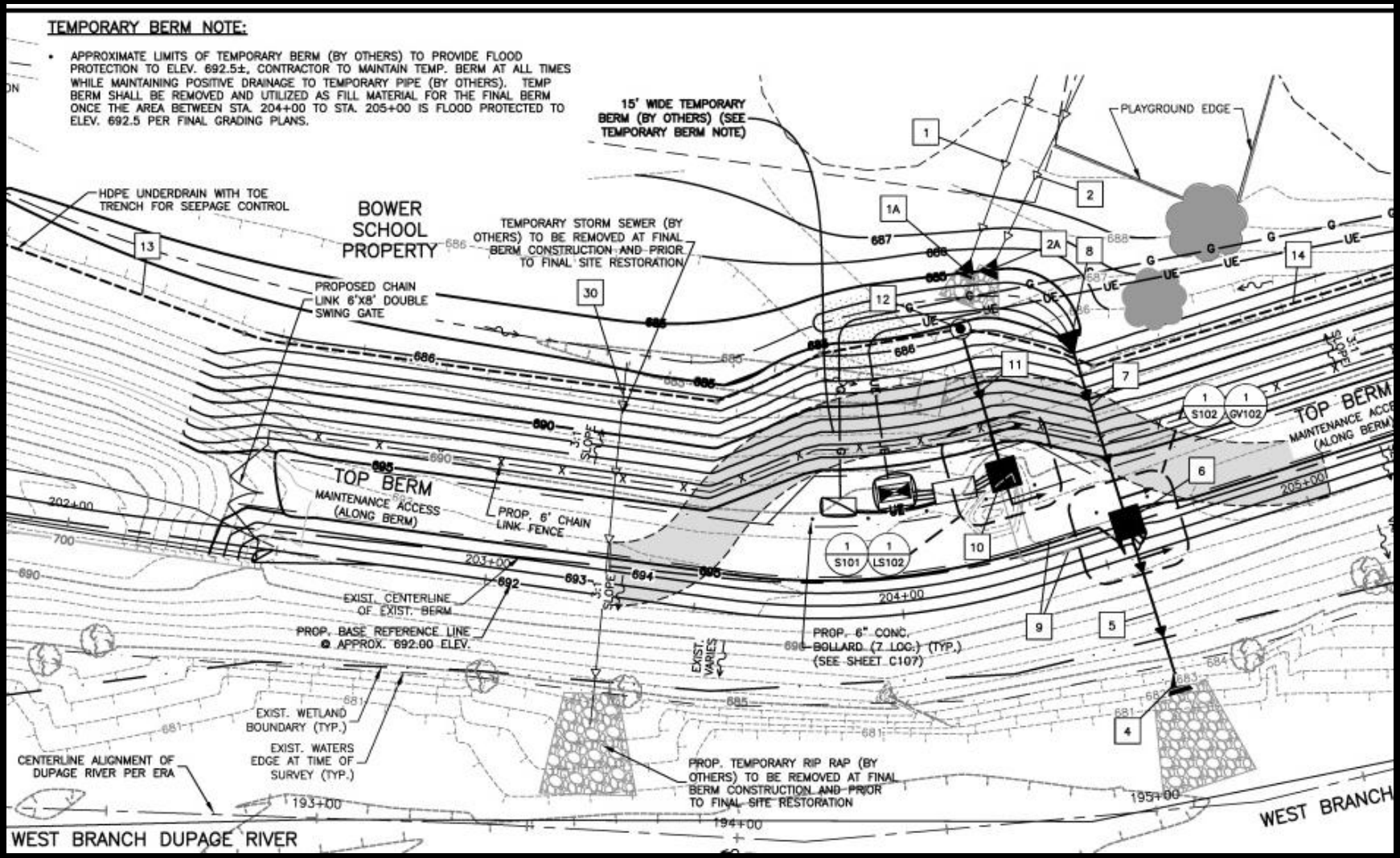
ILLINOIS DESIGN FIRM # 184.001322
420 N. FRONT STREET, SUITE 100
MCHENRY, ILLINOIS 60050
PHONE: 815.385.1778 | TOLL FREE: 800.728.7835
FAX: 815.363.1781 | HRGreen.com

BOWER SCHOOL BERM RESTORATION PROJECT
CITY OF WARRENVILLE
DUPAGE COUNTY, IL

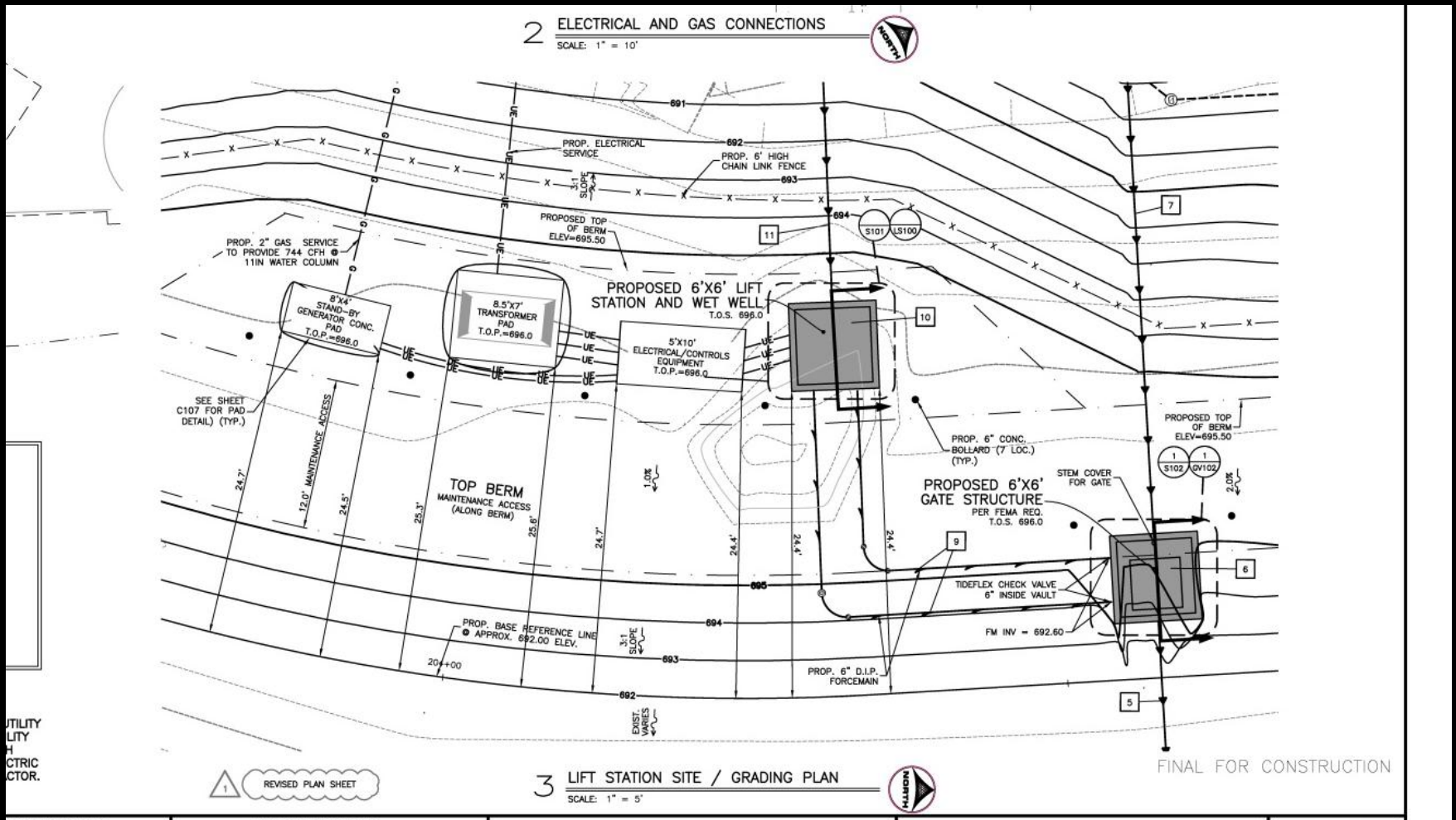
CIVIL
OVERALL AND ACCESS EASEMENT PLAN

SHEET NO.
C108

BERM CONSTRUCTION COORDINATION

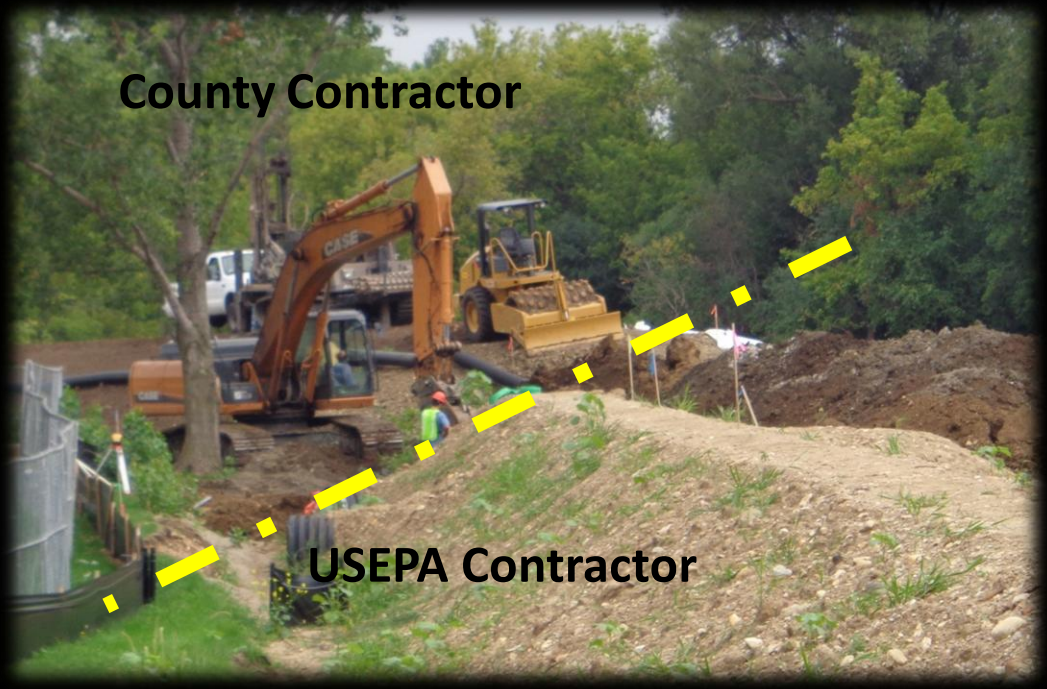


LIFT STATION, GATES, GENERATOR AND TRANSFORMER



REVISION DESCRIPTION				
	HRGreen ILLINOIS DESIGN FIRM # 184.001322 420 N. FRONT STREET, SUITE 100 McHENRY, ILLINOIS 60050 PHONE: 815.385.1778 | TOLL FREE: 800.728.7805 FAX: 815.385.1781 | HRGreen.com	BOWER SCHOOL BERM RESTORATION PROJECT CITY OF WARRENVILLE DUPAGE COUNTY, IL	LIFT STATION **LIFT STATION SITE PLAN**	SHEET NO. LS101

Bower School



Bower School

Bower School

Now that the levee passed the test in April 2013!

Levee Certification

DESIGN, OPERATION AND MAINTENANCE PLAN REQUOREMENTS
PER 44 CFR SECTION 65.10 :

DESIGN CRITERIA

- FREEBOARD DESIGN REQUIREMENTS
- CLOSURE
- EMBANKMENT PROTECTION
- EMBANKMENT AND FOUNDATION STABILITY ANALYSES
- SETTLEMENT ANALYSES
- INTERIOR DRAINAGE

OPERATION PLAN

- FLOOD WARNING SYSTEM
- PLAN OF OPERATION
- PERIODIC OPERATION OF CLOSURES
- INTERIOR DRAINAGE

MAINTENANCE PLAN

Levee Certification Report
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Levee Certificate
Engineer's Certificate

HR Green, Inc.
Project No.: 86120243

Levee Certification Report
Bower School Berm
DuPage County, IL

44 CFR 65.10(b) Tab

For levees to be recognized by FEMA, evidence that adequate design and operation and maintenance systems are in place to provide reasonable assurance that protection from the base flood exists is provided here forth in this submission.

Note: According to 44 CFR 65.2, *"(b) For the purpose of this part, a certification by a registered professional engineer or other party does not constitute a warranty or guarantee of performance, expressed or implied. Certification of data is a statement that the data is accurate to the best of the certifier's knowledge. Certification of analyses is a statement that the analyses have been performed correctly and in accordance with sound engineering practices. Certification of structural works is a statement that the works are designed in accordance with sound engineering practices to provide protection from the base flood. Certification of "as built" conditions is a statement that the structure(s) has been built according to the plans being certified, is in place, and is fully functioning.*
(c) For the purposes of this part, "reasonably safe from flooding" means base flood waters will not inundate the land or damage structures to be removed from the SFHA and that any subsurface waters related to the base flood will not damage existing or proposed buildings."

Signature: Michael J. Ryan 6/12/2014

Name: Michael J. Ryan, P.E.

License Number and State: 062.040694 Expires 11/30/2015

Levee Certification
Freeboard Certificate

HR Green, Inc.
Project No.: 86120243

Levee Certification Report
Bower School Berm
DuPage County, IL

44 CFR 65.10(b) (1) (i) Tab

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

P.E. Signature: Michael J. Ryan June 12, 2014

P.E. Name: Michael J. Ryan

P.E. License Number and State: No. 062.040694, State of Illinois, Expires 11/30/2015

Levee Certification
Closure Certificate

HR Green, Inc.
Project No.: 86120243

Levee Certification Report
Bower School Berm
DuPage County, IL

44 CFR 65.10 (b) (2) Tab

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

P.E. Signature: Michael J. Ryan June 12, 2014

P.E. Name: Michael J. Ryan

P.E. License Number and State: No. 062.040694, State of Illinois, Expires 11/30/2015

Levee Certification
Embankment Protection Certificate

HR Green, Inc.
Project No.: 86120243

Levee Certification Report
Bower School Berm
DuPage County, IL

44 CFR 65.10 (b) (3) Tab

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

P.E. Signature: Michael J. Ryan June 12, 2014

P.E. Name: Michael J. Ryan

P.E. License Number and State: No. 062.040694, State of Illinois, Expires 11/30/2015

Levee Certification
Embankment and Foundation Stability Certificate

44 CFR 65.10 (b) (4) Tab

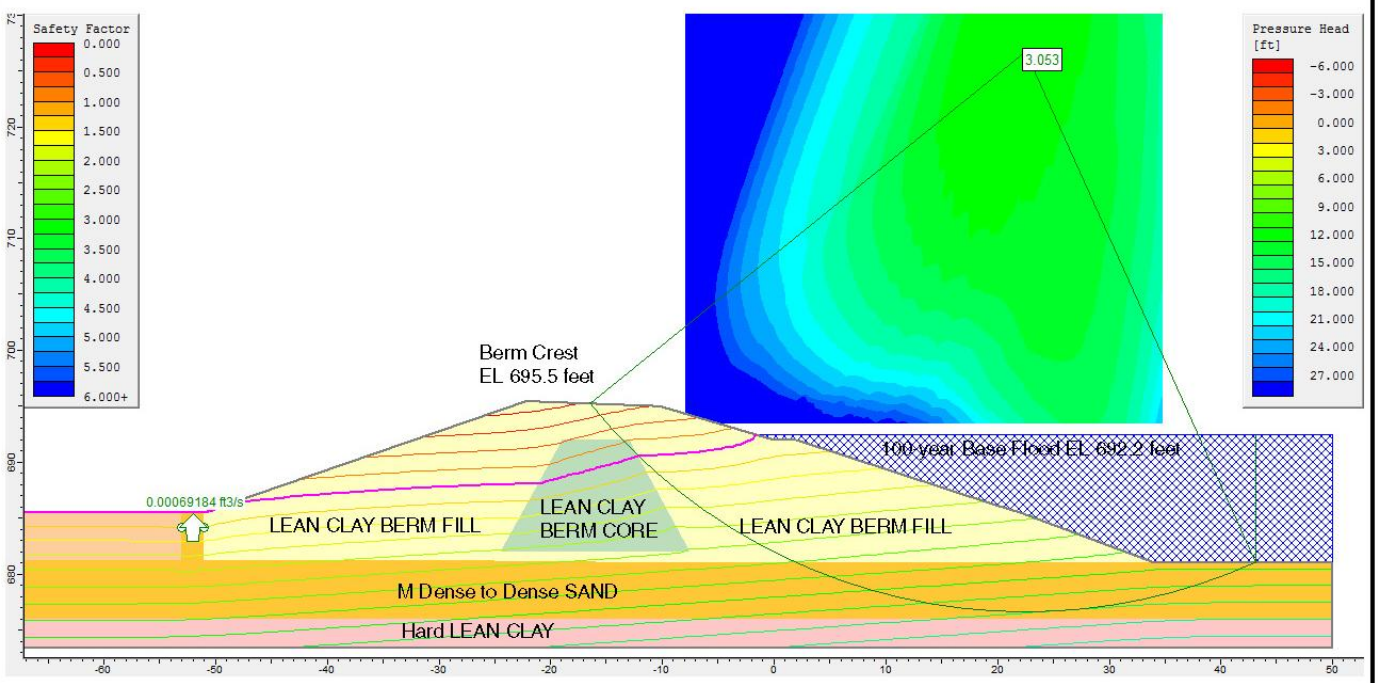
(4) *Embankment and foundation stability.* Engineering analyses that evaluate levee embankment stability must be submitted. The analyses provided shall evaluate expected seepage during loading conditions associated with the base flood and shall demonstrate that seepage into or through the levee foundation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

P.E. Signature: M. L.

P.E. Name: Mickey Snider

P.E. License Number and State: No. 062-058045 ILLINOIS

Levee Accreditation
Embankment and Foundation Stability Analyses



Drained Analysis for Berm Slope River Side, Ref Borings BB-6 and BB-7

Layer ID	Description	Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)	Hydraulic Conductivity (cm/sec)
1	LEAN CLAY BERM CORE	125	175	25	$5x10^{-8}$
2	LEAN CLAY BERM FILL	125	175	25	$1x10^{-6}$
3	M Dense to Dense SAND	120	0	32	$2x10^{-3}$
4	Hard LEAN CLAY	120	100	30	$1x10^{-7}$

GLOBAL STABILITY ANALYSIS: BOWER SCHOOL BERM FEMA ACCREDITATION, SECTION 44 CFR 65.10, DuPAGE COUNTY

SCALE: AS SHOWN | APPENDIX C-1 | DRAWN BY: MLS CHECKED BY: LMI

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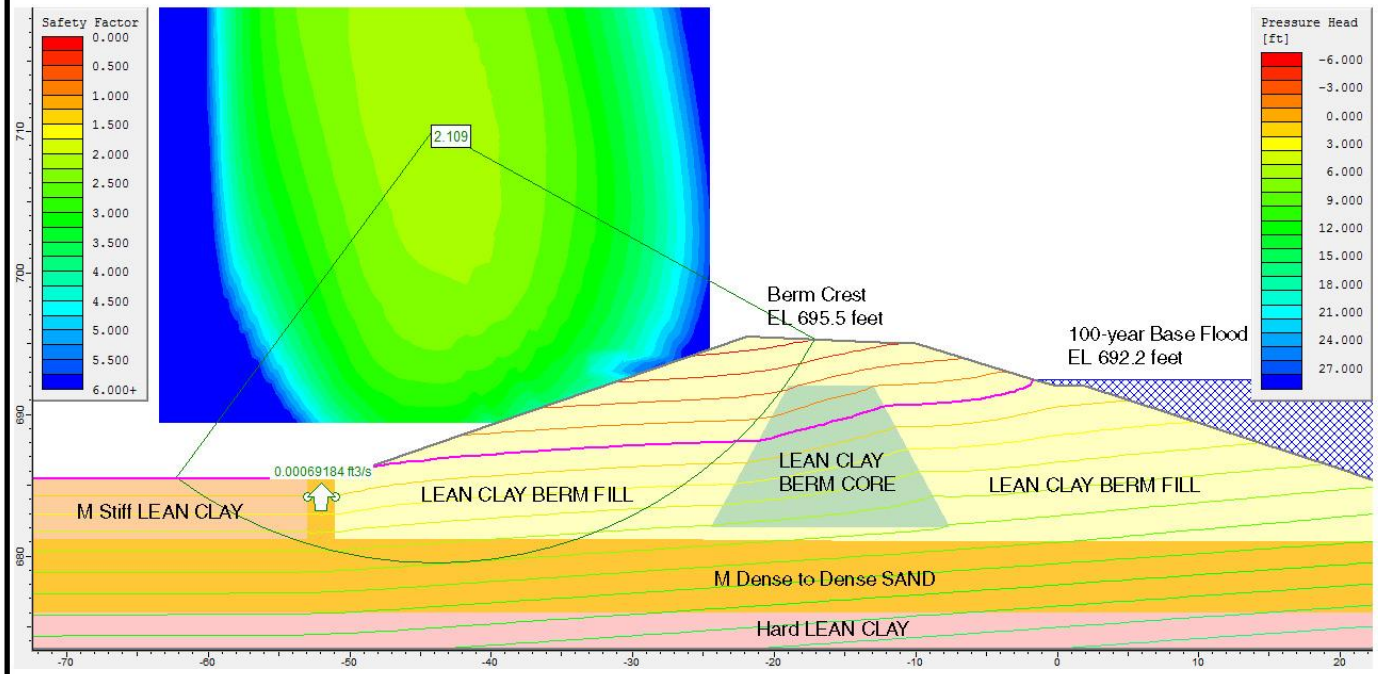
1145 N. Main Street
Lombard, IL 60148
www.wangeng.com

FOR DuPage County, Illinois | 888-01-01

Levee Accreditation
Embankment and Foundation Stability Analyses



Drained Analysis for Berm Slope Protected Side, Ref Borings BB-6 and BB-7

Layer ID	Description	Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)	Hydraulic Conductivity (cm/sec)
1	LEAN CLAY BERM CORE	125	175	25	$5x10^{-8}$
2	LEAN CLAY BERM FILL	125	175	25	$1x10^{-6}$
3	M Stiff LEAN CLAY	120	50	28	NA
4	M Dense to Dense SAND	120	0	32	$2x10^{-3}$
5	Hard LEAN CLAY	120	100	30	$1x10^{-7}$

GLOBAL STABILITY ANALYSIS: BOWER SCHOOL BERM FEMA ACCREDITATION, SECTION 44 CFR 65.10, DuPAGE COUNTY

SCALE: AS SHOWN | APPENDIX C-2 | DRAWN BY: MLS CHECKED BY: LMI

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FOR DuPage County, Illinois | 888-01-01

Levee Certification
Interior Drainage Certificate

HR Green, Inc.
Project No.: 86120243

Levee Certification Report
Bower School Berm
DuPage County, IL

44 CFR 65.10 (b) (6) Tab

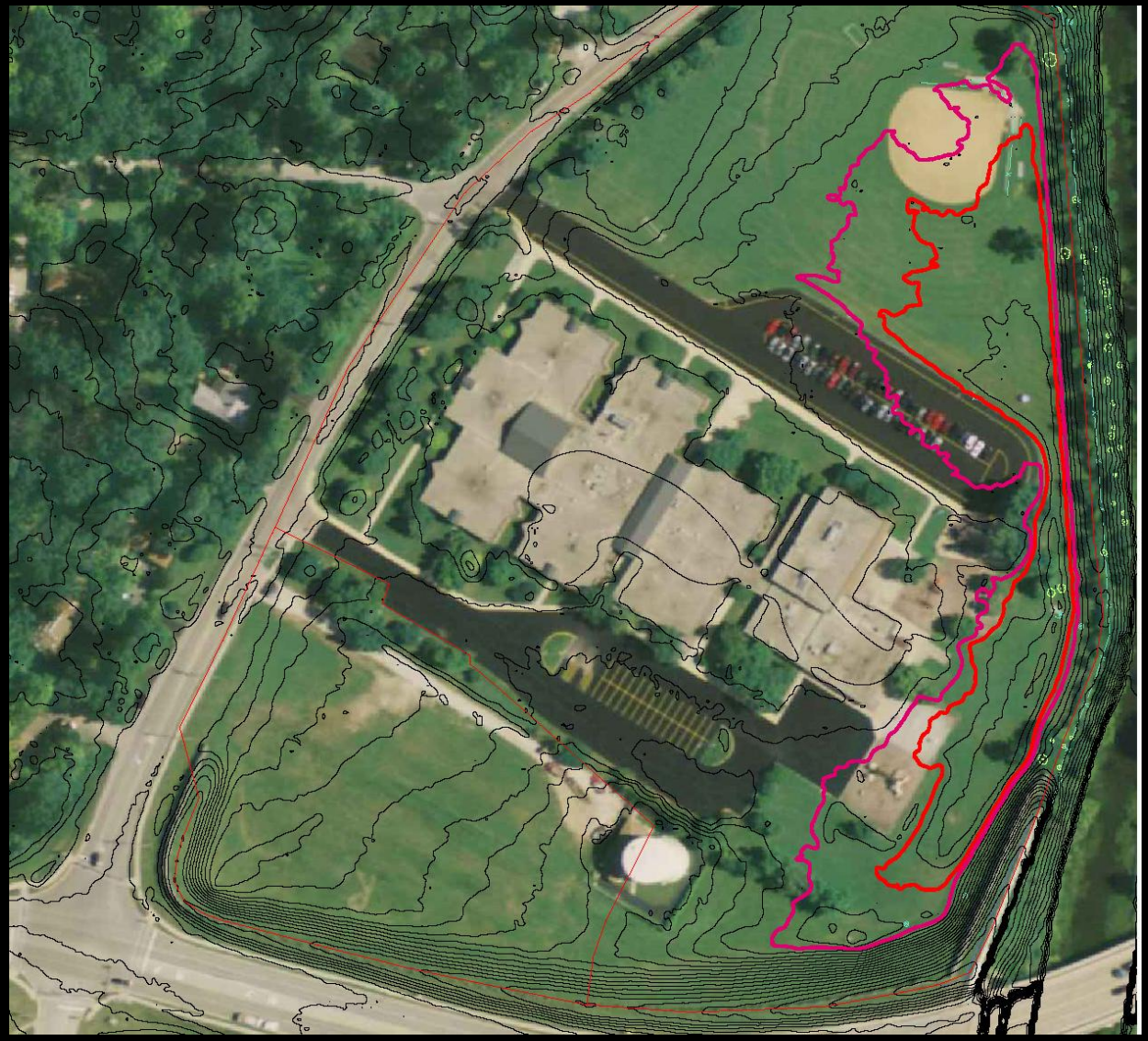
(6) *Interior drainage.* An analysis must be submitted that identifies the source(s) of such flooding, the extent of the flooded area, and, if the average depth is greater than one foot, the water-surface elevation(s) of the base flood. This analysis must be based on the joint probability of interior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

P.E. Signature: Michael J. Ryan June 12, 2014

P.E. Name: Michael J. Ryan

P.E. License Number and State: No. 062.040694, State of Illinois, Expires 11/30/2015

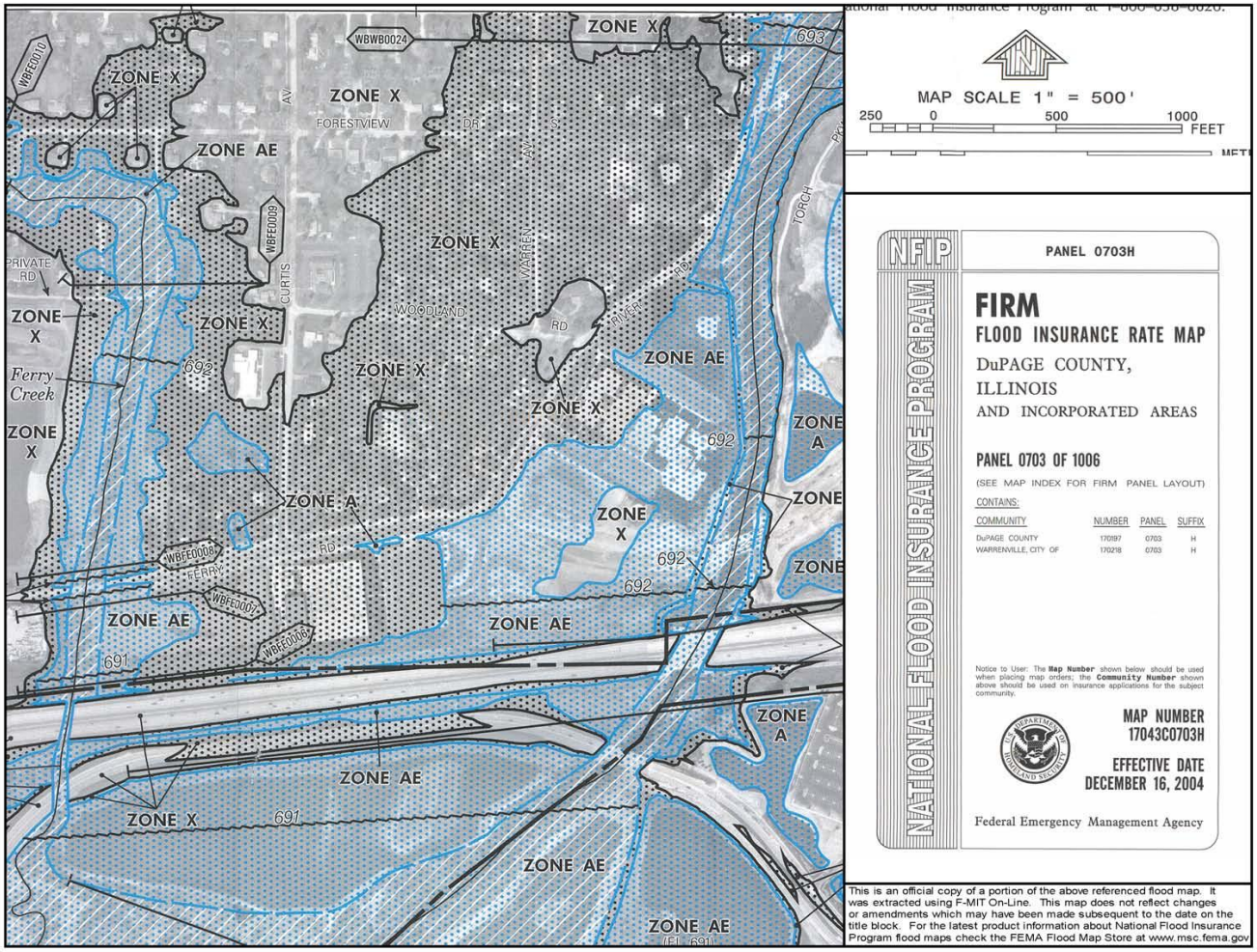
INTERIOR DRAINAGE DESIGN



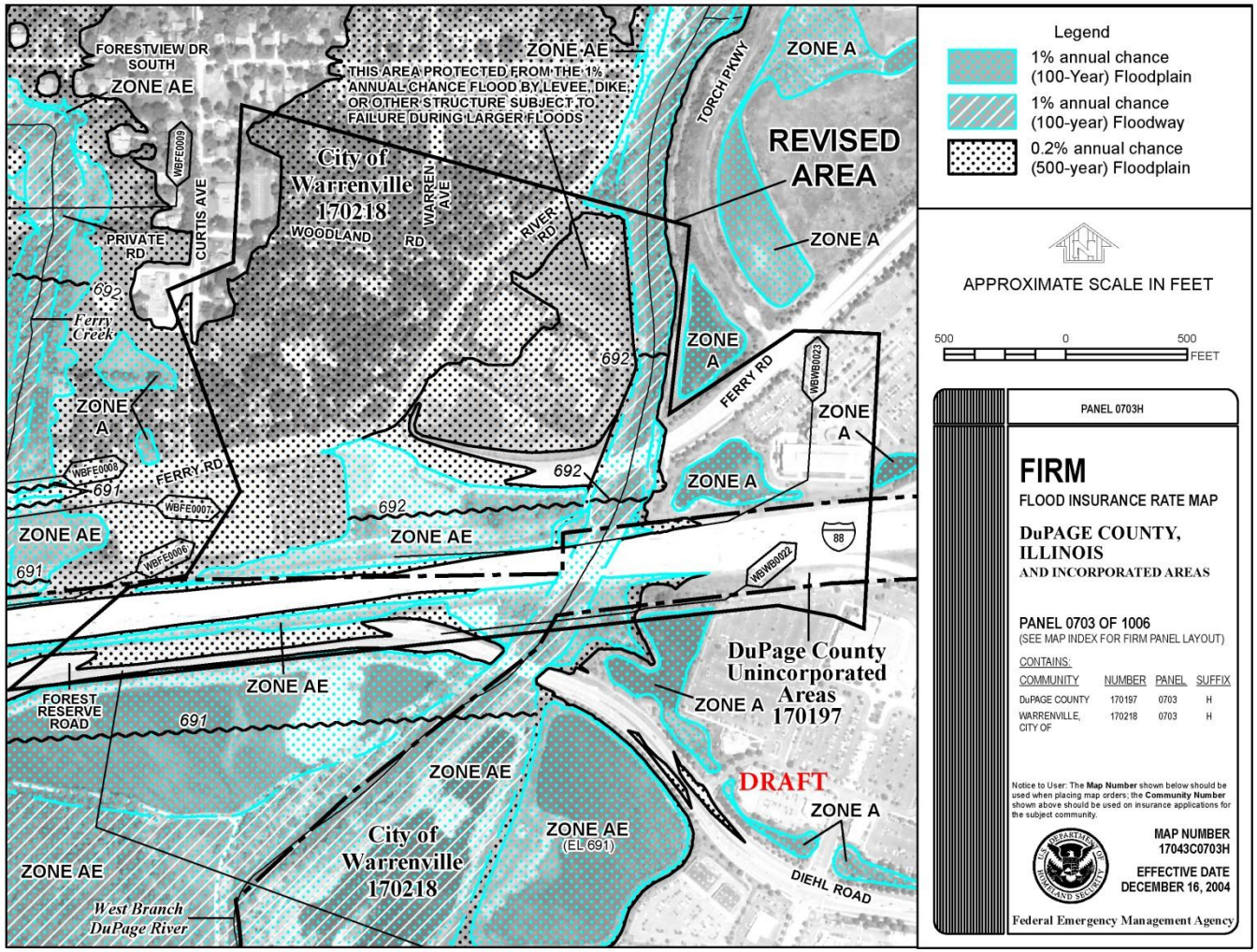
INTERIOR DRAINAGE
WORKED AS DESIGNED IN APRIL 2013 FLOOD

INTERIOR DRAINAGE
WORKED AS DESIGNED IN APRIL 2013 FLOOD

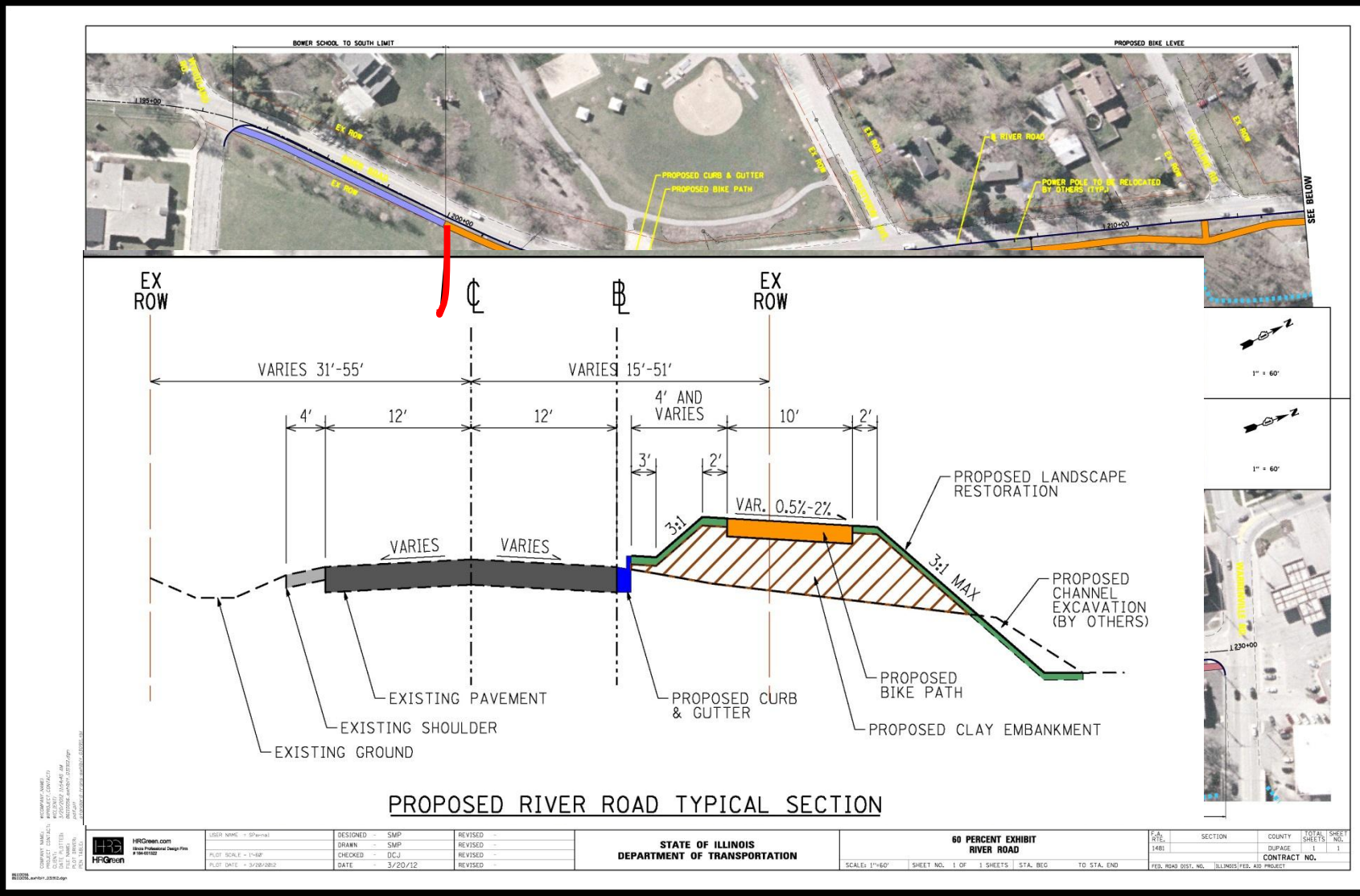
BOWER LEVEE
LETTER OF MAP REVISION – REGULATORY



BOWER LEVEE
LETTER OF MAP REVISION – REVISED 2015

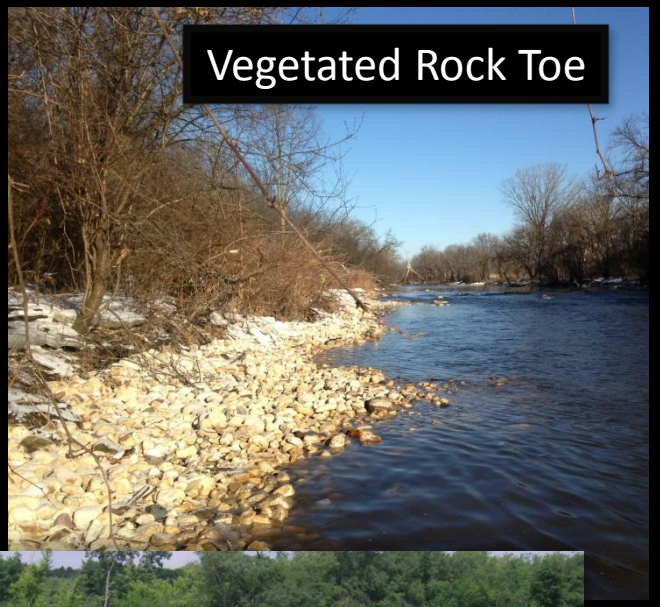


RIVER ROAD LEVEE



In-River Enhancements/ Restoration

Riffle Enhancement Area



Vegetated Rock Toe

Native Vegetation

Closing

- **What to take away from this**
  - Review and first obtain concurrence with all parties on flood protection elevation.
  - If the levee is to be certified, ensure all requirements for certification can be addressed.
  - Find a good geotechnical consultant who can take it from design through certification.
  - Coordinate early with FEMA
- **Multiple Alternatives/ Designs**
  - Required to satisfy all stakeholders
- **Costs**
  - Conscientious of all stakeholders needs while keeping budget on track
  - Cost Sharing contributes to successful completion and satisfied stakeholders
- **Keep big picture / goals in mind**

Questions/ Discussion

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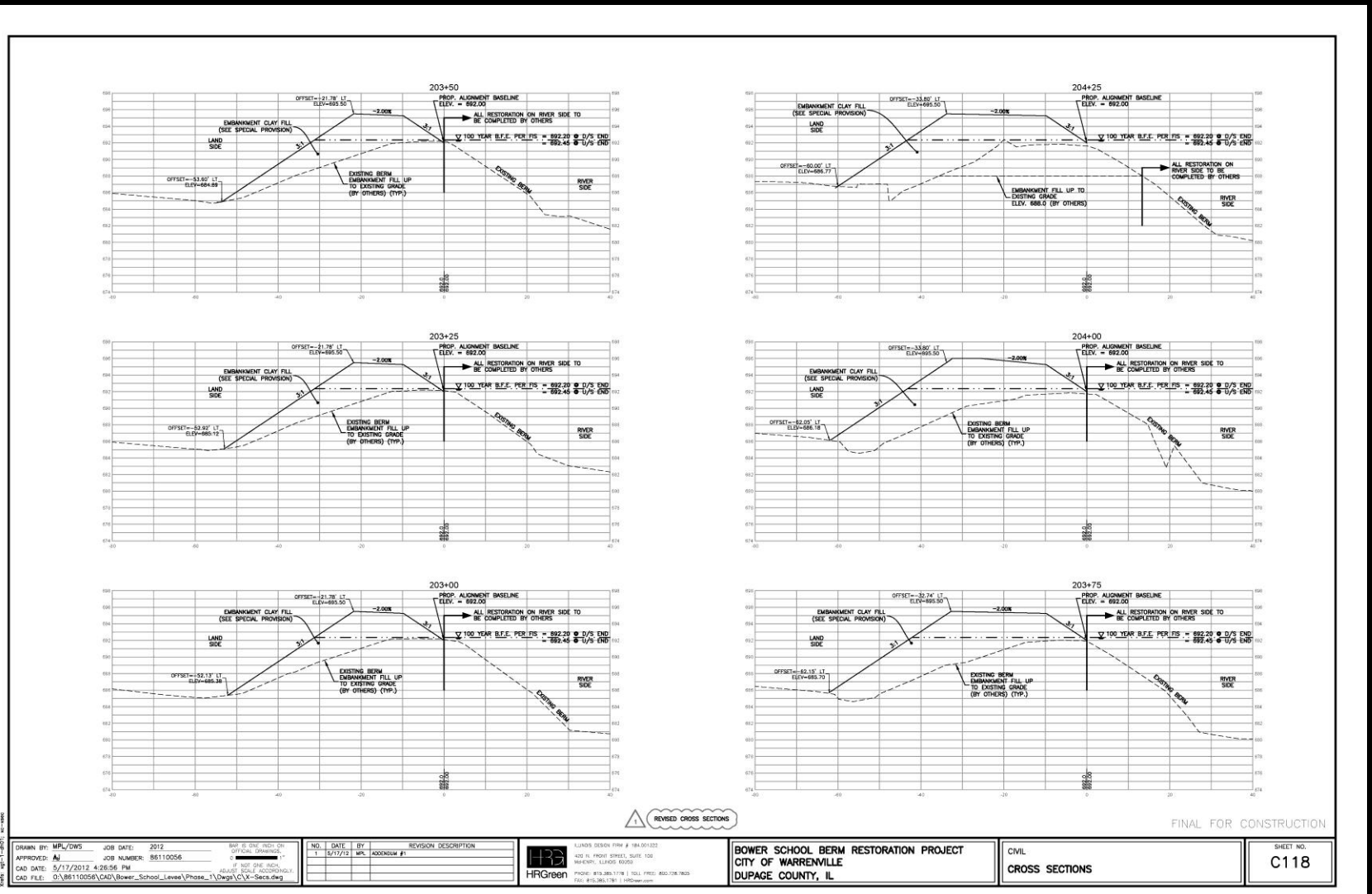
BOWER LEVEE



1 REVISED CROSS SECTIONS

FINAL FOR CONSTRUCTION

DRAWN BY: MPL/DWS JOB DATE: 2012
APPROVED: AJ JOB NUMBER: 86110056
CAD DATE: 5/17/2012 4:26:56 PM
CAD FILE: O:\86110056\CAD\Bower_School_Levee\Phase_1\Dwgs\C\X-Secs.dwg

BAR IS ONE INCH ON ORIGINAL DRAWINGS. IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION
1	5/17/12	MPL	ADDENDUM #1

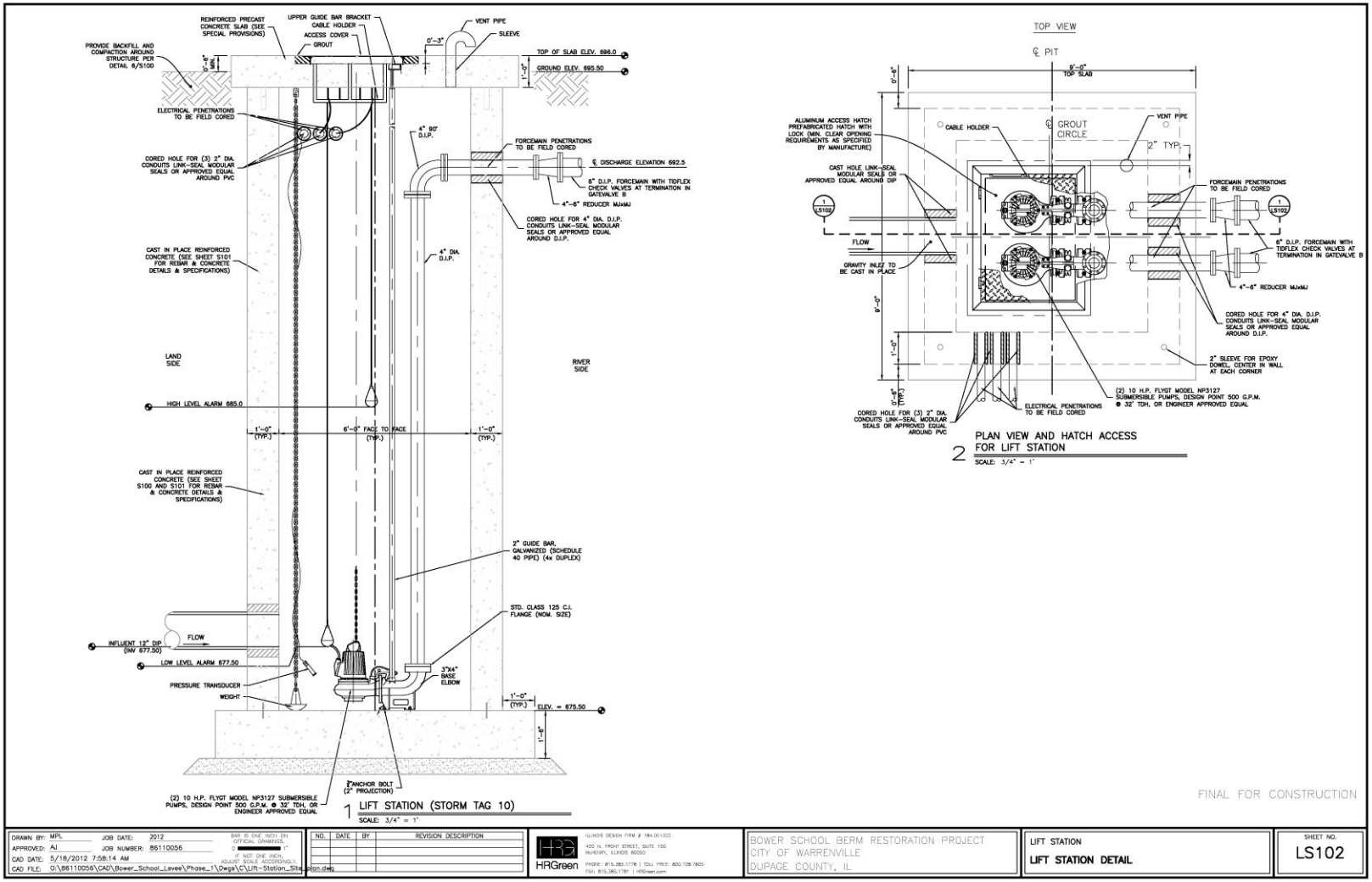
HRGreen
ILLINOIS DESIGN FIRM # 184.001.222
420 N. FRONT STREET, SUITE 100
MCHENRY, ILLINOIS 60050
PHONE: 815.385.1778 | TOLL FREE: 800.726.7825
FAX: 815.385.1781 | HRGreen.com

BOWER SCHOOL BERM RESTORATION PROJECT
CITY OF WARRENVILLE
DUPAGE COUNTY, IL

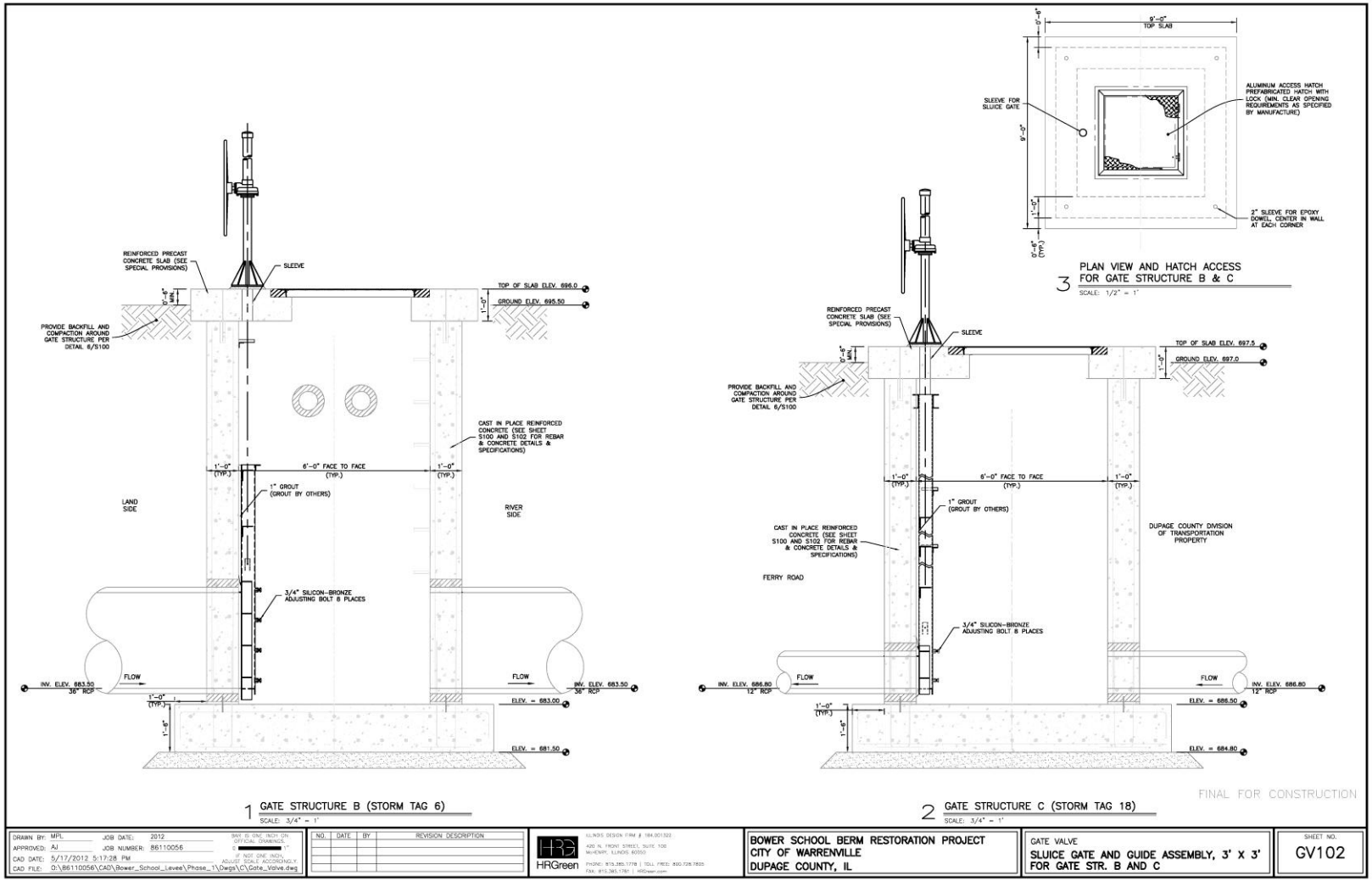
CIVIL
CROSS SECTIONS

SHEET NO.
C118

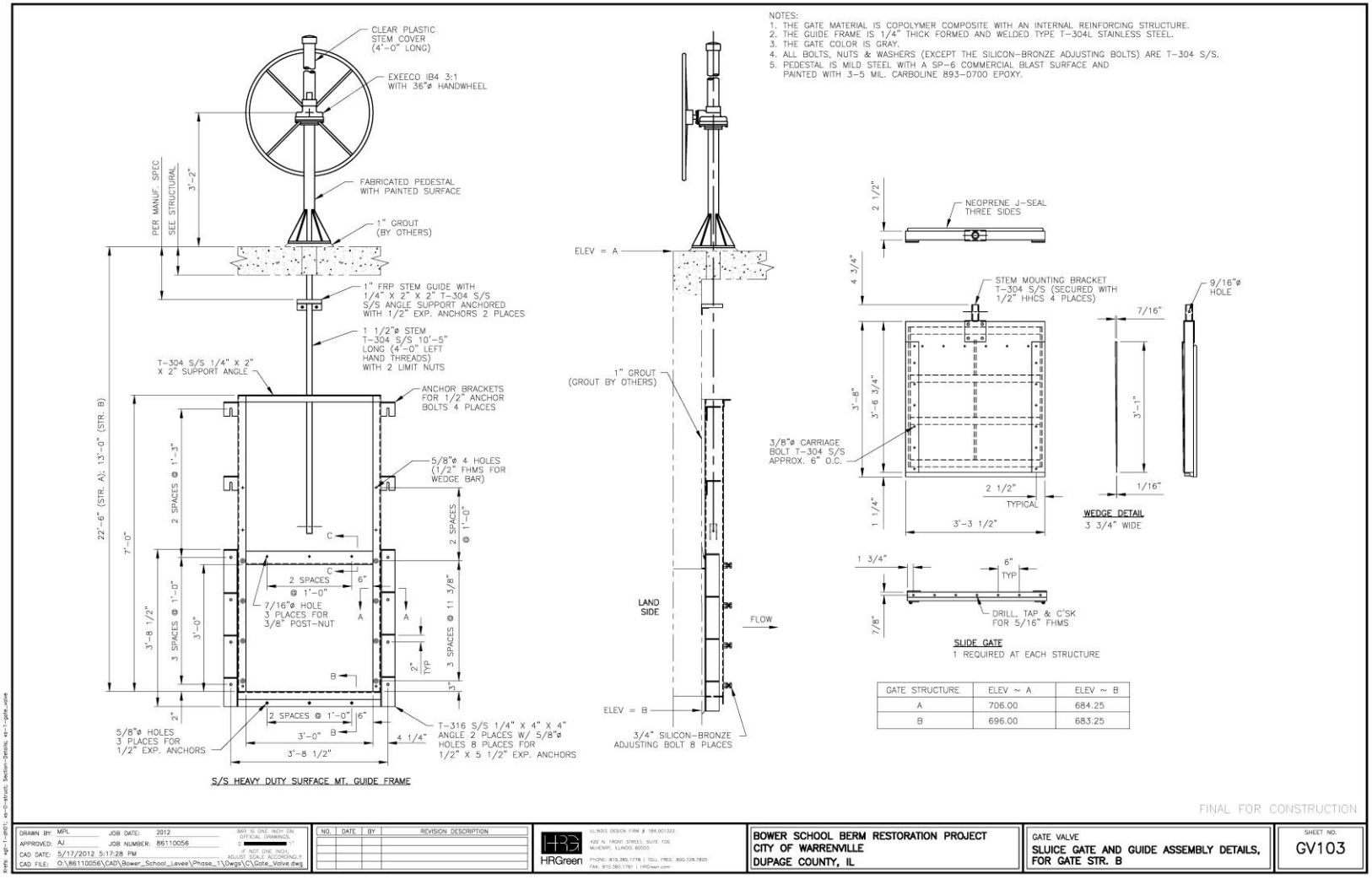
BOWER LEVEE LIFT STATION = 2 - 500 GPM PUMPS CAPACITY



BOWER LEVEE - CLOSURE GATE



BOWER LEVEE - CLOSURE GATE

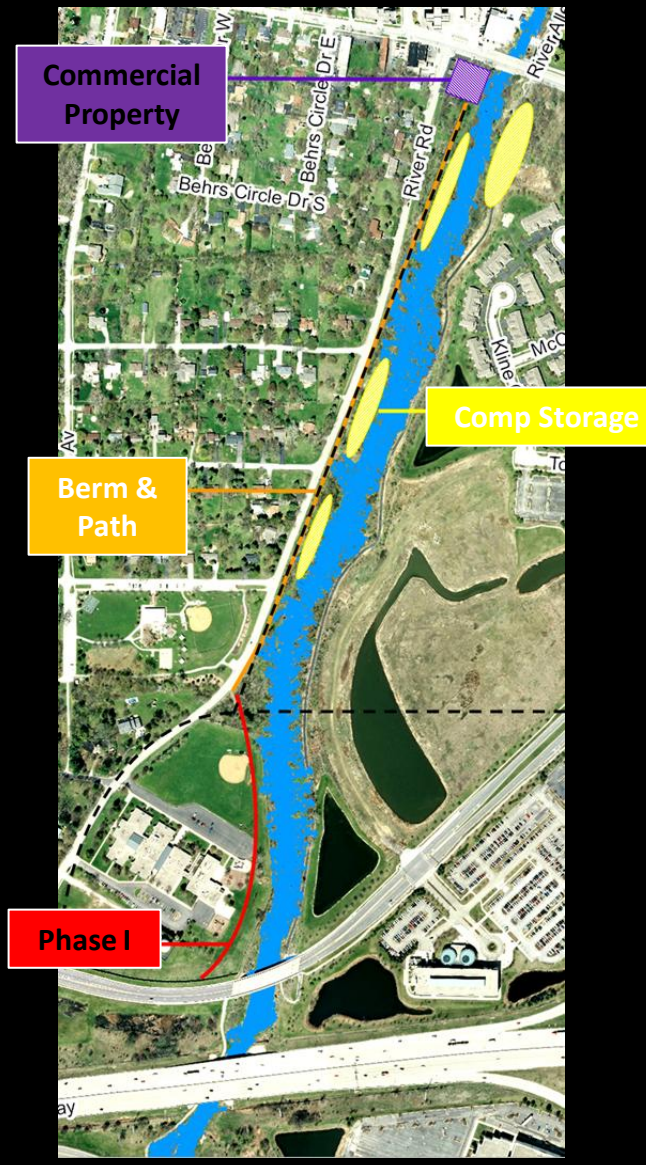


River Road

- Stakeholders
  - Residents
  - City of Warrenville
  - DuDOT
  - DuPage County

- Objective: Protect Business/Residents from Flooding

- Coordination
  - Cost Share (County, City)
  - Business and Residents for Property Impacts
  - DuDOT for Jurisdictional Transfer
  - County Consultant (ERA) for River Restoration One bid package (2 consultants!)



Commercial Property Improvements

[illegible] one of the construction pictures. [illegible] the construction of the berm, lime being mixed to the excavated and stockpiled contaminated material to dry it out before hauling.