Riverine Infrastructure Database – Data Guidelines

Contents:

1. General

The Riverine Infrastructure Database (RIDB) is a database of Iowa Department of Transportation facilities in the riverine environment. The database consists of location data in addition to hydrologic and hydraulic data so impacts to facilities during a flood event can be rapidly evaluated.

Data required at each site is outlined in the following sections.

Survey/data units shall be English / Survey Feet (US Feet).

GIS resource projection/units shall be NAD83/UTM15N, meters (EPSG:26915).

NBI refers to the National Bridge Inventory.

2. Site Identification Code / Site Location Mapping

A. Site Identification Code

The site identification code consists of two parts, the Stream ID and the River Mile.

Refer to Appendix A for the Stream ID codes.

The Stream ID code is intended to provide a short name, containing no spaces, for database indexing. The name should be appended with 'R' for named rivers and 'C' for named creeks (ex. WapsiR, BigC). For common stream names, the ID code should be appended with a shortened version of the county name where the mouth is located (ex. BigC_Henry, BigC_Mitch).

The RM at the mouth and the receiving stream ID code and RM are also required. For unnamed streams the Stream ID will be the receiving stream ID appended with the tag '_Trib##" where ## is the RM (w/o decimal) of the receiving stream (ex. OldMansC_Trib13, a unnamed stream at RM 12.7 of Old Mans Creek).

Refer to Appendix A for the River Mile reference used for a stream reach where available. The River Mile reference is taken from various sources. The primary reference should be USGS flood studies. For unmapped streams, Water Resources Investigations Report 03-4120, "Main Channel Slopes of Selected Streams in Iowa" can be used as a reference.

The primary consideration regarding the river mile assigned to a site is that the numbering/distance is continuous from the mouth of the stream. The length between sites, as determined from the River Mile, will be used to adjust flood peak timings. The River Mile should be carried to one decimal place.

The assignment of the River Mile will be made during the process of mapping the stream reach in GIS per the following section.

B. Site Location Mapping

Stream reaches and site locations will be mapped in GIS. The ESRI Shape File(s) for RIDB GIS mapping are at the following location:

W:\Highway\Bridge\PrelimSection\RiverineInfrastructureDB\gis

1) Stream Mapping –

The RIDB stream reach GIS feature is named RIDB_Stream and is a linear GIS feature. For stream reach mapping it is recommended that mapping begin from the mouth and continue upstream to aid in continuous River Mile assignment. The GIS element representing a stream reach should be broken into segments to avoid excessively long elements (>5 mi.). Breaks should generally be made at all State highways and at County roads as required to maintain desired segment lengths.

The RIDB_Stream feature has three data tags (attributes) as follows:

StreamID - Stream ID code per the above section (Text 50) (Ex. WapsiR, CedarC, etc.)

RM_From – Segment staring River Mile (double Fix 2) (Ex. 123.32)
Round River Mile to two decimal places.

RM_To - Segment ending River Mile (double Fix 2)

2) Site Mapping –

The RIDB GIS feature to be added for each site (roadway crossing or adjacent to a stream) is named RIDB_Site and is a linear GIS feature.

The RIDB_Site GIS feature should represent the extent of roadway addressed. For typical stream crossings the feature would extend across the entire floodplain. The feature should be drawn slightly downstream (50' +/-) of the roadway so as to not overlap other site feature mapping (structures, low road, see Section 4).

The RIDB_Site feature has five data tags (attributes) as follows:

StreamID - Stream ID code per the above section (Text 50) (Ex. WapsiR, CedarC, etc.)

RiverMile – River Mile per the above section (double Fix 2) (Ex. 123.3)
Round River Mile to one decimal place.

Route_Descript - Route name (Text 25) (Ex. IA 928)

STATEROUTE - Trans Data/GIMS route code (Text 4). For IA 928 value would be 0928. For US 30, 0030.

This record will provide common field with the Trans Data/GIMS database in the event queries are required along a given route. This code provides a unique identifier for each route. As a check select the route feature in GIS at the bridge site and check the value of the STATEROUT1 attribute.

STATUS – Site RIDB development status (Text 4). Refer to Sect. C below for code values.

C. Site STATUS Attribute

The STATUS attribute indicates the status of RIDB site development. The intent is to update the STATUS attribute as data compilation is performed at a site.

Attribute codes are as follows:

(Blank) – Site mapped. No development work completed.

C_ - RIDB dataset complete per RIDB Data Guidelines.

P_ - Partial dataset complete.

P_S_ - Partial dataset complete w/ survey.

P_R_ - Partial dataset complete w/ impact rating (see note below).

P_SR – Partial dataset complete w/ survey/impact rating.

The 'impact rating' code indicates that the flowrate at which the facility is impacted has been documented (Ex. flowrate where ETW inundation occurs). This code is used where the site rating curve is not complete, but the flowrate that the facility is impacted is known, generally obtained from flood observations.

3. General Site Data

General data required at each site is as follows:

A. Site Description

A descriptive name for the site. The description used in the maintenance records for the main channel bridge should generally be adequate. (ex. IA 928 over Cedar Creek, 0.5 Mi. W. of Wildwood). Where the maintenance file relates the location to another route (Ex. E of E Jct. Co Rd E48) we may want to come up with another description relative to a more locatable mapping feature (town, major route, etc.).

For sites that contain road overtop features only, develop a site description similar to bridge sites using 'near' in lieu of 'over' (ex. IA 928 Near Cedar Creek, 0.5 Mi. W. of Wildwood).

B. Datum correlation

All data in the Riverine Infrastructure database will be based on NAVD 88/IaRTN(2011) datum (RIDB Datum).

The correlation between RIDB datum to the following will be provided:

- NGVD 29 datum.
- Bridge design of record (original plan or last major reconstruction) for all NBI bridges included in the site. Not required for RCB/Culverts since surveyed obvert should provide adequate correlation.
- Iowa Statewide Lidar dataset for data near the site.

Refer to section 6 for datum correlation procedures.

C. Drainage Area

The drainage area at the site in square miles.

D. Lidar Tile List

List of Iowa Statewide Lidar tiles that encompass the site in text (.txt) format.

An ESRI shape file is available with the path and tile number necessary to access the tiles as stored by the Iowa DOT. The data can be found in the PATH attribute, example as follows:

\\ntdfs\(W)DataStor\RemoteSensing\LiDAR\State\Airborne\2012\NC09\LAS\03984766.las
\\ntdfs\(W)DataStor\RemoteSensing\LiDAR\State\Airborne\2012\NC10\LAS\03984768.las

E. Site Rating Location

This will generally be identical to the site identification code (Stream ID and the River Mile) and identifies where the site falls within the network. A few sites will require an adjustment to the River Mile and Stream ID. Refer to Sect. 5, Rating Curve/Hydrology.

4. Site Features

The site features are considered the primary waterway conveyances: bridges, large culverts and the low roadway inundation section. All open bottom (floorless) structures shall be included (bridgelets <20’ span) and larger culverts (see culvert section below for criteria).

Feature locations will be mapped in GIS (see section C below for guidelines).

A. Feature Data Requirements

Data required for each feature type is as follows:

1) Bridge –

NBI Structure (includes RCB and circular/arch culverts). A separate entry is required for each bridge, including dual bridges. The database requires a separate entry for each unique FHWA number for linking with external databases. In addition, at many dual facilities there are different structure types (steel, PPCB, etc) and low structure elevations between bridges. Data as follows:

Maintenance number

FHWA number

Conveyance location ~ Main channel, secondary channel, or overflow.

Low beam/slab/obvert elevation (refer to section 6 for addl.info.).

Rating curve ~ Rating curve (with offset if applicable) to be used.

Example: Main Channel, Main Channel +0.2’, N. Overflow -0.3’.

Structure description ~ Includes superstructure and substructure types. If the beams are steel it is critical to note this in the description.

Examples as follows:

62' x 30' PPCB, Conc. High Abutments
347' X 28' Steel And PPCB Beam, Frame Piers, Stub Abuts
1676' X 21' Steel Truss, Frame Piers, Stub Abuts.
53' X 30' Conc. Slab, Pile Bent Abuts Steel SP Backed
120' x 24' CCS, Pile Bent Pier, Timber Backed Pile Bent Abuts
TW 12’x12’x150’ RCB

2) Bridgelet –

Non-culvert structure, generally floorless or a non-integral floor. Similar to the data noted for a bridge above. If no FHWA/Maint. Number has been assigned develop unique numbers as noted in a following section.

For structure descriptions, the first number is the CL-CL bearing length, the second number is the face-face curb or barrier (bridge roadway) width. For structures not previously inventoried, length and width will have to be determined by measurement. The longest clear span (face-face abutment) can be used for length.

3) Culvert –

Larger culverts that appear to contribute to conveyance available to the stream. The intent is to identify larger culverts that could experience significant erosion which could threaten the traveled way. General size criteria for inclusion is as follows:

Single Culverts having a span >= 4 ft.

Multi-barrel Culverts (ex. RCB) having a combined span >= 4 ft.

Data required is as follows:

Maintenance number / FHWA number ~ If no FHWA/Maint. Number has been assigned, develop unique numbers as noted in a following section.

Conveyance location ~ Main channel, secondary channel, or overflow.

Obvert elevation (refer to section 6 for addl.info.).

Rating curve ~ See Bridge section above.

Structure description (Ex. TW 8' x 8'x80' RCB, 10' x 20'x75' CMPA, 48 in. RCP)

For RCB/Arch descriptions, the first number is an individual barrel width, the second is the barrel depth (neglecting 3" deep frost trough). Length (third number) is desirable but optional.

4) Low Roadway –

Roadway inundation location. Data required is as follows:

Maintenance number / FHWA number ~ Develop unique numbers as noted in a following section.

Location description ~ The location of the roadway inundation section relative to the major bridge features at the site. The intent is to provide the general location of the low road point. Examples as follows:

0.2 Mi. W. of main channel bridge
EB Ramp 0.35 Mi. E. of easternmost overflow bridge.

Low roadway Edge Travel Way (ETW) elevation ~ If the low ETW is on a ramp/auxiliary lane, the low ETW for the through lanes should be provided as a separate feature. Refer to section 6 for addl.info.

Rating curve ~ See Bridge section above.

B. Maintenance Number / FHWA Number Development

For structures (bridge, bridgelet, culvert) not in the NBI (non-NBI), and for road overtop locations, a maintenance number and Index similar to the FHWA number will have to be assigned.

1) Maintenance Number ~

Develop unique maintenance number similar to that used for NBI structures based on the distance from other NBI structures at the crossing. For discrete road overtop locations, estimate the milepost. Location codes and examples as follows:

Bridgelet / RCB -	9203.8B928	'B' for location code
Circ. Culvert -	9203.8C928	'C' for location code
Low Road -	9203.8-928	'-' for location code
Left/Right (Dual) -	'L' or 'R' following location code	
Bridgelet -	9203.8BL928	
Low Road	9203.8-L928	

2) Index/FHWA Number ~

For features in the NBI the FHWA number will be used for the Index number. For features not in the NBI a unique Index number based on the FHWA number from adjacent NBI structures will be developed. For discrete road overtop locations, use an adjacent NBI structure.

The number will be 8 digits, structures (bridge, bridgelet, culvert) starting with '8', low road starting with '9'. Start with the FHWA number, increment the second digit by one for each structure/low road feature.

Example assuming the main channel bridge has an FHWA of 59321:

80059321	Bridgelet
81059321	Culvert
90059321	Low road

The intent is to develop a unique Index number for each feature. The above procedure should generally ensure a unique number assignment.

C. Feature Location Mapping -

Site feature locations will be mapped in GIS. The Riverine Infrastructure Database GIS feature to be added is RIDB_Structure for each bridge/bridgelet/culvert and RIDB_LowRoad for low road locations. These are linear GIS features. The two data tags (attributes) for these features are as follows:

FHWANo – Index/FHWA No. (Long Integer) (Ex. 9059321)

MaintNo – Maintenance Number (Text 11) (Ex. 9203.8-L928)

Mapping guidelines are as follows:

RIDB_Structure – Approximate structure length based on aerial photographs.

RIDB_LowRoad – Approximate low road section to 1 ft. above low point elevation.

5. Rating Curve / Hydrology

A. Hydrology

A frequency/discharge relationship should be developed. Return periods should generally include the 2, 5, 10, 25, 50, 100 and 500 year events.

The procedure used to develop the hydrology should be similar in quality to that used for development projects as outlined in Sect. 3.2.2.1 of the Preliminary Design Guidelines. The intent is to develop a best estimate of the frequency/discharge relationship using current methodology. NFIP FIS frequency/discharge relationships should only be used if the relationship appears valid based on current methodologies (gage data, USGS regression equations, etc.).

Adequate documentation of the methodology used should be provided.

B. Rating Curve

A stage/discharge relationship will need to be developed for each Bridge/Bridgelet/Road Overtop feature at a site.

Generally, a single rating curve can be applied to all site features. At more complex sites an elevation offset from the ‘base’ curve, for example the main channel curve, will probably be adequate. Only at the most complex sites will multiple independent rating curves be required.

The roadway overtopping feature may require an offset from the ‘base’ curve to account for roadway overtop being a function of energy grade. In lieu of a more detailed analysis a kinetic energy coefficient (velocity head weighting coefficient) (alpha) of 2.2 should be adequate to estimate the velocity head (kinetic energy).

The rating curve should generally encompass the 5 yr. to 500 yr. events. The upper limit of the curve can be reduced somewhat if extension to the more extreme events is not practical. For example, at a location where discharges exceeding the 100 yr. event overtop major levees, a curve carried up the levee overtop discharge should be adequate, with the overtop stage used for less frequent events.

Generally, development of a valley rating curve from Lidar data, calibrated using historic flood data or FIS profile data, should be adequate. Where there is a detailed FIS of adequate extent and accuracy, development of a rating curve from the FIS data should be adequate.

C. Site Rating Location / Complex Sites

For complex sites at stream junctions it may be necessary to use a rating curve based on the total flow downstream of the junction (Appendix B - Site Example - Sht 3.pdf). The Site Rating Location indicates the network location to be used with the site rating curve(s) to determine the water surface.

For the Louisa IA 92 example, the Site Rating Location for the IA 70 site would be set to a River Mile downstream of the river junction river mile (the receiving stream RM entry for the Cedar River in Appendix A).

In the event there was a crossing of the Cedar River just upstream of the junction, the Site Rating Location for this crossing site would be set to IowaR and to a River Mile downstream of the river junction river mile. The combined flow downstream of the junction would be used to develop the rating curve.

In these cases two frequency/discharge relationships will be required, one downstream and one upstream of the stream junction. The return period estimate at the site will use the frequency-discharge relationship upstream of the junction.

When a Site Rating Location that differs from the Site Identification Code is used, a note documenting the reason should be placed in the comments.

D. Secondary Controls / Complex Sites

For sites where impact to the facility is controlled by a terrain feature (generally a dike, levee or side road) the control will be documented as a secondary control. Secondary controls are associated with a given RIDB site.

When a secondary control is utilized it should be noted in the site summary and documented as required. The Site Rating Location per 5.D should represent the network location of the control when required.

An example of a site with a secondary control is the I-35 Skunk River crossing. The main channel bridges and north low road impact elevations are relative to the open channel stage-discharge relationship. The south low road, however, is inundated when a levee is overtopped, with the low road elevation being lower than the top of levee. Therefore, the levee will be documented as a secondary control for the south low road. The rating curve and impact elevation are relative to the levee for the south low road feature.

The secondary control will be mapped similar to the SITE feature. The RIDB GIS feature to be added for each secondary control is named RIDB_Control and is a linear GIS feature. The RIDB_Control GIS feature should represent the extent of the control.

The RIDB_Control feature has three data tags (attributes) as follows:

StreamID - Stream ID code per the above section (Text 50) (Ex. WapsiR, CedarC, etc.)

RiverMile – River Mile per the above section (double Fix 2) (Ex. 123.3)
Round River Mile to one decimal place.

ControlNam – Description of the control (Text 25) (Ex. 210TH_ST, South_Levee)

E. Hydrology / Rating Documentation

The frequency/discharge and discharge/stage relationships shall be digitized in comma delimited text format (.csv) to facilitate data entry as follows. The first line is a comment preceded by a semi-colon ';'.

;F,Q	;Q,H, MainCh
2, 2000;	2000, 1171.4;
5, 4000;	4000, 1171.4;
10, 6000;	6000, 1171.4;
. . .	. . .

Documentation of hydraulic and hydrologic calculations should be provided. If a model (Bridge Backwater, HEC-RAS, etc.) is developed a copy of the model should be provided.

6. Survey Requirements

A. General Requirements

'GPS' in the following paragraphs refers to data collected in the field using the Iowa Real Time Network (IaRTN).

XY data will be exported/provided in Iowa State Plane North or Iowa State Plane South projection, US Feet (EPSG: 102675, EPSG: 102676). Vertical data will be exported in US Feet.

Refer to Appendix C for examples of survey observation points and submittal formats addressed in the following sections.

For non-redundant GPS observations multiple observations will be made and averaged to determine the elevations. Non-redundant observations are those made on structures, culverts, reference points, low road, etc. GPS observations for Lidar bias correction and ground (surface topography) are considered redundant since multiple observations are being made.

IA DOT Bridge Office policy for non-redundant GPS observations is to make a minimum of three (3) observations, one after the other (same setup). In the event of an outlier GPS return, the outlier is discarded and additional observations made.

Independent observations are considered separate GPS observations/setups.

In the event a GPS fixed observation cannot be acquired on a particular feature alternate survey methods that meet the XYZ observation precision obtained by GPS using the IaRTN shall be substituted. In this event an independent GPS observation shall be used for each elevation observation as the elevation reference. If multiple observations are required, a minimum of two independent GPS observations would be adequate for RCB/culvert features, three minimum for bridge features. See Commentary below. Alternately an elevation Reference Point (benchmark) established per Sect. 6.B.4 can be used.

Commentary: Due to variability in the IaRTN for elevations, observations that cannot be readily proofed in the office (non-redundant) it is desired to have independent observations. When a desired observation cannot be acquired by GPS, making a GPS observation and transposing the elevation (level, etc.) satisfies the requirement for independent observations.

If there are multiple obscured locations for a feature using two or three independent GPS observations for elevation reference should provide adequate redundancy. Where three are required (bridges) it is assumed that the GPS observations would be correlated (level loop, etc.) or distributed (one GPS observation for each observation).

The primary consideration is that each end of a bridge, RCB or large culvert use at least two independent GPS observations for elevation reference. For example, for an RCB, two GPS points are established on shoulder. One GPS point is used for the back station parapet shot, the other GPS point used for the ahead station parapet shot. Each end of the culvert is therefore based on two independent GPS derived elevations.

B. Vertical Datum Correlation

All data in the Riverine Infrastructure database will be based on NAVD 88/IaRTN(2011) datum (RIDB Datum). IaRTN(2011) refers to orthographic heights determined using the Iowa Real Time Network (IaRTN) using the NAD83(2011) datum, Geoid12A.

USGS/COE flood studies and FIS's are generally based on NGVD 29 datum. Past roadway/bridge projects were based on a variety of datums.

Recommended procedures to correlate to RIDB Datum are as follows.

1) USGS / COE Flood Studies / FIS -

Unless the study establishes a benchmark at or near the site that can be observed, use the CORPSCON program to establish the relationship between the study datum (NGVD 29) and RIDB datum at the project site.

2) Bridge Design Plan (NBI Bridges) -

For datum correlation observe points on the bridge where the original plan elevation can be determined and where it is reasonably certain that the vertical location is unchanged from the design plan. The recommended survey points outlined in Sect. 6.C.1. should provide adequate observations for correlation at most bridges. If face of barrier/curb gutter line observations are made, the maintenance record should be reviewed for a deck overlay since construction. If an overlay has been performed, assuming an overlay depth of 1.5 inch has yielded acceptable correlation results.

It is recommended that a minimum of three independent observations be used to establish the datum correlation. Plans for all NBI bridges, along with maintenance records, are available in the Structure Inventory and Inspection Management System (SIIMS).

Note: Per Sect. 3.B. datum correlation to bridge design of record is only required for bridges in the NBI. This will capture all of the major bridges where datum correlation is most useful (pier foundation elevations, etc.).

3) Lidar Data Bias Correction -

The statewide Lidar data is based on NAVD 88 datum. It has been found that in addition to the random error between individual Lidar returns, the entire dataset (tile) at a given location may have a systematic error (bias) of up to 0.7 ft. from NAVD 88 datum. In order to normalize the Lidar data at the site to the RIDB datum a bias correction will be required.

The bias may vary somewhat from tile to tile depending on the flight used to generate the tile(s) in question. Since the primary area of interest is near the crossing site, the bias correction for the Lidar dataset should address the tiles in this area.

The recommended procedure is as follows:

- Observe XYZ for 20+ points divided between at least two (2) discrete locations if possible. These points should be on a planar surface of at least 8’ x 8’ extent to ensure an adequate number of Lidar returns within the planar surface (~3.3’ return spacing). The preferable location is on pavement near the middle of a lane. The possibility of recent overlays (since the Lidar flight) should be considered. Observations on a bridge deck can also be used as noted below. For high volume roadways, consider using nearby paved local roadways if available.
- Compare the elevations from observations to the elevation obtained from a .tin file developed from the Lidar dataset. An unfiltered dataset (all returns) in the area of the observations is recommended. When a bridge deck is observed unclassified (not ground) returns in a Lidar dataset will have to be used. Returns off of bridge decks will be of value in the future since there are good records of when deck overlays occur.
- Based on the above comparison, determine the Lidar bias correction to the nearest 0.1 ft.

4) Reference Point Establishment -

For each site a minimum of two reference points shall be established using GPS. The intent is to provide at least two locations where observations can be taken in the future for datum comparison.

The RIDB project standard for establishing a reference point is a minimum of five (5) GPS observations (non-redundant per Sect. 6). Observations shall be separated by at least an hour, with the population distributed between AM and PM. Observations on different days is acceptable as long as the distribution between AM and PM and time of day is maintained (time of day for all observations at least an hour apart).

Reference point location preference should be DOT buttons (or equal) on the barrier rail wings for modern bridges (State or County) and RCB parapets. If the crossing structures at the site are relatively old, preference would be to seek out newer structures in the vicinity of the site.

C. Structure / Roadway Survey

1) Bridge / Box Culverts -

A minimum of four XYZ observations will be made to establish the XY location of the bridge/culvert and elevation component for datum correlation. For curved bridges, observations should also be made approx. in line with center line of each pier (or at mid-span for a single span bridge).

For newer bridges (having modern barrier rail) deck observations at the face of barrier, in line with the joint or end of deck, should be adequate. For older bridges with curb and retrofit rail, observations on top of the original curb at the facia/end of deck intersection should be adequate.

Low bridge beam/slab elevation at two locations should be determined by survey observation, independent of the deck observations, approximate location on structure should be noted. One observation should be should be the low beam/slab for the structure, the other is made for redundancy. These will generally be at the end of the bridge unless the bridge is located in a sag vertical alignment.

For Box Culverts XYZ observations at the parapet facia/edge barrel intersection should be adequate to establish the RCB location. The obvert elevation at each end of the RCB should be determined (neglecting chamfer). Measurement down from the top of parapet observations would be adequate.

2) Bridgelets / Box Culverts Non-NBI -

In addition to observations per Sect. 6.C.1. above, for bridgelets and box culverts not included in the NBI the flow line elevation on both sides of the structure should be determined. Measurement/offset from deck/parapet observations would be adequate. If the flow line is silted, silted thalweg is what should be recorded.

For bridgelets the waterway opening width should be recorded. For structures with pile cap abutments the face cap-cap and face pile-pile width should be recorded. For non-NBI structures RCB depth will have to be determined by measurement.

Note: The width of non-NBI box culverts is documented by the XY observations and description (ie. TW 10 x 4 RCB).

Note 2: For structures in the NBI a comprehensive record of depth relative to the deck in addition to other dimensions is maintained, therefore flow line/width measurements for NBI structures are not required.

3) Circular / Arch Culverts

Centerline top of culvert XYZ at both ends will be established. Obvert and flow line elevation at both ends will be determined, measurement/offset from top observation would be adequate. If the flow line is silted, silted thalweg should be recorded.

For non-NBI structures culvert width and depth will have to be determined by measurement. Survey will be made for all cross road and median culverts at the site.

For larger culverts per Sect. 4.A.3 (Clear Span >= 4 ft.) two independent observations will be required at each end.

Note: While only the larger culverts will be included in the RIDB, smaller (median) culverts have presented problems during flood events, so information on these culverts will be collected.

4) Low Roadway Elevation –

Observation of the low road point (XYZ) should be made to determine the Edge of Travel Way (ETW) elevation. The Lidar data can be used to establish the approximate location of the low roadway.

In the event of heavily travelled roadways the bias corrected Lidar data can be used to establish low road elevation. In this case a minimum of three observations will be made in the vicinity of the low point (paved shoulder, etc.) in order to verify the roadway has not been overlaid since the Lidar data was collected. If overlaid, these observations can be used to adjust elevations from the Lidar dataset as required.

D. Survey Submittal Format

Separate data sets will be submitted for each RIDB site. In the event of concurrent sites (inundation from two separate streams or two sites on a stream in relatively close proximity) a single data set can be submitted with appropriate notation.

A survey data set will consist of:

1) A survey description text file (.pdf format preferred) describing the survey location and units/projection. The file will also include a listing of the Reference Points and datum correlations (NAVD29, Lidar, Designs, etc.) established.

   The intent is to provide a quick reference for future survey use (reference points, datum correlation).

2) A text file with survey observations similar to Geopak format, comma delimited (PXYZF/C) with a '/' to delimit the beginning of the comment field following the feature code.

   ```
   1030,4890740.648,3782886.981,1179.687,BRG/TP-DECK  WL - 17.6 FT
   1048,4889635.151,3771342.092,1175.318,BRG/TP-DK AT GL, BACK ABUT
   ```

   Survey observations will include an adequate comment to describe the observation as required. When the observation elevation is used to derive multiple elevations (obvert, etc.) the measured value should generally be noted in the comment for audit purposes (ex. /TP-END 48IN RCP, OBV - 0.2 FT, SILTED FL - 3.0 FT).

3) A Microstation file containing plotted locations of survey observations. This CAD file should also include a simple representation of the features surveyed (rectangles/shapes).

   The CAD file should also note any derived elevations (obvert, low beam, etc.) and any measured horizontal dimensions (widths, etc.).

7. Submittal Format

Information will be submitted in electronic format (shape files, CAD files, .txt etc.). Items to be submitted as follows:

a) Survey data per Sect. 6.D.

b) Hydrology/rating data per Sect. 5.D.

c) Lidar tile list per Sect. 3.D.

d) A site summary sheet(s) (.txt) containing the following information:

- Site ID Code, Description, Drainage Area and Rating Location per Sect. 3.
- For each Site Feature to be included in the RIDB (bridge, RCB, low road, etc.), per Sect. 4.A.:

  Maint. No., FHWA/Index No., Structure/Location Description, Conveyance Location.

  Low Beam/Slab/Obvert/ETW elevation.

  Rating curve reference, curve offset.

8. Electronic File Location

Since a Riverine Infrastructure Database site is a collection of a number of features (NBI structures, bridgelets, low road) a separate folder for each site will be used to store the information generated. The site folder name will be the Site Identification Code. The location and an example name is as follows:

W:\Highway\Bridge\PrelimSection\RiverineInfrastructureDB\sites\UprIowaR_18.3

For each of the RIDB site features that are in the NBI (bridges) a folder under the

W:\Highway\Bridge\PrelimSection\Sites\

folder will be created (if not already present) and an empty text file noting the RIBD Site as the file name placed in the folder (Ex. "See_RIDB_UprIowaR_18.3").

Where the supporting data is located (PrelimSection\Sites or PrelimSection\ RiverineInfrastructureDB\Sites) is not critical as long as pointers (named text files) are provided for correlation. For large sites were the analysis addresses many features the RiverineInfrastructureDB\Sites folder is preferable.

Appendices:

Appendix A – Stream ID Codes (Database)

Appendix B – Example Riverine Infrastructure Database Sites

Sht. 1 – Allamakee IA 76 Over Upper Iowa River

Sht. 2 – Linn US 30 Over Cedar River

Sht. 3 – Louisa IA 92 Over Iowa River

Appendix C – Structure Survey Examples

Revisions:

5/27/10 – Initial Document

5/04/14 – Major revisions, expanded survey requirements.

5/15/15 – Update Stream ID Code guidelines.

1/25/16 – Editorial changes, rev. Sect. 8 Electronic File Location

3/01/17 – Add section stream mapping (2.B); Add STATUS attribute to SITE feature, remove HUC attribute (2.B, 2.C); Insert section secondary controls (5.D).

Appendix A

Stream ID Codes

(Refer To Database)

Appendix B

Example Riverine Infrastructure Database Sites

COMMENTARY:

SITE FEATURES (BRIDGES, RCB'S, LOW ROAD) ARE INDEPENDENT OF RIDB SITES.

IN THIS EXAMPLE, IF THE LOCAL ROAD WERE LOWER, THE BRIDGE AND LOW ROAD FEATURES WOULD BE COMMON TO BOTH THE UPPER IOWA RIVER AND BEAR CREEK RIDB SITES.

SEPARATE RATING CURVES WOULD BE ASSIGNED TO EACH FEATURE BASED ON THE RIDB SITE. AS FLOWRATES INCREASE, THE RATING CURVES FOR THE SEPARATE STREAMS SHOULD APPROACH EACH OTHER. FOR LOWER FLOW RATES THERE WOULD BE SOME DIVERGENCE BASED ON THE AMOUNT OF FLOW ACCROSS THE ROAD DIVIDE.

NOTES:

(A) SINCE EMBANKMENT PROVIDES A SEPARATION BETWEEN THE BASINS FOR THE CRITICAL EVENT, THE TWO STREAM CROSSINGS ARE TREATED AS SEPARATE SITES.

(B) IF THE EMBANKMENT DID NOT EXIST OR WAS LOW ENOUGH TO OFFLOAD SIGNIFICANT FLOW FROM THE UPPER IOWA RIVER TO BEAR CREEK, THE UPPER IOWA SITE WOULD INCLUDE THE BEAR CREEK BRIDGE AND ROADGRADE.

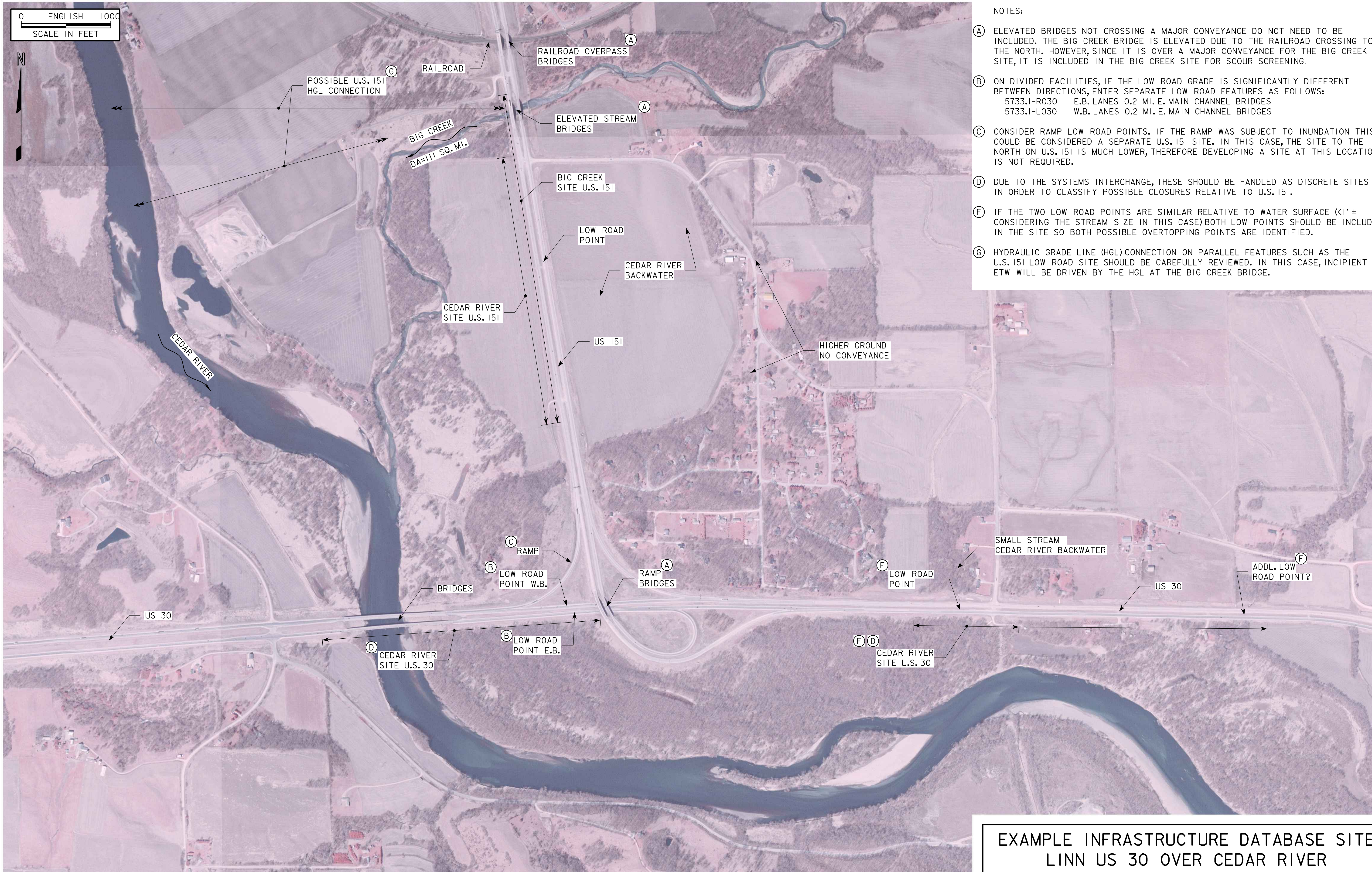
IF THE BEAR CREEK FLOWRATE FOR THE EXTREME EVENT IS LARGE ENOUGH TO RESULT IN SIGNIFICANT FLOW THROUGH THE UPPER IOWA RIVER BRIDGE, THE BEAR CREEK SITE WOULD INCLUDE THE UPPER IOWA BRIDGE.

(C) COMMON LOW ROAD POINT FOR BOTH SITES. IF THE LOCAL ROAD EMBANKMENT WERE HIGHER THAN IA 76, THE BEAR CREEK SITE WOULD HAVE A SEPARATE LOW ROAD POINT.

(D) POSSIBLE ADDITIONAL SITE ALONG BEAR CREEK. SINCE THE ROADWAY BETWEEN THE BRIDGE CROSSING AND THIS SITE IS RELATIVELY HIGH AND THE SITE IS 1/2 MI. UPSTREAM, WE WOULD PROBABLY DEVELOP A SEPARATE SITE FOR THIS LOCATION IN THE EVENT ROAD INUNDATION WAS POSSIBLE FOR THE EXTREME EVENT. THE RATING CURVE AND HYDROLOGY DEVELOPED FOR THE BRIDGE CROSSING WOULD BE APPLICABLE, WITH SLIGHT MODIFICATION, FOR THIS SITE.

EXAMPLE INFRASTRUCTURE DATABASE SITE
ALLAMAKEE IA 76 OVER UPPER IOWA RIVER

DESIGN TEAM | RIVERINE INFRASTRUCTURE DATABASE | SHEET NUMBER 1 OF 3



NOTES:

(A) ELEVATED BRIDGES NOT CROSSING A MAJOR CONVEYANCE DO NOT NEED TO BE INCLUDED. THE BIG CREEK BRIDGE IS ELEVATED DUE TO THE RAILROAD CROSSING TO THE NORTH. HOWEVER, SINCE IT IS OVER A MAJOR CONVEYANCE FOR THE BIG CREEK SITE, IT IS INCLUDED IN THE BIG CREEK SITE FOR SCOUR SCREENING.

(B) ON DIVIDED FACILITIES, IF THE LOW ROAD GRADE IS SIGNIFICANTLY DIFFERENT BETWEEN DIRECTIONS, ENTER SEPARATE LOW ROAD FEATURES AS FOLLOWS:
5733.1-R030 E.B. LANES 0.2 MI. E. MAIN CHANNEL BRIDGES
5733.1-L030 W.B. LANES 0.2 MI. E. MAIN CHANNEL BRIDGES

(C) CONSIDER RAMP LOW ROAD POINTS. IF THE RAMP WAS SUBJECT TO INUNDATION THIS COULD BE CONSIDERED A SEPARATE U.S. 151 SITE. IN THIS CASE, THE SITE TO THE NORTH ON U.S. 151 IS MUCH LOWER, THEREFORE DEVELOPING A SITE AT THIS LOCATION IS NOT REQUIRED.

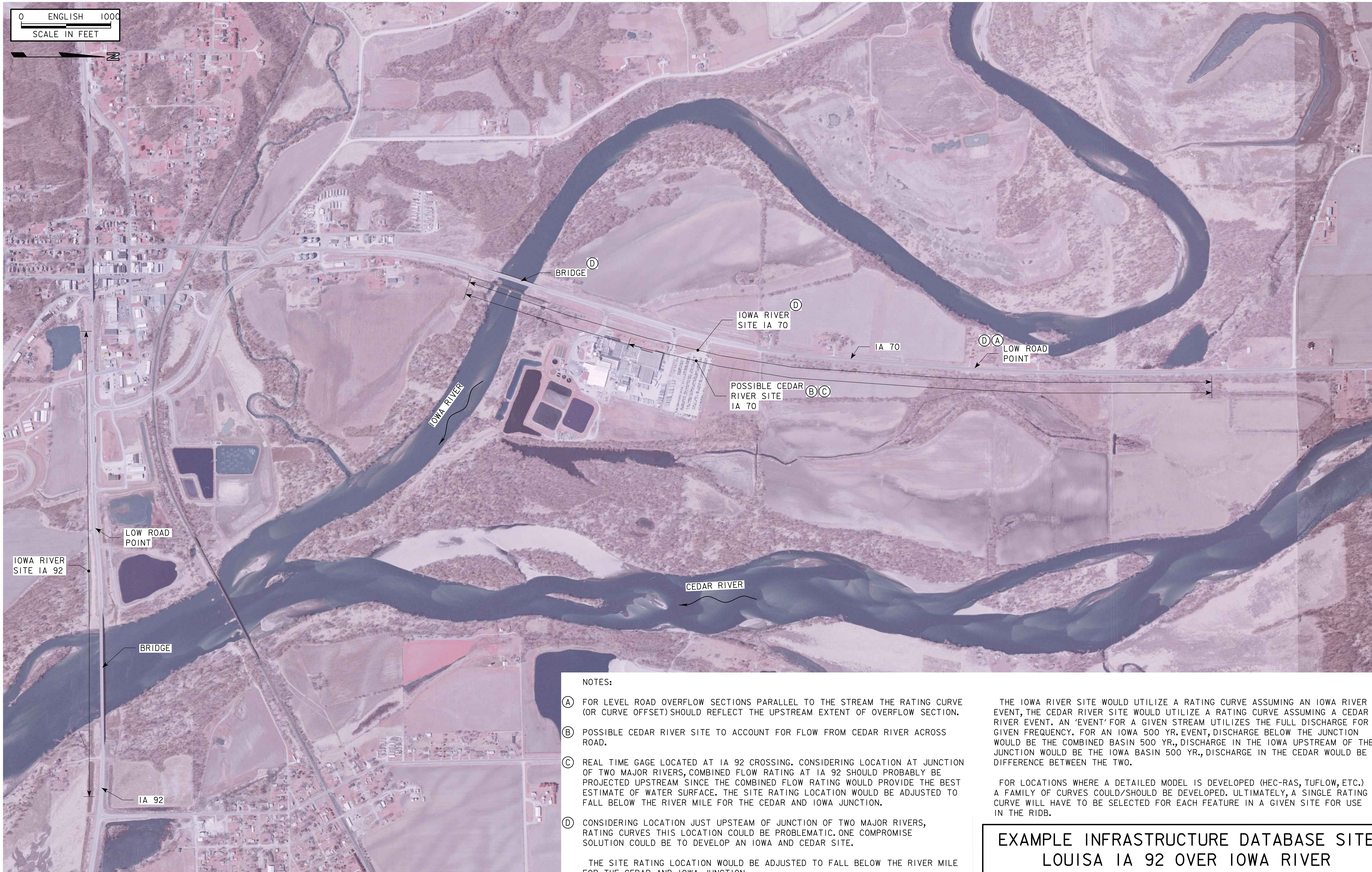
(D) DUE TO THE SYSTEMS INTERCHANGE, THESE SHOULD BE HANDLED AS DISCRETE SITES IN ORDER TO CLASSIFY POSSIBLE CLOSURES RELATIVE TO U.S. 151.

(F) IF THE TWO LOW ROAD POINTS ARE SIMILAR RELATIVE TO WATER SURFACE (<1' ± CONSIDERING THE STREAM SIZE IN THIS CASE) BOTH LOW POINTS SHOULD BE INCLUDED IN THE SITE SO BOTH POSSIBLE OVERTOPPING POINTS ARE IDENTIFIED.

(G) HYDRAULIC GRADE LINE (HGL) CONNECTION ON PARALLEL FEATURES SUCH AS THE U.S. 151 LOW ROAD SITE SHOULD BE CAREFULLY REVIEWED. IN THIS CASE, INCIPIENT ETW WILL BE DRIVEN BY THE HGL AT THE BIG CREEK BRIDGE.

EXAMPLE INFRASTRUCTURE DATABASE SITE
LINN US 30 OVER CEDAR RIVER

DESIGN TEAM	RIVERINE INFRASTRUCTURE DATABASE	SHEET NUMBER 2 OF 3



NOTES:

(A) FOR LEVEL ROAD OVERFLOW SECTIONS PARALLEL TO THE STREAM THE RATING CURVE (OR CURVE OFFSET) SHOULD REFLECT THE UPSTREAM EXTENT OF OVERFLOW SECTION.

(B) POSSIBLE CEDAR RIVER SITE TO ACCOUNT FOR FLOW FROM CEDAR RIVER ACROSS ROAD.

(C) REAL TIME GAGE LOCATED AT IA 92 CROSSING. CONSIDERING LOCATION AT JUNCTION OF TWO MAJOR RIVERS, COMBINED FLOW RATING AT IA 92 SHOULD PROBABLY BE PROJECTED UPSTREAM SINCE THE COMBINED FLOW RATING WOULD PROVIDE THE BEST ESTIMATE OF WATER SURFACE. THE SITE RATING LOCATION WOULD BE ADJUSTED TO FALL BELOW THE RIVER MILE FOR THE CEDAR AND IOWA JUNCTION.

(D) CONSIDERING LOCATION JUST UPSTEAM OF JUNCTION OF TWO MAJOR RIVERS, RATING CURVES THIS LOCATION COULD BE PROBLEMATIC. ONE COMPROMISE SOLUTION COULD BE TO DEVELOP AN IOWA AND CEDAR SITE.

THE SITE RATING LOCATION WOULD BE ADJUSTED TO FALL BELOW THE RIVER MILE FOR THE CEDAR AND IOWA JUNCTION

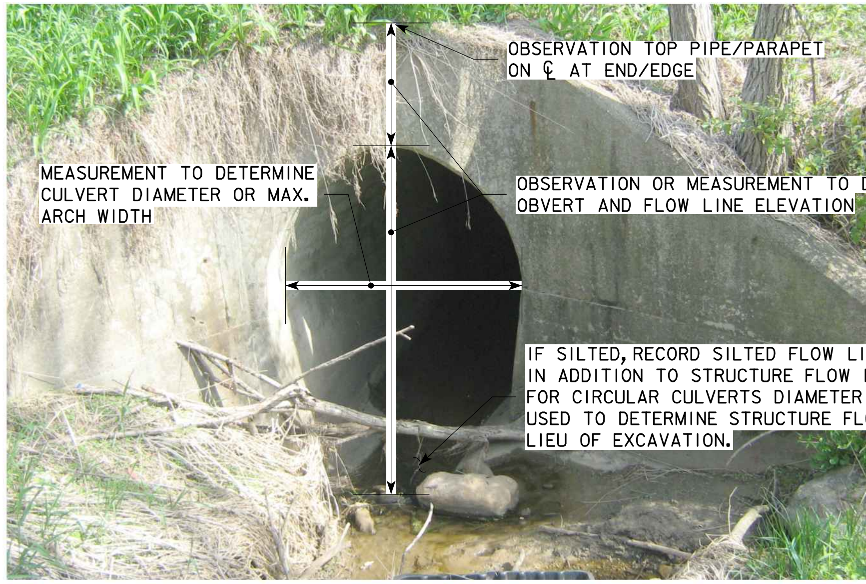
THE IOWA RIVER SITE WOULD UTILIZE A RATING CURVE ASSUMING AN IOWA RIVER EVENT, THE CEDAR RIVER SITE WOULD UTILIZE A RATING CURVE ASSUMING A CEDAR RIVER EVENT. AN 'EVENT' FOR A GIVEN STREAM UTILIZES THE FULL DISCHARGE FOR A GIVEN FREQUENCY. FOR AN IOWA 500 YR. EVENT, DISCHARGE BELOW THE JUNCTION WOULD BE THE COMBINED BASIN 500 YR., DISCHARGE IN THE IOWA UPSTREAM OF THE JUNCTION WOULD BE THE IOWA BASIN 500 YR., DISCHARGE IN THE CEDAR WOULD BE THE DIFFERENCE BETWEEN THE TWO.

FOR LOCATIONS WHERE A DETAILED MODEL IS DEVELOPED (HEC-RAS, TUFLOW, ETC.) A FAMILY OF CURVES COULD/SHOULD BE DEVELOPED. ULTIMATELY, A SINGLE RATING CURVE WILL HAVE TO BE SELECTED FOR EACH FEATURE IN A GIVEN SITE FOR USE IN THE RIDB.

EXAMPLE INFRASTRUCTURE DATABASE SITE
LOUISA IA 92 OVER IOWA RIVER

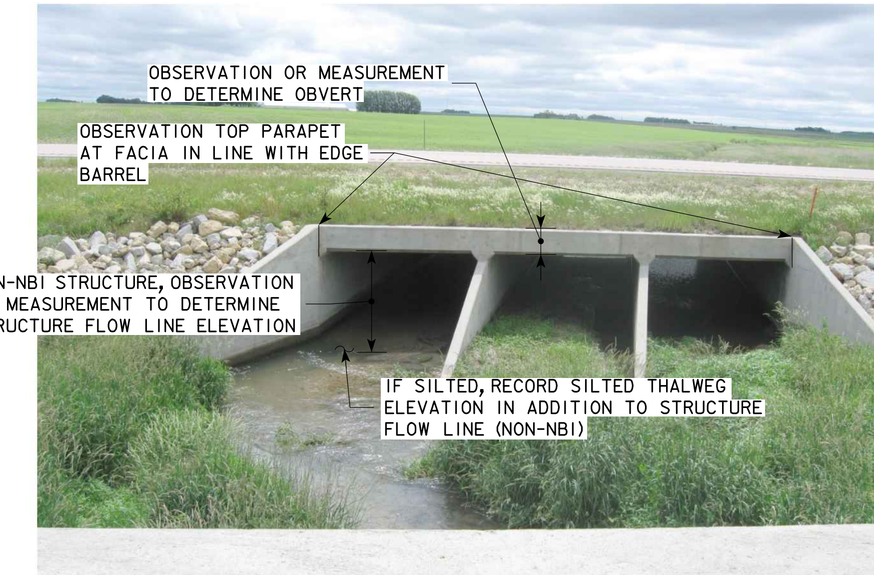
Appendix C

Structure Survey Examples



CIRCULAR / ARCH CULVERTS

SINGLE BOX CULVERT



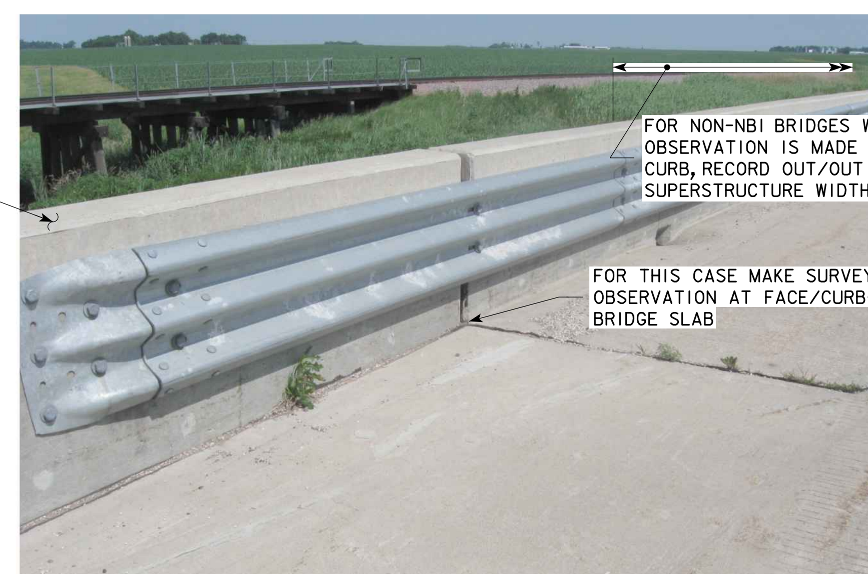
DOUBLE OR TRIPLE BOX CULVERT

FACIA / END DECK

FACIA / END DECK

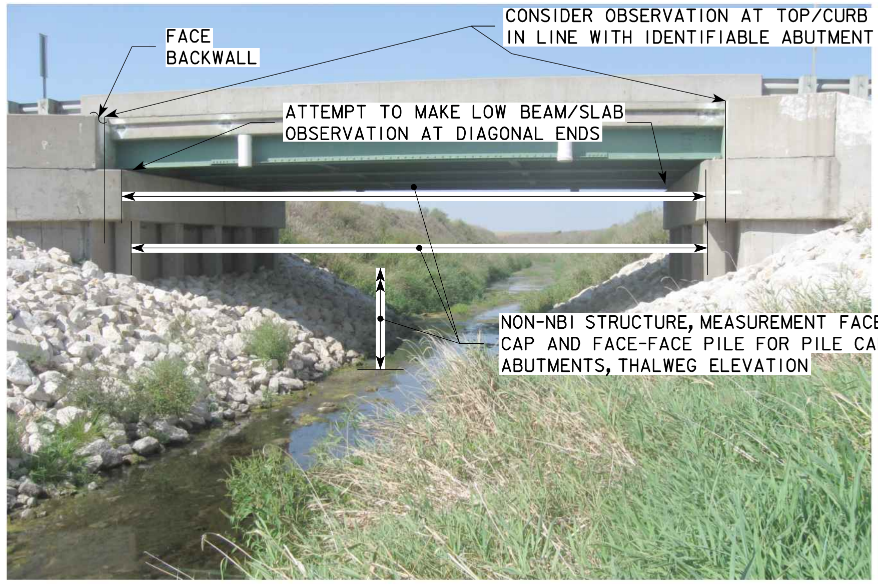
DOT BUTTON

CURB INTEGRATED INTO RAIL



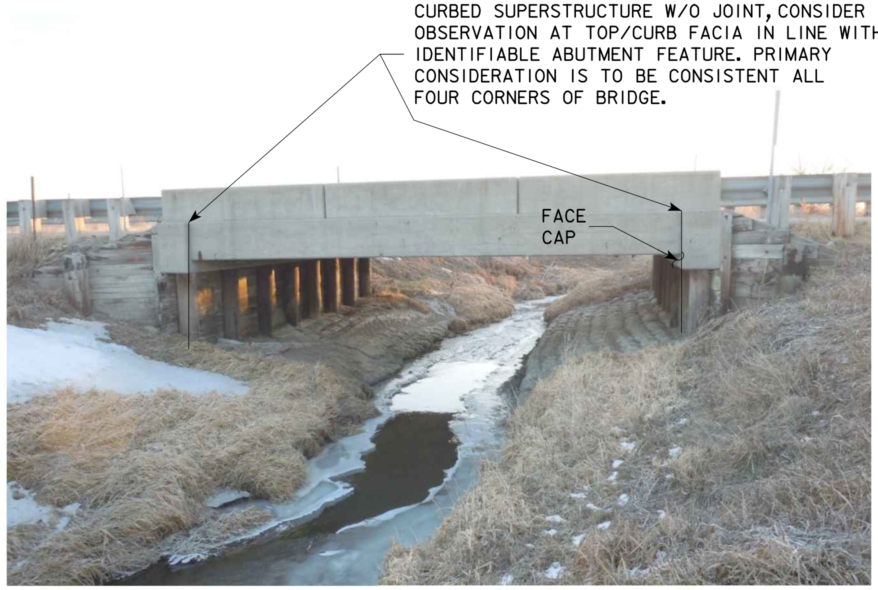
CURB INTEGRATED INTO RAIL

INFRASTRUCTURE DATABASE SURVEY
STRUCTURE SURVEY POINT EXAMPLES

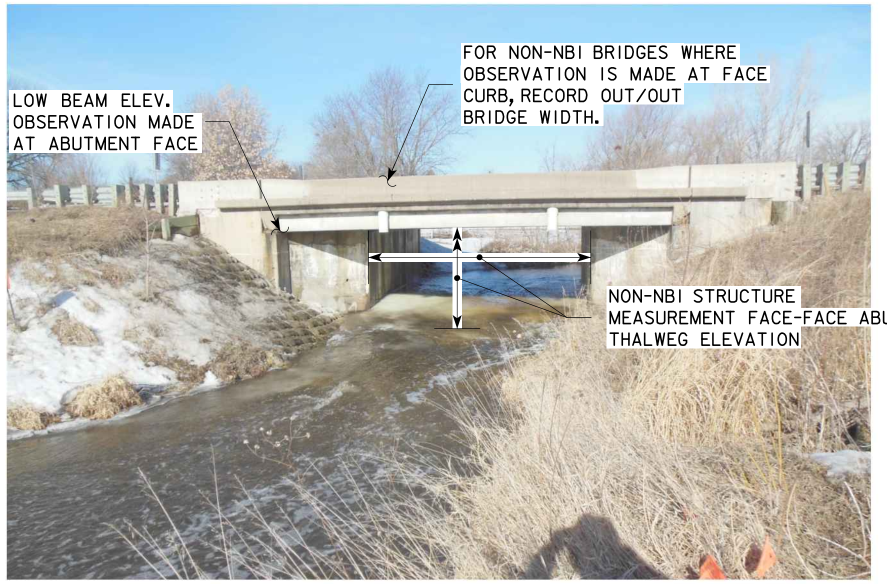


PILE CAP ABUTMENT

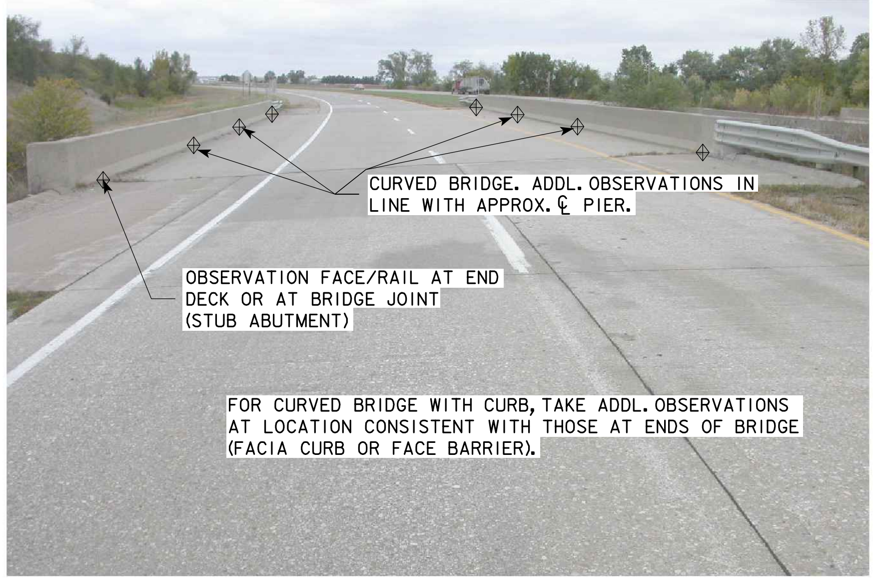
CURB W/ INTEGRAL SUPERSTRUCTURE



CURB W/ INTEGRAL SUPERSTRUCTURE

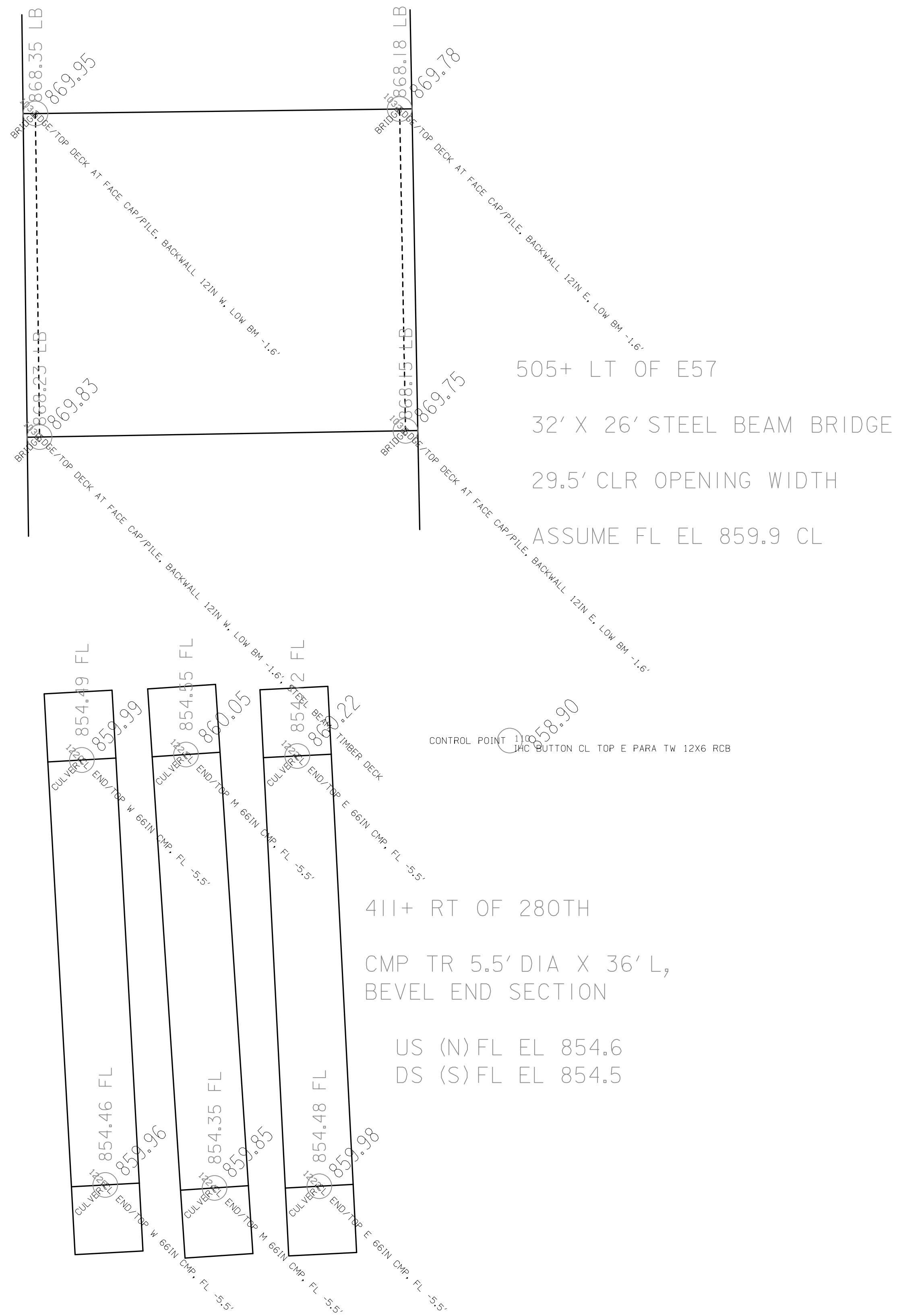


CONCRETE HIGH ABUTMENT



MODERN BRIDGE W/ BARRIER RAIL - CURVED BRIDGE

INFRASTRUCTURE DATABASE SURVEY
STRUCTURE SURVEY POINT EXAMPLES



EXAMPLE SYMBOLOGY SURVEY CAD FILE

Survey Description

By: W. Kaufman 07/23/13

Location: IowaR RM 312.1 Wright County Iowa River US 69 Crossings

Projection: NAD83(2011), Iowa State Plane North, NAVD 88 Datum (Geoid g2012au03), Survey Feet

Notes: Shots of prev BM's for NAD83(CORS96)>NAD83(2011) correlation (see below)

WL Bridges IowaR RM 326.47, 327.68; WF IowaR RM 326.32, 328.26

Bridge deck/LB Co. Rd. Bridges Iowa R RM 315.09, 316.53, 316.91, 324.74, 326.47

Reference Points Established:

Point 113 BM IHC BUTTON CL TOP E PARA TW 12X6 RCB CR70 OVER FOX CK,
0.3 MI W US 69
OBS=1170.12

NAD83(2011)>NAD83(CORS96) Correlation:

NAVD88 NAD83(CORS96)/Geoid09 IaRTN = NAVD88 NAD83(2011)/Geoid12A IARTN - 0.13 FT
(Per statistics attachment)

>>> NAVD88/IaRTN(CORS96) = NAVD88/IaRTN(2011) (-) 0.13 FT

EXAMPLE SURVEY DESCRIPTION FILE

INFRASTRUCTURE DATABASE SURVEY STRUCTURE SURVEY POINT EXAMPLES