LETTER OF TRANSMITTAL

WWC ENGINEERING

1275 Maple Street, Suite F
Helena, Montana 59601
(406) 443-3962
www.wwcengineering.com

DATE: 4/27/2020	JOB NO: 2020-090
ATTENTION: **Lindsay Morgan, Floodplain Administrator**	
RE: **Ryan Floodplain Application**	

TO: **Lewis & Clark County**
316 N. Park Ave., Rm 230
Helena, MT 59623

WE ARE SENDING YOU:

COPIES	DATE	NO.	DESCRIPTION
1	4/2020	1	Ryan Joint Application
1	4/2020	2	Ryan Flood Study Report
1	4/2020	3	HEC-RAS Model

THESE ARE TRANSMITTED as checked below:

- ☒ For approval
- ☒ For review and comment
- ☐ Approved as submitted
- ☐ Returned
- ☐ For your use
- ☐ As requested
- ☐ Approved as noted

Remarks: **Lindsay:**

On behalf of Bill Ryan we are submitting the above referenced documents for your review and approval. Please feel free to contact Gary Vert at our office with any questions.

Thank You!

Copy to: *File & Bill Ryan*

Signed: Marina Hogan

Revised: 6/5/15 (310 form 270). Form may be downloaded from: www.dnrc.mt.gov/licenses-and-permits/stream-permitting	**AGENCY USE ONLY**: Application # _____ Date Received _____ Date Accepted _____/ Initials _____ Date Forwarded to DFWP _____

This space is for all Department of Transportation and SPA 124 permits (government projects).
Project Name _____
Control Number _____ Contract letting date _____
MEPA/NEPA Compliance ☐ Yes ☐ No If yes, #14 of this application does not apply.

JOINT APPLICATION FOR PROPOSED WORK IN MONTANA'S STREAMS, WETLANDS, FLOODPLAINS, AND OTHER WATER BODIES

Use this form to apply for one or all local, state, or federal permits listed below. The applicant is the responsible party for the project and the point of contact unless otherwise designated. **"Information for Applicant"** includes agency contacts and instructions for completing this application. T**o avoid delays**, submit all required information, including **a project site map and drawings.** Incomplete applications will result in the delay of the application process. **Other laws may apply**.

The applicant is responsible for obtaining all necessary permits and landowner permission before beginning work.

✓	PERMIT	AGENCY	FEE
	310 Permit	Local Conservation District	No fee
	SPA 124 Permit	Department of Fish, Wildlife and Parks	No fee
✓	Floodplain Permit	Local Floodplain Administrator	Varies by city/county ($25 - $500+)
	Section 404 Permit, Section 10 Permit	U. S. Army Corps of Engineers	Varies ($0 - $100)
	318 Authorization 401 Certification	Department of Environmental Quality	$250 (318); $400 - $20,000 (401)
	Navigable Rivers Land Use License, Lease, or Easement	Department of Natural Resources and Conservation, Trust Lands Management Division	$50, plus additional fee

A. APPLICANT INFORMATION

NAME OF **APPLICANT** (person responsible for project)**:** Bill Ryan
Has the landowner consented to this project? ☒ Yes ☐ No
Mailing Address: 1901 S. Montana Street Butte, MT 59702
Physical Address: 97 Craig Main St. Wolf Creek, MT 59648
Day Phone: (406) 723-3203 Evening Phone: (406) 565-0761 E-Mail: bryan@ibew44.org

NAME OF **LANDOWNER** (if different from applicant): Click here to enter name or N/A.
Mailing Address: Click here to enter mailing address or N/A.
Physical Address: Click here to enter physical address or N/A.
Day Phone: Click here to enter or N/A. Evening Phone: Click here to enter or N/A. E-Mail: Click here to enter or N/A.

NAME OF **CONTRACTOR/AGENT**): Gary Vert, P.E., CFM
Mailing Address: 1275 Maple St. Suite F Helena, MT 59601
Physical Address: 1275 Maple St. Suite F Helena, MT 59601
Day Phone: (406) 443-3962 Evening Phone: (406) 443-3962 E-Mail: gvert@wwcengineering.com

B. PROJECT SITE INFORMATION

NAME OF **STREAM** or **WATER BODY** at project location Missouri River Nearest Town Craig, MT
Address/Location: 97 Craig Main St. Geocode (if available): 05-2446-10-1-02-03-0000
Choose.1/4 Choose. 1/4 Choose. 1/4, Section 10, Township 15 N, Range 3 W County Lewis and Clark
Longitude111°57'46.72"W, Latitude 47° 4'29.14"N

The state owns the beds of certain state navigable waterways. Is this a state navigable waterway? Yes or No.
If yes, send copy of this application to appropriate DNRC land office – see Information for Applicant.

ATTACH A PROJECT SITE MAP OR A SKETCH that includes: 1) the water body where the project will take place, roads, tributaries, landmarks; 2) a circled "X" representing the exact project location. IF NOT CLEARLY STATED ON THE MAP OR SKETCH, **PROVIDE WRITTEN DIRECTIONS TO THE SITE.**

C. PROJECT INFORMATION

1. **TYPE OF PROJECT** (check all that apply)

☐ Bridge/Culvert/Ford Construction	☐ Fish Habitat	☐ Mining
☐ Bridge/Culvert/Ford Removal	☐ Recreation (docks, marinas, etc.)	☐ Dredging
☐ Road Construction/Maintenance	☒ New Residential Structure	☐ Core Drill
☐ Bank Stabilization/Alteration	☒ Manufactured Home	☒ Placement of Fill
☐ Flood Protection	☐ Improvement to Existing Structure	☐ Diversion Dam
☐ Channel Alteration	☐ Commercial Structure	☐ Utilities
☐ Irrigation Structure	☐ Wetland Alteration	☐ Pond
☐ Water Well/Cistern	☐ Temporary Construction Access	☐ Debris Removal
☐ Excavation/Pit	☐ Other _____	

2. **PLAN OR DRAWING** of the proposed project **MUST** be attached. **This plan or drawing must include**:

- a plan view (looking at the project from above)
- dimensions of the project (height, width, depth in feet)
- location of storage or stockpile materials
- drainage facilities
- an arrow indicating north
- a cross section or profile view
- an elevation view
- dimensions and location of fill or excavation sites
- location of existing or proposed structures, such as buildings, utilities, roads, or bridges

3. **IS THIS APPLICATION FOR** an annual maintenance permit? ☐ Yes ☒ No
(If yes, an annual plan of operation must be attached to this application – see "Information for Applicant")

4. **PROPOSED CONSTRUCTION DATE**. Include a project timeline. Start date 6/1/2020
Finish date 8/1/2020 Is any portion of the work already completed? ☐ Yes ☒ No
(If yes, describe the completed work.)

5. **WHAT IS THE PURPOSE** of the proposed project?

Mr. Ryan would like to add a new residential structure on his property. The structure will be used as a vacation home by the Ryan family and guests. See building plans for the proposed structure in Appendix B of the attached flood study report.

6. **PROVIDE A BRIEF DESCRIPTION** of the proposed project.

The proposed project will involve the placement of enough fill material and foundation walls to raise the proposed structure two feet above the base flood elevation, per Lewis and Clark County and State of Montana standards. The structure has a 48' X 28' foundation footprint and consists of a prefabricated modular home by Riverside Cabins in Vaughn, MT. The cabin will be anchored to the foundation via a sill plate anchor and fastener. See attached building drawings from Riverside Cabins for details of the proposed structure.

7. **WHAT IS THE CURRENT CONDITION** of the proposed project site? Describe the existing bank condition, bank slope, height, nearby structures, and wetlands.

The lot is currently empty and does not have water frontage. Mr. Ryan also owns the lot that is closer to the river, but this parcel will not be impacted with this project. There is an existing cabin located on this lot and the river bank is riprapped and is steep, greater than 1:1 slopes. The bank height is approximately nine feet high from water to top of bank. The proposed new home will not impact the waterfront lot, existing bank condition, bank slopes, or wetland areas. All work on the proposed structure will be limited to the lot boundaries and will therefore not impact the river bank.

8. **PROJECT DIMENSIONS**. How many linear feet of bank will be impacted? How far will the proposed project encroach into and extend away from the water body?

The property does not have river frontage. The proposed project will not encroach into the active channel banks of the Missouri River. The existing bank will not be altered in any way. All work on the proposed structure will be limited to the lot boundaries and will therefore not impact the riverbank.

9. **VEGETATION.** Describe the vegetation present on site. How much vegetation will be disturbed or covered with fill material during project installation? (Agencies require that only vegetation necessary to do the work be removed.) Describe the revegetation plan for all disturbed areas of the project site in detail.

Current vegetation on site consists of sparse native grasses and gravel. Fill material will cover the majority of the gravel on-site and all disturbed areas will be re-seeded with a native seed mixture approved by the Lewis & Clark County Weed District. Residential landscaping will also be performed on-site, mostly in the immediate areas surrounding the proposed building.

10. **MATERIALS**. Describe the materials proposed to be used. Note: This may be modified during the permitting process. It is recommended you do not purchase material until all permits are issued.

Cubic yards/Linear feet	Size and Type	Source

150 Cubic Yards of fill material. The fill material will be sourced locally. The fill material will placed in small lifts and compacted to ensure no consolidation of the proposed residence and reduce the erosion potential of the placed fill material.
A proposed 48' X 28' pre-fabricated cabin from Riverside Cabins. See attached building drawings and details.

11. **EQUIPMENT**. List all equipment that will be used for construction of the project. How will the equipment be used on the bank and/or in the water? Note: Make sure equipment is clean and free of weeds, weed seeds, and excess grease before using it in the water waterway. To prevent the spread of aquatic invasive species, to the extent practical, remove mud and aquatic plants from heavy machinery and other equipment before moving between waters and work sites, especially in waters known to be infested with aquatic invasive species. Drain water from machinery and let dry before moving to another location.

Grader - will be used to grade building site.
Excavator - will be used to move material, excavate foundation footings, and place fill material.
Compactor – will be used to compact fill material at building site.
Crane – will be used to place modular home.
No machinery will enter any surface water or work on or near the river bank. Contractor will be responsible for implementing housekeeping measures such as cleaning and removing weeds from all vehicles at entry and exit of the site.

12. **DESCRIBE PLANNED EFFORTS TO MINIMIZE PROJECT IMPACTS**. Consider the impacts of the proposed project, even if temporary. What efforts will be taken to:

- Minimize erosion, sedimentation, or turbidity?

During construction of the proposed residence, Best Management Practices (BMPs) for storm water management will be utilized to prevent sediment from exiting the site. BMPs such as straw wattles, silt fence, or erosion control matting will be used to minimize erosion, sedimentation, and turbidity.

- Minimize stream channel alterations?

No work is proposed to take place within the stream channel.

- Minimize effects to stream flow or water quality caused by materials used or removal of ground cover?

Water quality within the Missouri River will be maintained throughout and after the construction of the proposed improvements. BMPs for storm water will be used during construction to prevent untreated runoff from entering the Missouri River. Wherever possible, disturbance will be minimized in order to leave as much ground cover as possible.

- Minimize effects on fish and aquatic habitat?

No work is being proposed within areas of fish or aquatic habitat. BMPs for storm water will be used during and after construction to prevent untreated runoff from entering the river. No work will be performed in the river and controls will be in place to limit erosion, sedimentation, and turbidity.

- Minimize risks of flooding or erosion problems upstream and downstream?

Upstream and downstream flooding and erosion will not be affected by this project. Minimal fill will be placed in the floodplain.

Current floodplain regulations require that fill in the floodplain not raise the base flood elevation by more than 0.5 foot. Based on hydraulic modeling of the existing and proposed conditions, the proposed fill for the property will result in a 0.0 foot rise and therefore will not result in an increase of the BFE by more than 0.5 foot.

- Minimize vegetation disturbance, protect existing vegetation, and control weeds?

Disturbance of vegetation on-site will be for the placement of fill material for the proposed modular home. No other vegetation disturbance is expected. Any vegetation disturbances that are outside of the building footprint will be reseeded with an approved native seed mixture or proposed landscaping. All equipment used in construction will be checked for weeds at the beginning and end of each use.

13. **WHAT ARE THE NATURAL RESOURCE BENEFITS** of the proposed project?

All disturbed areas will be re-seeded with a native seed mixture approved by the County Weed District that will promote a healthy vegetative community in the area. The established vegetation will help to prevent erosion, therefore eliminating sedimentation into the Missouri River, which will improve water quality and fish habitat.

14**. LIST ALTERNATIVES** to the proposed project. Why was the proposed alternative selected?

The proposed alternative was selected because of the minimal impact it would have on the site. The small footprint of the modular home will have minimal impacts to the floodplain. The modular home alternative was selected because of its simplicity in construction, being constructed off-site and simply installed on-site. No other alternatives were analyzed other than the No Action alternative.

D. ADDITIONAL INFORMATION FOR SECTION 404, SECTION 10, AND FLOODPLAIN PERMITS ONLY.
If applying for a Section 404 or Section 10 permit, fill out questions 1-3. If applying for a floodplain permit, fill out questions 3-6. (Additional information is required for floodplain permits – See "Information for Applicant.")

1. Will the project involve placement of dredged (excavated) and/or fill material below the ordinary high water mark, in a wetland, or other waters of the US? If yes, what is the surface area to be filled? How many cubic yards of fill material will be used? Note: Wetland delineations are required if wetlands are affected.

N/A. No dredged or fill material will be placed below the ordinary high water mark, in a wetland, or other waters of the US.

2. Description of avoidance, mitigation, and compensation (see Information for Applicant). Attach additional sheets if necessary.

N/A. The proposed project does not have water frontage and will not impact the top of bank. Appropriate BMP measures will be placed to minimize sediment impacts to the Missouri River, and the project will be reseeded with appropriate native vegetation/landscaping to stabilize the proposed fill material.

3. List the names and address of landowners adjacent to the project site. This includes properties adjacent to and across from the project site. (Some floodplain communities require certified adjoining landowner lists).

North
TAYLOR MICHAEL & DAYLE S
17 CRAIG MAIN ST
WOLF CREEK, MT 59648-8704
East
RYAN WILLIAM M & JAMES T
629 TRAVONIA ST
BUTTE, MT 59701-2354
South
MONTANA DEPT OF FISH WILDLIFE & PARKS
PO BOX 200701
HELENA, MT 59620-0701
West
DUVALL JOSEPH E & JUANITA
CRAIG BAR
WOLF CREEK, MT 59648

MISSOURI RIVER TROUT SHOP
110 BRIDGE ST
WOLF CREEK, MT 59648-8715

4. List all applicable local, state, and federal permits and indicate whether they were issued, waived, denied, or pending. Note: All required local, state, and federal permits, or proof of waiver must be issued prior to the issuance of a floodplain permit.

MT DEQ was contacted to see if permit coverage was needed and responded by waiving the need for a 318 or 401 permit. See attached correspondence in Attachment A for permit waivers.

5. Floodplain Map Number 30049C1425E

6. Does this project comply with local planning or zoning regulations? ☒ Yes ☐ No

E. SIGNATURES/AUTHORIZATIONS -- Each agency must have original signatures signed in blue ink.

After completing the form, make the required number of copies and **then sign each copy.** Send the copies with original signatures and additional information required directly to each applicable agency.

The statements contained in this application are true and correct. The applicant possess' the authority to undertake the work described herein or is acting as the duly authorized agent of the landowner. The applicant understands that the granting of a permit does not include landowner permission to access land or construct a project. Inspections of the project site after notice by inspection authorities are hereby authorized.

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APPLICANT (Person responsible for project):
Print Name: Bill Ryan

Signature of Applicant Date

LANDOWNER:
Print Name: Bill Ryan

Signature of Landowner Date

*CONTRACTOR/AGENT:
Print Name: Gary Vert

DocuSigned by:
Gary Vert
C4F86900A8C34DF...

4/27/2020

S[illegible]tractor/Agent Date

*Contact agency to determine if contractor signature is required.

ATTACHMENT A

PERMIT CORRESPONDENCE

Marina Hagenbuch

From: Bill Ryan <bryan@ibew44.org>
Sent: Thursday, April 16, 2020 12:51 PM
To: Gary Vert
Subject: RE: MT DEQ 318 Authorization, 401 WQC not needed for your project

WARNING: This email originated from an external sender. Please use caution when clicking links or opening attachments.

Army Corp of engineers said, it was dry and we didn't not need anything from them Tim Mcnew I sent them a photo.
DEQ Keenan Shaw said OK to go.
Mt dept of Natural resources said we needed nothing from them it is under an acre, Tracy Shears said just work with Lindsay Morgan.
Chris Evans at Soil Conservation district no 310 needed. Said no permit would be needed from FWP as well, although I never got return calls from FWP.

Bill

From: Gary Vert <gvert@wwcengineering.com>
Sent: Wednesday, April 15, 2020 1:38 PM
To: Bill Ryan <bryan@ibew44.org>
Subject: RE: MT DEQ 318 Authorization, 401 WQC not needed for your project

Bill,

Are there any other permitting agencies that you contacted about permits that may be needed for your project? Did you contact the Army Corps of Engineers? MT Fish Wildlife and Parks? The Local Conservation District? DNRC? If any of these agencies were contacted about permitting, it would be good to include the correspondence with our floodplain permit application.

Gary

WWC ENGINEERING
Gary Vert, P.E., CFM | Civil Engineer
1275 Maple Street, Suite F | Helena, MT 59601
Tel 406-443-3962
www.WWCengineering.com

From: Bill Ryan <bryan@ibew44.org>
Sent: Wednesday, March 25, 2020 4:38 PM
To: Gary Vert <gvert@wwcengineering.com>
Subject: FW: MT DEQ 318 Authorization, 401 WQC not needed for your project

WARNING: This email originated from an external sender. Please use caution when clicking links or opening attachments.

fyi

From: Storrar, Keenan <Keenan.Storrar@mt.gov>
Sent: Wednesday, March 18, 2020 5:24 PM
To: bryan@ibew44.org
Subject: MT DEQ 318 Authorization, 401 WQC not needed for your project

Dear Mr. Ryan,

Thank you for contacting me regarding your proposed project along the Missouri River in Craig, Montana. After discussing the extent and location of your project it sounds like you will be working in the upland and no construction work will take place within state waters. Since you will not be performing construction work in state waters, you do not need a 318 Authorization or a 401 Water Quality Certification for your project.

Thanks again and good luck with everything. Please let me know if you have any further questions.

Sincerely,

Keenan Storrar

318/401 Coordinator, MT DEQ

406.444.2734

Marina Hagenbuch

From: Bill Ryan <bryan@ibew44.org>
Sent: Wednesday, March 25, 2020 4:38 PM
To: Gary Vert
Subject: FW: MT DEQ 318 Authorization, 401 WQC not needed for your project

WARNING: This email originated from an external sender. Please use caution when clicking links or opening attachments.

fyi

From: Storrar, Keenan <Keenan.Storrar@mt.gov>
Sent: Wednesday, March 18, 2020 5:24 PM
To: bryan@ibew44.org
Subject: MT DEQ 318 Authorization, 401 WQC not needed for your project

Dear Mr. Ryan,

Thank you for contacting me regarding your proposed project along the Missouri River in Craig, Montana. After discussing the extent and location of your project it sounds like you will be working in the upland and no construction work will take place within state waters. Since you will not be performing construction work in state waters, you do not need a 318 Authorization or a 401 Water Quality Certification for your project.

Thanks again and good luck with everything. Please let me know if you have any further questions.

Sincerely,

Keenan Storrar

318/401 Coordinator, MT DEQ

406.444.2734

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RYAN FLOOD STUDY REPORT

MISSOURI RIVER

SECTION 10, T15N, R3W

LEWIS & CLARK COUNTY, MONTANA

PREPARED FOR:

BILL RYAN
1901 SOUTH MONTANA STREET
BUTTE, MT 59702

PREPARED BY:

WWC ENGINEERING

1275 MAPLE STREET, SUITE F
HELENA, MT 59601
(406) 443-3962
WWW.WWCENGINEERING.COM

Service | Quality | Integrity

APRIL 2020

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Ryan Flood Study Report- Missouri River Section 10, Township 15N, Range 3W, Lewis & Clark County, Montana

Prepared for: Bill Ryan
1901 South Montana Street
Butte, MT 59702
(406) 789-2422

Prepared by: WWC Engineering
1275 Maple Street Suite F
Helena, MT 59601
(406) 443-3962

Principal Authors: Gary Vert, Project Manager, P.E., CFM

Reviewed by: Shawn Higley, P.E. Helena Branch Manager

Date: April 2020

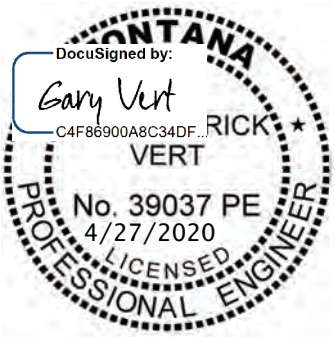

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Exhibit 3 Site Plan

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Appendix B Cabin Details and Specifications

Appendix C Flood Insurance Rate Map

Appendix D Hydrology Calculations

Appendix E HEC-RAS Data

OVERVIEW

The proposed Ryan Floodplain Project is located in Lewis and Clark County (Section 10, Township 15 North, Range 3 West) just off Interstate 15 (I-15), north of Helena and on the east side of the town of Craig. The subject property is physically located immediately downstream from the Craig Bridge that serves as a connector between I-15 and the old Highway, also known as Craig Frontage Road. The current landowner, Mr. William 'Bill' Ryan, wishes to build a modular home on this property within the FEMA-designated Zone A Floodplain boundary. This subject property is located in a 100-year floodplain boundary as shown on the Lewis and Clark County Flood Insurance Rate Map (Panel number 30049C1425E). The floodplain at this location is Zone A, developed by approximate methods. Due to the reconstruction of the bridge over the Missouri River immediately upstream of the project location, much of the hydrology and hydraulics information for the proposed building site was obtained from the previous bridge project conducted by the Montana Department of Transportation (MDT). The purpose of this report is to determine the impact on the Base Flood Elevation (BFE) of the Missouri River and verify conformance with Lewis & Clark County Floodplain requirements, due to the proposed site improvements in the floodplain. Exhibits and the Certificate of Survey, included in Appendix A, show the location of the subject property.

PROJECT DESCRIPTION

The proposed project will involve the placement of enough fill material and the construction of foundation walls to raise the proposed structure at least two feet above the BFE, per Lewis and Clark County and the State of Montana regulations. A pre-built modular home by Riverside Cabins in Vaughn, MT will be placed on the proposed fill material and foundation. The structure is proposed as a 48' X 28' modular home that will be placed on the proposed crawlspace foundation walls. The modular home will be anchored to the foundation walls with sill plate anchors. Cabin details and specifications are included in Appendix B. The existing lot is currently empty and does not contain any water frontage. Mr. Ryan owns the property to the east that is adjacent to the Missouri River active channel banks. The active channel bank of the Missouri River near the adjacent property is riprapped and is steep, approximately greater than 1:1 slopes. The bank height is approximately nine feet high from the normal water surface elevation to the top of bank. No work will be done within the active channel banks of the Missouri River.

FEMA DATA

The project area is located in a FEMA Zone A floodplain as shown on the FIRM Panel 1425 of 2450, community panel number 30049C1425E, provided in Appendix C. FEMA defines a Zone A floodplain as 'Areas subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies.' Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown on the FEMA FIRM Maps. As part of this study, BFEs have been calculated using the old hydraulic model from the previous MDT bridge project in order to comply with floodplain development requirements. Mandatory flood insurance purchase requirements and floodplain management standards apply.

SURVEY

As mentioned previously, an MDT project was completed on the Craig Bridge in 2000. Additionally, WWC performed a flood study on the John West property, located approximately 650 feet (200 meters) upstream of the Craig Bridge and the Dayl Taylor property, located immediately downstream (north) of Mr. Ryan's two properties. A site-specific survey was not conducted for this project because of the availability of existing data. The topographic data that was used in the development of hydraulic models for the John West, Dayl Taylor, and MDT projects was used for Mr. Ryan's project.

HYDROLOGY

MDT utilized a Log Pearson III analysis and USGS transfer equations to predict peak flows on the Missouri River at Craig for the previous bridge project that was completed in 2000. The peak flows were calculated using the flow data recorded by gage number 06078200 located on the left bank of the Missouri River at 9.01 km (5.6 miles) east of Ulm, Montana at latitude 47°26'05.88" and longitude 111°23'18.40". The drainage area for this gage is approximately 20,605 square miles and has been in operation since August 1957. The 2000 bridge project MDT Log Pearson III results for gage #6078200 near Ulm generated the following flows at the gage:

Q_2 = 16,131 cfs (457 cms)
Q_{50} = 41,741 cfs (1182 cms)
Q_{100} = 46,968 cfs (1330 cms)
Q_{500} = 59,298 cfs (1679 cms)

MDT utilized USGS transfer equations to transfer the flows from Ulm to Craig, yielding the following flows:

Q_2 = 15,682 cfs (444 cms)
Q_{50} = 40,626 cfs (1150 cms)
Q_{100} = 45,687 cfs (1294 cms)
Q_{500} = 57,614 cfs (1631 cms)

Due to updated hydrologic data available since 2000, WWC did not use the same flows from the MDT project. WWC utilized the same methods, with updated data from the nearest USGS gaging stations. Hydrologic flow data was obtained from two gaging stations operated by the USGS, gaging stations 06078200 (described as the "Missouri River near Ulm, MT") and 06066500 (described as the "Missouri River below Holter Dam near Wolf Creek, MT"). Using the USGS PeakFQ software, the following flows were developed for the Ulm gaging station:

Q_2 = 14,150 cfs (401 cms)
Q_{50} = 35,430 cfs (1,004 cms)
Q_{100} = 39,570 cfs (1,121 cms)
Q_{500} = 49,120 cfs (1,391 cms)

Similarly, the following flows were developed for the Wolf Creek gaging station:

Q_2 = 12,610 cfs (357 cms)
Q_{50} = 35,610 cfs (1,008 cms)
Q_{100} = 40,260 cfs (1,140 cms)
Q_{500} = 51,080 cfs (1,447 cms)

Due to the proximity to the project location (located approximately 7.92 miles upstream of the project location) and the more conservative flows from the most recent data, the Wolf Creek gaging station was used to evaluate the Ryan property. The USGS gaging station 06066500 is located on the left bank of the Missouri River downstream of Holter Dam near the Holter Dam fishing access site at latitude 46°59'40.99"N and longitude 112°00'38.16"W. The drainage area for this gage is approximately 16,924 square miles and has been in operation since October 1945. See Appendix D for the site hydrology calculations using the USGS PeakFQ software.

HYDRAULIC MODEL

The hydraulic method utilized in this analysis was the standard step backwater method. This analysis was performed using the U.S. Army Corps of Engineer's HEC-RAS computer program. The HEC-RAS analysis is a parametric method of estimating water surface profiles based on steady one-dimensional flow from site-specific data, in addition to providing hydrologic outputs for natural and man-made channels. Procedures followed in applying the method can be found in the HEC-RAS River

Analysis System Applications Guide, Hydraulic Reference Manual and User's Manual (HEC 2010).

As discussed previously, the HEC-RAS model developed by MDT for determination of the new bridge geometry and opening was obtained and verified for this analysis. The flow of the Missouri River at Craig is regulated by Holter Dam, located approximately 7.9 miles upstream. The west side of the river where the subject property is located is bordered by railroad tracks, residential areas, and a small urban area. The east side of the river is mostly flat, cultivated farm ground with some trees and small bushes on the north end. The channel consists of sand, gravel, and cobbles with an active channel width of approximately 447 ft. The selected Manning's n-values for this crossing are 0.028 for the main channel and 0.033 for overbanks. The channel slope was determined by plotting the surveyed water surface elevations from cross sections surveyed by MDT. The slope was determined to be 0.00073 ft/ft.

MDT surveyed cross-sections both above and below the existing bridge site that encompass the subject property. The cross sections start approximately 1,500 feet (450 m) downstream (D/S) and provide cross-sections at 1,500 feet (450 m) D/S, 1,000 feet (300 m) D/S, 500 feet (150 m) D/S, immediate D/S and U/S reaches of the existing bridge, 500 feet (150 m) upstream (U/S), and 1,000 feet (300 m) U/S. The surveyed cross-sections extend to the centerline of the railroad tracks west of the river, north and south of Craig and extend through the town of Craig to the west on the major east-west street in Craig. On the eastside of the river, the cross-sections extend to the Craig Frontage Road. Exhibit 2, included with this report, shows the cross-section locations for the MDT model.

The HEC-RAS model includes the geometry of the new bridge and provides a reasonably accurate representation of the 100-year water surface elevation at the subject property. As typically performed by MDT in a bridge opening recommendation analysis, several model runs were developed that include the natural channel with no bridge, the existing bridge, and several new bridge alternatives. For the sake of brevity, we have included only the final model run for the selected replacement bridge as well as the proposed conditions for the Taylor cabin, which represents existing conditions for the proposed Ryan site.

Two models were developed and analyzed to represent existing and proposed conditions. The MDT model with the selected bridge alternative, the existing Taylor cabin, and an interpolated cross section through the Ryan property was used as the existing conditions model. The proposed conditions model uses the same geometry as the existing conditions with the addition of the proposed grading superimposed onto the model's interpolated cross section. The interpolated cross section through Mr.

Ryan's property was manually adjusted in HEC-RAS to account for placement of fill for the proposed modular home. The flow data discussed in the previous Hydrology section of this report is input into both models. The model output includes existing and proposed water surface elevations, velocities, and flow area at each cross section. This data was used to determine the effects that the proposed grading will have on the existing Missouri River BFE.

Existing and Proposed Conditions

The existing conditions' cross sections were obtained from the previous Taylor cabin project model, which can be viewed on Exhibit 2. The proposed grading was created by interpolating a single cross section in order to get a cross section through the Ryan's property. Once the interpolated cross section was created, it was manually modified in HEC-RAS to achieve the required two feet above the BFE. The proposed improvements to the Ryan's property include placing enough fill to get the entire property at least two feet above the BFE. The following table lists data obtained from HEC-RAS showing the existing and proposed conditions model results at the 100-year flow event. The HEC-RAS model is included with this report and results from the model can be found in Appendix E.

Table 1 . Model Results

Station	Recurrence Interval	W.S.E. Existing Conditions (ft)	W.S.E. Proposed Conditions (ft)	Water Surface Elevation Rise (ft)
7	Q_{100}	3457.32	3457.32	0
6	Q_{100}	3457.15	3457.15	0
5	Q_{100}	3456.36	3456.36	0
4	Q_{100}	3456.40	3456.40	0
3.9	Q_{100}	Bridge	Bridge	Bridge
3.8	Q_{100}	3456.07	3456.07	0
3.5*	**Q_{100}**	**3456.00**	**3456.00**	**0**
3	Q_{100}	3455.87	3455.87	0
2	Q_{100}	3455.84	3455.84	0
1	Q_{100}	3455.35	3455.35	0

Note: * denotes the interpolated cross section that passes through the Ryan property.

Results Discussed

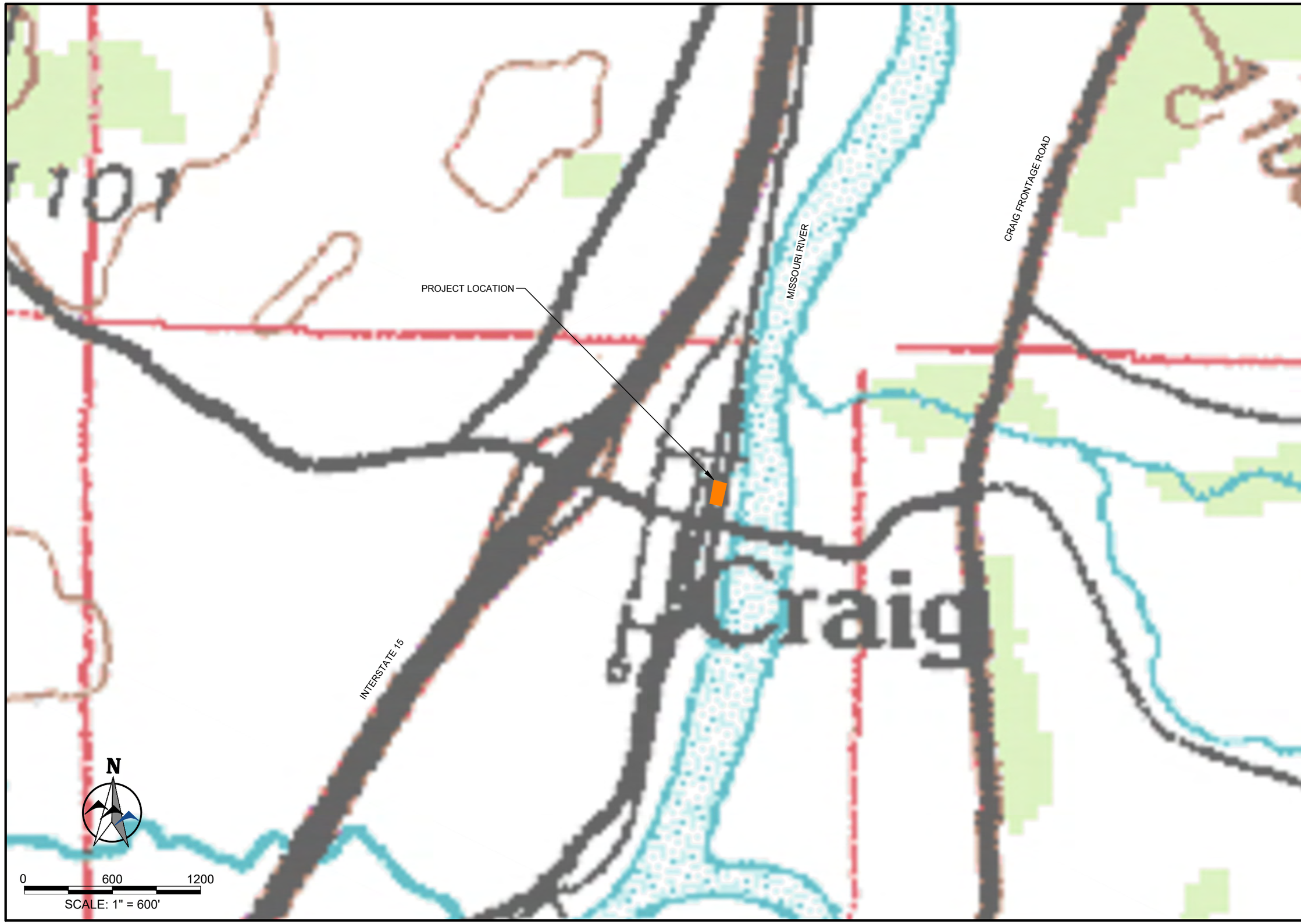
The model shows no change in the BFE from existing to proposed conditions, which includes the proposed fill placement to construct the proposed modular home well above the BFE. Although the project is located in the FEMA Zone A floodplain, the

hydraulic modeling showed that all proposed improvements to the Ryan property will be outside of the 100-year floodplain delineation; therefore, the BFE is not affected. The model indicates that there will be no rise in the BFE for the 100-year storm event; therefore, the proposed project conforms with the Lewis and Clark County Floodplain Regulation of no more than 6-inches of rise in the BFE within the floodplain. The existing conditions model indicated a BFE of 3,456.00 feet, corresponding to the interpolated cross section that passes through the proposed Ryan modular home location. In order to comply with Lewis and Clark County Floodplain Regulations, the proposed modular home's finished floor elevation must be at an elevation of 3,458.00 or higher. For the proposed conditions model, WWC raised the finish grade of the entire Ryan property to an elevation of 3,458.00, exactly 2 feet above the BFE. Using this data, the proposed conditions HEC-RAS model was created and analyzed to ensure compliance with floodplain regulations.

SUMMARY

The proposed project was determined to be located in a FEMA Zone A floodplain. An MDT HEC-RAS model that was used on a previous WWC flood study project (the Taylor cabin project) was obtained, verified and modified for the Ryan project, then evaluated based on updated USGS flowrate data developed from the USGS PeakFQ program. It was determined that the proposed project would result in no change to the BFE because the proposed improvements to the Ryan property are located outside of the 100-year floodplain delineation. The proposed fill, placed in order to get the modular home 2 feet above the BFE, will have no effect on the BFE of the Missouri River. The modular home's finished floor elevation will be set at 3,458.00 feet, or 2 feet higher than the BFE of the Missouri River. Therefore, the Ryan Floodplain Project will comply with Lewis and Clark County and the State of Montana's Floodplain Regulations.

EXHIBITS



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WWC ENGINEERING
1275 MAPLE STREET, SUITE F
HELENA, MT 59601
(406) 443-3962

BILL RYAN
1901 S. Montana Street
Butte, MT 59702
(406) 723-3203

PLOT STYLE: WWC-COLOR.ctb
4/04/2020 FILE PATH: C:\Users\gpvar\Desktop\05CAD\Sheets\TAYLOR LOCATION MAP.dwg

DSGN	DATE	CKD
GPV	4/17/20	STH
REV	DATE	CKD

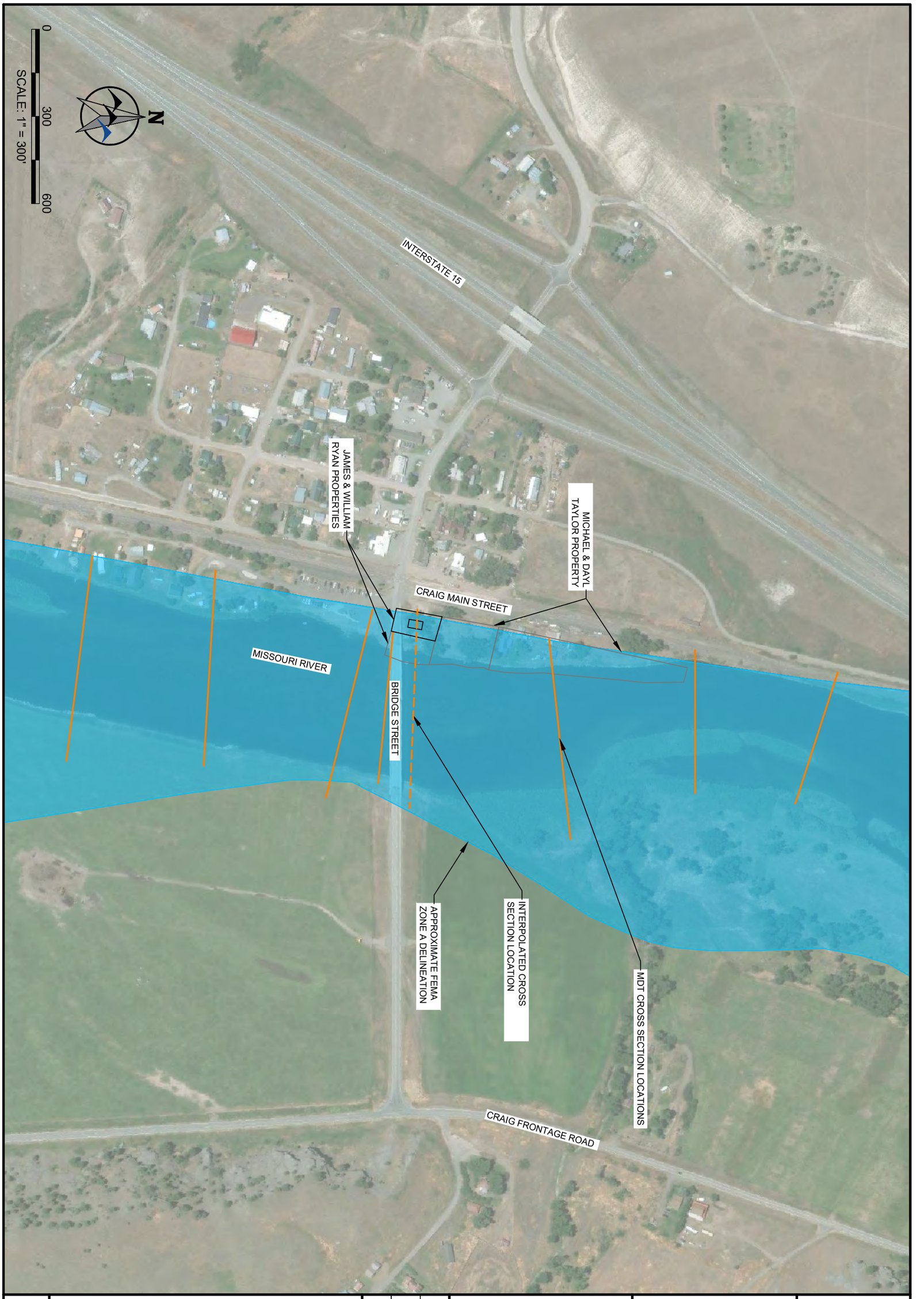
JOB # 2020-090

RYAN FLOODPLAIN STUDY

LOCATION MAP

E

SHEET NO. 1 OF 3



E

SHEET NO. 2 OF 3

RYAN FLOODPLAIN STUDY

CROSS SECTION LOCATION MAP

DSGN	DATE	CKD
GPV	4/17/20	STH
REV	DATE	CKD

JOB # 2020-090

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1901 S. Montana Street
Butte, MT 59702
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14/04/2020 FILE PATH: C:\Users\gpvar\Desktop\05CAD\Sheets\TAYLOR CROSS SECTION LOCATIONS MAP.dwg

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FILE PATH: C:\Users\gpv\Desktop\05CADSheets\TAYLOR SITE PLAN.dwg
14/04/2020

DSGN	DATE	CKD
GPV	4/17/20	STH
REV	DATE	CKD

JOB # 2020-090

RYAN FLOODPLAIN STUDY

SITE PLAN

E

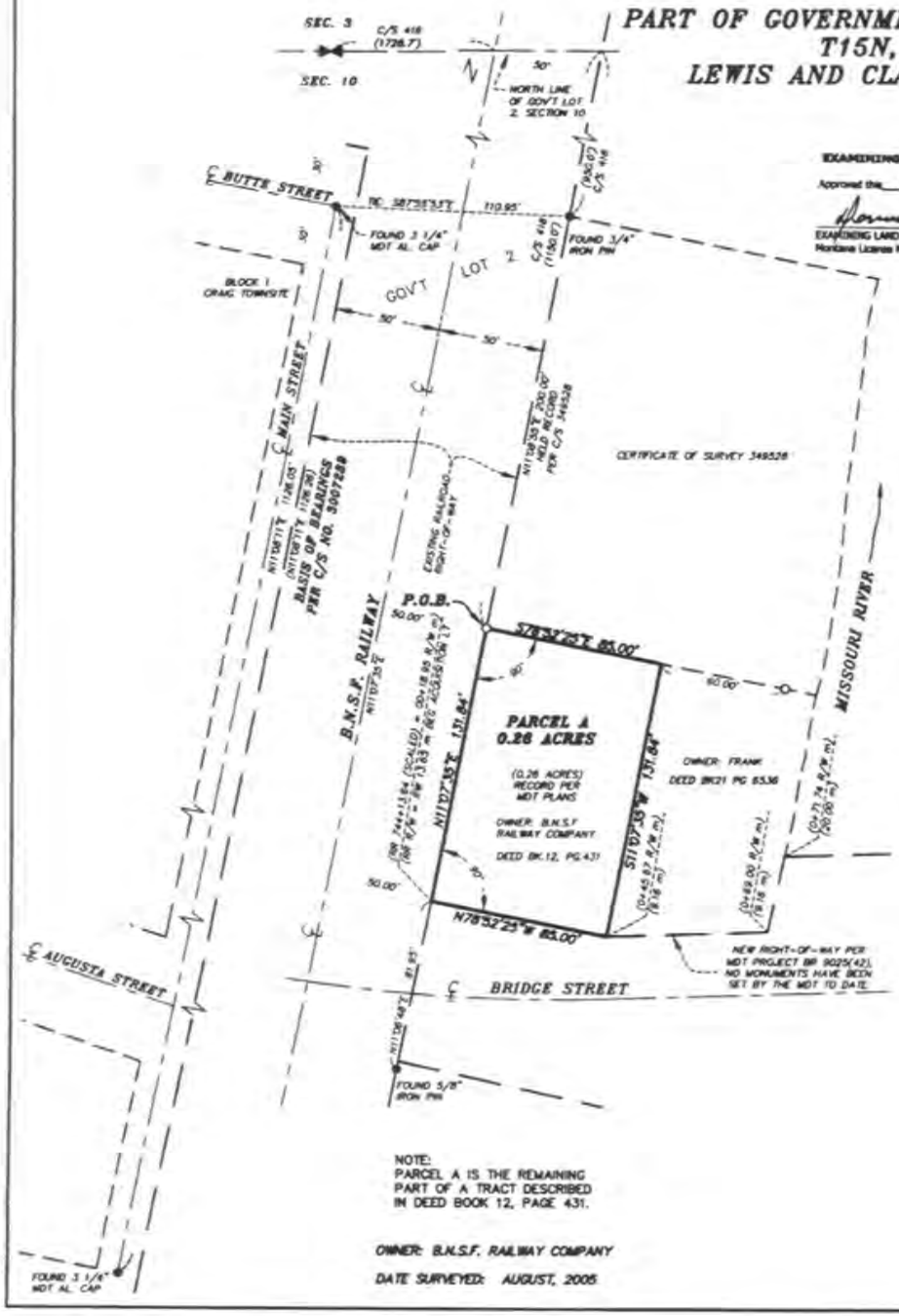
SHEET NO. 3 OF 3

APPENDIX A

CERTIFICATE OF SURVEY

CERTIFICATE OF SURVEY

PART OF GOVERNMENT LOT 2 OF SECTION 10
T15N, R3W, P.M.M.,
LEWIS AND CLARK COUNTY, MONTANA



EXAMINING LAND SURVEYOR APPROVAL

Approved this 2 day of DEC. 2005

EXAMINING LAND SURVEYOR,

Montana License No. 9962-LS

PURPOSE

The purpose for this survey is to retrace the exterior boundary lines of a tract of land.

DESCRIPTION

PARCEL A: A parcel of land in Government Lot 2 of Section 10, T15N, R3W, P.M.M., Lewis and Clark County, Montana, more fully described as follows:

Beginning at the southwesterly corner of Certificate of Survey 349528 and a point 50.00 feet easterly, measured at right angles from the centerline of the main track of B.N.S.F. Railway Company; thence S78°52'25"E, 85.00 feet along the southwesterly line of said Certificate of Survey 349528; thence S11°07'35"W, 131.84 feet along the northwesterly line of Deed Bk. 21 Pg. 6536; thence N78°52'25"W, 85.00 feet along the northerly right-of-way line of Bridge Street per Montana Department of Transportation Project BR 9025(42) to a point 50.00 feet easterly, measured at right angles from said main track centerline; thence N11°07'35"E, 131.84 feet along the easterly right-of-way line of B.N.S.F. Railway Company and parallel to said main track centerline to the point of beginning, containing 0.26 acres.

N

SCALE: 1" = 40'

0 40' 80' 120'
SCALE IN FEET

LEGEND

● = FOUND AS NOTED

○ = SET 5/8" REBAR W/YPC "LINDSETH 8644S"

( ) = RECORD PER MDT PLANS UNLESS OTHERWISE NOTED.

NOTE:
PARCEL A IS THE REMAINING PART OF A TRACT DESCRIBED IN DEED BOOK 12, PAGE 431.

OWNER: B.N.S.F. RAILWAY COMPANY

DATE SURVEYED: AUGUST, 2005

CERTIFICATE OF SURVEYOR

I hereby certify that the purpose for this survey is to retrace the exterior boundaries lines of an existing parcel of land and no division of land is hereby created; therefore, this survey is exempt from review as a subdivision under the Subdivision and Platting Act and from review by the Department of Environmental Quality pursuant to 76-3-103(17)(a), MCA.

Dated this 11TH day of NOVEMBER 2005.

Ronald A. Lindseth
Professional Land Surveyor
Mont. Reg. No. 8644S

MONTANA RONALD A. LINDSETH 8644S LICENSED PROFESSIONAL LAND SURVEYOR

¼	Sec.	T	R
NE	10	15N	3W

LINDSETH & MILBURN SURVEY CO.
GREAT FALLS, MONTANA
PH: 406-727-6983

JOB NO. 0535
DR. BY JTM
DATE SEPT. 8, 2005
REVISED OCT. 2, 2005
F.B. No. 39

SHEET NO. 1 OF 1

3098494
Page: 1 of 1
12/02/2005 03:46P
Lewis & Clark County

Barnes
Butte St
Craig Main St
Frank Dr
Missouri River
Zone A

APPENDIX B

CABIN DETAILS & SPECIFICATIONS

46 12TH ST.
VAUGHN, MT 59487
OFFICE: 406.564.1193

RIVERSIDE CABINS LLC.

LOCATION

MODEL #:

SERIAL #:

PAGE TITLE

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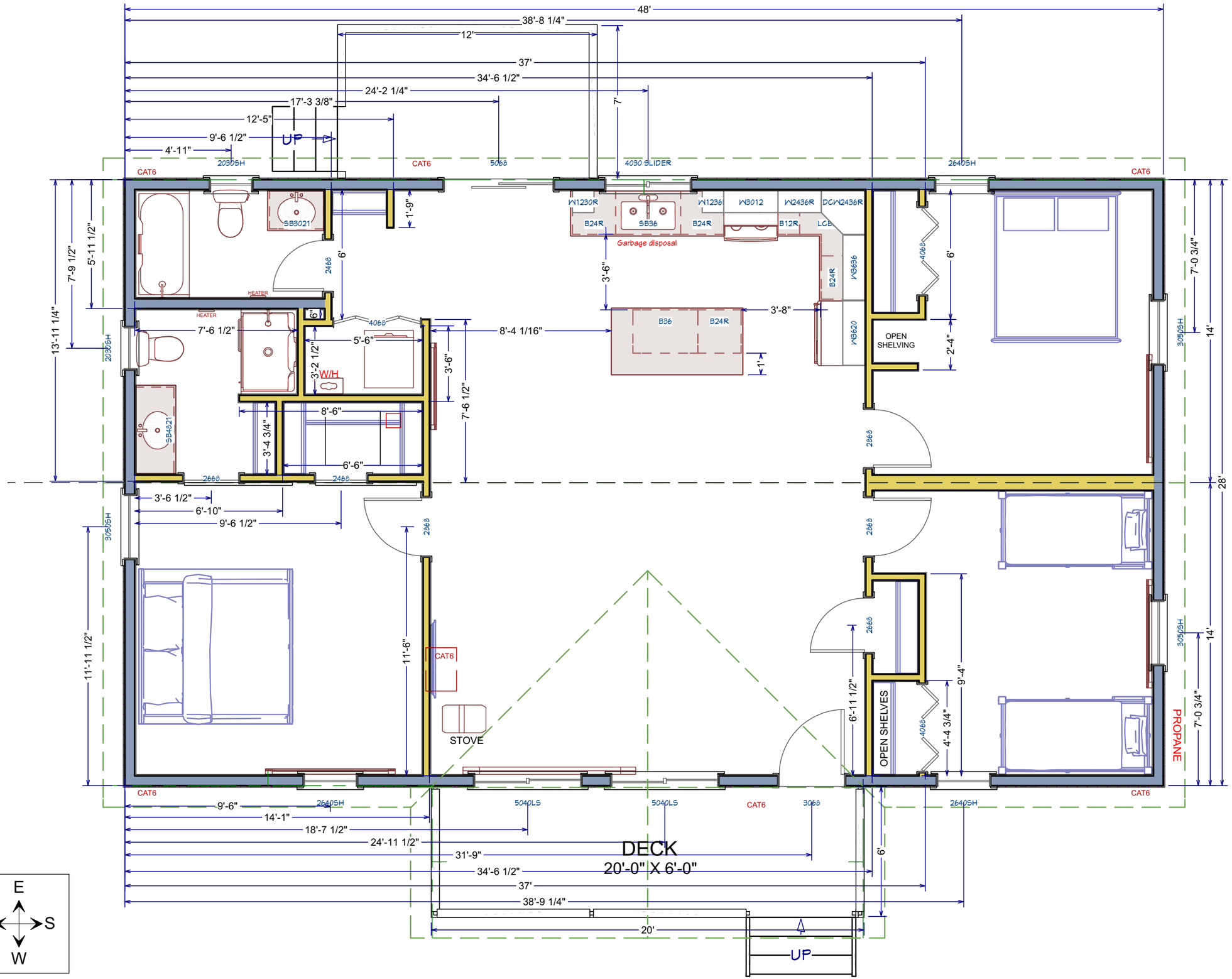
A-1



Riverside Cabins LLC

46 12TH ST.
VAUGHN, MT 59487
OFFICE: 406.564.1193

RIVERSIDE CABINS LLC.

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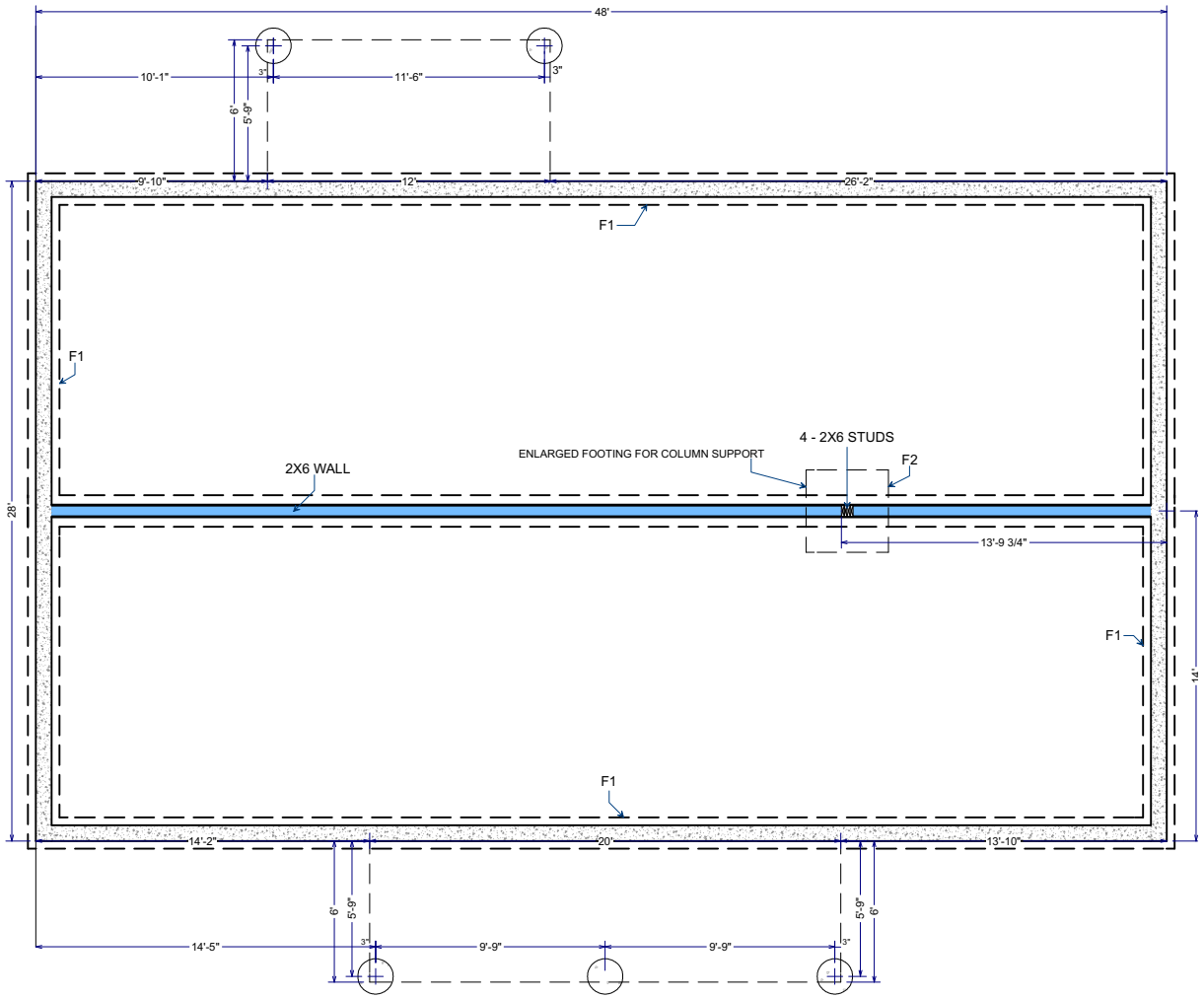
A-1



FOOTING SCHEDULE

F1: 8"X16" FOOTING WITH (2) #4 CONT.
F2: 42"X42"X10" FOOTING WITH (4) #4 E.W.

18" SONOTUBE PIERS OR 12" SONOTUBE PIERS WITH 18"X18"X6" FOOTING ("BIG FOOT BASE")

RIVERSIDE CABINS DOES NOT DESIGN ENGINEER, NOR BUILD THE FOUNDATION SYSTEM. THESE DRAWINGS ARE FOR STRUCTURE TO FOUNDATION ORIENTATION ONLY.

THE OWNER AND/OR CONTRACTOR ARE RESPONSIBLE TO OBTAIN SITE-SPECIFIC GEOTECHNICAL RECOMMENDATIONS FROM A LICENSED GEOTECHNICAL ENGINEER AND AN ADEQUATE FOUNDATION DESIGN BY A LICENSED STRUCTURAL ENGINEER.
(May be Subject to local jurisdiction regulations)

GENERAL FOUNDATION NOTES

1. A CRAWL FOUNDATION REQUIRES AN ACCESS R408.4, VERIFY WHETHER THIS IS IN THE BUILDING FLOOR OR NEEDS TO BE BUILT INTO THE FOUNDATION.
2. THE FOUNDATION WALL MAY BE RECESSED UP TO 2" TO ALLOW FOR EXT. RIGID BOARD INSULATION AND ICF FOUNDATION FORMS.
3. FOUNDATION WALLS MUST EXTEND AT LEAST 6" ABOVE THE FINISHED GRADE.
4. THE FOUNDATION MUST BE DESIGNED AND BUILT TO LOCAL CODES AND SOIL CONDITIONS. BE SURE TO OBTAIN ANY NECESSARY PERMITS BEFORE WORK BEGINS.

NON-CONDITIONED CRAWL SPACES NEED VENTILATION. THE IRC(R408.1) CALLS FOR 1 SQ.FT. OF VENTILATION FOR EACH 150 SQ.FT. OF CRAWL SPACE. THIS REQUIREMENT CAN BE REDUCED SIGNIFICANTLY BY INSTALLING A CLASS 1 VAPOR BARRIER OVER THE DIRT. A VENT OPENING SHOULD BE WITHIN 3' OF EACH CORNER OF THE BUILDING.

MANY JURISDICTIONS ARE REQUIRING A "CONCRETE ENCASED ELECTRODE" ELECTRICAL GROUNDING SYSTEM (UFER GROUND) BE INSTALLED IN THE FOUNDATION (IRX E3608.1.2). IT IS ADVISABLE TO INSTALL THIS SYSTEM PRIOR TO POURING CONCRETE.

RIVERSIDE CABINS SPECIFIC FOUNDATION REQUIREMENTS.

1. ALL SILL PLATES AND PONY/STEM WALLS NEED TO BE INSTALLED BEFORE THE BUILDING ARRIVES. THE TOP OF THE SILL PLATE MUST BE FLUSH. NO ANCHOR BOLTS CAN PROTRUDE ABOVE THE SILL PLATE. SEE FOUNDATION DETAIL PAGE S4 FOR SILL PLATE CONNECTION.
2. SOME JURISDICTIONS REQUIRE THE BUILDING FLOORS TO BE INSULATED. IF SO, IT WILL BE DONE PER N1102.1.1 AND SITE INSTALLED. IT IS STRONGLY ADVISED TO ALSO INSTALL 2" RIGID FOAM BOARD TO THE FOUNDATION WALLS TO PROTECT PIPES IN THE CRAWL SPACE.

46 12TH ST.
VAUGHN, MT 59487
OFFICE: 406.564.1193

RIVERSIDE CABINS LLC.

LOCATION

MODEL:

MODEL #:

PAGE TITLE

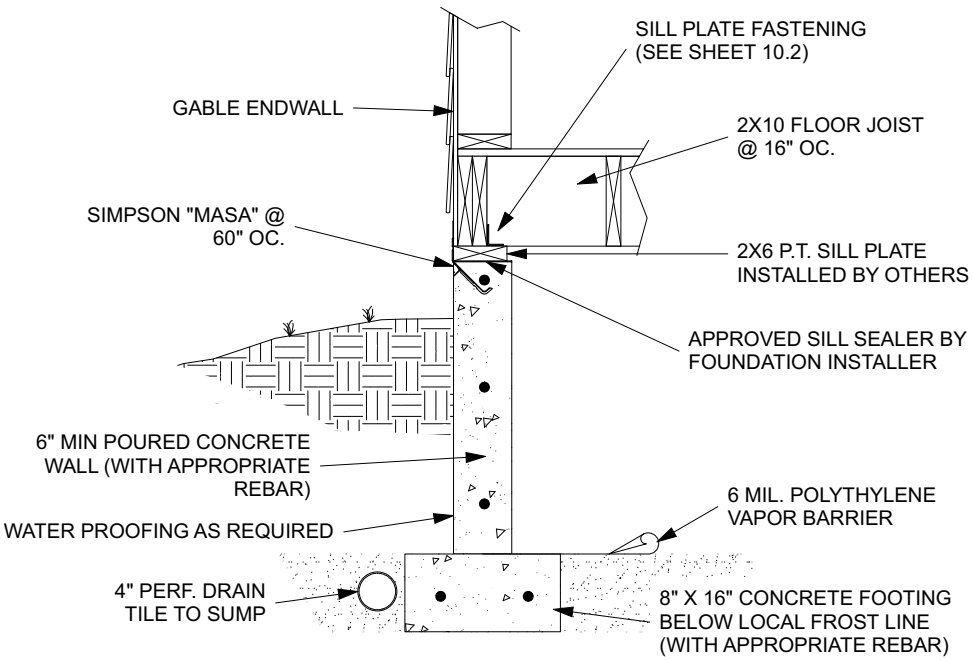
FOUNDATION PLAN

DATE: 00/00/00

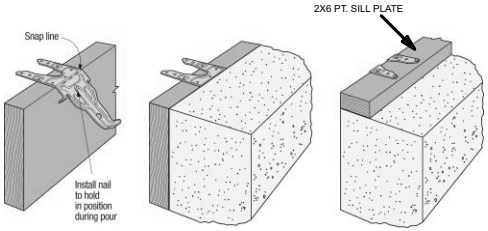
SCALE: # = #

F-1

TYPICAL CRAWL SPACE FOUNDATION DESIGN

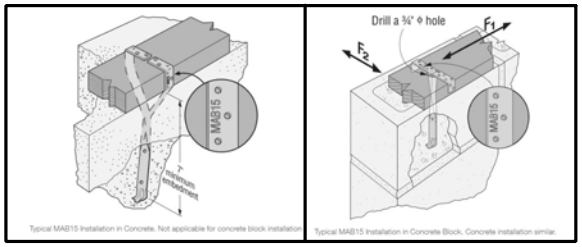


FOUNDATION TO SILL PLATE CONNECTIONS



SIMPSON "MASA" 60" O.C. 12" FROM END OF PLATE
(4) 10D X 1-1/2" NAILS ON TOP
(2) 10D X 1-1/2" NAILS IN SIDE

FOUNDATION TO SILL PLATE CONNECTIONS ***WITH INSULATED CONCRETE FORMS***



1. IF YOU WILL BE USING THE MASA OR MASAP TIES (MASAP WARK WELL FOR THIS) PLACE THEM ON THE INSIDE EDGE OF THE SILL PLATE SPACED 5' APART.
2. IF USING THE MAB15 TIES SPACING IS EVERY 3'.
3. MAKE THE OUTSIDE EDGE OF THE PRESSURE TREATED 2X6 FLUSH WITH THE OUTSIDE EDGE OF THE INSULATED FORMS.

Riverside Cabins does not design, engineer, nor build the foundation system.
These drawings are for **structure to foundation orientation only.**
Any foundation design given is generic in nature.
THE OWNER AND/OR CONTRACTOR ARE RESPONSIBLE TO OBTAIN SITE-SPECIFIC GEOTECHNICAL RECOMMENDATIONS FROM A LICENSED GEOTECHNICAL ENGINEER AND AN ADEQUATE FOUNDATION DESIGN BY A LICENSED STRUCTURAL ENGINEER.
(May be Subject to local jurisdiction regulations)

46 12TH ST.
VAUGHN, MT 59487
OFFICE: 406.564.1193

RIVERSIDE CABINS LLC.

LOCATION

MODEL:

MODEL #:

PAGE TITLE

ANCHORING DETAILS

DATE: 00/00/00

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F-2

APPENDIX C

FLOOD INSURANCE RATE MAP

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Montana State Plane Zone (FIPS zone 2500). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from NAIP Orthophotography produced with a one meter ground resolution from photography dated 2005.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

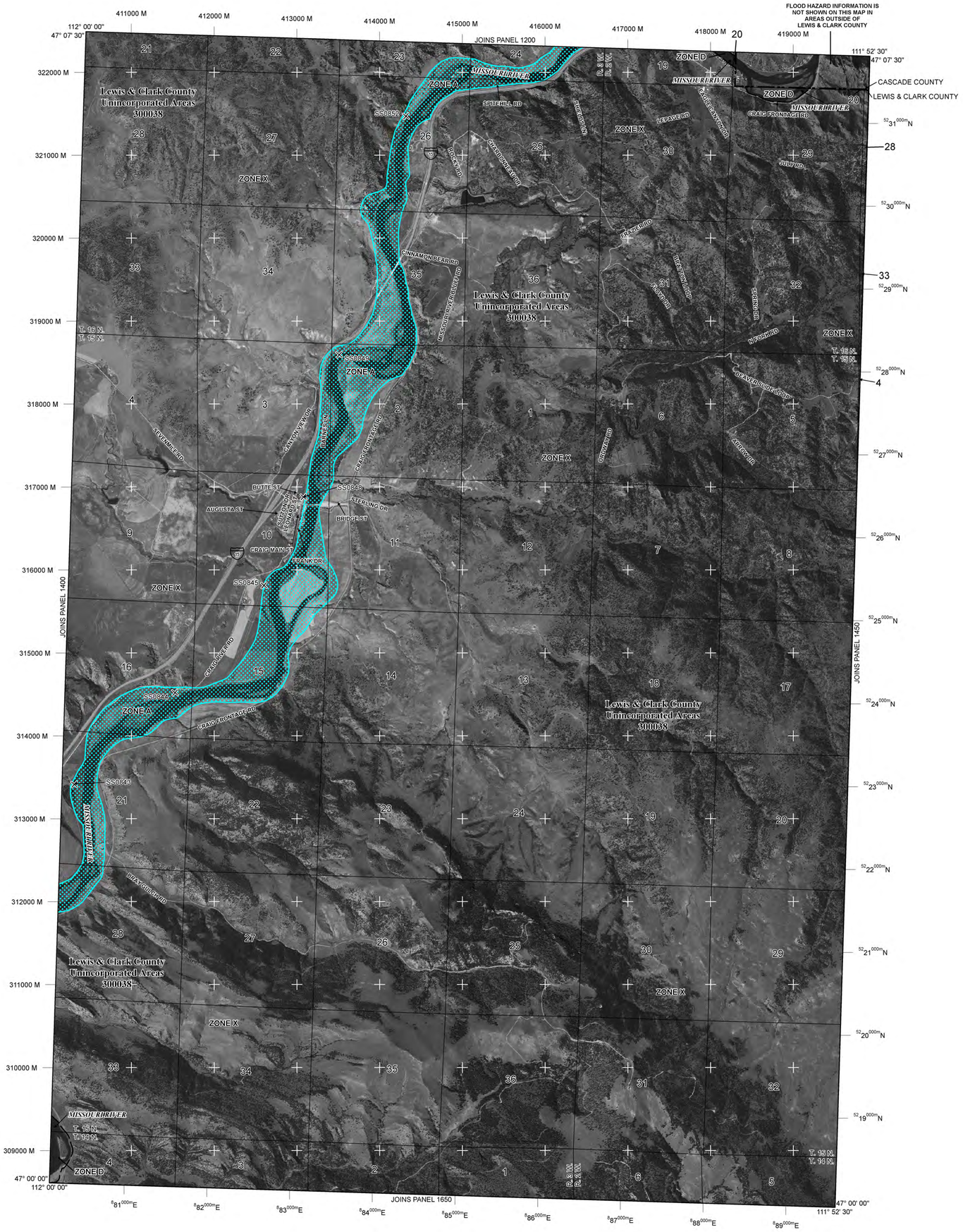
For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

Lewis & Clark County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)	Flooding Source	Vertical Datum Offset (ft)
Blackfoot River	3.7	Orofino Gulch	3.5
East Overflow of Prickly Pear Creek	3.4	Prickly Pear Creek	3.4
Elk Creek	3.3	Silver Creek	3.3
Grizzly Gulch	3.5	South Braid of Prickly Pear Creek	3.4
Last Chance Gulch	3.4	Ten Mile Creek	3.4
North Overflow of Prickly Pear Creek	3.4		

Example: To convert Blackfoot River elevations to NAVD 88, 3.7 feet were added to the NGVD 29 elevations.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% Annual Chance Floodplain Boundary
	0.2% Annual Chance Floodplain Boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
23 - - - - 23	Transect line
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
4989000 M	1000-meter ticks: Montana State Plane Zone (FIPS Zone 2500), Lambert Conformal Conic projection
$^{48}89^{000m}$ N	1000-meter Universal Transverse Mercator grid values, zone 11
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 19, 2012

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET
600 0 600 1200 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1425E

FIRM

FLOOD INSURANCE RATE MAP

LEWIS AND CLARK COUNTY, MONTANA AND INCORPORATED AREAS

PANEL 1425 OF 2450

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LEWIS & CLARK COUNTY, UNINCORPORATED AREAS	300038	1425	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
30049C1425E

EFFECTIVE DATE
SEPTEMBER 19, 2012

Federal Emergency Management Agency

APPENDIX D

HYDROLOGY CALCULATIONS

1

```
  Program PeakFq           U. S. GEOLOGICAL SURVEY             Seq.002.000
  Version 7.1         Annual peak flow frequency analysis      Run Date / Time
  3/14/2014                                                    04/14/2020 10:16

                        --- PROCESSING OPTIONS ---

                      Plot option         = None
                      Basin char output   = WATSTORE
                      Print option        = Yes
                      Debug print         = No
                      Input peaks listing = Long
                      Input peaks format  = WATSTORE peak file

                      Input files used:
                         peaks (ascii)  - K:\Helena\RYAN\2020090 Flood
Study\07Calc\Hydrology\USGS\WOLF CREEK.TXT
                         specifications - K:\Helena\RYAN\2020090 Flood
Study\07Calc\Hydrology\USGS\PKFQWPSF.TMP
                      Output file(s):
                         main - K:\Helena\RYAN\2020090 Flood
Study\07Calc\Hydrology\USGS\WOLF CREEK.PRT
                         bcd  - K:\Helena\RYAN\2020090 Flood
Study\07Calc\Hydrology\USGS\WOLF CREEK.BCD
```

1

```
  Program PeakFq           U. S. GEOLOGICAL SURVEY             Seq.001.001
  Version 7.1         Annual peak flow frequency analysis      Run Date / Time
  3/14/2014                                                    04/14/2020 10:16

        Station - 06066500  Missouri River bl Holter Dam nr Wolf Cr MT


                     I N P U T   D A T A   S U M M A R Y

                Number of peaks in record            =       74
                Peaks not used in analysis           =        0
                Systematic peaks in analysis         =       74
                Historic peaks in analysis           =        0
                Beginning Year                       =     1946
                Ending Year                          =     2019
                Historical Period Length             =        0
                Generalized skew                     =    0.278
                     Standard error                  =    0.550
                     Mean Square error               =    0.303
                Skew option                          =   WEIGHTED
```

```
Gage base discharge                  =      0.0
User supplied high outlier threshold =   --
User supplied PILF (LO) criterion    =   --
Plotting position parameter          =     0.00
Type of analysis                       BULL.17B
PILF (LO) Test Method                      GBT
Perception Thresholds            =   Not Applicable
Interval Data                    =   Not Applicable
```

```
*********  NOTICE  --  Preliminary machine computations.        *********
*********  User responsible for assessment and interpretation.  *********

  WCF134I-NO SYSTEMATIC PEAKS WERE BELOW GAGE BASE.                  0.0
  WCF195I-NO LOW OUTLIERS WERE DETECTED BELOW CRITERION.           2422.5
  WCF163I-NO HIGH OUTLIERS OR HISTORIC PEAKS EXCEEDED HHBASE.     62387.9
```

Kendall's Tau Parameters

	TAU	P-VALUE	MEDIAN SLOPE	No. of PEAKS
SYSTEMATIC RECORD	-0.265	0.001	-126.571	74

1

```
Program PeakFq          U. S. GEOLOGICAL SURVEY            Seq.001.002
Version 7.1        Annual peak flow frequency analysis     Run Date / Time
3/14/2014                                                  04/14/2020 10:16
```

Station - 06066500 Missouri River bl Holter Dam nr Wolf Cr MT

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE		LOGARITHMIC		
	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	1.0000	4.0897	0.2422	-0.446
BULL.17B ESTIMATE	0.0	1.0000	4.0897	0.2422	-0.270

BULL.17B ESTIMATE OF MSE OF AT-SITE SKEW 0.0976

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	<-- FOR BULLETIN 17B ESTIMATES --> VARIANCE OF EST.	95% CONFIDENCE INTERVALS LOWER	UPPER
0.9950	2539.	2317.	----	1931.0	3145.0
0.9900	3010.	2807.	----	2346.0	3664.0
0.9500	4716.	4602.	----	3903.0	5495.0
0.9000	5930.	5888.	----	5046.0	6780.0
0.8000	7756.	7813.	----	6784.0	8714.0
0.6667	9875.	10020.	----	8793.0	11000.0
0.5000	12610.	12810.	----	11320.0	14050.0
0.4292	13910.	14120.	----	12500.0	15550.0
0.2000	19770.	19820.	----	17590.0	22640.0
0.1000	24680.	24340.	----	21640.0	28900.0
0.0400	30940.	29810.	----	26630.0	37210.0
0.0200	35610.	33690.	----	30260.0	43610.0
0.0100	40260.	37400.	----	33820.0	50120.0
0.0050	44910.	40970.	----	37320.0	56750.0
0.0020	51080.	45480.	----	41900.0	65720.0

100-year flood event peak flow = 40,260 cfs

1

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.001.003
Version 7.1 Annual peak flow frequency analysis Run Date / Time
3/14/2014 04/14/2020 10:16

Station - 06066500 Missouri River bl Holter Dam nr Wolf Cr MT

I N P U T D A T A L I S T I N G

WATER YEAR	PEAK VALUE	PEAKFQ CODES	REMARKS
1946	16000.0		
1947	27200.0		
1948	34800.0		
1949	19600.0		
1950	18700.0		
1951	22000.0		
1952	23700.0		
1953	13500.0		
1954	5500.0		

1955	6720.0
1956	25500.0
1957	17000.0
1958	9450.0
1959	19200.0
1960	14900.0
1961	7760.0
1962	15000.0
1963	16700.0
1964	27100.0
1965	18300.0
1966	11800.0
1967	20300.0
1968	11200.0
1969	18100.0
1970	17500.0
1971	17200.0
1972	13300.0
1973	7170.0
1974	18600.0
1975	23300.0
1976	17900.0
1977	7210.0
1978	12700.0
1979	7620.0
1980	18300.0
1981	25300.0
1982	21100.0
1983	14400.0
1984	22300.0
1985	9820.0
1986	14700.0
1987	6340.0
1988	5090.0
1989	6050.0
1990	6360.0
1991	15600.0
1992	4940.0
1993	15800.0
1994	6380.0
1995	16200.0
1996	20000.0
1997	23500.0
1998	19500.0
1999	11700.0
2000	5270.0
2001	3990.0
2002	3370.0

2003	10300.0
2004	4070.0
2005	7070.0
2006	6880.0
2007	5910.0
2008	16000.0
2009	11700.0
2010	18900.0
2011	23200.0
2012	9130.0
2013	5240.0
2014	11500.0
2015	6200.0
2016	7140.0
2017	11800.0
2018	20000.0
2019	11500.0

Explanation of peak discharge qualification codes

PeakFQ CODE	NWIS CODE	DEFINITION
D	3	Dam failure, non-recurrent flow anomaly
G	8	Discharge greater than stated value
X	3+8	Both of the above
L	4	Discharge less than stated value
K	6 OR C	Known effect of regulation or urbanization
H	7	Historic peak

- Minus-flagged discharge -- Not used in computation
  -8888.0 -- No discharge value given
- Minus-flagged water year -- Historic peak used in computation

1

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.001.004
Version 7.1 Annual peak flow frequency analysis Run Date / Time
3/14/2014 04/14/2020 10:16

Station - 06066500 Missouri River bl Holter Dam nr Wolf Cr MT

EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

WATER YEAR	RANKED DISCHARGE	SYSTEMATIC RECORD	B17B ESTIMATE
1948	34800.0	0.0133	0.0133
1947	27200.0	0.0267	0.0267
1964	27100.0	0.0400	0.0400
1956	25500.0	0.0533	0.0533
1981	25300.0	0.0667	0.0667
1952	23700.0	0.0800	0.0800
1997	23500.0	0.0933	0.0933
1975	23300.0	0.1067	0.1067
2011	23200.0	0.1200	0.1200
1984	22300.0	0.1333	0.1333
1951	22000.0	0.1467	0.1467
1982	21100.0	0.1600	0.1600
1967	20300.0	0.1733	0.1733
1996	20000.0	0.1867	0.1867
2018	20000.0	0.2000	0.2000
1949	19600.0	0.2133	0.2133
1998	19500.0	0.2267	0.2267
1959	19200.0	0.2400	0.2400
2010	18900.0	0.2533	0.2533
1950	18700.0	0.2667	0.2667
1974	18600.0	0.2800	0.2800
1965	18300.0	0.2933	0.2933
1980	18300.0	0.3067	0.3067
1969	18100.0	0.3200	0.3200
1976	17900.0	0.3333	0.3333
1970	17500.0	0.3467	0.3467
1971	17200.0	0.3600	0.3600
1957	17000.0	0.3733	0.3733
1963	16700.0	0.3867	0.3867
1995	16200.0	0.4000	0.4000
1946	16000.0	0.4133	0.4133
2008	16000.0	0.4267	0.4267
1993	15800.0	0.4400	0.4400
1991	15600.0	0.4533	0.4533
1962	15000.0	0.4667	0.4667
1960	14900.0	0.4800	0.4800
1986	14700.0	0.4933	0.4933
1983	14400.0	0.5067	0.5067
1953	13500.0	0.5200	0.5200
1972	13300.0	0.5333	0.5333
1978	12700.0	0.5467	0.5467
1966	11800.0	0.5600	0.5600
2017	11800.0	0.5733	0.5733
1999	11700.0	0.5867	0.5867
2009	11700.0	0.6000	0.6000

```
    2014    11500.0     0.6133      0.6133
    2019    11500.0     0.6267      0.6267
    1968    11200.0     0.6400      0.6400
    2003    10300.0     0.6533      0.6533
    1985     9820.0     0.6667      0.6667
    1958     9450.0     0.6800      0.6800
    2012     9130.0     0.6933      0.6933
    1961     7760.0     0.7067      0.7067
    1979     7620.0     0.7200      0.7200
    1977     7210.0     0.7333      0.7333
    1973     7170.0     0.7467      0.7467
    2016     7140.0     0.7600      0.7600
    2005     7070.0     0.7733      0.7733
    2006     6880.0     0.7867      0.7867
    1955     6720.0     0.8000      0.8000
    1994     6380.0     0.8133      0.8133
    1990     6360.0     0.8267      0.8267
    1987     6340.0     0.8400      0.8400
    2015     6200.0     0.8533      0.8533
    1989     6050.0     0.8667      0.8667
    2007     5910.0     0.8800      0.8800
    1954     5500.0     0.8933      0.8933
    2000     5270.0     0.9067      0.9067
    2013     5240.0     0.9200      0.9200
    1988     5090.0     0.9333      0.9333
    1992     4940.0     0.9467      0.9467
    2004     4070.0     0.9600      0.9600
    2001     3990.0     0.9733      0.9733
    2002     3370.0     0.9867      0.9867
1


 End PeakFQ analysis.
   Stations processed :       1
   Number of errors   :       0
   Stations skipped   :       0
   Station years      :      74


Data records may have been ignored for the stations listed below.
(Card type must be Y, Z, N, H, I, 2, 3, 4,  or *.)
(2, 4, and * records are ignored.)

 For the station below, the following records were ignored:

 FINISHED PROCESSING STATION:  06066500       USGS Missouri River bl Holter Dam
```

For the station below, the following records were ignored:

FINISHED PROCESSING STATION:

APPENDIX E

HEC-RAS DATA

OVERALL HEC-RAS DATA

HEC-RAS River: Missouri River Reach: main

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
main	7	50-YR Flow	Exist	1008.00	1049.01	1053.58		1053.69	0.000349	1.56	915.16	648.57	0.26
main	7	50-YR Flow	Prop	1008.00	1049.01	1053.58		1053.69	0.000349	1.56	915.16	648.57	0.26
main	7	100-YR Flow	Exist	1140.00	1049.01	1053.79		1053.89	0.000329	1.57	1050.27	664.79	0.26
main	7	100-YR Flow	Prop	1140.00	1049.01	1053.79		1053.89	0.000329	1.57	1050.27	664.79	0.26
main	7	500-YR Flow	Exist	1447.00	1049.01	1054.21		1054.31	0.000295	1.60	1339.59	686.81	0.25
main	7	500-YR Flow	Prop	1447.00	1049.01	1054.21		1054.31	0.000295	1.60	1339.59	686.81	0.25
main	7	2-YR Flow	Exist	357.00	1049.01	1052.03		1052.10	0.000388	1.17	303.88	139.33	0.25
main	7	2-YR Flow	Prop	357.00	1049.01	1052.03		1052.10	0.000388	1.17	303.88	139.33	0.25
main	7	100-YR Flow MDT	Exist	1294.00	1049.01	1054.01		1054.11	0.000311	1.59	1198.66	681.72	0.25
main	7	100-YR Flow MDT	Prop	1294.00	1049.01	1054.01		1054.11	0.000311	1.59	1198.66	681.72	0.25
main	6	50-YR Flow	Exist	1008.00	1049.34	1053.53		1053.63	0.000370	1.58	892.60	602.90	0.27
main	6	50-YR Flow	Prop	1008.00	1049.34	1053.53		1053.63	0.000370	1.58	892.60	602.90	0.27
main	6	100-YR Flow	Exist	1140.00	1049.34	1053.74		1053.84	0.000349	1.59	1019.57	616.99	0.26
main	6	100-YR Flow	Prop	1140.00	1049.34	1053.74		1053.84	0.000349	1.59	1019.57	616.99	0.26
main	6	500-YR Flow	Exist	1447.00	1049.34	1054.16		1054.26	0.000314	1.62	1287.32	629.44	0.25
main	6	500-YR Flow	Prop	1447.00	1049.34	1054.16		1054.26	0.000314	1.62	1287.32	629.44	0.25
main	6	2-YR Flow	Exist	357.00	1049.34	1051.96		1052.03	0.000474	1.24	288.26	151.03	0.28
main	6	2-YR Flow	Prop	357.00	1049.34	1051.96		1052.03	0.000474	1.24	288.26	151.03	0.28
main	6	100-YR Flow MDT	Exist	1294.00	1049.34	1053.96		1054.06	0.000329	1.61	1157.69	624.14	0.26
main	6	100-YR Flow MDT	Prop	1294.00	1049.34	1053.96		1054.06	0.000329	1.61	1157.69	624.14	0.26
main	5	50-YR Flow	Exist	1008.00	1049.33	1053.34		1053.55	0.000686	2.04	494.00	152.14	0.36
main	5	50-YR Flow	Prop	1008.00	1049.33	1053.34		1053.55	0.000686	2.04	494.00	152.14	0.36
main	5	100-YR Flow	Exist	1140.00	1049.33	1053.50		1053.75	0.000746	2.19	521.38	190.43	0.38
main	5	100-YR Flow	Prop	1140.00	1049.33	1053.50		1053.75	0.000746	2.19	521.38	190.43	0.38
main	5	500-YR Flow	Exist	1447.00	1049.33	1053.85		1054.17	0.000861	2.50	615.72	312.56	0.41
main	5	500-YR Flow	Prop	1447.00	1049.33	1053.85		1054.17	0.000861	2.50	615.72	312.56	0.41
main	5	2-YR Flow	Exist	357.00	1049.33	1051.87		1051.96	0.000553	1.29	276.71	144.72	0.30
main	5	2-YR Flow	Prop	357.00	1049.33	1051.87		1051.96	0.000553	1.29	276.71	144.72	0.30
main	5	100-YR Flow MDT	Exist	1294.00	1049.33	1053.68		1053.97	0.000811	2.36	565.48	275.12	0.40
main	5	100-YR Flow MDT	Prop	1294.00	1049.33	1053.68		1053.97	0.000811	2.36	565.48	275.12	0.40
main	4	50-YR Flow	Exist	1008.00	1048.98	1053.34	1051.36	1053.52	0.000517	1.89	533.35	148.19	0.32
main	4	50-YR Flow	Prop	1008.00	1048.98	1053.34	1051.36	1053.52	0.000517	1.89	533.35	148.19	0.32
main	4	100-YR Flow	Exist	1140.00	1048.98	1053.51	1051.51	1053.72	0.000570	2.04	558.48	148.63	0.34
main	4	100-YR Flow	Prop	1140.00	1048.98	1053.51	1051.51	1053.72	0.000570	2.04	558.48	148.63	0.34
main	4	500-YR Flow	Exist	1447.00	1048.98	1053.85	1051.83	1054.14	0.000691	2.37	614.39	188.85	0.38
main	4	500-YR Flow	Prop	1447.00	1048.98	1053.85	1051.83	1054.14	0.000691	2.37	614.39	188.85	0.38
main	4	2-YR Flow	Exist	357.00	1048.98	1051.88	1050.48	1051.94	0.000345	1.12	318.85	144.35	0.24
main	4	2-YR Flow	Prop	357.00	1048.98	1051.88	1050.48	1051.94	0.000345	1.12	318.85	144.35	0.24
main	4	100-YR Flow MDT	Exist	1294.00	1048.98	1053.69	1051.67	1053.94	0.000632	2.21	585.61	160.24	0.36
main	4	100-YR Flow MDT	Prop	1294.00	1048.98	1053.69	1051.67	1053.94	0.000632	2.21	585.61	160.24	0.36
main	3.9			Bridge									
main	3.8	50-YR Flow	Exist	1008.00	1049.27	1053.25		1053.46	0.000655	2.04	494.28	147.07	0.35
main	3.8	50-YR Flow	Prop	1008.00	1049.27	1053.25		1053.46	0.000655	2.04	494.28	147.07	0.35
main	3.8	100-YR Flow	Exist	1140.00	1049.27	1053.41		1053.65	0.000720	2.20	517.36	147.66	0.37
main	3.8	100-YR Flow	Prop	1140.00	1049.27	1053.41		1053.65	0.000720	2.20	517.36	147.66	0.37
main	3.8	500-YR Flow	Exist	1447.00	1049.27	1053.72		1054.05	0.000875	2.57	564.70	170.15	0.42
main	3.8	500-YR Flow	Prop	1447.00	1049.27	1053.72		1054.05	0.000875	2.57	564.69	170.14	0.42
main	3.8	2-YR Flow	Exist	357.00	1049.27	1051.82		1051.90	0.000477	1.24	287.72	142.59	0.28
main	3.8	2-YR Flow	Prop	357.00	1049.27	1051.82		1051.90	0.000477	1.24	287.72	142.59	0.28
main	3.8	100-YR Flow MDT	Exist	1294.00	1049.27	1053.57		1053.86	0.000798	2.39	541.36	148.26	0.40
main	3.8	100-YR Flow MDT	Prop	1294.00	1049.27	1053.57		1053.86	0.000798	2.39	541.36	148.26	0.40
main	3.5	50-YR Flow	Exist	1008.00	1049.02	1053.23		1053.44	0.000639	2.05	493.23	145.21	0.35
main	3.5	50-YR Flow	Prop	1008.00	1049.02	1053.23		1053.44	0.000639	2.05	493.23	145.21	0.35
main	3.5	100-YR Flow	Exist	1140.00	1049.02	1053.39		1053.64	0.000706	2.21	515.62	145.82	0.37
main	3.5	100-YR Flow	Prop	1140.00	1049.02	1053.39		1053.64	0.000706	2.21	515.62	145.82	0.37
main	3.5	500-YR Flow	Exist	1447.00	1049.02	1053.69		1054.03	0.000867	2.59	560.85	164.49	0.42
main	3.5	500-YR Flow	Prop	1447.00	1049.02	1053.69		1054.03	0.000867	2.59	560.84	164.48	0.42
main	3.5	2-YR Flow	Exist	357.00	1049.02	1051.81		1051.89	0.000449	1.23	290.94	139.99	0.27
main	3.5	2-YR Flow	Prop	357.00	1049.02	1051.81		1051.89	0.000449	1.23	290.94	139.99	0.27
main	3.5	100-YR Flow MDT	Exist	1294.00	1049.02	1053.54		1053.84	0.000787	2.41	538.83	146.46	0.40
main	3.5	100-YR Flow MDT	Prop	1294.00	1049.02	1053.54		1053.84	0.000787	2.41	538.83	146.46	0.40
main	3	50-YR Flow	Exist	1008.00	1048.02	1053.20		1053.38	0.000491	1.92	598.75	266.31	0.31
main	3	50-YR Flow	Prop	1008.00	1048.02	1053.20		1053.38	0.000491	1.92	598.75	266.31	0.31
main	3	100-YR Flow	Exist	1140.00	1048.02	1053.35		1053.56	0.000549	2.08	643.85	322.31	0.34
main	3	100-YR Flow	Prop	1140.00	1048.02	1053.35		1053.56	0.000549	2.08	643.85	322.31	0.34
main	3	500-YR Flow	Exist	1447.00	1048.02	1053.67		1053.93	0.000642	2.37	754.56	378.07	0.37
main	3	500-YR Flow	Prop	1447.00	1048.02	1053.67		1053.93	0.000642	2.37	754.56	378.07	0.37
main	3	2-YR Flow	Exist	357.00	1048.02	1051.78		1051.85	0.000335	1.16	313.69	161.55	0.24
main	3	2-YR Flow	Prop	357.00	1048.02	1051.78		1051.85	0.000335	1.16	313.69	161.55	0.24
main	3	100-YR Flow MDT	Exist	1294.00	1048.02	1053.52		1053.75	0.000597	2.23	699.18	347.66	0.35
main	3	100-YR Flow MDT	Prop	1294.00	1048.02	1053.52		1053.75	0.000597	2.23	699.18	347.66	0.35
main	2	50-YR Flow	Exist	1008.00	1047.55	1053.18		1053.30	0.000356	1.64	827.61	436.72	0.27
main	2	50-YR Flow	Prop	1008.00	1047.55	1053.18		1053.30	0.000356	1.64	827.61	436.72	0.27
main	2	100-YR Flow	Exist	1140.00	1047.55	1053.34		1053.47	0.000374	1.73	898.79	448.77	0.28
main	2	100-YR Flow	Prop	1140.00	1047.55	1053.34		1053.47	0.000374	1.73	898.79	448.77	0.28
main	2	500-YR Flow	Exist	1447.00	1047.55	1053.68		1053.82	0.000414	1.92	1052.95	483.60	0.30

HEC-RAS River: Missouri River Reach: main (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
main	2	500-YR Flow	Prop	1447.00	1047.55	1053.68		1053.82	0.000414	1.92	1052.95	483.60	0.30
main	2	2-YR Flow	Exist	357.00	1047.55	1051.74		1051.80	0.000304	1.11	362.39	229.06	0.23
main	2	2-YR Flow	Prop	357.00	1047.55	1051.74		1051.80	0.000304	1.11	362.39	229.06	0.23
main	2	100-YR Flow MDT	Exist	1294.00	1047.55	1053.52		1053.65	0.000396	1.83	977.26	466.55	0.29
main	2	100-YR Flow MDT	Prop	1294.00	1047.55	1053.52		1053.65	0.000396	1.83	977.26	466.55	0.29
main	1	50-YR Flow	Exist	1008.00	1047.83	1053.03	1051.56	1053.22	0.000730	2.00	628.59	471.65	0.37
main	1	50-YR Flow	Prop	1008.00	1047.83	1053.03	1051.56	1053.22	0.000730	2.00	628.59	471.65	0.37
main	1	100-YR Flow	Exist	1140.00	1047.83	1053.19	1051.72	1053.38	0.000730	2.07	705.54	482.30	0.37
main	1	100-YR Flow	Prop	1140.00	1047.83	1053.19	1051.72	1053.38	0.000730	2.07	705.54	482.30	0.37
main	1	500-YR Flow	Exist	1447.00	1047.83	1053.52	1052.12	1053.73	0.000731	2.21	870.79	510.63	0.38
main	1	500-YR Flow	Prop	1447.00	1047.83	1053.52	1052.12	1053.73	0.000731	2.21	870.79	510.63	0.38
main	1	2-YR Flow	Exist	357.00	1047.83	1051.62	1050.28	1051.72	0.000731	1.44	247.82	134.90	0.34
main	1	2-YR Flow	Prop	357.00	1047.83	1051.62	1050.28	1051.72	0.000731	1.44	247.82	134.90	0.34
main	1	100-YR Flow MDT	Exist	1294.00	1047.83	1053.36	1051.95	1053.57	0.000731	2.14	789.93	495.06	0.37
main	1	100-YR Flow MDT	Prop	1294.00	1047.83	1053.36	1051.95	1053.57	0.000731	2.14	789.93	495.06	0.37

PROPOSED CONDITIONS REPORT

HEC-RAS Plan: Prop River: Missouri River Reach: main Profile: 100-YR Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
main	7	100-YR Flow	1140.00	1049.01	1053.79		1053.89	0.000329	1.57	1050.27	664.79	0.26
main	6	100-YR Flow	1140.00	1049.34	1053.74		1053.84	0.000349	1.59	1019.57	616.99	0.26
main	5	100-YR Flow	1140.00	1049.33	1053.50		1053.75	0.000746	2.19	521.38	190.43	0.38
main	4	100-YR Flow	1140.00	1048.98	1053.51	1051.51	1053.72	0.000570	2.04	558.48	148.63	0.34
main	3.9		Bridge									
main	3.8	100-YR Flow	1140.00	1049.27	1053.41		1053.65	0.000720	2.20	517.36	147.66	0.37
main	3.5	100-YR Flow	1140.00	1049.02	1053.39		1053.64	0.000706	2.21	515.62	145.82	0.37
main	3	100-YR Flow	1140.00	1048.02	1053.35		1053.56	0.000549	2.08	643.85	322.31	0.34
main	2	100-YR Flow	1140.00	1047.55	1053.34		1053.47	0.000374	1.73	898.79	448.77	0.28
main	1	100-YR Flow	1140.00	1047.83	1053.19	1051.72	1053.38	0.000730	2.07	705.54	482.30	0.37

EXISTING CONDITIONS REPORT

HEC-RAS Plan: Exist River: Missouri River Reach: main Profile: 100-YR Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
main	7	100-YR Flow	1140.00	1049.01	1053.79		1053.89	0.000329	1.57	1050.27	664.79	0.26
main	6	100-YR Flow	1140.00	1049.34	1053.74		1053.84	0.000349	1.59	1019.57	616.99	0.26
main	5	100-YR Flow	1140.00	1049.33	1053.50		1053.75	0.000746	2.19	521.38	190.43	0.38
main	4	100-YR Flow	1140.00	1048.98	1053.51	1051.51	1053.72	0.000570	2.04	558.48	148.63	0.34
main	3.9		Bridge									
main	3.8	100-YR Flow	1140.00	1049.27	1053.41		1053.65	0.000720	2.20	517.36	147.66	0.37
main	3.5	100-YR Flow	1140.00	1049.02	1053.39		1053.64	0.000706	2.21	515.62	145.82	0.37
main	3	100-YR Flow	1140.00	1048.02	1053.35		1053.56	0.000549	2.08	643.85	322.31	0.34
main	2	100-YR Flow	1140.00	1047.55	1053.34		1053.47	0.000374	1.73	898.79	448.77	0.28
main	1	100-YR Flow	1140.00	1047.83	1053.19	1051.72	1053.38	0.000730	2.07	705.54	482.30	0.37